

Department of Transportation
 FEDERAL AVIATION ADMINISTRATION
VFR PILOT EXAM-O-GRAM NO. 45

AIRSPEEDS AND AIRSPEED INDICATOR MARKINGS (Series 2)

Most FAA written tests contain several test items involving airspeed. Analyses show that many applicants are not knowledgeable concerning airspeeds. The use of performance charts, computation of navigation problems, and filing of flight plans involves the use of True Airspeed. However, in various configurations and flight conditions, airplanes are also operated with reference to Calibrated Airspeed.

WHAT ARE THE DIFFERENT AIRSPEEDS? The four principle airspeeds are defined below.

Indicated Airspeed (IAS) is the uncorrected speed read from the airspeed dial. It is the measurement of the difference between impact pressure and atmospheric pressure in the pitot-static system.

Calibrated Airspeed (CAS) is indicated airspeed corrected for instrument error and installation error in the pitot-static system. As the aircraft flight attitude or configuration is changed, the airflow in the vicinity of the static inlets may introduce impact pressure into the static source, which results in erroneous airspeed indications. The pitot section is subject to error at high angles of attack, since the impact pressure entering the system is reduced, when the pitot tube is not parallel to the relative wind. Note in the chart to the right the difference between indicated and calibrated airspeed in the lower speed ranges. Performance data in aircraft flight manuals is normally based on calibrated airspeed.

| AIRSPEED CORRECTION TABLE | | | | | | | | | | | | |
|---------------------------|-----|----|----|----|----|----|----|-----|-----|-----|-----|-----|
| FLAPS | IAS | 40 | 50 | 60 | 70 | 80 | 90 | 100 | 110 | 120 | 130 | 140 |
| FLAPS UP | CAS | 55 | 60 | 66 | 72 | 80 | 89 | 98 | 108 | 117 | 127 | 136 |
| FLAPS DOWN | CAS | 52 | 58 | 65 | 73 | 82 | 91 | 101 | * | * | * | * |

Equivalent Airspeed (EAS) is calibrated airspeed corrected for compressibility factor. This value is very significant to pilots of high speed aircraft, but relatively unimportant to pilots operating at speeds below 250 knots at altitudes below 10,000 feet.

True Airspeed (TAS) is calibrated airspeed (or equivalent airspeed if applicable) corrected for air density error. TAS is the actual speed of the aircraft through the air mass. Air density error is caused by nonstandard pressure and temperature for which the instrument does not automatically compensate. The standard airspeed indicator is calibrated to read correctly only at standard sea level conditions--that is, when the pressure is 29.92 inches Hg and the temperature is 15°C.

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HOW IS TRUE AIRSPEED DETERMINED? To find TAS, it is necessary to--(a) work a computer solution, or - (b) have in the aircraft an airspeed indicator, similar to the one illustrated to the left, which incorporates that portion of a computer which is necessary for determining TAS in the cruising speed range. This represents the current trend in the design of flight instruments that reduce pilot workload. In either case, the prerequisites for determining TAS are pressure altitude*, CAS, and outside air temperature. Example: For a pressure altitude of 6,500 feet, a CAS** of 175 mph, and an outside air temperature (OAT) of +20°C, you would use the instrument to the left as follows: With the adjusting knob, set the pressure altitude (6,500 feet) opposite the OAT (+20°C.). The needle then shows a TAS of 202 mph while on the inner portion of the dial the needle is registering an IAS of 175 mph or 152 knots.



*The most accurate method of solving for TAS is by use of pressure altitude. However, you can use indicated altitude without introducing too great an error in most instances.

**For this example the IAS and CAS are assumed equal.

NOTE: Free Air Temperature gages are subject to heat of compression (friction) errors. The higher the TAS the more the increase in indication above the actual temperature of the air.

DO SOME INSTRUMENTS AUTOMATICALLY REGISTER TRUE AIRSPEED? Yes, more advanced true airspeed indicators contain components which correct for pressure altitude, OAT, and compressibility to automatically provide TAS without computations on the part of the pilot.

WHAT ADDITIONAL AIRSPEED INDICATOR MARKINGS ARE REQUIRED IN MULTI-ENGINE AIRPLANES? FAR Part 23, which deals with Airworthiness Standards for airplanes of 12,500 lbs. or less, was amended November 11, 1965, to require the following airspeed markings in multi-engine

airplanes: (a) a blue radial line to show the best rate of climb speed (V_y) with one-engine-inoperative, (b) a red radial line to show V_{mc} - the minimum control speed with one-engine-inoperative. Note in the illustration to the left, that these markings for key speeds in multi-engine airplanes are in addition to those normally required for other airplanes.

WHICH MULTI-ENGINE AIRPLANES ARE REQUIRED TO HAVE THESE MARKINGS? Only those airplanes which were type certificated under Part 23 on or after November 11, 1965, are required to have these markings. However, airplanes type certificated before that date may also be so marked at the option of the owner.



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NOTE: THE COLORED MARKINGS ON AIRSPEED INDICATORS ARE BASED ON CAS, NOT IAS.