WHAT IS AIR DATA?

Air data is a measurement of the air mass surrounding an airplane. The two physical characteristics of the air mass measured are pressure and temperature. Air data is acquired by various sensors on the aircraft and used to calculate altitude, speed, rate of climb or decent and angle-of-attack or angle-of-sideslip.

What pressure data is measured?

Ps Static Pressure (Ps) is the absolute pressure of still air surrounding the aircraft. This is the barometric pressure at the altitude where the aircraft is traveling and is independent of any pressure disturbances caused by the motion of the air craft.

Pt Total Pressure (Pt) is the sum of the local atmospheric pressure (Ps) and the impact pressure (Qc) caused by the aircraft's motion through the air.

Qc Impact Pressure (Qc) is the pressure a moving stream of air produces against a surface which brings part of the moving stream to rest. It is the difference between the total pressure (Pt) and the static pressure (Ps)

How is altitude determined?

Altitude is proportional to the Static Pressure. Altitude calculations are based on "standard atmosphere", which assumes a known relationship between pressure, temperature and atmospheric density. The air is assumed to be in hydrostatic equilibrium.

What temperature data is measured?

Air temperature is the measurement of static air temperature (Ts) or total air temperature (Tt).

Ts Static air temperature (Ts) is the temperature of undisturbed air through which the aircraft is about to fly. It is independent of the velocity of the aircraft.

Tt Total air temperature (Tt) is the temperature of an airflow as the airflow is brought to rest without removal or addition of heat. Tt is greater (warmer) than Ts because of the adiabatic compression of the air going to zero velocity.

Temperature values are acquired by a temperature probe on the body of the aircraft. Pressure and temperature data sensing is sometimes combined in the same sensor.

What is 'Indicated Air Speed' (IAS), 'True Air Speed (TAS), and Mach Number?

IAS Indicated Airspeed (IAS) is the speed of an aircraft relative to the surrounding air. It is uncorrected for any installation or instument errors. Indicated Airspeed equals True Airspeed at standard sea level conditions only and it is a function of impact pressure, Qc.

TAS True Airspeed (TAS) is indicated airpseed corrected for nonstandard temperatures that can be determined usign Mach number and total temperature. It is the actual aircraft speed through the air mass.

M Mach Number is the ratio of True Airspeed and the speed of sound in the surrounding air. The speed of sound is proportional to the square root of the average temperature. Mach Number is calculated using the ratio of impact pressure (Qc) to static pressure (Ps).

What is RVSM?

RVSM stands for "Reduced Vertical Separation Minimum." RVSM airspace is any airspace or route between FL 290 (29,000 ft) and FL 410 (41,000 ft) inclusive where aircraft are required to be separated vertically by 1,000 ft (300 m).

The accuracy requirement for a RVSM altimeter is given in the 91-RVSM appendix 6 paragraph 5a as: "The mean uncorrected residual position error (static source error) of the group shall not exceed +/-80 feet (+/-25 m)". The "static source error" is defined as "The difference between the pressure sensed by the static system at the static port and the undisturbed ambient pressure" (91-RVSM paragraph 5L).

Many companies claim their Air Data Test Sets are RVSM compliant. Compliance might imply that there has been some third party verification that a manufacturers' Air Data Test Set is in compliance with some official document that gives a minimum requirement. This is not the case. Compliance is only a statement by the manufacturer that their calibrator is accurate enough to calibrate altimeters in an RVSM approved aircraft.

+/- 80 ft is the maximum error allowed for the Aircraft altimeter. Because Pressure and Altitude have an inverse relationship, the maximum error for a pressure calibrator occurs at the highest RVSM altitude (lowest pressure). RVSM applies to altitudes between FL 290 (29,000 ft) and FL 410 (41,000 ft). Therefore, the maximum error of a calibrator for this specific range will occur at 41,000 ft.

Rules specified in the "Guide for Uncertainty of Measurement" require that a calibrator be 4 times more accurate than what is being calibrated. Therefore, at 41,000 ft the calibrator must have an error of less than +/- 80 divided by 4. This is +/-20 ft.

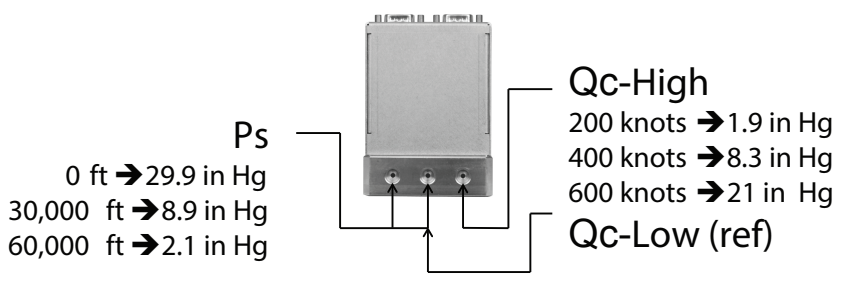
A typical range for sensor in an altimeter is 0-32 inches of mercury. The uncertainty of the Mensor sensor used in the CPA8001 Air Data Test Set is 0.009% IS-50, and the CPA 2501 Avionics Digital Pressure Gauge is 0.01% of full scale. The error for both device at 41,000 ft is less than +/-13 ft. Almost half of what is required to be "compliant" to the RVSM requirement.

CPA8001 AIR DATA TEST SET TRANSDUCER

In the Dual Sensor Transducer of the CPA8001, a correction function is applied to the Qc Transducer to correct for common mode Pressure Error.

What Is a True Differential Sensor?

A true differential sensor is a sensor that does not develop an offset as the common mode pressure increases or decreases. In other words, if the low side pressure and high side pressures are equal, no matter what pressure they are the differential should be zero. Some sensors will develop an offset when the pressure on the low side of the sensor is elevated. Becaue the Ps altitude channel is tied directly to the Qc reference, the CPA8001 transducer operates at various common mode pressures.



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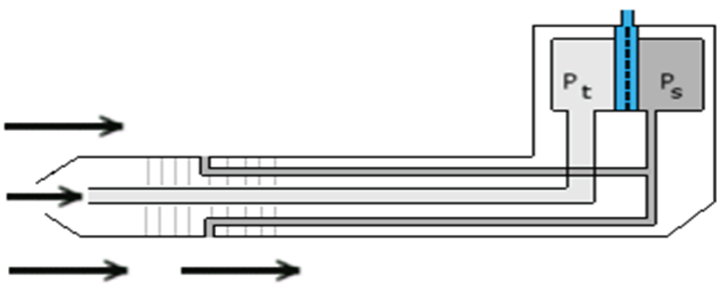
Pt is Total Pressure

Ps is Static Pressure (altitude)

Qc is the Impact Pressure (Pt-Ps) (airspeed)



Pt = Ps + Qc

Ps = Pt - Qc

Qc = Pt - Ps

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