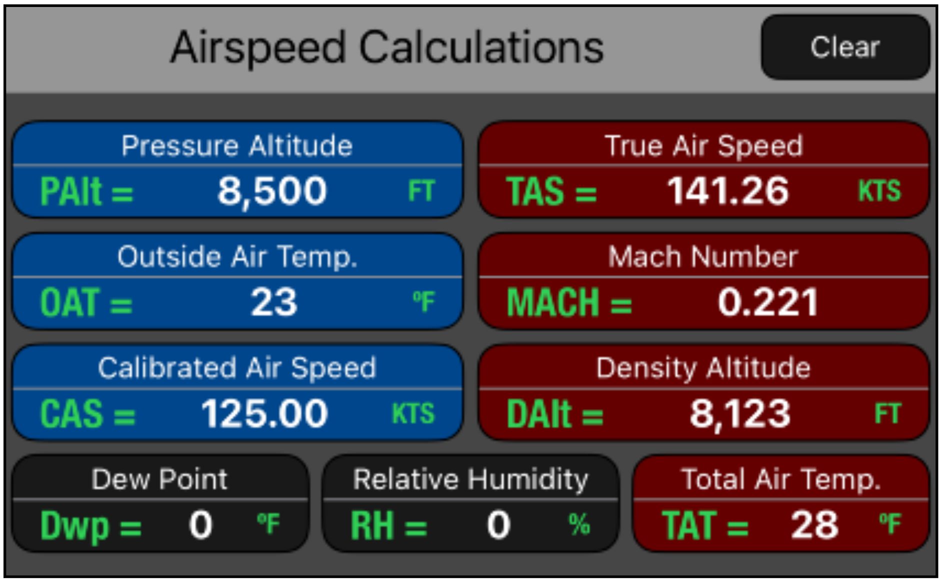
Airspeed Calculations Worksheet



Airspeed Calculations Buttons	
Clear	Set all variables to a invalid state keeping the current value. If it is touched again, clears all values to 0.
PAlt	**Pressure Altitude:** Stores or validate the **PAlt** value for the calculation of **TAS**, **MACH** or **TAT**.
OAT	**Outside Air Temperature:** Store or validate **OAT** value for the calculation of **PAlt**, **CASGL** and **TCL**. Also to calculate **Dew Point** or **RH%**.
CAS	**Calibrated Airspeed:** Stores or validate the **CAS** value for the calculation of **TAS** or **Baro**.
TAS	**True Airspeed:** Stores or validate the **DAlt** value for the calculation of **PAlt** or **OAT**.
MACH	**Mach Number:** Stores or validate
Dwp	**Dew Point:** Assuming **OAT** has a valid value, entering the **Dwp** calculates **RH%** , **AGL** and **TCL**.
RH%	**Relative Humidity:** Assuming **OAT** has a valid value, entering **RH%** calculates **Dwp** , **AGL** and **TCL**.
DAlt	**Density Altitude:** Stores or validate the **DAlt** value for the calculation of **IAlt** or **Baro**.
TAT	**Total Air Temperature:** Store or validate.

Planned and Actual True Airspeed (**TAS**) and Mach number can be calculated and are dependent on the temperature input. Planned airspeeds require the use of outside air temperature (**OAT**), obtainable from the preflight weather briefing or from what you read on a thermometer on the ground. Actual airspeeds require the use of total air temperature (**TAT**), which is obtained by a probe having velocity with respect to the air (essentially, the thermometer in your aircraft).

This worksheet calculates:

- **Planned TAS:** With the inputs of planned **CAS**, **OAT** and **PAlt**, calculates the **TAS**, **MACH** and **TAT** (OAT and PAlt values are at the planned flight altitude).

- **Actual TAS:** With the inputs of **PAlt**, **CAS** and **TAT**, computes **OAT**, **TAS** and **MACH**. The input information is from instruments during an actual flight.

- **Required CAS:** With the inputs of **PAlt**, **OAT** and **TAS**, computes the **CAS**, **TAT** and **MACH**.

- **Planned MACH#:** With the inputs of **OAT** and **MACH**, computes the **TAS** and **TAT** (OAT value is at the planned altitude and TAT can be used as a cross-check against the in-flight TAT reading).

- **Actual MACH#:** With the inputs of **MACH** and **TAT** from instruments during an actual flight, calculates the **OAT** and **TAS**.

NOTE: Always verify the physical units
To change the units of a variable, tap over the unit symbol and select the right one from the pop-up menu. To change the whole units in the worksheet select “Set Metric Units” or “Set US Units” from the **[UNITS▶]** button in the Navigation Bar.

All the following examples use US units. So please select “Set US Units” from the **[UNITS▶]** menu in the Navigation Bar.

Example 1: (Planned TAS)

You plan to fly 125 knots **CAS**, 8,500 feet **PAlt**, and 23°F **OAT**. Compute **TAS** and **TAT**.

Solution:

Keystrokes	Description
[Clear] [Clear]	Clears all variables to start a new calculation.
type 125 **[CAS]**	Stores 125 KTS in **CAS** (the button change to blue).
type 8500 **[PAlt]**	Stores 8,500 FT in **PAlt** (the button change to blue).
type 23 **[OAT]**	Stores 23 °F in **OAT** (the button change to blue) and automatically calculates the values of: **TAS = 141.26 KTS** (the button change to red). **MACH = 0.221** (the button change to red). **TAT = 28 °F** (the button change to red).

Example 2: (Actual TAS)

Compute the **TAS** at 6,500 feet **PAlt**, 40°F **TAT** and 120 KTS **CAS**.

Solution:

Keystrokes	Description
[Clear]	Invalidate all variables.
type 6500 **[PAlt]**	Stores 6,500 FT in **PAlt** (the button change to blue).
type 40 **[OAT]**	Stores 10°F in **OAT** (the button change to blue).
type 120 **[CAS]**	Stores 120 KTS in **CAS** (the button change to blue) and automatically calculates the values of: **OAT = 36 °F** (the button change to red). **TAS = 132.27 KTS** (the button change to red). **MACH = 0.205** (the button change to red).

Example 3: (Required CAS)

What is the required **CAS** or **MACH** to obtain **150** knots **TAS** with 41°F **OAT** and 6,500 feet **PAlt**?.

Solution:

Keystrokes	Description
[Clear]	Invalidate all variables.
type 6500 **[PAlt]**	Stores 6,500 FT in **PAlt** (the button change to blue).

Keystrokes	Description
type 41 **[OAT]**	Stores 30.35 IN·HG in **Baro** (the button change to blue) and automatically the resulting **PAlt** value is calculated: **PAlt = 3,500 FT** (the button change to red).
type 150 **[TAS]**	Stores 150 KTS in **TAS** (the button change to blue) and automatically calculates the values of: **CAS = 135.39 KTS** (the button change to red). **MACH = 0.231** (the button change to red). **TAT = 46 °F** (the button change to red).

Example 4: (Planned MACH)
Compute **TAS** for 0.72 **MACH** and -31°F **OAT**.
Solution:

Keystrokes	Description
[Clear] [Clear]	Clears all variables to start a new calculation.
type 0.72 **[MACH]**	Stores 0.72 in **MACH** (the button change to blue).
type 31 **[+/-]** **[OAT]**	Stores -31 °F in **OAT** (the button change to blue) and automatically calculates the values of: **TAS = 432.98 KTS** (the button change to red). **TAT = 13 °F** (the button change to red).

Example 5: (Actual MACH)
Compute the **TAS** given 0.82 **MACH** with -4°F **TAT**.
Solution:

Keystrokes	Description
[Clear] [Clear]	Clears all variables to start a new calculation.
type 0.82 **[MACH]**	Stores 0.72 in **MACH** (the button change to blue).
type 4 **[+/-]** **[TAT]**	Stores -4 °F in **TAT** (the button change to blue) and automatically calculates the values of: **TAS = 477.32 KTS** (the button change to red). **OAT = -58 °F** (the button change to red).

Appendix : Equations Used

The equations that this worksheet calculates are:

$$\mathbf{TAS} = \mathbf{CAS} \cdot \sqrt{(\rho_0 / \rho)}$$

$$\mathbf{MACH} = \mathbf{TAS} / [s_0 \cdot \sqrt{(\mathbf{OAT} / T_0)}]$$

$$\mathbf{TAT} = \mathbf{OAT} \cdot (1 + 0.2 \cdot \mathbf{MACH}^2)$$

$$\mathbf{RH} = e^{(17.625 \cdot [\mathbf{Dwp} / (\mathbf{Dwp} + 243.04) - \mathbf{OAT} / (\mathbf{OAT} + 243.04)])}$$

$$\mathbf{P_T} = P_0 \cdot [1 - L \cdot \mathbf{PAlt} / T_0]^{C1}$$

$$\mathbf{P_V} = \mathbf{RH} \cdot 610.78 \cdot 10^{[7.5 \cdot (\mathbf{OAT}-273.15) / (\mathbf{OAT}-35.85)]}$$

$$\rho = (\mathbf{P_T} - \mathbf{P_V}) / (Ra \cdot \mathbf{OAT}) + \mathbf{P_V} / (Rv \cdot \mathbf{OAT})$$

$$\mathbf{DAlt} = T_0 / L - 42266.5 \cdot \rho^{C5}$$

Where all variables are in S.I. units and :

T_0 = 288.15 (ºK)

L = 0.0065(ºC/m)

P_0 = 101325.0 (Pa)

ρ_0 = 1.2250 (kg/m³)

s_0 = 340.294 (m/s)

C1 = 5.255787741

C5 = 0.234969

Ra = 287.057899 (J/Kg·ºK)

Rv = 461.529825 (J/Kg·ºK)