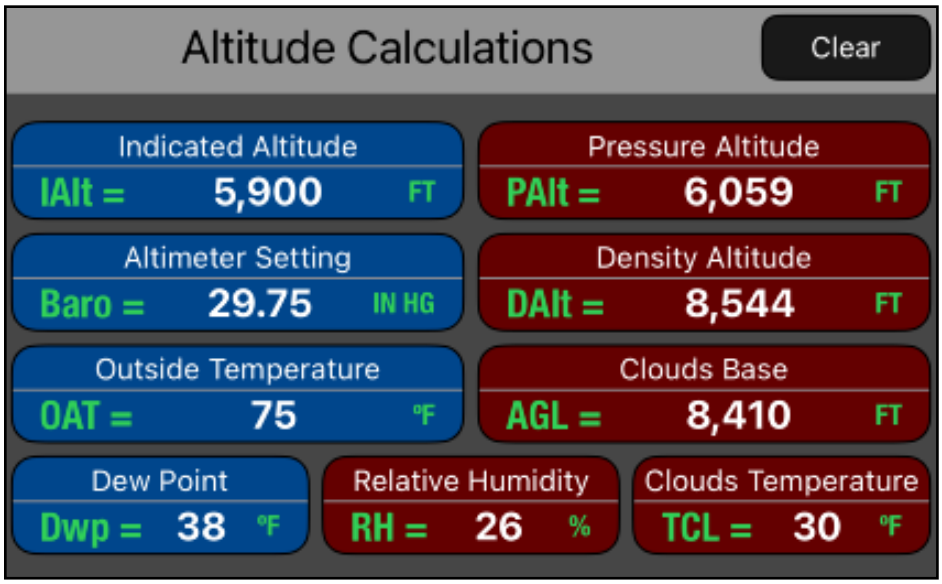
Altitude Worksheet



Altitude Calculations Buttons	
Clear	Set all variables to a invalid state keeping the current value. If it is touched again, clears all values to 0.
IAlt	**Indicated Altitude:** Stores or validate the **IAlt** value for the calculation of **PAlt** or **Baro**.
Baro	**Barometric Pressure or Altimeter Setting:** Stores or validate the **Baro** value for the calculation of **PAlt** or **IAlt**.
PAlt	**Pressure Altitude:** Stores or validate the **PAlt** value for the calculation of **IAlt** or **Baro**.
OAT	**Outside Air Temperature:** Store or validate **OAT** value for the calculation of **DAlt**, **AGL** and **TCL**. Also to calculate **Dew Point** or **RH%**.
DAlt	**Density Altitude:** Stores or validate the **DAlt** value for the calculation of **PAlt** or **OAT**.
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**.
AGL	Calculated the Clouds Above Ground Level.
TCL	Calculated the Total Cloud Temperature.

In aviation calculations, air pressure and air density are normally specified by an altitude in a standard atmosphere, instead of units of pressure or density. The altitude corresponding to a given pressure is called Pressure Altitude "**PAlt**". The altitude corresponding to a given density is called Density Altitude "**DAlt**".

An aviation altimeter displays "**PAlt**" when the altimeter setting "**Baro**" is adjusted to the standard atmospheric pressure at sea level, 29.92 inHg and displays the indicated altitude of the airfield when the altimeter setting "**Baro**" is obtained from the automated flight service station (AFSS), or Air Traffic Control (ATC) for that airfield.

This worksheet calculates:

- The Pressure Altitude "**PAlt**", the Indicated Altitude "**IAlt**" or the Altimeter Setting "**Baro**", given any of the other two.

- The Density Altitude "**DAlt**", the Pressure Altitude "**PAlt**" or the Outside Air Temperature "**OAT**", given any of the other two.

- The altitude of the cloud base above ground level "**AGL**" and Clouds Temperature "**TCL**" given the Dew Point "**Dwp**" or Relative Humidity "**RH%**" and the outside air temperature "**OAT**" at the airfield. If you want the elevation of the cloud base above mean sea level (MSL), you must add the elevation of the airfield to the resulting "**AGL**".

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:

The You are planning to fly at 4500 feet indicated altitude and the current altimeter setting is 30.15"Hg. What altitude (**PAlt**) should you use to calculate the true air speed (**TAS**)?.

Solution:

Keystrokes	Description
[Clear] [Clear]	Clears all variables to start a new calculation.
type 4500 **[IAlt]**	Stores 4,500 FT in **IAlt** (the button change to blue).
type 30.15 **[Baro]**	Stores 30.15 IN·HG in **Baro** (the button change to blue) and automatically the resulting **PAlt** value is calculated: **PAlt = 4,289 FT** (the button change to red).

Example 2:

What is the **PAlt** at an airport with elevation of 5,900 FT and a 29.75 IN HG altimeter setting?. What is the **DAlt** if **OAT** is 75ºF ?. At what altitude above the surface can the pilot expect the base of clouds to be if the dew point is 38ºF?.

Solution:

Keystrokes	Description
[Clear]	Invalidate all variables.
type 5900 **[IAlt]**	Stores 5,900 FT in **IAlt** (the button change to blue).
type 29.75 **[Baro]**	Stores 29.75 IN·HG in **Baro** (the button change to blue) and automatically the resulting **PAlt** value is calculated: **PAlt = 6,059 FT** (the button change to red).
type 75 **[OAT]**	Stores 75 ºF in **OAT** (the button change to blue) and automatically the resulting **DAlt** value is calculated: **DAlt = 8,427 FT** (the button change to red).
type 38 **[Dwp]**	Stores 38 ºF in **Dwp** (the button change to blue) and automatically the resulting **AGL**, **TCL** and **RH** values. are calculated: **AGL = 8,544 FT** (the button change to red). **TCL = 30ºF** (the button change to red). **RH = 26%** (the button change to red).

Example 3:

Determine the density altitude for these conditions: Altimeter setting 30.35, Runway temperature +25ºF, Airport elevation 3,894 FT MSL.

Solution:

Keystrokes	Description
[Clear]	Invalidate all variables.
type 3894 **[IAlt]**	Stores 3,894 FT in **IAlt** (the button change to blue).
type 30.35 **[Baro]**	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 25 **[OAT]**	Stores 25 ºF in **OAT** (the button change to blue) and automatically the resulting **DAlt** value is calculated: **DAlt = 2,044 FT** (the button change to red).

If the relative humidity is 80%, how the DAlt is affected and at what altitude should be the cloud base ?

Solution:

Keystrokes	Description
type 80 **[RH]**	Stores 80% in **RH** (the button change to blue).
type 80 **[RH]**	Stores 80% in **RH** (the button change to blue) and automatically the resulting **DAlt** and **AGL** values are calculated: **DAlt = 2,096 FT** (the button change to red). **AGL = 1,204 FT** (the button change to red).

Example 4:

What is the effect of temperature increase from 30 to 50ºF on the density altitude if the pressure altitude remains at 3,000 feet MSL?.

Solution:

Keystrokes	Description
[Clear] [Clear]	Clears all variables to start a new calculation.
type 3000 **[PAlt]**	Stores 3,000 FT in **PAlt** (the button change to blue).
type 30 **[OAT]**	Stores 30 ºF in **OAT** (the button change to blue) and automatically the resulting **DAlt** value is calculated: **DAlt = 1,767 FT** (the button change to red).

Keystrokes	Description
[RCL] [DAlt]	Recalls the calculated **DAlt** to the display.
[STO] 1	Stores 1767 in memory register 1
type 50 **[OAT]**	Stores 50 ºF in **OAT** (the button change to blue) and automatically the resulting **DAlt** value is calculated: **DAlt = 3,112 FT** (the button change to red).
[RCL] [DAlt]	Recalls the calculated **DAlt** to the display.
[-] [RCL] 1 [=]	Perform the operation 3112 - 1767 = … **Result = 1,345.10 (DAlt increases in about 1350 foot)**

Example 5:

What is the effect of temperature decrease and a pressure altitude increase on the density altitude from 90ºF and 1,250 feet pressure altitude to 55ºF and 1,750 feet pressure altitude?.

Solution:

Keystrokes	Description
[Clear] [Clear]	Clears all variables to start a new calculation.
type 1250 **[PAlt]**	Stores 1,250 FT in **PAlt** (the button change to blue).
type 90 **[OAT]**	Stores 90 ºF in **OAT** (the button change to blue) and automatically the resulting **DAlt** value is calculated: **DAlt = 3,492 FT** (the button change to red).
[RCL] [DAlt]	Recalls the calculated **DAlt** to the display.
[STO] 1	Stores 3492 in memory register 1
type 1750 **[PAlt]**	Stores 1,750 FT in **PAlt** (the button change to blue).
type 55 **[OAT]**	Stores 55 ºF in **OAT** (the button change to blue) and automatically the resulting **DAlt** value is calculated: **DAlt = 1,898 FT** (the button change to red).
[RCL] [DAlt]	Recalls the calculated **DAlt** to the display.
[-] [RCL] 1 [=]	Perform the operation 1898 - 3492 = … **Result = -1,594.38 (DAlt decreases in about 1,600 foot)**

Appendix : Equations Used

The equations that this worksheet calculates are:

$$\mathbf{PAlt} = \mathbf{IAlt} + (T_0 / \mathbf{L}) \cdot [\, 1 - (\mathbf{Baro} / P_0)^{C2} \,]$$

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

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

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

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

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

$$\mathbf{AGL} = 124.7 \cdot (\mathbf{OAT} - \mathbf{Dwp})$$

$$\mathbf{TCL} = \mathbf{OAT} - 1.227048 \cdot (\mathbf{OAT} - \mathbf{Dwp})$$

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

T_0 = 288.15 (ºK)
$\mathbf{L}$ = 0.0065(ºC/m)
P_0 = 101325.0 (Pa)
$\mathbf{C1}$ = 5.255787741
$\mathbf{C2}$ = 0.190266436
$\mathbf{C5}$ = 0.234969
$\mathbf{Ra}$ = 287.057899 (J/Kg·ºK)
$\mathbf{Rv}$ = 461.529825 (J/Kg·ºK)