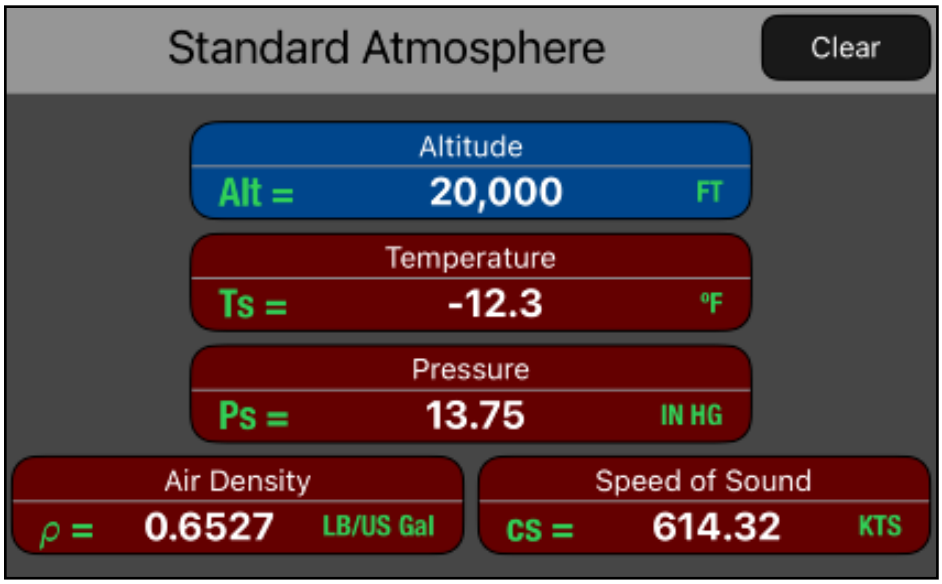
Standard Atmosphere Worksheet



Standard Atmosphere Buttons	
Clear	Set all variables to a invalid state keeping the current value. If it is touched again, clears all values to 0.
Alt	**Altitude:** Stores or validate the **Alt** value for the calculation of **Ts**, **Ps**, ρ and **CS**.
Ts	**Temperature:** Stores or validate the **Ts** value for the calculation of **Alt**, **Ps**, ρ and **CS**.
Ps	**Pressure:** Stores or validate the **Ps** value for the calculation of **Alt**, **Ts**, ρ and **CS**.
ρ	**Density:** Calculation of the standard air density for the current Altitude value.
CS	**Speed of Sound:** Calculation of the standard speed of sound for the current Altitude value.

The International Civil Aviation Organization (ICAO) has established standard conditions for temperature and pressure depending on the altitude. This is call the Standard Atmosphere function (StdAtmos).
You can enter an altitude (**Alt**) in the StdAtmos function and obtain the outside air temperature (**Ts**), air pressure (**Ps**), air density (ρ) and the speed of sound (**CS**) for the standard atmosphere. The StdAtmos function is valid up to 278,385 feet.

This worksheet calculates the standard atmosphere Altitude, Temperature and Pressure if any one is given. Also calculates the air density and the speed of sound for a given or calculated altitude.

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:

What are the standard atmospheric conditions at sea level and at 20,000 FT?.

Solution:

Keystrokes	Description
[Clear] [Clear]	Clears all variables to start a new calculation.
type 0 **[Alt]**	Stores 0 FT in **Alt** (the button change to blue) and automatically calculates the atmospheric conditions at sea level: **Ts = 59.0 °F** (the button change to red) **Ps = 29.92 IN HG** (the button change to red) **ρ = 0.0102 LB/US Gal** (the button change to red) **CS = 661.48 KTS** (the button change to red)
type 20000 **[Alt]**	Stores 20,000 FT in **Alt** (the button change to blue) and automatically calculates the atmospheric conditions at 20,000FT: **Ts = -12.3 °F** (the button change to red) **Ps = 13.75 IN HG** (the button change to red) **ρ = 0.0054 LB/US Gal** (the button change to red) **CS = 614.32 KTS** (the button change to red)

Example 2:

What is the standard altitude to have an air temperature of 0ºF ?.

Solution:

Keystrokes	Description
[Clear]	Invalidate all variables.
type 0 **[Ts]**	Stores 0ºF in **Ts** (the button change to blue) and automatically calculates the atmospheric conditions: **Alt = 16,544 FT** (the button change to red) **Ps = 15.86 IN HG** (the button change to red) ρ **= 0.0061 LB/US Gal** (the button change to red) **CS = 622.72 KTS** (the button change to red)

Example 3:

What is the standard altitude to have an air pressure of 20 IN HG ?.

Solution:

Keystrokes	Description
[Clear]	Invalidate all variables.
type 20 **[Ps]**	Stores 20 IN HG in **Ps** (the button change to blue) and automatically calculates the atmospheric conditions: **Alt = 10,731 FT** (the button change to red) **Ts = 20.7 ºF** (the button change to red) ρ **= 0.0074 LB/US Gal** (the button change to red) **CS = 636.61 KTS** (the button change to red)

Appendix : Equations Used

The equations that this worksheet calculates are:

Temperature Function: $T_S = IF(Alt < Trh , T_0 - L \cdot Alt , Trt)$

Pressure Function: $P_S = IF(Alt < Trh , P_0 \cdot (1 - Alt \cdot L / T_0)^{C1} , C4 \cdot e^{-C3 \cdot (Alt - Trh)})$

Air Density Function: $\rho = P_S(Alt) / [Ra \cdot T_s(Alt)]$

Speed of Sound Function: $CS = s_0 \cdot \sqrt{(T_S(Alt) / T_0)}$

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

Trh = 11,000 (m)
Trt = 216.65 (°K)
T_0 = 288.15 (°K)
L = 0.0065(°C/m)
P_0 = 101325.0 (Pa)
C1 = 5.255787741
C3 = $4.806346 \cdot 10^{-5}$
C4 = 22632.6344
Ra = 287.057899 (J/Kg·°K)
s_0 = 340.294 (m/s)