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# (no subject)

1 message

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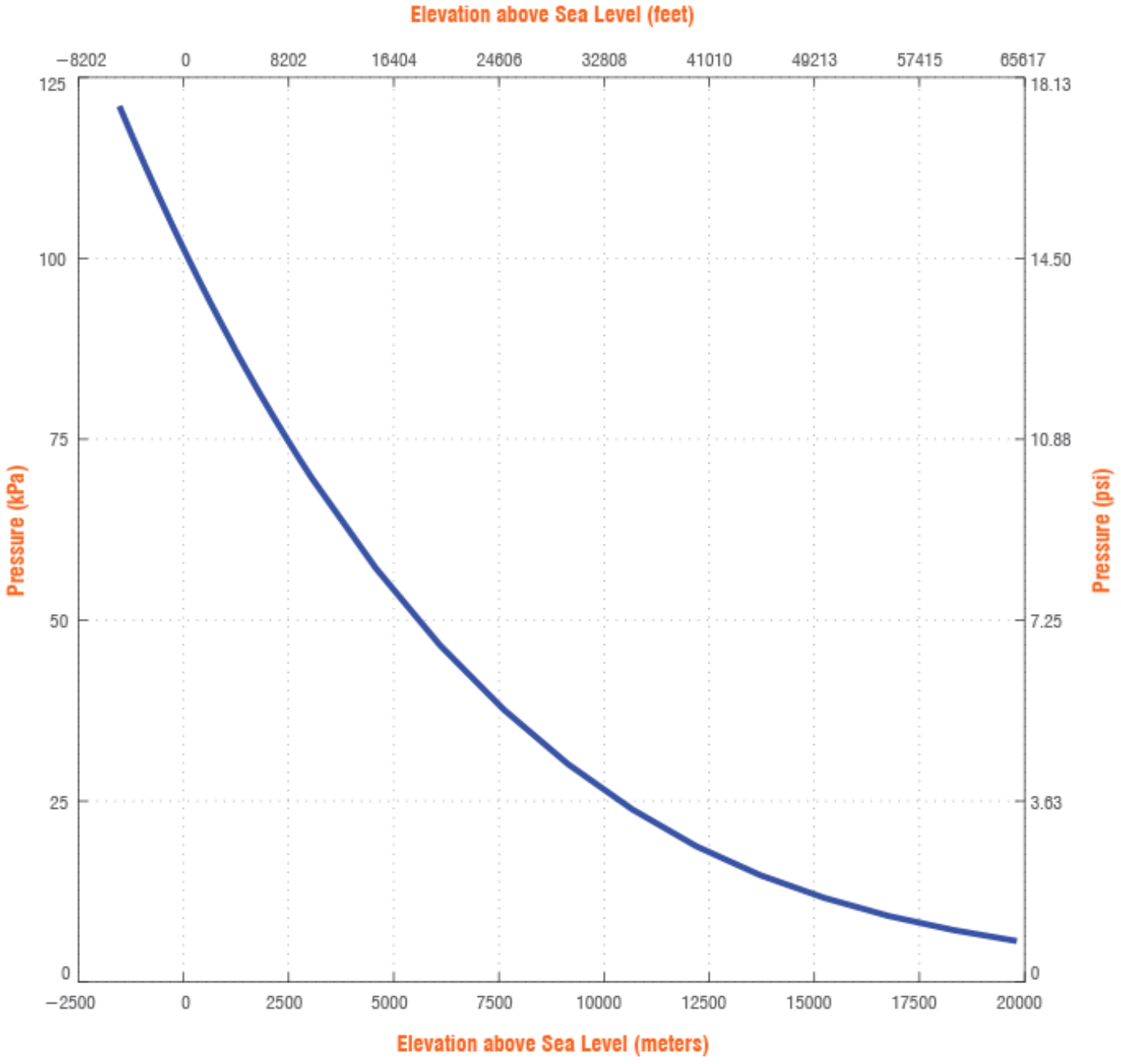
The following table and graph illustrate the relationship between altitude and pressure using the default values for pressure and temperature at sea level. Using ISA standards, the defaults for pressure and temperature at sea level are 101,325 Pa and 288 K.

| Altitude above Sea Level | | | Absolute Atmospheric Pressure | | |
|---|---|---|---|---|---|
| **feet** | **miles** | **meters** | **kPa** | **atm** | ***psia*** |
| **-5000** | -0.95 | -1524 | 121.0 | 1.19 | *17.55* |
| **-4000** | -0.76 | -1219 | 116.9 | 1.15 | *16.95* |
| **-3000** | -0.57 | -914 | 112.8 | 1.11 | *16.36* |
| **-2000** | -0.38 | -610 | 108.9 | 1.07 | *15.79* |
| **-1000** | -0.19 | -305 | 105.0 | 1.04 | *15.24* |
| **-500** | -0.09 | -152 | 103.2 | 1.02 | *14.96* |
| **0** | 0.00 | 0 | 101.3 | 1.00 | *14.70* |
| **500** | 0.09 | 152 | 99.5 | 0.98 | *14.43* |
| **1000** | 0.19 | 305 | 97.7 | 0.96 | *14.17* |
| **1500** | 0.28 | 457 | 96.0 | 0.95 | *13.92* |
| **2000** | 0.38 | 610 | 94.2 | 0.93 | *13.66* |
| **2500** | 0.47 | 762 | 92.5 | 0.91 | *13.42* |
| **3000** | 0.57 | 914 | 90.8 | 0.90 | *13.17* |
| **3500** | 0.66 | 1067 | 89.1 | 0.88 | *12.93* |
| **4000** | 0.76 | 1219 | 87.5 | 0.86 | *12.69* |
| **4500** | 0.85 | 1372 | 85.9 | 0.85 | *12.46* |
| **5000** | 0.95 | 1524 | 84.3 | 0.83 | *12.23* |
| **6000** | 1.14 | 1829 | 81.2 | 0.80 | *11.78* |
| **7000** | 1.33 | 2134 | 78.2 | 0.77 | *11.34* |
| **8000** | 1.52 | 2438 | 75.3 | 0.74 | *10.92* |
| **9000** | 1.70 | 2743 | 72.4 | 0.71 | *10.51* |
| **10000** | 1.89 | 3048 | 69.7 | 0.69 | *10.11* |

| | | | | | |
|---|---|---|---|---|---|
| **15000** | 2.84 | 4572 | 57.2 | 0.56 | *8.29* |
| **20000** | 3.79 | 6096 | 46.6 | 0.46 | *6.75* |
| **25000** | 4.73 | 7620 | 37.6 | 0.37 | *5.45* |
| **30000** | 5.68 | 9144 | 30.1 | 0.30 | *4.36* |
| **35000** | 6.63 | 10668 | 23.8 | 0.24 | *3.46* |
| **40000** | 7.58 | 12192 | 18.8 | 0.19 | *2.72* |
| **45000** | 8.52 | 13716 | 14.7 | 0.15 | *2.14* |
| **50000** | 9.47 | 15240 | 11.6 | 0.11 | *1.68* |
| **55000** | 10.42 | 16764 | 9.1 | 0.09 | *1.32* |
| **60000** | 11.36 | 18288 | 7.2 | 0.07 | *1.04* |
| **65000** | 12.31 | 19812 | 5.6 | 0.06 | *0.82* |



**Weather Conditions**

Due to the fact that weather conditions affect pressure and altitude calculations, the pressure and temperature at sea level must be known. The altitude at a given air pressure can be calculated using *Equation 1* for an altitude up to 11 km (36,090 feet). This equation can be arranged to also calculate the air pressure at a given altitude as shown in *Equation 2*.

$$h = h_b + \frac{T_b}{L_b} \cdot \left[ \left( \frac{P}{P_b} \right)^{\frac{-R \cdot L_b}{g_0 \cdot M}} - 1 \right] \qquad (1)$$

$$P = P_b \cdot \left[ 1 + \frac{L_b}{T_b} \cdot (h - h_b) \right]^{\frac{-g_0 \cdot M}{R \cdot L_b}} \qquad (2)$$

**where,**

$P_b$ = static pressure (pressure at sea level) [Pa]
$T_b$ = standard temperature (temperature at sea level) [K]
$L_b$ = standard temperature lapse rate [K/m] = -0.0065 [K/m]
$h$ = height about sea level [m]
$h_b$ = height at the bottom of atmospheric layer [m]
$R$ = universal gas constant = 8.31432 $\left[\frac{N \cdot m}{mol \cdot K}\right]$
$g_0$ = gravitational acceleration constant = 9.80665 $\left[\frac{m}{s^2}\right]$
$M$ = molar mass of Earth's air = 0.0289644 [kg/mol]

**Earth's Atmosphere**

Due to the fact that Earth's atmosphere experiences different rates of heating and cooling through each of its layers, these equations help to model this through the use of the temperature lapse rate, which is the rate at which temperature changes through altitude change. Some layers, such as the stratosphere (from 11km to 20km), have a constant temperature throughout the layer. This requires different equations to determine the altitude or pressure. *Equations 3* and *4* specify the calculation for altitude and pressure respectfully in this zero temperature lapse rate layer.

$$h = h_b + \frac{R \cdot T_b \cdot \ln(\frac{P}{P_b})}{-g_0 \cdot M} \qquad (3)$$

$$P = P_b \cdot exp\left[\frac{-g_0 \cdot M \cdot (h - h_b)}{R \cdot T_b}\right] \quad (4)$$

For these equations $h_b$, $P_b$, and $T_b$ correspond to the altitude, pressure, and temperature at the bottom of the stratosphere. The pressure at the bottom of the layer is determined from the user provided inputs of the pressure and temperature at sea level knowing that the altitude at the bottom of the layer is 11 km; assuming the default pressure was used at sea level, the pressure at the bottom of the stratosphere is 22,632 Pa. The temperature at the bottom of the stratosphere is determined by subtracting 71.5 K from the temperature at sea level.

**More Information**

Need more information? Please don't hesitate to Contact us.