

What if I want to convert a sea level pressure to a station pressure?

To convert a sea level pressure to a station pressure you will need to know your elevation above sea level and the current temperature at your location. The temperature can be estimated if you do not have a measurement of it.

This conversion relates to one of the first lessons of atmospheric science, namely the concept that pressure decreases exponentially with altitude and that this decrease is characterised by a distance called scale height.

What follows is the formula for the conversion and the origin of the constant involved, which is the scale height.

$$\text{Station Pressure} = \text{Sea Level Pressure} \times e^{-\text{elevation} / (\text{temperature} \times 29.263)}$$

or re-arranged

$$\text{Sea Level Pressure} = \text{Station Pressure} / e^{-\text{elevation} / (\text{temperature} \times 29.263)}$$

Where:

Station Pressure = the barometric pressure at your elevation in millibars (hectopascals)

Sea Level Pressure = the equivalent pressure at sea level in millibars (hectopascals)

elevation = the elevation of the station in meters

temperature = current temperature in Kelvin (K)

temperature in K = temperature (°C) + 273.15

The constant 29.263 is in units of meters per Kelvin (meters/K)

$$29.263 \text{ (m/K)} = \frac{1000 \text{ (g/kg)} \times R}{M_{\text{air}} \times g}$$

R is the molar gas constant (= 8.314 Joules per mole per Kelvin)

1000 is to convert kilograms to grams (1 Joule = 1 kg m²/sec)

M_{air} is the molecular weight of air (= 29.97 grams per mole)

g is the acceleration of gravity at the Earth's surface (= 9.807 meters per second per second [m/s²])

If you multiply this constant (29.263) by a temperature of 0°C, you get a value of 7993 meters or approximately 8km. This is the *scale height* of Earth's atmosphere under average conditions (as given in the U.S. Standard Atmosphere).

A simplified conversion, which should only be used for stations at elevations below a few hundred meters, is:

$$\text{Station Pressure} = \text{Sea Level Pressure} - (\text{elevation}/9.2)$$

or re-arranged

$$\text{Sea Level Pressure} = \text{Station Pressure} + (\text{elevation}/9.2)$$

The correction factor of 9.2 in the above formula is very nearly the change in elevation (vertically) that will correspond to a 1 millibar change in pressure, as given in the U.S. Standard Atmosphere.