Calculating Pressure and Density Altitude

Air density is defined as the mass of air per unit volume. It is a measure of the number of air molecules in a unit volume of air. Air is held to the earth's surface by the force of gravity and so, the higher one goes in the atmosphere, the 'thinner' (less dense) the air. An International Standard Atmosphere (ISA) has been defined as a measuring stick against which the actual atmosphere existing at a particular time and place can be compared. A number of characteristics (such as pressure, temperature and density) are specified for various levels in the International Standard Atmosphere.

- Air pressure in the ISA is 1013 hectoPascals at Mean Sea Level and the pressure decreases with altitude, at about 1 hPa per 30 feet gain in height in the lower levels of the atmosphere.
- Air temperature in the ISA is +15°C at Mean Sea Level and decreases at approximately 2°C per 1000 feet gain in altitude.
- Air density in the ISA decreases with a gain in altitude.

The main function of the Standard Atmosphere is to calibrate altimeters (which are basically pressure reading devices) so that they match up certain air pressures with the correct altitudes. With the altimeter set on 1013 hPa (ISA MSL), an altimeter will display a height that corresponds to an altitude in the International Standard Atmosphere. This is known as Pressure Height.

Fig 1. With standard pressure 1013 set in the sub-scale window an altimeter reads pressure height

Actual Mean Sea Level Pressure Varies

The actual air pressure that exists at a given place varies from day to day and from hour to hour. In aviation, we cope with this by using the QNH pressure setting in the altimeter sub-scale that relates the altimeter reading to the sea level pressure, whatever it happens to be at that time and place.

For the altimeter to read altitude (height above sea level) accurately, you must ensure that the correct QNH is set in the sub-scale.

Fig 2. With QNH set in the sub-scale, altimeter reads altitude

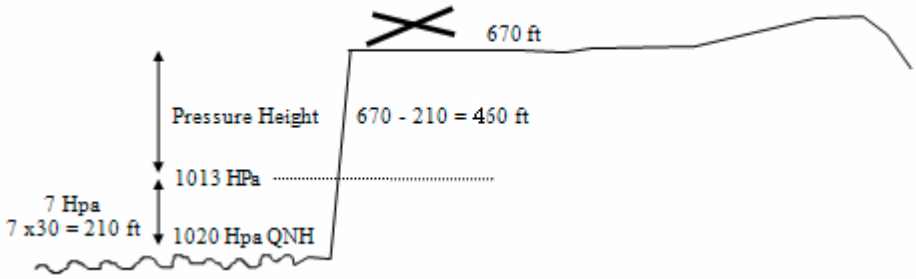
Calculating pressure height, knowing altitude

We can determine pressure height by either: reading the altimeter with 1013 set in the sub-scale; or by using the difference between QNH and 1013 to convert altitude to pressure height. If actual sea level pressure differs from the standard atmosphere of 1013 hPa, then a simple diagram will help us with any calculations of pressure height. We convert altitude to pressure height by allowing 30 feet for each 1 hPa pressure difference.

EXAMPLE. An aerodrome of elevation 670 ft has an Aerodrome QNH of 1020 hPa. What is its pressure height?

Elevation = 670 feet
QNH = 1020 hPa

Answer: Pressure Height = 670 – 7 x 30 = 460 feet



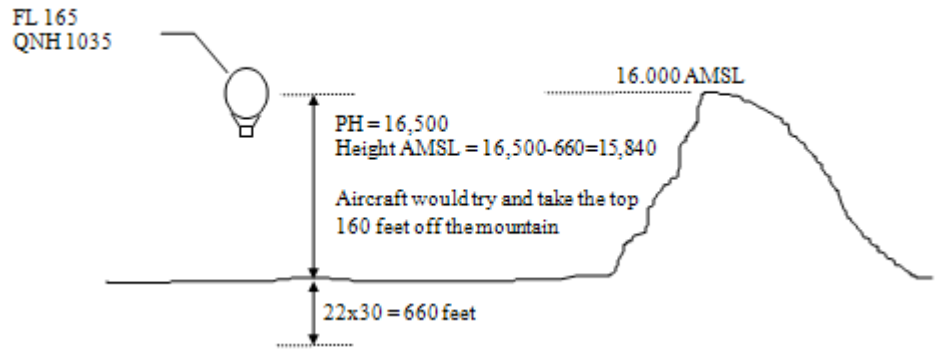


Fig 3. The highest terrain in Papua New Guinea is approximately 16,000 ft AMSL. For this reason, the transition from QNH setting to 1013 hPa is not made until 20,000 ft.

Calculating Density Altitude

EXAMPLE :Determine the density height at altitude 10,000 ft, QNH 1030, +6ₒC

DA = PA 9,490 + 10 x 120 = 10,690