PRESSURE SOLUTIONS

C104: Gravity

We learnt at school that F = m g and that g = 9,8 m/s².

The last bit is too imprecise for scientific use.

In much of our pressure calibration work, the value generated by a standard is dependent on the value of g, so g is very important to us.

We now talk about international standard gravity, defined as exactly 9.80665 m/s², which is approximately equal to the acceleration due to gravity on the Earth's surface.

This conventional value was established by the 3rd CGPM (1901, CR 70).

The law of universal gravitation states that two masses experience an attractive force defined as F = G x m1 x m2/d² where G is the gravitational constant, m1 and m2 are the two masses, and d is the distance between their centres of gravity. Gravity as we know it is exerted by the earth, so m1 becomes the mass of the earth and d is the distance to the centre of the earth, or the earth's radius. We can thus say that g = Gm1/d². G and m1 are constants, but d is not. This means that the value of g experienced at any point on earth, depends on how far we are from the centre of the earth. Because the earth is not perfectly round, this means that the value of g depends on the latitude and the altitude. Since the earth is flattened at the poles, the sea-level value of g is highest at the poles and lowest at the equator. As our altitude above sea level increases, the value of local g diminishes.

The usual formula to calculate the value of gravity at any place on earth is:-

$g = 9{,}7803184(1+.0053024 \times \sin^2\Phi - 0{,}0000059 \times \sin^2 2\Phi) - 0{,}00000308 \times h$

where Φ = latitude in degrees and h = altitude in metres above seal level.

This formula is usually accurate to 50 ppm. Reasons for diversion from this formula include:-

the earth is not homogenous
the earth is not a perfect sphere

Pressure and mass laboratories usually have their local gravity determined by means of local measurement done by the Geological Survey people.

The value of local g departs from ISG by about 0,2% on the Highveld, and about 0,1% at the coast, just to give you some ideas on how much it varies.

Users of deadweight testers or liquid columns should estimate local g and bring it to account when working with anything more accurate than a pressure gauge. This can be done with software supplied with modern testers.

P.O.Box 3357, Benoni 1500. 169, Elston Ave, Benoni, 1501, Gauteng, South Africa
Phone 422-1749/1840 Fax 421-5379 Dial code international +2711 local 011
E-mail: rod@pressuresolutions.co.za Web: www.pressuresolutions.co.za