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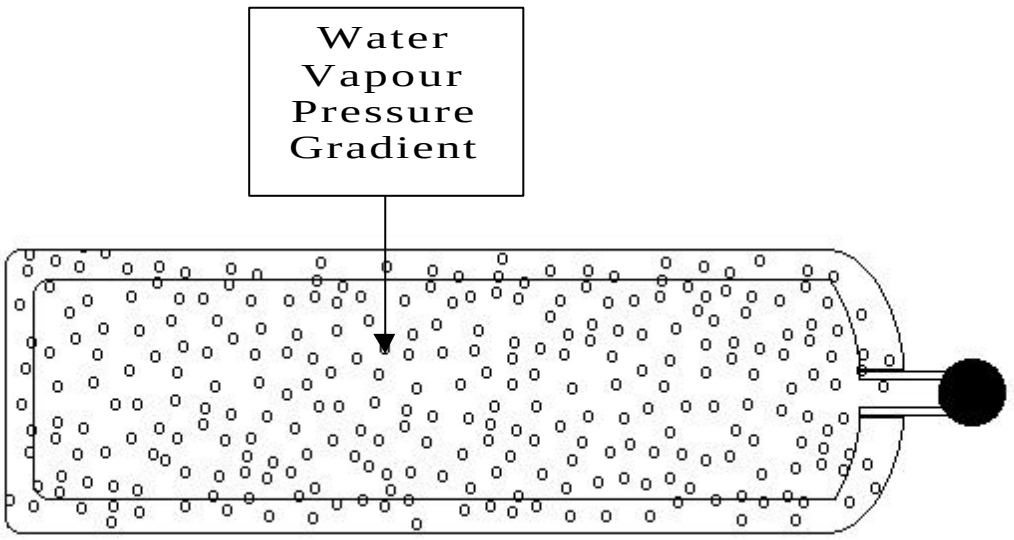
Calibration using Cylinder Gases

Cylinder gases have to meet a specification with respect to its composition, for example a Nitrogen cylinder will inevitably include a small amount of Oxygen, and Carbon Dioxide etc… and also moisture. It should be realised that a cylinder marked '100 ppm' is a maximum and therefore cannot be said to be a definitive quantity. It is also a fact that moisture within a sealed cylinder will vary according to its internal pressure, temperature and the ambient! Hence using a standard bottle of Nitrogen or other gas to compare instruments is therefore not viable.

Any compressed gas will have a water content, however as the walls of the cylinder are porous they will also store moisture vapour. This is because metals have a crystalline structure, as water is an extremely small molecule if will easily move through the crystal interfaces. The quantity of water vapour in the cylinder's wall will depend on the water vapour pressure in the cylinder, the water vapour pressure of the ambient, its temperature, and the nature of the material of the wall themselves.

A cylinder with 1 ppm moisture in it at 200 BarA will have a water vapour pressure of 0.2 mBarA, whilst ambient may be around 10 mBarA hence there is a fifty fold differential pushing water into the cylinder. It can therefore be seen that moisture can rise over a long period of time!



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A cylinder under stable conditions will achieve a 'balance' between the partial pressures inside the cylinder, its walls, and the ambient. As the gas in used, the overall pressure will fall and hence the partial water vapour will also fall. This balance will then be broken and so moisture can again migrate into the compressed gas, and at a greatly accelerated rate … wetting it up. This process is called out-gasing.

A major factor will all systems it temperature, the so called Diurnal effect. With the cylinder, as the walls are heated energy is imparted to the moisture molecule, this transfer causes oscillations and hence a pressure increase; as the pressure rises moisture is pushed into the cylinder. When cylinder cools the converse is true. Moisture migrating back into the wall in known as in-gasing These are short term effects, but the results are significant.

These effects are all due to the porous nature of the cylinders, BOC have developed 'Spectraseal' as a solution. With a secret coating on the cylinder in/out-gasing is drastically reduced, however they have to used extremely carefully under strict temperature requirements. When used correctly the can be very accurate, tests at NPL (National Physics Laboratory) have indicated that they could be transfer standard quality.

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