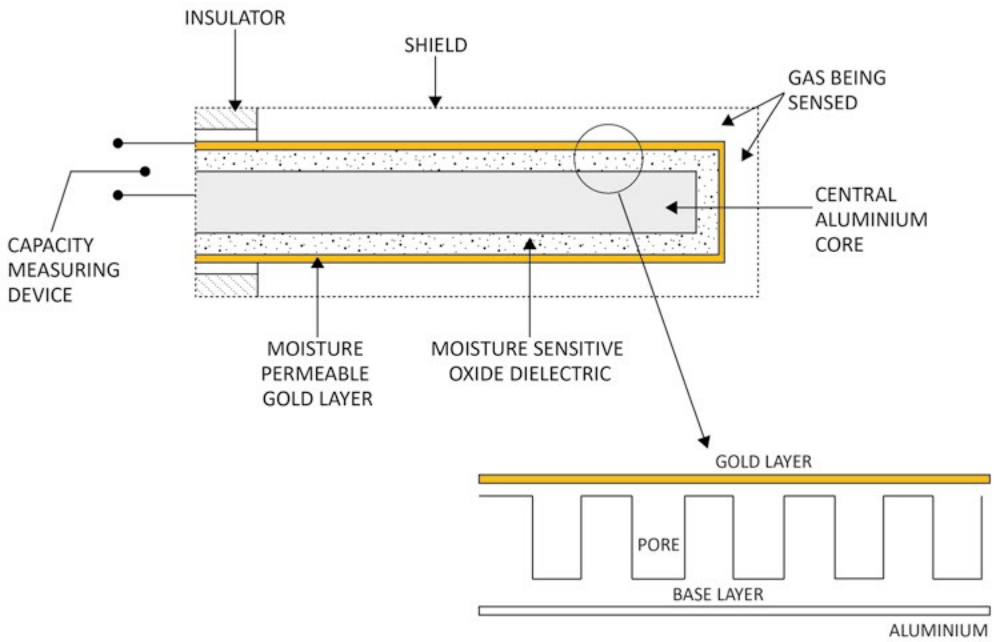
# Shaw Moisture Meters Sensor Technology

The general principle of operation of an aluminium oxide sensor, for the measurement of moisture in air and gases, is well documented but the actual construction of this type of sensor, which varies widely from manufacturer to manufacturer, is critical to the performance and reliability of systems in field operation.

Certain manufacturers have resorted to catchy marketing phrases such as Hyper Thin Film Technology, Ceramic and Silicon Sensing Technology (which are simply aluminium oxide sensors on a substrate) and Thin Film technology, to demonstrate their technical competence. However, in the final analysis the performance and stability in the field of the end product is the key test.

The basic construction of the sensor consists of a high purity aluminium wire, the surface of which is chemically oxidised to produce a pore filled insulating layer of partially hydrated aluminium oxide.  A porous but conductive gold film is then deposited on the oxide layer with the gold film and aluminium wire forming the two plates of a capacitor (see diagram below).

The oxide layer that forms the dielectric separating layer of the capacitor, is in the form of a mass of tubular pores running up from the aluminium core to the exposed surface.  Because a dynamic equilibrium is maintained between the water vapour outside the sensor and the absorbed water within it, the water absorbed into these pores is directly related to the moisture content of the gas surrounding the sensor. The general arrangement of an Aluminium oxide sensor is usually shown as below:-



The pore size of the aluminium oxide layer is specific to water vapour and smaller molecules but due to the dielectric constant of water compared to that of other vapours which may enter the pores, such as hydrogen, the sensor response is resistant to many contaminants and specific to changes in water vapour, regardless of the carrier gas.

The dewpoint range covered by the sensor is –100 °C to +20 °C dewpoint, which corresponds to 0.0015 ppm to 0.2 percent by volume.

Huge importance is always placed on the size and shape of the primary pores of the sensor, which is critical and determines the sensitivity and speed of response of the sensor, however very little attention is given to the construction of **Base Layer** of the sensor.

The construction of this **Base Layer** determines the base capacitance of a sensor and uniformity of this layer is critical for a reliable, stable and drift free sensor.

Pores or cracks in the **Base Layer** act as capillary pores and they absorb and desorb water molecules in the same way as the primary pores, although at a slower rate, therefore sensor with this construction, when used in 'dry' conditions will shift calibrations as these capillary pores dry out.

Other manufacturers do not have the capability to manufacture the sensor's **Base Layer** with such precision or this layer is porous or cracked, which allows the base capacitance to change when the sensor is permanently installed in a continuous 'dry' condition - e.g. when at the outlet of an air dryer. This results in large sensor **drift** and in this case the sensor will indicate dryer Dewpoint readings than actual - eventually reaching the 'bottom stop' of the instrument display.

In addition to being relatively slow to dehydrate (drying down), this layer can also be slow to rehydrate (wetting up), giving the impression of a **flat spot**, i.e. where the sensor is very slow or does not respond to increase in moisture levels at low dewpoints.

Aluminium oxide sensors operating on an impedance circuit will show an exaggerated drift caused by this effect, especially if the capillary pores in the **Base Layer** extend to the aluminium core, as this would increase the resistive effect of the sensor.

Many years of development have resulted in a sensor with a very evenly constructed **Base Layer**, which eliminates dry end drift and does not demonstrate a **flat spot** response.

As previously discussed, the primary pores of the sensor are responsible for the speed and sensitivity of the sensor. Our continuous research and development programme has resulted in our capability to manufacture a sensor with uniform and water vapour specific pores, giving large capacitance changes and rapid predictable response.

Advantages of the SHAW sensor include:

- Wide dynamic range from 0.001 ppm to 0.2 percent by volume
- Stability, low hysteresis and temperature coefficients
- Flow independent
- Can be intrinsically safe (when used in conjunction with barrier or isolator)
- High selectivity for moisture
- Can operate over a wide range of temperature and pressure
- Require little or no maintenance