

EXPERT PAPER

Ultra-Thin Film Aluminum Oxide Technology.

AquaXact 1688

Author:

Jim Belanger,

Product Business Manager, Servomex



The AquaXact 1688 ultra-thin film technology is based on major advances in micro layer deposition and metal oxide sciences. It provides measurements with a sensitivity several orders of magnitude larger than of those made with other technologies. The Servomex AquaXact 1688 sensor results are free of drift and insensitive to temperature changes.

OPERATING PRINCIPLE:

Aluminum Oxide (Al_2O_3) sensors measure the capacitance between an aluminum core and a gold film deposited on top of the oxide layer, which varies with the water vapor content in the pores of the oxide layer. Three fundamental structural improvements in the oxide layer give AquaXact 1688 sensors much increased sensitivity and stability: the Servomex sensors have a much thinner oxide layer, a better-defined barrier layer between the aluminum and the aluminum oxide, and a unique pore geometry enhancing the entrapment of water molecules.

ULTRA-THIN LAYER TECHNOLOGY:

The ultra-thin Aluminum Oxide AquaXact 1688 sensors are manufactured without compromising transmitter strength. The thinner oxide layer of the sensors results in much higher capacitance changes since capacitance is inversely proportional to the distance of the capacitor's plates from each other. The thinner layer also means that water molecules will

travel faster in and out of the pores. Servomex Aluminum Oxide sensors therefore respond several times faster than conventional Al_2O_3 sensors.

BARRIER LAYER:

In the AquaXact 1688 sensors, the transition between the aluminum oxide and the aluminum is sharp and clearly defined. This thinner barrier layer produces a capacitor with its electrodes very close together, which in turn causes the sensor's wet to dry capacitance ratio to be high. The benefit of high wet to dry capacitance ratio is that drift in capacitance due to undesirable factors is less significant.

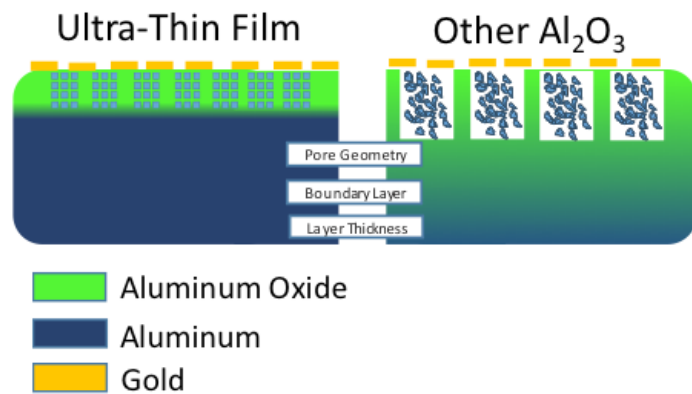
This is clearly a benefit as can be seen in the AquaXact 1688 sensor vs. conventional sensor comparisons of temperature sensitivity and aging drift.

The sharp transition from aluminum to aluminum oxide also reduces metal migration, one of the major causes of aging drift in conventional sensors.

PORE GEOMETRY:

The most significant difference between AquaXact 1688 sensors and conventional sensors is their pore geometry. While conventional sensors rely on non-uniform hygroscopic aluminum oxide structures to attract water, the AquaXact 1688's ordered pore geometry holds more water which increases the change in capacitance for a given change in dew point.

This produces more accurate results and a quicker response to a change in dew point. In addition, the AquaXact 1688 pore geometry does not significantly change over time, while conventional hygroscopic aluminum oxide structures are not stable and collapse slowly into non-hygroscopic structures. Therefore, conventional sensors are subject to drift and need to be re-calibrated frequently, while AquaXact 1688 sensors need only calibration checks yearly when used in clean, non-corrosive gases.

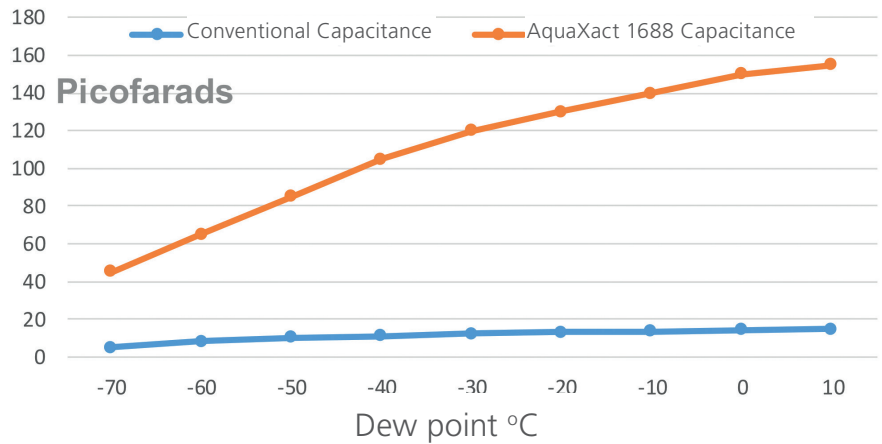


EXPERT PAPER: AquaXact 1688

SENSITIVITY:

The change of capacitance with moisture of AquaXact 1688 sensors over the full measurement range is 20 times larger than that of conventional sensors. However, because of the better linearity of the thin film sensors, at the low end, capacitance changes with moisture are about 40 times larger than that of conventional sensors. The higher sensitivity of sensors makes the AquaXact 1688 more stable and almost completely immune to other influences, such as temperature, electrical noise and even long-term drift. It puts AquaXact 1688 sensors in a league of their own.

Capacitance vs. Dew point



TEMPERATURE COEFFICIENT:

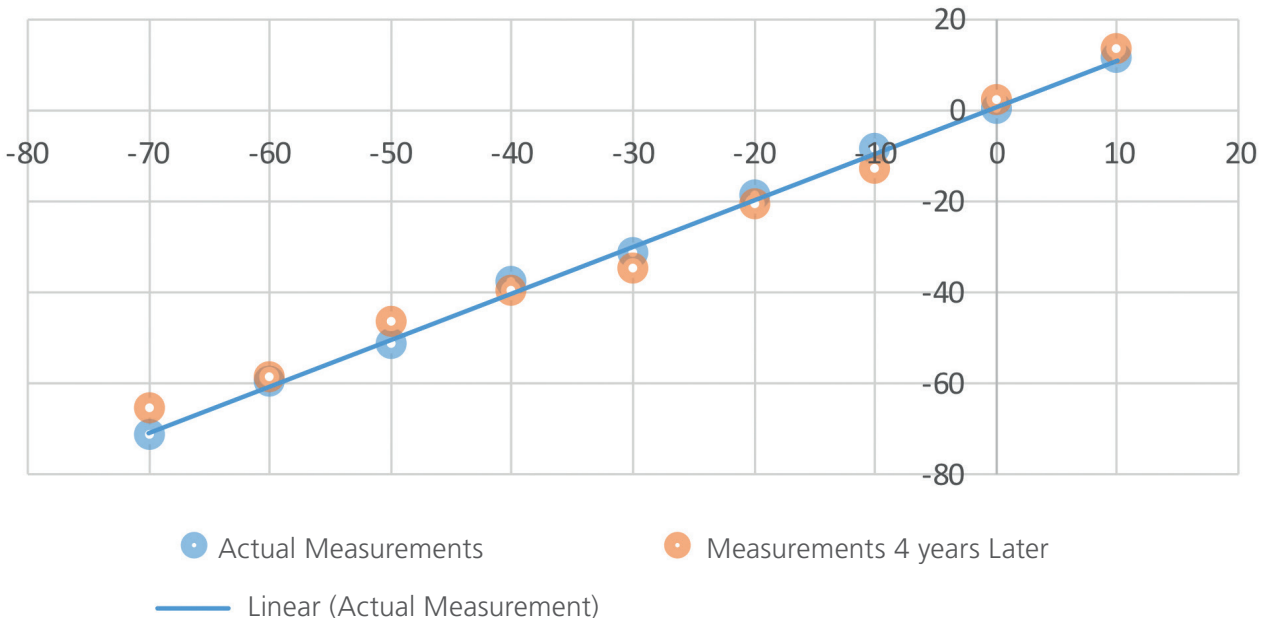
The AquaXact 1688 Aluminum Oxide sensors are completely temperature-stable over almost their full range. Only below -70°C dew point does the measurement become slightly temperature-sensitive. Temperature coefficients remain small enough though to allow for software compensation. The temperature

coefficients of conventional Aluminum Oxide and Ceramic sensors relative to their sensitivity are too large to allow for an accurate compensation through software.

DRIFT AND UNIFORMITY:

The AquaXact 1688 sensors do not suffer from drift like conventional sensors. Their response curve remains virtually the same even after many months of operation at an elevated temperature. The Servomex Aluminum Oxide sensors are manufactured with a high degree of uniformity. Sensors are freely exchangeable in the field.

Calibration Stability



visit servomex.com/AquaXact1688 or contact your local Servomex Business Center.

Servomex has a policy of constant product improvement and reserves the right to change specifications without notice. © Servomex Group Limited. 2014. A Spectris company. All rights reserved.