# Application Note AN-106

May 2016

# Gas Sampling and Material Considerations for SPEC sensors

## Scope

This application note describes the gas sampling and material considerations for SPEC Sensor™ electrochemical gas sensors.

## Dust & Condensation Protection

The sensor should be protected at all times from dust, oils, and condensed moisture. A typical solution is to mount a porous particulate filter over the gas exposure holes or mount the sensor with gas sampling face down in the system. If moisture does condense on the sensor, the signal may decrease and slow down noticeably and many membranes will lower or reduce the sensitivity. Once the condensing environment is eliminated, and the moisture dries, sensor performance will typically return to normal.

It is critical in product design to protect the sensing face of the sensor from accumulation of dust and oils. And do not poke or rub or press on the membrane or expose it to rapid pressure fluctuations or block it with materials as this can damage the delicate gas inlet system or interfere with the sample target gas getting to the sensor.

**NOTE:** Electronic self-test methods cannot detect loss of response caused by lack of gas diffusion when dust or water droplets cover the gas inlet holes and block gas diffusion. Not even a perfectly functional gas sensor will respond if the gas does not enter the sensor!! It is critical in product design to protect the sensing face of the sensor from accumulation of dust and oils. Often this can be accomplished with a gas-permeable membrane.

Contact SPEC Sensors for more information on membranes and suppliers.

## Gas Flow Considerations

The sensitivity and response time of the sensor is affected by the direction and velocity of the air stream past the face of the sensor. For very accurate measurements, it is recommended that the sensor is placed behind a gas permeable membrane or baffle to buffer the sensor from fluctuations in airflow. For sampling confined spaces, or remote points, one can draw a sample from the remote location to the sensor with a pump, and have a controlled flow rate across the sensor, with minimum internal volumes (to minimize lag and mixing). Our sensitivity and response time data is collected in a fixture in which the velocity of the gas stream is 0.1-0.2m/sec *parallel* to the face of the sensor, approximating diffusion conditions from ambient air flow in a room

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## Pump-flow sampling systems

- It is recommended that in pumped-flow systems, the use of baffles and other pressure/ flow modulators on the inlet and outlet tubes is considered
- Avoid sampling designs which subject the sensor to rapid pressure changes. When exposed to a rapid pressure change, SPEC sensors may show a baseline current spike, and then settle to a constant output.
    - Pump should always be upstream from the sensor.
    - A restrictor is recommended in the flow path between the pump and sensor. The combination of the flow restrictor and volume between pump and restrictor will act as "accumulator", or pressure pulse-dampener.
    - If the pump is **upstream** from the sensor ("pressure-flow") the sensor flow-cell exhaust port diameter must be larger D than the restrictor
    - If the pump is **downstream** from the sensor ("vacuum-draw") the flow-cell inlet port diameter must be larger D than the restrictor.

## Material Considerations

When dealing with very reactive gases, $H_2S$, $NO_2$, $SO_2$ and ozone, material selection is important. It is important to remember that these trace gases are quite reactive, and care must be used in selecting materials used for tubing, manifolds, and even pumps and valves. Common thermoplastics such as ABS and styrene will rapidly scrub out trace levels of gases such as ozone, SO2, H2S and NO2 because of surface adsorption. Additionally, new polystyrene cases will outgas high levels of VOCs (styrenes) which will react with any ozone, for example, in the immediate vicinity of the case, causing low or zero readings.

Aluminum, copper, and polymers such as Nylon and most rubber variants may tend to adsorb or react with these gases. If surface adsorption occurs on the exposed materials, the concentration reaching the sensor will be decreased, until the surfaces are saturated. Once the gas is no longer present in the sample, the adsorbed molecules may desorb ("bleed") from the surfaces if unreacted, and can be detected by the sensor. This may appear to the user as a slow return to background signal.

It is recommended that one minimize materials to which the gas is exposed before reaching the sensor, and wherever possible Teflon™, polypropylene, or stainless be used. Delrin and polycarbonate are suitable where close tolerances are required in machined/molded parts, and Viton™ and EPDM are a relatively inert materials used in seals and pump diaphragms. **Experts at SPEC Sensors can help with materials selection and system design.**

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