

# Carbon Monoxide Sensor Cross-Sensitivities Alcohols, VOCs & Hydrogen



Technical Bulletin

*Cross-sensitivity to gases other than the target gas of interest is a common sensor characteristic, especially among electrochemical sensors. Cross-sensitivities are limited as much as possible by MSA sensor design and filters; however, some key interactions still occur. CO sensors do have some inherent characteristics in terms of saturation, cross-sensitivity and cross-interference that may affect sensor performance.*

A typical electrochemical gas sensor contains three electrodes: the sensing electrode, the reference electrode and the counter electrode. Electrodes function as follows:

- The sensing electrode oxidizes or reduces the target gas.
- The counter electrode completes the circuit and produces an opposite reaction from that produced at the sensing electrode.
- The reference electrode acts as a reference point to ensure that sensing electrode potential is precisely maintained.

Sensing electrodes are manufactured using conductive catalytic materials that are carefully chosen to provide the best performance for the desired target gas. Proper choice of this catalyst provides selectivity for the target gas over other gases that may be present within the environment.

For carbon monoxide (CO) sensors, platinum is the catalyst of choice for the working electrode, as platinum is very stable when used within the electrolytic environment and is an excellent catalyst for creating carbon monoxide oxidation. Platinum is also a very good catalyst for many other gases, including most hydrocarbons, other volatile organic compounds (VOCs) and alcohols. To address these inherent properties, carbon monoxide sensors are typically designed with a chemical filter. Chemical filters allow CO the means to cross unhindered, while removing most interference gases from the inlet stream.



CO sensors can become saturated with target gas CO. If enough CO enters the sensor beyond maximum range (that listed in the instruction manual), the sensor is unlikely to be able to process all applied gas. When this scenario occurs, the electrolyte becomes saturated. A saturated sensor will continue to show high gas readings until the gas can be processed from the electrolyte. If saturation occurs, allow the instrument to sit powered off but charged for 24 hours. The sensor is typically not damaged, but needs recovery time.

Hydrogen commonly causes positive CO response, as hydrogen molecules are small enough and sufficiently non-reactive to pass directly through the filters of many sensors. Once through the filter, hydrogen is easily oxidized at the platinum working electrode. Hydrogen-resistant CO sensors are available, such as MSA's XCell® CO H<sub>2</sub>-Res/H<sub>2</sub>S Sensor, used with MSA multigas detectors and ALTAIR® PRO CO Steel Detectors.

*Because every life has a **purpose...***

Given enough residence time or high concentrations, most hydrocarbons and VOCs eventually break through filters and can also cause positive sensor response. These gases or vapors tend to be caught in the filter and can saturate the filter before desorbing over time. As a result, after exposure to a hydrocarbon or VOC, a sensor may need time to stabilize and show a reading, even after the substance is no longer present. In this case, the substance works its way through the filter and is read by the sensor upon breakthrough. Therefore, positive response may be present for several hours after exposure, due to slow desorption. If a user zeros or calibrates the instrument while the filter is still saturated, the possibility exists of producing negative instrument reading when the filter clears. If this scenario occurs, the instrument must be recalibrated after recovery.

Alcohols are also adsorbed as they enter the sensor and may also create CO positive cross-sensitivity reaction. Although alcohols generally cause positive reaction, they are caught in the sensor electrolyte and diffuse to the reference electrode. This diffusion changes the reference electrode potential, and given enough time and concentration, can cause negative response. If the CO channel is part of a two-tox sensor that includes another separate gas channel, the possibility exists that exposure enters from the other channel and reaches the counter electrode first, resulting in negative shift first followed by positive shift. If these events result in negative sensor response, they can cause an under-range alarm to occur.

As with hydrocarbons and VOCs, alcohols can get caught in sensor filters and can take time to clear. Alcohols, typical hydrocarbons and VOCs will not permanently damage sensors. Long exposure times or high concentrations can result in breakthrough of alcohols into the sensor working electrode, thereby producing a signal similar to CO oxidation response. In addition, temperature increase can drive off any alcohols that are adsorbed by the filter and cause breakthrough to occur. As a result, CO sensor response to alcohols is often delayed by minutes or possibly hours after initial exposure, creating difficulties in tracing the event's root cause.

From a practical standpoint, cleaning gas detectors with alcohol should be avoided, as alcohol use can trigger some undesired responses. If using alcohol-based cleaning or disinfecting agents, it is possible that high concentrations of these agents will overload the filter. When intensive cleaning or disinfection takes place, the presence of such agents can potentially reach excessive TWA concentrations resulting in a gas alarm. Accordingly, MSA recommends removal of antiseptic products from areas in which sensors are used or stored.

In summary, CO oversaturation, exposure to alcohols, VOCs and hydrogen can result in both positive and negative instrument alarms, depending upon the situation at hand. Sensors generally do completely recover without adverse effects; however, recovery time can range from one to 24 hours, depending upon time and exposure concentration.

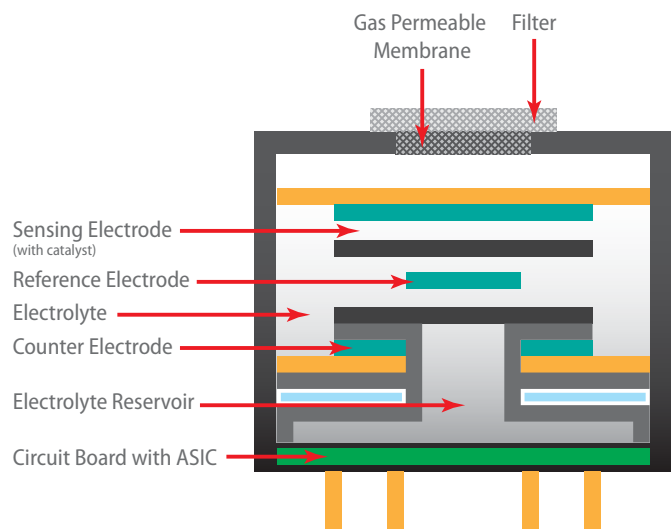


Figure 1. MSA XCell Sensor (electrochemical)

Note: This Bulletin contains only a general description of the products shown. While uses and performance capabilities are described, under no circumstances shall the products be used by untrained or unqualified individuals and not until the product instructions including any warnings or cautions provided have been thoroughly read and understood. Only they contain the complete and detailed information concerning proper use and care of these products.



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