

AP 1027: CLEANING AND SANITIZING PORTABLE GAS DETECTORS

Real time gas detectors may not be able to detect COVID-19, but they are vital tools for many essential workers. Sanitizing instruments, and the need to detect chemicals in the workplace introduced by new sanitization techniques are creating issues for many instrument users.

Keeping workers safe from COVID-19 exposure includes ensuring any equipment that is passed between workers, or which has potentially been exposed to pathogens, is safely disinfected before handing it off to another employee, or bringing it into an area where pathogens could be transferred by surface contact to other unprotected persons. Whenever possible, try to use procedures that reduce the need to pass instruments between users. Try to assign frequently used portable instruments to individual workers whenever you can. Include calibration or “bump test” kits with the assigned instruments, reducing the need to bring the instruments back to a central location for testing. Use gloves when handling instruments that may have been exposed to pathogens. Most importantly, make sure workers understand when the instrument needs to be disinfected, and how to sanitize the instrument.

Just like other equipment, gas detectors need to be disinfected before they are handed off to be serviced, tested, or calibrated by another worker. It is important to follow the guidelines of the manufacturer when cleaning or sanitizing the instrument. Using the wrong disinfectant or cleaning method can affect the performance, or even permanently harm the sensors used to detect gas. It is important to understand the potential effects of disinfectants on sensors commonly used in single and multi-gas portable instruments.

Almost all manufacturers recommend sticking with mild soap and water when cleaning or sanitizing instruments. Manufacturers agree that you should particularly avoid using alcohol or cleaning solutions that include solvents. To sanitize gas detectors, make sure they are turned off, then give them a sponge bath using mild dishwashing soap.

Turning the instrument off ensures that the response of the instrument to conditions and materials used during the decontamination process are not logged as part of the monitoring session readings.



Make sure that the gas detector has been properly sanitized before taking it to a common area, or handing it off to another worker.

It also protects the LEL sensor, which is more vulnerable to being poisoned when it is turned on and under power.

Even if they are “water resistant,” do not fully immerse the instruments. Sponge them off with the mild soapy solution, then sponge them off again with fresh water. Let them air dry. Do not use a blow drier or heated air source.

Perform a bump test or calibration check before the instrument is returned to service. Performing a bump check before each day’s use is always important, but it is even more important when the instrument has been through a sanitization procedure. Any condition, exposure or event that could potentially have an adverse effect on the proper operation of the instrument or the sensors should trigger performing a bump test or calibration check of the instrument before further use. Any instrument that fails a bump test or calibration check must be adjusted by means of a full calibration procedure before further use.

Make sure to perform any other operational checks required by the manufacturer.

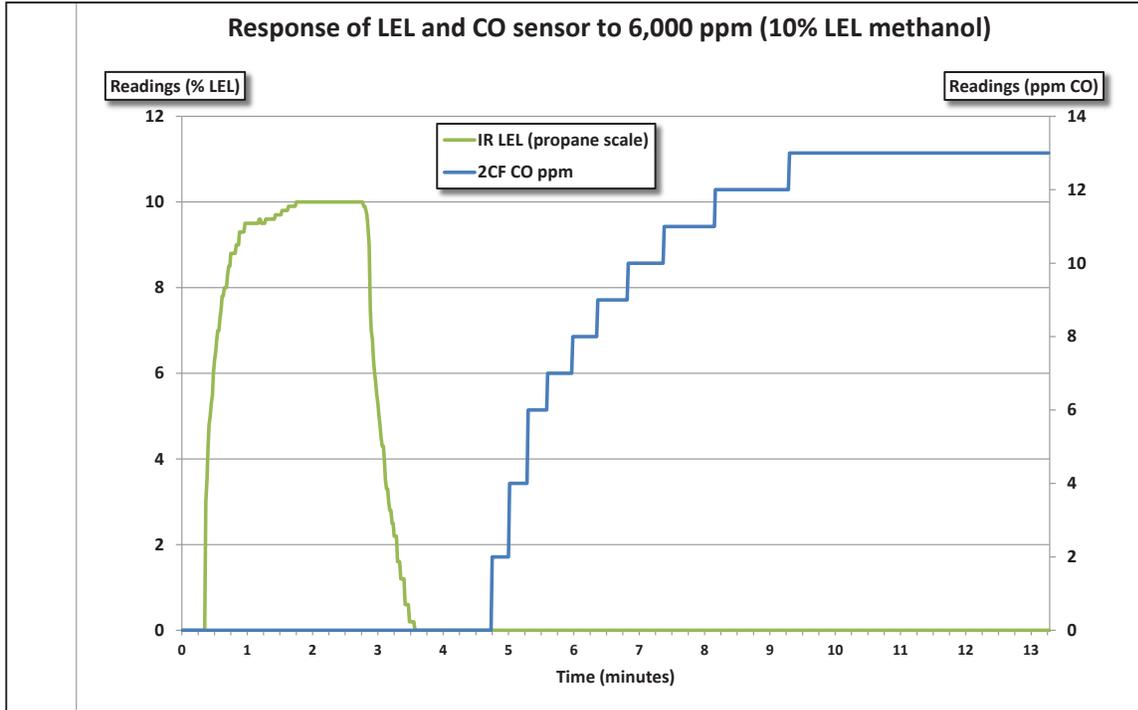


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The LEL sensor shows the actual start and stop times of the 6,000 ppm (10% LEL) methanol exposure. This is a very high concentration of methanol. The LEL reading is in percent LEL. If the concentration of solvent is high enough to get through the filter, CO sensors show a slow initial response and a slow clearing time to alcohols and similar solvent vapors. In this case the 2CF CO sensor showed a maximum stable reading of 13 ppm. This is a very low relative response to a very high concentration of solvent. It took about six hours for the CO sensor to restabilize on zero in fresh air.

For instance, instruments equipped with motorized pumps often include a protective hydrophobic barrier filter that swells and blocks the flow of air if it gets wet. Test the proper operation of the pump after sanitizing the instrument and replace the filter if necessary.

Part of the test procedure is to make sure the alarms are properly activated when the instrument is exposed to gas. Make sure the alarms are loud, and sound “normal.” Many instruments have an audible alarm opening that operates in the same way as a megaphone to amplify and focus the alarm. Residues from sanitizing materials that collect or leave a scum in the audible alarm port may reduce the loudness or prevent the proper operation of the alarm. This is one of the reasons it is better not to fully immerse the instrument, even if it is a “waterproof” or leak resistant design.

- **Do not use alcohol towelettes, alcohol solutions, hand sanitizers or solvents to clean or disinfect gas detectors!**

Carbon monoxide (CO) and other electrochemical sensors are particularly vulnerable to alcohol exposure. Alcohol still diffuses into the sensor even while the instrument is turned off. Once it is in the sensor it interferes with the normal detection reaction. The sensor recovers as the alcohol is slowly released and diffuses back out of the sensor, but this can take quite a bit of time.

Most multi-gas instruments include a single channel CO sensor, or a dual channel “COSH” sensor that measures both CO and H₂S. Both single channel CO and the COSH sensors use the same detection reaction.



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Electrochemical sensors are complicated devices that include many internal components such as barriers, membranes, separators, electrodes and protective internal filters. The detection reaction occurs in an aqueous electrolyte solution. For many common sensors, including CO and H₂S sensors, the electrolyte is a weak solution of sulfuric acid. Anything that affects the performance of the system affects the ability of the sensor to properly detect gas.

The sensing electrode in the CO sensor is where the detection reaction occurs. The CO sensing electrode responds to several other gases and vapors, including H₂S. The reason that single channel CO sensors do not respond to H₂S is that the sensor includes an internal filter used to remove H₂S and other sulfides, as well as other interfering gases, including VOC vapors. Once the internal filter is saturated however, interfering gases break through the filter and enter the part of the sensor where the detection reaction occurs. The presence of interfering gases can affect the electrolyte, changing the way detection reaction proceeds, or can directly react at the sensing electrode.

The internal filter in the CO sensor has enough capacity to handle a lifetime of daily bump test exposure to H₂S, but a more limited capacity to absorb alcohol and VOC vapors. When you use an alcohol towelette to clean the instrument, you are not exposing the sensors to a few parts per million of vapor, you are exposing the sensor to several thousand ppm of vapor.

Dual channel COSH sensors do not respond to H₂S for another reason. COSH sensors are internally divided into two chambers. H₂S is detected and measured, as well as removed by the detection reaction in the outer chamber. The H₂S detection reaction does not affect any CO that is present at the same time. The CO diffuses on through the outer chamber to the inner chamber, where the CO detection reaction occurs. COSH sensors depend on the sensor itself to remove the interfering H₂S gas. It is not possible to include a robust internal organic vapor filter, because the same filter used to protect the CO electrode would also remove some or all of the H₂S you are also trying to measure. For this reason, COSH sensors typically show a greater response, and take even longer to recover after alcohol or solvent exposure.

Typically, when exposed to alcohol, CO sensors and the CO channel of COSH sensors begin to show a response as soon as the internal protective OV filter is saturated. This can be right away, or it can take a minute or longer before the sensor begins to respond. The reading continues to rise slowly even after removal of the external source of alcohol exposure. The reading may continue to rise for 5 or 10 minutes or



Electrochemical sensors used to measure CO and other toxic gasses are complicated devices with many internal components. CO sensors often include filters to protect the sensor from exposure to alcohol and other VOC vapors.



Larger sized sensors have more room for internal filters. The larger size of the sensing electrode and greater volume of electrolyte make them harder to destabilize as well.



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longer. Often, the sensor reaches its maximum over-range concentration limit, and the instrument begins to display an alarm message rather than a numerical reading.

It takes an equally long, or even longer time, for the sensor to recover in fresh air. The filter can take a very long time to finish desorbing the last few ppm of alcohol, and for the vapor to finish diffusing back out of the sensor. For this reason, you sometimes see the CO reading “hang” at two or three ppm even after the instrument has been back in fresh air for several hours. Most often the reading eventually stabilizes back on zero, but it can take hours for the sensor to completely recover.

An instrument with a CO sensor with a “hung” reading or a reading that is declining very slowly should be allowed to recover to the extent that it can before performing a fresh air zero or returning the instrument to service. You do not need to leave diffusion type instruments turned on for the sensors to recover in fresh air. CO and other electrochemical sensors that have been exposed to alcohol continue to recover even while the instrument is turned off. That is true for instruments that are equipped with internal motorized sampling pumps also, but because the sensors are isolated by the pump and internal tubing from the ambient atmosphere, it takes even longer to recover. So, for pump equipped instruments, you may need to turn them on to speed up the recovery process.

Once the sensor signal has recovered below the over-range threshold the instrument will once again begin to display numerical readings. Full recovery after exposure to a high concentration of alcohol - which is what happens if you use an alcohol wipe or hand sanitizer - can sometimes take a day or longer. Most of the time the CO sensor largely recovers, but there is often at least some permanent loss of stability and performance. CO sensors become incrementally more affected with additional exposure. A sensor that has been permanently poisoned by high exposure will need to be replaced.

If you perform a fresh air zero before the sensor is fully recovered, you will wind up with a negative reading (or negative alarm) as the sensor finishes recovery. For instance, if you fresh air adjust the sensor while it is still showing a reading of 10 ppm during recovery, when it eventually



Use mild dish soap to clean the instrument, and a damp sponge to wipe it off with fresh water. Try not to get soapy water into the sensor openings or audible alarm.

finishes stabilizing it will show a negative reading, or the instrument may display a “negative” alarm.

Fresh air adjusting the sensor too soon can lead to needing to fresh air adjust the instrument repeatedly as the sensor continues to recover. Try to be patient! It is better to wait till the sensor has finished stabilizing before performing a fresh air zero. (And an even better idea to entirely avoid using alcohol or solvents to clean the instrument!)

How long it takes for the sensor to respond and recover from exposure to alcohol is dependent on the sensor design, the volume of the sensor, and the capacity and performance of the protective internal filters. Miniaturized CO sensors have smaller volumes of electrolyte and more limited internal filters. The reduced filter capacity makes them more vulnerable to breakthrough, and the smaller volume of electrolyte can make them easier to destabilize. In general, larger “full sized” 4-Series and 7-Series sized single channel CO sensors are better at withstanding and recovering from alcohol exposure than miniaturized single channel CO and COSH sensors. But whatever the size of the sensor, they are all vulnerable to alcohol and solvent exposure.



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High concentration alcohol is also hard on catalytic LEL sensors. Exposure to high concentration alcohol can cause a change in the response of the LEL sensor, which means it may need to be adjusted before further use.

- **What about other types of disinfectants?**

The best advice is to stick with mild dish soap and water to clean the instrument.

Do not use cleaners like Pine-Sol® type disinfectants that include pine oil, or “citrus oil” cleaners that include limonene. Besides the fact that these disinfecting cleaners usually include alcohol, they also include VOC chemicals like pinene and limonene that can additionally affect the sensors. While alcohol affects CO sensors more strongly, terpenes like limonene generally have a greater effect on H₂S sensors and the H₂S channel of COSH sensors.

The active ingredients in Lysol® include ammonium chloride and ethanolamine. Depending on the specific product, it can also contain alcohol. Ammonium chloride can inhibit or poison LEL sensors, while ethanolamine can interfere with some electrochemical sensors.

The primary active ingredient in Chlorox® and other types of household bleach is sodium hypochlorite. Sodium hypochlorite can inhibit or poison LEL sensors. Once again, depending on the specific product, it can also contain alcohol.

Always perform a bump test or calibration check after cleaning the instrument, no matter what kind of cleaning method you use!

- **What should you do about chemicals that are left over in the air after disinfecting or indoor areas or solid surfaces?**

Some of the disinfecting systems being installed in many indoor workplaces have the potential for introducing or leaving residual contaminants in the air. Unprotected workers may not be exposed to contaminants in concentrations that exceed the permissible exposure limit (PEL).

There are a wide variety of chemical disinfecting systems. Some of the most potentially toxic residual contaminants include ozone (O₃), chlorine dioxide (ClO₂), chlorine (Cl₂), ammonia (NH₃), ethylene oxide (EtO) and, of course, alcohol. All these contaminants are directly measurable via compact, portable single or multi-sensor instruments.

Make sure to confirm that the air is safe before workers re-enter the disinfected area. Instrument manufacturers have a wide range of fixed system and portable instrument solutions for measuring these hazards.

Keep it clean, use gloves, and stay safe through the pandemic crisis!

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