

# winemaking

## Product Review: Toxic Gas Detectors

Hand-held instruments for confined spaces in wineries

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OF ALL THE potential danger zones in a winery, OSHA's microscope is most focused on confined space. At issue are workers operating unsafely in small, toxic environments, which can quickly lead to death.

For wineries, one of the most critical times during which this can occur is the annual fermentation and the unavoidable abundance of carbon dioxide. With CO<sub>2</sub>'s ability to easily displace oxygen (O<sub>2</sub>), it is the most prevalent seasonal hazard and, with few warning signs, the number one "stealth killer." But CO<sub>2</sub> is not the only gas to monitor in a winery; add O<sub>2</sub>, sulfur dioxide (SO<sub>2</sub>) and ozone (O<sub>3</sub>) to the mix.

Attention to worker safety means being proactive, not reactive, so the best solution is to invest and use proper detection equipment. Portable, hand-held multi-gas meters, often referred to inaccurately as CO<sub>2</sub> meters, make all the difference in winery safety. There are also complete "built-in" systems that monitor entire cellars and evacuate gases via automatic ventilation systems. The scope of this article, however, is hand-held.

Hand-held multi-meters work for the majority of wineries because they are reasonable in cost, easy to use, reliable and help address OSHA compliance issues. The meter's "world" is the confined space.



The Micro-5 IR, from BW Technologies, is compact and offers three kinds of alerts.

### CONFINED-SPACE PROGRAM

It is an OSHA requirement to have a written "confined-space" program if an employee enters an environment with restricted entry or exit and the area is not designed for constant occupancy. In wineries, this can include sumps, pits, fermentation rooms and, most obviously, tanks.

"Permit-required confined space" means that just one of several characteristics is present, the first being "an area with the potential to contain haz-

ardous atmospheres." It is also possible to gain a "non-permit" certification by simply evacuating a space with fans, but the area must be constantly monitored.

Other criteria determine exposure limitations and warnings. TWA means Time Weighted Average and refers to levels of toxic gas a worker may encounter in an eight-hour day, 40 hours per week. STEL means Short Term Exposure Limit and refers to limited high exposure not to exceed 15

minutes, four times a day. The criteria you really want to avoid altogether is IDLH meaning "Immediately Dangerous to Life or Health."

OSHA has well defined rules and emergency procedures for evacuating an area if a problem should arise. The average citation for non-compliance, however, is \$7,000 per infraction plus attorney's fees.

That said, it is easy to control your exposure and promote safety. Today's high-tech gas detection meters are being used throughout a vast range of industries from coal mines to pipeline welding or municipal underground work. They are easily configured to address the immediate dangers of almost any environment. Wineries are pretty basic, but there are some specific issues to consider.

### ATTRIBUTES TO CONSIDER

As the name implies, hand-held multi-meters are compact units designed for ease of use and convenience. Generally weighing under a pound (16 ounces), they have a water-resistant (not water-proof) high-impact plastic case that houses a number of sensors, usually up to five. They have built-in alarm systems for TWA and STEL to warn of hazardous environments, are powered by alkaline or NiCad batteries (or both) and may have data recording capabilities.



The base cost for most units will be around \$1,500 to \$2,000 but are quantity-sensitive. The price will also increase if options are added, such as a data logger or a sampling pump.

While the units can be configured to detect a wide array of gases, a few are inherent to all wineries.

### KEY GASES TO MONITOR

First, do not buy a simple CO<sub>2</sub> meter. There are plenty of companies that only sell these but avoid them. The problem with a singular CO<sub>2</sub> meter is that it ignores O<sub>2</sub>. One gas floats, and one settles. Workers could be standing in an O<sub>2</sub>-rich environment inside a tank and then drop a tool. Bending over to retrieve the tool could immediately put them into a CO<sub>2</sub>-rich environment.

Worse, bending over an open-top fermentor in full production, while standing on a ladder 10 feet off the floor, can still expose a worker to 100 percent CO<sub>2</sub> and cause immediate loss of consciousness. Just a 5 percent increase in CO<sub>2</sub> can displace enough O<sub>2</sub> to create a serious hazard. If a worker waits until the O<sub>2</sub> deficiency alarm sounds on his meter, and it is due to increased levels of CO<sub>2</sub>, he may already be experiencing high levels of IDLH.

To repeat, OSHA first talks about O<sub>2</sub> displacement and then other toxins. As mentioned, other concerns for winery environments could include SO<sub>2</sub>, O<sub>2</sub> (from forklifts) and O<sub>3</sub>. If a winery really wants to cover all bases, there are even sensors for combustibles like ethanol alcohol during fermentation (defined on sensors as the Lower Explosive Limit or LEL).

Beyond CO<sub>2</sub> and O<sub>2</sub>, **Dan Kopache**, winemaker at **Redwood Valley Cellars** in Redwood Valley, California, uses his meter “to be proactive about O<sub>3</sub> and the inherent dangers during barrel cleaning, especially around drains.”

**David Jones**, winery production manager at **Merry Edwards Wines** in Sebastopol, California, pointed out the new regulations for SO<sub>2</sub>. “As of last November, OSHA has reclassified SO<sub>2</sub> from a fungicide to a pesticide. We now need a qualified application permit and must start monitoring,” he said.

As noted, many other sensors are available. One manufacturer offers 21. It makes sense to get as much detec-

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tion as possible because they are easy to configure to custom specifications and additional sensors may be added later.

### CALIBRATION

Most sensors will offer two levels of alarm: a “warning” when the environment has the potential to be hazardous and “danger” when the gas concentration exceeds the “warning” levels. Each gas has its own levels, and the meter is programmed by the manufacturer.

The accuracy of the meters depends on constant monitoring. There are two tests: the daily “bump” test and the factory certification. In either case, the meters are exposed to concentrations of selected target gases (called the cocktail mix) in factory-supplied cylinders to accurately calibrate the sensors to the different warning levels.

The **International Safety Equipment Association** (ISEA) recommends, at

minimum, verification of sensor accuracy before each day of use. This is known as the bump test. Unfortunately, sensors can sometimes experience “calibration drift,” and the equipment then becomes unreliable. This can be due to gradual degradation of the sensors (they have a lifespan), chronic exposure to low/high temperatures—generally 20° to 104°F, high humidity (wineries), airborne particulates, ingestion of liquid or rough handling.

Per ISEA, to perform the daily bump test, the instrument is (again) exposed to specific gases in cylinders at the winery. It is very important that these cylinders are readily available from the manufacturer. They will generally last about a year and come with a regulator that calibrates flow into the sensors.

The second and most accurate test will be performed either at the factory or a certified service station. Factory certification is usually valid for only six

months, and there will be a sticker (with date) attached to the sensor, similar to a fire extinguisher. This is what OSHA will be looking for.

**Jeff Smith**, assistant winemaker at **Ferrari-Carano Vineyards and Winery** in Healdsburg, California, said, “We have our instruments certified each year just prior to the crush. That way we know we are totally compliant and ready for the upcoming season.”

Wineries must check with the manufacturer to verify acceptable tolerance ranges, and the concentration of test gas must be high enough to trigger the alarms. If a sensor fails a bump test, the winery must revisit the certification station. “For this reason we always have a minimum of two sensors certified,” continued Smith. “If for some reason one should fail a test, we have an immediate back-up.”

Sensors are designed to be very reliable and with normal use may only lose about 5 percent of sensitivity per year. Typically the sensors have a two-year life and will be accurate until expiration.

Finally, there’s the “poor man’s bump” test, where the worker literally blows on the sensor to trigger a CO<sub>2</sub> alert. It is totally inaccurate and should not be used as an indicator.

### DATA LOGGERS

In this age of increased regulation, it is well worth having a built-in data logger. Not all units will automatically be equipped so ask about options and



Tetra-3, from Crowcon Detection

additional costs. This add-on ranges between \$200 and \$300.

With on-board loggers, TWA, STEL and maximum exposures throughout the time-referenced work day can be recorded (see cover photo). This encourages safety compliance by wineries. It also demonstrates good workplace safety policy to insurance companies, may be one more step in helping to reduce premiums and can provide critical information when tracing the history of a workplace injury.

“We download each day and maintain permanent records of every entry into each tank, and duration, and also document every day’s exposure and for how long,” said Smith. A sensor without a data logger is outdated technology.

### ALARMS

Three types of alarms are available. The sensor should have a minimum of two, but all three is best. These are not options. First are two flashing, wide-angle and bright electrical bars on the side of the unit. Second is a high decibel (95dB) alarm tone, and the third is a vibrator. The light may go unnoticed; the worker may miss the audio alarm in a noisy environment, so the final back-up is the physical warning. The alarms should be instantaneous for both low and high levels of gas alerts.

The LCD panel on the sensor should also contain a full range of alarms for self-test capability, which may include the circuit integrity and warnings of low battery life.

### PUMPS

Not all sensors come with an internal pump for remote sensing, and this option will usually add about \$150 to the base purchase price. A thin hose is attached to the sensor. The hose allows the operator to extend the sensing capability far inside a tank prior to entry. Some people may simply attach the sensor to an extendable rod.

When selecting the pump option, it is a good idea to make sure there is a sizable hydrophobic filter (moisture) in the event of unintentional liquid (wine) aspiration. The units will also have an alarm if this occurs, and the pump should automatically shut off.

On-board pumps, however, will shorten battery life.

Batteries must be able to supply power for the intended length of the worker’s shift. Generally 15 hours is considered adequate for sensors without integral pumps while a pump can almost cut that time in half.

Units will either be alkaline or NiCad (sometimes both), and all will come with charging units. In either case, they must all have back-up ‘hot-swappable’ battery packs, and the chargers should all be “smart” and shut off when the charge is complete. NiCad will generally have a longer life.

### SENSORS

Sensors are obviously the lifeblood of the detectors. As mentioned, units can be configured per a winery’s request, and there will be one internal sensor for each gas.

Sensors are time-dated and require attention to maintain accuracy. Galvanic sensors detect combustibles (ethanol), electrochemical ones detect toxins, while infrared (IR) sensors are responsible for CO<sub>2</sub>. Most will have a life of two years while the IR sensors can last up to five years. Replacement cost varies, but generally an O<sub>2</sub> sensor will run \$130.

Based on the type of sensors, the winery will specify the “cocktail mix” of gases to easily “bump test” their sensors. It is a good idea to qualify manufacturers about sensor calibration, what equipment they supply and the level of service they offer.

### USAGE SCENARIOS

#### Small Wineries

Wineries should only buy what they need. If they are smaller operations, it is a matter of simply auditing their activities and determining potential “confined space.” The best meters will have the ability to expand sensory ranges later. If most activities are done outside in well ventilated environments, then perhaps an initial purchase will only include the obvious sensors like CO<sub>2</sub> and O<sub>2</sub>. At the same time, however, buying just one unit with a wide range of sensors makes it more useful in the winery. For instance, a winery may want to add an O<sub>3</sub> sensor to its unit if it uses ozone to clean barrels.

### Medium to Large Facilities

Larger facilities may want to purchase multiple units. By monitoring the various environments, they might find that multiple meters with specific sensors make the most sense. Potential gas issues in fermentation cellars are different than the barrel room or where barrels are washed and sulfured. The units might be configured to be the most cost-effective for the intended workspace.

Having multiple detectors targeted at specific uses means the units will need only the sensors necessary for that use. This is a cheaper option than having all of the units outfitted with all the sensors needed throughout the winery.

### Sensors with Pumps

One accessory the winery might consider is the (sampling) pump. Generally these are used in areas where access is highly limited such as municipal underground environments once the manhole cover is removed. The hoses can vary in length. One workhorse is the RKI Eagle, which has the ability to pull samples from 125 feet away. This extreme may not be necessary in a winery, but a shorter version may be of use.

**Dan Kopache at Redwood Valley Cellars** said, “We also use our meter to monitor the 6 percent of O<sub>2</sub> in headspace we maintain during wine storage.” Here is a known situation where a remote hose may certainly be helpful. Again, make sure the unit has a large hydrophobic filter to prevent liquid incursion.

### TARGET MULTIPLE DETECTORS

Having multiple detectors targeted at specific uses means the units will need only the sensors necessary for that use. This is a cheaper option than having all of the units outfitted with all the sensors needed throughout the winery.

Sensors are also an overhead because they are time-dated and must be replaced periodically. This is why it is a good idea to look into a manufacturer’s distribution network.

The matrix at the back of this article lists a number of OEMs who will direct you to the nearest dealer. Portable, hand-held detectors are widespread and sold at just about all

safety equipment retailers across the country.

Since reliability is critical, it is advisable to not simply shop price but also service, maintenance, additional sensors, field training and, most important, facilities for certification and calibration.

Finally, consult fellow winemakers to qualify all of the above. Warranty for the base unit will generally be two years but remember each sensor is time-dated.

### DEVELOP PROCEDURES

Purchasing gas monitoring equipment is the first step in promoting worker safety in confined spaces. It is only the beginning because determining the presence of a hazard automatically implies some mode of evacuation. If you buy the detector, you logically must buy into the response.

OSHA not only addresses detection but also advises wineries about equipment, training and procedures when a situation arises. The first OSHA requirement for confined space mandates that an inclusive program be set up in-house. “They also have independent agencies which will visit the winery to help but not report,” said Smith. “They are there to get compliance, not punishment.”

A number of people will be involved in this program. Most winery tanks are considered permit-confined spaces requiring that a designated person document that all pre-entrance steps have been taken. Pre-entrance steps include proper training of other employees on the team, including the person who “breaks the plane” or enters the tank, the observer and the rescuer.

A harness and lanyard will be attached to the tank worker, and there must be an air cart on hand with 30 minutes of demand air. Someone on the team must be a designated certified safety professional. OSHA also recommends that wineries use fans to help purge tanks and to even alert the local fire departments of the activity. Do not forget the sign or stickers at the manway entrance warning of potential hazards.

“I developed a protocol and procedure from OSHA, safety meetings and experience, and I do not tolerate any deviation,” said Jones of Merry Edward



Multi-Gas Hand-Held Detector Manufacturers

| Company              | Location          | Phone        | Web                    | Model Multi-function | Data Logger Software | Alarms Vis/Aud/Vibrate | On-Board Pumps | Battery Alkaline/NiCad |
|----------------------|-------------------|--------------|------------------------|----------------------|----------------------|------------------------|----------------|------------------------|
| Bacharach            | Newkensington, PA | 724-334-5000 | www.bacharach-inc.com  | 2800-1               | Included             | Vis/Aud                | Included       | Alkaline               |
| BW Technologies      | Arlington, TX     | 817-274-2487 | www.gasmonitors.com    | Micro 5 - IR         | Option               | All Three              | Option         | Both                   |
| Crowcon Detection    | Erlanger, KY      | 800-527-6926 | www.crowcon.com        | Tetra-3              | Included             | All Three              | None           | Both                   |
| Draeger Safety, Inc. | Pittsburgh, PA    | 412-788-5671 | www.draeger.com        | Xam-7000             | Included             | All Three              | Included       | Both                   |
| RKI                  | Union City, CA    | 800-754-5165 | www.rkiinstruments.com | Eagle                | Option               | All Three              | Included       | Both                   |
| Sperian Protection   | Middletown, CT    | 800-711-6776 | www.Biosystems.com     | PHD-6                | Option               | Vis/Aud                | Option         | Both                   |
| ThermoScientific     | Franklin, MA      | 866-282-0430 | www.thermo.com         | GT-CO2               | Included             | Vis/Aud                | Included       | Both                   |



The Eagle meter from RKI with extension tube attached for remote monitoring

Wines. “We have training for seasonal and intern help prior to crush, but all of our permanent workers are constantly in training and everyone knows CPR. When there is an entry into a tank for a dig-out, everything else in the winery stops.”

Probably one of the best things a winery can do is to get help from professionals who specialize in helping wineries achieve compliance with state and federal OSHA standards. There are consultants who evaluate wineries and offer safety program development, training and updates on new regulations.

The insurance company for **Turnbull Wine Cellars** in Oakville, California uses an outside consultant who makes complimentary visits to discuss safety issues. “It makes us safer, shows we are making a good effort and allows everyone to go home and see their family,” said winemaker **Peter Heitz**.

At the same time, increasing numbers of insurance companies are focusing considerable attention on wineries and can advise in the start-up of a confined space program, including giving no-cost safety “audits.” For winemaker Dan Kopache at Redwood Valley Cellars that “translates into better rates on our insurance premiums.”

Under the watchful eye of the government, long gone are the days of testing for CO<sub>2</sub> by lighting a candle or buying a canary.

**WORKER SAFETY PARAMOUNT**

Confined space safety is really not rocket science, and there is even room for common sense like evacuating tanks with fans. But under the watchful eye of the government, long gone are the days of testing for CO<sub>2</sub> by lighting a candle or buying a canary.

Furthermore, developing an OSHA safety program with hand-held toxic gas meters can increase worker safety and even save lives. Every year we read about someone who went into confined space and did not come out. For the low cost, the ease of training, proactive investment in your operation and good intentions, they are a simple way

to assure a safe environment for everyone.

“We really do not want to be that winery, that company we read about in the newspaper which somehow overlooked safety,” said **Aaron Piotter**, winemaker at **Ferrari-Carano Vineyards & Winery**. **wbm**

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