Vehicle Exhaust **Monitoring**

Importance of monitoring the presence of carbon monoxide and nitrogen dioxide

MSA
The Safety Company

There are two reasons for gas detection integration within a parking structure: Safety and Economics.

The hazardous effects of CO and NO_2

Carbon Monoxide is commonly referred to as the silent killer. Colorless, odorless and tasteless, CO is extremely toxic and often affects victims in such a manner that they fail to recognize the danger until it's too late.

A product of incomplete combustion—that which occurs in internal combustion engines—CO is present in varying degrees in all vehicle exhaust systems. As little as .02 percent (200 ppm) CO concentration in air during a four-hour exposure period can cause severe effects such as nausea and dizziness. During the initial stages of CO poisoning, the victim's judgement is often impaired, presenting the likelihood of a serious accident.

Diesel-powered vehicles emit exhaust containing Nitrogen Dioxide, a major contaminant and carcinogen. Nitrogen dioxide detection and control is applied wherever numerous diesel engines are used, for example: train stations, bus and truck maintenance garages, rapid transit authorities, car dealerships, ambulance bays, loading docks and diesel-powered vehicle parking structures.

In enclosed areas such as parking garages, potentially lethal concentrations of CO and NO_2 can build up quickly—before exposed individuals have any indication of danger. The issue is not whether these gases reach hazardous concentrations, but rather how to control and ventilate it when it does.

Installation and Application Codes and Standards

ASHRAE

The operation of automobiles presents two concerns:

1. The most serious is the emission of carbon monoxide, with its own risks.
2. The second concern is the presence of oil and gasoline fumes… the ventilation required to dilute carbon monoxide to acceptable levels will also control the other contaminants satisfactorily.

To conserve energy, fan systems are controlled by carbon monoxide meters with multiple fan or variable speed stages for larger systems, if permitted by local codes. In multi-level parking garages or single-level structures of extensive area, independent fan systems, each under individual control, are recommended.

Building Code

IMC: International Mechanical Code—Mechanical ventilation systems for public garages are not required to operate continuously where the system is arranged to operate automatically upon detection of a concentration of carbon monoxide of 25 ppm by approved detection devices.

UBC: Uniform Building Code—Automatic carbon monoxide sensing devices may be employed to modulate the ventilation system to maintain a maximum average of carbon monoxide of 50 ppm during any eight-hour period, with a maximum average concentration not greater 200 ppm for a period not exceeding one hour.

Local and other building codes—Most state and local municipal building codes recommend using carbon monoxide monitors in enclosed parking garages. If requirements do not exist it is always best to error on the side of safety when dealing with hazardous gases such as carbon monoxide.

Integrating a Cost-effective System

When garage ventilation and make-up air fans run continuously at peak output or even on a time-cycling basis, they run harder and longer than necessary, wasting energy, requiring more maintenance and sustaining unnecessary wear.

MSA gas detection provides a reliable and cost-effective alternative. When used in conjunction with ventilation control equipment, continuously operating, permanently installed multi-point and single-point monitors can be used for fan activation only when a specified level of CO concentration is required. These concentrations are often based on OSHA and building code requirements.

"Zoning" enables grouping of multiple sensors mounted within an area into a single zone. If any sensor detects gas, the ventilation system is activated. A zoned dual-level gas detection system allows ventilation fan operation as needed and on low speeds, in only the areas requiring ventilation due to CO buildup. When CO levels rise above a present concentration, dampers are opened further and fans speed up, increasing their pitch for added ventilation. When the CO level drops, the fans slow down and decrease their pitch.

Most codes simplify this estimate by requiring four to six air changes per hour for fully enclosed garages. Reference your local codes for the specific requirements.

This method of operation generally results in the fans running at high speed only during relatively short periods of heavy traffic, which translates into lower power costs and greater energy savings than manually operated systems. It also provides better safety due to continuous monitoring.

Selecting Sensing Technologies

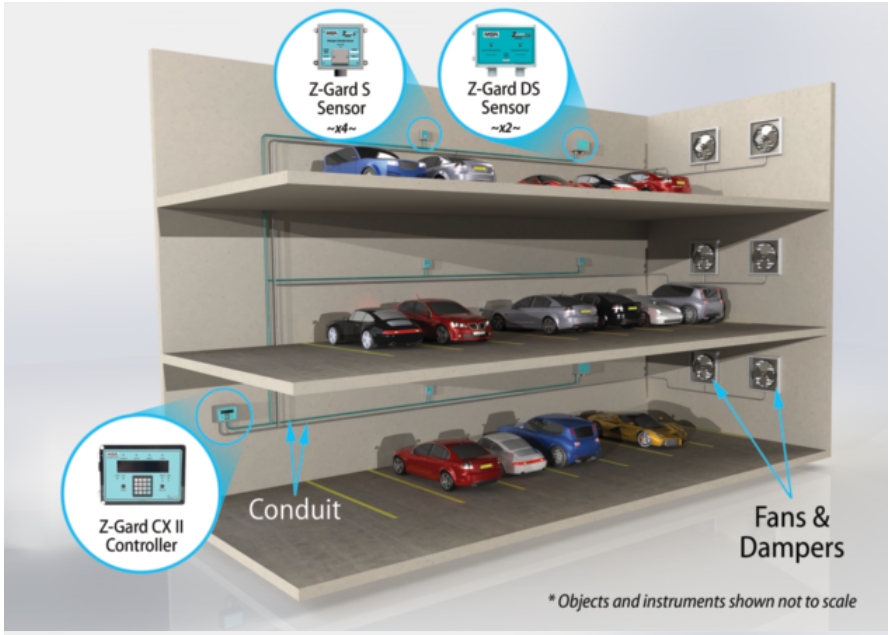
Two types of sensing technologies are typically used in parking garage monitors: *Solid State or Metal Oxide Semiconductor (MOS)* and *Electrochemical Sensors*. Below are the characteristics of the two types of sensing technologies.

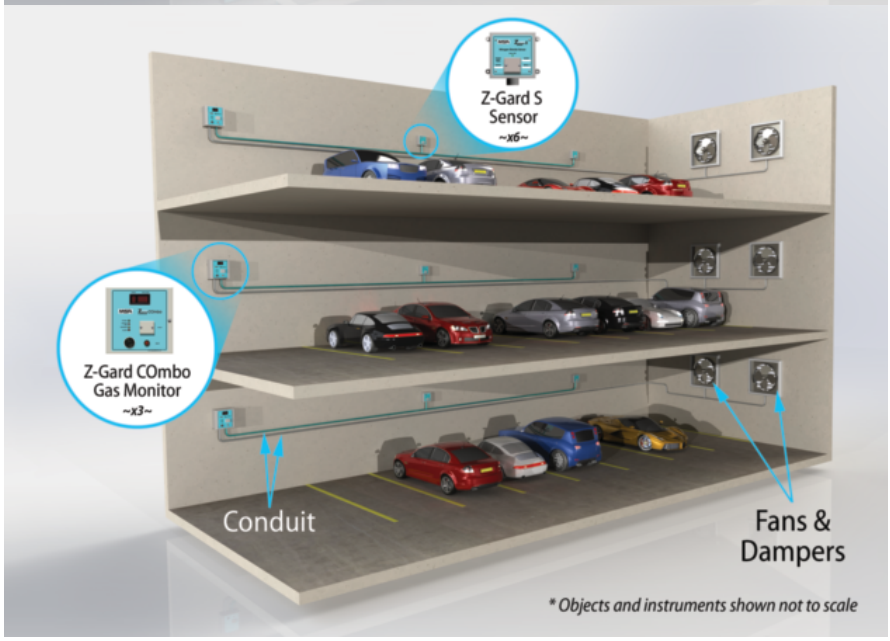
Electrochemical Sensors:
Uses an electrochemical reaction to generate a current proportional to the gas concentration

- Gas specific
- High accuracy and not significantly affected by humidity and temperature
- Low power requirements
- Linear output

Solid State Sensors:
Made of a metal oxide that changes resistance in response to the presence of a gas; this change is measured and translated into a concentration reading

- Gas generic
- Long life
- Low cost
- Susceptible to cross-sensitivities
- Lack of accuracy, tendency to be affected by humidity and temperature shifts





Recommended placement of CO sensors

For parking garages, place sensors where the highest concentration of co is expected: elevators, stairwells, offices, hallways, between adjacent parking aisles and at roadway intersections within the garage. Also pay attention to public areas such as pay booths and elevator waiting areas and to areas such as idling or stopping locations where carbon monoxide can buildup. Ensure that the area is sufficiently monitored by mounting additional sensors in little-used areas such as sub-basements and crawl spaces.

There is no set guideline for the correct number of sensors required to properly cover a facility. Divide the garage into zones and use those zones to coordinate fan operation. Each level of the parking structure must be totally covered without overlapping the coverage of the sensors. Place the monitor in the fan or control room and make sure that operators know its function and are trained in its use.

Since carbon monoxide has the same density as air, sensors should be mounted in the "breathing zone"—about five to size feet up from the floor. Consider the airflow pattern around each sensor, and position it so that it avoids the direct path of outside air, fan airstreams or intake vents. Ventilation smoke tubes are useful for pinpointing air flow patterns.

In summary, here is a checklist to reference when specifying your system:

Factors to consider when specifying a CO monitoring system include:

- ☐ **Size of the area to be monitored**
- ☐ **Number of areas or zones:** Sensors can be lumped together on a per-zone basis
- ☐ **Visual Indication needs:** Is real-time concentration readout per sensor alarm indication at the panel or sensor location required, or will a common alarm indication suffice? *An audible and/or visual alarm might be required to notify the proper personnel to take corrective actions including possibly evacuating the parking structure.*
- ☐ **Alarm contacts:** Are they required, or will the user provide the control functions, therefore requiring only sensor/transmitters?
- ☐ **Types of fuels used:** If diesel-powered vehicles will be present, nitrogen dioxide sensors will also be required
- ☐ **Auxiliary Equipment:** Include common relay outputs, ventilation, audible and visual alarms, and remote annunciation

Our Mission

MSA's mission is to see to it that men and women may work in safety and that they, their families and their communities may live in health throughout the world.

MSA: Because every life has a purpose.

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