BRASCH

ENVIRONMENTAL TECHNOLOGIES

Carbon Monoxide and Nitrogen Dioxide

Application Guide

- Basics of Gas Detection
- Standards
- Theory of Operation
- Other Considerations
- Estimated Coverage
- Mounting Locations

Basics of Gas Detection

Background

Exposure to high concentrations of toxic gas, or even prolonged exposure to low concentrations, poses a threat to health and safety wherever present. Specifically, carbon monoxide (CO) and nitrogen dioxide (NO_2) are both capable of causing serious illness or death within a very short period of time. CO and NO_2 are the primary toxins found in gasoline and diesel exhaust respectively, and any enclosed area where vehicles are present – parking garages, warehouses, repair shops, etc. – are candidates for gas detection systems. In fact, most building codes require their installation both to protect occupants from danger and to reduce energy costs associated with operating the HVAC system.

Gas Detection Systems

Gas detection systems include any system that monitors an area for the presence of toxic gas and activates ventilation/warning equipment to either clear the threat from the air or warn occupants to evacuate the space. These systems can be as simple as a single gas detector controlling a single fan, or as complex as a network of detectors throughout a facility communicating with each other to intelligently automate every aspect of the broader HVAC system. Regardless of the size or complexity, all gas detection systems feature three core components – sensors, relays, and zones.

Sensors

Sensors are the fundamental component of any gas detection system. They are responsible for measuring the concentration of gas present in the environment and reporting that information to the rest of the system.

Relays

Relays take the gas concentration provided by the sensors and use that information to actuate ventilation and warning equipment as necessary. The number of relays in a system dictates the number of alert/alarm levels that are possible.

Zones

Zones are a way to organize the physical components of a system into logical groups for a controller to manage. They break down the entire system into smaller areas like rooms, bays, or floors. This allows information to be presented in a user-readable format for understanding the status of the system, or in a computer-readable format for more precise control of equipment.

Standards

Regulatory Limits

In the United States, the three main agencies with regulations on hazardous gases are OSHA, NIOSH, and ACGIH – each with its own limits on exposure.

- Permissible Exposure Limit (PEL) is set by OSHA as the legal limit of chemical substance or physical agent that an employee can be exposed to
- Recommended Exposure Limit (REL) is set by NIOSH as a recommendation for OSHA to adopt as the new PEL
- Threshold Limit Value (TLV) is set by ACGIH as the daily level to which a worker may be exposed for his/her working lifetime without adverse health effects

Each of these limits can be broken down into three subcategories:

- Time-Weighted Average (TWA) concentration of gas in a worker's breathing zone for an 8-hour period during a 40-hour work week
- Short-Term Exposure Limit (STEL) to a particular substance expressed as a TWA concentration over a 15-minute period instead of 8-hours
- Ceiling (C) or maximum instantaneous concentration a worker can be exposed to without respiratory aid

OSHA	NIOSH	ACGIH
Carbon Monoxide	**Carbon Monoxide**	**Carbon Monoxide**
PEL – TWA: 50 PPM	REL – TWA: 35 PPM	TLV – TWA: 25 PPM TLV – STEL: 400 PPM
Nitrogen Dioxide	**Nitrogen Dioxide**	**Nitrogen Dioxide**
PEL – STEL: 1 PPM PEL – C: 5 PPM	REL – STEL: 1 PPM	TLV – TWA: 3 PPM TLV – STEL: 5 PPM

Brasch Limits

All Brasch Gas Detectors have adjustable limits to allow for flexible use in a variety of environments and applications. Limits can be lowered below the legally required level for added safety factor or raised to the limit to avoid excessive operation of ventilation equipment and the added cost that comes with it.

Theory of Operation

Low Alert

Low alert is the minimum gas threshold where ventilation equipment should begin to activate. Ideally, this level is low enough to present little danger to occupants while high enough to prevent ventilation equipment from running excessively. Low alert is most commonly used to open louvers and turn on a low-speed fan, introducing fresh air, removing contaminated air, and returning levels of gas below a safe level. Often, this is the only level that is ever used as gas levels are limited by engaging the ventilation equipment.

Medium Alert

Medium alert is the point at which gas levels are starting to rise to potentially dangerous levels. If this level is reached, the ventilation equipment connected to the low alert relay was insufficient to manage the gas concentration. While not always included, the medium alert level can be useful for turning on additional fans or increasing the fan speed without concerning personnel.

High Alert

High alert is the maximum gas threshold that should be present in a space. Reaching this level means previous attempts to reduce the gas concentration have failed. At this point, the ventilation system should be operating at maximum capacity to clear the hazard.

Alarm

If all efforts to vent toxic gas from the air are unsuccessful, the alarm state is engaged. Warning equipment, typically horns and/or strobes, should inform occupants to evacuate the area. In some cases, the fire protection system may be triggered to summon emergency personnel.

Delays

In addition to setpoints based on gas concentration, alert/alarm levels can be combined with time delays to specify the duration equipment should wait before turning on or off. These are useful for preventing transient gas levels from causing equipment to run unnecessarily, or for eliminating rapid cycling of equipment when gas levels are exactly at the setpoint.

Additional Outputs

Beyond connecting equipment to relays to operate at specific levels, additional outputs may be used to modulate a VFD or communicate with a BMS. These augment the capabilities of the system to allow for more granular control and more intelligent operation.

Other Considerations

Warm-Up

Any time a detector is powered on, the sensors must first stabilize before accurate measurements can be taken. To accommodate this period of uncertainty, Brasch Gas Detectors incorporate a short warm-up before commencing normal operation. Upon coming out of the warm-up phase, sensors have stabilized enough to reasonably protect against dangerous concentrations of gas. For best results, detectors should be allowed to run for at least two hours.

Overrides

In some situations, it may be desirable to force ventilation equipment to run on-demand as opposed to waiting for gas levels to rise. All Brasch Gas Detectors have a manual override feature built-in to do just this. Additionally, Brasch Control Panels have an automatic override that allows a user to schedule days and times equipment should run. These are especially useful when higher gas concentrations are expected, smoke (but not necessarily gas) is present, or an area gets uncomfortably hot.

Fail-Safe Condition

Whether there is a tripped circuit breaker, faulty wiring connection, or sudden power surge, Brasch Gas Detectors are designed to fail safely. In the event the detector loses power, the low alert and alarm relays will close, activating any connected ventilation and warning equipment that still has power. This prevents the build up of gas in scenarios where the detector, for whatever reason, can no longer monitor concentrations of hazardous gas.

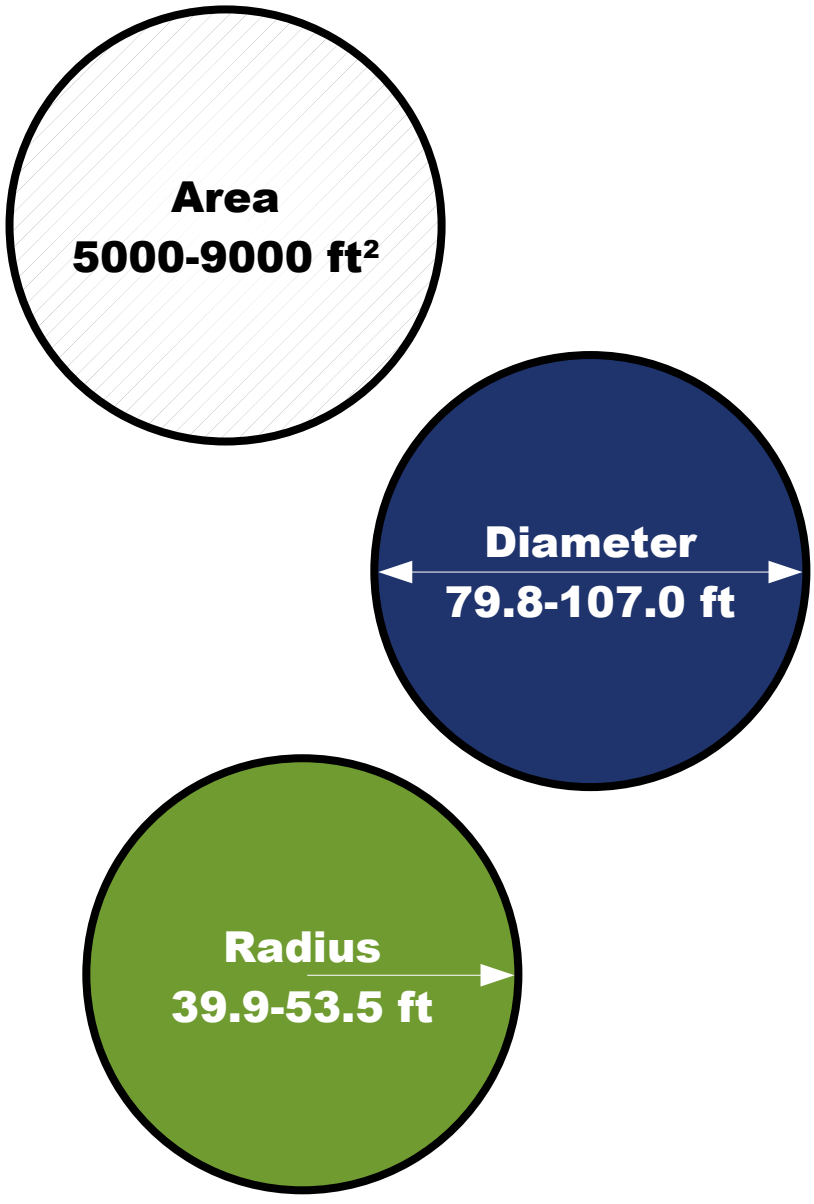
Maintenance

Ongoing maintenance is essential to keeping any gas detector in peak working condition. All components and wiring should be regularly inspected for compliance with regulations as well as to prevent wear from corrosion or degradation. Sensors should be bump-tested at least once every year to ensure proper response to gas and recalibrated or replaced when the response is no longer within acceptable tolerance. All relevant personnel should be trained to operate, adjust, troubleshoot, and maintain both detectors and ventilation systems. Keeping documentation on procedures, tests, results, and settings may help to minimize issues over the life of the detector.

Estimated Coverage

Brasch Gas Detectors are capable of covering up to 9000 ft² (836 m²) per sensor in areas with low ceilings and good air circulation. As ceiling height increases and air circulation decreases, so too does the coverage area. Note that detectors mounted on walls or in corners will see a reduction in the effective coverage area, regardless of ceiling height or air circulation. For maximum coverage, place sensors a distance of one diameter away from each other and one radius away from any walls or barriers. Use the information* below to help determine coverage in your specific application.

Ceiling Height (ft)	Air Changes Per Hour	Area (sq. ft.)	Diameter (ft)	Radius (ft)
8	30.000	9000	107.047	53.524
9	29.000	8806	105.887	52.944
10	28.000	8616	104.739	52.369
11	27.000	8430	103.602	51.801
12	26.000	8248	102.478	51.239
13	25.000	8070	101.366	50.683
14	24.000	7896	100.267	50.134
15	23.000	7726	99.182	49.591
16	22.000	7560	98.111	49.055
17	21.000	7397	97.047	48.524
18	20.000	7238	95.998	47.999
19	19.000	7082	94.958	47.479
20	18.000	6930	93.934	46.967
21	17.000	6781	92.918	46.459
22	16.000	6635	91.913	45.956
23	15.000	6492	90.917	45.458
24	14.000	6352	89.931	44.966
25	13.000	6215	88.956	44.478
26	12.000	6081	87.992	43.996
27	11.000	5950	87.039	43.519
28	10.000	5822	86.098	43.049
29	9.000	5697	85.168	42.584
30	8.000	5574	84.244	42.122
31	7.000	5454	83.332	41.666
32	6.000	5337	82.433	41.217
33	5.000	5222	81.541	40.770
34	4.000	5110	80.661	40.331
35	3.000	5000	79.788	39.894



* The numbers above are for estimation purposes only and do not necessarily reflect actual coverage capabilities. The customer assumes all liability for determining actual coverage in individual applications.

Mounting Location

The ability of the unit to efficiently sense the target gas depends greatly upon proper selection of the mounting location. The unit monitors the area around it by sampling the air that passes by the sensor. Therefore, the unit should be positioned where it can sample air that contains a target gas concentration representative of the average value in that area.

When determining the mounting location, give special consideration to the following guidelines:

- Use one sensor per target gas for each coverage area as determined on the previous page.
- Always prioritize locations with the highest occupation density.
- If using remote transmitters, do not locate any further than 4000 feet from the control unit.
- The types of gases each unit is designed to monitor have densities approximately equal to that of air. For maximum safety, mount the unit at the average breathing height – approximately 5-7 feet.
- Avoid mounting locations that would not be representative of the average gas value in that area. These include but are not limited to locations near doorways, fans, ventilation inlets and outlets, and areas with high volume of air flow.
- Avoid locations that would allow direct contact with water. Mounting the unit near outside garage doors may allow rain to hit the unit when the door is open.
- Avoid locations that are directly in the outlet air vents of heaters or air conditioners.
- Avoid mounting locations with normal ambient temperatures below -4°F (-20°C) or above 122°F (50°C).
- Do not allow exhaust from engines to flow directly on the unit. Each unit is designed to sense gas concentrations that are 300 to 1000 times less concentrated than the gas levels found in engine exhaust. Also, engine exhaust contains high levels of other components. These components can shorten the useful life of the sensor if they contact the sensor before being diluted by the room air volume.
- Avoid mounting locations where the unit may be hit by passing vehicles. If the unit must be mounted in these locations, provide a shielding cage around the unit for protection.
- Do not restrict the air flow to the unit housing.
- Do not mount the unit in a corner.
- Do not mount the unit near containers of chemicals such as gasoline, kerosene, alcohol, or other cleaning fluids. High level concentrations of these chemicals may be mistaken as the target gas by the sensor and cause false readings. Also, some welding gases may cause false readings.

Save Time. Save Money. Save Lives.

About Us

Brasch Environmental Technologies, formerly Brasch Manufacturing, has been a leading designer and manufacturer of quality gas detection systems for over 25 years. Brasch gas detectors are trusted by industry professionals and can be found installed in a variety of buildings from firehouses to parking garages all across the United States and beyond. Our mission is to help make the environment a safer and more comfortable place by protecting people from harmful gases. When customers install Brasch Environmental Technologies equipment, they have confidence they have the best products available, products that will far outlast their expectations.

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