**ENGINEERING SPECIFICATION**

**Carbon Monoxide (CO) [and Nitrogen Dioxide (NO2)] Detection and Control System**

**DIGITAL GAS CONTROL PANEL**

1. The Digital Control Panel shall provide continuous monitoring and display of the gas levels and control the ventilation system via digital and analog outputs in accordance with all applicable codes and standards.
2. The Digital Control Panel shall provide optional upward communication via BACnet or MODBUS communication protocol to any compatible electronic control, DDC/PLC control or automation system. Connection shall be capable at any point on the trunk.
3. The Digital Control Panel shall be capable of having 1 to 8 communication trunks, each with full trunk protection for the RS-485 and DC power. The trunks shall be capable of any distance with the appropriate number repeaters/power boosters.

1. The Digital Control Panel shall have the capability to accept at least [48 CO/NO2 sensor/transmitter pairs] [98 CO sensor/transmitters] [up to 98 sensor inputs in any combination of toxic gas, combustible gas and/or other environmental measurements such as temperature and humidity.
2. The Digital Control Panel shall provide for (5) stage thresholds for each sensor. To create zones of control, any of the five stages for any sensor can be assigned to any one or multiple of up to (30) local (at the controller panel) or remote relay outputs. Each remote relay module shall be able to perform on/off control and/or to control VFDs via analog outputs. The input to output connections shall be programmable in the field. Each sensor shall have a user-defined hysteresis value to prevent rapid cycling into and out of alarm stages.
3. The Digital Control Panel must provide user-defined start and stop delays and user-defined minimum on and off times. Start and stop delays shall be used to prevent fan starts upon detection of brief spikes in gas concentration. Minimum on and minimum off times shall be used to prevent short cycling of the fans.
4. The Digital Control Panel must provide fail-safe control whereby any sensor failure shall cause a pre-defined fan or fans to run.
5. The Digital Control Panel shall have (4) digital inputs that can be assigned for override or remote reset of the relays.
6. The operator shall be able to connect to the controller or to any digital sensor on the system via laptop to enable programming of all controller parameters and also allow display of all sensor values including alarm levels. This data can also be saved in historical csv files with time and date.
7. To facilitate system startup and lifecycle maintenance, the system shall be capable of recording sensor values, alarms and system events.
	* + 1. Sensor values shall be recorded for all active channels at a user defined interval between once every 10 seconds and once every 2 hours. The sensor value file must record the readings in scaled engineering units (i.e. PPM, %LEL, etc.) and indicate with error codes in appropriate cells if the sensor is locked (alarms inhibited), if data is unavailable due to a communication error, or if the reading of an analog channel is below 3mA.
			2. The alarm data file shall contain a time and date stamped entry each time any sensor crosses an alarm threshold both in the direction of the alarm or in the direction of return-to-normal (including hysteresis). Each alarm entry shall identify the sensor address, the gas type, the sensor reading, all currently exceeded threshold values for the channel and the relay number that is associated with each threshold alarm.
			3. The system event log file shall record communication errors and system power resets.

Data files shall be stored on commercially available, non-volatile, removable media such as a USB flash drive, in CSV or other non-proprietary text file format. For security purposes, the memory device shall not be visible when the controller is in its normal operating state. To ensure that file sizes do not exceed the limits of any analytic software, all files shall contain data for no more than one calendar day and sufficient storage shall be provided to log all channels at 1 minute intervals for one calendar year. Controllers or auxiliary data logging devices that record data in a proprietary format or which require proprietary software for viewing or analysis shall not be accepted.

1. Periodic sensor/transmitter calibration and system recommissioning is required to keep the Gas Detection and Control System in its optimum working condition. The System must be capable of generating calibration reports documenting the “as found” and “as left” zero and span readings for each sensor/transmitter as well as diagnostic information indicating the sensor element’s remaining effective life. Systems requiring replacement of sensors or sensor modules at fixed intervals are not acceptable due to their high lifecycle maintenance cost. The Gas Detection and Control System supplier must provide a system test certificate which the installation and/or service contractor will issue to the system owner at the time of initial commissioning and lifecycle recommissioning to document the condition and functionality of the System.
2. The Digital Control Panel shall have a 90db audible alarm assignable to stage level S1, S2, S3, S4, or S5. An external manual reset switch via the digital input or through the control panel menu shall acknowledge the alarm.
3. The Digital Control Panel shall have status indicator LEDs located on the front; Green = Power On, Flashing Red = Alarm, Flashing Yellow = Fault/Sensor Failure.
4. The Digital Control Panel shall have a supply output of 24VDC available for remote horn/strobes.
5. The Digital Control Panel parameters shall be password protected. There shall be four password levels to allow operation without modifying critical parameters.
6. The Digital Control Panel shall include an LCD display. The controller shall sequentially display the current measured gas level for each activated sensor/transmitter with a visual indication of whether the reading is “normal” or “alarm”. Via menu/pushbutton commands, the Controller must be able to identify all sensors currently in alarm.
7. The Digital Control Panel must monitor all communications and health of the system. Up to 20 system errors must be stored for review by the operator and also stored in history for review by the service technician.
8. The Digital Control Panel shall be NRTL performance tested and certified to ANSI/UL 2017.
9. The contractor shall supply the PolyGard® Series DGC5 Digital Control Panel, by INTEC Controls; phone (858) 578‑7887; fax (858) 578-4633. [www.inteccontrols.com](http://www.inteccontrols.com)

**CARBON MONOXIDE (CO) SENSOR/TRANSMITTER**

1. The carbon monoxide (CO) gas sensor/transmitter shall provide monitoring of the carbon monoxide levels in the parking garage and control the ventilation system via the Digital Gas Controller (DGC5) and BAS in accordance with all applicable codes and standards.
2. The sensors shall be electrochemical type. The sensor/transmitter shall have plug-in technology for ease of troubleshooting and replacement of both the element and the printed circuit board. Solid-state sensors or air sampling devices shall not be acceptable.

1. The sensor range shall be 0-250 ppm carbon monoxide. A microprocessor-based transmitter shall communicate over serial bus. The wiring between the transmitter and the controller (DGC5) shall be a 4-wire, polarity protected daisy-chained networked configuration. Communication circuitry shall be protected from accidental application to maximum of 30V power and also short circuit and surge protection to the serial bus.
2. Each carbon monoxide sensor/transmitter shall cover between 5,000 and 10,000 square feet of the garage floor and placement shall be applied strategically and appropriately per floor plan requirements.
3. The sensor shall have stability and resolution of 3.0 ppm of reading; repeatability ±3.0% of reading; long term output drift < 0.4% signal loss/month; response time t90 < 50 sec.; and sensor life expectancy of at least 5 years in normal operating conditions, The permissible ambient working temperature shall be 14°F to 104°F and permissible ambient humidity shall be 15 to 95% RH, non-condensing. The sensor shall require no routine maintenance other than periodic calibration. The manufacturer shall provide a two-year warranty for materials and workmanship.
4. Each digital sensor/transmitter printed shall have the capability of adding one (1) 4-20 mA transmitter input to monitor temperature, humidity or any other gas.
5. The sensor/transmitter shall be contained in a NEMA4X enclosure for protection from dirt and water and to prevent vandalism. The enclosure for the sensor /transmitter shall be installed on walls or columns approximately 5 feet AFF.
6. The sensor/transmitter shall be NRTL performance tested and conforms to ANSI/UL 61010-1.
7. The sensor shall be able to be addressed and calibrated with a digital programming tool (DPT). The DPT shall be capable of determining the remaining life of the sensor element. Potentiometer calibration is not acceptable. While performing calibration at the sensor it shall be possible to communicate with the controller to change any parameters and to visually see the status of all other sensors.
8. If the level of Carbon Monoxide reaches 25 PPM in the area of detection, the low alarm shall activate and the exhaust fans will be started. If the level of CO increases to 100 PPM, the high alarm shall activate. Where VFD’s are used analog output must be provided locally to ramp up the VFD based on concentration level.
9. The contractor shall supply the PolyGard® Series DT5-1112 CO sensor/transmitter, by INTEC Controls; phone (858) 578-7887; fax (858) 578-4633. [www.inteccontrols.com](http://www.inteccontrols.com)

**NITROGEN DIOXIDE (NO2) SENSOR/TRANSMITTER**

1. The nitrogen dioxide (NO2) gas sensor/transmitter shall provide monitoring of the nitrogen dioxide levels in the parking garage and control the ventilation system via the Digital Gas Controller (DGC5) and BAS in accordance with all applicable codes and standards.
2. The sensors shall be electrochemical type. The sensor/transmitter shall have plug-in technology for ease of troubleshooting and replacement of both the element and the printed circuit board. Solid-state sensors or air sampling devices shall not be acceptable.

1. The sensor range shall be 0-10 ppm nitrogen dioxide. The microprocessor-based transmitter shall communicate with the nearest carbon monoxide transmitter via an analog 4-20mA signal.
2. Each nitrogen dioxide sensor/transmitter shall cover between 4,000 and 6,000 square feet of the garage floor and placement shall be applied strategically and appropriately per floor plan requirements.
3. The sensor shall have stability and resolution of ±0.1 ppm; repeatability ±2.0% of reading; long term output drift < 2.0% signal loss/month; response time t90 < 60 sec; sensor life expectancy ≥ 2 years; permissible ambient working temperature shall be 14°F to 104°F and permissible ambient humidity shall be 15 to 95% RH, non-condensing. The sensor shall require no routine maintenance other than periodic calibration. The manufacturer shall provide a two two-year warranty for materials and workmanship.
4. The sensor/transmitter shall be contained in a NEMA4X enclosure for protection from dirt and water and to prevent vandalism. The enclosure for the sensor /transmitter shall be installed on walls or columns approximately 2 feet AFF.
5. If the level of nitrogen dioxide reaches 2 PPM in the area of detection, the low alarm shall activate and the exhaust fans will be started. If the level of NO2 increases to 4 PPM, the high alarm shall activate. Where VFD’s are used analog output must be provided locally to ramp up the VFD based on concentration level.
6. The contractor shall supply the PolyGard® Series AT-1130 NO2 sensor/transmitter, by INTEC Controls; phone (858) 578-7887; fax (858) 578-4633 [www.inteccontrols.com](http://www.inteccontrols.com)

**REMOTE FAN CONTROL MODULES**

1. The system shall include remote fan control modules which support on/off and variable speed control.
2. To minimize wiring complexity and cost, the fan control modules must be installed in close proximity to the fan starter.
3. Fans shall be controlled by associating any sensor point threshold with any on/off or variable speed control device in the system.
4. All system relays shall be individually configurable as either fail-safe or non-failsafe.
5. The fan control modules shall be contained in a NEMA4X enclosure for protection from dirt and water and to prevent vandalism.