

**SECTION 23 09 63
CARBON MONOXIDE MONITORING AND FAN CONTROL SYSTEMS**

PART 1 – GENERAL

1.01 WORK INCLUDED

- A. The work of this section shall include, but is not limited to, the following:
 - 1. Carbon monoxide (CO) monitoring and fan control system components
 - 2. Fan logic control panel(s)
 - 3. Remote sensors
 - 4. Fan control relays
 - 5. Power and control wiring from main control panel to all system components.
 - 6. Calibration gas cylinders
 - 7. Startup, commissioning, and training
 - 8. Analog output to BMS system to read CO concentrations from each point at the BMS
 - 9. Analog input from BMS system to control each fan speed at the BMS
- B. Provide all labor, materials, products, equipment, and service to supply and install CO detections and control system as indicated on the drawings and specified in this section.
- C. System shall be UL listed.

1.02 RELATED DOCUMENTS

- A. Section 23 05 01 - Mechanical General Provisions
- B. Section 23 05 14 - Variable Frequency Drives for HVAC
- C. Section 23 09 00 - Building Management System (BMS)
- D. Section 23 09 93 - Automatic Control Sequences
- E. Section 23 34 00 - HVAC Fans
- F. Division 26 - Electrical

1.03 REFERENCE STANDARDS

- A. UL 2075 Standard for Gas and Vapor Detectors and Sensors

1.04 QUALITY ASSURANCE

- A. Provide a one-year manufacturer's warranty on sensors from date of final acceptance.
- B. Provide a two-year manufacturer's warranty on materials and installation from date of final acceptance.
- C. Training of Owner personnel.

1.05 SUBMITTALS

- A. Product Data: Submit manufacturer's latest information on construction details, wiring diagrams and rough-in requirements.
- B. Submit complete installation description including but not limited to:
 - 1. Dimensioned installation and zoning drawing. Provide floor plans (minimum 11x17 sheet size) indicating all zones, sensor locations and control panel locations.
 - 2. Typical sensor mounting to column detail including sensor elevation above finished floor.
 - 3. Wiring diagram.
 - 4. Narrative description of controls and system operation.
 - 5. Schedule of all CO sensors. Provide a spreadsheet that includes point ID, point location, zone and supply and exhaust fans controlled and length of wiring between sensor and control panel.

PART 2 – PRODUCTS

2.01 ACCEPTABLE MANUFACTURERS

- A. Nagle Energy Solutions (NES) TR series (Tridium JACE) controller, with a Niagara programming framework, or approved equal.
- B. Vulcain Model VA-201C-AC: model 10 controller with VA-201T-Q1-CO transmitters
- C. ENMET Canada Model 66RLU
- D. Mine Safety Appliances Series 5000

2.02 CENTRAL CONTROLLER AND REMOTE SENSORS

- A. The controller shall be capable of monitoring a minimum of 5 zones with 10 separate remote sensors per zone. Sensor locations shall be as indicated on the Drawings.
- B. The controller(s) shall provide an analog output to BMS system to read CO concentrations at each point in parts per million. Coordinate the protocol, point mapping information and communication wiring diagram to provide seamless integration of the Carbon Monoxide Monitoring System with the BMS.
- C. Install the controller in a NEMA 3R or NEMA 4, wall-mount, with lockable removable door panel and view window for alarms and pilot LEDs. Provide a UL approved, Class 2 110 volt to 24 volt DC power supply integrated in enclosure.
- D. The system shall provide onsite interface to controller via plug-in PC via Ethernet or using an optional touch screen display.
- E. The controller shall be compatible with Danfoss model FC-102 variable frequency drive (VFD) or equal. The controller shall provide remote access to the system, and monitoring real-time energy use/savings reporting in conjunction with the VFDs.
- F. The CO sensors and drives shall communicate via BACnet and/or Modbus protocols and be wired in a daisy-chain configuration. The quantity of sensors indicated on drawings shall

be the minimum number of sensors required. Sensor spacing shall be based on 40-foot radius of coverage per sensor. Provide not less than one sensor per 5,000 square feet of monitored garage area. Zones shall be as indicated on the drawings.

- G. Sensors shall be solid state, pre-calibrated, low -voltage, plug-in type with a minimum 3-year sensor life. Sensor enclosure shall maximize ambient air contact. Each remote sensor shall be provided with local LED indicators for high and low alarm, power on, and sensor fault.
- H. Remote sensor channel shall consist of a remote sensor/amplifier with pilot and alarm LED's and pigtail wiring leads. These include a normal operation light, low level and high-level alarm indication, and failure indication light. These LED's shall be duplicated at the central controller for each zone.
- I. All sensors in each zone shall be connected to controller using shielded twisted pair cable. Wire shall be minimum 16 gauge, 3 or 4-wire cable. AWG 18 wire shall not be used. Follow manufacturer's recommendation for wire size based on distance between transmitters and number of transmitters per circuit.
- J. The system shall be provided with dual level alarms. Low alarm level shall be nominally set at 50 ppm (parts per million) CO. High alarm level shall be set at 100 ppm CO, and both levels shall be field adjustable. Zone supply and exhaust fans shall energize at low speed on low-level alarm. Schedules shall be adjustable for occupied, unoccupied, enable and purge.
- K. Central control panel shall contain zone LED indicators for high and low alarm, power on, sensor fault and wire break. System shall fail safe and activate ventilation equipment and panel mounted audible alarm. Sensor error shall activate strobe and indicate an alarm in the alarm console. A high level (100 ppm for more than 15 minutes) shall activate an alarm horn and a remote alert notification.
- L. System shall have sensor fault indication at each sensor and main control panel. The controller shall provide local and remote indication of required maintenance events, including sensor recalibration and replacement.
- M. The fan control circuit shall include time delay relays for fan activation and de-activation for each zone. Standard settings are a 2 minutes on-delay, and 15 minute off-delay to prevent nuisance alarms and fan cycling.
- N. The interface to the controller shall monitor potential alarms and faults on all aspects of system operation, including sensors, VFDs, fans and network wiring. The alarm center shall describe the alarm condition, escalate notification on alarms, and silence or resolve the alarm.
- O. Include provisions to allow fire alarm system to override the carbon monoxide monitoring and fan control system and take full control of all VFD and fans.

2.03 CO SENSOR PERFORMANCE CHARACTERISTICS

- 1. Gas detected: carbon monoxide.
- 2. Detector range: 0 to 250 ppm.
- 3. Stability and resolution: plus or minus 3 ppm of reading
- 4. Sensor/detection method: oxide semiconductor, electrochemical, diffusion.

5. Response time: 45 seconds for 90 percent full response.
6. Operating temperature range: 20 to 120 degrees F.
7. Accuracy: 5 percent
8. Repeatability: plus or minus 5 percent of measured value
9. Long-term output drift: less than 0.4 percent signal loss per month
10. Linearity: plus or minus 5 percent of measured value
11. Power supply: 18 to 28 volts DC, polarity protected
12. Power consumption: 4 to 22 milliamps or 0.6 volt-amps
13. Mounting height: 5 feet to center, above finished floor
14. Serial communications: digital, RS-485, proprietary protocol, 19200 baud
15. NRTL performance tested and certified. conforms to STD ANSI/UL 2075

2.04 VARIABLE FREQUENCY DRIVES FOR HVAC

- A. Refer to Section 23 05 14 - Variable Frequency Drives for HVAC

2.05 FAN CONTROL

- A. Fans shall operate from controller output to control exhaust and supply fans as required.
- B. Garage exhaust fans shall be capable of being monitored and controlled by the BMS system
- C. All exhaust fans serving the same zone shall be interlocked to operate simultaneously.
- D. The Garage exhaust fans shall be controlled based on the following schedule:

GARAGE EXHAUST FAN SPEEDS (CFM)						
EXHAUST FAN DESIGNATIONS	LOCATION/ SERVICE	CO CONCENTRATION				NOTES:
		< 25 PPM	BETWEEN 25-50 PPM	> 50 PPM SINGLE ZONE	> 50 PPM DUAL ZONE	
GEF-A-P2-1, 2, 3	TOWER-A P2	500	2500	6400	7500	1
GEF-B-P1-1	TOWER-B P2	1000	7500	14325	12700	1
GEF-B-P1-2, 3, 4, 5	TOWER-B P1	800	6800	11325	N/A	
EF-C-P1-3, 4	TOWER-C P1	400	1600	5800	N/A	
NOTES: 1. IF BOTH TOWER-A P2 AND TOWER-B P2 ARE ABOVE 50-PPM SIMULTANEOUSLY, USE THE DUAL ZONE CFM VALUE						

2.06 CALIBRATION GAS CYLINDERS

- A. Provide a calibration kit consisting of disposable gas cylinders, regulator, calibration adapter, and accessory carrying case. Include sufficient calibration gas quantity for startup and 1 year of system operation. Sensors shall be field calibrated in a one-person operation.

2.07 ZONING

- A. The Carbon Monoxide Monitoring and Fan Control System shall be zone and controlled according to the schedule below:

Zone	Sensors	Fans Controlled
TOWER-A, P2	A/P2	GARAGE EX FANS: GEF-A-P2-1, 2, 3 GARGE TRANSFER FANS: GTF-A-P2-05, 06, 07, 08, 09
TOWER-B, P2	B/P2	GARAGE EX FANS: GEF-B-P1-1 GARGE TRANSFER FANS: GTF-A-P2-01, 02, 03, 04 AND GTF-B-P2-01, 02, 03, 04, 05
TOWER-B, P1	B/P1	GARAGE EX FANS: GEF-B-P1-2, 3, 4, 5 GARGE TRANSFER FANS: GTF-A-P1-01, 02, 03, 04, 05, 06, 07, 08
TOWER-C, 91	C/P1	GARAGE EX FANS: EF-C-P1-3, 4 GARGE TRANSFER FANS: GTF-C-P1-01, 02, 03, 04

- B. Transfer fans shall activate at full speed in their zone when that zone concentration raises above 25-ppm.

PART 3 – EXECUTION

3.01 GENERAL

- A. Provide electrical wiring and conduit between the controller, remote sensors, and motor control center or individual fan starters.
- B. All wiring shall be in conduit. Conduit runs shall be installed tight to structure where possible. Conduit shall be run in a neat manner. All conduit turns or offsets shall be 90-degree long-radius bends. All conduit shall be installed parallel to the structural grid. Conduit and installation shall be as specified in Division 26.
- C. Provide technical start-up assistance and training of operator personnel at the job site for one 8-hour day.

END OF SECTION