acme

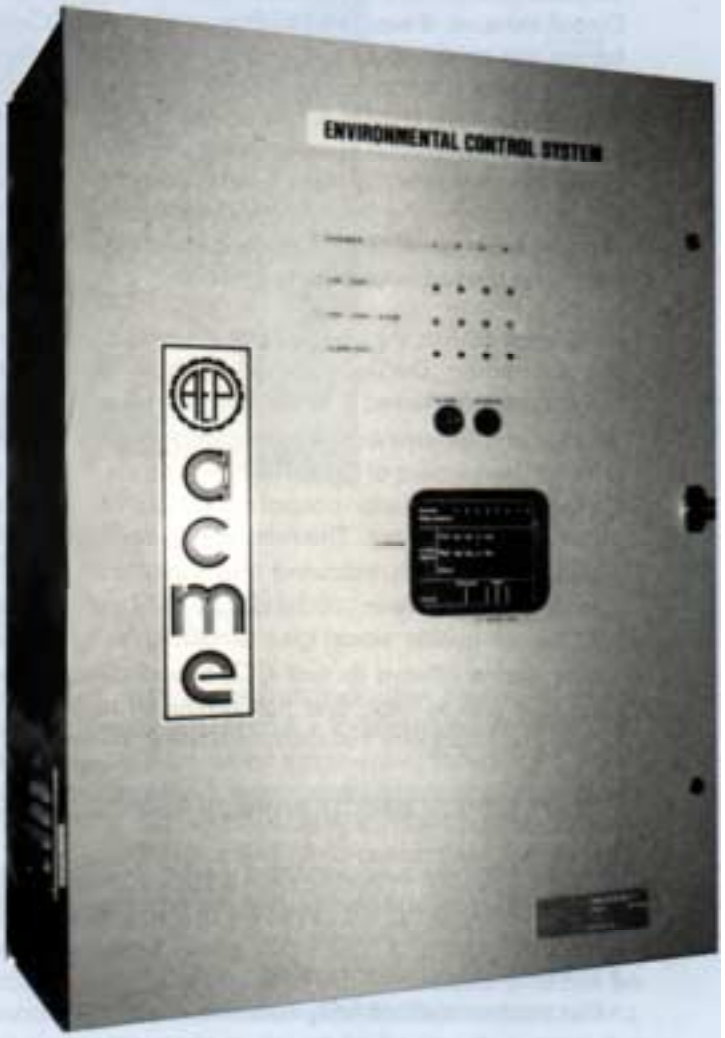
Bulletin **MGD-EN**

MGD

CARBON MONOXIDE & DIESEL FUMES

DETECTION SYSTEMS

ENVIRONMENTAL CONTROL SYSTEM



Features and Advantages

- Simple to operate and maintain by facility and building personnel.
- Infrared CO_2 or electrochemical cell NO_2 detection incorporating the latest microprocessor technology combined with Carbon Monoxide detection for total air quality control.
- Suitable for both existing and new systems in buildings.
- Saves money by operating the ventilation system only when required.
- Protection for personnel working in vehicular spaces.
- Rugged construction suitable for garages, tunnels, public spaces, etc.

Applications

- Parking garages where Diesel vehicles are the majority.
- Parking and service garages for buses, trucks, and road maintenance equipment.
- Platforms in bus, truck and railway terminals.
- Control of ventilation in vehicular tunnels.

The history of Diesel fumes detection

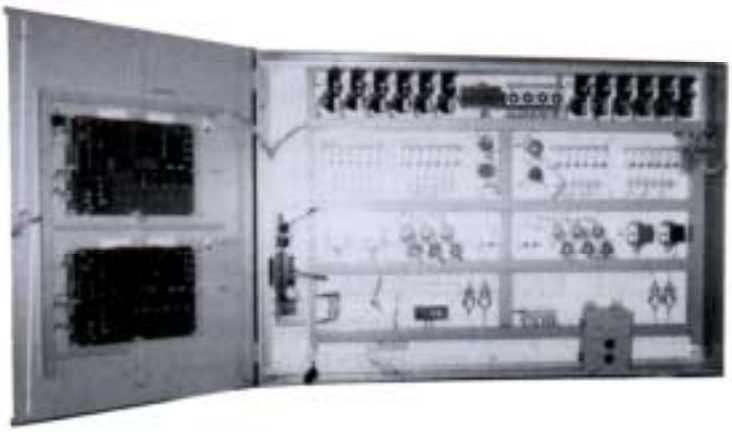
In the early 1970's, consulting engineers began specifying carbon monoxide (CO) detection and control systems for demand-based ventilation in enclosed parking garages and facilities. While CO detection was sufficient for ventilation control in locations where gasoline-fired engines were the norm, bus garages, fire stations, loading docks and other facilities dominated by Diesel engine powered vehicles presented a problem. While CO was present in Diesel exhaust, it was not the primary pollutant. Diesel fumes are made up of the oxides of nitrogen, sulphur dioxide, carbon monoxide, carbon dioxide and respirable combustible dust (RCD). While some consultants would specify CO-based detection systems anyway, personnel in Diesel-dominated facilities would complain about the air long before the carbon monoxide would rise to unacceptable levels. A new method of ventilation control had to be developed for these facilities.

In the early 1980's, the United States Bureau of Mines and the Canadian Department of Energy, Mines and Resources conducted a study into the nature of Diesel exhaust and determined that carbon dioxide (CO_2) already a major component of Diesel fumes, was an acceptable surrogate for ventilation control in facilities where Diesel vehicles were present. The relationship curves from the published research indicated that maintaining a CO_2 concentration between 1300 and 2500 PPM would ensure that the air quality would be maintained at acceptable levels. Acme offered its first CO_2-based Diesel fumes detection unit in 1982 and has produced hundreds of single and multipoint installations since that time.

Diesel fumes detection and sensor selection

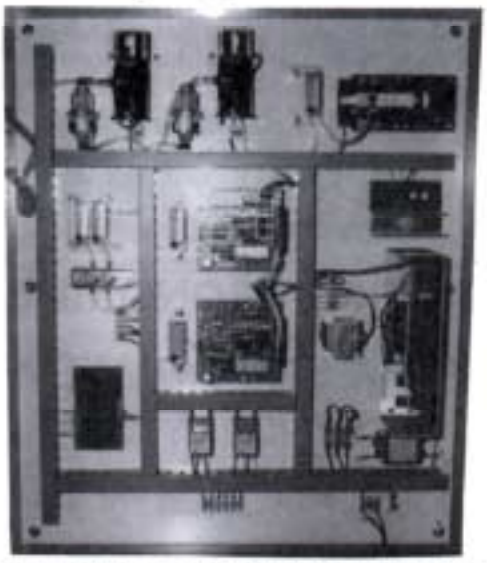
New technology has permitted Acme to offer Diesel fumes detection and control systems based on a variety of sensors. These include:

- Infrared CO_2 analyzers, and;
- Electrochemical cell NO_2 sensors.



Multipoint MGD panel with NO_2 electrochemical cell sensors for Diesel Fumes and CO detection.

2 point dual gas panel with CO sensor boards and infrared CO_2 analyzer for Diesel Fumes.



CO_2-based systems are acceptable in locations where direct-fired heating will not be used, as direct-fired systems create additional CO_2 emissions and render accurate Diesel fumes detection impossible. Systems with NO_2 sensors can be used in all locations regardless of the heating method employed. When specifying a detection system, engineers should note that infrared analyzers have a long life, while electrochemical cells need to be changed every 18-24 months. It is advantageous, therefore, to opt for a CO_2 infrared analyzer when conditions permit.

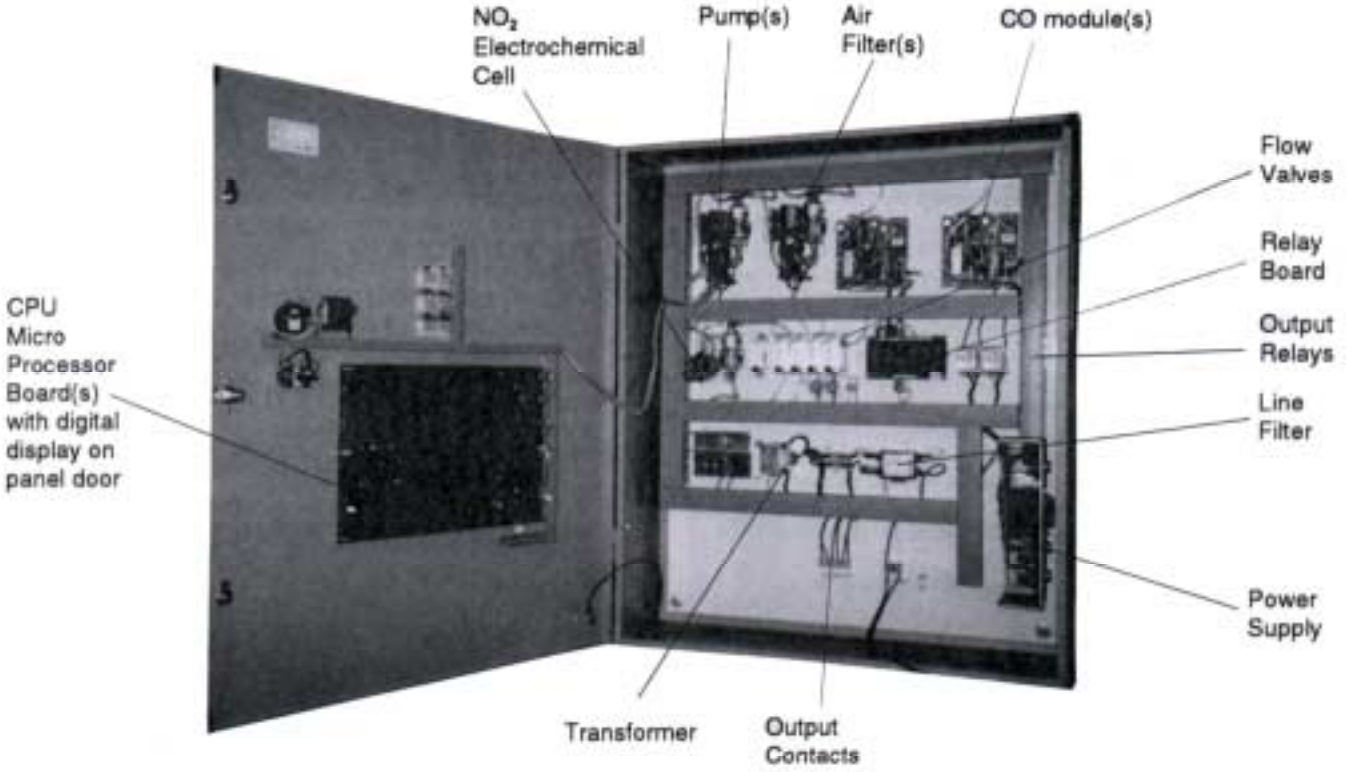
ACME's system design philosophy

Our systems are designed to be operated and maintained in a building environment where highly-trained instrumentation and laboratory personnel are unavailable or can only be obtained at high cost. We design components to be easily replaceable with commonly available tools by personnel with typical maintenance skills.

Addition of CO detection

Once the sensor has been selected for Diesel fumes detection, the modules for carbon monoxide (CO) are added to the panel design. Depending on the consultant's requirements, the CO detection may be comprised of individual solid state CO modules with metal oxide semiconductor sensors, or an electrochemical cell with sequential sampling from the sensing locations. The metal oxide CO sensors have a lifespan of 5-7 years, making them the preferred choice in installations where service may be infrequent. Electrochemical CO detection is typically used in larger panels where the addition of a dedicated CPU board for CO is the most economical solution. In either case, the output logic from the CO and Diesel fumes detection controllers is fully customizable to suit the requirements specified by the engineer.

TYIPICAL INTERNAL LAYOUT OF A
MGD-EN CONTROL PANEL



DESCRIPTION OF OPERATION

A. The air sub-assembly has a series of small independent pumps that continuously bring air samples from each point.

B. The MGD-EN system measures carbon dioxide using an infrared CO_2 gas analyzer. The analyzer's electronics produce an output signal proportional to the CO_2 concentration of the sample. An NO_2 electrochemical cell is used in place of the CO_2 analyzer in systems where direct fired heating is used in the space. The NO_2 cell produces a signal indicating the gas concentration for a given sampling point.

C. The CPU board can be programmed to sample up to eight points, recording the CO_2/NO_2 concentration for each detection point as it diverts the sampled air to the sensor using solenoid valves. Dwell time for each point is 60-90 seconds. The CPU displays the concentration on an LED display and provides a set of analog and digital outputs for each point.

D. The output relay boards combine to produce the required logic of operation, with multi-zone capability. System operation can be single or multiple step or proportional to the demand of the space. The proportional signal can be voltage, 4-20 mA or pneumatic 3-15 PSI.

E. The CO section of the MGD-EN panel consists of a combination of independent CO modules, (one for each point) each with its own sensor, flow meter, sampling chamber, control relays and calibration potentiometer. CO sensors are N-type metal oxide semiconductor for which the electrical resistance decreases as it comes into contact with CO. The sensor possesses a decontamination cycle to purge water vapor and other contaminants to ensure high selectivity and repeatability. Standard factory calibration settings are 35 PPM for "LOW" level, 100 PPM for "HIGH" level and a 100 PPM, 30 minute time delay (programmable) for the "ALARM" level. Each level has an associated relay and visual indicator. The modules have a self diagnostic cycle to detect faults, in which case the "SENSOR TROUBLE" visual indicator is lit and the "LOW" level contact is energized until the trouble is corrected.

F. Panel outputs control fans, dampers, make-up air units, VAV systems, plus local and optional remote alarms and supervision. Panels are compatible with all new or existing building automation and control systems.

G. Indicating lights and the LED display on the front of the panel continuously display conditions of all detection points, making it possible to see the complete condition of the space at a glance.

H. The panel incorporates the necessary power circuits for the above and operates from a dedicated 120V, 1 phase circuit.

TYPICAL SPECIFICATIONS FOR ACME's MDG-EN SERIES EQUIPMENT

1.0 GENERAL

1.1 Supply, install and connect MGD-EN Series Environmental Control System as manufactured by ACME Engineering Products. Equipment shall include the following basic features:

1.2 Remote sampling heads with high built-in high-efficiency filters for space mounting, located as shown on drawings.

1.3 Sampling pumps assembly. There shall be one pump and one adjustable flow indicator for each sampling point.

1.4 CO modules complete with CO sensor sampling chambers, one for each sampled point.

1.5 CO modules one for each sampled point shall be fully electronic incorporating solid state circuitry, with plug-in electronic board, factory calibrated to operate at 35 PPM and 100 PPM CO. Electronic board shall incorporate LED visual indicators. Sensor and electronics shall include necessary temperature compensating circuits.

1.6 Sensor response time in the order of few minutes to avoid frequent or unnecessary start-ups of ventilation equipment due to short temporary conditions.

1.7 Practically no maintenance required on the CO modules except for simple periodic calibration verification that are performed by introducing a known CO gas mixture into the sensor chamber.

1.8 3-way solenoid valve assembly to divert air flow from the sampling pumps into the CO_2/NO_2 analyzer according to the programmed CPU sequence.

1.9 Non-dispersive CO_2 infra-red analyzer technology or NO_2 electrochemical cell.

1.10 CPU with memory for programming, value storage, display and outputs.

1.11 Output relay boards with one operating and one alarm output for each sampling point.

1.12 Locking type enclosure with no adjustments accessible from the outside.

1.13 Visual status indicators on enclosure door. One set for each sampled point.

2.0 OPERATION

2.1 Individual sampling pumps shall run continuously bringing up-dated air samples to control panel.

2.2 For CO_2/NO_2 detection, each point (location) shall be sampled sequentially according to the CPU. The dwell time per point shall be fixed at 60-90 seconds. At the end of each dwell time the CPU shall acquire an up-dated CO_2/NO_2 reading for that point from the infra-red CO_2 analyzer or NO_2 electrochemical cell.

2.3 The CO_2/NO_2 output of each point shall be defined by the "LOW", "HIGH" and "ALARM" level user adjustable control level settings on the CPU.

2.4 For CO detection, all points shall be sampled simultaneously.

2.5 The output of each CO module shall be defined by the calibrated "LOW", "HIGH" and "ALARM" control levels on each module.

3.0 SETTINGS AVAILABLE PER SET OF OUTPUTS

3.1 Three "ON-OFF" levels for CO_2/NO_2: LOW, HIGH, ALARM; with user adjustable set-points.

3.2 Time-delay settings for CO "ALARM" level: 3-60 minutes adjustable.

3.3 Air flow adjustments on flow meters by means of metering valves.

4.0 DISPLAY

Unit shall display the following:

4.1 Flow indicators confirms air is flowing to the CO sensors and CO_2 analyzer or NO_2 electrochemical cell.

4.2 "LED" display shall indicate CO_2/NO_2 location in sampling stage.

4.3 LEDs for "ON-OFF" light up when relays are energized.

4.4 Digital display continuously indicates location number and CO_2/NO_2 value of all points sampled on fast sequence.

5.0 NIGHT OR WEEKEND OVERRIDE (INTERLOCK)-OPTIONAL

5.1 Unit shall be programmed for this type of operation through contact opening. All outputs shall go to "Zero", there shall be no sampling or display but unit circuitry shall be on "stand-by" for immediate operation on contact closure.

6.0 PNEUMATIC OUTPUTS (OPTIONAL)

(SPECIFY APPLICABLE PARAGRAPHS)

6.1 Provide main air (20 PSI) connection and gauge.
Provide 3-15 PSI proportional operating outputs. Signal value to be based on percentage of points in a zone demanding ventilation.

7.0 SYSTEMS OPERATIONAL CONTROL

7.1 DESCRIBE HERE FOR EACH HVAC OR SIMILAR SYSTEM WHAT THE OUTPUTS OF THE AIR QUALITY MONITOR SHOULD ACHIEVE, SUCH AS:
CONTROL OF FANS
CONTROL OF SPEED OF FANS
CONTROL OF FAN CAPACITY
CONTROL OF ON-OFF DAMPERS
CONTROL OF MODULATING DAMPERS
INFORMATION TO COMPUTERIZED BUILDING CONTROL SYSTEMS
ACTIVATION OF ALARM CIRCUITS
PROVIDING RECORD OF AIR QUALITY IN SPACES
PROVIDING RECORD OF ENERGY SAVINGS OBTAINED
ETC.

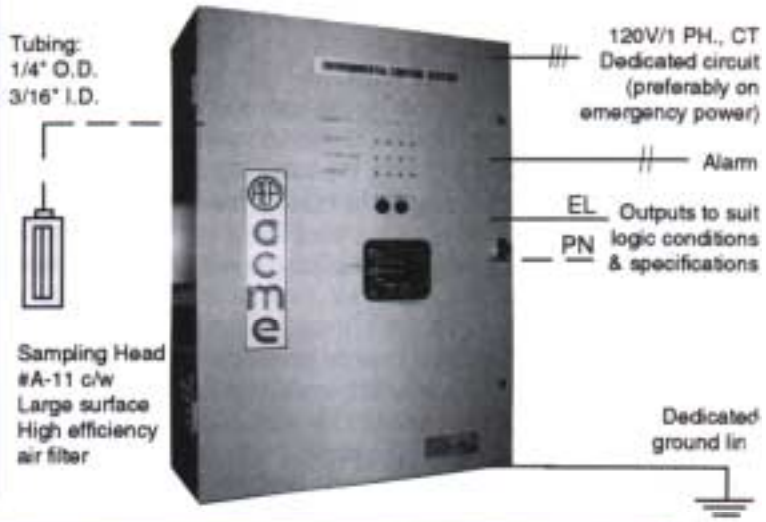
8.0 FACTORY TESTING & LISTING

8.1 EQUIPMENT shall be run for one week at the factory fully operational on simulator prior to shipment to the field. Records of testing shall be submitted to the engineers.
EQUIPMENT shall be ETL listed.

9.0 FIELD VERIFICATION

9.1 After the equipment has been put into operation, the owner-operator shall select the worst condition time for verification. The ACME representative shall come to the site at the specified time to verify the installation and system operation and readjust the operating set points up or down according to conditions specific to the area served by the system. A report shall be given to the engineers.

TYPICAL FIELD DIAGRAM



The information provided by this bulletin is a general description of ACME systems. All specifications are subject to change without notice. Installation, Maintenance and other instructions provided with the equipment shall be closely followed by installers, owners and users.