



UniCEM
Continuous Emissions
Monitoring System



UniCEM Continuous Emissions Monitoring System

The UniCEM system is an up to five channel field mount Continuous Emissions Monitoring System designed to continuously determine the concentration of O₂, CO, CO₂, SO₂, and NO_x in a flowing gaseous mixture. The UniCEM uses proven extractive monitoring technology, state of the art measurement detectors and modular Compact-PCI detector interface boards.

Designed for process type applications (O₂, Co, CO₂, NO_x, SO₂), the monitoring system uses proven sample handling techniques for reliable gas monitoring to assure accurate readings. The system also provides proven technology for monitoring by using time proven detector technologies, which can measure from low ppm levels to percent levels.



Indoor Panel Mount UniCEM



Outdoor Field Mount UniCEM

NEMA 4X Box designed for Outdoor monitoring. A high cost shelter is not required.



UniCEM Features

- ◆ Compact PCI computer design for reliability and modular design
- ◆ Long life reference-method detectors
- ◆ Includes a web-based interface
- ◆ Integrated with UniDAS for emission reporting.
- ◆ Available in panel mounts and outdoor field mount configurations.
- ◆ Time proven high Accuracy/Sensitivity gas detectors utilized: Paramagnetic (O₂), GFC-IR (CO and CO₂), Chemiluminescent (NO_x), GFC-UV (SO₂)
- ◆ An integrated web-based operator interface provides status, configuration and reporting from any connected computer.
- ◆ Small laptop can control the unit over a wireless network.
- ◆ Built in Data Acquisition and System Handling System - 40 CFR Part 60/75 compliant
- ◆ Easy to service front access components
- ◆ Independent Analysis and Sample conditioning panels allow maximum installation flexibility
- ◆ Heated Sample Line. Optional
- ◆ Industry standard robust sample conditioning components
- ◆ Optional Hazardous area Class I, Div. II option.

Sample Conditioning/Probe Box

The sample gas is extracted by a specially designed probe and is then conditioned by utilizing the UniCEM sample conditioning/Probe Box. The box is located at the sampling location and consists of the following equipment.



Housing

The housing is completely piped and wired and is accessible to customer via bulkhead and terminal block termination points.

All sample lines, fittings and valving are Stainless Steel, Teflon and/or Polypropylene.

Sample Box uses a Standard Compressor type Air Conditioner.

The housing is also equipped with a state of the art Thermo Electric Air Conditioner. The Thermo Electric air conditioner is a compressor-less type and does not require periodic maintenance. The unit will both heat and cool which will allow the Sample Box to operate in any hot to cold environments



Cleaning

The gas sample is cleaned with two levels of filtration: Primary filtration is performed at the probe tip by utilizing a 0.5 micron sintered filter. Secondary filtration occurs after the sample pump.

Sample Drying

The UniCEM provides a dry basis gas measurement. The reason is most regulatory agencies require measurements to be recorded as dry.

The UniCEM dries the sample gas by utilizing a dual pass thermo electric chiller. The chiller cools the sample gas and is allowed to continue through the system. The sample is then passed through a membrane-type high efficiency permeation dryer that will dry the sample to a minus 30°C dew point. This extreme drying process eliminates the requirement for heated sample line.

Sample Pump

The pump is a positive displacement type pump that uses a moving diaphragm. All wetted parts are 316 Stainless Steel and/or Teflon. In normal operation the pressure at the pump outlet is set between 5 -10 psi.

Vents and Drains

All vented gases or drained fluids are vented through bulkhead unions. Customer may route them to a sump. If the housing is located in a well-ventilated area, the gases can be vented to the atmosphere.

Wiring

All termination points for incoming or outgoing signals are provided on terminal strips or plugs.

Probe

A specially designed probe extracts sample gas from the stack. The probe is constructed of 316 Stainless Steel. The probe tip is fitted with a sintered filter and the filter can be easily changed and serviced. Calibration fittings are provided so that system complies with EPA guidelines for auto calibration as outlined in US EPA 40 CFR Part 60 regulations. The customer must provide the instrument air supply. The sample probe has optional 4" and 6" flange adaptors available and is available in a variety of probe lengths.

Measurement Analysis System

The UniCEM design includes an Analysis box which accommodates all of the measurement detectors and computer components. The box can be located at the sampling location or up to 300' away from the sample handling box for user installation flexibility. This enclosure is rated NEMA 4X and can be mounted directly in the outside environment. Sun and rain shields are mandatory to maintain proper performance specifications.





O₂ Detector (Paramagnetic)

The determination of oxygen is based on the measurement of the magnetic susceptibility of the sample gas. Oxygen is strongly paramagnetic, while other common gases are not.

The detector used is compact, has fast response and a wide dynamic range. The long life cell is corrosion resistant and may be easily cleaned. It has rugged self-tensioning suspension and is of welded Non-Glued construction. Standard range is 0-25%.

CO and CO₂ Detectors (NDIR-GFC)

The non-dispersive infrared method (Single beam double wave) is based on the principle of absorption of infrared radiation by the sample gas being measured. The gas specific wavelengths of the absorption bands characterize the type of gas while the strength of the absorption gives a measure of the concentration of the gas component being measured.

A pair of gas filled cuvettes is mounted on a rotating disc. The reference cuvette is filled with a sample of the gas to be measured and the measure cuvette with nitrogen. This technique is known as gas filter correlation. They pass through the beam of light alternately.

The difference in absorbance is measured by the detector and provides a direct output of the gas concentration.

CO Standard dual range capability between 3000-1000ppm is available. 1 percent and 10 percent Ranges are also available. CO₂ Standard Ranges of 25 percent, 50 percent and 100 percent.

NO_x (Chemiluminescence)

The NO_x detector consists of an ozone generator, chemiluminescence reaction chamber and a photomultiplier tube detector. The reaction chamber operates at atmospheric pressure, thus eliminating the need for the bulky vacuum pump found in other chemiluminescence instruments. The reaction between Ozone and Nitric Oxide is used to determine the presence of Oxides of Nitrogen (NO_x) in a sample gas. Nitric Oxide and Ozone readily react to form nitrogen dioxide in an electrically excited state. The excited NO₂ immediately reverts to the ground state, emitting photons.

The light intensity is measured by the thermoelectric cooler controlled photo detector. Standard dual range capability between 100 to 3000ppm are available.

SO₂ Detector (UV-GFC)

The absorption measurement in the UV spectral range is based on the same principle as the IRGFC measurement. The standard range capability is between 100 to 2000 ppm are available.

Accurate Detector Temperature Control Box

All measurement detectors are located in a box design equipped with a compact and highly efficient environmentally sealed thermo electric controlled system. The enclosure is kept at a constant temperature enabling the analyzer to produce extremely accurate measurement results due to the fact that the temperature control is stable and at ideal temperature.



Automatic Calibration

To minimize the effect of long term zero and span drift in each analyzer detector, the Compact-PCI system controller periodically initiates a calibration cycle as specified by the user. This feature assures reliable, accurate data while minimizing the attention required by operating personnel. At adjustable intervals, the microprocessor will energize the appropriate valves which cause first zero, mid and then span gas to flow through each analyzer.

When the analyzer readings stabilize, the PC Controller calculates the zero and span drift value for each detector. If a significant measurement deviation from the standard gas value exists, an alarm is generated which must be reset.

UniCEM Laptop Display

The UniCEM is provided with laptop computer which allows access to the UniCEM status and configuration. On UniDAS equipped UniCEMs, the laptop can also be used to generate reports.

Wireless Option

As an option the UniCEM can be equipped with a wireless network interface. The laptop can connect to the UniCEM at distances of up to 1000' away from the analysis enclosure.

Computer System Controller/Data Acquisition System

The Compact PCI controller is a standard off the shelf PC based platform and will perform all hardware control, as well as provide select data processing capability for the UniCEM.

Both analog and digital inputs and outputs are provided, including data correction and average values. The computer system:

Automatically calibrates each gas analyzer at selected time intervals to ensure accuracy and regulatory compliance.

- ◆ Automatically controls purge of the sample probe with instrument air.
- ◆ Provides system limit and failure alarms.
- ◆ Provides I/O digital and analog signal interfaces.
- ◆ Applies calibration correction factor for each analyzer output, data averaging for regulatory requirements (3 months data storage of 15 minute and 1 hour averages, 1 week storage of 1 minute averages),
- ◆ Applies O₂ diluent correction and stores data as separate value.
- ◆ Supports an array of communication mechanisms: RS-232/485, Ethernet, TCP/IP, ModBus, OPC, 4-20 mA Current Loops, USB.
- ◆ Uses an Intel processor with 512 MB RAM: USB Port and Monitor Port.
- ◆ Provides single button initiate to download data into excel format. Simple regulatory reports can then be tailored by the user.



Sample and Calibration Gas Distribution

The gas and calibration gas samples will be controlled by a single Mass Flow Controller. The MFC shall control the sample gas and calibration gas sample gas flow very accurately. The use of an MFC allows for very high accuracy and reliable monitoring.

The Analysis Panel is equipped with a 3 way universal solenoid that will accommodate the gas sample for either the normal stack gas sample or direct the calibration gases directly to the analyzers otherwise known as a local calibration.

The UniCEM is equipped with a manifold with up to four two-way Normally Closed solenoid valves that will direct the customer supplied calibration gases into the system. The valves will be used for Zero, Mid and Span gas calibrations respectively.

The panel is equipped with a gas vent line. The vent will be routed to a sump by customer. If the housing is located in a well ventilated area, the gases can be vented to the atmosphere. Otherwise they should be piped out of the room or building.

The Chemiluminescent detector requires a continuous source of instrument air from customer. The enclosure is equipped with a bulkhead fitting for this connection.

1 Year Ownership Cost Comparison

	UniCEM (US\$)	Others (US\$)
O2, NOx and CO	\$50,000	\$70,000
DAS cost (Part 60)	\$15,000	\$30,000
Shelter cost (8'D X 8'W X 8'H)	\$0	\$20,000
Annual shelter maintenance	\$0	\$5,000
Shelter installation	\$0	\$5,000
Peripheral installation costs	\$2,000	\$10,000
Heated Sample Line (250')	\$0	\$12,500
TOTALS	\$67,000	\$152,500
Savings PER UniCEM	\$85,500	

Equipment to be provided by others

- Calibration gas bottles
- Calibration gas regulators. Dual stage with CGA connector
- Instrument Air supply
- 85-125 VAC, 50-60Hz plant power supply
- Tubing between probe and sample handling panel
- Wiring trays for electrical interconnection wiring
- Sample ports for probe connection
- Mounting Hardware



Measurement Analysis System Specifications

General

Power:	Universal Power Supply 85 - 125VAC, 50 - 60 Hz, + 10%, 500 Watts Maximum at Start Up. 250 Watts Nominal
Microprocessor Board:	Intel processor, 512MB RAM, Compact PCI architecture, Windows XP Embedded Platform
Laptop:	Intel or AMD processor, 512MB RAM 800 x 600 pixels, Windows OS LCD, TFT color, Wireless LAN
Detectors//Number:	NDIR-GFC (CO and CO ₂), UV-GFC (SO ₂), Paramagnetic (O ₂), Electrochemical (O ₂), Chemiluminescent (NO _x), (THC) FID Up to five in one analyzer
Mounting:	Wall Mount
Area Classification:	General Purpose
Compliance's:	CSA (Pending)
Ambient Temperature Range:	-30° to 50°C.
Relative Humidity:	99%

Inputs/Outputs:

Digital:	RS-485 Serial Port. (Multi-Drop Network) RS-232 Serial Port. LAN, Ethernet 10/100/1000 -BaseT
Connectivity Protocols:	HTML (Web Browser) - Status, File transfer, Remote Control TCP/IP, HTTP ASCII String, Microsoft Shared drive FTP Logs download TELNET Server
Analog:	Analog Outputs: up to 8 isolated 4-20 mA dc, 500 ohms Max Load (O ₂ , CO, CO ₂ , SO ₂ , NO _x and 3 spares) Analog Inputs: up to 8 (Typically; Flow, Opacity, MW, Fuel Flow)
Digital:	Outputs: up to 14 dry contact digital Outputs; maximum 110VAC @ 1 amp load. Typical; O ₂ , CO, CO ₂ , SO ₂ , and NO _x limit exceed, data valid, in calibration, in maintenance, trouble alarm Digital Inputs: up to 8: (Typical Process on/off, Flame Detect, Shutdown or Initiate Cal, flow signals and Opacity signals). Interrogated with 5 VDC.
Instrument Weight:	60 lbs Typical
Size:	40" X 32" X 12" (H W D)
Ranges:	O ₂ : 0 -1 Selectable to 0 -25% (1% increments) CO: 0 -10 ppm Selectable to 100% (1 ppm increments) CO ₂ : 0 - 5 ppm Selectable to 100% (1 ppm/% increments) NO _x : 0 - 5 ppm Selectable to 10,000 ppm (1 ppm increments) SO ₂ : 0 - 25 ppm Selectable to 2000 ppm (1 ppm increments) THC: 0 - 5 ppm Selectable to percent levels
Sample Temperature:	0°C to 55°C
Sample flow rate:	0.5 to 1.5 litres/min
Warm Up Time:	Max 25 minutes

Sample Handling Box and Probe Specifications

General

Power:	Universal Power Supply 85 - 125VAC, 50 - 60 Hz, + 10% 500 Watts Maximum at Start Up. 250 Watts Nominal
Mounting:	Wall Mount
Area Classification:	General Purpose
Compliance's:	CSA (Pending) Ambient Range Temperature: -300 to 500C
Relative Humidity:	99%
Instrument Weight:	80 lbs Typical
Size:	24" x 24" x 12" (H W D)
Stack Sample Moisture:	Up to 30% max
Sample Cooler:	Thermo Electric type with dual pass Chiller.
Max. Stack Temperature:	Standard 14000F



Stack Pressure: Typical -5 to 15 inches H²O
 Sample Flow Rate: 500 to 2500cc/min
 Response Time: 30 seconds/100' of Heated Sample line (1/4" tubing)
 Probe Length: 48" length 316 Stainless Steel Probe with .5 micron sintered filter. Optional 5' and 6' probes.
 Probe Mounting Flange: Standard 4" 150# Raised Face (2 Hole Top). Shipped Equipped with Gasket
 Sample Pump: 316 Stainless Steel diaphragm type
 Instrument Air Requirements: Instrument grade air required. 15 SCFM @ 60 -100 PSIG (30 seconds 2 times per day)
 Pressure Regulation by Customer

	Paramagnetic O ₂	NDUV SO ₂ /FID THC	NDIR CO/CO ₂	Chemiluminescent NO _x
Linearity	< +/- 1%	< +/- 1%	< +/- 1%	< +/- 1% (1)
Zero Drift	< +/- 1% /day	< +/- 1% /day	< +/- 1% /day	< +/- 1% /day (1)
Span Drift	< +/- 1% /day	< +/- 1% /day	< +/- 1% /day	< +/- 1% /day (1)
Repeatability	< +/- 1%	< +/- 1%	< +/- 1%	< +/- 1%/day (1)
Response Time (t ₉₀)	10 < +/-t ₉₀ < +/-15	30 < +/-t ₉₀ < +/-45s	15s < +/-t ₉₀ < +/-30s	15s < +/-t ₉₀ < +/-30s

Influence of Ambient Temperature (-30°C to 50°C)

- On Zero	< +/-1%	< +/-2%	< +/-2%	+/-2%
- On Span	< +/-1%	< +/-2%	< +/-2%	+/-2%

(1) 0-10 ppm NO_x range is < +/-2%.

Sample Menu Screens





UniCEM Vs. Insitu COMPETITIVE ANALYSIS

Criteria	UniCEM	Insitu	Comments
Accuracy	High	Moderate	The Chemiluminescent (Nox), NDUV (SO ₂) and NDIR (CO) will offer much greater accuracy and allow for lower range capability
Ambient Temp High Range	60°C	55°C	All detector and Electrical components are located in a temperature controlled enclosure which will assure longevity and accuracy
Analytical Capabilities	Excellent	Poor	The UniCEM utilizes multiple detectors in order to measure each specific gas constituent. Insitu type one detector methods are very unreliable and unstable when measuring more than one gas.
Cost of Ownership	Low	Moderate	The field mount design allows for extremely low installation costs and the robust design of the electronics and detectors enhanced by the internal climate control allow the UniCEM to operate for a very low cost for many years to come.
Drift due to Ambient Temperature changes	None	Not listed	This is very important due to the nature of most applications. The analyzer will see as much as 20 degree C temperature changes daily. This temperature change will not affect the UniCEM
EPA 40 CFR Part 60 Reference Method Detectors	Yes	No	EPA specifically states that all certification tests must use chemiluminescent and NDIR technologies as the to certify all CEMS. This will be important due to the nature of discrepancies in measuring accuracy when using different than EPA specified detectors.
EPA Approval	Yes	No	UniCEM is approved for certification in an EPA 40 Part 60/75 application
Ethernet TCP/IP communications	Yes	No	User can simply use off the shelf Microsoft standard PC and communication equipment. No special software or hardware required to communicate with the UniCEM
Future Expansion	Yes	No	Modularity of the system allow users to add up to 5 gas measurements after installation. Important especially in territories where EPA requirements are constantly changing.
Internal Data Storage	12 months	None	This will eliminate the need to have a separate PLC to store back data. This also enables the user to quickly view any calibrations, alarms, measurements that occurred over the last 3 months.
Maintenance	Simple	Complicated	All service items are easy to replace without the removal of the analyzer from the stack
Repeatability	±1%	±2%	Equates to more reliable long term readings
Two point stream switch option	Yes	No	The UniCEM can also accommodate 2 separate stacks simultaneously. Very efficient for SCR inlet and outlet applications
Variable Range selection	Yes	No	Customer is able to change ranges on the fly without having to purchase vendor services or software.
Windows HTML interface	Yes	No	Customer can view UniCEM by utilizing a standard Microsoft Internet Explorer tool.
Wireless Communications with Monitor	Yes	No	User can simply use the standard pocket pc from their office to view or select menu functions. Saves time and money not having to climb the stack or drive/walk thru the plant.
Data Acquisition System	Built-in DAS	Limited	Optional DAS available On-board