



Focused Photonics Inc.



Continuous Emission Monitoring System

Focused Photonics Inc. (also known as FPI) measures gas, air, dust and water, is one of the world's leading manufacturers of analytical instrumentation for industrial process and environmental monitoring.

In late 1990's, FPI was initially registered in California, USA for research and development of Tunable Diode Laser (TDL) technology and utilization. The establishment of FPI in 2002 was shortly followed by its successful expansion to steel industry where the cross-stack TDL of FPI built an exceptional reputation for the industries as benchmark process monitor. The entry into environmental monitoring was soon driven by customer needs. Leveraging patented technologies of how-wet UV spectrometer combined with well established TDL, continuous emission monitoring system (CEMS) was re-defined by FPI resulted in sample conditioning minimized, reliability reinforced and cost reduced.



FPI provides one-stop monitoring of process, emission, ambient and water. By combining global expertise with local support, FPI delivers only the cutting-edge technologies of analytical instrumentation with an easily accessible networks worldwide. FPI continues to improve our local presence through subsidiaries and distributors aiming to provide optimal services to industries and municipalities.

Corporate Name	Focused Photonics Inc.
Establishment	January, 2002
Capital	445,000,000 CNY (approx. 73,000,000 USD) A ChiNext company of Shenzhen Stock Exchange
Head Office	760 Bin'an Road, Bingjiang District, Hangzhou 310052, China
Numbers of Employees	2,334 (As of December 5, 2014)
Business Description	1. Manufacturing and sales of industrial process instruments 2. Manufacturing and sales of environmental monitoring instruments 3. Manufacturing and sales of laboratory and scientific instruments 4. Manufacturing and sales of metal analysis instruments 5. Manufacturing and sales of hydrological instruments 6. Manufacturing and sales of other measuring and analytical instruments 7. Contracts for instrumentation services and operation 8. Contracts for instrumentation work, electrical work, telecommunication work, and other related work 9. All business accompanying the preceding items

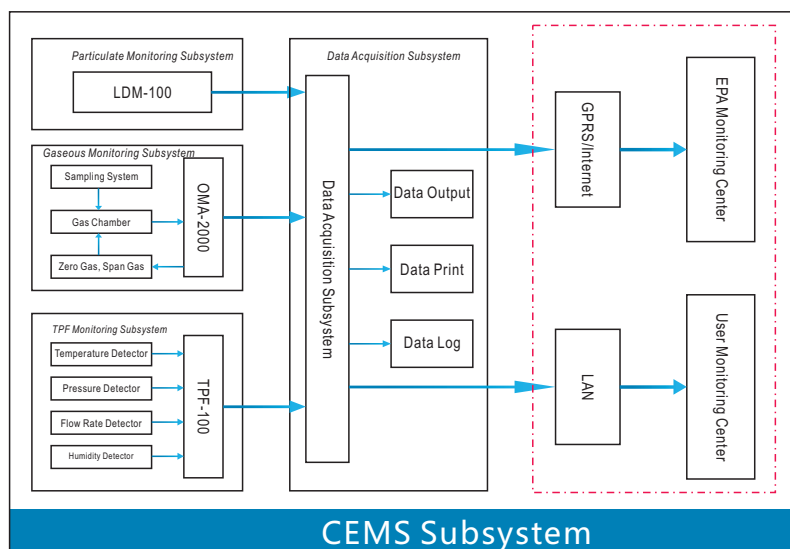
FPI, the formulator of international standard 'Tunable Laser Absorption Analyzer' (IEC 61207-7), and national standard 'Online Ultraviolet-visible Spectrophotometer', built its expertise of emission monitoring from 2 flagship products, LGA(NH₃, HCl, HF, H₂S) and CEMS-2000B(SO₂, NO_x).

Item	Model	Gas & Component
1	CEMS-2000BS	SO ₂ , NO _x , O ₂ Dust, Temperature, Pressure, Flow rate, Humidity
2	CEMS-2000BF	SO ₂ , NO _x , O ₂ , CO, CO ₂ Dust, Temperature, Pressure, Flow rate, Humidity
3	LGA-4100(cross stack) LGA-4500(extractive)	NH ₃ , HCl, HF, H ₂ S(single gas)
4	CEMS-2000 B FT	SO ₂ , NO _x , O ₂ , CO, CO ₂ , HCl, HF, NH ₃ , H ₂ O(simultaneous) Temperature, Pressure, Flow rate, Dust
5	CEMS-2000 B VOC	VOCs like Methane/Non-methane hydrocarbon, Benzene, Methylbenzene, Paraxylene and 1,3-butadiene
6	CEMS-2000 B XRF	Pb, Hg, Cd, Cr, As, Cu, Zn, Ni, Fe, Ag, Mn, Ca, K, etc. totally 28 heavy metal elements

The new generation FPI 'smart CEMS' features smart self inspection, smart operation and maintenance.

- ⊙ Traceable record of inspection, operation and maintenance.
- ⊙ Remote zero/span calibration, remote purge control.
- ⊙ Remote operation and diagnosis through user monitoring center or EPA monitoring center.
- ⊙ Malfunction precaution and healthy operation by embedded detectors to key parts of the system.

CEMS-2000



SO₂, NO_x, O₂, CO, CO₂

Measuring principle

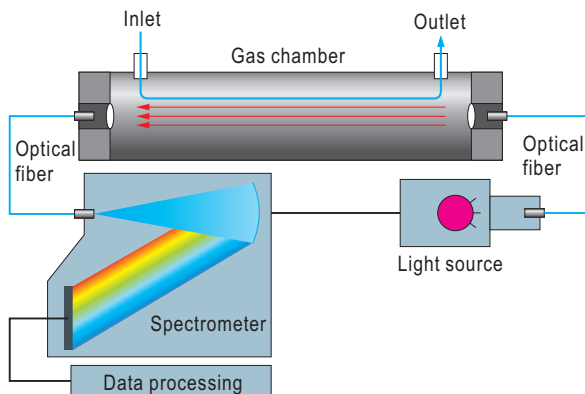


Fig. 1.1: Flow chart of UV analysis

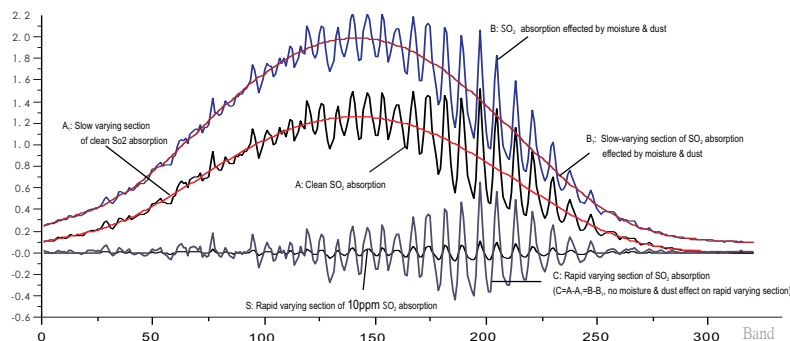


Fig. 1.2: DOAS algorithm principle

- ⦿ The light source emits ultraviolet beam which transfers to gas cell through optical fiber.
- ⦿ After absorption by measuring gas, the light beam transfers through optical fiber to spectrometer.
- ⦿ Being dispersed through the grating, and converted into electric signal by the array sensor, a continuous absorption spectrum of measuring gas is thereafter obtained.

TECHNOLOGY COMPARISON

Item	UV Hot-wet method	NDIR
Spectral Range	Complete and continuous absorption spectra obtained through holographic grating and diode array detection	Non Dispersive characteristic absorption spectra obtained through band-pass filter
Linear Response	High wavelength resolution secures linear response	Band-pass filtration compromises linear response
SO ₂ Loss	Hot-wet prohibits SO ₂ dissolution	Condensation inevitably causes SO ₂ loss
Sampling system	Heat tracing. Requests only dust filtration, simple and no corrosive	Cold-dry. Requests dust filtration, condensation, water removal and corrosion proof
Zero Calibration Period	Long(DOAS algorithm)	Short
Anti-Interference	Combination of complete & continuous absorption spectra, high wavelength resolution, DOAS algorithm erases interference from dust, moisture and background gases	Vulnerable to moisture interference
Gas Cell Maintenance	Connected by optical fiber, easy to replace and low maintenance cost	Complex to replace and maintenance
Reliability	No moving parts	Moving parts existed

OMA-2000



Features and Benefits

- ⦿ Full spectrum measurement and DOAS (Differential Optical Absorption Spectroscopy) algorithm, excelling in accuracy, repeatability and anti-interference with moisture, dust.
- ⦿ Modular design and no moving parts, higher reliability and easier maintenance.
- ⦿ Pulse Xenon Lamp used as light source with over 10-year lifetime.
- ⦿ The adoption of diode array sensor enables instant spectrum acquisition and rapid response.

TECHNICAL DATA	
SO₂, NO_x Analyzer	OMA-2000
Technical Principle	UV-DOAS
Installation Type	Hot-wet Extractive
Measurement Range	0~200ppm, 0~1000ppm, 0~3000ppm
Zero Drift	≤±2%F.S.
Span Drift	≤±2%F.S.
Accuracy	≤±1%
Response Time (T90)	≤60s
Linearity	≤±1%F.S.
O₂ Analyzer	Zro-100/KE-25F3
Technical Principle	Zirconia/Electrochemical
Measurement Range	0~25%
Response Time (T90)	≤60s
Linearity	≤±2%F.S.
CO, CO₂ Analyzer	TOC(CO, CO₂)
Technical Principle	NDIR
Installation Type	Extractive
CO Measurement Range	0~1000ppm
CO ₂ Measurement Range	0~20%
Zero Drift	≤±2%F.S.
Span Drift	≤±2%F.S.
Accuracy	≤±1%
Response Time (T90)	≤60s
Linearity	≤±2%F.S.

NH₃, HCl, HF, H₂S

Measuring principle

⊙ No Cross Interference

By utilizing the 'single-line' spectroscopy, a well-targeted laser spectrum can be sort out to cover only the measuring gas without overlapping spectrum of all background gases.

⊙ No Effects from Dust and window Contamination

TDLAS gas analyzers use a laser spectral scanning technique. The unit periodically scans the gas under test with a modulation frequency range larger than the gas absorption spectral line-width such that, within one scan period, there are two distinctive areas T_{gd} and T_d. The transmittance of the gas under test is then calculated accurately by T_g=T_{gd}/T_d. The interference from dust and optical window contamination is, therefore, automatically screened out.

⊙ Automatic Temperature & Pressure Compensation

By having 4-20mA process temperature and pressure input, the LGA system automatically compensates for them with a proprietary algorithm to ensure measurement accuracy.

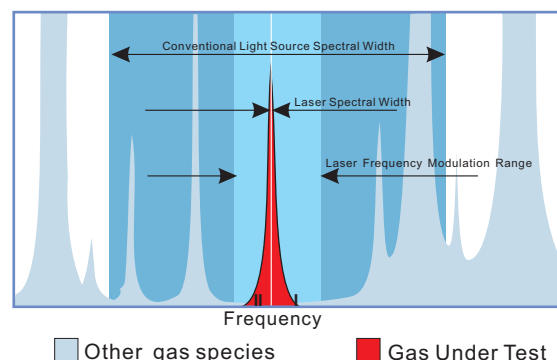
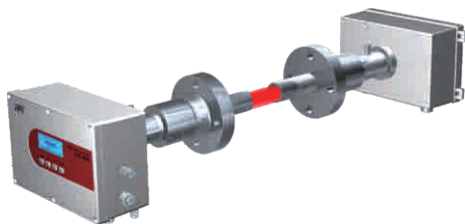


Fig.2.1: "Single Line Spectrum" Measurement

TECHNOLOGY COMPARISON

Item	LGA Laser System	Conventional Online Analyzer
Adaptability	Applicable to high temperature, pressure, moisture, dust density and corrosion	Applicable to constant temperature, pressure and dust free
Measurement	In-situ, continuous/real-time measurement, sample gas evacuation free	With sample conditioning system, discontinuous measurement
Response time	Fast, only limited by electronics response, less than 1sec	Slow, limited by gas sampling, transport, and instrument electronics response 20+sec
Accuracy	Average concentration along the optical path, no cross interference from other species, dust, and gas parameter fluctuations	Gas concentration at the tip of the sampling probe only, affected by gas influence and absorption, and leaked during gas sampling and transport; cross interference from other gas species, dust, and gas parameter fluctuations
Reliability	No moving parts, highly reliable	Many moving parts, low reliability
Calibration & Maintenance	Calibration: < 2 times/year Maintenance: < 2 times/year	Calibration: <2-3 times/month Maintenance: frequent
Operation costs	No spare parts, only cost electricity	Lots of spare parts, around 20% of the equipment cost per year

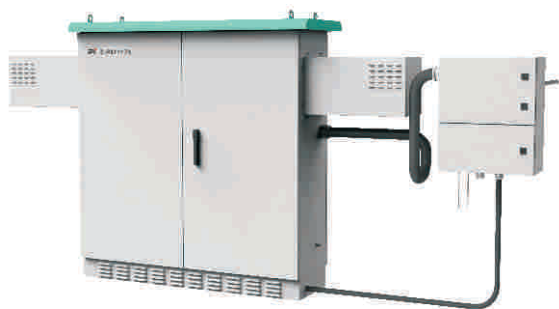
LGA-4100



LGA-4100 Features and Benefits

- ⦿ Cross stack, fast response < 1s
- ⦿ No gas sampling, no cross interference
- ⦿ No zero drift, diverse optical length(0.5-20m)
- ⦿ ATEX certified

LGA-4500



LGA-4500 Features and Benefits

- ⦿ Low detection limit, no cross interference
- ⦿ Online calibration, no zero drift
- ⦿ Reliable in all harsh conditions: high temperature & pressure, dust density, moisture and corrosion
- ⦿ ATEX certified

TECHNICAL DATA		
Model	LGA-4100/LGA-4500/LGA-4500IC	
Technical Principle	TDLAS	
Installation Type	Cross duct/Extractive	
GAS	DETECTION LIMIT	MEASUREMENT RANGE
NH ₃	0.1ppm	0-10ppm, 0-100%
HCL	0.2ppm	0-50ppm, 0-100ppm
HF	0.1ppm	0-10ppm, 0-1,000ppm
H ₂ S	0.1ppm	0-50ppm, 0-100%
Repeatability	≤±1%F.S.	
Linearity	≤±1%F.S.	
Span drift	≤±1%F.S./6 months	
Response Time (T90)	< 1s	
Warm-up time	≤15min	
Optical path length	0.5-20m	
Flue gas temperature	max. 1500°C	
Flue gas pressure	0.8 to 4 bar abs.	
Analog outputs	2 outputs 4-20mA, max. load 750 Ω, electrically isolated	
Relay outputs	3 outputs 24V DC/1A	
Analog inputs	2 inputs 4-20mA, for gas temp. & pres. compensation	
Communications	RS485(or Bluetooth, RS232 or GPRS)	
ATEX certified	EX d op is pxIIC T5 Gb	

Dust

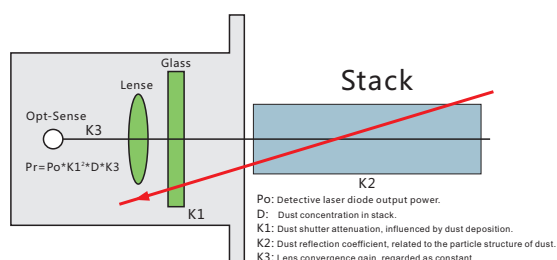


Fig.3.1: Back scattered

Measuring Principle

The laser beam passes across the stack or duct work and is reflected by the dust particles, the reflected light is then detected by the photoelectric sensor. The intensity of reflected laser signal is proportional to dust concentration, by which the resulting signal is analyzed to yield dust concentration.

LDM-100(D)



Features and Benefits

- On-line continuous monitoring for various emission sources
- Combined techniques: adaptive stabilization, dynamic adaptive phase-lock amplification
- Very low zero drift, patented technology of on-line calibration
- Compact, easy to install, anti-lightning, high adaptability, low cost and less maintenance

TECHNICAL DATA

Model	LDM-100(D)
Technical Principle	Laser Back Scattered
Installation Type	In-situ
Measurement Range	0~200, 0-1000 mg/m ³
Zero Drift	≤±2%F.S./d
Span Drift	≤±2%F.S./d
Response Time(T90)	< 10s
Analog Output	(4-20)mA
Communication	RS485
Protection Class	IP66

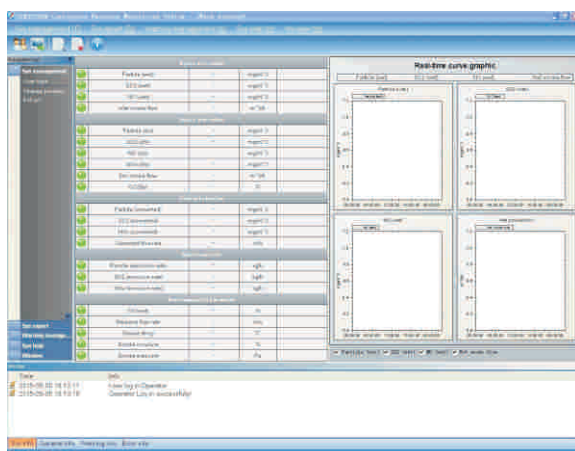
TPF, Humidity, DAS

TPF-100



TECHNICAL DATA

TPF-100	Temperature	Pressure	Flow rate	Humidity(GRL-12D)
Principle	Pt100	Polysilicon	Pitot tube	Film capacitance
Range	0~400℃	-5~5Kpa	5~40m/s	0~40%
Accuracy	≤±0. 5%F.S.	±0. 5%	≤±1%F.S.	±2%
Analog Output	4~20mA	4~20mA	4~20mA	4~20mA

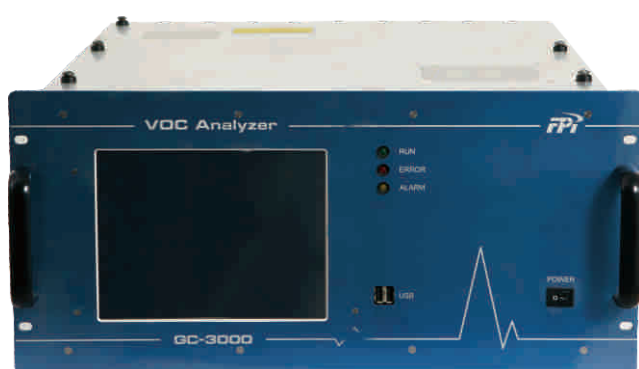


DAS Features and Benefits

- Full capabilities of data acquisition, processing, storage and transfer
- Daily, monthly, yearly reports automatically created
- Data value & curve real-time display, history data traceable
- Remote monitoring, management and remote parameter configuration
- Alarm message and log file automatically recorded

VOC

GC-3000



Measuring Principle

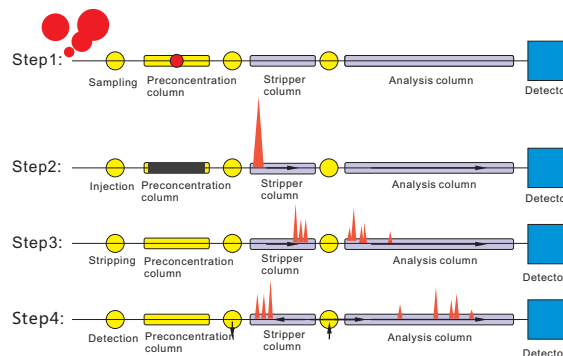


Fig.4.1: Gas chromatography measuring principle

Features and Benefits

- ⊙ Sensitivity
 - Separation efficiency and signal-noise ratio enhanced by utilizing adsorption, thermal desorption technology
 - Complementary detection combined FID with PID in serial for an optimal sensitivity
- ⊙ Response time
 - Enable synchronous sampling and separation based on 2D chromatography, time saving
 - Fast separation and analysis through precisely temperature control
- ⊙ Reliability
 - Ignition and extinction safety automatically protected
 - EFC, EPC control technology adopted
- ⊙ User Friendly
 - Automatic calibration and span check
 - Software based automatic maintenance and diagnosis
 - Touch screen

TECHNICAL DATA

Methane/Non-methane hydrocarbon

Model	GC3000-110
Technical Principle	Gas Chromatograph
Installation type	Extractive
Measurement Range	0~1000 ppm(customizable))
Detection Limit	Non-methane hydrocarbon 0.05ppm
Detector	FID
Analysis Period	2min(determined by specific substance)
Repeatability	GC-3000-110:<2%(methane)
Consumption	N ₂ : 99.999%, 0.4MPa, 25ml/min; H ₂ : 99.999%, 15ml/min

Benzene, Methylbenzene, Ethylbenzene, Xylene and the Isomerides

Model	GC3000-210
Technical Principle	Gas Chromatograph
Installation type	Extractive
Measurement Range	0-50ppm(customizable)
Detection Limit	<2ppb
Detector	PID
Analysis Period	2min(determined by specific substance)
Repeatability	<2%
Consumption	N ₂ : 99.999%, 0.4MPa, 20ml/min

Heavy Metal

Measuring Principle

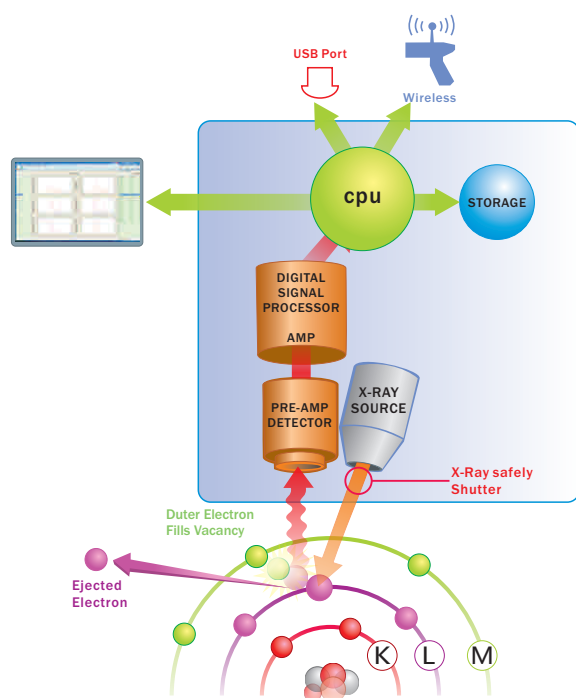


Fig.5.1: Measuring principle of X-ray fluorescence

XRF-2000



Features and Benefits

- Simultaneously analyzing 28 most regular heavy metal elements, others scalable
- High sensitivity, lower detection limit down to ng/m^3
- Truly continuous and non-destructive measurement, no pretreatment needed
- No chemical, no liquid waste, reliable and less maintenance
- 13 patents borne by the single analyzer
- Radiation safety certified

X-rays used to expel tightly held electrons from the inner orbitals of the atom. The removal of an electron in this way makes the electronic structure of the atom unstable, and electrons in higher orbitals 'fall' into the lower orbital to fill the hole left behind.

Each of these transitions yields a fluorescent photon with a characteristic radiation equal to the difference in energy of the initial and final orbital. The fluorescent radiation is then analyzed by separating the characteristic wavelengths (qualitative) and detecting intensity of each characteristic radiation (quantitative).

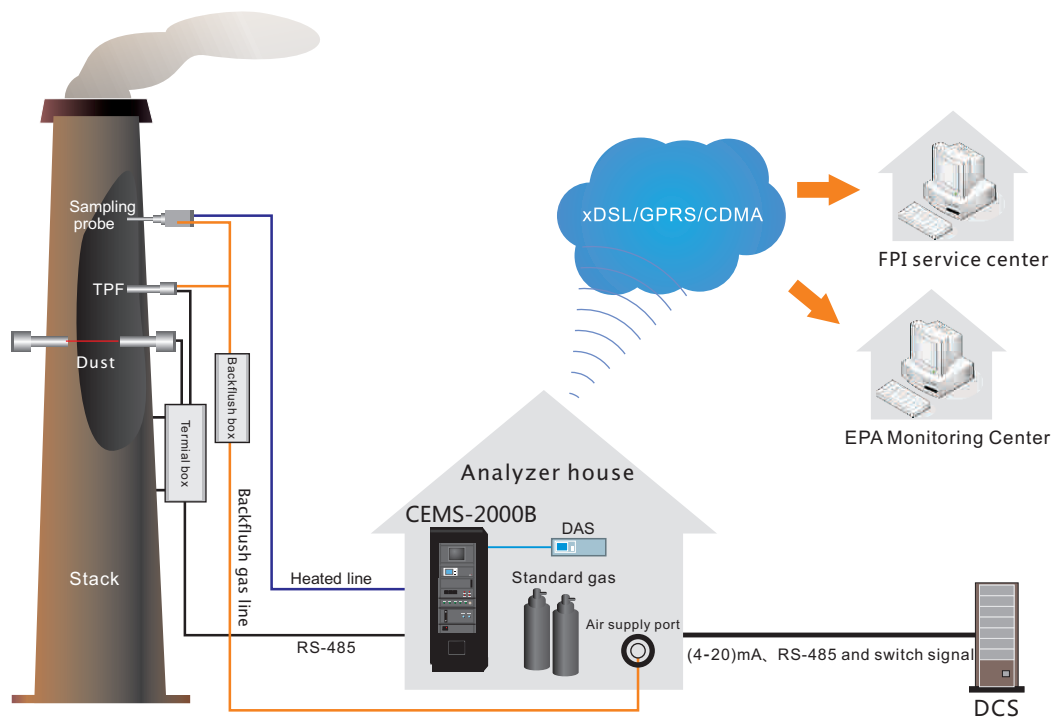
TECHNICAL DATA	
Model	XRF-2000
Technical Principle	X-ray Fluorescence
Installation type	Extractive
Measuring Element	Hg, Pb, Cd, As, Cr, Cu, Zn, Ni, Fe, Ag, Mn, Ca, K, etc. totally 28 heavy metal elements
Measurement Range	0~2000 $\mu\text{g}/\text{m}^3$
Detection Limit	0.1 $\mu\text{g}/\text{m}^3$
Linearity	Correlation coefficient>0.99
Accuracy	<1.5%(Pb)
Gas Temperature	(-20~600) $^{\circ}\text{C}$
Gas Pressure	(-20~50)KPa
Sampling & Analysis Period	10~120mins(Selectable)
Filter tape consumption	Replace every 3 months
Size	1500x1200x480mm (HxWxD)
Weight	Around100kg

Criteria Emission Monitoring

System Features

- ⊙ CEMS all-route heat tracing(120°C~180°C) from probe, sampling line through to gas cell.
- ⊙ Coal fired industries: LGA all-route heat tracing(240°C) from probe, sampling line through to gas cell.
- ⊙ Non-coal fired industries: cross-stack LGA ensures no sampling no NH_3 loss and very low detection limit.
- ⊙ Patented probe features overlaid filtration holes, internal/external dual back flush and corrosion proof lining.

Emission Monitoring



Application	Measuring Point	Componets	Analyzer Model
Emission: Power Plant Iron & Steel Cement ...	Exhaust stack(Chimney)	SO_2 , NO_x , O_2 , Dust, Temperature, Pressure, Flow rate, Humidity	CEMS-2000BS
		SO_2 , NO_x , CO, CO_2 , O_2 , Dust, Temperature, Pressure, Flow rate, Humidity	CEMS-2000BF

System Features

- ⦿ CEMS all-route heat tracing($120^{\circ}\text{C}\sim 180^{\circ}\text{C}$) from probe, sampling line through to gas cell.
- ⦿ Coal fired industries: LGA all-route heat tracing(240°C) from probe, sampling line through to gas cell.
- ⦿ Non-coal fired industries: cross-stack LGA ensures no sampling no NH_3 loss and very low detection limit.
- ⦿ Patented probe features overlaid filtration holes, internal/external dual back flush and corrosion proof lining.

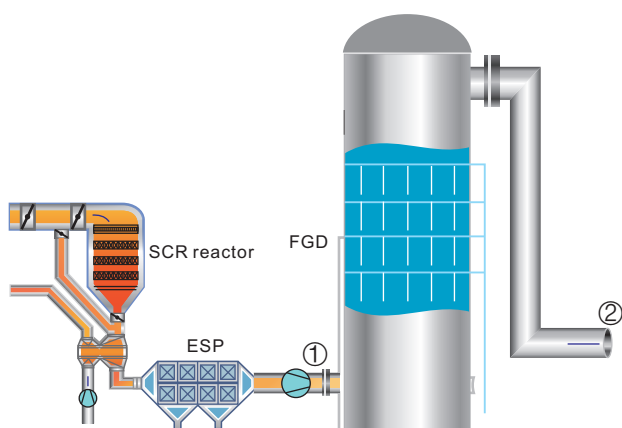


Fig.6.1: DeSO_x Efficiency Control

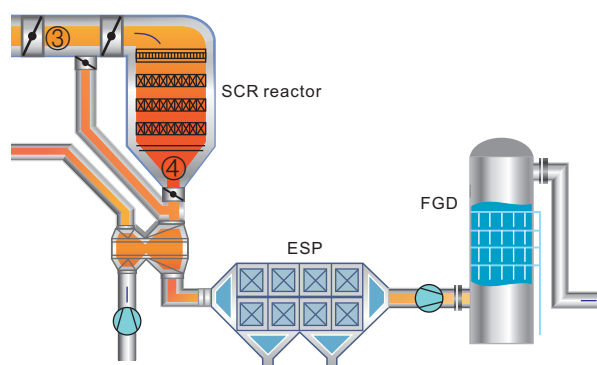


Fig.6.2: DeNO_x Efficiency Control

Application	Measuring Point	Components	Analyzer Model
DeSO _x Efficiency Control	① or ②	SO ₂ , NO _x , O ₂ , Dust, Temperature, Pressure, Flow rate, Humidity	CEMS-2000BS
DeNO _x Efficiency Control	③ or ④	NO _x , O ₂ , Flow rate	CEMS-2000BS
	④	NH ₃	LGA-4500

Explosion Area Emission Monitoring

System Features

- ⦿ CEMS-2000B(EX) explosion proof certified to work at Zone II.
- ⦿ The analyzers and sample conditioning system are secured within a positive pressure enclosure.
- ⦿ Laser Analyzer, Power supply, cable connection box and electric parts are explosion suppression certified.
- ⦿ Sampling probe, dust monitor and TPF analyzer are explosion proof available.



Fig.7.1: Ex-proof Cabinet

Application	Measuring Point	Componets	Analyzer Model
Emission: Oil & Refinery Chemical ...	Exhaust stack(Chimney)	SO ₂ , NO _x , O ₂ , Dust, Temperature, Pressure, Flow rate, Humidity	CEMS-2000BS(EX)
		SO ₂ , NO _x , CO, CO ₂ , O ₂ , Dust, Temperature, Pressure, Flow rate, Humidity	CEMS-2000BF(EX)
		H ₂ S	LGA-4500IC
		VOC	CEMS-2000B VOC

Incineration Emission Monitoring

(Fertilizer, Aluminum, Chlor-alkali and more)

System Features

- ⊙ HCl, HF(and/or NH₃), single component, dual component, or multiple components selectable by using alternative Laser analyzer or FTIR.
- ⊙ CEMS all-route heat tracing (120°C-180°C) from probe, sampling line through to gas cell.
- ⊙ Cross-stack LGA ensures no sampling no measurement loss and very low detection limit.
- ⊙ Patented probe features overlaid filtration holes, internal/external dual back flush and corrosion proof lining.

CEMS-2000B VOC



Application	Componets	Analyzer Model
Emission: Incineration Fertilizer Aluminum Chlor-alkali ...	SO ₂ , NO _x , CO, CO ₂ , O ₂ , Dust, Temperature, Pressure, Flow rate, Humidity	CEMS-2000BF
	HCl, HF(NH ₃)	LGA-4100
	SO ₂ , NO _x , CO, CO ₂ , O ₂ , HCl, HF, NH ₃ , H ₂ O, etc.	CEMS-2000B FT
Oil & Refinery, Chemical, Coating, Pharmaceutical, Semiconductor ...	VOC	CEMS-2000B VOC
Incineration, Non-ferrous Metal, Cement, Chemical, Coal fired boiler ...	Heavy Metal Elements	CEMS-2000B XRF

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