General Specification for Inciner8 Ltd

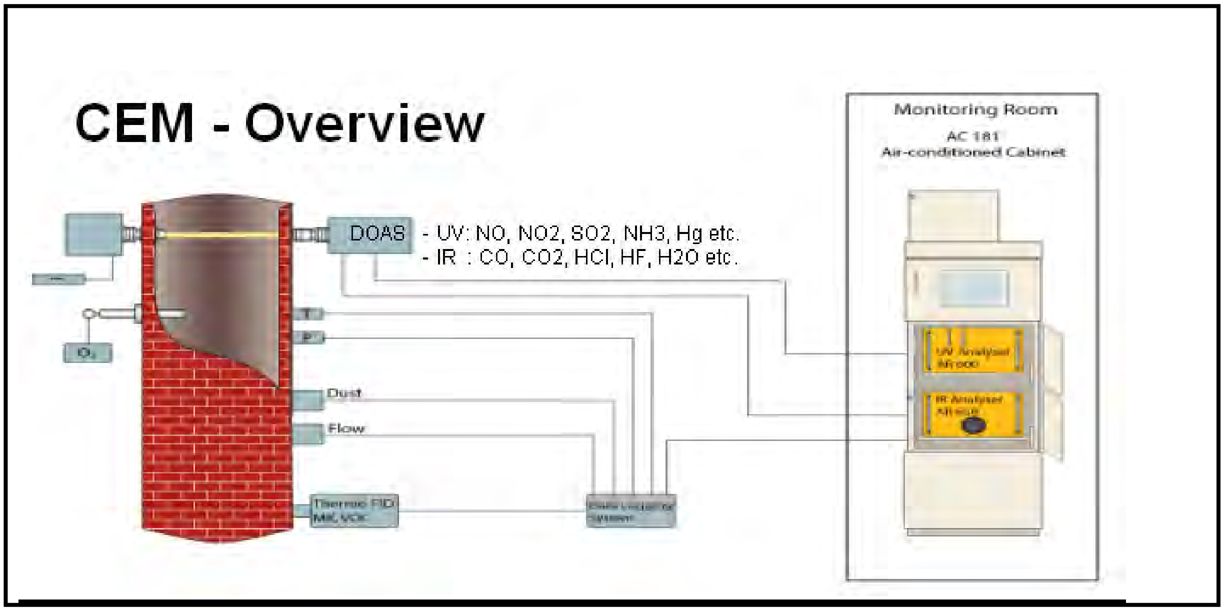
General Specification for Waste Incineration Processes

The Opsis systems are based on optical cross stack monitoring, Ultra Violet (UV), Infra Red (IR) Using DOAS (**D**ifferential **O**ptical **A**bsorption **S**pectroscopy) provides an open path, non-contact monitoring system unaffected by the gas interferences, temperature and particulate matter present in the stack. Other parameters and techniques are listed below. The system offered will be setup for monitoring:

Determinand		Principle of Measurement	MCERTs Approved	WID ELV Daily Average mg/m^3	MCERTS Certified Range mg/m^3	Max Range mg/m^3
NO	NOx	DOAS	Yes	200	0 to 150	0-2000
NO2		DOAS	Yes		0 to 20	0-2000
SO2		DOAS	Yes	50	0 to 75	0-5000
HCl		DOAS	Yes	10	0 to 15	0-5000
NH3		DOAS	Yes	?	0 to 20	0-1000
CO		DOAS	Yes	50	0 to 75	0-10000
TOC		FID	Yes	10	0 to 15/30	0-500,000
Ancillary Measurements						
H2O		DOAS	Yes	N/A	0 – 300 g/m3	0-2000
O2		Zirconia	Yes	N/A	0 – 25 %	0 – 25 %
Temperature		Thermocouple	N/A	N/A	N/A	0 to 1200oC
Pressure		Dynamic pressure	N/A	N/A	N/A	0-2000

To cater for individual applications, a number of options are available such as outdoor weatherproof analyser housings and air conditioned 19” rack cabinets to suit the site conditions and requirements.

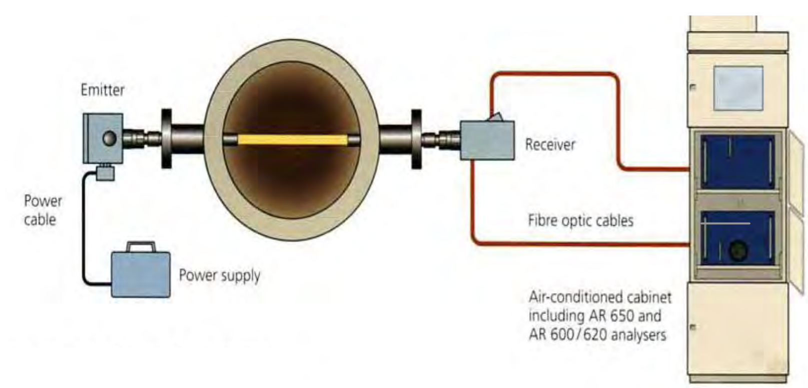
Each analyser used in the CEMS system is fully accredited with MCERTS and/ or TUV certification to the standards required under WID and BS:EN14181



The Opsis Gas Analysers
Accreditation: MCERTS & TUV

The Opsis system includes one or more light paths crossing the stacks or ducts depending on application. In each path, light is projected from an emitter to a receiver. The light is then transmitted to the Opsis analyser via a fibre optic cable. Using Beer Lambert's Law, the analyser then detects and measures compound concentrations specified in the system software and logs data to a hard disk, both on a local hard drive and the remote PC. This computer may act as a real-time display or, when required, run a data presentation and reporting software.

The Opsis analyser can also accept continuous data from sensors monitoring process variables such as temperature, pressure and flow (4 to 20 mA or digital input). This, combined with the system's ability to provide alarm outputs and/or interface with other plant systems via serial communication, allows Opsis to operate as a process control system. Integrating sensor and measurement data in Opsis software also allows the automatic calculation and generation of reports meeting legislative requirements.



This diagram shows the 19" rack mounted AR600 and AR650 analysers connected to the emitter / receiver unit on the stack and the signal light transmitted to the analysers through fibre optic cable. ***No stack gas or other influences are ever in contact with the analyser, ensuring maximum reliability and long maintenance intervals***.

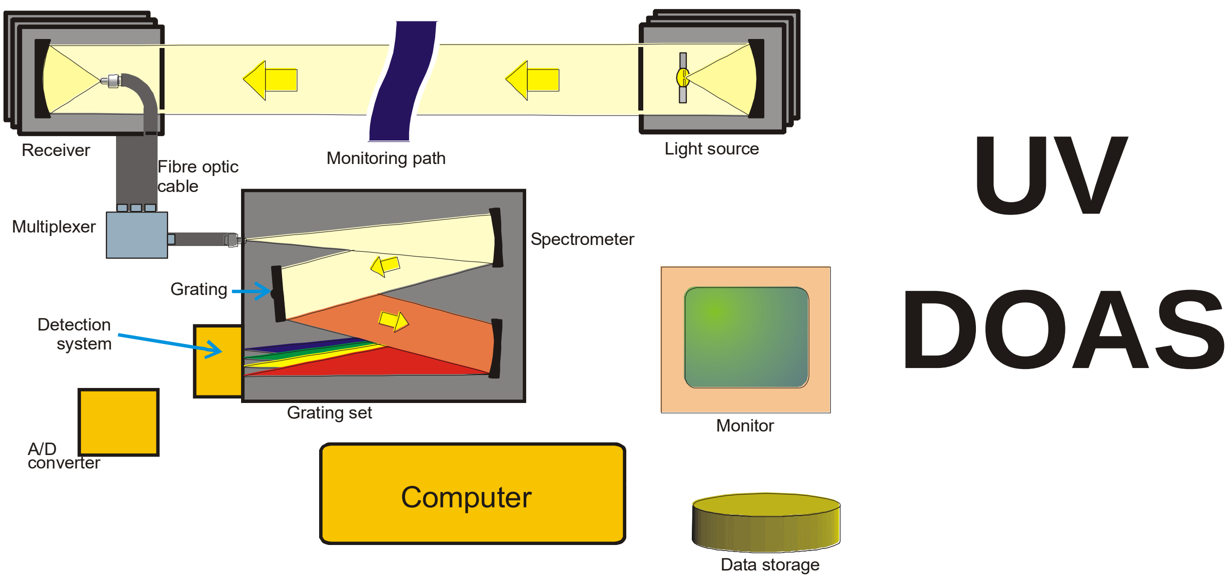
OPSIS DOAS UV Technique

The basis of the principle used by Opsis to identify and measure concentrations of different gases is scientifically well established: Differential Optical Absorption Spectroscopy (DOAS), which is based on Beer-Lambert's absorption law. It states the relationship between the quantity of light absorbed and the number of molecules in the light path.

Because every type of molecule, every gas, has its own unique absorption spectrum properties, or "fingerprint", it is possible to identify and determine the concentrations of several different gases in the light path at the same time.

DOAS is based on transferring a beam of light from a special source – a high-pressure xenon lamp – over a known path and then using advanced computer calculations to evaluate and analyse the light losses due to molecular absorption along the path. The light from the xenon lamp is very intense, and includes both the visible spectrum and ultraviolet and infrared wavelengths. The light is captured by a receiver and focussed via an optical fibre to the analyser. The fibre allows the analyser to be installed away from potentially aggressive environments.

The analyser includes a high-quality spectrometer, a computer and associated control circuits. The spectrometer splits the light into narrow wavelength bands using an optical grating. This can be adjusted so that an optimum range of wavelengths is detected.

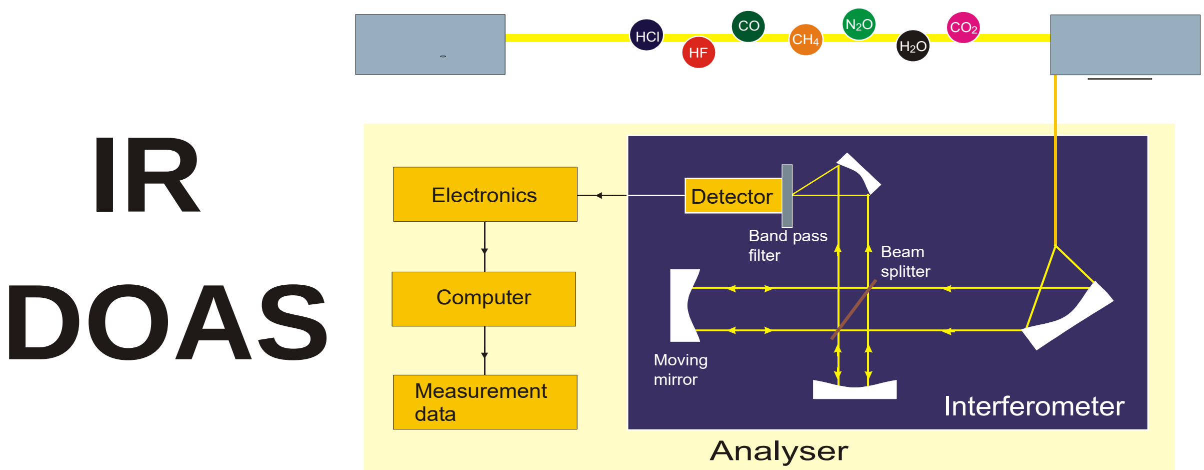


The light is transformed into electrical signals. A narrow slit sweeps past the detector at high speed, and a large number of instantaneous values are built up to form a picture of the spectrum in the relevant wavelength range. This scan is repeated 100 hundred times a second, and the registered spectra are accumulated in the computer's memory while awaiting evaluation.
Evaluation is carried out for one wavelength range at a time. It works by comparing absorption curves. The absorption spectrum recorded from the light path is compared with one calculated by the computer. The calculated spectrum consists of a well-balanced summation of the reference spectra for the analysis concerned.

The computer proceeds by varying the size factors for each reference spectrum until it reaches the best possible match. From this the different gas concentrations can be calculated with high accuracy.

OPSIS DOAS IR Technique

Opsis has developed an analyser for monitoring compounds specifically in the infra-red wavelength range area. The Opsis IR technique is based on the same method for identifying and measuring concentrations of various compounds as the comprehensive Opsis spectrometer technique, described on the previous page.
The IR technique is also based on Beer-Lambert's absorption law, which states the relationship between the quantity of light absorbed and the number of molecules in the light path. A light source projects a light beam through the stack gas and onto a receiver, which transfers the light via an optical fibre to the analyser.
The analyser includes an interferometer, a computer and control circuit cards. The interferometer consists of a beam splitter, which divides the light towards two moving mirrors. By varying the position of the mirrors, an interference pattern is formed. This technique is identical to that used in an FTIR (Fourier Transform Infra-Red) analyser.



By using advanced computer calculations, the interference pattern is transformed into a wavelength spectrum, corresponding to the spectrum, which is measured in the Opsis spectrometer.
A band pass filter limits the spectral area, which facilitates the evaluation of the spectrum.
The interferometer gives higher spectral resolution in the infrared wavelength range than the spectrometer does.
The evaluation is carried out, as is the case for the spectrometer, for one wavelength range at a time, by comparing absorption curves (references) to the absorption spectrum just registered.

The computer proceeds by varying the size factors for each reference spectrum until it reaches the best possible match. From this the different gas concentrations can be calculated with high accuracy.

What happens in the computer?

Once the data has been collected, the raw spectrum is stored in the computer's memory.

First the raw spectrum is compared with a zero-gas spectrum. This has previously been taken and stored with no absorption gases present and is used as a system reference.

After division by the zero-gas spectrum, the total light absorption between the transmitter and the receiver is obtained. The gases of interest cause absorptions, as do other influences such as dust in the stack gas and dirt on the optics. The task now is to separate the light absorption of the gases from other influence.

To do this, the system takes advantage of the fact that only gas molecules will cause rapid variations in the absorption spectrum. The slow variations, which give rise to the gradient on the absorption curve, result from a large number of known and unknown factors. Their influence can be eliminated completely by mathematically matching a curve which does not follow the rapid variations in the spectrum.

After a new division, all that remains are the rapid variations. For the remaining calculations, the logarithm of the curve is taken, which turns the curve upside down. A differential absorption spectrum has now been obtained. This spectrum is a combination of the various gases present between the transmitter and the receiver at the moment of detection. In the example this is called Z.

The gases that absorb light in this wavelength range are already known, and a pre-recorded reference spectrum for each gas is stored in the computer's memory. In this example there are only two gases, called X1 and X2. The task is to determine the proportions of X1 and X2 that combine to give the best match for Z. The system achieves this by very rapidly creating a new curve out of the sum of the two reference spectra, varying values until the best correspondence is achieved.

The equation the computer uses can be expressed as $C1X1 + C2X2 = Z$, where C1 and C2 are the proportions of each gas. From C1 and C2 it is then possible to calculate the current concentrations.

Finally, the result is checked by determining the difference between the measured and the calculated curves. This means that every measurement result can be stated with a standard deviation.
The more reference curves stored in the computer's memory, the more accurate the result of the calculation will be. However, even if there should be some unknown interference, i.e. when the measurements are affected by a gas whose reference spectrum is not stored in the computer's memory, the computer nevertheless evaluates the gases it is programmed for. The influence of the unknown gas is presented as an increase in the standard deviation in the measurement result.

Total Hydrocarbons (VOC)

Thermo-FID model ES

Accreditation: MCERTS & TUV

The Thermo-FID ES measures Organic Carbon components from high range (LEL) to very low range (ppm).

The need for routine maintenance, e.g. sample filter change, can be indicated by using the status and remote control functions of the FID.
All gas fittings, signal and main power connections are located at the bottom of the instrument rack.

Application Note:
The sample pressure conditions at the take-off point should be between 750 and 1600 mbar abs.
Utility gas supplies such as Hydrogen, Span gas and Instrument Air are required.
The Instrument air supply must be oil & water free with minimum dew point at –25°C (-4°F) and should be supplied @ 4 bar.

Oxygen Accreditation: MCERTS & TUV

The Opsis O_{2000} Oxygen Analyser is especially designed for continuous monitoring on industrial and process applications. The Zirconia in-situ probe mounts in the stack or duct by means of a 3" BSP socket welded to the stack and comprises of a 316 stainless steel probe casing housing the zirconia sensor, heater element and filter assembly. The mounting arrangement comprises a 3" BSP screwed nut and locking ring which allows for fixing to the stack and adjustment to the insertion length of the probe. A junction head and fittings for connection of reference air and calibration gas completes the assembly. A 10 metre long combined signal and power cable is supplied as standard to connect the Zirconia probe assembly to the O_{2000} analyser and control unit. The analyser contains an embedded micro processor for fast and easy operation with the 4 user friendly touch pads. A 2 x 20 characters LCD display with backlight is included for oxygen readings and set up information.
Two versions are available - standard, that is suitable for gas streams up to 500 ^{O}C and High Temperature that is suitable for gas streams up to 1800 ^{O}C. The high temperature assembly supplied with this unit requires a flanged stub and a compressed air supply for applications with a negative pressure in the stack or duct to be measured.

Analyser O_{2000}
Technical Specifications

Measuring range	0.01–25.0% O_2
Accuracy	O_2<10.0% ± 0.01% at 2% O_2, O_2≥10.0% ± 0.1%
Linearity	<0.5% FS
Lag time	<2 sec.
Response time	<5 sec.
Warm-up time	<30 min.
Power supply	100–240 V_{AC} 50–60 Hz
Power consumption	<100 VA warm up, <50 VA steady state
Max. load, analogue output	500 Ω
Max. load, relay contacts	220 V_{AC} 5 Amp.
Max. ambient temperature	0–50°C
Max. humidity	90% RH
Enclosure	IP 65 Steelbox
Dimensions old (H × W × D)	400 × 300 × 210 mm
Dimensions new (H × W × D)	300 × 380 × 210 mm
Weight	10 kg

Probe
Technical Specifications

Max. stack gas temperature	500°C
Sensor type	ZrO_2 (Zirconia)
Material	AISI 316 Stainless steel
Mounting	3" Withworth pipe thread DIN ISO 228
Total length	730 mm
Insert length	Variable 200–500 mm (EPL 1500 max. insert length 1500 mm)
Cable length	Maximum 10 m, without stack unit
Weight	4 kg

High Temperature Probe

Other key features are:

- Built-in self-checks and diagnostics
- Built-in reference pump

Weatherproof Analyser Enclosure

A GRP weatherproof, air conditioned enclosure is normally required to house the gas analysers, dust meter evaluation units, flowmeter evaluation unit and other equipment as necessary. This enclosure will be complete with a lockable door for security and ease of maintenance. The enclosure is normally finished in green. Other colours are available at extra cost. ETS will normally build the house with equipment mounted at our works for inspection and testing purposes and then partially disassemble it for transport to site.

Size Options

A number of different sized enclosures are available to suit different installations. We are always happy to provide custom designs to suit individual site requirements. Some standard options available from ETS are :-

PR10 – 2m x 1.2m x 2.3m (h)
This is the preferred option for CEMS projects as it enables engineers and customer staff to stand inside the enclosure to work on or inspect the system

PR7 – 2m x 0.8m x 1.6m (h)
This smaller unit is ideal for locations with limited space, and is the smallest house size that should normally be located outdoors

PR5 – 1.5m x 0.85m x 1.5m (h)
This is the smallest unit that can accommodate the CEMS analysers, but is not ideal as the equipment is mounted at a low level and is harder to work on when service is required.