



Beijing United Sterling Trading Company.

**TECHNICAL DESCRIPTION
OF THE
LAB-IMPEX
PARTICULATE, IODINE AND NOBLE GAS MONITORING
SYSTEM (P.I.G)**



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1 SYSTEM DESCRIPTION

The system monitors stack air for the presence of Alpha and Beta particulates, Iodine 131 and Noble gasses. A sample of air is drawn from the stack; it passes through a series of detectors and is returned back into the stack for atmospheric release.

The system comprises:

- CMS2000CAB+ Beta Monitor with CMS2000RS remote detector head.
- CMS1L10 Monitor
- Iodine 131 stand with:
 - Lead shielded scintillation detector with temperature sensor
 - Three Channel Analyser (TCA)
 - Universal Detector Interface (UDI)
 - External Flow Monitor (EFM)
- Noble Gas stand with :
 - Lead shielded scintillation detector
 - Universal Detector Interface (UDI)
 - Variable Aperture (VA) flow Meter with flow control valve
 - Flow Control Valve for Alpha, Beta and Iodine gas flow
 - Vacuum pump
- Service Valves
- Differential Pressure Gauges
- Shrouded Probe
- Return Probe
- Mains Isolator

Gasses are taken from the stack by a shrouded probe and piped to a service valve attached to the CMS2000RS remote detector head.



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The stack sample passes through a replaceable filter card which is mounted in a special holder on the CMS2000RS remote head. Alpha and Beta particulates are trapped on the filter card, where they are monitored by a high-resolution solid-state detector. A second solid-state detector enables the CMS2000CAB+ to compensate for background gamma radiation. A differential pressure gauge mounted across the remote head provides a visual indication of any blockage.

The stack sample then passes through a service valve and into the Iodine detector. The Iodine detector has a replaceable cartridge that is used to collect gaseous iodine compounds. Iodine is detected using a temperature compensated scintillation detector. Temperature compensation is used to ensure that the detector response remains stable and the energy spectrum does not shift with temperature. A ring sensor fitted around the detector feeds temperature information via the TCA to the CMS-1L10. The CMS-1L10 then sends a compensation signal to the UDI which in turn adjusts the high voltage to the detector. The UDI generates the high voltage supply for the detector and interfaces the detector pulses to the CMS-1L10. A differential pressure gauge mounted across the Iodine detector provides a visual indication of any blockage.

The stack sample then passes through an External Flow Monitor (EFM) and a service valve. The CMS-1L10 monitors the flow rate signal from the EFM and warns of high or low flow rates.

The stack sample then passes through a service valve and the pipe work splits into two branches. This enables the Noble Gas detector to operate at a lower flow rate than the other detectors.

One branch carries a flow control valve which sets the flow through the CMS2000RS remote head and Iodine stand, the other branch connects into the Noble Gas detector. Noble Gases are detected by a scintillation detector which is interfaced to the CMS-1L10 via a UDI. The UDI generates the high voltage supply for the detector and interfaces the detector pulses to the CMS-1L10. A differential pressure gauge mounted across the Noble Gas detector provides a visual indication of any blockage.

The stack sample then passes through a Variable Aperture (VA) flow meter with built in flow control valve and float detector. The CMS-1L10 monitors the signal from float detector and warns of low flow rates.

Pipe work then joins the two branches and feeds them into the vacuum pump which draws the sample through the system. The outlet from the vacuum pump passes through a service valve and is returned to the stack via pipe work and a return Probe.

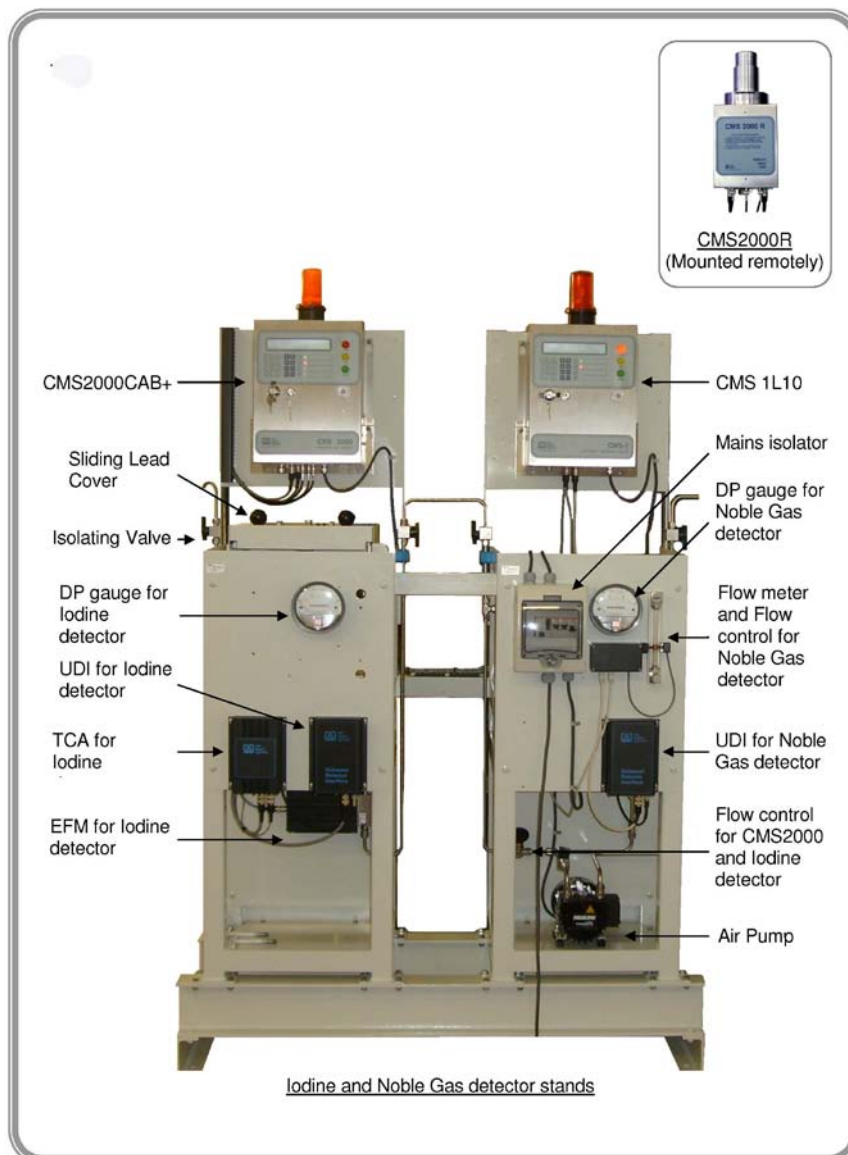


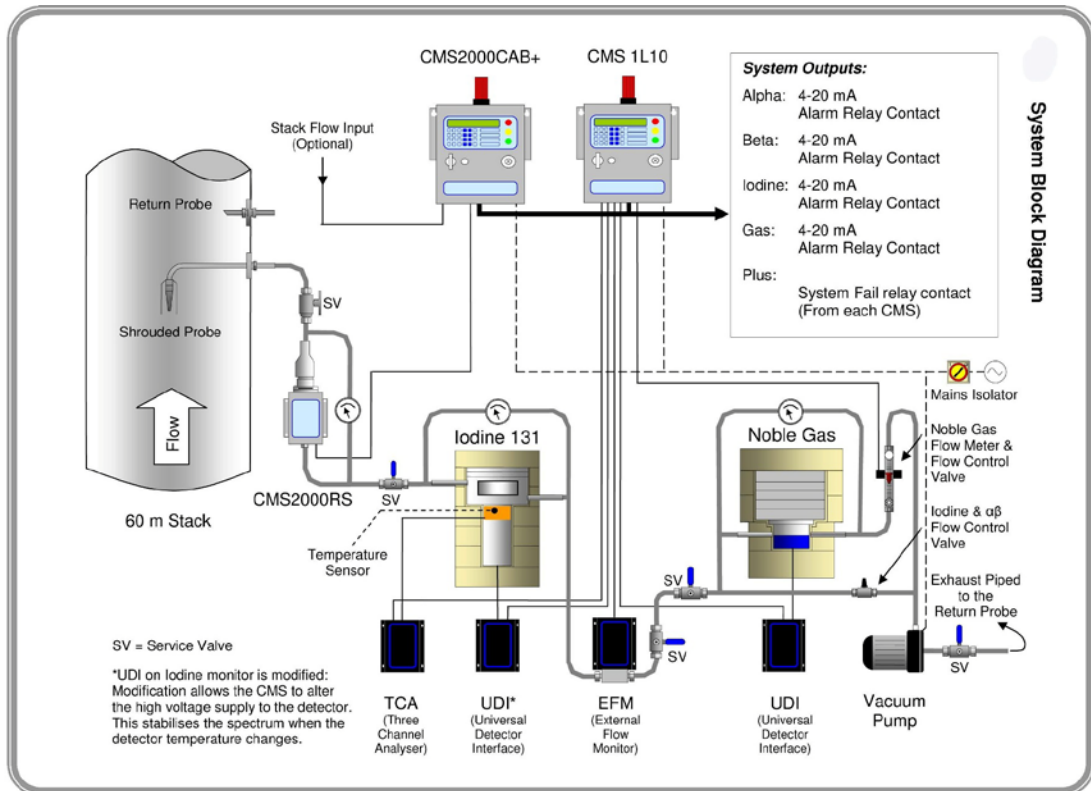
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The Iodine 131 and Noble gas detector stands are joined together and mounted on a skid. Also mounted on this assembly are the CMS2000CAB+, CMS-1L10 and a mains isolator. The CMS2000RS detector head and its service valve will be mounted on a wall closer to the stack.



Each CMS continuously monitors the count rates from the detectors, calculates and displays activity concentration and provides programmable alarm levels for each detector channel. Measurement data is stored in the CMS and it can be transferred to an external computer using Lab Impex DAS software.





System Block Diagram

2 DESCRIPTION OF SYSTEM COMPONENTS

The following descriptions outline the functions of each component.

2.1 Alpha-Beta Particulate Monitoring

The proposed Alpha-Beta Particulate Monitor, the CMS2000AB+ comprises of two modules a CMS2000 Remote Head and a CMS2000 Controller. Both modules are wall mountable.

2.1.1 CMS2000 Remote Head:

The use of the Remote Head allows the detection part of the system to be mounted as close to the sample collection point as possible and in an orientation that minimizes the number of bends in the sample line.

The Remote Head is fitted with two 450mm rugged ion implanted silicon detector. One detector is used for measurement of alpha-beta emissions from the filter, the second for dynamic compensation of gamma background.



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The Remote Head holds a card mounted filter paper*. The paper has an active area of 25 mm. During filter exchange a release button is pressed which releases the filter card from its air tight seal, and signals the CMS2000 controller that the filter card has been removed.

*Optionally, a moving filter is available from LIS. However, in our experience, a fixed filter system is normally the preference, in order to allow laboratory analysis of the filter after sampling.

Valves either side of the remote head allow the item to be isolated. The main isolation valve (upstream of the remote head) will be fitted with compression fittings for mating with a 25 mm OD ss. sample line. If this is not suitable for the installation, alternative fittings may be supplied. Downstream of the remote head, smaller bore stainless steel pipe will make the connection to the Iodine sensor. The supply and installation of this pipe will be made by LIS engineers.

2.1.2 The CMS2000 Controller:

The CMS2000 Controller processes the signal from the Remote Head.

The front panel of the CMS2000 Controller comprises a large 40 character liquid crystal display, tactile keypad, three multi element alarm LED's and operator key switch.

The LCD provides a continually updating display of measured values. By using the dedicated "arrow keys", the user may scroll the display to any of the counting channels, which offer the latest measurement of Beta concentration (in Bq/m³, pCi/ml or any other engineering unit) and integrated filter counts (cpm etc.). All system parameters used to select alarm levels, time constants etc., are held in secure non volatile memory to ensure system integrity is maintained in the event of power failure or out of service periods.



Once set to work, the majority of internal working parameters will not require reprogramming. Intermittent calibration procedures however may require the Supervisor to modify conversion factor parameters. In normal operation all working parameters are totally protected by two levels of parameter protection. These are:



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- 1) A physical key switch on the front panel. To enable the CMS2000 Controller keypad, the supervisor key must be inserted and turned.
- 2) Then, to enter parameter mode, a function key needs to be pressed and a five digit passcode entered.

This ensures that only authorised staff or competent engineers have access to critical working parameters.

The CMS2000 Controller has three alarm levels per detection channel. These are detection failure, activity alert level and activity alarm level. All alarm thresholds are user programmable parameters that may be set, according to requirements, at any point within the range of detection.

The three front panel 20 mm LED's are used to indicate high activity, alert and failure states. Each multi element LED when active is clearly visible from 15m (45 feet). High activity alarms are further indicated by a top mounted high intensity strobe and 80 dB acoustic sounder.

All alarms may be latched or unlatched, and can be accepted and muted (dependant on status) by authorised staff via the keypad.

The CMS Controller has a “watchdog” timer that ensures the correct operation of the processor and hardware at all times. The watchdog timer is repeatedly retriggered by a pulse from the processor during normal operation and does not normally time out. In the unlikely event time out does occur, the CMS can be programmed to either reset, generate an alarm, or reset and alarm.

To safeguard result data, the CMS-Controller possesses a FIFO buffer that retains a result measurement every 10 minutes during normal operation and every 2 minutes during alarm conditions. The contents of the buffer data may be transmitted at any time to a PC running CMS-DAS or the 9205 Data Management System.

2.2 Iodine Monitoring

The detector and measurement chamber used for radioiodine detection is known as the CGADC (Continuous Gas Analysis and Detection Chamber). The CGADC consists of an opening lid, detection chamber, membrane, detection crystal and photomultiplier tube. Inlet and outlet pipes are located in the side of the detector body.



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The CGADC measurement chamber is a precision-engineered assembly with 200 ml active volume. For Iodine 131 detection the sample is routed through an absorbent canister (Silver zeolite or charcoal) placed in the chamber. A NaI (tl) scintillation crystal (specifically optimised for the I-131 photopeak) views the counts originating from the absorber. A single channel analyser (SCA) is used to set a thin region of interest around the I-131 photopeak and a second ROI may be used for another area of the spectrum. For added sensitivity and stability, automatic spectrum stabilisation is performed using a thermistor sensor located in the CGADC body.



A four-legged shielding assembly is supplied to house the CGADC.

Each leg is constructed from 50mm x 50mm x 3mm angle iron giving the detector platform a fixed overall height of 700mm. The legs have a cross member, located 250mm from the floor. The cross member supports a 10mm thick shelf which holds the detector and the main body of the lead shielding. The shield assembly consists of a number of cast lead interlocking cylindrical rings. A second cross member and shelf, positioned 100mm from the floor supports a lower shine shield allowing sufficient clearance for cable entry and release.

As standard the shield offers 50mm thick, 4π coverage, minimising background count interference in the CGADC. The whole assembly is supplied bolted onto a skid arrangement together with the other PIG equipment.

The Universal Detector Interface (or UDI) is a small electronics module that provides the high voltage supply to the CGADC and also the necessary amplifier electronics for the detector pulses. For Iodine detection, the UDI operates as a single channel analyser (SCA) with an ROI set around the I-131 photopeak. The UDI continually stabilises the detector spectrum by monitoring the output of the temperature sensor and automatically regulating the gain of the system to fix the I-131 peak in the centre of the ROI.

The EFM flow meter monitors air flow through the system and the result is used to provide an accurate volumetrically derived result (i.e. uCi/cc). The EFM is also used to generate flow alarms for high flow, low flow and pump fail.

After amplification and discrimination pulses are transmitted to the CMS Continuous Monitoring Station.



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2.3 Noble Gas Monitoring

The detector and measurement chamber used for Noble gas detection is known as the BG-10 (Beta Gas Detection Chamber).

The BG-10 comprises a 0.75 litre measurement chamber and plastic scintillation detector. The assembly incorporates a mounting flange into which is fitted a plastic phosphor scintillant and photomultiplier. The BG-10 may be supplied with a mylar window, or in an alternative configuration with a windowless plastic scintillator. This configuration provides added sensitivity, but should only be used for ducts where no corrosives are present.

A four-legged shielding assembly is supplied to house the BG-10.

Each leg is constructed from 50mm x 50mm x 3mm angle iron giving the detector platform a fixed overall height of 700mm. The legs have a cross member, located 250mm from the floor. The cross member supports a 10mm thick shelf which holds the detector and the main body of the lead shielding. The shield assembly consists of a number of cast lead interlocking cylindrical rings. A second cross member and shelf, positioned 100mm from the floor supports a lower shine shield allowing sufficient clearance for cable entry and release.

As standard the shield offers 50mm thick, 4Π coverage, minimising background count interference in the BG-10. The whole assembly is supplied bolted onto a skid arrangement together with the other PIG equipment.

The Universal Detector Interface (or UDI) is a small electronics module that provides the high voltage supply to the BG-10 and also the necessary amplifier electronics for the detector pulses.

For Kr85 detection, the UDI operates as a gross counter with a lower discriminator set at 50 Kev.

After amplification and discrimination pulses are transmitted to the CMS Continuous Monitoring Station.

2.4 Sample Probes

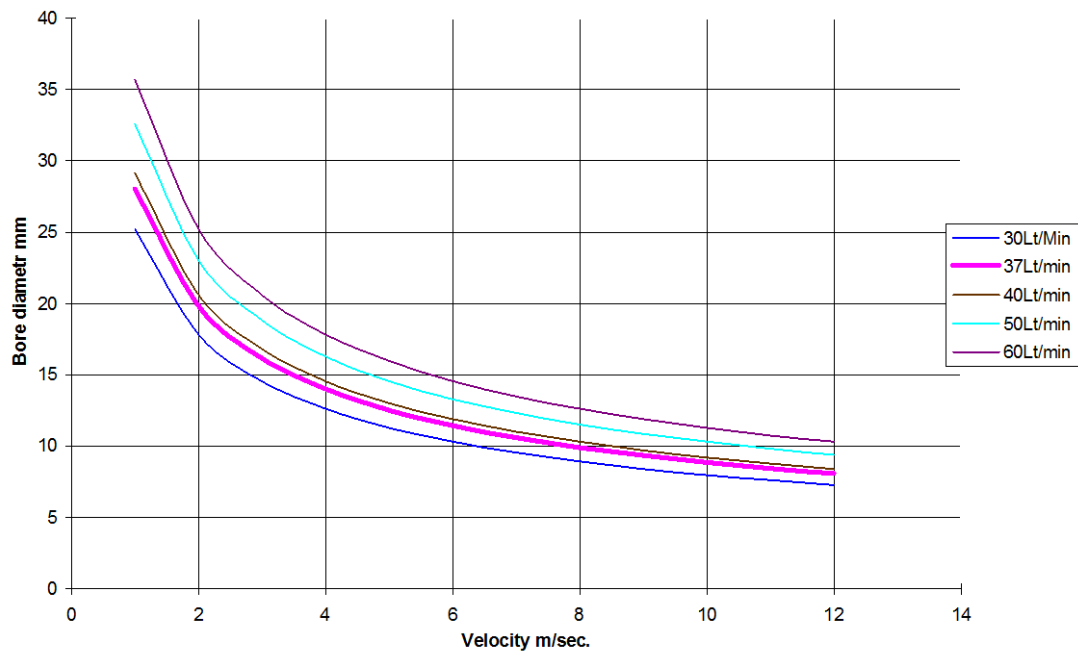
LIS will supply a sample probe and return probe for the duct.

The sample probe can be either isokinetic or shielded and will be designed to ensure that the sample draw off-rate is at same velocity as the stack velocity.



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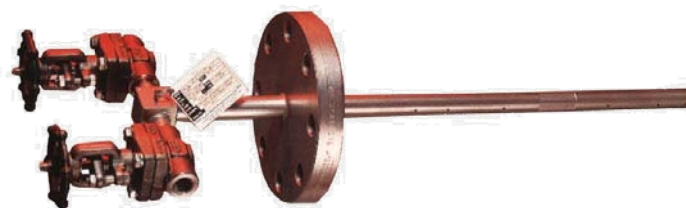
Nozzle Bore / Draw-off Rate



The probe will be of stainless steel construction and comprise nozzle, stack transport line and mounting flange. The probe will be fitted to the stack using Flange type 65 mm PN6 with 75 mm standoff from the stack. The return probe is of 25 mm outer diameter and has a 45 degree chamfered edge. The return probe is fitted to the stack using Flange type 25 mm PN6 with 75 mm standoff from the stack.

2.5 Duct Flow Monitoring

In addition equipment for Duct Flow Monitoring is also available as an option.





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It is proposed that a multi point insertable pitot is used to provide a measurement of volumetric flow. In a typical installation, where the Pitot is located and installed into a straight duct length of 10 hydraulic diameters or more; an accuracy of +/- 5% will be achieved – significantly improving the accuracy achieved from conventional flow meters such as thermal anemometers.



The pitot is a passive device - where the differential pressure produced across the device is related to a Duct flow - and a small local pressure measurement system called the DP2001 is used to monitor and record Duct flow.

The DP2001 differential pressure transmitter provides a continually updating measurement of volumetric flow, which will be normalised to standard conditions (25°C and 760 mm Hg as per ANSI N13.1-1999 paragraph 6.2.2.2). A 5-valve manifold is fitted to the instrument, to allow easy isolation and equalisation of the signal differential pressures. From the DP2001, a 2 wire 4-20 mA output is used to transmit flow to the CMS2000 Controller.

