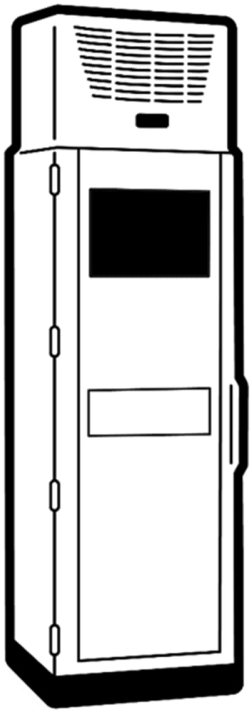
gasmet
A Nederman Company

Continuous Emissions Monitoring System II *e* (CEMS II *e*)

ON-LINE Series

Instruction and Operating Manual



V.E.2.04

Warranty Statement

This warranty applies to the Gasmet brand name products sold with this warranty statement. This warranty is applicable in all countries and may be enforced in any country where Gasmet Technologies Oy or its subsidiaries or its authorized service providers offer warranty service subject to the terms and conditions set forth in this warranty statement. The warranty period varies by product, check the warranty period, if necessary.

Gasmet Technologies Oy and its subsidiaries guarantee that all products manufactured and sold by it are free of defects in materials and workmanship under normal use during the warranty period. The products of Gasmet Technologies Oy and its subsidiaries are manufactured using new materials or new and used materials equivalent to new in performance and reliability. Spare parts may be new or equivalent to new.

Gasmet Technologies Oy and its subsidiaries agree to either replace or repair free of charge (Ex Works Vantaa, Incoterms 2020) any such defective product or part that is returned to its repair facility within one (1) year of the delivery date. All parts or products removed under this warranty become the property of Gasmet Technologies Oy or its subsidiaries. The replacement product or part takes on the warranty status of the removed product or part.

The warranty does not extend to any product from which the serial number has been removed or that has been damaged or rendered defective (a) as a result of accident, misuse, abuse, normal wear of components or other external causes; (b) by operation outside the usage parameters stated in the user documentation that is provided with the product; (c) by the use of parts not manufactured by Gasmet Technologies Oy and its subsidiaries; or (d) by modification or service by anyone other than Gasmet Technologies Oy and its subsidiaries.

Gasmet Technologies Oy and its subsidiaries are not liable for any damages caused by the product or the failure of the product to perform, including any loss of profits or savings, incidental damages, or consequential damages.

Recycling Information

At the end of the product's life cycle, we encourage you to recycle the product in accordance with best local recycling practices. Contact your local authorities for more information on recycling of your old product. You can also contact Gasmet Technologies Oy for advice (contact@gasmet.fi).

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Preface

Thank you for choosing Gasmet, the state-of-the-art FTIR continuous emission monitoring system manufactured by Gasmet Technologies Oy. Gasmet is a high-technology product made of high-quality components.

The substantial investment of Gasmet Technologies Oy in R & D is targeted at innovative, customer-driven solutions. Working closely with customers and global distribution network, the company offers extensive technical applications support services. Along with high reliability, the products of Gasmet Technologies Oy offer easy operation and consistent and accurate results, together with competitive pricing.

The development of the powerful technology of FTIR has required uncompromising commitment and expertise in several fields of high technology. As a result, the products of Gasmet Technologies Oy are not only superior in performance, but also simple to operate and maintain. The continuing philosophy of Gasmet Technologies Oy is to provide reliable measurements in a variety of industrial applications now and in the future.

Wherever you are and whatever your applications are, we hope you will find the Gasmet gas analyzer and its appliances fast, accurate, reliable, and easy to use.

1. Gasmet CEMS II *e* Overview

1.1. Basic Structure

The Gasmet CEMS II *e* is especially designed for continuous emissions monitoring (CEM) and for continuous process monitoring. Typical application is measurement of H_2O, CO_2, CO, N_2O, NO, NO_2, SO_2, HCl, HF, NH_3, CH_4, C_2H_6, C_3H_8, C_2H_4 and CH_2O. The Gasmet CEMS II *e* can be easily configured for new set of gases. Measured components and calibration ranges can be changed according to application.

The Gasmet CEMS II *e* is designed for on-line measurements of trace concentrations of pollutants in wet, corrosive gas streams. Depending on version, all sample-wetted parts of the Gasmet CEMS II e are temperature regulated to 180 ºC. No dilution or water removal is needed. Thus, Gasmet CEMS II *e* measures always-representative sample gases as well as so-called 'difficult gases' (NH_3, HCl, HF, SO_3, etc.).

The Gasmet CEMS II *e* consists of Gasmet FTIR gas analyzer, the Gasmet industrial computer, and the Gasmet sampling system. As an option, the system can be equipped with Gasmet oxygen analyzer and/or total hydrocarbon analyzer (GFID). All parts of the system are 19” rack mounted and are installed on pullout shelves. The Gasmet CEMS II *e* includes all power connections and temperature controllers for heated lines and heated sample probe.

The Gasmet industrial computer and Calcmet application software control CEMS II *e* (Figure 1). The measuring data can be transferred from the computer to control room with fieldbus or with analogue outputs 4 - 20 mA. The status signals are transferred with relay outputs. ‘System error’ signal indicates that the system does not operate properly. When the ‘Service request’ signal is activated, a service technician's attention is required at the CEMS II *e*. ‘Results valid’ signal indicates that analyzed results are valid. ‘Maintenance’ signal indicates that a service technician is at the CEMS II *e* performing a maintenance and/or repair task. ‘Maintenance’ signal is also activated during automatic operations such as background, and span check measurements.

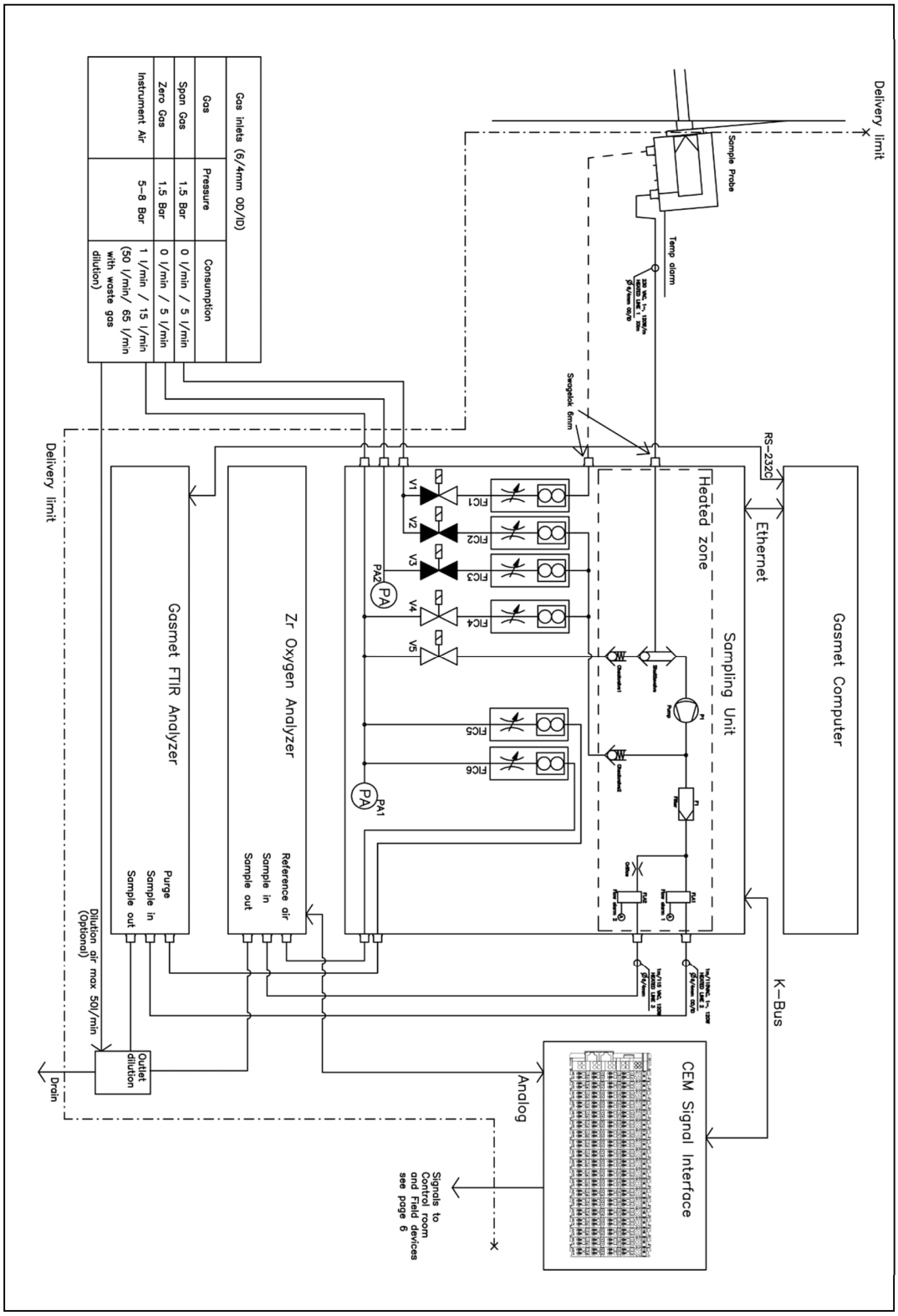


Figure 1. Gasmet CEMS II e drawing. For a more detailed drawing, please look at the Gasmet USB flash drive delivered with your system.

In Figure 2 and Figure 3, the components of the Gasmet CEMS II e A and B systems, respectively, are displayed:

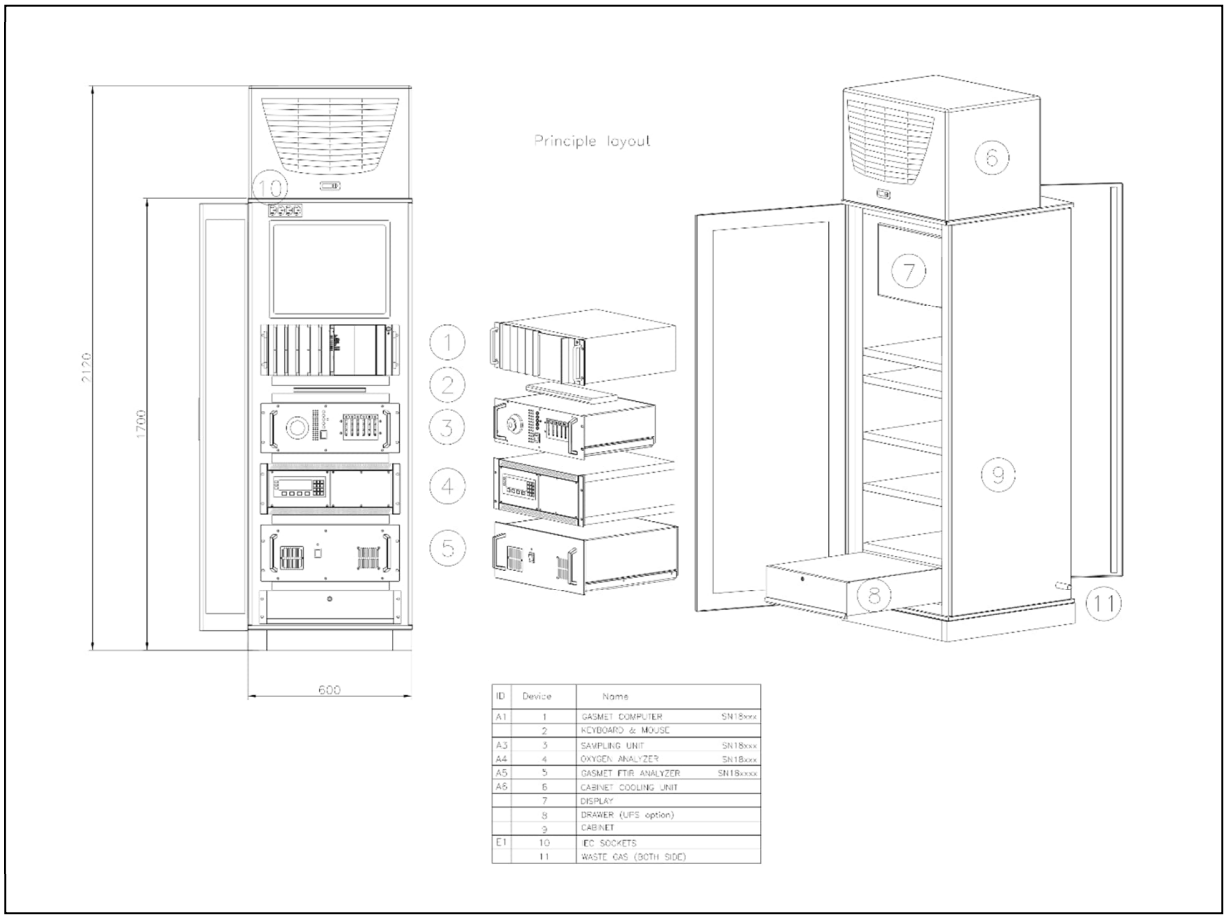
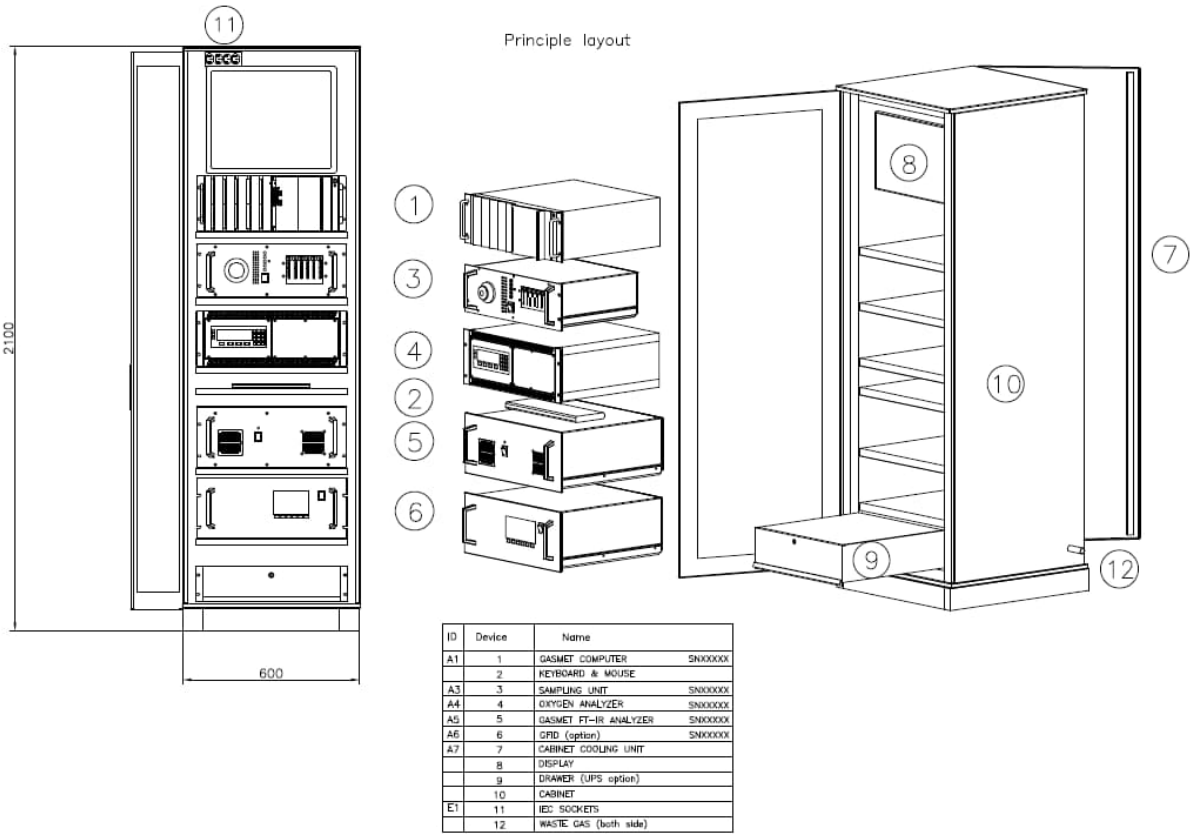


Figure 2. Gasmet CEMS II e A system structure.



ID	Device	Name	
A1	1	GASMET COMPUTER	SNXXXXX
	2	KEYBOARD & MOUSE	
A3	3	SAMPLING UNIT	SNXXXXX
A4	4	OXYGEN ANALYZER	SNXXXXX
A5	5	GASMET FT-IR ANALYZER	SNXXXXX
A6	6	GRID (option)	SNXXXXX
A7	7	CABINET COOLING UNIT	
	8	DISPLAY	
	9	DRAWER (UPS option)	
	10	CABINET	
E1	11	IEC SOCKETS	
	12	WASTE GAS (both side)	

Figure 3. Gasmet CEMS II e B system structure.

All electrical and signal connections are on the back side of the analyzer cabinet on a connector plate.

The heated sample gas line, all power and signal cables are directed into the cabinet either through the top or the bottom of the cabinet. But usually, the heated sample line is directed into the cabinet through the top of the cabinet.

1.2. Gasmet CEMS II *e* Technical Data

This part includes general technical data of Gasmet CEMS II *e*. A more detailed technical data can be found from the individual operating manuals and data sheets.

System specifications

General Parameters	Measuring principle:	FTIR (Fourier Transform Infrared) spectroscopy
	Performance:	Simultaneous analysis of up to 50 gas components
	Operating temperature:	0…40 °C non-condensing / certified for +5…40 °C
	Storage temperature:	-20 - +60 °C
	Response time, T_{90}:	< 120 s with 20-meter heated line
	Sample-wetted parts regulated temperature:	180 °C
	Sample gas:	Non-condensing, particle free
	Flow rate:	~ 4 l/min
	Sample gas pressure:	Ambient
	Installation place:	Dust free and clean ambient air, without external vibrations
	Product compliance:	CE, UKCA
Analyzer Cabinet	Material:	Bake painted steel
	Dimensions without door handles (mm):	**Cabinet A** (H x W x D): 2120 x 600 x 600 (A/C unit on the cabinet roof) **Cabinet B** (H x W x D): 2100 x 600 x 800 (A/C unit at the back of the cabinet) Depth with backdoor A/C unit: +260 mm
	Weight:	~290 kg (A), ~330 kg (B)
	Protection:	IP 54
Air conditioning	Cooling capacity (A cabinet):	A35 °C / A35°C 1500 W A50 °C / A35°C 1100 W

	Cooling capacity (B cabinet):	A35 °C / A35°C 1500 W A50 °C / A35°C 1230 W
	Power consumption (A cabinet):	1050 W
	Power consumption (B cabinet):	1125 W
	Internal circulation:	500 m^3/h
	Protection:	Ext. circuit IP 34 / Int. circuit IP54
Instrument air	**Instrument air inlet:**	6 mm tube
	Instrument air quality:	Dry, oil and particle free
	Consumption:	1 l/min with continuous instrument purge, 15 l/min with safety flushing (error mode), 50 l/min with waste gas dilution(optional)
Electrical connections	**Main power supply:**	The main power supply system model is TN-S (3 x L, N + PE).
	Power consumption:	Depends on the length of the heated sample line. The full Gasmet CEMS II e including sample probe and heated line (21 m) it is max. 7.5 kW while heating up
Signal interface	**Hardwired signals**	
	Analog output:	
	Output range:	4 - 20 mA, isolated, active
	Channels:	16 freely programmable
	Analog input:	
	Input range:	4 - 20 mA, isolated, passive
	Channels:	8 freely programmable
	Digital output:	
	Output range:	24 VDC
	Channels:	15 freely programmable
	Digital input:	
	Control:	By potential free contacts
	Channels:	16 freely programmable

	Alarm output: Output range: Potentially free relay contact Channels: 4 fixed: System alarm, Service Request, Maintenance, Results Valid More digital and analog signals available upon request. **<u>Bus Output</u>** Output format: Modbus RTU, ASCII (RS 232), DDE link Modbus RTU can be converted into TCP/IP, Profibus or RS422/485. Other fieldbus formats are available on request
Industrial computer	*See Gasmet Industrial Computer Technical Datasheet*
Gasmet CX4000 FTIR Analyzer	*See Gasmet CX4000 Technical Datasheet*
Oxygen Analyzer (Optional)	*See Gasmet Oxygen Analyzer Technical Datasheet*
GFID Analyzer (Optional / Only in CEMS II ef version)	The Gasmet Flame Ionization Detector (GFID) is designed for continuous total hydrocarbon (THC) measurements. Gasmet Continuous Emission Monitoring System CEMS ll ef is equipped with GFID analyzer, offering a TÜV certified solution (QAL1) for measuring pollutants from hot, wet and corrosive gas streams. *For more information please see Gasmet GFID Analyzer Technical Datasheet*

2. Delivery

Gasmet CEMS II *e* can be shipped either by air cargo or by land. The system is transported either in vertical position, where all components are inside the cabinet, excluding the analyzer, which is always packed separately in a plywood box (standard) or in horizontal position, where all components are packed separately in plywood boxes (optional, additional charge). Horizontal packing is especially recommended for air cargo.

2.1. Package

In case horizontal shipment is chosen, the Gasmet CEMS II *e* is shipped in several plywood boxes. To open a box, first open the lid of the box. Remove any additional smaller items on the top of the contents. Finally, lift the contents out of the box.

All gas fittings are closed with caps in order to prevent contamination by dirt and dust. Please do not remove caps until you connect the sample gas lines.

Gasmet FTIR gas analyzer plywood box includes all important documents and Gasmet USB flash memory, which are recommended to keep in safe place. Please keep one box in store in case for the service delivery back to Gasmet Technologies Oy.

2.2. Contents of the Gasmet CEMS II *e* Delivery

The Gasmet CEMS II *e* delivery contains following parts:

1. Analyzer cabinet with air conditioning unit and electrical connector plate
2. Gasmet FTIR gas analyzer
3. Gasmet sampling unit
4. Gasmet industrial computer
5. Oxygen analyzer (optional)
6. Display and Scandinavian keyboard with touchpad mouse
7. Sample probe (optional)
8. Heated sample lines (lengths according to the application)
9. Gasmet USB flash memory (relevant documentation)
10. Accessories
    a. Mains and signal cables inside the cabinet
    b. Filters and o-rings for the sampling unit

Please check the delivery carefully and inform supplier as soon as possible, if any part of the delivery is missing or damaged.

2.3. Storing and Transporting

All parts of the Gasmet CEMS II *e* must be stored, installed, and operated in a **dry and frost-free** place, especially **FTIR analyzer** and **industrial computer**. It is essential to avoid sample condensation and adsorption effects within the analyzer and Industrial computer. The environment should be clean enough so that no dirt will accumulate inside the instrument enclosures. Store the equipment in following conditions:

- 0 - 60 °C storage temperature
- 0 - 95 % relative humidity, **non-condensing**

None of the individual instruments of Gasmet CEMS II *e* should be exposed to strong mechanical vibration or shocks. Shocks during transport, for example, can cause serious damage. When transporting the instruments, use the original boxes with original shock absorbing materials.

3. Installation

3.1. Probe (e.g. M&C TechGroup's standard probe SP2000-H)

A complete gas sample probe consists of the heated filter part and a sample tube or prefilter. The filter housing with its all-round heating element (number 1 in Figure 4) forms a unit with the standard mounting flange DN65 PN6 (2) and the laterally mounted electrical connection box (3).

The heat-insulated cover (5) is mounted on the stainless-steel angled sheet (4) which is mounted on the mounting flange. It is secured with two pressure clamps. The cover ensures a uniform distribution of heat over the probe heater and at the same time serves as protection against weather and accidental contact.

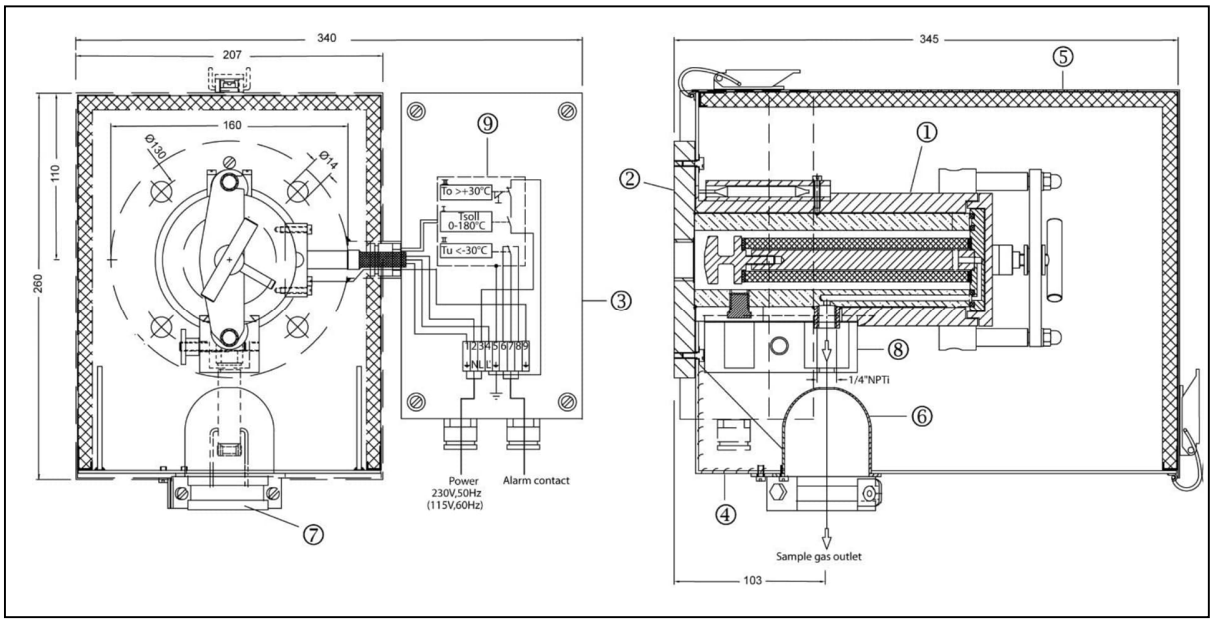


Figure 4. Basic structure of the SP2000-H sample probe.

The connecting clamp (7) for attaching heated sample lines with external dimensions of between 40 mm and 50 mm is located at the aperture on the underside of the angle sheet, which is closed with a silicon lid (6). The clamp is mounted on an adjustable mounting bracket which allows adjustment for various sample line diameters.

The standard probe's sample gas outlet connection has a ¼" NPT internal thread to which the customer must connect a suitable size of temperature resistant and threaded connector to connect the sample line in a gas tight manner. Probe is delivered together with a 6mm Swagelok connector, that fits the heated sample line's 4/6 mm tube.

After the threaded pipe connector and sample line have been mounted, the sample gas outlet connection is enclosed in special heat-conducting jaws (8) in order to avoid temperature failures in the critical connection areas. The size of the heat-conducting jaws allows connection joints up to an external pipe dimension of 10 mm.

The stack coupling of the probe must be ready before the delivery. The size of the probe is approximately 340 x 260 x 345 mm (length x height x depth) and the weight about 17 kg (Figure 4). The flange is of the type DN65PN6. Please see more details from the M&C SP2000-H Mounting Flange DN65PN6 manual.

3.1.1. Installation Location

The distance between the inner stack and the probe coupling is 100 – 200 mm and it should be insulated. The flange should be installed approximately 5 degrees downwards from the stack (Figure 5). The heated line is installed downwards from the probe.

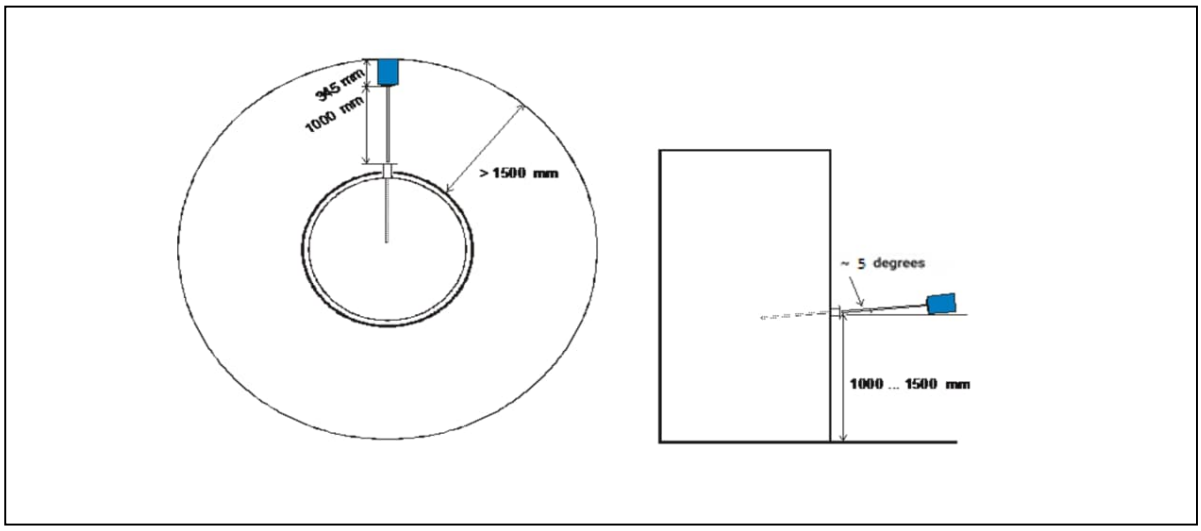


Figure 5. Minimum space requirements for accessing the probe (1000 mm tube).

3.1.2. Mechanical Installation

Screw either the probe tube or prefilter with thread G3/4” directly or using an extension tube with the ¾" flat gasket into the ¾" inner thread of the flange of the probe and tighten. Insert sample tube or prefilter of the complete probe unit into the connection piece and screw probe at the connection piece using the screws, spring rings and nuts supplied.

3.1.3. Electrical Installation

Remove the lid of the terminal block. The electrical connection layout is shown on the lid. Insert the mains cable (minimum is 3 x 1.5 mm²) through the cable gland and connect to the appropriate terminals. Insert the alarm signal cable through the treaded cable connection and connect to the appropriate terminals (polarity free). Install the lid.

Pin	Function	Electrical wire color
1	PE	Yellow/green
2	N	Blue
3	L	Brown
7	Alarm	Black
8	Alarm	Black

3.1.4. Span Line Connection (option)

Span gas connector is situated under heat-conducting straps towards the flange. A Teflon tube (diameter is 6 mm, comes from the cabinet) is connected to the connector. If span line is not delivered, the connector must be plugged.

3.2. Heated Sample Line

The heated sample line must be installed from the probe to the sampling unit through the cabinet ceiling.

3.2.1. Mechanical Installation

The inner core is 4/6 mm (ID/OD) PTFE with silicone insulation. The outer diameter is approximately 55 mm. The smallest bending radius is 300 mm. The type label of the heated line and the power supply wires must be situated at the cabinet side. Please read Kletti's *Operating Instructions for Heating Hoses and Gasmet Pre- installation instructions* for details regarding heated line installation.

3.2.2. Sample Line Connection on probe side

Detailed mounting instructions can be found on section 3.1.

3.2.3. Sample Line Connection on cabinet side

The sample line is connected straight to the sampling system “sample in” connector. No additional connectors are allowed to be placed there due to possibility of condense. An insulating ring must be placed around the connector.

3.3. Cabinet

3.3.1. Installation Location

The cabinet should be situated in a place with easy access. There should be enough space to open the doors in front , and on the rear side (Figure 6) of the cabinet. On the side where the drain block is attached, additional 100 mm should be reserved. There should be no mechanical vibrations.

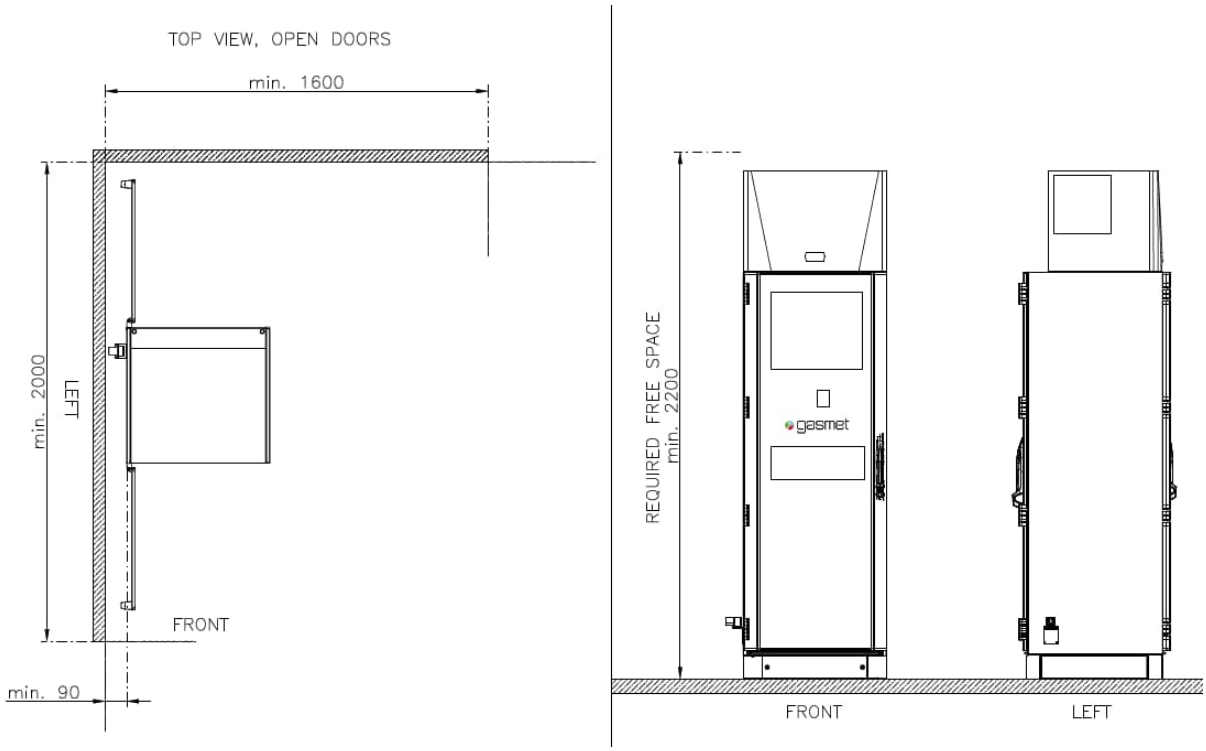


Figure 6. Minimum space requirements for accessing the CEMS II A cabinet.

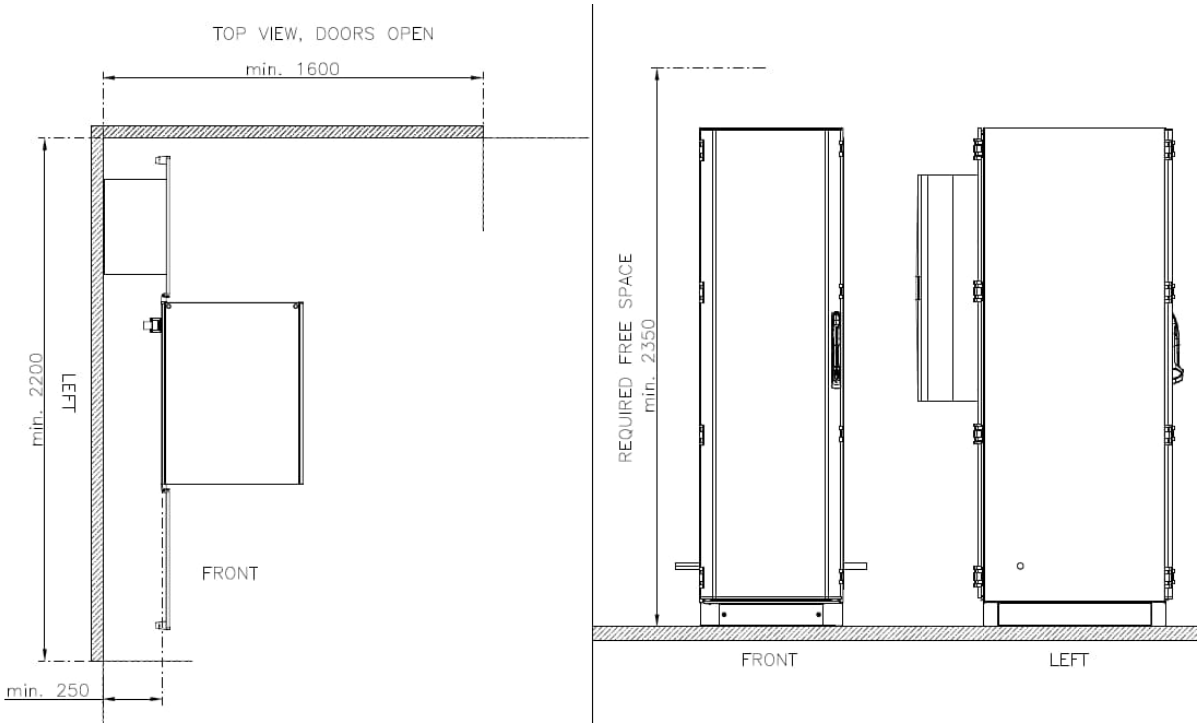


Figure 7. Minimum space requirements for accessing the CEMS II B cabinet.

3.3.1.1. Ambient Conditions

The analyzer cabinet must be protected from sample condensation and dust. The ambient temperature should be 0 – 40 °C. A heat load of 2 kW from the analyzer cabinet should be taken into consideration.

3.3.1.2. Explosion Protection

Unless it is stated in the system documentation, Gasmet CEMS II *e* cannot be installed in explosive area.

3.3.2. Electrical Installation

All electrical connections will be made to the terminals in the mounting plate (Figure 8). Signal cable connections are made directly to the I/O modules. The cables can be brought alternatively through the ceiling inlet or through the floor inlet. There are cable ducts inside the cabinet through which the cables can be led to the terminals.

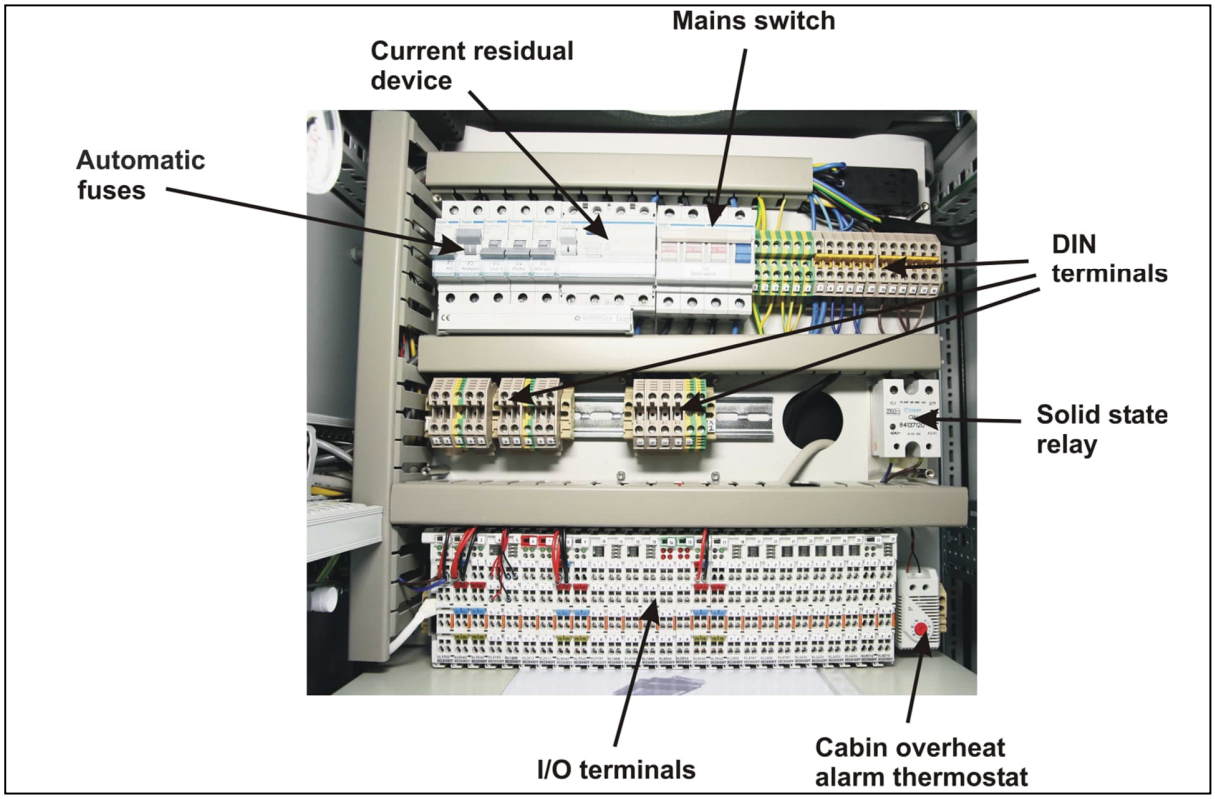


Figure 8. The CEMS II e mounting plate

3.3.2.1. Mains In

The electrical system has to be of model TN-S. The mains cable is connected to the X2 terminal behind the finger shield on the connector plate. The connectors are marked L1, L2, L3, N, and PE. The power consumption of the system and the cross section of the wire depends on the length of heated line. Please check the required power input from the electrical schemes of the system.

3.3.2.2. Heated Sample Line

The power input of the heated sample line is connected to the X2 connector bar on the connector plate.

Pin	Function	Electrical wire color
X2:1	TcK+	Green
X2:2	TcK-	White
X2:3	PE	Yellow/green
X2:4	N	Blue
X2:5	L	Brown

3.3.2.3. Probe

The power input of the probe is connected to the X2 terminal of the connector plate. The electrical wires between the cabinet and the probe are inside the heated line.

Pin	Function	Electrical wire color
X2:6	Alarm	Black
X2:7	Alarm	Black
X2:8	PE	Yellow/green
X2:9	N	Blue
X2:10	L	Brown

3.3.2.4. I/O signals

I/O signal wires can be connected directly to the Beckhoff modules found on the mounting plate. The signal wiring should be shielded, twisted pair and 0.5 mm^2 in cross-section. Please see the connection details in CEMS II e electrical documentation.

3.3.3. Gas connections inside cabinet

All gas connections (zero-, span gas and instrument air) should be brought to the cabinet in 6 mm diameter tubings. Looking from the rear side of the cabinet, the Swagelok fittings for the mentioned gases are found on the left-hand side. (Figure 9)

3.3.3.1. Instrument Air

The used instrument air should always be as pure as possible: dew point should be -40 °C, clean, dry particle and oil free. ISO 8573-1 Class 1.2.1 is recommended. Instrument air pressure should be between 5-8 bar. The CEMS cabinet is fitted with pressure reducer which should always be adjusted to regulate the secondary pressure to 1.5 bar.

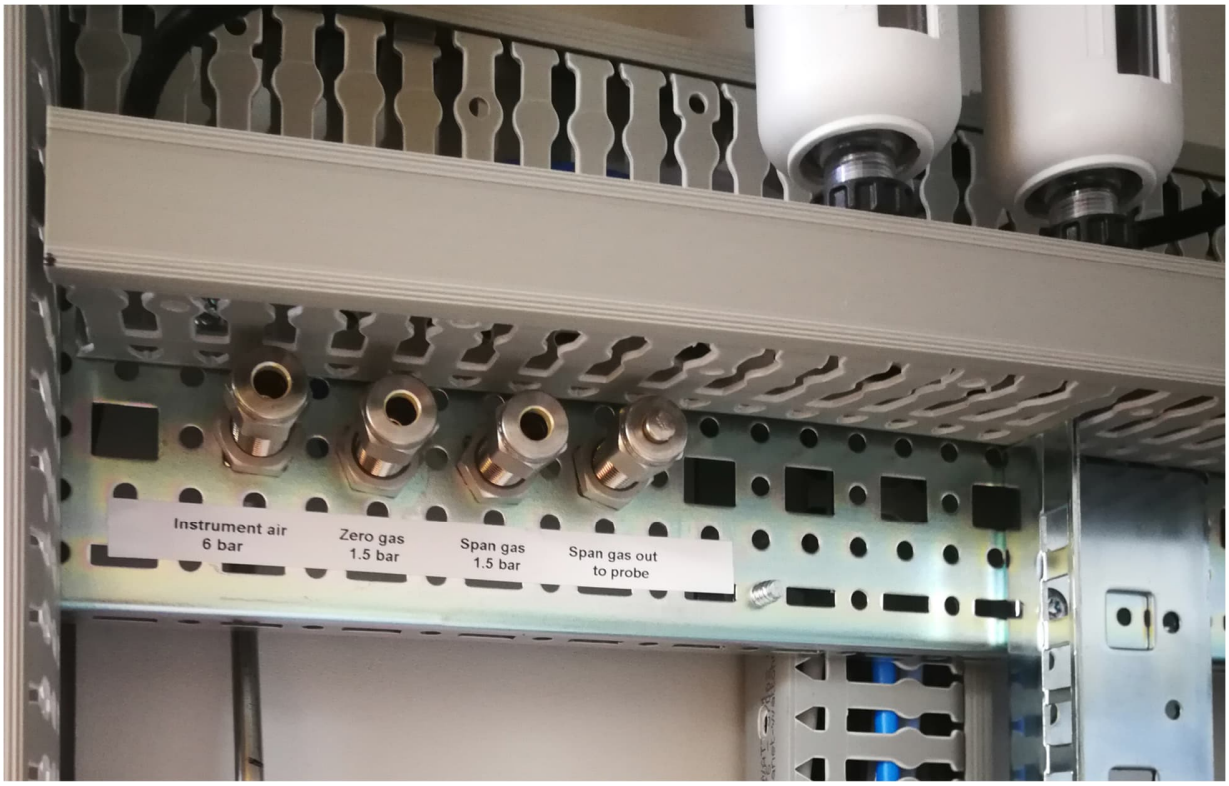


Figure 9. The gas connectors inside the CEMS II e cabinet.

3.3.3.2. Zero Gas

The used zero gas is nitrogen gas (purity 5 .0 or higher N2 recommended). The nitrogen pressure connected to CEMS II cabinet should be adjusted to 1.5 bar. A higher pressure might damage the system.

3.3.3.3. Span Gas

Span gas pressure connected to CEMS II cabinet should be adjusted to 1.5 bar. A higher pressure might damage the system. The span gas should be mixed with nitrogen and the concentration of span gas should be 70 – 90 % of the full measuring range.

3.3.4. Sample out connections

All sample gas outlets should be connected to the drain block (see Figure 10) which can be fitted either on the left or the right side of the cabinet. From the drain block onwards a 32 mm tube, sloped downwards all the time, will lead the cooled sample gas and condensate further away from the CEMS II cabinet. The drain ending must be always kept open (no freezing) and in atmospheric pressure. If required, the outlet gases can be diluted with instrument air.

Figure 10. Drain block connected

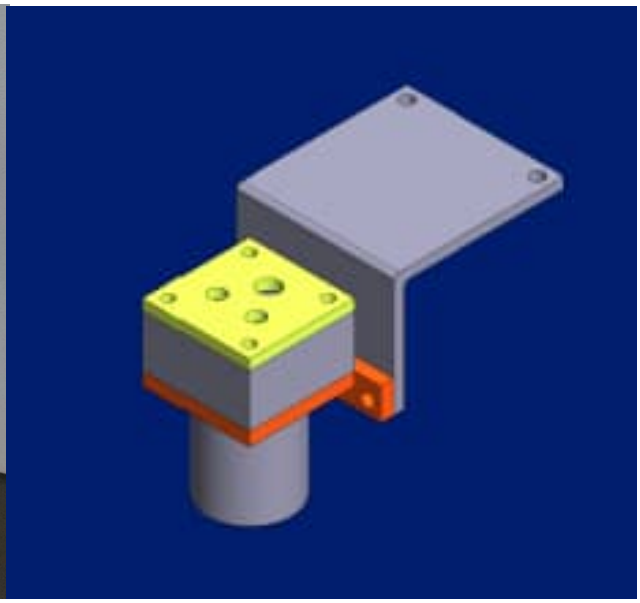


Figure 11. Drain block drawing

3.3.5. A/C Unit Condense Water Outlet

On the back corner of the cooler is the outlet connector of condensed water. A small piece of 14 mm transparent tube may be attached to the connector in case of unlike event of condensate formation.

3.4. Gasmet FTIR

3.4.1. Electrical Connections

The power and serial connectors are shown in Figure 12.

3.4.2. Sample Gas Fittings

Sample gas fittings are marked as follows, see Figure 12.

- “SAMPLE IN”, sample gas goes into the Gasmet FTIR analyzer (Swagelok 6 mm)
- “SAMPLE OUT”, sample gas goes into drain (Swagelok 8 mm)

3.4.3. Purge Gas Fitting

Purge gas fitting is marked as follows, see Figure 12.

- "PURGE IN", purge gas flow into the Gasmet FTIR analyzer (Swagelok 6 mm)

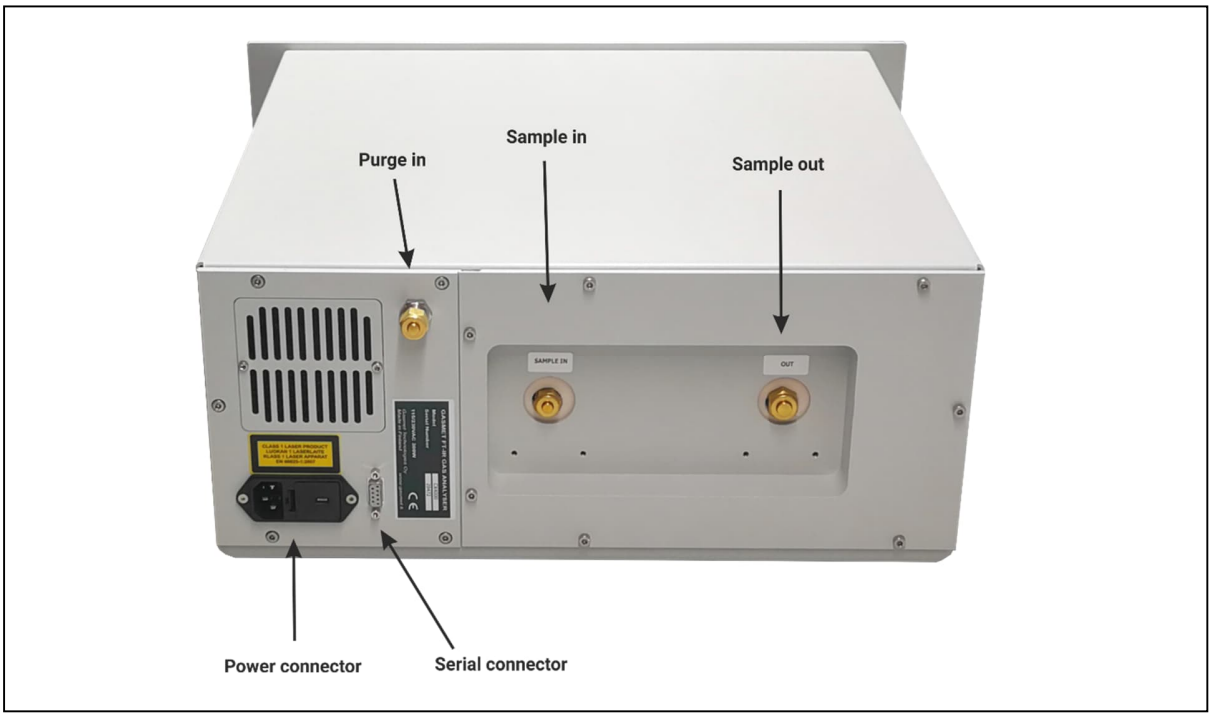


Figure 12. Gas fittings of Gasmet CX4000 gas analyzer.

Purge gas fitting is used in the Gasmet FTIR analyzer to purge the interferometer inside the analyzer. For purge gas, always use high quality instrument air. The suitable purge flow is about half a liter per minute (0.5 l/min). Too high flow can introduce air turbulence inside the interferometer, which will result in elevated noise level in the spectrum and in the measuring results.

3.5. Oxygen Analyzer

The 19" frame analyzer with microprocessor technology has the ZrO_2 cell inside and is used for O_2 measurement in CEMS II *e* cabinet. The oxygen analyzer can measure the O_2 content in wet flue gas down to less than 1 ppm O_2.

3.5.1. Electrical Connections

The power connector and the signal connector array (Figure 13) are situated on the back panel of Gasmet oxygen analyzer.

3.5.2. Sample Gas Fittings

Sample gas fittings are marked as follows, see Figure 13. Both are 6 mm Swageloks.

- "measuring gas in", sample gas goes into the oxygen analyzer
- "measuring gas out", sample gas goes out of the oxygen analyzer

Make sure that all sample lines are regulated to 180 °C, before introducing the sample gas into the oxygen analyzer. Recommended sample gas flow rate for oxygen analyzer is less than 1,5 liters per minute (< 1.5 l/min). CEMS II sampling system is providing the correct sample flow, and alarms if it drops too low.

3.5.3. Reference Air Fitting

Reference air fitting is marked as follows, see Figure 13.

- "Ref. Air in", reference gas goes into the Gasmet oxygen analyzer.

Use dry, particle free and non-condensing instrument air as reference air for the oxygen analyzer. The suitable reference airflow is about half a liter per minute (0.5 l/min). Too high a flow will cool down the measuring cell and might distort the oxygen measurement. Remember to keep the reference air flow as stable as possible.

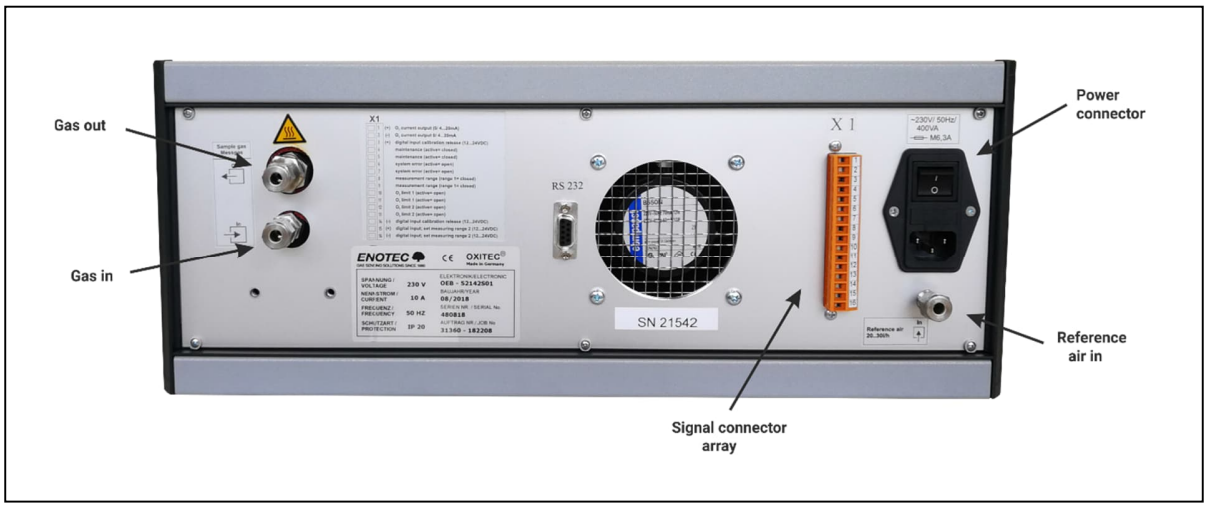


Figure 13. Gas fittings and electrical connectors of Gasmet oxygen analyzer.

3.6. Gasmet Sampling Unit

The Gasmet CEMS II *e* sampling unit is especially designed for continuous emission monitoring (CEM) system in fixed installations, e.g. as an integral part of the Gasmet continuous emissions monitoring system (CEMS).

The Gasmet CEMS II *e* sampling unit is used for on-line measurements. It is an ideal tool to use for measuring trace concentrations of pollutants in wet, corrosive gas streams. The sample pump, filter and sample lines are temperature regulated to 180 ºC. It can be used for undiluted gases and the sample gases do not need drying beforehand.

The Gasmet CEMS II *e* sampling unit is built in 19” rack and includes all valves, flow meters, pump, filters and LED indicators that are needed for measuring and maintenance. Sample flow and instrument air pressure status signals are provided.

The Gasmet CEMS II *e* sampling unit includes temperature controllers for heated sample lines and heated zone. The function of the sampling unit is fully automatic and controlled by the Calcmet software. It is connected to Gasmet computer via Ethernet cable.

3.6.1. Electrical Connections

Electrical connections of the Gasmet sampling unit are shown in Figure 14 and Figure 15. The power switch in located on the front panel and computer, I/O and 24 VDC connectors are on the back panel. Also, on the back panel are electrical connectors for the heated lines and the power cord.

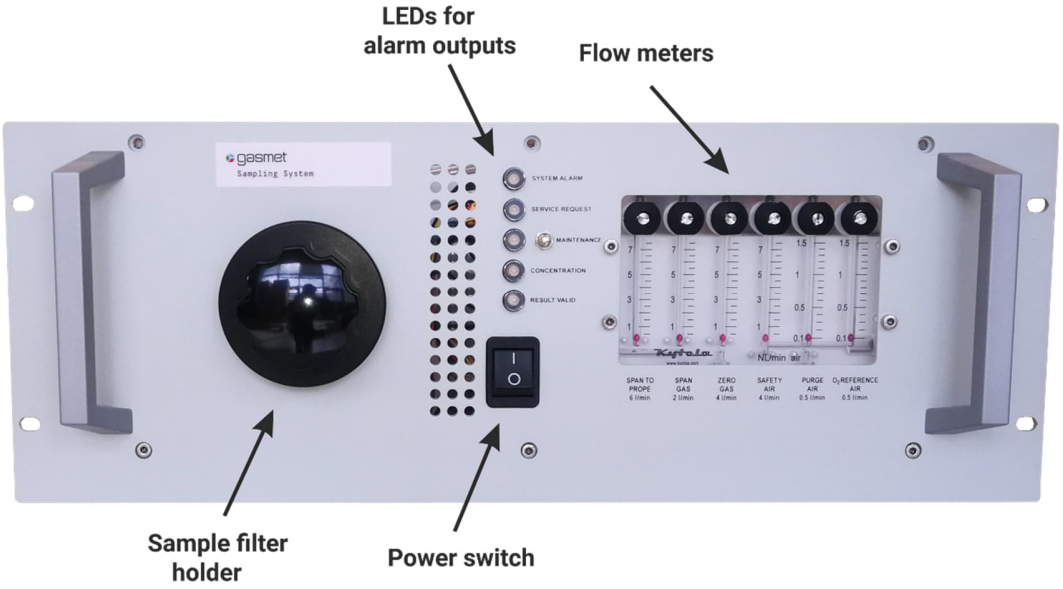


Figure 14. Gasmet sampling unit, front panel.

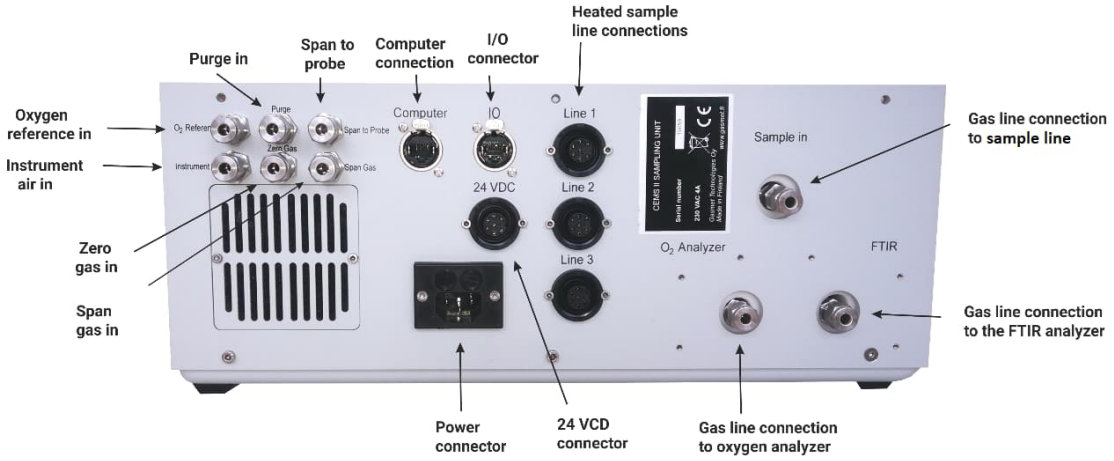


Figure 15. Gasmet sampling unit, back panel.

3.6.2. Sample Gas Fittings

The following sample gas fittings are located on the back panel of the Gasmet sampling unit: Sample in, FTIR out, and oxygen analyzer out.

3.6.3. Dry Gas Fittings

The following dry gas fittings are located on the back panel of the Gasmet sampling unit: O_2 reference, purge, span to probe, instrument air, zero gas, and span gas.

3.7. Gasmet Industrial Computer

Gasmet industrial computer is required to operate the analyzer, to control the sampling system, translate measured and analyzed concentrations and status signals to higher level automation and control systems (Figure 16).

In essence, the Gasmet software (Calcmet) can be operated in any Windows computer.

The standard computer configuration provides analyzer control via a serial port, watchdog support and remote control for service and troubleshooting purposes.

Figure 16. Gasmet industrial computer.

3.7.1. Electrical Connections

The Gasmet industrial computer has the following electrical connections on the back panel:

- 3 x COM (RS232)
- 1 x DVI-D display
- 2 x DisplayPort
- 3 x RJ45 Ethernet
- 4 x USB type A, 2 x USB type C
- 1 x audio: Line Out/In/Micro
- 1 x power connector (100-240 V, 50-60 Hz)

4. Calcmet

4.1. General information

The purpose of Calcmet software is to control the functionalities of Gasmet CEMS II emission monitoring system and to compute the concentrations of the different components present in the sample gas.

All operations in CEMS II emission monitoring system are done in Calcmet software. It is the interface for project specific parametrizations including the measured gas component specifications, their measuring ranges and units as well as all the other I/O configurations in the system.

4.2. Parametrization during the first-time start up

A qualified, Gasmet trained service person performs commissioning activities for the Gasmet CEMS II e Emission Monitoring System. These activities include e.g:

- Checking the installation of the system components mechanically and electrically. Only after that, the system can be electrified for the first time and the components start to heat up.
- Checking the gas connections of instrument air, nitrogen (zero gas) and possible span gas for correct pressure and adjustment of flow.
- Check the Calcmet configuration and make the needed changes to ensure the desired and reliable function of the system. The customer I/O interface needs to be configured and tested as well as the optional fieldbus interface.

Before you start to operate with Gasmet CEMS II or make any changes on the parametrization, read this *Manual* and *Calcmet Manual* carefully and thoroughly. If you do not understand something or you are unsure what to do, please contact the nearest distributor or Gasmet Technologies Oy main office.

4.2.1. Analysis settings

The main parametrization of the function of CEMS II, such as measured gas components including their analysis areas and measuring ranges, can be done in the menu: [Edit] [Analysis Settings…]

All the Calcmet internal signals are listed in the *analysis settings* window tabs, where their appearance and functionalities can be configured. Additionally, the signals can be linked to customer I/O or optional fieldbus channels according to the project design. For more detailed information please refer to Calcmet manual Chapter 5.2.3.

4.2.2. Measuring Times

In the menu [Options] [Measuring Times…], the measuring sequence of the CEMS II system is defined. As a standard in emission measuring systems, the measuring time is 60 s, which means that new measurement results are updated once per minute.

The measuring times interval is determined once during the commissioning activities, usually it does not need to be changed after that.

4.2.3. Calibrations

During the normal operation, automatic background measurement is performed once per day by using nitrogen gas. Background spectrum compensates any variations in the IR-source, sample cell etc. The background measurement is the only real calibration which needs to be performed during the normal operation, besides the water calibration which is done during the annual service.

In the menu [Options] [Calibrations] the start-time for the background measurement can be determined, as well as durations for zero gas flush and measurement.

To fulfill the legislative needs for quality assurance during the operation (QAL3), a sequential zero and span check can be automatically triggered. However, the purpose of these checks is to prove the measurement accuracy on the tested component, not to calibrate it. The span gas composition can be specified in the menu *'Analysis Settings / Component Options - Calibration' tab*.

In the menu [Options] [Calibrations…] the interval (in days) for the span checks can be determined, as well as durations for span gas flush and measurement.

In the menu [View] [Calibration Info] the results for the last calibration/checks can be viewed.

4.3. Operating Calcmet software

With the help of Calcmet software, the user can anytime for example view the current measured results and check the status of the system. And if necessary, make a diagnose for the reasons behind the actual alarms.

The typical view of Calcmet software is shown in the picture below:

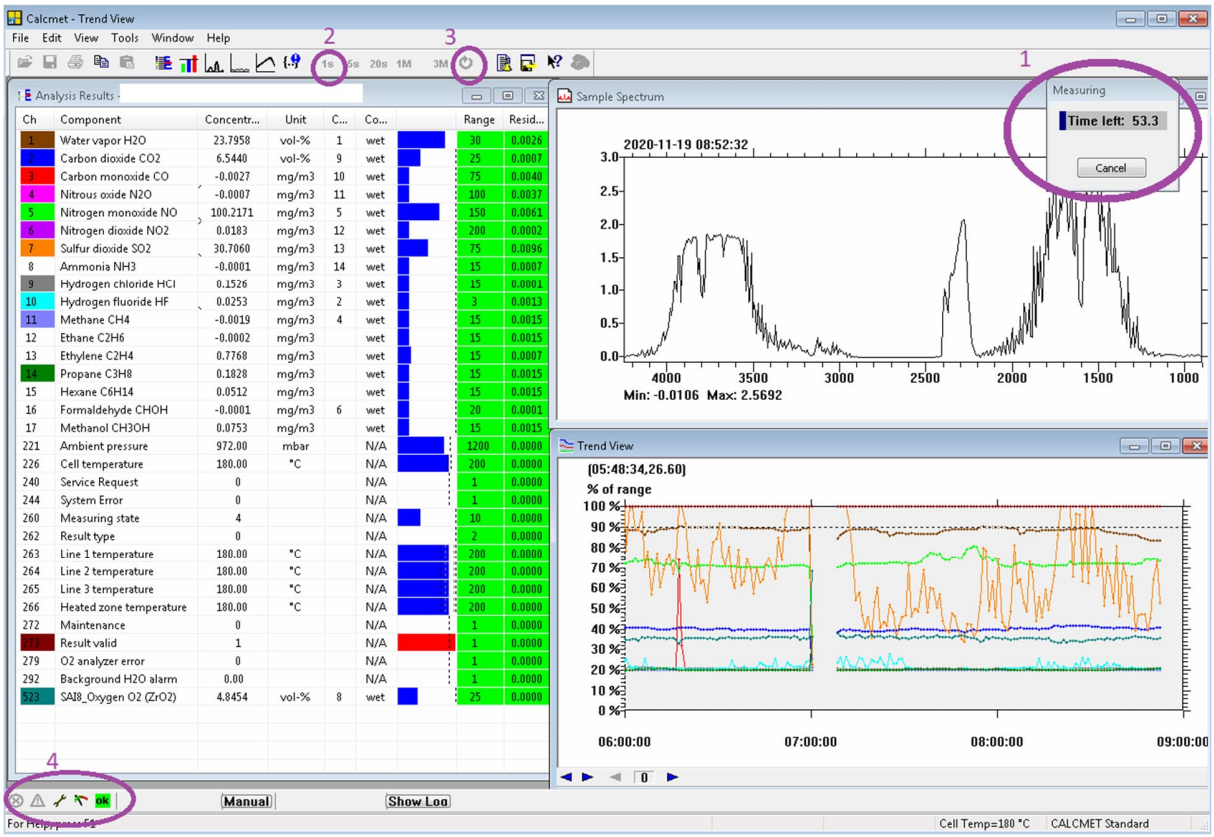


Figure 17. Calcmet view

In the following chapters a few key functions are explained to help the user to perform basic operations with the system.

4.3.1. Start and stop continuous measurement

On the upper right corner on the Calcmet software, a time counter for different functions e.g. remaining measuring time, is shown (see Figure 17 point 1).

Below the counter there is a button “Stop” to stop the current measuring action. It can be pushed any time, and as a result the sample pump is stopped and the sample system flushing with instrument air will be initiated. Please note that the display values are not updated automatically anymore. If the values need to be updated press the 1 second measurement button (see Figure 17, point 2).

The command for starting the continuous measurement mode can be given in the menu [Measure] [Continuous] or by pushing the hotkey (see Figure 17, point **3**).

4.3.2. Review alarms and key events

Alarms & key events are visible in the bottom of the main screen. By clicking the respective alarm button, a pop-up window will open showing the causes of the alarm in clear text.

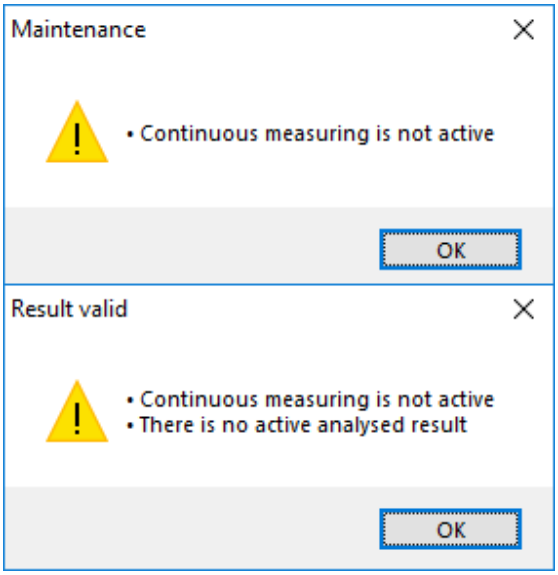


Figure 18. Pop-up window showing causes of the respective alarm

The program log contains information and warnings related to the use of Calcmet. The latest event is shown for the user in an automatically opening and closing dialogue on the bottom of the screen. The log can be opened and closed at will, by clicking the 'Show Log' button. This dialogue is showing only the latest 10 messages. To access a log file where all the messages are shown please go to [Tools] [Event Log] or [Alarm Log] respectively.

4.3.3. Send files and results (support package)

If the CEMS II e user runs into problems and needs support from Gasmet Technologies, the best way to share the current status of the system is to create a so-called support package. To create it please go to [Tools] [Create support package].

This command creates a compressed file (SUPPORT.CAB) on the desktop including the following files:

- the currently selected application (*.LIB) file
- all the reference spectra included in the selected application
- all Calcmet registry settings
- the most recent alarm log file

- the most recent event log file
- the analysis log file
- the most recent background spectrum
- the original background spectrum
- the O2Calibration.LOG file

It is recommended that this file is immediately created following an error condition without first shutting down the software because on startup of the software, new log files are created. In this way the included log files contain relevant information concerning the encountered problem. Include the package in your emailed request for support.

4.3.4. Manual measurements

Gasmet CEMS II is capable of performing all the needed measurements and calibrations fully automatically. In case needed, the measurements can be initiated manually by the user. The following three chapters are describing the different measurements in detail.

4.3.4.1. Background measurement (Zero calibration)

It is first necessary to measure the background spectrum for subsequent sample spectrum measurements. Before making the background measurement, wait until the instrument has reached a steady condition. The sample cell temperature and interferometer temperatures must be stable.

For the background measurement, the sample cell must be filled with zero gas N_2 (grade 5.0 or higher). Make sure there is no sample gas or other unwanted substances in the sample cell. The sample cell must be flushed with the zero gas a few minutes before initiating the background measurement. System performs the flushing automatically, i.e. according to the flushing times that have been set.

To start the background measurement, open the *Measure* menu and choose the command *Background*. A typical background spectrum is presented in Figure 19. The background spectrum is used as the zero level, to which the actual sample measurements are later compared.

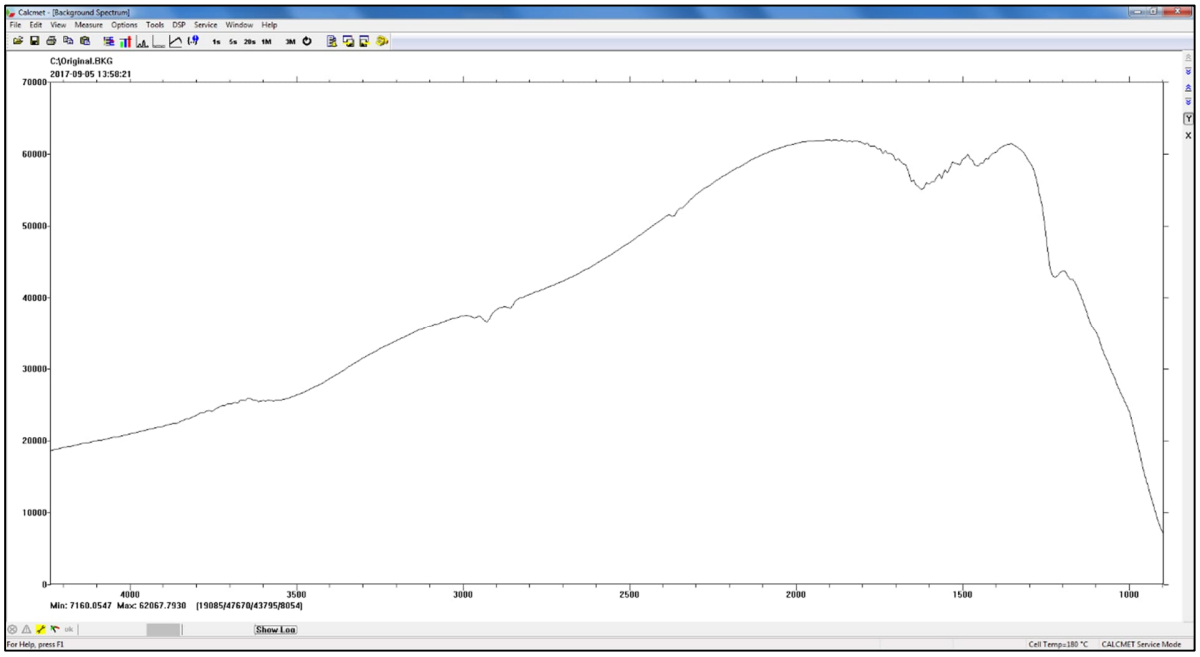


Figure 19. A typical background spectrum.

In normal conditions, the shape of the background spectrum should be near to that shown in Figure 19. The absorbance peak at 2350 cm^{-1} results from CO_2 that is typically present in the optical path. The smaller peaks in the range of 1300 - 1800 cm^{-1} result from humidity that is also normally present in the optical path.

4.3.4.2. Zero check

Zero check in CEMS II is a feature serving the QAL3 requirements. It is usually initiated automatically (parametrization see chapter 4.2.3) but also manual initiation is possible with command [Measure] [Zero Check]. Calcmet allows only one zero check measurement to be performed. If it needs to be renewed, the results of the previous zero check needs to be reset in the [View] [Calibration Info] window.

4.3.4.3. Span check

Span check in CEMS II is a feature serving the QAL3 requirements. It is usually initiated automatically (parametrization see chapter 4.2.3) but also manual initiation is possible with command [Measure] [Span Check]. Calcmet allows only one span check measurement to be performed. If it needs to be renewed, the results of the previous Span check needs to be reset in the [View] [Calibration Info] window.

If the option “span gas extension” module is used in CEMS II setup, the command [Measure] [Span Check] initiates the full span gas cycle i.e. all the configured span gas lines, will be measured one by one.

4.3.5. Changing Calcmet configuration

The Calcmet configuration parameters define the conditions under which the measurements are performed. Once these parameters are set correctly as part of commissioning activities, it is likely that no changes will be needed in the future.

Some of the parameters are factory set, and the user should not change them. But there are some changes that the end user is able to make, for example change the gas component measuring range or alarm limit value. If the parameter values are changed, the new values are automatically saved upon clicking ok in the respective control. The saved parameter values are written automatically to the Calcmet application lib file. Therefore, before making any changes to Calcmet configuration, make a copy of the current used lib file and rename it as a next version number for example File Name_Ver1 -> File Name_Ver2. This way it is possible to return to the original application if the configuration changes were not successful.

To make a copy of a Calcmet application file, go to [*Options] [Application…]* and press the '*Browse…*' button in the pop-up window (see Figure 20), and a windows *Open* dialogue will open. Activate the current lib file name, copy and paste it and name it as next free version number. Activate the new lib file, so that it appears in the bottom in the file name field and then press *Open*.

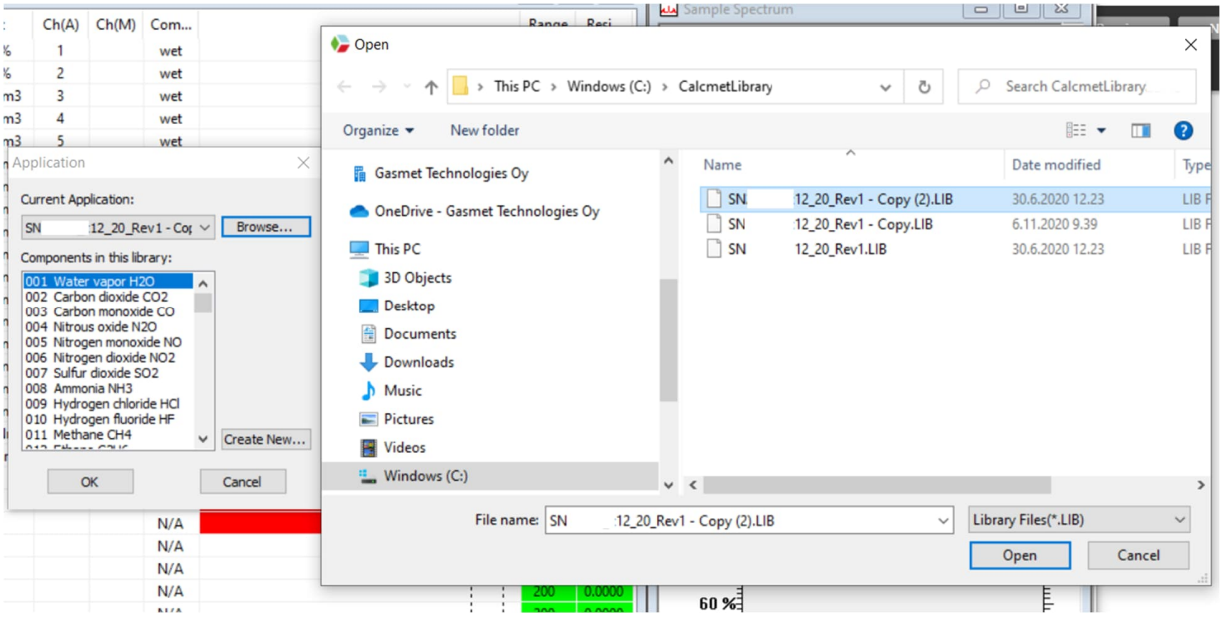


Figure 20. Making a copy of a Calcmet application

4.3.6. Calcmet window positions

In Calcmet window menu, can be found the standard windows commands ‘Cascade’, ‘Tile’ and ‘Arrange icons’. With these commands, it is possible to reorder windows that are open on screen.

Figure 21. 'Window' menu

In addition, the menu contains ‘Save positions’ and ‘Restore positions’ commands as shown in Figure 21. These commands can be used to save and restore the position and size of the main application window and all open views in it. When saving window positions, the individual window column widths are saved at the same time. When Calcmet is restarted, it will automatically perform the ‘Restore positions’ function.

If the ‘Save positions’ feature is used e.g. at the end of the commission activities, the user has always the possibility to return to the usual Calcmet view, if for example any of the windows has been accidentally closed.

5. CEMS II I/O Signals

5.1. Alarm Outputs

The system has four (4) relay outputs which report vital information of the state of the CEMS II *e*.

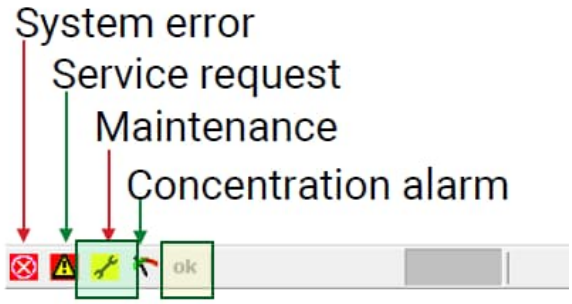


Figure 22. Key events and alarms

The outputs should always be connected to the control room. Each alarm has its own symbol also in Calcmet display on the lower left corner (see Figure 17 point 4). By clicking the respective alarm button, a pop-up window will open showing the causes of the alarm in clear text.

5.1.1. System Error

When system error occurs the alarm relay 1 will open.

5.1.1.1. Signal Description

A serious hardware problem has occurred, that prevents performing reliable measurements. Continuous measurement mode is stopped immediately, and system is flushed with instrument air or nitrogen. It is not possible to go back to continuous measurements before the cause of the alarm is eliminated.

5.1.1.2. Configuring the Signal

The internal signals causing a system alarm error to occur can be viewed and configured in Calcmet under 'View Alarm Info' display. A table of the default signals causing a System Error alarm can be seen in Appendix B. For more detailed info see Calcmet user's manual section 5.3.12.

5.1.2. Service Request

When service request occurs the alarm relay 2 will open.

5.1.2.1. Signal Description

There is an alarm in the CEMS II *e* which requires immediate inspection. During the service request the system measures the sample and the results MAY still be valid.

5.1.2.2. Configuring the Signal

The internal signals causing a service request to occur can be viewed and configured in Calcmet under 'View Alarm Info' display. A table of the default signals causing a Service request alarm can be seen in Appendix B. For more detailed info see Calcmet user's manual section 5.3.12.

Service request may arrive if the gas analyzer parameters are not quite correct. Other possible reasons include:

- flow alarm of the sample gas
- failure of span and/or zero gas check
- zero gas or instrument air flow alarm
- cabinet overheat alarm
- air conditioning error alarm
- lack of space on the hard disk
- error in the oxygen analyzer
- oxygen flow alarm

5.1.3. Maintenance

When maintenance mode is active the alarm relay 3 will open.

5.1.3.1. Signal Description

The system has an on-going automatically or manually started maintenance operation, for example a background measurement.

5.1.3.2. Configuring the Signal

The internal signals causing a maintenance mode to occur can be viewed and configured in Calcmet under 'View Alarm Info' display. A table of the default signals causing a Maintenance alarm can be seen in Appendix B. For more detailed info see Calcmet user's manual section 5.3.12.

Maintenance signal is activated whenever the system is performing any other operations than continuous (sample) measuring mode. It is also activated when the 'Maintenance' switch on the sampling system cover is pressed (the signal LED starts to flash) or after the HASP key is inserted into the computer (LED is continuously on).

5.1.4. Result Valid

When result valid is active the alarm relay 4 is closed.

5.1.4.1. Signal Description

This signal informs that the analyzed results are reliable and reportable.

5.1.4.2. Configuring the Signal

The internal signals causing a result valid to occur can be viewed and configured in Calcmet under 'View Alarm Info' display. A table of the default signals causing a Result valid alarm can be seen in Appendix B. For more detailed info see Calcmet user's manual section 5.3.12.

5.2. External Controls

The system can be controlled with external input signals. These contacts override the Calcmet controls.

5.2.1. System StandBy

The 'System StandBy' input forces the flushing of the CEMS II *e*. Calcmet continues measuring as normal but it analyzes instrument air and the 'Result valid' signal is deactivated. Furthermore, the system goes to maintenance mode.

5.2.2. Span Test via Probe

'Span test via probe' input signal opens the test gas inflow into the probe as long as the 'span to probe' gas outlet is connected to 'probe calibration' inlet. Calcmet continues to measure normally but instead of the sample gas it analyzes the test gas that flows via the probe. When the CEMS II *e* is under the 'span test via probe', the 'Maintenance' mode is activated but 'Result valid' signal is not.

5.3. Analog Outputs

The CEMS II e has 16 pcs 4 – 20 mA analog outputs. The signals are active. The analog channel maximum impedance is 350 Ω. The FTIR gas component signals are updated at the end of the measurement cycle (standard 60 s). Analog output signals that are redirected from analog input signals (e.g O_2 concentration) are updated real time.

5.3.1. Configuration of AO signals

The desired signal can be connected to the output signal using the 'Analysis Settings' option in Calcmet software.

For more details please see the Calcmet manual Chapter 5.2.3.11.

5.4. Digital Outputs

The CEMS II *e* has 16 digital outputs but only 15 can be freely configured (one is reserved always for oxygen analyzer). Digital output card will feed 24 VDC into the signal loop. In other words, the signals are active.

5.4.1. Signal Description

With digital output signals the various states of CEMS II e as well as of the external devices connected to the system can be forwarded. The digital output signals are also used for CEMS II e control purposes, i.e. controlling the possible additional span or sample gas valves.

5.4.2. Configuration of DO signals

The desired signal can be connected to the output signal using the 'Analysis Settings' option in Calcmet software.

For more details, please see the Calcmet manual Chapter 5.2.3.9.

5.5. Analog Inputs

The CEMS II e has 8 pcs 4 – 20 mA analog inputs. The signals are passive which means that they do *not* feed the operating voltage into the signal loop. The resistance of the input is less than 80 Ω.

5.5.1. Signal Description

Using the analog inputs the measuring signals of various external devices, such as oxygen and dust analyzer, can be brought to the system.

5.5.2. Configuration of AI signals

The desired signal can be connected to the input signal using the 'Analysis Settings' option in Calcmet software.

For more details please see the Calcmet manual Chapter 5.2.3.10.

The analog input signals may be rerouted to analog outputs in Calcmet 'Analysis Settings'.

5.6. Digital Inputs

The system has 16 digital inputs that can be freely configured. The signals are active and they should be controlled through potentially free contacts.

5.6.1. Signal Description

The status information and error signals of various external devices may be brought into the system using this signal. Certain remote access actions are also available through these signal inputs.

5.6.2. Configuration of DI signals

The desired signal can be connected to the input signal using the 'Analysis settings' option in Calcmet software.

For more details, please see the Calcmet manual Chapter 5.2.3.8.

Informative input signal can also be rerouted to the output signal using the 'Analysis Settings' option in Calcmet.

5.7. Fieldbus (optional)

Measurement data may be read through the serial interface (RS232) located in Gasmet Industrial PC. For more information about RS232 serial connection please read the Calcmet manual chapter 10.2. Signal can be converted to various fieldbus formats with optional signal converters.

5.7.1. Modbus

Configuration of the Modbus channels is done in the *Edit analysis settings* Modbus tab. There are total 29 channels, which can be assigned freely for measured components or for digital output signals. The digital outputs can be grouped together (max. 16 pcs) in one Modbus channel. More details to this function, please refer to the Calcmet manual chapter 5.2.3.3 Digital groups.

For more information about the Modbus format, please refer to the Calcmet Manual chapter 10.2.2.4 Modbus format.

6. Gasmet CEMS II Emission Monitoring System's Maintenance

6.1. Safety Precautions

Improper handling of any components inside Gasmet CEMS II may damage the equipment. Thus, adjusting any components inside Gasmet CEMS II voids warranty. Only a qualified technician is allowed to perform any service operations that require opening the case of any parts of Gasmet CEMS II *e*.

The user should pay attention to the following points:

1 Before turning off the power of Gasmet CEMS II , the whole system should be carefully flushed with instrument air or nitrogen. Sample cell and purge connector should be closed with caps if the sample lines are disconnected from the gas cell. If corrosive gases remain in the sample cell when the power has been switched off, the optics inside the sample cell will be damaged. Measuring strongly acidic or caustic gases may shorten the lifetime of the sample cell.

2 If the sample gas contains solid particles, it should be filtered before introducing it into the sample cell. If it is not filtered, dirt will accumulate in the sample cell and lower the quality of the measurements. Any liquid droplets or aerosols inside the gas cell may destroy sample cell mirrors or windows. Normally Gasmet CEMS II includes two filters one in a sampling unit and one in the sample probe. If the sample gas includes dust more than > 2 g/m^3, pre-filter with backflush option is recommended to be used.

3 Intensive shocks may damage the analyzers inside the cabinet. Be always very careful if you move or transport the instrument. In case you need to move the system, FTIR analyzer must be taken out of the cabinet during the transportation.

4 Use a rag to wipe off the dirt on the cabinet outside panels. The cabinet of Gasmet CEMS II is not waterproof. Do not apply pressurized water when cleaning the cabinet. Do not use strong detergents or acetone. If the system is used in dusty conditions, it is recommended to check the condition of the dust filters of all instruments inside the cabinet (and replace if necessary) at least every month.

5 The whole system is recommended to be installed after uninterruptible power system, UPS. The warranty is not valid, if the gas cell of the FTIR analyzer has been damaged due to corrosion as a result of power failure.

6 The heated lines may emit odour and/or visible fumes during the first heating to full temperature. The first heating needs to be performed in a well-ventilated area or outside to minimize exposure to the fumes.

6.2. Maintenance Plan

Table 1 presents a rough maintenance plan. The maintenance required depends strongly on the application. The maintenance work procedures are described in this manual. Detailed operations are

described in the service manuals of each individual instrument of Gasmet CEMS II *e*. For any other service, please contact to the nearest service office.

Maintenance interval	Maintenance work
1 week	System and analyzer visual inspection.
2 – 6 months	Probe and sampling system filter check and replacement (included in annual service)
Approximately 12 months	FTIR analyzer sample cell inspection (performed by trained service technician. Included in annual service).
Approximately 12 months	Sample pump diaphragms replacement, if needed (performed by trained service technician. Included in annual service).
Approximately 12 months	Water calibration (performed by trained service technician. Included in annual service).
18 – 60 months	Replacement of optoelectronic components (for example laser and infrared source) of the FTIR analyzer (performed by trained service technician).

Table 1. Maintenance plan.

6.2.1. Automatic Maintenance

6.2.1.1. Background measurement

The system performs periodically an automatic background measurement every morning (typically at 7 am) using zero gas. It takes about 7 minutes with flushing to perform this. The previous measurement results are valid during the background measurement .

6.2.1.2. Span & Zero Checks

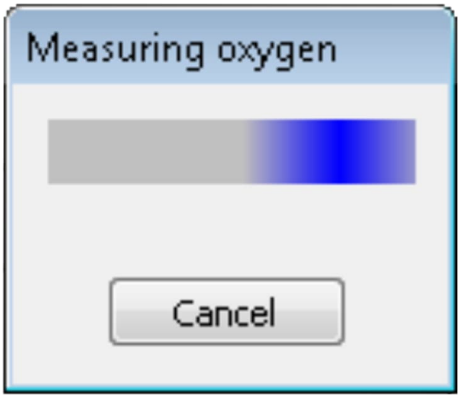
The system inspects automatically the zero level and the measurement accuracy of the used span gas. This inspection is performed typically every 30 days before background measurement. A Service alarm is generated if the error limits are exceeded.

6.2.1.3. Single Point Calibration of Oxygen Analyzer (optional)

To ensure accurate and reliable measuring results, the oxygen analyzer needs to be calibrated regularly. The procedure is called single point calibration, during which instrument air is fed to the analyzer. Calibration interval is depending on the application but usually it is performed every 2-4 weeks. The appropriate interval can be determined in Calcmet and after that, it is performed fully automatically.

Please note that a successful single point calibration changes the oxygen calibration value “Offset”. If the single point calibration is aborted due to a system fault or manually by the user, the system will revert to the previous stored oxygen calibration values.

During the calibration, the following window appears:



Simultaneously, a notification appears on the oxygen analyzer display. The progress of calibration is indicated by a moving time bar.

6.2.2. Periodic Maintenance Done by Customer

Only an authorized person is allowed to perform maintenance duties.

6.2.2.1. Visual Inspection

When making the visual inspection, check that:

- There is enough pressure in Nitrogen (N_2) and in span gas cylinder(s) for automatic background and span measurements. Replace the cylinders if needed.
- There are no active alarms visible in Calcmet display.
- The only illuminated LED in the front of the sampling system module is the green LED for Result valid. Check also, that the instrument air flow for interferometer purge and reference air for optional oxygen analyzer are 0.5 liters per minute (l/min). Adjust if necessary.
- Air conditioning system is in good condition and dust free, and that the cabinet inside temperature reading is around ~23-28 .
- After opening the rear door, that the sample lines and gas connectors are in good condition, and that the insulation rings are in place.
- There is no dust inside the cabinet.
- The waste gas outlet from the cabinet is not blocked (if visible).

6.2.2.2. Replacement of Particle Filters

The replacement frequency of the filters depends a lot on the quality of the measured sample gas. In the beginning of the operation after installation, it is recommended to check the quality of the filters very often, so that the correct replacement frequency can be established.

Gasmet CEMS II *e* includes at least two filters, one in the sample probe, and one in the sampling unit. Sampling unit filter is used as backup filter for the sample probe main filter.

Checking or replacing the filters, press **Maintenance button** of the sampling system and stop measurement so that sample pump stops and instrument air flows through the system.

WARNING!

AGGRESSIVE CONDENSATE MAY HAVE FORMED, WEAR PROTECTIVE GLASSES, AND PROPER PROTECTIVE CLOTHING!

HIGH SURFACE TEMPERATURE, WEAR PROTECTIVE GLOVES!

Remember not to touch with bare hands on the new filter element (wear heat resistant leather gloves), and to also replace the gaskets.

If a detailed information about the filter exchange procedure for probe is needed, please refer to the manufacturer's manual.

Please do not use any excess power when turning open the sampling system filter holder lid, otherwise the handle might break.

6.2.3. Annual Maintenance Done by Service Technician

In the annual maintenance of the CEMS II, the service technician inspects the complete system and carries out at least the following maintenance activities: Water calibration, replacement of sampling system's pump and/or it's membranes, checking of the oxygen analyzer, checking of the FTIR signals and if necessary, replacement of the filters.

6.2.3.1. Replacing the Sampling System Pump And The Membranes

1. Turn the power off from the sampling system.
2. Disconnect all the heated lines and electrical lines from the sampling system.
3. Remove the side and top insulation from around the oven and let the oven cool down.
4. Remove the electrical wires from the Beckhoff modules that come from the oven.
5. Remove the top of the oven.
6. Disconnect the pump power cables.
7. Disconnect the Teflon and steel lines which are connected to the pump.
8. Lift the pump up.
9. Replace the pump or the membranes.
10. To assemble the sampling system, reverse the steps 1-9.

6.2.3.2. Oxygen Analyzer Manual Single Point Calibration

During the annual CEMS II maintenance activities also the oxygen analyzer will be checked, and if necessary, the single point calibration will be executed manually. It can be initiated either using the Calcmet software ([Measure] [Oxygen]) or from the oxygen analyzer display panel.

6.2.3.3. Two-Point Calibration of the oxygen analyzer

In some cases, the oxygen single point calibration is not enough, and a two point calibration needs to be performed. For this procedure, see the oxygen analyzer manual.

6.2.4. Manual Span & Zero Gas Checks

If in any point of the CEMS II operation, there is a need to prove the correct measuring behavior of the system, the user may manually initiate the span and zero gas checks from Calcmet [Measure] [Zero check] / [Measure] [Span check]. If more than one span gas is connected to the cabinet they will be tested consecutively, one by one. But even with one span gas, the measuring performance of the system can be proven.

6.2.5. Changing the span gas cylinder

The calibration gas cylinders have an expiration date and after that, it should be replaced. If the concentration of the new gas cylinder is different than in the previous cylinder, the new concentration has to be changed in the Calcmet *[Edit] [Analysis Settings…]* under the components '*Options*' (see Figure 23). As a decimal separator for the span gas concentration, a dot must be used instead of comma.

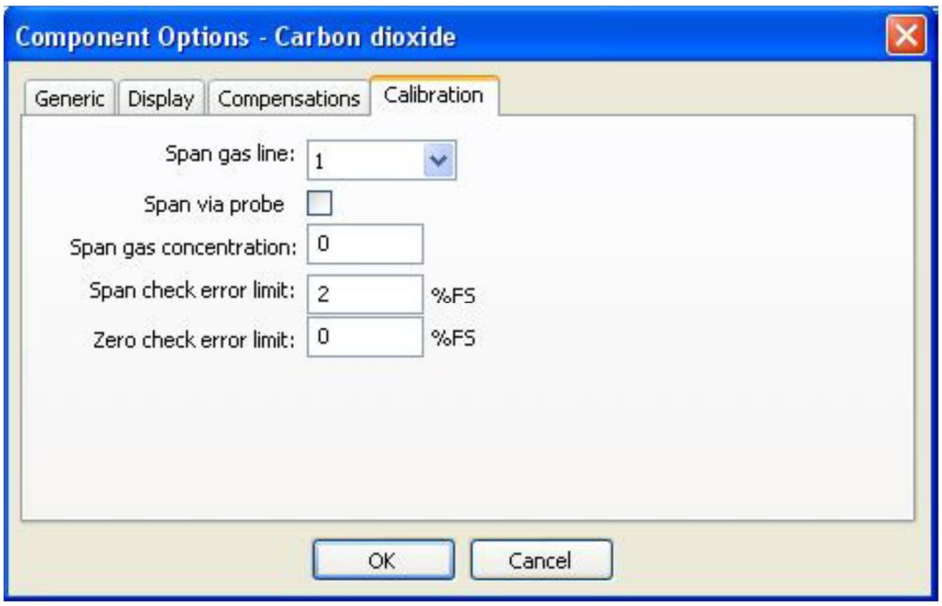


Figure 23. 'Analysis Settings / Component Options - Calibration' tab.

APPENDIX B: Alarm info

Component	System Error	Service Request	Maintenance	Concentration alarm	Result Valid
Cell temperature	X	X			
Interferometer temperature		X			
Source intensity		X			
Zero gas pressure alarm (external)		X			
Probe temperature alarm	X				X
Heated zone temperature alarm	X				
Heated lines alarm	*				*
Flow alarm		X			
Force span check			*		
Force zero check			X		
Cabinet cooler alarm		X			
Cabinet temperature alarm		X			
Instrument air pressure alarm		X			X
O2 calibrating			X		
Standby			X		X
Maintenance switch			X		X
Cannot start measuring		X			
Measuring cancelled					X
Cannot read data		X			
High residual alarm		X			X
Background signal low	X	X			
Hard disk space low		X			
Manual mode out			X		X
Measuring action			*		
O_2 analyzer error		X			
O_2 flow alarm		X			
GFID analyzer general alarm (for CEMS II ef)		X			

The *Alarm info* command views all the components that can be included in one of the five system main alarms, system error, service request, maintenance, concentration alarm and result valid. If a '*' sign appears instead of a 'X' sign to indicate the alarm is included, the right mouse button can be double clicked on such a component to select further details of the alarm activation.
For more information, please see *Calcmet v12 manual*.

Appendix: Gasmet Sales and Support Offices

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