ENCAL2000PGC

Process Gas Chromatograph

Model ENCAL 2000 PGC

Installation Manual

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1 Introduction

The ENCAL 2000 PGC is a Process Gas Chromatograph designed to separate and identify the components in natural gas samples. This manual describes the analyser and the connection to auxiliary equipment necessary for readout, control and set-up of the analyser. For detailed information of the auxiliary equipment and the set-up software, refer to the following manuals.

- ENCAL 2000 CONTROL UNIT – Instrument Instruction Manual
  Version 3.0 issue 1

- RGC 2000 – Users Guide
  Version 3.0 issue 1

Depending on the options some sections of this manual may not apply. Where possible the options have been identified.

The analyser has been designed to meet the ATEX requirements for equipment located in Zone 1 Hazardous area. For more detailed information concerning ATEX certificate and other applicable approvals, refer to Section 3 of this manual.

SPECIAL NOTICE

Installation instructions mentioned in this manual are intended for information only. The installation of this equipment <u>must</u> conform to any national, local, or company codes applicable to the location. Instromet BV assumes no responsibility for compliance with these requirements. It is suggested that a review of the codes be made prior to installation.

2 Table Of Contents

3 General Description

3.1 Model 2000 PGC Process Gas Chromatograph

The analyser is designed to separate and identify the components in natural gas samples using process chromatography techniques. It automatically samples and analyses process streams using the internal electronics to control analytical functions.

The analyser (Figure 3-1) exists of a freestanding cabinet containing an electrical heated oven compartment, an EEx-d electronics housing, a sample selection system and a sample conditioning system. On the right side of the oven compartment the carrier gas pressure regulator and moisture filter are located, as well as the sample gas flow regulator.
In the lower section of the analyser there is a power supply box with the mains switch and a possible three other switches to supply power to the optionally available cabinet heater and the external heated sample lines and calibration gas heaters.

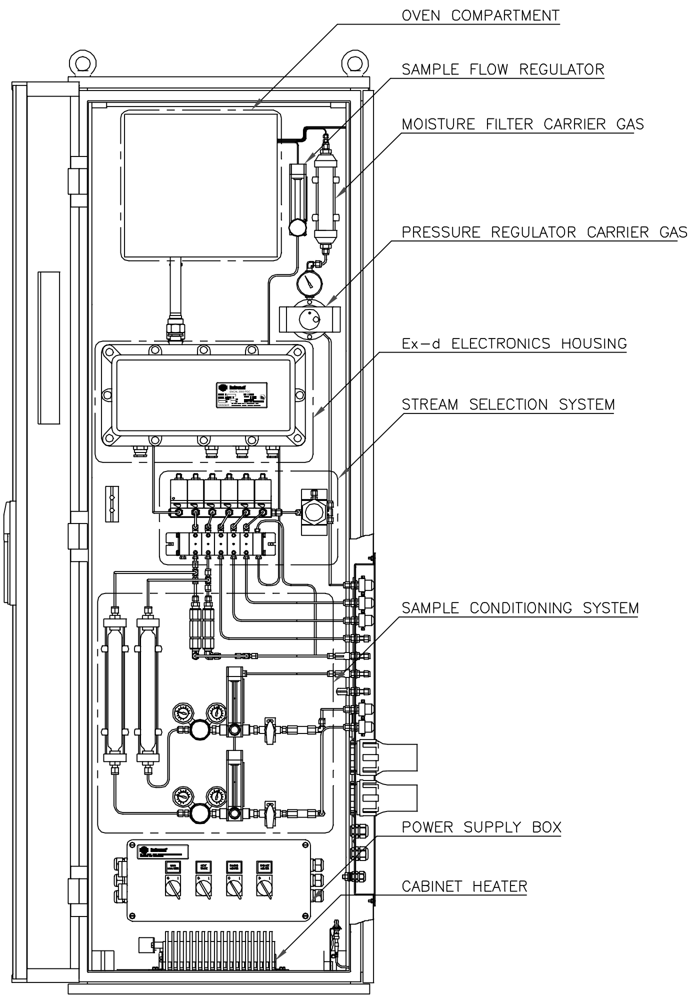


Figure 3-1 Typical ENCAL 2000 PGC (door opened)

The oven compartment is insulated with a removable insulation cover referred to as the “hot cap”. It contains an oven block in which the analytical columns are placed, a Thermal Conductivity Detector (TCD), and the 10 ports sample valve.

The Electronics housing contains a power supply board and a digital board which perform the following functions: Temperature control of the oven, control and readout of the detector signal, control of sample selection valves, integration of the detector signal, and communication with auxiliary equipment such as the control unit and/or personal computer system. Communication is established by means of two optical fibre connections.

The sample selection system can select between five different streams of which two can be conditioned by the integrated sample conditioning system(s). The three remaining streams are used as calibration gas or reference gas input which need no conditioning.

The sample conditioning system is used to reduce the sample pressure and to filter any moisture and particles from the sample gas. A bypass stream can also be created if sample inlet pressure exceeds 2 barg.

3.1.1 ATEX Approval

The analyser is ATEX certified for hazardous areas and complies with the following harmonised European standards:

EN 50014; 1992, General requirements
EN 50018; 1994, Flameproof enclosures

The apparatus marking is: Ex **II 2 G** **EEx d IIB T3**

3.1.2 CE Approvals

The CE mark is the official marking required by the European Community for all Electric- and Electronic equipment that will be sold, or put into service for the first time, anywhere in the European community. It proves to the buyer -or user- that this product fulfils all essential safety and environmental requirements as defined in the so-called European Directives. The CE marking directive (93/68/EEC) was adopted on 07-22-1993. It amends 12 other directives including the directives mentioned below.

The EMC directive refers to both electromagnetic “emissions” and electromagnetic “immunity”. Electromagnetic emission from electronic devices cause electromagnetic interference (EMI) to the radio frequency spectrum which can disrupt emergency communications, radio and television broadcasts, and interference with the operation of other electronically controlled devices. Electromagnetic immunity refers to an electronic device’s ability to handle interference from a wide variety of sources, such as radiation, conduction, surges etc.

Applied standards:

EN 50081-1: 1992 (generic emission standard)
EN 50082-2: 1995 (generic immunity standard)

The ENCAL 2000 PGC has been tested and certified as complying with the standards as mentioned.

The Low Voltage Directive 73/23/EEC is one of a series of measures introduced under article 100a of the Treaty of Rome. Article 100a directives all have the primary objective of creating a single European market in goods and services with the objective of providing producers and consumers with the benefits of economies of scale. The directive was originally enacted in 1973 but was modified in 1993 by directive 93/68/EEC to include a requirement for CE marking and the creation of a technical file.

The effect of the directive has been to introduce identical requirements for the safety of electrical products in every country within the European Economic Area (EEA).
It applies to (almost all electrical) equipment, designed to operate in the voltage range 50-1000 V ac or 75-1500 V dc. It states that electrical and electronic equipment placed on the market in the European Union (EU) must be safe.

Applied standards:

EN 61010: 1993 (incl. EN 61010/A2:1995)

The ENCAL 2000 PGC has been tested and certified as complying with the standard as mentioned.

3.1.3 Type plate information

The type plate is located on the EEx-d electronics housing. Figure 3-2 shows an example of the type plate indicating the information it provides.

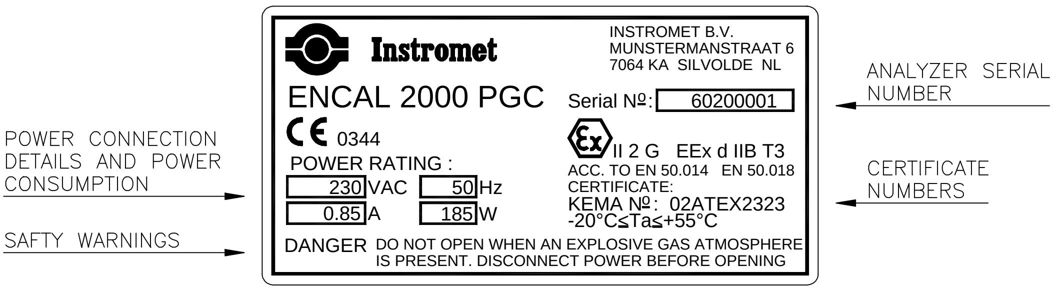


Figure 3-2 Type plate

3.2 Auxiliary equipment

The ENCAL 2000 PGC has no integrated read-out or set-up facilities. Communication with the analyser is established by a personal computer using the RGC 2000 software and/or the ENCAL 2000 Control Unit (CU). Both PC and CU should always be placed in a **safe area**. Connection to the PC and CU is established using a four-wire fibre optic cable and a fibre optic→ RS232 converter module. (Connection details are given in paragraph 5.6)
Using a fibre optic connection results automatically in a galvanic separation between equipment in the Hazardous area (Analyser) and equipment in the safe area (PC / CU).

3.2.1 ENCAL 2000 Fibre Optic Board

The fibre optic converter module (Figure 3-3) provides the signal conversion between the fibre optic communication ports on the analyser side and the RS-232 connections on the Control Unit and the personal computer. It is a DIN-rail mountable device, which is 24 VDC powered. The module can only be used in a **safe area**.

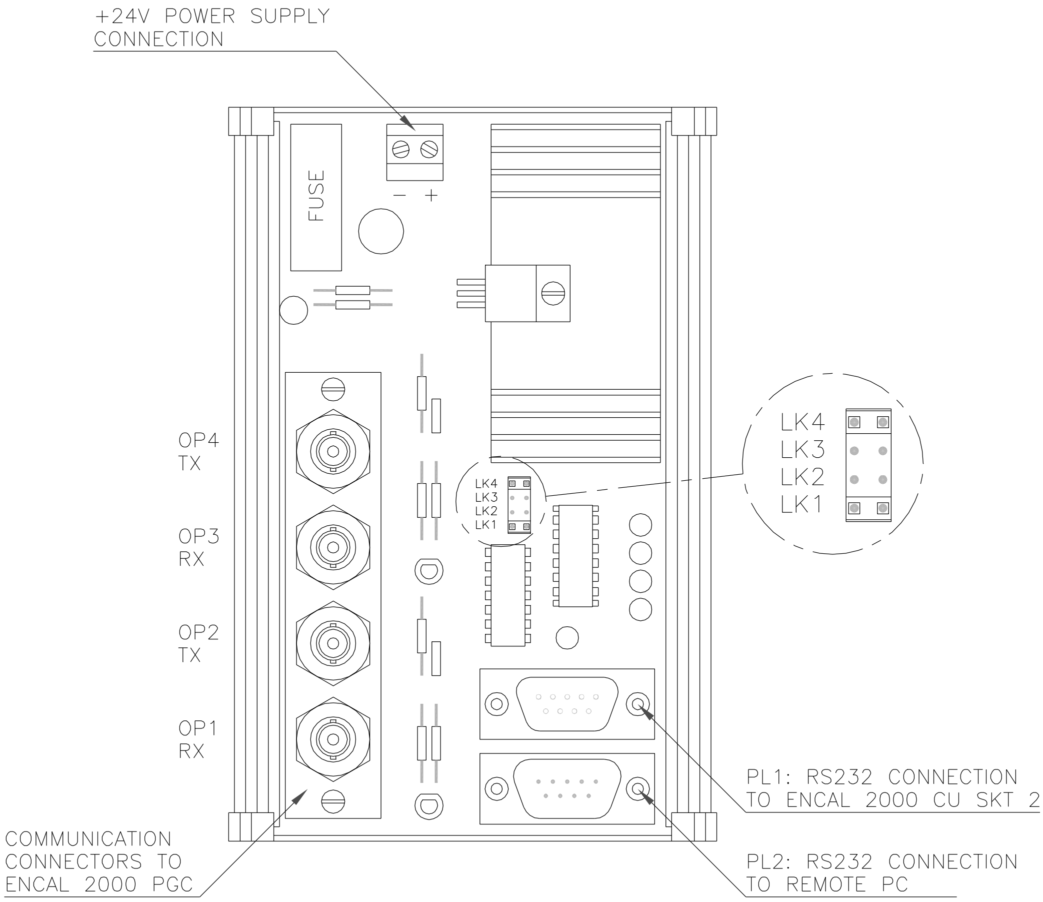


Figure 3-3 ENCAL 2000 Fibre Converter Module

3.2.2 ENCAL 2000 Control Unit

The ENCAL 2000 Control Unit (CU) is designed to provide the interface to the Model 2000 Process Gas Chromatograph (PGC). The Control Unit is connected to the fibre converter module which provides the signal isolation necessary between the hazardous area and the safe area by using a fibre optical data communications link to the Process Gas Chromatograph.
The Control Unit gives local indication of the gas data and status of the Process Gas Chromatograph. It also provides additional serial communication facilities and analogue 0/4-20 mA output signals. All data is tested to ensure that they are within the designed operating limits. An alarm display records the time when alarms occur and are cleared.
A serial data printer output or an internal printer unit can be provided enabling reports to be printed at regular intervals. Multiple serial outputs can be provided for interfacing to Gas Measurement Corrector systems using Modbus (ASCII) protocols.

3.2.3 RGC 2000 Software

The Remote Gas Chromatograph software (RGC 2000) is an application program that runs under the Microsoft "Windows" operating systems. It is designed to monitor, control and configure the ENCAL 2000 PGC. The program can also be used to store data on the PC's hard disk. Some of the functions of the RGC program are listed below.

- Create method tables
- Perform calculations according to ISO 6976
- Program sampling sequence
- Perform calibrations
- Create reports
- Show and print chromatograms
- Store analysis results

The following hardware/software is required as a minimum to run the RGC 2000 software:

- Windows 95, 98, 2000 or NT
- Hard disk (3 GB) file storage device
- Pentium II or higher
- Serial communication port (minimal 1)
- Parallel printer port (or USB) for chromatogram printer
- Optional Modem port (9600 baud)

4 Safety Instructions

Prior to installation and operation of the ENCAL 2000 PGC the following warnings and precautions should always be noted.

SPECIAL NOTICE

The following warnings and precautions are intended for information only. Any International, national, local, or company codes and regulations applicable to the location of the analyser should always be considered and applied. Instromet BV assumes no responsibility for compliance with these requirements.

4.1 General warnings

WARNING !!

The ENCAL 2000 PGC is a 230 VAC or 115 VAC powered apparatus. High voltage connections are located in the EEx-e power supply box and in the EEx-d electronics housing.

WARNING !!

Depending on the configuration of the analyser ; it can weigh up to 175 kg. You should have one or more persons help you lift it and move it.

WARNING !!

When powered the analyser oven will be heated and can reach temperatures up to 150 °C. Do not touch any of the objects inside the Hot Cap without using protection gloves.

4.2 Analysers in hazardous area's

The analyser is designed for use in a hazardous area. The protection types used are EEx "e" (increased safety), EEx "d" (explosion proof), EEx "m" (Encapsulation). Housings which are used as a EEx-d protection housing should not be opened when a hazardous gas is present.
In the ENCAL 2000 two EEx-d housings are used. The first one is the EEx-d Electronics housing. The assembly of the detector cover, detector block, heater block and the connected piping forms the second one. Both EEx-d housing should not be opened in hazardous area.

WARNING !!

Do not open the EEx-d ELECTRONICS HOUSING when an explosive gas atmosphere is present ! Since batteries are present on the digital board in the EEx-d box it is not sufficient to shut of power supply.

WARNING !!

Do not remove the DETECTOR COVER when an explosive gas atmosphere is present !

PRECAUTION

Before working on any electrical part of the analyser ensure that there are no hazardous gasses present in the immediate area of the analyser, as they may create a potential for fire, explosion, damage to property and injury to personnel. Obtain proper work permits such as hot work etc.

4.3 Use of pressurised (explosive) gasses

WARNING !!

Calibration gasses for the analyser are flammable and may form an explosive mixture with air. Follow the applicable safety precautions and use extreme care in making connections.

WARNING !!

Make sure that the sample gas pressure does not exceed the maximum inlet pressure of 10 barg.

WARNING !!

Optimal pressure for calibration and/or reference gasses is 1 barg. For safety reasons make sure these pressures never exceed 10 barg.

5 Installation Instructions

5.1 Unpacking

Remove the analyser and accessory items from the main packing box. Depending on the various options purchased there may be additional items in the main box such as fibre optic cable, converter module etc.

WARNING !!

Depending on the configuration of the analyser ; it can weigh up to 175 kg. You should have one or more persons help you lift it and move it.

5.2 Location of the analyser

The location of the analyser should be selected after considering a number of factors. In some cases existing facilities dictate the location of the analyser. The following factors should be considered in installing the analyser.

- Location of the sample tap in the pipeline
- Availability of utilities
- Environmental conditions
- Relation to other equipment if inter connections are required
- Operator comfort if maintenance is required

When locating the sample tap and analyser location the following should be kept in mind. The optimum condition is to take the sample from the pipeline and transport it to the chromatograph in the shortest possible time. Therefore the location of the analyser should be as close as possible to the sample tap while still considering the other site-selection criteria.

The analyser cabinet has a protection class IP55 and as a consequence the analyser should be protected against the elements when placed outside. Ambient temperature ranges of –20°C to +55 °C are allowed if the analyser is equipped with the optionally available cabinet isolation and heating package. The standard analyser temperature range is +5 to +55 °C.

The maximum distance between analyser and Control Unit or Personal Computer depends on the Fibre optic cable, the optical budget and optic losses in the fibre connections etc. Typically a distance of 1000 meter is possible provided that the Fibre optic cable used is the Instromet BV standard as described in paragraph 6.9.

5.3 Dimensions and weight

The analyser without socket has the following dimensions:

Height: 1863 mm (1963 mm including socket)
Width: 610 mm
Depth: 450 mm

Weight: ± 175 kg (analyser including all available options)

A dimensional drawing is shown in APPENDIX A-11

5.4 Wiring Connections

All wiring connections are to be entered on the right hand side of the analyser cabinet where the analyser connection panel is located. All connection terminals are located in the EEx-e power supply box. This box is equipped with a minimum of one switch and a maximum of four switches. The function of the switches is indicated on the EEx-e box. The switches are used to supply power to the following devices:

SW 1: Analyser / Emergency switch, this is the main switch for the complete analyser cabinet and connected equipment.
SW 2 t/m 4: Cabinet heater / heated sample line(s) / Calibration gas heater(s)

5.4.1 Mains supply/Earth connection

The analyser is either 230 VAC 50 Hz powered or 115 VAC 60 Hz. The applicable power rating is indicated on the type plate (sticker), which is located on the EEx-d electronics housing.

Insert the power supply cable into the analyser using the cable gland indicated with "mains supply". Insert the cable into the EEx-e power supply box and make the connections on the two terminals on the right as indicated in the box. The power supply cable must be a two-wire cable!

The earth connection is already internally wired and the <u>single</u> customer earth connection <u>must</u> be made on the connection panel on the right side of the analyser as labelled. (See Figure 5-1)

For the external earthing or bonding connection a cable lug shall be used so that the conductor is secured against loosening and twisting and that the contact pressure is permanently secured.

The cable entries and closing elements of unused openings in the Ex-d housing shall be certified in type of protection flameproof enclosure "d", suitable for the connection of use and correctly installed.

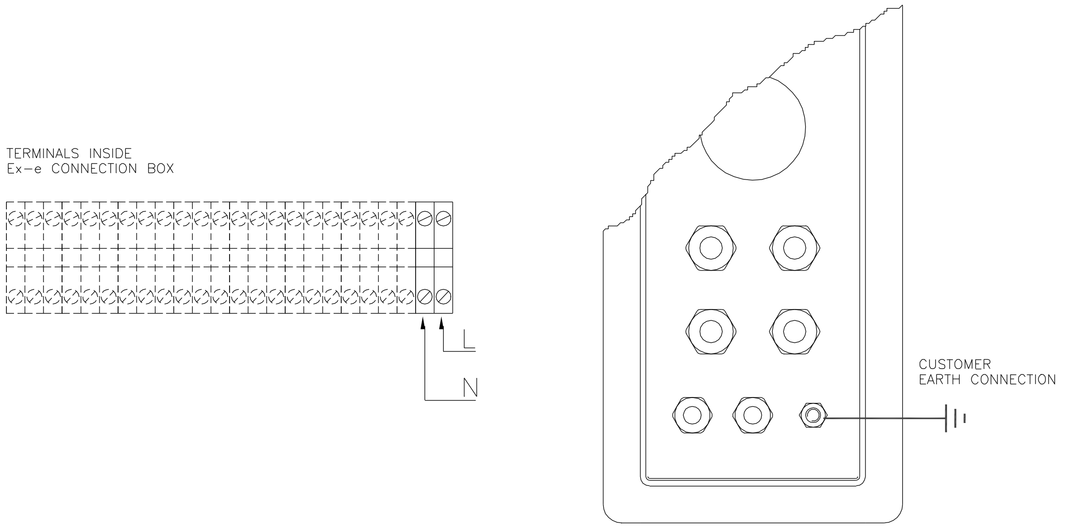


Figure 5-1 Power supply/earth connection

5.4.2 Heat traced sample line(s)

If in the purchase order it is indicated that heat traced sample lines are to be connected to the analyser, the analyser will be equipped with 50 mm glands instead of 1/8” bulkhead connectors for stream 1 and/or stream 2. After inserting the heat traces cable as indicated in Figure 5-2 the cable gland can be “heat-shrunk” to form a watertight barrier.

Additionally the power supply box contains the necessary electrical connections and switches for these heat traced sample lines. The required cable gland to feed the heat tracing connection wire in the power supply box is a M25 cable gland, which will be supplied with the heat tracings (only if the tracing is delivered by Instromet BV). Connect the heat trace cable on the terminals as indicated in the power supply box.

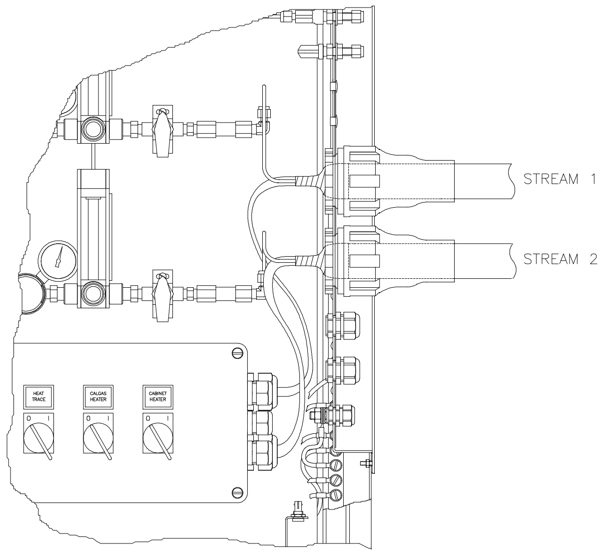


Figure 5-2 Heat trace connection

5.4.3 Calibration gas cylinder heater(s)

To prevent condensation of heavy components in the reference or calibration gas a so-called “calibration gas heater” can be used to heat the gas cylinder. The power supply box in the analyser can provide the power supply for 1 or 2 of these heaters. Provided that this requirement is indicated in the purchase order, the necessary cable glands and switch are provided. Connect the power supply cable of the calibration gas heaters to the terminals as indicated in the power supply box.

5.5 Gas connections

All connections for the Helium (carrier gas), calibration gas(ses), reference gas, and sample gas(ses) are made on the right side of the Analyser cabinet. Refer to Figure 5-3 for these connections. The various connections are also labelled on the panel. All gas connections are Swagelok connections for 1/8” tubes. All gas supplying lines should be of chromatography quality (internally cleaned).

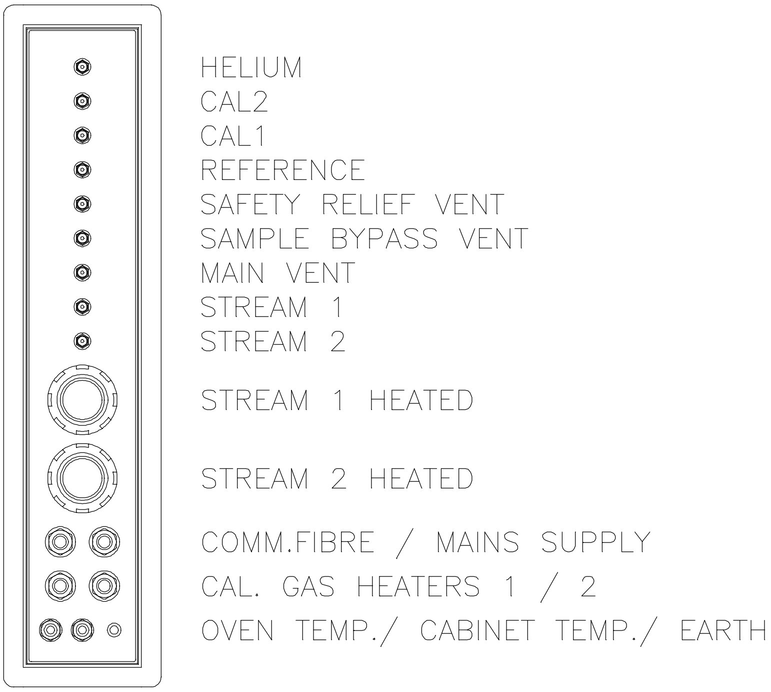


Figure 5-3 Analyser connection panel

5.5.1 Helium

Helium is used as the carrier gas to carry the sample through the chromatograph columns and to cause the component separation. The Helium also serves as the reference gas for the detector. Helium will flow through both the measurement and reference side of the detector and will cool the thermistor beads of the detector. The thermistor beads are very rugged and are not likely to be damaged by contact with air, however, it is best to have Helium flowing through the system when the analyser is powered. The Helium is also used as the actuating gas for the actuation of the sample valve, and in the case of a “double block and bleed” stream-selection system, it will also actuate the stream selection valves.

Connect the Helium supply from the cylinder pressure regulator or if applicable from the Helium switch over system to the port labelled “Helium”. Adjust the He-regulator outlet pressure to approximately 10-12 barg. The Helium regulator in the analyser is set to provide approximately 110-120 PSI for the Column head pressure and 50 PSI for the valve actuation.

5.5.2 Calibration / Reference gas

Calibration gasses and the reference gas should be connected to the ports labelled “Calibration gas 1”, “Calibration gas 2” and “Reference gas”. The pressure regulator on the gas cylinders should be adjusted to provide approximately 1 barg. Since the calibration gas and reference inlets are not filtered or conditioned they have to be clean, free from dust and moisture.

5.5.3 Sample gas

Sample gas can be connected to the ports “sample 1” and “sample 2” or if traced sample lines are used they should be connected in the analyser cabinet to the inlet connectors of the sample conditioning system(s) as indicated in Figure 5-2.

5.5.4 Vent lines

The analyser is equipped with three vent ports which vent the following gasses:

The safety relief vent vents sample gas in case of failure of the sample pressure reducer of the sample conditioning system(s) and sample gas coming from the vent outlet of the "double block and bleed" stream selection valves (if applicable).

The sample bypass vent, vents the sample gas flowing through the sample bypass(es) of the sample conditioning system(s).

The main vent vents the Helium (+ sample gas) coming from the column outlet. This vent line can be used to measure the helium flow through the columns for tuning or trouble shooting.

Optimal installation practice would be to connect a separate vent line to each of the vent-ports. The vent lines should flow free to the atmosphere outside the hazardous areas.

SPECIAL NOTICE

Make sure that the outlet of the vent lines flow to atmospheric pressure. Protect the outlets against wind. Pressure differences in the outlet of especially the MAIN VENT might influence the Helium flow through the columns and could result in unstable retention times.

5.5.5 Leak Detection

All connections and in specific the inlet connection should be checked for leaks. The use of liquid leak check detection methods is not recommended because of the contamination they can cause in the system. We recommend the use of suitable electronic leak check instruments.

CAUTION

Do not use any type of liquid leak detection methods inside the oven at any time

5.5.6 Required utilities

Electrical:

Power supply:	230 VAC 50 Hz or 115 VAC 60 Hz	
Power consumption:	- analyser electronics:	185 Watt
	- cabinet heater:	400 Watt
	- heat traced line:	± 15 Watt/meter [1]
	- calibration gas heater:	200 Watt/heater

Ensure that the power supply is sufficiently fused for the total consumption of the applicable connected options as mentioned above.

Carrier gas:

Type:	Helium 4.5 quality (99.995 % pure)
Consumption:	± 20-25 ml/min This means an annual consumption of approx. 10-13 m^3
Pressure:	10-12 barg

Calibration gas:

Type:	10 or 11 component natural gas. Composition to be advised depending on application
Consumption:	Depending on calibration frequency and analyser cycle time For example: for an analyser with a 7.5 minutes cycle time, a daily calibration of two calibration runs the gas consumption will be less then 150 l/year. (normal conditions)
Pressure:	1-2 barg

[1] Depending on type of heat trace used / check data sheets of the applicable heat trace

5.6 Connections to auxiliary equipment

The ENCAL 2000 PGC communication is established through a four wire fibre optic cable. The connections to the Control Unit and Personal Computer are to be made as followed;

Connect the fibre optic cable delivered with the unit to the fibre optic converter module, making sure the fibre colours match with the internal fibre cable. The fibre cable must be connected as indicated in Figure 5-4

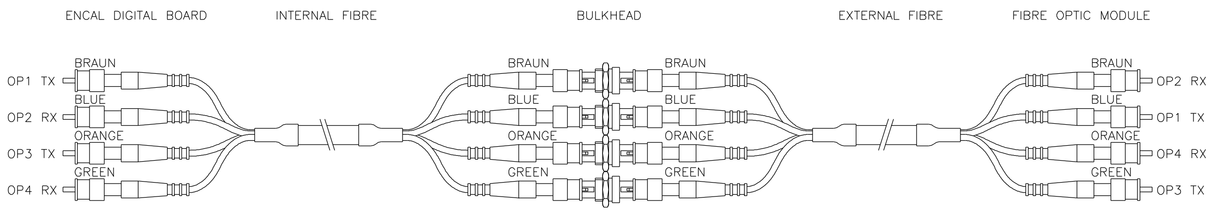


Figure 5-4 Fibre connections

The Fibre Optic Converter module has two 9-pins sub-D ports labelled PL1 and PL2 to connect to respectively, the ENCAL 2000 CU and the Personal computer COM port.

PL1 is directly connected to the SKT 2 connection on the CU back panel using a 9 wire D-type cable (1 to 1). Using the SKT 2 connection on the CU will also provide the Fibre Optic Converter module with the 24 VDC power supply coming from Pin 1 on SKT 2 of the Control Unit

PL2 is connected to an available COM port on the PC. The connection cable used is a 9 wire D-type cable. Depending on the link settings on the board the cable to be used is either 1 to 1 or crossed. If link 1 and 4 are fitted the cable must be crossed. If link 2 and 3 are fitted the cable must be 1 to 1.

6 ENCAL 2000 PGC Hardware

6.1 Analyser Cabinet

The analyser cabinet is a plate-steel cabinet with protection IP55. This means it is protected against dust and water jets. It can be used as a free standing cabinet with an optional socket. If placed outdoors the cabinet is to be protected against direct sunlight and the elements.

The triple surface treatment (Phosphatising, electroforetic dipping primer, structure powder coating) gives optimal protection against corrosion. The cabinet is powder coated in the colours RAL 7035 and RAL 5018

The cabinet can be isolated and heated for applications where ambient temperature might drop below 5 °C. The cabinet temperature will be controlled at 10 °C at ambient temperatures down to –20 °C.

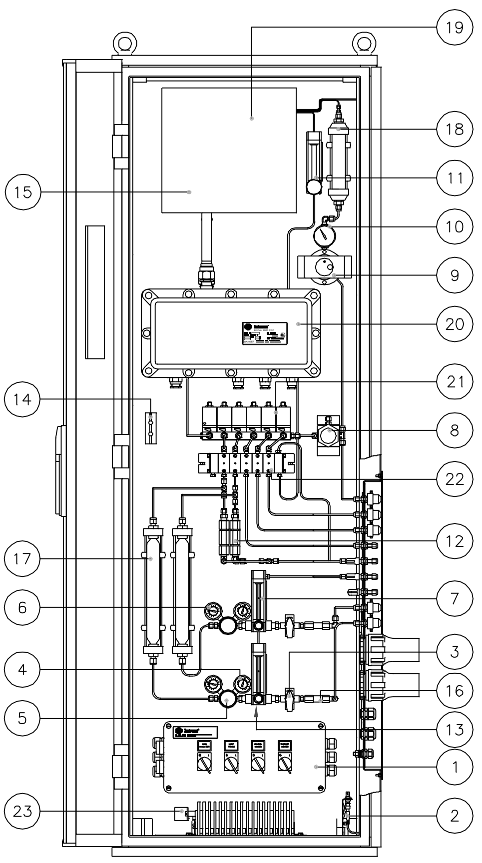


Figure 6-1 Analyser items identification

6.2 Door lock

As a standard the door is equipped with a cylinder lock. The lock is covered by a plate which must be lifted upwards to enable the key to enter the lock. Turning the key counter clockwise will push the door handle forward. Turning this door handle will open the door. As indicated in the figure below.

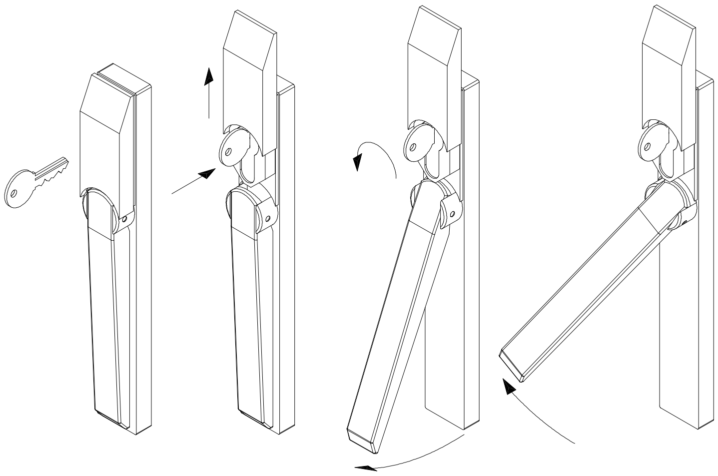


Figure 6-2 Cylinder door lock

6.3 Power supply box

The power supply box is an EEx-ed box located in the bottom of the cabinet where all electrical power connections are established. The electrical diagrams of all possible versions of the power supply box are available in Appendix A-1 to A-6. The power supply box is equipped with one to four EEx-d switches as indicated in Figure 6-3

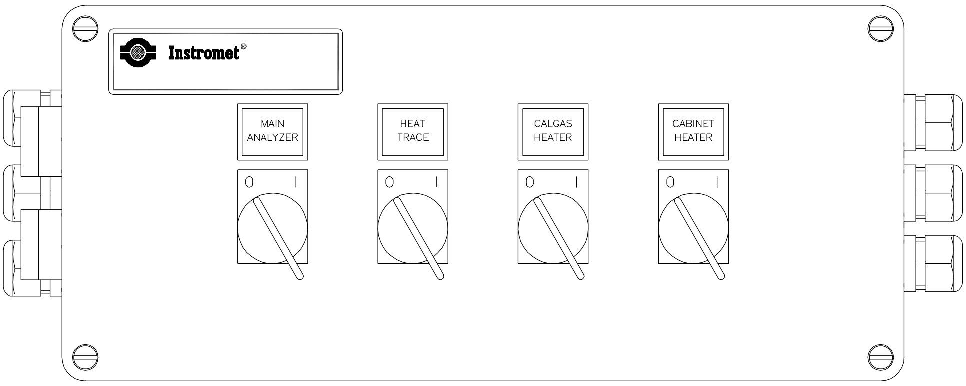


Figure 6-3 Power supply box

6.4 Sample conditioning

The ENCAL 2000 PGC's sample conditioning system has the following functions:

- Pressure reducing
- Removal of harmful contamination in sample gas (moisture and particles)
- Create a sample bypass for fast analyser response

A maximum of two sample systems can be conditioned. Additional streams that need conditioning must be conditioned externally before they are connected to the analyser. The maximum sample pressure that can be connected directly to the analyser is 10 barg.

6.4.1 Inlet filter

Directly at the stream inlet a particle filter 2 µm (item 16) is placed to protect the analyser against contamination in the form of particles in the gas. The filter element can and should be exchanged if the pressure drop over the filter element rises. How to change the filter element is described in paragraph 9.1

6.4.2 Sample bypass system

In many cases the ENCAL 2000 PGC will be placed close to the sample take off point(s). If this is not the case it might be necessary to create a sample bypass system to create a higher flow through the analyser. The sample gas flow through the analyser without sample bypass is approximately 20 ml/min. Depending on the internal volume of the sample line it might take several minutes to get a representative sample to the analyser.

The bypass flow regulator (item 7) can increase the sample flow through the analyser to 60 l/hr (1 l/min.). Increasing the flow will result in a higher pressure drop over the sample line. To make sure that the sample pressure at the analyser will not drop below approximately 1.5 barg a check valve (item 13) is placed at the inlet of the bypass flow regulator, which will close at this pressure. This means that a sample bypass can only be created if sample pressure at analyser inlet is higher then 1.5 barg

6.4.3 Pressure reducer

At the outlet of the sample bypass system the pressure reducer (item 5) will reduce the sample pressure to the desired value. The two pressure gauges indicate respectively the sample inlet pressure and the sample outlet pressure. The sample outlet pressure must be set to 1 barg.
It is important to make sure that calibration gas and sample gas pressure are the same. Small differences are allowed but major differences might result in a less accurate analysis because the sample volume will be injected under different pressures for the calibration as for the analysis of the sample gas.

6.4.4 Moisture filter

To prevent 'wet gas' from damaging the columns inside the oven a moisture filer is used. (item 17). The absorbent inside the filter has been specially developed for natural gas applications. It will not absorb any hydrocarbons (including C_6^+) so the accuracy of the analysis will not be effected. Because of the use of a glass tube the possibility of hydrocarbon bleed associated with plastic bodies is eliminated. The filter has a maximum capacity of 50 grams H_2O total.

6.4.5 Safety relief valve

In case of failure of the internal pressure regulator the downstream system is protected against high pressures by means of the safety relief valve (item 12). This valve will open at pressures exceeding approximately 1.5 barg. Excess gas will be vented to the outlet connection labelled 'safety relief vent'.

6.5 Sample Selection System

The ENCAL 2000 PGC is a 'multi-stream' gas chromatograph. In the maximum configuration there are five streams labelled as follows:

Sample gas 1 and 2:	These are stream connections for sample gas streams coming from process lines which are to be monitored. The sample gas 1 and 2 inlets are connected to the two sample conditioning systems in the cabinet.
Calibration gas 1 and 2:	These connections are used for calibration gasses in gas cylinders. These gasses are considered to be clean and dry. Conditioning is assumed to be unnecessary. (except for calibration gas heaters). These gasses are used to calibrate the analyser and must therefore be certified or at least have an accurately known composition.
Reference gas:	This connection can be used to connect a test gas with an accurately known composition (lab analysis). Periodically analysis of this gas can be used to check the accuracy of the analyser.

All streams are connected to a sample selection system which is controlled by the analyser electronics. The selection of each of streams can either be through a programmed sequence or by manual selection using the RGC2000 software. (For details refer to the RGC2000 software manual). The sample selection valves used for the selection of streams are available in two different versions referred to as either a **"Double block and bleed system"** or a **"Non double block and bleed system"** Both systems are described in the following paragraphs.

6.5.1 Non double block and bleed system

The most straightforward way of selecting between two streams is by means of three-way valves. An analyser with only one stream and one calibration gas connection would use one three-way valve as indicated in Figure 6-4.

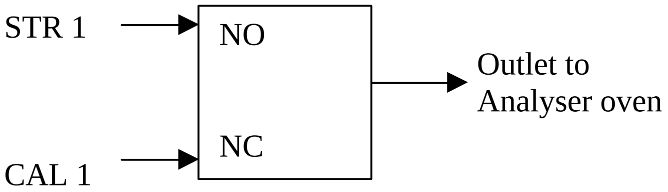


Figure 6-4 Three-way valve selection

The three-way solenoid is electrically actuated directly from the analyser electronics. The configuration is such that in the normally open position the stream 1 gas is always selected.

In case of a system with more then two streams additional valves will be used. A system with the maximum configuration is configured as in Figure 6-5.

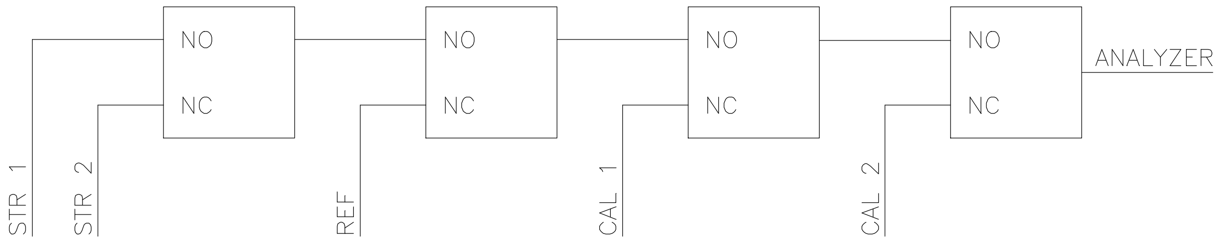


Figure 6-5 Multiple three-way valve system

The advantage of this way of sample selection is the simplicity and relatively low costs of the system. The disadvantage of using three way valves is the possibility of cross contamination of one stream to another in case of malfunction or internal leakage of one of the valves.

On the valve block there is always one valve which is used to actuate the 10-ports sampling valve in the analyser oven compartment. Details concerning the 10 ports valve are given in paragraph 9.5

6.5.2 Double block and bleed system

The double block and bleed system is designed to provide maximum reliability in the sample selection system even in the case of malfunction or internal leakage of one of the valves.

The system exist of several double block and bleed valves (item 22 Figure 6-1) which are pneumatically actuated by the solenoid valves (item 21) controlled by the analyser electronics.

The principle of a double block and bleed valve is indicated in the Figure 6-6 below.

Figure 6-6 indicates that each stream can be blocked twice (double block). Between the two blocking valves there is an outlet which will be opened in case the blocking valves are closed. In this situation a possible leakage of the first blocking valve will be vented (bleed function). The “bleed” valve will be closed as soon as the two blocking valves are opened. This will result in the situation as indicated for stream 1 in Figure 6-6. The connected stream gas will flow to the sample gas flow meter and then to the oven compartment. Because of the bleed function of this system it is not possible that a leakage of any of the blocking valves could lead to mixing up of the streams and as a consequence, faulty analysis.

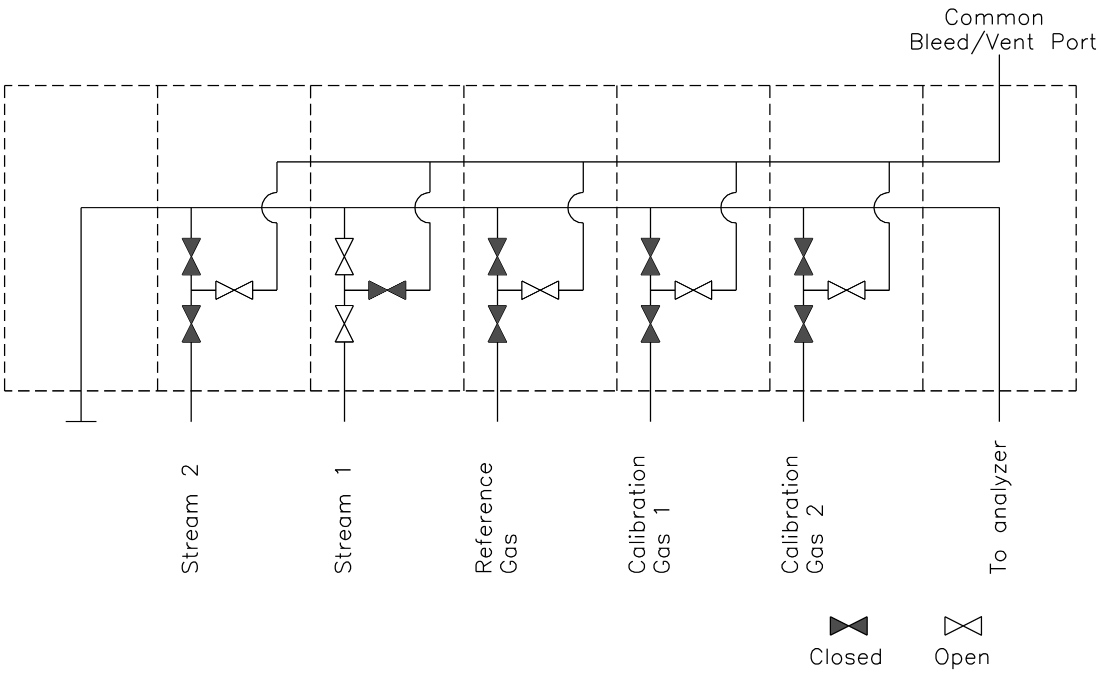


Figure 6-6 Double block and bleed principle

6.5.3 Sample flow regulator

At the outlet of the sample selection system a flow meter with regulator (item 11 Figure 6-1) indicates the sample gas flow which is flowing through the sample loop in the oven. This flow should be adjusted to approximately 20 ml/min.

6.6 Helium regulator and Helium moisture filter

The carrier gas for the ENCAL 2000 PGC is Helium. The Helium's supply pressure to the analyser is 10-12 barg. The required column "head pressure" is approximately 8 barg. The ENCAL's internal Helium pressure regulator (item 9, Figure 6-1) is normally set to approximately 120 PSI (approx. 8.5 barg). The outlet of the pressure regulator is connected to a moisture filter that will remove any unexpected moisture from the Helium gas.

6.7 Electronics

The analyser electronics are housed in the EEx-d enclosure (item 20). The EEx-d box-cover can be removed by loosening the 12 Hex-nuts.

Cable entries are made using EEx-d cable glands M20. If for any reason a cable glands is loosened (e.g. replacement of solenoid valve) make sure it is tightened so that the grommet fits tightly around the cable. If a cable is completely removed, the cable gland should be plugged off or replaced by a M20 plug.

WARNING !!

Do not open the EEx-d ELECTRONICS HOUSING when an explosive gas atmosphere is present ! Since batteries are present on the digital board in the EEx-d box it is not sufficient to shut of power supply.

The electronics can be divided in three parts which are discussed in the following paragraphs.

6.7.1 Power supply filter

This noise filter is placed in the same housing as the electronics boards and for EMC / CE reasons the filter is separated from the electronics board by means of a perforated plate which prevents disturbance of sensitive signals (e.g. detector signals). In the perforated housing of the filter a 1.25 Ampere slow acting fuse is fitted (in case of a 110 VAC unit this value is 2.5 Ampere).

6.7.2 Power supply board

Besides the obvious AC-DC converter the power supply board also provides the power connections for the valves of the sample selection system and for the 10 ports valve actuation as well as the power connections for the oven heater cartridges and the max-temperature protection switch. For the electrical connection diagram refer to appendix A-7. Several fuses are located on the power supply board as indicated in Figure 6-7.

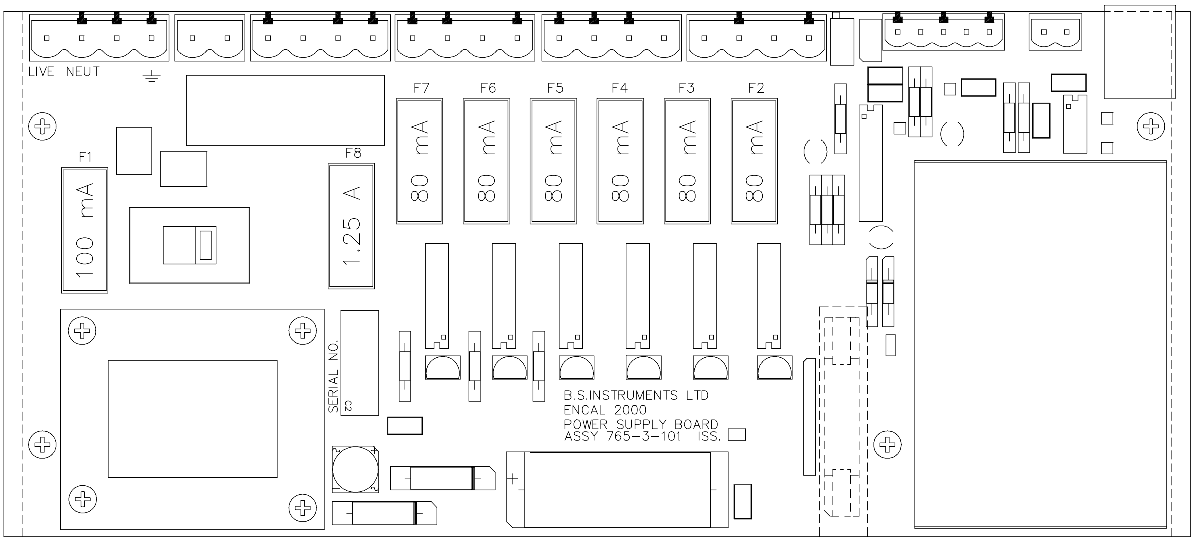


Figure 6-7 Location and values of fuses on the power supply board (230 VAC)

Fuse values for 230 VAC analyser:		Fuse values for 115 VAC analyser:	
Fuse 1	: 100 mA	Fuse 1	: 200 mA
Fuse 2 - 7	: 80 mA	Fuse 2 - 7	: 160 mA
Fuse 8	: 1.25 A	Fuse 8	: 2.5 A
Fuse Noise filter	: 1.25 A	Fuse Noise filter	: 2.5 A

A thermocouple (type J) connector is available on the right side of the board for readout of the oven temperature. The temperature can be adjusted by adjusting the potentiometer located next to the red LED.

6.7.3 Processor board

This board contains the embedded software, the internal memory, the two communication ports with fibre connections, and the connections to the analyser oven compartment.

Two batteries are located on this board. They are used to power the internal clock device in case of power failure. These batteries have typical life time of 10 years. The specifications of the batteries are:

Make:	Duracell
Type:	Lithium Coin Cell CR 2325
Capacity:	190 mAh

On the board there is a dip-switch module whose settings are not to be changed. The standard factory setting is that switch 1 and 2 are in the ON position and switch 3 to 8 in the OFF position.

The LEDS on the top of the board indicate which of the valve outputs is activated. LED1 (left side) is always the 10 ports membrane valve. LED2 to LED6 represent the stream selection valves. In case of a double block and bleed system the LEDS represent the following streams;

LED 2: Stream 2
LED 3: Stream 1
LED 4: Reference gas
LED 5: Calibration gas 1
LED 6: Calibration gas 2

For non-double block and bleed units the LED2 to LED6 represent different streams depending on the configuration of the analyser.

Note: If none of the LEDS 2 to 6 are illuminated, stream 1 is always active. This can be derived from Figure 6-5. (If all valves are in normally open position stream 1 will be flushing through the system).

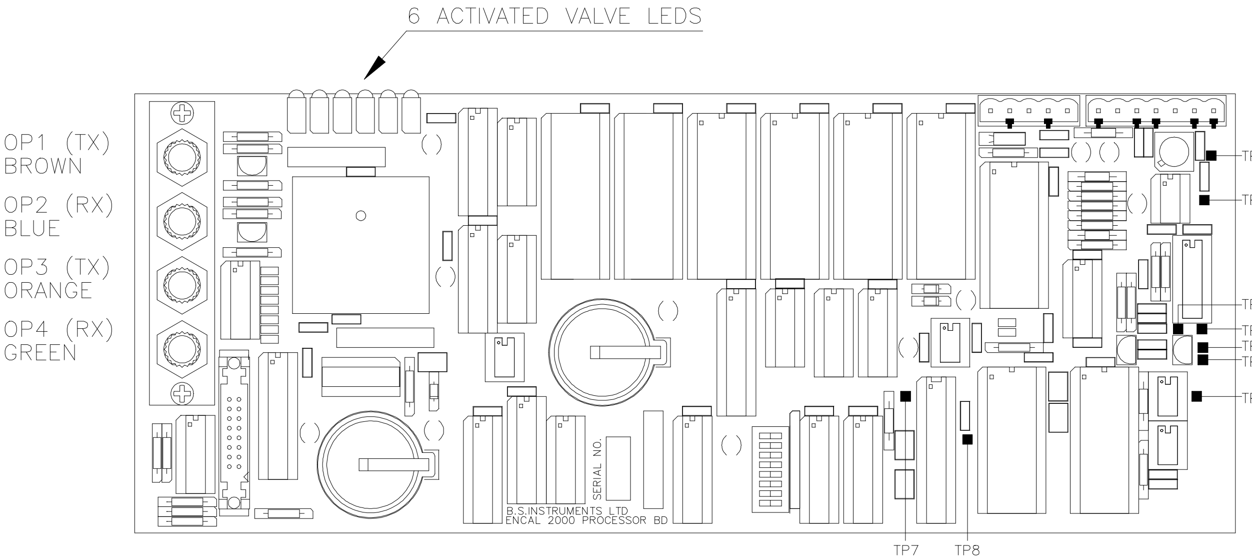


Figure 6-8 Processor board

6.8 Oven compartment

The insulating cover also referred to as the "Hot Cap" forms the housing of the oven compartment. The oven compartment contains a heater block, the detector block, as well as the analytical columns and the10 ports membrane valve for sampling and column switching.

The heater block is heated by means of two heater cartridges and its temperature is controlled to approximately 135 °C. The detector block and 10 ports sampling valve are mechanically connected to the heater block and will also obtain a temperature of 135 °C. The analytical columns are micro-packed columns and are located in the chamber of the heater block and covered by the so-called column cover. The following paragraphs provide more detailed information concerning these items.

6.8.1 Detector block

The ENCAL 2000 PGC uses a highly sensitive TCD (thermal conductivity detector). The detector exists of a measurement and a reference side both consisting of a thermistor element which is placed in the gas stream. The reference side is constantly flushed with pure Helium. The measurement side is connected to the column outlet side and will be flushed with Helium and with the separated natural gas components. The thermistors are connected to the analyser electronics through the piping connecting the heater block with the EEx-d housing

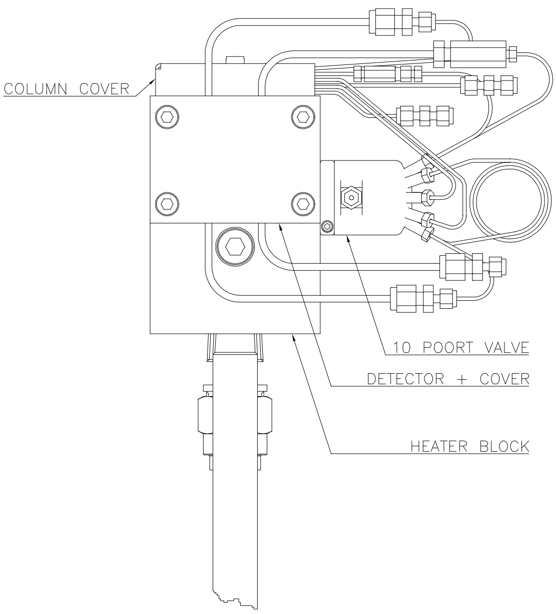


Figure 6-9 Oven compartment components

6.8.2 Columns

The ENCAL 2000 PGC uses the so called “backflush to measure” technique. The application uses three micro-packed columns (1/16” OD). The column set designed especially for Instromet, enables the ENCAL 2000 PGC to use a single valve only, for both injecting the sample and switching the backflush column.

The column configuration and connections to the 10 port valve and detector block can be found in appendix A-8.

6.8.3 Sample loop

The sample loop is directly mounted to the membrane valve’s connection port no. 3 and 10. It is a piece of stainless steel tubing (OD 1/16”) with a certain internal volume (approx. 200-350 µl). During an analysis the sample loop is flushed with sample gas. At the start of an analysis the 10 ports valve will be switched and “inject” the gas in the sample loop on the analytical columns. The volume of the sample loop has a big influence on the peak height and peak area and also on the peak separation and as a consequence on the accuracy of the analyser.

Do not replace the sample loop with self-manufactured loops as the performance of the analyser is no longer guaranteed!

For pre-manufactured replacement loops refer to appendix A-12

6.8.4 Sample valve

The sample valve used for injection of the sample and switching of the backflush column is a 10 ports membrane valve which is pneumatically actuated by one of the solenoid valves from the sample selection system. In both ‘double block and bleed’ and ‘non double block and bleed’ systems this is the solenoid valve located on the far left. The inlet side of this solenoid is connected to the Helium pressure regulator for the valve actuation (item 8, Figure 6-1). This pressure regulator is set to 50 PSI, which is the pressure needed to actuate the 10 ports injection/backflush valve.

The 10 ports membrane valve is a highly reliable valve with a guaranteed lifetime of 1.000.000 actuations. This is equivalent to a lifetime of at least 10 years in the ENCAL 2000 PGC system.

The mini diaphragm valve consists of plungers and ports arranged in a circular pattern, with the plungers controlled by the reciprocation action of two Helium actuated pistons. Maintenance procedures are greatly simplified, since a single screw holds the valve together and locating pins insure proper alignment. Extremely long lifetime, very short actuation time (10 milliseconds), minimum internal dead volume, and reliability make this type of valve very successful in process gas chromatography for both sample injection and column switching. Figure 6-6 shows the working principle of the valve.

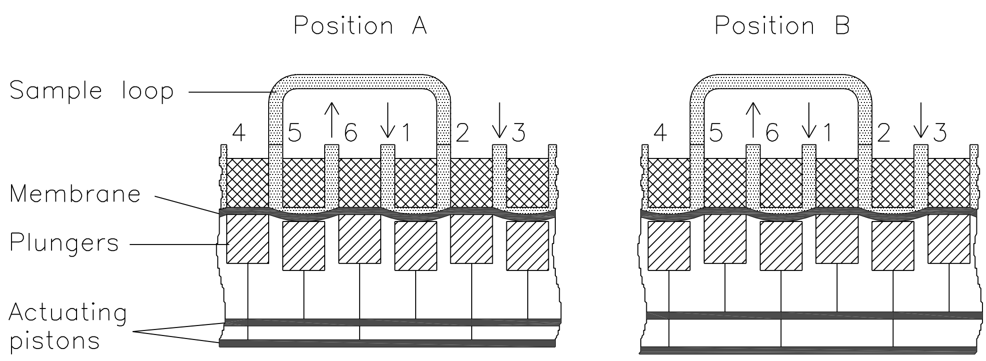


Figure 6-10 Membrane valve principle

6.8.5 Backflush to Measure principle

Backflush to Measure is a technique that treats Hexane and heavier hydrocarbons as a single component, which is collectively known as C6+.

The technique relies on the components' property where its elution time is proportional to molecular weight. The column that performs the physical separation of components is split into two sections, a backflush and main column. The backflush column is much shorter than the main column.
Prior to sample injection, the columns are configured such that the components first elude through the backflush column and then through the main column (The backflush column is upstream of the main column). The sample is injected onto the backflush column. The lighter components quickly elude from the backflush column and enter the main column. At a point in time where only C6+ remains in the backflush column, the columns are re-configured by switching the 10 port valve. Flow through the backflush column is reversed and is placed downstream of the main column.

The C6+ components that have begun to separate recombine in the backflush column due to reversal of flow direction. Due to this reconfiguration, the C6+ component is the first to encounter the detectors and elude from the columns. The other components that have passed on to the main column now enter the backflush column (for the second time) and then flow past the detectors. The column reconfiguration is achieved via valve switching. The backflush valve time is the time in seconds after sample injection that this column reconfiguration occurs. Setting this time is crucial to repeatable energy measurement results.

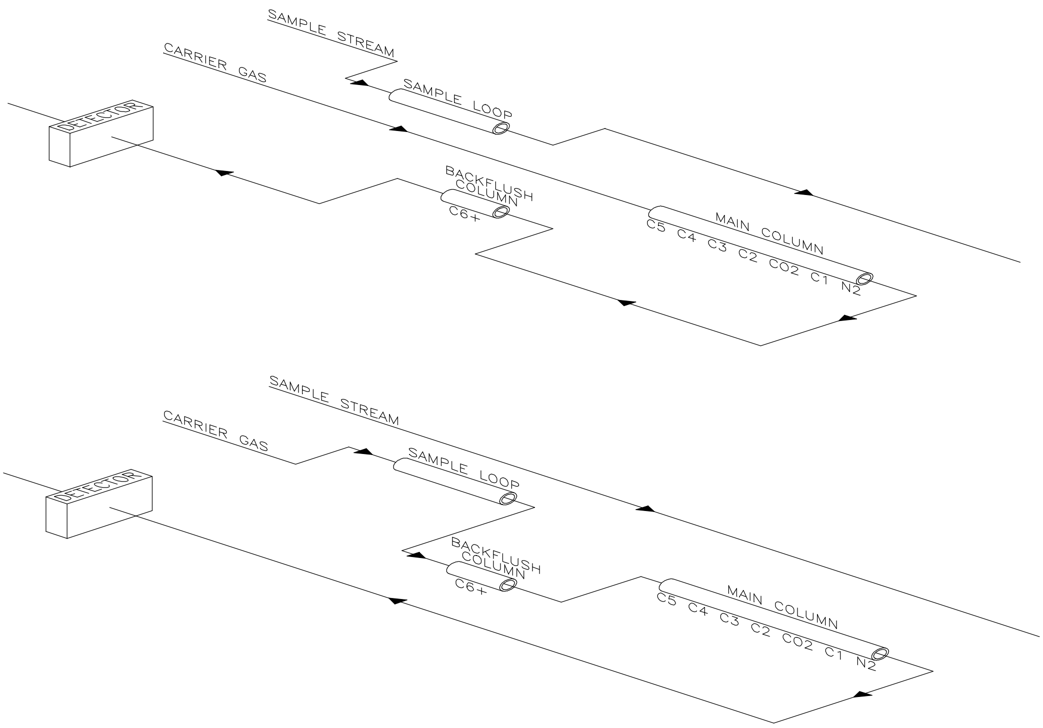


Figure 6-11 Backflush principle

6.9 Fibre Optic Cable

The communication fibre is an industrial type cable with four type ST connectors.
The internal fibre cable is connected to the processor board in the EEx-d enclosure and to the customer connection point (item 2, Figure 6-1). The external fibre must be connected to this customer connection point and the other side to the fibre optic converter module (Figure 5-4)

The optical budget which is available from the optical transmitters is –20,0 dBm. Losses over external fibre cables (not supplied by INSTROMET) must not exceed this optical budget.
The wavelength of the used light source is 850 nm.

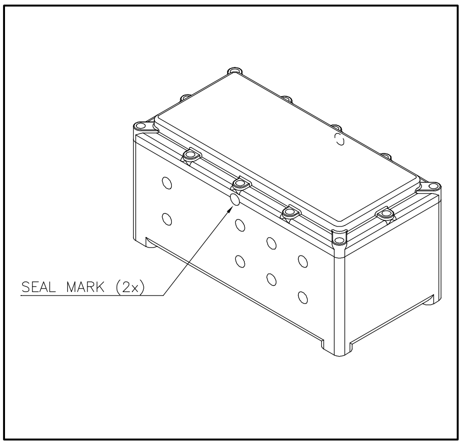
6.10 Sealing facilities

Depending on company codes and/or government regulations it might be required to seal certain parts of the analyser. The sealing possibilities offered by the ENCAL 2000 PGC are both software and hardware “seals”. The analyser control unit can be set to run in secure mode which means that certain parameters in the analyser can not be changed using the RGC2000 software.

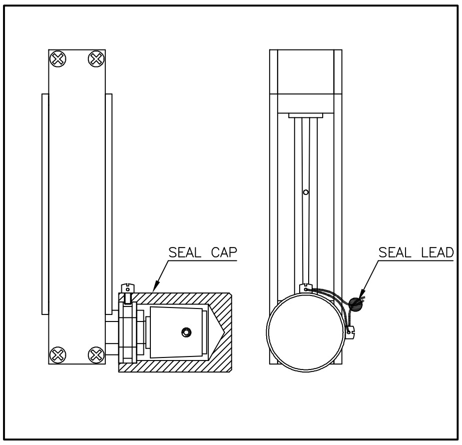
Hardware sealing facilities are available for the following analyser parts:

- Oven isolation (hot cap)
- EEx-d Electronics housing
- Sample flowmeter/regulator
- He-carrier gas pressure regulator

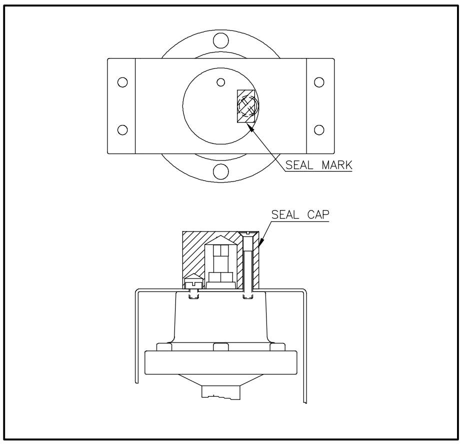
In the following figures the sealing facilities are shown



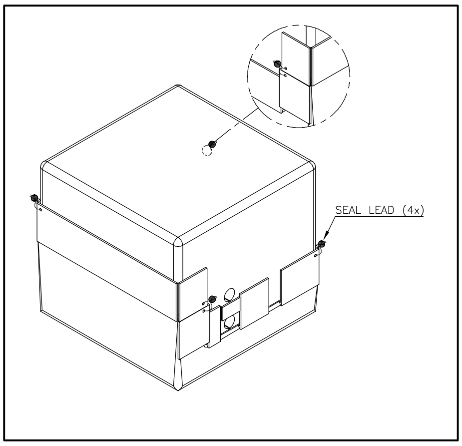
EEx-d Electronics housing



Sample flowmeter



Helium pressure regulator



Hot Cap

Figure 6-12 Sealing facilities

7 Options

The following paragraphs describe the options that are available on the ENCAL 2000 PGC.

7.1 Heated sample line connections

For applications where the ambient temperature might drop below the sample gas dew point, it is recommended that heated sample lines be used. If these traced sample lines are connected to the analyser sample inlets, it is possible to make the power supply connection for the heated sample line(s) in the EEx-ed power supply box. An extra EEx-d switch is built in next to the analyser mains switch in the cover of the box and also the terminals in the box are fitted for a maximum of two heated sample lines.

Additionally two cable glands are located in the right hand side of the power supply box to insert the heating cable into the box. The heated sample line itself can be inserted through a 50 mm cable gland in the connection panel (see Figure 5-2)

7.2 Calibration gas heater connections

Due to legal or other applicable regulations it may be required that calibration gasses must be stored or installed at temperatures above +5 °C. Below this temperature heavy components like C_6^+ might condensate and result in a different gas mixture. Calibration gas heaters may be used to control the calibration bottle temperature.

If calibration gas heaters are placed near the analyser the electrical connection for maximum two heaters can be made in the ENCAL 2000 PGC power supply box.

7.3 Analyser Cabinet Heater

The ENCAL 2000 PGC can be heated by means of an EEx-d heater on the bottom of the cabinet. This heater will always be used in combination with insulation of the cabinet. The heater is controlled by a thermostat which will switch in at 10 °C. The analyser with the cabinet heater option can be used in environments where ambient temperatures drop to a minimum of –20 °C.

7.4 Oven/Cabinet temperature sensors

For diagnostics or alarming purposes the analyser oven as well as the analyser cabinet can be equipped with a Pt-100 temperature sensor. Three wire Pt-100 sensors can be used via an external signal isolator to any read out/alarming device.

7.5 Enhanced analysis by extended analytical column

For some applications where enhanced accuracy is required it is possible to have an additional analytical column installed which provides enhanced peak separation and as a consequence, enhanced accuracy. Analysis time will be about 12-13 minutes instead of 7.5 minutes. For details we suggest the Instromet sales office in your country or Instromet BV in the Netherlands be contacted.

8 Start-up/Operation

Since the operation of the analyser is mainly controlled through the RGC 2000 software programme, this paragraph is restricted to the settings that can be made to the analyser hardware.
For parameter settings etc. refer to the RGC 2000 user manual.

SPECIAL NOTICE

Before starting up the analyser ensure the installation conforms to the description in the installation section of this manual (SECTION 5
Installation Instructions**).**

SPECIAL NOTICE

Oven temperature and Helium pressure are normally factory set and should not be changed unless discussed with your INSTROMET service contact person.

WARNING !!

Do not open the EEx-d ELECTRONICS HOUSING when an explosive gas atmosphere is present ! Since batteries are present on the digital board in the EEx-d box it is not sufficient to shut of power supply.

PRECAUTION

Before working on any electrical part of the analyser ensure that there are no hazardous gasses present in the immediate area of the analyser, as they may create a potential for fire, explosion, damage to property and injury to personnel. Obtain proper work permits such as hot work etc.

8.1 Power supply

The power supply to the analyser can be turned on by switching the left switch, labelled “Analyser Mains” on the EEx-ed power supply box. It is recommended that the power supply be turned on only if the Helium is connected and flowing through the system.

8.2 Oven temperature

The oven temperature is factory set between 130-145 °C. The temperature can be read out either through the optional oven temperature sensor or by connecting a Type J temperature reader to the connector on the processor circuit board.

Change the temperature to the required value by adjusting the potentiometer (POT 1) on the front of the processor circuit board. Turning the potentiometer screw clockwise will result in higher temperature. By turning it counter-clockwise the temperature will decrease. Next to this potentiometer a red LED is located. If this is constantly illuminated the temperature is increasing to the new set point. If the oven temperature is decreasing to the set point the LED will be extinguished. If the temperature has reached the set point the LED will start blinking.

NOTE: Do not adjust oven temperature above 150 °C. The oven is protected by a maximum temperature switch which will become active and cut power supply to the heater cartridges if the oven temperature exceeds ± 150 °C.

8.3 Helium pressure

The Helium pressure is controlled by the Helium pressure regulator (item 9, Figure 6-1).
To prevent unintended adjustment of the regulator, the piston is locked by means of the hex-nut; there is no knob mounted on the piston. To adjust the Helium pressure, loosen this Hex-nut and turn the piston by using a 5/16” hex wrench.

WARNING !!

Maximum allowable Helium pressure is 125 PSI. Do not increase Helium pressure above this maximum for Helium leakage at moisture filter could occur.

8.4 Temperature stabilisation period after power up

After power-up the analyser should be allowed to stabilise for at least two hours before any analysis can be made and the system can be tuned. Complete stabilisation will be reached after approximately 24 hours of analysis.

8.5 Sample pressure

Adjust the outlet of the sample pressure regulator(s) (item 5, Figure 6-1) to 1 barg. This must be done for all available stream connections. The Calibration gas supply pressure should also be adjusted to 1 barg.

8.6 Sample flow

Sample flow can only be adjusted if a stream is selected and gas is running through the sample flow meter (item 11, Figure 6-1). The sample flow must be set at approximately 20 ml/min.

9 Maintenance

This section describes the hardware components of the ENCAL 2000 PGC that require maintenance. The frequency of the replacement of consumable parts often depends on the quality of gasses and the environmental conditions of the analyser. Therefore, the typical frequencies of replacement and/or lifetime of certain parts mentioned in this section may not be relevant in all situations.

9.1 Sample gas particle filters

Particle filters are mounted in the inlet sections of the sample conditioning systems (item 16, Figure 6-1). These filters contain a sintered filter element 2µm. To replace the filter element first make sure the sample connection to the applicable sample stream is shut off. Remove the sample connection at the filter’s inlet side. The filter can be removed by turning it out of the blocking valve. The filter body exists of two parts screwed together. By loosening the two parts the filter element becomes visible and can be replaced. (see Figure 9-1). Re-assemble the filter and replace the old Teflon tape on the NPT connections. Make sure the first pitch is free from tape as excessive tape might be cut-off when the filter is reassembled and will then clog-up the system. Re-connect the filter to the closing valve and to the stream inlet connector. Always check for possible leakage after filter replacement. When finished the system must be flushed for a number of analyses to remove any air from the system.

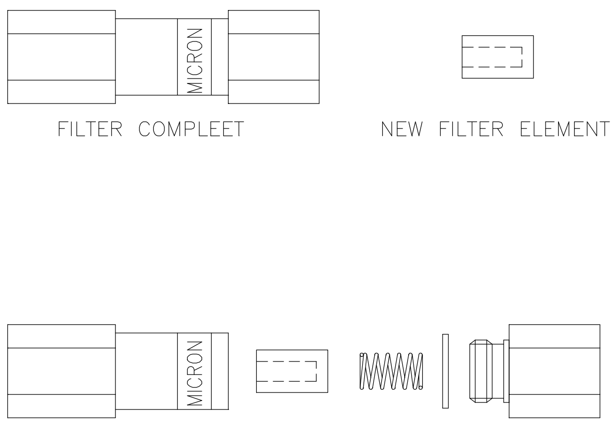


Figure 9-1 Disassembly of particle filter

The best way to determine if the filter has to be replaced is to check the pressure drop over the filter element.

9.2 Sample gas moisture filter

To prevent ‘wet gas’ from damaging the analytical columns a moisture filter is used. (item 17, Figure 6-1). The absorbent inside the filter is especially developed for natural gas applications. It will not absorb any hydrocarbons (including C_6^+) so the accuracy of the analysis will not be effected. Because the use of a glass tube the possibility of hydrocarbon bleed associated with plastic bodies is eliminated. The filter has a maximum capacity of 50 grams H_2O total.

WARNING !!

If the moisture filter is exchanged, take great care while loosening the connectors. The Inner glass tube can easily break if it is exposed to friction or bending.

The complete filter must be replaced typically every two years. To replace the filter, shut off the closing valve of the applicable stream. Loosen the ¼” swagelok nuts as indicated in Figure 9-2. A 9/16”wrench must be used for the nut and a 13/16” wrench for the connector body. While loosening the nut the connector body should be kept in place to prevent friction on the glass tube. Connect the new filter and tighten the two ¼” swagelok nuts following the same procedure.
After opening the closing valve of the applicable stream the system should be checked for leakage. The connectors on the glass tube use PTFE ferrules. Possible leakage at this connection must be handled with care for the glass tube might break if the tightening of the connectors is not performed correctly. To make the connections to the glass tube accessible the aluminium grey nuts on the Perspex protection tube must be loosened. The protection tube can now be moved upwards or downwards. Use a Hex wrench 7/8” for the nut and a 13/16” hex wrench for the counterpart. To tighten the connection the nut must be turned while the counter part is kept in place. (see Figure 9-2).

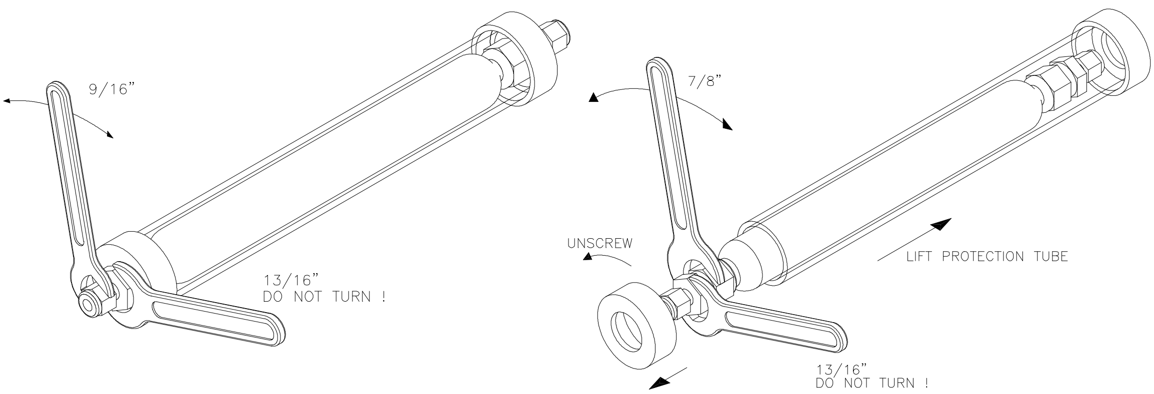


Figure 9-2 Moisture filter replacement

After replacement of the filter the system must be flushed for a number of analyses to remove any air from the system.

9.3 Helium moisture filter

If the absorbent in the Helium filter is saturated the blue particle will turn yellow/white. To refill the filter shut off the Helium supply to the analyser. Loosen the inlet and outlet connections to the moisture filter (5/16" hex wrench). Remove the filter from the mounting brackets and remove the black top cover of the filter. Replace the saturated absorbent by new absorbent. Re-install the filter and make sure all connections are gas tight. Restore Helium supply to the analyser and flush the filter by loosening the 1/16" outlet connection for about 10 seconds. This flushes the air out of the system. However a number of analyses must be run before the analyser becomes stable again.

9.4 Check valve adjustment

Each of the sample conditioning systems contains two adjustable check valves. One at the inlet of the bypass flow meter (item 13 Figure 6-1) and one at the outlet of the moisture filter (item 12 Figure 6-1). The functionality is described in paragraph 6.4.2 and 6.4.5. The factory setting for these check valves 1 is 1.5 barg. If for any reasons the opening pressure of any of these check valves has to be adjusted the following sequence should be followed.

Check valve 1 (item 13, Figure 6-1)

- Remove sample pressure
- Disconnect inlet connection and moisture filter connection
- Remove complete sample inlet assembly (all parts upstream from the moisture filter)
- Remove mounting bracket from flow meter
- Remove check valve
- Adjust check valve to desired pressure as indicated in Figure 9-3.
- Re-assemble in the reverse sequence

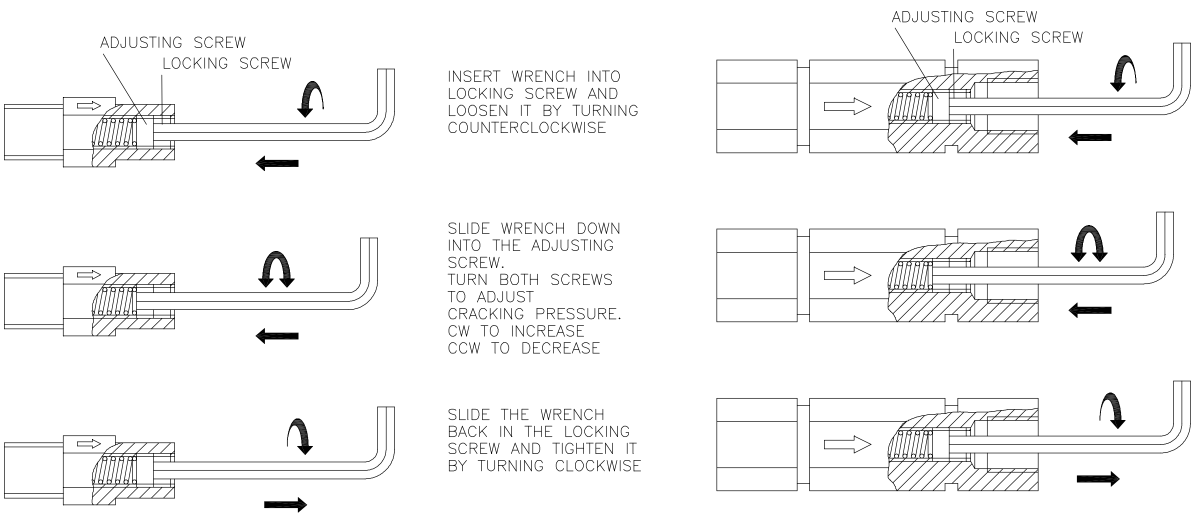


Figure 9-3 Check valve adjustment

Check valve 2 (item 12, Figure 6-1)

- Loosen the mounting screws of double block and bleed valves manifold, or the inlet connections to non double block and bleed valve sample selection system if applicable.
- Remove all connections to the check valve
- Remove check valve from the mounting bracket
- Adjust check valve switching pressure analogue to Figure 9-3
- Re-assemble in the reverse sequence

9.5 Membrane valve

The membrane valve does not require any maintenance for years as long as clean gasses are used. If the membrane has become filthy this will normally result in irregularities in the chromatogram. To replace or clean the membrane the hex screw on the top of the valve should be removed with a 9/64” Allen wrench by turning it counter clock wise (see Figure 9-4). Remove the valve head from the valve body. (Make sure the positioning pins don’t fall out) Remove the membrane from the positioning pins and clean with a piece of cloth or replace with a new membrane.
Note: The membrane is marked with “TOP”, this side must face the valve head!

After positioning of the membrane the head can be mounted. The positioning pins are also used for the positioning of the valve head. The hex nut should be turned tight. (clockwise)

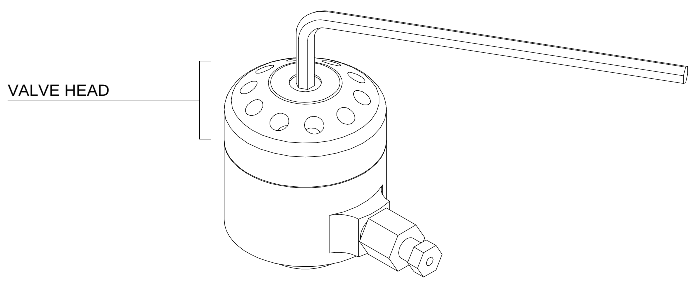


Figure 9-4 Membrane 10-ports valve replacement

9.6 Column replacement

Replacement of analytical columns must be carried out with the utmost care. The columns are 1/16” tubes with a very small wall thickness and can easily crack. To replace any of the columns, shut off the power of the analyser and allow the oven to cool down.

Remove the column cover (see Figure 6-9) and replace the relevant column (1/4” hex key). After replacement of the column the analyser will need up to one day to stabilise completely.

9.7 Detector block replacement

In case of detector failure we recommend replacing the detector block and have it repaired by Instromet. Replacement of thermistors is not possible since they have to be matched and tested under special conditions. Replacement of the detector block must be done according to the following description.

WARNING !!

Do not remove the DETECTOR COVER when an explosive gas atmosphere is present!

PRECAUTION

Before working on any electrical part of the analyser ensure that there are no hazardous gasses present in the immediate area of the analyser, as they may create a potential for fire, explosion, damage to property and injury to personnel. Obtain proper work permits such as hot work etc.

WARNING !!

When powered the analyser oven will be heated and can reach temperatures up to 150 °C. Do not touch any of the objects inside the Hot Cap without using protection gloves.

After taking the required precautions, first remove Helium pressure from the system. Remove the “hot cap” and loosen the detector cover (4 x hex bolt) using an Allen wrench 5 mm. While removing the detector cover keep the detector block in place by taking hold of the connecting tubes to the detector block. After removing the detector cover two of the hex bolts can be used to keep the detector block in place. Remove the wiring to the thermistors. Loosen the connectors to the in- and outlet tubes of the detector using two 7/16” hex wrenches.
The detector block can now be removed.

Installation of a new detector block must be done in the reversed order. Make sure the detector wiring insulation is properly protected to prevent the wires from contact with the detector cover!

NOTE: The detector wiring to measurement and reference detector should not be switched! The green and white wire must be connected to the left thermistor labelled **R** (Reference) and the red and black wire must be connected to the right thermistor labelled **M** (Measurement).

Restore the Helium supply to the system and check for potential leakage using an electronic Helium leak check device. Reinstall the “hot cap” and allow the system to stabilise for at least 3 hours. Refer to the RGC 2000 software manual for bridge balancing and fine tuning.

9.8 Solenoid valves

The solenoid valves in the ENCAL 2000 are used for the stream selection and for the actuation of the membrane valve. Depending on the analyser version the following solenoid valves are used.

The double block and bleed unit uses solenoid valves for the actuation of both the double block and bleed valves and the 10-ports membrane valve. These solenoids are mounted on a base plate with a common inlet. Helium is used for the valve actuation. The valves can be powered with 230 VAC or 115 VAC.

Figure 9-5 shows the valves and indicates where O-ring seals are located. The coil can be removed by removing the hex nut on top of the valve using a 14 mm wrench. After the coil has been removed the black plate covering 4 torque screws must be removed. The valve can then be removed from the base plate by unscrewing 2 of the 4 torque screws with a torque 20 key. Re-assembling the valve must be done in the reversed order. The 14 mm Hex nut should be tightened with a maximum force of 5 Nm. For part numbers of the valves refer to the spare parts list in Appendix A-12.

The non-double block and bleed unit uses 3/2-way solenoid valves (stainless steel) for the stream selection. One 3/2-way solenoid valve (brass) is used for the actuation of the 10-ports membrane valve. These valves are not base plate mounted but have their own “valve assembly” with in- and outlet ports. The valves are mounted on a bracket. To remove one of the valves the mounting bracket should be taken from the mounting plate making the M4 bolts screwed in the valve assembly accessible. Figure 9-5 shows how the valve should be disassembled.

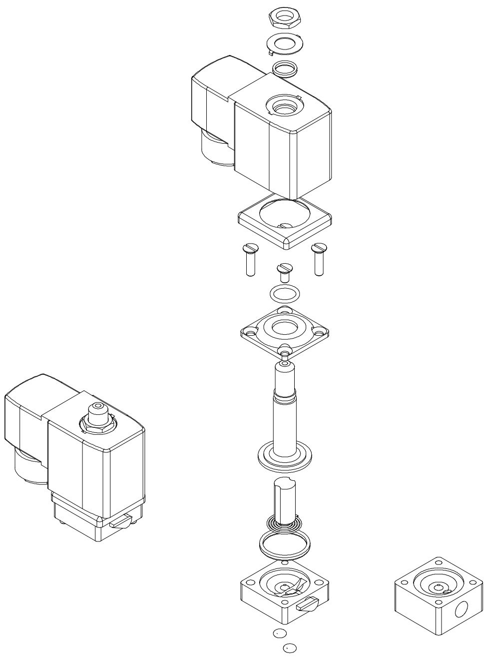


Figure 9-5 3/2 way solenoid valve

9.9 Electronics repair

In case of suspected failure to the electronics the following checks can be made.

9.9.1 Power supply check

The power supply board converts the mains power (230/115 VAC) to +/- 15 VDC and 5 VDC signals which power the Processor board. Refer to the 'Electronic Connection Diagram' in Appendix A-7. The following signals should be available on terminal J8.

J8-1	Power fail
J8-2	+15 VDC
J8-3	-5 VDC
J8-4	0 VDC
J8-5	+ 5 VDC

If any of these signals fail, check the fuses F1 and F8 (Figure 6-7) and the main fuse which is located at the inlet of the power line filter.

9.9.2 Detector signal check

In case of problems with the detector signal the following test points on the processor boards can be used to do initial tests to the detector signal. The location of the test points is indicated in Figure 6-8.

TP1	+10 VDC
TP9	0 VDC

<u>Polarity check:</u>

Between TP 4 and TP 5 there is a voltage difference which is the bridge balance offset (baseline level in the chromatogram). This voltage difference should be somewhere between 0.3 en 1 mV. It is important that the polarity of TP 4 is positive with reference to TP 5.
The signal level (TP4 or TP5 vs. TP9) must be between 1.6 and 2.2 VDC. If the polarity is incorrect there will be no detector signal available and the RGC 2000 software will not find the chromatograms.

Note: polarity can only be checked when Helium is being used to flush the system; make sure there are no analysis running during this check. The oven temperature should on the normal operating temperature during these tests.

If it is not possible to balance the bridge check the next listed items:

- Polarity check as indicated above
- Bridge balance settings (RGC 2000 software)
- Electrical connections of the reference and measurement thermistor (Swapped wires?)
- The reference thermistor must have the highest resistance value of the matched pair and must be connected to the Reference thermistor terminal input (J10, pin 3 and pin 4)
- Verify the both Thermistor Currents and Voltages in a live circuit and calculate the resistance values for both thermistors.

WARNING !!

Do not use a dvm ohmmeter for this purpose, since the source currents will be different and therefore the values as measured are not representative for an ENCAL 2000 analyser!

9.9.3 Valve actuation check

Using the RGC 2000 Software it is possible to test the valve actuation (refer to the RGC 2000 software manual).

If any of the valves are not switching, check whether the outputs on terminal J4, J5 and J6 are activated. Depending on the mains voltage these should be 230 VAC or 115 VAC.
If any of these outputs fail check the Fuses F2-F7 (Figure 6-7).

If the outputs are functioning correctly the solenoid valve is probably failing.

10 Specifications

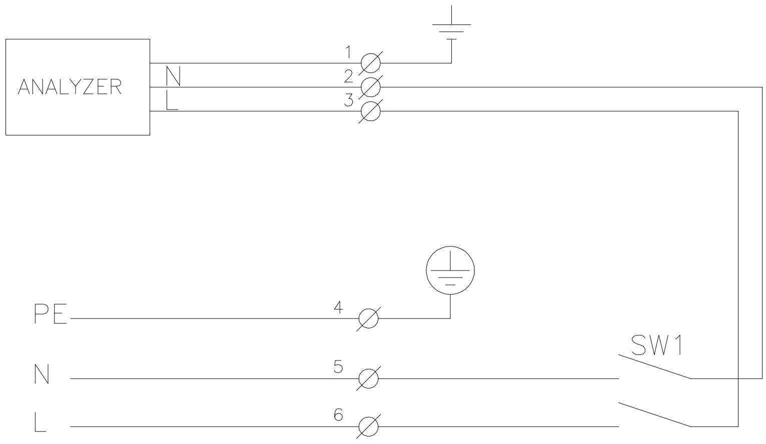
Measurement system	Process Gas Chromatograph for continuous analysis of natural gas.
Power supply	230 VAC 50 Hz / 115 VAC 60 Hz 100 W at normal operation 180 W at start-up
Dimensions	1863 x 610 x 450 (H x W x D) in mm
Weight	ca. 175 kg
Cabinet material	Plate steel. Triple surface treatment: Phosphatised, electroforetic dipped (primer) structure powder coated. Colours RAL 7035 and RAL 5018
Protection class	Ex II 2 G EEx d IIB T3 Certificate number 02ATEX2323 IP 55
Ambient temperature range	+5 to +55 °C (standard) -20 to + 55 °C (with cabinet heating/isolation)
Standard configuration	1 x sample stream including gas conditioning 1 x calibration gas stream
Options	Extra sample stream including gas conditioning Extra calibration gas stream Reference stream connection (excl. conditioning) Cabinet heating and isolation for ambient temperatures down to –20 °C Electrical power supply connections for max.2 heat trace sample lines. Electrical power supply connections for max.2 calibration gas heaters. Oven temperature sensor (Pt-100) Cabinet temperature sensor (Pt-100)

Options (continuation)	Extended analytical column for enhanced analysis
Measured values	11 components; Nitrogen (N_2), Methane (CH_4), Carbon Dioxide (CO_2), Ethane (C_2H_6), Propane (C_3H_8), Iso-Butane (i-C_4H_{12}), Normal-Butane (n-C_4H_{10}), Neo-Pentane (neo-C_5H_{12}), Iso Pentane (i-C_5H_{12}), Normal Pentane (n-C_5H_{12}), and Hexane Plus (C_6^+).
Calculated values	Heating value superior (H_s) Heating value inferior (H_i) Normal density Relative density Wobbe superior Wobbe inferior Calculations according to ISO 6976 or DIN 5158
Measurement ranges	H_s = 7.000 - 14.000 kWh/m^3 d = 0.7 - 1.0 kg/m^3 CO_2 = 0 - 16 % (mol)
Analysis time	450 seconds
Accuracy:	< 0.15 % on heating value with appropriate calibration gas
Repeatability	< 0.05 % of measured value
Certifications	KEMA 02ATEX2323 PTB approval 7.614/97.30 NMI Performance certificate NMI Testcertificate TC3503

Appendix A: Drawings and diagrams

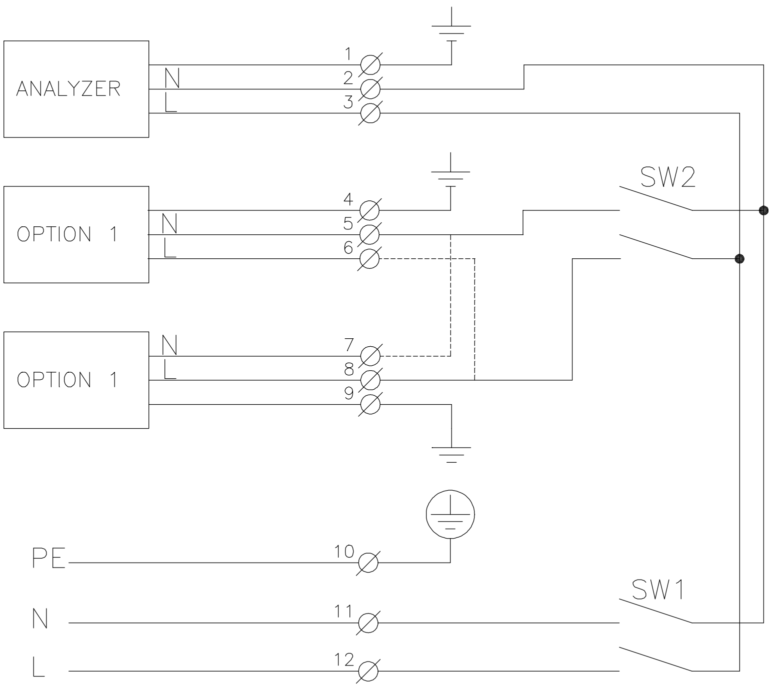
A-1
EEx-ed connection box, 1 switch

Switch 1: Analyser mains



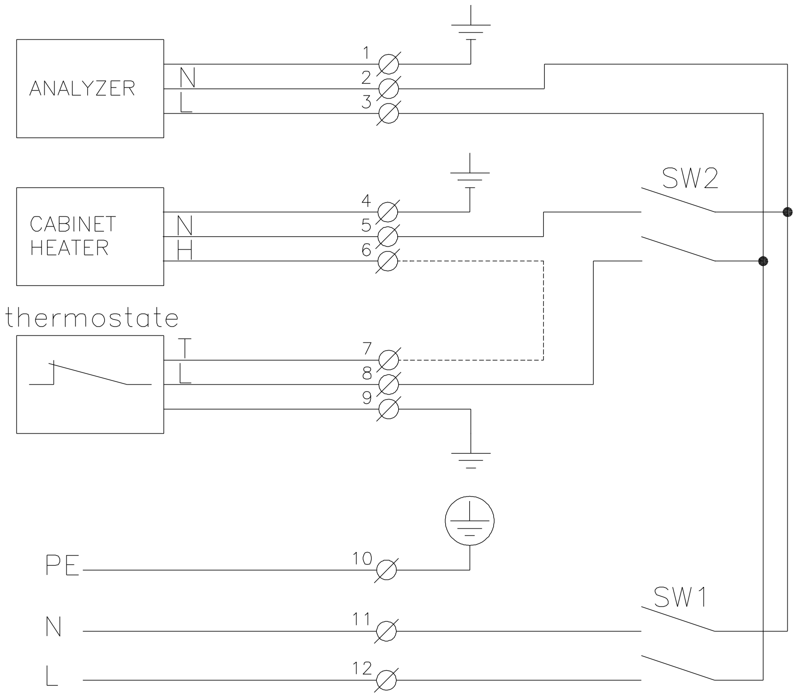
A-2
EEx-ed connection box, 2 switches

Switch 1: Mains power
Switch 2: Two heat traced sample lines OR two calibration gas heaters



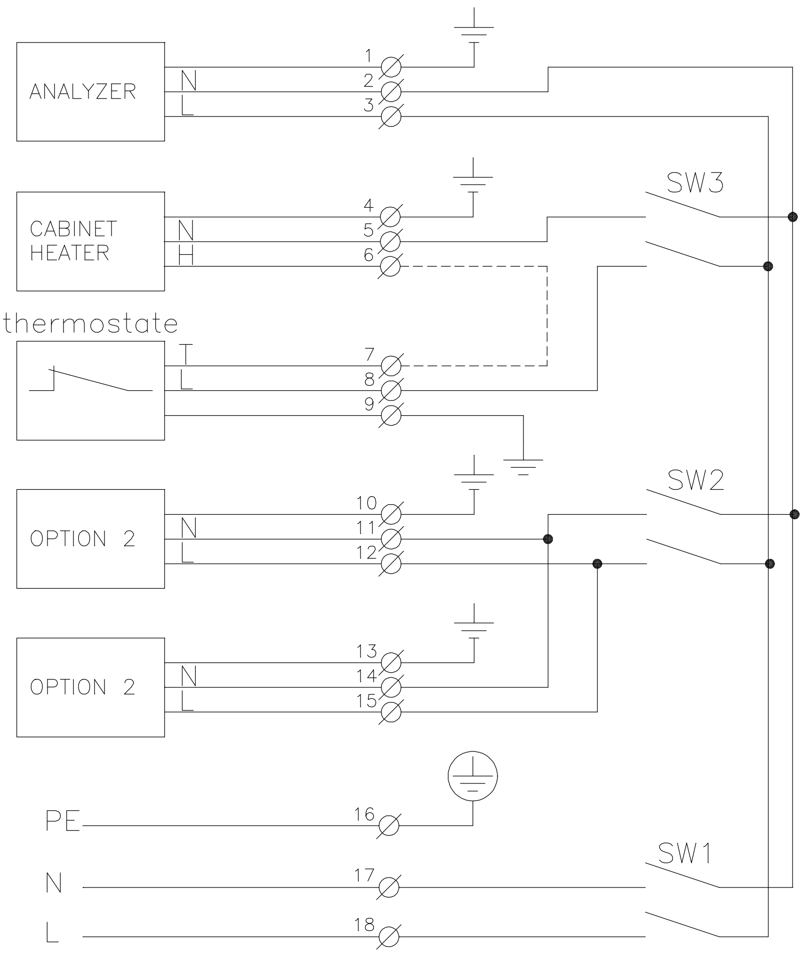
A-3
EEx-ed connection box, 2 switches

Switch 1: Mains power
Switch 2: Cabinet heater



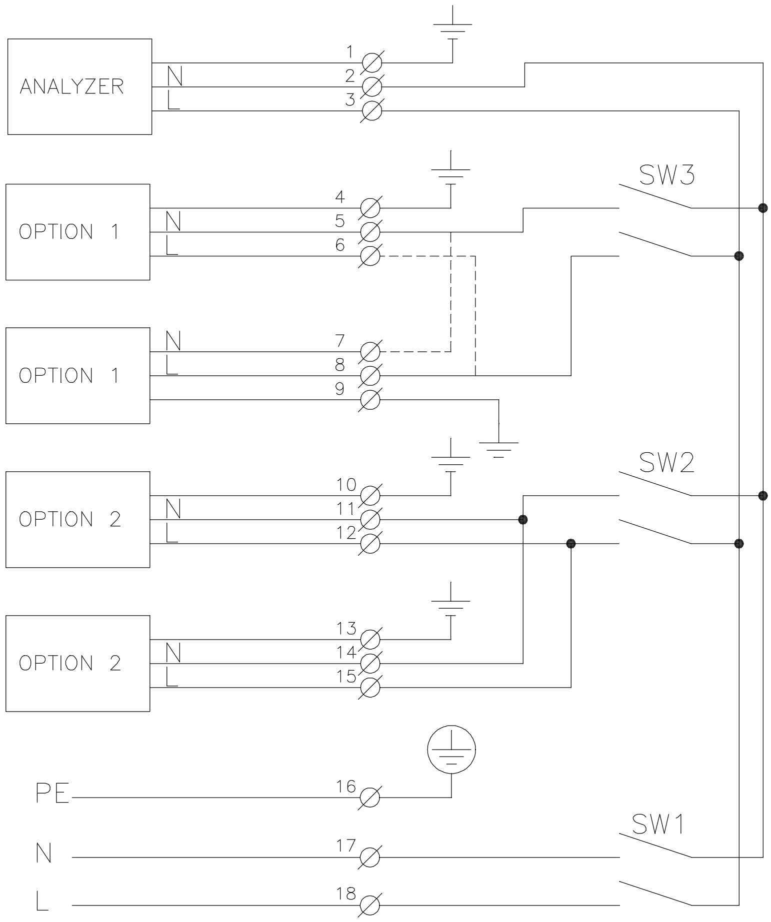
A-4
EEx-ed connection box, 3 switches

Switch 1: Mains power
Switch 2: Two heat traced sample lines OR two calibration gas heaters
Switch 3: Cabinet heater



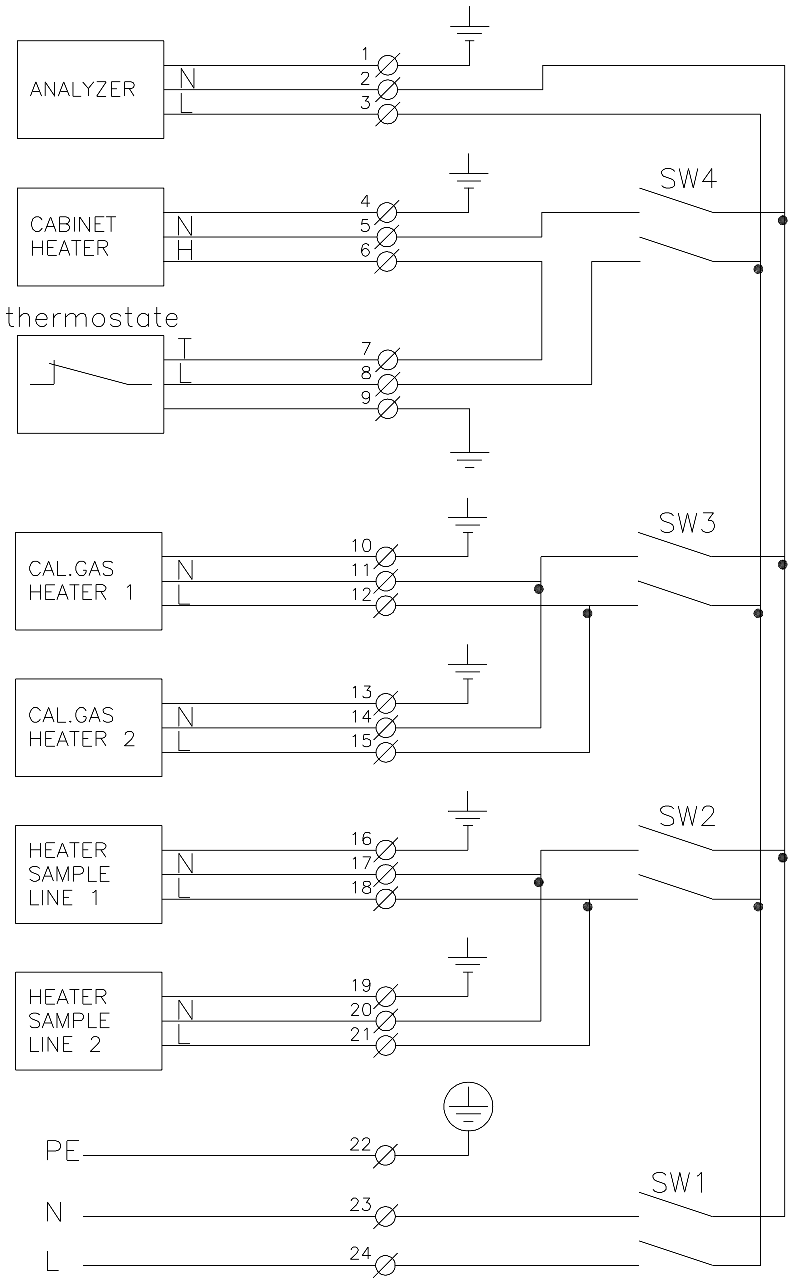
A-5
EEx-ed connection box, 3 switches

Switch 1: Mains power
Switch 2: Two heat traced sample lines
Switch 3: Two calibration gas heaters

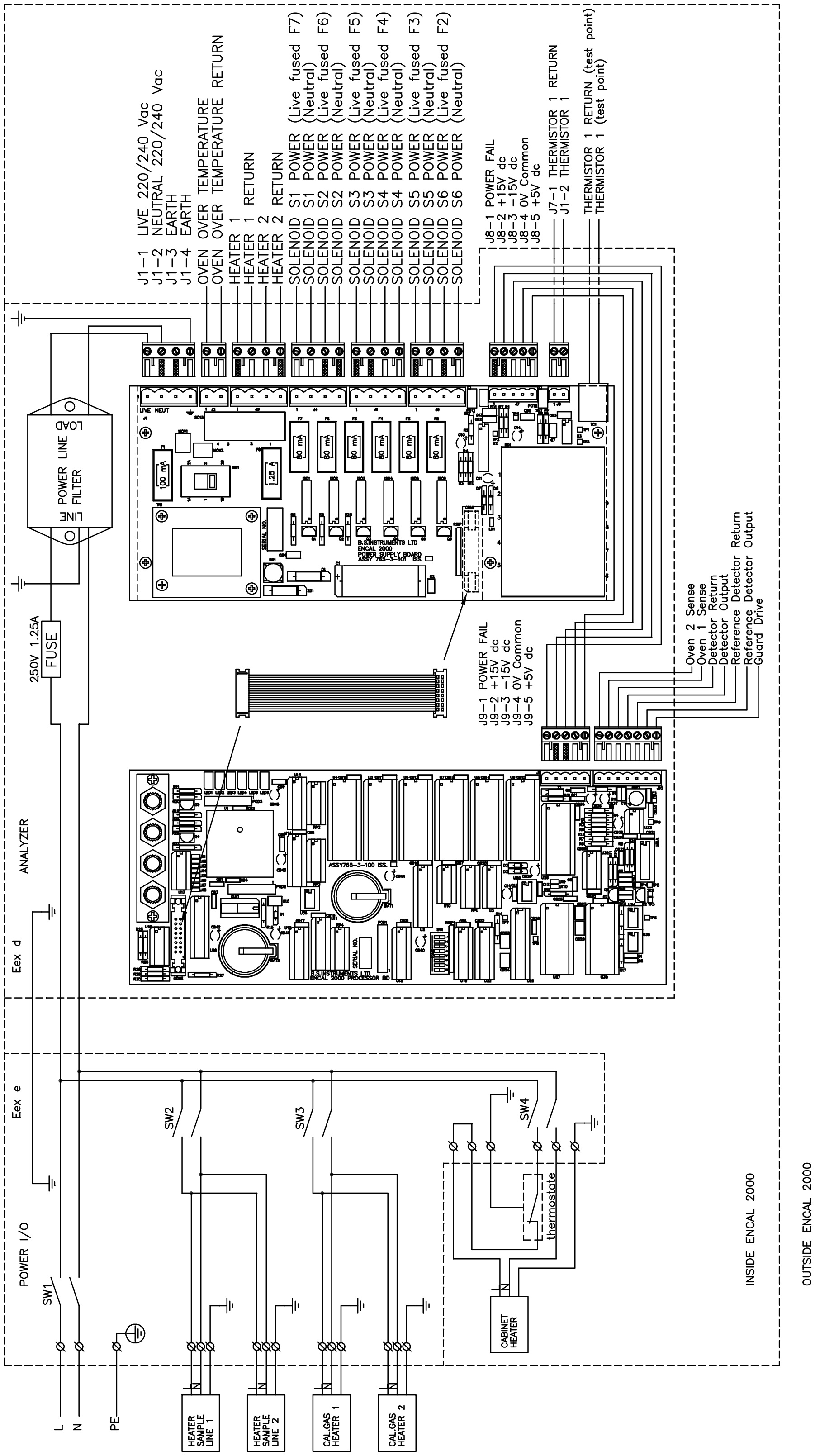


A-6
EEx-ed connection box, 4 switches

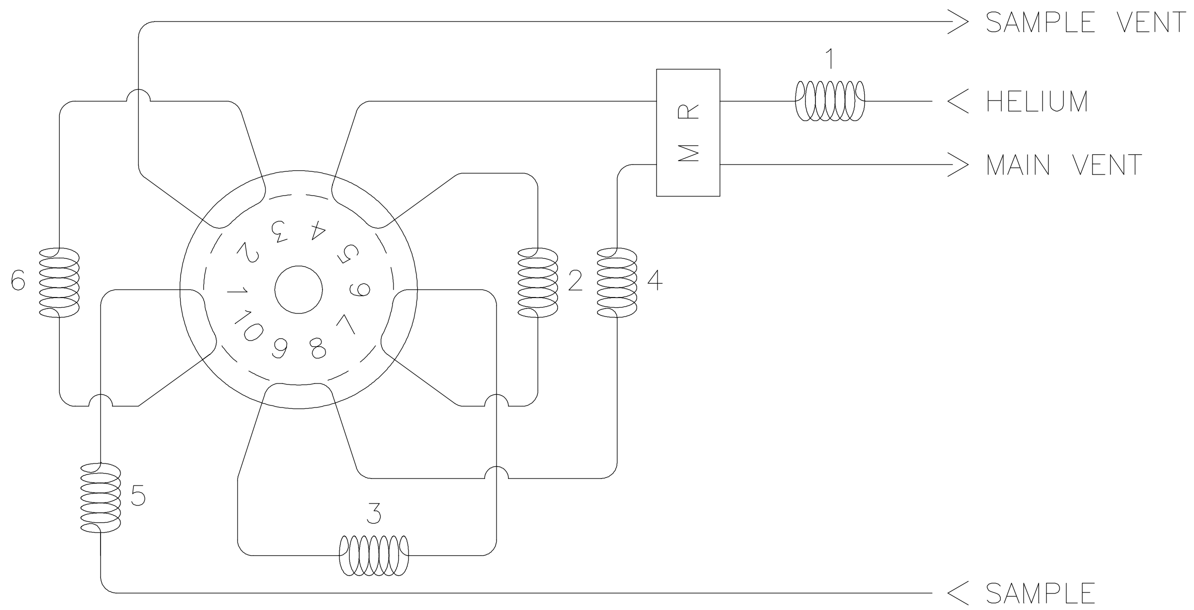
Switch 1: Mains power
Switch 2: Two heat traced sample lines
Switch 3: Two calibration gas heaters
Switch 4: Cabinet heater



A-7
Electronic connection diagram (230 VAC unit)

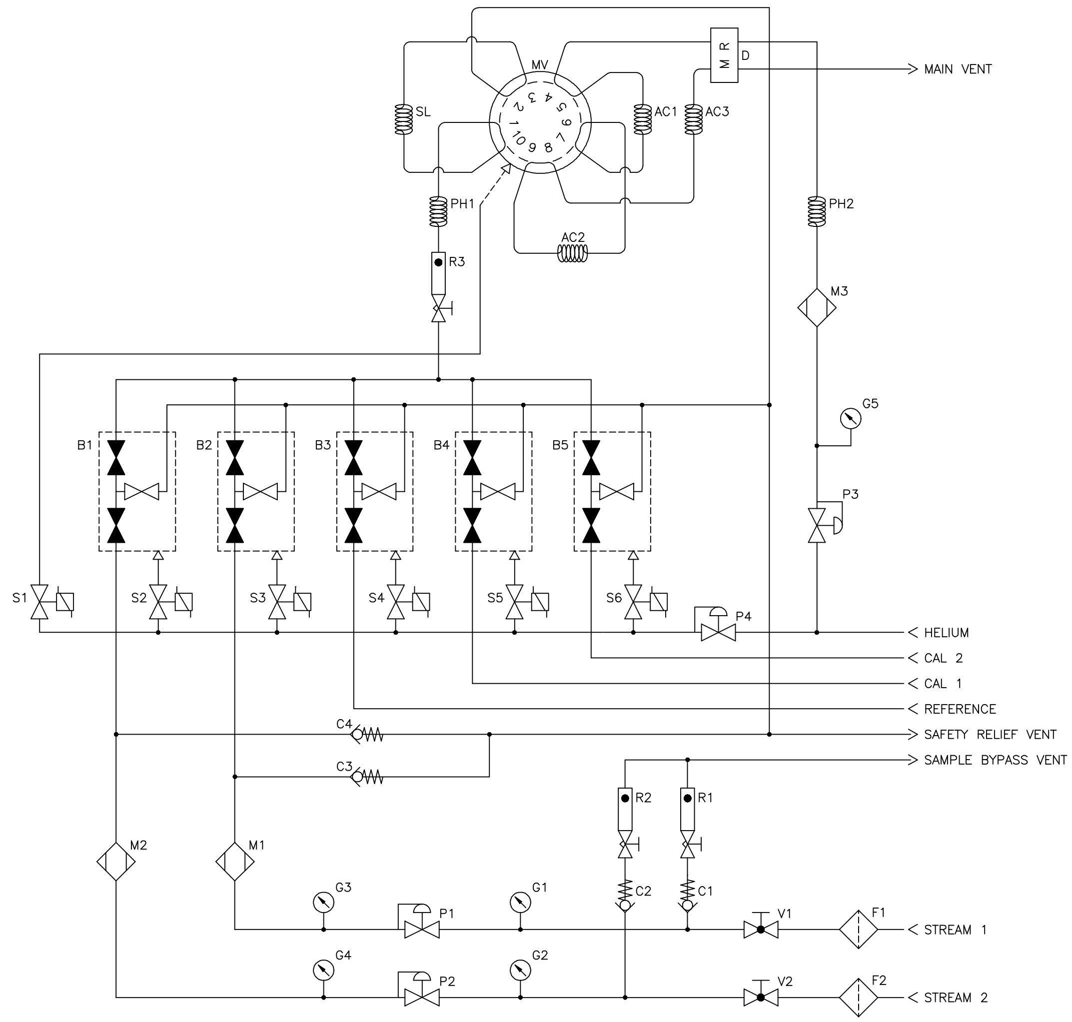


A-8
Column configuration



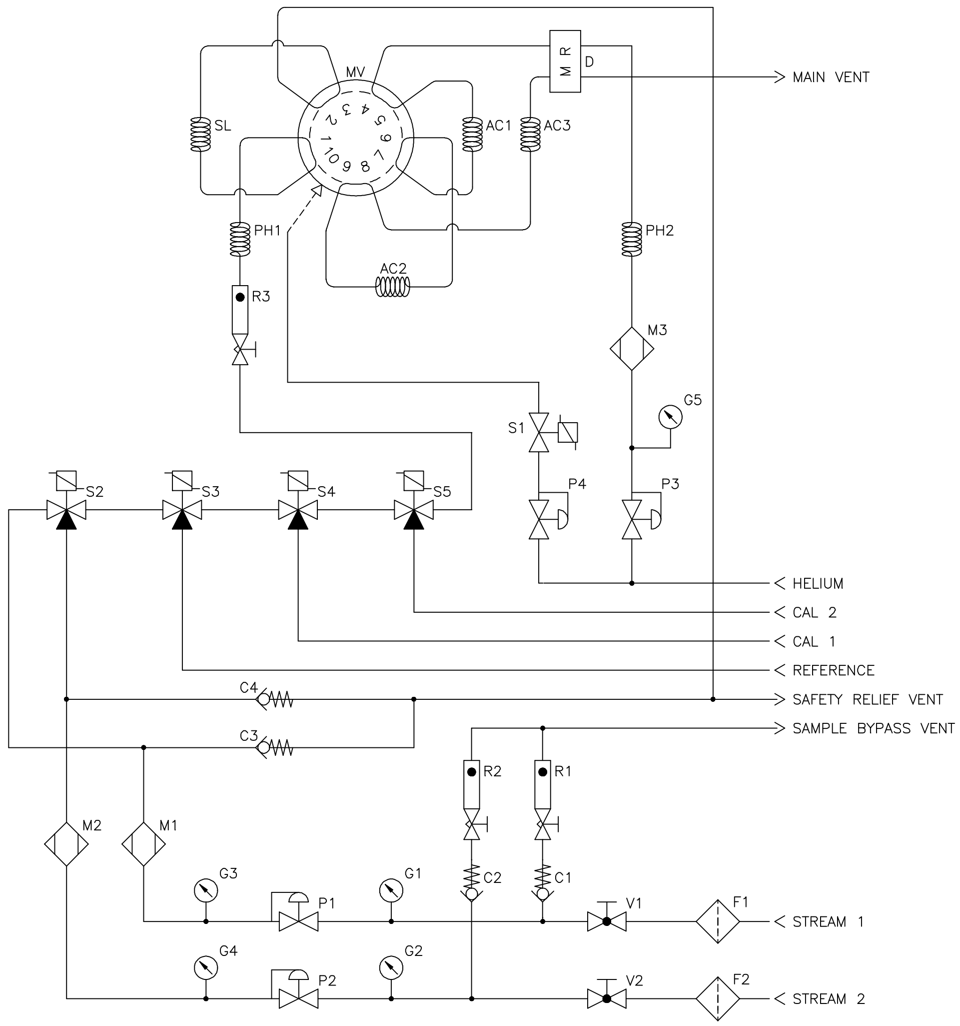
1. Helium pre-heat column
2. Main column
3. Backflush column
4. Regrouper column
5. Sample pre-heat column
6. Sample loop

A-9
Flow diagram (double block and bleed system)



F1, F2:	particle filter sample gas	B1-B5:	Double block and bleed valves
V1, V2:	Shut off valves	P3:	Carrier gas pressure reducer
C1, C2:	Check valve bypass	G5:	Carrier gas pressure gauge
R1, R2:	Rotameters bypass stream	M3:	Moisture filter carrier gas
G1, G2:	Inlet pressure gauge	R3:	Rotameter
P1, P2:	Pressure reducers sample gas	PH1:	Sample pre-heat tube
G3, G4:	Outlet pressure gauge	PH2:	Carrier gas pre-heat tube
M1, M2:	Moisture trap sample gas	AC1:	Main column
C3, C4:	Over pressure check valve	AC2:	Back flush column
P4:	Pressure reducer actuator gas	AC3:	Regrouper column
S1:	Solenoid valve for 10-ports valve actuation	SL:	Sample loop
S2-S6:	Solenoid valves for actuation of double block & bleed valves	MV:	10-ports membrane valve
		D:	Detector block

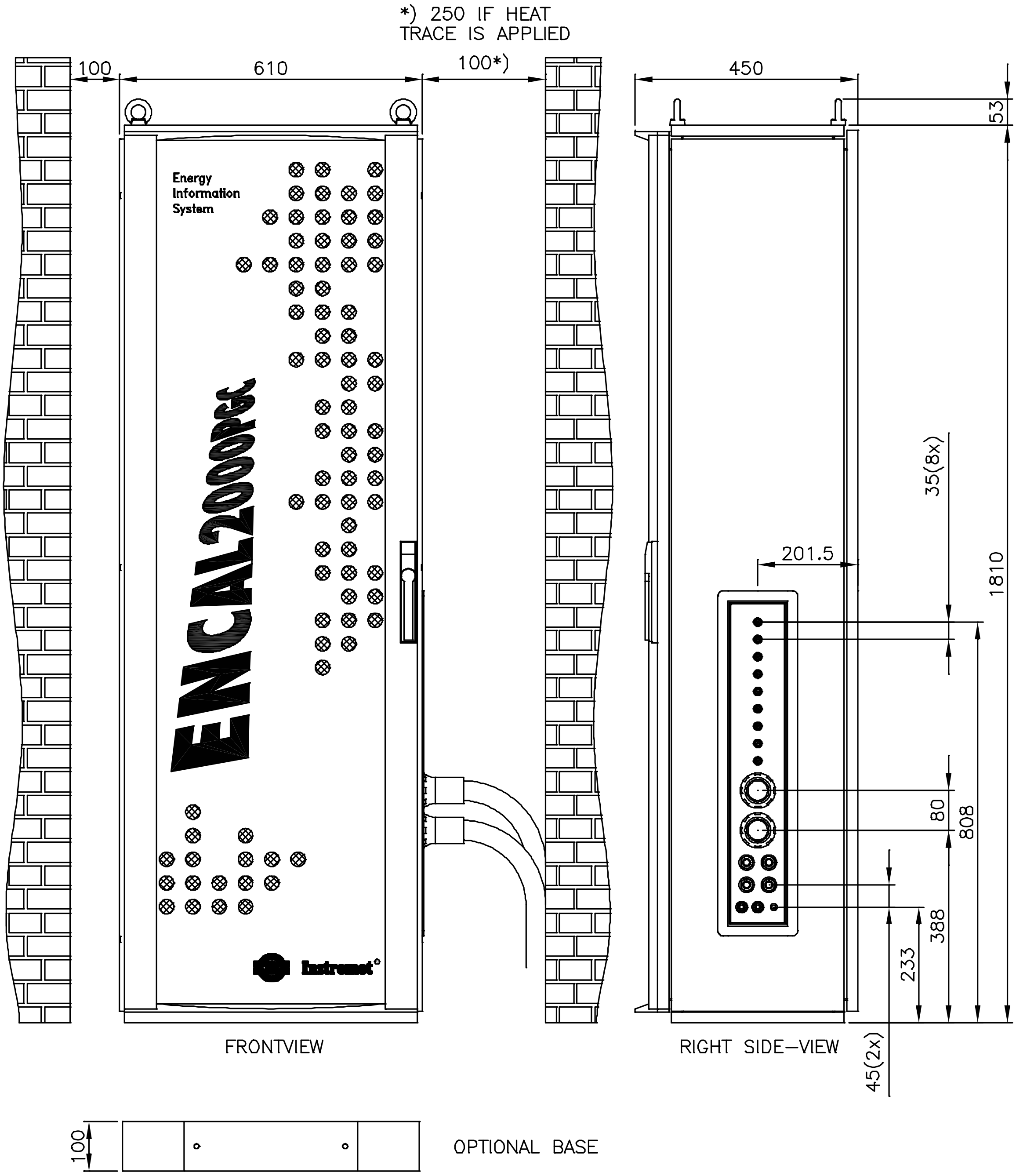
A-10
Flow diagram (non double block and bleed system)



F1, F2:	particle filter sample gas
V1, V2:	Shut off valves
C1, C2:	Check valve bypass
R1, R2:	Rotameters bypass stream
G1, G2:	Inlet pressure gauge
P1, P2:	Pressure reducers sample gas
G3, G4:	Outlet pressure gauge
M1, M2:	Moisture trap sample gas
C3, C4:	Over pressure check valve
P4:	Pressure reducer actuator gas
S1:	Solenoid valve for 10-ports valve actuation

S2-S5:	Solenoid valves for stream selection
P3:	Carrier gas pressure reducer
G5:	Carrier gas pressure gauge
M3:	Moisture filter carrier gas
R3:	Rotameter
PH1:	Sample pre-heat tube
PH2:	Carrier gas pre-heat tube
AC1:	Main column
AC2:	Back flush column
AC3:	Regrouper column
SL:	Sample loop
MV:	10-ports membrane valve
D:	Detector block

A-11
Dimensional / weight drawing ENCAL 2000 PGC



A-12
Spare parts list

1.	Filter element (2 µm) for inlet particle filter	801.06.583
2.	Moisture trap sample gas	102.49600009
3.	Double block and bleed valve module	801.06.570
4.	Solenoid valve double block and bleed 230 VAC	102.49600002
5.	Solenoid valve double block and bleed 115 VAC	102.49600014
6.	Solenoid valve non double block and bleed 230 VAC	102.49600006
7.	Solenoid valve non double block and bleed 115 VAC	102.49600015
8.	Solenoid valve for 10 ports membrane valve actuation (non double block and bleed) 230 VAC	102.49600012
9.	Solenoid valve for 10 ports membrane valve actuation (non double block and bleed) 115 VAC	102.49600016
10.	Helium pressure regulator	700.99.001
11.	Moisture trap (Helium)	102.49600007
12.	Main column	799.70.130
13.	Back flush column	799.70.129
14.	Regrouper column	799.70.131
15.	Extension column	799.70.132
16.	Complete column set	2.875.406
17.	Sample loop 250 µl	799.70.154
18.	Sample loop 300 µl	799.70.158
19.	Sample loop 350 µl	799.70.159
20.	10 ports membrane valve	799.70.143
21.	membrane for 10 ports valve	799.70.150
22.	Detector block	1.875.431
23.	Processor board	2.875.400S
24.	Power supply board	2.875.401S

A-13
ATEX Certificate

KEMA

(1) **EC-TYPE EXAMINATION CERTIFICATE**

(2) Equipment or protective system intended for use in potentially explosive atmospheres - Directive 94/9/EC

(3) EC-Type Examination Certificate Number: **KEMA 02ATEX2323**

(4) Equipment or protective system: **Gaschromatograph Type ENCAL 2000 PGC**

(5) Manufacturer: **Instromet B.V.**

(6) Address: **Mustermanstraat 6, 7064 KA Silvolde, The Netherlands**

(7) This equipment or protective system and any acceptable variation thereto is specified in the schedule to this certificate and the documents therein referred to.

(8) KEMA Quality B.V., notified body number 0344 in accordance with Article 9 of the Council Directive 94/9/EC of 23 March 1994, certifies that this equipment or protective system has been found to comply with the Essential Health and Safety Requirements relating to the design and construction of equipment and protective systems intended for use in potentially explosive atmospheres given in Annex II to the directive.

The examination and test results are recorded in confidential report no. 2024889.

(9) Compliance with the Essential Health and Safety Requirements has been assured by compliance with:

EN 50014 : 1997 **EN 50018 : 2000**

(10) If the sign "X" is placed after the certificate number, it indicates that the equipment or protective system is subject to special conditions for safe use specified in the schedule to this certificate.

(11) This EC-Type Examination Certificate relates only to the design, examination and tests of the specified equipment or protective system according to the Directive 94/9/EC. Further requirements of the directive apply to the manufacturing process and supply of this equipment or protective system. These are not covered by this certificate.

(12) The marking of the equipment or protective system shall include the following:

Ex **II 2 G EEx d IIB T3**

Arnhem, 29 January 2003
KEMA Quality B.V.

T. Pijpker
Certification Manager

KEMA Quality B.V.
Utrechtseweg 310, 6812 AR Arnhem, The Netherlands
P.O. Box 5185, 6802 ED Arnhem, The Netherlands
Telephone +31 26 3 56 20 08, Telefax +31 26 3 52 58 00

ACCREDITED BY THE DUTCH COUNCIL FOR ACCREDITATION

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KEMA

(13) **SCHEDULE**

(14) **to EC-Type Examination Certificate KEMA 02ATEX2323**

(15) **Description**

The Gaschromatograph Type ENCAL 2000 PGC consists of an aluminium electronics housing and heater/detector-block assembly, both forming a flameproof enclosure "d" .
The ENCAL 2000 PGC is used to perform a quantitative analysis of gas mixtures.

Ambient temperature range -20 ºC ... +55 ºC.

Electrical data

Power supply ………..... 110-130 Vac / 220-240 Vac, max. 185 W

Installation instructions

The cable entries and closing elements of unused openings shall be certified in type of explosion protection flameproof enclosure "d" suitable for the conditions of use and correctly installed.

For external earthing or bonding connection a cable lug shall be used so that the conductor is secured against loosening and twisting and that the contact pressure is assured.

Routine tests

Each detector-block with welded capillary tubes must be submitted to the routine test according to Clause 16 of EN 50018, with a test pressure of 4,7 bar, during 1 minute.

(16) **Report**

KEMA No. 2024889.

(17) **Special conditions for safe use**

None

(18) **Essential Health and Safety Requirements**

Covered by the standards listed at (9).

(19) **Test documentation**

1. Certificate of Conformity KEMA No. Ex-01.E.2047

	dated
2. Drawing No. RE 4409	03.10.2002

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