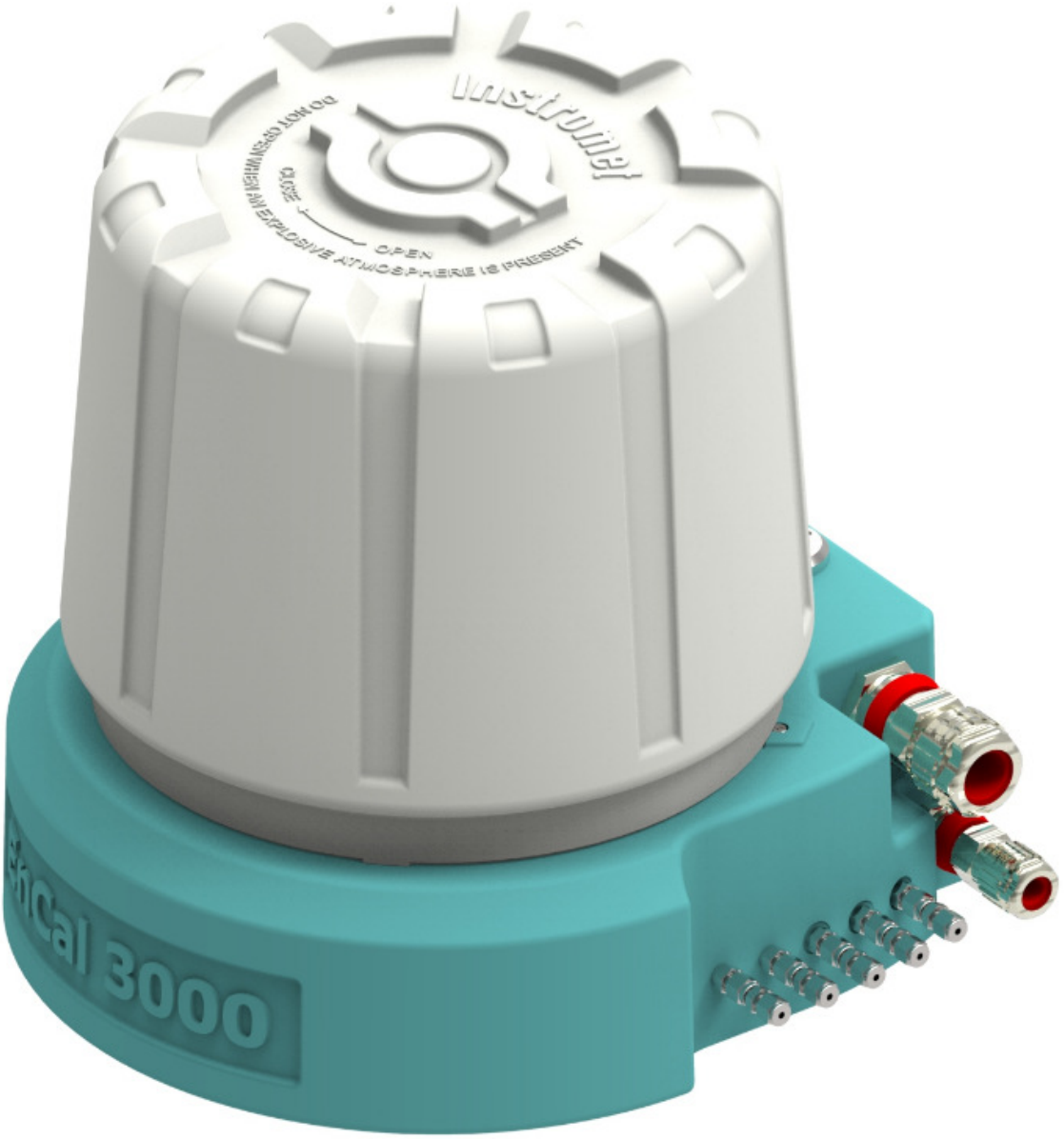
Honeywell
THE POWER OF CONNECTED

GASCHROMATOGRAPH ENCAL 3000

HARDWARE MANUAL



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The printed documentation supplied with the device represents the situation at the time of delivery and may be regarded as accurate. All obligations on the part of the manufacturer result only from concluded contracts and the General Terms and Conditions in force on the date of the conclusion of contract. In no circumstances will the manufacturer accept liability for any direct, special or consequential damage.

Subject to amendments in the course of further development. Any such amendments will be included in the latest version without prior notice. The latest version of this document is available in PDF format at **www.docuthek.com**. Ensure that you use the appropriate version for your device.

The illustrations are designed to provide a visual depiction of the topics covered. They may differ slightly from the actual design.

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1 About this Manual and Device delivery

1.1 Scope (Aim)

This user manual for the **Gas quality measurement system EnCal 3000**, hereinafter referred to as the **EnCal 3000**, describes the Hardware of this gas chromatograph (measuring unit). The other subsystems are described in separate manuals.

The measurement system consists in its basic configuration of a measuring unit and an optional Encal3000 controller. The measuring unit is the real gas chromatograph. It performs the analysis by measuring technology autonomously.

It is configured with the PC program "**RGC 3000**" and it is possible to install an additional optional **Encal3000 controller**. (See separat manuals). The subsystems communicate with each other via Modbus (see Figure 1.1 for basic configuration with measuring unit and an optional Encal3000 controller).

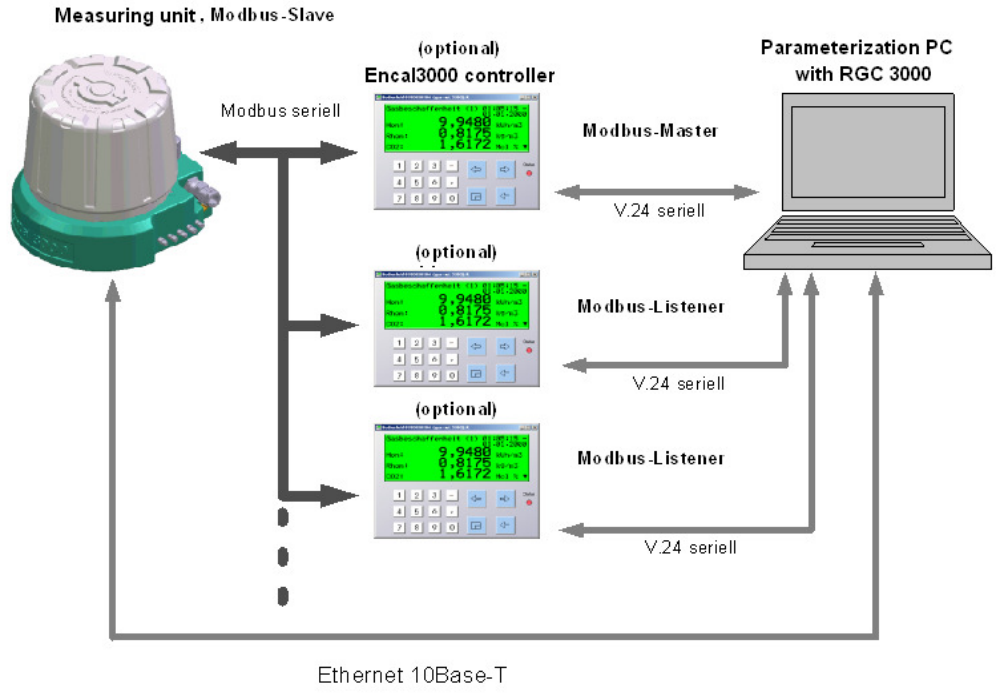

Figure 1.1: Parts of the Gas quality measurement system

The **enCal 3000** is suitable for worldwide use. You should use a manual in your mother tongue or a language with which you are extremely familiar to ensure that you understand all the information. The safety and warning information on the device are in English or French. This information is stated in this document in the appropriate language. In accordance with Honeywell's "**Safety first**" principle the maual starts after the following introductory with this topic.

In general the manual is aimed at trained personnel in the gas industry or process measuring sector. It contains the explosion-relevant information as well as a summary of relevant safety and warning notices. In addition to general expertise, it enables the **enCal 3000** to be handled safely and efficiently.

Compliance with all given information and instructions is a requirement for safe working practice and correct handling of the device. It will ensure the functions of the device, deliver reliable measurement results, extend the service life of the device and save you service and spare parts costs.

Furthermore, the directives, standards, local accident prevention regulations and general safety regulations, which apply to the field of application of the device, must be applied and obeyed..

Following table shows the development of this document.

Revision	Date	Description
a to l	2008 until 2016	Historic development
m	August 04, 2017	New Interconnection board
n	Feb. 22, 2018	New temperature range
o	August 20, 2018	New CE Declaration and extension to Honeywell document design

1.1.1 How to use this manual

It is essential that you read through the relevant section of this document before starting work to ensure that you have a thorough understanding of the measuring system.

ATTENTION	**Safety information and warnings must be followed to the letter.**

CAUTION	**A lack of symbols or information does not release you from your safety duties or responsibility for safety.**

If you use the device together with devices from other manufacturers or third-party equipment, you must ensure that these are suitable components. These components will have their own product documentation which also must be obeyed. Ensure that all the technical documentation is available in the system and near the device.

1.1.2 Symbols

The safety and warning information in this document and on the device is designed to help use the measuring instrument correctly. The signs, symbols and terminology are defined in the following. Texts which are preceded by a sign of this type must be followed to the letter. General safety rules and expertise in conduct in plants and in dealing with gas are assumed to be known and are therefore not reproduced here in full.

Symbol in ducument	Meaning
 ATTENTION	**Attention** denotes information which is relevant to safety and important for the functioning of the device. If this information is ignored, the result may be health impairment, environmental or property damage and injuries or even death. This information must be followed and given due consideration in all circumstances.
 CAUTION (Explosion/ Very serious health impairment / Prohibited action)	Explosion or danger of explosion means that death and/or injuries may be suffered by several people and, in addition, the plant, equipment and environment may suffer significant damage if the appropriate precautions are not taken.
	Very serious health impairment means that serious physical injury, health impairment and, as a result, death may occur if the appropriate precautions are not taken.
	Prohibited action means that you must not complete the action described unless the specified conditions and requirements are satisfied and you are qualified for this work.

Symbol on device	Meaning
 Device symbol	The symbol on the device is a reminder to comply with all the instructions and important information in the manual (in this document). The appropriate parts are marked with the other symbols in this table.
 Device symbol	The symbol on the device is a reminder to comply with the WEEE directive of the EU. In the interest of our environment the WEEE directive did not allow to dispose the device with household waste within the EU!
 Device symbol	This symbol on the device means that the power supply is 24 V DC.
 Device symbol	This symbol on the device designates the equipotential bonding connection (PA) or the terminal for the electrical connection to the equipotential bonding system and earth.
 Device symbol	This symbol on the device designates the connection for the functional earth (FE).
	Denotes tips and recommendations which are interesting and useful for a certain topic, but which have no bearing on safety.

1.2 Device delivery

1.2.1 Checking the delivery (list of supplied and required parts)

Unpack the measuring instrument and any other components and check them for signs of damage and missing or incorrect parts. Use your order documents and the information in this manual as a guide for this purpose. The device is supplied ready-assembled with all interior components and includes the required connections and potential connections for gas, electricity and signals in standard operation unless otherwise ordered. You should therefore check the following points:

- Every gas connection must be fitted with a Swagelok pipe fitting with a suitable thread or a blind plug.
- Every electrical connection must be fitted with a cable gland of a suitable size or a blind plug.
- There are not normally any openings on the device that do not have plugs or fittings/glands.
- The local display is included (optional, if ordered).
- Fastening materials, for example wall mounting bracket with screws, are included as ordered.

1.2.2 Transporting and storing the device

Prevent transport damage, incorrect storage. Please also refer to the liability information at the start of this manual.

! ATTENTION	**Store the device in a clean, dry location. Prevent dirt getting inside it. Prevent material damage caused by the formation of condensation and corrosion**

The following applies to storage:

- The ambient conditions (see chapter „**Technical spezifications**“) must be maintained.
- The packages may only be stored in enclosed rooms.
- Avoid mechanical impacts during storage.
- The storage time with a battery is up to one year, 2 years if the battery is then replaced.

CAUTION	**Do not expose the device to temperatures below or above temperatures defined in the chapter “Technical spezifications”**

If the device is transported in cold weather or extreme temperature fluctuations have occurred, the EnCal 3000 must be returned to room temperature (temperature at the place of use) slowly to prevent damage caused by the formation of condensation.

CAUTION	**Do not remove transport guards and other safety devices, for example for gas connections, before the device has been installed at its destination and if dirt can still ingress into it.**

1.3 Intended use of Device

The device is designed and built exclusively for its intended use. This is the analysis of natural gas or gas similar to natural gas (see details in Hardware section). Intended use also includes compliance with all the information in this document and on the measuring instrument. Any additional use or use other than that intended will be deemed to be misuse. Claims of any kind due to damage as a result of misuse will be void.

ATTENTION	**Use the device only for its intended purpose as described in this document. If you use the device for other tasks or purposes, protection may be adversely affected. This may result in dangerous situations.** **The device may only be installed and used in the potentially dangerous zones specified on it.**

1.4 Responsibility of the device or system operator

The operator of the device or system is subject to legal duties relating to industrial safety. In addition to the safety information in this document, compliance with the safety, accident prevention and environmental protection regulations valid for the field of application of the device is mandatory. Furthermore, the operator is responsible for keeping the device in technically perfect condition at all times.

ATTENTION	The operator must use high-pressure reduction systems and safety devices to ensure that the maximum inlet pressure, even in the event of a fault; of the respective gas does not exceed the maximum permitted value. The following limits apply: Sample gas/Calibration gas/ Verification gas: 0.40 MPa(g) (4.0 bar(g)). Carrier gas: 0.55 MPa(g) (5.5 bar(g)).

CAUTION	The equipment shall not be used with process gases which contain oxygen or any other oxidizer in concentrations greater than found in normal air.

ATTENTION	The system operator must ensure that the electrical installation does not give rise to any danger to personnel or components. The operator must ensure that no earth potential shift takes place (for example by using an equipotential bonding cable).

ATTENTION	The operator must ensure that the installation and maintenance work described in this document is carried out correctly. The operator is responsible for ensuring that the device remains in technically perfect, safe condition throughout its period of operation.

1.5 Additional technical help and repairs

If you have any questions, any points in this document are unclear or you require repair work, the TAC or our customer service department will be delighted to help. The contact details are provided at the start of this manual

Training classes

Honeywell holds technical training classes that are taught by process control systems experts. For more information about these classes, contact your Honeywell representative, or see http://www.automationcollege.com

2 Safety information and warnings

The safety and warning information in this manual (and on the device in English) is designed to enable the device to be used correctly and prevent personal injury and property damage.

The device complies with the relevant safety standards. If it is handled correctly, it does not pose any danger which may adversely affect health or cause property damage.

To avoid risks, no changes or modifications may be made unless they have been expressly approved by the manufacturer. Avoidable damage, for example caused by inadequate device expertise, will render all liability claims void.

 CAUTION	**The safety and warning information must be read and obeyed in all circumstances to ensure safe, flawless operation. We assume that users will have the appropriate language skills.**

 ATTENTION	**Always refer to the whole safety information in this documentation and on the device. Also refer to the other relevant sections and the technical specifications.** **Please contact your TAC if you have any questions or doubts!** **A lack of warning signs does not release you from your personal responsibility for safety**

 CAUTION	**It is vorbidden to operate devices, or other parts used for measuring, if they are damaged, have a modified housing or unsuitable connections since protection from explosions will no longer be guaranteed.**

 CAUTION	**If you discover that the measuring equipment or other parts used for measuring are damaged, shut down everything, disconnect everything from the gas and voltage supplies and secure them to prevent them being used accidentally.**

 CAUTION	**Direct contact with hot or cold surfaces can cause heat and ice burns. Prevent this by using your personal protective equipment (for example, wear gloves).**

2.1 Information for handling the device

The device is designed for installation in potentially explosive atmospheres and certified to several approvals:

FM Approval
ATEX II 2 G  Ex-db IIC T6 Gb and IECEx Ex-db IIC T6 Gb Class I, Division 1. Groups B, C, D T6 Class I, Zone 1, AEx IIC T6 Gb
In compliance with: IECEx: IEC 60079-0 : 2011 IEC 60079-1 : 2014
ATEX: EN 60079-0 : 2012 EN 60079-1 : 2014
United States standards Class 3600 : 2011 Class 3615 : 2006 Class 3810 : 2005
ANSI/ISA 60079-0 : 2013 ANSI/UL 60079-1 : 2015
NEC:  FM №: FM16US0020X
Detailed information on this certificate can be found in ANNEX

ATEX Approval
ATEX II 2 G Ex-d IIC T6 Gb IECEx Ex-d IIC T6 Gb Class I, Division 1, Groups B, C, D T6 Class I, Zone 1, AEx db IIC T6
In compliance with: IECEx: IEC 60079-0 : 2011 IEC 60079-1 : 2014
ATEX: EN 60079-0 : 2012 EN 60079-1 : 2014
FM standards Class 3600 : 2011 Class 3615 : 2006 Class 3810 : 2005
ANSI: ANSI/ISA 60079-0 : 2013 ANSI/UL 60079-1 : 2015
Detailed information on this certificate can be found in ANNEX

CAUTION	**The device may only be installed and used in the potentially dangerous zones specified on it.**

The safety and warning information in this manual (and on the device in English) is designed to enable the device to be used correctly and prevent personal injury and

ATTENTION	• **To avoid risks, no changes or modifications may be made unless they have been expressly approved by the manufacturer** • **A lack of warning signs does not release you from your personal responsibility for safety.**

CAUTION	**It must be ensured (for example by an air-conditioned housing) that the device is not exposed to any excessive temperatures during storage or operation. The temperature range is specified on the device.**

ATTENTION	**The ambient conditions must comply with the technical specifications; otherwise, an additional air-conditioned housing must be used. The device may only be used in potentially corrosive atmospheres by agreement and with the consent of your TAC.**

CAUTION	**When carrying out mechanical work (transport, assembly, etc.), use your personal protective equipment (safety footwear, gloves, etc.) to avoid injury. Never lift weights which may jeopardize your health.**

2.2 Authorized (hardware) personnel

The operator of the system or device is responsible for selecting the personnel. Suitable personnel have been verified as possessing the required knowledge from this manual, have received induction training and at least satisfy the requirements set out in this document.

The manufacturer cannot accept any liability for damage and consequential damage caused by untrained personnel.

ATTENTION	**Assembly, electrical installation, commissioning and inspection and maintenance work (opening the housing) may only be carried out by trained personnel authorized by Honeywell.**

The appropriate personnel have the expertise set out in Annex A of EN IEC 60079-14 or has comparable expertise, including:

- General safety rules
- Care and use of reasonable safety equipment
- Electrical safety and explosion-protection rules
- Working on electrical circuits for systems with potentially explosive atmospheres
- Working with high pressures and aggressive or hazardous media
- Safety and warning information from this manual

CAUTION	**Suitable personnel must definitely have the ability to identify dangers and risks, assess their work and avoid possible hazards.**

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ATTENTION	**Before starting work, everybody engaged to carry out hardware work on or with the device must be familiar with the content of this manual. Any unclear points and questions must be clarified before starting work.**

2.3 Information and warnings on the device housing

There are warnings in English and/or French on the device. This information is also repeated at the appropriate point in the documentation in the documentation language. There is not sufficient space on the type label for this and there are therefore additional warning signs on the housing. The figure below shows the possible locations on the device and an example of a warning in English and French on an additional label.

The safety instructions for opening the device can be found on the top of the hood. The gas inlets and outlets are also labelled with details of the maximum pressure values.

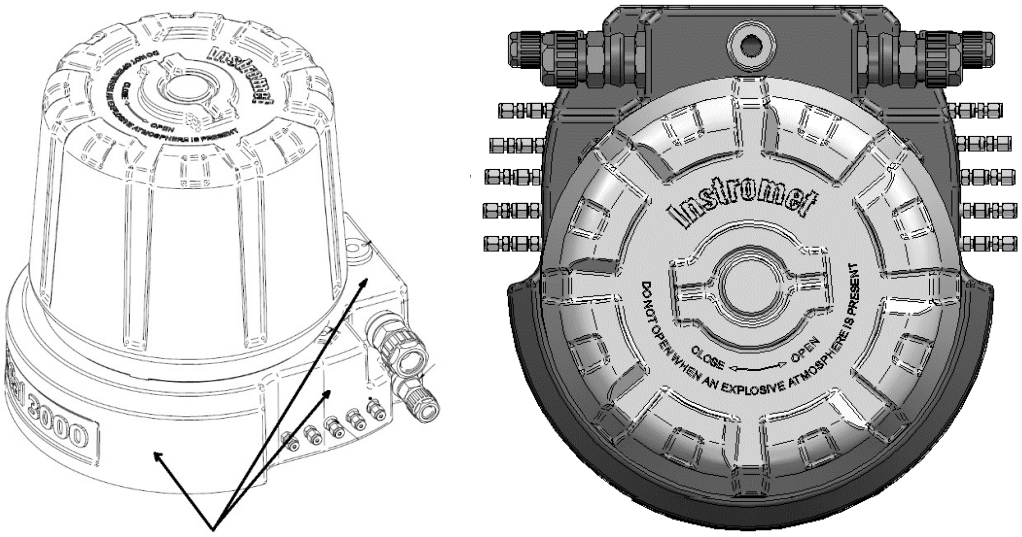

Figure 2.1: Warning and information labels on the device

ATTENTION	**Information on the device must be noted and obeyed in all circumstances. You must have adequate language skills to understand their meaning.**

2.4 Safety information about gases

The measuring instrument requires various gases for operation and measurement with different hazard potentials. Supply all gases to the device and remove all waste gases from it through pipelines which comply with the listed switching, connection and pipework plans in the relevant chapters.

CAUTION	**When working on the gas pipelines, always ensure there is adequate ventilation and protect yourself from gases which contain aggressive or toxic components.**

CAUTION	**When mixed with air, gases may form an explosive mixture or be toxic, harmful or polluting.**

CAUTION	**Do not supply the device with any gas which contains more than 3.0% v/v of oxygen.** ***Il n'est pas autorisé de connecter un gaz contenant plus de 3 % d'oxygène (basé sur le volume).*** **It is not allowed to connect gasses that are flammable or explosive under exclusion of oxygen (i.e. acetylene (C2H2)).** ***Il n'est pas autorisé de connecter des gaz inflammables ou explosifs à l'exception de l'oxygène (par exemple, l'acétylène (C2H2)).***

ATTENTION	**Only natural gas and gases similar to natural gas (all components in gaseous form) as specified in the technical specifications or approved calibration gases may be used in the specified pressure range.** **For other gases and pressures, please contact your TAC before use.**

CAUTION	**The equipment should not be installed in a location where it might be subjected to external conditions which might cause electrostatic charges on non-conducting surfaces.**

The breather valve is not part of the waste gas system and is in direct contact with the ambient atmosphere. Gas will only escape from the breather valve in the event of a fault. Take suitable precautions to discharge it. For example, for installations in a building, this may take the form of a vent line into a safe ventilation area or appropriate ventilation of the installation site.

ATTENTION	**The breather valve must not be sealed or blocked.** **It may only be replaced by personnel authorized by Honeywell.**

CAUTION	**Do not loosen or unscrew the breather valve in a potentially explosive atmosphere.**

ATTENTION	**A vent line does not need to be connected to the breather valve as no gas escapes in normal operation.** **If a vent line is connected, it must be routed into a safe ventilation area as specified below and must be protected from dirt and rain**

The following specifications apply to a vent line (please contact your TAC if you are in any doubt):

- The additional pressure drop caused by the pipeline depends on fittings, bends and the material used. It must not allow the pressure inside the housing to rise above 100 mbar (10 kPa). If a straight smooth pipe is used with a minimum internal diameter of 8 mm and an inlet pressure of up to 3 bar, lengths of around 40 m are possible. If you would like to use smaller diameters and lengths of over 40 m, please contact your TAC.
- Completely separate pipeline, connection using the breather valve's internal thread.

CAUTION	**DO NOT CONNECT THE BREATHER VALVE'S PIPELINE TO OTHER PIPELINES.**

2.5 Electrical information connecting with earth and emergency stop

Reference is made to the appropriate technical regulations regarding the installation, commissioning, decommissioning and maintenance work in general. All national, local or company standards and regulations which apply at the installation site of the device must always be given due consideration and applied. For example, Directive 99/92/EC (ATEX 137) governs the installation and operation of electrical systems in potentially explosive atmospheres. Do not fail to comply with this Directive in territories in which it applies.

Honeywell cannot accept any responsibility for compliance with provisions and regulations unless the work was carried out by Honeywell. We recommend that you read through the appropriate regulations again before installation.

Compliance with standards and directives on the following topics, in particular, is mandatory:

- Electrical equipment for potentially explosive gas atmospheres
- Operation of electrical systems
- Testing and maintaining electrical systems in potentially explosive gas atmospheres
- Erection of power installations with rated voltages below 1000 V – tests – initial tests
- German Ordinance on Industrial Safety and Health

ATTENTION	**The place of use and installation must have a functioning, effective lightning protection system to protect personnel and equipment.** **The device must be connected by personnel authorized by the manufacturer in accordance with the instructions of this document.**

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CAUTION	**CASE MUST BE EARTHED!** **The housing and mounting base must be included in the local earthing system and must not be opened or disconnect from erth in a potentially explosive atmosphere. The earth connection on the device (together with other connections if necessary) must be used for this purpose**

CAUTION	**This device must not be operated without an equipotential bonding system/cable or earthing or if this connection has been intentionally broken. No earth potential shift must take place.**

ATTENTION	**The 24 V DC power supply (including mains fluctuations of ± 15%) must have a safe electrical isolation. This may be provided, for example, by Quint-PS-100-240AC / Quint-PS-24DC/24DC/10 / Siemens SITOP / Siemens Logo or equivalent power supply units.** **Every device must be operated with a separate power supply. This is protected externally by a fuse or a miniature circuit breaker.**

ATTENTION	**Supply and communication cables (not supplied) which are shielded and comply with local installation regulations must be used.** **Use cables or wires and cable entries suitable at least up to 70°C (158°F / 343 K) ambient temperature.** **Utilisez des câbles ou des fils et des entrées de câbles adaptés à une température ambiante d'au moins 70°C (158°F / 343 K).**

ATTENTION	The installation personnel must ensure that the wiring is protected from overloads and short-circuits and has the required overvoltage and overcurrent protection. Connecting the device only when the power supply is off

CAUTION	Fuses and batteries may only be replaced by trained personnel authorized by Honeywell. *Les fusibles et les batteries ne peuvent être remplacés que par du personnel qualifié et autorisé par Honeywell.*

CAUTION	The installation must comply with the local standards which apply to electrical and explosion protection (e.g. DIN, EN, VDE, UL, etc.). All connected devices have increased insulation against mains voltage.

ATTENTION	In addition to the SELV system, a PELV system may also be used. The housing must be earthed using the equipotential bonding connection (PA) on the underside of the housing.

ATTENTION	The device does not have its own off switch. It must be operated using an isolating device (switch or circuit breaker) and current limiting device (or a combination of the two) to comply with ISO/IEC 60079-14 and ISO/IEC 61010-1. (Operating voltage of the isolating device at least 48 V DC.)

This isolating device (not supplied) must be located close to the device to comply with explosion protection and electrical safety regulations, thus contributing to the formation of the power-limited circuit. The isolating device must also isolate all the power supply cables leading into the potentially explosive atmosphere. It must comply with the requirements for the installation site as mentioned in the standard. One example of such an isolating device is a C 5A circuit breaker.

ATTENTION	Warning: this device is a Class A device (according to EN 55016-2-3). It may cause radio interference in residential areas. In this case, the operator may be requested to take suitable action at their cost

ATTENTION	The enclosure is non-conducting and may generate an ignition capable level of electrostatic charge under certain extreme conditions. The user should ensure that the equipment is not installed in a location where it might be subjected to external conditions which might cause a build-up of electrostatic charges on non-conducting surfaces. Additionally, cleaning of the equipment should be done only with a damp cloth.

Cable glands and connections

There are four boreholes for electrical inlets and outlets on the device. The threaded bore holes can be fitted as required with blind plugs, adapters or cable glands. These screw-in parts must be suitable for the IIC Zone and have explosion-protection certification.

ATTENTION	**The enCal 3000 may only be connected using cable glands. These must comply with local explosion-protection regulations and be installed or replaced by authorized trained personnel. To comply with explosion-protection regulations, they must be installed and sealed as specified by the manufacturer of the cable glands. The relevant regulations must be observed during this process.**

ATTENTION	**The cable inlets must satisfy or exceed the IP rating of the device. NEC-compliant cable inlet equipment must be used in the USA. CEC-compliant equipment must be used in Canada.**

Cable glands may only be used with cables which have the following properties:

- Not sensitive to cold flow, impermeable to air and at least three metres long (only suitable if cable and cable gland are designed for temperatures of at least 70°C)
  (ne convient que si le câble et le presse-étoupe sont conçus pour des températures de 70°C et plus)
- Terminal boxes, cable conduits if they are sealed:
  - within 1xD outside the housing for ATEX and IECEx

2.6 Explosion protection

CAUTION	**The regulations in the relevant national and international standards (for example IEC/EN 60079-14, installation of explosion-protection equipment) must be followed to the letter.**

Handling explosion-proof devices

The installation and connection work must be carried out using the circuit, connection and pipework plans mentioned in the document. Follow the instructions set out below carefully and ensure that you have completed all the required safety steps before you work on the measuring unit or switch it on.

Work in potentially explosive atmospheres requires a license. You need a written operator license (fire service license certificate), for example for the following:

- Transporting and/or using a PC or laptop through or in a potentially explosive atmosphere.
- Opening the device in a potentially explosive atmosphere when the operating voltage is live.
- Connecting the control and parameterization device or laptop in a potentially explosive atmosphere.

CAUTION	DO NOT OPEN (THE DEVICE) WHEN AN EXPLOSIVE ATMOSPHERE IS PRESENT DO NOT OPEN IF THE CONDITIONS DESCRIBED IN ISO/IEC 61010-1 ARE NOT COMPLIED WITH

CAUTION	The cable inlets must not be disconnected in any circumstances in this case. Never work on live systems.

ATTENTION	You require a written operator license for carrying out work in potentially explosive atmospheres.

Maintaining explosion protection

ATTENTION	Please note: The test certificate for this device describes all the conditions and regulations specified for the installation and operation of the device to maintain explosion protection.

ATTENTION	Only qualified personnel may operate and maintain explosion-proof devices. These persons must only use explosion-proof, approved equipment and measuring instruments. Do not disconnect cable inlets and breather valves in a potentially explosive atmosphere.

Switch off the device in any event when working on it. Comply with the following procedure:

- Close all gas supplies.
- Switch off the supply voltage.
- Protect all open pipelines and connections from dirt.

CAUTION	ATTENTION! ELECTROSTATIC DANGER! ELECTROSTATIC HAZARD Because of the potential electrostatic charging of the paint layer, the housing should only be cleaned by using a damp cloth to prevent lectrostatic charging, since otherwise sparks are possible

 CAUTION	Recommissioning must not be carried out in a potentially explosive gas atmosphere and before you switch on the device, ensure that all the gas connections are sealed and the earthing or protective conductor has been installed correctly.

 CAUTION	The used flame paths for this device are not intended for repair.

 ATTENTION	All removable covers and hoods for opening the housing must be protected against accidental opening by security screws

Danger of explosion

 CAUTION	Danger of explosion in the event of incorrect installation and connection. Before the device is switched on or switched back on, ensure that all the gas connections are sealed and the earthing or PE wire is correctly installed.

 CAUTION	Do not operate or use damaged devices or devices with modified housings or with an incorrect connection since explosion protection is no longer guaranteed in this case.

 CAUTION	Safety information on the device: DISCONNECT POWER BEFORE OPENING DO NOT OPEN WHEN AN EXPLOSIVE ATMOSPHERE IS PRESENT

 CAUTION	If the device is not serviced or maintained correctly, there is a danger that it will explode. Contact the manufacturer for repair work which affects the explosion protection and the flameproof properties of the device.

 CAUTION	DO NOT OPEN THE DEVICE IF. • IT IS IN A POTENTIALLY EXPLOSIVE ATMOSPHERE • THE CONDITIONS DESCRIBED IN ISO/IEC 61010-1 ARE NOT COMPLIED WITH • YOU DO NOT HAVE THE PERMISSION OF THE MANUFACTURER AND OF THE STATION OPERATOR TO DO SO

3 Functional Design of EnCal 3000

3.1 Introduction /Enclosure/Hausing

The **EnCal 3000** is an on-line gas chromatograph. The device is fully automatic and is enclosed in a tailor-made Ex-d housing which contains the electrical and analytical equipment. The explosion-proof aluminium housing essentially consists of a low base on to which a relatively high hood/cap is screwed using an M270 thread

It can be positioned close to the sampling unit. In the housing is place for up to two analytical channels that are controlled by one processor board. The Encal 3000 Process Gas Chromatograph (PGC) transfers the core laboratory technique to process conditions. Once the cap is removed from the base, almost all the internal components are directly reachable.

The **EnCal 3000 (measuring unit)** includes the analytical components, the stream selection and all the electronic components required for autonomous automated operation.It can analyse up to 5 gas streams sequentiallyChanges in ambient temperature have no significant influence on the peak retention times. The device therefore does not need an expensive temperature-controlled environment. Maintenance work is only required once per year. Routine calibration takes place automatically at a time programmed by the user and leads to significantly lower consumption of carrier and calibration gases. This reduces operating expenses compared to conventional gas chromatographs.

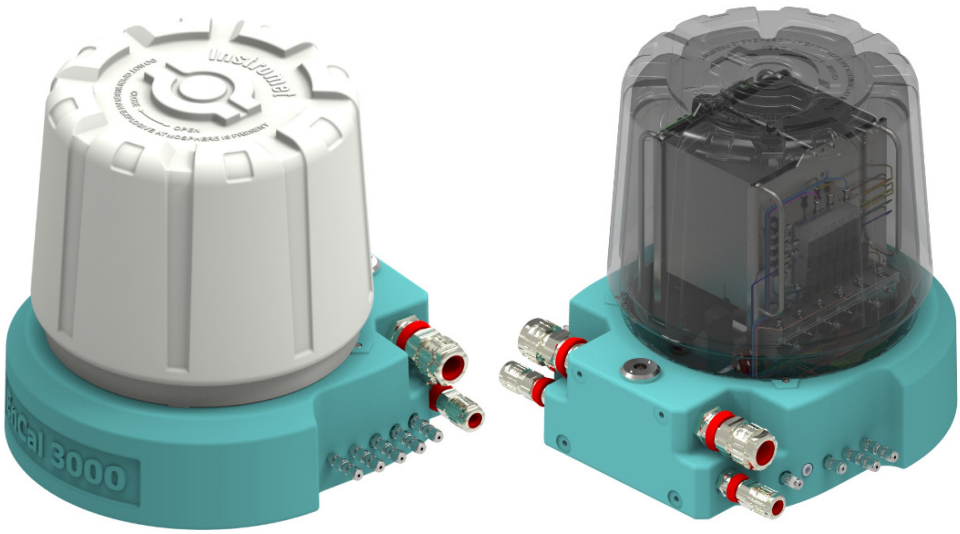


Figure 3.1: Housing complete with the (transparent)hood

	Further information ⇨ see technical data and the type labels on the device

3.2 Most important features and functions

- Compact EX-d design allows for the harshest conditions imaginable in natural gas applications
- installation clearance Ø 55 cm x 70 cm height, weight <30 kg
- Complete stand-alone operation
- mount the device on a platform, a pole or to the wall
- Capillary and micro packed columns in combination with MEMS analytical components
- Fast analysis (C6+ in less than 3 minutes)
- High analytical performance :
- Uncertainty < 0.1 % for a wide range of gases
- Repeatability < 0.005 %
- Up to 5 sample streams sequential without external stream selection
- All gas tubing (sample lines, cal. gas, vent lines, helium in and out) and all electrical connections can be directly connected to the unit.
- Integrated sample system
- Internal data storage for the last 35 days of all data
- Suitable for extreme environmental conditions
- Two analytical modules (which do each a part of the total analysis, in parallel)
- Processor board
- Internal sample system (stream selection and pressure regulation)
- All electrical field connections (Ethernet, ModBus, analogue IN, digital I/O, solenoid drivers), fuses, switches and jumpers
- Explosion proof certified for ATEX / IECEx / NEC
- IP 66 ingress protection against dust and precipitation (suitable for offshore applications)
- Standard temperature range: 0 to +60 ° C (32 to 140 ° F), optional extension for devices with ATEX/IECEx-Approval. 0 to 55°C (32 to 130°F) for devices with FM-Approval with internal heating to -20 ° C (-4 ° F), with internal heating and external insulation to -40 ° C (-40 ° F)
- EMC certification according to EN 61000-6 - 2/4 (Industrial devices)
- Vibration and shock test according to OIML D11 11- 1/2
- Coating according to Shell specifications DEP 40.4800.30 for off-shore applications
- For check or maintenance procedures of most parts, only the cap has to be removed.

The following paragraphs give a general description of the main parts of the unit.

4 Process Gas Chromatography – General Introduction

4.1 Analytical Principle

Gas chromatography in general is an analytical technology which is used to analyse gas mixtures, i.e. to measure the concentrations of the different components of a gas.The analytical principle is shown in figure 4.1

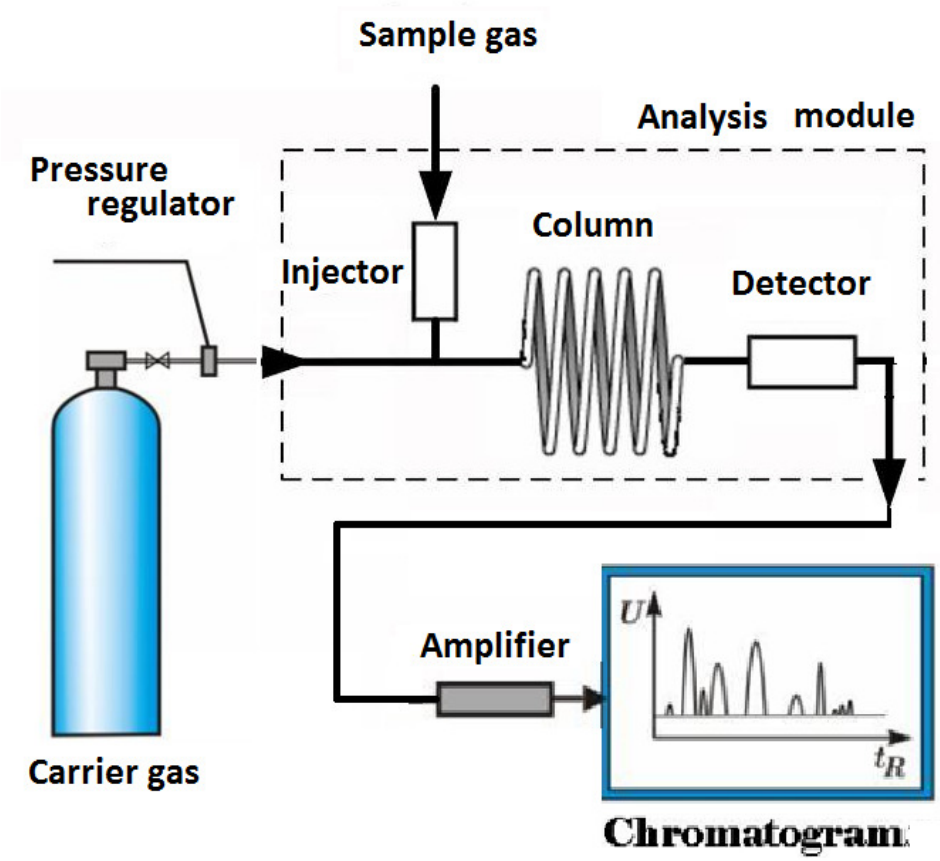


Figure 4.1: The analytical principle

A very small volume of sample gas (typically much less than 1 ml), which is a mixture of several components, is injected into a stream of carrier gas, which takes the sample gas through the column. This column acts as a separator through the difference in absorption rate of the different components of the sample gas, they are separated from each other during their passage through the column and elute as individual components. The concentration of each component is then measured at the end of the column by a detector. From the knowledge of the concentrations of each component, any property of the gas can be calculated.

4.1.1 Column

The **separation column**, or **column** for short, of a gas chromatograph traditionally consists of a relatively long spiral tube wound in a coil with a very small internal diameter.

The interior of this "column tube" is made of slow-reaction materials such as quartz glass or stainless steel. These coating or filler materials are known as the "**stationary phase**". They are used as an adsorption layer for the gas molecules flowing through the column and ensure the actual separation of the components. There are various types of columns, see the figure below.

Typical dimensions of the used columns in the **enCcal3000** have a length of several meters and internal diameters of <0.1 mm. They are made of inert materials like fused silica and stainless steel.

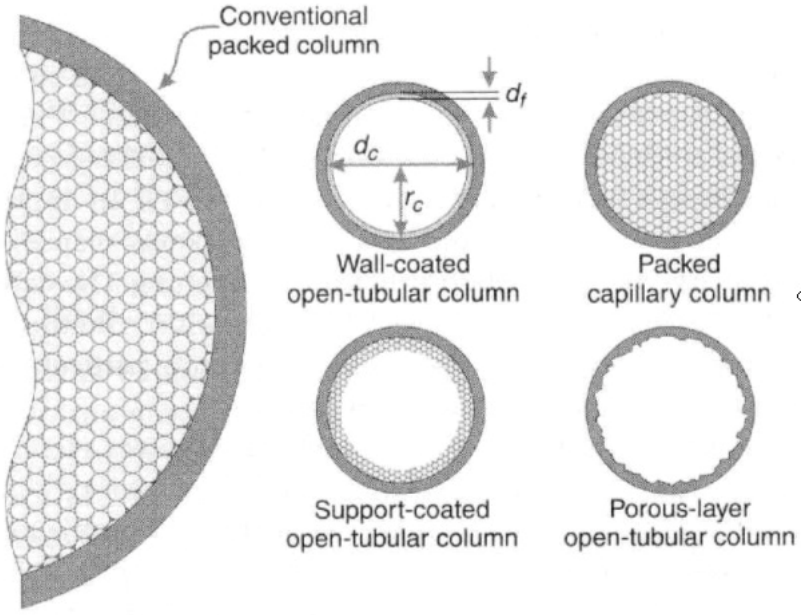


Figure 4.2: Different types of gas chromatographic columns

Various configurations exist:

- **Wall-coated open tubular column**: the stationary phase is a thin liquid layer coated on the inner wall of the column (for example type 5CB)
- **Packed capillary column**: the stationary phase is coated on a packing, which is equally distributed throughout the column (for example type HSA)
- **Support-coated open tubular column (SCOT column)**: the stationary phase is a coated packing, which itself is coated on the inner wall of the column (for example type M5S mole sieve)
- **Porous layer open tubular column**: the stationary phase is a porous layer on the inner wall of the column (for example type PPU)

4.1.2 Detector

The **thermal conductivity detector (TCD)**, known as the **detector** for short, is a relatively simple, very efficient, robust detector which is very widely used in the natural gas industry. The most popular detector is the TCD: Thermal Conductivity Detector.

Another reason for the popularity of the TCD in the natural gas industry is the fact that gas chromatographs are used mainly for the measurement of gas properties like heating value, Relative density and Wobbe index. The calculation of these parameters is based on the concentrations of the main gas components.

TCDs newer design in MEMS technology (MEMS = Micro-Electro-Mechanical System), which are also used in the **EnCal 3000** are much smaller in terms of volume. The components can be integrated at the same time much more accurately, so that the analytical precision is for example 1 ppm for n-pentane.

Traditionally the two TCD's (reference + measurement detector) are integrated in a so-called Wheatstone configuration, which increases significantly the signal-to-noise ration of the measurement.

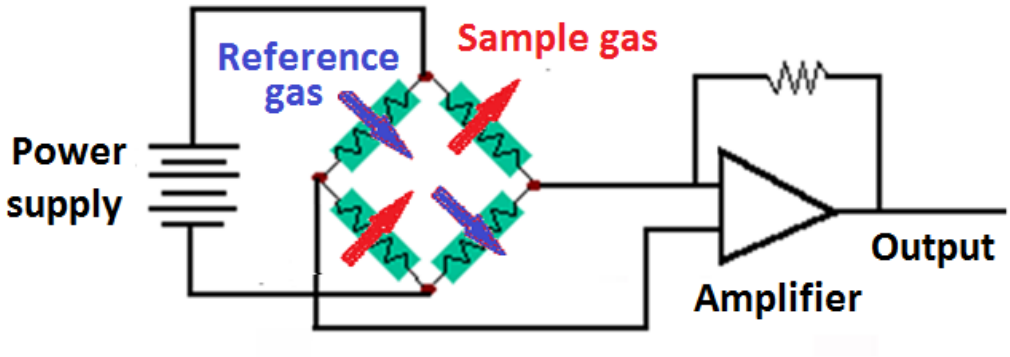


Figure 4.3: Typical electrical TCD circuit

4.1.3 Sample Injector

The **sample injector**, also known as simply the **injector**, injects the sample into the stream of carrier gas.The sample injection must assure a precise injection of sample into the flow of the carrier gas.

In principle the amount injected must be very precisely controlled, both in volume, pressure, temperature and flow (to avoid viscosity effects) to guarantee a high level of repeatability of the analytical results, but in practice the normalisation of the measured concentrations will compensate for a large part of the fluctuations of these parameters.

However, to reach repeatability for the heating value below 0.01 %, these parameters do have effect and need to be controlled to a high degree.

The used MEMS technology allows a fundamental improvement of the sample injection quality compared to the traditional fine-mechanical technologies used for most of the current process GC's on the market. The picture below shows a typical MEMS sample injector, etched in silicon channel, with membrane valves to control flow directions.

This injector allows for a very precise control of the injection volume and temperature, on a remote base.

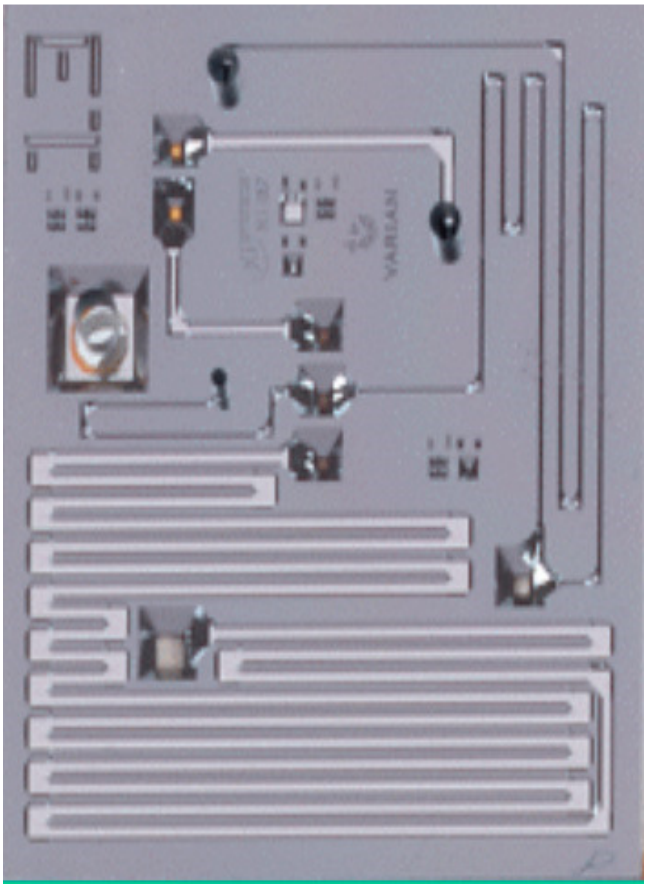


Figure 4.4: MEMS Sample Injector

4.1.4 Result findig and presentation

Two fluidically independent collums for reference gas and sample gas are used. Differences in temperatue and thermal conductivity occur between them and let to changes in the electrical evaluation circuit which are analysed. It results in the “signal mountain” known as the **peak** in the chromatogram. The figure below shows examples of what chromatograms look like.

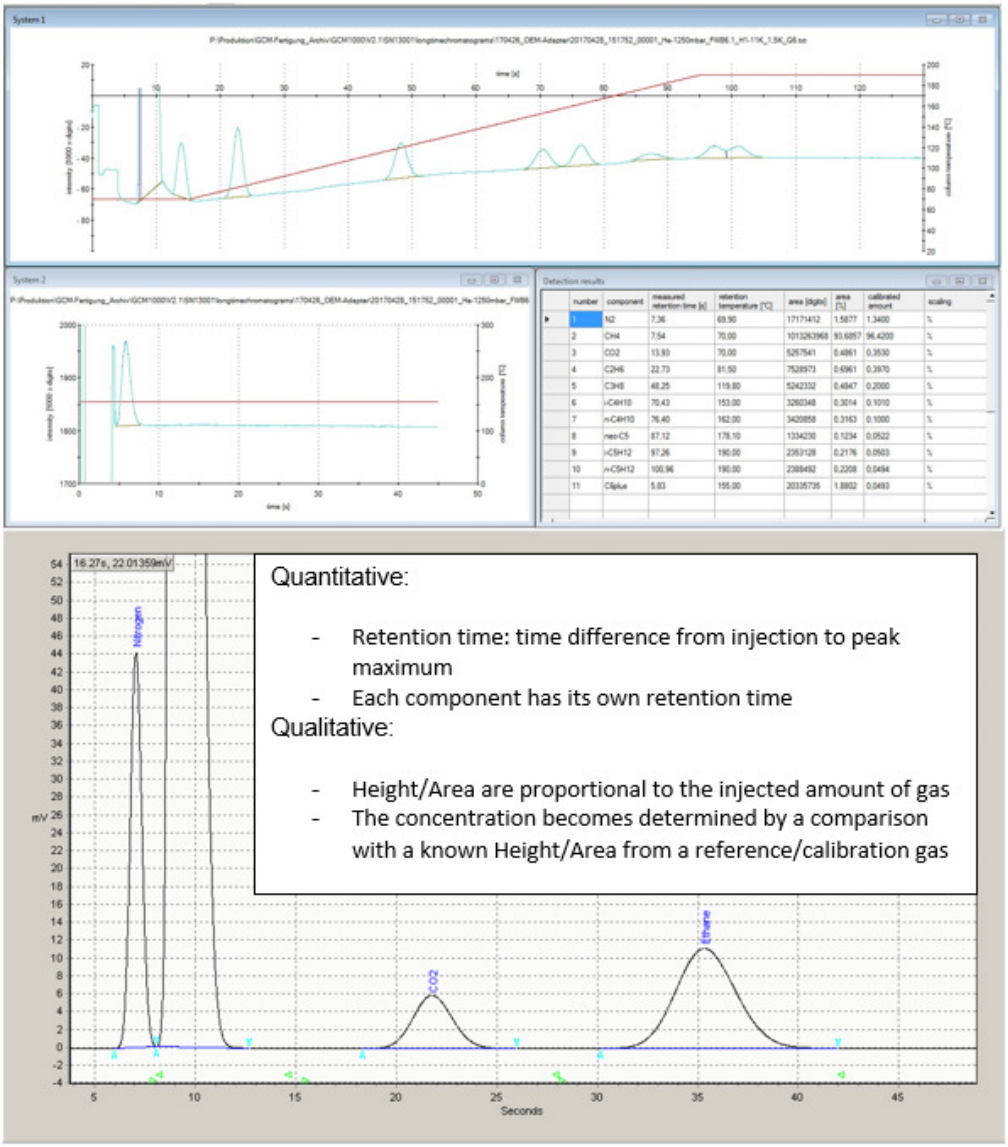


Figure 4.5: Chromatograms

All the main gas components can therefore be recorded directly and can undergo further processing.

5 Housing interior with major internal components

Only the hood must be removed for inspections, maintenance work and the electrical installation.

CAUTION	DO NOT OPEN THE DEVICE IF. • IT IS IN A POTENTIALLY EXPLOSIVE ATMOSPHERE • THE CONDITIONS DESCRIBED IN ISO/IEC 61010-1 ARE NOT COMPLIED WITH • YOU DO NOT HAVE THE PERMISSION OF THE MANUFACTURER AND OF THE STATION OPERATOR TO DO SO

Turn the security screws as far as possible downwards to allow the hood to be removed. As soon as the hood has been unscrewed and removed, almost all the internal components are directly accessible:

CAUTION	**When the device is open, there is a risk of damaging the internal components and thus generating safety problems and malfunctions.** **You should therefore complete the work with the appropriate care and always obey the explosion protection regulations.**

The open housing provides a view of the layout of the main components and internal parts. The skid is designed to secure the various components. It enables most components to be removed by unscrewing just a few screws.

Due to the long application time of the device and the different conditions of use, individual components are used in different variants. The following figure shows the exploded view of the different internal components of the Master Unit of the EnCal3000, the individual parts and variations are explained in detail with the functionalities of each component in the following paragraphs.

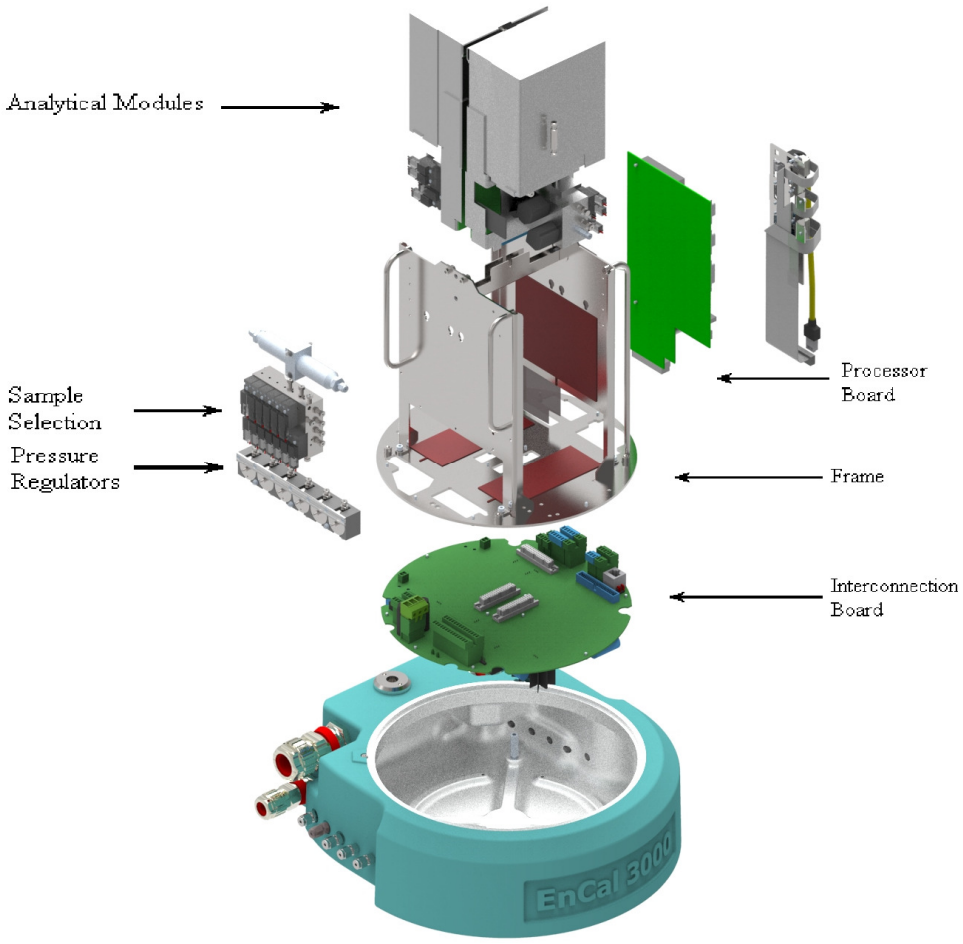


Figure 5.1: Exploded View on the Internal Parts of the EnCal 3000

The frame is used for mounting the components and allows the removal of all the direct and individual components, with the exception of the interconnection board.

If the Interconnection Board must be removed (bottom), the frame has to be removed from the enclosure base first. This arrangement permits the service engineer to easily review the board in case malfunctions would occur.

5.1 The Channel

A channel consists of the following subcomponents:

- Analytical Module: This is the heart of the EnCal 3000: it contains the column, sample injector, detector and the heaters for the columns and the injector
- AMI (Analytical Module Interface): electronic circuit which controls the analytical components of the Analytical Module. It has its own EDS (Electronic Data Sheets) which stores the local configuration parameters

- EPC: Electronic Pressure Control for adjusting the pressure of the analytical column
- Channel Controller: electronic circuit which controls the communication between AMI and Processor Board, and also controls the EPC (Electronic Pressure Control) and valves needed for the control of the internal gas flow circuit.

Both AMI and Channel Controller have their own EDS (Electronic Data Storage) which stores the local configuration parameters. This enables to swap to channels without a need for reconfiguration, uploading the internal settings is sufficient to fully install a new channel in an existing unit.

The Analytical Module uses different columns for different applications. In the EnCal 3000 two columns are used:

- HSA column (HaySep), for the analysis of N2, CH4, CO2 and C2H6
- 5CB column 4m or 8m, for the analysis of the higher hydrocarbons (C3H8 up to C8H18 or up to C9H20)

For devices build before 2008 the 5CB-4m channel was used for the analysis up to C6+ and the 5CB-8m channel just for the analysis up to C9. Since 2008 the 5CB-8m becomes used for both options, the main reason for this change is that the separation of the peaks especially for n-butane and neo-pentane is better for the 8m long column.

Another possible Channel configuration for the special application biogas is:

- M5A column (molesieve), 10m long, for the analysis of H2, O2 and N2.
- PPU column, 10m long, for the analysis of the hydrocarbons (CH4 up to n-C4H10) and CO2

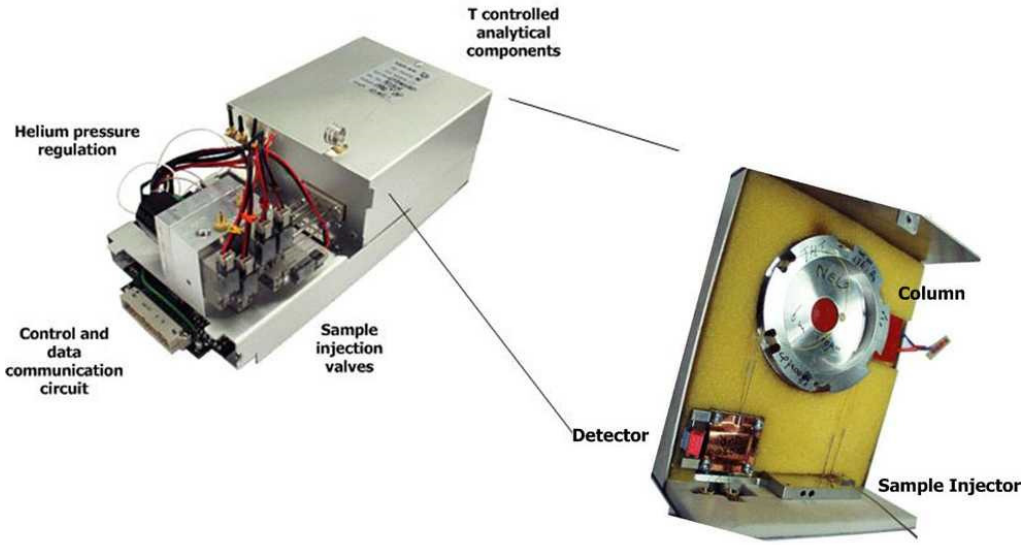
Another possible Channel configuration for the analysis of hydrogen and natural gas is:

- COX column, 1m long for the components (He), H2, N2, CH4, CO2 and C2H6
- 5CB column, 8m long for the higher hydrocarbons (C3H8 to C9H20)

In the biogas-application for the M5A column, two additional internal humidity filters are required, which are mounted on the module. These filters are used to reduce humidity to a minimum. Humidity can penetrate by diffusion of air into the analytical column.

Without the filter, this humidity would reach the analytical module and be absorbed by the column material. Therefore, the retention times of the measured components would reduce always so that the separation of the measured components is deteriorated and a heating up of the column would be required after about 3 months.

With the filters ensures that a heating up of the M5A column is not necessary within a year (calibration cycle). As the capacity of the attached filter is very low, the filter should be changed with each recalibration. For the carrier gas argon always an additional external humidity filter should be used.



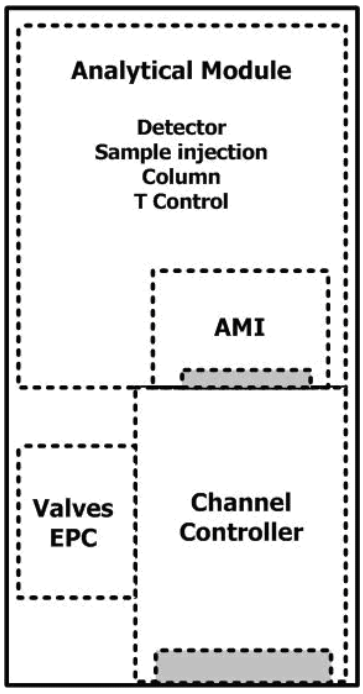


Figure 5.2: Overview of Channel Components

The next page shows the internal gas flow configuration of the channels.

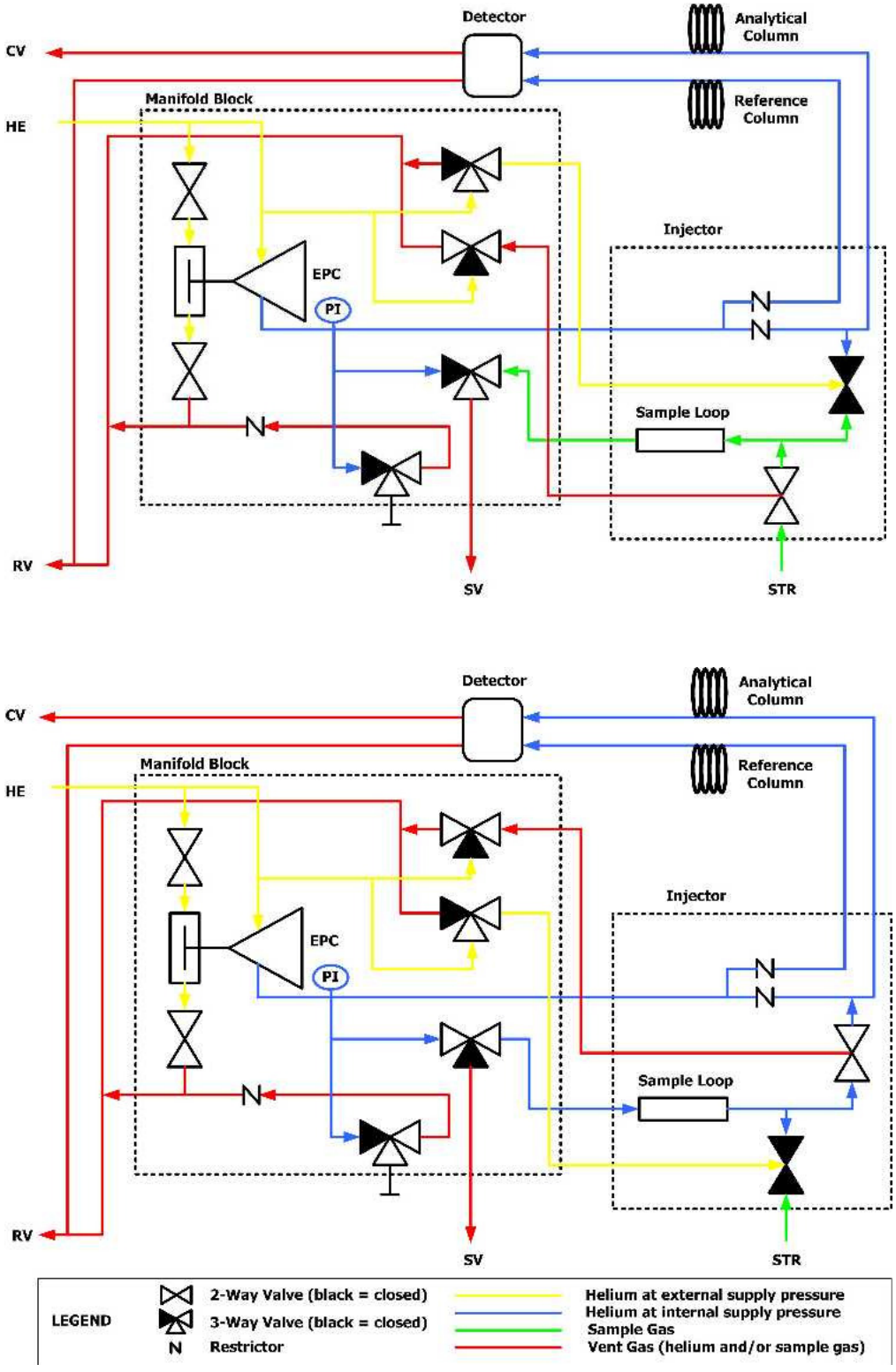


Figure 5.3: Internal Gas Flow Circuit for each Analytical Channel of the EnCal 3000, during Normal Operation (top) and sample Injection (below)

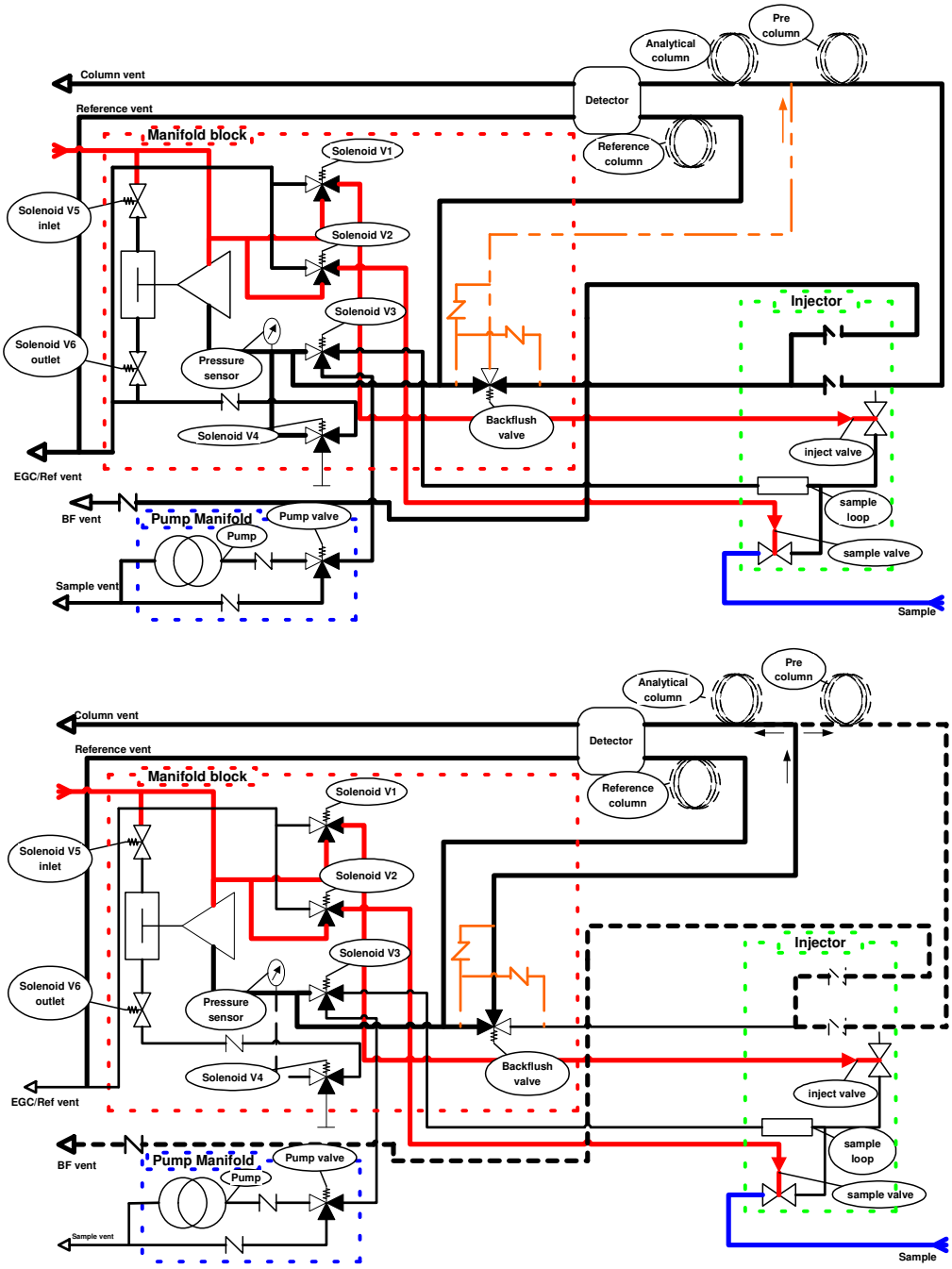


Figure 5.4: Internal Gas Flow Circuit for each Analytical Channel with backflush of the EnCal 3000, before activating backflush valve (top) and after activating backflush valve (below)

5.2 Processor Board

The main components of the board are:

- Arm9 Processor
- A Flash-Memory 32 MB for local data storage
- The Ethernet-Port
- Data communication ports (COM1-4) for serial Modbus, Analogue and Digital I/O
- USB Port
- I/O Controller for Communication to the analytical channels
- Pressure- and Temperature Sensor

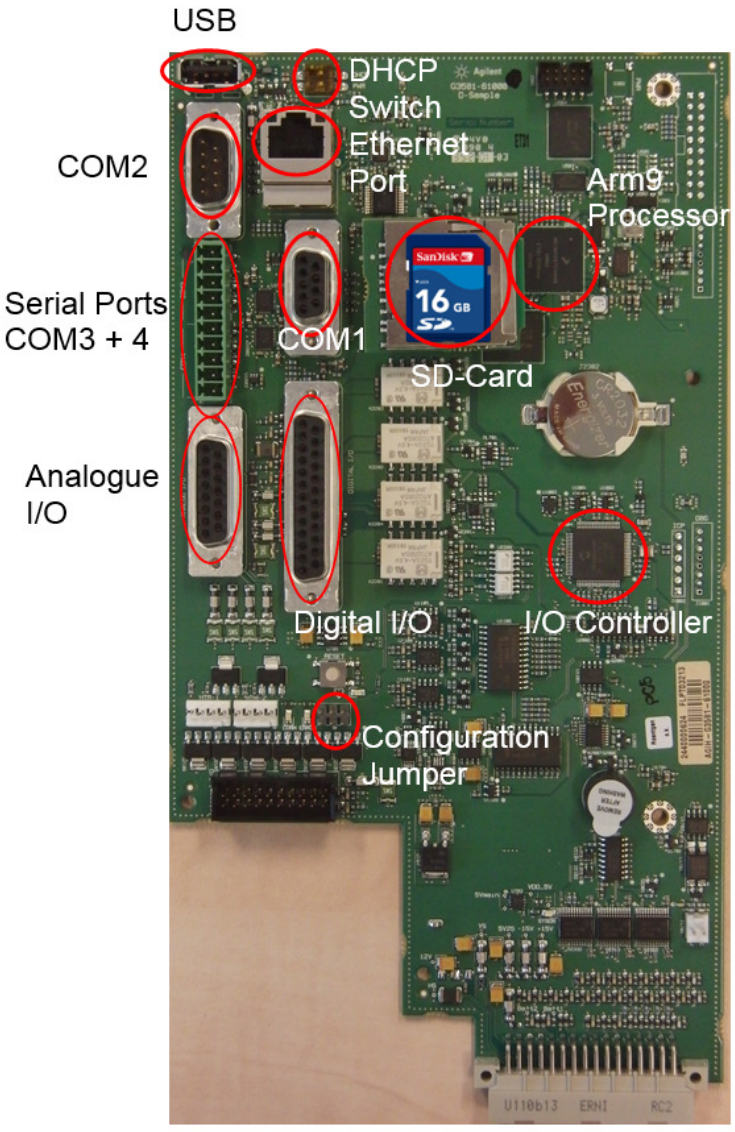


Figure 5.5: Processor Board connections

5.2.1 Save parameters in the measuring unit

Setting the "Configuration Jumpers" can protect the parameters on the measuring unit computer witch was loaded by using the software RGC 3000. This configuration Jumper is at the same position for the all mainboard types. (see following figure) If the jumper is set, the parameters inside the measuring unit cannot be override. Changes in the parameters can only be transferred to the measuring unit, if the jumper is not set.

The setting of the jumper, can be checked on the display of the “instrument status” page. See Section 3.2 of the software manual. How to set the jumper is shown in below.

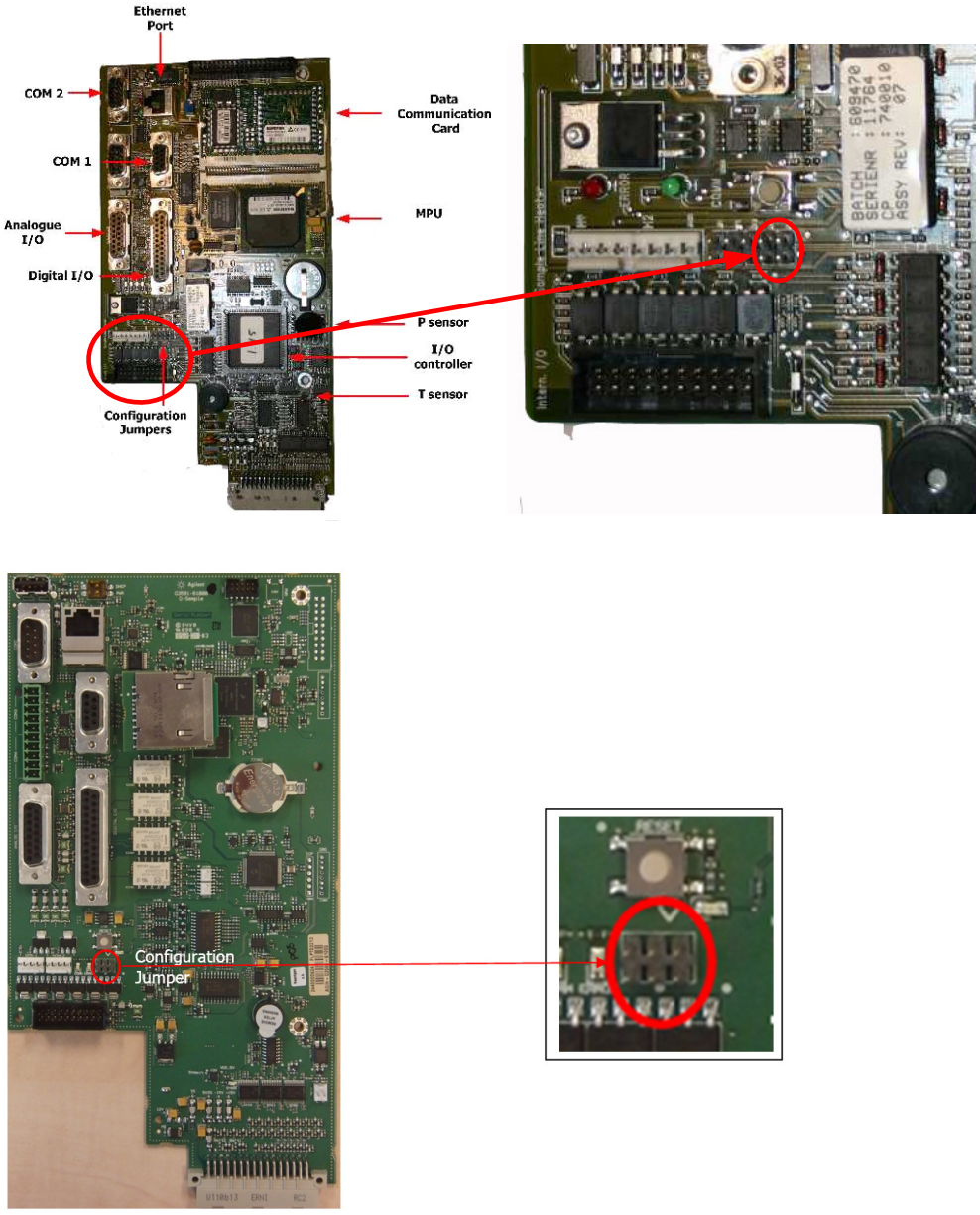


Figure 5.6: Save parameters in the measuring unit all bord versions

5.2.2 Processor Board installed

When installed in the EnCal 3000, a flat cable makes the connection between the communication ports of the Processor Board and the Interconnection Board, which provides field connections (Phoenix connector) for the data communication signals. Also 2 fans can be mounted to cool the processor in case of elevated ambient temperatures.

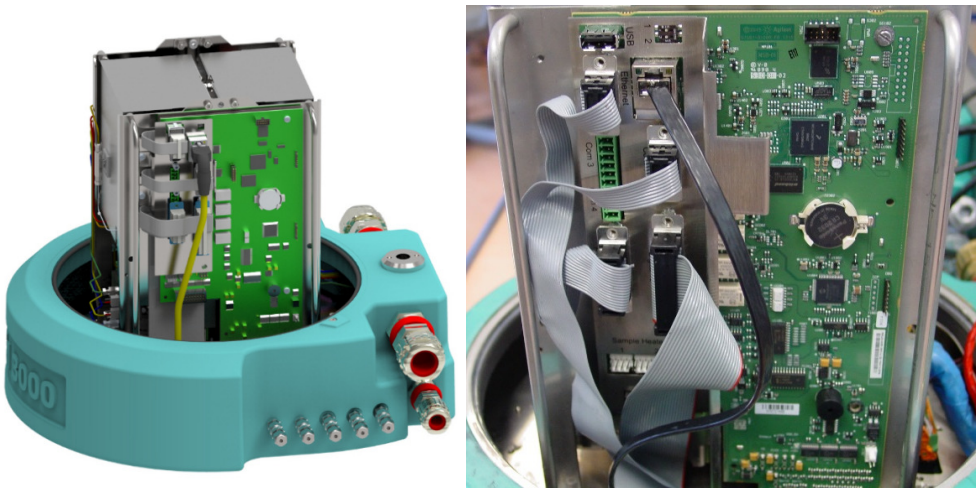


Figure 5.7: Processor board with ribbon flat cables mounted in the EnCal 3000

5.3 Interconnection Board

This board in all variations has the following functions:

- Power supply input (24 VDC)
- DC/DC converter
- Connection of Processor Board with Analytical Modules
- Field data communication connectors
- Actuation of stream select solenoids
- Enclosure temperature regulation
- Internal DC/DC conversion for various circuits

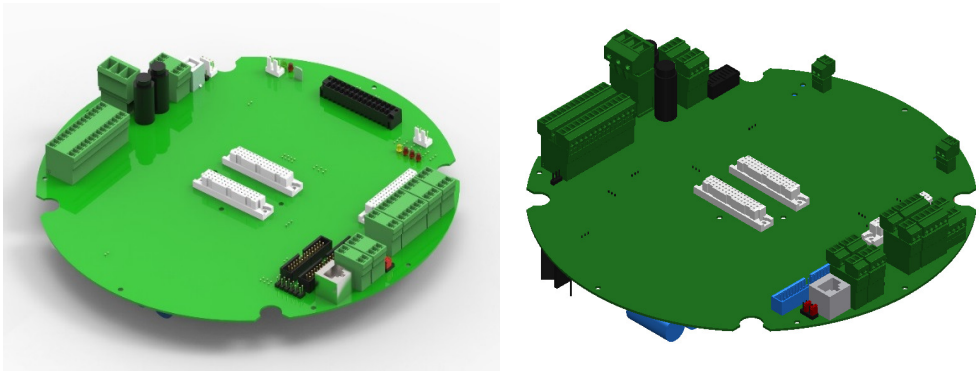


Figure 5.8: Interconnection Board in different variations

The following diagram shows the overall electrical configuration EnCal3000 in a rough overview.

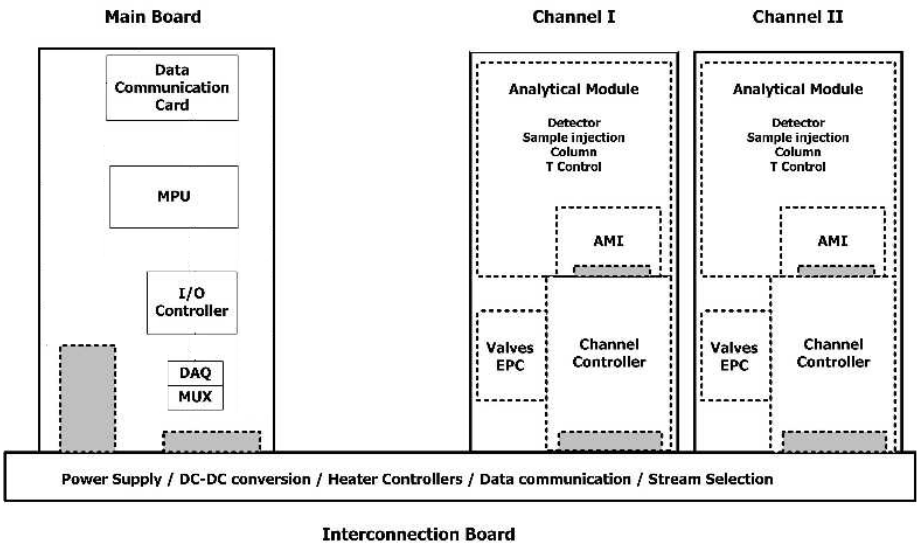


Figure 5.9: Overall Electrical Configuration of the EnCal 3000

5.4 Internal sample system

The internal sample system has the following functions:

- Double block and bleed stream selection (up to 5 streams / 1 cal)
- Pressure regulator. Advised input pressure is 2 barg. Input pressure range is 1 to 5 barg
- Split of the helium and sample gas to the 2 analytical columns
- Combination of the vent lines of the 2 modules
- Purge of the cabinet with Helium (optional)
- Integrated fast loop function (stream purge)

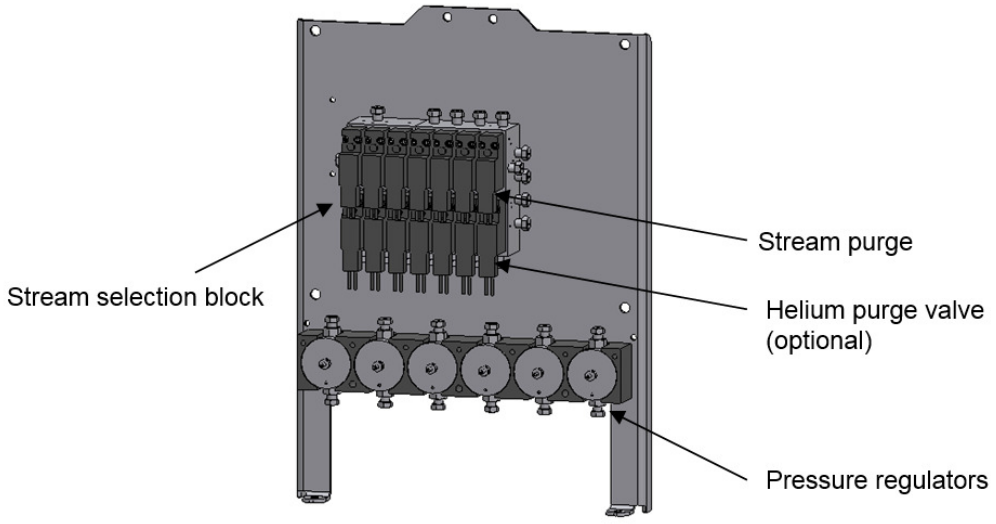


Figure 5.10: Front view of the internal sampling/stream selection system

Helium Purging (optional)

Helium enters the manifold and is split to both analytical modules. Through a purge valve the helium can be vented into the housing, to expel the air in the housing (activated by time relay 3). Additionally to this the column vent is released into the housing which is nearly pure helium. If there is a leak in the housing no combustible mixture can be formed because of the absence of air. The housing withstands the pressure of an explosion but by purging the housing with Helium the chance of internal damage is also reduced significantly. The purge and the small amount of helium that is vented into the housing also protects the internal components against moisture or other aggressive components entering the housing through the breather.

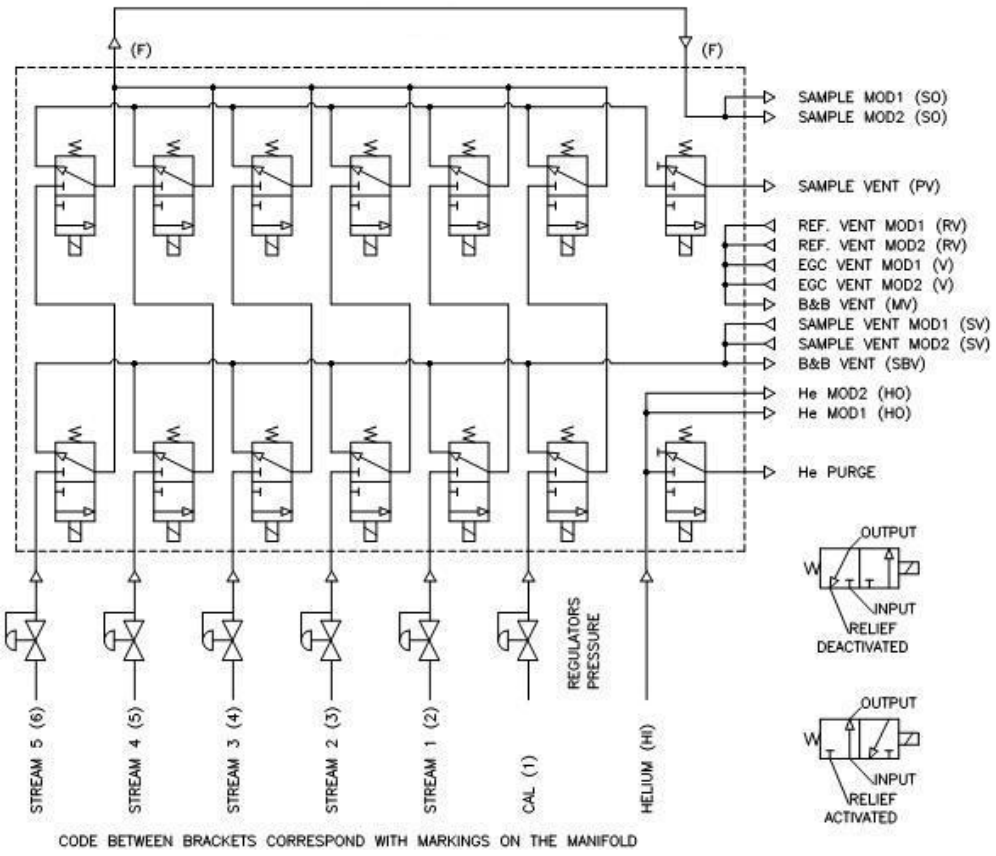


Figure 5.11: Flow diagram Sample Conditioning and Selection System

5.4.1 Double Block and Bleed Function

After small particles are filtered out by the inlet filters in the inlet couplings, the pressure is reduced to approximately 0.8 barg. From the pressure regulators the gas will flow to the manifold. There are several valves mounted on the manifold.

The two most right valves are purge valves. The upper purge valve is the sample bypass valve (Activated by timed relay 2). The lower is a helium purge valve and activated by timed relay 3.

The stream and calibration valves form pairs that are actuated at the same time.

The valves left from the purge valves are used for the calibration. Next to the calibration valves there are 1 up to 5 pairs used for the streams. Depending on the configuration the manifold can support up to 3 or up to 6 streams (including the calibration gas stream). Unused positions on the manifold are blocked.

Gas will enter at the first (lower) valve which will guide the flow to the second (upper) valve in actuated situation.

The second valve guides the flow into a common channel. In deactivated situation, the input from the first valve is blocked and the output is linked to the relieve port of this valve, which vents to the SBV vent. The input of the second valve is also blocked so it is not possible to build up pressure between both valves. In case one or both valves would leak, the pressure between the valves won't rise above the pressure that is present in the common channel because of the vent to the SBV vent, so mixing up the streams is not possible.

5.4.2 Internal Sample Bypass

The output from all second valves is combined on the common channel. Depending on which channel is activated, a section of this channel and the deactivated valves, form a dead volume. The outputs from deactivated valves are therefore relieved to a second common vent channel, which is blocked by the sample bypass valve. Activating this valve will result in a flow from the activated valves, through the deactivated valves, to the bypass valve. This refreshes all second valves and the common channels with the new gas, so all dead volumes are refreshed. Actuating the bypass valve results in a flow that is approximately 15 times higher than the normal flow. The purge valve should be activated for a short period (±30 seconds default) when a new stream is selected.

If there is a long sample line between the sample point and the Encal, or there is a relatively high pressure in this line the bypass time can be increased up to 150 seconds. The new stream is selected one analysis prior to the injection, so during the analysis the new sample is already flushed through the manifold. The best moment to activate the sample purge is ending 10 seconds before the injection and then extended to the front depending on the purge duration.

Keep in mind the purge time also applies to the calibration gas which must be purged, but larger purge times and frequent purging will deplete the bottle faster. Further information for the needed setting in the software can be found in the software manual.

The flow through the analytical modules will be reduced during the activation of the bypass, but will continue. Closing the bypass valve will restore the normal flow to the analytical modules. After the sample gas has passed the manifold it becomes split for the transport to the two analytical channels. The vent outputs from both modules return to the manifold and are combined to two venting outputs.

6 Hardware Installation

 CAUTION	**All safety and warning notes in this document must be observed before further workis done**

6.1 Installation specifications

The installation of this equipment must conform to any national, local, or company codes applicable to the location. Elster-Instromet assumes no responsibility for compliance with these requirements. It is suggested that a review of the codes be made prior to installation.

ATTENTION	**Installations in the US shall comply with the relevant requirements of the National Electrical Code® (ANSI/NFPA-70 (NEC®). Europe installations shall comply with the 60079-14 according the attached certificates**

6.2 Design of the measurement point

A typical measurement point consists of up to five sampling lines from the gas pipeline(s) to the measuring instrument. If the pipeline pressure is higher than the maximum inlet pressure, a pressure reduction system must be installed and adjusted upstream of the sample gas inlet.

The streams of gas are measured in sequence. Gases which have passed through the device are fed into the waste gas.

The carrier gas and calibration gas are generally supplied from gas cylinders with pressure reducers installed near the device. These auxiliary gases are used to maintain operation and measurement accuracy. The gas supply will generally last for several years of operation and can be increased if necessary by using a changeover valve. This option is shown on the helium cylinders in the picture below.

All components and pipelines (made of stainless steel) should be installed permanently and may require additional heating. The waste gases must not cause any backpressure in the exhaust system and must not interfere with each other. To enable this, the gas from the module vent (MV) must always be discharged separately. The power supply and the communication cables must be connected and installed as usual in industrial environments. The following diagram shows a typical system layout in simplified form:

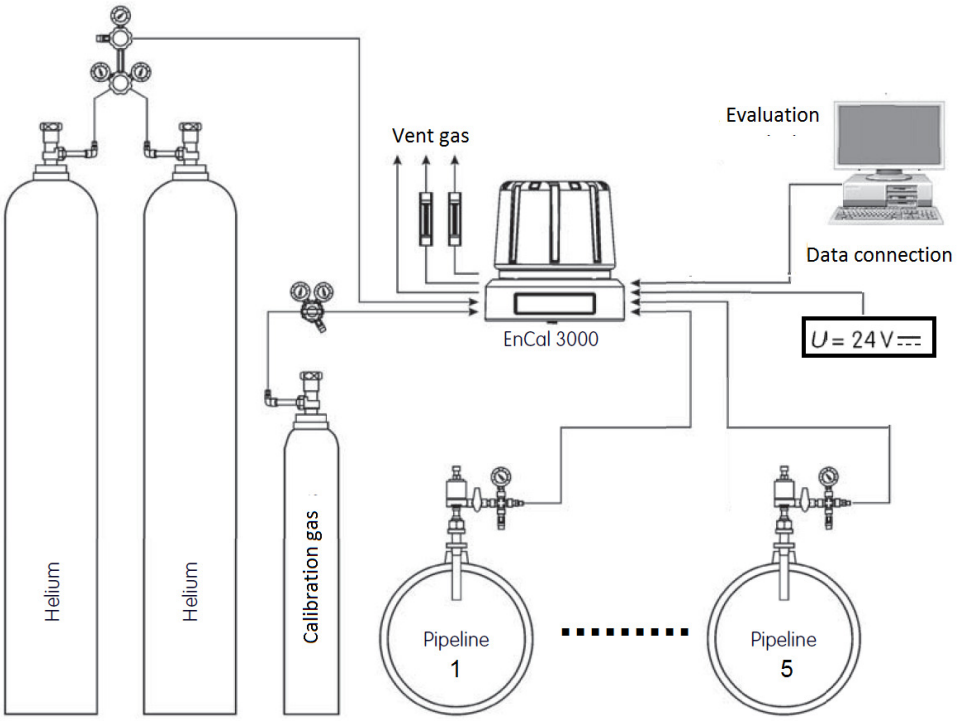


Figure 6.1: System overview

Flow meters may be installed in the stream of waste gas as an option to provide further control of the device.

6.3 Mechanical installation (assembly)

Professional installation is the only way to ensure that the device operates safely and without problems. Always observe the general safety rules, particularly in a potentially explosive atmosphere. Always use a gas detector for your own protection to check your respiratory air for toxic or explosive gases when you are working on the device in areas where such hazards exist. Do not carry out any unauthorized modifications or technical changes.

ATTENTION	**If the product is modified or changed without authorization, its CE declaration will immediately become void. This may result in a safety risk!**

There must be a minimum gap of 700 m above the base of the device and 100 mm in front of the gas connections or a radius of 225 mm around the centre of the cover.

	Select an installation height between 1.00 m and 1.50 m above the floor which is suitable for maintenance work.

We recommend that you use larger gaps to make installation and maintenance work easier. The following sketch shows these requirements.

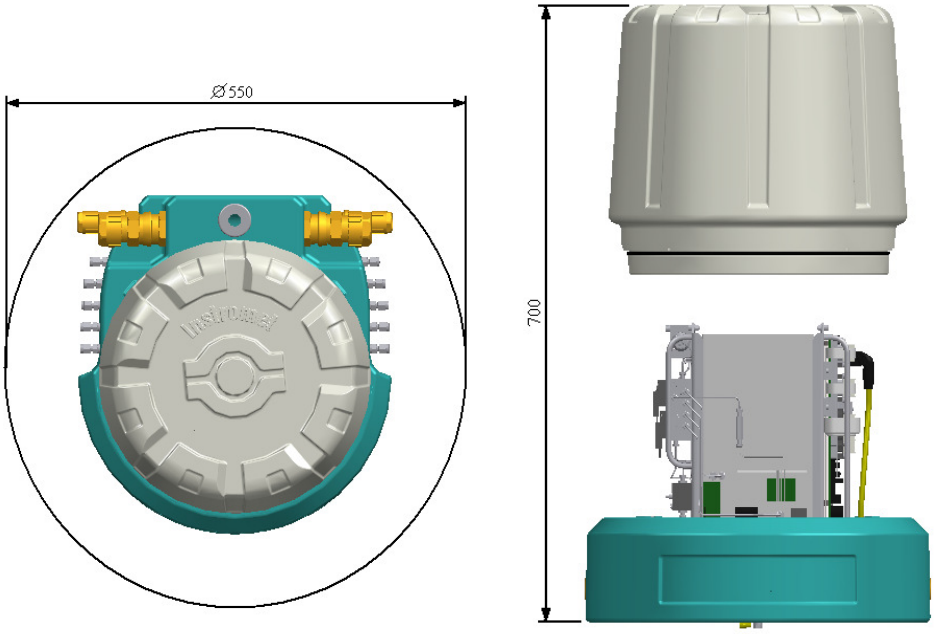
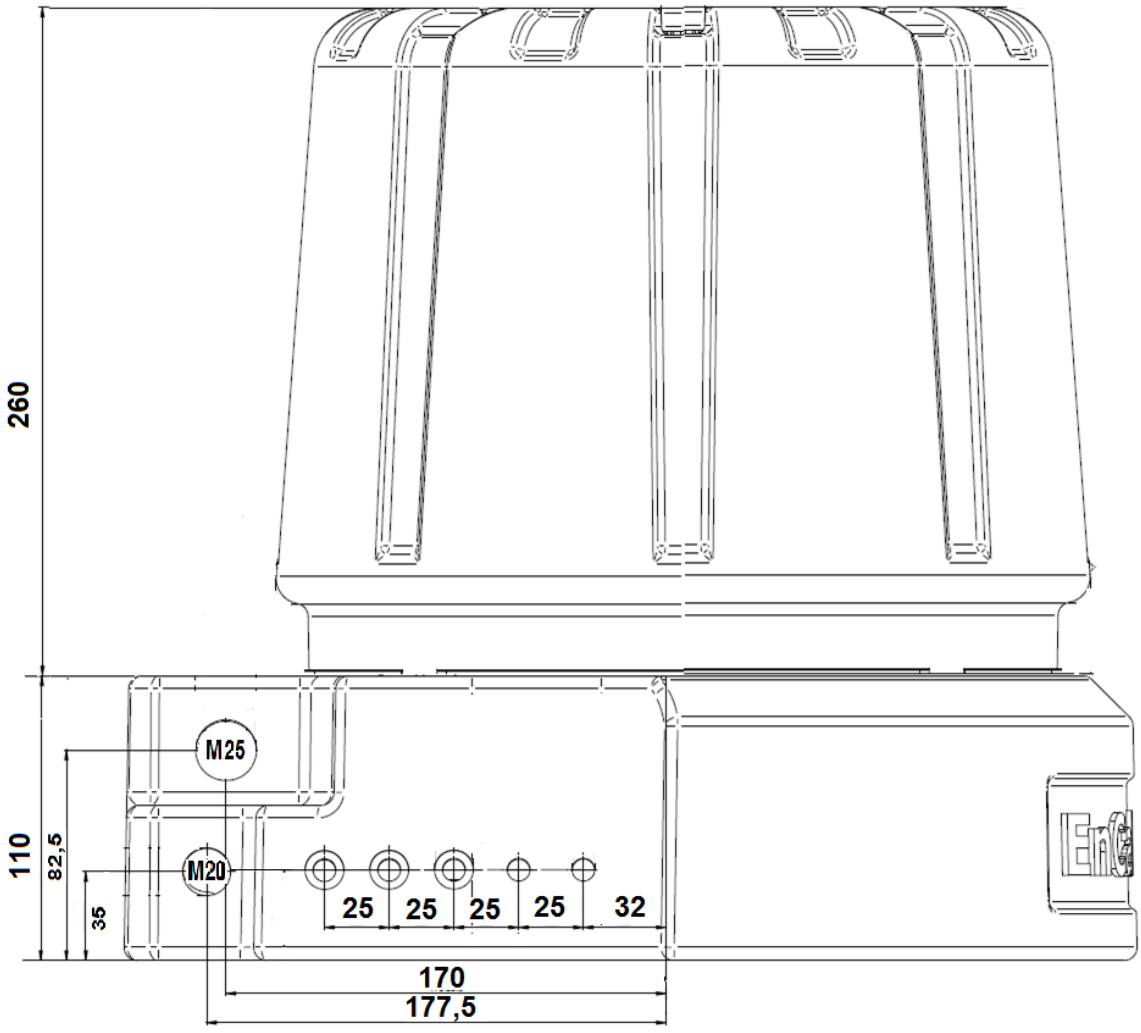


Figure 6.2: Minimum installation gaps

6.3.1 Device dimensions

Please note that all dimensions in the following drawing are shown in mm. The relevant dimensions (raw dimensions) are highlighted in bold. Some of them will change depending on the types of fluid and electrical couplings used.



ATTENTION	**Depending on local regulations, the weight of the EnCal 3000 (28kg) may exceed the allowable manual lifting limit for one person.** **Be sure the appropriate manpower or lifting equipment and protective equipment such as safety shoes are available.**

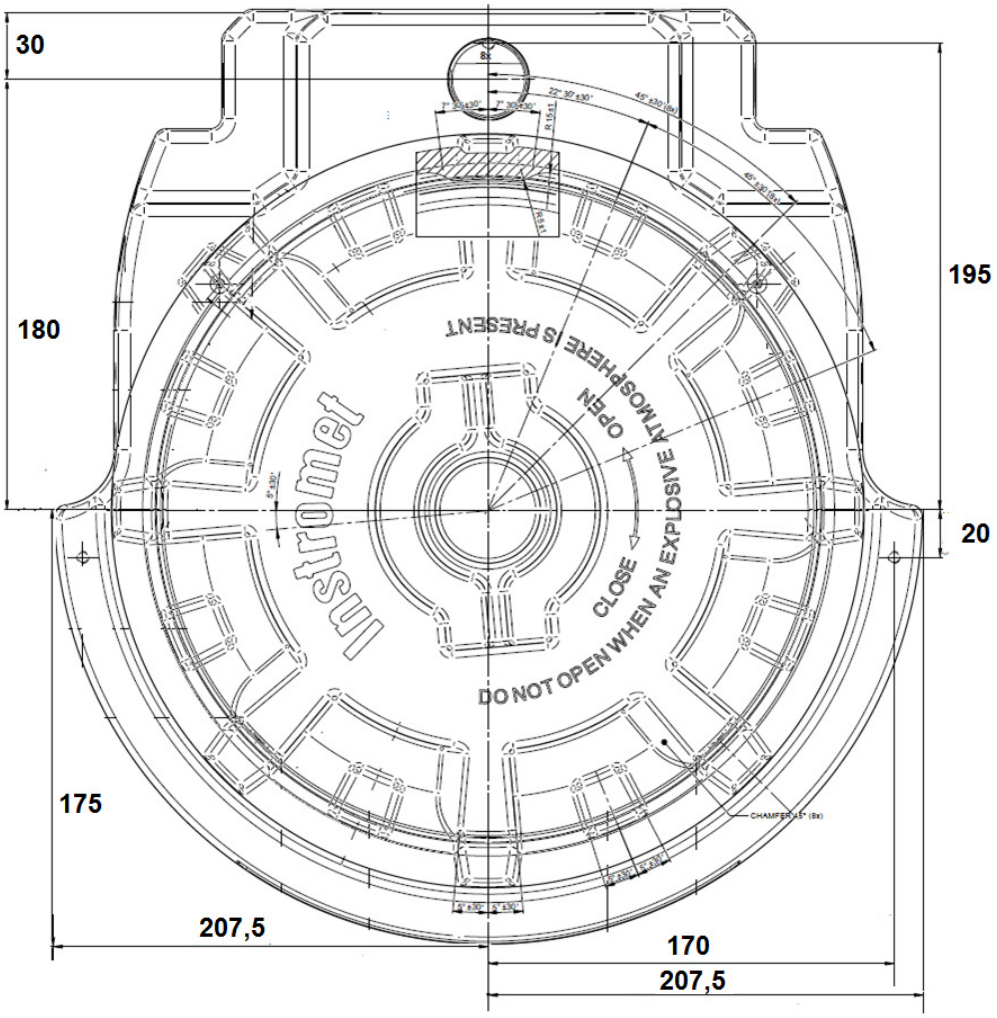


Figure 6.4: Plan view with dimensions (without couplings and connections)

6.3.2 Place of use and installation site (protection from environmental influences, etc.)

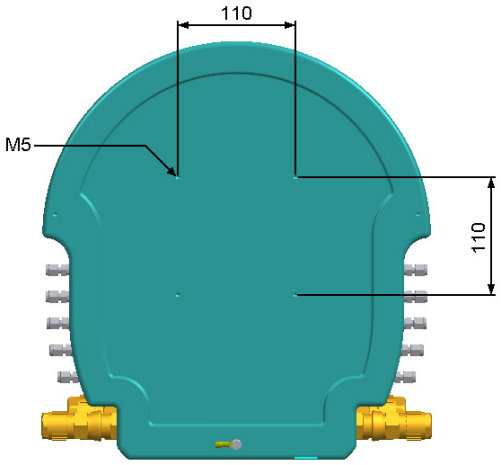
CAUTION	**Obey the explosion-protection rules at all times when working with tools or on items in hazardous zones**

	The EnCal 3000 must be installed as close as possible to the process gas sampling point to avoid having long supply lines and to ensure that you obtain current measurements.

ATTENTION	**The installation site must satisfy the required ambient conditions. If this is not the case, for example outside buildings, the device must be protected from direct sunlight and rain, for example by a metal roof or an additional air-conditioned housing. Ensure that the device cannot be struck by a jet of water (for example when cleaning). Further information is available from your TAC.**

The measuring instrument weighs around 28 kg. Before installing it, ensure that the installation surface is strong enough to support it. The **EnCal 3000** can be installed on a flat vertical surface (wall/measuring board) or on a horizontal surface.

Use the fastening holes provided in the housing and, if necessary, additional mounting plates (as shown) for this purpose.
The drawings below and to the side show the various installation options:



For example, the measuring unit can be secured to a horizontal surface with four screws using the four threaded blind holes in the housing base plate.See drawing to the side (dimensions in mm).

It can be installed vertically (wall/board mounting) using a wall mounting bracket secured as shown in the figures below (dimensions in mm).

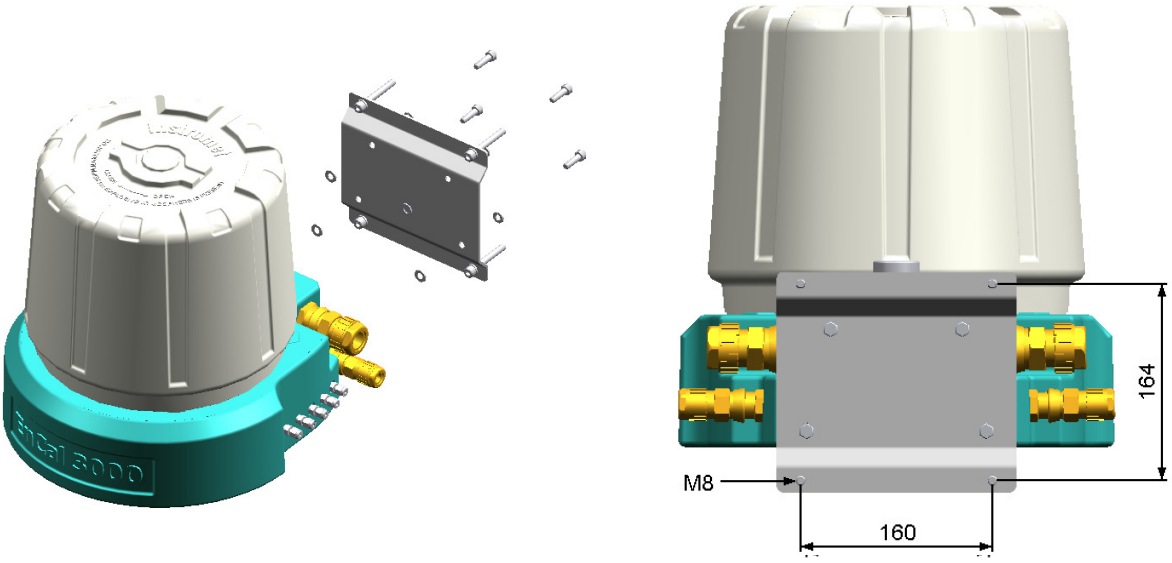


Figure 6.5: Installation options 1

Use suitable fastenings and mating parts in each fastening hole (i.e. nuts and bolts or anchorings which fill the holes as much as possible). Select them on the basis of the material and the type of installation surface. Ensure that your fastenings will withstand a combined vertical load of at least 1000 N.

ATTENTION	**Ensure that the device is installed in the correct position:** **The device must always be operated in a horizontal position, with the analytical modules and hood at the top.** **The technical specifications and flawless operation will only be guaranteed if the device is installed in the correct position.**

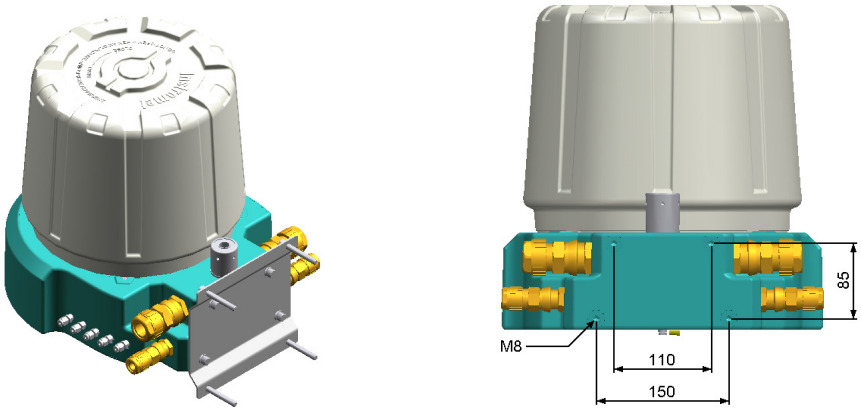


Figure 6.6: Installation options 2

6.3.3 Assembly hints

The generally accepted rules of engineering for handling gases and/or electronic components must be followed when carrying out the replacement work described below. Many components are assembled with screws. Ensure that these screws are securely tightened.

ATTENTION	**When fitting the replacement parts, ensure that they are in the correct position (left/right/top/bottom). The following figures show these positions where necessary.** **Prevent dirt and/or moisture getting into the device as it could possibly falsify the measurements or cause damage.**

Surfaces which come into contact with gas must be free of grease, oil, solvents and other impurities.

CAUTION	Screws which connect gas components must be additionally secured. Use Loctite 243 thread lock and apply it to the thread flanks in the last third of the internal thread.

Coat other screws with “OKS 250” or, alternatively, spray them with Fin Super if you are not using any thread lock product.

ATTENTION	Always replace the affected seals if they are in a gas route. Apply a very thin coating of Molykote 55 to all new O-rings/seals.

CAUTION	Ensure that you conduct a tightness test after replacing parts coming into contact with gas before you use the new parts.

NOTE	You should not be or become electrostatically charged before or during the work.

CAUTION	Check that connectors and screws are secure when all the work has been completed. Reassemble the device fully and fit the hood.

6.4 Electrical installation

The device does not have its own off switch.To comply with Electrical Safety Standards IEC 60947-1 and IEC 60947-3, an external external off switch (not supplied) has to be located close to the analyser, enabling an operator to close down the unit in case of emergency. It has to be marked with "Disconnecting Device". Practical implementation of this requirement will differ from site to site. In any case the external switch installation has to comply with all national, local, and company codes applicable to the location.

CAUTION	A functioning, effective lightning protection system must exist at the place of use to protect personnel, equipment and the device.

CAUTION	All input, output signals and power connections shall be of non-hazardous voltage and reinforced isolated from main

The power supply must be reinforced isolated from mains. Voltage range: 24 V DC. Fluctuations, including mains fluctuations: ± 15%.It must be possible to supply a rating of up to 120 W. Only one device may be operated on each power supply unit.

The overvoltage/overcurrent and electrical cable protection must be provided by the power supply unit. Suitable external safety devices must shut down a current of 8.3 A or over within 120 seconds, thus limiting the power supply.

The device must be connected to the equipotential bonding system at the place of use and earthed. Use a suitable connection on the base (see Figure 6.7) to connect the device to the local earth and the equipotential bonding system. If other metal parts are connected to the device during the installation work, they must be expertly included in the earthing and the equipotential bonding system. Use the appropriate connections or install such connections.

The device will only operate correctly if all the system parts have the same earthing potential. The wire cross-section for earthing is 6 mm² copper wire. The earthing cable can be connected at various points on the base, depending on the installation configuration. Generally, the underside is used with M5 threaded bolts, but the rear with M8 threaded bolts may also be used, see figure 6.7.

ATTENTION	**When connecting the earthing cable, ensure that it has a good, permanent, stable electrical contact. When making the contact and selecting the fastening materials, comply with the appropriate regulations, for example IEC/EN 60079-14.**

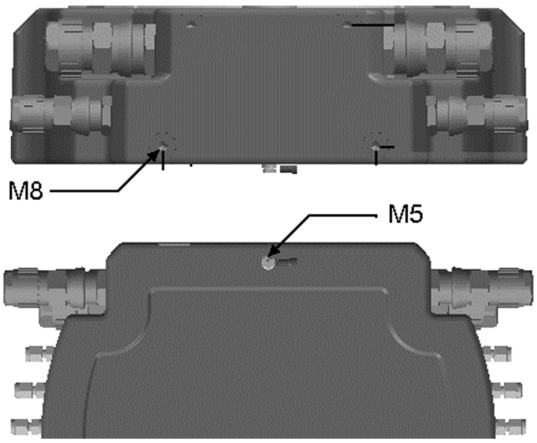


Figure 6.7: Example of earthing points on the device

6.4.1 Cable glands cables andwires

There are four threaded bore holes which pass completely through the device base (2x M20x1.5 and 2x M25x1.5) (see Figures 6.7 and 6.8). All the electrical connections can be directly connected to the device here using cable glands.

Since most systems only require connections for data transfer and power supply (24 V DC), the other threaded boreholes can be fitted with blind plugs, adapters or other cable glands, for example for signal cables or signalling contacts. A local display or a USB connection can also be screwed into one of these boreholes as an option.

These screw-in parts must have the correct IP rating and suitable explosion-protection certification. To comply with the specified explosion-protection regulations, they must be installed and sealed in their function as securing parts as specified by the manufacturer of the cable glands.

The M25 cable glands used as standard are suitable for reinforced cable with a diameter of 11 – 17 mm, while the M20 cable end glands can be used for reinforced cable with a diameter of 6 – 12 mm. The following cable properties are required in order to comply with the explosion-protection regulations:

- Not sensitive to cold flow, impermeable to air and at least three metres long.
- The cable and cable gland are suitable for temperatures of 70°C and higher. (Le câble et le presse-étoupe conviennent pour des températures de 70°C et plus.)
- Conduit stop boxes must be sealed between 1xD and 45 cm depending on the regulations.

The device can also be fitted with bespoke cable glands, for example with ½" NPT threads, using adapters. Please contact your TAC for further details if you wish to change the standard equipment.

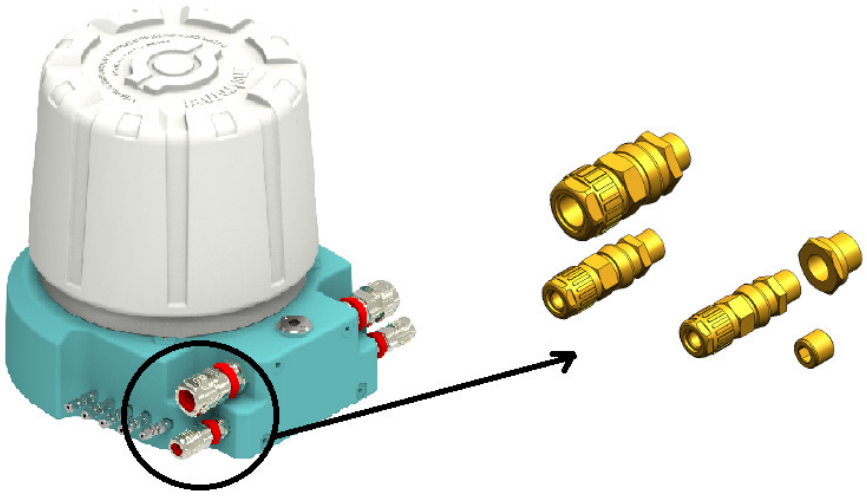


Figure 6.8: Position of the cable end glands on the housing base

Followind figure shows the number and position of cable glands (looking from the wall towards the device). The relevant installation guidelines must be obeyed for routing the cables. The insulation must at least comply with flammability class 1. Use screened cables.

Figure 6.9: Position of the cable end glands on the housing base

CAUTION	**The electrical inputs are sealed for reasons of explosion protection. In the event of a replacement, the complete gland must be replaced. The residual cable in the device must then be cut and can no longer be used.**

The replacement and extension of the electrical connections involve similar work to a new installation. Proceed as described and

in any event, obey the explosion protection regulations.

ATTENTION	**Use only suitable and approved cable inlet equipment. The cable inlets must satisfy or exceed the IP rating. NEC-compliant cable inlet equipment must be used in the USA. CEC-compliant cable inlet equipment must be used in Canada.**

Cable glands with a sealing system are typically required or, to fulfil the FM regulations, seal all conduits within 18 inches. See below table for use of gland or conduit

Approval	Glands / Conduits	Additional info
ATEX	Glands	Use Barrier glands
IECEx	Glands	Use Barrier glands
NEC (US)	Conduit	seal within 18 inches (45 cm)

Installation directive EN 60079-14 recommends for Ex-d devices with an internal volume > 2 dm3 the so-called “Barrier Glands”, incorporating compound filled seals around the individual cores or other equivalent sealing arrangements. The cable entry devices and blanking elements of unused apertures shall be of a certified flameproof type, suitable for the conditions of use and correctly installed. For connection of an external earthling or bonding conductor a cable lug shall be used. The conductor shall be mounted so that it is secured against loosening and twisting and that the contact pressure is permanently maintained.

The prepared cables must be fed through the cable glands in the device base. All the electrical interfaces, are located on a single terminal board and electrically isolated. The screened cables must be connected in compliance with local conditions and regulations. Also take note of the specifications of the cable gland manufacturer.

Cables, wires, cable glands, adapters and blind plugs are standard products not manufactured by Honeywell which are required for operating the device. The basic equipment can be extended or adapted by using other parts or buying additional ones. We recommend that the data cables are separated from the power supply cable.

Standard industrial 2-wire cable, wire cross-sections AWG 12-13 (2.5 - 4 mm²) can be used for the power supply. (The use of an external junction box is responsibility of the customer / installer) Armoured cable required for outdoor installation – OD between 12 and 25 mm Power rating 24 VDC / 120 W max nominal (ambient T > 0 °C or >32 °F). The cable cross-section must be chosen sufficiently large.

A maximum rated operating current of 5 A should be considered for the **power supply**. (Remember to take the cable voltage drop into account.) Ensure that the power supply is capable of tripping the external circuit breakers or the internal 5 A fuse in the event of a short-circuit.

Wire cross-sections of 0.14 mm² to 1.5 mm² are suitable for signals. When making your selection, also note that the wire cross-section must satisfy the electrical and mechanical requirements. For example, signal cables generally require wire cross-sections of over 0.25 mm². In general, the connection cables can be routed to two separate locations without additional Ex-rated junction boxes.

Various data communication cable are suitable for the connection between the enCal 3000 and other devices. They should be selected on the basis of the requirements at the place of use. Honeywell generally recommends a signal cable with a conductor-to-conductor capacitance of less than 120 pF/m and an inductance of less than 0.7 ☒H/m.

The number of cores varies depending on the application, whereby the cores should be twisted in pairs and screened jointly. The maximum cable length depends on the type of signal and must not be exceeded. A cable type of category 5 (Cat 5) is recommended for data communication links via Ethernet.

ATTENTION	*The housing temperature may rise above the maximum ambient temperature.* *Cable inlets and cables must be suitable for 70°C (158°F / 343 K) ambient temperature or higher.* *Les entrées de câbles et les câbles doivent être adaptés à une température ambiante de 70°C (158°F / 343 K) ou plus.*

See following examples:

Ethernet cable (PC and/or ModBus TCP/IP clients):

- Standard straight cable, shielded twisted 4 wire cable or industrial CAT5 quality. For the location of the Ethernet connector see figure 5.7.

Serial Modbus:

- Standard industrial data communication cable shielded twisted pair
- 3-wire for RS 485 communication
- 3-wire for RS 232 communication
- 2 serial ModBus ports are available, each of them independently user configurable into RS 232 or 485
- (Pin lay-out and link locations see figures 5.8 and 5.9)

6.4.2 Making the electrical and signal connections

ATTENTION	**The following work cannot be carried out without opening the housing.** **Please contact your TAC if you are not authorized to open the device**

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ATTENTION	**The integrated circuits can be destroyed by electrostatic discharge.** **When working on the device, it must be protected by an ESD guard (e.g. one which complies with EN 61340-5-1). Avoid short-circuits**

The cables are connected to the **Interconnection board** using plug connectors. Compliance with the local/national installation guidelines (e.g. EN 60079-14) is mandatory. The connection terminals in the interior are different for the voltage supply and signals.

It must be ensured that enclosure IP 66 is maintained and therefore the parts used must comply with this or a better (higher) rating. Openings which are not required must be fitted with appropriate blind plugs.

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ATTENTION	• Ensure that the device is not live (power supply and signals) before wiring work is completed. .

CAUTION	The device must be connected to the equipotential bonding system at the place of use and earthed. Use the equipotential bonding connection (PA) on the underside of the housing.

Check the voltage used at the place of use to ensure it is correct and suitable as described in the following instructions. Ensure that the same earthing potentials are always connected to each other.

	The device will not work if the connections are reversed (polarity reversal protection). In some cases, the fuse also triggers and must be replased. This protective equipment (thermal trips and electrical fuses) cannot be accessed without opening the housing. Please contact your TAC if you are not authorized to open the housing and replace the protective equipment.

ATTENTION	When making the contact and selecting the fastening materials, comply with the appropriate regulations, for example IEC/EN 60079-14.

ATTENTION	When connecting the earthing cable, check that it has a good, permanent, stable electrical contact. Use earthing points outside the device as discriped bevore

ATTENTION	Tighten the screws on any unused terminals. Check that the connectors are secure when all the work has been completed.

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	In addition to the wiring work, special parameterization may be required e.g. for Modbus communication. Detailed information is given in the software manual.

6.4.3 Connections on the EnCal 3000 Interconnection board Version 1.x

The drawing below shows the top lay-out of the Interconnection Board Version 1.x at the bottom of the unit. It contains all the connectors for external cables (marked with grey). For flame retardant wiring use cables according an ISO norm. To fulfill the FM regulations always use cables / wiring according to UL94 V-1 or equal for installation. All the wiring with the other electronic boards is done in the factory, and may not be changed during field installation.

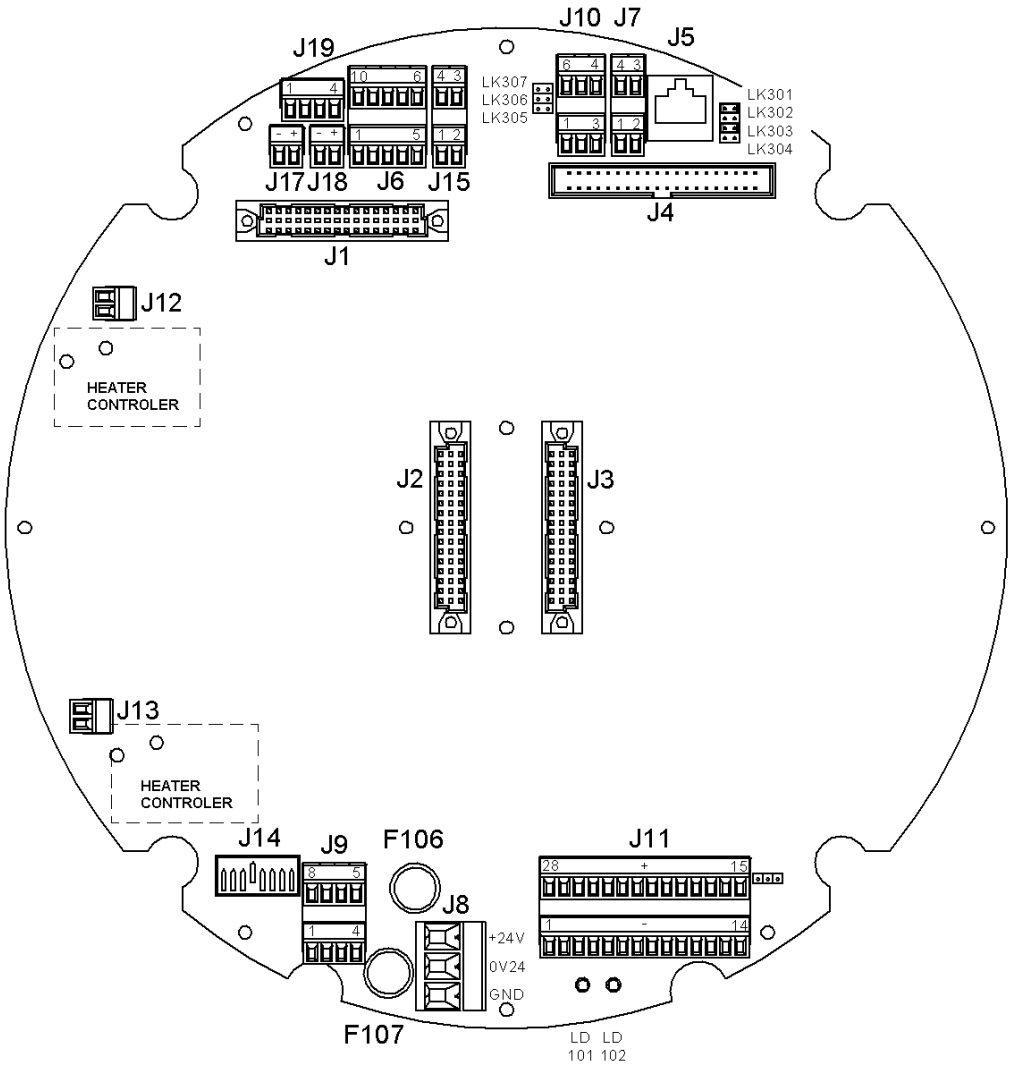

Figure 6.10: Interconnection Board V1.x: top view lay-out

Part	Description
J1	Processor board connection
J2	Channel 1 Connector 1
J3	Channel 2 Connector 2
J4	I/O Flat cable to Processor board
J5	TCP/IP connection between Interconnection board and Processor board
J6	Modbus RS485/232 connections
J7	Ethernet connection
J8	Solenoids terminal power suppl. 24 V DC
J9	Power supply out (12 VDC / 24 VDC)
J10	Analogue inputs (0-10 V DC)
J11	Solenoids terminal for valves of stream selection (0-12 V DC)
J12	Power supply heater 1 (24 V DC)
J13	Power supply heater 2 (24 V DC)
J14	Dip Switch Power supply valves (internal current supply circuit)
J15	Digital Inputs (passive contact)
J17	Fan1 power supply connection (12 V DC)
J18	Fan2 power supply connection (12 V DC)
J19	Input
F106	Fuse analytical channels Module (6,3A)
F107	Fuse additional cabinet heaters (5A)
LD101	LED (internal 12 V- circuit)
LD102	LED (activation valves stream selection)
LK 301-304	4 jumper for selection between RS232 and RS485
LK 305-307	**3** jumper for selection of analogue input (4-20 mA or 0-10 V)

Power Supply Connection:

Power Supply is 24 VDC, with conductor size AWG 12-13 (2.5 – 4 mm²). The cable has to be connected to connector J8. See picture below and **Fehler! Verweisquelle konnte nicht gefunden werden.** for location and polarity. Just a two wire connection for + and – is required, don't connect a third wire for the ground. Instead of that the device should be grounded at the bottom of one housing at a M5 connection or at a free M8 connection at the mounting plate.

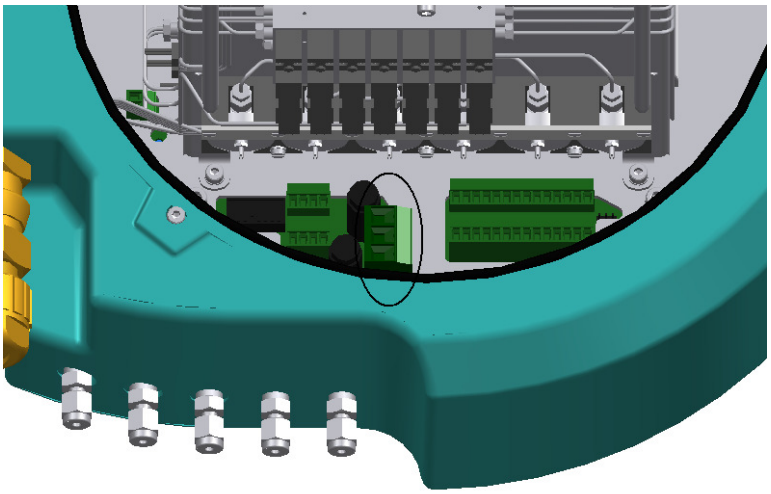

Figure 6.11: Location of Power Supply connector (J8)

Ethernet connection:

The Ethernet connection is used for connection with a PC or ModBus TCP/IP clients. It uses 4 wires, connected to connector J7. See picture below for location and wiring scheme.

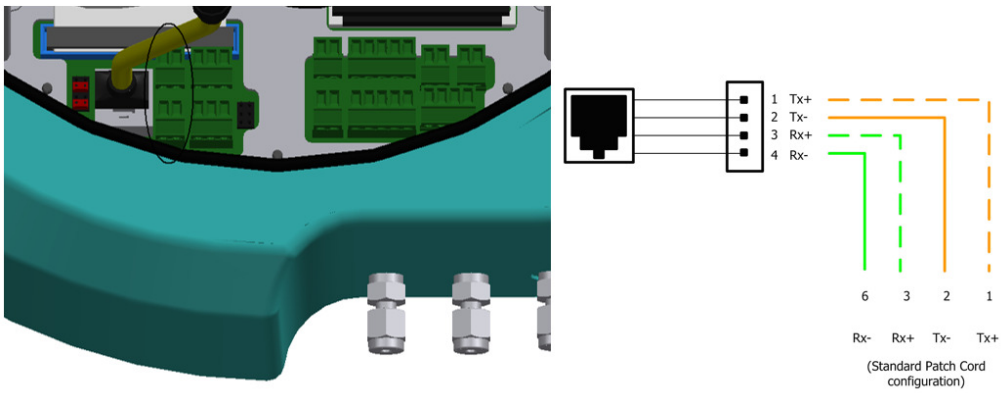

Figure 6.12: Location of Ethernet connector and wiring scheme

Serial ModBus connection

The Serial ModBus connection is used for connection with Serial ModBus clients like for example Flow Computers. The EnCal features 2 Serial ModBus ports with identical output. They are both independently configurable for RS232 or RS485 communication through link settings 301 to 304 (see pictures below for location, wiring scheme and link settings).

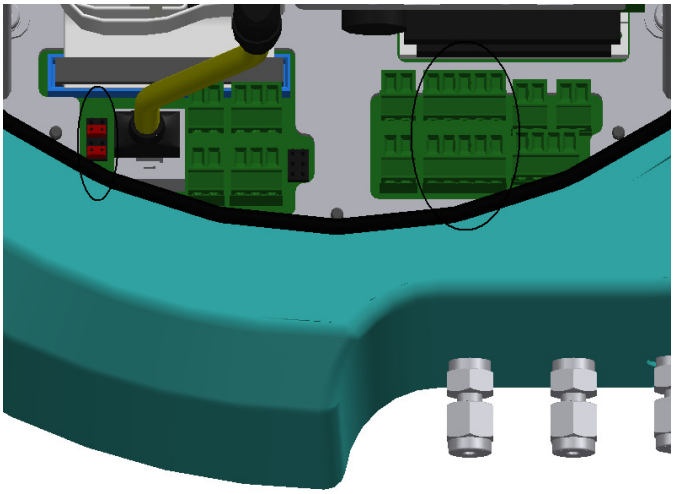

Figure 6.13: Location of Serial ModBus connector (J6)

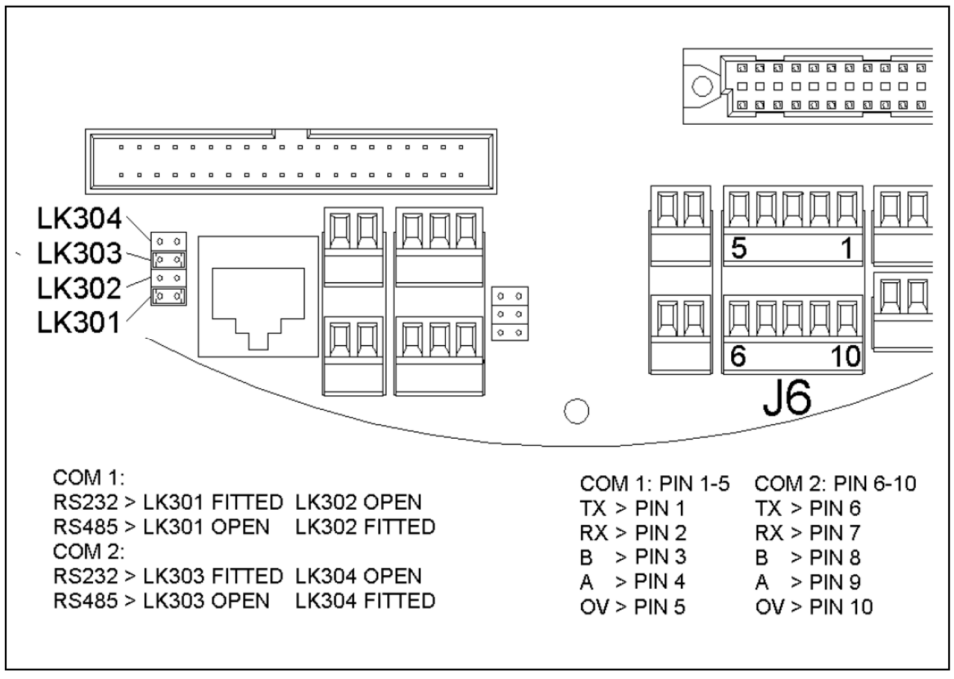

Figure 6.14: Modbus Connection and Link settings

6.4.4 Connections on the EnCal 3000 Interconnection board Version 2.x

The drawing below shows the top lay-out of the Interconnection Board at the bottom of the unit. It contains all the connectors for external cables. For flame retardant wiring use cables according an ISO norm. To fulfill the FM regulations always use cables / wiring according to UL94 V-1 or equal for installation. All the wiring with the other electronic boards is done in the factory, and may not be changed during field installation.

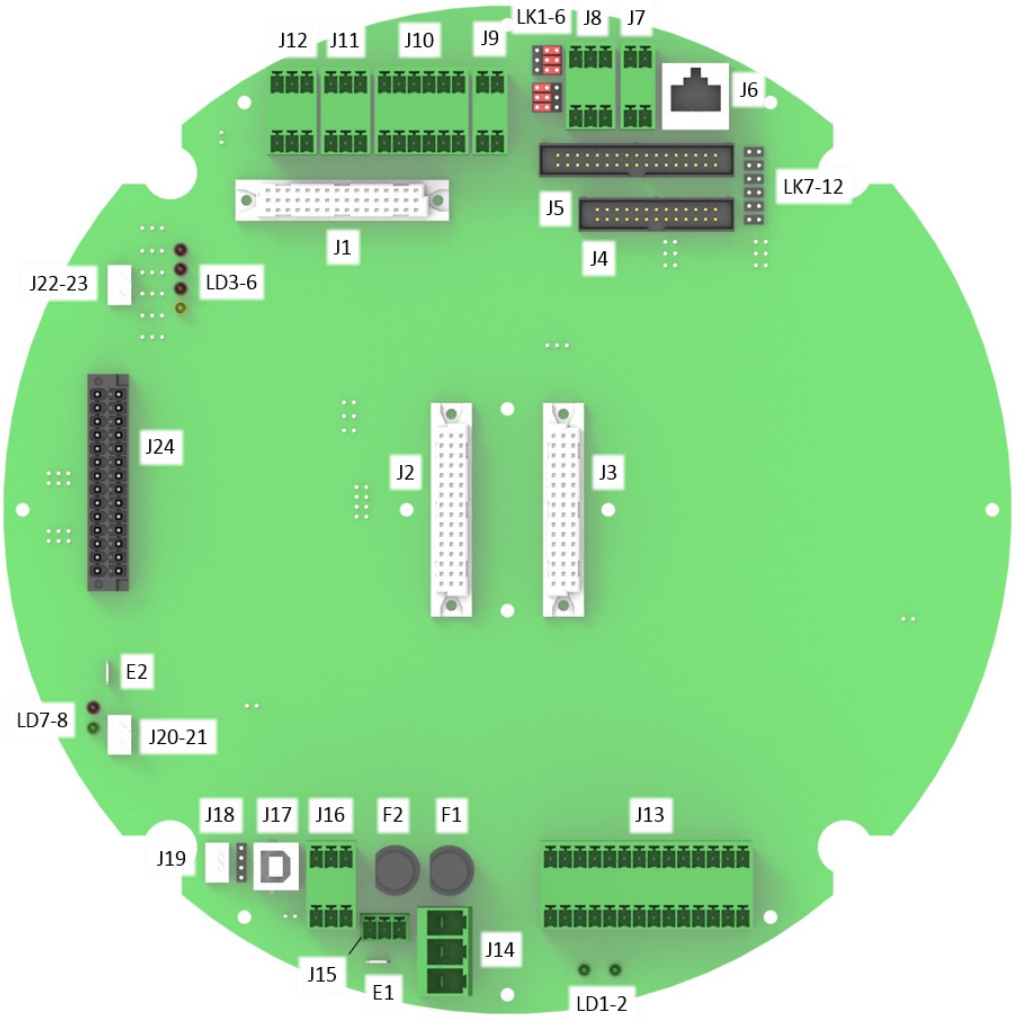

Figure 6.15: Interconnection Board V2.x: top view lay-out

Part	Description
J1	Connection of Processor Board
J2	Connection for Analytical Module 1
J3	Connection for Analytical Module 2
J4	26-pin Connector for first part of data connection cable between IC-Board and processor board
J5	34- pin Connector for first part of data connection cable between IC-Board and processor board
J6	Ethernet cable connection
J7	Connection for TCP-IP communication
J8	Connection for Modbus-Communication
J9	Connection for Digital Inputs (passive)
J10	Connection for Analogue Inputs (0-10 V DC)
J11	Connection for 24V supply of external transmitters (24V, 25 mA)
J12	Connection for Analogue Outputs (4-20mA)
J13	14-pin Connector for supply of timed relays and Vents
J14	24V Power Supply Connection
J15-J16	Additional optional 24V supply
J17	Connection for communication cable used for parameterization of the regulation for the internal heating
J18	Connection for temperature sensor for regulation of the internal heating
J19	Connection of over temperature protection for internal heating
J20-23	Power supply connection for internal heating
J24	Connector for data communication between Master and Slave housing
E1-E2	optional connector for shield of cables
F1	Fuse 5A for die analytical Modules
F2	Fuse 5A for heating circuit
LD1	LED 24V Power Supply
LD2	LED 12V Supply for analytical modules and Vents
LD3-6	LEDs Diagnostic of Analogue Outputs
LD7-8	LEDs Diagnostic of internal Heating
LK1-6	Jumper-Connections for RS232 and RS485
LK7-12	Jumper-Connections for data communication cable between IC-Board and processor board

Power Supply Connection:

Power Supply is 24 VDC, with conductor size AWG 12-13 (2.5 – 4 mm²). The cable has to be connected to connector J14. See picture below and **Fehler! Verweisquelle konnte nicht gefunden werden.** for location and polarity. Just a two wire connection for + and – is required, don't connect a third wire for the ground. Instead of that the device should be grounded at the bottom of one housing at a M5 connection or at a free M8 connection at the mounting plate.

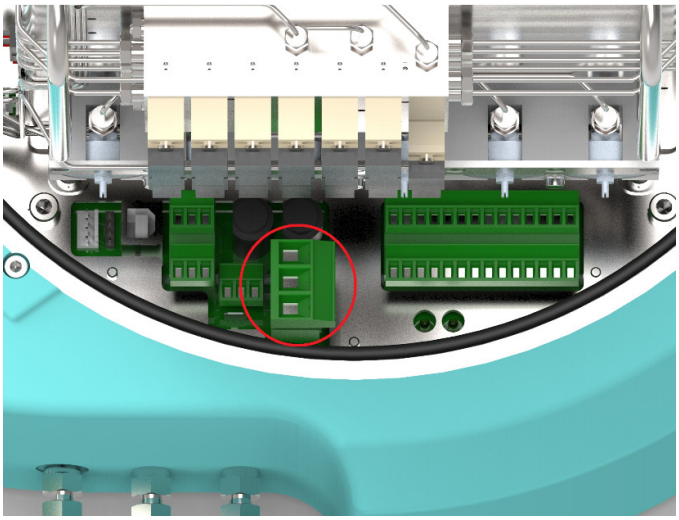

Figure 6.16: Location of Power Supply connector (J14)

Ethernet connection:

The Ethernet connection is used for connection with a PC or ModBus TCP/IP clients. It uses 4 wires, connected to connector J7. See picture below for location and wiring scheme.

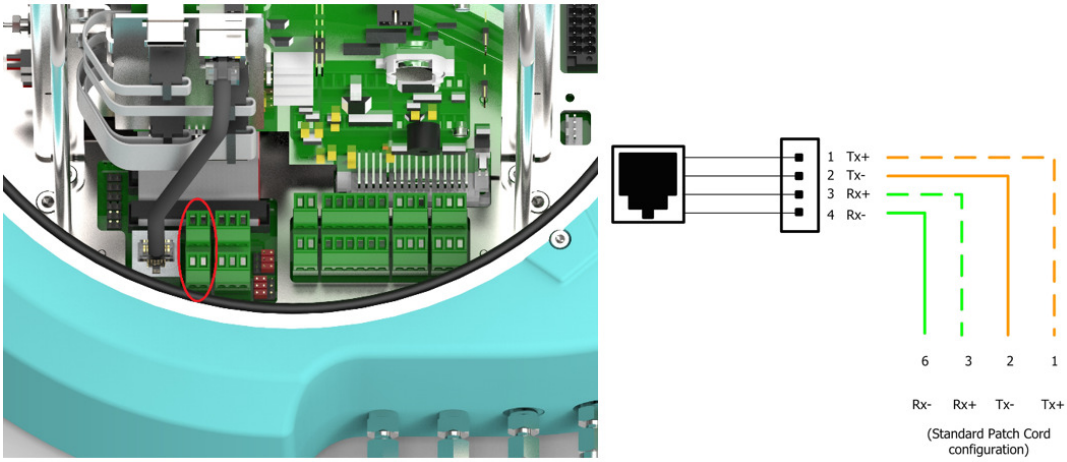

Figure 6.17: Location of Ethernet connector (J7) and wiring scheme

Serial ModBus connection

The Serial ModBus connection is used for connection with Serial ModBus clients like for example Flow Computers. The EnCal features 2 Serial ModBus ports with identical output. They are both independently configurable for RS232 or RS485 communication through link settings LK1-3 and LK4-6 (see pictures below for location, wiring scheme and link settings).

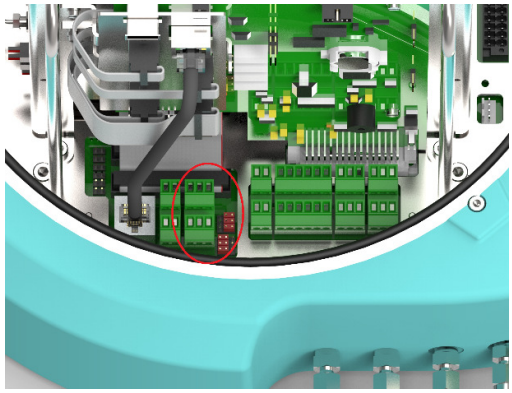

Figure 6.18: Location of Serial ModBus connector (J8)

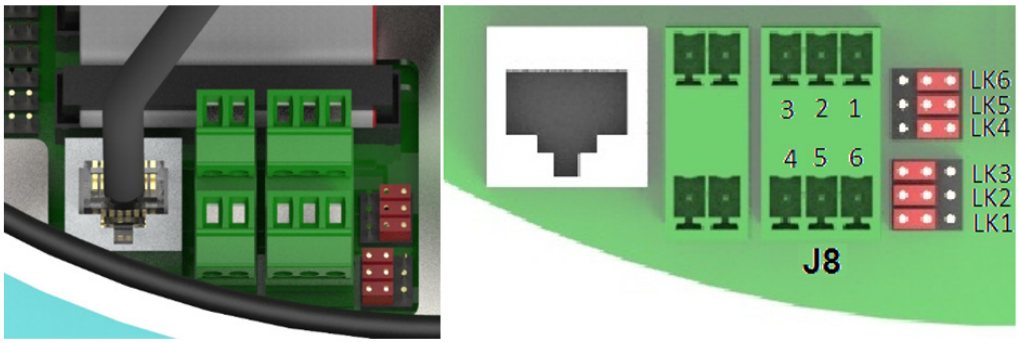

Figure 6.19: Modbus Connection and Link settings

Position in J8	Signal	Jumper Setting	Port-Type	Remarks
1	A	LK1 right	RS485	
2	B	LK2 right	RS485	
3	0	LK3 right	RS485	
4	A	LK4 right	RS485	Like shown in the above picture
5	B	LK5 right	RS485	
6	0	LK6 right	RS485	
1	A	LK1 left	RS232	Like shown in the above picture
2	B	LK2 left	RS232	
3	0	LK3 left	RS232	
4	A	LK4 left	RS232	
5	B	LK5 left	RS232	
6	0	LK6 left	RS232	

6.4.5 Electrical device test to verify correct installation

After concluding the electrical work, you should conduct a test to rule out the possibility of errors, e.g. insulation faults in the supply voltage and communication. This test must be carried out by the personnel responsible for the electrical installation. The operator should obtain written confirmation that the device is in perfect electrical condition.

CAUTION	**Do not conduct the tests in a potentially explosive atmosphere.** **You will require the permission of the system operator to conduct the test**

The use of a multimeter is required to conduct the test. You should check the following points:

Test point	Test step
1	Conduct a visual inspection of the interior of the device. There must be no loose wires. All wires are connected as shown in the circuit diagram. Spare wires have been dealt with correctly and routed safely.
2.	The supply voltage is 24 V DC. ± 15% is available after switching on the terminals on the terminal board.
3.	A rating of up to 120 W can be supplied. Connect a load resistor in parallel if necessary.
4.	Cause a short-circuit and the supply voltage must be switched off within 120 seconds.
5.	Check all switches and fuses outside the device. Is everything accessible and can everything be switched off and on?
6	Conduct resistance measurements to ensure that all the electrical connections have low resistance. Check the earthing as well.
7	Conduct resistance measurements to ensure that all the cables are adequately isolated from each other and to earth.

If you find any discrepancies or errors during the test, repeat the appropriate items in the installation procedure until all the points are error-free and OK. This concludes the installation work. Seal the device again correctly.

ATTENTION	**Close the device.** **Position the hood with the sealing ring and fully tighten the thread. Then turn the countersunk security screws upwards to the edge of the hood to prevent the hood being removed accidentally or through ignorance.**

6.5 Fluidic installation

The installation of the fluid interfaces / connections is described in the following.
Always remember :

ATTENTION	**The maximum pressure at the gas inlets on the device must not be exceeded so as to prevent damage and dangerous situations.** **This must be guaranteed on site by external protection which is not part of the device. Refer to the information in chapter 2.4 when setting the maximum pressure.** **The required pipelines and safety devices must be fitted to comply with current general regulations and the specifications in this manual.**

6.5.1 Fluid connections

The device has multiple **gas connections** for various functions. They are always fitted by the manufacturer. All gas and vent lines do have a 1/8" Swagelok connection to the EnCal 3000. On request also 3 mm connections are available.

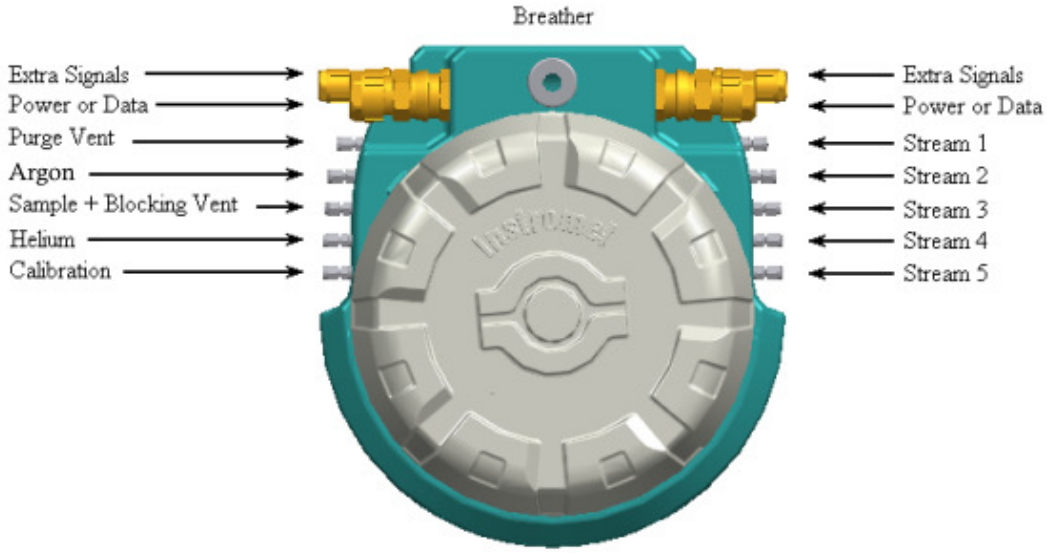

Figure 6.20: Fluidic connections

Connection	Position on the device/Note
Sample gas streams 1 – 5 Inlet pressure1-4 barg (15-57 PSIg)	**Right-hand side**It is possible to measure up to 5 different gases in sequence.
CAL Calibration Gas 1-4 barg (15-57 PSIg)	**Left-hand side, first connection** Used to maintain measurement accuracy.
Carrier 1: HE Helium 5-6 barg (71-86 PSIg) Recommended pressure 5.5 barg)	**Left-hand side, second connection** For transporting the measurement gas inside the device; waste gas is released into the housing.
Sample and blocking vent (SBV)	**Left-hand side, third connection** The unmeasured sample gas is released at ambient pressure.
Carrier 2: AR Argon 5-6 barg (71-86 PSIg) Recommended pressure 5.5 barg	**Left-hand side, penultimate connection** Second carrier gas only needed to analyse biogas or hydrogen in natural gas. In standard applications this connection is not used and closed without piping inside
Purge vent (PV)	**Left-hand side last connection** Flushing or bypass gas is released at a high flow rate.

In the standard version, they take the form shown in the figure below.

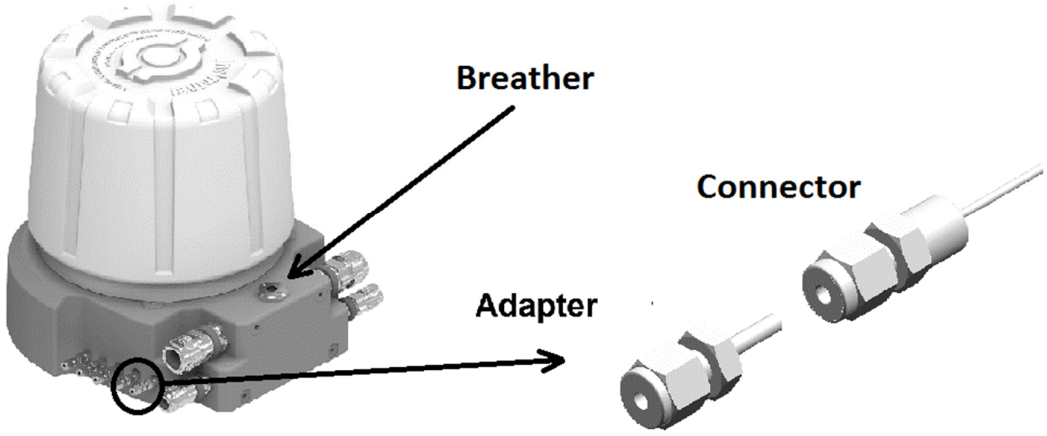

Figure 6.21: Layout of the gas connections

Each gas inlet consists of the coupling (a 1/8" Swagelok pipe fitting) and an adapter with an internal 2 µ filter. Inside the device, the gas connections are each soldered (at the connector) to a 1/16" pipe and connected to the internal sample gas system. This pipe is used as a flame arrester and must not be reduced in size. It must be more than 25 cm (19") in length and its maximum internal diameter may be 0.015".

ATTENTION	WARNING! DO NOT LOOSEN THE CONNECTORS FROM THE ENCAL 3000 HOUSING. THE SOLDERED TUBE WILL BE DAMAGED! THE JOINT BETWEEN CONNECTOR AND HOUSING IS AN INTEGRAL PART OF THE ENCAL 3000's SAFETY APPROVAL

To prevent loosening the connectors use a second key wrench to prevent the coupling from turning.

CAUTION	IF THE CONNECTOR IS ACCIDENTALLY LOOSENED PLEASE SWITCH OF THE ENCAL 3000 AND CONTACT THE MANUFACTURER

The adapter can be replaced without removing the hood from the gas chromatograph and is suitable for connecting a Swagelok pipe fitting (3 mm or 1/8").

Each gas outlet consists of the coupling (a 1/8" Swagelok pipe fitting) and a filterless adapter. The adapter can be replaced without removing the hood from the gas chromatograph and is suitable for connecting a Swagelok pipe fitting (3 mm or 1/8").

The external pipework required should be made of stainless steel and permanently connected. The supplied sample gases must comply with the specifications or be pre-filtered as the particulate filters in the adapters are only designed to protect the device

The breather valve (also known as a vent valve or short breater) on the rear of the housing is used to allow an atmospheric pressure equalization process between the interior of the device and the ambient area so as to comply with the ATEX regulations.

These state that the gauge pressure inside the housing must not exceed 100 mbar in the event of a complete gas rupture, in other words, if all the gas supply lines inside the housing were to be detached at the same time.

CAUTION	DO NOT UNSCREW THE BREATHER VALVE. DO NOT CONNECT THE BREATHER VALVE'S PIPELINE TO OTHER PIPELINES.

The **breather valve** in the device is made from Stainless steel and sintered metal. It is suitable for a IIC and for Class I/Division 1 environment in conjunction with capillary flame arrestors with an ID of maximum 0.015" (0.38mm) and a length of minimal 250mm. It has an outlet connection of ¼" NPT

It must not be sealed or blocked, for example by water, condensation, ice, insects, dirt or the like, as otherwise the pressure equalization process will be adversely affected. In the case of outdoor installation, it may be protected, for example by connecting a gooseneck pipe or a vent line.

ATTENTION	PROTECT THE BREATHER VALVE FROM BLOCKAGES.

If this optional pipeline is connected using the ¼ "NPT thread, it must have a minimum internal diameter of 8 mm. With the pipeline connected (comply with the length details in chapter 2.4), IP 66 protection is achieved and a vent line flow rate of around 10.5 l/min is possible

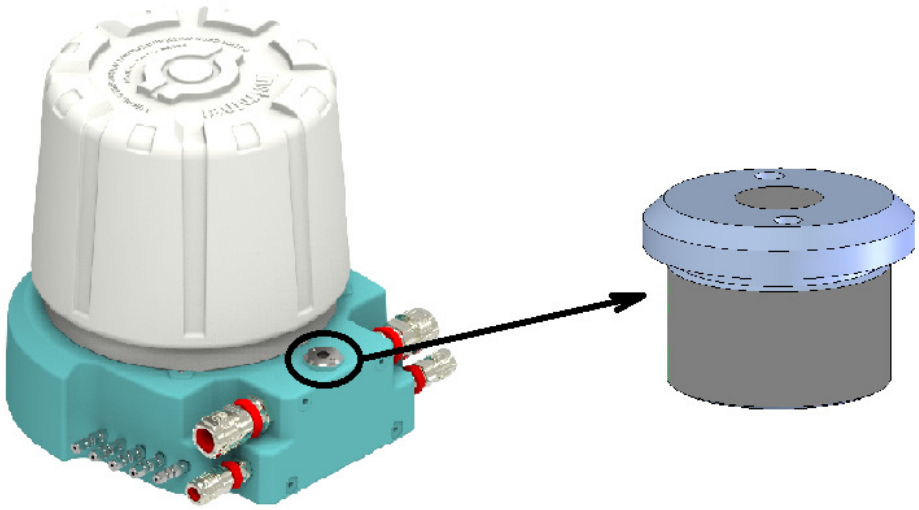

Figure 6.22: Breather as required by Explosion proof directives

ATTENTION	**Flame barriers can generally only be replaced by the manufacturer. Please contact your TAC**

Surfaces which come into contact with gas must be free of grease, oil, solvents and other impurities.

Gases must not be contaminated or falsified when being transported from the source (pipeline or cylinder) to the measuring instrument. This applies to all gases. Route the gas pipelines to the measuring instrument. Use the pipework diagram specified and prepared by the system operator. Ensure that every pipeline and every gas route is fitted with the required safety and shut-off equipment. All pipelines are to be kept as short as possible. Use only tight, clean stainless steel gas pipes.

	Prevent dirt and/or moisture getting into the device as it could possibly falsify the measurements or cause damage. Controls and pipe couplings with low dead spaces are to be given preference.

CAUTION	**Never mix connection elements from various system suppliers to connect gas appliances.**

ATTENTION	**Before connecting to the device, ensure that the pipeline is clean inside, for example by flushing it with gas for around 30 seconds. The flushing gas must be discharged correctly and safely**

The process gas is taken from the process pipeline. The tapping equipment should have a temperature equalization system and pressure regulator and be as close as possible to the device.

CAUTION	**The integrated inlet filters are designed to protect the device and are not a substitute for a primary filter system. A primary filter system is always required if the gas specifications cannot be satisfied.**

The volume and pressure of the sampling line determine how current the measurement result is in addition to the dead time of the measuring instrument itself.

Additional shut-off valves and possibly additional pressure reducing systems, filters, gas dryers, etc. must also be fitted in the pipeline if required so that the process gas sample is transported to the device still complying with the required specifications.

Steps to prepare the process gas sampling line	
1.	Ensure that there is a shut-off valve* in the process gas pipeline system. Check that the shut-off valve* is closed. A suitable pressure regulator* may also be required. If there is a pressure regulator*, turn the regulator to its lowest setting.
2.	Connect the process gas to the pipeline system. Do not connect the measuring instrument yet.
3.	Check that the pressure and other parameters are correct before you carefully open the shut-off valves on the pipeline section so as to create a permitted gas flow above the operating conditions.
4.	Then flush for around 30 seconds** to clean the pipeline system. Discharge the gas at the end of the pipeline correctly into the waste gas system using a hose.
5.	Then close the pipeline shut-off valves again and restore the previous settings. The precise pressure is set later after the device has been connected.
6.	The pipeline is now ready for connection ⇨ see steps below. Prevent the ingress of dirt and moisture if the connection is not made immediately.

* Not part of the measuring instrument and not included in the delivery; use only suitable standard types.

** This time must be extended accordingly in very long pipelines.

During normal measurement, all the gas flows through the device and is then discharged as waste gas via other pipelines into safe venting areas outside buildings due to the permanent flow of flammable gas. It must be discharged without any backpressure. Therefore, the diameter of the pipeline must never be reduced.

A 6 mm pipeline is generally sufficient. If a great deal of gas passes through the bypass or a high volume of flushing gas is to be used, a separate waste gas line should ideally be installed for this gas to prevent return effects. The waste gas lines must be protected from dirt and moisture.

ATTENTION	**If gas inlets or outlets are not used, they must be sealed using blind plugs.**

CAUTION	**The pipeline at the breather valve (if connected) is not part of the waste gas system and must never be connected to other waste gas lines**

Steps to connect the waste gas line	
1.	Connect the waste gas to the relevant outlets. Always discharge the gas from (MV) separate. Avoid back pressure formation and mutual interference in the exhaust system.
2.	Connect the pipelines immediately after you have removed the sealing elements (blind plugs or screw plugs) from the gas outlets on the device.
3.	Since it is not possible to conduct a tightness test when the device is switched off, the waste gas line must be checked for leaks with a gas detector during the flushing cycle. This test must be carried out first of all once the device has been installed and is operating.

Steps to connect the measuring instrument to the process gas pipeline	
1.	Ensure that the required work described in the previous sections has been completed. In particular, the pipelines must have been flushed.
2.	Ensure that the process gas pipeline is connected to the sample sensor and that the shut-off valve in the process gas pipeline is closed. (If there is a pressure regulator, turn the regulator to its lowest setting.)
3.	Ensure that a process gas inlet pressure range according to chapter 2.4 can be set.
4.	Remove the protection (sealing plugs or screw plugs) from the relevant inlets, ensuring that the connection on the housing is not released since otherwise the pipes soldered to it will be damaged. Therefore use a second wrench to limit the rotary movement on the connection coupling.
5.	Connect the pipeline properly. NEVER OPEN THE GAS SUPPLY IF THE COUPLING HAS BEEN DETACHED. In this case; you should always contact your TAC.
6.	Carefully open all the shut-off controls, valves and regulators in the process gas route to slowly increase the pressure up to operating conditions.

CAUTION	A tightness test must be conducted once the installation work has been completed in full and when all the gas pipelines have been connected and pressurized. Since the test cannot be carried out on all parts when the device is switched off, the tightness test for these parts must be carried out first of all when the device is running.

6.5.2 Configuration with two Carrier Gases

For some applications like the analysis of biogas a use of different carrier gases for the two analytical modules can be an advantage. In the application Biogas for the module from type mole sieve Argon is used as carrier gas and for the second module from type PPU Helium is used as carrier gas. In the following picture this configuration is shown. The two connections for the two different carrier gases are marked on the housing.

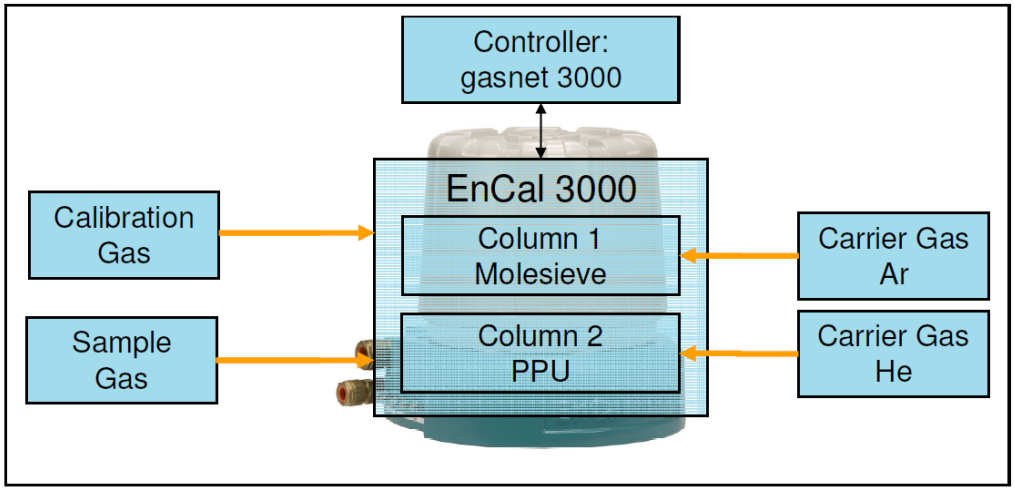

Figure 6.23: Configuration with two Carrier Gases

6.5.3 Connecting and replacing gas cylinders

Regular automatic calibration/adjustment with a calibration gas is required for the **EnCal 3000** to operate correctly. A gas cylinder containing the calibration gas mixture is required for this purpose. A gas cylinder containing helium or argon to act as the carrier gas is also required for operation. These gas cylinder should be replaced as soon as the outlet pressure can no longer be held at a stable level. This will generally take place at around 0.5 MPa, depending on the regulator. The cylinder pressure should be monitored, for example with a pressure gauge or contact pressure gauge. Further options and details about the calibration gas mixture and carrier gas can be provided by your TAC on request.

Some situations make it necessary to connect additional gas cylinders, for example for a verification measurement. This work must be carried out as described in the steps below.

CAUTION	**Always follow the steps of the cylinder change according to local regulations and the working steps in the Operating Instructions.** ***Suivez toujours les étapes du changement de cylindre établies selon les normes locales en respectant les étapes de travail inscrites dans les instructions de ce manuel.*** **Failure to comply may result in substantial damage to the device or the station.** ***Le non-respect de ces étapes peut entraîner des dommages importants à l'appareil ou au système!***

A suitable pressure reduction is required to connect a gas cylinder to the calibration gas inlet of the **EnCal 3000**. Honeywell offers prefabricated panels with high pressure reductions for this purpose.

Steps to connect the gas cylinder (parts marked with an asterisk (*) are not necessarily included in the delivery and must be obtained before starting the work; use suitable standard-compliant types only)

Observe the generally accepted rules of engineering for handling gases during all work as described. Surfaces which come into contact with gas must be free of grease, oil, solvents and other impurities.

ATTENTION	**Take action to prevent dirt and/or moisture getting into the device during the replacement process.**

Steps to connect /replace a gas cylinder	!Obey the explosion protection regulations!
1.	Close the main valve on the gas cylinder.
2.	Depressurize the connected gas pipeline.
3.	Remove all equipment from the cylinder connector.
4.	Close the connection thread on the valve with the screw cover.
5.	Place the protective cap onto the gas cylinder and screw it tight.
6.	Release the anti-tipping device and remove the gas cylinder.
7.	Replace the cylinder with a new/different one.
8.	Secure the new cylinder to prevent it tipping over and unscrew the protective cap.
9.	**Ensure that the main valve on the cylinder is closed. Only then remove the screw cover (blind plug) from the valve connector.**
10.	**Reconnect the equipment you removed in step 3 to the valve connector on the gas cylinder. Do not apply any oil or grease to the thread.**
11.	**Ensure that the reconnected controls are closed.**
12.	**Ensure that gas can flow in the parts you wish to flush. For this purpose, disconnect the pipeline immediately upstream of the device while the gas cylinder is closed. Ensure that the flushing gas is discharged safely (via a flow indicator).**
13.	Now slowly open the main valve on the gas cylinder.
14.	Adjust the gas flow. Do not exceed the maximum pressure levels.
15.	Now close the main valve on the gas cylinder again.
16.	If the outlet pressure of the high-pressure reducer or cylinder pressure regulator has fallen almost to 0 MPa, open the gas cylinder briefly and then close it again.
17.	Repeat the procedure described above several times to ensure that there is no more air in the dead space of the regulator and the pipeline. Everything will be flushed after a total of 5 filling and emptying cycles.
18.	After the flushing cycle, reconnect the pipe to the appropriate gas inlet on the device.
19.	Open the main valve on the gas cylinder. Set the outlet pressure to the operating pressure recommended in section 1 of the User Manual.
20.	**Carefully check the tightness by means of a tightness test.**

6.5.4 System tightness test

CAUTION	**Leaks in the gas supply lines increase the danger of explosion and may result in inaccurate measurement results.**

Step	Action: Tightness test
1.	If the device is already operating, stop the gas consumption by switching off the power supply, for example.
2.	Supply all inlet gas lines for the measuring equipment with gases at the maximum pressure values so that the pipelines contain a gas volume.
3.	Check all the parts of the system for leaks using a gas detector.
4.	• **If you identify a leak, it must be sealed immediately.** • **Shut off the gas supply for this purpose.** • **Seal the leak.** • **Repeat the test described in step 3.**
5.	**Do not complete any further action or work before the entire system is tight and item 4 no longer applies.**

7 Commissioning and decommissioning

CAUTION	**This should be done by an experienced technician, with a proven knowledge of electrical installations in explosion proof areas. Always remember to make sure there is no hazardous condition present during installation. Follow the instructions below carefully and make sure you have fulfilled all necessary safety steps before powering up the EnCal 3000.**

This chapter describes the main points for commissioning and decommissioning the measuring instrument. All new devices are supplied with default parameter set. This default parameter set should generally be sufficient.

It may be that in different ambient conditions in the field, additional adjustments may be required and integration parameters or other parameters will have to be adjusted a little. Furthermore, only the streams of gas and the carrier and calibration gas properties will have to be adjusted. The information required for the standard commissioning procedure is listed below in chronological order.

If, in addition, (integration) parameters have to be adjusted, the information required for this purpose can be found in the software section and in the service manual.

CAUTION	**Do not carry out any of the work described in this section if you do not have permission and have not received the required training from the manufacturer or its agents. (Honeywell can provide the required device-specific service and commissioning training)**

If the device is used for fiscal measurements, the presence of a calibration officer or its representative is required for the final commissioning of the device. In this case, the conditions set out in the relevant approval must also be satisfied.

For official (fiscal) operation, make sure that you also comply with the current regulations relating to sealing and closing off the housing.

Finally, this section contains information which you should take into account if you no longer wish to use the device or if you wish to use it at a different location.

7.1 Requirements for commissioning and operation

All the safety and warning information in chapters before has been complied with and the device has been installed and connected as described before. There is no condensation in the device. If you are in any doubt, wait for around 12 hours or contact your TAC.

CAUTION	**Refer to the regulations for explosion protection and the safety information, particularly for commissioning the device in a potentially explosive atmosphere**

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Requrirements for gas connections:

- Make sure the helium cylinder is tightly secured to the wall and the regulators are tightly mounted on the cylinder. Check the helium and Argon quality (5.0 – equivalent to Zero Grade classification - or better). Do not connect yet the tubing to the helium inlet at the EnCal 3000. Open carefully the helium regulator and check the helium pressure at the outlet of the regulator. Adjust to 5.5 barg (80 psig). Purge the tubing before connecting to the EnCal 3000 for about 30 s. Make the connection with Helium inlet. Check for leaks.
- Make sure the cal. gas cylinder is tightly secured to the wall and the regulators tightly mounted on the cylinder. Check the cal. gas certificate. The tube should be flushed once before it is connected to the Encal3000 with a non-flammable gas like the carrier gas Helium. Open carefully the cal. gas regulator and check the cal. gas pressure at the outlet of the regulator. Adjust to 1-4 barg (15-57 psig). Purge the tubing before connecting to the EnCal 3000 for about 30 seconds. After the connection a check for leaks is required.
- Check the stream gas pressure at the connection point with the EnCal 3000. Adjust to 1-4 barg (15-57 psig). Purge the tubing before connecting to the EnCal 3000 for about 30 s. Make the connection with inlet STR1. Check for leaks. (calibration is already connected in the section above)
- Make a careful leak check of the total system.
- Make sure that the sample gas flow is nowhere blocked. To be able to guarantee this the Encal3000GC has to use a separate Vent line which doesn't become blocked by any kind of restriction. The Vent lines PV and SBV can be combined to one vent line.

7.2 Hardware Start-up

Mount the cap on the unit, hand-tight fixed. The marked screws in the following figure are security screws. Screw out the security screws to prevent removing of the cap by accident or ignorance.

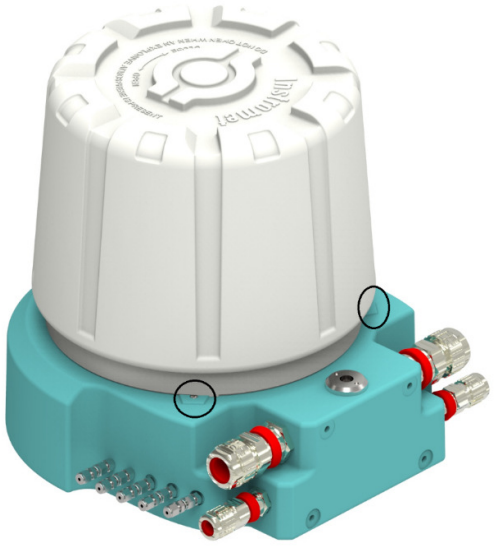

Figure 7.1: Location of security screws to fix the cap after mounting on the base

Complete all the commissioning work in the specified sequence to avoid possible damage and fault situations affecting the device.

Steps	Hardware Start-up / Commissioning !Obey the explosion protection regulations!
1.	Open the carrier gas cylinder (setting: 0.55 MPag).
2.	Open the process calibration gas cylinder (setting: 0.4 MPag)
3.	Open the process gas (recommended setting 0.2 MPag)
4.	Switch on the power supply.
5.	Connect with RGC 3000 (future steps in software manual)

The unit will automatically start-up (as defined in the software). The start-up sequence takes about 5 minutes, including temperature and pressure stabilisation, and system flushing. After this sequence the unit is ready for the software configuration.If you wish to make any changes, please refer to software manual or contact your TAC.

The device can be fitted with an optional additional heating system for use in temperatures below freezing. Further details of this option is listet in the annex.

CAUTION	**Check one more time if all gas connections are leak tight connected and all cable glands for electrical connection are securely tight. Check also one more time the different gas pressures for correct settings. Apply power to the unit (24 VDC) by turning on the external switch.**

7.2.1 Checking the device settings and signals

If you have completed the commissioning steps listed above, it may be necessary to adjust the flow of some gases or adjust some other settings.

Since the default settings cannot take account of the site conditions which may differ from the standard ones, it may be necessary to readjust the settings, for example the flush times, in some cases.

This is also the case if the gas chromatograph was not supplied with the calibration gas in which case the calibration settings must be repeated.

If the device is not working well after you have made changes, an extended (complete) check of the current device parameters is required.

This can be carried out according to the hints in the software manual. For example, you must check and adjust the bespoke alarm limits and settings for the sequence of sample gases and the calibration and protocol settings.

Parameterized output signals can be measured using suitable measuring equipment.

The digital communication (Modbus, etc.) can be checked using suitable tools (for example a protocol analyser).

7.3 Decommissioning

Please proceed in the following sequence to decommission the measuring instrument if you wish to use it again later at a different location. Also refer to the information in the section entitled “Dismantling” and particularly remember the following:

ATTENTION	**Data will be lost if there is no power supply and no internal power supply from the battery (for example archive data and time settings). The device will no longer start correctly. You will then require a Honeywell service visit.**

Steps Decommissioning (temporary) !Obey the explosion protection regulations!	
1.	Switch off the voltages (supply and communication) and secure them against being switched on again.
2.	Shut down all gas streams and depressurize all gas inlets. Ensure that you prevent the shut-off valves being reopened unintentionally by taking suitable precautions.

If you intend to remove the device in full, supplement the above steps with the following:

Steps Decommissioning (long-term) !Obey the explosion protection regulations!	
3.	Allow the device to cool to ambient temperature and disconnect all the gas pipelines at the couplings. Immediately seal all outlets and inlets.
4.	Cut all the cables near the cable glands in an area which does not contain a potentially explosive atmosphere and remove the device mechanically.
5.	Comply with the storage and disposal instructions, regardless of whether you have completed all the above steps.

Removed devices should generally be stored in the same way as new devices. We recommend replacing the battery by Honeywell service personnel before using again.

At the end of the period of use of this device, the manufacturer offers professional, environmentally compatible disposal.

	**Send the device to the address specified on the type label. The EU-WEEE sign with a crossed-out dustbin, which you will also find on the device, symbolises that the device in the EU must not be disposed of with household waste. Instead, you must return it to the local collection points for electrical waste, if you not want send it back.** **Outside the EU, it is essential that you comply with the current laws for disposing of industrial waste, if you dispose of the device yourself**

7.3.1 Dismantling

Follow the instructions below before finally removing the device to prevent dangers through electric shock, leaking gases and explosions (in potentially explosive atmospheres).

ATTENTION	**If the device contains hazardous media, they must be removed before its dismantling.**

CAUTION	**Do not dismantle the device without first shutting down all supplies such as pressure and electricity (including communication).**

ATTENTION	**Ensure that the supply voltage, communication and gases cannot be activated again by accident so that no danger will occur as a result of the dismantling work.** **Prevent the release of potentially pollutant substances.**

Return the device to the condition in which it was delivered if you wish to use the device again at a later time or return it to the manufacturer (transport guard, blind plugs, covers, etc.).

8 Maintenance and repair

As the operator, you are responsible for ensuring that the installation and maintenance work described in this document is carried out correctly. Honeywell will be delighted to help you with this work. Please contact your TAC. To ensure long-term use, in addition to the regular calibration work described in separat manual , the device must undergo annual maintenance/cleaning and repair work if necessary. Renewed basic calibration may also be required if, for example, the calibration gas cylinder is replaced. We recommend that this work is carried out by the manufacturer or personnel contracted or trained by it to rule out the possibility of malfunctions and to adapt the software correspondingly. .

ATTENTION	**The operator is responsible for ensuring that the device remains in technically perfect, safe condition throughout its period of operation.**

8.1 Troubleshooting (Identifying hardware errors)

This chapter contains troubleshooting guidelines to help with troubleshooting and rectifying faults. The causes of these faults can be localized and rectified by checking the input.

TIP	**Honeywell can provide assistance with troubleshooting work. You're TAC or the service helpdesk can be contacted using the contact details at the start of this manual.**

Step	Action: Troubleshooting
1.	Check that the process gas or sample gas is available at the correct pressure.
2.	Check that the carrier gas is available at the correct pressure.
3.	Check that the calibration gas is available at the correct pressure.
4.	Check that the waste gas line is not blocked.
5.	Check that the supply voltage is available with the correct values.
6.	Check the supply cables and the housing earth.
7.	If you can't fix the faults with items 1 –6, please contact your TAC

The following describes action to prevent some faults. It is essential to comply with all the safety regulations when troubleshooting, particularly the following:

CAUTION	**The following hardware check should only be carried out in compliance with explosion-protection procedures. Any housing opening may only take place if there is no potentially explosive atmosphere.**

CAUTION	• The housing may only be opened by authorized/trained personnel • You require a written operator license. • Use only explosion-proof, approved equipment. • Do not open the device without having taken all the necessary safety precautions. • Do not disconnect cable inlets in a potentially explosive atmosphere.Do not loosen or unscrew the breather valve. • Only carry out work after disconnecting the power supply and depressurizing the system, the gas atmosphere must not be potentially explosive. • Protect all open pipelines and connections from dirt. • Before the device is switched on again, ensure that all the gas connections are sealed and the earthing or PE wire is correctly installed.

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8.1.1 Troubleshooting in the gas supply

The following action can be taken if a fault occurs in the gas supply, (rectification of the faults under items 1 – 4), e.g. abnormal calibration gas or carrier gas shrinkage.

Step	Action: Gas supply fault rectification
1.	Complete a tightness test by checking the entire gas route (from the cylinder/pipeline to the device) using a gas detector.
2.	Seal any leaks properly.
3.	Set the regulators and valves to the required values.
4.	Disconnect blocked lines from the switched-off device and flush the pipeline with non-flammable gas to remove any blockages and deposits while observing the maximum admissible pressure.
5.	Discharge the flushing gas properly.

ATTENTION	**Use suitable gas detectors for the tightness test. These must reliably display even very small quantities of the possibly leaking process, calibration and carrier gases.**

8.1.2 Troubleshooting in the electrical supply and insulation

You can take the following action if an error occurs in the electrical power supply (rectification of the faults under items 5 and 6). Use a voltmeter to localize the error.

If the device is not supplied with electricity or the supply voltage/current is too low, you cannot establish a connection.

CAUTION	**The connection plugs on the edge of the terminal board must always be inserted until they lock. Check that they are secure.**

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ATTENTION	**Tighten the screws on any unused terminals.**

Power supply	24 V DC Fluctuations, including mains fluctuations ± 15%, for example with Quint-PS-100-240AC / Quint-PS-24DC/24DC/10 / Siemens SITOP / Siemens Logo or equivalent power supply units with safe electrical isolation
	A rating of up to 5 A/120 W can be supplied.

Step	Action: Testing the electrical supply
1.	Check all switchgear and fuses and replace any defective parts.
2.	Check that the cable connection between the device and the electrical supply is OK (no interruptions in the wiring). Ensure that a low-resistance electrical contact is established. Reconnect the cores if necessary.
3.	Check that voltage is being supplied to the inlet point and that the voltage is not impaired or reduced by overload, insulation errors or defective components. Remove or replace these parts if necessary. Measure the idling voltage (without connections). Replace or repair the electrical supply if it is defective.
4.	Measure the idling voltage (without connections). Replace or repair the electrical supply if it is defective.
5.	Check that the connection between the device and the equipotential bonding system is OK (no interruptions in the wiring). Ensure that a low-resistance electrical contact is established. Reconnect the earthing cable if necessary.
(6.)	**Only with authorization and in compliance with explosion-protection procedures!** Measure the incoming idling voltage on the supply cable at the device. To do so, switch off the electrical supply and disconnect the supply cable plug from the PCB. Switch on the electrical supply again and measure the voltage in the plug. If there is no voltage or if it is significantly lower than the idling voltage, replace the cable after disconnecting it from the power supply.
7.	If the problem has not been rectified after completing steps 1 – 5 (6), the error is inside the device. Please contact your TAC to check the internal fuse. The housing must be opened to replace it and this should only be done by service personnel or appropriately trained personnel for safety reasons.

8.2 Maintenance and remote maintenance

Maintenance consists of an inspection of the entire system and preventive checks as well as cleaning the device. Check the possible ranges of consumables and look out for signs of unusual damage which may have occurred since the installation and commissioning work by following the steps described below. The regular maintenance interval is one year. This monitoring work may be carried out more often to identify discrepancies at an early stage.

TIP	**Document all work completed, events which occur and general operations in a maintenance report.**

CAUTION	**The regulations for explosion protection (for example IEC/EN 60079-14) must be followed to the letter. In addition, the operator must check the function of all safety devices regularly, even outside the maintenance interval if necessary.**

The best thing for cleaning the device is a damp cloth with a mild detergent solution or a mild cleaner such as those used for household purposes.

CAUTION	• **Do not use any equipment for cleaning which charges statically and may generate sparks.** • **Do not pour or spray water or cleaning products directly into the breather valve or vent line.** • **Do not use high-pressure cleaners or similar equipment for cleaning**

CAUTION	• **If the device is installed in a potentially explosive atmosphere, compliance with the explosion protection regulations is also mandatory.** • **Furthermore, the operator must check all safety devices at regular intervals, possibly independently of the maintenance work, to ensure that it all functions correctly.**

General maintenance procedures

Step	Action: Testing the electrical supply
1.	Check the device and the surrounding area (gas connections and pipelines) with a methane detector. If you discover any leaks, close the gas supply, identify the leaks and seal them. If this is not possible, notify the TAC.
2.	Check the device for signs of damage and loose parts. Notify the TAC if you identify any damage. Tighten any loose parts. Activate any existing loosening guards, for example on the hood.
3.	Check the vent line/breather valve. Ensure there is no dirt or blockage. If there is, clean it or notify your TAC. **Do not use liquids.**
4.	Check the fluid connections and electrical cables to ensure they are undamaged. If they are damaged, replace any damaged components. If this is not possible or spare parts are required or the housing must be opened, please notify the TAC.
5.	**Ensure all unused openings are sealed.** If this is not possible or spare parts are required, please notify your TAC.
6.	Read the cylinder pressure of the calibration gas and carrier gas on the pressure gauges. Note: you can empty the cylinder up to a minimum pressure of 1 MPa, but the cylinder must then be replaced, regardless of the maintenance interval. Replace the auxiliary gas cylinders if necessary.
7.	Check the inlet pressures
8.	Optional: check the flow rates. If you have flow meters available, compare the current values with the values obtained during commissioning. If they are different, readjust the flow rates. If this is not possible with the current inlet pressure, the inlet filters may have to be replaced. In this case, please contact your TAC.
9.	Create a report on the completion of the work and the results of items 1 – 8 to document your work and results

8.2.1 Visual inspection of the connections

Step	Action: Visual connection inspection
1.	Check the connections (fluid and electrical) and stainless steel pipelines or cables to determine whether they are undamaged, complete and free of corrosion.
2.	If you find any damaged or corroded parts or notice that components are missing, immediately disconnect the gas and voltage supply.
3.	Replace damaged and/or corroded parts and add missing components so that all the unused openings are sealed. If you require any spare parts, you can simply order them at your TAC.
4.	Do not carry out any measurements or work using the device before the repair work has been completed.

8.2.2 Checking the gas connections with a tightness test

CAUTION	**Leaks in the gas supply lines increase the danger of explosion and may result in inaccurate measurement results.**

Step	Action: Tightness test
1.	If the device is already operating, stop the gas consumption by switching off the power supply, for example.
2.	Supply all inlet gas lines for the measuring equipment with gases at the maximum pressure values so that the pipelines contain a gas volume.
3.	Check all the parts of the system for leaks using a gas detector.
4.	• **If you identify a leak, it must be sealed immediately.** • **Shut off the gas supply for this purpose.** • **Seal the leak.** • **Repeat the test described in step 3.**
5.	**Do not complete any further action or work before the entire system is tight and item 4 no longer applies.**

Tips to seal the leak

If you identify a leak, it must be sealed. You have some options to do this.

- Replace the seals. Switch off the gas supply for this purpose. You need the corresponding replacement seal.
- Tighten the connections. In the course of time, connections may have come loose easily and can be sealed again by retightening.

CAUTION	**Take care not to block the flow of the line, this can happen if you tighten the line connections too much. In this case the GCM module flashes red and in enSuite unusual pressures are displayed for EBC and PPC.**

8.2.3 Checking the cylinder pressures (visual inspection)

Step	Action: Reading the gauges
1.	Read the calibration gas cylinder pressure on the pressure gauge.
2.	If there is still a minimum pressure of over 1.0 MPa, the cylinder can remain in use. Note: if the pressure is close to the minimum, the cylinder must be replaced independently of the maintenance work if necessary.
3.	Read the carrier gas cylinder pressure on the pressure gauge.
4.	If there is still a minimum pressure of over 1.0 MPa, the cylinder can remain in use. Note: if the pressure is close to the minimum, the cylinder must be replaced independently of the maintenance work if necessary.
5.	**Please notify your TAC if you require a new gas cylinder. You may use the device without calibration gas but not without carrier gas. In this case, the results are less accurate.**

8.2.4 Checking the inlet pressures (visual inspection)

Step	Action: Reading the gauges
1.	Read the process gas inlet pressure of the sample gas streams (1 – 5) on the pressure gauges.
2.	If the inlet pressure (PG) is not like specified (see chapter “Technical Specifications), adjust the pressure within this range
3.	**If you cannot complete step 2, disconnect the gas and voltage supply. Do not proceed with any further action or work unless step 2 is correct.**
4.	Attempt the repair work described in sections 5 and 6 of this manual. If necessary, notify your TAC.

8.2.5 Checking the flow rates (optional visual inspection)

In some systems, there are also variable area flow meters installed in the gas streams. These are not absolutely essential since the flow rate is generally controlled via the pressure, but provide an option for additional checks.

Step	Action: Reading the gauges
1.	The flow rates are correct, the ranges are as described in section 2 of the User Manual.
2.	The flow rates are incorrect, a process gas pressure alarm is active, the inlet pressures are already at maximum.
3.	**If the case described in step 2 applies, the gas and voltage supply must be disconnected. Filters or flame barriers must be replaced. Do not complete any further measurements unless step 2 is correct.**
4.	Attempt the repair work described in sections 5 and 6 of this manual. If necessary, notify your TAC.

8.2.6 Checking / Replacing the inlet filters and adapters

The inlet filters should be inspected at regular intervals to prevent errors caused by blockages. If they must be replaced despite the upstream external filter system, proceed as follows:

Steps to replace an inlet filter !Obey the explosion protection regulations!		
1	Close the main valve on the gas supply line and relieve the pressure in the supply line to the device.	
2.	When the residual gas has flowed through the device, switch off the electrical supply to the device.	
3.	**Only carry out the following work when the device is depressurized and the ambient conditions are similar to the interior.** Disconnect the gas pipe from the device. **Ensure that no gas escapes.**	
4.	Disconnect the Swagelok pipe fittings from the filter and replace it with a new filter	
5.	Refit the fittings and pipelines to the device.	
6	Open the gas supply to the supply line.	
7	**It is essential that you conduct a tightness test. Ensure that no gas escapes.**	
8	If everything is tight, switch on the device or restart operations.	

8.2.7 Checking the housing parts

CAUTION	• The housing may only be repaired by the manufacturer. • Explosion-proof devices and equipment which have not been repaired by the manufacturer must not be reused until they have been inspected by an accredited expert and comply with the design documents again.

Step	Action: Checking the housing parts
1.	Inspect the housing parts visually for signs of damage and leaks (ensure all parts are secure).
2.	If any parts are loose, tighten them and secure them with thread lock.
(3.)	Please notify your TAC if parts are damaged and, in this case, disconnect the gas and voltage supply.
(4.)	**Do not complete any further action or work until the damaged parts have been replaced.**

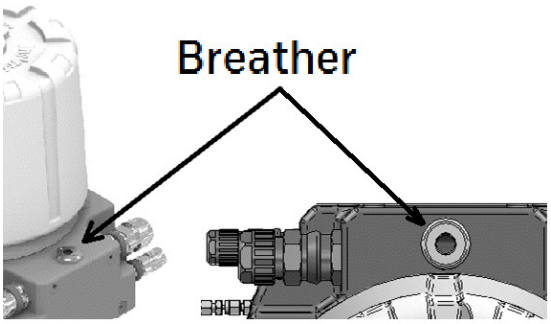
8.2.8 Inspecting the interior of the housing

CAUTION	The housing hood may only be removed in a non-hazardous area in controlled conditions as described in ISO/IEC 61010-1. If it is not possible to establish these conditions on site, the complete device must be removed while it is still sealed.

Step	Action: Visual inspection of device interior
1.	Disconnect the gas and voltage supply.
2.	**Only in an atmosphere which is not potentially explosive! Remove the housing hood to ensure that there is no damage/corrosion, unused open connections or loose wires.**
3.	Replace any defective components and connect any loose cables as shown in the circuit diagram. Please notify your TAC if you require any spare parts.
(4.)	**Do not complete any further action or work until the damaged parts have been replaced and the hood has been closed again.**
5.	Only connect the device to the power supply when all the required steps have been completed and are OK.

8.2.9 Inspecting and cleaning the breather valve

The breather valve (also known as the vent valve) is made of sintered metal. It is located in the rear section of the base and must not be sealed or blocked to ensure compliance with the ATEX regulations, see figure.



Step	Action: Monitoring the breather valve
1.	Check whether the openings on the breather valve or the line connected to it are free of dirt and blockages.
2.	**If they are dirty or blocked, clean the components. (See the following instructions.)Do not pour or spray water or cleaning products into the breather valve.**
(3.)	Please notify your TAC if the breather valve cannot be cleaned and, in this case, disconnect the gas and voltage supply.
(4.)	**Do not complete any further action or work until the damaged parts have been replaced.**

The following describes action you can take if the breather valve is dirty or blocked. The breather valve must be removed for this purpose. This is only allowed in controlled conditions outside the Ex Zone as described in ISO/IEC 61010-1.

Step	Action: Cleaning the breather valve/vent line
1.	Disconnect the gas and voltage supply and, if connected, detach the vent line.
2a	If the dirt is located in the vent line, flush the line from the connection point to the end with compressed air or a non-flammable gas, e.g. nitrogen, with the pressure required to remove the foreign bodies.
2b	If the dirt is located on the actual breather valve, you must unscrew the valve using a suitable tool (tool available from Honeywell).
3.	Clean the component without liquid cleaning products. Use a vacuum cleaner or compressed air to remove the dirt from the outside or blow it out from the inside.
4.	Apply Fin Super before you screw in the component so that the threads do not seize. Screw the breather valve back into place. Ensure that the O-ring is undamaged. Only use alternative lubricants after consulting your TAC.
5.	Reconnect the vent line if applicable. Reconnect the gas and voltage supply.

8.3 Consumables (carrier and calibration gas cylinder)

A gas cylinder with the calibration gas is required to ensure that the **enCal 3000** operates correctly. A gas cylinder containing helium (and or argon) to act as the carrier gas is also required for operation. These gas cylinders should be replaced as soon as the outlet pressure can no longer be held at a stable level. Depending on the regulator, this should be around 1.0 MPag. At a pressure below 2 MPa, you should keep a replacement cylinder available. The required work should be carried out using the steps described in "**Connecting and replacing gas cylinders**".

	**Hints about the needed gas cylinders could be found in the technical specifications**

8.3.1 Spare and replacement parts for general maintenance work

The device requires hardly any consumables and has hardly any wear parts. Honeywell therefore recommends the annual inspection primarily for preventive reasons and to replace the auxiliary gases if they are close to being empty and to identify errors. Our contact details can be found at the start of this manual. Spare and replacement gases can also be ordered using these contact details.

 ATTENTION	**For safety reasons, work which requires the device to be opened may only be carried out by the manufacturer or by personnel trained or authorized by it. Please contact us if the device suffers any damage or to arrange an appointment for service work.**

 ATTENTION	**Do not take any safety risks by carrying out incorrect maintenance work or using non-genuine spare and replacement parts. No liability can be accepted for damage caused by the use of non-genuine, non-approved spare and replacement parts or incorrectly completed maintenance work.**

8.4 Honeywell service work

If you have the annual maintenance work carried out by a Honeywell service technician, any errors can be rectified immediately. Naturally, you will also receive detailed documentation of the work. Then you only have to archive these documents.

CAUTION	In any case, the following always applies: DO NOT OPEN WHEN AN EXPLOSIVE ATMOSPHERE IS PRESENT DISCONNECT POWER BEFORE OPENING

After several years of operation, additional maintenance and repair work may be required due to wear and ageing. Examples of this include battery replacement (around 5 years) and the replacement of blocked inlet filters. Furthermore, factory maintenance is required if defects are identified during the annual maintenance work which cannot be rectified or if the housing has suffered damage.

Depending on the nature of this work, it may require the housing to be opened or the device to be completely dismantled or returned to the manufacturer.

The required work (with the exception of the complete replacement of the device) may therefore only be carried out by Honeywell service staff or by personnel trained by Honeywell.

For example, the housing can only be repaired by the manufacturer since the dimensions of the explosion-protection gaps are not part of the public domain and are only specified in the manufacturer's design documents. Please contact your TAC if you require such services.

9 Data Communication

9.1 Data safety information and Warning

Devices and therefore also the **enCal 3000** are used in modern infrastructures and network control systems with the aim of transferring process information such as meter readings, measurements and messages to a central billing or control point. A connection of this type constitutes a significant security risk which must be given due consideration when designing the network.

9.1.1 Security considerations for your network

As soon as you identify a possible vulnerability in a Honeywell product, please report it direct to Honeywell. A vulnerability is if an error or a weakness in the software can be exploited to adversely affect or reduce the operation or security of the parameterization or device software. Honeywell reviews all reports about vulnerabilities relating to Honeywell products and services.

 ATTENTION	**Report a vulnerability to Honeywell at:** **https://honeywell.com/pages/vulnerabilityreporting.aspx.** **or by e-mail to security@honeywell.com** **or contact your Honeywell Technical Assistance Center (TAC)**

9.1.2 Implement stringent password guidelines

Since various types of attacks on passwords take place these days, Honeywell recommends that best practices for password management are used. Here are a few time-tested methods:

- Always change standard passwords.
- Use secure passwords.
  (When assigning passwords, always use a combination of upper and lower case letters, numbers and special symbols. Furthermore, protection increases with the length of the password. A secure password always consists of at least eight characters.)

	**Document any changes from time-tested methods.** **If your system does not allow one of these time-tested methods to be used, Honeywell recommends that this should be documented. For example, if special symbols such as the equals sign "=" are not allowed in passwords.**

9.1.3 Prevent unauthorized external access using a firewall.

To reduce the risk for your network, we recommend that you use a firewall or another mechanism to restrict network traffic between the “external” central billing or control system and the “internal” network of the gas metering systems. We also recommend that you only allow protocols and ports which are actually used for data exchange with the external network and that these are added, for example, to the firewall’s white list. See the following data protocols with their TCP standard ports (Ethernet) and the explanatory illustration.

Protocol	Standard port	Description
HTTP	80	Hypertext Transfer Protocol allows, for example, access to an enCore device via the remote operation panel.
MMS	102	Manufacturing Messaging Specification (pursuant to ISO standard 9506) allows communication between enSuite and enCore devices.
Modbus TCP	502	Protocol for data exchange by user-defined registers between AMR and enCore devices using a standard TCP/IP network.
NTP	123	Network Time Protocol for the high-precision time synchronization of enCore devices with an NTP time server.

Example of a router and firewall between the metering system and control room and data exchange via Modbus TCP in a trustworthy network

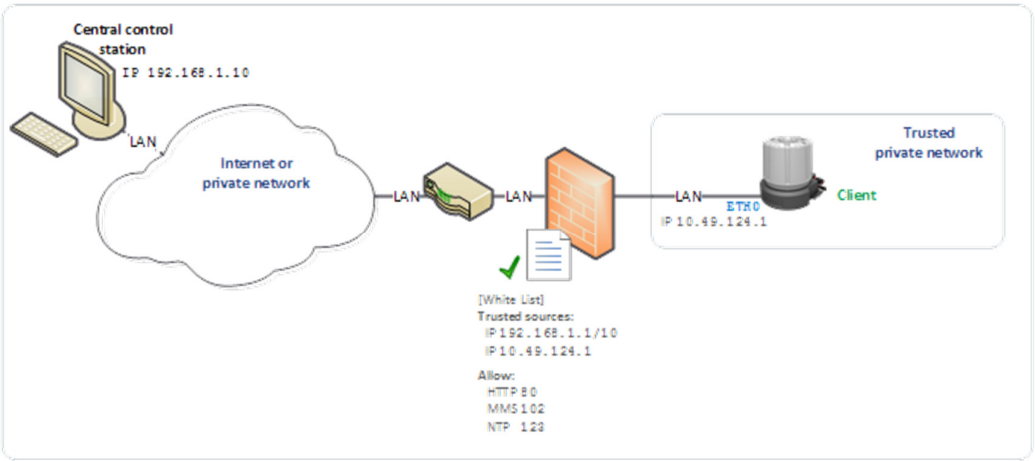


Figure 9.1: Example of a router and firewall

9.2 Local TCP/IP Data Communication

The main Data Communication Port of the EnCal 3000 is the TCP/IP port, although 2 serial ModBus ports are also available (see next paragraph). The TCP/IP Port (Ethernet UTP 10 Base-T) is necessary for connection with RGC 3000 (Windows based interface for configuration, diagnostics and report generation), but is also used by preference for ModBus communication with Flow Computers, PLC and other ModBus hosts, if they are able to handle ModBus TCP/IP. If not, ModBus serial to TCP/IP are easily available nowadays. For existing systems the 2 serial ModBus ports can of course also be used.

The picture below shows a typical set-up:

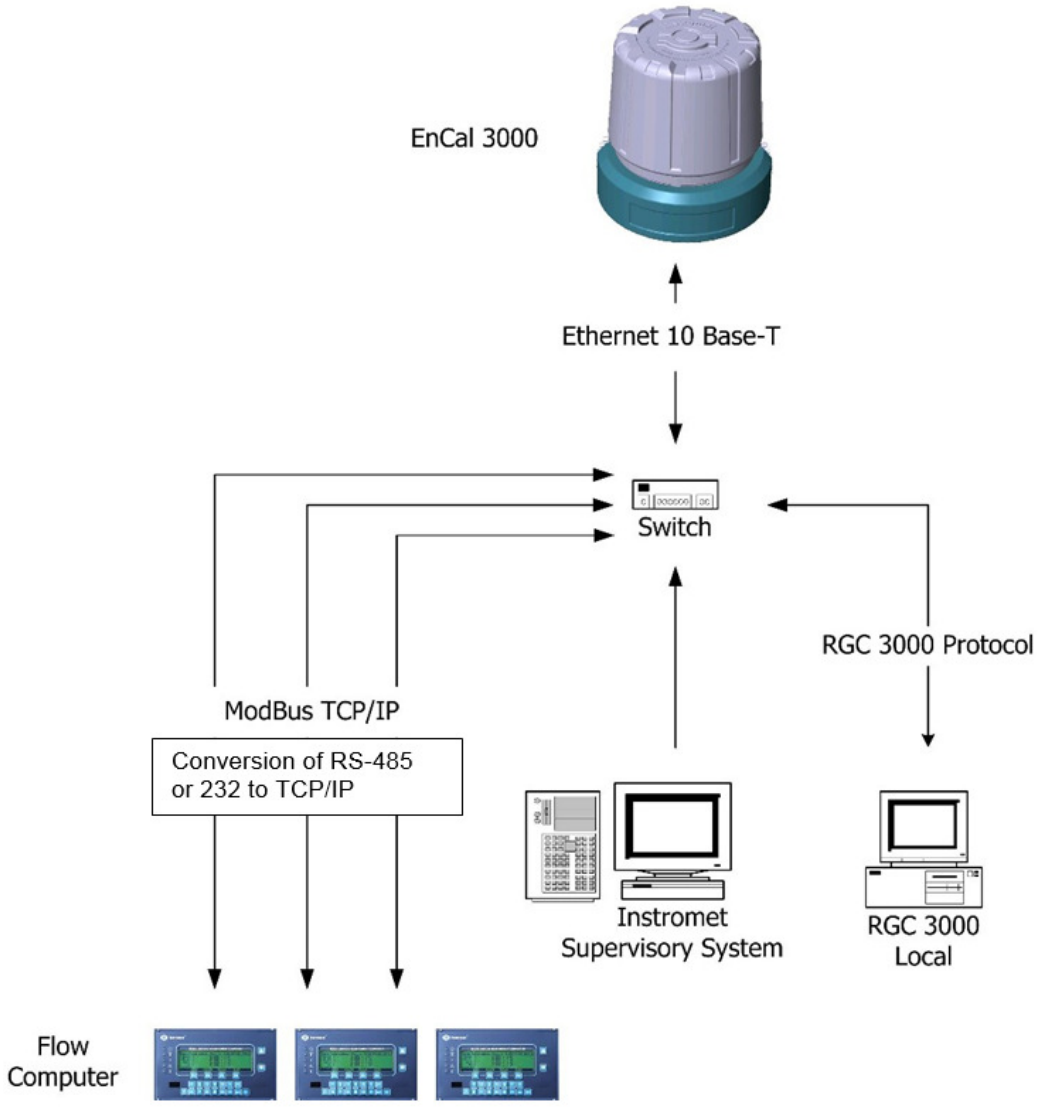


Figure 9.2: Typical Data Communication Set-up for Ethernet Communication

9.3 Local Serial ModBus Data Communication

Flow computers or another ModBus host could also be directly connected to one of the 2 serial ModBus ports internally integrated in the EnCal 3000.

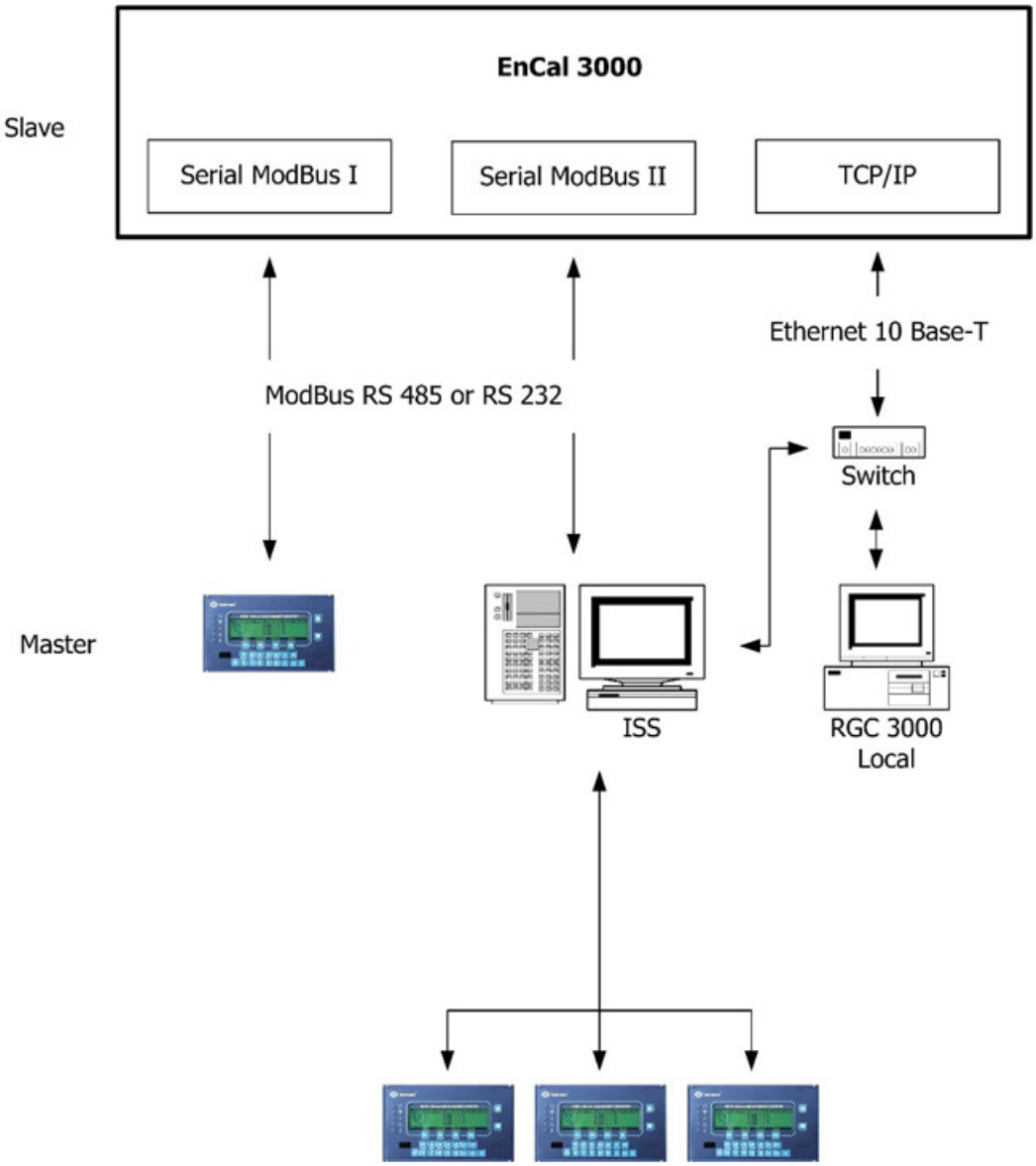


Figure 9.3: Typical Data Communication Set-up for TCP/IP combined with Serial ModBus Communication with the EnCal 3000

9.4 Remote Access

The schematic below shows the different options for remote access to the EnCal 3000:

Through Internet:

- Or through a direct connection of the Ethernet switch with Internet (through cable or ADSL modem, or wireless)
- Or through a VPN connection with the customer's network, if the Ethernet switch or the local PC is integrated in this network. In this case the customer has to give (if required only temporarily) a User Account and Login ID to the remote PC.

If network connection is not available, telephone line connection is also possible:

- Or by using an Ethernet modem with dial-in capability
- Or by using the internal modem of the local PC, and a remote access program like PC Anywhere.

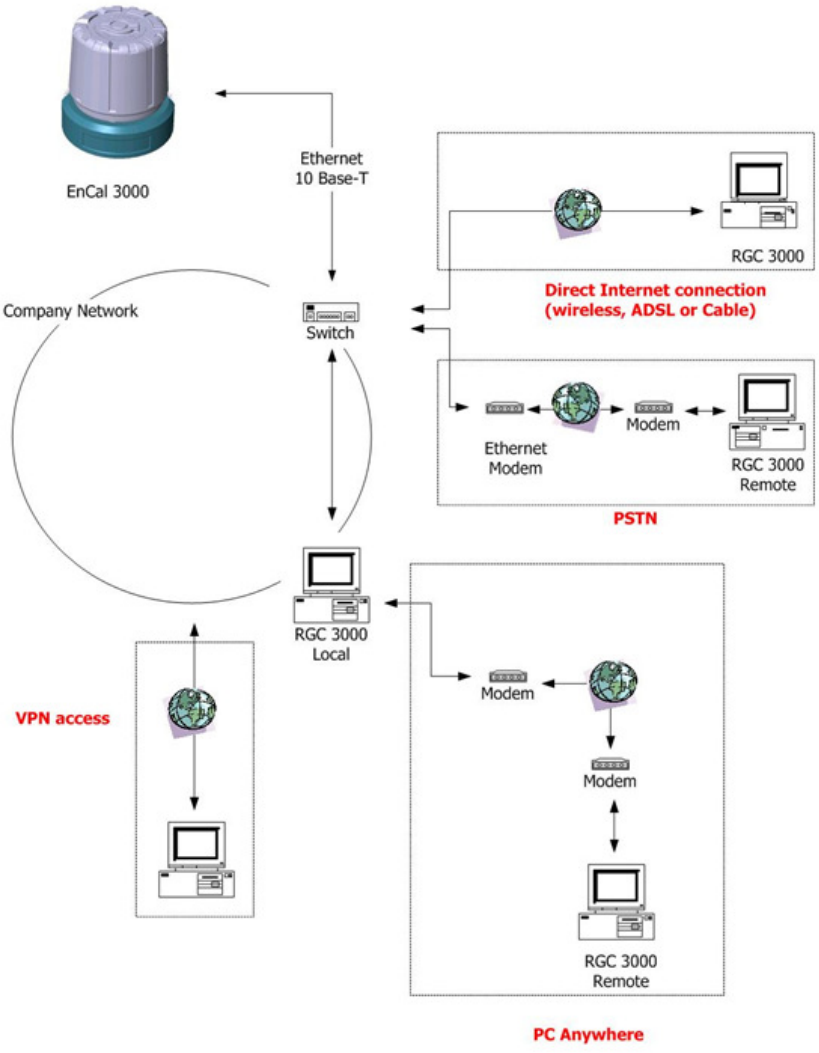


Figure 9.4: Remote Access to the EnCal 3000

9.5 ModBus Communication

The picture below shows the ModBus Configuration screen for the EnCal 3000 (see also Software Manual)

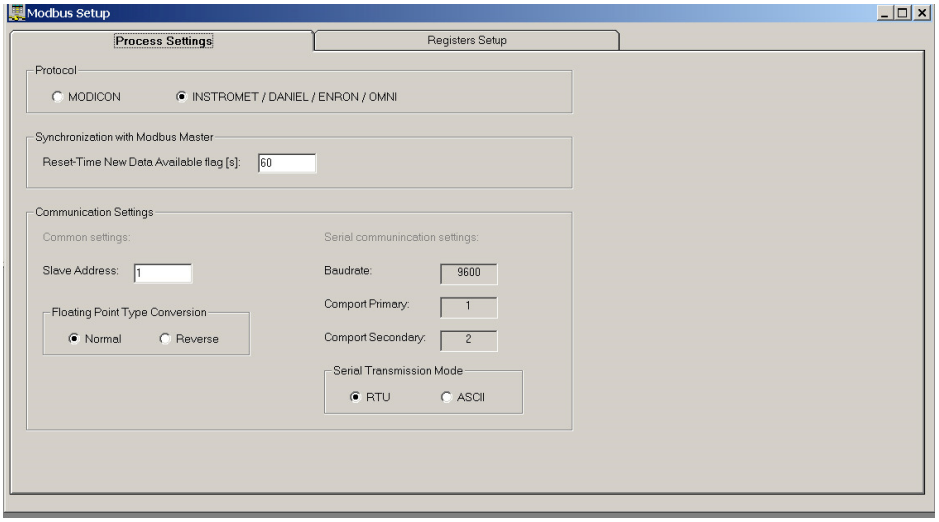


Figure 9.5: ModBus Configuration Screen

The ModBus registers are user configurable:

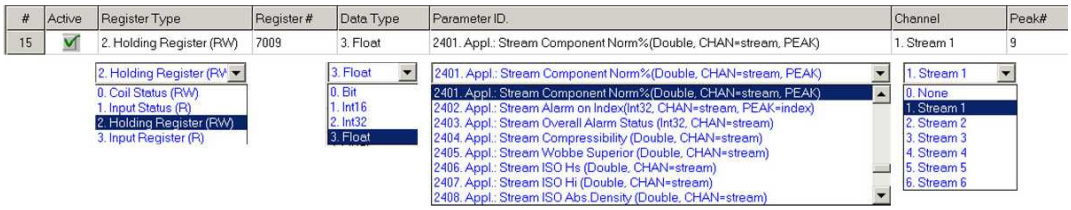


Figure 9.6: ModBus Register Details

- Register Type: Either Read Only (R) or Read/Write (R/W), and either bit (Status) or register size
- Register #: User selectable. For the Instromet protocol be aware of the following restrictions:
  - 0 – 4999 : 2 bytes per Registers
  - 5000 – 6999: 4 bytes Integers
  - 7000 – higher: 4 bytes Floating Point

  The Modicon protocol always uses 4 registers
- Data Type: Bit when Status is defined, Integer (16 bit or 32 bit) or Float when Register is defined
- Parameter ID: Instruction set which is available in EnCal 3000.
- Channel: This column is reserved to define channel # or stream #, depending on the type of Parameter ID defined
- Peak #: Component number, if applicable

	For further details concerning the Modbus communication please refer to the Software Manual of RGC 3000

10 Technical Specifications

The main technical data are noted on various type plates and labels on the device. They are also listed below and can be found in total on the data sheet.

Installation	
Place of use	Installation close to the sampling point up to Ex Zone 1 If installed outdoors, the device may need a sun shade or have to be placed in an air-conditioned housing
Installation	Wall mounting using a supplied bracket or installation on a bench or platform

Mechanical	
Dimensions	Base Ø 37 mm x height 37 cm (Ø 14" x height 14") Installation Clearance: Ø 55 cm x Height 70 cm (Ø 20" x Height 28")
Weight:	28 kg
Approvals	ATEX II 2 G Ex-d IIC T6 Gb and IECEx Ex-d IIC T6 Gb ATEX (EN 60079-0: 2012/EN 60079-1: 2014) IECEx (IEC 60079-0: 2011 Sixth edition/IEC 60079-1:2014 seventh edit.) INMETRO: NEC Class I/Div. 1, Groups B, C & D NEC Class I/Zone 1 AEx db IIC T6
Mechanical strength	Vibration and shock test to IEC 60068-2-31 and -64
Enclosure	IP 66

Electrical	
Electrical Safety	Designed to be installed in hazardous areas.
Power supply (single supply) Maximum current/rating	24 VDC, 50W nominal non-heated and 120 W nominal heated version (ambient < 0 °C) Created for example with Quint-PS-100-240AC / Quint-PS-24DC/24DC/10 / Siemens SITOP / Siemens Logo or equivalent power supply units with safe electrical isolation
Battery back-up	Button battery, Panasonic Type BR 2032 3V
EMC strength	to EN 61000-6-2 and EN 61000-6-4

Interfaces / Inputs/Outputs	
Gas connections	Inlets (up to 5 x process gas, 1(2) x carrier gas, 1 x calibration gas) Outlets (process gas & gas measured) 1/8" or 3 mm Swagelok pipe fitting Breather line Connection at breather valve: 1/4" NPT (standard equipment, others on request)
Electrical connections	M20/M25 cable gland for armoured cable per default Diameters Ø 5.5-12 mm / Ø 12.5-20 mm / Ø 17-26 mm Optionally with adapters to NPT or other sizes
Ethernet communication	Ethernet UTP 10 Base-T for ModBus TCP/IP and PC link
Serial communication	Two RS 232/485 ports (user selectable) for ModBus RTU
Analog I/O	3 analogues I/O for local sensors (4-20 mA or 0-10 VDC)

:

Software	
Analyser	ProTM: complete stand-alone operation, inclusive all calculations and generation of report formats, without need for operator intervention.
Calculations to	ISO 6976, GPA 2172 or GOST 22667
PC	RGC 3000: Windows based program for configuration, diagnostics and report generation (Compatible with Windows XP/Vista/7/10)
Data Logging	History Log: local storage of last 35 days of all analytical data (analysis, events, alarms, averages, last chromatogram, calibration data) according to API Report 21.1. All data available on remote workstation in XML format
DCS	Remote monitoring and trending of the system as an integral part of the Instromet Supervisory Suite

Analytical	
Hardware	2 parallel isothermal GC modules with narrow-bore capillary column technology in combination with MEMS based analytical components
Analysis Output	Full composition of any natural gas up to C6+ (standard) or C9+ (optional)Heating Value, Density, Wobbe Index
Gas group	Only gases set out in the list of suitable gases below The gases must be technically free of dust and liquids. Concentrations outside these ranges and other components on request
Analysis time	3 minutes for C6+ analysis, 5 minutes for biogas or C9 analysis

Analytical		
Component Range	Concentrations outside this scope might be possible, but verification with Honeywell is needed	
	for natural gas N2 : 0.005 – 20 % CH4 : 55 – 100 % CO2 : 0.001 – 20 % C2 : 0.001 – 14 % C3 : 0.001 – 6 % C4 : 0.001 – 3 % Neo-C5 : 0.005 – 0.25 % C5 : 0.001 – 0.25 % C6 : 0.001 – 0.1 % C7 : 0.001 – 0.05 % C8 : 0.001 – 0.05% C9+ : 0.001 – 0.05 %	for biogas N2 : 0.005 – 15% CH4 : 60 – 100% CO2 : 0.001 – 10% C2 : 0.001 – 14 % C3 : 0.001 – 6 % C4 : 0.005 – 3 % H2 : 0.001 – 5 % O2 : 0.005 – 4% H2S : 0.0002 – 1% COS : 0.0001 – 1%
Uncertainty	< 0.1 % for all calculated properties	
Repeatability	< 0.005 % (RSD) for all calculated properties :	
Detection limit	for C5: 1 ppm; Detection limit for C9: 2 ppm	

Ambient conditions	
Ambient pressure	Atmospheric pressure
Temperature range	for devices with ATEX/IECEx-Approval: 0 °C to 60 °C (32 to 140 °F), extendable to -40 °C to 60 °C (-40 to 140 °F) for devices with FM-Approval: 0 °C to 55 °C (32 to 130 °F), extendable to -40 °C to 55 °C (-40 to 130 °F)
Humidity	0 – 100% RH

Gas Cylinders	
Carrier gas Helium / Argon Quality 5.0 or better	50 l gas cylinder(not always included in Honeywell package) Option: 2 cylinders with automatic changeover system Supply pressure 5.5 barg Flow ± 4 ml/min per column (max. 8 ml/min with 2 columns) Ensure that only suitable standard-compliant types are used if you do not source them from Honeywell. Cylinder pressure greater than 1.0 MPa(g) required. At a pressure below 2 MPa, keep a replacement cylinder available. Other accessories required: pressure regulators and connection lines.
Calibration gas Quality 2.0 or higher	10 l gas cylinder (not always included in Honeywell package) Composition preferably close to pipe line composition (with a maximal uncertainty of 1% relative deviation for each component) Supply pressure 1 to 4 barg nominal Pressure peak protection up to 4 barg Flow ± 30 ml/min Ensure that only suitable standard-compliant types are used if you do not source them from Honeywell. Cylinder pressure greater than 1.0 MPa(g) required. At a pressure below 2 MPa, keep a replacement cylinder available. Other accessories required: pressure regulators and connection lines

11 Possible hardware options and type plates

The EnCal 3000 can be delivered with several options. These options are described in the following segments of this appendix.

Option	Meaning	Explanation
HT	Heaters installed	Frost protection has been added to keep the internals in the housing above 0 degrees Celsius
SC	Single Channel	This a single channel analyser
QS	Quad Slave	This housing is the slave (2nd dome) housing of an EnCal 3000 Quad. It has no CPU board inside.
H2	Hydrogen	This analyser is configured to work with Hydrogen as carrier gas. As such it needs venting of the carrier to safe area.

Position of the type indication:

The main type label with the most important details is located above the sample gas inlets on the right-hand rear base area. This information must be noted and obeyed in all circumstances.

If the main type label cannot provide sufficient space for all the details, the additional details can be read off an additional type label which is also affixed to the housing base.

The figure shows the positions of the type labels.

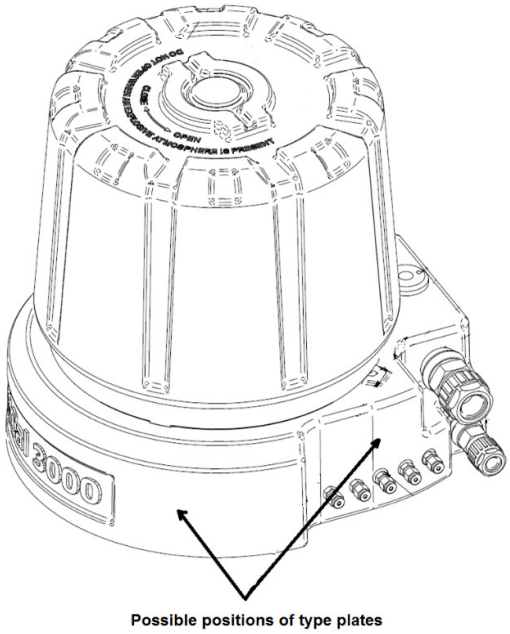
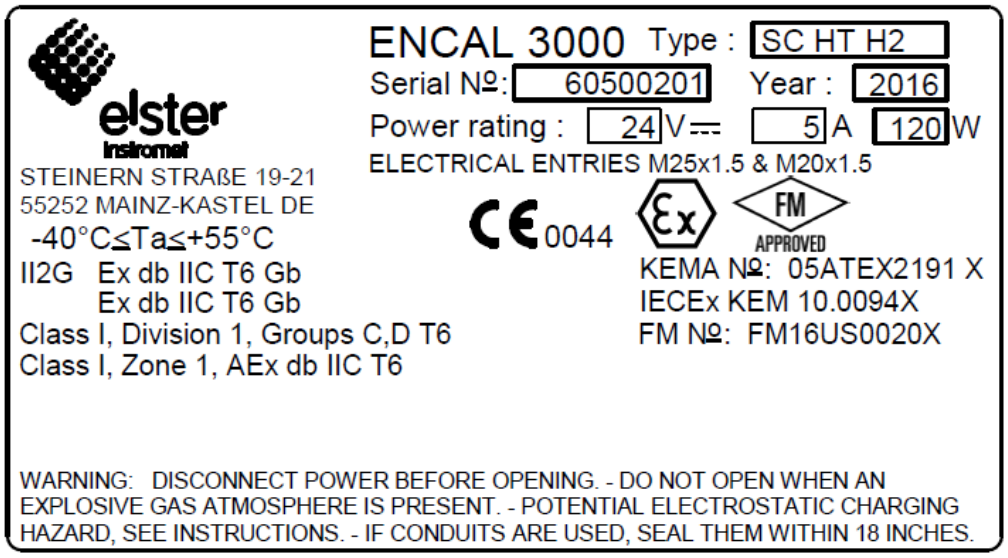
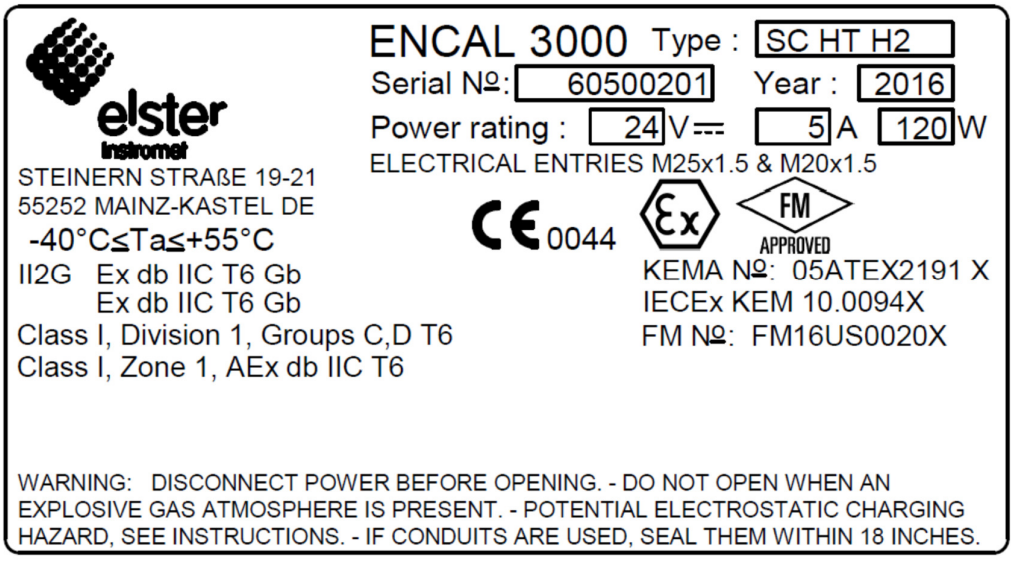


Figure 11.1: Positions of the type labels

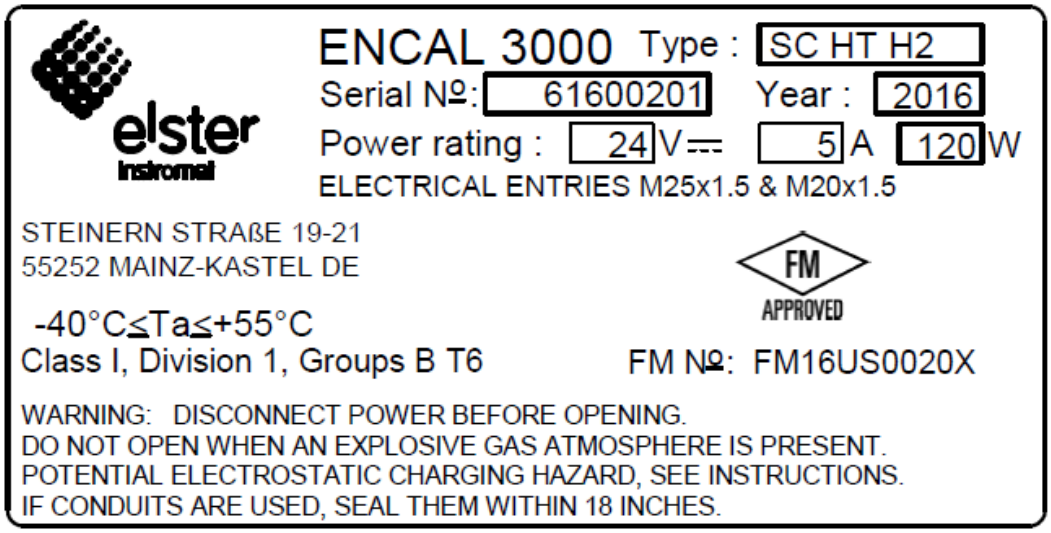
The type label will vary depending on the application and country of use for the device. The language and specified standards or regulations will be adjusted accordingly. The details on the affixed label or labels apply at all times and exclusively to the device. These labels always contain the following data, possibly spread over multiple labels:

Example: Example for Type plate for devices with FM-Approval for Group C and D:

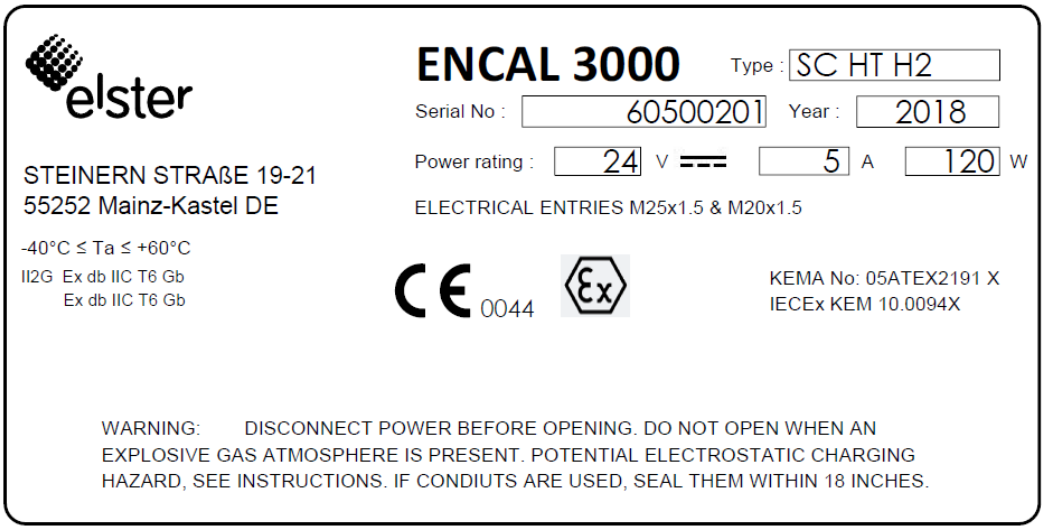




Example for Type plate for devices with FM-Approval for Group B:



Example for Type plate for devices with ATEX/IECEx Approval (extended to 60°C in 2018)



The images are showing the IIC version

11.1 Option HT: Heaters installed

The device has the option for an additional heating system (cabinet heaters) for use in temperatures around freezing and below.

They are attached directly to the mounting plates and provide additional heat when the internal enclosure temperature goes below 10 °C (50 °F). Figure 2.10 shows the location of the cabinet heaters.

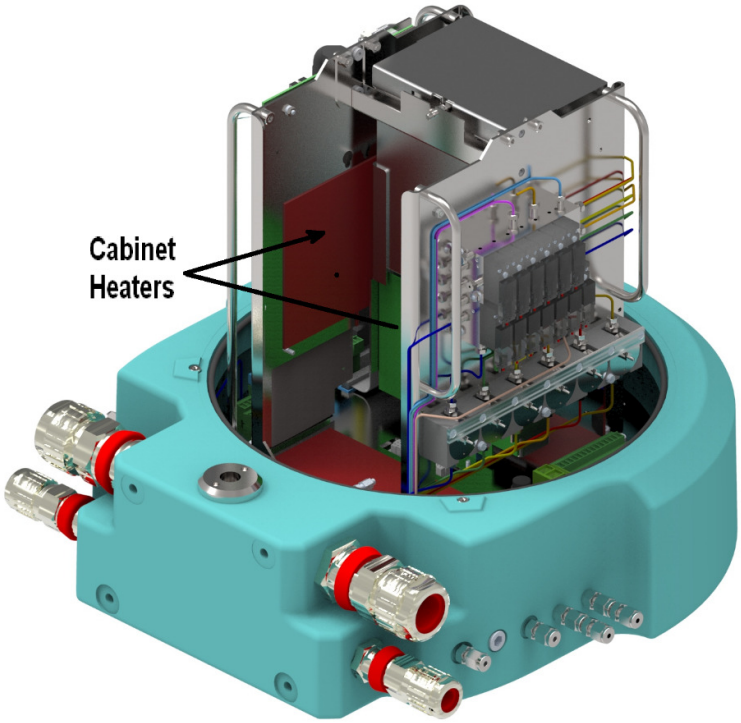
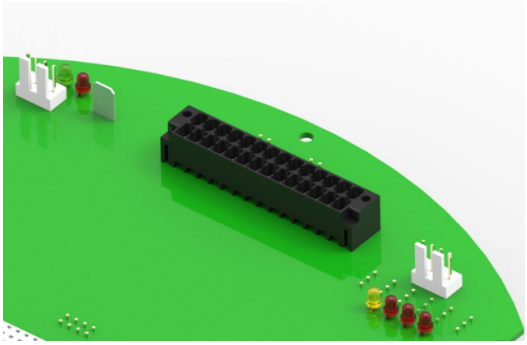


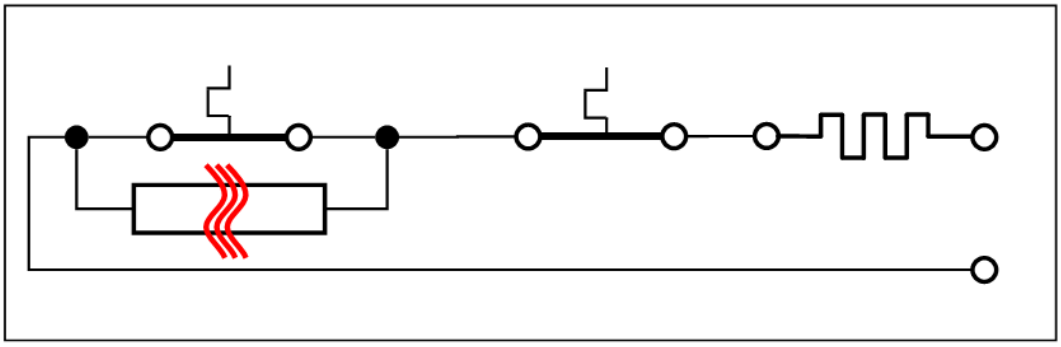
Figure 11.2: Cut-out of an EnCal 3000 showing heaters installed

For the regulation of the heaters standard thermostats with a fixed setting are used. These thermostats are connected to the interconnection board close to the connectors for the power supply of the heaters (see also Interconnection board connectors in Version 2 they are located close to the connectors for the power supply of the heaters.



The heaters have a protection against overheating. When the protection is activated it will cut the power to the heaters and stay open until the power of the analyser has been switched off and on again.

If the protection activates more than once, please contact Elster for an intervention. See below for an overview of the heater schematic:



11.2 Option SC: Single Channel analyser

Whenever option SC is on the nameplate of the analyser, this will indicate that this EnCal will only have one channel installed in the housing. This is the case when, for instance, the EnCal 3000 is used to measure a single component only (like H2S or THT).

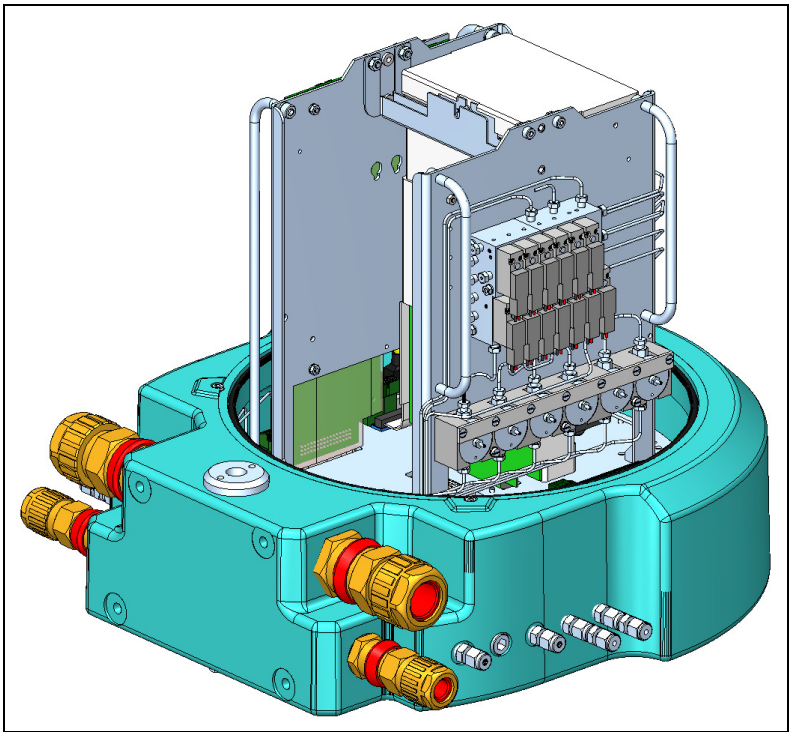


Figure 11.3: Cut-out of an EnCal 3000 showing one channel installed

11.3 Option QS : Quad Slave

The Encal 3000 Quad is the combination of two housings in one measurement System. The two housing each have an explosion safety approval label. In the two housings is place for up to four analytical channels that are controlled by one processor board. This System is especially developed for extended analysis applications which cannot be solved with just two channels.

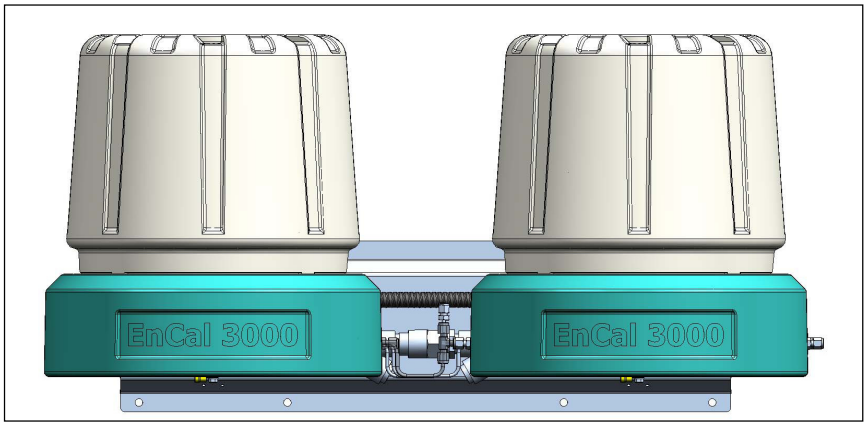


Figure 11.4: EnCal 3000 Quad (right master / left slave)

With up to four channels it is possible to analyse all typical components of interest in one system. The two housings are mounted on a metal plate to have a stable connection. The right housing, further referred as “Master unit” contains the first two channels, the processor board for the control of the measurement system and the sample selection.

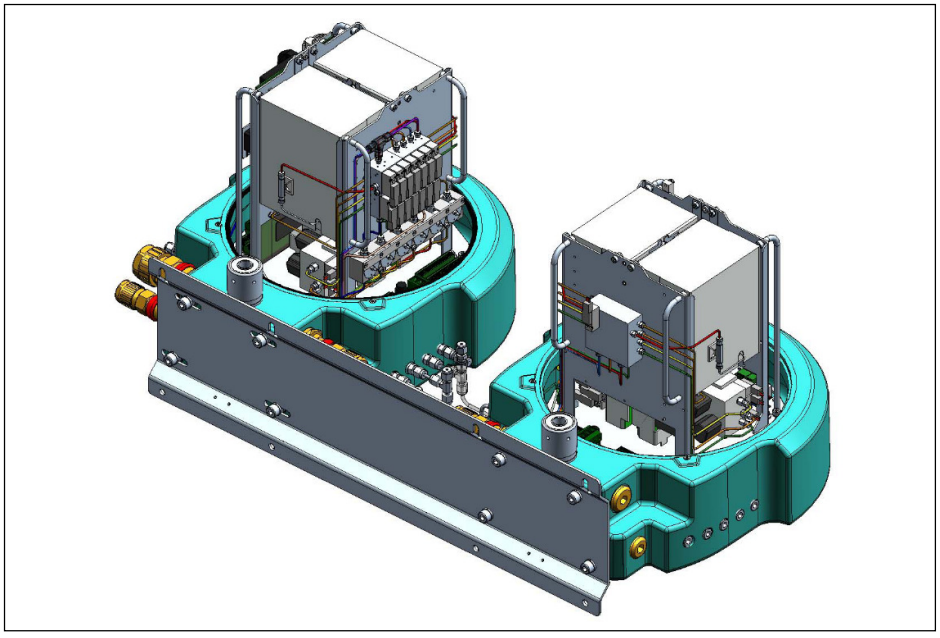


Figure 11.5: Quad with open covers

The other housing, further referred as “Slave unit” contains the third and optionally fourth channel (depending in the application). It has no CPU board inside. It is labelled as “QS” on the Safety approval label.

Both housings have a separate power supply board (interconnection board). The slave unit shares the output of the stream selection in the master unit and therefore no additional stream selection is needed.

The required gas connections between the two housings are preinstalled.

11.4 Option H2: Hydrogen carrier gas

This analyser is configured to work with Hydrogen as carrier gas. Normally the carrier gas is a non-explosive one (Helium / nitrogen / Argon) and it is purged inside the housing to keep the atmosphere in the housing clean. However with hydrogen we cannot do that since it might cause an explosive atmosphere. As such it needs venting of the carrier to safe area.

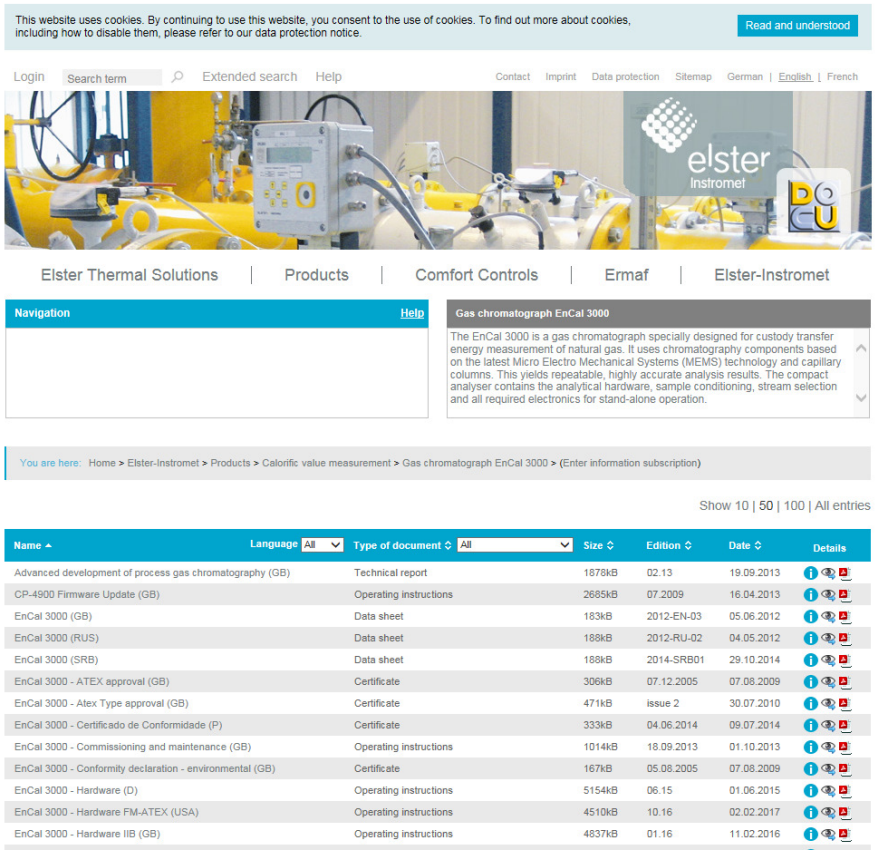
There is a vent connection marked “column vent” that should be connected to a vent going to safe area without restriction or back pressure.

12 Annex

The annex contains abbreviations and explanations of the terms used as well as ceritfilates, certificates and declarations. Since the device is used in different areas and regions, not all certificates are always appropriate. Current versions can always be found in our Docuthek (www.docuthek.com).

The documents for the Encal3000 chromatograph can be found at the following link:

http://docuthek.kromschroeder.com/documents/index.php?menuid=31&topmenu=31&lang=en&selclass=&sellang=&folder=400079



Name	Language	Type of document	Size	Edition	Date	Details
Advanced development of process gas chromatography (GB)		Technical report	1878kB	02.13	19.09.2013	
CP-4900 Firmware Update (GB)		Operating instructions	2685kB	07.2009	16.04.2013	
EnCal 3000 (GB)		Data sheet	183kB	2012-EN-03	05.06.2012	
EnCal 3000 (RUS)		Data sheet	188kB	2012-RU-02	04.05.2012	
EnCal 3000 (SRB)		Data sheet	188kB	2014-SRB01	29.10.2014	
EnCal 3000 - ATEX approval (GB)		Certificate	306kB	07.12.2005	07.08.2009	
EnCal 3000 - Atex Type approval (GB)		Certificate	471kB	issue 2	30.07.2010	
EnCal 3000 - Certificado de Conformidade (P)		Certificate	333kB	04.06.2014	09.07.2014	
EnCal 3000 - Commissioning and maintenance (GB)		Operating instructions	1014kB	18.09.2013	01.10.2013	
EnCal 3000 - Conformity declaration - environmental (GB)		Certificate	167kB	05.08.2005	07.08.2009	
EnCal 3000 - Hardware (D)		Operating instructions	5154kB	06.15	01.06.2015	
EnCal 3000 - Hardware FM-ATEX (USA)		Operating instructions	4510kB	10.16	02.02.2017	
EnCal 3000 - Hardware IIB (GB)		Operating instructions	4837kB	01.16	11.02.2016	

12.1 Nomenclature/Abbreviations

The following abbreviations, definitions and terminology are used in the documentation.

Short form	Description
°C	Temperature (Celsius) = TC = TK - 273.15 = 5/9 (TF - 32)
°F	Temperature (Fahrenheit) = TF = 1.8 TC + 32 = 1.8 TK - 459.67
ATEX	Atmosphère explosible (French for explosive atmosphere)
bar	Pressure 1 bar = 0.1 MPa = 14.504 psi
C2H6	Ethane
C3H8	Propane
CH4	Methane
CO2	Carbon dioxide
CPU	Central processing unit
d	Relative density (density ratio of fuel and air)
DBB	Double-block-and-bleed (valve block technology)
DC	Direct current
DHCP	Dynamic Host Configuration Protocol
DIN	Deutsches Institut für Normung e.V. (German Institute for Standardization)
EN	European standard
EN/IEC 60079-14	Standard on explosive atmospheres
EPC	Electronic pressure control
FE	Functional earth
GC	Gas chromatograph
Hi/HiM/HiV	Lower heating value; molar/Lower heating value; mass/Lower heating value; volume
Hs/HsM/HsV	Higher heating value; molar/Higher heating value; mass/Higher heating value; volume

Short form	Description
HTTP	HyperText Transfer Protocol
Hz	Frequency
i-C4H10	i-butane
i-C5H12	i-pentane
IECEx	(IECEx SYSTEM) International explosion-protection (Ex) rating
IP	Internet protocol
ISO	International Organization for Standardization
K	Temperature (Kelvin) = TK = 5/9 (TF + 459.67) = TC + 273.15 (Δ 1K = Δ 1°C)
m	Mass
M (Mm)	Molar mass (of the mixture)
m or mm	Length in SI unit (metre) 1 m = 1000 mm = 39.73 in = 39.73"
MEMS	Micro-electro-mechanical system
MLC	Multi-level calibration
MPa	Megapascal (pressure) 1 MPa = 10 bar = 145.04 psi
MPag	Gauge pressure in megapascals
N2	Nitrogen (gas component)
NC	Switch/output which is closed when de-energized (NC contact)
n-C4H10	n-butane
n-C5H12	n-pentane
NEC	National Electrical Code (USA)
neo-C5H12	Neopentane
NO	Switch/output which is open when de-energized (NO contact)
NPT	National Pipe Thread (self-sealing (pipe) thread)
NTP	Network Time Protocol (standard for clock synchronization in computer systems)
P1-11K	PTB calibration gas mixture (EnCal MLC gas)

Short form	Description
PA	Equipotential bonding system connection
PC	Personal computer
PELV	Protective extra-low voltage
PGC	Process gas chromatograph
ppm	Parts per million
RS 485	Interface standard for cable-based differential serial data transfer
SELV	Safety extra-low voltage
SLC	Single level calibration
TAC	Honeywell Technical Assistance Center
TCD	Thermal conductivity detector
TCP	Transmission Control Protocol (Internet)
VDE	German Association for Electrical, Electronic & Information Technologies
WEEE	Waste of Electrical and Electronic Equipment (directive of the EU)
Wi	Inferior Wobbe index
Ws	Superior Wobbe index

12.2 Definitions and explanations

List of the definitions and explanations used in this document, please refer also to the user manual.

Term	Explanation
Alarm	Alarms are faults which jeopardize the correctness of the results. An alarm is generated, for example, if a measurement is outside the defined measuring range. The start and end of the alarm is entered in the relevant error list with a time stamp. If the cause of the alarm no longer exists, the alarm can be accepted and thus removed from the error list.
Audit trail	is a two-part protocol archive (parameter change archive) which enables the user to conduct changes relevant to billing without opening the SSW. These changes are monitored and documented in the Fiscal section. If the SSW is opened, data are only included in the General section.
Breather valve	The breather valve, also known as the vent valve or flame barrier, is designed to equalize the pressure on explosion-proof housings during operation. This pressure equalization device is required during operation and must not be sealed.
Calibration gas	is kept in a cylinder permanently connected to the device and is an integral part of the measuring instrument. This is a mixture with officially defined properties and is required for automatic calibration.
Calibration officer	or representative is a person with country-specific authorization who may carry out officially protected work on gas systems which are to be used for fiscal measurements.
Carrier gas (mobile phase)	The carrier gas (inert gas) carries the sample through the separation column. The most commonly used carrier gases are helium, nitrogen and hydrogen. The selection depends on the measuring task.
Carrier gas	is kept in a cylinder permanently connected to the device. This gas, for example helium, carries the sample through the separation column of the gas chromatograph.
Chromatogram	is the visual representation of the measurement results from a chromatograph

Term	Explanation
DBB technology	is a valve technology to seal gas streams. The series connection of 2 solenoid valves, between which there is a vent, ensures that gases cannot mix even if the valves are leaking.
EnCore devices	are representatives of a highly developed series of measuring instruments based on the same hardware components and software concepts. enCore is the name of the product platform. Both the hardware and software have a modular design; the configuration is variable (modular principle).
Error list	is used by the user to identify faults and reproduce the history of the fault. The start and end of a message is entered in the error list with a time stamp and recorded in the logbook.
Gas chromatograph or process gas chromatograph	is a measuring instrument which uses gas chromatography. In an industrial version, it is the low-maintenance and explosion-proof upgrade of the measuring instrument, known as a process gas chromatograph.
Gas chromatography	Process which allows the separation of a mixture of gaseous substances due to the differing distribution of its individual components using a carrier gas (mobile phase) and separation columns (stationary phase).
HyperText Transfer Protocol	HTTP allows, for example, access to an enCore device via the remote operation panel.
Internal sampling system	is a gas manifold which defines a gas route using valves. The gas channels in this metal block also enable DBB technology to be used.
Logbook	also known as the system audit trail is a log archive which can be used by all software parts and records every extraordinary situation, for example faults in the measuring equipment.

Term	Explanation
Message	is an event which applies to multiple evaluation cycles of the device. It may be reset by a user with the appropriate user rights.
Network Time Protocol.	NTP for the high-precision time synchronization of enCore devices with an NTP time server.
Note	is generated if a measurement violates a state defined by the user. The start is entered in the error list with a time stamp and logged in the logbook. Notes cannot be accepted and are automatically deleted from the error list after the cause of the note has ended.
PELV	PELV protective extra-low voltage systems which comply with DIN EN 60079-14: the power supply to generate PELVs must ensure that no short-circuit is possible between the primary voltage and the extra-low voltage and its connections. It has a safe electrical isolation point (safety isolation transformer) and complies with IEC 61558-2-6. The circuits are earthed. All bodies of electrical equipment must be connected to a common earthing (and equipotential bonding) system.
Place of use	or installation site is the room or position at which the measuring instrument is located. It must satisfy the defined requirements of the manufacturers, authorities and operators.
Power-limited circuit	A power-limited circuit is a circuit separated from other circuits by at least BASIC INSULATION in which the direct voltage (U) is no greater than 60 V. The current which can occur in the circuit is limited by certain measures to a value of less than 200/U. These measures must interrupt the circuit within 120 seconds if this value is exceeded.
Process gas	is the gas which is to be analyzed or measured. It is supplied to the measuring equipment in normal operation and is also known as the operating gas or sample gas.
SELV	SELV safety extra-low voltage systems which comply with DIN EN 60079-14: the power supply to generate SELVs must ensure that no short-circuit is possible between the primary voltage and the extra-low voltage and its connections. It has a safe electrical isolation point (safety isolation transformer) and complies with IEC 61558-2-6. Live parts of circuits must not be earthed or connected to live parts or PE wires of other circuits. All bodies of electrical equipment cannot be earthed (for example for electromagnetic compatibility).

Term	Explanation
Separation column (stationary phase)	is a capillary with a defined internal diameter and a defined length. It is clad internally with a material which separates the gas components over time. Traditionally, this component is known as a “column”. Current technology uses thin tubes on a coil or chips manufactured using Micro-electro-mechanical system technology.
Signal	is an event which is only output for a short time. Accepting by the user is not required or possible and signals are also entered in the logbook.
Status LED	indicates whether an error, in other words, an alarm or a warning is active or has been active. It is simulated on the operation panel.
Test gas	A gas mixture with known properties which can be supplied to the measuring instrument through a sample inlet instead of the process gas for verification purposes.
Time stamps	are time details which relate to an event. They contain the time in seconds since 1 January 1970, the local time zone and the local time difference (additional deviation in minutes). The format for displaying time stamps depends on the language selected on the device, for example YYYY-MM-DD hh:mm:ss or DD.MM.YYYY hh:mm:ss.
Trained personnel	is the designation for a person who, as a result of their technical training, possesses skills and experience and who is familiar with the relevant standards and regulations. Trained personnel can assess their work and identify possible dangers. Hardware work on the device requires, among others, the expertise described in EN/IEC 60079-14, Annex A.
User management	ensures that unauthorized changes are suppressed and authorized changes are permitted.
User	is a person who operates or parameterizes the device. The user is identified by a user name and password.
Warning (message or signal)	Fault messages which do not falsify the results but are important for monitoring the measurement. The calculation is continued without falsification. If the cause no longer exists, it can be accepted on the operation panel and the entry thus removed from the error list.
Methane number	According to the definition, the methane number specifies the percentage methane content in a mixture of methane and hydrogen. It is used to measure the knock resistance of gaseous fuels. If, therefore, a natural gas knocks as strongly as a mixture comprising 85% methane and 15% hydrogen, it has a methane number of 85.

Term	Explanation
Wobbe index Ws	is used to characterize the quality of fuel gases and is a calculated variable for monitoring and regulating the heat output. A distinction is made between a superior Wobbe index (Ws) and an inferior Wobbe index (Wi). The unit is J/m³ or kWh/m³, depending on the unit used for the superior and lower heating value.
WEEE directive	serves to avoid waste of electrical and electronic equipment and to reduce such waste, especially in household waste. It lays down minimum standards for the treatment of WEEE in the EU. The Directive will enter into force on 14 August 2018 for all electrical and electronic equipment used for private and commercial purposes. To achieve this goal, used electrical and electronic equipment is collected separately and the raw materials obtained from it are recycled.
Peak	is the maximum deflection of a signal. In a chromatogram, this is illustrated with rising and falling edges, thus forming a “signal mountain”.
Modbus protocol	Modbus TCP protocol for data exchange by user-defined registers between AMR and enCore devices using a standard TCP/IP network.
Lower heating value Hi	(Colloquially energy content or energy value) is a heat variable. In contrast to the higher heating value, all the combustion products are in gaseous form. This is why the higher heating value is higher than the lower heating value. The lower heating value is quoted as a mass-related heating value, for example in kilojoules per kilogram in (kJ/kg) or as the heating value of the gas quantity over the measured volume, for example in building services engineering in kWh/m³.
Higher heating value Hs	is a heat variable used to monitor the gas composition and energy content of fuel gases. The higher heating value can be specified in molar, mass or volume, for example in kWh/m³.
Density/Density at base conditions	Density or density at base conditions is a heat variable used to monitor the gas composition and energy content of fuel gases. It is the quotient of the mass of a gas sample and its volume in specified pressure and temperature conditions or at base conditions in kg/m³.
Carbon dioxide (CO2)	is an acidic, non-flammable, colourless and odourless gas comprising a chemical compound of carbon and oxygen. The gas is also known as carbonic anhydride or colloquially carbonic acid.
Cable	To ensure greater differentiation between gas and electrical lines, electrical lines are always referred to as “cables” in the following.

12.3 CERTIFICATE EC-Type Examination

CERTIFICATE

EU-Type Examination

(1)

(2) **Equipment or protective systems intended for use in potentially explosive atmospheres - Directive 2014/34/EU**

(3) EU-Type Examination Certificate Number: **KEMA 05ATEX2191 X** Issue Number: **6**

(4) Product: **Gas Analyzer type ENCAL 3000**

(5) Manufacturer: **Elster GmbH**

(6) Address: **Steinern Strasse 19-21, 55252 Mainz-Kastel, Germany**

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

(8) DEKRA Certification B.V., Notified Body number 0344 in accordance with Article 17 of Directive 2014/34/EU of the European Parliament and of the Council, dated 26 February 2014, certifies that this product has been found to comply with the Essential Health and Safety Requirements relating to the design and construction of products intended for use in potentially explosive atmospheres given in Annex II to the Directive.

The examination and test results are recorded in confidential test report number NL/KEM/ExTR10.0103/03.

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

EN 60079-0 : 2012 + A11 **EN 60079-1 : 2014**

(10) If the sign "X" is placed after the certificate number, it indicates that the product is subject to the Specific Conditions of Use specified in the schedule to this certificate.

(11) This EU-Type Examination Certificate relates only to the design and construction of the specified product. Further requirements of the Directive apply to the manufacturing process and supply of this product. These are not covered by this certificate.

(12) The marking of the product shall include the following:

Ex **II 2 G Ex db IIC T6 Gb**

Date of certification: 23 March 2018

DEKRA Certification B.V.

R. Schuller
Certification Manager

Page 1/2

DEKRA Certification B.V. Meander 1051, 6825 MJ Arnhem P.O. Box 5185, 6802 ED Arnhem The Netherlands
T +31 88 96 83000 F +31 88 96 83100 www.dekra-certification.com Registered Arnhem 09085396

DEKRA

(13) **SCHEDULE**

(14) **to EU-Type Examination Certificate KEMA 05ATEX2191 X** Issue No. 6

(15) **Description**

The Gas Analyzer type ENCAL 3000 is used to measure the concentrations of the different components of a gas.

Ambient temperature range 0 °C to +60 °C.
Optional temperature extension with internal heating -20°C to +60 °C.
Optional temperature extension with internal heating and external insulation -40°C to +60 °C.

Electrical data

Power supply : 24 Vdc, 50 W, nominal non-heated and 120 W nominal heated version.

Installation instructions

The instructions provided with the product shall be followed in detail to assure safe operation.

(16) **Report Number**

No. NL/KEM/ExTR10.0103/03.

(17) **Specific conditions of use**

The flameproof enclosure shall not be opened when an explosive gas atmosphere may be present.

The process pressure shall be limited to 2 MPa to ensure that the pressure rise inside the flameproof enclosure remains below 10 kPa.

For information on the dimensions of the flameproof joints the manufacturer shall be contacted.

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

Covered by the standards listed at item (9).

(19) **Test documentation**

As listed in Report No. NL/KEM/ExTR10.0103/03.

(20) **Certificate history**

Issue 1 - 207611900	Initial certificate.
Issue 2 - 212675200	Update of the standards.
Issue 3 - 216331000	Update of the production place.
Issue 4 - 218209100	Updated of the standards.
Issue 5 - 217229400	Update to Gas group IIC and change of the Manufacturer.
Issue 6 - 222460600	Update of the ambient temperature range.

Page 2/2

Form 227A
Version 1 (2016-04)

12.4 DECLARATION OF CONFORMITY ENCAL 3000

CE **EU Declaration of Conformity No.** **DEMZE1803** Honeywell
EU-Konformitätserklärung Nr.

Type, Model *Typ, Ausführung* — **EnCal3000**

Manufacturer *Hersteller* — **Elster GmbH, Postfach 1880, D - 55252 Mainz-Kastel; Steinern Straße 19-21**

Product *Produkt* — **Gas Chromatograph** *Gaschromatograph*

This declaration of conformity is valid for the following Directives:
Diese Konformitätserklärung gilt für folgende Richtlinien:

2014/30/EU (EMC)	2014/34/EU (ATEX)	2011/65/EU (RoHS)

The object of the declaration described above is in conformity with the relevant harmonization legislation from the European Union:
Der oben beschriebene Gegenstand der Erklärung erfüllt die einschlägigen Harmonisierungsrechtsvorschriften der Europäischen Union:

OIML-R140: 2007 OIML-D11: 2013	EN 60079-0:2012 EN 60079-1:2014	EN 50581: 2012

Certificates and interventions by notified bodies:
Bescheinigungen und Maßnahmen durch notifizierte Stellen:

Test report E172552E1	KEMA 05 ATEX 2191 X EU-type examination *EU-Baumusterprüfung*	Not applicable *Entfällt*
Phoenix Testlab Königswinkel 10 32825 Blomberg, Germany	DEKRA Certification B.V. Meander 1051 6825 MJ Arnhem Netherlands	

This declaration of conformity is valid for products labelled accordingly:
Diese Konformitätserklärung gilt für entsprechend gekennzeichnete Produkte:

CE	CE 0044 Ex II 2G Ex db IIC T6 Gb	CE

The production is subject to the following surveillance procedures:
Die Herstellung unterliegt folgenden Überwachungsverfahren:

Directive Annex II *Richtlinie Anhang II*	Directive Annex IV+VII *Richtlinie Anhang IV+VII*	Directive Article 7 Richtlinie Artikel 7
	Notified Body 0044 TÜV NORD CERT GmbH D-30519 Hannover	

This declaration of conformity is issued under the sole responsibility of the manufacturer. If alterations are made to the product or it is modified, this declaration becomes void with immediate effect.
Die alleinige Verantwortung für die Ausstellung dieser Konformitätserklärung trägt der Hersteller. Bei Umbau des Produkts oder Änderungen am Produkt verliert diese Erklärung mit sofortiger Wirkung ihre Gültigkeit.

Elster GmbH	**Mainz-Kastel, 06.08.2018**		
Signed for and on behalf of *Unterzeichnet für und im Namen von*	Place and date of issue *Ort und Datum der Ausstellung*	Piet Platschorre, Managing Director, General Manager PMC Europe	Jörg Kern Sr. R&D Manager

12.5 IECEx Certificate ENCAL 3000

IECEx Certificate of Conformity

INTERNATIONAL ELECTROTECHNICAL COMMISSION
IEC Certification Scheme for Explosive Atmospheres

for rules and details of the IECEx Scheme visit www.iecex.com

Certificate No.: IECEx KEM 10.0094X

Issue No: 4

Certificate history:
Issue No. 4 (2018-03-23)
Issue No. 3 (2015-12-10)
Issue No. 2 (2015-04-30)
Issue No. 1 (2014-03-21)
Issue No. 0 (2010-12-31)

Page 1 of 4

Status: **Current**

Date of Issue: **2018-03-23**

Applicant: **Elster GmbH**
Steinern Straße 19-21
55252 Mainz-Kastel
Germany

Equipment: **Gas Analyzer type ENCAL 3000**
Optional accessory:

Type of Protection: **Ex d**

Marking:
Ex db IIC T6 Gb

Approved for issue on behalf of the IECEx Certification Body: R. Schuller

Position: Certification Manager

Signature:
(for printed version)

Date: 2018-03-23

1. This certificate and schedule may only be reproduced in full.
2. This certificate is not transferable and remains the property of the issuing body.
3. The Status and authenticity of this certificate may be verified by visiting the Official IECEx Website.

Certificate issued by:

DEKRA Certification B.V.
Meander 1051
6825 MJ Arnhem
The Netherlands

DEKRA

IECEx Certificate of Conformity

Certificate No: IECEx KEM 10.0094X Issue No: 4

Date of Issue: **2018-03-23** Page 2 of 4

Manufacturer: **Elster GmbH**
Steinern Straße 19-21
55252 Mainz-Kastel
Germany

Additional Manufacturing location(s):

This certificate is issued as verification that a sample(s), representative of production, was assessed and tested and found to comply with the IEC Standard list below and that the manufacturer's quality system, relating to the Ex products covered by this certificate, was assessed and found to comply with the IECEx Quality system requirements. This certificate is granted subject to the conditions as set out in IECEx Scheme Rules, IECEx 02 and Operational Documents as amended.

STANDARDS:

The apparatus and any acceptable variations to it specified in the schedule of this certificate and the identified documents, was found to comply with the following standards:

IEC 60079-0 : 2011 Explosive atmospheres – Part 0: General requirements
Edition:6.0

IEC 60079-1 : 2014-06 Explosive atmospheres – Part 1: Equipment protection by flameproof enclosures "d"
Edition:7.0

*This Certificate **does not** indicate compliance with electrical safety and performance requirements other than those expressly included in the Standards listed above.*

TEST & ASSESSMENT REPORTS:

A sample(s) of the equipment listed has successfully met the examination and test requirements as recorded in

Test Report:

NL/KEM/ExTR10.0103/00 NL/KEM/ExTR10.0103/01 NL/KEM/ExTR10.0103/02
NL/KEM/ExTR10.0103/03

Quality Assessment Report:

DE/TUN/QAR11.0003/05

IECEx Certificate of Conformity

Certificate No: IECEx KEM 10.0094X Issue No: 4

Date of Issue: 2018-03-23 Page 3 of 4

Schedule

EQUIPMENT:

Equipment and systems covered by this certificate are as follows:

Description

The Gas Analyzer type ENCAL 3000 is used to measure the concentrations of the different components of a gas.

Ambient temperature range 0 °C to +60 °C.
Optional temperature extension with internal heating -20°C to +60 °C.
Optional temperature extension with internal heating and external insulation -40°C to +60 °C

Electrical data

Power supply : 24 Vdc, 50 W, nominal non-heated and 120 W nominal heated version

SPECIFIC CONDITIONS OF USE: YES as shown below:

The flameproof enclosure shall not be opened when an explosive gas atmosphere may be present.

The process pressure shall be limited to 2 MPa to ensure that the overpressure inside the flameproof enclosure remains below 10 kPa.

For information on the dimensions of the flameproof joints the manufacturer shall be contacted.

IECEx Certificate of Conformity

Certificate No: IECEx KEM 10.0094X Issue No: 4

Date of Issue: **2018-03-23** Page 4 of 4

DETAILS OF CERTIFICATE CHANGES (for issues 1 and above):

Update of the ambient temperature range.

12.6 FM Certificate of Conformity

CERTIFICATE OF CONFORMITY

FM Approvals
Member of the FM Global Group

1. **HAZARDOUS (CLASSIFIED) LOCATION ELECTRICAL EQUIPMENT**
2. **Certificate No:** **FM16US0020X**
3. **Equipment:** **EnCal 3000**
   (Type Reference and Name) **Gas Chromatograph**
4. **Name of Listing Company:** **Elster GmbH**
5. **Address of Listing Company:** **Steinern Straße 19-21**
   Mainz-Kastel, 55252
   Germany
6. The examination and test results are recorded in confidential report number:

   3058077 dated 6th September 2016

7. FM Approvals LLC, certifies that the equipment described has been found to comply with the following Approval standards and other documents:

   FM Class 3600: 2011, FM Class 3615: 2006, FM Class 3810: 2005,
   ANSI/ISA 60079-0: 2013, ANSI/UL 60079-1: 2015

8. If the sign 'X' is placed after the certificate number, it indicates that the equipment is subject to specific conditions of use specified in the schedule to this certificate.
9. This certificate relates only to the design, examination and tests of the specified equipment. Further requirements of FM Approvals apply to the manufacturing process and supply of this equipment. These are not covered by this certificate. FM Approvals apply to the manufacturing process and supply of this equipment. These are not covered by this certificate.
10. Equipment Ratings:

    Explosionproof for Class I, Division 1, Group B; Explosionproof for Class I, Division 1, Groups C and D; Flameproof for Class I, Zone 1 AEx db IIC Gb; hazardous (classified) locations with a T6 temperature class;

Certificate issued by:

J.E. Marquedant
Manager, Electrical Systems

6th September 2016
Date

To verify the availability of the Approved product, please refer to www.approvalguide.com

HIS CERTIFICATE MAY ONLY BE REPRODUCED IN ITS ENTIRETY AND WITHOUT CHANGE

FM Approvals LLC. 1151 Boston-Providence Turnpike, Norwood, MA 02062 USA
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F HLC DRAFT

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SCHEDULE

Hazardous (Classifed) Location Electrical Equipment to FM16US0020X

11. The marking of the equipment shall include:

Class I Division 1, Group B; T6 Ta = -40°C to +55°C;

Class I Division 1, Groups C, D; T6 Ta = -40°C to +55°C;

Class I, Zone 1, AEx db IIC T6 Gb Ta = -40°C to +55°C,

12. **Description of Equipment:**

General – The EnCal 3000 is an on-line gas chromatograph that is housed in an exploionproof housing with one or two analytical channels that are controlled by one processor board.

Construction – The Gas Chromatograph type EnCal 3000 consists of a flameproof enclosure with a low base, to which a relatively high cap is attached through a screw connection. Once the cap is removed from the base, almost all the internal components are directly reachable. Up to two analytical modules (which do each a part of the total analysis, in parallel), processor board, Internal sample system (stream selection and pressure regulation) all electrical field connections (Ethernet, ModBus, analogue IN, digital I/O, solenoid drivers), fuses, switches and jumpers.

The internal free volume of the enclosure is max. 18600 cm3. The compactness of the unit (installation clearance Ø 55 cm x 70 cm height, weight <30 kg) allows it to mount the device on a platform, a pole or to the wall. Mounting holes at the back (M8) and in the bottom (M5) allow for fixation. All gas tubing (sample lines, cal gas, vent line, helium in and out) and all electrical connections can be directly connected to the unit. Enclosure is made of aluminum. It is provided with 4 (2X M25X1.5 & 2X M25X1.5) entry openings, a threaded cover, a sintered breathing device and process connections.

The difference in the units rated for Group B and those rated for Groups C and D is the length and diameter of the flame arresting feedthrough (capillary). For use in Group B environment, the stainless steel tube in the flame arresting feedthrough is at least 250 mm and has a maximum internal diameter of 0.01" (0.25 mm), while it is at least 500 mm long and has a maximum internal diameter of 0.015" (0.38 mm) for use in Groups C and D.

Ratings – The EnCal 3000 operates at 24 Vdc (50 W) non-heated and 120 W nomidal heated version. The transmitters are rated for use in an ambient temperature range of -40°C to +55°C.

EnCal 3000 Gas Chromatograph

Option	*Meaning*	*Explanation*
HT	Heated	Heaters for frost protection installed to keep the housing above 0°C
SC	Single Channel	The analyzer has only one analytical channel
QS	Quad Slave	By linking two analyzers electrically, one processor board can control the modules in the other housing. The slave unit doesn't have a processor board. Both units have an additional PCB with a connector for the cable.
H2	Hydrogen	The analyzer can have hydrogen as carrier gas, and instead of venting the non-flammable gas into the housing, the vent is lead outside (optionally via a dampening volume).

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SCHEDULE

Hazardous (Classifed) Location Electrical Equipment to FM16US0020X

13. **Specific Conditions of Use:**

1. The flamepaths of the equipment are not intended to be repaired. Consult the manufacturer if repair of the flamepath joints is necessary.
2. The process pressure shall be limited to 2 MPa to ensure that the pressure rise inside the flameproof enclosure remains below 10 kPa.

14. **Test and Assessment Procedure and Conditions:**

This Certificate has been issued in accordance with FM Approvals US Certification Requirements.

15. **Schedule Drawings**

A copy of the technical documentation has been kept by FM Approvals.

16. **Certificate History**

Details of the supplements to this certificate are described below:

Date	Description
6th September 2016	Original Issue.

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13 Keywords and figures

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Honeywell

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EnCal 3000 pro Chain GC
October 2018

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