Process Gas Chromatograph
PGC 9000 VC

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Reliability in gas supply -
single-sourced across the board

Fields of application

The PGC 9000 VC process gas chromatograph analyzes the composition of natural gas and determines the 11 major gas components as contents in mol%. From these contents, the following variables are calculated on the basis of the characteristics of the gas components (as per ISO 6976): superior calorific value (Hs,n), inferior calorific value (Hi,n), standard density (ρ_n), relative density (rd) and Wobbe index (Ws,n and Wi,n). These variables can be outputted through analog or digital interfaces, just as the contents of the individual gas components.

Approval

The PGC 9000 VC process gas chromatograph has been approved for custody transfer measurement of the superior calorific value, standard density and carbon dioxide content.

The PGC 9000 VC, therefore, provides the analytical data required for PTZ correction, including the calculation of the K coefficient as per GERG 88-S, while satisfying the requirements of custody transfer measurement.

Operating ranges

Custody transfer measurement can be performed in the following operating ranges:

Component	Content (mol%)
Nitrogen	0 - 20
Methane	70 - 100
Carbon dioxide	0 - 20
Ethane	0 - 20
Propane	0 - 5
i-Butane	0 - 2
n-Butane	0 - 2
neo-Pentane	0 - 0.3
i-Pentane	0 - 0.3
n-Pentane	0 - 0.3
C6+	0 - 0.3

Standard density: 0.7 - 1 kg/m^3
Superior calorific value: 7 - 14 kWh/m^3

Measuring uncertainty

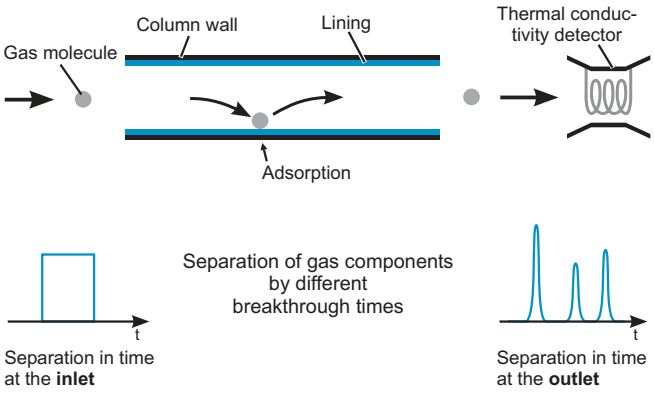
As to the variables measured in compliance with custody transfer measurement requirements, the limits for the measuring uncertainty are:

Superior calorific value: < ±0.25%
Standard density: < ±0.25%
Carbon dioxide content: < ±0.3 mol%

Method of operation

At the heart of the gas chromatograph lies a capillary tube, what is called the column. This capillary tube, which is lined with a specific silicone material, serves to separate the individual components of a gas mixture.

The column is continuously swept with helium, which is used as the carrier gas for the transport through the column. For analytical purposes, a precisely metered quantity of natural gas is injected into the helium flow at the inlet of the column. On their way through the column, the molecules of the natural gas components hit the column lining and are retained there for a short time (adsorption). Since the molecules of the various gas components are retained on the wall for different periods of time, the individual components leave the column at different times. Therefore, the gas components can be identified by these times.



After leaving the column, the gas flows through a thermal conductivity detector which measures the volume contents of the individual gas components. Each time a gas component leaves the column, the thermal conductivity of the gas changes, which is measured by the detector. From this change, the volume content of the gas component concerned can be calculated.

In order to ensure constant accuracy, the gas chromatograph is automatically calibrated at 7-day intervals. For this purpose, a gas mixture of which the composition is known is analyzed.

Construction

The PGC 9000 VC process gas chromatograph consists of the following components:

– The **sampling probe** is used to take samples of the measuring gas to be analyzed from the gas pipe.

– The **pressure reducer** reduces and stabilizes the pressure of the measuring gas.

– The **gas supply unit** contains the cylinders for the carrier gas (helium) and the calibration gases.

– The **CP 2002 measuring element** with the gas distribution system (valve block for switching between measuring and calibration gases) is the actual analyzing unit. It contains two measuring columns.

– The **GC 9000 analytical computer** controls the analytical process and calculates the superior calorific value and the standard density.

– The **DS 900 data logger** stores all data which are outputted through the printer interface of the analytical computer.

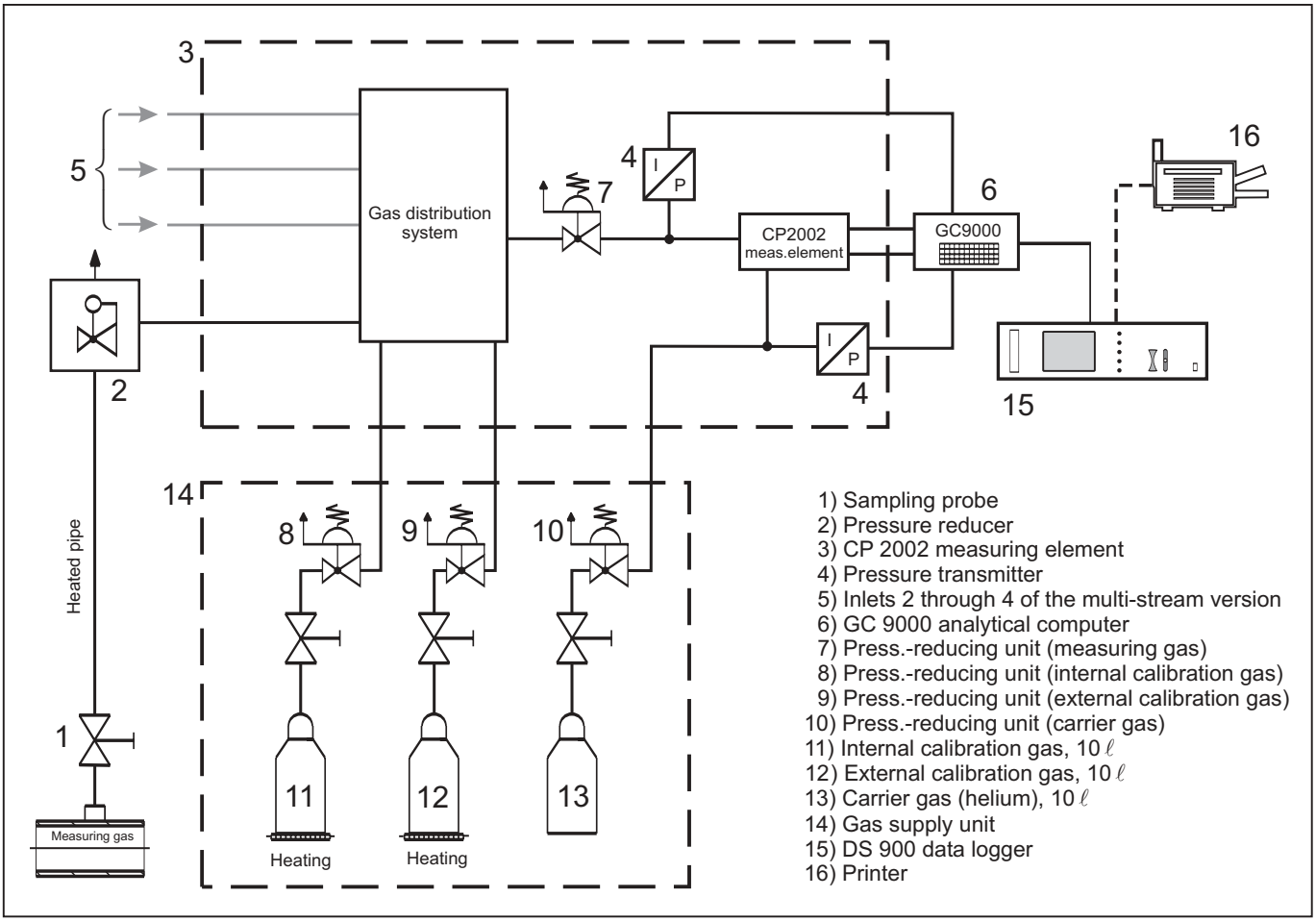
– A **printer** is only prescribed in such cases where no data logger is connected.

The pipe from the sampling probe to the pressure reducer can be heated. This is required if the gas used is humid and condensate formation is likely to occur.

All system components are linked with high-quality steel pipes which are coupled through Swagelok connections.

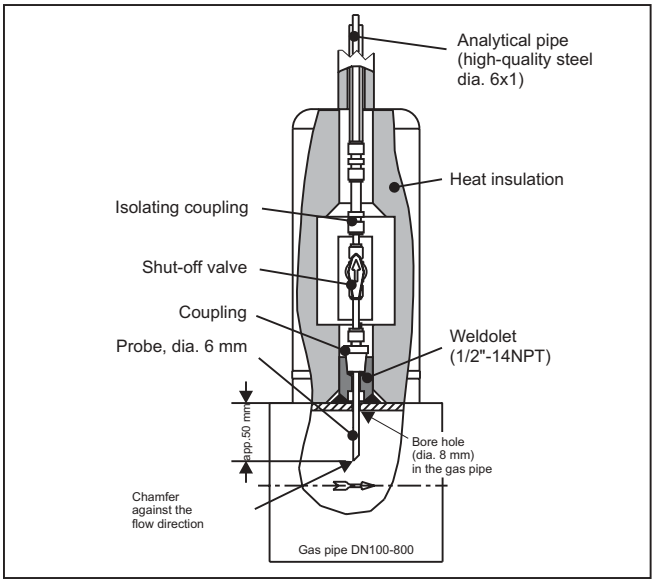
Features

- **Short analysis time of 3 minutes**
- **High long-time stability**
  Column ageing is delayed thanks to a low column temperature.
- **Low gas consumption** due to miniaturization (inside column dia. ≤0.3 mm)
- **Fully automated recalibration**
- **Multi-stream design** for a maximum of four measuring gas inlets possible
- **Saturation of the columns with water does not result in the columns being destructed** (recovery by heating up inside the device without removing the columns)
- **No replacement of columns** required for annual recalibration
- **Low on maintenance:** The operator's maintenance work is limited to recording operating parameters.
- **Suitable for mounting in weather-proof protective cabinet** for outside installation (option)



Configuration of the overall system

Sampling probe



Sampling probe of the type PES 50

The sampling probe is chamfered at its opening. This results in less condensate reaching the analytical pipe. An isolating coupling electrically isolates the gas pipe and the analytical pipe. If the alternatively available type PPS 02-R is used, the probe can be extended or retracted under pressure by means of a special tool.

Pressure reducer

The DRS 200 pressure reducer reduces the inlet pressure from a maximum of 100 bar to an outlet pressure in the range of 2 to 7 bar. It is fitted into a heated and insulated protective polyester cabinet with an inspection window.

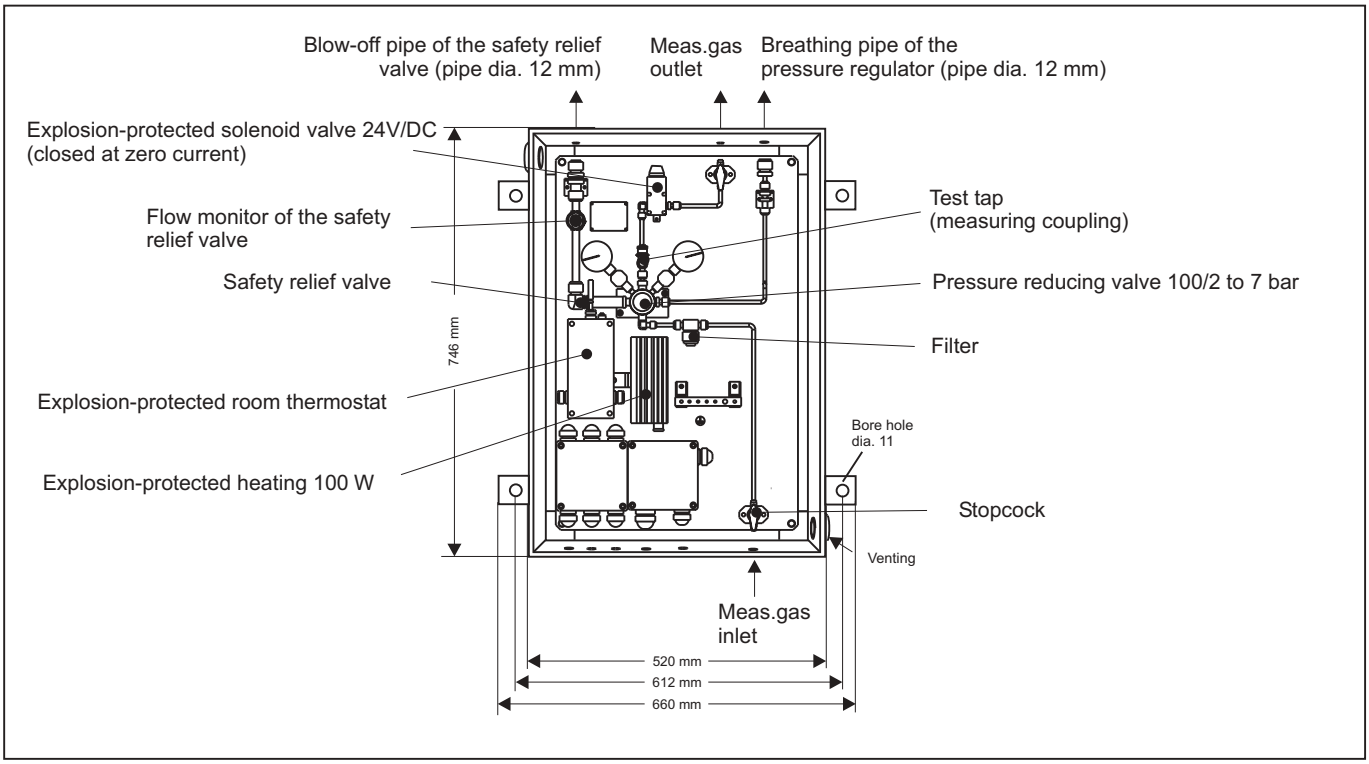
The pressure reducer includes the following components:

- Inlet filter
- Test tap with measuring coupling and shut-off valve
- Pressure regulator
- Upstream / downstream pressure gauge at the pressure regulator
- Safety relief valve
- Explosion-protected solenoid valve for safety shutdown (option)

The pipe from the sampling probe to the pressure reducer can be heated. In this case, the heater is connected to the pressure reducer.

The blow-off pipe of the safety relief valve and the breathing pipe of the pressure reducer are designed as pipes with a diameter of 12 mm.

The DRS 200 pressure reducer is available either fitted into a bold-on case for wall mounting or mounted on a stand. If the stand-mounted version is provided with a weather shield, it can also be installed outside.



DRS 200 pressure reducer (wall-mounting case)

CP 2002 measuring element

The CP 2002 is available either as a "Non-Ex" or "Ex" version with an explosion-proof enclosure. The case incorporates the measuring mechanism with two columns, the electronic control system and the pressure transmitters for the measuring and carrier gases.

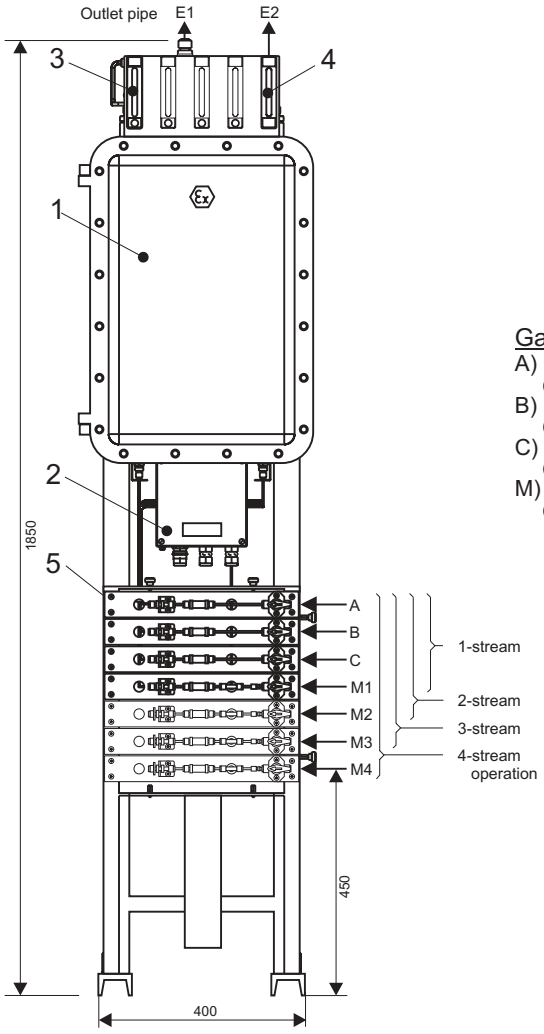
Furthermore, the gas distribution system is located inside the case, i.e. a valve block used for switching between the individual measuring and calibration gas inlets. By arranging the valves in a specific way ("double block and bleed"), it is ensured that the gas to be analyzed is not contaminated with gas from other inlets.

A total of up to four measuring gas flows can be analyzed. The sequence of connecting the different measuring gases and the number of analyses to be performed can be programmed through the analytical computer.

By using a bypass, part of the measuring gas can be discharged without passing the measuring mechanism. This increases the flow in the supply pipe, and all the time current measuring gas is analyzed. The flow in the bypass can be adjusted via a needle valve.

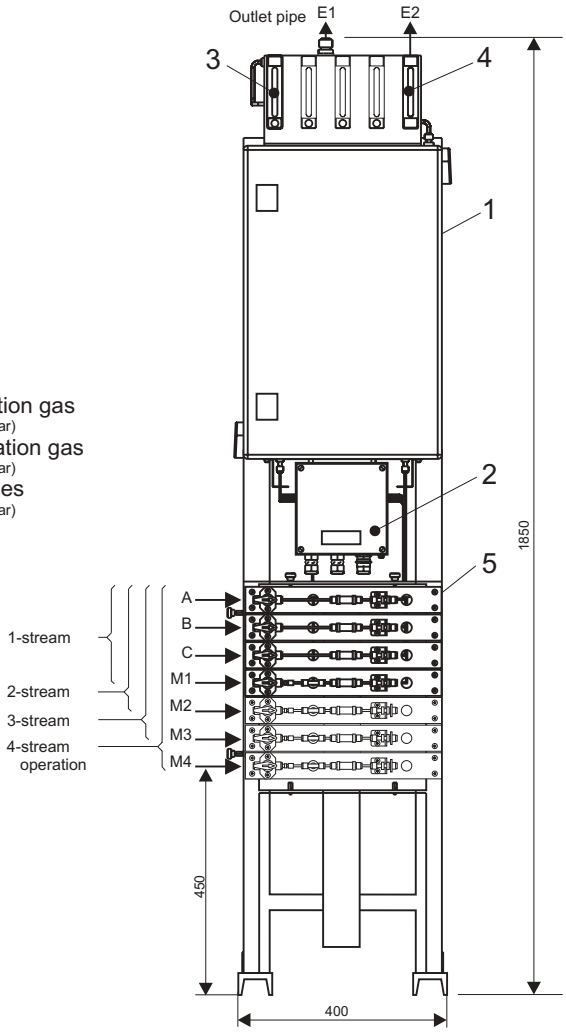
The location for installation of the CP 2002 measuring element requires no air conditioning. The ambient temperature may vary in a range from -10 to 55°C without restriction. All that is needed to monitor the temperature is a min./max. thermometer; a temperature recorder is not required.

Explosion-protected ("Ex") design



Gas inlets:
A) Carrier gas
(inlet pressure 5.5 bar)
B) Internal calibration gas
(inlet pressure 2 to 3 bar)
C) External calibration gas
(inlet pressure 2 to 3 bar)
M) Measuring gases
(inlet pressure 2 to 3 bar)

Not explosion-protected ("Non-Ex") design



1) CP 2002 measuring element with valve control system and explosion-proof enclosure
2) EEx e connection box
3) Variable-area flowmeter for the bypasses of the measuring gases
4) Variable-area flowmeter for the outlet pipe of the measuring mechanism
5) Gas inlet module with filter
(The gas inlet can optionally be located on the left or right side)

Supply pipes for connections A, B, C:
1/8“ pipe with Swagelok connection
Supply pipes for connections E2, M1 through 4:
6 mm pipe with Swagelok connection
Supply pipe for connection E1:
12 mm pipe with Swagelok connection

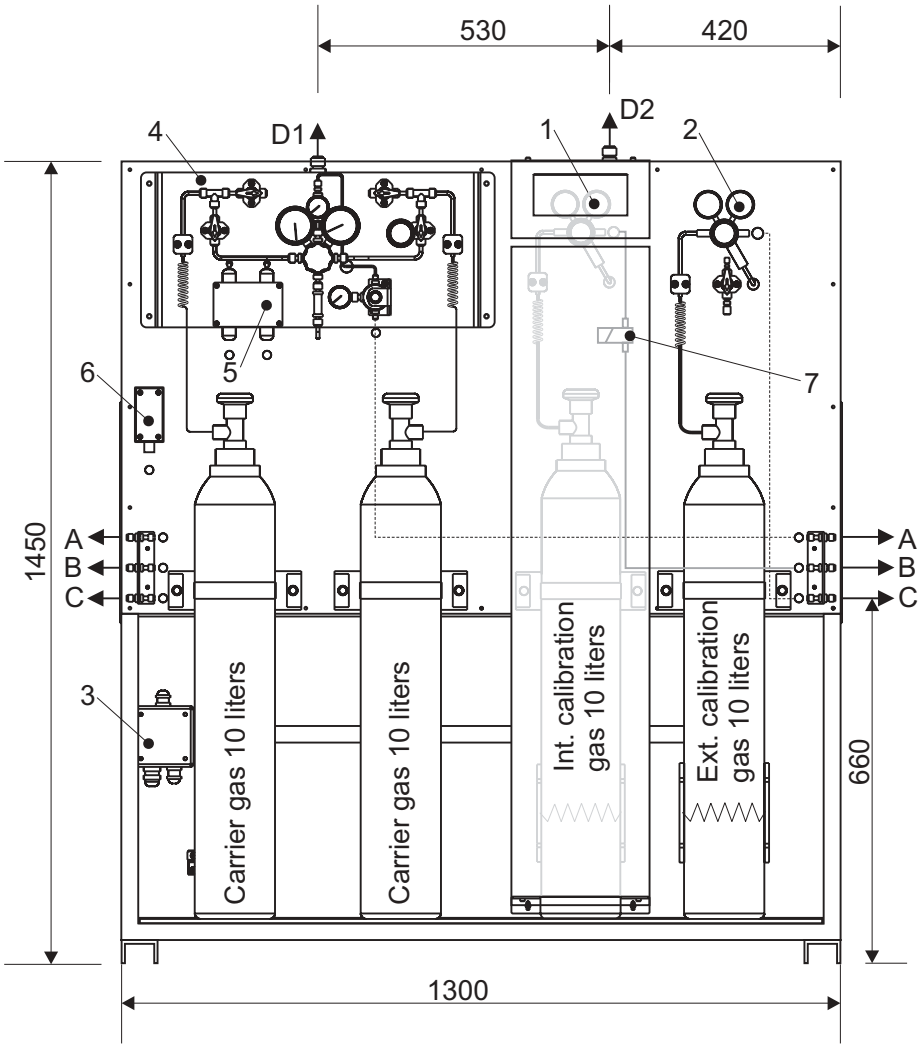
Gas supply unit

The gas supply unit accommodates the gas cylinders (10 ℓ) for the carrier gas (helium) and the calibration gases (special designs with 50 ℓ carrier gas cylinders are possible). The "internal" calibration gas is used for the weekly automatic calibration. It contains a gas mixture of a known composition of all the 11 gas components analyzed by the PGC 9000 VC. The "external" calibration gas is used for the annual inspection during recalibration and its composition corresponds to that of the measuring gas which is mainly analyzed.

A cylinder heating prevents calibration gases separating and heavy gas components condensing on the cylinder walls.

One location space of the gas supply unit is intended to take up a spare carrier gas cylinder. A manual or automatic switching unit can be installed for the two carrier gas cylinders.

A 10 ℓ carrier gas cylinder lasts for approximately six months, while a calibration gas cylinder lasts for five years in normal operation.



1) Upstream pressure reducer with safety relief valve for internal calibration gas
2) Upstream pressure reducer with safety relief valve for external calibration gas
3) EEx e connection box for explosion-protected cylinder heating

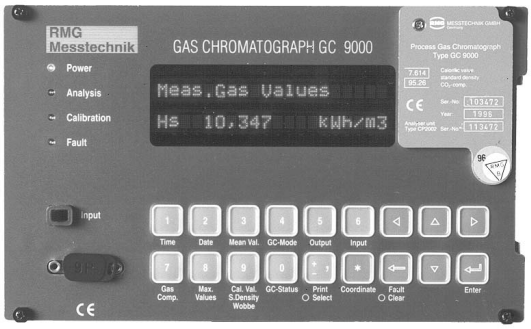
Options:
4) Automatic or manual switching unit for two carrier gas cylinders
5) EEx i connection box for contact manometer (switching unit)
6) Temperature controller
7) Explosion-protected solenoid valve for internal calibration gas cut-off

Connections:
A) Carrier gas outlet
B) Internal calibration gas outlet
C) External calibration gas outlet
D) Blow-off pipe (carrier gas)
E) Blow-off pipe (internal calibration gas)

The outlets A, B, C can optionally be located on the left or right side.

GC 9000 analytical computer

The GC 9000 analytical computer controls the analytical process and calculates the contents of the gas components in per cent from the measured data. From these contents, it calculates the superior calorific value and the standard density as per ISO 6976, as well as the Wobbe index, relative density and inferior calorific value for secondary applications. Operation of the process gas chromatograph is also performed through the analytical computer. Here, operating modes can be selected or printouts started.



The analytical computer is a variant of the RMG ERZ 9000 Flow Computer. It offers the following features:

- Ease of operation: All configuration data and measured and calculated data are stored in an easy-to-survey table. All the cells of this table can be reached and displayed by pressing arrow keys. Moreover, major variables, such as the superior calorific value, can be directly accessed by pressing a single key.
- Bus interface (RS 485) to connect to a DSfG bus, MODBUS or RMG bus, with the RMG bus being exclusively used to transfer data from the analytical computer to the volume corrector.
- Front interface for reading out data, parameterization or servicing.
- Calculation of hourly, daily and monthly mean values for superior calorific value, inferior calorific value, standard density, relative density, CO_2 content and Wobbe index.
- Rack-mounting case for installation into 19" racks.
- Installation at a distance of up to 1,000 m from the CP 2002 measuring element is possible.

DS 900 data logger

The approval of the PGC 9000 VC process gas chromatograph requires that a printer is connected to the analytical computer for outputting analytical results, calibration reports, etc. As an alternative, the DS 900 data logger, which represents a complete printer substitute, has been approved. With the data logger, large quantities of paper are no longer required, and there will be no more disturbances caused by paper jams inside the printer.

The DS 900 data logger is to be connected to the printer interface of the GC 9000 analytical computer instead of a printer.

The DS 900 data logger is an industrial PC with the following features:

- Suitable for use with a 1-stream or multi-stream gas chromatograph with up to a maximum of four analyzed gas streams.
- Data are stored on two hard disks with a capacity of 1.6 gigabytes each, which is sufficient for at least three years. The redundant storage of data on the two hard disks ensures a high degree of data protection.
- Data are stored chronologically and can be browsed through using a joystick.
- Text is stored in the ASCII format, while graphics (chromatograms) are stored in the PCX format. This enables data to be processed using standard programs.
- 3.5" floppy disk drive for archiving data and installing new software versions.
- Option for connecting a printer.
- Standard 19" slide-in case.

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Specifications

CP 2002 Measuring Element

Ambient temperature	-10°C to +55°C, no air conditioning required
Degree of protection - Explosion-protected design ("Ex") - Not explosion-protected design ("Non-Ex")	 IP 54 IP 43
"Ex" device protection type	II2 G EEx de IIB T5
Carrier gas	Helium 5.0
Weight - "Ex" design - "Non-Ex" design	 75 kgs 60 kgs
Power supply	24 V DC / 230 V AC
Power requirement	80 W
Process connections - Carrier, measuring and calibration gases - Exhaust gas	 1/8” Swagelok 6 mm Swagelok
Gas consumption - Carrier gas - Measuring gas	 approx. 8 mℓ/min continuously approx. 35 mℓ during purging

Gas Supply Unit

Dimensions	W x H x D = 1300 x 1450 x 500 mm
Power supply	230 V AC
Power requirement	100 W per heated cylinder

GC 9000 Analytical Computer

Dimensions	W x H x D = 213 x 128.4 x 300 mm (42 DU / 3 HU)
Power supply	24 V DC / 230 V AC
Power requirement	30 W
Outputs	Relay contact for alarm indication (potential-free, max. 24 V, 100 mA) 4 electrically isolated analog outputs (potential-free, 0/4-20 mA, assignment freely selectable)
Interfaces	Front panel: 1 x RS 232 C Rear panel: 4 x RS 232 C 1 x DSfG or RMG bus

DS 900 Data Logger

Dimensions	W x H x D = 426 x 128.4 x 280 mm (84 DU / 3 HU)
Power supply	24 V DC / 230 V AC
Power requirement	55 W

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