BARTEC BENKE

Pour Point Process Analyzer PPA-4 Operation Manual

Version 1.1
January 2012

Doc. No.: P30011 MDH EN A

Read this manual carefully before installing and running your instrument.

No technical modifications may be made to the Pour Point Process Analyzer without the prior written agreement of BARTEC BENKE. Unauthorized modifications may affect the instrument safety or result in accidents.

Table of Contents

1 Introduction

Please read this manual carefully and familiarize yourself with the functions of the Pour Point Process Analyzer before installation.

Make sure that everyone who will work with the instrument has read and understood the contents of this manual. It is assumed that users possess basic technical skills.

Warning:
Read the section "Safety" carefully before operating the instrument for the first time.

Always keep this manual and the accompanying electrical documentation near the instrument, so as to able to quickly solve possible problems.

This manual contains the information necessary to install and use your Pour Point Process Analyzer. However, it is not a substitute for proper training carried out by BARTEC BENKE service and training personnel before the first start-up.

Correct operation and regular maintenance will ensure a long operating life for the analyzer.

The instrument represents the latest technology and recognized safety regulations available at the time of delivery. When used correctly it is safe to operate, and it left our factory in a safe condition.

BARTEC BENKE offers a high level of after-sales support to ensure your satisfaction with our products and serviced. If you have any problems, please contact BARTEC BENKE.

Telephone: +49 (0)40 – 72 70 30

Fax: +49 (0)40 – 72 70 32 62

E-mail: service@bartec-benke.de

1.1 Conventions used in this manual

The following conventions and symbols are used:

Bold type	Field names, dialog boxes or windows, e.g. **Init**.
Bold + italic type	Buttons and menu options you can select, e.g. ***Break***. The expression ***IO – Configure*** advises you to select ***IO*** from the main menu and afterwards ***Configure*** from the options appearing.
ALT, etc.	Keys to press on the keyboard
`Typewriter text`	Text to be entered via the keyboard, e.g. `BARTEC BENKE`

The following safety warnings are used:

Danger:
Used when failure to observe a safety precaution may result in serious injury or death.

Warning:
Used when there is danger of minor injury or serious damage to the system if you do not follow the precautions.

Caution:
Used when there is a danger of minor damage to the system if you do not follow the precautions.

Used for safety warnings specially related to explosion risk.

NOTE: Used to indicate supplementary information or to call attention to recommendations which simplify daily operation.

2 Safety precautions

2.1 General

The Pour Point Process Analyzer represents the latest technology available at the time of delivery, and is designed in conformity with the standards and safety regulations of the European Community for Explosion Protection.

Wherever possible danger exists for the operator, safety notices are included in the text. Pay attention to these notices and take special care to follow the instructions. In addition to the safety instructions in this manual, it is necessary to observe and follow the current legal regulations for general safety and accident protection.

Please note also the relevant regulations for environmental protection and noise avoidance.

The instrument should only be started up, operated, maintained or serviced by persons instructed by a trained user or BARTEC BENKE staff. Danger can result if the instrument is used or maintained incorrectly by untrained staff. Incorrect operation can result in the risk of accidents.

Make sure that every person who works with the instrument has been informed of the possible dangers which may occur during operation.

The analyzer is fitted with safety and protection devices in accordance with the current state of technology and legal requirements. The operator must ensure that the instrument is only used under safe and functional conditions, in accordance with the instructions in this manual.

If there is any change in the original state of the safety devices (e.g. the protective cover or the explosion-proof area), the instrument must immediately be shut down correctly and secured against re-use in an unsafe condition

Analyzers which are not functioning correctly or whose safety devices are ineffective may not be used. Safety and protection devices must not be removed, bypassed or disabled.

Unauthorized modifications or changes in the instrument by the operator are not allowed.

2.2 Instrument-specific safety precautions

In addition to the safety instructions described here, it is necessary to follow the safety notes in the following sections.

Observe the safety and danger warnings on the analyzer and make sure they are legible. Damaged or missing warning labels must be replaced without delay.

Before using the instrument each time, all the available protection covers (e.g. the cover of the EEx-d and the door of the EEx-p housing) must be closed.

Before opening the cover of EEx-d housings or other explosion-protected items, note the explosion safety requirements of VDE DIN 57 165 and the related test certificates for the installed explosion components (see attachment) or obtain a similar certification from the local safety officer.

If the cover of the EEx-d housing, which is secured by screws, is opened during operation, there is the RISK OF EXPLOSION.

In the interest of their personal safety, operating staff must check all the safety and protection devices every day for visible defects and damage.

3 Pour-Point Measurement

3.1 Application

The Pour-point Analyzer (PPA) determines the pour-point of mineral oil products according to the conditions described in the international norms DIN/ ISO 3016 and ASTM D-97.

3.2 Measuring principle

A sample which has been previously prepared (filtered and with water removed) is warmed up and then cooled according to the procedure described in the standard method in temperature steps of 3 ^{0}C. The lowest temperature at which the smallest movement of the sample can be detected is defined as the Pour-Point Temperature.

3.3 Functional description

As described above, the Pour-point Analyzer determines the lowest temperature at which a mineral oil sample shows fluid properties as described in standard method DIN/ISO 3016.

The computer-controlled analysis cycle is controlled via the solenoid valves (F) and pneumatic valves (P). A previously prepared sample liquid flows through the measuring system (A) for a measured time. After rinsing and sample filling (E), about 10 ml of the sample remains in the measuring cell (B).

If the cell outlet is not free due to a blockage or a fault in the valve system, the sample pressure may rise to a maximum of 2 Bar. The capillary (L) and the non-return valve (K) prevent sample from flowing back into the valves or the analyzer housing.

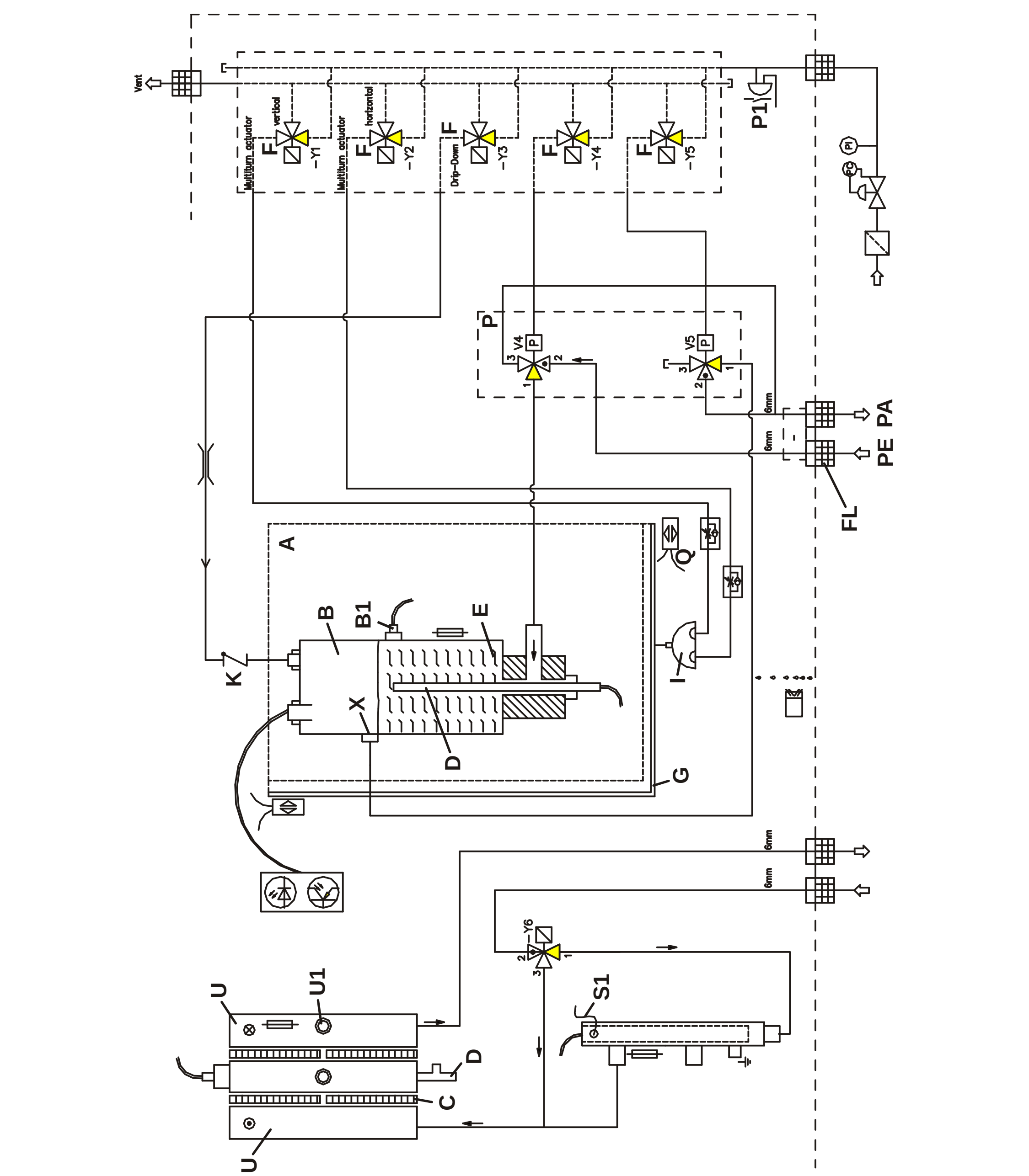
The sample in the measuring cell is then slowly warmed up if necessary to the start temperature of max. 36°C by the Peltier element (C).

The computer-controlled cooling process of the sample (E) now begins at a constant, slow rate defined by the standard method. The electrical Peltier elements in the cell (B) cool the sample at an average rate of ca. 150 sec./°C. When the sample reaches a temperature threshold of at least 9°C above the expected Pour-point, the tilting procedure for the measuring system (A) is started.

A pneumatic rotator (I) moves the measuring system (A) together with the module holder (G) out of the vertical position. The optical proximity sensors (Q) register the exact position of the holder. The tilt of the cell causes the surface of the sample (when it is still liquid) to move relative to the cell. An optical system detects this movement. **In the PPA High Viscosity Option** an NTC sensor is used, whose tip enters the sample fluid at even a small change in angle. The change in current and resistance signals to the program that the sample is still liquid.

The tilting procedure stops and the system is returned to the vertical position. The process is repeated throughout the cooling process with every 3°C drop in temperature.

If the angle has changed by 90° and remained for 5 seconds without any detectable movement of the sample surface, the sample temperature from the previous test is taken as the determined Pour-Point Temperature.



A	**Module holder**	**K**	**Non-return valve**
B	**Measuring cell body**	**P**	**Pneumatic valve block**
B1	**Measuring cell temperature**	**P1**	**Pressure switch**
C	**Peltier elements**	**PE**	**Sample inlet**
D	**Temperature sensor**	**PA**	**Sample outlet**
E	**Sample**	**S1**	**Temperature sensor for water heater**
F	**Miniature solenoid valves**	**Q**	**Proximity sensor**
FL	**Flame arrestor**	**U**	**Heat exchanger**
G	**Rotator**	**U1**	**Heat exchanger temperature**
I	**Drive**	**X**	**Sample outlet and movement area**

Fig. 3.1: Functional diagram PPA – Standard

3.4 Sample heating and cooling water circuit

The heating elements (position V in Fig. 3.1) have a maximum power of 38W. The complete Pour-point determination requires both warm and cold water for heat supply and removal to the Peltier elements (C). The warm water is provided by a 2-point controller with a 3/2-way solenoid valve Y.6 (R) and a heat exchanger (S) with an integrated heater (T).

The heat exchanger (U) for the Peltier elements normally requires cold water at 5 – 18 °C. This flows via valve Y.6 (R) from 2 to 3. Port 1 is closed so that the warm water generator is not flushed in the by-pass.

When warm water is required, valve Y.6 (R) connects ports 1 and 2 and the water passes through the heat exchanger (S). The control temperature at sensor (S1) is max ca. 40°C. The warm water supply is protected against over-heating by a mechanical fuse which triggers at 76°C and is thermally coupled to the heat exchanger pipe.

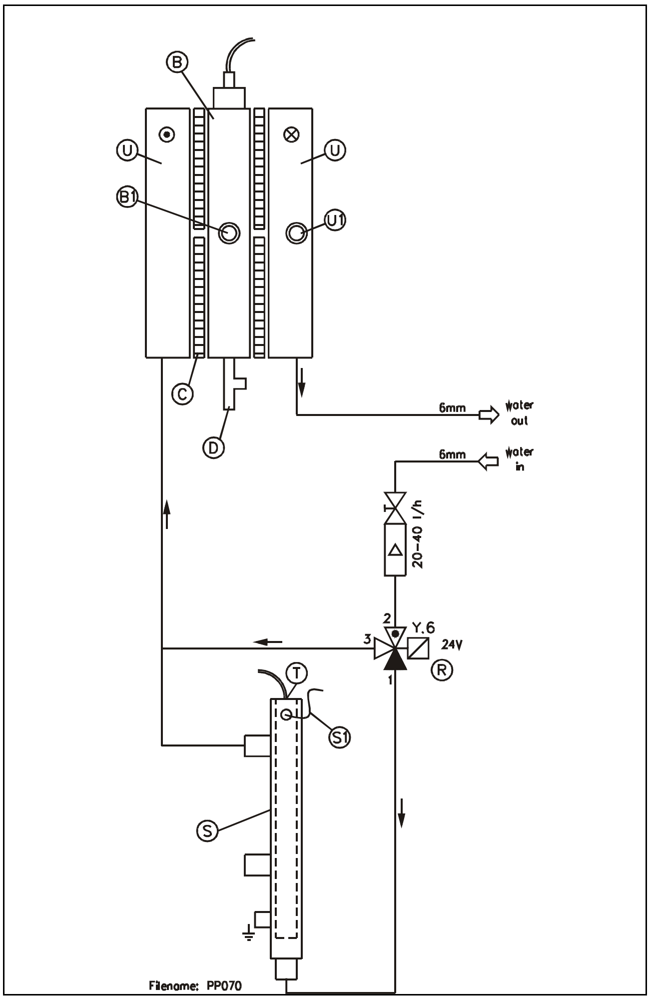


Fig. 3.2: Sample heating and cooling water circuit

Auxiliary heater (option)

Some components which contact the sample, e.g. transmission pipes (PE+PA) in -G1- need to be heated, even for routine measurements. The heater is protected by an emergency thermal fuse which activates at 76°C in series with the element.

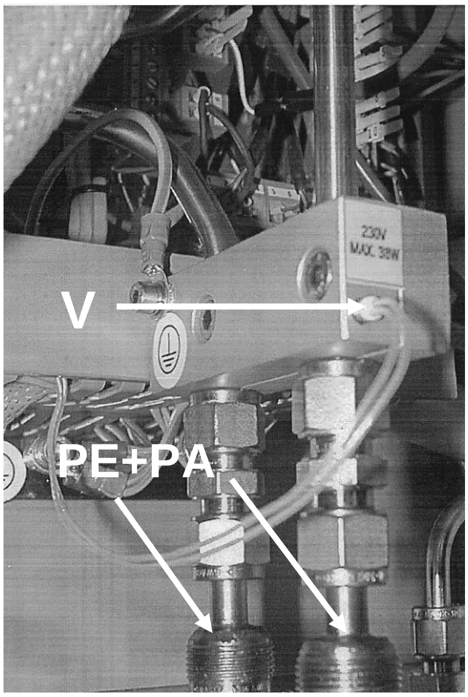
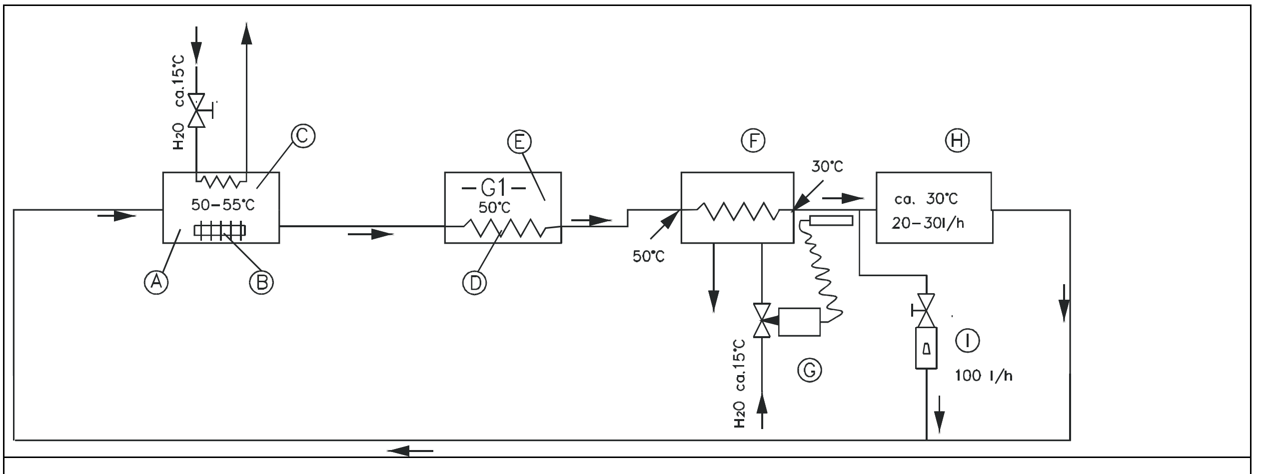


Fig. 3.3: Auxiliary heater for sample inlet and outlet

3.5 Option: PPA High-Viscosity

For use with high viscosity products (ca. 70 cst./ ~ 60°C), an explosion proof hot water system with a circulating pump is used to maintain the required operating temperatures. **This replaces the standard version**. This accessory is needed for the **PPA High-Viscosity** version for the Peltier heat exchanger (ca. 30°C) and the air inside the housing -G1- . The heat exchanger for the internal air in –G1- is the baseplate in the back wall, to which pipes are soldered through which the warm water passes via connectors (A) and (B).



A	**Container for hot water**	**F**	**Plate heat exchanger**
B	**Ex-Heater**	**G**	**Control valve**
C	**Cooling coil**	**H**	**Peltier element heat exchanger**
D	**Heating for housing –G1-**	**I**	**Bypass flow**
E	**Mounting plate**		

Fig. 3.4: Ex-Warm Water Auxiliary System

3.6 Option: Ex – Warm Water System

The Ex - Warm Water System consists of a stainless steel container fitted with an explosion-protected E-heater and a heat exchanger cooling coil which is connected to an external cold water supply. The container also holds an optical level sensor, a float switch which provides run-dry protection, a Pt 100 temperature sensor and a mechanical temperature limiter. The Ex-heater has an emergency over-temperature cut-off which removes the power when the surface of the heating coil exceeds a safe limit (e.g. when there is too little water in the container).

3.7 Technical Data: Ex - Warm Water System

Container volume	ca. 30 l
Heater	EEx d, max. 1200 W with adjustable temperature controller
Heat exchange medium	Clean water
Temperature sensor for regulator	Pt-100 stainless steel no. CFP-1-37 (circuit conforms to spark protection class EEx i and is intrinsically safe)
Mechanical temperature controller	max. cut-off temperature 60°C (circuit conforms to spark protection class EEx i and is intrinsically safe)
Water level monitor	Float switch (circuit conforms to spark protection class EEx i and is intrinsically safe)
Drive motor	EEx de 0.25K W; 1400 min $^{-1}$
Circulating pump	max. 360 l with filter and over-pressure protection
Pressure	max. 300 kPa
Connectors for cooling water	Inlet and outlet 12 mm or ½" compression ring
Connectors for hot water	Inlet and outlet 12 mm or ½" compression ring

3.8 Containment System Auxiliary Heating

This system is available as an option.

In the **PPA High-Viscosity** version the entire Containment System in housing -G1- is kept warm by an auxiliary heater (W). The auxiliary heating tape is fixed to all components which carry the sample. The power of the **Standard Heater** is insufficient for this purpose. The heating tape temperature is controlled by sensor (P1.1) on valve block (P). An emergency cut-off at temperatures above 76 °C is provided by fuse (F) in the 110V / 230V heater circuit.

After any service activity on or around the heating tape, **make sure there is always good thermal contact between the tape and the metal components.**

Warning:
The heating tape (W) is not self-regulating and has no overheat protection.

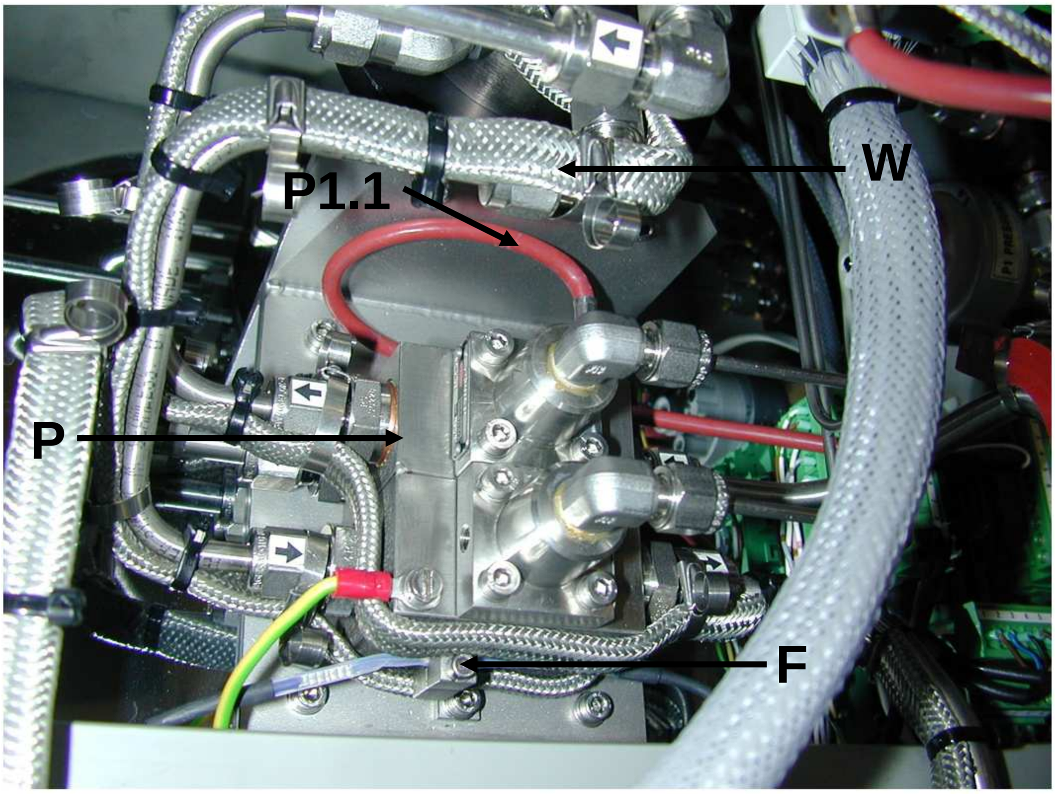


Fig. 3.5: Containment Auxiliary Heating

4 Explosion Protection

The liquid hydrocarbons tested by the Pour - Point Process Analyzer belong to Explosion Group IIA.

The PPA is designed to the latest specification and norms of the EU and incorporates a protection system for use in areas with explosion risk. It conforms to the following ignition-protection standards:

- II 2G EEx dpe IIB T4 or. II 2G EEx dpe [ia] IIB T4
- II.2G EEx dpe IIB+H_2 T4 or II 2G EEx dpe [ia] IIB+H_2 T4

Danger:
Do not make any changes to the PPA. Changes made by unauthorized persons can lead to personal and material damage and endanger the operational certification.

5 Construction

The PPA comprises the following main modules:

- EEx-d Analyzer housing -G1-
- EEx-p Electronic housing -G2-
- EEx-e Junction box -J1-

It can be extended with the additional optional modules:

- Ex-cooling system type FKS-L / KWS
- Ex-Warm water system
- Sampling system
- Validation system
- Recovery system

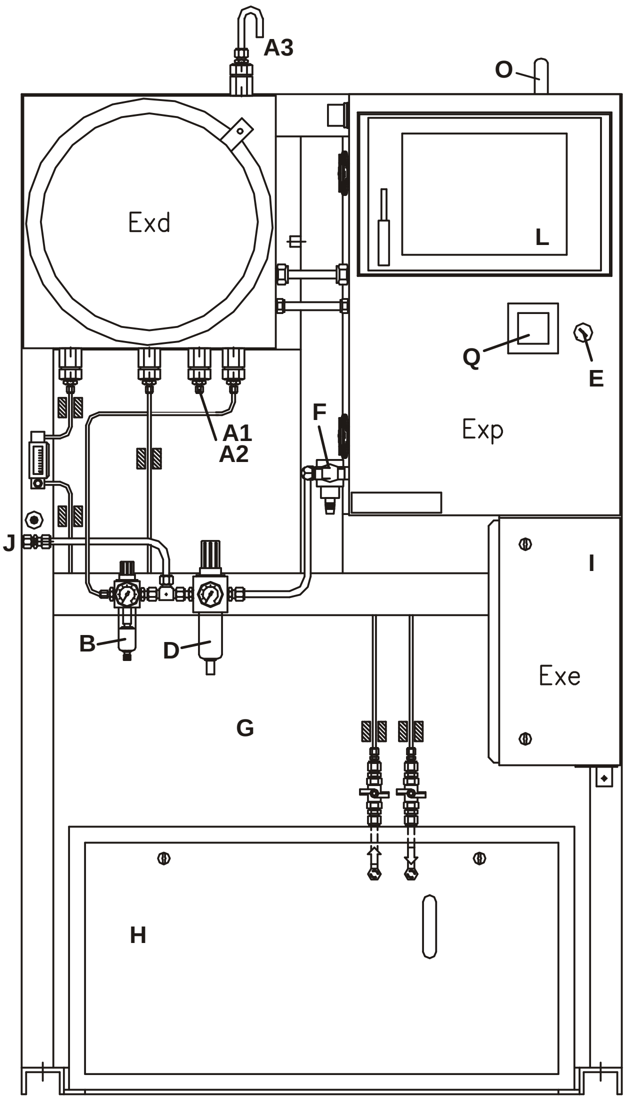
All the necessary components for automatic analysis are in the ex-housings -G1- and -G2-. Both housings and optional accessories are factory mounted on a galvanized steel U-form frame, and the system is delivered ready for use.

The pressure-resistant encapsulated EEx-d-Housing -G1- contains all the components needed for automatic Pour-point analysis.

The pressurized EEx-p-Housing -G2- contains the electronic components which control the analysis process. The external cable connections are made via junction box –J1- which also holds the terminals for the power supply and the input and output signals.

Underneath the analyzer housing sample-specific options can be fitted such as the sampling system with the Ex-cooling system or an Ex-Warm Water system as sub-components.

The entire Containment System, i.e. all components which come into contact with the sample, and the lines and seals, are of stainless steel or plastic resistant to mineral oil. The line fittings are metric dual-compression ring Swagelok types. Imperial fitting adapters are available on request.



A1	**Sample inlet 6mm or 1/4”**	**G**	**Space for sampling system option**
A2	**Sample outlet 12mm or 1/2”**	**H**	**Cooling / warm water system option**
A3	**Vent 8mm or 3/8”**	**I**	**Junction box**
B	**Pressure reducer for compressed air**	**J**	**Instrument air inlet 12mm 1/2”**
D	**Pressure reducer for purge air -G2-**	**L**	**Touchscreen**
E	**Key switch**	**O**	**Vortex cooler option**
F	**Digital rinse valve**	**Q**	**Sensor module**

Fig. 5.1: Construction of the PPA

For the High Viscosity option, all pipes (A1), (A2) leading from the Containment-System out of the analyzer housing -G1- must be heated.

Pressure reducer (B) sets the pressure for pneumatic valves V4 and V5 in -G1-.

Pressure reducer (D) regulates the over-pressure for the purge air in Ex p housing –G2-.

Option: For air-driven vortex cooler (O) a third pressure reducer is installed in the instrument air system.

Housing –G2- contains all the non-explosion proof components needed for general operation.

When the key switch (E) is operated, the Ex-protection for the Ex-p housing -G2- is removed but simultaneously electrical operation is maintained via the bypass module.

The over-pressure control can be run via the Sensor-Module (Q).

The digital valve (F) provides the Ex p housing -G2- with the prescribed volume of purge air.

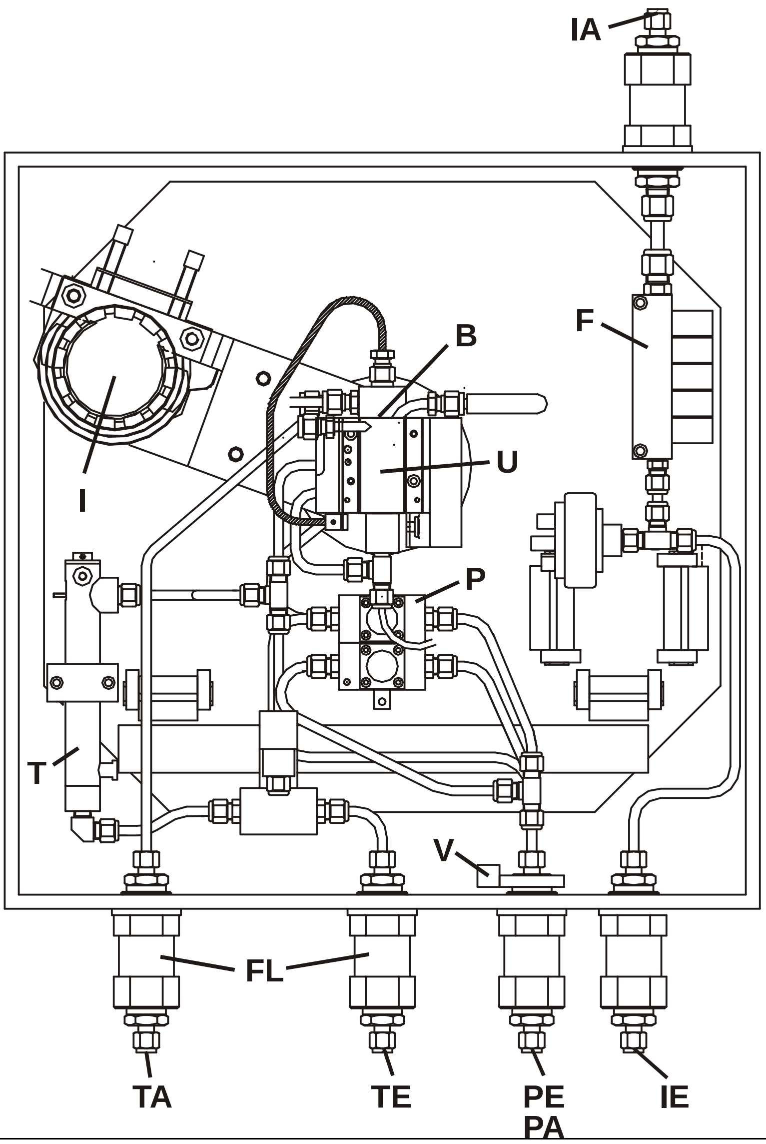
All the connections for power and signals are made in the junction box (I).

Option: In the Sampling system (G) the sample is filtered and the pressure and flow are indicated.

Optional Water Supply: An Ex-Cooling System or Ex - Warm Water System (H) stabilize the sample inlet temperature via a heat exchanger and remove the heat from the Peltier elements. Fig. 3.4 shows an Ex- Warm Water System with a counter-cooler using 12mm or ½ " connectors.

The touchscreen (L) shows the PACS menus, the temperatures, program status and error messages.

5.1 Construction of Analyzer Housing -G1-



B	**Measuring Cell body**	**P**	**Pneumatic 3/2-way valves**
F	**Miniature solenoid valves**	**PE**	**Sample inlet**
FL	**Flame arrestor**	**PA**	**Sample outlet**
I	**Rotary drive**	**T**	**Heater for heat exchanger**
IE	**Instrument air inlet**	**TA**	**Heating-cooling medium outlet**
IA	**Instrument ari outlet**	**TE**	**Heating-cooling medium inlet**
V	**Heater for trace heating**	**U**	**Peltier heat exchanger front**

Fig. 5.2: Interior view -G1-

5.2 Description of -G1- Component Assemblies

5.2.1 Measuring Cell Assembly

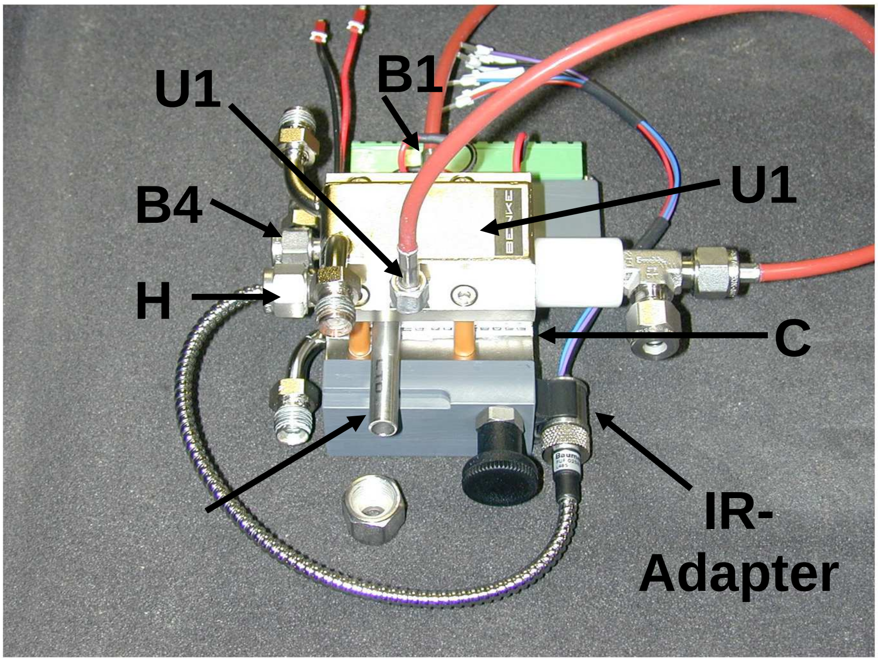


Fig. 5.3: Standard Measuring Cell with optical IR-Reflex system

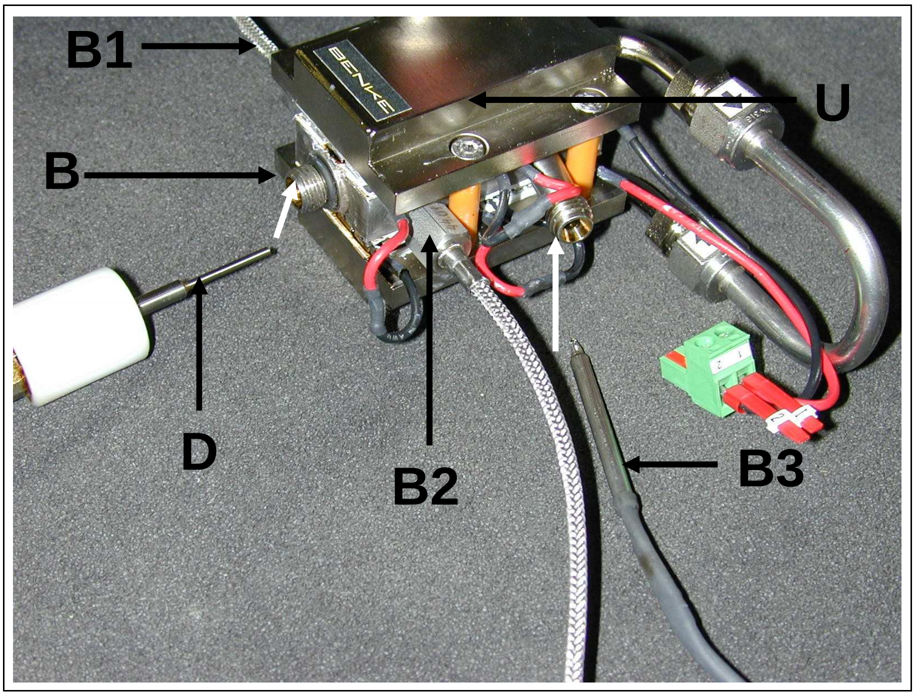


Fig. 5.4: High Viscosity measuring cell, with NTC sensor

The Measuring Cell (B) is fitted with four Peltier elements (C) used to cool the sample (E).

The Pt-100 sensor (D) measures the temperature of the sample (E)

The temperature sensor AD-590 (U1) measures the temperature of the heat exchanger (U).

The Pt-100 sensor (B2) monitors independently of (B1) an unacceptably high temperature in the Measuring Cell and cuts the power to the Peltier elements as a final safety measure.

The Pt-100 sensor (B1) measures the body temperature of the Measuring Cell to control the cooling rate.

The optical fiber (H) measures the sample surface in the Measuring Cell via an optical IR Reflex system.

Compressed air is pumped into the interior through inlet (B4) via non-return valve (K) and capillary (L).

The NTC-sensor (B3) detects the movement of the sample surface in the High-Viscosity option. (instead of the optical IR Reflex System)

The Measuring Cell is freely suspended in the holder (G) and is held laterally by a stop. All cable connections are made via a multiple connector. The auxiliary supply pipes are secured with screw connectors to the rear-mounted stator of the supply adapter.

5.2.2 Pneumatic Valve Block Assembly

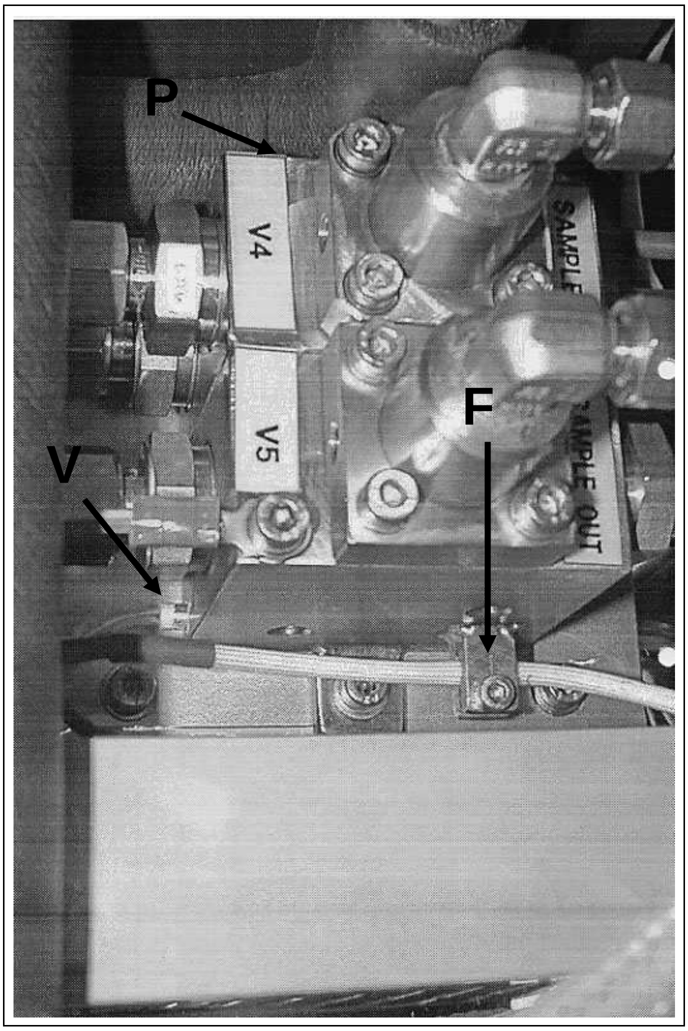


Fig. 5.5: Valve block for heat and over-temperature protection

The pneumatic valve block (P) comprises sample control valves V4 and V5.

The valve block is heated by one of the miniature heating elements (V) and controlled by temperature sensor (P1.1, not shown). The nominal supply voltage is 110V / 230VAC and the power max. 38W.

An over-temperature fuse (F) protects the valve block if the temperature exceeds 76°C. A temperature sensor on the fixing bracket measures the block temperatures and transmits it to the controller.

5.2.3 Solenoid Valve Assembly

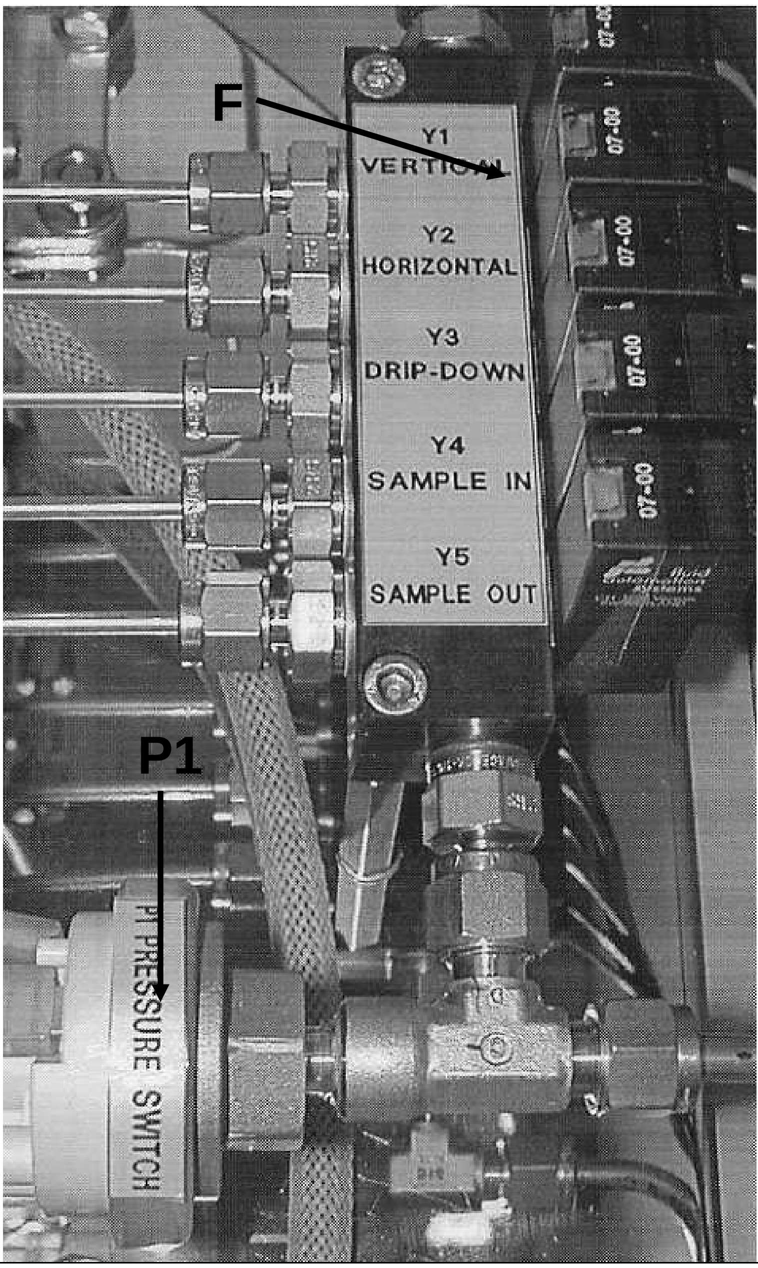


Fig. 5.6: Mini solenoid valve block assembly

The block of 5 mini solenoid valves (F) controls the pneumatic operation cycle. The 3/2-way, 24V valves are supplied by a central air inlet and vented by common exhaust vent. The minimum air inlet pressure is monitored by pressure switch (P1).

5.2.4 Warm Water Assembly for Peltier Cooler

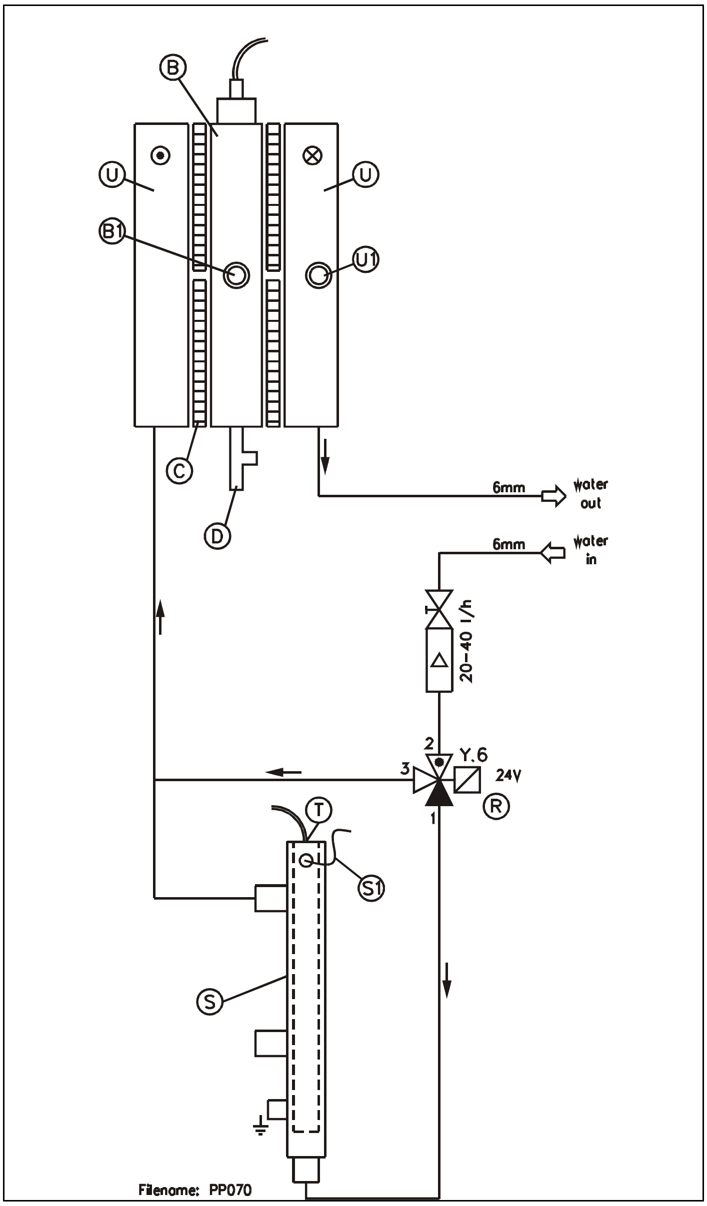


Fig. 5.7: Warm water supply for Peltier cooler

The heat exchanger (U) for the Peltier elements needs cold water at a temperature of ≤ 5°C. The flow path is then via valve Y.6 (R) from 2 to 3. The valve path 1 is closed, so that the warm water supply in the bypass line is not flushed.

If warm water is needed, valve Y.6 (R) switches from position 2 to 1 and the water circulates through the heat exchange pipe (S). The control temperature is ca. 40°C. The warm water supply (S) is switched off by a mechanical protection device (as for the pneumatic valve block) if the temperature exceeds 76°C. The protection device is mechanically coupled to the heat exchange pipe.

Auxiliary heating for protection against sample solidification (Option)

In the **PPA High-Viscosity** version the entire Containment-System in housing -G1- is heated by an electrical auxiliary heater (W). The heating tape is applied to all pipes and components carrying the sample so as to give the best possible heat transmission. The power of the standard heating element is too low to supply sufficient heat. The temperature of the heating tape is controlled by temperature sensor (P1.1) on the pneumatic valve block. A mechanical over-temperature protection in the 110V / 230V heater power supply shuts off the current if the temperature exceeds 76°C.

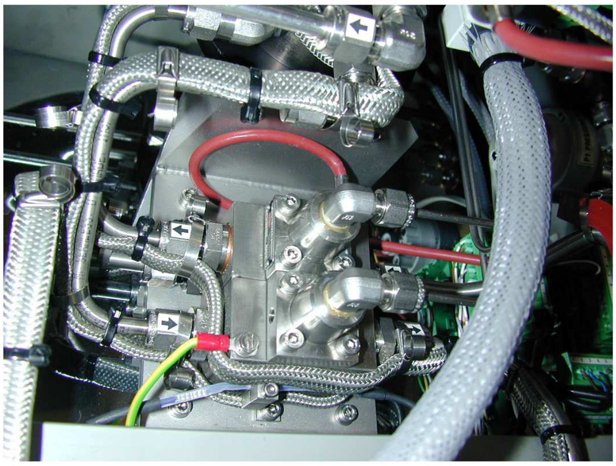


Fig. 5.1: Auxiliary heating

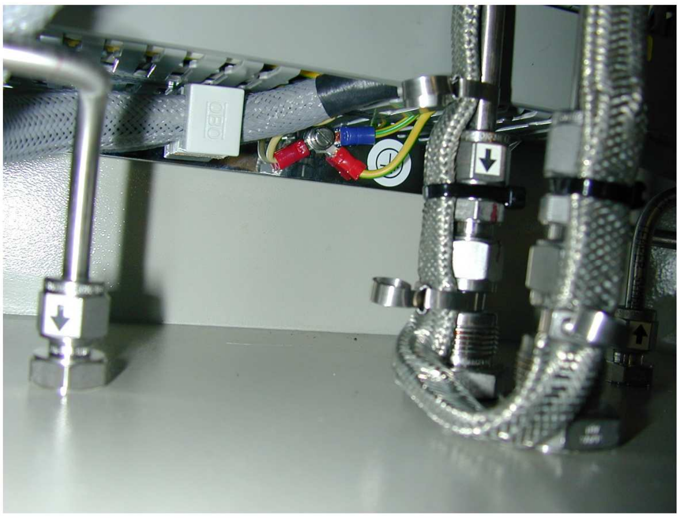


Fig. 5.8: Heating tape fixing to sample inlet and outlet

5.3 Construction of the Electronic Housing -G2-

The pressurized electronic housing (G2) provides a safe explosion-proof working environment when the PPA is installed in an explosive atmosphere.

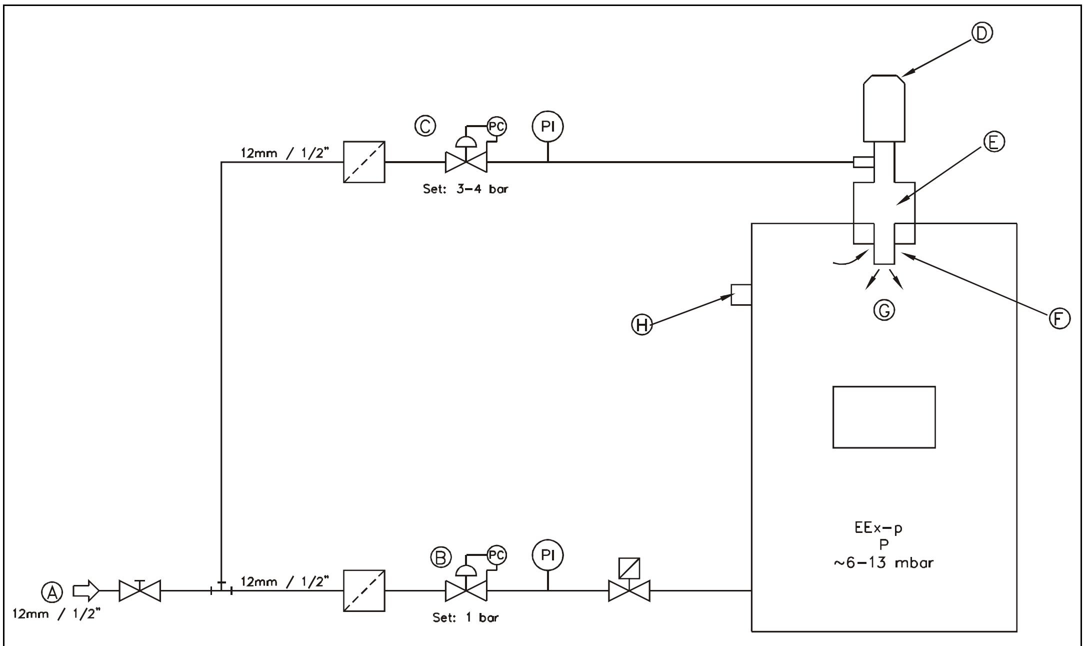
Inside the housing are all the components needed for central measurement and control of the instrument and for the process-controlled analysis program function.

The computer continually records the status of the program, time and temperature values and these can be displayed on the touchscreen. The program assigns priorities between messages describing the analysis cycle and error messages and actions taken in the case of fault correction, temperatures, cycle data and error messages which are displayed on the touchscreen. Together with the inputs and outputs, temperature sensors and other sensors, connection is established from the computer via the I/O board to all components of the system. The analog measuring signals are output as a 4-20mA current loop. Intrinsically safe outputs are available as an option.

Housing cooling (option)

The electronic housing -G2- can be fitted with a vortex air cooler for use in areas of high temperature.

Fig. 5.9: Vortex cooler



A	**Instrument air inlet**	**E**	**Vortex cooler**
B	**Pressure regulator flushing air (D)**	**F**	**Warm air from housing**
C	**Pressure regulator cooling air (D1)**	**G**	**Cool air in housing**
D	**Warm air outlet**	**H**	**Screen 15mm**

Fig. 5.10: Functional principle EEx p housing -G2- with vortex cooler

5.4 Specification of Electronic Housing -G2-

Type	PUC2
Protection type	II 2 G Ex px [ia] IIC T4 Gb
Test certificate number	TÜV 12 ATEX 556300
Housing volume	ca. 200 dm^3
Dimensions (L x D x H) in mm	515 x 470 x 800
Protection class	IP65
Power supply	115 or 230 V / 50/60 Hz; -10 % / +6 %
Power consumption	600 + (1000 W with liquid cooling system)
Maximum power loss	≤ 515 W
Ignition prevention gas	Instrument air, dry, oil-free
Dew point for instrument air	≤ -30 °C
Instrument air primary pressure	2 … 7 bar
Switching pressure	0.8 … 20.0 mbar
Instrument air consumption, normal operation	1 Nm^3/h
Instrument air consumption, purging phase	8 Nm^3/h

5.5 The overpressure control system

The electronic housing -G2- operates under constant overpressure to create a neutral protection area to eliminate risk in explosive atmospheres. The capsule design in conjunction with the protective gas, "instrument air", enables components which are not explosion-proof to be used inside the housing.

In order to prevent an explosive mixture from entering the interior of the housing, the pressure inside must be higher than the surroundings. A controller ensures that this overpressure is established and maintained.

When the pressure of the instrument air inside the housing falls below 80 Pa, the safety system, a combination of a pressure monitor and a controller, operates to switch off all electrical operations inside the housing and to separate all external signal connections (DI, DO, AO, Modem) using the EEx-d comb relay. Additionally, before each instrument start the interior is flushed with instrument air. During this process the controller initiates a flushing cycle with air so that any traces of explosive gas previously inside the housing are diluted and expelled. This automatic cycle is known as "pre-flushing".

To maintain the overpressure inside the electronic housing and to compensate for possible leaks during operation, a needle valve is integrated in the flushing valve. The opening allows sufficient instrument air to pass so as to make up for leakage losses and to provide the necessary cooling in a constant airflow.

For service purposes it is possible to operate the key switch on the front panel of –G2- to remove the explosion protection for the Ex-p-Housing and maintain operation of all non-explosion proofed components. ***This may only be done by certified operators!***

Further information on the function of the overpressure system is shown on page 40 and in the manual of the Ex p contol modul.

6 Sampling system

6.1 Construction of the sampling system

Under the Analyzer housing assembly is a stainless steel plate for the Sampling System. As standard, this consists of the following components, listed in the order of the liquid flow:

- Inlet valve
- Manual sampling point
- Pressure reducer
- Pressure gauge
- Heat exchanger
- Thermometer
- Two filters
- Water separator
- Sample flowmeter
- Coolant flowmeter
- Waste port for water separator.

Except for the water separator and the filter, which are made of mild steel, all components are made of stainless steel 1.4571 or mineral oil resistant material. The lines in the sampling system and in the analyzer housing are also stainless steel.

The sample is connected externally via a 6 mm or ¼″ threaded coupling. The cooling water is also available with 6 mm or ¼″ connectors.

Note: The description below refers to a standard system. Some user-specific systems may differ.

6.2 Start-up

The start-up procedure for the sampling system is as follows:

- Switch on the PPA.
- Open the inlet valve and screw the pressure reducer in by about 3 – 4 turns.
- Now open the isolating valve on one of the filters in flow direction (the second filter is a reserve to allow quick filter changes).
- Unscrew the needle valve on the sample flow meter by about 3 – 4 turns. The sample pressure gauge will only show the full sample pressure when the system is completely full.

For the required sample temperature please refer to section 8.5.

7 Installation

7.1 Transport

Unless otherwise specified, the PPA is delivered in packing which conforms to the German standard "Verpackungsrichtlinien des Bundesvertapees: Holzmittel, Paletten, Exportverpackungen e.V."

A ring bolt at the top of the lifting frame can be used to lift the PPA by crane. After fixing the lifting tackle make sure that it sits correctly, to avoid damage to the PPA.

The lifting frame of the PPA must be supported by suitable wooden spacers when lifted from below. The lifting fork of a fork-lift truck must be positioned under the lower side of the lifting frame before moving it.

Danger:
When loading and transporting the PPA, make sure that suitable lifting tackle is used and that the lifting machinery is capable of supporting the load. Do not stand under a suspended or supported load.

Check the delivery contents for completeness against the delivery note immediately after delivery and check the PPA for possible exterior damage before disposing of the packing material.

Report shortages or damage immediately in writing to the transport company and to BARTEC BENKE.

Note: Only promptly reported claims can be considered.

Remove the PPA packing carefully and dispose of it in an environmentally correct manner. Pay attention to the notes on the packing exterior.

7.2 Storage

The PPA is delivered ready to run. If it is necessary to store the instrument before installation, keep it in the closed transport packing in a dry place. The storage area should not be subject to large temperature variations or strong vibration.

Note: Damage due to incorrect storage is not covered by the guarantee.

7.3 Operating area requirements

The PPA should be installed in a weather-protected analyzer cabin. The temperature range must be between 10 and 30 °C. To simplify maintenance we recommend that heating or air-conditioning facilities are available in the analyzer cabin.

The installation point should be selected to provide adequate lighting to the front and back of the instrument. This helps to identify and rectify faults, and is necessary for proper service and maintenance. If the PPA is mounted near a wall it must be accessible from the front, right and left, to allow sufficient space for service or de-installation.

The floor should be even and level. A power supply connection must be available nearby.

Note the external dimensions of the analyzer, so as to ensure sufficient clearance around it (see also Fig. 7.1).

7.4 Installation

The PPA is installed as follows:

Ensure correct vertical and horizontal positioning, then secure the instrument with the four M12 bolts. Note that the sample outlet from the analyzer must be higher than the highest inlet to the waste line of the analyzer cabin. The waste must be at atmospheric pressure.

Warning:
Pressurized systems may only be installed by qualified personnel in accordance with the local standards and regulations.

Note: When samples with high viscosity or a high paraffin content with a high Pour-point will be analyzed, we recommend that all components which will come into contact with the sample, including the waste line, be provided with heating facilities.

Validation tank (option)

We recommend that an additional validation tank be installed close to the PPA so that the analyzer can be checked at any time with a reference sample. For products with a high Pour-point a heated tank is available.

The BARTEC BENKE Standard Reference container is a 20 l stainless steel pressure vessel with a test certificate. It contains a sight glass to check the liquid level, a pressure gauge, a safety valve, a filling port and a manual sample take-off point.

The line between the validation tank and the test inlet of the analyzer is a 6 mm stainless steel line fitted with a ball valve. The ½ " R emptying connection is connected to waste with a 12 mm stainless steel line via a stop valve.

Mount a ball valve and a reducer on the pressurized gas connector and connect the blow-off line of the overpressure valve directly to the waste line via a 6 mm stainless steel line.

7.4.1 Tubing connections

Danger:
Work on pressurized systems may only be carried out by qualified staff. Make sure the system is depressurized before starting work. Do not loosen or tighten any screw thread connections when the system is under pressure. Incorrect procedures with pressurized systems can lead to serious accidents.

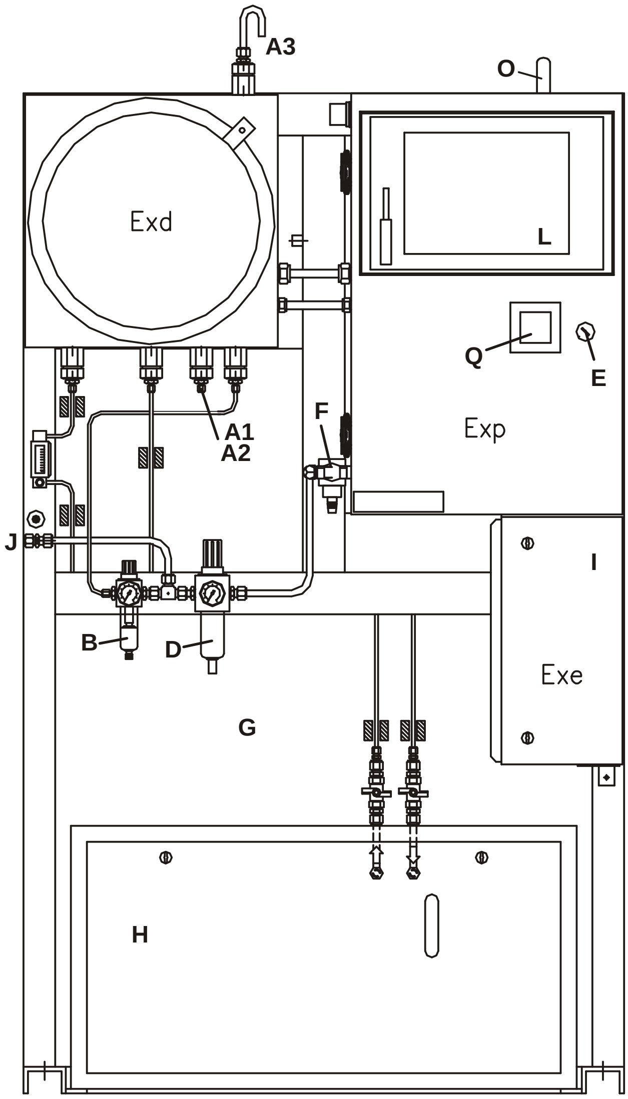
The lines leading to the analyzer must be laid according to the flow and functional diagrams (see Fig. 7.1). All supply lines should be fitted with manual shut-off valves.

Make sure the minimum permissible bending radius is observed for all lines and that there are no kinks.

Before start-up, check all connections for leaks and make sure that all inlet lines connected to the PPA are free from dirt and metal filings.

This table shows the connectors for the sample and other lines:

Tube connection Swagelok	**Connection standard / optional**
Sample inlet ∅ 6 mm	6 mm / ¼″
Sample outlet ∅ 6 /12 mm	6 /12 mm ¼" / ½″
Cooling water in / out ∅ 6 mm	6 mm / ¼″
Vent ∅ 8 mm	8 mm / $^{3}/_{8}$"
Instrument air ∅ 12 mm	12 mm / ½″



A1	**Sample inlet 6mm or 1/4”**	**G**	**Space for sampling system option**
A2	**Sample outlet 12mm or 1/2”**	**H**	**Cooling / warm water system option**
A3	**Vent 8mm or 3/8”**	**I**	**Junction box**
B	**Pressure reducer for compressed air**	**J**	**Instrument air inlet 12mm 1/2”**
D	**Pressure reducer for purge air -G2-**		

Fig. 7.1: Installation and connecting diagram

7.4.2 Electrical connections

All the necessary installation data for the electrical connections to a specific instrument are shown on the accompanying wiring diagram.

Danger:
Only qualified staff should perform electrical work. Before starting work the main power must be switched off and secured against unauthorized reconnection or the fuses removed. The analyzer may only be used when properly grounded.

Make sure that only screened cable (single-screening) is used for control connections.

Before starting work, make sure that the power supply voltage matches that shown on the instrument data panel. If it does not, contact BARTEC BENKE.

All external cable connections (power supply and measuring and signal outputs) must be permanently wired in the junction box (position I in Fig. 5.1) according to the instrument-specific wiring diagram supplied with the instrument. Check the polarity of the 4 - 20 mA signal cable.

The protection switches for the compressor motor and the cooling circulator(if fitted) must be checked for their nominal current rating in accordance with the values on the data panel.

The PPA mounting frame must be incorporated in the local equipotential bonding using cable with at least 16 mm^2 cross section.

Note: Marked grounding terminals for the -G1- and -G2- housings are provided, which have been permanently connected to the frame during production.
It is possible that the terminals could loosen during transport. Check all the connection threads, terminal connectors and carriers on the analyzer for proper connection and rectify if necessary.

M25 x 1.5 user connectors are provided in the junction box.

To connect the power and signal cables proceed as follows.

- Open the junction box and connect a 16 mm^2 Pa-cable.

- Remove the protective cover from terminals L1 and N, and make the required power connections, referring to the instrument wiring diagram and the instrument specification.
- Make the signal connections as shown in the wiring diagram.
- Replace the protective covers on the terminals and close the junction box.

All signals, the 0 V DC reference potential and the accessory supply are made via comb relays with a maximum current load of 1A.

0 V DC and 24 V DC are connected via self-resetting fuses (Poly-Switch) and have a trigger current of 1 A, i.e. the total current via 0 V and 24 V DC can not exceed 1 A. With the maximum number of 8 analog (20 mA each) and 6 digital outputs (106 mA each) the total current is 800 mA.

There are four types of signal:

Digital OUT

Standard: Potential-free contacts.

Optional: In the active logic state 24 V DC is available, in the inactive state 0 V DC. The voltage is relative to the 0 V DC reference potential. The outputs are specified at 1 A short-circuit proof. The current load is reckoned from the total available current via 0 V DC given above.

Digital IN

The active state is represented by a voltage between 15 V and 28 V DC, the inactive state by a voltage between 0 V and 4 V DC. The voltage is relative to the 0 V DC reference potential. If potential-free contacts are used, 24 V DC can be used for the supply voltage. The input current at 24 V DC is ca. 5 mA.

Analog OUT

These signals are of the 4 – 20 mA type. The reference potential is DC 0 V. The maximum load is 800 Ω and corresponds to an output voltage of 18 V.

Analog IN

These signals are of the 4 – 20 mA type. The reference potential is DC 0 V. The 24 V DC can be used as auxiliary energy. The input impedance is 200 Ω.

8 Commissioning the system

The housing covers holding red warning signs may only be opened in a non-explosive atmosphere and when the housing is electrically neutral.

When opening the explosion-proof housing or other explosion-risk components, make sure that the regulations concerning explosion danger and high temperature work are observed.

Danger:
Use the special handle supplied with the analyzer to open the cover, otherwise there is the risk of injury.

Each instrument is checked by BARTEC BENKE after manufacture in a long test run to check for correct function and compliance with customer specification. The PPA is delivered in a fully functional and safe condition.

The analyzer must be installed, set up, fixed in place and the proper connections made by the user in accordance with the supplied plans. After installation it will be started up by BARTEC BENKE service staff as agreed with the user. When the instrument is ready for use and an order has been placed, on-site training can be performed by BARTEC BENKE staff.

8.1 Starting up the overpressure control system

The pressure of the instrument air for the overpressure control system is adjusted with pressure reducer II (position D in Fig. 5.1). The reducer is fitted with a pressure gauge and a filter element.

The required pressure of ca. 120 kPa can be read from the pressure gauge. For the initial flushing of the electronic housing -G2- the instrument air is introduced to the bottom of the interior via the solenoid valve.

The air must be free of solids and have a dew point of ≤ –30 °C.

The air volume and the internal pressure of -G2- are monitored with a type-approved device in the Ex-p Housing.

At start-up and during the flushing phase, if the minimum pressure is exceeded and the air flow is adequate, the sensors transmit a signal to the control module. The preset flushing time now counts down to zero.

At the end of the flushing period the operation phase starts automatically as follows:

1. The digital valve closes and the leakage losses are compensated for by the integrated needle valve and jet.

2. The LED "Operation" lights. (You can´t see it by closed front door -G2-)

3. Relay K2/3 connects the electrical components inside the EEx-p Housing.

4. The remaining flushing time display on the sensor module is replaced by the internal pressure.

5. Relays K4 and K5 switch, depending on the configuration.

8.2 Starting up the instrument air system

When starting up the instrument air system, set the pressure reducer **B** (nominal value see label on device).

Set the purge air pressure for -G2- with pressure reducer **D** (nominal value see label on device).

Set the operating air for the vortex cooler by using pressure reducer C in Fig. 5.10. (nominal value see label on device).

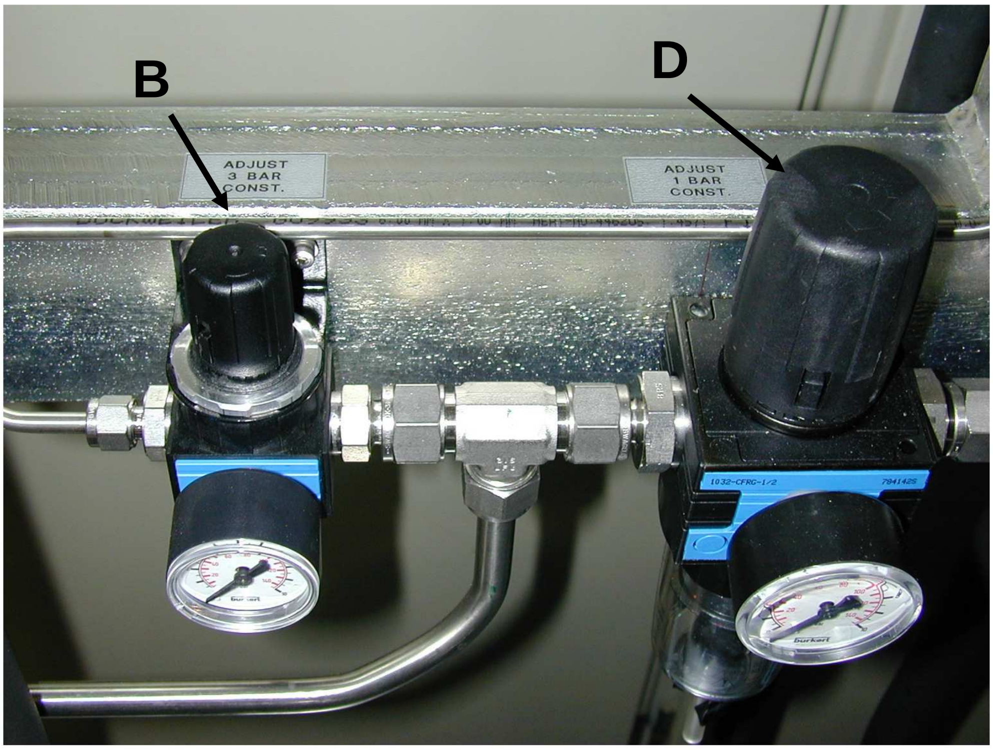


Fig. 8.1: Pressure reducer

8.3 Connections for cool or warm water

A cool or warm water supply system is available as an option.

Check the flow direction on the water connector. The water pressure should be ca. 150 – 200 kPa ± 10 kPa and flow rate ca. 20 – 100 l/h. Make sure only clean water is used.

The start-up procedure for the optional liquid cooling system is described in the manual of the chiller.

8.4 Flushing the sample supply

(Only if the Sampling System option is fitted)

Before starting the sample supply system it must be flushed with sample to clean it and fill it. Do this as follows:

- Open the sample supply line at the interface between the analyzer and your sample supply system.
- Flush the new sample supply line with about 3 liters of sample, to make sure that any possible dirt or contamination is removed.
- Reconnect the sample line, and switch the sample supply to the analyzer.

The start-up procedure for the sample supply system is shown in section 6.2.

Note: The sample supply can be flushed without the analyzer being switched on.

8.5 Operating parameters of process material

The following table shows the normal operating values for the liquids and gas used by the analyzer.

Operating conditions	Min	Normal	Max
Sample inlet pressure	100 kPa	200 kPa	300 kPa
Sample outlet pressure	Open to atmosphere		
Instrument air pressure for pneumatic valves	290 kPa	300 kPa	350 kPa
Cooling water pressure	100 kPa	200 kPa	300 kPa
Cooling water flow	20 l/h	30 l/h	40 l/h
Cooling water temperature (depending on the expected Pour-point temp.)	Ca. 15 °C	Ca. 20 °C	Ca. 30 °C
Total measuring cell volume Test sample volume Vented volume for liquid movement	16.24 cm^3 10 cm^3 6.24 cm^3	16.24 cm^3 10 cm^3 6.24 cm^3	16.24 cm^3 10 cm^3 6.24 cm^3
Sample flow through measuring cell during rinse cycle, per hour	Ca. 2 l/h	Ca. 3 l/h	Ca. 4 l/h
Sample and bypass volume	Ca 20 l/h	Ca. 30 l/h	Ca. 40 l/h
Sample inlet temperature (standard) (min. 20 °C above expected pour point) **At inlet viscosity of max. 70 cst.** High Viscosity option Product quality: dark heating or cylinder oil	20 °C 60 °C	30 °C 65 °C	50 °C 70 °C

9 Maintenance

9.1 General remarks

Before starting maintenance work on the PPA , the instrument must be completely switched off. Do this as follows:

Switch off the PPA:

- Click on the "running" button in –PACS- (PROCESS ANALYZER CONTROL SYSTEM) software. The program is interrupted and "stopped" appears in the LC Display window.
- End PACS and stop the operating system.
- Disconnect the power at the mains or remove the fuse.

⚠ **Danger:**
Note that the overpressure controller and the Exd-protection are still connected to the mains power when you shut down the instrument from the overpressure control panel.

- Turn off the water and air supply.

⚠ **Danger: Use the special handle supplied to open the housing cover, otherwise there is the risk of crushing your hand.**

- Open the EExp-Housing -G2- at the side by loosening the hexagonal screw on the cover and then raising and turning the cover.

When you have finished, close the door of the EExp-Housing -G2- and the lid of the analyzer section -G1- and restart the analyzer. To do this, proceed as follows:

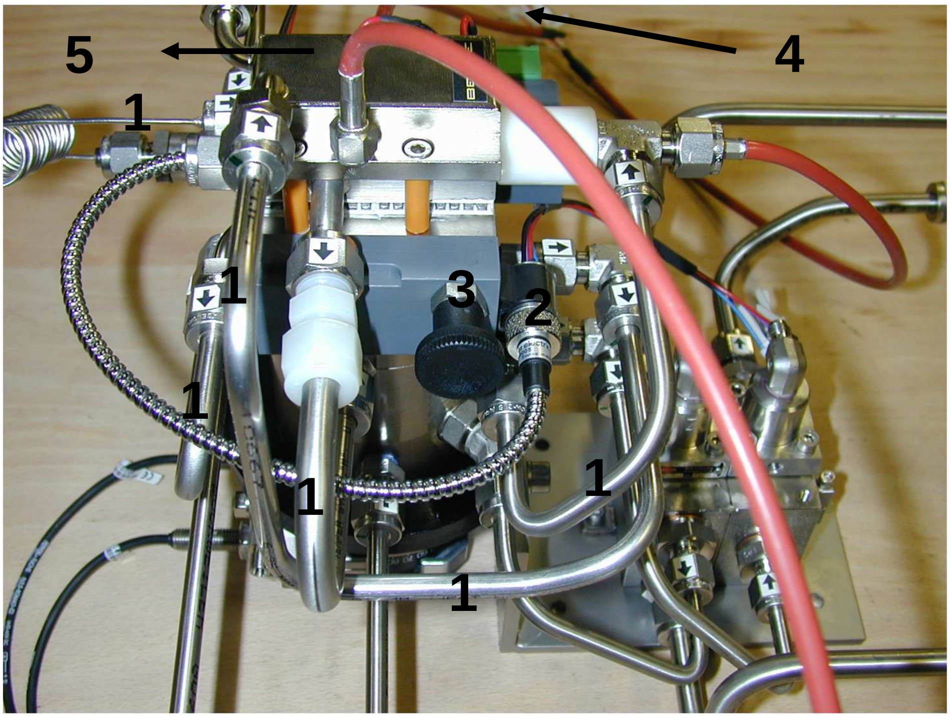
Switch on the PPA:

- Turn on the instrument air, product (sample) and water supply.
- Switch on the power . Start the computer operating system. PACS starts automatically.

9.2 Removing and replacing the Measuring Cell

Danger:
Before opening any housing and before all work on the analyzer, make sure the person doing the work has the necessary qualification for work in explosive areas.

- Switch off the power.
- Open EEx-d housing -G1-.
- Close the valves for product inlet and return, instrument air and cooling water supply and return.
- Using a suitable wrench remove all the connections (1) between the Measuring Cell and the rotor section of the supply head. Use a second wrench to provide counter-torque if necessary.
- Press the IR – Adapter (2) out of the holder on the module holder then unscrew the nut holding the optical fiber and separate the two parts.
- Unplug the multi-connector (4) from the module holder, pull the black stop (3) and lift the Measuring Cell upwards (5) out of the module holder.
- With one hand pull the black knob (3) to the side, then with the other hand pull the Measuring Cell up and out of its holder.



9.3 Replacing the warm water heater

- Shut down the analyzer as described previously.
- Separate the cable connections.
- Unscrew safety screw M3 at the top of the heat exchanger.
- Using suitable pliers gently twist the heating element and pull it up and out.

Warning:
To avoid risk of explosion, only original spare parts must be used as a replacement for the heating element. The maximum power (125 W) of the heater must not be exceeded for safety reasons based on the maximum permissible heat loss in the EEx d housing.

Note: To give better heat transfer we recommend that you apply a thin film of copper paste CU-31 (Lubical) to the element before replacing it.

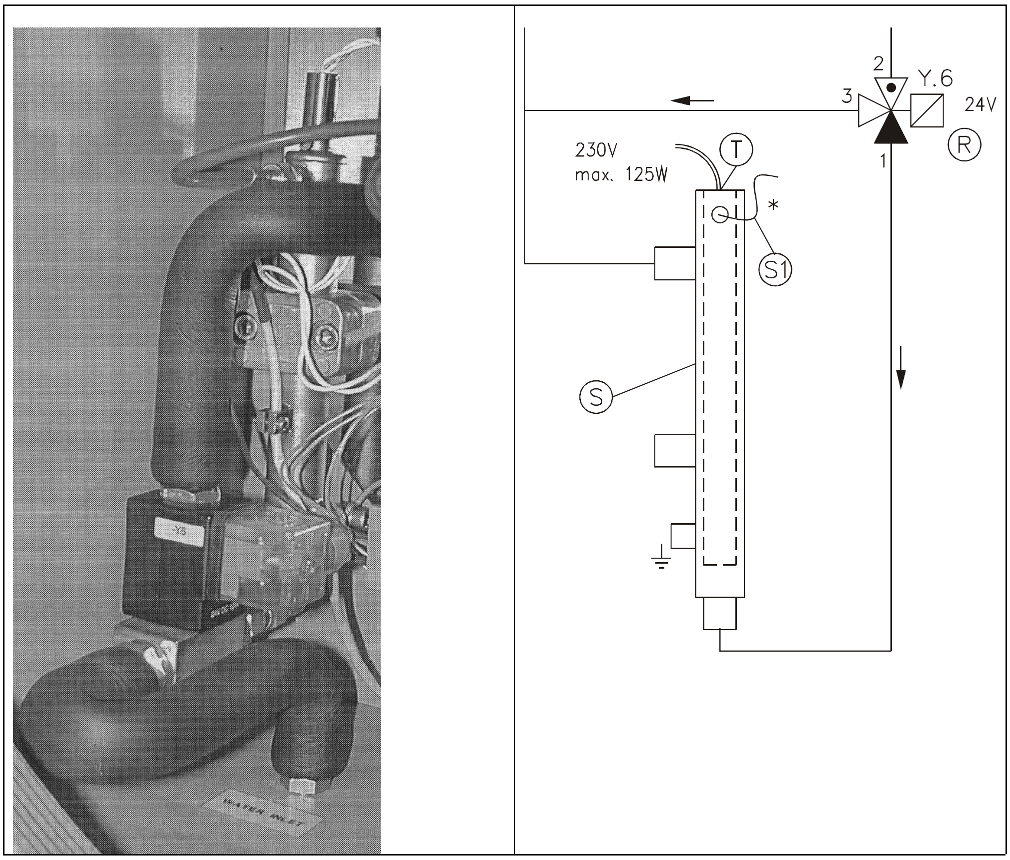


Fig. 9.1: Warm water supply with heating element

9.4 Servicing the pneumatic valves

9.4.1 General

The pneumatic valves should be disassembled every 6 months to check the seals, O-rings and valve components for distortion and proper action .

The seals and O-rings which come into contact with the samples are replaceable parts and must be checked and replaced if necessary after one year's operation.

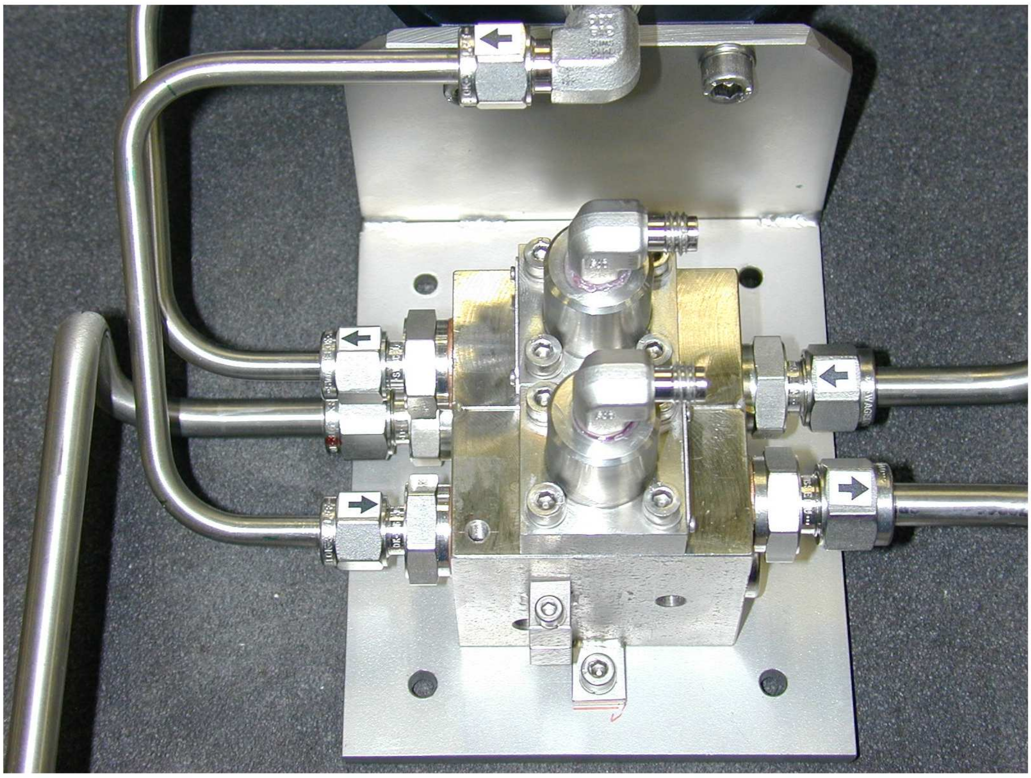


Fig. 9.2: Pneumatic valves

9.4.2 Servicing the pneumatic 3/2-way valves

To replace the seals which contact the sample proceed as follows. See also Fig. 9.2 and

Fig. 9.3:

- Shut down the PPA as described previously.
- Remove the pneumatic connection line from the valve head.
- Unscrew the four 5 mm screws and remove the head.
- With suitable pliers, pull the circular recess fitting and the tappet out of the valve body, and lever out the O-ring.
- You can now pull the lower valve seat and O-ring out of the valve body.
- Disassemble the tappet consisting of spring ring, lock washer, spring feather, spring retainer, lip seal, sleeve and valve plunger.
- Now you can replace the valve plunger, the lip seal, the spring feather and all the O-rings.
- Remove the piston in the valve head and replace the lip seal.
- The valve can now be reassembled, in the reverse order. Lightly lubricate all components with suitable grease (SKF LGMT 2/0.2).
- Start up the PPA as described in section 9.1.

Note: The solenoid valves Y1 to Y5 in the valve block need no maintenance.

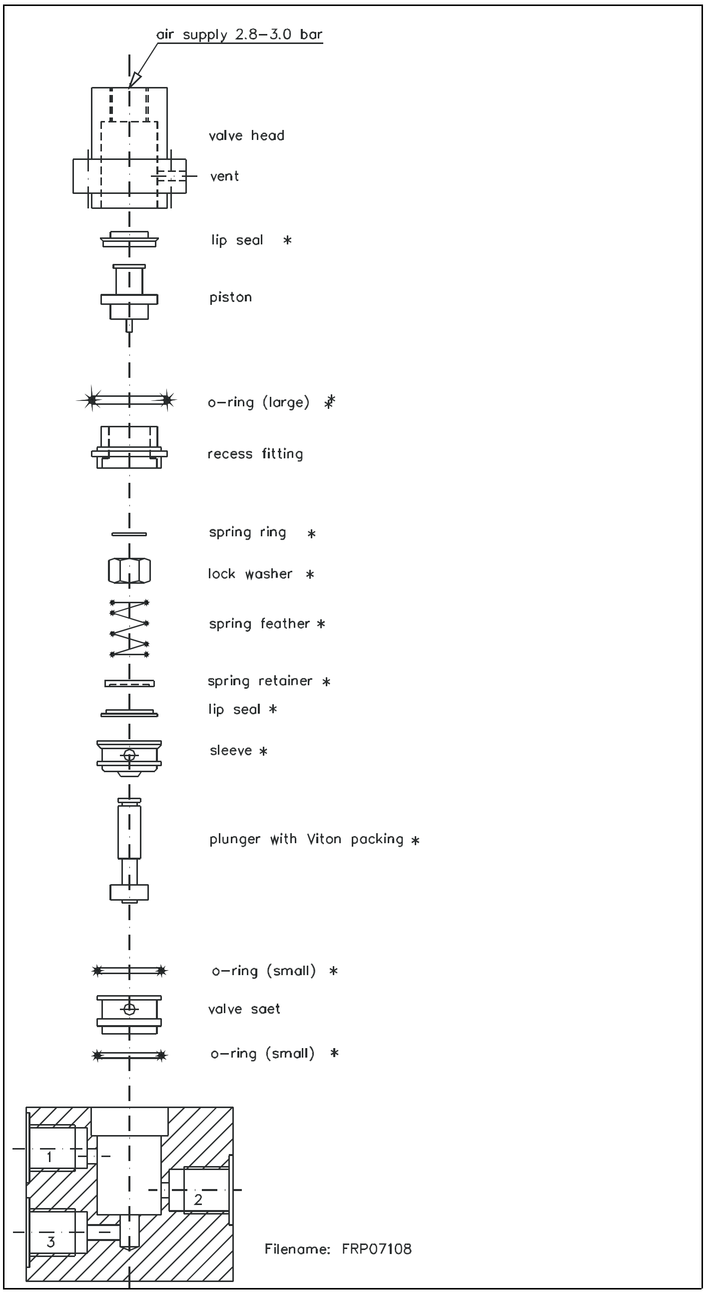


Fig. 9.3: Removing the pneumatic valves

9.5 Replacing the filters in the sampling system

The sample filters should be replaced every 3 months as follows:

Note: Before you remove a filter make sure that it is not under pressure. Use the bypass function to switch to the other filter.

- Lightly oil the seal.
- Screw the filter into position and secure it hand-tight.
- Check the filter for correct sealing and retighten if necessary.

9.6 Replacing the filter in the sampling system moisture trap

Under normal conditions the filter in the moisture trap should be replaced every 6 weeks as follows:

Note: Before you remove the filter make sure that it is not under pressure.

- Loosen the screw by hand and remove the cover.
- Slowly pull out the old filter while rotating it slightly, and insert the new filter.
- Replace the cover and tighten the screw hand tight.

9.7 Replacing the TEC (peltier) modules

To replace the TEC modules, proceed as follows:

- Remove the measuring cell (see chapter 9.2)

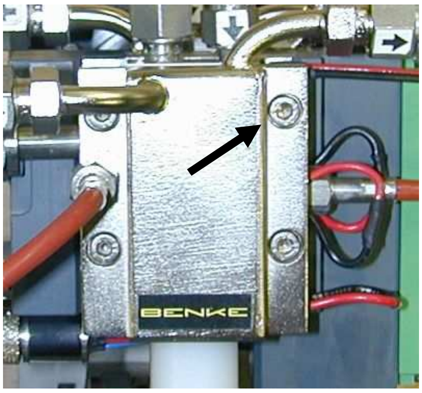


Fig. 9.7: Measuring cell

- Remove 4 scews (arrow)
- Lift off the upper heat exchanger
- Lift off the measuring cell body from the lower heat exchanger
- Remove the TEC modules

To install the TEC modules, proceed as follows:

- Clean all contact area
- Apply heat-conductive paste very sparingly to all contact area
- Draw off the heat-conductive paste evenly to a very thin layer with a knife blade
- Remove surplus paste from all parts
- Place two TECs on the lower heat exchanger - Installation position: labeled side (point) up. Also note the position of the cables, see fig. 9.7
- Press each individual TEC against the heat exchanger and move it back and forth until the resistance increases noticeably
- Place the measuring cell body on the TECs
- Press the measuring cell body against the TECs and move it back and forth until the resistance increases noticeably

- Place the third and fourth TEC on the measuring cell body - Installation position: labeled side down. Also note the position of the cables, see fig. 9.7
- Proceed as described above
- Place the upper heat exchanger and proceed the same way

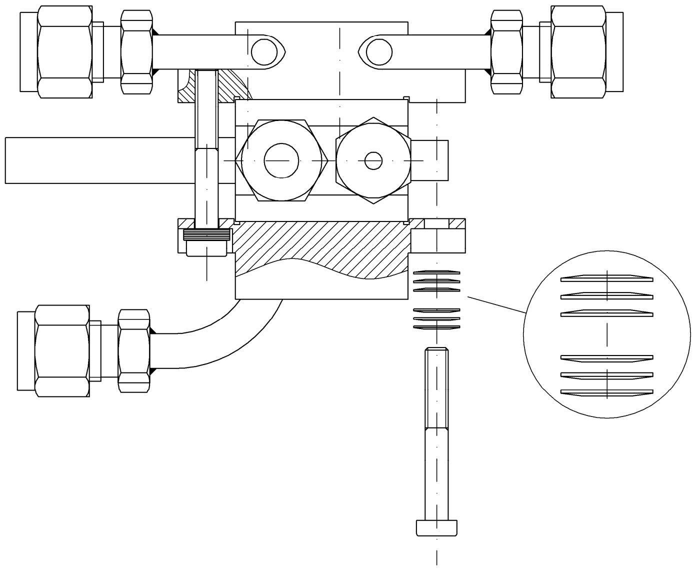


Fig. 9.8: Assembling of disc springs

- Assemble 6 disc springs to each screw as shown in fig. 9.8 (three of the springs in one direction)
- Gently tighten the srews crosswise by hand until the resistance increases. The screws are to rest against the disc springs
- Tighten the screws crosswise further ½ turn
- Loosen the screws and repeat the last two steps
- Install the measuring cell to the analyzer
- After one week of operation shut off the analyzer as described in chapter 9.1, loosen the screws again and the tighten them as described above

10 Specification of the PPA

Specification	
Method	DIN/ISO 3016 / ASTM D-97
Comparability	≤ ISO or ASTM
Reproducibility	< ISO or ASTM
Measuring cycle	Discontinuous 15-90 Min. (depending on POUR POINT Temp.)
Environmental temperature	max. 40 °C
Measuring range	-30°C / 30°C total test range, following standard method
Software	Windows XP; PACS, PC Anywhere (optional)
Input and output signals	2 x 4 – 20 mA, 800 Ω, galvanically separated
General alarm	Potential-free contact (NO/NC)
Save signal for measured value	Potential-free contact (NO/NC)
Options	
Analyzer-Reset	Binary input contact NC
Modbus	RS485 / LWL
Modem	V90
Type approval number	TÜV 99 ATEX 1463
ATEX marking	II 2G EEx dpe IIB T4 or II 2G EEx dpe [ia] IIB T4 II 2G EEx dpe IIB+H2 T4 or II 2G EEx dpe [ia] IIB+H2 T4
Weight	ca. 400 kg inc. Chiller
Standard connections	
Threaded pipe connections	6 / 8 / 12 metric SWAGELOK
Cable connectors	M25
Dimensions, L x D x H	1200 x 1800 x 700 mm
Sample	
Sample on the analysis unit	Clean and dry, as in standard method
Flow rate	20 - 40 l/h
Pressure	100 – 300 kPa

Temperature	normal 30 °C, max. 50 °C, min. 20 °C above Pour-point Temperature
Outlet	Open to atmosphere
Accessories	
Cooling water	Closed system, temperature variable (dependent from the application), pressure 100-300 kPa, flow 20-40 l/h
Warm water	Closed system, temperature variable (dependent from the application), pressure 100-300 kPa, flow 20-40 l/h
Air for explosion protection	
Instrument air	Humidity class 1 (dew point ≤ -30 °C)
Pressure	2 … 7 bar
Consumption Normal operation Purging phase	 1 Nm^3/h 8 Nm^3/h
Power supply	
Analyzer	110 / 230V / 50Hz –10/+6%, ca. 600VA

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