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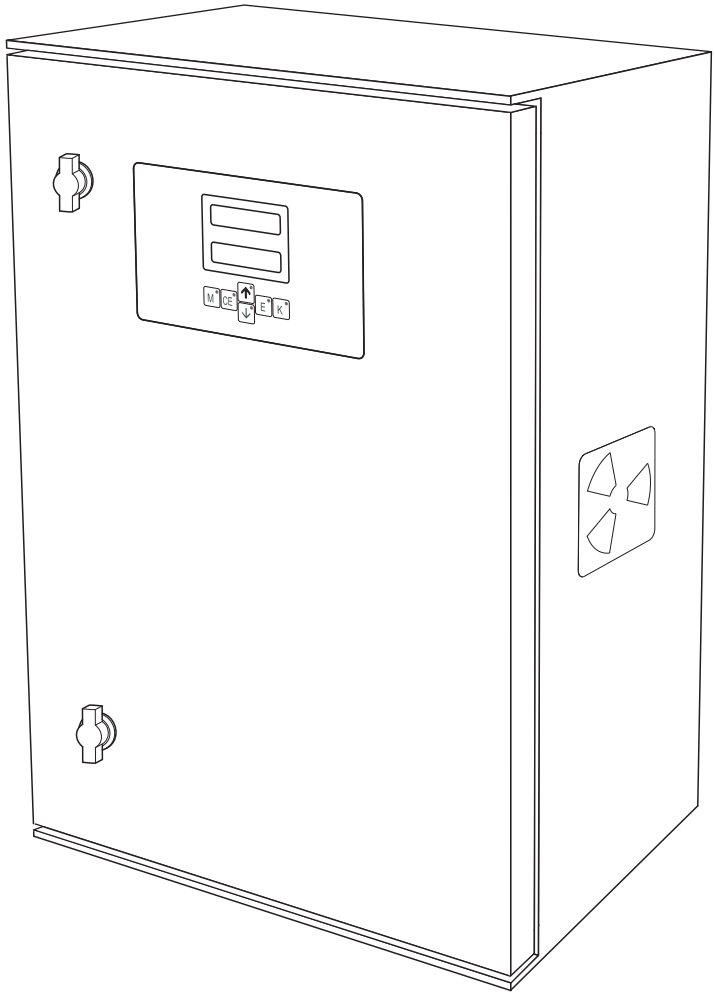
Software version 01.03.06

Operating Instructions
Stamolys CA71CODcr

Photometric analytical system for determining the chemical oxygen demand following the DIN dichromate method



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1 Document information

1.1 Warnings

The structure, signal words and safety colors of the signs comply with the specifications of ANSI Z535.6 ("Product safety information in product manuals, instructions and other collateral materials").

Safety message structure	Meaning
⚠ DANGER **Causes (/consequences)** Consequences if safety message is not heeded ▶ Corrective action	This symbol alerts you to a dangerous situation. Failure to avoid the situation **will** result in a fatal or serious injury.
⚠ WARNING **Causes (/consequences)** Consequences if safety message is not heeded ▶ Corrective action	This symbol alerts you to a dangerous situation. Failure to avoid the situation **can** result in a fatal or serious injury.
⚠ CAUTION **Causes (/consequences)** Consequences if safety message is not heeded ▶ Corrective action	This symbol alerts you to a dangerous situation. Failure to avoid this situation can result in minor or medium injury.
NOTICE **Cause/situation** Consequences if safety message is not heeded ▶ Action/note	This symbol alerts you to situations that can result in damage to property and equipment.

1.2 Symbols used

1.2.1 General symbols

→ 1 This symbol stands for a cross-reference to a specific page (e.g. Page 1).

→ 2 This symbol stands for a cross-reference to a specific graphic (e.g. Fig. 2).

Additional information, tips

Permitted or recommended

Forbidden or not recommended

1.2.2 Special messages

Wear protective clothing
Wear a laboratory coat, protective gloves and protective goggles when working on the analyzer and when handling chemicals.
Please observe the information on the safety data sheets with regard to the dangers posed by the chemicals used.

2 Basic safety instructions

2.1 Requirements for personnel

- Installation, commissioning, operation and maintenance of the measuring system must only be carried out by specially trained technical personnel.
- The technical personnel must be authorized to perform such tasks by the owner-operator.
- The electrical connection must only be performed by an electrical technician.
- Technical personnel must have read and understood these Operating Instructions and must adhere to them.
- Measuring point faults may only be rectified by authorized and specially trained personnel.

Repairs not described in the Operating Instructions supplied may only be carried out directly at the manufacturer's or by the service organization.

2.2 Designated use

The analyzer is a compact photometric analysis system.

In particular, CA71 is designated for:
- Monitoring sewage treatment plant outlets
- Monitoring the sewage treatment plant inlet
- Monitoring process wastewater
- Monitoring the discharge of industrial wastewater

Any other use than the one described here compromises the safety of persons and the entire measuring system and is not permitted.
The manufacturer is not liable for damage caused by improper or non-designated use.

2.3 Occupational safety

As the user, you are responsible for complying with the following safety conditions:
- Installation instructions
- Local prevailing standards and regulations

Electromagnetic compatibility
This device has been tested for electromagnetic compatibility in accordance with the applicable European standards for industrial applications.
The electromagnetic compatibility indicated only applies for a device that has been connected as described in the instructions in these Operating Instructions.

2.4 Operational safety

- Before commissioning the entire measuring point, check all the connections for correctness. Ensure that electrical cables and hose connections are not damaged.
- Do not operate damaged products and secure them against unintentional commissioning. Mark the damaged product as being defective.
- If faults can not be rectified, the products must be taken out of service and secured against unintentional commissioning.

2.5 Product safety

The analyzer has been designed and tested according to the state of the art and left the factory in perfect functioning order.
Relevant regulations and European standards have been met.

3 Device description

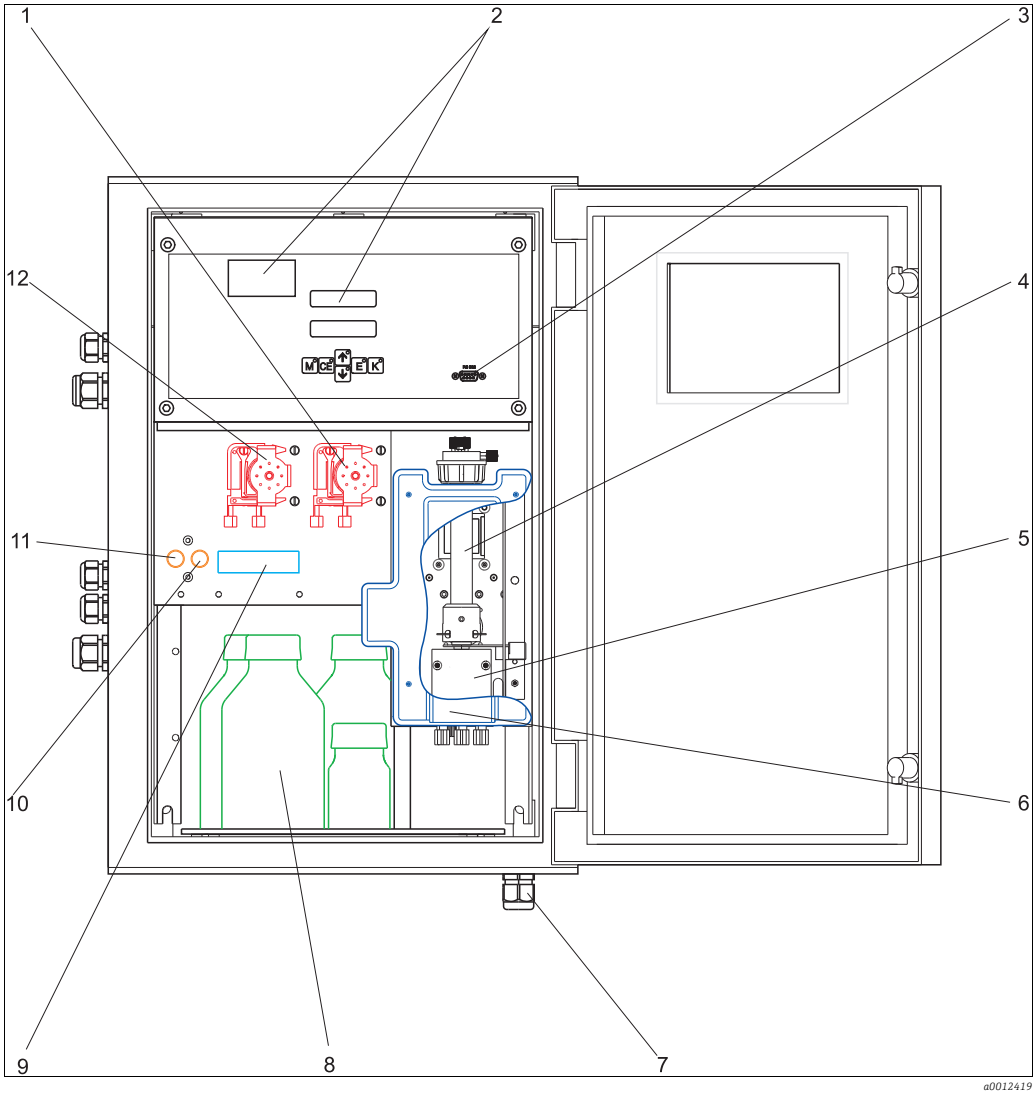


Fig. 1: Analyzer (cabinet version without hoses)

1 *Reagent pump (P2), inlet from canister*
2 *Display and temperature indicator*
3 *Serial interface RS 232*
4 *Reactor unit*
5 *Valve V4*
6 *Cover (broken open in the graphic)*
7 *Rinse outputs (wastewater, chromate waste, overflow)*
8 *Reagents, standard*
9 *Valve V3*
10 *Valve V2*
11 *Valve V1*
12 *Sample and sulfuric acid pump P1*

Inlet to the sample pump:
- Valve V1
  - Front hose: sample inlet
  - Rear hose: inlet from valve V2 (0 mg/l O_2 standard or standard)
- Valve V2
  - Front hose: inlet from canister with standard
  - Rear hose: inlet from canister with 0 mg/l O_2 standard

4 Incoming acceptance and product identification

4.1 Incoming acceptance

1. Make sure the packaging is undamaged.
   ↳ Inform the supplier about damage to the packaging.
   Keep the damaged packaging until the matter has been settled.
2. Make sure the contents are undamaged.
   ↳ Inform the supplier about damage to the delivery contents.
   Keep the damaged products until the matter has been settled.
3. Check the delivery to make sure nothing is missing.
   ↳ Compare it against the shipping documents and your order.
4. Pack the product in such a way as to protect it reliably against impact and moisture for storage and transportation.
   ↳ The original packaging provides optimum protection.
   The permitted ambient conditions must be observed (see "Technical data").

If you have any questions, contact your supplier or your local sales center.

4.2 Product identification

4.2.1 Nameplate

Compare the (extended) order code on the nameplate (on the analyzer) to the product structure and your order.

You can read the following information from the nameplate:
- Order code
- Extended order code (= order code from the product structure)
- Serial number
- Measuring range
- Outputs and communication
- Power supply
- Ingress protection
- Environment

4.2.2 Order code and device version

To find out the version of your product, enter the order code indicated on the nameplate in the search screen at the following address: www.products.endress.com/order-ident

4.3 Scope of delivery

The scope of delivery comprises:
- an analyzer with power supply plug
- 4 plastic fastening clips
- a cleaning injector
- 1 tube of silicone grease
- 1 NORPRENE hose, length 2.5 m (8.2 ft), ID 1.6 mm (1/16")
- 1 C-FLEX hose, length 2.5 m (8.2 ft), ID 3.2 mm (1/8")
- 1 PVC hose, length 2.5 m (8.2 ft), ID 10 mm (0.39")
- 2 hose fittings of each size:
  - 1.6 mm x 1.6 mm (1/16" x 1/16")
  - 3.2 mm x 1.6 mm (1/8" x 1/16")
- 1 hose fitting 3.2 mm x 1.6 mm (1/8" x 1/16") for TYGON hose
- 2 T-hose fittings of each size:
  - 1.6 mm x 1.6 mm x 1.6 mm (1/16" x 1/16" x 1/16")
  - 3.2 mm x 3.2 mm x 3.2 mm (1/8" x 1/8" x 1/8")
- an interference suppressor for the current output
- 4 edge covers
- Protective gloves
- Protective goggles
- Laboratory coat
- Hose 4/6 mm (0.16/0.24") natural PTFE, length 4.5 m (14.7 ft)
- 5 l container (1.32 US gal.) for chromate waste
- Cover for container with hose connection nipple
- a quality certificate
- 1 set of Operating Instructions (English)

4.4 Certificates and approvals

4.4.1 CE mark

With this declaration, the manufacturer guarantees that the product complies with the regulations of EMC Directive 2004/108/EC and the Low Voltage Directive 2006/95/EC. This is proven by observing the standards listed in the Declaration of Conformity.

4.4.2 Manufacturer certificate

Quality certificate
With the certificate, the manufacturer confirms that all technical regulations are met and specified tests have been carried out individually for your product.

5 Installation

5.1 Installation conditions

5.1.1 Design, dimensions

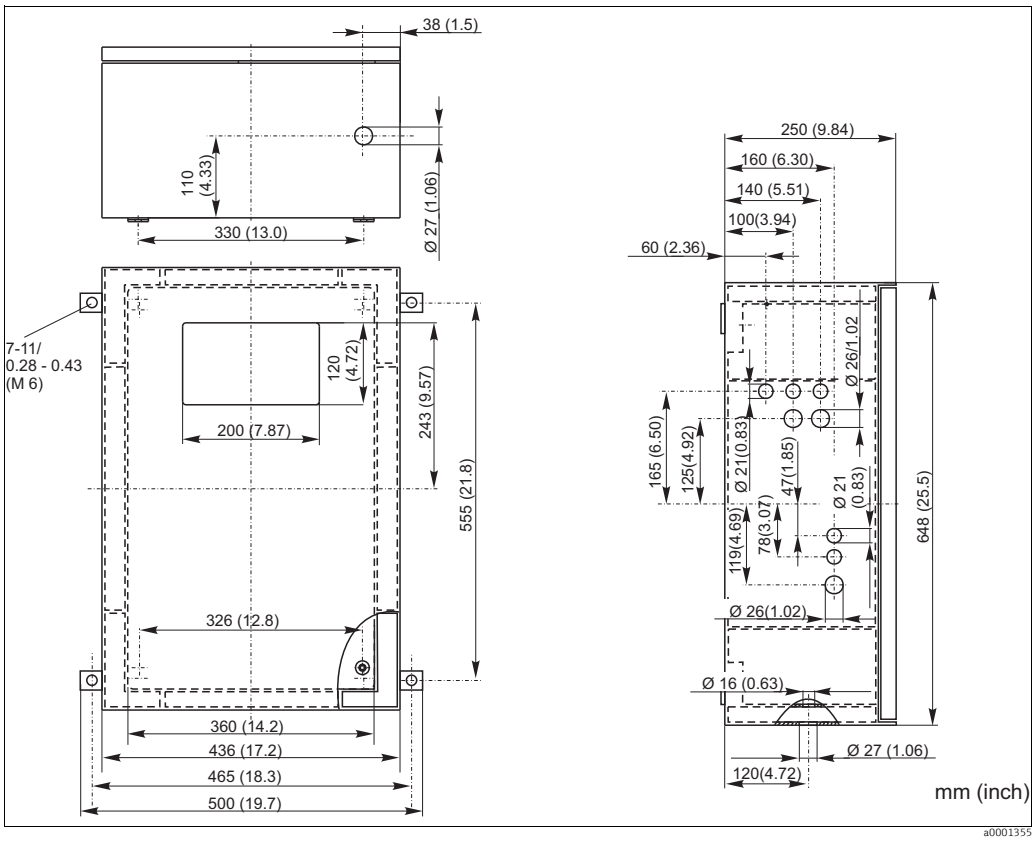


Fig. 2: GFR version

NOTICE

Sufficient space and backwater in the outflow hose

- Allow at least 400 mm (16") under the housing as space for the waste collecting tank.
- On the left-hand side of the device, observe a lateral distance of at least 350 mm (13.8") for mounting the collecting vessel.
- The outflow hose should not form a siphon.

5.1.2 Connecting the sample line

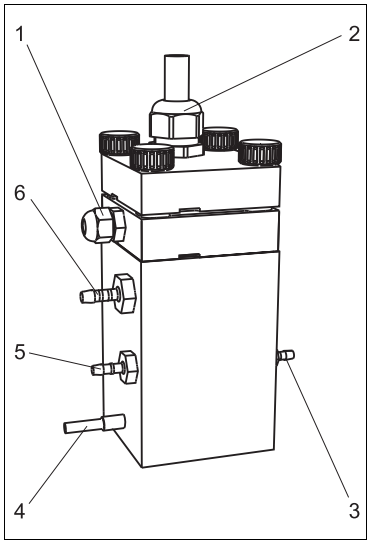


Fig. 3: Collecting vessel

1 Connection for level measurement
2 Ventilation
3 Sample supply to analyzer, connection for hose with ID 3.2 mm (0.13")
4 Connecting cable of electric agitator
5 Sample supply, connection for hose with ID 3.2 mm (0.13")
6 Sample overflow, connection for hose with ID 10 mm (0.39")

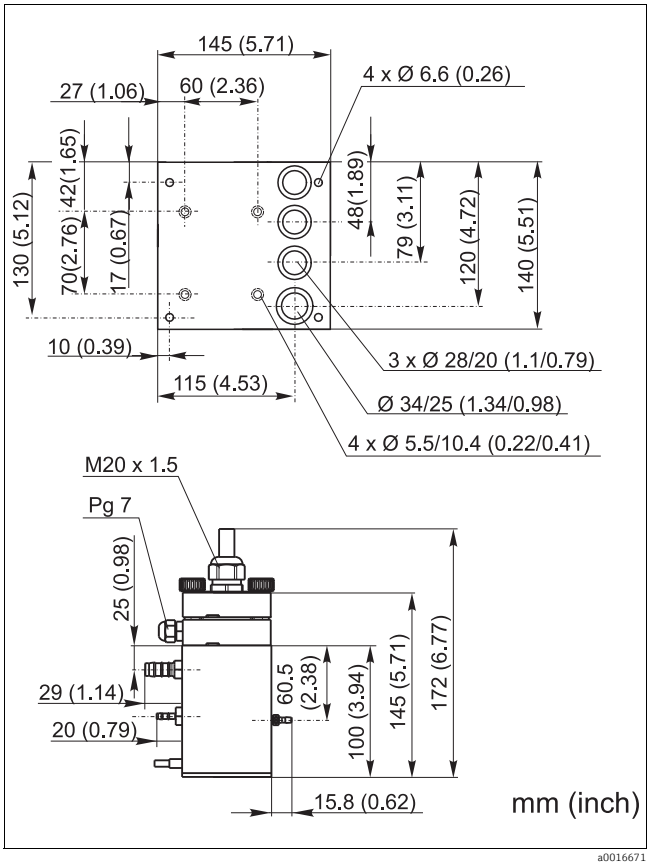


Fig. 4: Dimensions of collecting vessel and base plate

Collecting vessel (at analyzer outer side, with or without level monitoring)

Connection	hose ID 3.2 mm (1/8 inch)

Customer collecting vessel

Connection (affix at the level of the peristaltic pumps)	hose ID 1.6 mm (1/16 inch)
Max. distance from the collecting vessel to analyzer	1 m (3.3 ft)
Max. high difference from the collecting vessel to analyzer	0.5 m (1.6 ft)

5.2 Mounting the measuring device

5.2.1 Setting up/securing the analyzer

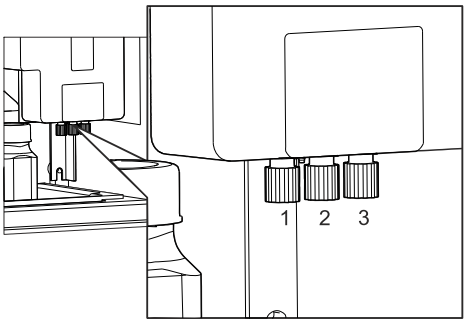
To install the analyzer at the intended location, proceed as follows:

1. Fit the edge covers (with GFR housing only).
2. Fasten the fastening clips on the analyzer.
3. Mount the analyzer and secure it to a vibration-free wall using screws (Ø6 mm / 0.24"). The fastening clips make sure that the necessary distance to the wall is observed for ventilation purposes.

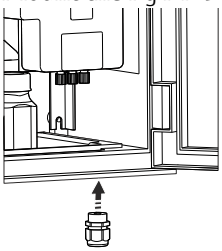
   ↳ For the installation dimensions, see the previous chapter.
4. Using a spirit level, check that the cabinet is hanging straight.

5.2.2 Routing the drain hoses

1. Connect the enclosed drain hoses (PTFE 4/6 mm) to the connections marked for dichromate waste (3), rinse waste (2) and emergency overflow (1).



2. Mount the Pg M25 gland supplied on the device floor from the outside.



3. Route the drain hoses (PTFE 4/6 mm) through the gland boreholes to the outside.
4. Route the drain hose for dichromate waste into the cover of the appropriate canister and make sure the drain hose for the rinse water and that for emergency overflow end in the drain.

   ↳ The drain hose for emergency overflow must be open to air. Avoid siphon formation for all the hoses!

5.2.3 Releasing the transportation lock

⚠ WARNING

Hot chromosulfuric acid

Danger of scalding and serious chemical burns, risk of destroying the electronics, short-circuiting and fire

- ▶ Never put the analyzer into operation without having first put the reactor in the correct position.
- ▶ Prior to mounting, make sure that the reactor is empty and cool.
- ▶ Disconnect the analyzer from the power supply before you remove the reactor cover.

The reactor was raised slightly for transportation purposes (→ 5). Therefore you must put the reactor in the correct position (→ 6).

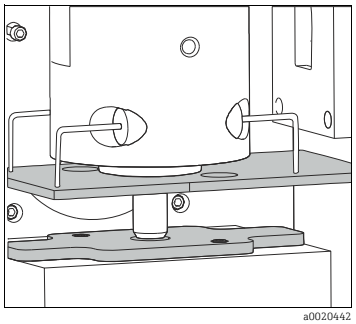


Fig. 5: Transportation lock

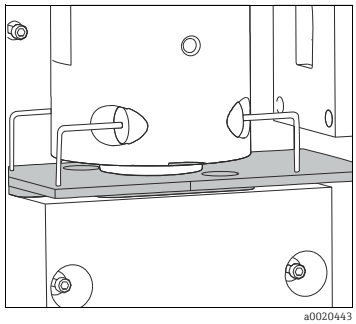
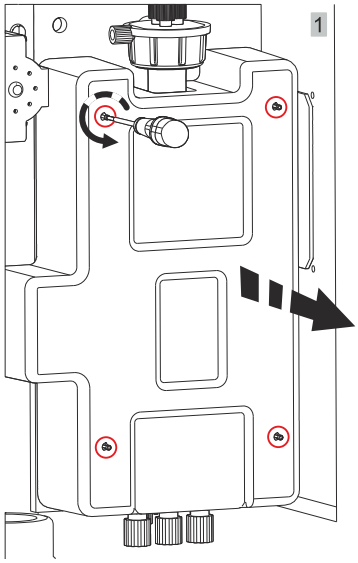
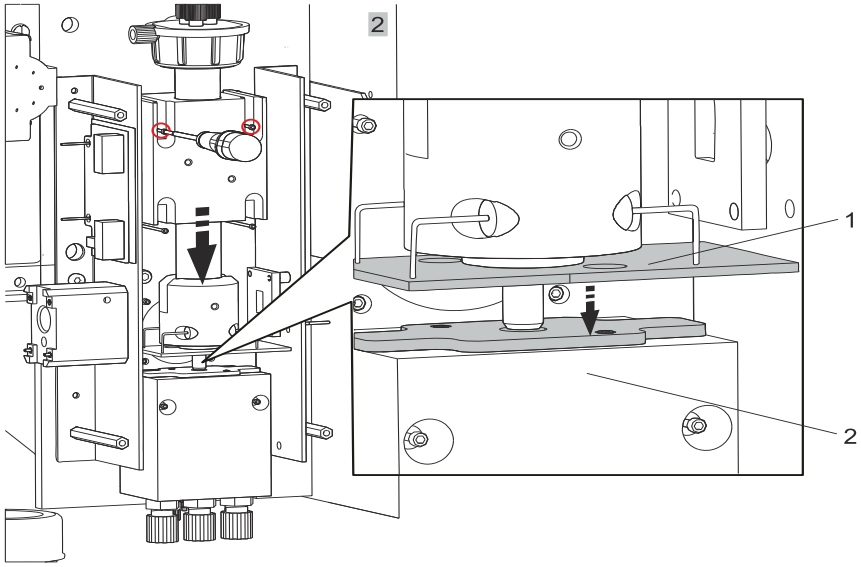


Fig. 6: End position

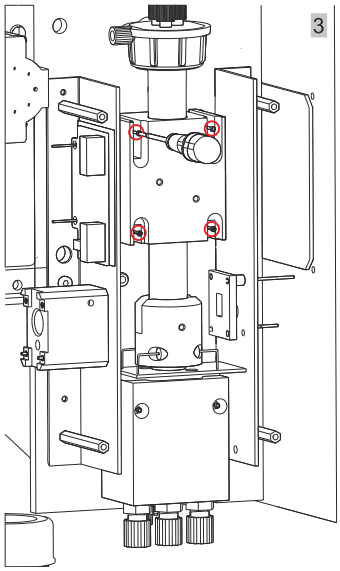
1. Release the screws on the reactor cover and remove the cover.



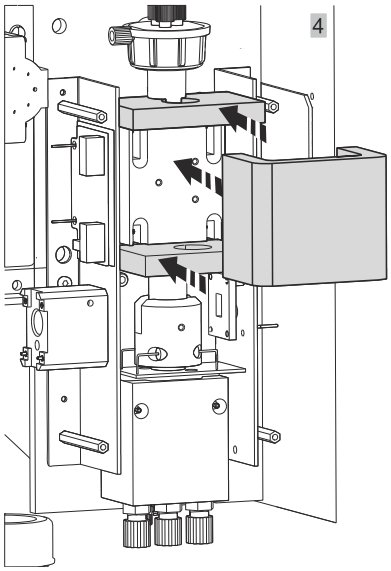
2. Release the screws of the cooling block and **carefully** move the entire reactor downwards until the printed circuit board (1) rests flush on the valve manifold (2).



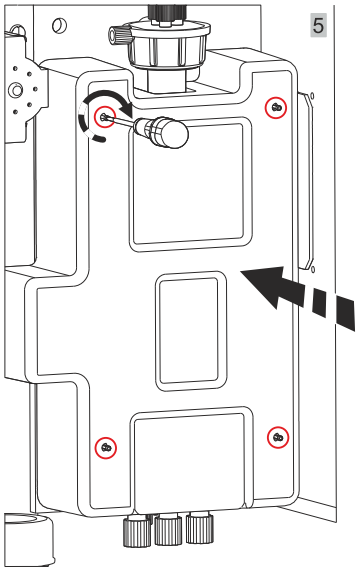
3. Fix the cooling block in place with the screws.



4. Remove the protective foil from the adhesive surfaces of the foam rubber parts. Insert the foam rubber parts as shown, exerting a slight amount of pressure on the adhesive surfaces.



5. Put the cover back on the reactor and fix it in place with the screws.



⚠ CAUTION

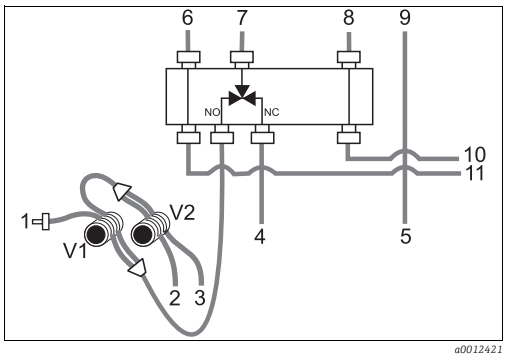
Hot surfaces

Danger of scalding

- Never put the analyzer into operation without ensuring that the reactor cover is intact and correctly installed.

5.2.4 Connecting the sample supply

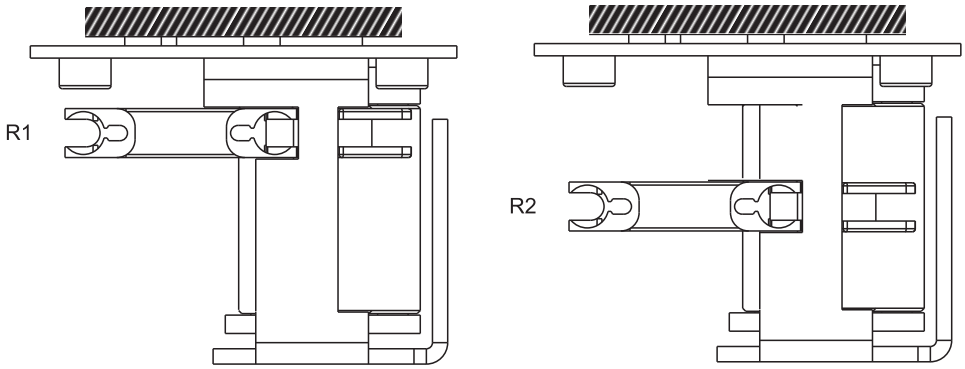
The valve hoses were partly removed from the valves for transportation. This prevents them from sticking or pressure being applied to a point in the hose over an extended period.



1 *Sample*
2 *Standard (30, 100 or 2500 mg/l O_2)*
3 *0 mg/l O_2 standard*
4 *Sulfuric acid R1*
5 *Dichromate solution R2*
6 *From sample/acid pump P1*
7 *Inlet to sample/acid pump P1*
8 *From reagent pump P2*
9 *Inlet, reagent pump P2*
10 *Inlet, reagent to reactor*
11 *Inlet, sample/acid to reactor*

Fig. 7: Valves and valve hoses

1. Insert the valve hoses (→ 7).
2. Secure the hose cases in the appropriate pump holders: Sample/acid pump **left** (rear position), reagent pump **right** (center position).
   ↳ The direction of flow of the sample and reagent must be counterclockwise.



3. Connect the sample supply.
4. Connect the tubes from canisters containing reagents and standards to the following nozzles:

Canister	Tube designation (mark)
Sample	P
Reagent R1	none (PTFE hose)
Reagent R2	R2
Standard	S
0 mg/l O_2 standard	0

5.2.5 Collecting vessel (optional)

1. Mount the base plate and collecting vessel on the left-hand side of the analyzer.
2. Connect the hoses for sample intake, sample supply to analyzer and sample overflow to the appropriate hose connections (→ 3, → 10).

Electrical connection of the level measurement unit and agitator → 22

5.2.6 Back-flush pump (optional)

▶ Install the back-flush pump unit on the analyzer's side as shown in diagram. Use the couplings shipped with the device for this purpose.

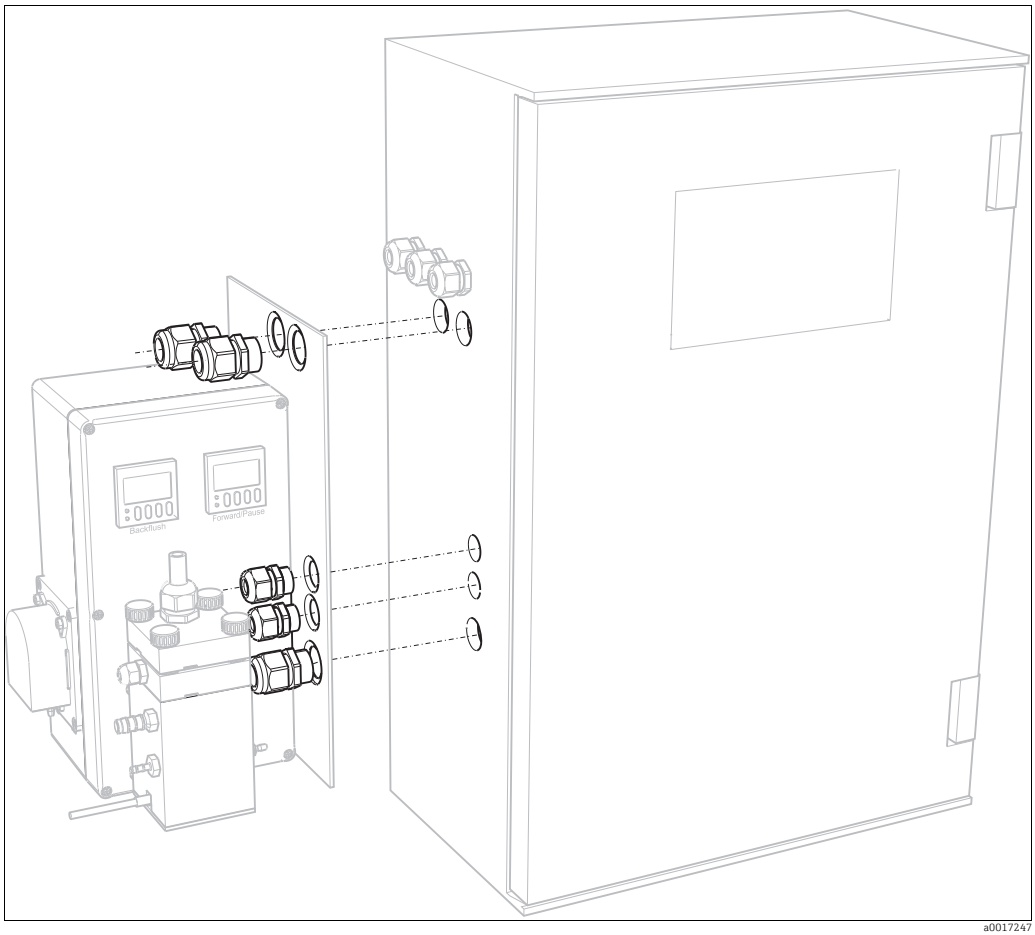


Fig. 8: Installation of the back-flush pump unit

5.3 Installation examples

5.3.1 Stamoclean CAT221

A complete measuring system comprises:
- A CAT221 filter system
- An agitated collecting vessel
- A CA71CODcr analyzer
- A sample pump or pressurized sample supply
- A compressor or compressed air line

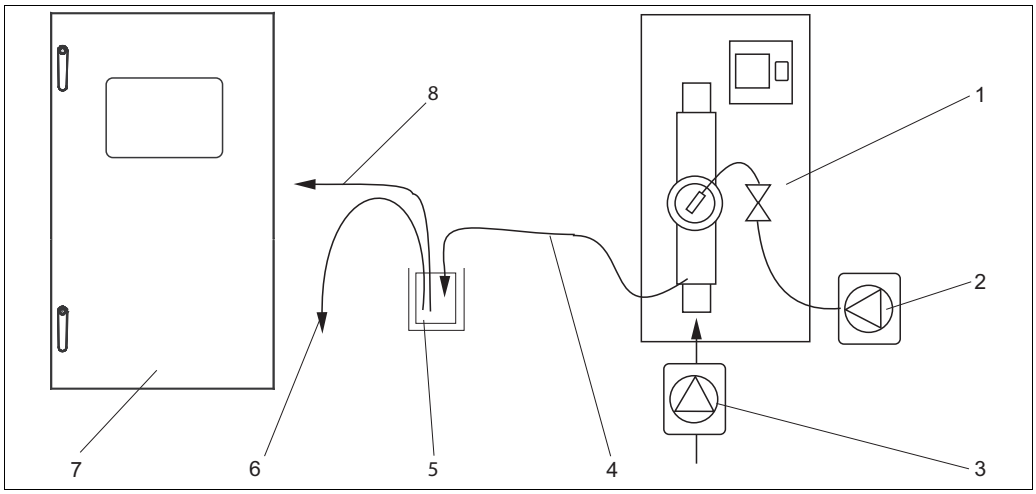


Fig. 9: Complete measuring system

1	*Backwash filter*	*5*	*Agitated collecting vessel*
2	*Compressor or compressed air line*	*6*	*Overflow*
3	*Sampling pump or sample pressure line*	*7*	*Analyzer*
4	*Sample outlet*	*8*	*Sample line to analyzer*

5.3.2 No filter used

A complete measuring system comprises:

- A sample pump with backwash function
- An agitated collecting vessel
- A CA71CODcr analyzer

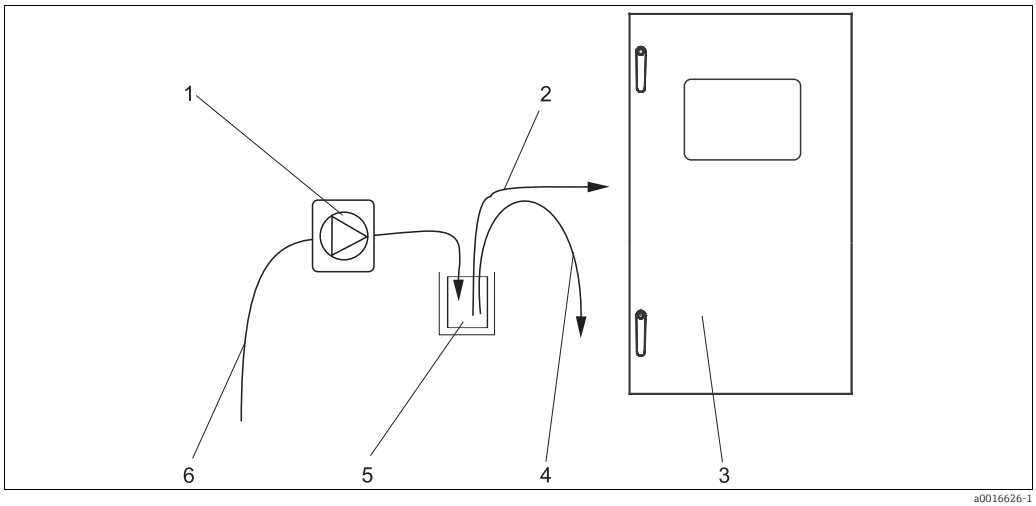


Fig. 10: Complete measuring system

1	*Sample pump with backwash function*	*4*	*Overflow*
2	*Sample line to analyzer*	*5*	*Agitated collecting vessel*
3	*Analyzer*	*6*	*Sample*

5.4 Post-installation check

1. After installation, check that all connections are secure and leaktight.
2. Ensure that the hoses cannot be removed without effort.
3. Check all hoses for damage.

6 Electrical connection

⚠ WARNING

Device is energized

Inappropriate connection can cause serious injuries or death

- The electrical connection may only be established by an electrical technician.
- The electrical technician must have read and understood these Operating Instructions and must follow the instructions they contain.
- **Before beginning** the connection work, ensure that no voltage is applied to the cables.

6.1 Connection conditions

NOTICE

Reaching the terminal block and avoiding damage

- You have to fold out the frame of the analyzer to reach the terminal block.
- After folding the frame into position, check that all the tubes are properly secured and fit properly into the bottles, as otherwise there is a risk of flooding or incorrect measurement.

Fold out the frame as follows:

1. Release the two bottom Allen screws (AF 6) by 3-4 rotations (→ 11, item 1).
2. Unscrew the two upper Allen screws completely so that the frame folds out.
   ↳ In this way, you reach the terminal block (item 2).

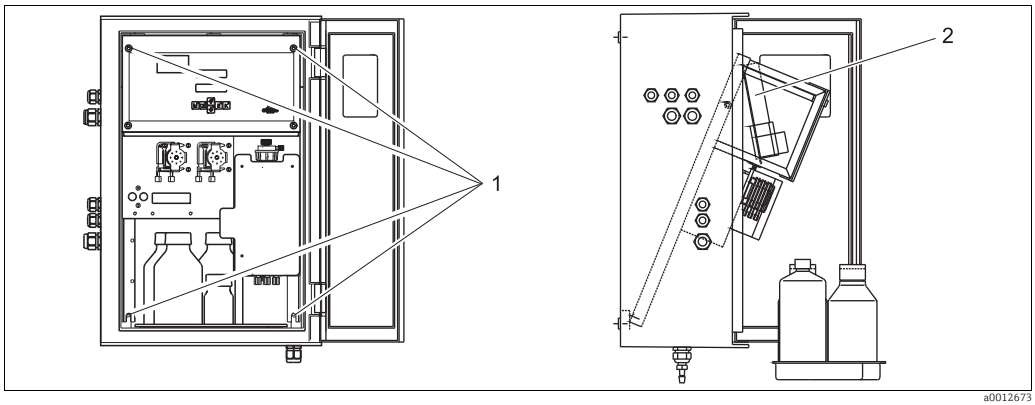


Fig. 11: Folding out the frame

1 Allen screws AF 6
2 Terminal block

NOTICE

The device does not have a mains switch

- You must install the device near an easily accessible fused socket.

6.2 Connecting the measuring device

6.2.1 Terminal assignment

⚠ CAUTION

The diagram shown (→ 12) is an example

The terminal assignment and cable colors can deviate from the actual assignment and colors!

▶ Only use the terminal assignment of the sticker **in the device** (→ 13) to connect your analyzer!

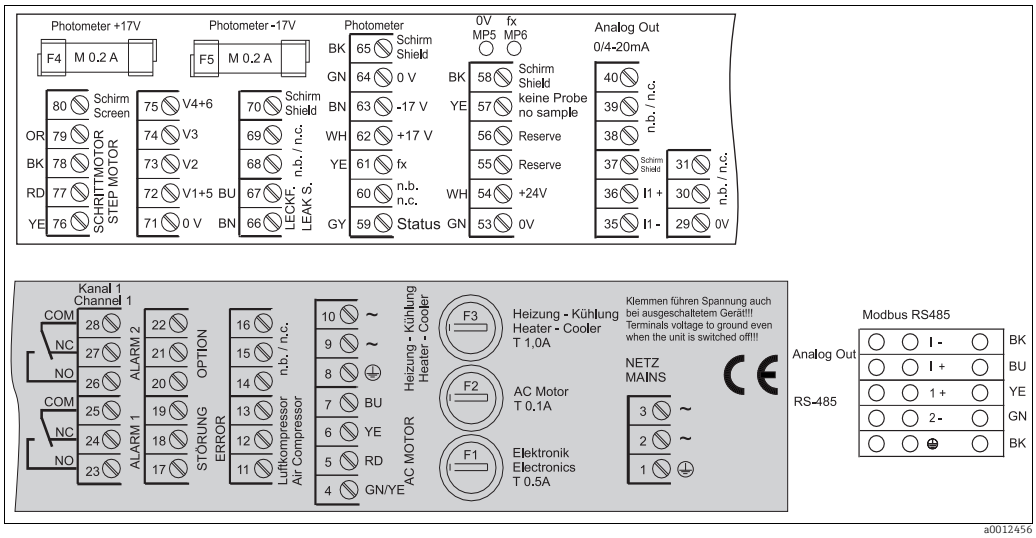


Fig. 12: Example of the connection sticker

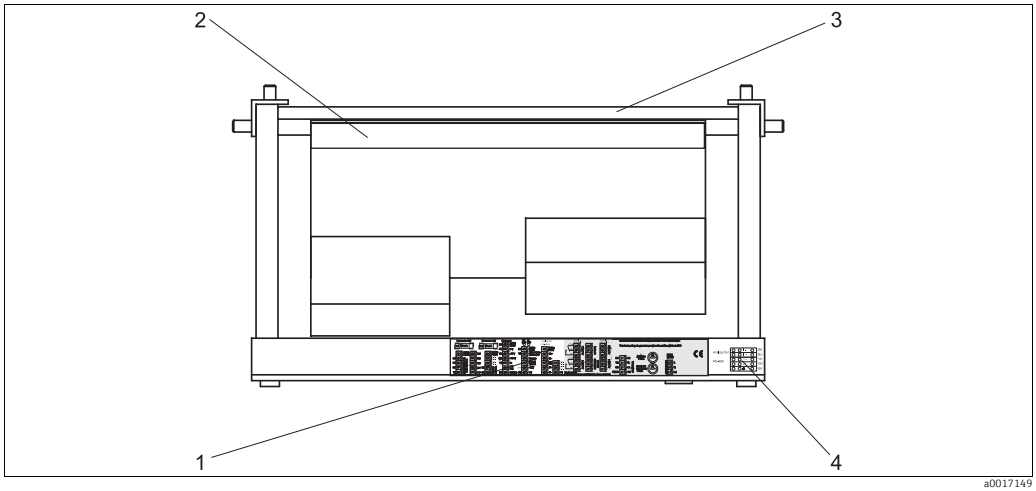


Fig. 13: Analyzer from above (open/folded out)

1 Connection compartment sticker
2 Printed circuit board with terminal strip
3 Backside of the analyzer
4 Connection compartment sticker, Modbus RS485 (optional)

Version without Modbus

Function	Designation	Terminal One-channel version
Mains	~	3
	~	2
	PE[1)]	1
Alarm value 1, channel 1	COM	25
	NC	24
	NO	23
Alarm value 2, channel 1	COM	28
	NC	27
	NO	26
Fault	COM	19
	NC	18
	NO	17
Unassigned	COM	22
	NC	21
	NO	20
Analog output 1 0/4 to 20 mA	+	36
	–	35
	Screen	37
Sample conditioning remote control	Input	57
	0 V	53

1) Brass screw with bolt at top right in the connection compartment (marked with ⏚)

Version with Modbus

Function	Designation	Terminal
Mains	L	3
	N	2
	PE[1)]	1
Alarm value 1	COM	25
	NC	24
	NO	23
Alarm value 2	COM	28
	NC	27
	NO	26
Fault	COM	19
	NC	18
	NO	17
Unassigned	COM	22
	NC	21
	NO	20

Function	Designation	Terminal
Analog output 1 0/4 to 20 mA[2)]	+	I +
	–	I -
	Screen	⏚
Modbus RS485 [3)]	+	1 +
	–	2 –
Sample conditioning remote control	Input	57
	0 V	53

1) Brass screw with bolt at top right in the connection compartment (marked with⏚)

2) At Modbus module terminals

3) The Modbus module is already installed and wired up at the factory.

NOTICE

Terms for special terminals

- Limit switches 1 and 2 do not need to be connected if the PLC sets its own alarm values at the analog output.
- When using a sample conditioning system: Connect terminals 57 and 53 on CA71 to the corresponding terminals of the sample conditioning system. For the allocation of these terminals, see the sample conditioning system operating instructions.
- If there is a 24 V voltage at terminal 57, the analyzer will not begin measurement (sample not ready). To start measurement, the voltage must stay at 0 V for at least 5 seconds.
- All external relay contacts have to be connected to 230 V.

6.2.2 Signal connection

Shielding of the analog outputs

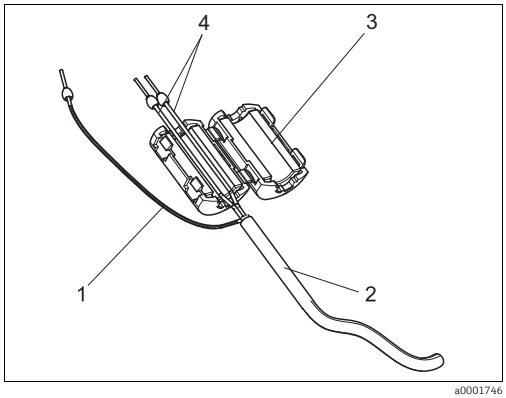


Fig. 14: Interference protection of the signal cable

1 Cable shield (to PE in connection compartment!)
2 Signal cable
3 Interference suppressor
4 Cable cores of the signal cable

The interference suppressor attenuates electromagnetic interference on control, power and signal lines.

After connecting the data transfer cables:

1. Clip the interference suppressor (in scope of delivery) on the cable cores (not on the outer insulation of the cable!). → 14).

2. Route the cable shield around the interference suppressor on the outside and connect it to the PE (brass screw with bolt) at the top right in the connection compartment.

One-channel version

Connection	Designation	Function
Signal inputs	Leak	Liquid has collected in the drip pan
	No sample	No sample available, measurement is not started, display flashes
Signal outputs	AV 1	Alarm value 1 exceeded or undershot
	AV 2	Alarm value 2 exceeded or undershot
	Fault	Retrieves error message using operation menu
	measurement end	Displays "Measurement finished" (5 s)
Analog output	I-1 channel 1	0 or 4 mA = measuring range start 20 mA = measuring range end

6.2.3 Switching contacts

	Terminal connection for condition fulfilled	Terminal connection for condition not fulfilled	Terminal connection for power off
AV 1	A: 25 - 23 R: 25 - 24	A: 25 - 24 R: 25 - 23	25 - 24
AV 2	A: 28 - 26 R: 28 - 27	A: 28 - 27 R: 28 - 26	28 - 27
Fault	A: 19 - 17 R: 19 - 18	A: 19 - 18 R: 19 - 17	19 - 18
Unassigned	22 - 20 16 - 14 13 - 11	22 - 21 16 - 15 13 - 12	22 - 21 16 - 15 13 - 12
A = NO current configured R = NC current configured			

"Condition fulfilled" means:
- AV 1: concentration > Alarm value 1
- AV 2: concentration > Alarm value 2
- Fault: error occurred

Contacts AV 1, AV 2 and fault are only affected during automatic operation.

6.2.4 Serial interface

RS 232 of CA71		COM 1/2 at PC	
SUB-D, nine-pin	Function	Function	SUB-D, nine-pin
3	TxD	RxD	2
2	RxD	TxD	3
8	CTS	RTS	7
		CTS	8
5	GND	GND	5
Software protocol: 9600 baud, 8 data bits, 1 stop bit, no parity (9600, N, 8, 1) Output format: ASCII			

The results (measured value+engineering unit) are output in the "Data memory-Measured values" menu.
The calibration results (measured value+engineering unit) are output in the "Data memory-Calibration factors" menu.

A null modem cable is required (crossed wires for RxD/TxD and RTS/CTS).
It is not possible to configure the interface at the analyzer.

The following commands can be sent from the PC in order to read out data:
- "D" = Data memory-Measured values
- "C" = Data memory-Calibration factors
- "S" = Setup (parameter entry, configuration...)
- "F" = Frequency (current)

6.3 Connecting the collecting vessel

1. Disconnect the analyzer from the mains.
2. Fold out the frame (→ 17).
3. Guide the cable of the level measurement unit into the analyzer and connect the connecting cables as follows:
   - Black cable (BK) in terminal 58
   - Yellow cable (YE) in terminal 57
   - White cable (WH) in terminal 54
   - Green cable (GN) in terminal 53
4. Fold the frame of the analyzer back in.
5. Connect the analyzer and the agitator of the collecting vessel to the mains.

6.4 Guaranteeing the degree of protection

Only the mechanical and electrical connections that are described in this manual, and are necessary for the required, designated application, may be established on the device supplied.

▶ Please play close attention when performing the work as degrees of protection individually confirmed for this product (ingress protection (IP), electrical safety, EMC interference immunity) can no longer be guaranteed as a result of things such as:
- Leaving off covers
- Not tightening cable glands sufficiently (must be tightened with 2 Nm for the confirmed level of IP protection)
- Loose or insufficiently tightened cables/cable ends)
- Conductive cable strands left in the device

6.5 Post-connection check

Carry out the following checks after electrical connection:

Device status and specifications	Note
Is the analyzer or cable externally undamaged?	Visual inspection

Electrical connection	Note
Does the supply voltage correspond to the data on the nameplate?	230 V AC / 50 Hz
Are current outputs shielded and connected?	
Are the mounted cables relieved of tension?	
Cable type properly disconnected?	Guide power supply and signal lines separately over the entire travel distance. Separate cable channels are ideal.
Cable routing without scuffing or crossovers?	
Are power supply and signal lines connected correctly according to wiring diagram?	
Are all screw terminals tightened?	
Are all cable entries mounted, tightened and leak-resistant?	
Interference suppressor at the analog output?	
Current output test	See procedure below

Current output test:

1. Hold both arrow keys down (see "Display and operating elements" chapter) and connect the analyzer to the mains. Wait until the display shows "0 mA".
2. Check on your PLC, PCS or you data logger whether the current value is the same.
3. Press the E key. This allows you to browse to the next current values (4, 12, 20 mA, depending on the setting).
4. Check that the respective current values are also on your PLC, PCS or your data logger.
   ↳ If the values are not present:
   1. Check the terminal assignment for analog output 1 or 2.
   2. Disconnect the analog outputs from your PLC, DCS or data logger and repeat steps 1-4 but this time measure the current values at the terminals of the analyzer and not at the PLC, DSC or data logger.
      ↳ If these current values are correct, check your PLC, DCS, the data logger and/or the electrical cables.

7 Operation options

7.1 Overview

7.1.1 Analyzer control

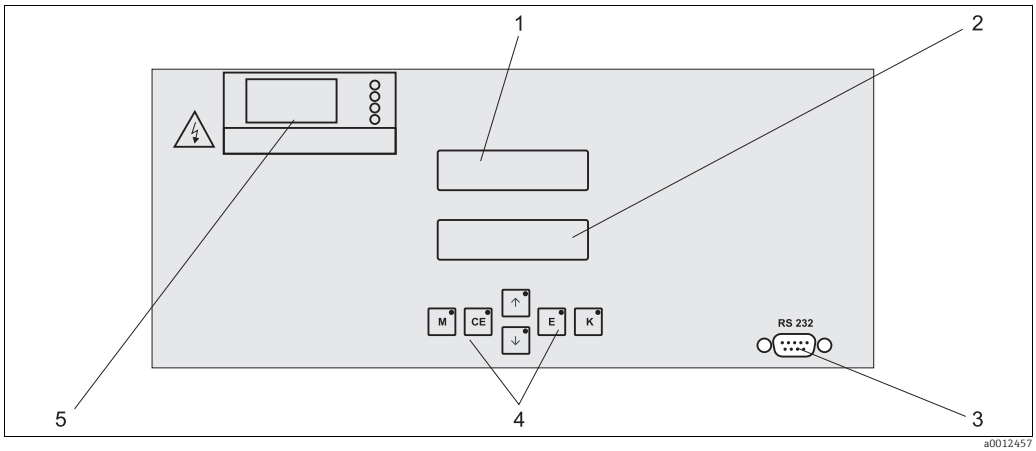


Fig. 15: Display and operating elements

1 LED display (measured value)
2 LC display (status)
3 Serial interface RS 232
4 Operating keys and control LEDs
5 Temperature indicator of the heating element

7.1.2 Timers for the back-flush pump

The back-flush pump for sample preparation is controlled by two multi-function timers. The timers are already installed and wired-up at the factory.

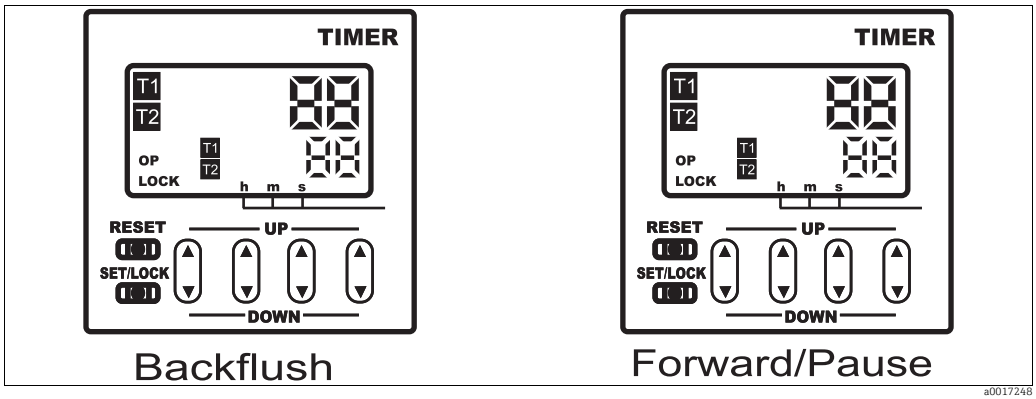


Fig. 16: Timers of the back-flush pump

7.2 Access to the operating menu via the local display

The operating keys and the integrated indicator LEDs have the following functions:

Key	Key function	Indicator LED function
M	– "Auto measuring" option – back to the main menu from all sub-menus	Alarm value 1 exceeded
CE	– backwards in the sub-menu (horizontal, see Appendix,)	Alarm value 2 exceeded
↑	– backwards in the main menu (vertical) – Increase value	Measuring range exceeded
↓	– forwards in the main menu (vertical) – Reduce value	Measuring range undershot
E	– Select option – Adopt value, forwards in the sub-menu (horizontal)[1)]	Retrieve error message
K	– Selection in the sub-menu – Select sign +/-	Cleaning interval running

1) The number of decimal places can be changed by pressing the E key and ↑ or ↓ key simultaneously.

7.2.1 Main menu

Access the main menu by holding down the M key until AUTO MEASURING is displayed. For the main menu options and information about them, please see the following table.

Menu item	Display	Info
AUTO MEASURING	AUTO MEASURING	Calibration, measurement time-controlled actions
PARAMETER ENTRY	PARAMETER ENTRY	Default settings for measuring ranges, alarm values, calibration
CONFIGURATION	CONFIGURATION	Basic settings such as parameters, engineering units, assignment of analog outputs and alarm values, date, time, offset values.
LANGUAGE	LANGUAGE	Selecting menu language
ERROR DISPLAY	ERROR DISPLAY	Displaying error messages
MAINTENANCE	MAINTENANCE	For manually emptying the reactor and composite container and level of the composite container
SERVICE	SERVICE	Manually switching valves and pumps
DATA STORAGE	DATA MEMORY	Last 1024 measured values

7.2.2 AUTO MEASURING

The action "measuring" is triggered by time-control.
The settings for this are made in the "PARAMETER ENTRY" menu.
The respective action is displayed in the LC display. The most recently registered concentration value is displayed until the end of the next measurement.

Otherwise, "wait" is displayed when
- the time of the first measurement has not yet been reached or
- the measuring interval has not yet expired.

"Measuring" flashes when the analyzer is ready for the next measurement but has not yet received the enable signal from the sample collector or the sample conditioning unit.

7.3 Modbus RS485 (optional)

The Modbus module is preconfigured at the factory (see "Protocol-specific data", → 54).
The transmitted measured value is a current [mA] which is calculated in the module from an internal register value.

8 Commissioning

8.1 Function check

⚠ CAUTION

Avoid damage due to incorrect power supply and inaccurate or insecure hose connections.

- ▶ Check that all connections have been made correctly. Check, in particular, that all hose connections are secure, so that no leaks occur.
- ▶ Ensure that the power supply voltage corresponds to the voltage specified on the nameplate.

8.2 Switching on the measuring device

⚠ CAUTION

Inappropriate handling of the waste containers can cause chemicals to leak and pose a threat to humans and the environment

- ▶ The waste containers must be secured in place under the analyzer to ensure correct operation.
- ▶ Prior to commissioning, you must fill the container for the chromate waste with the detoxicant (reagent 3, CAY440 or CAY441).

When the analyzer has been configured and calibrated, the measuring cycle starts automatically. Entering parameters is no longer necessary.

Initial commissioning or new settings for device parameters

1. Plug-in the plug into a socket.
2. Press the M key until AUTO MEASURING is displayed.
   ↳ Preheat the analyzer in the AUTO MEASURING mode.
   - At the start of measurement with a cold analyzer, new hoses, longer interruption of the measurement or variable measurement cycles, the first measuring results will be errored. The reaction is temperature-dependent and if the temperature is too low the predefined reaction time is insufficient for a complete reaction. For this reason, never carry out calibration with a cold analyzer. Wait for two or three measurements to be taken before carrying out calibration.
   - The accuracy mode and increased rinse cycles improve the repeatability and accuracy of the measurement.
3. Select the CONFIGURATION menu and configure all the parameters up to and including "Tank capacity".
   ↳ With M you can return to the main menu.
4. Now work through the PARAMETER ENTRY menu.

NOTICE

Incorrectly combined function controls can damage the analyzer.

- When using the manual operation via the Service menu, make sure that chloride-containing sample never gets in contact with reagent R2 in the reactor. Otherwise precipitating silver chloride can cause film or coating on the optical windows, which would result in measuring errors.
- Make sure you have detailed knowledge of how the analyzer works and operates before you make any settings in the Service menu.
- Exit the Service menu with the "M" key. All functions will be reset to the delivery state then.

SERVICE menu

1. Switch the P2 reagent pump "on" (select P2 with E and set to "g" with ↑).
   ↳ Leave it running until you can tell that there is reagent at the reactor.
   After this, switch P2 "off" (s) again with ↓.
2. Drain the reactor by switching valves V1 and V4 to passage for chromate waste (V1: S; V4: o).
3. Close the reactor again (V1: P; V4: c).
4. Switch the valves to passage for reagent 1 (select V3: H; with E or CE, switch to "H" with ↑).
5. Switch the P1 sample pump "on" (select P1 with E and set to "g" with ↑).
   ↳ Leave the pump running until you can tell that there is reagent 1 at the reactor.
   Switch P1 off again (set to "s" with ↓).
6. Now switch the valves to passage for standard (select V1: S, V2: S, V3:P; with E or CE, switch to "S" with ↑).
7. Switch the P1 sample pump "on" (select P1 with E and set to "g" with ↑).
   ↳ Leave the pump running until you can tell that there is standard at the reactor.
   Switch P1 off again (set to "s" with ↓).
8. Now switch the valves to passage for 0 mg/l O_2 standard (V1: S, V2: 0, V3:P).
9. Switch the P1 sample pump to "on".
   ↳ Leave the pump running until you can tell that there is 0 mg/l O_2 standard at the reactor.
   Switch P1 off again (set to "s" with ↓).
10. Empty the reactor (V1: P, V2: S, V3: P, V4: o).
11. Close the reactor again (V4 : c).
12. Now switch the valves to passage for sample (V1: P, V2: S, V3:P).
13. Then switch on the P1 sample pump. If you notice that there is sample at the reactor, let the pump run for another minute.
    ↳ This removes any residues of standard or 0 mg/l O_2 standard.
    Switch P1 off again (set to "s" with ↓).
14. Empty the reactor (V1: P, V4: o).
15. Press the M key.
    ↳ This takes you back to the main menu.

The analyzer starts automatically (triggered by a control signal or integrated timer) with the "Measurement" procedures with your device parameters (1st measurement and the respective intervals control the procedure).

8.3 Setting the operating language

The following languages are available:
- Deutsch
- English

1. Hold M down until AUTO MEASURING is displayed.
2. Press ↓ to navigate down to LANGUAGE.
3. Press E to select the menu.
4. Select your language with ↓.
   ↳ Press E to select your chosen option.
5. Press M and then E.
   ↳ You have set the desired language and are now back in the measuring mode.

8.4 Configuring the measuring device

8.4.1 CONFIGURATION

Some settings that can be made in this menu affect the defaults in the PARAMETER ENTRY menu.
▶ Complete the CONFIGURATION menu first during initial startup.

Menu item	Range of adjustment (default settings in bold)	Display	Info
Code number	**03**	Code-No. ? 0	Input 03. If an incorrect code is entered the program exits the sub-menu.
Photometer	Depending on specification: **COD-A** **COD-B**	Photometer COD-A	The setting displays the parameter that is being measured. This is defined by the product specification and set in this option at the factory. Do not change the value. Otherwise, you will receive an "Incorrect photometer" error message.
Default settings	yes / no	default setup y:↑+↓ n:E	If "yes" is selected, all the settings are reset to the factory settings. You must set the current date and time (scroll through the menu, fourth-last point). In the event of a reset, the date for the 1st calibration is set to the following day.
Measuring unit	**mg/l O_2**	Unit of measure mg/l O2	No options can be selected
Calibrate slope	yes / no	Calibrate slope? y:↑+↓ n:E	Manual calibration. Use the K key to start measuring the standard solution to determine the calibration factor (slope of the calibration lines). **The calibration factor depends on the frequency offset. For this reason, first define the frequency offset and only then define the calibration factor using this function.**

Menu item	Range of adjustment (default settings in bold)	Display	Info
Calibration factor [1]	0.20 to 5.00 **1.00**	Calibr. factor 1.00	The calibration factor is the ratio of the measured concentration of the calibration standard to the predefined concentration of the standard (see "PARAMETER ENTRY", calibration solution). The deviation results from factors such as reagent aging, aging of constructive components, etc. The calibration factor compensates for these effects. CA71 checks the registered calibration factor logically. If the factor lies outside of the error tolerance, the calibration is automatically repeated. If the repeat also lies outside, an error message appears and the analyzer continues to work with the most recently registered, logically correct factor. The last 100 calibration factors are filed in the memory with the date and time and can be retrieved by pressing the [K] key. The calibration factor ca be changed manually.
Concentration offset	**0.00** to 50.0 mg/l O_2	c-Offset 0.00 mg/l	The offset specifies the zero shift of the calibration function. (Change the sign with the [K] key.)
Dilution	0.10 to 100.00 **1.00**	Dilution 1.00	If the sample is diluted externally between taking the sample and the analyzer, the dilution factor has to be entered here.
Rinse cycles	**1** to 5	Rinse cycles 1	For cleaning the reactor and drawing in the sample for the next measurement. Increase the number of rinse cycles if the sample concentration fluctuates greatly or in the event of a long sample line to the analyzer.
Stripping time	1 to 30 min **10 min**	Stripping time 10 min	During this time, any chloride in the sample is removed to avoid incorrect measured values. Increase the stripping time if chloride concentrations > 1g/l Cl^- (chloride precipitate in the reactor or excess COD). – ≤ 1 g/l CL^- : 10 min – ≤ 2 g/l CL^- : 15 min – ≤ 3 g/l CL^- : 20 min – ≤ 4 g/l CL^- : 25 min – ≤ 5 g/l CL^- : 30 min
Digestion time	10 to 180 min **120 min**	Digestion time 120 min	You can shorten the digestion time for samples that are easily digested. In such situations, check whether the measurement results are correct by using comparison measurements based on the standard method.
Accuracy mode	on **off**	Accuracy mode off	**Accuracy mode="off"** The reactor is rinsed with sample. **Accuracy mode="on"** The accuracy mode increases the repeatability and accuracy of the measurement. The reactor is rinsed with 0 mg/l standard, which increases the consumption of this standard.
Analog output	0 to 20 mA / **4 to 20 mA**	Analog output 4-20 mA	Selection for the measuring range scope. If the concentration measuring range is 0 to x mg/l O_2, either 4 mA or 0 mA corresponds to 0 mg/l O_2. The end of the measuring range is the same in both cases at 20 mA.

Menu item	Range of adjustment (default settings in bold)	Display	Info
Alarm value AV1	NO **NC** Changes will only be activated after a Reset (Power off/on)!	Alarm val. 1 norm. closed	Setting as to whether the contact for alarm value 1 works as an NO or NC contact.
Alarm value AV2		Alarm val. 2 norm. closed	Setting as to whether the contact for alarm value 2 works as an NO or NC contact.
Error contact		Error contact norm. closed	Setting for whether error contact factory as NO current or NC current contact
Current date/time	01.01.96 00:00 to 31.12.95 23:59	act. Date/Time 25.01.02 15:45	Setting the system clock. Format DD.MM.YY hh:mm.
Calibrate offset	yes / no	Calibrate offs yes:K no:E	Frequency offset[1)] Pressing the [K] key starts blind value measurement for compensating the reagent's inherent color.
Frequency offset[1)]	**COD-A** 500 ... 1500 **1000** **COD-B** 0 ... 500 **200**	f-Offset [Hz] 1000	Manually changing the frequency offset.
Tank capacity	0 to 50 l **5.0 l**	Tank capacity 5.0 l	The volume entered must correspond to the volume of the collecting tank for chromate waste. When the volume entered is reached, an error is displayed ("Empty tank!"). This error can be canceled once the collecting tank has been replaced (menu "Maintenance/Empty tank?").

1) Redetermine the frequency offset and the calibration factor every time the reagents are changed, the photometer is replaced and the digestion time is changed.

8.4.2 PARAMETER ENTRY

Menu item	Range of adjustment (default settings in bold)	Display	Info
Measuring range start	COD-A: 0 to 200 mg/l / **0 mg/l** COD-B: 0 to 5000 mg/l / **0 mg/l**	Range start 0.00 mg/l	The specified concentration is allocated a value of 0 or 4 mA[1)] at the analog output.
Measuring range end	COD-A: 50 to 200 mg/l / **200 mg/l** COD-B: 50 to 5000 mg/l / **5000 mg/l**	Range end 200 mg/l	The specified concentration is allocated a value of 20 mA at the analog output.
Alarm value AV1	COD-A: 0 to 200 mg/l / **50 mg/l** COD-B: 0 to 5000 mg/l / **1000 mg/l**	Alarm val. 1 50 mg/l	Concentration threshold value for limit relay 1, (switching hysteresis 2% of alarm value).
Alarm value AV2	COD-A: 0 to 200 mg/l / **150 mg/l** COD-B: 0 to 5000 mg/l / **4000 mg/l**	Alarm val. 2 150 mg/l	Concentration threshold value for limit relay 2, (switching hysteresis 2% of alarm value).
Time 1st measurement	01.01.96 00:00 to 31.12.95 23:59	1. Measurement 10.02.02 08:00	Date format DD.MM.YY, time hh.mm. After each change the device does not wait for the measuring interval. If the measurement is to start immediately, set the time in the past.
Measuring interval	2 min to 1440 min **2 min**	Meas. interval 2 min	Time between two measurements. If the setting is 2 minutes, the measurements take place without any pauses.

Menu item	Range of adjustment (default settings in bold)	Display	Info
Time 1st Calibration	01.01.96 00:00 to 31.12.95 23:59	1. Calibration 01.01.02 08:00	Time of 1st automatic calibration (DD.MM.YY, time hh.mm. After each change the device does not wait for the calibration interval. If the calibration is to start immediately, set the time in the past.
Calibration interval	0 to 720 h **0 h**	Calib.interval 0 h	Time between two calibrations. The "0 h" setting means that automatic calibration does not take place. You can perform manual calibrations at any time.
Calibration solution	COD-A: 1 to 200 mg/l / **100 mg/l** COD-B: 1 to 5000 mg/l / **2500 mg/l**	Calib. solution 100 mg/l	Concentration of the calibration standard.

1) Option 0 or 4 mA: see "CONFIGURATION".

8.4.3 ERROR DISPLAY

- This menu is a "Read-Only-Menu".
- You can find the individual error messages, their meaning and solutions to problems in chapter "Troubleshooting instructions".
- If there is at least one error message, the signal output is set to "fault".
- Causes of faults are requested for every measurement. If an error which occurred previously no longer exists, it is automatically canceled.

8.4.4 MAINTENANCE

Menu item	Display	Info
Empty reactor	Empty reactor? yes:K no:E	Starts a process of cooling, draining and rinsing the reactor so you can perform maintenance work on the reactor assembly without any safety hazards. Also empty the reactor before replacing the hoses to remove the acid from the pump hose.
Tank fill level (read only)	Tank fill level 0.0 l	Displays the current level.
Empty tank?	Empty tank? yes:K no:E	Empty the tank manually and then select "Yes" in this menu. This resets the internal level counter for the composite container to 0.

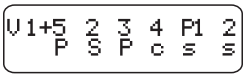
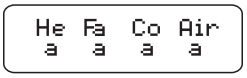
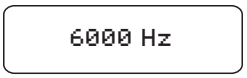
8.4.5 SERVICE

In this menu, you can trigger direct function controls.

NOTICE

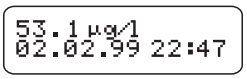
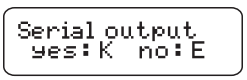
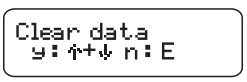
Incorrectly combined function controls can damage the analyzer.

- ▶ When using the manual operation via the Service menu, make sure that chloride-containing sample never gets in contact with reagent R2 in the reactor. Otherwise precipitating silver chloride can cause film or coating on the optical windows, which would result in measuring errors.
- ▶ Make sure you have detailed knowledge of how the analyzer works and operates before you make any settings in the Service menu.
- ▶ Exit the Service menu with the "M" key. All functions will be reset to the delivery state then.

Menu item	Display	Info
Pumps and valves		"Virtual switching board" Various valve and pump combinations can be selected. The setting options are: – Valve 1 and valve 5: P (sample/rinse water outlet) or S (standard/ chromate waste outlet) – Valve 2: S (standard) or 0 (0 mg/l O_2 standard) – Valve 3 : P (sample) or H (acid) – Valve 4 (to empty the reactor): c (closed) or o (open) – Pump 1 (sample or standard/0 mg/l O_2 standard) and pump 2 (reagents): s (stop) or g (go) The following valve combinations are possible: – V1: P, V2: S, V3:P Passage for the sample. This combination is automatically reset on leaving the service menu. – V1: S, V2: S, V3:P Passage for standard solution – V1: S, V2: 0, V3:P Passage for 0 mg/l O_2 standard – V1: P, V2: S, V3:H Passage for reagent 1
Heating and cooling		He = Heating Fa = Cooling ventilator on reactor Co = Peltier cooling Air = Compressor (air supply to reactor)
Frequency		Signal frequency of the photometer (read only)

In the event of silver chloride precipitate, clean the reactor with 2% ammonium hydroxide solution.

8.4.6 DATA STORAGE

Menu item	Display	Info
Measured values		The data memory contains the last 1024 concentration measured values with date and time. If there are no values available, "Empty set" appears. Browse through the data sets by pressing the ↑ and ↓ keys.
Serial output		You can output all data sets (in ASCII-format) via the serial interface. For this, the receiving end (PC) must be configured like this: 9600, N, 8, 1. To send data, the PC must send the ASCII character 68 ("d").
Clear data		**This deletes all data sets.**

8.5 Setting the timer (only for version with back-flush pump)

When the pump is switched on the T1 fields are lit or flash red and yellow on the display, as does the OP message on the bottom left of the screen.

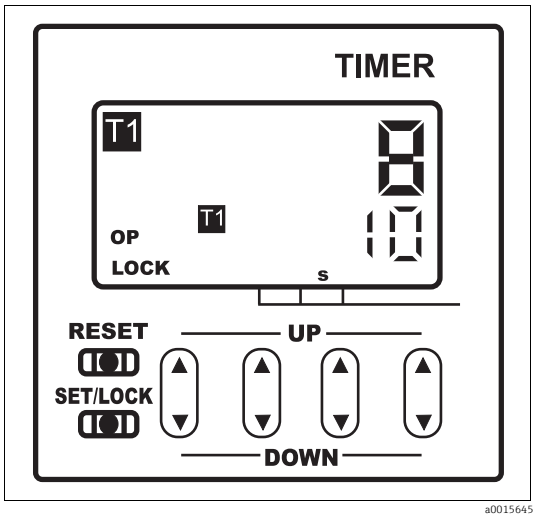


Fig. 17: Timer

The red number at the top displays the switch-on time that has already elapsed while the yellow value at the bottom displays the target value for the switch-on time. All values are full seconds.
When the pump is switched off the T2 fields light up or flash, as do the actual and target values for the switch-off time. The OP message is not displayed.
The switch cycle and the time values are already preset when the device is delivered from the factory.
However, you might need to alter the settings depending on the hose length or if a timer has to be replaced.

8.5.1 Operating the timers

1. Press the yellow SET/LOCK button on the bottom left while simultaneously pressing the blue rocker switch (located right beside the SET/LOCK button) up or down.
   ↳ The "LOCK" message on the bottom left of the display disappears and the device is in the programming mode. You can ignore the actual time highlighted in red on the screen.
2. By pressing the SET/LOCK button a second time, you can switch between the target value for the switch-on time (yellow T1 field is lit) and for the switch-off time (yellow T2 field is lit).
   ↳ The yellow value indicates the target value currently set.

You can change the target value by changing each individual position using the individual rocker switches located under the display area. Press the UP arrow to increase the value and the DOWN arrow to decrease the value.

3. Therefore in order to extend the switch-on period from 10 seconds to 20 seconds, for example, you must press the UP arrow of the second rocker switch from the right once only and the yellow T1 field must be lit.

Once both times are set correctly:

4. Lock the settings by pressing the SET/LOCK key and the adjacent rocker switch again simultaneously.
   ↳ "LOCK" appears on the display again.

8.5.2 Timer settings

The two timers control when the back-flush pump is switched on and off.
The timer on the right ("Forward") controls the sample transportation into the collecting vessel and the timer on the left ("Backflush") controls the back-flush function of the pump.

Setting the value for the pump delivery period into the collecting vessel (timer on the right, "Forward")

1. Set the time t_1 to 99 min, 99 s.
   ↳ The sample is transported forward into the collecting vessel.
2. Note the time up until the collecting vessel is filled up to the contacts of the level measurement unit.
3. Set twice that measured time as the new value for t_1.
4. Set any value from 1 to 3 minutes for the pause interval t_2 at the timer on the right.

Setting the value for the back-flush period (timer on the left, "Backflush")

1. Set the time t_1 to any value from 1 to 3 minutes.

Calculate the value for t_2 from the values previously set:

t_2 ("Backflush") = t_1 ("Forward") + t_2 ("Forward") - t_1 ("Backflush")

2. Set the calculated value as the new value for t_2 at the timer on the left.

Overview of the timer settings

Timer on the right "Forward"		**Timer on the left "Backflush"**	
t_1	**t_2**	**t_1**	**t_2**
Twice the filling time of the collecting vessel	1 to 3 min	1 to 3 min	$t_{1\ (Forward)} + t_{2\ (Forward)} - t_{1\ (Backflush)}$

Timer synchronization

▶ Briefly disconnect the power supply to the back-flush pump.

8.5.3 Time range

The correct time range for the switch-on and switch-off time is between 1 and 9999 seconds. It is normally set at the factory and should not be changed. To change the time ranges, you first have to remove the timer.

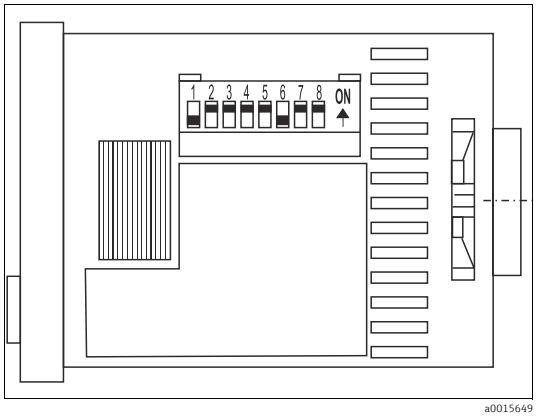


Fig. 18: Timer (side view)

When the timer is set correctly, switches 1 and 6 must be switched on, i.e. in the top position, while all the other switches are in the bottom position.

Changing the time range
e.g. switching from seconds to minutes

1. Remove the timer.
2. Set switches 1-3 for the switch-on time and switches 6-8 for the switch-off time as indicated in the written instruction under the switches.
3. Install the timer again.

8.5.4 Operation mode

Checking the configuration
The timer must be configured as an asymmetric clock, starting with the switch-on phase.

1. Press the SET/LOCK button and the adjacent blue rocker switch simultaneously.
   ↳ This switches you to the programming mode. The "LOCK" message on the display must have disappeared.
2. Now simultaneously press the SET/LOCK button and the second rocker switch from the right.
   ↳ "Pu-c" must appear on the display for approx. 2 seconds.

If another message appears:

3. Simultaneously press the SET/LOCK button and the rocker switch on the far right.
4. Then release both buttons.
5. Now press the rocker switch on the far right until Pu-c appears on the display.
   ↳ Select this setting by pressing the yellow RESET button located above the SET/LOCK button.
6. Then return to the secured mode by simultaneously pressing the SET/LOCK button and the blue rocker switch directly beside it.

8.6 Calibration

Recommendation:
Start offset and standard calibration manually via the CONFIGURATION menu. **First define the frequency offset and only then define the calibration factor.**
You can also view the current calibration data in this menu.

Calibration example 1
Manual calibration

1. Hold M down until AUTO MEASURING appears.
2. Use ↓ to move through the CONFIGURATION menu and press E.
3. Use ↑ to enter "3" and press E.
4. Use E to go to the "Calibrate offset?" item and press K to confirm.
   ↳ Once the offset calibration has been performed, the current frequency offset is displayed in Hertz.
5. Use CE to go to the "Calibrate slope?" item and press K to confirm.
   ↳ Once the standard calibration has been performed, the current calibration factor is displayed.
6. Press M.
   ↳ You are now back in the main menu (AUTO MEASURING).
7. Press E for the measuring mode.

Calibration example 2

Automatic calibration, consisting of two offset measurements and a calibration of the K-factor.

1. Hold M down until AUTO MEASURING appears.
2. Use ↓ to move through the PARAMETER ENTRY menu and press E.
3. Use E to go to the "Calibration interval" item.
4. Use the ↓ and ↑ keys to set a value > 0.
5. Press E to accept the value and then press M twice.
   ↳ You are now back in the main menu (AUTO MEASURING).
6. Press the E key again. This takes you back to measuring mode.
   ↳ The calibration is now carried out automatically.

9 Diagnostics and troubleshooting

Although the analyzer is not very prone to faults due to its simple assembly, problems can, of course, not be completely ruled out.
Possible errors, their causes and their possible remedies are listed below.

9.1 General troubleshooting

Errors	Possible cause	Tests and / or corrective measures
Measured values always the same	Reagents contaminated or aged	The dichromate solution (R2) must be orange to brown in color. It should not have a green hue. Sulfuric acid (R1) must be clear and colorless.
	No sample, no reagents	Make sure sample and reagents are supplied, check and clean the level measurement unit.
	System blocked upstream of the analyzer	Flush with 2 % ammonium hydroxide solution.
Measured values inaccurate	Incorrect concentration of standard	Check the concentration in the laboratory. Adjust the standard accordingly (PARAMETER ENTRY, "Calibration solution") or replace the standard.
	Reagents contaminated or aged	The dichromate solution must be orange to brown in color. It should not have a green hue.
	Reagent blank value too high	After replacing the reagents, carry out an offset calibration and then a calibration (CONFIGURATION, "Offset calibration")
	Incorrect setting for "photometer"	Check the setting in the CONFIGURATION menu, "Photometer"
	Sample suction time too short	Increase the number of rinse cycles (CONFIGURATION, "Rinse cycles").
	Matrix effects (substances that interfere with the photometric methods)	Detect interfering substances (see Technical Information, "Measuring principle"), possibly use sample conditioning
	Filter life too long	Take counter sample at analyzer inlet and check the concentration in the laboratory. If the analyzer measured values have no deviations, clean ultrafiltration modules or back-flush filters more frequently.
	System blocked or contaminated upstream of the analyzer	Flush with 2 % ammonium hydroxide solution.
	Dosing	Replace pump hoses.
	Optical cell dirty	First clean with 2% ammonium hydroxide solution and then rinse with water.
Counter sample in the laboratory delivers deviating measured values	Sample aging	Shorten time between sampling and analysis.
Measured value transfer errored	Wrong size of analog output	Check the setting (CONFIGURATION, "Analog output 1" or "- 2").
	Incorrect measuring range	Adjust measuring range (PARAMETER ENTRY, "Measuring range")
	Background noise	Check line for interference from strong sources of induction.
Analyzer will not switch on	No power	Check the electrical connection and ensure power supply.
	Fuse	Replace fuse F1 (time-lag 0.5 A)
Analyzer is running but display reading is incorrect or off	Initialization failed	Switch the analyzer off and after 30 seconds back on.

Errors	Possible cause	Tests and / or corrective measures
Pumps fail to run	Leak	See "Spillage error" error message
	Leak sensor bypassed	Interrupt contact between two leak sensors (pins 67-66)
	Fuse	Check all fuses and replace if necessary.
	Pump defective	Service
Measurement does not start	Leak at photometer	Service
"Measurement" display flashes	Time of 1st measurement not reached	The date must be between 01.01.1996 and the current date.
	Interval not expired	Change parameters.
Leak at photometer	Device or discharge blocked	Remove blockage. Service
Blockage, deposits in sample conditioning	Not enough sample conditioning	Shorten the cleaning intervals of sample conditioning. Improve filtering and homogenization.
	Water hardness	Lime deposits can be removed by flushing with 5% hydrochloric acid.

9.2 Diagnostic information on the local display

Error message	Possible cause	Tests and / or corrective measures
Calibration failed		If a calibration fails, you can enter a new calibration factor manually (CONFIGURATION menu, "Calibration factor"). Cancel the error message by switching the analyzer off and on briefly. If the error occurs frequently, you will have to search for the cause.
	Air bubbles in system	Start calibration manually (PARAMETER ENTRY, "1st calibration", change the date accordingly, start measurement) or enter a new calibration factor.
	Incorrect concentration of standard	Check the concentration in the laboratory. Adjust the standard accordingly (PARAMETER ENTRY, "Calibration solution") or replace the standard.
	Reagents contaminated or aged	Make sure that the reagent is not past its expiry date.
	Standard dosing defective	Check the valves for contamination, obstructions (visual inspection). Replace valve hoses if necessary.
	Incorrect photometer	Check the setting in the CONFIGURATION menu.
Offset cal. failed	Incorrect concentration of standard	Make sure that the standard is connected correctly.
	Reagents contaminated or aged	Make sure that the reagent is not past its expiry date.
	Valve hoses stuck	Move the hoses in the valve and coat them with silicone grease.
Photometer is dirty	Not enough light intensity at receiver	– Flush with 2 % ammonium hydroxide solution – When using a CAT430: Check the filter.
Wrong optical cell	Incorrect photometer configured	Check the setting in the CONFIGURATION menu, "Photometer".
Collecting vessel empty	No sample	Ensure sample transfer.
	Level measurement defective	Check level measurement at collecting vessel.
Spillage error	Leak at canisters or hoses	Replace defective components, clean and dry the analyzer or those components affected by the leak.

Error message	Possible cause	Tests and / or corrective measures
No measuring signal	Photometer defective	Inform E+H Service
	Electrical connection	Check all electrical connections.
	Fuse defective	Replace fuses F4 and F5 (semi-delay 0.2 A)
	Silver chloride precipitate	Because of a short stripping time or high salt contents (>5 g/l Cl^-) silver chloride precipitates in the reactor and can affect the measurement. Increase the stripping time or dilute the sample. Ensure that the expected measured value is still in the measuring range. Clean with 2% ammonium hydroxide solution and then rinse with water.
Empty tank!	The level measurement system has found that the maximum volume level of the tank has been reached.	Replace the tank with an empty tank and in the MAINTENANCE menu, select "Yes" when the prompt "Empty tank" appears. Make sure that the volume of the canister matches the volume set under CONFIGURATION "Tank capacity".
C-meas.range overflow	The COD of the sample is unusually high.	Dilute the sample if the error occurs frequently.
C-meas.range underflow	The COD of the sample is unusually low.	If the value drops below the measuring range lower limit, < 5 mg/l (CA71COD-A) or < 50 mg/l (CA71COD-B) appears on the display. 5 mg/l or 50 mg/l is output at the current output. You can call up the value actually measured in the memory.

9.3 Firmware history

Date	Version	Changes to the firmware	Documentation
02/2012	01.03.06	Extension ▪ Modbus RS485	BA00458C/07/XX/14.12
11/2011	01.03.03	Improvement ▪ Optimized data processing	BA00458C/07/XX/13.11
02/2011	01.03.02	Improvement ▪ Optimized calibration procedure	
10/2010	01.02.00	Improvement ▪ Optimized factory settings	
08/2010	01.00.09	Hardware modification	
06/2010	01.00.06	Improvement ▪ Modification in workflows ▪ Optimized factory settings	BA00458C/07/XX/06.10
11/2009	01.00.04	CA71COD original firmware	BA00458C/07/XX/11.09

10 Maintenance

⚠ CAUTION
Unauthorized maintenance work
Risk of injury and damage to equipment
- ▶ Any maintenance work **not** listed in the following sections may only be performed by Endress+Hauser Service.
- ▶ Wear your personal protective clothing when carrying out any maintenance work.

The use of components that have not been approved by Endress+Hauser renders the guarantee and the certified device conformity void.

10.1 Maintenance schedule

All maintenance duties that have to be carried out during normal operation of the analyzer are explained below.
If you are using a sample conditioning unit, e.g. CAT430, coordinate the maintenance work required for it with that of the analyzer. For this, read the maintenance chapter in the respective operating instructions.

Period of time	Duty	Note
weekly	– Check and note calibration factor (for service purposes) – Move the valve hoses and grease with silicone grease (extends the operating time). – Check the reagents and replace if necessary – Clean sample hose and valve 3 – Check collecting vessel for fouling and clean it if necessary	CONFIGURATION see chapter "Replacing reagents" see chapter "Cleaning valve 3"
monthly	– Check standards, replace if necessary – Rotate pump hoses – Grease pump hoses and pump heads with silicone grease – Clean filter mat of housing fan – Check collecting volume of waste container and clean if necessary	 see chapter "Replacing pump hoses" see chapter "Cleaning the filter mats of the housing fan"
every 2 months	– Replace pump hoses	see chapter "Replacing pump hoses"
every 6 months	– Replace valve hoses	– see chapter "Replacing valve hoses"

Prior to working on the reagent hoses, the hoses must be disconnected from the canisters in order to prevent contamination of the reagents. In addition, drain the reagent hoses via the Service menu.

10.2 Replacing reagents

⚠ CAUTION

Corrosive chemicals and other risks

Eye and skin injuries or crushing possible

- There is a danger of crushing limbs at doors, inserts and pump heads.
- Refer to the warning instructions in the safety data sheets when handling reagents and cleaning solutions.
- Wear protective clothing, gloves and goggles.
- If reagents come into contact with the skin or eyes, carefully rinse with copious amounts of water and consult a physician immediately.
- Never add water to reagents. Reagents containing acids may splash and heat may build up.

If you store the reagents correctly (in the dark, up to 5 - 20 °C) they will keep (unopened) for a minimum of 12 weeks from the date of production (batch number). When this period of time has expired, the reagents must be replaced. A cool, dark storage area is required to achieve the maximum shelf life.

The reagents absolutely must be replaced when:

- the reagents have been contaminated by sample (see "Troubleshooting instructions")
- the reagents are too old
- the reagents have been spoilt by incorrect storage conditions or environmental influences.

10.2.1 Checking reagents

Visual inspection: reagent R2 with an orange hue is OK. Reagent R2 with a green hue must be replaced.

1. Mix approx. 5 ml reagent R2 with a few crystals of dichromate detoxicant R3. If the reagent is OK, the color quickly changes from orange-brown to green.
2. Check the standard solution concentration in the laboratory. Adapt the values (PARAMETER ENTRY, "Calibration solution") or replace the standard solution.
3. Reagent R1 must be clear and colorless.

10.2.2 Replacing reagents

1. Carefully remove the hoses from the canisters and wipe them with a clean and dry (paper) cloth. Wear protective gloves when doing this.
2. In the Service menu, first switch valve V1 to "S" and valve 4 to "o".
   ↳ This ensures that the liquids required in the subsequent steps can flow out of the reactor.
3. Switch the P2 reagent pump to "g" for approximately 5 seconds to empty the hoses.
4. Switch valve V3 to "H" and sample and acid pump P1 to "g" for 5 seconds.
5. Place a beaker with distilled into the device and place the hoses for reagent R2 (dichromate solution) and for sulfuric acid into the beaker. Then flush the reagent pipes for about three minutes (until all the reagent is removed). To do so, switch both pumps to "g" (on). Then switch them back to "s" (off). Afterwards, remove the two hoses from the water and pump air for about one minute.
6. Replace the reagent canister and feed the hoses into the new canister.
7. Fill the reagent hose with the new reagents (SERVICE). To do so, switch both pumps to "g" (on). If there are no more air bubbles to be seen in the hoses, switch the pumps to "s".
8. Exit the Service menu. This reseals the drain valve of the reactor.
9. Perform a calibration (see "Calibration") after 2-3 measurements.

10.3 Replacing pump hoses

10.3.1 Analyzer

⚠ CAUTION

When removing hoses from the hose nozzles, beware of reagent splashing.

▶ Wear protective clothing, gloves and goggles.

NOTICE

Acid and reagents

Hose cases can become brittle and break

▶ Ensure that you always wear clean gloves to handle the hose cases.

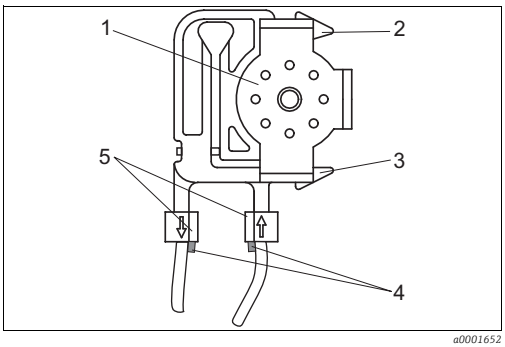
The peristaltic pumps used for the analyzer convey the medium in a combination of vacuum and displacement pump. The pump rate is dependent on the elasticity of the pump hoses. Elasticity decreases as mechanical stress increases and the pump rate drops. Wear depends on mechanical stress (measuring interval, pump starting pressure). The effect of wear can be compensated for by regular calibration. If the hoses lose too much elasticity and it is no longer possible to reproduce the pump rate, the hoses need to be replaced.

Removing the old hoses

1. Remove the reagent hoses from the reagent canisters in order to prevent contamination of the reagents from liquid backflow.
2. Flush the old hoses with ultrapure water first and then with air to empty them (see SERVICE).
3. Disconnect the hoses from the valve manifold.

Release the hose case(s) (1 to 3 per pump):

4. Press against the lower retainer (item 3).
   ↳ You can now remove the hose case along with the pump hose.
5. Remove the old hose from the case any dispose of it.
6. Clean the hose case and the pump head (item 1) with a towel.



1 Pump head
2 Upper retainer of hose case
3 Lower retainer of hose case
4 Guide at pump hose
5 Stopper with guide

Fig. 19: Peristaltic pump

Installing the new hoses

NOTICE

Danger of mix-up and resulting malfunction

- ▶ Make sure you connect the new pump hoses to the correct connections on the connection strip.
- ▶ For the order numbers of the pump hoses (kit) see the chapter "Troubleshooting/Spare parts".

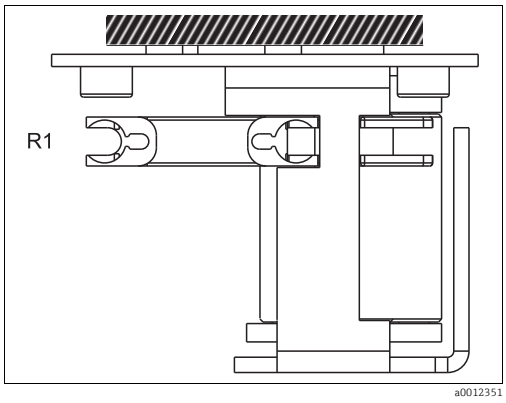


Fig. 20: Pump 1, top view

R1 Reagent 1

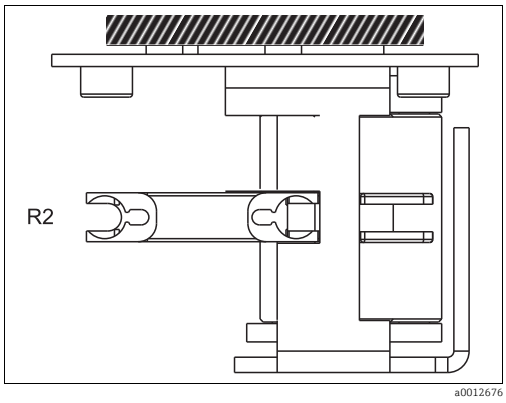


Fig. 21: Pump 2, top view

R2 Reagent 2

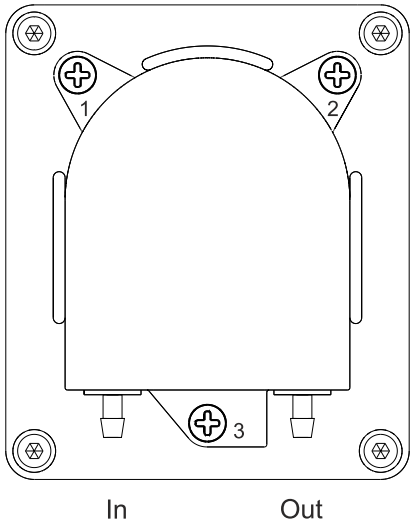
1. Grease the new pump hoses and the pump heads with silicone grease.
2. Fit the new hose on the hose case.
3. First pull the hose downwards at both ends and then push the guide on the hose into that of the stopper on the hose case. Make sure it is seated correctly.
4. First place the hose case into the upper retainer (item 2) of the pump and then press the case into the lower retainer (item 3).
5. Reconnect the reagent hoses to the canisters and the valve manifold.
6. After installation, refill the hoses with sample, standard or 0 mg/l O_2 standard and reagents (SERVICE).

   ↳ Make sure that the hoses are bubble-free when filled.
7. Perform a calibration after 2-3 measurements ("Calibration").

10.3.2 Back-flush pump (optional)

Removing the old hose

1. Flush the old hose with ultrapure water first and then with air to empty it (see SERVICE).
2. Disconnect the back-flush pump from the power supply.
3. Loosen screws 1 to 3 of the safety cover and remove the cover.



4. Remove the old hose.

Installing the new hose

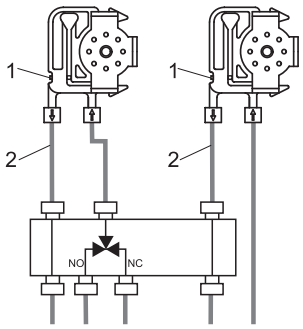
1. Install the new hose. In doing so fix the white plastic clips in the guides.
2. Grease the new pump hose with silicone grease.
3. Put the safety cover back on and fix it in place with screws 1 to 3.
4. Reconnect the back-flush pump to the power supply.

10.4 Setting the hose cases

The analyzer is supplied with preset hose cases.

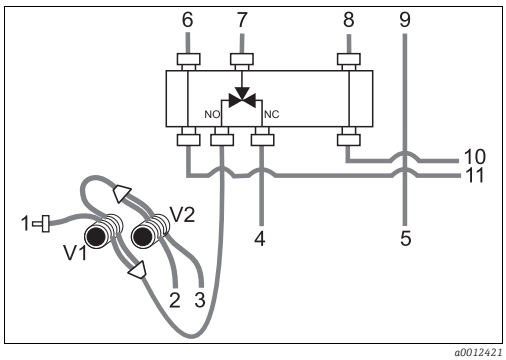
You must only reset these cases if you discover that little or no medium is pumped after a hose has been replaced.

1. Place a beaker with distilled into the device and place the hoses for sample and reagent R2 into the beaker.
2. Flush the hoses (sample and reagent R2) with water first and then with air to empty them (see SERVICE).
3. Disconnect the pump hoses (item 2) coming from pumps P1 and P2 from the valve manifold:



4. Pump (via SERVICE menu) until water starts dripping out of the ends of the hoses.
5. At the adjusting screw (item 1, Allen screw, AF 2.5) reduce the contact pressure until the water stops dripping but does not flow back into the hose.
6. Increase the contact pressure by turning the screw 3/4 of a revolution.
7. Reconnect the hoses to the valve manifold.
8. Fill the hoses again with sample and reagent R2.
9. Perform a calibration after 2-3 measurements.

10.5 Replacing valve hoses



1 Sample
2 Standard (30, 100 or 2500 mg/l O_2)
3 0 mg/l O_2 standard
4 Sulfuric acid R1
5 Dichromate solution R2
6 From sample/acid pump P1
7 Inlet to sample/acid pump P1
8 From reagent pump P2
9 Inlet, reagent pump P2
10 Inlet, reagent to reactor
11 Inlet, sample/acid to reactor

Fig. 22: Valves and valve hoses

To replace the hoses (valve 1 and 2) , proceed as follows:

1. Flush the old hoses with water first and then with air to empty them (see SERVICE).

Remove the hoses from the valves:

2. You can disconnect the front hoses directly because the valves are open when de-energized
3. To remove the back hoses, press the black feeler on the valve and disconnect the hoses.

4. Grease the new hoses with silicone grease before inserting them.
5. Replace the new pump hoses in the reverse sequence of operations.
   ↳ Ensure that the hoses are connected correctly.
6. After installation, refill the hoses with sample or standard (SERVICE).
7. Carry out a calibration.

10.6 Cleaning

10.6.1 Cleaning valve 3

1. Disconnect the sample hose (→ 22, item 1) from the collecting vessel.
2. First rinse the hose with water and then purge with air in order to empty it.
3. Disconnect the hose (item 7) from the connector on the valve manifold.
4. Connect an injector filled with water to the connector and back-flush valve 3 and the sample hose.
5. Repeat step 4 two to three times.
6. Then use an injector to purge valve V3 and the sample hose with air.
7. Reconnect pump hose P1 to the connector on the valve manifold.
8. Fill the hoses again with sample (SERVICE).

10.6.2 Cleaning the housing

NOTICE

When cleaning, ensure that you do not damage the nameplate on the analyzer.

▶ Do not use any solvent-based cleaning agents.

To clean the analyzer housing, proceed as follows:

1. Wipe up any reagent contamination with a disposable cloth and rinse the area with clean water. Then dry the cleaned areas with a cloth.
2. The hose cases have come into contact with acid if they are brightly stained or broken. In such situations, the hose cases must be replaced. Cleaning is no longer an option.

10.6.3 Cleaning the filter mat of the housing fan

The fan ensures the housing is well ventilated. A blocked filter mat can affect the cooling capacity.

The fan is located on the right-hand side panel of the analyzer.

▶ Remove the cover and the filter mat.

To clean the filter mat you have various options:

1. Wash the filter mat in water (approx. 40 °C) with a mild detergent if necessary.
2. Alternatively you can beat or vacuum the mat or blow it with compressed air.
3. In case of greasy substances: Wash the filter mat in benzine, isopropyl alcohol or warm water with grease solvent added.

NOTICE

Residues of organic solvents and an incorrectly inserted filter mat can damage the device

The degree of protection associated with the device no longer applies if the filter mat is damaged, missing or installed incorrectly

- ▶ If organic solvents are used, allow the mat to dry completely before reinserting it.
- ▶ Insert the filter mat correctly. If you operate the analyzer without a filter mat, the degree of protection is no longer guaranteed.

10.7 Placing out of service

You must place out of service the analyzer before shipping or before longer operation breaks (more than 2 days).

⚠ CAUTION

Residues of chemicals can cause injuries

- ▶ Thoroughly rinse all of the lines of the measuring system with clean water.

Placing out of service

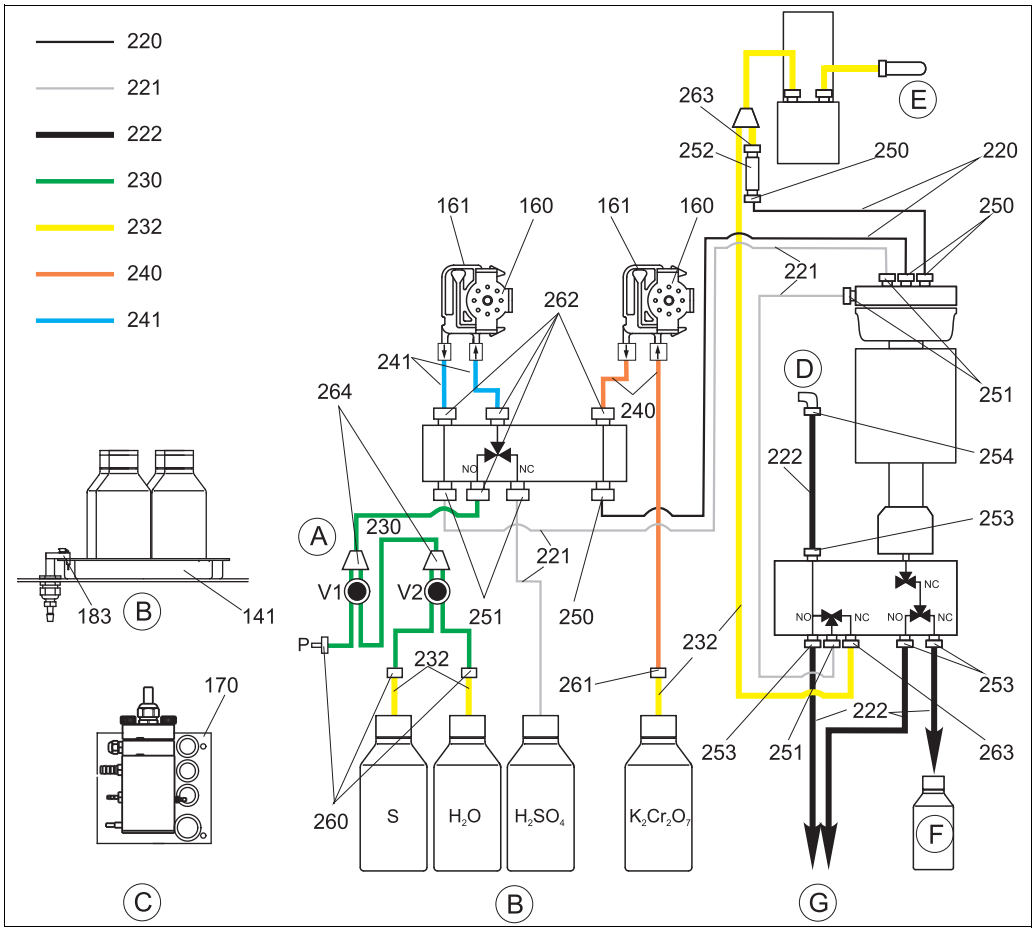
1. Remove the reagent and standard hoses from the canisters and immerse them in a tank containing water.
2. If using a continuous sample supply, disconnect the sample line and immerse the hose in the tank too.
3. Switch pump 2 on for 3 min (see SERVICE).
4. Drain the reactor by switching valves V1 and V4 to passage for chromate waste (V1: S; V4: o).
   ↳ Then close the reactor again (V1: P; V4: c).
5. Switch these valves and pumps one after the other in the following order:
   – V1: P, V2: S, V3: H and pump P1 "on" for one minute
   – V1: S, V2: S, V3: P and pump P1 "on" for one minute
   – V1: S, V2: O, V3: P and pump P1 "on" for one minute
   – V1: P, V2: S, V3: P and pump P1 "on" for one minute
6. Remove the hoses from the water and repeat steps 3 and 5. Allow the pumps to run until the hoses are empty and dry.
7. Empty the reactor (V1: S, V4: o).
8. Remove the valve hoses from the valves (V1 and V2).
9. Release the pump hoses by removing the hose cases from the holder.

Store open reagent and standard containers in the refrigerator. Bear the shelf life in mind.

11 Repair

11.1 Spare parts

11.1.1 Overview



A	*Sample input*	*G*	*Wastewater*
B	*Standard and reagent canister tray*	*P*	*Sample*
C	*Collecting vessel*	*S*	*Canister for standard (100 or 2500 mg/l O_2)*
D	*Outlet air*	*H_2O*	*Canister for 0 mg/l O_2 standard*
E	*Compressed air supply (optional)*	*H_2SO_4*	*Canister for sulfuric acid R1*
F	*Composite container for chromate waste*	*$K_2Cr_2O_7$*	*Canister for dichromate solution R2*

11.1.2 Spare parts for sample and reagent transportation

Item	Spare part	Order number
135	Kit CA71, connection nipples for collecting vessel (10 pieces)	51512099
136	Kit CA T-hose fitting 3.2 mm x 3.2 mm x 3.2 mm (10 pieces)	51518417
141	Kit CA71, collecting tank	51512102
160	Kit CA71, pump head with holder for hose pump	51512085
161	Kit CA71 hose case for pump (1 piece)	51512086
170	Kit CA71, agitated collecting vessel with level measurement	71154317
183	Kit CA712, leak sensor for collecting tank (2 pieces)	51515581

Item	Spare part	Order number
230 - 264	Kit CA71COD wear parts ▪ 4 Tygon pump hoses, yellow/blue ▪ 4 Tygon pump hoses, orange/white ▪ 2 m C-FLEX hose, ID 1.6 mm ▪ 2.5 m NORPRENE hose, ID 1.6 mm ▪ 3 hose fittings, 1.6 x 1.6 mm ▪ 2 reduction fittings, PP ▪ 4 glands with nozzle, PTFE ▪ 2 hose cases ▪ 1 hose extension tool ▪ 1 tube of silicone grease, 2 g ▪ 1 cleaning injector, 20 ml	71102950
220-222	Kit CA71COD hose set ▪ 1 PTFE hose, ID 1.6 mm (item 221) ▪ 1 PTFE hose, ID 4.0 mm (item 222) ▪ 1 PFA hose, ID 0.8 mm (item 220)	71103284
250-263	Kit CA71COD hose fittings (item 250, 251, 253, 254, 262, 263)	71103286
F	Kit CA71COD composite container for chromate waste	71103287
-	Kit CA71COD sample pump with return line	71155802
-	Kit CA71COD pump hoses for sample pump with return line	71155805

11.2 Return

The product must be returned if repairs or a factory calibration are required, or if the wrong product has been ordered or delivered. According to legal regulations Endress+Hauser, as an ISO-certified company, is required to follow certain procedures when handling returned products that are in contact with the medium.

To ensure swift, safe and professional device returns:
Check the website for information about the return procedure and basic conditions
www.services.endress.com/return-material

11.3 Disposal

NOTICE

Waste containing chromate and waste free from chromate are produced. The latter contains sample residue and acid.

Reagent waste must be disposed of correctly.

- ▶ Your local sales office will be happy to assist in the correct disposal of reagent waste.
- ▶ Please observe local regulations.

Electronic components are used in the product. For this reason, the product must be disposed of as electronic waste.
Please observe local regulations.

12 Accessories

The following section provides you with information on the most important accessories available at the time this documentation was issued.
Contact your local Service Center or Sales Center for accessories that are not listed here.

12.1 Collecting vessel

Agitated collecting vessel with level measurement
- Prevents particles from settling in the collecting vessel
- Order No. 71154317

12.2 Reagents, cleaners, standard solutions

NOTICE

Reagents can be harmful to the environment

▶ Note the disposal instructions in the safety data sheets of the reagents!

Reagent set for CA71COD-A
- Order No. CAY440-V10AAE
  - 250 ml (8.45 fl.oz.) dichromate solution
  - 4 x 1 l (34 fl.oz.) H_2SO_4
  - Dichromate detoxicant
- Order No. CAY440-V20AAE
  - 250 ml (8.45 fl.oz.) dichromate solution
  - 2 x 2.5 l (85 fl.oz.) H_2SO_4
  - Dichromate detoxicant

Reagent set for CA71COD-B
- Order No. CAY441-V10AAE
  - 250 ml (8.45 fl.oz.) dichromate solution
  - 4 x 1 l (34 fl.oz.) H_2SO_4
  - Dichromate detoxicant
- Order No. CAY441-V20AAE
  - 250 ml (8.45 fl.oz.) dichromate solution
  - 2 x 2.5 l (85 fl.oz.) H_2SO_4
  - Dichromate detoxicant

Standard solutions, 1 l bottles (34 fl.oz.)
- 0 mg/l O_2, Order No. CAY442-V10C00AAE
- 30 mg/l O_2, Order No. CAY442-V10C03AAE
- 100 mg/l O_2, Order No. CAY442-V10C01AAE
- 2500 mg/l O_2, Order No. CAY442-V10C25AAE

12.3 Maintenance kit

Kit CA71COD: wear parts
- 4 TYGON pump hoses, yellow/blue
- 4 TYGON pump hoses, orange/white
- 2 m C-FLEX hose, ID 1.6 mm
- 2.5 m NORPRENE hose, ID 1.6 mm
- 3 hose fittings, 1.6 x 1.6 mm
- 2 reduction fittings, PP
- 4 glands with nozzle, PTFE
- 2 hose cases
- 1 hose extension tool
- 1 tube of silicone grease, 2 g
- 1 cleaning injector, 20 ml
- Order No. 71102950

12.4 Additional accessories

- Interference suppressor for control, power and signal lines
  Order No. 51512800
- Medium-viscosity silicone grease, 35g tube
  Order No. 71017654
- Kit CA71COD hose set
  Order No. 71103284
- Kit CA71COD hose fittings
  Order No. 71103286
- Kit CA71COD composite container for chromate waste
  Order No. 71103287

13 Technical data

13.1 Input

Measured variable

COD [mg/l O_2]

Measuring range

CA71COD-A
5 to 200 mg/l O_2

CA71COD-B
50 to 5000 mg/l O_2

Wave length

CA71COD-A
465 nm and 625 nm

CA71COD-B
589 nm

13.2 Output

Output signal

0/4 to 20 mA

Modbus RS485 (optional)

Signal coding	EIA/TIA-485
Data transmission rate	9600 baud
Galvanic isolation	Yes
Connectors	Top-hat rail clamps
Bus termination	-

Signal on alarm

Contacts: 2 limit contacts, 1 system alarm contact

Load

max. 300 Ω

Serial interface

RS232-C
Modbus RS485 (optional)

Data logger

1024 data pairs with date, time and measured value
100 data pairs with date, time and measured value for determining the calibration factor (diagnostics tool)

Load capacity

230 V AC max. 2 A

Protocol-specific data

Modbus RS485

Protocol	RTU
Function codes	03 (read holding registers)
Broadcast support for function codes	-
Output data	1 main measured value at address 40008 (2 bytes)
Data format	16 bit
Input data	-
Supported features	Slave address, data format, check sum and baud rate can be configured using Advantech ADAM Utility Software at re-boot with set init switch

13.3 Power supply

Supply voltage

230 V AC, 50/60 Hz

Power consumption

approx. 210 VA

Current consumption

approx. 0.9 A

Fuses

1 x slow-blow 0.5 A for electronics
2 x semi-delay 0.2 A for photometer
1 x slow-blow 0.1 A for motors
1 x slow-blow 1 A for heating and cooling

13.4 Performance characteristics

Maximum measured error and repeatability

CA71COD-A
< 110 mg/l O_2: ± 11 mg/l O_2
> 110 mg/l O_2: ± 10 %

CA71COD-B
< 500 mg/l O_2: ± 50 mg/l O_2
> 500 mg/l O_2: ± 10 %

Measuring interval

t_{meas} = 150 min (factory setting, shorter digestion times can be set)

t_{meas} = sample dosing + reagent dosing + chloride expulsion + reagent dosing + digestion + measured value calculation + discard sample + measuring interval + rinse time

Sample requirement

54 ml (1.82 fl.oz.) / measurement

Reagent requirement

250 ml (8.45 fl.oz.) dichromate solution
4 l (1.06 US gal.) H_2SO_4 for 60 days with a digestion time of 2 h

Calibration interval

0 to 720 h

Maintenance interval	1 week (typically)
Servicing requirements	15 minutes / week (typically)

13.5 Installation

Mounting location	Mount on a vibration-free wall

13.6 Environment

Ambient temperature	10 to 35 °C (50 to 95 °F), avoid strong fluctuations
Humidity	below the condensation limit, installation in usual, clean rooms outdoor installation only possible with protective devices (customer supplies)
Ingress protection	IP 43

13.7 Process

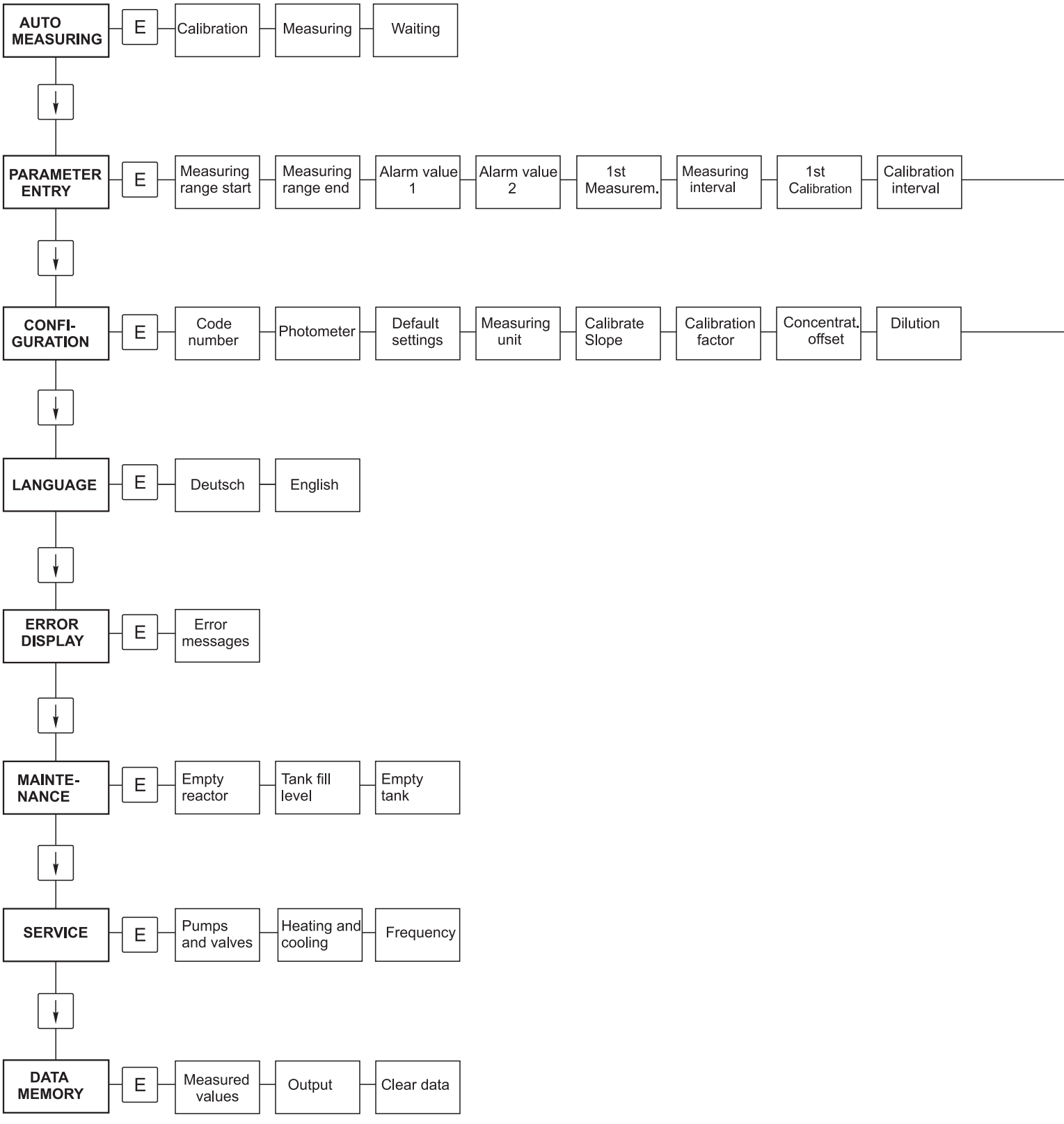
Sample temperature	5 to 40 °C (40 to 100 °F)
Sample flow rate	Min. 5 ml/min (0.17 fl.oz./min)
Consistency of the sample	Aqueous and homogenized
Sample inlet	pressureless

13.8 Mechanical construction

Design, dimensions	see chapter "Installation"	
Weight	Approx. 32 kg (71 lbs)	
Materials	Housing	GFR
	Front windows	Polycarbonate
	Hose	C-FLEX, NORPRENE, PTFE, PFA
	Pump hose	TYGON
	Valves	C-FLEX, PVDF, FFKM

14 Appendix

14.1 Operating matrix



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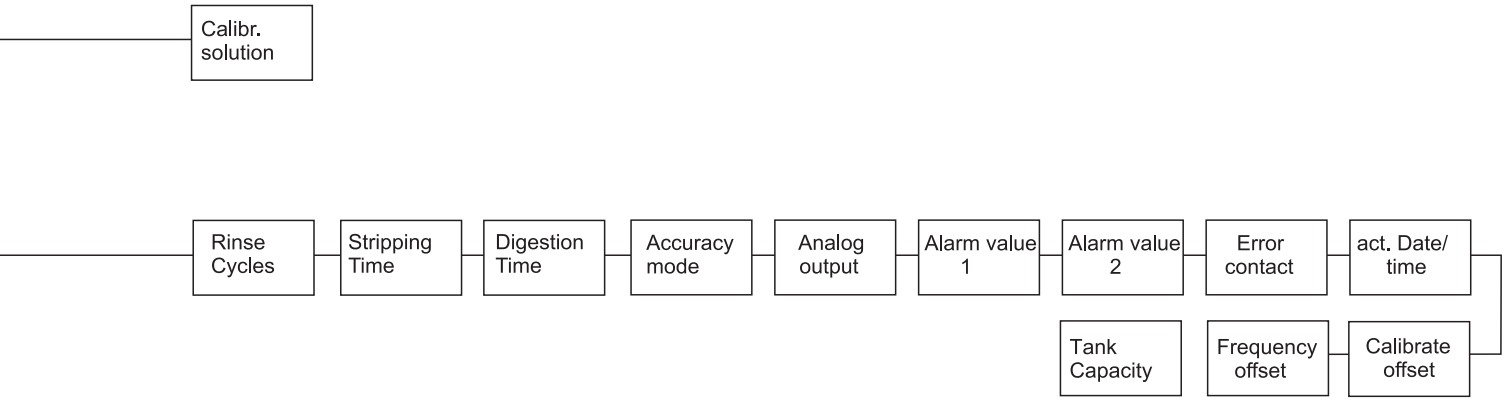
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Calibrate offset

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