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BioTector B3500dw Online TOC Analyzer

Installation and Operation

12/2025, Edition 4

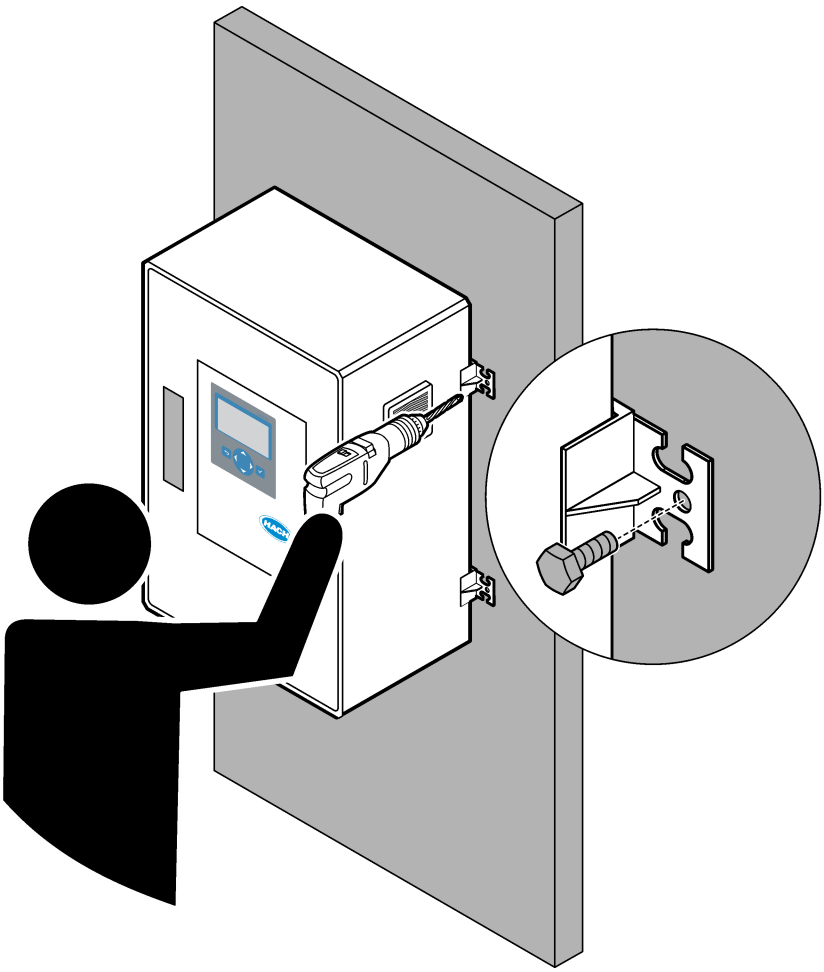


Table of Contents

Section 1 Specifications 3

Section 2 General information 7

2.1 Safety information 7

2.1.1 Safety symbols and markings 7

2.1.2 Use of hazard information 8

2.1.3 Ozone precautions 8

2.1.4 Zeolite precautions 9

2.2 EMC compliance 9

2.3 Compliance and certification marks 10

2.4 EMC compliance statement (Korea) 10

2.5 Product overview 11

2.6 Product components 13

Section 3 Installation and startup checklist 15

Section 4 Installation 19

4.1 Installation guidelines 19

4.2 Wall mount 19

4.3 Electrical installation 21

4.3.1 Electrostatic discharge (ESD) considerations 21

4.3.2 Open the door 21

4.3.3 Connect power 22

4.3.4 Connect the relays 24

4.3.5 Connect the analog outputs 25

4.3.6 Power, analog output and relay terminals 25

4.3.7 Connect Modbus RTU (RS485) 27

4.3.8 Connect Modbus TCP/IP (Ethernet) 30

4.3.8.1 Configure the Modbus TCP/IP module 30

4.3.8.2 Connect the Modbus TCP/IP module 30

4.4 Plumbing 32

4.4.1 Tube connections 32

4.4.2 Plumb the sample stream(s) and manual stream 33

4.4.3 Sample line guidelines 33

4.4.4 Install a sample overflow chamber (optional) 36

4.4.5 Plumb the drain lines 36

4.4.6 Connect instrument air 37

4.4.7 Plumb the exhaust 37

4.4.8 Plumb the reagents 38

4.4.8.1 Use a stainless steel fitting for the base reagent (optional) 41

4.4.9 Install the sample pump tubing 42

4.4.10 Connect the internal tubing 43

4.4.11 Connect the air purge 44

Section 5 Startup 45

5.1 Set the power to on 45

5.2 Set the language 45

5.3 Set the time and date 45

5.4 Adjust the display brightness and contrast 46

5.5 Examine the oxygen supply 46

5.6 Examine the pumps 46

5.7 Examine the valves 47

5.8 Set the reagent volumes 48

5.9 Measure deionized water 48

5.10 Analysis enclosure 48
Section 6 Configuration 53
6.1 Set the measurement interval 53
6.2 Set the sample pump times 53
6.2.1 Do a sample pump test 53
6.3 Set the stream sequence and operation range 54
6.4 Configure the COD and BOD settings 54
6.5 Configure the DW PROGRAM settings 55
6.6 Configure CF PROGRAM settings 56
6.7 Configure the install new reagents settings 56
6.8 Set reagent monitoring 56
6.9 Configure the analog outputs 57
6.10 Configure the relays 59
6.11 Configure the communication settings 62
6.12 Configure the Modbus TCP/IP settings 62
6.13 Save the settings to memory 63
6.14 Set security passwords for menus 64
6.15 Show the software version and serial number 64
Section 7 Calibration 65
7.1 Start a zero calibration or zero check 65
7.2 Start a span calibration or span check 66
7.3 Plumb the calibration standard 68
7.4 Prepare the calibration standard 68
Section 8 User interface and navigation 71
8.1 Keypad description 71
8.2 Reaction Data screen 71
8.3 Status messages 72
8.4 Reaction Graph screen 73
Section 9 Operation 75
9.1 Start or stop measurements 75
9.2 Measure a grab sample 75
9.3 Save data to an MMC/SD card 76

Section 1 Specifications

Specifications are subject to change without notice.

This product does not comply with, and is not intended to be put into, regulated bodies of water or fluid, which includes drinking water or food contact materials in food and beverage.

Table 1 General specification

Specification	Details
Dimensions (H x W x D)	750 x 500 x 320 mm (29.53 x 19.69 x 12.60 in.)
Enclosure	Rating: IP44 with the doors closed and latched; optional IP54 with air purge or vortex cooler Material: Fiberglass reinforced polyester (FRP)
Weight	< 50 kg (110 lb)
Mounting	Wall mount, indoor installation
Protection class	Class 1 (PE connected)
Pollution degree	2
Installation category	II
Electrical requirements	110–120 VAC, 50/60 Hz, 300 W (2.6 A), or 200–230 VAC, 50/60 Hz, 300 W (1.3 A) Refer to the product rating label for the electrical requirements. Use a permanent field wiring connection.
Cable entry	Typically, four cable glands (strain relief fittings) are supplied with the analyzer. ***Note:*** *PG13.5 cable glands have a clamping range of 6-12 mm. PG11 cable glands have a clamping range of 5-10 mm.*
Mains power wire	2 Core +PE[1] +Screened; 1.5 mm^2 (16 AWG) rated 300 VAC, 60 °C, VW-1; The cable type is to be SJT, SVT, SOOW or <HAR> equivalent cable, depending on the application. The power cable installed in accordance with local and regional codes, suitable for end application. Connected to a dedicated and isolated branch circuit protected supply rated 10 A.
Signal wire	4 wires (twisted pair, shielded cable) and more 2 wires for each additional signal, 0.22 mm^2 (24 AWG) minimum and rated 1 A; depending on the configuration and options installed on the analyzer
Modbus RTU wire	2 wires (twisted pair, shielded cable), 0.22 mm^2 (24 AWG) minimum UL AWM Style 2919 or equivalent for application
Fuses	Refer to the fuse location diagram in the enclosure. In addition, refer to the Maintenance and Troubleshooting manual for the specifications.
Operating temperature	5 to 45 °C (41 to 113 °F) Cooling options are available for the analyzer.
Operating humidity	5 to 85% non-condensing relative humidity
Storage temperature	2 to 60 °C (35 to 140 °F)
Altitude	2000 m (6562 ft) maximum
Display	High contrast, 40 character x 16 line backlit LCD with LED backlight
Sound	< 60 dBa
Sample streams	One or two sample streams and one manual grab sample. Refer to Table 2 for sample requirements.
Data storage	6000 measurements and 99 error entries in analyzer memory

[1] Protective earth

Table 1 General specification (continued)

Specification	Details
Data send	MMC/SD card to save data, software updates and configuration updates
Analog outputs	Four 4–20 mA output signal, programmable (direct or multiplex mode), optically isolated, self powered, 500 Ω impedance maximum
Analog inputs	Two 4–20 mA input signals, programmable
Relays	Six configurable relays; volt free contacts, 1 A at 30 VDC maximum
Remote control	Digital inputs for remote standby, remote stream selection and remote grab sample measurement In addition, the analyzer can be controlled remotely with Modbus.
Communications (optional)	Modbus RTU, Modbus TCP/IP or Profibus. The software requirement for Modbus RTU and TCP/IP is version 2.12 or later. ***Note:*** *When the Profibus option is selected, the analyzer sends the digital output signals through the Profibus converter with the specific communication protocol of Profibus.*
Reagents	4.0 N sodium hydroxide (NaOH) 6.0 N sulfuric acid (H_2SO_4) that contains 350-mg/L manganese sulfate monohydrate For the reagent usage rate, refer to Plumb the reagents on page 38.
Instrument air	Dry, oil and dust free, ≤ -20 °C (-4 °F) dew point, < 5.4 m^3/h at 6 bar (87 psi) (average consumption), 5 to 40 °C (41 to 104 °F). Setpoint: • 1.5 bar (21.7 psi) • 1.5 and 0.9 bar (21.7 and 13 psi) when the oxygen concentrator is on. • 1.2 bar (17.4 psi) when the BioTector air compressor is used. ***Note:*** *A filter pack is recommended if the instrument air is not within specifications.*
Purge air	4 to 7 bar (58 to 101.5 psi), -20 °C (-4 °F) dew point (free of water, oil and dust) Initial purge air consumption is less than 15 m^3/hour. Normal operation air consumption is less than 6 m^3/hour.
Calibration standard	Zero calibration: None or deionized water Span calibration: TIC (total inorganic carbon) and TOC (total organic carbon) concentration in the calibration standard is based on the operation range selected for span calibrations.
Certifications	CE, cETLus
Warranty	1 year

Table 2 Sample requirements

Specification	Details
Sample types	Samples cannot contain fats, greases, oils or calcium. Samples can contain 0.1% chlorides (salts) maximum. Refer to Table 5 for sodium chloride interference. ***Note:*** *Chlorides (salts) do not interfere with measurements, but can cause corrosion.*
Sample particle size	100 µm diameter maximum, soft particulates ***Note:*** *Hard particulates (e.g., sand) will cause damage to the analyzer.*
Sample pressure	Ambient at sample and manual (grab sample) inlets ***Note:*** *For pressurized sample streams, use the optional Sample Overflow Chamber to supply sample at ambient pressure to the analyzer.*
Drain pressure	Ambient ***Note:*** *For pressurized drains, use the optional systems available.*
Sample temperature	2 to 60 °C (36 to 140 °F)

Table 2 Sample requirements (continued)

Specification	Details
Sample flow rate	100 mL minimum for each sample stream
Sample volume (usage)	12.0 mL maximum

Table 3 Performance specifications

Specification	Details
Operation range [2]	0 to 25 mgC/L
Cycle time	5.5 minutes to measure TIC and TOC (minimum) ***Note:*** *The cycle time is based on the operation range and application.*
Repeatability	**TOC 0 to 25 mgC/L**— ±3% of reading or ±0.03 mgC/L (the larger value)
Signal drift (1 year)	< 5%
Detection limit[3]	TOC: 0.06 mg/L

Table 4 Analysis specifications

Specification	Details
Oxidation method	Two-stage advanced oxidation process (TSAO) with hydroxyl radicals
TOC measurement	NDIR (non-dispersive infrared sensor) measurement of CO_2 after oxidation
COD and BOD	Calculated with correlation algorithm that includes TOC measurement results

Table 5 Sodium chloride interference

Parameter	Interference level
TOC	None ***Note:*** *Chlorides (salts) do not interfere with measurements, but can cause corrosion.*

[2] There is one operation range maximum for each parameter (e.g., TOC) and each sample stream (e.g., STREAM 1).
[3] TOC range of 0 to 25 ppm

In no event will the manufacturer be liable for direct, indirect, special, incidental or consequential damages resulting from any defect or omission in this manual unless otherwise required by applicable law or contract between the parties. The manufacturer reserves the right to make changes in this manual and the products it describes at any time, without notice or obligation. Revised editions are found on the manufacturer's website.

2.1 Safety information

The manufacturer is not responsible for any damages due to misapplication or misuse of this product including, without limitation, direct, incidental and consequential damages, and disclaims such damages to the full extent permitted under applicable law. The user is solely responsible to identify critical application risks and install appropriate mechanisms to protect processes during a possible equipment malfunction.

Please read this entire manual before unpacking, setting up or operating this equipment. Pay attention to all danger and caution statements. Failure to do so could result in serious injury to the operator or damage to the equipment.

If the equipment is used in a manner that is not specified by the manufacturer, the protection provided by the equipment may be impaired. Do not use or install this equipment in any manner other than that specified in this manual.

2.1.1 Safety symbols and markings

Read all labels and tags attached to the instrument. Personal injury or damage to the instrument could occur if not observed. A symbol on the instrument is referenced in the manual with a precautionary statement.

The safety symbols and marking that follow are used on the equipment and in the product documentation. The definitions are in the table that follows.

	Caution/Warning. This symbol identifies that an appropriate safety instruction should be followed or a potential hazard exists.
	Hazardous voltage. This symbol indicates that hazardous voltages are present where a risk of electrical shock exists.
	Hot surface. This symbol indicates that the marked item can be hot and should not be touched without care.
	Corrosive substance. This symbol identifies the presence of a strong corrosive or other hazardous substance and a risk of chemical harm. Only individuals qualified and trained to work with chemicals should handle chemicals or perform maintenance on chemical delivery systems associated with the equipment.
	Toxic. This symbol indicates a toxic/poisonous substance hazard.
	This symbol indicates the presence of devices sensitive to Electro-static Discharge (ESD) and indicates that care must be taken to prevent damage with the equipment.
	This symbol indicates a flying debris hazard.
	Protective earth. This symbol indicates a terminal which is intended for connection to an external conductor for protection against electric shock in case of a fault (or the terminal of a protective earth (ground) electrode).

	Noiseless (clean) earth. This symbol indicates a functional earthing (grounding) terminal (e.g., a specially designed earthing (grounding) system) to avoid a malfunction of the equipment.
	This symbol indicates an inhalation hazard.
	This symbol indicates that respiratory personal protectve equipment (PPE) is required when there is powder or dust in the enclosure.
	This symbol indicates there is a lifting hazard because the object is heavy.
	This symbol indicates a fire hazard.
	Electrical equipment marked with this symbol may not be disposed of in European domestic or public disposal systems. Return old or end-of-life equipment to the manufacturer for disposal at no charge to the user.

2.1.2 Use of hazard information

⚠DANGER

Indicates a potentially or imminently hazardous situation which, if not avoided, will result in death or serious injury.

⚠WARNING

Indicates a potentially or imminently hazardous situation which, if not avoided, could result in death or serious injury.

⚠CAUTION

Indicates a potentially hazardous situation that may result in minor or moderate injury.

NOTICE

Indicates a situation which, if not avoided, may cause damage to the instrument. Information that requires special emphasis.

2.1.3 Ozone precautions

⚠CAUTION



Ozone inhalation hazard. This instrument produces ozone that is contained within the equipment, specifically within the internal plumbing. The ozone could be released under fault conditions.

It is required to plumb the exhaust gas port to a fume hood or to the building exterior in accordance with local, regional and national requirements.

Exposure to even low concentrations of ozone can damage delicate nasal, bronchial and pulmonary membrane. In sufficient concentration, ozone can cause headaches, coughing, eye, nose and throat irritation. Immediately, move the victim to uncontaminated air and seek first aid.

The type and harshness of symptoms are based on the concentration and exposure time (n). Ozone poisoning includes one or more of the symptoms that follow.

- Irritation or burning of the eyes, nose or throat
- Lassitude
- Frontal headache
- Sensation of sub-sternal pressure
- Constriction or oppression
- Acid taste in mouth
- Asthma

In case of more severe ozone poisoning, the symptoms can include dyspnea, cough, choking sensation, tachycardia, vertigo, lowering of blood pressure, cramping, chest pain, and generalized body pain. Ozone can cause a pulmonary oedema one or more hours after exposure.

2.1.4 Zeolite precautions

⚠CAUTION



Inhalation hazard. The molecular sieve material used in the oxygen concentrator is classified as an irritant substance. Molecular sieve material can be released in a fault condition. Exposure to dust or particles from this material may pose serious health risks, including respiratory irritation and long-term effects.

Immediate or short-term effects

- Respiratory irritation: Coughing, throat irritation, and difficulty breathing are common initial symptoms due to dust exposure. Chest discomfort or pain: Some individuals report chest pain shortly after exposure.

Chronic or long-term risks

- Pulmonary fibrosis: Scarring and thickening of lung tissue, leading to chronic shortness of breath and persistent cough.

Precautions

- Always wear appropriate personal protective equipment (PPE) when handling or servicing components containing molecular sieve material.
- PPE must include chemical-resistant gloves, protective eyewear, and a NIOSH-MSHA face mask or respirator rated for fine particulate filtration. Refer to the applicable safety data sheet (SDS). Refer to maintenance and troubleshooting manual for more information on troubleshooting.

2.2 EMC compliance

⚠CAUTION

This equipment is not intended for use in residential environments and may not provide adequate protection to radio reception in such environments.

CE (EU)

The equipment meets the essential requirements of EMC Directive 2014/30/EU.

UKCA (UK)

The equipment meets the requirements of the Electromagnetic Compatibility Regulations 2016 (S.I. 2016/1091).

Canadian Radio Interference-Causing Equipment Regulation, ICES-003, Class A:

Supporting test records reside with the manufacturer.

This Class A digital apparatus meets all requirements of the Canadian Interference-Causing Equipment Regulations.

Cet appareil numérique de classe A répond à toutes les exigences de la réglementation canadienne sur les équipements provoquant des interférences.

FCC Part 15, Class "A" Limits

Supporting test records reside with the manufacturer. The device complies with Part 15 of the FCC Rules. Operation is subject to the following conditions:

1. The equipment may not cause harmful interference.
2. The equipment must accept any interference received, including interference that may cause undesired operation.

Changes or modifications to this equipment not expressly approved by the party responsible for compliance could void the user's authority to operate the equipment. This equipment has been tested and found to comply with the limits for a Class A digital device, pursuant to Part 15 of the FCC rules. These limits are designed to provide reasonable protection against harmful interference when the equipment is operated in a commercial environment. This equipment generates, uses and can radiate radio frequency energy and, if not installed and used in accordance with the instruction manual, may cause harmful interference to radio communications. Operation of this equipment in a residential area is likely to cause harmful interference, in which case the user will be required to correct the interference at their expense. The following techniques can be used to reduce interference problems:

1. Disconnect the equipment from its power source to verify that it is or is not the source of the interference.
2. If the equipment is connected to the same outlet as the device experiencing interference, connect the equipment to a different outlet.
3. Move the equipment away from the device receiving the interference.
4. Reposition the receiving antenna for the device receiving the interference.
5. Try combinations of the above.

2.3 Compliance and certification marks

CE	The CE (European Conformity "Conformité Européene") mark on the instrument indicates that “The instrument complies with the European product directives, health, safety and environmental protection legislations”.
C ETL US LISTED Intertek 3187097	The ETL (Electrical Testing Laboratories) Listed mark on the instrument indicates that “This product has been tested to Safety Requirements of Electrical Equipment for Measurements, Control and Laboratory use; Part 1: General Requirements of ANSI/UL 61010-1 and CAN/CSA-C22.2 No 61010-1”. The Intertek ETL listed mark on the instrument identifies that the product has been tested by Intertek, found in compliance with accepted national standards, and the instrument meets the minimal requirements required for sale or distribution.

2.4 EMC compliance statement (Korea)

Type of equipment	Additional information
A 급 기기 (업무용 방송통신기자재)	이 기기는 업무용 (A 급) 전자파적합기기로서 판매자 또는 사용자는 이 점을 주의하시기 바라며, 가정외의 지역에서 사용하는 것을 목적으로 합니다.
Class A equipment (Industrial Broadcasting and Communication Equipment)	This equipment meets Industrial (Class A) EMC requirements. This equipment is for use in industrial environments only.

2.5 Product overview

NOTICE

Perchlorate Material—Special handling may apply. Refer to www.dtsc.ca.gov/perchlorate. This perchlorate warning applies only to primary batteries (provided singly or installed on this equipment) when sold or distributed in California, USA.

The B3500dw TOC analyzer is intended for the measurement of total organic carbon and has an internal oxygen concentrator.

The analyzer can measure the parameters that follow in wastewater, process water, surface water and seawater:

- **TIC**—Total in-organic carbon in mgC/L
- **TOC (NPOC)**—Total organic carbon in mgC/L, includes NPOC (non-purgeable organic carbon)
- **COD** [4]—Chemical oxygen demand
- **BOD** [4]—Biochemical oxygen demand

The analyzer uses the analysis methods in Table 4 on page 5.

For theory of operation information, refer to the BioTector B3500 videos on youtube.com and Hach Support Online (https://support.hach.com).

Figure 1 shows an overview of the analyzer exterior.

Refer to Analysis enclosure on page 48 for interior views of the analyzer.

NOTICE

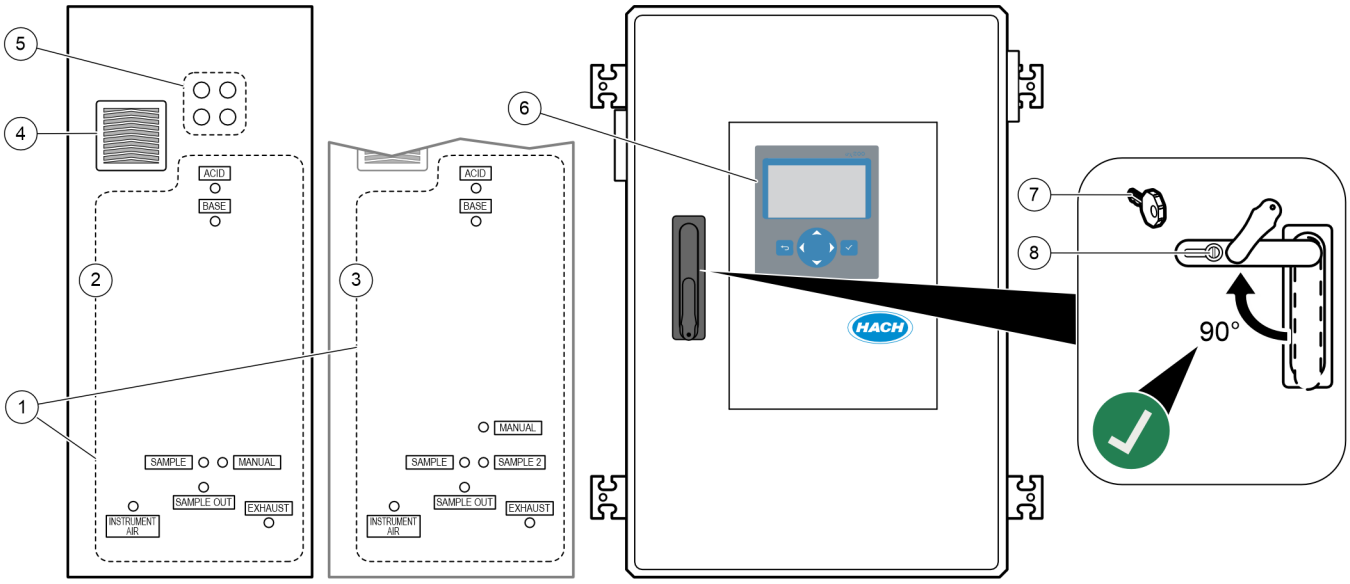
Make sure that the door handle is fully turned before the door is opened or damage to the door seal can occur. If the door seal has damage, dust and liquid can enter the enclosure.

NOTICE

The accessories for the analyzer (e.g., compressor) have separate user manuals.

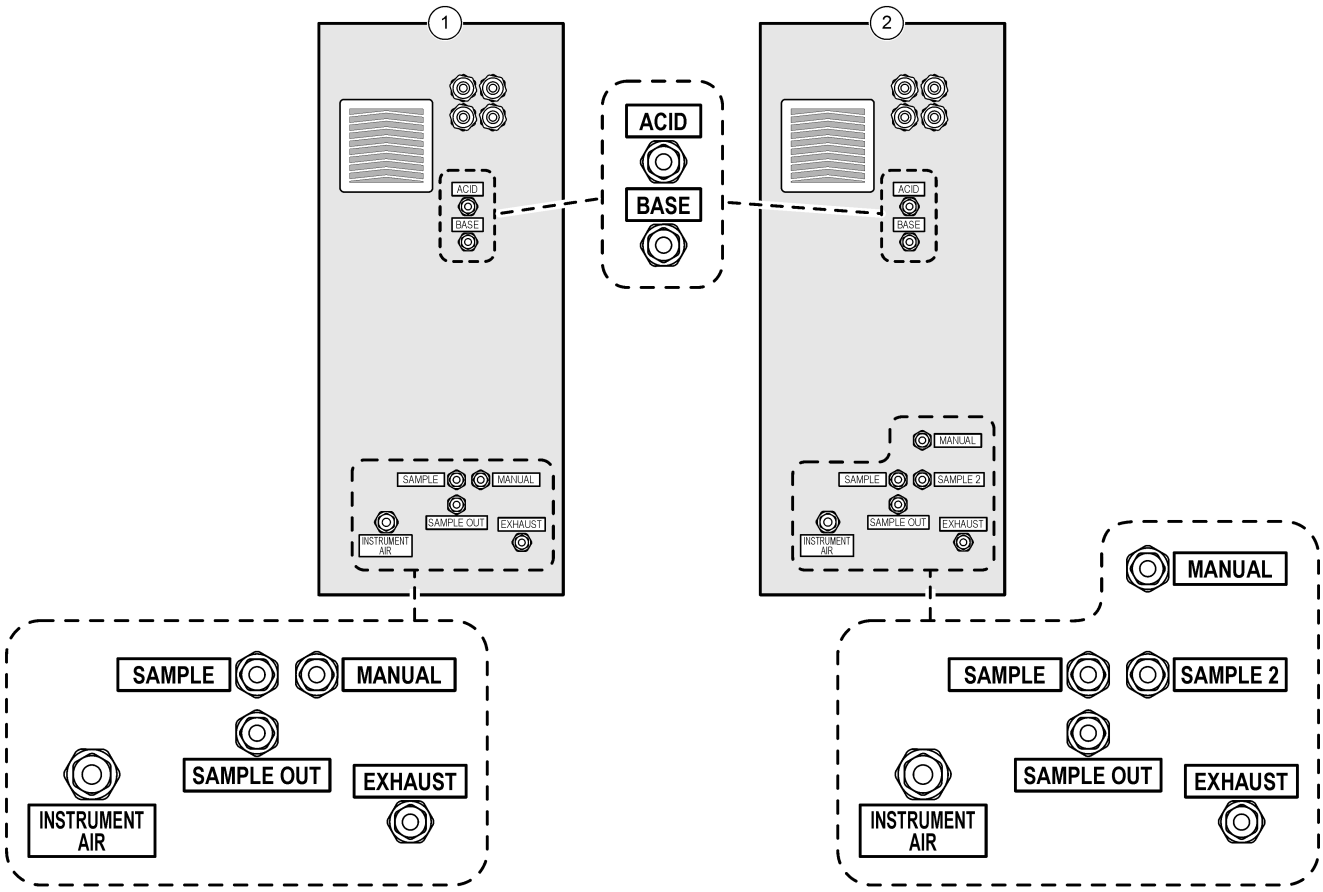
[4] Calculated with a correlation algorithm that includes TOC. To show the calculated results on the display, set the DISPLAY setting on the COD and/or BOD PROGRAM menu to YES.

Figure 1 Product overview with side view



1	Reagent, sample and drain fittings (Figure 2)	**5**	Cable strain-relief fittings for electrical connections
2	Single-stream analyzer	**6**	Display and keypad
3	Dual-stream analyzer	**7**	Door key
4	Fan	**8**	Door lock

Figure 2 Reagent, sample and drain fittings



1 Single-stream analyzer	**2** Dual-stream analyzer

2.6 Product components

Make sure that all components have been received. Refer to the supplied documentation. If any items are missing or damaged, contact the manufacturer or a sales representative immediately.

Section 3 Installation and startup checklist

Use the checklist that follows to complete installation and startup. Do the tasks in the order given.
If the analyzer is certified for hazardous areas, read the hazardous area documentation supplied with the analyzer. The hazardous area documentation contains important information for compliance with explosion protection regulations.

Task	Initial
Wall mounting:	
Identify the correct installation location. Refer to Installation guidelines on page 19.	
Install the mounting brackets. Attach the analyzer to a wall. Refer to Wall mount on page 19.	
Electrical connections:	
Connect an earth cable to the M8 earth bolt that is above the cable glands on the left side of the analyzer.	
Connect the analyzer to power. Then, install the supplied ferrite on the power cable. Refer to Connect power on page 22. The analyzer is a permanently wired device and configured for 120V or 240V as indicated on the product type label on the left side of the upper enclosure. Do not set the power to on.	
(Optional) Connect the relays (e.g., fault relay) to external devices. Refer to Connect the relays on page 24.	
(Optional) Connect the 4–20 mA outputs to external devices. Refer to Connect the analog outputs on page 25.	
(Optional) Connect the digital inputs to external devices to remotely control the analyzer. Refer to Power, analog output and relay terminals on page 25.	
Connect the Modbus TCP/IP option if installed. Refer to Connect Modbus TCP/IP (Ethernet) on page 30.	
Connect the Modbus RTU option if installed. Refer to Connect Modbus RTU (RS485) on page 27.	
Make sure that there are no loose electrical connections in the analyzer.	
Plumbing:	
The orientation of the ferrules used to connect the tubing is important. Refer to Tube connections on page 32.	
Plumb a sample stream(s) to the SAMPLE fitting(s) on the analyzer. Connect a 2 to 2.5 m (79 to 98 inch) length of tubing to the MANUAL fitting. Refer to Plumb the sample stream(s) and manual stream on page 33.	
Plumb the drain lines. Refer to Plumb the drain lines on page 36.	
Plumb instrument air to the INSTRUMENT AIR fitting on the left side of the analyzer. Refer to Connect instrument air on page 37. Make sure that the set point of the instrument air pressure supply is 1.5 bar (21.7 psi) (or 1.2 bar (17.4 psi) for the BioTector air compressor). ***Note:*** *The minimum air supply flow rate is 8.4 m^3/hour. The average air consumption is less than 5.4 m^3/hour, and typically 3.6 m^3/hour during online operation.*	
Plumb the EXHAUST fitting to a ventilated area. Refer to Plumb the exhaust on page 37.	
Plumb the reagent containers to the fittings on the left side of the analyzer. Refer to Plumb the reagents on page 38.	
Install the tubing on the sample pump. Refer to Install the sample pump tubing on page 42.	
Connect the tubes that were disconnected for shipping. Refer to Connect the internal tubing on page 43.	
Make sure that there are no loose plumbing connections in the analyzer.	
If the analyzer is supplied as an "air purge ready" system (no fan) or there are corrosive gasses in the area, connect the air purge to the analyzer. Refer to Connect the air purge on page 44.	
Look at all of the tubes and connections for possible leaks. Repair the leaks found.	

Installation and startup checklist

Task	Initial
Startup:	
Set the circuit breaker for the analyzer to on, then set the main power switch to on. Refer to Set the power to on on page 45.	
Set the language that shows on the display (default: English). Refer to Set the language on page 45.	
Set the time and date on the analyzer. Refer to Set the time and date on page 45.	
Adjust the display brightness and contrast as necessary. Refer to Adjust the display brightness and contrast on page 46.	
Make sure that the set point of the instrument air pressure supply is 1.5 bar (21.7 psi) (or 1.2 bar (17.4 psi) for the BioTector air compressor). The instrument air pressure goes between 1.5 and 0.9 bar (21.7 and 13 psi) when the oxygen concentrator is on.	
Select MAINTENANCE > DIAGNOSTICS > O2-CTRL STATUS. Make sure that the pressure reading that shows on the display is between 390 and 400 mbar when the MFC is off.	
Select MAINTENANCE > DIAGNOSTICS > SIMULATE. Select MFC. Set the flow to 60 L/h. Push ✔ to start the mass flow controller (MFC). Select O2-CTRL STATUS. Make sure that the pressure reading is not less than 320 mbar.	
Identify if there is CO_2 contamination in the oxygen supply. Refer to Examine the oxygen supply on page 46.	
Examine the sample, acid and base pump operation. Refer to Examine the pumps on page 46.	
Make sure that the valves open and close correctly. Refer to Examine the valves on page 47.	
Set the reagent volumes on the analyzer and start a new reagent cycle. Refer to Set the reagent volumes on page 48. ***Note:*** *The new reagent cycle includes a zero calibration.*	
Push ⮌ to go to the main menu, then select OPERATION > START,STOP > START to start the analyzer. Do 5 to 10 measurements until the measurements are stable.	
Do another zero calibration. Select CALIBRATION > ZERO CALIBRATION > RUN ZERO CALIBRATION.	
Measure deionized water five times at operation range 1 to make sure that the zero calibration is correct. Connect deionized water to the MANUAL fitting. Refer to Measure deionized water on page 48. If the CO_2 peak values on the display are not almost zero, do a pH test. Refer to the instruction in the Maintenance manual.	
When the startup tests are complete, make sure that the top-left corner of the Reaction Data screen does not show "SYSTEM FAULT" or "SYSTEM WARNING". ***Note:*** *If "SYSTEM FAULT" or "SYSTEM WARNING" show, select OPERATION > FAULT ARCHIVE. Faults and warnings preceeded by an "*" are active. Refer to Troubleshooting in the Maintenance and Troubleshooting Manual for more information.*	
Configuration:	
Set the INTERVAL setting to set the time between reactions. Refer to Set the measurement interval on page 53.	
Set the sample pump forward times for each sample stream. Refer to Set the sample pump times on page 53.	
Set the stream sequence, the number of reactions to do at each stream and the operation range for each stream. Refer to Set the stream sequence and operation range on page 54. ***Note:*** *If Modbus RTU or TCP/IP is installed, the Modbus master controls the stream sequence and operation ranges (default).*	
(Optional) Set the analyzer to show COD, BOD and/or DW (drinking water) information on the display. Refer to Configure the COD and BOD settings on page 54.	
Configure the install new reagents settings. Refer to Configure the install new reagents settings on page 56.	
Configure the alarm settings for low reagents and no reagents. Refer to Set reagent monitoring on page 56.	

Task	Initial
Configure the analog outputs that are connected to an external device. Refer to Configure the analog outputs on page 57.	
Configure the relays that are connected to an external device. Refer to Configure the relays on page 59.	
Make sure that the operation of the analog outputs and relays is correct. Refer to the instructions in the Maintenance manual.	
If the optional Modbus TCP/IP module is installed in the analyzer, configure the Modbus settings. Refer to Configure the Modbus TCP/IP settings on page 62.	
Set the PRINT MODE setting to select the type of reaction data saved to the MMC/SD card (STANDARD or ENGINEERING) and the type of decimal point (POINT (.) or COMMA (,). Refer to Configure the communication settings on page 62. ***Note:*** *The manufacturer recommends that PRINT MODE is set to ENGINEERING so that troubleshooting data is saved.*	
Calibration:	
Let the analyzer operate for 24 hours for measurements to become stable.	
Set the operation range and the calibration standard for span calibrations. Refer to Start a span calibration or span check on page 66.	
Plumb the calibration standard to the MANUAL fitting. Refer to Plumb the calibration standard on page 68.	
Start a span calibration. Select CALIBRATION > SPAN CALIBRATION > RUN SPAN CALIBRATION.	
When the span calibration is complete, examine two or three reactions (measurements). Make sure that the CO_2 peak values are correct. Refer to Reaction Graph screen on page 73.	
(Optional) Set the days and time when the analyzer does a span calibration, span check, zero calibration and/or zero check. Refer to the instructions in the Advanced Configuration manual.	
Save the changes:	
Put the supplied MMC/SD card in the MMC/SD card slot if not already installed. Refer to Figure 23 on page 78.	
Push ↩ to go to the main menu, then select MAINTENANCE > DIAGNOSTICS > DATA OUTPUT > SEND ALL DATA to save the reaction archive, fault archive, analyzer settings and diagnostics data to the MMC/SD card.	

Section 4 Installation

DANGER

Multiple hazards. Only qualified personnel must conduct the tasks described in this section of the document.

4.1 Installation guidelines

- Install the analyzer near an open drain. The analyzer waste usually has a low pH (acidic) and can be hazardous. Refer to local regulatory agency instructions for disposal.
- Install the analyzer as near to the sampling point as possible to decrease analysis delay.
- Install the analyzer indoors in a clean, dry, well-ventilated and temperature-controlled location. Refer to the operating temperature and humidity specifications in Specifications on page 3.
- Mount the analyzer upright and level on a flat, vertical surface.
- Do not install the analyzer in direct sunlight or near a heat source.
- Install the analyzer so that the power disconnect device is visible and easily accessible.

4.2 Wall mount

WARNING

Personal injury hazard. Make sure that the wall mounting is able to hold 4 times the weight of the equipment.

WARNING

Personal injury hazard. Instruments or components are heavy. Use assistance to install or move.

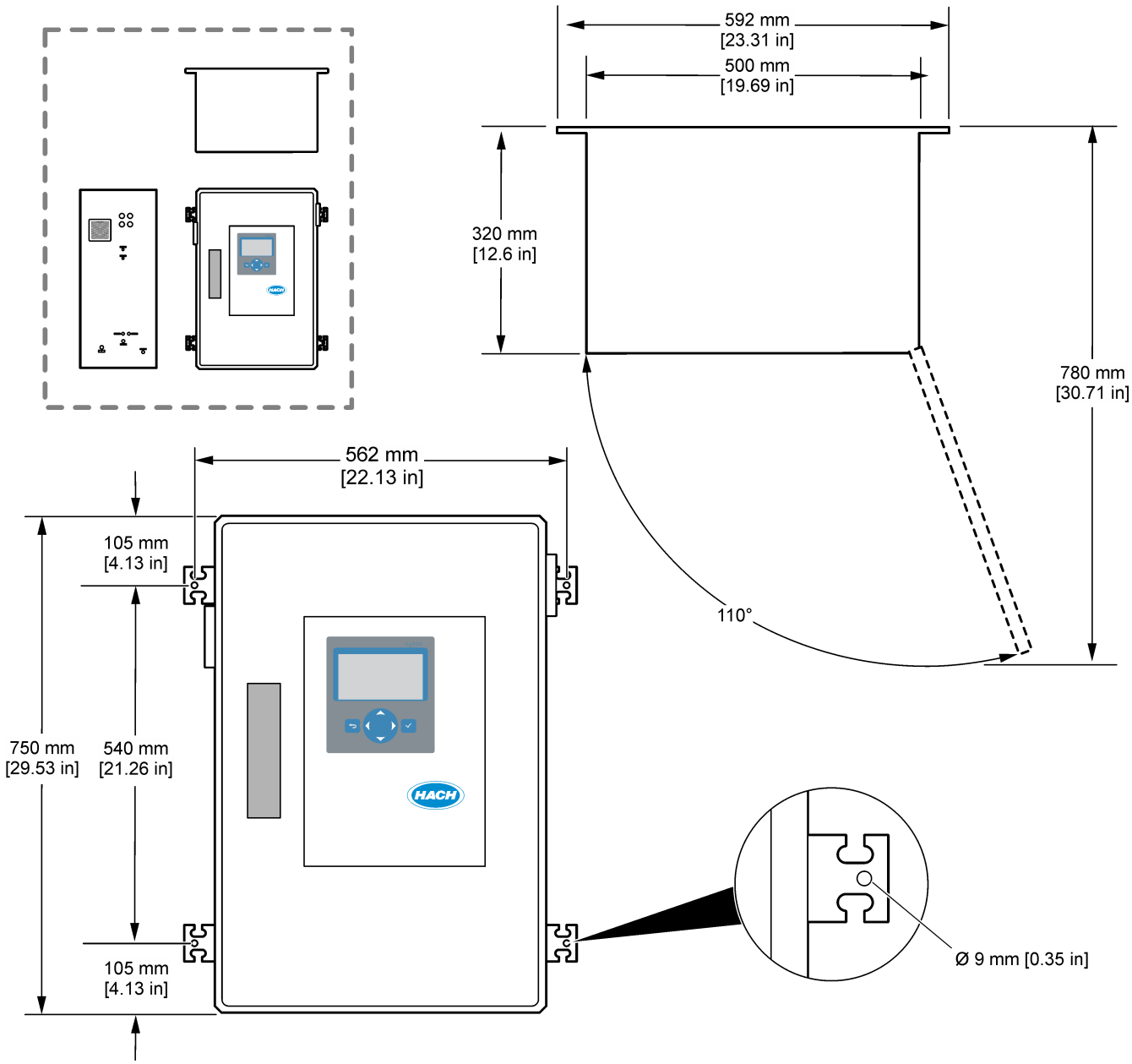
NOTICE

To prevent instrument damage, make sure that there is at least 300 mm (12 in.) of clearance on the sides and 1500 mm (59 in.) in the front of the analyzer. Refer to Figure 3 for dimensions.

1. Attach the wall mounting brackets to the back of the analyzer. Refer to the documentation supplied with the wall mounting brackets.
2. Install mounting hardware on a wall that can hold 4 times the weight of the analyzer (size M8 bolts minimum). Refer to Figure 3 for the mounting hole dimensions.

   Refer to Specifications on page 3 for the weight of the analyzer. Mounting hardware is supplied by the user.
3. Lift the analyzer with a forklift to attach the analyzer to the wall with the wall mounting brackets.
4. Make sure that analyzer is level.

Figure 3 Mounting hole dimensions



4.3 Electrical installation

DANGER

Electrocution hazard. Always remove power to the instrument before making electrical connections.

CAUTION

Multiple hazards. This instrument must be installed by Hach trained installation engineer in accordance with local and regional electrical codes.

The analyzer is a permanently wired device and configured for 120V or 240V as indicated on the product type label on the left side of the upper enclosure.

4.3.1 Electrostatic discharge (ESD) considerations

NOTICE

Potential Instrument Damage. Delicate internal electronic components can be damaged by static electricity, resulting in degraded performance or eventual failure.

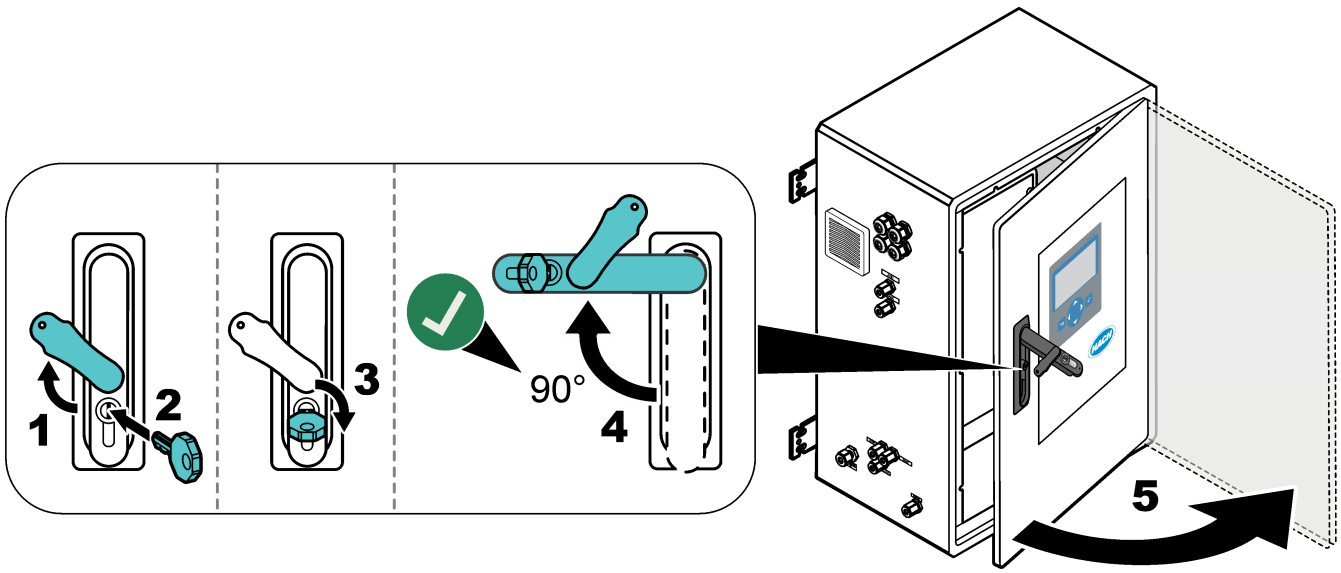
Refer to the steps in this procedure to prevent ESD damage to the instrument:

- Touch an earth-grounded metal surface such as the chassis of an instrument, a metal conduit or pipe to discharge static electricity from the body.
- Avoid excessive movement. Transport static-sensitive components in anti-static containers or packages.
- Wear a wrist strap connected by a wire to earth ground.
- Work in a static-safe area with anti-static floor pads and work bench pads.

4.3.2 Open the door

NOTICE

Make sure that the door handle is fully turned before the door is opened or damage to the door seal can occur. If the door seal has damage, dust and liquid can enter the enclosure.



4.3.3 Connect power

⚠DANGER



Electrocution hazard. Protective Earth Ground (PE) connection is required.

⚠DANGER



Electrical shock and fire hazards. Make sure to identify the local disconnect clearly for the installation.

⚠WARNING



Potential electrocution hazard. If this equipment is used in potentially wet locations, a **Ground Fault Interrupt** device must be used for connecting the equipment to its mains power source.

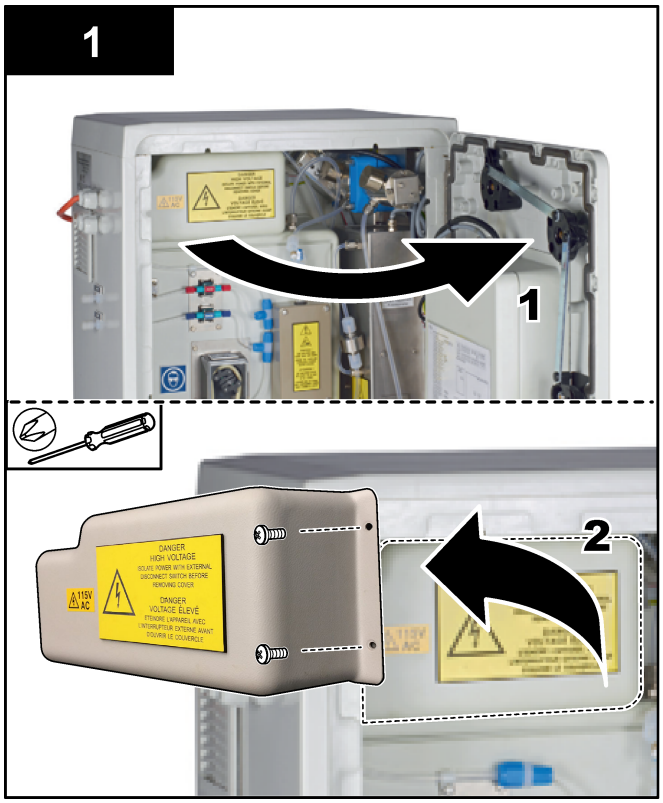
NOTICE

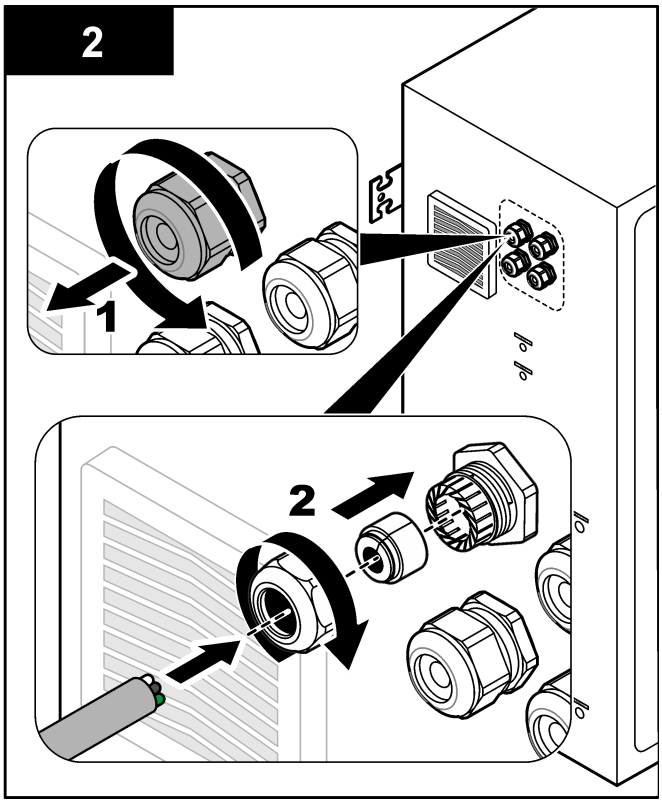
Install the device in a location and position that gives easy access to the disconnect device and its operation.

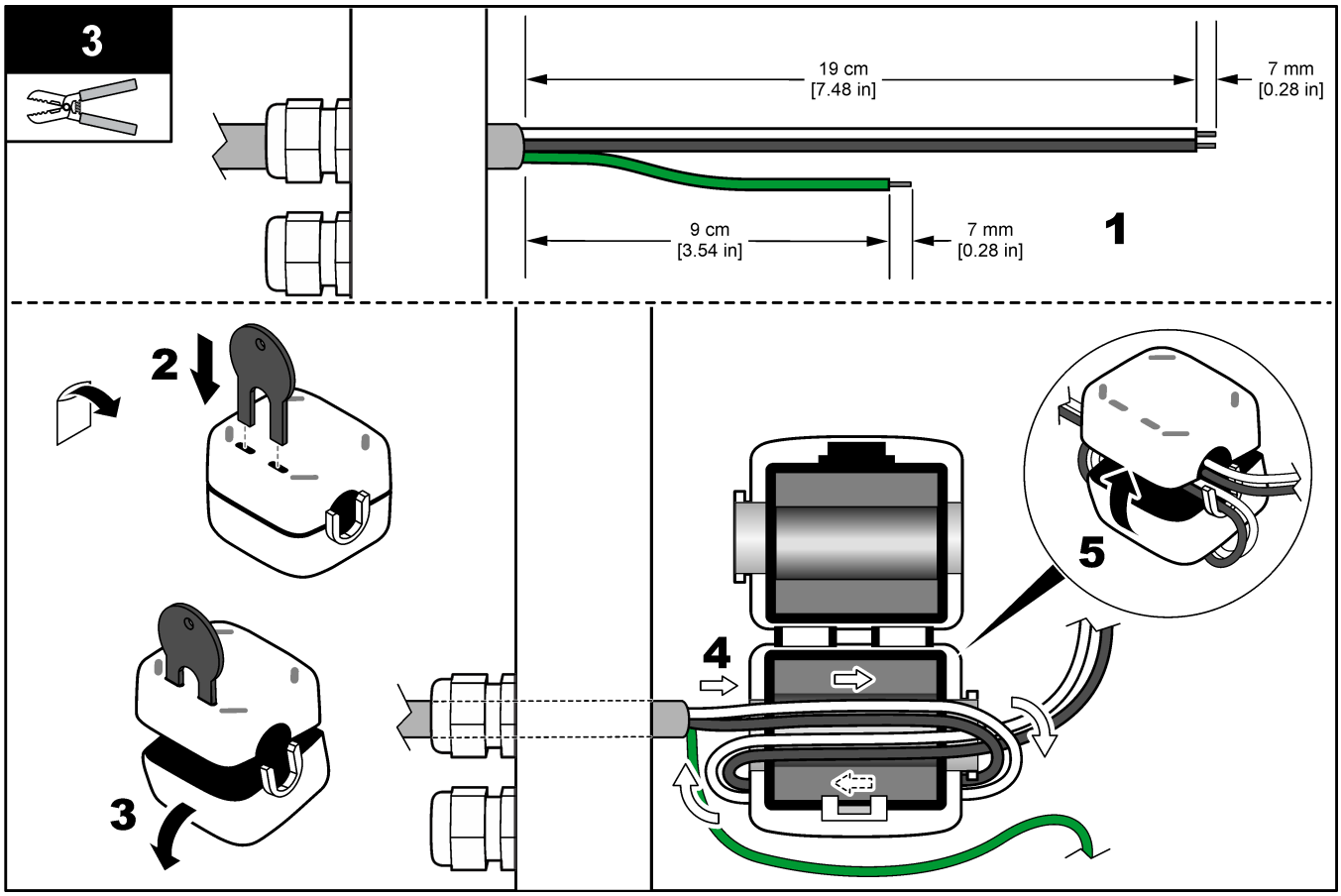
Do not use a power cord to supply power. Refer to the illustrated steps that follow and Power, analog output and relay terminals on page 25 to connect power. Make sure to install the supplied ferrite on the power cable (illustrated step 3).

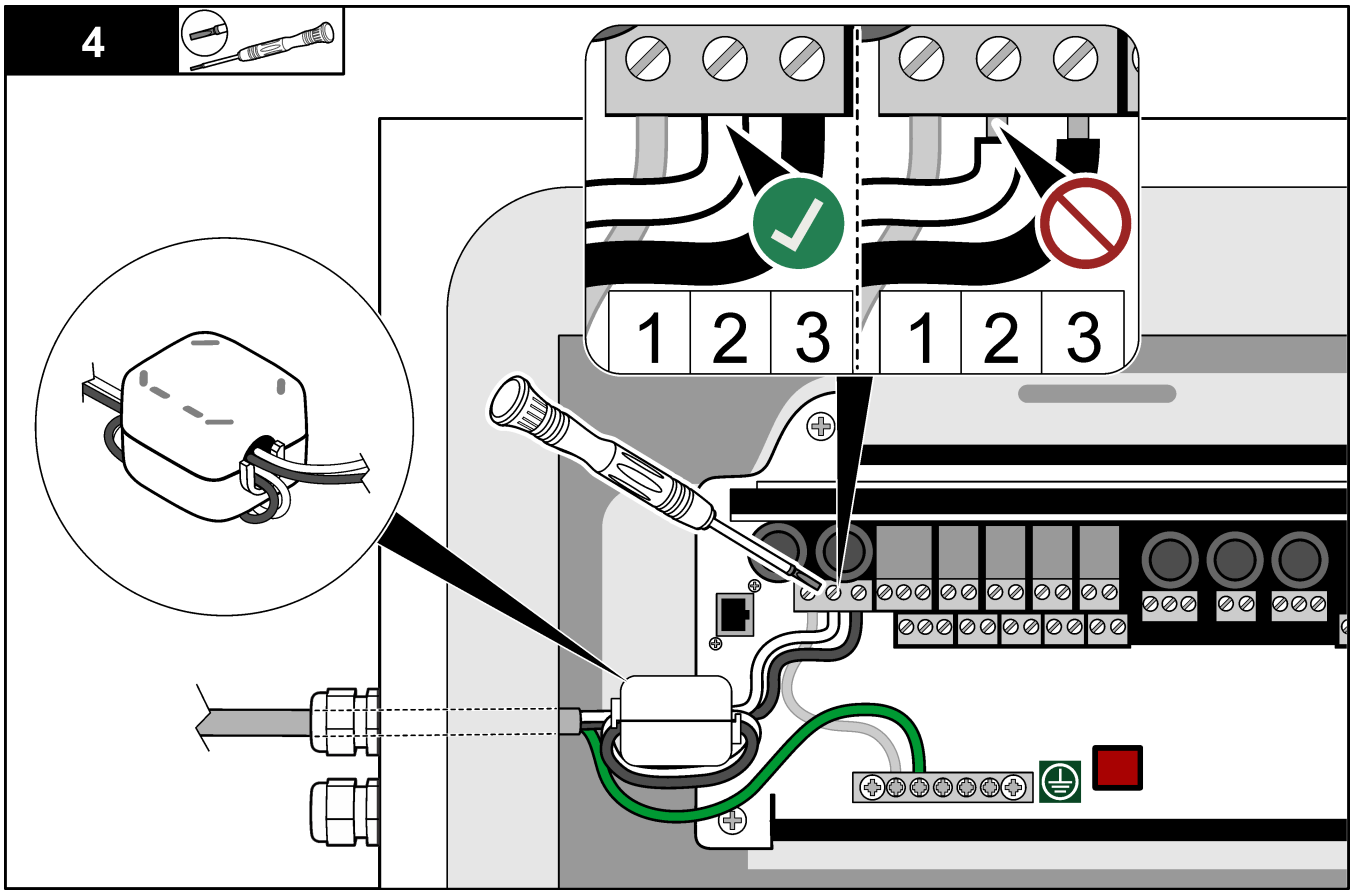
The analyzer is a permanently wired device and configured for 120V or 240V as indicated on the product type label on the left side of the upper enclosure. The analyzer requires a dedicated branch circuit protected power source and an isolator within 1 m (3.3 ft).

- Install a 2-pole, 10 A maximum local disconnect switch for the analyzer within 2 m (6.5 ft) of the analyzer. Put a label on the disconnect that identifies it as the main disconnect device for the analyzer.
- Make sure that the mains wire power and safety ground service drops for the analyzer are a 2-wire and protective earth cable, 1.5 mm^2 (16 AWG), 10 A minimum and the wire insulation is rated 300 VAC minimum, 60 °C (140 °F) minimum and VW-1 for fire.
  Use a shielded mains power cable connected to a shielded earth to comply with the Electromagnetic Compatibility Directive (2004/108/EC).
  Use SJT, SVT SOOW or <HAR> equivalent cable as applicable to the application.
- Connect the disconnect switch to a branch circuit/miniature circuit breaker (MCB) protection rated 10 A/ Type D. Install an earth leakage circuit breaker in accordance with local and regional regulations if applicable.
- Connect equipment in accordance with local, regional or national electrical codes.
- Typically, four cable glands (strain relief fittings) are supplied with the analyzer. PG13.5 cable glands have a clamping range of 6–12 mm. PG11 cable glands have a clamping range of 5–10 mm.


1
1
2


2
1
2


3
19 cm
[7.48 in]
7 mm
[0.28 in]
9 cm
[3.54 in]
7 mm
[0.28 in]
1
2
3
4
5



4.3.4 Connect the relays

DANGER

Electrocution hazard. Do not mix high and low voltage. Make sure that the relay connections are all high voltage AC or all low voltage DC.

WARNING

Potential Electrocution Hazard. Power and relay terminals are designed for only single wire termination. Do not use more than one wire in each terminal.

WARNING

Potential fire hazard. Do not daisy-chain the common relay connections or jumper wire from the mains power connection inside the instrument.

CAUTION

Fire hazard. Relay loads must be resistive. Always limit current to the relays with an external fuse or breaker. Obey the relay ratings in the Specifications section.

The analyzer has a maximum of six non-powered relays. The relays are programmable. The relays are rated at 1 A, 30 VDC maximum.

Use the relay connections to start or stop an external device such as an alarm. Each relay changes state when the selected condition for the relay occurs.

Refer to Power, analog output and relay terminals on page 25 and Table 6 to connect an external device to a relay. Refer to Configure the relays on page 59 to select the condition that sets each relay to on.

The relay terminals accept 1.0 to 1.29 mm^2 (18 to 16 AWG) wire (as determined by load application)[5]. Wire gauge less than 18 AWG is not recommended. Use wire with an insulation rating of 300 VAC or higher. Make sure that the field wiring insulation is rated 80 °C (176 °F) minimum.

Make sure to have a second switch available to remove power from the relays locally if there is an emergency or for maintenance.

Table 6 Wiring information—relays

NO	COM	NC
Normally open	Common	Normally closed

4.3.5 Connect the analog outputs

The analyzer has a maximum of four 4–20 mA analog outputs. Use the analog outputs for analog signaling or to control external devices.

Refer to Power, analog output and relay terminals on page 25 to connect an external device to an analog output.

Wrap the 4-20 mA cables one time around the supplied ferrite to form a single loop.

Depending on the configuration and options installed on the analyzer, the minimum specifications for signal and communications cable is 4 wires (twisted pair, shielded cable) and more 2 wires for each additional signal, 0.22 mm^2 (24 AWG) minimum and rated 1 A.

Select the full scale value shown as 20 mA on each analog output. Select the analysis result each analog output shows. Refer to Configure the analog outputs on page 57.

Notes:

- The analog outputs are isolated from the other electronics, but are not isolated from each other.
- The analog outputs are self-powered. Do not connect to a load with voltage that is independently applied.
- The analog outputs cannot be used to supply power to a 2-wire (loop-powered) transmitter.

4.3.6 Power, analog output and relay terminals

⚠ DANGER



Electrocution hazard. Always remove power to the instrument before making electrical connections.

Refer to Figure 4 for the location of the power, analog output, relay terminals and digital inputs. Table 7 gives the terminal descriptions.

The four digital inputs in Table 7 are used for remote standby, remote stream selection and remote grab sample measurement. To identify the digital input functions, select MAINTENANCE > DIAGNOSTICS > INPUT/OUTPUT STATUS > DIGITAL INPUT.

There are two digital inputs. Contact technical support for information about the digital input functions and configuration.

Make electrical connections through the cable strain-relief fittings on the side of the analyzer.

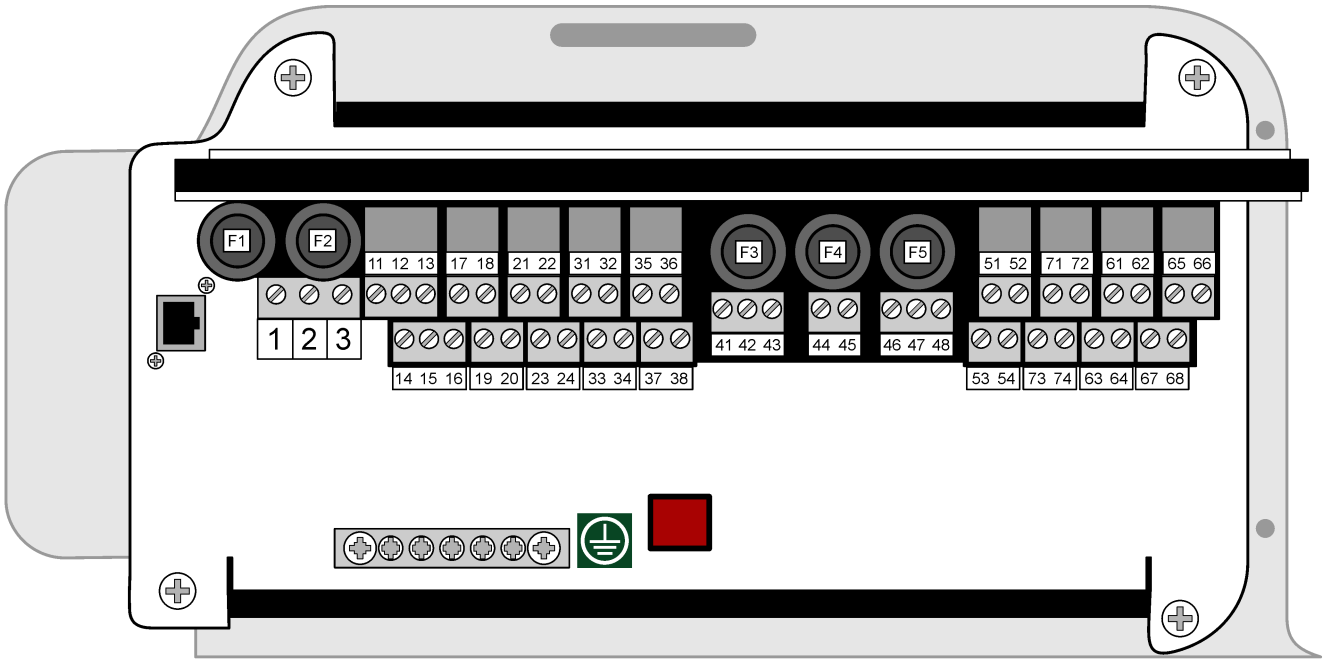
[5] Recommend 1.0 mm^2 (18 AWG) minimum stranded UL/AWM Style 1015 rated 600 V, 105 °C, VW-1.

Always remove power to the instrument before making electrical connections. Refer to Figure 5 on page 28.

To keep the environmental rating:

- Do not put more than one cable (or two wires) through a strain-relief fitting.
- Make sure that the strain-relief fittings that are unused have rubber cable plugs in them.

Figure 4 Power and Input/Output Board



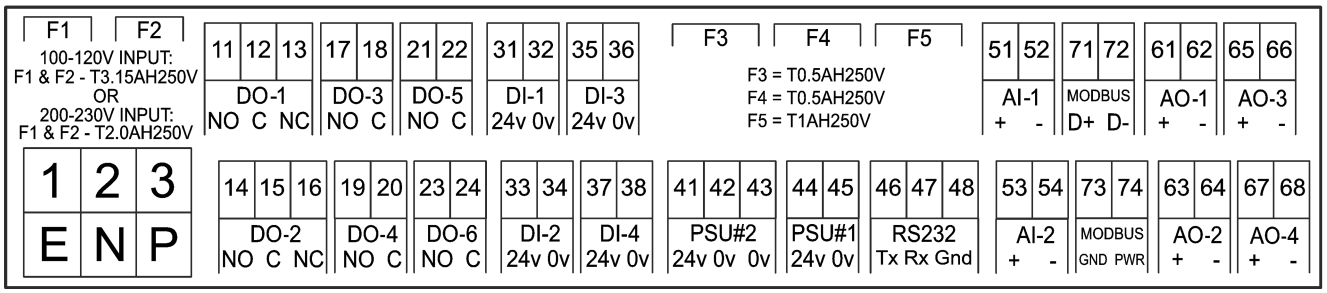


Table 7 Terminal descriptions

Terminal	Description	Terminal	Description
E ⏚	Protective earth for mains power and screened earth cable	41	Power supply 2 output, 24 VDC
N	Neutral (or L2 for US and Canada)	42	Power supply 2 output, 0 VDC
P	110–120 VAC or 200–230 VAC 1 phase	43	Power supply 2 output, 0 VDC
11	Relay 1, NO	44	Power supply 1 output, 24 VDC
12	Relay 1, COM	45	Power supply 1 output, 0 VDC
13	Relay 1, NC	46	RS232 output: TX (not used)
14	Relay 2, NO	47	RS232 output: RX (not used)

Table 7 Terminal descriptions (continued)

Terminal	Description	Terminal	Description
15	Relay 2, COM	48	RS232 output: GND (not used)
16	Relay 2, NC	51	4–20 mA signal in 1+
17	Relay 3, NO	52	4–20 mA signal in 1-
18	Relay 3, COM	53	4–20 mA signal in 2+
19	Relay 4, NO	54	4–20 mA signal in 2-
20	Relay 4, COM	71	Modbus D + *
21	Relay 5, NO	72	Modbus D - *
22	Relay 5, COM	73	Modbus ground *
23	Relay 6, NO	74	Modbus power *
24	Relay 6, COM	61	4–20 mA signal out 1+
31	Digital input 1, 24 VDC	62	4–20 mA signal out 1–
32	Digital input 1, 0 VDC	63	4–20 mA signal out 2+
33	Digital input 2, 24 VDC	64	4–20 mA signal out 2–
34	Digital input 2, 0 VDC	65	4–20 mA signal out 3+
35	Digital input 3, 24 VDC	66	4–20 mA signal out 3–
36	Digital input 3, 0 VDC	67	4–20 mA signal out 4+
37	Digital input 4, 24 VDC	68	4–20 mA signal out 4+
38	Digital input 4, 0 VDC		

* = optional

4.3.7 Connect Modbus RTU (RS485)

For Modbus RTU data transmission, connect the Modbus RTU terminals in the analyzer to a Modbus master device as follows:

1. Remove power to the analyzer. Refer to the illustrated steps in Figure 5.
2. Put a 4-wire, twisted pair, shielded cable through a cable strain-relief fitting on the left side of the analyzer. Use wire gauge of 0.2 mm^2 (24 AWG) minimum.
3. Connect three of the wires to the Modbus RTU terminals in the analyzer. Refer to Figure 6 and Table 8 for wiring information.

   Refer to Figure 7 for the location of the Modbus RTU terminals in the analyzer.
4. Connect the shield wire of the cable to terminal 73 of the analyzer. Refer to Figure 6 and Table 8 for wiring information.

   Note: *As an alternative, connect the shield wire to the ground terminal of the Modbus master device.*
5. Tighten the cable strain-relief fitting.
6. Connect the other end of the cable to a Modbus master device. Refer to Figure 6.
7. Make sure that the wire connected to terminal 71 (D+) is positively biased compared to terminal 72 (D–) when the bus is in an idle condition.
8. To terminate the bus, install a jumper on J18 of the motherboard. Refer to Figure 7.

   The motherboard is in the electronic enclosure on the door behind the cover.

Figure 5 Remove power to the analyzer

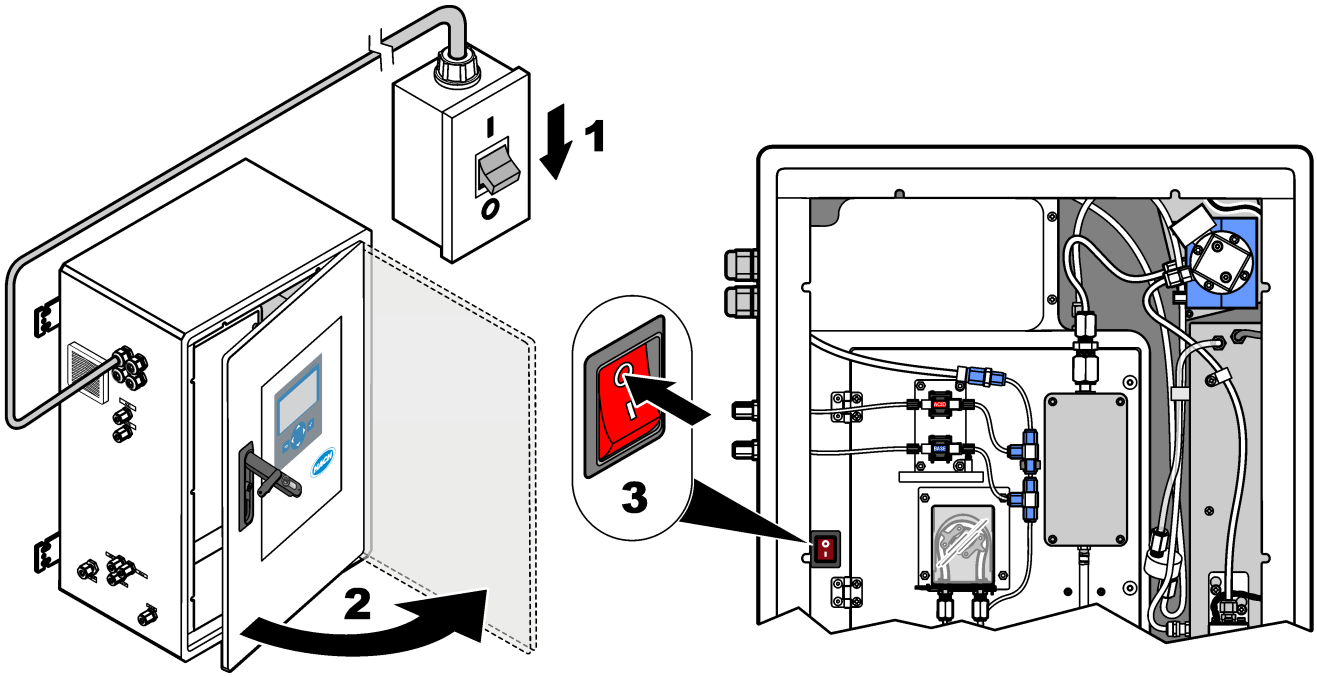
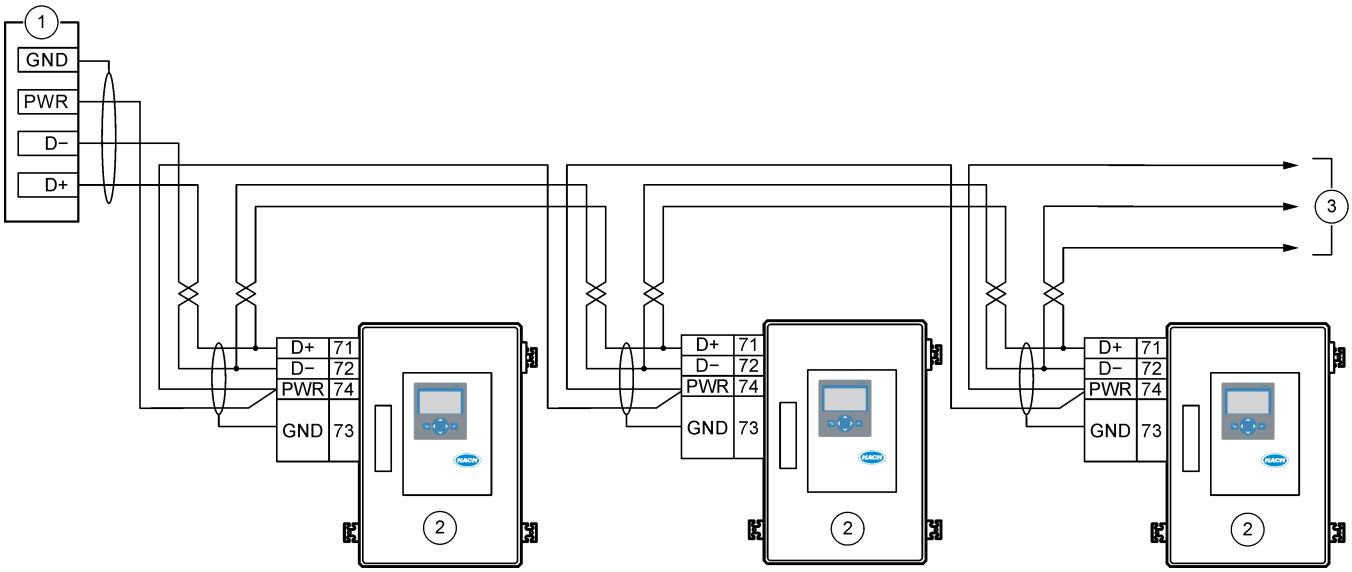


Figure 6 Wiring diagram

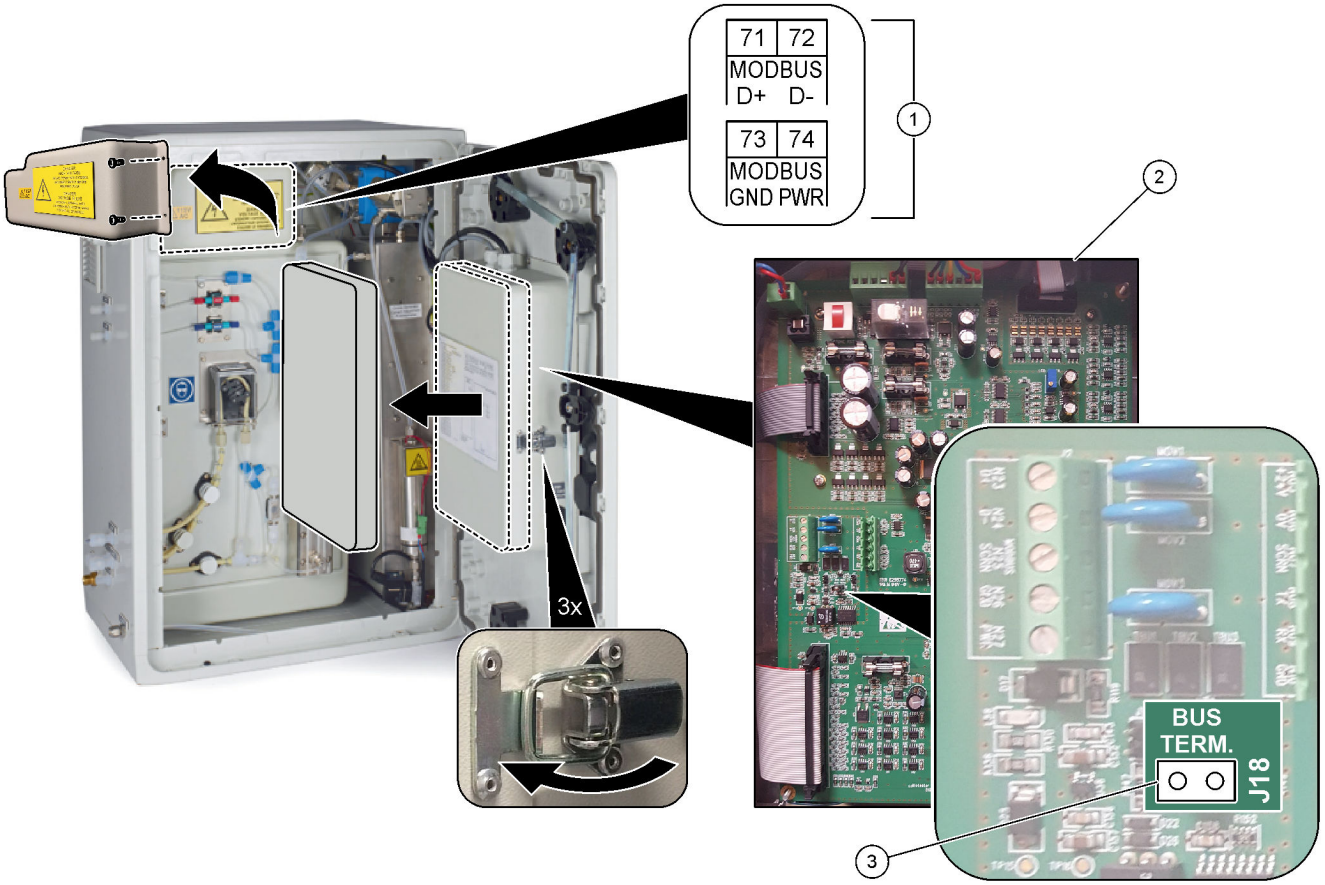


1 Modbus master	**3** To other RS485 devices
2 Analyzer	

Table 8 Wiring information

Terminal	Signal
71	D+
72	D–
73	Modbus ground
74	Modbus power

Figure 7 Location of Modbus RTU terminals and bus-termination jumper



1 Modbus RTU terminals	**3** Bus-termination jumper (J18)
2 Motherboard	

4.3.8 Connect Modbus TCP/IP (Ethernet)

If the optional Modbus TCP/IP module is installed in the analyzer, configure the Modbus module and connect the module to a Modbus master device. Refer to the sections that follow.

The Modbus TCP/IP module is marked "MODBUS" and is below the terminals for the mains power, analog output and relays.

4.3.8.1 Configure the Modbus TCP/IP module

1. Set the analyzer power to on.
2. Use an Ethernet cable to connect a laptop to the Modbus TCP/IP (RJ45) connector in the analyzer. Refer to Figure 8 on page 31.
3. On the laptop, click the Start icon and select Control Panel.
4. Select Network and Internet.
5. Select Network and Sharing Center.
6. On the right side of the window, select Change adapter settings.
7. Right-click Local Area Connection and select Properties.
8. Select Internet Protocol Version 4 (TCP/IPv4) from the list, then click **Properties**.
9. Record the properties to go back to the properties in the future as necessary.
10. Select Use the following IP address.
11. Enter the IP address and subnet mask that follow:
    - IP address: 192.168.254.100
    - Subnet mask: 255.255.255.0
12. Click **OK**.
13. Close the open windows.
14. Open a web browser.
15. In the address bar of the web browser, enter the default IP address (192.168.254.254).

    The web-interface of the Modbus TCP module shows.
16. Enter the user name and password:
    - User name: Admin
    - Password: admin
17. Use a web-interface at port 80 to change the configuration of the Modbus TCP module, such as the IP address (192.168.254.254) or the TCP/IP port (502).

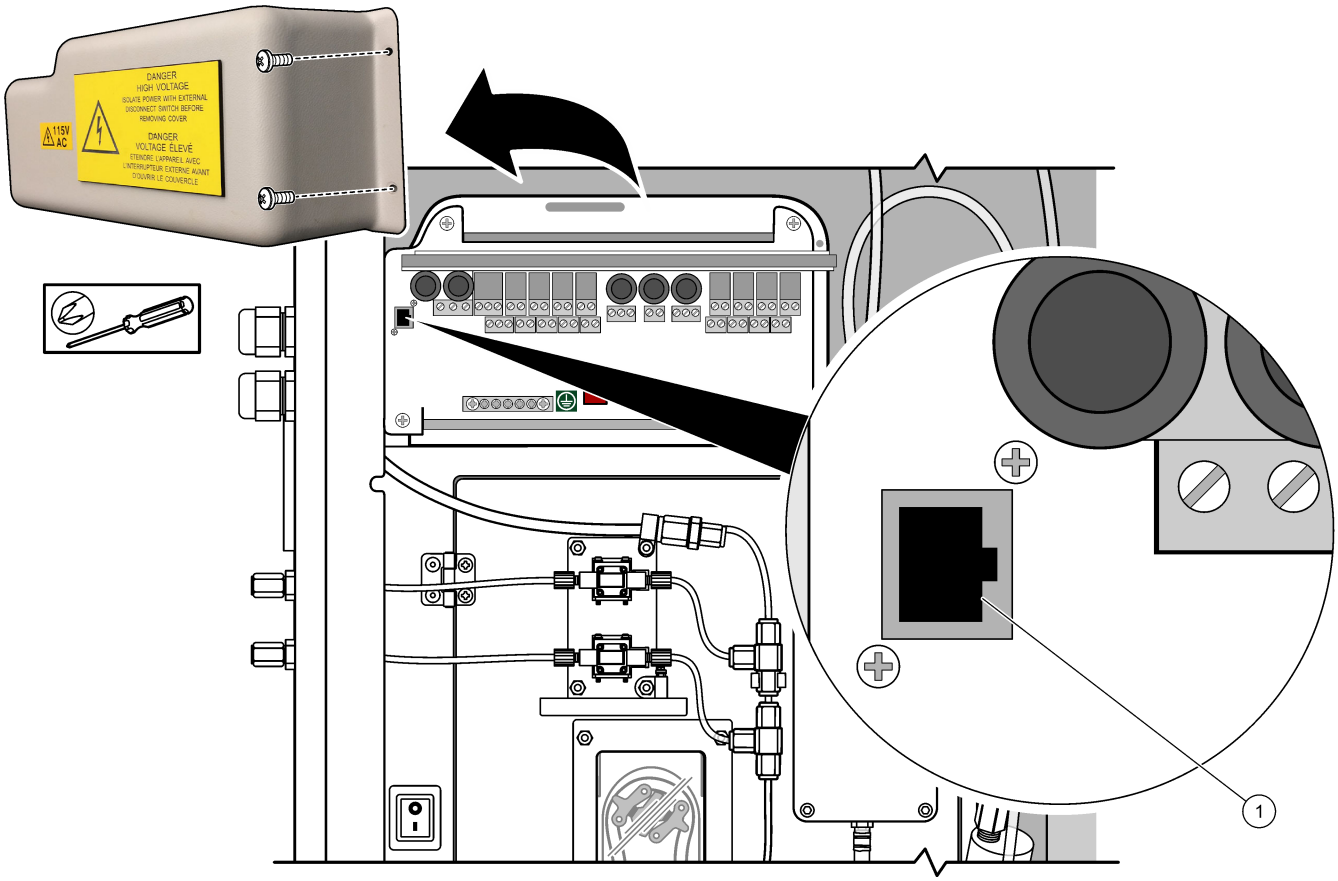
4.3.8.2 Connect the Modbus TCP/IP module

For Modbus TCP data transmission, connect the Modbus TCP/IP connector in the analyzer to a Modbus master device as follows:

1. Put an Ethernet cable through a cable strain-relief fitting on the left side of the analyzer.
2. Connect the Ethernet cable to the Modbus TCP/IP connector in the analyzer. Refer to Figure 8.
3. Tighten the cable strain-relief fitting.
4. Connect the other end of the Ethernet cable to a Modbus master device. Refer to Figure 9.

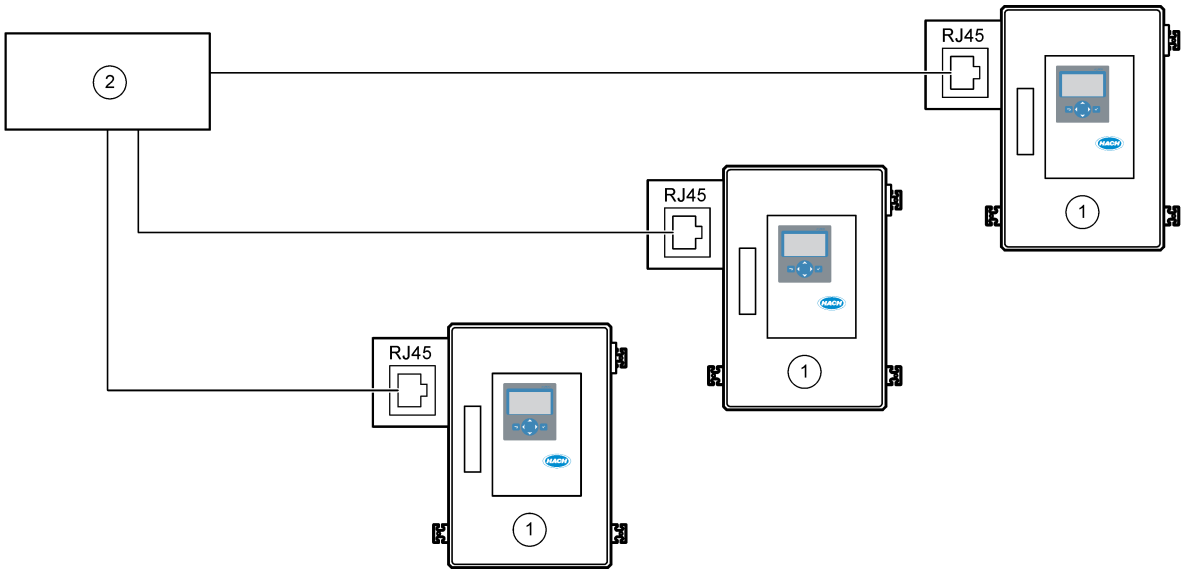
   If the analyzer has two Modbus TCP/IP connectors, fully redundant data transmission is possible. To connect an analyzer to two Modbus master devices, refer to Figure 10.

Figure 8 Modbus TCP/IP connector



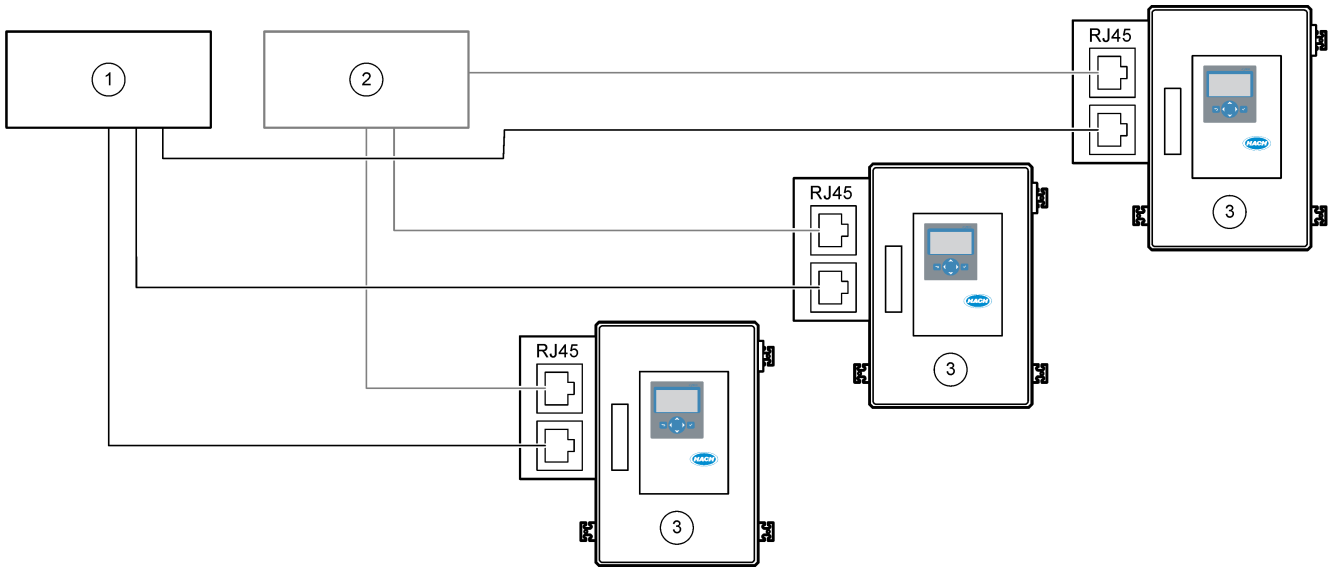
1 Modbus TCP/IP connector	

Figure 9 Normal Modbus TCP wiring



1 Analyzer	**2** Modbus master

Figure 10 Redundant Modbus TCP wiring



1 Modbus Master 1	**3** Analyzer
2 Modus Master 2	

4.4 Plumbing

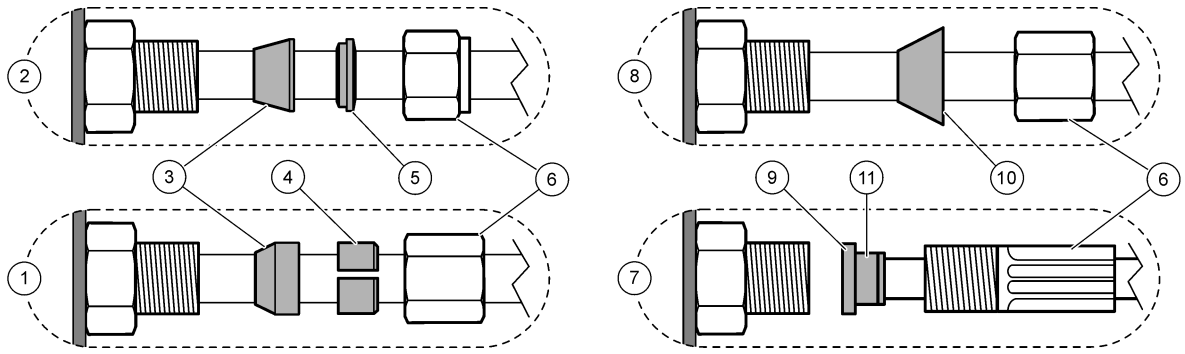
4.4.1 Tube connections

The orientation of the ferrules used to connect the tubing is important. Incorrect ferrule orientation can cause leaks and/or air bubbles in the analyzer tubing. Refer to Figure 11 for the correct ferrule orientation.

1. Cut tubing with a tube cutting tool. Do not use a blade or scissors or leaks can occur.
2. Put the tube fully into the fitting.
3. Tighten the nut by hand. If the fittings are tighten too much, damage to the fittings and leaks will occur.
   - **Stainless Steel fittings**—Tighten another 1¼ turn with an adjustable wrench. Stainless steel fittings used on 1/8-in. ID PFA tubing must be tightened only another ¾ of a turn.
   - **PFA fittings**—Tighten another ½ turn with an adjustable wrench.
   - **Swagelok PFA tee fittings with blue nuts**—Tighten until the nut stops (or cannot be tightened more) with an adjustable wrench. The tee fittings with blue nuts have only one ferrule and no back cutting ring or back ferrule.
   - **Acid and base pump fittings**—Tighten the ferrule by hand. Do not use an adjustable wrench.

   To tightening a fitting that was tightened before, tighten the number of turns the fitting was tightened before plus a little more with an adjustable wrench.

Figure 11 Ferrule orientation



1 PFA and PVDF fittings	**5** Back ferrule	**9** ETFE ferrule
2 Stainless steel fittings (SS-316)	**6** Nut	**10** PFA ferrule
3 Front ferrule	**7** Acid and base pump fittings	**11** Stainless steel ferrule
4 Back cutting ring	**8** Swagelok PFA tee fittings with blue nuts	

4.4.2 Plumb the sample stream(s) and manual stream

Refer to Specifications on page 3 for the sample specifications. The sample pressure at the sample inlet must be at ambient pressure.

For pressurized sample streams, install the optional Sample Overflow Chamber in the sample line to supply sample at ambient pressure. Refer to Install a sample overflow chamber (optional) on page 36.

1. Use 1/4-in. OD x 1/8-in. ID PFA tubing to plumb the SAMPLE fitting to a sample stream. Make the sample line as short as possible.

   Refer to Sample line guidelines on page 33 for instructions.
2. Plumb the SAMPLE 2 fitting to a sample stream, if available.
3. Connect 1/4-in. OD x 1/8-in. ID PFA tubing to the MANUAL fitting as necessary. Make sure that the tubing length is 2 to 2.5 (6.5 to 8.2 ft).

   Use the MANUAL fitting to measure grab samples or deionized water as necessary and to measure the calibration standard during span calibrations.
4. When all of the tubes are connected, look for possible leaks. Repair the leaks found.

4.4.3 Sample line guidelines

Select a good, representative sampling point for the best instrument performance. The sample must be representative of the entire system.

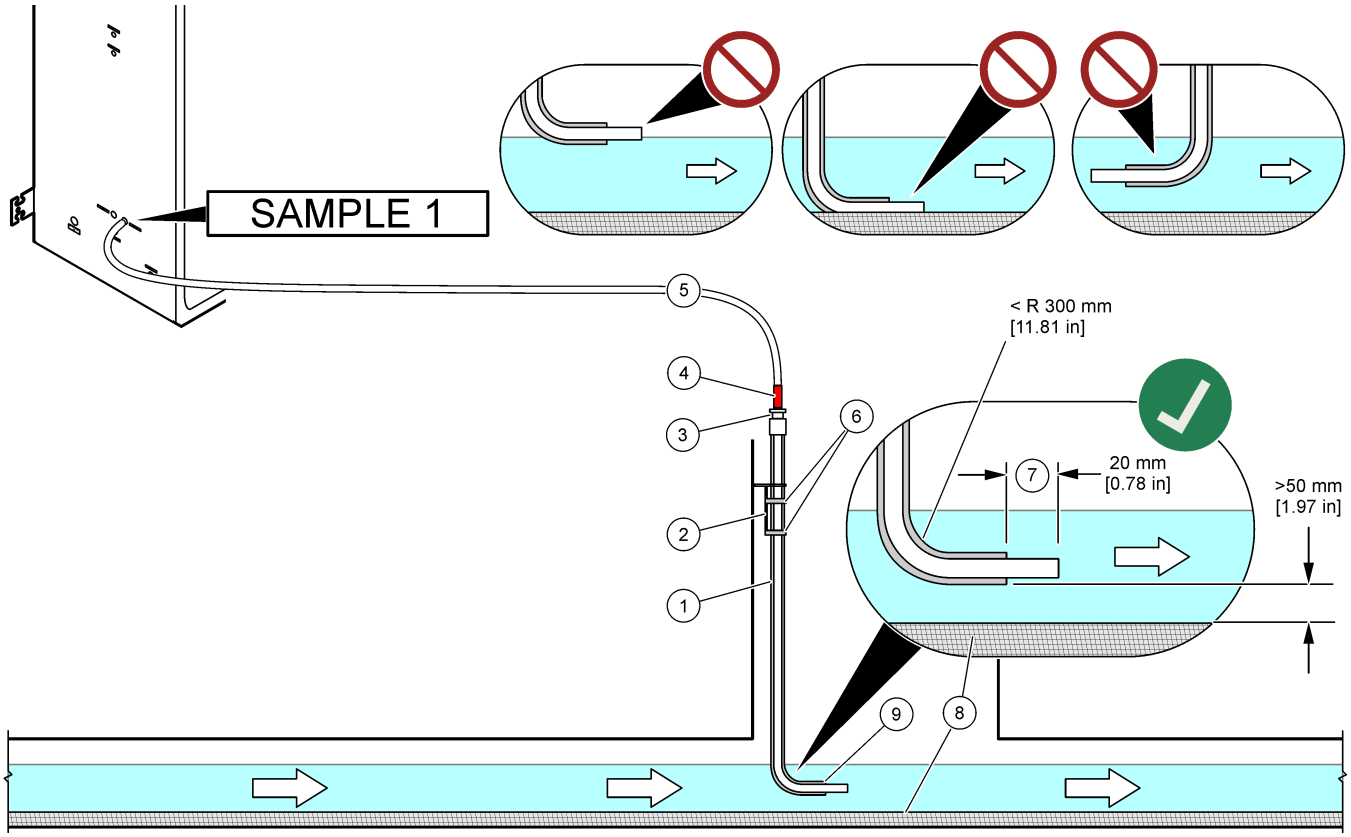
To prevent erratic readings:

- Collect samples from locations that are sufficiently distant from points of chemical additions to the process stream.
- Make sure that the samples are sufficiently mixed.
- Make sure that all chemical reactions are complete.

Install the sample tubing in an open channel or a pipe as shown in Figure 12 or Figure 13. To connect the sample tube to a metal pipe, use a Swagelok reducer (e.g., SS-400-R-12).

The length of the sample tubing, between the water surface and the SAMPLE fitting, must be 2.5 m (8.2 ft).

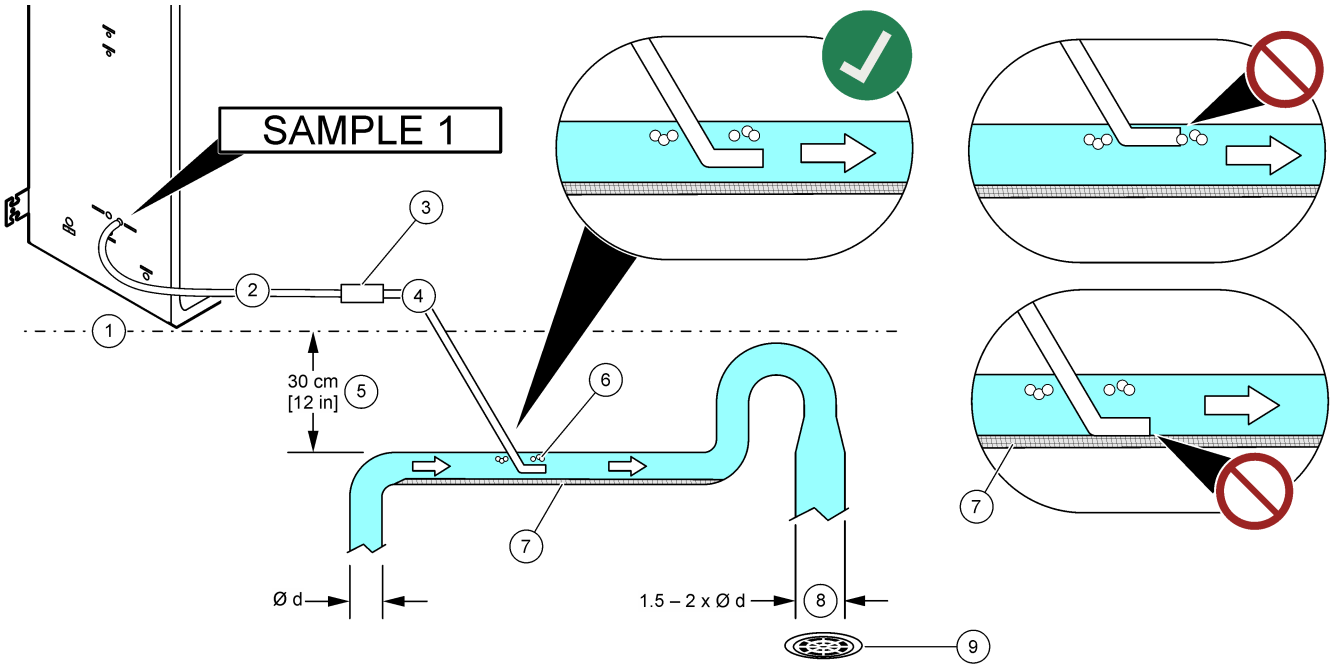
Figure 12 Sample line in an open channel



1 Sleeve for sample tubing	**4** Depth mark on tube	**7** Sample tubing goes past end of sleeve (20 mm)
2 Sleeve bracket	**5** Sample tubing, 1/4-in. OD x 1/8-in. ID PFA	**8** Silt
3 Compression gland to hold sample tubing	**6** Clamps	**9** Sleeve opening[6]

[6] Sleeve must be below the low water level but more than 50 mm above the silt.

Figure 13 Sample line in a pipe



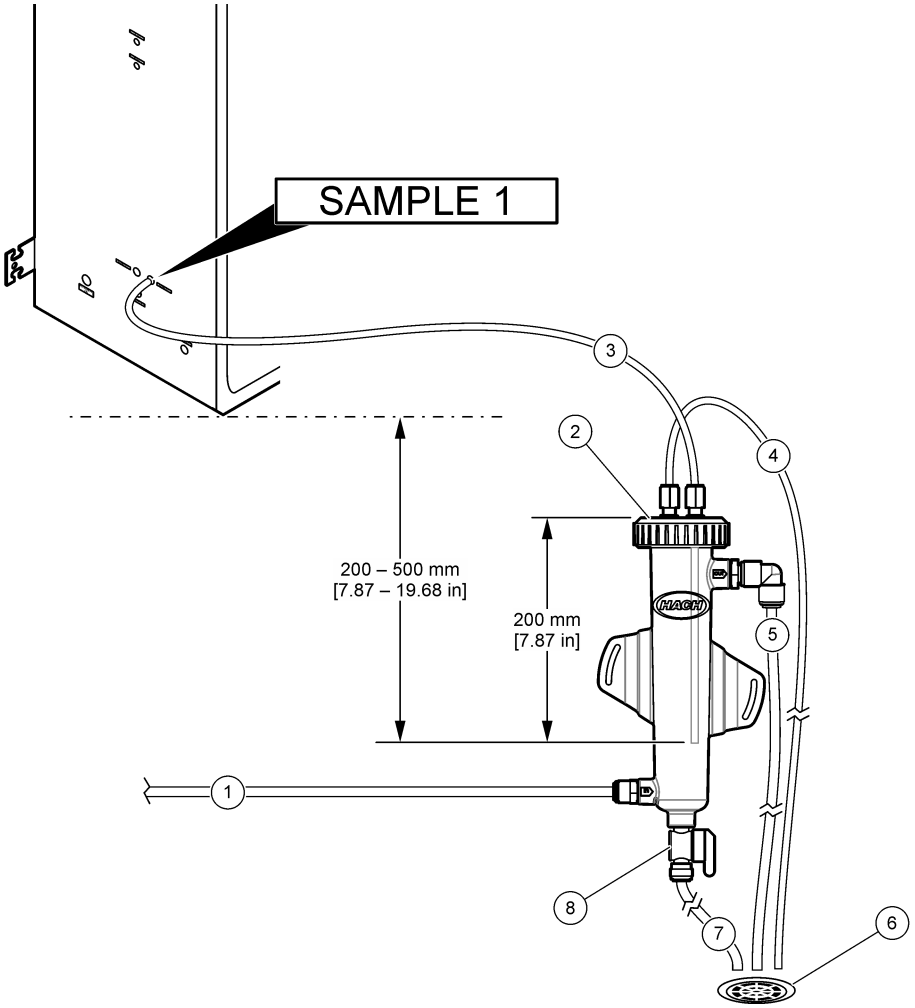
1 Bottom of analyzer	**4** Stainless steel tube, 1/4-in. OD x 1/8-in. ID	**7** Dirt moves under the sample pipe
2 Sample tubing, 1/4-in. OD x 1/8-in. ID, PFA	**5** Distance between analyzer and pipe[7]	**8** Larger pipe (1.5 to 2 times larger diameter) so pressure does not increase
3 Connection between PFA tubing and stainless steel tube	**6** Air bubbles move over the sample pipe	**9** Open drain as near to this location as possible

[7] A 30 cm (12 in.) difference in height gives a pressure of 30 mbar (04. psi) if the flow rate is low.

4.4.4 Install a sample overflow chamber (optional)

For pressurized sample streams, install the optional Sample Overflow Chamber (19-BAS-031) in the sample line to supply sample at ambient pressure.

Figure 14 Installation of the sample overflow chamber



1 Sample inlet tube (flow rate: 0.7 to 1.7 L/min)	**4** Vent tube	**7** Drain tube
2 Cap	**5** Sample overflow tube	**8** Manual drain valve
3 Sample tube to analyzer	**6** Open drain	

4.4.5 Plumb the drain lines

⚠CAUTION

Chemical exposure hazard. Dispose of chemicals and wastes in accordance with local, regional and national regulations.

NOTICE

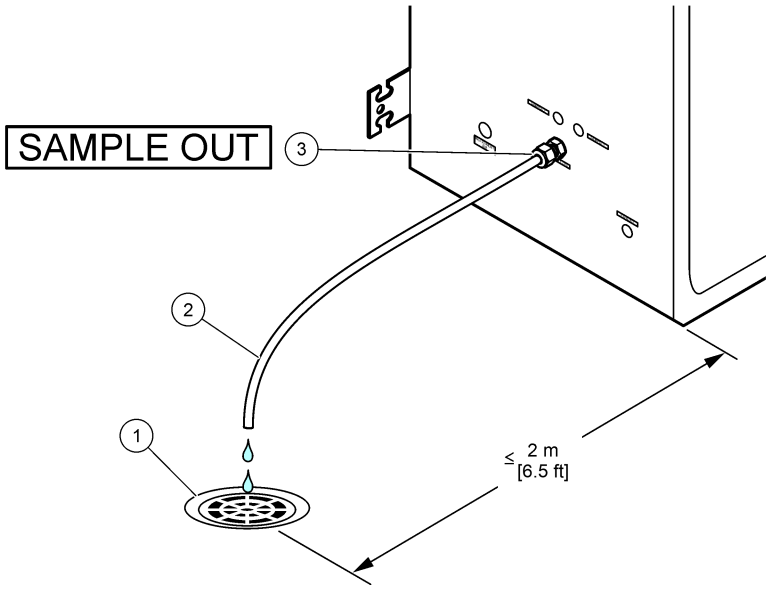
Incorrect installation of the drain lines can cause liquid to go back into the instrument and cause damage.

Make sure that the open drain used for the analyzer is in a ventilated area. Oxygen and very small quantities of carbon dioxide, ozone and volatile gases can be present in the waste liquids plumbed to the drain.

- Make the drain lines as short as possible.
- Make sure that the drain lines have a constant slope down.
- Make sure that the drain lines do not have sharp bends and are not pinched.
- Make sure that the drain lines are open to air and are at zero pressure.

Use the supplied $^{1}/_{4}$-inch OD x $^{1}/_{8}$-inch ID tubing to plumb the SAMPLE OUT fitting to an open drain. Refer to Figure 15. The maximum distance between the fitting and the drain is 2 m (6.5 ft).

Figure 15 Plumb the drain



1 Open drain	**2** $^{1}/_{4}$-inch OD x $^{1}/_{8}$-inch ID tubing	**3** SAMPLE OUT fitting

4.4.6 Connect instrument air

Use $^{3}/_{8}$-in. OD tubing to connect instrument air (or the BioTector air compressor and optional air filter pack) to the INSTRUMENT AIR fitting on the left side of the analyzer. Refer to the instrument air specifications in Specifications on page 3.

The air plumbed to the oxygen concentrator must be -20 °C dew point, 5 to 40 °C (41 to 104 °F) and contain no water, oil or dust. The optional air filter pack is recommended.

Oxygen quality: The oxygen supplied by the oxygen concentrator is 93% oxygen minimum and the remaining gas is argon.

Safety precautions for compressed air:

- Use the same precautions necessary for high-pressure or compressed gas systems.
- Obey all local and national regulations and/or the manufacturer's recommendations and guidelines.

4.4.7 Plumb the exhaust

Use ¼-in. OD PFA tubing to plumb the EXHAUST fitting to a ventilated area.

The maximum tubing length is 10 m (33 ft). If longer tubing is necessary, use a larger ID tubing or pipe.

Make sure that the tubing has a constant downward slope from the analyzer so condensation or liquid at the outlet of the tubing cannot freeze.

4.4.8 Plumb the reagents

⚠ CAUTION

Chemical exposure hazard. Obey laboratory safety procedures and wear all of the personal protective equipment appropriate to the chemicals that are handled. Refer to the current safety data sheets (MSDS/SDS) for safety protocols.

⚠ CAUTION

Chemical exposure hazard. Dispose of chemicals and wastes in accordance with local, regional and national regulations.

NOTICE

Keep dust and particles out of the reagent tubing or damage to the acid and base pumps can occur. The acid and base pumps have a 50 µm particle tolerance.

Plumb the reagents to the analyzer. The top of the reagent containers must be at the same level and no more than 0.6 m (2 ft) below the analyzer. Refer to Figure 16.

Items supplied by the user:

- Personal protective equipment (refer to MSDS/SDS)
- Base reagent, 19 to 25 L—4.0 N sodium hydroxide (NaOH), low in carbonate
- Acid reagent, 19 to 25 L—6.0 N sulfuric acid (H_2SO_4) that contains 350-mg/L manganese sulfate monohydrate

Use deionized water that contains less than 100-µg/L (ppb) of organics to prepare reagents. For the reagent usage at 100% online time, refer to Table 9.

1. Put on the personal protective equipment identified in the safety data sheets (MSDS/SDS).
2. Put a reagent spill tray (bund) under the reagent containers to keep spills contained.
3. Assemble the supplied caps for the reagent containers. Refer to the documentation supplied with the caps. Only one of the two acid reagent cap assemblies (19-PCS-021) is used.

   Note: *If a supplied cap is not the correct size for the reagent container, use the cap that came with the reagent container. For the acid reagent, make an opening in the cap and install the supplied tube fitting in the cap. For the base reagent, refer to* Use a stainless steel fitting for the base reagent (optional) *on page 41.*
4. Attach the weight supplied with each cap (item 4 in Figure 16) to the end of the reagent tube that goes in the reagent container.

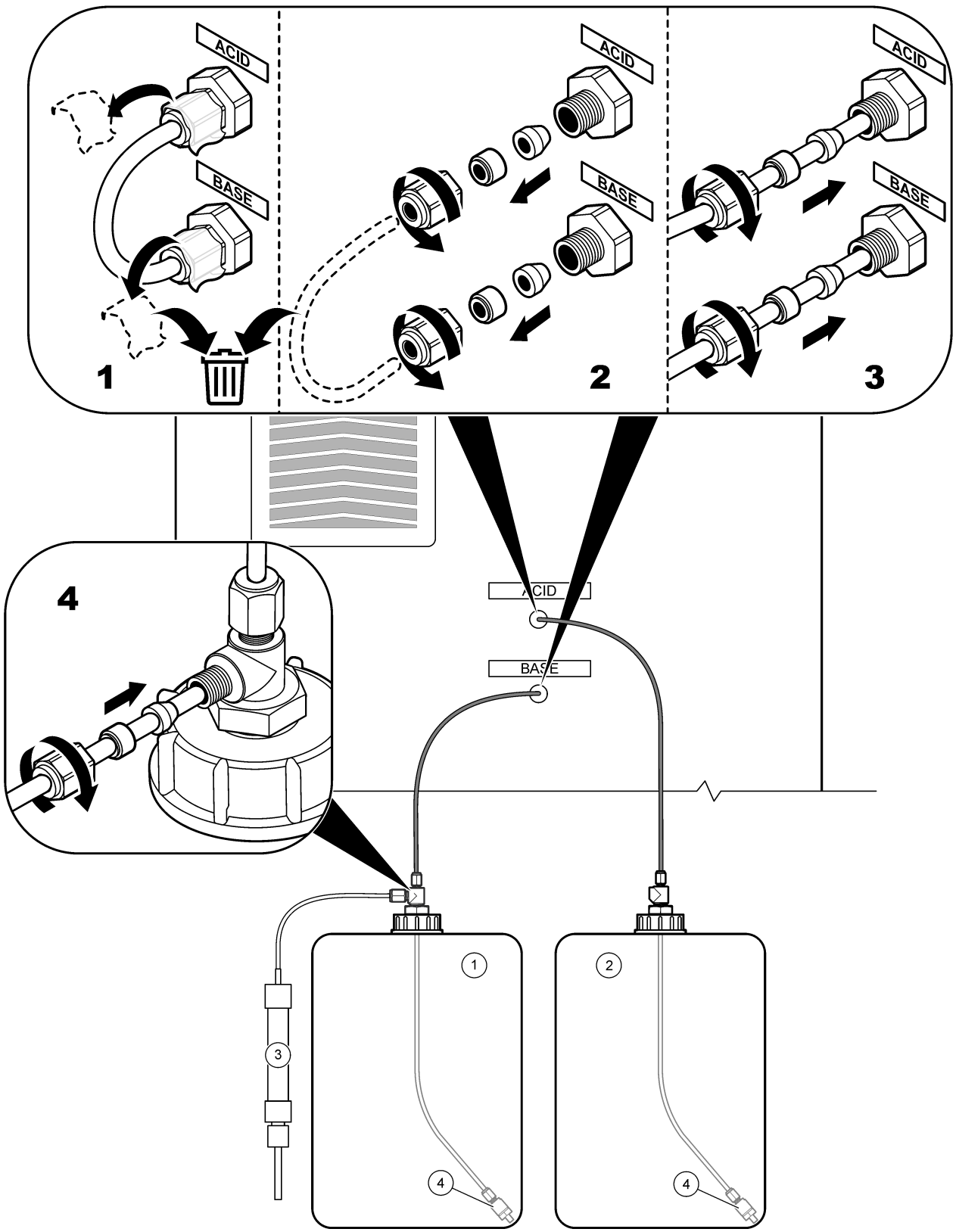
   Note: *The weights contain a 70 µm filter.*
5. Install the caps on the reagent containers.

   - **Base reagent container**—Install the cap that has a port on the side of the fitting. The port is used to connect the supplied CO_2 filter. As an alternative to the tube fitting supplied, use a stainless steel fitting. Refer to Use a stainless steel fitting for the base reagent (optional) on page 41.
   - **Acid reagent container**—Install the cap that has $^1/_8$-inch OD PFA tubing and a weight.
6. Tighten the tube fittings on the caps so the weight stay at the bottom of the reagent containers.
7. Remove the tube that connects the ACID and BASE fittings on the left side of the analyzer. Discard the deionized water in the tube. Refer to illustrated steps 1–2 in Figure 16.

8. Plumb the reagent containers to the reagent fittings on the left side of the analyzer with $^{1}/_{8}$-inch OD tubing. Refer to illustrated step 3 in Figure 16. Make the reagent lines as short as possible (2 m (6.5 ft) maximum).
9. Remove the tape from the CO_2 filter (item 3 in Figure 16).
10. Connect the supplied CO_2 filter to the cap of the base reagent container. Refer to illustrated step 4 in Figure 16. Make sure that the connection is air tight.

    Note: *If atmospheric CO_2 enters the base reagent container, the analyzer TIC and TOC readings will increase.*

Figure 16 Reagent installation



1 Base reagent	**3** CO_2 filter
2 Acid reagent	**4** Weight

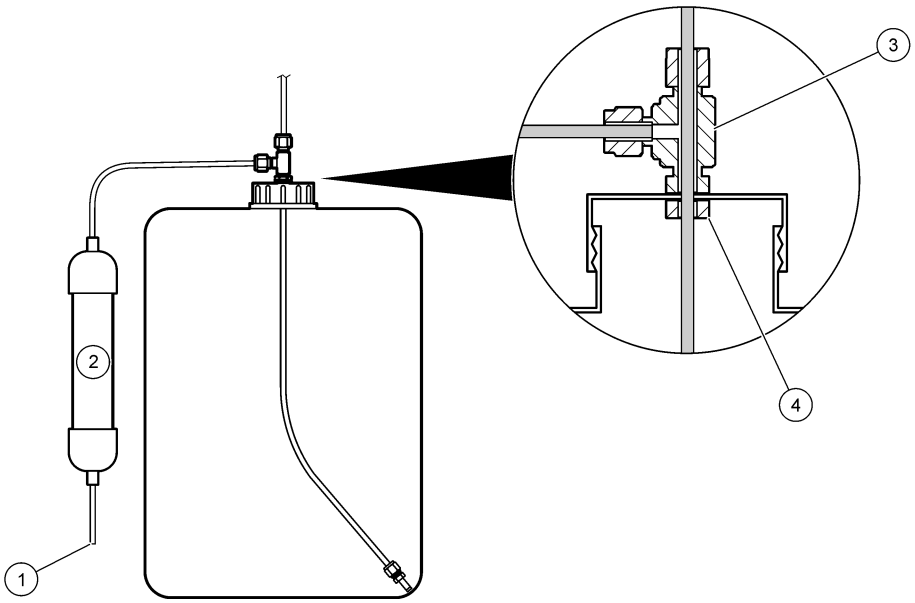
Table 9 Reagent usage

Reagent	Container size	0–25 mgC/L
Acid	19 L	239 days
Base	19 L	239 days

4.4.8.1 Use a stainless steel fitting for the base reagent (optional)

As an alternative to the plastic tube fitting supplied for the base reagent container, use a stainless steel fitting. Refer to Figure 17. The tee fitting must supply an air tight seal with the cap. If atmospheric CO_2 enters the base reagent container, the analyzer TIC and TOC readings will increase.

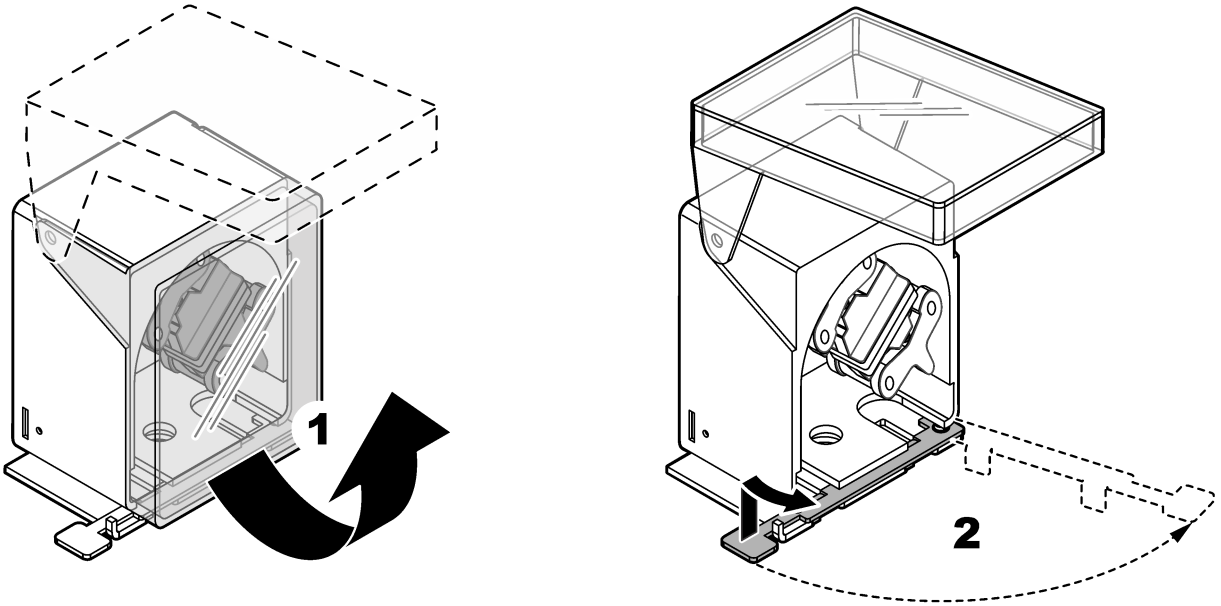
Figure 17 Base reagent container

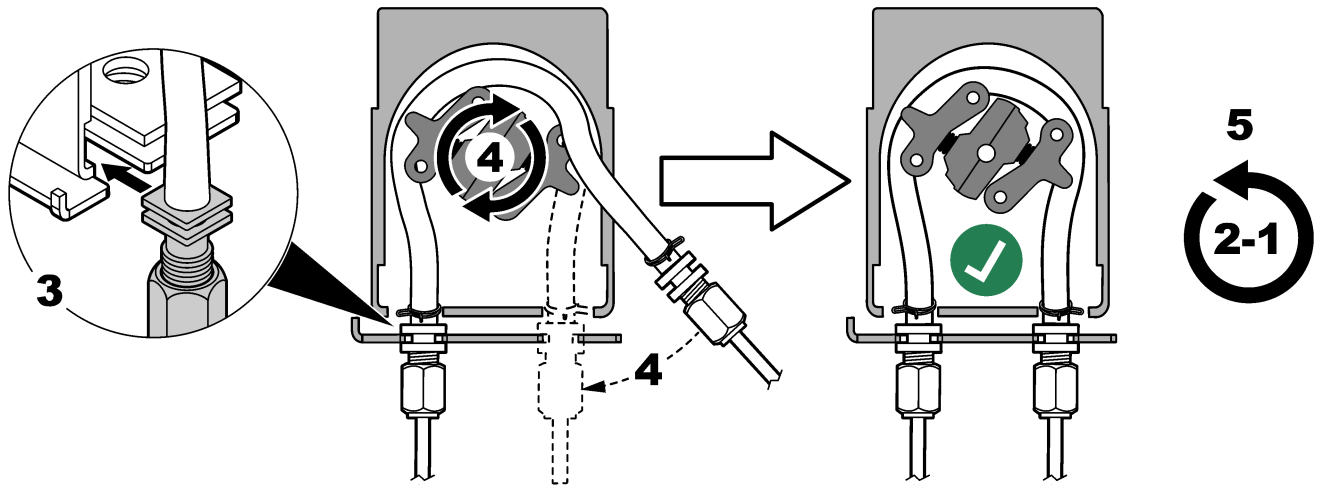


1 Air inlet	**3** Swagelok SS-400-3TST tee fitting, drilled to 7.0 mm (0.28 in.)
2 CO_2 filter	**4** Swagelok SS-45ST-N nut

4.4.9 Install the sample pump tubing

Refer to the illustrated steps that follow.

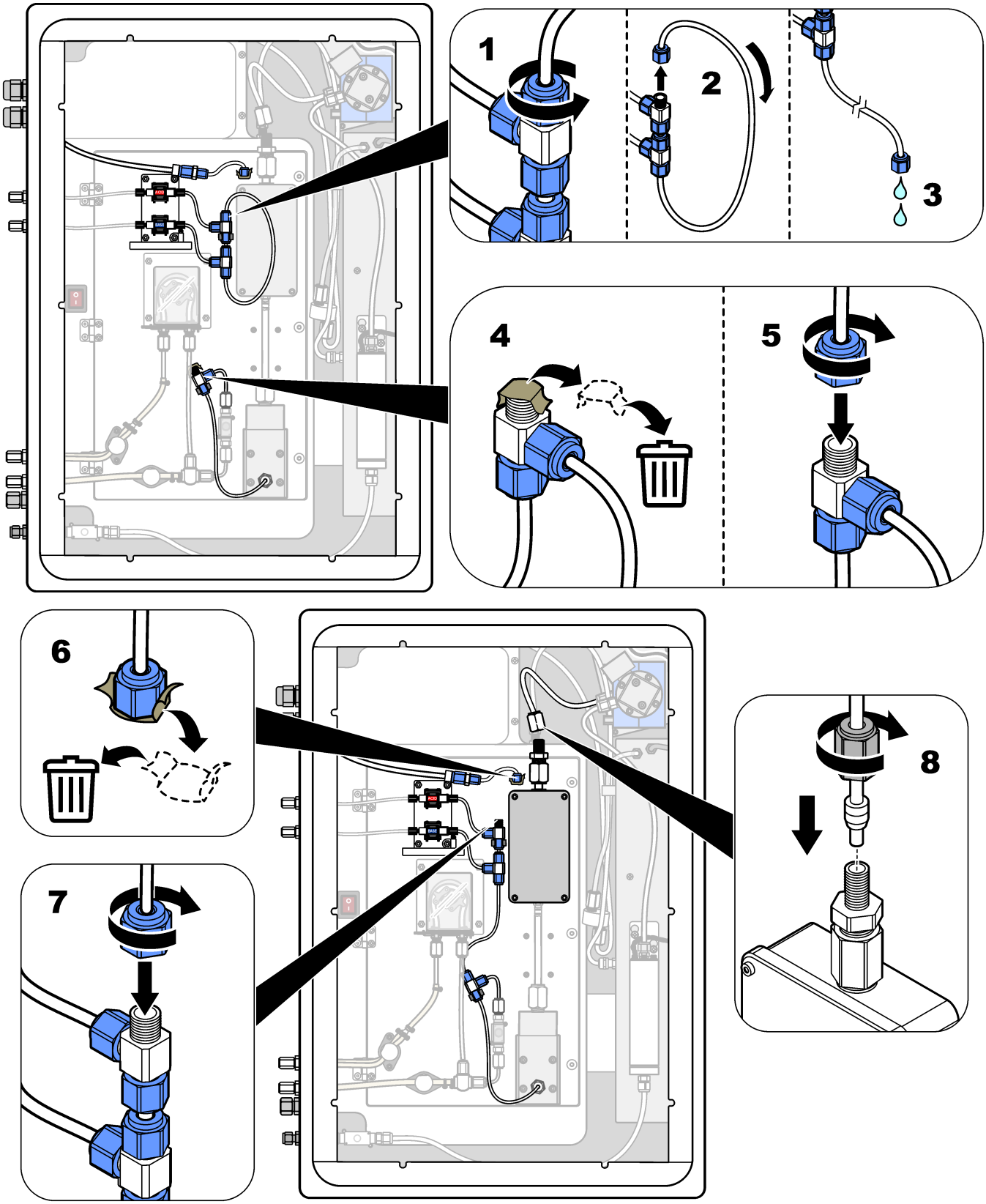




4.4.10 Connect the internal tubing

Refer to the illustrated steps that follow.

Note: *The reagent pump tubing contains deionized water, which should be discarded.*



4.4.11 Connect the air purge

Connect the air purge to supply positive air pressure in the analyzer if one or more of the statements that follow are true:

- There are corrosive gasses in the area.
- The analyzer is supplied as a "purge ready" system

A "purge ready" system has a Purge Air Inlet (¼-inch Swagelok fitting) on the left side of the analyzer and no fan.

If the analyzer is not a "purge ready" system, contact technical support to connect the air purge.

1. From the inner side of the electrical enclosure, remove the fitting blank (plug) from the Purge Air inlet.
2. Supply clean, dry instrument-quality air at 60 L/min to the Purge Air Inlet on the left side of the analyzer.

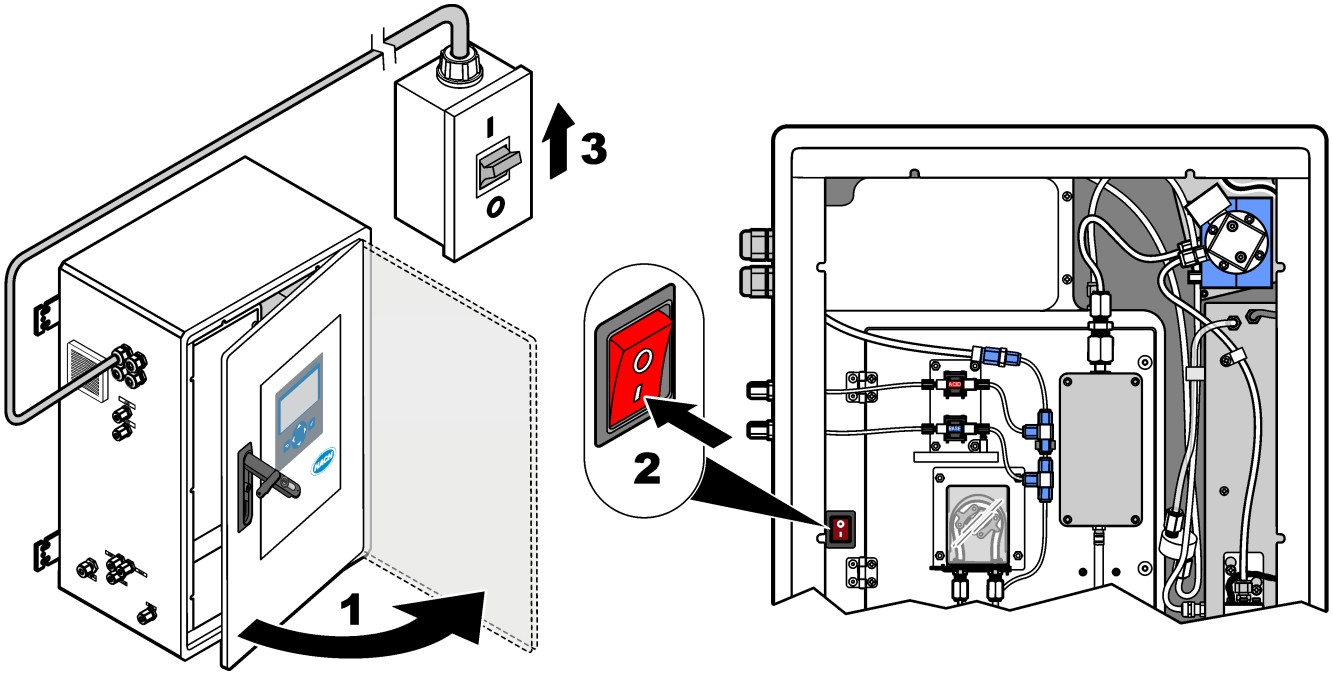
   Clean, dry instrument-quality air is -20 °C dew point air that does not contain oil, water vapor, contaminants, dust or flammable vapor or gas.
3. Install a 40 micron (or smaller) air filter in the air purge line.

   Additional requirements:

   - Make sure that all of the purge gas supplies are made to prevent contamination.
   - Make sure that the purge gas pipe has protection from mechanical damage.
   - Make sure that the air compressor intake for the purge gas is in an unclassified location.
   - If the compressor intake line goes through a classified location, make sure that the compressor intake line is made of noncombustible material and made to prevent leakage of flammable gases, vapors or dusts into the purge gas. Make sure that the compressor intake line has protection from mechanical damage and corrosion.

Section 5 Startup

5.1 Set the power to on



5.2 Set the language

Set the language that shows on the display.

1. Push ✔ to go to the main menu, then select MAINTENANCE > SYSTEM CONFIGURATION > LANGUAGE.
2. Select the language, then push ✔. An asterisk (*) identifies the language selected.

5.3 Set the time and date

Set the time and date on the analyzer.
Note: *When the time is changed, the analyzer may automatically start tasks that are scheduled to start before the new time setting.*

1. Push ✔ to go to the main menu, then select OPERATION > TIME & DATE.
2. Select an option. Use the UP and DOWN arrow keys to change the setting.

Option	Description
CHANGE TIME	Sets the time.
CHANGE DATE	Sets the date.
DATE FORMAT	Sets the date format (e.g., DD-MM-YY).

5.4 Adjust the display brightness and contrast

1. Push ✔ to go to the main menu, then select OPERATION > LCD ADJUST.
2. Select an option. Use the UP and DOWN arrow keys to change the setting.

Option	Description
CONTRAST	Sets the display contrast (default: 50%).
BACKLIGHT	Sets the display brightness (default: 50%).

3. Push ✔ to save.

5.5 Examine the oxygen supply

Identify if there is CO_2 contamination in the oxygen supply as follows:

1. Let the oxygen concentrator operate for a minimum of 10 minutes.
2. Select MAINTENANCE > DIAGNOSTICS > SIMULATE.
3. Select MFC. Set the flow to 10 L/h.
4. Push ✔ to start the mass flow controller (MFC).
5. Operate the MFC for 10 minutes. The measured CO_2 in the oxygen supply shows at the top of the display.
6. If the reading is not ± 0.5% (B3500e, B3500c/s and B3500dw) or ± 2.5% (B3500ul) of the CO_2 analyzer range, do the steps that follow:
   a. Remove the CO_2 filter from the base reagent container.
   b. Install the CO_2 filter between the cooler and the CO_2 analyzer inlet port.
      Note: *Temporary connections can be made with EMPP tube.*
   c. Do steps 3 to 5 again.
      If the reading is less than before, there is CO_2 contamination in the oxygen supply. Identify if the CO_2 analyzer has dirty lenses. Identify if the CO_2 filters on the CO_2 analyzer have contamination. Identify if the CO_2 analyzer operation is correct.
      If the reading is not less than before, there is no CO_2 contamination in the oxygen supply.
   d. Remove the CO_2 filter from between the cooler and CO_2 analyzer inlet port.
   e. Connect the CO_2 filter to the base reagent container.

5.6 Examine the pumps

Make sure that the acid pump, base pump and sample pump operate correctly as follows:

1. Select CALIBRATION > ZERO CALIBRATION > RUN REAGENTS PURGE to start a reagent purge cycle. A reagent purge cycle primes the reagents in the analyzer.
2. If the reagent tubing does not fill with reagents during the reagents purge cycle, prime the pumps manually as follows:
   a. Remove the dip tubes from the reagent containers.
   b. Close the reagent containers.
   c. Put the dip tubes in a small container of deionized water or tap water.
   d. Hold the container of water higher than the analyzer.
   e. Do step 1 again.
   f. Install the dip tubes in the reagent containers.
   g. Do step 1 again.
3. Make sure that there are no leaks at the sample pump, acid pump or base pump.

4. Put the outlet tubing of the acid pump into an empty 10-mL graduated cylinder.
5. Select MAINTENANCE > DIAGNOSTICS > SIMULATE.
6. Select ACID PUMP.
7. Select ON, then enter the number of pulses identified in Table 10.

   Note: *400 pulses must be done as 2 x 200 pulses due to an internal system interlock.*
8. Push ✔ to start the acid pump.
9. Wait the number of pulses identified in Table 10.

   400 pulses = 24 seconds, 16 pulses = 8 seconds
10. Compare the volume of water in the graduated cylinder to Table 10. Record the volume.
11. Discard the reagent from the graduated cylinder. Make sure that the graduated cylinder is fully empty.
12. Do steps 4 and 6 to 10 again for the base pump.

    Make sure that the difference in the measured volumes for the acid pump and base pump is 5% (0.2 mL) or less.
13. Use a 1.5 mm Allen wrench to adjust the acid or base pump volume as necessary. The adjustment dial is on the back of the pump. Only turn the adjustment dial a few degrees.

    Note: *Turn the adjustment dial clockwise to decrease the pump volume. Each notch on the adjustment dial is approximately 1 µL.*
14. Do steps 4 and 6 to 10 again for the sample pump.
15. Connect the tubing that was disconnected.

Table 10 Pump volumes

Pump	Pulses	Volume
ACID PUMP	400	3.8 to 4.2 mL
BASE PUMP	400	3.8 to 4.2 mL
SAMPLE PUMP	16	5.5 to 7.5 mL

5.7 Examine the valves

Make sure that the valves open and close correctly and there are no leaks. Refer to Analysis enclosure on page 48 for the valve locations.

1. Make sure there are no leaks at the valves.
2. Push ⮌ to go to the SIMULATE menu.
3. Select REACTOR VALVE (MV3) on the display to open the reactor valve. The LED is on when the valve is open.
4. Do step 3 again for the valves that follow:
   - SAMPLE VALVE (MV4)
   - EXHAUST VALVE (MV1)[8]
   - STREAM VALVE (MV6)
   - MANUAL VALVE (MV5)
5. If the sample (out) valve (MV4), manual valve (MV5) or stream valve (MV6) does not open, disassemble the valve and clean the membrane seal.

[8] The LED is on when the valve is open.

5.8 Set the reagent volumes

1. Select OPERATION > REAGENTS SETUP > INSTALL NEW REAGENTS.
2. Change the reagent levels that show on the display as necessary.
3. If the ZERO WATER setting in the SYSTEM CONFIGURATION menu is set to YES, plumb deionized water to the MANUAL fitting for the zero calibrations. The default setting for ZERO WATER is NO (no sample).
4. If the SPAN CALIBRATION or SPAN CHECK setting is set to YES on the MAINTENANCE > COMMISSIONING > NEW REAGENTS PROGRAM menu, install the calibration standard before a span calibration is started. Refer to Plumb the calibration standard on page 68.
5. Scroll down to START NEW REAGENT CYCLE, then push ✔.

   The analyzer fills all of the reagent lines with the new reagents and does a zero calibration.

   In addition, if the SPAN CALIBRATION or SPAN CHECK setting is set to YES on the MAINTENANCE > COMMISSIONING > NEW REAGENTS PROGRAM menu, the analyzer does a span calibration or span check after the zero calibration.

   If the CO2 LEVEL setting is set to AUTO, the analyzer sets the reaction check levels for TOC.

5.9 Measure deionized water

Measure deionized water five times to make sure that the zero calibration is correct as follows:

1. Connect deionized water to the MANUAL fitting.
2. Set the analyzer to do five reactions at operation range 1. Refer to Measure a grab sample on page 75.

   If the results of the measurements are almost 0 mgC/L CO_2, the zero calibration is correct.
3. If the results of the measurements are not almost 0 mgC/L CO_2, do the steps that follow:

   a. Do a pH test. Use deionized water for the sample. Refer to *Do a pH test* in the Maintenance and Troubleshooting Manual.
   b. Measure the TIC pH. Make sure that the TIC pH is less than 2.
   c. Measure the BASE pH. Make sure that the BASE pH is more than 12.
   d. Measure the TOC pH. Make sure that the TOC pH is less than 2.
   e. Measure the deionized water two more times. Refer to step 2.
   f. Do the steps in Set the reagent volumes on page 48 again.

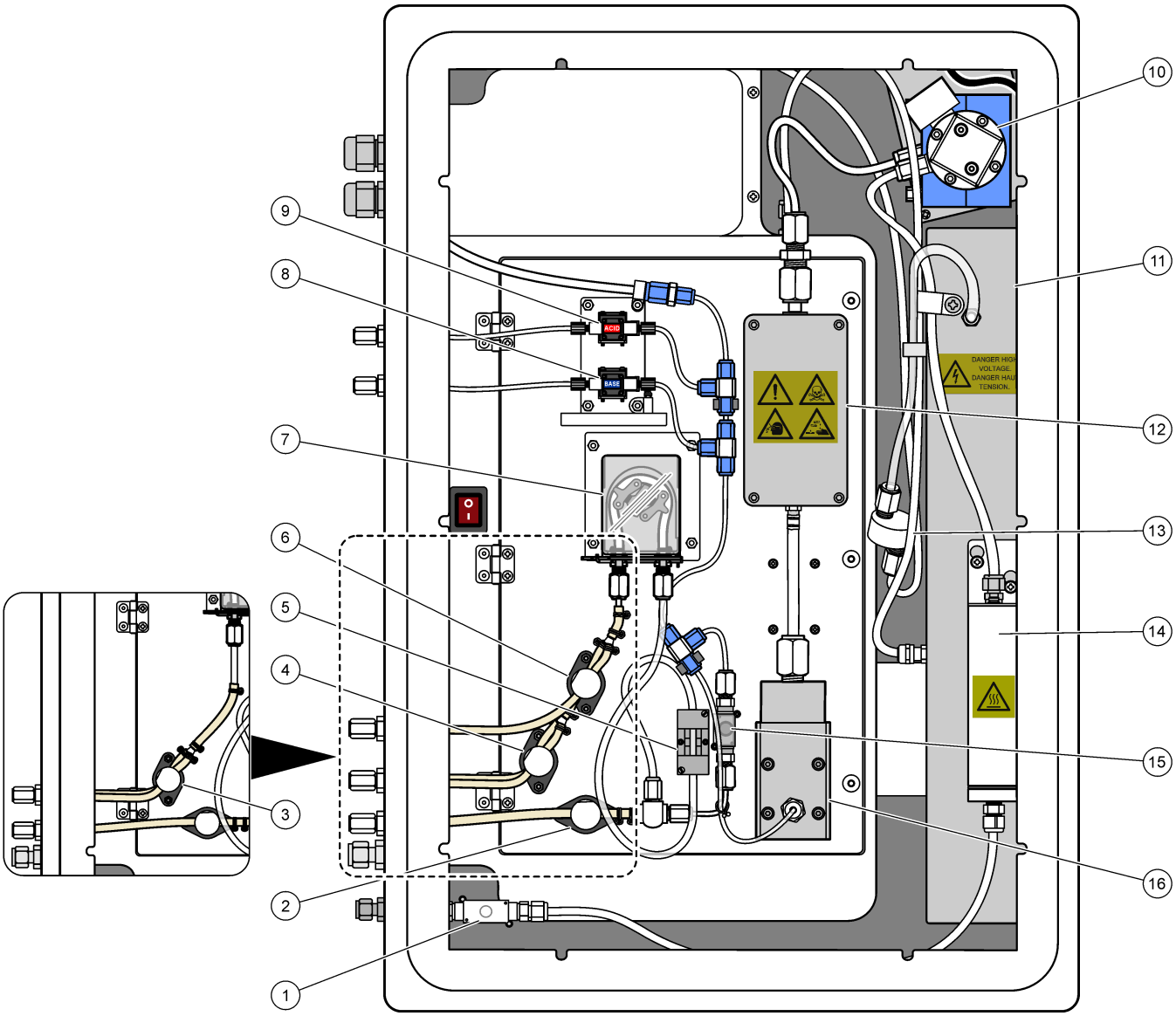
5.10 Analysis enclosure

Figure 18 shows the interior view of the analyzer.

Figure 19 shows how to open the inner door.

Figure 20 shows the internal view with the inner door open.

Figure 18 Internal view



1 Exhaust valve, MV1	**9** Acid pump, P3
2 Sample (out) valve, MV4	**10** NDIR CO_2 analyzer
3 Sample and Manual valve, MV5[9]	**11** Ozone generator
4 Sample 1 and Sample 2 valve, MV6[10]	**12** Cooler
5 Sample sensor	**13** Ozone line filter
6 Manual valve, MV5[10]	**14** Ozone destructor
7 Sample pump, P1	**15** Reactor valve, MV3
8 Base pump, P4	**16** Mixer reactor

[9] Single-stream analyzers (one exterior sample fitting)
[10] Dual-stream analyzers (two exterior sample fittings)

Figure 19 Open the inner door

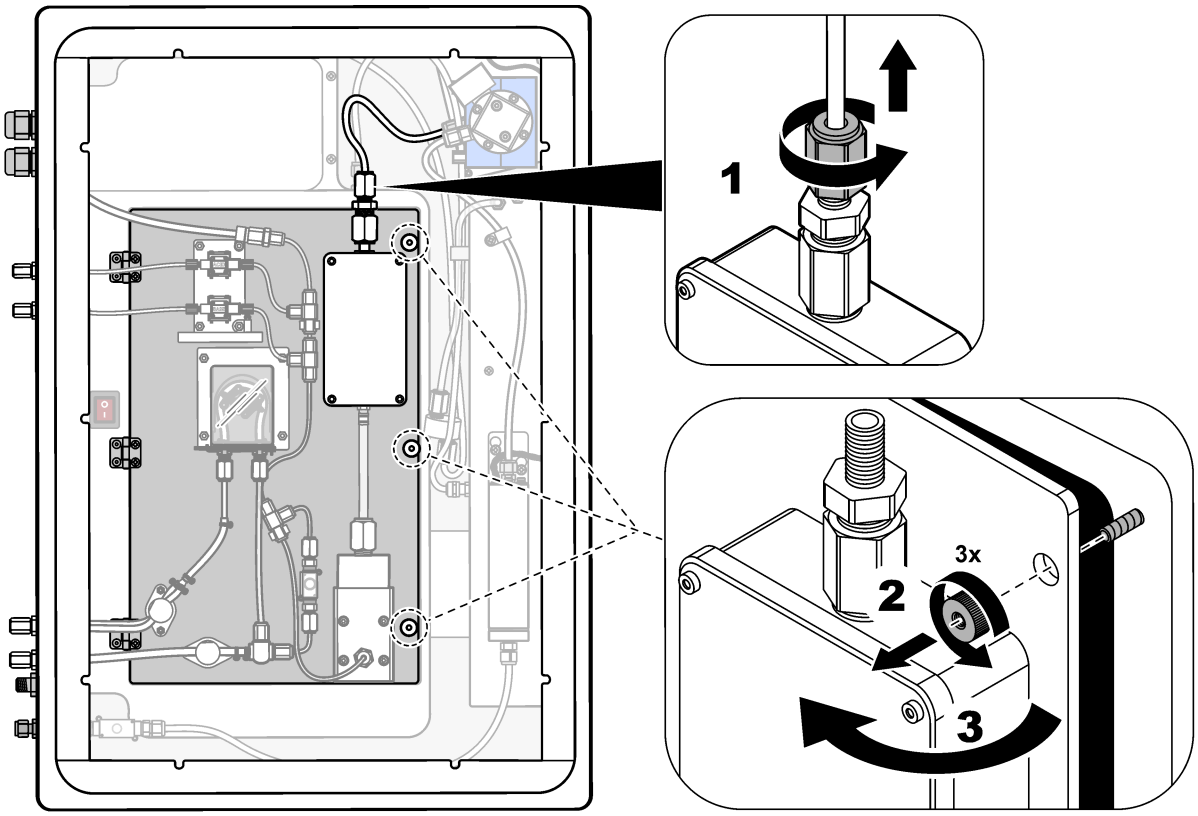
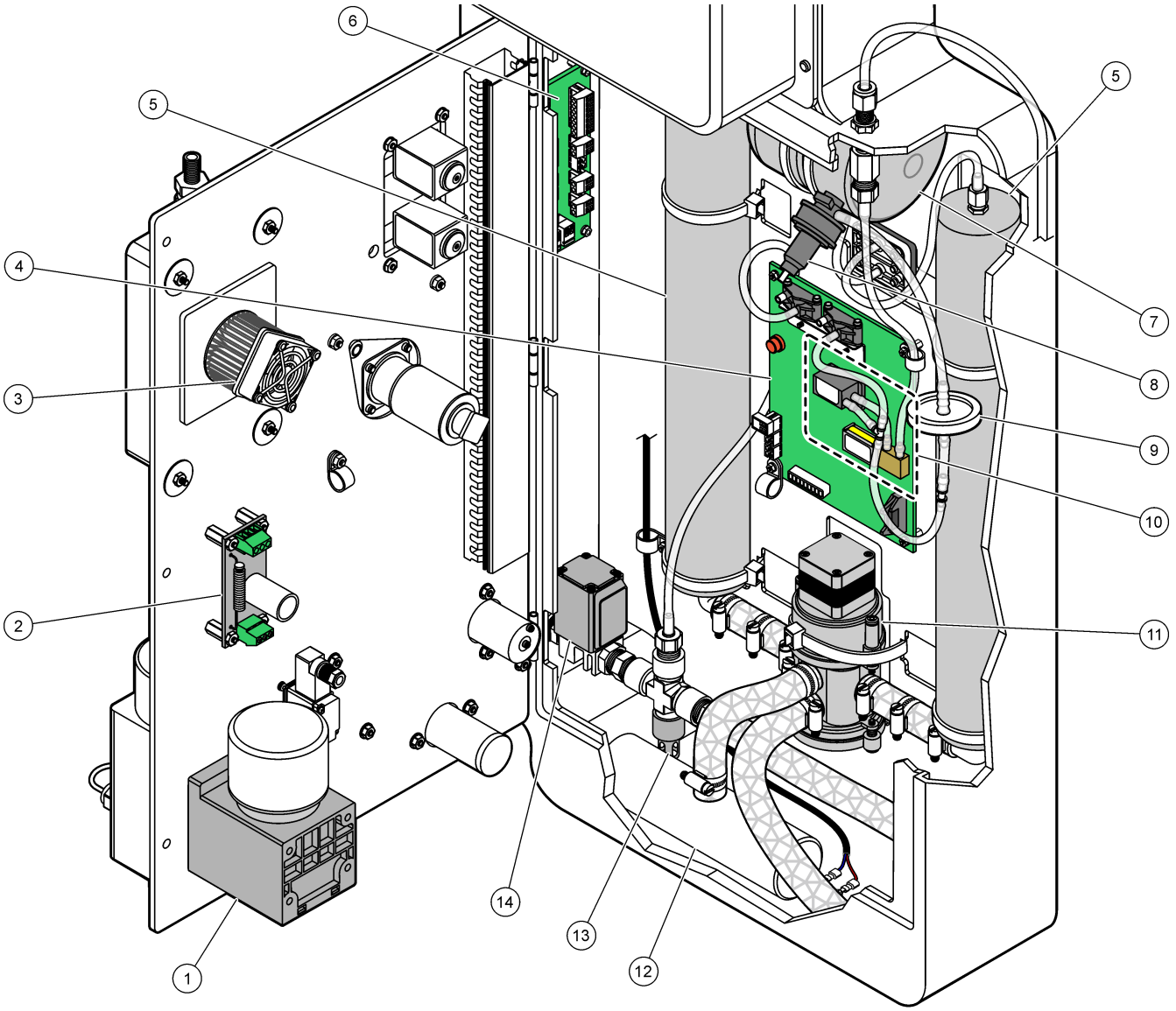


Figure 20 Internal view—Inner door open



1 Mixer reactor motor, P2	**8** Oxygen pressure regulator
2 Filter Board	**9** HEPA filter
3 Cooler fan	**10** Mass flow controller (MFC)
4 Oxygen Control Board	**11** Oxygen concentrator rotary valve, OV2
5 Molecular sieve beds for oxygen concentrator	**12** Exhaust filter
6 Termination Board	**13** Pressure relief valve
7 Oxygen tank	**14** Air isolation valve, OV1

Section 6 Configuration

6.1 Set the measurement interval

Set the time between reactions to set the measurement interval.

1. Select MAINTENANCE > COMMISSIONING > REACTION TIME.
2. Select an option.

Option	Description
REACTION TIME	Shows the total reaction time (minutes and seconds) for operation range 1 (default: 5m30s). The analyzer calculates the total reaction time with the OXIDATION PROGRAM 1 settings in the SYSTEM PROGRAM menu.
INTERVAL	Sets the time between reactions. Options: 0 (default) to 1440 minutes (1 day). ***Note:*** *When the analyzer automatically increases the reaction time because of a high level of TIC and/or TOC in the sample, the analyzer subtracts the added reaction time from the interval time.*
TOTAL	Shows the total reaction time plus the interval time.

6.2 Set the sample pump times

Set the forward and reverse times for the sample pumps.
Note: *If the forward or reverse times are more than the maximum time, the analyzer adjusts the measurement interval setting. The maximum times are based on the SYSTEM PROGRAM 1 settings.*

1. Do a sample pump test for each sample stream to identify the correct forward and reverse times. Refer to Do a sample pump test on page 53.
2. Select MAINTENANCE > COMMISSIONING > SAMPLE PUMP.

   The default sample pump times show for each stream (default: 45s forward, 60s reverse).
3. Enter the FORWARD time from the sample pump test.

   The analyzer sets the REVERSE time as the FORWARD time plus 15 seconds.
   Note: *The REVERSE time for a Manual stream is only set if an optional manual bypass valve is installed. The manual bypass valve sends the previous grab sample (or calibration standard) out the drain line.*

6.2.1 Do a sample pump test

Do a sample pump test to identify the correct forward and reverse times for the sample pump for each sample stream.

1. Select MAINTENANCE > DIAGNOSTICS > PROCESS TEST > SAMPLE PUMP TEST.
2. Select an option.

Option	Description
VALVE	Sets the SAMPLE or MANUAL valve used for the test. For example, to select the SAMPLE valve, select STREAM 1.
PUMP FORWARD TEST	Starts the sample pump in the forward direction. ***Note:*** *First select PUMP REVERSE TEST to empty the sample lines, then select PUMP FORWARD TEST.* 1. Push ↩ to stop the timer when the sample comes out the SAMPLE OUT fitting on the left side of the analyzer. 2. Record the time on the display. Add 10 seconds to the time. The time is the correct forward time for the selected stream.

Option	Description
PUMP REVERSE TEST	Starts the sample pump in the reverse direction.
SAMPLE PUMP	Goes to the MAINTENANCE > COMMISSIONING > SAMPLE PUMP menu to set the forward and reverse times for each sample stream.

6.3 Set the stream sequence and operation range

Set the sample stream sequence, the number of reactions to do at each sample stream and the operation range for each sample stream.

1. Select MAINTENANCE > COMMISSIONING > STREAM PROGRAM.
2. Select an option.

Option	Description
SAMPLER	***Note:*** *The B3500 analyzers cannot be operated with a sampler (venturi or vacuum samplers).* Set to YES if a sampler is used with the analyzer (default: NO). When SAMPLER is set to YES (default), the sampler time shows on the SAMPLE PUMP screen.
CONTROL	Set to BIOTECTOR (default) to control the stream sequence and operation ranges with the analyzer. Set to EXTERNAL to control the stream sequence and operation ranges with an external device (e.g., Modbus master). STREAM INPUT is not used with single-range analyzers.
START-UP RANGE	***Note:*** *The START-UP RANGE setting is available when CONTROL is set to BIOTECTOR and the first operation range setting for a stream is set to AUTO.* Sets the operation range used for the first reaction when the analyzer starts (default: 1).
RANGE LOCKED	***Note:*** *The RANGE LOCKED setting is available if one or more of the RANGE settings for the stream sequence is set to AUTO.* Sets the operation range to change automatically (NO) or to stay at the START-UP RANGE setting (YES, default).
PROGRAMMED STREAMS	Shows the number of streams installed and configured.
STREAM x, x RANGE x	***Note:*** *If CONTROL is set to EXTERNAL, an external device (e.g., Modbus master) controls the stream sequence and operation ranges.* Sets the number of reactions and the operation range for each stream. **STREAM** —The first setting is the stream valve number. The second setting is the number of reactions done at the sample stream before the analyzer does reactions with the next sample stream. When STREAM is set to “- , -" and RANGE is set to "-“, the stream is not measured. **RANGE** —Sets the operation range for each sample stream. Options: 1, 2, 3 (default) or AUTO. Select OPERATION > SYSTEM RANGE DATA to see the operation ranges. ***Note:*** *The AUTO (automatic) range option is disabled in analyzers with more than one stream.*

6.4 Configure the COD and BOD settings

Set the analyzer to show COD and/or BOD information on the Reaction Data screen as necessary. Set the values used to calculate the COD and/or BOD results.

1. Select MAINTENANCE > COMMISSIONING > COD/BOD PROGRAM.
2. Select COD PROGRAM or BOD PROGRAM.
3. Select an option.

Option	Description
DISPLAY	Sets the analyzer to show COD and/or BOD information on the Reaction Data screen and show the COD and/or BOD (mgO/L) results on a 4–20 mA output if configured (default: NO).
STREAM 1–3	The first setting is the overall factor (default: 1.000). Refer to the equation that follows. The second setting is the offset factor (default: 0.000). The stream factors for each stream come from the procedures in the information sheet *I030. TOC to COD or BOD Correlation Method*. STREAM 1 factors are used for manual samples and calibration standards. COD (and/or BOD) = Overall factor × { (TOC FACTOR × TOC) } + Offset factor
TOC FACTOR	Sets the TOC FACTOR (default: 1.000).

6.5 Configure the DW PROGRAM settings

Set the analyzer to show DW (drinking water) information on the Reaction Data screen as necessary. Set the values used to calculate the DW results.

Note: *DW PROGRAM is only available on analyzers set to TIC+TOC analysis mode.*

1. Select MAINTENANCE > COMMISSIONING > DW PROGRAM.
2. Select an option.

Option	Description
DISPLAY	Sets the analyzer to show DW (drinking water REMOVAL% and PASS/FAILRESULT) information on the Reaction Data screen and show the REMOVAL% results on a 4–20 mA output if configured (default: NO). When DISPLAY is set to YES, the analyzer calculates the REMOVAL% (organic removal) value between Stream 1 (Sample 1) and Stream 2 (Sample 2). REMOVAL% is calculated as follows: (Stream 1 TOC – Stream 2 TOC) ÷ Stream 1 TOC × 100 Where: Stream 1 TOC—The TOC result of Stream 1. Stream 1 is the sample water before the organic removal. Stream 2 TOC—The TOC result on Stream 2. Stream 2 is the sample water after the organic removal (after the DETENTION TIME). The "TOC <" and "TOC >" values on the display are the limits for REMOVAL %. The limit for REMOVAL% is based on the TOC results. For example, if Stream 1 TOC is 3.4 mgC/L, the result is evaluated with the "TOC < 4.0 mgC/L, 35%" category on the display. If the Stream 2 TOC is 2.1 mgC/L, the REMOVAL% calculated value is 38.2%. Since 38.2% is more than 35%, "PASS" shows on the Reaction Data screen for the DW result. The DW FAIL relay is set to off if configured. If the REMOVAL% is less than the limit, "FAIL" shows on the Reaction Data screen. The DW FAIL relay is set to on if configured.
DETENTION TIME	Sets the site-specific time interval that water flows through the treatment system for organic removal (default: 5m). The time interval is selected at the site base on the site-specific process conditions and requirements.

6.6 Configure CF PROGRAM settings

CF PROGRAM settings are not used with the B3500 analyzers, because the samples cannot contain oils or grease. Do not change the default settings.

6.7 Configure the install new reagents settings

Configure the analyzer options for the OPERATION > REAGENTS SETUP > INSTALL NEW REAGENTS function.

1. Select MAINTENANCE > COMMISSIONING > NEW REAGENTS PROGRAM.
2. Select an option.

Option	Description
SPAN CALIBRATION	Sets the analyzer to do a span calibration during the INSTALL NEW REAGENTS cycle (default: NO). Refer to Start a span calibration or span check on page 66 for the span calibration function. If set to YES, make sure to install the calibration standard before a span calibration is started. Refer to Plumb the calibration standard on page 68.
SPAN CHECK	***Note:*** *It is not possible to set SPAN CALIBRATION and SPAN CHECK to YES.* Sets the analyzer to do a span check during the INSTALL NEW REAGENTS cycle (default: NO). Refer to Start a span calibration or span check on page 66 for the span check function. If set to YES, make sure to install the calibration standard before a span check is started. Refer to Plumb the calibration standard on page 68.
AUTOMATIC RE-START	Set the analyzer to go to back to operation when the INSTALL NEW REAGENTS cycle is completed (default: YES).

6.8 Set reagent monitoring

Configure the alarm settings for low reagents and no reagents. Set the reagent volumes.

1. Select MAINTENANCE > COMMISSIONING > REAGENTS MONITOR.
2. Select an option.

Option	Description
REAGENTS MONITOR	Sets the Reagent Status screen to show on the display (default: YES).
LOW REAGENTS	Sets the low reagents alarm as a notification or a warning. Options: NOTE (default) or WARNING
LOW REAGENTS AT	Sets the number of days before the reagent containers are empty when a 85_LOW REAGENTS alarm should occur (default: 20 days). ***Note:*** *The analyzer calculates the number of days before the reagent containers are empty.*
NO REAGENTS	Sets the no reagents alarm as a notification, warning or a fault. **NOTE** —A relay for notifications is set to on when a no reagents alarm occurs if configured. **WARNING** (default)—A relay for warning events is set to on and a 20_NO REAGENTS warning occurs if configured. **FAULT** —The fault relay is set to on, measurements stop and a 20_NO REAGENTS fault occurs.
ACID VOLUME	Sets the volume (liters) of the acid reagent in the reagent container.
BASE VOLUME	Sets the volume (liters) of the base reagent in the reagent container.

6.9 Configure the analog outputs

Set what is shown on each 4–20 mA output, the full scale range of each 4–20 mA output and when each 4–20 mA output changes. Set the fault level for the 4–20 mA outputs.

After the analog outputs are configured, do a 4–20 mA output test to make sure that the correct signals are received by the external device. Refer to the instructions in the Maintenance and Troubleshooting manual.

1. Select MAINTENANCE > COMMISSIONING > 4-20mA PROGRAM.
2. Select OUTPUT MODE.
3. Select an option.
   - **DIRECT** (default)—Refer to Table 11 to configure the settings. Configure each channel (4–20 mA output) to show a specified stream (STREAM 1) and result type (e.g., TOC).
   - **BASIC** —The 4–20 mA outputs (Channels 1–4) that are set to show STREAM 1 also show the zero and span calibration/check results. Refer to Table 11 to configure the settings.
   - **STREAM MUX** —Refer to Table 12 to configure the settings. The CHANNEL 1 setting cannot be changed. Configure Channels 2 to 4 (4–20 mA Outputs 2 to 4) to each show one result type (e.g., TOC). The 4–20 mA outputs can show a maximum of 35 results. Refer to *4–20 mA output modes* in the Advanced Configuration Manual for more information.
   - **FULL MUX** —Refer to Table 13 to configure the settings. The CHANNEL 1–4 settings cannot be changed. No other channels are used. The 4–20 mA outputs can show a maximum of 35 results. Refer to *4-20 mA output modes* in the Advanced Configuration Manual for more information.

Table 11 Direct mode settings

Option	Description
CHANNEL 1–4	Sets what is shown on the 4–20 mA Outputs 1–4 (Channel 1–4), the full scale range of each 4–20 mA output and when each 4–20 mA output changes. First setting—Sets what the 4–20 mA output shows. • **STREAM #** (default)—Shows the selected sample stream (e.g., STREAM 1). • **MANUAL #**—Shows the selected manual grab sample (e.g., MANUAL 1). • **CAL** —Shows the zero and span calibration results. • **CAL ZERO** —Shows the zero calibration results. • **CAL SPAN** —Shows the span calibration results. Second setting—Sets the result type. Options: TOC, TIC, COD, BOD or DW% (drinking water removal %). When DW% is selected, the channel is automatically set to Stream 2 and 100% is represented as 20 mA. Third setting—Sets the result that the output shows as 20 mA (e.g., 25mgC/L). The output shows 4 mA for 0 mgC/L. Fourth setting—Sets when the outputs change. • **INST** —The output changes at the end of each reaction. • **AVRG** —The output (average result of the last 24 hours) changes at the AVERAGE UPDATE time selected in SYSTEM CONFIGURATION > SEQUENCE PROGRAM > AVERAGE PROGRAM. ***Note:*** *The 4–20 mA outputs that show calibration results change when the system completes the number of calibration reactions set in MAINTENANCE > SYSTEM CONFIGURATION > SEQUENCE PROGRAM > ZERO PROGRAM or SPAN PROGRAM.*
SIGNAL FAULT	Sets all of the 4–20 mA outputs to change to the FAULT LEVEL setting when a fault occurs. **YES** (default)—All of the 4–20 mA outputs change to the FAULT LEVEL setting when a fault occurs. **NO**—The 4–20 mA outputs continue to show the results when a fault occurs.
FAULT LEVEL	Sets the fault level (default: 1.0 mA).

Table 11 Direct mode settings (continued)

Option	Description
OUTPUT < 4mA	Sets the percentage applied to the result shown at the output if the output value is less than 4 mA, which is a negative result (default: 0%). For example, if the OUTPUT setting is 100%, the analyzer sends 100% of the negative result as the 4–20 mA signal. If the OUTPUT setting is 50%, the analyzer sends 50% of the negative result as the 4–20 mA signal. When the OUTPUT setting is 0%, the analyzer does not send a negative result. The analyzer shows a negative result as 4 mA (0 mgC/L).
EXCLUDE RESULTS	***Note:*** *The EXCLUDE RESULTS setting is only available when the OUTPUT MODE setting in the 4-20mA PROGRAM menu is set to DIRECT.* Sets the number of sample reactions that the analyzer ignores after a zero calibration, span calibration, zero check or span check (default: 3). The analyzer keeps the calibration output relay active until the analyzer completes the selected number of sample reactions.

Table 12 Stream multiplex mode settings

Option	Description
CHANNEL 1–4	Sets the result type that shows on the 4–20 mA outputs (Channels 1–4). Options: TOC, TIC, COD, BOD or DW% (drinking water removal %). ***Note:*** *The CHANNEL # and OUTPUT # settings identify what Channels 2 to 4 show. Refer to the OUTPUT option description for more information.*
OUTPUT PERIOD	Sets the time to show a full set of reaction results (results sequence) on the 4–20 mA outputs plus the idle time before the next results sequence starts (default: 600s). If a new result is available during the idle period, the results sequence starts. The idle period is not completed. If a new result is available before a results sequence is completed, the analyzer shows the new result then continues the result sequence. Make sure that OUTPUT PERIOD is sufficient to complete a results sequence. Use the formulas that follow to calculate the minimum OUTPUT PERIOD: • **Stream multiplex mode**—OUTPUT PERIOD = [2 x (SIGNAL HOLD TIME) + 1 second] x [number of streams] • **Full multiplex mode**—OUTPUT PERIOD = {[2 x (SIGNAL HOLD TIME) + 1 second] x (number of result types)]} x [number of streams]
SIGNAL HOLD TIME	Sets the amount of time that Channel 1 holds a signal before Channel 1 goes to 4 mA (change level) or to the next stream identification level (e.g., 6 mA = STREAM 2). Default: 10s When the SIGNAL HOLD TIME setting is 10 seconds, Channels 2 to 4 hold their signal for 20 seconds (2 x SIGNAL HOLD TIME).
SIGNAL FAULT	Refer to SIGNAL FAULT in Table 11.
FAULT LEVEL	Refer to FAULT LEVEL in Table 11.
OUTPUT < 4mA	Refer to OUTPUT < 4mA in Table 11.
OUTPUT 1–35	Sets what is shown on the 4–20 mA outputs (Channels 2 to 4), the full scale value of each 4–20 mA output and when each 4–20 mA output changes. The result type in the OUTPUT setting (e.g., TOC) identifies the channel (Channel 2 to 4) on which the result shows. For example, if CHANNEL 3 is set to TOC and the OUTPUT 1 setting has a result type of TOC, the result identified in the OUTPUT 1 setting shows on Channel 3. If OUTPUT 1 is set to STREAM 1, TOC, 25 mgC/L and INST, when the Channel 1 signal identifies STREAM 1, Channel 3 shows the TOC result where 25 mgC/L is shown as 20 mA. Refer to CHANNEL in Table 11 for descriptions of the four settings for each OUTPUT setting.

Table 13 Full multiplex mode settings

Option	Description
CHANNEL 1–4	The CHANNEL 1–4 settings cannot be changed. ***Note:*** *The OUTPUT # settings identify what Channels 3 and 4 show.*
OUTPUT PERIOD	Refer to OUTPUT PERIOD in Table 12.
SIGNAL HOLD TIME	Sets how the long Channel 1 and 2 hold their signal before the channels go to 4 mA (change level or not defined level) or to the next stream identification level or result type level. Default: 10s When the SIGNAL HOLD TIME setting is 10 seconds, Channel 3 holds the signal for 20 seconds (2 x SIGNAL HOLD TIME).
SIGNAL FAULT	Refer to SIGNAL FAULT in Table 11.
FAULT LEVEL	Refer to FAULT LEVEL in Table 11.
OUTPUT < 4mA	Refer to OUTPUT < 4mA in Table 11.
OUTPUT 1–35	Sets what is shown on the 4–20 mA outputs (Channels 3 and 4), the full scale value of each 4–20 mA output and when each 4–20 mA output changes. The result type in the OUTPUT setting (e.g., TOC) identifies the channel on which the result shows. For example, if CHANNEL 3 is set to TOC and the OUTPUT 1 setting has a result type of TOC, the result identified in the OUTPUT 1 setting shows on Channel 3. If OUTPUT 1 is set to STREAM 1, TOC, 25 mgC/L and INST, when the Channel 1 signal identifies STREAM 1, Channel 3 shows the TOC result where 25 mgC/L is shown as 20 mA. Refer to CHANNEL in Table 11 for descriptions of the four settings for each OUTPUT setting.

6.10 Configure the relays

Configure the relay idle conditions and the conditions that set the relays to on. After the relays are configured, do a relay test to make sure that the relays operate correctly. Refer to the instructions in the Maintenance and Troubleshooting manual.

1. Configure the relays as follows:
   a. Select MAINTENANCE > COMMISSIONING > PROGRAMMABLE OUTPUTS > PWR BRD OUT 1.
      Note: *PWR BRD OUT 1 is Relay 1 on the Power and Input/Output Board. Refer to* Power, analog output and relay terminals *on page 25.*
   b. Select DEFAULT STATE.
   c. Set the relay to N/E (normally energized) or N/D (normally de-energized).
   d. Select the conditions that trigger the relay. Refer to Table 14.
      Note: *One or more conditions can be selected. For example, when CAL SIGNAL and MAINT SIGNAL are selected, the relay is set to on when a zero or span calibration starts or when the maintenance switch is set to on. The selected conditions are marked with an asterisk "*".*

Table 14 RELAY settings

Setting	Description	Setting	Description
- - -	No setting	**ZERO CAL**	The relay is set to on when the manual valve opens during a zero calibration or zero check.
STOP	The relay is set to on when the analyzer is stopped. ***Note:*** *Remote standby does not set the relay to on.*	**CAL SIGNAL**	The relay is set to on when a zero or span calibration, or a zero or span check starts.
FAULT	The relay is set to on when a system fault occurs (normally energized relay).	**STREAM 1–3**	The relay is set to on when the sample inlet valve opens.

Table 14 RELAY settings (continued)

Setting	Description	Setting	Description
WARNING	The relay is set to on when a warning occurs (normally energized relay).	**MANUAL 1–3**	The relay is set to on when the manual valve opens.
NOTE	The relay is set to on when a notification is saved to the fault archive.	**SAMPLE STATUS 1–3**	The relay is set to on when there is no sample or the sample quality is less than 75% (default) for stream 1 or 2. For example, when there are a lot of air bubbles in the stream/manual grab sample lines.
SAMPLER FILL	The relay is set to on when from the start of the sampler fill time to the completion of the sample injection. The relay controls the sampler.	**STM ALARM 1–3**	The relay is set to on when a selected alarm condition occurs. The alarm conditions are set on the ALARM PROGRAM screen. Refer to step 2 that follows.
SAMPLER EMPTY	The relay is set to on for 5 seconds after the sample pump reverse operation is complete. The relay controls the sampler.	**CO2 ALARM 1–3**	The relay is set to on when a CO2 ALARM occurs for stream 1 or 2. Refer to step 2 that follows.
SAMPLER ERROR	The relay is set to on when a BioTector sampler error occurs.	**4-20mA CHNG**	The relay is set to a 4–20 mA change flag relay. The relay is set to on for a period of 10 seconds when a new result on any sample stream causes an analog output value to change.
SYNC	The relay is set to a synchronization relay. A synchronization relay is used to synchronize the analyzer with external control devices.	**4-20mA CHNG 1–3**	The relay is set to a 4–20 mA change flag relay for a specific sample stream (1–2). The relay is set to on for a period of 10 seconds when a new result on stream 1 or 2 causes an analog output value to change.
REMOTE STANDBY	The relay is set to on when the remote standby switch (digital input) is set to on.	**4-20mA READ**	The relay is set to on when the 4–20 mA outputs are set to stream multiplex or full multiplex mode and there are valid/stable values on the 4–20 mA outputs.
MAN MODE TRIG	The relay is set to on when manual reactions (grab sample measurements) are started at the keyboard or with the Manual-AT Line option. ***Note:*** *The Manual-AT Line option is a small box with only a green button. The Manual-AT Line cable is connected to the analyzer.*	**SAMPLE FAULT 1–3**	The relay is set to on when the external SAMPLE FAULT 1 input signal is activated.
MAINT SIGNAL	The relay is set to on when the maintenance switch (digital input) is set to on.	**COMPRESSOR**	The relay is set to on when the compressor (Valve 1–J7 on the Oxygen Control Board) is on.
TEMP SWITCH	The relay is set to on when the temperature switch of the analyzer sets the fan to on (default: 25 °C).	**EQUALIZATION**	The relay is set to on when the sample pump operates in forward direction until the sample valve opens to let sample leave the analyzer.

Table 14 RELAY settings (continued)

Setting	Description	Setting	Description
CAL	The relay is set to on when the manual valve opens during a span calibration or span check.	**SAMPLE PUMP REVERSE**	The relay is set to on when the sample pump operates in the reverse direction.
DW FAIL	The relay is set to on when the drinking water REMOVAL% value is a FAIL condition. The relay is set to off when the drinking water REMOVAL% value is a PASS condition.		

2. Select MAINTENANCE > COMMISSIONING > ALARM PROGRAM.
3. Configure the relays set to ALARM and CO2 ALARM if configured.

Option	Description
ALARM 1–3	Sets the idle condition of the ALARM relay and the condition that sets an ALARM relay to on. First setting—Sets the parameter (TOC, COD, BOD or TIC). Second setting—Selects stream 1 or 2. Third setting—Sets the minimum concentration (default: 10.00 mgC/L) that sets the alarm relay to on at the end of a reaction for any of the sample streams. ***Note:*** *The TOC results of the last completed reaction control the alarm relays.*
CO2 ALARM 1–3	***Note:*** *Only use the CO2 ALARM settings with multi-stream systems that operate on fixed operation ranges, or systems that operate on a single operation range. Do not use the CO2 ALARM setting with an analyzer that uses automatic range change.* Sets the CO_2 peak value for stream 1 or 2 that sets the CO2 ALARM relay to on (e.g., 500 ppm). The default is 500 ppm. Carefully select the CO_2 peak value. Think about the temperature effect, which could have a important effect on the CO_2 peaks. To disable the alarm relay, select 0.0 ppm. The CO_2 alarm identifies a possible high TOC (COD and/or BOD if programmed) level. The CO_2 alarm supplies a warning of an unusually high TOC result from the rising slope of the CO_2 peak during a reaction. ***Note:*** *The CO_2 peak used for the CO_2 alarm is the TOC CO_2 peak.*

4. Select MAINTENANCE > SYSTEM CONFIGURATION > OUTPUT DEVICES > SYSTEM OUTPUTS.
5. Select an option.

Option	Description
POWERED ALL TIME	Sets if the relays are powered all of the time, even if the analyzer is stopped or paused (YES) or powered only when necessary (NO).

Option	Description
VALVE ACTIVATION	Sets when the multi-stream valve changes to the next sample stream. **SPF** (sample pump forward, default)—Sets the valve to the next stream when the sample pump starts forward to pull sample from the next stream. **SPR** (sample pump reverse)—Sets the valve to the next stream when the reverse operation of the sample pump is completed or when power is first supplied to the analyzer after power was removed. ***Note:*** *If SAMPLER is set YES on the STREAM PROGRAM screen, VALVE ACTIVATION is set to SPF/SAMPLER.*
OUTPUT 1–6	***Note:*** *OUTPUT 4-6 menus are reserved for future use.* Sets the internal output settings that are associated with system operation. The relay outputs are on the motherboard and are optional features. STREAM 1 is always functional as default in the system software. One or more conditions can be selected. For example, when CAL SIGNAL and MAINT SIGNAL are selected, the relay is set to on when a zero or span calibration starts or when the maintenance switch is set to on. The selected conditions are marked with an asterisk "*". Refer to Table 14.

6.11 Configure the communication settings

Configure the communication settings for the output devices: MMC/SD card and/or Modbus.
Note: *Analyzer communication with a printer or Windows PC is no longer available.*

1. Select MAINTENANCE > COMMISSIONING > DATA PROGRAM.
2. Select MMC/SD CARD.
3. Select an option.

Option	Description
PRINT MODE	Sets the type of data sent to the MMC/SD card. Options: STANDARD or ENGINEERING (default). Refer to Table 19 on page 78 and Table 20 on page 79 for descriptions of the reaction data sent when STANDARD or ENGINEERING is selected. ***Note:*** *The manufacturer recommends that PRINT MODE is set to ENGINEERING so that troubleshooting data is saved.*
REACTION ON-LINE	No longer used. Sends the reaction data to the printer at the end of each reaction (default: NO).
FAULT ON-LINE	No longer used. Sends the faults and warnings to the printer when a fault or warning occurs (default: NO).
CONTROL CHARS	Sends the control characters with the Modbus RS232 data (default: NO).
DECIMAL	Sets the type of decimal point included in the reaction data sent to the MMC/SD card (default: POINT). Options: POINT (.) or COMMA (,)

6.12 Configure the Modbus TCP/IP settings

If the optional Modbus TCP/IP module is installed in the analyzer, configure the Modbus settings.

Note: *The Modbus register maps are supplied in the Advanced Configuration Manual.*

1. Select MAINTENANCE > COMMISSIONING > MODBUS PROGRAM.
2. Select an option.

Option	Description
MODE	Shows the Modbus operating mode: BIOTECTOR. The MODE setting cannot be changed.
BAUDRATE	Sets the Modbus baudrate for the instrument and the Modbus master device (1200 to 115200 bps, default: 57600). ***Note:*** *For Modbus TCP/IP, do not change the BAUDRATE setting. The RTU-to-TCP converter uses the default BAUDRATE setting.*
PARITY	Sets the parity to NONE (default), EVEN, ODD, MARK or SPACE. ***Note:*** *For Modbus TCP/IP, do not change the PARITY setting. The RTU-to-TCP converter uses the default PARITY setting.*
DEVICE BUS ADDRESS	Sets the Modbus address of the instrument (0 to 247, default: 7). Enter a fixed address that a Modbus protocol message cannot change. If DEVICE BUS ADDRESS is set to 0, the analyzer will not communicate with the Modbus Master.
MANUFACTURE ID	Sets the manufacturer ID of the instrument (default: 1 for Hach).
DEVICE ID	(Optional) Sets the class or family of the instrument (default: 2816).
SERIAL NUMBER	Sets the serial number of the instrument. Enter the serial number that is on the instrument.
LOCATION TAG	Sets the location of the instrument. Enter the country where the instrument is installed.
FIRMWARE REV	Shows the firmware revision installed on the instrument.
REGISTERS MAP REV	Shows the Modbus register map version used by the instrument. Refer to the Modbus register maps in the Advanced Configuration Manual.

6.13 Save the settings to memory

Save the analyzer settings to internal memory or an MMC/SD card. Then install the saved settings on the analyzer as necessary (e.g., after a software update or to go back to the previous settings).

1. Select MAINTENANCE > SYSTEM CONFIGURATION > SOFTWARE UPDATE.
2. Select an option.

Option	Description
LOAD FACTORY CONFIG	Installs the analyzer settings saved to internal memory with the SAVE FACTORY CONFIG option.
SAVE FACTORY CONFIG	Saves the analyzer settings to internal memory.
LOAD CONFIG FROM MMC/SD CARD	Installs the analyzer settings from the MMC/SD card with the SAVE CONFIG TO MMC/SD CARD option. ***Note:*** *Use this option to go back to the previous settings or install the settings after a software update.*

Option	Description
SAVE CONFIG TO MMC/SD CARD	Saves the analyzer settings to the syscnfg.bin file on the MMC/SD card. ***Note:*** *The MMC/SD card supplied with the analyzer contains the factory default settings in the syscnfg.bin file.*
UPDATE SYSTEM SOFTWARE	Installs a software update. Contact the manufacturer or distributor for the software update procedure.

6.14 Set security passwords for menus

Set a four-digit password (0001 to 9999) to restrict access to a menu level as necessary. Set a password for one or more of the menu levels that follows:

- OPERATION
- CALIBRATION
- DIAGNOSTICS
- COMMISSIONING
- SYSTEM CONFIGURATION

1. Select MAINTENANCE > SYSTEM CONFIGURATION > PASSWORD.
2. Select a menu level, then enter a 4-digit password.
   Note: *When a password is set to 0000 (default), the password is disabled.*

6.15 Show the software version and serial number

Show the contact information for technical support, the software version or the serial number of the analyzer.

1. Select MAINTENANCE > COMMISSIONING > INFORMATION.
2. Select an option.

Option	Description
CONTACT INFORMATION	Shows the contact information for technical support.
SOFTWARE	Shows the software version installed on the analyzer. Shows the date the software version was released.
IDENTIFICATION	Shows the serial number of the analyzer.

Section 7 Calibration

7.1 Start a zero calibration or zero check

Start a zero calibration after a maintenance task or after reagent replacement or addition. After maintenance, measure water ten times before a zero calibration is done to remove contamination from the analyzer.

A zero calibration sets the zero offset values. Start a zero check to see if the zero offset values set by the analyzer are correct as necessary.

The zero adjust values remove the effect that the items that follow can have on measurement results:

- Contamination in the analyzer
- Organic carbon in the acid reagent and base reagent
- Absorbed CO_2 in the base reagent

1. Select CALIBRATION > ZERO CALIBRATION.
2. Select an option.

Option	Description
ZERO ADJUST	(Optional) Sets the zero adjust values for zero calibrations manually for each range (1, 2 and 3) and each parameter. When the zero adjust values are entered manually, the analyzer records the information in the reaction archive with the prefix “ZM” (zero manual). ***Note:*** *The TOC zero adjust values are the zero offset values in mgC/L measured by the CO_2 analyzer.*
RUN REAGENTS PURGE	Starts a reagent purge cycle, which primes the reagents in the analyzer. ***Note:*** *To change the pump operation time for the reagent purge cycle, select MAINTENANCE > SYSTEM CONFIGURATION > SEQUENCE PROGRAM > REAGENTS PURGE.*
RUN ZERO CALIBRATION	Starts a zero calibration, which sets the zero adjust values automatically for each range (1, 2 and 3) for each parameter. Zero calibration reactions have the prefix “ZC”. Stop measurements before a zero calibration is started. ***Note:*** *Based on the ZERO WATER setting in the SYSTEM CONFIGURATION menu, a zero calibration reaction is a reaction with no sample or with deionized water, and the sample pump does not operate in the reverse direction.* If the ZERO WATER setting in the SYSTEM CONFIGURATION menu is set to YES, make sure to plumb deionized water (< 5 ppb TOC) to the MANUAL fitting before a zero calibration is started. The default setting for ZERO WATER is NO (no sample). ***Note:*** *Approximately 500 to 800 mL of deionized water is used for a zero calibration or zero check.* At the end of a zero calibration, the analyzer does the actions that follow: • **TOC zero adjust value**—The analyzer uses the uncalibrated TOC measurement (not the results that show on the display) to calculate and set new zero adjust values. • **CO2 LEVEL setting**—The analyzer sets the CO2 LEVEL setting to AUTO (automatic) on the REACTION CHECK screen. Then a new reaction check CO_2 level is saved. • **CO_2 level**—The analyzer compares the CO_2 level to the BASE CO2 ALARM setting in the FAULT SETUP menu. If the measured CO_2 level is more than the BASE CO2 ALARM value, a 52_HIGH CO2 IN BASE warning occurs.

Option	Description
RUN ZERO CHECK	Starts a zero check. A zero check is the same as a zero calibration, but the analyzer does not change of the zero adjust values or the CO2 LEVEL settings. Zero check reactions have the prefix “ZK”. Stop measurements before a zero check is started. If the ZERO WATER setting in the SYSTEM CONFIGURATION menu is set to YES, make sure to plumb deionized water to the ZERO WATER or MANUAL fitting before a zero check is started. If those fittings are not available, plumb deonized water to the SAMPLE 1 fitting. The default setting for ZERO WATER is NO (no sample). At the end of a zero check, the analyzer does the actions that follow: • The analyzer identifies the zero response at each range and shows the suggested zero adjust values in brackets “[ ]” near the zero adjust values set by the analyzer. ***Note:*** *Manually change the zero adjust value settings on the RUN ZERO CHECK screen if necessary.* • The analyzer compares the CO_2 level to the BASE CO2 ALARM setting in the FAULT SETUP menu. If the measured CO_2 level is more than the BASE CO2 ALARM value, a 52_HIGH CO2 IN BASE warning occurs.
ZERO PROGRAM	***Note:*** *Do not change the default setting unless necessary. Changes can have a negative effect on the zero adjust values.* Sets the number of zero reactions done during a zero calibration or zero check for each operation range (R1, R2 and R3). ***Note:*** *The analyzer does not do a zero reaction for the operation ranges set to 0. The analyzer calculates the zero adjust values for the operation ranges set to 0.*
ZERO AVERAGE	***Note:*** *Do not change the default setting unless necessary. Changes can have a negative effect on the zero adjust values.* Sets the number of zero reactions averaged for each operation range at the end of the zero cycles for all of the measured parameters.

7.2 Start a span calibration or span check

Set the operation range and the calibration standards for span calibrations. Start a span calibration to set the span adjust values, which adjust the measurement results. Start a span check to identify if the span adjust values saved to the analyzer are correct.

1. Select CALIBRATION > SPAN CALIBRATION.
2. Select an option.

Option	Description
TIC SPAN ADJUST **TOC SPAN ADJUST**	(Optional) Sets the TIC and TOC span adjust values for span calibrations manually for each range.

Option	Description
RUN SPAN CALIBRATION	Starts a span calibration, which sets the span adjust values automatically. Span calibration reactions have the prefix of “SC”. Make sure that measurements are stopped before a span calibration is started. Make sure to install the calibration standard before a span calibration is started. Refer to Plumb the calibration standard on page 68. ***Note:*** *The analyzer uses the same span adjust value calculated for the selected RANGE for the other ranges, unless the span adjust values are manually changed.* A span calibration reaction is the same as a normal reaction, but the prepared calibration standard is measured and the sample pump does not operate in reverse.
RUN SPAN CHECK	Starts a span check. A span check is the same as a span calibration, but the analyzer does not change the span adjust values. Span check reactions have the prefix “SK”. Stop measurements before a span check is started. Make sure to install the calibration standard before a span check is started. Refer to Plumb the calibration standard on page 68. At the end of a span check, the analyzer identifies the span response at each range and shows the suggested span adjust values in brackets “[ ]” near the span adjust values set by the analyzer. ***Note:*** *Manually change the span adjust value settings on the RUN SPAN CHECK screen if necessary.*
SPAN PROGRAM	***Note:*** *Do not change the default setting unless necessary. Changes can have a negative effect on the span adjust values.* Sets the number of span reactions done during a span calibration and a span check (default: 5).
SPAN AVERAGE	***Note:*** *Do not change the default setting unless necessary. Changes can have a negative effect on the span adjust values.* Sets the number of reactions the analyzer uses to calculate the average value used for the span adjust values (default: 3).
RANGE	Sets the operation range for span calibration reactions and span check reactions (default: 1). Select the operation range that agrees with normal measurements for the sample stream(s). Refer to the System Range Data screen to see the operation ranges. Select OPERATION > SYSTEM RANGE DATA. ***Note:*** *If the RANGE setting is not applicable to the TIC CAL STD and TOC CAL STD setting, the analyzer shows “CAUTION! REACTION RANGE OR STANDARDIS INCORRECT”.*
TIC CAL STD **TOC CAL STD**	Sets the concentrations of the TIC and TOC calibration standards for span calibrations. Enter concentrations that are more than 50% of the full scale value for the operation range selected in the RANGE setting. For example, if the operation range for TIC or TOC is 0 to 25 mgC/L, 50% of the full scale value is 12.5 mgC/L. If a calibration standard selected is 0.0 mgC/L, the analyzer does not change the span adjust value for that parameter.
TIC CHECK STD **TOC CHECK STD**	Sets the concentrations of the TIC and TOC calibration standards for span checks (defaults: TIC = 0 mgC/L and TOC = 20.0 mgC/L). If the calibration standard selected is 0.0 mgC/L, the analyzer ignores the span check results. In addition, the warning set with the TIC BAND or TOC BAND settings do not occur.

7.3 Plumb the calibration standard

Plumb the calibration standard container to the MANUAL fitting.

1. Prepare the calibration standard. Refer to Prepare the calibration standard on page 68.
2. Connect 1/4-in. OD x 1/8-in. ID PFA tubing to the MANUAL fitting. Make sure that the tubing length is 2 to 2.5 (6.5 to 8.2 ft).
3. Put the tubing in the calibration standard container. Make sure that the calibration standard container is 100 to 500 mm (4 to 20 inches) below the analyzer.

7.4 Prepare the calibration standard

⚠ CAUTION



Chemical exposure hazard. Obey laboratory safety procedures and wear all of the personal protective equipment appropriate to the chemicals that are handled. Refer to the current safety data sheets (MSDS/SDS) for safety protocols.

⚠ CAUTION



Chemical exposure hazard. Dispose of chemicals and wastes in accordance with local, regional and national regulations.

Items to collect:

- Deionized water, 5 L
- Volumetric flask, 1 L (5x)
- Personal protective equipment (refer to MSDS/SDS)

Before starting:

- Put all hygroscopic chemicals in crystal form in a 105 °C oven for 3 hours to remove all water.
- Mix the prepared solutions with a magnetic stirrer or invert the solutions until all of the crystals are fully dissolved.
- If the purity of the chemical to be used is different than the purity given for the chemical in the steps that follow, adjust the quantity of chemical used. Refer to Table 15 for an example.

Shelf life and storage of calibration standards:

- TOC standards prepared from potassium hydrogen phthalate (KHP) are normally stable for 1 month when kept in a closed glass container at 4 °C.
- All the other standards (e.g., TOC prepared from acetic acid and TIC standards) should be used within 48 hours.

Prepare the calibration standard for TIC/TOC span calibrations and span checks as follows.

Note: *The concentration of the calibration standard and the operation range for span calibrations and span checks are set on the SPAN CALIBRATION screen. Refer to* Start a span calibration or span check *on page 66*.

Procedure:

1. Put on the personal protective equipment identified in the safety data sheet (MSDS/SDS).
2. For the TOC standard, use an off-the-shelf TOC standard. Refer to *Replacement parts and accessories* in the Maintenance Manual for ordering information.

3. Prepare a 1000-mgC/L TIC standard solution as follows:
   a. Add one of the chemicals that follow to a clean 1-L volumetric flask.
      - Sodium carbonate (Na_2CO_3)—8.84 g (99.9% purity)
      - Sodium hydrogen carbonate ($NaHCO_3$)—7.04 g (99.5% purity)
      - Potassium carbonate (K_2CO_3)—11.62 g (99.0% purity)
   b. Fill the flask to the 1-L mark with deionized water.
4. To prepare a TOC only standard with a concentration less than 1000-mgC/L, dilute the prepare standards with deionized water.

   For example, to prepare a 50 mg/L standard solution, put 50 g of the 1000-mg/L prepared standard in a clean 1-L volumetric flask. Fill the flask to the 1-L mark with deionized water.
5. To prepare a standard with a concentration less than 5-mg/L, prepare the standard with two or more dilution steps.

   For example, to prepare a 1-mgC/L (ppm) standard, first prepare a 100-mgC/L standard. Then use the 100-mgC/L standard to prepare the 1-mgC/L standard. Put 10 g of the 100-mgC/L standard in a clean 1-L volumetric flask. Fill the flask to the 1-L mark with deionized water.
6. To prepare a standard with a concentration at µg/l (ppb) levels, use multiple dilution steps.

Table 15 Quantity of KHP at different purities to prepare a 1000-mgC/L standard

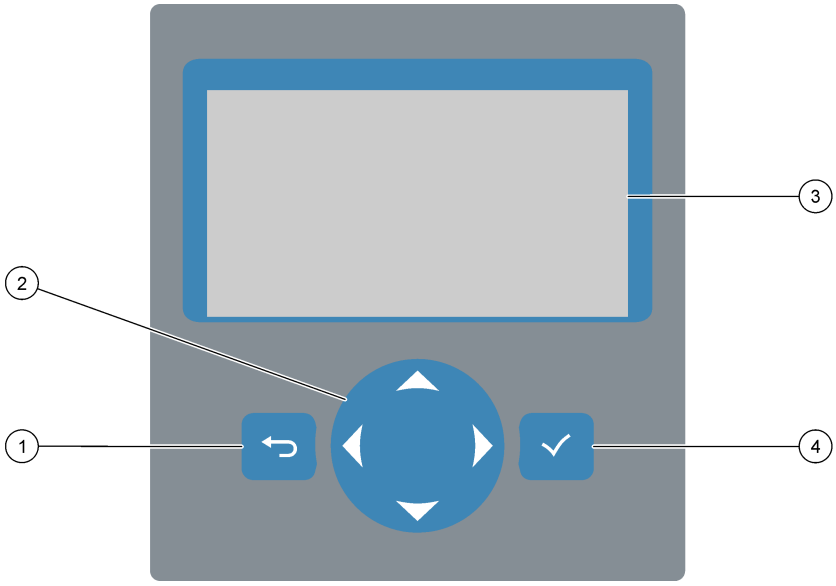
Purity of KHP	Quantity of KHP
100%	2.127 g
99.9%	2.129 g
99.5%	2.138 g
99.0%	2.149 g

Table 16 Quantity of KHP to prepare different concentrations of TOC standard

Concentration of TOC standard	Quantity of 99.9% KHP
1000 mgC/L	2.129 g
1250 mgC/L	2.661 g
1500 mgC/L	3.194 g
2000 mgC/L	4.258 g
5000 mgC/L	10.645 g
10000 mgC/L	21.290 g

Section 8 User interface and navigation

8.1 Keypad description



1 **Back key**—Push to go back to the previous screen or cancel changes. Push for 1 second to go to the main menu.	**3** Display
2 **Arrow keys**— Push to select menu options or to enter numbers and letters.	**4** **Enter key**—Push to confirm and go to the next screen.

8.2 Reaction Data screen

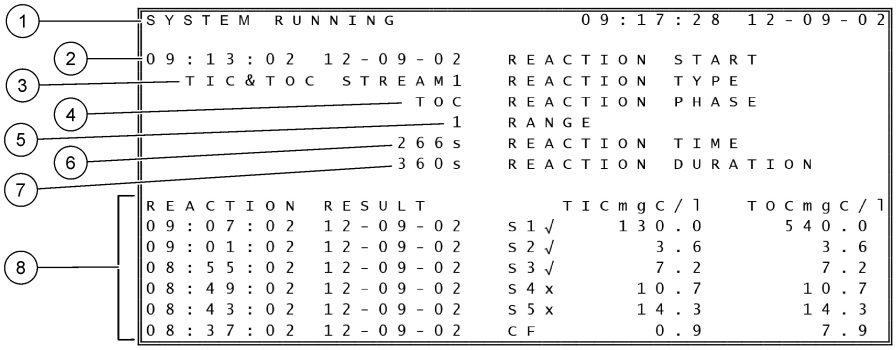
The Reaction Data screen is the default (home) screen. The Reaction Data screen shows the current reaction information and the results of the last 25 reactions. Refer to Figure 21.

Note: *If no key is pushed for 15 minutes, the display goes back to the Reaction Data screen.*

Push ✔ to see the Reagent Status screen and then the main menu.

Note: *To see more than the last 25 reactions, push the enter key to go to the main menu, then select OPERATION > REACTION ARCHIVE. Enter the reaction date for the first reaction to show on the display.*

Figure 21 Reaction Data screen



1	Status message (refer to Status messages on page 72)	**5**	Operation range (1, 2 or 3)
2	Reaction start time and date	**6**	Reaction time since start (seconds)
3	Reaction type	**7**	Total reaction time (seconds)
4	Reaction phase	**8**	Results of the last 25 reactions: start time, date, record type[11] and results. Refer to Table 17 for the record types.

Table 17 Record types

Symbol	Description	Symbol	Description
S1 ... S2	Sample Stream 1 to 2	ZK	Zero check
M1	Manual Stream 1	ZM	Zero adjust value set manually
√	There is sample or the quantity of air bubbles in the sample stream and manual stream is small.	SC	Span calibration
x	There is no sample or the quantity of air bubbles in the sample stream and manual stream is large.	SK	Span check
RS	Remote standby reaction	SM	Span adjust value set manually
ZC	Zero calibration	A1 ... A2	24-hour average result, Sample Stream 1 to 2

8.3 Status messages

A status message shows in the top-left corner of the Reaction Data screen and the Reagent Status screen. The sequence of the status messages in Table 18 show the priority from highest to lowest.

[11] TIC and TOC. In addition, the calculated results (COD, BOD and/or drinking water REMOVAL% and PASS/FAILRESULT) show on the display when the DISPLAY setting on the COD PROGRAM and/or BOD PROGRAM menu is set to YES (default: OFF).

Table 18 Status messages

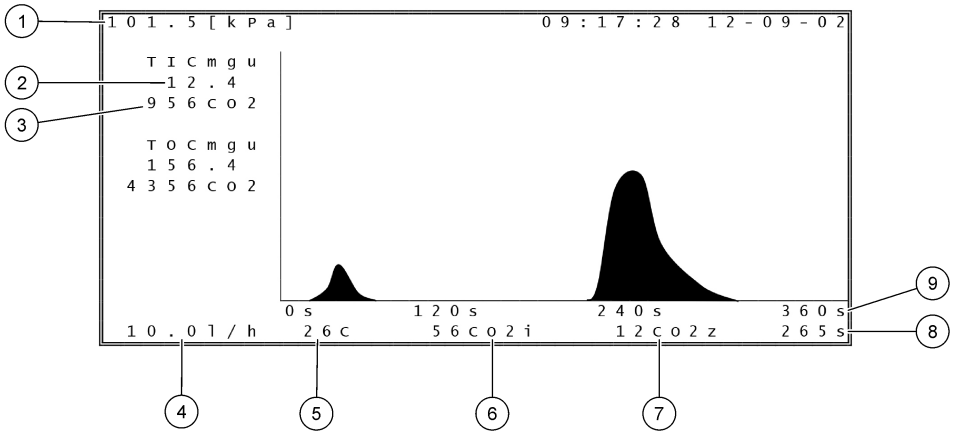
Message	Description
SYSTEM MAINTENANCE	The instrument is in maintenance mode. The maintenance switch is set to on.
SYSTEM FAULT	The instrument needs immediate attention. Measurements have stopped. The 4–20 mA outputs are set to the FAULT LEVEL setting (default: 1 mA). The fault relay is on. To identify the system fault, push ✔ to go to the main menu, then select OPERATION > FAULT ARCHIVE. Faults and warnings preceeded by an "*" are active. To start the analyzer again, complete the troubleshooting steps in the Maintenance and Troubleshooting Manual. ***Note:*** *"FAULT LOGGED" shows intermittently on the top-right corner of the screen where the date and time show.*
SYSTEM WARNING	The instrument needs attention to prevent a failure in the future. Measurements continue. The fault relay is on. To identify the warning, push ✔ to go to the main menu, then select OPERATION > FAULT ARCHIVE. Faults and warnings preceeded by an "*" are active. Complete the troubleshooting steps in the Maintenance and Troubleshooting Manual. ***Note:*** *"FAULT LOGGED" shows intermittently on the top-right corner of the screen where the date and time show.*
SYSTEM NOTE	There is a notification. The notification shows on the display (e.g., 86_POWER UP. ***Note:*** *"FAULT LOGGED" shows intermittently on the top-right corner of the screen where the date and time show.*
SYSTEM CALIBRATION	The instrument is in calibration mode (span calibration, span check, zero calibration or zero check).
SYSTEM RUNNING	Normal operation
SYSTEM STOPPED	The instrument was stopped with the keypad or a fault occurred.
REMOTE STANDBY	The instrument was put in remote standby with the optional digital input for remote standby. The analog outputs and relays do not change. Refer to REMOTE STANDBY in Start or stop measurements on page 75. ***Note:*** *A grab sample measurement can be done when the instrument is in remote standby.*

8.4 Reaction Graph screen

Push ↩ to go to the Reaction Graph screen. The Reaction Graph screen shows the reaction in progress. Refer to Figure 22.

Note: *To go to back to the Reaction Data screen, push the enter key.*

Figure 22 Reaction Graph screen



1 Atmospheric pressure	**6** CO_2 instantaneous (i) measured value
2 TIC mgC/L un-calibrated (mgu), no compensation for atmospheric pressure	**7** CO_2 zero (z) value at start of reaction
3 CO_2 peak value	**8** Reaction time since start (seconds)
4 Oxygen flow (L/hour)	**9** Total reaction time
5 Temperature of the analyzer (°C)	

Section 9 Operation

9.1 Start or stop measurements

1. Push ✔ to go to the main menu, then select OPERATION > START,STOP.
2. Select an option.

Option	Description
REMOTE STANDBY	An optional digital input is used to put the analyzer in remote standby (e.g., from a flow switch). When the analyzer is in remote standby: • "REMOTE STANDBY" shows in the top-left corner of the Reaction Data screen and the Reagent Status screen. • Measurements stop and the analog outputs and relays do not change. • The analyzer does one remote standby (RS) reaction at 24-hour intervals at the time set in the PRESSURE/FLOW TEST menu (default: 08:15 AM) in the SYSTEM CONFIGURATION > SEQUENCE PROGRAM menu. • Sample is not used during the remote standby reaction, only acid reagent and base reagent is used. • A grab sample measurement can be done. When REMOTE STANDBY is unselected, the analyzer starts measurements unless the analyzer was stopped with the keypad or a fault occurred.
START	Starts the analyzer. The analyzer does an ozone purge, pressure test, flow test, reactor purge and analyzer purge, then starts the analysis of the first stream in the programmed stream sequence. If a fault has occurred, the analyzer cannot be started until the fault is removed. ***Note:*** *To start the analyzer without the pressure test or flow test (quick startup), select START and push the RIGHT arrow key at the same time. When a quick startup is done, a 28_NO PRESSURE TEST warning occurs. The warning stays active until a pressure test is passed.* • **Ozone purge**—Pushes residual ozone through the ozone destructor. • **Pressure test**—Identifies if there is a gas leak in the analyzer. • **Flow test**—Identifies if there is a blockage in the gas exhaust or the sample out lines. • **Reactor purge**—Removes liquid from the reactor through the SAMPLE OUT fitting. • **Analyzer purge**—Removes CO_2 gas from the CO_2 analyzer through the EXHAUST fitting. ***Note:*** *If the analyzer is started while the remote standby signal is active, the analyzer goes to remote standby.*
FINISH & STOP	Stop the analyzer after the last reaction is completed. The analyzer does an ozone purge, reactor purge and analyzer purge and then stops.
EMERGENCY STOP	Stops the analyzer before the last reaction is completed. The analyzer does an ozone purge, reactor purge and analyzer purge and then stops. ***Note:*** *If EMERGENCY STOP is selected soon after FINISH & STOP is selected, an EMERGENCY STOP is done.*

9.2 Measure a grab sample

The grab sample settings can be changed while the analyzer is in operation, unless:

- A manual mode (grab sample) sequence is scheduled to start when the last reaction is completed.
- A manual mode sequence has started.

Plumb and configure the analyzer to do a grab sample measurement as follows:

1. Use 1/4-in. OD x 1/8-in. ID PFA tubing to plumb the grab sample container to the MANUAL fitting. Make sure that the tubing length is 2 to 2.5 (6.5 to 8.2 ft).

   Refer to Table 2 on page 4 for the sample specifications.
2. Put the tubing in the grab sample. Make sure that the grab sample is 100 to 500 mm (4 to 20 inches) below the analyzer.
3. Do a sample pump test for the manual stream(s) to identify the correct forward and reverse times. Refer to Do a sample pump test on page 53.
4. Set the sample pump times for the manual stream(s). Refer to Set the sample pump times on page 53.
5. Select OPERATION > MANUAL PROGRAM.
6. Select an option.

Option	Description
RUN AFTER NEXT REACTION	Starts the manual mode (grab sample) sequence after the next reaction. If the analyzer is stopped, the manual mode sequence will start immediately. ***Note:*** *If the analyzer has the Manual-AT Line option, push the green button to select RUN AFTER NEXT REACTION. The Manual-AT Line option is a small box with only a green button. The Manual-AT Line cable is connected to the analyzer.* ***Note:*** *When a manual mode sequence starts, all of the cleaning cycle, pressure/flow tests, zero or span cycles stop temporarily. In addition, the reverse operation of the sample pump is disabled (default).*
RUN AFTER	Starts the manual mode (grab sample) sequence at a selected time (default: 00.00).
RETURN TO ON-LINE SAMPLING	Sets the analyzer to stop or go back to online operation when the manual mode sequence is completed. **YES**—The analyzer goes back to online operation. **NO** (default)—The analyzer stops.
RESET MANUAL PROGRAM	Sets the MANUAL PROGRAM settings back to the factory default settings.
MANUAL x, x **RANGE x**	Sets the number of reactions and the operation range for each manual (grab sample) stream. **MANUAL** —The first setting is the manual valve number (e.g., MANUAL VALVE 1 is connected to the MANUAL 1 fitting on the side of the analyzer). The second setting is the number of reactions done at the manual stream before the analyzer does reactions at the next manual stream. **RANGE** —Sets the operation range for each manual stream. Options: 1, 2 or 3 (default). Refer to the SYSTEM RANGE DATA screen to see the operation ranges. Select OPERATION > SYSTEM RANGE DATA. If the concentration of the grab sample is not known, select AUTO. ***Note:*** *If RANGE is set to AUTO, enter 5 for the number of reactions so the analyzer can find the best operation range. It may be necessary to discard the first two or three analysis results.* ***Note:*** *When a MANUAL is set to "- , -" and RANGE is set to "-", the manual stream is not measured.*

9.3 Save data to an MMC/SD card

Save the reaction archive, fault archive, configuration settings and/or diagnostic data to an MMC/SD card.

1. Put the supplied MMC/SD card in the MMC/SD card slot. Refer to Figure 23.
2. Select MAINTENANCE > DIAGNOSTICS > DATA OUTPUT.

3. Select an option.

Option	Description
OUTPUT DEVICE	Sets where the analyzer sends the data (MMC/SD CARD). This setting cannot be changed. To configure the settings for the MMC/SD card, select MAINTENANCE > COMMISSIONING > DATA PROGRAM. Refer to Configure the communication settings on page 62. Make sure that the MMC/SD card is configured with FAT, FAT12/16 or FAT32 file systems. As an alternative, use an SDHC card. Data is saved to an MMC/SD card in text format. The binary files on the card are system firmware (sysfrmw.hex) and system configuration (syscnfg.bin).
SEND REACTION ARCHIVE	Sends the contents of the reaction archive to the output device. Set the start date and number of entries to send, then select START SENDING. OUTPUT ITEMS shows the number of entries sent. The analyzer sends the data in the display language. If PAUSE SENDING is selected, entries are not sent for 60 seconds or until PAUSE SENDING is selected again. If the output device is an MMC/SD card, the reaction archive is saved to the file RARCH.txt. ***Note:*** *To see the reaction archive, go to the main menu, then select OPERATION > REACTION ARCHIVE.* Refer to Table 19 and Table 20 for descriptions of the data sent. To select standard or engineering data, select DATA PROGRAM > PRINT MODE.
SEND FAULT ARCHIVE	Sends the contents of the fault archive to the output device. Select START SENDING. OUTPUT ITEMS shows the number of entries sent. The data is sent in the display language. If PAUSE SENDING is selected, entries are not sent for 60 seconds or until PAUSE SENDING is selected again. If the output device is an MMC/SD card, the fault archive is saved to the file FARCH.txt. ***Note:*** *To see the fault archive, go to the main menu, then select OPERATION > FAULT ARCHIVE. The fault archive contains the last 99 faults and warnings.*
SEND CONFIGURATION	Sends the analyzer settings to the output device. Select START SENDING. OUTPUT ITEMS shows the number of entries sent. The data is sent in the display language. If PAUSE SENDING is selected, entries are not sent for 60 seconds or until PAUSE SENDING is selected again. If the output device is an MMC/SD card, the analyzer settings are saved to the file CNFG.txt.
SEND ALL DATA	Sends the reaction archive, fault archive, analyzer settings and diagnostics data to the output device. Select START SENDING. The data is sent in English. If PAUSE SENDING is selected, entries are not sent for 60 seconds or until PAUSE SENDING is selected again. If the output device is an MMC/SD card, the analyzer settings are saved to the file ALLDAT.txt.
DATA PROGRAM	Goes to the MAINTENANCE > COMMISSIONING > DATA PROGRAM menu to set the communication settings for the output devices: MMC/SD card and Modbus.

Figure 23 Insert MMC/SD card

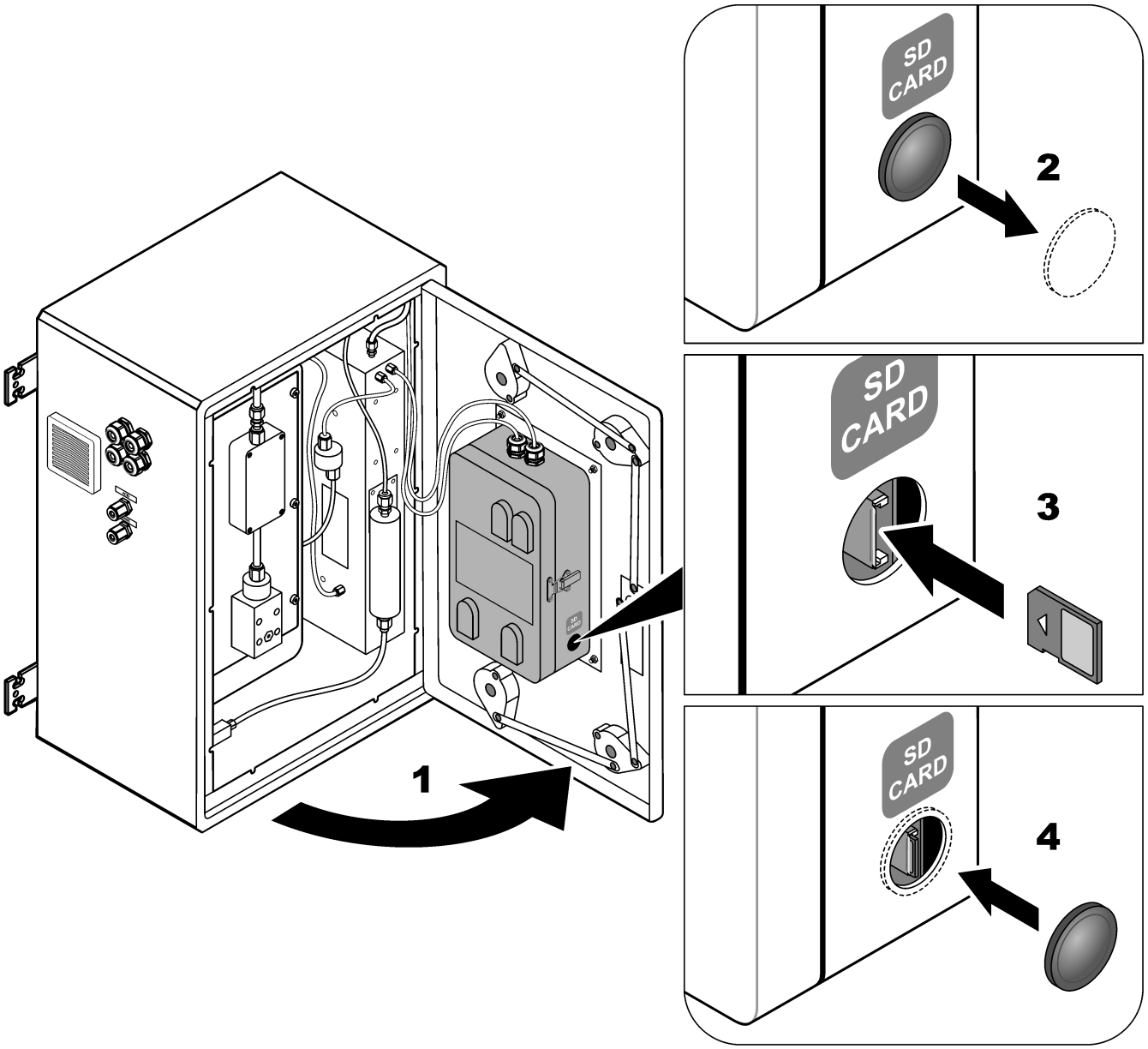


Table 19 Reaction archive data—Standard mode

Item	Description
TIME	Time the reaction started
DATE	Date the reaction started
S1:2	Reaction type (e.g., Stream 1) and operation range (e.g., 2)
TICmgC/L	Calibrated TIC value in mgC/L
TOCmgC/L	Calibrated TOC value in mgC/L (TOC is NPOC)
COD/BODmgO/L	Calculated COD and/or BOD value in mgO/L (if set to on in the COD PROGRAM and/or BOD PROGRAM menu)
REMOVAL%	Drinking water REMOVAL% value (if set to on in the DW PROGRAM menu)
RESULT	Drinking water RESULT in FAIL/PASS condition (if set to on in the DW PROGRAM menu)

Table 20 Reaction archive data—Engineering mode (TIC + TOC analysis)

Item	Description
TIME	Time the reaction started
DATE	Date the reaction started
S1:2	Reaction type (e.g., Stream 1) and operation range (e.g., 2)
CO2z	Zero adjust value for the CO_2 analyzer for the last reaction
CO2p	Maximum height of the CO_2 peak
mgu	Un-calibrated value in mgC/L
mgc	Calibrated value in mgC/L
COD/BODmgO/L	Calculated COD and/or BOD value in mgO/L (if set to on in the COD PROGRAM and/or BOD PROGRAM menu)
REMOVAL%	Drinking water REMOVAL% value (if set to on in the DW PROGRAM menu)
RESULT	Drinking water RESULT in FAIL/PASS condition (if set to on in the DW PROGRAM menu)
BT_DegC	Analyzer temperature (°C)
MB_DegC	Motherboard temperature (°C)
Atm	Atmospheric pressure (kPa)
SAMPLE	Sample quality (%) from the Sample Sensor signal used to activate the SAMPLE STATUS output
SMPL PUMP	The five items, which are number coded or number data, give information on the sample pump as follows: 1) Operation mode (0 = time mode or 1 = pulse mode) 2) Number of pulses during operation (e.g., injection) 3) Total time (milliseconds) for the total number of pulses 4) The time (milliseconds) for the last pulse 5) Error counter (0 to 6). When a pulse is not done or identified, the pump goes to time mode for that specific operation (e.g., injection or synchronization). A pump warning only occurs if there are six consecutive failures.
ACID PUMP	Error counter for the acid pump. Refer to SMPL PUMP description.
BASE PUMP	Error counter for the base pump. Refer to SMPL PUMP description.
COOLER	The status of the cooler (e.g., OFF).
O3 HEATER	The status of the ozone destructor heater (e.g., OFF).

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