AO2000 System

Advanced CGA Solutions

Analyzer System for Emission Monitoring, Cement Applications and Process Measurement

Measurement made easy

AO2000 System

Introduction

The AO2000 system is a complete system solution for continuous gas analysis.

The AO2000 system includes everything from probe, heated lines, sample conditioning to reliable and time-tested analyzers of the Advance Optima series. It can be operated from the outside.

The AO2000 system is available in various variants tailored to your measuring tasks – emission monitoring, cement applications and process gas measurements.
It is especially designed for easy service and maintenance.

Additional Information

Additional documentation on AO2000 System is available for download free of charge at www.abb.com/analytical.
Alternatively simply scan this code:

Advanced CGA Solutions

AO2000 System

Analyzer System for Emission Monitoring, Cement Applications and Process Measurement

Operating Instruction

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Table of Contents

Foreword

The Content of this Operator's Manual

This operator's manual contains all the information you will need to safely and efficiently install, operate and maintain the AO2000 System.

This operator's manual contains information on all the functional units in the analyzer system. Your analyzer system as delivered may differ from the version described in this operator's manual.

System documentation

The system documentation includes the following:

- Device Data Sheet
- Instructions in brief for installation, commissioning and operation
- Certificates
- Project-relevant CD-ROM with
  - Set of drawings (arrangement diagram, piping diagram, interface diagram) as well as
  - Information on function block configuration as needed
- System CD-ROM 'Continuous Gas Analysis – Software Tools and Technical Documentation'
- CD-ROM 'Spare Parts Catalog for Analyzer Technology'

Information on the Internet

Information on ABB Analytical products and services is available on the Internet at "http://www.abb.com/analytical".

Service Contact

If the information in this manual does not cover a particular situation, ABB Service is prepared to supply additional information as needed.

Please contact your local service representative. For emergencies, please contact

ABB Service
Telephone: +49-(0)1805-222580, Telefax: +49-(0)621-38193129031,
E-mail: automation.service@de.abb.com

Symbols and Type Format in this Operator's Manual

indicates safety information to be heeded during analyzer system operation in order to avoid risks to the user.

identifies specific information on operation of the analyzer system as well as on the use of this manual.

1, ***2***, ***3***, … identifies reference numbers in figures.

`Display` identifies a message in the display.

`Input` identifies a user entry
- either by pressing a soft key
- or by selecting a menu item
- or via the numeric keypad.

Safety Information

Important Safety Information

Intended Conditions of Use

The analyzer system is designed for continuous measurement of concentrations of specific components in gases or vapor. Any other application is not compliant with the specified use. Observation of this manual is also part of the specified use.

The analyzer system must not be used to measure flammable gases or combustible gas/air or gas/oxygen mixtures. The analyzer system must not be installed in hazardous locations.

The analyzer system interior remains free of explosive atmosphere during normal operation. Therefore, the integration of explosion protection measures inside the analyzer system is not required.

Requirements for Safe Operation

In order to operate in a safe and efficient manner, the analyzer system should be properly handled and stored, correctly installed and set-up, properly operated and carefully maintained.

Personnel Qualifications

Only persons familiar with the installation, set-up, operation and maintenance of comparable analyzer systems and certified as being capable of such work should work on the system.

Special Information and Precautions

These include

- The content of this manual,
- The safety labels affixed to the analyzer system,
- The applicable safety precautions for installing and operating electrical devices,
- Safety precautions for working with gases, acids, condensates, etc.

Safety Labels Affixed to the Analyzer System

Observe the safety labels affixed to the analyzer system or to the individual components:

Consult Documentation!

Hot Surface! (Temperature > 60 °C)

Corrosive Material!

Risk of Electric Shock!

National Regulations

The regulations, standards and guidelines cited in this operator's manual are applicable in the Federal Republic of Germany. The applicable national regulations should be followed when the analyzer system is used in other countries.

Analyzer System Safety and Safe Operation

The analyzer system is designed and tested in accordance with EN 61010 Part 1/ IEC 1010-1, "Safety Provisions for Electrical Measuring, Control, Regulation and Laboratory Instruments" and has been shipped ready for safe operation.

To maintain this condition and to assure safe operation, read and follow the safety information identified with the safety symbols in this manual. Failure to do so can put persons at risk and can damage the analyzer system as well as other systems and instruments.

Safety Tips for Handling Electronic Measurement Devices

Protective Lead Connection	The protective lead should be attached to the protective lead connector before any other connection is made.
Risks of a Disconnected Protective Lead	The analyzer system can be hazardous if the protective lead is interrupted inside or outside the analyzer cabinet or if the protective lead is disconnected.
Correct Operating Voltage	Be sure the analyzer system voltage setting matches the line voltage before connecting the power supply.
Risks Involved in Opening the Covers	Current-bearing components can be exposed when covers or parts are removed, even if this can be done without tools. Current can be present at some connection points.
Risks Involved in Working with an Open Analyzer System	The analyzer system must be disconnected from all power sources before being opened for any work. All work on an analyzer system that is open and connected to power should only be performed by trained personnel who are familiar with the risks involved.
Charged Capacitors	The capacitors in the analyzer system can retain their charge even when it is disconnected from all power sources.
Use of Proper Fuses	Only fuses of the specified type and rated current should be used as replacements. Never use patched fuses. Do not short-circuit the fuse holder contacts.
When safe operation can no longer be assured ...	If it is apparent that safe operation is no longer possible, the analyzer system should be taken out of operation and secured against unauthorized use. The possibility of safe operation is excluded: • if the analyzer system is visibly damaged, • if the analyzer system no longer operates, • after prolonged storage under adverse conditions, • after severe transport stresses.

Safety Tips for Handling the Analyzer System

CAUTION!

Do not open any gas paths in the analyzer system or in the integrated analyzers. Doing so will damage gas path seal integrity.

If system-internal gas paths are opened, a seal integrity check must be performed with a leak detector (thermal conductivity) when the device is reassembled.

Additional Safety Tips for Handling the Analyzer System with Integrated VOC Analyzer

CAUTION!

The combustion gas path in the analyzer system and especially in the integrated VOC analyzer must not be opened! The combustion gas feed path can become leaky as a result!

If the system-internal combustion gas path is opened, a seal integrity check must be performed with a leak detector (thermal conductivity) when the device is reassembled.

The bulkhead connector with integrated flow limiter for connection of the combustion gas line is a safety relevant part. It must not be removed, modified or replaced!

It is recommended to check regularly the seal integrity of the combustion gas line outside the analyzer system.

WARNING!

Combustion gas flowing out of leaks in the gas paths can cause fire and explosions (even outside the analyzer system itself).

A shut-off valve must be installed in the combustion gas supply line to increase safety in the following operating conditions:

- During shutdown of the gas analyzer,
- In the event of failure of the instrument air supply,
- Leakage in the combustion gas feed path inside the gas analyzer.

This shut-off valve should be installed outside the analyzer house in the vicinity of the combustion gas supply (cylinder, line).

Safety Tips for Handling Corrosive and Acidic Substances

CAUTION!

When working with corrosive reagents note the hazard information and safety precautions contained in the applicable material safety data sheets.

Condensates are often acidic. Neutralize condensates and follow the prescribed measures for disposal.

Safety Tips for Handling Harmful Gases

CAUTION!

Some of the gases measured with the analyzer system are harmful to health.

Therefore, the sample gas must not escape from the gas path during normal operation and maintenance works.

A seal integrity check of the analyzer system has to be performed at regular intervals.

The diluted exhaust gas must be drained out of the installation room of the analyzer cabinet.

Notes on data safety

Obligations of the owner

This product is designed to be connected to and to communicate information and data via a network interface. It is operator's sole responsibility to provide and continuously ensure a secure connection between the product and your network or any other network (as the case may be).

Operator shall establish and maintain any appropriate measures (such as but not limited to the installation of firewalls, application of authentication measures, encryption of data, installation of anti-virus programs, etc.) to protect the product, the network, its system and the interface against any kind of security breaches, unauthorized access, interference, intrusion, leakage and/or theft of data or information.

ABB and its affiliates are not liable for damages and/or losses related to such security breaches, any unauthorized access, interference, intrusion, leakage and/or theft of data or information.

Digital communication

The ABB guidelines prevent communication through unsecured communication protocols, provided that the operator does not explicitly allow this.

These communication protocols are blocked by default.

The device software has been supplemented with menu items through which the operator can explicitly release communication.

The communication protocols are blocked again after software updates and must be released once again.

Services and ports on the Ethernet interface

Port	Description
22/tcp	Used only for software updates. No direct access to the device.
8001/tcp	Binary proprietary protocol for: • Remote HMI for operation • AnalyzeIT program for continuous monitoring • OPC Server, external OPC Server for AO2000 Systems
501/tcp	Used for Modbus/TCP. The device allows connection to any Modbus client.

Installation Preparation

"Hydrogen Monitoring of the Analyzer Cabinet" option

Function

If an FID (VOC Analyzer) is installed, the analyzer system can be supplied with the 'Hydrogen monitoring of the analyzer cabinet' option as an additional safety measure. If a leak occurs in the hydrogen path inside the analyzer cabinet and hydrogen accumulates inside the cabinet, both the hydrogen supply and the power supply are shut off before the explosion limit is reached – at 40 % LEL. This prevents formation of an ignitable mixture.

Scope of delivery

Installed in the analyzer cabinet:

- in the upper area, an ATEX-certified gas sensor with connection socket,
- on the exterior on the right-hand side wall, a solenoid valve, connected with the combustion gas input of the analyzer cabinet, which cuts off hydrogen supply in the event of a failure of the power supply, or at 40 % LEL (H_2safety valve).

Also supplied:

- a gas warning center for evaluating the gas sensor signal,
- a contactor for disconnecting the power supply to the analyzer cabinet,
- a contactor for disconnecting the UPS if the system is prepared for a UPS.

Installation

The electric wiring of the gas sensor and the gas warning center to shut down the power supply in the event of a fault is not installed in the analyzer system in the factory-delivered condition.

The gas warning center must be installed outside the analyzer cabinet in a non-hazardous area in a distribution cabinet or similar. It must be electrically connected to the gas sensor (see the order-specific set of drawings in this regard).

The solenoid valve for disconnecting the hydrogen supply (H_2) as well as the coils of the contactors and relays for disconnecting the power supply and UPS (if present) must be connected to a fault-signalling contact in the gas warning center. The fault-signalling contact must be set so that the voltage is shut off at 40% LEL and the contact itself latches.

The measuring signals (analog outputs and inputs), the status signals (digital outputs and inputs) as well as the bus systems of the analyzer system are so designed that after the power supply (and possibly the UPS) are disconnected no component in the analyzer cabinet (contactor, relay, motor etc.) that could generate an ignition spark can be actuated from the outside.

The measurement and status signals supplied potential-free as well as bus connections must not be activated separately in the event of a gas alarm. If however a non potential-free external signal is fed in, the operator should make sure that if a gas alarm is triggered, it is activated via a cut-off relay, for example.

- The gas sensor installed in the analyzer cabinet is not factory calibrated; it is inoperable without calibration. Calibration of the gas sensor is the responsibility of the operator.
- Installation, commissioning, parameterization, operation, signal evaluation and maintenance of the supplied gas warning center are the responsibility of the operator.

WARNING!

If the above-mentioned instructions are not observed or the hydrogen monitoring of the analyzer cabinet is installed incorrectly, a hydrogen explosion may occur in the event of a malfunction.

Operation of this safety device should be checked during commissioning and at regular intervals (min. 1 time a year).

Installing the Analyzer System

- We recommend having the analyzer system installed by ABB.
- When installing the analyzer system, in addition to this manual, comply with the information contained in the drawings set.
- If there is shipping damage which points to improper handling file a damage claim with the shipper (railway, mail or freight carrier) within seven days.
- Make sure the enclosed accessories are not lost (see the “Items Delivered” section, page 25).
- Keep the packaging material for future shipping needs.

Installation – Overview

Step	Action	Page
1	Prepare the gas sampling probe installation site.	17
2	Prepare the analyzer cabinet installation site.	18
3	Install the gas sampling probe and filter unit.	27
4	Install the sample gas line.	37
5	Install the back-purging unit (if applicable).	41
6	Install the analyzer cabinet.	49
7	Install the instrument air and test gas supply (if applicable).	51
8	Connect the gas lines to the analyzer cabinet.	53
9	Connect the electrical leads to the analyzer cabinet.	54

Choosing the Extraction Point, Wall Tube Installation

Choosing the Extraction Point

The extraction point must be suitable for extracting a representative specimen flow.

In the case of emission monitoring systems the extraction point is specified by the responsible technical inspection authority.

Wall Tube Installation

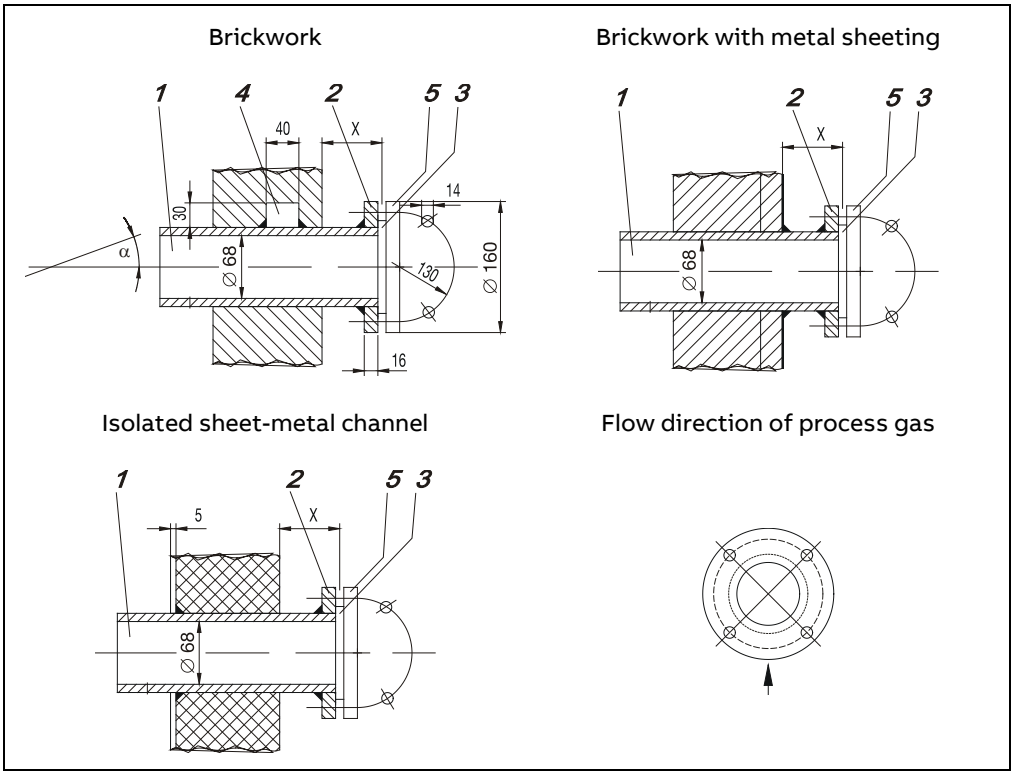
- Install the wall tube with mounting flange (DN 65, PN 6, type A according to DIN EN 1092-1; not supplied) at the extraction point in such a way that the sampling probe tube can be easily installed and removed (see Figure 1).
- The sampling probe tube must be easily accessible to allow maintenance work to be performed.
- Align the boreholes of the mounting flange in relation to the flow direction of the process gas (see Figure 1).

Observe the separate instructions for installation of probe tube type 40W on page 29!

Figure 1

Wall Tube Installation

(Dimensions in mm)



Wall tube
Wall tube mounting flange DN 65, PN 6, Form A to DIN EN 1092-1
Gasket
Welded-on rectangular block
Sampling probe tube flange

Minimum distance x_{min} of the mounting flange (wall tube flange) from the wall depending on mounting angle α:

α	10°	15°	20°	25°	30°	35°
x_{min} / mm	229	248	268	287	307	324

Analyzer System Installation Site Requirements

CAUTION!

The analyzer system must not be installed in hazardous locations.

Short Gas Paths

The analyzer cabinet should be installed as close as possible to the sampling site. A short sample gas line results in brief lead times.

The sample gas line length is limited to 60 meters with 230 VAC power supply and to 40 meters with 115 VAC power supply on account of pressure drop build-up in the line and the required electrical fusing.

For fast measurement at preheater / CO monitoring of ESP, the sample gas line length is limited to 10 meters.

The test gas cylinders should be installed as close as possible to the analyzer system.

Protection from Adverse Conditions

Protect the analyzer cabinet against

- Water spray
- Contact with chemicals
- Strong sunlight and heat radiation
- Strong air currents
- Heavy dust load
- Corrosive atmospheres
- Vibration

Installation Indoors or Outdoors

The sheet steel cabinet and the mounting plate are only suitable for installation indoors. An air-conditioned room is recommended.

The GRP cabinet is suitable for installation indoors and outdoors. A weather protection roof must be provided.

Wet locations

Installation in wet locations is not permitted.

Ambient Temperature

Operation:	Mounting plate		5 to 35 °C
	Sheet steel cabinet	with ventilation fan	5 to 35 °C
		with cooling unit	5 to 50 °C
	GRP cabinet	with ventilation fan	–20 to 35 °C
		with cooling unit	–20 to 50 °C
Storage and transport:			2 to 60 °C
	after draining and drying parts in contact with condensate		–25 to 60 °C

Relative Humidity

Year-round average max. 75 %, short-term max. 95 %, occasional slight condensation is permitted

Installation Site Altitude

The maximum installation altitude is 2000 m above sea level.

Altitude above 2000 m on request.

Continued on next page

Dimensions and Space Requirement

Refer to the “Layout Plan” in the drawings set.

Installation Site Stability

The installation site floor must be plane and capable of supporting the cabinets weight (see page 24).

The installation site wall must be capable of supporting the weight of the mounting plate and the separate electrical distribution cabinet (see page 24).

Sample Gas Inlet Conditions (at the Extraction Point)

CAUTION!

The analyzer system must not be used for measurement of flammable gases and ignitable gas/air or gas/oxygen mixtures!

In the case of toxic gases, the threshold limit value (TLV) must be complied with.

Application	Temperature	Pressure p_{abs}		Flow
Emission Monitoring	max. 500 °C	850 to 1100 hPa	(0.85 to 1.1 bar)	max. 250 l/h
Kiln or Calciner Outlet (T > 900 °C)	max. 1300 °C	850 to 1100 hPa	(0.85 to 1.1 bar) [1)]	max. 100 l/h
Calciner	max. 900 °C	850 to 1100 hPa	(0.85 to 1.1 bar)	max. 125 l/h
Wet Kiln Gas Outlet	max. 300 °C	850 to 1100 hPa	(0.85 to 1.1 bar)	max. 250 l/h [2)]
Preheater / CO Monitoring of ESP	max. 450 °C	850 to 1100 hPa	(0.85 to 1.1 bar)	max. 250 l/h [3)]
Coal Bunker, Coal Mill	max. 500 °C	850 to 1100 hPa	(0.85 to 1.1 bar)	max. 250 l/h
Process Measurement	max. 500 °C	850 to 1100 hPa	(0.85 to 1.1 bar)	max. 250 l/h

1) at the sample gas inlet of the analyzer system

2) max. 60 l/h with SO_2 measurement

3) max. 300 l/h with probe F

Test Gas Connection at the Gas Sampling Probe or upstream of the Sample Gas Cooler: Test Gas Inlet Conditions

CAUTION!

When handling test gases, the lower explosion limit (LEL)as well as the threshold limit value (TLV) must be complied with.

	Specification	Pressure p_e	Flow
Test gases 1, 2, 3	Sample component or substitute gas component in N_2 or air	1000 ± 100 hPa (1.0 ± 0.1 bar)	130 to 250 l/h

AO2000-Magnos27: Test Gas Inlet Conditions

	Characteristic	Pressure p_e	Flow
Zero Gas	N_2	500 ± 50 hPa (= 0.5 ± 0.05 bar)	130 to 250 l/h
Span Gas	Air		

AO2000-Fidas24: Supply Gas and Test Gas Inlet Conditions

	Characteristic	Pressure p_e	Flow
Instrument Air [1)]	Based on ISO 8573-1 Class 2 (particle size max. 1 µm, particle density max. 1 mg/m³, oil content max. 0.1 mg/m³, pressure dew point at least 10 °C below the lowest expected ambient temperature)	4000 ± 500 hPa (4.0 ± 0.5 bar)	approx. 1500 l/h
Combustion Air [2)]	Synthetic air or catalytically cleaned air with an org. C content of < 1% of the span	1200 ± 100 hPa (1.2 ± 0.1 bar)	max. 40 l/h
Combustion Gas [3)]	H_2 (quality 5.0)	1200 ± 100 hPa (1.2 ± 0.1 bar)	approx. 3 l/h
Zero Gas	N_2 (quality 5.0) or synthetic air or catalytically cleaned air	1000 ± 100 hPa (1.0 ± 0.1 bar)	130 to 250 l/h
Span Gas [4)]	Sample component or substitute gas component in N_2 or air	1000 ± 100 hPa (1.0 ± 0.1 bar)	130 to 250 l/h

1) Provide a shutoff valve with a p_e = 4.5 to 7 bar pressure gauge.
   Instrument air is used as
   - drive air for the air injector (if installed),
   - combustion air,
   - emergency purge air.
2) Separate combustion air supply is required if the analyzer system is not equipped with a combustion air conditioning module (catalyst).
3) Recommendation: Provide two 40 l cylinders and a switchover station.
   Note: For safety reasons, a flow limiter is integrated in the bulkhead connector provided for connection of the combustion gas line to limit the combustion gas flow to 10 l/h.
4) As the VOC analyzer only measures the number of carbons the concentration of the span gas has to be calculated from ppm or mg/m³ C_nH_m to ppm or mg/m³ C (see page 92).

- Perform regular inspections of the external combustion gas line.
- Install a pressure relief valve in the combustion gas line outside of the analyzer cabinet
- Set the pressure relief valve to < 2 bar to securely limit the maximum supply pressure.

Definition

$p_e = p_{abs} - p_{amb}$
with p_e = positive pressure, p_{abs} = absolute pressure, p_{amb} = atmospheric pressure

Back-Purging Unit: Installation Site and Air Supply Requirements

Design of the Back-Purging Unit

The back-purging unit consists of a protective cabinet with shut-off valve, 6 bar pressure reduction valve, solenoid valves for back-purging, pressure regulator and 5 l compressed air receiver for effective pressure pulses also with lower airflow rate.

Distance to Sampling Probe

The distance between the back-purging unit and the sampling probe must not exceed 5 m (length of the steel-braided compressed-air hoses = 6 m).

Protection from Adverse Conditions

Protect the back-purging unit against

- Water spray
- Contact with chemicals
- Strong sunlight and heat radiation
- Strong air currents
- Heavy dust load
- Corrosive atmospheres
- Vibration

Pressurized air supply requirements

- dry (dew point < 3 °C), oil- and dust-free
- max. 6 bar for back-purging
- approx. 4 bar as control air (needed for 2-stage back-purging with Type PFE2 filter unit and AO2000-Fidas24 VOC analyzer)
- Required air capacity approx. 100 m^3/h
- Instrument air following ISO 8573-1 Class 2 (particle size max. 1 µm, particle density max. 1 mg/m^3, oil content max. 0.1 mg/m^3, pressure dew point max. –20 °C)

CAUTION!

If the compressed air is not dry and clean, this will result in damage to the sample conditioning components (valves, filters, sample gas cooler, sample gas feed unit) as well as to the gas analyzer.

Power Supply Requirements

Operating Voltage

230 / 400 V AC, ±10 %, 50 / 60 Hz or
120 / 208 V AC, ±10 %, 50 / 60 Hz;
3~, L1, L2, L3, N, PE

Non-floating PEN conductor is forbidden.

Power Consumption

Basic version		1000 W
Cooling unit		+ 940 W
Analyzer module AO2000-Fidas24		+ 285 W
NO_2 / NO converter		+ 350 W
Probe tube type 40W, partially heated (24 V AC)		+ 120 W
Probe tube type 42, heated		+ 800 W
Filter unit type PFE2 or PFE3, heated		+ 250 W
Probe 2, partially heated		+ 255 W
Probe F, partially heated		+ 400 W
Back-purging unit		+ 150 W
Sample gas line type TBL01-S, TBL01-C, heated	regulated 180 °C	+ 90 W/m
	self-regulating 100 °C	+ 35 W/m
	self-regulating 30 °C	+ 15 W/m

Uninterruptible Power Supply

Prepared for Uninterruptible Power Supply (UPS), 400 W.

230 V AC or 120 V AC, ± 10 %, 48…62 Hz; L, N, PE.

Non-floating PEN conductor is forbidden.

Overvoltage category

II

Pollution degree

2

Service Socket

230 V AC or 120 V AC, 48 to 62 Hz, max. 5 A.

The service socket is located
- in the cabinet light or
- mounted on a top hat rail in the separate electrical distribution cabinet.

Continued on next page

Fuses

-F10	Power supply / leakage current indicator (option)	25 A / 30 mA
-F20	Power supply UPS / leakage current indicator (option)	25 A / 30 mA
-F01	Lighting, service socket, ventilation fan or cooling unit	6 A or 16 A
-F02	Heated probe tube, heated filter unit, back-purging unit, test gas connection valves	10 A or 16 A or 6 A
-F03	Heated sample gas line	16 A
-F04	NO_2 / NO converter	6 A
-F05	AO2000-Fidas24, air catalyst	6 A
-F06	Sample gas cooler, sample gas feed unit	6 A
-F07	AO2000 central unit, power supply	6 A
-F11	Temperature controller	T 2 A
-F12	Temperature controller	T 2 A
-F13	Temperature controller	T 2 A
-F14	Emergency purging AO2000-Fidas24	T 0.5 A
-F17	Test gas valve 1	T 0,5 A
-F18	Test gas valve 2	T 0,5 A
-F19	Test gas valve 3	T 0,5 A
-F22	Filter unit 2nd sampling point	10 A or 16 A
-F23	Heated sample gas line 2nd sampling point	16 A

Weight, Sound Level

Weight of the Individual System Components

Sheet steel cabinet		max. 430 kg
GRP cabinet		max. 370 kg
Mounting plate		max. 170 kg
Separate electrical distribution cabinet		max. 65 kg
Probe tube type 40, unheated	500 mm	1 kg
	1000 mm	2 kg
	1500 mm	3 kg
Probe tube type 40W, partially heated	3500 mm	13 kg
	4000 mm	15 kg
	4500 mm	17 kg
Probe tube type 42, heated	1000 mm	8 kg
	1500 mm	10 kg
	2000 mm	12 kg
Probe 2 with protective case	1200 mm	17 kg
Probe F	1200 mm	10 kg
Filter unit type PFE2, heated, with protective case		20 kg
Filter unit type PFE3, heated, with protective case		17 kg
Back-purging unit		70 kg
Sample gas line type TBL01-S or TBL01-C, heated		1 kg/m

Sound Level

Ventilation fan	50 Hz	59 dB(A)
	60 Hz	61 dB(A)
Cooling unit		< 64 dB(A)

Items Delivered

Standard Equipment

Quantity	Description
1	Analyzer cabinet or Mounting plate with separate electrical distribution cabinet
	System documentation (provided in a ring binder, see page 8)

Additional Items Delivered Per Order

Quantity	Description
1	Gas sampling probe tube Type 40 (unheated) or Type 40W (partially heated) or Type 42 (heated) or Gas sampling probe Type 2 optionally with separate protective case or Type F
1	Filter unit type PFE2 or PFE3 with ring heater or heating sleeve
1	Sample gas line type TBL01-S or TBL01-C (heated)
1	Back-purging unit 1-stage or 2-stage with compressed-air hoses
1	Hydrogen switch-over station with cylinder pressure reducers on mounting plate (for AO2000-Fidas24)
1	Reagent supply bottle
1	Condensate collection bottle
1	Wear parts set

'Hydrogen monitoring of the analyzer cabinet' option

Quantity	Description
1	Unipoint gas warning center
1	Contactor for disconnecting the power supply to the analyzer cabinet
1	Contactor for disconnecting the UPS if the system is prepared for a UPS.
1	Unipoint Multilingual Manual CD
1	Sensepoint Manuals CD

The gas sensor and the H_2 safety valve are securely installed in or on the analyzer cabinet.

Materials Needed for Installation (not supplied)

Gas Sampling

- Wall tube with mounting flange (DN 65, PN 6, Type A to DIN EN 1092-1, see Figure 1, page 17)

Gas Lines

• Sample gas (unheated line)	PTFE pipe 4 / 6x1 mm
• Sample gas outlet	PTFE pipe 4 / 6x1 mm
• Test gas N_2	PTFE pipe 4 / 6x1 mm
• Test gases 1, 2, 3	PTFE pipe 4 / 6x1 mm
• Instrument air	Stainless steel pipe, 8 mm O.D., or compressed-air hose (plus pressure gauge and shut-off valve)
• Fidas24 combustion air	PTFE pipe 4 / 6x1 mm
• Fidas24 combustion gas	Purified stainless steel pipe (SS316), 6 mm O.D.
• Fidas24 zero gas	PTFE pipe 4 / 6x1 mm
• Fidas24 span gas	PTFE pipe 4 / 6x1 mm
• Fidas24 exhaust gas	Stainless steel pipe, 12 mm O.D.
• Condensate collecting bottle	PVC tube 4 / 6x1 mm

Input Wiring

- Input wiring
  - 5 x 6 mm^2 (5 x AWG 8)
  - If applicable, uninterruptible power supply wiring 3 x 2.5 mm^2 (3 x AWG 14)
- Cables to connect the heated gas sampling probe, filter and sample gas line to the analyzer cabinet (if applicable, in a heat-resistant version; note the power requirements of these components, page 22)
- Grounding cable with cross section ≥10 mm^2 (≥ AWG 8)

Signal Leads

- Shielded cable for analog outputs (current outputs)
- Cable for digital outputs
- Cable for data lines (Modbus, Profibus, Ethernet)
- Cable for the Pt100 resistance thermometers of the heated components

When selecting conductor materials, follow all applicable national safety regulations for the installation and operation of electrical devices.

Mounting

- Screws and nuts to secure the analyzer cabinet to the floor
  or
- Screws and nuts (stud bolts if applicable) to secure the mounting plate and the electrical distribution cabinet to the wall

For details regarding the size of the screws and nuts see the “Layout Plan” in the drawings set.

Type 40 Probe Tube and Filter Unit Installation

CAUTION!

The weight of the probe tube with filter unit amounts to approx. 18–20 kg! Two persons are needed for transportation and mounting!

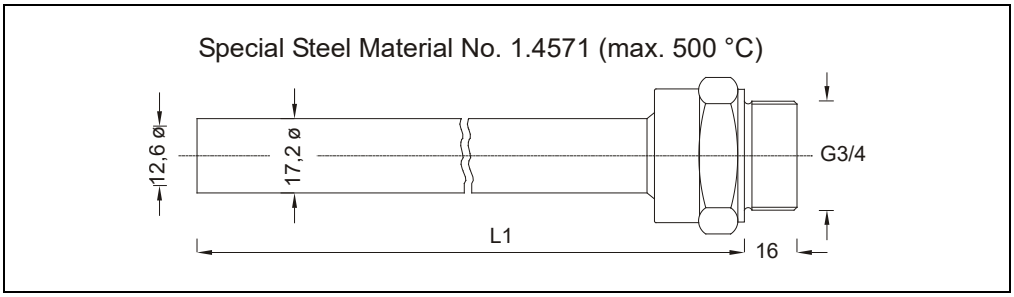
Before the Installation

- Observe the “Piping Plan” in the drawings set.
- Make sure that the wall tube is installed at the extraction point (see page 17).

Figure 1

Type 40 Probe Tube

L1=500/1000/1500 mm (Dimensions in mm)



Type 40 Probe Tube and Filter Unit Installation

Step	Action
1	Screw the probe tube into the internal thread of the filter unit.
2	Insert the pre-assembled probe tube with filter unit in the wall tube and screw the flange of the filter unit to the flange of the wall tube. Use the green seal from the accessories pack to seal the space between the flanges of wall tube and filter unit.
3	Mount the heating sleeve or the ring heater on the filter unit.
4	If applicable, install the compressed-air hoses between the filter unit and the back-purging unit (see page 41).

Type 42 Probe Tube and Filter Unit Installation

CAUTION!

The weight of the probe tube with filter unit amounts to approx. 28–32 kg! Two persons are needed for transportation and mounting!

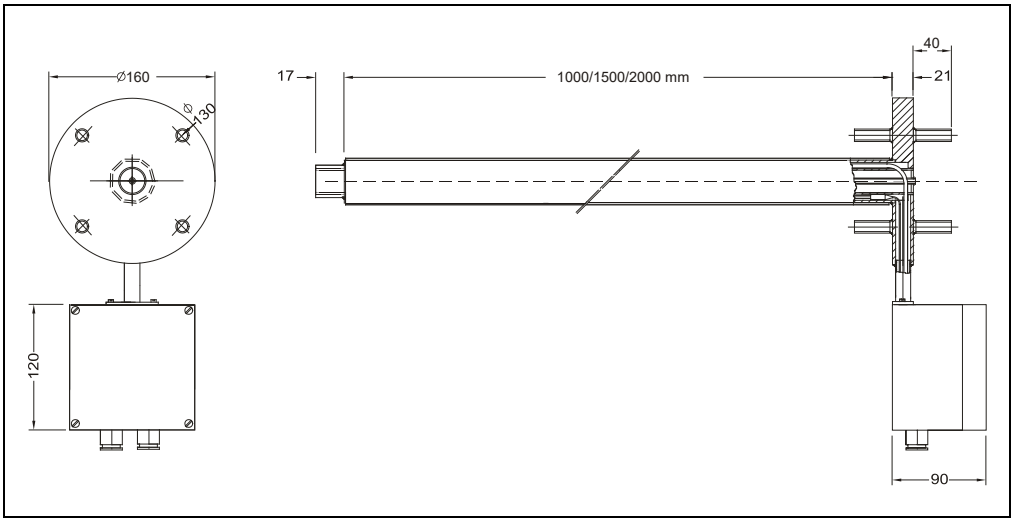
Before the Installation

- Observe the “Piping Plan” in the drawings set.
- Make sure that the wall tube is installed at the extraction point (see page 17).

Figure 2

Type 42 Probe Tube

(Dimensions in mm)



Type 42 Probe Tube and Filter Unit Installation

Step	Action
1	Insert the probe tube in the wall tube and screw the probe tube flange to the wall tube flange. Use the green seal from the accessories pack to seal the space between the flanges.
2	Screw the filter unit to the flange of the probe tube. Use the green seal from the accessories pack to seal the space between the flanges of probe tube and filter unit.
3	Mount the heating sleeve on the filter unit.
4	If applicable, install the compressed-air hoses between the filter unit and the back-purging unit (see page 41).

Type 40W Probe Tube and Filter Unit Installation

CAUTION!

The weight of the probe tube with filter unit amounts to approx. 50 kg!
Two persons are needed for transportation and mounting!

Before the Installation

Observe the “Piping Plan” in the drawings set.

Vertical Installation

The type 40W probe tube must be installed in the smoke chamber almost in vertical orientation (see Figure 3, page 30).

Protection Pipe for Type 40W Probe Tube

The probe tube must be installed in a protection pipe with the following characteristics:

Material:	Mild steel
Length:	3.0 m (for protection of the heated part of the probe tube)
Inner diameter:	50 mm or 100 mm for probe tube without or with prefilter
Flange:	for connection to the flange of probe tube, location min. 300 mm above the roof of the smoke chamber or its platform

Due to the probe tube’s length (normally 3.5 m, 4.0 m or 4.5 m), it can be necessary to make a hole in the roof above the smoke chamber in order to install the probe tube as well as the protection pipe.

Installation of the protection pipe is preferably carried out during a shut down of the kiln. The opening should be closed with a blind flange until the installation of the probe tube takes place.

Type 40W Probe Tube and Filter Unit Installation

Step	Action
1	Remove the blind flange from the protection pipe and lay on a flange seal on the protection pipe flange.
2	Insert the probe tube from above in the protection pipe. Do not damage the electrical connection (porcelain terminals) of the probe tube heating at the probe tube flange!
3	Lay on the supplied flange seal on the probe tube flange and mount the filter unit.
4	Interconnect the 3 flanges with bolts and nuts.
5	Mount the heating sleeve on the filter unit.
6	Connect the cable of the heating sleeve to the terminals in the terminal box of the filter unit.
7	Connect the cable of the probe tube heating (2 x 2.5 mm^2) to the 26 VDC connection of the transformer in the back-purging unit.

Continued on next page

Figure 3

Type 40W Probe Tube Installation in the Smoke Chamber

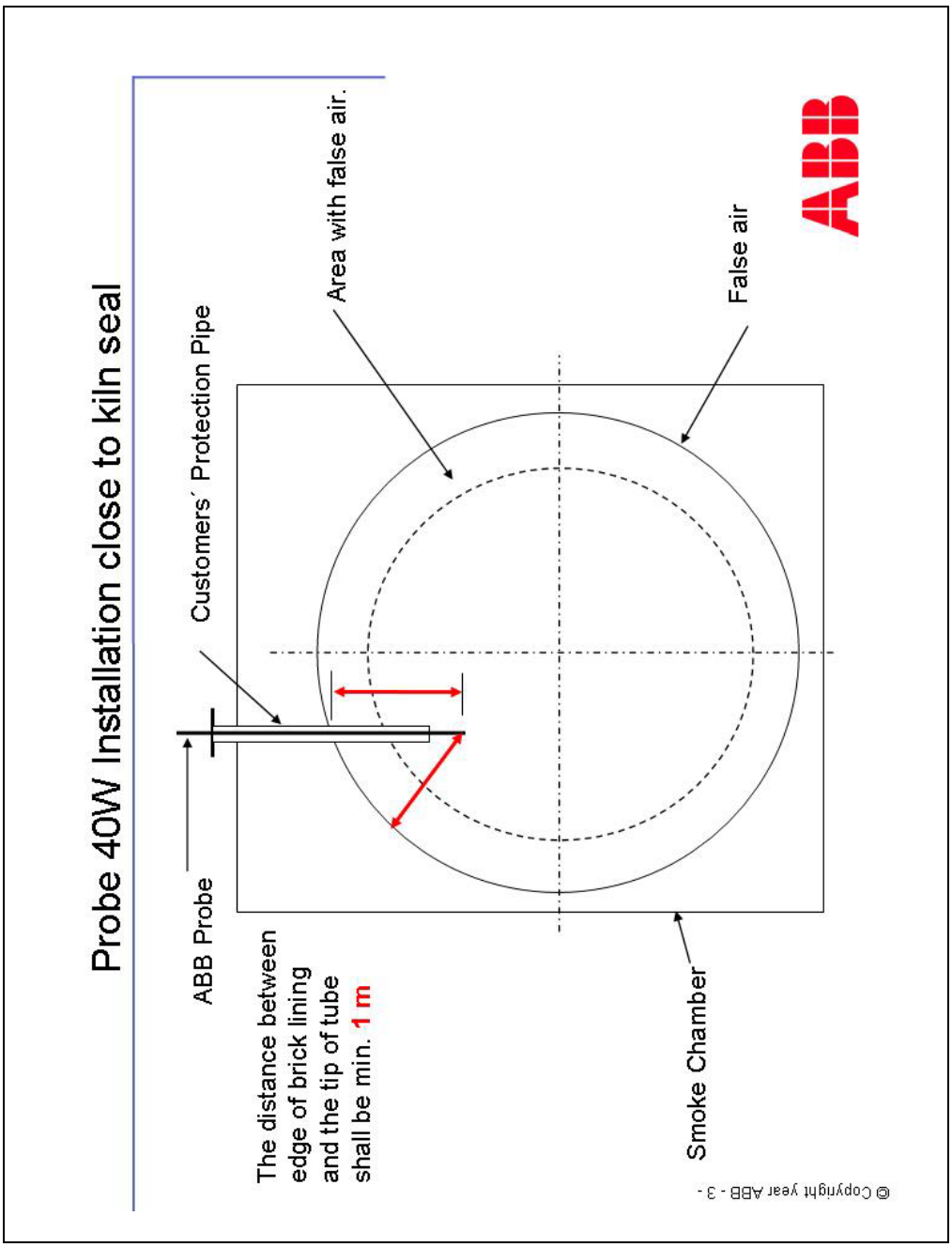
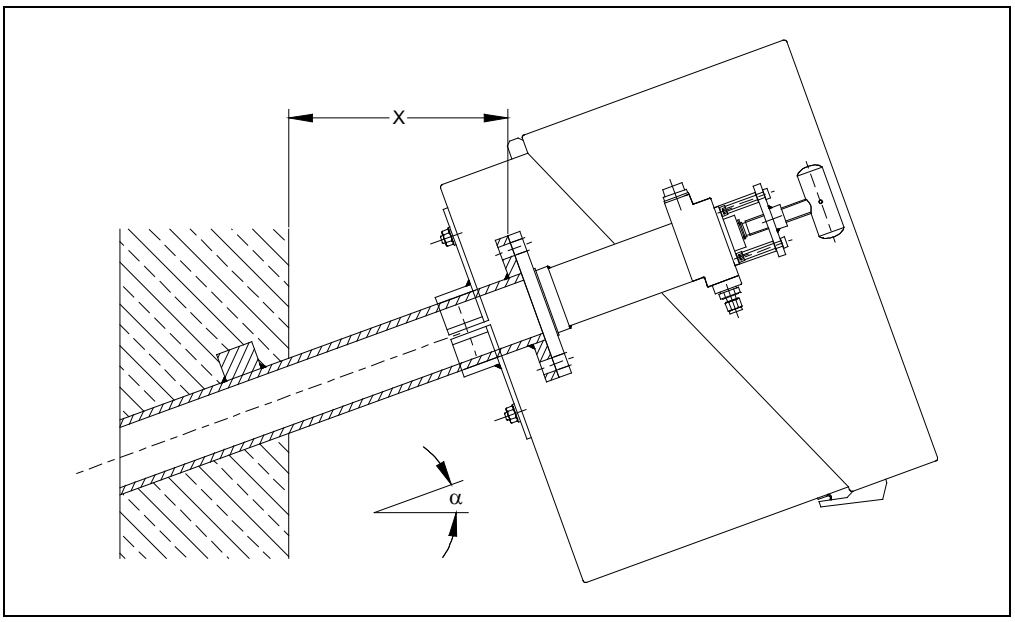


Figure 4

PFE2 Filter Unit: Mounting of Probe Protective Case



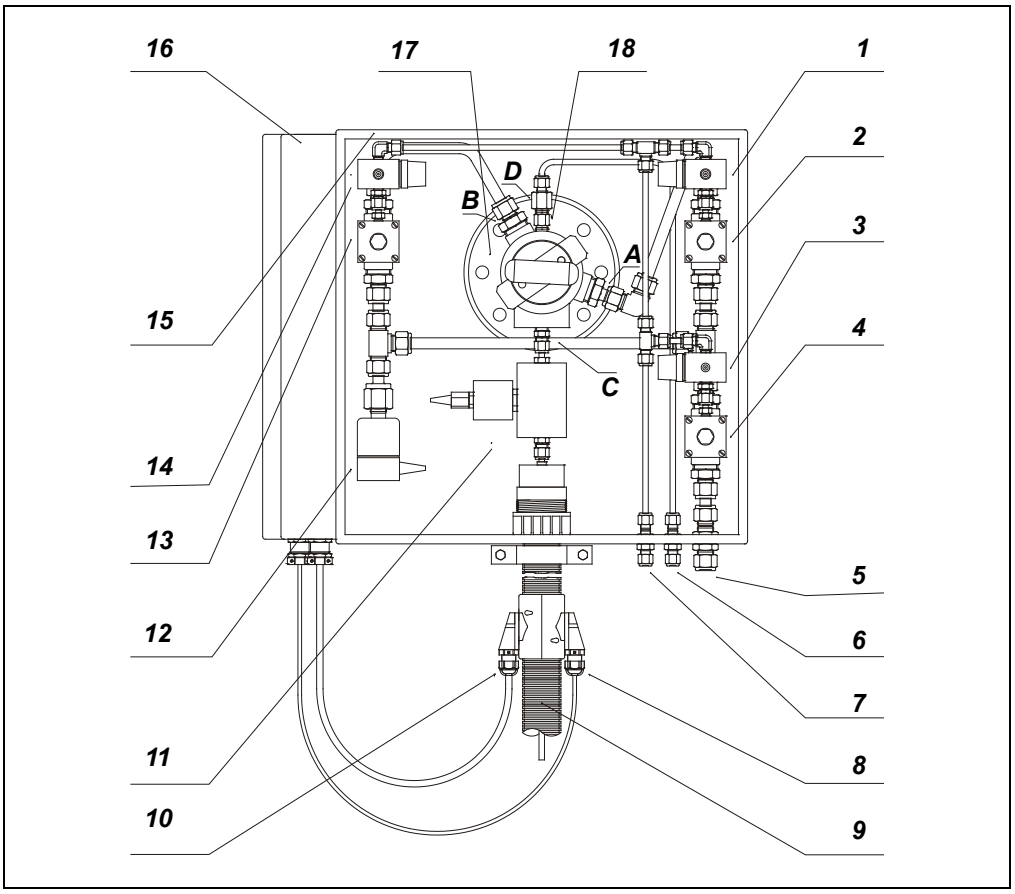
Minimum distance x_{min} of the mounting flange (wall tube flange) from the wall depending on mounting angle α:

α	10°	15°	20°	25°	30°	35°
x_{min} / mm	229	248	268	287	307	324

PFE2 Filter Unit: Gas Connection

Figure 5

PFE2 Filter Unit: Gas Connections (with Back-Purging)

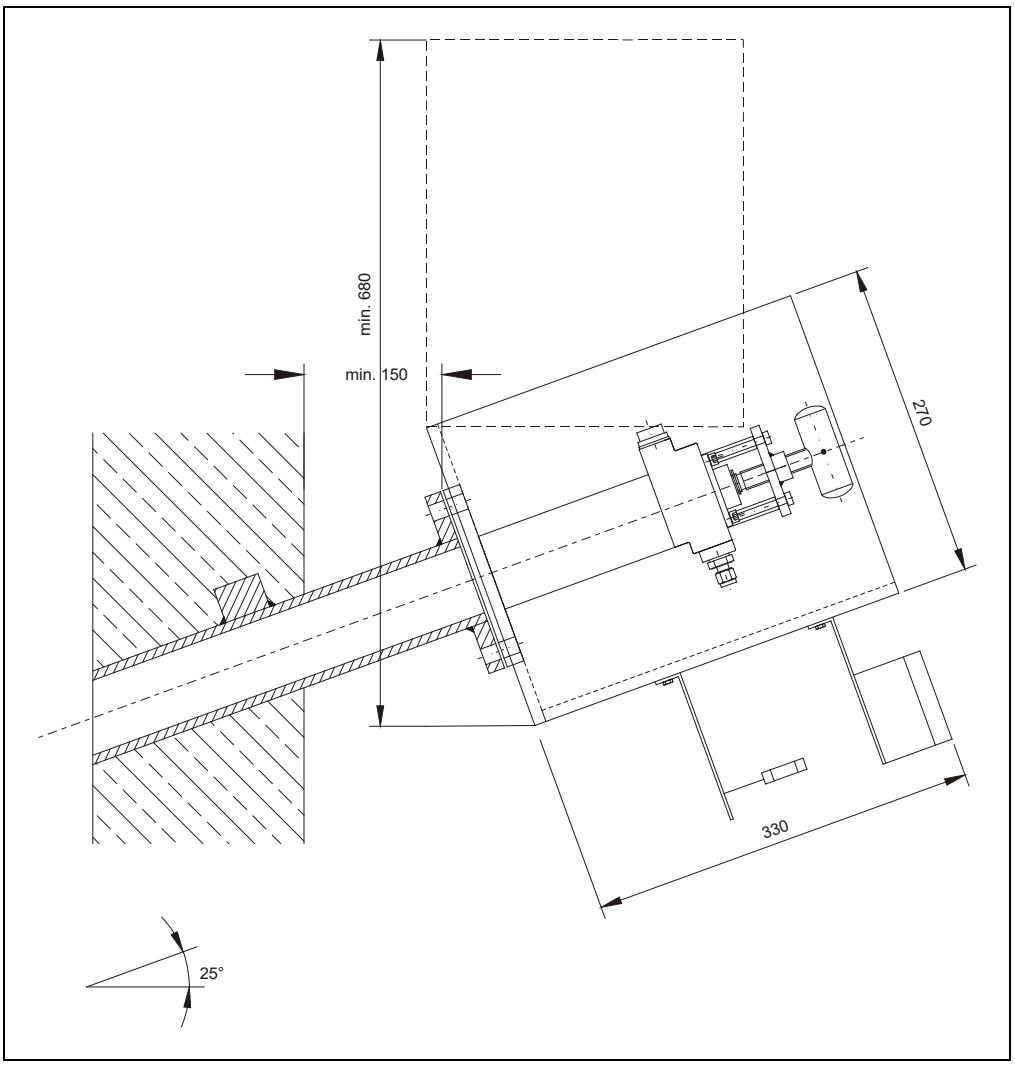


1 Pilot Operation Valve Cleaning Filter -Y2.1
2 Diaphragm Valve Cleaning Filter -Y2.2
3 Pilot Operation Valve Pulsed Instrument Air -Y1.1
4 Diaphragm Valve Pulsed Instrument Air -Y1.2
5 Instrument Air Inlet Bulk Head Union 12 mm
6 Test Gas Inlet Bulk Head Union 6 mm
7 Control Air Inlet Bulk Head Union 6 mm
8 Pt100 Connection
9 Heated Sample Gas Line -E13
10 Power Supply
11 Heated Check Valve -Y5
12 Solenoid Valve Aeration -Y4
13 Diaphragm Valve Cleaning Filter Surface and Probe Tube -Y3.2
14 Pilot Operation Valve Cleaning Filter Surface and Probe Tube -Y3.1
15 Protection Box
16 Terminal Box
17 Filter Unit
18 Check Valve
A Back Purging Filter Inlet G 1/2″
B Back Purging Filter Surface / Probe Tube Inlet G 1/2″
C Sample Gas Outlet G 1/4″
D Test Gas Inlet G 1/4″

Figure 6

PFE3 Filter Unit: Mounting of Probe Protective Case

(Dimensions in mm)



Minimum distance x_{min} of the mounting flange (wall tube flange) from the wall depending on mounting angle α:

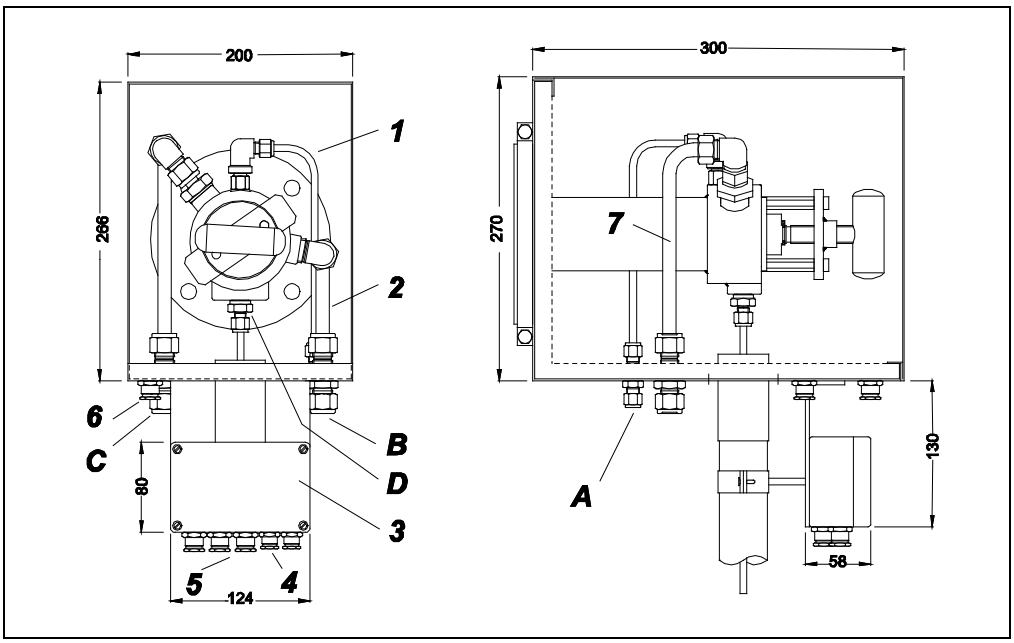
α	10°	15°	20°	25°	30°	35°
x_{min} / mm	229	248	268	287	307	324

PFE3 Filter Unit: Gas Connection

Figure 7

PFE3 Filter Unit: Gas Connections (with Back-Purging)

(Dimensions in mm)



1 Tube Test Gas, VA 1.4571, 6x1 mm
2 Tube Compressed Air, CU, 15x1 mm
3 Terminal Box -X1 IP66
4 2 x M12x1.5 Cable Connectors
5 3 x M20x1.5 Cable Connectors
6 2 x M20x1.5 Cable Connectors
7 Tube Compressed Air, CU, 15x1 mm
A Test Gas Connection with Check Valve, Bulkhead Fitting 6 mm
B Back-purging of Filter (max. 6 bar), Bulkhead Fitting 18 mm
C Back-purging of Filter Surface / Probe Tube (max. 6 bar), Bulkhead Fitting 18 mm
D Sample gas connection, male fitting 6 mm

Probe 2 Installation

Probe 2 Delivery Form

Probe 2 is supplied in various partially pre-assembled component parts:

- Gas sampling probe with flange and internal heating rod
- Ceramic inlet filter (inner filter)
- Installation set for mounting the ceramic inlet filter (4 bolts M12 x 70 with nuts, spring washers and washers)
- Harting connector, degree of protection IP55
- Protective box (option), degree of protection IP54

CAUTION!

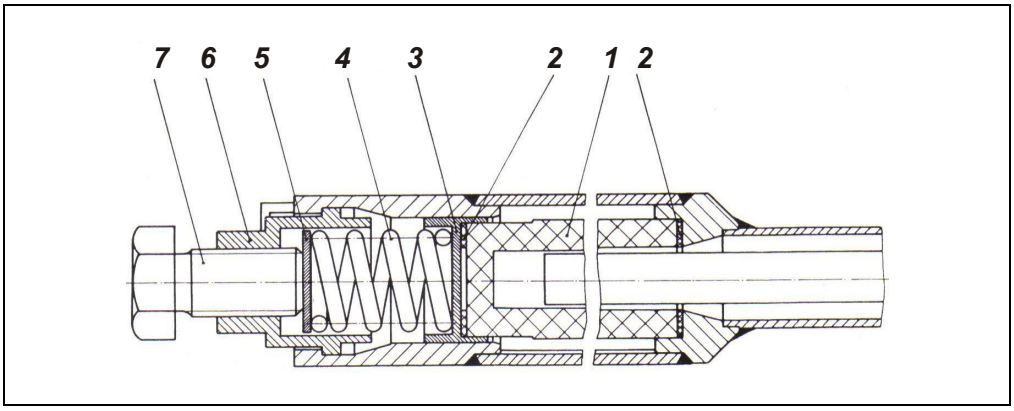
Danger of breakage! The ceramic inlet filter of probe 2 is fragile.

Assembly of the Ceramic Inlet Filter

First of all, assemble the ceramic inlet filter as shown in Figure 8. Please note that the compression spring ***4*** has to be compressed by approx. 15 mm.

Figure 8

Probe 2: Ceramic Inlet Filter



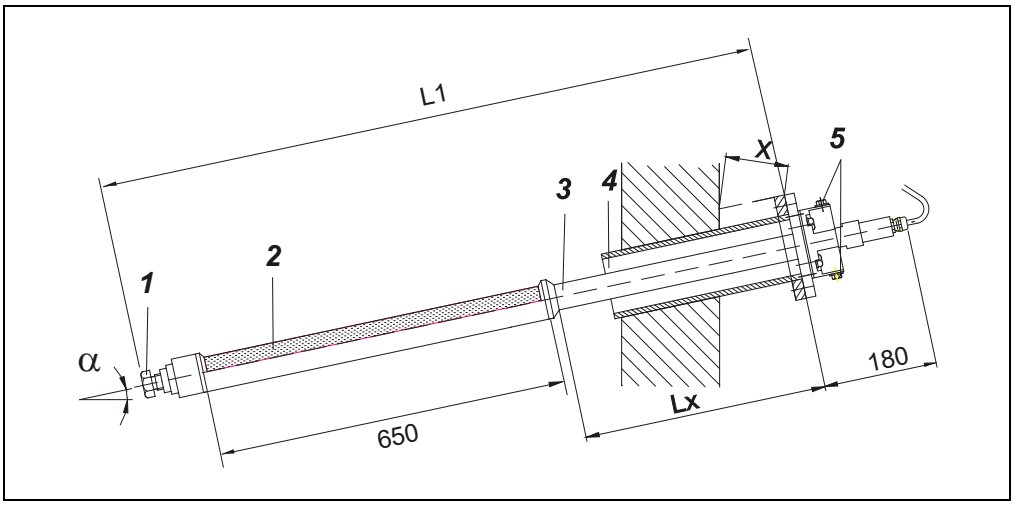
1 Filter Element
2 Sealing Gasket
3 Bush
4 Compression Spring
5 Pressure Disk
6 Bush
7 Screw

Continued on next page

Figure 9

Probe 2 Installation

(Dimensions in mm)



1 Mounting for the Ceramic Inlet Filter
2 Inlet Filter (Inner Filter) with Internal Heating Rod
3 Gas Sampling Tube
4 Wall Tube with Inlet Flange
5 Sample Gas Outlet and Test Gas / Purge Air Inlet G 1/4
L1 Fitting Length
Lx Length of the Gas Sampling Tube (approx. 400 mm)

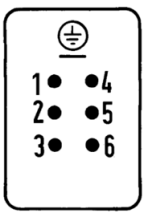
Minimum distance x_{min} of the mounting flange (wall tube flange) from the wall depending on mounting angle α:

α	10°	15°	20°	25°	30°	35°
x_{min} / mm	133	138	143	147	151	153

Probe 2 Installation

Step	Action
1	Align the probe so that the protection shield is directed towards the process gas flow.
2	Insert the probe in the wall tube and screw it to the wall tube flange with the enclosed screws M12 x 70.
3	Connect the sample gas line to one of the two gas ports ***5*** by means of a clamp ring screw fitting.
4	If 1-stage probe back-purging is available, connect the compressed-air hose to the other of the two gas ports ***5***. Please note the maximum permissible air pressure of 6 bar.

Probe 2 Electrical Connection

Step	Action		
1	Connect the cables of the current lead to the connector as shown in the connector pin assignment.		⏚ PE 1 N 2 L1 3–6 not assigned
2	Connect the connector to the power supply.		

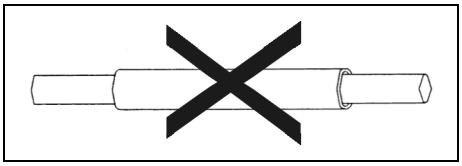
Sample Gas Line Installation

Installing the Sample Gas Line

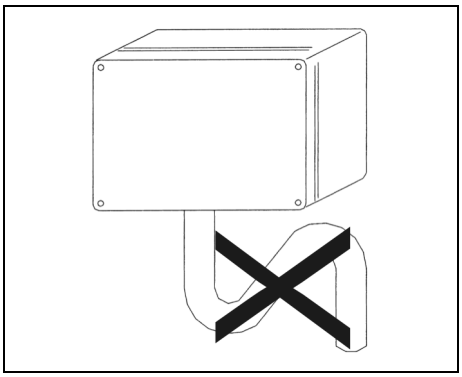
- Observe the “Piping Plan” in the drawings set.
- Connect the sample gas line to the filter unit / gas sampling probe.
- Route the sample gas line through the opening provided in the right wall of the cabinet.

When a VOC analyzer is installed in the analyzer system no fat or grease should be used when installing the sample gas line (see page 53). Otherwise the measurement values would drift for a prolonged period of time.

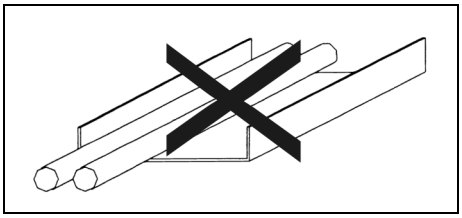
Fundamentals for Laying the Sample Gas Line



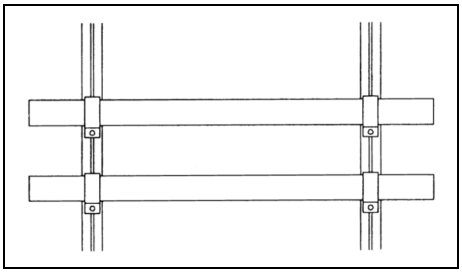
Do not lay the heated sample gas line in a thermowell.



When laying the sample gas line, avoid the formation of water locks, particularly at the sampling points.



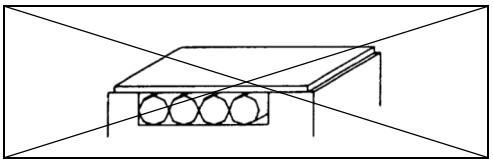
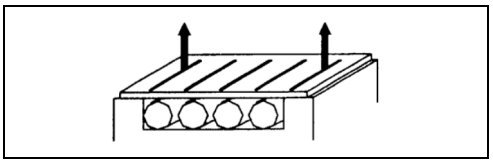
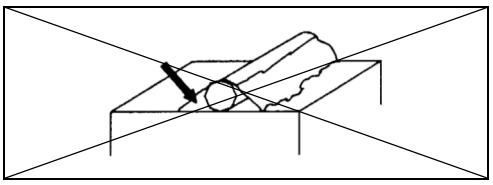
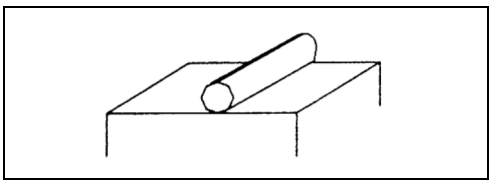
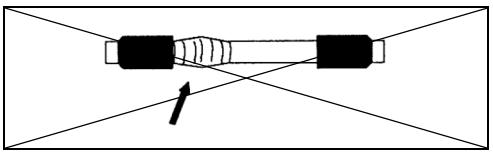
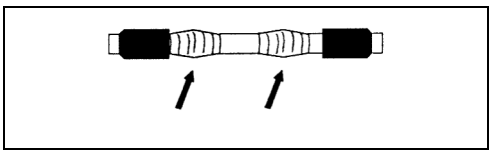
Do not lay the heated sample gas line in a cable tray together with other electrical or pneumatic lines, especially not in an enclosed cable tray.



When laying the heated sample gas lines on exposed C-profiles with BBS cable clips:
Do not overtighten the cable clips, in order to prevent damage to the sample gas line through crushing.

Continued on next page

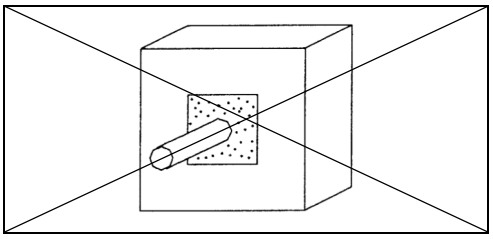
Procedures for Laying the Sample Gas Line

Incorrect	Correct
	
Do not lay the heated sample gas lines directly side-by-side in an enclosed duct or shaft. This results in heat accumulation.	Ensure that the hoses do not touch. Maintain a distance of 25 mm. Provide adequate ventilation. Heat can be conducted away as a result.
	
Prevent powdery substances, adhesives or other thermally insulating materials from soiling the heated sample gas line. Otherwise, overheating will occur at these points.	If soiling occurs, clean the materials and remedy the cause. Heat can be conducted away again as a result.
	
Avoid heat accumulation through wrapping the heated sample gas line with other materials, otherwise the sample gas line will overheat at these points. Do not cover the area near the temperature sensor, otherwise the rest of the sample gas line will cool down.	Do not wrap the sample gas line. Ensure that the area near the temperature sensor is exposed. This results in error-free temperature measurement.

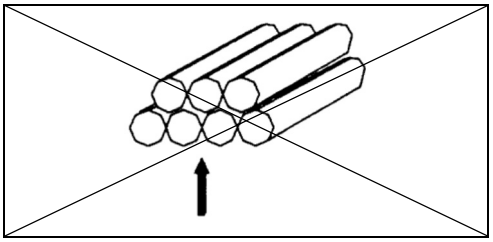
Continued on next page

Procedures for Laying the Sample Gas Line (continued)

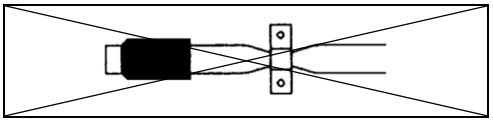
Incorrect



Do not lay the heated sample gas line in wall break-throughs which are subsequently sealed with a sealing compound under any circumstances. The sample gas line will be destroyed by overheating in this case!

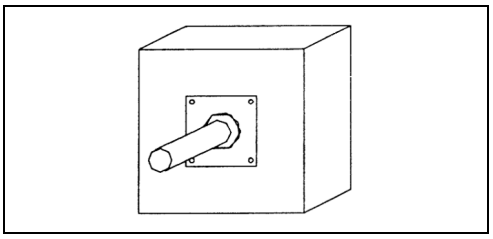


Avoid bundling or laying several heated sample gas lines, so that they touch each other. This results in overheating at the contact points.

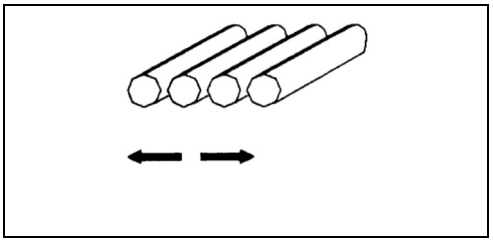


Do not squeeze the heat insulation in mounting brackets tightly together, so that the outer braiding is pressed on to the heat conductor. If you disregard this, damage to the protective braiding and the heated sample gas line may occur.

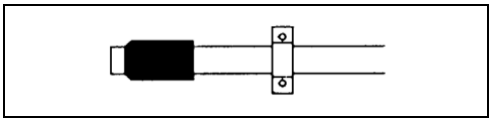
Correct



When laying the heated sample gas line through a wall break-through, use bulkhead plates with conduit thread cable glands, in order to provide adequate cooling of the sample gas line.



Lay several heated sample gas lines separately with a distance of at least 2.5 cm and provide adequate ventilation. Heat can be conducted away as a result.



Tighten the BBS cable clips sufficiently but not excessively, in order to prevent damage to the protective braiding and the heated sample gas line.

Continued on next page

Permissible Values for Laying the Sample Gas Line

Characteristic	Permissible value
Maximum line length	see table below
	65 m for version with anti-frost heater
Minimum bending radius	300 mm
Maximum clip distance	1.2 m with horizontal laying
	3.5 m with vertical laying
Lowest laying temperature	–10 °C
Temperature of the sheathing	max. 60 °C

Application	Ambient Temperature	Sample Components	Type of Sample Gas Line	Length of Sample Gas Line
Emission Monitoring			heated, Type TBL01-S, regulated heating, 200 °C, heating power approx. 90 W/m	230 / 400 V AC [1]: 3-phase max. 60 m 1-phase max. 35 m
				120 / 208 V AC [1]: 3-phase max. 40 m 1-phase max. 15 m
Kiln or Calciner Outlet, Calciner	> 0 °C	w/o SO_2, NO	unheated (PTFE)	max. 20 m (recommended)
		with SO_2, NO	heated, Type TBL01-C, self-regulating, 100 °C	
	< 0 °C			
Wet Kiln Gas Outlet	> 0 °C	w/o SO_2, NO	unheated (PTFE)	max. 10 m (recommended)
		with SO_2, NO	heated, Type TBL01-C, self-regulating, 120 °C	
	< 0 °C			
Preheater / CO Monitoring of ESP	> 0 °C	w/o SO_2, NO	unheated (PTFE)	max. 10 m (must not be exceeded!)
		with SO_2, NO	heated, Type TBL01-C, self-regulating, 120 °C	
	< 0 °C			
Coal Bunker, Coal Mill	> 0 °C		unheated (PTFE)	max. 20 m (recommended)
	< 0 °C		heated, Type TBL01-C, self-regulating, 100 °C	
Process Measurement			heated, Type TBL01-S, regulated heating, 200 °C, heating power approx. 90 W/m	230 / 400 V AC [1]: 3-phase max. 60 m 1-phase max. 35 m
				120 / 208 V AC [1]: 3-phase max. 40 m 1-phase max. 15 m
			heated, Type TBL01-S, self-regulating heating, 100 °C, heating power approx. 30 W/m	max. 60 m
			unheated (PTFE)	max. 25 m

1) with “measuring point switch-over” option (2 measuring points):
230 / 400 V AC, only 1-phase allowed, length max. 35 m per measuring point
120 / 208 V AC, only 1-phase allowed, length max. 15 m per measuring point

Back-Purging Unit Installation

Before the Installation

Observe the “Piping Plan” in the drawings set.

Installation Site

The distance between the back-purging unit and the sampling probe must not exceed 5 m (length of the steel-braided compressed-air hoses = 6 m).

Connecting the Compressed-air Hoses to PFE2 Filter Unit

Connect the compressed-air hoses for purge air and control air to the respective ports at the PFE2 filter unit (see Figure 5, page 32).

Connecting the Compressed-air Hoses to PFE3 Filter Unit

Connect the compressed-air hoses for purge air (filter and filter / probe tube) to the respective ports at the PFE3 filter unit (see Figure 7, page 34).

Connecting the Compressed-air Hose to Probe 2

Connect the compressed-air hose for purge air to one of the two gas ports at Probe 2 (see Figure 9, page 36).

Gas Sampling with Automatic Back-Purging

In General

Filter Plugging

During operation of the AO2000 system the dust which is contained in the sample gas will accumulate in the probe filter of the gas sampling system. This is uncritical if dust concentration is low and only requires a cleaning of the filter periodically in longer time intervals.

But if the dust concentration is high, the dust accumulation in the filter will cause an increasing pressure loss, and the gas feed of the sample gas pump decreases and also the sample gas flow, and finally the filter is blocked in an extreme case.

Pump Suction Increase

At first this effect can be compensated by occasional adjustment of the sample gas flow, which increases the suction of the sample gas pump.

The pump is strong enough, but if the fouling continues, the needed suction for keeping up the required gas flow will increase to such a high value, that several unfavorable effects will emerge and can finally be accepted no longer.

Filter Cleaning

If the suction exceeds a limit of about 300 mbar (accordingly the absolute pressure falls below 700 mbar), the sampling system filter has to be cleaned. The PFE2 and PFE3 filter units can be cleaned automatically by a back-purging procedure with compressed air. To control this procedure a function block program is used.

Components for Automatic Back-Purging Procedure

Components for Automatic Back-Purging Procedure

To carry out the automatic back-purging of the filter unit, components are integrated in the AO2000 System as follows:

- the PFE2 filter unit with valves combination for back-purging or
- the PFE3 filter unit and separate back-purging unit with integrated compressed-air conditioning components and
- the control program.

Control of the Automatic Back-Purging Procedure

The back-purging procedure is integrated into the main control program of the AO2000 System. The manual handling is carried out with softkeys on the system's display and control unit.

Start of the Back-Purging Procedure

Start of the Back-Purging Procedure

The start of the back-purging procedure can be carried out

- Controlled by time
- Controlled by event
- Manually controlled.

Start Controlled by Time

After a cycle time has run down, the back-purging procedure will start automatically. The cycle time can be adjusted individually (see section “Adjustment of Cycle Time and Post-Purge Time”, page 48). A cycle time of 4 hours is factory-set.

Start Controlled by Event

A flow fault during normal measuring operation will start the automatic back-purging procedure. After back-purging was started by event, the procedure will run only once. If the procedure is finished (waiting time 30 sec) and the starting event (flow fault) is still active, the back-purging procedure will not start again, even not controlled by time, and a status message “Probe or line is plugged” will be generated. However, the back-purging procedure can be started manually.

Manually Controlled Start

The manual start of back-purging procedure can be executed locally by softkey “Start Purge” on the system’s display and control unit (see section “Control Panel Screen”, page 66) or remote-controlled via Modbus-DI or Profibus-DI.

PFE2		Digital output:	-D08 DO2	-D08 DO3	-D08 DO1	-D08 DO4	-D08 DO5	-E05 MV1	Display	Status signal
		Valve:	-Y1.1	-Y2.1	-Y3.1	-Y4	-Y5 [6]	-Y01	Message	
Step	Duration	Function	Impulse Compr. Air	Filter Back-purging	Tube Back-purging	Venting	Sample Gas Valve	Position Calibr. Valve [5]	"Purge back active"	Maint. Mode
0	4 hrs [1]	Measure	closed	closed	closed	open	open	Measure	off	off
1	10 sec [8]	Back-purging probe filter	Impulse	open	closed	closed	closed	Calibrate	on	on
2	14 sec [9]	Back-purging probe tube	Impulse	closed	open	closed	closed	Calibrate	on	on
3	6 sec	Venting	closed	open	closed	open	closed	Calibrate	on	on
4	150 sec [2]	Post-purging	closed	closed	closed	open	open	Measure	on	on
0	4 hrs [1]	Measure	closed	closed	closed	open	open	Measure	off	off

PFE3, Probe 2, Probe F, Probe Tube 40W		Digital output:		-A01 DO1	-A01 DO2	-A01 DO3		-E05 MV1	Display	Status signal
		Valve:		-Y12 [7]	-Y11	-Y07		-Y01	Message	
Step	Duration	Function		Filter Back-purging	Tube Back-purging	Venting		Position Calibr. Valve [5]	"Purge back active"	Maint. Mode
0	4 hrs [1]	Measure		closed	closed	closed		Measure	off	off
1	2 sec	Switch over		closed	closed	closed		Calibrate	on	on
2	4 sec [3]	Back-purging probe filter		open	closed	closed		Calibrate	on	on
3	8 sec [4]	Back-purging probe tube		closed	open	closed		Calibrate	on	on
4	6 sec	Venting		closed	closed	open		Calibrate	on	on
5	150 sec [2]	Post-purging		closed	closed	closed		Measure	on	on
0	4 hrs [1]	Measure		closed	closed	closed		Measure	off	off

1) Cycle time factory-set to 4 hours
2) Post-purging time factory-set to 150 sec. For an analyzer system with Probe F, this period must be as short as possible (to be determined during start-up)
3) 1x pressure impulse 2 sec, 1x interrupt 2 sec
4) 1x pressure impulse 2 sec, 1x interrupt 2 sec, 1x pressure impulse 4 sec
5) Calibration valve on = "Measure", calibration valve off = "Calibrate"
6) Only in version with VOC analyzer AO2000-Fidas24: open = sample gas path open, closed = relaxation against atmosphere
7) not in a system with Probe 2, Probe F
8) 3x interrupt 2 sec, 2x pressure impulse 2 sec
9) 3x interrupt 2 sec, 2x pressure impulse 2 sec, 1x pressure impulse 4 sec

Continued on next page

Switch Over

At first the calibration valve -Y01 [1)] is switched over to position “Calibrate”. This separates the sample gas conditioning system and the analyzer system from the sampling system and protects it against the back-purging pressure. At the same time the status “Maintenance mode” is activated and all analog outputs and limits are set on hold. The display reports “Purge Back is active”.

Back-Purging Probe Filter

The back-purging procedure continues with the back-purging of the probe filter. To increase the cleaning effect, the compressed air is applied not continuously but by two 2 sec pressure impulses alternating with a 2 sec interval each.

Back-Purging Probe Tube

After this the probe tube is purged back in the same way with two pressure impulses. A single pressure impulse of 4 sec is followed, to blow out the remaining dust from the tube.

Venting and Switch Over

Next the pneumatic system is vented for 6 sec and finally the calibration valve -Y01 [1)] is switched back from position “Calibrate” to position “Measure”. This venting time removes an internal remaining pressure which might be still present in the pneumatic system and so avoids a damage of the analyzer’s measuring cell.

Post-Purging Period

The calibration valve switch back to position “Measure” will not finish the back-purging procedure, because first the actual sample gas must flow through the pneumatic system to purge it, and the analyzer must adjust to the new actual measuring value. This post-purge time must be adjusted individually according to the given conditions (see section “Adjustment of Cycle Time and Post-Purge Time”, page 48). A purge time of 150 sec is factory-set.

End of the Back-Purging Procedure

The back-purging procedure is not finished until the purge time has expired. Now the analog outputs and limits are set free again and they will take over the actual values. The message “Purge back active” in the display as well as the status signal “Maintenance Mode” will vanish.

1) In system version with VOC analyzer AO2000-Fidas24, the sample gas path is blocked and unblocked with the valve -Y5 which is built-in in the PFE2 filter unit.

Cycle Time

Cycle Time Duration

The cycle time is given as the time interval between two automatic starts of the back-purging procedure. The higher the dust concentration in the sample gas and the higher the sample gas flow, the shorter this time interval must be set, to avoid a blocking of the gas sampling probe filter.

Cycle Time Factory Setting

The parameter “Cycle time” is factory-set to 4 hours.

The parameter “Next event time” is factory-set to 08:00 / 12:00 / 16:00 / 20:00 / 00:00 / 04:00 o’clock.

Optimum Cycle Time Setting

The cycle time should not be adjusted shorter than needed, because during the back-purging procedure (approx. ca. 28 sec) and especially during the post-purge time (factory-set to 150 sec) no measurement can be made. The optimum time will have to be found out by operational experience.

Cycle Time Minimum Value

The cycle time should not be below a lower limit. The back-purging procedure with cold compressed air causes a cooling of the heated probe filter, and the filter temperature regulation needs some time to correct this temperature decrease. As the filter heating regulation is a rather slow control loop, this time will be relatively long. Therefore the cycle time should not fall below approx. 60 min.

Event-controlled Start of the Back-purging Procedure by Filter Plugging

Should despite the time controlled back-purging a probe filter blocking occur caused by temporary larger amounts of dust, with the result of a sample gas flow decrease beneath the admissible limit, an additional back-purging procedure is started as a result, and the probe filter is purged free in between.

Post-Purge Time

Post-Purge Time Duration

The post-purge time at the end of the back-purging procedure must be such, that the complete pneumatic system is flushed with the actual sample gas and the analyzer gets time to take over the actual measuring value again. The needed post-purge time depends on the respective layout of the system (i.e. the length of the sample gas line) and will have to be adjusted individually. A post-purge time of 150 sec is factory-set.

Guide for the Post-Purge Time

A guide for the needed post-purge time is given in the table below. Please add the times for the pneumatic system, the analyzer and the sample gas line.

	Response time (3 x T_{90}, approx.) for sample gas flow		
	60 l/h	100 l/h	200 l/h (Bypass)
Pneumatic system without sample gas line	45 sec	27 sec	20 sec
plus analyzer Uras26	23 sec	20 sec	23 sec
plus for each 10 m sample gas line I.D. = 4 mm	8 sec	5 sec	2.5 sec
plus PFE2 / PFE3 with probe tube 40, length = 1 m	75 sec	45 sec	23 sec

Example

For an AO2000 System with filter unit PFE2 / PFE3 and 15 m sample gas line at 60 l/h sample gas flow the post-purge time is calculated as follows:

Post-purge time = 45 sec + 23 sec + 1.5x 8 sec + 75 sec = 155 sec

Adjustment of Cycle Time and Post-Purge Time

Adjustment of Cycle Time and Post-Purge Time

To adjust the cycle time or post-purge time you must change the parameters of function blocks.

WARNING!

Only changes as described below may executed! Changes of function block parameters inappropriately executed may affect the complete function of the function blocks program!

Procedure

Step	Action
1	Push Softkey **MENU**. The window MAIN MENU is shown.
2	Select menu **Configure**. The window CONFIG: is displayed.
3	Select menu **Functions blocks**. The window CONFIG: FUNCTION BLOCK is displayed.
4	Select menu **Miscellaneous** and after this menu **Timer**. The window CONFIG.: TIMER is displayed.
	To adjust the cycle time:
5	Select timer **Zycl.**. The window CONFIG: TIMER CYCL. is shown with the parameters of this function block.
6	Select the parameter **Low time**. The window PASSWORD ENTRY is shown, if the password is not already active.
7	Enter the password, using the numeric keys. The factory-set password is 325465. The window CONFIG: TIMER CYCL. with indication of the parameter Cycle time is shown.
8	Change the shown value (factory-set = 4 hrs) to the new value required.
9	Return to normal measuring operation using the key **MEAS**.
	To adjust the post-purge time:
5	Select timer **DELAY**. The window CONFIG: TIMER DELAY is shown with the parameters of this function block.
6	Select the parameter **Low time**. The window PASSWORD ENTRY is shown, if the password is not already active.
7	Enter the password, using the numeric keys. The factory-set password is 325465. The window CONFIG: TIMER DELAY with indication of the parameter Low time is shown.
8	Change the shown value (factory-set = 150 sec) to the new value required.
9	Return to normal measuring operation using the key **MEAS**.

Installing the Analyzer Cabinet

Installing the Foundation

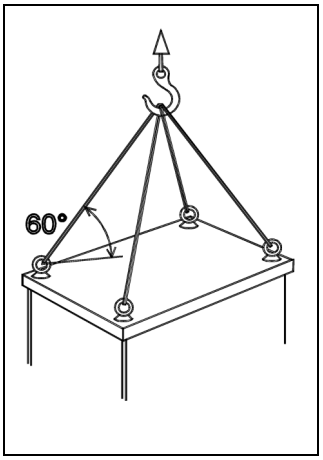
- Observe the installation site requirements, see page 14
- Observe the “Layout Plan” in the drawings set.

CAUTION!

The analyzer cabinet weighs approx. 370 to 430 kg.
A suitable lifting device (crane, block and tackle, lifting truck, etc.) is required for transport, setting upright and installation!

Use the handling lugs provided to connect any lift cables to the analyzer cabinet.

The lift cable must be long enough to have an angle of at least 60° relative to the top of the cabinet when under tension (see the illustration).
If this is not done the handling lugs can be bent or the analyzer cabinet can be warped.



It is strongly recommended that the analyzer cabinet is
- transported by a specialist firm
- transported in a horizontal position as far as possible and
- not set upright until immediately before the installation!

Unpacking the Analyzer Cabinet

- Lift out the analyzer cabinet from the shipping box.
  Do not remove the plastic sheet in which the analyzer cabinet is wrapped. Unpacking a cold analyzer cabinet can lead to condensation.
- Do not remove the plastic film until just before the analyzer cabinet will be connected and it has reached room temperature. This takes at least 24 hours.

Setting Up the Analyzer Cabinet

- Installation site requirements, see page 14
- Material required, see page 26
- Follow the “Layout Plan” in the drawings set.
- Ground by means of the central grounding screw, route the grounding cable (≥10 mm^2 / AWG 6) through the M16 cable gland.

Mounting Plate and Electrical Distribution Cabinet: Installation

Preparing the Installation Site

- Observe the installation site requirements, see page 14
- Observe the “Layout Plan” in the drawings set.
- Mounting on a rack or wall. The loading capacity must be high enough to bear the weight of the mounting plate and electrical distribution cabinet (see page 24).
- Attachment with M8 bolts or studs.

ATTENTION!

The mounting plate weighs approx. 170 kg! The electrical distribution cabinet weighs approx. 65 kg! A suitable lifting device (crane, block and tackle, lifting truck, etc.) is required for transport, setting upright and installation!

It is strongly recommended that the mounting plate and the electrical distribution cabinet are

- transported by a specialist firm
- transported in a horizontal position as far as possible and
- not set upright until immediately before the installation!

Unpacking the System Components (Mounting Plate and Electrical Distribution Cabinet)

- The system components are shipped in two separate transport crates.
- Open the transport crates and lift out the system components.

  Do not remove the plastic foil in which the system components are shrink-wrapped! Unpacking cold system components could cause condensation.
- Do not remove the plastic foil until the system components have reached room temperature. This takes at least 24 hours.

Installing the System Components

- Installation site requirements, see page 14
- Material required, see page 26
- Follow the “Layout Plan” in the drawings set.
- Hang the electrical distribution cabinet on the left of the mounting plate.
  The distance is predetermined by the length of the prepared cables which are connected to the modules on the mounting plate. The cables are tied together in bundles for transport.
- Connect the ground lead (green-yellow, $\geq$10 mm^2 / AWG 6) to the central ground-terminal screw of the mounting plate and pass it through the provided M16 screwed cable gland to the ground-terminal screw in the electrical distribution cabinet.
- Connect the prepared cables to the electrical distribution cabinet:
  - Open the sliding cable entry plate on the underside of the cabinet (knurled screws)
  - Insert the ready-made cables
  - Attach the cable connectors to the appropriate terminal strip as per the wiring diagram and
  - Close the cable entry plate

Analyzer System with Integrated VOC Analyzer: Installing the Supply Gases and Test Gases

- Gas inlet conditions, see page 20
- Material required, see page 26
- Observe the “Piping Plan” in the drawings set.
- Pay special attention to complete cleanliness when connecting the gas lines. Gas inlets, outlets, fittings, tubes and pipes must be free of dust and grease. Contaminants can enter the gas analyzer and damage it or lead to false measurement results.
- Follow the fitting manufacturer’s instructions. Be sure to use a backup wrench when tightening gas line bulkhead connections (gas ports).
- Heat the gas lines if there is a danger of frost.

CAUTION!

The pertinent safety regulations for handling combustible gases must be followed.

Installing the Instrument Air Supply

- Connect the instrument air line to the bulkhead connector provided for this purpose on the right wall of the cabinet.
- Install a shutoff valve with a p_e = 4.5 to 7 bar pressure gauge in the instrument air supply system.

Installing the Combustion Gas Supply

- Clean the combustion gas line: Pump cleaning agent (alkaline cleaner, solvent, stainless steel pickling fluid) through the tube. Purge tube thoroughly with distilled water. Purge tube for several hours at a temperature above 100 °C with synthetic air or nitrogen (10 to 20 l/h). Close off tube ends.
- Connect the combustion gas line: Connect two-stage pressure-reducing valve (for ultra-pure gases) with flow limiter to the combustion gas cylinder. Connect the combustion gas line to the bulkhead connector provided for this purpose on the right wall of the cabinet.
  Note: For safety reasons, a flow limiter is integrated in this bulkhead connector to limit the combustion gas flow to 10 l/h.
- Check combustion gas line seal integrity: Adjust the high-pressure stage of the pressure-reducing valve of the combustion gas cylinder to p_e = 1200 ± 100 hPa (1.2 ± 0.1 bar) and purge the combustion gas line. Check seal integrity of the combustion gas line with a leak detector (measuring principle: thermal conductivity). Close combustion gas cylinder.

Continued on next page

Analyzer System with Integrated VOC Analyzer: Installing the Supply Gases and Test Gases, *cont'd*

Setting Up the Test Gas Cylinders

- Comply with permissible ambient temperatures and the warning labels on the pressure reducers.
- Fit the test gas cylinders with pressure reducers and place them near the analyzer cabinet. Short test gas lines result in short lag times.
- Connect the test gas lines to the bulkhead connectors provided for this purpose on the right wall of the cabinet.

Installing the Exhaust Gas Line

- Connect the exhaust gas line to the bulkhead connector provided for this purpose on the right wall of the cabinet (using the shortest possible line with an I.D. $\geq$ 8 mm). Allow the exhaust air to pass freely and do not install reduction sections or shutoff valves. The diameter of the exhaust gas line should be widened at the shortest possible distance outside the cabinet to prevent any backpressure due to long line length.

AO2000-Fidas24: Connecting the Sample Gas Line

CAUTION!

Before start-up of the gas analyzer it is imperative to remove any plastic sealing stopper inserted in the sample gas inlet at the factory.

Sample Gas Line Connection

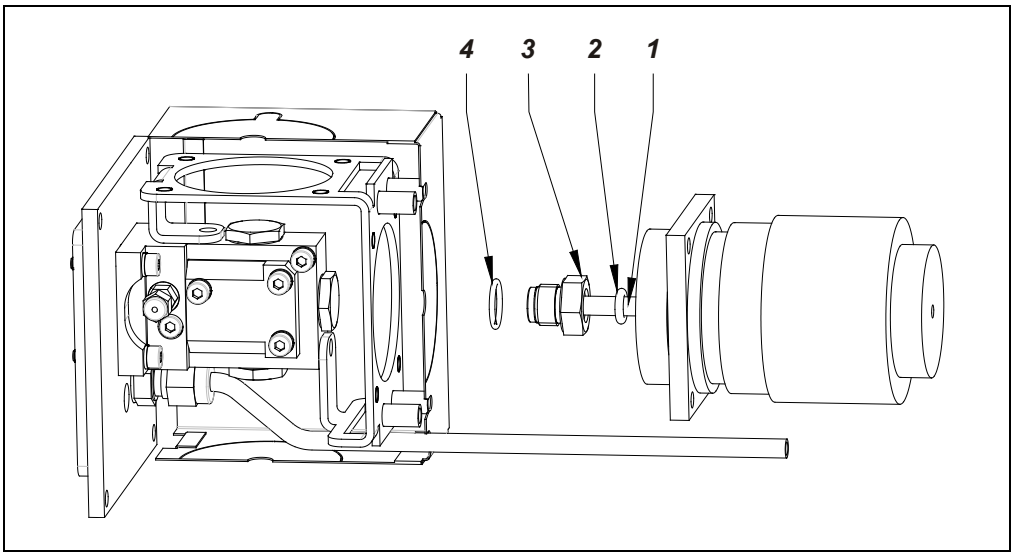
Connect the heated sample gas line directly to the sample gas inlet of the AO2000-Fidas24 VOC analyzer (see Figure 10). Make sure that the O-rings are properly seated and the sample gas line is fully inserted in the sample gas port.

Fittings and O-Rings

The required fittings and O-rings are supplied in the accessory kit.

Figure 10

Sample Gas Line Connection on AO2000-Fidas24 Heated Sample Gas Port



1 Heated Sample Gas Line (tube with 4/6-mm ID/OD)

2 O-Ring 6.02 x 2.62

3 Fitting

4 O-Ring 12.42 x 1.78

Analyzer Cabinet: Connecting the Electrical Leads

Connecting the Electrical Leads

- Material required, see page 26
- Observe the “Interface Plan” in the drawings set.
- When routing the electrical lines, follow all applicable national safety regulations for the installation and operation of electrical devices.

Connecting the Signal Leads

- Route the signal leads separately from the power supply lines.
- Locate the analog and digital signal lines separately from each other.
- Carefully plan the arrangement of signal leads in the cables as well as the use of openings for cable connectors.
- Connect the signal leads to the terminal strips.
- Cable shielding should be connected according to local regulations. Differences in potential and signal interference must be taken into consideration.

Connecting the Input Wiring

- Power supply requirements, see page 22
- Before connecting the power supply, make sure the analyzer system operating voltage is set to match the line voltage.
- The protective lead connector and protective lead should be connected before any other connection is made. The analyzer system can be hazardous if the protective lead is interrupted inside or outside the system or if the protective lead is disconnected.
- Connect
  - the input wiring of the analyzer cabinet
  - the input wiring of the heated sample components (temperature-resistant as needed)
  - the Pt100 resistance thermometer leads
  - the input wiring of the back-purging unit (solenoid valves)

  to the terminal strips.

Analyzer System Start-Up

Initial startup of the analyzer system should be performed by trained personnel of the manufacturer or the supplier.

Prior to Analyzer System Start-Up

WARNING!

The analyzer system must stand in its operating position for about 24 hours prior to start-up.

Purge the Combustion Gas Line

Purge the combustion gas line before analyzer system start-up. This should ensure that the combustion gas line is free of impurities – especially containing hydrocarbons – that could lead to erroneous measurement values. Purge the combustion gas line for approx. 20 seconds with a nitrogen flow of approx. 100 l/h.

Transportation Restraints Release

see “Transportation Restraints Release” section, page 56

Reagent Fill

see “Reagent Fill” section, page 57

Check Analyzer System Seal Integrity

see “Analyzer System: Seal Integrity Check” section, page 101

Transportation Restraints Release

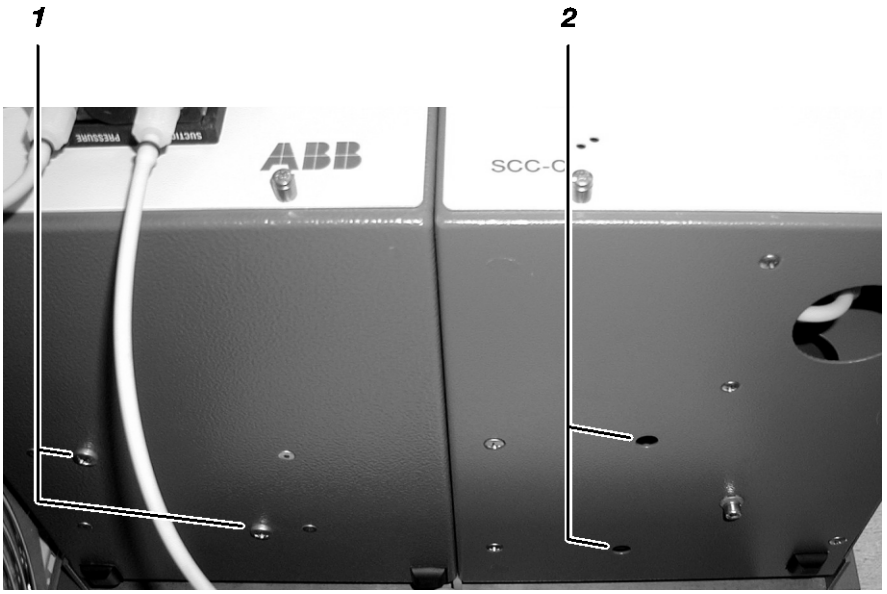
Transportation Restraints Release

(see Figure 11)

Step	Action
Sample Gas Feed Unit SCC-F: Diaphragm Pumps Transportation Restraints:	
1	Using a Ph2 crosshead screwdriver, loosen the two M6x25 screws ***1*** in the base plate. Retain the screws in case the unit needs to be transported again in the future.
Sample Gas Cooler SCC-C: Compressor Transportation Restraints:	
2	Using a Ph2 crosshead screwdriver, turn the two screws counterclockwise through the holes ***2*** in the base plate to the point at which resistance can be felt.
	In case that the “Zero Air Generator” (catalyst for combustion air conditioning) is mounted underneath the sample gas cooler use an offset screwdriver to release the transportation restraints. If no offset screwdriver is at hand the “Zero Air Generator” must be dismounted according to the following instructions.
	1 Loosen the nuts of the hose fittings on the left and right side of the “Zero Air Generator” and pull the hoses out of the fittings.
	2 Loosen the mounting screws (2 above, 1 below) and lay the “Zero Air Generator” on the cabinet floor.
	3 Release the transportation restraints as described above.
	4 Mount the “Zero Air Generator” to the cabinet rear wall.
	5 Insert the hoses into the hose fittings as far as they will go and hand-tighten the nuts. Perform this step carefully in order to ensure leak-tightness of the hose connections.

Figure 11

Transportation Restraints
left: **SCC-F Sample Gas Feed Unit**
right: **SCC-C Sample Gas Cooler**



Reagent Fill

CAUTION!

When working with corrosive reagents note the hazard information and safety precautions contained in the applicable material safety data sheets.

Reagents should be purchased from a local chemical distributor in order to keep the route of transport as short as possible!

Reagents

Depending on the measurement task involved, reagents can be used to eliminate interfering gas components or to stabilize the desired sample components.

Reagent Fill

Fill the reagent supply bottle (optional) with the reagent needed for the measurement task.

Mixture Ratio

Reagents (concentrate) are used in the following mixture ratios:

	Phosphoric Acid (H_3PO_4)	**Hydrogen Peroxide (H_2O_2)**
Concentration	85 %	30 %
Mixture ratio (in 10-liter bottle)	½ liter phosphoric acid 9½ liters water [1)]	1 liter hydrogen peroxide 9 liters water [1)]
Solution sufficient for	2 fills	1 fill

1) e.g. distilled water or water from an ion exchanger

CAUTION!

Before activating the power supply check once again that the analyzer system operating voltage is set to match the line voltage.

Power Supply Activation

Step	Action	
1	Make sure that all fuse switches are deactivated.	
2	Turn on the analyzer system power supply with main switch ***-Q10*** and ***-Q20*** if applicable.	
3	Activate the ground fault circuit interrupters ***-F10*** or ***-F20*** if applicable.	
4	Activate the fuse switches of the individual modules one after the other:	
	-F01	Lighting, service socket, fan or cooling unit
	-F02	Heated probe tube, heated filter unit, back-purging unit, test gas connection valves
	-F03	Heated sample gas line
	-F04	NO_2 / NO converter
	-F05	AO2000-Fidas24, air catalyst
	-F06	Sample gas cooler, sample gas feed unit
	-F07	AO2000 central unit, power supply

Function Check

The following events will occur after the power supply is turned on:

Phase	Description
1	The three “Power”, “Maint” and “Error” LEDs light up.
2	The different booting phases are displayed on the screen. Also the software version is displayed.
3	After a brief time the screen switches to measurement mode.
4	The STATUS MESSAGE softkey appears on the screen. This indicates the possibility of a temperature or flow problem during the warm-up phase (see page 63). By pressing the softkey the user can recall the status message summary and view status message details (see page 157).

Date and Time Check

A correct date and time setting is required for proper operation of functions such as automatic calibration and time / date logging of error messages.

Step	Action
1	Select the Date/time menu item: **MENU → Configure → System → Date/Time**
2	Check and, if necessary, correct the date and time (for more information see “Setting the Time Zone, Date and Time”, page 70).

The analyzer system is factory-set to the GMT+1 time zone.

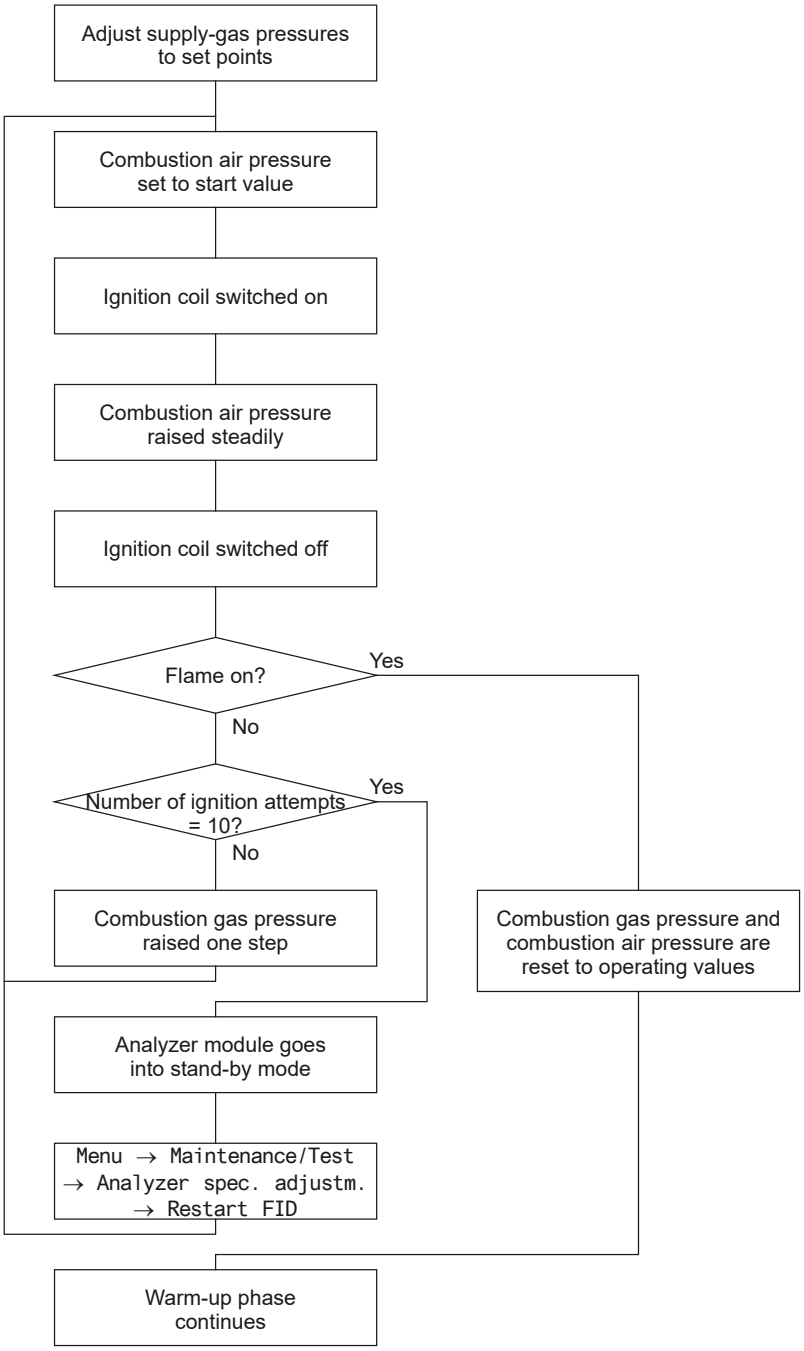
VOC Analyzer Start-Up Procedure

Step	Action
Turn on supply gases	
1	Select the `Controller values` menu item: **MENU → Diagnostic/Information → Module specific → Controller values** The variables for the temperature regulators are indicated under this menu item: `T-Re.D` Detector temperature `T-Re.E` Heated sample gas port temperature The temperature values will rise slowly after the power supply is activated.
2	Turn on instrument air, combustion air and combustion gas (H_2). Using the appropriate external pressure regulator, adjust the initial pressure to the value specified in the analyzer data sheet. The pressure values shown on the gas port labels and in the "Supply Gas and Test Gas Inlet Conditions" section (see page 20) are only typical values. Only the factory-determined values shown in the analyzer data sheet of the analyzer module are applicable for safe operation.
3	In the `Controller values` menu item also the variables for the internal pressure regulators are indicated; set the supply gas pressures by means of the variables: `Input` Instrument air at combustion-chamber inlet `Output` Instrument air at combustion-chamber outlet `Air` Combustion air `H2` Combustion gas (H_2) Random values may be displayed at first for the variables. The values are updated for the first time approx. 30 seconds. after selection of the menu item and thereafter approx. every 30 seconds. Pressure control continues to run in the background. Depending on the pilot pressure setting, pressure setting times can be long. If the operator does not press any key for more than five minutes while in menu operation, the analyzer switches automatically to measuring operation to display of sample values ("time out").
4	As soon as the temperature of the detector has reached the threshold value (150 °C) the appropriate solenoid valve in the analyzer module automatically connects the instrument air. The vacuum and combustion air controllers work to keep pressures at the applicable set points. Sample gas begins to flow through the analyzer as soon as the instrument air is connected.
5	After the pressures are at the applicable set points, the associated solenoid valve in the analyzer module automatically starts the combustion gas supply. The combustion gas controller attempts to establish the set point pressure value.

Continued on next page

Step	Action
Adjust the variables for the internal pressure regulators	
	Steps 6 to 8 should only be performed if the analyzer module does not automatically start operation at the pressure values indicated on the analyzer data sheet. If the internal pressure controller values do not match these values, the pilot pressures must be changed.
6	Instrument air: Use the external pressure regulator to set the `Output` variable to approx. 60 % (max. 70 %). Variable too large ⇒ reduce pressure. Variable too small ⇒ raise pressure. (The `Input` variable depends on the sample gas flow rate.)
7	Combustion air: Use the external pressure regulator to set the `Air` variable to approx. 50 % (max. 60 %). Variable too large ⇒ raise pressure. Variable too small ⇒ reduce pressure.
8	Combustion gas: Use the external pressure regulator to set the `H2` variable to approx. 35 % (max. 40 %). Variable too large ⇒ raise pressure. Variable too small ⇒ reduce pressure.

Continued on next page

Step	Action
Flame ignition (automatic)	
9	

Flame ignition may take up to 10 minutes, depending on the number of ignition attempts.
The flame temperature is displayed in the `Flame` parameter under the `Auxiliary raw values` menu item; it must be at least 30 °C higher than the detector temperature.
Actual start-up of the analyzer is complete when the flame ignites.

Continued on next page

Initial Heating Phase

The initial heating phase covers the period after the power supply has been turned on until the detector temperature reaches the threshold value (150 °C).

Status Messages

The following status messages are present during the initial heating phase:

Short Text	Description
Working temperature	The detector temperature has not yet reached the threshold value.
Flame fault	The flame is not yet lit.
Temperature limit value 1, 2	The temperature of the detector (T-Re.D) and possibly of the heated sample gas port (T-Re.E) is above or below the upper or lower limit value 1 (2).
Pressure limit value 1, 2	The pressure at one of the internal pressure regulators for instrument air (Input, Output), combustion air (Air) or combustion gas (H2) is above or below the upper or lower limit value 1 (2).

Reading

The reading and ––E–– flash alternately, signaling that the displayed measurement value is not valid.

CAUTION!

Never pull the 115 / 230 VAC power supply plug connectors for the detector heater and the heated sample gas port while the power is on.

CAUTION!

The heated sample gas port cover is hot during operation. Its temperature is higher than 70 °C.

Warm-Up Phase

Warm-Up Phase

The warm-up time is approx. 2 to 4 hours.

The warm-up phase can take longer if the analyzer system was not brought to room temperature before the power supply was activated.

During the warm-up phase measurement values can be outside the ranges specified in the data sheet.

End of the Warm-Up Phase

The warm-up phase is over when the temperature and flow status messages are gone and the measured value drift is acceptable. The latter depends on the size of the measurement range.

Readiness, Sample Gas Supply

At the end of the warm-up phase the analyzer system is ready for operation and automatically activates the sample gas supply.

Calibration

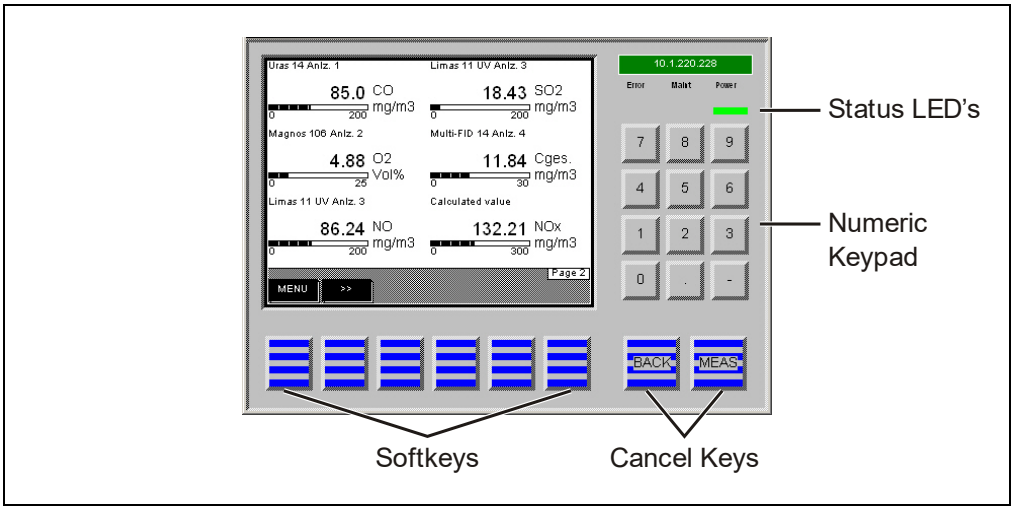
Calibration should only be started after the warm-up phase (see “Analyzer System Calibration” chapter, page 80).

Analyzer System Operation

Display/Control Unit

Figure 12

Display/Control Unit



Status LED's

Power — Green LED: The power supply is on.

Maint — Yellow LED: The "Maintenance Request" status signal is on. The measured value is valid.

Error — Red LED: The "Error" status signal is on. The measured value is no longer valid.

Cancel Keys

Allows the operator to cancel a function or menu item and to return to the previous menu level.

Allows the operator to cancel a function or menu item and to return to the measured value display in measurement mode.

Only entries confirmed with ENTER are stored; unconfirmed items are not accepted.

Softkeys

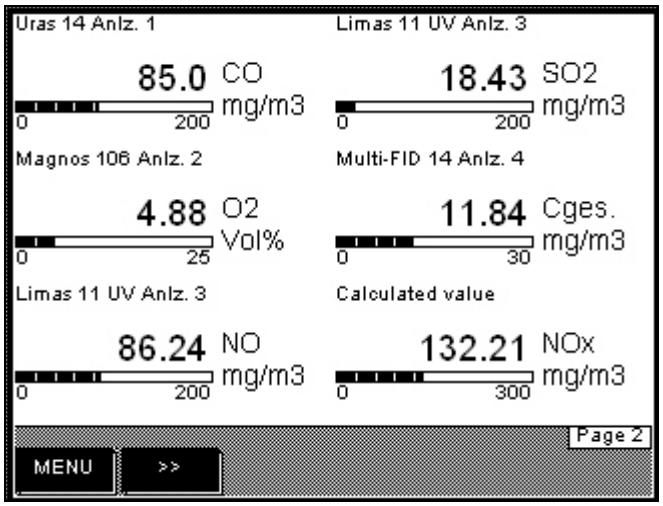
Allows the operator to scroll to the next display "page". This key only allows forward scrolling.

Appears in measurement mode if an "Error" or "Maintenance request" condition arises. This key allows the operator to call up the status message log and view the status messages. The operator can also call up a detailed display for any message in the log.

“Measured Values” Screen

Figure 13

“Measured Values” Screen



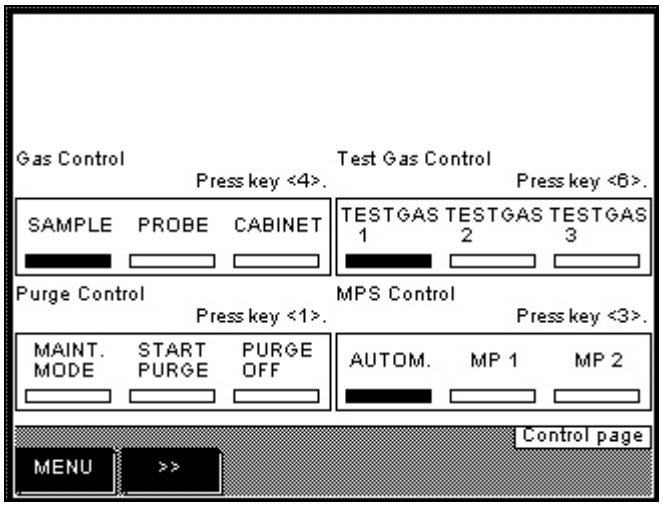
Indication

Values measured by the analyzer system are displayed on the “Measured Values” screen. Up to six measured values are displayed on one page. The actual number of pages depends on the number of measurement components configured in the analyzer system.

“Control Panel” Screen

Figure 14

“Control Panel” Screen



Indication

The “Control Panel” screen offers controls for various functions of the analyzer system.

Functions activated manually are indicated by means of a filled rectangle below the function’s name (see the following example).

“Maintenance Mode” deactivated (off)

“Maintenance Mode” activated (on)

Operation

The controls are operated in the following manner:

Press the number key that corresponds to the position of the control and is indicated above the control. In the following screen, press the corresponding function key. Thereby, the system switches back to the control panel screen, and the function just activated is indicated by means of a filled rectangle.

Password Protection

All control panel functions except the “Maintenance control” are password protected.

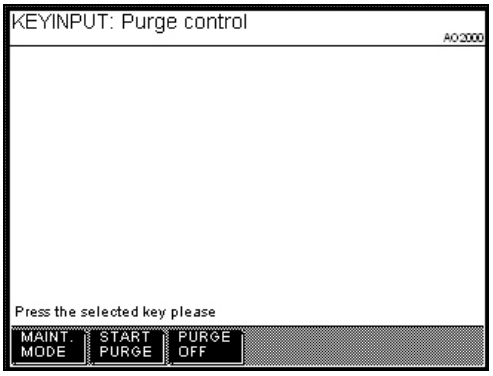
Changing the password is described on page 72.

Continued on next page

“Control Panel” Screen, *continued*

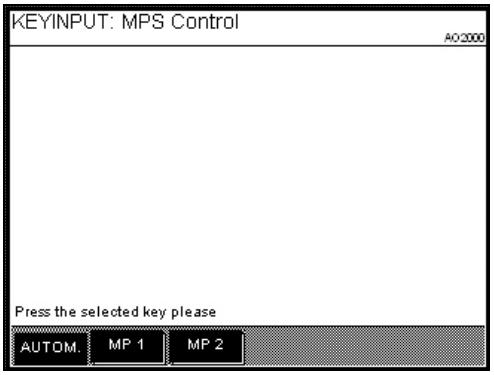
Purge Control

MAINT. MODE	Operate this key before starting and after finishing maintenance work (“Maintenance Key Switch”)
START PURGE	Start back-purging manually
PURGE OFF	Disable back-purging



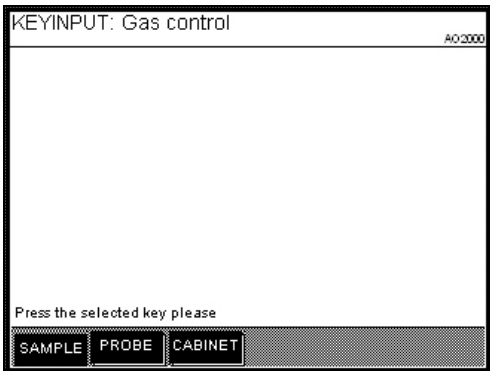
MPS Control (Measuring Point Switchover)

AUTOM.	Automatic measuring point switchover
MP 1	Select measuring point 1 manually
MP 2	Select measuring point 2 manually



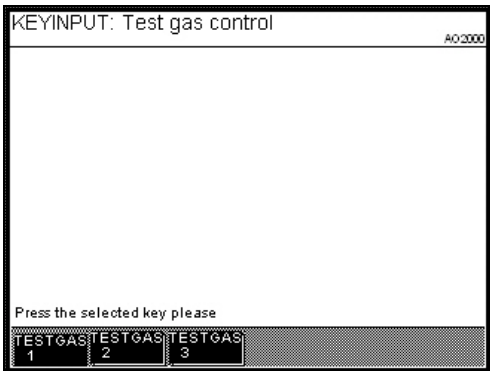
Gas Control

SAMPLE	Sample gas supply (normal operation)
PROBE	Test gas supply at the probe
CABINET	Test gas supply at the analysis cabinet



Test Gas Control

TESTGAS 1	Select test gas 1
TESTGAS 2	Select test gas 2
TESTGAS 3	Select test gas 3



Menu Tree

Menu Tree

The following table summarizes the analyzer system menu tree.

For reasons of brevity only the top level parameters and functions are shown; the menu branches more extensively at most menu items, e.g. into the various measurement components or into the selection and adjustment of values.

Some menu items are analyzer-specific, i.e. they only appear when particular analyzer modules are integrated into the analyzer system.

Password Levels

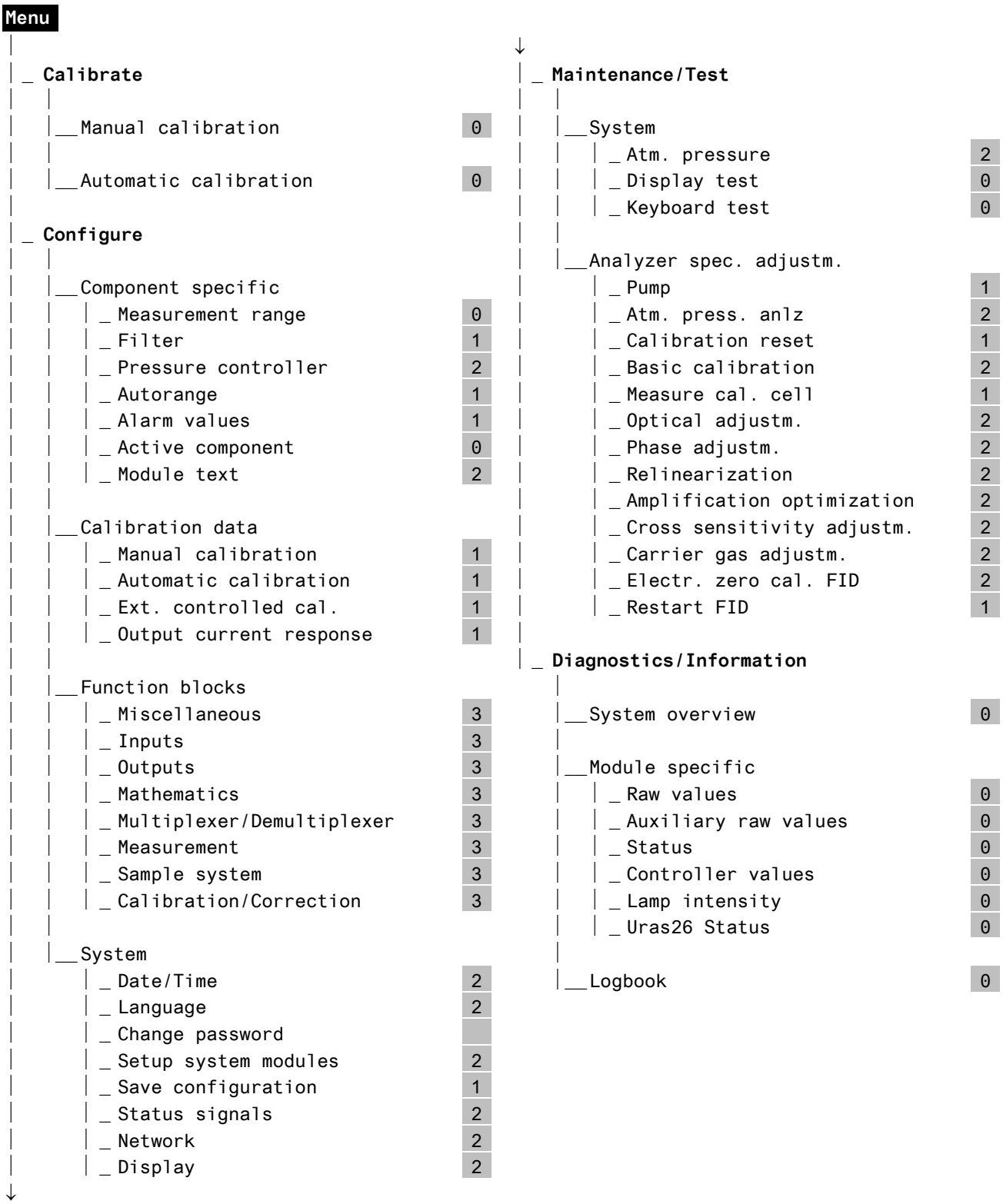
For each menu item its password level (0, 1, 2, 3) is shown in the table.

For some menu items, individual sub-menu items are on a higher password level. These applies especially to those sub-menu items which allow access to function block applications.

Note: The “Change password” menu item is not assigned to a specific password level. To change a password the old password of the respective level must be entered (see “Changing the Password” section, page 72).

Continued on next page

Menu Tree, *continued*



Setting the Time Zone, Date and Time

Menu Path

MENU → Configure → System → Date/Time

Procedure

Parameter	Explanation
Time zone	The time zone can be selected either from the GMT (Greenwich Mean Time) values or from the continent / country / city list.
Date	Date must be entered in month/day/year format. Enter year with 4 digits.
Time	Time must be entered in hour:minute:second format. Enter seconds, too.

Daylight Savings Time

The analyzer system is automatically set to daylight savings time.

Note: This applies only when the time zone has been selected from the continent / country / city list and not from the GMT values list.

Factory Setting

The analyzer system is factory-set to the GMT+1 time zone.

Accept the Time Settings

Press the softkey SET TIME to accept the modified time settings.

Selecting User Interface Language

Menu Path MENU → Configure → System → Language

Language Selection The user interface languages English and German are factory-configured (per order) in the analyzer system. In the menu item Language the user can switch between these two languages.

Changing the Password

Menu Path MENU → Configure → System → Change password

Password Protection See page 73 for basic information on “Password Protection”.

We strongly recommend to change all passwords from their default value.

Factory Setting

User group	Access to Password levels	Password
Every user	0	None
Maintenance team	0, 1	471100
Specialist team	0, 1, 2	081500
Function block specialist	0, 1, 2, 3	325465

Procedure Select the Change password menu item, select the user group, enter the old password, enter the new password (6 digits), re-enter the new password, leave the menu item with **Back**.

Password level 0 is not displayed in the Change password menu item.

CAUTION!

After entering the password for password level 3, you can access all of the function block applications. When configuring function blocks, existing applications with their configurations and links can be damaged or destroyed.

Password Protection

Elements of Password Protection

Password protection consists of three elements:

- Password level
- User group
- Password

Password Level

Each menu item is assigned an password level. Password levels are numbered 0, 1, 2 and 3.

Menu items are assigned to different password levels in order to assure that specific menu items can only be changed by authorized users.

User Group

The members of a user group are authorized to access a specific password level, i.e. to change the menu items at that level.

Some user groups are set-up at the factory.

A user group can be made up of one or more users.

Password

Every user group set-up in the system has a password.

The password consists of six digits which can be entered via the numeric keypad.

Passwords are pre-assigned for the factory-set user groups.

Factory Setting

User group	Access to password levels	Password
Every user	0	None
Maintenance team	0, 1	471100
Specialist team	0, 1, 2	081500
Function block specialist	0, 1, 2, 3	325465

CAUTION!

After entering the password for password level 3, you can access all of the function block applications. When configuring function blocks, existing applications with their configurations and links can be damaged or destroyed.

Technical Bulletin “AO2000 Function Blocks – Descriptions and Configuration” (publication no. 30/24-200 EN) contains complete information on the “Function Block” concept as well as detailed descriptions of the individual function blocks.

Continued on next page

Viewing Menu Items

All users can view all menu items, regardless of password level, without entering a password.

Changing Menu Items

All users can execute all password level 0 menu items without entering a password.

Password level 1, 2 and 3 menu items can only be changed if the user belongs to the group authorized for that level and after the user's password has been entered.

Note

Entering the main menu and thus switching to the menu mode can be password protected (see the "Inhibit Operation" section, page 75).

Change Privilege

After entering the password the user is authorized to change any menu items accessible at the user's level.

Duration of the Change Privilege

The change privilege remains in effect until:

- The analyzer automatically switches to measurement mode if the user has not pressed a key for more than about 5 minutes (time out).
- Or the user presses the "Meas" key twice in succession.

The change privilege remains in effect if the user presses the "Meas" key only once to return to measurement mode. This is indicated by the "Password active" status message.

In this manner the user does not have to re-enter a password to change a menu item if he or she returns to the menu mode within approximately 5 minutes.

Note

The change privilege thus refers to a temporary authorization to change menu items. In contrast, the access privilege refers to a fundamental and configurable authorization to change menu items at certain password levels.

Inhibit Operation

Menu Path

MENU → Configure → System → Change password

Inhibit Operation

Operation of the analyzer system, i.e. entering the main menu and thus switching to the menu mode, can be password protected.

After inhibition the analyzer system can only be operated when the level 1 password has been entered.

The level 3 password must be entered to configure the password protection.

Procedure

Press the MENU ACCESS softkey in the “Change password” menu item and set the password protection.

Changing Measurement Range Limits

Menu Path

MENU → Configure → Component specific → Measurement range (→ Select component) → …

Selection

All measurement ranges configured (at the factory) for a sample component are displayed.

Procedure

Select the measurement range with the arrow keys, press CHANGE LIMITS, select START VALUE or END VALUE, change the measurement range limit and confirm with ENTER.

For the automatic measurement range changeover (see page 78) to function properly, the measurement ranges MB1, MB2, … must be configured in ascending order, i.e. MB1 < MB2 < … .

The measurement range selected or changed and the altered number of decimal places is shown on the screen after switching to measurement mode.

Steps After Changing Measurement Range Limits

Calibration of the associated measurement range should be verified after changing measurement range limits. If the ratio of the old to the new measurement range is ≥1:10, we recommend manually calibrating the end point.

Parameters of the auto-range function should be verified after changing measurement range limits (see page 78).

Notes for Individual Analyzer Modules

Magnos27	Measurement ranges are factory-set and cannot be modified.
Magnos206, Magnos28	Measurement ranges are freely selectable. At the factory they are either set to 0-10 / 15 / 25 / 100 Vol.-% O_2 or per order.
Limas21, Uras26	Measurement ranges are freely selectable. See the “AO2000-Limas21, AO2000-Uras26: Notes for Changing Measurement Range Limits” section, page 77.
Oxygen Sensor	Measurement range 1 is freely adjustable from 0–5 Vol.-% O_2 to 0–25 Vol.-% O_2. Measurement range 2 is factory-set to 0–25 Vol.-% O_2.

AO2000-Limas21, AO2000-Uras26: Notes for Changing Measurement Range Limits

Physical Measurement Range

The Limas21 and Uras26 analyzer modules have one physical measurement range per sample component. The limits of this measurement range are determined by the minimum and the maximum value of the product of the gas concentration and measurement cell length $(c \cdot l)_{min}$ or $(c \cdot l)_{max}$.

Measurement Ranges in a Delivered Analyzer Module

Up to four measurement ranges – within the limits of the physical measurement range – can be ordered for each sample component. The maximum ratio of the spans is 1:20. The measurement ranges can be starting measurement ranges or suppressed measurement ranges.

Analyzer Module with Calibration Cells

If a calibration cell is provided for the measurement component, its set point will always be the upper end of the largest measurement range.

If the new measurement range is smaller than the old measurement range, the associated calibration cell can still be used.

After Changing Measurement Range Limits

It is recommended after changing the measurement range limits

- To verify the end point of the new measurement range,
- To verify the linearity of the new measurement range (see “AO2000-Limas21, AO2000-Uras26: Relinearization” section, page 126),
- To measure the associated calibration cell (see “AO2000-Limas21, AO2000-Uras26: Measurement of Calibration Cells” section, page 125).

Auto-Range Initialization

Menu Path

MENU → Configure → Component specific → Autorange → Select component → …

The automatic measurement range changeover only functions properly when the measurement ranges MB1, MB2, … have been configured in ascending order, i.e. MB1 < MB2 < … (see page 76).

Lower Threshold, Upper Threshold

On reaching the lower threshold value set here (as a percentage of the current measurement range scale), the analyzer module automatically switches to the next lower range.

On reaching the upper threshold value set here (as a percentage of the current measurement range scale), the analyzer module automatically switches to the next higher range.

The lower and upper threshold values should be selected so that the gas analyzer is not constantly switching between two measurement ranges (see the example below).

Assigned Measurement Ranges

The measurement ranges to be included for autoranging can be initialized. The number of measurement ranges available depends on the analyzer module.

The parameter cannot be selected if the analyzer module has only two measurement ranges since these are automatically included in the autoranging function.

Status

Autoranging can be off or on.

Example

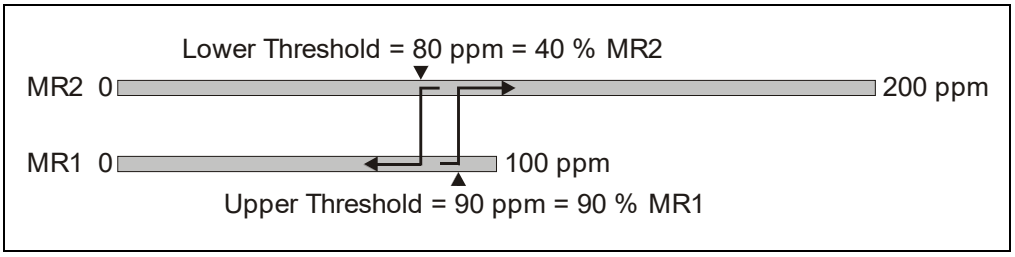
(see Figure 15)

Measurement Range 1: 0–100 ppm, Measurement Range 2: 0–200 ppm

Lower Threshold = 80 ppm = 40 % MR2, Upper Threshold = 90 ppm = 90 % MR1

Figure 15

Auto-Ranging



Procedure

Parameter	Range	Action
Lower threshold	0...100%	Set
Upper threshold	0...100%	Set
Assigned ranges	MR1, MR2, MR3, MR4	Select
Status	on or off	Select

Filter Initialization

Menu Path

MENU → Configure → Component specific → Filter → Select component → …

Range

0 to 60 seconds

Procedure

Parameter	Explanation	Action
Linear Filter (Limas21, Magnos27):		
T90	Time constant	Set
Non-linear Filter (Magnos206, Magnos28, Uras26):		
T90-1	Time constant for constant measured value	Set
T90-2	Time constant for measured value changes	Set
Threshold	T90-2 applies to overshoot	Set

T90-2 should be adjusted ≤ T90-1 for the non-linear filter.

The switching threshold (in %) is generally based on the largest measurement range selected (reference measurement range).

Recommendation for
Magnos206: T90-1 = 3 sec., T90-2 = 0 sec., Threshold = 0.1%
Uras26 T90-1 = 5 sec., T90-2 = 0 sec., Threshold = 0.6 %

Release of communication via port 8001/tcp

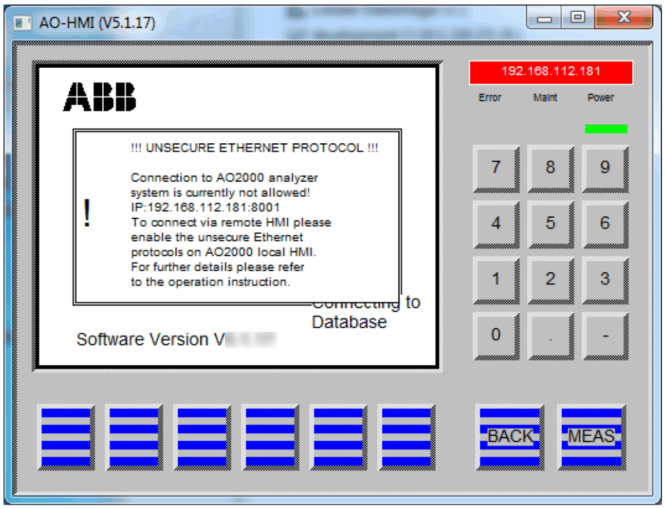
In the AO2000 System, a proprietary protocol has been implemented on port 8001 for communication with remote clients:

- In the AO2000 System, communication is blocked on all Ethernet interfaces (X8 / X9) by default.

When communication is blocked, a corresponding message is issued on the Remote HMI.

Image 1

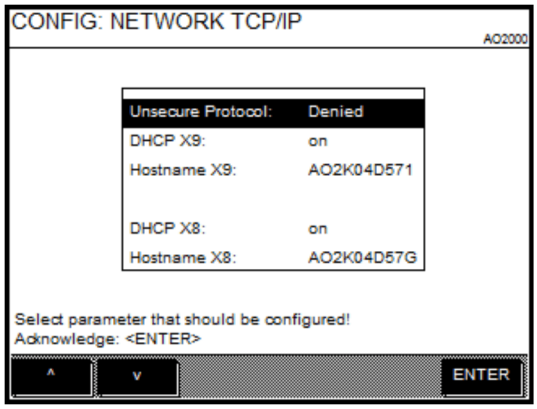
Message on the Remote HMI (example)



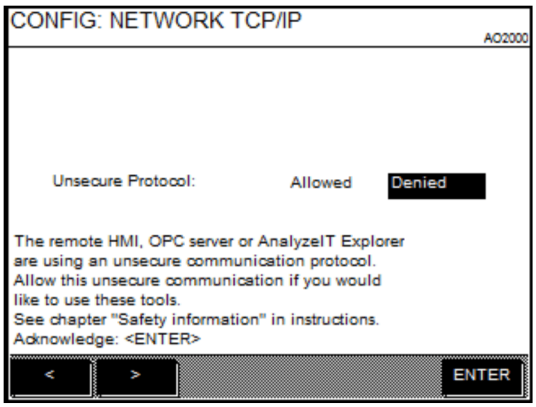
Release communication via the proprietary protocol

Implement the following steps to release communication via the proprietary protocol:

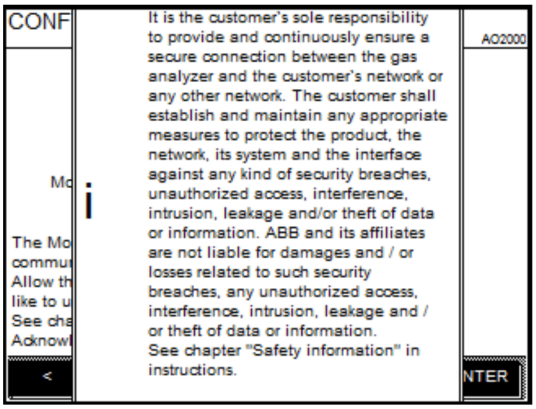
1. Select the '…\Configure\Network\TCP/IP Network' menu.
2. Select the 'Unsecured protocol' menu item



3. Select the ‘Unsecured protocol’ menu item and set the parameter to ‘Permit’.



4. Confirm the information field by selecting <BACK>.



- Communication via the proprietary protocol has now been released.

The proprietary protocol via port 8001/tcp is an unsecured protocol (in the meaning of IT security or cybersecurity).

Release of communication via Modbus® TCP/IP

In the AO2000 System, communication via Modbus® TCP/IP is blocked on all Ethernet interfaces (X8 / X9) by default.

Release communication via Modbus® TCP/IP

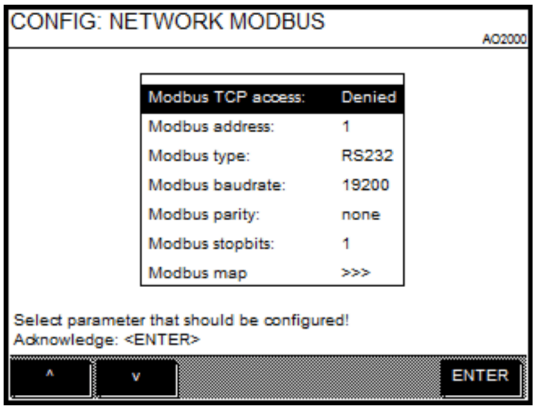
Implement the following steps to release communication via Modbus® TCP/IP:

1. With the Modbus card installed, select the '…\Configure\Network\Modbus' menu.

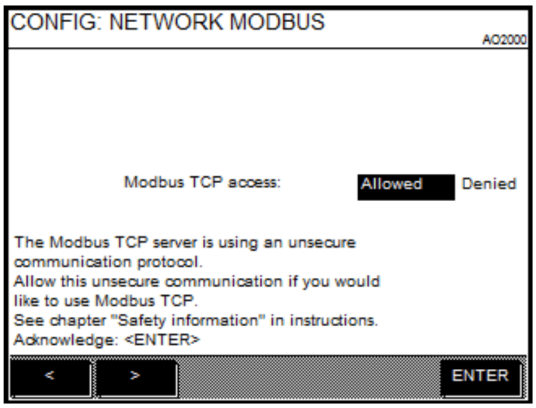
or

The '…\Configure\Network\Modbus' menu is **not** available if the Modbus card is not installed. In this case, the Release menu is called up directly via 'Modbus TCP'.

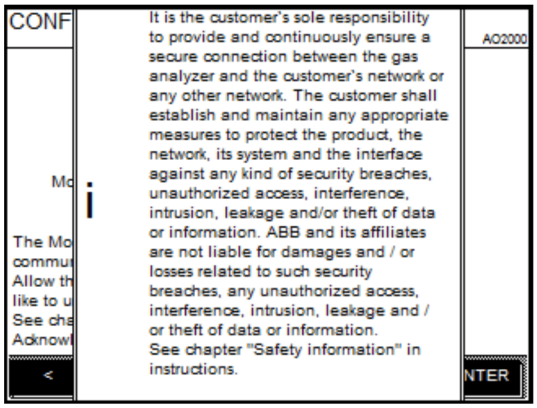
2. Select the 'Modbus TCP Access' menu item and confirm by selecting <ENTER>.



3. Select the 'Modbus TCP Access' menu item and set the parameter to 'Permit'.



4. Confirm the information field by selecting <BACK>.



- Communication via the Modbus® TCP/IP protocol has now been released.

The Modbus® protocol is an unsecured protocol (in the meaning of IT security or cybersecurity), as such the intended application should be assessed before implementation to make sure that the protocol is suited.

Analyzer System Calibration

Calibration Principles

No Test Gases Required

With a few exceptions, no test gases are required for the regular calibration of the analyzer modules.

Uras26, Limas21

The analyzer modules AO2000-Uras26 and AO2000-Limas21 are calibrated at the zero point by means of ambient air, which must be free of sample components. The air is drawn in by the integrated pump by switching over a solenoid valve and conducted through the sample gas cooler. It is thereby guaranteed that the same gas conditions (humidity) are present during the calibration and during the measurement. The solenoid valve is controlled by the electronics module.

Gas-filled calibration cells are inserted into the optical beam path for the end-point calibration of the analyzer modules. Cleaned ambient air with a constant moisture content continues to flow through the sample cell during the calibration.

The calibration cells are tested by means of test gases from gas cylinders during the recommended annual functional test by the ABB after sales service. These test gases are fed in upstream of the cooler.

Magnos206, Magnos28 Electrochemical O_2 Sensor

The calibration of the oxygen analyzer AO2000-Magnos206, Magnos28 and the electro-chemical O2 sensor takes place as single-point calibration with the oxygen concentration of atmospheric air (20.9 % Vol.).

Magnos27

If the analyzer module AO2000-Magnos27 is used for oxygen measurement, a zero reference gas (N_2 gas cylinder with pressure reduction valve, see page 21) is also required. The automatic calibration of this analyzer module is possible by means of a further solenoid valve.

Fidas24

The analyzer module AO2000-Fidas24 for the measurement of org. C is calibrated by means of conventional test gases (see page 20).

Test Gas Feed-in

The test gas is fed in upstream the sample gas cooler if applicable.

As an option for emission monitoring applications, calibration according to the EPA directives can be carried with test gas infeed at the sampling probe.

Test Gas Dew Point

The test gas dew point must be nearly identical to the sample gas dew point.

Analyzer Modules with Multiple Detectors

In analyzer modules with several detectors (e.g. the Uras26) all detectors are calibrated simultaneously.

Calibration Control

Starting Calibration

Calibration is started

- At time intervals determined by the internal clock or
- Manually via the analyzer system's display and control unit.

Internal Start

Normally calibration is started on a time interval basis by the internal clock.

The cycle time is initialized with the calibration data (see page 87).

Manual Start

Calibration can be started manually on the display and control unit. It is effected

- Only as zero calibration or
- Only as span calibration or
- As a common zero and span calibration.

Manual start of the calibration is described on page 86.

Calibration of an analyzer module is impossible

- when it is operated with the test and calibration software TCT and
- during setting up system modules.

Message Display

During calibration an `Autocal running` message blinks in the softkey line.

Waiting Period Following Calibration

If the `Output Current Response` parameter is set to Hold, current output is halted for a specific time to allow the measurement value to stabilize after calibration.

This interval is:
Test gas → Sample gas purge time + 4 x T90 or
Test gas → Sample gas purge time + 1 x T90-1 + 3 x T90-2.

Plausibility Test in Calibration

If during calibration the analyzer system finds implausible values (e.g. if the span and zero values are equal), calibration is stopped and an error message is generated. The values stored after the last calibration remain in effect.

Status Signal

The "Maintenance Mode" status signal is set during calibration.

Manual Start of the Calibration

For information on the calibration data, please refer to page 87.

Manual Start of the Calibration

Calibration is started

- Only as zero calibration or
- Only as span calibration or
- As a common zero and span calibration.

For the Magnos206, Magnos28 and Magnos27 analyzer modules, it is not admissible to perform only a span calibration. A zero calibration must always precede a span calibration.

Proceed as follows to manually start the calibration – even outside of the cycle intervals initialized:

Step	Action	
1	Select the Automatic Calibration menu: **MENU → Calibrate → Automatic calibration**	
2	Only zero calibration:	**ZERO AUTOCAL**
	Only span calibration:	**SPAN AUTOCAL**
	Common zero and span calibration:	**ZERO & SPAN AUTOCAL**

Manual Stop of the Calibration

The user can end the calibration process by pressing the STOP softkey.

When calibration is stopped, the analyzer module is in an indefinite state. For instance, it is possible for zero calibration to be finalized while span calibration has not yet been started.

For this reason, calibration will have to be restarted and allowed to run to completion after any cancellation of calibration.

Calibration Data

Menu Path

`MENU → Configure → Calibration data → Automatic calibration → …`

Activation

Calibration is only performed when activated. The “off” setting applies only to the interval-controlled start of calibration.

Cycle Time

The cycle time shows the time intervals over which calibration is to be carried out.

Date and Time of Next Calibration

The analyzer system will perform the next calibration at the time established here. The cycle time will begin to run at that point.

Operating Mode

Calibration is based on the function block **autocalibration**. This function block operates either as calibration or as validation.

Section “Validation” contains a detailed description of the validation (see page 91).

Technical Bulletin “AO2000 Function Blocks – Descriptions and Configuration” (publication number 30/24-200 EN) contains a detailed description of the function block **autocalibration**.

Test Gas Concentration

The zero and span test gas concentrations to be used as set points for calibration need to be set for the selected sample component and measurement range.

If the Limas21 or Uras26 analyzer module is equipped with calibration cells the test gas concentration does not have to be set.

Components for Calibration

The sample components to be calibrated during zero and span calibration need to be selected.

Cancel Management

Calibration is always terminated when there is a system bus fault and when the input “block” is set.

You can configure if the calibration is to be terminated when one of the three states occurs: “system failure”, “analyzer failure” or “analyzer maintenance request”.

You can also configure if the analyzer system should repeat calibration after the cause of termination has been eliminated. Set the number of repetitions and the time between repetitions.

The configured repetition is not effective when the calibration has been terminated by enabling the input “Cancel” of the **autocalibration** function block.

Continued on next page

Pump

This determines whether the pump is on or off during automatic calibration. This setting also applies to manual calibration.

Purge Time

This determines the length of the interval during which the gas paths will be purged to eliminate any residual gases that might interfere with calibration or measurement:

- Between turning on the zero gas flow and starting zero calibration
- Between turning on the test gas flow and starting span calibration
- Between restarting the sample gas flow and initiating measurement

The purge time should be set to at least three times the T_{90} time of the entire analyzer system.

Single Zero Calibration

Determines whether zero calibration will always or never be carried out alone, i.e. without subsequent span calibration.

Single Span Calibration

Determines whether span calibration will always or never be carried out alone, i.e. without prior zero calibration.

Zero and Span Calibration

Determines whether zero and span calibration will be carried out jointly always or never or at every n^{th} automatic calibration.

Example:
- Single Zero Calibration — Always
- Single Span Calibration — Never
- Common Zero and Span Calibration — Every 7^{th}

This setting effects with a cycle time of 1 day a zero calibration being carried out every day and a span calibration being carried out once a week.

For the Magnos206, Magnos28 and Magnos27 analyzer modules, these parameters must be set up such that the zero point calibration always precedes end point calibration.

Calibration Method

The method for automatic calibration needs to be set for the selected sample component (see also “Calibration Methods” section, page 89).

The zero and span calibration measurement ranges for common and substitute gas calibration are chosen in the `Manual calibration` → `Calibration method` parameter.

The “Calibration method” parameter is not available in the Limas21 and Uras26 analyzer modules since automatic calibration is always run as common calibration.

Calibration Methods

Calibration Method

An analyzer module (detector) can have one or more (gas) components with one or more measurement ranges each.

To calibrate the analyzer module, establish whether the components and ranges should be calibrated jointly or individually. This decision is based on the calibration method configuration.

Single Calibration

The analyzer module start and span values for each measurement range are calibrated individually for each sample component.

Single calibration has no effect on other measurement ranges for the same sample components and on other sample components.

Single calibration is only possible and practical in the manual calibration mode. Single calibration is required if there are skips in the readings during measurement range switches because these indicate differences in the calibrations of the individual measurement ranges.

Note: Skips in readings during measurement range switches do not occur in the Uras26, Limas21 and Magnos206, Magnos28 since these analyzer modules have only one physical measurement range.

Common Calibration

Only the analyzer module start- and end-points in one measurement range are calibrated for each sample component. The start- and end-points of the other measurement ranges are then corrected electronically on the basis of the values established by this calibration.

A common calibration has no effect on the other sample components in the analyzer module.

In general the start-point (zero) is calibrated in the smallest measurement range and the end-point (span) is calibrated in the measurement range for which a suitable test gas is available.

Substitute Gas Calibration

If test gases are not available for calibration, e.g. because test gas containers cannot be filled with them or because of incompatibilities between their components, an analyzer module can be set to substitute gas calibration. In this case, in addition to the sample component measurement ranges, one or more ranges are set up at the factory for substitute gas components.

One start-point and one end-point are calibrated in the analyzer module's substitute gas measurement ranges. The start- and end-points of all substitute gas and sample gas measurement ranges are then corrected electronically on the basis of the values established by the substitute gas calibration.

Substitute gas calibration **must always** be used to calibrate **all** (sample gas and substitute gas) components for analyzer modules set up for substitute gas calibration. Single or common calibration either in the sample component or substitute gas measurement ranges leads to erroneous analyzer module calibration.

Continued on next page

Overview

The following table summarizes the various calibration methods.

Quantity SC	Quantity MR	Calibration Method	To configure ...	Calibrate ...	Calibration affects ...
1	**1**	**Test Gas / Single**		• Zero • Span individually for each sample component and range	Measurement range
≥ 1	**> 1**	**Test Gas / Common**	Measurement ranges for zero and span calibration	• Zero in one measurement range • Span in another range for each sample component	All sample component measurement ranges
> 1	**≥ 1**	**Substitute Gas**	Components and measurement ranges for zero and span calibration	• Zero in one component measurement range • Span in one range for another component for each detector	All detector components and measurement ranges

SC = Sample and Substitute Gas Components
MR = Measurement Ranges per Component

Setting the Calibration Method

(see Figure 16)

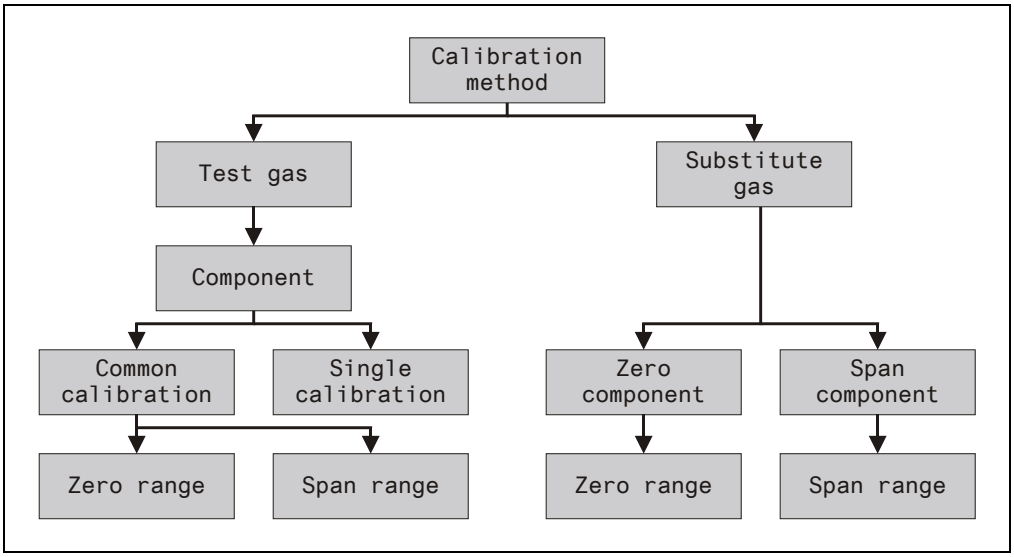
The calibration method can be set separately for manual, automatic and externally controlled calibration.

For common and substitute gas calibration the sample ranges for start- and end-point calibration of all three types of calibration control are adjusted jointly.

For substitute gas calibration the zero and span calibration components should also be set.

Figure 16

Setting the Calibration Method



Validation

Validation Procedure

Validation runs in principle just like an automatic calibration. The difference is that during validation a measurement value deviation from the set point values is not corrected automatically. Instead the procedure is as follows:

- When the (test gas) measurement values for start and end point are within the initialized limit values the success of the validation is recorded in the logbook.
- When the (test gas) measurement values for start and end point are outside the initialized limit values the failure of the validation is recorded in the logbook. Either the “maintenance request” status is set or a calibration of the sample component is performed.

Validation Parameters

The parameter settings for automatic calibration also apply to validation.

After selecting validation in the `Operating mode` parameter, it must be set

- If the validation result shall be logged and
- If in case of a validation failure
  - the “maintenance request” status shall be set or
  - the sample component shall be calibrated.

In the `Test gas concentration` parameter the start- and end-point limit values have to be set for each sample component. If these limit values are over- or undershot the validation is rated as failure.

AO2000-Fidas24: Concentration Data Conversion

Different Concentration Data Units

The concentration is expressed in various units in the measurement of organic carbon compounds (total C):

- mg org. C / m^3 (e.g., in measurements per 17. BImSchV [17th Regulation of Federal Emission Protection Act])
- mg C_nH_m / m^3
- ppm C_nH_m (e.g., in measurements per TA-Luft [Technical Directive for Air], data on test-gas cylinders)

Thus it is often necessary to convert concentration data from one unit to another.

Conversion ppm → mg C_nH_m / m^3

$$\text{mg } C_nH_m/m^3 = \text{ppm} \times \frac{\text{Molecular Weight}}{V_m}$$

Conversion ppm → mg C / m^3

$$\text{mg C}/m^3 = \text{ppm} \times \frac{\text{Number of C atoms} \times 12.011}{V_m}$$

Mole volume V_m = 22.414 for 0 °C and 1013 hPa, V_m = 24.05 for 20 °C and 1013 hPa

Example 1

A Fidas24 analyzer has a measurement range of 0-50 mg C/m^3. Propane (C_3H_8) in N_2 or in air is used as the test gas.

How large can the maximum test gas concentration be in ppm or mg/m^3 without exceeding the measurement range?

$$\frac{50 \times 22.414}{3 \times 12.011} = 31.102 \text{ ppm } C_3H_8$$

$$\frac{31.102 \times (3 \times 12.011 + 8 \times 1.008)}{22.414} = 61.19 \text{ mg } C_3H_8/m^3$$

Continued on next page

Example 2

If a gas other than propane is used, its response factor must be considered (see “Response Factor” section on page 94).

If methane (CH_4) is used, how large can the maximum test gas concentration be in ppm or mg/m^3 without exceeding the measurement range?

$$\frac{50 \times 22.414}{1 \times 12.011} = 93.306 \text{ ppm } CH_4$$

$$\frac{93.306 \times (1 \times 12.011 + 4 \times 1.008)}{22.414} = 66.785 \text{ mg } CH_4/m^3$$

The methane response factor is 1.07; i.e. the sample value indication is too large by this factor. To determine the maximum test gas concentration that avoids exceeding the measurement range, the measured value reading should be divided by the response factor.

$$\frac{93.306}{1.07} = 87.202 \text{ ppm } CH_4$$

$$\frac{66.785}{1.07} = 62.416 \text{ mg } CH_4/m^3$$

A test gas container with approx. 80 ppm of CH_4 is specified. According to the certificate, the test gas concentration in the test gas container is 81.2 ppm CH_4.

This is equivalent to a concentration of

$$\frac{81.2 \times 1 \times 12.011}{22.414} = 43.513 \text{ mg C}/m^3$$

Considering the response factor, the indication should be adjusted to

$$43.513 \times 1.07 = 46.559 \text{ mg C}/m^3$$

AO2000-Fidas24: Response Factor

Definition

$$\text{Response factor} = \frac{\text{Meas. value indication}}{\text{Concentration}} \text{ or}$$

$$\text{Concentration} = \frac{\text{Meas. value indication}}{\text{Response factor}}$$

By definition, the response factor for propane (C_3H_8) is equal to 1.00.

Response Factors

Response factors for the AO2000-Fidas24 analyzer module are listed in the table below.

Response factors for an individual analyzer module may differ slightly from the values below.

Sample Component		Response Factor[1)]
Acetone	C_3H_6O	0.71
Benzene	C_6H_6	1.07
Butane	C_4H_{10}	0.98
Butyl acetate	$C_6H_{12}O_2$	0.84
Chlorobenzene	C_6H_5Cl	1.02
Cyclohexane	C_6H_{12}	1.02
Ethane	C_2H_6	1.01
Ethyl acetate	$C_4H_8O_2$	0.72
Ethylbenzene	C_8H_{10}	0.89
Ethyne (Acetylene)	C_2H_2	0.95
Isopropanol	C_3H_8O	0.74
Methane	CH_4	1.07
n-Heptane	C_7H_{16}	0.94
Perchloroethylene (Tetrachloroethene)	C_2Cl_4	0.97
Propane	C_3H_8	1.00
p-Xylene	C_8H_{10}	0.89
Toluene	C_7H_8	0.96

1) Measurement of the components in synthetic air

Safety Information

CAUTION!

Only persons familiar with the maintenance of comparable analyzer systems and certified as being capable of such work should work on the system.

Safety Labels Affixed to the Analyzer System

CAUTION!

Observe the safety labels affixed to the analyzer system or to the individual components:

Consult Documentation!

Hot Surface! (Temperature > 60 °C)

Corrosive Material!

Risk of Electric Shock!

Harmful Substances

CAUTION!

When working with corrosive reagents note the hazard information and safety precautions contained in the applicable material safety data sheets.

Condensates are often acidic. Neutralize condensates and follow the prescribed measures for disposal.

Harmful Gases

CAUTION!

Some of the gases measured with the analyzer system are harmful to health.

Therefore, the sample gas must not escape from the gas path during normal operation and maintenance works.

A seal integrity check of the analyzer system has to be performed at regular intervals.

The diluted exhaust gas must be drained out of the installation room of the analyzer cabinet.

Filter Unit: Replacing the Filter Element

CAUTION!

Prior to performing any maintenance works on the analyzer system be sure to activate the “Maintenance Mode” on the “Control Panel” screen (see page 66) thus setting the “Maintenance Mode” status signal.

Be sure to reset this setting after finishing the maintenance work.

Part Numbers

Filter insert: 0730683
Filter stone: 0730682 (0,3 µm)

Cleaning the Filter Element

If the filter element is not permeable enough anymore, remove it so that you can remove the contamination mechanically.

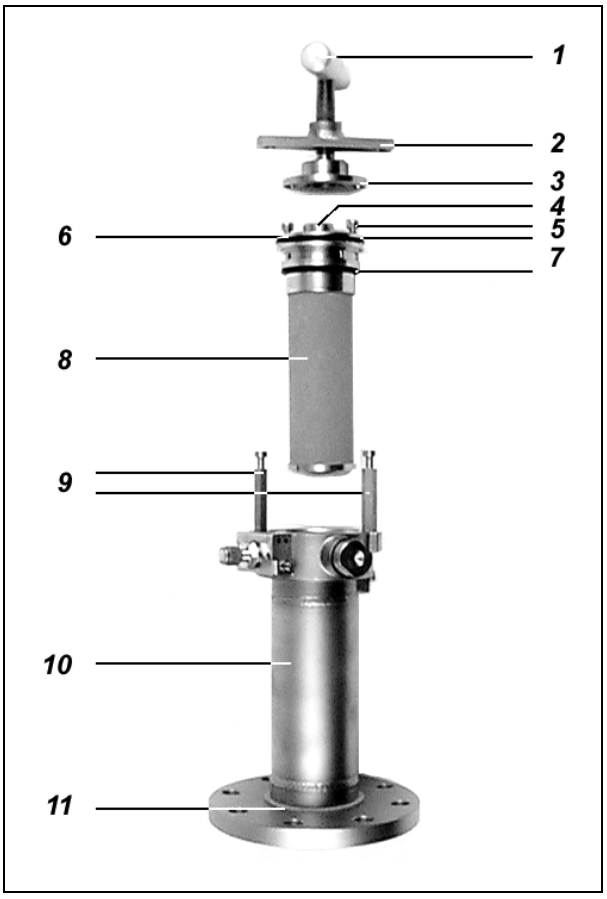
Replacing the Filter Stone

If the filter stone is obviously damaged, replace it with a new one.

To avoid a prolonged down time of the analyzer system the complete filter insert should be changed. The disassembling, cleaning and assembling of the used filter stone and O-rings should be done separately.

Figure 17

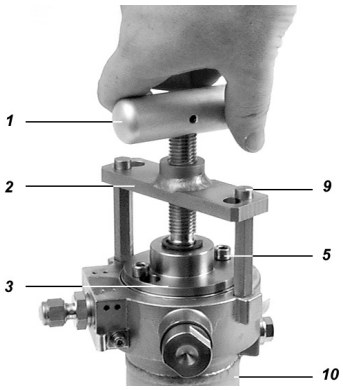
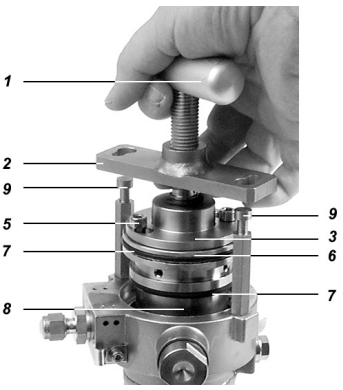
Filter Element



1 T-handle
Bridge
Detaching disk
Locking screw
Removal screws
Flange
O-ring seals
Filter element
Bridge holding device
Casing
Casing inner seal (green)

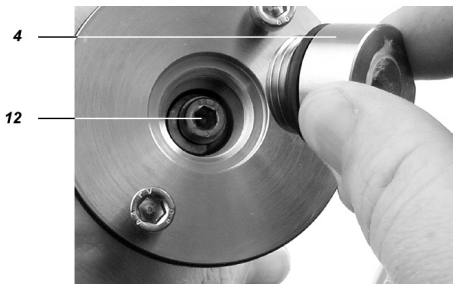
Continued on next page

Replacing the Filter Element

Step	Action	
1	Turn the T-handle ***1*** of the filter removal device ***1-3*** in counter-clockwise direction. This pulls the filter element ***8*** via the detaching disk ***3*** out of the casing ***10***.	
2	Turn bridge ***2*** until it can be pulled off from the bridge holding device ***9*** through the elongated holes.	
3	Pull out filter element ***8*** with bridge ***2*** and detaching disk ***3***.	
4	Turn detaching disk ***3*** until it can be pulled off from the hexagon screws ***5*** via the elongated holes.	
	⚠ Never loosen or tighten the hexagon screws ***5***. They have been adjusted at the factory so that the detaching disk ***3*** can be easily moved.	

Continued on next page

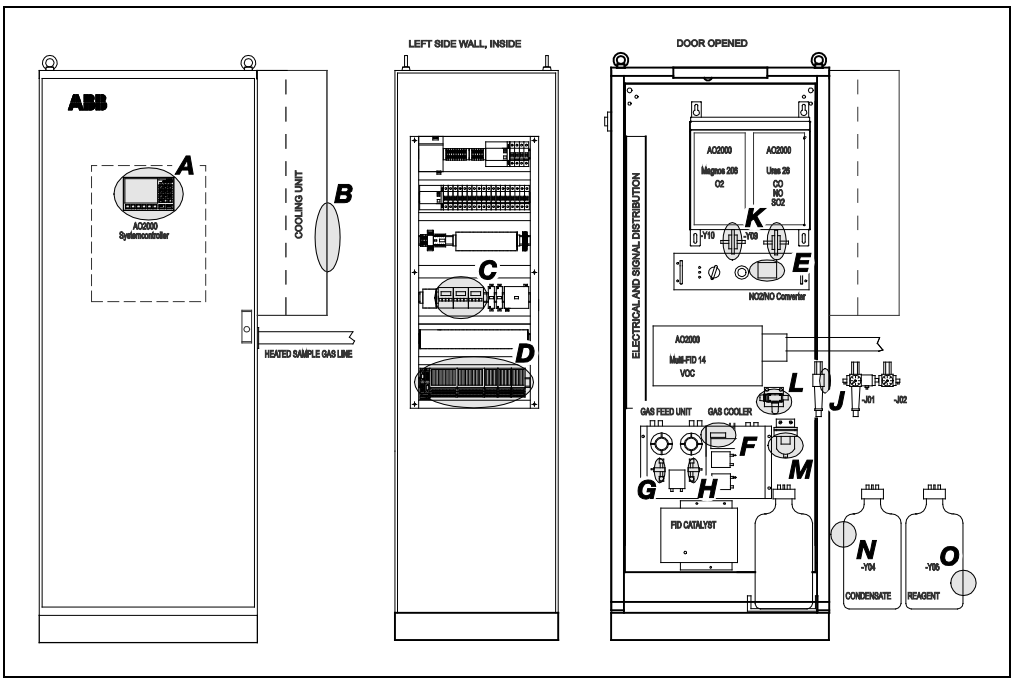
Step	Action
either	
5	Clean the filter element ***8***.
6	Replace seals ***7*** (O-rings from the accessory set). Re-lubrication is not necessary even after replacing O-rings ***7***. It is not necessary to replace the green casing inner seal ***11*** between flange ***6*** and casing ***10***.
7	Re-install the filter element ***8***: Steps 1 to 4 in reverse order.
or	
5	Screw off locking screw ***4*** with open-end spanner NW 22.
6	Screw out the hexagon socket screw ***12*** underneath locking screw ***4***.
7	Take out the filter stone.
8	Insert a new filter stone (with new O-rings from the accessory set).
9	Replace seals ***7*** (O-rings from the accessory set). Re-lubrication is not necessary even after replacing O-rings ***7***. It is not necessary to replace the green casing inner seal ***11*** between flange ***6*** and casing ***10***.
10	Re-install the filter element ***8***: Steps 1 to 4 in reverse order.



Analysis Cabinet: Visual Inspection

Figure 18

View of the Analysis Cabinet



Visual Inspection

(see Figure 18)

	Device, Module	Nominal condition
	External gas cylinder pressure reducers:	
	Test gas oxygen analyzer AO2000-Magnos27	1.2 ± 0.1 bar
	Combustion gas VOC analyzer AO2000-Fidas24 (H_2)	1.2 ± 0.1 bar
	Zero gas VOC analyzer (N_2)	1.2 ± 0.2 bar
	Span gas VOC analyzer (Propane in N_2)	1.2 ± 0.2 bar
A	Display: Measured values, status messages	see page 65 see page 157
B	Cooling unit or fan outlet filter: Filter mesh	see page 104
C	Temperature controllers of heated probe tube, heated filter and heated sample gas line	180 °C each
D	Status LEDs of analog and digital output modules	Green
E	Temperature of NO_2/NO converter	340 °C
F	Temperature of sample gas cooler	+ 3 °C
G	Sample gas flow gas path 1	> 60 l/h
H	Sample gas flow gas path 2 (option)	> 60 l/h
J	Instrument air pressure regulators:	
	Main regulator (-J01)	4.0 ± 0.5 bar
	Combustion air VOC analyzer (-J02)	1.2 ± 0.1 bar
K	Condensate traps -Y09, -Y10	see page 105
L	Air filter	see page 106
M	Acid filter (filter element)	see page 107
N	Level of condensate collection bottle -Y04	see page 108
O	Level of reagent supply bottle -Y05	see page 108

Analysis Cabinet: Cleaning

Cleaning Hints

- Never use water or any solvents to clean parts inside the analysis cabinet.
- Always operate the analyzer system with cabinet door closed. Remove dust inside the analysis cabinet using a broom and a vacuum cleaner.
- Clean the outside of the analysis cabinet with a wet towel and mild cleaning agents. Pay attention that no droplets invade the cabinet.

Analyzer System: Seal Integrity Check

CAUTION!

Prior to performing any maintenance works on the analyzer system be sure to activate the "Maintenance Mode" on the "Control Panel" screen (see page 66) thus setting the "Maintenance Mode" status signal.

Be sure to reset this setting after finishing the maintenance work.

When is the seal integrity check needed?

The seal integrity check must be performed regularly. It must be performed in any event when the respective status message is displayed.

The seal integrity check methods differ depending on whether a VOC analyzer (AO2000-Fidas24) is installed in the analyzer system.

Seal Integrity Check of Analyzer System without VOC Analyzer

The seal integrity check should be performed according to the pressure-drop method using a U-tube manometer when no VOC analyzer is installed in the analyzer system.

Step	Action
1	Interrupt the sample gas supply.
2	Close the sample gas outlet.
3	Disconnect the sample gas line from the sample gas inlet and connect a tee fitted with a shut-off valve.
4	Connect a U-tube manometer half filled with water to the free end of the tee.
5	Blow air or nitrogen through the shutoff valve to a gauge pressure of $p_e \approx$ 100 hPa (= 1000 mm water column).
6	Close the shut-off valve. The pressure should not change measurably in 1 minute (pressure drop $\leq$ 1 hPa). A sharp pressure drop is a sign of a leak.

Seal Integrity Check of Analyzer System with VOC Analyzer

When a VOC analyzer is installed in the analyzer system,

- disconnect the sample gas line which runs to the other gas analyzers from the AO2000-Multi-FID14 sample gas connection and
- perform the seal integrity check for the analyzer system without the AO2000-Fidas24 according to the pressure-drop method described above.

The sample gas path in the AO2000-Fidas24 cannot be checked for seal integrity.

Continued on next page

Seal Integrity Check of Combustion Gas Path in an Analyzer System with VOC Analyzer

Check seal integrity of the combustion gas line in the analyzer system with a leak detector (measuring principle: thermal conductivity). Leak rate < 2×10^{-4} hPa l/s. Do not use leak detection spray!

It is recommended to check regularly the seal integrity of the combustion gas line outside the analyzer system.

The combustion gas path inside the VOC analyzer is checked for leaks at the factory. No seal integrity testing is required during normal operation.

Seal Integrity Check of Back-Purging Unit

Step	Action
1	Close the water precipitator outlet (part of the pressure regulator combination).
2	Connect instrument air with operating pressure = 6 bar to the back-purging unit inlet.
3	Spray the complete compressed-air path with leak detection spray.

Analyzer System: Wear Part Replacement

CAUTION!

Prior to performing any maintenance works on the analyzer system be sure to activate the “Maintenance Mode” on the “Control Panel” screen (see page 66) thus setting the “Maintenance Mode” status signal.

Be sure to reset this setting after finishing the maintenance work.

Spare Parts Information

Spare parts information can be found on the Internet in the “Spare Parts Information and Ordering System Parts OnLine” using the address

http://www.abb.com/partsonline.

Battery on the System Controller

Type “Sonnenschein SL-360/S” or “Saft LS14500”

Analyzer Cabinet: Replacing the Cooling Unit / Fan Outlet Filter Mesh

Part No. Filter mesh: 830859

When is filter mesh replacement needed? The cooling capacity of the cooling unit or the ventilation fan depends upon the cleanness of the filter mesh. It should be replaced if it begins to turn dark.

Replacing the Filter Mesh

Step	Action
1	Remove the grid which holds the filter mesh in place.
2	Change the filter mesh.
3	Re-assemble the grid.

Analyzer System: Replacing the Condensate Trap

CAUTION!

Prior to performing any maintenance works on the analyzer system be sure to activate the “Maintenance Mode” on the “Control Panel” screen (see page 66) thus setting the “Maintenance Mode” status signal.

Be sure to reset this setting after finishing the maintenance work.

CAUTION!

The liquid precipitated in the condensate trap may contain acid! The used condensate trap can be loaded with acid!

Acid is caustic! Wear protection gloves and safety goggles! After contact with the eyes, rinse the eyes immediately with water and consult your doctor!

Dispose of the used condensate trap according to regulations!

Part No.

Condensate trap: 8018512

Inspection and Replacement

Inspect the condensate traps (1 per gas path) monthly. Every 12 months the condensate traps have to be replaced.

However, the condensate trap has to be replaced earlier

- if it has blocked the gas flow as a result of condensate penetration and
- if the minimum sample gas flow cannot be adjusted any longer.

Analyzer System: Replacing the Air Filter

CAUTION!

Prior to performing any maintenance works on the analyzer system be sure to activate the “Maintenance Mode” on the “Control Panel” screen (see page 66) thus setting the “Maintenance Mode” status signal.

Be sure to reset this setting after finishing the maintenance work.

Part No.

Air filter: 8018418

Inspection and Replacement

Inspect the air filter monthly. Every 12 months the air filter has to be replaced.

Replacing the Air Filter

Step	Action
1	Interrupt the sample gas supply.
2	Unscrew air filter -Y02 from solenoid valve -Y01 and replace with new air filter.
3	Supply the sample gas.

Analyzer System: Replacing the Acid Filter

CAUTION!

Prior to performing any maintenance works on the analyzer system be sure to activate the “Maintenance Mode” on the “Control Panel” screen (see page 66) thus setting the “Maintenance Mode” status signal.

Be sure to reset this setting after finishing the maintenance work.

CAUTION!

The liquid precipitated in the acid filter may contain acid! The used filter element can be loaded with acid!

Acid is caustic! Wear protection gloves and safety goggles! After contact with the eyes, rinse the eyes immediately with water and consult your doctor!

Dispose of acid according to regulations!

Part No.

Filter element: 23004-4-8018013

Inspection and Replacement

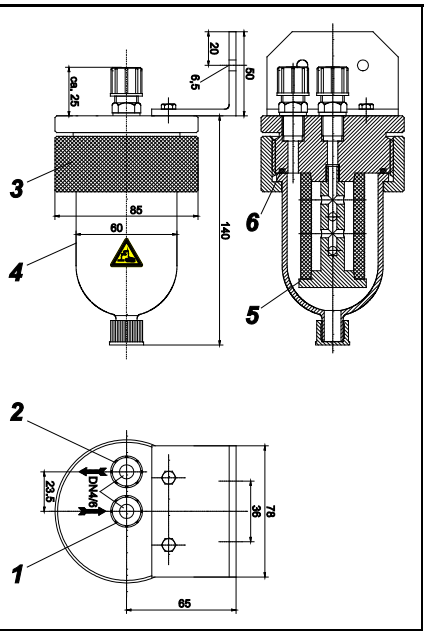
Inspect the acid filter monthly. Every 12 months the filter element has to be replaced.

However, it has to be replaced earlier

- if it is soiled and
- if the minimum sample gas flow cannot be adjusted any longer.

Replacing the Filter Element

Step	Action
1	Loose coupling nut ***3*** and remove glass tube ***4*** downwards.
2	Dispose of liquid according to regulations.
3	Screw the used filter element ***5*** out of the filter enclosure.
4	Screw new filter element in into the filter enclosure.
5	Check O-ring seal ***6*** in the filter enclosure for damage and correct position. If necessary, replace O-ring seal.
6	Put on glass tube ***4*** to filter element ***5*** from bottom and insert upwards into the filter enclosure. Tighten coupling nut ***3*** (not too firm and not too loose).
7	Check acid filter for leaks.
i	Sample gas inlet ***1*** and sample gas outlet ***2*** are marked with arrows on the filter case.



Analyzer System: Condensate Collection and Reagent Supply Bottles

CAUTION!

When working with corrosive reagents note the hazard information and safety precautions contained in the applicable material safety data sheets.

Condensates are often acidic. Neutralize condensates and follow the prescribed measures for disposal.

Condensate and Reagents

Empty the condensate collecting bottle and fill the reagent supply bottle when the applicable status messages are displayed (see page 166).

SCC-C Sample Gas Cooler: Cleaning the Heat Exchanger

CAUTION!

Prior to performing any maintenance works on the analyzer system be sure to activate the “Maintenance Mode” on the “Control Panel” screen (see page 66) thus setting the “Maintenance Mode” status signal.

Be sure to reset this setting after finishing the maintenance work.

CAUTION!

Residual condensate may be present in the heat exchanger. The condensate is often acidic.

Appropriate precautions should be taken, and relevant regulations on disposal should be complied with.

Cleaning the Heat Exchanger

The heat exchanger must be removed and re-installed when it is dirty and requires cleaning.

Removing and Installing the Heat Exchanger

(see Figure 19)

Step	Action
1	Stop the sample gas supply and shut off the sample gas cooler power supply.
	Remove the heat exchanger:
2	Disconnect sample gas and condensate pipes from connections ***1*** and ***2*** respectively of the heat exchanger.
3	Turn the heat exchanger slightly and draw it upwards to remove it from the cooling block ***3***.
	Prepare for installation of the heat exchanger:
4	Using a cloth, clean and dry the opening in the cooling block and the heat exchanger.
5	Use some adhesive tape to close off the condensate outlet on the heat exchanger in order to prevent the ingress of thermal conductive paste into the heat exchanger during installation.
6	Spread an even thin coating of thermal conductive paste over the entire surface of the opening in the cooling block and the heat exchanger in order to ensure good thermal transition.
	Install the heat exchanger:
7	Insert the heat exchanger in the opening in the cooling block ***3*** and, turning it slightly, push it downwards right to the limit stop.
8	Remove the adhesive tape from the condensate outlet on the heat exchanger and remove any thermal conductive paste that has been squeezed out.

Continued on next page

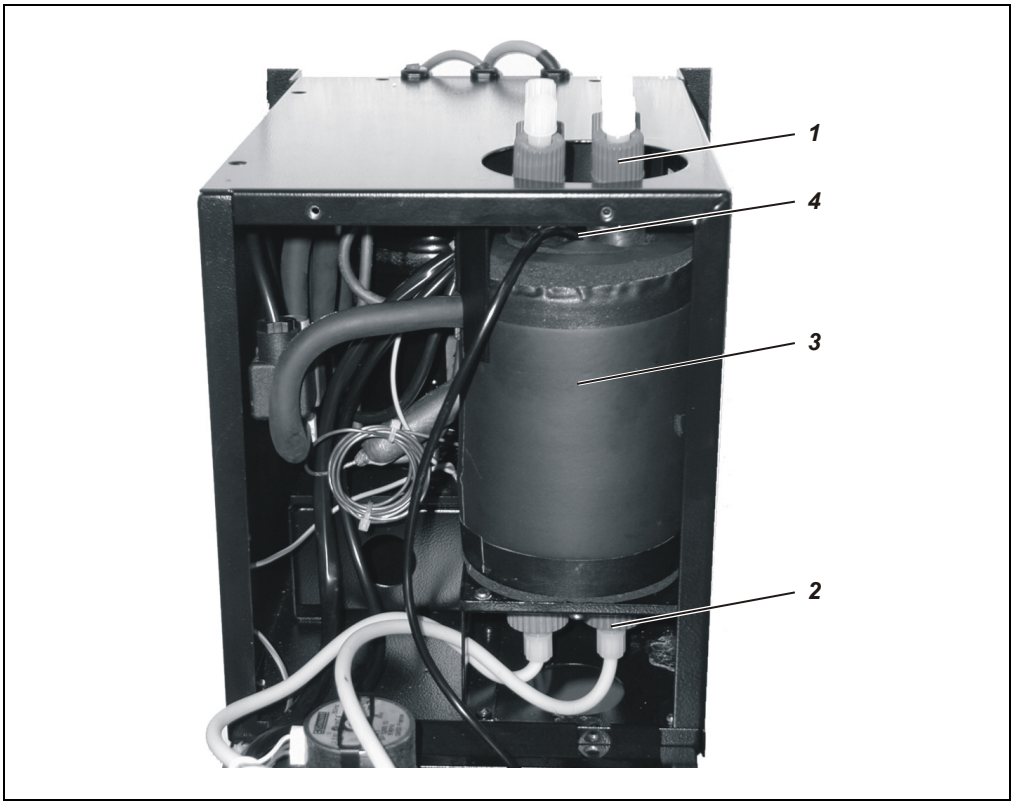
Removing and Installing the Heat Exchanger

(continued)

Step	Action
9	Connect the sample gas and condensate pipes to connections 1 and 2 respectively of the heat exchanger. Note the following points when installing a glass heat exchanger: Before fitting the GL coupling nuts you should check that the PTFE / silicone compression fittings are not damaged. The compression fittings should be fitted with their PTFE surface facing the glass. The GL coupling nuts should be hand-tightened.
10	Ensure that the temperature sensor ***4*** is inserted in the cooling block all the way to the limit stop.
	Start the sample gas cooler again:
11	Verify the integrity of the open gas path.
12	Switch power supply to sample gas cooler back on.
13	The sample gas flow should only be restarted after the lead time period.

Figure 19

Sample Gas Cooler, Front View, with Front Cover Open



1 Heat Exchanger Sample Gas Connections
Condensate Connections of the Heat Exchangers
Cooling Block
Temperature Sensor

SCC-C Sample Gas Cooler: Cleaning the Condenser Fins

CAUTION!

Prior to performing any maintenance works on the analyzer system be sure to activate the “Maintenance Mode” on the “Control Panel” screen (see page 66) thus setting the “Maintenance Mode” status signal.

Be sure to reset this setting after finishing the maintenance work.

When Should the Condenser Fins be Cleaned?

Cooling performance is reduced by the accumulation of dust on the condenser fins.

For this reason the condenser fins should be inspected regularly and cleaned if any dust deposits are visible.

Cleaning the Condenser Fins

(see Figure 20)

Step	Action
1	Stop the sample gas supply and shut off the sample gas cooler power supply.
2	Undo the 4 fastening screws on the front cover and open it forwards (the front cover remains attached in the rebate of the base plate).
3	Undo the 8 fastening screws on the covering hood, release the cable lug of the protective leads from the quick terminal on the inside of the covering hood, then lift the covering hood off.
4	Carefully blow compressed air onto the condenser fins ***1***.
5	Press the cable lug of the protective leads onto the quick terminal on the inside of the covering hood, put the covering hood in place (taking care not to trap any cables or hoses), and secure it in place with the 8 screws.
6	Close front cover (taking care not to trap cables or hoses), and fasten it with the 4 screws.
7	Switch power supply to sample gas cooler on.
8	The sample gas flow should only be restarted after the lead time period.

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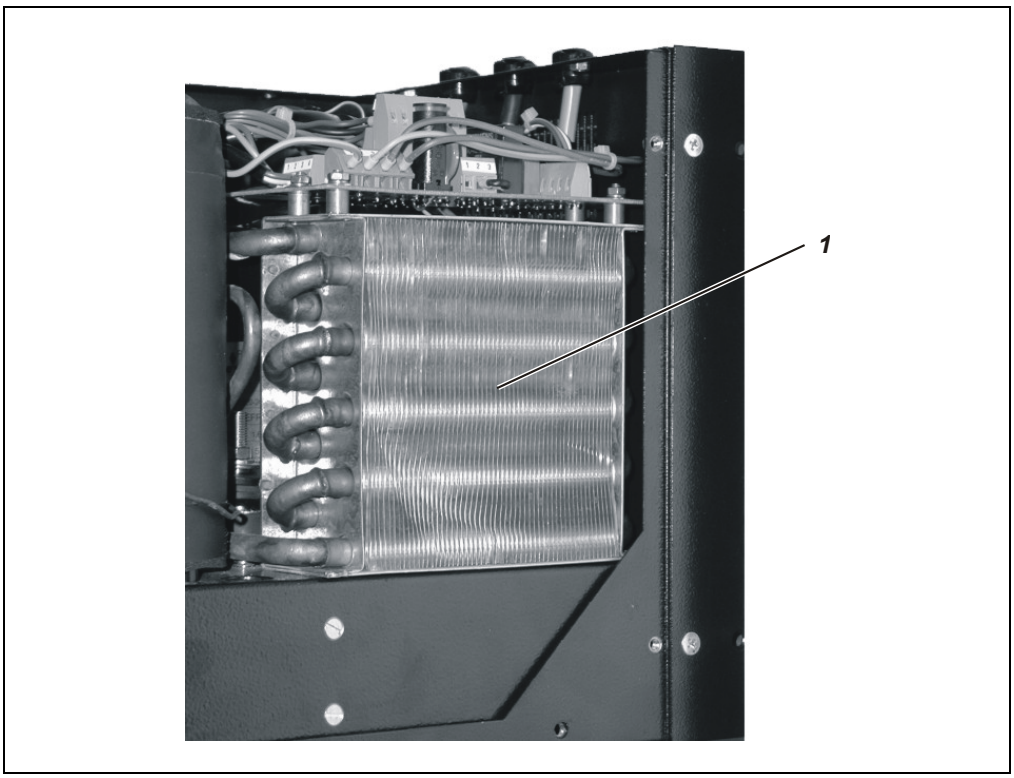
Figure 20

Condenser



1 Condenser Fins

SCC-C, SCC-F: Replacing the Pump Hose

CAUTION!

Prior to performing any maintenance works on the analyzer system be sure to activate the “Maintenance Mode” on the “Control Panel” screen (see page 66) thus setting the “Maintenance Mode” status signal.

Be sure to reset this setting after finishing the maintenance work.

CAUTION!

The pump hose can contain acid residue. These materials can flow out when the hose connections are opened.

Take appropriate measures where needed to collect residual acid. Appropriate precautions should be taken, and relevant regulations on disposal should be complied with.

When does the hose need to be replaced?

Depending on the operating cycle, the pump hose should be replaced at least every 6 months.

Replace Pump Hose

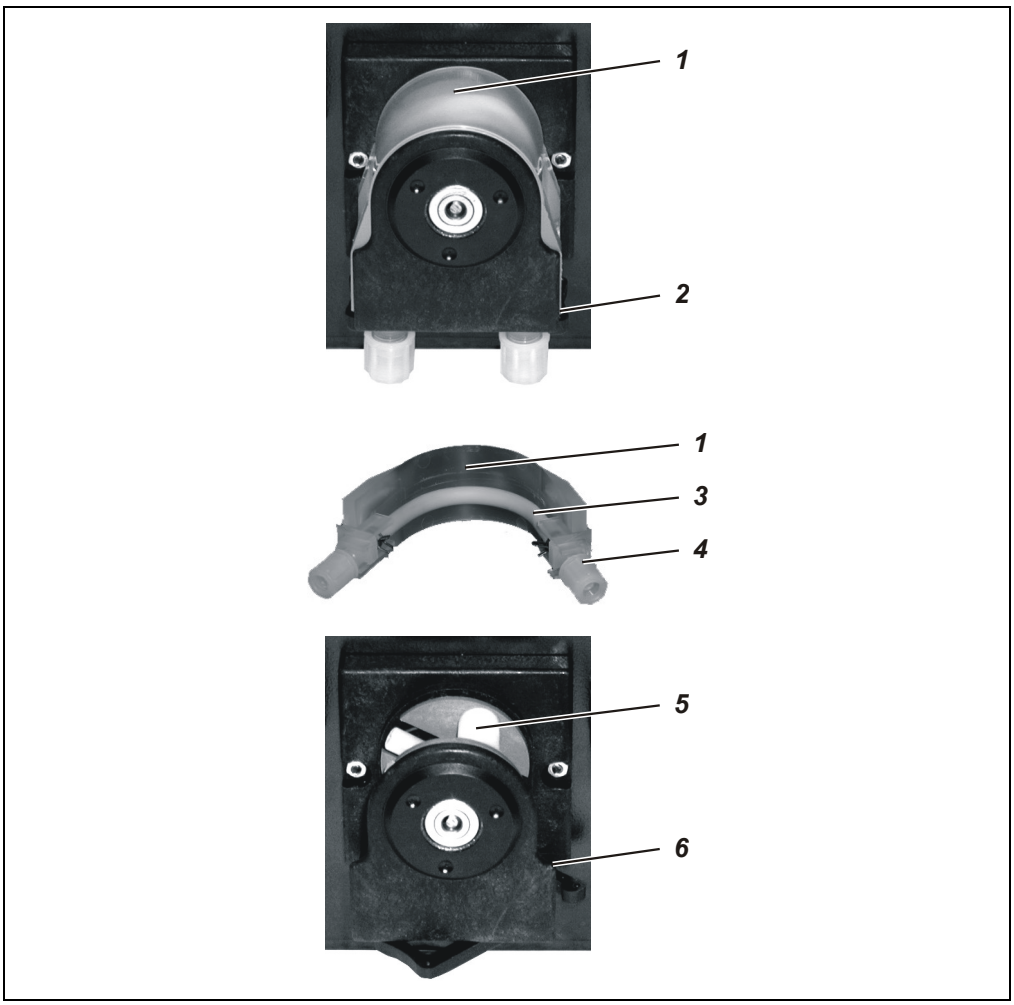
(see Figure 21)

Step	Action
1	Stop the sample gas supply and shut off the sample gas feed unit power supply.
Remove the old hose:	
2	Loosen the hose from the hose connections ***4***.
3	Using the handles, press the moving belt ***1*** together and turn the S-clip ***2*** in a clockwise direction as far as its limit stop.
4	Remove the moving belt ***1*** from the pump head and pull the old hose ***3*** by the hose connections ***4*** to release it from the moving belt’s guides.
5	Press the pressure rollers ***5*** together and check the spring pressure; if it is too weak, then the pressure springs and possibly rollers should be replaced (see page 115).
Fit a new hose:	
6	Insert a new hose ***3*** with hose connections in the guides on the moving belt ***1***. Do not lubricate the pump hose!
7	Insert moving belt ***1*** with the new hose in the dovetail guide ***6*** in the pump head; using the handles, press the moving belt together while at the same time turning the S-clip ***2*** counterclockwise until it engages.
8	Screw the hose to the hose connections ***4***. Take care not to kink or crush the hoses.
Start the sample gas feed unit again:	
9	Switch on power supply to feed unit.
10	The sample gas flow should only be restarted after the lead time period.

Continued on next page

Figure 21

**Hose Pump:
Hose and Pump Head
with Roller Mounting**



1 Moving belt
Hose
Pressure rollers
S-clip
Hose connections
Dovetail guides

SCC-C, SCC-F: Replacing the Pump Pressure Rollers and Springs

CAUTION!

Prior to performing any maintenance works on the analyzer system be sure to activate the “Maintenance Mode” on the “Control Panel” screen (see page 66) thus setting the “Maintenance Mode” status signal.

Be sure to reset this setting after finishing the maintenance work.

When do the pressure rollers and springs need to be replaced?

The pressure rollers in the hose pump must be replaced when their surface is damaged.

The pressure springs in the hose pump must be replaced when they are broken.

Replace Pressure Rollers and Springs

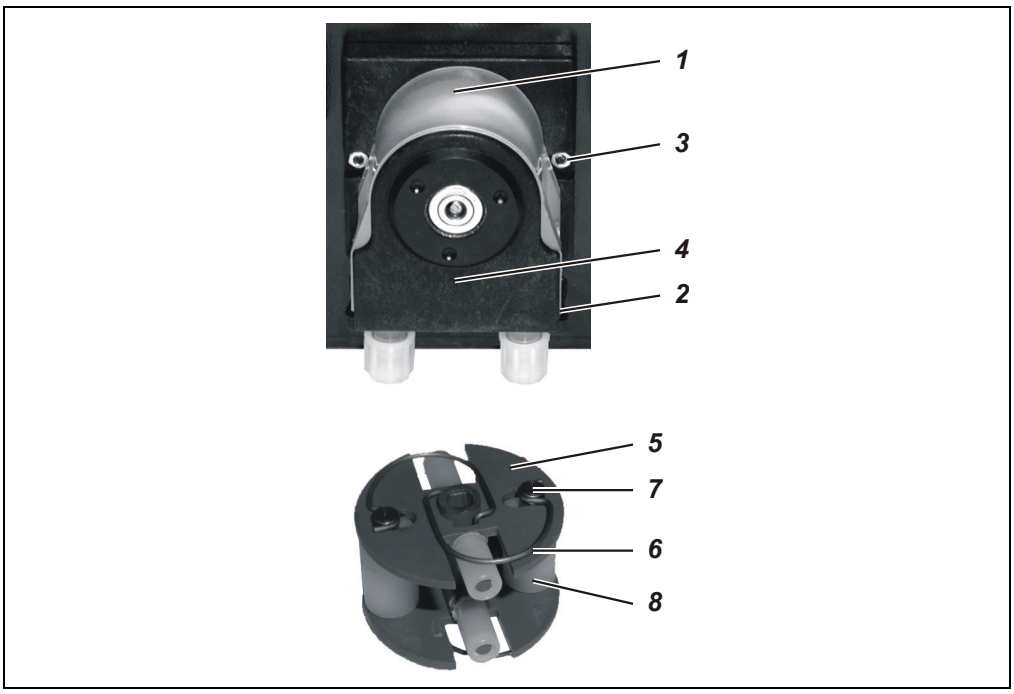
(see Figure 22)

Step	Action
1	Stop the sample gas supply and shut off the sample gas feed unit power supply.
Remove the hose:	
2	Using the handles, press the moving belt ***1*** together and turn the S-clip ***2*** in a clockwise direction as far as its limit stop; then remove the moving belt and hose from the pump head.
Dismantle the pump head:	
3	Unscrew the two nuts ***3*** that secure the pump head (spanner size 5.5).
4	Pull the pump head ***4*** off the roller bearing axle, and remove the roller mounting ***5*** from the pump head.
Replace pressure rollers and springs:	
5	Pull the pressure springs ***6*** out of the hole in the roller mounting ***5*** and out of the retaining slot in the roller axle ***7***. Remove the roller axle from the roller mounting, and pull the pressure roller ***8*** off the roller axle.
6	Push the new pressure roller ***8*** onto the roller axle ***7*** and secure with new pressure springs ***6*** in the roller mounting ***5***.
Fit the pump head:	
7	Insert the roller mounting ***5*** in the pump head ***4***, and push both components together onto the roller mounting axle. During this process, check to ensure that the roller mounting axle and roller mounting fit together properly.
8	Secure the pump head ***4*** with the two nuts ***3***. It is expedient to open the front panel forwards: this enables the pump’s base plate with the fastening screws to be secured from inside.
Refit the hose:	
9	Insert moving belt ***1*** with the hose in the pump head; using the handles, press the moving belt together while at the same time turning the S-clip ***2*** counterclockwise until it engages.
Start the sample gas feed unit again:	
10	Switch on power supply to sample gas feed unit.
11	The sample gas flow should only be restarted after the lead time period.

Continued on next page

Figure 22

Hose Pump: Roller Mounting



1 Moving belt
S-clip
Nuts for Securing the Pump Head (x 2)
Pump Head
Roller Mounting
Pressure Springs (x 4)
Roller Axle
Pressure Roller (x 2)

SCC-F Sample Gas Feed Unit: Replacing the Diaphragm and Valve Plates in the Diaphragm Pump

CAUTION!

Prior to performing any maintenance works on the analyzer system be sure to activate the “Maintenance Mode” on the “Control Panel” screen (see page 66) thus setting the “Maintenance Mode” status signal.

Be sure to reset this setting after finishing the maintenance work.

CAUTION!

Residues from the gas that the pump has been feeding may be found on the diaphragm and valve plates. These materials can flow out when the diaphragm pump is opened. Take appropriate measures where needed to collect such residues.

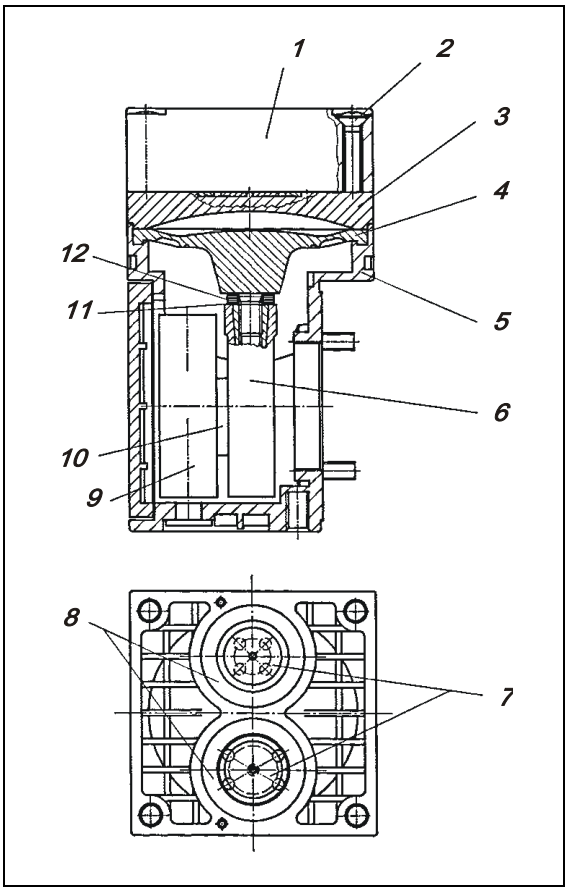
The medium being fed may be corrosive and poisonous. Appropriate precautions must be taken.

When do the diaphragm and valve plates need to be replaced?

The diaphragm and valve plates in the diaphragm pump must be replaced when the diaphragm pump no longer feeds gas efficiently enough.

Figure 23

Diaphragm Pump

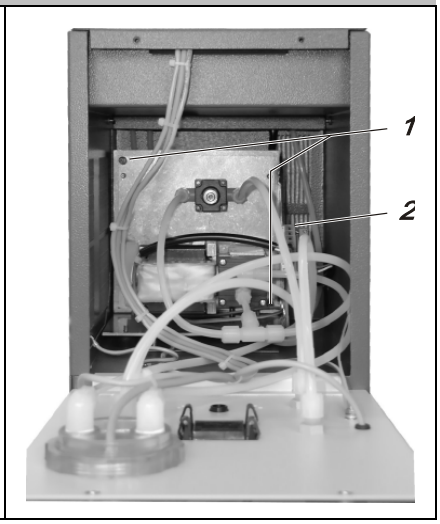


1 Head cap
Head cap screws
Spacer plate
Structural diaphragm
Casing
Connecting rod
Valve plates
Sealing rings
Counter weight
Eccentric
Belleville spring
Distance ring(s)

Continued on next page

Replace Diaphragm and Valve Plates in the Diaphragm Pump

(see Figure 23)

Step	Action
1	⚠ Stop the sample gas supply and shut off the sample gas feed unit power supply.
Dismantle the diaphragm pumps:	
2	Disconnect electrical connection ***2***, loosen two hex socket head screws ***1*** and remove mounting plate with the pumps from the sample gas feed unit's casing. 
3	Take off the pump hoses and clean the outside of the pump.
Remove the pump head:	
4	Mark the head cap ***1***, spacer plate ***3*** and casing ***5*** with a felt pen. This prevents the possibility of these parts being fitted incorrectly when the pump is reassembled later.
5	Undo the four head cover screws ***2*** and remove the head cap along with the spacer plate from the pump casing.
Replace diaphragm:	
6	Move the structural diaphragm ***4*** by rotating the fan impeller to its upper return point.
7	Hold opposite sides of the structural diaphragm, raise it, then remove it by rotating in a counterclockwise direction. ⓘ During this procedure you should take care to ensure that the Belleville spring ***11*** and the distance ring(s) ***12*** do not fall from the structural membrane's threaded bolt into the casing.
8	Remove the Belleville spring ***11*** and distance ring(s) ***12*** from the structural diaphragm's threaded bolt and retain them.
9	Check all the parts for dirt and, if necessary, clean them with a dry cloth or compressed air. ⓘ Do not use solvents for cleaning as they can attack the plastic parts.
10	Push the distance ring(s) and the Belleville spring in that order onto the threaded bolt of the new structural diaphragm. ⓘ The disk edge of the spring must be aligned with the structural diaphragm.
11	Move the connecting rod ***6*** to its upper return point.

Continued on next page

Replace Diaphragm and Valve Plates in the Diaphragm Pump

(continued)

Step	Action
12	Screw the new structural diaphragm with distance ring(s) and Belleville spring in a clockwise direction onto the connecting rod and hand-tighten it.
Replace valve plates:	
13	Separate head cap ***1*** from the spacer plate ***3***.
14	Remove the valve plates ***7*** and the sealing rings ***8*** from the spacer plate ***3***.
15	Check that the valve seats, spacer plate and head cap are clean; if any of them display unevenness, scratches or corrosion they should be replaced.
16	Insert the new valve plates in the valve seats on the spacer plate. The valve plates for the compression and suction sides are identical; the same applies to the upper and lower sides of the valve plates.
17	Move the valve plates gently in a horizontal plane to ensure that they are not locked.
18	Insert sealing rings in the spacer plate.
Fit the pump head:	
19	Using the fan impeller, move the structural diaphragm to its upper dead point.
20	Place the spacer plate ***3***, the valve plates ***7***, sealing rings ***8*** and the head cap ***1*** on the casing in accordance with the markings.
21	Check that the head cap is centered correctly by moving it gently sideways.
22	Tighten the head cap screws ***2*** crosswise only slightly.
23	Check that the pump moves freely by turning the fan impeller.
24	Using the fan impeller, move the structural diaphragm to its upper dead point.
25	Hand-tighten the head cap screws.
Reinstall diaphragm pumps:	
26	Connect pump hoses.
27	Insert mounting plate with the pumps into the sample gas feed unit's casing and fasten it with the two hex socket head screws ***1***. Connect electrical connection ***2***.
Start the sample gas feed unit again:	
28	Check that the gas paths have no leaks.
29	Switch on power supply to feed unit.
30	The sample gas flow should only be restarted after the lead time period.

SCC-K NO_2/NO Converter: Replacing the Catalyst Cartridge

CAUTION!

Prior to performing any maintenance works on the analyzer system be sure to activate the “Maintenance Mode” on the “Control Panel” screen (see page 66) thus setting the “Maintenance Mode” status signal.

Be sure to reset this setting after finishing the maintenance work.

CAUTION!

The catalyst cartridge is hot! Touching the cartridge can lead to very severe burns. Wear protective gloves and safeguard cartridge against unauthorized access!

CAUTION!

The catalyst material is irritant and highly flammable! Follow the instructions for use, storage and disposal of the catalyst material given in the enclosed information sheet!

Only original ABB spare parts and consumables may be used!

Catalyst Service Life

The catalyst service life depends essentially on the following factors:

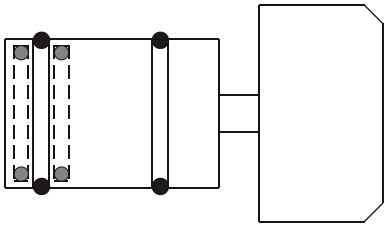
- Sample gas flow rate
- Temperature
- NO_2 concentration in the sample gas
- O_2 concentration in the sample gas

The catalyst service life is > 6 months for 30 l/h, 320 °C, 10 ppm NO_2 and 5 Vol.-% O_2. During the stated service life, conversion is over 95 %. If the degree of efficiency falls notably below 95 %, the used catalyst cartridge should be replaced.

Adverse conditions in the installation can lead to a substantially shorter catalyst service life!

Continued on next page

Replacing the Catalyst Cartridge

Step	Action
1	Switch the converter's sample gas path either internally or externally to bypass. Sample gas can exhaust from the converter during the replacement procedure if the sample gas path is not switched to bypass.
Removing the catalyst cartridge:	
2	Unlock the adapter of the catalyst cartridge by turning the handle and pull it out of the tube furnace. **CAUTION!** **The catalyst cartridge is hot!**
3	Pull the catalyst cartridge out of the adapter by twisting gently.
4	Remove the two outside and the two inside O-ring seals from the adapter. 
Mounting the catalyst cartridge:	
5	Insert new O-ring seals into the outside and inside seal grooves of the adapter. Do not damage the O-ring seals.
6	Introduce the new catalyst cartridge into the adapter with gentle twisting movements. In order to obtain the required gas tightness, take care that the cartridge is always inserted into the adapter right up to the stop!
7	Insert the catalyst cartridge into the tube furnace. Moisten the outer O-rings helps placing the cartridge into the tube furnace. Do not use grease for O-rings because it could affect the efficiency of the catalyst!
8	Lock the adapter of the catalyst cartridge in place by turning the handle.

AO2000-Uras26: Optical Alignment

Definition

Optical alignment of the Uras26 analyzer module will minimize asymmetry of the radiation which falls in through the sample and reference sides of the sample cell.

When should optical alignment be performed?

An optical alignment must always be performed

- If the offset drift has fallen below the permissible range (50% of the physical measurement range)
- After a component (emitter, sample cell, calibration unit / cell, detector) is installed in or removed from a beam path.

How should optical alignment be performed?

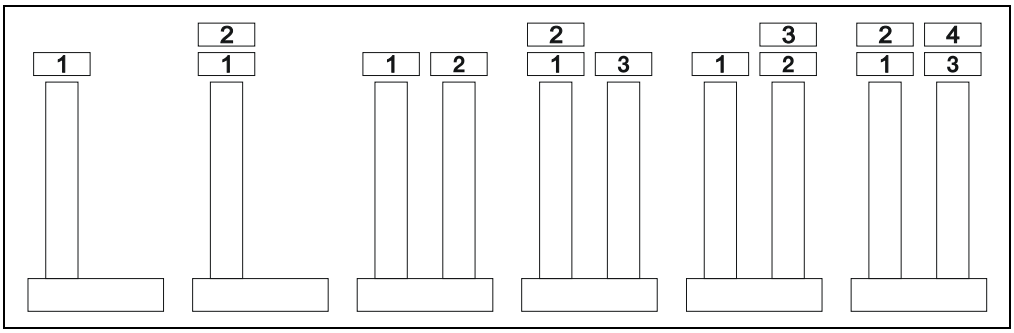
Each beam path in the analyzer module must be optically aligned separately. If there are two detectors in a beam path, the optical alignment should be performed in the rearmost detector (as seen from the emitter). During an optical alignment, beam path intensity is varied by means of mechanical apertures and, if necessary, by turning the emitter case.

Detector Arrangement

Figure 24 shows the detector arrangement. Detector numbers correspond to the numbers assigned to the series of measurement components as shown on the analyzer module identification plate.

Figure 24

Uras26 Analyzer Module Detector Numbering



Test Gas

During optical alignment the zero gas supply must be turned on.

Emitter Wrench

An “emitter wrench” is required to rotate the emitter case (see Figure 25, page 123). It is affixed to the analyzer module.

CAUTION!

Current-bearing components can be exposed when the covers or parts are removed, even if this can be done without tools. Current can be present at some connection points. All work on a analyzer system that is open and connected to power should only be performed by trained personnel who are familiar with the risks involved.

Menu Path

`MENU → Maintenance/Test → Analyzer spec. adjustm. → Optical adjustm.`

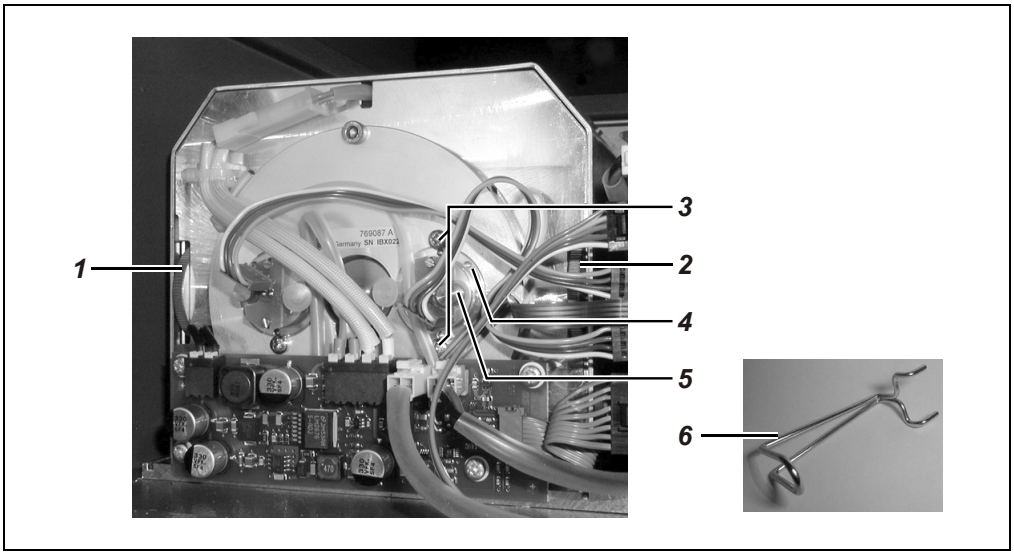
Continued on next page

Procedure

Step	Action		
1	Turn on the zero gas supply.		
2	Open the housing door.		
3	Select the `Optical adjustm.` menu item.		
4	Select the `Sample component` to be measured in the rear detector (as seen from the emitter).		
5	Minimize the (zero gas) value displayed by turning the applicable beam path aperture adjustment screw ***1*** or ***2*** with a screwdriver (see Figure 25).		
	If		Then
	The measurement value is much smaller than 1,000,000		Go to Step 10.
	The measurement value is greater than 1,000,000		Go to Step 6.
6	Loosen the two emitter case mounting screws ***3*** and insert the emitter wrench ***6*** in openings ***4***.		
7	Turn the emitter case ***5*** until the displayed value is minimized. (The minimum can be greater than 150000.)		
8	Tighten the emitter unit mounting screws ***3***.		
9	Repeat steps 5 to 8 until a minimum value is displayed.		
10	Close the housing door.		
11	If	Then	
	The emitter is replaced	Perform a phase alignment for all sample components (see page 9-6).	
	The emitter is not replaced	Calibrate the zero and span points for all sample components in the beam path.	

Figure 25

Uras26 Analyzer Module Emitter



1 Beam path 1 aperture adjustment wheel
Beam path 2 aperture adjustment wheel
Two emitter case mounting screws (beam path 2 here)
Openings for emitter wrench insertion
Emitter case
Emitter wrench

AO2000-Uras26: Phase Alignment

Definition

Sample / reference signal phasing is optimized in the Uras26 by performing a phase alignment.

When should phase alignment be performed?

A phase alignment must always be performed after optical alignment when the emitter is replaced (see page 122).

How should phase alignment be performed?

A separate phase alignment must be performed for each detector (= sample component) in an analyzer module.

The phase alignment is performed electronically and there is no need to open the system housing.

Test Gases

During the phase alignment a zero and span gas supply should be turned on successively for each sample component.

If the analyzer module is equipped with calibration units the calibration cells are automatically inserted in the beam path for span alignment. Meanwhile zero gas must remain turned on.

Menu Path

MENU → Maintenance/Test → Analyzer spec. adjustm. → Phase adjustm.

Procedure

Step	Action	
1	Select the `Phase adjustm.` menu item.	
2	Select the `Sample component`.	
3	Turn on the zero gas supply.	
4	Wait until the measurement value reading stabilizes and activate the alignment procedure.	
5	If	Then
	The analyzer module has no calibration cells	Turn on the span gas supply.
	The analyzer module is equipped with calibration cells	Let the zero gas be turned on.
6	Wait until the measurement value reading stabilizes and activate the alignment procedure.	
7	Repeat steps 2 to 6 for all sample components.	
8	Calibrate the zero and span points for all sample components in the analyzer module.	

AO2000-Limas21, AO2000-Uras26: Measurement of Calibration Cells

Definition

The measurement of a calibration cell in the Limas21 and Uras26 analyzer modules means:

Determining what calibration cell “deflection” is equivalent to the test gas calibration reading. This “deflection” is stored as the calibration cell “set value”.

When should calibration cells be measured?

We recommend measuring the calibration cells once a year.

We recommend measuring the calibration cells
- after end-point calibration of a sample component with test gas or
- after any change in measurement range limits (see page 77) or
- after a relinearization (see page 126).

Before Measuring the Calibration Cells

Prior to measuring the calibration cells, the zero and end points of the applicable sample components must be calibrated with test gases.

Test Gas

During calibration cell measurement the zero gas supply must be turned on.

Menu Path

`MENU → Maintenance/Test → Analyzer spec. adjustm. → Measure cal. cell`

AO2000-Limas21, AO2000-Uras26: Relinearization

When should relinearization be performed?

Sample component relinearization should be performed
- If the linearity deviation exceeds the permissible 1% of span
- If the start of a suppressed measurement range is to be calibrated
- After a component (lamp / emitter, sample cell, calibration unit / cell, and detector) is installed in or removed from a beam path.

We recommend performing the relinearization of a sample component after measurement range limits have been changed (see page 77).

Test Gases

Depending on the number and type of measurement ranges, test gases with varying concentrations are required for relinearization.

Number and Type of Meas. Ranges	Test Gas Concentration
1 Measurement Range	Approx. 40-60% of the measurement range end value (“center point gas”)
2 Measurement Ranges	End value of smaller measurement range
2 Measurement Ranges, 1 of which is suppressed	Start value of suppressed measurement range

Menu Path

`MENU → Maintenance/Test → Analyzer spec. adjustm. → Relinearization`

Procedure

Step	Action
	Relinearization is performed separately for each sample component.
1	Perform the basic calibration for the zero and span of the sample component to be relinearized (see page 146).
2	Select the `Relinearization` menu item.
3	Select the `Sample component`.
4	Turn on the test gas supply.
5	Enter the test gas concentration set point value.
6	Wait until the measurement value reading stabilizes and activate the alignment procedure.
7	Repeat steps 3 to 6 for all sample components.

AO2000-Limas21: Thermal Link Replacement

When should a thermal link be replaced?

A defective thermal link will usually be indicated by an Insufficient Sample Cell Temperature (T - Re . K) or Lamp Temperature (T - Re . L) error message (see “Status Messages” section, page 158). In this case check the thermal link and replace as necessary.

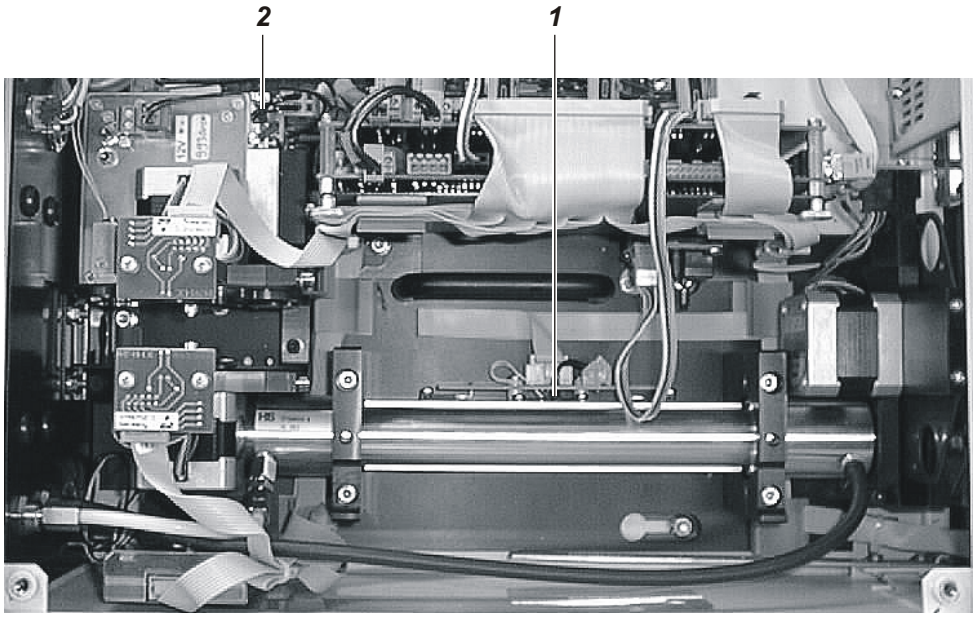
Thermal Link Replacement

(see Figure 26)

Step	Action
1	Turn off the gas analyzer power supply.
2	Open the housing door. **CAUTION!** **The sample cell and the lamp are hot (approx. 55 / 60 °C)!**
3	Disconnect the thermal link from the sample cell ***1*** and / or the lamp ***2***.
4	Release the spring clips and/or retainer and pull the thermal link from the opening.
5	Check the continuity of the thermal link; if necessary, insert a new thermal link (part number 0745836) in the opening and secure it with the spring clips and/or retainer.
6	Connect the thermal link.
7	Close the system housing. Light penetration during operation leads to erroneous measurement values and measurement range overflows (“Intensity” status message).
8	Turn on the gas analyzer power supply.

Figure 26

Thermal Links in the Limas21 Analyzer Module



1 Sample cell thermal link

Lamp thermal link

AO2000-Limas21: Aluminum Sample Cell Cleaning

When should the sample cell be cleaned?

Sample cell contamination can result in unstable measurement values due to low lamp intensity (see “Limas21 Problems”, page 174).

Status Messages

When beam intensity becomes too low the appropriate status messages will be displayed. For additional information see the “Status Messages” section, page 158.

Material Required

Quantity	Description
	For cleaning: Neutral detergent, deionized water, ethanol
	For drying: Oil- and dust-free (instrument) air or nitrogen
1	Spray bottle
2	Plug to close off sample cell
2	Pieces of FPM / FKM tubing or PTFE pipe

Aluminum Sample Cell Cleaning

(see Figure 27)

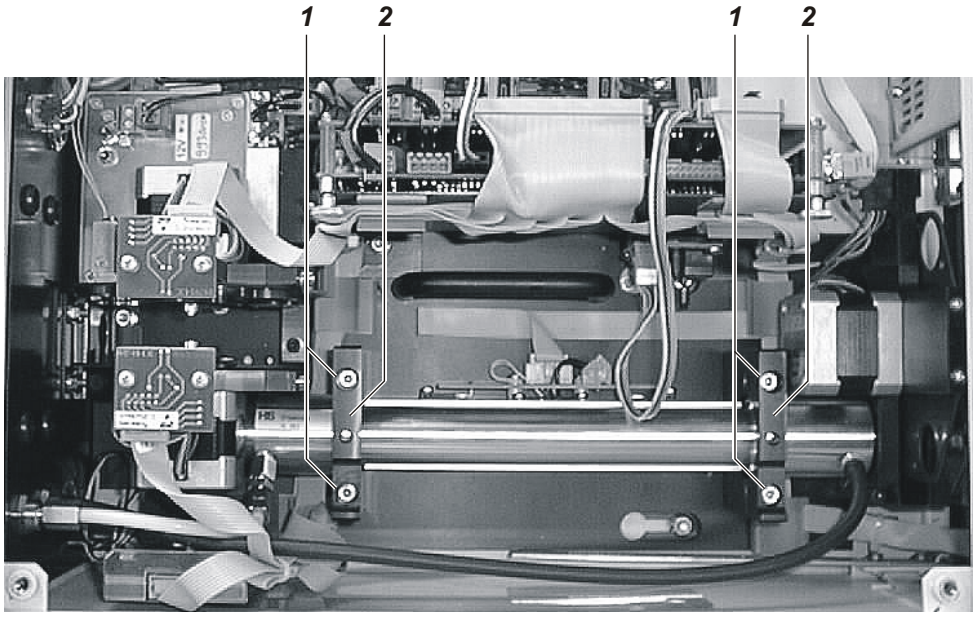
Step	Action
Preparation for sample cell removal:	
1	Turn off the sample gas supply to the analyzer module. Turn off the gas analyzer power supply.
2	Open the housing door. **CAUTION!** **The sample cell is hot (approx. 55 °C)!**
Sample cell removal:	
3	Loosen the sample gas tubing/pipe from the sample cell ports and housing wall and pull them from the housing. When removing the sample gas tubing / pipe make sure no fluids drip into the housing. The sample gas tubing / pipe removed should not be reused since it is contaminated; follow the appropriate rules for disposal.
4	Loosen 4 screws ***1*** (3-mm Allen screws) and remove 2 mounting brackets ***2***.
5	Remove the sample cell from its housing.
Sample Cell Cleaning:	
6	Wash the sample cell with a warm detergent / water mixture. Do not use other cleaners as they can damage the sample cell.
7	Thoroughly rinse the sample cell with deionized water and then with ethanol.
8	Dry the sample cell with oil- and dust-free air (30-100 liters/hour).
9	Check that the contamination has been removed.
	Also clean the sample gas line system.

Continued on next page

Step	Action
Sample Cell Installation:	
10	Place the sample cell in its housing. The index pin should be on the side of the sample cell that is toward the beam splitter. Turn the sample cell in its housing until the index pin engages in the hole in the housing.
11	Install the 2 mounting brackets ***2*** and secure them with the 4 screws ***1***.
12	Install the sample gas tubing or pipes on the sample cell ports and on the module's rear wall.
13	Check the integrity of the analyzer module gas paths (see page 9-2).
Restarting the analyzer module:	
14	Close the system housing. Light penetration during operation leads to erroneous measurement values and measurement range overflows ("Intensity" status message).
15	Turn on the gas analyzer power supply.
16	Wait for the warm-up phase to end. Start the sample gas supply.
17	Check linearity.

Figure 27

Aluminum Sample Cell in the Limas21 Analyzer Module



1 Allen Screws (3 mm)

2 Mounting Bracket

Aluminum Sample Cell with Center Connection

An aluminum sample cell with center connection is built-in in the Limas21 UV analyzer module with Class 2 NO measurement ranges. In this version, the sample gas inlet is in the center and the sample gas outlets are at the ends of the sample cell. This has to be observed when re-installing the sample cell after cleaning.

AO2000-Limas21: Quartz Sample Cell Cleaning

When should the sample cell be cleaned?

Sample cell contamination can result in unstable measurement values due to low lamp intensity (see “Limas21 Problems”, page 174).

Status Messages

When beam intensity becomes too low the appropriate status messages will be displayed. For additional information see the “Status Messages” section, page 158.

Material Required

Quantity	Description
	For cleaning: Neutral detergent, deionized water, ethanol
	For drying: Oil- and dust-free (instrument) air or nitrogen
1	Spray bottle
2	Plug to close off sample cell
1	Spare parts kit (part number 0768823)

CAUTION!

The quartz sample cell should be handled with extreme care! Especially the connection ports can easily break when the sample cell is handled improperly.

Quartz Sample Cell Cleaning

(see Figure 28 and Figure 29)

Step	Action
Preparation for sample cell removal:	
1	Turn off the sample gas supply to the analyzer module. Turn off the gas analyzer power supply.
2	Open the housing door. **CAUTION!** **The sample cell is hot (approx. 55 °C)!**
Sample cell removal:	
3	Loosen the sample gas pipes ***2*** from the connections on the sample cell ***5*** and from the housing back wall ***1*** and pull them from the housing. Save the nut, cutting rings and sealing rings for reinstallation. When removing the sample gas pipes make sure no contaminants contained in the pipes fall into the housing. The sample gas pipes removed should not be reused since they are contaminated; follow the appropriate rules for disposal.
4	Loosen 4 screws ***3*** (3-mm Allen screws) and remove 2 mounting brackets ***4***.
5	Remove the sample cell ***6*** from its housing.
6	Unscrew the elbow / pivot fittings ***5*** from the sample cell.

Continued on next page

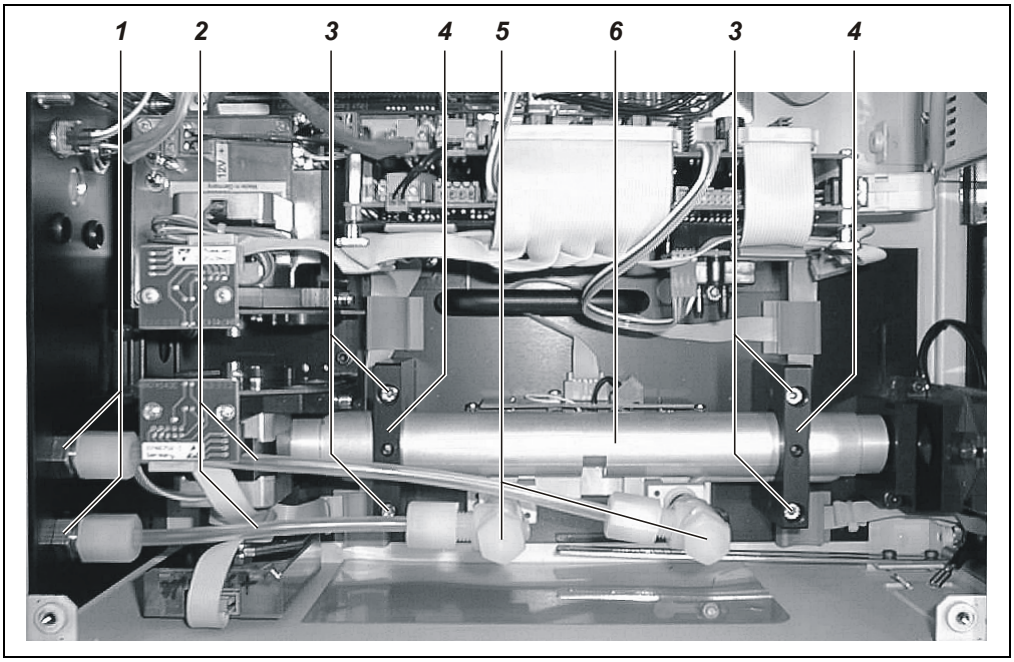
Step	Action
Sample Cell Cleaning:	
7	Wash the sample cell with a warm detergent / water mixture. Acids, alkalis or solvents can be used as cleansers in case of severe contamination. Be sure to follow the appropriate instructions for use and disposal when using acids, alkalis or solvents. Do not use hydrofluoric acid (HF) as it can destroy the sample cell.
8	Rinse the cell very thoroughly with deionized water until the detergent is completely removed. Finally, rinse the cell with ethanol until all water is removed.
9	Dry the sample cell with oil- and dust-free air (30-100 liters/hour).
10	Check that the contamination has been removed.
	Also clean the elbow fittings and the sample gas line system.
Sample Cell Installation:	
11	Place new FFKM75 O rings ***7*** on the sample cell connection ports.
12	Place the internal parts ***8*** of the elbow/pivot fittings on the connection ports and tighten them by hand. Place the elbows ***9*** on the internal parts with their ports facing toward the housing back wall and secure them by hand-tightening the nuts ***10***. The threaded connections must never be tightened any more than hand-tight. Otherwise the connections may not be securely sealed.
13	Place the sample cell ***6*** in its holder with the gas ports pointing to the left wall (as seen from the front / above).
14	Install 2 mounting brackets ***4*** – making sure that the notches for the sample cell gas lines also face the left wall – and secure with 4 screws ***3***.
Connect the sample gas lines to the sample cell.	
15	Push the sample gas tubes ***2*** through the threaded fittings ***1*** on the housing back wall. Make sure the sample gas lines are smooth and straight on both ends and that there are no kinks.
16	Slide nuts ***13***, cutting rings ***12*** and sealing rings ***11*** on the sample gas pipes ***2***.
17	Slide the sample gas tubes ***2*** up to the stop in the elbow/pivot fittings ***5*** on the sample cell and high-tighten nuts ***13***. Hand-tighten the nuts on fittings ***1*** on the housing back wall. The threaded connections must never be tightened any more than hand-tight. Otherwise the connections may not be securely sealed.
18	Check the integrity of the analyzer module gas paths. Remember the higher seal integrity requirements.

Continued on next page

Step	Action
Restarting the analyzer module:	
19	Close the system housing.
	Light penetration during operation leads to erroneous measurement values and measurement range overflows (“Intensity” status message).
20	Turn on the gas analyzer power supply.
21	Wait for the warm-up phase to end. Start the sample gas supply.
22	Check linearity.

Figure 28

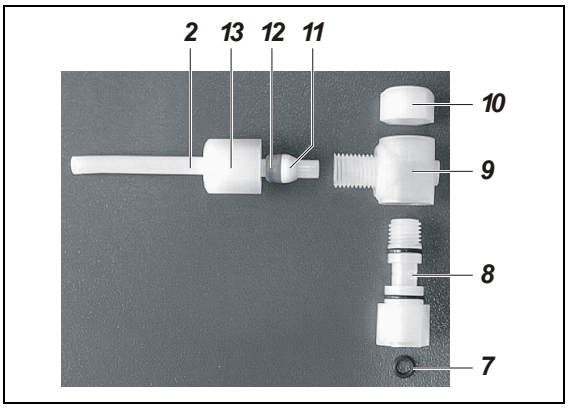
Quartz Sample Cells in the Limas 11Analyzer Module



1 Threaded Fittings on Housing Back Wall
2 Sample Gas Tubes
3 Allen Screws (3 mm)
4 Mounting Bracket
5 Elbow / Pivot Fittings (see Figure 29 for Components)
6 Quartz Sample Cell

Figure 29

Elbow / Pivot Fitting Components



2 Sample Gas Tube
7 FFKM75 O ring
8 Internal Part
9 Elbow
10 Nut
11 Sealing Ring
12 Cutting Ring
13 Nut

AO2000-Limas21 UV: Lamp (EDL) Replacement

When should the lamp be replaced?

Over a period of 2–3 years the plasma-discharge fill gas will dissipate, causing a loss of lamp intensity. The lamp must be replaced when its intensity reaches a value at which the short-term stability of the smallest measurement range is too low.

Status Messages

When beam intensity becomes too low the appropriate status messages will be displayed. For additional information see the “Status Messages” section, page 158.

Determining Lamp Service Life

Lamp service hours are displayed in the `Maintenance/Test` → `Analyzer spec. adjustm.` → `Amplification Optimization` menu.

Lamp Replacement

(see Figure 30)

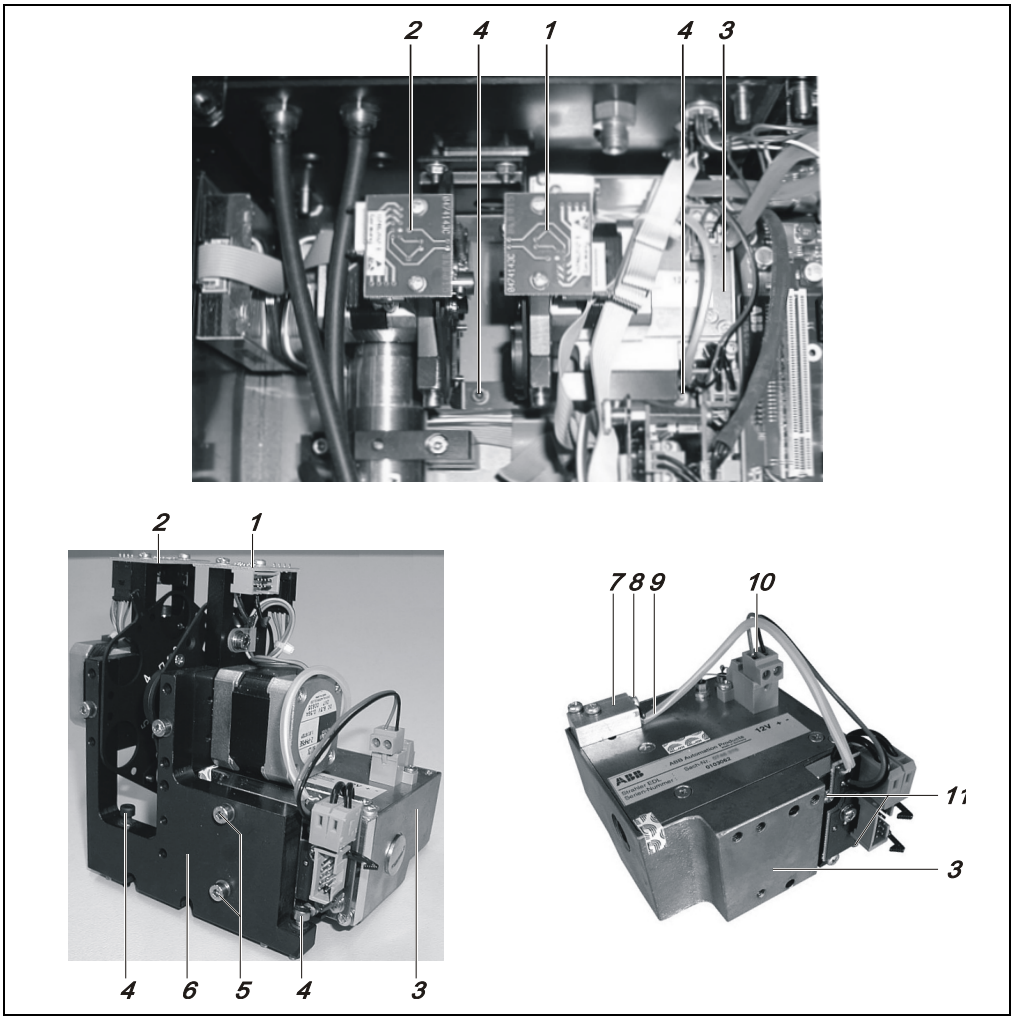
Step	Action
Remove the old lamp:	
1	Turn off the gas analyzer power supply.
2	Open the housing door. **CAUTION!** **The lamp is hot (approx. 60 °C)!**
3	Remove the cables to the light barrier boards ***1*** und ***2*** above the filter wheels.
4	Remove the cables from the lamp ***3***.
5	Loosen 2 fastening screws ***4*** of the support using a 3-mm Allen wrench.
6	Remove the support with both filter wheels, step motors and lamp.
7	Loosen 2 fastening screws ***5*** of the lamp ***3*** using a 3-mm Allen wrench.
8	Remove complete lamp ***3*** from the support ***6***.
9	Loosen the 12-V-supply connector ***10***.
10	Remove the fastening screw ***8*** with washer and holder of the temperature sensor ***9***. These parts are needed to mount the temperature sensor to the new lamp!
11	Remove the temperature sensor ***9*** from the hole in the temperature sensor block ***7***.
12	Loosen 2 fastening screws ***11*** of the heater block and remove the complete heater block from the lamp ***3***.
Install the new lamp:	
13	Before installing the new lamp, record the serial number shown on the identification plate. It will be needed during amplification optimization.
14	Perform steps 3–12 in reverse order.

Continued on next page

Step	Action
Restart the analyzer module:	
15	Close the system housing. Light penetration during operation leads to erroneous measurement values and measurement range overflows (“Intensity” status message).
16	Turn on the gas analyzer power supply and wait for the warm-up phase to end.
17	Perform an amplification optimization (see “Amplification Optimization” section, page 135).
18	Recommendation: Check sensitivity and linearity.

Figure 30

Lamp (EDL) in the Limas21 UV Analyzer Module



1 Light Barrier Board 1
2 Light Barrier Board 2
3 Lamp (EDL)
4 Fastening Screws of the Support
5 Fastening Screws of the Lamp
6 Support
7 Temperature Sensor Block
8 Fastening Screw of the Temperature Sensor
9 Temperature Sensor
10 12-V-Supply Connector
11 Fastening Screws of the Heater Block

AO2000-Limas21: Amplification Optimization

Definition

The amplification optimization procedure automatically seeks and identifies the optimum measurement range for the sample and reference receiver analog/digital converter.

When should amplification optimization be performed?

Amplification optimization should be performed,

- after the lamp has been replaced,
- after a module (sample cell, calibration cell, interference filter, receiver) has been removed or inserted in the beam path,
- if the status message No. 301 “Measurement value exceeds the analog/digital converter value range” is present (with system housing closed).

Amplification optimization alone cannot correct the causes for the status messages No. 358 and 359 “Lamp intensity above or below (middle of) permissible range”.

How should amplification optimization be performed?

- When the lamp has been replaced:
  - Write down the serial number of the new lamp prior to installation.
  - Perform amplification optimization for all sample components, thereby entering the serial number of the new lamp.
- When a module has been removed or inserted in the beam path:
  - Write down the serial number of the installed lamp.
  - Perform amplification optimization for all sample components, thereby entering an arbitrary lamp number.
  - Perform amplification optimization for all sample components, thereby entering the serial number of the installed lamp.
- When the status message No. 301is present:
  - Perform amplification optimization for each sample component for which the status message is present.

Soft Keys

`New Lamp`	Optimizes all receiver signals for all sample components; this overwrites any stored initial intensities with a new initial value.
`Optimize`	Optimizes receiver signals for a specific sample component; this does not overwrite the stored initial intensities.
`Optimize All`	Optimizes receiver signals for all sample components; this does not overwrite the stored initial intensities.

Test Gas

The zero gas supply should be turned on during amplification optimization.

Continued on next page

AO2000-Limas21: Amplification Optimization, *continued*

Menu Path

MENU → Maintenance/Test → Analyzer spec. adjustm. → Amplification optimization

Procedure

Step	Action
1	Turn on the zero gas supply. If a solenoid valve is used to switch to zero gas, the supply will be activated automatically.
2	Select the Amplification optimization menu item.
3	Select the first sample component for which status message No. 301 is present.
4	Press the **New Lamp** or **Optimize** or **Optimize All** softkey. After pressing New Lamp a window will be appear for entering the serial number of the new lamp. After this the amplification optimization procedure will run automatically for all sample components and cannot be interrupted.
5	Wait for measurement value readings to stabilize and end the amplification optimization procedure by pressing **ENTER**.
6	Confirm the amplification optimization by pressing **ENTER** (the zero point will be automatically aligned) or reject the result by pressing **Back** or **Meas**.
7	Repeat steps 3 to 6 for all sample components for which status message No. 301 is present..

AO2000-Fidas24: Sample Gas Filter Replacement at Heated Sample Gas Port

When is replacement needed?

Replace the sample gas filter in the heated sample gas port if it is contaminated and the sample gas flow is reduced.

Material Required

- Sample gas filter with O-rings (part number 0768649)
- 4 mm hex wrench

Sample Gas Filter Replacement

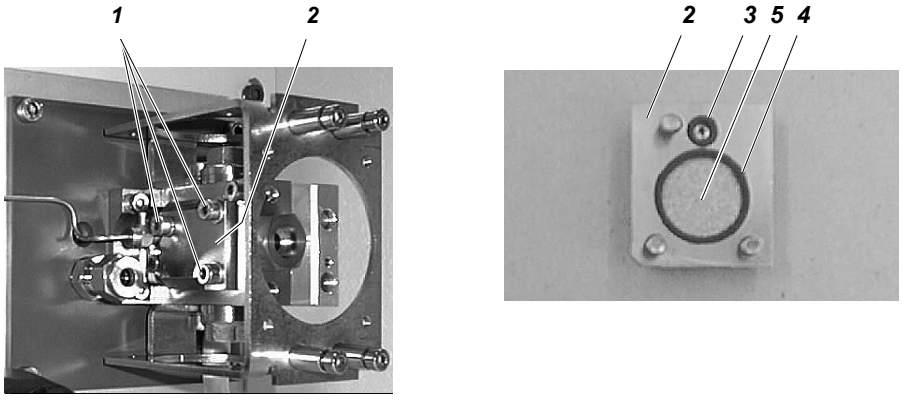
(see Figure 31)

Step	Action
1	Turn off the sample gas supply to the analyzer module. Turn off 115 / 230 VAC power supply of analyzer and heater and, if applicable, the separate 24 VDC supply of the analyzer module. **CAUTION!** **The heated sample gas port is hot (approx. 180 °C).**
2	Loosen the three mounting screws ***1*** (4 mm hex key) and remove the sample gas filter ***2*** from the sample gas port unit.
3	Remove O-rings ***3*** and ***4***, as well as the contaminated sample gas filter ***5*** from sample gas filter holder ***2***.
4	Place the new sample gas filter ***5*** and new O-rings ***3*** and ***4*** in the sample gas filter holder ***2***. Always use new O-rings with a new sample gas filter. Contaminated or damaged O-rings will reduce sample gas path seal integrity and lead to erroneous measurement values.
5	Place sample gas filter holder ***2*** on the sample gas port block and secure it with three mounting screws ***1***. Tighten mounting screws only sufficiently to achieve metal-to-metal contact of the sample gas filter holder. Make sure that O-rings ***3*** and ***4*** do not fall out of the sample gas filter holder.
6	Restore sample gas supply to the analyzer module.
7	Activate power supply.
8	Check supply gas variables and adjust if necessary (see page 60).
9	Calibrate analyzer at end of warm-up phase.

Continued on next page

Figure 31

Sample Gas Filter in Heated Sample Gas Inlet



1 Mounting screws
2 Sample Gas Filter Holder
3 O-Ring
4 O-Ring
5 Sample Gas Filter

AO2000-Fidas24: Cleaning the Air Injector

When is cleaning needed?

The air injector should be cleaned when the sample gas outlet pressure is too high, i.e. if the negative pressure can no longer be set to p_{abs} < 600 hPa.

Material Required

- 14-mm open-end wrench
- Detector O-ring set (part number 0768646)
- Ultrasound bath with aqueous cleaner (e.g. Extran)

Cleaning the Air Injector

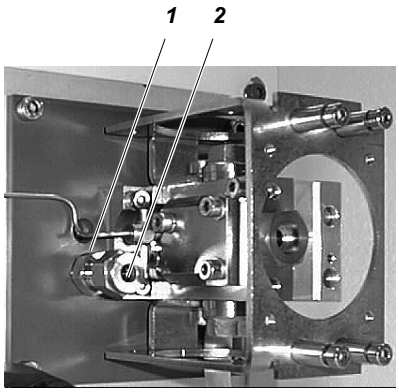
(see Figure 32)

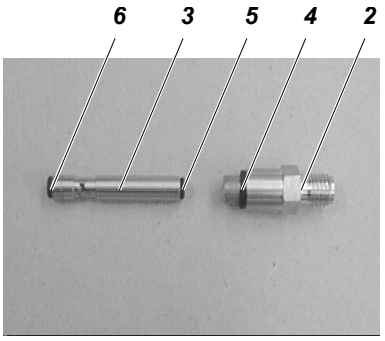
Step	Action
1	Turn off the sample gas supply to the analyzer module. Turn off 115 / 230 VAC power supply of analyzer and heater and, if applicable, the separate 24 VDC supply of the analyzer module. **CAUTION!** **The heated sample gas port is hot (approx. 180 °C).**
2	Remove the exhaust line from exhaust outlet ***1***
3	Loosen fastener ***2*** (14-mm wrench). Remove air injector ***3*** from the exhaust outlet.
4	Clean the air injector in an ultrasound unit. Use aqueous cleanser (e.g., Extran).
5	Replace O-rings ***4***, ***5*** and ***6*** with new O-rings. Always replace O-rings when cleaning the air injector. Contaminated or damaged O-rings will reduce sample gas path seal integrity and lead to erroneous measurement values.
6	Place air injector ***3*** in the exhaust outlet (orient as shown in Figure 15). Tighten fastener ***2***.
7	Connect the exhaust line to the exhaust air outlet ***1***
8	Restore sample gas supply to the analyzer module.
9	Activate power supply.
10	Check supply gas variables and adjust if necessary (see page 60).
11	Calibrate analyzer at end of warm-up phase.

Continued on next page

Figure 32

Air Injector





1 Exhaust Outlet
Fastener
Air Injector
O-Ring
O-Ring
O-Ring

AO2000-Magnos27: Thermal Link Replacement

When is replacement needed?

The thermal link should be replaced if a thermal link failure is the probable cause of a temperature error (see also “Magnos206, Magnos27 Problems” section, page 175).

Part Number

Thermal link: 0740712

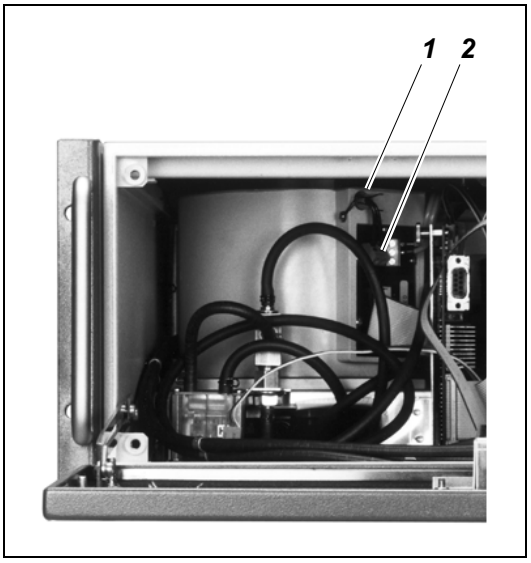
Thermal Link Replacement

(see Figure 33)

Step	Action
1	⚠ Turn off the gas analyzer power supply.
2	Open the housing door.
3	Disconnect the thermal link from the thermostat connection terminals ***2***.
4	Bend back the thermal link spring clips on the cable guide and pull the thermal link ***1*** from the cavity in the thermostat annular heater.
5	Insert a new thermal link (part number 0740712) in the cavity and close the spring clips.
6	Connect the new thermal link to the thermostat connection terminals.
7	Close the system housing.
8	Turn on the gas analyzer power supply.

Figure 33

Location of Magnos27 Analyzer Module Thermal Link



1 Thermal Link

2 Thermostat Connection Terminals

AO2000: Disposable Filter Replacement

When should the disposable filter be replaced?

The gas module disposable filter should be changed if it is stained by contaminants.

We recommend changing the disposable filter every six months.

Part Number

Disposable filter: 23044-5-8018418

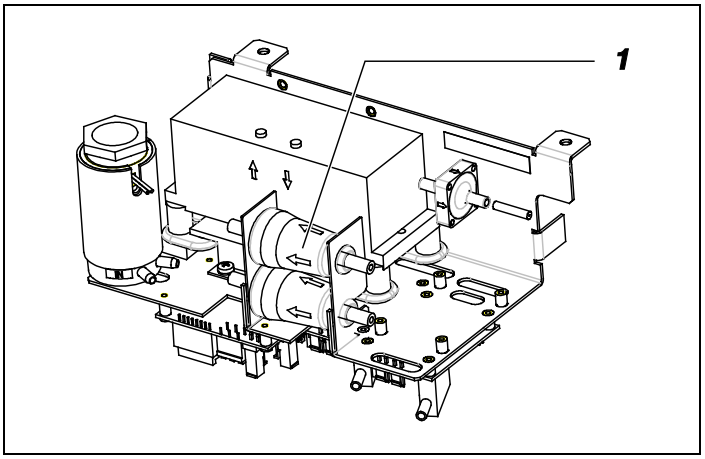
Disposable Filter Replacement

(see Figure 34)

Step	Action
1	Turn off the sample gas supply to the analyzer module. Turn off the gas analyzer power supply.
2	Open the housing door.
3	Remove the disposable filter ***1*** from the bracket.
4	Remove the hose clamps from both sides of the disposable filter and disconnect the hoses. Properly dispose of the contaminated filter.
5	Attach the hoses to the new disposable filter and fasten them with the hose clamps. Pay attention to the flow direction. The flow direction is marked on the disposable filter housing.
6	Place the disposable filter in the bracket.
7	Check the integrity of the analyzer module gas paths.
8	Close the system housing.
9	Turn on the gas analyzer power supply.
10	Wait for the warm-up phase to end. Turn on the sample gas supply.

Figure 34

Location of Disposable Filter in Gas Module



1 Disposable Filter

⇨ Flow Direction

AO2000: Air Pressure Correction

Air Pressure Effect

A specific amount of change in air pressure will result in a specific change in a measurement value, depending on the measurement principle employed by the analyzer module.

Measures to Minimize Air Pressure Effect

Air pressure effect can be minimized by:

- Installing a pressure sensor in the analyzer module (this can only be done at the factory) or
- Entering the current atmospheric pressure as a correction value.

In which analyzer modules is a pressure sensor installed?

Analyzer module	Pressure sensor
Uras26, Limas21, Magnos206, Magnos28	installed ex works
Magnos27, Fidas24	cannot be installed

Use the MENU → Diagnostic/Information → System overview menu item and select the appropriate analyzer module to determine if a pressure sensor is installed.

Air Pressure Values

Operating Altitude meters above mean sea level	Mean Air Pressure hPa (mbar)	psi	mm Hg (Torr)	in Hg
–200	1037	15.04	778	30.63
–100	1025	14.87	769	30.28
±0	1013	14.69	760	29.92
+100	1001	14.52	751	29.57
200	989	14.34	742	29.21
300	977	14.17	733	28.86
400	965	14.00	724	28.50
500	955	13.85	716	28.19
600	943	13.68	707	27.84
700	932	13.52	699	27.52
800	921	13.36	691	27.21
900	909	13.18	682	26.85
1000	899	13.04	674	26.54
1100	888	12.88	666	26.22
1200	877	12.72	658	25.91
1300	867	12.57	650	25.59
1400	856	12.42	642	25.28
1500	845	12.26	634	24.96
1600	835	12.11	626	24.65
1700	825	11.97	619	24.37
1800	815	11.82	611	24.06
1900	804	11.66	603	23.74
2000	793	11.50	595	23.43

AO2000: Air Pressure Value Correction

An incorrect air pressure value will produce erroneous measurement values.

When should the air pressure value be set?

The air pressure value must be checked and readjusted as required in the following cases:

- If the analyzer system's operating site altitude has changed since the last calibration
- If the air pressure effect on the measured value is too high.

Limas21 and Uras26 with Integral Pressure Sensor and Calibration Cells

A pressure sensor is installed as standard equipment in the Limas21 and Uras26 analyzer modules. The pressure sensor is calibrated to 1013 hPa. This is the reference pressure for the test gas concentration when measuring the calibration cells.

If the air pressure value needs to be changed, the following items are also required

- Calibrate the sample components with test gases and then
- Measure the calibration cells

Air Pressure Value Correction

The current atmospheric pressure can be entered as a correction value for each analyzer module or for all analyzer modules as a group.

Menu Path

For one analyzer module:
MENU → Maintenance/Test → Analyzer spec. adjustm. → Atm. press. anlz → …

For all analyzer modules as a group:
MENU → Maintenance/Test → System → Atm. pressure

If the pressure sensor is connected to the sample gas output line, the sample gas flow must be interrupted while calibrating the pressure sensor so that the sample gas pressure does not distort the measured pressure.

AO2000: Calibration Reset

When should a calibration reset be performed?

A calibration reset should be performed if an analyzer module can no longer be calibrated by normal means. A possible cause of this is calibration of the analyzer module with the wrong test gases.

What does the calibration reset do?

A calibration reset returns the analyzer module's calibration to basic calibration values. Additionally, the offset drift and amplification drift are electronically returned to basic calibration values (see "Basic Calibration" section, page 146).

Note

The absolute offset and amplification drift values are calculated in cumulative fashion starting from the last basic calibration.
The relative offset and amplification drift values are calculated between the last and next to last automatic calibration.
The absolute and relative offset and amplification drift values can be viewed in the *MENU → Diagnostic/Information → Module specific → Status* menu item.

Menu Path

MENU → Maintenance/Test → Analyzer spec. adjustm. → Calibration reset

The analyzer module should be calibrated after a calibration reset.

AO2000: Basic Calibration

When should an basic calibration be performed?

Basic calibration of an analyzer module should be performed whenever changes that affect calibration have been made.

An analyzer module basic calibration should also be performed if the offset drift and amplification drift exceed permissible limit values. Prior to this, however, check and ensure

- That the gas analyzer is in proper operating condition
- That the sample preparation units are in proper operating condition
- That the correct test gases are being used.

What does an basic calibration do?

An basic calibration of an analyzer module places the module's calibration status back in the initial state with respect to all physical changes made to the measurement section (such as those due to aging). Additionally, the offset drift and amplification drift are set to zero.

Performing the Basic Calibration

The basic calibration is performed for each sample component or – for the Magnos27 analyzer module – for each measurement range.

The basic calibration can be performed

- Individually at the zero point
- Individually at the end point, as well as
- Together (successively) at the zero and end points

A calibration reset is also performed in the case of common basic calibration at the zero and end points.

The current atmospheric pressure value is entered during the basic calibration.

Test Gases

The zero and span calibration test gases are required for an basic calibration.

Menu Path

MENU → Maintenance/Test → Analyzer spec. adjustm. → Basic calibration

AO2000: Cross-Sensitivity Alignment

Electronic Cross-Sensitivity Correction

AO2000 offers the ability to electronically correct cross sensitivity, in contrast to using purely physical methods (for example, for infrared absorption, optical filter or flowing reference gas).

Electronic cross sensitivity correction is possible with the Limas21, Magnos206, Magnos28 and Uras26 analyzer modules. In addition, this function must be factory-set per customer order. It is configured as a function block application.

A detailed description of the function block **Cross sensitivity correction** is contained in the Technical Bulletin “AO2000 Function Blocks – Descriptions and Configuration” (Publication No. 30/24-200 EN).

Cross sensitivity correction is an offset correction.

Interference component concentration is continuously measured and corrected by means of the measurement value. Alternatively, the interference component concentration can be entered directly as a correction value during the cross sensitivity alignment.

Internal and External Cross Sensitivity Correction

Interference component concentration can be measured in two ways:

- Using the analyzer module with which the sample component is measured (internal cross sensitivity correction, possible only with the Limas21 and Uras26 analyzer modules) or
- With another AO2000 analyzer module or another analyzer (external cross sensitivity correction) The correction signal, i.e. the measured value of the interference component is transferred to the analyzer module with the sample component to be corrected via the system bus or analog input.

When should a cross sensitivity alignment be performed?

A cross sensitivity alignment, i.e. alignment of the cross sensitivity correction function, should not be performed in normal operation.

We recommend checking the cross sensitivity correction once a year.

Test Gas for Cross Sensitivity Alignment

One of the following test gases is needed for the cross sensitivity alignment:

- Either a sample component-free test gas containing the maximum concentration of the interference component
- Or the interference component span gas.

Prior to the Cross Sensitivity Alignment

Prior to the cross sensitivity alignment, the zero and end points of the applicable sample and interference components must be calibrated with test gases in the respective analyzer module.

Menu Path

`MENU → Maintenance/Test → Analyzer spec. adjustm. → Cross sensitivity adjustm.`

AO2000: Carrier Gas Alignment

Electronic Carrier Gas Correction

In principle, the electronic carrier gas correction operates in the same manner as the cross sensitivity correction (see “Cross Sensitivity Alignment” section, page 147).

Carrier gas correction is possible only if the cross sensitivity correction function has been factory-configured per customer order.

Carrier gas correction is similarly configured as a function block application. A detailed description of the function block **Carrier gas correction** is contained in the Technical Bulletin “AO2000 Function Blocks – Descriptions and Configuration” (Publication No. 30/24-200 EN).

Carrier gas correction is an amplification correction.

When should a carrier gas alignment be performed?

A carrier gas alignment, i.e. alignment of the carrier gas correction function, should not be performed in normal operation.

We recommend checking the carrier gas correction once a year.

Test Gas for Carrier Gas Alignment

A gas mixture with the appropriate concentrations of sample and interference components is required as the test gas.

Prior to the Carrier Gas Alignment

Prior to the carrier gas alignment, the zero and end points of the applicable sample and interference components must be calibrated with test gases.

If the interference component influences the zero indication of the sample component, a cross sensitivity alignment is required prior to the carrier gas alignment.

Set Point Entry

Enter the sample component concentration as the set point.

Menu Path

`MENU → Maintenance/Test → Analyzer spec. adjustm. → Carrier gas adjustm.`

Dynamic QR Code

Application

Dynamic QR Code is a unique feature to display dynamically generated QR codes on the gas analyzer screen.

The QR code contains static information for device identification as well as dynamically generated information on system configuration and gas analyz-er health status .

Static data for device identification are among other data:

- Production number
- Production date
- Software version
- Serial numbers of built-in analyzer modules and components

Dynamic data for error diagnosis are among other data:

- Status messages
- Measured values
- Temperature, pressure and flow values
- Drift values
- Analyzer-specific values

In combination with mobile devices (smartphone, tablet, etc.) Dynamic QR Code represents an innovative way of customer’s communication which allows, for instance, improved case-specific support by ABB resulting in an increased availability of analyzer assets.

Dynamic QR Code is compatible with the ABB application "my Installed Base" as well as with standard QR code scanner applications.

Handling

The QR code is selected in the gas analyzer's diagnosis menu and displayed on the gas analyzer's screen.

There is a direct link from the status messages overview to the diagnosis menu. In addition, the QR code can be selected in Remote HMI and scanned from the computer screen.

The displayed QR code is scanned using the QR code scanner application installed in the mobile device. The resulting text information displayed on the mobile device's screen is then sent by e-mail or a suitable messenger service to the local service representative defined in the "Measurement Care" agreement.

As an alternative, a photo of the displayed QR code can be sent to the ser-vice representative.

Select QR code

Menu path

`Menu → Diagnosis/Info. → QR Code Display`

Vorgehensweise

1. Select system overview or specific analyzer module.
2. Select QR code with **ENTER**.
3. Scan QR code.
4. Return to selection with **Back**.

The diagnosis menu can be selected directly from the status messages overview.

The QR code can also be selected in Remote HMI and scanned from the computer screen.

Recommended QR code scanner applications

ABB recommends the use of the following QR code scanner applications (available free of charge for iOS and Android):

"my Installed Base" by ABB

Download in App Store:

Download in Google Play:

"QR Scanner" by Kaspersky

Download in App Store:

Download in Google Play:

Status Messages

Process Status

Definitions

Process status provides information on measurement values and the process being monitored by the analyzer system.

System status (see page 152) provides information on the analyzer system itself.

Process Status

The term “process status” includes
- Transgression of measurement range limits
- Transgression of measurement value limit values

Transgression of Measurement Range Limits

If a sample component value is > +130% or < –100% of the measurement range span, the sample component value in the display flashes. A status message is also generated which is not entered into the logbook.

The thresholds established cannot be changed.

System Status: Status Messages

Where are status messages generated?

Status messages are generated

- By the gas analyzer, i.e.
  - The system controller (signal processing, calibration, system bus)
  - The analyzer modules
  - The gas module:
  - The temperature and pressure regulators
  - The I/O boards
- By peripherals, for example
  - The system cooler
  - Other sample gas preparation modules

User-Configured Status Messages

Status messages are automatically generated by the gas analyzer and by peripherals.

Additionally, by configuring the **Message generator** function block, status messages from the analyzer and peripherals can be linked into the status message processing system (see Technical Bulletin 30/24-200 EN “AO2000 Function Blocks – Descriptions and Configuration” for details).

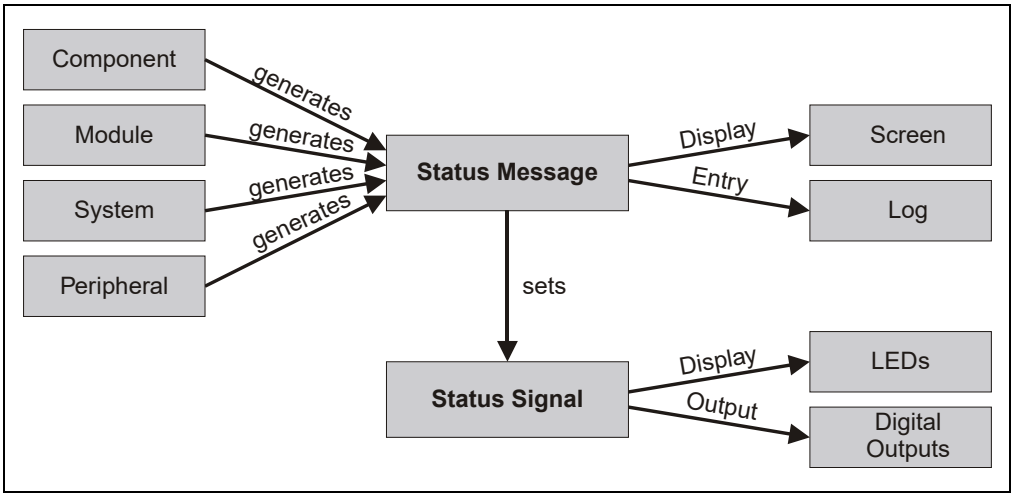
How are status messages processed?

(see Figure 35)

- Status messages are shown on the screen and recorded in the log.
- Status messages set a corresponding status signal (overall status or individual status).
- Status signals are indicated using status LEDs and output via the system controller digital outputs.

Figure 35

Status Message Processing



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Status Message Display

The STATUS MESSAGE softkey appears as soon as a status message is generated. By pressing the softkey the user can recall the status message summary and view status message details.

Logging Status Messages

Status messages are logged.

Messages concerning a transient analyzer system state with no direct effect on measurements are not logged. Such messages include

- “A password is active!”
- “This system is temporarily under remote control!”
- “Automatic calibration in progress.”

System Status: Status Signals

Overall Status or Individual Status

The status signal is factory-configured to output as an overall or individual status indicator.

Overall Status

If the analyzer system is configured to output overall status, status messages are issued as overall status indications.

Individual Status

The following table shows possible causes of individual status signals and how to evaluate the values measured.

Status Signal	Cause	Evaluation of Measured Value
Error	The analyzer system is in a state that requires immediate user intervention.	The value is invalid.
Maintenance Required	The analyzer system is in a state that will soon require user intervention.	The value is valid.
Maintenance Mode	The analyzer system is being calibrated or serviced.	Discard the value as a process measurement value.

Individual Status by Analyzer Module or Sample Component

In principle, the individual status signals apply to the entire gas analyzer (system status).

However, by configuring the **Message input** function block, individual status messages for each analyzer module or for each sample component can be output separately via digital outputs (see Technical Bulletin 30/24-200 EN “AO2000 Function Blocks – Descriptions and Configuration” for details).

I/O board status messages are only reported as system status signals.

Status Indication

Analyzer system status is indicated by means of status LEDs.

LED	Status
Error 	Overall or Individual “Error” Status
Maint 	Individual “Maintenance Required” status

Status Message Categories

Status Message Categories

In terms of operator reaction, there are three categories of status messages (see the summary on the following page):

- Status messages not requiring acknowledgment
- Status messages requiring acknowledgment
- Status messages requiring acknowledgment and intervention

Status Messages Not Requiring Acknowledgment

The system operates normally after the status is cleared.

When the status is cleared, the LED goes out, the status signal is reset and the status message is canceled.

Example: Temperature error during the warm-up phase.

Status Messages Requiring Acknowledgment

The system operates normally after the status is cleared; however, the operator is aware of the status.

When the status is cleared, the LED goes out and the status signal is reset. The status message is only canceled after operator acknowledgment. In this manner, the operator is aware of the system malfunction.

Example: No new measurement values from the analog/digital converter.

Status Messages Requiring Acknowledgment and Intervention

The system may not operate normally after the status condition is cleared; therefore, the operator should acknowledge the condition and actively eliminate the cause of the message.

The LED goes out, the status signal is reset and the status message is only canceled after the operator acknowledges the status message and eliminates the cause.

Example: The offset drift between two calibrations exceeds the permissible range.

Continued on next page

Status Message Categories, *continued*

Summary

The following table shows

- The time sequence of the three status message categories (phases 1-3)
- The identifier used to identify the status messages in the summary (a, A and I).

Phase 1	Phase 2	Phase 3
Status Messages Not Requiring Acknowledgment		
Status begins	**Status ends**	
LED lights up	LED goes out	
Status signal set	Status signal reset	
Status message appears	Status message canceled	
Status Messages Requiring Acknowledgment		
Status begins	**Status ends**	**Acknowledge**
LED lights up	LED goes out	
Status signal set	Status signal reset	
a Status message appears	I Status message remains	Status message canceled
Status begins	**Acknowledge**	**Status ends**
LED lights up		LED goes out
Status signal set		Status signal reset
a Status message appears	A Status message remains	Status message canceled
Status Messages Requiring Acknowledgment and Intervention		
Status begins	**Status ends**	**Acknowledge, correct**
LED lights up		LED goes out
Status signal set		Status signal reset
a Status message appears	I Status message remains	Status message canceled
Status begins	**Acknowledge, correct**	**Status ends**
LED lights up		LED goes out
Status signal set		Status signal reset
a Status message appears	A Status message remains	Status message canceled

Status Messages Lists

List Layout

The status messages lists contain the following information:

No.	Number of the status message as shown in the detailed display
Text	Full text of the status message as shown in the detailed display
O	x = Status message sets the overall status
E	x = Status message sets the “Error” individual status
M	x = Status message sets the “Maintenance Request” individual status
F	x = Status message sets the “Maintenance Mode” individual status
Reaction / Remark	Explanations and corrective measures in case of status messages

No.	Text	O	E	M	F	Reaction / Remark
Runtime Error						
1–21	Runtime Error 1–21					Notify service if these status messages occur repeatedly.
System Controller						
101	System controller shut down at					For information; shows date and time
102	System controller starts up at					For information; shows date and time as well as warm start or cold start
103	Installing Module:					For information
104	Removing Module:					For information
105	Reactivating Module:					For information
106	A user installed module:					For information
107	A user removed module:					For information
108	A user replaced module:					For information
109	A password is active! To delete, press the <MEAS> key on the measurement value display.					Not logged
110	System booting.					Not logged
111	This system is temporarily under remote control!					Not logged
112	Display/control unit synchronizing with analyzer. Please wait.					Not logged
113	The system time was changed from -> to:					Not logged
114	The system is saving the changed parameters. Please wait!					
116	The Profibus Module is mounted on the wrong slot! The Profibus interface is not working. Please remount the Profibus Module on slot X20/X21	x	x			
117	The configuration backup was saved.					
118	The configuration backup was loaded. The system has been restarted.					

Continued on next page

No.	Text	O	E	M	F	Reaction / Remark
119	The system configuration could not be loaded! This system contains no configuration now. Please enter menu Configure/System/Save configuration to load your backup configuration. Or use SMT to re-install your configuration.					
System Bus						
201	The selected system bus module could not be found.	x	x			Check plug connections and terminating resistors on the system bus. Make sure the system bus module serial number is correctly entered: MENU → Diagnostics/ Information → System overview
203	The selected system bus module does not exist.	x	x			Check plug connections and terminating resistors on the system bus.
208	The system bus was not able to transfer data into the database.	x	x			The system bus module software version is not compatible with that of the system controller; update the system controller software.
209	The system bus connection to this module is interrupted.	x	x			Check the system bus connection to the indicated module. Check the power supply system of the indicated system bus module.
210	The system bus module configuration has changed.	x	x			For information; the configuration data are automatically updated
211	The system bus module has no more on-board memory.	x	x			Check the system bus module configuration: MENU → Diagnostics/Information → System overview
214	The system is currently maintained with Optima SMT.				x	
Analyzer Modules						
300	No new measurement values from analog/digital converter.	x	x			Notify service.
301	Measurement value exceeds the analog/digital converter value range.	x	x			Check sample gas concentration. Notify service.
302	Offset drift exceeds half the permissible range.			x		Check analyzer module and sample preparation. Permissible range: 150% of smallest installed measurement range; 50% of physical measurement range for Uras26
303	Offset drift exceeds permissible range.	x	x			Perform a basic calibration of the detector indicated: MENU → Maintenance/Test → Analyzer spec. alignment → Basic calibration Permissible range: 150% of smallest installed measurement range

Continued on next page

No.	Text	O	E	M	F	Reaction / Remark
304	Amplification drift exceeds half the permissible range.			x		Check analyzer module and sample preparation. Permissible range: 50% of detector sensitivity; 50% of physical measurement range for Uras26
305	Amplification drift exceeds permissible range.	x	x			Perform a basic calibration of the detector indicated: `MENU → Maintenance/Test → Analyzer spec. alignment → Basic calibration` Permissible range: 50% of detector sensitivity
306	The offset drift between two calibrations exceeds the permissible range.			x		Perform manual zero calibration on indicated detector. (This message is generated by automatic calibration.) Permissible range: 15% of smallest installed measurement range; for measurements per 17. BImSchV, 6% of smallest installed measurement range
307	The amplification drift between two calibrations exceeds the permissible range.			x		Perform manual span calibration on indicated detector. (This message is generated by automatic calibration.) Permissible range: 15% of sensitivity; for measurements per 17. BImSchV, 6% of sensitivity
308	A computer error occurred during calculation of the measurement value.	x	x			Notify service.
309	The temperature regulator is defective.			x		See the status message from the applicable temperature detector
310	Temperature correction turned off for this component because of invalid temperature measurement value.			x		See the status message from the applicable temperature detector
311	The pressure regulator is defective.	x	x			See the status message from the applicable pressure detector
312	Pressure correction turned off for this component because of invalid pressure measurement value.			x		See the status message from the applicable pressure detector
313	Cross-sensitivity correction is impossible for this component because the correction value is invalid.			x		See the status message from the applicable correction detector
314	Carrier gas correction is impossible for this component because the correction value is invalid.			x		See the status message from the applicable correction detector

Continued on next page

Gas Analyzer Status Messages, *continued*

No.	Text	O	E	M	F	Reaction / Remark
Auxiliary Detector						
315	No new measurement values from analog/digital converter.			x		Notify service.
316	Measurement value exceeds the analog/digital converter value range.			x		Notify service.
317	A computer error occurred during calculation of the measurement value.			x		Notify service.
Uras						
318	No new measurement values from analog/digital converter.	x	x			Notify service.
Magnos						
319	The measurement bridge is improperly balanced.	x	x			Notify service.
320	The measurement amplifier offset is too high.	x	x			Notify service.
MultiFID						
321	The detector temperature is below the lowest permissible temperature.	x	x			Status message during the warm-up phase. If the status message appears after warm-up: Check the thermal link and replace as needed.
322	The flame is out.	x	x			Status message during the warm-up phase. If the status message appears after warm-up: Check the gas supply.
323	The analyzer is in the fail-safe state.	x	x			Inadequate combustion gas supply; turn power supply off and back on after ≥ 3 seconds. Notify service.
Temperature Regulator						
324	Temperature above or below upper and/or lower limit value 1.			x		Status message during the warm-up phase. If the status message appears after warm-up: Check if the permissible ambient temperature range is being maintained. Check the analyzer module thermal link and replace if necessary.
325	Temperature above or below upper and/or lower limit value 2.			x		
Pressure Regulator						
326	No new measurement values from analog/digital converter.	x	x			Notify service.
327	Measurement value exceeds the analog/digital converter value range.	x	x			Notify service.
328	A computer error occurred during calculation of the measurement value.	x	x			Notify service.

Continued on next page

No.	Text	O	E	M	F	Reaction / Remark
329	Pressure above or below upper and/or lower limit value 1.			x		Fidas24: Check the supply gas pressure.
330	Pressure above or below upper and/or lower limit value 2.			x		Fidas24: Check the supply gas pressure.
331	The pressure regulator control variable is beyond the valid range.	x	x			Fidas24: Check the supply gas pressure.
I/O Boards						
332	Accessory voltage defect on I/O board.	x	x			Defective I/O board. Replace the board.
333	Unavailable I/O type configured.	x	x			Correct the configuration with the test and calibration software.
334	No new measurement values from analog/digital converter.	x	x			Defective I/O board. Replace the board.
335	Measurement value exceeds the analog/digital converter value range.	x	x			Check signals at analog inputs. If OK, check the configuration and calibration of the analog inputs.
336	A computer error occurred during calculation of the measurement value.	x	x			Check the configuration and calibration of the analog inputs and outputs.
337	Broken analog output line.	x	x			Check the analog output lines.
338	Broken digital input line (moisture sensor).	x	x			Check the moisture sensor in the system cooler.
339	Broken or shorted analog input line.	x	x			Check system cooler temperature.
340	Analog input value above or below upper or lower limit value 1.			x		Check system cooler temperature.
341	Analog input value above or below upper or lower limit value 2.			x		Check system cooler temperature.
Flow Monitor (Gas Module)						
342	Flow rate under limit value 1.			x		Check sample preparation. Limit value 1 = 25% MRS.
343	Flow rate under limit value 2.	x	x			Check sample preparation. Limit value 2 = 10 % MRS. Automatic calibration is interrupted and locked out.

Continued on next page

No.	Text	O	E	M	F	Reaction / Remark
Measurement Value						
344	Value above measurement value range.					Value > +130 % MRS, not logged
345	Value below measurement value range.					Value < –100 % MRS, not logged
Limas						
356	Analyzer in warm-up phase.	x	x			Status message during warm-up phase. If the status message appears after warm-up, a temperature error has occurred in the lamp or in the sample cell or in the measurement or reference detector amplifier. Notify service.
357	Limas motor optimization in progress.	x	x			Status message after warm-up phase
358	Lamp intensity above or below middle of permissible range.			x		Lamp intensity has fallen to 10% of Init value. Check the intensity values in the `Diagnostics/Test → Module specific → Lamp Intensity` menu. If all four values have fallen by about the same amount compared to the Init values, the cause is reduced lamp intensity. The lamp should soon be replaced. If only the two measurement detector values have dropped, the cause is probably a contaminated sample cell. Clean the sample cell or exchange it.
359	Lamp intensity above or below permissible range.	x	x			Lamp intensity has fallen to 5% of Init value. Check the intensity values in the `Diagnostics/Test → Module specific → Lamp Intensity` menu. If all four values have fallen by about the same amount compared to the Init values, the cause is reduced lamp intensity. Replace the lamp and perform an amplification optimization.
360	Filter wheel 1 cannot be initialized.	x	x			Notify service.
361	Filter wheel 2 cannot be initialized.	x	x			Notify service.
362	The calibration filter wheel cannot be initialized.	x	x			Notify service.
363	The Limas analyzer board cannot be initialized.	x	x			Notify service.

Continued on next page

Gas Analyzer Status Messages, *continued*

No.	Text	O	E	M	F	Reaction / Remark
Uras						
378	Chopper wheel jammed.	x	x			Notify service.
379	Chopper wheel speed not OK.	x	x			Notify service.
380	IR radiator or electronics faulty.	x	x			Notify service.
381	High voltage at preamplifier faulty.	x	x			Notify service.
Calibration						
500	System bus communication defect.	x		x		
501	Requested function is not available on the system module.					Check the analyzer module software version and perform an update if needed.
502	A system error occurred in the system module addressed.					Calibration is interrupted. Notify service.
503	Amplification error during calibration. Calibration impossible.					Calibration is interrupted. Insufficient span gas concentration – Check.
508	Unknown error number. Check software versions.					Message during automatic calibration. Check analyzer module and system controller software versions.
509	Automatic calibration started.					For information
510	Automatic calibration ended.					For information
511	Automatic calibration externally interrupted.					For information
512	Automatic calibration in progress.				x	For information, not logged
513	System bus communication defect during automatic calibration.	x		x		
514	External calibration started.					For information
515	External calibration ended.					For information
516	External calibration in progress.				x	For information, not logged
517	Device being serviced.				x	For information, e.g. during manual calibration, not logged
519	Preamplifier overflow error: Calibration could not be performed because of preamplifier override.					
520	Initial zero calibration started.					For information
521	Initial zero calibration ended.					For information

Continued on next page

No.	Text	O	E	M	F	Reaction / Remark
522	Initial zero calibration interrupted.					For information
523	Initial zero calibration incomplete. System bus communication defect during calibration.					
524	Initial zero calibration in progress.				x	For information, not logged
525	Linearization impossible: Linearization did not produce a valid result. Measurement value possibly inaccurate. Check center point gas.					See message text
526	Linearization impossible: Linearization could not be performed because the characteristic is linear.					See message text
527	Initial calibration for component:					For information
529	Calibration stopped because no raw measurement values were found.	x		x		
530	Calibration stopped because the pressure switch did not detect any calibration gas.	x		x		
531	Automatic validation started.					For information
532	Automatic validation ended.					For information
533	Automatic validation externally interrupted.					For information
534	Automatic validation in progress.				x	For information, not logged
535	Automatic validation successful for:					
536	Automatic validation out of limits for:					
537	Automatic validation out of limits for:			x		

Continued on next page

User-Configured Messages						
800	An external error occurred during:	x	x			These **Message Generator** function block default texts are supplemented with the text prepared during function block configuration.
801	A user-defined error occurred during:	x	x			
802	A user-defined maintenance requirement occurred during:			x		
803	A user-defined maintenance mode event occurred during:				x	
Miscellaneous Messages						
1000	This function block has an error:	x	x			Supplemented with a reference to the function block type.
1001	Condensate penetration					Overall message for guiding reaction to condensate penetration; not logged
1002	Flow rate excessive at this point.	x	x			Currently not used
1003	Flow rate inadequate at this point.	x	x			Currently not used
System Cooler						
1100	Cooler temperature too high.	x	x			Sample gas feed module pump is automatically turned off. Check the system cooler and sample gas preparation.
1101	Cooler temperature too low.	x	x			
1102	Condensate penetration in cooler.	x	x			
1103	Flow rate inadequate in cooler.			x		Check the system cooler and sample gas preparation.
1105	Cooler condensate level too high.			x		Empty the condensate bottle.
1106	Cooler reagent level too low.			x		Fill the reagent supply bottle.

No.	Text	O	E	M	F	Reaction / Remark
10000	Automatic start of calibration disabled.					
10001	Converter temperature too low.			x		
10002	Combustion gas pressure too low.			x		
10003	Span gas pressure too low.			x		
10004	Probe filter temperature out of range.		x			
10005	Sample gas line temperature out of range.		x			
10006	Probe tube temperature out of range.		x			
10007	Compressed air pressure for back-purging too low.			x		
10008	Maintenance mode enabled.				x	
10009	Back-purging of filter and probe tube disabled.					
10010	Back-purging of filter and probe tube running.				x	
10011	Back-purging of filter and probe tube failed.		x			
10014	Temperature in analysis cabinet too high.			x		
10015	Zero gas pressure too low.			x		

Continued on next page

No.	Text	O	E	M	F	Cause	Corrective Action
	Condens. & Cooler		x			Cooler temperature not in set range	Wait for warm-up phase to end (approx. 0.5 to 1 hour)
	Condens. & Cooler		x			Condensate penetration of a gas path	Eliminate the cause of condensate penetration, e. g.
						• Peristaltic pump pressure too low	• Increase pump pressure
						• Peristaltic pump motor blocked or failure	• Replace peristaltic pump
						• Defective hose	• Replace hose
						• Increased condensate level	• Check the cooler if condensation is excessive Clean and dry the flow chamber
						• Sensor/line break	• Replace the sensor Change sensor leads
	Condensate Level		x			Condensate buffer container full in sample gas cooler.	Eliminate the cause of elevated condensation, e. g.
						• Peristaltic pump pressure too low	• Increase pump pressure
						• Peristaltic pump motor blocked or peristaltic pump motor failure	• Replace peristaltic pump
						• Defective hose	• Replace hose
						• Increased condensate level	• Check the cooler if condensation is excessive Clean and dry the downstream components as required.
	Conv. Overall Status		x			Converter Overall Status active	Check the converter (see page 172).
	Intk. Overall Status		x			Overall status of the probe and sample gas line service module active (sampling problem message)	Check the probe and sample gas line service module.
	Empty Cond. Cont.			x		Condensate collection bottle full	Empty the condensate collection bottle and clean and dry the downstream components as required.
	Fill Reag. Cont			x		Reagent supply bottle empty	Fill the reagent supply bottle.

Continued on next page

No.	Text	O	E	M	F	Cause	Corrective Action
	Min. Gas Flow Rate			x		• Intake filter plugged	• Replace filter element
						• Gas lines contaminated or plugged	• Separate the gas lines from the gas analyzer and clear them mechanically or with compressed air.
						• Gas lines kinked	• Route gas lines directly.
						• Disposable filter contaminated or plugged	• Replace the disposable filter.
						• Gas path frozen in the sample gas cooler	• At ambient temperatures < 5 °C the analysis cabinet should be heated. Maintain the operating specifications.
	Serv. Key				x	Service key switch on “Service”	Return key switch to “Operation” after maintenance work is finished.
	Backflush				x	Probe flush active	Deactivate backflush.

Analyzer System Reaction

The following messages cause the analyzer system to be switched to the zero gas and interrupt calibration:

- “Condens. & Cooler”
- “Condensate Level”
- “Conv. Overall Status”
- “Intk. Overall Status”

The following messages cause calibration to be interrupted:

- “Min. Gas Flow Rate”

It the analyzer system fails, the system is switched to the zero gas.

CAUTION!

The tasks described in this chapter require special training and under some circumstances involve working with the analyzer system open and powered up. Therefore, they should only be performed by qualified and specially trained personnel.

SCC-F Sample Gas Feed Unit Problems

Problem	Cause	Remedy
Sample gas feed unit not working	Power supply interrupted	• Reconnect the power supply.
	Fuse blown	• Replace fuse (2 A T).
	Pump motor blocked	• Remove blockage.
	Defective pump	• Replace pump.
	Defective diaphragm	• Replace diaphragm (see page 117).
Drops of condensate in the condensate monitor or flow monitor (liquid alarm)	Condensate being produced by the gas analyzer system Fluid from the process penetrating Condensate collecting bottle full	1. Check operability of the upstream condensate separation device, and rectify cause. 2. Empty, clean and dry the upstream sample gas pipe and sample gas conditioning units. 3. Empty, clean and dry the condensate monitor. 4. Replace filter diaphragm. 5. Press reset switch on the front panel to deactivate the condensate lock.
Sample gas flow insufficient (flow alarm)	Upstream sample gas pipe or modules blocked or sealed off	• Remove blockage or open modules.
	Downstream modules blocked or sealed off	• Remove blockage or open modules.
	Negative pressure on the gas sampling side	• Rectify negative pressure.
	Positive pressure in the waste gas pipe	• Rectify positive pressure.

SCC-C Sample Gas Cooler Problems

Problem	Cause	Remedy
Condensate in the sample gas outlet	Ambient temperature < 5 °C	• Heat the downstream assemblies.
	Sample gas cooler overloaded	• Ensure sample gas inlet conditions (see page 19) and operating specifications are followed.
	Defective peristaltic pump	• Replace the peristaltic pump.
	Defective pump hose	• Replace hose (see page 113).
	Cooling performance inadequate although sample gas cooler not overloaded	• Provide adequate cooling air flow. • The fan should operate. • Clean condenser fins (see page 111).
	Compressor motor breaker tripped	• Eliminate the thermal overload caused by the sample gas flow or excessive ambient temperature. • Clean condenser fins (see page 111). • Ensure sample gas inlet conditions (see page 19) and operating specifications are followed. • Allow the compressor to cool before the next run.
Sample gas flow blocked	Sample gas paths contaminated	• Contamination can result from the failure to remove dust or sublimates. Ensure dust is removed before the sample gas enters the sample gas cooler; eliminate sublimates prior to this point. • Clean the sample gas lines and cooling system; consider the effects of corrosion and reduced service life when using chemical cleaners and flush with an inert gas in order to avoid any cleaning agent influence on measurement results.
Inaccurate temperature indication	Defective temperature controller	• Replace temperature controller.
	Refrigerant escaping	• Send the sample gas cooler to the service department for service.
Defective sample gas cooler	Power supply disconnected	• Reconnect the sample gas cooler power supply.
	Defective motor breaker or winding, i.e. the compressor motor is not running	• Measure the electrical resistance of the motor winding (guide value is approx. 40 Ω). • If the difference is considerable (with measuring circuit open or short-circuited), then the motor breaker should be replaced. • If the motor winding is defective, send the sample gas cooler to the service department for repair.

SCC-K NO_2/NO Converter Problems

Problem	Cause	Remedy
LEDs do not light up **Valves do not switch over** **Temperature controller out of order**	No mains power	• Check that mains cable fits properly (X1); ok?
	Sub-D plug not inserted in socket X2	• Check whether sub-D plug is present and is properly plugged in; ok?
	Fuses F1, F2 defective	• Check fuses and replace if necessary.
Converter does not heat up	Heater defective	• Measure voltage at terminals X4/2 and 3; ok? • Replace heater; not ok?
	Temperature controller defective	• Measure voltage at terminal X4/6 and 7; Voltage < 8 V DC? • Check controller according to operator's manual; Voltage > 8 V DC?
	Solid-state relay defective	• Replace solid-state relay.
Valves do not switch over **LEDs do not light up**	No mains supply (see above) Sub-D plug not inserted into socket X2 (see above)	• See above
	Internal circuit: No solder link 1-6 in sub-D plug	• Check Sub-D plug and if necessary solder link
	External circuit: Error in external control	• Check external control
Valves do not switch over **LEDs light up**	Valves defective	• Check that valves function
No sample gas flow	Valves defective (see above)	• See above
	Gas sample lines blocked or leaking	• Check gas sample lines
No conversion	Cartridge does not heat up (see above)	• See above
	No sample gas flow (see above)	• See above

AO2000 Gas Analyzer Problems

Problem	Cause	Remedy
Blinking Measurement Value Readout	Measured signal violates measurement range limits	Note: Measurement value > +130 % MRS or measurement value < –100 % MRS. Additionally, status messages 344 or 345 are generated.
Blinking --E-- in Measurement Value Readout	Problem in measured signal processing	• View status messages. • Identify cause and repair.
Blinking --E-- in mA Value Readout	Problem in output current circuit	• Identify cause (e.g. line break) and repair.
Power Supply Fuse Failure (only for Limas21 or Fidas24 power supply)	Wrong voltage setting on power supply	• Use the proper voltage setting • Change the fuse (G fuse element per EN 60127-2, 4 A rating, slow-blow for 115 VAC and 230 VAC).
	Power supply defect	• Contact Service.
Flow Problem	External gas lines or filters dirty, plugged or leaking	• Disconnect the gas analyzer from the gas preparation system. • Blow out the gas lines with compressed air or clear them mechanically. • Change the filter elements and packings. • Check gas line seal integrity.
	Gas analyzer gas paths crimped or leaking	• Disconnect the gas analyzer from the gas preparation system. • Check the analyzer module gas lines and the gas module lines for crimping or loose connections. • Check the integrity of the analyzer module gas paths and (if applicable) of the lines to the gas module.
Temperature Problem	Gas analyzer still in warm-up phase	• The duration of the warm-up phase depends on which analyzer module is installed in the system. Limas21 Approx. 15 hours Magnos206 ≤ 1 hour Magnos27 2-4 hours Uras26 Approx. 30 minutes without, approx. 2 hours with thermostat
	Excessive air movement	• Reduce the flow of air around the gas analyzer. • Install shielding against drafts.
	Ambient temperature outside of permissible range	• Protect the gas analyzer from cold and heat sources such as the sun, ovens and vats. • Maintain the permissible ambient temperature range:

AO2000-Limas21 Problems

Problem	Cause	Remedy
Temperature Problem	Faulty temperature sensor or heater connections	• Check the connecting lines and plugs. • Check the line seating in the insulated jackets.
	Defective thermal link	• Check thermal link continuity and replace if necessary (see page 127 for instructions).
Unstable Readings	Gas path leakage	• Check the integrity of the analyzer module gas paths and (if applicable) of the lines to the gas module.
	Emitter intensity too low	• Read the current intensity value using the `Diagnostics/Test → Module specific → Lamp Intensity` menu item (start the zero gas supply for this) and compare this value to the Init value displayed (the Init values were stored following amplification optimization after installation of a new lamp). A significant decrease (by a factor of 10 or more) is the probable cause of unstable measurement value readings. Three different cases can be identified: 1 If only the measurement receiver values have dropped the sample cell is probably contaminated. Clean the sample cell (see page 128 or page 130 for instructions). 2 If all four values are have dropped by similar amounts then lamp intensity has probably decreased. Perform an amplification optimization (see page 135 for instructions) or replace the lamp (see page 133 for instructions). 3 For NO measurement only: If the reference receiver “Reference” value has increased or not as markedly decreased as a percentage relative to the reference receiver “Measurement” value and if at the same time the sensitivity span has decreased (loss of sensitivity), aging of the selectivity cell is the probable cause (see the service manual for more information).
“Sample Value Overflow or Underflow” Status Signal	Drift or aging of optical elements (lamp, sample cell, detector, etc.)	• Determine the cause • Clean or replace the affected elements. • Perform an amplification optimization (see page 135 for instructions) to bring the receiver signal back to its optimal range.

AO2000-Magnos206, -Magnos27 Problems

Problem	Cause	Remedy
Temperature Problem	Faulty temperature sensor or heater connections	• Check the connecting lines and plugs. • Check the line seating in the insulated jackets.
	Defective thermal link	• Check thermal link continuity and replace if necessary (see page 141 for instructions).
	Leaking thermostat or open purge gas connections	• Check the seal integrity between the thermostat chamber and the mounting flange; tighten mounting bolts or replace O rings as needed. • Seal the analyzer purge gas inlet and outlet with sealing connectors. • Check the purge gas flow (maximum operating level of 20 l/h; positive pressure p_e = 2 to 4 hPa) and reduce as needed.
Unstable Readings	Gas path leakage	• Check the integrity of the analyzer module gas paths and (if applicable) of the lines to the gas module.

AO2000-Fidas24 Problems

Problem	Cause	Remedy
Flow Problem	Sample gas nozzle or sample gas filter plugged	• Check for obstructions in sample gas nozzle and sample gas filter in sample gas port. Change the sample gas filter (see page 137 for instructions).
Temperature Problem	Faulty temperature sensor or heater connections	• Check the connecting lines and plug connectors. Check the line seating in the insulated jackets.
Unstable Readings	Vibration	• Reduce vibrations where the analyzer is installed.
	Sample gas path leakage	• Check the integrity of the analyzer module sample gas paths.
	Loss of sensitivity	• Check the sensitivity variation. Contact service personnel for sample gas nozzle replacement.
	Excessive sample gas outlet pressure	• Check air injector for obstructions and clean as needed (see page 139 for instructions). Increase instrument air pressure. Check exhaust air line: It must have a large ID.
	Combustion air contaminated	• Check combustion air supply.
	Fluctuating supply gas pressures	• Check instrument air, combustion air and combustion gas supply.

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Problem	Cause	Remedy
Pressure Regulator Problems	Unstable pressure values	• Adjust supply gas pressures such that the variables have the following values (see page 60): for instrument air (Outlet) approx. 60 % for combustion air (Air) approx. 50 % for combustion gas (H2) approx. 35 % • Have the pressure regulator modules checked.
	Pressure regulator variables do not match set values	• Air Variable ≤ 40 % Lower combustion air pressure. Variable ≥ 90 % Raise combustion air pressure. • H2 Variable ≤ 30 % Lower combustion gas pressure. Variable ≥ 90 % Raise combustion gas pressure. • Inlet Variable ≤ 50 % Lower sample gas inlet pressure. Clean bypass nozzle. • Outlet Variable ≤ 50 % Raise instrument air pressure. Clean air injector (see page 139 for instructions). Reduce sample gas line length. Variable ≥ 90 % Clean bypass nozzle. Lower instrument air pressure.
Zero Drift	Sample gas line contaminated	• Clean sample gas line.
	Inadequate combustion air catalytic converter performance	• Reduce hydrocarbon content.
	Contaminated combustion gas line	• Clean combustion gas line.
	Saturated active charcoal filter	• Replace active charcoal filter.
Flame Does Not Ignite	Air in the combustion gas line	• Make sure no air enters the combustion gas feed lines when the combustion gas tank is connected or changed. Air drawn into the combustion feed line can cause the flame to go out in the analyzer. • The analyzer module will attempt to restart the flame up to 10 times in a period of approx. 10 minutes using progressively higher combustion gas pressures. If this is not successful, the unit goes into the stand-by mode. In this case the flame ignition process is restarted: **Menu → Maintenance/Test → Analyzer spec. Adjustm. → Restart FID** Note: Standby operation means: Heater on, combustion gas valve closed, instrument air valve closed.
	Excessive combustion air pressure	• Reduce combustion air pressure (per analyzer data sheet).

AO2000-Uras26 Problems

Problem	Cause	Remedy
Temperature Problem	Faulty temperature sensor or heater connections	• Check the connecting lines and plugs. • Check the line seating in the insulated jackets.
	Defective thermal link	• Check thermal link continuity and replace if necessary.
Unstable Readings	Vibration	• Take measures to reduce vibration. Permissible vibration levels: for analyzer max. ±0.04 mm at 5 to 55 Hz, 0.5 g at 55 to 150 Hz; when installed in cabinet max. 0.01 ms^{-2} at 0.1 to 200 Hz. • Increase the low pass time constant T90 (see page 79 for instructions).
	Gas path leakage	• Check the integrity of the analyzer module gas paths and (if applicable) of the lines to the gas module.
	Loss of sensitivity	• Check the sensitivity variation: Indication < 75%: The “Maintenance request” status signal appears. The detector involved will need to be changed soon. Indication < 50 %: The “Failure” status signal appears. Replace the detector involved.
	Uneven emitter modulation	• Remove the emitter.  **CAUTION! The emitter temperature is approx. 60 °C in the thermostat version of the Uras26!** • Check if the chopper wheel turns smoothly. • Check the clamp ring seating. • The chopper wheel should not extend beyond the notch. • Have the emitter and modulator assembly checked by the service department.

AO2000 Gas Module Problems

Problem	Cause	Remedy
Flow Problem	Condensation in the flow meter	• Disconnect the gas analyzer from the gas preparation system. • Dry the flow meter by heating it and blowing it with compressed air. • Check the operation of the upstream sample gas cooler.
	Inadequate gas supply	• Connect the flow meter, ball chamber or pressure gauge directly to the gas supply pump and measure the pressure or vacuum. • Check the pump and change the membrane as necessary. • Check and, if necessary, replace the disposable filter (see page 142 for instructions). • Check and, if necessary, replace the solenoid(s).

Notify Service

Who to contact for further help?

Please contact your local service representative. For emergencies, please contact

ABB Service
Telephone: +49-(0)1805-222580, Telefax: +49-(0)621-38193129031,
E-mail: automation.service@de.abb.com

Before you notify service ...

Before calling for service because of a problem or status message, determine whether there actually is an error and whether the analyzer system is actually operating out of specifications.

When you notify service ...

When calling for service because of a problem or status message have the following information available:

- The **production number** (F-No.) of the defective or improperly operating unit. It is located on the unit's identification plate as well as in the analyzer data sheet.
- The system controller and system module **software versions** are found in the MENU → Diagnostics/Information → System overview menu item
- An **exact description** of the problem or status as well as the status message text or number

This information will enable service personnel to help you quickly.

When calling for service because of a problem or status message have the analyzer data sheet available. It contains important information that will help the service personnel find the cause of the fault.

When you return an analyzer system to the service department ...

When returning an analyzer system to the service department, e.g. for repair, please indicate which gases have been supplied to the analyzer system. This information is needed so that service personnel can take any safety precautions required for harmful gases.

Analyzer System Shut-Down

CAUTION!

Before being shut down the analyzer system should be purged in order to prevent condensation and condensate deposits in the individual units.

CAUTION!

When working with corrosive reagents note the hazard information and safety precautions contained in the applicable material safety data sheets.

Condensates are often acidic. Neutralize condensates and follow the prescribed measures for disposal.

Shutting Down the Analyzer System

Step	Action
1	Flush the sampling probe, filter and sample gas line, e. g. by drawing outside air from the sampling probe.
2	Purge the gas paths of the analyzer system for 30 minutes.
3	Turn off the analyzer system with main switch ***-Q10***.

Disposing of Reagents

Empty the (optional) reagent supply bottle and dispose of reagents according to applicable regulations.

Emptying the Condensate Collecting Bottle

Empty the condensate collecting bottle and dispose of condensates according to applicable regulations.

Make sure the analyzer system is free of residual moisture that can freeze if low temperatures are encountered during shipping and storage.

Transportation Restraints Activation

Step	Action
Sample Gas Feed Unit SCC-F: Diaphragm Pumps Transportation Restraints:	
1	Using a Ph2 crosshead screwdriver, screw two M6x25 screws through the holes in the base plate into the diaphragm pumps base plate and tighten them.
Sample Gas Cooler SCC-C: Compressor Transportation Restraints:	
2	Using an offset Ph2 crosshead screwdriver, turn the two screws clockwise through the holes in the base plate to the point at which the compressor housing is in contact with the base plate (noticeable resistance).

Ambient Temperature

During storage and transport:	+2 to +60 °C
After draining and drying parts in contact with condensate:	–25 to +60 °C

Packing the Analyzer Cabinet or System Components

Packing

Step	Action
	It is strongly recommended that the analyzer cabinet / mounting plate / electrical distribution cabinet are • transported by a specialist firm and • transported in a horizontal position
1	Vacuum-pack the analyzer cabinet / mounting plate / electrical distribution cabinet in foil.
2	Put desiccating agent in the transport crate. The amount of desiccating agent should be sufficient for the package volume and the expected shipping duration (at least 3 months).
3	Place the analyzer cabinet / mounting plate / electrical distribution cabinet on vibration dampers in the transport crate and fix with wedges.
4	Mark the transport crate according to the regulations (in particular, “Fragile Goods”).

Ambient Temperature

During storage and transport:	+2 to +60 °C
After draining and drying parts in contact with condensate:	–25 to +60 °C

ABB Measurement & Analytics

For your local ABB contact, visit:
www.abb.com/contacts

For more product information, visit:
www.abb.com/analytical

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