Exhibit SAD1-13

Date	November 20th 2018
To	**Sol Ucciani** Engineering Project Manager Vanguard Renewables 781-475-4796
Email	succiani@vanguardrenewables.com
Prepared by	Paul-Louis Crouzat

Dear Sol,

As per our discussions, please see below our preliminary answers to the questions from the DPS pertaining to the operation and safety of the DMT installation.

Sincerely,

Paul-Louis Crouzat
Sales Engineer
DMT Clear Gas Solutions
(971) 407-0951

1. Facility Design and Construction

The Department is requesting design documents and specifications regarding the following:

a. Gas transmission facilities from Salisbury AD 1's gas upgrade equipment to the connection with VGS distribution facilities, including pipeline material specifications, installation specifications, pipeline welding specifications, and connection specifications at both the project location and the connection to VGS facilities;

Please see attached the Process Flow Diagram (PFD) of our gate-feeder. This is the last skid before the gas is sent to the utility.

In regard to the materials, DMT recommends carbon steel or stainless steel. As for the installation, pipeline welding and connection to VGS facilities, this should be addressed by the EPC contractors.

We recommend the following for the interconnection:

- When possible, the fittings must be fitted with stainless steel bonded seals to keep the use of loctite or other seals to a minimum.
- Galvanic isolation wherever possible. If stainless steel and steel will be mounted in contact with each other, this must be separated with brass couplings.

Furthermore, the EPC contractor must obey with the following codes and standards:

- ASME Section VIII, Boiler and Pressure Vessel Code
- ASME/ANSI B31.3 Process Piping
- ASME B16.5: Pipe Flanges and Flanged Fittings
- ASME B16.11: Forged Fittings, Socket-Welding and Threaded
- ASME B16.34: Valves Flanged, Threaded and Welding End
- API RP-520: Sizing, Selection and Installation of Pressure-relieving Devices in Refineries, Part I Sizing and Selection and Part- II Installation
- ANSI/Hydraulic Institute Pump Standards
- NFPA70: Electrical distribution and control panels
- Class I, Div II, Group D hazardous zone classification for equipment outside the container.

b. Design specifications for gas quality monitoring equipment, and;

We always use gas monitoring equipment that satisfies the below conditions:

1. Specific pressure as in the process line
2. UL or CSA listed
3. Class 1, Div 2
4. Continuous or intermittent.

Please see attached an example of ABB sensors we have used in the past.

c. Design specifications for gas pressurization equipment.

All of the piping is rated for 300 psi(g). The maximum pressure at the outlet of the compression is 250 psi(g).
Pressure is measured using pressure transmitters across the system.

2. <u>Facility Operation and Maintenance</u>

The Department requests documentation regarding the following:

a. Detailed operations and maintenance protocols;

Please see the document: "*Carborex MS - Sample Operation and Maintenance Instructions*."

b. Overpressure protection protocols, and;

DMT takes over-pressurization very seriously and ensures protection against it through out its systems. Below are a few examples:

In the low-pressure system (from the inlet of our system to our compressor) the outlet of the activated carbon filters is equipped with pressure relief valves, which open if the pressure in the carbon filter exceed 1 bar(g) | 14 psi(g).

In regard to the compressor, should the pressure become too high then a high-pressure safety switch shuts down the compressor. In the event of this system failing there is a relief valve on the oil gas separator vessel that will relieve too high overpressure.

c. Protocols for integrity management of plant facilities and gas transmission facilities, including pressure testing, and monitoring and repair of corrosion or leaks.

Please refer to the document: "*Carborex MS - Sample Operation and Maintenance Instructions*."

3. Input and Output Quality Control Measures

The Department requests documentation regarding the following:

a. Detailed gas pressurization control protocols;

The gas pressure is checked at multiple points along the process to ensure that it is in line with normal operating conditions.

Before leaving the upgrading plant, the product gas is adjusted to the Customer's requirements:

- Pressure adjustment through a pressure reducer.

The gas is then ready to leave the upgrading plant to be post-treated.

b. Detailed gas quality control protocols;

The gas quality is checked at three different points along the process, using a gas analyzer system located in the control room.

c. Detailed protocols for the monitoring and management of byproducts and adulterants in the output gas

The off-gas (stage 1 permeate) exits the process via the stack (which is located on the container rooftop).
This off-gas contains a very low amount of oxygen and does not support life, so it is vented at such a high altitude to ensure good dispersion within the surrounding air.
Check valves are used to prevent air (or gas) to flow back into the membrane system under various circumstances.

The flowrate of the off-gas is monitored and the CH_4 concentration in the permeate (P1) is measured using an infrared sensor.

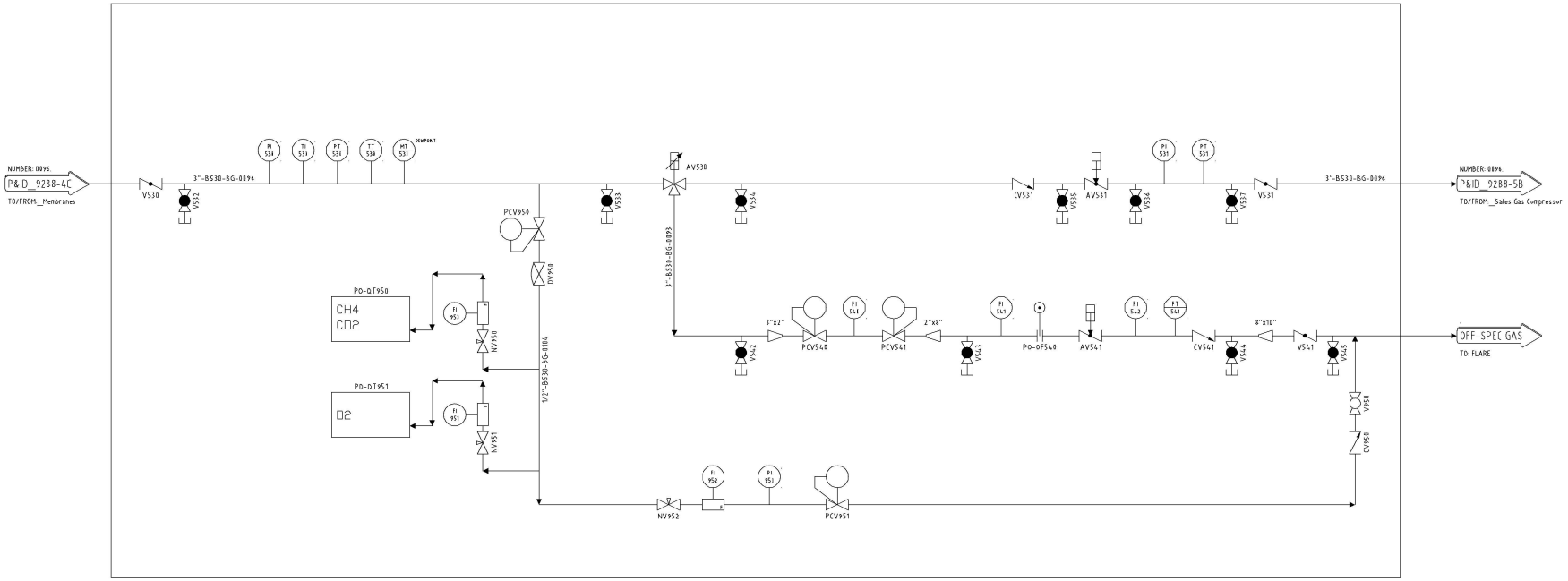
The output of the DMT system would be the following:

	Biogas IN	RNG OUT	Off Gas	Unit
Flow	300-520	165-345	135-230	scfm
Average flow:	270,000	180,000		Mcf/year
CH_4	55-65	>96	3-5	%
Calorific value		>970		btu/ft^3
CO_2	35-45	<4	95-97	%
H_2S (average)	500	<4	<4	ppm
VOC	200	<4	<4	mg/Nm^3
Ammonia	150	<4	<4	ppm
O_2	Negligible	Negligible	Negligible	%
N_2	Negligible	Negligible	Negligible	%
Dew point	Saturated	<7	<7	lbs/MMSCF
T	77-95	77-95	77-95	°F
P	0.1-1.0	220	1-5	psi (g)

d. Discussion of measurement and management of feedstock tolerances to achieve output gas which adheres to gas quality and safety standards.

No matter what feedstock is used in the digester, the biogas will be constantly monitored by DMT by the use of sensors described above. Furthermore, automatic control valves downstream stage 2 (retentate side) are used to maintain a stable operating pressure on the membranes.

Keeping the operating pressure and temperature as stable as possible in this section ensures the most stable product quality. The quality of the upgraded gas depends primarily on the operating pressure of the retentate of stage 1/2, as well as on the pressure of stage 2 permeate.



Rev.nr.	Date	Drawn by	Description
0.01	09-06-2017	H. Hessels	First Draft

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Drawing description:
P&ID Gas Upgrading
Gatekeeper

Draw. nr.
9288-5A

Project name: 9288 Wasatch

Drawn by	: H. Hessels	**Date**	: 20/06/2017
Note	:-		
Note	:-		

Papersize : A3

Carborex MS: Sample Instruction for Operation and Maintenance

Tasks overview during operation

Section	Item	Frequency	Remarks
General	Check control interface for alarms and warnings	Daily	
§ 6.2.1	Check all components for leakages, unusual noises or anomalities	Daily	
§ 6.2.3	Check if temperature drops below 0 ˚C	Daily	
§ 6.2.4	Check if temperature drops below -15 ˚C	Daily	
§ 6.3.1	De-aerate chiller CH700	Weekly	
§ 6.3.2	Check pressure reducer to sample system (PCV900)	Weekly	
§ 6.3.3	Oil level compressor	Weekly	
§ 6.3.4	Check gas directed to membranes for hydrocarbons	Weekly	
	Advice: VOC, NH_3 draeger or GC analysis of biogas feed.	Weekly	
§ 6.3.5	De-aerate hot water circuit	Weekly	
§ 6.4.1	Check condensate glass of analysis system	Monthly	
§ 6.4.2	Check AC filter F340 for breakthrough	Monthly	
	Check all parts that require cooling (e-motors, chillers, pump housings) for dirt, and clean those if the system is in off position	Monthly	
	Determine and analyze performance of chillers and heat exchangers	Monthly	
§ 6.5.1	Power consumption and electrical resistance vacuum blower	Every 6 month	Special trained / by supplier equipment
§ 6.5.2	Power consumption electrical heater	Every 6 month	Special trained / by supplier equipment
§ 6.5.3	Check operation automatic valves	Every 6 month	
§ 6.6.1	Check switching on tracing	Winter	
§ 6.6.2	Check glycol concentration cooling circuit	Winter	
§ 6.6.3	Check glycol concentration heating circuit	Winter	
§ 6.7.1	Calibration of gas measurements	Yearly	By supplier equipment
§ 6.7.2	Inspection of oil vessel	Yearly	
§ 6.7.3	Check earthing	Yearly	Special trained / by supplier equipment
§ 6.7.4	Check P,T switches compressor	Every 3 years	
§ 6.7.5	Check relief valves compressor	Every 3 years	

Maintenance overview:

Section	Item	Frequency	Remarks
§ 9.1 -9.2	Inert (prepare for maintenance)		
§ 9.3	Replace active carbon F340	Yearly	
§ 9.4	Check fine filter F350 for oil/ condensate	Every 2 month	
§ 9.6	Inspect strainers in cooling circuit		
§ 9.7.1	Drain cooling circuit CH700		
§ 9.8	Refill and re-pressurize hot water circuit		
§ 9.8.1	Deaerate hot water		
§ 9.9	Refill and re-pressurize cooling water circuit		
Generally, (part of maintenance plan)	Inspection all sensors (pressure, temperature, level)	Yearly	Special trained technician
	Electrical inspection all electrical cabinets, wiring.	yearly	Special trained technician
	Inspection cooling machines by the manufacturer	Yearly	Requires service contract (depending on country)
	Calibration LEL detectors (calibration gas needed)	Yearly	Special trained / by supplier equipment
	Inspection Atex ventilators (container)	Yearly	Special trained technician
	Revision of vacuum blower	Each 2 year	It is recommended to hire the manufacturers of the equipment to perform this tasks.
	Inspection pressure safety devices	Each 2 - 4 year	Requires service contract (depending on country)

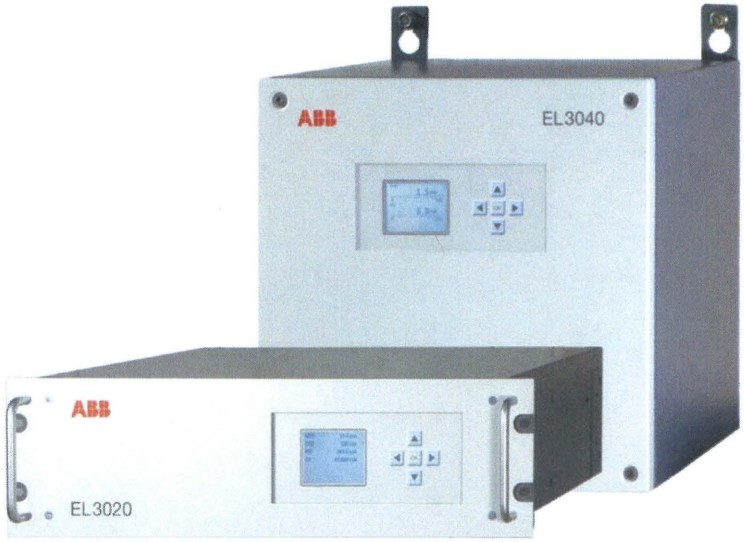
EasyLine Continuous Gas Analyzers

EL3000 Series

Models EL3020, EL3040

Data Sheet

10/24-4.10 EN August 2008



- Detectors with different measurement principles for numerous process and emission monitoring applications
- Up to five measurement components per gas analyzer
- Suitable for measuring flammable gases
- Version with protection type II 3G for measurement of non-flammable gases
- Performance-tested versions for emission monitoring according to Directive 2001/80/EC
- QAL3 monitoring according to EN 14181 (optional)
- Automatic calibration including pump and valve control
- Simplified calibration with air or integral calibration cells eliminating the need for test gas cylinders
- Customizable analog outputs, digital inputs and digital outputs
- Modbus and Profibus interface
- Simple menu-driven operator interface
- Clear-text status messages
- Configuration of rarely required functions with included configuration program
- Self-monitoring function indicates when maintenance is required
- Housing versions for 19-inch rack mounting (Model EL3020) and wall mounting (Model EL3040)
- Integral gas feed (optional in Model EL3020)

Contents

Overview of the Gas Analyzers

Measuring Technology (Analyzers)

The following analyzers are available for selection:

- Uras26 infrared photometer for the measurement of infrared-active gas components e.g. CO, NO, SO_2
- Magnos206 oxygen analyzer for the measurement of O_2 in process gas or in N_2
- ZO23 trace oxygen analyzer for the measurement of O_2 in pure gases (N_2, CO_2, Ar)
- Caldos27 thermal conductivity analyzer for the measurement of binary gas mixtures with different thermal conductivity e.g. Ar in O_2, H_2 in Ar, CH_4 in N_2
- Electrochemical oxygen sensor for the measurement of O_2

The electrochemical oxygen sensor can only be used in combination with the Uras26 infrared photometer.

The Magnos206 oxygen analyzer and the Caldos27 thermal conductivity analyzer can also be used in combination with the Uras26 infrared photometer.

The ZO23 trace oxygen analyzer cannot be used in combination with one of the other analyzers. Only one ZO23 trace oxygen analyzer can be installed in the gas analyzer.

Each analyzer has one physical measurement range per sample component. A section of the physical measurement range can be mapped to the current output (analog output) by on-site configuration. Calibration is always executed in the physical measurement range. The permissible measurement range limits are given by the specification of the smallest and largest measurement ranges for the individual analyzers.

A total of up to five measurement components can be measured with one gas analyzer.

Overview of the Gas Analyzers

Integral Gas Feed

The integral gas feed (optional in Model EL3020) is available in two versions. It includes

- either the solenoid valve, pump, coarse filter, capillary tube and flow sensor modules
- or a flow sensor module.

Electrical Interfaces

The electrical interfaces for the output of measured values and communication with external systems include

- The integrated Ethernet-10/100BASE-T interface (for configuration, software update and QAL3 data transfer))

as well as the integrated I/O modules depending on the functional range and order

- Analog output module with two analog outputs,
- Digital I/O module with four digital inputs and four digital outputs,
- Modbus module with one RS485 and one RS232 interface,
- Profibus module with one RS485 and one MBP interface.

Housing Design

The housing for the EL3020 gas analyzer model is designed as a 19-inch housing with 3 height units and degree of protection IP20.

The housing for the EL3040 gas analyzer model is designed as a wall-mount housing with degree of protection IP65.

QAL3 Monitoring

QAL3 monitoring is available as an option in the gas analyzer. It is used to fulfill the requirements according to EN 14181 for storage and analysis of device adjustment data. The QAL3 monitoring option features the following functions:

- Automatic acquisition, verification and documentation of drift und precision at zero and reference points
- Reporting via CUSUM and Shewhart control charts
- QAL3 data storage in the gas analyzer (maximum 1 year)
- QAL3 data display and query as well as parameter setting via web browser
- Status messages on deviations beyond requirements
- Data export for further processing with spreadsheet programs

The gas analyzer must be connected to a PC via the Ethernet interface for QAL3 monitoring operation.

Measurement Principle

Non-dispersive infrared absorption

Photometer to measure up to 4 components

Sample Components and Measurement Ranges

Sample Components and Smallest Measurement Ranges

Sample Component	Smallest Measurement Range
CO	0–100 ppm
CO_2	0–100 ppm
NO	0–150 ppm
SO_2	0–100 ppm
N_2O	0–100 ppm
CH_4	0–100 ppm

Measurement Range Quantity
2 measurement ranges

Measurement Range Limits

Smallest Measurement Range	Largest Measurement Range
0–100 ppm (NO: 0–150 ppm)	0–500 ppm (NO: 0–750 ppm)
0–200 ppm	0–1000 ppm
0–600 ppm	0–3000 ppm
0–2000 ppm	0–10000 ppm
0–0.6 Vol.-%	0–3 Vol.-%
0–2 Vol.-%	0–10 Vol.-%
0–6 Vol.-%	0–30 Vol.-%
0–20 Vol.-%	0–100 Vol.-%

An individual measurement range within the limits shown in the table can be factory-set on special order.
Measurement ranges are freely adjustable within the limits shown in the table.
Measurement ranges should not be set within ignition limits.

Stability

The following data apply only if all influence factors (e.g. flow rate, temperature, atmospheric pressure) are constant.

Linearity Deviation
≤ 1 % of span

Repeatability
≤ 0.5 % of span

Zero Drift
≤ 1 % of span per week

Sensitivity Drift
≤ 1 % of measured value per week

Output Fluctuation (2 σ)
≤ 0.2 % of span at electronic T90 time (static/dynamic)
= 5/0 sec

Detection Limit (4 σ)
≤ 0.4 % of span at electronic T90 time (static/dynamic)
= 5/0 sec

Influence Effects

Flow Effect
Flow rate in the 20–100 l/h range: Within detection limits

Associated Gas Effect/Cross Sensitivity
The knowledge of the sample gas composition is necessary for the analyzer configuration.
Selectivity measures to reduce associated gas effect (optional): Incorporation of interference filters or filter cells, internal electronic cross-sensitivity correction for one sample component by other sample components measured with the gas analyzer.

Temperature Effect
Ambient temperature in permissible range
- At zero-point: ≤ 2 % of span per 10 °C
- On sensitivity without thermostat: ≤ 3 % of measured value per 10 °C
- On sensitivity with thermostat (optional): ≤ 2 % of measured value per 10 °C
  Thermostat temperature = 55 °C

Air Pressure Effect
- At zero-point: No effect
- On sensitivity with pressure correction by means of integral pressure sensor: ≤ 0.2 % of measured value per 1 % barometric pressure change

The pressure sensor is located in the sample gas path if hoses are used as the internal gas lines.
If stainless-steel tubing is used for internal gas lines the pressure sensor is routed to the outside via a hose.
Pressure sensor working range: p_{abs} = 600–1250 hPa

Power Supply Effect
Voltage and frequency in the permissible range: No effect

Dynamic Response

Warm-Up Time
Approx. 30 minutes without thermostat; approx. 2 hours with thermostat

90% Response Time
T_{90} = 2.5 sec for measurement cell length = 175 mm, sample gas flow = 60 l/h and electronic T90 time (static/dynamic) = 5/0 sec.

Calibration

Zero-Point Calibration
With inert gas, e.g. N_2, or with ambient air that is free of the sample component.

End-Point Calibration
With gas-filled calibration cells (optional) or with test gas mixtures. It is recommended to verify the calibration cell set values once a year.

Materials in Contact with the Sample Medium

Analyzer (Sample Cells)
Tubing: Aluminum; Window: CaF_2 or BaF_2;
Connectors: Stainless steel 1.4305

Gas Lines and Connectors
FPM (Fluorocarbon rubber) hoses, PVDF connectors.
When flammable components are present in the sample gas: Stainless steel tubes 1.4571, stainless steel connectors 1.4305

Gas Inlet Conditions

The analyzer must not be used for measurement of ignitable gas/air or gas/oxygen mixtures.

Temperature
The sample gas dew point should be at least 5 °C below the temperature throughout the sample gas path. Otherwise a sample gas cooler or condensate trap is required.

Inlet Pressure
p_e = 2–500 hPa
Lower pressures require a sample gas pump and higher pressures require a pressure reducer.

Outlet Pressure
Atmospheric pressure

Flow Rate
20–100 l/h

Corrosive Gases
Highly corrosive associated gas components, e.g. chlorine (Cl_2) and hydrogen chloride (HCl), as well as gases or aerosols containing chlorine must be cooled or undergo prior absorption.

Flammable Gases
In the version with gas lines and connectors made of stainless steel the analyzer is suitable for measuring flammable gases in general purpose environment. The special requirements must be observed (see operator's manual).

Gas Connections
See page 20 (Model EL3020) and page 22 (Model EL3040).
The version with two separate gas paths is used for NOx measurement with NO_2/NO converter connected upstream.

Measurement Principle

Paramagnetic behavior of oxygen

Magnetomechanical oxygen analyzer; short 90% response time

Sample Component and Measurement Range

Sample Component
Oxygen (O_2)

Smallest Measurement Range
0–2 Vol.-% O_2

Quantity and Measurement Range Limits
2 measurement ranges
Measurement ranges are freely adjustable; they are factory-set per order to 0–5 or 0–100 or 98–100 Vol.-% O_2.

Largest Measurement Range
0–100 Vol.-% O_2
Measurement ranges should not be set within ignition limits.

Measurement Ranges with Suppressed Zero-Point
Suppressed measurement ranges are freely adjustable in the range 0–100 Vol.-% O_2. Smallest span 2 Vol.-% O_2. The combination of a suppressed and an initial measurement range is not possible.
Pressure correction with a pressure sensor is required.
A pressure sensor is installed when the analyzer has been ordered with suppressed measurement range.

Stability

The following data apply only if all influence factors (e.g. flow rate, temperature, atmospheric pressure) are constant. They are based on a span of 2 Vol.-% O_2.

Linearity Deviation
≤ 0.5 % of span

Repeatability
≤ 50 ppm O_2 (time base for gas exchange ≥ 5 minutes)

Zero Drift
≤ 3 % of span of the smallest measurement range (per order) per week, minimum 300 ppm O_2 per week; following prolonged transport and storage time the drift can be higher during the first weeks of operation.

Sensitivity Drift
≤ 0.1 Vol.-% O_2 per week or ≤ 1 % of measured value per week (not cumulative), whichever is smaller.
≤ 0.25 % of measured value per year, minimum 0.05 Vol.-% O_2 per year

Output Fluctuation (2 σ)
≤ 25 ppm O_2 at electronic T90 time (static/dynamic) = 3/0 sec

Detection Limit (4 σ)
≤ 50 ppm O_2 at electronic T90 time (static/dynamic) = 3/0 sec

Influence Effects

Flow Effect
≤ 0.1 Vol.-% O_2 in the 30–90 l/h range

Associated Gas Effect
The effect of associated gases as a shift of the zero-point – expressed in Vol.-% O_2 – can be estimated using the approximate values in the following table:

Associated Gas Concentration 100 Vol.-%		Zero-Point Shift in Vol.-% O_2
Hydrogen	H_2	+0.28
Hydrogen Sulfide	H_2S	–0.45
Argon	Ar	–0.26
Helium	He	+0.30
Neon	Ne	+0.13
Nitrogen	N_2	0
Nitrogen Oxide	NO	+43
Nitrogen Dioxide	NO_2	+28
Nitrous Oxide	N_2O	–0.20
Carbon Monoxide	CO	–0.01
Carbon Dioxide	CO_2	–0.32
Carbon Oxysulfide	COS	–0.90
Ethane	C_2H_6	–0.46
Ethylene	C_2H_4	–0.29
Methane	CH_4	–0.24
Propane	C_3H_8	–0.98
Propylene	C_3H_6	–0.55
Trichloroethane	C_2HCl_3	–2.17
Vinyl Chloride	CH_2CHCl	–0.75

For further associated gases refer to EN 61207-3

Temperature Effect
Ambient temperature in the permissible range
- At zero-point: ≤ 1 % of span per 10 °C, ≤ 2 % of span per 10 °C in combination with Uras26
- On sensitivity: ≤ 0.2 % of measured value per 10 °C

Thermostat temperature = 64 °C

Air Pressure Effect
- At zero-point: No effect
- On sensitivity with no pressure correction: ≤ 1 % of measured value per 1 % air pressure change
- On sensitivity with pressure correction using integrated pressure sensor (optional): ≤ 0.01 % of measured value per 1 % pressure change or ≤ 0.002 Vol.-% O_2 per 1 % pressure change, whichever is greater
  Pressure sensor working range: p_{abs} = 600–1250 hPa

Power Supply Effect
Voltage and frequency in the permissible range: ≤ 0.2 % of span

Position Effect
Zero-point shift ≤ 0.05 Vol.-% O_2 per 1° deviation from horizontal orientation. Position has no effect on the hard-mounted unit.

Dynamic Response

Warm-Up Time
< 1 hour

90% Response Time
$T_{90} \leq 4$ sec at a sample gas flow of 90 l/h and electronic T90 time (static/dynamic) = 3/0 sec, gas change from N_2 to air

Calibration

Zero-Point Calibration
With oxygen-free process gas or substitute gas

End-Point Calibration
With process gas with a known oxygen concentration or a substitute gas such as dried air

Single-Point Calibration
Zero-point calibration with any oxygen concentration, e.g. with nitrogen (N_2) or ambient air, processed through a cooler or H_2O absorber; sensitivity deviation ≤ 0.05 Vol.-% O_2 per year.
Pressure correction by means of pressure sensor is recommended for single-point calibration with air.
Depending on the measurement task involved, the zero- and end-points should be verified periodically.

Calibration of Measurement Ranges with Suppressed Zero-Point
Highly suppressed measurement ranges (≥95–100 Vol.-% O_2) should only be calibrated with test gases with concentrations in the selected measurement range.

Materials in Contact with the Sample Medium

Analyzer
Sample chamber (direct connection): Stainless steel 1.4305, glass, platinum, rhodium, epoxy resin;
Seals: FPM (Fluorocarbon rubber), PEEK

Gas Inlet Conditions

The analyzer must not be used for measurement of ignitable gas/air or gas/oxygen mixtures.

Temperature
+5 to +50 °C
The sample gas dew point should be at least 5 °C below the temperature throughout the sample gas path. Otherwise a sample gas cooler or condensate trap is required. Water vapor content variations cause volume errors.

Inlet Pressure
p_e = 2–100 hPa
Lower pressures require a sample gas pump and higher pressures require a pressure reducer.

Outlet Pressure
Atmospheric pressure

Flow Rate
30–90 l/h
Abrupt changes in gas flow rates should be avoided when using highly suppressed measurement ranges.

Corrosive Gases
Consultation with ABB Analytical is required if the sample gas contains Cl_2, HCl, HF or other corrosive components.
The AO2000-Magnos206 analyzer should be used if the sample gas contains NH_3.

Flammable Gases
The analyzer is suitable for measuring flammable gases in general purpose environment. The special requirements must be observed (see operator's manual).

Gas Connections
see page 21 (Model EL3020) and page 23 (Model EL3040)

Measurement Principle

Potentiometric measurement; zirconium dioxide cell for determination of the oxygen concentration in accordance with Nernst's equation; reference gas: ambient air.

The analyzer is used for the continuous measurement of oxygen in pure gases (N_2, CO_2, Ar). The measuring cell is catalytically inactivated to the extent that flammable carrier components in stoichiometric concentrations only negligibly reduce the oxygen value.

Sample Component and Measurement Ranges

Sample Component
Oxygen (O_2)

Measurement Ranges
2 measurement ranges
Measurement ranges are freely adjustable within the 0...1 ppm to 0...250,000 ppm O_2 range; they are factory-set to 0 to 1/ 0 to 10 ppm O_2.
The following measurement data refer to a measurement span of 100 ppm O_2 with an integrated pump and flow control.

Stability

Linearity
Owing to the measurement principle, zirconium dioxide cells are base linear.

Repeatability
< 1 % of the measurement range or 100 ppb O_2 (whichever is greater)

Zero Drift
The zero point (reference point) is displayed if ambient air is present on the sample gas side. The value for air of 20.6 % Vol. of O_2 may deviate through aging of the cell.
< 1 % of the measurement range per week or 250 ppb O_2 (whichever is greater)

Sensitivity Drift
Depends on possible interfering components (catalyst poisons) in the sample gas and the aging of the cell.
For pure gas measurements in N_2 and Ar:
< 1 % of the measurement range per week or 250 ppb O_2 (whichever is greater)

Output Fluctuation (2 σ)
< ±0.5 % of the measured value or 50 ppb O_2 (whichever is greater)

Influence Effects

Flow Effect
≤ 1 % of the measurement span or 100 ppb O_2 (whichever is greater) for a flow rate of 8 ± 0.2 l/h.
The flow rate must be kept constant to ±0.2 l/h in the permissible range. The permissible range is 5 to 10 l/h. The flow rate is kept constant to 8 ± 0.2 l/h with integrated pump and flow control.

Associated Gas Effect
Inert gases (Ar, CO_2, N_2) have no effect. Flammable gases (CO, H_2, CH_4) in stoichiometric concentrations to the oxygen content: Conversion of O_2 < 20 % of the stoichiometric conversion. If higher concentrations of flammable gases are present, higher O_2 conversions must be expected. The concentration of flammable gases in the sample gas must not exceed 100 ppm.

Temperature Effect
The effect of the ambient temperature in the permissible range of +5 to +45 °C is < 2 % of the measured value or 50 ppb O_2 per 10 °C change in the ambient temperature (whichever is greater).

Air Pressure Effect
No effect through a change in air pressure; sample gas must flow out of the outlet without back pressure.

Power Supply Effect
24 V DC ± 5 %: no effect

Position Effect
No position effect for permanently installed instruments

Dynamic Response

Warm-Up Time
The operating temperature of the cell is reached after approx. 15 min. Offset calibration with reference gas (ambient air) after 2 h flow. The measurement is ready-to-run after valves and lines have been purged with sample gas. Typical purging time for valves and lines: approx. 2 to 5 h.

90% Response Time
T_{90} < 60 s for the alternation of 2 test gases in the measurement range 10 ppm with a sample gas flow rate = 8 l/h and electronic T90 time = 3 s

Calibration

Offset Calibration
The reference value for ambient air is calibrated at 20.6 % Vol. by means of ambient air on the sample gas side.

End-Point Calibration
By means of test gas O_2 in N_2 (or in CO_2 or in Ar);
O_2 concentration in the measurement range, e.g. 10 ppm O_2

Function Test

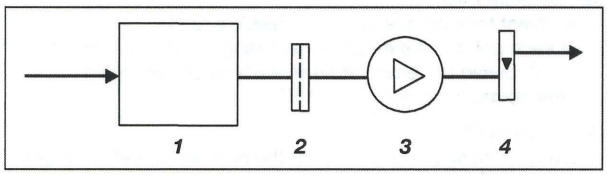
An extended response time or reduced sensitivity are dimensions for the correct functioning of the measuring cell. The function test can be carried out by feeding the sample gas without any additional test gases. On the basis of the progression of the test, it can be assessed whether the reaction time of the sensor lies within a specified tolerance. The function test is started manually and lasts approx. 15 min.

Materials in Contact with the Sample Medium

Analyzer
Zirconium dioxide cell: ZrO_2, electrodes containing platinum; Dust filter: PP; Pump: EPDM; Flow sensor: on semiconductor basis, nickel-plated brass

Gas Lines and Connectors
Stainless steel 1.4571, FPM and silicon hoses in the gas outlet; Gas connections: stainless steel 1.4401/1.4305

Pneumatics Diagram



1 Measuring cell
2 Dust filter (option)
3 Pump (option)
4 Flow sensor (option)

As an option, an integrated gas feed can be installed in the trace oxygen analyzer (see pneumatics diagram). The analyzer cannot be connected to the EL3000 series integral gas feed.

Gas Inlet Conditions

The analyzer must not be used for measurement of ignitable gas/air or gas/oxygen mixtures.

Temperature
+5 to +50 °C

Inlet Pressure
p_e = 2 to 20 hPa

Outlet Pressure
Atmospheric pressure

Flow Rate
5 to 10 l/h. The flow rate must be kept constant to ±0.2 l/h in this range.
The flow rate is kept constant to 8 ± 0.2 l/h with integrated pump and flow control. The sample gas must be taken from a bypass at zero pressure.

Corrosive Gases
The presence of corrosive gases and catalyst poisons, e.g. halogens, gases containing sulfur and heavy-metal dust, leads to faster aging and/or destruction of the ZrO_2 cell.

Flammable Gases
The concentration of flammable gases in the sample gas must not exceed 100 ppm.

Purge Gas
If case purging is selected, purging may only be carried out with air (not with N_2), since the ambient air is used as a reference gas.

Gas Connections
see page 21 (Model EL3020) and page 23 (Model EL3040)

Measurement Principle

Difference in thermal conductivity of various gases

Micromechanical silicon sensor with especially short T_{90} time

Sample Components and Measurement Ranges

Sample Component and Associated Gas	Smallest Meas. Range	Smallest Meas. Range With Suppr. Zero-Point
Air in Ar	0– 6 Vol.-%	94–100 Vol.-%
Ar in air	0– 6 Vol.-%	94–100 Vol.-%
Air in CO_2	0–10 Vol.-%	90–100 Vol.-%
CO_2 in air	0–10 Vol.-%	90–100 Vol.-%
Air in H_2	0– 3 Vol.-%	–
H_2 in air	0– 1 Vol.-%	–
Air in He	0– 3 Vol.-%	98–100 Vol.-%
He in air	0– 2 Vol.-%	97–100 Vol.-%
Ar in CO_2	–	50–100 Vol.-%
CO_2 in Ar	0-50 Vol.-%	–
Ar in H_2	0– 3 Vol.-%	99–100 Vol.-%
H_2 in Ar	0– 1 Vol.-%	97–100 Vol.-%
Ar in He	0– 3 Vol.-%	99–100 Vol.-%
He in Ar	0– 1 Vol.-%	97–100 Vol.-%
Ar in N_2	0– 6 Vol.-%	94–100 Vol.-%
N_2 in Ar	0– 6 Vol.-%	94–100 Vol.-%
Ar in O_2	0–10 Vol.-%	90–100 Vol.-%
O_2 in Ar	0–10 Vol.-%	90–100 Vol.-%
CH_4 in H_2	0– 3 Vol.-%	99–100 Vol.-%
H_2 in CH_4	0– 1 Vol.-%	97–100 Vol.-%
CH_4 in N_2	0– 6 Vol.-%	94–100 Vol.-%
N_2 in CH_4	0– 6 Vol.-%	94–100 Vol.-%
CO in H_2	0– 3 Vol.-%	99–100 Vol.-%
H_2 in CO	0– 1 Vol.-%	97–100 Vol.-%
CO_2 in H_2	0– 3 Vol.-%	99–100 Vol.-%
H_2 in CO_2	0– 1 Vol.-%	97–100 Vol.-%
CO_2 in N_2	0–10 Vol.-%	90–100 Vol.-%
N_2 in CO_2	0–10 Vol.-%	90–100 Vol.-%
H_2 in N_2	0– 1 Vol.-%	97–100 Vol.-%
N_2 in H_2	0– 3 Vol.-%	99–100 Vol.-%
H_2 in NH_3	0–10 Vol.-%	90–100 Vol.-%
NH_3 in H_2	0–10 Vol.-%	90–100 Vol.-%
He in N_2	0– 2 Vol.-%	97–100 Vol.-%
N_2 in He	0– 3 Vol.-%	98–100 Vol.-%

Measurement Ranges for Monitoring Hydrogen-Cooled Turbo Generators

Sample Component and Associated Gas	Measurement Range
CO_2 in air or Ar in air	0–100 Vol.-%
H_2 in CO_2 or H_2 in Ar	100–0 Vol.-%
H_2 in air	100–80 Vol.-%

Other sample components on request.

Quantity and Measurement Range Limits
2 measurement ranges
Measurement ranges are freely adjustable within the limits shown in the table.

Largest Measurement Range
0–100 Vol.-% or 0 Vol.-% to saturation, depending on measurement task
Measurement ranges should not be set within ignition limits.

Stability

The following data apply only if all influence factors (e.g. flow rate, temperature, atmospheric pressure) are constant. They relate to smallest measurement ranges given in the table. The deviations may be larger for smaller measurement ranges.

Linearity Deviation
≤ 2 % of span

Repeatability
≤ 1 % of span

Zero Drift
≤ 2 % of smallest possible measurement range per week

Sensitivity Drift
≤ 0.5 % of smallest possible measurement range per week

Output Fluctuation (2 σ)
≤ 0.5 % of smallest measurement range span at electronic T90 time = 0 sec

Detection Limit (4 σ)
≤ 1 % of smallest measurement range span at electronic T90 time = 0 sec

Influence Effects

The following data relate to smallest measurement ranges given in the table. The influence effects will be larger at operating altitudes > 2000 meters.

Flow Effect
≤ 0.5 % of span at a flow change of ±10 l/h. At an identical flow rate for test and sample gases the flow rate effect is automatically compensated.

Associated Gas Effect
The knowledge of the sample gas composition is necessary for the analyzer configuration. If the sample gas contains components in addition to the sample component and associated gas (binary gas mixture), this will result in erroneous measurements.

Temperature Effect
Ambient temperature in the permissible range
at each point in the measurement range: ≤ 1 % of span per 10 °C, based on temperature at the time of calibration
Thermostat temperature = 60 °C

Air Pressure Effect
≤ 0.25 % of span per 10 hPa for the smallest possible ranges given; for larger spans the effect is correspondingly lower.
Pressure sensor working range: p_{abs} = 600–1250 hPa

Power Supply Effect
Voltage and frequency in the permissible range: ≤ 0.2 % of span

Position Effect
< 1 % of span up to 30° deviation from horizontal orientation

Dynamic Response

Warm-Up Time
Approx. 30 minutes

90% Response Time
$T_{90} \leq 2$ sec at sample gas flow of 60 l/h and electronic T90 time (static/dynamic) = 0/0 sec

Calibration

Zero-Point Calibration
With test gas, measurement component-free process gas or substitute gas

End-Point Calibration
With test gas, process gas having a known sample gas concentration or substitute gas

Single-Point Calibration
A single-point calibration can be performed with standard gas, since the zero- and end-points will not drift independently due to the sensor principle employed. This technique leaves out safety-related measurements. Depending on the measurement task involved, the zero- and end-points should be verified periodically (Recommendation: once a year).

Materials in Contact with the Sample Medium

Analyzer
Sample chamber (direct connection): Stainless steel 1.4305; Sensor: Gold, silicon oxi-nitride; Seal: FFKM75 (Perfluoro rubber)

Gas Inlet Conditions

The analyzer must not be used for measurement of ignitable gas/air or gas/oxygen mixtures.

Temperature
+5 to +50 °C
The sample gas dew point should be at least 5 °C below the temperature throughout the sample gas path. Otherwise a sample gas cooler or condensate trap is required. Water vapor content variations cause volume errors.

Inlet Pressure
p_e = 2–100 hPa
Lower pressures require a sample gas pump and higher pressures require a pressure reducer.

Outlet Pressure
Atmospheric pressure

Flow Rate
Normally 10–90 l/h, minimum 1 l/h

Pressure Drop
< 2 hPa at 60 l/h N_2

Corrosive Gases
Consultation with ABB Analytical is required if the sample gas contains Cl_2, HCl, HF, SO_2, NH_3, H_2S or other corrosive components.

Flammable Gases
The analyzer is suitable for measuring flammable gases in general purpose environment. The special requirements must be observed (see operator's manual).

Gas Connections
see page 21 (Model EL3020) and page 23 (Model EL3040)

Electrochemical Oxygen Sensor

Measurement Principle

Electrochemical oxygen sensor

Sample Component and Measurement Range

Sample Component
Oxygen (O_2)

Smallest Measurement Range
0–5 Vol.-% O_2

Measurement Range
Adjustable from 0–5 Vol.-% O_2 to 0–25 Vol.-% O_2

Stability

Linearity Deviation
Linear in the range > 1 Vol.-% O_2

Repeatability
≤ 0.5 % of span

Zero Drift
Stable over long-term due to absolute zero point

Sensitivity Drift
≤ 1 % of the measurement range per week

Output Fluctuation (2 σ)
≤ 0.2 % of the measurement range at electronic T90 time (static/dynamic) = 5/0 sec

Detection Limit (4 σ)
≤ 0.4 % of the measurement range at electronic T90 time (static/dynamic) = 5/0 sec

Influence Effects

Flow Effect
Flow rate in the 20–100 l/h range:
≤ 2 % of the measurement range

Temperature Effect
Ambient temperature in the +5 to +40 °C range:
≤ 0.2 Vol.-% O_2 per 10 °C

Air Pressure Effect
- At zero-point: No effect
- On sensitivity with no pressure correction:
  ≤ 1 % of measured value per 1 % air pressure change
- On sensitivity with pressure correction:
  ≤ 0.2 % of sample value per 1 % air pressure change
  Pressure correction is only possible if the oxygen sensor is connected to the Uras26 infrared photometer with an integral pressure sensor.

Power Supply Effect
Voltage and frequency in the permissible range: ≤ 0.2 % of span

Dynamic Response

90% Response Time
T_{90} ≤ 30 sec at sample gas flow of 60 l/h and electronic T90 time (static/dynamic) = 5/0 sec

Calibration

Zero-Point Calibration
The oxygen sensor zero is not calibrated since it is fundamentally stable.

End-Point Calibration
With ambient air at 20.96 Vol.-% O_2

Materials in Contact with the Sample Medium

Sensor
Polystyrol-ABS, PTFE, FPM (Fluorocarbon rubber)

Housing Body
PVC, FPM (Fluorocarbon rubber) seals

Gas Ports
Stainless steel 1.4571

Gas Inlet Conditions

The oxygen sensor must not be used for measurement of flammable gases and ignitable gas/air or gas/oxygen mixtures.

Temperature
The sample gas dew point should be at least 5 °C below the temperature throughout the sample gas path. Otherwise a sample gas cooler or condensate trap is required.

Moisture Content
H_2O dew point ≥ 2 °C
The oxygen sensor should not be used with dry sample gas.

Inlet Pressure
p_e = 2–500 hPa

Outlet Pressure
Atmospheric pressure

Flow Rate
20–100 l/h

Associated Gas
The oxygen sensor should not be used if the associated gas contains the following components: H_2S, chlorine or fluorine compounds, heavy metals, aerosols, mercaptane, base components.

Note

The oxygen sensor can only be used in combination with the Uras26 infrared photometer. It cannot be used when the internal gas lines in the Uras26 are made up of stainless steel pipes.

Integral Gas Feed

Versions

The integral gas feed (optional in Model EL3020) is available in two versions. It includes
- either the solenoid valve, pump, coarse filter, capillary tube and flow sensor modules
- or the flow sensor module.

The integral gas feed cannot be installed when the internal gas lines are made up of stainless steel pipes. It cannot be used in combination with the trace oxygen analyzer ZO23.

Test Gas Supply

Type
3/2-way solenoid valve

Power Consumption
Approx. 3 W

Materials in Contact with the Sample Medium
PVDF, FPM

Gas Feed

Type
Magnetic piston pump

Feed Rate
Max. of 60 l/h, depending on the analyzer type and inlet/outlet pressure

Flow Rate
Adjustable

Power Consumption
Approx. 10 W

Materials in Contact with the Sample Medium
PVDF, EPDM, stainless steel 1.4571

Flow Monitor

Type
Miniature flow sensor

Materials in Contact with the Sample Medium
Al_2O_3, silicon, gold, GFK

Gas Inlet Conditions

The integral gas feed modules must not be used for measurement of flammable gases and ignitable gas/air or gas/oxygen mixtures.

Temperature
+5 to +45 °C
The sample gas dew point should be at least 5 °C below the temperature throughout the sample gas path. Otherwise a sample gas cooler or condensate trap is required.

Flow Rate
30–60 l/h

Corrosive Gases
Corrosive associated gas components and aerosols must be cooled or undergo prior absorption.

General Data

Housing

	Model EL3020	Model EL3040
Version	19-inch housing	Wall-mount housing
Protection Type	IP20	IP65
Materials		
Housing	Galvanized sheet steel Outer surfaces varnished	Stainless steel
Analyzer Rear Panel	Aluminum, PVC-C	Aluminum, PVC-C
Keypad Sheet	Polyester	Polyester
Colors	Light gray (RAL 7035), basalt gray (RAL 7012)	
Weight	approx. 7–15 kg	approx. 13–21 kg
Dimensions	see page 15	see page 16

Housing Purge
Possible only with Model EL3040 (wall-mount housing). Housing purge is mandatory when measuring flammable gases (see page 14). Purge gas flow during operation min. 10 l/h, max. 20 l/h. Purge gas pressure p_e = 2–4 hPa.

Display and Operation

Display
Backlit graphics display with 240 x 160-pixel resolution

Measured value display
- Numerical value with physical unit, also with bar graph indication in single display
- Resolution better than 0.2 % of the measurement span
- Simultaneous display of up to 5 measured values
- Flow: bar graph indication

Status display
Symbols in the display; the active status messages can be accessed directly from the measured value display

Operation
5 keys (cursor cross and OK); menu-assisted operation

Limit Value Monitoring

Limit values can be set using the configuration program. The limit value signals (alarms) are output via the digital ports.

Pressure Sensor

Use
Standard for Uras26 and Caldos27, option for Magnos206

Materials in Contact with the Sample Medium
Silicon gel, plastics, FPM (Fluorocarbon rubber)

Fine Filtration

Version
Disposable filter with Borosilicate glass microfiber filter element (supplied as accessory)

Retention Rate
99.99 % for particles > 0.1 µm

Materials in Contact with the Sample Medium
Polyamide, borosilicate glass with PVDF binder

Electromagnetic Compatibility

Noise Immunity
Tested to EN 61326:1997 + A1:1998 + A2:2001 + A3:2003. Inspection severity: Industrial area, fulfills at least the rating "continuously monitored operation" to Table 2 of EN 61326.

Emitted Interference
Tested to EN 61326:1997 + A1:1998 + A2:2001 + A3:2003, EN 61000-3-2:2000 and EN 61000-3-3:1995 + A1:2001. Limit value class B for interference field strength and interference voltage is met.

Electrical Safety

Tested per EN 61010-1:2001

Protection Class
I

Overload Category/Pollution Level
Power supply, signal inputs and outputs: III/2

Safe Isolation
The power supply is galvanically isolated from other circuits by means of reinforced or double insulation. Operational low voltage (PELV) on low-voltage side

Mechanical Stress

Operation
Vibration test to EN 60068-2-6:1996
Vibrations up to 0.5g/150 Hz have no influence on the measured value. In Uras26, slight transient effects on the measured value can occur in the region of the modulation frequency.

Transport
Vibration test to EN 60068-2-6:1996,
shock test to EN 60068-2-27:1995
In its original packaging, the gas analyzer will withstand normal shipping conditions.

Ambient Conditions

The gas analyzer is intended for indoor installation only.

Ambient Temperature

Operation:	+5 to +45 °C
Uras26 in combination with another analyzer:	+5 to +40 °C
Storage and transport:	–25 to +65 °C

Relative Humidity
< 75 %, slight condensation allowed

Air Circulation
For sufficient air circulation, multiple housings in a 19-inch rack must be installed with a separation of at least one height unit between housings.

Installation Location Altitude
Max. 2000 m above sea level (over 2000 m on request)

Power Supply

Input Voltage
100–240 V AC (– 15 %, + 10 %); 50–60 Hz (± 3 Hz)

Power Consumption
Max. 187 VA

Connection
3-pin plug per EN 60320-1/C14; connection cable supplied

Version for Measurement of Flammable Gases

In the version with gas lines and connectors made of stainless steel the gas analyzer (Models EL3020 and EL3040) is suitable for measuring flammable gases in general purpose environment. In Model EL3040, housing purge with nitrogen or air must be provided. The special requirements must be observed (see operator's manual).

Version with Protection Type II 3G for Installation in Hazardous Location for Measurement of Non-flammable Gases and Vapors

The gas analyzer Model EL3040 is tested for explosion protection. It is suitable for installation in hazardous locations when the technical data and the special requirements (see operator's manual) are observed.

The gas analyzer may be used for measurement of non-flammable gases and vapors. It is marked according to the Directive 94/9/EC with

Ⓔx II 3G EEx nAC II T4 X

In undisturbed operation there cannot be any sparking, arcing or impermissible temperatures inside the device.

Explosion protection through: Non-sparking instruments and devices with low power consumption; sealed or encapsulated devices

Judgment according to EN 60079-15:2005: Electrical apparatus for explosive gas atmospheres – Part 15: Type of protection "n", Sections 1 to 16, 19, 20, 22, 23, 29

Marking according to EN 60079-15:2005, Section 35

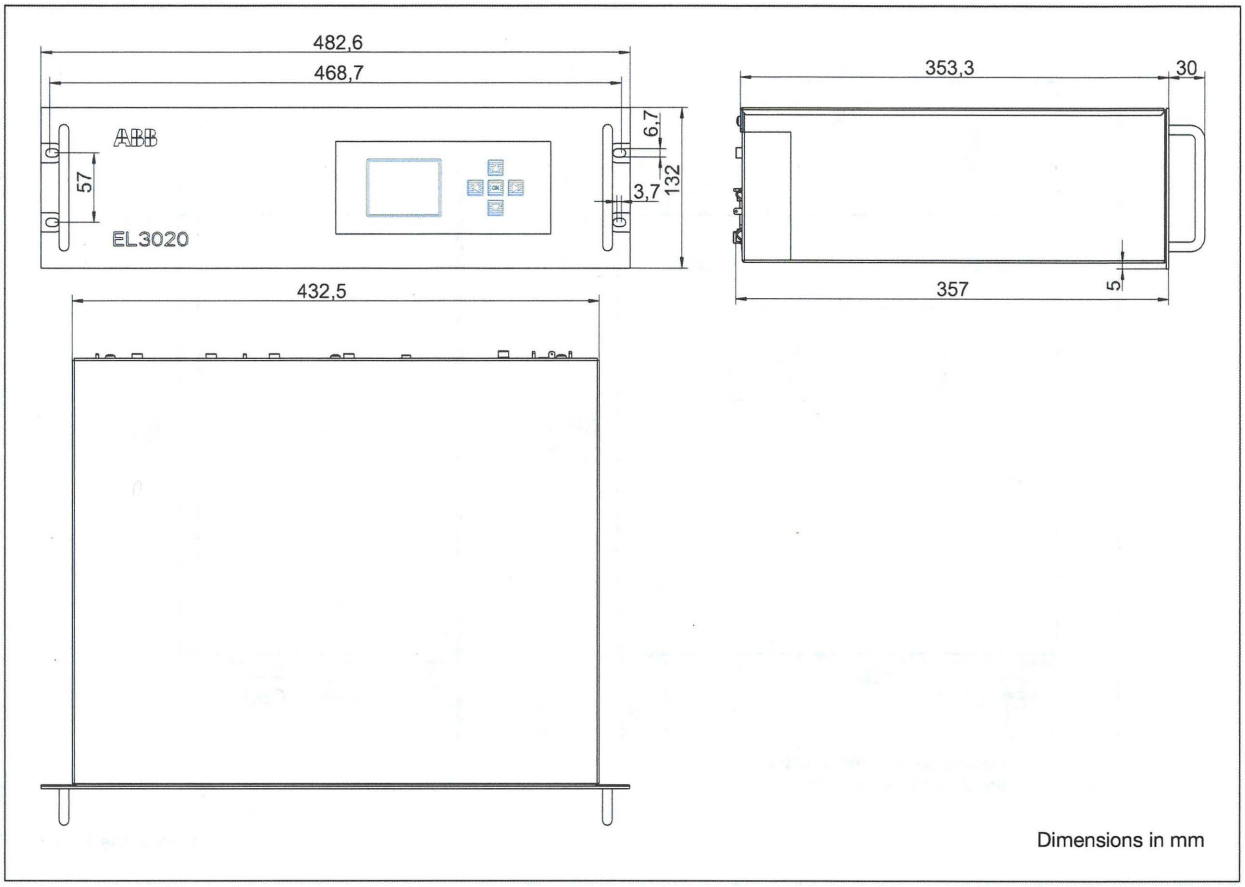
Housing Degree of Protection IP65

Note Regarding the Performance Characteristics of the Analyzers

The performance characteristics of the analyzers have been determined according to the international standard IEC 1207-1: 1994 "Expression of performance of gas analyzers". They are based on N_2 as the associated gas. Compliance with these characteristics when measuring other gas mixtures can only be assured if their composition is known.

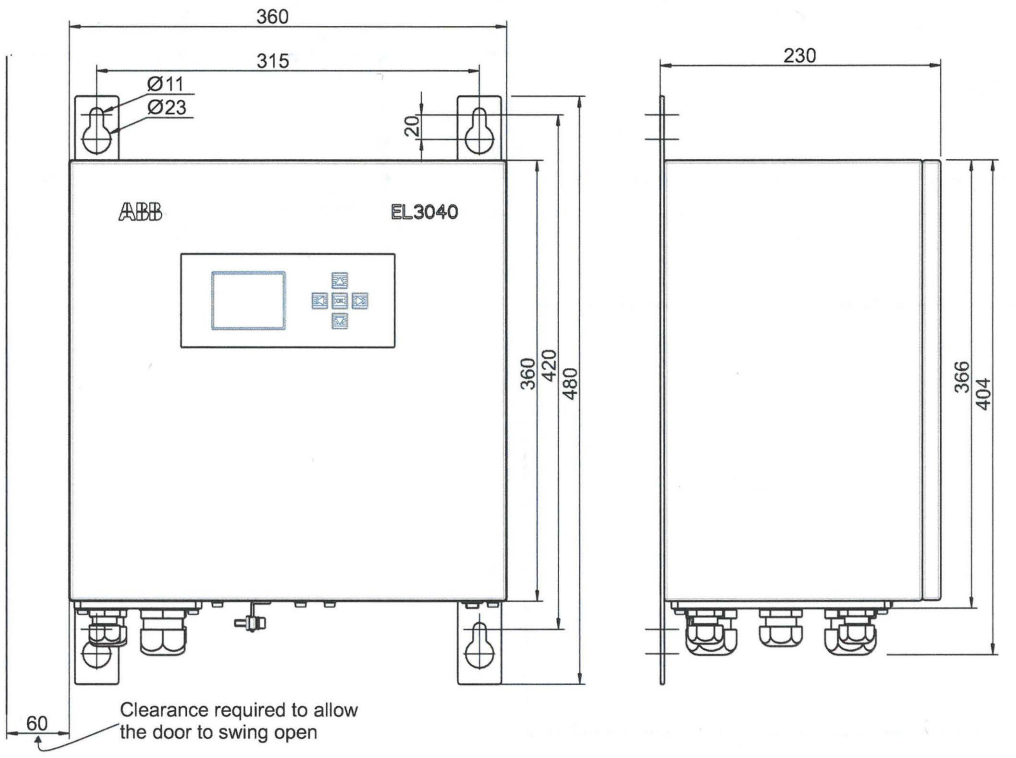
Dimensional Drawings

19-Inch Rack Housing (Model EL3020)



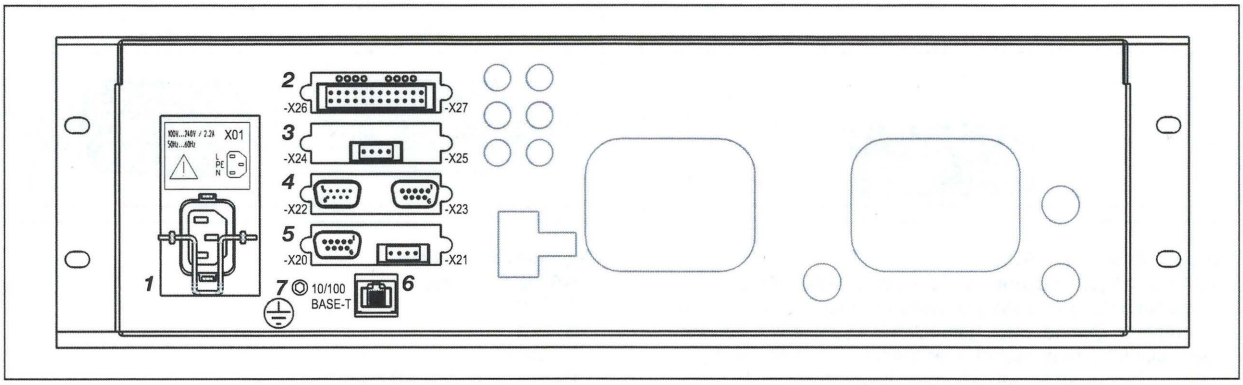
Dimensional Drawings

Wall-mount Housing (Model EL3040)

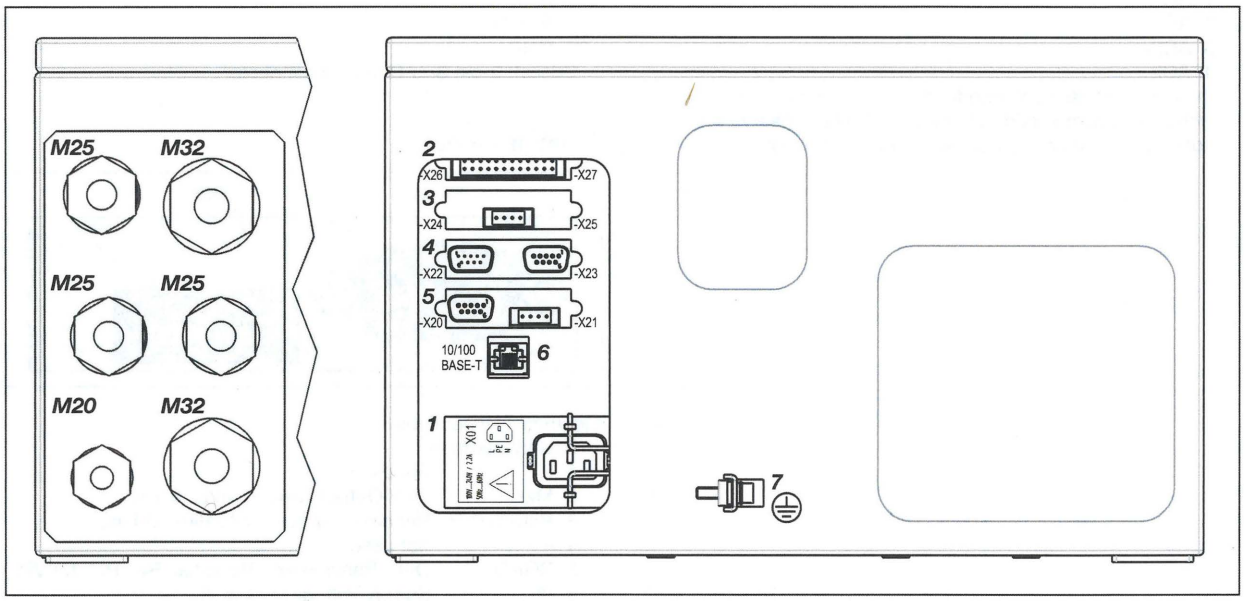


Dimensions in mm

Power Supply and Signal Lines Model EL3020 (View from behind)



Power Supply and Signal Lines Model EL3040 (View from below)



1 Power Supply Connection
(3-pin plug per EN 60320-1/C14; connection cable supplied)

I/O Modules (4 slots, assembly example):

2 Digital I/O Module (max. 2 modules)
3 Analog Output Module (max. 3 modules)
4 Modbus Module (RS232 and RS485 interface)
5 Profibus Module (RS485 and MBP interface)

6 Ethernet-10/100BASE-T Connection (8-pin RJ45 plug)

7 Potential Compensation Connection (clamping range max. 4 mm²)

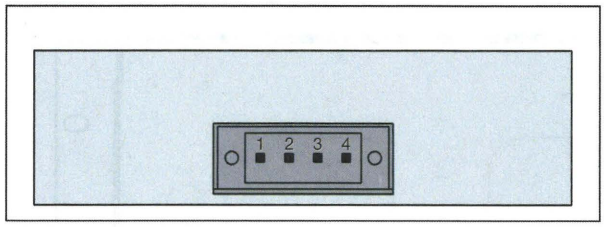
Screwed Cable Glands for Cable Diameter:

M20 Power Supply	5–13 mm
M25 Modbus/Profibus	8–17 mm
M25 Network	8–17 mm
M25 3x Analog Outputs	8–17 mm
M32 Digital Inputs/Outputs	12–21 mm
M32 Digital Inputs/Outputs	12–21 mm

Notes Regarding Conductor Section for I/O Module Connection:
- The maximum capacity of terminals for stranded or solid conductors is 1 mm² (17 AWG).
- The stranded conductor may be tinned on the tip or twisted for simplified connection.
- When using wire end ferrules the total section should not exceed 1 mm², i.e. the maximum stranded conductor section is 0.5 mm². The Weidmüller PZ 6/5 crimping tool must be used for crimping the ferrules.

Note Regarding the Functional Scope of the Ethernet Interface:
The Ethernet interface is intended for
- Communication with configuration software ECT for gas analyzer configuration and software update and
- QAL3 data transfer if the QAL3 monitoring option is integrated in the gas analyzer.

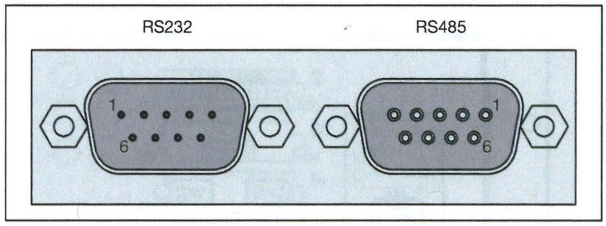
Analog Output Module



Analog Outputs (AO1, AO2)
0/4–20 mA (configurable, factory-set to 4–20 mA), common negative pole, galvanically isolated from ground, freely connectable to ground, max. gain relative to protective ground potential 50 V, max. working resistance 750 Ω. Resolution 16 bit. The output signal cannot be lower than 0 mA.

Electrical Connections
1 AO1+
2 AO1–
3 AO2+
4 AO2–
Design: 4-pin terminal strip for braided or solid conductors with a maximum section of 1 mm² (17 AWG). Observe the notes regarding conductor section (see page 17)!

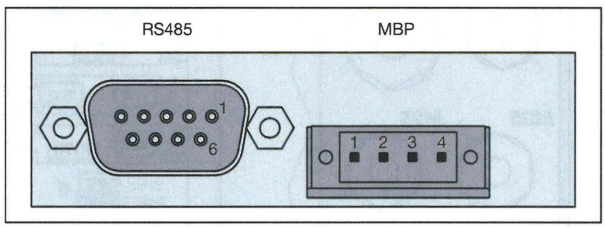
Modbus Module



Electrical Connections
RS232 Interface:
2 RxD
3 TxD
5 GND
Design: 9-pin Sub-D male connector

RS485 Interface:
2 RTxD–
3 RTxD+
5 GND
Design: 9-pin Sub-D female connector

Profibus Module



Electrical Connections
RS485 Interface:

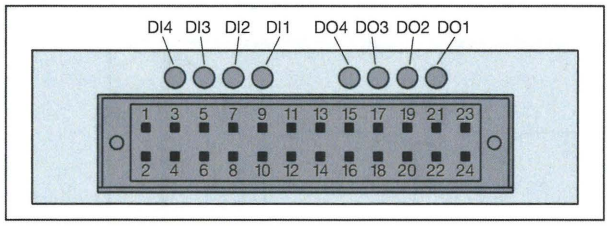
1	–	not used
2	M24	24 V Output Ground, max. 0.2 A
3	RxD/TxD-P	Receive/Transmit Data Plus, B-Line
4	–	not used
5	DGND	Data Transmission Potential (Ref. Pot. for VP)
6	VP	Supply Voltage Plus (5 V)
7	P24	24 V Output Voltage Plus
8	RxD/TxD-N	Receive/Transmit Data N, A-Line
9	–	not used

Design: 9-pin Sub-D female connector

MBP Interface (non-intrinsically safe):
1 +
3 –
4 GND

Design: 4-pin terminal strip for braided or solid conductors with a maximum section of 1 mm² (17 AWG). Observe the information regarding conductor section (see page 17)!

Digital I/O Module



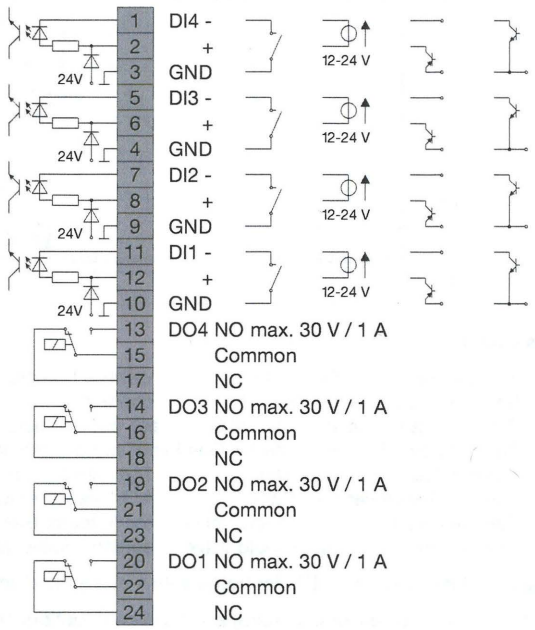
Digital Inputs (DI1 to DI4)
Optocouplers with internal 24 VDC power supply. Control with floating contacts, with external voltage 12–24 VDC or with open collector drivers PNP or NPN.

Digital Outputs (DO1 to DO4)
Floating double-throw contacts, max. contact load rating 30 VDC / 1 A
Relays must at all times be operated within the specified data range. Inductive or capacitive loads are to be connected with suitable protective measures (self-induction recuperation diodes for inductive loads and series resistors for capacitive loads).

Digital input and output signals	Standard assignment [1] Digital I/O Module 1	2
Error		
Maintenance request		
Maintenance mode		
Overall status	DO1	
Start automatic calibration	DI1	
Stop automatic calibration		
Disable automatic calibration	DI2	
Sample gas valve	DO4	
Zero gas valve		
Span gas valve		
Pump on/off [2]		
Limit 1	DO2	
Limit 2	DO3	
Limit 3		DO1
Limit 4		DO2
Limit 5		DO3
Limit 6		DO4
Limit 7		
Limit 8		
Limit 9		
Limit 10		
Measuring range switch-over		
Measuring range feedback		
Bus DI 1–8		
External failure [3]	DI3	
External maintenance request [3]	DI4	

1) factory-set, can be changed by on-site configuration
2) when a pump (integral gas feed) is installed
3) Multiple external status signals can be configured depending on the number of free digital inputs.

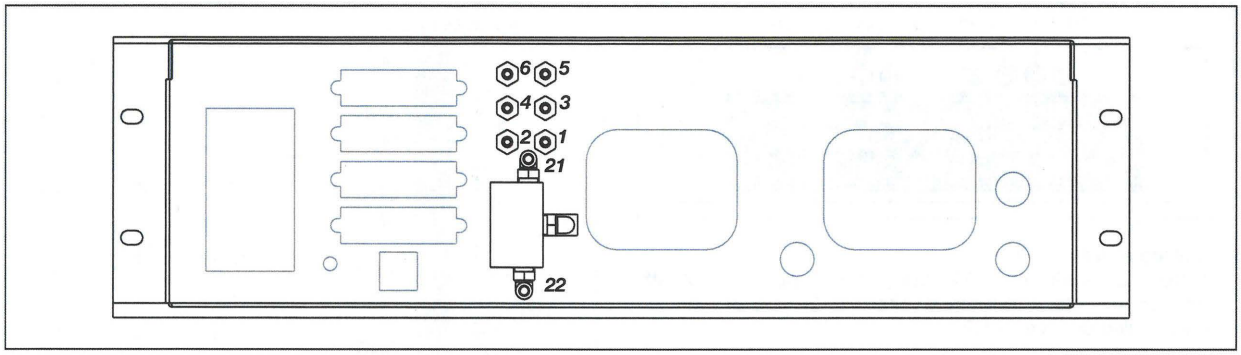
Connection Diagram



Relays are shown in the unpowered state. The unpowered state is the failure mode.

Electrical Connections
see connection diagram
Design: 2x12-pin terminal strip for braided or solid conductors with a maximum section of 1 mm² (17 AWG). Observe the notes regarding conductor section (see page 17)!

Analyzer Uras26 – Version with Gas Connections for Hoses (internal gas lines made up of hoses)



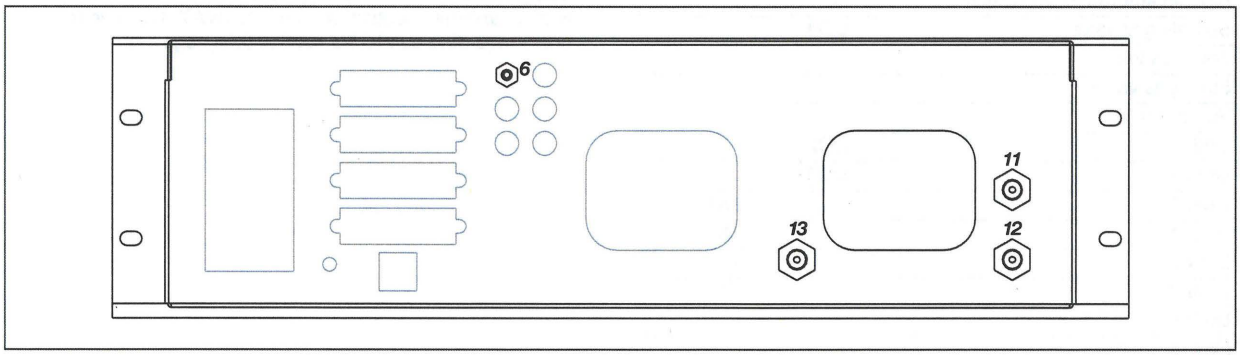
Gas Connections

1	Sample Gas Inlet	Gas Path 1	without "Integral Gas Feed" option
2	Sample Gas Outlet	Gas Path 1	connected to sample gas inlet of Caldos27 or Magnos206 if applicable
3	Sample Gas Outlet	for "Integral Gas Feed" option, factory-connected to Sample Gas Inlet gas Path 1	
4	Sample Gas Inlet	for "Integral Gas Feed" option with flow sensor only (without solenoid valve)	
5	Sample Gas Inlet	Gas Path 2	} The version with two separate gas paths is used for
6	Sample Gas Outlet	Gas Path 2	} NOx measurement with a NO_2/NO converter connected upstream.
21	Sample Gas Inlet	at solenoid valve	} for "Integral Gas Feed" option with
22	Test Gas Inlet	at solenoid valve	} solenoid valve, pump, filter, capillary and flow sensor

Design: Hose nozzles (PVDF) for hoses with 4 mm inner diameter

Note: Pressure sensor (standard) and O_2 sensor (option) are connected internally as follows:
downstream the sample cell 1 outlet for one sample cell or for two separate gas paths,
downstream the sample cell 2 outlet for two sample cells in series.

Analyzer Uras26 – Version with Gas Connections for Pipes (internal gas lines made up of stainless steel pipes)



Gas Connections

6 Pressure Sensor

Design: Hose nozzle (PVDF) for hose with 4 mm inner diameter

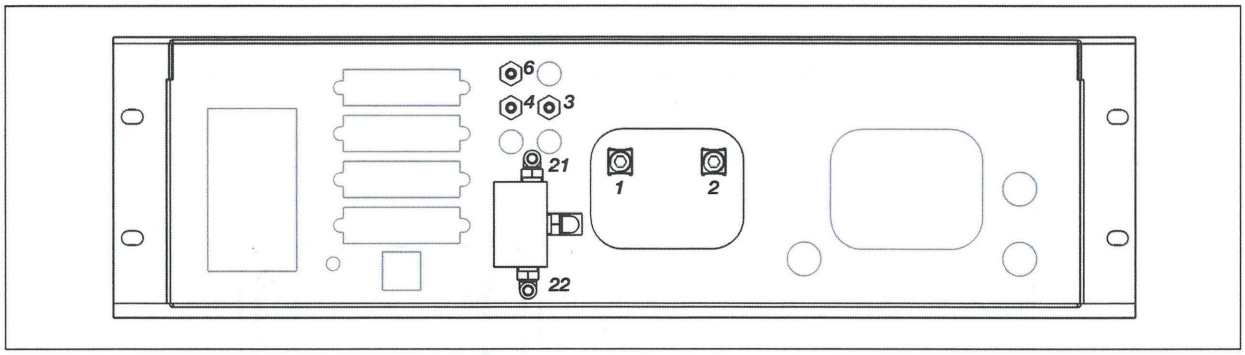
11	Sample Gas Inlet		
12	Sample Gas Outlet	for one sample cell	} connected to sample gas inlet of
13	Sample Gas Outlet	for two sample cells in series	} Caldos27 or Magnos206 if applicable

Design: 1/8 NPT female thread for threaded connections (not supplied)

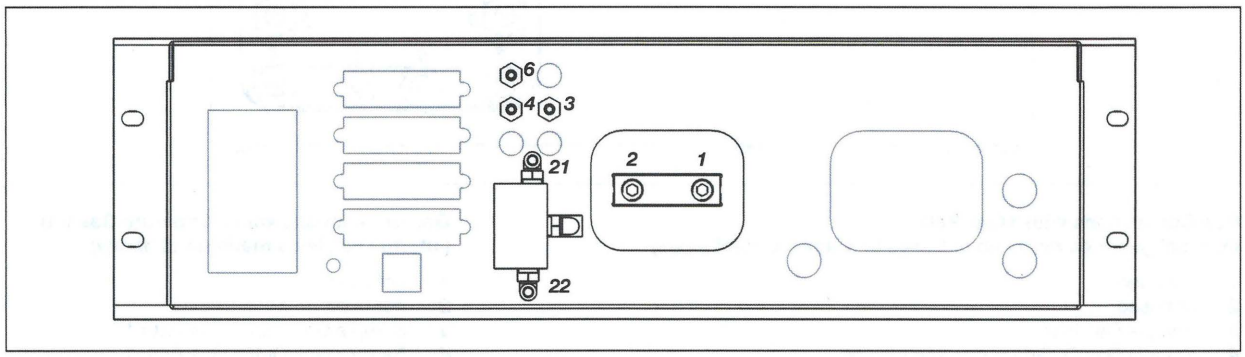
Notes: This version is used when flammable components are present in the sample gas.

O_2 sensor, "Integral Gas Feed" option and version with two separate gas paths cannot be provided.

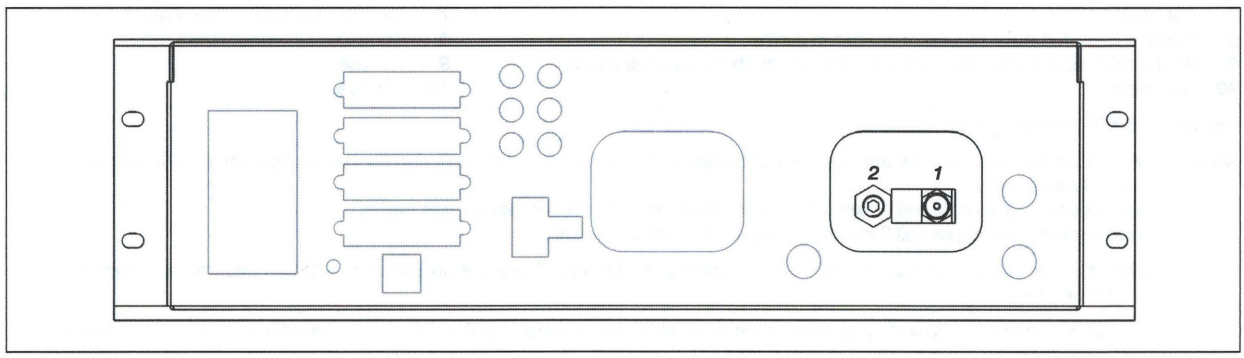
Analyzer Magnos206



Analyzer Caldos27



Analyzer ZO23



Gas Connections

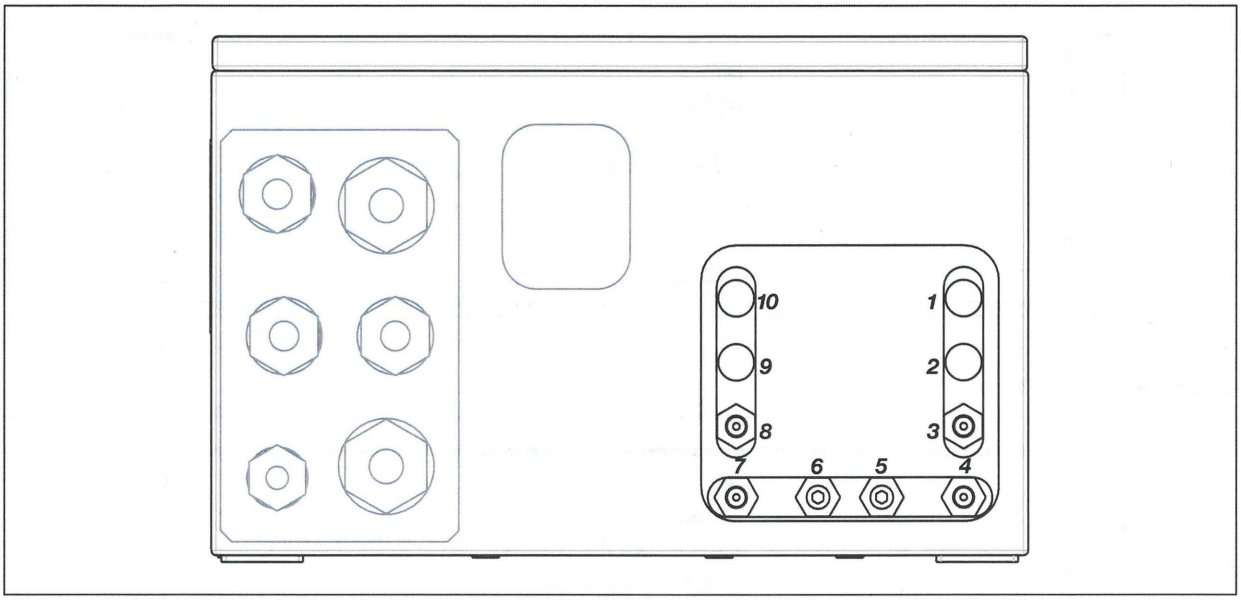
1 Sample Gas Inlet
2 Sample Gas Outlet

Design: 1/8 NPT female thread (ZO23: Gas inlet 3 mm Swagelok®); connection of
flexible tubes: 2 straight screwed fittings (PP) with nozzles for hoses with 4 mm inner diameter (supplied)
pipelines: Threaded connections (not supplied)

3 Sample Gas Outlet for "Integral Gas Feed" option, factory-connected to ***1*** Sample Gas Inlet
4 Sample Gas Inlet for "Integral Gas Feed" option with flow sensor only (without solenoid valve)
6 Pressure Sensor Option for Magnos206, standard for Caldos27
21 Sample Gas Inlet at solenoid valve } for "Integral Gas Feed" option with
22 Test Gas Inlet at solenoid valve } solenoid valve, pump, filter, capillary and flow sensor

Design: Hose nozzles (PVDF) for hoses with 4 mm inner diameter

Analyzer Uras26



Gas Connections with 1 Gas Path
(internal gas lines made up of hoses or stainless steel pipes)

1 not used
2 not used
3 Sample Gas Inlet
4 Sample Gas Outlet for one sample cell
5 Purge Gas Inlet Housing
6 Purge Gas Outlet Housing
7 not used
8 Sample Gas Outlet for two sample cells in series
9 Pressure Sensor (internal gas paths made up of stainless steel pipes)
10 not used

Gas Connections with 2 Separate Gas Paths
(internal gas lines made up of hoses)

1 not used
2 not used
3 Sample Gas Inlet Gas Path 1
4 Sample Gas Outlet Gas Path 1
5 Purge Gas Inlet Housing
6 Purge Gas Outlet Housing
7 Sample Gas Inlet Gas Path 2
8 Sample Gas Outlet Gas Path 2
9 not used
10 not used

Design: 1/8 NPT female thread

Notes: When the internal gas paths are made up of hoses, pressure sensor (standard) and O_2 sensor (option) are connected internally as follows:
downstream the sample cell 1 outlet for one sample cell or for two separate gas paths,
downstream the sample cell 2 outlet for two sample cells in series.

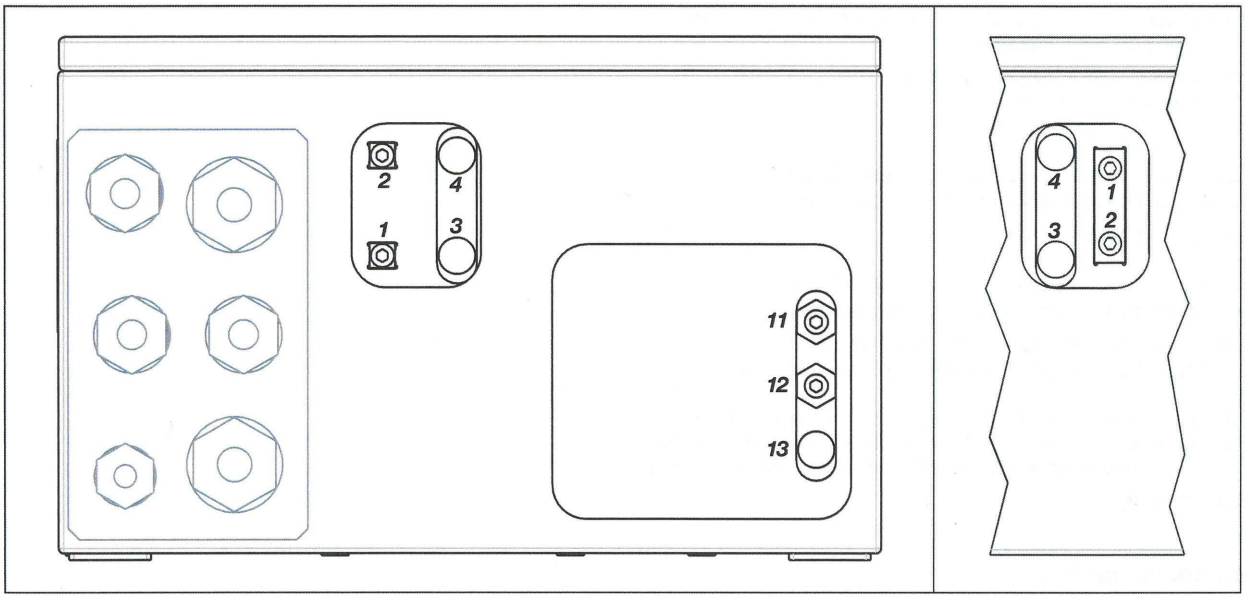
When the internal gas paths are made up of stainless steel pipes, O_2 sensor and version with two separate gas paths cannot be provided.

The version with two separate gas paths is used for NOx measurement with a NO_2/NO converter connected upstream.

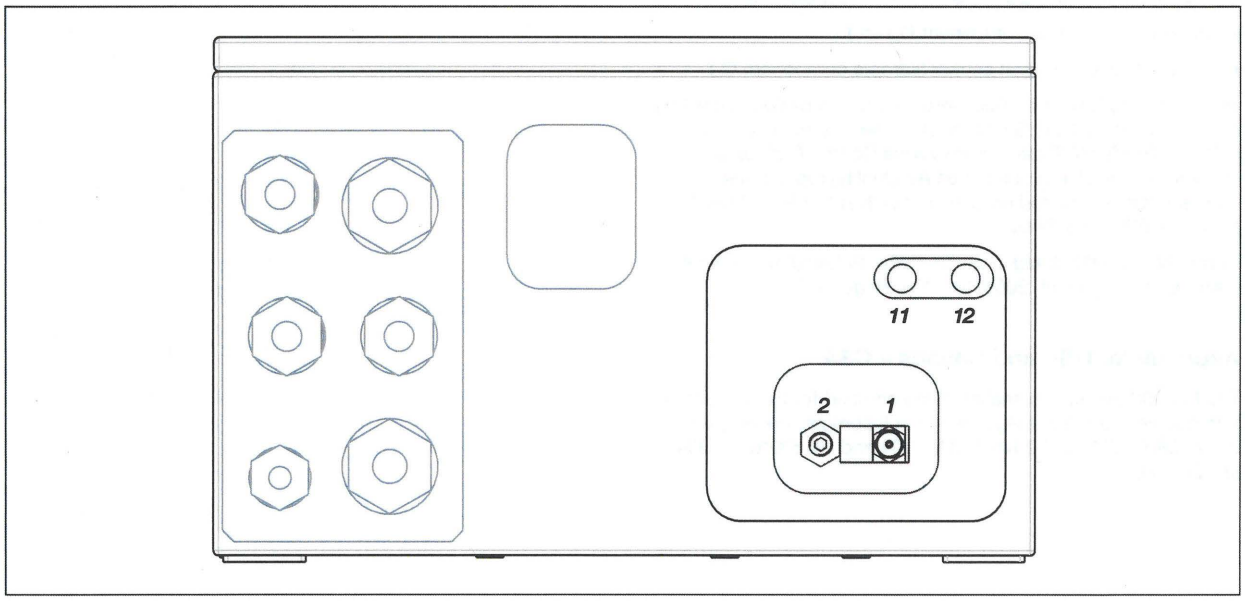
Gas Connections Model EL3040

Analyzer Magnos206

Analyzer Caldos27



Analyzer ZO23



Gas Connections

1 Sample Gas Inlet
2 Sample Gas Outlet
3 not used
4 not used
11 Purge Gas Inlet Housing
12 Purge Gas Outlet Housing
13 Pressure Sensor Option for Magnos206, standard for Caldos27

Design: 1/8 NPT female thread (ZO23: Gas inlet 3 mm Swagelok®)

Certifications

CE Declaration of Conformity

The EL3060 Series gas analyzers satisfy the provisions of the following European directives:

2006/95/EC Low Voltage Directive
2006/108/EC EMC Directive
94/9/EC ATEX Directive

Compliance with the provisions of directive 2006/95/EC is evidenced by full compliance with European standard:

EN 61010-1:2001

Compliance with the provisions of directive 2006/108/EC is evidenced by full compliance with European standards:

EN 61326:1997 + A1:1998 + A2:2001 + A3:2003,
EN 61000-3-2:2000 and EN 61000-3-3:1995 + A1:2001

Compliance of the version in Category 3G for measurement of non-flammable gases and vapors with the provisions of directive 94/9/EC is evidenced by full compliance with European standard:

EN 60079-15:2005

Performance Test

The EL3000 Series gas analyzers

- Uras26 (sample components CO, NO, SO_2, CO_2, N_2O),
- Magnos206 (sample component O_2) and
- Electrochemical oxygen sensor (sample component O_2)

are certified for use in facilities requiring authorization according to Directive 2001/80/EG and meet the requirements of the 27th/30th BImSchV (Federal Immissions Control Ordinance) and TA-Luft (Technical Instructions on Air Quality) regulations. The requirements based on QAL1 according to EN 14181 and EN ISO 14956 are fulfilled.

Report No. 691317 dated June 30, 2006. Publication: Federal Gazette of October 14, 2006, No. 194, Page 6715

Approval for USA and Canada – CSA

The EL3000 Series gas analyzers are certified for use in general purpose environment, evidenced by full compliance with standards CAN/CSA-C22.2 No. 61010-1-04 and UL 61010-1:2004 (2nd Edition).

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