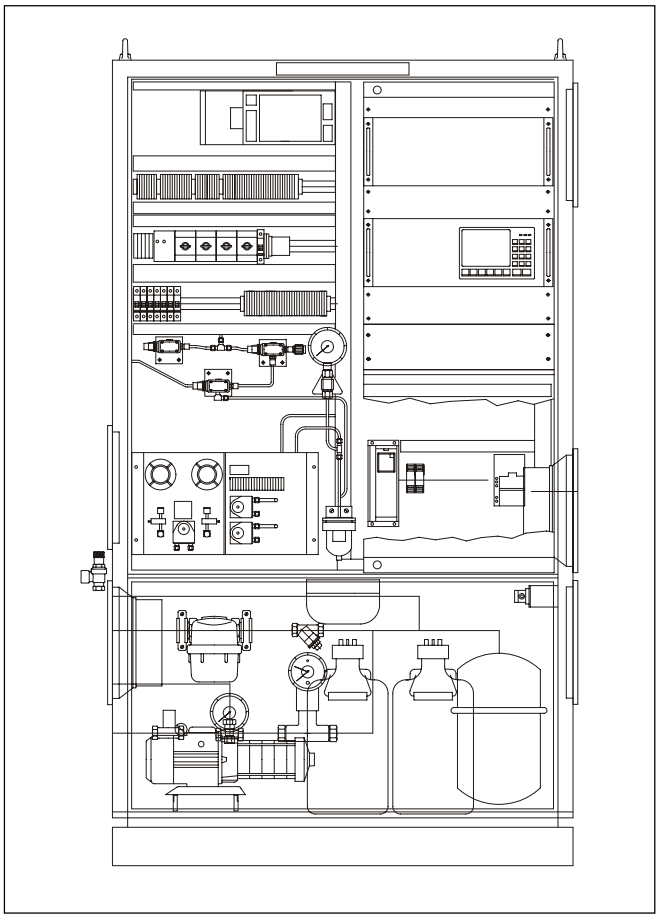
ACK Cement Analysis System

Dry Gas Sampling and Multi-Component Measuring System for Process Gas Monitoring at Kiln Gas Exit and Calciner Gas Exit

Data Sheet

10/23-8.40 EN July 2004

- **Robust probe construction (probe H or probe 60S)**
- **Automatic removal of material build-ups**
- **Automatic mechanical removal of encrustations at the gas entry of probe H**
- **Fast filter exchange**
- **Pneumatic probe retractor**
- **Probe retracts automatically at power supply breakdown**
- **Speed-controlled heat exchanger**
- **Simple sampling system with few component parts**
- **Continuous measurements of CO, NO and O_2**
- **Automatic calibration with air and built-in calibration cells without test gas bottles**
- **Stability of calibration cells after several years of testing confirmed by neutral test institutes**
- **Maintenance on request by self-monitoring**
- **Compact system design through the use of the analyzer AO2000-Uras14 in a swing frame**
- **SCC-C Sample Gas Cooler and SCC-F Sample Gas Feed Unit**



Application and Description

The ACK cement analysis system is used for continuous, quantitative measurements of gas concentrations of the primary firing at kiln gas exit or of the secondary firing at calciner gas exit.

By using the Probe H, long measuring periods without interruptions are possible. The plunger, which is bound to the filter, breaks the encrustations at the gas entry without interrupting the measurement. After a preset number of plunger movements the probe is automatically retracted and inserted again and a purging of the filter with compressed air starts. Through these movements it is assured that only small build-ups deposit on the probe.

The gas analyzer AO2000-Uras14 and the O_2-module allow a selective measurement of the gas components CO, NO and O_2. The measuring principles are the infrared absorption to determine the components CO and NO as well as the electro-chemical reaction of oxygen to determine O_2. Measurement of SO_2, CH_4 or CO_2 is possible. Other measurement principles and analyzer modules are possible.

The built-in PLC unit is responsible for the control functions of the analysis system. The whole system is installed in a cabinet. Thus it is suitable for applications in rough environmental conditions.

Devices and Components

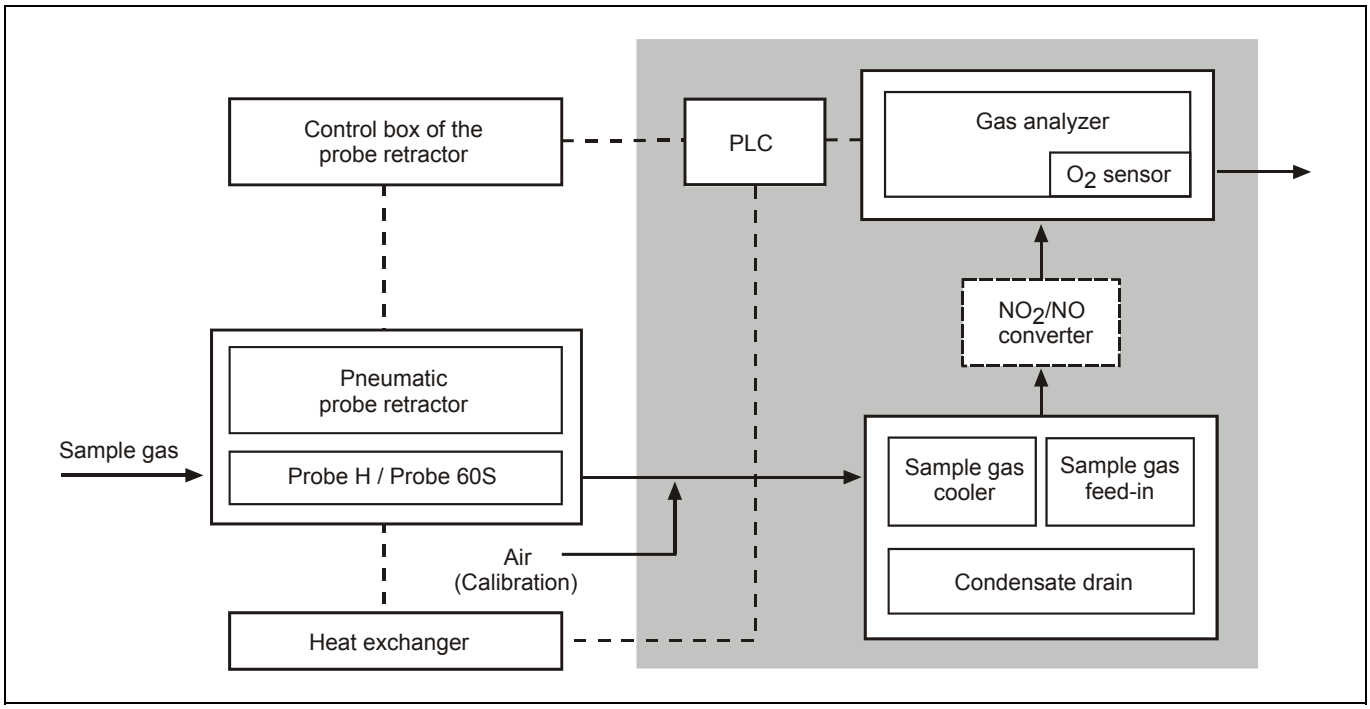
The ACK cement analysis system consists of the following components:

- Probe H or Probe 60S incl. accessories
- Pneumatic probe retractor
- Control box for retractor
- Heat exchanger
- Steel sheet cabinet with:
  - Gas analyzer AO2000-Uras14 incl. calibration cells and O_2-module (electro-chemical)
  - Sample gas cooler SCC-C incl. automatic condensate drain
  - Sample gas feed unit SCC-F incl. dosing facility
  - PLC unit
  - Water circulation pump
  - Water pressure monitor, water temperature indicator and water flow monitor

For outdoor installation, a glass-fiber reinforced plastic cabinet is available, incl. heating element and cooling unit.

A combination of the Uras14 infrared gas analyzer with the Magnos17 thermo-magnetic oxygen analyzer as well as with the Limas11 UV process photometer module is also possible.

System Design



Calibration

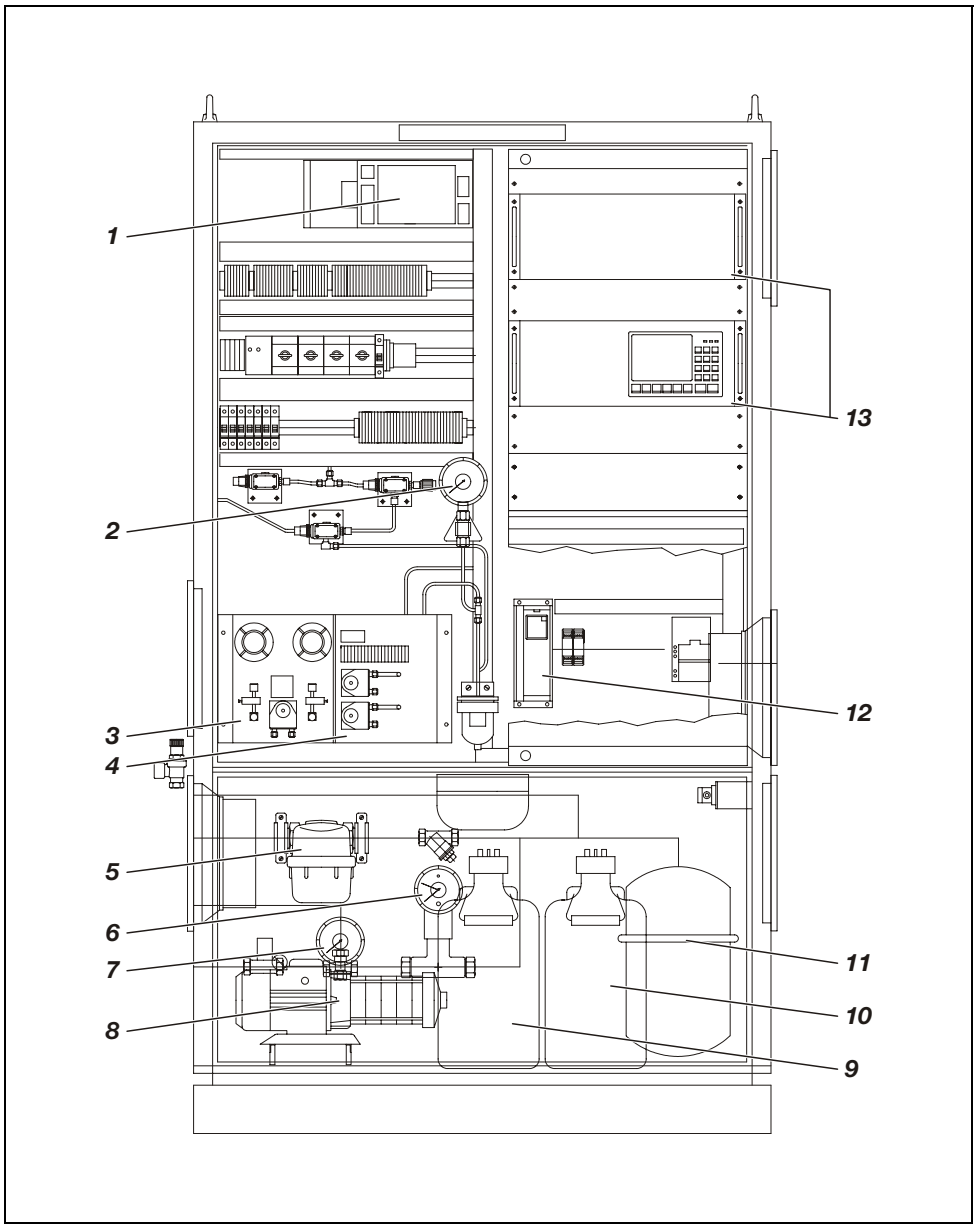
For regularly calibration of the analyzer, no bottled zero or span gases are necessary. The zero point is calibrated with filtered and cooled fresh air which has to be free from CO- and NO-components. This fresh air, which now corresponds to calibration gas, is fed into the system by the built-in gas feed module and is led through the sample gas cooler by switching over a solenoid valve. This guarantees equal gas conditions for sample gas and calibration gas.

For the span point calibration, the gas-filled calibration cells are inserted. During the calibration, conditioned fresh air flows through the measuring cell at a constant level of humidity. The span point of the oxygen sensors is calibrated with the oxygen concentration of the fresh air.

During the recommended yearly functional tests through the ABB Service, the calibration cells are checked with bottled test gases. These test gases are fed into the system in front of the sample gas cooler.

When using the Magnos17 module for the O_2-measurement, zero gas (N_2) and additional test gas valves are necessary.

View of the Analysis Cabinet



1 PLC unit
2 Sample gas gauge
3 Sample gas feed unit SCC-F
4 Sample gas cooler SCC-C
5 Water filter
6 Flow monitor
7 Cooling water gauge
8 Cooling water pump
9 Reagent supply bottle
10 Condensate collecting bottle
11 Pressure compensation vessel
12 Frequency converter
13 Gas analyzers

Technical Data

Application

Sampling of hot cement flue gas with a high dust load for gas analysis of CO, NO and O_2 at kiln gas exit and at calciner gas exit in dry process cement kilns.

Process Gas Sample Conditions

Pressure
± 3 kPa over-/underpressure

Temperature
max. 1300 °C

Dust load
max. 500 g/m^3

Sample gas flow
max. 100 l/h

Gas velocity
max. 20 m/sec

Gas Components and Measuring Ranges

Two measuring ranges per measuring component, for example:

CO	0 to 0.5 Vol%	and 0 to 2 Vol%
NO	0 to 3000 ppm	and 0 to 5000 ppm
O_2	0 to 10 Vol%	and 0 to 25 Vol%

Other measuring ranges are possible, see “AO2000 Series” Data Sheet. Additional components, SO_2, CH_4 or CO_2, are possible. The analyzer modules Uras14 and Limas11 UV are basically equipped with calibration cells for automatic calibration.

Signal Interface

Analog outputs
1 current output per measuring component:
0/4 to 20 mA, load max. 750 Ω

Binary outputs
3x common status signal 24 V, 1 A
(error, maintenance mode, maintenance request)

Single status signals (optional)
floating-free contacts max. 230 VAC, 1 A

Interfaces

Profibus
Profibus DP slave RS232/RS485 (optional)

Ethernet (analyzer only)
for remote control and remote diagnostics, TCP/IP protocol

Power Supply

3-phase connection (N-conductor necessary)
230/400 V AC, ± 5 %, 50 Hz, fuses 3 x 16 A
230/400 V AC, ± 5 %, 60 Hz, fuses 3 x 20 A
other voltages are possible (transformer necessary)

Energy consumption
max. 4 kW, additional consumption through:
- heated sample gas line, approx. 40 W/m
- electr. cabinet heating, 500 W
- cooling unit, approx. 1 kW

Compressed Air Supply

Consumption
approx. 1000 l during one probe movement (2 x 20 s)
approx. 3 m^3/h (at standard conditions)

Compressed air requirement
compressed air free of oil and water droplets, 6 bar, dried to +3 °C or lower

Compressed air tank min. 250 l
supply through client or ABB Analytical (option)

Complete compressed air station (compressor, drier, tank)
supply through ABB Analytical possible (option)

Sample Gas Line

Either as unheated line or as electrically heated line
weight: approx. 1 kg (25 m unheated type)
weight: approx. 1 kg/m (heatable type)

Probes

Probe 60S incl. accessories
for sampling points where only small encrustations are to be expected; weight: approx. 170 kg (incl. 3.0 m probe)

Probe H incl. accessories
for sampling points where hard encrustations are to be expected; weight: approx. 180 kg (incl. 3.0 m probe)
probe lengths: 1.5 m / 2.0 m / 2.5 m / 3.0 m / 3.5 m

Water Cooling

Closed system. Cooling water requirements: Drinking-water quality with antifreeze if necessary (do not use anti-corrosion agents)

Pneumatic Probe Retractor

For cyclic, automatic probe movements, double beam construction with chain drive

dim.:	(W x H x L) approx. 750 x 600 x (L + 1500) mm; L = length of probe
weight:	approx. 350 kg (without probe)

Technical Data

Control Box for Retractor

Steel sheet casing
- dim.: (W x H x D) 800 x 1000 x 300 mm
- weight: approx. 75 kg

Heat Exchanger

For cooling the circulating cooling water,
cooler block in copper/brass
- dim.: (W x H x D) 900 x 1005 x 590 mm
  incl. three-phase motor
- weight: approx. 120 kg

Analysis Cabinet

Version, color
- steel sheet or glass-fiber reinforced plastic cabinet, RAL 7032

Thermal loss
- approx. 1.5 kW

Degree of protection
- IP 54 acc. to EN 60529

Dimensions (W x H x D):
- steel sheet: 1200 x 2110 x 600 mm
- plastic: 1500 x 2100 x 600 mm

Weight
- approx. 400 kg

Analyzer AO2000

Installed in the analysis cabinet
- Uras14 module for 1 to 3 IR components;
  Limas11 UV module for 1 to 2 UV components;
  automatic calibration with calibration cells

Oxygen module
- electro-chemical cell (alternative: Magnos17 module)

Sample Gas Conditioning

Installed in the analysis cabinet
- Sample gas cooler SCC-C, max. 125 l/h, +3 °C, incl. condensate pump; sample gas feed unit SCC-F incl. condensate monitor and dosing pump

Connections

Electrical connections
- through cable fittings on terminal strips, conductor cross section: power supply 4 mm^2, signal cables 1.5 mm^2

Gas connection
- gas outlet of cabinet
  bulkhead fitting PVDF 6/4x1 (supplied)

Compressed air connection
- fittings galvanized, diameter 18 mm (supplied)

Water connection
- at analysis cabinet: 1 inch (supplied)

Ambient Conditions

Ambient temperature
- +5 °C to +35 °C steel sheet cabinet with ventilation fans (normal for analysis rooms)
- –10 °C to +35 °C steel sheet cabinet with electr. heating and ventilation fans
- –20 °C to +50 °C plastic cabinet with electr. heating and cooling unit

Transport and storage temperature
- +5 to +55 °C

Relative air humidity
- ≤ 75 % yearly average

Installation site
- The analysis cabinet has to be installed at a vibration-free site and has to be protected from dust and heat radiation.
  Outdoor installation requires daily maintenance of the ventilation filters.
  Recommendation: Installation in an air-conditioned room; outdoor installation has to be avoided!

Ordering Information

Catalog No. 23914-0-												
	↓	↓	↓	↓	↓	↓	↓	↓	↓	↓	↓	↓
Measuring Components												
IR ($CO/CO_2/NO/CH_4/SO_2$ <500ppm); UV(NO/SO_2 >500 ppm); O_2 (Sensor/Magnos17)												
O_2/Magnos17	**1**											
1x IR-Comp. + O_2/Sensor	**2**											
1x IR-Comp. + O_2/Magnos17 (2 Housings)	**3**											
2x IR-Comp. + O_2/Sensor	**4**											
2x IR-Comp. + O_2/Magnos17 (2 Housings)	**5**											
2x IR-Comp. + 1x UV-Comp. (SO_2) + O_2/Sensor (2 Housings)	**6**											
2x IR-Comp. + 1x UV-Comp. (SO_2) + O_2/Magnos17 (2 Housings)	**7**											
2x IR-Comp. + 2x UV-Comp. (SO_2 + NO) + O_2/Sensor (2 Housings)	**8**											
2x IR-Comp. + 2x UV-Comp. (SO_2 + NO) + O_2/Magnos17 (2 Housings)	**9**											
3x IR-Comp. + O_2/Sensor (1 Housing)	**A**											
Converter												
without		**0**										
included		**1**										
Steel Sheet Cabinet IP 54												
incl. ventilation fans			**1**									
incl. ventilation fans and heating			**2**									
incl. ventilation fans, cooling unit and heating			**3**									
Glass Fiber Cabinet IP 54												
incl. ventilation fan, cooling unit and heating			**4**									
External Signal Interface												
Analog 0/4 to 20 mA + 3 common status 24 V, 1 A				**1**								
Additional interfaces acc. to BA-No.												
Power Supply												
230/400 VAC, 50 Hz (3-phase; 5-wiring); N conductor necessary					**1**							
230/400 VAC, 60 Hz (3-phase; 5-wiring); N conductor necessary					**2**							
Sample Gas Line												
PTFE 6/4x1 mm, length = 25 m						**1**						
electrically heated, length acc. to BA-No. 571						**2**						
Probe 60S incl. Accessories												
Length 1.5 m							**1**					
Length 2.0 m							**2**					
Length 2.5 m							**3**					
Length 3.0 m							**4**					
Length 3.5 m							**5**					
Probe H incl. Accessories												
Length 1.5 m							**6**					
Length 2.0 m							**7**					
Length 2.5 m							**8**					
Length 3.0 m							**9**					
Length 3.5 m							**A**					
	↓	↓	↓	↓	↓	↓	↓	↓	↓	↓	↓	↓
Catalog No. 23914-0-								**0**	**0**	**0**	**0**	**0**

Supplementary Ordering Information

Supplementary Ordering Information		BA-No.	Additional Information
Special design		**300**	on request
Operating altitude > 2000m (only for Magnos17)		**380**	
Length of electric heated sample gas line		**571**	Length = ... m
Wiring incl. conductor identification		**572**	
Prepared for external UPS		**574**	
Automatic fuses in bipolar design		**575**	
External signal interface:			
Profibus DP slave RS232/RS485		**DP1**	
Single and collective status signals as floating free contacts 230 VAC, 1 A		**573**	
Manufacturer's certificate acc. to DIN 55350-18-4.1		**B31**	
AO2000: Inspection certificate 3.1 B per analyzer module		**B32**	... sets
Documentation DE, 1 x A4		**G21**	
Additional DE-Doc. Sets		**G41**	... sets
Documentation EN, 1 x A4		**G22**	
Additional EN-Doc. Sets		**G42**	... sets
Documentation DE and EN, both		**G23**	
Arrangement plans, piping layouts and electrical wiring diagrams on CD-ROM	PDF format	**PDF**	
	DXF format	**DXF**	
	DWG format	**DWG**	
System FAT		**FAT**	... days
Option for Magnos17:			
Bottle pressure reducer for N_2, 2-stage, acc. to DIN (Catalog No. 23422-5-8018376), incl. PTFE tube, 6 mm, length = 2 m and connection set		**576**	
Option for test gas bottles:			
N_2 bottle pressure reducer, acc. to DIN (Catalog-No. 23421-5-5864912) incl. PTFE tube, 6 mm, length = 2 m, connection Viton tube		**577**	
Additional options:			
Compressed air tank, 250 l, incl. accessories		**578**	incl. packaging
Transformer in protection casing IP 44; Prim.: ... VAC, 50/60 Hz / Sec.: 230/400 VAC, 50/60 Hz; 7 kVA		**579**	incl. packaging
Options on request:			
Test gas bottles			
Compressed air station (screw compressor, dryer, tank 280 l)			
Compressed air dryer (diaphragm dryer)			

Supplementary Ordering Information

Supplementary Ordering Information	BA-No.	Additional Information
Measuring Components and Measuring Ranges		
Measuring Component 1	**310**	...
Measuring Range 1	**311**	...
Measuring Range 2	**312**	...
Measuring Component 2	**320**	...
Measuring Range 1	**321**	...
Measuring Range 2	**322**	...
Measuring Component 3	**330**	...
Measuring Range 1	**331**	...
Measuring Range 2	**332**	...
Measuring Component 4	**340**	...
Measuring Range 1	**341**	...
Measuring Range 2	**342**	...
Measuring Component 5	**350**	...
Measuring Range 1	**351**	...
Measuring Range 2	**352**	...
Standard Measuring Ranges for O_2 Measurement:		
Electro-chemical O_2-sensor		
Measuring Range 1: 0 to 10 Vol% O_2		
Measuring Range 2: 0 to 25 Vol% O_2		
Analyzer Magnos17		
Measuring Range 1: 0 to 10 Vol% O_2 in cement flue gas		
Measuring Range 2: 0 to 25 Vol% O_2 in cement flue gas		
Measuring Range 3: 0 to 25 Vol% O_2 in N_2		

Comments on Ordering Information

ACK Cement Analysis System	This system is exclusively meant for the rotary kiln gas exit (max. 1300 °C) or calciner gas exit (max. 1000 °C) (other applications on request).
Basic Price	The following assembly parts are included: – Steel sheet cabinet, completely mounted, wired and tested – Pneumatic retractor – Control box for retractor – Heat exchanger
Measuring Components IR	The following IR-components are measured with the Uras14 module: CO, CO_2, NO, CH_4 and SO_2 (< 500 ppm).
Measuring Components UV	The following UV-components are measured with the Limas11 module: SO_2 > 500 ppm and NO (Note: SO_2 up to 20,000 ppm for petrol coke firing).
	NO is normally measured with Uras14. The analyzer modules will be supplied including calibration cells.
Measuring Component O_2	Either with electrochemical O_2 cell or with Magnos17
with Magnos17 module	If chloride-containing residues are burnt in the kiln, the Magnos17 module should be chosen. This solution requires an additional N_2 bottle, a 2-stage pressure regulator for the bottle and a solenoid valve in front of the sample gas cooler. The additional bottle (acc. to DIN) is placed outside the cabinet. At measurement with Magnos17 the “Option for Magnos17” and “Test Gas Bottle N_2” can be chosen. Standard measuring ranges: 0 to 10/0 to 25 Vol% O_2
Standard Measurement Ranges	2 measurement ranges per measurement component is standard. CO: 0 to 0.5 Vol% and 0 to 2 Vol% NO: 0 to 3000 ppm and 0 to 5000 ppm SO_2: 0 to 5000 ppm and 0 to 20000 ppm (possible only with Limas11) CO_2: 0 to 30 Vol% and 0 to 40 Vol% CH_4: 0 to 5000 ppm and 0 to 10000 ppm O_2: 0 to 10 Vol% and 0 to 25 Vol%
Converter	Due to the fact that the NO-measurement is used for trend estimations, a converter is normally not required.
Steel Sheet Cabinet IP 54	The steel sheet cabinet contains all the necessary equipment and is completely mounted, wired and tested. An installation in the analysis room is absolutely necessary due to dust and ambient temperature.
incl. ventilation fans	Ambient temp. +5 °C to +35 °C (normal for analysis room)
incl. ventilation fans and electr. heating	Ambient temp. –10 °C to +35 °C (heating 500 W/thermostat)
incl. cooling unit and electr. heating	Ambient temp. –10 °C to +50 °C (avoid outdoor location!)
Plastic Cabinet IP 54	The plastic cabinet is suited for outdoor installation and is equipped with ventilation fans, electr. heating and cooling unit (mounted on the roof). Daily maintenance of the ventilation filters is required. However, ABB Analytical recommends the installation of the analysis system in an analysis room with steel sheet cabinet, see above.
External Signal Interface	As standard on terminal: Analog signals: 0/4 to 20 mA; binary signals: 3 x common status 24 V, 1 A (Error, Maintenance Mode, Maintenance Request) Optional: Single status and common status signals as floating contacts via relays (max. load 230 VAC, 1 A) and/or Profibus DP Slave RS232/RS485 according to BA-No. DP1
Power Supply	3-phase connection; N-conductor necessary, otherwise chose transformer according to BA-No. 579
Sample Gas Line	
PTFE 6/4x1 mm; length = 25 m	This unheated sample gas line should only be installed in plants where the ambient temperature is always higher than 0 °C. However, this alternative requires higher maintenance due to formation of condensate in the line.
electrically heated; length acc. to BA-No. 571	Self-regulating, highly flexible sample gas line which can be shortened acc. to your requirements, especially designed for Advance Cement Kiln. Gas temperature approx. 110 °C. The heated sample gas line is absolutely needed at ambient temperatures below 0 °C and for SO_2 measurements. The length of the heated sample gas line has to be completed with BA-No. 571.

Comments on Ordering Information

Type of Probe	
Probe 60S	60S = reinforced design of probe tube 60: diameter of probe tip 60 mm (usually 89 mm); outside diameter of probe flange 285 mm. Probe tube 60S should be installed in kilns where no hard encrustations are to be expected. The used filter unit is FE2. **Note:** The normal probe 60 may not be used as this probe does not fit to the pneumatic probe retractor due to a different flange. Follow the specific installation instructions.
Probe H	The probe H should be used where hard encrustations are to be expected. It should not be used for SO_2 measurement. **Note:** If material build-ups and encrustations often occur in the kiln, only probe H should be chosen. In case of doubt always choose probe H. The probe H should be installed vertical to the sample gas flow. Follow the specific installation instructions.
Probe 60S incl. Accessories 60S	The length of probe tube 60S is to be chosen acc. to installation recommendation.
Probe H incl. Accessories H	The length of probe tube H is to be chosen acc. to installation recommendation.

Comments on Supplementary Ordering Information

Operating Altitude	With Magnos17, the operating altitude higher 2000 m has to be given.
Length of the Electrically Heated Sample Gas Line	If the heated sample gas line is chosen, the exact length has to be indicated in the order. Note: The line can be shortened acc. to the customer's requirements.
Wiring incl. Conductor Identification	For the cabinet and the pneumatic control box.
Prepared for External USV	Analyzer, PLC unit and sample gas cooler will be powered separately.
Automatic Fuses in Bipolar Design	The N-conductor is also fused.
Profibus DP Slave RS 232/RS485	Connection to PLC unit.
Single Status Signals as Relay Contacts	Coupling relays for adaptation to the customer's signal voltage., max. 230 VAC, 1 A The signal voltage has to be specified in the order.
ACK Constructors Certificate	According to DIN 55350-18-4.1. For the whole system.
AO2000 Inspection Certificate 3.1B	Chose per analyzer module, for example the deviation of linearity is measured.
Documentation in German, 1 x A4, Documentation in English, 1 x A4	1 set of documentation is supplied as standard. The name of project/client will be given on the drawings. Layout and numbering of the drawings are acc. to ABB Analytical standard. The number of additional documentation sets has to be indicated in the order.
Documentation in German and English	Surplus price if both languages are required.
Option for Magnos17	For the automatic zero point calibration with N_2, a 2-stage bottle pressure reducer according to DIN and 2 m PTFE tube incl. connection set is required.
Option for Test Gas Bottles	Bottle pressure reducer, 1-stage, brass, according to DIN incl. 2 m PTFE tube and viton connection.
Transformer in Protection Casing IP 44	Necessary if no N-conductor is available or the power supply is not 230/400V. Even with 220/380V a transformer is necessary!
Test Gas Bottles	Different test gas bottles according to DIN with 1 to 3 gas components. Note: No airfreight possible with gas bottles!
Compressed Air Station	on request
Compressed Air Dryer	on request

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