Miller, Diane M. (CDC/NIOSH/EID)

From:	Bill Worthington [hugo.maihak@earthlink.net]
Sent:	Thursday, February 22, 2007 6:26 PM
To:	NIOSH Docket Office (CDC)
Cc:	'brian tripoli'
Subject:	100 - Mine Seals Comments

Attachments: PI_S 700_en_D07-03_8009716.pdf

**Explosion Pressure Design Criteria for New Seals in U.S. Mines
Docket # NIOSH-100**

In the document above, the tube bundle monitoring system is discussed on page 25 with some figures (photographs) on page 88. The analytical equipment is incorrectly called a "gas chromatograph"
The wall mounted gas analyzer is a SICK-Maihak Model 715 which incorporates a UNOR optical bench to measure Carbon Monoxide (CO) at a ranges of 0-100 and 0-1000 ppm,. This unit operates under the principle of a non-dispersive infrared analyzer (NDIR) and is a continuous gas analyzer. The S715 shown also incorporates a MULTOR optical bench for the simultaneous measurement of Methane (CH4) and Carbon Dioxide (CO2) at ranges of 0-10 and 0-100%. The MULTOR optical bench is also a NDIR principle unit. Also included is an OXOR-P paramagnetic oxygen analyzer that measures oxygen at ranges of 0-10% and 0-25%. All of these units are within the single gas analyzer and are continuous gas analyzers.

Gas chromatographs are intermittent in their analysis and require a cycle time of probably 3 – 5 minutes for the analysis of these gases. A gas chromatograph is not capable of continuous analysis.

The Tube Bundle System was supplied by Gas Analysis Systems (G.A.S.), which is now a part of Sick Maihak Australia.
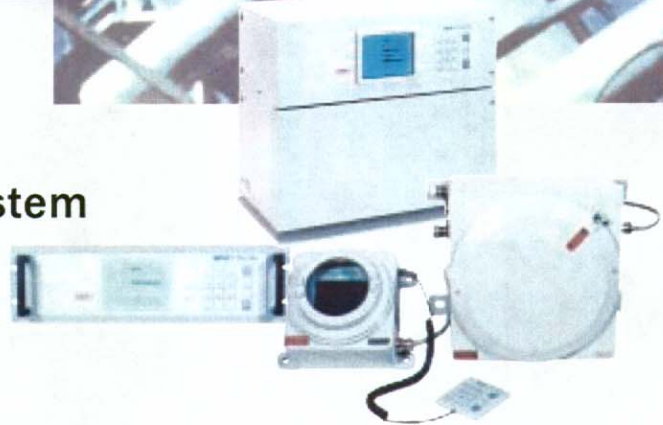
Product info attached

Best regards,
Bill Worthington
Product Manager
Sick Maihak USA, inc
RR2 Box 273
Lewisburg, WV 24901

304 645 6208 Office
612 203 3838 Mobile
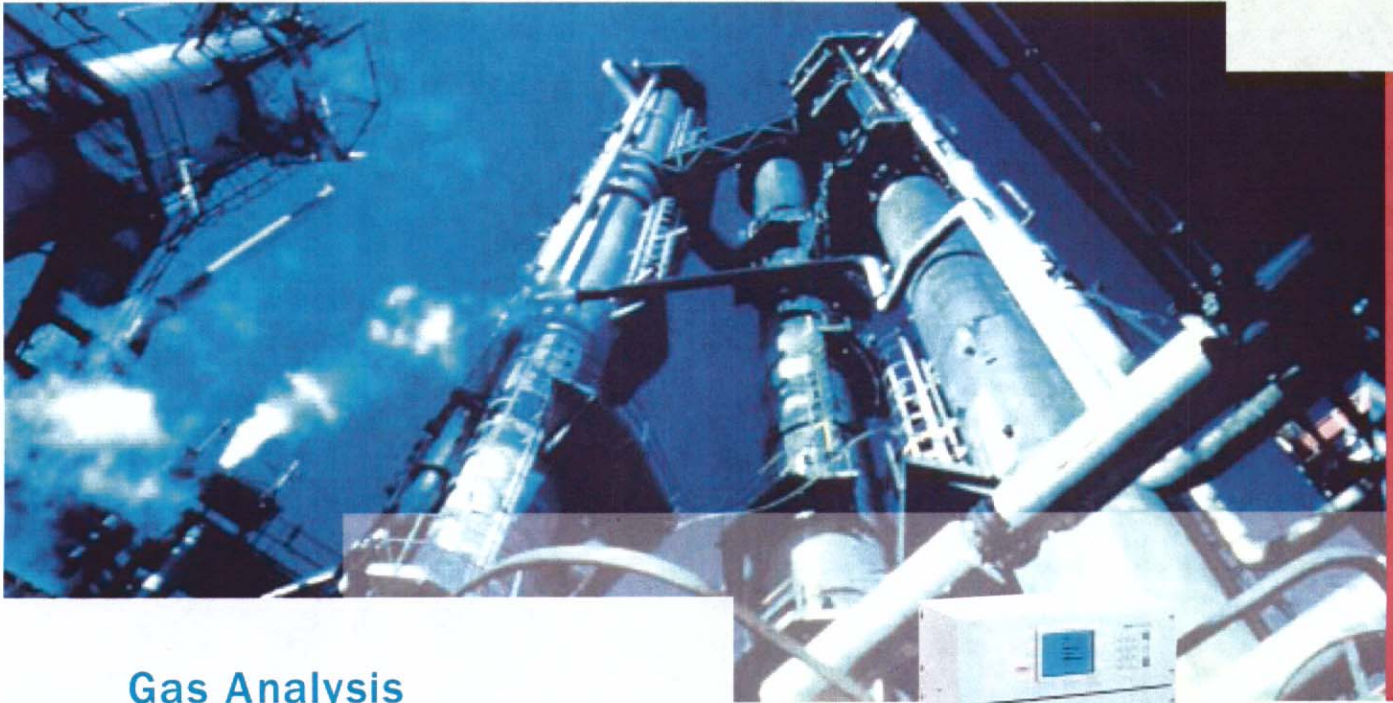
Gas Analysis
S 700
Modular Gas Analyzer System

SICK | MAIHAK

Using the modular system **S 700**, a customized and application specific analyzer can be assembled for nearly every industrial measurement application. A total of 6 different analyzer modules are available for the measurement of more than 60 different gases. Many applications and the associated technical requirements can be achieved: from emission measurements according to German standards for industrial boilers, waste incinerators and crematories, to applications in biological gas analysis and process gas analysis.

Depending on the installation location, measuring gas composition and the environmental conditions, there are 3 types of enclosures to choose from:

- for standard applications the enclosure **S 710**, a 19"-rack mounted chassis is recommended.
- the vapor-tight enclosure **S 715** is suitable for installations in rougher environmental conditions, or for Ex-Zone 2 areas, and is also purgeable.
- the flame-proof EEx-d enclosure **S 720 Ex** has been designed for the industrial environments which are classified as hazardous i.e. Ex-Zone-1 (corresponds to the requirements of Class 1, Div 1).

As **special version** following enclosures are available:

- The enclosure **S 711** is similar to the enclosure S 710, but with shorter installation depth which allows replacement of older instruments and installation in cabinets with limited space.
- The enclosure **S 721 Ex** is similar to the enclosure S 720 Ex, but with a larger housing which allows the maximum number of possible configurations.

The enclosures can be factory set to include up to 3 analyzer modules controlled by one set of electronics without the need for any external cabling or additional housings. This means that we can provide a very compact and cost-effective system solution.

Through a large range of options and numerous freely-configurable digital and analog inputs and outputs, a complete measurement system can be very easily put together. In addition to the built-in analyzer modules, 2 other analog signals from external sources can be input and used in the system. Up to 5 analog signals can be considered, calculated with one another and displayed. From these 5 signals, 4 can be given as analog
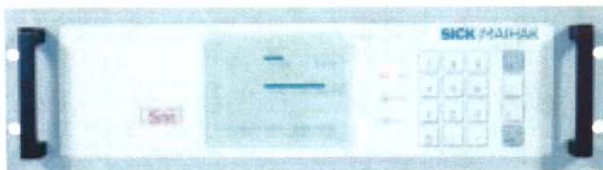
outputs. With output to the serial interface all 5 signals are available, plus information about date, time and status.

A calculated measuring value can be obtained through computation of the actual analog measuring values. This virtual measuring value can be displayed and given as one of the analog output signals and it can also be associated with an alarm contact.

The intelligent microprocessor control provides fully automatic and low maintenance operation with control functions for industrial plants as well as all important instrument functions such as fully automatic calibration with test gas, or calibration cuvette. Self diagnostics and internal watch-dog functions are also integrated. The menu-driven operator interface includes

easy to understand text messages on a large LCD. A number of help texts are included to allow easy operator intervention even if it is seldom required. All of the inputs and help texts are clearly visible on the LC display and as it is our tradition, the texts are available in eight different languages.

* Option

Possible Analyzer Module Combinations

Combination possibilities: Up to 3 analyzer modules can be integrated in one single housing. The chosen combination is valid for many types of enclosures. Depending on enclosure, choice of modules and application some restrictions in combination may occur. The maximum number of possible combinations of analyzer modules can be obtained from the table below.

How to select: Chose from each column one module. If a module is not required in a specific column simply select "no module" and proceed to the next column.

Column 1	Column 2	Column 3
UNOR	UNOR *	THERMOR
MULTOR	OXOR-P	OXOR-P
FINOR	OXOR-E	OXOR-E
OXOR-P	no module	no module
OXOR-E		
no module		

* combination is only possible when selection in column 1 is UNOR or MULTOR

Example 1

MULTOR	UNOR	OXOR-P
for SO₂, NO	for CO	for O₂

Example 2

FINOR	no module	THERMOR
for CO, CO₂, CH₄		for H₂

Up to 5 analog signals can be considered, calculated with one another and displayed. From these 5 signals, 4 can be given as analog outputs. With output to the serial interface all 5 signals are available, plus information about date, time and status.

Analyzer Modules

UNOR The UNOR uses the well proven NDIR-absorption principle of operation. It can selectively measure every gas which absorbs energy in the infrared spectral range.

MULTOR The MULTOR is a multi-component NDIR-gas analyzer, which can be used to measure up to three different IR absorbing components and additionally H_2O for cross sensitivity compensation.

THERMOR The THERMOR uses the different thermal conductivity of gases, to determine the gas concentration of a particular gas in a binary or quasi-binary gas mixture. The influence of other components in non-binary gas mixtures can be taken into account by the cross sensitivity correction* in case that the components are measured with other modules* or by external measuring devices*. The THERMOR is also available as high corrosion resistant measuring cell.

FINOR The FINOR operates with the inferference filter correlation (IFC) principle. Up to three different gas components can be measured simultaneously.

OXOR-P The OXOR-P uses the paramagnetic measuring principle to determine the concentration of oxygen in a gas sample. The OXOR-P is also available as high corrosion resistant and solvent resistant version.

OXOR-E The OXOR-E determines the oxygen concentration using an electrochemical cell.

* Option

Enclosures

S 710
- 19"-3HU-chassis
- IP 20
- dimensions see page 14/15
- weight: ≈ 10 ... 20 kg, depending on configuration

S 711
- special version of enclosure S 710 with reduced installation depth
- dimensions see page 14/15
- weight: ≈ 9 ... 19 kg, depending on configuration

S 715
- wall mounting enclosure
- IP 65 (Nema 4X)
- gas-tight separation of the measuring and electronic sections
- each section is separately purgeable*
- vapor tight enclosure according to VDE 165/2.91 section 6.3.1.4
  suitable for zone 2 areas acc. EN 50021
- TÜV 01 ATEX 1725X
  II 3 G EEx n R II T6
  or
  II 3 G EEx n P II T6 if operated in type of protection "Simplified Pressurization"*
  - integrated flame arrestors*
    for gas inlet and outlet
- intrinsically safe signal outputs*
- dimensions see page 14/15
- weight: ≈ 20 ... 30 kg, depending on configuration

S 720 Ex
- flame-proof enclosure / intrinsically safe
- IP 65 (Nema 7)
- TÜV 97 ATEX 1207 X
  EEx d ia IIC T6 or
  EEx d ia [ia] IIC T6 with intrinsically safe* signal output
- purgeable*
- can be used without any additional precaution in Ex-zone 1
- integrated flame arrestors*
  for gas inlet and outlet
- intrinsically safe signal outputs*
- dimensions see page 14/15
- weight: ≈ 60 ... 70 kg, depending on configuration

S 721 Ex
- special version of enclosure S 720 Ex with a larger housing which allows the maximum number of possible configurations
- dimensions see page 14/15
- weight: ≈ 90 ... 100 kg, depending on configuration

Common Features

Measuring Value, Status and Control Outputs

Measurement signals (analog)
- 4 measuring value outputs
- assigned either to an analyzer module, calculated value or to an external analog signal*, freely selectable
- 0 / 2 / 4 ... 20 mA, linear
- potential-free (galvanically isolated) max. load 500 Ω, max load 390 Ω with intrinsically safe* output
- programmable live zero
- during the calibration cycle, the output signal can be selected to either follow the calibration values or to hold the last process measurement value during the calibration cycle

Output ranges
- 2 output ranges* freely programmable over the basic measuring range
- max. range switching ratio* 1:10**, e.g. 400 ... 500 ppm with basic meas. range 0 ... 1000 ppm ratio 1:20 on request*
- data sheet specification is valid for the basic measuring range and ordered output ranges*

Status- and control outputs
- 8 relay contacts
- 8 open-collector-outputs
- 3 relay contacts pre-set, all other contacts can be defined by the user, e.g.:
- 4 alarm levels, freely programmable for high or low alarm limits
- Fault
- Service required (NAMUR-signal "Service required")
- Service / Calibration (NAMUR-signal "function monitoring")
- 4 measuring range IDs
- 5 signals to control the solenoid valves for manual or automatic calibration for sample gas, zero and test gases
- manual control of an external sample gas pump and automatic shut-down thereof in the event of a fault: external sample pump ON / OFF
- logic freely selectable

Measuring Value and Control Inputs

Measurement value inputs
- 2 inputs
- 0 / 2 / 4 ... 20 mA or 0 ... 10 V
- for cross-sensitivity* or other signal computation*
- shown in LC-Display
- output on analog measuring value output possible

Control inputs
- 8 inputs
- galvanically isolated via internal opto-couplers
- can be freely programmed for up to 24 different meanings, e.g.:
- calibration control
- external measuring range switching
- monitoring of external system components, e.g. cooler, test gas bottles, etc.
- Service / Calibration lock-out (NAMUR-Signal "*communication*") to insure uninterrupted sample analysis

* optional
** FINOR: max. 1 : 2

Digital Interfaces

RS 232C (uni-directional)
- automatic output of measuring value and status with date and time

RS 232C (bi-directional)
- limited AK-protocol*
- remote control via modem or serial PC direct connection

Display and Menu Drive

Display
- back-lit LC-graphic display (120 mm wide, 90 mm high)

Measuring value display
- digital, 5-digit (17.5 mm high)
- quasi-analog (bargraph)
- in engineering units: ppb, ppm, %, mg/m^3_n, g/m^3_n, to be specified
- measuring value and status messages are always shown in every menu step

Menu drive
- understandable and clear directions in three levels according to NAMUR-standard
- two levels are protected against unauthorized access
- context related and understandable help texts always accessible

Clear text messages

clear and comprehensive text messages such as
- **Status conditions** ("calibration", ...)
- **Fault diagnostics** ("gas flow", "IR-source", ...)
- **Service required** ("zero point drift", ...) etc.

Menu languages
- German, English, French, Italian, Spanish, Dutch, Polish, Swedish

Calibration

Automatic*
- fully automatic at pre-programmed intervals, via manual or via external start signal
- calibration lock-out in critical measuring situations
- only zero gas when using the calibration cuvette* (UNOR and MULTOR only) or
- by use of zero and span gases

Manual
- only zero gas when using the calibration cuvette* (UNOR and MULTOR only) or
- by use of zero and span gases

Gas Inlet and Outlet Conditions

Gas temperature
- +0 ... +45 °C

Gas quality
- dew point of sample gas must be below ambient temperature
- sample gas must be free of dust, particles and aerosol

Sample gas pressure relative to ambient pressure
- tubed gas lines: -200 ... +1000 hPa (-0,2 ... +1 bar)
- hosed gas lines: -200 ... +300 hPa (-0,2 ... +0,3 bar)

Sample gas pump*
- max. 60 l/h at 100 hPa (0,1 bar) subpressure
- pump capacity adjustable by software
- only for hosed gas lines

Sample gas / reference gas flow rate*
- without built-in sample pump:5 ... 100 l/h
- with built-in sample pump*:30 ... 60 l/h

Hardware Options

Sample gas pump
- for controlled sample gas delivery

Stainless steel tubing
- for increased safety

Separate gas lines
- up to 3 separate gas lines possible

Calibration cuvette
- for calibration without the need for span gases (UNOR, MULTOR)

Filter cuvette
- for the reduction of cross interference (UNOR, MULTOR)

Fault monitor flow
- for monitoring the gas flow

Fault monitor moisture
- to check for condensate in the sample gas

Barometric pressure correction
- to compensate for changes in air pressure

Sample gas pressure correction
- to compensate for changes in sample gas pressure

Sample point switch
- for switching between up to 8 sample points with external solenoid valves

EMI-Protection / Electrical safety

CE-Label
- EMI guidelines 89/336/EC, low voltage guidelines 72/23/EC

EMI-testing according to
- EN 50081
- EN 50082

Criteria
- according to NAMUR-standard

Protection class
- EN 61010

General Data

Line voltage
- 100/115 or 230 VAC (+10%, -15%), switchable, fuse change necessary
- 48 ... 62 Hz

Special version
- 24 VAC

Power consumption
- max. 150 VA, typically 50 VA, depending on configuration

Ambient temperature during operation
- +5 ... +45 °C

Transport and storage temperature
- -20 ... +70 °C

Relative humidity
- Humidity class F (DIN 40040)
  ≤ 75% annual average
  ≤ 95% occasionally
- non-condensing

Gas Connections

Enclosure S710
Enclosure S711
- PVDF bulkhead fitting for 6 x 1 mm hose
- 6 mm SERTO* (stainless steel)
- 6 mm SWAGELOK* stst
- ¼" SWAGELOK* stst

Enclosure S715
Enclosure S720 Ex
Enclosure S721 Ex
- G ¼" inner winding for screw fittings
- integrated flame arrestors*

Screw fittings:
- 6 mm SWAGELOK* stst
- ¼" SWAGELOK* stst
- 6 mm SERTO* stst
- 6 mm PVDF* (for hosed gas lines)

Purge Gas Connections

Enclosure S710
Enclosure S711
- 6 mm SERTO* (stainless steel)
- 6 mm SWAGELOK* stst

Enclosure S715
- SERTO, 6 mm gas inlet and 15 mm gas outlet*
- ⅜" SWAGELOK*
- 6 mm SERTO*
- 8 mm SERTO*
- 12 mm SERTO*
- 8 mm SWAGELOK*
- 10 mm SWAGELOK*

Enclosure S720 Ex
Enclosure S721 Ex
- G ¼" inner winding for screw fittings (see gas connections)

The module UNOR is a precision NDIR gas analyzer for continuous measurement of CO, CO_2, SO_2, CH_4, NO, and more than 60 other components with high selectivity and measuring sensitivity. Through variable, adjustable chopper frequency, the instrument is not sensitive to building vibrations.

Technical Data

Zero point drift ■ ≤ 1 % of the smallest meas. span / week**

Sensitivity drift ■ ≤ 1 % / week

Noise ■ ≤ 0.5 % of the smallest output range**

Linearity deviation ■ ≤ 1 % of selected output range

Ambient temperature influence
■ ≤ 1 % of the smallest output range per 10 K for the zero point**
■ ≤ 1 % of measuring value per 10 K for sensitivity**

Flow dependency
■ ≈ 1 % change in meas. signal / 100 l/h change in flow rate

Air pressure influence with open sample gas outlet or process gas pressure influence with sample return to process
■ without pressure compensation: 0.6 ... 1 % change in meas. value for 1 % change in pressure
■ with option barometric press. corr.* and open sample gas outlet or
■ with option sample press. corr.* and with sample gas return to process:
≤ 0.1 % change in meas. value for 1% change in pressure
(pressure range 700 ... 1300 hPa)

Line voltage, line frequency influence
■ ≤ 0.5 % of the smallest meas. span within the specified voltage and frequency ranges

Times

Display delay (T_{90})
■ dependant on the cuvette length and gas flow, typically 3 s at 60 l/h

Time constant (T_{90},el)
■ 1 ... 300 s selectable

Warm-up time ■ ≈ 45 min

General Data

Materials in contact with the sample gas
■ Viton B, PVDF, glass, stst 1.4571 (gold)

Certifications (TÜV)

TA Luft /
13. BImSchV /
17. BImSchV /
27. BImSchV
■ CO 0-100 mg/m³
■ NO 0-100 mg/m³
■ SO_2 0-100 mg/m³

* optional
** double values for ranges < 2 x smallest meas. range

Measuring Components and Lowest Meas. Ranges

Component	Chemical formula	Lowest meas. range [ppm]	[mg/m³]
Acetylene	C_2H_2	300	350
Ammonia	NH_3	300	250
1,3 Butadiene	C_4H_6	300	750
Butane	C_4H_{10}	100	250
1-Butanol	$C_4H_{10}O$	1000	3000
2-Butanone	C_4H_8O	1000	3000
1-Butene	C_4H_8	500	1300
Trans-2-Butene	C_4H_8	500	1300
Carbon dioxide	CO_2	10	20
Carbon disulfide	CS_2	500	1600
Carbon monoxide	CO	20	30
Chloroform	$CHCl_3$	3000	15000
Cyclohexane	C_6H_{12}	300	1100
Cyclohexanone	$C_6H_{10}O$	500	2100
1,1-Dichloroethane	$C_2H_4Cl_2$	500	2100
1,1-Dichloroethene	$C_2H_2Cl_2$	500	2000
Dichloromethane	CH_2Cl_2	200	800
Dimethylether	$(CH_3)_2O$	1000	2000
Ethane	C_2H_6	100	130
Ethanol	C_2H_5OH	1000	2000
Ethylene	C_2H_4	300	350
Formaldehyde	CH_2O	1000	1300
Freon 11	CCl_3F	100	600
Freon 12	CCl_2F_2	100	510
Freon 13	$CClF_3$	100	450
Freon 13B1	$CBrF_3$	300	2000
Freon 22	$CHClF_2$	500	1800
Freon 113	$C_2Cl_3F_3$	300	2400
Freon 114	$C_2Cl_2F_4$	300	2200
Freon 134a	$C_2H_2F_4$	100	500
n-Heptane	C_7H_{16}	500	2100
n-Hexane	C_6H_{14}	300	1100
Methane	CH_4	100	70
Methanol	CH_3OH	500	700
Methylal	$C_3H_8O_2$	1000	3400
Methylchloride / Chloromethane	CH_3Cl	500	1100
Nitric oxide	NO	75	100
Nitrous oxide	N_2O	50	100
n-Pentane	C_5H_{12}	300	900
Propadiene	C_3H_4	500	900
Propane	C_3H_8	100	200
n-Propanol	C_3H_7OH	1000	2500
Propylene	C_3H_6	300	600
Sulfur dioxide	SO_2	40	100
Sulfur hexafluoride	SF_6	50	300
Tetrachloroethene (Per)	C_2Cl_4	500	3500
Toluene	C_7H_8	500	2000
1,1,1-Trichloroethane	$C_2H_3Cl_3$	1000	5600
Trichloroethylene (Tri)	C_2HCl_3	1000	5500
Water vapor	H_2O	1000	820
o-Xylene	C_8H_{10}	500	2200

Other measuring components and measuring ranges on request.
Calculated values from ppm into mg/m³ are at 20 °C, 1013 hPa.
All data are valid for gas mixtures of sample gas and N_2.

MULTOR

The module MULTOR is a precision NDIR gas analyzer for the continuous measurement of up to 3 IR-components. H_2O can be measured as 4th component for internal cross sensitivity correction*. The MULTOR has a high selectivity and measuring sensitivity. Through variable, adjustable chopper frequency, the instrument is not sensitive to building vibrations.

Technical Data

Zero point drift ■ ≤ 1 % of the smallest meas. span / week **

Sensitivity drift ■ ≤ 1 % / week

Noise ■ ≤ 1 % of the smallest measuring span

Linearity deviation ■ ≤ 2 % of the selected measuring span

Incline influence ■ none

Ambient temperature influence
■ zero point:
≤ 1.5 % of the meas. span / 10 K
■ sensitivity:
≤ 2 % of the meas. span / 10 K

Flow dependency < 0.1 % change in meas. value in the range of 10 ... 80 l/h at 10 l/h change in flow rate

Air pressure influence with open sample gas outlet or process gas pressure influence with sample return to process
■ without pressure compensation: ≤ 1 % change in meas. value for 1 % change in pressure
■ with option barometric press. corr. * and open sample gas outlet or
■ with option sample gas press. corr.* and sample gas return to process:
≤ 0.1 % change in meas. value for 1 % change in pressure
(pressure range 700 ... 1300 hPa)

Line voltage, line frequency influence ■ ≤ 0.5 % of the smallest measuring span within the specified voltage and frequency ranges

General Data

Materials in contact with the sample gas ■ Viton B, PVDF, glass, stst 1.4571 (gold)

Measuring Components and Lowest Meas. Ranges

Component	Chemical Formula	lowest meas. range	
Carbon dioxide	CO_2	100 ppm	200 mg/m³
Carbon monoxide	CO	160 ppm	200 mg/m³
Methane	CH_4	470 ppm	335 mg/m³
Nitric oxide	NO	190 ppm	250 mg/m³
Sulfur dioxide	SO_2	85 ppm	250 mg/m³

Calculated values from ppm to mg/m³ at 20°C, 1013 hPa.
Other measuring components and measuring ranges on request *.
All data are valid for gas mixtures of sample gas and flue gas.
Other gas compositions upon request.

Times

Display delay (T_{90}) ■ dependant on the cuvette length, gas flow rate and the number of components, max. 25 s at 60 l/h

Time constant (T_{90},el) ■ 1 ... 300 s adjustable

Warm-up time ■ ≈ 45 min

Certifications (TÜV)

13. BImSchV / TA Luft:
■ CO 0-200 mg/m³
■ NO 0-250 mg/m³
■ SO_2 0-250 mg/m³

* optional
** double values for ranges < 2 x smallest meas. range

THERMOR

The module THERMOR is a precision thermal conductivity gas analyzer. H_2, He, CO_2, Ar as well as other gases in binary or quasi-binary mixtures can be measured with high measuring sensitivity. The influence of other components in non-binary gas mixtures can be taken into account by the cross sensitivity correction* in case that these components are measured with other modules* or by external measuring devices*.

As an option, the analyzer can be configured for monitoring H_2 cooled turbine generators*.

Technical Data

Zero point drift ■ ≤ 1 % of the smallest meas. span / week **

Sensitivity drift ■ ≤ 1 % per week

Noise ■ ≤ 0.5 % of the smallest meas. span ** (at T_{90},el = 10 s)

Linearity deviation ■ ≤ 1 % of the selected output range

Ambient temperature influence
■ ≤ 1 % of the smallest meas. span per 10 K for the zero point
■ ≤ 1 % of the measuring value per 10 K for sensitivity

Flow dependency
■ < 0.2 % change in measuring value in the range of 10 ... 80 l/h for a change in flow of 10 l/h
■ for the smallest measuring ranges $\Delta\lambda \leq 20$ μW/(cm K): < 0.3 % change in measuring value in the range of 10 ... 80 l/h change in flow rate

Atmospheric pressure influence ■ none

Line voltage, line frequency influence ■ ≤ 0.5 % of the smallest measuring span within the specified voltage and frequency ranges

Thermal Conductivity of Gases

relative thermal conductivity of gases relative to air = 1 (at 150 °C)
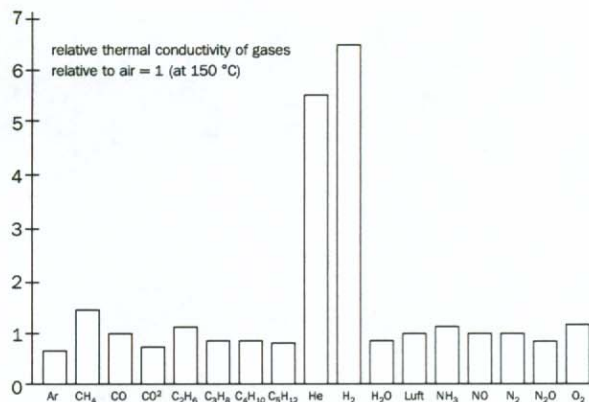
Times

Display-delay ($T_{90,\text{ges}}$) ■ < 20 s at T_{90},el = 1 s and sample gas flow 60 l/h

Time constant ($T_{90,\text{el}}$) ■ 1 ... 300 s adjustable

Warm-up time ■ $\approx$ 30 min

Measuring Components and Smallest Meas. Ranges

Component	in	Chemical Formula	Smallest measuring span in %
Argon	Oxygen	Ar in O_2	5
	Nitrogen	Ar in N_2	5
Ammonia	Carbon dioxide	NH_3 in CO_2	15
	Room air	NH_3 in air	75
Carbon dioxide	Air	CO_2 in air	5
Helium	Nitrogen	He in N_2	1
Hydrogen	Argon	H_2 in Ar	1
	Air	H_2 in air	1
	Blast furnace gas	H_2 in blast furnace gas	1
	Methane	H_2 in CH_4	1
	Oxygen	H_2 in O_2	1
	Nitrogen	H_2 in N_2	1
Methane	Ferment. gas	CH_4 in ferment. gas	60

Other measuring components and measuring ranges on request.

General Data

Materials in contact with the sample gas
■ glass, stst 1.4571 or
■ glass, PVDF (HCl resistant version)*

Option: Turbogenerator Cooling Gas Monitoring

Application ■ monitoring of H_2 cooled turbo generators: during filling and emptying process as well as during operation for H_2 purity

Measuring ranges
■ 0 ... 100 % CO_2 in air
■ 0 ... 100 % H_2 in CO_2
■ 80 ... 100 % H_2 in air

Calibration ■ for test and zero gas only 100 % H_2 and 100 % CO_2 are required

Control and monitoring functions
■ manual range switching
■ external measuring range switching from control system
■ 4 alarm messages freely programmable
■ high level of up time through automatic calibration and analyzer self-diagnostics

Special Measuring Cell*

As special model* of the measuring cell a corrosive resistance cell made of PVDF is available.

* optional
** double values for ranges < 2 x smallest meas. range

FINOR

The module FINOR is a single beam NDIR photometer which operates on the principle of interference filter correlation (IFC). The analyzer can determine up to 3 components in parallel.

The measuring system incorporates a solid-state detector and as such the entire construction is rugged and insensitive to mechanical vibration.

Technical Data

Zero point drift ■ ≤ 1.5 % of the smallest meas. span / week**

Sensitivity drift ■ ≤ 1 % / week**

Noise ■ ≤ 1 % of the smallest measuring span

Linearity deviation ■ ≤ 1.5 % of the selected output range

Incline influence ■ none

Ambient temperature influence
■ zero point:
≤ 1.5 % of the meas. span / 10 K
■ sensitivity:
≤ 1.5 % of the meas. span / 10 K

Flow dependency ■ < 0.1 % change in measuring value in the range of 10 ... 80 l/h at 10 l/h change in flow rate

Air pressure influence with open sample gas outlet or process gas pressure influence with sample return to process
■ without pressure compensation:
≤ 1 % change in meas. value for 1 % change in pressure
■ with option barometric press. corr.* and open sample gas outlet or
■ with option sample pressure compensation* and sample return to process:
≤ 0.1 % change in meas. value for 1 % change in pressure (pressure range 700 ... 1300 hPa)

Line voltage, line frequency influence ■ ≤ 0.5 % of the smallest measuring span within the specified voltage and frequency ranges

Output ranges
■ 2 output ranges* freely programmable over the basic measuring range
■ max. range switching ratio 1:2
■ data sheet specification is valid for the basic measuring range and ordered output ranges*

Measuring Components and Smallest Meas. Ranges

Component	Chemical Formula	Smallest meas. range	
		mg/m³	%
Carbon dioxide	CO_2	2000	0,1
Carbon monoxide	CO	6000	0,5
Hydrocarbons [1]	CnHm		2,0
Methane	CH_4	15000	2,0
Sulfur hexafluoride	SF_6		10

Calculation from ppm to mg/m³ at 20 °C, 1013 hPa.
Other components and measuring ranges on request*.
All data are valid for gas mixtures of sample gas and N_2.

[1] The measurement of hydro carbons is performed via a broad range filter and allows only for a rough estimation of the existing hydro carbon concentration.

Times

Display delay (T_{90}) ■ dependant on the cuvette length and gas flow rate and number of components, max. 25 s at 60 l/h

Time constant ($T_{90,el}$) ■ 1 ... 300 s selectable

Warm-up time ■ ≈ 45 min

General Data

Materials in contact with the sample ■ Viton B, PVDF, stst 1.4571

* optional
** double values for ranges < 2 x smallest meas. range

The module OXOR-P is a precision oxygen analyzer. The measuring module operates on the principle of a rotating diamagnetic dumbbell, which is suspended in an inhomogeneous magnetic field. The paramagnetic characteristic of oxygen exerts torque on the dumbbell which is proportional to the concentration of O_2 in the sample gas.

Technical Data

Zero point drift	■ < 1 % of the meas. span / week or < 0.05 % O_2 / week for meas. spans less than 5 % O_2
Sensitivity drift	■ < 1 % of the measuring value / week
Noise	■ < 0.5 % of the meas. span (at T_{90},el = 10 s) **
Detection limit	■ < 0.5 % of the meas. span
Linearity deviation	■ < 1% of the selected output range
Ambient temperature influence	■ < 2 % of the meas. span / 10 K ■ < 0.1 % O_2 / 10 K for meas. spans ≤ 5 % O_2
Incline influence	■ < 0.05 % O_2 / 1° change
Flow dependency	■ < 0.2 % O_2 in the range of 10 ... 60 l/h
Air pressure influence with open sample gas outlet or process gas pressure influence with sample return to process	■ without pressure compensation: ≤ 1 % change in meas. value for 1 % change in pressure ■ with option barometric press. corr.* and open sample gas outlet or ■ with option sample gas press. corr.* and sample return to process: ≤ 0.1 % change in meas. value for 1 % change in pressure (pressure range 700 ... 1300 hPa)
Line voltage, line frequency influence	■ ≤ 0.5 % of the smallest measuring span within the specified voltage and frequency ranges

Measuring and Output Ranges

Basic measuring ranges	■ from 0 ... 1 % O_2* to 0 ... 100 % O_2 ■ zero-suppressed ranges* (up to 95 ... 100 % O_2)
Output ranges	■ up to 2 output ranges* freely adjustable within the basic measuring range, smallest output range 1 % O_2 ■ maximum range ratio* 1:10, ratio 1:20 on request* for example: ■ output range10 - 12.5 % O_2 with basic meas. range 0 - 25 % O_2 ■ data sheet specifications are valid for basic measuring ranges and factory set output ranges*
Smallest measuring range	■ 1 % O_2*

* optional
** double values for ranges < 2 x smallest meas. range

Influences

The influence of the sample gas composition is normally quite small. The following table shows the theoretical cross sensitivities of some of the components due to their magnetic susceptibility. Here it is assumed that the carrier gas is nitrogen.

Component (100%)	Chemical Formula	Zero point offset in % O_2
Argon	Ar	-0.22
Acetylene	C_2H_2	-0.01
Benzene	C_6H_6	-1.24
Ethane	C_2H_6	-0.34
Ethanol	C_2H_5OH	-0.63
Ethylene	C_2H_4	0.00
Carbon dioxide	CO_2	-0.23
Carbon monoxide	CO	+0.06
Hydrogen	H_2	+0.23
Hydrogen sulfide	H_2S	-0.39
Methane	CH_4	-0.01
Neon	Ne	+0.15
n-Octane	C_8H_{18}	-2.45
Nitric oxide	NO	+42.71
Sulfur dioxide	SO_2	-0.18
Water vapor	H_2O	-0.03
Xenon	Xe	-0.92

Times

Display delay ($T_{90, gas}$)	■ < 4 s, standard (at T_{90},el=1 s and sample gas flow = 60 l/h)
Time constant ($T_{90,el}$)	■ 1 ... 300 s adjustable
Warm-up time	■ ≈ 120 min

General Data

Operating altitude	■ ≤ 2000m above sea level, if installation is to be higher, please notify us at the time of order
Materials in contact with the sample gas	■ corrosion-resistant in Viton B, PVDF, glass, stst 1.4571, Platinum, Nickel

Special Versions

Solvent resistant or corrosion resistant measuring cells are available as special versions.

Certifications (TÜV)

13. BImSchV / ■ 0 ... 25 Vol% O_2
17. BImSchV
27. BImSchV
TA Luft

OXOR-E

The module OXOR-E is a precision oxygen analyzer. It operates using an electrochemical cell for the detection of oxygen.

Technical Data

Zero point drift ■ ≤ 2 % of the smallest meas. span / month

Sensitivity drift ■ ≤ 1 % / week

Noise < 0.1 % O_2

Linearity deviation ■ ≤ 1.5 % of the selected meas. span

Incline influence ■ none

Ambient temperature influence
■ zero point:
≤ 1.5 % of the meas. span / 10 K
■ sensitivity:
≤ 1.5 % of the meas. span / 10 K

Flow dependency ■ 0.1 % change in meas. value in the range of 10 ... 80 l/h at 10 l/h change in flow rate

Atmospheric pressure influence with open sample gas outlet or process gas pressure influence with sample gas return to process
■ without pressure compensation: ≤ 1 % change in measuring value for 1 % change in pressure
■ with option barometric press. corr.* and open sample gas outlet or
■ with option sample gas press. corr.* and sample return to process: ≤ 0.1 % change in meas. value with 1 % change in pressure (pressure range 700 ... 1300 hPa)

Line voltage, line frequency influence ■ ≤ 0.5 % of the smallest meas. span within the specified voltage and frequency range

Times

Display delay (T_{90}) ■ dependant on gas flow, typically 20 s at 60 l/h

Time constant ($T_{90,ei}$) ■ 1 ... 300 s adjustable

Warm-up time ■ none

Measuring and Output Ranges

Basic measuring range: ■ 0 ... 25 % O_2

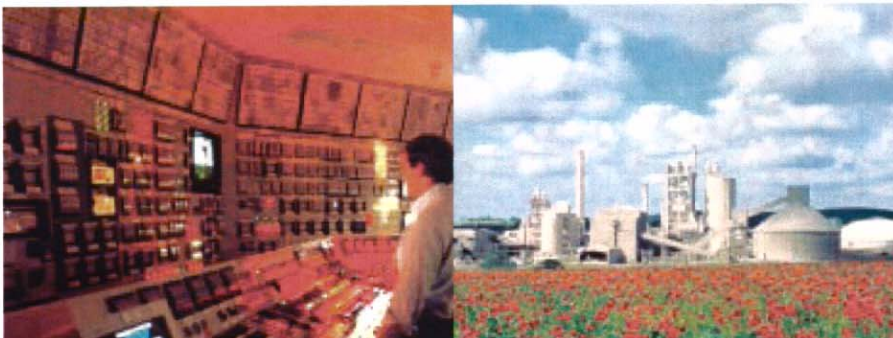**Smallest measuring range** ■ 10 % O_2

Output ranges
■ up to 2 output ranges* freely adjustable over the basic measuring range
■ smallest output range 10 % O_2
■ data sheet specifications are valid for the basic measuring range and factory ordered output ranges*
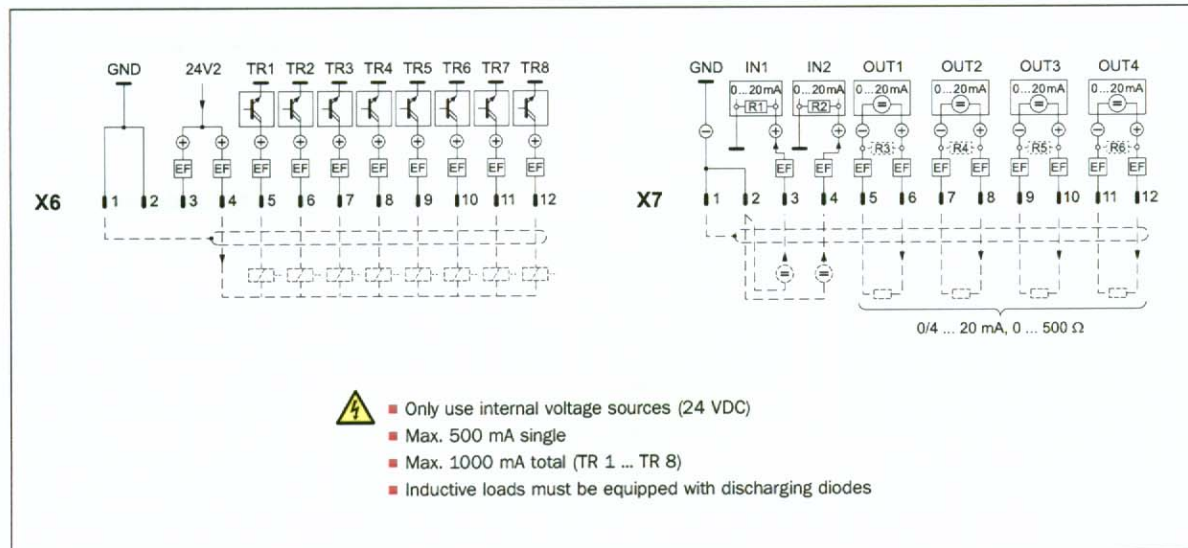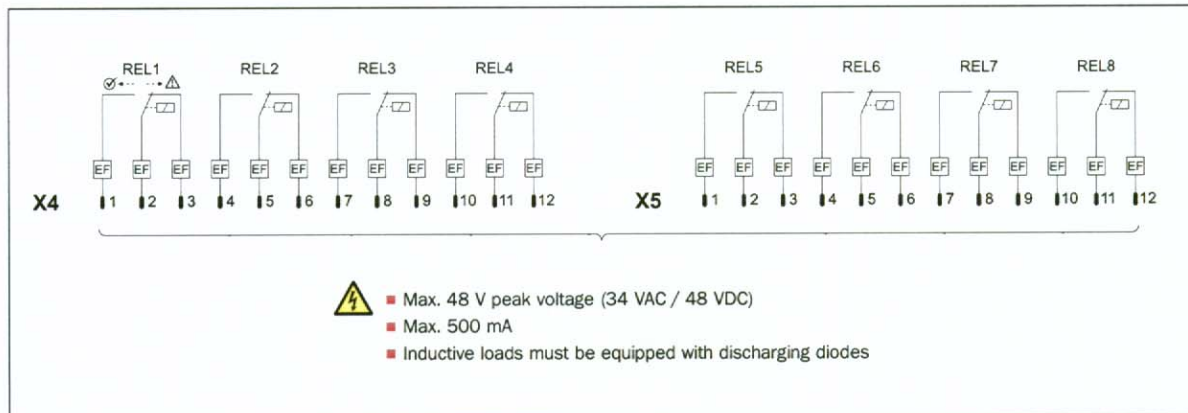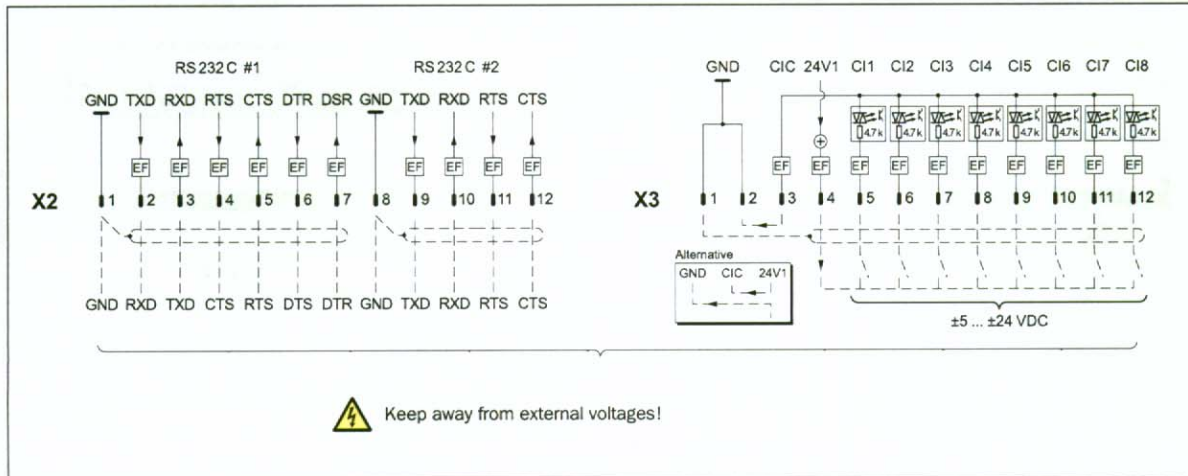
General Data

Materials in contact with sample gas ■ corrosion-resistant in Viton B, PVDF, stst 1.4571

Certifications (TÜV)

13. BImSchV / ■ 0 ... 25 Vol% O_2
17. BImSchV
27. BImSchV
TA Luft

X2

RS 232 C #1   RS 232 C #2

GND TXD RXD RTS CTS DTR DSR GND TXD RXD RTS CTS

EF EF EF EF EF EF EF EF EF EF

1 2 3 4 5 6 7 8 9 10 11 12

GND RXD TXD CTS RTS DTS DTR GND TXD RXD RTS CTS

X3

GND CIC 24V1 CI1 CI2 CI3 CI4 CI5 CI6 CI7 CI8

4.7k 4.7k 4.7k 4.7k 4.7k 4.7k 4.7k 4.7k

EF EF EF EF EF EF EF EF EF EF

1 2 3 4 5 6 7 8 9 10 11 12

Alternative
GND CIC 24V1

±5 ... ±24 VDC

⚡ Keep away from external voltages!

X4

REL1   REL2   REL3   REL4

EF EF EF EF EF EF EF EF EF EF EF EF

1 2 3 4 5 6 7 8 9 10 11 12

X5

REL5   REL6   REL7   REL8

EF EF EF EF EF EF EF EF EF EF EF EF

1 2 3 4 5 6 7 8 9 10 11 12

⚡ ■ Max. 48 V peak voltage (34 VAC / 48 VDC)
■ Max. 500 mA
■ Inductive loads must be equipped with discharging diodes

X6

GND   24V2   TR1 TR2 TR3 TR4 TR5 TR6 TR7 TR8

EF EF EF EF EF EF EF EF EF EF

1 2 3 4 5 6 7 8 9 10 11 12

X7

GND   IN1   IN2   OUT1   OUT2   OUT3   OUT4

0...20mA 0...20mA 0...20mA 0...20mA 0...20mA 0...20mA

R1 R2 R3 R4 R5 R6

EF EF EF EF EF EF EF EF EF EF

1 2 3 4 5 6 7 8 9 10 11 12

0/4 ... 20 mA, 0 ... 500 Ω

⚡ ■ Only use internal voltage sources (24 VDC)
■ Max. 500 mA single
■ Max. 1000 mA total (TR 1 ... TR 8)
■ Inductive loads must be equipped with discharging diodes

S 710

S 711
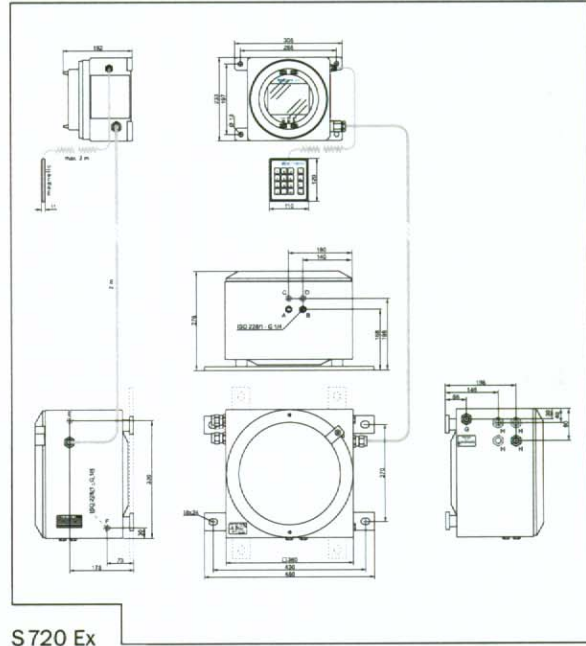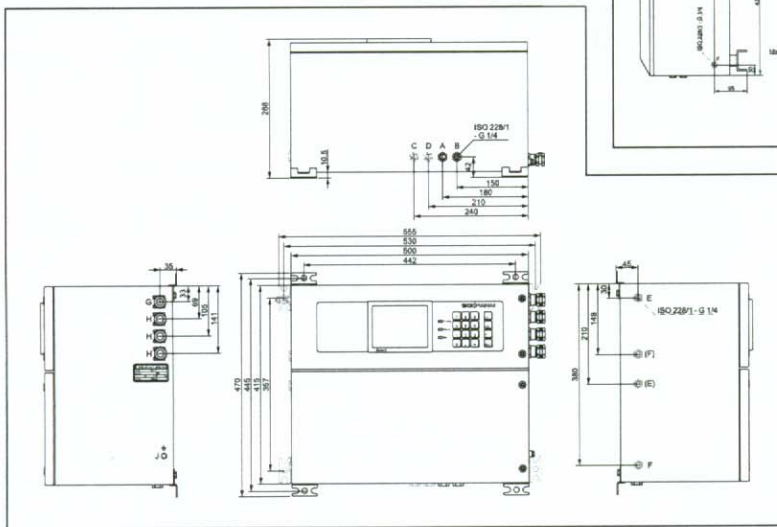
S 710

S 720 Ex
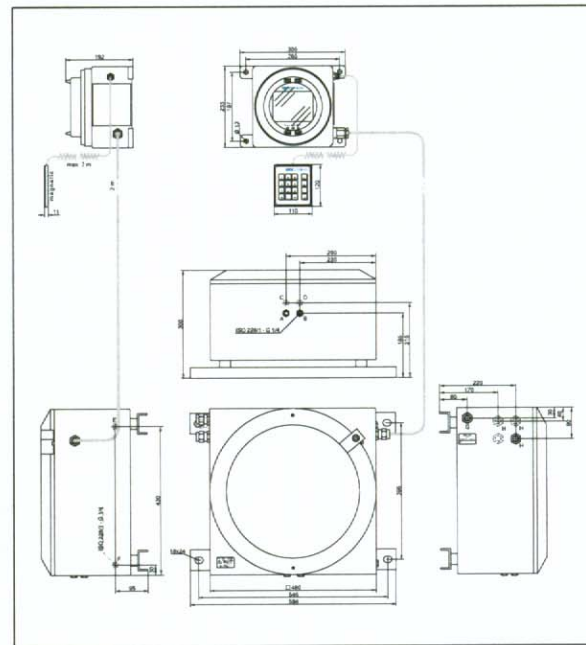
A   measuring gas entry
B   measuring gas outlet
C   Sample 2
D   Sample 3
E   purge gas entry
F   purge gas outlet
G   power cable
H   signal/status cable
J   without function

S 715

S 721 Ex

The dialogue continues.

Copy, complete and fax to +49 7641-4 69 11 49

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Phone/Fax	
Industry/Field of Application	

PI 2.03 en

Yes, I would like to know more about the field of:

☐ I would like a detailed consultation with one of your project advisors. Please arrange a meeting for me.

☐ Process gas analysis
☐ Flue gas monitoring
☐ Emission monitoring
☐ Dust measurement
☐ Volume flow measurement
☐ Data acquisition and evaluation
☐ Water analysis
☐ Liquid analysis
☐ Level measurement
☐ Tunnel sensors
☐ Special measuring technology

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