ENOTEC
GAS SENSING SOLUTIONS SINCE 1980

Installation and Operation Manual

O_2 and water vapor analyzer system

AQUATEC® 1000

Version 04
for Software Version: 4.10

ENOTEC REMOTE

Doc.-ID: AQUA_16012020_EN

ENOTEC
GAS SENSING SOLUTIONS SINCE 1980

Preface

Dear Customer,

For many years now, our AQUATEC® 1000 oxygen and water vapor analyzer systems have been operating in numerous applications with many thousand units being produced and shipped around the world. ENOTEC are committed to total quality and performance and we have continuously enhanced our products to integrate various additional features and functions. In this package, the electronic unit uses the very latest Microprocessor Technology permitting you to reduce your maintenance & fuel costs, and to achieve increased measuring accuracy with more operational reliability using these monitoring functions.

In our oxygen measuring probes you will find that the Zirconium Oxide measuring cell is soldered in place using a special process and technique developed by our company. This results in a considerably increased service life compared to "glued or cemented" measuring cells, which have a tendency to leak or crack during operation. The Zirconium Oxide measuring cell has a proven gas-tight design, providing greater measuring accuracy, durability and longer working life.

All ENOTEC instruments are thoroughly tested in the factory and are subject to a strict ISO 9001 Quality Assurance procedure. Therefore, with the correct installation, the operation of the AQUATEC® 1000 oxygen and water vapor analyzer system is very easy and user friendly and will provide you with many years of operation with perfect measuring results.

Symbols used in this Manual

All symbols listed beneath, attached to the analyzer or noted in this manual show important information as well as safety instructions for installation, operation and maintenance, to protect the personnel and the equipment.

	**Warning** Follow all instructions of this manual
	**Warning hot Surface** Warns of danger of burns which could occur from hot system parts
	**Caution** Warns of risks of destroying the system or its components or its functionality

	**Consider Information** Points out important information which must be considered before execution
	**Note** Contains further detailed information
	Ground earth electrical protection

Safety Instructions

The System is operated with line voltage. After removal of terminal covers some parts of this system may be accessible which are under high line voltage.

Only well trained and authorized personnel are allowed to work on this system. The personnel must know and understand all precautions, safety instructions, installation and maintenance instructions of this manual. The trouble free and safe operation of the system requires safe transportation, professional storage, installation, operation and maintenance.

Furthermore all local safety requirements at the point of installation and operation must be considered.

This analyzer may not be used to measure oxygen in combustible gases or in an environment with combustible gases. Parts of this system may cause an explosion risk.

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1 System Description

1.1 System Overview

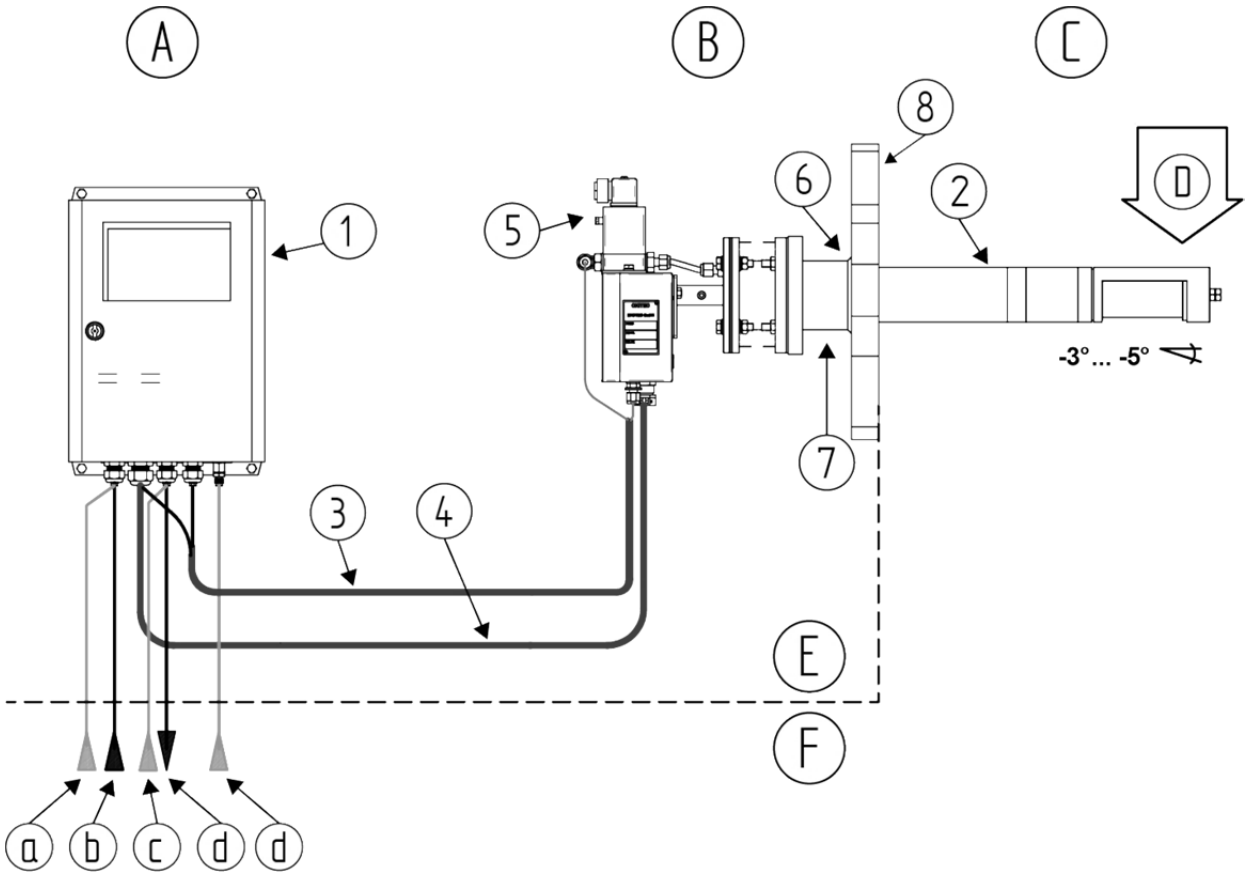


Figure 1 - AQUATEC 1000 analyzer system with active carbon filter

1	Electronic unit SME5 / IP66
2	In-situ measuring probe / IP65
3	Pneumatic cable
4	O_2 probe signal cable
5	Solenoid valve (Optional)
6	Counter flange (Optional)
7	Isolation: Customer
8	Duct wall

A	Safe Area - Max. ambient temp.:-20°C to +55°C (-4°F to + 131°F)
B	Safe Area - Max. ambient temp.:-20°C to +80°C (-4°F to + 167°F)
C	Process
D	Process gas direction – max. flue gas temp. 200 °C (392 °F)
E	Manufacturer supply
F	Customer supply
a	Test gas in
b	Power supply
c	Instrument air in *(Reference air in for pump systems)*
d	Output signals *(analog and digital)*
e	Test air in *(only for pump systems)*

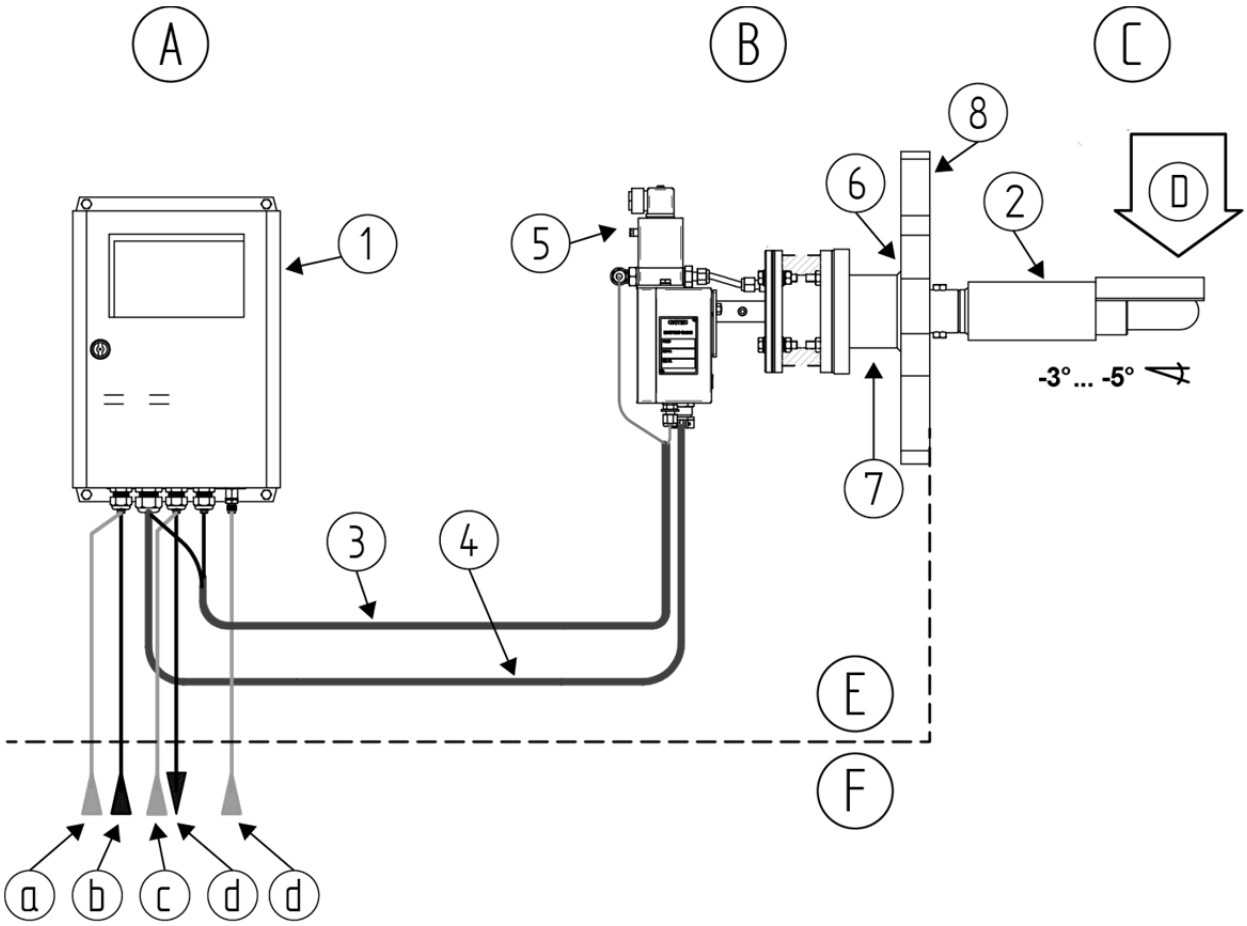


Figure 2 - AQUATEC 1000 analyzer system with standard filter

1	Electronic unit SME5 / IP66
2	In-situ measuring probe / IP65
3	Pneumatic cable
4	O_2 probe signal cable
5	Solenoid valve (Optional)
6	Counter flange (Optional)
7	Isolation: Customer
8	Duct wall

A	Safe Area - Max. ambient temp.:-20°C to +55°C (-4°F to + 131°F)
B	Safe Area - Max. ambient temp.:-20°C to +80°C (-4°F to + 167°F)
C	Process
D	Process gas direction – max. flue gas temp. 400 °C (752 °F)
E	Manufacturer supply
F	Customer supply
a	Test gas in
b	Power supply
c	Instrument air in *(Reference air in for pump systems)*
d	Output signals *(analog and digital)*
e	Test air in *(only for pump systems)*

1.2 Measuring Principle

The AQUATEC® 1000 O_2 / H_2O analyzer system consists of an in-situ probe which is installed in a process to measure non-combustible process gases and of an electronic unit for voltage and gas supply, as well as for signal processing.

The oxygen sensor is at the tip of the probe and is regulated to 800 °C and works on the zirconium oxide principle of measurement. Here, a mV signal between the reference gas side of the sensor (inside, instrument air 20.95% O2) and the measured gas side is measured, which depends logarithmically on the ratio of oxygen partial pressures on both sides of the sensor.

The mV signal is converted according to the Nernst equation into oxygen partial pressure within the process gas, whereby the O_2 concentration is determined in the process gas. Gas-tight separation of reference air and process gas is of particular importance.

1.3 Measuring Principle Water Vapor

The AQUATEC 1000 does not measure water vapor directly, but calculates it using the measured oxygen content. The water vapor concentration is proportional to the quantity of the displaced oxygen.

The formula for water vapor evaluation is represented as follows (see chapter 3.9 for details):

$$\frac{O_2 \text{ reference value (dry)} - O_2 \text{ measured value}}{O_2 \text{ reference value (dry)}} \times 100 \text{ vol. \%}$$

1.4 Intended use

Info

The AQUATEC® 1000 analyzer system is a system for measuring the oxygen (O_2) concentration in non-combustible process gases and to calculate the water vapor content (H_2O) using the oxygen concentration.

Warning

The system cannot be used to determine the oxygen concentration of combustible gases or in a location where combustible gases are present as the measuring cell temperature of 800°C could present an explosion hazard!

Info

The minimum concentration of O_2 in flue gas should under normal process conditions, not be less than 0,5%.
If the O_2 concentration is regularly below 0,5%, we recommend the option of **CSP (Cell Surface Protection)** to protect the O_2 sensor.

Caution

Under no circumstance should the measuring probe be directly connected to the 230V main power supply, as this will immediately destroy the probe heater element!

1.5 Safety Hazards

Warning hot surface

During operation, the temperature of the probe filter head and of other parts exposed to flue gas is 150°C - 800°C (302°F - 1472°F). Direct contact with the hot parts when dismantling or maintenance will cause severe burns!

The probe may only be removed with heat-insulated gloves. Before removing the probe, always switch off the supply voltage of the electronic system. After removal, store the probe in a safe, protected place and wait until it has cooled down below 35°C (95°F).

1.6 Disruption of the Process

The analyzer system has to be kept in operation also in the event of the process being disrupted or if the plant is powered off temporarily (e.g. at night or during the weekend). Frequently cooling down and heating up of the probe results in thermal stress of the hot probe parts (heater, thermocouple and sensor) and reduces their product life. ENOTEC will not accept any responsibility for resultant damage.

1.7 Storage instructions

ENOTEC equipment is to be stored in a dry and ventilated environment. Paint fumes, silicone sprays, etc. must be avoided in the storage environment.

1.8 Name Plates

The name plate contains information about the line voltage, the nominated current, frequency, protection class, year of manufacture, serial number, order number and system order code..

The system order code refers to information which is detailed in the system test report and supplied with the system.

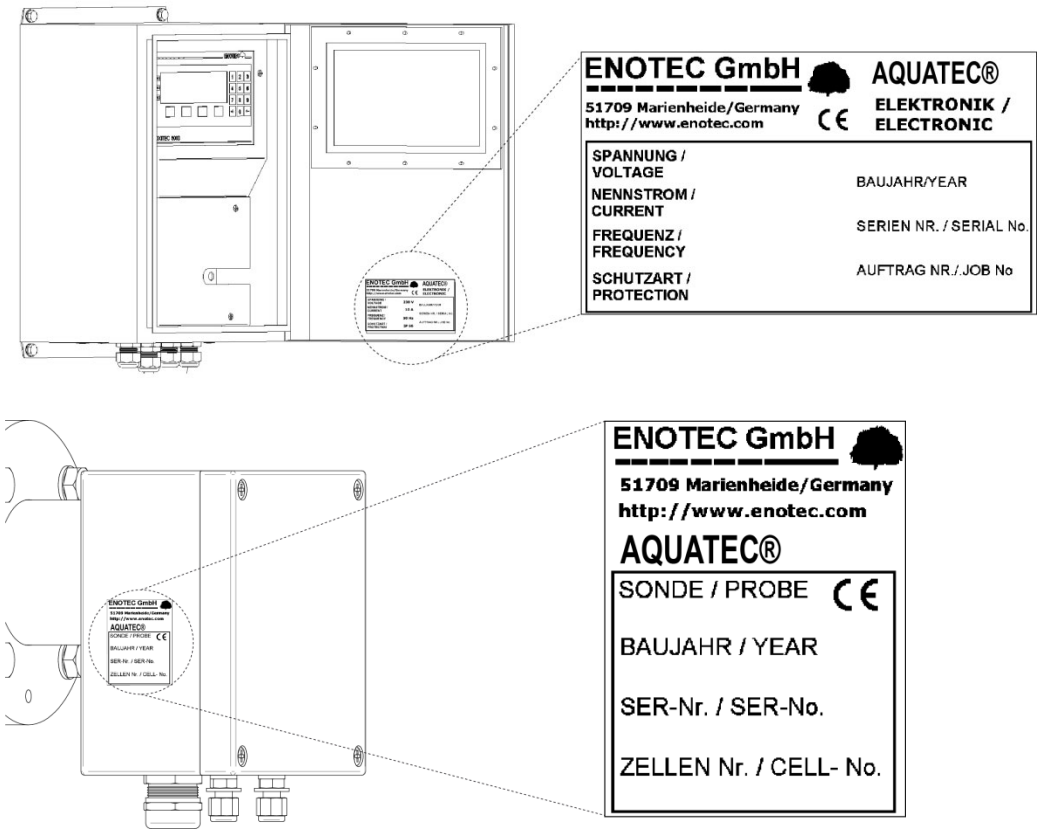


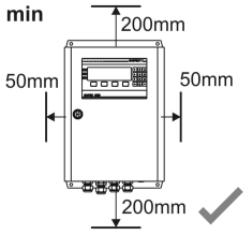
Figure 3 - Position of the name plates

2 Installation

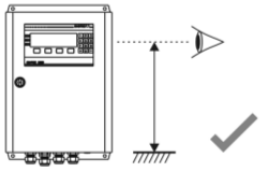
Warning

The system is not equipped with an external power-off switch. The line voltage switch/fuse/breaker must be installed and be in accordance with local technical standards and should be near to the electronic unit and must be clearly marked as such. The probe cable is suitable for an ambient temperature range from -40°C to +90°C. All other installed cables must be suitable for the ambient temperature range at side and must have the required size. All electronic unit terminals are specified from 0,08 mm² (AWG 26) to 2,5 mm² (AWG 14). If wire end ferrules are used the next smaller size is required. Before removal of the electronic terminal cover the line voltage must be switched off. The line voltage to the electronic unit must be switched on again after the cover is back in position. After installation power conducting parts may not be accessible.

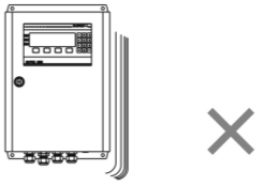
2.1 Installation Requirements for Electronic Unit



Keep the minimum distance to adjacent objects

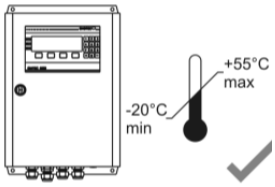


Install at eye level



Avoid vibrations greater than 2g

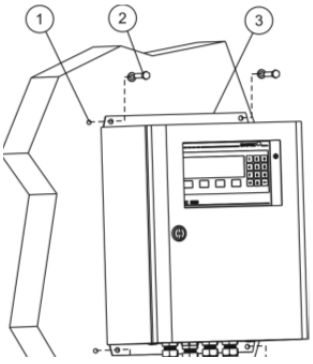
Mind the IP code



Heavy equipment, ensure proper lifting and carrying

Ambient temperatures

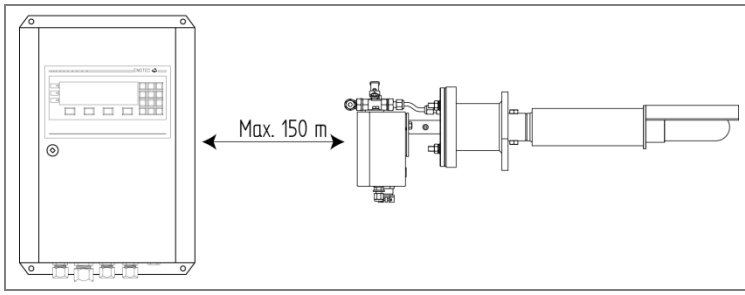
Min.: -20 °C (-4 °F) / Max.: +55 °C (+131 °F) - (Pump version -20 °C to +50 °C)



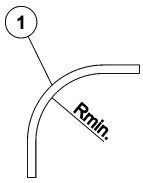
1	Drill holes for the electronic unit
2	Use suitable screws
3	Electronic unit

Figure 4 - Installation of the Electronic unit

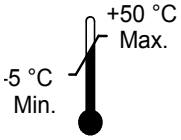
2.2 Installation of Probe Signal Cable FEP-0001



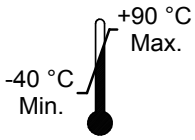
Abide by the maximum cable length (max. 150m)



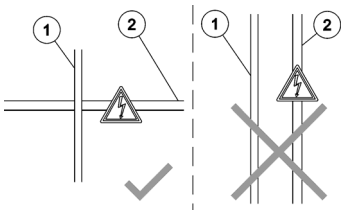
Note the minimum bending radius.
FEP-0001 ➔R_{min} = 96 mm



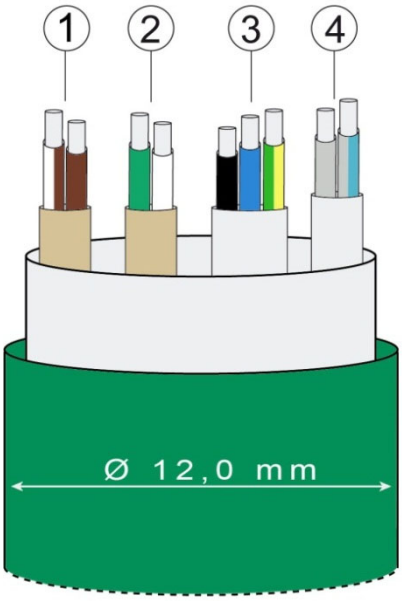
Temp. during installation



Temp. during operation



Cross the probe signal cable (1) (FEP-0001) at right angle to power supply cables (2)



Probe Cable FEP-0001 (FEP-0004 armored version)				
No.	**Function**	**Diameter**	**Colors**	**Additional info.**
(1)	Measuring cell	2 x 0,75 mm^2	white-brown / brown	With shield
(2)	Thermocouple	2 x 0,75 mm^2	green / white	With shield
(3)	Probe heating	3 x 1,5 mm^2	black / blue / green-yellow	
(4)	Solenoid valve	2 x 0,75 mm^2	grey / grey-blue	

Figure 5 - Probe cable FEP-0001

Caution

The shield of the probe cable must only be connected at the electronic housing at the PE terminal. Under no circumstance should the shield also be connected at the probe.

2.3 Access to the Terminals

Warning

Before removing the terminal covers, switch off the mains voltage to the system. Switch the mains voltage on only after attaching the terminal cover. After the installation has been completed, live parts may no longer be accessible.

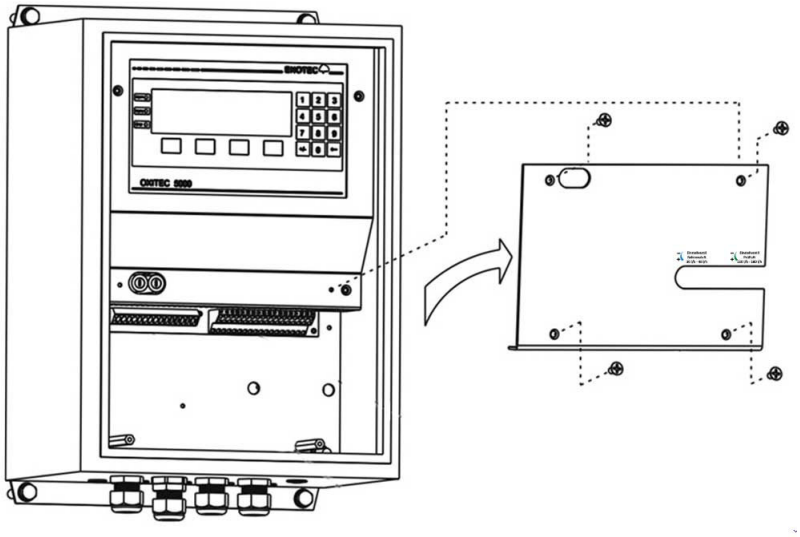


Figure 6 - Access to the Terminals

2.4 Ferrite Sleeves (EMC)

Caution

In order to avoid cable related disturbances to the electronic unit, the supplied ferrite sleeves must be used.
CE-conformity is invalid if these ferrite sleeves are not fitted!

2.5 Wiring Diagram of the Electronic Unit

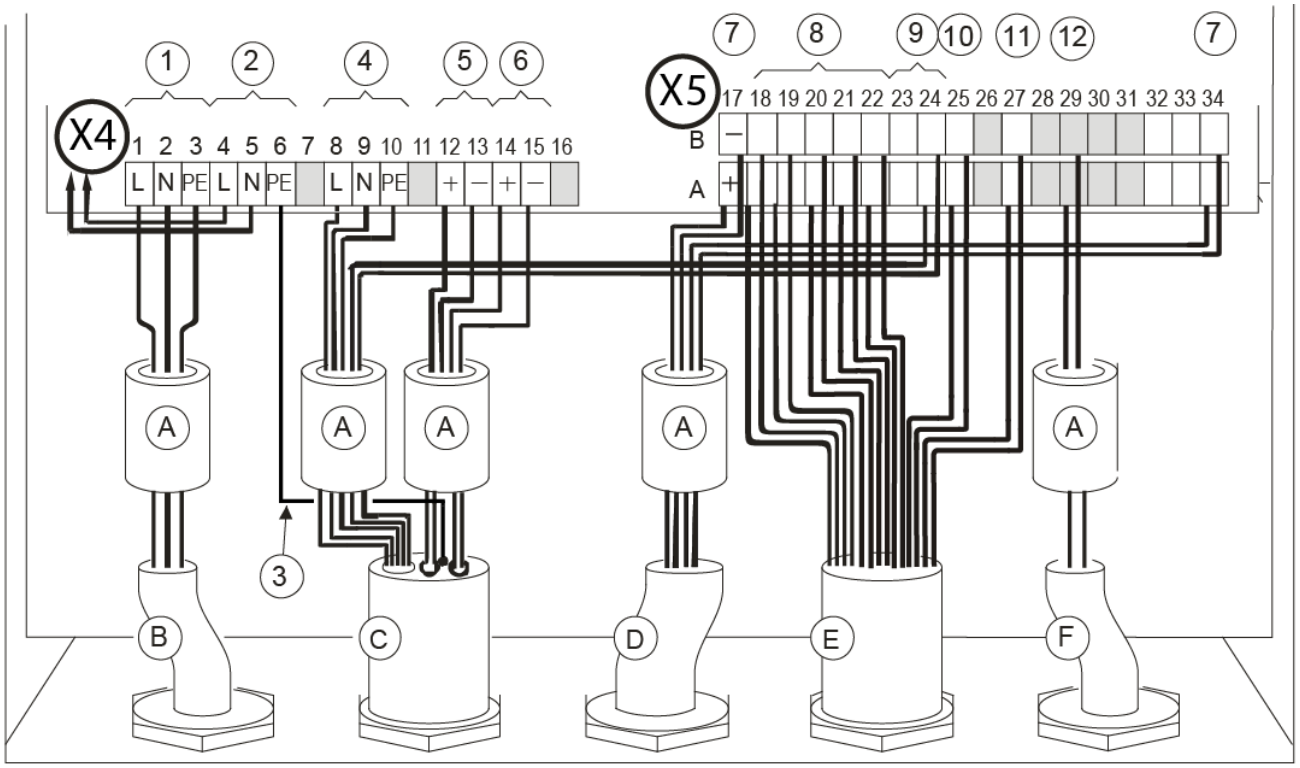


Figure 7- Wiring diagram of the Electronic Unit

(A) Ferrite sleeves (Enclosed)

(B) Power supply cable (customer)

(C) Probe signal cable

(1) **Internal Power supply**

1	L	phase
2	N	neutral wire
3	PE	grounding conductor

(2) **Internal Power supply** [1]

4	L	phase
5	N	neutral wire
6	PE	grounding conductor

(3) **Shielding**

(4) **Power supply probe heater (115V)**

8	L	black
9	N	blue
10	PE	green/yellow

(5) **O_2-sensor signal**

12	+	brown
13	-	brown/white

(6) **Thermocouple (O_2 sensor)**

14	+	green
15	-	white

(7) **Analogue outputs (active 4-20mA)**

17A	+	O_2
17B	-	O_2
34A	+	H_2O
34B	-	H_2O

(D) Analogue output cable (customer)

(E) Status signal cable (customer)

(F) Pressure transmitter analogue input cable (customer)

(8) **Relay contacts for status signals - Potential free**

18 A/B	Maintenance
19 A/B	System Error
20 A/B	Output A O_2 measuring range
21 A/B	O_2 Limit Alarm 1
22 A/B	O_2 Limit Alarm 2

(9) **Probe solenoid valve**

23 A 23 B	Internal Power supply for probe solenoid valve (115VAC)	
24A	L	grey
24B	N	grey/blue

(10) **Measuring Range O_2 (12..24V DC- External supply)**

25A	+
25B	-

(11) **Calibration release (12..24V DC - External supply)**

27A	+
27B	-

(12) **Input Process pressure (passive 4-20mA)**

29A	+
29B	-

[1] The output voltage of these contacts (4…6) always have the same voltage as on the power supply input on contacts (1…3)

2.6 AQUATEC® 1000 Wiring diagram

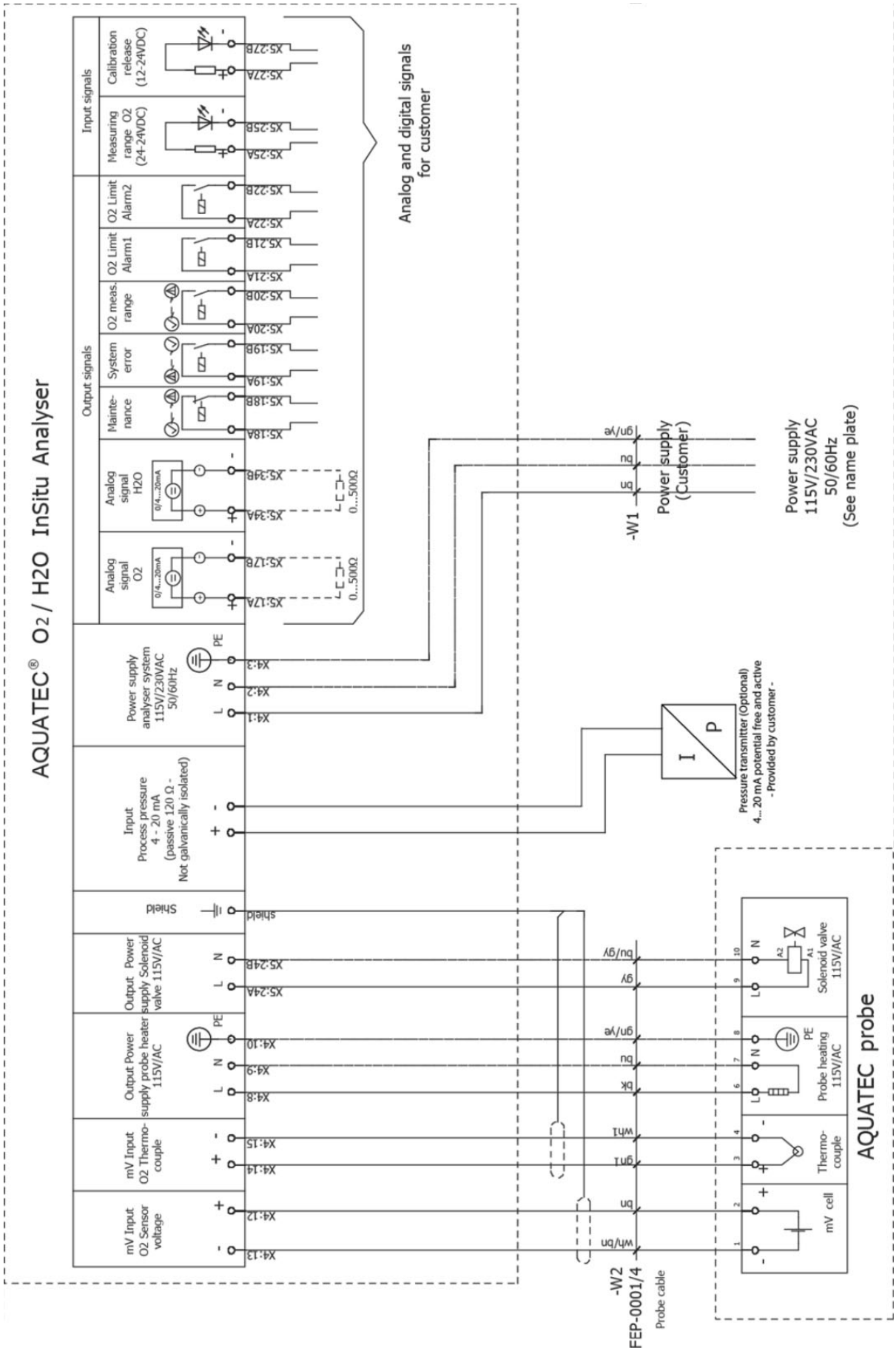
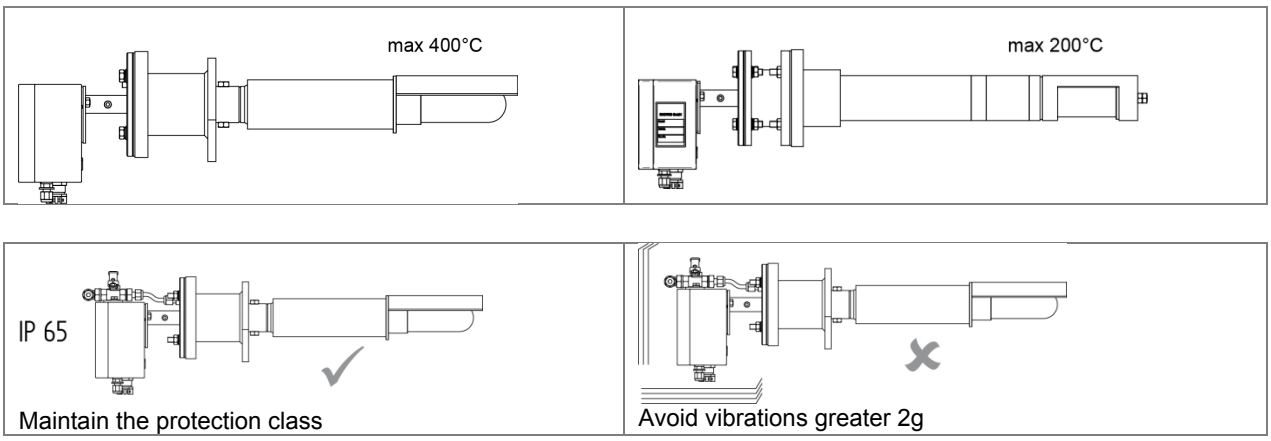


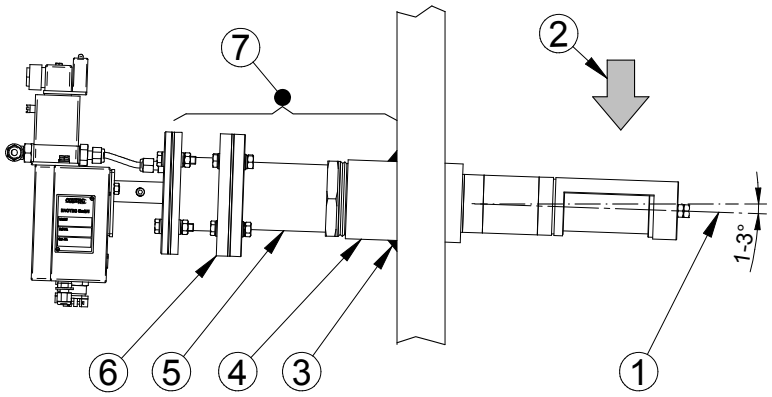
Figure 8 - Wiring diagram of the AQUATEC 1000 Analyzer system

2.7 Installation of the probe

The flue gas temperature, pressure and all other process conditions must be in accordance with the specification. Leave enough space for insertion/removal of the probe and protection tube (if supplied) and ensure access to the measuring probe and/or connecting box. Before cutting a hole in the flue gas duct, make sure that the inside of the duct has enough space for probe installation and that no soot is blown out nearby or any obstacles are in the way. For probe lengths exceeding 2000 mm, a support must be mounted inside the duct (every 2m) to prevent the probe and mounting tube from flexing or bending. **ENOTEC recommends installing the probe horizontally for the fastest possible response time.**



2.8 Mounting of the Probe



1. The mating flange must be welded at the specified angle
2. Process gas flow
3. The welded seam must be gas-tight
4. Adapter (supplied by customer)
5. Stainless steel adapter with R2½"-thread
6. AQUATEC – Probe
7. Insulation

Figure 9 - Mounting the KES 132x with filter head KES-132060AK and adapter plate ASR-1320-KN

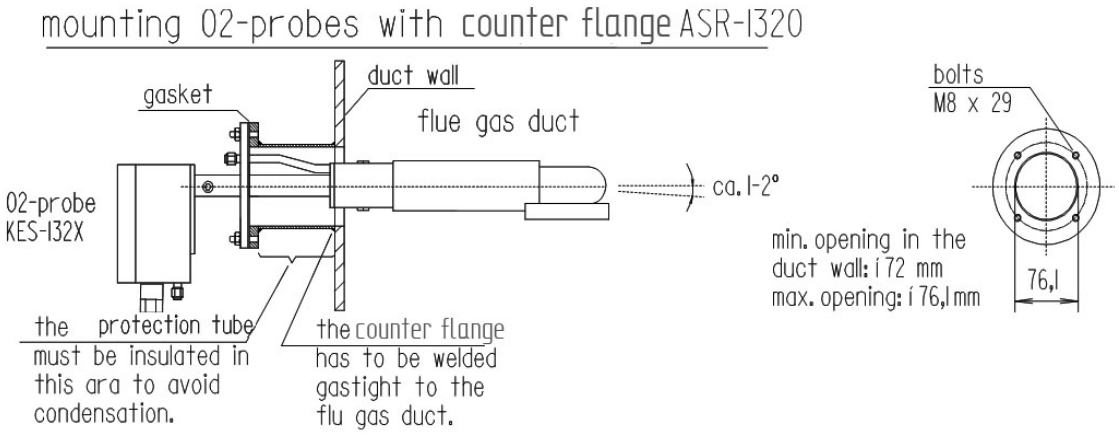
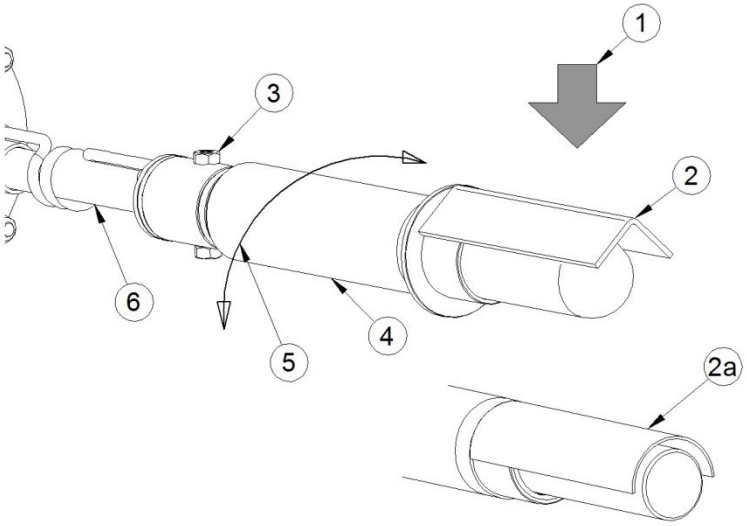


Figure 10 - Mounting of the O_2 probe KES-132x with ASR-1320

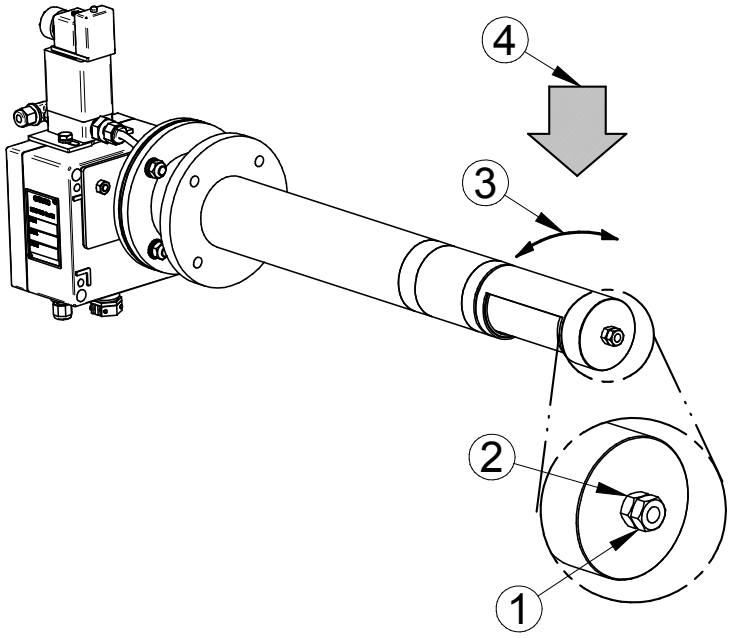
2.9 Adjusting the V-shield / filter head

Before installing the probe, **the direction of flue gas flow must be determined** and the filter head assembly turned to such a position that the V-shield faces the oncoming flue gas. The filter head can be turned freely a full 360° for this purpose, by loosening the counter nut, loosening the Allen screw and rotating the filter head / V-shield to the required position, and then tightening the Allen screw and counter nut.



①	Flue gas direction
②	V-shield (KES-132X/KES-200X)
②a	V-shield (KES500X)
③	Screws to secure filter head
④	Filter head
⑤	Rotation of filter head
⑥	Probe

Figure 11 - Adjustment of the V-shield



Loosen the locknut ①

Loosen the locknut ②

Adjust the filter head.③ Adjust the position of the shield against the flow direction④

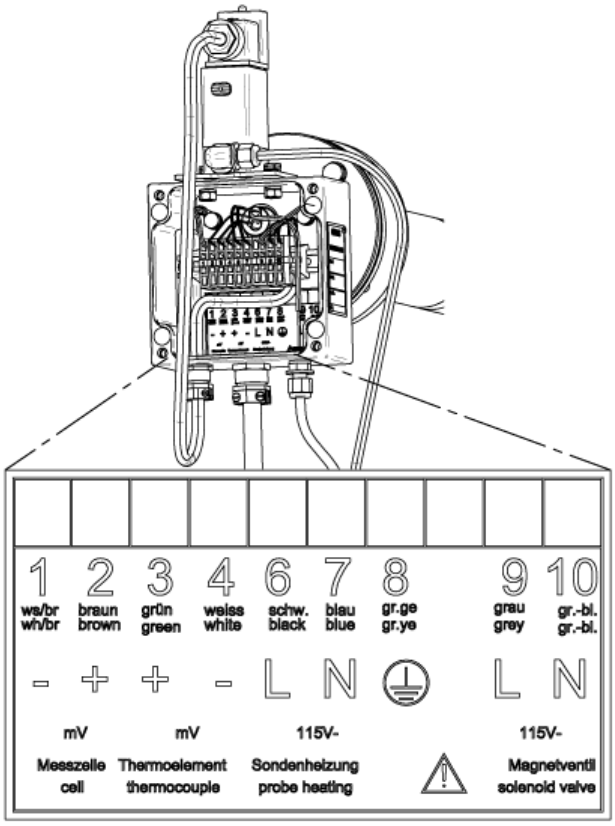
Tighten the locknut②

Tighten the locknut ①

Figure 12 - Adjustment the fitter head

2.10 Electrical Connections of the Probe

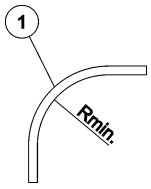
	Info The probe cable (FEP-0001) has to be connected to the terminal board in the probe terminal box. **Please do not attach the shield to the probe**.

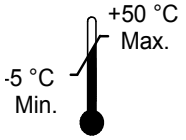
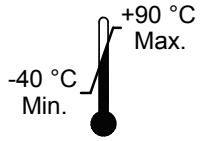


1 : - mV O_2 sensor (white-brown)
2 : + mV O_2 sensor (brown)
3 : + mV thermocouple 1 (green)
4 : - mV thermocouple 1 (white)
6 : L 115VAC heater (black)
7 : N 115VAC heater (blue)
8 : PE Protection earth (green yellow)
9 : L 115VAC solenoid valve (grey)
10: N115VAC solenoid valve (grey-blue)

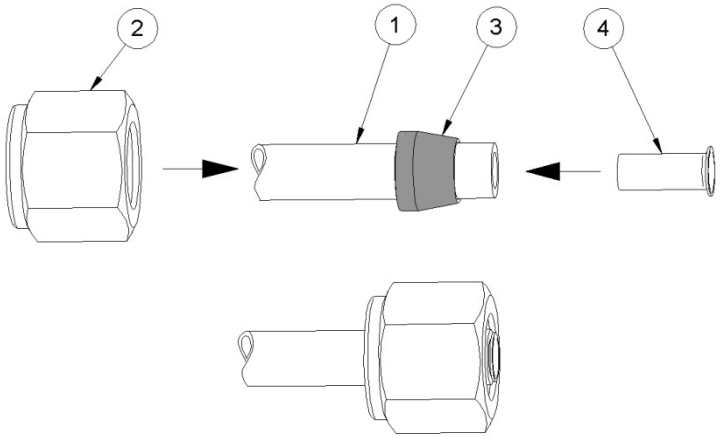
Figure 13 - Electrical Connections of the Probe connections box

2.11 Requirements for Pneumatic Cable FEP-0002

	Note the minimum bending radius. FEP-0002➔R_{min} = 138 mm

 Temp. during installation	 Temp. during operation

2.12 Preparation of the pneumatic Cable



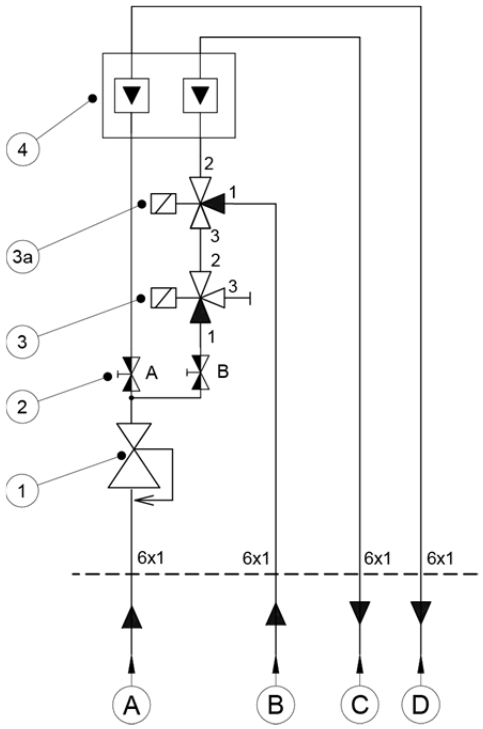
1	Pneumatic tubing FEP-0002
2	Nut
3	Clamp ring
4	Support sleeve

Both, the pneumatic tubing for the reference air (blue) and the test gas (green) have to be prepared with support sleeves (4), clamp rings (3) and nuts (2).

Figure 14 - Preparation of pneumatic tubes

2.13 Gas plans

Pneumatic version for Instrument air
SME-50000010



Pneumatic version with pumps
SME-50000020

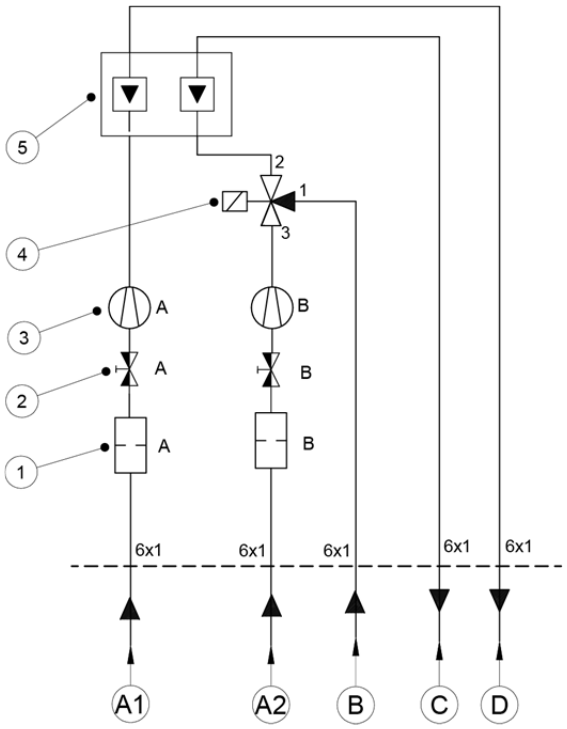
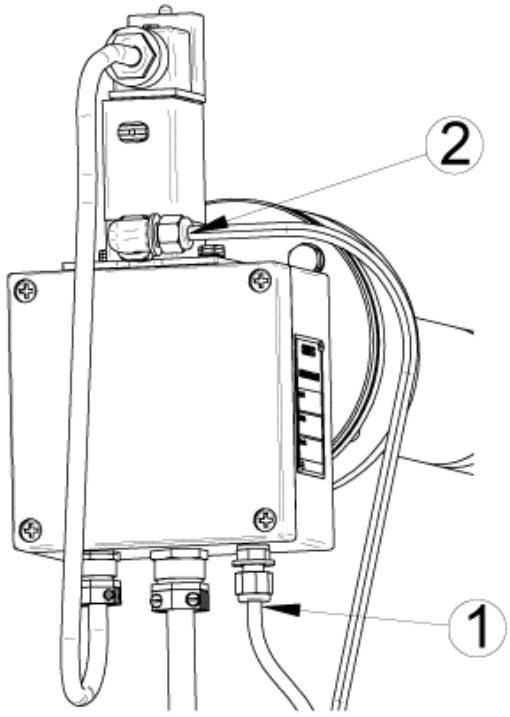


Figure 15 - Gas plans

1	Pressure control valve
2	Choke non return valve
3	Solenoid valve 3/2 ways
3a	Solenoid valve 3/2 ways
4	Flow meter
A	Instrument air in, 4 – 10 Bar
B	Test gas in, Max. 3 Bar
C	Test gas out, 150 - 180 l/h
D	Reference air out, 30 – 40 l/h

1	Filter
2	Choke non return valve
3	Reference air pump / Test air pump
4	Solenoid valve 3/2 ways
5	Flow meter
A1	Reference air in
A2	Test air in
B	Test gas in
C	Test gas out, 150 - 180 l/h
D	Reference air out

2.14 Pneumatic Connections of the Probe



①	**Reference air** in (FEP-0002: blue tube)
②	**Test gas** in (FEP-0002: green tube)

Figure 16 - Pneumatic connections of the probe

2.15 Pneumatic Connections of the Electronic Unit

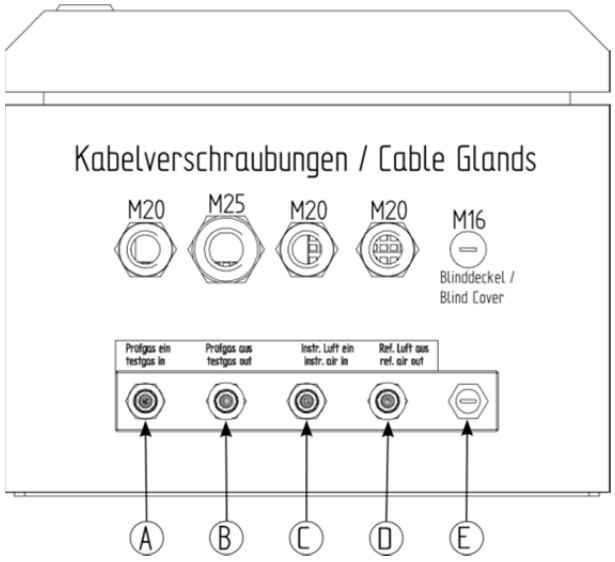


Figure 17 - Bottom view of SME-53 with integrated pneumatic unit

Nr.	Tube	Pump version	Instrument air version
Ⓐ	1/4“	Testgas in	Testgas in
Ⓑ	1/4“	Testgas out	Testgas out
Ⓒ	1/4“	Reference air input	Instrument air in
Ⓓ	1/4“	Reference air output	Reference air out
Ⓔ	1/4“	Test air input	

3 Initial Operation

3.1 Checklist before commissioning the system

- Is the system number of the probe identical to the system number of the electronic unit? If not, change the assignment.
- Does the voltage specified on the name plate correspond to the line voltage? (See section **1.8 *Name Plates***)

If not, contact ENOTEC.

- Is the electrical wiring connected correctly? (See section **2.6 *AQUATEC 1000 Wiring Diagram***)
- Are the pneumatic connections correct and gas tight? (See sections **2.15 *Pneumatic Connections***)
- Make sure that there are no leakages at the probe - e.g. is the counter flange welded gas tight to the duct and are the flange bolts tightened sufficiently? Are gaskets in use? (See section **2.8 *mounting of the Probe***)
- Do the conditions at site match the specification in the data sheets? (See section **A *Technical Data***)
- Has the O2 reference value been entered into the system? (See section **3.9**)

3.2 System Power Up

Switch on the line voltage to the system. After a short power up information, the user is prompted to **Select language**, set the **System date** and **System time**.

The probe heating phase now begins which is followed by the measuring mode.

Figure 18 - System Power up. Note the software version at the bottom right of the display.

3.3 Display - Probe Heating Phase

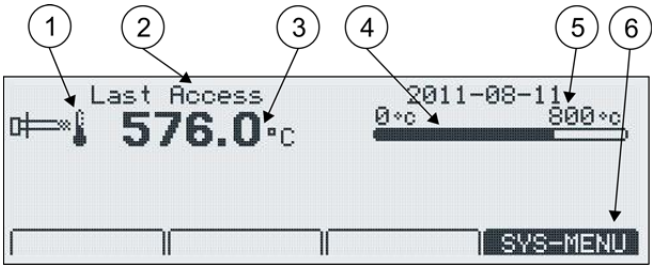
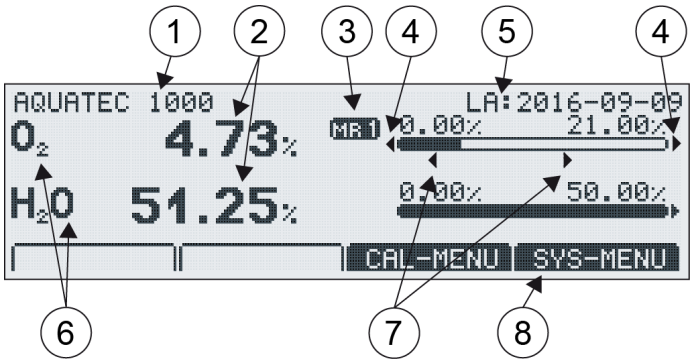


Figure 19 - O_2 sensor heating phase

The probe heating phase begins with the heating up of the O_2 sensor.

1		Rising probe temperature
		(or) waiting period
		(or) heater error
2	Last access with corresponding date	
3	Current temperature	
4	Analogue temperature bar	
5	Set point probe temperature	
6	Softkey title: e.g. System menu	

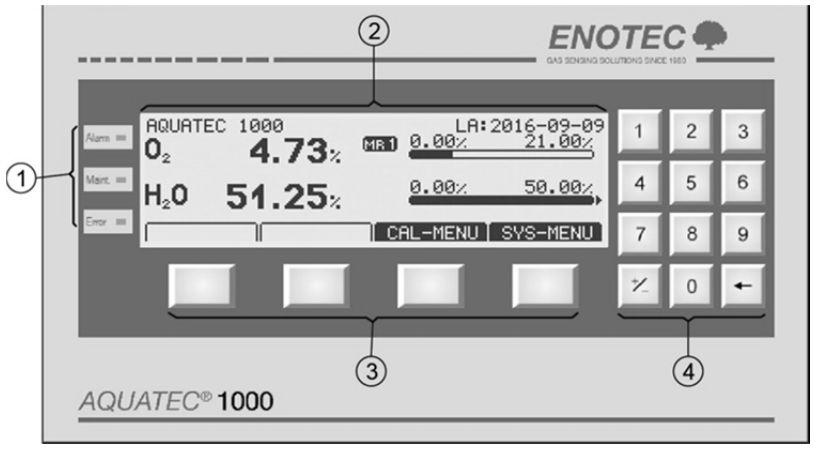
3.4 Display - Measuring Mode



1. Measured component
2. Measured value
3. Active measuring range
4. Blinking indicators showing under or over measuring range
5. Analogue bar showing measured value and measuring range start and end
6. Softkey titles

Figure 20 - Measuring mode

3.5 Keypad and Display

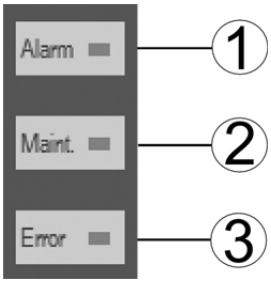


The controls and display of the AQUATEC 1000 are housed in the electronic unit and are comprised of:

1. Three LED indicators depicting active status
   reports for limit alarms, maintenance and system faults
2. Graphic enabled, back-lit display
3. Four softkeys with varying layout (softkeys)
4. Numeric number bloc

Figure 21 - Keypad and display

3.6 Status LEDs



Alarm, - orange - is lit when an alarm has been activated (e.g. O_2 limit alarm)

Maint. - Orange - a function has been accessed which may affect the measurement

Error - red - is lit when a system error has occurred

3.7 Softkey Symbols

- Moves the selection one position upwards
- Moves the selection one position down-wards
- Leave an area
- Abort a function or entry
- Select or confirm a function/value

3.8 System Code

Info

The system code on delivery is 0000. In this state, entry into the system is granted without having to enter the system code. The system code protects the system from unauthorized use. Functions which may alter the measurement of O_2 are therefore also protected.

Caution: If the system code has been altered, it must be kept in a safe place!

3.9 Adjustment of the Analyzer to the Dryer

The water vapor is not measured directly, but is calculated using the measured oxygen content. The water vapor concentration is proportional to the quantity of the displaced oxygen. The water vapor is calculated using the measurement of the O_2 concentration.

The O_2 reference value (dry), which is necessary for this evaluation, is different for each dryer and process.

Before commissioning, the system must be adjusted to the dryer, of which moisture content is to be measured. This is carried out under:

SYS MENU -> System configuration -> H2O measuring range -> O2 reference value (dry).

4 Software Overview and Explanations

4.1 Menu Overview - SYS-MENU

SYS-MENU

- **System Information**
- **Actual measured values**
  - O_2 measured value (% O_2) {may be ppm}
  - O_2-mA output 17A/B (mA)
  - O_2 sensor input (mV)
  - H_2O measured value
  - H_2O mA output 34A/B
  - Flow rate reference air (l/h)
  - O_2 probe temperature (°C / °F)
  - O_2 probe heater power (%)
  - Thermocouple input (mV)
  - Terminal temperature (°C / °F)
  - Internal temperature (°C / °F)
  - Process pressure (rel) (mbar/psi)
  - O_2 sensor life (%)
  - Lambda
- **Calibration results**
  - e.g. 2012-05-11 (Choose date/time)
    - Executed at
    - Calibration method
    - O_2 sensor calibration
    - ~~ Calibration results ~~
    - O_2 value at test air (20,95 % O_2)
    - ♦ calibrated to (% O_2)
    - O_2 value at test gas (% O_2) } *only if determined*
    - ♦ calibrated to (% O_2)
    - ~~ Calibration data ~~
    - O_2 sensor offset (mV)
    - O_2 sensor slope (mV / dec) } *only 2 point calibration*
    - ~~ Test gas data ~~
    - Test air (20,95 % O_2)
    - Test gas (e.g. 2,1 % O_2)
    - ~~ Sensor raw data~~
    - O_2 voltage at test air (mV)
    - ♦ at pressure (mbar/psi)
    - O_2 voltage at test gas (mV) } *only if determined*
    - ♦ at pressure (mbar/psi)
    - O_2 response to test gas (s) } *only if determined*
    - O_2 response to process (s) } *only if determined*
    - O_2 sensor life

Device operating data
- Powers on counter
- Hours in operation
- Min. internal temperature
- Max. internal temperature

Software version and options
- Software AQUATEC 1000
- ~~ Options ~~
- ♦ .....

System configuration

O_2 Measuring ranges
- Meas.range 1 from (% O_2, ppm O_2)
- Meas.range 1 to (% O_2, ppm O_2)
- Meas.range 2 from (% O_2, ppm O_2)
- Meas.range 2 to (% O_2, ppm O_2)
- Meas.range select by (dig.input / keypad)
- Meas.value averaging for (s)
- Conversion wet → dry (% H_2O)
- mA output type (0-20 mA / 4-20 mA)
- mA output on system error (mA)

O_2 limit alarms
- O_2 limit alarm 1 (OFF/ON)
  - ♦ at
  - ♦ hysteresis

  } *visible when set to "ON"*
- O_2 limit alarm 2 (OFF/ON)
  - ♦ at
  - ♦ hysteresis

  } *visible when set to "ON"*

O_2 sensor calibration values
- O_2 cal.value - offset (mV)
- O_2 cal.value - slope (mV/dec)

H_2O measuring range
- Meas. Range from (% H_2O)
- Meas. Range to (% H_2O)
- Meas. Value averaging for (s)
- O2 reference value (dry) (20,95%)
- mA output on system errors (mA)

Calibration settings

Time per test gas apply (Min.)

Delay time to process (Min.)

Measurement value hold on calibration (ON/OFF)

Auto.calibration (ON/OFF)

- ♦ Calibration method (O_2 1-Point / 2-Point) } *visible when set to "ON"*
- ♦ Test gas (bottle value % O_2) { when preset to 2-point} } *visible when set to "ON"*
- ♦ Start by (Time, dig. Input, both) } *visible when set to "ON"*
  - ♦ Interval (days) } *not applicable with dig.input*
  - ♦ next ACAL at (set date)

Pressure compensation

Pressure input from (mbar)

Pressure input to (mbar)

Location altitude (m)

System date/time

System date (jjjj-mm-tt)

System time (hh:mm:ss)

TAG

ENOTEC REMOTE settings (optional) } *Visible when ENOTEC REMOTE interface is activated*

ENOTEC REMOTE (ON/OFF)

Passkey (8 digit code) } *Visible when ENOTEC REMOTE is ON*

Range (Short / Medium / Maximum)

Measuring units

Temperature (°C / °F)

Pressure (mbar / psi)

Language

Choose language (Deutsch / English / Spanish / Polish / French)

Change system code

Load factory settings

Service

4.2 Software Explanations - SYS-MENU

4.2.1 O_2 Measuring Ranges (Scaling)

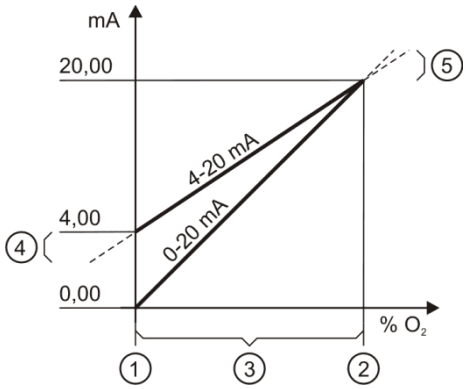


Figure 22 - O_2 Measuring Ranges

The O_2 Measuring range ③ is linearly scaled and converted to a linear current output (0/ 4-20 mA).

The parameter „O_2 Measuring range from“ ① is the start value of the O_2 range, leading to an analogue output of 4,00 mA.

„O_2 measuring range to“ ② is the end value of the O_2 range, leading to an output of 20,00 mA.

If a measured value is lower than the start value of the O_2 measuring range, the current output signal drops to 3,60 mA.

(If the current output is set to 0- 20 mA the output is 0 mA)

If the measured O_2 value is higher than the end value of the O_2 measuring range end, the analogue output rises to 20,40 mA.

If during normal operation the measured O_2 value is under, ④ or over ⑤ the programmed measuring range, an error message appears on the display (in measuring mode).

4.2.2 Measuring value averaging for

This entry sets the duration for the continuous average measurement (flowing average). During a calibration or sensor verification, the measurement average is not shown, though still active for the analogue output.

4.2.3 mA output on system errors

The mA output value for a system error is specified in range of 0 - 3,55 mA or 20,41 to 20,80 mA. The mA output value for a system error cannot be set in the mA measuring range.

4.2.4 O_2 limit alarm settings

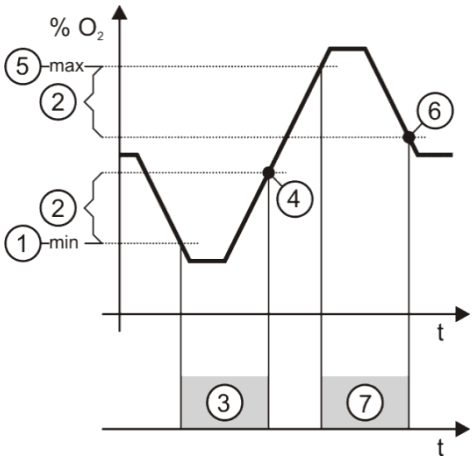


Figure 23 - O_2 limit alarm settings

The entry "by" sets the value at which the O_2 limit alarm is activated.

The O_2 limit alarm function "min" ① defines a value by which the limit alarm ③ is activated if the measured O_2 value falls below the set limit.

If the hysteresis is set to greater than 0,00, ②
the limit alarm is reset when the measured O_2 value rises above the set O_2 limit plus the hysteresis value ④.

The O_2 limit alarm function "max" ⑤ defines a value by which the limit alarm ⑦ is activated if the measured O_2 value rises above the limit.

If the hysteresis is set to greater than 0,00, ②
the limit alarm is reset when the measured O_2 value falls below the O_2 limit minus the hysteresis value. ⑥
If the hysteresis is set to 0,00 % O_2, the triggered limit alarm must be manually reset.

4.2.5 O_2 Sensor calibration values

	**Info** The sensor calibration values can be altered through a 1 or 2 point calibration. Manual entry of values is only necessary after replacing the O_2 sensor. (The sensor calibration values, "cell constant" and "cell slope" can be found on the probe test protocol for new probes.)

4.2.6 Time per test gas apply

Here the maximum duration of time for the application of test gas or test air is set. If sensor stability is not reached within the maximum time, the following error message is displayed: "**O_2 Sensor calibration failed - O_2 sensor signal instable**" This problem can be offset by setting a longer duration. The factory setting for maximal duration is 10 Minutes. If necessary, the time can be adjusted between 5 minutes and 30 minutes.

4.2.7 Delay time to process

Here the delay time showing the last measured O_2 value from the data storage is frozen after test air or test gas has been applied (only when "Meas. value hold on cal. is set to on) This value also sets the time for showing the trend representation on the display after test air or test gas application after a sensor calibration is set.

4.2.8 Automatic Calibration (ACAL)

Automatic calibration enables a cyclic, time-based or remote controlled calibration (using the digital input) of the O_2 sensor. The ACAL can be globally switched on or off and can only be started from the main screen of the display.

When a 2 Point ACAL is set, a test gas bottle must be permanently connected and turned on.

	**Info** Make sure that the test air and test gas volume and flow settings needed for calibration are correct. For systems with flow monitoring: The flow rates can be checked under System Checks → O_2 sensor check For systems without flow monitoring: Check the flow rates through an external flow meter and adjust to 150 - 180 l/h via an external throttle valve.

4.2.9 Automatic Calibration Settings

Only when the ACAL is switched on, are the ACAL settings visible. The calibration method determines whether the ACAL is carried out as a 1 point calibration only with test air (instrument air or ambient air) or as a 2 point calibration with test air and test gas. Ambient air is preset to a fixed O_2 concentration of 20.95% and this value is not shown nor can it be changed.

The ACAL can be started by:

Time: Time based start with set intervals in days and the corresponding time

Time + Digital Input: Same as "Time", additionally a control voltage of 12-24V DC must be applied to the "calibration release" so that an automatic calibration can be started.

Digital Input: A control voltage of 12-24V DC must be applied to the "calibration release" so that an automatic calibration can be started. If the control voltage is still present after the calibration has ended, the calibration will immediately restart

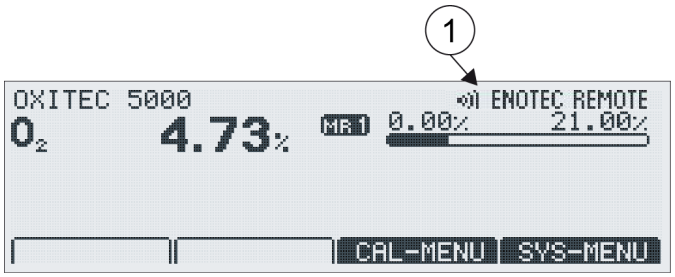
4.2.10 Bluetooth

	**Info** ENOTEC REMOTE is disabled by default. Password and range are not displayed. After activation (only possible from system access level), the 8-digit password that is requested during the remote connection setup must be assigned.

The ENOTEC REMOTE password is used for:

- authentification and pairing with a smartphone / tablet / laptop / pc.
- authentification / login after every connection. Without Authentication / login, device data cannot be read or modified. The device configuration can also not be altered.

Range limits the transmission power of the ENOTEC REMOTE module. **Maximum** = 100m, **medium** = 10m, **short** = 1m. The actual possible range may vary due to structural factors and the reception strength of the Smartphone/Tablet.



When an ENOTEC REMOTE connection to the analyzer is active, the connection is shown in the upper right corner of the display ①.

Figure 24 - ENOTEC REMOTE connection active

	**Info** A maximum of 16 users (smartphones /tablets) can connect to the ENOTEC REMOTE module of an ENOTEC analyzer. Should additional users attempt a connection, the connection will fail. In this case, manually switch off the ENOTEC REMOTE and switch it back on again **SYS MENU => System configuration => ENOTEC REMOTE Settings** which will reset the module. All previously paired users will need to delete their saved connection to the analyzer and re-pair their devices.

4.2.11 Measuring units

Measuring units can be set for temperature (°C / °F) and pressure (mbar / psi).

4.2.12 Language

Set the language for all text shown on the display. One can choose between English, German, Spanish and Polish.

4.2.13 Change system code

	**Info** **The system code on delivery is 0000. In this state, entry into the system is granted without entering the system code. For security reasons, change the code and store it in safety. In case of loss of the system code, a system reset has to be carried out. The reset process may only be carried out by trained service technicians. As an option, a 6 digit code is available.**

4.2.14 Load factory settings

Loading factory settings will restore all original settings and values to the default values programmed in the factory. If activated, all set parameters and also values such as sensor calibration values and calibration results are lost. Take note of the sensor calibration values beforehand and re-enter them after the loading the factory settings. If this is not done, a calibration has to be carried out.

4.2.15 Service (Factory Service Settings)

The service functions are password protected and are only accessible by trained service personnel. These functions are protected with a code, different to the system code.

4.3 Calibration Menu

CAL MENU

1 point calibration, O_2

2 point calibration, O_2

4.3.1 Calibration Menu - Display Overview

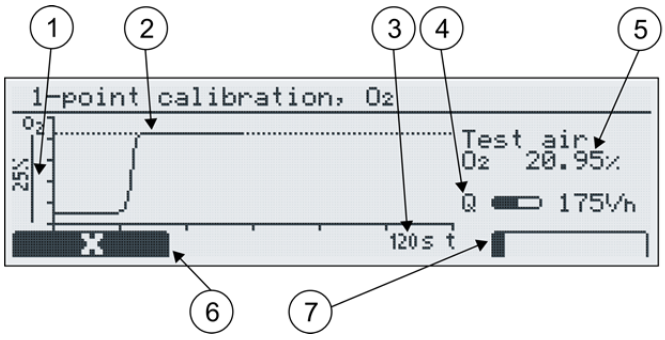


Figure 25 - display of a 1 Point Calibration

1	The max. adjustable measuring range
2	Trend representation of measured O_2 value ▬▬▬▬▬ and O_2 target value ▪▪▪▪▪▪▪▪▪▪▪▪▪▪▪▪ The target value is determined by the O2 concentration in the test gas / test air
3	Time scale showing the elapsed time of the current calibration process. The amount in seconds (here 120 s) refers to the end of the time scale
4	The flow rate currently measured
5	Current measured value of O_2
6	Abort the calibration
7	Progress bar

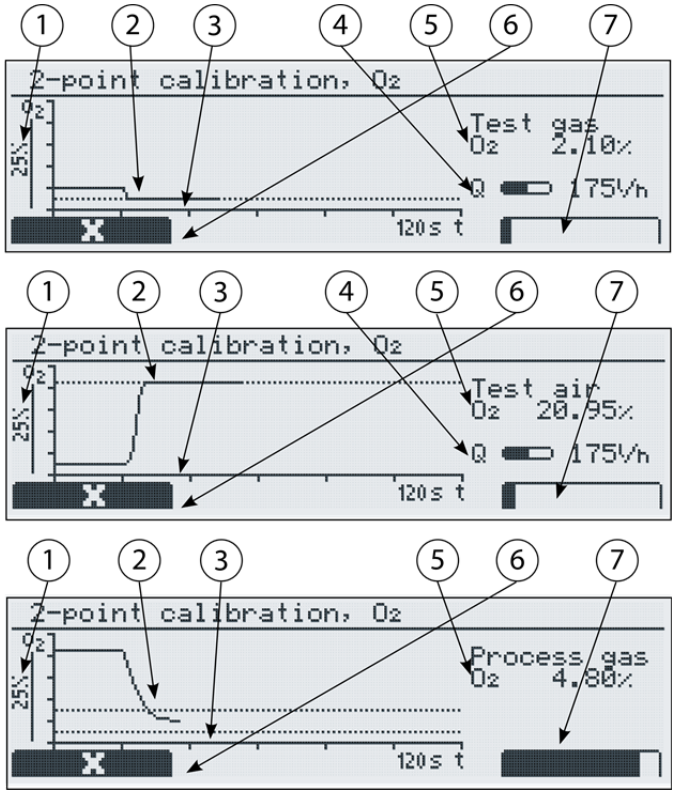


Figure 26 - The 3 phases of a 2 point calibration, Test Gas apply, Test Air apply and Return to Process gas.

	Info The oxygen concentration in test air needs not be entered as it is known (20,95 % O_2). During calibration, entry of the test gas concentration value takes place after test gas has been applied.

4.3.2 1-point calibration (manual)

During the 1-point calibration of the sensor, the calibration offset is determined. Test air is hereby applied to the sensor. In systems without an integrated pneumatic unit, test gas needs to be applied manually and the flow control also may need to be checked and adjusted if necessary.

Course of events

(1) Enter System Code

(2) Maintenance LED is lit

(3) Prompt to apply test air *(only for systems without flow monitoring)*

(4) The calibration process is carried out with test air

(5) Prompt to end the test air application. *(only for systems without flow monitoring)*

(6) Display of the return to process if the difference between the measured concentration in the process and the O_2 concentration with test air is more than 3.00%.

(7) Enter the O_2 concentration of test gas *(does not apply to test air)*

(8) Display of the calibration results (max. 1 minute)

(9) Maintenance LED switches off *(is delayed by the set value in "Delay time to process" if "Meas. Value hold on cal" is set ON)*

(10) Revert to main display

4.3.3 2-point calibration (manual)

During the 2-point calibration of the sensor, the calibration offset and slope is determined. Hereby two gases are applied to the sensor (test air and test gas. In systems without integrated pneumatic units, test gas needs to be applied manually and the flow control also may need to be checked and adjusted if necessary.

Course of events

(1) Enter System Code

(2) Maintenance LED is lit

(3) Prompt to apply test gas *(only for systems without flow monitoring)*

(4) The calibration process is carried out

(5) Prompt to apply test air *(only for systems without flow monitoring)*

(6) The calibration process is carried out with test air

(7) Prompt to end the test air application. *(only for systems without flow monitoring)*

(8) Display of the return to process if the difference between the measured O_2 concentration in the process and the concentration with test air (test gas 1) is more than 3.00%.

(9) Prompt to enter test gas concentration(s)

(10) Display of the calibration results (max. 1 minute)

(11) Maintenance LED switches off *(is delayed by the set value in "Delay time to process" if "Meas. Value hold on cal" is set ON)*

(12) Revert to main display

4.4 System Checks

O_2 Sensor checks

Source: **Test air**
O_2 sensor .. mV = .. %
Flow rate .. l/h

Source: **Testgas**
O_2 sensor .. mV = .. %
Flow rate (3 bar max) .. l/h

Source: **Process**
O_2 sensor .. mV = .. %
Flow rate .. l/h

Check mA outputs

Set mA output 17A/B (mA)

Set mA output 34A/B (mA)

Check relay outputs

Relay contact at 18A/B (opened / closed)

Relay contact at 19A/B (opened / closed)

Relay contact at 20A/B (opened / closed)

Relay contact at 21A/B (opened / closed)

Relay contact at 22A/B (opened / closed)

Check digital inputs

Input status at 25A/B

Input status at 27A/B

5 Service and Maintenance

5.1 Exchange fuses

⚠	**Warning** De-energize the system first!

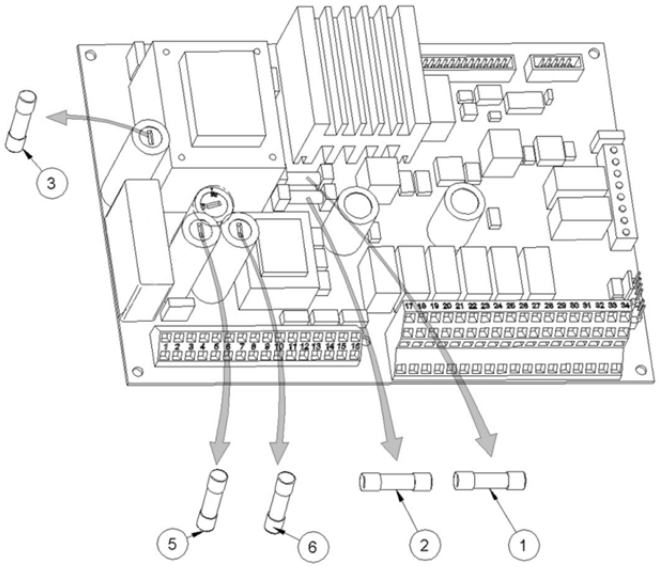


Abb. 27 Position of the fuses

	fuse	system voltage	ampere	nominal voltage	characteristic	Size
①	F3	115 / 230 V AC	0.5 A	250 V AC	T / L	5x20 mm
②	F4	115 / 230 V AC	0.5 A	250 V AC	T / L	5x20 mm
③	F5	115 / 230 V AC	1.0 A	250 V AC	M / L	5x20 mm
⑤	F1	230 V AC	2.0 A	250 V AC	T / H	5x20 mm
⑤	F1	115 V AC	4.0 A	250 V AC	T / H	5x20 mm
⑥	F2	115 / 230 V AC	4.0 A	250 V AC	M / H	5x20 mm

5.2 Flow rates for Test Air and Reference Air

The systems are factory-set to the correct amounts of test air and/or reference air. The instrument air versions are designed for an inlet pressure of 1-10 bar. With a higher inlet pressure of 6 bar, it is necessary to readjust the flow of reference air and/or test air.

The flow rates for air should be in the following range:

Test air: 150l/h - 180l/h

Reference air: 30l/h - 40l/h

5.3 Adjusting Flow Rate (integrated Pneumatics)

In the instrument air version in the Safe Area housing with an integrated pneumatic unit, it is possible to adjust the reference and test air at the electronic unit. In this respect, the pump and instrument air versions are different:

- In the pump version ambient air is used. Only the flow rate of test air can be adjusted.
- The instrument air version requires an external supply of clean, dry and oil free air (instrument air) Both flow rates (test air and reference air) can be adjusted.

In systems with integrated pneumatics unit, the flow rate of reference air can be seen in the menu actual measured values.

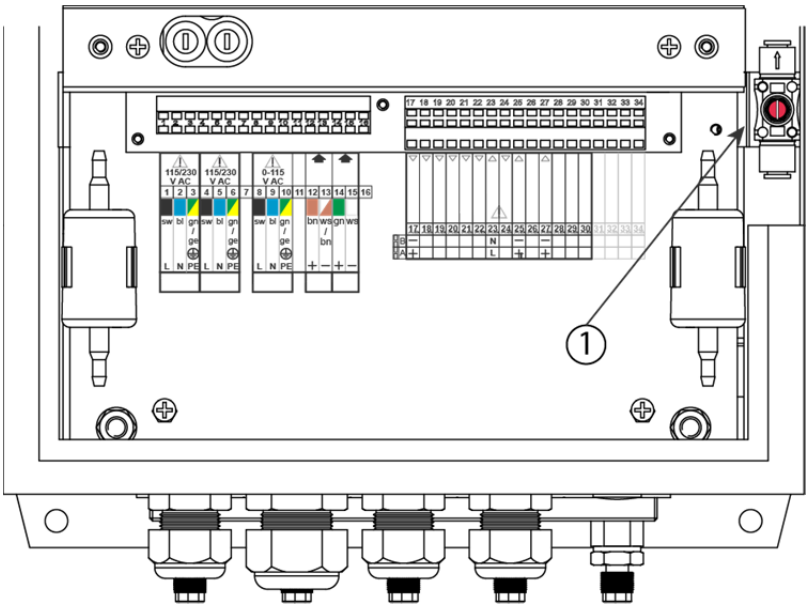


Figure 28 - Adjust flow of test air ① - (pump version)

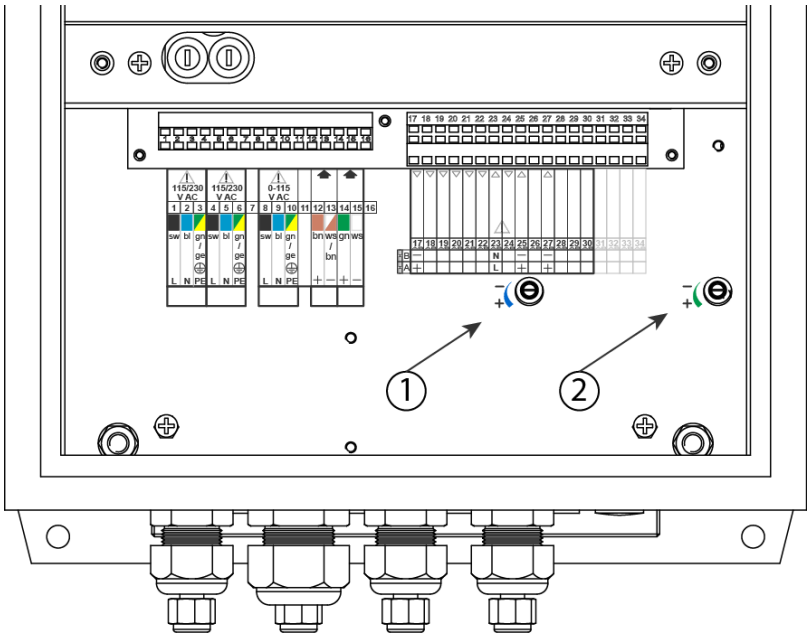


Figure 29 - Adjust flow of reference air ① and test air ② - (instrument air version)

5.4 Position of the adjustment valves

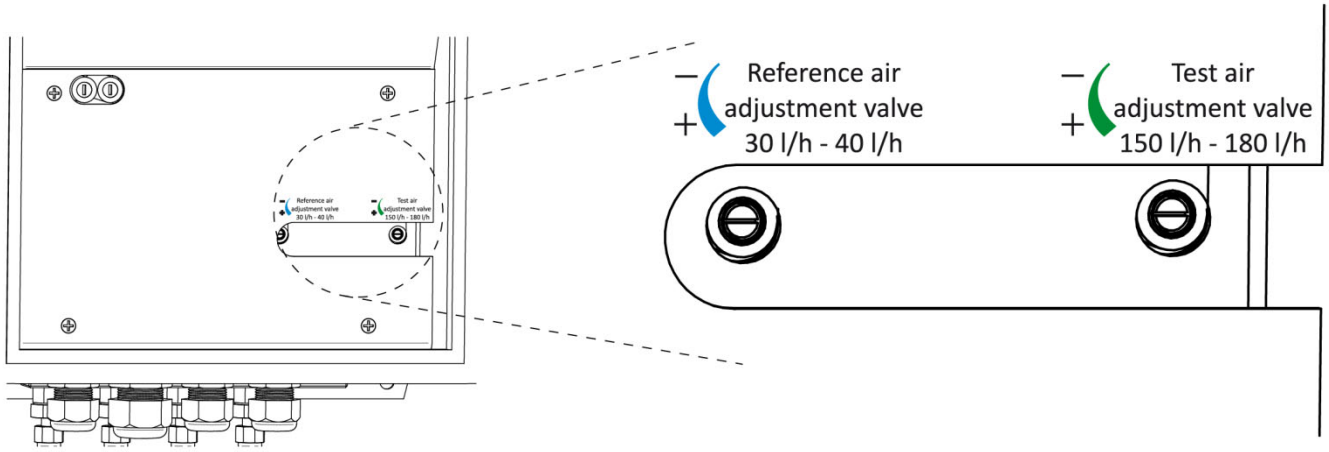


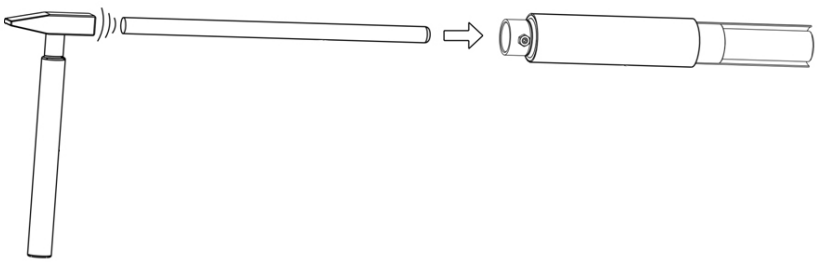
Figure 30 - Terminal cover of the SME-53 Electronic Unit
showing the position of the reference air and test air valves below

5.5 Replacing the Filter

	Warning hot surface The probe may only be removed with heat-insulated gloves. Before removing the probe, always switch off the supply voltage to the electronic system. After removal, store the probe in a safe, protected place and wait until it has cooled down below 35°C/95°F.

	Note Only cemented ceramic, basalt and sintered metal filters can be replaced

5.5.1 Remove old Filter



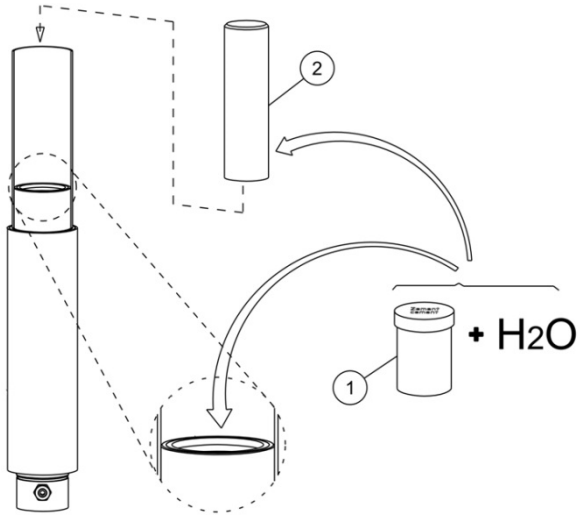
Loosen the holding screws.

Clamp the filter head in a vice.

Free the filter by using a hammer and a metal extension to force it from the filter head

Figure 31 - Remove old filter

5.5.2 Cement in new Filter



Mix the supplied glue ① with water according to the instructions. Spread the glue into the grooves of the seat and onto the filter part which comes into contact with the seat. Push - turn the filter ② into the seat. Evenly smooth the glue between the filter and seat and remove all excess glue.

Figure 32 - Cement new filter in

	Note The cement dries at room temperature within 24 hours. Using the cement supplied by ENOTEC, all types of ceramic, basalt and sintered metal filters supplied by can be inserted and fixated.

5.6 Replacing the probe

	Warning Hot Surface The probe may only be removed with heat-insulated gloves. Before removing the probe, always switch off the supply voltage to the electronic system.

1. Disconnect the wires at the probe connection box.
2. Loosen the bolts connecting the probe to the counter flange and remove the probe
3. Insert the replacement probe using a new gasket. Consider the flue gas direction and adjust the V-Shield (filter head) accordingly. See chapter ***2.9 – Adjusting the V-Shield.***
4. Tighten the flange bolts and reconnect the wiring at the connection box.
5. Switch on the power to the analyzer and wait for the probe to reach its setpoint temperature.
6. Carry out a 2-point calibration (under process conditions)

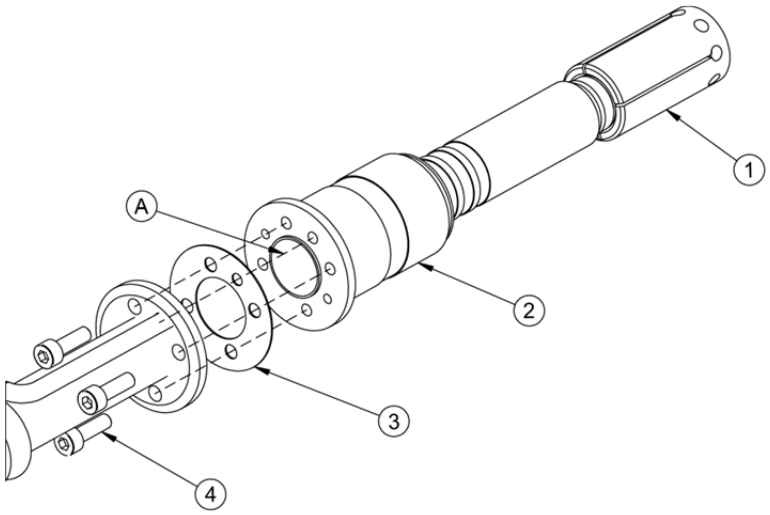
5.7 Replacing the O_2 Sensor

Warning Hot Surface

The probe may only be removed with heat-insulated gloves. Before removing the probe, always switch off the supply voltage to the electronic system. After removal, store the probe in a safe, protected place and wait until it has cooled down below 35°C/ 95°F.

Note

An exchange of the measuring cell is only necessary if the cell is leaking (erratic or incorrect measured values).



Disconnect the wires in the connection head and loosen the 2 torx screws, which hold the inner parts of the tube. Pull off the thin transparent reference air pipe from the entry fitting at the connection box.

Pull out probe internal assembly carefully (4-hole ceramic rod with signal measuring wire, thermocouple element and heater)

Unscrew the 4 torx screws at the measuring cell holder with flange and remove the measuring cell.

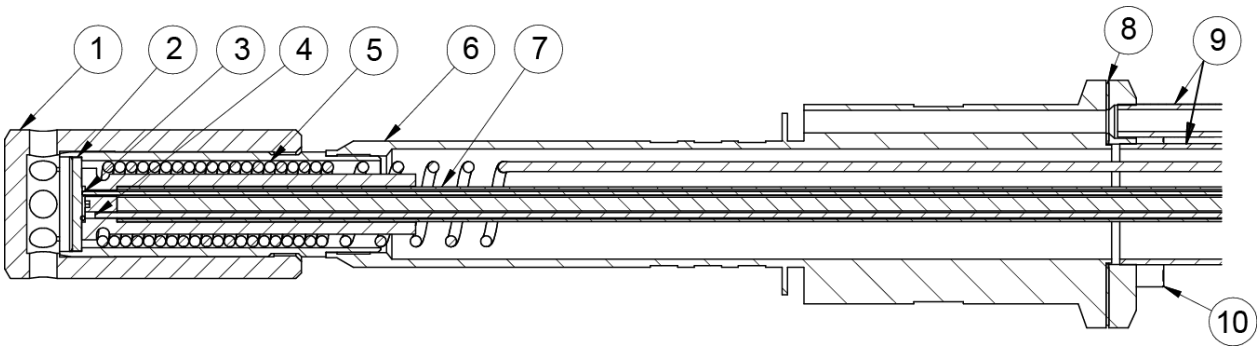
Figure 33 - O_2 sensor replacement

Clean the flange at the probe tube with fine sandpaper. Tighten the new measuring cell with a new metal gasket sealing and four new screws at the measuring cell flange of the probe tube. Insert the probe inner parts and ensure that the inner parts do not bind in the probe tube. Press the locking bolt against the spring, so that the inner parts assembly is pressed against the measuring cell with enough spring tension.

Tighten locking bolt and connect wires as follows:

Terminal	Color	Description	Polarity	Unit
1	White/brown	signal wire, measuring cell	-	mV
2	Brown	signal wire, measuring cell	+	mV
3	Green	thermocouple element	+	mV
4	White	thermocouple element	-	mV
6	Black	heating element		
7	Blue	heating element		
8	green/yellow	ground/earth heater		
9	Grey	solenoid valve (optional)		
10	Grey / blue	solenoid valve (optional)		

Install the probe; wait for the system to reach its operating temperature. Carry out an O_2 two point calibration after 24 hours of operation.

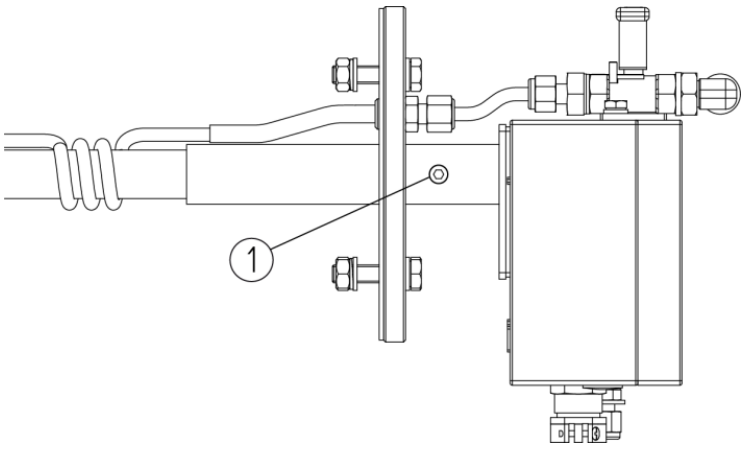


①	Protection cap	⑥	Cell tube
②	Cell	⑦	Ceramic rod
③	Signal wire	⑧	Flange gasket
④	Thermocouple	⑨	Probe tube
⑤	Heater	⑩	Screw M5

Figure 34 - Construction of the O_2 sensor holding tube

5.8 Exchange of Probe Inner Parts

Proceed as described in **chapter 0** to dismantle the probe inner parts assembly. The exchange of the thermocouple element is an exception, because this can be changed without dismounting the probe inner part as a whole.



Disconnect the wires in the connection box and loosen the 2 allen screws ①, which hold the inner parts of the probe. Pull off the thin transparent reference air pipe from the entry fitting at the connection box.

Pull out probe internal assembly carefully (4-hole ceramic rod with signal measuring wire, thermocouple element and heater)

Figure 35 - Loosen the allen screws holding the probe inner part

5.9 Exchange of Thermocouple Element

The thermocouple element is a covered thermocouple element with an Inconel-covering and a Ni-Cr-Ni thermocouple. The thermocouple element is in one hole of the 4-hole-rod (beside the reference air tube). Disconnect the thermocouple element at the probe connection box, pull it out and insert a new thermocouple element. If the probe is very long, it may be necessary to pull out the complete probe inner parts assembly.

5.10 Exchange of Heating Element

Remove the probe inner part assembly, loosen the clamp, pull out the signal measuring wire and the thermocouple and pull off the heater complete with ceramic support, from the 4-hole ceramic rod.
Assemble the new heater, if necessary with new ceramic support and new 4-hole ceramic rod.

Insert signal measuring wire (from the measuring sensor side) and thermocouple element (from the connection side); assemble clamps and connection sleeves (for long probes).

Caution

The heater support has three drilled holes, which must correspond with three holes of the 4-hole ceramic rod. The reference air flows through the medium hole, the thermocouple is fitted in the larger hole at the side and the third (smallest) hole is for the signal wire. Make sure, that the tap of the signal wire lies in the depression of the heater support.

After the insertion of a thermocouple in a new heater support, this hole will be sealed with cement. This avoids the thermocouple touching the signal wire and causing a short circuit. If the heater support is changed, the hole of the thermocouple in the heater support has to be sealed with cement after the insertion of the thermocouple as well**.**

5.11 Exchange of Signal Measuring Wire

The signal measuring wire has a specially shaped contact for taking the mV-value of the reference electrode of O_2 sensor. It is possible that a small metal net is fixed on the signal measuring wire which has been pulled out. This net has no effect on the function of the probe and it need not to be replaced.

The contact wire is pressed against the measuring cell by means of spring tension of the inner parts assembly. If there is not enough spring tension or if the wire is broken, the mV-signal cannot be received any longer, and an error signal will occur.

5.12 Exchange of 4-Hole Ceramic Rod

Depending on the length, the probe has one or more 4-hole rods. In the case of long probes, during assembly, one has to ensure that the holes correspond to one another, so that installation can be carried out and the reference air can be routed to the inner reference air side of the O_2 sensor.

5.13 Relay Outputs / Functions and Correlation

The relay contacts are designed for 24V and 1A ~, 1A = (Exception: probe valve)

Relay	Contact	Function	Terminal
System error*	Normally closed	Signals operation-critical errors	X5 (19A/B)
Maintenance	Normally open	System code entered, system in maintenance mode	X5 (18A/B)
Measuring range	Normally open	Closed: Measuring range 1 active	X5 (20A/B)
Probe valve**	Normally open	Triggering of the probe valve	X5 (24A/B)
Limit value 1	Normally closed	Signals a violation of limit value 1	X5 (21A/B)
Limit value 2	Normally closed	Signals a violation of limit value 2	X5 (22A/B)

Relay outputs and functions

- The relay „system error“ is active also during the heating phase.

** The relay contact for the probe valve is designed for max. 230V and 1A ≅.

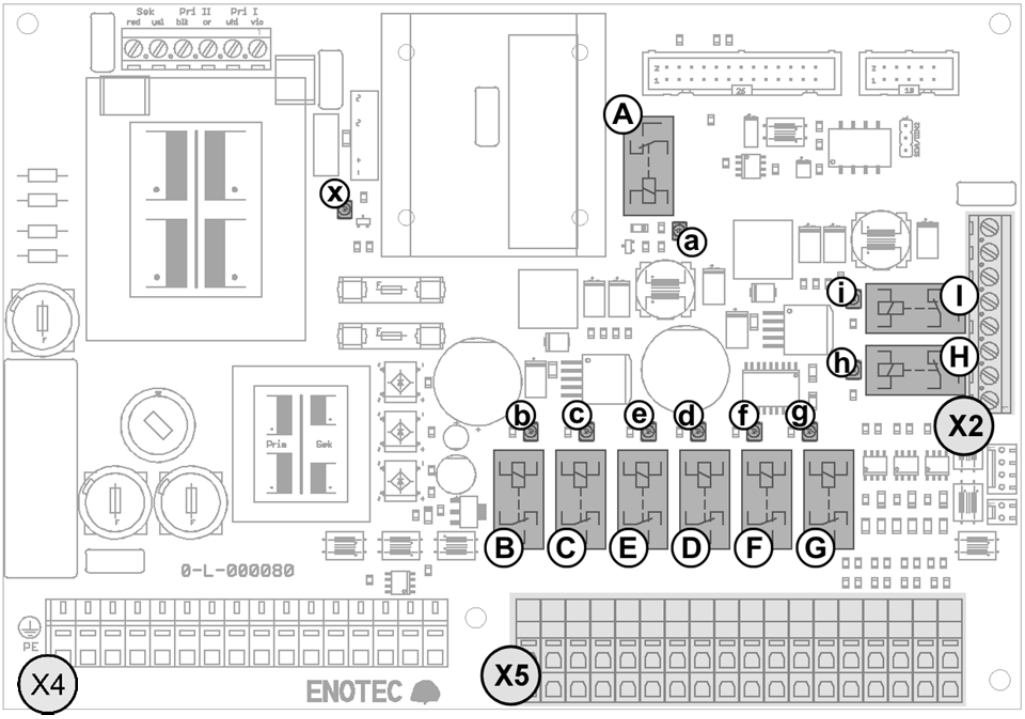


Figure 36 - Relay plate with marked relays and LEDS

Relay marking	LED Marking	Function
A	a	Probe heater relay
B	b	Maintenance
C	c	System error
D	d	Limit O_2 1
E	e	Measuring range
F	f	Limit O_2 2
G	g	Probe valve
H	h	Solenoid valve test gas 1
I	i	Solenoid valve test gas 2
	x	Probe heater control

5.14 Digital Inputs

The digital inputs are designed for a direct voltage of 12 V - 24 V DC for logical “High”. Logical “Low” corresponds to a voltage less than 1 V.

Digital input	Function
Calibration release	External release for calibration with ACAL
Measuring range switch	Switching on the second measuring range

5.15 Stability Criteria for Calibration

During calibration, the cell is checked for stability. This check operates according to the following criteria.

The last measured value is always temporarily saved. When the next value is outside the tolerance, the internal timer is reset and the new value temporarily saved. This means that if the timer was not reset, the value is stable. In this way, the last measured value after the timer has elapsed (2 min.) is used to calculate the cell constant or slope.

5.16 Reaction Time of the mA Output

The reaction time of the mA output to a change of the O_2 cell input voltage is less than 200 ms.

5.17 Extension Modules

As an option, the electronic unit is available with several interfaces (RS232, RS485, HART, Fieldbus and ENOTEC REMOTE). If one of these options is ordered you will find a separate manual/specification for the respective interface together with the shipment.

6 Status Messages

6.1 Error Messages

Error Message	Relay contact	O_2 signal output	Description
Hardware error 1-7	System error, open	2.00 mA, when not set differently	The error can occur at any time and signalizes a failure of one of the electronic components. The O_2 sensor heater is switched off. Contact a service point, if the error returns after restarting the system.
Open circuit thermocouple	System error, open	2.00 mA, when not set differently	The error can occur at any time and signals a break in the circuit of the thermocouple. The O_2 sensor heater is switched off. Once the fault has been corrected, the error can be reset. **Possible causes:** contact problems of the thermocouple wire to the terminal points of the electronics or the sensor, sensor cable is damaged or the thermocouple is defective.
O_2 probe set point temp. not reached	System error, open	2.00 mA, when not set differently	The error can occur during the heating of the O_2 sensor (Max. 90 minutes). The O_2 sensor heater is switched off. An error reset can be carried out by the user in order to restart the heating process. **Possible causes:** F2 fuse defective, contact problem of the O_2 sensor heater wire to the terminal points of the electronics or the sensor, sensor cable is damaged, short-circuited thermocouple, reference air flow greater than 60 l / h, power supply too low, flow rate too high and / or temperature in the process too low , electronic failure.
O_2 probe temperature too low	System error, open	2.00 mA, when not set differently	The error can occur during measurement, indicating that the O_2 sensor temperature drops 20 ° C (68 ° F) below the set point temperature. The O_2 sensor heater is switched off. An error reset can be carried out by the user in order to restart the heating process. **Possible causes:** F2 fuse defective, contact problem of the O_2 sensor heater wire to the terminal points of the electronics or the sensor, sensor cable is damaged, short-circuit thermocouple, reference air flow greater than 60 l / h, power supply too low, flow rate too high and / or temperature in the process too low, electronic failure.
O_2 probe temperature too high	System error, open	2.00 mA, when not set differently	The error can occur during measurement, indicating that the O_2 sensor temperature has risen 20 ° C (68 ° F) above the set point temperature. The O_2 sensor heater is switched off. An error reset can be carried out by the user in order to restart the heating process. **Possible causes:** Process temperature too high, O_2 sensor cable to the transmitter connected incorrectly, electronic failure.
Open circuit O_2 sensor	System error, open	2.00 mA, when not set differently	The error can occur at any time and signals a break in the circuit of the O_2 sensor. Once the fault has been corrected, the error can be reset. **Possible causes:** contact problem of the O_2 sensor wire to the terminal points of the electronics and the probe, probe cable is defective, contact problem of the probe the inner part of the O_2 sensor.
O_2 sensor calibration failed	System error, open		O_2 sensor calibration has failed for one of the following reasons. An error reset can be carried out by the user. All corresponding entries are then reset as well.
Test gas flow rate too low	System error, open		The error can occur during an O_2 sensor calibration and signals an insufficient test gas flow. An error reset can be carried out by the user. A successful re-calibration also resets the error. **Possible causes:** test gas bottle empty, test gas flow incorrectly set, instrument air supply to the system does not exist.
Test gas flow rate too high	System error, open		The error can occur during an O_2 sensor calibration and signals a test gas flow which is too high. An error reset can be carried out by the user. A successful re-calibration also resets the error. **Possible causes:** test gas bottle empty, test gas flow incorrectly set, instrument air supply to the system does not exist.
O_2 sensor offset too low	System error, open		The error can only occur only during an O_2 sensor calibration. An error reset can be carried out by the user. A successful re-calibration also resets the error. **Possible causes:** inadequate reference air supply, process pressure is too high, incorrect test gas, O_2 sensor defective.

Error Messages (cont.)

Error Message	Relay contact	O_2 signal output	Description
O_2 sensor offset too high	System error, open		The error can only occur during an O_2 sensor calibration. An error reset can be carried out by the user. A successful re-calibration also resets the error. **Possible causes:** defective false test gas (not applicable with test air), test gas flow too low, O_2 sensor defective.
O_2 sensor slope too low	System error, open		The error can only occur only during an O_2 sensor calibration. An error reset can be carried out by the user. A successful re-calibration also resets the error. **Possible causes:** Incorrect calibration gas, test gas flow too low, probe filter damaged, filter head missing, faulty O_2 sensor.
O_2 sensor slope too high	System error, open		The error can only occur only during an O_2 sensor calibration. An error reset can be carried out by the user. A successful re-calibration also resets the error. **Possible causes:** Incorrect calibration gas, O_2 sensor defective.
O_2 sensor signal instable	System error, open		The error can only occur only during an O_2 sensor calibration. An error reset can be carried out by the user. A successful re-calibration also resets the error. **Possible causes:** test gas flow too low, probe filter is damaged, process pressure fluctuations too high.
mA input for process pressure	System error, open		Circuit open or pressure transmitter signal less than 3.6 mA / greater than 20.4 mA
Error REMOTE module	System error, open		Indicates a hardware error of the REMOTE module. **Possible cause:** the REMOTE module is defective.

Unlisted errors: Other errors cannot be remedied by the customer. Please contact a service point

6.2 Alarm Messages

Error Message	Relay contact	Description
Reference air flow too low		**Possible Cause:** reference air flow set incorrectly, instrument air supply is inadequate, reference air pump is faulty.
Reference air flow too high		**Possible Cause:** reference air flow is set incorrectly.
O_2 limit alarm 1	O_2 limit alarm 1, open	**Possible Cause:** Over or under range of the O_2 limit alarm.
O_2 limit alarm 2	O_2 limit alarm 2, open	**Possible Cause:** Over or under range of the O_2 limit alarm.
Electronic temp. too low		**Possible Cause:** The ambient temperature of the transmitter is lower than the specified lower limit. The specified measurement tolerances are no longer guaranteed.
Electronic temp. too high		**Possible Cause:** The ambient temperature of the transmitter is higher than the specified upper limit. The specified measurement tolerances are no longer guaranteed.
Clock battery low		The alarm can only be reset by the user after replacing the clock battery (Lithium type 2032). As long as the system is connected to AC power, the alarm has no impact. Only after restarting system will the time / date be incorrect. A possible timed automatic calibration can no longer work correctly.

Unlisted alarm messages: Other messages cannot be remedied by the customer. Please contact a service point

6.3 Maintenance Messages

Maintenance message	Relay contact	Description
Measured value(s) held	Service, closed	When ***measured values held*** is set to on, the determined O_2-mA output remains saved for a duration before a calibration.

7 Troubleshooting

Unsteady, widely varying measuring value (O_2)

Possible reasons	Procedure
Intermittent contact caused by wire breakage	Eliminate bad/loose contact
Intermittent contact inside the probe - internal mV connection	
Broken filter element	Visual inspection by dismounting the probe
Wrongly installed V-shield	
Probe has been installed without filter head	

O_2 display remains at the end of the measuring range or is higher than expected

Possible reasons	Procedure
Leakages at the measuring probe or at the O_2 sensor flange seal.	Check all flanges and screw connections for tightness. Exchange O_2 sensor or replace O_2 sensor flange seal. In case of a leakage in the area of the O_2 sensor, the O_2 sensor must be exchanged.
Probe flange not welded gas tight.	Tighten flange bolts with required torque, possible renew the gasket.

Local Displays correct, Output not correct

Possible reasons	Procedure
Electronic unit is defective	Check measuring range. Check whether the current value is outside the measuring range
	Measure the mA output on the strip terminal.

O_2 Display Indicates 0 %, although the Process Operation Mode expects a higher O_2 Value

Possible reasons	Procedure
Measuring probe heater defective (resistance must be approx. 37.5-47.5 Ohm, disconnect probe and check).	Check the measuring cell temperature (set value 800°C/1472°F. A lower temperature could have the effect of showing a value of 0 %.
Thermocouple defective (check resistance, approx. 2-80 Ohm).	Check the mV value of the O2 measuring cell
Fuse for heater voltage defective.	Replace the fuse
Cable short circuit. Electronic units input defective. Wire break	Check wiring. Measure probe cable.
Transformer (230/115V) is defective	Check the fuse
There is no mV contact in the probe (measuring signal wire) or it is interrupted.	Check probe inner part for good contact.
Combustibles in the flue gas.	Check whether the probe reacts to test gas. If it does, there may be a high proportion of combustibles in the flue gas. In this case, there are reducing conditions at the probe sensor, which reduce the oxygen content at the sensor surface. **Caution: Explosion hazard!**
Measuring cell defective.	Replace the sensor.

A Technical Data

A.1 Technical Specifications - Electronic Unit

Housing:	Sheet steel ST37 RAL6029 (SME-57, 19” rack optional)
IP Code:	Safe Area Housing: IP66 19“ housing: IP20
Display:	LC Dot Matrix 240 x 64 LED backlit
Keypad:	Membrane keypad
Signal LEDs:	Alarm, Maintenance, Error
O_2 measuring ranges:	2 x 0,00 to 25,00 Vol.% O_2
Accuracy:	± 0,2 % of measured value
Response time:	Change of 100mV at sensor input < 200ms
Manual or ACAL (Automatic calibration):	1 or 2 point (automatic calibration)
Mains Voltage:	230V ±10 % 50 to 60 Hz 115V ±10 % 50 to 60 Hz *(see Name Plate)*
Power consumption:	400 VA (heating phase) 200 VA (typical measuring mode)
Recommended fuse:	10A
Output signal O_2:	Active, 0/4 to 20 mA, max. load 500 Ω Galvanically isolated
Relay contact:	24 V AC/DC, 1 A
Relay contact solenoid valve:	230 V AC/DC, 1 A
Dimensions:	300 x 440 x 240 mm (B x H x T)
Weight:	ca. 19 kg
Temperature range - storage: *	-40 °C to +80 °C
Temperature range - operation: *	-20 °C to +55 °C

* Other temperature ranges on request

A.2 Technical Specifications - Probe

Process gas temperature:	KES-132x: up to 400°C (with standard ceramic filter) KES-132x: up to 200°C (with active carbon filter)
Immersion depth:	See dimensional drawings
Measuring principle:	Zirconium oxide
Operating temperature O_2 sensor:	800 °C
Raw signals from O_2-sensor:	Air (20,95 % O_2: 0 mV ± 1mV 2,1 % O_2: 50 mV ± 1 mV
O_2-Sensor Reference Air:	Instrument air 40 l/h Adjustment at SME-53
Process gas pressure:	-50 to +50mbar
Flow Velocity:	0 to 50m/s
Ambient temperature:	-40°C to +80°C
Reaction Time:	0,5s (Process flow velocity > 10m/sec.)
T90:	5s (Process flow velocity > 10m/sec.)
Probe material:	V4A (DIN 1.4571 / SS316Ti) Others on request
IP Code:	IP65
Detection limit:	< 1ppm O2
Power supply:	Through electronic unit

A.3 Gas Supply - Systems with Instrument Air

The analyzer system uses the connected instrument air continuously for the supply of reference air, and during calibration and system test respectively, for the supply of test air (test gas 1).

Instrument air supply for reference air / test air	
Specification:	According to ISO 8573-1 class 2 (Particle size max. 1µm, Particle density max. 1mg/m³, Oil content max. 0,1mg/m³, Pressure dew point max. -20 °C) Constant 20,95 Vol % O_2
Input pressure:	2-10 bar
Flow rate	continuously maximum 40 l/h (for reference air supply) 180 l/h during calibration

Test gas (test gas bottle) for calibration / system test	
Input pressure:	max. 3 bar
Specification test gas 1 (optional):	21 Vol. % O_2 in N_2 (synthetic air – in case instrument air is not available)
Specification test gas 2:	2.1 Vol. % O_2 in N_2 (accuracy +/- 2%)
Flow rate	180 l/h at 1,1 bar (+/- 0,1).

Note

The flow rate of the test gas bottle is set via the bottle pressure regulator.

B Dimensional drawings

B.1 Dimensions of Electronic Unit Housing versions

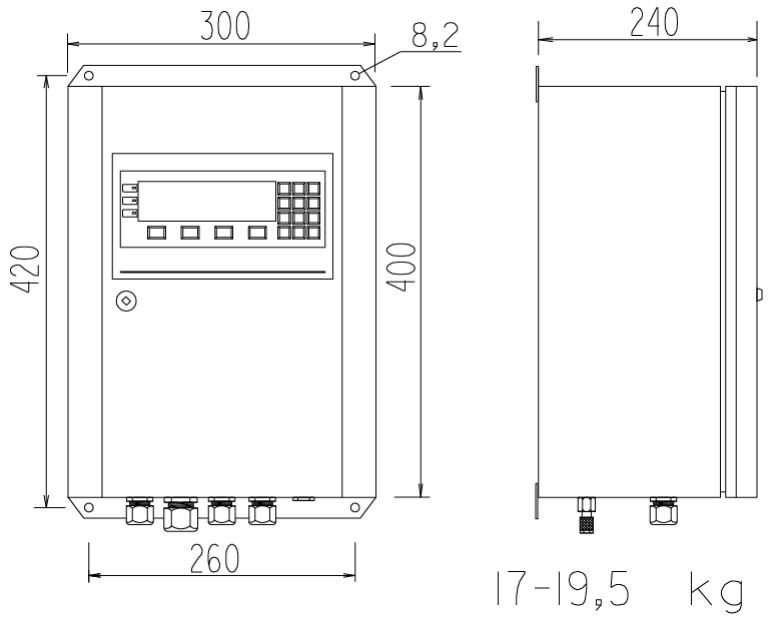
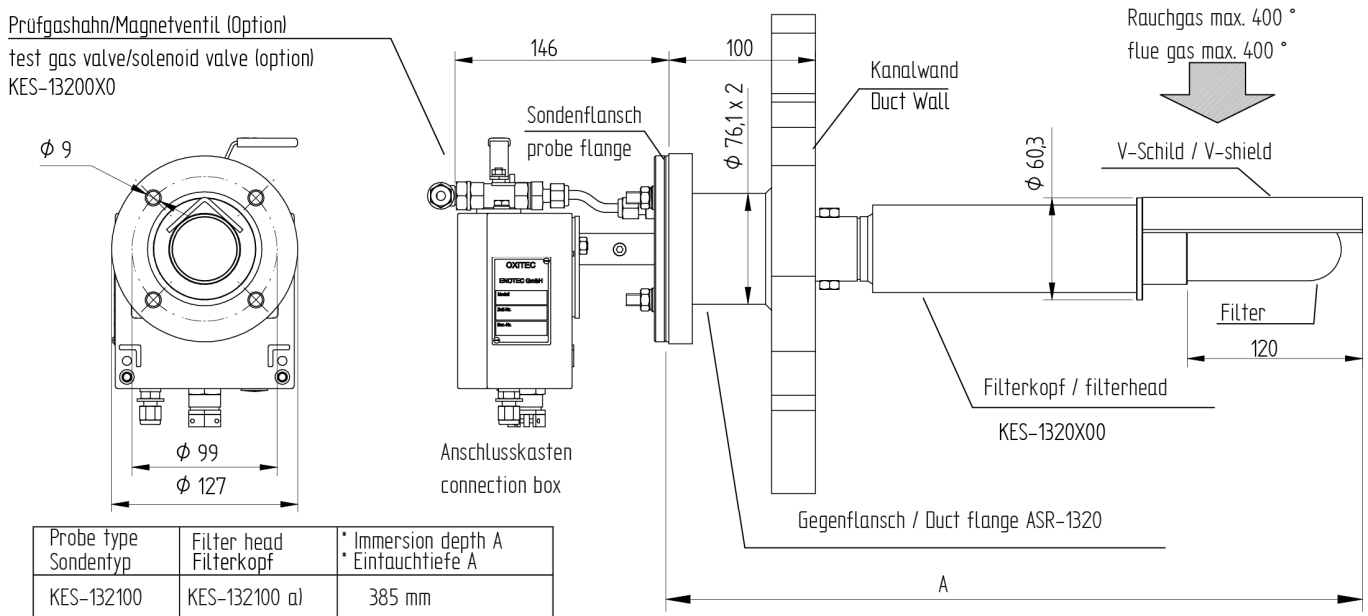


Figure 36 - Dimensions in mm of the SME-53

B.2 Probe Dimensions



Probe type Sondentyp	Filter head Filterkopf	* Immersion depth A * Eintauchtiefe A
KES-132100	KES-132100 a)	385 mm
KES-132200	KES-132200 a)	475 mm
KES-132300	KES-132300 a)	615 mm

All Dimensions in mm
Alle maße in mm

a) with ceramic filter
a) mit Keramikfilter

Figure 37 - Dimensions of the KES-132X probes

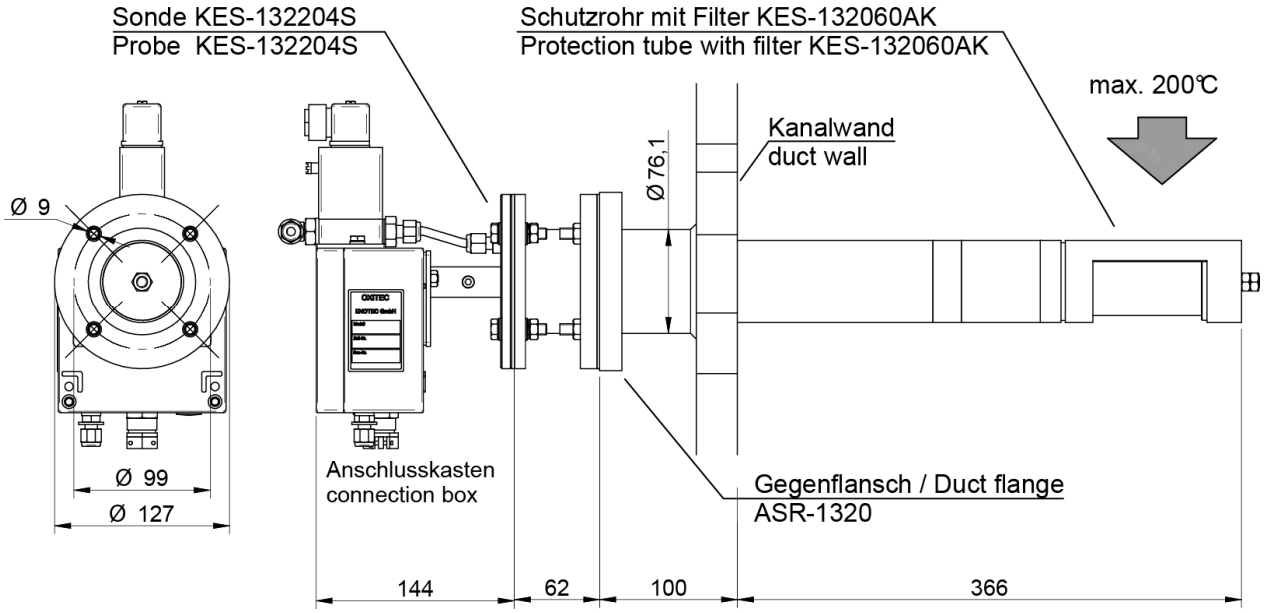


Figure 39 – Dimensions in mm of the KES-132X probes with KES-1320600AK (active carbon filter)

B.3 Counter Flange Dimensions

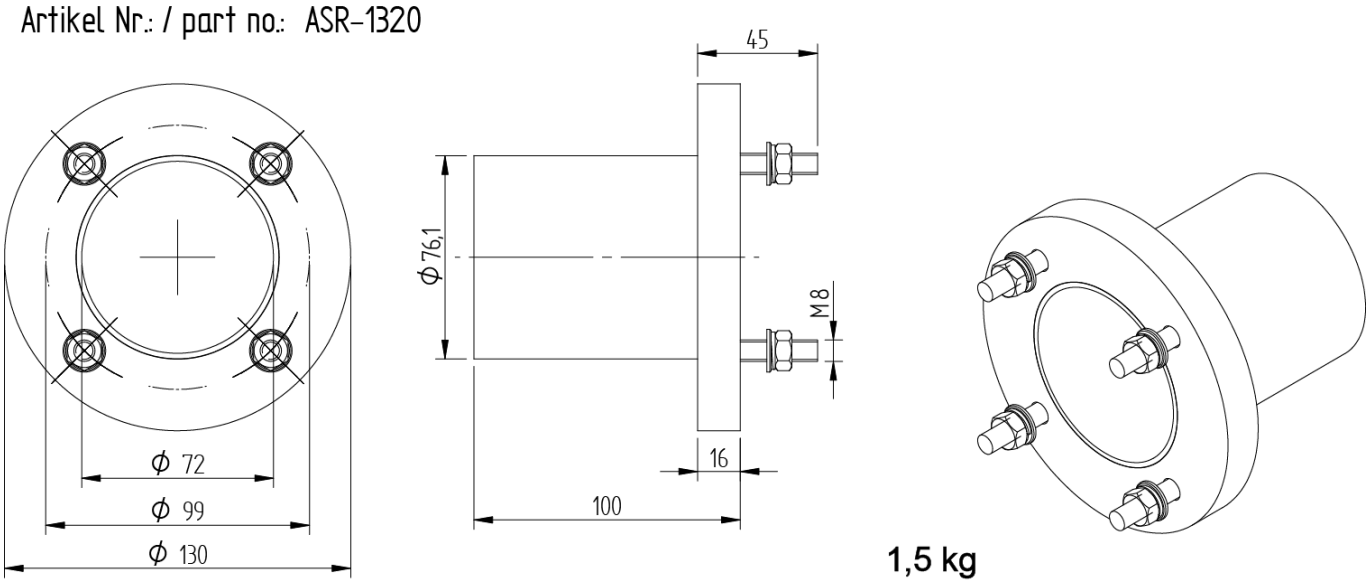
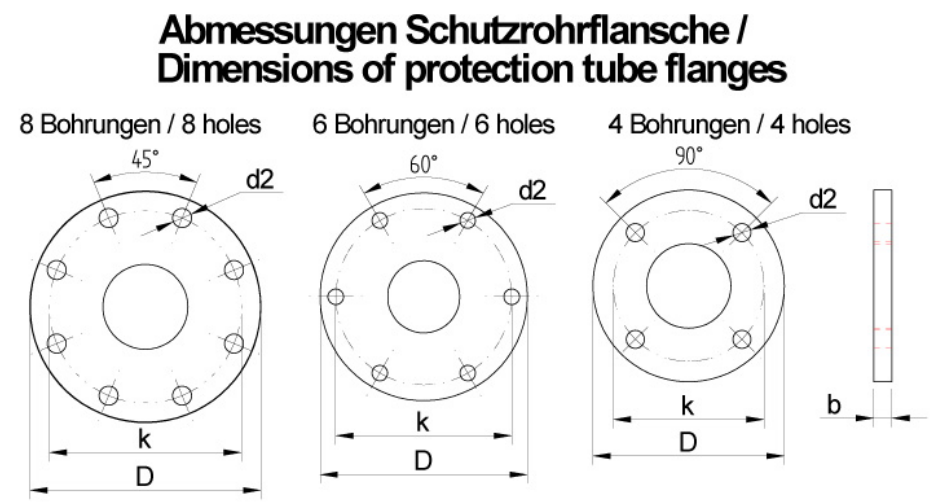


Figure 38 - Dimensions of counter flange for KES 132X

B.4 Dimensions of protection tube flanges



Schutzrohrflansch
Mat.: DIN 1.4571 / AISI 316 Ti
Abmessungen: siehe Tabelle
Aussendurchmesser Schutzrohr: 57/76,1mm
Protection tube flange
Mat.: DIN 1.4571 / AISI 316 Ti
Dimensions: see table
Outside diameter protection tube:
57mm/76,1mm

Gültig für alle KES500X.
Für StaubEx auf Anfrage
Available for all KES500X
On request for DustEx

Technische Änderungen vorbehalten.
Andere Flansche auf Anfrage.
Data subject to change without notice.
Other flange types on request.

Abmessungen / Dimensions / Flanschtyp / type of flange	D	b	k	d2	Bohr. holes
ANSI 4" 150lbs FF eq. Best.-Nr./Order code: **A**	228,6 (9,00)	12,5 (0,50)	190,5 (7,50)	19,0 (0,75)	8
DIN2527 DN65/PN16 Best.-Nr./Order code: **B**	185,0 (7,28)	18,0 (0,71)	145,0 (5,71)	18,0 (0,71)	4
DIN2527 DN65/PN6 Best.-Nr./Order code: **C**	160,0 (6,27)	14,0 (0,55)	130,0 (5,12)	14,0 (0,55)	4
ANSI 2" 150lbs FF eq. Best.-Nr./Order code: **D**	153,0 (6,00)	12,5 (0,50)	121,0 (4,75)	20,0 (0,78)	4
DIN2527 DN50/PN16 Best.-Nr./Order code: **E**	165,0 (6,47)	18,0 (0,71)	125,0 (4,90)	18,0 (0,71)	4
ANSI 3" 300lbs Best.-Nr./Order code: **F**	209,5 (8,25)	28,6 (1,13)	168,3 (6,63)	22,2 (0,87)	8
ZFG2 probes eq. Best.-Nr./Order code: **G**	165,0 (6,47)	12,0 (0,47)	140,0 (5,49)	12,5 (0,50)	6
DIN2527 DN80/PN16 Best.-Nr./Order code: **H**	200,0 (7,87)	20,0 (0,79)	160,0 (6,29)	18,0 (0,71)	8
Mod. 132 eq. Best.-Nr./Order code: **I**	127,0 (4,98)	8,0 (0,31)	99,0 (3,88)	9,0 (0,35)	4
ANSI 3" 150lbs Best.-Nr./Order code: **J**	190,5 (7,50)	23,9 (0,94)	152,4 (6,00)	19,1 (0,75)	4
DIN2527 DN100/PN25 Best.-Nr./Order code: **K**	235,0 (9,25)	24,0 (0,95)	190,0 (7,48)	22,0 (0,86)	8
Servomex 700 eq Best.-Nr./Order code: **N**	155,0 (6,10)		120,6 (4,75)	11,0 (0,43)	8
Servomex 790M eq Best.-Nr./Order code: **P**	220,0 (8,66)		186,0 (7,32)	11,0 (0,43)	4
DIN2527 DN100/PN16 Best.-Nr./Order code: **R**	220,0 (8,66)	20,0 (0,79)	180,0 (7,09)	18,0 (0,71)	8
ANSI 4" 150lbs RF Best.-Nr./Order code: **T**	228,6 (9,00)	23,9 (0,94)	190,5 (7,50)	19,1 (0,75)	8
Kundenspez./Customer spec. Best.-Nr./Order code: **X**					

Alle Abmessungen in mm (inch) / All dimensions in mm (inch)

Figure 39 - Dimensions of protection tube flanges

C Spare Parts

C.1 Probe Components - KES-132X

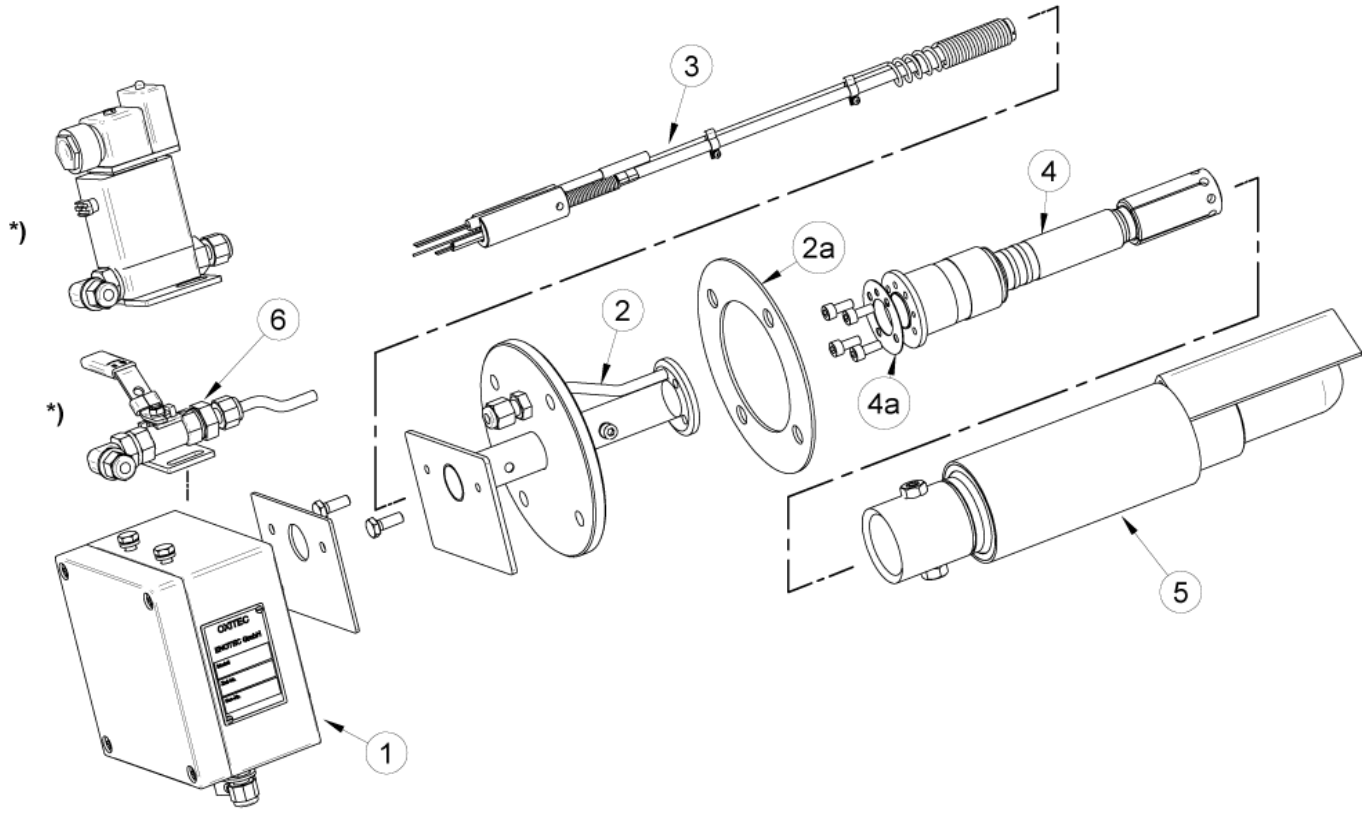


Figure 40 - KES-132X Probe Components

No.	Part	Part No.
1	Connection Box	ASK-1001
2	Measuring probe tube	MSR-132X
2a	Probe flange gasket	FLD-132X
3	Probe inner part	SIK-132X
4	Oxygen measuring cell	ZO2-00(0/1)1
4a	Measuring cell gasket	MZD-0001
5	Filter head	KES-1320X00
6	*)Test gas valve / *) Solenoid valve	KES-13200X0

C.2 Probe inner parts assembly

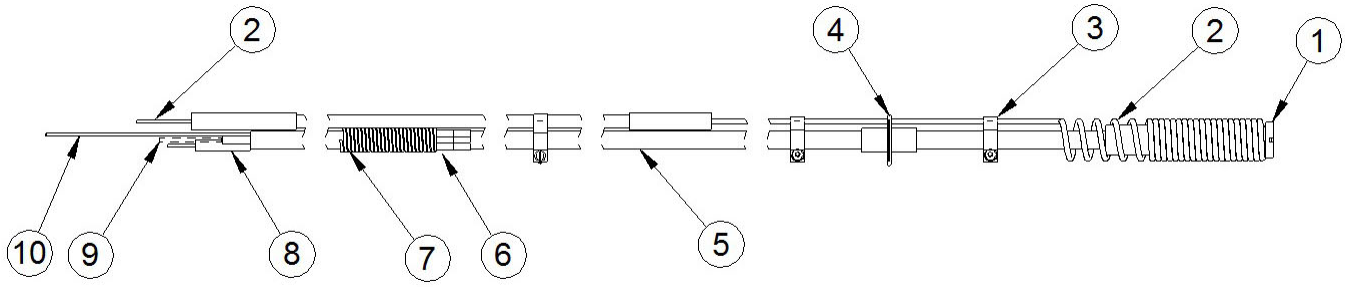


Figure 41 - Probe inner parts assembly (KES-1321-2)

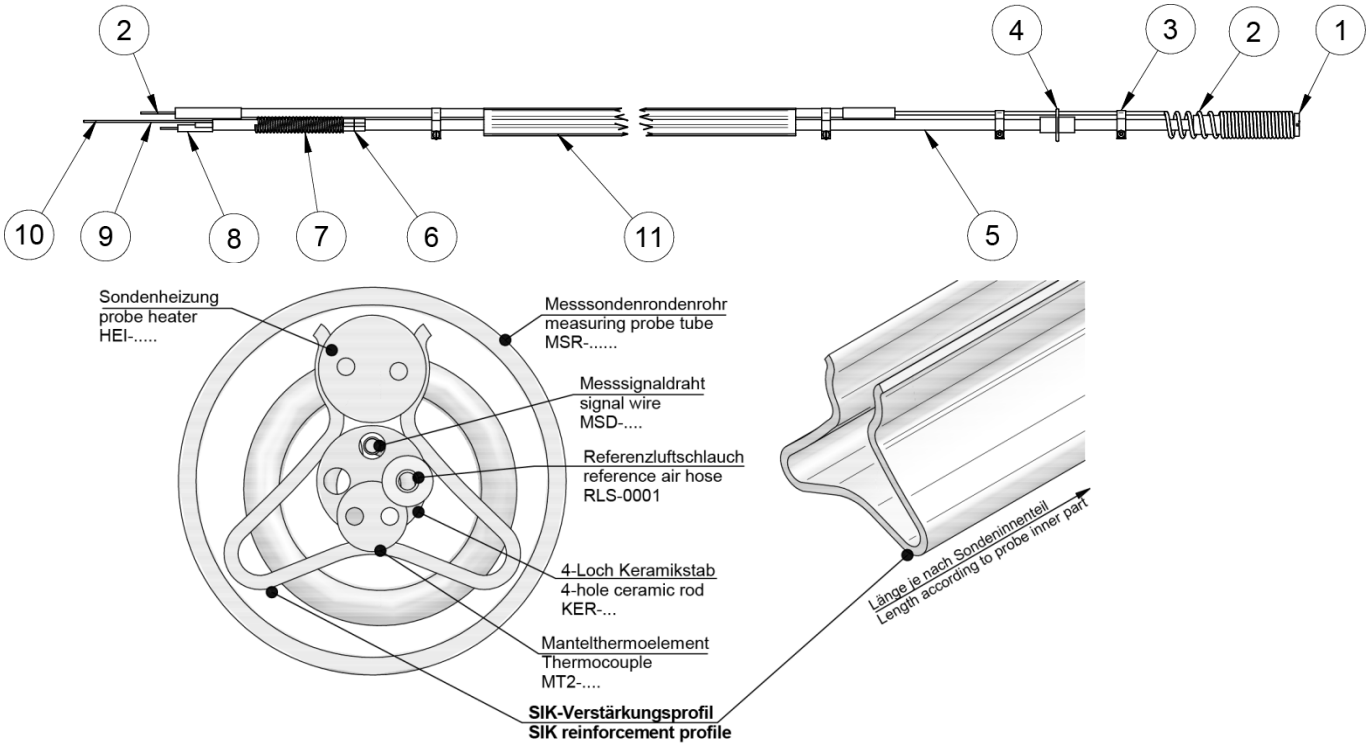
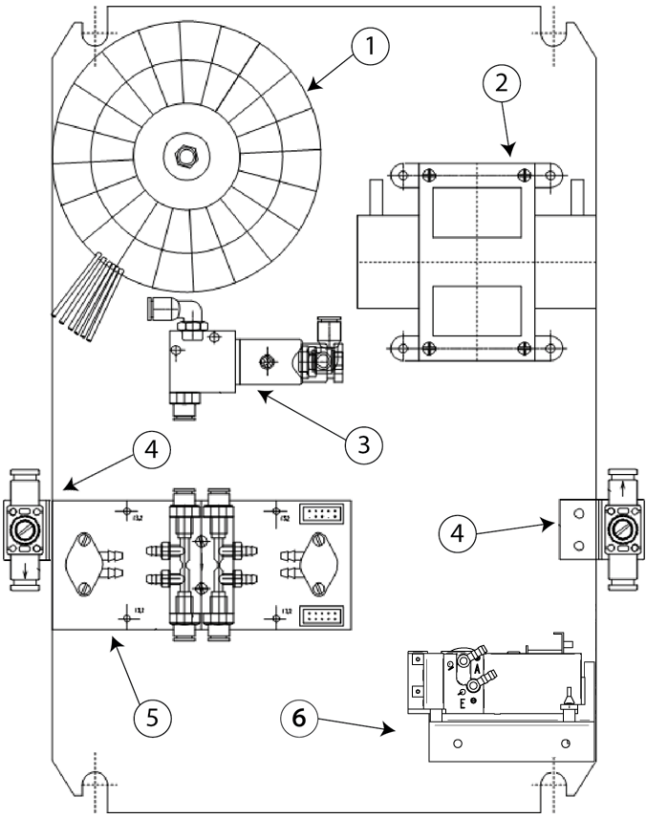


Figure 42 - Reinforced probe inner part assembly (KES/KIS-1323)

Nr.	Description	Article Number (depends on probe type)	
		KES-1321-2	KES-1323 /
1	Heater support tube	**HZH-00002**	**HZH-00002**
2	Heater	**HEI-132X**	**HEI-2001**
3	heater clamp	**0-R-000474**	**0-R-000474**
4	Distance sleeve	**-**	**0-R-000201**
5	Ceramic rod	**KER-132X**	**KER-2001**
6	Tube clamp	**0-R-000500**	**0-R-000500**
7	Spring	**0-R-000044**	**0-R-000044**
8	Thermocouple	**MT2-132X**	**MT2-2001**
9	Reference air hose	**RLS-0001**	**RLS-0001**
10	Signal wire	**MSD-132X**	**MSD-2001**
11	Reinforcement profile		
	Repair kit	**RSI-132X ***	**RSI-2001 ***

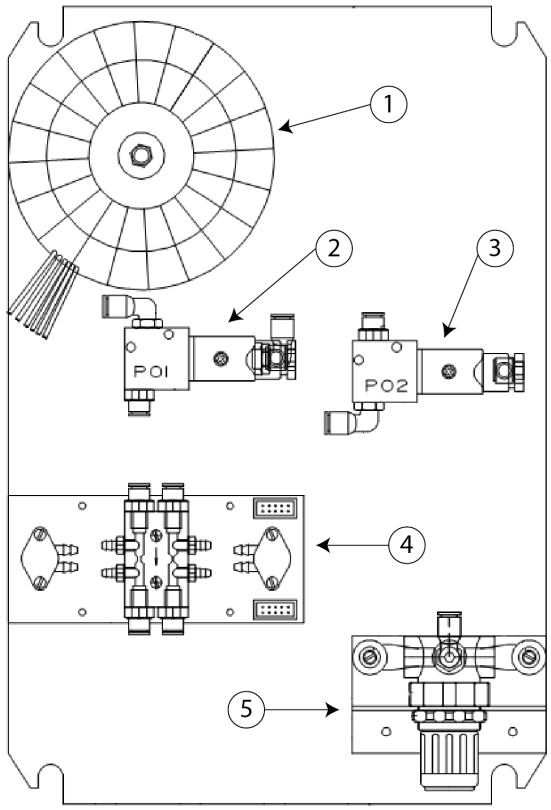
*** consists of pos. 3,4,6,7**

C.3 Mounting Plates of the Electronic Unit



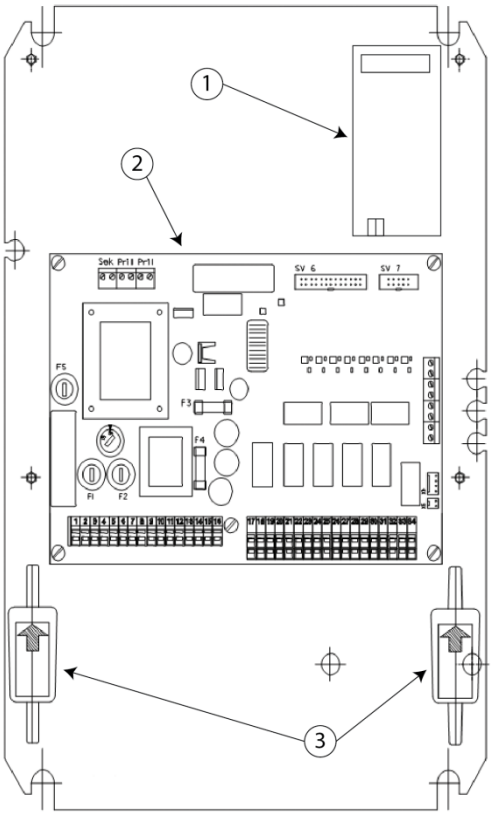
Parts List Test gas and reference air unit with internal		
1	TRA-0017	Transformer prim. 2*115V, sec. 115V
2	PLU-0028	Test air pump for SME5 720 l/h
3	PGM-0001	Test gas solenoid valve P01 for SME53 - with pneumatic unit and fittings
4	0-P-001508	Restrictor one way
5	DFM-00001	Internal flow meter for reference air and test gas SME5
6	PLU-0025	Reference air pump for SME5 30l/h

Figure 43 - Mounting plate 1 (version with pumps)



Parts List Test gas and reference air unit for instrument air		
1	TRA-0017	Transformer primary 2*115V, sec. 115V
2	PGM-0001	Test gas solenoid valve P01 for SME53 - with pneumatic unit and fittings
3	PGM-0002	Test gas solenoid valve P02 for SME5 - with instrument air unit and fittings
4	DFM-00001	Internal flow meter
5	0-P-000752	Pressure regulator

Figure 44 - Mounting plate 1 (version with instrument air)



Parts List **Mounting plate 2**		
1	0-L-000047	Optional mA-output board.
2	0-L-000180	SME5 power board
3	PLF-0003	Filter for reference air and test air - for version with internal pumps

Figure 45 - Mounting plate 2

C.4 Display Board

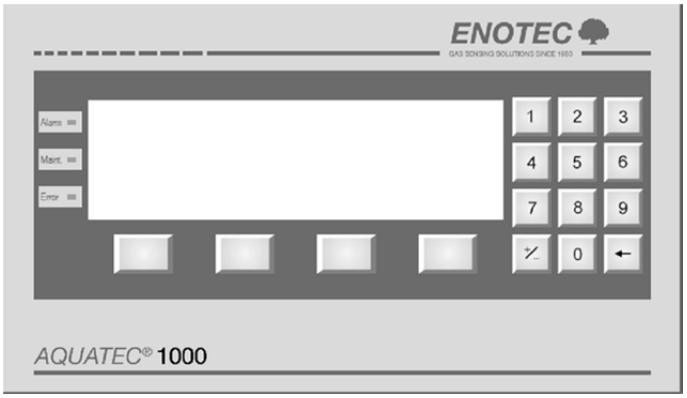


Figure 46 - Display board

Parts List **Display Board**	
0-L-000035+	SME5 display board without pneumatic
0-L-000036+	SME5 display board with pneumatic
0-L-000108+	SME5 display board with CSP with pneumatic
0-L-000110+	SME5 display board with RS232 with pneumatic

D Warranty

E N O T E C W A R R A N T Y

ENOTEC warrants that systems manufactured and sold by it will, upon shipment, be free of defects in workmanship or material. Should any failure to conform to this warranty become apparent during the relevant warranty periods, ENOTEC shall, upon prompt written notice from the purchaser, correct such nonconformity by repair or replacement of the defective part or parts. The purchaser is not entitled to claim any other legal remedies on the basis of this warranty. Please refer to the ENOTEC international warranty conditions for details.

The warranty durations are as follows:

24 months after delivery for systems.
12 months after delivery for spare parts.

ENOTEC accepts no responsibility or liability for defects and damage to ENOTEC products which are to be attributed to the following causes: Wear, corrosion, improper use, unauthorized modifications, inadequate maintenance and non-compliance with the operating instructions.

All ENOTEC products and systems which incorporate a heated sensor must be operated under continuous conditions. If the heater power is switched off and on regularly, the resultant thermal stress for the probe heater, probe thermocouple and sensor will cause a shorter life span. If it is not possible to operate the heated equipment continuously for a longer period of time, please contact ENOTEC for technical advice.

Note: When installing the equipment, the customer must ensure that all necessary supply lines are connected and the operating temperature of the probe is reached. Experience has shown that products installed but not put into operation may be damaged by the process or by external influence. ENOTEC will not accept any responsibility for such damages.

Suitable tools must be used when installing and commissioning ENOTEC products and systems. If any damage is caused due to the use of unsuitable tools, ENOTEC will not accept any responsibility for damages.

MANUFACTURER:

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Höher Birken 6
D-51709 Marienheide, Germany
TEL: +49 (0) 2264 / 45780
FAX: +49 (0) 2264 / 457830
Email: info@enotec.de

E Declaration of Conformity

We hereby declare that the products listed below, based on their conception and design as well as in the equivalent execution which we have brought into circulation, comply with the essential safety and health requirements of the EC-directives as follows. Any unauthorized changes to the products, renders this declaration invalid. The manufacturer carries the sole responsibility for issuing this declaration.

Manufacturer:

ENOTEC GmbH
Höher Birken 6
51709 Marienheide - Germany
Tel.: +49 2264 45 78-0

Product model:

System:	*OXITEC*® 5000, *OXITEC*® Economy
Electronic units:	SME-53, SME-54
Probe types:	KES-1000, KES-132X, KES/KIS-200X, KES-500X

Description:

InSitu oxygen analyzer system

Relevant EC directives:

- 2014/30/EU, electromagnetic compatibility (EMC)
- 2014/35/EU, low voltage directive
- 2014/53/EU, radio and telecommunications terminal equipment directive
- 1985/374/EWG, product liability directive

Applied harmonized standards:

- EN 55011 Kl.B:2009 + A1
- EN 61326-1:2013
- EN 61010-1:2010
- EN 300 328:V2.1.1
- EN 301 489-1:V2.1.1
- EN 301 489-17:V3.1.1

Marienheide, 09.06.2017

Manufacturer signature: _____

Fred Gumprecht
Managing Director

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