Operating Instructions
ZIRKOR100

Oxygen Analyzer

Endress+Hauser
People for Process Automation

Notes concerning this Manual

This manual contains important information about the design, installation, commissioning, operation, maintenance and troubleshooting. Safe work with the ZIRKOR100 requires the users to become familiar with all warnings, safety instructions and maintenance aspects of this manual.

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 in this manual
	**Warning hot Surface** Warns of danger of burns which could occur from hot system parts
	**Attention** Warns of risks by destroying the system or its components or its functionality

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

Safety Instructions

The ZIRKOR100 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 ZIRKOR100 requires safe transportation, professional storage, installation, operation and maintenance.

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

ZIRKOR100 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.

Manufacturer

Endress+Hauser SICK GmbH+Co. KG
Bergener Ring 27
01458 Ottendorf-Okrilla
Deutschland

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1 System Description

1.1 System Overview

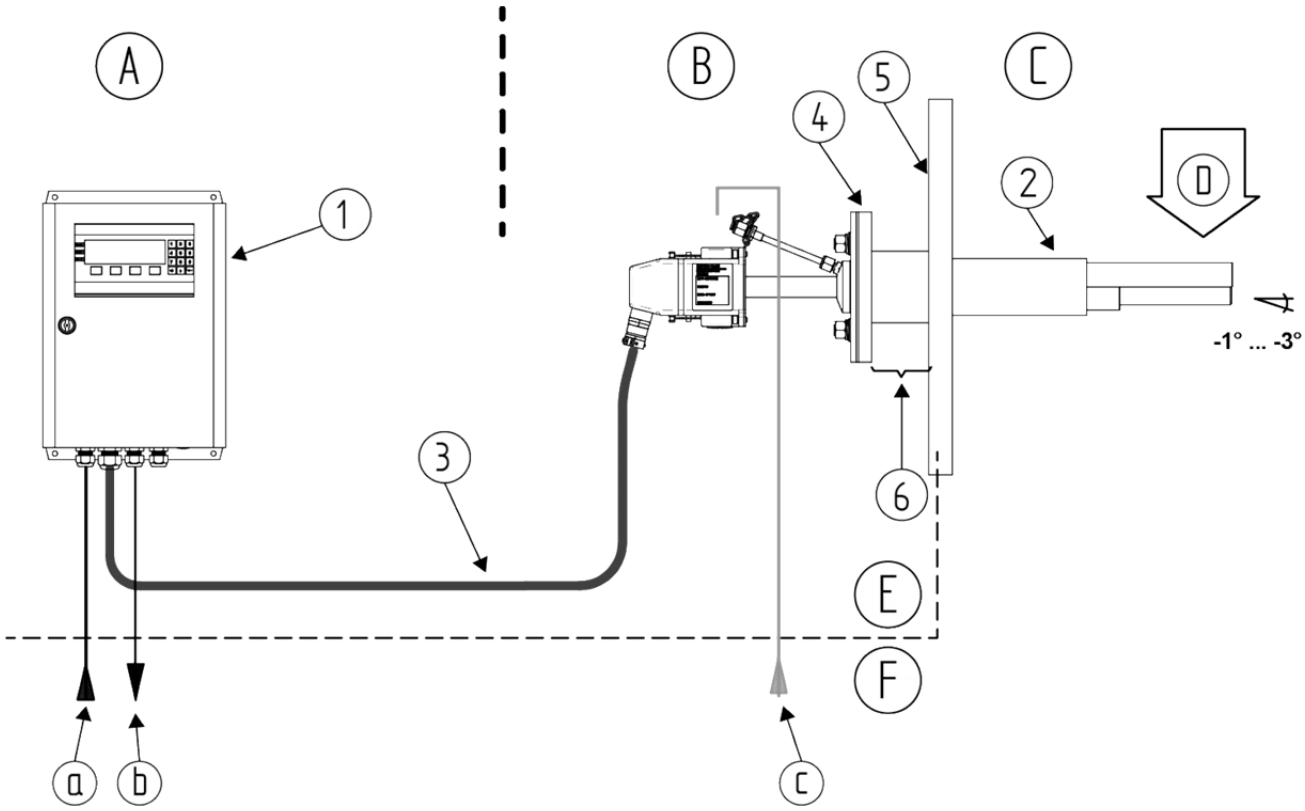


Figure 1 – ZIRKOR100 system (for flue gas temperatures of up to 400°C)

1	Electronic unit / IP66
2	In-situ probe / IP20
3	O_2 probe signal cable
4	Counter flange (Optional)
5	Duct wall
6	Isolation: Customer

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	Duct / combustion chamber
D	Flue gas direction – max. flue gas temperature 400 °C
E	Manufacturer supply
F	Customer supply
a	Power supply
b	Output signals (analog and digital)
c	Test gas in

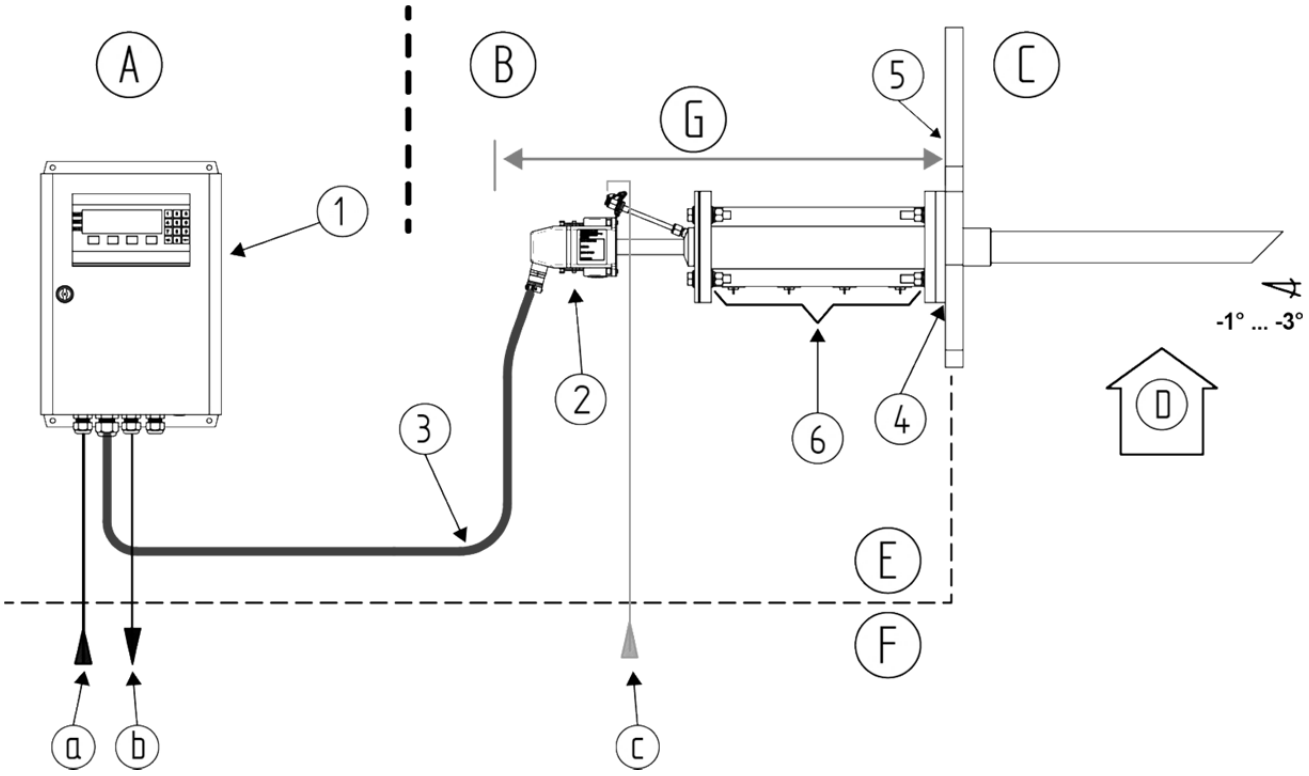


Figure 2 - ZIRKOR100 system (with cooling protection tube for flue gas temperatures of up to 1400°C)

1	Electronic unit SME5 / IP66
2	In-situ measuring probe / IP20
3	O_2 probe signal cable
4	Counter flange (Optional)
5	Duct wall
6	Isolation: Customer

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	Duct / combustion chamber
D	Flue gas direction – max. flue gas temperature 1600 °C
E	Customer supply
F	Manufacturer supply
G	Space required: 1,5 m for standard installation.
a	Power supply
b	Output signals (analog and digital)
c	Test gas in

1.2 Measuring Principle

The ZIRKOR200 O_2 analyzer system consists of an in-situ probe which is installed in a duct 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% O_2) 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.

Should combustible components such as CO or H_2 be present in the sample gas, they will react with oxygen at the sensor surface and can reduce the measured value.

1.3 Intended Use

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!

1.4 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).

1.5 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. Responsibility will not be accepted for resultant damage.

1.6 Storage instructions

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

1.7 Name Plates

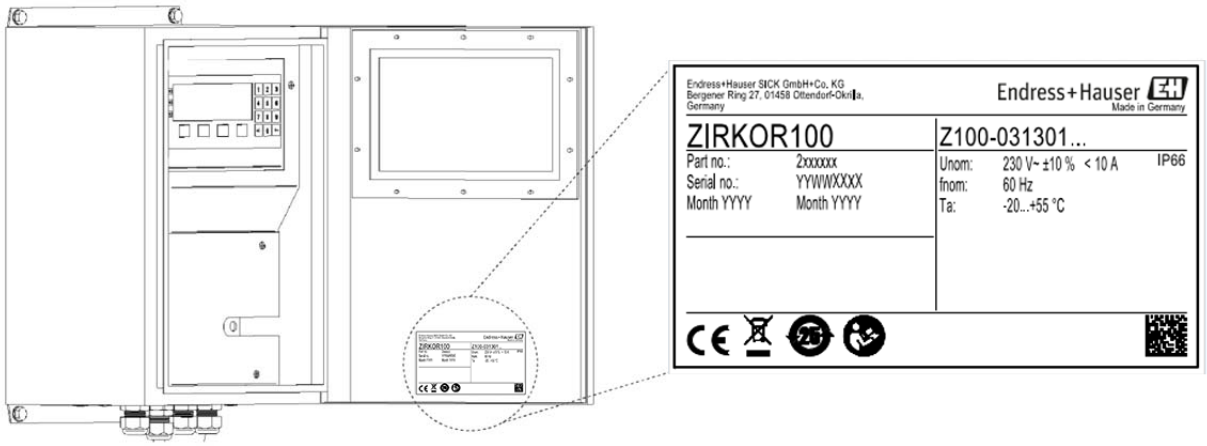


Figure 3 - Name Plate Electronic Unit

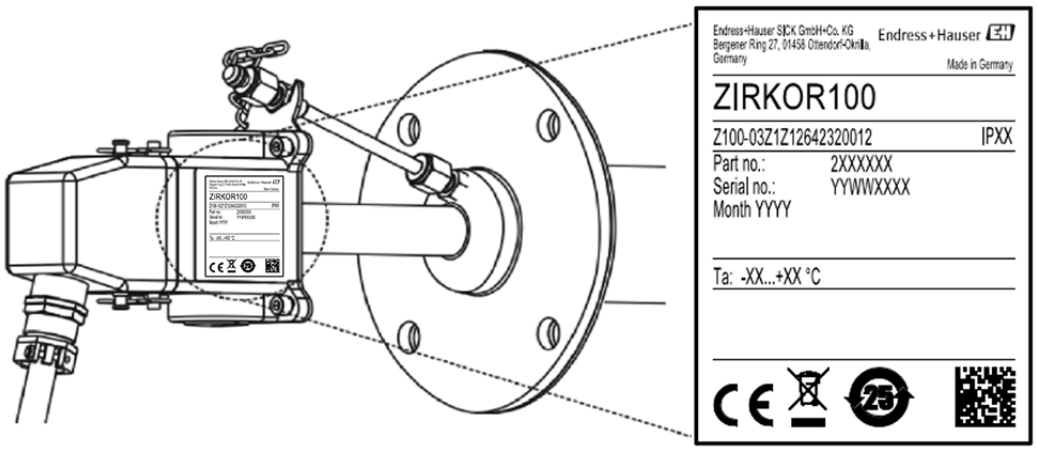


Figure 4 - Name Plate O_2 Probe

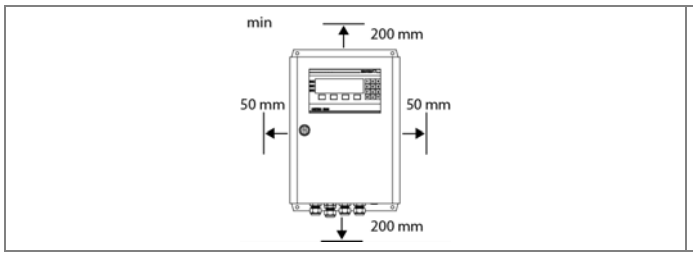
The name plates contain year of manufacture, probe serial number, O_2 sensor number and system order code. The system order code contains detailed system information which is detailed in the system test report and is supplied with the system.

2 Installation

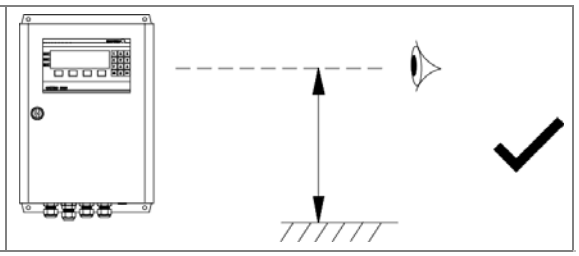
Warning

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.

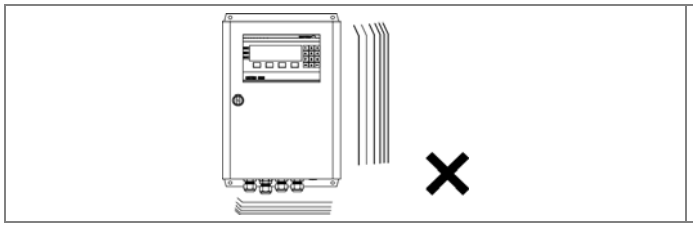
2.1 Installation Requirements for Electronic Unit



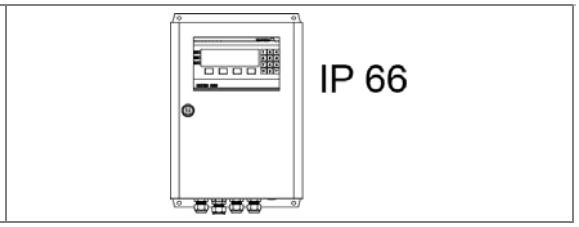
Keep the minimum distance to adjacent objects



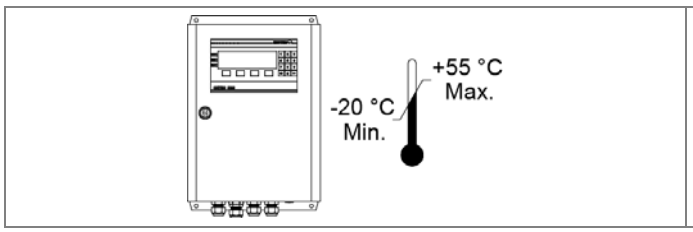
Install at eye level



Avoid vibrations greater than 2g



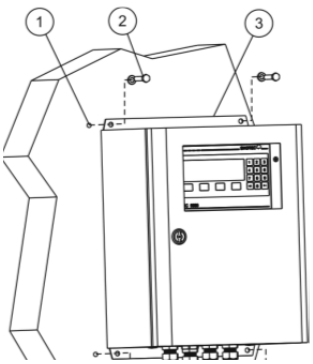
Mind the IP code



Heavy equipment, ensure proper lifting and carrying

Ambient temperatures

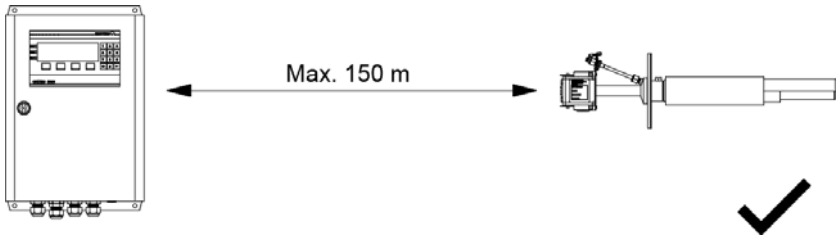
Min.: -20 °C (-4 °F) / Max.: +55 °C (+131 °F)



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

Figure 5 - Installation of the Electronic unit

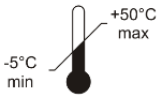
2.2 Installation of Probe Signal Cable



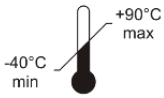
Abide by the maximum cable length (max. 150m)

Cross the probe signal cable ① at right angle to power supply cables.
Note the minimum bending radius

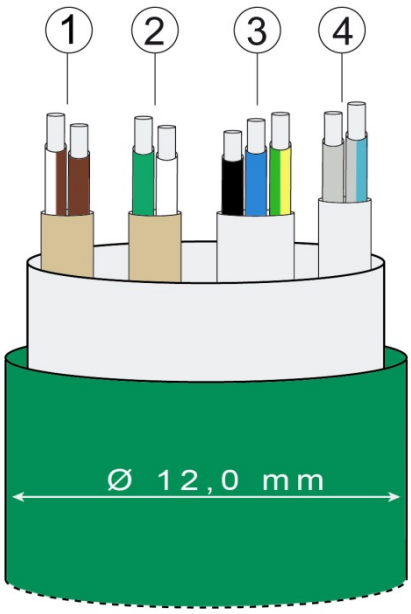
Ambient temperatures



Temp. during installation



Temp. during operation



Probe Cable				
No.	Function	Diameter	Colours	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 0,75mm^2	grey / grey-blue	

Figure 6 - Probe cable

Warning
The shielding of the probe cable must be connected only to the electronic unit ground (PE) clamp. Do not connect the shield of the probe cable probe.

2.3 Access to the Terminals

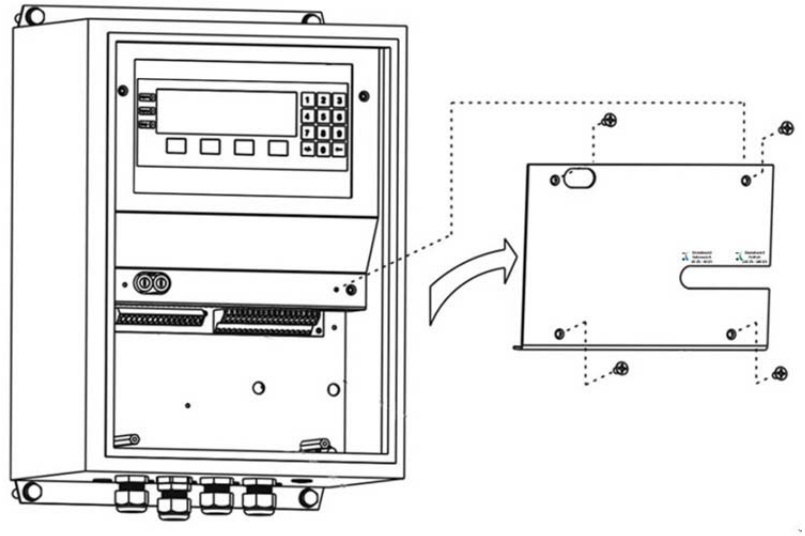


Figure 7 - Access to the terminals

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 Electrical Connections of the Electronic Unit

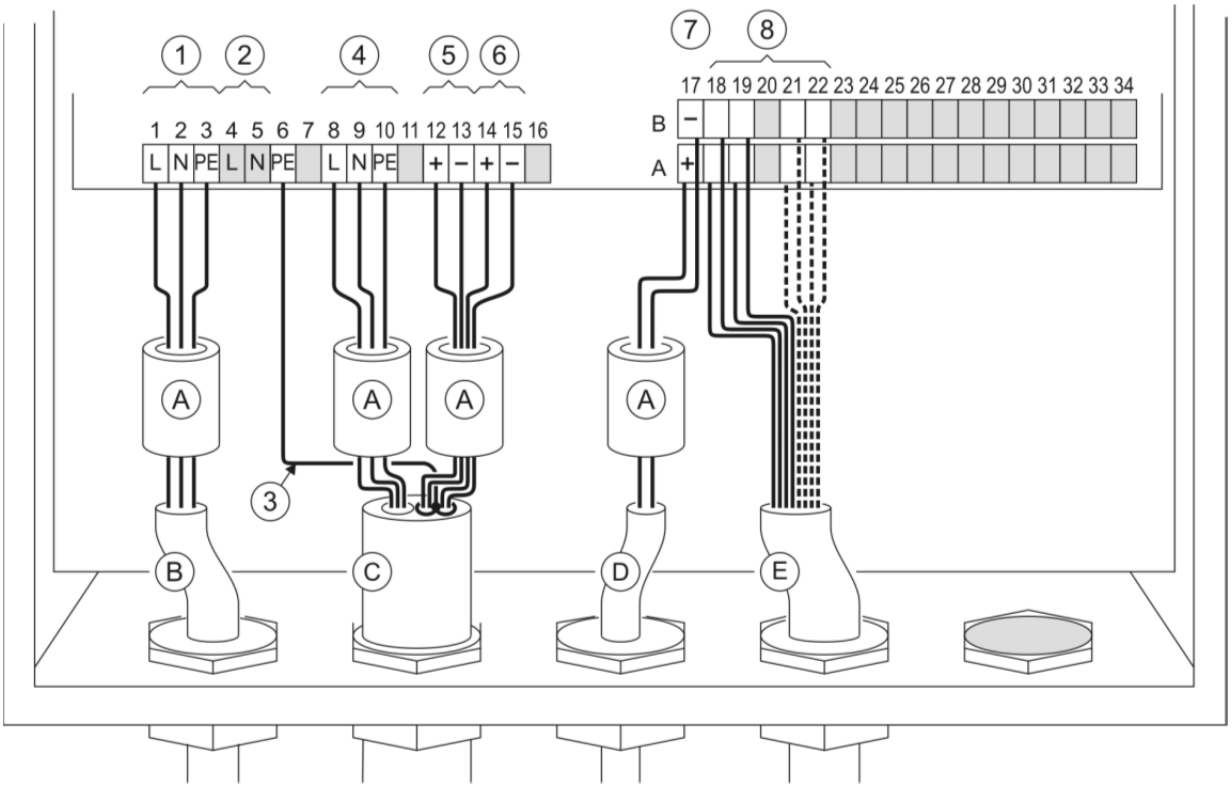


Figure 8 - Electrical connections of the electronic unit

Ⓐ Ferrite sleeves (enclosed)

Ⓑ Line voltage supply cable (Customer)

Ⓒ O_2 Probe cable (already connected)

① Line Voltage[1]

1	L	Phase
2	N	Neutral Conductor
3	PE	Ground Earth

② Internal Power Supply (not in use)

4	L	
5	N	

③ Shielding

6	PE	

④ O_2 Probe heater 0-115V AC (controlled)

8	L_H	black, phase
9	N_H	blue, neutral conductor
10	PE	green/yellow, protective earth conductor

Ⓓ Analogue output cable (Customer)

Ⓔ Digital output cable (Customer)

⑤ O_2 Sensor Signal

12	+	brown
13	-	brown/white

⑥ thermocouple

14	+	green
15	-	white

⑦ O_2 Analogue Output 4-20 mA[2] (active)

17 A / B	A + / B -

⑧ Relays contact Outputs[3]

18 A / B	Maintenance
19 A / B	System fault
21 A / B	O_2 Limit alarm 1[4]
22 A / B	O_2 Limit alarm 2[5]

[1] Line voltage, frequency and rated current, see electronic name plate [2] Isolated mA output, Burden see technical data electronic unit

[3] Voltage and current limits see technical data electronic unit

[4] Option

[5] In certain applications, it is possible that the contact function is inverted

2.6 Electrical Wiring Diagram

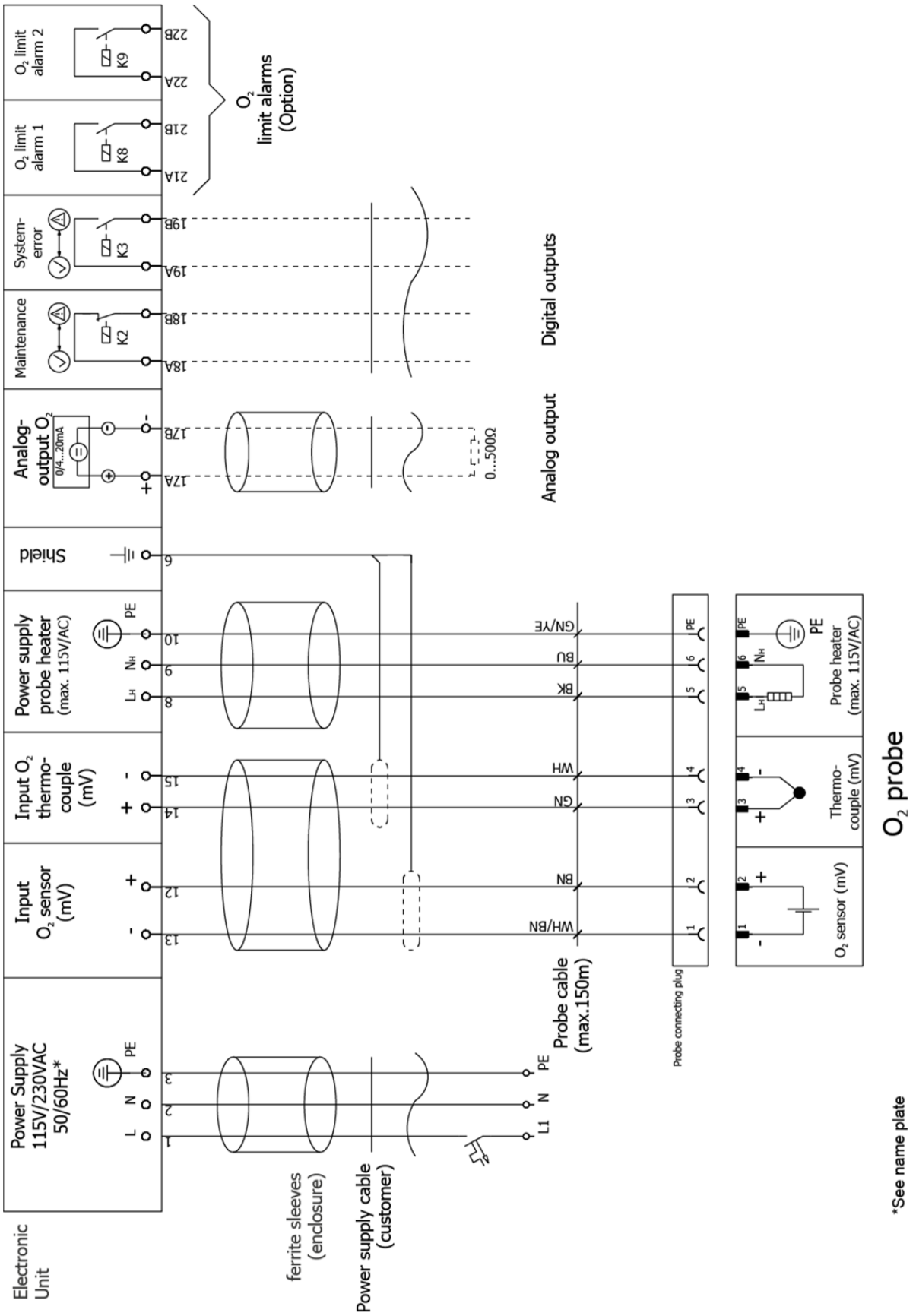
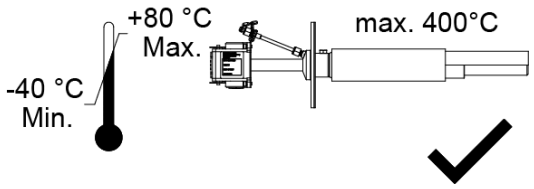
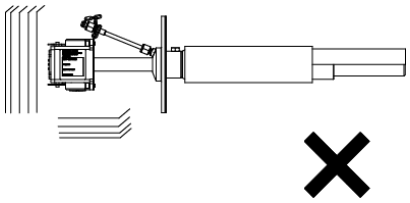


Figure 9 - Electrical wiring diagram

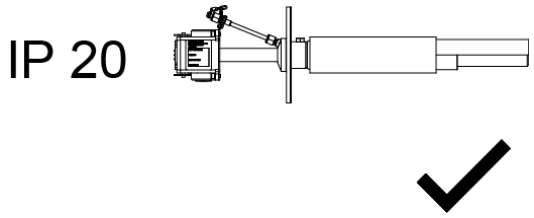
2.7 Installation of the Probe



The ambient temperature at the connection box and process temperatures may not be exceeded



Avoid vibrations greater 2g

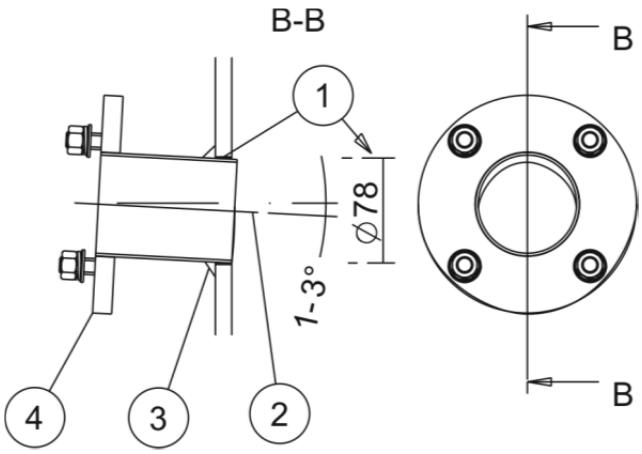


Maintain the protection class of the connection box

2.8 Install O_2 Probe

2.8.1 Welding of the Counter Flange

!	**Caution** The counter flange must be welded gas tight to the duct wall at the required angle. Make sure that the combustion process is not in operation and the temperature of the flue gas duct at the mounting place allows work without any risk of burns.

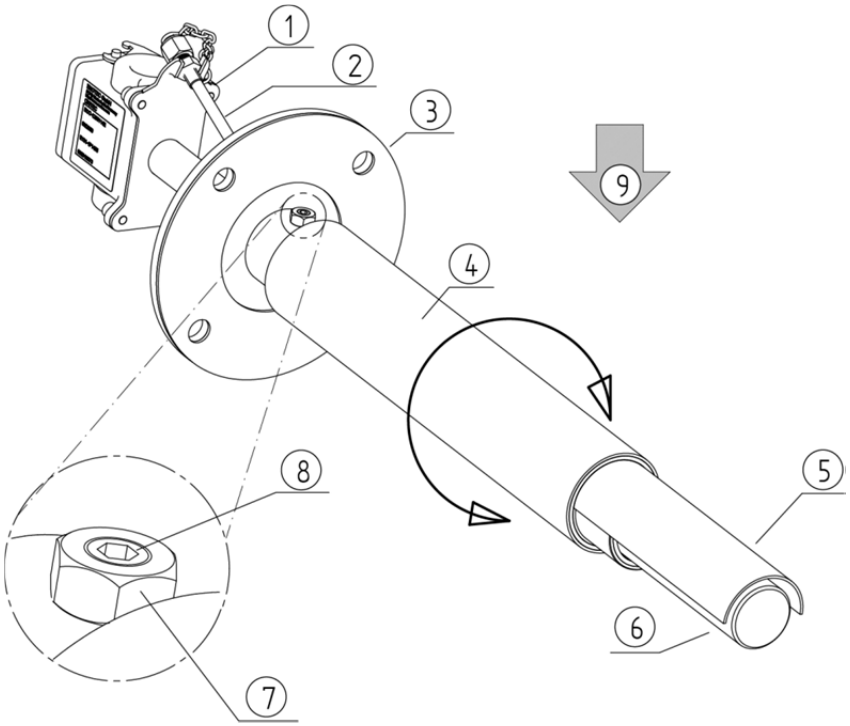


①	Flue gas duct for the probe counter flange
②	Counter flange which has been welded at correct angle to duct
③	Weld must be gas tight
④	Duct flange (optional)

Figure 10 - Welding of duct flange

2.8.2 Adjustment of the probe filter head

	Info Please take note of the flue gas flow direction at the place of installation

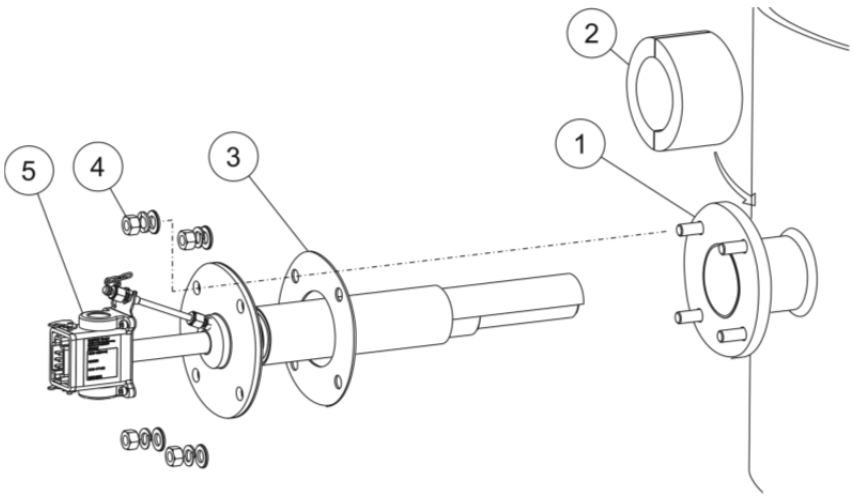


1	Connection plug
2	Test gas connection
3	Probe flange
4	Filter head
5	V-Shield
6	Filter
7	Nut
8	Hexagon socket
9	Flue gas direction

Figure 11 - Filter head adjustment

2.8.3 Installation of the O_2 Probe

	Caution For probe installation into the duct flange use only new and undamaged gaskets ③ . Tighten the flange nuts ④ correctly to get a gas tight flange connection. Insulate the duct flange ② to prevent against dew point corrosion problems. Do not leave the O_2 probe unheated inside of the duct for a period longer than 30 minutes.

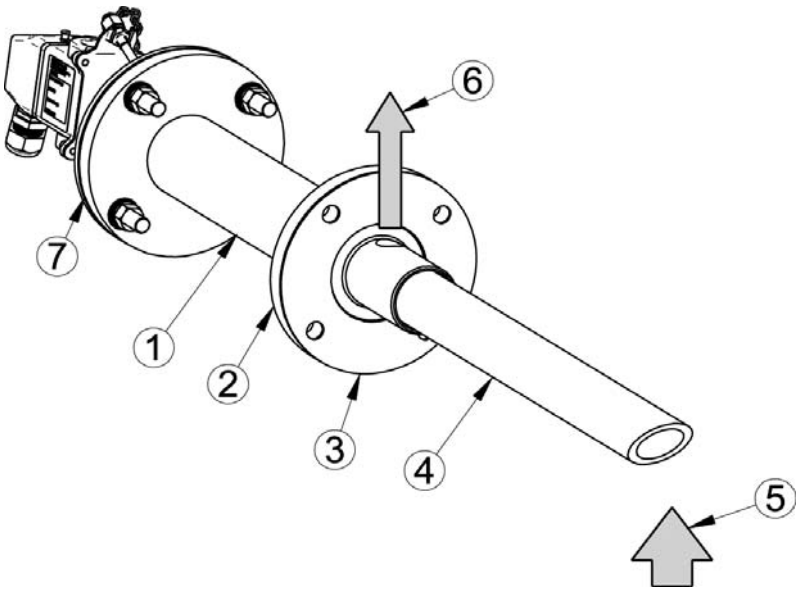


1	Duct Flange
2	Insulation of the duct flange
3	Probe flange gasket
4	Nut M12 with washer and spring
5	O_2 probe terminal socket

Figure 12 - O_2 probe Installation

2.8.4 O_2 Probe installation with Cooling Protection Tube

!	**Caution** Make sure that the process gas outlet is not blocked. Adjust the cooling protection tube so that the gas exit is directed into the flue gas flow direction



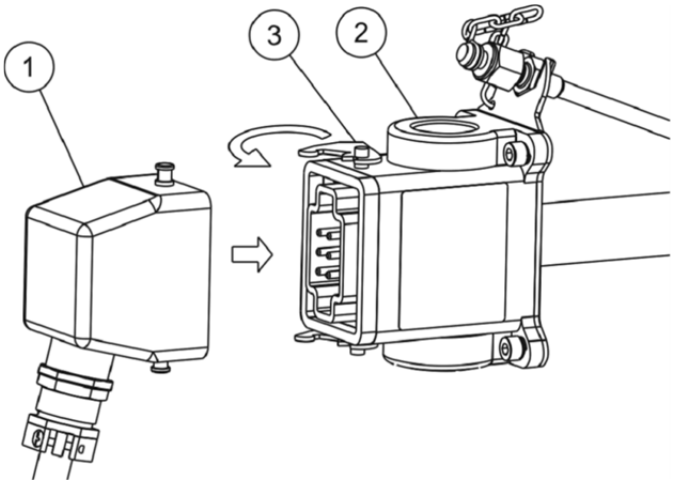
1	Cooling protection tube
2	Protection tube flange
3	Counter flange
4	Nut M12 with washer and spring
5	Process gas direction
6	Process gas outlet
7	Flange gasket

Figure 13 - O_2 probe installation with cooling protection tube

2.8.5 Relay Contacts, Functions

Relay Contact for	Contact closed	Contact open
System fault	No System fault	System fault has occurred (error code on display)
Maintenance	System switched off or Maintenance active	No maintenance
O_2 Limit alarm 1 (optional)	O_2 Limit alarm 1 not active	System switched off or O_2 Limit alarm 1 active
O_2 Limit alarm 2 (optional)	O_2 Limit alarm 2 not active	System switched off or O_2 Limit alarm 2 active

2.8.6 Probe Connection



O_2 Probe plug ① has to be inserted into the probe socket ② and locked with the retaining clip ③.

Figure 14 - Probe connection

3 Initial operation

3.1 Checklist before commissioning the system

- Is the serial number of the probe identical to the serial 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 **1.7 - *Name Plates***)
- Is the electrical wiring connected correctly? (See section **2.6 - *Wiring Diagram***)
- 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 – *Install O_2 Probe***)
- Do the conditions at site match the specification in the data sheets? (See section **7 - *Technical Data***)

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**, **System time,** enter a **TAG number** and **REMOTE code** (only if option REMOTE is factory activated).

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

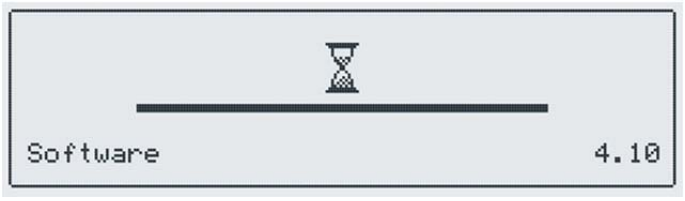


Figure 15 - System Power up. Note the software version at the bottom right of the display.

3.3 Display - Probe Heating Phase

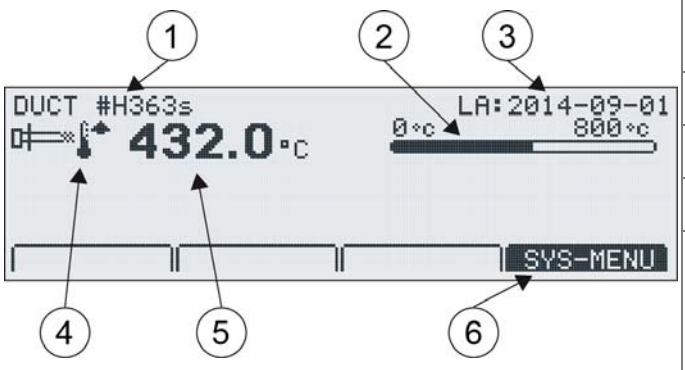
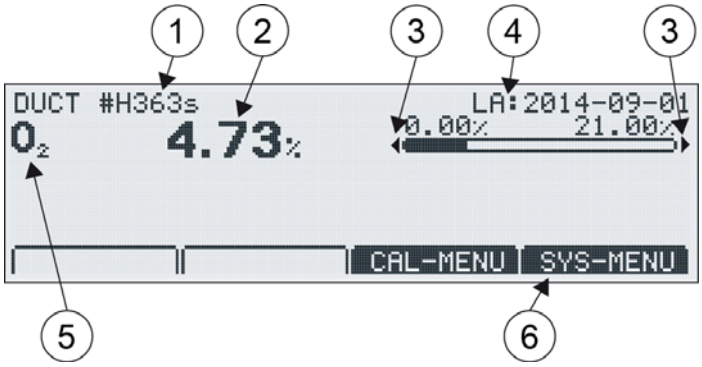


Figure 16 - O_2 sensor heating phase

The probe heating phase begins with the heating up of the O_2 sensor.		
①	TAG number	
②	Analogue temperature bar	
③	Last access with corresponding date	
④		Rising probe temperature
		(or) waiting period
		(or) heater error
⑤	Current temperature	
⑥	Softkey title: e.g. System menu	

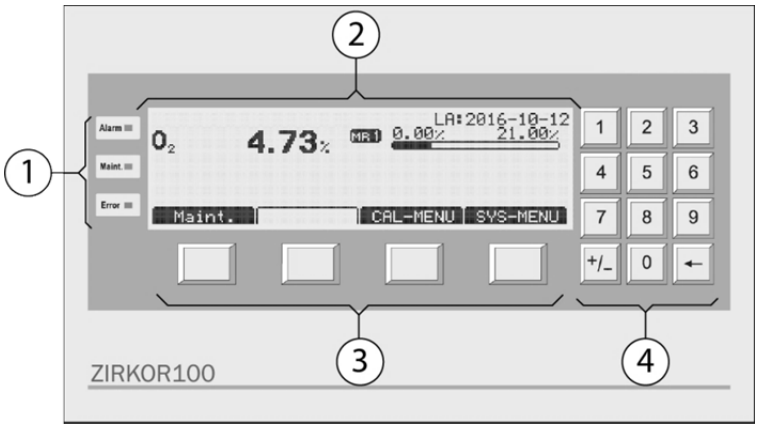
3.4 Display - Measuring Mode



1	TAG number
2	Measured value
3	Blinking indicators showing under or over measuring range
4	Last access
5	Measured component
6	Softkey titles

Figure 17 - Measuring mode

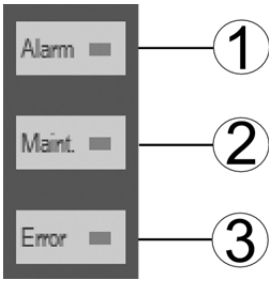
3.5 Keypad and Display



The controls and display 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 18 - 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 downwards
- 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 measurements are therefore also protected.

4 Software Overview and Explanations

4.1 Software Overview - SYS-MENU

SYS-MENU

- System Information
- ✓ Actual measured values
  - O_2 measured value (% O_2)
  - O_2-mA output 17A/B (mA)
  - O_2 sensor input (mV)
  - O_2 probe temperature (°C / °F)
  - O_2 probe heater power (%)
  - Thermocouple input (mV)
  - Terminal temperature (°C / °F)
  - Internal temperature (°C / °F)
  - O_2 sensor life (%)
- Calibration results
- ✓ e.g. 2011-01-31 (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)
  - O_2 voltage at test gas (mV) } *only if determined*
  - 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 ZIRKOR100
  - ~~ Options ~~
- ← ← ←

SYS-MENU

System configuration

O_2 Measuring ranges

Meas.range from (% O_2)

Meas.range to (% O_2)

mA output type (0-20 mA / 4-20 mA)

mA output on system error (mA)

O_2 sensor calibration values

O_2 cal.value - offset (mV)

O_2 cal.value - slope (mV/dec)

Calibration settings

Time per test gas apply (Min.)

Delay time to process (Min.)

System clock/TAG number

System date (yyyy-mm-dd)

System time (hh:mm:ss)

TAG

REMOTE settings (optional)

REMOTE (ON/OFF)

REMOTE-Code (8 digit code)

Range (Short / Medium / Maximum)

Measuring units

Temperature (°C / °F)

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)

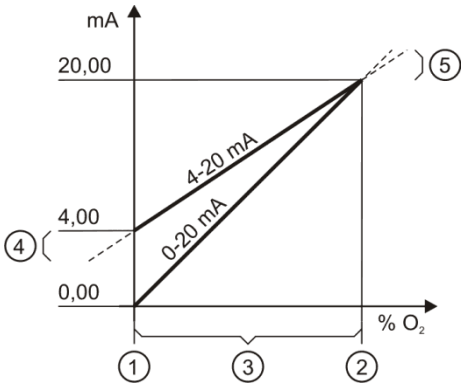


Figure 19 - O_2 Measuring Ranges

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 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.

4.2.3 O_2 limit alarm settings

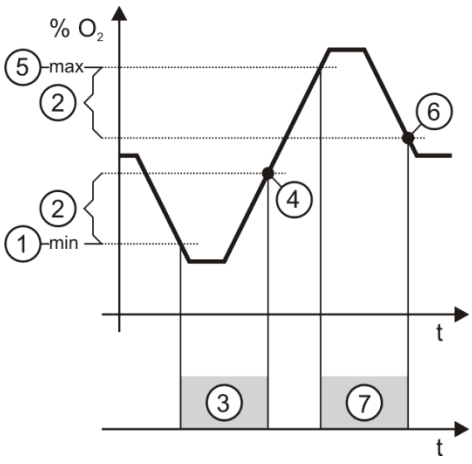


Figure 20 - O_2 limit alarm settings

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.

4.2.4 O_2 Sensor calibration values

i	**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.

4.2.5 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.

4.2.6 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.

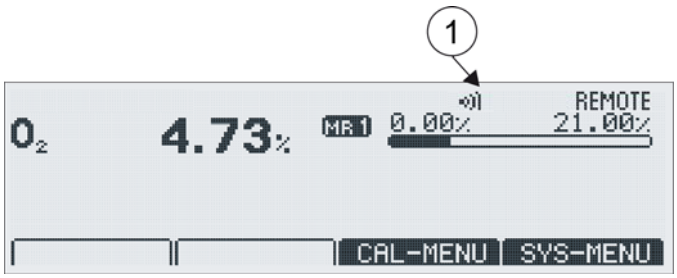
4.2.7 REMOTE

	**Info** If REMOTE is set to "OFF", password and range are not displayed.

The REMOTE password is used for:

- Authentication and pairing with a smartphone / tablet / laptop / pc.
- Authentication / 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 REMOTE module. **Maximum** = 100m, **medium** = 10m, **short** = 1m. The actual possible range may vary due to structural factors and the reception strength of the strength of the Smartphone/Tablet.



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

Figure 21 - REMOTE connection active

	**Info** A maximum of 16 users (smartphones /tablets) can connect to the REMOTE module of an analyzer. Should additional users attempt a connection, the connection will fail. In this case, manually switch off the REMOTE and switch it back on again **SYS MENU => System configuration => 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.

4.2.8 Measuring units

Measuring units can be set for temperature (°C / °F).

4.2.9 Language

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

4.2.10 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.**

4.2.11 Load factory settings

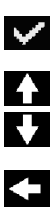
Loading factory settings will restore all original settings and values to the default values programmed in the factory. If activated, all set parameters and also values such as sensor calibration values and calibration results are lost. Take note of the sensor calibration values beforehand and re-enter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

4.2.12 Service

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 CAL MENU

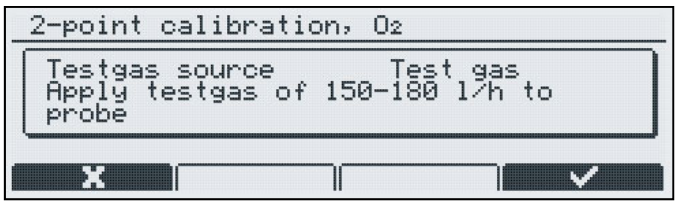
CAL MENÜ



1 point calibration, O_2

2 point calibration, O_2

4.3.1 Check Test air / Test gas settings



Check and confirm test air/ test gas flow rate before commencing with the calibration

Figure 22 - Confirm test air/ test gas flow rate

4.3.2 Calibration Menu - Display Overview

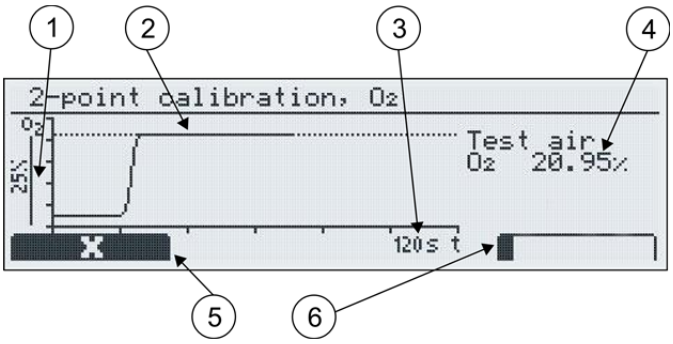


Figure 23 - Calibration overview

(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)	Current measured value of O_2
(5)	Abort the calibration
(6)	Progress bar

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.

4.3.3 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. Test air needs to be applied manually and the flow rate 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
(4) The calibration process is carried out with test air
(5) Prompt to end the test air application
(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

4.3.4 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. Test gas/air needs to be applied manually and the flow rates 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
(4) The calibration process is carried out
(5) Prompt to apply test air
(6) The calibration process is carried out with test air
(7) Prompt to end the test air application.
(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 Check

O_2 Sensor check

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

Source: **Test gas**
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)

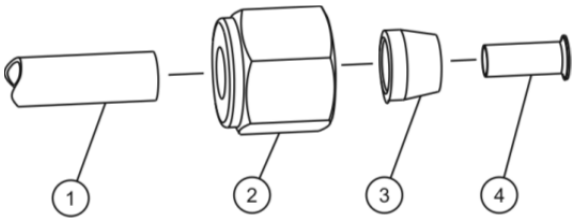
Check relay outputs

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)

5 Service and Maintenance

5.1 Test Gas Tubing (Customer supply)

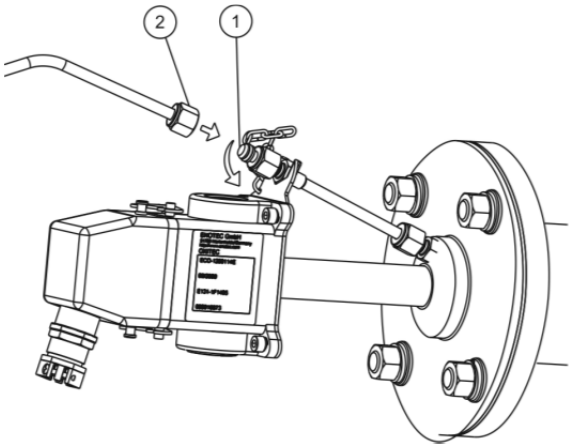
5.1.1 ... preparation



Preparation of the test gas tubing prior to the connection to the O_2 Probe:	
①	Test gas tubing (customer) ¼" or 6/4mm outside/internal
②	Nut (enclosed)
③	Seal ring (enclosed)
④	Support sleeve (enclosed)

Figure 24 - Preparation of test gas tubing

5.1.2 ... connecting

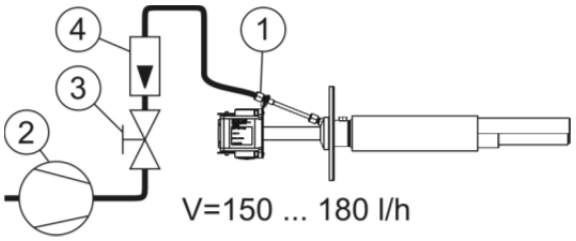


①	Open the test gas port
②	Connect the test gas tube

Figure 25 - Connect test gas tube

5.2 Test Air Supply to the O_2 Probe

5.2.1 ...with Test Air Pump



①	Connect test gas tube
②	Supply test air with a pump
③	Valve for flow adjustment
④	Flow control with flow indicator

Figure 26 - Test air supply

5.2.2 …with Test Gas Bottle

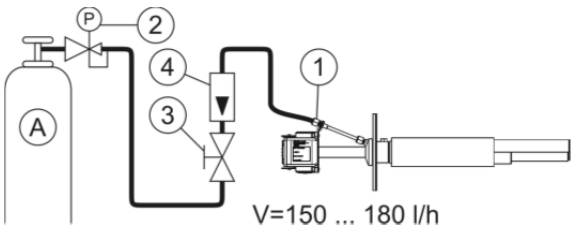
Test Gas “Air“ Specification: 20,95 Vol.% O_2 ± 2% rel. in N_2 (Factory recommendation)
alternative: Instrument Air as follows:

Particle Size: max. 1µm	Oil Content: max. 0,1mg/m³
Particle Density: max. 1mg/m³	Dew point: max. - 40°C

The Supply of a second bottle test gas is described as follows.

5.3 Bottle Test Gas Supply to the O2 Probe

Test Gas Specification: 2,1 Vol.% O_2 ± 2% rel. in N_2



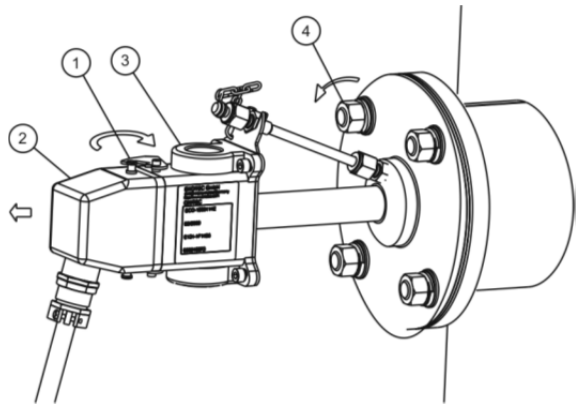
Ⓐ	Test gas bottle
①	Connect the test gas tube
②	Bottle pressure reducer set to max. 2 bar
③	Valve for flow adjustment
④	Flow control with flow indicator

Figure 27 - Test gas supply

5.4 O_2 Probe Dismounting

⚠	**Warning** Disconnect the system from the line voltage supply. Please make sure that the process conditions allow for taking the probe out of the flue duct.

♨	**Warning hot surface** The O_2 Probe, the duct flange, bolts and nuts of the O_2 probe still may be hot. Protective gloves are required.

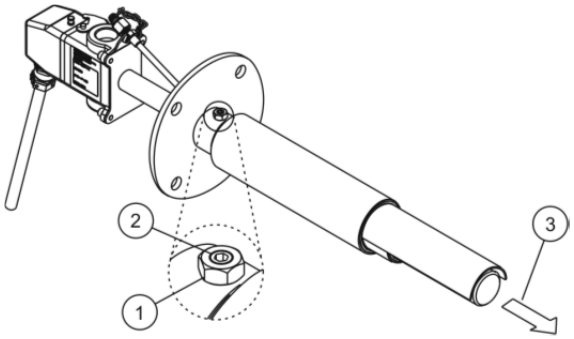


①	Open O_2 Probe locking plug
②	Disconnect the plug from the socket ③
④	Disconnect all 4 nuts M12 with washer and spring and take the O_2 probe (hot) carefully out of the duct flange.

Figure 28 - O_2 probe dismounting

5.5 Exchange the O_2 Probe Filter Head

5.5.1 Remove the Filter Head



①	Loosen counter nut M8
②	loosen Allen key screw M8
③	Remove filter head from the O_2 probe

Figure 29 - Removing the filter head

5.6 Maintenance Intervals

In general, maintenance as well as the maintenance intervals always depends on the flue or process gas conditions in which the probe is installed. Maintenance intervals may therefore vary between a few months up to a few years.

The biggest influencing factors are the presence of corrosive ingredients such as SO_2 or HCl, a continuous reducing atmosphere (reduced oxygen concentration, increased levels of combustibles) and the characteristics of the solid components in the flue gas.
These may have the following effects: chemical or mechanical destruction of the probe, clogging of the filter element or accelerated aging of the sensor. This may lead to a distortion of the measured values as well as an increase in the response time, which can in turn lead to false process operation afterwards.

For this reason, a sensor check is recommended with test gas and test air every six months. If a significant deviation between the values obtained and those presently anticipated, a 2-point calibration should be carried out. A visual inspection of the probe should be conducted at least annually, which includes cleaning of the filter element if necessary.

Notwithstanding these recommendations, the operator must define an appropriate maintenance interval which reflects the criticality of the measurement and the process.

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 heating line 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.
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.
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 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 Changes too high.
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 causes:** 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 are 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

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	
Intermittent contact inside the probe – low spring tension for the O_2 signal contact wire internally	Check the spring tension

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 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 O_2 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. Combustibles in the flue gas. Measuring cell defective	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!**

A Technical Data

A.1 Technical Specifications - Electronic Unit

Housing:	Sheet steel ST37 powder coated RAL2004
IP Code:	IP66
Display:	LC Dot Matrix 240 x 64 LED backlit
Keypad:	Membrane keypad
Signal LEDs:	alarm -orange, maintenance - orange, error -red
O_2 measuring range:	0,00 to 25,00 Vol.% O_2
Accuracy:	± 0,2 % of measured value
Response time:	Change of 100mV at sensor input < 200ms
Mains Voltage:	230V ±10 % 50 to 60 Hz 115V ±10 % 50 to 60 Hz
Power consumption:	350 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
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 (W x H x D)
Weight:	ca. 17 kg
Temperature range - storage:	-40 °C to +80 °C
Temperature range - operation:	-20 °C to +55 °C

A.2 Technical Specifications - Probe

Process gas temperature	max. 400°C/752°F Up to 1400°C/2552°F with cooling protection tube
Insertion depth:	Up to 500 mm
Insertion depth with cooling tube:	Up to 1000 mm
Measuring principle:	Zirconium oxide
Process gas pressure:	-50 to +50mbar (-0.725 to +0.725 PSIG) Others on request
Flow Velocity:	0 to 50m/s
Ambient temperature:	-40°C/-40°F to +80°C/+176°F
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:	IP20
Detection limit:	< 1ppm O2
Power supply:	Through electronic unit

A.3 Technical Specifications - Probe Cable

Design		
Outer sheath	Polyurethane, green (~RAL 6026)	
O_2 probe heater	3 x 1,5mm², black/blue/yellow-green	
Control wire	2 x 0,75mm², grey/grey-blue (not in use)	
O_2 sensor signal	2 x 0,75mm², brown/white-brown	
Compensation line for thermocouple	2 x 0,75mm², green/white	
Dimensions and Weights		
Outer diameter	11,7mm	
Min. bending radius	94mm	
Weight (approx.)	160kg/1000m	
Temperature Range		
Operation	-40°C … +90°C	
Installation	-5°C … +50°C	
Standards		
Flame retardancy IEC60332-1	Amount of halogen acid gas IEC60754-1	Degree of acidity of gases IEC60754-2
Ozone resistance EC60811-2-1 Abs.8	Oil resistance IEC60811-2-1 Abs.10	Exd Zone 1 and 2, group II specific range IEC60079-14

B Dimensional Drawings

	Info All dimensions are in mm.

B.1 O_2 Probes

Probe with filter head for high dust

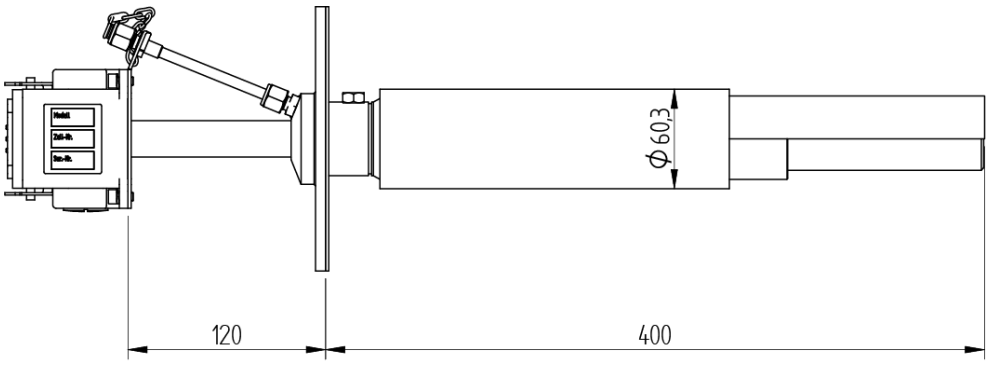


Figure 30 - High Dust Probe (max. 400°C)

Probe with cooling tube

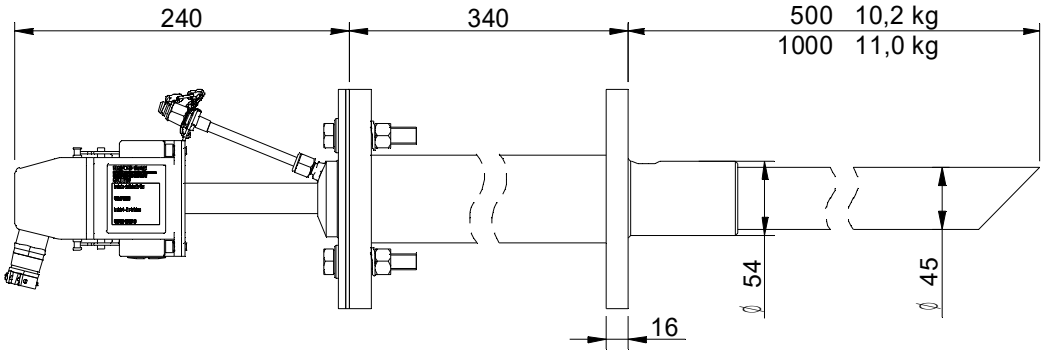


Figure 31 - Low Dust Probe (max. 1400°C)

B.2 Counter Flanges (Optional)

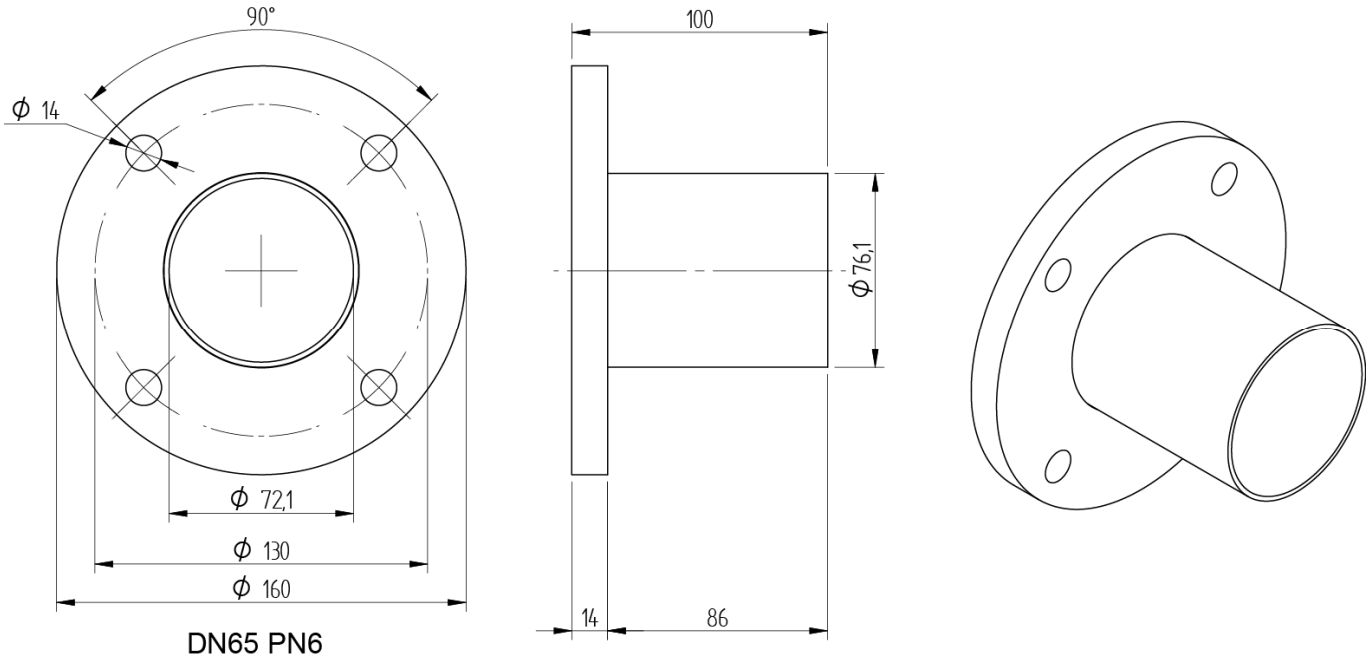


Figure 32 - Dimensions of counter flange

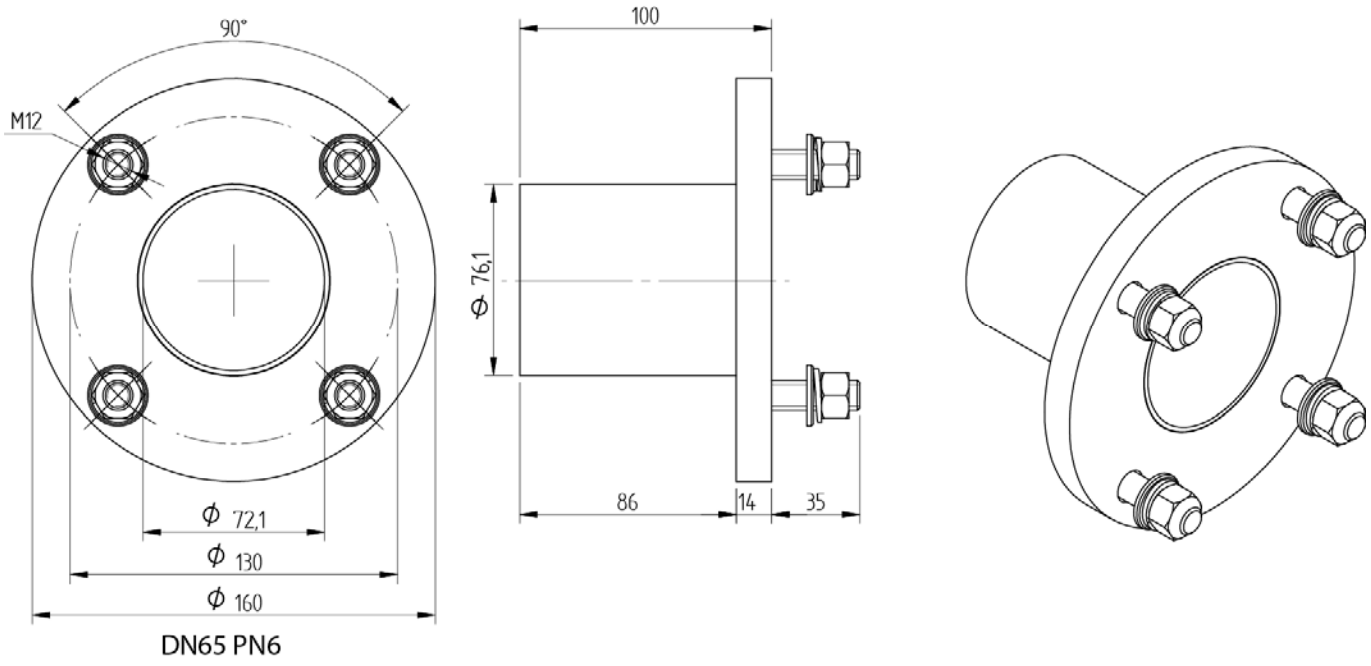
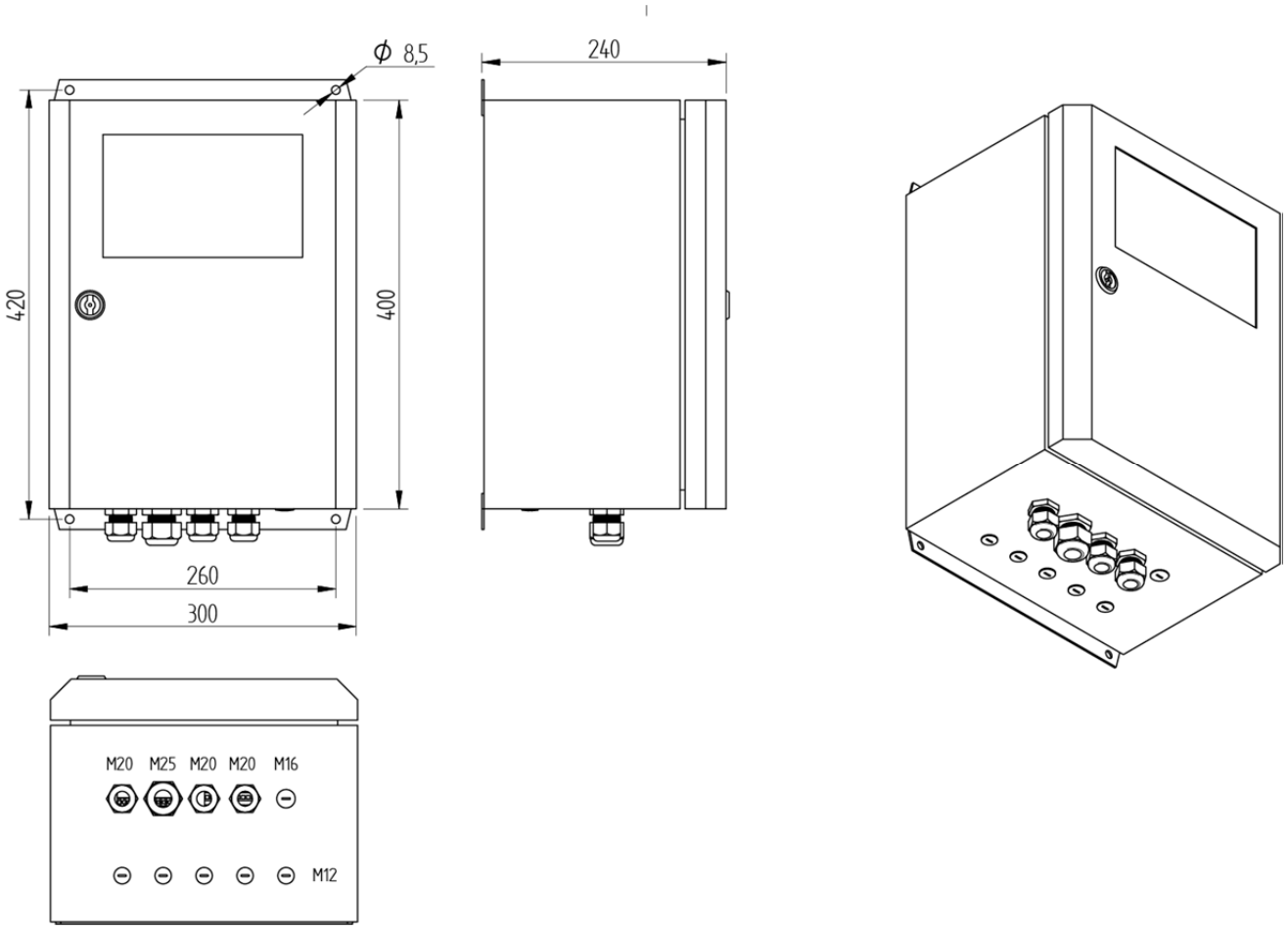


Figure 33 - Dimensions of counter flange

B.3 Dimensions of Electronic Unit

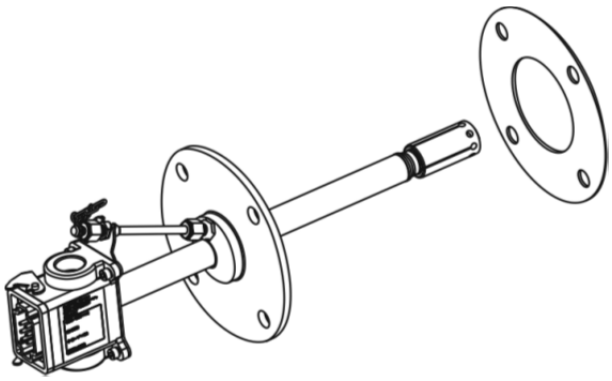


IP 66 (NEMA4)
Weight 17 kg

Figure 34 - Dimensions of electronic unit

C Spare Parts

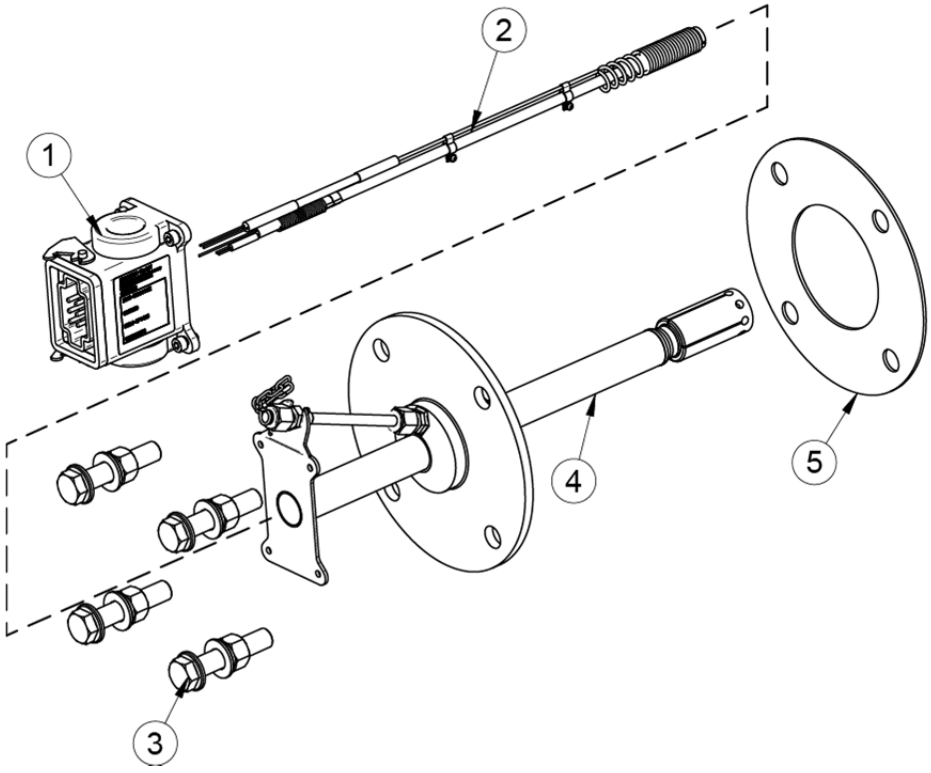
C.1 O_2 Probe without Filter Head



Article No.:	Part description
2089288	O_2 Probe without Filter Head with Flange Gasket
2089293	Probe Flange Gasket

Figure 35 - O_2 probe

C.2 O_2 Probe Components



1	Connection Box	2089297
2	Probe inner part assembly	2089269
3	Screws M12 x 60	
4	Probe tube	2089307
5	Flange gasket	2089293

Figure 36 - O_2 probe components

C.3 Components of the Cooling Tube

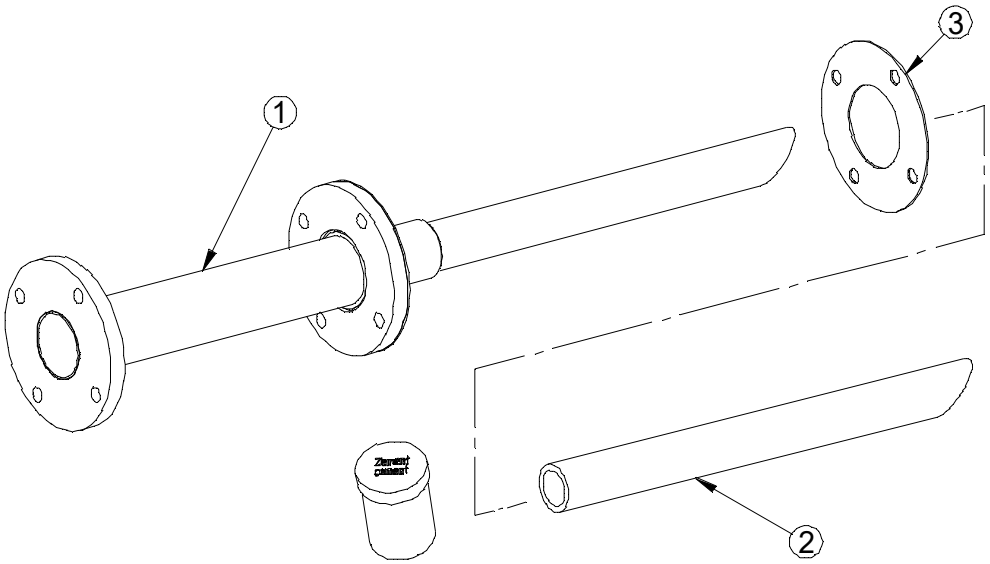
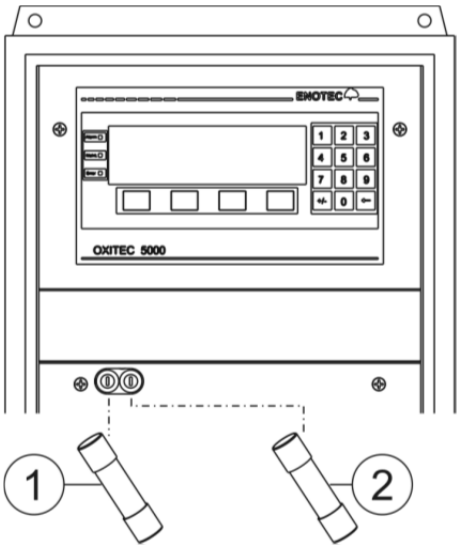


Figure 37 - Cooling tube components

No.	Article No.	Description
①		Cooling Tube with immersion depth 500mm Cooling Tube with immersion depth 1000mm
②	2089372 2089373	PROTEC® Spare Tube 500mm PROTEC® Spare Tube 1000mm
③	2089293	Cooling Tube Gasket

C.4 Electronic Unit



①	Article No.	Description
②	2089370	F1, Main Fuse 6,3A Medium 5x20mm
③	2089370	F2, Fuse O_2 Probe Heater 4A Medium 5x20mm

Figure 38 - Electronic unit - main fuses

Electronic Unit (continued)

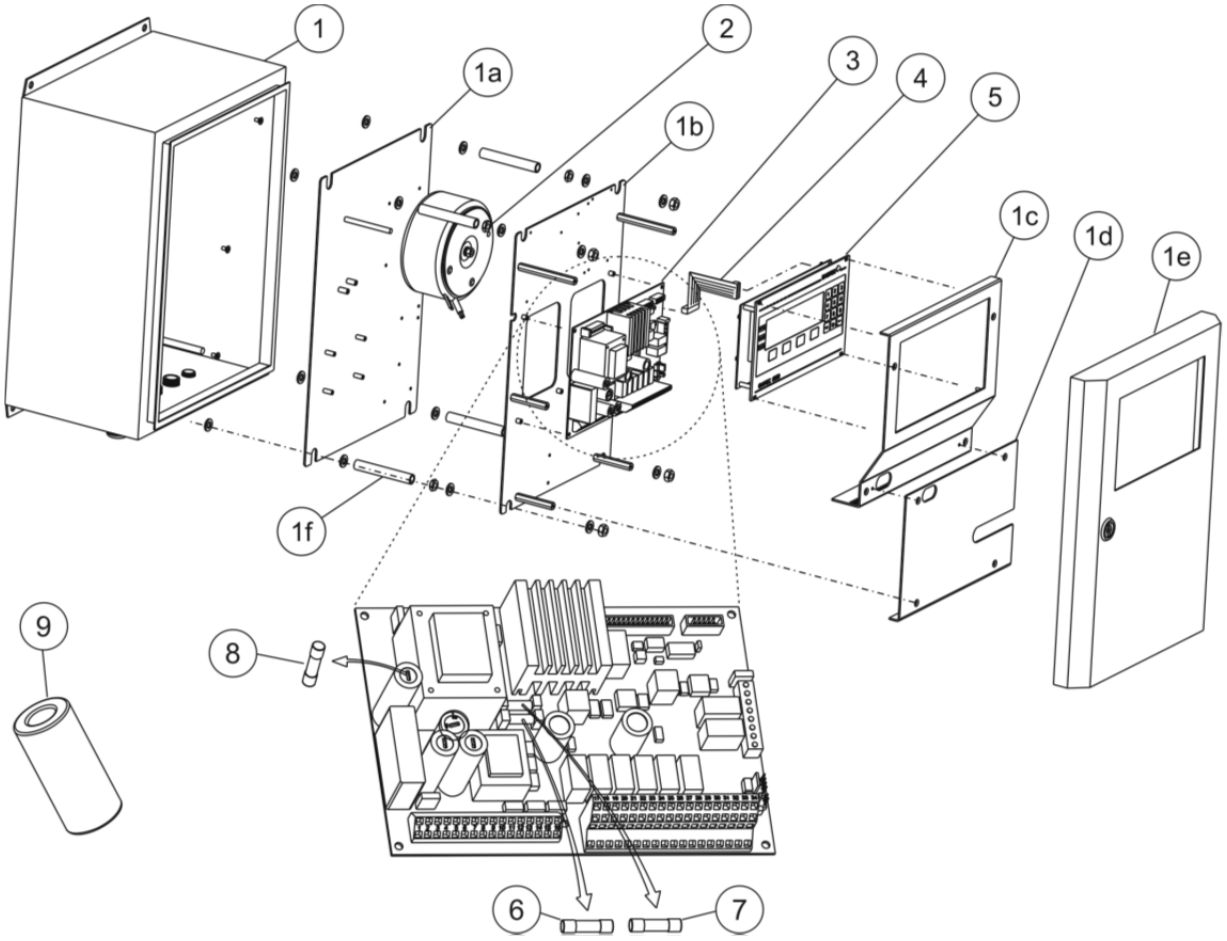
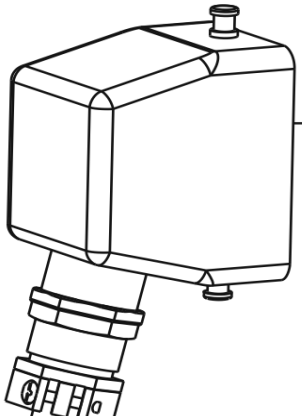


Figure 39 - Electronic unit components

No.	Article No.	Description
①		Housing (with ⑯, ⑯, ⑯, ⑯, ⑯ and ⑯)
⑯		Lower Mounting Plate
⑯		Upper Mounting Plate
⑯		Cover Front plate
⑯		Cover Terminals
⑯		Front Door
⑯		Distance Bolts
②	2089317	Transformer for Probe Heater
③	2089319	Power Board
④	2089316	Flat Cable 26pol.
⑤	2089322	Display board with software
⑥	2089370	F3, Internal Fuse1A Fast 5x20mm
⑦	2089370	F4, Internal Fuse 1A Fast 5x20mm
⑧	2089370	F5, Internal Fuse 1A Medium 5x20mm
⑨		Ferrite Sleeve

C.5 Probe Cable with Plug

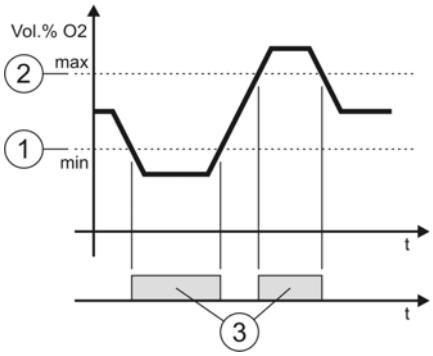


Article No.	Description
2093731	O_2 Probe Connection Plug with socket insert and screw

Figure 43 - Plug

D System Options

D.1 O_2 Limit Alarms



The option O_2 limit alarms observes if the actual O_2 Values are above or below of the adjusted O_2 limits.

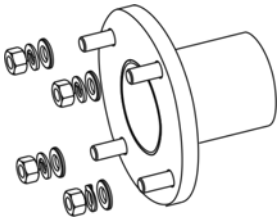
There can be up to two O_2 limits defined independently of each other. Each O_2 limit alarm has its own relay output for signalling.

The O_2 limit alarm function “min“-alarm will the limit alarm ③ triggered, if the O_2 measuring value falls below the defined O_2 limit ①. The resetting of the limit alarm is only happen if the measuring value is rising again above the O_2 limit.

The O_2 limit alarm function “max“-alarm will the limit alarm ③ triggered if the O_2 measuring value increase above the defined O_2 limit ②. The resetting of the limit alarm is only happen if the measuring value falls below the O_2 limit.

Figure 41 - O_2 Limit alarms

D.2 Duct Flange



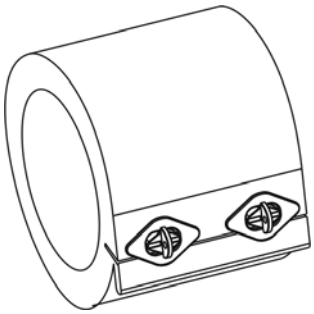
The duct flange is required for the probe installation at the flue duct.

The duct flange has to be welded gas tight to the flue duct by the customer.

Nuts, washer and springs are for the installation of the probe also contained in the scope of delivery.

Figure 42 - Duct flange

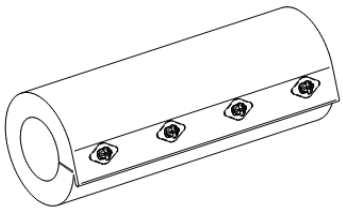
D.3 Duct Flange Insulation



The insulation protects the duct flange and the O_2 components who are in the flue gas by preventing of water vapour condensation and acid condensation.

Figure 43 - Duct flange insulation

D.4 Cooling Tube Insulation



The insulation protects the cooling tube and the O_2 components which are in the flue gas by preventing of water vapor condensation and acid condensation.

Figure 44 - Cooling tube insulation

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