EMISSION MONITORING SYSTEMS

We care about the environment

# User Manual

# OXYGEN MONITORING SYSTEM

# OMS 420


Read and observe before commissioning!

***Ex Situ oxygen analyzer based on $ZrO_2$ sensor***

MRU AIR fair
EMISSION MONITORING SYSTEMS

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# Caution!

Please inspect in the presence of the transporting agent all consignments regarding damages removing possible packing. All damages have to be confirmed by the transporting agent and have to be reported within 3 days.

Otherwise those cannot be accepted.

# Advices!

**Store original packing in order to prevent transportation damages, if the device has to be sent in.**

The products described in this manual are subject to a continuous development and amelioration. Therefore, this manual may be incorrect or incomplete. We appreciate every customer feedback, comments and suggestions regarding our product and its operation manual.

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This manual is intended as instruction for the use of the product.

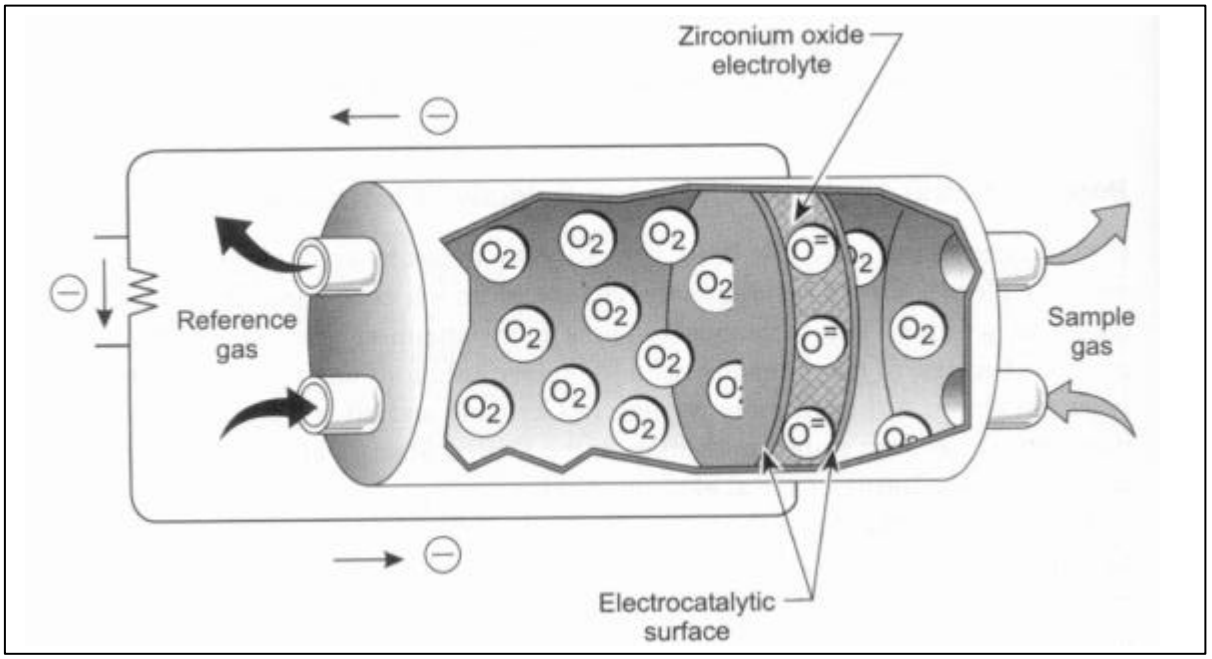
MRU is not liable for damages caused by incorrect interpretation of information taken of this manual or by wrong use of these instructions.

# 1 Security Instructions

- The $O_2$ probe may only be used in faultless condition and in accordance with the operation manual.
- All persons dealing with the installation, commissioning, operation and maintenance of the device have to be qualified correspondingly and have to strictly observe this operation manual.
- Arbitrary reconstructions and modifications lead to considerable security risks and are prohibited due to security reasons !
- Do not let the $O_2$ probe get in touch with the condensate!
- The $O_2$ probe may only be installed and put into service by trained qualified personnel.
- The $O_2$ probe may not be reached by condensate or spray water!
- **The $O_2$ probe has always to be supplied with voltage! Otherwise condensate formation may occur which will damage the probe!**
- The inclusion of corrosive gas (silicone vapor, alkaline metals, P, Pb, high $SO_2$ etc.) will shorten the life of the sensor.

## 2 Principle of the ZrO2 sensing element

Stabilized zirconium ($ZrO_2$) is used as a ceramic solid electrolyte. This ceramic is a good oxygen ion conductor at temperatures around 850°C, generated by an on board low power heater element.




The electro-motive force (emf) that is generated across the solid electrolyte by the passage of oxygen ions, can be measured as a sensor voltage.

$$U_S = U_0 + \frac{RT}{4F} \ln \frac{P_{O2\ ref}}{P_{O2\ sample}}$$

where:

| | | |
|---|---|---|
| $U_0$ | = | offset voltage (for $P_{O2\ ref} = P_{O2sample}$) |
| R | = | universal gas constant |
| T | = | zirconium temperature |
| F | = | Faraday constant |
| $P_{O2ref}$ | = | oxygen partial pressure reference side |
| $P_{O2sample}$ | = | oxygen partial pressure sample side |

This voltage is measured by a local micro-controller based transmitter electronics and translated into a standard 4 – 20 mA signal, linearized for oxygen measuring range 0 – 25 %.

Lifetime of this sensor is about 5 years and more and do not depends of the used fuel type but :

**CAUTIONS:**

- If combustible gas (CO, $H_2$, HC) exists in the sample gas, error will occur due to local combustion at the sensors hot surface.
- The inclusion of corrosive gas (silicone vapor, alkaline metals, P, Pb, high $SO_2$ etc.) will shorten the life of the sensor.

# 3 Transmitter TOM 420

The transmitter for oxygen monitor TOM-420 is a 4 – 20 mA intelligent transmitter type, with on board micro-controller.

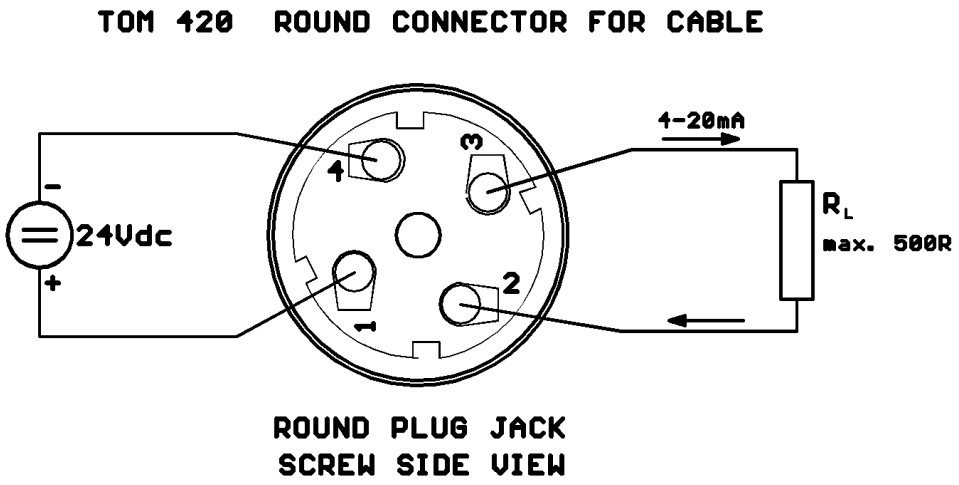
It is used to continuously measure oxygen concentrations in stacks of industrial boilers or furnaces, ideally suited for combustion monitoring and control. The transmitter is:

- compact and reliable, rugged industrial design
- no need for reference air, true wet gas analysis
- low response time and low energy consumption
- micro-controller based electronics with on board small LCD for $O_2$ value and error message
- linearized 4-20mA signal output (for direct transfer to process PLC) or RS485 digital data transfer ( optionally both, analog and digital data transfer )
- HART interface superimposed to 4-20mA (option, no local display at HART communication)
- 2x pushbuttons for calibration and changing of measuring range in 0,5%$O_2$ steps.
- field replaceable transmitter and servicing without removing the probe from the stack
- dust tight and water proof enclosure, easy operation and maintenance.


## 3.1 Specifications

| | |
|---|---|
| measuring task: | oxygen contained in non-combustible flue gas, wet gas analysis |
| measuring principle: | direct insertion zirconium cell into the sample gas |
| life time of $ZrO_2$ cell: | more than 5 years in normal conditions |
| warm up time: | min. 10 minutes |
| measuring range: | 0 to 25 %, change of measuring range in 0,5%$O_2$ steps |
| repeatability: | within +/- 1,0 % of full scale |
| linearity: | better than +/- 1 % of full scale |
| accuracy: | +/- 0,2 % or +/- 2 % of reading (whichever is larger) |
| response time: | < 10 sec. (from calibration gas inlet port) |
| output signal: | 4 to 20 mA, max. 500R load, or RS485 ( with PC software ), or HART |
| power supply: | 24 Vdc, 1 A |
| ambient temperature: | -20°C to +50°C |
| ambient humidity: | 0 % to +95 %, non condensing |
| case protection: | IP 65 (NEMA 4) |
| dimensions: | 100 x Φ 95 x 65 mm with tube 200 x 32 mm |

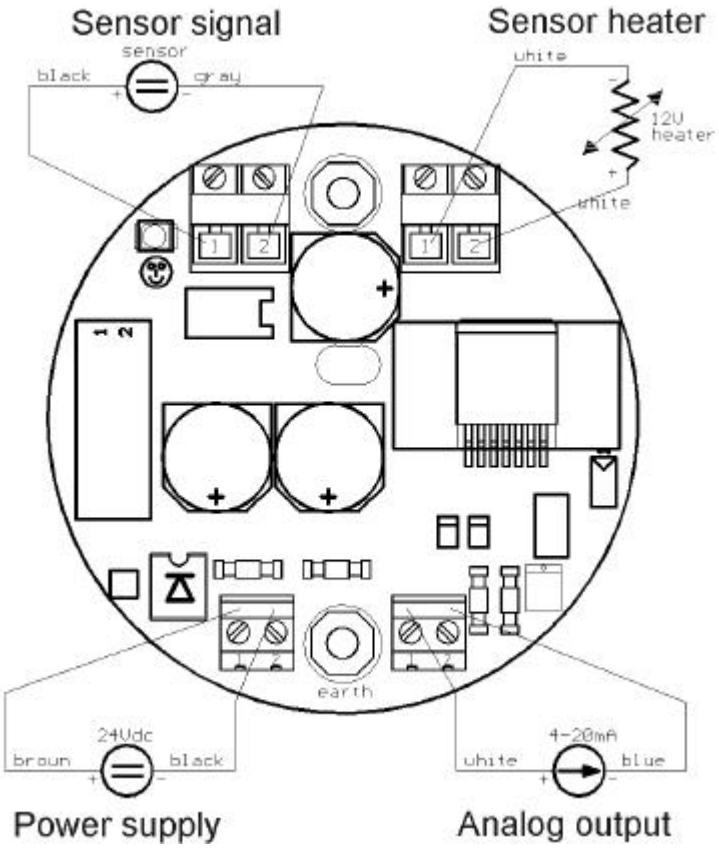
## 3.2 Terminal assignment of plug-in connector



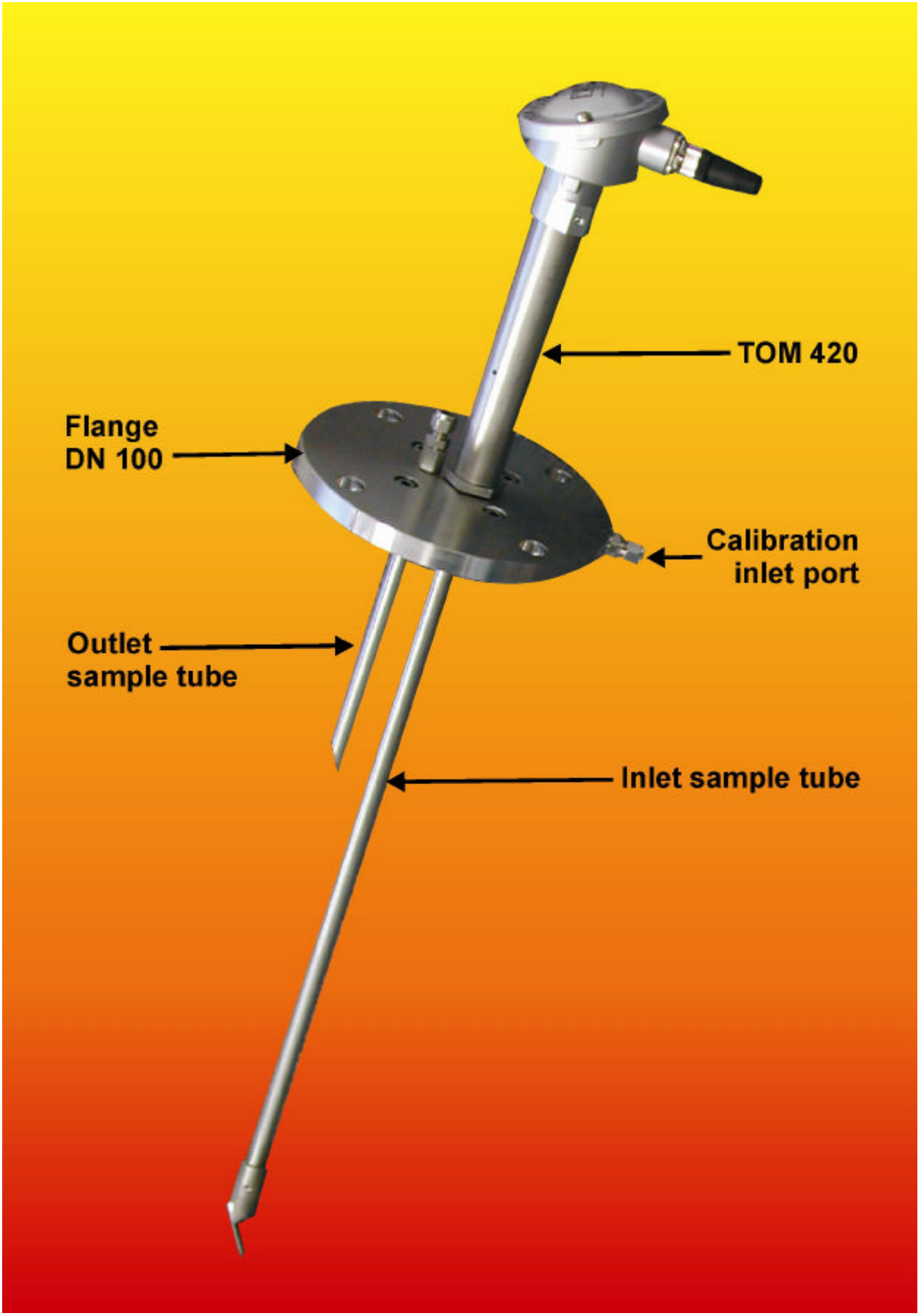

**Wiring:**

Remove probe cap cover and attach two pair, # 24 AWG cable to the four –pin electrical connector drawings. Terminate the other end of the # 24 AWG cable at the control unit according to drawings. The power should be bought in through separate conduit, provide circuit breakers for the control unit.

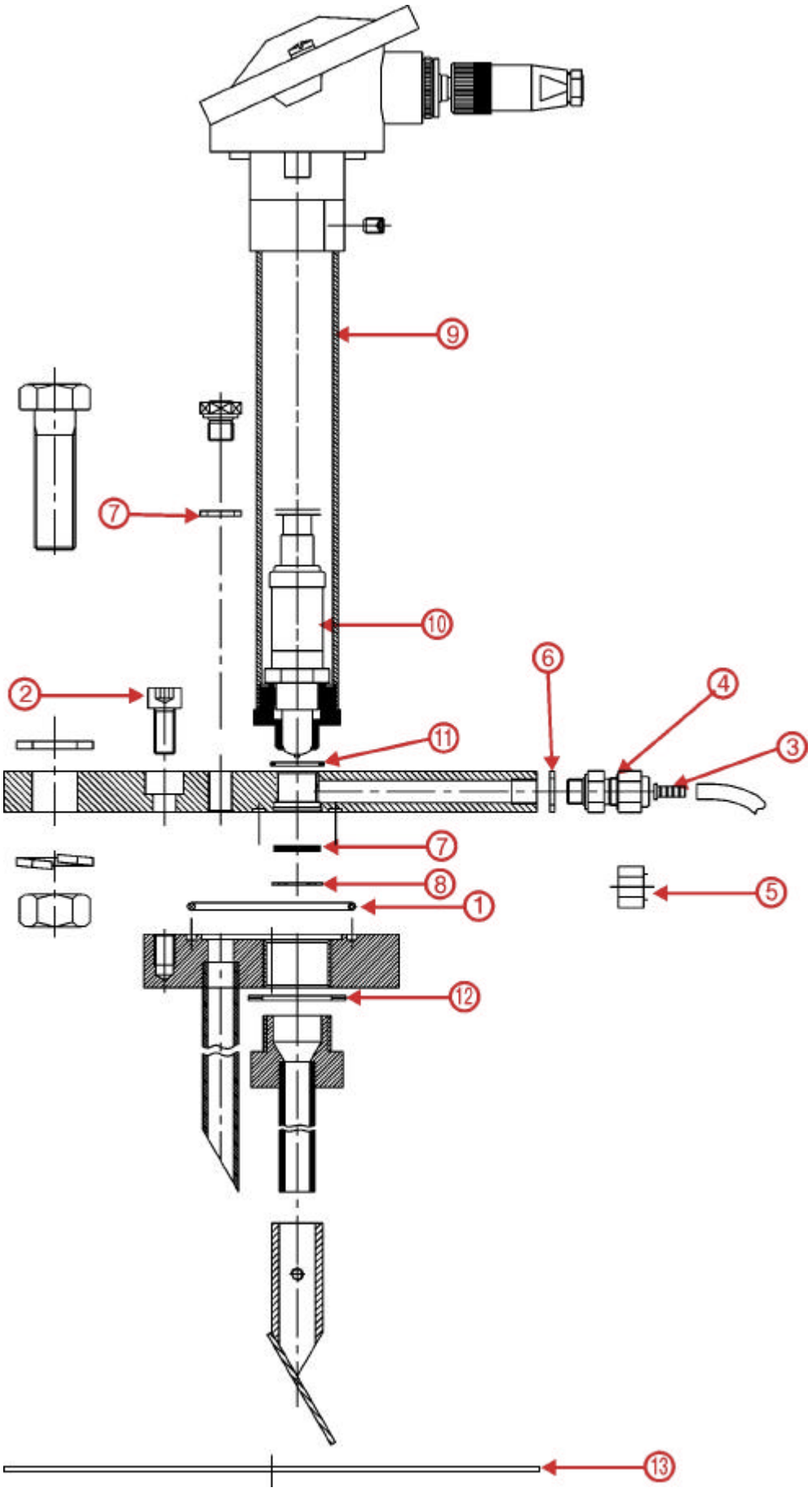
## 3.3 Connection to electronic board of the Zirconium sensor



## 4 Illustration probe OMS 420-LD-FG



## 5 Probe construction



## 5.1 MRU ordering numbers for spare parts OMS 420

Prices upon demand.

| No | denomination | MRU No. |
|---|---|---|
| 1 | O-ring Viton 500, 60x3 mm | 59104 |
| 2 | Screw M 8x18 mm, Hexagon socket, DIN 912 A2 | 59450 |
| 3 | Tube insert | 54519 |
| 4 | Fitting 1/8” | 55105 |
| 5 | Plug, unscrew after adjustment | 56912 |
| 6 | Seal bushing 1/8“ RS DIN3852 | 55106 |
| 7 | Sintered metal filter 18x2 mm, CrNi steel | 59447 |
| 8 | Lock washer 18x1 mm, DIN 472 | 59449 |
| 9 | Transmitter TOM 420 complete | 59485 |
| 10 | Zirconium sensor | 59528 |
| 11 | Seal bushing G 3/8”, Copper | 59455 |
| 12 | Seal bushing ¾” | 54899 |
| 13 | Seal bushing for flange, DN 100/PN6 up to 250°C | 59464 |

# 6 Assembly of probe OMS 420 to the stack

Connect TOM 420 with flange DN100 PN6 by means of a wrench 36. Please observe correct fit!
Don’t forget copper seal bushing (11)!

Before installing the probe refer to the drawings to determine the mounting configuration and the hardware requirements for your installation. Vertical mounting of the probe can be used.

Cut a 110 mm diameter hole in the stack breeching where the probe is to be mounted.

Measure the thickness of the wall through the hole and add 8 mm.

Weld a DN 100 carbon steel, raised or flat faced flange to the end of the pipe. (see pipe /flange assembly)

Insert the pipe/flange assembly into the hole until the flange facing is 8 mm from the stack wall. Tilt the pipe/flange assembly approx. 5° from horizontal to allow condensation to drain into the stack.

Weld the pipe/flange assembly in place.

**IMPORTANT: Insulate the mounting flange to prevent condensation from forming!**

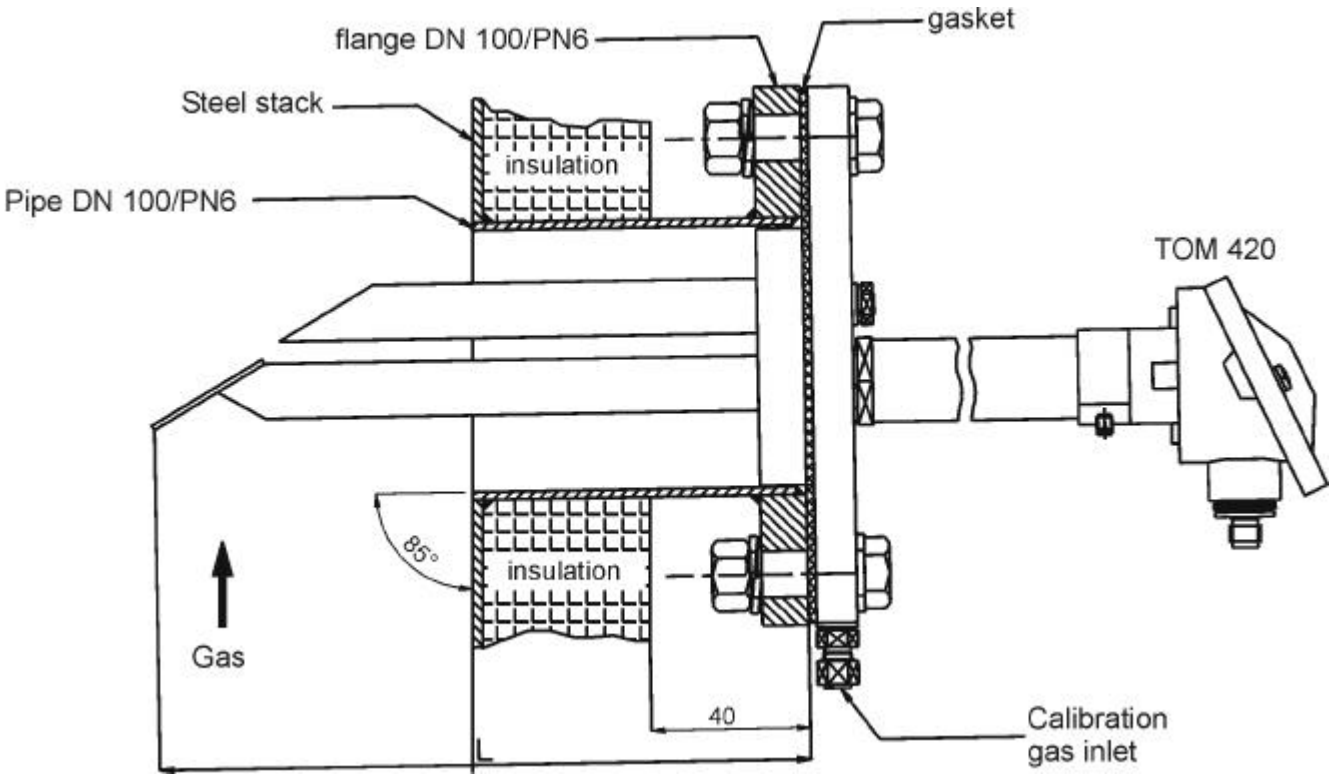
The probe can now be installed. Slide the flange gasket over the sensor end of the probe and bring the gasket to the mounting flange.

Carefully insert the sensor end of the probe through the pipe, into the stack, and bolt the probe mounting flange and the pipe /flange assembly together.

Caution: Whenever the probe is inserted or extracted in a hot stack, it must be done a few cm’s at a time to prevent damage due to thermal shock.

## 6.1 Assembly at the exhaust channel

The probe for oxygen monitoring system OMS 420 will be mounted to the stack by means of a mounting flange as shown in the drawing below



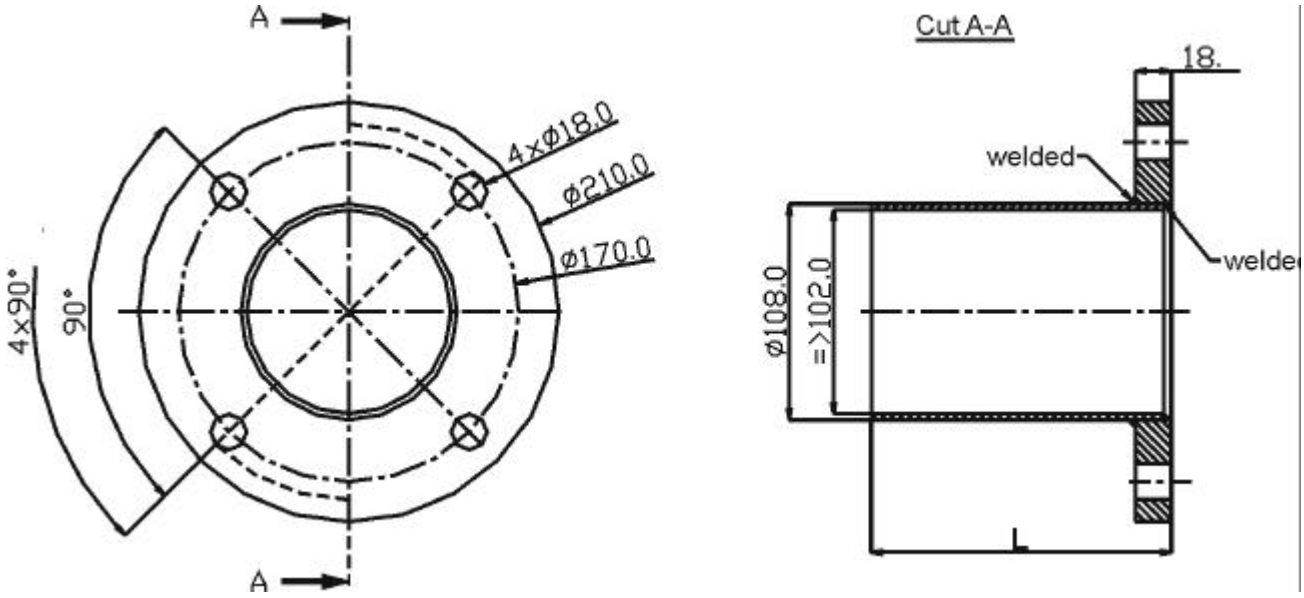
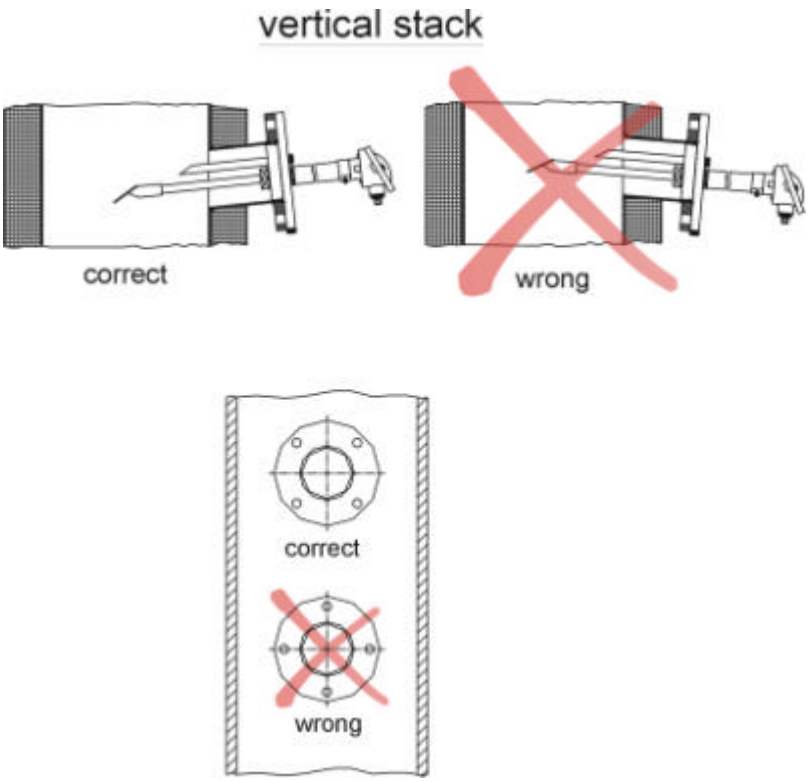
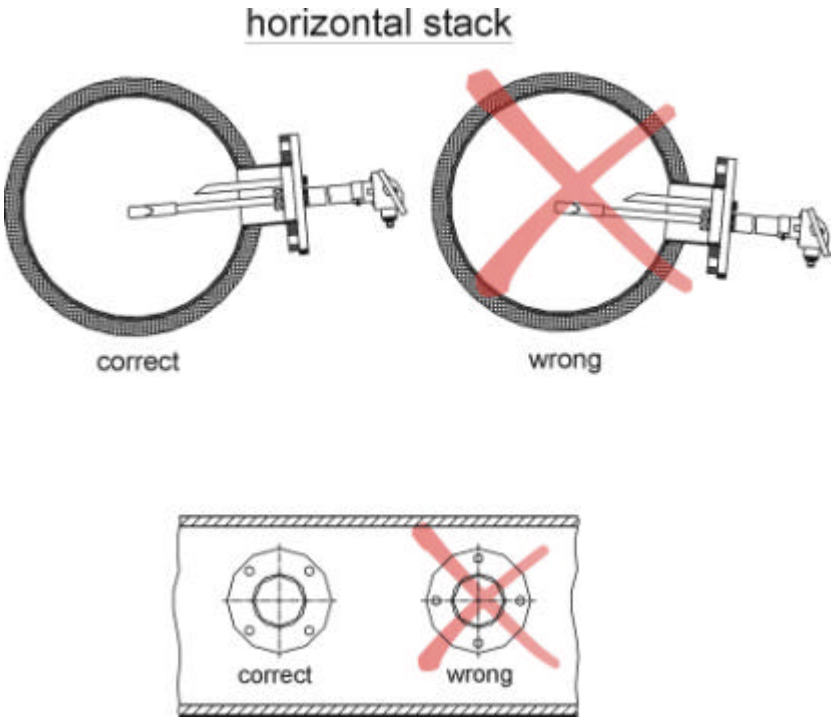




**illustration** pipe/flange assembly (supplied by customer)

### 6.1.1 Mounting guidelines – vertical stack



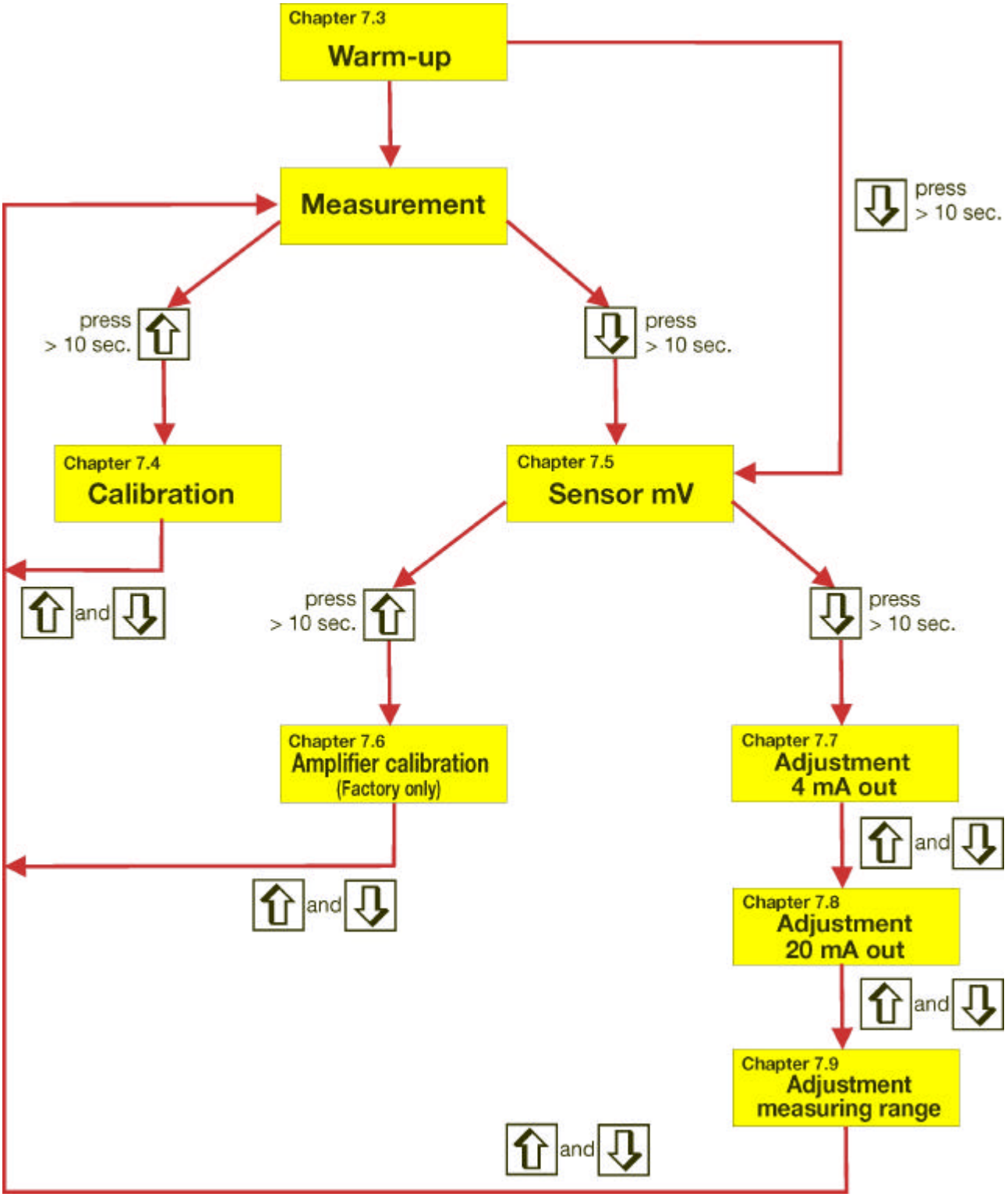

### 6.1.2 Mounting guidelines – horizontal stack




Clean the surface of the tube and drill a hole with a diameter of 110 mm into the exhaust channel. Fix the tube with few welding points, adjust it correctly and weld it completely to the steel skin of the stack.

# 7 Operation

## 7.1 Flow chart



## 7.2 Start-up

Before start-up, please verify with the following check list, if all conditions are complied for the failure-free operation of the transmitter:

*Checklist transmitter*

- Cast cover closed and screwed?
- Transmitter well accessible and visibly mounted?
- Ambient temperature within range to -20 to 50°C
- Correct location of transmission cable (not beside power cable)?
- Connection for power supply connected properly?
- Signal connection connected properly?
- Power supply (factory-provided mains fuse) switched on?
- Start up considerations

  Incorrect wiring: Most problems are due to incorrect wiring. Please double check the wiring. Shields must be grounded as shown in the drawings do not ground at any other points.

  *Leaks:* Check all air lines for any leaks, especially the calibration gas lines. The calibration gas inlet must be closed off to ambient air at all times other than when checking for 20,9% oxygen.

  *Insulation:* Check that the mounting flange has been well insulated to prevent condensation forming.

  Check that all electronic boards are in place before the power is turned on.

## 7.3 Warm-up

Duration of the warm-up: min. 10 minutes
During the warm-up time, in alternation the measured $O_2$ value and a countdown of the Warm-up is displayed.

(H = Heat)

In case of an error display will show:

Error 1 : Heating current > 0,5 A [sensor element defect]

Error 2 : Configuration not ok (Checksum wrong) [new adjustment required]

Error 3 : Heating current > 0,5 A and Configuration not ok (Checksum wrong)

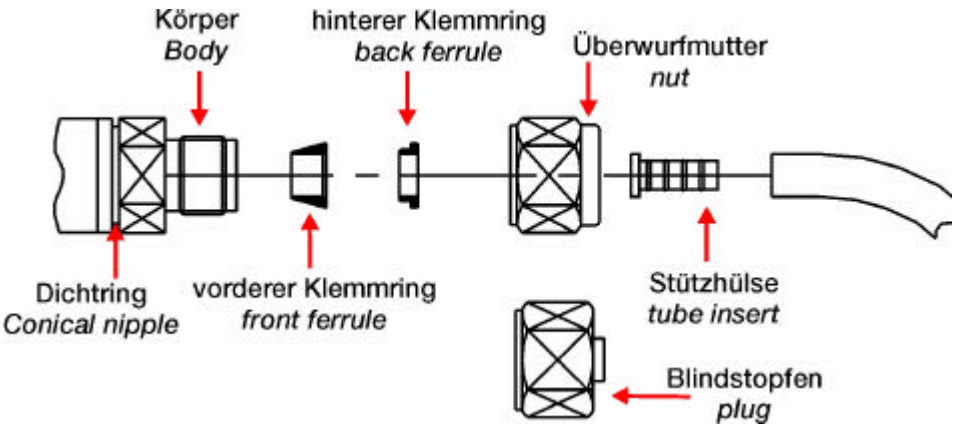
## 7.4 Calibration

### 7.4.1 Adjustment of Oxygen Reference Value

A testing gas cylinder will be connected to the calibration gas inlet port for adjustment of transmitter. (Manually or automatically via solenoid valves of the optionally pneumatic unit.

The testing gas (air or calibration gas) inlets the interstice between sensor and sample tube and afterwards exits via the sintered metal filter.

If calibration is not used, please tightly close the calibration inlet port after the calibration procedure by means of a plug.




The transmitter should already have been powered-up for at least one hour before. Clean air serves as reference gas ( 20,9vol.% $O_2$)

Perform adjustment:

1 Purge transmitter with ambient air (30l/h´on the calibration gas inlet port) or remove the transmitter from the probe.

**2** On fresh air, the transmitter TOM 420 output signal should be 17,37 mA (readout for 0 – 25 % $O_2$ measuring range).

**After commissioning:**

3 The adjusted value should be checked again after further 12 hours of operation.

4 The Oxygen Transmitter TOM 420 now is ready for operation.

**IMPORTANT**

Only authorized persons or manufacturers trained stuff are allowed to carry out adjustments on the transmitters electronics.

## Calibration

Press  until the current $O_2$-value e.g.  and  displayed in alternation.

**High calibration ( $O_2$ = 20,9 % )**

$O_2$-value high > 15% ( mV-value of sensor < 0) Press  or  to adjust $O_2$ to 20,9 %.

**Low calibration at ( $O_2$ < 10 % )**

$O_2$-value low < 15% ( mV-value of sensor > 0) Press  or  to adjust $O_2$ until the reading value is the same as in the gas cylinder.

Press  and  simultaneous to store adjustment and leave calibration mode back to measurement.

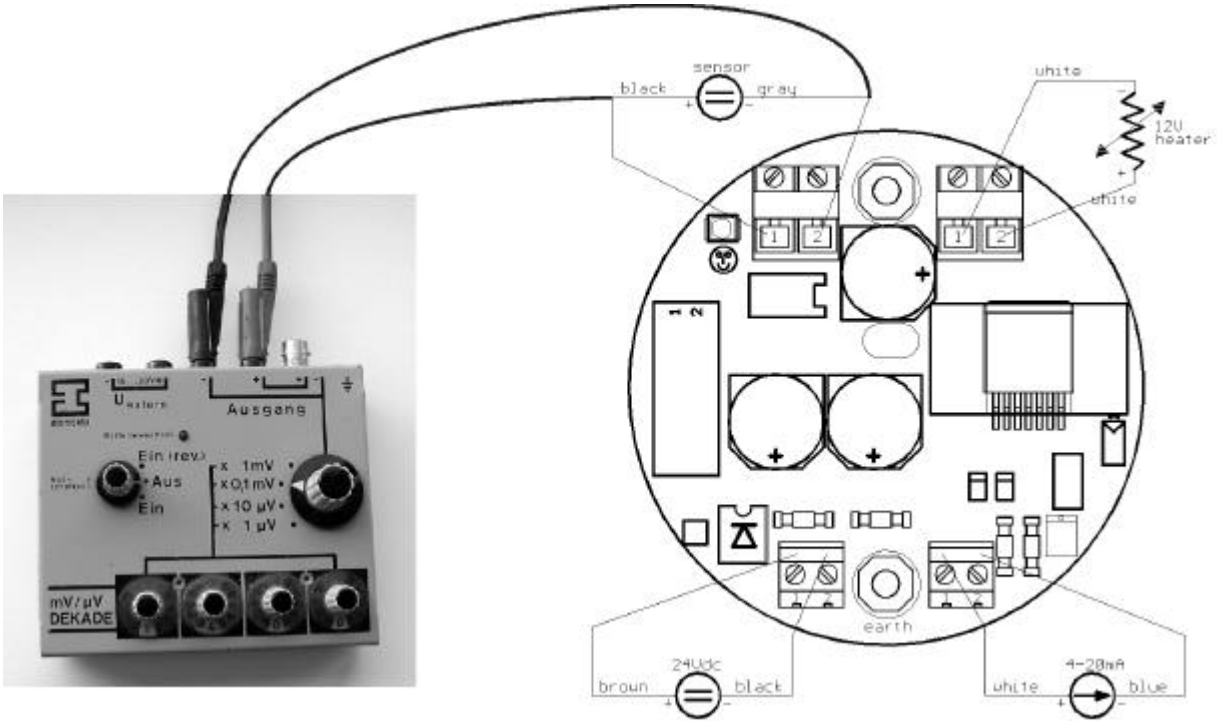
### 7.5 Sensor mV

Press  until the mV- values are displayed.
(This function is also available in the Warm-up mode.

 mV = approx. 20,9% $O_2$

 mV = approx. 0,0% $O_2$

## 7.6 Amplifier calibration (Factory only)




Connect precision voltage source in place of sensor signal input.

Press ⇧ until the mV- values of the sensor alternates with SE1.

Set mV-values 100: Press ⇧ or ⇩ to set the factor of the amplifier.

Display value equal to source voltage value
Range of adjustment: 0,60 to 1,50.

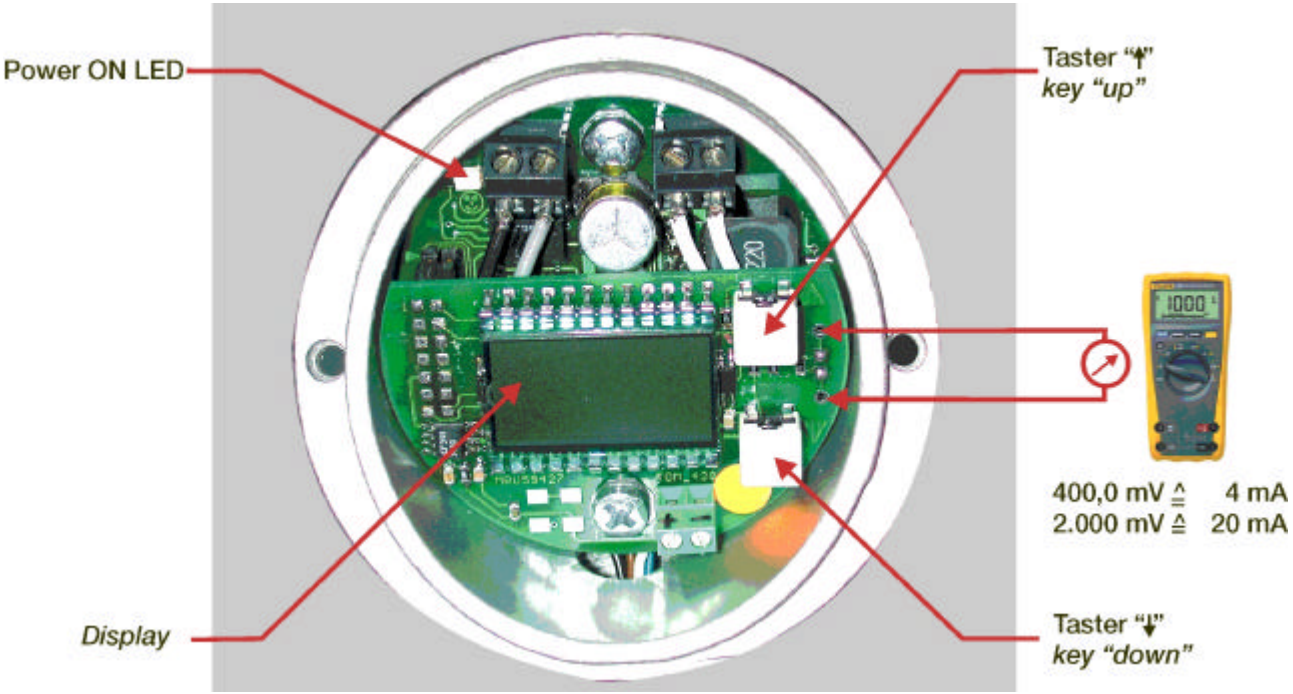
Set mV-values -10 : Press ⇧ or ⇩ to set the offset of the amplifier

Display value equal to source voltage value
Range of adjustment: +/- 10 mV.

Offset and factor influence themselves , therefore first factor setting, then Offset setting and repeat procedure once or twice.

Press ⇧ and ⇩ simultaneous to store adjustment and leave amplifier calibration menu back to measurement.

## 7.7 Adjustment 4 mA output




Press ⇩ until 4.0 alternates with out.

Measurement with a multi-meter above the onboard test load resistor (100 Ohm) and set the voltage with ⇧ or ⇩ to 400 mV.

Press ⇧ or ⇩ to set the 4 mA exactly. (read value on the digital multi-meter)

Range of adjustment: +/- 0,5 mA.

The analog output current has to drive a load resistor 0 to 500 Ohms.

Press ⇧ and ⇩ simultaneous leave 4 mA output setting

## 7.8 Adjustment 20 mA output

After leaving 4 mA adjustment display  alternates with  .

Measurement with a multi-meter above the onboard test load resistor (100 Ohm) and set the voltage with  or  to 2.000 mV.

Press  or  to set the 20 mA exactly. (read value on the digital multi-meter)

Range of adjustment: +/- 1 mA.

The analog output current has to drive a load resistor 0 to 500 Ohms.

Press  and  simultaneous leave 20 mA output setting

## 7.9 Adjustment measuring range

After leaving 20 mA adjustment display  alternates with  .

Default-setting: 25,0 => 0% $O_2$ ⇔ 4,0 mA 25% $O_2$ ⇔ 20 mA.

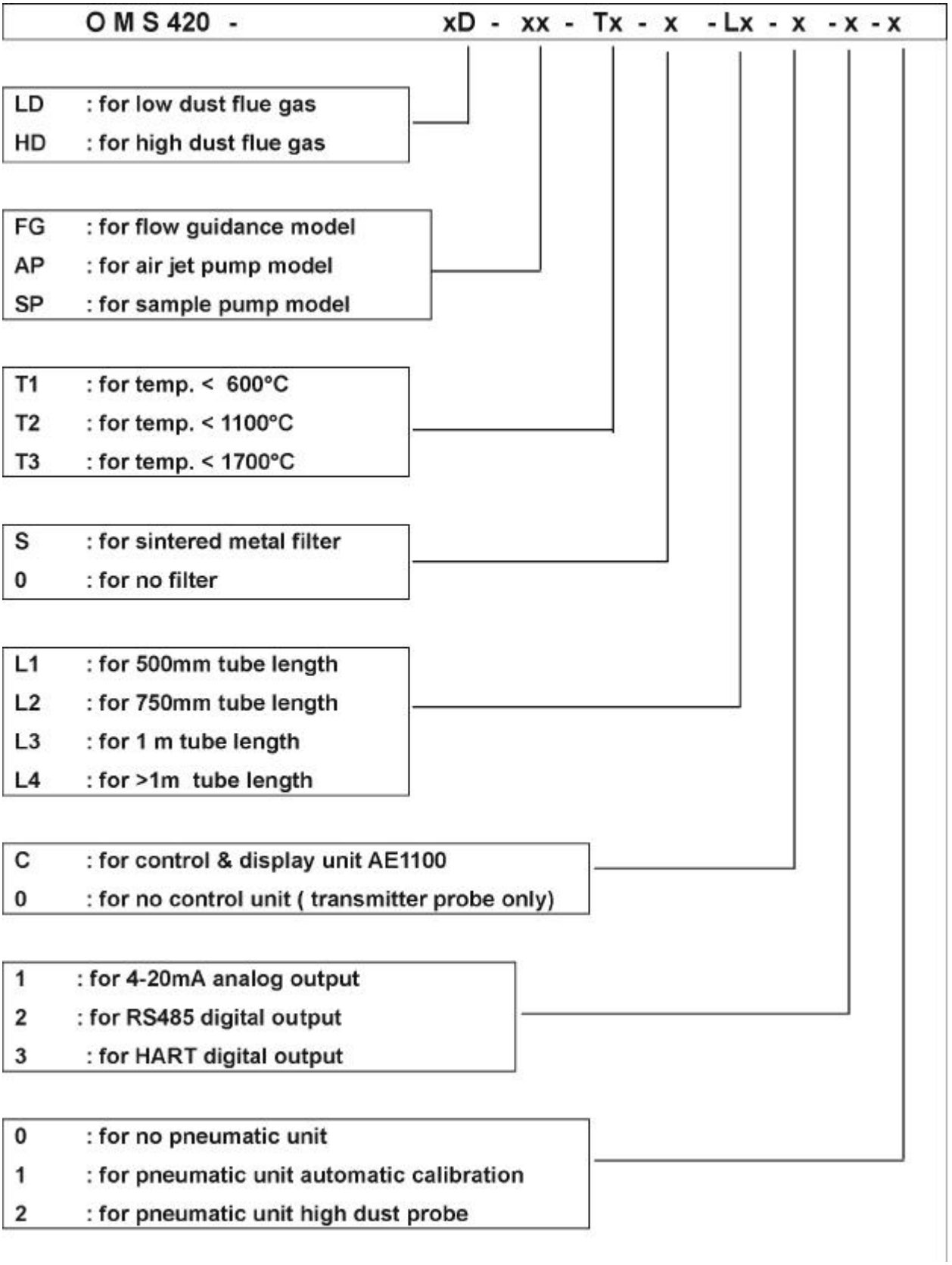
Press  or  to set the range between 4.0 and 32.0 in steps of 0,5 %.

Press  and  simultaneous to store and leave adjustment menu back to measurement.

## 8 Emergency maintenance

| **malfunction:** | **correctives:** |
|---|---|
| no display<br>no LED flashing | check power supply, check connector<br>short circuit or cable burst at the connection cable. |
|  Heating current < 0,5 A | Sensor element defect |
|  Configuration not ok<br>Checksum wrong | New adjustment required |
|  Heating current < 0,5 A<br>and configuration wrong | Please contact your dealer respectively the manufacturer. |
| Transmitter does not react with sample gas from stack | Clean the sintered metal filter. |
| Transmitter does not react with test gas | Please contact your dealer respectively the manufacturer. |

## 9 OMS 420 Ordering code



# 10 Options

## 10.1 Control and display unit CU-420

Separate user manual!

## 10.2 Pneumatic unit PU-420

Separate user manual!

# 11 Appendix

## 11.1 Addresses „Your contacts to MRU“

| | |
|---|---|
| | Manufacturer |
| Address: | **M R U**<br>Emission Monitoring Systems GmbH<br>Fuchshalde 8<br>D-74172 Neckarsulm-Obereisesheim |
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| Service-Hotline: | +49 71 32 – 99 62 -59 |
| E-Mail: | info@mru.de |
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| Street address: | P. O. Box 2736<br>D-74017 Heilbronn |
| Express station: | Heilbronn-Hbf<br>self-collect |

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