Oxygen Flue Gas Analyzer

BA 2000

Installation and Operation Instructions

Original instructions
Read this instruction carefully prior to installation and/or use. Pay attention particularly to all advises and safety instructions to prevent injuries. Bühler Technologies can not be held responsible for misusing the product or unreliable function due to unauthorised modifications.

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1 Introduction

1.1 Intended Use

The oxygen flue gas analyzer BA 2000 is intended for ‘quasi in situ’ measurement of the oxygen concentration in combustion processes. The ZrO$_2$ sensor is installed inside a self-regulating probe which is heated to approx. 180 °C (356 °F) to prevent condensation. The injector built into the filter housing continuously supplies the ZrO$_2$ sensor with fresh process gas through a quick and easy to replace filter element and then returns it to the process. The potentiometric ZrO$_2$ sensor in the BA 2000 provides accurate, extremely fast measurements. No reference gas needed for operation.

In addition to the BA 2000 base version we also offer the special versions BA 2000-MF (separate sample gas recovery) and BA 2000-SE (separated electronics up to approx. 15 m).

Please note the drawing in the appendix and check whether the technical data specified match the application parameters before installing the analyzer. Further verify all contents are complete.

Please note the specific values of the analyzer when connecting, and the correct versions when ordering spare parts.

1.2 Type Plate

Example:

Manufacturer and address

Type designation

Order no., Item no.

Electrical supply

Measuring range

1.3 Ordering instructions

<table>
<thead>
<tr>
<th>Item no.</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>55200099</td>
<td>BA 2000, 230 V 50/60Hz</td>
</tr>
<tr>
<td>55201099</td>
<td>BA 2000-MF, 230 V 50/60Hz</td>
</tr>
<tr>
<td>55202099</td>
<td>BA 2000-SE, 230 V 50/60Hz</td>
</tr>
<tr>
<td>5520098</td>
<td>BA 2000, 115 V 50/60Hz</td>
</tr>
<tr>
<td>55201098</td>
<td>BA 2000-MF, 115 V 50/60Hz</td>
</tr>
<tr>
<td>55202098</td>
<td>BA 2000-SE, 115 V 50/60Hz</td>
</tr>
<tr>
<td>5520098I</td>
<td>BA 2000I, 115 V 50/60Hz, US sized</td>
</tr>
<tr>
<td>55201098I</td>
<td>BA 2000I-MF, 115 V 50/60Hz, US sized</td>
</tr>
<tr>
<td>55202098I</td>
<td>BA 2000I-SE, 115 V 50/60Hz, US sized</td>
</tr>
<tr>
<td>5520099I</td>
<td>BA 2000I, 230 V 50/60Hz, US sized</td>
</tr>
<tr>
<td>55201099I</td>
<td>BA 2000I-MF, 230 V 50/60Hz, US sized</td>
</tr>
<tr>
<td>55202099I</td>
<td>BA 2000I-SE, 230 V 50/60Hz, US sized</td>
</tr>
</tbody>
</table>

$MF =$ separate sample gas recovery

$SE =$ separated electronics up to approx. 15 m

Adapter flanges

<table>
<thead>
<tr>
<th>Item no.</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>55200001</td>
<td>Adapter flange DN65 PN6 to Servomex</td>
</tr>
<tr>
<td>55200002</td>
<td>Adapter flange DN65 PN6 to Thermox</td>
</tr>
<tr>
<td>5520001I</td>
<td>Adapter flange DN3-150 to Servomex</td>
</tr>
<tr>
<td>5520002I</td>
<td>Adapter flange DN3-150 to Thermox</td>
</tr>
</tbody>
</table>
1.4 Scope of delivery

- 1x oxygen flue gas analyzer
- 1x flange seal and screws
- 1x product documentation

The analyzer may come with different factory installed accessories depending on the order:

- outlet filter (required for operation!)
- sampling tube or inlet filter
- sampling tube/inlet filter extension
- adapter flange
- pump (if instrument air not available)
- digital display

This accessory, as well as separate accessories included, are listed as separate line items in the order.
2 Safety instructions

2.1 Important notices

Please particularly note the following analyser instructions:

– Always transport the equipment diligently and carefully. Strong impact and shock may damage the measuring cells in the analyser or shorten their life!

– Avoid condensation inside the equipment, as the measurement system could be damaged and become defective. If the sample gas contains condensable components, the analyser must have suitable upstream sample gas conditioning. Our customer service will gladly help you select a system.

Signal words for warnings

| DANGER | Signal word for an imminent danger with high risk, resulting in severe injuries or death if not avoided. |
| WARNING | Signal word for a hazardous situation with medium risk, possibly resulting in severe injuries or death if not avoided. |
| CAUTION | Signal word for a hazardous situation with low risk, resulting in damaged to the device or the property or minor or medium injuries if not avoided. |
| NOTICE | Signal word for important information to the product. |

Warning signs

In this manual, the following warning signs are used:

- Warning against hazardous situations
- General notice
- Disconnect from mains
- Wear respirator
- Wear eye/face protection
- Wear protection gloves
- Wear protection gloves
- Warning against hot surface

2.2 General hazard warnings

The equipment must be installed by a professional familiar with the safety requirements and risks. Be sure to observe the safety regulations and generally applicable rules of technology relevant for the installation site. Prevent malfunctions and avoid personal injuries and property damage.

The operator of the system must ensure:

– Safety notices and operating instructions are available and observed,
– The respective national accident prevention regulations are observed,
– The permissible data and operational conditions are maintained,
– Safety guards are used and mandatory maintenance is performed,
– Legal regulations are observed during disposal.
**Maintenance, Repair**

Please note during maintenance and repairs:

- Repairs to the unit must be performed by Bühler authorised personnel.
- Only perform conversion-, maintenance or installation work described in these operating and installation instructions.
- Always use genuine spare parts.

Always observe the applicable safety and operating regulations in the respective country of use when performing any type of maintenance.

<table>
<thead>
<tr>
<th>DANGER</th>
<th>Electric voltage</th>
</tr>
</thead>
<tbody>
<tr>
<td>Risk of electric shock</td>
<td></td>
</tr>
<tr>
<td>a) Disconnect all poles of the unit from the mains for any maintenance on electric components.</td>
<td></td>
</tr>
<tr>
<td>b) Secure the equipment from accidental restarting.</td>
<td></td>
</tr>
<tr>
<td>c) The unit may only be opened by trained, competent personnel.</td>
<td></td>
</tr>
<tr>
<td>d) Ensure the correct voltages supply.</td>
<td></td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>DANGER</th>
<th>Toxic, corrosive gases</th>
</tr>
</thead>
<tbody>
<tr>
<td>The measuring gas led through the equipment can be hazardous when breathing or touching it.</td>
<td></td>
</tr>
<tr>
<td>a) Check tightness of the measuring system before putting it into operation.</td>
<td></td>
</tr>
<tr>
<td>b) Take care that harmful gases are exhausted to a save place.</td>
<td></td>
</tr>
<tr>
<td>c) Before maintenance turn off the gas supply and make sure that it cannot be turned on unintentionally.</td>
<td></td>
</tr>
<tr>
<td>d) Protect yourself during maintenance against toxic / corrosive gases. Use suitable protective equipment.</td>
<td></td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>DANGER</th>
<th>Potentially explosive atmosphere</th>
</tr>
</thead>
<tbody>
<tr>
<td>Explosion hazard if used in hazardous areas.</td>
<td></td>
</tr>
<tr>
<td>The device is not suitable for operation in hazardous areas with potentially explosive atmospheres.</td>
<td></td>
</tr>
<tr>
<td>Do not expose the device to combustible or explosive gas mixtures.</td>
<td></td>
</tr>
</tbody>
</table>
3 Transport and storage

Transport
This device is sensitive to shock and vibration. Therefore, where possible, transport in the original packaging or large, sturdy packaging with at least 3 layers of cardboard, plastic or aluminium sheet. Line the inside of the packaging with padding at least 10 cm thick on all sides.

The device should be marked fragile for shipping.

Storage
During extended periods of non-use, protect the analyzer against moisture and heat.

The analyzer must be stored in a covered, dry location free from vibration and dust, at a temperature between –20 °C and +60 °C (-4 °F to 140 °F).
4 Installation and connection

4.1 Installation

The analyzer is intended for flange mounting. The installation location and position are determined by the specific application factors. If necessary, the connection piece should be slightly tilted toward the centre of the channel. The installation site should be protected from the weather.

In addition, adequate and safe access for installation and future maintenance work should be provided. Particularly note the uninstalled size of the sampling tube!

The outlet filter, inlet filter (optional) and the sampling tube (optional) are included in the package and must be installed prior to use.

**NOTICE**

The outlet filter and the O-ring for the handle must be inserted prior to first startup. **Operating without outlet filter prohibited!**

![O-ring handle](image)

*Fig. 1: O-ring handle*

The sampling tube or the inlet filter (if necessary with matching extension) must be screwed in. Then attach the analyzer to the mating flange using the included seals and screws.

The exposed flange areas and, if applicable, the connection piece must be completely insulated following assembly to prevent any thermal bridges. The insulating material must meet the application requirements and be weatherproof.

**NOTICE**

If the heat dissipation is very high near the analyzer due to the application, the customer must install an appropriate shield to protect the probe, sensor and electronics.

4.2 Connecting the gas lines

4.2.1 Connecting instrument air for the injector

A pipe fitting is located under the weather hood to connect a Ø6 mm tube for instrument air.

Please be sure to use filtered air with a minimum rating of **PNEUROP/ISO Class 4**.

<table>
<thead>
<tr>
<th><strong>Class</strong></th>
<th><strong>Particle/m³</strong></th>
<th><strong>Pressure dew point [°C]</strong></th>
<th><strong>Residual oil content [mg/m³]</strong></th>
</tr>
</thead>
<tbody>
<tr>
<td>4</td>
<td>up to 1000</td>
<td>≤ 3</td>
<td>≤ 5</td>
</tr>
<tr>
<td></td>
<td>(no particles ≥ 15 μm)</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>
4.2.2 Required instrument air pressure

The response time of the analyzer varies by the pressure of the instrument air used for the injector. The attached data sheet contains diagrams which show the $t_{90}$ times based on the volume flow and instrument air pressure.

As seen in the diagrams, as the instrument air pressure rises (or the volume flow increases, respectively) the response time $t_{90}$ of the analyzer becomes faster.

However, there are some drawbacks to a fast response time:
- increased wear on the ZrO$_2$ sensor (sample gas is taken in via the sensor)
- rising operating cost due to high usage of compressed air
- risk of sample gas taken in and recovered sample gas/instrument air mixture mixing

We therefore recommend a pressure setting of max. 0.5 bar (7.25 psi) for instrument air (measured with injector running).

4.2.3 Operating the injector with a pump

When operating the injector with a pump instead of instrument air, the air taken in by the pump must meet the same requirements as instrument air.

We again recommend a pressure setting of max. 0.5 bar (7.25 psi) on the pressure end of the pump (measured with injector running).

4.2.4 Connecting test gas

At the side, next to the flange, is a pipe fitting with a sealing cap for connecting a $\Omega 6$ mm or $\frac{1}{4}$“ tube for the test gas. The test gas connection must be sealed airtight during operation. This can either be achieved by using the sealing cap or - with a fixed test gas line connected - an airtight shut-off valve.

**WARNING**

Gas emanation

Sample gas can be harmful to the health!
Check the lines for leaks.

4.2.5 Installing a separate sample gas recovery

The special version BA 2000-MF is ready for separate sample gas recovery. The sample gas recovery connects to a $\Omega 12$ mm or $\frac{1}{2}$“ tube under the weather hood, depending on the version. Ensure that both the pressure and the flow rate at both the sampling site and return are identical.

4.3 Electrical connections

**CAUTION**

Incorrect mains voltage

An incorrect mains voltage can destroy the unit.
When connecting the unit, ensure the mains voltage matches that specified in the type plate.
The connection must be made by a trained professional.

**WARNING**

Electric voltage

Insulation test will damage the device
Do not test the electric strength if the entire unit is under high voltage!

This analyzer is equipped with extensive EMC protection. Testing the electric strength will damage electronic filter components. The necessary tests of all assemblies requiring testing were carried out at the factory (test voltage 1 kV or 1.5 kV depending on component).
4.3.1 Probe
The probe contains self-regulating heating elements. It comes with two cubic plugs per EN 175301-803. One plug is for the power supply, the other is the alarm output. The power supply is already connected to the electronics. Connect the alarm output per the terminal diagram (see appendix). The plugs are configured so they cannot be reversed. For safety reasons this configuration must not be modified.

4.3.2 ZrO2 sensor
The sensor comes with a 5-pin M12 connector and is already connected to the electronics.

4.3.3 Power supply and outputs
Inside the electronics housing is a terminal block for connecting the mains supply, the alarm output, and the mA signal. The connection to the included terminal blocks is shown in the connection diagram in the appendix. The plugs can be removed from their sockets for this purpose and reinserted after wiring. The pin assignment is also printed onto the board.
5 Initial operation

5.1 Calibration

The ZrO₂ sensor must be running for at least 1 hour before calibrating.

5.1.1 Introduction to calibration

Changes to external factors such as the ambient temperature and atmospheric pressure as well as changes in the sample gas conditions such as flow rate, pressure and temperature can affect the measurement results. These changes in the measuring performance is called drift.

To compensate this drift the device must be calibrated regularly. A calibration checks the measuring performance of the device with test gas.

A 1-point calibration with instrument air is entirely sufficient for operation. However, if desired a 2-point calibration with instrument air and an additional test gas may also be performed. The O₂ concentration of the test gas should ideally be the same as the sample gas.

When is a calibration necessary?

The device should be calibrated in the following cases:

- with every initial operation, after initialising
- regularly during operation (recommended: every 14 days)

5.1.2 1-point calibration

The injector of the analyzer must be running during calibration. The pressure of the instrument air for the injector must correspond with the conditions of subsequent measurements.

- Use instrument air per PNEUROP/ISO Class 4 with a primary pressure of approx. 0.1 bar (1.45 psi) as the test gas.
- Wait at least 5 min until the end value is stable.
- In the menu, open Calibration Point 1 (CAL1).
- Press \( \text{E} \) to confirm the value of 20.9 Vol.% O₂.
- Press \( \text{E} \) to close the menu. The display shows a concentration of 20.9 (Vol.% O₂).

Note: Disabling 2-point calibration: If a 2-point calibration was performed, the measurement calibration also applies to the 2nd calibration point. In this case, an “indirect” 2-point calibration must be performed. To do so, under menu item CAL2 set the O₂ value to 0.0% and confirm. The standard parameters will be loaded, 2-point calibration is disabled.

5.1.3 2-point calibration

In addition to the steps required for 1-point calibration, this calibration uses an additional test gas with an O₂ concentration which ideally corresponds with the sample gas which will later be used.

- 1-point calibration with instrument air
- Use test gas at the known O₂ concentration with a primary pressure of approx. 0.1 bar (1.45 psi).
- Wait at least 5 min until the end value is stable. The value displayed should be about the same as the O₂ concentration of the test gas.
- Open “Calibration Point 2” (CAL2) from the menu.
- Set the concentration of the test gas and press \( \text{E} \) to confirm. Note: When setting this to 0.0 Vol.% O₂, the default parameters will be used, which corresponds to 1-point calibration.
- Press \( \text{E} \) to close the menu. The display will show the concentration of the test gas.
6 Operation and Control

**NOTICE**

The device must not be operated beyond its specifications.

### 6.1 ZrO2 sensor function

**CAUTION**

Hot surface

Risk of burns
With the sensor installed, the sensor tube can be up to 650 °C (1202 °F).

The sensor electronics regulate the sensor heater to 650 °C (1202 °F). The mV sensor signal is processed by the electronics and output as a linear 4–20 mA signal (0 … 21 Vol. % O\(_2\) corresponds to 4 … 20 mA).

Whilst heating up (approx. 1 h), the display alternates between “init” and the temperature of the sensor heater. Once the operating temperature is reached, the temperature display switches to oxygen display and alternates with “init”. Until the operating temperature is reached, the output signal will indicate 0 mA. Once the operating temperature is reached, the current mA value will be output. After heating up, the oxygen concentration will be continuously displayed.

The temperature is displayed to monitor the sensor temperature and appears when the temperature deviates by ± 1.5 K. An alarm will be output when over- or underrunning the fixed set value for heating the sensor or the programmable setting of the O\(_2\) concentration.

<table>
<thead>
<tr>
<th>Status</th>
<th>Display</th>
<th>mA signal output</th>
</tr>
</thead>
<tbody>
<tr>
<td>Heat-up phase, operating temperature not yet reached</td>
<td>Temperature alternating with “init”</td>
<td>0 mA</td>
</tr>
<tr>
<td>Heating up, operating temperature reached</td>
<td>O(_2) concentration alternating with “init”</td>
<td>Current mA value</td>
</tr>
<tr>
<td>Heat-up complete, temperature within target range</td>
<td>Oxygen concentration</td>
<td>Current mA value</td>
</tr>
<tr>
<td>Heat-up complete, temperature outside the target range</td>
<td>Temperature flashing</td>
<td>0 mA</td>
</tr>
<tr>
<td>Heat-up complete, O(_2) concentration outside the target range</td>
<td>O(_2) concentration flashing</td>
<td>Current mA value</td>
</tr>
</tbody>
</table>

### 6.2 Using the controller

#### 6.2.1 Use of menu functions

**Overview of the operational principal:**

Use this short description if you have experience with the device.

Operation is carried out by only the keys with the following functions:

<table>
<thead>
<tr>
<th>Key</th>
<th>Function</th>
</tr>
</thead>
<tbody>
<tr>
<td>➔➔</td>
<td>– Switch from measurement display to main menu</td>
</tr>
<tr>
<td></td>
<td>– Selection of the display menu item</td>
</tr>
<tr>
<td></td>
<td>– Accepting the changed value or selection</td>
</tr>
<tr>
<td>🗼</td>
<td>– Switch to the upper menu item</td>
</tr>
<tr>
<td></td>
<td>– Increase of the value of switching the selection</td>
</tr>
<tr>
<td></td>
<td>– Temporary display of the alternative measurement display (if option is installed)</td>
</tr>
<tr>
<td>⤇</td>
<td>– Switch to lower menu item</td>
</tr>
<tr>
<td></td>
<td>– Decrease of the value of switching the selection</td>
</tr>
<tr>
<td></td>
<td>– Temporary display of the alternative measurement display (if option is installed)</td>
</tr>
</tbody>
</table>
6.2.2 Detailed description of the operational principle

The detailed description will guide you through the menu step by step.

- Connect the unit to the power supply and wait for the startup procedure to complete. At first the software version implemented on the unit will be displayed for a brief period. The unit will then switch directly into measured value display.
- Pressing the button will take you from display mode to the main menu. (The control will continue running whilst in menu mode.)
- Use these buttons to navigate the main menu.
- After confirming a main menu item the associated submenu will open

Here you can configure operating parameters:
- Cycle through the submenu to configure the parameters,
- then confirm the menu item to be changed.

You can now set values within specific limits.
- After confirming the value the system will save it. This will automatically return you to the submenu.
- If no button is pushed for approx. 5 s, the unit will automatically return to the submenu. Changes to values will not be saved.

The same applies to the sub- and main menu. The system will automatically return to display mode without saving the (last) value changed. Parameters which were previously changed and saved will be retained and not reset.

**NOTICE! After saving values with the Enter key they will be applied to the control.**

- To exit the main or submenu, select menu item E (Exit).
6.2.3 Menu navigation overview

The O2 concentration is displayed in 0.1 Vol.% increments. Press the Enter key to access the main menu.

6.2.4 Description of menu functions

6.2.4.1 Main menu

Analyzer BA 2000 (bA20)

Analyzer:

From here you can access all relevant analyzer settings. The related submenu allows you to select the calibration points and the alarm thresholds.

Global settings (ToP Settings)

Top Settings:

Global temperature unit setting. Choose from degrees Celsius (C) or degrees Fahrenheit (F).

Note:

This main menu item has no submenu item. The temperature unit will be selected directly.
Exit Main Menu

Exit: Selecting this will return you to display mode.

Note: When switching from the main menu to the display range, the sensor temperature will temporarily be displayed.

6.2.4.2 Analyzer submenu (display: bA20)

BA 2000 → calibration point 1 (CAL1)

Temperature: This value is fixed at 20.9 Vol.% \( \text{O}_2 \).

Note: This value will be used for calibration.

BA 2000 → calibration point 2 (CAL2)

Temperature: This setting defines the value of the test gas concentration.

This value can be set within a range of 0.1 – 15 Vol.% \( \text{O}_2 \).

A display 0.0 Vol.% \( \text{O}_2 \) corresponds to 1-point calibration.

Note: The default value on delivery is 0.0%, i.e. the unit was not factory calibrated with CAL2, as calibration with CAL1 is entirely sufficient.

BA 2000 → upper alarm limit (Alarm high)

Alarm high: Here you can set the upper threshold for the visual signal and the alarm relay. The range for the alarm threshold setting is 1 – 22 Vol.% \( \text{O}_2 \).

Note: The default value on delivery is 22 (unless otherwise agreed).

BA 2000 → lower alarm limit (Alarm low)

Alarm Low: Here you can set the lower threshold for the visual signal and the alarm relay. The range for the alarm threshold is 21 – 0 Vol.% \( \text{O}_2 \).

Note: The default value on delivery is 0 (unless otherwise agreed).

mA scaling → select range (nA)

mA scaling: Oxygen concentration range setting, scaled to an output range of 4 to 20 mA.

1.0 = 0 – 2.5 Vol.% \( \text{O}_2 \)
2.0 = 0 – 5 Vol.% \( \text{O}_2 \)
3.0 = 0 – 10 Vol.% \( \text{O}_2 \)
4.0 = 0 – 15 Vol.% \( \text{O}_2 \)
5.0 = 0 – max. Vol.% \( \text{O}_2 \)

Note: The default value on delivery is 5.0 (unless otherwise agreed).

Exit Submenu

Exit: Selecting this will return you to the main menu.
7 Maintenance and repair

7.1 General warnings

- Never operate the analyzer outside the specifications.
- Observe the safety notices prior to initial operation.
- Repairs to the device must be performed by Bühler authorised personnel.
- Only perform conversion-, maintenance or installation work described in these operating and installation instructions.
- Always use genuine spare parts.
- Observe the respective safety regulations and operating specifications when performing any type of maintenance.

**DANGER**

**Electrical voltage**

Electrocution hazard.

a) Disconnect the device from power supply.
b) Make sure that the equipment cannot be reconnected to mains unintentionally.
c) The device must be opened by trained staff only.
d) Regard correct mains voltage.

**DANGER**

**Toxic, acidic gasses**

Sample gas can be harmful.

a) The probe must not be pressurised or energised when opened.
b) If necessary, ensure safe gas discharge
c) Protect yourself from toxic / corrosive gasses when performing maintenance, particularly when changing the filter. Wear suitable protective equipment.
d) Purge the gas line with air prior to performing maintenance.

**CAUTION**

**Hot surface**

Risk of burns

Depending on the operating parameters, the housing temperature may reach over 100 °C during operation.

Allow the unit to cool down before performing maintenance.

**CAUTION**

**Excess pressure**

The unit mustn’t be pressurised or energised when opened.

If necessary, close the gas supply and ensure a safe pressure on the process end before opening.

7.2 Replacing the microfuse

- Disconnect the unit from the mains.
- Open the cover of the electronics housing and remove the lower section of the front panel. The fuse is located on the main board
- Remove the insulator cap from the fuse holder.
- Replace the fuse and reinstall the insulator cap. Please note the mains voltage in order to select the correct fuse.
- Install the front panel, close the cover and reconnect to power.

7.3 Maintaining the filter element

The analyzer features a particle filter which needs to be changed as it becomes dirty. When doing so, if necessary disconnect the power and switch off the process.
7.3.1 Outlet filter

– Unlock and raise the weather hood.
– Turn the handle at the back end of the probe by 90° (handle must then be horizontal), pushing in slightly, and remove.
– Remove the dirty filter element and check the sealing surfaces.
– Before installing the new filter element, replace the seal on the handle plug (seal included with the filter element).
– Then insert the handle with the new filter and turn 90° (handle must be vertical), pushing in slightly.
– With the filter removed, if necessary also need clean the inside of the sampling tube by blowing it out or using a cleaning wand.

**Attention:** Do not damage the rear filter seat.

<table>
<thead>
<tr>
<th>NOTICE</th>
</tr>
</thead>
</table>
| The **ceramic filter elements** are very fragile. Therefore handle the elements with care, do not drop.  
The **stainless steel filter elements** can be cleaned with an ultrasonic bath and reused several times; in this case always use new seals on the filter and handle plug.  
The **weather hood** can only be closed if the handle is absolutely vertical. To do so, loosen the hood from the locking supports by lifting slightly, then flip down. Ensure that the hood lock clicks into place correctly. |

7.3.2 Inlet filter

The analyzer can further be equipped with an inlet filter, which is always inside the process stream.

Process conditions may cause the filter to clog over time. In this case the inlet filter will need to be replaced.

To do so, the analyzer must be completely removed and reinstalled according to chapter 6 after changing the element.
8 Service and repair

This chapter contains information on troubleshooting and correction should an error occur during operation.

Repairs to the unit must be performed by Bühler authorised personnel.

Please contact our Service Department with any questions:

Tel.: +49-(0)2102-498955 or your agent

If the equipment is not functioning properly after correcting any malfunctions and switching on the power, it must be inspected by the manufacturer. Please send the equipment inside suitable packaging to:

Bühler Technologies GmbH
- Reparatur/Service -
Harkortstraße 29
40880 Ratingen
Germany

Please also attach the completed and signed RMA decontamination statement to the packaging. We will otherwise be unable to process your repair order.

You will find the form in the appendix of these instructions, or simply request it by e-mail:

service@buehler-technologies.com

8.1 Troubleshooting

<table>
<thead>
<tr>
<th>Problem/malfunction</th>
<th>Possible cause</th>
<th>Action</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>LED doesn’t light up/No controller display</strong></td>
<td>No electric supply</td>
<td>Check mains connection</td>
</tr>
<tr>
<td></td>
<td>Fuse missing</td>
<td>Check fuse and replace if necessary</td>
</tr>
<tr>
<td></td>
<td>Controller failure</td>
<td>Send in unit</td>
</tr>
<tr>
<td><strong>Sensor not heating</strong></td>
<td>Temperature controller failure</td>
<td>Send in unit</td>
</tr>
<tr>
<td></td>
<td>Heater failure</td>
<td>Send in unit</td>
</tr>
<tr>
<td><strong>Probe temperature alarm</strong></td>
<td>Heat-up not yet completed</td>
<td>Wait for heat-up to complete</td>
</tr>
<tr>
<td></td>
<td>Heater failure</td>
<td>Send in unit</td>
</tr>
<tr>
<td></td>
<td>No/incorrect power supply</td>
<td>Check the power supply</td>
</tr>
<tr>
<td><strong>No heat output at probe</strong></td>
<td>Heat failure</td>
<td>Send in unit</td>
</tr>
<tr>
<td><strong>No mA signal from sensor</strong></td>
<td>Heat-up not yet completed</td>
<td>Wait for heat-up to complete</td>
</tr>
<tr>
<td></td>
<td>Heater failure</td>
<td>Send in unit</td>
</tr>
<tr>
<td><strong>Condensation forming</strong></td>
<td>Thermal bridges at the sampling point</td>
<td>Insulate to eliminate thermal bridges</td>
</tr>
<tr>
<td><strong>No sample gas flowing</strong></td>
<td>Gas line leak</td>
<td>Test tightness</td>
</tr>
<tr>
<td></td>
<td>Gas line clogged</td>
<td>Check gas line</td>
</tr>
<tr>
<td></td>
<td>Filter element clogged</td>
<td>Clean or replace filter element, clean sampling tube</td>
</tr>
<tr>
<td><strong>Controller display shows Error 13</strong></td>
<td>If Temp. target value is not reached after 1 h =&gt; heater failure =&gt; heater automatically switches off.</td>
<td>Send in unit</td>
</tr>
<tr>
<td><strong>Controller display shows Error 06</strong></td>
<td>Actual temperature was below 300 °C for &gt; 5 min =&gt; heater failure =&gt; heater automatically switches off.</td>
<td>Send in unit</td>
</tr>
</tbody>
</table>
8.2 List of spare parts and consumables:

Please also specify the model and serial number when ordering parts.

Upgrade and expansion parts can be found in our catalog.

Available spare parts:

<table>
<thead>
<tr>
<th>Spare part</th>
<th>Item no.</th>
</tr>
</thead>
<tbody>
<tr>
<td>Microfuse 115 V/230 V, 800 mA</td>
<td>91 10 00 0001</td>
</tr>
<tr>
<td>Flange seal DN65PN6</td>
<td>55 200 09 90 14</td>
</tr>
<tr>
<td>Sampling tube flange seal</td>
<td>90 090 68</td>
</tr>
<tr>
<td>O-ring kit for filter element and probe, material: Viton</td>
<td>46 222 01 2</td>
</tr>
<tr>
<td>ZrO₂ sensor complete with seals</td>
<td>55 299 99 9</td>
</tr>
<tr>
<td>M12 connection cable for sensor</td>
<td>55 200 09 90 17</td>
</tr>
<tr>
<td>Ceramic filter element incl. Viton O-rings, filter fineness 3 µm</td>
<td>46 222 02 6</td>
</tr>
<tr>
<td>Sintered stainless steel filter element incl. Viton O-rings, filter fineness 5 µm</td>
<td>46 222 01 0</td>
</tr>
</tbody>
</table>
9 Disposal

Dispose of parts so as not to endanger the health or environment. Follow the laws in the country of use for disposing of electronic components and devices during disposal.
# 10 Appendix

## 10.1 Technical Data

**BA 2000 Technical Data**

<table>
<thead>
<tr>
<th>Parameter</th>
<th>Details</th>
</tr>
</thead>
<tbody>
<tr>
<td>Sampling tube length</td>
<td>0.5 ... 2 m</td>
</tr>
<tr>
<td>Voltage</td>
<td>115 or 230 V, 50/60 Hz</td>
</tr>
<tr>
<td>Probe heat output</td>
<td>400 W</td>
</tr>
<tr>
<td>Measuring range</td>
<td>0.1 to 21 Vol.-% O₂</td>
</tr>
<tr>
<td>Output signal</td>
<td>4-20 mA = 0-21 Vol.-% O₂ (scalable 0-2.5/0-5/0-10/0-15)</td>
</tr>
<tr>
<td>Accuracy</td>
<td>relative error &lt; 5 %</td>
</tr>
<tr>
<td>Sensor Tₚ time</td>
<td>&lt; 15 sec</td>
</tr>
<tr>
<td>Alarm Sensor</td>
<td>Upper and lower limit of nominal value for heating (fixed)</td>
</tr>
<tr>
<td></td>
<td>Upper and lower limit of O₂ concentration (adjustable)</td>
</tr>
<tr>
<td>Probe alarm</td>
<td>Insufficient temperature</td>
</tr>
<tr>
<td>Ambient temperature</td>
<td>-20 ... +70 °C</td>
</tr>
<tr>
<td>Process temperature</td>
<td>up to 1600 °C, depending on sampling tube</td>
</tr>
<tr>
<td>Probe operating temperature</td>
<td>max. 200 °C</td>
</tr>
<tr>
<td>Probe material</td>
<td>1.4571</td>
</tr>
<tr>
<td>Test gas 1-point calibration</td>
<td>Instrument air 20.9 Vol.-% O₂</td>
</tr>
<tr>
<td>Test gases 2-point calibration</td>
<td>Instrument air 20.9 Vol.-% O₂ and test gas 0.1 to 15 Vol.-% O₂</td>
</tr>
</tbody>
</table>

### 10.2 Connection Diagram

![Connection Diagram](image)

- **Probe plug low temperature alarm**: max. voltage 250 VAC 50 Hz, max. switching current 4 A
- **Mainboard**: Sensor (TYPE B), Sensor temperature status or O₂ concentration
- **Output signal**: 4-20 mA = 0-21 Vol.-% O₂
- **Probe heater**: Mains

(contact opens when operating temperature is reached)
10.3 Drawings
11 Attached documents

– Declaration of Conformity KX550010
– RMA - Decontamination Statement
Hiermit erklärt Bühler Technologies GmbH, dass die nachfolgenden Produkte den wesentlichen Anforderungen der Richtlinie in ihrer aktuellen Fassung entsprechen.
Folgende Richtlinie wurde berücksichtigt:

2006/42/EU (MRL/MD)
2014/30/EU (EMV/EMC)

Produkt / products: Rauchgas Sauerstoffanalysator / Oxygen flue gas analyser
Typ / type: BA 2000

Das Betriebsmittel dient zur Messung der Sauerstoffkonzentration in Verbrennungsprozessen.
The equipment is designed for measuring oxygen concentration in combustion processes.

Das oben beschriebene Produkt der Erklärung erfüllt die einschlägigen Harmonisierungsrechtsvorschriften der Union:
The object of the declaration described above is in conformity with the relevant Union harmonisation legislation:

EN 61010-1:2010

Die alleinige Verantwortung für die Ausstellung dieser Konformitätserklärung trägt der Hersteller.
This declaration of conformity is issued under the sole responsibility of the manufacturer.

Dokumentationsverantwortlicher für diese Konformitätserklärung ist Herr Stefan Eschweiler mit Anschrift am Firmensitz.
The person authorized to compile the technical file is Mr. Stefan Eschweiler located at the company’s address.

Ratingen, den 24.04.2018

Stefan Eschweiler
Geschäftsführer – Managing Director

Frank Pospiech
Geschäftsführer – Managing Director
RMA-Formular und Erklärung über Dekontaminierung
RMA-Form and explanation for decontamination

RMA-Nr. / RMA-No. [ ]

Die RMA-Nummer bekommen Sie von Ihrem Ansprechpartner im Vertrieb oder Service / You may obtain the RMA number from your sales or service representative.

Zu diesem Rücksendeschein gehört eine Dekontaminierungserklärung. Die gesetzlichen Vorschriften schreiben vor, dass Sie uns diese Dekontaminierungserklärung ausgefüllt und unterschrieben zurücksenden müssen. Bitte füllen Sie auch diese im Sinne der Gesundheit unserer Mitarbeiter vollständig aus. / This return form includes a decontamination statement. The law requires you to submit this completed and signed decontamination statement to us. Please complete the entire form, also in the interest of our employee health.

<table>
<thead>
<tr>
<th>Firma/ Company</th>
<th>Ansprechpartner/ Person in charge</th>
</tr>
</thead>
<tbody>
<tr>
<td>Straße/ Street</td>
<td>Name/ Name</td>
</tr>
<tr>
<td>PLZ, Ort/ Zip, City</td>
<td>Abt./ Dept.</td>
</tr>
<tr>
<td>Land/ Country</td>
<td>Tel./ Phone</td>
</tr>
<tr>
<td>Gerät/ Device</td>
<td>E-Mail</td>
</tr>
<tr>
<td>Anzahl/ Quantity</td>
<td>Serien-Nr./ Serial No.</td>
</tr>
<tr>
<td>Auftragsnr. / Order No.</td>
<td>Artikel-Nr./ Item No.</td>
</tr>
</tbody>
</table>

**Grund der Rücksendung/ Reason for return**
- [ ] Kalibrierung/ Calibration
- [ ] Modifikation/ Modification
- [ ] Reklamation/ Claim
- [ ] Reparatur/ Repair
- [ ] andere/ other

Bitte spezifizieren/ please specify

**Ist das Gerät möglicherweise kontaminiert?/ Could the equipment be contaminated?**
- [ ] Nein, da das Gerät nicht mit gesundheitsgefährdenden Stoffen betrieben wurde./ No, because the device was not operated with hazardous substances.
- [ ] Nein, da das Gerät ordnungsgemäß gereinigt und dekontaminiert wurde./ No, because the device has been properly cleaned and decontaminated.
- [ ] Ja, kontaminiert mit:/ Yes, contaminated with:

![Safety symbols]

**Bitte Sicherheitsdatenblatt beilegen/ Please enclose safety data sheet**

Das Gerät wurde gespült mit:/ The equipment was purged with:


Falls die Ware nicht gereinigt, also kontaminiert bei uns eintrifft, muss die Firma Bühler sich vorbehalten, diese durch einen externen Dienstleister reinigen zu lassen und Ihnen dies in Rechnung zu stellen.

**Datum/ Date**

Datum/ Date

rechtsgültige Unterschrift/ Legally binding signature

DE000011  Bühler Technologies GmbH, Harkortstr. 29, D-40880 Ratingen  01/2019  Tel. +49 (0) 21 02 / 49 89-0, Fax: +49 (0) 21 02 / 49 89-20  E-Mail: service@buehler-technologies.com  Internet: www.buehler-technologies.com
Die Analyse defekter Baugruppen ist ein wesentlicher Bestandteil der Qualitätssicherung der Firma Bühler Technologies.

Um eine aussagekräftige Analyse zu gewährleisten muss die Ware möglichst unverändert untersucht werden. Es dürfen keine Veränderungen oder weitere Beschädigungen auftreten, die Ursachen verdecken oder eine Analyse unmöglich machen.


Analysing defective assemblies is an essential part of quality assurance at Bühler Technologies.

To ensure conclusive analysis the goods must be inspected unaltered, if possible. Modifications or other damages which may hide the cause or render it impossible to analyse are prohibited.

Electronic assemblies may be sensitive to static electricity. Be sure to handle these assemblies in an ESD-safe manner. Where possible, the assemblies should be replaced in an ESD-safe location. If unable to do so, take ESD-safe precautions when replacing these. Must be transported in ESD-safe containers. The packaging of the assemblies must be ESD-safe. If possible, use the packaging of the spare part or use ESD-safe packaging.

Observe the above specifications when installing the spare part. Ensure the part and all components are properly installed. Return the cables to the original state before putting into service. When in doubt, contact the manufacturer for additional information.