



## testo 350 · Combustion & Emission Analyzer

Short manual





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**i** These brief instructions provide an overview over the most important functions of the product. Before using the product you should absolutely read and follow the operating instructions!

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This document describes the product testo 350 with the device setting **Country version | USA**

## 1.1. Technical data

### 1.1.1. Measurement ranges and resolution

#### Analysis box

Measurement parameter	Measurement range without dilution of all sensors	Measurement range with dilution of all sensors (option)
O <sub>2</sub>	0...25Vol.%	The reading does not appear in the display.
CO, H <sub>2</sub> -comp.	0...10000ppm	2500...50000ppm
CO <sub>low</sub> , H <sub>2</sub> -comp.	0...500ppm	500...2500ppm
NO	0...4000ppm	1500...20000ppm
NO <sub>low</sub>	0...300ppm	300...1500ppm
NO <sub>2</sub>	0...500ppm	500...2500ppm
SO <sub>2</sub>	0...5000ppm	500...25000ppm
H <sub>2</sub> S	0...300ppm	200...1500ppm
CO <sub>2</sub> (IR)	0...50Vol.%	The reading does not appear in the display.
HC <sup>1, 2</sup>	Natural gas: 100...40000ppm Propane: 100...21000ppm Butane: 100...18000ppm	Natural gas: 500...8000000ppm Propane: 500...42000000ppm Butane: 500...36000000ppm

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<sup>1</sup> Detection limit: 50ppm

<sup>2</sup> Strict compliance with the lower explosion limit is mandatory.

The dilution of all sensors results in an additional measuring error (measuring inaccuracy).

### 1.1.2. Other instrument data

#### Control Unit

Feature	Values
Rech. batt. service life	approx. 5hr (display switched on, Bluetooth® deactivated)

#### Analyzer box

Rech. batt. service life	2.5hr (with gas cooler and IR module) / 4.5hr (without gas cooler and IR module)
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## 2 Product description

### 2.1. Control Unit

#### 2.1.1. Overview



- 1 IrDA interface
- 2 Switch On / Off

### 3 Magnetic holder (on rear)

#### CAUTION

Strong magnets

#### Damage to other devices!

- > Keep a safe distance from products which could be damaged by magnets (e.g. monitors, computers, pacemakers, credit cards).

4 Display

5 Keyboard

6 Electrical contact bar for analyzer box (on rear)

7 Interfaces: USB 2.0, charger, Testo Data bus

## 2.1.2. Keyboard

Key	Functions
[⏻]	Switch measuring instrument on / off
[OK] Example	Function key (orange, 3x), relevant function is shown on the display
[▲]	Scroll up, increase value
[▼]	Scroll down, reduce value
[esc]	Back, cancel function
[☰]	Open main menu
[i]	Open menu <b>Instrument diagnosis</b>

## 2.1.3. Connections / interfaces



1 USB 2.0

2 Testo Data bus

3 Connecting socket for AC power supply 0554 1096

4 Guide groove for locking with analyzer box

## 2.2. Analyzer Box

### 2.2.1. Overview



- 1 Condensate trap and condensate container
- 2 Locking/unlocking button for Control Unit
- 3 Particle filter
- 4 Filter fresh air inlet (option: fresh air valve / measurement range extension overall (5x))
- 5 Contact bar for connection to Control Unit
- 6 Guide pins for locking with Control Unit
- 7 Dilution air filter
- 8 Status display

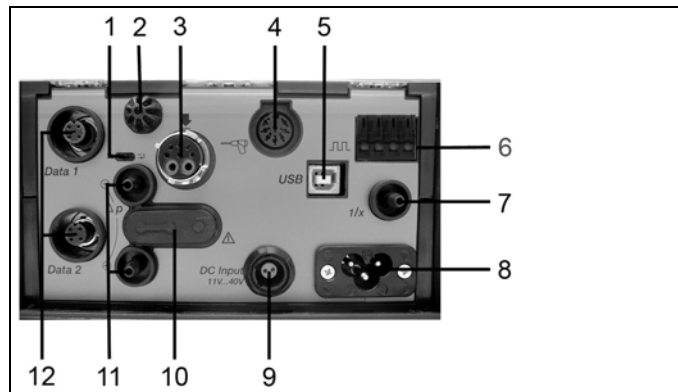


## 2.2.2. Status display

The status display shows the operating status of the analyzer box:

Display	Status
green / permanent (analyzer box switched on)	AC power supply operation or rech. batt operation / rech. batt. fully charged
red / flashing (analyzer box switched on)	<ul style="list-style-type: none"><li>Rech. batt. operation / residual rech. batt. capacity &lt; 20%</li><li>other device error</li></ul>
green / flashing (analyzer box switched off)	Charge rech. batt.
green / permanent (analyzer box switched off)	Rech. batt. fully charged, trickle charge
green, red / alternately flashing	Update flash mode active

## 2.2.3. Connections / interfaces



- 1 Data bus termination slide switch
- 2 Sensor for combustion air temperature
- 3 Flue gas probe
- 4 Sensor input
- 5 USB 2.0
- 6 Trigger input
- 7 Dilution gas inlet for measurement range extension
- 8 Power socket 100...240V AC, 47...63Hz

- 9 DC-voltage input 11...40V DC (option)
- 10 Covering cap gas channel access (only for servicing purposes)



Plugged in covering cap: Position (●—● ●) must not be changed!

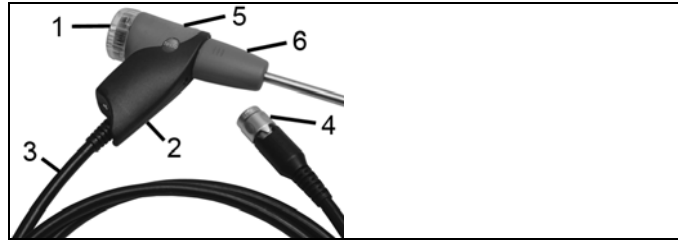
- 11 Pressure ports p+ and p-
- 12 Testo data bus

#### 2.2.4. Analyzer box menu

Main menu	Menu	Description
Applications	-	Select an application in accordance with the measuring task to be performed
Folders	-	Create and manage folders and measurement sites
Fuels & Test Option	-	Select and configure fuels
Saved Measurements	-	Display and manage measurements

<b>Main menu</b>	<b>Menu</b>	<b>Description</b>
<b>Device settings</b>	<b>Dilution</b>	Set the dilution factor
	<b>Measurement view</b>	Configure the display, set measurement parameters and units for selected application and measurement type
	<b>Units</b>	Set units for display variables
	<b>Date/Time</b>	Set date, time, time format
	<b>Power Options</b>	Set automatic instrument shut-down and switch off display backlight in rech. batt. operation
	<b>Display brightness</b>	Set display brightness
	<b>Printer</b>	Select printer, enter print text
	<b>Bluetooth</b>	Bluetooth on/off
	<b>Language</b>	Set instrument language
	<b>Country version</b>	Set country version (fuels, display variables, calculation formulas)
	<b>Password protection</b>	Change password
	<b>Analog input</b>	Configure analog input
<b>Data bus</b>	Display of bus address, enter bus length	
<b>Sensor settings</b>	-	Make sensor settings, perform calibration/adjustment
<b>Programs</b>	-	Configure and activate measuring programs
<b>Instrument diagnosis</b>	<b>Error diagnosis</b>	Display of present errors
	<b>Gas path check</b>	Perform tightness test
	<b>Sensor diagnosis</b>	Perform sensor diagnosis
	<b>Device information</b>	Display of device information

## 2.2.5. Modular flue gas probe



- 1 Removable filter chamber with window and particle filter
- 2 Probe handle
- 3 Connecting cable
- 4 Connector plug for measuring instrument
- 5 Probe module lock release
- 6 Probe module

## 3 First steps

### 3.1. Commissioning/Rechargeable Battery Operation

#### 3.1.1. Control Unit

The Control Unit has a permanently installed rechargeable battery.

- > Remove the protective film from the display.
- > Charge the rech. batt. fully before using the Control Unit.

#### **Recharging the rech. batt. of the Control Unit**

The rech. batt. can only be charged at an ambient temperature of  $\pm 32^{\circ}\dots +95^{\circ}\text{F}$ . If the rech. batt. had been completely discharged, the charging time at room temperature will take about 7hr (charging with AC power supply) or approx. 14hr (charging via Testo Data bus).

#### **Charging via analyzer box**

- ✓ Control Unit is locked to analyzer box or is connected via the Testo Data bus cable.

- ✓ The analyzer box is supplied via the power supply.
- During operation with low charge power or in switched off state.

### 3.1.2. Analyzer box

The analyzer box is supplied with a rech. batt. already fitted.

- > Charge the rech. batt. fully before using the analyzer box.

#### **Charging the rech. batt. of the analyzer box**

The rech. batt. pack can only be charged at an ambient temperature of  $\pm 32^{\circ} \dots +95^{\circ} \text{F}$ . If the rech. batt. has been discharged completely, the charging time at room temperature is approx. 6hr.

- ✓ The analyzer box is switched off.
- > Connect power cable to analyzer box and power socket.
- Charging will start, the fan may come on automatically. The status LEDs lights green while the rech. batt. is being charged.
- Once the rech. batt. has been charged the instrument will automatically change to trickle charge. The status LEDs permanently light green.

#### **Analyzer box via DC-voltage input DC**

Cable with battery terminals and adapter for connection to analyzer box required (0554 1337, accessory)

- If the analyzer box is switched off the rech. batt. charging process will start automatically. Battery charging stops when the flue gas analyser is switched on by the Control Unit.

## 3.2. Getting to know the product

### 3.2.1. Connecting probes / sensors

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**i** Sensor detection takes place during startup: Sensors that are required must always be connected before the flue gas analyzer is switched on, or the flue gas analyzer must be switched off and then on again after a sensor change, so that the correct sensor data can be read.

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- > Connect the required probes / sensors to the corresponding ports.

## 3.2.2. Connecting system components

### 3.2.2.1. Connection using contact strip



The Control Unit can be plugged on and locked to the analyzer box.

1. Place the guide groove in the bottom side of the Control Unit over the guide pins of the analyzer box.
2. Press the Control Unit against the analyzer box until the locking/unlocking buttons noticeably clicks into place **two times**.

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**i** To protect the display (i.e. during transport) the Control Unit can also be inserted with the back facing up, however, in this case there is no power connection to the analyzer box.

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### 3.2.2.2. Connecting via Data bus cable (accessory)

The individual components (e.g. Control Unit with analyzer box or analyzer box with analyzer box) can be connected using the Testo databus cable.

> Connect the Data bus cable to the Data bus interfaces.

Please observe the following points when setting up a connection via databus cable:

- Use only Testo databus cables
- Do not route databus cables in the vicinity of electric power cables.
- Ensure sufficient power supply by supplying each analyzer box with AC voltage.
- The cables should ideally be plugged in before the system is switched on. Connecting during operation (hot plugging) is possible, however, depending on the combination the system may need to be switched off and on again.
- The connection cannot be separated under load.

- Data bus limitations: max. 16 analyzer boxes in one Data bus system.
- Cable length: max. 164 ft. between Control Unit and analyzer box, max. 2,624 ft. between all analyzer boxes in the databus system.
- Each component in the Data bus system must have a different bus address.
- The bus system must have a defined electrical termination, see below.

#### **Electrical termination of the bus system**

The databus system is linear in structure. The Control Unit or the Testo databus controller with USB connection represents the beginning of the line.

The end is represented by the last components connected in the system (analyzer box or analog output box). This component must have a defined electrical termination. For example:

An analog output box is the furthest subscriber or last one in system.

- > Insert the Data bus termination plug into the Data bus socket on the analog output box.

An analyzer box is the furthest subscriber or last one in system.

- > Set the Data bus termination slide switch in the analyzer box to switch position right (→).

#### **3.2.2.3. Connection via Bluetooth® (option)**



or



or



The Control Unit can be connected to an analyzer box or a PC/ Notebook via Bluetooth, as long as both components are equipped with Bluetooth.

### 3.2.3. Switching on

#### Before switching on

- > Connect all system components.
- > Connect all required probes/sensors.
- > Connect all system components to the electric power supply.

When switching on the Control Unit

- should be plugged on the contact strip of the analyzer box


or

- connected with a Data bus cable

or


- plugged to the AC power cord of the analyzer box, so that starting via Bluetooth is enabled.

#### Switching on

- > press .
- The Welcome Screen is displayed (approx. 5 sec.)
- The Control Unit display screen appears.
- The Control Unit searches for connected analyzer boxes and shows these as independent tabs in the display.



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**i** Control Unit and analyzer box are not connected:  
If the Control Unit has already been switched on, you must press  once again for a short moment to set up a connection to the analyzer box.

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### 3.2.4. Printing / saving data

Printing and saving is accomplished via the menu **Options**, which is accessed via the left function key and is available in many different menus (e.g. in the menu **Measurement Options**).

Assign the function **Save** or **Print** to the right function key.

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**i** Only readings, which have a display field in the measurement view assigned, will be saved/printed out.

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**i** The measurement data can be printed out parallel to the saving (data logging) process, while a measurement program is running.

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### 3.2.5. Switching off

**i** Unsaved readings will be lost when the flue gas analyzer is switched off.

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#### Rinse phase

When switched off, the analyzer box checks whether flue gases are still in the sensors. The sensors are rinsed with fresh air, if this should be necessary. The duration of the rinse phase depends on the gas concentration in the sensors.

- > Press .
- The rinse phase starts.
- The flue gas analyzer switches off. It is normal for the fan of the analyzer box to run for a short time.

## 3.3. Folders / Measurement sites

(Only available via **Analyzer Box** tab)

All readings can be saved under the currently active measurement site. Readings not yet saved are lost when the measuring instrument is switched off.

Folders and measurement sites can be created, edited, copied and activated. Folders and measurement sites (incl. protocols) can be deleted.

Calling up the function:

>  → **Folders** → **[OK]**.

#### Changing the display:

> Toggle between overview (display of number of measurement sites per folder) and detailed view (display of all measurement sites per folder): **[Overview]** or **[Details]**.

#### Activating a measurement site:

- > Select the measurement site → **[OK]**.
- The measurement site is activated and the menu **Measurement Options** is opened.

#### Creating a new measurement site:

A measurement site is always created in a folder.

1. Select the folder in which the measurement site is to be created.
2. **[Options]** → **New Measurement site** → **[OK]**.
3. Enter values or make settings.

The following inputs/settings are possible:

Parameter	Description
<b>Measurement site</b>	Enter name
<b>Application</b>	Select application
<b>Fuel</b>	Select fuel
<b>Profile</b>	Enter diameter, length, width, height and area. For correct measurement of the volume flow you must set the profile and area. A volumetric flow rate is calculated from the geometries entered here together with the measured velocity.
<b>Pitot Tube Factor</b>	The parameter "Pitot tube factor" influences the measurement of flow speed, volume flow rate and mass flow. The Pitot factor depends on the type of Pitot tube used: Straight Pitot tubes: Factor = 0.67 Prandtl Pitot tubes (bent): Factor = 1

Parameter	Description
Humidity	The parameter "Humidity" (combustion air humidity) influences the calculation of flue gas loss and flue gas dew point. The factory setting is 80.0% humidity. To achieve a higher accuracy, the values can be adjusted to the actual ambient conditions.
Pressure Absolute	<p>The absolute pressure influences the calculation of flow speed, volume flow, mass flow and flue gas dew point. The factory setting is 393.43 "H<sub>2</sub>O. To achieve a higher accuracy, the values can be adjusted to the actual ambient conditions.</p> <p><b>i</b> If a CO<sub>2</sub>-(IR) module is installed, the absolute pressure value measured there will automatically be used.</p>
Barometric pressure	<p><b>i</b> The input of the barometric pressure and the height above sea level is only required when no absolute pressure is available (no CO<sub>2</sub> IR module present).</p> <p>The barometric pressure influences the calculation of flow speed, volume flow, mass flow and flue gas dew point. To achieve a higher accuracy, the values can be adjusted to the actual ambient conditions.</p> <p>This is 406.68 "H<sub>2</sub>O as an annual average, regardless of the altitude. Depending on the current weather, this pressure can fluctuate by 8.02 "H<sub>2</sub>O around the annual average.</p>
Altitude	The height above sea level influences the calculation of flow speed, volume flow, mass flow and flue gas dew point. To achieve a higher accuracy, the value can be adjusted to the actual ambient conditions.
Dewpoint	The parameter "Dewpoint" (combustion air dewpoint) influences the calculation of flue gas loss and flue gas dew point. The factory setting for the dewpoint is 34.7 °F. To achieve a higher accuracy, the values can be adjusted to the actual ambient conditions.

4. Finalize the entry: **[Finished]**.

#### Other measurement site options:

- > **[Options]** → **Edit measurement site**: Make changes to an existing measurement site.
- > **[Options]** → **Copy measurement site**: Make a copy of an existing measurement site in the same folder.
- > **[Options]** → **Delete measurement site**: Delete an existing measurement site.

#### Create a new folder:

1. **[Options]** → **New Folder** → **[OK]**.
2. Enter values or make settings.
3. Finalise the entry: **[Finished]**.

#### Other folder options:

- **Edit Folder**: Make changes to an existing folder.
- **Copy Folder**: Make a copy of an existing folder.
- **Delete Folder**: Delete an existing folder, including the measurement sites created therein.
- **Delete All Folders**: Delete all existing folders, including the measurement sites created therein.



## 4 Using the product

### 4.1. Performing settings

#### 4.1.1. Assigning the right hand function key

The right function key can have a function from the **Options** menu assigned to it. The menu **Options** is accessed via the left function key and is available in many different menus. This assignment is only valid for the currently opened menu / the opened function.

✓ A menu / function is opened in which the **Options** menu is displayed on the left function key.

1. Press **[Options]**.
2. Select option: , .

Depending on the menu / function from which the **Options** menu was opened, various functions are available.

3. Assign the selected function to the right function key: Press the **[Config. Key]**.

## 4.1.2. Device settings

### 4.1.2.1. Measurement view

(only available via **Analyzer Box** tab)

The parameters / units and the display representation (number of readings displayed per display page) can be set.

The settings are only valid for the currently chosen combination of application and measurement type, which is indicated by the symbol (application) and the text (measurement type) in the info field.

Total overview of selectable parameters and units (available selection depends on the chosen application / measurement type):

<b>Display</b>	<b>Measurement parameter</b>
<b>Tstack</b>	Flue gas temperature
<b>Tamb</b>	Combustion air temperature
<b>Δp</b>	Differential pressure
<b>Δp1</b>	Differential pressure 1 (flue gas + m/s)
<b>Δp2</b>	Differential pressure 2 (flue gas + ΔP)
<b>Draft</b>	Flue Draft
<b>Pabs</b>	Absolute pressure
<b>Pump</b>	Pumping capacity
<b>O2</b>	Oxygen
<b>O2ref</b>	Oxygen reference
<b>CO2</b>	Carbon dioxide
<b>CO2max</b>	Maximum carbon dioxide content
<b>qAnet</b>	Abgasverlust
<b>CO</b>	Carbon monoxide
<b>COundil</b>	Carbon monoxide undiluted
<b>COamb</b>	Ambient carbon monoxide
<b>NO</b>	Nitrogen monoxide
<b>NO<sub>2</sub></b>	Nitrogen dioxide
<b>NOx</b>	Nitrogen oxide
<b>SO<sub>2</sub></b>	Sulphur dioxide
<b>H2S</b>	Hydrogen sulphide

Display	Measurement parameter
CxHy	Hydrocarbon
H <sub>2</sub>	Hydrogen
ExAir	Air ratio
cCO	Corrected carbon monoxide value
cSO <sub>2</sub>	Corrected sulphur dioxide value
CO2IR	Carbon dioxide IR active
Vel	Flow velocity
Volume flow	Volume flow
DewPt	Flue gas dew point temperature
MCO	Mass flow CO
MNOx	Mass flow NOx
MSO <sub>2</sub>	Mass flow SO <sub>2</sub>
MH <sub>2</sub> S	Mass flow H <sub>2</sub> S
effn	Efficiency
cNO	Correct NO
cNO <sub>2</sub>	Correct NO <sub>2</sub>
cNOx	Corrected Nitrogen oxide value
MCO2IR	Mass flow CO <sub>2</sub> -IR
ambCO <sub>2</sub>	Ambient carbon dioxide
%rF ambient	Humidity measuring value external sensor
UI ext	external voltage
Tsensor	Instrument temperature

Calling up the function:

>  → **Device settings** → **[OK]** → **Measurement view** → **[OK]**

#### Change parameter / unit in a line:

1. Select the line: **[▲], [▼]** → **[Change]**
2. Select the parameter: **[▲], [▼]** → **[OK]**
3. Select the unit: **[▲], [▼]** → **[OK]**
4. Save changes: **[OK]**

### Options:

- > **[Options]** → **Number of lines**: Change the number of measuring values per display page.
- > **[Options]** → **Blank line**: Insert the empty line before the selected line.
- > **[Options]** → **Delete line**: Delete the selected line.
- > **[Options]** → **Factory setting**: Reset the readings display to factory setting.

### 4.1.2.2. Date / time

This function is available in both the analyzer box and the Control Unit. Changes are accepted for the Control unit and for the analyzer box.

Date, time mode and time can be set.

Calling up the function:

- > **[Menu]** → **Device Settings** → **[OK]** → **Date/Time** → **[OK]**

### Set date/time

1. Select parameter: **[◀]**, **[▲]**, **[▼]** → **[Edit]**.
2. Set parameter: **[▲]**, **[▼]** and partly **[◀]**, **[▶]** → **[OK]**.
3. Save changes: **[Save]**.

### 4.1.3. Programs

Five flue gas measuring programs can be set, saved and executed.

The **Trigger** function (trigger signal as start/stop criterion) is only available for devices with the trigger input option.



Device settings cannot be changed if a program is active or running.



The program **Exhaust Gas (before + after cat)** checks whether the analyzer box is equipped with a fresh air valve. If not, a measuring program with normal flue gas measurement will be added, instead of the program **Exhaust Gas (before + after cat)**. A program **Exhaust Gas (before + after cat)** without fresh air valve does not show any sensible measuring results.

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Calling up the function:


- > **[Menu]** → **Programs** → **[OK]**.

### Activating / deactivating a program:


- > Select the program: [▲], [▼] → [Enable] or [Disable].
- When activating a program: The program is activated and the measurement type matching the program is opened.







### Editing the measuring program:

Adjustable parameters:

Parameter	Function
Measurement program	Edit program name
Measurement type	Select flue gas menu: <ul style="list-style-type: none"><li>• Flue gas</li><li>• Flue gas + m/s</li><li>• Flue gas <math>\Delta P</math></li><li>• Exhaust gas b+a cat (before and after catalyst)</li><li>• EPA/CTM-034 program for all boxes</li></ul>
Reading per mean value	With mean value <b>Yes</b> only mean values will be saved.
Start	Determine the start criterion <ul style="list-style-type: none"><li>•  The measuring program is started at any time (the function key automatically changes to the stop function).</li><li>• Time Start of measurement at a pre-programmed time.</li><li>• External signal Trigger signal to control the start of measuring programs.</li></ul>



Parameter	Function
Stop	<p>Determining the stop criterion</p> <ul style="list-style-type: none"> <li> The measuring program is stopped at any time (the function key automatically changes to the start function)</li> <li>Time The recoding of readings stops at a desired time.</li> <li>External signal Trigger signal to control the stop of measuring programs.</li> <li>Duration Defining number of test cycles.</li> <li>Memory full Saving readings ends when the memory is full.</li> </ul>
Gas time	Selection of gas time cycle
Rinse time	<p>Enter the rinse time.</p> <hr/> <p><b>i</b> The measurement program always begins with a rinse phase (duration: 6min). Measuring phases (gas time) and rinsing phases (rinsing time) alternate according to the programmed values.</p>
Analyzer rate	The analyzer rate is the saving cycle for mean values It is programmed in units of seconds, minutes, whereby the smallest possible analyzer rate depends on the number and type of connected probes.

1. Select the program: ,  → **[OK]**.
2. Press **[Change]**.
3. Press **[Change]**.
4. Edit program name: , , , .
5. Confirm the entry: **[OK]**.
6. Repeat steps 4 and 5 as required.
7. Press **[Next]**.
8. Perform steps 4 and 7 for further criteria accordingly.
9. Press **[Finished]**.

## 4.2. Measuring

### 4.2.1. Preparing for measurement

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**i** The air temperature is continuously measured by the temperature sensor installed in the analyzer box. The fresh air required for the zeroing phase is drawn in through the exhaust if no fresh air valve (option) is installed and through the valve inlet if a fresh air valve is installed. The flue gas probe can thus already be inside the flue gas channel before or during the zeroing phase.

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#### **Before switching on**

- > Check whether:
  - All system components are properly connected.
  - All required probes / sensors are connected.
  - The power supply of all system components is guaranteed.

#### **During then zeroing phase**

During the zeroing phase the sensors of the flue gas analyzer are zeroed. The zero point and the drift of the sensors are checked. The O<sub>2</sub> value is set to 21% O<sub>2</sub>.

- > Make sure that the ambient air is free of interfering gases (e.g. CO, NO) during zeroing!

#### **Before the measurement**

- > Set the fuel for the furnace system to be measured.
- > Assign the required measurement parameters and units to a display field in the measurement view.
- > Activate the measurement site to which the readings are to be assigned.
- > Make sure that the gas outlets are free, so that the gas can escape without obstruction. Otherwise the measurement results may be corrupted.

## 4.2.2. Applications

You can choose from the applications provided or a user defined application (application defined on the basis of the combustion applications).

The memory contains suitable device settings for the analyzer box and typical fuels and calculations for these applications. These quickly provide you with optimized device configurations for the respective measuring task and the device will automatically inform you about important application specific peculiarities (information in the display).







Calling up the function:

>  → **Applications** → **[OK]**.



Press the function key **Options** to open configuration menus.

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1. Selecting an application: ,  → **[OK]**.
2. Selecting fuel: ,  → **[OK]**.
3. Choose measurement type: ,  → **[OK]**.



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