



testo 325 M/XL
Flue gas analyser

Instruction manual

en



Preface

Dear Customer

Thank you for purchasing a Testo product. We hope you will enjoy the benefits of this product for a long time to come and that it will aid you with your work.

Please read this instruction manual carefully and familiarise yourself with the operation of the instrument before putting it to use.

If problems should occur which you cannot rectify yourself, please consult our Customer Service Department or your nearest distributor. We will do our best to help you quickly and competently to reduce downtimes.

Copyright

This documentation is subject to the copyright of Testo AG. Reproduction and use contrary to the legitimate interests of Testo AG are prohibited without the prior, written consent of the company.

We reserve the right to modify technical details from the descriptions, specifications and illustrations contained in this documentation.

Testo AG
Postfach 11 40
D-79849 Lenzkirch

Symbols

Incorrect operation of this instrument could lead to danger. Particularly important information, which has to be observed when working with this product, is highlighted in this instruction manual as follows:

Warnings are highlighted by a warning triangle. The **Warning title** indicates the danger level:



Warning title

Warning! means death or serious physical injury may occur if the specified safety measures are not carried out.

Caution! means minor physical injury or damage to property may occur if the specified safety measures are not carried out.

Read all the warnings carefully and carry out all the specified safety measures to avoid danger.

! Notes on special cases and peculiarities in the handling of your unit are indicated by an exclamation mark.

Standards/tests



The conformity certificate confirms that this product fulfills the guidelines in accordance with 89/336/EEC.

This product is TÜV approved.

Test Code Number: **testo 325 M**: TÜV By RgG 218

testo 325 XL: TÜV By RgG 222

Contents

Preface / Copyright.....	2
General information	3
Contents.....	4
1. Basic safety instructions	6
2. Intended use	7
3. Product description	8
3.1 Power supply	8
3.2 Display and control elements	8
3.3 Menu overview	10
3.4 Gas path	10
4. Initial operation.....	11
4.1 Putting in rechargeable batteries / batteries	11
4.2 Connecting the mains unit.....	11
4.3 Connecting sensors / probes	11
5. Basic instructions.....	12
5.1 Switching on	12
5.2 Selecting menu items	12
5.3 Measuring ambient air temperature	12
5.4 Measuring flue gas temperature	13
5.5 Regular maintenance	13
5.6 Switching off	14
6. Settings	15
6.1 Selecting fuel.....	15
6.2 Setting display sequence	15
6.3 Selecting units.....	16
6.4 Setting date/time	16
7. Measuring	18
7.1 Measuring flue gases	17
7.2 Measuring pressure.....	17
7.3 Measuring differential temperature	18
7.4 Measuring undiluted CO	19
7.5 Measuring ambient CO	19
7.6 Printing readings taken	20
7.7 Saving/reading/deleting readings	21
7.8 Printing saved readings.....	22

8. Maintenance	23
8.1 Changing rechargeable batteries/batteries	23
8.2 Emptying the condensate trap	23
8.3 Changing the filter	24
8.4 Cleaning the analyser	24
8.5 Cleaning the flue gas probe	24
8.6 Changing the thermocouple	25
8.7 Cleaning the flue gas pump	25
8.8 Changing the measuring cells.....	26
9. Troubleshooting	29
10. Technical data	31
10.1 Measuring ranges and accuracies	31
10.2 Other instrument data	32
10.3 Calculation fundamentals	32
10.4 Calculation formulae	33
11. Accessories / Spare parts.....	34
Short instructions.....	35

1. Basic safety instructions



Avoid electrical hazards:

- ▶ Never make measurements with the unit and its external probes on or near live components unless the unit is expressly approved for current and voltage measurements.
- ▶ Use only the supplied power supply unit when using the instrument under mains power.
- ▶ Allow only authorised persons to replace damaged mains cables.



Protect the unit/measuring cells:

- ▶ Never store the unit together with solvents (e.g. acetone).
- ▶ The condensate trap should be emptied once the maximum line has been reached. Switch off the pump to empty.



Measure correctly:

- ▶ Prior to every measurement, check the complete measurement system (probe, condensate trap, hoses and connections) for leaks in order to avoid incorrect measurements caused by the intake of air.
- ▶ Ensure that the gas output in the instrument is always free of obstacles so that the sample gas can escape unhindered.



Preserve product safety/warranty entitlement:

- ▶ Operate the instrument only within the parameters specified in the technical data.
- ▶ Please handle the instrument with care.
- ▶ Force should never be applied.
- ▶ The temperature data for the probes only refer to the sensor measuring range. Never subject handles or pipes to temperatures greater than 70°C unless they are expressly approved for higher temperatures.
- ▶ The instrument should only be opened for maintenance and repair work if expressly described in the Instruction manual.
- ▶ Only carry out the maintenance and repair work described in the Instruction manual. Please follow instructions. For safety reasons, only original spare parts from Testo should be used. Any other work should only be carried out by authorised trained personnel. Otherwise responsibility for the perfect functioning of the instrument following repairs and for the validity of approvals will be denied by Testo.



Ensure correct disposal:

- ▶ The measuring cells contain low concentrations of alkaline solutions and acids. Please dispose of carefully.
- ▶ Dispose of defective rechargeable batteries and spent batteries responsibly.
- ▶ You can return your instrument directly to us at the end of its service life. We will dispose of it responsibly.

2. Intended use

Employ the analyser for the following applications only:

testo 325 M/XL is a hand-held instrument for the professional analysis of flue gas in burners:

- Small-scale burners (oil, gas, wood)
- Low temperature and condensing boilers
- Gas heaters

These systems can be adjusted using **testo 325 M/XL** and checked for their adherence to valid limit values.

testo 325 M/XL can be used to carry out the following tasks:

- Adjustment of O₂, CO and CO₂ values in burners in order to guarantee smooth operation
- Measurement and adjustment of gas flow pressure in gas heaters
- Measurement and adjustment of flow and return temperatures in heating systems

3. Product description

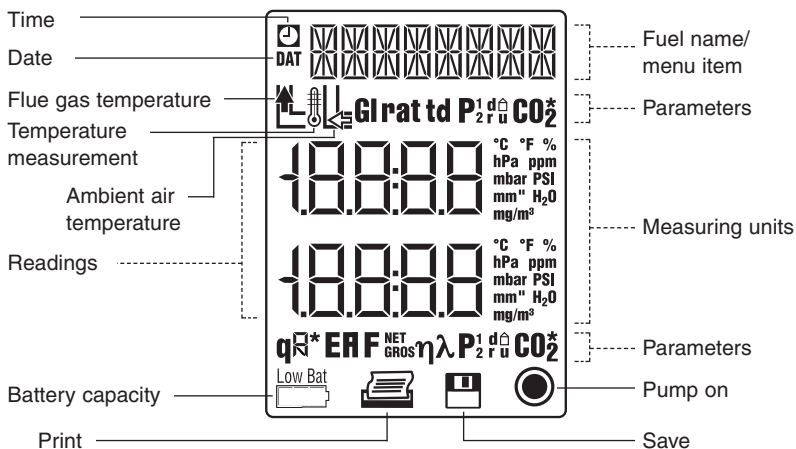
3.1 Power supply

testo 325 M / XL can be powered as follows:

- 4 batteries (1.5V round cell alkaline IEC LR6 Type AA)
- 4 rechargeable batteries (1.5V IEC KR 15/51 corresp. Type AA)
- Mains connection via mains unit (Part no. 0554 1084)
- Rechargeable battery pack (**testo 325 XL** only)

3.2 Display and control elements

Display



Battery capacity

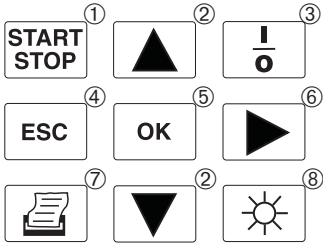
A warning flashes in the display if the battery is running low during rechargeable battery/battery operation:



Remaining capacity is then approx. 1 hour for batteries, approx. 1 hour for rechargeable batteries

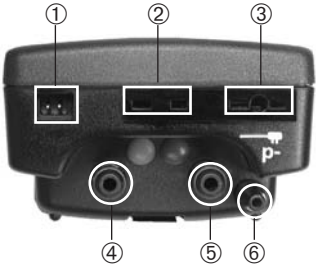
! The instrument switches itself off automatically when the rechargeable battery/battery capacity is too low, in order to protect from total discharge.

3. Product description



Keyboard

- ① Start/stop flue gas pump
- ② Select display, select menu items
- ③ Switch analyser on/off
- ④ Interrupt operation, return to superior menu level
- ⑤ Open main menu / sub-menu / menu item, confirm selection
- ⑥ Select parameters
- ⑦ Print current readings
- ⑧ Switch display light on/off

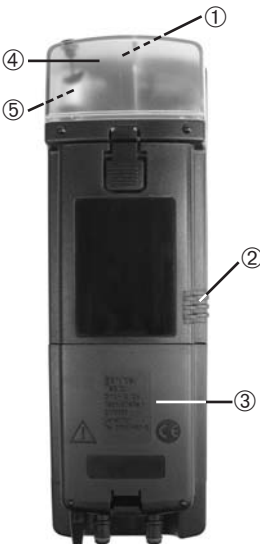


Connections

- ① Mains unit
- ② Probes: ambient air temperature (AT) / temperature T2
- ③ Probes: flue gas temperature (FT) / temperature T1
- ④ Flue gas (red)
- ⑤ Pressure + (blue)
- ⑥ Pressure - (p-)

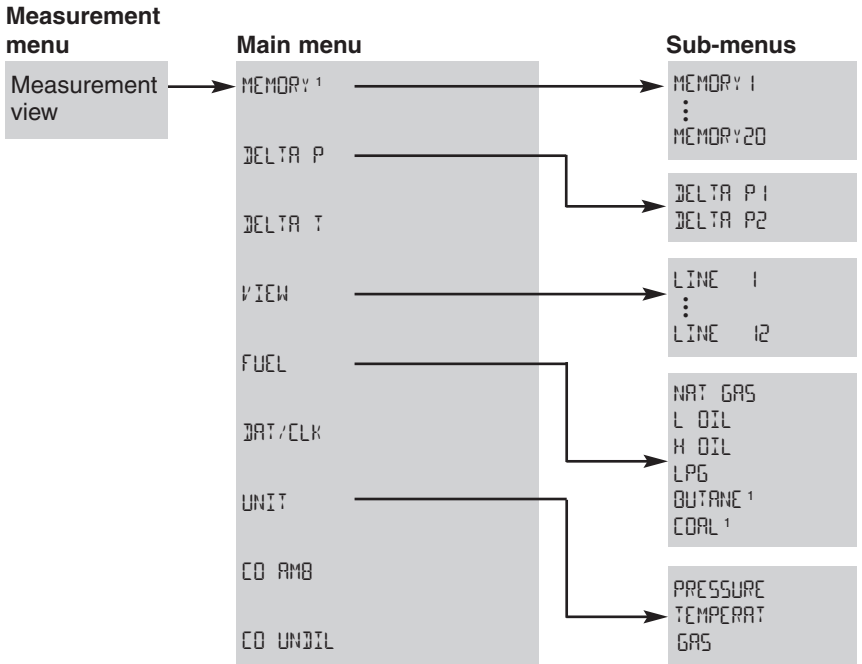
Other

- ① Infrared interface (on front side)
- ② Gas outlet
- ③ Battery compartment
- ④ Condensate trap
- ⑤ Filter (behind the condensate trap)



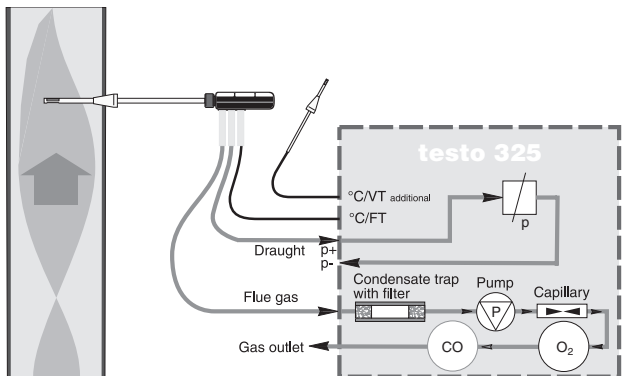
3. Product description

3.3 Menu overview



¹ (testo 325XL only)

3.4 Gas path



4. Initial operation

4.1 Putting in rechargeable batteries / batteries



testo 325XL: Insert and connect rechargeable battery pack. No other steps are necessary.

testo 325M: 4 batteries are included, please insert prior to initial operation:

- 1 Remove battery cover at rear of instrument.
- 2 Insert batteries correctly (+/-).
- 3 Close cover on battery compartment.

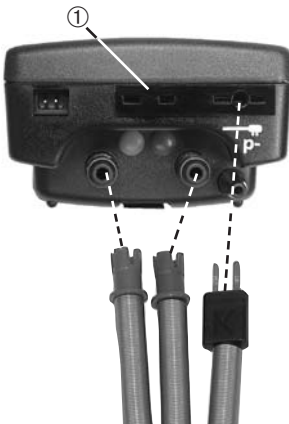
Refer to Chapter 6, Setting up on page 15 for information on how to set date/time, fuel and measurement units.

4.2 Connecting the mains unit

! Operation via mains unit (0554 1084) is also possible if the rechargeable batteries/batteries are spent. It is normal for the mains unit to heat up. If the temperature becomes too high (e.g. due to a defect in the analyser), the mains unit is protected from overheating by a thermal safety switch.

The rechargeable battery block in **testo 325 XL** is recharged in the analyser when it is switched off and is connected to the mains (battery symbol flashes during recharging, recharging stops and battery symbol disappears when rechargeable battery is full). Conventional rechargeable batteries cannot be recharged in the analyser.

- 1 Connect plug to analyser.
- 2 Connect mains plug to mains.



4.3 Connecting sensors/probes

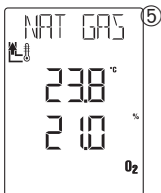
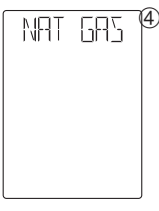
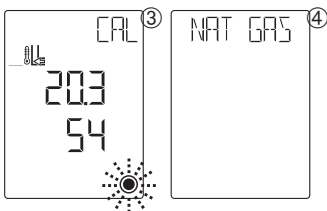
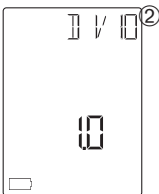
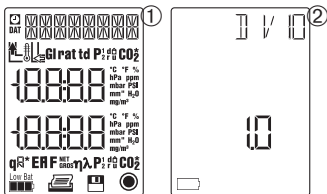
Flue gas probe (accessory)

- 1 Connect hose for gas (red) to the socket marked by red.
- 2 Connect hose for pressure (blue) to the pressure + socket (blue).
- 3 Connect flue gas temperature probe pipe to the FT socket.

Ambient air probe (accessory)

- ▶ Connect ambient air probe pipe to the AT socket ①.

5. Basic instructions



5.1 Switching on

1 Press to switch on analyser.

① Display test: All segments in the display light up for approx. 5s.

② The software version number and the power is displayed for 3s (rechargeable batteries/batteries: , mains unit:).

③ Zeroing phase: CAL lights up, pump runs for approximately 60s (remaining time is shown in display).

! The flue gas probe must be located in fresh air during zeroing!

! In the case of error messages, refer to “Troubleshooting” on page 28.

④ The set fuel flashes in the display

2 Use or to select the required fuel and confirm with .

⑤ Selected fuel now applies. The analyser changes to the measurement menu and is ready to operate.

5.2 Selecting menu items

! The pump stops automatically when the main menu is opened.

1 Open main menu using .

2 Select required menu item via or and confirm via .
If sub-menu is available:

3 Select required menu item via or and confirm via .

► Press to go back one menu level.

5. Basic instructions

5.3 Measuring ambient air temperature

There are 2 ways to measure the ambient air temperature:

1. Measurement using flue gas probe

If a separate ambient air probe is not connected, the temperature measured by the flue gas probe thermocouple during the zeroing phase is used as the ambient air temperature. All dependent variables are calculated with this value. This type of ambient air temperature measurement is sufficient for systems dependent on ambient air.

- ▶ Ensure that the flue gas probe is located near the intake duct of the burner during the zeroing phase.

2. Measurement using separate probe

If a separate ambient air probe is connected, the ambient air temperature is measured continuously by this probe.

5.4 Measuring flue gas temperature

The flue gas temperature is measured via the flue gas probe thermocouple. The probe pipe has openings at the side so that the thermocouple is protected and can simultaneously come into contact with the flue gas.

- ▶ Ensure that the thermocouple is positioned in the flue gas flow.

The thermocouple should not be covered by the probe stem frame. This is the only way to make it possible to measure the flue gas temperature accurately and consequently to determine the exact flue gas loss.

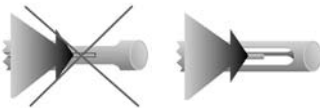
The tip of the thermocouple should not touch the protective casing!

- ▶ If possible, bend back the tip of the thermocouple.

Inserting probe pipe in flue gas duct

- ▶ Insert flue gas probe pipe, horizontally if possible, in the flue gas duct.

Condensation drops running down the probe pipe could lead to a dramatic drop in the temperature measured.



5. Basic instructions

5.5 Regular maintenance



Check the level in the condensate trap



Caution

Condensate trap overflowing

Damage to pump and measuring cells

- ▶ Check the level in the condensate trap prior to every measurement: Hold the instrument horizontally or vertically. The condensate trap should be emptied once the MAX level has been reached (See 8.2 Emptying the condensate trap, P. 23)!

Check the state of the filter



Caution



Filter dirty

Damage to pump!

- ▶ The state of the filter should be checked on a regular basis: change the filter when clogged (See 8.3 Changing the filter, P.24).

Rinse measuring cells

The measuring cells should be rinsed with fresh air after each measurement :

- 1 Remove flue gas probe from flue gas duct.
- 2 Start pump using  .
- 3 Wait until the O₂ level is above 20.0% and the CO level is below 50ppm.
- 4 Press  to stop pump.


You will find more information about servicing and maintaining your analyser in Chapter 8. Maintenance, P.23!

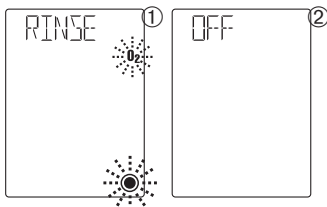
5.6 Switching off

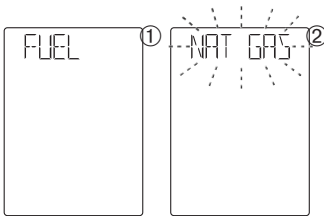
! The readings stored in the instrument are lost when the analyser is switched off.

! In the case of error messages, refer to “Troubleshooting” on page 29.

▶ Switch off analyser using .

- The analyser automatically rinses the measuring cells if the O₂ level drops below 20% or the CO level exceeds 50ppm ①.
- OFF is displayed for 5s ② (press  to discontinue switch-off), the analyser then switches off.





6.1 Selecting fuel




- 1 Select **FUEL** in main menu ① and confirm selection using **OK**.
 - The set fuel flashes in the display ②.
- 2 Select required fuel via **▲** or **▼** and confirm selection using **OK**.
 - Selected fuel is accepted and the analyser changes to the measurement menu.

6.2 Setting display sequence

The sequence in which the parameters are shown in the display can be selected as required. In this way, frequently used parameters can be combined and then called up quickly

- 1 Select **VIEW** in the main menu and confirm selection with **OK**.
 - **LINE 1** flashes in the display and the set parameters and units for line 1 and 2 are shown.
- 2 Use **▶** to select required parameter for line 1.
- 3 Use **▼** to change to **LINE 2** and select required parameter for line 2 with **▶**.
 - Selected settings are accepted and the analyser changes to the measurement menu.
- 4 Set up additional parameters for lines 3 to 12. Repeat procedure as described in step 3.
- 5 Confirm settings with **OK**.
 - Selected settings are accepted and the analyser changes to the measurement menu.

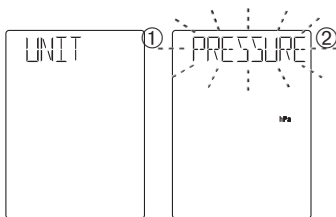
Selectable parameters:

O₂	Oxygen level
	Flue gas temperature (FT)
	Ambient air temperature (AT)
	Differential temperature (FT - AT)
EFF^{NET}	Efficiency referred to H _u
EFF^{GROS}	Efficiency referred to H _o
rat	Ratio
EA	Excess Air (EXA)
CO₂	Carbon dioxide
CO	Carbon monoxide
uCO	Carbon monoxide undiluted
λ	Air ratio
P¹	Pressure (0 to 40hPa)
P₂	Pressure (0 to 200hPa)
td	Dew point ¹
CO*	CO maximum
CO	CO ambient

¹ (testo 325XL only)

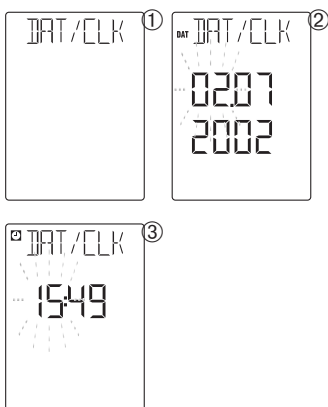
6. Settings

6.3 Selecting units



- 1 Select **UNIT** in the main menu ① and confirm with **OK**.
 - **PRESSURE** flashes and the set unit for pressure is shown in the display ②.
- 2 Select required pressure unit using **▶**.
- 3 Change to **TEMPERAT** using **▼** and select required temperature unit using **▶**.
- 4 Change to **GRS** using **▼** and select required gas unit using **▶**.
- 5 Confirm settings using **OK**.
 - Selected units are accepted and the analyser changes to the measurement menu.

6.4 Setting date/time

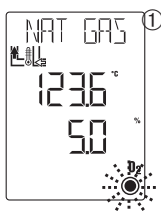


- 1 Select **DAT/CLK** in the main menu ① and confirm selection via **OK**.
 - The set date is shown and “Day” flashes ②.
- 2 Set “Day” using **▲** or **▼**.
- 3 Change to “Month” and “Year” using **▶** and set using **▲** or **▼** respectively.
- 4 Change to time setting via **▶**.
 - The set time is shown and “Hour” flashes ③.
- 5 Set “Hour” via **▲** or **▼**.
- 6 Use **▶** to change to “Minutes” and set via **▲** or **▼** “Minutes”.
- 7 Confirm selection via **OK**.
 - Selected date and time are accepted and the analyser changes to the measurement menu.

! Measurements are carried out with the flue gas probe unless otherwise indicated.

7.1 Measuring flue gases

- ▶ Select fuel (See: 6.1 Selecting fuel, P. 15).
- 1 Insert flue gas probe pipe in the flue gas duct.
- 2 Begin measurement by pressing **START/STOP**.
 - The pump starts, ● flashes and the current readings are displayed ①.
- ▶ Use ▲ or ▼ to change between the different views.
- 3 End measurement with **START/STOP**.
 - The pump stops and the last readings are retained in the analyser until the next flue gas measurement.



7.2 Measuring pressure

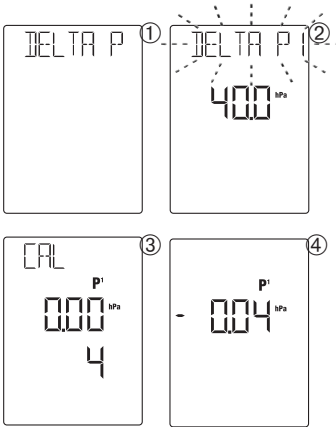
With this function, you can measure the draught in a flue gas channel or the flow pressure in gas heaters.

! Draught is measured using the flue gas probe.
! You will need the pressure set (Part no. 0554 0315) to measure the gas flow pressure.

Please observe the following when measuring pressure:

- It is only possible to measure pressure if the pump is switched off.
- When the pump is switched off, there is still a dynamic pressure in the hose which first has to be reduced.
 - ▶ Wait approximately 30 s before starting to measure pressure.
- ▶ Remove any condensate in the flue gas probe prior to measuring pressure (shake probe with tip pointing towards the ground).
- ▶ Hold flue gas probe in fresh air during the zeroing phase.
- ▶ Do not change the position of the analyser while measuring pressure.
- ▶ Do not change between rechargeable battery/battery operation and mains operation when measuring pressure; fluctuations in the current could influence the measured result.
- Reading display: negative symbol stands for negative pressure, positive sign stands for positive pressure.

7. Measuring



Measuring draught

- 1 Select **DELTA P** in the main menu ① and confirm selection via **OK**.
- 2 Select required pressure range: **DELTA P1** (0 to 40hPa) or **DELTA P2** (0 to 200hPa) ②.
- 3 Confirm selection via **OK**.
 - The analyser starts zeroing (duration: 5s), **CAL** lights up in the display ③.
- 4 Once the zeroing phase is complete, insert the flue gas probe pipe in the flue gas duct.
 - The selected pressure range and the current reading are displayed ④.
- 5 End measurement via **OK**.
 - The last reading is retained in the analyser until the next draught measurement.

Measuring gas flow pressure

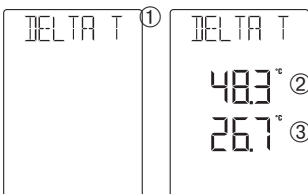
Gas flow pressure is measured in the same way as draught is measured. Please note the following:

- The silicone hoses from the pressure set should only be connected to the gas heater after the zeroing phase.

7.3 Measuring differential temperature

Use this function to measure the flow and return temperature in heating systems.

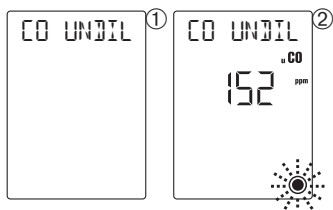
! You will need 2 pipe clamp probes (Part no. 0628 0020) for the measurement.



- 1 Connect probes to analyser.
- 2 Select **DELTA T** in the main menu ① and confirm selection via **OK**.
 - ② The temperature at the FT socket (T1) is shown in the top reading line.
 - ③ The temperature at the AT socket (T2) is shown in the bottom reading line.
- 3 End measurement with **OK**.
 - The last reading is retained in the analyser until the next differential temperature measurement.

7.4 Measuring undiluted CO

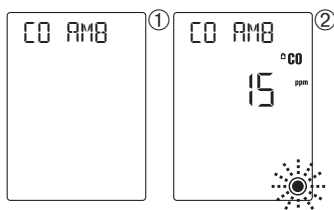
- ▶ Always carry out a COundiluted measurement prior to a flue gas measurement because the values for O₂, CO and λ in the instrument are overwritten during a COundiluted measurement.



- 1 Select **CO UNDIL** in the main menu ① and confirm via **OK**.
 - The pump starts automatically and the measured value for undiluted CO (**uCO**) is shown ②.
- 2 End measurement via **OK**.
 - The last reading is retained in the instrument until the next COundiluted measurement.

7.5 Measuring ambient CO

- ! ▶ Always carry out an ambient CO measurement before a flue gas measurement since a value for CO, retained in the analyser, will be written over when ambient CO is measured.
- ▶ Carry out zeroing in fresh air (preferably outdoors) prior to measuring ambient CO.



- 1 Select **CO AMB** in the main menu ① and confirm selection with **OK**.
 - The pump starts automatically and the measured value for ambient CO (**aCO**) is displayed.
- 2 End measurement via **OK**.
 - The last reading is retained in the analyser until the next ambient CO measurement.


7. Measuring

7.6 Printing readings taken

! You will need the Testo printer 0554 0545 to print the readings in the analyser. Follow the instructions in the printer manual.

You will have to be in the measurement menu before you can start printing and the pump must be switched off.

► Start printing procedure by pressing .

-  lights up and the following data is printed:


```
① -----  
    t325XL  
    -----  
② 30.06.2002  10:05:38  
③ NAT GAS  
④ FT      130.6  °C  
   O2      4.5   %  
   AT      26.6  °C  
   AmCO    150   PPM  
   dP 1    -0.50 hPa  
   CO2     12.1  %  
   %       1.27  
   CO      101   PPM  
⑤ HCT:    -----  
   SmoN:   -----  
⑥ # 00000000  
    -----
```

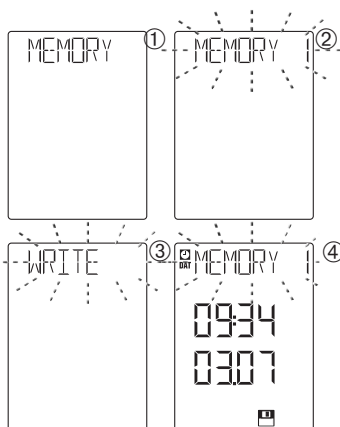
- ① Header: Device name
- ② Date / Time
- ③ Selected fuel
- ④ Parameters with corresponding reading and unit: the printout is completed according to the display sequence set in the instrument (See: 6.2 Setting display sequence, P. 15), parameters which occur twice are only printed once.
AmCO = ambient CO, CO_{mx} = CO*
- ⑤ HCT: / SmoN: Heat carrier temperature or smoke number can be entered by hand
- ⑥ Serial number of instrument








7.7 Saving/reading/deleting readings

Readings can only be saved with **testo 325XL**.



! 20 memory blocks are available (MEMORY 1 to MEMORY 20) in which 1 set of readings can be saved.

Blocks which are already occupied are identified by  and the date and time when saved are displayed. Saving on a memory block which is already occupied means that the readings that are already saved are overwritten.




- 1 Select MEMORY in the main memory ① and confirm your selection with .
- 2 Select required memory block with  or  ② and confirm with .
- 3 Using  or  choose from WRITE (save readings) ③, READ (read readings) or DELETE (delete readings) and confirm selection with .

If you select WRITE:

- Clearance query (REALLY) appears if data is already stored on the memory block.
 - ▶ Answer clearance query (REALLY) with .
- The selected memory block name flashes and  and date/time when saved light up ④. The readings are saved.



-or-

If you select READ:

- The readings contained in the selected memory block are displayed and  flashes.

-or-


If you select DELETE:

- ▶ Answer clearance query (REALLY) with .
- The readings stored in the selected memory block are deleted.
- ▶ Press  to return to memory selection or measurement menu.

7. Measuring



7.8 Print saved readings

! You will need the Testo printer 0554 0545 to print the readings saved in the instrument. Please also follow the instructions in the printer manual.

1 Select MEMORY in main memory and confirm selection with .

2 Select required memory block using  or  and start printout via .

-or-

▶ Start printout via  while the saved readings are displayed ( is shown).

-  is shown and the data is printed.

8.1 Changing rechargeable batteries / batteries

► Switch off the analyser before opening it!

! ► Connect the analyser to the mains unit (accessories), otherwise the analyser settings (e.g. date/time ...) and the readings retained in the analyser are lost.
Saved Readings (**testo 325XL** only) do not get lost!



1 Place analyser on its front and open and remove battery compartment cover at the back of the analyser.

2 Remove spent rechargeable batteries/batteries from the battery compartment.

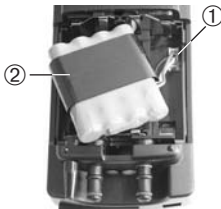
3 Place new rechargeable batteries/batteries in the battery compartment. Insert correctly (+/-).

- The analyser switches off once the rechargeable batteries / batteries are inserted!

4 Close cover on battery compartment.

Changing the rechargeable battery block

! The rechargeable battery block (**testo 325XL** only) is changed in the same way as the rechargeable batteries/batteries, however it must be connected to the white socket in the battery compartment via the plug-in connection ① and held in position in the battery compartment via the available adapter ②.



8.2 Emptying the condensate trap

► Switch off analyser before emptying the condensate trap!

1 Hold analyser with the condensate trap outlet in an upward position and remove the plugs ① somewhat from the outlet opening.

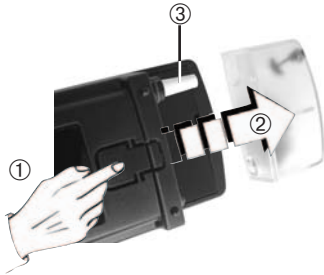
The condensate is made up a weak acidic mixture. Avoid contact with skin.

2 Empty condensate into container.

3 Close off outlet using plugs.



8. Maintenance

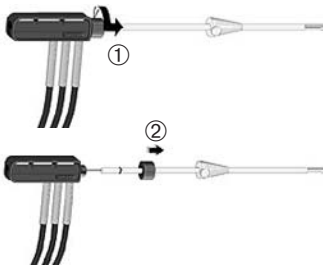


8.3 Changing the filter

- ▶ Change the filter if clogging is visible
 - ▶ Switch off the analyser before changing the filter and empty the condensate trap (See: 8.2 Emptying condensate trap, P. 23)!
- 1 Release condensate trap holder at the back of the analyser ① and remove condensate trap ②.
- ! ▶ Only original Testo filters should be used (Part no. 0554 0040)!
- 2 Remove clogged filter ③ and attach new filter.
 - 3 Attach condensate trap to analyser until it clicks into place.

8.4 Cleaning the analyser

- ▶ The analyser housing should be cleaned with a damp cloth. Please do not use corrosive cleaning substances or solutions. Weak household cleaning agents or soap solutions can also be used.



8.5 Cleaning the flue gas probe

Deposits in the flue gas probe pipe can be removed as follows:

- 1 Release knurled nut in the handle of the flue gas probe by turning it anti-clockwise ① and remove flue gas pipe ②.
- 2 Rinse flue gas pipe with hot water and then purge with air or clean with a brush (e.g. made of brass).
- 3 Push flue gas pipe over the thermocouple pipe of the flue gas probe and screw knurled nut tightly by turning it clockwise.

8.6 Changing the thermocouple



- 1 Unscrew the back bending protection spring on the flue gas probe handle and the bending protection spring in the thermocouple plug from their holders by turning them in an anti-clockwise direction.
- 2 Release thermocouple cable from the holders in the handle part and pull the defective thermocouple out of the probe pipe using a pincers ①.

8. Maintenance



- 3 Remove thermocouple cable from the slit hose sleeve ② and pull out the defective thermocouple through the bending protection springs.
- 4 Guide the new thermocouple through the bending protection springs and through the handle into the probe pipe.
- 5 Position thermocouple cable in the holders in the handle.
- 6 Place thermocouple cable in the slit hose sleeve and press bending protection springs in the handle and plug in clockwise direction onto the holders.

8.7 Cleaning the flue gas pump

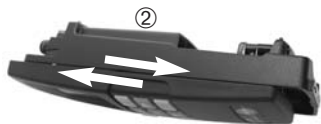
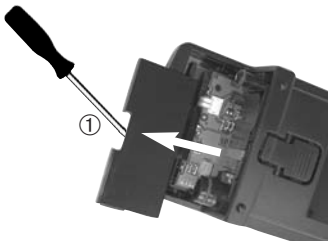
! You will need the Pump Tool (Part no. 0192 0468) to clean the flue gas pump.

When cleaning the flue gas pump, retained or saved readings and the instrument settings (Date / Clock...) are lost.

- Print out the readings you still need beforehand.

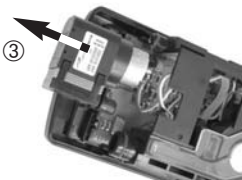
Open instrument

- Switch off the instrument before opening and empty the condensate trap (See: 8.2 Emptying the condensate trap P. 23)!
- Remove the connected sensors, probes and mains units from the analyser.
- Reduce the static charge in your body by touching a conducting and grounded object. Avoid contact with instrument electronics.



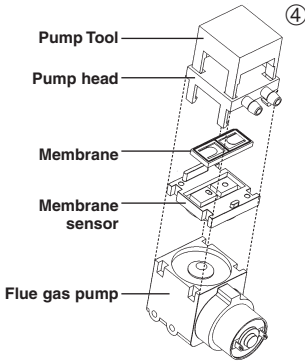
- 1 Place analyser on its front and open and remove the battery compartment cover at the back of the analyser.
- 2 Remove rechargeable batteries/batteries from the battery compartment.
- 3 Release the holder for the condensate trap at the back of the analyser and remove the condensate trap.
- 4 Remove filter and release and remove the fixing plate using a screwdriver ①.
- 5 Remove top part of housing from bottom part of housing as shown in the figure opposite ②.

Remove flue gas pump and clean



- 6 Carefully remove flue gas pump from analyser ③ and disconnect flue gas pump plug-in connection using a small flat nose pincers.
- 7 Place Pump Tool in the holder in the pump head and then pull it out.

8. Maintenance



- 8 Remove membrane sensor and membrane from pump head ④.
- 9 Clean removed parts and the pump plate with spirit or water.
- 10 Place membrane and membrane sensor in the pump head.
- 11 Attach pump head and remove Pump Tool.
- 12 Insert plug-in connection of flue gas pump and plug flue gas pump into analyser (watch out cables don't get caught!).

Reassemble analyser

- 1 Place bottom part of housing on top part of housing and put back together again by sliding the two parts against each other.
- 2 Attach fixing plate, filter and condensate trap.
- 3 Put in rechargeable batteries/batteries. Insert correctly (+/-)
- 4 Close cover on battery compartment.

8.8 Changing the measuring cells

Measuring cell type	Part no.
O ₂	0390 0085
CO (testo 325M)	0390 0297
CO/H ₂ (testo 325XL)	0390 0245

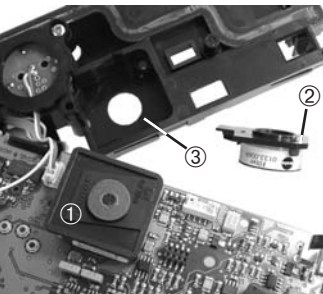
- ! Retained or saved (testo 325XL only) readings and instrument settings (Date / Clock...) are lost when the measuring cells are changed.
 - ▶ Print the readings which are still needed beforehand.
 - ▶ Only the original Testo measuring cells, listed opposite, should be used.

Opening the instrument



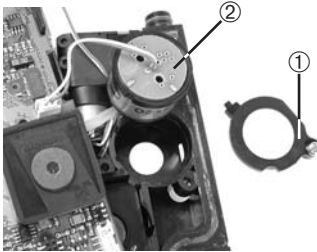
- ▶ Proceed as described in the paragraph "Open instrument" in the Chapter 8.6 Cleaning the flue gas pump, P. 25 and continue as follows:
- 6 Remove the 3 screws at the back of the mounting block and remove the mounting block from the upper part of the housing ①.
 - 7 Carefully remove board with display from mounting block ①.

Changing CO measuring cell in testo 325M



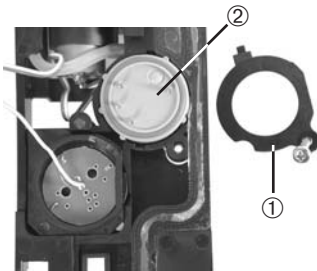
- ! The NO filter also has to be changed when the CO measuring cell is changed!
 - ▶ Before doing so, carefully remove the short-circuit spring from the measuring cell contacts of the spare measuring cell.
- 8 Remove defective CO measuring cell and attach spare measuring cell to board ①.
 - 9 Remove filter holder and NO filter ② from the measuring chamber ③, clip new NO filter into filter holder and place in the measuring chamber (perforated side of filter should point downward).

8. Maintenance



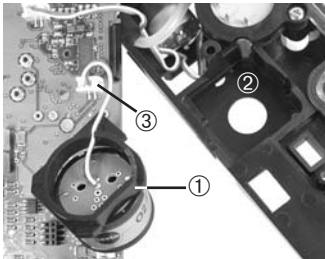
Changing O₂ measuring cell in testo 325M

- 8 Remove screw from O₂ measuring cell holder and remove holder ①.
- 9 Remove defective O₂ measuring cell ② from measuring chamber and disconnect plug-in connection.
- 10 Connect plug-in connection of the spare measuring cell and place spare measuring cell in the measuring chamber.
- 11 Attach O₂ measuring cell holder (place cable through opening of cell holder) and keep in position using screw.



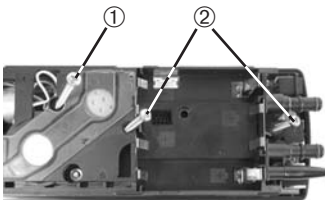
Changing the CO/H₂ measuring cell in testo 325XL

- 8 Remove screw from CO/H₂ measuring cell holder and remove holder ①.
 - 9 Remove defective CO/H₂ measuring cell ② from the measuring chamber and replace by a spare measuring cell.
- ! ▶ Please ensure the measuring cell is correctly aligned: The lone standing PIN has to be positioned at the right outer side of the measuring block!
- 10 Attach CO/H₂ measuring cell holder and keep in position using screw.



Changing the O₂ measuring cell in testo 325XL

- 8 Remove measuring cell holder and measuring cell ① from the measuring chamber ② and disconnect the plug-in connection from the defective O₂ measuring cell ③.
 - 9 Place spare measuring cell in the measuring chamber and place measuring cell holder on the measuring cell (thread cable through cell holder).
 - 10 Connect plug-in connection of spare measuring cell and position plug-in connection cable in the holder slot.
- ! ▶ Ensure that the connections for measuring cell and pump do not get mixed up. The measuring cell will be destroyed if connected incorrectly.



Assembling the analyser




- 1 Carefully attach board with display to mounting block (ensure cables are not trapped and ensure that the pressure sensor connections are connected correctly).
 - 2 Place mounting block in the upper part of the housing and fix into position using 3 screws (① long screw, ② short screws).
- ▶ Proceed as described in the paragraph "Reassemble the analyser" in 8.7 Cleaning the flue gas pump, P. 25. Now adjust the new O₂ measuring cell and enter the cell coefficients for the new CO or CO/H₂ measuring cell (See page 28)!

8. Maintenance

Calibrating the O₂ measuring cell

! Your readings will be incorrect if full adjustment has not been carried out. Adjustment takes 15 minutes.

If a flue gas probe is connected, it should be located in fresh air during adjustment.

- 1 Switch on analyser by pressing  and press  and  simultaneously while version number and rechargeable battery/battery capacity are being displayed (duration: 3s)

- O₂-CALIB lights up ①.

testo 325M:

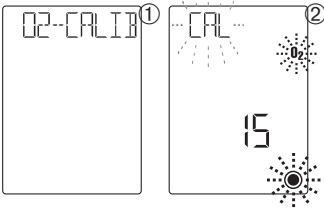
- 2 Start calibration by pressing .

testo 325XL:

- 2 Start calibration by pressing  twice.

- The pump starts, O₂ and CAL flash and the minutes until the end of the calibration are displayed ②.

- Once calibration is complete, zeroing is carried out and is then ready for operation.






Entering cell coefficients for CO or CO/H₂ measuring cell

! The readings will be incorrect if the correct cell coefficients are not entered! You will find the cell coefficients on the sheet enclosed with the spare measuring cell.

If input is incorrect:

▶ Cancel procedure with  and enter cell coefficients once again.




- 1 Switch on analyser by pressing  and press  and  simultaneously while version number and rechargeable battery/battery capacity are being displayed (duration: 3s)

- O₂ CALIB lights up ①.

- 2 Select  via  ② and confirm selection with .

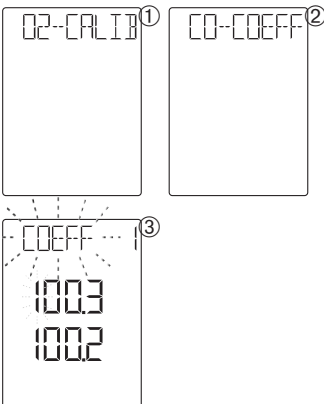
- The first digit in the first cell coefficient flashes ③.

- 3 Set digit using  or .

- 4 Advance to the next positions and change to the next cell coefficients using . Set digits using  or .

- 6 Complete input by pressing .



- The set values are accepted. The analyser carries out zeroing and is now ready for operation.



9. Troubleshooting



If defects not described here should occur, please contact your distributor or Testo Customer Service. You will find contact details in the Warranty booklet or in Internet at www.testo.com.

Defects when switching on:

Defect	Possible causes	Remedy
Analyser cannot be switched on	Spent rechargeable batteries/batteries	▶ Change rechargeable batteries/batteries (See Chapter 8.1, P. 23) or connect mains unit (accessory)
 flashes and zeroing starts again	Operating temperature too high or too low	▶ Analyser should be brought into permissible operating temperature range
 flashes and zeroing starts again	Flue gas temperature probe not attached or incorrectly attached -or- Thermocouple of flue gas temperature probe defective	▶ Connect flue gas temperature probe or check connection ▶ Change thermocouple (See Chapter 8.6 Changing thermocouple, P. 25)
O ₂ flashes and zeroing starts again	O ₂ value too low because flue gas probe pipe is in flue gas duct	▶ Expose probe to fresh air and run zeroing phase again. If not successful: O ₂ measuring cell is defect and has to be changed (See 8.8 Changing measuring cells, P.26)
CO flashes and zeroing starts again	Flue gas probe pipe in flue gas duct -or- CO value not stable	▶ Expose probe to fresh air and run through zeroing phase. If not successful: CO / CO/H ₂ measuring cell is defect and has to be changed (See 8.8 Changing measuring cells, P. 26)
ERROR and an error number are displayed	Various	▶ Switch off analyser and contact Testo Customer Service Department or contact your nearest dealer

9. Troubleshooting

Defects when measuring

Defect	Possible causes	Remedy
 flashes and ----- appears	Flue gas temperature probe is not or is incorrectly connected -or- Thermocouple in flue gas temperature probe defective	<ul style="list-style-type: none"> ▶ Connect flue gas temperature probe or check connection ▶ Change thermocouple (See 8.6 Changing thermocouple, P. 25)
---- is shown in place of reading	Probe not/incorrectly connected or defective	<ul style="list-style-type: none"> ▶ Connect probe or check connection or change filter
O₂ flashes and ----- appears	O ₂ measuring cell defect	<ul style="list-style-type: none"> ▶ Change O₂ measuring cell (See 8.8 Changing measuring cells, P. 26)
CO flashes and ----- appears	CO / CO/H ₂ measuring cell defective	<ul style="list-style-type: none"> ▶ Change CO/ CO/H₂ measuring cell (See 8.8 Changing measuring cells, P. 26)
Pump stops and CO flashes	CO value is above the switch-off limit	<ul style="list-style-type: none"> ▶ Expose probe to fresh air and start pump via , to purge the measuring cells. ⚠ Caution! Meas. cell can be destroyed if CO value is too high!
Analyser switches itself off	Rechargeable batteries/ batteries spent	<ul style="list-style-type: none"> ▶ Change rechargeable batteries/batteries (See Chapter 8.6, P. 23) or connect mains unit (accessory)

Defects when switching off:

Defect	Possible causes	Remedy
CO and / or O₂ flash	CO value too high and / or O ₂ value too low	<ul style="list-style-type: none"> ▶ Expose probe to fresh air and wait for rinse to end. If not successful: O₂ or CO/ CO/H₂ measuring cell is defective and has to be changed (See Chapter 8.8 Changing measuring cells, P. 26)

10.1 Measuring ranges and accuracies

testo 325 M

Measurement type	Meas. range	Accuracy	Resolution	Adapt. time 90%
Temperature ¹	- 40 to + 600°C	< 100°C ± 0,5°C > 100°C ± 0.5% of reading	0.1°C	Depending on probe used
Efficiency	0 to 120%	-	0.1%	-
Oxygen	0 to 21%	± 0.2%	0.1%	Approx. 30s
Carbon dioxide	0 to CO _{2max}	-	0.1%	Approx. 40s
Carbon monoxide ²	0 to 4000ppm	< 400ppm ± 20ppm 400 to 1000ppm ± 5% of reading > 1000ppm ± 10% of reading	1ppm	Typically 60s
Pressure (Delta P1) ³	0 to 40hPa	< 3hPa ± 0.03hPa > 3hPa ± 1.5% of reading	0.01hPa	-
Pressure (Delta P2) ³	0 to 200hPa	< 50hPa ± 0.5hPa > 50hPa ± 1.5% of reading	0.1hPa	-

testo 325 XL

Measurement type	Meas. range	Accuracy	Resolution	Adapt. time 90%
Temperature ¹	- 40 to + 1000°C	< 100°C ± 0.5°C > 100°C ± 0.5% of reading	0.1°C	Depending on probe used
Efficiency	0 to 120%	-	0.1%	-
Oxygen	0 to 21%	± 0.2%	0.1%	Approx. 30s
Carbon dioxide	0 to CO _{2max}	-	0.1%	Approx. 40s
Carbon monoxide	0 to 4000ppm	< 400ppm ± 20ppm 400 to 2000ppm ± 5% of read. > 2000ppm ± 10% of reading	1ppm	Typically 40s
Pressure (dP1) ³	0 to 40hPa	< 3hPa ± 0.03hPa > 3hPa ± 1.5% of reading	0.01hPa	-
Pressure (dP2) ³	0 to 200hPa	< 50hPa ± 0.5hPa > 50hPa ± 1.5% of reading	0.1hPa	-

¹ Sensor: Thermocouple Type K (NiCr-Ni) to DIN IEC 584 Part 2, Class 1

² Accuracy data apply to H₂ level < 10%

³ Max. overload: 1000hPa

10. Technical data

10.2 Additional instrument data

Power supply	Batteries: 4x 1.5V round cell alkaline IEC LR6 Type AA Rech. batt.: 4x 1.5V IEC KR 15/51 Type AA Rech. batt. 4x 1.5V IEC KR 15/51 Type AA cascaded with plug block: (testo 325XL only) Mains unit: 8V/1A (Part no. 0554 1084)
Rechargeable battery life at 20°C	Approx. 8h (pump on, light off)
Battery life at 20°C	Approx. 8h (pump on, light off)
Storage/Transport temperature	-20 to +50°C
Operating temperature	-5 to +45°C
Weight incl. rechargeable battery	450g
Housing material	ABS
Dimensions (h x w x l)	52x68x216mm
Switch-off threshold for CO	4500ppm
Memory (testo 325XL only)	20 memory blocks
Recharging time/rech. batt. pack (testo 325XL only)	4h (when recharged in analyser)
Warranty	Instrument: 2 years CO, CO/H ₂ measuring cells: 12 months O ₂ measuring cells: 18 months Probes and sensors: 24 months Thermocouples: 6 months

10.3 Calculation fundamentals

Fuels and their calculation formulae

Fuel	K_{gr}^1	K_{net}^1	$K1^1$	Q_{gr}^1	Q_{net}^1	MH_2O^1	H^1	CO_{2max}	O_2 ref.
Natural gas	0.35	0.39	40	53.42	48.16	0.0	24.4	11.9	3
Light Oil	0.48	0.51	53	45.60	42.80	0.0	13.0	15.5	3
Heavy Oil	0.51	0.54	54	42.90	40.50	0.2	11.5	15.8	3
LPG	0.42	0.45	48	50.00	46.30	0.0	18.2	13.8	3
Butane ²	0.43	0.46	48	49.30	45.80	0.0	17.2	14.1	3
Coal ²	0.62	0.45	63	26.75	25.50	13.0	4.0	18.4	7

¹ Fuel-specific factor

² **testo 325XL** only

10.4 Calculation formulae

The formulae are specified for the instrument version (GB).

Carbon dioxide:
$$CO_2 = \frac{CO_{2max} \times (21\% - O_2)}{21\%}$$

CO_{2max} : Maximum carbon dioxide value specific to fuel
 21%: Oxygen level of air
 O_2 : Measured oxygen level in %

Ratio:
$$rat = \frac{CO}{CO_2 \times 10000}$$

CO : Measured carbon monoxide value in ppm
 CO_2 : Calculated carbon dioxide value in %

Efficiency referred to H_o :
$$EFF_{GROS} = 100 - \left(\left(\frac{K_{gr} \times (FT - AT)}{CO_2} \right) + \left(\frac{(MH_2O + 9 \times H) \times (2488 + 2.1 \times FT - 4.2 \times AT)}{Q_{gr} \times 1000} \right) + \left(\frac{K1 \times CO}{CO_2 + CO} \right) \right)$$

Efficiency referred to H_u :
$$EFF_{NET} = 100 - \left(\left(\frac{K_{net} \times (FT - AT)}{CO_2} \right) + \left(\frac{(MH_2O + 9 \times H) \times (210 + 2.1 \times FT - 4.2 \times AT)}{Q_{net} \times 1000} \right) + \left(\frac{K1 \times Q_{gr} \times CO}{Q_{net} \times (CO_2 + CO)} \right) \right)$$

$K_{gr}/K_{net}/Q_{gr}/Q_{net}/K1/MH_2O/H$: Fuel-specific factors
 FT: Flue gas temperature
 AT: Ambient temperature
 CO : Measured carbon monoxide value in %
 CO_2 : Calculated carbon dioxide value in %

Excess Air (EXA):
$$ER = \left(\frac{21\%}{21\% - O_2} - 1 \right) \times 100$$

21%: Oxygen level of air
 O_2 : Measured oxygen level in %

Air ratio:
$$\lambda = \frac{CO_{2max}}{CO_2}$$

CO : Measured carbon monoxide value in %
 CO_2 : Calculated carbon dioxide value in %

Carbon monoxide undiluted:
$$uCO = \frac{21\%}{21\% - O_2}$$

CO : Measured carbon monoxide value in %
 21%: Oxygen level of air
 O_2 : Measured oxygen level in %

Conversion of ppm in mg/m^3 , referred to O_2 reference value:

CO (mg/m³)
$$= \left(\frac{21\% - O_{2ref}}{21\% - O_2} \right) \times CO \text{ (ppm)} \times 1.25$$

21%: Oxygen level of air
 O_2 : Measured oxygen level in %
 O_{2ref} : O_2 reference value in % (fuel-specific)

Dew point of flue gas:
$$td = \frac{\ln \left(\frac{F_{H2O} \times P_{Abs}}{610.78} \right) \times 234.175}{\ln \left(\frac{F_{H2O} \times P_{Abs}}{610.78} \right) - 17.08085}$$

F_{H2O} : Fuel-dependent water vapour factor in vol.%
 P_{abs} : Absolute pressure in mbar/hPa

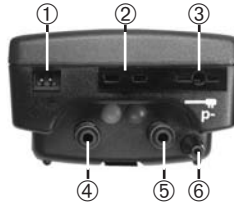
11. Accessories / Spare parts

Name	Part no.
Flue gas probes and temperature probes	
Standard flue gas probe, 180mm	0600 9544
Standard flue gas probe, 300mm	0600 9542
TÜV approved flue gas probe, 180mm	0600 9543
TÜV approved flue gas probe, 300mm	0600 9546
Flexible flue gas probe, 300mm	0600 9440
High temperature probe, 300mm, 1000°C	0600 8540
Dual wall clearance probe	0632 1244
Mini ambient air probe	0600 9798
Ambient air probe	0600 9788
Pipe clamp probe with velcro for pipe diameter to max. 120mm	0628.0020
Measuring cells	
O ₂ measuring cell for testo 325 M/XL	0390 0085
CO measuring cell for testo 325 M incl. NO filter (0133 0069)	0390 0297
CO / H ₂ measuring cell for testo 325 XL	0390 0245
Case	
Aluminium case	0516 0325
Transport case (plastic)	0516 3250
System case (plastic)	0516 0326
Printer	
Testo printer	0554 0545
Other	
PE filter (10 off)	0554 0040
Printer paper (6 rolls)	0554 0569
Spare rechargeable battery for testo 325 XL	0515 0104
Pump membrane	0193 0072
Pump Tool (pump disassembly tool)	0192 0468
Thermocouple for probe 0600 9546	0430 0073
Thermocouple for probe 0600 8540	0430 0074
Thermocouple for probe 0600 9544	0430 0070
Thermocouple for probe 0600 9542	0430 0071
Thermocouple for probe 0600 9543	0430 0072
Hose connection set	0554 0315
Probe stop	0170 9051
SoftCase incl. magnetic plate	0516 2572
Mains unit (230V)	0554 1084

Short instructions for testo 325 M / XL

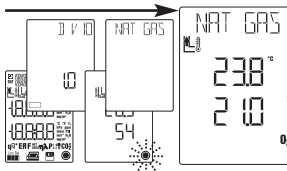
► Please also follow instructions in Instruction manual

Connections



- ① Mains unit
- ② Probes: Ambient air temperature (AT) / temperature T2
- ③ Probes: Flue gas temperature (FT) / Temperature T1
- ④ Flue gas inlet (red)
- ⑤ Pressure + (blue)
- ⑥ Pressure - (p-)

Switching on instrument and selecting fuel



- 1 Switch on analyser via .
 - The following appear: display test, software version/ power, zeroing phase.
 - Instrument changes to fuel selection.

- 2 Set fuel using or and confirm selection by pressing .
 - Instrument changes to measurement menu and is ready to operate.

Switching off analyser

- 1 Press to switch off analyser.
- 2 Wait on automatic rinse.
 - OFF is displayed for 5 s and then the analyser switches off.

Switching background light on/off

► Switch background light on or off by pressing .

Selecting menu item

- 1 Open main menu by pressing .
- 2 Use / to select menu item and confirm selection via .

If sub-menu is available:

- 3 Select menu item via / and press to confirm.

► Press to go back one menu level.

Setting date/time

- 1 Select in main menu and press to confirm.
- 2 Set value via / , change to next value via .
- 3 Press to confirm settings.

Selecting units

- 1 Select UNIT in main menu and press **OK** to confirm.
- 2 Select parameter via **▲** / **▼** and confirm selection via **OK**.
- 3 Set unit via **▶**, change to next parameter via **▼**.
- 4 Press **OK** to confirm settings.

Measuring flue gases

- 1 Press **START/STOP** to start measurement.
- 2 Press **▲** / **▼** to change between the options possible.
- 3 Press **START/STOP** to end measurement.

Measuring draught

- 1 Select **ΔELTR P** in main menu and press **OK** to confirm.
- 2 Use **▲** / **▼** to select pressure range **ΔELTR P 1** (0 to 40hPa) or **ΔELTR P 2** (0 to 200hPa) and press **OK** to confirm.
 - The analyser runs zeroing.
- 3 Insert probe pipe in flue gas duct.
 - The current reading is displayed.
- 4 Press **OK** to end measurement.

Measuring gas flow pressure

Pressure set (0554 0315) required. Procedure same as for draught measurement.

Printing readings taken

Testo printer (0554 0545) required.

- ▶ Start printing by activating **PRINT** in measurement menu.

Saving/reading/deleting readings (testo 325XL only)

- 1 Select **MEMORY** in main menu and press **OK** to confirm.
- 2 Use **▲** / **▼** to select memory block and confirm via **OK**.
- 3 Select **WRITE, READ** or **DELETE** via **▲** / **▼** and press **OK** to confirm.
 - ▶ Confirm clearance query with **OK**.

Printing saved readings (testo 325XL only)

Testo printer (0554 0545) required.

- 1 Display readings (See: saving/reading readings).
- 2 Activate **PRINT** to start printing.



testo AG

Postfach 11 40, D-79849 Lenzkirch
Testo-Straße 1, D-79853 Lenzkirch

Tel. (0 76 53) 6 81 - 0

Fax (0 76 53) 6 81 - 1 00

E-Mail: info@testo.de

<http://www.testo.de>