testo 335
Flue gas analyser

Instruction manual en

General notes

Please read this documentation through carefully and familiarise yourself with the operation of the product before putting it to use. Keep this document to hand so that you can refer to it when necessary.

This document describes the country-specific version GB of the testo 335 measuring instrument.

Identification

Symbol	Meaning	Comments
 Warning!	Warning advice: Warning! Serious physical injury could be caused if the specified precautionary measures are not taken.	Read the warning advice carefully and take the specified precautionary measures!
 Caution!	Warning advice: Caution! Slight physical injury or damage to equipment could occur if the specified precautionary measures are not taken.	Read the warning advice carefully and take the specified precautionary measures!
!	Important note.	Please take particular notice.
Text	Text appears on the instrument's display	-
	Key	Press the key.
OK	Function key with the function **"OK"**.	Press function key.
→ **xyz**	Short form for operating steps.	See *Short form*, p. 3.

Short form

This document uses a short form for describing steps (e.g. calling up a function).

Example: Calling up the **Flue gas** function

Short form: (1) → **Measurements** (2) → [OK] (3) → **Flue gas** (4) → [OK] (5)

Steps required:

1 Open the Main menu: (1).

2 Select **Measurements** menu: (▲), (▼).

3 Confirm selection: [OK].

4 Select **Flue gas** menu: (▲), (▼).

5 Confirm selection: [OK].

Content

! See also *Functional overview*, p. 60.

A. Safety advice

Avoid electrical hazards:

- Never use the measuring instrument and probes to measure on or near live parts!

Protect the measuring instrument:

- Never store the measuring instrument/measuring cells together with solvents (e.g. acetone). Do not use any desiccants.

Product safety/preserving warranty claims:

- Operate the measuring instrument only within the parameters specified in the Technical data.
- Handle the measuring instrument properly and according to its intended purpose.
- Never apply force!
- Temperatures given on probes/sensors relate only to the measuring range of the sensors. Do not expose handles and feed lines to any temperatures in excess of 70 °C unless they are expressly permitted for higher temperatures.
- Open the measuring instrument only when this is expressly described in the instruction manual for maintenance purposes.
- Carry out only the maintenance and repair work that is described in the instruction manual. Follow the prescribed steps exactly. For safety reasons, use only original spare parts from Testo.

  Any additional work must only be carried out by authorised personnel. Testo will otherwise refuse to accept responsibility for the proper functioning of the measuring instrument after repair and for the validity of certifications.

Ensure correct disposal:

- Dispose of defective rechargeable batteries and spent batteries at the collection points provided for that purpose.
- Send the measuring instrument directly to us at the end of its useful life. We will ensure that it is disposed of in an environmentally friendly manner.

B. Intended purpose

This chapter describes the areas of application for which the measuring instrument is intended.

The testo 335 is a handheld measuring instrument used in professional flue gas analysis for:

- Engineers servicing/monitoring industrial combustion plants (process systems, power stations)
- Emissions inspectors
- Engine manufacturers and operators
- Service engineers/mechanics of burner/boiler manufacturers in the industrial sector

Typical measuring tasks and particular characteristics of the testo 335 include:

- Measurement on engines of all kinds (CO/NO dilution)
- Measurement on gas turbines (high precision CO and NO plus optional dilution)
- Emissions measurement (integrated flow speed and real moisture content measurement)

testo 333 should not be used:

- for continuous measurements
- as a safety (alarm) instrument

C. Product description

This chapter provides an overview of the individual components of the product.

C.1 Measuring instrument

C.1.1 Overview

① On/Off button
② Interfaces: USB, PS2, infrared

Do not point infrared beam at people's eyes!

③ Condensate trap (on rear)
④ Fixing eyelet for carrying strap (left and right)
⑤ Display
⑥ Magnetic holders (on rear)

Caution!

Strong magnets

Damage to other instruments!

- Keep well away from products which could be damaged through the effects of magnetism (e.g. monitors, computers, heart pacemakers, credit cards).

⑦ Keypad
⑧ Service cover (on rear)
⑨ Gas outlet
⑩ Instrument connections: flue gas probe, sensor, pressure probe, mains unit

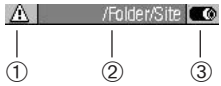
C.1.2 Keypad

Key	Functions
⏻	Switch measuring instrument on/off
○	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:** press briefly (changed settigs are stored, measurement values are carried over into the menu **Flue gas)**; open **Measurements** menu: press and hold down for 2s (changed settigs are stored, measurement values are carried over into the menu **Flue gas)**
ⓘ	Open **Inst' diagnosis** menu
☼	Change display light: display light stays on permanently or display light is switched on for 10s every time the key is pressed.

C.1.3 Display

Depending on the menu that is active, the display shows a variety of elements.

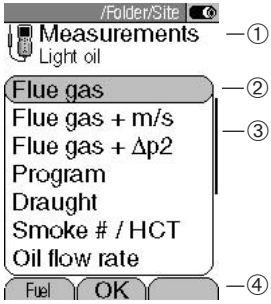
Header (active in all views)



① Warning symbol (only if there is a device error; device errors are displayed in the **Inst' diagnosis** menu).
② Active folder and location.
③ Power supply symbol:

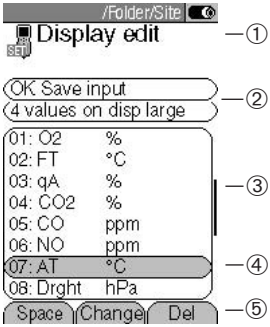
Symbol	Characteristic	Symbol	Characteristic
	Mains operation		Rech. battery operation, capacity: 26-50%
	Rech. battery operation, capacity: 76-100%		Rech. battery operation, capacity: 6-25%
	Rech. battery operation, capacity: 51-75%		Rech. battery operation, capacity: 0-5%

Function select view



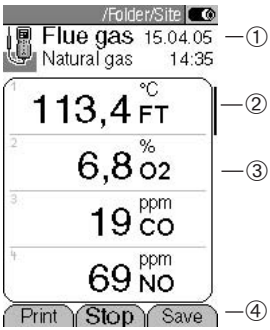
① Active menu, activated fuel
② Function selection field:
The selected function has a grey background.
Unavailable functions are written in grey type
③ Scroll bar
④ Function keys for entering commands

Settings view



① Active menu
② Function fields for entering commands
③ Scroll bar
④ Selection field for adjustable values:
The selected value is shown with a grey background. Unavailable values are written in grey type.
⑤ Function keys for entering commands

Measuring view



① Active menu, depending on the selected function: Additional information (e.g. activated fuel, date and time)
② Scroll bar
③ Display field for readings, parameters
④ Function keys for entering commands

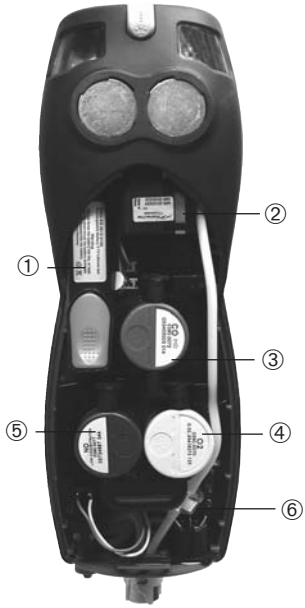
C.1.4 Instrument connections

① Sensor socket
② Flue gas socket
③ Mains unit socket
④ Pressure socket p+ (can only be used with the option "Pressure/flow speed measurement")
⑤ Pressure socket p- (can only be used with the option "Pressure/flow speed measurement")

C.1.5 Interfaces

① USB interface:
connection to PC
② PS2 interface:
Adapter for automatic furnaces
③ Infrared interface (IrDA):
connection to Testo-printers/Pocket PC

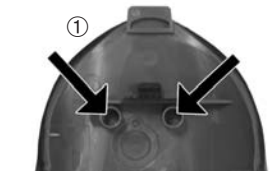
C.1.6 Components



① Rechargeable battery
② Measuring gas pump
③ Measuring cells - slot 2: CO, NO2, SO2
④ Measuring cells - slot 1: O2
⑤ Measuring cells - slot 3: NO, SO2
⑥ Additional filter

C.1.7 Carrying strap

To secure the carrying strap:



1 Remove sealing caps from the sides of the housing.

Fix sealing caps on the inside of the service cover:

1 Place the measuring instrument on its front.
2 Pick the service cover up at the markings (arrows) using your index finger and thumb and press gently to release the lock.
3 Lift the service cover up and remove.
4 Secure the sealing caps in the two holders on the inside of the service cover (①).
5 Fit the service cover and clip into place.

2 Engage the carrying strap clip in the fixing eyelets on the side of the device. Note the guide groove. The strap must point "down" (②).

C.2 Modular flue gas probe

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

D. Commissioning

This chapter describes the steps required to commission the product.

- Remove the protective film from the display.

The measuring instrument is supplied with a rechargeable battery already fitted.

- Charge the rechargeable battery up fully before using the measuring instrument (see *Charging batteries*, p. 16).

E. Operation

This chapter describes the steps that have to be executed frequently when using the product.

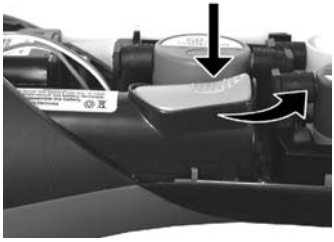
! Please read this chapter carefully. The following chapters of this document will assume you are already familiar with the content of this chapter.

E.1 Mains unit/rechargeable battery

If the mains unit is connected, the measuring instrument is automatically powered from the mains unit. It is not possible to charge the rechargeable battery in the measuring instrument during operation.

E.1.1 Changing the battery

! The measuring instrument must not be connected to a mains socket via the mains unit. The measuring instrument must be switched off. Change the rechargeable battery within 60 minutes, otherwise instrument settings (e.g. date/time) will be lost.



1 Place the measuring instrument on its front.
2 Remove the service cover: Take hold of it at the markings (arrows) using the index finger and thumb, press slightly, fold up and remove.
3 Open the rechargeable battery compartment: Press the orange key and push in the direction of the arrow.
4 Remove the rechargeable battery and insert a new one. Use only Testo 0515 0100 rechargeable batteries!
5 Close the rechargeable battery compartment: Press the orange key and push against the direction of the arrow until the rechargeable battery engages.
6 Fit the service cover and clip into place.

E.1.2 Charging batteries

The rechargeable battery can only be charged at an ambient temperature of ±0...+35°C. If the rechargeable battery has discharged completely, the charging time at room temperature is approx. 5-6 hrs.

Charging in the measuring instrument

! The measuring instrument must be switched off.

1 Connect the plug of the mains unit to the mains unit socket on the measuring instrument.

2 Connect the mains plug of the mains unit to a mains socket.

- The charging process will start. The charge status will be shown on the display. The charging process will stop automatically when the rechargeable battery is fully charged.

Charging in the charger (0554 1087)

▶ Refer to the documentation that comes with the charger.

Battery care

▶ If possible, always discharge the rechargeable battery and recharge it fully.

▶ Do not store the battery for long periods when discharged. (The best storage conditions are at 50-80 % charge level and 10-20 °C ambient temperature; charge fully before further use).

E.1.3 Operation with the mains unit

1 Connect the plug of the mains unit to the mains unit socket on the measuring instrument.

2 Connect the mains plug of the mains unit to a mains socket.

- The measuring instrument is powered via the mains unit.

- If the measuring instrument is switched off and a rechargeable battery is inserted, the charging process will start automatically. Switching the measuring instrument on has the effect of stopping rechargeable battery charging and the measuring instrument is then powered via the mains unit.

E.2 Probes/sensors

E.2.1 Connecting probes/sensors

! Sensor socket:
Sensor detection is carried out at the sensor socket during the activation process: Always connect the sensors you need to the measuring instrument before switching it on or switch the device on and then off again after a change of sensor so that the correct sensor data are read into the measuring instrument.

Flue gas socket:
Probe/sensor detection at the flue gas socket is carried out continuously. It is possible to change the probe/sensor even while the measuring instrument is switched on.

Connecting flue gas probes

- Plug the connector onto the flue gas socket and lock by turning it clockwise gently (bayonet lock).

! There must be no more than two extension leads (0554 1201) between the measuring instrument and the flue gas probe.

Connecting other sensors

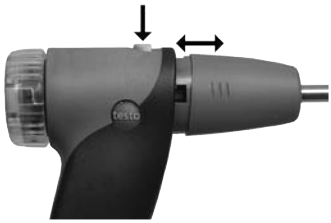
- Insert the connector of the sensor into the sensor socket.

Connecting the pressure tube

Pressure sockets p+ and p- can only be used with instruments offering the "Pressure/flow speed measurement" option.

- Connect the pressure tube/tubes to the connecting nipple/nipples of the pressure socket(s).

E.2.2 Replacing the probe module



1 Press the key on the top of the probe handle and remove the probe module.
2 Fit a new probe module and engage it in place.

E.3 Regular care

E.3.1 Condensate trap

The fill level of the condensate trap can be read from the markings on the trap. A warning message is displayed if the level in the condensate trap reaches 90% (⚠, red flashing light).

Emptying the condensate trap

! The condensate consists of a weak mix of acids. Avoid contact with the skin. Make sure that the condensate does not run over the housing.

Caution!

Condensate entering the gas path.

Damage to the measuring cells and flue gas pump!

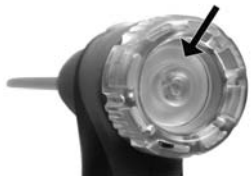
▶ Do not empty the condensate trap while the flue gas pump is in operation.

1 Hold the measuring instrument so that the condensate outlet points up.
2 Open the condensate outlet of the condensate trap: Push out approx. 5 mm to the stop (①).
3 Let the condensate run out into a sink (②).
4 Mop up any remaining drops on the condensate outlet using a cloth.
5 Close the condensate outlet.

! The condensate outlet must be completely closed (marking), otherwise measuring errors could occur if external air gets in.

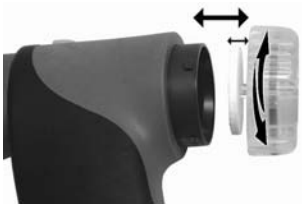
E.3.2 Checking/replacing the particle filter

Checking the particle filter:



- ▶ Check the particle filter of the modular flue gas probe for contamination at regular intervals: Check visually by looking through the window of the filter chamber.
  Replace the filter if there are signs of contamination

Replacing the particle filter:



! The filter chamber may contain condensate

1. Open the filter chamber by turning it gently anticlockwise.
2. Remove the filter plate and replace it with a new one (0554 3385).
3. Fit the filter chamber again and close it by turning it gently clockwise.

E.4 Basic operating steps

E.4.1 Switching the measuring instrument on

▶ ⏻.

- The start screen is displayed (for about 5 s).
- Display light is switched on for 10 s.

Option:

▶ To go directly to a measurement while the start screen is being displayed, press the function key for the desired measurement. See also *Start keys edit*, p. 30.

- The **Measurements** menu is opened.

-or-

- If the power supply was interrupted for a longer period: the **Date / Time** menu is opened.

-or-

- There is a device error: The **Error diagnosis** is displayed.

E.4.2 Calling up the function

! Functions which cannot be selected because the required sensor/probe is not connected are shown in grey type.

1 Select function: ▲, ▼.

- The selected function is shown with a grey background.

2 Confirm selection: OK.

- The selected function is opened.

E.4.3 Entering values

Some functions require values (numbers, units, characters) to be entered. Depending on the function that is selected, the values are entered via either a list field or an input editor.

List field

1 Select the value to be changed (number, unit): ◄, ►.
2 Adjust the value: ▲, ▼.
3 Repeat steps 1 and 2 as required.
4 Confirm the input: OK.
5 Save the input: **OK Save input**→ OK.

Input editor

1 Select value (character): ◄, ►, ▲, ▼.
2 Accept the value: OK.

Options:

- Switch between uppercase/lowercase letters: **A <=> a** (not always available).
- Delete character: **<=**.
- To position the cursor in the text: Select the text input field: ▲, ▼ and position the cursor: ◄ , ► .
  - To delete character in front of the cursor: Del.

3 Repeat steps 1 and 2 as required.
4 Save the input: **OK Save input**→ OK.

E.4.4 Printing data

Data are printed out via the function key Print. The function is only available if a printout is possible.
If data are to be transferred to a protocol printer via the infrared interface, the printer that is to be used must be activated, see *Printer*, p. 29.

E.4.5 Saving data

Data are saved either via the function key Save or the function field **OK Save input**. The functions are only available if saving is possible.

See also *Memory*, p. 23.

E.4.6 Confirming an error message

If an error occurs, an error message is shown in the display.

▶ To confirm an error message: OK.

Errors which have occurred and have not yet been rectified are shown by a warning symbol in the header (⚠).

Messages for errors which have not yet been rectified can be viewed in the **Error diagnosis** menu, see *Instrument diagnosis*, p. 27.

E.4.7 Switching the measuring instrument off

! Unsaved readings are lost when the measuring instrument is switched off.

▶ ⏻.

- Possibly: The pump starts and the measuring cells are rinsed until the shutoff thresholds (O_2 >20%, other parameters <50ppm) are reached. Rinsing lasts no more than 2 minutes.
- The measuring instrument switches off.

E.5 Memory

All readings are allocated to the location that is activated at the time and can be saved in the Flue gas menus. Unsaved readings are lost when the measuring instrument is switched off.

Folders and locations can be created (max. 100 folders, max. 10 locations per folder), edited and activated and measurement protocols can be printed.
The special function **Extras memory** can be used to display the remaining free memory space. All protocols can be printed or deleted. The entire memory (folders and locations incl. protocols) can also be cleared.

Calling up the function:

(menu) → **Memory** → [OK].

E.5.1 Folders

Creating a new folder:

Folders are given a unique identification via the folder number. A folder number can only be allocated once. The folder number cannot be changed afterwards.

1 **New Folder** → [OK].
2 Select **Folder Number** → [change].
3 Enter values → **OK Save input** → [OK].
4 Repeat steps 2 and 3 for the other criteria as required.
5 [OK].

Ordering the folders list:

1 **Folders list**.
2 Select the order criterion: [Folder], [Name], [Addr'].

Restoring the folders list:

▶ Order the list in the sequence in which the folders were created:
Restore list → [OK].

Editing folders:

▶ Select the folder.

Options:

- ▶ Delete the folder: [Del].
- ▶ Edit the folder: [Edit].

E.5.2 Location

Creating a new location:

A location is always created in a folder.

1 Select the folder → OK → **New location** → OK.

2 Select the **Location name** → Change.

3 Enter values → **OK Save input**→ OK.

4 Repeat steps 2 and 3 for the other criteria accordingly.

5 **OK Go to measurement** or **OK To location** → OK.

Ordering the locations list:

1 Select the folder → OK.

2 **Locations list** → OK.

Activating a location:

▶ Select the folder → OK → Select location → OK.

- The location is activated and the **Measurements** menu is opened.

Restoring the locations list:

▶ To arrange the list in the order in which the folders were created:
Select the folder → OK → **Restore list** → OK.

Delete a location:

1 Select the folder → OK.

2 Select the location → Edit.

3 Select **Delete site with data** → OK.

Performing location settings:

For devices with the "Pressure/flow speed measurement" option:

For flow speed, air flow and mass flow to be measured correctly, the shape and surface area of the cross-section must be set.

The parameters **Pitot factor** and **Offset factor** influence the measurement of flow speed, air flow and mass flow. The pitot factor depends on the type of pitot tube that is used.
The offset factor should be set at 1.00 for all standard applications.

For all instruments:

The parameters **Temp./amb.** (ambient air temperature), **Hum/amb.** (ambient air humidity) and **Dew p./amb.** (ambient air dew point) influence calculation of the qA (Flue gas loss) and DP (Flue gas dew point temperature). The parameters should be set to the factory settings for all standard applications (Temp./amb.: 20.0 °C, Hum/amb.: 80.0 %, Dew p./amb.: 16.4 °C). To achieve greater accuracy, the values can be adjusted to the actual ambient conditions.

If the ambient air temperature sensor is plugged in, the value for Temp./amb. is accepted automatically. The parameter **Dew p./amb.** can be calculated from the values of **Temp./amb.** and **Hum/amb.** via the function key [calc].

1 Select the folder → [OK].

2 Select the location → [Edit].

Options:

- To set the shape of the cross-section:
  Cross section → [Change] → Select the cross-section → [✔].
- To set the surface area of the cross-section:
  Cross section → [Change] → Select the cross-section → [Change] → Set the values → [OK].
- To set parameters:
  Select the parameter → [Change] → Set the values → [OK].

3 **OK To location** → [OK].

E.5.3 Protocols

Printing/deleting all protocols:

▶ Select the folder → [OK] → Select a location → [Data].

- The saved protocols are displayed. Protocols of measurement programs are marked with a vertical line and the number of individual measurements (e.g.. **l245**), for more than 999 measurements dots are used (**l...**). If automatic furnace data are stored with a measurement protocol the following symbol is displayed next to the protocol name:  . The data are printed with the protocol printout.

  Options:

  ▶ To print all data: Print all → [OK].

  ▶ To delete all data: Delete all → [OK].

Displaying/printing/deleting a individual protocol:

1 Select the folder → [OK] → Select a location → [Data].

- The saved protocols are displayed. Protocols of measurement programs are marked with a vertical line and the number of individual measurements (e.g.. **l245**), for more than 999 measurements dots are used (**l...**). If automatic furnace data are stored with a measurement protocol the following symbol is displayed next to the protocol name:  . The data are printed with the protocol printout.

2 Select the protocol → [Value].

Options:

▶ To print the data: [Print].

▶ To delete the data: [Del].

E.5.4 Extras Memory

Calling up the function:

▶ Ⓜ → **Memory** → [Extra].

- The remaining free memory space is displayed.

Options:

▶ **Print all data** → [OK].

▶ **Delete all data** → [OK].

▶ **Delete memory** → [OK].

E.6 Instrument diagnosis

Important operating values and instrument data are displayed. A gas path check can be carried out. The status of the measuring cells and any device errors not yet rectified can be displayed.

Calling up the function:

▶ Ⓜ → **Inst' diagnosis**.

-or-

▶ ⓘ.

Performing a gas path check:

1 **Gas path check** → OK.

2 Place the black sealing cap on the tip of the flue gas probe.

- The pump flow is displayed. If the flow rate ≤0.02 l/min, the gas paths are not leaking.

3 End the check: OK.

Viewing device errors:

▶ **Error diagnosis**→ OK.

- Unrectified errors are displayed.
  - ▶ View next/previous error: ▲, ▼.

Viewing the sensor diagnosis:

1 **Sensor check** → OK.

- Possibly: Gas zeroing (30 s).

2 Select the measuring cell: ▲, ▼.

- The status of the measuring cell is displayed.

F. Configuration

This chapter describes the possible steps for adapting the product to the particular measurement task or the requirements of the user.

! Familiarity with the contents of the chapter *Operation* (see p. 15) is assumed.

F.1 Instrument settings

F.1.1 Display edit

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

Available parameters and units (may vary from one instrument to another):

Display	Parameter	Units
FT	Flue gas temperature	°C, °F
CO2	Carbon dioxide	%
qA	Flue gas loss	%
λ	Air ratio	-
O2	Oxygen	%
CO	Carbon monoxide	ppm, %, g/GJ mgm³, mgKW
uCO	Carbon monoxide undiluted	ppm
η	Efficiency	%
NO	Nitrogen monoxide	ppm, %, g/GJ, mgm³, mgKW
NOx	Nitrogen oxide	ppm, %, g/GJ, mgm³, mgKW
AT	Ambient temperature	°C, °F
Drght	Flue draught	mbar, hPa, mmWS, inW, pa, psi, inHG
SO2	Sulfur dioxide	ppm, %, g/GJ mgm³, mgKW
NO2	Nitrogen dioxide	ppm, %, g/GJ mgm³, mgKW
Itemp	Instrument temperature	°C, °F
DP	Flue gas dew point temperature	°C, °F

Display	Parameter	Units
ΔP2	Differential pressure (200hPa)	mbar, hPa, Pa mmWS, inW psi, inHG
GasFl	Gas flow rate	m³/h, l/h
GasP	Gas burner output	kW
OilFl	Oil flow rate	kg/h
Oil p	Oil pressure	bar
OilP	Oil burner output	kW
Pabs	Absolute pressure	hPa, mbar, Pa, mmWS, inW psi, inHG
Pump	Pump output	l/m
ΔP1	Differential pressure (40hPa)	mbar, hPa, Pa mmWS, inW psi, inHG
Speed	Flow speed	m/s, fpm
Flow	Airflow	m3/s, m3/m, m3/h, m3/d, m3/y, f3/s, f3/m, f3/h, f3/d, f3/y, l/min
MCO, MNOx, MSO2	Mass flow	kg/h, kg/d, t/d, t/y, lb/h
H2	Hydrogen	ppm

Calling up the function:

▶ ⓜ → **Inst' settings** → OK → **Display edit** → OK.

Setting the display representation:

▶ Select **4 values on disp large** or **8 values on disp small** → OK.

Changing parameters and units:

1 Select the display position.

Options:

▶ To insert a space: Space.

▶ To delete a parameter: Del.

2 Change → Select parameter → OK → Select unit→ OK.

Saving settings:

▶ **OK Save input**→ OK.

F.1.2 Printer

The headers (lines 1-3) and the footer for the printout can be set. The printer that is used can be activated.

Calling up the function:

▶ ⓜ → **Inst' settings** → OK → **Printer** → OK.

Setting the print text:

1 **Print text** → OK.

2 Select **Line 1**, **Line 2**, **Line 3** or **Footnote** → Change.

3 Enter the values → **OK Save input**→ OK.

4 Repeat steps 2 and 3 for the other lines in the same way.

5 **OK Save input**→ OK.

Printer selection:

▶ **Select Printer** → OK → Select Printer → OK.

F.1.3 Start keys edit

The assignment of the function keys depends on the function that is selected. Only the function keys in the start screen (shown when the measuring instrument is switched on) can be assigned any function from the **Measurements** menu.

The function keys are only active if the required sensors are connected.

Calling up the function:

▶ ⓜ → **Inst' settings** → OK → **Start keys edit** → OK.

Assigning functions to the start keys:

1 Select function → Press the function key that is to be assigned the selected function.

2 Repeat step 1 for the other function keys as required.

Saving settings:

▶ **OK Save input**→ OK.

F.1.4 AutoOff

With the AutoOff function active, the instrument switches itself off automatically if no key is pressed after the set period of time.

Calling up the function:

▶ ⓜ → **Inst' settings** → OK → **AutoOff** → OK.

Switching AutoOff on and off:

▶ Select **Auto Off** → Change → select **On** or **Off** → OK.

Setting the AutoOff time:

▶ Select **Time** → Change → Set the value → OK.

F.1.5 Date/Time

The date and the time can be set.

Calling up the function:

▶ ⓜ → **Inst' settings** → OK → **Date/Time** → OK

Setting the date/time:

▶ Select **Time** or **Date** → Change → Set the values → OK.

Saving settings:

▶ **OK Save input**→ OK.

F.1.6 Language

The menu language can be set.

Calling up the function:

▶ ⓜ → **Geräteeinst.**→ OK → **Sprache** → OK.

-or-

▶ ⓜ → **Inst' settings** → OK → **Language** → OK.

Setting the language:

▶ Select **Deutsch** or **Englisch** → OK.

-or-

▶ Select **German** or **English** → OK.

F.2 Sensor settings

It is possible to set an NO_2 addition and thresholds for activating sensor protection (dilution/disconnect). The actual calibration data and the status of the measuring cells can be displayed. Recalibration can be carried out.

Calling up the function:

▶ ☰ → **Sensor settings** → OK.

Setting the NO2 addition:

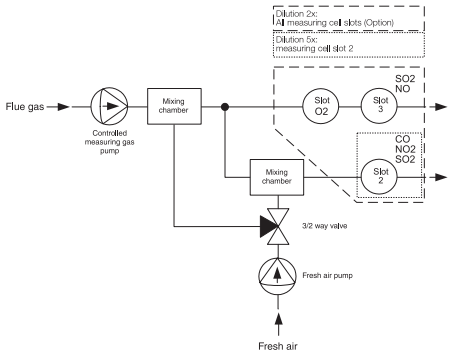
1 **NO2 addition**.

Option:

▶ Reset N02 addition to default value: DefIt.

2 Change → Set the value → OK.

Setting sensor protection:



To extend the measuring range and protect the measuring cells against overloads, you can set thresholds which, when exceeded, activate sensor protection. Thresholds for a variety of parameters can be set, depending on the measuring cells that are connected.

For instruments without "Dilution of all sensors" option: If a threshold of the measuring cell in slot 2 is exceeded, the gas to sensor 2 is diluted by a factor of five. There is switch-off if a measuring cell threshold value is exceeded in slot 3.

For devices with the "Dilute all sensors" option: If a measuring cell threshold value is exceeded in slot 2, the gas to sensor 2 is diluted by factor five. If a measuring cell threshold value is exceeded in slot 3, gas to all sensors is diluted by factor two.

With dilution active, the reading resolution and accuracies will change, see Technical data. Diluted values are represented inversely.

If the threshold is still exceeded despite dilution, the instrument is switched off. To deactivate sensor protection, set the thresholds to 0 ppm.

1 **Sensor protection** → [OK].
2 Select the parameter.

Option:

- Reset selected parameter to default value: [DefIt].

3 [Change] → Set the values → [OK].
4 Repeat steps 2 and 3 for the other parameters accordingly.

- Saving settings: **OK Save input**→ [OK].

Displaying actual calibration data/cell status:

- **Calibrationdata** → [OK].

Options:

- To change between the actual calibration data of the individual measuring cells: ▲, ▼.
- To print out the actual calibration data of all measuring cells: [Print].
- To display the status of the measuring cell as a graphic: [Graphic].
  - The status of the measuring cell is checked on every recalibration. Any deviation from the condition on delivery is indicated as a percentage.
    70%-threshhold: “Gas cell reading unstable, replace item recommended.“,
    50%-threshhold: “Replacement gas cell.“
    The last 25 recalibrations are shown.
  - To return to the display of the actual calibration data: [Value].

Recalibration:

CO, SO2, NO2, NO measuring cells and the O2 reference value can be recalibrated. Measurement gas dilution in slot 2 can be recalibrated.

If obviously unrealistic readings are displayed, the measuring cells should be checked and recalibrated as required.

Dangerous gases

Danger of poisoning!

- ▶ Observe safety regulations/accident prevention regulations when handling test gases.
- ▶ Use test gases in well ventilated rooms only.

! Recalibration with low gas concentrations can lead to deviations in accuracy in the upper measuring ranges.
Sensor protection is not deactivated during recalibration. For this reason, test gas concentration should be lower than the threshold values set for sensor protection.
Recalibrating the measuring cell at slot 2 has an effect on the dilution:Always carry out a recalibration of measurement parameters before a recalibration of dilution.

The following conditions must be met when recalibrating:

- · Use absorption-free tube material
- · Switch the measuring instrument on at least 20 min before recalibration (warming-up)
- · Use clean air for gas zeroing
- · Charge the test gas via calibration adapter (0554 1205, recommended) or the tip of the probe
- · Maximum overpressure of the test gas: 30 hPa (recommended: unpressurised via bypass)
- · Charge the test gas for at least 3 min

Recommended test gas concentrations and compositions are given in Testo's field guide to test gases.

1 **Recalibration** → OK.

- Possibly:Gas zeroing (30 s).

2 Select the parameter → Change → Enter the test gas concentration (nominal value).

3 Charge the measuring cell with test gas.

4 Start calibration: Start.

If the parameter of the measuring cell inserted in slot 2 has been selected:

- You will receive a query as to whether dilution should be initialised.

▶ Start recalibration of parameter: No → Start.

▶ Start recalibration of dilution: Yes → Start.

5 Accept the nominal value as soon as the actual value is stable: OK.

F.3 Fuels

The fuel can be selected. The fuel-specific coefficients can be set. Ten fuels can be set for each customer.

Calling up the function:

▶ → **Fuels** → OK.

Activating fuel:

▶ Select the fuel → OK.

Setting coefficients:

1 Coeff.

Option:

▶ To reset all coefficients to default values: **Default values** → OK.

▶ To change the name of the fuel (only possible with customer-specific fuel): **Name** → Change → Set the values → OK.

2 Select the coefficient

Option:

▶ To reset the chosen coefficients to default values: DefIt.

3 Change → Set the values → OK.

4 **OK Save input**→ OK.

G. Measuring

This chapter describes the measuring tasks that can be carried out with the product.

! Familiarity with the contents of the chapter *Operation* (see p. 15) is assumed.

G.1 Preparing measurements

G.1.1 Zeroing phases

Measuring the ambient air temperature (AT)

If no ambient air temperature sensor is connected, the temperature measured by the thermocouple of the flue gas probe during the zeroing phase is used as the ambient air temperature. All dependent parameters are calculated by this value. This method of measuring ambient air temperature is sufficient for systems dependent on ambient air. However, the flue gas probe must be near the intake duct of the burner during the zeroing phase!

If an ambient air temperature sensor is connected, the ambient air temperature is measured continuously via this sensor.

Gas zeroing

The first time a gas measuring function is called up after the instrument has been switched on, the measuring cells are zeroed.

! The flue gas probe may already be in the flue gas duct during zeroing if a separate AT sensor is connected.

Draught/pressure zeroing (only with the "Pressure/flow speed measurement" option)

The pressure sensors are zeroed when a pressure measuring function is called up.

! The pressure sockets of the instrument must be free (i.e. unpressurized, not closed) during zeroing.

G.1.2 Using the modular flue gas probe

Checking the thermocouple

The thermocouple of the flue gas probe must not lie against the probe cage.

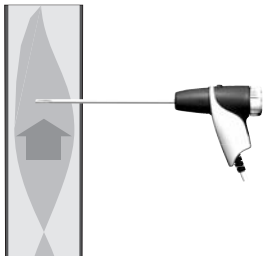
- ▶ Check before use. Bend the thermocouple back if necessary.

Aligning the flue gas probe

The flue gas must be able to flow freely past the thermocouple.

- ▶ Align the probe by turning it as required.

The tip of the probe must be in the centre of the flue gas flow.



- ▶ Align the flue gas probe in the flue gas duct so that the tip is in the centre of the flow (area of the highest flue gas temperature).

G.1.3 Configuring the reading display

Only those parameters and units which are activated in the reading display appear in the reading display, the saved measurement protocols and the protocol printouts.

- ▶ Before beginning measurements, configure the reading display so that the required parameters and units are activated, see *Display edit*, p. 28.

G.2 Measurements

G.2.1 Flue gas, Flue gas + m/s, Flue gas + Δp2

The **Flue gas + m/s** and **Flue gas + Δp2** menus are only available on instruments with the "Pressure/flow speed measurement" option.

The flue gas menus are the central measurement menus in which - in addition to the readings measured with this function - the readings of all measurements carried out are displayed (if this is selected in the **Display edit** menu). All readings can also be saved in or printed out from these menus.

The flue gas menus are always available, regardless of which sensors are connected.

Measuring functions of the three flue gas menus:

- The **Flue gas** function enables flue gas to be measured.
- The **Flue gas + m/s** function enables flue gas to be measured in addition to flow speed (+ air/mass flow calculation) by means of a Pitot tube (the connection cable for the Pitot tube thermocouple should not be connected to the instrument probe socket).
- The **Flue gas + Δp2** function enables flue gas to be measured in addition to differential pressure measurement.

! After measurements with high concentrations and longer measurements, the instrument should be rinsed with fresh air in order to enable the measuring cells to regenerate, see Chapter Recommended rinsing times, p. 57.

! For flow speed and differential pressure measurement:
Before beginning measurement, configure the location settings (shape and surface area of cross-section, parameters), see chapter *Location*, p. 24.
Do not measure for longer than 5 min, as the drift of the pressure sensor means that the readings could be outside the tolerance limits.

Calling up the function:

▶ ☰ → **Measurements** → OK → **Flue gas** → OK.

-or-

▶ ☰ → **Measurements** → OK → **Flue gas + m/s** → OK.

-or-

▶ ☰ → **Measurements** → OK → **Flue gas + Δp2** → OK.

- Possibly: gas zeroing (32 s).

For the functions **Flue gas + m/s** and **Flue gas + Δp2**:

▶ Depressurise the pressure sensor and carry out pressure zeroing with [V = 0].

If no fuel has yet been selected:

▶ Select the fuel → [OK].

Measuring:

1 Start measuring: [Start].

- The readings are displayed.

Option:

▶ Interrupt measurement and rinse measurement cells: [Air],
Continue measurement: [Gas].

2 Stop measuring: [Stop].

Options:

▶ To print readings: [Print].

▶ To save readings: [Save].

- The readings from the flue gas measurement, as well as any readings taken over into the menu **Flue Gas** from other measurement functions are stored and/or printed in a measurement protocol (automatic furnace data are not printed).

G.2.2 Program

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

Calling up the function:

▶ (📋) → **Measurements** → [OK] → **Program** → [OK].

Changing a measuring program:

1 Select the program → [Change].

2 **Meas rate** → [Change] → Enter the values → [OK].

3 Repeat step 2 for the other criteria accordingly.

4 **OK Save input**→ [OK].

Running a measuring program:

1 Select the program → Start.

2 Select **Start without zeroing** (only available if gas zeroing has already been carried out) or **Start with zeroing** and start the program with OK.

- If selected: Gas zeroing (32 s).
- Stabilisation phase (60 s).
- The program will run and then stop after the programmed time.

Option:

▶ To print readings: Print.

▶ To cancel the program: Stop, start again: Start.

G.2.3 Draught

The **Draught** function is only available on instruments with the "Pressure/flow speed measurement" option and with a flue gas probe connected.

! Do not measure for longer than 5 min, as the drift of the pressure sensor means that the readings could be outside the tolerance limits.

Calling up the function:

▶ → **Measurements** → OK → **Draught** → OK.

Measuring:

1 Start measuring: Start.

- Draught zeroing (5 s).

2 Position the flue gas probe in the centre of the flow (area of the highest flue gas temperature). The display showing the maximum measured flue gas temperature (FT) helps when positioning the probe.

- The reading is displayed.

3 Stop measuring Stop.

- The reading is recorded.

Option:

▶ To print the reading: Print.

4 To copy the reading to the **Flue gas** menu: OK.

- The **Measurements** menu is opened.

G.2.4 Smoke#/HCT

Calling up the function:

▶ 📖 → **Measurements** → [OK] → **Smoke#/HCT** → [OK].

Entering the smoke tester no./smoke #/oil derivative:

The function is only available if the chosen fuel is an oil.

1 **Sm. tester no.** → [Change] → Enter the tester number → [OK].

2 **Smoke # 1** → [Change] → Enter the value → [OK].

3 Repeat step 2 for the other smoke # and the oil derivative accordingly.

Entering the heat carrier temperature:

▶ **Heat carrier** → [Change] → Enter the value → [OK].

Copying values to the Flue gas menu:

! The values are not shown on the instrument's display. In the menu **Flue Gas**, they can be stored and/or printed in a measurement protocol together with the readings from a flue gas measurement, or transferred to a Pocket PC/PC

▶ **OK Copy readings** → [OK].

- The **Measurements** menu is opened.

G.2.5 Gas flow rate

The **Gas flow rate** function is only available if the activated fuel is a gas.

Calling up the function:

▶ 📖→ **Measurements** → [OK] → **Gas flow rate** → [OK].

Measuring:

1 Enter the measurement period: **Sample time** → [Change] → Enter the value (**18** or **36** s) → [OK].

2 Start measuring: [Start]. Note the counter status of the gas counter.

- The remaining measurement period is displayed.
- When the measurement period has lapsed, a long beep is emitted. The last 5 s are indicated by a short beep.

3 Enter the flow rate: **Gasflow** → Enter the value → [OK].

- The calculated gas burner output is displayed.

4 Copy the values to the **Flue gas** menu: **OK Copy readings** → [OK].

- The **Measurements** menu is opened.

G.2.6 Oil flow rate

The **Oil flow rate** function is only available if the activated fuel is an oil.

Calling up the function:

► ⓜ → **Measurements** → OK → **Oil flow rate** → OK.

Measuring:

1 Enter the flow rate: **Flowrate** → Change → Enter the value → OK.

2 Enter the oil pressure: **Oil pressure** → Change → Enter the value → OK.

- The calculated oil burner output is displayed.

3 Copy the values to the **Flue gas** menu: **OK Copy readings** → OK.

- The **Measurements** menu is opened.

G.2.7 m/s

The **m/s** function is only available on instruments with the "Pressure/flow speed measurement" option.

! A Pitot tube must be connected, the connection cable for the Pitot tube thermocouple must be connected to the instrument probe socket.

For flow speed, air flow and mass flow to be measured correctly, the parameters of cross-section shape, cross-section surface area, Pitot factor and offset factor must be set, see *Location*, p. 24.

! Do not measure for longer than 5 min, as the drift of the pressure sensor means that the readings could be outside the tolerance limits.

Calling up the function:

► ⓜ → **Measurements** → OK → **m/s** → OK.

Measuring:

1 Start measuring: Start.

- Pressure zeroing (5 s).

2 Position the Pitot tube in the duct. The display showing the measured flow speed (Speed) helps when positioning the probe.

- The reading is displayed.

3 Stop measuring: Stop.

- The reading is recorded.

Option:

▶ To print the reading: Print.

4 Accept the reading: OK.

- The **Measurements** menu is opened.

G.2.8 Δp2

The **Δp2** function is only available on instruments with the "Pressure/flow speed measurement" option.

! Do not measure for longer than 5 min, as the drift of the pressure sensor means that the readings could be outside the tolerance limits.

When measuring the gas flow pressure of gas heaters:

Dangerous mixture of gases

Danger of explosion!

▶ Make sure there are no leaks between the sampling point and the measuring instrument.

▶ Do not smoke or use naked flames during measurement.

Calling up a function:

▶ ☰ → **Measurements** → OK → **Δp2** → OK.

Measuring:

1 Start measuring: Start.

- Pressure zeroing (5 s).

2 Position the Pitot tube in the duct.

3 Stop measuring Stop.

- The reading is recorded.

Option:

▶ To print the reading: Print.

4 Accept the reading: OK.

- The **Measurements** menu is opened.

G.2.9 Burner control

With the help of the readout adapter for automatic furnaces (0554 1206), status data and malfunction reports can be read out from compatible automatic furnaces, see also documentation for readout adapter. The range of data which can be read out is dependent on the automatic furnace type.

Calling up the function:

1 Connect readout adapter to the instrument (PS2 interface) and the automatic furnace (use adapter ring if necessary).

2 ☰ → **Measurements** → OK → **Burner Control**.

Option:

▶ Display type and version of the adapter: Adapt..

3 OK.

- The data are read from the automatic furnace. An update of the data takes place every 30s at the latest, this is dependent on the automatic furnace.

Reading out current status data:

The current data are displayed when a connection to the automatic furnace exists. The following data are displayed with the help of symbols:

Component	Status ON	Status OFF	Component	Status ON	Status OFF
Air controller			Flame		Symbol not displayed
Motor			Ignition		
Valve1			Oil prewarmer		
Valve 2					

Printing data:

▶ Print.

Display identification data:

▶ **Info** → OK.

Display failure statistic:

▶ **Failure statistic** → OK.

Reading out failure store:

Automatic furnaces are equipped with circular buffer memories, i.e. failure reports are overwritten when the failure store is full.. The last failure occurring is at position 1 in the failure list.

▶ Failure.

Option:

▶ Scroll through failure list: ▲, ▼.

Taking readings over into the menu Flue Gas:

! The readings are not presented in the display, in the menu **Flue Gas** they can be stored with the readings from a flue gas measurement, stored in a measurement protocol or transferred to a pocket PC/PC.

For taking data over into the menu **Flue Gas** the function fields **Info** and **Failure statistic** must not be active (grey background).

▶ OK.

- The Menu **Measurements** is opened.

H. Transferring data

H.1 Protocol printer

If data are to be transferred to a Testo protocol printer via the infrared interface, the printer that is to be used must be activated, see *Printer*, p. 29.

Data are printed out via the function key Print. The function is only available if a print-out is possible.

H.2 PC/Pocket PC

An instrument/PC connecting cable (0409 0178) is required in order to transmit data to a PC. Data are transferred to a Pocket PC via the infrared interface.

You must also refer to the documentation that comes with the software.

I. Care and maintenance

This chapter describes the steps and action required in order to keep the product functioning properly.

See also *Regular care*, p. 18.

I.1 Cleaning the measuring instrument

- If the housing of the instrument is dirty, clean it with a damp cloth. Do not use any aggressive cleaning agents or solvents. Weak household cleaning agents and soap suds may be used.

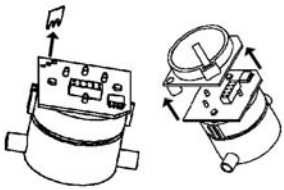
I.2 Replacing measuring cells

A slot bridge (0192 1552) must be inserted in slots which do not have a measuring cell. Used measuring cells must be disposed of as special waste!

Retrofitted measuring cells: The enclosed cell heating unit is not required for testo 335.

The measuring instrument must be switched off.

1 Place the measuring instrument on its front.
2 Remove the service cover: Take hold of it at the markings (arrows) using the index finger and thumb, press slightly, fold up and remove.
3 Pull tube connections from the faulty measuring cell/bridge.
4 Remove the faulty measuring cell/bridge from the slot.



! Do not remove shorting jumpers/auxiliary circuit boards of the new measuring cells until immediately before installation. Do not leave the measuring cells without a shorting jumper/auxiliary circuit boards for longer than 15 min.

- CO, CO_{low}, NO2, SO2 measuring cells:
  Remove the shorting jumper.
- NO/NO_{low} measuring cells:
  Remove the auxiliary circuit board.

5 Insert a new measuring cell/bridge in the slot.
6 Attach tube connections to the measuring cell/bridge.
7 Attach the service cover and engage it in place.

! After replacing an O2 measuring cell, wait 60 min before using the instrument again. If retrofitting a measuring cell, you must activate the relevant measuring parameter and unit, see *Display edit*, p. 28.

I.3 Recalibrating measuring cells

See *Sensor settings*, p. 32.

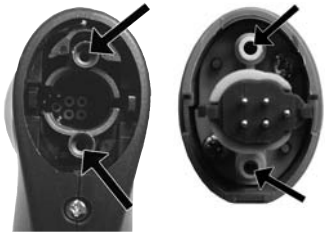
I.4 Replacing additional filter

The additional filter provides added protection should problems occur with the particle filter in the flue gas probe. The additional filter is very rarely contaminated if the measuring instrument is used normally.

▶ Check the additional filter (visually) for contamination from time to time and replace it if necessary.

1 Place the measuring instrument on its front.
2 Remove the service cover: Take hold of it at the markings (arrows) using the index finger and thumb, press slightly, fold up and remove.
3 Release the additional filter from the tube connections.
4 Fit a new filter (0133 0010) on the tube connections.
5 Fit the service cover and clip into place.

I.5 Cleaning the modular flue gas probe



! Detach the flue gas probe from the measuring instrument before cleaning.

1 Release the probe catch by pressing the key on the probe handle and remove the probe module.

▶ Probe shafts with preliminary filter:
Unscrew the preliminary filter.

2 Blow compressed air through the flue ducts of the probe module and probe handle (see illustration). Do not use a brush!

▶ Probe shafts with preliminary filter:
Blow compressed air through the preliminary filter. For thorough cleaning, use an ultrasonic bath or a cleaner for dentures. Screw the preliminary filter back on to the probe shaft after cleaning.

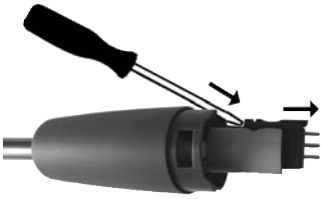
3 Fit a new probe module on the handle and engage it in place.

I.6 Replacing probe preliminary filter

The preliminary filter in probe modules fitted with a preliminary filter can be replaced.

▶ Unscrew the preliminary filter from the probe shaft and screw on a new filter.

I.7 Replacing thermocouple



1 Release the probe catch by pressing the key on the probe handle and remove the probe module.

2 Detach the plug-in head of the thermocouple from its mounting using a screwdriver and pull the thermocouple from the probe shaft.

3 Lead a new thermocouple into the probe shaft until the plug-in head engages.

4 Fit probe module on the handle and engage it in place.

J. Questions and answers

This chapter gives answers to frequently asked questions.

Question	Possible causes	Remedy
Measuring instrument keeps switching itself off **or** instrument will not switch on.	AutoOff function is switched on. Battery spent.	▶ Switch AutoOff function off (see *AutoOff*, p. 30). ▶ Charge rech. battery or connect mains unit (see *Operation*, p. 15).
Measuring instrument will not switch on.	Battery spent.	▶ Charge rech. battery or connect mains unit (see *Operation*, p. 15).
Display of the battery capacity appears faulty	Battery was often not fully discharged/ charged.	▶ Discharge rechargeable battery fully (until instrument switches off by itself) and then charge fully.
Failure report: **Pump flow rate to high**	Gas output closed.	▶ Ensure that gas output is free

If we could not answer your question, please contact your dealer or Testo Customer Service. Contact details can be found on the guarantee card or on the Internet under *www.testo.com*.

K. Technical data

K.1 Standards and tests

- As declared in the certificate of conformity, this product complies with Directive 89/336/EEC.
- This product is TÜV approved to EN50379 part 2, exception: SO2 and NO2 parameters are not tested, recalibration is not blocke d.

K.2 Measuring ranges and accuracies

Parameter	Measuring range	Accuracy		Resolution	t90[1]
O2	0...25Vol.%	±0.2Vol.%		0.01Vol.%	<20s
CO, H2-comp.	0...10000ppm	±10ppm or ±10% of reading[2] at 0...200ppm ±20ppm or ±5% of reading[2] at 201...2000ppm ±10% of reading at 2001...10000ppm		1ppm	<40s
COlow	0...500ppm	±2ppm ±5% of reading	at 0.0...39.9ppm at 40.0...500ppm	0.1ppm	<40s
NO2	0...500ppm	±10ppm ±5% of reading	at 0.0...200.0ppm at 200.1...500.0ppm	0.1ppm	<40s
SO2	0...5000ppm	±10ppm ±5% of reading ±10% of reading	at 0...200ppm at 201...2000ppm at 2001...5000ppm	1ppm	<40s
NOlow	0...300ppm	±2ppm ±5% of reading	at 0.0...39.9ppm at 40.0...300.0ppm	0.1ppm	<30s
NO	0...3000 ppm	±5ppm ±5% of reading ±10% of reading	at 0...100ppm at 101...2000ppm at 2001...3000ppm	1ppm	<30s
Draught, Δp1	-40...40hPa	+1.5% v. Mw. + 0.03hPa + 1.5% v. Mw.	at -40.00...-3.00hPa at -2.99...2.99hPa at 3.00...40.00hPa	0.01hPa	-
Δp2	-200...200hPa	±1.5% of reading ±0.5hPa ±1.5% of reading	at -200.0...-50.0hPa at -49.9...49.9hPa at 50.0...200.0hPa	0.1hPa	-

K. Technical data
K.2 Measuring ranges and accuracies

Parameter	Measuring range	Accuracy	Resolution	t90[1]
Pabs	600...1150hPa	±10hPa	1hPa	-
Temperature (NiCrNi)	-40...1200°C	±0.5°C at 0.0...100.0°C ±0.5% of reading in rest of range	0.1°C at -40.0...999.9°C 1°C at 1000°C...1200°C	depends on probe
Temperature (PtRhPt)	-40...1600°C	±1°C at 0.0...200.0°C ±0.5% of reading in rest of range	1°C	depends on probe
Efficiency	0...120%	-	0.1%	-
Flue gas loss	-20.0...99.9%	-	0.1%	-

[1] Response time 90%, recommended minimum measurement duration to guarantee correct readings: 3min
[2] Whichever is the greater

With activated dilution sensor 2

Parameter	Measuring range	Accuracy	Resolution	t90[1]
CO	0...50000ppm	+10% of reading (additional error)	1ppm	
COlow	0...2500ppm	+10% of reading (additional error)	0.1ppm	
NO2	0...2500ppm	+10% of reading (additional error)	0.1ppm	
SO2	0...25000ppm	+10% of reading (additional error)	1ppm	

With activated dilution of all sensors (optional)

Parameter	Measuring range	Accuracy	Resolution	t90[1]
O2	0...25Vol.%	±1Vol.% of reading additional error (0...4,99Vol.%) ±0,5Vol.% of reading additional error(5...25Vol.%)	0.01Vol.%	<20s
CO, H2-komp.	0...20000ppm	+10% of reading (additional error)	1ppm	
COlow	0...1000ppm	+10% of reading (additional error)	0.1ppm	
NO2	0...1000ppm	+10% of reading (additional error)	0.1ppm	
SO2	0...10000ppm	+10% of reading (additional error)	1ppm	
NOlow	0...600ppm	+10% of reading (additional error)	0.1ppm	
NO	0...6000ppm	+10% of reading (additional error)	1ppm	

[1] Response time 90%, recommended minimum measurement duration to guarantee correct readings: 3min

K.3 Other instrument data

Characteristic	Values
Operating temperature	-5...50 °C
Storage/transport temperature	-20...50 °C
Power supply	Battery block: 3.7 V/2.4 Ah Mains unit: 6.3 V/1.2 A
Dimensions (L x W x H)	270 x 90 x 65mm
Weight	600 g (excluding battery)
Memory	max. 100 folders, max. 10 locations per folder
Display	Monochrome, 4 grey levels, 160 x 240 pixels
Battery storage temperature:	±0...35 °C
Battery life	>6 h (pump on, display light off, 20 °C ambient temperature)
Battery charge time	approx. 5-6 h
Guarantee (according to Testo guarantee conditions)	Measuring instrument: 24 months Measuring cells: 12 months, O2 measuring cell: 18 months Flue gas probe: 24 months Thermocouple: 12 months Battery: 12 months

K.4 Principles of calculation

K.4.1 Fuel parameters

Fuel	A2[1]	B[1]	CO_2max[2]	O_2-Bezug[2]	$V_{AGtrMin}$[1]	V_{LMin}[1]
Natural gas	0.660	0.009	11.9 Vol.%	3 Vol.%	8.36	9.12
Light oil	0.680	0.007	15.4 Vol.%	3 Vol.%	10.53	11.26
Heavy oil	0.806	0.000	15.9 Vol.%	3 Vol.%	10.09	10.73
Propane	0.630	0.008	13.7 Vol.%	3 Vol.%	23.80	25.95
Wood	0.765	0.000	20.3 Vol.%	13 Vol.%	7.64	7.66
Pellets	0.765	0.000	20.3 Vol.%	13 Vol.%	7.64	7.66
Briquettes	0.833	0.000	18.9 Vol.%	8 Vol.%	5.08	5.20
Brown coal	0.955	0.000	19.8 Vol.%	8 Vol.%	4.01	4.09
Anthracite	0.758	0.000	20.5 Vol.%	8 Vol.%	7.81	7.82
Coke oven gas	0.600	0.011	10.3 Vol.%	3 Vol.%	3.86	4.28
Town gas	0.630	0.011	13.6 Vol.%	3 Vol.%	3.61	3.90
Diesel	0.686	0.007	15.5 Vol.%	3 Vol.%	10.45	11.17
Petrol	0.659	0.007	15.0 Vol.%	3 Vol.%	10.10	10.8
Test gas	0.0000	0.000	0.00 Vol.%	0 Vol.%	0.00	0.00

[1] Fuel-specific factor
[2] Factory setting

K.4.2 Calculation formulae

Carbon dioxide:

$$CO_2 = \frac{CO_{2max} \times (O_{2ref} - O_2)}{O_{2ref}}$$

CO_{2max}: Fuel-specific carbon dioxide value
O_2ref: O2 reference value
O_2: Measured oxygen content as %

Flue gas loss:

$$qA = \left((FT\text{-}AT) \times \left(\frac{A2}{O_{2ref} - O_2} + B\right)\right) - K_k$$

FT: Flue gas temperature
AT: Ambient air temperature
A2/B: Fuel-specific parameters
O_2ref: O2 reference value
O_2: Measured oxygen content as %
K_k: Calculated value taking into account the recovered condensation heat when the dew point is undershot (for fuel value systems).

Efficiency:

$$\eta = 100 - qA$$

qA: Calculated flue gas loss

Air ratio:

$$\lambda = 1 + \frac{V_{AGtrMin}}{V_{LMin}} \times \frac{O_2 - \frac{CO}{2}}{O_{2ref} - O_2 + \frac{CO}{2}}$$

$V_{AGtrMin}$: Dry flue gas volume with stoichiometric combustion
V_{LMin}: Air requirement for stoichiometric combustion of the fuel
O_{2ref}: O2 reference value
O_2: Measured oxygen content as %

Nitrogen oxides:

No NO2 measuring cell connected:
$NO_x = NO + (NO_{2Add.} \times NO)$
NO2 Measuring cell connected:
$NO_x = NO + NO_2$

NO: Measured nitrogen monoxide value
$NO_{2Add.}$: Nitrogen dioxide addition factor

Carbon monoxide undiluted:

$$uCO = CO \times \lambda$$

CO: Measured carbon monoxide value
λ: Calculated air ratio

Flue gas dew point:

$$ATP = \frac{\ln\left(\frac{F_{H20} \times P_{Abs}}{610.78}\right) \times 234.175}{\ln\left(\frac{F_{H20} \times P_{Abs}}{610.78}\right) - 17.08085}$$

F_{H20}: Flue gas-specific water vapour content as vol.%
P_{Abs}: Absolute pressure in mbar/hPa

Flow speed:

$$v = \sqrt{\frac{575 \times \Delta P \times (FT + 273.15)}{P_{abs}}} \times \alpha$$

P_{abs}: Absolute pressure
ΔP: Differential pressure
FT: Flue gas temperature
α: Pitot tube factor

Air flow:

$$V = v \times a$$

v: Flow speed
a: Cross-section area

Mass flow:

Mass flow CO: $MCO = CO\ [kg/h]\ [ppm] \times F_{Gas} \times 1.25\ [kg/m^3] \times Z$

Mass flow NO_X: $MNO_x = NO_x\ [kg/h]\ [ppm] \times F_{Gas} \times 2.05\ [kg/m^3] \times Z$

Mass flow SO_2: $MSO_2 = SO_2\ [kg/h]\ [ppm] \times F_{Gas} \times 2.86\ [kg/m^3] \times Z$

Fgas: Fuel-specific humidity value
T: Dew point
Z: Calculation term (see below)

Calculation term Z:

$$Z = \frac{273.15 \times P_{abs}\ [mbar]}{273.15 + T\ [°C] \times 1013} \times V\ [m^3/s] \times 10^{6}\ [1/ppm] \times 3600$$

Conversion from ppm to mg/m3:

Carbon monoxide:

$$CO\ [mg/m^3] = \frac{O_{2ref} - O_{2Bez}}{O_{2ref} - O_2} \times CO\ [ppm] \times 1.25$$

Nitrogen oxide:

$$NOx\ [mg/m^3] = \frac{O_{2ref} - O_{2Bez}}{O_{2ref} - O_2} \times NO_x\ [ppm] \times 2.05$$

Sulfur dioxide:

$$SO2\ [mg/m^3] = \frac{O_{2ref} - O_{2Bez}}{O_{2ref} - O_2} \times SO_2\ [ppm] \times 2.86$$

O_{2ref}: O_2 Reference value
O_2: Measured oxygen content as %
O_{2Bez}: Fuel-specific oxygen reference index as %

K.5 Recommended rinsing times

Recommended rinsing times in measurements with high concentrations and longer measurements:

▶ Rinse instrument: Expose probe to fresh air and start flue gas analysis

Parameter	Concentration [ppm]	Measurement duration [min]	Recommended rinsing time [min]
CO	50	60	5
	100	30	5
	200	20	10
	500	10	10
	1000	10	15
	2000	10	20
	4000	5	30
	8000	5	60
COlow	10	60	5
	20	30	5
	50	20	10
	100	10	10
	200	10	15
	500	10	20
NO	50	60	5
	100	45	5
	200	30	5
	500	20	10
	1000	10	10
	2000	10	20
	3000	5	30
NOlow	10	60	5
	20	45	5
	50	30	5
	100	20	10
	200	10	10
	300	10	20
NO2	10	60	5
	20	45	5
	50	30	5
	100	20	10
	200	10	10
	500	10	20
SO2	50	60	5
	100	30	5
	200	20	10
	500	15	10
	1000	10	10
	2000	10	20
	5000	5	40

L. Accessories/spare parts

Designation	Article no.
Modular flue gas probes	
Modular flue gas probe 300mm, 500°C, thermocouple 0.8mm	0600 9766
Modular flue gas probe 700mm, 500°C, thermocouple 0.8mm	0600 9767
Modular flue gas probe 300mm, 1000°C, thermocouple 0.8mm	0600 8764
Modular flue gas probe 700mm, 1000°C, thermocouple 0.8mm	0600 8765
Modular flue gas probe with preliminary filter 300mm, 1000°C, thermocouple 0.8mm	0600 8766
Modular flue gas probe with preliminary filter 700mm, 1000°C, thermocouple 0.8mm	0600 8767
Probe modules/accessories for modular flue gas probes	
Module probe shaft 300mm, 500°C, thermocouple 0.8mm	0554 9766
Module probe shaft 700mm, 500°C, thermocouple 0.8mm	0554 9767
Module probe shaft 300mm, 1000°C, thermocouple 0.8mm	0554 8764
Module probe shaft 700mm, 1000°C, thermocouple 0.8mm	0554 8765
Module probe shaft with preliminary filter 300mm, 1000°C, thermocouple 0.8mm	0554 8766
Module probe shaft with preliminary filter 700mm, 1000°C, thermocouple 0.8mm	0554 8767
Extension lead for modular flue gas probe, 2.80m	0554 1202
Particle filter, 10 pcs	0554 3385
Replacement preliminary filter for modular flue gas probe with preliminary filter (2 pcs.)	0554 3372
Other probes/sensors	
Pitot tube, 350mm	0635 2041
Pitot tube, 700mm	0635 2042
Ambient air temperature (AT) sensor, 60 mm	0600 9797
Retrofit measuring cells	
NOlow retrofitting kit	0554 3928
NO retrofitting kit	0554 3935
COlow retrofitting kit	0554 3925
CO retrofitting kit	0554 3933
NO2 retrofitting kit	0554 3926
SO2 retrofitting kit	0554 3927
Replacement measuring cells	
O_2 measuring cell	0390 0049
CO measuring cell	0390 0088
NOlow measuring cell	0390 0077
NO measuring cell	0390 0093
NO2 measuring cell	0390 0075
SO2 measuring cell	0390 0081

Designation	Article no.
Other accessories	
Desktop printer	0554 0547
Mains unit	0554 1086
Charger with replacement battery	0554 1087
Replacement battery	0515 0100
Instrument/PC connecting cable	0449 0047
testo EasyEmission PC configuration software	0554 3334
Additional filter	0133 0010
Calibration adapter	0554 1205
Aluminium system case	0516 3350

Functional overview

The table gives an overview of the most important functions configured on the individual instruments. Detailed information about the individual functions can be found on the pages indicated.

Task	Call/function	see page
	→ **Measurements** → OK →	
Flue gas measurement	**Flue gas** → OK	38
Flue gas measurement with parallel flow measurement (+ air/mass flow calculation)	**Flue gas + m/s** → OK	38
Flue gas measurement with parallel differential pressure measurement	**Flue gas + Δp2** → OK	38
Change/save/run measuring program	**Program** → OK	39
Draught measurement	**Draught** → OK	40
Enter smoke #/heat carrier temperature	**Smoke # / HCT** → OK	41
Determine gas flow rate	**Gas flow rate** → OK	41
Determine oil flow rate	**Oil flow rate** → OK	42
Flow speed and pressure measurement	**m/s** → OK	42
Pressure measurement	**Δp2** → OK	43
Read automatic furnace	**Burner control** → OK	44
	→ **Memory** → OK →	
Create new folder	**New folder** → OK	23
Sort folder list by **Folder**, **Name** or **Addr'**	**Folders list** → Folder or Name or Addr'	23
Sort locations list by order of creation	**Restore list** → OK	23
Create new location	**Folder** → OK → **New location** → OK	23
Sort locations list by **location name**	**Folder** → OK → **Locations list** → Locat	23
Sort locations list by order of creation	**Folder** → OK → **Restore list** → OK	23
Activate location	**Folder** → OK → Select location → OK	23
Perform location settings	**Folder** → OK → Select location → Change	23
Display measurement data of one location	**Folder** → OK → Select location → Data	23
Print all measurement data of a location	**Folder** → OK → Select location → Data → **Print all** → OK	23
Delete all measurement data of a location	**Folder** → OK → Select location → Data → **Delete all** → OK	23
Display readings of a selected measurement protocol	**Folder** → OK → Select location → Data → Select protocol → Value	23
Print a single measurement protocol	**Folder**→ OK → Select location → Data → Select protocol → Print	23

Task	Call/function	see page
	(menu) → **Memory**→ [Extra] →	
Print all protocols in the memory	**Print all data** → [OK]	23
Delete all protocols in the memory	**Delete all data** → [OK]	23
Clear whole memory (protocols and locations)	**Delete memory** → [OK]	23
	(menu) → **Inst' settings** → [OK] →	
Set reading display	→ **Display edit** → [OK]	28
Select printer, set print text	→ **Printer** → [OK]	28
Set function key assignment, start screen	→ **Start keys edit** → [OK]	28
Set date/time	→ **Date / Time** → [OK]	28
Set language	→ **Language** → [OK]	28
Set automatic instrument disconnect	→ **AutoOff** → [OK]	28
	(menu) → **Sensor settings** → [OK] →	
Display calibration data	**Calibration data** → [OK]	32
Set NO2 addition	**NO2 addition** → [Change]	32
Set O2 reference	**O2 reference** → [Change]	32
Set sensor protection	**Sensor protection** → [OK]	32
Perform recalibration	**Recalibration** → [OK]	32
	(menu) → **Fuels** → [OK] →	
Activate fuel	Select fuel → [OK]	35
Change fuel coefficients	Select fuel → [Coeff.]	35
	(i) **-or -** (menu) → **Inst' diagnosis** → [OK] →	
Perform gas path check	**Gas path check** → [OK]	27
View instrument errors	**Error diagnosis**→ [OK]	27
View sensor diagnosis	**Sensor diagnosis** → [OK]	27

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