



testo 310 · Flue gas analyzer

Instruction manual [en]



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2 Safety and the environment


2.1. About this document

Use

- > Please read this documentation through carefully and familiarize yourself with the product before putting it to use. Pay particular attention to the safety instructions and warning advice in order to prevent injuries and damage to the products.
- > Keep this document to hand so that you can refer to it when necessary.
- > Hand this documentation on to any subsequent users of the product.

Warnings

Always pay attention to information that is marked by the following warnings with warning pictograms. Implement the specified precautionary measures.

Representation	Explanation
 CAUTION	indicates potential minor injuries
NOTICE	indicates circumstances that may lead to damage to the products

Symbols and writing standards

Representation	Explanation
i	Note: Basic or further information.
1. ... 2. ...	Action: more steps, the sequence must be followed.
> ...	Action: a step or an optional step.
- ...	Result of an action.
[OK]	Control keys of the instrument or buttons of the program interface.

2.2. Ensure safety

- > Only operate the product properly, for its intended purpose and within the parameters specified in the technical data. Do not use any force.
- > Do not operate the instrument if there are signs of damage at the housing, mains unit or feed lines.
- > Do not perform contact measurements on non-insulated, live parts.
- > Do not store the product together with solvents. Do not use any desiccants.
- > Carry out only the maintenance and repair work on this instrument that is described in the documentation. Follow the prescribed steps exactly. Use only original spare parts from Testo.
- > Any further or 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.
- > Only use the device in closed, dry rooms and protect it from rain and moisture.
- > 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.
- > The objects to be measured or the measurement environment may also pose risks: Note the safety regulations valid in your area when performing the measurements.
- > Improper use of rechargeable batteries can lead to destruction or injuries by means of current surges, fire or escaping chemicals. The following instructions must be observed to avoid such hazards:
 - Only use in accordance with the directions in the instruction manual.
 - Do not short, take apart or modify.
 - Do not expose to heavy impacts, water, fire or temperatures above 60 °C.
 - Do not store in the proximity of metal objects.
 - Do not use leaky or damaged rechargeable batteries. In the event of contact with battery acid: Thoroughly wash affected area with water and consult a doctor, if necessary.

- Only charge in the instrument or the recommended charging station.
- Immediately stop the charging process if this is not completed in the given time.
- In the event of improper function or signs of overheating, immediately remove the rechargeable battery from the measuring instrument/charging station. Caution: Rechargeable battery may be hot!

2.3. Protecting the environment

- > Dispose of faulty rechargeable batteries/spent batteries in accordance with the valid legal specifications.
- > At the end of its useful life, send the product to the separate collection for electric and electronic devices (observe local regulations) or return the product to Testo for disposal.

3 Specifications

3.1. Use

The testo 310 is a handheld measuring instrument for the professional flue gas analysis of combustion plants:

- Small combustion plants (oil, gas, wood, coal)
- Low-temperature and condensing boilers
- Gas water heaters

These systems can be adjusted using the testo 310 and checked for compliance with the applicable limit values.

The following tasks can also be carried out using the testo 310:

- Regulating the O₂, CO and CO₂ values in combustion plants for the purpose of ensuring optimal operation.
- Draught measurement.
- Measuring and regulating the gas flow pressure in gas water heaters.
- Ambient CO measurement.

The testo 310 must not be used:

- as a safety (alarm) device

3.2. Technical data

3.2.1. Measurement ranges and resolution

Measurement parameter	Measurement range	Resolution	Accuracy	Response time t90
O ₂	0.0 to 21.0 Vol.%	0.1 vol.%	±0.2 vol.%	30s
CO	0 to 4000 ppm	1 ppm	±20 ppm (0 to 400 ppm) ±5% of meas. val. (401 to 2000 ppm) ±10% of meas. val. (2001 to 4000 ppm)	60s
COamb	0 to 4000 ppm	1 ppm	±20 ppm (0 to 400 ppm) ±5% of meas. val. (401 to 2000 ppm) ±10% of meas. val. (2001 to 4000 ppm)	60s
Draught	-20.00 to 20.00 hPa	0.01 hPa	± 0.03hPa (-3.00 to 3.00 hPa) ±1.5% of meas. val. (rest of range)	-
ΔP	-40.0 to 40.0 hPa	0.1 hPa	± 0.5hPa	-
Flue gas temperature	0.0 to 400.0 °C	0.1°C	± 1°C (0.0 to 100.0°C) ± 1.5% of meas. val. (>100°C)	<50s
Ambient temperature	-20.0 to 100.0 °C	0.1°C	± 1°C	<50s

3.2.2. Other instrument data

Flue gas analyser

Feature	Values
Storage and transport temperature	-20 to 50 °C
Operating temperature	-5 to 45 °C
Power supply	Rechargeable battery: 1500mAh Mains unit: 5 V/1 A
Protection class	IP40
Weight incl. probe	approx. 700g
Dimensions	201 x 83 x 44 mm
Battery charge time	Approx. 5-6 hours

Feature	Values
Rechargeable battery life	> 8h (pump on, 20°C ambient temperature)
EU Directive	2004/108/EC
Warranty	Measuring instrument, flue gas probe: 24 months Thermocouple: 12 months Sensors O ₂ , CO: 24 months, Rechargeable battery: 12 months
Terms of warranty	Terms of warranty: see website www.testo.com/warranty

4 Product description





4.1. Measuring instrument



4.1.1. Front view



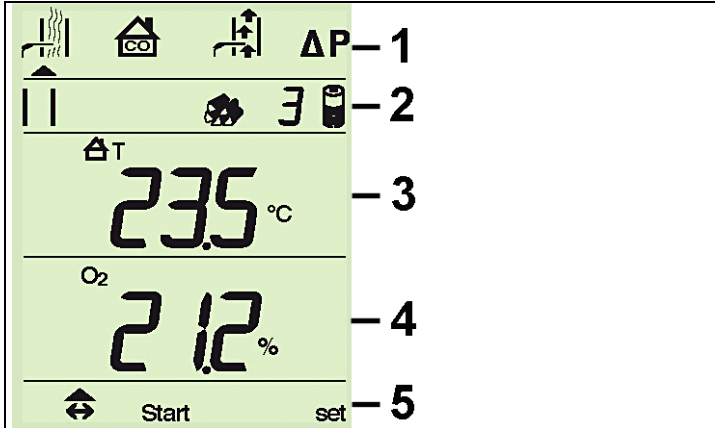
- 1 Display
- 2 Function keys
- 3 Keypad

4.1.2. Keypad




Button	Functions
	Switch measuring instrument on / off
 Example	Function key (orange, 3x), relevant function is shown on the display
	Increase value, select parameter
	Decrease value, select parameter

Button	Functions
[esc]	Back, cancel print process
	Switch display light on/off
	Transmit data to the Testo protocol printer.






4.1.3. Display



- 1 Measurement type (an arrow marks the measurement type that is activated):

Icon	Measurement
	Flue gas (icon visible when the instrument is switched off)
	Ambient CO (icon visible when the instrument is switched off)
	Draught (icon visible when the instrument is switched off)
ΔP	Differential pressure (icon visible when the instrument is switched off)

2 Status:

Icon	Meaning
	Measuring gas pump (icon visible when the instrument is switched off) The inner segments light up alternately when the measuring gas pump is running.
	Error Flashes when an error occurs, an error code is also displayed.
	Print Lights up during data transmission to the report printer
set	Open configuration menu
	Fuel type / fuel number Depending on the set fuel, one of the icons (solid fuel, oil, gas) and the associated fuel number lights up.
	Battery capacity. Indication of the remaining capacity of the rechargeable battery by fill level of the battery icon: <ul style="list-style-type: none"> • 3 segments 75-100% • 2 segments 50-75% • 1 segment 25-50% • no segment <25%




3 Reading display line 1

See Area versions, page **15**.

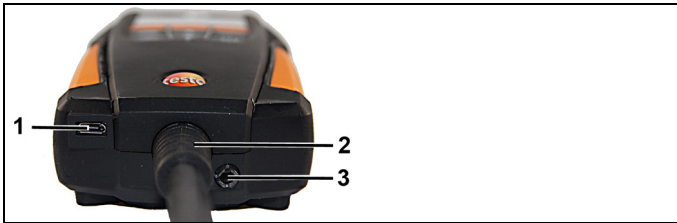
4 Reading display line 2

See Area versions, page **15**.

5 Function key assignment:

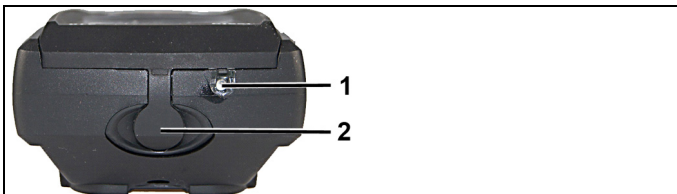
Icon	Possible assignment
 	Left function key: Start print process Select measurement type
OK Start Stop	Middle function key: Confirm input Start measurement Stop measurement
Set 	Right function key: Open configuration menu Switch to the next parameter:

4.1.4. Connections



- 1 Charging socket for mains unit (Micro USB)
- 2 Cable to the flue gas probe
- 3 Gas outlet

4.1.5. Condensate outlet/interface



- 1 Infrared interface
- 2 Condensate outlet

4.1.6. Rear view



- 1 Attachment for carrying strap
- 2 Condensate trap
- 3 Magnetic holder
- 4 Gas outlet
- 5 Magnetic holder

⚠ CAUTION
Damage to other equipment caused by strong magnets!
> Keep a safe distance from products which could be damaged by magnets (e.g. monitors, computers, pacemakers, credit cards).

4.2. Flue gas probe



- 1 Thermocouple
- 2 Probe shaft
- 3 Probe handle
- 4 Connecting cable
- 5 Removable filter chamber with window, particle filter, and sealing plug for differential pressure measurement

4.3. Area versions

The instrument can be configured for four area versions. Country-specific calculation formulas, associated measurement parameters and fuels are activated with this setting. Similarly, the setting influences the date and time format. The area version is set in the instrument configuration menu / commissioning, see Instrument configuration menu / commissioning, page **19**.

Area version (ArEA)	Countries (recommendation)	Parameters	Fuels
1	USA, HU, IN, KR	Line 1: O ₂ , T, CO ₂ , CO ₂ , P ₁ , P ₂ , uCO Line 2: CO, Eff, ΔT, EXA, CO ₂	nAt GAS – Natural gas ProP GAS – Propane FUEL OIL2 – Fuel oil 2 Bioh 5 – Biomass 5% Uood 20 – Wood 20%
2	GB, RU, IT, CZ, DK, AU, JP, CN	Line 1: rat, O ₂ , T, P ₁ , CO ₂ , P ₂ , uCO Line 2: CO ₂ , CO, EXA, Eff.net, Eff.gross, ΔT, O ₂	nAt GAS – Natural gas LPG GAS – LPG ProP GAS – Propane But GAS – Butane LI OIL – EL fuel oil CEro SEnE – Kerosene HE OIL – Heavy fuel oil Uood PELL - Wood pellets
3	NL, SE, TR, RO	Line1: O ₂ , P ₁ , T, GI, uCO, P ₂ Line 2: CO, CO ₂ , ΔT, Eff, qA, λ, CO ₂	nAt Hb – Natural gas Hb nAt Ho – Natural gas Ho ProP Hb – Propane Hb ProP Ho – Propane Ho but Ho – Butane Ho LPG Ho – LPG Ho LI OIL – EL fuel oil Uood PELL – Wood pellets
4	DE, AT, CH, FR, ES, BE, PL, PT, AR, BR	Line1: T, CO, uCO, ΔT, O ₂ , P ₁ , P ₂ , CO ₂ Line 2: O ₂ , qA, CO ₂ , Eff, λ, T, ΔT	nAt GAS - Natural gas ProP GAS - Propane but GAS - Butane CoO GAS - Coke oven gas Toun GAS - Town gas LI OIL - EL fuel oil HE OIL - Heavy fuel oil Uood 15 - Wood 15%

4.4. Reading display

Display	Measurement parameter
\hat{T}	Ambient temperature
T	Flue gas temperature
CO	Carbon monoxide
O ₂	Oxygen
CO \hat{T}	Ambient carbon monoxide
qA	Flue gas loss without due consideration of the calorific value range
Eff.net	Net efficiency (without due consideration of the calorific value range)
Eff.gross	Gross efficiency (with due consideration of the calorific value range)
Eff.	Efficiency
λ	Air ratio
P2	Differential pressure
CO ₂	Carbon dioxide
P1	Flue draught
uCO	Carbon monoxide undiluted
rat	Ratio
EXA	Air surplus

5 Using the product

5.1. Mains unit / rechargeable battery

i The rechargeable battery is permanently installed and can only be changed by a Testo service centre.

The measuring instrument is supplied with a partially charged rechargeable battery.

- > Charge the rechargeable battery fully before using the measuring instrument.
-

5.1.1. Charging the rechargeable battery

The rechargeable battery can only be charged at an ambient temperature of ± 0 to $+35^{\circ}\text{C}$. If the battery has been discharged completely, the charging time at room temperature is approx. 5-6 hrs.

Charging in the measuring instrument

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 battery is fully charged.

Battery care

- > Do not fully exhaust the rechargeable battery.
- > Only store instrument with battery charged and at low temperatures, but not below 0°C (best storage conditions with a charge level of 50-75% = 2 segments, at an ambient temperature of $10-20^{\circ}\text{C}$, recharge completely before use).
- > The rechargeable battery life depends on the storage, operating and ambient conditions. The available useful life of the rechargeable battery reduces more and more with frequent use. If the useful life is significantly shortened, the rechargeable battery should be replaced.

5.1.2. Mains operation

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 by the mains unit.

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

5.2. Performing settings


The instrument has two different configuration menus. The menu that is opened depends on the instrument status when called up.

5.2.1. Instrument configuration menu / commissioning

When the instrument is switched on initially, the configuration menu is opened automatically.

Following initial commissioning, the configuration menu can also be opened again by pressing the right function key **[set]** during the instrument's initialisation phase (a duration of approx. 4 seconds). The values for area version, measuring units, time and date can be set.

Making settings

1. Switch the instrument on: Hold down , until all segments are shown on the display.
2. Open instrument configuration menu: Press right function key **[set]** during the initialisation phase.
3. Make settings:



Use **[esc]** to revert to the previous parameter at any time.

Display / parameter	Explanation
ArEA (area version)	Selecting the area version activates different calculation formulas and associated measurement parameters, see Area versions, page 15. > Select area version code: [▲] and [▼] . > Switch to the next parameter: [OK] .
Unit of pressure	> Select the unit: [▲] and [▼] . > Switch to the next parameter: [OK] .
Unit of temperature	> Select the unit: [▲] and [▼] . > Switch to the next parameter: [OK] .

Display / parameter	Explanation
Setting the time	<ul style="list-style-type: none"> > Set values: [▲] and [▼]. > Switch selection between hour, minute (tens) and minute (single units): [→]. > Switch to the next parameter: [OK].
Setting the date	<ul style="list-style-type: none"> > Set values: [▲] and [▼]. > Switch selection between year (tens), year (single units), month, day (tens) and day (single units): [→]. > Exit the configuration menu: [OK].

5.2.2. Measurements configuration menu

This configuration menu enables you to make important settings relating to a measurement. Fuels and measuring units can be set.

i Press right function key ([set]) after the instrument's initialisation phase.

1. Switch the instrument on: Hold down [⏻], until all segments are shown on the display.
2. Open Measurements configuration menu: Press right function key ([set]).
3. Make settings:

i Use [esc] to revert to the previous parameter at any time.

Display / parameter	Explanation
Fuel	<p>Selecting the area version activates different calculation formulas and measurement parameters, see Area versions, page 15.</p> <ul style="list-style-type: none"> > Select the fuel: [▲] and [▼]. > Switch to the next parameter: [→]. > Exit the configuration menu: [OK].
Unit of pressure	<ul style="list-style-type: none"> > Select the unit: [▲] and [▼]. > Switch to the next parameter: [OK].
Unit of temperature	<ul style="list-style-type: none"> > Select the unit: [▲] and [▼]. > Exit the configuration menu: [OK].

5.3. Measuring

5.3.1. Preparing for measurement

5.3.1.1. Zeroing phases

Gas sensors

If flue gas measurement (Ⓐ) or ambient CO measurement (Ⓒ) is configured, the gas sensors are zeroed when the instrument is switched on (zeroing phase).



The flue gas probe must be in the open air during the zeroing phase!

Pressure sensor

If draught measurement (Ⓐ) or differential pressure measurement (ΔP) is configured, the pressure sensor is zeroed when the instrument is switched on (zeroing phase).

Measuring the combustion air temperature

During the zeroing phase, the temperature is measured via the thermocouple of the flue gas probe. This temperature is permanently accepted by the instrument once the zeroing phase has been completed. All dependent parameters are calculated using this value. However, ensure that the flue gas probe is near the intake duct of the burner during the zeroing phase.

5.3.1.2. Using the flue gas probe

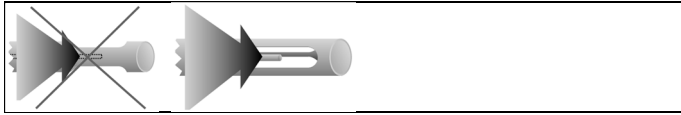
Checking the thermocouple



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

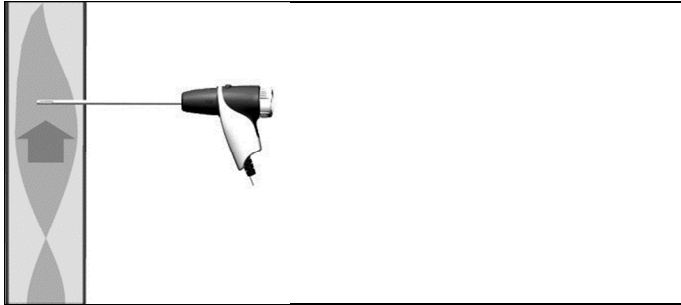
- > Check before use. Bend the thermocouple back if necessary.

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 core current of the flue gas flow.

- > Align the flue gas probe in the flue gas duct so that the tip is in the core current (area of the highest flue gas temperature).

5.3.1.3. Setting fuel

To carry out a flue gas measurement, the fuel must be set correctly, see Measurements configuration menu, page 20.

5.3.2. Flue gas

Select measurement type

- > Select :  → [OK].

Carry out the measurement

1. Start measurement: [Start].
 - The readings are displayed.
 - > Change reading display line 1: [▲].
 - > Change reading display line 2: [▼].
2. Quit measurement: [Stop].
 - > Remove flue gas probe from the flue gas duct and purge with fresh air.

5.3.3. Ambient CO

- i** Cigarette smoke influences the measurement by more than 50 ppm. The breath of a smoker influences the measurement by about 5 ppm.
The probe must be in the open air (CO-free) during the zeroing phase!

Select measurement type

> Select :  → [OK].

Carry out the measurement

1. Start measurement: [Start].
- The reading is displayed.
2. Quit measurement: [Stop].

5.3.4. Draught measurement

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

Select measurement type

> Select :  → [OK].

Performing the measurement

- The flue gas probe must be outside the flue.
1. Start measurement: [Start].
 - Draught zeroing is carried out.
 2. After zeroing, position the flue gas probe in the core current (area of the highest flue gas temperature).
The indication of the measured flue gas temperature in line 2 helps when positioning the probe.
 - The reading is displayed.
 3. Quit measurement: [Stop].

5.3.5. Differential pressure

⚠ WARNING

Dangerous mixture of gases

Danger of explosion!

- > Before measurement close the gas path with the sealing plug, as described below!
- > Make sure there are no leaks between the sampling point and the measuring instrument.
- > Do not smoke or use naked flames during measurement.

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

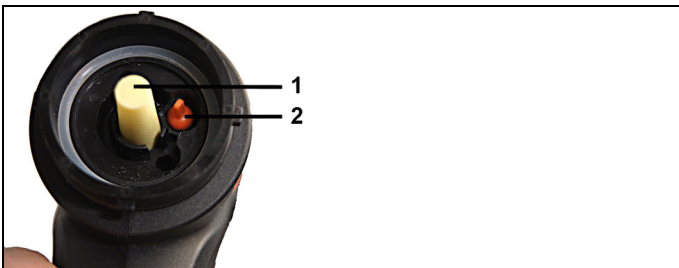
Select measurement type

- > Select ΔP : [↔] → [OK].

Prepare for measurement



1. Open filter chamber of the flue gas probe: turn it gently anti-clockwise.



2. Remove particle filter (1).
3. Remove the sealing plug (2) in the filter chamber from the holder.



4. Close the gas path with the sealing plug.
5. Check that the sealing plug is fitted tightly. It should not yield at all on being tugged gently.

⚠ CAUTION

Hot probe shaft! Risk of burns!

- > Allow the probe shaft to cool down after a measurement, before touching it!
- > Only attach the silicone hose to the probe shaft once it has cooled down!



6. Fit silicone hose onto the probe shaft of the flue gas probe. The probe shaft openings must be closed.

Carry out the measurement

- The silicone hose must be clear (pressureless, no kinks).
1. Start measurement: **[Start]**.
 - Pressure zeroing.
 2. Connect the silicone hose to the sampling point.
 3. Pressurise the system.
 - The reading is displayed.
 4. Quit measurement: **[Stop]**.

After the measurement

1. Open filter chamber of the flue gas probe: turn it gently anti-clockwise.
2. Remove the sealing plug from the gas path.
3. Insert the filter into the gas path and check that it is fitted securely,
4. Close filter chamber of the flue gas probe.
5. Remove silicone hose from the probe shaft.

6 Maintaining the product

6.1. Cleaning the measuring instrument

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

6.2. Cleaning the flue gas probe

- > In case of contamination, clean the probe shaft and the handle of the flue gas probe with a damp cloth. Do not use any aggressive cleaning agents or solvents! Mild household cleaning agents and soap suds may be used.



Any cleaning of contamination within the probe shaft may only be carried out by Testo Customer Service.

6.3. Draining the condensate container

The fill level of the condensate trap can be monitored via the markings on the condensate trap.

Draining the condensate container



CAUTION

Skin irritation due to condensate!

- > Avoid skin contact.
- > Make sure that the condensate does not run over the housing.

NOTICE

Damage to the sensors and the flue gas pump due to condensate entering the gas path!

- > Do not empty the condensate container while the flue gas pump is in operation.

1. Hold the instrument upright, so that the condensate outlet points upwards.



2. Open the sealing plug of the condensate trap.
3. Let the condensate run out into a sink.
4. Dab off any remaining drops on the condensate outlet with a cloth.
5. Close condensate outlet with sealing plug and press on it firmly.



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

6.4. Checking / replacing the particle filter

Checking the particle filter:

- > Check the particle filter of the 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: Turn gently anti-clockwise.
2. Remove the filter and replace it with a new one (0554 0040).
3. Attach the filter chamber and lock it Turn gently clockwise.

7 Tips and assistance

7.1. Questions and answers

Question	Possible causes / solution
Rechargeable battery low	> Switch to mains operation.
Measuring instrument switches off automatically or cannot be switched on	Batteries / rechargeable batteries empty. > Charge rechargeable battery or switch to mains operation.
When switching off, the instrument rinses the gas path for a long time and does not shut down.	The gas path is closed by the sealing plug. > Remove the sealing plug and insert the filter.
Error message: E04	O2 sensor is worn out > Contact Testo Service
Error message: E05	O2 measuring value is outside the measuring range > Note the measuring range (see Technical data)
Error message: E06	Zeroing in the flue gas duct > Carry out zeroing outside the flue gas duct (zeroing is repeated a maximum four times).
Error message: E08	CO measuring value outside the measuring range (>4000ppm) > Note the measuring range (see Technical data) > Purge CO sensor with fresh air to prevent destruction of the CO sensor.
Error message: E12 / E13	CO measuring value unstable > Carry out zeroing outside the flue gas duct (zeroing is repeated a maximum four times).
Error message: E14	Checksum error > Critical error, contact Testo Service

Question	Possible causes / solution
Error message: E15	Instrument temperature is outside the permissible range > Adjust instrument to the permissible ambient temperature (see Technical data)
Is it possible to print out company data?	Company data should be displayed in the header of the print-out. > Input/reading in of the company data by Testo Service.

For more information, please contact your local dealer or the Testo Customer Service. For contact details, see the back of this document or the website: www.testo.com/service-contact

7.2. Accessories and spare parts

Printer

Description	Item no.
Protocol printer	0554 3100
Spare thermal paper for printer (6 rolls)	0554 0568

Accessory for flue gas probe

Description	Item no.
Particle filter, 10 pcs.	0554 0040

Other accessories

Description	Item no.
Mains unit	0554 1104
Instrument cleaner (100 ml)	0554 1207
Mini USB connecting cable	0449 0134

For other accessories and spare parts, please refer to the product catalogues and brochures or look up on the internet at www.testo.com

