

KIGAZ 50

Combustion gas analyser



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1. Introduction

1.1. Analyser description

KIGAZ 50 is a flue gas analyser with **two sensors (O₂ and CO)**.

Its main features are the following :

- 9 combustibles pre-programmed
- Autozero : 30 seconds
- 10 h battery-life
- Backlight
- Automatic stop
- External printer (optional)

The analyser is supplied in a transport bag, with a flue gas probe and its water trap, a Li-Ion battery and its USB charger and an adjustment certificate.



This gas analyser is designed to control parameters of flue gas in exhaust duct of heating units. It can not be used in a permanently way and/or used as an alarm system.

1.1.1. Overview of the analyser

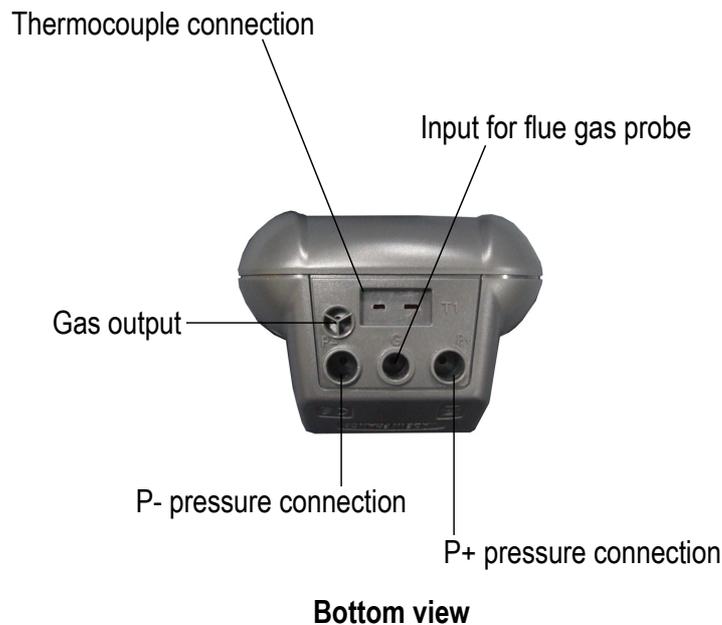


1.1.2. Presentation of the keypad and screen



uCO₂ T Rat GI Top line	ref CO₂ T Q η_s t λ Bottom line
1 - O ₂ : O ₂ measurement in flue gas	1 - CO : CO measurement in flue gas
2 - T : ambient temperature measurement	2 - Ref CO : CO concentration according to O ₂ reference calculation
3 - T : flue gas temperature measurement	3 - CO ₂ : CO ₂ calculation in flue gas
4 - T flashing : differential temperature measurement	4 - O ₂ : O ₂ measurement in flue gas
5 - CO : CO measurement in flue gas	5 - T : ambient temperature measurement
6 - CO ₂ : CO ₂ calculation in flue gas	6 - T : flue gas temperature measurement
7 - Rat : CO/CO ₂ ratio	7 - T flashing : differential temperature measurement
8 - GI : CO/CO ₂ ratio	8 - Q : losses calculation
9 - uCO : undiluted CO measurement	9 - η _S : lower efficiency calculation
	10 - η _t : higher efficiency calculation
	11 - λ : excess air calculation

1.1.3. Connection of the analyser



1.2. Main features

- **Screen**

Customized screen, active view dimensions : 54 x 50 mm. It allows to display measured parameters in a more comfortable format for the operator.

- **Printer (option)**

The paper of the instrument is a thermal paper with a 10-year guarantee. It has an easy replacement system of the paper (Easyload). In addition, printing is fast. The printer is proposed as an option and it communicates with the analyser in infrared.

- **Battery charger (option)**

The instrument is supplied 12V, 3.75A power adapter to load the internal batteries. The current loading is indicated by a battery symbol on the top right of the screen. The red LED on the right side of the gas analyser stays on until the battery loading is completed. The battery charging time is 12 hours.

- **Flue gas suction pump**

The pump, inside the gas analyser, is a diaphragm pump with a motor energized in direct current directly by the instrument in a way to get an optimal suction of flue gases.

- **Flue gas probe**

Probe in stainless steel with handle in plastic with a standard length of 18 cm (others lengths are available as option, please see the technical datasheet for kigaz) A fixing cone to maintain the contact tip in the duct is available as option.

- **Measurement sensors**

The analyser uses electrochemical sensors to measure the oxygen and the carbon monoxide.

- **Temperature sensors**

Flue gas temperature is measured with a thermocouple integrated in the contact tip. The connection to the analyser is made thanks to a single male connector compensated in temperature. K thermocouple (nickel-nickel chromium) allows continuous measurements up to **1250°C**.

The instrument has a NTC thermoresistance for the measurement of internal temperature ; this sensor is also used for the measurement of ambient temperature.

- **Types of combustibles**

The analyser is supplied with a memorization of technical data which characterize the 9 most known combustibles.

- **Adjustment certificate**

The analyser is adjusted by comparison with standard of metrology laboratories, which are periodically certified closed to laboratories known at the international level. Each analyser is supplied with its adjustment certificate in which, for every parameters, are indicated the nominal value, the one measured, the admitted error limits and the found error.

- **EMC compatibility**

The analyser complies with n°2004/108/EC directive on electromagnetic compatibility. Document available on request.

- **Water trap**

The water trap is placed on the tube that links the flue gas probe to the Kigaz 50. The measured gases go through the filtering element allowing the recovery of condensates (liquid one or solid one).

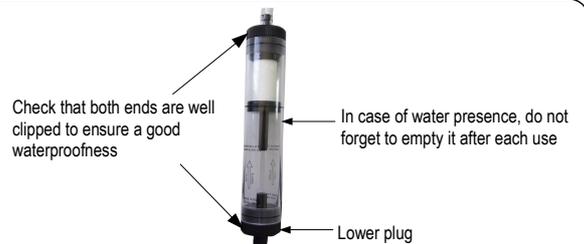
The filtering element is placed 15 cm from the analyser and is divided into 2 parts :

- one recovers the liquid particles.
- the other contains a filter that stops the smallest particles in suspension and avoid them to reach the electro-chemical sensors

Condensates are evacuated by opening the plug.



**For a better measurement, the water trap must be in vertical position.
Empty and clean the water trap after use.**



- **Gas network leak testing (optional)**

It is possible to check the tightness of an installation. For this control, use the pressure sensor used for the draft measurement of the shaft.

- **Measured values**

- **O₂** : percentage of oxygen in flue gases
- **CO** : concentration of CO in flue gases
- **T_f** : flue gases temperature
- **T_a** : combustive air temperature

- **Calculated values :**

- **λ : Air Excess** : connection between the volume of combustive air and the requested volume necessary for a combustion in stoichiometric conditions.
- **CO₂** : percentage of carbon dioxide in flue gases
- **ΔT** : difference between the flue gases temperature and the combustive air temperature
- **Q_s** : percentage of waste heat throughout the shaft
- **η_s : Lower efficiency (or sensible)** : calculated burner efficiency. This is a ratio between the conventional heating power and the burner heating power. Among the combustion losses, only the sensible heat lost with the flue gases is taken into account, neglecting the radiation losses and incomplete combustion losses. This value is referred to LHV (Lower Heating Value) and can not be higher than 100%.
The sensible efficiency value is to be compared with the minimum efficiency stated for the heating systems performances.
- **η_t : Higher efficiency (or total)** : is the sum of sensible efficiency and the additional efficiency deriving from the recovery of water vapour condensation contained in the flue gases. When it's greater than sensible

efficiency, then condensation is taking place. It is referred to HHV (Higher Heating Value) and can exceed 100%. The HHV is calculated by an algorithm developed by Kimo and its value must be considered as indicative.

- **CO (ref O₂)** : Concentration of CO in flue gases in ppm. It is calculated according to O₂ reference value indicated in the analyser

1.3. Technical features

Parameter	Sensor	Measuring range	Resolution	Accuracy*	T ₉₀ response time
O ₂	Electro-chemical	from 0% to 21%	0.1% vol.	±0.2% vol.	30 s
CO	Electro-chemical	from 0 to 8000 ppm	1 ppm	From 0 to 200 ppm : ±10 ppm From 201 to 2000 ppm : ±5% of the measured value From 2001 to 8000 ppm : ±10% of the measured value	30 s
CO ₂	Calculated**	From 0% to 99%	0.1% vol		
Flue gas temperature	K thermocouple	from -100 to +1250°C	0.1°C	± 0.4 % measured value or ±1.1°C	45 s
Ambient temperature	Internal NTC	From -20 to +120°C	0.1°C	±0.5°C	
Differential pressure Draft	Semiconductor	From -20 000 to +20 000 Pa	1 Pa	From -20 000 to -751 Pa : ±(-0.5% of measured value +4.5 Pa) From 750 to -61 Pa : ±(-0.9% of measured value +1.5 Pa) From -60 to 60 Pa : ±2 Pa From 61 to 750 Pa : ±(0.9% of measured value +1.5 Pa) From 751 to 20 000 Pa : ±(0.5% of measured value + 4.5 Pa)	
Losses	Calculated**	From 0 to 100%	0.1%		
Excess air (λ)	Calculated**	From 1 to 9.99	0.01		
Lower efficiency (η _s)	Calculated**	From 0 to 100%	0.1 %		
Higher efficiency (η _t) (condensing)	Calculated**	From 0 to 120%	0.1%		

*All accuracies indicated in this document were stated in laboratory conditions and can be guaranteed for measurements carried out in the same conditions, or carried out with required compensation.

**Calculation is made based on the measured values by the analyser.

2. Safety instructions



The following safety instructions have to be strictly observed.
Not respecting these safety instructions can lead to a loss of warranty.



- The analyser should not to be used in and under water.
- The analyser should not to be placed near or directly at open fire or heat.
- The indicated range of temperature of the probe is not to be exceeded, as the probe and temperature sensor could be destroyed.
- After measurements, before packing the analyser, wait for the probe to be cold. As long as it is hot, the probe could produce injuries.
- The exhalations of alcohol liquids (lubricants, petrol, spirit, vanish...) may damage the sensors of the analyser. Therefore, it is forbidden to preserve or use these fluids nearby the analyser.
- Load the battery only with Kimo charger. Use another type of charger can damage the battery and the analyser and can cause electrical shocks.

3. Perform a combustion analysis

3.1. Prepare the instrument before the analysis



During the measurement, the analyser must be in vertical position or in horizontal position. Do not hold the analyser in inclined position.



Before the 1st use of the analyser, a full charge of the battery must be made during 12 hours.



Empty the water trap.



In case of any default or damage of the instrument, Kimo After sales service shall be contacted. On the back of the analyser, there is a label with the analyser serial number. This number shall be communicated for every operation (technical operation or request of spare parts).

3.2. List of available combustibles

To perform a combustion analysis, a combustible must be selected.

9 different combustibles are recorded in the analyser :

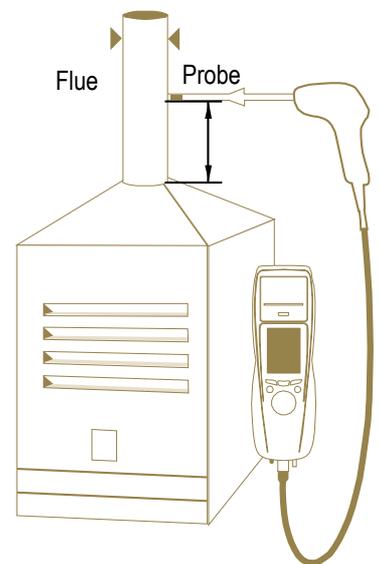
Natural gas
Propane
Butane
Coke gas
Light oil

Heavy oil
Bio fuel 5% (fuel with 5.75% of bio fuel)
Pellets 8% (pellet with 8% of humidity)
Wood 20% (wood with 20% of humidity)

To select the required combustible, please see below chapter 3.3.

3.3. Perform an analysis

- Connect the flue gas probe to the analyser : connect the K thermocouple connector on the K thermocouple connection; connect the cable of the water trap in the gas input (“G” on the analyser) and the pressure cable on the P+ input (“P+” on the analyser).
- Press the **On/Off** key to turn on the instrument.
*The analyser displays all the digits, then the firmware version of the analyser and it performs an autozero.
Once this information has been displayed, the analyser displays the type of combustible.*
- Press **OK** if the required combustible is the natural gas.
or
- Press **Up** and **Down** key to select the required combustible then press **OK**.
The analyser starts the analysis and calculates and measures the different parameters. The different parameters of the analysis are displayed according to the following order :
 - on the top line : O₂ , ambient temperature, flue gas temperature, Delta temperature, Rat, Gl, uCO, CO, CO₂ values
 - on the bottom line: CO, CO ref O₂, CO₂, O₂, ambient temperature, flue gas temperature, Delta temperature, losses, lower efficiency, higher efficiency, Excess air values
- Use the up and down arrow keys to select the required line (an arrow symbol indicates the selected line).
- Use right and left arrows keys to display the required values.



3.4. Pause the analysis

During the analysis it is possible to stop momentarily the measurements :

- Press the function key “**Set menu**” briefly during an analysis.
The measured and calculated values blinks.
- Press the function key “**Set menu**” to continue the analysis.

3.5. Change the measurement units

During the analysis it possible to change the measurement unit :

- Press the function key “**unit autozero**” briefly during an analysis or during a pause until the required unit is displayed.

3.6. Save the analysis

During the analysis :

- Press the function key “**Store/Print**” briefly.
*The measurements displayed on the screen are held and momentarily saved until the device turns off.
If the operator backs to a menu where values have been saved, the values are displayed. Press the function key “**Set menu**” to restart the measurement.*

3.7. Print the analysis (optional)



To print the analysis, measurements on the screen must be saved.

- Turn on the printer.
- Press the function key “**Store/Print**” briefly to save the analysis.
- Make a long press on the function key “**Store/Print**”.
All the saved values are printed on the ticket.

4. Set the different parameters of the analyser

The “**Settings**” menu allows to set the following parameters :

- Ambient temperature
- O₂ reference
- Atmospheric pressure
- Backlight
- Date
- Time
- Autozero
- Auto-off

This menu also allows to get the serial number of the analyser.



The “**Settings**” part allows to set parameters that can affect the performed measurements. These settings must be made by a qualified technician.

4.1. Set the ambient temperature

This part allows to set the ambient temperature. This temperature can be measured by the internal sensor or it can be manually set.

- Turn on the instrument.
Once the selected combustible is displayed :
- Press “**Esc**” key.
The symbol of combustibles blinks on the on the top left of the screen.
- Press the function key “**Set Menu**” .
*“**AMB.T**” blinks on the screen.*
- Press **OK**.
- Press **OK** on “**INT**” line : the ambient temperature will be measured by the internal sensor of the analyser.
Or
- Go to “**EXT**” line and press **OK**.
- Set the temperature with arrow keys : modify the blinking figure with **Up** and **Down** keys, press **OK** to go to the following figure. Repeat this procedure until the last figure is set. Once this last figure is set, press **OK**.
*“**EXT**” blinks.*
- Press **Esc** key to back to the setting menu.

4.2. Set the O₂ reference



This setting must be performed by a qualified technician.

- Turn on the instrument.
Once the selected combustible is displayed :
- Press “**Esc**” key.
The symbol of combustibles blinks on the on the top left of the screen.
- Press the function key “**Set Menu**” .
*“**AMB.T**” blinks on the screen.*
- Press down key then press **OK** on “**O₂ REF.**” .
*“**CO**” blinks.*
- Press **OK**.
- Set the reference with arrow keys : modify the blinking figure with **Up** and **Down** keys, press **OK** to go to the following figure. Repeat this procedure until the last figure is set. Once this last figure is set, press **OK**

“CO” blinks.

- Press **Esc**.

4.3. Set the atmospheric pressure

This part allows to set the atmospheric pressure of the location where the measurements are performed.



This setting must be performed by a qualified technician.

- Turn on the instrument.
Once the selected combustible is displayed :
- Press “**Esc**” key.
The symbol of combustibles blinks on the on the top left of the screen.
- Press the function key “**Set Menu**”.
“AMB.T” blinks on the screen.
- Press down key until reach “**ATM.P**” line.
- Press **OK**.
- Press **OK**.
- Set the atmospheric pressure with arrow keys : modify the blinking figure with **Up** and **Down** keys, press **OK** to go to the following figure. Repeat this procedure until the last figure is set. Once this last figure is set, press **OK**.
- Press **Esc**.

4.4. Set the backlight

- Turn on the instrument.
Once the selected combustible is displayed :
- Press “**Esc**” key.
The symbol of combustibles blinks on the on the top left of the screen.
- Press the function key “**Set Menu**”.
“AMB.T” blinks on the screen.
- Press down key until reach “**Backlight**” line.
- Press **OK**.
- Press **OK**.
- Press **Up** and **Down** key to set the backlight at 25%, 50%, 75% or 100%.
- Press **Esc**.

4.5. Set date and time

4.5.1. Set the date

- Turn on the instrument.
Once the selected combustible is displayed :
- Press “**Esc**” key.
The symbol of combustibles blinks on the on the top left of the screen.
- Press the function key “**Set Menu**”.
“AMB.T” blinks on the screen.
- Press down key until reach “**dATE**” line.
- Press **OK**.
- Press **OK** on “**FORMAT**” line.
- Select the date format : DD:MM or MM:DD with **Up** and **Down** key.
- Press **OK** then go to “**SET**” line and press **OK**.
- Set the date with arrow keys : modify the blinking figure with **Up** and **Down** keys, press **OK** to go to the following figure. Repeat this procedure until the last figure is set. Once this last figure is set, press **OK**.
- Press **Esc**.

4.5.2. Set the time

- Turn on the instrument.
Once the selected combustible is displayed :
- Press “**Esc**” key.
The symbol of combustibles blinks on the on the top left of the screen.
- Press the function key “**Set Menu**” .
“AMB.T” blinks on the screen.
- Press down key until reach “**TIME**” line.
- Press **OK**.
- Press **OK** on “**FORMAT**” line.
- Select the date format : 24H or 12H with **Up** and **Down** key.
- Press **OK** then go to “**SET**” line and press **OK**.
- Set the time with arrow keys : modify the blinking figure with **Up** and **Down** keys, press **OK** to go to the following figure. Repeat this procedure until the last figure is set. Once this last figure is set, press **OK**.
- Press **Esc**.

4.6. Set the duration of autozero

The autozero allows the analyser to exhaust ambient fresh air and as a result to put the sensors at 0 ppm.

- Turn on the instrument.
Once the selected combustible is displayed :
- Press “**Esc**” key.
The symbol of combustibles blinks on the on the top left of the screen.
- Press the function key “**Set Menu**” .
“AMB.T” blinks on the screen.
- Press down key until reach “**AUTO-ZERO**” line.
- Press **OK**.
- Press **Up** and **Down** keys to select the duration : 30 s, 40 s, 50 s, 1 min, 2 min, 3 min 4 min or 5 min.
- Press **OK**.

4.7. Set the auto-extinction

The auto-extinction turn off the analyser automatically after some time of non-use.

- Turn on the instrument.
Once the selected combustible is displayed :
- Press “**Esc**” key.
The symbol of combustibles blinks on the on the top left of the screen.
- Press the function key “**Set Menu**” .
“AMB.T” blinks on the screen.
- Press down key until reach “**AUTO-OFF**” line.
- Press **OK**.
- Press **Up** and **Down** keys to select the duration : OFF, 15 min, 30 min, 45 min or 60 min.
- Press **OK**.

4.8. Get the serial number of the analyser

The version number can be a useful information in case of intervention on the analyser.

- Turn on the instrument.
Once the selected combustible is displayed :
- Press “**Esc**” key.
The symbol of combustibles blinks on the on the top left of the screen.
- Press the function key “**Set Menu**” .
“AMB.T” blinks on the screen.
- Press down key until reach “**INFO**” line.
- Press **OK** : the analyser displays the serial number.

5. Perform a CO measurement

5.1. Perform the measurement

The measurement of ambient CO can be realized with the flue gas probe.

- Turn on the instrument.
- Press right key to go to CO ambient measurement menu.
The symbol of CO measurement blinks on the top left of the screen.
- Press **OK**.
- Press the function key “**Unit autozero**” to perform an autozero.



The flue gas probe must be set in open air during the autozero.

At the end of the autozero, the instrument displays the CO measurement with 30 s below.

- Press the function key “**Set menu**” to start the CO measurement.
The countdown starts, the analyser performs the CO measurement and indicates at the end the result :
 - *between 0 and 10 ppm : the analyser displays “OK”.*
 - *between 11 and 50 ppm : the analyser displays “NOT OK”*
 - *> 50 ppm : the analyser displays “DANGER”**■ is displayed on the bottom left of the screen.*
- Press the function key “**Set menu**” to restart the CO measurement if necessary.

5.2. Save the CO measurement

During the measurement :

- Press the function key “**Store/Print**” briefly.
The measurements displayed on the screen are held and momentarily saved until the device turns off.
If the operator backs to a menu where values have been saved, the values are displayed. Press the function key “Set menu” to restart the measurement.

5.3. Print the CO measurement (optional)



To print the CO measurement, measurement on the screen must be saved.

- Turn on the printer.
- Press the function key “**Store/Print**” briefly to save the measurement.
- Make a long press on the function key “**Store/Print**”.
All the saved values are printed on the ticket.

6. Perform a draft measurement

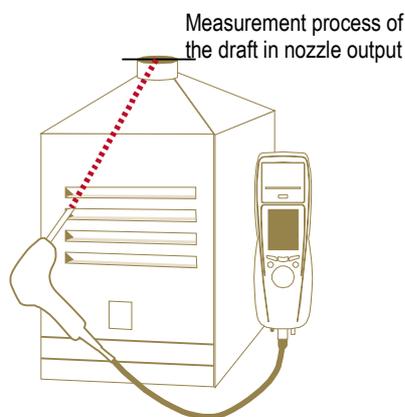
The draft measurement allows to check if the chimney of the boiler correctly clears flue gas caused by the combustion.

6.1. Perform the measurement

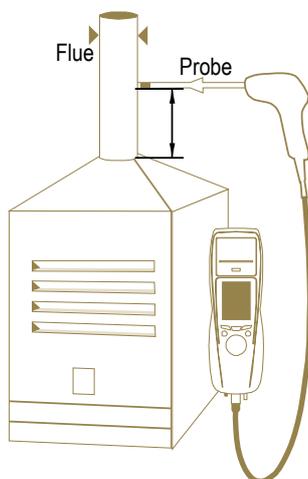


The probe must be disconnected from the analyser and it must be in fresh air environment.

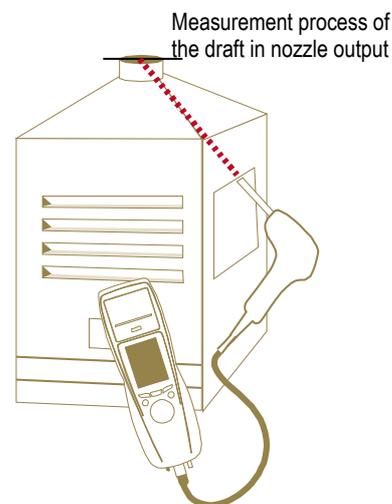
- Turn on the analyser.
- Go to **“Draught P.”** menu with right arrows.
The symbol of draught pressure blinks.
- Press **OK**.
- Make a long press on the function key **“Unit autozero”** to perform an autozero.
- Connect the flue gas probe on the analyser.
- Press the function key **“Set menu”**.
Measurement launches and the analyser displays the draft.



Put the probe of the KIGAZ 50 in the draft hood, going through the front face of the boiler.



Put the probe of the KIGAZ 50 in the nozzle output, from the beginning of the connecting flue.



Put the probe of the KIGAZ 50 in the draft hood, going through the side openings of the boiler.

6.2. Save the measurement

During the measurement :

- Press the function key **“Store/Print”** briefly.
The measurements displayed on the screen are held and momentarily saved until the device turns off. If the operator backs to a menu where values have been saved, the values are displayed. Press the function key “Set menu” to restart the measurement.

6.3. Print the measurement (optional)



To print the analysis, measurements on the screen must be saved.

- Turn on the printer.
- Press the function key **“Store/Print”** briefly to save the measurement.
- Make a long press on the function key **“Store/Print”**.
All the saved values are printed on the ticket.

7. Perform a differential pressure measurement

7.1. Perform the measurement



The probe must be disconnected from the analyser and it must be in fresh air environment.

- Turn on the analyser.
- Go to “**Diff P.**” menu with right arrows.
The symbol of differential pressure blinks.
- Press **OK**.
- Make a long press on the function key “**Unit autozero**” to perform an autozero.
- Connect the probe on “**P+**” and “**P-**” connections of the analyser. Use the differential pressure connectors supplied with the differential pressure kit available as option.
- Press the function key “**Set menu**”.
Measurement launches and the analyser displays the differential pressure.

7.2. Save the measurement

During the measurement :

- Press the function key “**Store/Print**” briefly.
*The measurements displayed on the screen are held and momentarily saved until the device turns off.
If the operator backs to a menu where values have been saved, the values are displayed. Press the function key “**Set menu**” to restart the measurement.*

7.3. Print the measurement (optional)



To print the analysis, measurements on the screen must be saved.

- Turn on the printer.
- Press the function key “**Store/Print**” briefly to save the measurement.
- Make a long press on the function key “**Store/Print**”.
All the saved values are printed on the ticket.

8. Maintenance of the analyser

8.1. Life-time of the sensors

Sensors are electrochemical type : inside them, in the presence of gas to detect, a chemical reaction occurs that causes an emission of electrical current. The electric current strength detected by the instrument is converted into a corresponding gas concentration. The life-time of the sensor is strongly linked to the reagent consumption present in the sensor. As their consumption increases, features of the sensor are getting worse until their exhaustion, after which it is necessary to replace it. To ensure the measurement accuracy, sensors have to be calibrated on Assistance centre qualified by Kimo.

Sensors	Average life-time	Required calibration
O ₂	2 years	Annual
CO	From 2 to 3 years	Annual

8.2. Replace the battery

Follow this procedure to replace the battery :

The analyser must be turned off.

- Turn the analyser.
- Unscrew the battery cover with a crosshead screwdriver.
- Remove the battery cover.
- Disconnect the battery.



Do not pull the cable, unplug softly the connector.

- Connect the new battery.

9. Calculations of the different parameters

9.1. CO conversion

$$\lambda = \frac{CO_{2max}}{CO_2} = \frac{21}{21 - O_2}$$

$$CO \left[\frac{mg}{kWh} \right] = CO \left[\frac{mg}{m^3} \right] \lambda \frac{V_f}{PCI \times 0.277778}$$

$$CO \left[\frac{ppm}{O_{2ref}} \right] = CO [ppm] \times \frac{21 - O_{2ref}}{21 - O_2}$$

$$CO [\%] = CO [ppm] \times 0.0001$$

With :

- O_{2ref} a reference value selected by the user, this value has to be entered in the device in %.
- O_2 oxygen value measured in %.
- CO_{2max} the maximum level in % in carbon dioxide of flue gas dry products (given in the table of coefficient)

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