seitron
Innovation Technology

# CHEMIST 900
# Industrial emissions analyzer

CE

## OPERATIONS AND MAINTENANCE MANUAL

Respect your environment: think before printing the full manual on paper.

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# 1.0 IMPORTANT INFORMATION

## 1.1 Information about this manual

- This manual describes the operation and the characteristics and the maintenance of the Combustion Analyzer Chemist 900.
- Read this operation and maintenance manual before using the device. The operator must be familiar with the manual and follow the instructions carefully.
- This use and maintenance manual is *subject to change due to technical improvements - the manufacturer assumes no responsibility for any mistakes or misprints.*

## 1.2 Danger levels and other symbols

| Symbol | Meaning | Comments |
|---|---|---|
|  | Warning | **Read information carefully and prepare safety appropriate action!**<br><br>To prevent any danger from personnel or other goods. Disobey of this manual may cause danger to personnel, the plant or the environment and may lead to liability loss. |
|  | Information on LCD | |
|  | Ensure correct disposal | Dispose of the battery pack at the end of its working life only at the dedicated collecting bin.<br><br>The customer takes care, on his own costs, that at the end of its working life the product is collected separately and it gets correctly recycled. |
|  | Keyboard with preformed keys with main control functions. | |

# 2.0 SAFETY

## 2.1 Proper use of the product

**This chapter describes the areas of application for which this instrument is intended.**
All products of the series CHEMIST 900 are portable measuring devices for flue gas and emissions analysis for the following machinery:

- Furnaces (fuel oil, gas, wood, coal)
- Low-temperature and condensing boilers
- Gas heaters
- Combustion in industrial processes
- Measures for control of emissions
- Machinery test compliance
- Gas turbines
- Gas engines
- Furnaces and boilers manufacturer's technical assistance
- Technical assistance in industrial heating systems

This measuring device is capable of measurements under German regulations on emissions protection (1. BImSchV)[1].

Additional functions of this measuring instrument:

- Flue gas analysis according to 1. BImSchV or qA-a mean value (selectable)
- Calculating of stack heat loss and efficiency
- CO environment measurement
- Tightness test of gas tubes under standards UNI 7129-1: 2015 and UNI 11137: 2012
- Smoke value, calculation of average value
- Measurement of differential pressure
- Draft measurement
- Pressure measurement in the gas supply line

## 2.2 Improper use of the product

The use of CHEMIST 900 in application areas other than those specified in Section 2.1 "Intended use of the product" is to be considered at the operator's risk and the manufacturer assumes no responsibility for the loss damage or costs that may result. It is compulsory to read and pay attention to the instructions in this use and maintenance manual.

CHEMIST 900 should not be used:

- as an alarm device for safety purposes
- in classified zones with explosion risk (ATEX or equivalent)

# 3.0 GENERAL FEATURES

## 3.1 General overview of the Analyzer

CHEMIST 900 is a portable industrial analyzer for flue gas and emissions.

**The instrument is equipped with:**

- Pneumatic circuit which can accommodate up to 9 sensors in the FLEX-sensors series.
- Housing for fitting an NDIR (infrared) bench for measurement of CO, CO2 and CH4.

**Moreover:**
- The gas autozero cycle can be performed with the probe inserted in the chimney.
- The autozero of the pressure sensor (piezoresistive, temperature compensated) can also be performed with the gas probe inserted in the chimney.
- Intuitive user interface: the instrument can be used without the support of the user manual.
- Wide (55x95 mm) and bright TFT color display which delivers great readability thanks to the zoom function and an efficient backlight.
- Single rechargeable 'Li-Ion' battery pack, used to power both the unit and the thermal printer. The battery charger is internal to the instrument and allows to perform the dual function of battery charging and power supply for the instrument, thus enabling the user to work even with the batteries fully discharged by connecting the AC power cable, once connected to a 90 to 264Vac mains source.
- Thermal printer integrated in the instrument.
- Connectivity with a computer through the USB connection and/or Bluetooth ®. Once the special software provided with the instrument is used, this allows for the storage of combustion analysis as well as the configuration of the main parameters.
- Connectivity with a smartphone through Bluetooth®. Once the specific APP 'SMARTFLUE MOBILE' available on Google play-store is installed on the device, the user can start remote analysis of combustion and/or view real-time data of the analysis in progress.

CHEMIST 900 Analyzer is transportable and therefore is delivered in a bulky aluminium case.

**Main functions:**
- Combustion analysis in manual or automatic mode (UNI 10389-1 or BImSchV or according to the data logger function, user-defined mode).
- Comes with 11 most used fuel parameters (such as natural gas, LPG, gas oil and fuel oil).
- Possibility to store in memory the parameters for 16 further fuels, once their chemical composition is known.
- Monitoring of pollutants (emissions)
- Memory capable of storing up to 16,000 full analysis.
- Storing of acquired data and their averaging.

**Measurable gases:**
- CO (NDIR), $CO_2$ (NDIR), CxHy (NDIR)
- $O_2$
- CO (ambient monitoring)
- CO / $H_2$
- CO (low, medium, high)
- NO (low, medium)
- $NO_2$ (low, medium)
- $SO_2$ (low, medium)
- NOx
- $H_2S$

**Measurements**:
- Ambient CO (with the internal sensor)
- Draft in the chimney.
- Smoke (with the use of the external manual pump).
- Gas pressure in the piping, pressure in the burning chamber and check of the pressure switches, using the measurement range up to 200hPa.
- Combustion air measurement
- Auxiliary temperatures
- Tightness test according to UNI 7129-1: 2015 and UNI 11137: 2012
- Air speed for air or flue gas leaving the chimney with the use of Pitot tube
- Ionization current measurement (with external auxiliary probe)

**Maintenance:**
- Sensors can be replaced by the user without having to ship the instrument to the service center, because the spare sensors delivered are pre-calibrated.
- The instrument requires annual calibration, as required by the standard UNI 10389-1, carried out at any authorized service center.

**Certificate of calibration**
The instrument is accompanied with a calibration certificate.

# 4.0 DESCRIPTION OF THE PRODUCT

## 4.1 Working principle

The gas sample is taken in through the gas probe, by a diaphragm suction pump inside the instrument.
The measuring probe has a sliding cone that allows the probe to be inserted in holes with a diameter of 11 mm to 16 mm and to adjust the immersion depth: **it is recommended to have a gas sampling point roughly in the center of the flue/stack.**
The gas sample is cleaned of humidity and impurities by a condensate trap and filter located inside the instrument.
The gas is then analyzed in its components by electrochemical and infrared sensors.
The electrochemical cell guarantees high precision results in a time interval of up to about 60 minutes during which the instrument can be considered very stable. When measurement is going to take a long time, we suggest auto-zeroing the instrument again and flushing the inside of the pneumatic circuit for three minutes with clean air.
During the zero calibrating phase, the instrument aspirates clean air from the environment and detects the cells' drifts from zero (20.95% for the O2 cell), then compares them with the programmed values and compensates them. The pressure sensor autozero must, in all cases, be done manually prior to measuring pressure.
The values measured and calculated by the microprocessor are viewed on the LCD display which is backlit to ensure easy reading even when lighting is poor.

## 3.2 Measurement cells

The instrument takes advantage of pre-calibrated FLEX-series gas sensors for the measurement of Oxygen ($O_2$), Carbon Monoxide (CO - Hyrogen compensated measurement, Nitrogen Oxide (NO), Nitrogen Dioxide ($NO_2$), Sulphur Dioxide ($SO_2$) and hydrogen sulphide ($H_2S$).
The sensors do not need particular maintenance yet they have to be replaced periodically when exhausted.
Measurement of the oxygen ($\%O_2$) is carried out with an electrochemical cell that behaves like a battery which it is subject, over time, to lose sensitivity due to the fact that normally is ever present in the air about 20.9% Oxygen.
The toxic gases (CO, $SO_2$, NO, $NO_2$) are measured with electrochemical sensors that are not subject to natural deterioration being intrinsically lacking of oxidation processes.
The measurement cells are electrochemical cells made up of an anode, a cathode, and an electrolytic solution, which depends on the type of gas to be analysed. The gas penetrates the cell through a selective diffusion membrane and generates an electric current proportional to the absorbed gas. Such current is measured, digitalized, temperature-compensated, processed by the microprocessor, and displayed.
The gas shall not be at such a pressure to damage or destroy the sensors; for this reason the suction pump is continuously adjusted, in order to ensure an appropriate flow to the sensors. The maximum estimated allowed pressure is ±100hPa gage.

The response times of the measurement cells used in the analyzer are::
$O_2$ = 20 sec. at 90% of the measured value
$CO(H_2)$ = 50 sec. at 90% of the measured value
CO = 50 sec. at 90% of the measured value
NO = 40 sec. at 90% of the measured value
$NO_2$ = 50 sec. at 90% of the measured value
$SO_2$ = 50 sec. at 90% of the measured value
$H_2S$ = 50 sec. al 90% of the measured value

**It is therefore suggested to wait 5 minutes (anyway not less than 3 minutes) in order to get reliable analysis data.**

If sensors of toxic gases are submitted to concentrations higher than 50% of their measurement range for more than 10 minutes continuously, they can show up to ±2% drift as well as a longer time to return to zero. In this case, before turning off the analyzer, it is advisable to wait for the measured value be lower than 20ppm by intaking clean air. If there is an automatic calibration solenoid, the device performs an automatic cleaning cycle and it turns off when the sensors return to a value close to zero.
The auto-zero solenoid valve allows the operator to turn the instrument on with the probe inserted in the flue. Up to 4 alarm set points are programmable with visual and acoustic signals for the relevant measurement parameters.
The UNI 10389-1 standard provides that the instrument must be calibrated by a certified laboratory that is authorized to issue annual calibration certificates. Exhausted cells can be easily replaced by the user without depriving himself of the instrument and without complicated calibration procedures with certified mixtures as they are pre-calibrated before being supplied.
Seitron certifies the accuracy of the measurements only upon a calibration certificate issued by its laboratory or other approved laboratory.

## 4.3 Infrared bench - Optional

On this instrument it is possible to install an infrared bench, for the measurement of gases, which is based on the

infrared spectroscopy (IR). With this method it is possible to measure CO, CO2 (which are therefore not calculated, but measured instead), and hydrocarbons CxHy. Along the pneumatic circuit, before the IR bench, an additional dust filter is inserted.
The principle is based on non-dispersive absorption of infrared radiation (NDIR) at two different wavelengths, which allows accuracy, stability over time and high response speed.
The gases absorb light at particular wavelengths, most in the IR range. An NDIR system includes: an IR light source, a chamber containing the gas sample to be analyzed, and a photodetector equipped with an optical filter. The light passes through the chamber and the sample of the gas will absorb it at a specific wavelength (eg. 4.26µm for CO2) or on specific bands.
The signal collected by the photodetector is then processed by the electronics in order to obtain the concentration of CO, CO2 or CxHy.
The filter is the non-dispersive optical component and allows the photodetector to uniquely identify the gas based on the performance of the absorption spectrum. The more narrow the bandwidth of the filter, the greater the specificity of the sensor.
The intensity of light (at a certain wavelength) that reaches the detector is inversely proportional to the concentration of the gas treated. The infrared measurement technique allows measurements that are not interfered by the presence of other gases.

## 4.4 CO dilution

One of the characteristics of the electrochemical sensor for the measurement of CO is the need to require very long self-calibration time in case it has been in contact with high gas concentration (greater than the full scale) for a long time.
The CO sensor is therefore protected in this instrument by an automatic dilution system that allows to extend the measuring range of the sensor without overloading the sensor itself.
The dilution system allows to have the CO sensor efficient any time and ready to perform properly even in case of very high concentration of CO.
The dilution system also allows to extend the measurement range of the CO sensor as follows:

- up to 100,000 ppm for a CO sensor with 8000 ppm full scale
- up to 250,000 ppm for a CO sensor with 20,000 ppm full scale

In this way in addition to better manage the wearing of the sensor, it is also possible to continue sampling, without any work interruption.

## 4.5 Fuel types

The device is provided with the technical data of the most common types of fuels stored in its memory. By using the PC configuration program, available as an optional, it is possible to add fuels and their coefficients in order to define up to a maximum of 32 fuels, other than the default ones.
For more details see Annex B.

## 4.6 Sample treatment

The gas sample to be analyzed must be delivered to the measuring sensors properly dried and cleaned of solid residues of combustion; actually for this reason it is usually named ‘dry analysis’.
For this purpose CHEMIST 900 accepts two different modules for sample treatment:
- Peltier module condensation assembly (Cooler)
- Watertrap

### 4.6.1 Peltier module condensation assembly (Cooler) - Option

This is an integrated system for the conditioning of the gas sample.
The condensation assembly with Peltier module has the goal of cooling as fast as possible the gas sample down to the temperature of 5° C.
The cooler causes the moisture contained in the gas to condensate thus allowing the gas to reach the sensors without undergoing significant changes in its composition. This system is particularly useful when water-soluble components have to be analyzed (eg. SO2, NO2, etc.).
In order to raise the efficiency of the Peltier module condensation assembly, it is advisable to use, for the sampling of gas, a special probe with heated head and/or heated hose.
This probe includes in its interior a thermoresistance for the automatic control of the temperature, which must be maintained above the dew point any time, to prevent unwanted condensation at the probe level.
The heated hose allows the gas to reach Peltier module condensation assembly unchanged in its chemical characteristics.
In conditions of extreme ambient temperature (+45° C) it is possible that the internal temperature of the cooler is not maintained at +5° C but tends to move up to +10° C /+15° C, this internal temperature is still sufficient to obtain the drying of the gas, in these conditions it is possible to lose about a 10% efficiency of drying.

### 4.6.2 Water trap - Optional

Consisting of a cylinder in transparent polycarbonate it is positioned along the pneumatic circuit inside the body of the analyzer.
Its purpose is to decrease the speed of the air so that it will be no longer able to carry the heavy particles of dust and water which, consequently, will fall into the cylinder.
The bottom of the water trap's body is connected to a peristaltic pump, controlled directly by the microprocessor, for the emptying thereof. The condensation water is expelled through the condensation drain positioned at the bottom of the analyzer. The peristaltic pump is activated in an intermittent manner in order to preserve the life of the hose, which is an integral part of the pump itself.
The hose has an average life of about 500 hours; the diagnosis menu features a timer which countdowns the residual life of the hose. When the hose is replaced, it is mandatory to manually reset the timer **see section 9.9.2).**

## 4.7 Remote condensate drain

On the bottom side of the instrument suitcase is located the output of the condensation water.
By properly connecting an appropriate silicone hose it is possible to move the output point of the condensation water.

## 4.8 External dust filters

In order to protect the pneumatic circuit and the gas sensors, two protecting filters are placed inside the analyzer. These two filters are in series with each other: the first is the lowest one, the second is at the top.
Consisting of a cylinder in transparent polycarbonate, these are located on the left side of the analyzer protected from impacts with a protection bar.
A replaceable, low-porosity filter is positioned within each cylinder with the purpose of retaining solid particles suspended in the flue gas. The filter has an efficiency of 99% for 20um solid particles.
It is recommended to replace the filters any time they are significantly dirty (see section '**MAINTENANCE**').

## 4.9 Dust filter for the NDIR bench protection

For further protection of the NDIR bench, an additional dust filter has been inserted into the analyzer. Located aside of the cells, it is made of a cylinder in transparent polycarbonate with a replaceable, low-porosity filter inside, with the purpose of retaining solid particles suspended in the flue gas. We recommend to check the filter once a year during periodic maintenance.

## 4.10 Air filter

A further dust filter is located inside the analyzer with the purpose to protect the circuit that samples air from the environment during the autozero cycle. We recommend to check the filter once a year during periodic maintenance.

## 4.11 Remote air intake

The top panel of the analyzer is a pneumatic connector labelled as 'ZERO CAL'. This connector is the air intake used to perform the auto-zero for the gas sensors.
In particular conditions, where the instrument is placed in a closed and potentially polluted environment, it is possible to move the air intake of the instrument to an environment with clean air, through the use of a hose with an appropriate male fitting connected to the 'ZERO CAL' input.

## 4.12 Pressure sensor, piezoelectric, temperature compensated

The instrument is internally provided with a piezoresistive differential pressure sensor, temperature compensated, for measuring pressure or draft.
This sensor is differential type thus, thanks to the second measurement port, can be used for measuring the draft (depressure) in the chimney, for the leak test of the pipes, for differential pressure measurement, for measuring the velocity of the flue gas using a Pitot tube, for flow measurement, and possibly for other measurements (pressure of gas in the piping, pressure loss across a filter, etc.).
The measurement range is -1,000 Pa .. +20,000 Pa.
Any potential drift of the sensor are nulled thanks to the autozeroing system which in this instrument can be operated with the flue gas probe inserted in the chimney, because the instrument is equipped with an electrovalve that switches the pressure measurement to the ambient, thus allowing to zero the sensor in air.

**WARNING**
**ANY PRESSURE APPLIED TO THE SENSOR GREATER THAN ±300 hPa MAY CAUSE A PERMANENT DEFORMATION OF THE MEMBRANE, THUS DAMAGING IRREVERSIBLY THE SENSOR ITSELF.**

## 4.13 Suction pump

This diaphragm pump, located inside the instrument, is operated with a DC motor powered by the instrument in order to obtain the optimal suction flow rate of the flue gas for the ongoing analysis; an internal sensor measuring the flow allows to:
- Maintain a constant flow rate of the pump
- Check the state of efficiency of the pump
- Check the level of filter clogging

## 4.14 Simultaneous measurement of pressures, $O_2$, pollutants

The instrument, to obtain boiler's perfect combustion parameters, allows to measure simultaneously the input and output pressure of the gas valve, the level of O2, the levels of pollutants and all the calculated parameters needed to obtain the correct value of yield.
See section 13.1.3.

## 4.15 Peristaltic pump

The peristaltic pump has the purpose to automatically empty the condensation water and it is controlled directly by the microcontroller with alternating intervals of on/off in order to preserve the life of the neoprene hose.
While the interval of ignition is not user controllable, and it is equal to 30 seconds, the duration of the interval is configurable by the user in the range 30..3600 seconds.

## 4.16 Draft measurement with sensor automatic autozero

CHEMIST 900 performs the draft pressure measurement. The auto-calibration of the sensor is carried out through the switching of an internal valve that allows to perform the zeroing procedure without removing the probe from the chimney.
This feature is particularly useful when the analysis in taken in 'data logger' mode.

## 4.17 Smoke measurement

It is possible to enter the smoke values measured according to the Bacharach scale. The instrument will calculate the average and print the results in the analysis report.
The measurement must be performed with the appropriate probe head heated to measure the carbon black or an external pump which may be required as an accessory .

## 4.18 Temperature measurements

CHEMIST 900 can measure several types of temperatures taking advantage of dedicated probes.

## 4.19 Auxiliary measurements

This analyzer also features a connection to optional external sensors for draft measurement according to the UNI10845 standard as well as for the measurement of the ionization current in the boilers.

## 4.20 Tightness test

The instrument can perform the tightness test of a piping according to the italian standards UNI 7129-1: 2015 and UNI 11137: 2012.

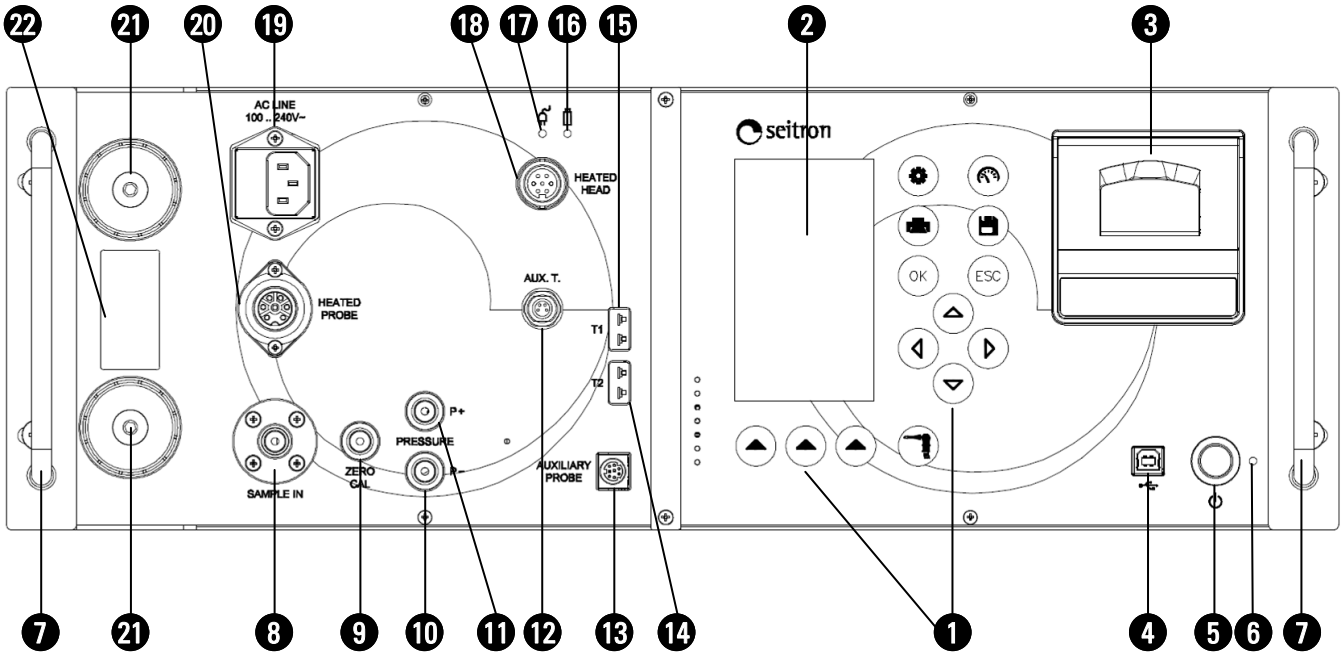
## 4.21 Bluetooth® connection

The CHEMIST 900 analyzer is internally equipped with a Bluetooth® module, which allows the communication with the following remote devices:
- Remote Bluetooth® printer
- Smartphone or tablet with installed the OS Google Android v.4.1 (Jelly Bean) or later and the proper APP 'SmartFlue Mobile' (available on Google Play Store) installed.
- PCs running Microsoft Windows 7 or later and Bluetooth® interface upon installation of the specific software 'SmartFlue' supplied together with the instrument.

The maximum transmission range in open field is 100 meters (Class 1 Bluetooth® module), provided that also the communication companion is equipped with a Class1 Bluetooth® interface.
This solution allows greater freedom of movement for the operator who is no longer bound directly to the instrument for acquisition and analysis, with significant advantages for many applications.

# 5.0 DESCRIPTION OF COMPONENTS

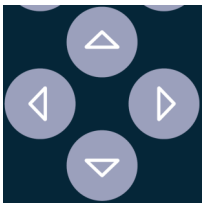
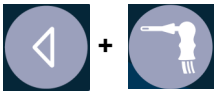
## 5.1 Front panel




**DESCRIPTION:**

### ❶ Polycarbonate touch keypad and relevant main functions:

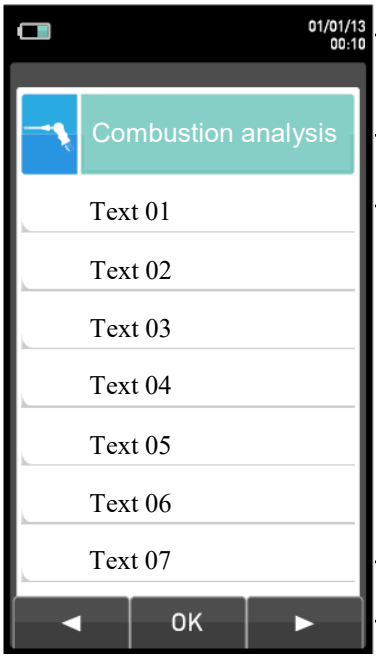
| KEY | FUNCTION |
|---|---|
|  | Activates the context keys shown on the display |
|  | Performs the combustion analysis |
|  | Access to the Configuration menu |
|  | Access to the Measurements menu |
|  | Access to the Printing menu |
|  | Access to the Memory menu |

| KEY | FUNCTION |
|---|---|
|  | Confirm settings |
|  | Quits the current screen |
|  | Select and/or Modify |
|  | Turns off the display backlight |

### ❷ Display

TFT 272 x 480 pixel backlit color display with 21 characters available and 8 lines. Allows the user to view the measured parameters in the most comfortable format; a Zoom function displays the measured values in magnified form.

**CAUTION:**
**If the instrument is exposed to extremely high or extremely low temperatures, the quality of the display may be temporarily impaired. Display appearance may be improved by acting on the contrast key.**




Date, time and battery status.

Selected menu.

Parameters relative to the selected menu.

Context keys. In the various menus the functions vary depending on the type of operation being carried out.

**Backlight:**

The backlight can be turned off with the simultaneous pressure on keys + .
The backlight is turned on when any key is pressed, except the 'On-Off' key.

### ❸ Printer

Thermal printer on thermal paper.
By pressing the print button you get access to the corresponding menu from which, in addition to printing the receipt, you can choose the print settings and manually feed the paper in order to simplify the replacement of the paper roll.

### ❹ USB connector (type B)

Used to connect the instrument to a personal computer running Microsoft Windows 7 or later upon installation of the specific software 'SmartFlue', supplied with the instrument.

### ❺ ON / OFF key

To turn on or off the analyzer hold this key down for a few seconds.

### ❻ Programming LED

This LED provides important information during the firmware update procedure.
For further details please refer to section 15.9 'Firmware Update'.

### ❼ Handles for the extraction of the instrument from its case

### ❽ 'SAMPLE IN' pneumatic connector

Input for connecting the gas sample probe.

### ❾ 'ZERO CAL' pneumatic connector

Input for the connection of a hose to remote air source to properly perform the autozero. If the instrument is placed in a closed and potentially polluted environment, the user can remote the air intake for the instrument to a clean air environment using the 'ZERO CAL' connector.

### ⑩ 'P' pneumatic connector
Pressure negative input (P-): used for measuring draft according to the standard UNI10845; it connects to the second hose (with the larger pneumatic connector) of the sample probe for simultaneous measurement of draft and combustion analysis.

### ⑪ 'P+' pneumatic connector
Positive input (P+): used for measuring the pressure in general as well as for the leakage test.

**Inputs 'P+' and 'P-' are respectively the positive and negative inputs of the internal differential pressure sensor, piezoresistive, temperature compensated; therefore these can be simultaneously used to measure the differential pressure.**

### ⑫ 'AUX. T.' Auxiliary Temperature Connector
M8 4-pole connector for an external temperature sensor (Pt100).

### ⑬ 'AUXILIARY PROBE' connector
Serial connector, Mini Din 8-pin, for connection of an external probe such as:
- Probe for measurement of the ionization current
- Micromanometer

### ⑭ 'T2' Connector
Used to connect the Tc-K plug of the incoming combustion air temperature probe.

### ⑮ 'T1' Connector
Used to connect the Tc-K male connector of the gas temperature probe.

### ⑯ Battery-charging indicator
This LED, while the batteries are charging, provides the following information:
On (red): Battery charging
Off: Fully charged batteries
Once recharging is started the display is turned on and shows the charging status.

### ⑰ Mains power indicator
On (green): The instrument is powered directly from the mains.
Off: The instrument is not powered from the mains.

### ⑱ 'HEATED HEAD' connector
7-pin DIN connector used to power the heated head.

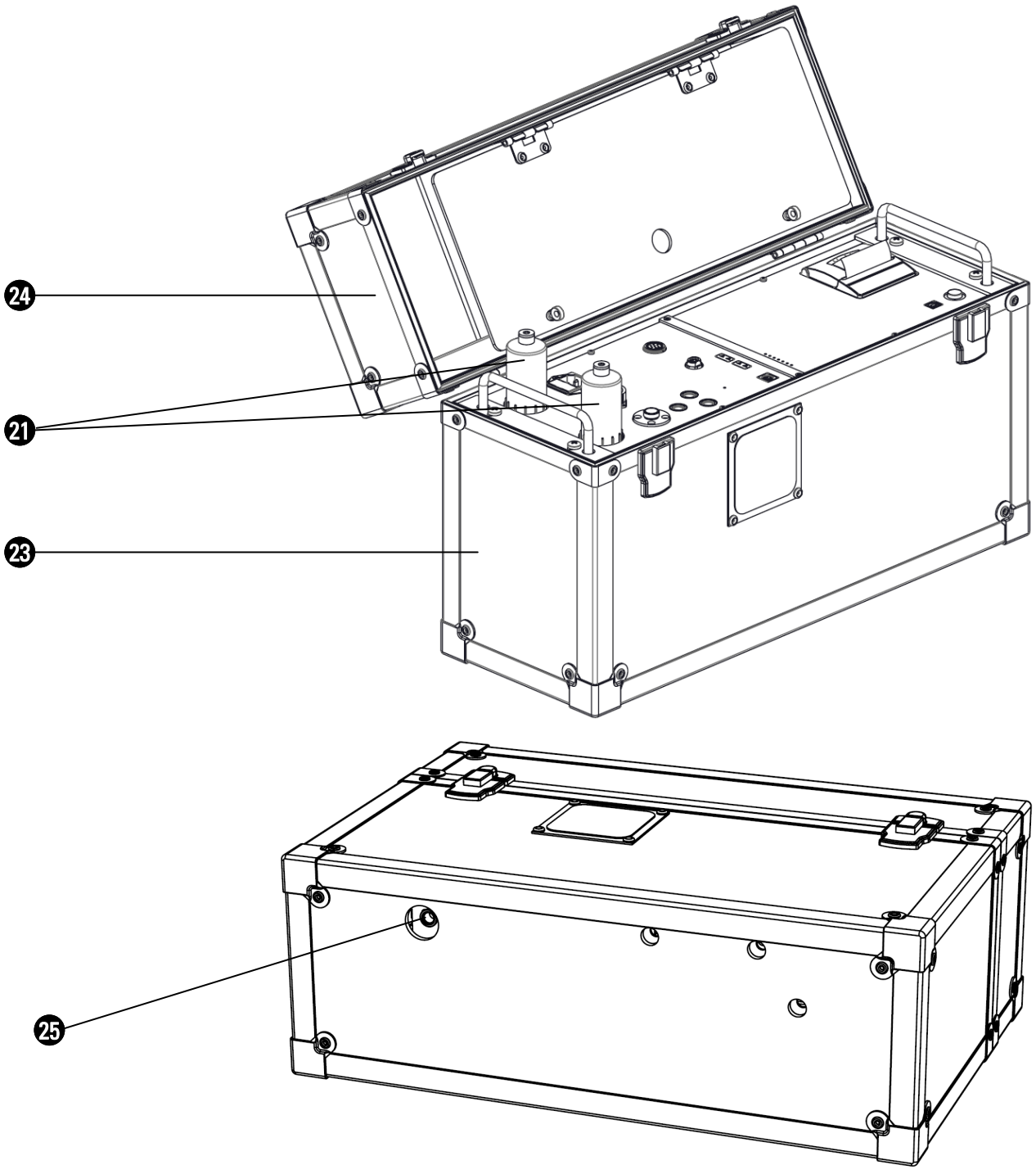
### ⑲ 'AC LINE - 100..240V ~' connector
IEC C14 socket for the power cable, supplied with the instrument. On the socket is located a fuse-holder drawer for 2 5x20 4A T type fuses .

### ⑳ 'HEATED PROBE' connector
Used to connect the relevant connector of the heated probe thus powering the heated hose.

### ㉑ Two external dust filters

### ㉒ Instrument data label

## 5.2 Parts external to the instrument




**DESCRIPTION:**

**21 Two external dust filters**

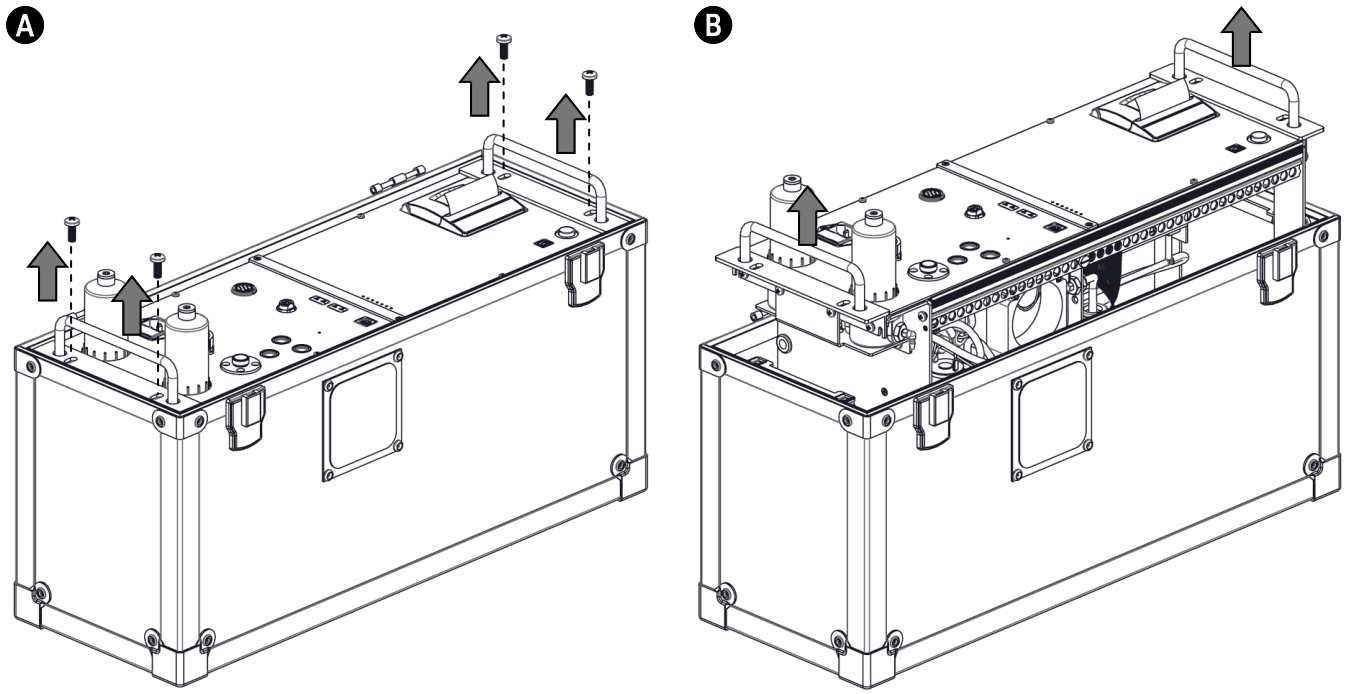
**23 Case**

**24 Case - accessories compartment**

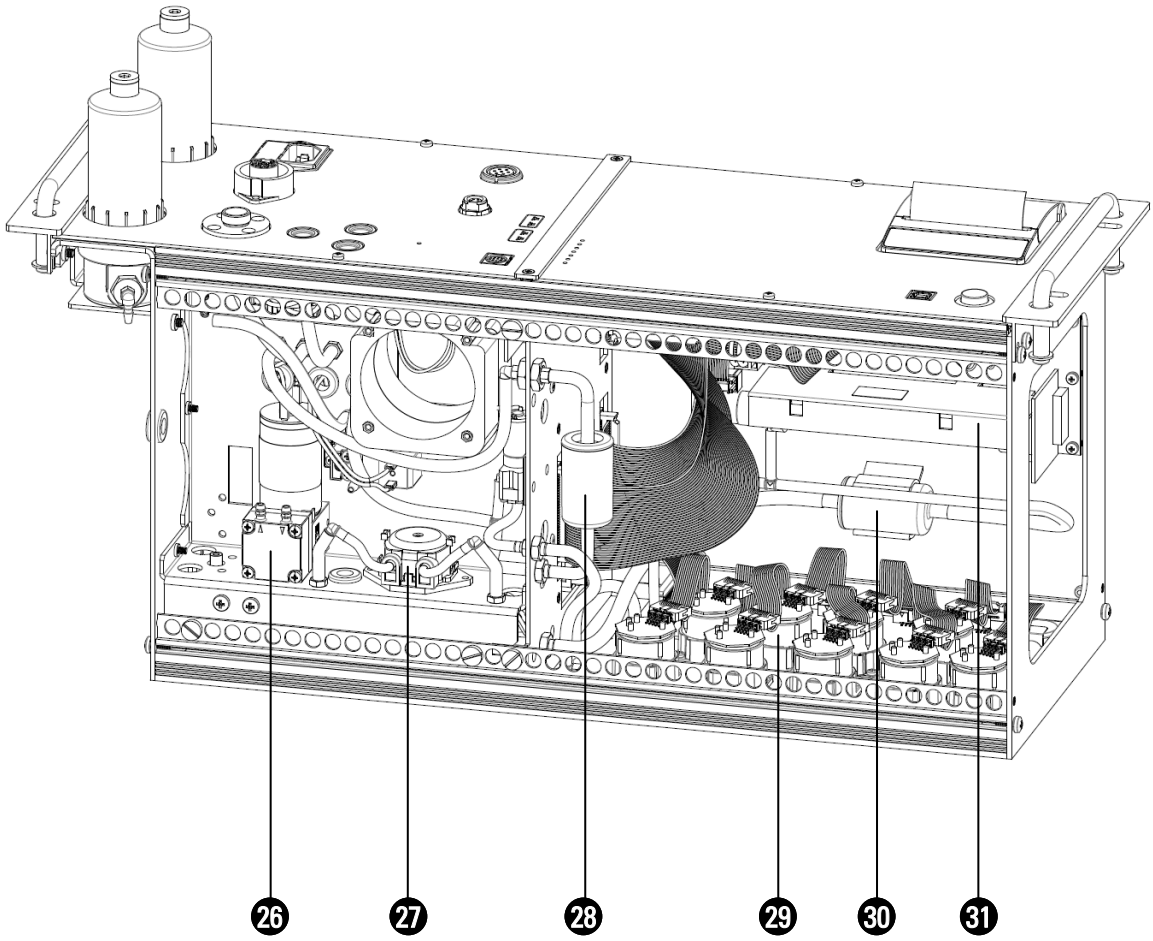
**25 Condensate drain**

## 5.3 Access to internal parts

To access the internal parts of the analyzer the instrument has to be removed from the case, as shown in the following pictures:



## 5.4 Instrument internal parts - sensors side




**DESCRIPTION:**

**26** **Gas suction pump**

**27** **Peristaltic pump**

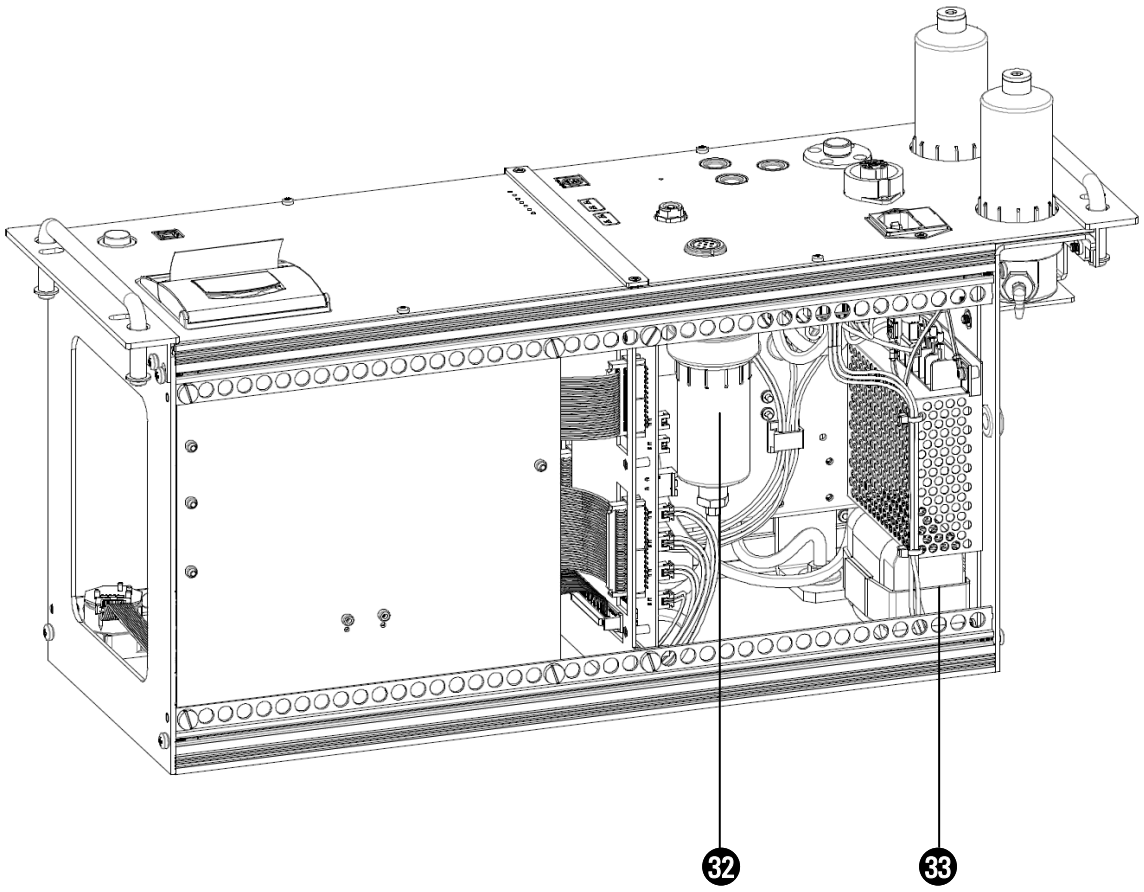
**28** **Air filter**

**29** **Sensors manifold**

**30** **Dust filter for NDIR (infrared) bench protection**

**31** **NDIR (infrared) bench**

## 5.5 Instrument internal parts - sample treatment side and condensate trap

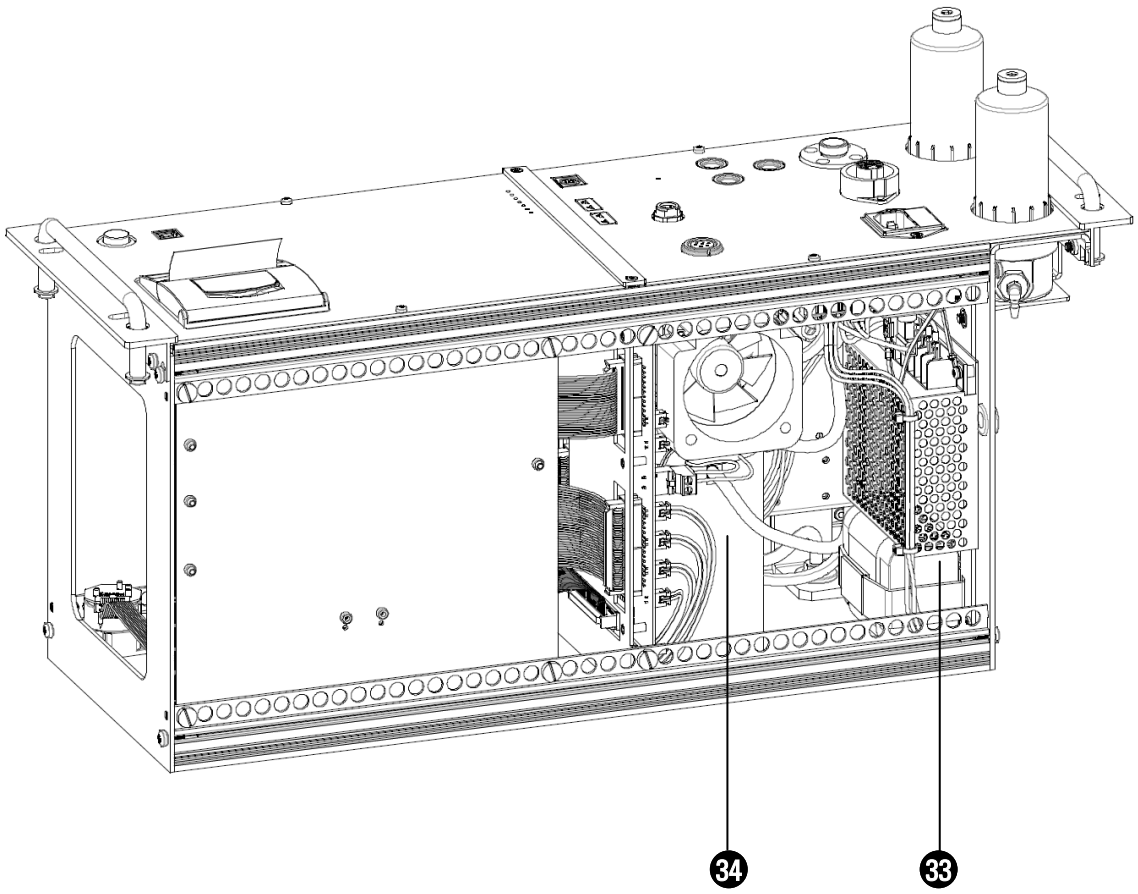



**DESCRIPTION:**

**32 Condensate trap**

**33 Battery pack**

## Instrument internal parts - sample treatment side and Peltier module cooler




**DESCRIPTION:**

**34** **Condensing assembly with Peltier module (Cooler)**

**33** **Battery pack**

## 6.1 Technical features

| | |
|---|---|
| Power supply: | 90 .. 264Vac<br>or<br>Li-Ion battery pack with internal protection circuit, rechargeable. |
| Battery charger: | With power cable with IEC C14 socket. |
| Charging time: | 8 hours for charging from 0% to 90% |
| Instrument operating time: | 10 hours of continuous operation (without printing and Peltier module cooling assembly operation).<br>2 hours with cooler active. |
| Display: | 4.3” TFT 272x480 pixels graphic color with backlight |
| Connectivity: | |
| Communication port: | USB connector type B. |
| Bluetooth: | Class 1. Communication distance <100 meters (in open field) |
| Autozero: | Automatic autozero cycle with the probe inserted in the chimney. |
| Dilution: | Widens the CO sensor measurement range up to 100.000ppm (10.00%).<br>Programmable as simple protection of the CO sensor with the intervention level set by the user. |
| Gas measurement sensors: | Up to 9 configurable sensors: electrochemical, NDIR (single cell) and pellistor. |
| Infrared bench: | NDIR bench for 3-gases: CO, CO2, CxHy. |
| Programmed fuels: | 13 factory preset plus 32 user-programmable. |
| Self-diagnosis: | Checks all functions and internal sensors and reports any abnormal operation. |
| Temperature measurement: | Two K-type thermocouple inputs with mini connector (ASTM E 1684-96 ) for differential temperature measurement (supply and return). |
| Room temperature measurement: | With internal sensor or through T2 thermocouple input and remote sensor. |
| Printer: | Integral thermal printer with ‘easy loading paper’ system and paper presence sensor. |
| Printer power supply: | With the analyzer batteries. |
| Printer autonomy: | Up to 40 reports with fully charged batteries. |
| Internal data memory: | 16,000 complete data analyses, also storing time and name of the customer. |
| User Data: | 8 programmable user names. |
| Print header: | 6 lines x 24 characters user-customized. |
| Line filter: | Replaceable cartridge, 99% efficiency with 20um particles. |
| Suction pump: | 2.0 l/min head at the chimney up to 300 hPa. |
| Flow measurement: | Internal sensor. |
| Sample treatment | |
| Cooler | |
| Drying system: | Quick moisture condensation with cyclone |
| Type: | Peltier module |
| Cooler set-point temperature: | +5° C |
| Max temp. deviation from the set-point: | +10° C |
| Condensate drainage: | With peristaltic pump 38 ml/min |
| Peristaltic pump duty cycle: | 30 sec On + 30 sec Off |
| Warm up time: | 15..20 minutes |
| Operating temperature: | -5° C .. + 45° C |
| Water trap: | |
| Type: | Integral to the instrument |

| | |
|---|---|
| Condensate drainage: | With peristaltic pump 38 ml/min |
| Operating temperature: | -5° C .. + 45° C |

---

| | |
|---|---|
| Smoke: | With external hand pump; input and printing of the smoke index |
| Leakage test (if applicable): | Performed with AAKT04 accessory: separated report print.<br>According to UNI7129-1: 2015 (new systems) or UNI 11137: 2012 (existing systems), with automatic calculation of the piping volume. |
| Condensing boiler efficiency: | Automatic detection condensing boiler, with efficiency calculation and printout (>100%) based on PCI according to UNI10389-1. |
| Ambient gas: | Measurement and separate report for ambient CO. |
| Draft measurement: | According to UNI 10845.<br>TPerformed with the internal sensor connected to port P-.<br>0.1 Pa resolution, 0.5 Pa accuracy. |

---

| | |
|---|---|
| Operating temperature: | -5 °C .. +45 °C |
| Storage temperature: | -20 °C .. +50 °C |
| Humidity limit: | 20% .. 80% RH |
| IP rating: | IP42 |
| Air pressure: | Atmospheric |
| External dimensions: | 50 x 36 x 20 cm (W x H x D)<br>50 x 46 x 13 cm (W x H x D)<br>with the intermediate tray for transportation of probe and heated head . |
| Weight: | **~ 12 Kg** (*Typical configuration: nine sensors - Cooler - IR bench - flue gas sampling probe - power supply cable - USB cable - shoulder strap - two paper rolls - USB flash drive - condensate drain tube - remote air intake tube - combustion air temperature sensor*).<br>**~ 13 Kg** (*Typical configuration with additional accessories: gas probe 3 mt extension - auxiliary air temperature probe - 300 mm Pitot tube - draft gauge probe).*<br>**~ 16,7 Kg** (*Typical configuration with additional accessories and a middle drawer containing a heated head probe with 300 mm tip and heated tube*). |

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Compliant with European Standards EN 50379-1 and EN 50379-2: See the declaration of conformity (ANNEX D)

## 6.2 Measurement and Accuracy Ranges

| MEASUREMENT | SENSOR | RANGE | RESOLUTION | ACCURACY |
|---|---|---|---|---|
| **$O_2$** | Electrochemical sensor | 0 .. 25.0% vol | 0.1% vol | ±0.2% vol |
| **CO with $H_2$ compensation** | Electrochemical sensor | 0 .. 8000 ppm | 1 ppm | ±10 ppm 0 .. 200 ppm<br>±5% measured value 201 .. 2000 ppm<br>±10% measured value 2001 .. 8000 ppm |
| **diluted** | Electrochemical sensor | 10.00% vol | 0.01% vol | ±20% measured value |
| **CO Low range with $H_2$ compensation** | Electrochemical sensor | 0 .. 500 ppm | 0.1 ppm | ±2 ppm 0 .. 40.0 ppm<br>±5% measured value 40.1 .. 500.0 ppm |
| **diluted** | Electrochemical sensor | 6250 ppm | 10 ppm | ±20% measured value |
| **CO Mid range** | Electrochemical sensor | 0 .. 20000 ppm | 1 ppm | ±100 ppm 0 .. 2000 ppm<br>±5% measured value 2001 .. 4000 ppm<br>±10% measured value 4001 .. 20000 ppm |
| **diluted** | Electrochemical sensor | 25.00% vol | 0.01% vol | ±20% measured value |
| **CO Hi range** | Electrochemical sensor | 0 .. 10.00% vol | 0.01% vol | ±0.02% vol or ±5% m.v. 0 .. 2.00 %<br>±5% measured value 2.01 .. 10.00 % |
| **NO** | Electrochemical sensor | 0 .. 5000 ppm | 1 ppm | ±5 ppm 0 .. 100 ppm<br>±5% measured value 101 .. 5000 ppm |
| **NO Low range** | Electrochemical sensor | 0 .. 500 ppm | 0.1 ppm | ±2 ppm 0 .. 40.0 ppm<br>±5% measured value 40.1 .. 500.0 ppm |
| **NOx** | Calculated | | | |
| **$SO_2$** | Electrochemical sensor | 0 .. 5000 ppm | 1 ppm | ±5 ppm 0 .. 100 ppm<br>±5% measured value 101 .. 5000 ppm |
| **$SO_2$ Low range** | Electrochemical sensor | 0 .. 500 ppm | 0.1 ppm | ±2 ppm 0 .. 40.0 ppm<br>±5% measured value 40.1 .. 500.0 ppm |
| **$NO_2$** | Electrochemical sensor | 0 .. 1000 ppm | 1 ppm | ±5 ppm 0 .. 100 ppm<br>±5% measured value 101 .. 1000 ppm |
| **$NO_2$ Low range** | Electrochemical sensor | 0 .. 500 ppm | 0.1 ppm | ±2 ppm 0 .. 40.0 ppm<br>±5% measured value 40.1 .. 500.0 ppm |
| **CxHy** | Pellistor sensor | 0 .. 5.00% vol | 0.01% vol | ±0.25% vol |
| **$H_2S$** | Electrochemical sensor | 0 .. 500 ppm | 0.1 ppm | ±5 ppm 0 .. 100.0 ppm<br>±5% measured value 100.1 .. 500.0 ppm |
| **$CO_2$** | Calculated | 0 .. 99.9% vol | 0.1% vol | |
| **$CO_2$** | NDIR sensor | 0 .. 20.0% vol | 0.01% vol | ±0.3% vol 0.00 .. 6.00 %<br>±5% measured value 6.1 .. 20 % |
| **$CO_2$ *** | NDIR bench | 0 .. 50.0% vol | 0.1% vol | ±0.3% vol 0.00 .. 8.00 %<br>±5% measured value 8.01 .. 40.00 %<br>±10% measured value 40.01 .. 50.00 % |
| **CO*** | NDIR bench | 0 .. 15.0% vol | 0.01% vol | ±0.03% vol 0.0 .. 10.0 %<br>±5% measured value 10.1 .. 15 % |
| **CH4 *** | NDIR bench | 0 .. 50000 ppm | 1 ppm | ±50 ppm 0 .. 200 ppm<br>±2% measured value 201 .. 50000 ppm |
| **Air temperature** | TcK sensor | -20.0 .. 1250.0 °C | 0.1 °C | ±1 °C 0 .. 100 °C<br>±1% measured value 101 .. 1250 °C |
| **Flue gas temperature** | TcK sensor | -20.0 .. 1250.0 °C | 0.1 °C | ±1 °C 0 .. 100 °C<br>±1% measured value 101 .. 1250 °C |
| **Auxiliary temperature probe** | Pt100 | -20.0 .. 200.0 °C | 0.1 °C | ±0.5 °C |
| **Pressure (draft and differential)** | Piezoelectric | -10.00 .. 200.00 hPa | 0.01 hPa | ±1% valore misurato -10.00 .. -2.01 hPa<br>±0.02 hPa -2.00 .. +2.00 hPa<br>±1% valore misurato +2.01 .. +200.00 hPa |
| **Differential temperature** | Calculated | 0 .. 1250.0 °C | 0.1 °C | |
| **Air index** | Calculated | 0.00 .. 9.50 | 0.01 | |
| **Excess air** | Calculated | 0 .. 850 % | 1 % | |
| **Stack loss** | Calculated | 0.0 .. 100.0 % | 0.1 % | |
| **Efficiency** | Calculated | 0.0 .. 100.0 % | 0.1 % | |

| MEASUREMENT | SENSOR | RANGE | RESOLUTION | ACCURACY |
|---|---|---|---|---|
| **Efficiency (condensing)** | Calculated | 0.0 .. 120.0 % | 0.1 % | |
| **Smoke index** | External instrument | 0 .. 9 | | |

Note:

*: The NDIR bench always measures all 3 gases CO, $CO_2$ e CH4.

# 7.0 STARTUP

## 7.1 Preliminary operations

Remove the instrument from its packing and check it for damage. Make sure that the content corresponds to the items ordered. If signs of tampering or damage are noticed, notify the SEITRON service center or distributor immediately and keep the original packing. A label applied on the instrument carries the model and the serial number. **Both these data should always be stated when requesting technical assistance, spare parts or clarification on the product or its use.**
Seitron maintains an updated database for each and every instrument.
Before using for the first time we recommend you charge the batteries completely.

## 7.2 WARNING

- Use the instrument with an ambient temperature between -5° and +45° C.

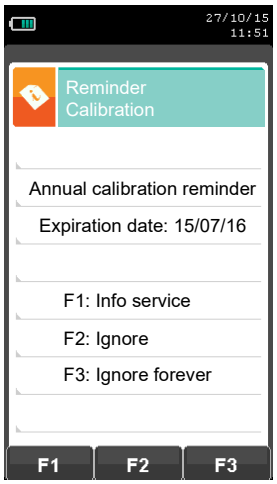
**IF THE INSTRUMENT HAS BEEN KEPT AT VERY LOW TEMPERATURES (BELOW OPERATING TEMPERATURES) WE SUGGEST WAITING A WHILE (1 HOUR) BEFORE SWITCHING IT ON TO HELP THE SYSTEM'S THERMAL BALANCE AND TO PREVENT CONDENSATE FORMING IN THE PNEUMATIC CIRCUIT.**

- After use and before turning the instrument off remove the probe and let ambient clean air through it for at least 30 seconds in order to purge the pneumatic path from all residues of gas.
- Do not use the instrument if the filters are clogged or damp.
- Before placing the measuring probe back in its case after use, make sure it is has cooled down enough and there is no condensate in the tube. It might be necessary to periodically disconnect the filter and the condensate separator and blow compressed air inside the tube to empty all residues.
- Remember to have the instrument checked and calibrated once a year in order to comply with the existing standards.

**STARTING FROM 30 DAYS BEFORE THE DUE DATE OF THE INSTRUMENT CALIBRATION, THE DISPLAY WILL SHOW A MESSAGE REMINDING THE USER TO SEND THE INSTRUMENT TO THE SERVICE CENTER.**

**Example:**

Press and hold for a few seconds




| CONTEXT KEY | FUNCTION |
|---|---|
| F1 | **Shows all information relevant to service center.** |
| F2 | **Temporarily ignores the message. At next turn-on of the instrument the reminder will be shown again.** |
| F3 | **Permanently ignores the message .** |

## 7.3 Analyzer power supply

The instrument contains a high-capacity LiIon rechargeable battery.
The battery feeds the instrument, built-in printer and any other probes or remote devices that may be connected. The instrument runs for approximately 10 hours if the printer is not used or 2 hours with the Cooler active. Should the battery be too low to effect the necessary measurements, the instrument can be hooked up to the mains via the power pack provided, allowing operations (and analysis) to proceed. The battery will be recharged whilst the instrument is being used.
The battery full charging cycle takes up to 8/10 hours. This cycle is automatically ended; the end of the charging cycle is displayed with the turn-off of the red LED located on the front panel as well as with the display which will show the battery and the number '100%'.

**ATTENTION: If the instrument is not going to be used for a long time we suggest recharging it at least once every 4 months.**

### 7.3.1 Checking and replacing the batteries

The state of the internal battery can be displayed during the auto-calibration of the device and possibly later via the information menu.
In the menu, the remaining battery power is displayed.
If battery charge appears to be low, let it discharge completely and then carry out a full 100% charge cycle by connecting the instrument to the mains for 8/10 hours.
If the problem persists, replace the battery pack with a SEITRON original or contact the SERVICE CENTER to carry out the necessary repairs.
The average life of the battery pack is 500 charging/discharging cycles. To exploit this characteristic to the full it is advisable to always use the instrument powered by the internal batteries and to charge it only when it gives the battery flat message.

**THE INSTRUMENT IS SHIPPED WITH THE BATTERY HALF CHARGED SO IT IS ADVISABLE TO CHARGE IT COMPLETELY BEFORE USE, TAKING 8 HOURS.**

**IT IS ADVISABLE TO CHARGE THE BATTERY AT AN AMBIENT TEMPERATURE RANGING BETWEEN 10°C AND 30°C.**

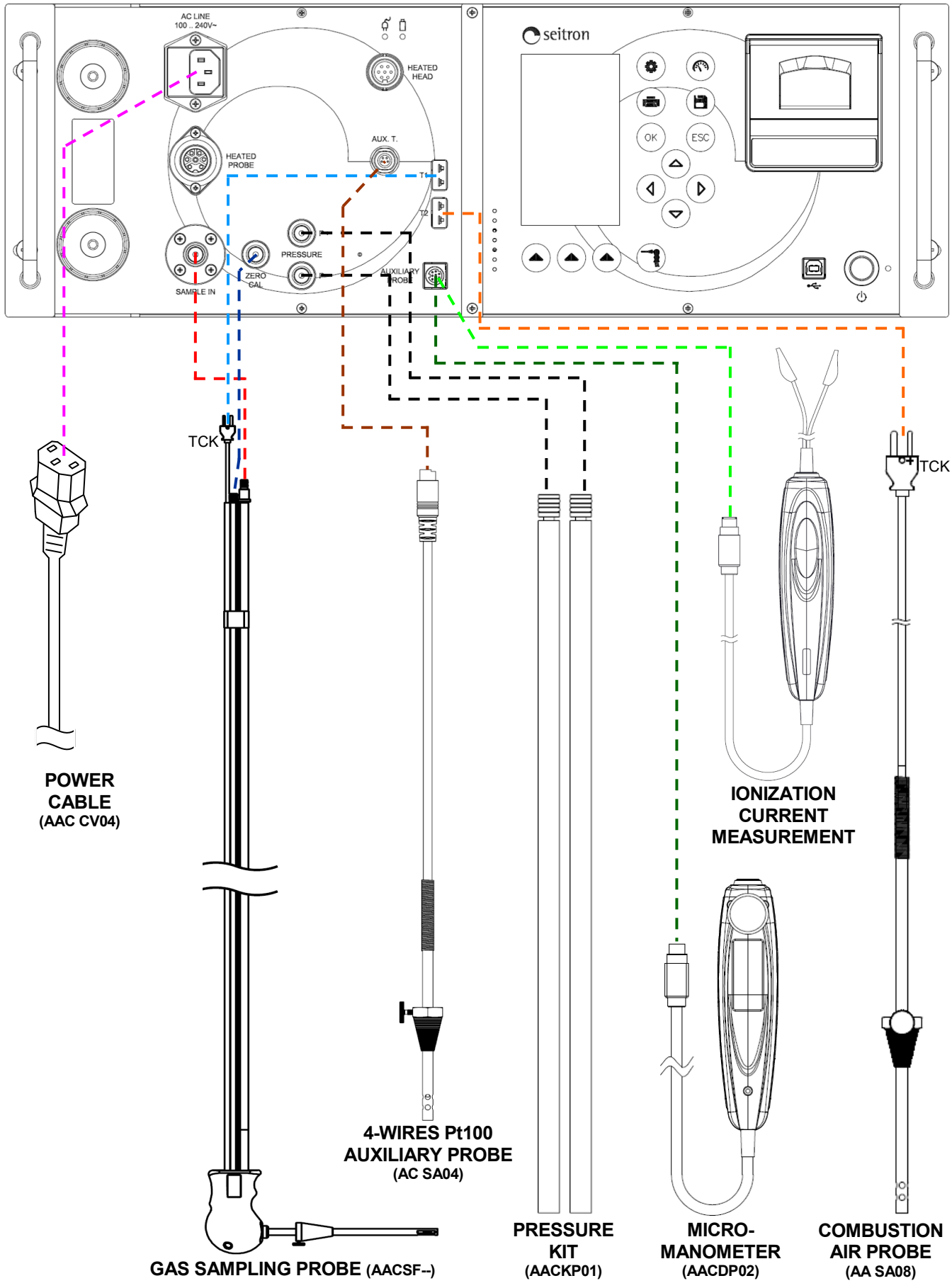
### 7.3.2 Use with power supply cord

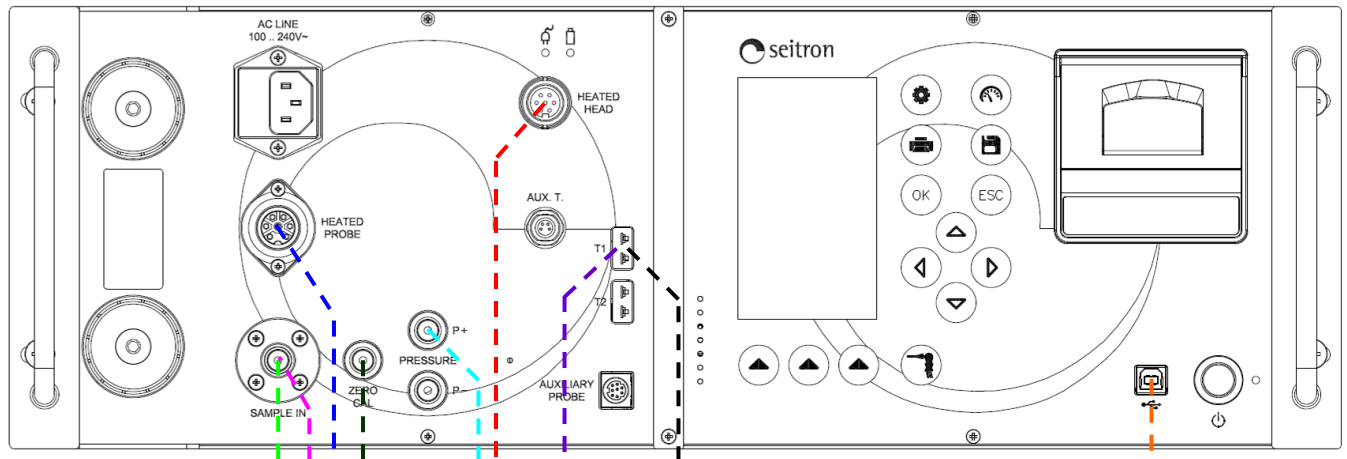
This instrument can operate even with batteries fully discharged provided it is connected to the mains power through the IEC C14 power cord (supplied).

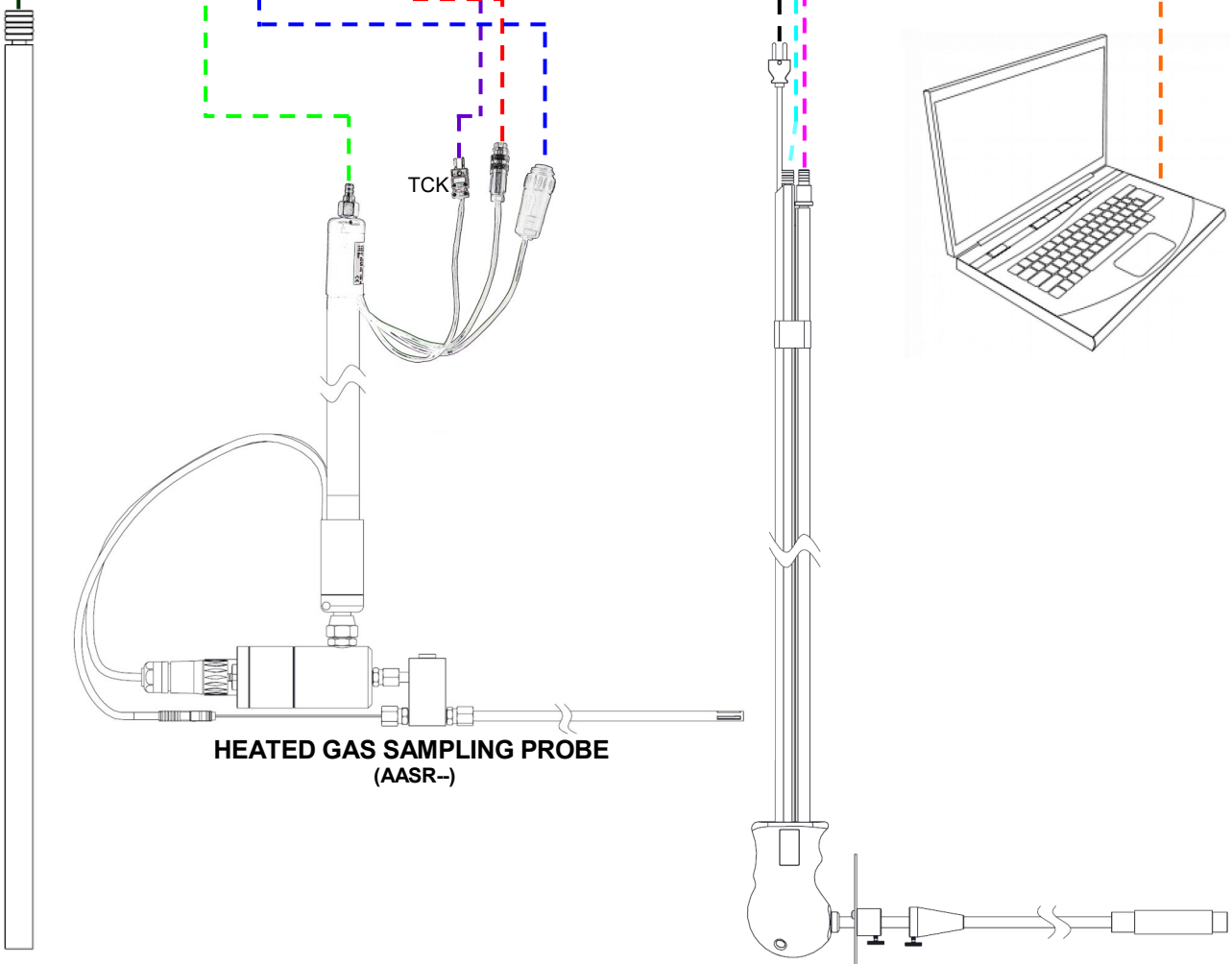
**THE POWER SUPPLY/BATTERY CHARGER IS SWITCHING TYPE.**
**THE APPLICABLE INPUT VOLTAGE RANGES BETWEEN 90Vac AND 264Vac.**
**INPUT FREQUENCY: 50-60Hz.**
**LINE PROTECTION: 2 FUSES 4A T 5x20 SIZE**

**IN CASE OF PROLONGED USE CONNECT THE INSTRUMENT TO MAINS.**

## 7.4 Connection diagram






**HEATED GAS SAMPLING PROBE**
**(AASR--)**

**ZERO AIR**
**REMOTE**
**SAMPLING HOSE**
**(AATP01)**

**GAS SAMPLING PROBE**
**FOR INDUSTRIAL ENGINES**
**(AASX02)**

### 7.4.1 Gas probe

**General description**
The gas sampling probe is made of a stainless steel tube with a plastic hand grip and includes an internal K-type thermocouple (Ni-NiCr) for measuring the gas temperature of the gas. The thermocouple is located in the probe tip. It is connected to the instrument via a compensated cable running in a specific slot of the rubber hose of the sample probe. The compensation of the cold junction is performed with a Pt100 RTD (Resistance Temperature Detector) that measures the temperature in correspondence of the thermocouple connector.
The K-type thermocouple (Ni-NiCr) allows continuous measurements at high temperatures.
The instrument has another internal Pt100 RTD for measuring the internal temperature; this sensor is also used for measuring the ambient temperature.
In case you wish to detect the temperature of the combustion air directly into the intake duct you will have to use the Tc-K type optional remote sensor. It is suggested to perform this measurement to carry out the calculation of the efficiency of the system when the temperature of the combustion air is different than the temperature of the environment where the instrument is positioned.

**Technical features:**

| | | |
|---|---|---|
| Tip: | Material: | AISI 304 stainless steel |
| | Diameter: | 8 mm |
| | Length: | 180mm rigid |
| | | 300mm rigid |
| | | 750mm rigid |
| | | 1000mm rigid |
| Adaptor for pockets: | Material: | Galvanized steel |
| | External diameter: | 10 .. 22 mm. |
| Handle: | Material: | Nylon |
| | Color: | Black |
| Tube: | Material: | EPDM |
| | Length: | 3 meters |
| Temperature sensor: | K-type thermocouple (Ni-NiCr) - IEC584 - class 1 | |
| Pneumatic connectors: | Pressure: Male - diameter 8.9 mm | |
| | Gas input: Male - 8mm diameter | |
| Temperature sensor connector: | Tc-K mignon | |
| Operating temperature: | AA SF31: max. 400° C insertion depth 100mm | |
| | AA SF32: max. 600° C insertion depth 160mm | |
| | AA SF35: max. 800° C insertion depth 500mm | |
| | AA SF36: max. 1200° C insertion depth 500mm | |

**WARNING: in case of measurement of very high temperatures it is recommended to remove the tip slowly in order to let it cool down without suffering heat stress; once extracted from the measurement point do not place it on a cold surface, otherwise this could affect the internal temperature sensor; in case of failure of the thermocouple it is possible to replace the bare element with a compensated cable (see section 16 'Spare parts and service').**

**Connection**
As shown in section 7.4, the gas probe must be connected to the instrument as follows:

- TcK male connectore: connect into plug **T1**.
- Gas male connector: connect into plug labelled as **'SAMPLE IN'**.
- Pressure male connector: connect into plug labelled as **'P-'**.

### 7.4.2 Heated gas sampling line (hose + head with internal internal AISI 316L stainless steel filter for NOx - SOx measurement)

This optional type of probe is used for applications where the measurement of NOx/SOx is required for long periods of time. This probe can be connected only to combustion analyzers equipped with integrated cooler.
A heated tube allows to keep the gas temperature above the dew point up to the integrated cooler. The Peltier cell conditioning unit allows the drying of the sample thus preventing the dilution of NO2 and SO2 into the condensate water. The heated gas sampling line (temperature> 90°) allows to sample the gases to be analysed and carry them into the analyzer without condensation occurring on the way in order to avoid that gases like NOx

and SOx dissolve in the condensate water making them not measurable by the sensors in the measuring chamber.
The gas, kept warm by the heated line, flows in the instrument passing through an efficient Peltier module cooler which reduces very quickly the gas temperature down to 5ºC. This quick thermal shock creates an immediate condensation of the water in a dedicated tank; the gas, now dried, is therefore carried to the measuring chamber. The condensation water resulting from the combustion process is then extracted from the analyzer with a peristaltic pump.
Applications that have very dirty fumes require a pre-filtration system right after the point where the samples are taken: for this purpose the head is equipped with a filter made of sintered stainless steel (1257 cartridge 95% eff. 40µm). In order to avoid condensation and therefore the dissolution of NOx and SOx in the water, the filter is heated up to a temperature higher than 90° C.
This filter can be cleaned in an ultrasonic bath or using solvents and steel brushes.

**Technical features:**

| | | |
|---|---|---|
| Tip: | Material: | AISI 304 stainless steel |
| | Diameter: | 8 mm |
| | Length: | 300mm<br>1000mm |
| Heated head: | | |
| | Material: | Anodised aluminium (black)<br>Sintherised AISI 316L stainless steel internal filter (95% eff. with 40um particles) |
| | Power supply: | From the instrument with round DIN 7 poles connector |
| | Temperature control: | TcK thermocouple |
| | Temperature set-point: | Adjustable from 90°C to 130°C |
| Heated hose: | | |
| | Material: | Internal measurement hose: teflon<br>External insulation: water-repellent |
| | Length: | 3 m |
| | Bending radius: | 140 mm |
| | Power per meter: | 65 Watt |
| | Power supply: | From the instrument with special R24 connector<br>110Vac - 230Vac automatic voltage switching |
| | Temperature control: | NTC 10k |
| | Temperature set-point: | Adjustable from 90°C to 130°C |
| Temperature sensor: | | Type K thermocouple (Ni-NiCr) - IEC584 - class 1 500mm<br>Type K thermocouple (Ni-NiCr) - IEC584 - class 1 1000mm |

| Code: | Heated head with sinterised filter | Type K thermocouple | 300 mm tip | 1000 mm tip | 3 m electrically heated hose |
|---|---|---|---|---|---|
| **AASR03** | ✓ | ✓ | ✓ | | ✓ |
| **AASR04** | ✓ | ✓ | | ✓ | ✓ |

**Available probes**:
**WARNING**: The heated probe and heated head can only be used if the analyzer is connected to the mains, with AC voltage between 90 V and 264 V.

**Connection**:
For the gas sampling heated line see section 7.4.

### 7.4.3 Gas probe for industrial engines

This type of probe is typically used in processes where the fumes sampled are very dirty and must be filtered out before reaching the measurement instrument. To preserve the internal system it is mandatory to filter the dust out of the gas directly on the probe tip, using an AISI 316L stainless steel filter.

Condensate and fumes are then separated inside the instrument using the internal separation assembly. The probe tip is provided with a flange that acts as a heatsink to make sure that, in case of very high temperature at the chimney, the handle is not damaged by a temperature that might exceed 100 .. 120° C (max. allowed temperature).

**Technical features:**

| | | |
|---|---|---|
| Tip: | Material: | AISI 304 stainless steel |
| | Diameter: | 8 mm |
| | Length: | 750mm rigid tip + flange, insertion depth 600 mm |
| Handle: | Material: | Nylon |
| | Color: | Black |
| Hose: | Material: | EPDM |
| | Length: | 3 m |
| Filter: | | AISI 316L sintherised stainless steel, washable with ultrasonic bath or with solvents and steel brush. |
| Temperature sensor: | | Type K thermocouple (Ni-NiCr) - IEC584 - Class 1 |
| Pneumatic connectors: | | Male - 8.9 mm diameter |
| | | Male - 8.0 mm diameter |
| Temperature sensor connector: | | TcK mignon size |
| Operating temperature: | | max. 800°C |

### 7.4.4 Probe with heated head for carbon black measuring.

This kind of probe, optionally available, is used for the carbon black measuring.
The heated head (temperature > 90°) avoid the formation condensation that might be deposited on the filter paper.

**Technical features**

| | | |
|---|---|---|
| Tip: | Material: | AISI 316L stainless steel |
| | Diameter: | 8 mm |
| | Length: | 300mm rigid |
| | | 750mm rigid |
| Adapter for wells: | Material: | Galvanized steel |
| | External diameter: | 10.. 20 mm |
| Handle: | Material: | Nylon |
| | Color: | Black |
| Hose: | Material: | EPDM |
| | Length: | 3,5 meters |
| Temperature sensor: | | Type K thermocouple (Ni-NiCr) - IEC584 - Class 1 |
| Pneumatic connectors: | | Male - 8.9 mm diameter pressure connections |
| | | Male - 8.0 mm diameter gas input connection |
| Electric signals connectors: | | for pressure measuring and heater power. |
| Operating temperature: | AA SX04: | max. 600°C immersion depth 160mm |
| | AA SX05: | max. 800°C immersion depth 500mm |

**USING THE PROBE WITH HEATED HEAD FOR THE MEASUREMENT OF THE CARBON BLACK REDUCES THE INSTRUMENT'S BATTERY AUTONOMY.**

**Connection**:
For the wiring conncetion of the fumes heating sampling line see section 12.3.2.

### 7.4.5 Ambient CO probe (not available)

Probe for monitoring the concentration of CO and checking safe conditions in the boiler room.

### 7.4.6 Combustion air temperature sensor

This probe is used to measure the temperature of the combustion air.
Use: to be used when the sampling site of the combustion air is located in a different area than the boiler room or the heating plant; when the combustion air sampling site is located in a different place than the boiler room, the

temperature of the combustion air can be very different compared with the temperature of the air in the boiler room, generating a less accurate efficiency calculation.

**Technical features:**

| | | |
|---|---|---|
| Tip: | Material: | AISI 304 stainless steel |
| | Diameter: | 6 mm |
| | Length: | 200 mm rigid tip |
| Adapter for thermowells: | Material: | AISI 303 stainless steel |
| | External diameter: | 7,5 .. 17 mm |
| Temperature sensor: | Sensing element: | Type K thermocouple (Ni-NiCr) - IEC584 - Class 1 |
| | Cable length: | 2 m |
| Connector: | TcK mignon size | |
| Measurement range: | -25.0°C .. +125.0°C | |

**Connection**

As shown in section 7.4 the probe must be connected to the instrument as follows:

- The polarized male connector of the thermocouple must be connected to the **T2** plug. The improper insertion of the same is not possible thanks to the different length of the tips.

### 7.4.7 Tc-K temperature measurement probe

Using the same input as for the Tc-K thermocouple 'T1' (i.e. the one used for gas temperature), it is possible to measure the supply and return water temperature. If this temperature is taken on the pipe itself, it is suggested to use contact probes with diameter matching as close as possible the pipe diameter.

**Connection**

As shown in section 7.4 the probe must be connected to the device as follows:

- The polarized male connector of the thermocouple must be connected to the **'T1'** plug. The improper insertion of the same is not possible thanks to the different lengths of the tips.

### 7.4.8 Auxiliary temperature measurement probe

Input for 4-wires Pt100 temperature probe.

**Connection**

As shown in section 7.4 the probe must be connected to the device as follows:

- The 4-poles M8 type connector must be connected to the **'AUX T'** plug on the analyzer.

### 7.4.9 Ionization current measurement probe

This special probe has been developed to extend the functions of the analyzer to check the quality of the combustion flame.
This probe allows the combustion analyzer to measure the current that is created within the combustion chamber between the chamber metal body and the measurement electrode.

**Connection**

As shown in section 7.4 the probe must be connected to the device as follows:

- The 8-poles mini-DIN type connector must be connected to the **'AUXILIARY PROBE'** serial port on the analyzer.

### 7.4.10 Draft measurement gauge

This device has been designed to extend the functions of the combustion analyzer to the draft measurement in compliance with the UNI 10845 standard. It enables the combustion analyzer to measure the draft and generally the pressure with an higher accuracy and resolution than the internal sensor of the instrument.

**Connection**

As shown on the section 7.4 the probe shall be connected to the instrument as follows:

- The draft gauge is provided with a female connector (ø 9mm) of the same type of the one for the pressure

inputs on the combustion analyzer. Thanks to this connector the draft gauge can be connected directly to the shorter male connector (ø 9mm) of the flue gas sampling probe supplied.

- The 8-pole MiniDin connector shall be connected to the " **AUXILIARY PROBE** " serial port of the analyzer.

### 7.4.11 Pressure Test Kit

Two types of pressure measurement kit are available:

1st Kit includes two 1mt hoses and two ø 9mm fittings; to be used for the differential pressure measurement.

2nd Kit includes one 1mt hose and one ø9mm fitting for pressure measurement.

**Connection**

As shown on section 7.4 the kits shall be connected to the instrument as follows:

1st hose connector shall be connected to the P+ connector, while the other hose connector shall be connected to the analyzer P– connector.

2nd The hose connector shall be connected to the analyzer P+ or P- connector.

### 7.4.12 Burner pressure verification probe

This probe must be used to measure the burner pressure of the gas-powered boiler so it can be regulated in real time. It is made of a silicone tube, 8x4mm and 1 metre long, complete with connector for connecting to the analyzer.

### 7.4.13 Hose for remote zero air suction

It consists of one 2mt tube and one ø 9mm male fitting to be used to move the clean air suction point to perform the instrument autozeroing.

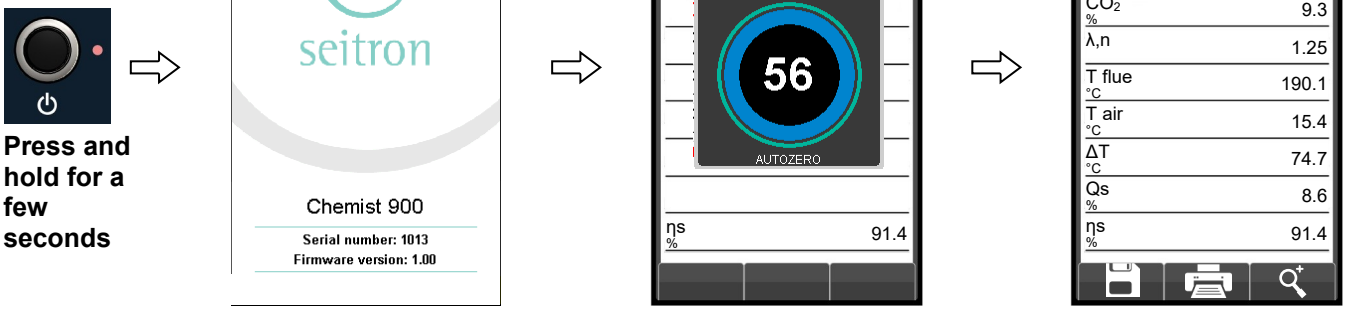
**Connection**

As shown on section 7.4 the tube shall be connected to the instrument as follows:

- The tube fitting shall be connected to the analyzer " **ZERO CAL** " pneumatic connector.

# 8.0 POWER ON - OFF

## 8.1 Starting the device



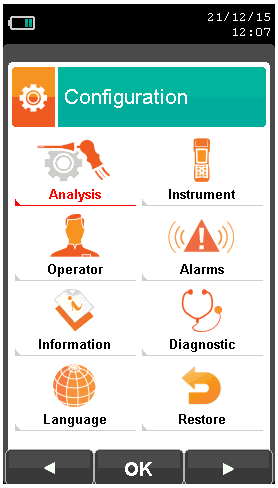

**During autozero, you can only use the menus that do not require autozero.**


**This error message is displayed if the autozero of the device is not successfully completed.**

| KEY | FUNCTION |
|---|---|
|  | **Activate the context keys shown on the display.** |
|  | **Goes through the measurements available.** |
|   | **Activates the context key located in the left side of the display.** |
|   | **Returns to the previous screen.** |

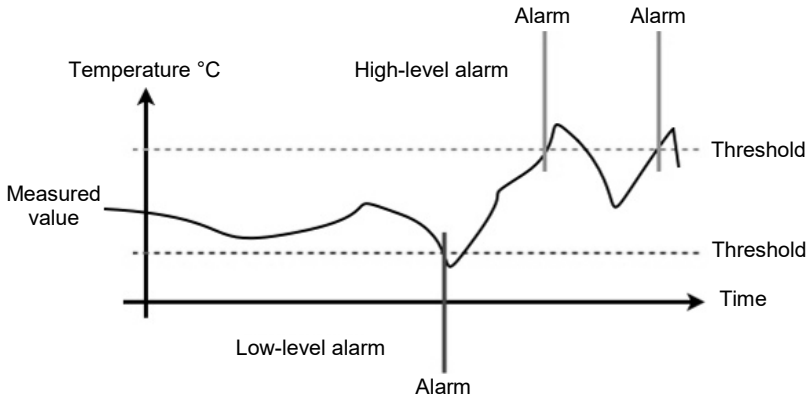
| CONTEXT KEY | FUNCTION |
|---|---|
| F1 | **Repeats autozero (is shown in the case of an error).** |
| F2 | **The device will suspend autozero and display the screen "Combustion Analysis"; it is possible to carry out the analysis of combustion (displayed in the case of an error).** |
| F3 | **The device displays the screen "Sensor Diagnostics" (displayed in the case of an error).** |
|  | **Save analysis.** |
|  | **Print the test paper print-out according to the settings.** |
|  | **Zoom. By pressing this interactive key repeatedly, the device displays the following sequence:** **AAA → AAA → AAA → AAA** |

## 9.1 Configuration menu

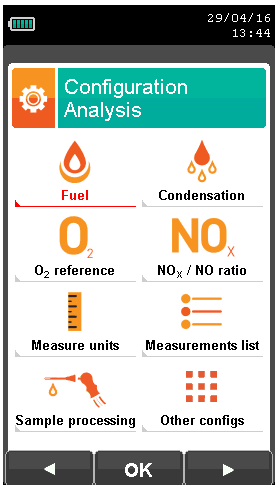



| KEY | FUNCTION |
|---|---|
|  | **Activate the context keys shown on the display.** |
|  | **Returns to the previous screen.** |

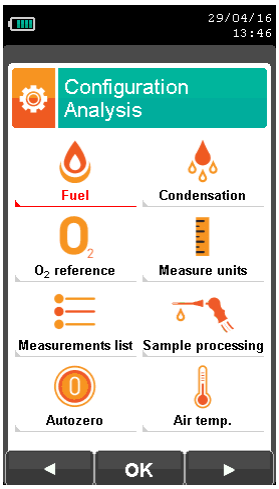
| CONTEXT KEY | FUNCTION |
|---|---|
| ◄ | **Selects the available parameters.** |
| OK | **Enters in the selected parameter setting.** |
| ► | **Selects the available parameters.** |

| PARAMETER | DESCRIPTION |
|---|---|
| Analysis | Through this menu the user can configure the available parameters for a proper combustion analysis.<br>SEE SECTION 9.2. |
| Instrument | This menu is used to configure the instrument's reference parameters.<br>SEE SECTION 9.3. |
| Operator | In this sub menu you can enter or change the name of the operator that will carry out the analysis. Up to 8 lines are available. Also, you can select the name of the operator that will carry out the analysis and this will be printed on the analysis report.<br>SEE SECTION 9.4. |
| Alarm | This submenu allows the user to set and memorize 10 alarms, defining the monitored parameter for each (gas, pressure, Ta, Tf), the alarm threshold and relevant measurement unit and whether it is a low or high-level alarm. Low-level alarms are triggered when the reading drops below the defined threshold, whereas high-level alarms are triggered when the reading rises above the defined threshold.<br>SEE SECTION 9.5.<br>  |
| Information | This menu provides information regarding instrument status.<br>SEE SECTION 9.6. |
| Diagnostic | The user, with this menu, can check any anomalies of the device.<br>SEE SECTION 9.7. |
| Language | Set the desired language for the various menus and the test paper print-out.<br>SEE SECTION 9.13. |
| Restore | Restore factory settings.<br>SEE SECTION 9.14. |

## 9.2 Configuration→Analysis




or



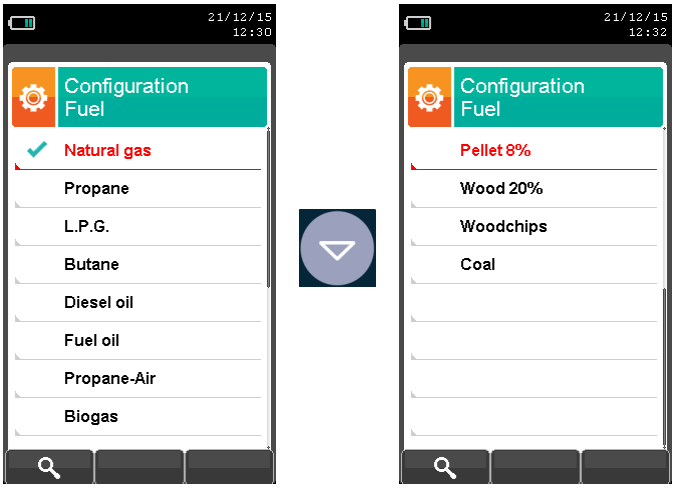

| KEY | FUNCTION |
|---|---|
|  | **Activate the context keys shown on the display.** |
|  | **Returns to the previous screen.** |

| CONTEXT KEY | FUNCTION |
|---|---|
| ◄ | **Selects the available parameters.** |
| OK | **Enters in the selected parameter setting.** |
| ► | **Selects the available parameters.** |

| PARAMETER | DESCRIPTION |
|---|---|
| Fuel | Lets the user select the type of fuel to be used during analysis. Fuel selection can be done either from this menu or during the analysis itself.<br>By selecting the sub menu **Fuel coefficients** the user can view the characteristics of the fuels used in the calculation of performance. SEE SECTION 9.2.1. |
| Condensation | The burner efficiency figure when condensation takes place is influenced by atmospheric pressure and humidity of the combustion air. As the atmospheric pressure is hardly precisely known, the operator is asked to enter a related parameter, i.e. the altitude of the place above the sea level, from which the pressure is then derived once the dependency from atmospheric conditions is neglected. In calculations the value of 101325 Pa is assumed as atmospheric pressure at sea level. Further the air relative humidity input is allowed, being this calculated at the combustion air temperature as measured from the instrument; in case this value is unknow the operator is recommended to enter 50% for this value. VSEE SECTION 9.2.2. |
| $O_2$ reference | In this mode the user can set the oxygen percentage level to which pollutant emission values detected during analysis will be referenced.<br>SEE SECTION 9.2.3. |
| $NO_x$/NO ratio | NOx/NO: all the nitrogen oxides which are present in the flue emissions (Nitrogen oxide = NO, Nitrogen dioxide = $NO_2$); total nitrogen oxides = NOx (NO + $NO_2$).<br>In the combustion processes, it is found out that the $NO_2$ percentage contained in the gas is not far from very low values (3% or above); hence it is possible to obtain the NOx value by a simple calculation without using a direct measurement with a further $NO_2$ sensor.<br>The $NO_2$ percentage value contained in the gas can be however set at a value other than 3% (default value). This menu is only available when the $NO_2$ sensor is not installed.<br>SEE SECTION 9.2.4. |

| PARAMETER | DESCRIPTION |
|---|---|
| Measure units | Through this submenu the user can modify the measurement units for all the analysis parameters, depending on how they are used.<br>SEE SECTION 9.2.5. |
| Measures list | In this sub menu the user can see the list of measurements that the device can perform. With the interactive keys, the user can add, delete or move a selected measurement.<br>SEE SECTION 9.2.6. |
| Sample processing | In this mode the user can activate/disactivate the whole operating system of the heated probe. The user can also set the required temperature of the heated tube and the heating head.<br>**The activation of the Cooler system is indicated on the display with the icon " ".**<br>**WHEN THE INSTRUMENT COOLER SYSTEM IS TURNED ON, THE BATTERY LIFE IS REDUCED DOWN TO 2 HOURS.**<br>SEE SECTION 9.2.7. |
| Other config. | If the ' NOx/NO Ratio ' parameter is provided, the instrument shall display this icon which represents the ' Autozero ' and ' Air Temperature ' menus described below. |
| Autozero | In this sub menu the user can change the length of the autozero cycle of the analyzer and start it manually.<br>SEE SECTION 9.2.8. |
| Air temp. | This submenu allows to acquire or enter manually the combustion air temperature.<br>SEE SECTION 9.2.9. |

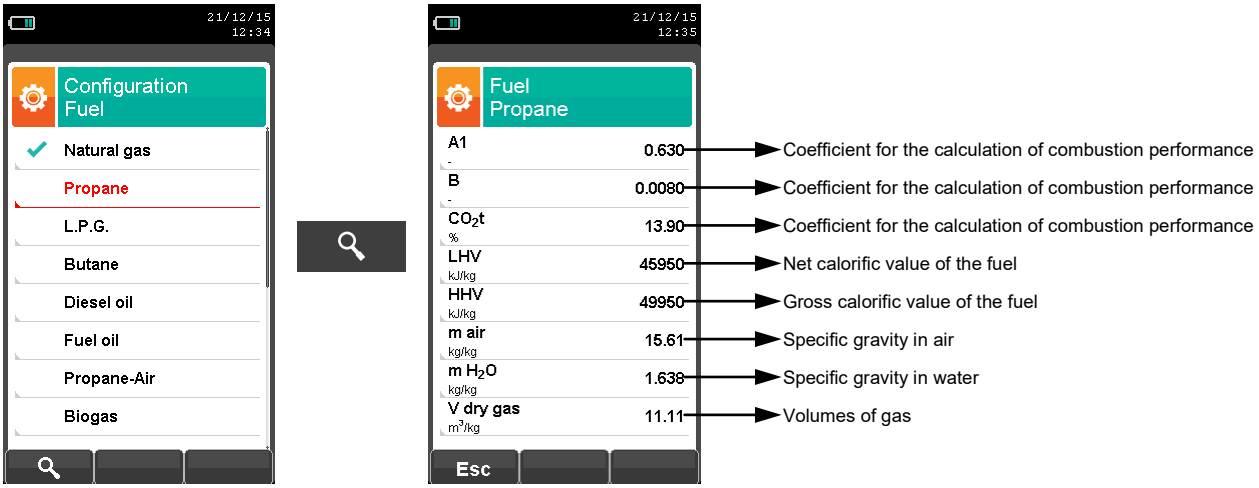
## 9.2.1 Configuration→Analysis→Fuel



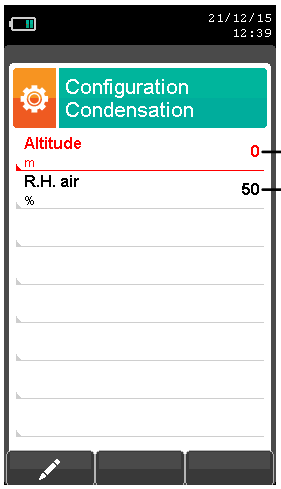

| KEY | FUNCTION |
|---|---|
|  | **Activate the context keys shown on the display.** |
|  | **The arrows select each line displayed.** |
|  | **Confirms the choice of fuel to be used during the analysis.** |
|  | **Returns to the previous screen.** |

| CONTEXT KEY | FUNCTION |
|---|---|
|  | **Shows the details of the selected fuel (see example below).** |
|  | **Returns to the previous screen.** |

Esempio:



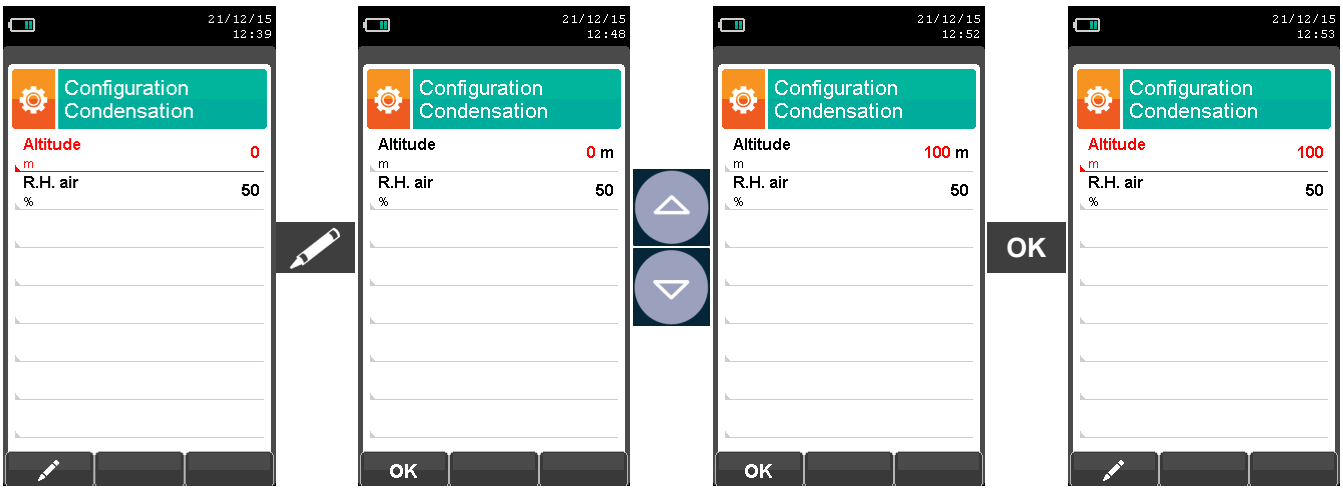
## 9.2.2 Configuration→Analysis→Condensation



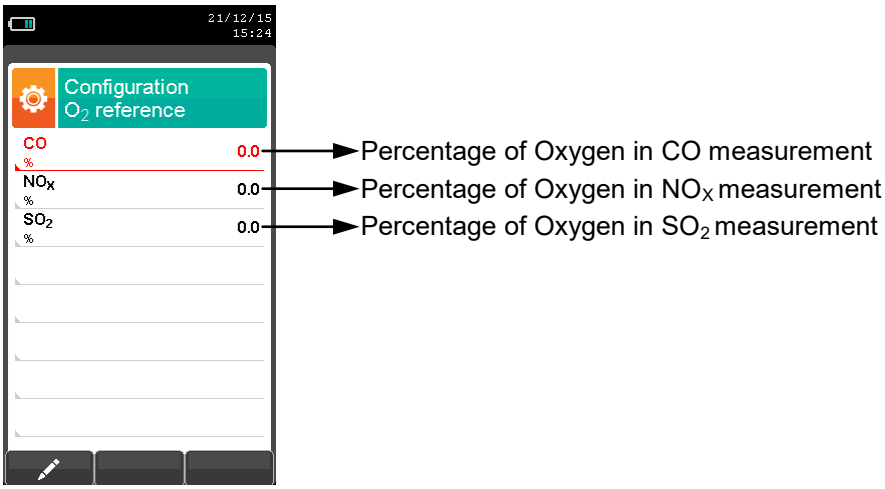

| KEY | FUNCTION |
|---|---|
|  | **Activate the context keys shown on the display.** |
|  | **The arrows select each line displayed (the selected line is red).**<br>**In edit mode, it scrolls through the suggested values.** |
|  | **Enters the modify mode for the selected parameter, then confirms the modification.** |
|  | **When pressed in modify mode cancels the selection made, otherwise returns to the previous screen.** |

| CONTEXT KEY | FUNCTION |
|---|---|
|  | **Enters the modification mode for the selected parameter.** |
|  | **Confirms the modification.** |

Example:



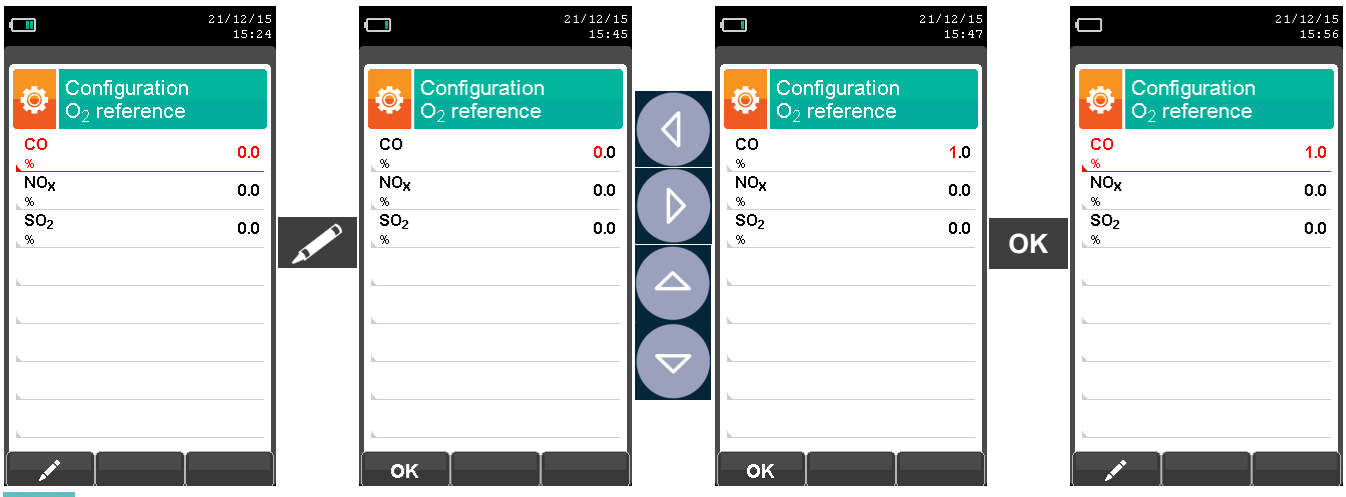
## 9.2.3 Configuration→Analysis→Reference $O_2$



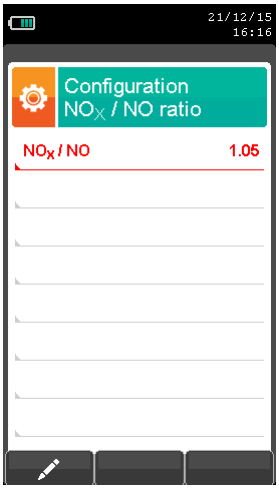

| KEY | FUNCTION |
|---|---|
|  | **Activate the context keys shown on the display.** |
|  | **Keys '▲' and '▼' select any line shown on the display (the selected line is displayed in red).**<br>**When in modify mode, sets the desired value.** |
|  | **Enters the modify mode for the selected parameter, then confirms the modification.** |
|  | **When pressed in modify mode cancels the selection made, otherwise returns to the previous screen.** |

| CONTEXT KEY | FUNCTION |
|---|---|
|  | **Enters the modify menu for the selected parameter.** |
|  | **Confirms the modification.** |

Example:



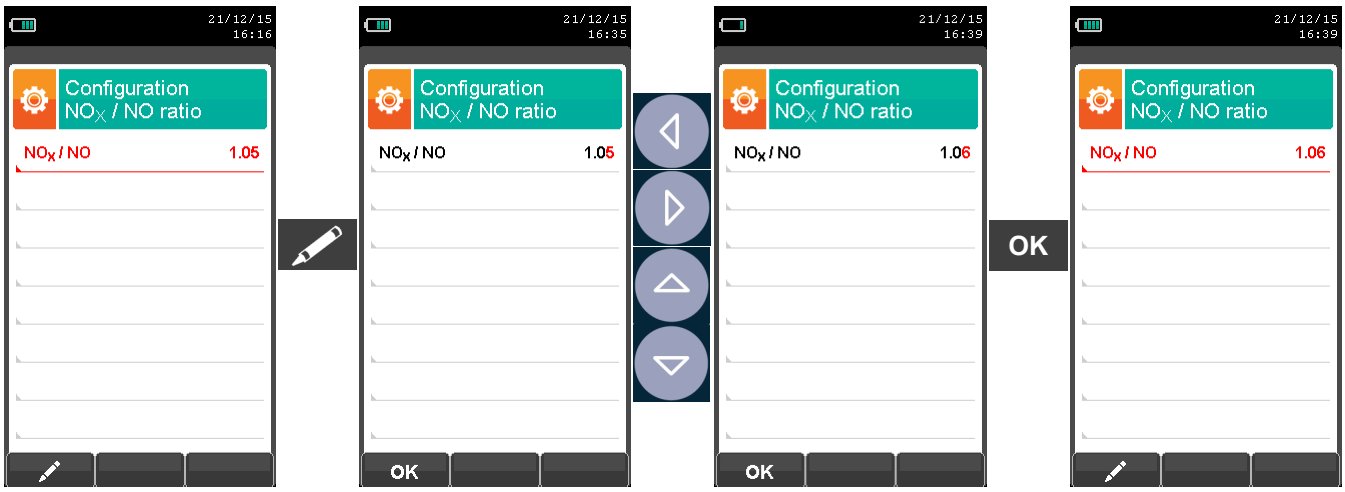
## 9.2.4 Configuration→Analysis→$NO_X$/NO ratio



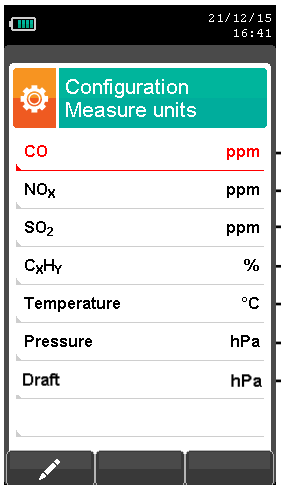

| KEY | FUNCTION |
|---|---|
|  | **Activate the context keys shown on the display.** |
|  | **When in modify mode, sets the desired value.** |
|  | **Enters edit mode of the selected element and then confirms the change.** |
|  | **When pressed in modify mode cancels the selection made, otherwise returns to the previous screen.** |

| CONTEXT KEY | FUNCTION |
|---|---|
|  | **Enters edit mode.** |
|  | **Confirms the modification.** |

Example:



## 9.2.5 Configuration→Analysis→Measurement units




Measurement unit can be set as: ppm - mg/m$^3$ - mg/kWh - g/GJ - g/m$^3$ - g/kWh - %

Measurement unit can be set as: ppm - mg/m$^3$ - mg/kWh - g/GJ - g/m$^3$ - g/kWh - %

Measurement unit can be set as: ppm - mg/m$^3$ - mg/kWh - g/GJ - g/m$^3$ - g/kWh - %

Measurement unit can be set as: ppm - mg/m$^3$ - mg/kWh - g/GJ - g/m$^3$ - g/kWh - %

Measurement unit can be set as: °C - °F

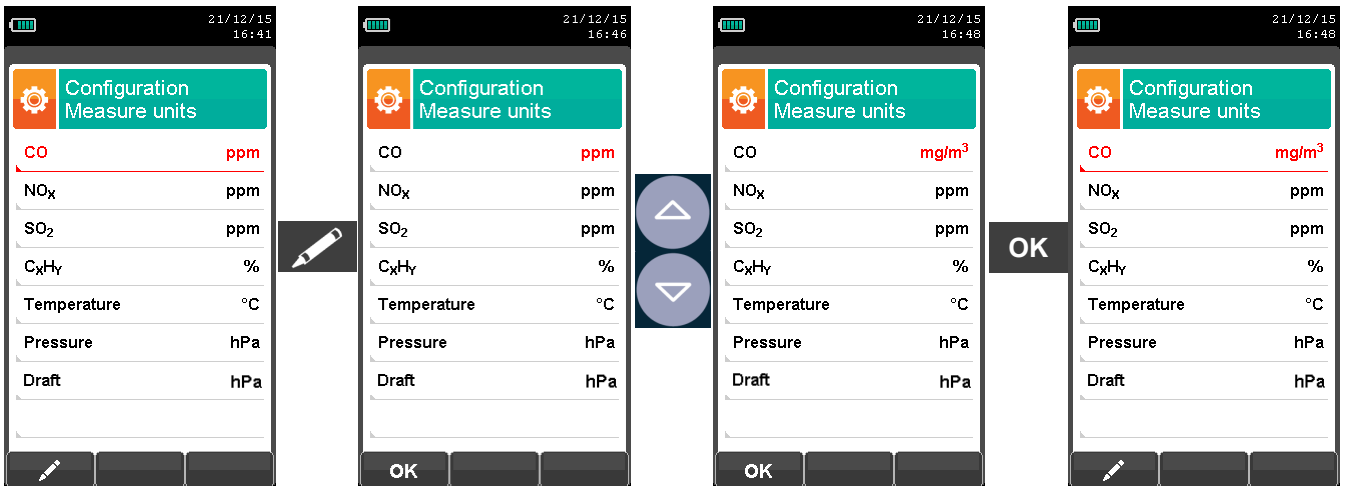
Measurement unit can be set as: hPa - Pa - mbar - mmH2O - mmHg - inH2O - psi

Measurement unit can be set as: hPa - Pa - mbar - mmH2O - mmHg - inH2O - psi

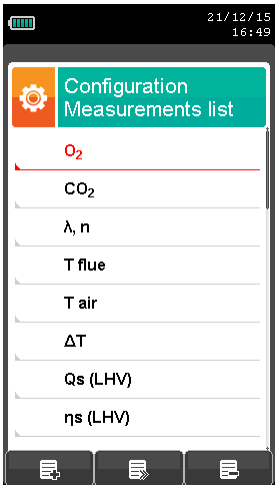
| KEY | FUNCTION |
|---|---|
|  | **Activate the context keys shown on the display.** |
|  | **Keys '▲' and '▼' select any line shown on the display (the selected line is displayed in red).**<br>**When in modify mode, sets the desired value.** |
|  | **Enters edit mode of the selected element and then confirms the change.** |
|  | **When pressed in modify mode cancels the selection made, otherwise returns to the previous screen.** |

| CONTEXT KEY | FUNCTION |
|---|---|
|  | **Enters the modification mode for the selected parameter.** |
|  | **Confirms the modification.** |

Example:



## 9.2.6 Configuration→Analysis→Measures list

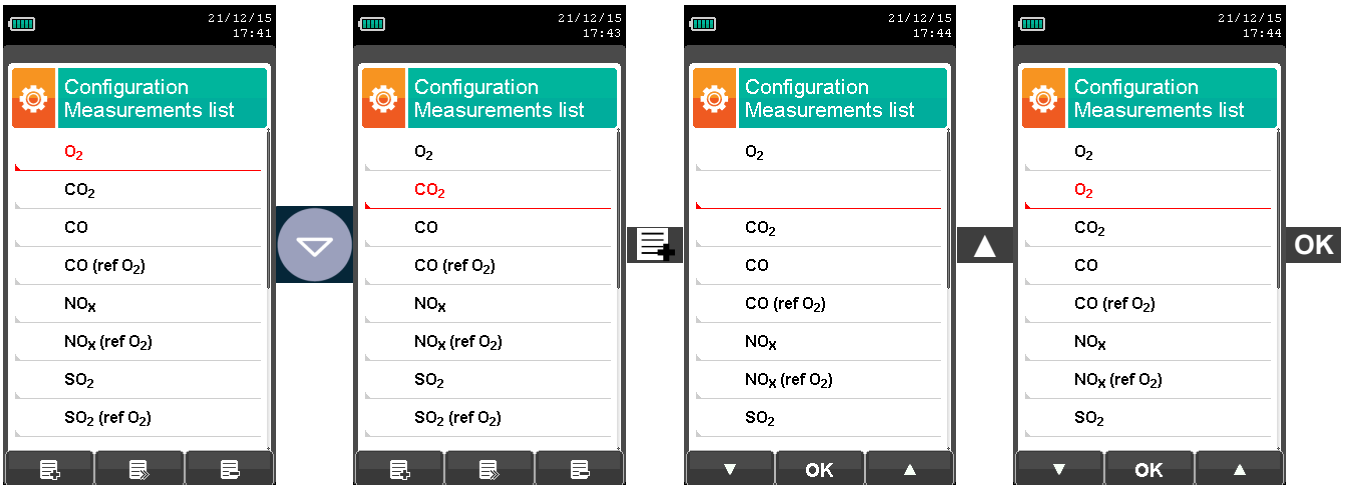



| KEY | FUNCTION |
|---|---|
|  | Activate the context keys shown on the display. |
|  | Select each line displayed (the line selected is red).<br>In edit mode, it sets the desired value. |
|   | When pressed in modify mode cancels the selection made, otherwise returns to the previous screen. |

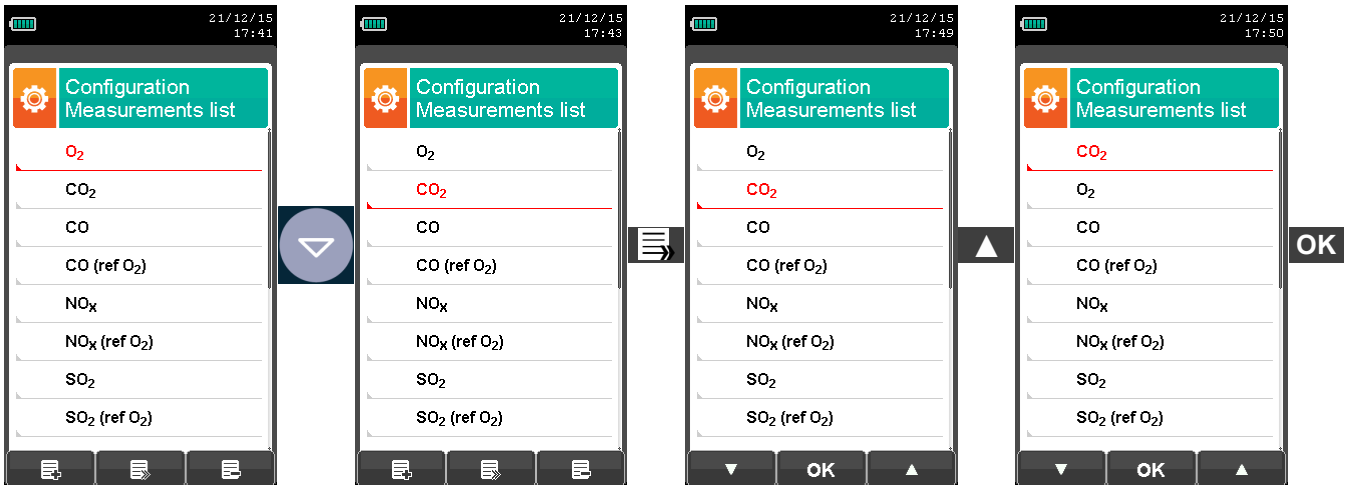
| CONTEXT KEY | FUNCTION |
|---|---|
|  | Adds a line to the list of available measurements. |
|  | Activates the movement of a measurement from its current position. |
|  | Deletes a measurement from the list of available measurements. |
|  | After the activation of the function '  '.<br>It scrolls through the available measurements.<br>After the activation of the function '  '.<br>It moves the element from its current position. |
| OK | Confirms the operation. |
| Esc | Cancels the operation. |

## Example:

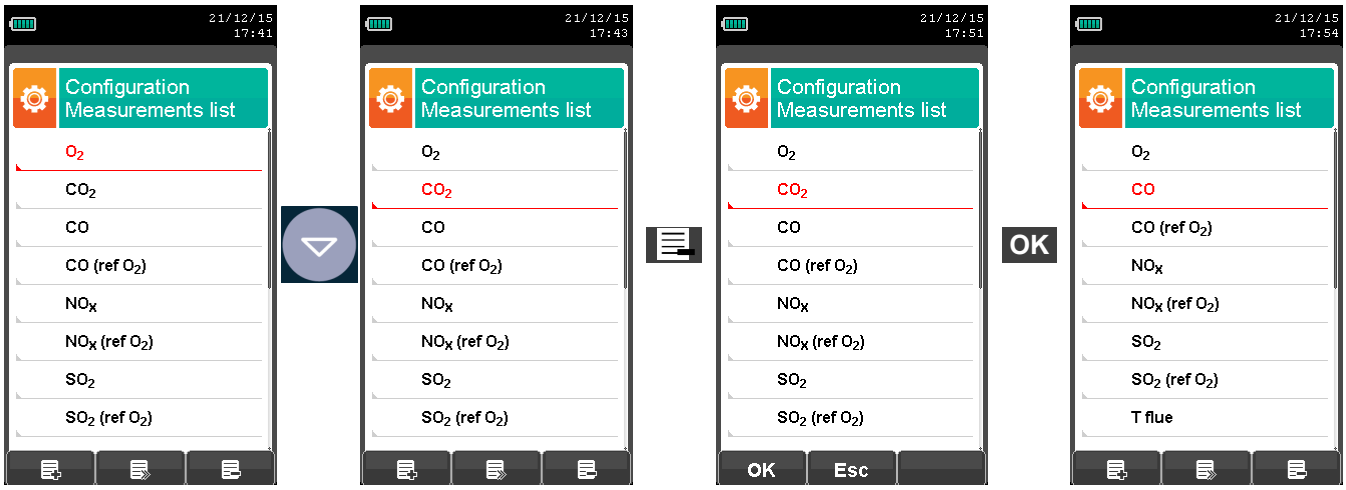
### 1. Add a measurement to the list - example



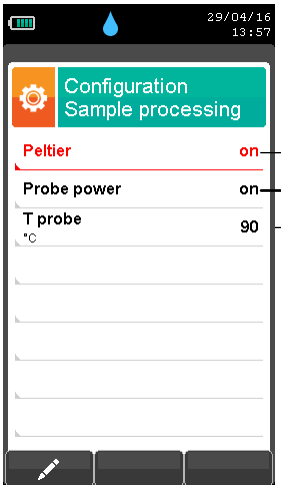

### 2. Change the position of a measurement - example




### 3. Delete a measurement from the list - example



## 9.2.7 Configuration→Analysis→Sample processing




Available settings: on (Cooler is switched on) or off (Cooler is switched off).

Available settings: on (Heated Tube and Probe are switched on) or off (Heated Tube and Probe are switched off).

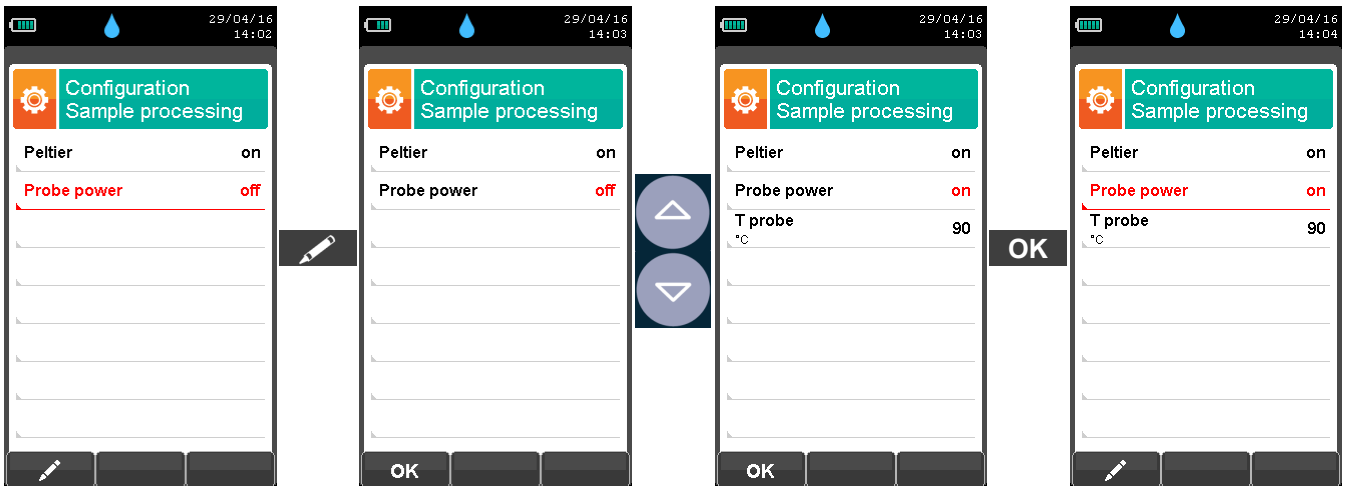
Heated tube and heated head probe temperature: 90°C .. 130°C.

**WARNING**
**The activation of the Cooler system is indicated on the display with the icon "💧"**

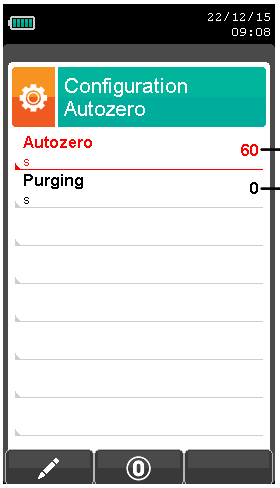
| KEY | FUNCTION |
|---|---|
|  | **Activate the context keys shown on the display.** |
|  | **The arrows '▲' and '▼' select each line displayed (the selected line is highlighted in red ).**<br>**When in modify mode, sets the desired value.** |
|  | **Enters the modify mode, then confirms the modification.** |
|  | **When pressed in modify mode, it cancels the selection made or returns to the previous screen.** |

| CONTEXT KEY | FUNCTION |
|---|---|
|  | **Enters the modification mode for the selected parameter.** |
| OK | **Confirms the modification.** |

Example:



## 9.2.8 Configuration→Analysis→Autozero



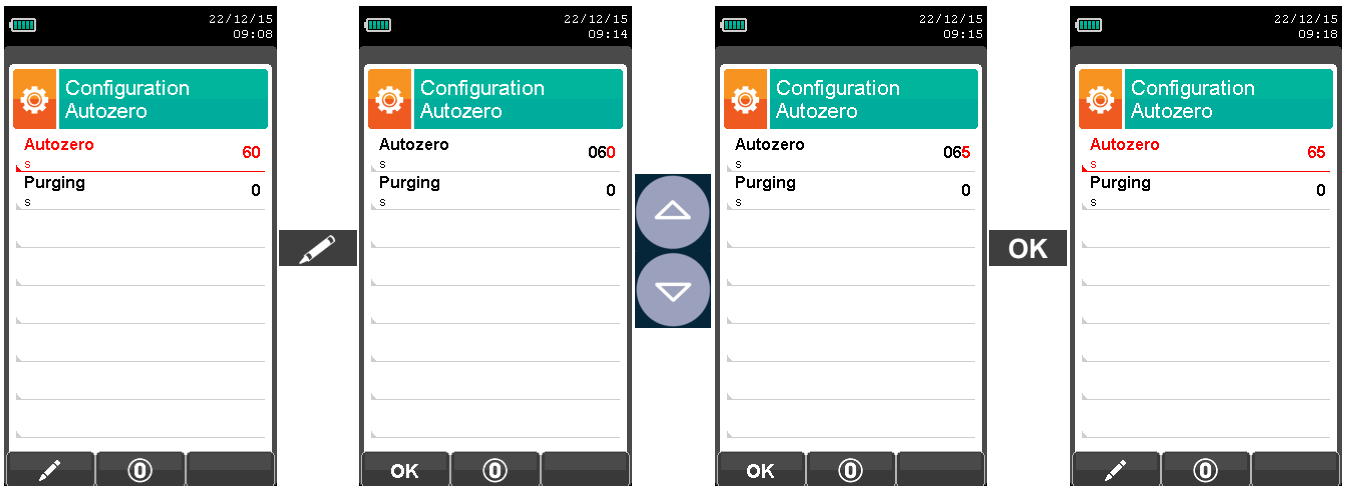

Duration of autozero, expressed in seconds.

Duration of the cleaning cycle, expressed in seconds.

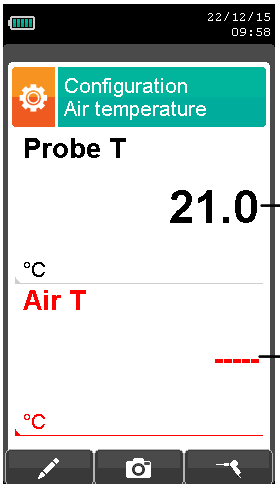
| KEY | FUNCTION |
|---|---|
|  | **Activate the context keys shown on the display.** |
|  | **The arrows '▲' and '▼' select each line displayed (the selected line is highlighted in red ).**<br>**When in modify mode, sets the desired value.** |
|  | **Enters edit mode of the selected element and then confirms the change.** |
|  | **When pressed in modify mode cancels the selection made, otherwise returns to the previous screen.** |

| CONTEXT KEY | FUNCTION |
|---|---|
|  | **Enters the modify menu for the selected parameter.** |
|  | **Confirms the modification.** |
|  | **Starts autozero for the selected duration.** |

Example:



## 9.2.9 Configuration→Analysis→Air temperature



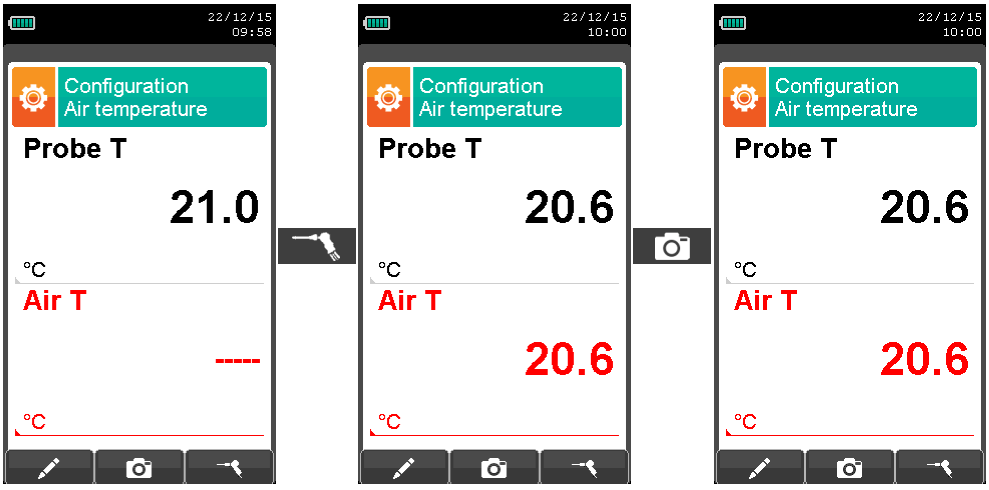

Combustion air temperature detected by the Tc-K probe connected to the T1 connector. If the probe is not connected, a sensor error is displayed.

Combustion air temperature entered manually or detected by the Tc-K probe.

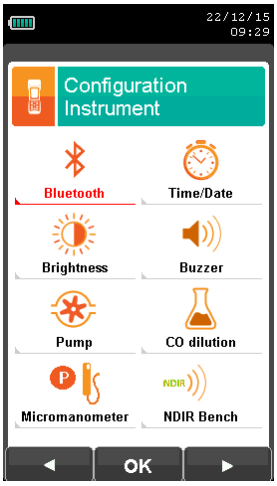
| KEY | FUNCTION |
|---|---|
|  | **Activate the context keys shown on the display.** |
|  | **When in modify mode, sets the desired value.** |
|  | **Activates the context key located in the left side of the display.** |
|  | **Returns to the previous screen without saving the changes made.** |

| CONTEXT KEY | FUNCTION |
|---|---|
|  | **Enters the modify mode for the "Air T" parameter: the user can set the required air temperature value to be be used during the combustion analysis.** |
|  | **Saves the value acquired or entered in the "Air T" parameter.** |
|  | **Acquires the temperature value detected by the flue gas sampling probe. This value is shown on the "Air T" parameter.** |
| OK | **Confirms the modification .** |

Example:



## 9.3 Configuration→Instrument



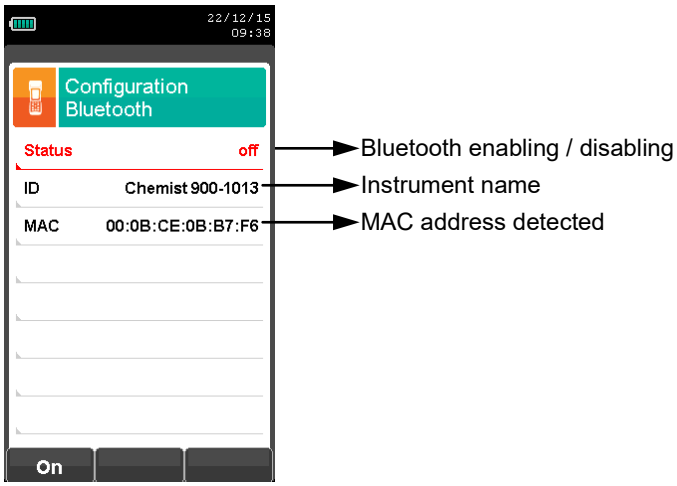

| KEY | FUNCTION |
|---|---|
|  | **Activate the context keys shown on the display.** |
|  | **Returns to the previous screen.** |

| CONTEXT KEY | FUNCTION |
|---|---|
| ◄ | **Selects the available parameters.** |
| OK | **Enters in the selected parameter setting.** |
| ► | **Selects the available parameters.** |

| PARAMETER | DESCRIPTION |
|---|---|
| Bluetooth | Through this sub menu the user can turn on and off the instrument Bluetooth wireless communication with a PC or PDA.<br>**SEE SECTION 9.3.1.** |
| Time/Date | This allows the current time and date to be set. The user can select the date and hour format either in EU (European) or USA (American) mode.<br>**SEE SECTION 9.3.2.** |
| Brightness | The display brightness may be increased or decreased by acting on cursor keys. This operation may be performed even when the introductory screen is active.<br>**SEE SECTION 9.3.3.** |
| Buzzer | The instrument is fitted with an internal buzzer which is mainly used to signal any faults and/or alarms. In this submenu you can enable or disable the buzzer or enable it and mute the key tones.<br>**SEE SECTION 9.3.4.** |
| Pump | In this submenu you can access the settings of the fumes suction pump and the peristaltic pump.<br>**SEE SECTION 9.3.5.** |
| CO dilution | The CO sensor is protected by a pump which, in case of need, can inject clean air in the gas path in order to dilute the gas concentration measured by the sensor. This function can be either triggered by the overcoming of a CO concentration threshold which can be set by the user or, in case it is known that the flue gases contain high CO concentration, kept enabled any time, independently of CO concentration.<br>**The activation of the dilution pump is shown on the display by the icon " ".**<br>**THE MAIN PURPOSE CO AUTO-DILUTION FEATURE IS FOR PROTECTION OF THE CO SENSOR AGAINST OVER-SATURATION. THE ACCURACY AND RESOLUTION OF THE CO MEASUREMENT IS NOT AS GREAT WHEN THIS FEATURE IS ENABLED.**<br>**SEE SECTION 9.3.8.** |

| PARAMETER | DESCRIPTION |
|---|---|
|  Micromanometer | Allows to configure the micromanometer input (optional) as P+ or P- port. In case P- is selected, the sign of pressure is inverted. SEE SECTION 9.3.9. |
|  NDIR bench | Allows to enable (on) or disabile (off) the NDIR bench. SEE SECTION 9.3.10. |

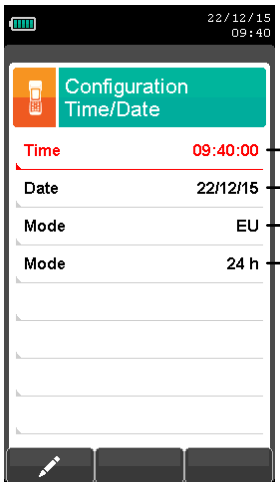
### 9.3.1 Configuration→Instrument→Bluetooth




| KEY | FUNCTION |
|---|---|
|  | **Activate the context keys shown on the display.** |
|  | **Also activates the context key shown on the display.** |
|  | **Returns to the previous screen.** |

| CONTEXT KEY | FUNCTION |
|---|---|
| on | **Turns on Bluetooth communication.** |
| off | **Turns off Bluetooth communication.** |

## 9.3.2 Configuration→Instrument→Time/Date

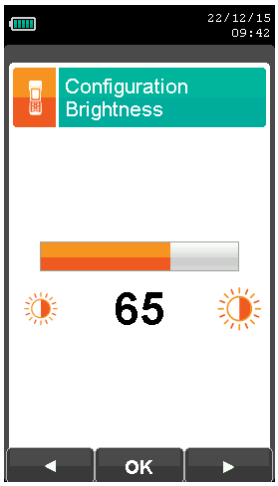



→ Time, in the chosen format
→ Date, in the chosen format
→ Date format: EU (Europe) or USA (America)
→ Time format: 24h or 12h

| KEY | FUNCTION |
|---|---|
|  | **Activate the context keys shown on the display.** |
|  | **The arrows '▲' e '▼' select each line displayed (the selected line is highlighted in red).**<br>**When in modify mode, sets the desired value.** |
|  | **Enters edit mode of the selected element and then confirms the change.** |
|  | **When pressed in modify mode cancels the selection made, otherwise returns to the previous screen.** |

| CONTEXT KEY | FUNCTION |
|---|---|
|  | **Enters edit mode of the selected parameter.** |
|  | **Confirms the modification.** |

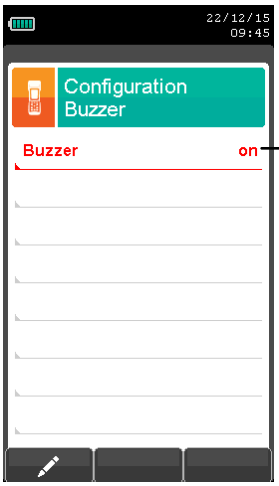
### 9.3.3 Configuration→Instrument→Brightness




| KEY | FUNCTION |
|---|---|
|  | Activate the context keys shown on the display. |
|  | Increases or decreases the brightness of the display. |
|   | Confirms the modification. |
|   | When pressed in modify mode cancels the selection made, otherwise returns to the previous screen. |

| CONTEXT KEY | FUNCTION |
|---|---|
| ◄ | Decreases the brightness of the display. |
| OK | Confirms the setting. |
| ► | Increases the brightness of the display. |

## 9.3.4 Configuration→Instrument→Buzzer




Available settings :

**on**: the buzzer is enabled (key tones and signalling of faults/alarms are enabled ).

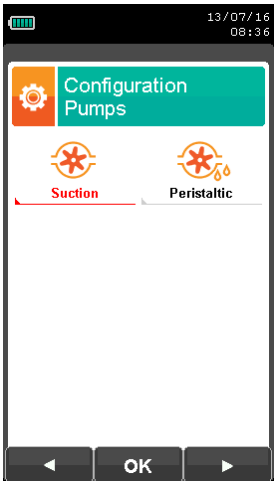
**limited**: the buzzer is enabled in a limited mode (key tones are disabled, while signalling of faults/alarms is enabled).

**off**: the buzzer is disabled.

| KEY | FUNCTION |
|---|---|
|  | **Activate the context keys shown on the display.** |
|  | **When in modify mode, sets the desired value.** |
|   | **Enters edit mode of the selected element and then confirms the change.** |
|   | **When pressed in modify mode cancels the selection made, otherwise returns to the previous screen.** |

| CONTEXT KEY | FUNCTION |
|---|---|
|  | **Enters edit mode of the selected parameter.** |
|   | **Confirms the modification.** |

## 9.3.5 Configuration→Instrument→Pumps

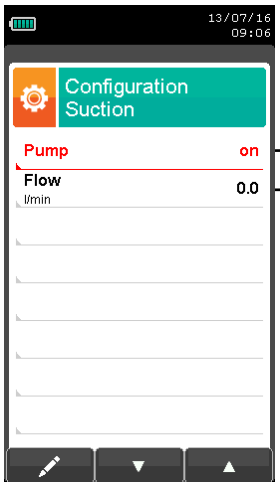



| KEY | FUNCTION |
|---|---|
|  | **Activate the context keys shown on the display.** |
|  | **Back to the previous screen.** |

| CONTEXT KEY | FUNCTION |
|---|---|
| ◄ | **Select the available parameters.** |
| OK | **Enter the selected parameter.** |
| ► | **Select the available parameters.** |

| PARAMETER | DESCRIPTION |
|---|---|
| Suction | In this submenu you can turn on and off the fumes suction pump. Also, if the pump is on, it is possible to view and modify the pump flow measured in liters per minute.<br>It will not be possible to turn off the pump if the auto-zero cycle is currently running.<br>**SEE SECTION 9.3.6.** |
| Peristaltic | In this submenu it is possible to set the off interval of the peristaltic pump.<br>**SEE SECTION 9.3.7.** |

## 9.3.6 Configuration→Instrument→Pumps→Suction



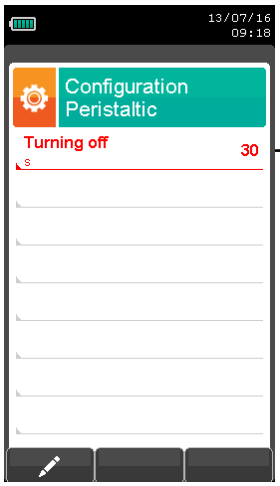

Available options: on (pump switched on) or off (pump switched off).

Display of the pump's flow, expressed in Liters per minute. The data is modifiable in the range (1.4 .. 2.2).

| KEY | FUNCTION |
|---|---|
|  | **Activate the context keys shown on the display.** |
|  | **When in modify mode, sets the desired value.** |
|   | **Enters edit mode of the selected element and then confirms the change.** |
|   | **When pressed in modify mode cancels the selection made, otherwise returns to the previous screen.** |

| CONTEXT KEY | FUNCTION |
|---|---|
|  | **Activates edit mode: it is possible to turn on / off the fumes suction pump.** |
| OK | **Confirm the option selected.** |
| ▼ | **Holding down the key, decreases the pump's flow.** |
| ▲ | **Holding down the key, increases the pump's flow.** |

## 9.3.7 Configuration→Instrument→Pumps→Peristaltic

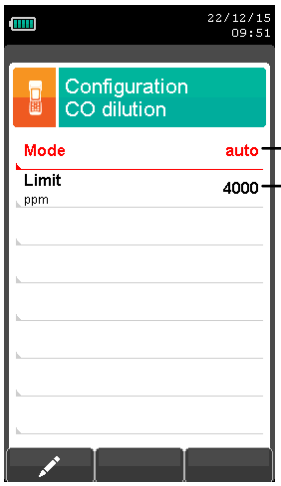



→ Power-off time configurable in the range 30 .. 3600 seconds.

| KEY | FUNCTION |
|---|---|
|  | **Activate the context keys shown on the display.** |
|  | **When in modify mode, sets the desired value.** |
|   | **Enters edit mode of the selected element and then confirms the change.** |
|   | **When pressed in modify mode cancels the selection made, otherwise returns to the previous screen.** |

| CONTEXT KEY | FUNCTION |
|---|---|
|  | **Edit mode: it is possible to set the range of time while the peristaltic pump remains disabled.** |
| OK | **Confirms the modification.** |

## 9.3.8 Configuration→Instrument→CO dilution




Available settings: auto, on or off

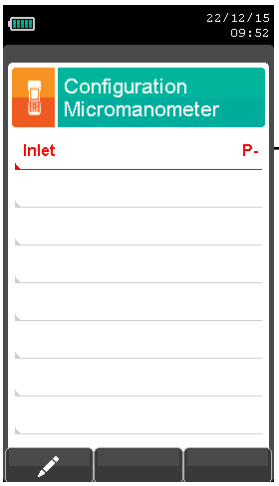
Threshold that activates the dilution pump (available only if the "Mode" parameter is set to "auto".

**WARNING**
**'The activation of the dilution pump is shown on the display by the icon " ".**

| KEY | FUNCTION |
|---|---|
|  | **Activate the context keys shown on the display.** |
|  | **Select each line displayed (the line selected is red).**<br>**In edit mode, it sets the desired value.** |
|   | **Enters edit mode of the selected element and then confirms the change.** |
|   | **When pressed in modify mode cancels the selection made, otherwise returns to the previous screen.** |

| CONTEXT KEY | FUNCTION |
|---|---|
|  | **Enters edit mode of the selected parameter.** |
| **OK** | **Confirms the modification.** |

## 9.3.9 Configuration→Instrument→Micromanometer

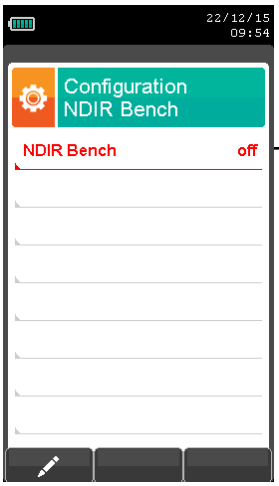



→ Sets the input used for the test: P+ or P-

| KEY | FUNCTION |
|---|---|
|  | **Activate the context keys shown on the display.** |
|  | **In edit mode, it sets the desired input.** |
|   | **Enters edit mode of the selected element and then confirms the change.** |
|   | **When pressed in modify mode cancels the selection made, otherwise returns to the previous screen.** |

| CONTEXT KEY | FUNCTION |
|---|---|
|  | **Enters edit mode of the selected parameter.** |
|   | **Confirms the modification.** |

## 9.3.10 Configuration→Instrument→NDIR bench



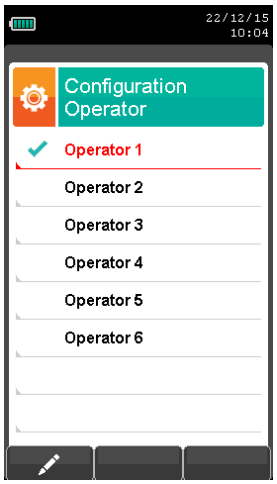

Available settings: **on**: NDIR bench is enabled - **off**: NDIR bench is disabled.

**WARNING:**
**In order to make effective the new configuration, please turn the instrument off and then on again.**

| KEY | FUNCTION |
|---|---|
|  | **Activate the context keys shown on the display.** |
|  | **In edit mode, it sets the desired input.** |
|   | **Enters edit mode of the selected element and then confirms the change.** |
|   | **When pressed in modify mode cancels the selection made, otherwise returns to the previous screen.** |

| CONTEXT KEY | FUNCTION |
|---|---|
|  | **Enters edit mode of the selected parameter.** |
|   | **Confirms the modification.** |

## 9.4 Configuration→Operator

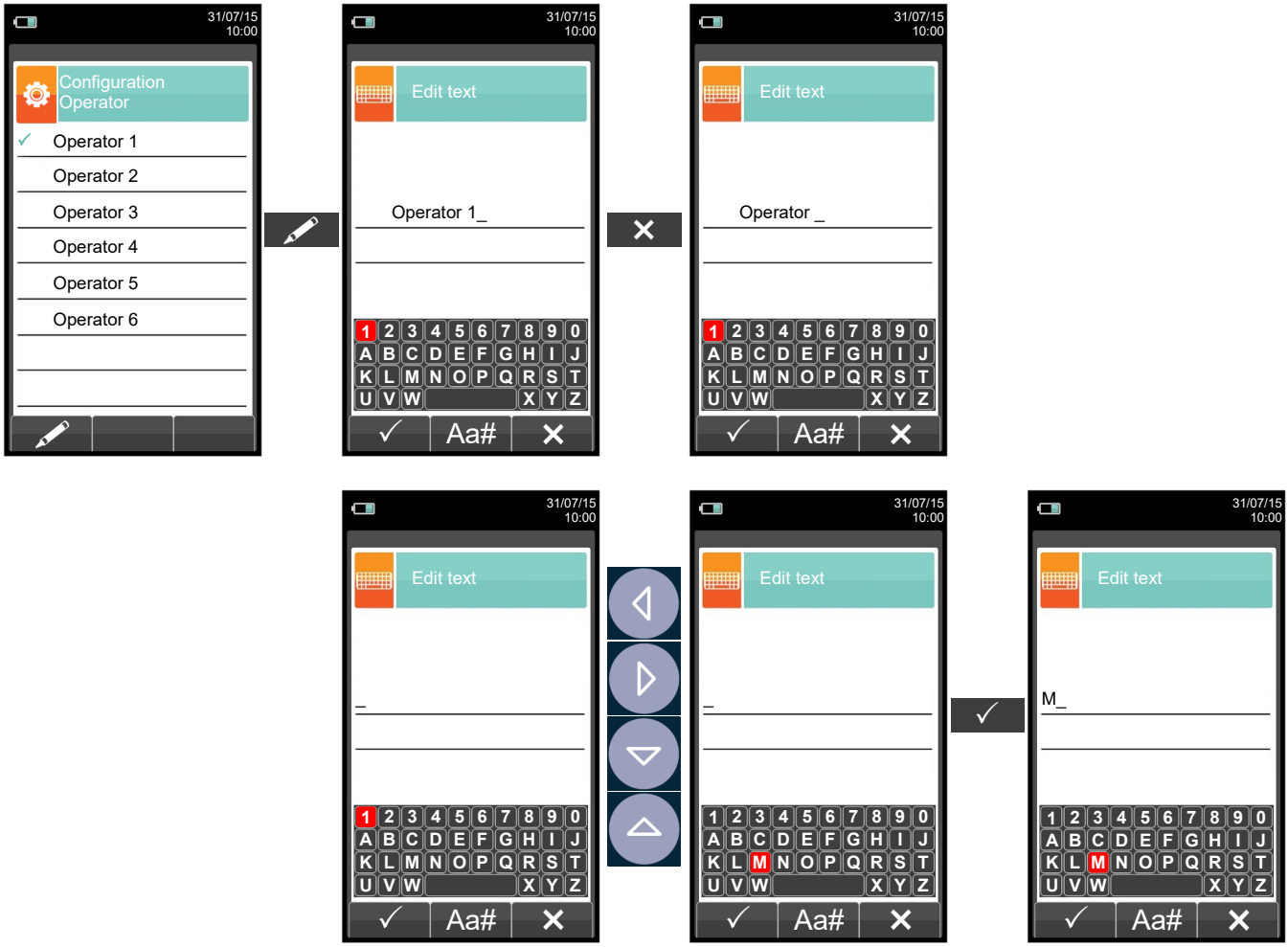



| KEY | FUNCTION |
|---|---|
|  | Activate the context keys shown on the display. |
|  | In "edit text": Moves the cursor on the box corresponding to the letter or number required to form the word. |
|  | In "Operator Configuration": Scrolls through the available operators. |
|  | In "edit text": Confirms text input.<br>In "Operator Configuration": selects the operator who will carry out the analysis; the operator is highlighted with the symbol "✓". |
|  | Returns to the previous screen.<br>In "edit text" mode returns to the previuous screen without saving the changes. |

| CONTEXT KEY | FUNCTION |
|---|---|
|  | Enters edit mode of the selected line: it is possible to enter the name of the operator (24 characters available). |
|  | Confirms the selected letter or digit. |
|  | Cancels the letter or digit before the cursor. |
|  | Cycles through uppercase, lowercase, symbols and special characters. |

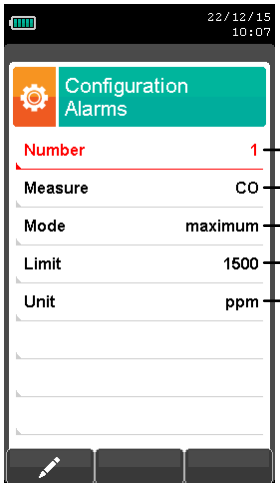
## Example:

### 1. Edit text

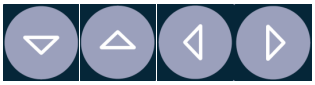



### 2. Select the operator who will carry out the analysis

## 9.5 Configuration→Alarms

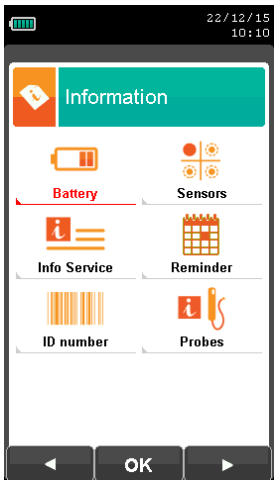



- Number of the alarm set
- Monitored parameter: $O_2$ - CO - NO - $NO_2$ - P diff - Plow - P ext - T1 - T2
- Type of alarm set: maximum - minimum - off
- Threshold setting for the alarm: ±999999.999
- Measurement unit for the threshold set: **ppm**, **mg/m$^3$**, **mg/kWh**, **g/GJ**, **g/m$^3$**, **g/kWh**, **%**

| KEY | FUNCTION |
|---|---|
|  | **Activate the context keys shown on the display.** |
|  | **Keys '▲' and '▼' select any line shown on the display (the selected line is displayed in red).**<br>**When in modify mode, sets the desired value.** |
|  | **Enters the modify mode for the selected parameter, then confirms the modification.** |
|  | **When pressed in modify mode cancels the selection made, otherwise returns to the previous screen.** |

| CONTEXT KEY | FUNCTION |
|---|---|
|  | **Enters the modify menu for the selected parameter.** |
|  | **Confirms the modification.** |

## 9.6 Configuration→Information

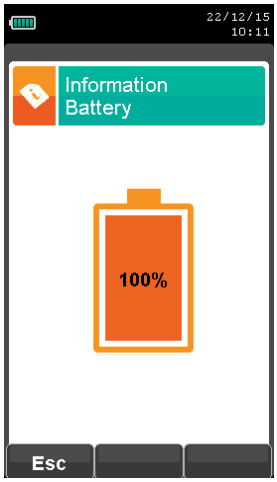



| KEY | FUNCTION |
|---|---|
|  | **Activate the context keys shown on the display.** |
|  | **Returns to the previous screen.** |

| CONTEXT KEY | FUNCTION |
|---|---|
| ◄ | **Selects the available parameters.** |
| OK | **Enters in the selected parameter setting.** |
| ► | **Selects the available parameters.** |

| PARAMETER | DESCRIPTION |
|---|---|
| Battery | Displays the current battery power status in percentage from 0 to 100%, both in text and graphically.<br>**SEE SECTION 9.6.1.** |
| Sensors | Allows to check which sensors are installed on the instrument, and in which position they are installed. The instrument automatically detects whether a sensor has been either added or removed. The screen page allows whether to accept the new configuration or ignore the change performed.<br>**SEE SECTION 9.6.2.** |
| Infoservice | This submenu contains details regarding the nearest Service Center to be contacted in the event of instrument fault or ordinary maintenance. The instrument model, serial number and firmware version are also displayed, thus allowing for a quick product identification.<br>**SEE SECTION 9.6.3.** |
| Reminder | In this menu the user can see the reminder of the instrument annual calibration that was entered in the factory or in the service center.<br>**The menu is protected by the following password: " 2908 ".**<br>**SEE SECTION 9.6.4.** |
| ID number | Not available. |
| Probes | Displays useful information about the probe connected to the serial cable shown in **13** in section 5.0 'Description of Components'.<br>**SEE SECTION 9.6.5.** |

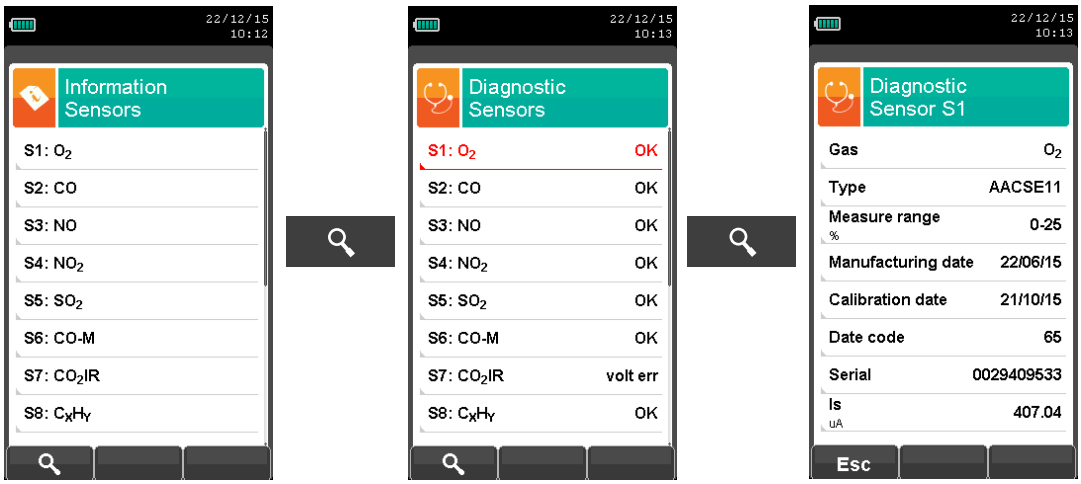
### 9.6.1 Configuration→Information→Battery




| KEY | FUNCTION |
|---|---|
|  | **Activate the context keys shown on the display.** |
|   | **Returns to the previous screen.** |

| CONTEXT KEY | FUNCTION |
|---|---|
| Esc | **Returns to the previous screen.** |

## 9.6.2 Configuration→Information→Sensors




**For further information see section 9.7.**

| KEY | FUNCTION |
|---|---|
|  | **Activate the context keys shown on the display.** |
|  | **Returns to the previous screen.** |

| CONTEXT KEY | FUNCTION |
|---|---|
|  | **Displays the details of the main features of the sensors installed.** |
|  | **Returns to the previous screen.** |

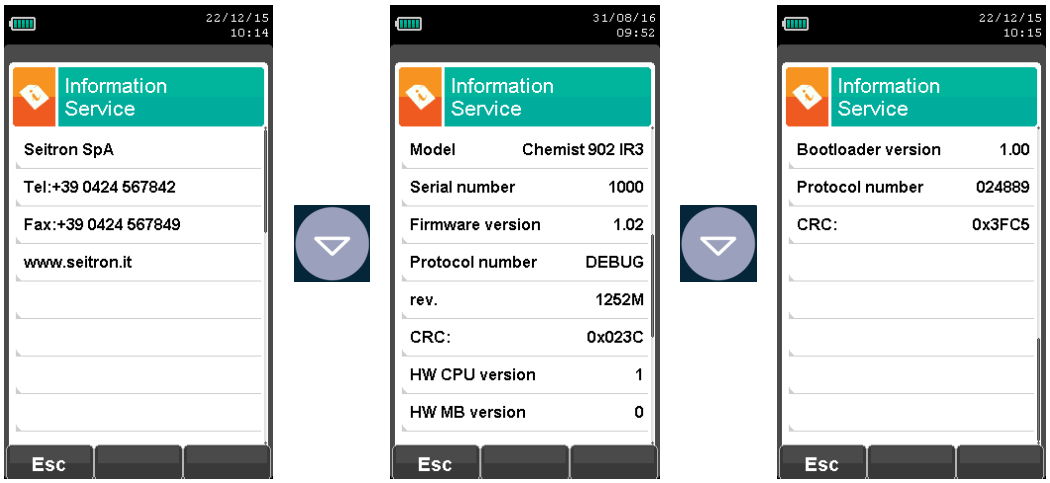
**This screen displays, for each position, the following messages:**

| MESSAGE | DESCRIPTION |
|---|---|
| **OK** | **Sensor configured OK (normal operation).** |
| **-----** | **Sensor is not communicating or has been removed. For sensors in positions 10, 11 and 12: NDIR bench is not installed or has been disabled .** |
| ***The name of the detected gas is flashing*** | **New sensor detected.** |
| **Pos err** | **Detected sensor in wrong position.** |
| **Volt err** | **Detected voltage is out of the normal operating range; repeat the autozero.** |
| **Curr err** | **Detected current is out of the normal operating range; repeat the autozero.** |
| **Err autozero** | **NDIR bench autozero failed.** |

**Error messages displayed:**

| MESSAGE | DESCRIPTION |
|---|---|
| **Cal err** | **Calibration error.** |
| **Data err** | **Sensor not recognized.** |
| **No cal** | **Sensor not calibrated.** |

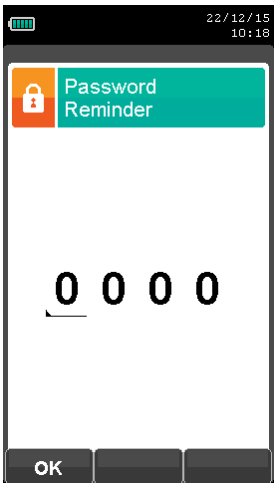
## 9.6.3 Configuration→Information→InfoService

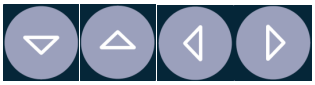



| KEY | FUNCTION |
|---|---|
|  | **Activate the context keys shown on the display.** |
|   | **Returns to the previous screen.** |

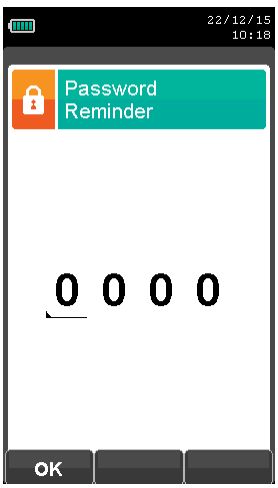
| CONTEXT KEY | FUNCTION |
|---|---|
| Esc | **Returns to the previous screen.** |

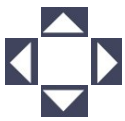
## 9.6.4 Configuration→Information→Reminder




| KEY | FUNCTION |
|---|---|
|  | **Activate the context keys shown on the display.** |
|  | **Sets the password to access the remainder menu.<br>The password is: 2908.** |
|  | **Returns to the previous screen.** |

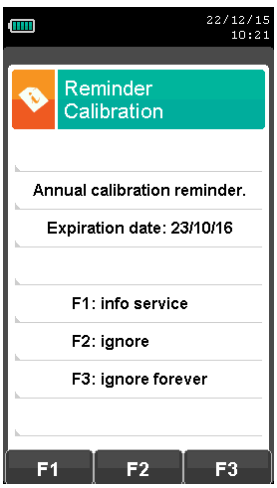
| CONTEXT KEY | FUNCTION |
|---|---|
| OK | **Shows details about the main features of the sensors installed.** |
| Esc | **Returns to the previous screen.** |
| F1 | **Shows all information relevant to service center.** |
| F2 | **Temporarily ignores the message. At next turn-on of the instrument the reminder will be shown again.** |
| F3 | **Ignores the message permanently.** |



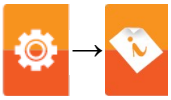



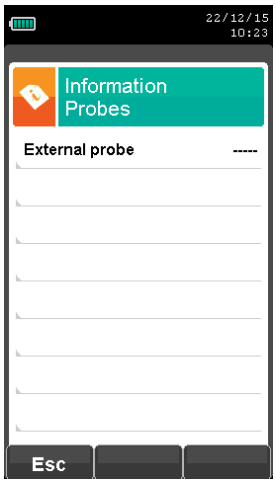
Enter the password for the reminder menu ' **2908** '


OK



## 9.6.5 Configuration→Information→Probes

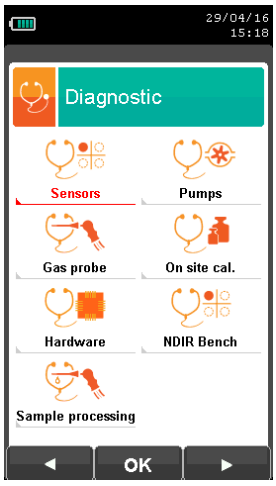





| KEY | FUNCTION |
|---|---|
|  | **Activate the context keys shown on the display.** |
|  | **Returns to the previous screen.** |

| CONTEXT KEY | FUNCTION |
|---|---|
|  | **Returns to the previous screen.** |

## 9.7 Configuration→Diagnostic

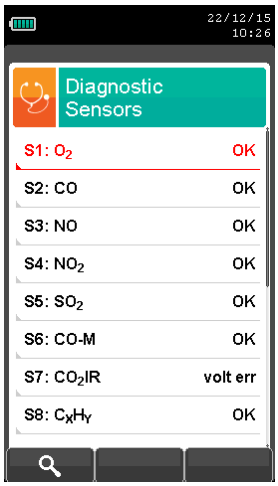



| KEY | FUNCTION |
|---|---|
|  | **Activate the context keys shown on the display.** |
|  | **Returns to the previous screen.** |

| CONTEXT KEY | FUNCTION |
|---|---|
| ◄ | **Selects the available parameters.** |
| OK | **Enters in the selected parameter setting.** |
| ► | **Selects the available parameters.** |

| PARAMETER | DESCRIPTION |
|---|---|
| Sensors | Displays information on the state and calibration of the electrochemical sensors:<br>**Ok** No problem detected<br>**absent** The sensor was not detected<br>**err data** Memory data error of the sensor<br>**unknown** It is necessary to update the FW of the device<br>**err pos** The sensor has been installed in the wrong position<br>**err cal** Calibration error (sensor not calibrated)<br>**err curr** Currents outside the range<br>**err cfg** Do not use this sensor as it has not been accepted on the screen "types of sensors".<br>Also, from this screen the user can access the identification data of the sensor: type, serial number, date of manufacture and calibration. There are also the measured currents; in this way it is possible to perform a quick diagnosis in the event of a malfunction.<br>**SEE SECTION 9.8.** |
| Pumps | The user can access to the management of the flue gas sampling pump and the peristaltic pump.<br>**SEE SECTION 9.9.** |
| Gas probes | Allows to check the tightness of the flue sampling probe.<br>**SEE SECTION 9.10.** |
| On site cal. | It is possible to make a recalibration of the instrument's gas sensors with suitable known concentration gas cylinders. Recalibration of Oxygen ($O_2$) sensor is not availbale since it is already recalibrated during every autozero sequence.<br>**The sensors recalibration procedure is protected with the password ' 2908 '.**<br>**SEE SECTION 9.11.** |
| Hardware | At instrument turn on the firmware performs a full check on the physical efficiency of all types of HW memories installed on the instrument, as well as on the integrity of the data stored into them. Any issue is displayed in the screen 'Memories Diagnostics'. Should this happen it is advisable to turn the instrument off and then on again. In case the problem is permanent or frequently recurring, the user should contact the Service Center reporting the error code shown by the instrument.<br>**SEE SECTION 9.12.** |
| NDIR Bench | The user can check the status of the infrared bench NDIR.<br>**SEE SECTION 9.13.** |
| Sample processing | The user can check the status of the heated line (heated tube, heated head and Peltier cell unit).<br>**SEE SECTION 9.14.** |

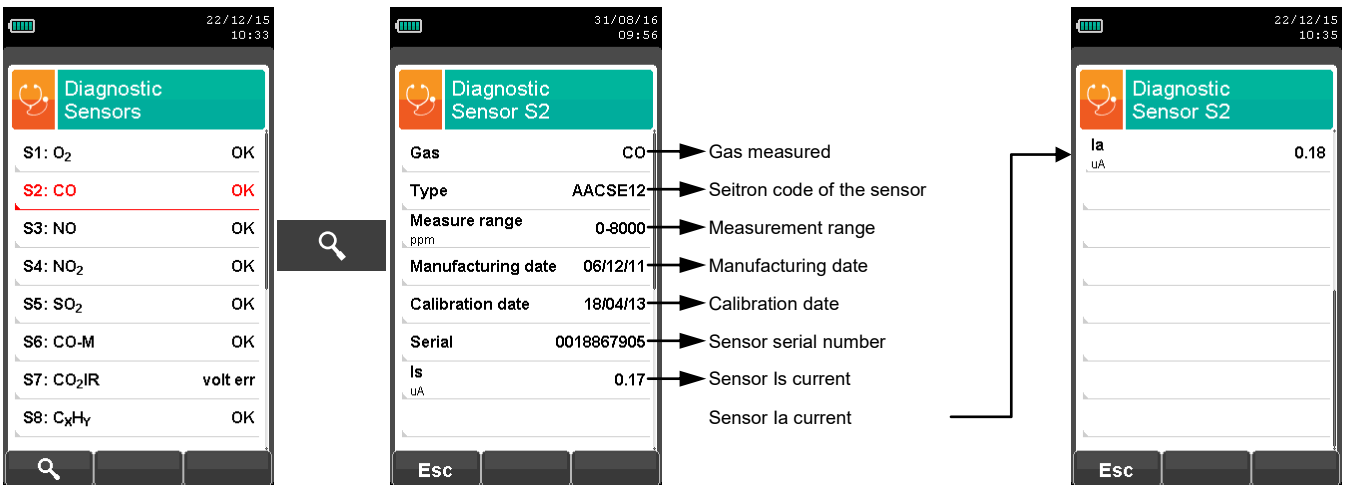
## 9.8 Configuration→Diagnostic→Sensors



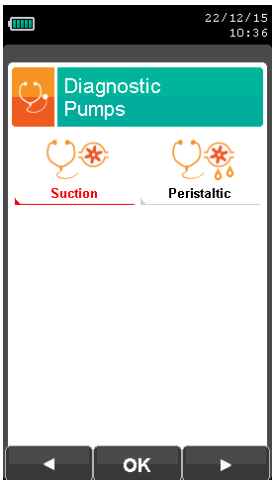

| KEY | FUNCTION |
|---|---|
|  | **Activate the context keys shown on the display.** |
|  | **Selects the fuel.** |
|   | **Activates the context keys located in the left side of the display.** |
|   | **Returns to the previous screen.** |

| CONTEXT KEY | FUNCTION |
|---|---|
|  | **Displays the details of the selected sensor (see example below).** |
|   | **Returns to the previous screen.** |

Example:



## 9.9 Configuration→Diagnostic→Pump




| KEY | FUNCTION |
|---|---|
|  | **Activate the context keys shown on the display.** |
|  | **Returns to the previous screen.** |

| CONTEXT KEY | FUNCTION |
|---|---|
| ◄ | **Selects the available parameters.** |
| OK | **Enters in the selected parameter setting.** |
| ► | **Selects the available parameters.** |

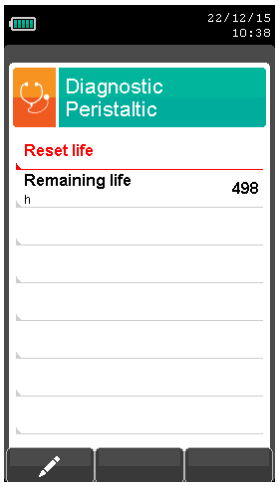
| PARAMETER | DESCRIPTION |
|---|---|
|  Suction | In this submenu the user can temporarily turn the gas suction pump on or off. Also, it is possible to view the actual flow rate of the pump in litres per minute. It will not be possible to turn off the pump during an autozero cycle. SEE SECTION 9.9.1. |
|  Peristaltic | In this submenu the remaining useful lifetime of the tube of the peristaltic pump is displayed. After replacing the tube of the peristaltic pump, perform a reset to restart the countdown of the hours of use of the tube. SEE SECTION 9.9.2. |

## 9.9.1 Configuration→Diagnostic→Suction


| KEY | FUNCTION |
|---|---|
|  | **Activate the context keys shown on the display.** |
|  | **Selects the fuel.** |
|  | **Activates the context keys located in the left side of the display.** |
|  | **Returns to the previous screen.** |

| CONTEXT KEY | FUNCTION |
|---|---|
|  | **Enters edit mode: it is possible to turn the gas suction pump on and off.** |
| OK | **Confirms the modification.** |

## 9.9.2 Configuration→Diagnostic→Peristaltic

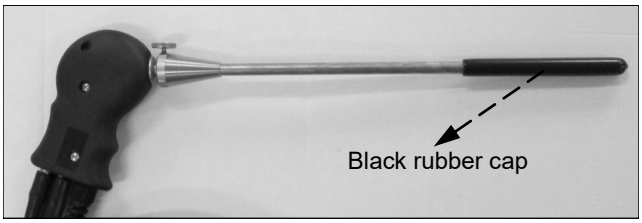



| KEY | FUNCTION |
|---|---|
|  | Activate the context keys shown on the display. |
|  | Enters in the modification mode then confirms the changes made. |
|  | Activate the context keys shown on the display. |

| CONTEXT KEY | FUNCTION |
|---|---|
|  | Enters the modify mode: you can reset the timer of the time left for replacing the tube of the peristaltic pump. |
| F1 | Resets the timer. |
| F2 | Cancels and returns to the previous screen. |

## 9.10 Configuration→Diagnostic→Gas probe

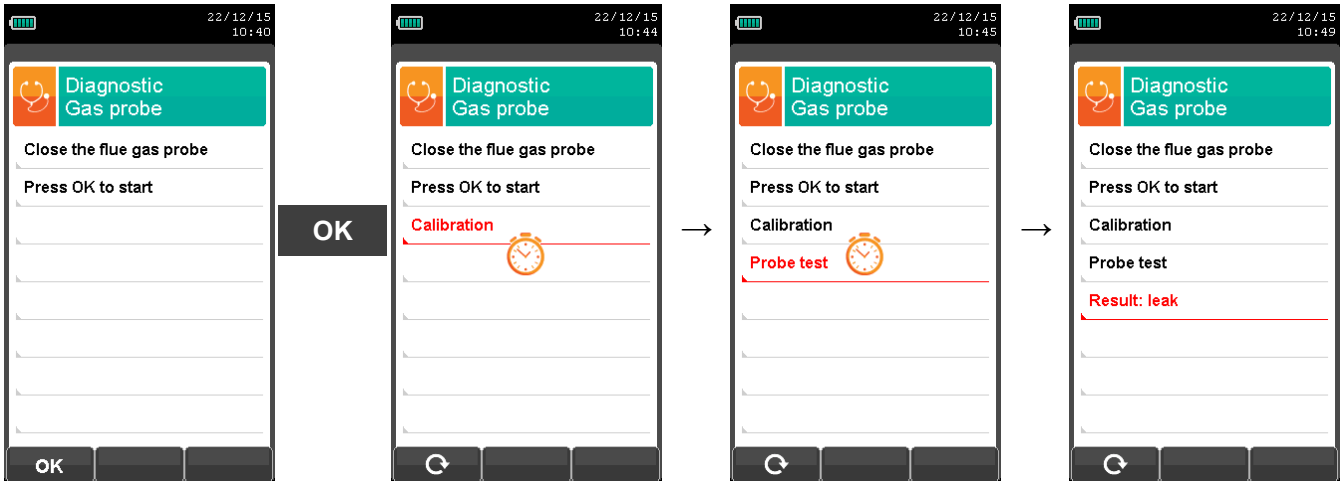

Connect the flue gas sampling probe and filter unit assembly to the instrument;
Fully insert the black rubber cap on the gas probe tip, as shown in the following picture:




| KEY | FUNCTION |
|---|---|
|  | **Activate the context keys shown on the display.** |
|  | **Activates the context key located in the left side of the display.** |
|  | **Returns to the previous screen.** |

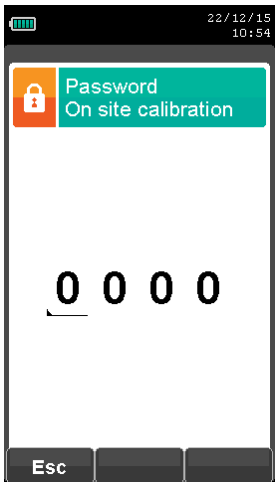
| CONTEXT KEY | FUNCTION |
|---|---|
|  | **Starts the test to check the tightness of the gas sampling probe.** |
|  | **Starts the test of the gas sampling probe.** |

**Tightness test of the probe.**




**Results:**
**Tightness**: The system is tight.
**Errore**: Make sure that the probe is connected to the input P-, check the seals of the pneumatic connections and/or the seal of the condensation trap and check that the test cap is correctly inserted on the tip of the probe. **WARNING: a damaged probe tip may impair the test.**

## 9.11 Configuration→Diagnostic→On site cal.




| KEY | FUNCTION |
|---|---|
|  | Activate the context keys shown on the display. |
|  | Sets the password. |
|  | Selects line; the selected line is displayed in red.<br>In modification sets the value or the desired mode. |
|  | Activates the context key located in the left side of the display. |
|  | Returns to the previous screen.<br>When in modify mode cancels the modification just made. |

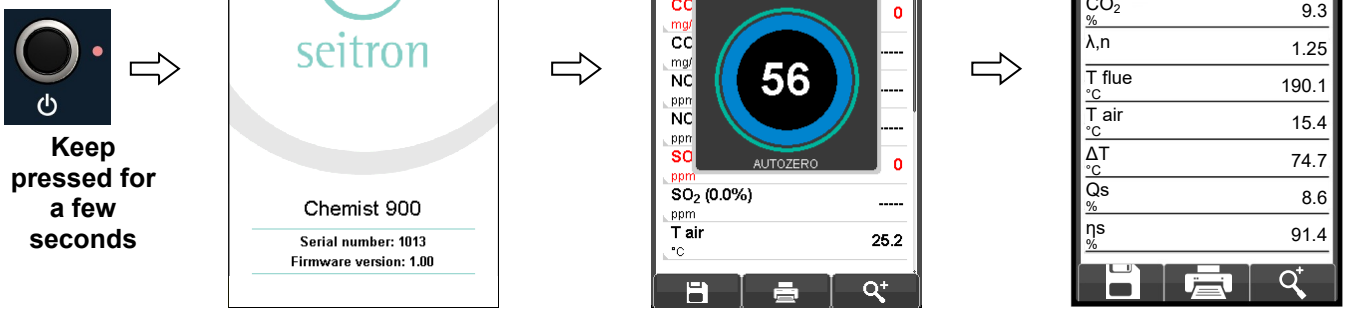
| CONTEXT KEY | FUNCTION |
|---|---|
| OK | Once password is entered, gives access to the 'On site calibration' menu. |
|  | Shows details for the selected sensor. |
|  | Zeroes the timer. |
|  | Enters the modification mode for the selected parameter. |

## Calibration procedure

To perform the recalibration the following instruments are needed:
- Known concentration gas cylinder suitable for the sensor, complete with a pressure regulator
- Flow meter
- Hose with Tee fitting to connect the cylinder to the flowmeter and to the instrument

In the following is described a recalibration example for the CO sensor.

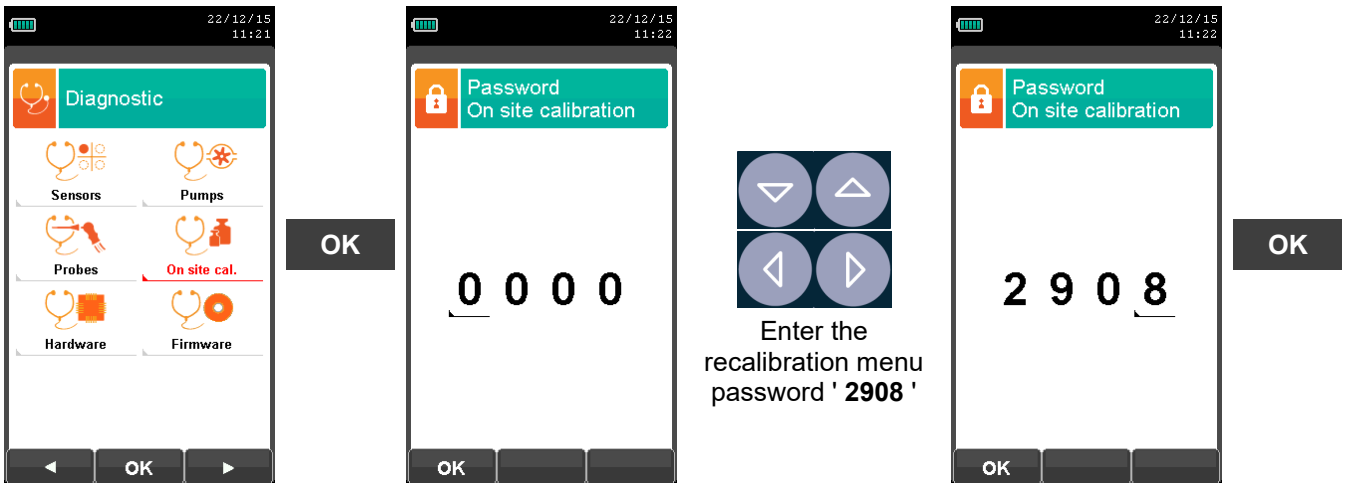
### 1. Start the instrument



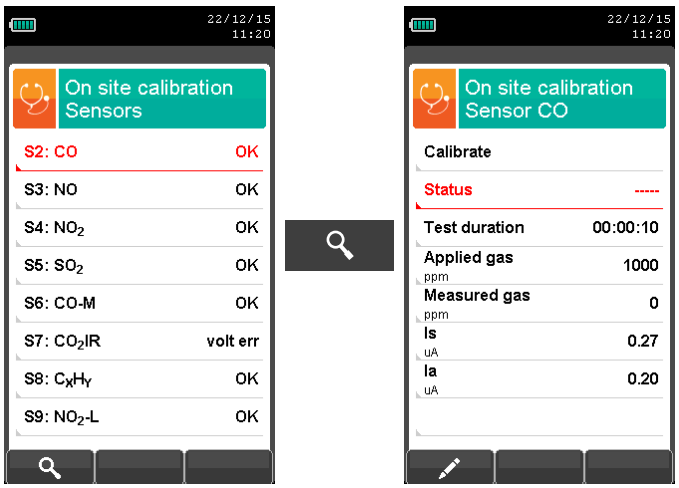

**ATTENTION**

- **Perform the autozero cycle in a clean air environment and confirm it properly completes.**
- **Do not connect the gas probe to the instrument.**
- **Check the battery charge level or connect the power adapter to avoid data loss during recalibration.**

### 2. Once autozero is completed press the key and select the diagnostic icon.



3. **Once in the 'On site calibration' menu, the list of the installed sensors for which the recalibration is available is shown. In the recalibration screen all information related to the last performed calibration is shown, as well as the relevant values.**




**Calibrate**: saves new calibration

**Status**: not active: returns to the factory calibration

active: returns to the last calibration made by the user

----: no 'on site calibration' has been previously stored

**Elapsed time**: timer

**Applied gas**: enters the concentration of the applied calibration gas

**Measured gas**: measures the concentration of the applied gas

**Is**: 'Is' current from the sensor

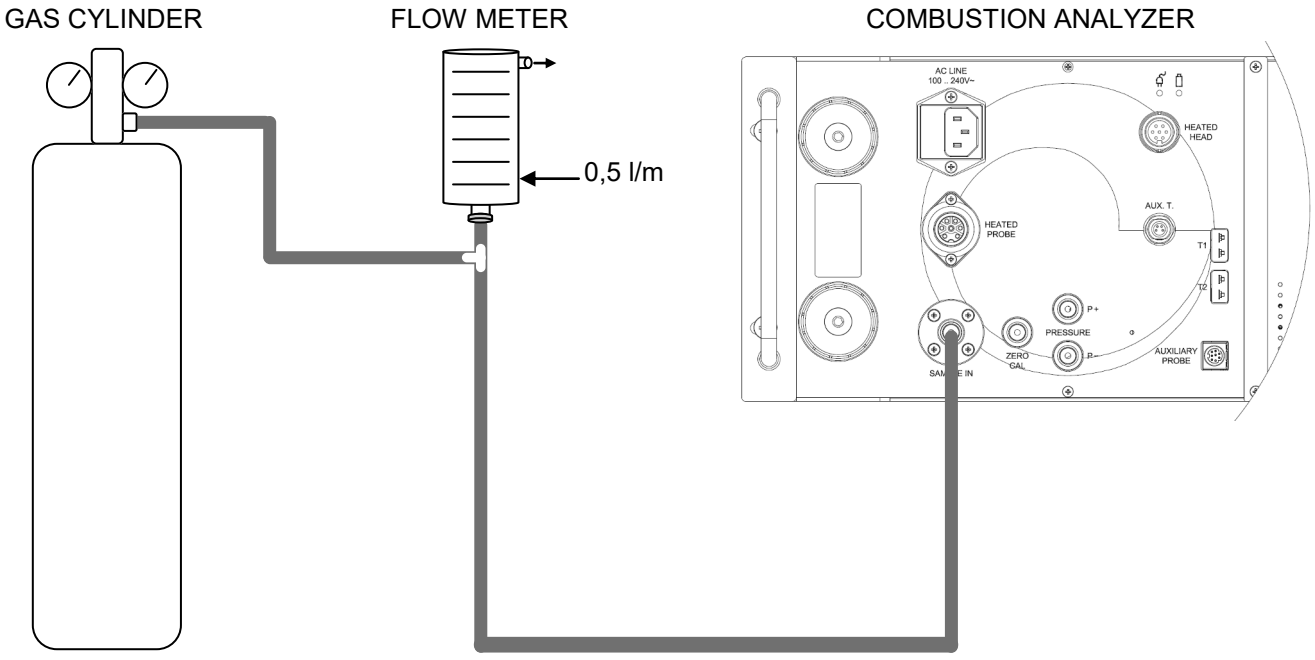
**Ia**: 'Ia' current from the sensor

4. **In the following is described in detail a recalibration example for CO sensor**.

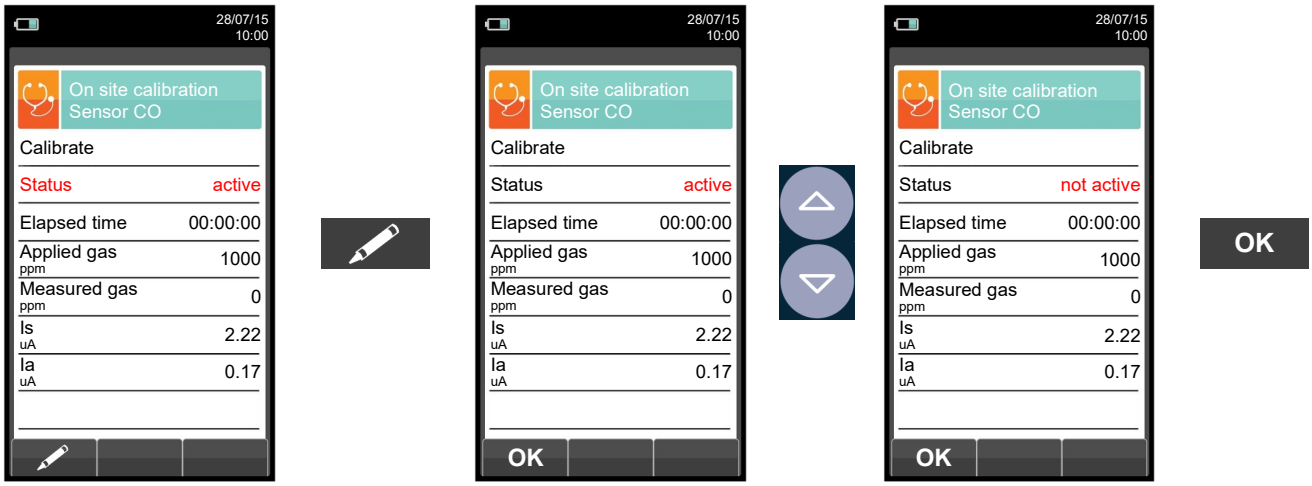
**CHOOSE THE SENSOR TO BE RECALIBRATED AND PROCEED AS DESCRIBED (CO SENSOR EXAMPLE):**

- Connect the known concentration gas cylinder to the instrument as shown in the following scheme:

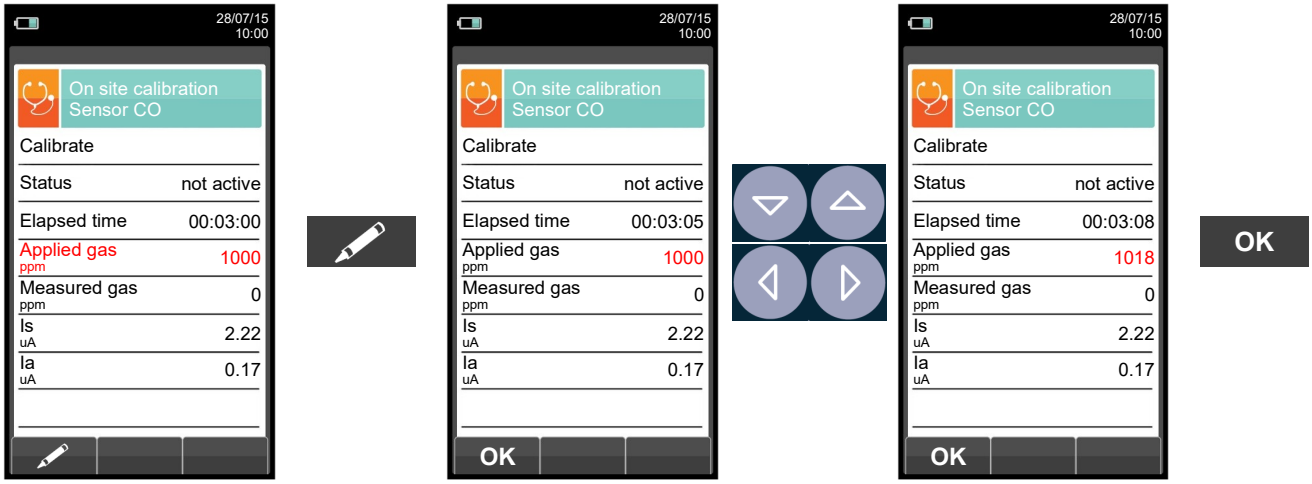
**WARNING!**
**Adequate ventilation must be provided when working with toxic gases, expecially for the outlet of the flow meter and analyzer exhaust.**



- The calibration will be possible only when the status is set to '----' or 'inactive'.

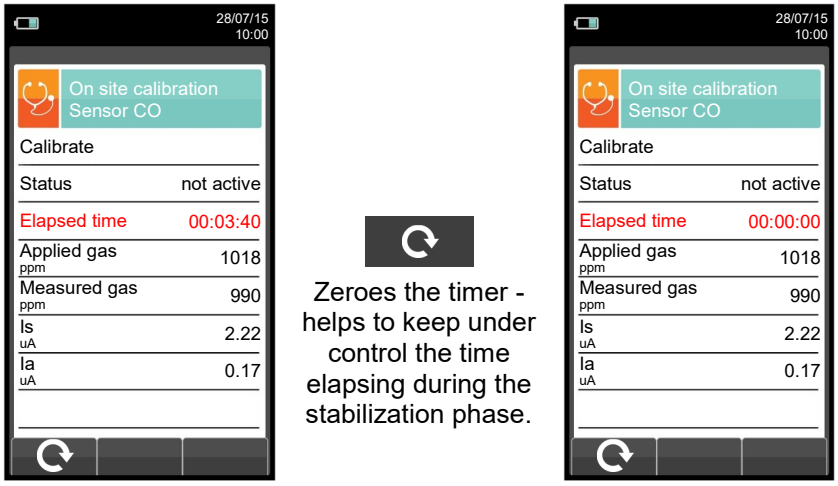



- Enter the value of the concentration of the gas applied.

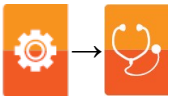



- Apply the calibration gas to the instrument and adjust the output pressure of the gas from the cylinder so that the flow meter indicates a minimum flow of 0.5 l/m to ensure a sufficient flow rate of calibration gas is being supplied to the analyzer.

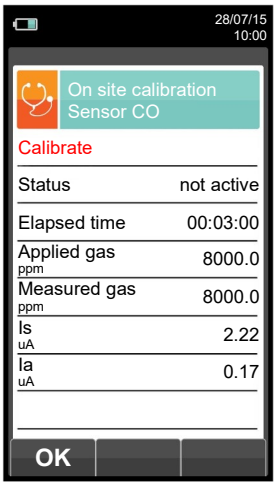
- The instrument measures the concentration of gas applied: **<u>wait at least 3 minutes to allow the reading to stabilize</u>**. The reading is shown in line 'Gas measured'.



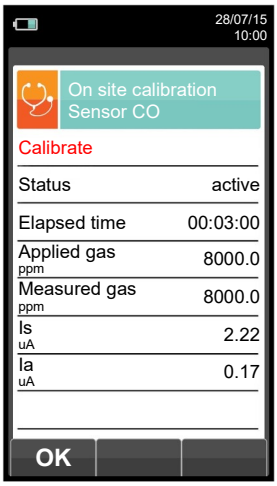

Zeroes the timer - helps to keep under control the time elapsing during the stabilization phase.



- After the stabilization time, select 'Calibrate' and activate the function ' **OK** ' to store the new calibration.




**OK**




Messages in the 'Status' line:

**saving:** the instrument is saving the performed calibration

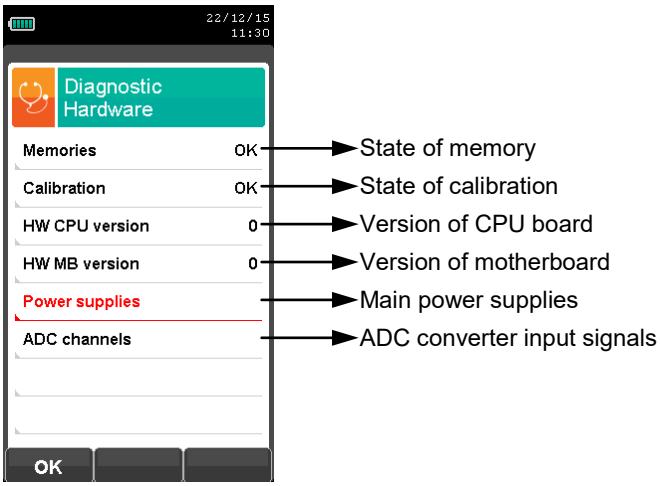
**error:** the sensor has NOT been recalibrated for any of the following reasons:

- The calibration gas cannot properly reach the instrument.
- Concentration for the calibration gas has not been set in the relevant line 'Applied gas'.
- The user didn't allow for the stabilization time to properly elapse.
- The sensor could be damaged or exhausted and must therefore be replaced.

**WARNING**

- **At any time the user can restore the factory calibration in the instrument by setting the 'Status' line on 'not active'.**
- **The recommended stabilization time for the on-site calibration of the sensors is 3 minutes. This time can be up to 5 minutes for NO2 and SO2 sensors.**

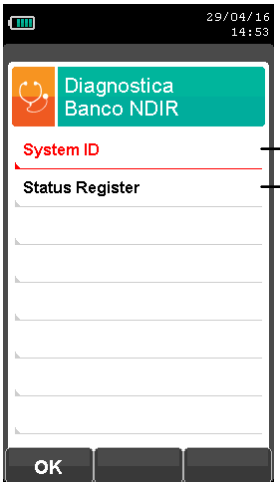
## 9.12 Configuration→Diagnostic→Hardware




| KEY | FUNCTION |
|---|---|
|  | **Activate the context keys shown on the display.** |
|   | **Returns to the previous screen.** |

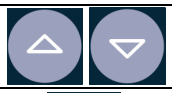
| CONTEXT KEY | FUNCTION |
|---|---|
| ESC | **Returns to the previous screen.** |
| mV | **Shows values in mV** |
| bit | **Shows values in bits** |

## 9.13 Configuration→Diagnostic→NDIR bench



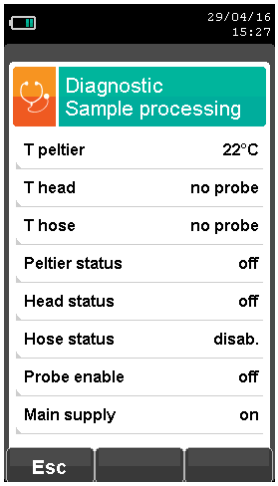

NDIR bench identification data.

NDIR bench information about operational status.

| KEY | FUNCTION |
|---|---|
|  | **Activate the context keys shown on the display.** |
|  | **Selects line; the selected line is displayed in red.** |
|   | **Activates the context key located in the left side of the display.** |
|   | **Returns to the previous screen.** |

| CONTEXT KEY | FUNCTION |
|---|---|
| **OK** | **Enters in the selected data setting.** |
| **ESC** | **Returns to the previous screen.** |

## 9.14 Configuration→Diagnostic→Sample processing




| KEY | FUNCTION |
|---|---|
|  | **Activate the context keys shown on the display.** |
|  | **Activates the context key located in the left side of the display.** |
|  | **Returns to the previous screen.** |

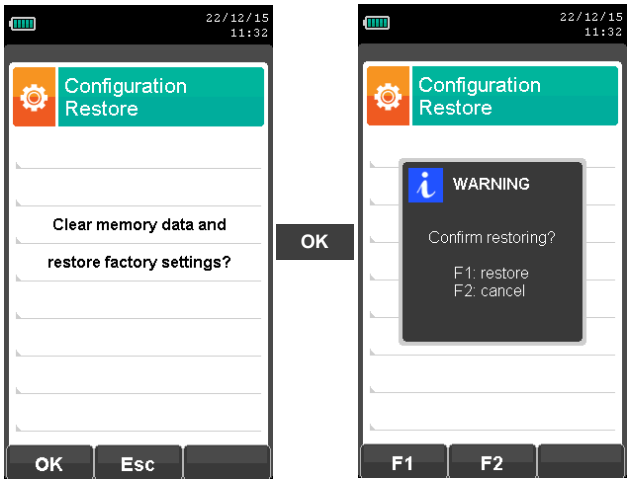
| CONTEXT KEY | FUNCTION |
|---|---|
| ESC | **Returns to the previous screen.** |

## 9.15 Configuration→Language


| KEY | FUNCTION |
|---|---|
|  | **Activate the context keys shown on the display.** |
|  | **Scrolls through the available languages.** |
|   | **Sets the selected language.** |
|   | **Returns to the previous screen.** |

| CONTEXT KEY | FUNCTION |
|---|---|
| OK | **Sets the selected language.** |

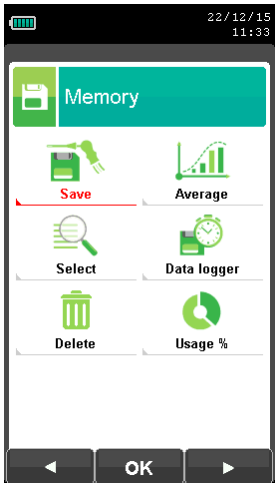
## 9.16 Configuration→Restore




| KEY | FUNCTION |
|---|---|
|  | **Activate the context keys shown on the display.** |
|  | **Starts the factory values reset phase.** |
|  | **Exits the current screen without resetting to factory values.** |

| CONTEXT KEY | FUNCTION |
|---|---|
| **OK** | **Starts the factory data reset phase.** |
| **Esc** | **Exits the current screen without resetting.** |
| **F1** | **Factory reset.** |
| **F2** | **Cancels the factory data reset phase and goes back to the previous screen.** |

## 10.1 Memory Menu



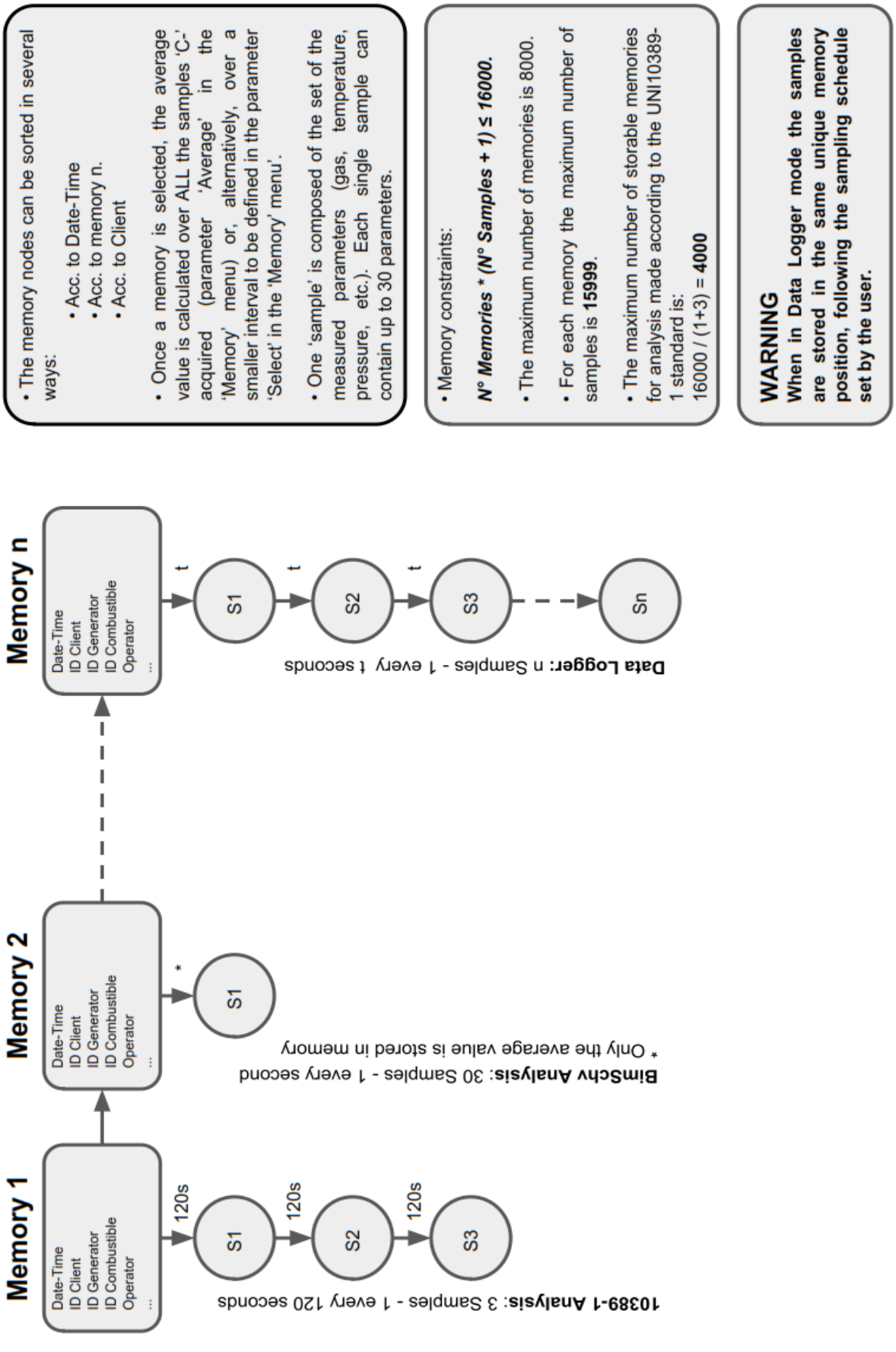

| KEY | FUNCTION |
|---|---|
|  | **Activate the context keys shown on the display.** |
|  | **Returns to the previous screen.** |

| CONTEXT KEY | FUNCTION |
|---|---|
| ◄ | **Selects the available parameters.** |
| OK | **Enters in the selected parameter setting.** |
| ► | **Selects the available parameters.** |

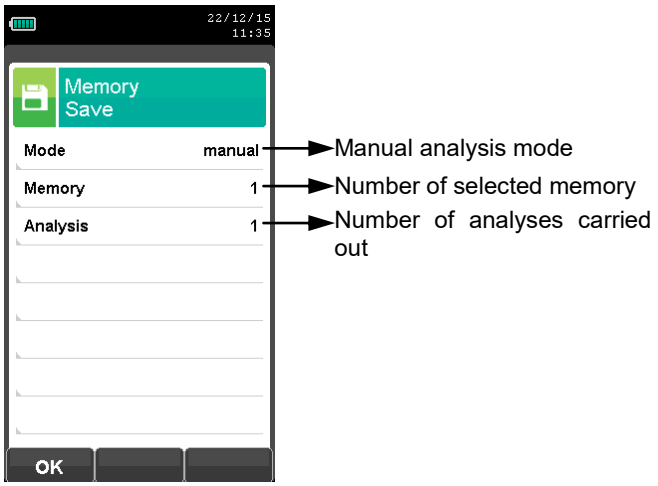
| PARAMETER | DESCRIPTION |
|---|---|
| Micromanometer | From this screen the user can start the combustion analysis.<br>The data shown summarizes the mode of analysis and the selected memory.<br>**SEE SECTION 10.2.** |
| Average | Allows the user to see the average of the analyses contained in the selected memory.<br>**SEE SECTION 10.3.** |
| Select | - Allows the user to choose the memory position to be used to save the combustion analysis and/or the draft/pressure measurament. For each memory it is possible to enter the personal information of the customer (name of the customer, address, telephone number, type of boiler, etc.).<br><br>- Allows the user to see and print the stored analyses, individually or as an average. The analyses can be found (via the context key "find") by memory location or by the date they were saved; it is also possible to see the draft, carbon black and ambient CO.<br>In the menu "Find Memory" the activation of the Print Memory is enabled only on the page where the analyses or the draft, carbon black and ambient CO data are displayed.<br><br>**SEE SECTION 10.4.** |
| Data logger | This submenu allows the user to define the mode of analysis and of memory selection:<br>**Automatic analysis modes:**<br>**UNI 10389 - See section '10.5.2 Details on UNI 10389 - BImSchV - data logger'**<br>The factory settings of the device are in accordance with the Italian standard UNI 10389-1, which requires that you perform at least 3 samples spaced at least 120 sec.<br>**BImSchV - See section '10.5.2 Details on UNI 10389 - BImSchV - data logger'**<br>The factory settings of the device are in accordance with the German standard BImSchV, which requires that you perform at least 30 samples spaced 1 sec.<br>**data logger - See section '10.5.2 Details on UNI 10389 - BImSchV - data logger'**<br>This mode is entirely configurable by the user (it is necessary to set the number of samples to be acquired, the duration of acquisition of each sample and the printing mode).<br>When the combustion analysis starts, the device will automatically carry out and store the number of samples set, spaced from one another according to the set time.<br>After the combustion analysis (indicated by a beep), if the "Manual Print" mode has been selected, the device will display the average of the samples taken with the possibility to recall them individually; the user can then print them (total, complete, …).<br>On the contrary, if the user has selected the option "Automatic Print", the device will automatically proceed to print the analyses, according to the current printing settings, without displaying the average. |

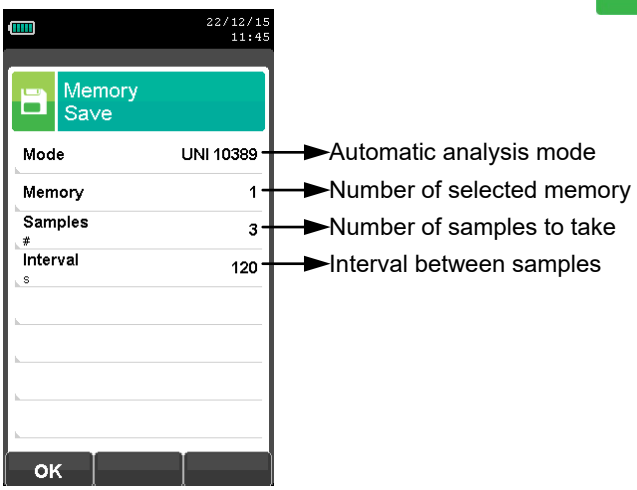
| | |
|---|---|
|  Data logger | **periodic - <u>see section "10.5.3 Memory > Data logger > Data logger".</u>**<br>This mode can be completely configured by the user and allows to monitor the emissions of pollutants at set intervals of time.<br>The start of the analysis of the emissions can be set by the user (immediately or at a scheduled day and time).<br>When the emission analysis begins, the instrument shall automatically acquire and store the set number of samples.<br>During the acquisition it is possible to monitor the performance.<br><br>**NOTE:**<br>**IN THIS ANALYSIS MODE THE ANALYZER MUST BE CONNECTED TO THE MAINS SUPPLY.**<br>**THE INSTRUMENT AUTO-ZEROING IS PERFORMED AT THE BEGINNING OF EVERY ANALYSIS CYCLE AND IN ANY CASE ON AN HOURLY BASIS; THE DURATION SHALL BE SET BY THE USER.**<br>At the end of the analysis of emissions (an audible alarm will be emitted) the instrument shall display the average acquired samples.<br>The stored tests can be displayed and individually printed directly from the instrument or transferred to the PC for further processing.<br>**Warning: in automatic mode, the measurements of carbon black, draft and ambient CO must be taken before starting the combustion analysis.**<br><br>**Manual analysis mode - <u>See section '10.5.1 Details on manual mode'.</u>**<br>If the user chooses the manual mode, he will perform the combustion analysis manually; in this case, the settings regarding printing and duration of the automatic analysis will not be considered. At this point the user can start the manual analysis after waiting for the measured displayed to stabilize. Then he can proceed to save or directly print the data, which will be prepared in accordance with the previously configured settings.<br>At the end of the three analyses, the screen with the average can be displayed, which also contains all the data necessary to fill in the booklet of the system or plant.<br><br>**Memory selection mode**<br>**Manual**: the memory will have to be selected manually via the parameter "Select"<br>**Auto**: the memory, to which the measurements and combustion analyses will be saved, will be suggested automatically when the device is turned on.<br>**<u>SEE SECTION 10.5.</u>** |
|  Delete | Allows the user to delete the contents of each memory or of all memories.<br>**<u>SEE SECTION 10.6.</u>** |
|  Usage % | The user, through this menu, can view the percentage of memory usage.<br>**<u>SEE SECTION 10.7.</u>** |

### 10.1.1 Memory Organization



## 10.2 Memory Menu→Save

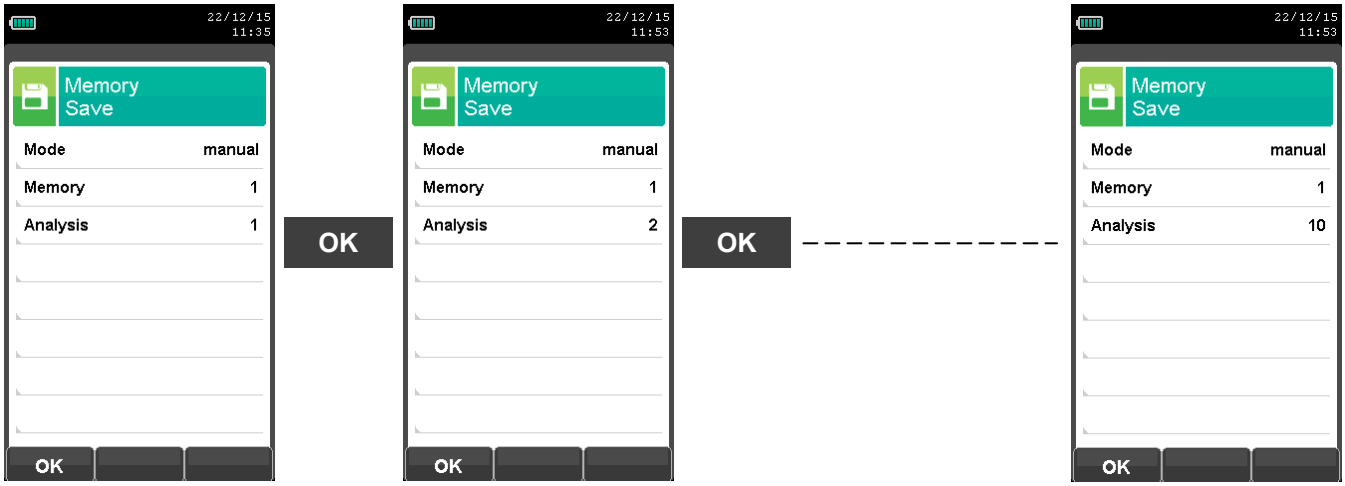


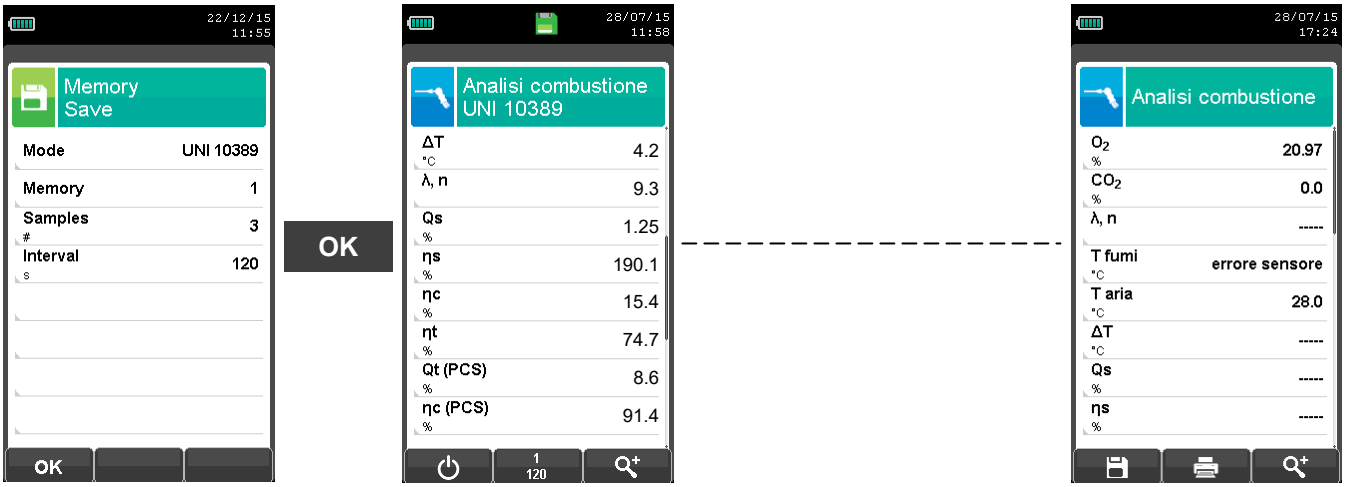

| KEY | FUNCTION |
|---|---|
|  | **Activate the context keys shown on the display.** |
|  | **Starts saving the combustion analysis according to the mode set in the parameter 'Data logger'.** |
|  | **Returns to the previous screen.** |

| CONTEXT KEY | FUNCTION |
|---|---|
| OK | **Starts saving the combustion analysis according to the mode set in the parameter 'Data logger'.** |
| F1 | **Deletes the contents of the selected memory.<br>(Visible when the selected memory contains previous analyses).** |
| F2 | **Cancels the deletion of the contents of the selected memory.<br>(Visible when the selected memory contains previous analyses).** |

### Example 1: Saving the combustion analysis in manual mode

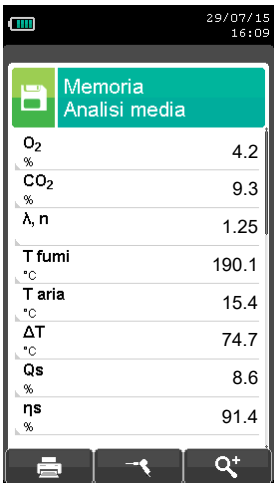



### Example 2: Saving the combustion analysis in automatic mode (example UNI 10389)




**FOR FURTHER INFORMATION SEE SECTION 13 'COMBUSTON ANALYSIS'.**

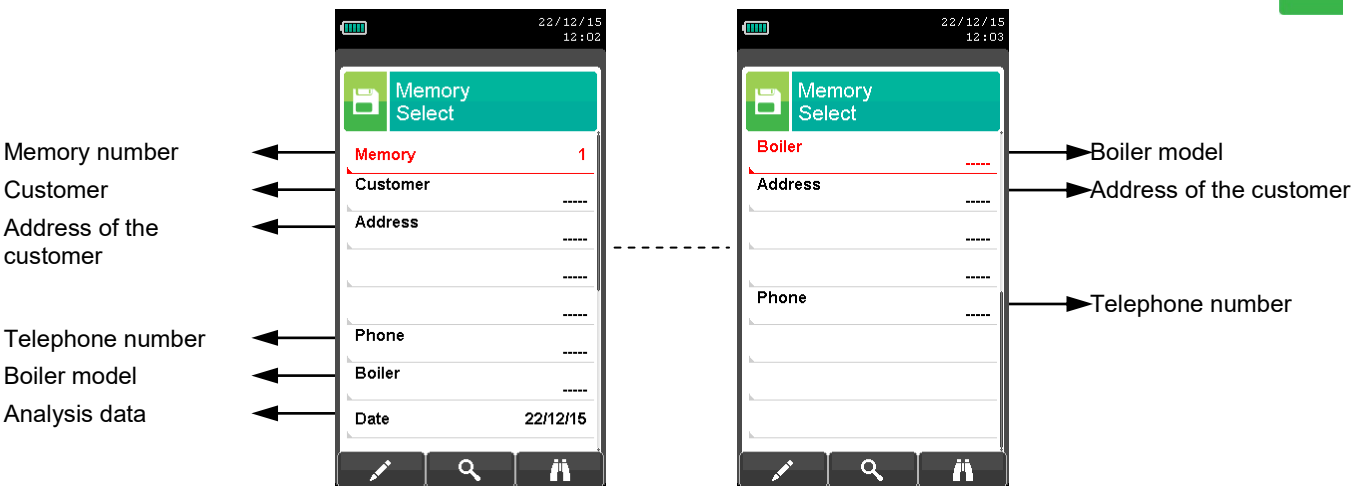
## 10.3 Memory Menu→Average

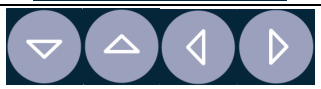



| KEY | FUNCTION |
|---|---|
|  | Activate the context keys shown on the display. |
|  | Scrolls through the values of the average analysis. |
|   | Activates the context key located in the left side of the display. |
|   | Returns to the previous screen without saving the changes made. |

| CONTEXT KEY | FUNCTION |
|---|---|
|  | Starts printing the test paper print-out. See section 11. |
|  | Displays the status of the heated line when the stored analysis is performed. |
|  | Zoom. By pressing this interactive key repeatedly, the device displays the following sequence:<br>AAA → **AAA** → **AAA** → AAA |

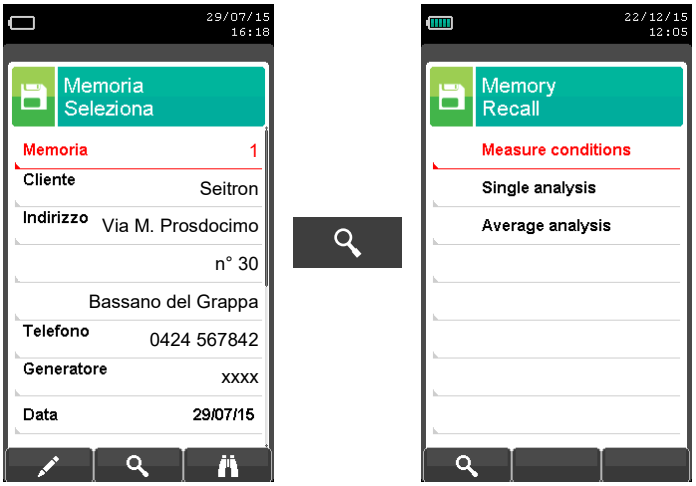
## 10.4 Memory Menu→Select




| KEY | FUNCTION |
|---|---|
|  | **Activate the context keys shown on the display.** |
|  | **In "edit text"/"search for data"/"search for memory number": it moves the cursor on the box corresponding to the desired letter or number.** |
|  | **Selects line; the selected line is displayed in red.** |
|   | **Activates the context key located in the left side of the display.** |
|   | **Returns to the previous screen without saving the changes made.** |

| CONTEXT KEY | FUNCTION |
|---|---|
|  | **Enters the modification mode for the selected parameter. It is possible to select the number of the memory to use for the combustion analysis and/or to enter the information relative to the plant.** |
|  | **Recall memory. By activating this function, the user has the possibility to view the data present in the selected memory. Measurement conditions, single analysis, average analysis. SEE SECTION 10.4.1.** |
|  | **Search function. Thanks to this function, the user has the possibility to quickly search for a specific analysis. The search can be carried out considering the memory number (by selecting the parameter "Memory"), the customer (by selecting one of the following parameters: "Customer", "Address", "Telephone" or "Generator") or the date (by selecting the parameter "Date").** |
|   | **Confirms the settings and, if the search function is enabled, it starts the research.** |
|  | **In "Edit text" it confirms the input of the selected letter or number.** |
|  | **In "Edit text" it cancels the letter or number that precedes the cursor.** |
|   | **In "Edit text" it goes from uppercase to lowercase, to symbols, to special characters.** |
|  | **Selects the memories within the range of the research carried out.** |
|  | **Selects the memories within the range of the research carried out.** |

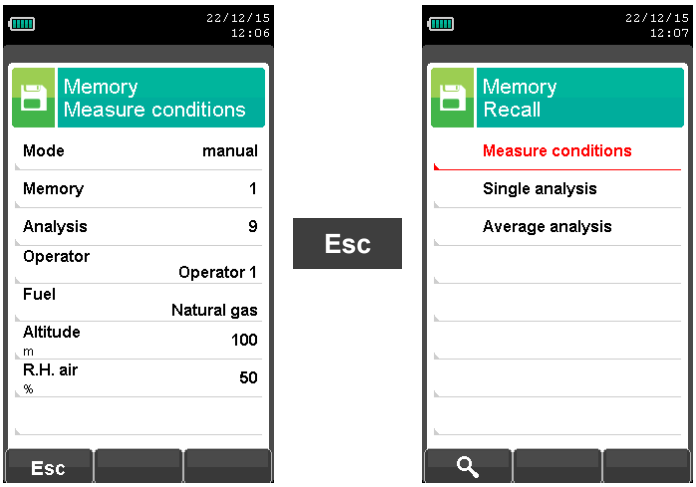
## 10.4.1 Memory Recall




| KEY | FUNCTION |
|---|---|
|  | Activate the context keys shown on the display. |
|  | Selects line; the selected line is displayed in red. |
|  | Activates the context key located in the left side of the display. |
|  | Returns to the previous screen. |

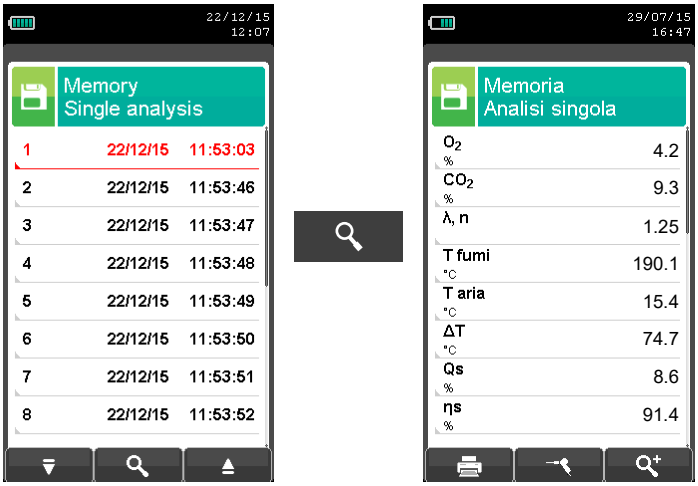
| CONTEXT KEY | FUNCTION |
|---|---|
|  | Displays the details of the selected parameter. |

### 1. Details of measurement conditions




| CONTEXT KEY | FUNCTION |
|---|---|
| Esc | Returns to the previous screen. |

## 2. Details of Single analysis



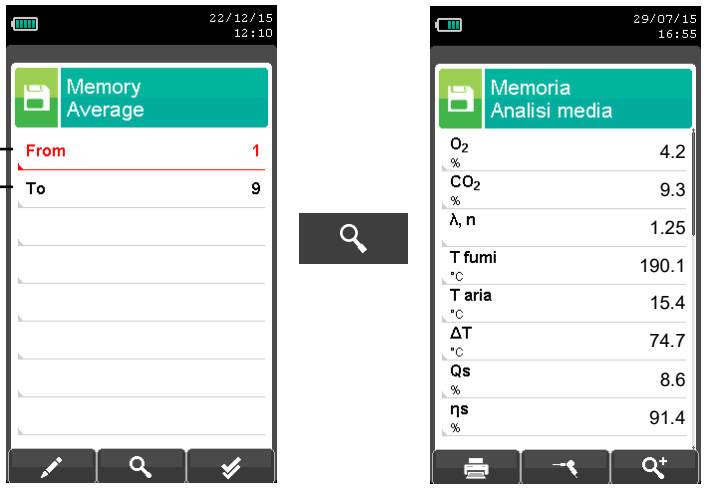

| KEY | FUNCTION |
|---|---|
|  | Activate the context keys shown on the display. |
|  | Selects line; the selected line is displayed in red.<br>In "view detail" the previous or next pages are shown. |
|  | Views the details of the selected parameter. |
|  | Returns to the previous screen. |

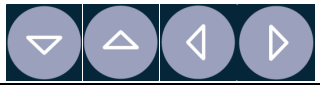
| CONTEXT KEY | FUNCTION |
|---|---|
|  | Selects line; the selected line is displayed in red. |
|  | Views the details of the selected parameter. |
|  | Selects line; the selected line is red. |
|  | Jumps to next page. |
|  | Jumps to previous page. |
|  | Starts printing the test paper print-out. See section 11. |
|  | Displays the status of the heated line when the stored analysis is performed. |
|  | Zoom. By pressing this interactive key repeatedly, the device displays the following sequence:<br>AAA → AAA → **AAA** → AAA |

### 3. Average analysis details

Defines the **start** sample to define the analysis average.

Defines the **end** sample to define the analysis average.



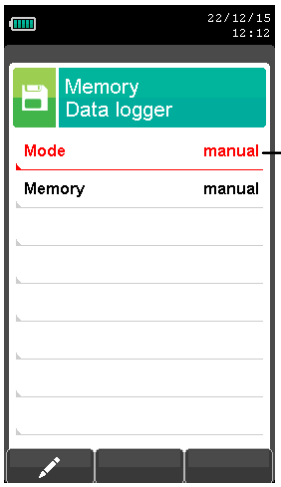

| KEY | FUNCTION |
|---|---|
|  | **Activate the context keys shown on the display.** |
|  | **In edit mode, it sets the number of the desired sample; the number to change is red.** |
|  | **Selects line; the selected line is displayed in red.** |
|  | **Activates the context key located in the left side of the display.** |
|  | **Returns to the previous screen without saving the changes made.** |

| CONTEXT KEY | FUNCTION |
|---|---|
|  | **Enters edit mode: it is possible to select the number of the sample to use to have the average of the analysis carried out.** |
|  | **Shows the average analysis in the interval set.** |
|  | **Zoom. By pressing this interactive key repeatedly, the device displays the following sequence:** **AAA → AAA → AAA → AAA** |
|  | **Sets all the samples of the analyses carried out: From 1 (first sample) To xxx (last sample).** |
| OK | **Confirms the settings.** |
|  | **Starts printing. See section 11.** |
|  | **Displays the status of the heated line when the stored analysis is performed.** |

## 10.5 Memory Menu→Data logger

In this submenu the user can set the analysis modes and the relating parameters. 4 automatic modes and 1 manual mode can be selected.

**Note: The display of parameters is contextual to the selected analysis mode.**

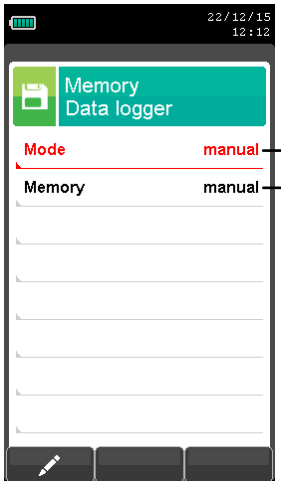



The selectable analysis modes are:
**manual - UNI 10389 - BImSchV - data logger - periodic**

| KEY | FUNCTION |
|---|---|
|  | **Activate the context keys shown on the display.** |
|   | **Returns to the previous screen.** |

| CONTEXT KEY | FUNCTION |
|---|---|
|  | **Enters the modification mode for the selected parameter.** |

## 10.5.1 Manual mode details



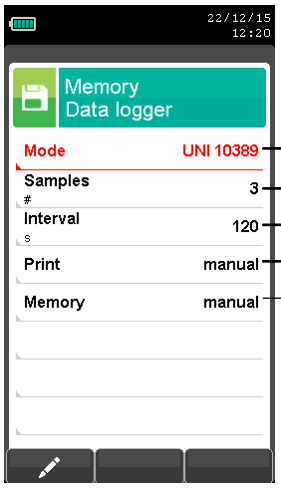

Manual selection mode

The memory selection modes are: **manual** or **auto**.
If "**auto**" mode has been selected, the research of the available memory will be performed automatically when the device is turned on).

| KEY | FUNCTION |
|---|---|
|  | **Activate the context keys shown on the display.** |
|  | **Selects the line; the selected line is highlighted in red.**<br>**When in change mode sets the desired value or mode.** |
|  | **Activates the context keys located in the left side of the display.** |
|  | **Returns to the previous screen.** |

| CONTEXT KEY | FUNCTION |
|---|---|
|  | **Enters the modification mode for the selected parameter.** |
|  | **Confirms the settings.** |

## 10.5.2 Details on UNI 10389 - BImSchV - data logger




Selected modes: **manual - UNI 10389 - BImSchV - data logger - periodic**

Number of samples to acquire.

Lapse of time between one sample and the next one.

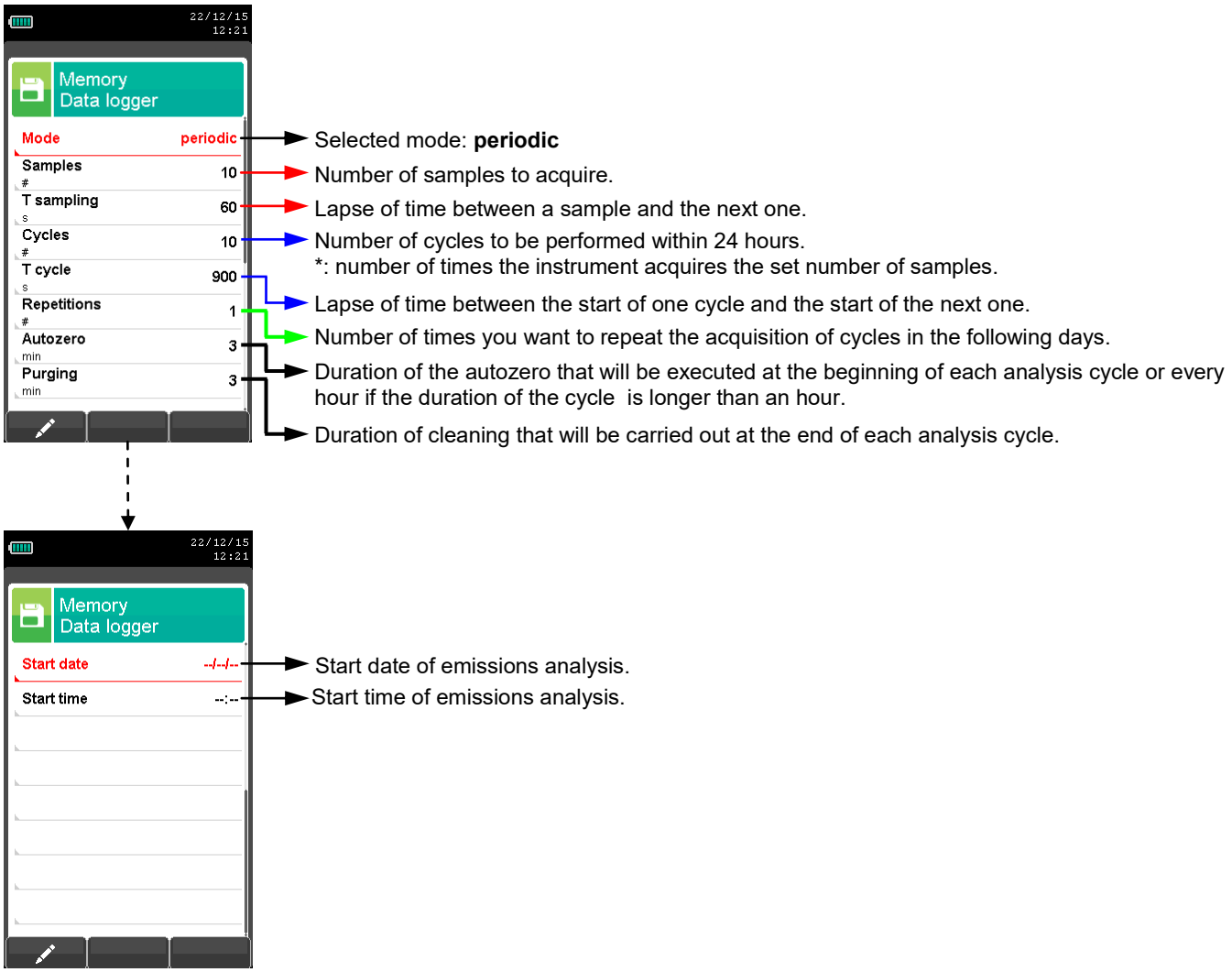
The selectable printing modes are: **manual** or **auto**.
If "**auto**" mode has been selected, the printing will be performed automatically at the end of the combustion analysis (parameter not visible in manual analysis mode).

The memory selection modes are: **manual** or **auto**.
If "**auto**" mode has been selected, the research of the available memory will be performed automatically when the device is turned on).

| KEY | FUNCTION |
|---|---|
|  | **Activate the context keys shown on the display.** |
|  | **Selects the line; the selected line is highlighted in red.**<br>**When in change mode sets the desired value or mode.** |
|  | **Activates the context key located in the left side of the display.** |
|  | **Returns to the previous screen.** |

| CONTEXT KEY | FUNCTION |
|---|---|
|  | **Enters the modification mode for the selected parameter.** |
|  | **Confirms the settings.** |

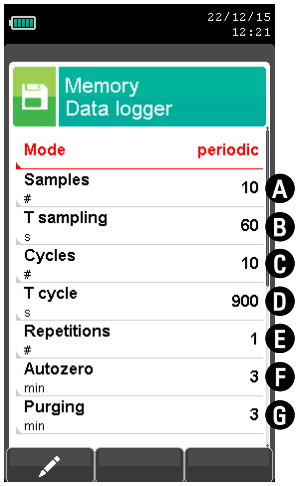
## 10.5.3 Details of periodic mode

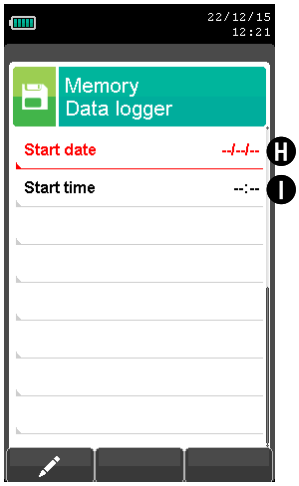



| KEY | FUNCTION |
|---|---|
|  | **Activate the context keys shown on the display.** |
|  | **Selects the line; the selected line is highlighted in red.**<br>**When in change mode sets the desired value or mode.** |
|  | **Activates the context key located in the left side of the display.** |
|  | **Returns to the previous screen.** |

| CONTEXT KEY | FUNCTION |
|---|---|
|  | **Enters the modification mode for the selected parameter.** |
| OK | **Confirms the settings.** |

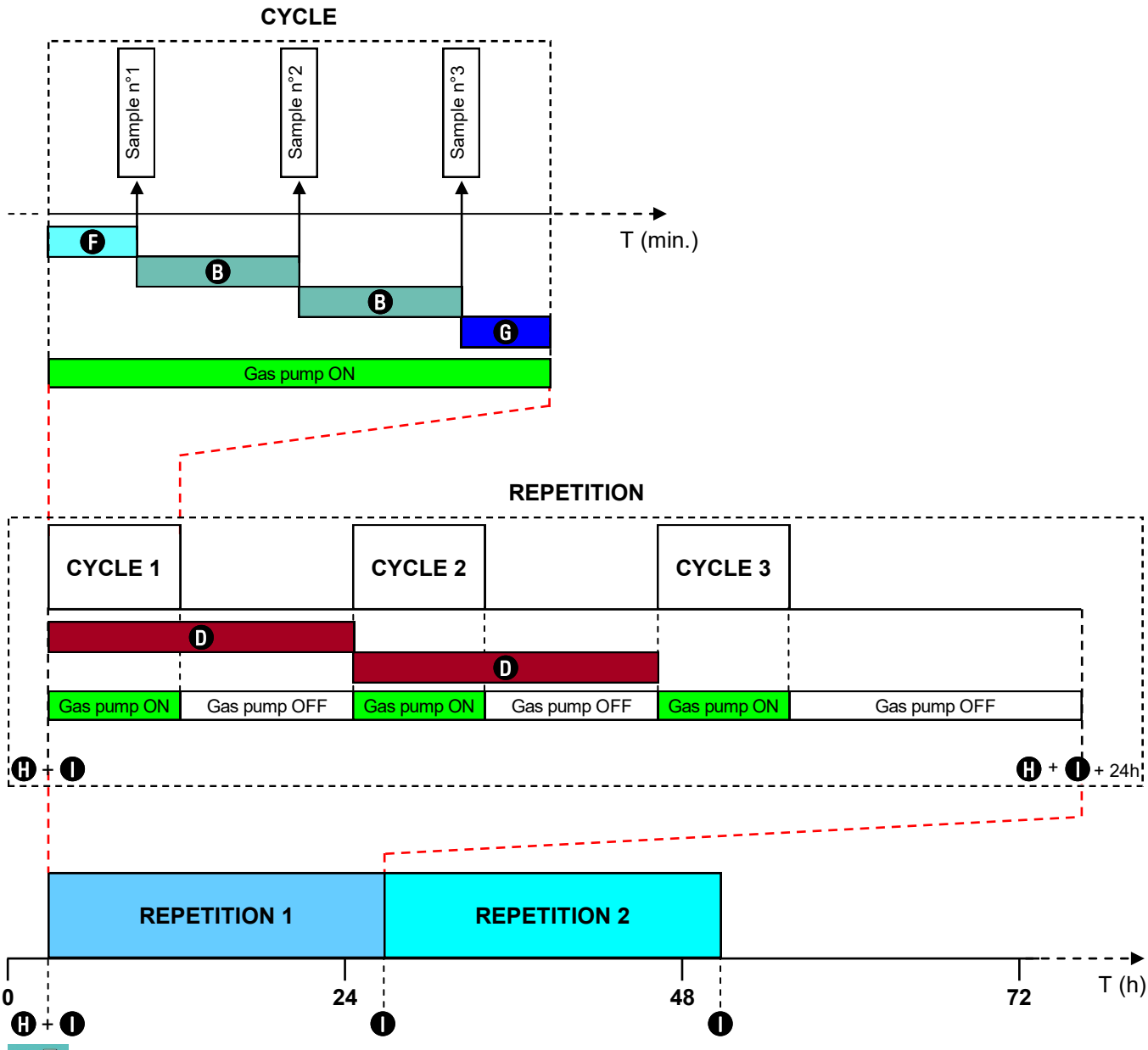
## Operational logic of the periodic mode



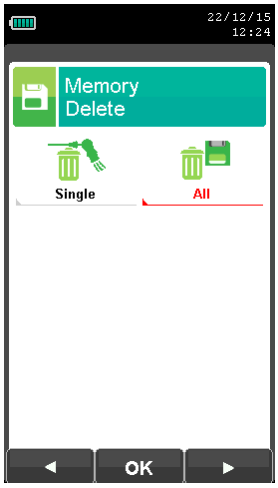



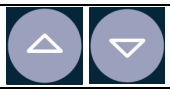

**WARNING**
- **When in periodic mode, the heated line (if included and enabled) is always working.**
- **The heated line is activated 20 minutes before the analysis starts.**

## Operating modes relating to the above settings:



## 10.6 Memory→Delete



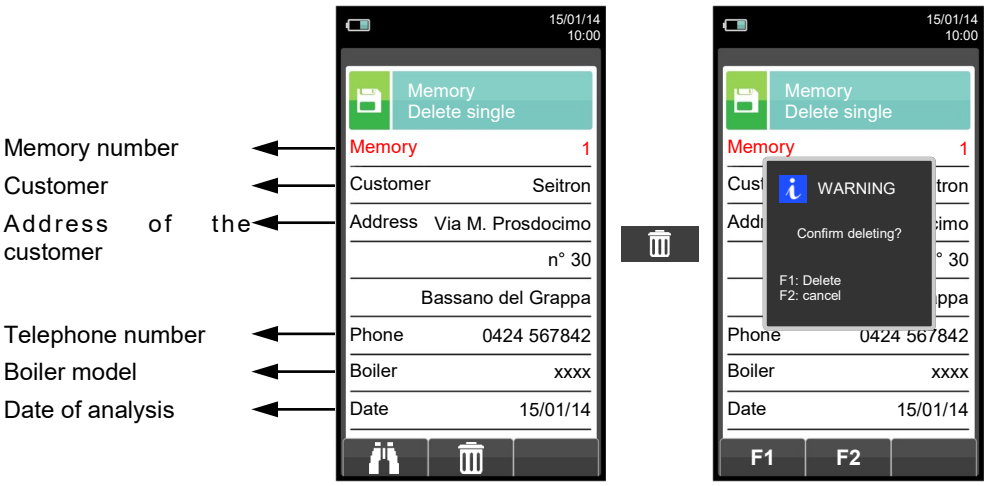

| KEY | FUNCTION |
|---|---|
|  | **Activate the context keys shown on the display.** |
|  | **Returns to the previous screen.** |

| CONTEXT KEY | FUNCTION |
|---|---|
| ◄ | **Selects the available parameters.** |
| OK | **Enters in the selected parameter setting.** |
| ► | **Selects the available parameters.** |

| PARAMETER | DESCRIPTION |
|---|---|
|  Single | This option allows the user to delete the contents of each individual memory; to do this, the user will have to confirm the operation so as to avoid losing previously saved data. SEE SECTION 10.6.1. |
|  All | This option allows the user to delete the contents of all the memories; to do this, the user will have to confirm the operation so as to avoid losing previously saved data. SEE SECTION 10.6.2. |

**IT IS TO BE CONSIDERED NORMAL THAT THE MEMORIES ERASING PROCESS REQUIRES SOME MINUTES.**

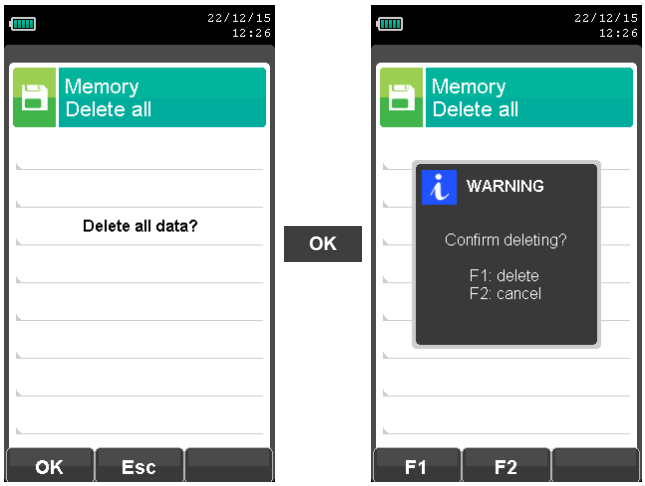
## 10.6.1 Memory→Delete→Single




| KEY | FUNCTION |
|---|---|
|  | **Activate the context keys shown on the display.** |
|  | **In "edit text"/"search for data"/"search for memory number": it moves the cursor on the box corresponding to the desired letter or number.** |
|  | **Selects line; the selected line is displayed in red.** |
|   | **Activates the context key located in the left side of the display. In "edita testo": Conferma l'inserimento del testo.** |
|   | **Returns to the previous screen.** |

| CONTEXT KEY | FUNCTION |
|---|---|
|  | **Search function. Thanks to this function, the user has the possibility to quickly search for a specific analysis. The search can be carried out considering the memory number (by selecting the parameter "Memory"), the customer (by selecting one of the following parameters: "Customer", "Address", "Telephone" or "Generator") or the date (by selecting the parameter "Date").** |
| OK | **Confirms the settings and, if the search function is enabled, it starts the research.** |
| ✓ | **In "Edit text" it confirms the input of the selected letter or number.** |
| ✕ | **In "Edit text" it cancels the letter or number that precedes the cursor.** |
| Aa# | **In "Edit text" it goes from uppercase to lowercase, to symbols, to special characters.** |
| ▼ | **Selects the memories within the range of the research carried out.** |
| ▲ | **Selects the memories within the range of the research carried out.** |
|  | **Starts deleting the selected memory.** |
| F1 | **Deletes the selected memory.** |
| F2 | **Cancels the deleting and goes back to the previous page.** |

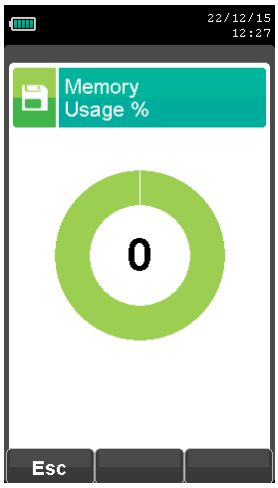
## 10.6.2 Memory→Delete→All




| KEY | FUNCTION |
|---|---|
|  | **Activate the context keys shown on the display.** |
|  | **Start erasing all memories.** |
|  | **Returns to the previous screen.** |

| CONTEXT KEY | FUNCTION |
|---|---|
| **OK** | **Start erasing all memories.** |
| **Esc** | **Returns to the previous screen.** |
| **F1** | **Deletes all memories.** |
| **F2** | **Cancels the deleting and returns to the previous page.** |

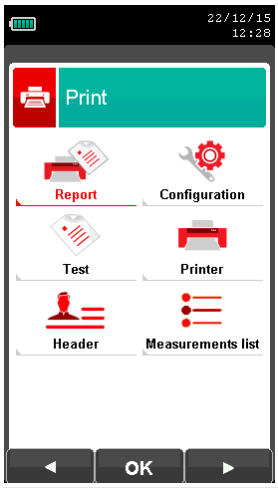
## 10.7 Memory→Usage %




| KEY | FUNCTION |
|---|---|
|  | **Activate the context keys shown on the display.** |
|  | **Returns to the previous screen.** |

| CONTEXT KEY | FUNCTION |
|---|---|
| **Esc** | **Returns to the previous screen.** |

## 11.1 Print Menu

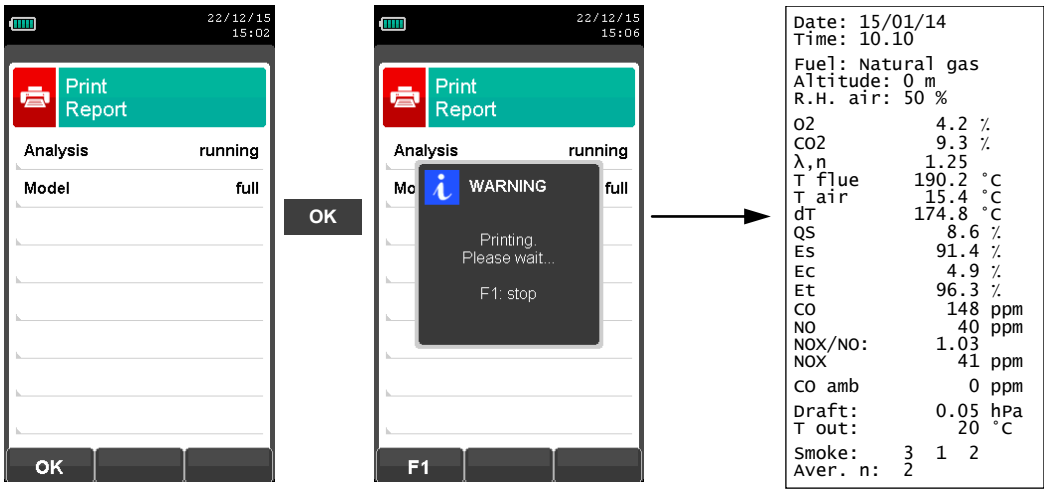



| KEY | FUNCTION |
|---|---|
|  | **Activate the context keys shown on the display.** |
|  | **Returns to the previous screen.** |

| CONTEXT KEY | FUNCTION |
|---|---|
| ◄ | **Selects the available parameters.** |
| OK | **Enters in the selected parameter setting.** |
| ► | **Selects the available parameters.** |

| PARAMETER | DESCRIPTION |
|---|---|
| Report | Enables the Print Menu. A hard copy of the complete combustion analysis can be printed. The printed values are those shown on the display when the menu is enabled. This menu can be used for combustion analysis, even when recalled from the memory, for draft, smoke, ambient gas and for tightness test results.<br>SEE SECTION 11.2. |
| Configuration | The user, by means of this menu, can confugure the test report format:<br>**Copies**: Allows to set the number of printed copies and layout of the paper print-out. Several copies of the test paper print-out can be printed, choosing among different layouts according to the informations included.<br>**Report**: The paper print-out layout selection is only valid for combustion analysis and can be chosen among Complete, Partial and Total. Paper print-outs for draft, smoke, ambient gas concentration and tigthness test only allow a specific layout. Layouts options for combustion analysis are specified as described in the following:<br>**Full:** includes a header with company data as well operator data previously programmed in the configuration menu, measurements sampled in the combustion analysis and, when sampled, the draft, smoke and CO ambient gas values.<br>**Partial:** only reports the combustion analysis measurement values and informations, without any header, comments or blank lines for operator comments.<br>**Total:** prints full print-out of average values with individual test data.<br>**Date/Time**: It allows you to define whether or not to print the date and time at which the combustion analysiswas performed.<br>**Manual:** The date and time are not printed in the header of the analysis report . It is the responsibility of the operator to enter the data manually .<br>**Auto:** The date and time are printed in the header of the analysis report.<br>SEE SECTION 11.3. |
| Test | **Print:** Prints a graphical/alphanumeric test paper print-out for a complete check of the printer operation.<br>**Paper feed:** Feeds paper in the printer; this function is most useful when replacing the paper roll in the printer.<br>SEE SECTION 11.4. |
| Printer | Selects the printer type: internal or Bluetooth.<br>When Bluetooth printer is selected a pairing procedure will be needed in order to match the printer to the instrument. The pairing procedure has to be performed only once.<br>SEE SECTION 11.5. |
| Header | Allows the user to enter, in six lines of 24 characters each the name of the Company or owner of the device or the information regarding the latter (e.g. address, telephone number), which will be printed in the header of the analysis report.<br>SEE SECTION 11.6. |
| Measurements list | In this submenu the user has the possibility to view the list of measurements that the device performs. With the interactive keys, the user can add, delete or move a selected measurement.<br>SEE SECTION 11.7. |

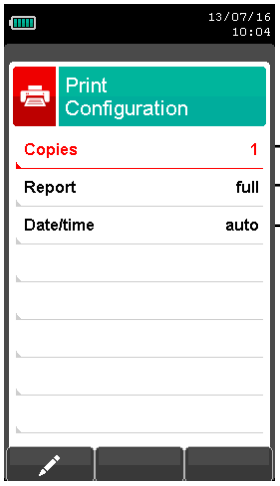
## 11.2 Print→Report




| KEY | FUNCTION |
|---|---|
|  | **Activate the context keys shown on the display.** |
|  | **Returns to the previous screen.** |

| CONTEXT KEY | FUNCTION |
|---|---|
| OK | **Starts printing the test paper print-out.** |
| F1 | **Stops printing the test paper print-out.** |

## 11.3 Print→Configuration




Set the number of copies to print: 1 .. 5.

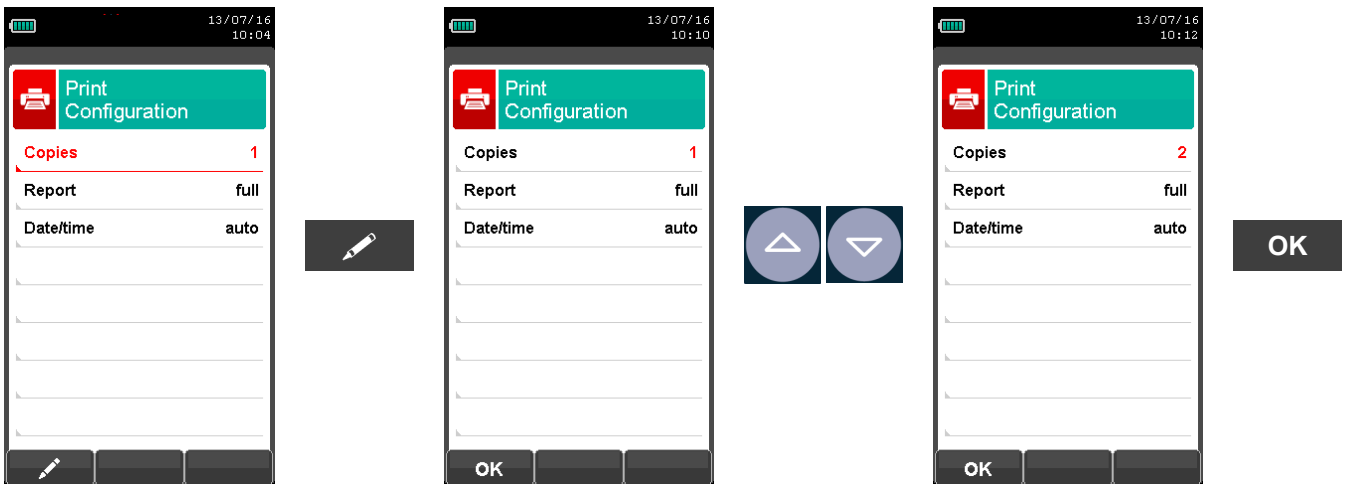
The test paper print-out models that can be selected are: **partial - full - total**
**For further details see Annex A.**

Set between: **Manual**: date and time are not printed on the analysis report.
**Auto**: date and time are printed automatically on the analysis report.

| KEY | FUNCTION |
|---|---|
|  | **Activate the context keys shown on the display.** |
|  | **Selects line; the selected line is displayed in red.**<br>**In modification sets the value or the desired mode.** |
|  | **Activates the context key located in the left side of the display.** |
|  | **Returns to the previous screen.**<br>**When in modify mode cancels the modification just made.** |

| CONTEXT KEY | FUNCTION |
|---|---|
|  | **Enters the modification mode for the selected parameter.** |
|  | **Confirms the settings.** |

**Example:**

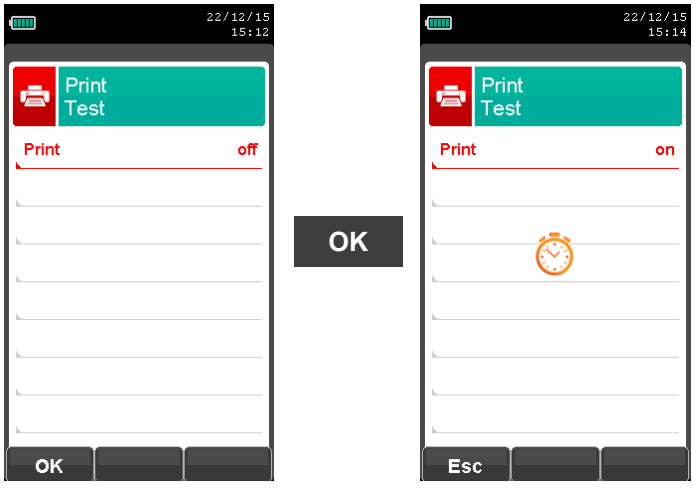


## 11.4 Print→Test

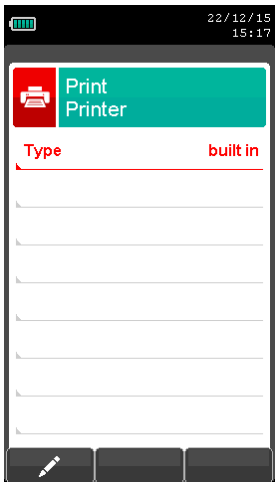

| KEY | FUNCTION |
|---|---|
|  | Activate the context keys shown on the display. |
|  | Selects line; the selected line is displayed in red.<br>In modification sets the value or the desired mode. |
|   | Activates the context key located in the left side of the display. |
|   | Returns to the previous screen.<br>When in modify mode cancels the modification just made. |

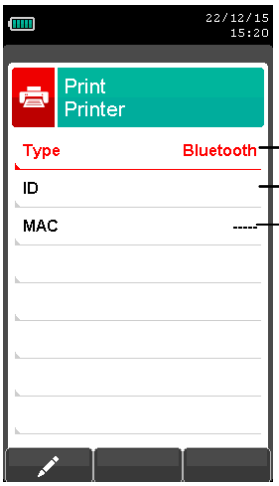
| CONTEXT KEY | FUNCTION |
|---|---|
| OK | Confirms the settings. |

**Example:**



## 11.5 Print→Printer




Printer type: **built in (internal) - Bluetooth (external)**.

Name of the Bluetooth printer associated with the instrument.

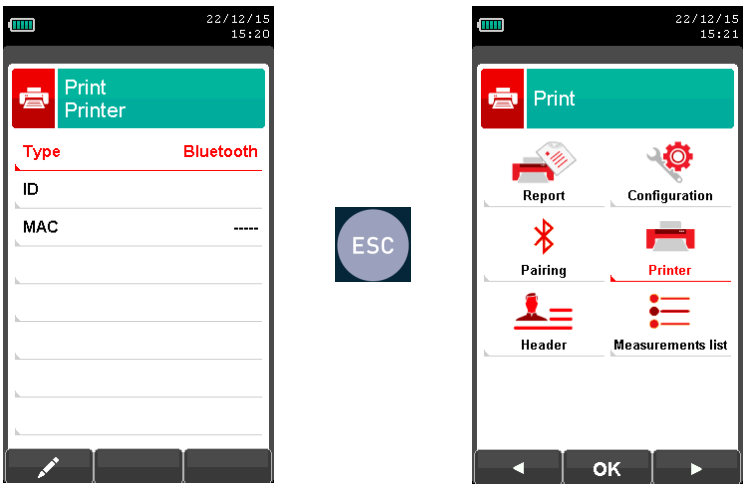
Address of the Bluetooth printer associated with the instrument.

**WARNING**
**If you select the Bluetooth printer, you will need to pair the instrument to a Bluetooth printer. The pairing procedure must be performed once only.**

| KEY | FUNCTION |
|---|---|
|  | **Activate the context keys shown on the display.** |
|  | **Selects line; the selected line is displayed in red.**<br>**In modification sets the value or the desired mode.** |
|  | **Activates the context key located in the left side of the display.** |
|  | **Returns to the previous screen.**<br>**When in modify mode cancels the modification just made.** |

| CONTEXT KEY | FUNCTION |
|---|---|
|  | **Enters the modification mode for the selected parameter.** |
| OK | **Confirms the settings.** |

## 11.5.1 Print→Pairing

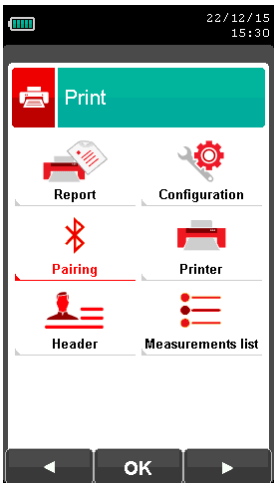



| KEY | FUNCTION |
|---|---|
|  | Activate the context keys shown on the display. |
|  | Selects line; the selected line is displayed in red.<br>In modification sets the value or the desired mode. |
| OK | Activates the context key located in the left side of the display. |
| ESC | Returns to the previous screen.<br>When in modify mode cancels the modification just made. |

| CONTEXT KEY | FUNCTION |
|---|---|
| ◄ | Selects the available parameters. |
| OK | Enters in the selected parameter setting. |
| ► | Selects the available parameters. |
| F1 | Starts the search for Bluetooth devices. |
| F2 | Quits and returns to the previous screen. |
|  | Enters the modification mode for the selected parameter. |
|  | Repeats the pairing procedure. |
| OK | Confirms the settings. |
| ✓ | Confirms the selected letter or digit. |
| ✕ | Cancels the letter or digit before the cursor. |
| Aa# | Cycles through uppercase, lowercase, symbols and special characters. |

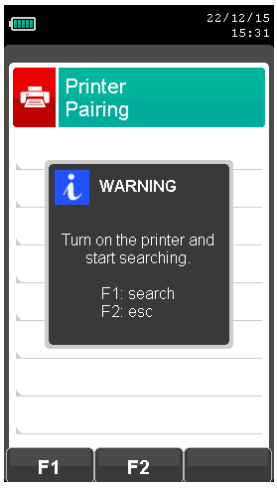
**In the following pages the pairing procedure between the instrument and a Bluetooth printer is described.**

1. **Once the Bluetooth printer is configured, proceed as follows:**

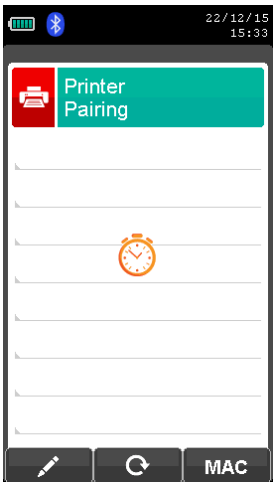



Select icon 'Pairing' to start configuration

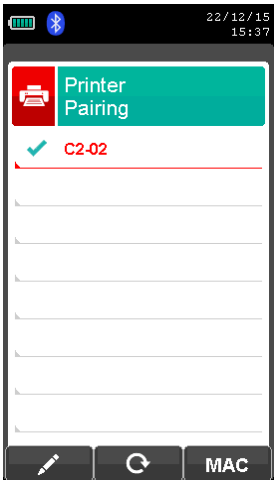
OK




F1

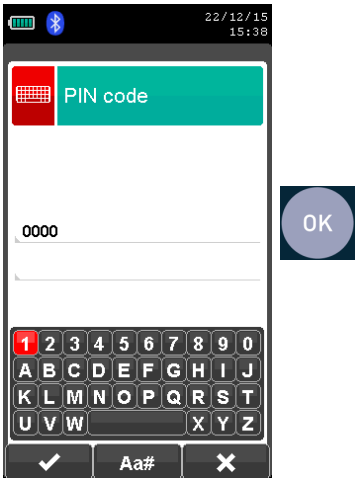



2. **Select the line corresponding to the desired Bluetooth printer, then proceed as follows:**



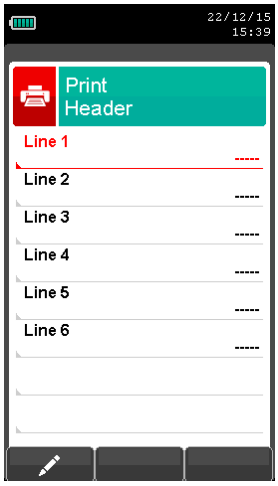


Enter the PIN code (or the password) of the printer (this can be found in the printer user manual) to complete the instrument-printer pairing procedure.




3. **The instrument-printer pairing is completed. Press key '** ESC **' to return to the previous screen.**

## 11.6 Print→Header

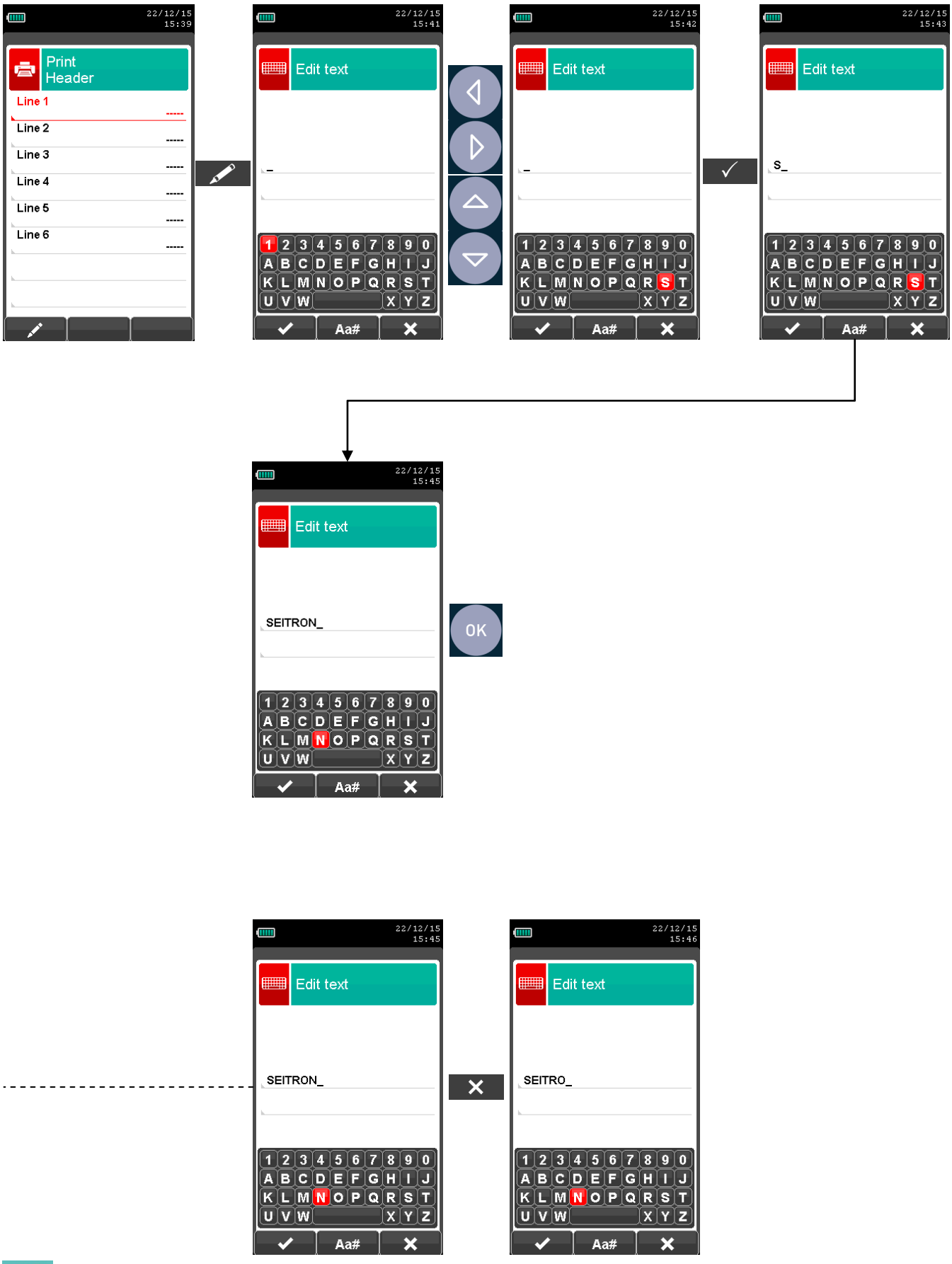



| KEY | FUNCTION |
|---|---|
|  | Activate the context keys shown on the display. |
|  | In "edit text": It moves the cursor on the box corresponding to the letter or number required to form the desired word. |
|  | In edit mode it moves the cursor through the available lines. |
|  | In "edit text": it confirms the text input.<br>In "Print header": It activates the context key displayed on the left. |
|  | Returns to the previous screen.<br>In "edit text" it goes back to the previous screen without saving the changes made. |

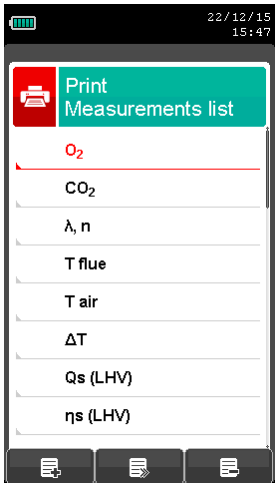
| CONTEXT KEY | FUNCTION |
|---|---|
|  | Enters edit mode of the selected line: it is possible to enter the name of the operator (24 characters available). |
|  | Confirms the selected letter or digit. |
|  | Cancels the letter or digit before the cursor. |
|  | Cycles through uppercase, lowercase, symbols and special characters. |

## Example:

### 1. Edit text



## 11.7 Print→Measures list

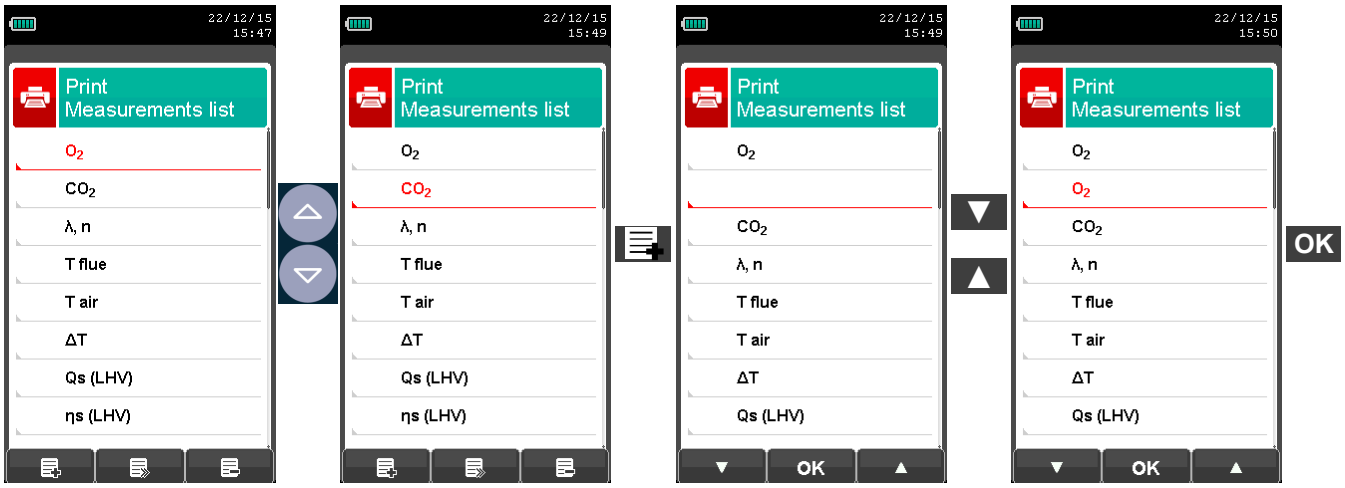



| KEY | FUNCTION |
|---|---|
|  | Activate the context keys shown on the display. |
|  | Selects the available measurements from the suggested list. In edit mode, it scrolls through the measurements present. |
|  | Confirms the modification. |
|  | When pressed in modify mode cancels the selection made, otherwise returns to the previous screen. |

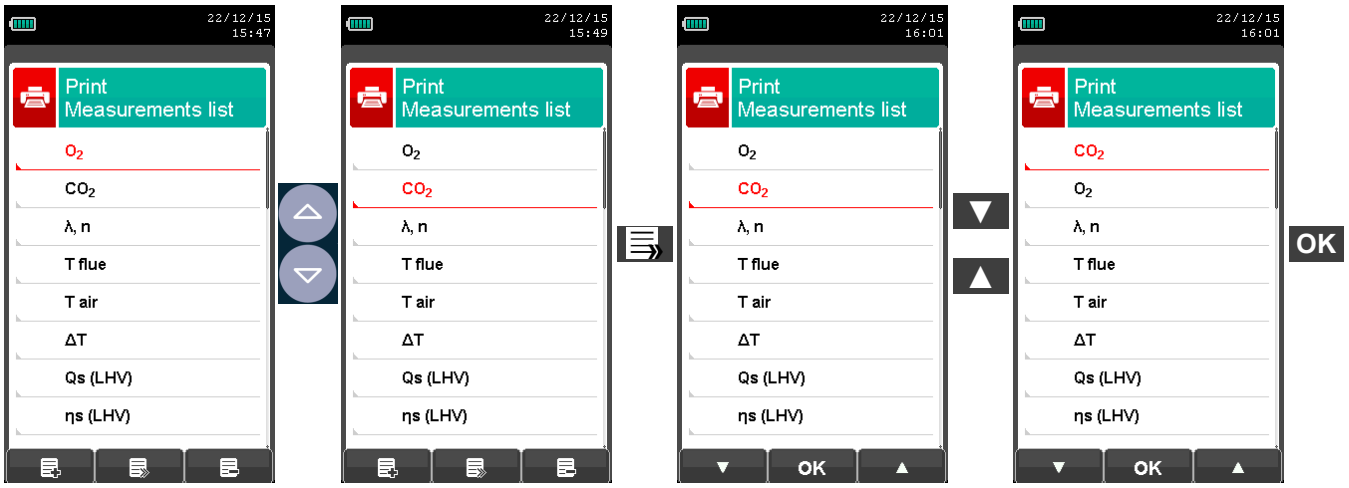
| CONTEXT KEY | FUNCTION |
|---|---|
|  | Adds a measurement. |
|  | Moves the position of a measurement. |
|  | Delets a measurement from the list. |
|  | Scrolls through the available measurements. |
|  | Confirms the change made. |
|  | Scrolls through the available measurements. |
|  | Cancels the change made. |

## Example:

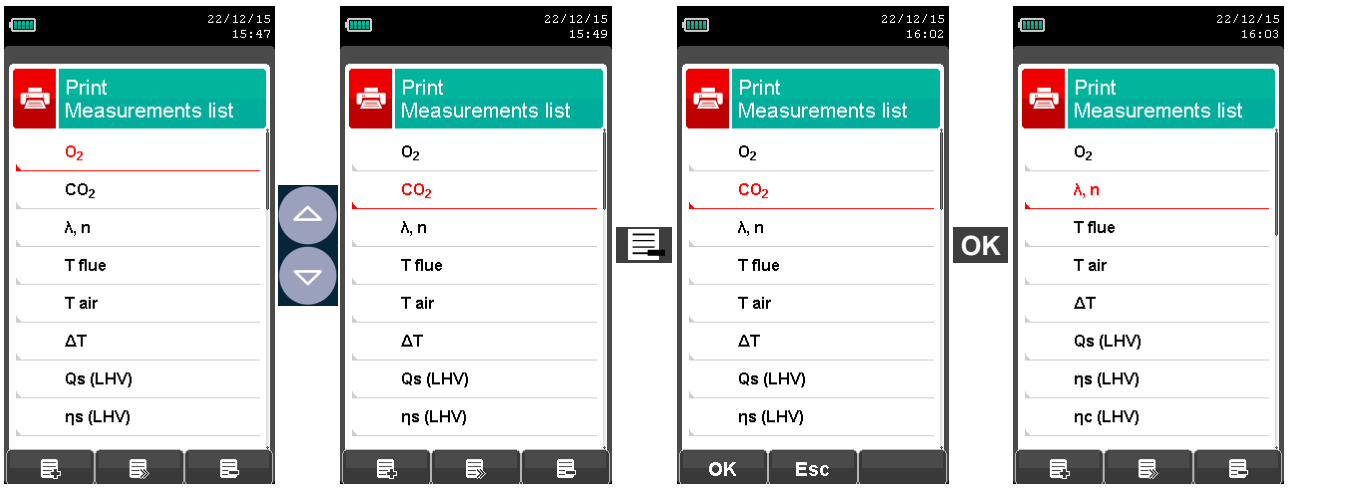
### 1. Add a measurement to the list



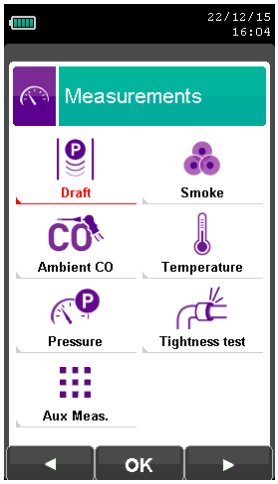

### 2. Move the position of a measurement

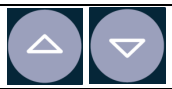



### 3. Deletes a measurement from the list



## 12.1 Measurements Menu



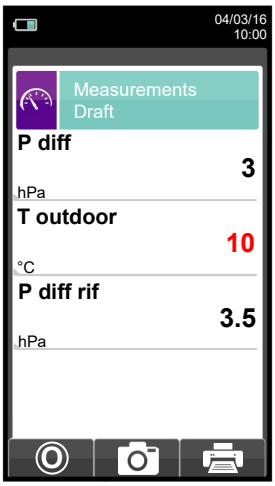

| KEY | FUNCTION |
|---|---|
|  | **Activate the context keys shown on the display.** |
|  | **Returns to the previous screen.** |

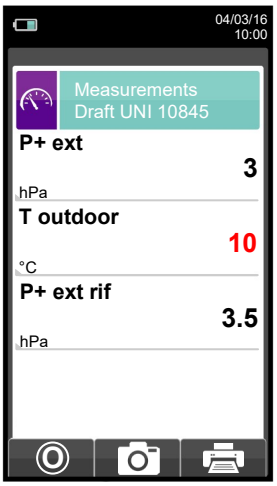
| CONTEXT KEY | FUNCTION |
|---|---|
| ◄ | **Selects the available parameters.** |
| OK | **Enters in the selected parameter setting.** |
| ► | **Selects the available parameters.** |

| PARAMETER | DESCRIPTION |
|---|---|
| Draft | The DRAFT menu gives access to the stack draft measurement. Being a negative pressure, in accordance with standard UNI10845, draft must be measured using the negative pressure input P-. The correct values for a natural draft boiler are therefore positive by definition. Before performing the measurement the instrument allows the user to input the external air temperature as required by the standard. When making the measurement and the temperature has been inserted, the instrument provides a stack draft value related (P diff ref) to the external temperature of 20° C as requested by law. When the inserted external temperature is higher than 20° C the instrument reports a stack draft value reference equal to the measured draft. Afterwards the user can acquire the value displayed in order to add it to the running analysis measurements or, alternatively, print the relevant paper print-out through the 'PRINT' menu.<br><br>**NOTE: The measurement may not be accurate due to condensation inside the gas probe. Should you notice an inaccurate or unstable reading on the instrument, it is advisable to disconnect the gas probe from the instrument itself, and purge pipes by blowing with a compressor. In order to be sure there is no humidity, it is suggested to perform the measurement by means of the transparent rubber pipe supplied on issue.**<br>**SEE SECTION 12.2.** |
| Smoke | It is possible to enter the data concerning one to three CARBON BLACK measurements taken by means of an optional device (BACHARACH PUMP); see the relevant instructions.<br>The method consists in taking a certain quantity of combustion gas from the middle of the flue behind the surfaces of the exchangers at the end of the boiler, and make it pass through a special filter paper. The soot stain obtained is compared with the surfaces blackened in a different way according to a comparison scale; it is thus determined the "soot number", which will be entered in the instrument by hand.<br>These measurements can be either stored in memory together with the combustion analysis data or printed on a paper print-out.<br>**SEE SECTION 12.3.** |
| Ambient CO | This type of analysis lets the user measure the CO value present in the environment, with the scope of checking the personal safety conditions of a specific working environment. The instrument leaves our factory with the following preset threshold values:<br>**COmax**: 35 ppm Recommended exposure limit (REL) stipulated by the National Institute for Occupational Safety and Health (NIOSH), equivalent to 40 mg/m$^3$ and calculated as an 8-hour Time-Weighted Average (TWA).<br>**Make sure to perform to perform the autozero in a clean air enviroment (preferably outdoors), so that the ambient CO measurement is correct. It is advisable to turn on the instrument and wait for the autozero completion outside the area where the test is being performed.**<br>**The instrument allows to carry out ambient CO measurements only by means of sensors for low CO concentrations.**<br>**SEE SECTION 12.4.** |

| PARAMETER | DESCRIPTION |
|---|---|
|  Temperature | With this menu it is possible to measure the temperature of the supply water, by means of an OPTIONAL thermocouple K-type contact probe to be connected to the input T1.<br>Also, it is also possible to measure the temperature of the return water, by connecting an OPTIONAL thermocouple K-type contact probe to be connected to the input T2.<br>With the function ΔT it is possible to obtain the relevant temperature difference.<br>**SEE SECTION 12.5.** |
|  Pressure | It is possible, through the use of the external flexible pipe made in RAUCLAIR (supplied), to measure a pressure value within the range stated in the technical features (connect the pipe to P+ input). During the pressure measurement the 'HOLD' function is made available, which allows to 'freeze' the value shown on the display, by pressing 'HOLD' key.<br>**SEE SECTION 12.6.** |
|  Tightness test | According to the version, CHEMIST 500 can perform the tightness test on heating plants which use combustible gases according to the standards UNI 7129-1: 2015 and UNI 11137: 2012, respectively applicable to new or renewed pipings and to existing pipings, or according to the German standard DVGW TRGI 2008. The result of this tightness test, whose steps are described in the following, can be printed, once acquired, by starting the ' print menu ' in any of the screens of the ' Tightness Test ' menu.<br>**SEE SECTION 12.7 .. 12.12.** |
|  Aux. Meas. | Through this menu the user can access additional measures.<br>**SEE SECTION 12.13.** |

## 12.2 Measurements→Draft




**This screen is shown if a draft gauge is used to measure the draft.**

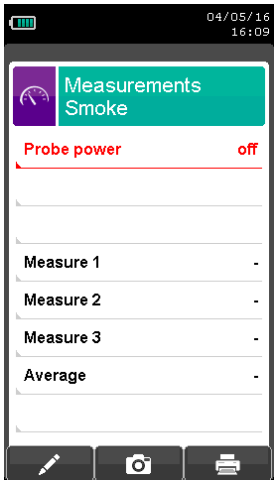
| KEY | FUNCTION |
|---|---|
|  | **Activate the context keys shown on the display.** |
|  | **Sets the value of the external temperature.** |
|  | **Returns to the previous screen.** |

| CONTEXT KEY | FUNCTION |
|---|---|
| F1 F2 F3 | **The activation of one of these keys starts the Draft measurement.** |
|  | **Carries out pressure zeroing.** |
|  | **Saves, in the memory selected in the "Memory Select" menu, the value of the draft measured.** |
|  | **Starts printing the test paper print-out. See section 11.** |

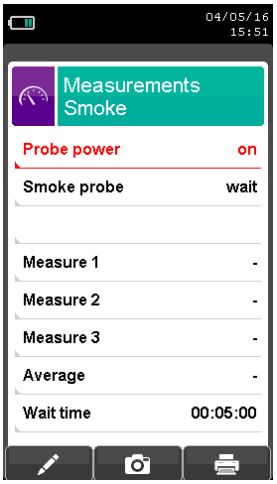
**To measure the draft proceed as follows:**
- Connect the probe pressure input hose to the instrument **P-** input.
- Enter the external air temperature.
- Before starting the pressure zeroing sequence pay attention to remove the gas probe from the stack.
- Having carried out the pressure zeroing sequence, insert the probe in the chimney and measure the draft.
- The draft values to be stored in the memory must be acquired before storing the analysis data.
- To attach the draft value to the readings of the current analysis, activate the "save" function '  '.
- To print the test paper print-out with the value of the draft, activate the function '  '.
- It is possible to cancel an acquired draft from the memory; to overwrite a new one, activate the "save" function again '  '.
- After saving the draft measurement, to carry out the combustion analysis, press the key '  '.

## 12.3 Measurements→Smoke

**Smoke measurement with manual pump kit.**




**Smoke measurement with heated head.**



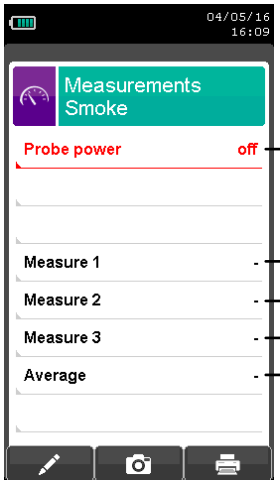

| KEY | FUNCTION |
|---|---|
|  | **Activate the context keys shown on the display.** |
|  | **Sets the "soot number" found by the device when measuring the carbon black.** |
|  | **Also activates the context key located in the lower left side of the display.** |
|  | **Returns to the previous screen.** |

| OPERAZIONI INTERATTIVE | DESCRIZIONE |
|---|---|
|  | **Enters the modification mode for the selected parameter.** |
|  | **Starts measurement (only when the heated head probe for smoke is used).** |
| OK | **Confirms the value entered.** |
|  | **Saves, in the memory selected in the "Select Memory" menu, the values entered.** |
|  | **Starts printing the paper print-out. See section 11.** |

- **Perform the smoke measurements with the proper manual pump or with the heated head probe.**
- Enter the values found.
- The values of the carbon black that you want to save must be acquired before saving the analyses.

- To join the values of the carbon black to the measurements of the current analysis use the '  ' function.
- To print the paper print-out with the measurement of the carbon black, activate the '  ' function.
- It is possible to delete the values of the carbon black acquired in the memory by overwriting them by activating the '  ' function again.
- After saving the carbon black values, to carry out the combustion analysis, press the key '  '.

## 12.3.1 Smoke measurement with manual pump (optional)




When manual pump kit is used set to ' **off** ' the probe power supply.

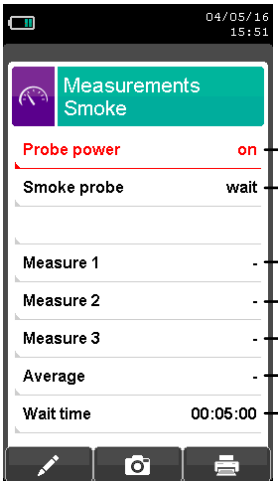
1st measurement value, to be entered manually.

2nd measurement value, to be entered manually.

3rd measurement value, to be entered manually.

Average value of the above measurements, automatically calculated by the instrument.

## 12.3.2 Smoke measurement with heated head probe (optional)




When the heated head probe is used for smoke measurement set to ' **on** ' the probe power supply.

Probe status: Wait (heating up) or Ready (probe is ready for measurement) or Measurement (acquisition).

1st measurement value, to be entered manually.

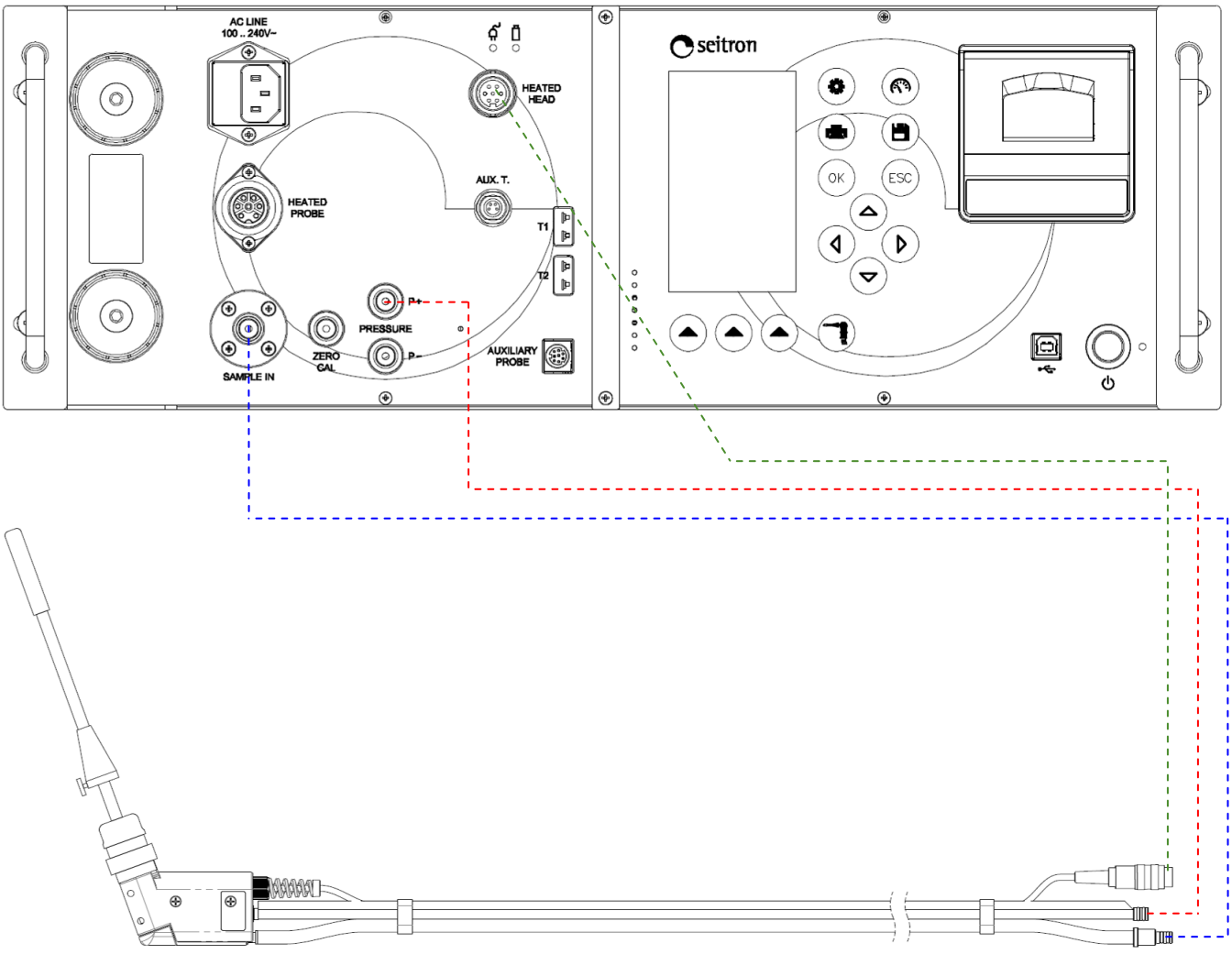
2nd measurement value, to be entered manually.

3rd measurement value, to be entered manually.

Average value of the above measurements, automatically calculated by the instrument.

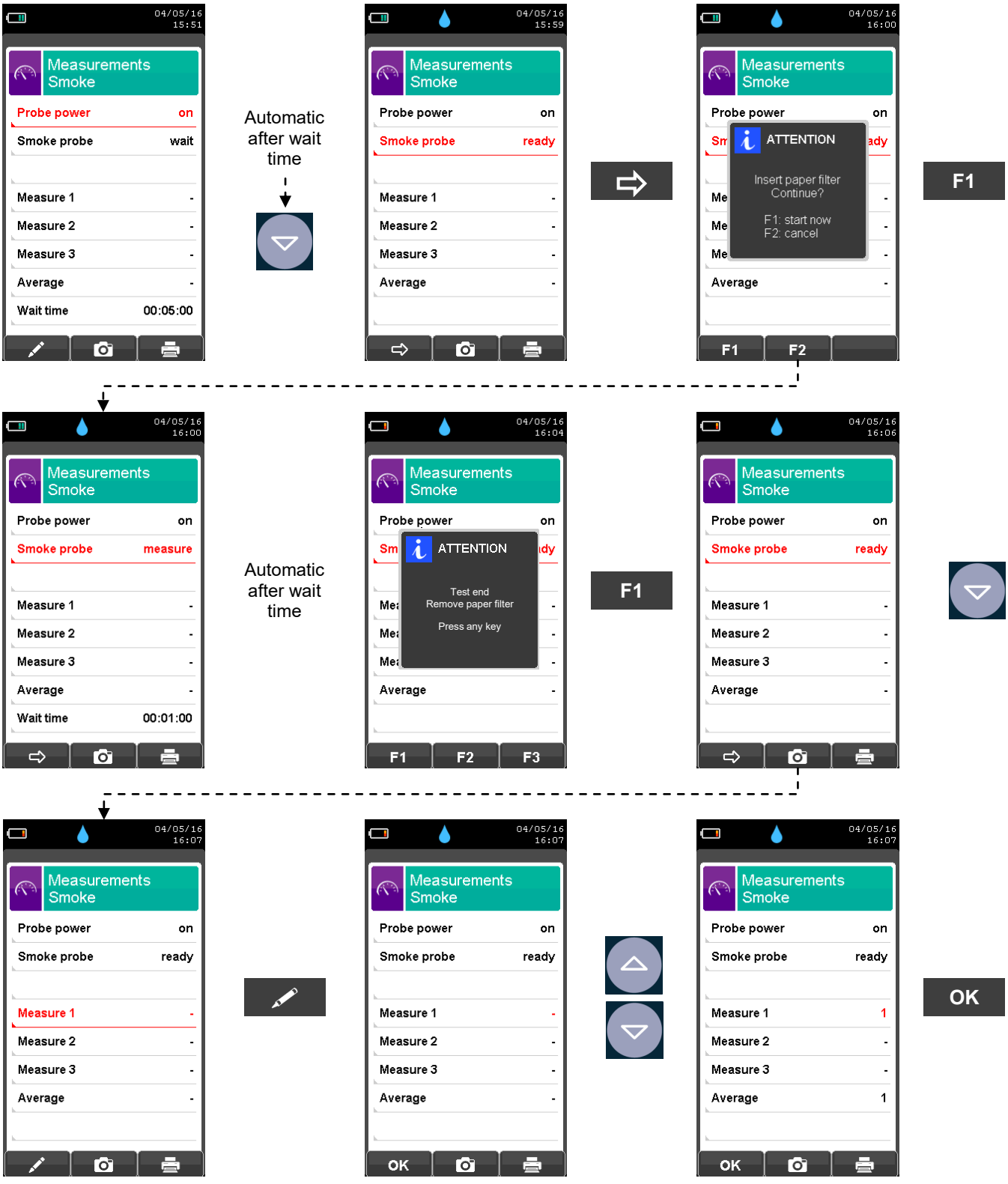
Residual wait time.

## 12.3.3 Connecting the heated head probe for smoke measurement



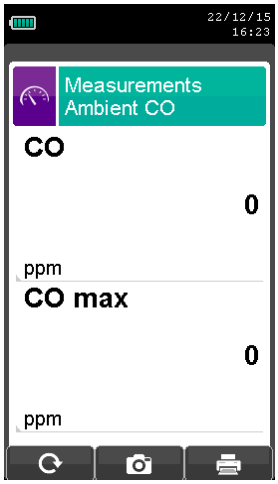

**Heated head probe for smoke measurement: (AASX04 / AASX05).**

## 12.3.4 Performing the test with the smoke probe




**In order to perform additional measurements, please repeat all the described operations.**

## 12.4 Measurements→Ambient CO



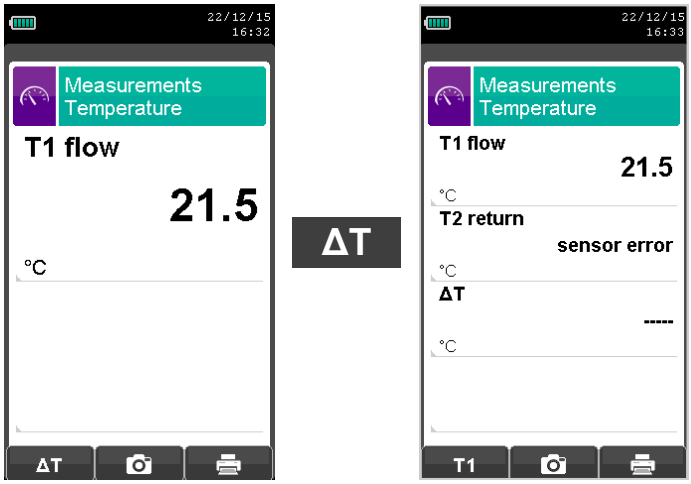

| KEY | FUNCTION |
|---|---|
| | **Activate the context keys shown on the display.** |
| ESC | **Returns to the previous screen.** |

| CONTEXT KEY | FUNCTION |
|---|---|
| | **Updates the measurement.** |
| | **Saves, in the memory selected in the "Select Memory" menu, the data acquired.** |
| | **Starts printing the paper print-out. See section 11.** |

**Make sure to perform to perform the autozero in a clean air enviroment (preferably outdoors), so that the ambient CO measurement is correct. It is advisable to turn on the instrument and wait for the autozero completion outside the area where the test is being performed.**

- The values of the ambient CO that you want to save must be acquired before saving the analyses.
- To join the values of the ambient CO to the measurements of the current analysis use the " " function.
- To print the paper print-out with the measurement of the ambient CO, activate the " " function
- It is possible to delete a draft value acquired by the memory by overwriting it by activating the " " function again.
- After saving the draft values, to carry out the combustion analysis, press the key ' '.

## 12.5 Measurements→Temperature

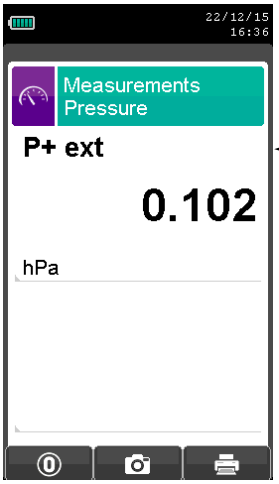



| KEY | FUNCTION |
|---|---|
|  | Activate the context keys shown on the display. |
|  | Returns to the previous screen. |

| CONTEXT KEY | FUNCTION |
|---|---|
| ΔT | Accesses the acquisition of the temperature difference between the supply water (measured by the probe connected to the connector T1 of the device) and the return water (measured by the probe connected to the connector T2 of the device). |
| T1 | Goes back to the visualisation of the supply water temperature. |
|  | Saves, in the memory selected in the "Select Memory" menu, the data acquired. |
|  | Starts printing the paper print-out. See section 11. |

## 12.6 Measurements→Pressure


Measurement of the differential pressure by means of the internal pressure sensor (piezoresistive, temperature compensated).



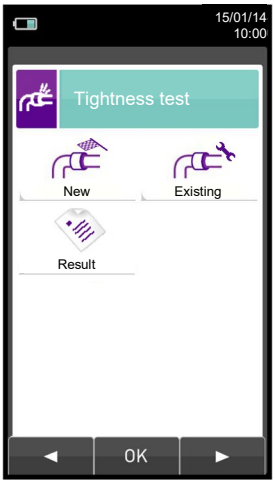

Measurement of the pressure by means of an external micromanometer.

| KEY | FUNCTION |
|---|---|
|  | Activate the context keys shown on the display. |
|  | Returns to the previous screen. |

| CONTEXT KEY | FUNCTION |
|---|---|
|  | Performs pressure zeroing. |
|  | Saves, in the memory selected in the "Select Memory" menu, the data acquired. |
|  | Starts printing the paper print-out. See section 11. |

## 12.7 Measurements→Tightness test

**Tightness test according UNI 7129-1: 2015 and UNI 11137: 2012 (when the instrument version so provides).**



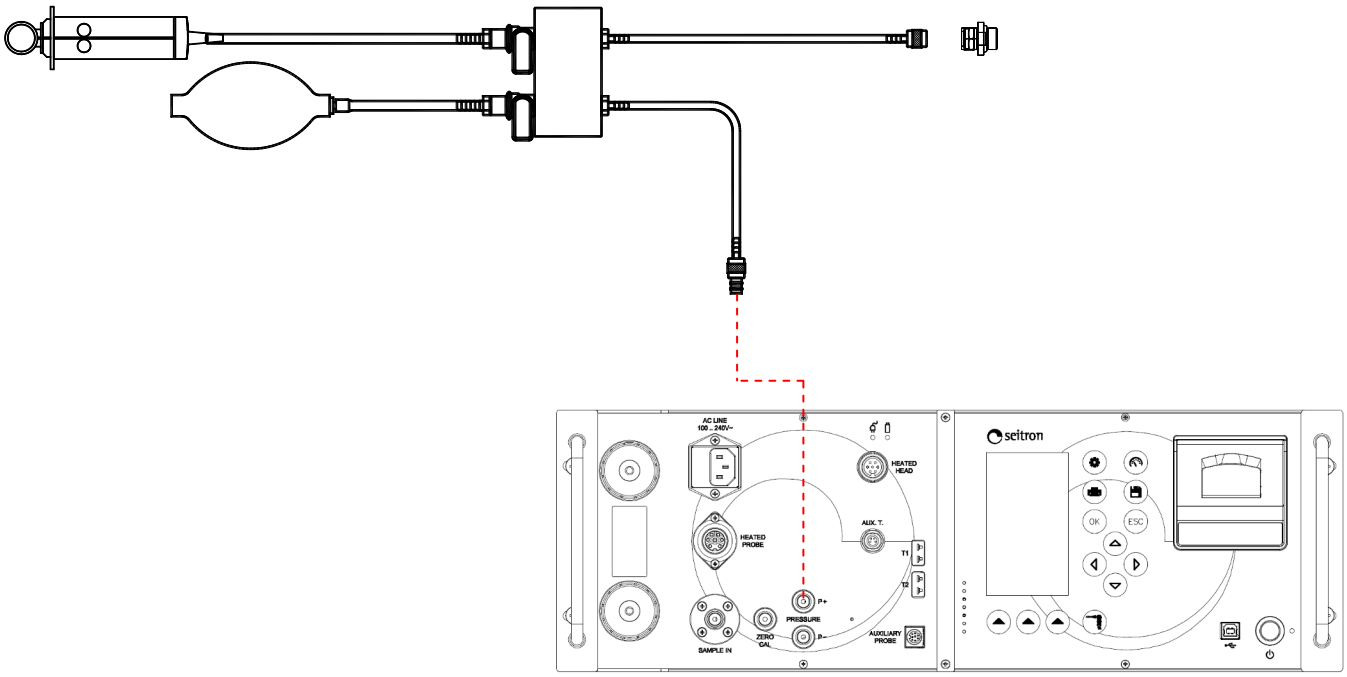

**Tightness test according DVGW TRGI (when the instrument version so provides).**


| KEY | FUNCTION |
|---|---|
|  | **Activate the context keys shown on the display.** |
|  | **Returns to the previous screen.** |

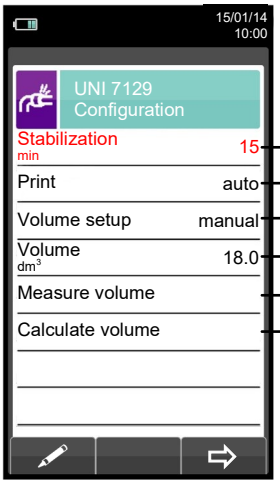
| CONTEXT KEY | FUNCTION |
|---|---|
| ◄ | **Selects the available parameters.** |
| OK | **Enters in the selected parameter setting.** |
| ► | **Selects the available parameters.** |

| PARAMETER | DESCRIPTION |
|---|---|
|  New | With this menu it is possible to perform a tightness test, in accordance with UNI 7129-1: 2015 (on new systems or systems that have been restored after a repair) or in accordance with DVGW TRGI 2008. **SEE SECTION 12.8 or 12.10**. |
|  Existing | With this menu it is possible to perform a tightness test, in accordance with UNI 11137: 2012, on existing systems. **SEE SECTION 12.9**. |
|  Gas meter | It is possible to enter the gas meter no. or location (4 rows up to 24 characters each) in accordance with DVGW TRGI 2008. This data will be printed on the header of the report. **SEE SECTION 12.11**. |
|  Result | This menu allows the user to view and/or save the last test carried out. **SEE SECTION 12.12**. |

## 12.7.1 Connecting the tightness test kit to the instrument.



## 12.8 NEW PIPING: UNI 7129-1: 2015 STANDARD
**(when the instrument version so provides)**




- Duration of the stabilization phase that can be set between 15 and 240 minutes
- Printing mode, that can be set as manual or automatic.
- Volume input mode can be set as 'manual' or 'default'.
- System volume, which can be set if known.
- Measures the volume of the system.
- Calculates the volume on the basis of the characteristics of the piping.

| KEY | FUNCTION |
|---|---|
|  | **Activate the context keys shown on the display.** |
|  | **Selects line; the selected line is displayed in red.**<br>**In edit mode, it sets the desired value.** |
|  | **Activates the context key located in the left side of the display.** |
|  | **Returns to the previous screen.**<br>**When in modify mode cancels the modification just made.** |

| CONTEXT KEY | FUNCTION |
|---|---|
|  | **Enters the modification mode for the selected parameter.** |
|  | **Goes to the next phase of the tightness test.** |
|  | **Performs pressure zeroing.** |
|  | **Interrupts the current phase.** |
|  | **Repeats the tightness test.** |
|  | **Saves, in the memory selected in the "Select Memory" menu, the data acquired.** |
|  | **The tightness test has been saved.** |
|  | **Starts printing the paper print-out.** |

## Details of the test:

The standard UNI 7129-1: 2015 can be adopted for testing new piping systems or reconditioned ones.
This test requires to charge the piping up to a pressure between 100 hPa and 150 hPa, then wait for a stabilization which must last at least 15 minutes and required in order for the thermal effects caused by the test gas compression to fade out, and finally to test the piping tightness by analysing the decay of pressure over time.

The maximum pressure decay measured, espresse as a function of the piping volume, must be smaller than the values shown in the following table:

| Internal piping volume (litters) | Wait time (minutes) | Maximum pressure decay allowed (hPa) |
|---|---|---|
| V ≤ 100 | 5 | 0,5 |
| 100 < V ≤ 250 | 5 | 0,2 |
| 250 < V ≤ 500 | 5 | 0,1 |

**Table 1.**

Chemist 900 allows the user to customize the stabilization phase through the following parameter:

**WAIT TIME:** it is the stabilization time and can be set by the user from 15 to 99 minutes. Please note that UNI 7129-1: 2015 standard requires a stabilization time of at least 15 minutes, anyway there is the possibility to skip stabilization by pressing ' ⏻ ' button.

**VOLUME SETUP:** An accurate tighness test performed according to the UNI 7129-1: 2015 standard requires to know the piping volume.

Because this data if often unavailable, Chemist 900 splits the test from the beginning into two different paths:

**Default**: valid for systems with a volume under 100 $dm^3$ (litres), the most frequent, where it is not required to enter the value of the volume since it is assumed that the system has a volume of 100 $dm^3$.
**Manual:** in this case it is necessary to set the volume of the system by entering the numeric value if known, or by calculating the amount as the sum of the contributions of the different sections of piping or, even, by assessing the measurement with a simple procedure that requires the injection into the system of a known amount of gas using a syringe.
If you use volume calculation, for each section of piping it is necessary to set the material, the nominal diameter and the length of the same. CHEMIST 900 calculates the volume of the section ("partial volume") and it adds it up, activating the context key ' V+ ' (sum piping), to the calculation of the volume of the system. To correct any errors of to modify the current calculation, the subtraction operation is also allowed by activating the context key ' V- ' (subtract piping).
When the 'Volume measurement' option is selected instead, the procedure, described also in the flow charts of the tightness test according to UNI 7129-1: 2015, is described in the following steps:

- Close both valves of the piping kit supplied for the test.
- Connect the syringe to the kit opposite the la siringa graduata al tubo del kit opposto the pump.
- Press the key relative to the context key ' OK '
- Open the valve on the side where the syringe is connected, take exactly 100 ml (100 cc) of the gas present in the system.
- Wait for the stabilization of the pressure of the system. After a few seconds, the device displays the measured volume. The suggested value can be accepted by pressing the key ' ESC ' and then modified by selecting, in "UNI 7129 Configuration" the line "volume".
  It is also possible to repeat the measurement of the volume by pressing the key relative to the interactive function ' ⟳ '.

---

Once the stabilization parameter has been set the user can proceed with the tightness test. By pressing the key relative to the context key ' ⇨ ', first the test pressure is indicated, as required by law, then you can access a screen which displays the pressure reading of the inputs of the device.
After zeroing the device and putting the system under a pressure of at least 100 hPa, it is possible to start the

tightness test by pressing the key relative to the context key ' ⇨ ', which starts the stabilization phase. In the stabilization screen, the following values are displayed:

**P**: Actual pressure measured by the instrument, in the selected measurement unit.
∆**P1'**: Pressure variation in the last minute, updated every 10 seconds. This value gives a rough indication about the stabilization level reached in the piping system.
**Wait time**: Remaining time before the stabilization phase ends.

Once the stabilization phase is terminated the tightness test is started. This test is performed by observing how the pressure decays in time during a fixed 5 minutes interval, as stated in the applied standard.

During the tightness test phase the following values are displayed:

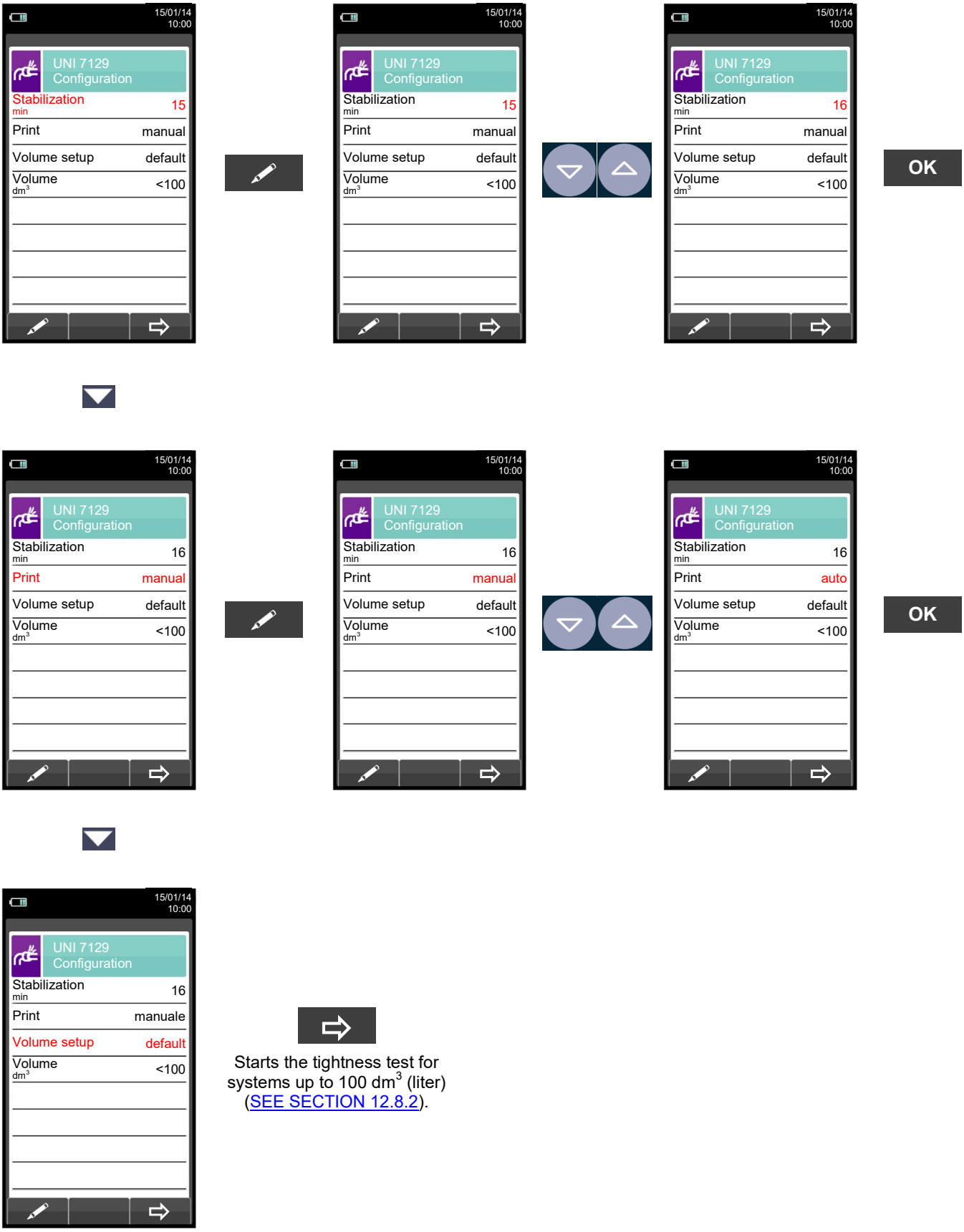
**P1**: Pressure measured at the beginning of the test.
**P2**: Pressure actually measured by the instrument.
∆**P**: Pressure variation with respect to the initial value. In case the actual pressure is lower than the initial value (pressure is decreasing) this value has a negative sign.
**Wait time**: Remaining time of the tightness test.

---

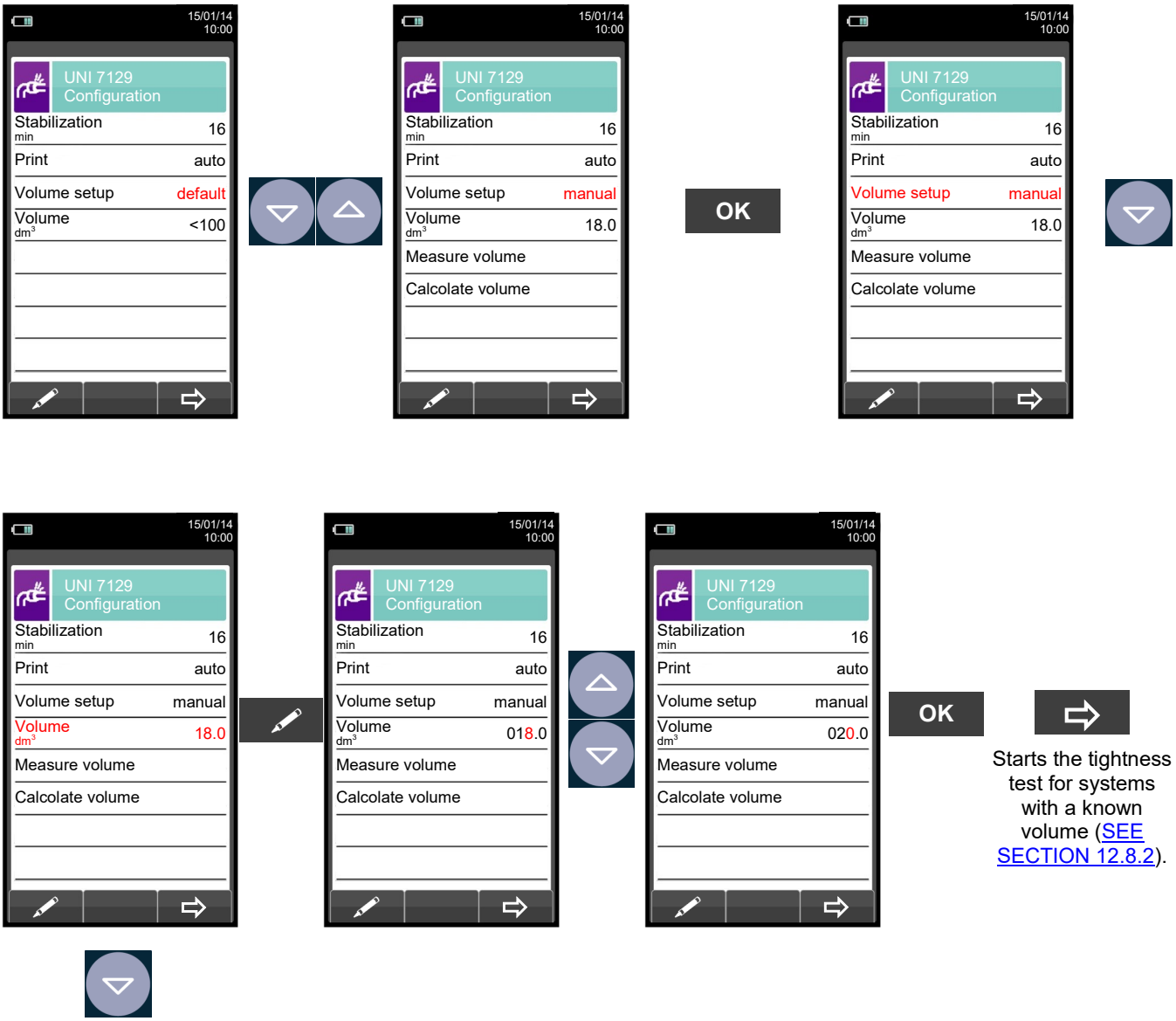
After the tightness test, the results are displayed: the data displayed is as follows:

**P1**: Pressure measured at the beginning of the test.
**P2**: Pressure measured by the device.
∆**P**: Pressure variation between the last instant and the first instant of the test. If the pressure decreased, it presents a negative value.
**Result**: Reports the test result:
**tight** when the pressure is within the limit of table 1.
**leak** when the pressure is outside the limit of table 1.
Positive pressure changes are symptom of a temperature change meanwhile the test is performed. Should this happen it is advisable to repeat the entire test.

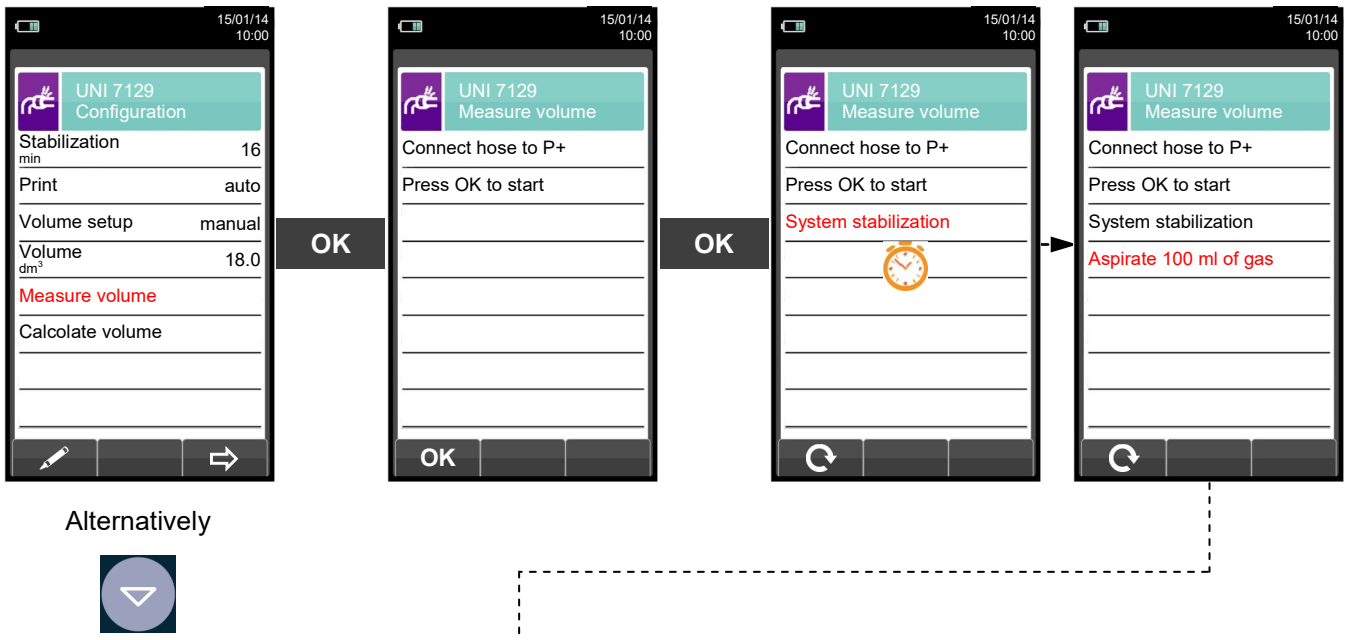
## 12.8.1 CONFIGURATION OF TIGHTNESS TEST ACCORDING TO UNI 7129-1: 2015




Starts the tightness test for systems up to 100 $dm^3$ (liter) (SEE SECTION 12.8.2).

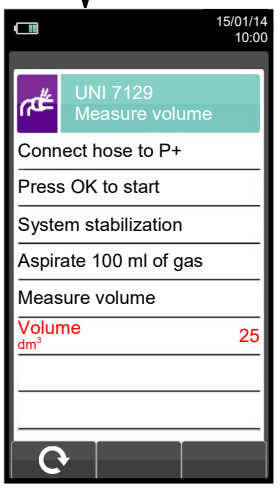



Starts the tightness test for systems with a known volume (SEE SECTION 12.8.2).

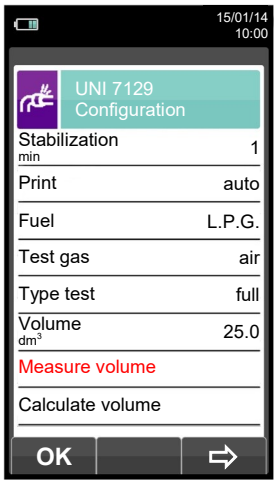



Alternatively

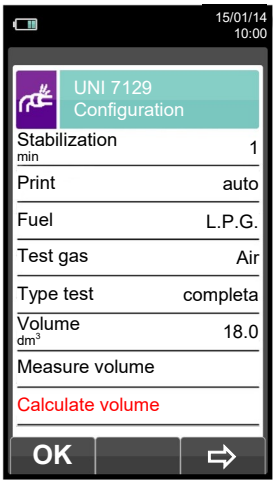
Take, with the syringe (that comes with the tightness test kit), 100 ml of gas.
If the volume measuring procedure of the system ends correctly, CHEMIST 500 automatically displays the measured volume, otherwise it requires another test.



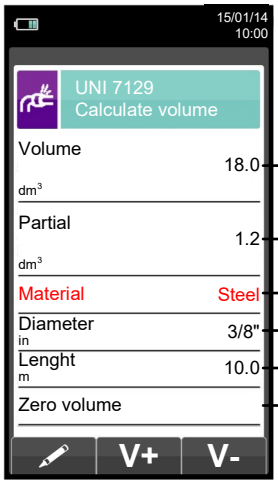

ESC




Starts the tightness test after measuring the volume (SEE SECTION 12.8.2).

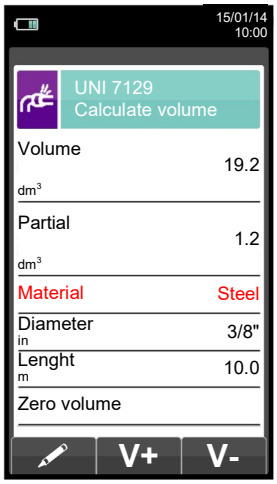



OK

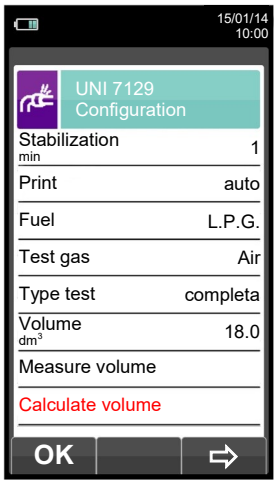



- Total volume acquired.
- Volume of the section of piping set below.
- Sets the material of the section of piping.
- Sets the nominal diameter of the section of piping.
- Sets the length of the section of piping.
- Zeroes the volume previously acquired.

**V+** Adds up the volume of the section of piping entered.

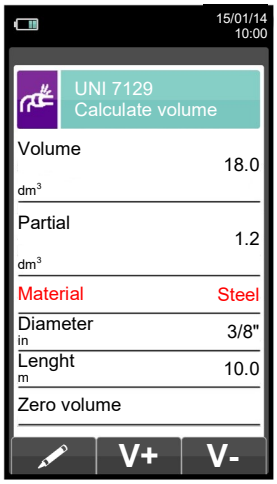



ESC

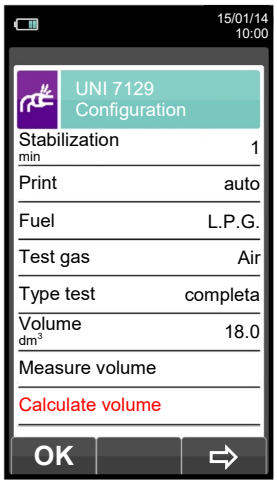



Starts the tightness test (SEE SECTION 12.8.2).

**V-** Subtracts the volume of the section of piping entered.

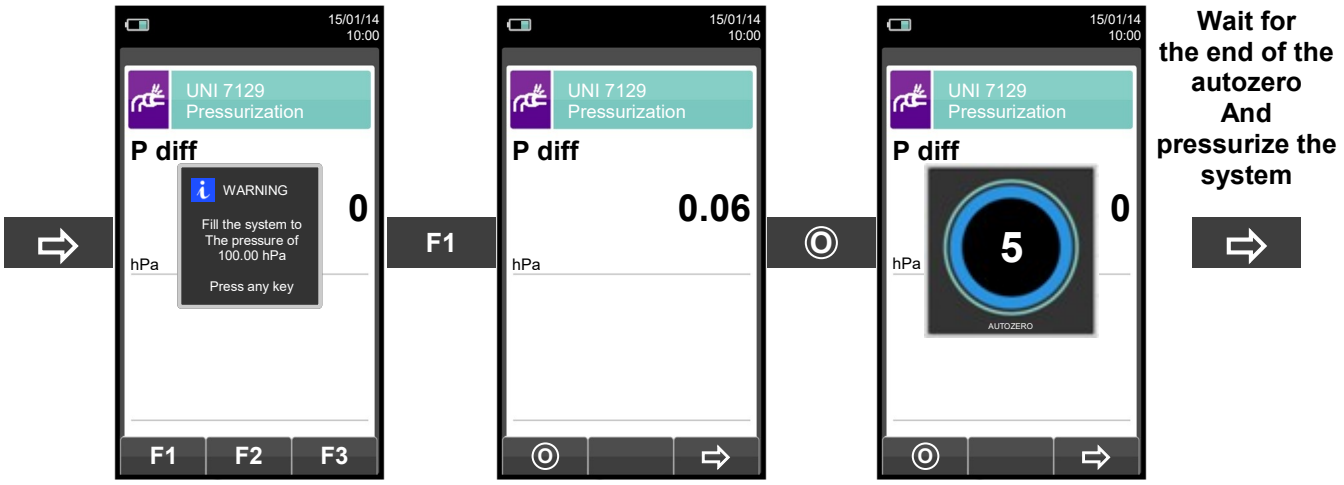


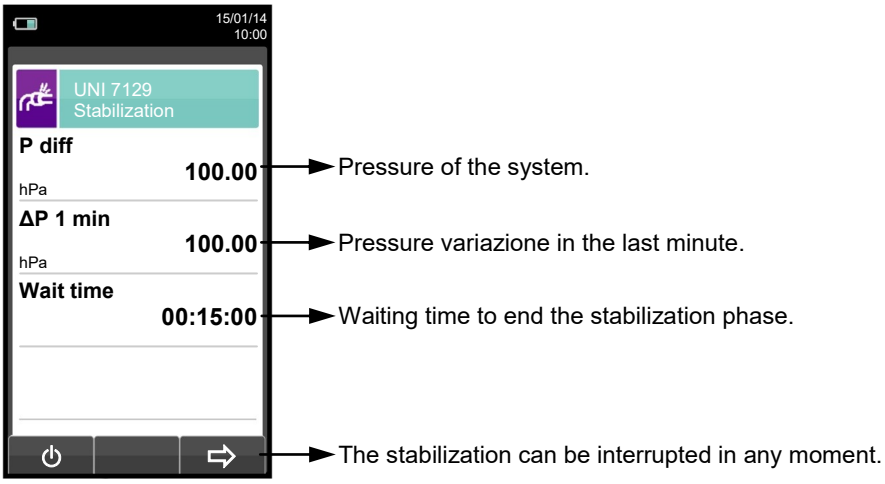

ESC



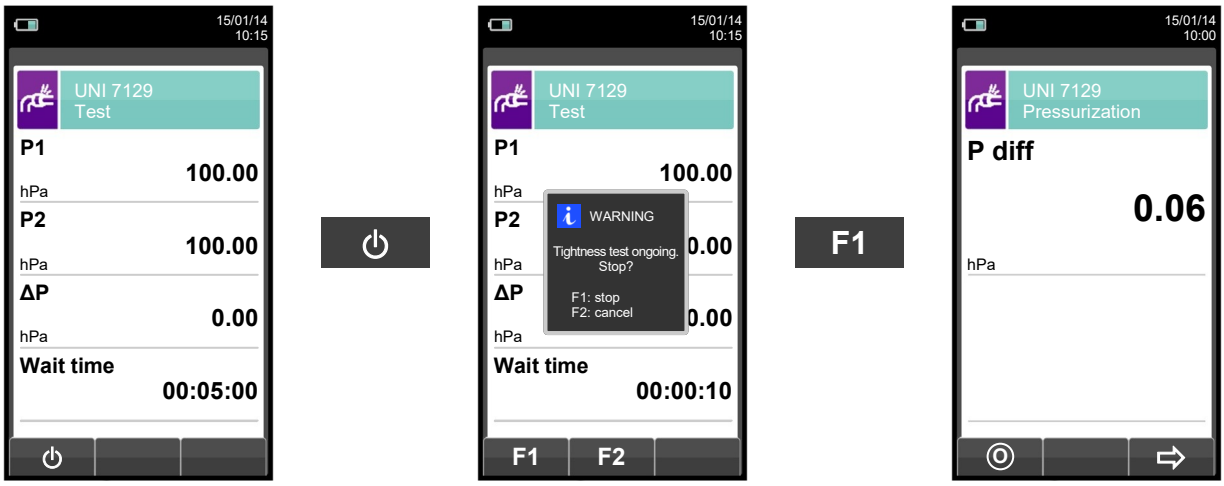

Starts the tightness test (SEE SECTION 12.8.2).

## 12.8.2 PERFORMING TIGHTNESS TEST ACCORDING TO UNI 7129-1: 2015



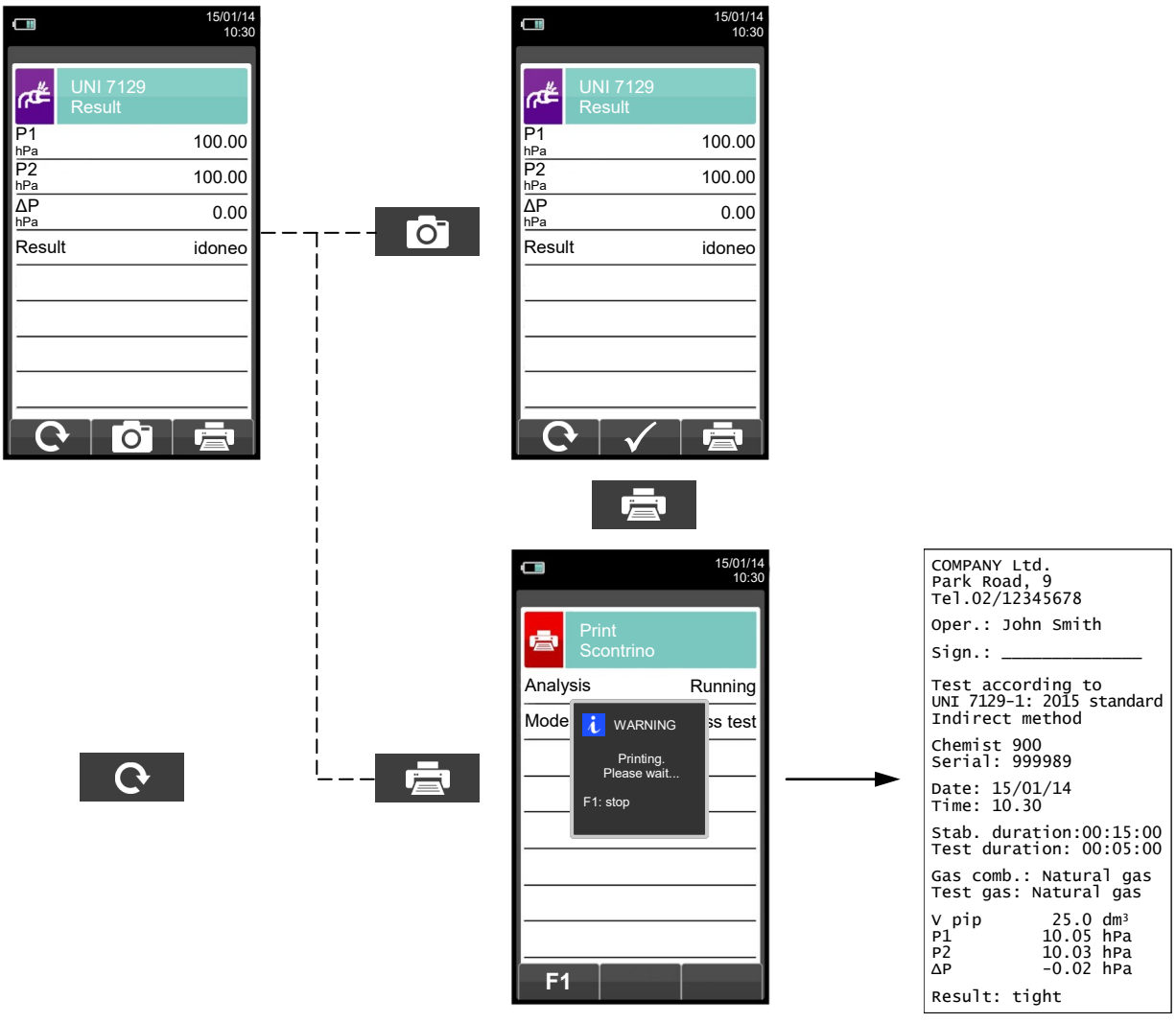

**Automatically**



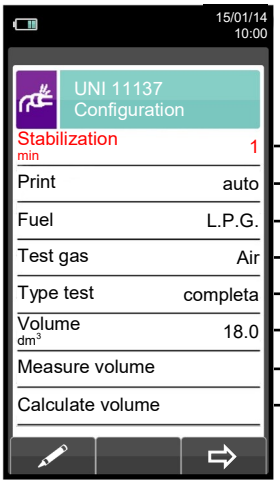

**Automatically,**
**after 5 minutes.**

**NOTE: If, while configuring the tightness test the automatic printing mode has been selected, the tightness test is printed automatically.**

**Instead, if the manual printing mode has been selected (exemplified case), at the end of the tightness test the results are displayed and they can be saved and/or printed.**
**In this case proceed as follows:**




## 12.9 EXISTING OR RENEWED SYSTEM: UNI 11137: 2012 STANDARD.
**(when the instrument version so provides)**




→ Duration of the stabilization phase that can be set between 1 and 240 minutes.
→ Printing mode, that can be set as manual or automatic.
→ Fuel used in the system: L.P.G. - Natural gas.
→ Gas used in the test: Air - fuel.
→ Type of test to perform: preliminary (system volume <18.0dm$^3$) - Complete.
→ System volume, which can be set if known.
→ Measures the volume of the system.
→ Calculates the volume on the basis of the characteristics of the piping.

| KEY | FUNCTION |
|---|---|
|  | **Activate the context keys shown on the display.** |
|  | **Selects line; the selected line is displayed in red.**<br>**In edit mode, it sets the desired value.** |
|  | **Activates the context key located in the left side of the display.** |
|  | **Returns to the previous screen.**<br>**When in modify mode cancels the modification just made.** |

| CONTEXT KEY | FUNCTION |
|---|---|
|  | **Enters the modification mode for the selected parameter.** |
|  | **In "Calculate Volume" it adds up one or more sections of piping.** |
|  | **In "Calculate Volume" it corrects any errors or modifies the current calculation by subtracting one or more sections of piping.** |
|  | **- Confirms the element entered.**<br>**- in "Measure Volume" it starts the volume measuring procedure.**<br>**- in "Calculate Volume" it zeroes the volume acquired.** |
|  | **Goes to the next phase of the tightness test.** |
|  | **Performs pressure zeroing.** |
|  | **Interrupts the current phase.** |
|  | **- Repeats the tightness test.**<br>**- In "Measure Volume" it repeats the volume measuring procedure.** |
|  | **Saves, in the memory selected in the "Select Memory" menu, the data acquired.** |
|  | **The tightness test has been saved.** |
|  | **Starts printing the paper print-out.** |

**Details of the test:**

The standard UNI 11137: 2012 can be adopted for testing already existing internal piping systems. This test requires to charge the piping up to the test pressure, then wait for an unspecified stabilization time until the thermal effects caused by the test gas compression are nulled, and then calculate the amount of the possible leakage from the measure of the pressure decays in 1 minute time for Methane and LPG in air and 2.5 minutes for the LPG fuel.
The test pressure should be as close as possible as the reference conditions following explained.

**REFERENCE CONDITIONS:** According to the combustible gas to be used in the piping, the tightness test must be performed in one of the following reference conditions:

| | | |
|---|---|---|
| Methane: | Reference pressure for test with supply gas | 2200 Pa |
| | Test pressure with air | 5000 Pa |
| L.P.G.: | Reference pressure for test with supply gas | 3000 Pa. |
| | Test pressure with air | 5000 Pa. |

**Note: The instrument allows the user to perform the tightness test even with a combustible gas different from the supply gas. Anyway the reference standard does not provide a reference pressure in this situation, so the reference pressure is taken like test gas is the same. Test result should be considered only indicative.**

CHEMIST 900 allows the user to customise the stabilization phase:

**STABILIZATION:** the stabilization phase duration can be set in the 1 .. 99 minutes range. As the UNI 11137: 2012 standard does not prescribe any stabilization duration, the factory setting for this value is borrowed from the UNI 7129 standard, which requires a minimum stabilization time of 15 minutes.
The waiting time can however be interrupted by activating the context key ' ⏻ ' even if the interval is not over.

The tightness test performed according to the UNI 11137: 2012 standard requires the input of some data regarding the piping system and the test conditions, as described in the following.

**COMBUSTIBLE GAS:** consider that the amount of the leakage is strictly related to the nature of the gas under pressure. When the tightness of a piping has to be evaluated it is mandatory to specify the family to which the gas belongs: Methane or L.P.G.

**TEST GAS:** again the amount of the leakage is related to the nature of the gas under pressure, therefore it is mandatory to specify the type of the gas used: Natural Gas, L.P.G. or air. Please note that the gas used for the test could also be different from the gas to be used in the plant and could even be a not flammable gas.

**TYPE OF TEST:** An accurate tighness test performed according to the UNI 11137: 2012 standard requires to know the piping volume.

Because this data if often unavailable, the instrument splits the test from the beginning into two different paths:

**Preliminary**: valid for systems with a volume under 18 $dm^3$ (litres), the most frequent, where it is not required to enter the value of the volume since it is assumed that the system has a volume of 18 $dm^3$.
**Complete:** in this case it is necessary to set the volume of the system by entering the numeric value if known, or by calculating the amount as the sum of the contributions of the different sections of piping or, even, by assessing the measurement with a simple procedure that requires the injection into the system of a known amount of gas using a syringe.
If you use volume calculation, for each section of piping it is necessary to set the material, the nominal diameter and the length of the same. The instrument calculates the volume of the section ("partial volume") and it adds it up, activating the context key ' V+ ' (sum piping), to the calculation of the volume of the system. To correct any errors of to modify the current calculation, the subtraction operation is also allowed by activating the context key ' V- ' (subtract piping).
When the 'Volume measurement' option is selected instead, the procedure, described also in the flow charts of the tightness test according to UNI 11137: 2012, is described in the following steps:

- Close both valves of the piping kit supplied for the test.
- Connect the syringe to the hose of the kit opposite to the hand pump.

- Press the key relative to the context key ' OK '
- Open the valve on the side where the syringe is connected, take exactly 100 ml (100 cc) of the gas present in the system.
- Wait for the stabilization of the pressure of the system. After a few seconds, the device displays the measured volume. The suggested value can be accepted by pressing the key ' ESC ' and then modified by selecting, in "UNI 11137 Configuration" the line "volume".
  It is also possible to repeat the measurement of the volume by pressing the key relative to the interactive function ' ⟳ '.

**Table of volumes:**
**Examples relating to the various lengths of indoor systems, capacity approximately corresponding to 18dm$^3$, depending on the material and the diameter of the fuel gas adduction pipe.**

| Steel | | Copper / Multilayer/ Polyethylene | |
|---|---|---|---|
| **Diameter** | **Length (m)** | **Internal diameter (mm)** | **Length (m)** |
| 1/2" | 82 (68) | 10 | 228 (190) |
| 3/4" | 49 (40) | 12 | 160 (133) |
| 1" | 28 (23) | 14 | 116 (97) |
| 1 1/4" | 17 (14) | 16 | 90 (75) |
| | | 19 | 64 (53) |
| | | 25 | 37 (31) |
| | | 26 | 34 (28) |
| | | 34 | 20 (17) |

Note: When the measurement group can not be excluded from the test, the indicative length of the plant is given in brackets.

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Once the stabilization mode has been defined and the required data has been entered, you can proceed with the tightness test. By pressing the key relative to the context key ' ⇨ ', first the test pressure is indicated, as required by law, then you can access a screen which displays the pressure reading of the inputs of the device. After zeroing the device and putting the system under a pressure of at least 100 hPa, it is possible to start the tightness test by pressing the key relative to the context key ' ⇨ ', which starts the stabilization phase. In the stabilization screen, the following values are displayed:

**P diff**: Actual pressure measured by the instrument, in the selected measurement unit.
**ΔP 1 min**: Pressure variation in the last minute, updated every 10 seconds. This value gives a rough indication about the stabilization level reached in the piping system.
**Wait time**: Remaining time before the stabilization phase ends.

Once the stabilization phase is terminated the tightness test is started. This test is performed by observing how the pressure decays in time during a fixed 1 minute interval for Methane and LPG in air and 2.5 minutes for the LPG fuel, as stated in the applied standard.
During the tightness test phase the following values are displayed:

**P1**: Pressure measured at the beginning of the test
**P2**: Pressure actually measured by the instrument
**ΔP**: Pressure variation with respect to the initial value. In case the actual pressure is lower than the initial value (pressure is decreasing) this value has a negative sign.
**Wait time**: Remaining time before the Test phase ends.

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Once the test has finished, the results are displayed; the data dsplayed is as follows:
**P1**: Pressure measured at the beginning of the test
**P2**: Pressure measured by the device.

**ΔP**: Pressure variation between the last instant and the first instant of the test. If the pressure decreased, it presents a negative value.

**Qtest**: Is the calculated leakage measured in $dm^3/h$ according to the conditions under which the test has been performed, i.e. the gas used for the test as well as the final pressure measured during the test.

**Qref**: is the calculated leakage measured in $dm^3/h$ according to the reference conditions described in the standard, it is related to the gas to be used in the piping as well as to the reference pressure.

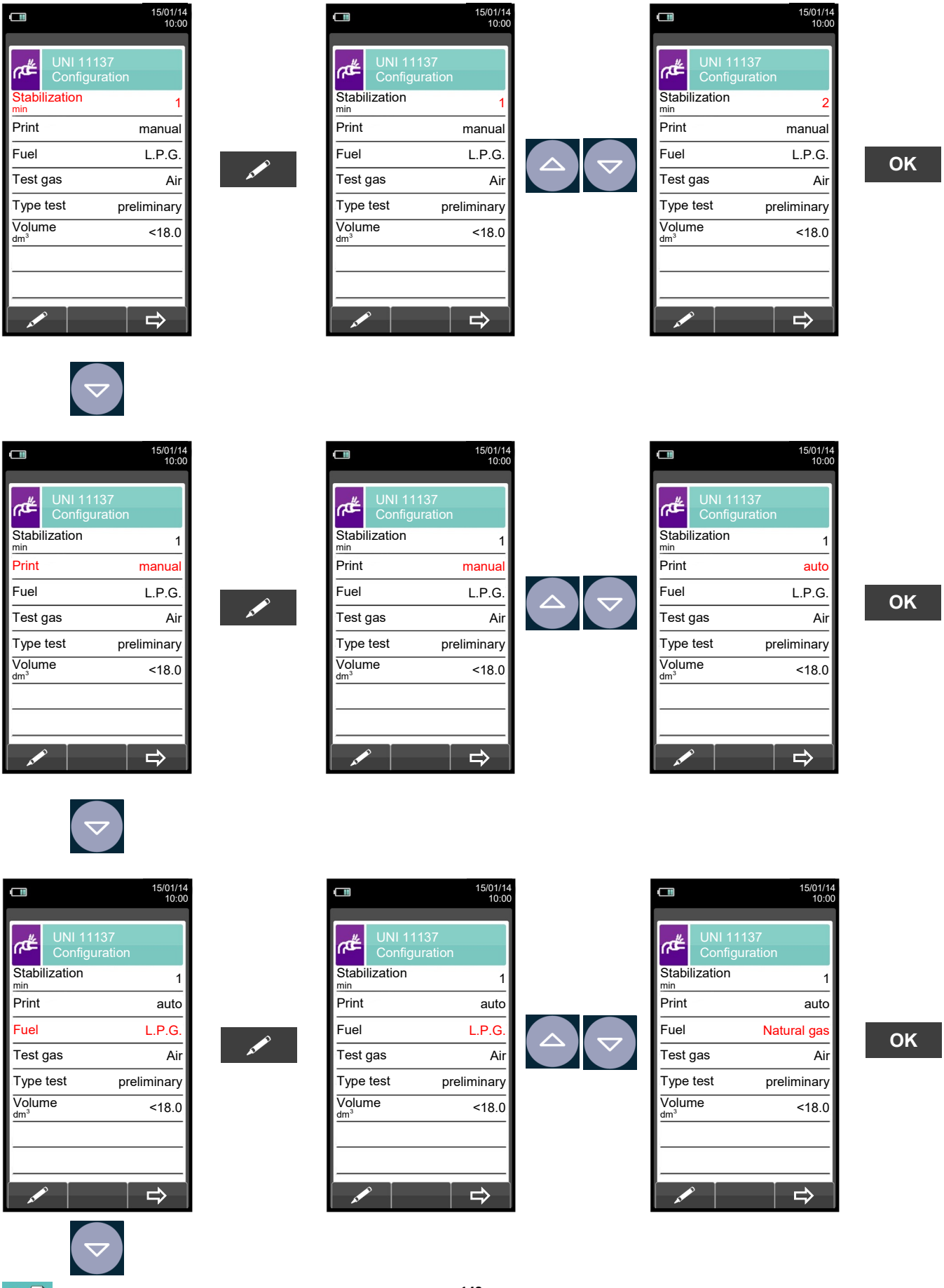
**Result**: is the result of the tightness test.

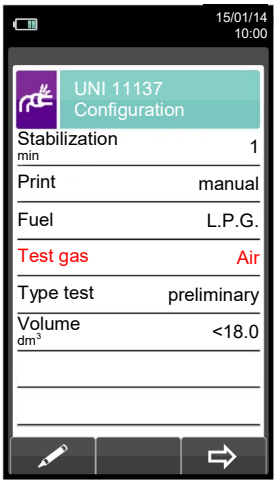
**Compliant (piping suitable for operation):** when the leakage flow calculated in the reference conditions is not greater than 1 $dm^3/h$ for methane and not greater than 0,4 $dm^3/h$ for LPG the system is authorized to operate without restrictions or intervention.

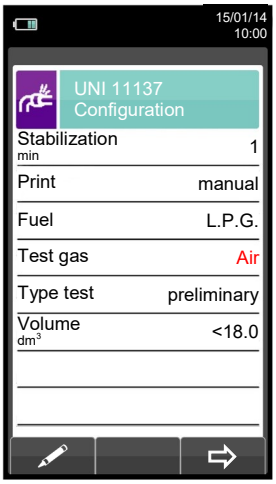
**Compl. 30 DD (piping temporarily suitable for operation):** when the leakage flow calculated in the reference conditions is included in the range 1 $dm^3/h$ < Qref ≤ 5 $dm^3/h$ for methane and in the range 0,4 $dm^3/h$ < Qref ≤ 2 $dm^3/h$ for LPG. The system is authorized to operate only for the time needed for the maintenance of the pipe in order to fix the leakage problem, and in any case for no more than 30 days after the testing day. Once the fixing has been completed the piping must tested again for its tightness according to the UNI 7129 standard.

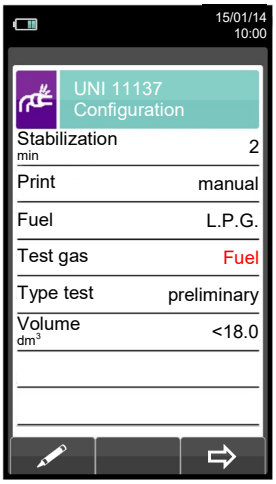
**Non compliant (not suitable for operation):** when the leakage flow is greater than 5 $dm^3/h$ for methane and greater than 2 $dm^3/h$ for LPG. In this situation the measured leakage is such that the piping is not suitable for operation and must immediately placed out of order. Once the leakage problem has been fixed the piping must tested again for its tightness according to the UNI 7129 standard.

## 12.9.1 CONFIGURATION OF TIGHTNESS TEST ACCORDING TO UNI 11137: 2012

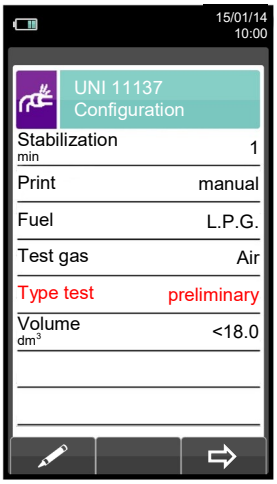




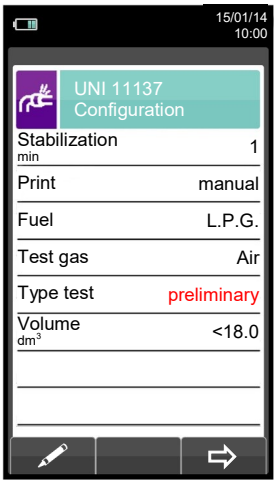



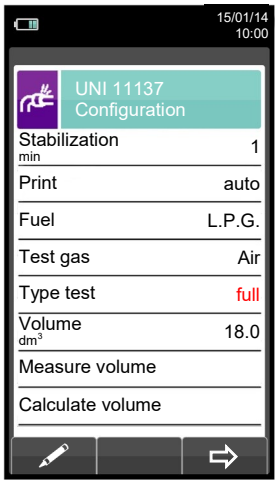




OK

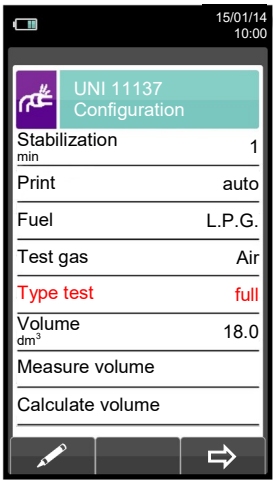


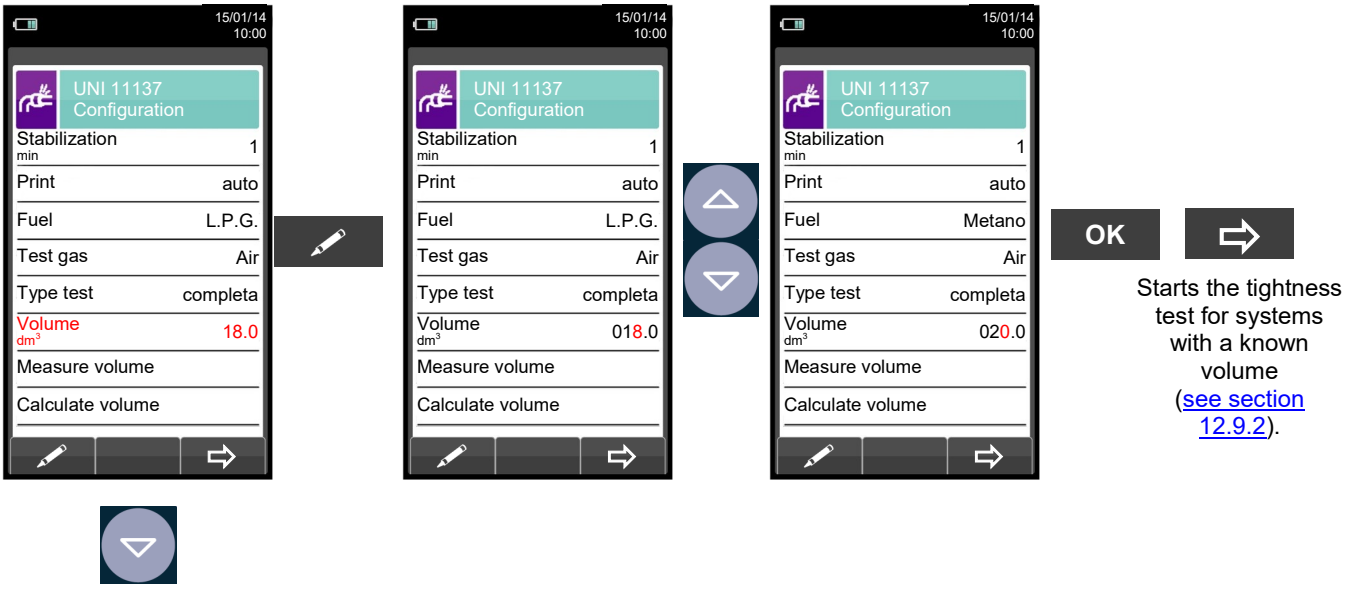

Starts the tightness test for systems up to 18 $dm^3$ (see section 12.9.2).



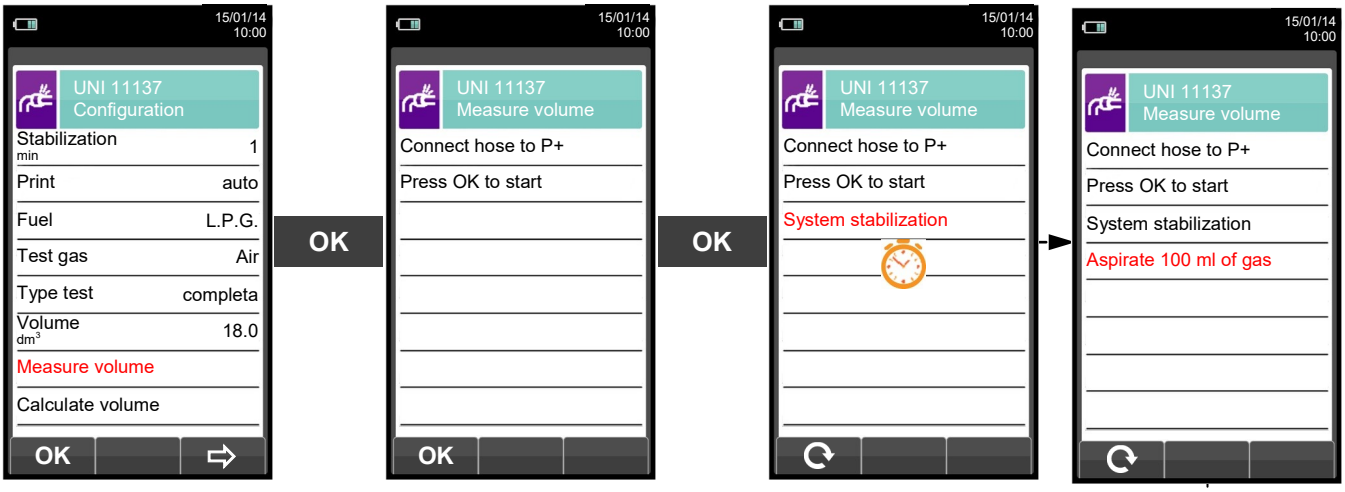




OK



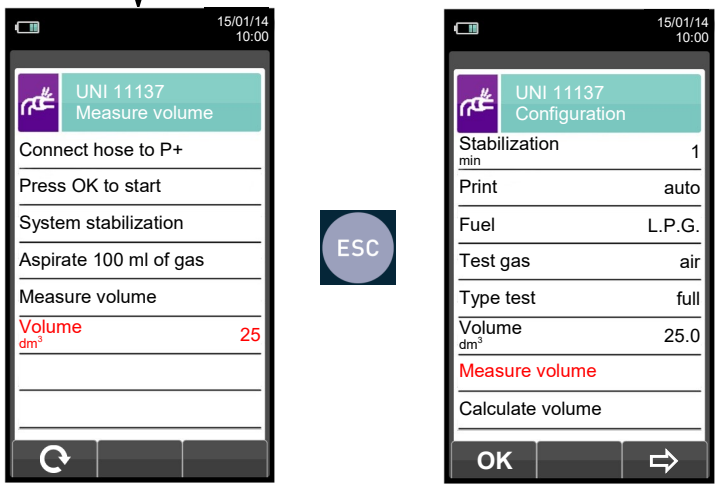




Starts the tightness test for systems with a known volume (see section 12.9.2).

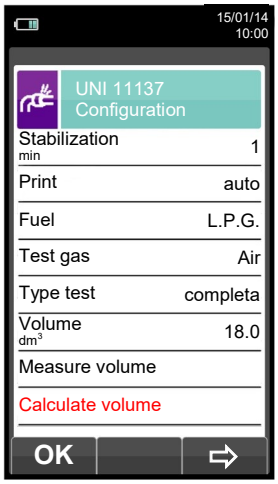



Alternatively

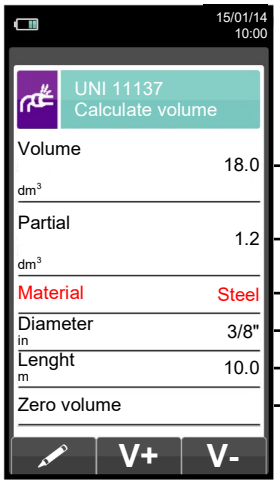
Take, with the syringe (that comes with the tightness test kit), 100 ml of gas.
If the volume measuring procedure of the system ends correctly, the instrument automatically displays the measured volume, otherwise it requires another test.




Starts the tightness test after measuring the volume (see section 12.9.2).




OK




→ Total volume acquired.

→ Volume of the section of piping set below.

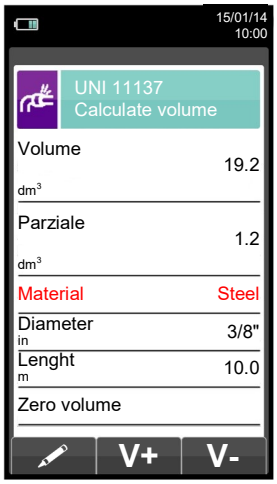
→ Sets the material of the section of piping.

→ Sets the nominal diameter of the section of piping.

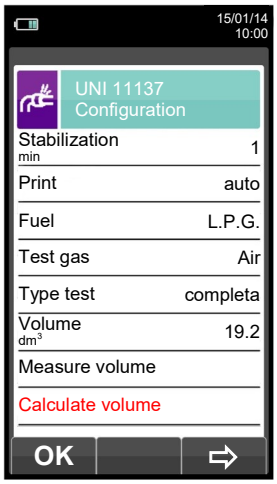
→ Sets the length of the section of piping.

→ Zeroes the volume previously acquired.

**V+** Adds up the volume of the section of piping entered.



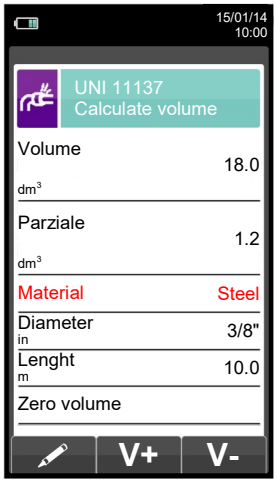

ESC



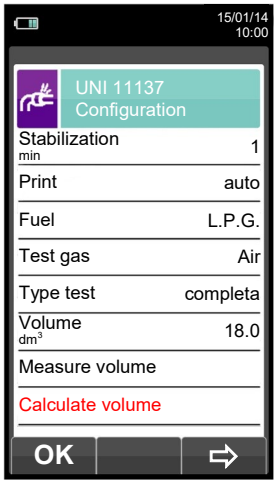

⇨

Starts the tightness test (see section 12.9.2).

**V-** Subtracts the volume of the section of piping entered.



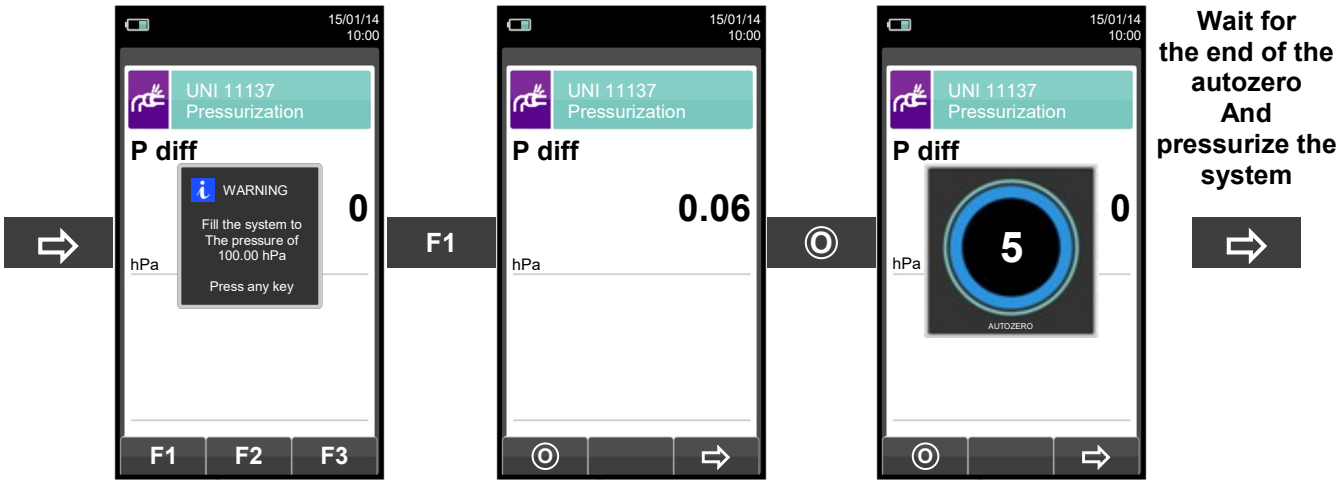

ESC

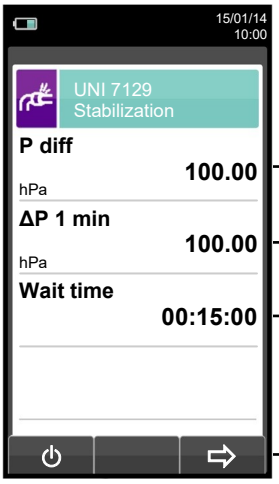



⇨

Starts the tightness test (see section 12.9.2).

## 12.9.2 PERFORMING THE TIGHTNESS TEST ACCORDING TO UNI 11137: 2012



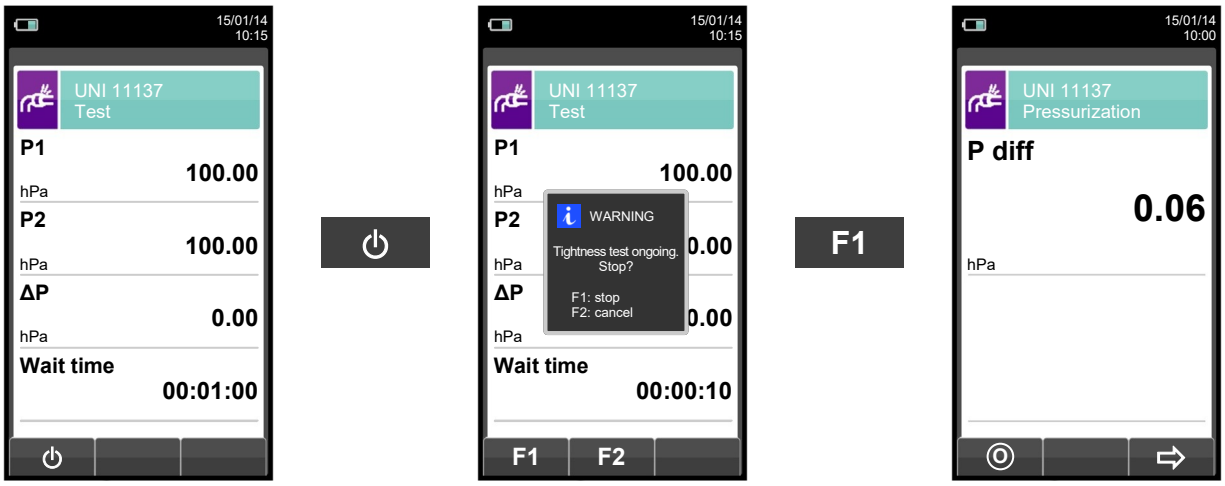

→ Pressure of the system.

→ Pressure variazione in the last minute.

→ Waiting time to end the stabilization phase.

→ The stabilization can be interrupted in any moment.

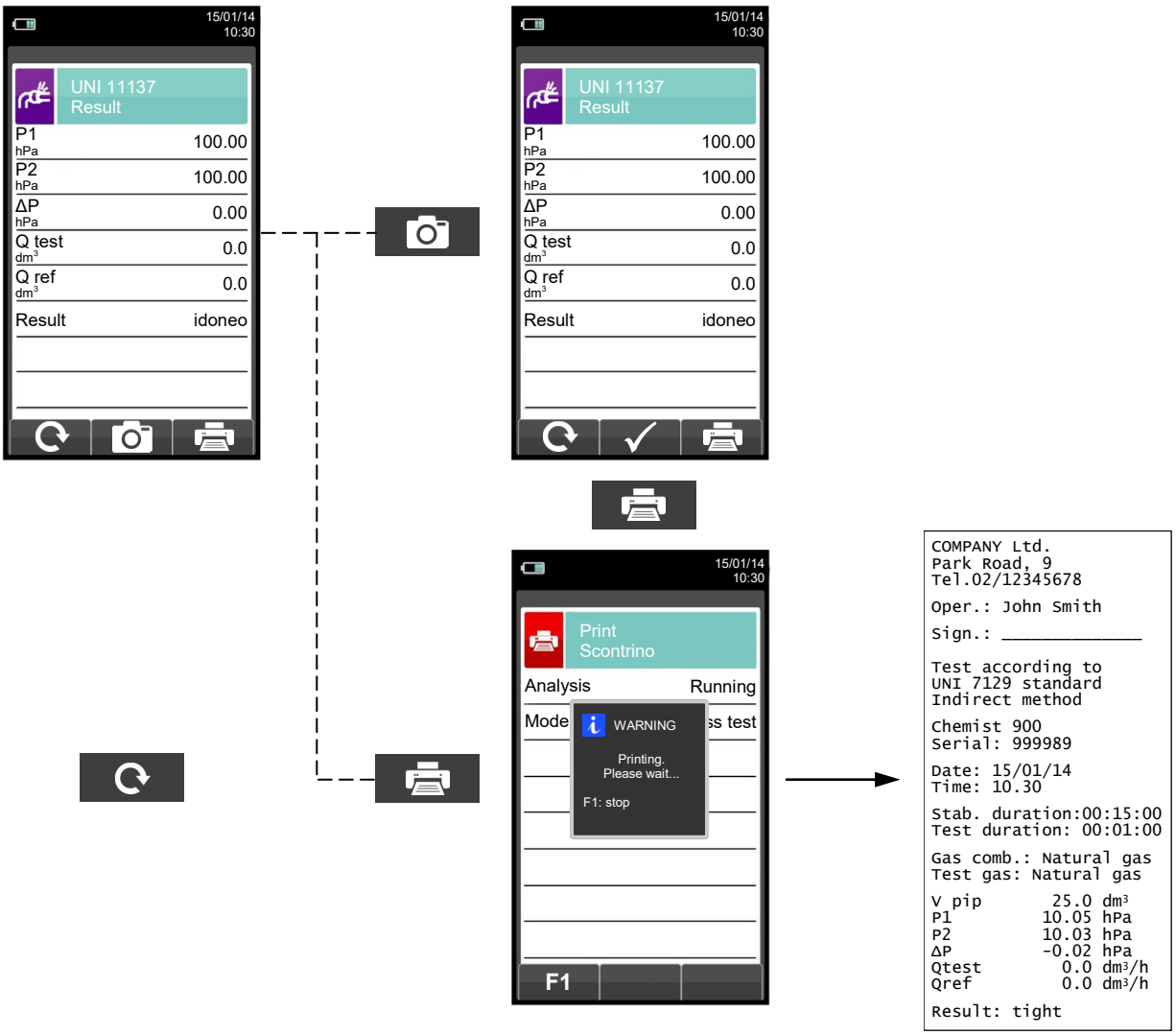
**Automatically**



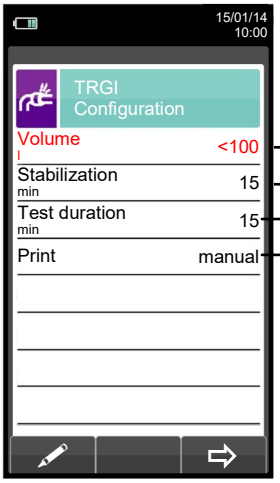

**Automatically,**
**after 1 minute.**

**NOTE: If, while configuring the tightness test the automatic printing mode has been selected, the tightness test is printed automatically.**

**Instead, if the manual printing mode has been selected (exemplified case), at the end of the tightness test the results are displayed and they can be saved and/or printed.**
**In this case proceed as follows:**




## 12.10 Measurements → Tightness test TRGI → New
**(when the instrument version so provides)**




→ Volume of the gas line <100 oder 100..200 oder >200 liter.
→ Waiting time 15 ... 240 minutes.
→ Duration time of test 15 ... 240 minutes.
→ Print out test of the result (manuel or automatic).

| KEY | FUNCTION |
|---|---|
|  | **Activates the context keys shown on the display.** |
|  | **Select line; the selected line is displayed in red.<br>In edit mode, it is the desired value.** |
|   | **Enters the selected parameter setting.** |
|   | **Returns to the previous screen.<br>When in modify mode cancels the modification just made.** |

| CONTEXT KEY | FUNCTION |
|---|---|
|  | **Enters the modification mode for the selected parameter.** |
|  | **Goes to the next phase of the tightness test.** |
|  | **Performes pressure zeroing.** |
|  | **Interrupts the current phase.** |
|  | **Repeats the tightness test.** |
|  | **Saves, in the memory selected in the "Select Memory" menu, the data acquired.** |
|  | **Tightness test has been saved.** |
|  | **Starts printing the paper print-out.** |

## Details of the test:

With the flue gas analyzer CHEMIST 500 (according to the model) it is possible to to test gas lines (DVGW TRGI 2008).

This test procedure is valid for gas lines with maximum operating pressure of 100 mbar:
The Standard DVGW TRGI 2008 is valid for new or after service existing gas lines. The tightness test uses a test pressure of 150mbar (test gas: air) all other parameter have to be selected according the gas line volume: waiting time and time duration for the test (time duration were the gas line is under pressure with 150 mbar).

| **Tightness test - DVGW TRGI 2008** | | |
|---|---|---|
| **Volume of the gas line *** | **Waiting time before test starts** | **min. duration for the test** |
| < 100 liter | 10 min | 10 min |
| ≥ 100 l bis 200 liter | 30 min | 20 min |
| ≥ 200 liter | 60 min | 30 min |

*** Benchmark**

**waiting time (Stabilization phase):** You can edit manually the waiting time according to the volume of the gas line before you start the test procedure. The range is variable from 10 … 99 minutes.

**P**: Current pressure measured when waiting time started.
∆**P1'**: Current pressure difference.
**wait time**: Time to stabilize the pressure in the gas line, the pressure must be higher than 150 mbar. On the display is the timer shown (count backwards).

Minumum duration time of tightness test according to the volume of the gas line: ***duration time***
Waiting time according to the volume of the gas line: ***wait time***
After the waiting time is finished the tightness test can start.

During the tightness test the follwoing values measured for the duration time of the test will shown at the display:

**P1**: Pressure measured at the moment the tightness test begins (minimum 150 mbar).
**P2**: Curent measured pressure.
∆**P**: Pressure diffenence between start and finished test; negative value means pressure drop.

**Result**: **tight or leak.**

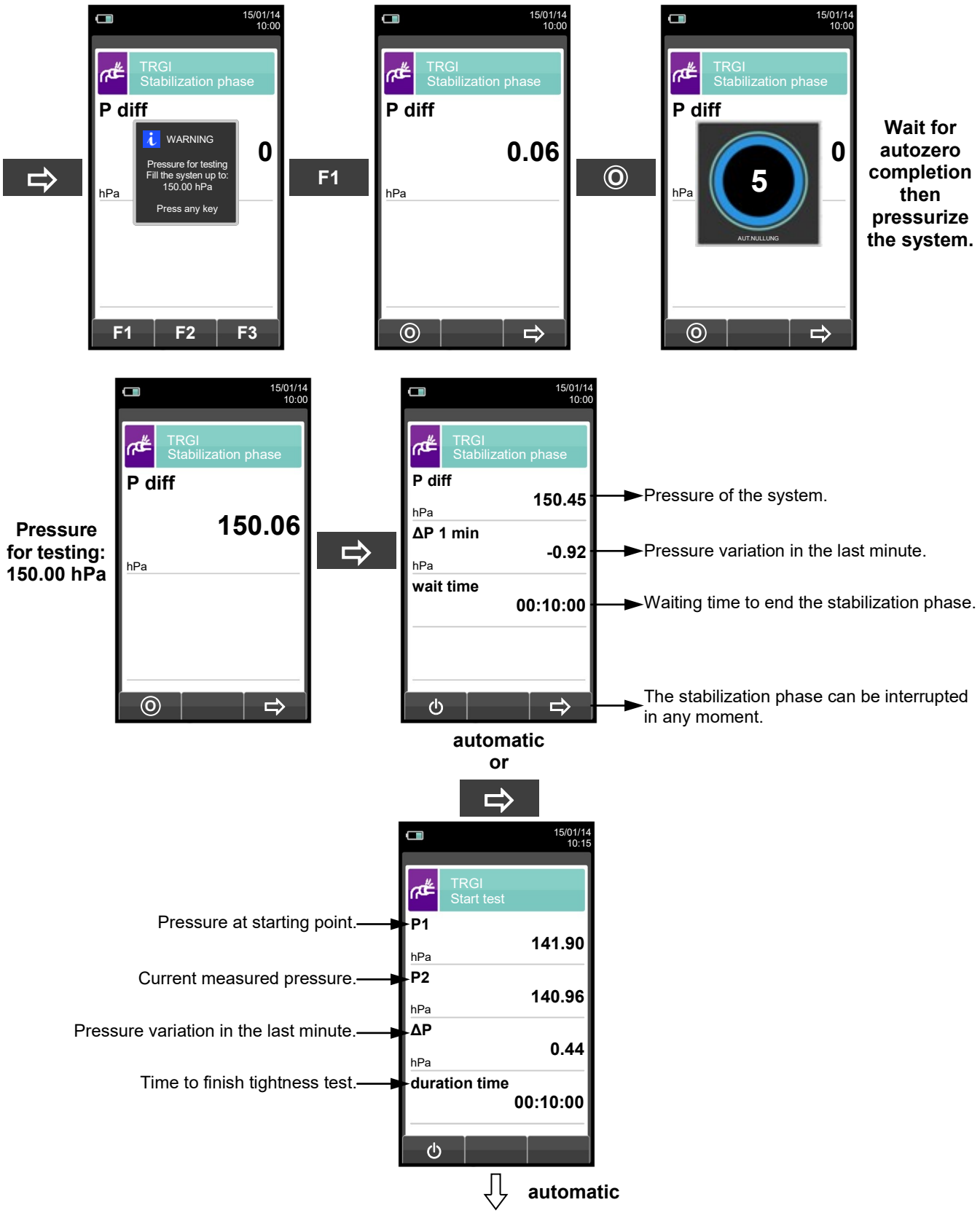
According to DVGW TRGI 2008 - no pressure drop is allowed!

It is possible to enter the data of the gas line (e.g. location, …). They are shown later on the print out (report).

If duration time or waiting time varies (according the DVGW Standard) you can change the used time by yourself.

The loading and the serviceability test can not be testetd with the flue gas analyzer CHEMIST 500, you have to use other measuring devices.

## 12.10.1 Performing a tightness test for a gas line up to 100 liter.



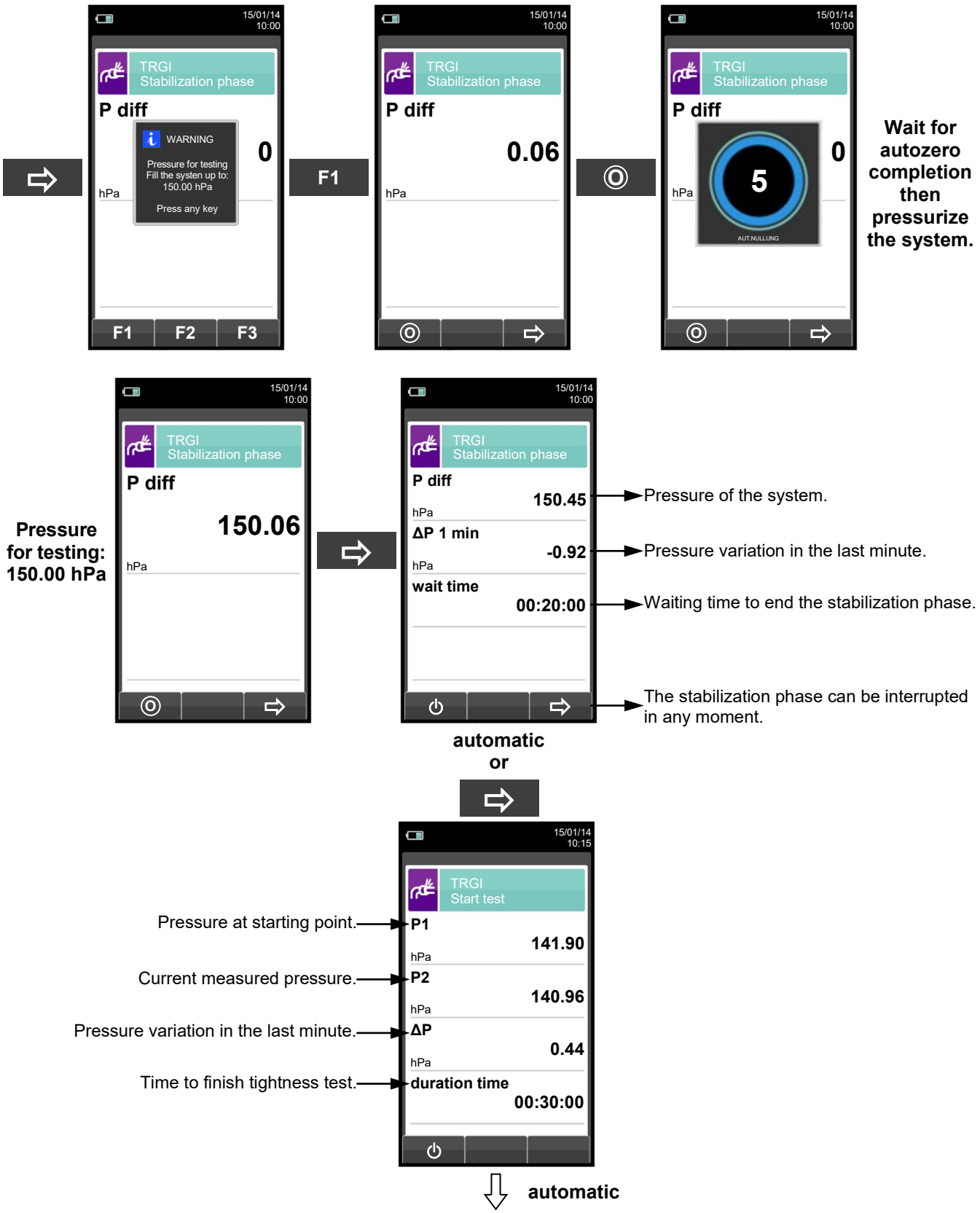

**NOTE: If, while configuring the tightness test the automatic printing mode has been selected, the tightness test is printed automatically.**

**Instead, if the manual printing mode has been selected (exemplified case), at the end of the tightness test the results are displayed and they can be saved and/or printed. In this case proceed as follows.**


15/01/14
10:30
Tightness test
Result
P1 hPa 116.27
P2 hPa 106.16
ΔP hPa -10.11
Result leak
15/01/14
10:30
Tightness test
Result
P1 hPa 116.27
P2 hPa 106.16
ΔP hPa -10.11
Result leak
15/01/14
10:30
Tightness test
Result
P1 hPa 116.27
P2 hPa 106.16
ΔP hPa -10.11
Result leak
15/01/14
10:30
Print
Report
Analysis running
Mode ndard
WARNING
Printing
Please wait ...
F1: stop
F1
COMPANY Ltd.
Park Road, 9
Tel.02/12345678
Oper.: John Smith
Sign.: _____
Test according to
TRGI
Chemist 900
Serial: 999989
Date: 15/01/14
Time: 10.30
wait time: 00:15:00
Duration time: 00:15:00
P1 116.27 hPa
P2 106.16 hPa
ΔP -10.11 hPa
Result: leak
Note: .....
.....
.....
.....

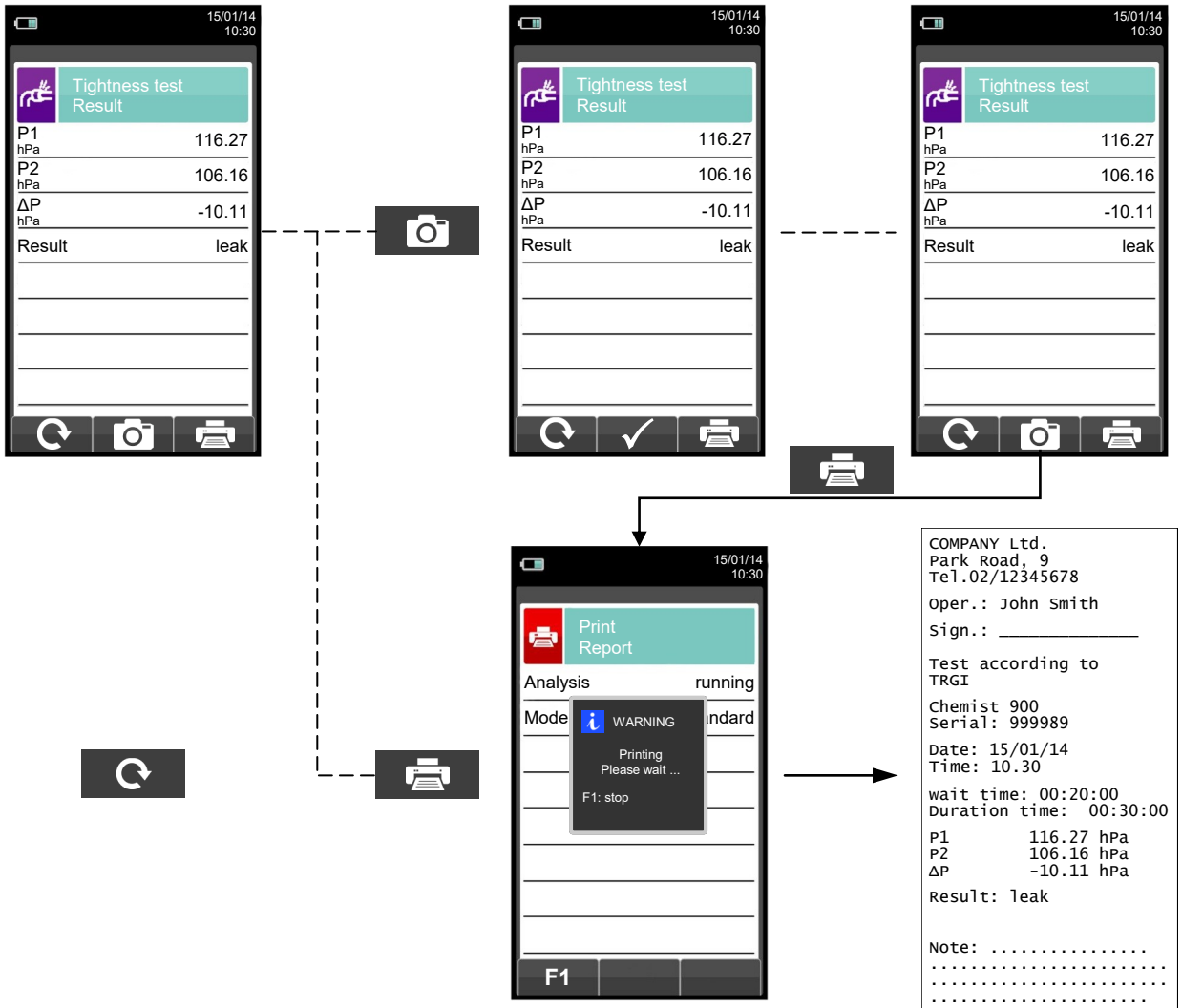

15/01/14
10:00
TRGI
Stabilization phase
P diff
0.06
hPa

## 12.10.2 Performing a tightness test for a gas line up to 100 / 200 liter.



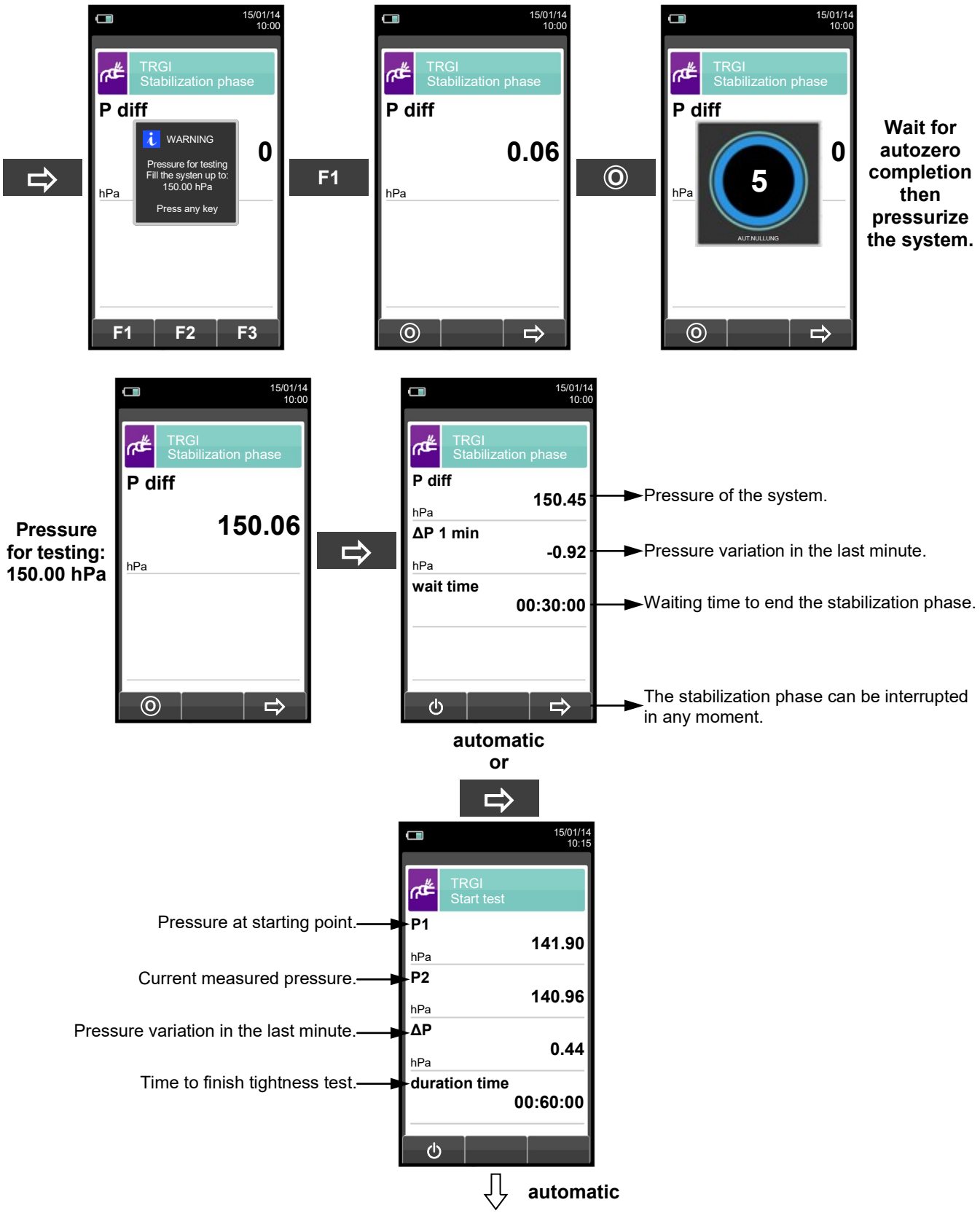

**NOTE: If, while configuring the tightness test the automatic printing mode has been selected, the tightness test is printed automatically.**

**Instead, if the manual printing mode has been selected (exemplified case), at the end of the tightness test the results are displayed and they can be saved and/or printed. In this case proceed as follows.**


15/01/14
10:30
Tightness test
Result
P1 hPa 116.27
P2 hPa 106.16
ΔP hPa -10.11
Result leak
Print
Report
Analysis running
Mode ndard
WARNING
Printing
Please wait ...
F1: stop
F1
COMPANY Ltd.
Park Road, 9
Tel.02/12345678
Oper.: John Smith
Sign.: _____
Test according to
TRGI
Chemist 900
Serial: 999989
Date: 15/01/14
Time: 10.30
wait time: 00:20:00
Duration time: 00:30:00
P1 116.27 hPa
P2 106.16 hPa
ΔP -10.11 hPa
Result: leak
Note: .....

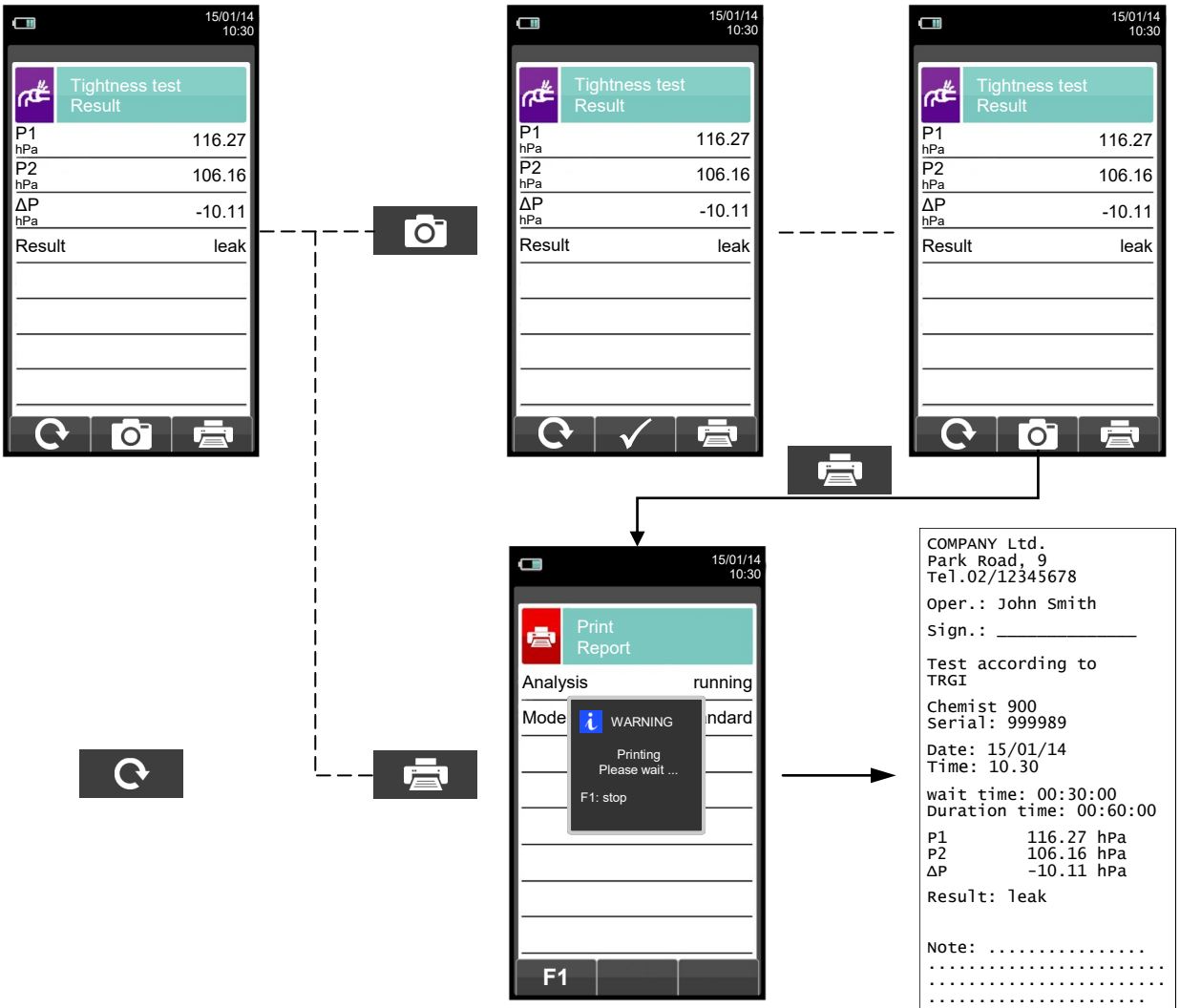

15/01/14
10:00
TRGI
Stabilization phase
P diff
0.06
hPa

## 12.10.3 Performing a tightness test for a gas line with volume greater 200 liter.




**NOTE: If, while configuring the tightness test the automatic printing mode has been selected, the tightness test is printed automatically.**

**Instead, if the manual printing mode has been selected (exemplified case), at the end of the tightness test the results are displayed and they can be saved and/or printed. In this case proceed as follows.**


15/01/14
10:30
Tightness test
Result
P1 hPa 116.27
P2 hPa 106.16
ΔP hPa -10.11
Result leak
Print
Report
Analysis running
Mode ndard
WARNING
Printing
Please wait ...
F1: stop
F1
COMPANY Ltd.
Park Road, 9
Tel.02/12345678
Oper.: John Smith
Sign.: _____
Test according to
TRGI
Chemist 900
Serial: 999989
Date: 15/01/14
Time: 10.30
wait time: 00:30:00
Duration time: 00:60:00
P1 116.27 hPa
P2 106.16 hPa
ΔP -10.11 hPa
Result: leak
Note: .....


15/01/14
10:00
TRGI
Stabilization phase
P diff
0.06
hPa

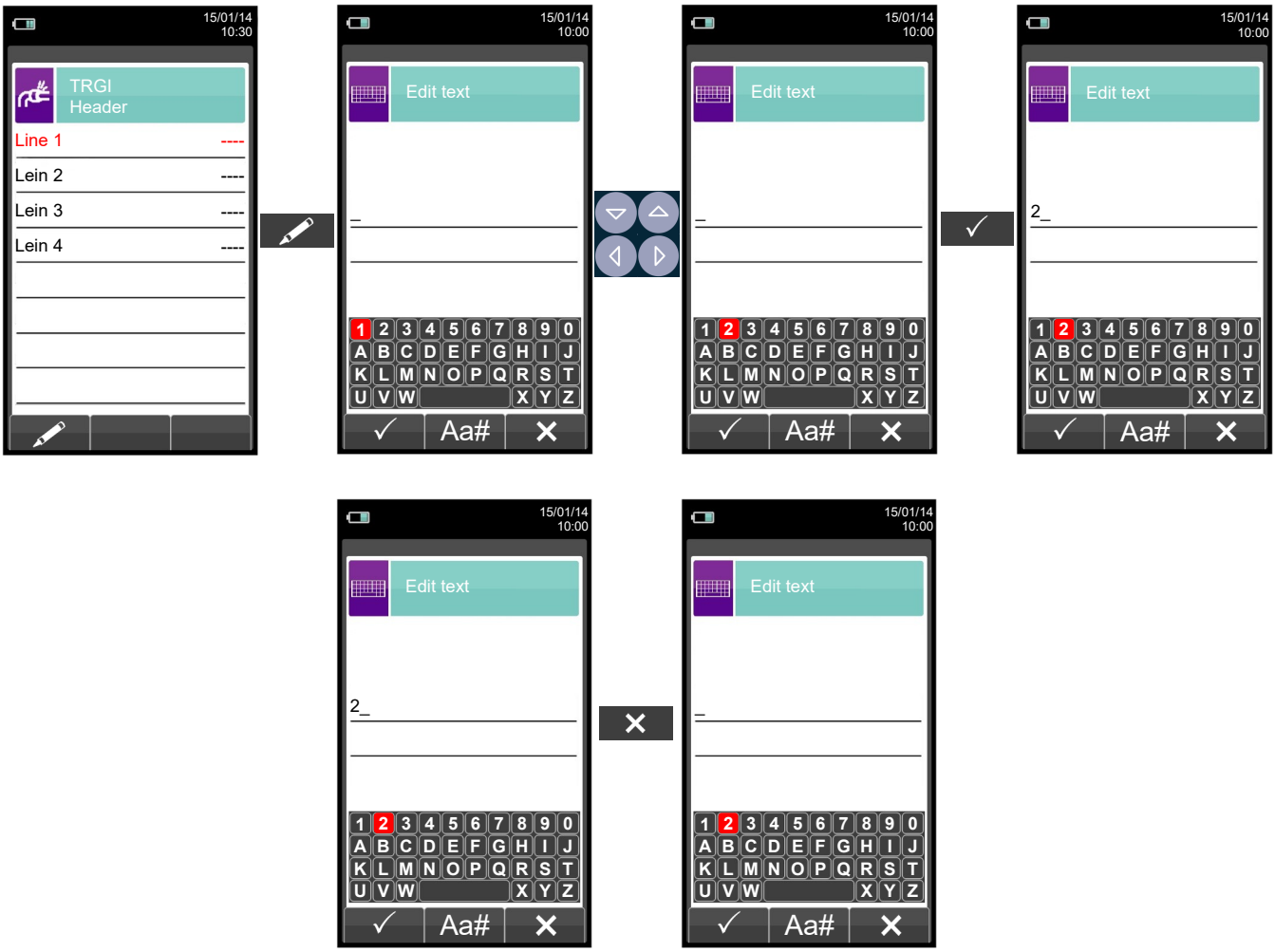
## 12.11 Measurements → Tightness test → Header


| KEY | FUNCTION |
|---|---|
|  | Activate the context keys shown on the display. |
|  | In "edit text": Moves the cursor on the box corresponding to the letter or number required to form the word. |
|  | Selects line; the selected line is displayed in red. |
|   | Activates the context key located in the left side of the display. |
|   | Returns to the previous screen.<br>When in modify mode cancels the modification just made. |

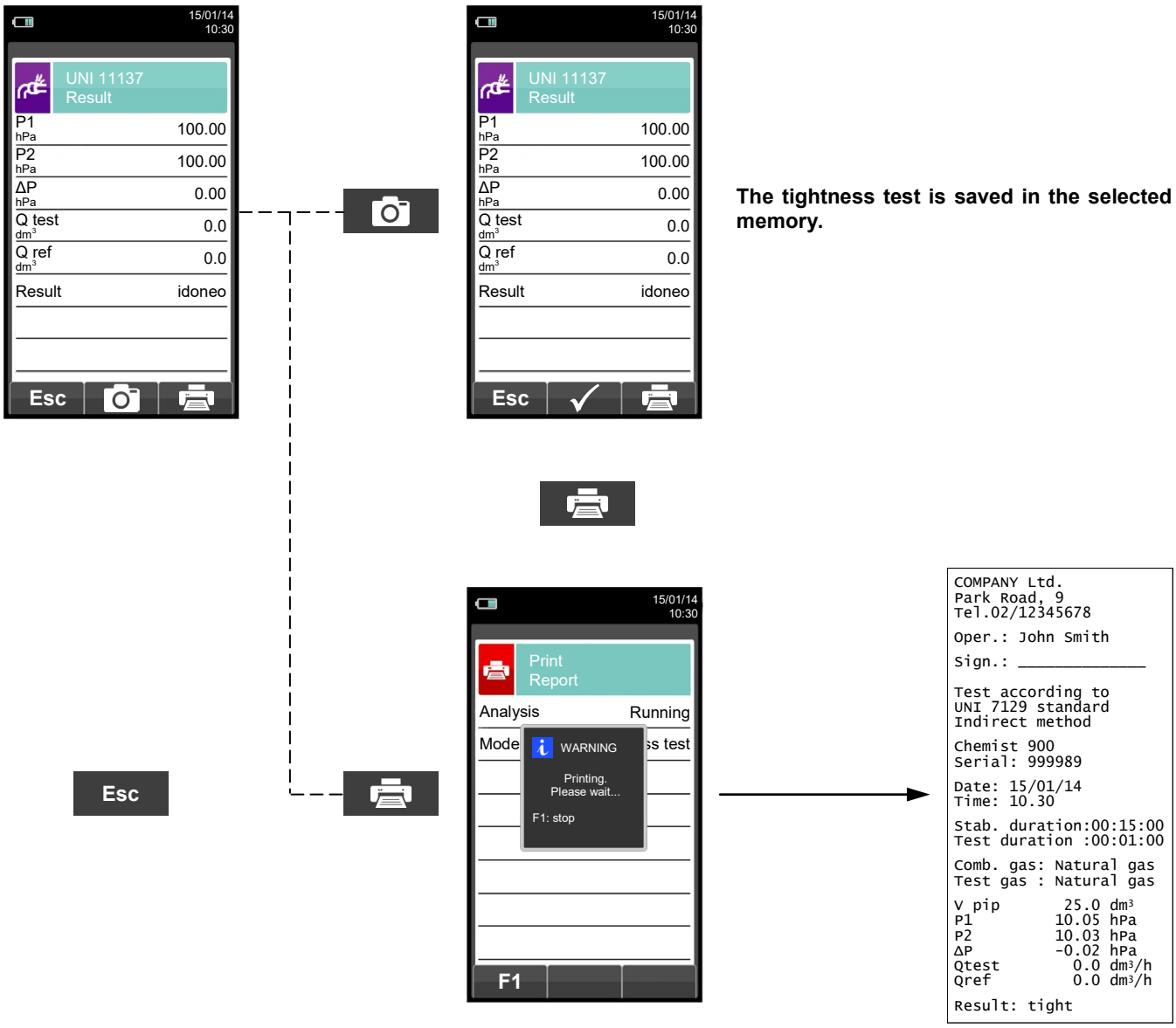
| CONTEXT KEY | FUNCTION |
|---|---|
|  | Enters edit mode of the selected line: it is possible to enter the name of the operator (24 characters available). |
|  | Confirms the selected letter or digit. |
|  | Cancels the letter or digit before the cursor. |
|   | Cycles through uppercase, lowercase, symbols and special characters. |

## Example:

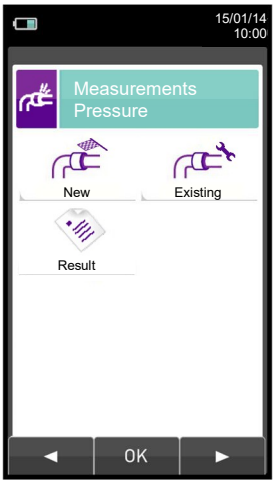
### 1. Edit text



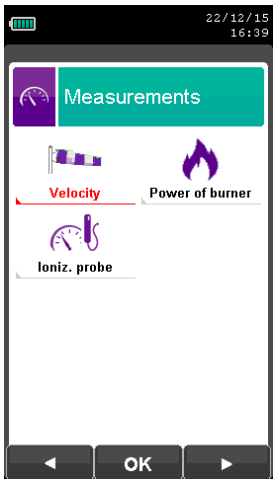
## 12.12 RESULTS OF THE TIGHTNESS TEST (example)




**The tightness test is saved in the selected memory.**



## 12.13 Measurements→AUX measurements

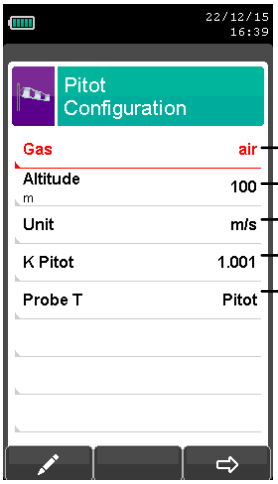



| KEY | FUNCTION |
|---|---|
|  | **Activate the context keys shown on the display.** |
|  | **Returns to the previous screen.** |

| CONTEXT KEY | FUNCTION |
|---|---|
| ◄ | **Selects the available parameters.** |
| OK | **Enters in the selected parameter setting.** |
| ► | **Selects the available parameters.** |

| PARAMETER | DESCRIPTION |
|---|---|
| Velocity | When a Pitot tube and a Tc-K thermocouple are connected, the instrument is capable to measure at the same time both temperature and velocity of a gas (air/flue gas).<br>**SEE SECTION 12.14.** |
| Power of burner | **Thermal power of the burner**<br>The measurement of the thermal power at the burner can be performed in different ways, depending on the type of fuel selected.<br>**Boilers using gaseous fuels**<br>FLOW: if the system is equipped with a volumetric flow meter just enter the value of the fuel volume flow ($m^3$ / h).<br>COUNTER: this mode can be used if the system is equipped with a volumetric flow meter. The volume flow is calculated by reading on the counter, while the generator is in steady operation, the volume of gas flown in a time interval of at least 120 s.<br>MANUAL: if the procedure was provided by the manufacturer and appropriate instructions have been specified on the user manual, the operator can find out the thermal power of the burner and enter it manually. In the absence of counter or any other system for measuring the flow, the nominal thermal power of the boiler stated by the manufacturer is to be assumed as the proper value.<br>**Boilers using liquid fuels**<br>FLOW: the value of the mass flow rate (kg / h) of the fuel must be entered.<br>MANUAL: if the procedure was provided by the manufacturer and appropriate instructions have been specified on the user manual, the operator can find out the thermal power of the burner and enter it manually. In the absence of counter or any other system for measuring the flow, the nominal thermal power of the boiler stated by the manufacturer is to be assumed as the proper value.<br>**SEE SECTION 12.13.** |
| Ioniz. probe | You can measure the ionization current of a boiler and test its value based on the technical features of the boiler by connecting the ionization probe (optional) to the serial port (See section 7.4 and/or section 7.4.8).<br>**SEE SECTION 12.14.** |

## 12.14 Measurements→Velocity




Measurement: air or flue gas.

Altitude above sea level.

Measurement unit selectable across m/s, km/h, fpm, mph.

Insert the K-factor of the Pitot tube stated by the tube manufacturer.

Temperature acquisition mode:
Pitot (with Tc-K thermocouple) or Flue gas probe (or external Tc-K thermocuple).

| KEY | FUNCTION |
|---|---|
|  | **Activate the context keys shown on the display.** |
|  | **Selects line; the selected line is displayed in red.**<br>**In edit mode, it sets the desired value.** |
|   | **Activates the context key located in the left side of the display.** |
|   | **Returns to the previous screen.**<br>**When in modify mode cancels the modification just made.** |

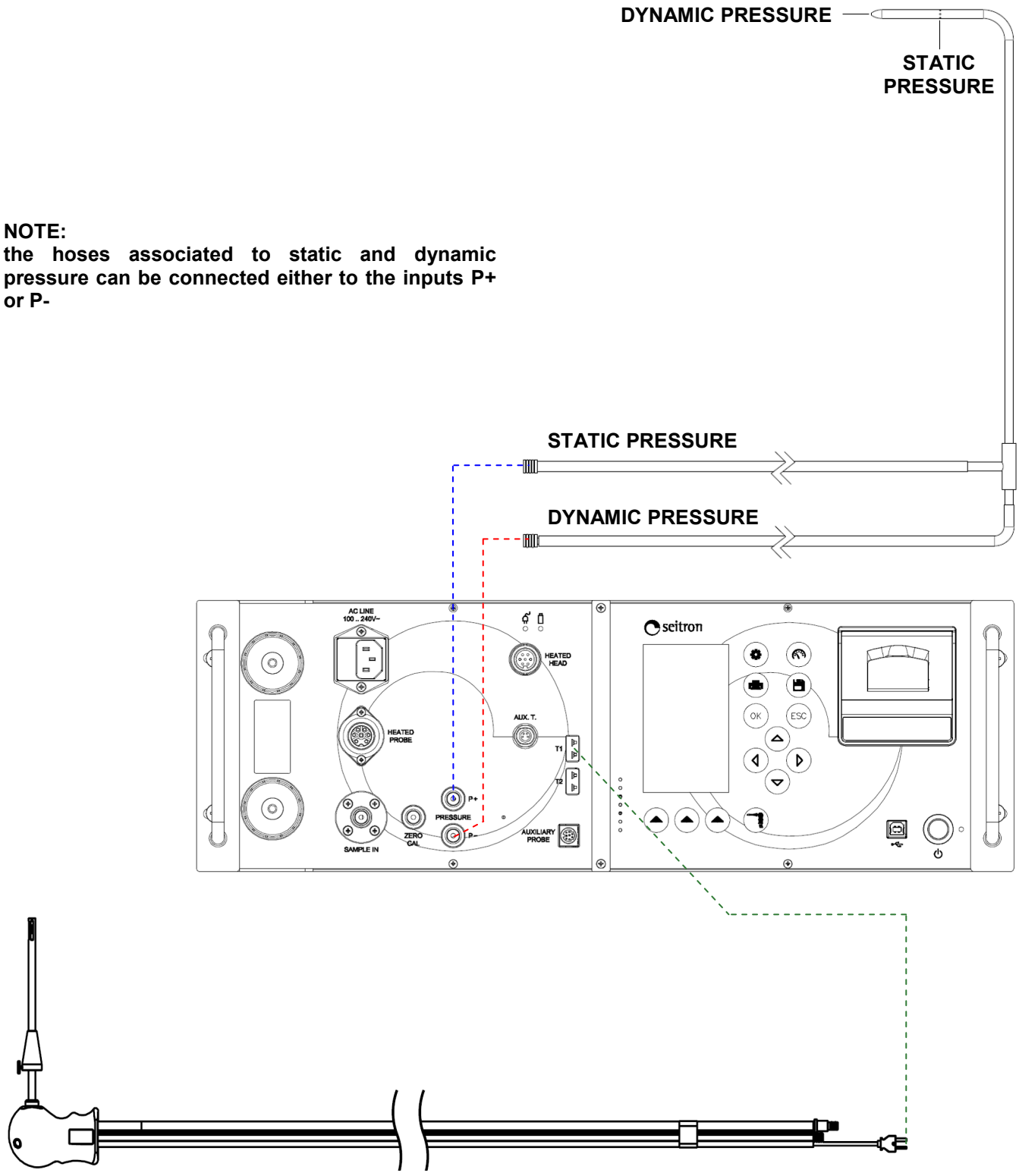
| CONTEXT KEY | FUNCTION |
|---|---|
|  | **Enters the modification mode for the selected parameter.** |
|   | **Confirms the value entered.** |
|  | **Go to next step.** |
|  | **Make the zero for the measurement.** |
|  | **Saves, in the memory selected in the "Select Memory" menu, the data acquired.** |
|  | **Starts printing the paper print-out. See section 11.** |

## 12.14.1 Connecting the Pitot tube to the instrument

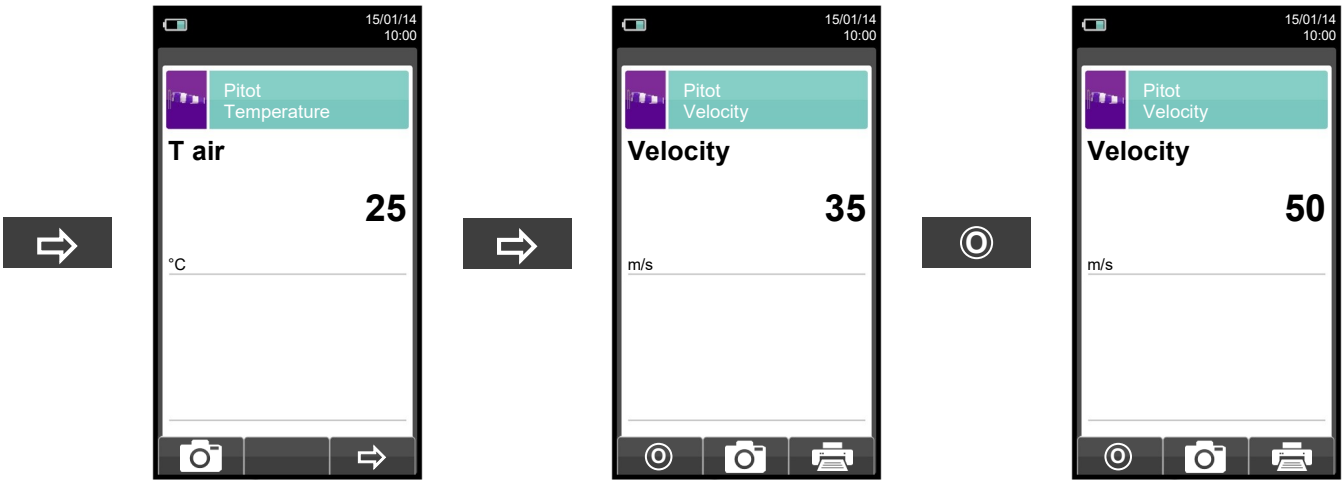
- Connect the Pitot tube (accessory) to inputs P+ and P- (which are normally used for the differential pressure measurement)
- Connect the Tc-K thermocouple cable from the flue gas probe to connector T1 of the instrument.

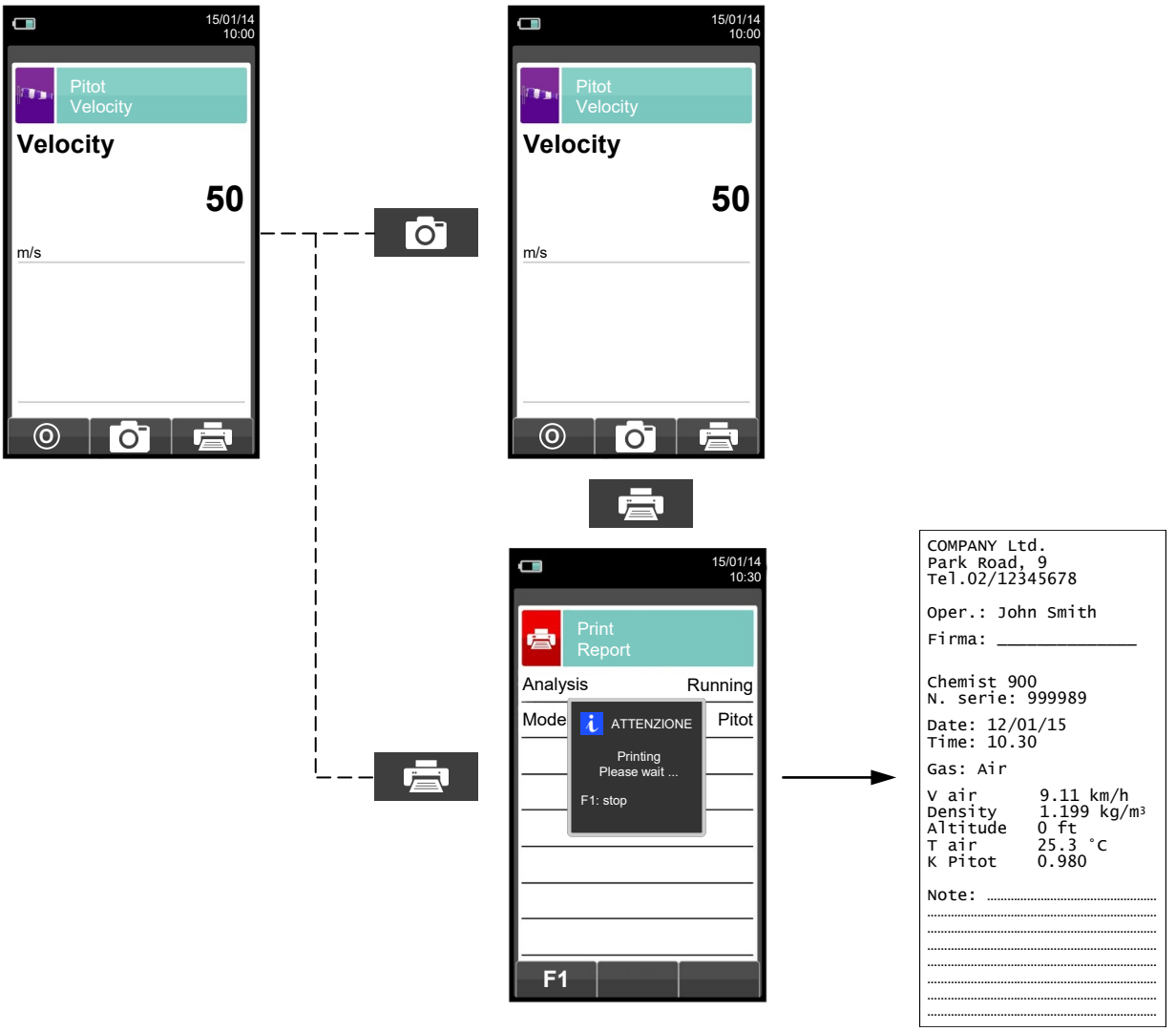
**WARNING:** **When a Pitot tube integrated to a Tc-K thermocouple is used, remember to connect the thermocouple connector to T1 input at instrument side. In this case the flue gas probe must not be connected.**

**NOTE:**
**the hoses associated to static and dynamic pressure can be connected either to the inputs P+ or P-**

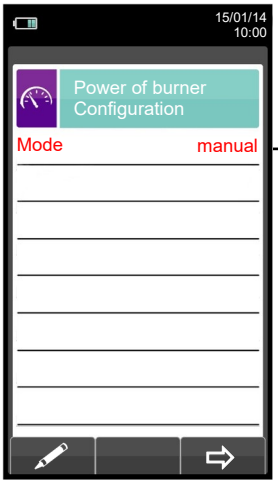


## 12.14.2 PERFORMING THE TEST

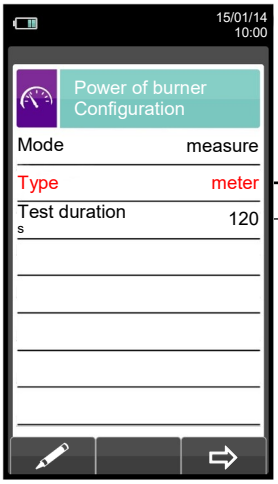


## 12.15 Measurements→Power of burner

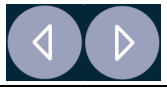



Enter the thermal power value calculated manually by the operator.



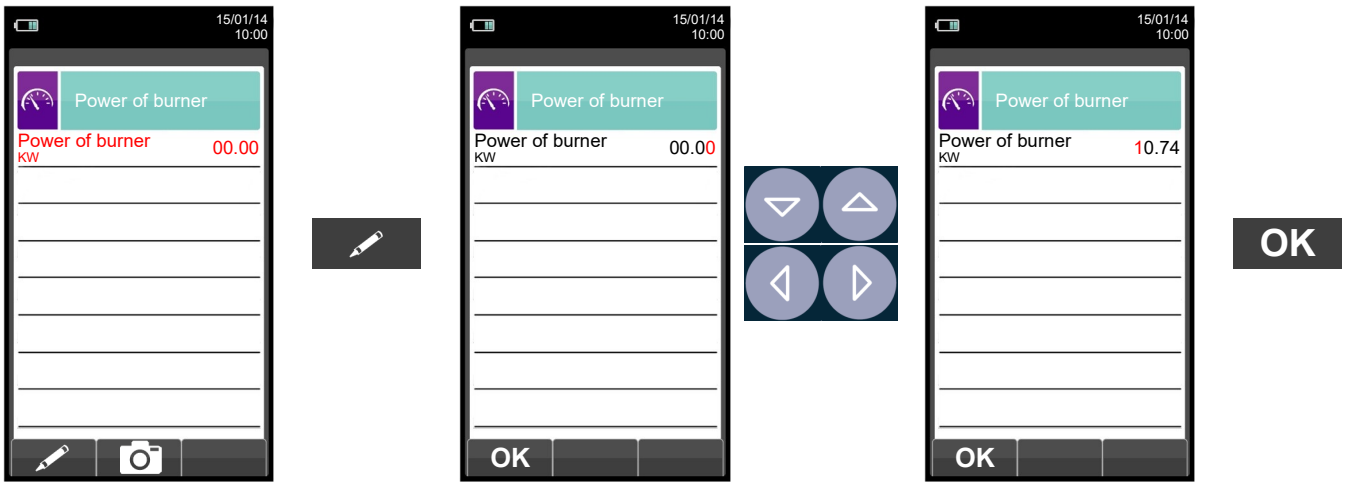

Test mode: you can choose to calculate the thermal power by entering a flow value, or by reading the volumetric counter (gaseous fuels only).

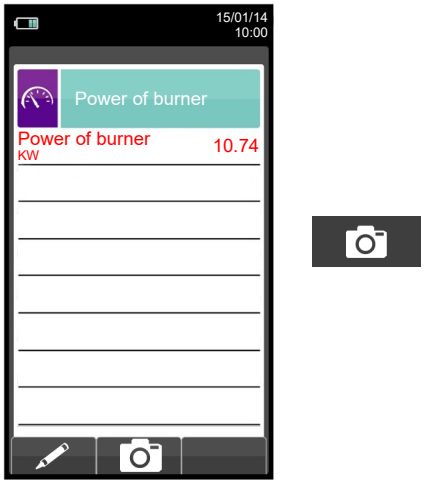
Duration of test: the option is displayed only for the test mode 'COUNTER', available for gaseous fuels. It is possible to enter the number of seconds between the reading of the initial and final gas volume. The minimum time required by law is 120 s.

| KEY | FUNCTION |
|---|---|
|  | **Activate the context keys shown on the display.** |
|  | **Selects line; the selected line is displayed in red.**<br>**When in modify mode, sets the desired value.** |
|  | **In change moves the cursor to the box corresponding to the desired number to set the desired value.** |
|  | **Activates the context key located in the left side of the display.** |
|  | **Returns to the previous screen.**<br>**When in modify mode cancels the modification just made.** |

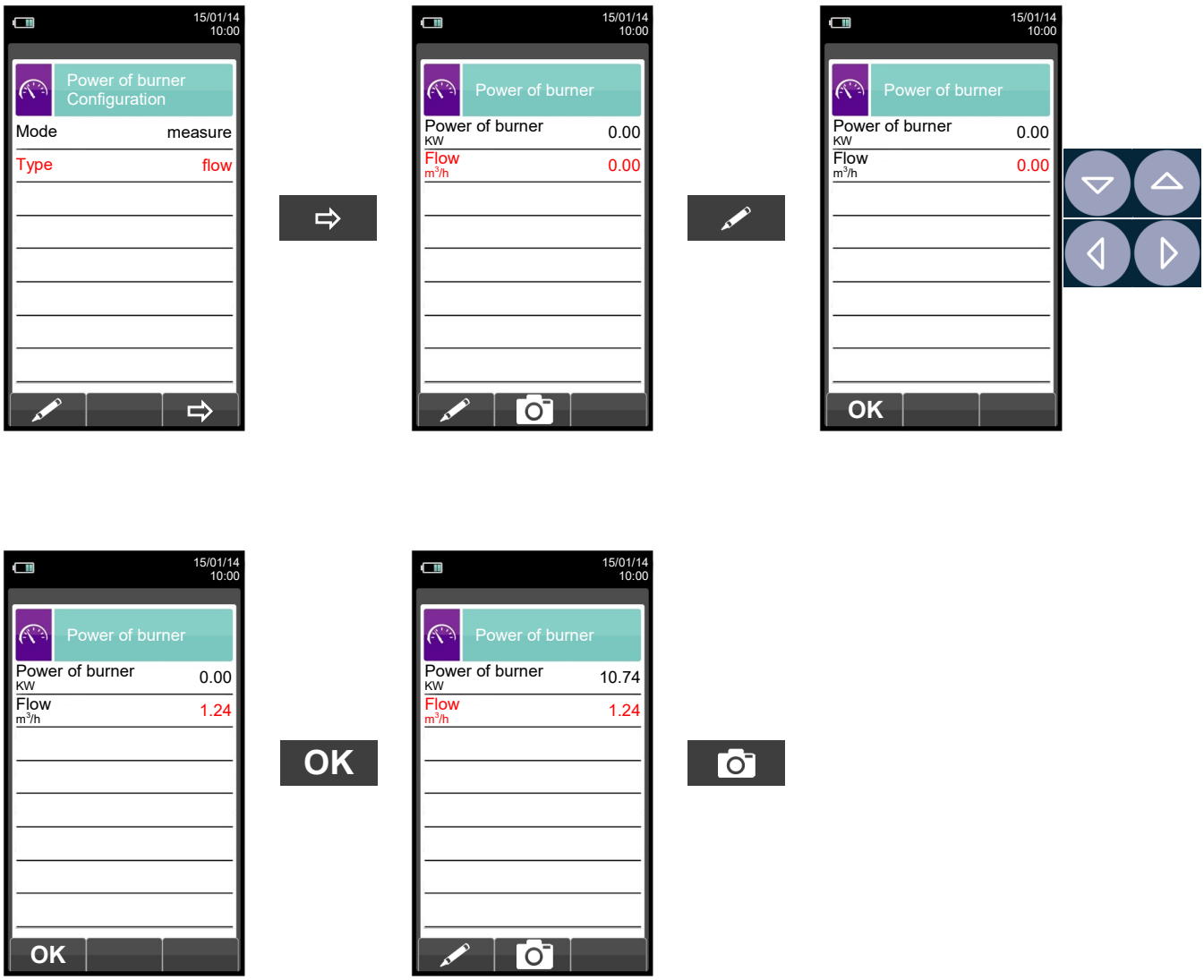
| CONTEXT KEY | FUNCTION |
|---|---|
|  | **Enters the modification mode for the selected parameter.** |
|  | **Confirms the settings.** |
|  | **Go to next step.** |
|  | **Saves, in the memory selected in the "Memory Select" menu, the value of the draft measured.** |
|  | **Stops the test.** |

## 12.15.1 TESTING IN 'MANUAL' MODE

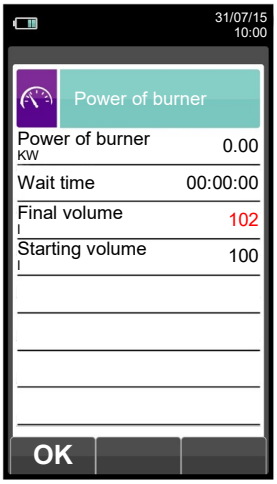


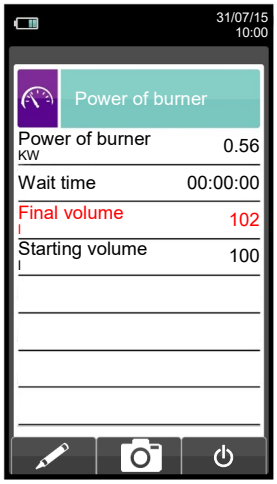
## 12.15.2 TESTING IN 'MEASURE' MODE (based on Flow rate)



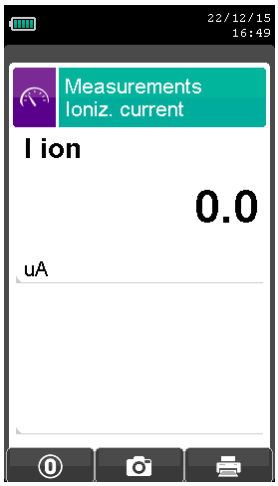
## 12.15.3 TESTING IN 'MEASURE' MODE (based on meter)


31/07/15
10:00
Power of burner
Power of burner
KW
0.00
Wait time
00:00:00
Final volume
l
102
Starting volume
l
100
OK

OK


31/07/15
10:00
Power of burner
Power of burner
KW
0.56
Wait time
00:00:00
Final volume
l
102
Starting volume
l
100

## 12.16 Measurements→Ionization probe




| KEY | FUNCTION |
|---|---|
|  | Activate the context keys shown on the display. |
|  | Returns to the previous screen. |

| CONTEXT KEY | FUNCTION |
|---|---|
|  | Zeroes the current value. |
|  | Acquires the current value for a further saving in the memory selected in the "Select Memory" menu. |
|  | Starts printing the report. See section 11. |

# 13.0 COMBUSTION ANALYSIS

## 13.1 FLUE GAS ANALYSIS

To perform a full flue gas analysis, follow the instructions below.

**SOME IMPORTANT WARNINGS TO CONSIDER DURING THE COMBUSTION ANALYSIS ARE LISTED BELOW:**

**FOR A CORRECT ANALYSIS NO AIR MUST FLOW INTO THE PIPE FROM OUTSIDE DUE TO A BAD TIGHTENING OF THE CONE OR A LEAK IN THE PIPELINE.**

**THE GAS PIPE MUST BE CHECKED IN ORDER TO AVOID ANY LEAKAGES OR OBSTRUCTIONS ALONG THE PATH.**

**THE CONNECTORS OF THE GAS SAMPLING PROBE AND OF THE CONDENSATE FILTER MUST BE WELL CONNECTED TO THE INSTRUMENT.**

**KEEP THE CONDENSATE TRAP IN THE VERTICAL POSITION DURING THE ANALYSIS; A WRONG POSITIONING MAY CAUSE CONDENSATE INFILTRATIONS IN THE INSTRUMENT AND THUS DAMAGE THE SENSORS.**

**DO NOT PERFORM ANY MEASUREMENT WHEN THE FILTER IS REMOVED OR DIRTY IN ORDER TO AVOID ANY RISK OF IRREVERSIBLE DAMAGES ON SENSORS.**

### 13.1.1 Switching on the instrument and auto-calibration

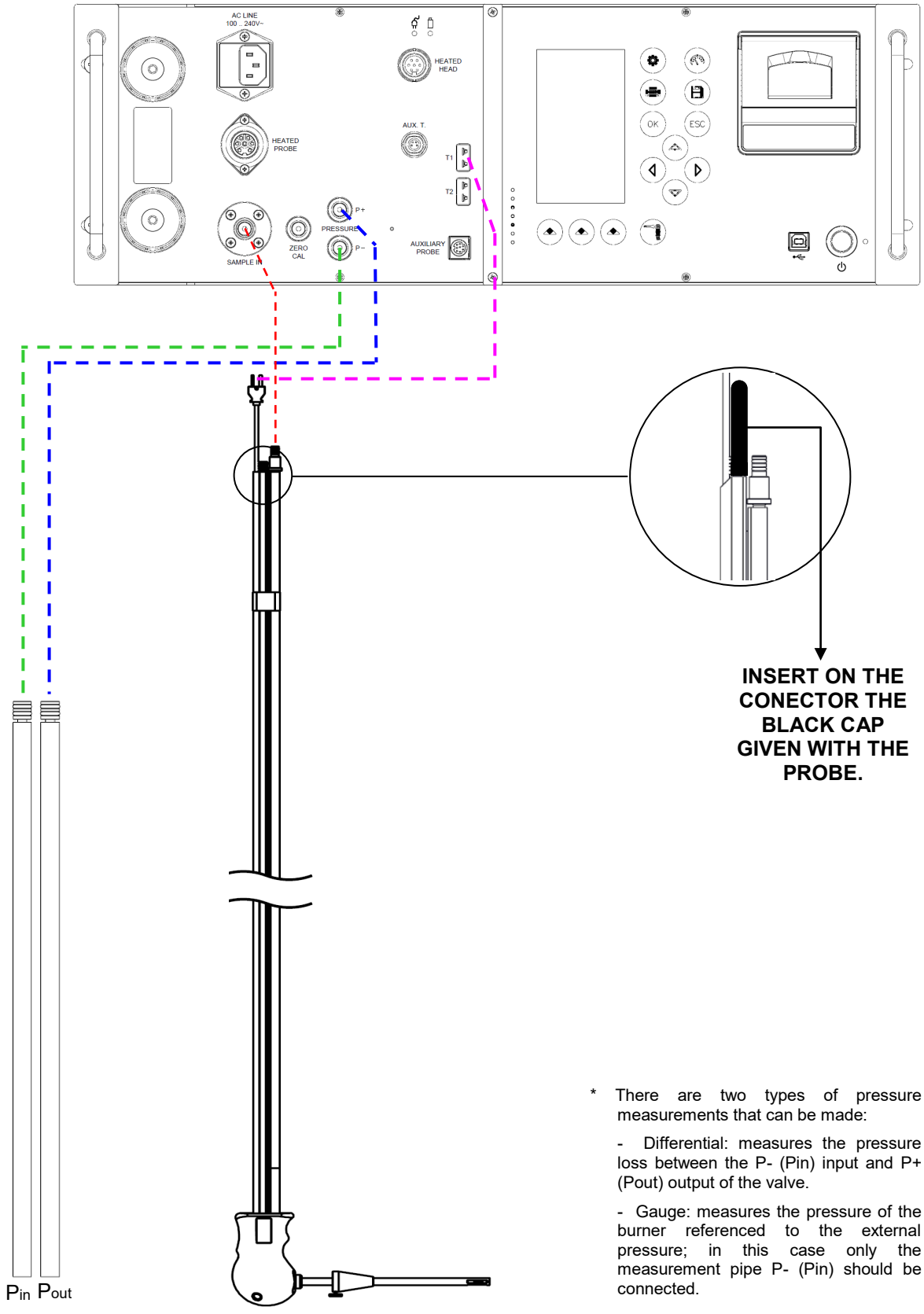
Press the On/Off key to switch on the instrument - an introductory screen will appear. After a couple of moments the instrument will zero itself and will state that the sample probe should not be inserted in the stack.
In case the instrument is equipped with the electrovalve for automatic auto-zeroing, it will ask for the insertion of the gas probe in the stack. On the other hand if the instrument has not the electrovalve, it will require not to insert the gas probe in the stack.
In the latter it is important that the sample probe is not inside the stack since, during auto-calibration, the instrument draws fresh air from the environment and detects the zero value of the $O_2$, CO and NO sensors, the details of which are then memorized and used for reference during the analysis. It is equally important that this phase is performed in a fresh-air environment.
The pressure sensor (piezoresistive, temperature compensated) is also zeroed during auto-calibration.

### 13.1.2 Inserting the probe inside the stack

When auto-calibration is complete the instrument will instruct the user to insert the sample probe that has been previously connected to the relative input on the instrument, and the analysis screen will appear automatically.
In order for the probe to be inserted at the right point within the stack, its distance from the boiler has to be twice the diameter of the stack pipe itself or, if this is not possible, must comply with the boiler manufacturer's instructions.
In order to position the probe correctly, a reliable support must be provided by drilling a 13/16 mm hole in the manifold (unless already present) and screwing in the positioning cone provided with the probe - in this way no air is drawn from the outside during sampling.
The screw on the cone allows the probe to be stopped at the right measuring depth - this usually corresponds to the center of the exhaust pipe. For greater positioning accuracy, the user may insert the probe gradually into the pipe until the highest temperature is read. The exhaust pipe must be inspected before carrying out the test, so as to ensure that no constrictions or losses are present in the piping or stack.

### 13.1.3 Simultaneous measurement of pressure, $O_2$, pollutants

In order to measure simultaneously pressure, $O_2$ and pollutants levels as well as all the others calculated parameters necessary to obtain the correct performance value, connect the instrument as follows:




* There are two types of pressure measurements that can be made:

- Differential: measures the pressure loss between the P- (Pin) input and P+ (Pout) output of the valve.
- Gauge: measures the pressure of the burner referenced to the external pressure; in this case only the measurement pipe P- (Pin) should be connected.

### 13.1.4 Flue Gas Analysis

After the sample probe has been inserted in the stack and the combustion air temperature probe (if used) has been inserted in the relative sample manifold, if the instrument has not been configured during auto-calibration, the following data must be configured:
**Memory:** use this submenu to define the memory in which the test data and client details are to be stored.
**Fuel:** select the type of of fuel burned in the combustion equipment producing the flue/exhaust gas being measured.
**Operator:** this is where the name of the test operator can be entered.
**Mode:** by entering this submenu, the user can determine the analysis mode - manual or automatic.
If automatic mode is chosen, the reading duration of each and every test must be set, besides the printing mode - manual or automatic. When flue gas analysis begins, the instrument will perform and memorize the three tests automatically, at the respective intervals set (at least 120 sec. according to UNI 10389-1).
At the end of each test the instrument will emit an audible alarm (one "beep" after the first test, two "beeps" after the second test and three "beeps" after the third test).
At this point, when all three tests are over, if "Manual Printing" has been chosen the instrument will display the average of the three tests with the possibility of recalling the individual values.
If desired, the user can then print the relative data (total, complete, etc....). On the contrary, if "Automatic Printing" was selected, the instrument will print the test data automatically, based on the current print settings, without displaying the average test values.

**Caution: when in automatic mode Draft, Smoke and ambient CO (NO) measurements must be taken before initiating the flue gas analysis.**

If, on the other hand, manual analysis mode is chosen, flue gas analysis will proceed manually (please see relative Flow Chart). In this case the print settings and automatic test duration will not be considered.
At this point manual analysis may commence, first waiting at least two minutes until the displayed values stabilize: The user can then proceed with data storage, if required, or print the analysis report directly, which will be printed in the format set beforehand.
When all three tests are over, the user can recall the average analysis screen containing all the data necessary for compiling the maintenance log of the boiler or plant.
In both modes, automatic and manual, the displayed data of the pollutants CO / NO / $NO_x$ can be translated into normalized values (with reference to the concentration of $O_2$ previously set).

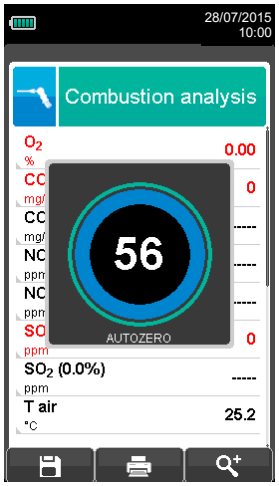
### 13.1.5 End of Analysis

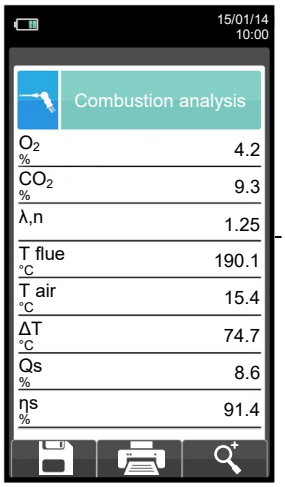
At the end of the combustion analysis, carefully remove the sample probe and remote air temperature probe, if used, from their relative ducts, taking care not to get burnt.
It is recommended to purge the analyzer with clean fresh air for at least 5 to 10 minutes before turning off the instrument by pressing the On/Off key.
At this point, if the instrument has detected a high concentration of CO and/or NO, a self-cleaning cycle will be initiated during which the pump will draw fresh outside air until the gas levels drop below acceptable values.
At the end of the cycle (lasting no longer than 3 min.) the instrument will switch itself off automatically.

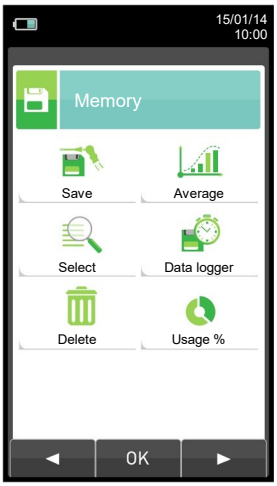
## 13.2 FLUE GAS ANALYSIS - PRELIMINARY OPERATIONS

**Insert the gas sample probe in the chimney:**

**Hold down for a few seconds**

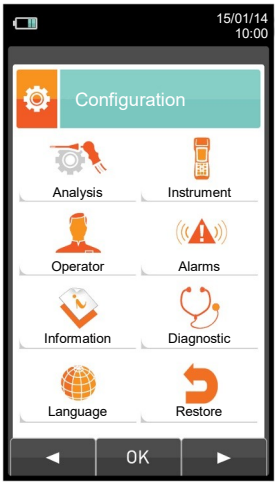



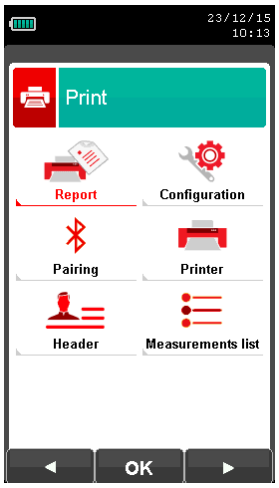

**PARAMETERS TO SET BEFORE PROCEEDING (vsee section 10.0):**

**Select**
**Data logger**



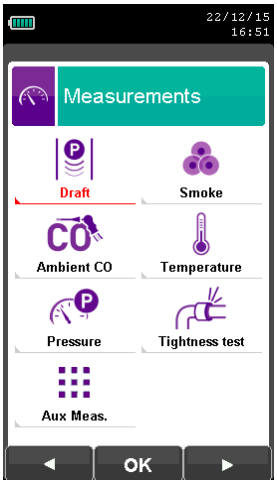

**PARAMETERS TO SET BEFORE PROCEEDING (see section 9.0):**

**Analysis**
**Operator**




**PARAMETERS TO SET BEFORE PROCEEDING (see section 11.0):**

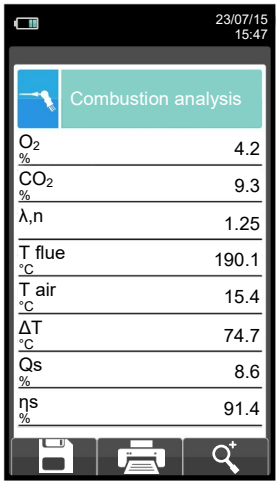
**Configuration**
**Header**
**Measures list**




**ACQUIRE THE FOLLOWING MEASUREMENTS BEFORE PROCEEDING WITH THE COMBUSTION ANALYSIS (see section 12.0):**

**In you don't, the measurements will not be printed with the combustion analysis.**

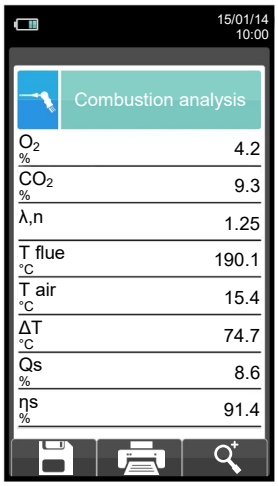
**Draft**
**Smoke**
**Ambient CO**
**Temperature**
**Pressure**

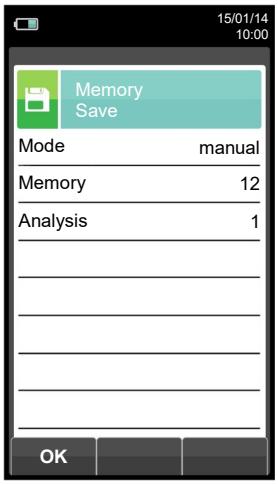



**PRESS THE KEY ' ':**
**This starts saving the current analysis according to the set mode.**
**- Manual** See section 10.5.1
**- UNI 10389** See section 10.5.2
**- BImSchV** See section 10.5.2
**- Data logger** See section 10.5.2
**- Periodic** See section 10.5.3

**PRESS THE KEY ' ':**
**This starts the printing on test paper print -out of the current analysis; additional measurements are also printed, if they are present in the memory.**

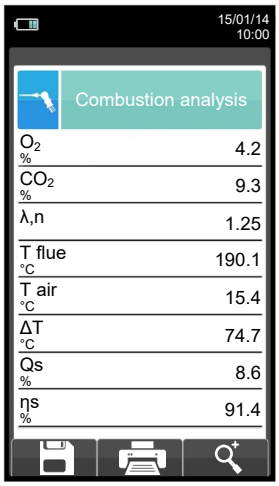
## 13.3 PERFORMING COMBUSTION ANALYSIS - MANUAL MODE

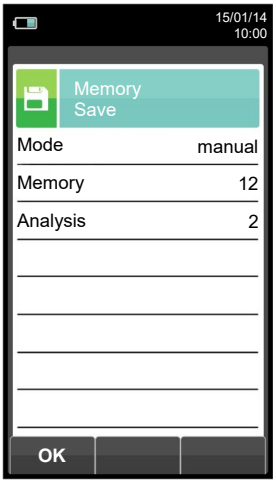



**OK**

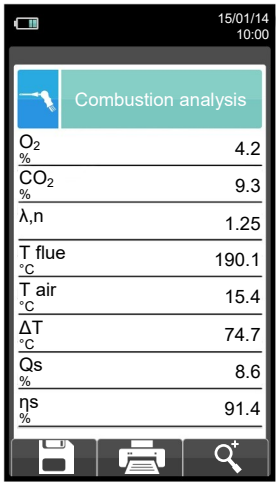
**Saves analysis number 1**

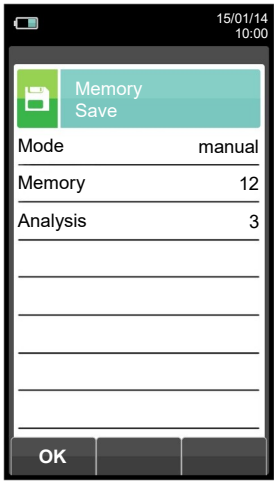



**OK**

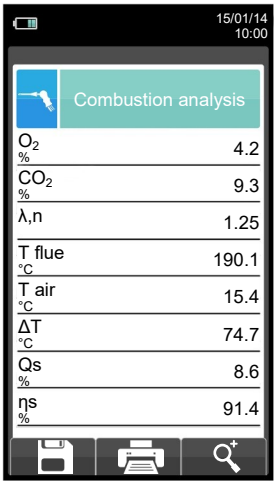
**Saves analysis number 2**

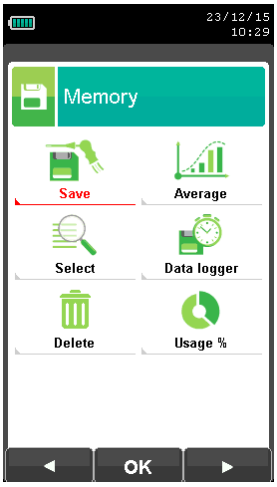


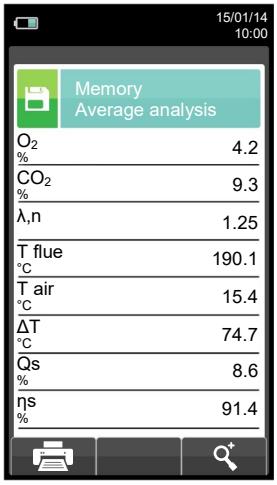

**OK**

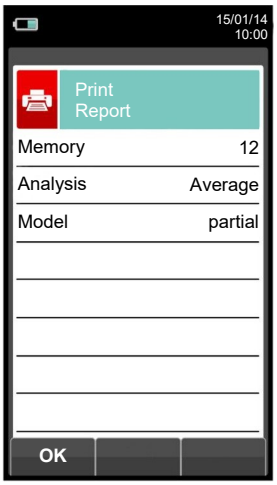
**Saves analysis number 3**



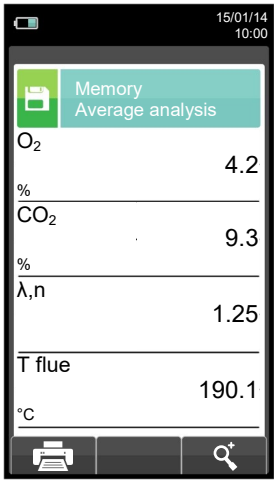




**Recalls the average analysis.**

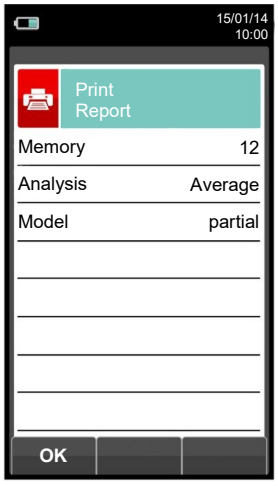



OK

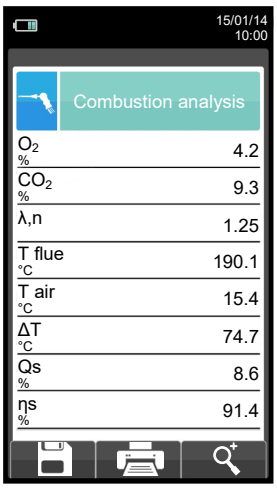



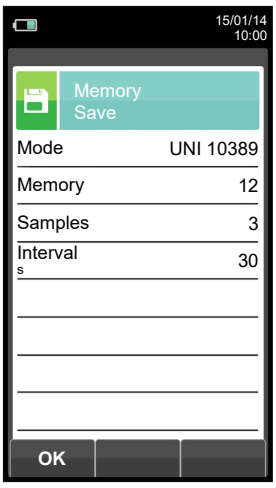

```
Date: 15/01/14
Time: 10.10
Fuel: Natural gas
Altitude: 0 m
R.H. air: 50 %
O2              4.2 %
CO2             9.3 %
λ,n            1.25
T flue        190.2 °C
T air          15.4 °C
dT            174.8 °C
QS              8.6 %
Es             91.4 %
Ec              4.9 %
Et             96.3 %
CO              148 ppm
NO               40 ppm
NOX/NO:        1.03
NOX              41 ppm
Amb. CO           0 ppm
Draft:         0.05 hPa
T out:           20 °C
Smoke:    3  1  2
Aver. n:          2
```



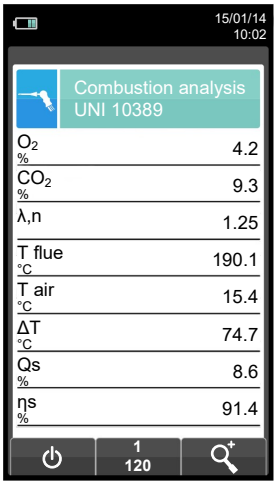

OK

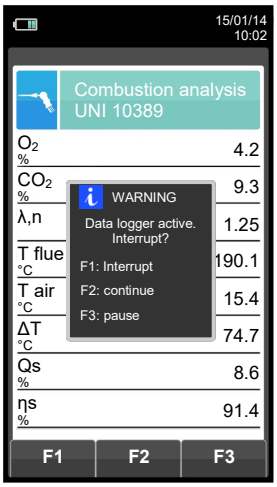
## 14.4 PERFORMING THE COMBUSTION ANALYSIS- UNI 10389 MODE



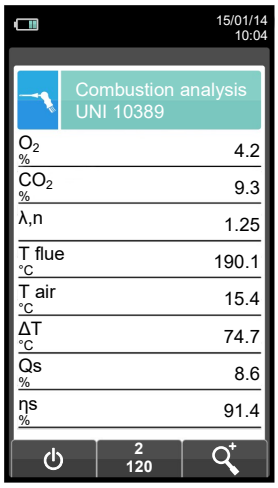




OK

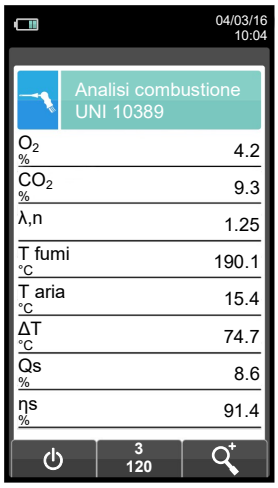


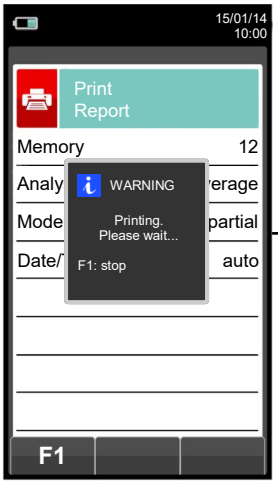

**Automatically saves the first sample when the set time is over.**




**Automatically saves the second sample when the set time is over.**




**Automatically saves the third sample when the set time is over.**

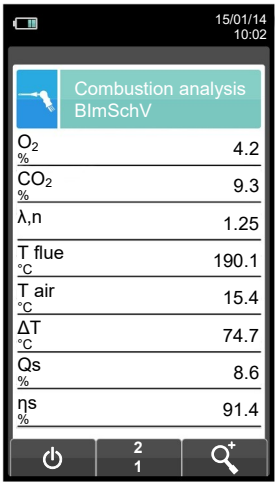



**NOTE: If, while configuring the tightness test the automatic printing mode has been selected, the tightness test is printed automatically.**

**Instead, if the manual printing mode has been selected (exemplified case), at the end of the tightness test the results are displayed and they can be saved and/or printed. In this case proceed as follows:**

## 13.5 PERFORMING THE COMBUSTION ANALYSIS - BImSchV MODE


**Automatically saves the first sample when the set time is over.**

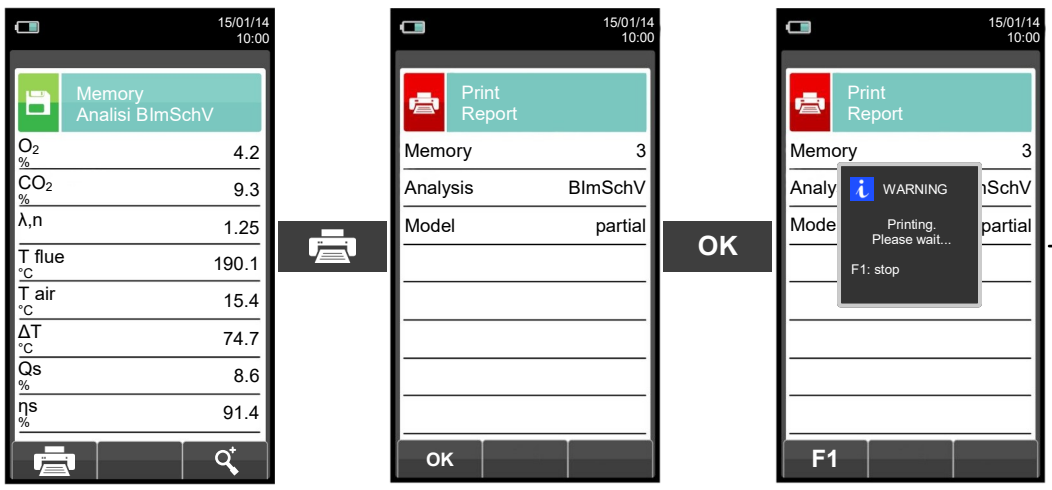



**Automatically saves the second sample when the preset time interval has elapsed and so on until the last sample.**

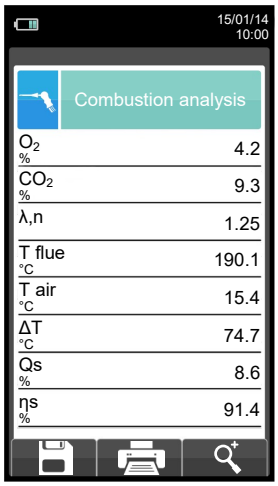
**Once the flue gas analysis is completed the instrument saves the average value of the samples taken.**

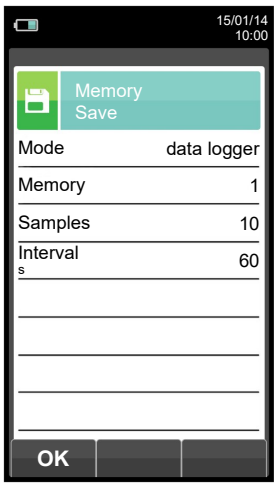
**NOTE: If, while configuring the tightness test the automatic printing mode has been selected, the tightness test is printed automatically.**

**Instead, if the manual printing mode has been selected (exemplified case), at the end of the tightness test the results are displayed and they can be saved and/or printed. In this case proceed as follows:**

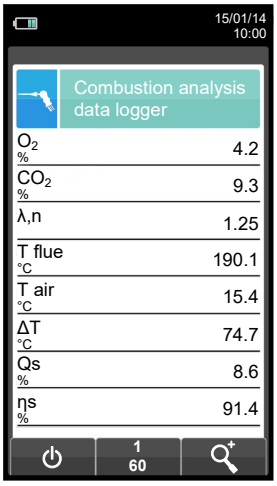


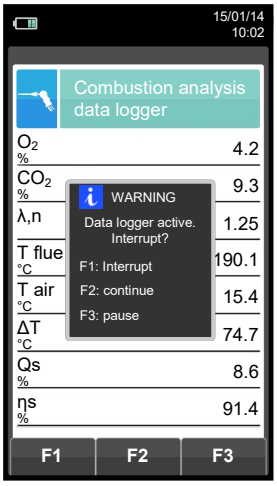
## 13.6 PERFORMING THE COMBUSTION ANALYSIS - data logger MODE



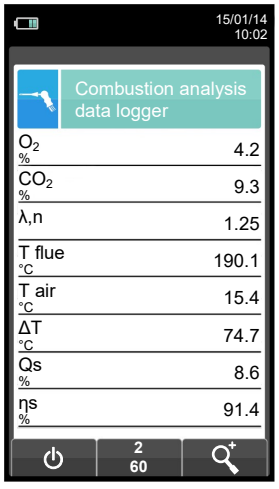




OK

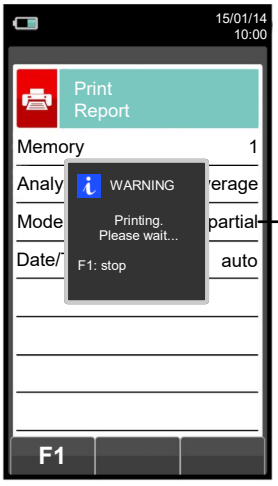



**Automatically saves the first sample when the set time is over.**

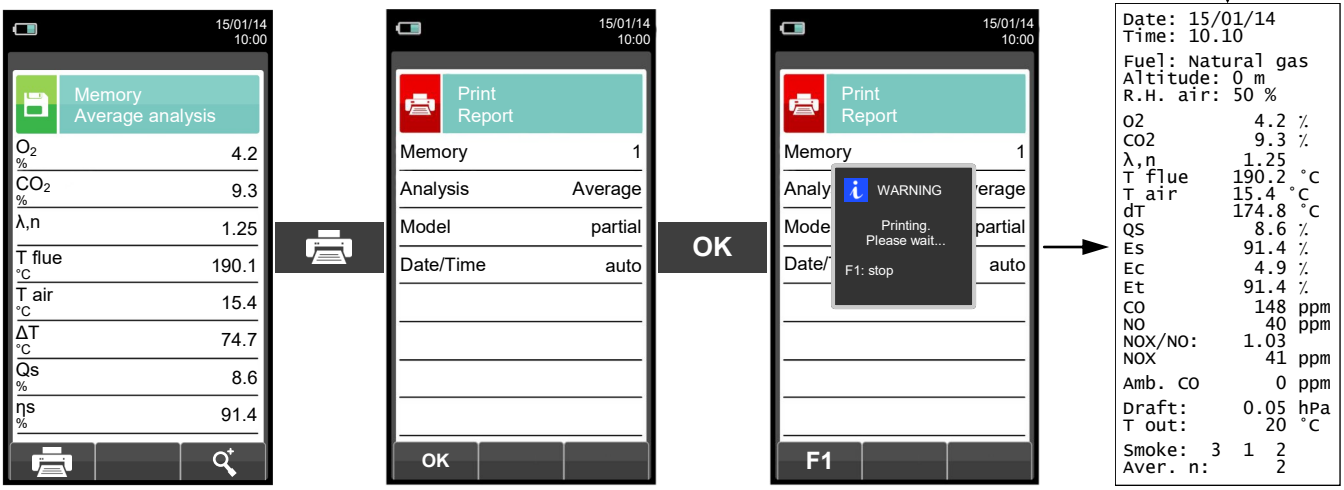



**Automatically saves the second sample when the set time is over and so on until the last sample.**

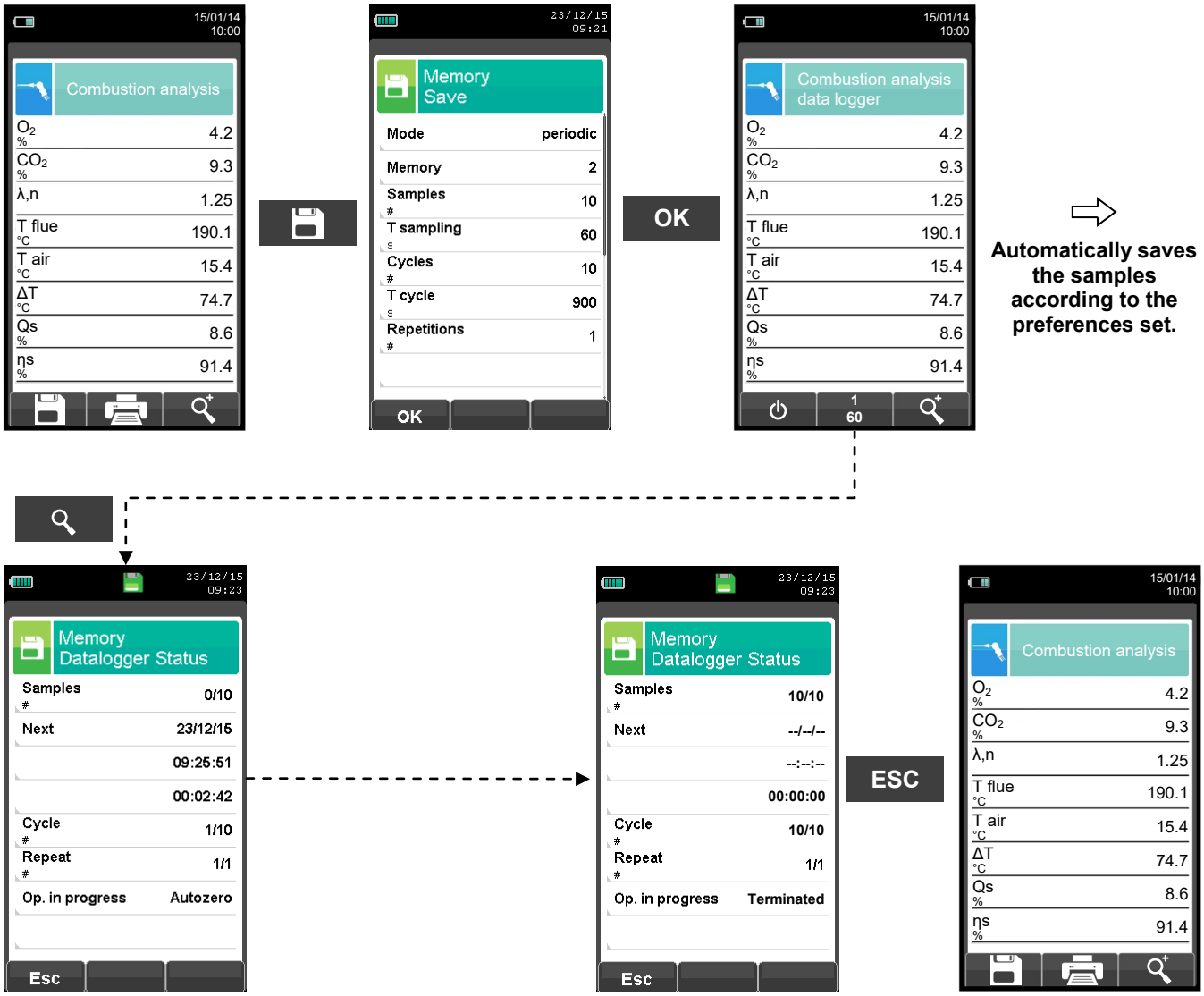



**NOTE: If, while configuring the tightness test the automatic printing mode has been selected, the tightness test is printed automatically.**

**Instead, if the manual printing mode has been selected (exemplified case), at the end of the tightness test the results are displayed and they can be saved and/or printed. In this case proceed as follows:**

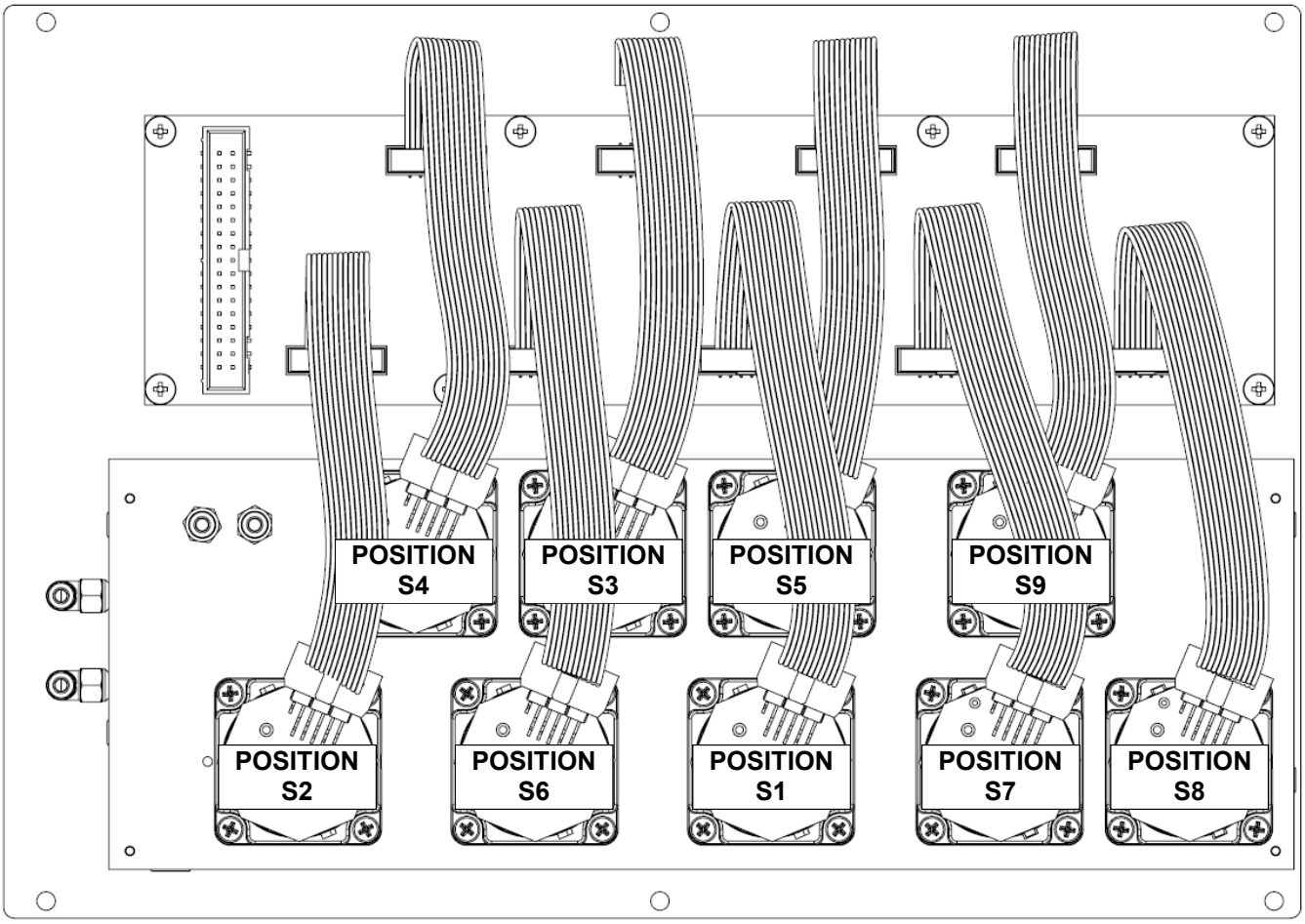


## 13.7 PERFORMING THE COMBUSTION ANALYSIS - PERIODIC MODE

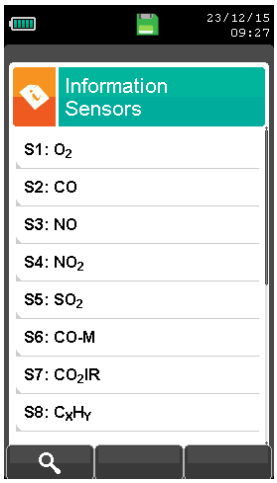


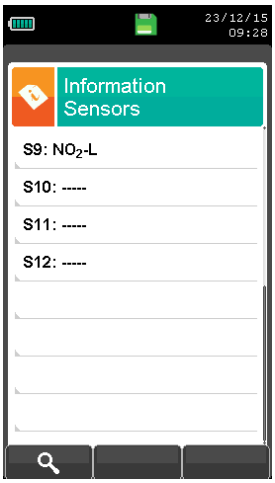

**NOTE: Once the emissions analysis is completed (an audible signal will be emitted), the average of the samples acquired will be displayed on the instrument.**
**The stored analyses can be individually displayed and printed directly from the instrument or can be downloaded to the PC for further processing.**

## 14.1 Positioning of sensors inside the sensor compartment




## 14.2 Sensors list




**Note**
- **Positions S10, S11, S12 are related to the infrared bench.**
- **If two or more identical sensors are installed, the measured gas (i.e. NO2, SO2, ..) and the installation position (S2, S5, ..) will be shown on the display.**

## 14.3 Sensor types and relevant positioning

| POSITION / CODE | S1 | S2 | S3 | S4 | S5 | S6 |
|---|---|---|---|---|---|---|
| **Flex-Sensor $O_2$ LL** Cod. AACSE43 | ✓ | ✓ | ✓ | | | |
| **Flex-Sensor $O_2$** Cod. AACSE48 | ✓ | ✓ | ✓ | ✓ | ✓ | ✓ |
| **Flex-Sensor CO+$H_2$** Cod. AACSE12 | | ✓ | | | | |
| **Flex-Sensor CO+$H_2$ low range** Cod. AACSE24 | | ✓ | | | | |
| **Flex-Sensor CO 100.000 ppm** Cod. AACSE17 | ✓ | ✓ | ✓ | ✓ | ✓ | ✓ |
| **Flex-Sensor CO 20.000 ppm** Cod. AACSE18 | ✓ | ✓ | ✓ | ✓ | ✓ | ✓ |
| **Flex-Sensor NO** Cod. AACSE10 | ✓ | ✓ | ✓ | | | |
| **Flex-Sensor NO low range** Cod. AACSE25 | ✓ | ✓ | ✓ | | | |
| **Flex-Sensor $NO_2$** Cod. AACSE14 | ✓ | ✓ | ✓ | ✓ | ✓ | ✓ |
| **Flex-Sensor $NO_2$ low range** Cod. AACSE26 | ✓ | ✓ | ✓ | ✓ | ✓ | ✓ |
| **Flex-Sensor $SO_2$** Cod. AACSE13 | ✓ | ✓ | ✓ | ✓ | ✓ | ✓ |
| **Flex-Sensor $SO_2$ low range** Cod. AACSE28 | ✓ | ✓ | ✓ | ✓ | ✓ | ✓ |
| **Flex-Sensor CxHy 0-5.00% vol. referred to CH4** Cod. AACSE39 | ✓ | ✓ | ✓ | ✓ | ✓ | ✓ |
| **Flex-Sensor $CO_2$ 0-20%** Cod. AACSE41 | ✓ | ✓ | ✓ | ✓ | ✓ | ✓ |
| **Flex-Sensor $CO_2$ 0-50%** Cod. AACSE47 | ✓ | ✓ | ✓ | ✓ | ✓ | ✓ |
| **Flex-Sensor $H_2S$** Cod. AACSE35 | ✓ | ✓ | ✓ | ✓ | ✓ | ✓ |

## 14.4 Gas sensors life

The gas sensors used in this instrument are electrochemical: thus, when the relative gas is detected, a chemical reaction takes place inside them that generates an electrical current.
The electrical current acquired by the instrument is then converted into the corresponding gas concentration. Sensor life is strongly related to the consumption of the reagents within.
Sensor characteristics diminish as the reagents are consumed and when these have been used up completely the sensor must be replaced. The sensors must be recalibrated on a regular basis to assure measuring accuracy: recalibration can only be performed by a qualified SEITRON service center. Chart 14.5 illustrates the characteristics inherent to each sensor.

## 14.5 Table gas sensors life

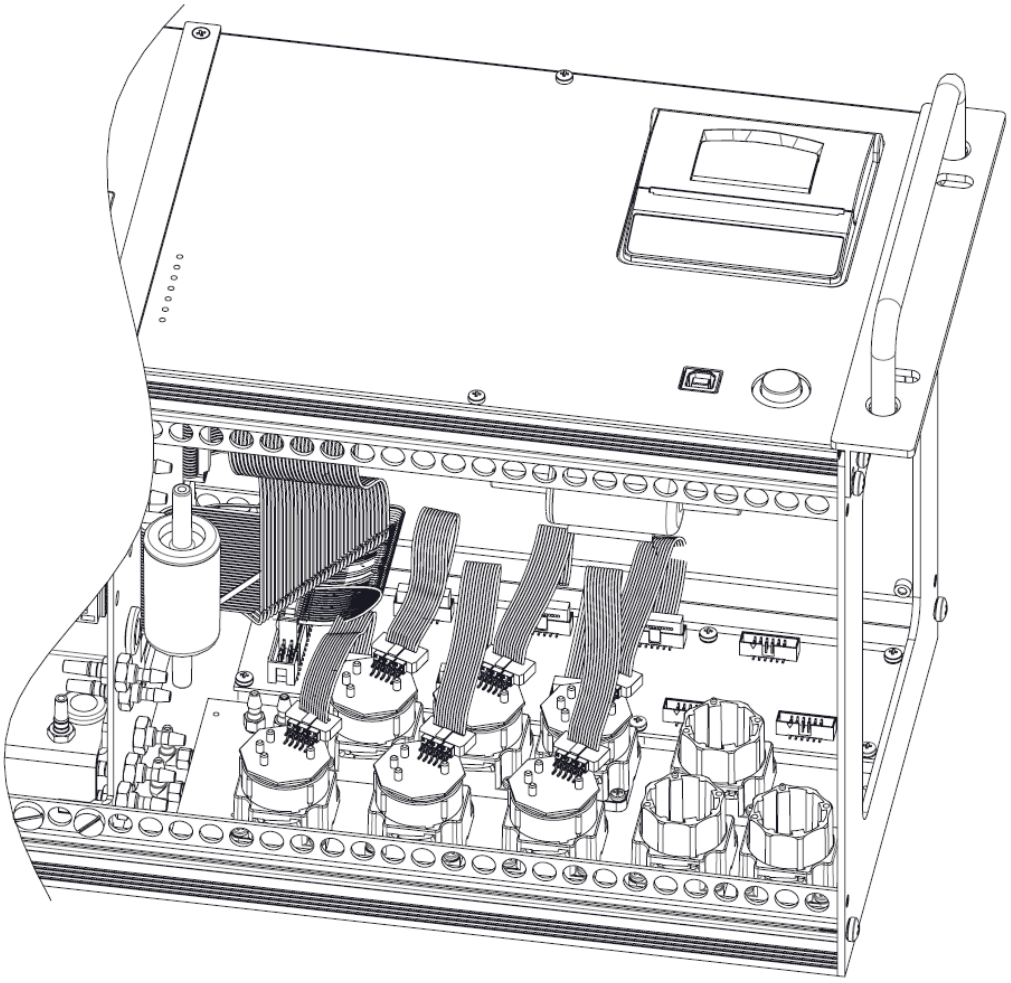
| CODE | MEASURED GAS | IDENTIFYING COLOR (1) | AVERAGE LIFE | RECALIBRATION |
|---|---|---|---|---|
| **Flex-Sensor $O_2$ LL** Cod. AACSE43 | $O_2$ Oxygen | | 48 months | not required |
| **Flex-Sensor $O_2$** Cod. AACSE48 | $O_2$ Oxygen | | >48 months | Not necesary |
| **Flex-Sensor CO+$H_2$** Cod. AACSE12 | CO Carbon Monoxide | Red | 48 months | yearly (2) |
| **Flex-Sensor NO** Cod. AACSE10 | NO Nitrogen Oxide | Orange | 48 months | yearly (2) |
| **Flex-Sensor $NO_2$** Cod. AACSE14 | $NO_2$ Nitrogen Dioxide | White | 36 months | yearly (2) |
| **Flex-Sensor $SO_2$** Cod. AACSE13 | $SO_2$ Sulfur Dioxide | Green | 36 months | yearly (2) |
| **Flex-Sensor CO 100000 ppm** Cod. AACSE17 | CO Carbon Monoxide | Purple | 48 months | yearly (2) |
| **Flex-Sensor CO 20.000 ppm** Cod. AACSE18 | CO Carbon Monoxide | Blue | 48 months | yearly (2) |
| **Flex-Sensor CxHy 0-5.00% vol. riferito al CH4** Cod. AACSE39 | CxHy Unburnt Hydrocarbons | | 48 months | yearly (2) |
| **Flex-Sensor CO+$H_2$ low range** Cod. AACSE24 | CO Carbon Monoxide | Red | 48 months | yearly (2) |
| **Flex-Sensor NO low range** Cod. AACSE25 | NO Nitrogen Oxide | Orange | 48 months | yearly (2) |
| **Flex-Sensor $NO_2$ low range** Cod. AACSE26 | $NO_2$ Nitrogen Dioxide | White | 48 months | yearly (2) |
| **Flex-Sensor $SO_2$ low range** Cod. AACSE28 | $SO_2$ Sulphur Dioxide | Green | 48 months | yearly (2) |
| **Flex-Sensor $CO_2$ 0-20%** Cod. AACSE41 | $CO_2$ Carbon Dioxide | | >48 months | yearly (2) |
| **Flex-Sensor $CO_2$ 0-50%** Cod. AACSE47 | $CO_2$ Carbon Dioxide | | >48 months | Yearly (2) |
| **Flex-Sensor $H_2S$** Cod. AACSE35 | $H_2S$ Hydrogen Sulfide | | 36 months | yearly (2) |

***Note:***
*(1) Colored dot on the sensor electronic board.*
*(2) UNI 10389-1 standard requires for the instrument calibration once per year to be performed in a laboratory authorized to issue calibration certificates.*

## 14.6 Expandability to 9 sensors

The CHEMIST 900 combustion analyzer can be expanded up to 9 cells.

**EXAMPLE OF AN EXPANDABLE 6 SENSORS CHEMIST 900**



The upgrading of the number of sensors can be easily done by the user by performing the following directions:

- The expandable instruments are arranged in a way to accept up to a maximum of 9 sensors.
- Identify, with the help of paragraph 14.3 "Sensor types and relevant positioning", the sensor(s) which must be added to the existing configuration (Seitron delivers all FLEX-series sensors already pre-calibrated and ready to use).
- To install the new sensors follow all the steps described in the paragraph 'MAINTENANCE' in "gas sensors replacement".

**THE INSTRUMENT AUTOMATICALLY DETECTS WHEN AN ADDITIONAL SENSOR IS INSTALLED OR HAS BEEN REMOVED. THE SCREEN 'SENSORS CONFIGURATION' ALLOWS TO ACCEPT THE NEW PROPOSED CONFIGURATION OR TO IGNORE THE CHANGE DETECTED. IN THIS SCREEN ARE SHOWN, FOR EACH POSITION, THE FOLLOWING MESSAGES:**

**EXAMPLE OF AN 'NO' SENSOR IN POSITION 3 REPLACED WITH AN 'NO2' SENSOR:**

**NO→NO2 A SENSOR DIFFERENT FROM THE PREVIOUS ONE HAS BEEN DETECTED.**

**EXAMPLE OF A NEW SENSOR INSTALLED IN POSITION 4 (PREVIOUSLY NOT PRESENT):**

**SO2→□ A NEW SENSOR HAS BEEN DETECTED.**

## 14.7 CxHy sensor for measurement of the unburnt hydrocarbons (pellistor)

The unburnt hydrocarbons are chemicals produced by an incomplete combustion of molecules (hydrocarbons) made of Carbon and Hydrogen.
These are usually named as HC or (better) CxHy: when this is filled with the actual values for the number of C and H atoms, the actual type of fuel is exactly defined. In case of Methane, as an example, the correct formula is CH4. In the following table is shown the cross sensitivity of the CxHy sensor when exposed to fuels different from Methane (CH4), assumed as 1.00.

| GAS / VAPOR | RELATIVE RESPONSE (with respect to Methane) | GAIN ADJUSTMENT |
|---|---|---|
| Ethanol | 0.75 | 1.33 |
| Iso-Butane | 0.60 | 1.67 |
| Methane | 1.00 | 1.00 |
| Methanol | 1.00 | 1.00 |
| n-Butane | 0.60 | 1.67 |
| n-Heptane | 0.45 | 2.22 |
| n-Hexane | 0.50 | 2.00 |
| Propane | 0.70 | 1.43 |

Calculation example:

Type of gas: iso-butane
Relative response: 0.6
Gain adjustment: 1.67
Reading value (related to methane): 1.34

Value = reading value x gain adjustment

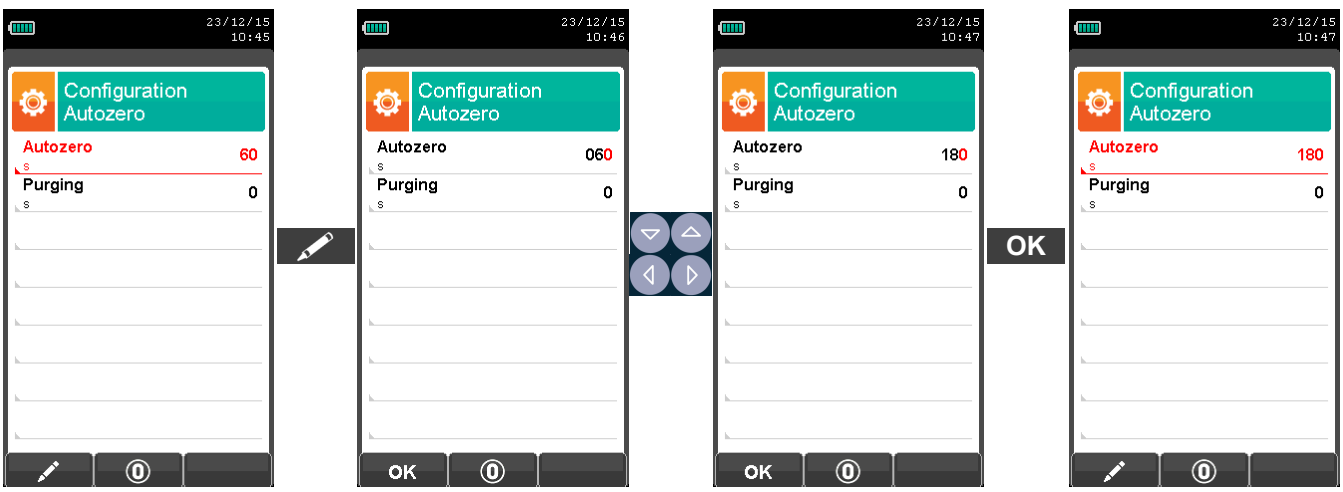
Example: 1.34 x 1.67 = 2.24

**WARNING**
**Gases that contain acidic or silicone compounds (HMDS) can irreversibly damage the sensor.**

### 14.7.1 Installing the CxHy sensor

When the CxHy (position S3/S4) is mounted in the instrument, it is mandatory to configure the autozero by setting it at 180 seconds, in order to allow for a proper pre-heating of the sensor itself.

**Configuration→Analysis→Autozero (See section 9.2.8)**



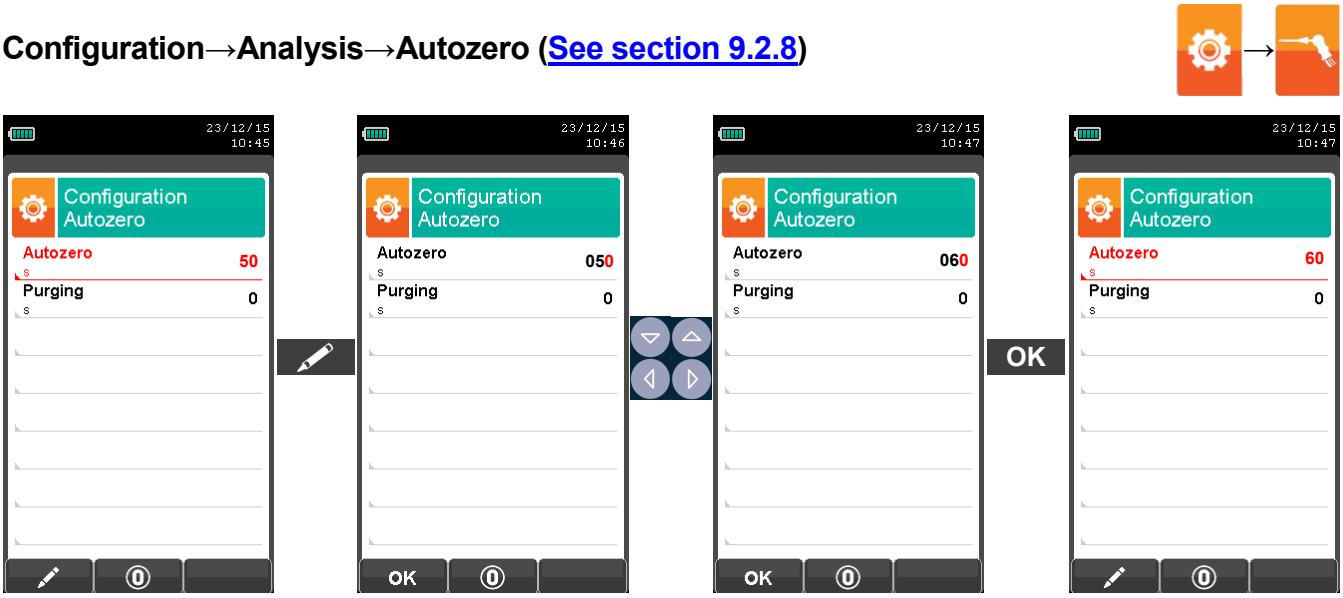
## 14.8 $CO_2$ sensor for Carbon Dioxide measurement in combustion processes (NDIR - Single Cell)

Carbon Dioxide ($CO_2$) is the result of combustion of an organic compound in presence of a quantity of oxygen sufficient to complete its oxidation. In nature, it is also produced by aerobic bacteria during the process of alcoholic fermentation and is the by product of respiration.
Many combustion processes are defined with 'mixed fuel' and is therefore difficult to calculate the amount of $CO_2$ produced. To avoid this drawback, the only way to know the amount of $CO_2$ produced in a combustion process with 'mixed fuel' is to measure the $CO_2$ with special NDIR sensors.

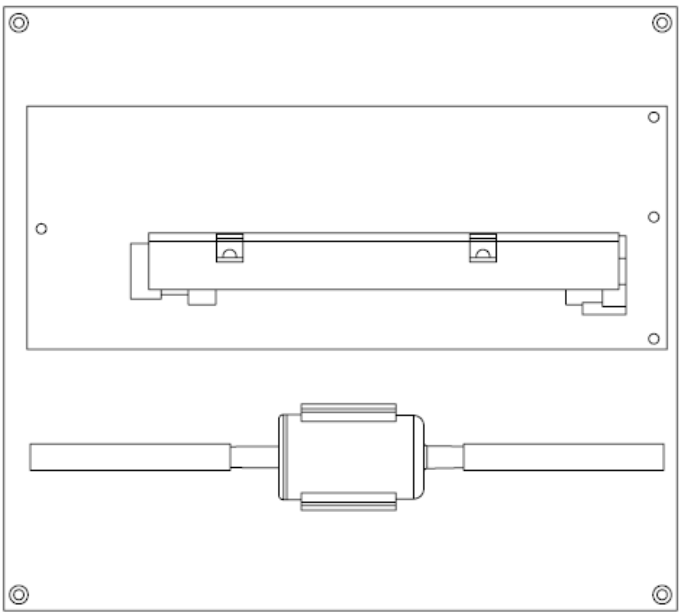
### 14.8.1 Installing the $CO_2$ sensor

When the $CO_2$ (position S3/S4) is mounted in the CHEMIST 900, it is mandatory to configure the autozero by setting it at 60 seconds, in order to allow for a proper pre-heating of the sensor itself.

**Configuration→Analysis→Autozero (See section 9.2.8)**



## 14.9 Infrared bench



An infrared bench for the detection of gases based on (NDIR) infrared spectroscopy can be installed on **CHEMIST 900**. By this system it is possible to simultaneously detect CO, CO2 and CxHy.
An additional antidust filter is fitted along the the pneumatic circuit before the IR bench.
The principle is the (NDIR) nondispersive infrared absorption at two wavelengths, stability over time, no interference with other compounds of the process, very fast response and quick return to zero value even after measuring concentrations up to the maximum measurement limit.
Gases absorb light at specific wavelengths, typically in the IR. An NDIR system includes: an IR light source, a chamber which contains the gas sample to be analysed and a detector equipped with an optical filter. The light goes through the chamber and the gas sample will absorb it at a specific wavelength (i.e. 4.26µm for CO2) or in specific bands.
The filter is the nondispersive optical component which allows the detector to unequivocally identify the gas according to the absorption spectrum pattern. The narrower the filter bandwidth the higher is the specificity of the sensor. The intensity of light (at a specific wavelength) that reaches the detector is inversely proportional to the relevant gas concentration. The signal picked up by the detector is then processed by the downstream electronics in order to have the concentration of CO, CO2 or CxHy.

## 15.1 Ordinary maintenance

This instrument has been designed and made using high quality components. A systematic and proper maintenance shall prevent the occurance of any malfunctioning and increase the overall life cycle of your device.

The operator is recommended to carry out the following basic operations:

- Avoid any great thermal shock before using the instrument or possibly wait that its temperature is within the operating parameters.
- Do not extract flue gas directly without a dust/condensate trap.
- Do not exceed the sensor overload tresholds.
- When the analysis is completed, disconnect the water trap and hoses and let the analyzer purge with clean fresh air for at least 5 to 10 minutes, or at least until the displayed parameters return to their original values in air.
- Clean the filter unit as necessary, by replacing the antidust filter and blowing air inside the tube of the sampling probe to release any condensate.

Do not use abrasive cleaners, solvents or other aggressive detergents to clean the instrument.

## 15.2 Scheduled Maintenance

Send the instrument to the SERVICE CENTER to be thoroughly cleaned and checked at least once a year.
SEITRON highlly qualified personnel is always at your disposal for any commercial or technical information and implementation or maintenance issues.
The service center is always ready to timely return the instrument like brand new. Calibrations are carried out using gases and instruments in compliance with National and International Sampling standards.
The annual test and certificate of calibration guarantee the proper operation of the instrument as provided by the UNI 10389-1 standard and are mandatory for users who require ISO 9000 certification.

## 15.3 Cleaning of the sampling probe

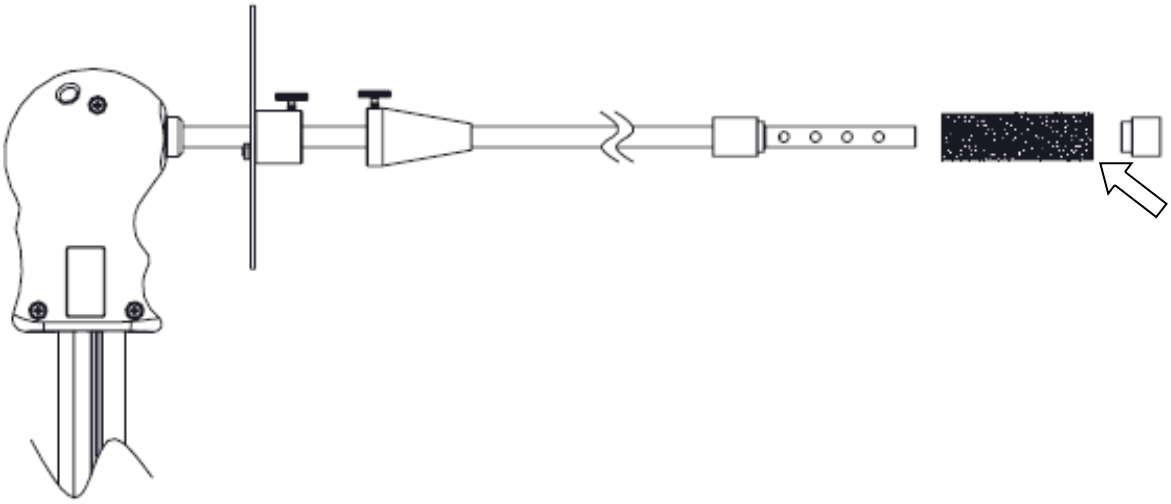
After using the sampling probe and before placing it in its case, it is recommended to throroughly clean it as follows:

- Disconnect the sampling probe from the instrument.
- Blow clean air in both tubes of the probe to release any remaining condensate.

## 15.4 Cleaning the sampling probe for industrial motors

After using the sampling probe for industrial motors, it is recommended to thoroughly clean it as follows :

- Disconnect the sampling probe from the instrument. .
- Remove the filter from the probe tip by loosening the nut shown by the arrow.
- Blow clean air in both tubes of the probe (shown by the arrow) to release any residual condensate.
- Clean the filter in an ultrasonic bath or by using solvent and steel wire brushes.

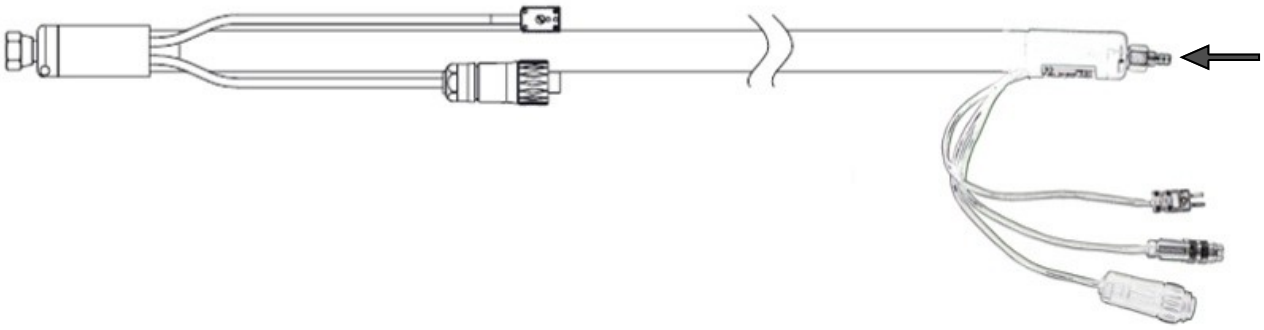


- To reassemble the probe logically reverse this procedure.

## 15.5 Cleaning the heated sampling probe

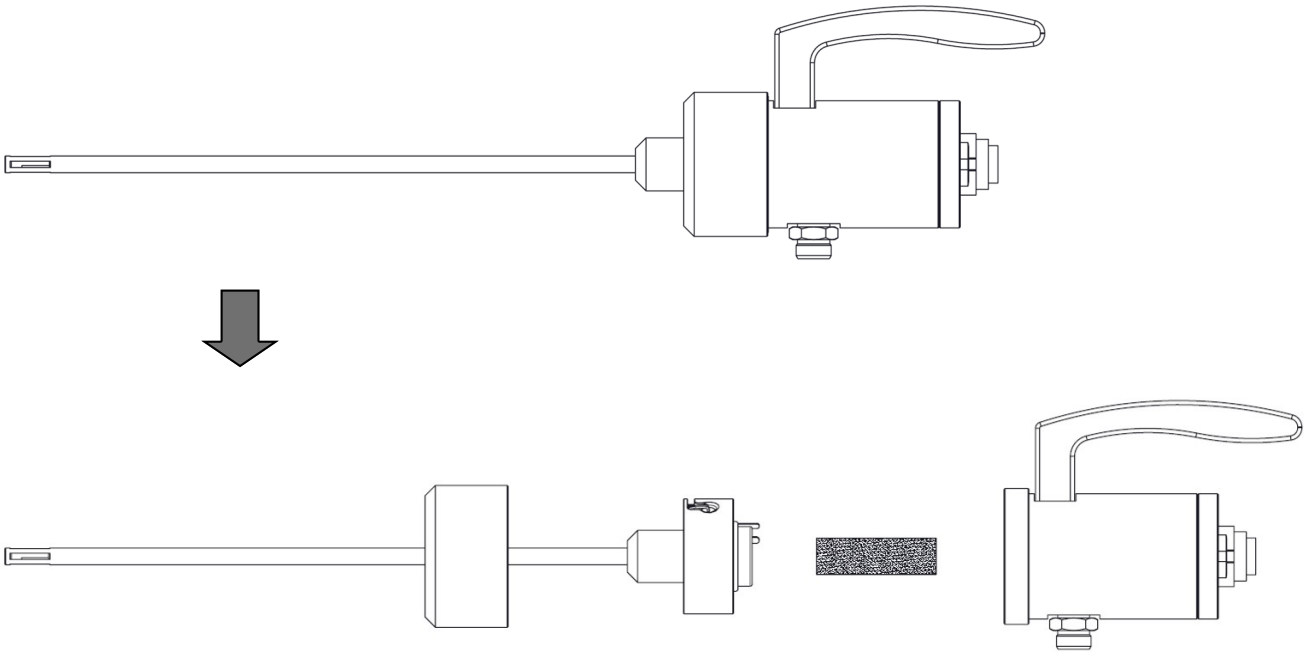
After using the sampling probe and before placing it in its compartment (available accessory) it is recommended to thoroughly clean it as follows :

- Disconnect the sampling probe from the instrument.
- Disconnect the tube from the heated head and blow clean air in the tube of the probe to release any remaining condensate.
- Open the heated head by unscrewing the body, remove the stainless steel filter and blow clean air in the internal compartment of the filter holder.



- Clean the filter in an ultrasonic bath or by using solvents and steel wire brushes.

**CAUTION**
**OPEN THE HEATED HEAD ONLY WHEN IT IS COMPLETELY COLD.**



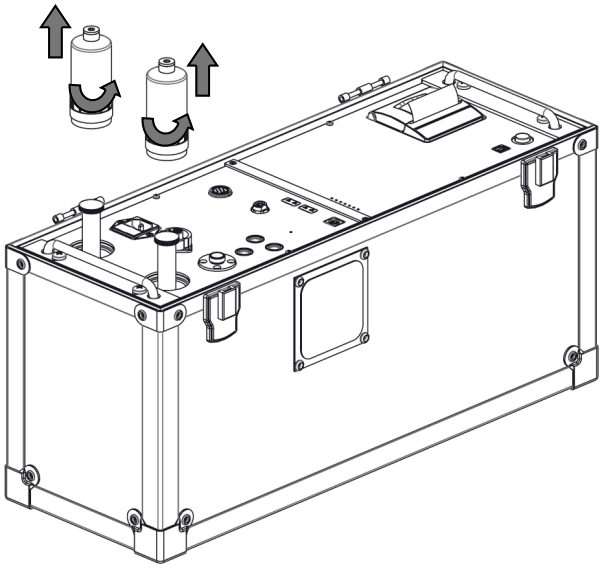
- To reassemble the probe logically reverse this procedure.

- To reassemble the probe logically reverse this procedure.

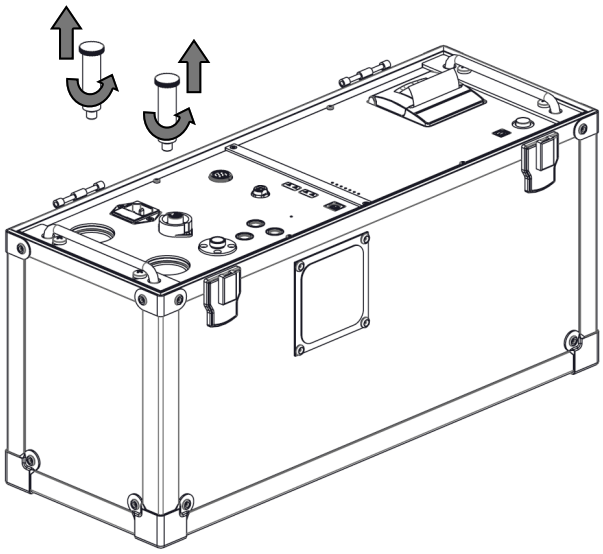
## 15.6 Cleaning the external antidust filters

If the external antidust filters of the instrument turn black, replace them immediately.

1. Unscrew the transparent cover.



2. Unscrew the antidust filter



3. Clean the cover inside by using compressed air, soap and water or ultrasonic cleaner (do not use solvents or thinners as the case/container is made of PVC plastic material).

4. Replace the antidust filter with a new one.

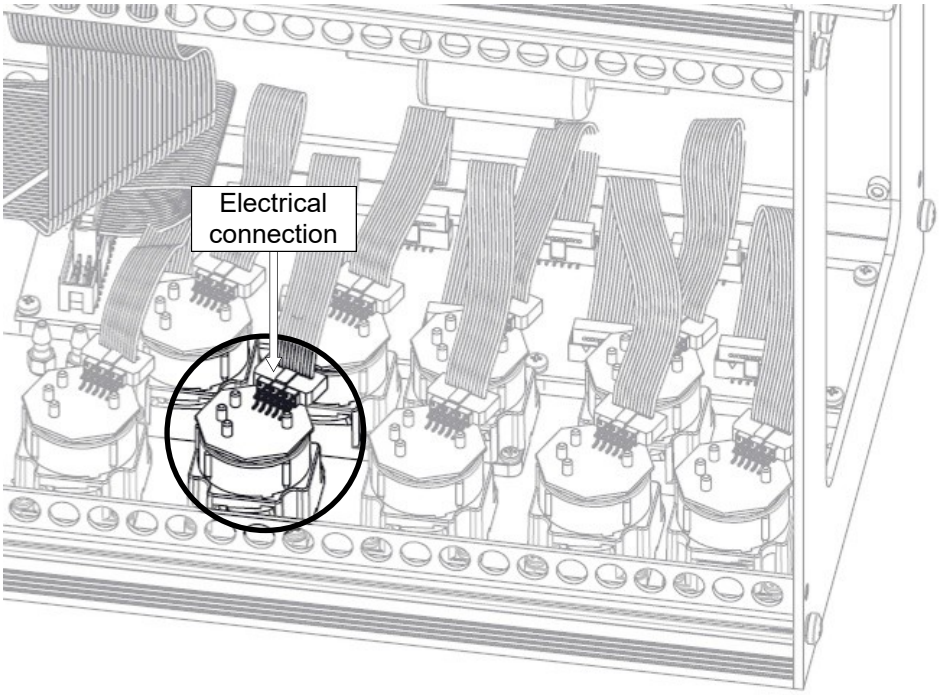
5. To reassemble the filter logically reverse this procedure.

## 15.7 Replacing the gas sensors

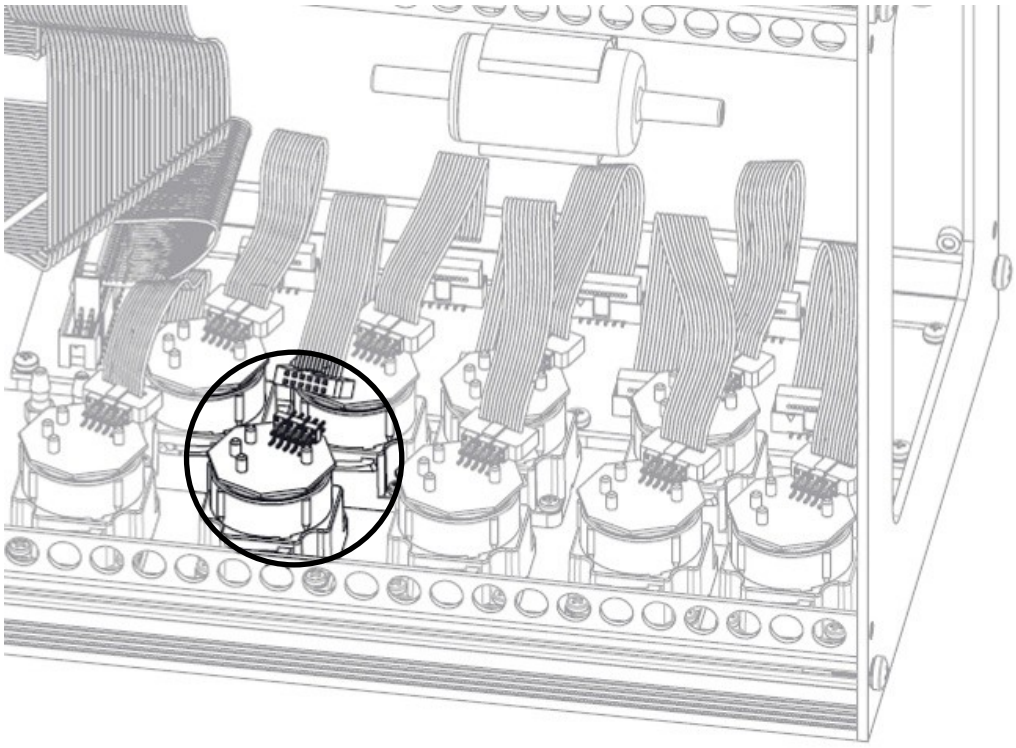
The gas sensors of the instrument shall be periodically replaced (see the following table) with new or recalibrated sensors.
The user can easily perform this replacement operation according to the following instructions:

1. Gain access to the internal parts of the instrument, as explained in section 5.3 " Access to internal components ".

2. Locate the sensor to be replaced; here is an example of a connected sensor to be replaced (with the electrical connector still coupled).

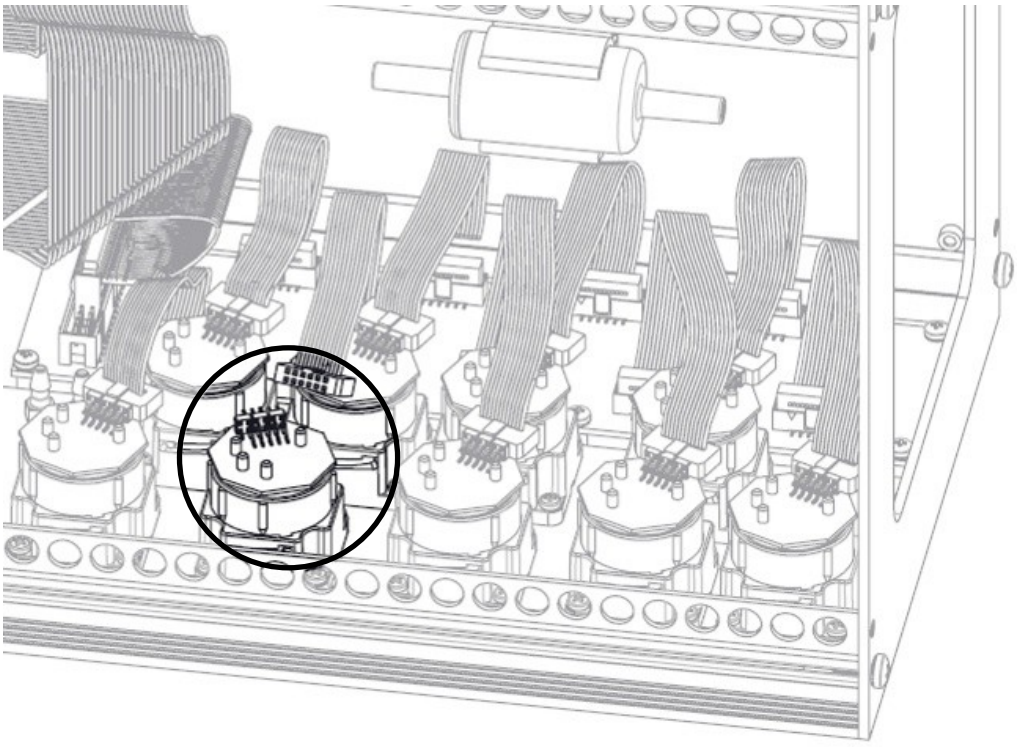



3. Disconnect the sensor to be replaced; here is an example of a disconnected sensor to be replaced (the electrical connector has been disconnected).

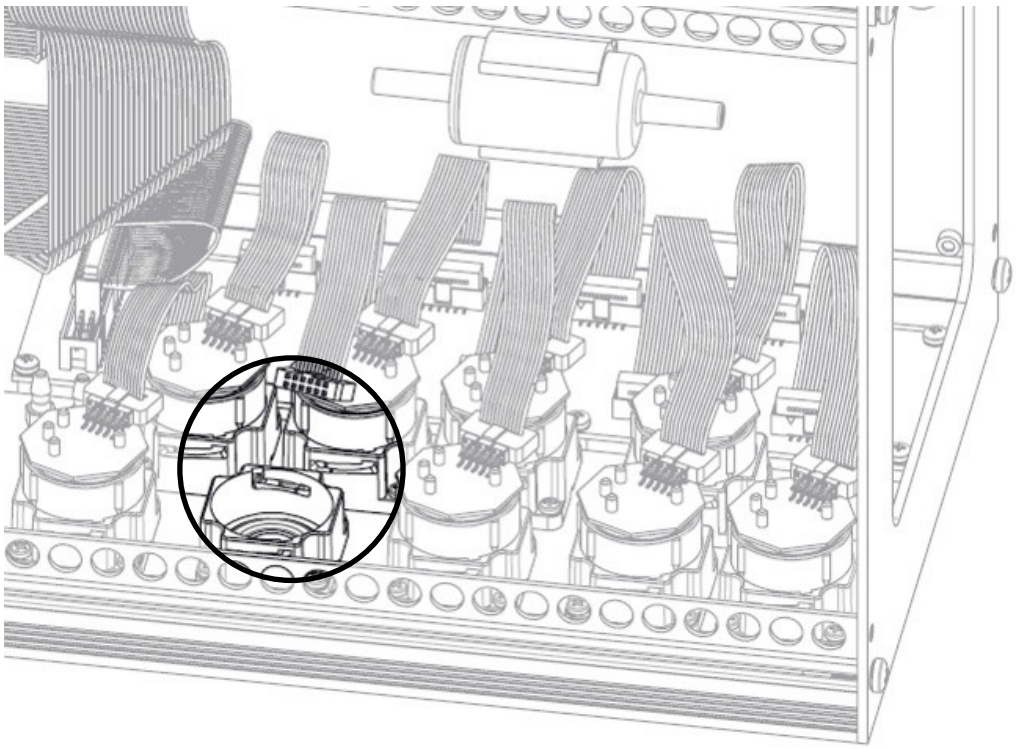


4 The sensor is bayonet-connected to its socket; rotate it counter-clockwise to remove it. Here is an example of a rotated sensor.

**While rotating the sensor, take care not to exert any pressure on the printed circuit board mounted on the top of the sensor: exert pressure only onto the plastic body.**



5 After rotating the sensor, pull it upward; here is an example of the sensor compartment with a sensor removed.



6 Fit the new sensor again taking care the electric connection is turned to the outside the instrument, not the inside (See point 4).

7. Rotate the sensor clockwise until hearing a click (See point 3).

**While rotating the sensor, take care not to exert any pressure onto the printed circuit above: exert pressure onto the plastic body only.**

8. Reconnect the sensor (See point 2).

9. Reinsert the instrument assembly into its case, as described in section 5.3 " Access to the internal components"

Turn on the instrument to check the new sensor works correctly through the menu "Sensor Troubleshooting".
It is normal if a newly installed sensor gives a 'current error': it is necessary to wait some time, so that the sensor polarization can settle. The table here below shows the minimum settling time for each sensor.

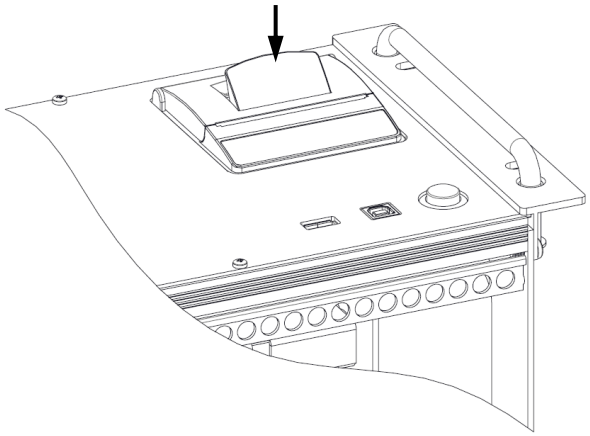
| CODE | MEASURED GAS | SETTLING TIME |
|---|---|---|
| **Flex-Sensor $O_2$ LL**<br>Cod. AACSE43 | $O_2$<br>Oxygen | 24 hours (1) |
| **Flex-Sensor $O_2$**<br>Cod. AACSE48 | $O_2$<br>Oxygen | 2 hours (1) |
| **Flex-Sensor CO+$H_2$**<br>Cod. AACSE12 | CO<br>Carbon Monoxide | 2 hours (1) |
| **Flex-Sensor CO+$H_2$ low range**<br>Cod. AACSE24 | CO<br>Carbon Monoxide | 2 hours (1) |
| **Flex-Sensor CO 100.000 ppm**<br>Cod. AACSE17 | CO<br>Carbon Monoxide | 2 hours (1) |
| **Flex-Sensor CO 20.000 ppm**<br>Cod. AACSE18 | CO<br>Carbon Monoxide | 2 hours (1) |
| **Flex-Sensor NO**<br>Cod. AACSE10 | NO<br>Nitrogen Oxide | 48 hours (2) |
| **Flex-Sensor NO low range**<br>Cod. AACSE25 | NO<br>Nitrogen Oxide | 48 hours (2) |
| **Flex-Sensor $NO_2$**<br>Cod. AACSE14 | $NO_2$<br>Nitrogen Dioxide | 2 hours (1) |
| **Flex-Sensor $NO_2$ low range**<br>Cod. AACSE26 | $NO_2$<br>Nitrogen Dioxide | 2 hours (1) |
| **Flex-Sensor $SO_2$**<br>Cod. AACSE13 | $SO_2$<br>Sulphur Dioxide | 2 hours (1) |
| **Flex-Sensor $SO_2$ low range**<br>Cod. AACSE28 | $SO_2$<br>Sulphur Dioxide | 2 hours (1) |
| **FLEX-Sensor CxHy**<br>**0-5.00% vol. referred to CH4**<br>Cod. AACSE39 | CxHy<br>Unburnt Hydrocarbons | 1/2 hour (3) |
| **Flex-Sensor $CO_2$ 0 .. 20% vol.**<br>Cod. AACSE41 | $CO_2$<br>Carbon Dioxide | 2 hours (1) |
| **Flex-Sensor $CO_2$ 0 .. 50% vol.**<br>Cod. AACSE47 | $CO_2$<br>Carbon Dioxide | 2 hours (1) |
| **Flex-Sensor $H_2S$ 500 ppm**<br>Cod. AACSE35 | $H_2S$<br>Hydrogen Sulfide | 2 hours (1) |

Note:
(1) 2 hours settling time is required.
(2) 48 hours settling time is required; should the sensor be equipped with an external polarization battery, the settling time is reduced down to 2 hours.
(3) 1/2-hour settling time is required.

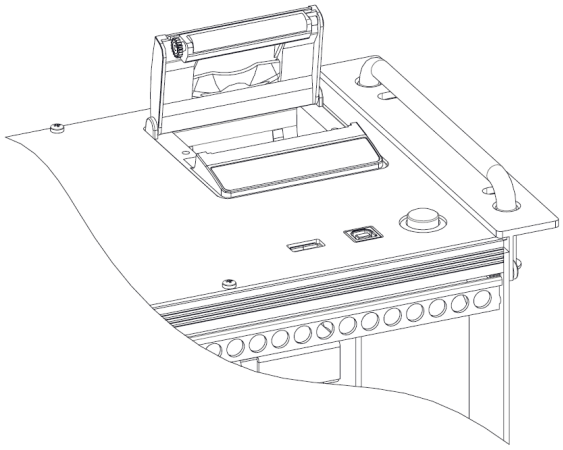
## 15.8 Replacing the printer paper

Follow these instructions to change the paper roll in the printer.

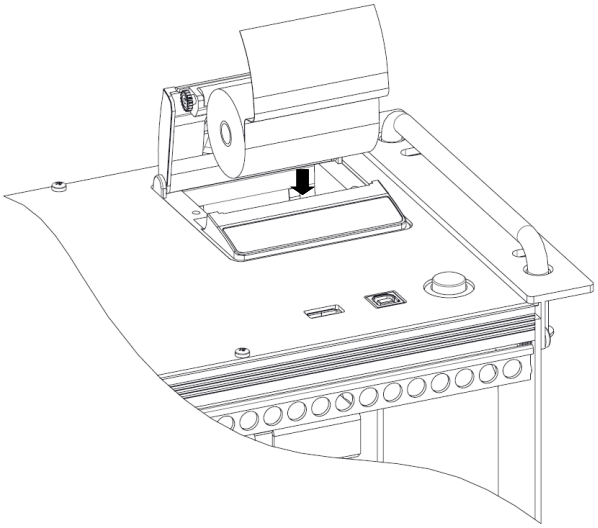
1. Lift the shiny tile, indicated by the arrow.

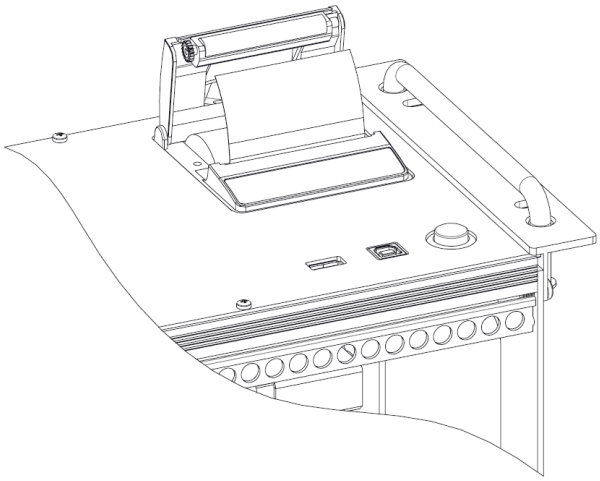


2. Lift the whole block of the lid completely.

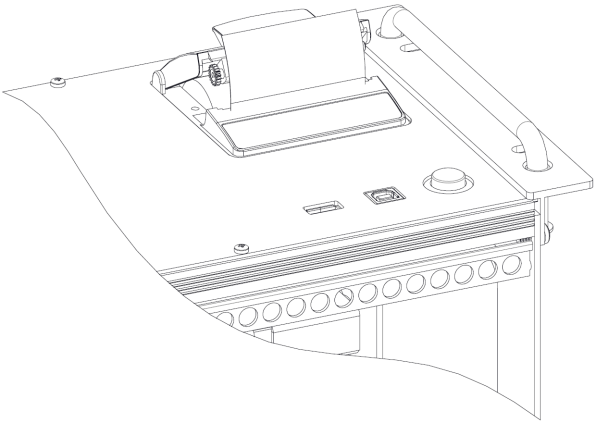


3. Insert the roll of printing paper as shown in the following figures.

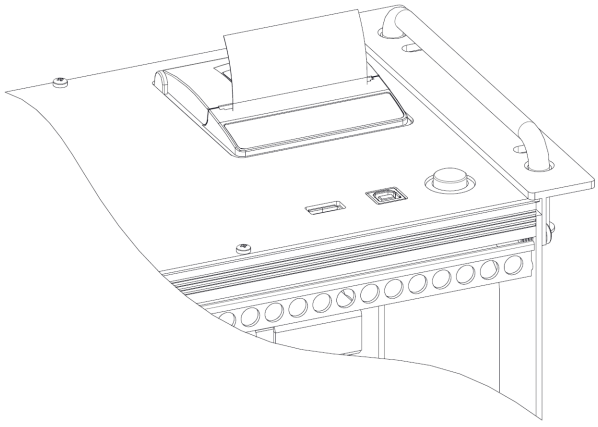




4. Close the whole block of the lid of the printer, pressing it lightly so as to hook it on to the device.



5. At this point it is possible to use the printer. See the parameter. See section 11 " Print ".

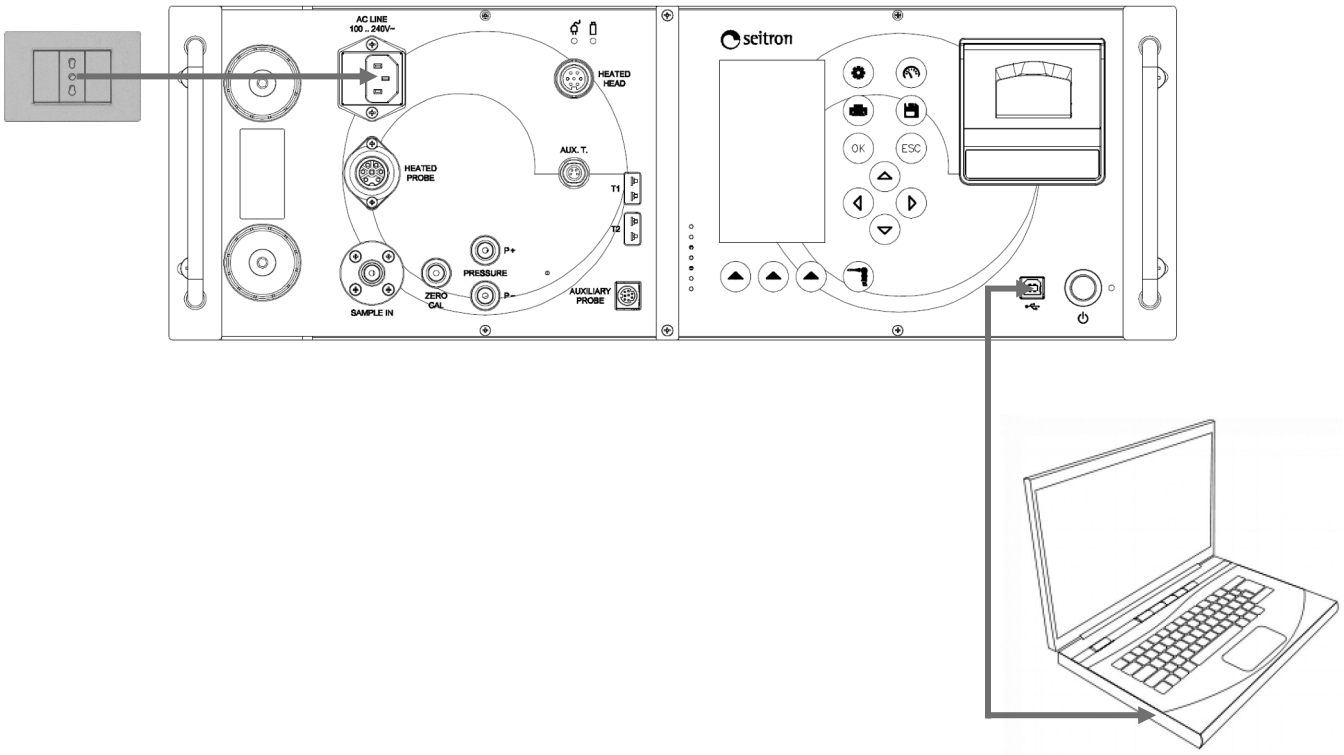


## 15.9 Firmware Update

The manufacturer periodically releases firmware updates of the instrument in order to correct unavoidable mistakes or improve the instrument performance or add new functions.
This update can be performed by the user by following the simple instructions below.

**WARNING:**
**Since the firmware update could imply a different organization of the data stored in the instrument memory, maintaining the existing analysis data in the instrument is not guaranteed. Therefore it is always mandatory to make the transfer of the analysis from the instrument to the PC prior to the firmware update procedure.**
**Moreover, for the same reasons, it is absolutely mandatory that the management software tool installed on the PC is updated to a version compatible with the firmware version installed on the instrument.**

**Instructions to update the combustion analyzer with a new firmware:**




1. Log in to the website www.seitron.it and download the firmware file available in the "combustion analyzers" section. This file is in a compressed version .zip.
2. Unzip the file thus obtaining the contents of the .zip file (extension .srec).
3. Plug in the analyzer to the PC via the USB cable.
4. Connect the analyzer to the mains supply using the cable with the IEC C14 socket supplied
5. Press and hold the ON/OFF key of the combustion analyzer for approx. 10 seconds
6. Release the ON/OFF key; the red led turns on steady
7. Press and hold the ON/OFF key until the red led turns off
8. Release the ON/OFF key; the red led turns on flashing slowly (1 flash/second)
9. The analyzer will be recognized by the operating system as a portable device drive.
10. Copy the firmware file (extension .srec) to the directory of the analyzer.
11. The red led blinks quickly to indicate that the firmware is being updated; wait till the end of the file copy operation.
12. The red led is steady on.
10. The file copy directory will be closed and the analyzer will restart.
11. The analyzer is now updated, it can be powered off and it can be unplugged from the PC and from the mains.

## 16.1 Troubleshooting guide

| SYMPTOM | PROBABLE CAUSES AND REMEDIES |
|---|---|
| The instrument does not work; when pressing the On/ Off key, it does not switch on. | **a.** Press and hold the On/Off key down for longer than 2 seconds.<br>**b.** The battery is discharged; connect the battery charger to the instrument .<br>**c.** The battery pack is not connected to the instrument; remove the instrument from its case and insert the connector of the battery pack in the attachment of the printed circuit board.<br>**d.** The instrument is defective: send it to the service center. |
| The battery pictogram ▭ is empty. | Batteries are exhausted. Connect it to the battery charger.<br>If the pictogram is flashing, the shutdown is imminent. |
| After the instrument turns on, the sensor diagnostic screen displays an error in one or more cells. | Sensor communication error (sensor may be broken or not properly connected) or a change in the sensors installed in relation to the configuration is signalled. |
| After switching on, the instrument fails to perform the autozeroing. | **a.** If the NDIR bench is installed and enabled, check that the autozero time is set at 70 seconds at least.<br>**b.** An error has occured in one or more sensors, see the sensor Diagnostic screen. |
| The pressure/draft screen signals an error of the piezoresistive temperature compensated pressure sensor. | There is a calibration problem.<br>Send the instrument to the service center. |
| The analysis screen gives a flue gas temperature (Tf) error. | **a.** The thermocouple is not connected; connect the thermocouple to the analyzer.<br>**b.** The sensor has been exposed to temperatures greater or lower than its operating temperature range.<br>**c.** The thermocouple is faulty. Send the complete probe to a service center. |
| The “----” icon appears in the analysis screen. | The instrument is unable to calculate the numerical value based on the combustion analysis carried out. When the analyzer detects valid combustion data, the “----” icons are replaced with numerical data. |
| In the analysis screen, the “----” icon appears next to the gases detected by the NDIR bench. | **a.** Check if the NDIR bench is enabled, then switch off and switch the instrument on again.<br>**b.** If in "Diagnostic➞Bench NDIR➞Status Register" the CO2, CO, CH4 indicate "invalid", it means that the inlet gas is out of the measurement range.<br>**c.** If in "Diagnostic➞Bench NDIR➞Status Register" the Sample Temp. indicates "Out of Range", it means that the measurement temperature (detected in the cell /IR tube) is out of the 0-75°C range.<br>**d. Warning: in the "Diagnostic➞Bench NDIR➞ Status Register" ignore the messages relating to "Zero Required" and "Proc. In Progress".**<br>**e.** If the problem persists, contact the service center. |
| "Max. Lim." or "Min. Lim" appears on the analysis screen. | The relevant sensor is detecting a value that is beyond the analyzer’s measuring range. "Max. Lim" or "Min. Lim." are replaced by numbers when the instrument reveals values that are within the measuring range. |

## Troubleshooting guide

| SYMPTOM | PROBABLE CAUSES AND REMEDIES |
|---|---|
| The suction pump does not work or the flow is lower than 1,5l/min. | **a.** The suction flow is blocked. Check that the particulate filter is clean.<br>**b.** Contact the service center. |
| The instrument is switched on, but the display seems to be off. | **a.** Check the display brightness level (see the configuration menu).<br>**b.** If the problem persists, contact the service center. |
| During the tightness test a "sensor error" is reported. | Check for the correct connection of the hose to the positive pressure input. |
| The heated probe is enabled, but the heated tube status displays ' disab. '. | The probe connector is not properly connected to the 'HEATED PROBE' connector of the instrument . |
| The heated probe is enabled, but the heated tube status displays 'off '. | The instrument is not connected to the power supply. |
| The heated probe is enabled, but the heated head status displays ' disab. '. | The heated head connector is not properly connected to the 'HEATED HEAD' connector of the instrument . |
| T head indicates ' no probe '. | The heated head connector is not properly connected to the 'HEATED HEAD' connector of the instrument . |
| T tube indicates ' no probe '. | The heated head connector is not properly connected to the 'HEATED PROBE' connector of the instrument . |
| T tube and/or T head indicates ' error '. | **a.** The connector may be damaged.<br>**b.** The cable of the temperature sensor may be damaged. Send it to the service center. |
| The heated probe is enabled, but the tube status and/ or the head status and/or Peltier status display ' fault '. | **a.** Check that the T head, T tube and T Peltier temperatures are within the parameters that have been set.<br>**b.** Contact the service center. |
| The Cooler is enabled, but the Peltier status indicates ' fault '. | **a.** Check that the T Peltier temperature is within the parameter that has been set.<br>**b.** Contact the service center. |
| The integrated printer of the instrument does not print. | **a.** Check that the set printer is the internal printer. **b.** Start the test print; if the problem persists, contact the service center. |

# 17.0 SPARE PARTS AND SERVICING

## 17.1 Spare parts

| CODE | DESCRIPTION |
|---|---|
| **AACPB06** | Li-Ion 7,2V 2,4Ah battery pack |
| **AARC05** | Unerasable thermal polyester paper rolls for printer, h=57mm Diam.=35mm |
| **AARC06** | Unerasable thermal paper roll for printer, h=58mm Diam.=35mm |
| **AACADX005** | Dummy sensor |
| **AACSE43** | FLEX-Sensor $O_2$, long life, pre-calibrated and interchangeable |
| **AACSE48** | FLEX-Sensor $O_2$, pre-calibrated and interchangeable |
| **AACSE12** | FLEX-Sensor CO+$H_2$, pre-calibrated and interchangeable |
| **AACSE10** | FLEX-Sensor NO/NOx, pre-calibrated and interchangeable |
| **AACSE14** | FLEX-Sensor $NO_2$, pre-calibrated and interchangeable |
| **AACSE13** | FLEX-Sensor $SO_2$, pre-calibrated and interchangeable |
| **AACSE17** | FLEX-Sensor CO 100.000 ppm, pre-calibrated and interchangeable |
| **AACSE18** | FLEX-Sensor CO 20.000 ppm, pre-calibrated and interchangeable |
| **AACSE39** | FLEX-Sensor CxHy related to CH4, pre-calibrated and interchangeable |
| **AACSE24** | FLEX-Sensor CO+$H_2$ low range, pre-calibrated and interchangeable |
| **AACSE25** | FLEX-Sensor NO low range, pre-calibrated and interchangeable |
| **AACSE26** | FLEX-Sensor $NO_2$ low range, pre-calibrated and interchangeable |
| **AACSE28** | FLEX-Sensor $SO_2$ low range, pre-calibrated and interchangeable |
| **AACSE41** | FLEX-Sensor $CO_2$ 0-20% v/v, pre-calibrated and interchangeable |
| **AACSE47** | FLEX-Sensor $CO_2$ 0-50% v/v, pre-calibrated and interchangeable |
| **AACSE35** | FLEX-Sensor $H_2S$, pre-calibrated and interchangeable |

## 17.2 Accessories

| CODE | DESCRIPTION |
|---|---|
| **AACCV01** | Schuko plug cable. |
| **AACCV04** | European plug cable. |
| **AACCV06** | US plug cable. |
| **AACDP02** | Deprimometer for Draft test. |
| **AACSO01** | Probe for measuring the ionization current. |
| **AACSA04** | 100 mm Auxiliary temperature probe PT100 4w with 3 mt cable. |
| **AASA08** | 200 mm Remote combustion air temperature probe with 3 mt cable. |
| **AASF31** | 180 mm flue gas sampling probe with 3 mt cable. Working temperature range: 400°C. |
| **AASF32** | 300 mm flue gas sampling probe with 3 mt cable. Working temperature range: 600°C. |
| **AASF35** | 750 mm flue gas sampling probe with 3 mt cable. Working temperature range: 800°C. |
| **AASF36** | 1000 mm flue gas sampling probe with 3 mt cable. Working temperature range: 1200°C. |
| **AASX03** | 750 mm flue gas sampling probe for industrial motors with 3 mt cable. |
| **AACEX02S** | 3 m extension cable for gas sampling probe. |
| **AASR01** | Flue gas sampling probe with heated head, 300 mm tip and electro-heated 3 mt tube (without thermocouple). |
| **AASR02** | Flue gas sampling probe with heated head, 1000 mm tip and electro-heated 3 mt tube (without thermocouple). |
| **AASR03** | Flue gas sampling probe with heated head, 300 mm tip and electro-heated 3 mt tube with thermocouple. |
| **AASR04** | Flue gas sampling probe with heated head, 1000 mm tip and electro-heated 3 mt tube with thermocouple. |
| **AASP01** | Heat protection shield for flue gas sampling probes. |
| **AATT01** | 'L' shaped Pitot Tube (without Tc-K thermocouple): length 300mm - external ø 6 mm. Supplied with two silicone tubes with length 2 meters. |
| **AATT02** | 'L' shaped Pitot Tube (without Tc-K thermocouple): length 800mm - external ø 6 mm. Supplied with two silicone tubes with length 2 meters. |
| **AACKP01** | Differential pressure kit. |
| **AAKT04** | Tightness test kit. |
| **AAPM02** | Manual pump kit for smoke measurement. |
| **AASW08** | Configuration software on USB flash drive. |
| **AAUA01** | USB-A / USB-B adapter cable. |
| **AAEB02** | Trunk extension. |
| **AATY01** | Trunk trolley. |
| **AATS01** | Remote condensate drain hose. |
| **AACKP02** | Remote air intake hose. |

## 17.3 Service Centers

**Headquarters:**
Seitron S.p.A. a socio unico
Via Prosdocimo, 30
I-36061 Bassano del Grappa (VI)
Tel.: +39.0424.567842
Fax.: +39.0424.567849
E-mail: info@seitron.it
http://www.seitron.it

**Service for North-West Italy**
Seitron S.p.A. a socio unico
Via Leonardo da Vinci, 1
I-20090 Segrate (MI)
Tel.: +39.02.83647671
Fax.: +39.02.83647671
E-mail: service.milano@seitron.it
http://www.seitron.it

**Example of Total analysis report.**

COMPANY Ltd.
Park Road, 9
Tel.02/12345678

Oper.: John Smith

Sign.: _____

Test according to
UNI 10389-1
L. 10/1991 and s.m.i.
D.Lgs. 192/2005 and s.m.i.

Chemist 900 X
Serial: 999989

Memory: 01
Analysis: Average
Date: 04/04/14
Time: 10.30

Fuel: Natural gas
Altitude: 0 m
R.H. air: 50 %

| | |
|---|---|
| $O_2$ | 15.7 % |
| $CO_2$ | 2.9 ppm |
| λ,n | 4.01 |
| T flue | 100.6 °C |
| T air | 27.0 °C |
| dT | 73.6 % |
| Qs | 10.0 % |
| Es | 90.0 % |
| Ec | 0.0 % |
| Et | 90.0 % |
| CO | 23 ppm |
| NO | 14 ppm |
| $NO_x$ | 15 ppm |
| Ref. $O_2$: | 0.0 % |
| CO ref | 92 ppm |
| Ref. $O_2$: | 0.0 % |
| NO ref | 56 ppm |
| Ref. $O_2$: | 0.0 % |
| $NO_x$ ref.: | 60 ppm |
| Draft | 4.5 Pa |
| T ext. | 10.0 °C |

Note: ----------
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Analysis: 1
04/03/16 10.00

| | |
|---|---|
| $O_2$ | 15.7 % |
| $CO_2$ | 2.9 % |
| λ,n | 4.01 |
| T flue | 100.4 °C |
| T air | 27.0 °C |
| dT | 73.4 °C |
| QS | 10.0 % |
| Es | 90.0 % |
| Ec | 0.0 % |
| Et | 90.0 % |
| CO | 23 ppm |
| NO | 14 ppm |
| $NO_x$ | 15 ppm |
| Ref. $O_2$: | 0.0 % |
| CO ref | 92 ppm |
| Ref. $O_2$: | 0.0 % |
| NO ref | 52 ppm |
| Ref. $O_2$: | 0.0 % |
| $NO_x$ ref.: | 56 ppm |
| Tiraggio | 4.5 Pa |
| T ext. | 10.0 °C |

Analysis: 2
04/03/16 10.15

| | |
|---|---|
| $O_2$ | 15.7 % |
| $CO_2$ | 2.9 % |
| λ,n | 4.01 |
| T flue | 100.6 °C |
| T air | 27.0 °C |
| dT | 73.6 °C |
| QS | 10.0 % |
| Es | 90.0 % |
| Ec | 0.0 % |
| Et | 90.0 % |
| CO | 23 ppm |
| NO | 14 ppm |
| $NO_x$ | 15 ppm |
| Ref. $O_2$: | 0.0 % |
| CO ref | 92 ppm |
| Ref. $O_2$: | 0.0 % |
| NO ref | 56 ppm |
| Ref. $O_2$: | 0.0 % |
| $NO_x$ ref.: | 60 ppm |
| Draft | 4.5 Pa |
| T ext. | 10.0 °C |

Analysis: 3
04/03/16 10.20

| | |
|---|---|
| $O_2$ | 15.7 % |
| $CO_2$ | 2.9 % |
| λ,n | 4.01 |
| T flue | 100.8 °C |
| T air | 27.0 °C |
| dT | 73.8 °C |
| QS | 10.1 % |
| Es | 89.9 % |
| Ec | 0.0 % |
| Et | 89.9 % |
| CO | 23 ppm |
| NO | 14 ppm |
| $NO_x$ | 15 ppm |
| Ref. $O_2$: | 0.0 % |
| CO ref | 92 ppm |
| Ref. $O_2$: | 0.0 % |
| NO ref | 56 ppm |
| Ref. $O_2$: | 0.0 % |
| $NO_x$ ref.: | 60 ppm |
| Draft | 4.5 Pa |
| T ext. | 10.0 °C |

### Example of Full analysis report.

```
COMPANY Ltd.
Park Road, 9
Tel.02/12345678

Oper.: John Smith

Sign.: _______________

Test according to
UNI 10389-1
L. 10/1991 and s.m.i.
D.Lgs. 192/2005 and s.m.i.

Chemist 900 X
Serial: 999989

Memory: 01
Analysis: Average
Date: 04/04/14
Time: 10.30

Fuel: Natural gas
Altitude: 0 m
R.H. air: 50 %

O2              15.9 %
CO2              2.8 ppm
λ,n             4.18
T flue          80.6 °C
T air           26.9 °C
dT              53.7 %
Qs              7.6 %
Es              92.4 %
Ec               0.0 %
Et              92.4 %
CO                27 ppm
NO                11 ppm
NOx               12 ppm
Ref. O2:         0.0 %
CO ref            113 ppm
Ref. O2:         0.0 %
NO ref             46 ppm
Ref. O2:         0.0 %
NOx ref.:          50 ppm
Draft             4.5 Pa
T ext.          10.0 °C

Note: ------------------
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```

### Example of Partial Paper print-out.

```
Date: 04/04/14
Time: 10.15

Fuel: Natural gas
Altitude: 0 m
R.H. air: 50 %

O2              15.7 %
CO2              2.9 ppm
λ,n             4.01
T flue          95.4 °C
T air           26.9 °C
dT              68.5 %
Qs               9.3 %
Es              90.7 %
Ec               0.0 %
Et              90.7 %
CO                23 ppm
NO                13 ppm
NOx               14 ppm
Ref. O2:         0.0 %
CO ref            92 ppm
Ref. O2:         0.0 %
NO ref            52 ppm
Ref. O2:         0.0 %
NOx ref.:         56 ppm
Smoke         4.5 Pa
T ext.          10.0 °C

Smoke:     3  1  2
Aver n°:      2
```

### Example of Draft Paper print-out.

```
COMPANY Ltd.
Park Road, 9
Tel.02/12345678

Oper.: John Smith

Sign.: _______________

Chemist 900 X
Serial: 999989
Memory: 01

Date: 04/04/14
Time: 10.30

Draft           4.5 Pa
T ext.        10.0 °C

Note: ------------------
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```

### Example of tightness test report paper print-out.

```
COMPANY Ltd.
Park Road, 9
Tel.02/12345678

Oper.: John Smith

Sign.: _______________

Test according to
UNI 11137: 2012 standard
Indirect method

Chemist 900 X
Serial: 999989
Memory: 01

Date: 04/04/14
Time: 10.30

Stab. duration: 1 min
Test duration: 1 min

Comb. Gas: Metano
Test gas:  Aria

Vimp         25.0 dm³
P1          10.05 hPa
P2          10.03 hPa
ΔP          -0.02 hPa
Qtest         0.0 dm³/h
Qref          0.0 dm³/h

Result: compliant

Note: ------------------
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```

### Example of Smoke Paper print-out.

```
COMPANY Ltd.
Park Road, 9
Tel.02/12345678

Oper.: John Smith

Sign.: _______________

Chemist 900 X
Serial: 999989
Memory: 01

Date: 04/04/14
Time: 10.30

Fuel: Diesel

Smoke:    3  1  2
Aver. n°:       2

Note: ------------------
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```

### Example of ambient CO Paper print-out.

```
COMPANY Ltd.
Park Road, 9
Tel.02/12345678

Oper.: John Smith

Sign.: _______________

Chemist 900 X
Serial: 999989
Memory: 01

Date: 04/04/14
Time: 10.30

CO amb            0 ppm

Note: ------------------
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```

### Example of Velocity Paper print-out.

```
COMPANY Ltd.
Park Road, 9
Tel.02/12345678

Oper.: John Smith

Sign.: _______________

Chemist 900 X
Serial: 999989
Memory: 01

Date: 04/04/14
Time: 10.30

Gas: Air

V air         9.11 km/h
Density       1.199 kg/m³
Altitude      0 ft
T air         25.3 °C
K Pitot       0.980

Note: ------------------
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```

## Coefficients of the fuels and Formulas

The following chart, derived from standard UNI 10389-1, lists the coefficients of the memorized fuels, used for calculating losses and efficiencies.

| Coefficients for calculating combustion efficiency | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|
| **Fuel** | **A1** | **A2** | **B** | **CO2t** (%) | **PCI** (KJ/Kg) | **PCS** (KJ/Kg) | **M air** (Kg/Kg) | **M $H_2O$** (Kg/Kg) | **V dry gas** ($m^3$/Kg) |
| Natural gas | 0,660 | 0,380 | 0,0100 | 11,70 | 50050 | 55550 | 17,17 | 2,250 | 11,94 |
| Propane | 0,630 | 0,420 | 0,0080 | 13,90 | 45950 | 49950 | 15,61 | 1,638 | 11,11 |
| L.P.G. | 0,630 | 0,420 | 0,0080 | 13,90 | 45730 | 49650 | 15,52 | 1,602 | 11,03 |
| Butane | 0,630 | 0,420 | 0,0080 | 13,90 | 45360 | 49150 | 15,38 | 1,548 | 10,99 |
| Diesel oil | 0,680 | 0,500 | 0,0070 | 15,10 | 42700 | 45500 | 14,22 | 1,143 | 10,34 |
| Fuel oil | 0,680 | 0,520 | 0,0070 | 15,70 | 41300 | 43720 | 13,73 | 0,990 | 10,06 |
| Propane air | 0,682 | 0,447 | 0,0069 | 13,76 | 28250 | 30700 | 9,13 | 0,999 | 6,77 |
| Biogas | 0,719 | 0,576 | 0,0086 | 16,81 | 19200 | 21250 | 6,38 | 0,840 | 5,82 |
| Pellets (8% RH) | 0,740 | 0,670 | 0,0071 | 19,01 | 18150 | 19750 | 6,02 | 0,660 | 4,58 |
| Wood (20% RH) | 0,761 | 0,686 | 0,0089 | 18,93 | 15450 | 17170 | 5,27 | 0,700 | 4,01 |
| Chipped wood | 0,8020 | 0,785 | 0,0108 | 20,56 | 11950 | 13565 | 4,20 | 0,660 | 3,25 |
| Coal | 0,7620 | 0,691 | 0,0023 | 19,06 | 31400 | 32300 | 10,70 | 0,370 | 8,14 |
| Olive pits | 0,749 | 0,689 | 0,0065 | 19,33 | 18780 | 20309 | 6,290 | 0,626 | 4,79 |

Details of the coefficients of the fuels:

- **CO2 t**: The value of $CO_2$ generated by combustion in stoichiometric condition, i.e. without excess Oxygen and therefore maximum.
- **A1, A2, B**: Also please have a look at the Siegert formulas from the European standard EN50379-1 (in the following).
  A1 is the parameter in the Siegert Formula when the $O_2$ measurement is available.
  A2 is used when the $CO_2$ measurement is available.
  Note: - Please also consider that in the U.S. usually the A1 parameter is the same as the 'european' A1 BUT divided by 2.
  - For Germany coefficients A1 and A2 are swapped.

$$q_A = (t_A - t_L) \times \left( \frac{A1}{21 - O_2} + B \right)$$

Flue gas heat losses are calculated from measured oxygen content according to the relationship:

$$q_A = (t_A - t_L) \times \left( \frac{A2}{CO_2} + B \right)$$

Flue gas heat losses are calculated from measured carbon dioxide content according to the relationship:

- **CO conv**: Conversion coefficient from ppm to mg/KWh. It can be expressed as a function of the gas density (CO in this case) and the volume of the dry smoke.
- **NO conv**: Same as CO conv, but for NO.
- **NOx conv**: Same as CO conv, but for NO.
- **SO2 conv**: Same as CO conv, but for NO.
- **PCI**: Potere Calorifico Inferiore. Italian for LHV (Lower Heating Value).
- **PCS**: Potere Calorifico Superiore. Italian for HHV (Higher Heating Value).
- **m H2O**: Mass of the air produced (per each Kg of fuel) in the combustion in stoichiometric condition.
- **m Air**: Mass of the air needed for combustion in stoichiometric condition.
- **V g.d.**: Volume of dry smoke produced in the combustion.

## Flue gas analysis according to Italian Law No. 10/1991 and subsequent modifications and supplements, Legislative Decree 192/2005 and the UNI 10389-1 standard

### Preamble

It is Seitron's intention, by means of this compact guide, to provide boiler installers/service technicians with a quick and easy way to understand whether a boiler conforms to the requirements of Italian Law no. 10 dated January 1991, and subsequent modifications and supplements, and Legislative Decree 192/2005.
The contents of this guide have been extremely simplified whereby they are not to be deemed at all comprehensive of the complex phenomenon of combustion.

### Flue Gas Analysis: theory

During the combustion process taking place in a boiler, part of the heat evolved by the burner is transferred to the water or air to be heated. The quantity of heat available at the burner is called the input rating (Pf) and is usually declared by the boiler manufacturer. Part of this energy, known as the useful output (Pu), is used by the boiler. The remainder is lost to the flue gas in the stack and is known as Stack loss (Qs).

Thus we can say that: $Pf=Pu+Qs$

THE THERMAL EFFICIENCY OF COMBUSTION is given by:

$$\eta=100-Qs$$

According to the Italian Legislative Decree 192/2005 the MINIMUM thermal efficiency η should respect the values below:

For hot water generators:

| Period of installation | Minimum efficiency % | Minimum with Pn < 35 kW |
|---|---|---|
| Before 29/10/1993 | 84 + 2 * log Pn - 2 | around 85 % |
| From 29/10/1993 to 31/12/1997 | 84 + 2 * log Pn | around 87 % |
| From 01/01/1998 to 07/10/2005 | Standard boilers<br>84 + 2 * log Pn | around 87 % |
| | Low temperature boilers<br>87.5 + 1.5 * log Pn | around 90 % |
| | Condensing boilers<br>91 + 1 * log Pn | around 92.5 % |
| After 08/10/2005 | Condensing boilers<br>90 + 2 * log Pn - 1 | around 92 % |
| | Other boilers<br>88 + 2 * log Pn - 1 | around 90 % |

For hot water generators:

| Period of installation | Minimum efficiency % | Minimum with Pn < 35 kW |
|---|---|---|
| Before 29/10/1993 | 83 + 2 * log Pn - 6 | around 80 % |
| After 29/10/1993 | 84 + 2 * log Pn - 3 | around 83 % |

Stack loss is calculated by applying a simple formula which relates it to other easily measurable parameters:

$$Qs = \left( \frac{A2}{CO_2} + B \right) ( Tf - Ta )$$

Where: A2, B = factor that depends on the fuel used
Tf = flue gas temperature
Ta = combustion air temperature
$CO_2$ = % carbon dioxide in the flue gas

Thus in order to calculate the stack loss and hence the thermal efficiency of a plant, one must measure the two temperatures (flue gas and air) and the level of carbon dioxide contained in the flue gas (% $CO_2$). These operations are performed automatically by the flue gas analyzer during testing.

## Let's take a look at the gases produced by combustion that need to be kept under control:

### *$CO_2$ : CARBON DIOXIDE*

The maximum $CO_2$ values that can be obtained from perfect combustion (theoretical) for the different types of fuels are:

| Fuel | % max $CO_2$ |
|---|---|
| Methane | 11,7 |
| Propane | 13,9 |
| LPG | 13,9 |
| Butane | 13,9 |
| Diesel oil | 15,1 |
| Fuel oil | 15,7 |

In truth, the percentage of $CO_2$ that can be detected during analysis will always be lower than these limit values. .

### *CO: CARBON MONOXIDE*

Carbon monoxide (CO) is usually produced by bad combustion that is weak in oxygen: since CO is a highly dangerous gas (it is fatal for man even in very low concentrations: exposure to 400 ppm for 3 hours is already fatal), standard UNI 10389-1 has established a limit value beyond which the test results of the boiler plant are deemed unsatisfactory. The percentage of gas considered by the standards, however, is not the value measured directly in the flue gas, which is "diluted" with other combustion products, but is the value referred to the volume of flue gas generated by perfect combustion, that is, where the oxygen is zero.
This limit is:

**CO (referenced to 0% $O_2$) = 1000 ppm = 0.1%**

**Flue Gas Analysis: in practice**
Below is an example of the flue gas analysis of a methane-fired boiler (natural gas) that is working correctly:

```
COMPANY Ltd.
Park Road, 9
Tel.02/12345678

Oper.: John Smith

Sign.: _______________

Test according to
UNI 10389-1
L. 10/1991 and s.m.i.
D.Lgs. 192/2005 and s.m.i.

Chemist 900 X
Serial: 999989

Memory: 01
Analysis: Average
Date: 04/04/14
Time: 10.30

Fuel: Natural gas
Altitude: 0 m
R.H. air: 50 %

O2              15.9 %
CO2              2.8 %
λ,n             4.18
T flue          80.6 °C
T air           26.9 °C
dT              53.7 %
Qs              7.6 %
Es              92.4 %
Ec               0.0 %
Et              92.4 %
CO                27 ppm
NO                11 ppm
NOx               12 ppm
Ref. O2:         0.0 %
CO ref            113 ppm
Ref. O2:         0.0 %
NO ref             46 ppm
Ref. O2:         0.0 %
NOx ref.:          50 ppm
Draft             4.5 Pa
T ext.          10.0 °C

Note: ------------------
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**Flue gas temperature Tf**
This should be as low as possible: less heat leaving the stack will leave more heat available for heating purposes.

**Combustion air temperature Ta**
This is not always the same as the ambient temperature.
Combustion air may be heated by the flue gas in coaxial pipes, or may be drawn from outside: in these cases the remote air temperature probe is necessary.

**Oxygen $O_2$**
The percentage of oxygen in air is around 21%: an ideal combustion process will "burn" all the oxygen present; in truth, however, the residual percentage is never zero due to the presence of excess air.

**Carbon Monoxide CO**
This is expressed in parts per million and indicates the concentration of CO "diluted" in the flue gas.

**Excess air λ, n**
This is the ratio between the volume of air that actually enters the combustion chamber and that which is theoretically required.

**Carbon Dioxide $CO_2$**
This results from good combustion and should approach the theoretical threshold value as much as possible.

**Stack loss Qs**
This is the percentage of heat lost through the stack.

**Sensible efficiency Es**
It is the burner efficiency calculated according to the UNI 10389-1 standard, as the ratio between conventional heating power and the burner heating power. Among the combustion losses, only the sensible heat lost with flue gasses is taken into account, thus neglecting the radiation losses and incomplete combustion losses. This value is referred to the Lower Heating Value (LHV) of the fuel and cannot exceed 100%.
The sensible efficiency value is to be compared against minimum efficiency stated for the heating system performances.

**Condensation efficiency Ec**
Efficiency deriving from the condensation of water vapor contained in flue gasses, calculated according to the UNI 10389-1 standard.

**Total efficiency Et**
Total efficiency. It is the sum of sensible efficiency and condensation efficiency. It is referred to LHV (Lower Heating Value) and can exceed 100%.

**Differential temperature dT**
This is the difference between the temperature of the flue gas and that of the combustion air.

**Carbon Monoxide CO (referenced to 0% $O_2$)**
This is expressed in parts per million and indicates the concentration of CO that the law requires us to keep under control (it should be lower than 1000 ppm).

**Instructions for accurate testing**
In order to achieve a certain degree of accuracy when conducting flue gas analysis, the following should be respected:

- the boiler being checked should be running in steady state conditions.
- the flue gas analyzer should be switched on at least 3 minutes before testing (time to auto-calibrate) with the probe located in fresh air.
- the point in which the probe is inserted for analysis has to be at a distance of approximately twice the stack diameter or, alternatively, as directed by the boiler manufacturer.
- the water trap should be completely empty and positioned vertically.
- before switching off the instrument, extract the probe and wait at least 3 minutes (the CO value has to drop below 10 ppm).
- Before returning the instrument to its place, clean the water trap and relative hose; if water is present in the hose clean the latter by blowing inside.

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# DICHIARAZIONE DI CONFORMITA' UE
## *EU DECLARATION OF CONFORMITY*

**Nr.** 027948

**Pag.** 01 di 01

**Nome del fabbricante:** Seitron S.p.A. a socio unico
*Constructor name:*

**Indirizzo del fabbricante:** Via Prosdocimo, 30
*Constructor address:* 36061 Bassano del Grappa (VI) Italia

**dichiara sotto la propria esclusiva responsabilità che il seguente prodotto:**
*declares under its sole responsibility that following product:*

**Nome del prodotto:** K2
*Product name:* Analizzatore industriale di emissioni
*Industrial emissions analyzer*

**Versioni del prodotto:** Tutte
*Product versions:* *All*
Nomi commerciali: Chemist 90- -
*Sales models:*

**e' conforme alla pertinente normativa di armonizzazione dell'Unione:**
*is in conformity with the relevant Union harmonisation legislation:*

**EMC (2014/30/UE):** EN-50270 (2006)

**LVD (2014/35/UE):** EN 60335-1 (2012)
(Per le parti citate nella norma di prodotto)
*(For parts mentioned in the Product Standard)*

**Di prodotto:** EN 50379-1 (2012)
*(Product):* (Requisiti generali e metodi di prova)
*(General requirements and test methods)*

EN 50379-2[1] (2012)
(Requisiti prestazionali per apparecchiature impiegate per ispezioni e valutazioni obbligatorie)
*(Performances requirements for apparatus used in statutory inspections and assessment)*

**RoHS2 (2011/65/UE):** EN-50581 (2012)
Per i sensori di $O_2$ elettrochimici vale l'esenzione di cui all'Allegato IV, punto 1b.
*Electrochemical $O_2$ sensors are exempted according to Annex IV, point 1b.*

**Note aggiuntive:** Lo strumento è conforme alle norme italiane UNI 10389-1, per la misurazione del rendimento di combustione.
*Further notes:* This instrument is compliant with the requirements of the Italian standard UNI 10389-1, for combustion efficiency measurement.

Bassano del Grappa, li 24/01/17

Ing. Vito Feleppa
Amministratore Delegato Seitron S.p.A. a socio unico

Seitron spa a socio unico
00775330249
Via Prosdocimo, 30
36061 Bassano Gr. - VI - ITALIA

1 Valido per le configurazioni che includono uno o più dei seguenti sensori:
Valid for configurations equipped with one or more of the following sensors:

| | |
|---|---|
| $O_2$: | Qualunque codice / All codes |
| $CO+H_2$: | Cod. AAC SE12 (Low+Mid) |
| CO: | Cod. AAC SE18 (High) |
| NO (optional): | Cod. AAC SE10 |
| $SO_2$ (optional): | Cod. AAC SE13 |

**Seitron S.p.A. a socio unico** Via Prosdocimo, 30 36061 Bassano del Grappa (VI) Tel. (+39).0424.567842 Fax. (+39).0424.567849

# WARRANTY CERTIFICATE

## WARRANTY

Chemist 900 combustion analyzer is guaranteed for 24 months from the date of delivery note, electronic parts, measurement cells and printer included.
Seitron undertakes to repair or replace, free of charge, those parts that, in its opinion, are found to be faulty during the warranty period. The products which are found defective during the above mentioned periods of time have to be delivered to Seitron's Laboratories carriage paid. The following cases are not covered by this warranty: accidental breakage due to transport, inappropriate use or use that does not comply with the indications in the product's use and maintenance manual.
Any mistreatment, repairs and modifications to the product not explicitly authorized by Seitron shall invalidate the present warranty.

## IMPORTANT

For the product to be repaired under Warranty, please send a copy of this Certificate along with the instrument to be repaired, together with a brief explanation of the fault observed.

*Space reserved for user*

Name: _____

Company: _____

User's notes:

_____

_____

_____

_____

_____

Date: _____

S.N.:

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seitron
Innovation Technology

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