seitron
dispositivi elettronici
di regolazione, misura e controllo

CHEMIST 500
Combustion Analyzer

CE

USE AND MAINTENANCE MANUAL

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

TABLE OF CONTENTS

seitron

TABLE OF CONTENTS

seitron

TABLE OF CONTENTS

seitron

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 500.
- 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

The magnets in the back of the instrument can damage credit cards, hard driver, mechanical watches, pacemakers, defibrillators and other devices proven sensitive to magnetic fields. It is recommended to keep the instrument at a distance of at least 25cm away from these devices.

Symbol	Meaning	Comments
	WARNING	**Read information carefully and prepare safety appropriate action!** 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. 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.	

2.1 Intended purpose

This chapter describes the areas of application for which the CHEMIST 500 is intended.

Using the CHEMIST 500 in other application areas is on the risk of the operator and the manufacturer assumes no responsibility and liability for loss, damage or costs which could be a result. It is mandatory to read and pay attention to the operating/maintenance manual.

All products of the series CHEMIST 500 are handheld measuring devices in professional flue gas analysis for:

- Small furnaces (burning oil, gas, wood, coal)
- Low-temperature and condensing boilers
- Gas heaters

Due to other configuration with electrochemical cells it is possible to use the measuring instrument in following application area:

- Service engineers/mechanics of burner/boiler manufacturers
- Service industrial combustion plants

Additional functions of the measuring instrument:

- Flue gas analysis according 1. BImSchV or qA-mean value (selectable)
- Calculating of stack heat loss and efficiency
- CO- and NO environment measurement
- Tightness test
- Store Smoke value, calculating mean value
- Measuring differential pressure
- Draught measurement

2.2 Improper use of the product

The use of CHEMIST 500 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 500 should not be used:

- For continuous measurements > 1h
- As safety alarm instrument

3.0 WORKING PRINCIPLE

3.1 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: **the gas picking point must be roughly in the centre of the flue section.**
The gas sample is cleaned of humidity and impurities by a condensate trap and filter positioned along the rubber hose that connects the probe to the analyser.
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

Oxygen (%O_2) is measured with an electrochemical cell that acts like a battery which, over time, is apt to lose sensitivity.
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 a pressure such to damage or destroy sensors. The maximum estimated allowed pressure is ±100mbar gage.
The response times of the measurement cells used in the analyser 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
It is therefore suggested to wait 5 minutes (anyway not less than 3 minutes) in order to get reliable analysis data.
If sensors of poison 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 analyser, 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 CO sensor can be protected from high gas concentrations through the dilution function which allows for a wider measurement range of the sensor without overcharging the sensor itself.
The dilution function allows the CO sensor to always be efficient and ready to respond even in the case of very high concentrations of CO.

4.0 DESCRIPTION OF THE PRODUCT

4.1 General Description of the Combustion Analyser

The design of the handheld combustion analyser "CHEMIST 500" is clean and ergonomic with an extremely clear and user-friendly keypad.
"CHEMIST 500" immediately suggests just how even the most sophisticated engineering can give life to an incredibly comfortable and easy to use work instrument.
Devised to analyse flue gases, monitor the pollutants emitted and measure environmental parameters, "CHEMIST 500" uses two electrochemical cells that provide the oxygen and carbon monoxide values while a third cell is used to measure the pollutants NO and NOx.
The most complete version can house a fourth sensor for measuring NO2, SO2 and CxHy. CO,NO,NO2 and SO2 measuring sensors are also available with a reduced measuring range, with a resolution of 0.1 ppm and better accuracy.
Two external sensors measure the environmental parameters; it is also possible to measure flue draught and carbon black and, with the measuring range of up to 200mbar, system pressure and pressure in the combustion chamber can be measured and the pressure switches checked.
Intended for eleven main types of combustibles amongst which natural gas, LPG, diesel and fuel oil, it is also possible to insert into the memory of "CHEMIST 500" another 16 combustibles of which the chemical composition is known. The functions of "CHEMIST 500" include the storage and the average of the data acquired, the printing (on a roll of thermal polyester paper) of the results and the possibility of connecting the device to a computer to store to data via USB connection.
Its memory is able to store 1000 complete analyses and using the dedicated SW and mini-USB serial communication cable it is possible to download the data to a PC. It is also interesting to know that "CHEMIST 500" is equipped with a single "Li-Ion" rechargeable battery pack used both to power the unit and for the printer: it also has a bright and wide (55 x 95 mm) TFT colour display that has an excellent readability also thanks to the zoom function and the backlight.
Another characteristic that distinguishes it from other similar products in the market is the fact the power supply that comes with the product can carry out the dual function of battery charger and power supply for the instrument which means the user can carry out analyses even if the batteries are completely flat.
Another important function is the possibility of carrying out an autozero cycle with the probe inside the stack, exploiting a sophisticated flow deviation system.
As for maintenance, it is useful to know that the sensors can be replaced by the user himself without having to send the device to a service centre because the sensors are pre-calibrated; it will however be necessary to get the device calibrated at least once a year, as required by the standard UNI 10389-1.
Also:

- **Operator interface**: user-friendly - so much so that it can be used without the instruction manual.
- **Wide and bright TFT colour display**: great readability thanks to the Zoom function and to an efficient backlight.
- **Integrated thermal printer**: with thermal polyester paper or thermal paper you get maximum readability and durability and heat resistance.
- **One battery pack**: rechargeable for powering the instrument and the printer, indicating the charge level and is accessible from outside.
- **Pneumatic input connectors (gas and pressure/draught) staying inside the profile of the instrument**: for greater resistance to knocks.
- **Precalibrated sensors, directly replaceable by the user.**

4.2 General features of the Flue Gas Analyser

The portable analyzer CHEMIST 500 has been carefully designed in accordance with regulatory requirements and the specific needs of the customers.
The device contains a single board with all the basic operating circuits, pre-calibrated measuring cells, a gas extraction pump, a solenoid valve, a dilution pump, a membrane keyboard, a TFT backlit graphic display, a high-capacity "Li-Ion" rechargeable battery pack and an integrated thermal printer. The two halves of the casing are securely fastened together with seven screws on the back of the device.
The pneumatic circuit and the measuring cells with electronic module are positioned in the back of the casing and they are accessible, for rapid maintenance and replacement, by removing the magnet cover in the lower part of the device. The roll of paper is located at the top, above the display, and it can be replaced easily by removing the pressure-locked door. On the bottom part of the analyzer are the pneumatic connectors for gas sampling and for the measurement of the pressure/draught: the T1 connector to connect the gas probe thermocouple plug and the T2 connector to connect the combustion air probe thermocouple plug. On the right side of the device are the B-type USB connector for the connection of the external power source or of the PC and the 8-pole mini DIN connector for the serial interface or for an external probe (optional).
The user interface includes a TFT graphic display with back light always active and a membrane keyboard. The menu screens and all the operator messages can be set in the desired language.

The use of the analyzer is simplified by the symbol keys with direct access to the most important functions. Navigation through the various menu screens is easy and intuitive.

Gas extraction pump

The sample pump located inside the instrument is a DC-motor-driven diaphragm pump, powered by the instrument, and is such as to obtain optimal flow of the sampled gas being analysed; an internal sensor that measures the flow allows to:
- Keep the flow rate of the pump constant
- Check the efficiency of the pump
- Check the degree of clogging of the filters

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.

Measurement cells

The instrument uses precalibrated gas sensors of the long-lasting FLEX-Sensor series for measuring oxygen (O_2), carbon monoxide CO (compensated in hydrogen H_2), nitrogen oxide (NO), nitrogen dioxide (NO_2) and sulphur dioxide (SO_2). An automatic internal device dilutes the concentration of CO when the instrument measures high concentrations. The diluting system also allows the CO sensor measuring range to be extended up to 100.000 ppm (for full scale 8,000ppm sensor). The valve for the optional automatic fast autozero lets the operator turn the instrument on with the probe inserted in the flue. Up to 4 alarms can be programmed with visual and acoustic warning for the same number of measuring parameters.
The measuring cells are the electrochemical type.
The UNI 10389-1 standard prescribes that the instrument must be calibrated once a year by an authorised laboratory to issue calibration certificates. When the cells are flat they can be replaced easily by the user without having to send the instrument away and without complicated calibration procedures requiring sample mixtures as they are supplied already calibrated.
Seitron does, however, certify measurement accuracy only when a calibration certificate has been issued by its own laboratory or by an authorised laboratory.

Pressure sensor

The device is internally provided with a piezoresistive differential pressure sensor to measure the draught (depression) of the chimney, according to UNI 10845, for the tightness test of the piping and possible for other measurements (gas pressure in the network, loss of pressure through filters, etc.).

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 combustibles and their coefficients in order to define up to a maximum of 16 combustibles, other than the default ones.
For more details see Annex B.

Smoke measurements

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.
An external pump, available as an optional, must be used to effect this measurement.

Pressure decay test

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

Measuring ambient CO (available soon)

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

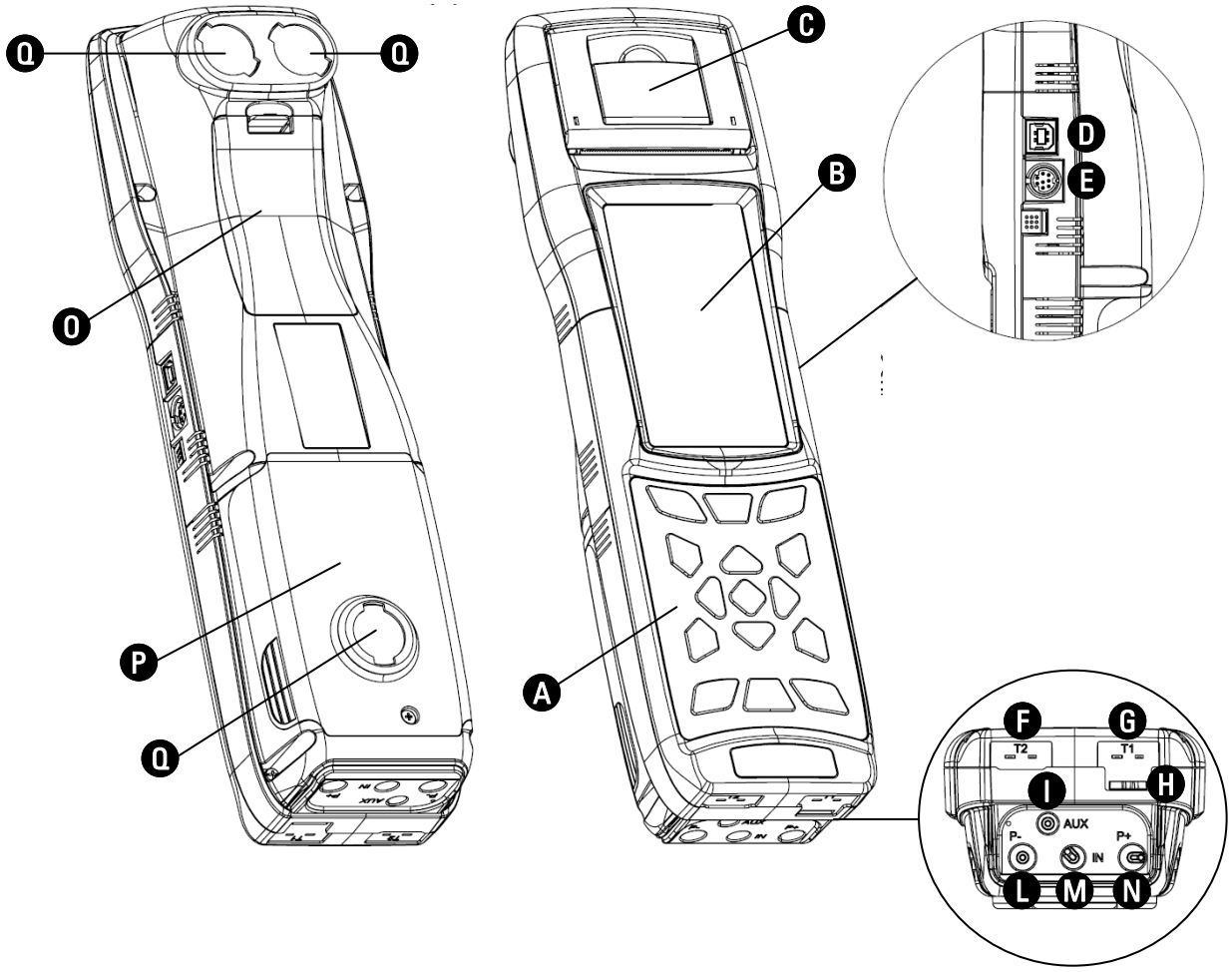
Calibration certificate

The device comes with a calibration certificate compliant with standard ISO/IEC 17025.

Electromagnetic compatibility

The instrument was designed to comply with Council Directive 2004/108/EC governing electromagnetic compatibility. Seitron's declaration of conformity may be found in Annex D.

4.3 Overview of Flue Gas Analyser Components



LEGEND

A Keypad

B Display

C Cover for access to the printer to replace the roll of paper

D B-type USB connector to connect the device to the power source or to a PC

E Serial cable connector for connection with accessory probes

F T2 - Tc-K female connector to connect combustion air temperature probe

G T1 - Tc-K female connector to connect gas probe

H Gas output

I AUX connector (input for optional external probes)

L P connector- (negative input to measure draught)

M IN connector (gas exhaust probe input by means of a complete condensate separator unit)

N P+ connector (positive input to measure differential pressure)

O Cover to access battery compartment

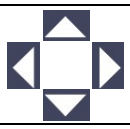
P Cover to access cell compartment

Q Magnets

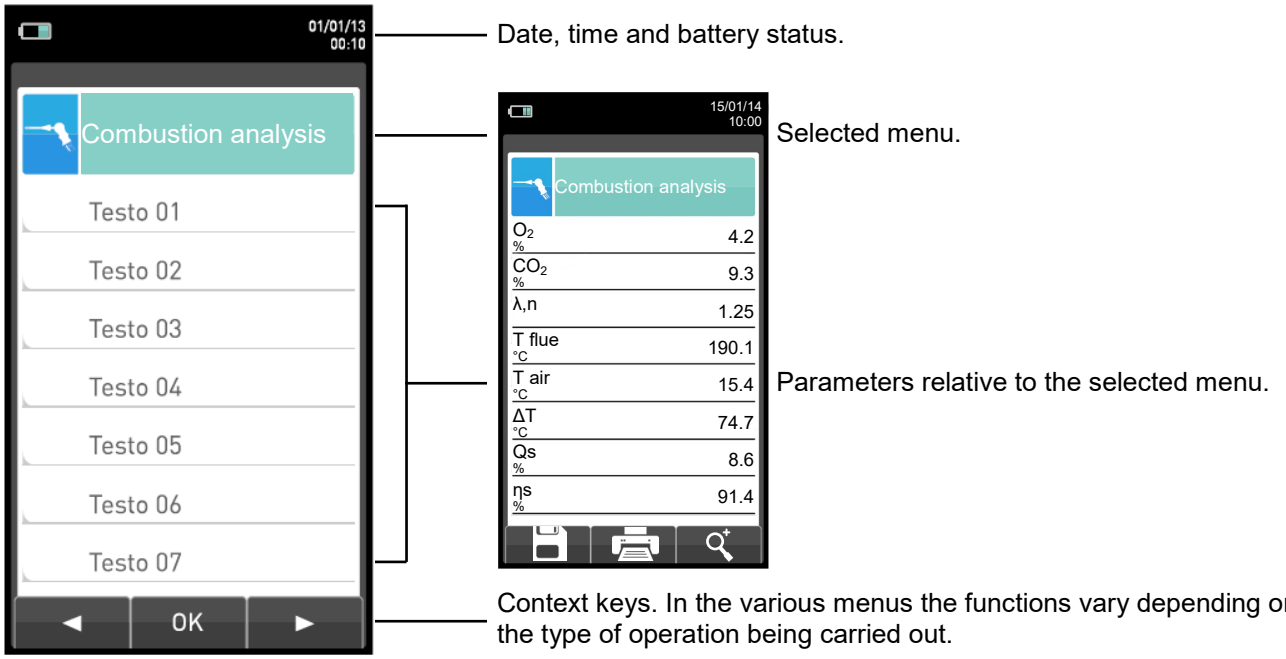
4.3.1 Keypad

Adhesive polyester keypad with preformed keys featuring main control functions:

KEYS	FUNCTION
	**Activates the context keys shown on the display**
	**Access to the Memory menu**
	**Access to the Printing menu**
	**Access to the Configuration menu**
	**Performs the analysis of the combustion**
	**Access to the Measurements menu**

KEYS	FUNCTION
	**Turns the device On/Off**
	**Exits the current screen**
	**Select and/or Modify**
	**Confirm settings**
	**+ Backlight turn-off.**

4.3.2 Display



TFT 272 x 480 pixel backlit colour 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.

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

4.3.3 Printer
Thermal on thermal polyester or thermal paper. Thermal polyester cannot be altered and it is resistant to light, to temperature, to humidity and to water.
The print menu is accessed by pressing the relative key and, besides enabling read-out printing, the menu also allows you to modify print settings and to advance the paper manually so as to facilitate paper roll replacement.

4.3.4 B-Type USB connector
Connector to connect the device to a personal computer or to the battery charger.
The device comes with a feeder with output 5V=, 2A to charge the internal batteries. In **D** (section 4.3) you can see the socket to connect the battery charger to the device. Once it has started charging, the display turns on and the charging state is displayed.

4.3.5 Serial connector (Mini Din 8-pole)
In **E** (section 4.3) we find the socket of the serial cable for connecting the instrument to an external probe, for example, to the draught gauge (optional), or to the ionisation current probe (optional).

4.3.6 Pneumatic connector inputs / TC-K
Pneumatic connector "**A**": input for the connection of the branch of the gas sampling probe with the condensation separating and anti-dust filter assembly.
Pneumatic connector "**P-**": negative input (P-) to be used to measure the draught in accordance with the standard UNI10845; it must be connected to the second branch of the gas sampling probe in order to measure the draught and analyse combustion at the same time.
Pneumatic connector "**P+**": positive input (P+) to be used to measure the pressure in general and for tightness tests.

WARNING: the inputs "P+" and "P-" are respectively the positive and the negative inputs of the internal differential pressure sensor, therefore they are used simultaneously to measure the differential pressure.

Female connector TC-K "**T1**": input for the connection of the male TC-K connector of the gas sampling probe.
Female connector TC-K "**T2**": input for the connection of the male TC-K connector of the combustion air temperature probe.

5.0 MAIN CONFIGURATIONS

seitron

	CHEMIST 501	CHEMIST 502 B	CHEMIST 502	CHEMIST 502 C	CHEMIST 503 B	CHEMIST 503	CHEMIST 504 N	CHEMIST 504 S	CHEMIST 500 X (1)	CHEMIST 500 XB (1)
O2 SENSOR	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓
CO+H2 SENSOR	✓	✓	✓		✓	✓	✓	✓		
CO SENSOR										
CO SENSOR 0 .. 20000 ppm (2%)				✓						
NO SENSOR					✓	✓	✓	✓		
NO2 SENSOR							✓			
SO2 SENSOR								✓		
NOT EXPANDABLE	✓									
EXPANDABLE TO 4 SENSORS		✓	✓	✓	✓	✓				✓
AUTOMATIC AUTOZERO	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓
CO DILUTION			✓	✓		✓	✓	✓	✓	
BLUETOOTH	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓
TIGHTNESS TEST	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓
DRAUGHT MEASUREMENT ACCORDING TO UNI 10845	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓
CALIBRATION CERTIFICATE	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓
QUICK GUIDE	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓
GAS SAMPLE PROBE 180mm	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓
COMBUSTION AIR TEMPERATURE PROBE	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓
CONDENSATE TRAP	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓
PRESSURE MEASURING KIT										
KIT MISURA PRESSIONE DIFFERENZIALE	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓
BATTERY CHARGER	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓
EUROPEAN PLUG FOR BATTERY CHARGER	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓
PC SOFTWARE	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓
HARD CASE	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓
ROLL OF PAPER PRINTER	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓

1 This model identifies custom configurations different to standard ones.

6.0 TECHNICAL SPECIFICATIONS

6.1 Technical Specifications

Autozero:	Automatic autozero cycle.
Dilution (where provided):	Expansion system of the CO sensor measuring range up to 100.000ppm (10.00%) programmable as a simple protection of the CO sensor with triggering threshold programmable by the user. Preset triggering threshold at 1500 ppm.
Gas measurement sensors:	Up to 4 configurable sensors: electrochemical, NDIR and pellistor
Self-diagnosis:	All the functions and internal functions are checked and anomalies signalled.
Temperature measurement:	Double K thermocouple input with mini connector (ASTM E 1684-96) to measure differential temperature (supply and return)
Measurement of ambient temp.:	Via internal sensor or T2 thermocouple input with remote probe.
Type of combustible:	12 predefined by the factory and 16 that can be programmed by the user.
Power:	Li-Ion battery pack with internal protection circuit.
Battery charger:	External 5Vdc 2A battery charger with female A-type USB connector + connection to the device with the same serial communication cable supplied.
Charging time:	5 hours to charge from 0% to 90% (6 hours for 100%). The device can also be charged by connecting it to the PC, the device must be turned off, the charging time depends on the output current from the PC and may be more than 12 hourse.
Instrument working time:	12 hours of non-stop operation (excluding printing).
Printer:	Thermal integrated with easy loading paper and sensor for the presence of paper
Printer powered:	By the analyser batteries.
Printer autonomy:	Up to 40 analysis reports with the batteries fully charged.
Internal data memory:	1000 complete data analyses, time and name of the customer can be stored.
User data:	8 programmable user names.
Print-out heading:	4 lines x 24 characters, customisable by the user.
Display:	Graphic 272 x 480 pixels, backlit, colour TFT 4.3".
Communication port:	USB with B-type connector
Bluetooth (where provided):	Class 1 / Communication distance: <100 meters (in open range).
Line filter:	With replaceable cartridge, 99% efficient with 20um particles.
Suction pump:	1.0 l/min heads at the flue up to 135mbar.
Measurement of flow:	Internal sensor to measure the flow of the pump.
Condensate trap:	Outside the instrument.
Carbon black:	Using an external hand pump; it is possible to enter and print the smoke index.
Leak test:	Gas pipes tested for leaks with separate printout of the result, by means of the attachment AACKT02, according to UNI 7129 (new systems) and UNI 11137: 2012 (existing systems), with automatic calculation of pipe volume.
Condensing boiler efficiency:	Automatic recognition of the condensing boiler, with calculation and printout of efficiency (>100%) on the LHV (Lower Heating Value) in accordance with UNI10389-1.
Environmental gases:	Measurement and separate printout of the ambient CO values.
Draught test:	Draught tested as per the UNI 10845 standard. By using the internal sensor connected to the port P-, resolution 0,1 Pa , accuracy 0,5 Pa.
Operating temperature range:	-5°C to +45°C
Storage temperature range:	-20°C to +50°C
Operating humidity range:	20% to 80% RH
Protection grade:	IP42
Air pressure:	Atmospheric
Outer dimensions:	Analyser: 9 x 31 x 6 cm (L x A x P) Case: 50 x 39 x 13 cm (L x A x P)
Weight:	Analyser: ~ 0,9 Kg

Compliant with the European standard EN50379-1 and EN50379-2: 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 ±5% measured value 201 .. 2000 ppm ±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 ±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 ±5% measured value 2001 .. 4000 ppm ±10% measured value 4001 .. 20000 ppm
diluted	Electrochemical sensor	25% vol	0.01% vol	±20% measured value
CO Hi range	Electrochemical sensor	0 .. 10.00% vol	0.01% vol	±0.1% vol 0 .. 2.00 % ±5% measured value 2.01 .. 10.00 %
CO high immunity H_2	Electrochemical sensor	0 .. 8000 ppm	1 ppm	±20 ppm 0 .. 400 ppm ±5% measured value 401 .. 4000 ppm ±10% measured value 4001 .. 8000 ppm
NO	Electrochemical sensor	0 .. 5000 ppm	1 ppm	±5 ppm 0 .. 100 ppm ±5% measured value 101 .. 5000 ppm
NO Low range	Electrochemical sensor	0 .. 500 ppm	0.1 ppm	±2 ppm 0 .. 40.0 ppm ±5% measured value 40.1 .. 500.0 ppm
NOx	Calculated			
SO_2	Electrochemical sensor	0 .. 5000 ppm	1 ppm	±5 ppm 0 .. 100 ppm ±5% measured value 101 .. 5000 ppm
SO_2 Low range	Electrochemical sensor	0 .. 500 ppm	0.1 ppm	±2 ppm 0 .. 40.0 ppm ±5% measured value 40.1 .. 500.0 ppm
NO_2	Electrochemical sensor	0 .. 1000 ppm	1 ppm	±5 ppm 0 .. 100 ppm ±5% measured value 101 .. 1000 ppm
NO_2 Low range	Electrochemical sensor	0 .. 500 ppm	0.1 ppm	±2 ppm 0 .. 40.0 ppm ±5% measured value 40.1 .. 500.0 ppm
CxHy	Pellistor sensor	0 .. 5.00% vol	0.01% vol	±0.25% vol
CO_2	Calculated	0 .. 99.9% vol	0.1% vol	
CO_2	NDIR sensor	0 .. 20.0% vol	0.1% vol	±0.3% vol 0.00 .. 6.00 % ±5% measured value 6.01 .. 20.0 %
Air temperature	TcK sensor	-20.0 .. 120.0 °C	0.1 °C	±0.5 °C
Flue gas temperature	TcK sensor	-100.0 .. 1250.0 °C	0.1 °C	±0.5 °C 0 .. 100 °C ±0.5% measured value 101 .. 1250 °C
Pressure UNI 10845	Piezoelectric sensor	-250.0 .. 250.0 Pa	0.1 Pa	±0,5 Pa -10.0 .. +10.0 Pa ±2 Pa +10.1 .. +250.0 Pa ±2 Pa -10.1 .. -250.0 Pa
Pressure (draught & differential)	Piezoelectric sensor	-10.00 .. 200.00 hPa	0.01hPa	±1% measured value -2.01 .. –10.00 hPa ±0.02 hPa - 2.00 .. +2.00 hPa ±1% measured value +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 %	
Efficiency (condensing)	Calculated	0.0 .. 120.0 %	0.1 %	
Smoke index	External instrument	0 .. 9		

7.0 USING THE FLUE GAS ANALYSER

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 centre or agent immediately and keep the original packing. A label at the rear of the analyser bears the serial number. This serial number 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

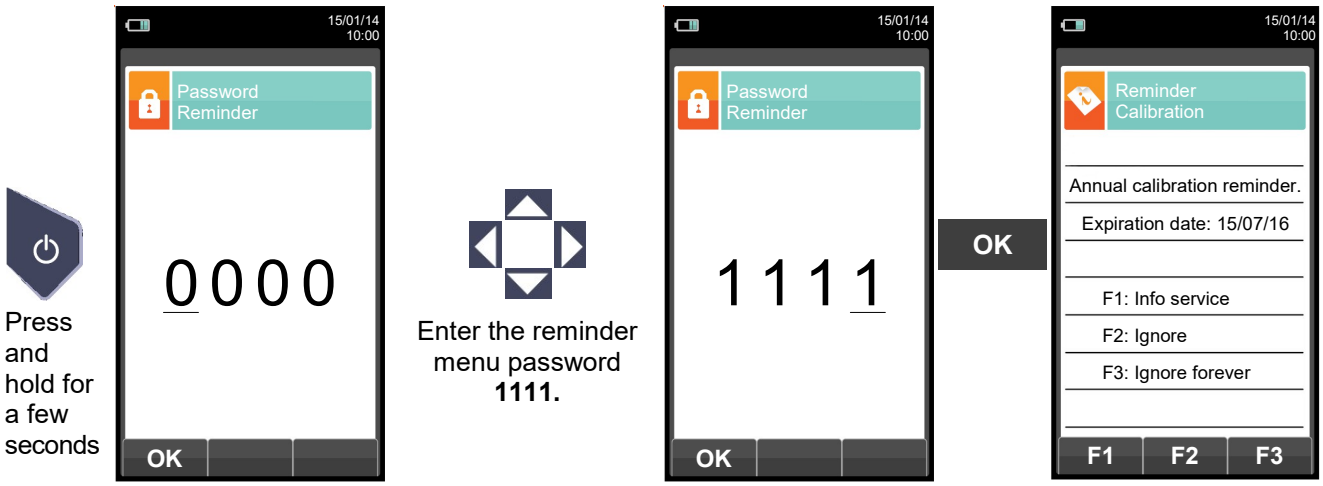
- Use the instrument with an ambient temperature between -5 and +45°C.

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.

- When it has finished being used, before turning the instrument off remove the probe and let is aspirate ambient clean air for at least 30 seconds to purge the pneumatic path from all traces of gas.
- Do not use the instrument if the filters are clogged or damp.
- Before putting 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 eliminate all residues.
- Remember to have the instrument checked and calibrated once a year in order to comply with the existing standards.

IF ENABLED BY FACTORY OR THE ASSISTANCE CENTER, FROM 30 DAYS PRIOR TO THE CALIBRATION TO EXPIRE, THE DISPLAY WILL SHOW A MESSAGE TO REMIND THE USER THAT THE INSTRUMENT HAS TO BE SENT TO THE ASSISTANCE CENTER.

Example:



CONTEXT KEY	FUNCTION
F1	**Displays the informations about the assistance center.**
F2	**Ignores temporarily the message. Next time the instrument will be turned on, the remainder will be displayed again.**
F3	**Ignores permanently the message.**

7.3 Analyser 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 18 hours if the printer is not used. 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 charging cycle takes up to 3 hours for a complete charge and finishes automatically.

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 power pack for 3 hours.
If the problem persists, replace the battery pack with a SEITRON original or contact the SERVICE CENTRE 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 3 HOURS.

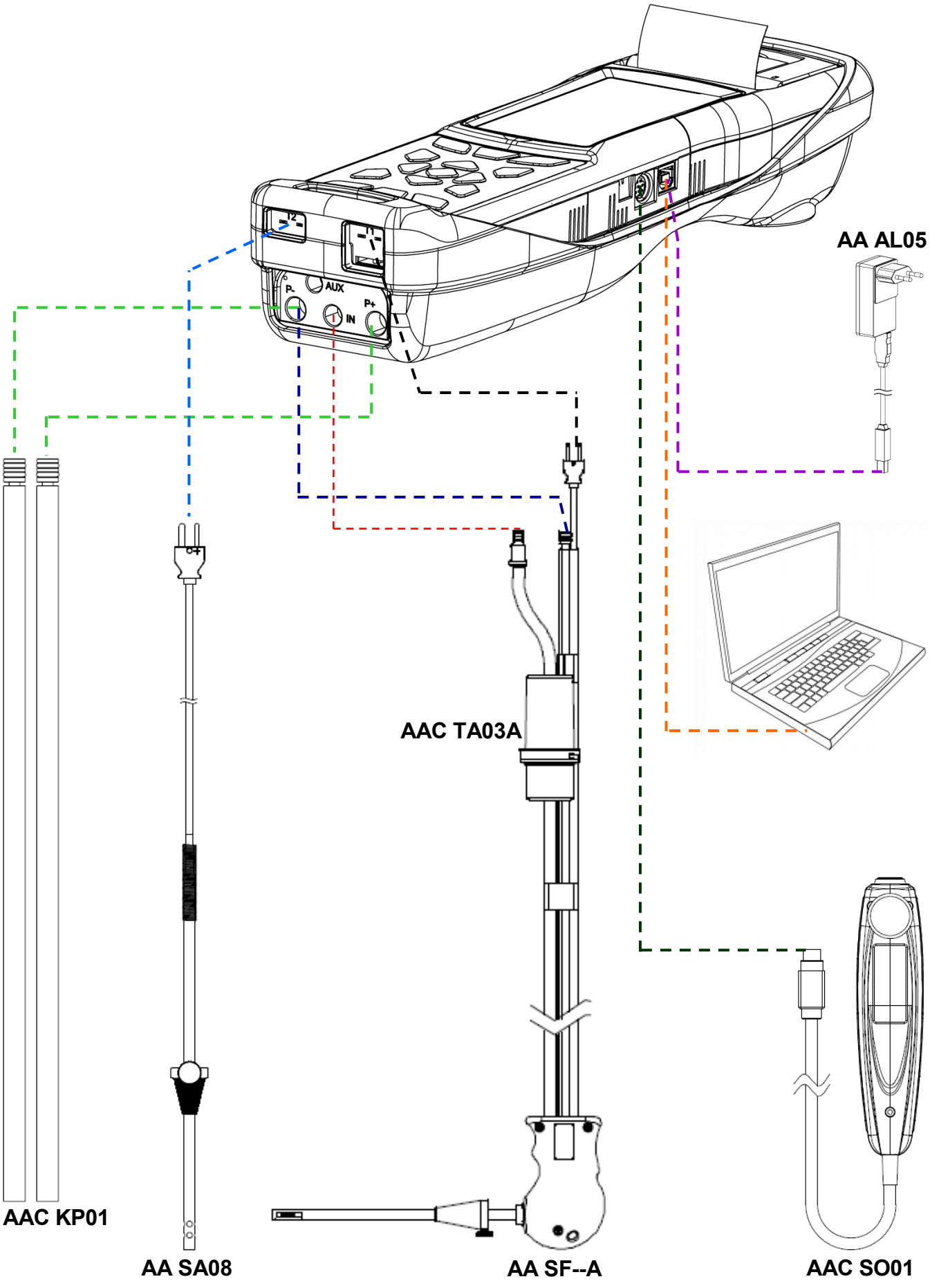
IT IS ADVISABLE TO CHARGE THE BATTERY AT AN AMBIENT TEMPERATURE RANGING BETWEEN 10°C AND 30°C.

7.3.2 Use with external power pack

The instrument can work with the batteries fully discharged by connecting the external power pack provided.

THE POWER SUPPLY/BATTERY CHARGER IS A SWITCHING TYPE ONE.
THE APPLICABLE INPUT VOLTAGE RANGES BETWEEN 90Vac AND 264Vac.
INPUT FREQUENCY: 50-60Hz.
THE LOW VOLTAGE OUTPUT IS 5 VOLT WITH AN OUTPUT CURRENT GREATER THAN 1.5A.
LOW VOLTAGE POWER CONNECTOR: A-TYPE USB CONNECTOR + CONNECTION CABLE WITH B-TYPE PLUG.

7.4 Connection diagram



7.4.1 Gas sampling probe

The gas sampling probe is made up of an INOX steel tube with a plastic hand grip and an internal K-type thermocouple (Ni-NiCr) for measuring the gas temperature up to 800°C. Flue gas temperature is measured by means of a thermocouple inserted in the tip of the probe.
The thermocouple is connected to the instrument via a compensated cable housed in a special seating in the rubber hose of the sample probe. The cold junction is compensated by a Pt 100 resistance thermometer which measures the temperature at the thermocouple connector. The type K thermocouple (nickel/nickel chromium) permits continuous measurements up to 800°C. If special-purpose probes are used, the instrument is able to measure temperatures as high as 1250,0°C.
A Pt 100 resistance thermometer located inside the instrument measures the internal temperature; this sensor is also used to measure the ambient temperature.
Should the user want to measure the combustion air temperature directly in the intake duct, the optional remote Tc-K sensor must be used - this measurement is recommended for more precise calculation of plant efficiency.
This type of probe is available with a rigid tip and with a flexible tip with different lengths:
180mm: rigid tip
300mm: rigid and flexible tip
750mm: rigid tip
1000mm: rigid tip
The gas sampling with a flexible tip is suitable for measurements in chimneys where the flue gas sampling point is in a place that is difficult to reach.
All models have a tip with an external nominal diameter of 8 mm and they are equipped with an adaptor for a chimney diameter of 8/22 mm.

7.4.2 Condensate trap and fine dust filter

The sample gas to be analysed shall reach the measurement cells after being properly dehumidified and purified from the residual combustion products. To this purpose, a condensate trap is used, which consists of a transparent polycarbonate cylinder placed along the rubber hose of the sampling probe. Its purpose is to decrease the air speed so that the heavier fine dust particles can precipitate and the vapour in the combustion gases can condensate.
The condensate trap must be always kept in the vertical position in order to prevent condensate from touching the measurement cells. This is also the reason why it is important to periodically drain the trap, anyhow at the end of each test (see chapter 'MAINTENANCE').
A replaceable low-porosity line filter is placed after the condensate trap aimed at keeping the solid particles suspended in the gases. It is recommended to replace the filter whenever visibly dirty (see chapter 'MAINTENANCE').

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

AFTER EACH ANALYSIS, CHECK FOR ANY PRESENCE OF WATER IN THE CONDENSATE COLLECTION BOWL AND ELIMINATE IT, IF ANY. PUT THE PROBE BACK IN THE CASE ONLY AFTER YOU HAVE ELIMINATED CONDENSATE FROM THE TUBE AND THE EXPANSION TANK (SEE CHAPTER 'MAINTENANCE').

REPLACE THE FINE DUST FILTER IF IT IS VISIBLY DIRTY OR WET (SEE CHAPTER 'MAINTENANCE'). DO NOT PERFORM ANY MEASUREMENT WHEN THE FILTER IS REMOVED OR DIRTY IN ORDER TO AVOID ANY RISK OF IRREVERSIBLE DAMAGES ON SENSORS.

7.4.3 Connecting the gas sampling probe and water-trap assembly

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

- The polarized male connector of the thermocouple must be connected to the lower part of the device in the **T1** socket. The improper insertion of the same is not possible thanks to the different lengths of the tips.
- The shorter tube of the probe must be inserted in the condensation trap with ant-dust filter (see section 7.4.2).
- The male connector of the filter assembly must be connected to the central female connector of the device marked with "**IN**".
- The longer tube of the probe, which ends with a male connector, must be connected to the negative pressure input of the device marked with the letter "P-".

The different diameter of the connectors does not allow improper connections: this avoids damage to the device.

7.4.4 Connecting the TcK probe

Using the same input as for the K thermocouple "**T1**" (the same used for gas temperature), it is possible to measure the water delivery and return temperature by connecting some **special probes**. If temperature is taken on the pipe, it is suggested to use arc probes with a suitable diameter.

7.4.5 Combustion air temperature probe

The probe to measure the temperature of the combustion air (necessary for an exact calculation of the efficiency of the boiler) features a stainless steel tube with an adapter for wells of the diameter of 7,5 / 17 mm and K-type internal thermocouple (Ni-NiCr) to measure the temperature between -20°C and +100°C.
The probe comes complete with a 2 m cable with a connector for connection with the analyzer.

7.4.6 Connection of combustion air temperature probe

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 lower part of the device in the **T2** socket. The improper insertion of the same is not possible thanks to the different lengths of the tips.

7.4.7 Burner pressure verification probe (available soon)

It must be used to measure 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 analyser.

7.4.8 Ionisation current measuring probe

With this special probe it is possible to measure the ionisation current of a boiler and check its value depending on the boiler's technical features.

7.4.9 Measurement of ambient CO (available soon)

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

7.4.10 Measurement of differential pressure

The device is equipped with a temperature compensated piezoresistive internal pressure sensor to measure pressures and depressions. This sensor, mounted onto the device, is of the differential type.
Thanks to the positive and negative pressure connectors, it can therefore be used to measure the differential pressure by purchasing the special KIT. The measurement range is -1000 Pa ... +20000 Pa.

7.4.11 Connection to PC

By using the USB cable supplied or via Bluetooth connection (optional) it is possible to connect the device to a personal computer after installing the dedicated software supplied.
Functions:

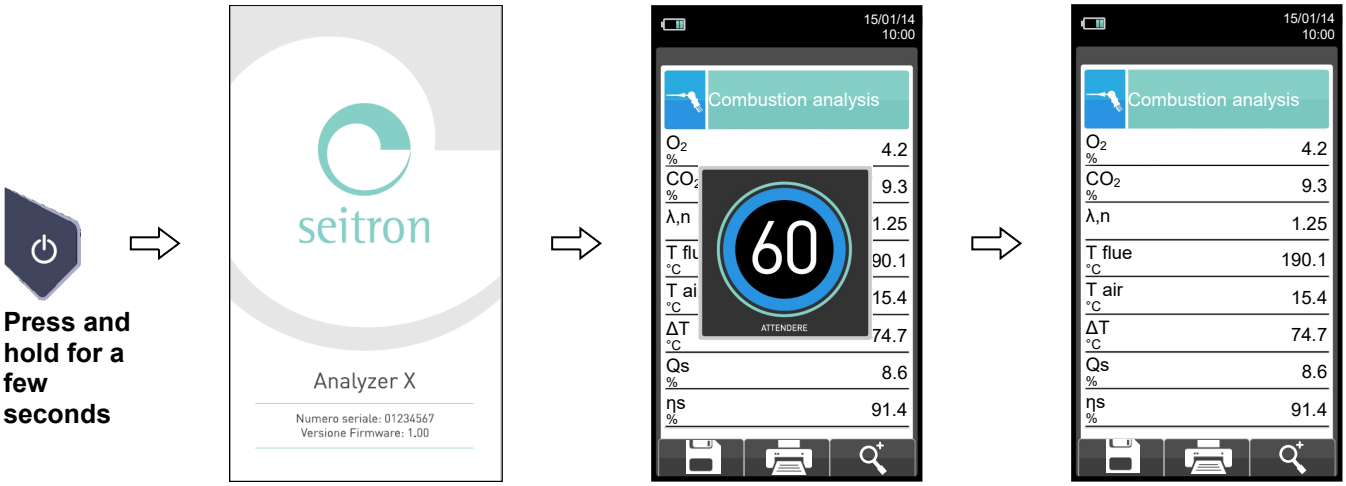
- See the data plate of the device
- See and/or export (in csv format, importable into excel, and/or pdf) or delete the stored analyses.
- Configure the device.

7.4.12 Connection to battery charger

Supplied with the device is a feeder with output 5V=, 2A to charge the internal batteries. In section 4.3 you can see the socket for the connection of the battery charger to the device. Once it has started charging, the display turns on and the state of charge of the battery is displayed.

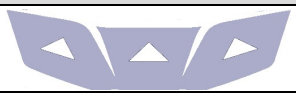
8.0 POWER ON - OFF

8.1 Starting the device



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

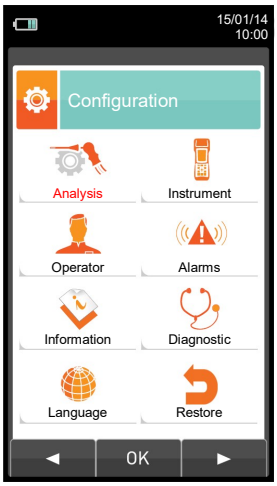
This error message is displayed if the autozero of the device is not carried out.

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 ticket according to the settings.**
	**Zoom. By pressing this interactive key repeatedly, the device displays the following sequence:** **AAA → AAA → AAA → AAA**

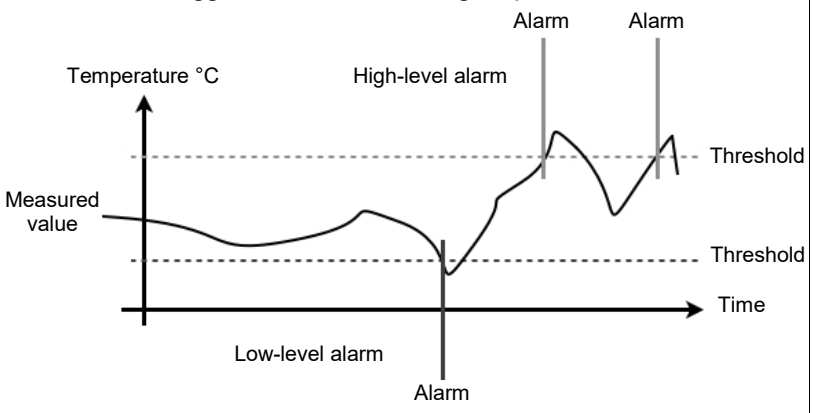
9.0 CONFIGURATION

9.1 Configuration menu



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

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

PARAMETER	FUNCTION
Analysis	Through this menu the user can configure the available parameters for a proper combustion analysis. SEE SECTION 9.2.
Instrument	This menu is used to configure the instrument's reference parameters. 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. SEE SECTION 9.4.
Alarm	This submenu allows the user to set and memorise 10 alarms, defining the monitored parameter for each (gas, pressure, Ta, Tf), the alarm threshold and relative unit of measurement 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. When an alarm threshold is crossed, the instrument emits an intermittent audible alarm besides activating a visible alarm wherein the background of the name of the relative reading will start flashing in the analysis screen. SEE SECTION 9.5. 
Information	This menu provides information regarding instrument status. SEE SECTION 9.6.
Diagnostic	The user, with this menu, can check any anomalies of the device. SEE SECTION 9.7.
Language	Set the desired language for the various menus and the test ticket. SEE SECTION 9.8.
Restore	Restore factory settings. SEE SECTION 9.9.

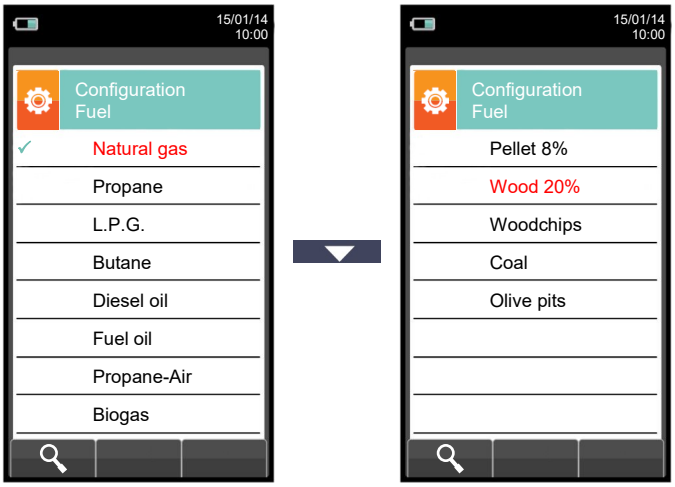
9.2 Configuration→Analysis

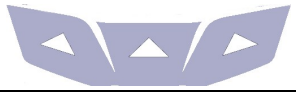
KEY	FUNCTION
	**Activate the context keys shown on the display.**
	**Returns to the previous screen.**

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. This datum can be varied either from this menu or during the analysis itself. 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. SEE 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. 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). 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%); hence it is possible to obtain the NOx value by a simple calculation without using a direct measurement with a further NO_2 sensor. The NO_2 percentage value contained in the gas can be however set at a value other than 3% (default value). SEE SECTION 9.2.4.
Measure units	Through this submenu the user can modify the units of measurement for all the analysis parameters, depending on how they are used. SEE SECTION 9.2.5.
Autozero	In this sub menu the user can change the length of the autozero cycle of the analyzer and start it manually. SEE SECTION 9.2.6.
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. SEE SECTION 9.2.7.
Air temp.	In this submenu there is a possibility to acquire or manually enter the combustion air temperature. SEE CHAPTER 9.2.8.

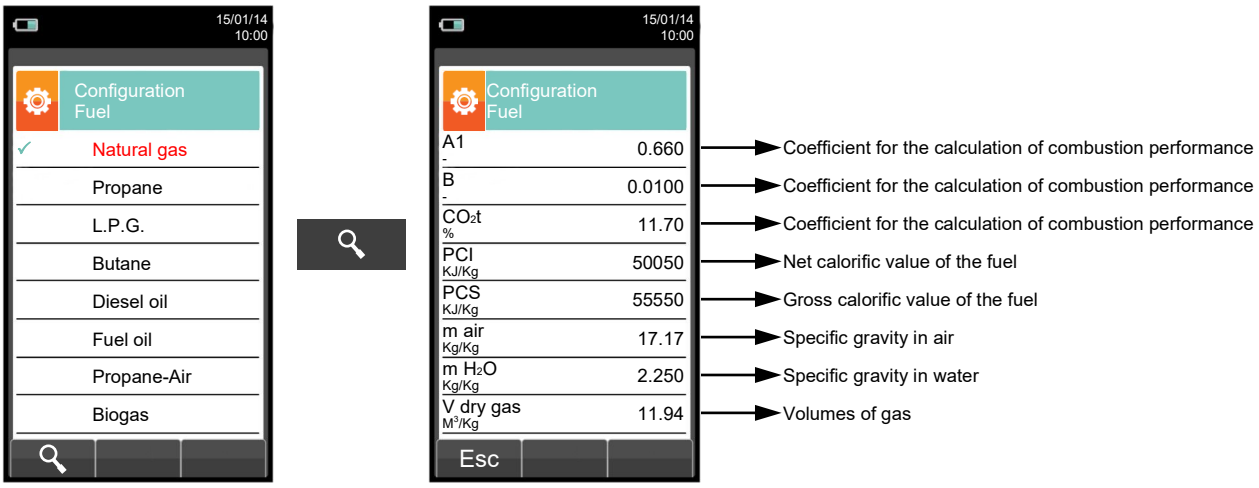
9.2.1 Configuration→Analysis→Fuel



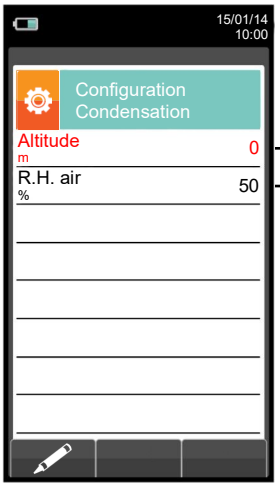
KEY	FUNCTION
	**Activate the context keys shown on the display.**
	**The arrows select each line displayed.**
	**Confirms the choice of fuel to be used during the analysis.**
	**Returns to the previous screen.**

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

Example:

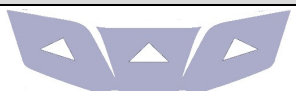


9.2.2 Configuration→Analysis→Condensation



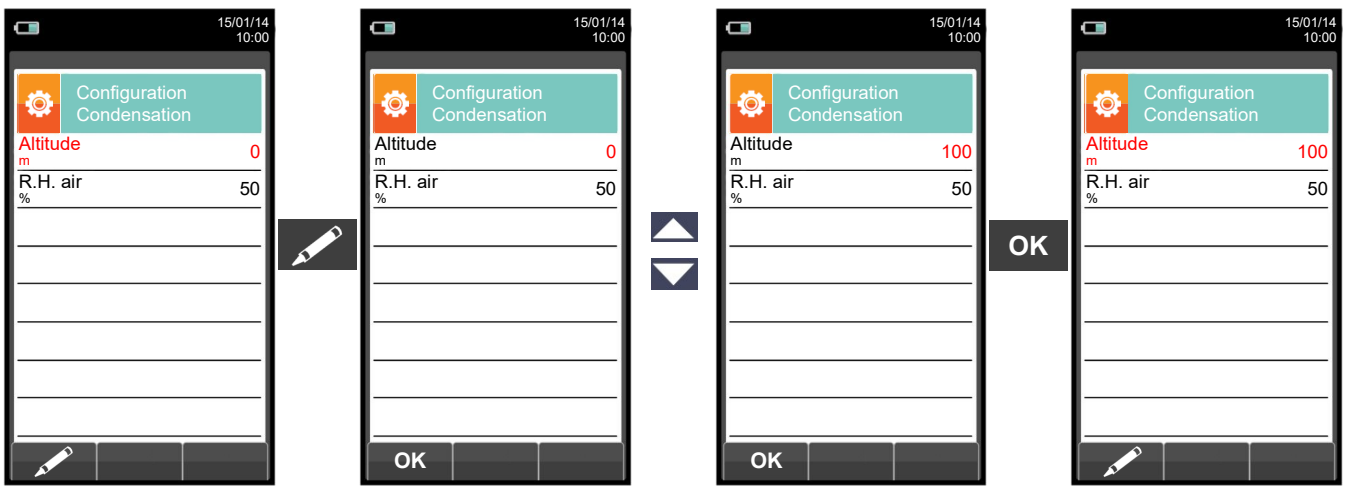
→ Altitude above sea level

→ Relative humidity of air

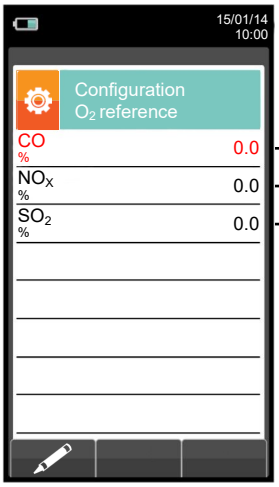
KEY	FUNCTION
	**Activate the context keys shown on the display.**
	**The arrows select each line displayed (the selected line is red).** **In edit mode, it scrolls through the suggested values.**
	**Enters the modify mode for the selected parameter, then confirms the modification.**
	**When pressed in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

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

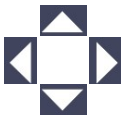
Example:



9.2.3 Configuration→Analysis→Reference O_2

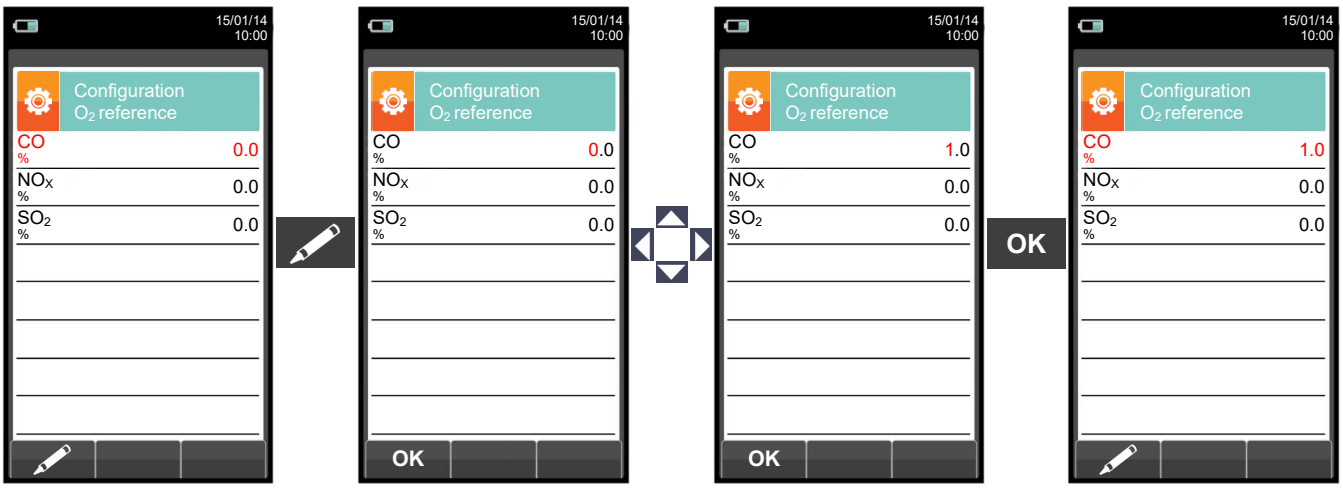


→ Percentage of Oxygen in CO measurement
→ Percentage of Oxygen in NO_X measurement
→ Percentage of Oxygen in SO_2 measurement

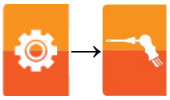
KEY	FUNCTION
	**Activate the context keys shown on the display.**
	**Keys '▲' and '▼' select any line shown on the display (the selected line is evidenced in red).** **When in modify mode, sets the desired value.**
	**Enters the modify mode for the selected parameter, then confirms the modification.**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

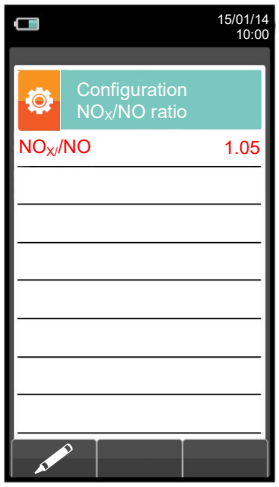
CONTEXT KEY	FUNCTION
	**Enters the modify menu for the selected parameter.**
	**Confirms the modification.**

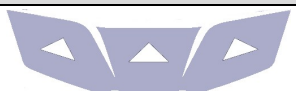
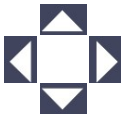
Example:



9.2.4 Configuration→Analysis→NO_X/NO ratio

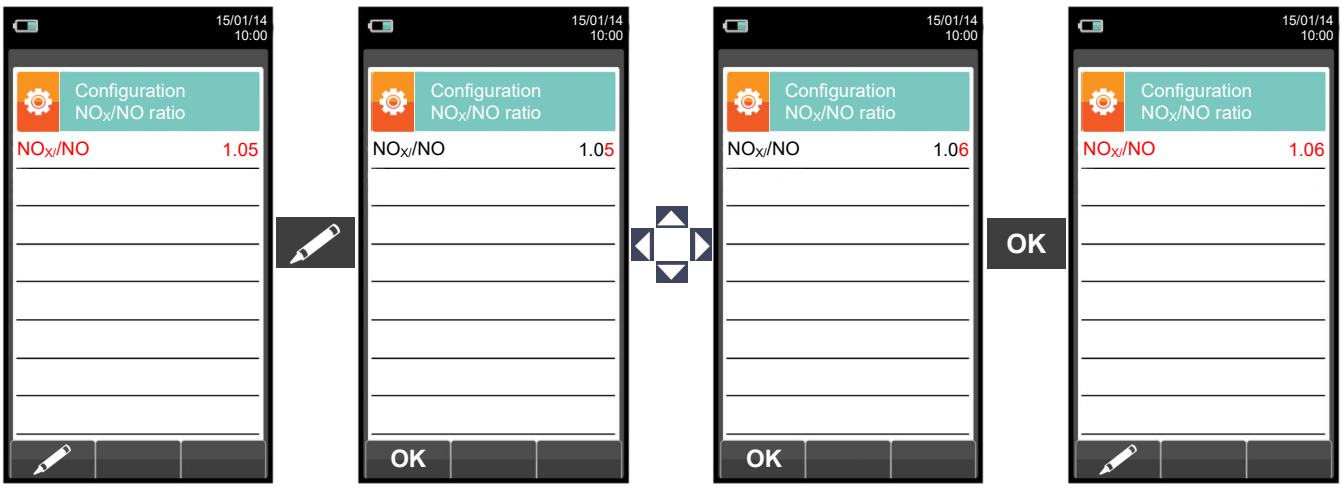




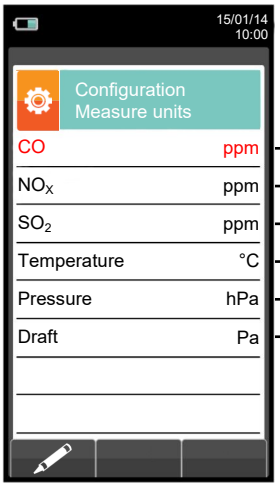
KEY	FUNCTION
	**Activate the context keys shown on the display.**
	**When in modify mode, sets the desired value.**
	**Enters edit mode of the selected element and then confirms the change.**
	**When pressed in modify mode cancels the selection made, otherwise returns to the previous screen.**

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 - %

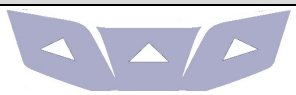
→ Measurement unit can be set as: ppm - mg/m^3 - mg/kWh - g/GJ - g/m^3 - g/kWh - %

→ 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: °C - °F

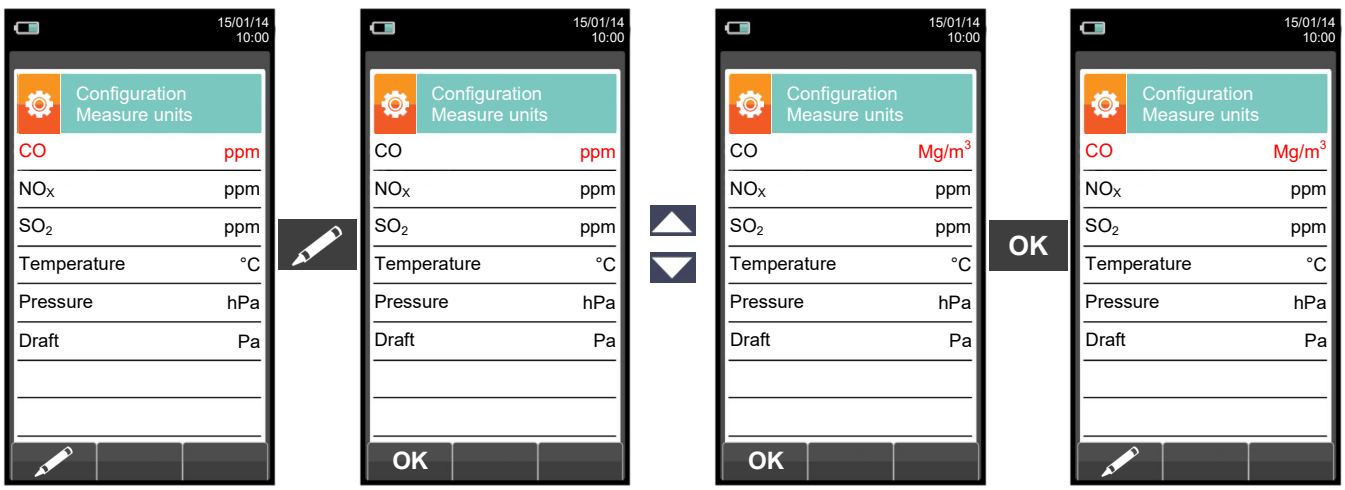
→ Measurement unit can be set as: hPa - Pa - mbar - mmH_2O - mmHg - inH_2O - psi

→ Measurement unit can be set as: hPa - Pa - mbar - mmH_2O - mmHg - inH_2O - psi

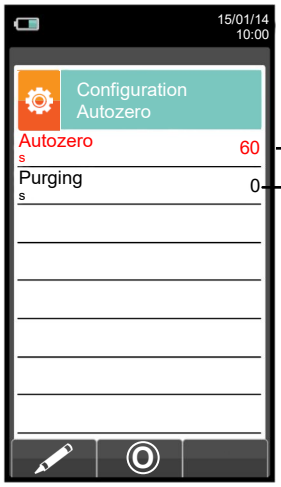
KEY	FUNCTION
	**Activate the context keys shown on the display.**
	**Keys '▲' and '▼' select any line shown on the display (the selected line is evidenced in red).** **When in modify mode, sets the desired value.**
	**Enters edit mode of the selected element and then confirms the change.**
	**When pressed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

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

Example:

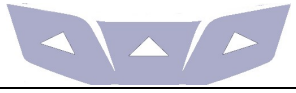
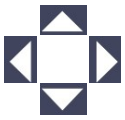


9.2.6 Configuration→Analysis→Autozero



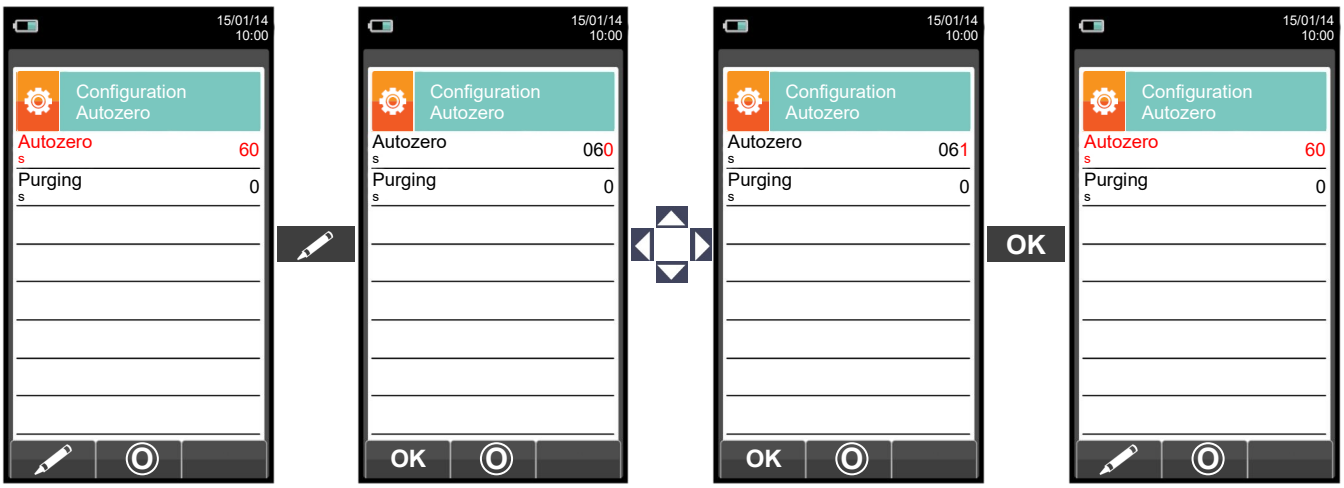
→ Duration of autozero, expressed in seconds.

→ Duration of the cleaning cycle, expressed in seconds.

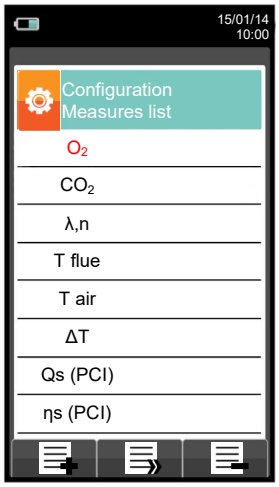
KEY	FUNCTION
	**Activate the context keys shown on the display.**
	**When in modify mode, sets the desired value.**
	**Enters edit mode of the selected element and then confirms the change.**
	**When pressed in modify mode cancels the selection made, otherwise returns to the previous screen.**

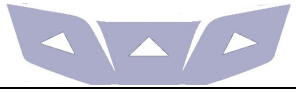
CONTEXT KEY	FUNCTION
	**Enters the modify menu for the selected parameter.**
	**Confirms the modification.**
	**Starts autozero for the selected duration.**

Example:



9.2.7 Configuration→Analysis→Measures list

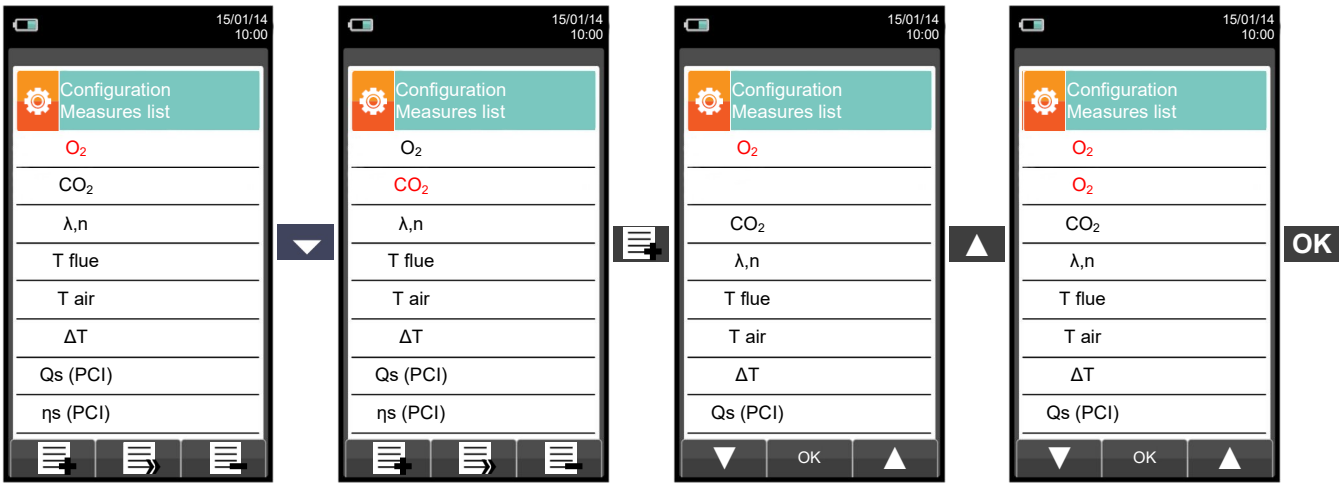


KEY	FUNCTION
	**Activate the context keys shown on the display.**
	**Select each line displayed (the line selected is red).** **In edit mode, it sets the desired value.**
	**When pressed in modify mode cancels the selection made, otherwise returns to the previous screen.**

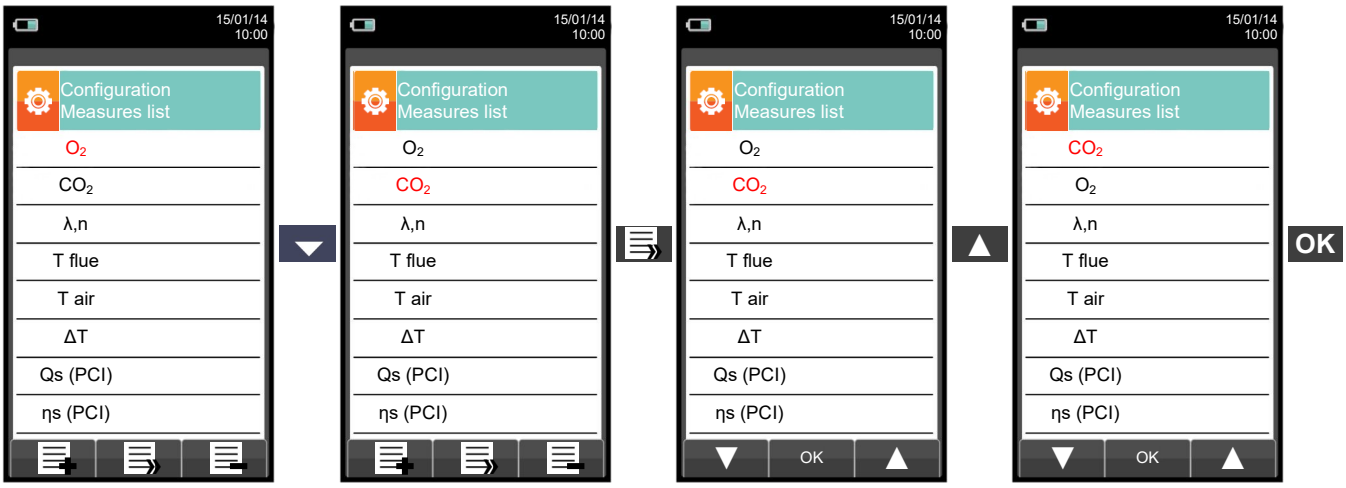
CONTEXT KEY	FUNCTION
	**Adds a line to the list of available measurements.**
	**Activates the movement of a measurement from its current position.**
	**Deletes a measurement from the list of available measurements.**
	**After the activation of the function '**  **'.** **It scrolls through the available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

Example:

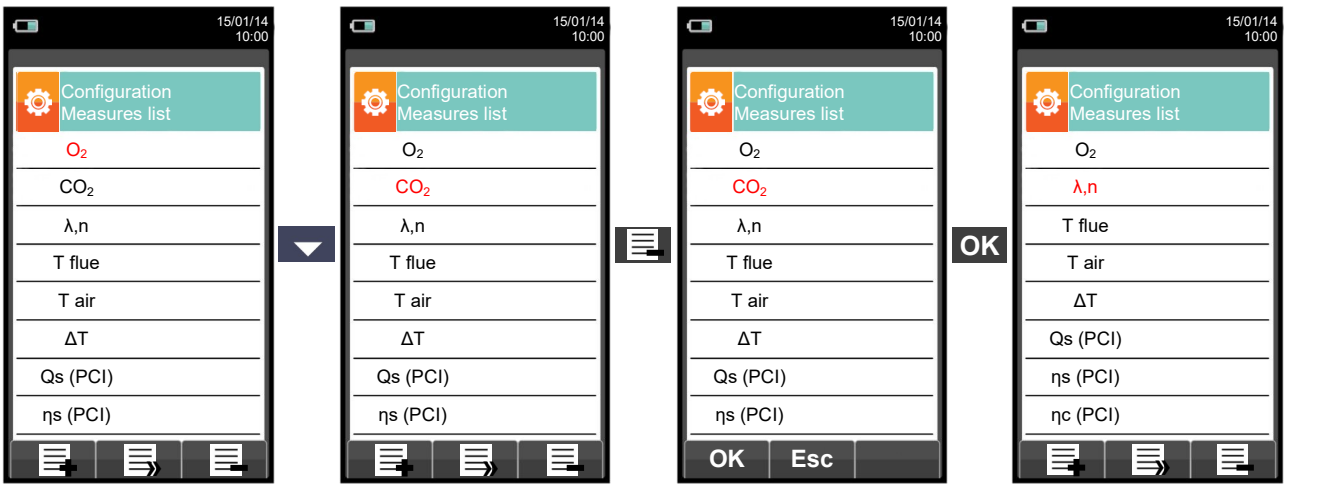
1. Add a measurement to the list - example



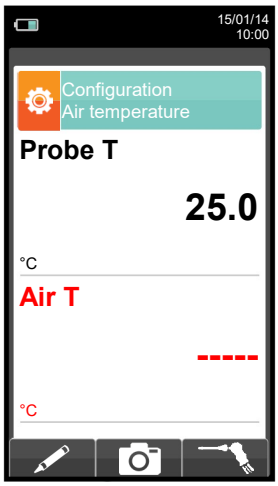
2. Change the position of a measurement - example

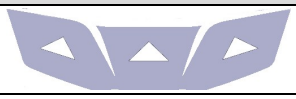
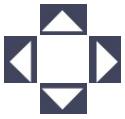


3. Delete a measurement from the list - example



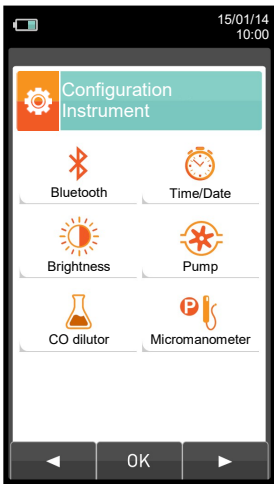
9.2.8 Configuration→Analysis→Air temperatur



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
	**Accesses the Editing mode of the parameter 'Air T': it is possible to enter the desired value of the combustion air temperature that will be used in the combustion analysis.**
	**It saves the value, acquired or entered in the parameter 'Air T'.**
	**Acquires the temperature value detected from the sampling probe. That value is reported in the parameter 'Air T'.**
OK	**Confirms the operation.**

9.3 Configuration→Instrument

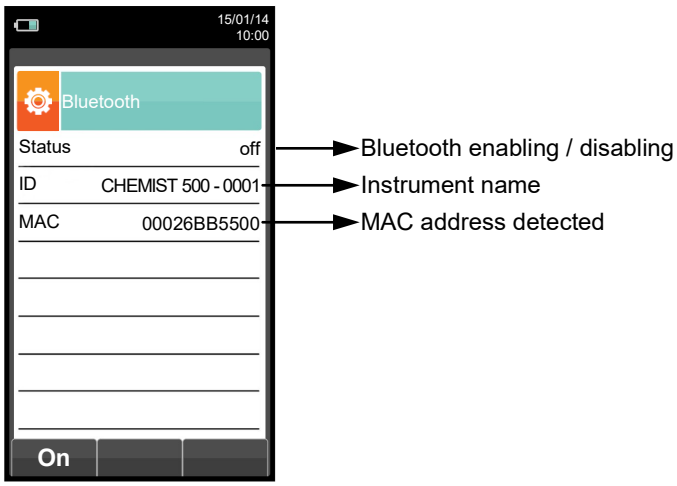


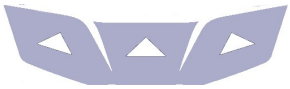
KEY	FUNCTION
	**Activate the context keys shown on the display.**
	**Returns to the previous screen.**

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. **WHEN THE INSTRUMENT BLUETOOTH INTERFACE IS TURNED ON, THE BATTERY LIFE IS REDUCED DOWN TO 10 HOURS.** 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. SEE SECTION 9.3.2.
Brightness	The display contrast may be increased or decreased by acting on cursor keys. This operation may be performed even when the introductory screen is active. SEE SECTION 9.3.3.
Pump	In this sub menu the user can turn the gas suction pump off or back on. Also, if the pump is on, the user can view the flow of the pump in litres per minute. It is not possible to turn off the pump during an autozero cycle. SEE SECTION 9.3.4.
CO dilutor	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. **CO Auto-Dilution feature must only be considered as a means of protection for CO sensor, as its activation heavily deteriorates both accuracy and resolution of the CO measurement.** SEE SECTION 9.3.5.
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 9.3.6.

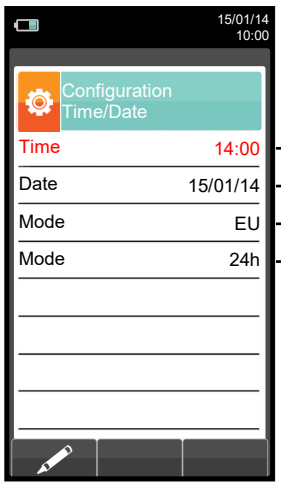
9.3.1 Configuration→Instrument→Bluetooth



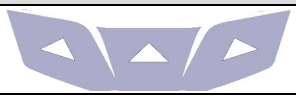
KEY	FUNCTION
	**Activate the context keys shown on the display.**
	**Also activates the context key shown on the display.**
	**Returns to the previous screen.**

CONTEXT KEY	FUNCTION
on	**Turns on Bluetooth communication.**
Esc	**Turns off Bluetooth communication.**

9.3.2 Configuration→Instrument→Time/Date

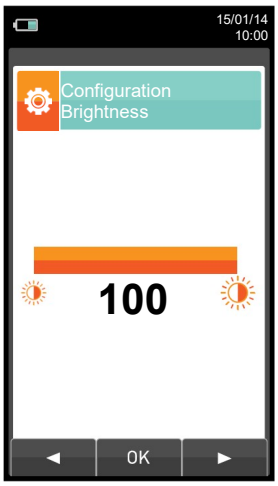


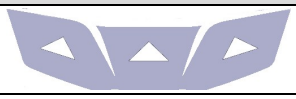
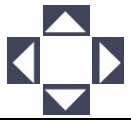
→ Time, in the chosen format
→ Date, in the chosen format
→ Date format: EU (Europe) or USA (America)
→ Time format: 24h or 12h

KEY	FUNCTION
	**Activate the context keys shown on the display.**
	**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.**

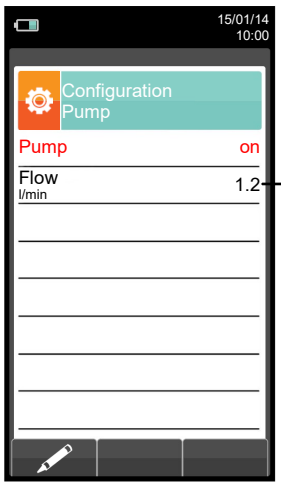
9.3.3 Configuration→Instrument→Brightness



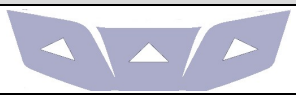
KEY	FUNCTION
	**Activate the context keys shown on the display.**
	**Increases or decreases the brightness of the display.**
	**Confirms the modification.**
	**When pressed in modify mode cancels the selection made, otherwise returns to the previous screen.**

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

9.3.4 Configuration→Instrument→Pump

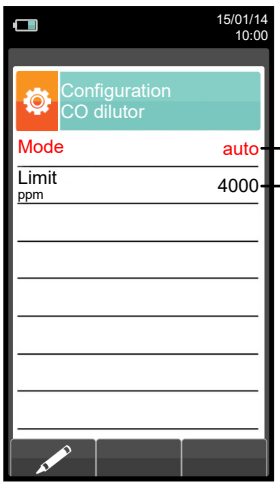


→ Displays the flow of the pump, expressed in litres per minute.

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.**

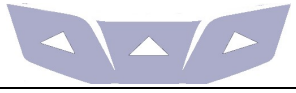
CONTEXT KEY	FUNCTION
	**Enters edit mode: it is possible to turn the gas suction pump on or off.**
OK	**Confirms the modification.**

9.3.5 Configuration→Instrument→CO dilutor



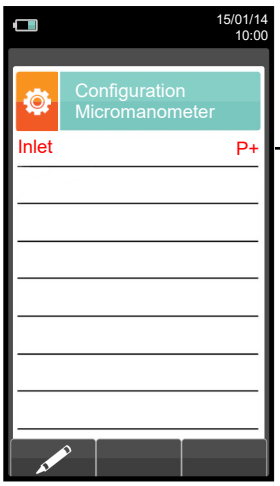
Available settings: auto, on or off

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

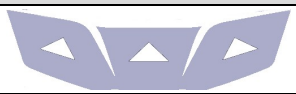
KEY	FUNCTION
	**Activate the context keys shown on the display.**
	**Select each line displayed (the line selected is red).** **In edit mode, it sets the desired value.**
	**Enters edit mode of the selected element and then confirms the change.**
	**When pressed in modify mode cancels the selection made,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

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

9.3.6 Configuration→Instrument→Micromanometer

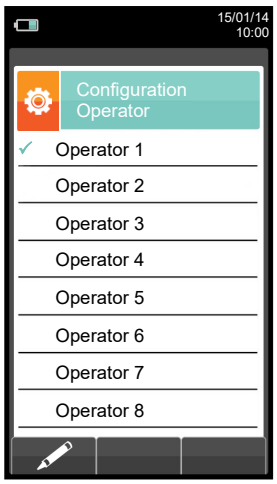


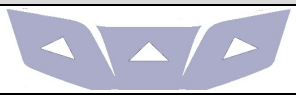
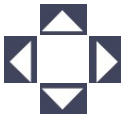
→ Sets the input used for the test: P+ o P-

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.**

9.4 Configuration→Operator

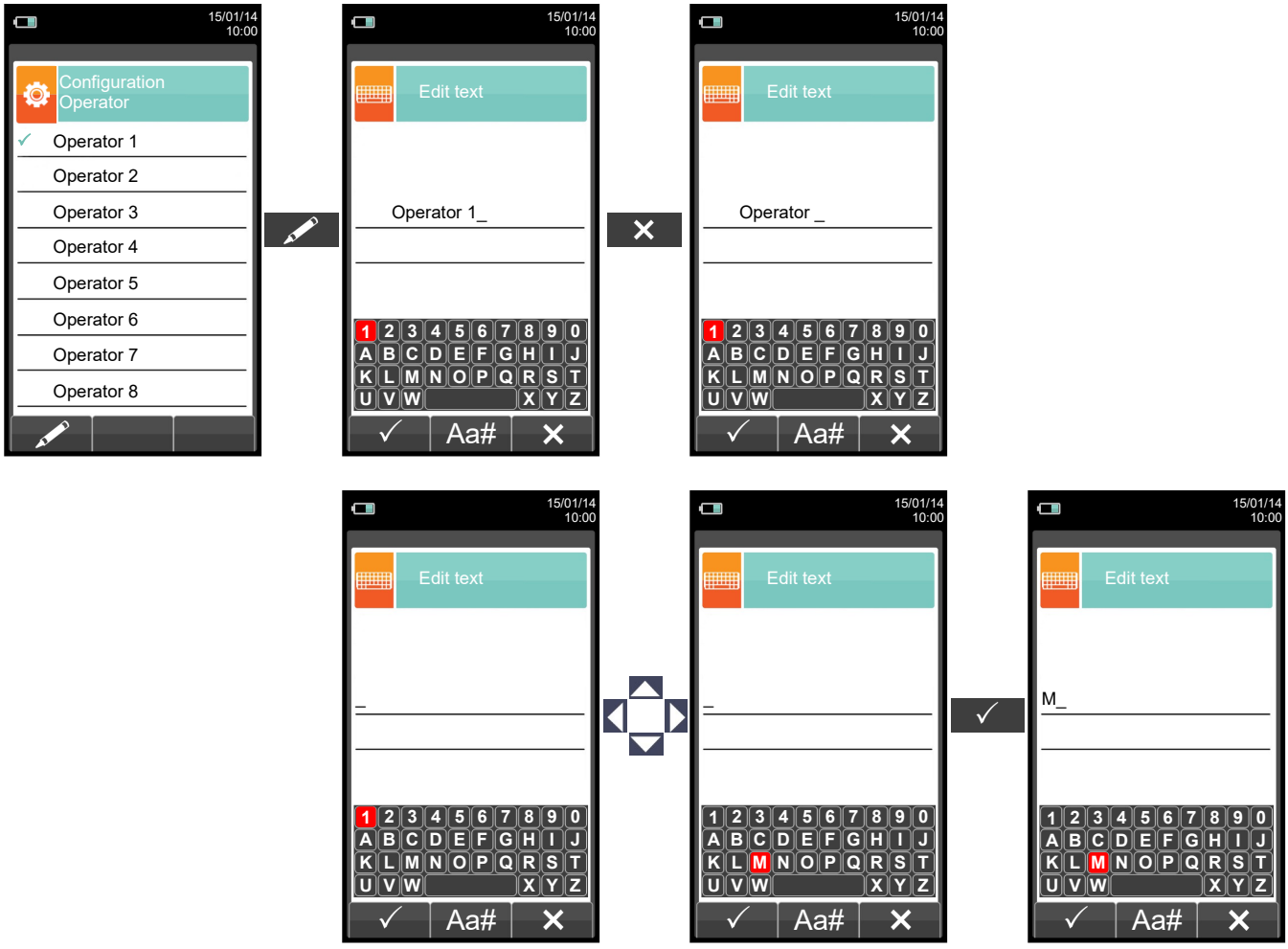


KEY	FUNCTION
	**Activate the context keys shown on the display.**
	**In "edit text": Moves the cursor on the box corresponding to the letter or number required to form the word.**
	**In "Operator Configuration": Scrolls through the available operators.**
	**In "edit text": Confirms text input.** **In "Operator Configuration": selects the operator who will carry out the analysis; the operator is highlighted with the symbol "✓".**
	**Returns to the previous screen.** **In "edit mode" 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:

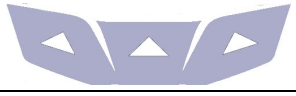
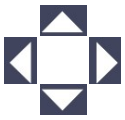
1. Edit text



2. Select the operator who will carry out the analysis

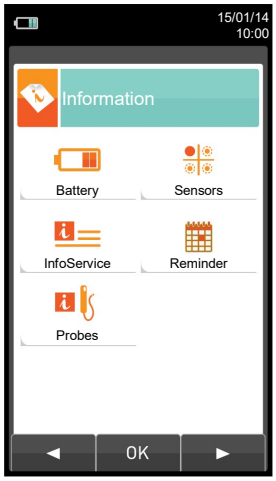
9.5 Configuration→Alarm

- Number of the alarm set
- Monitored parameter: O_2 - CO - NO - NO_2 - P diff - Plow - P ext - T1 - T2
- Type of alarm set: massimo - minimo - spento
- 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 evidenced in red).** **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.**
OK	**Confirms the modification.**

9.6 Configuration→Information

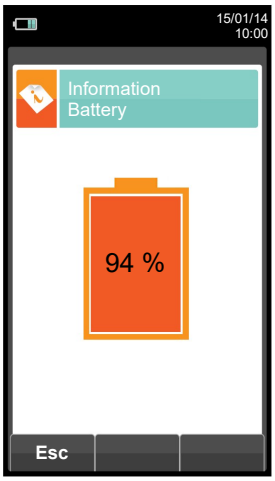


KEY	FUNCTION
	Activate the context keys shown on the display.
ESC	**Returns to the previous screen.**

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

PARAMETER	DESCRIPTION
Battery	Displays the state of charge of the internal battery. Displays the state of charge of the battery in percentage from 0 to 100%, both in text and graphically. SEE SECTION 9.6.1.
Sensors	It 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. 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. SEE SECTION 9.6.3.
Reminder	Accessing this menu you can see the calibration's expiration date of the instrument, inserted by factory or assistance center. **The menu is protected with a password: password is " 1111 ".** SEE SECTION 9.6.4.
Probes	Displays useful information on the probe connected to the serial cable connector visible in **E** in section 4.3 (Description of the Components of the Combustion Analyzer). SEE SECTION 9.6.5.

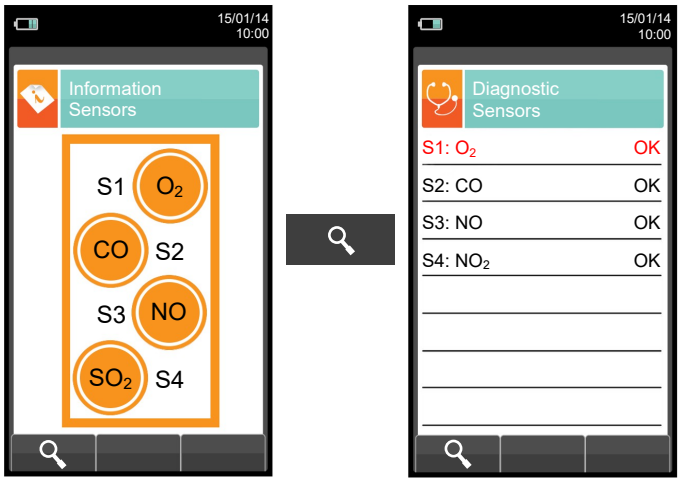
9.6.1 Configuration→Information→Battery



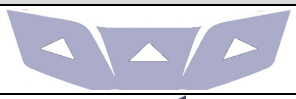
KEY	FUNCTION
	**Activate the context keys shown on the display.**
	**Returns to the previous screen.**

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

9.6.2 Configuration→Information→Sensor



For further information, see section 9.7.1.

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.**
Esc	**Returns to the previous screen.**

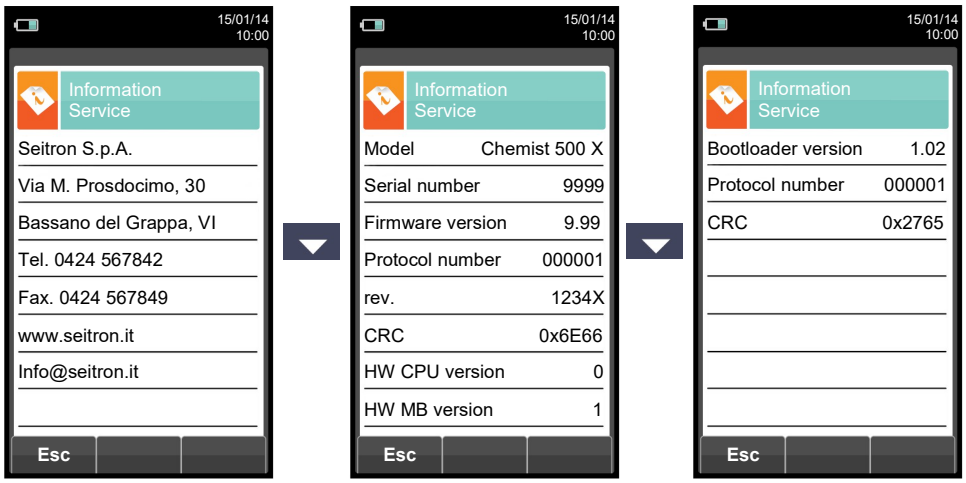
This screen displays, for each position, the following messages (example referring to the sensor in position S3):

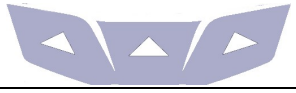
MESSAGE	DESCRIPTION
	**Sensor configured OK (normal operation).**
Flashing orange circle without writing indicating the gas detected	**Sensor is not communicating or has been removed.**
Flashing orange circle with writing indicating the gas detected	**New sensor detected.**
Flashing orange circle with writing indicating the new gas detected	**Detected sensor different from the one previously installed.**
	**Detected sensor in wrong position.**

Error messages displayed:

MESSAGE	DESCRIPTION
Err cal	**Calibration error.**
Err dati	**Sensor not recognized.**
No cal	**Sensor not calibrated.**

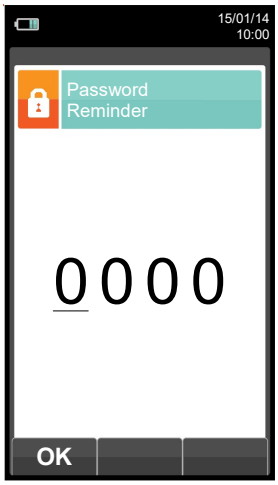
9.6.3 Configuration→Information→InfoService



KEY	FUNCTION
	**Activate the context keys shown on the display.**
	**Toggle view between next or previous screen.**
	**Returns to the previous screen.**

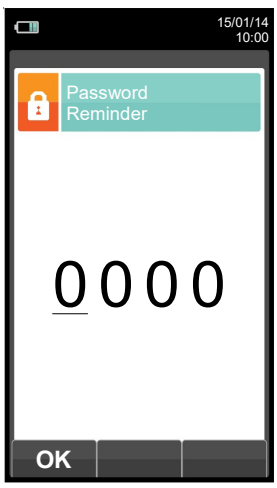
CONTEXT KEY	FUNCTION
Esc	**Returns to the previous screen.**

9.6.4 Configuration→Information→Reminder



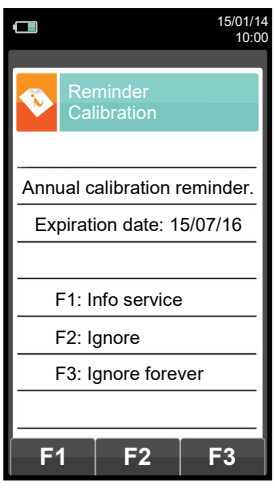
KEY	FUNCTION
	Activate the context keys shown on the display.
	Sets the password. The password is: 1111.
ESC	**Returns to the previous screen.**

CONTEXT KEY	FUNCTION
OK	**Confirm password and enter the menu “Reminder”.**
Esc	**Returns to the previous screen.**
F1	**Displays the informations about the assistance center.**
F2	**Ignores temporarily the message. Next time the instrument will be turned on, the remainder will be displayed again.**
F3	**Ignores permanently the message.**



Enter the recalibration menu password **1111.**

OK

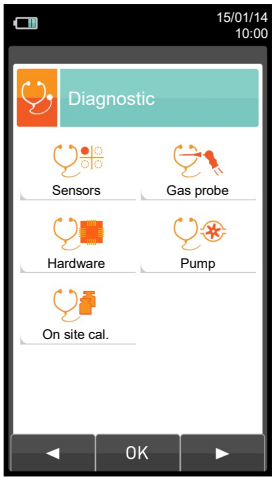


9.6.5 Configuration→Information→Probe

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

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

9.7 Configuration→Diagnostic

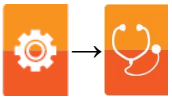


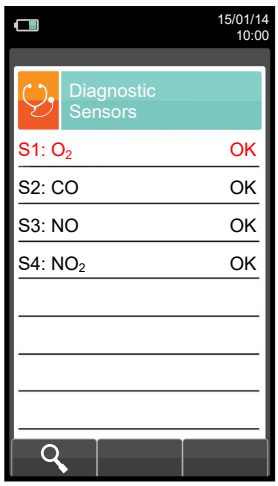
KEY	FUNCTION
	Activate the context keys shown on the display.
ESC	**Returns to the previous screen.**

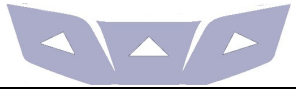
CONTEXT KEY	FUNCTION
◄	**Selects the available parameters.**
OK	**Enters in the selected parameter setting.**
►	**Selects the available parameters.**

PARAMETER	DESCRIPTION
Sensors	Displays information on the state and calibration of the electrochemical sensors: **Ok** No problem detected **absent** The sensor was not detected **err data** Memory data error of the sensor **unknown** It is necessary to update the FW of the device **err pos** The sensor has been installed in the wrong position **err cal** Calibration error (sensor not calibrated) **err curr** Currents outside the range **err cfg** Do not use this sensor as it has not been accepted on the screen "types of sensors". 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. **SEE SECTION 9.7.1.**
Gas probe	Tests the tightness of the gas probe pneumatic path. **SEE SECTION 9.7.2.**
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 evidenced 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. **SEE SECTION 9.7.3.**
Pump	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 9.7.4.**
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. **The access to the sensor recalibration is password protected, the password is ' 1111 '.** **SEE SECTION 9.7.5.**

9.7.1 Configuration→Diagnostic→Sensors

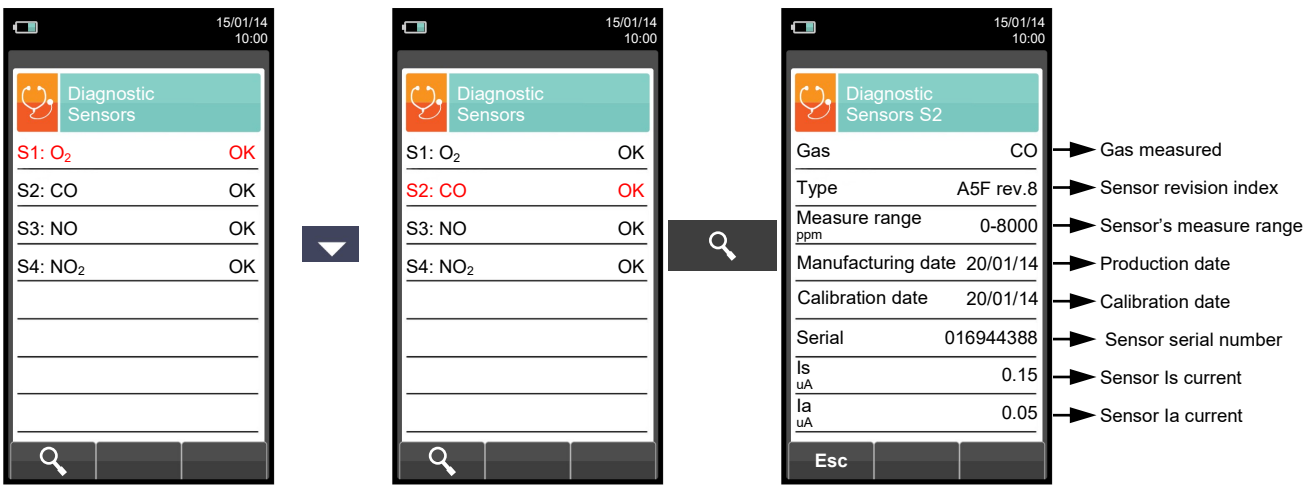




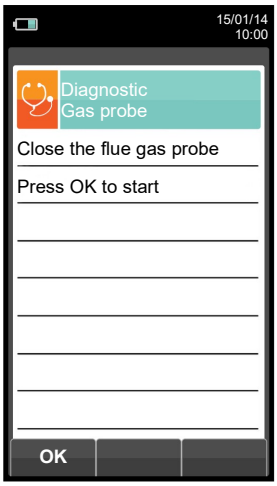
KEY	FUNCTION
	**Activate the context keys shown on the display.**
	**Selects the fuel.**
	**Activates the context keys located in the left side of the display.**
	**Returns to the previous screen.**

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

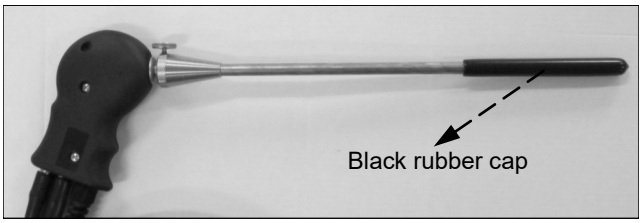
Example:



9.7.2 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:



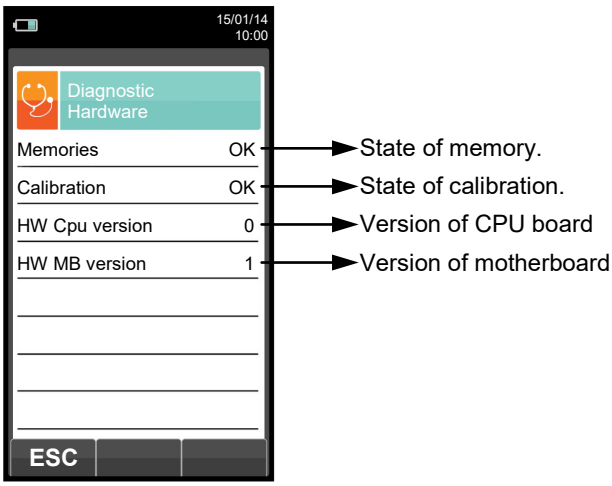
KEY	FUNCTION
	**Activate the context keys shown on the display.**
	**Activates the context key located in the left side of the display.**
	**Returns to the previous screen.**

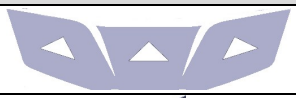
CONTEXT KEY	FUNCTION
OK	**Starts the test to check the tightness of the gas sampling probe.**
	**Starts the test of the gas sampling probe.**

Tightness test of the probe.

Results:
Tightness: The system is OK
Error: 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.**

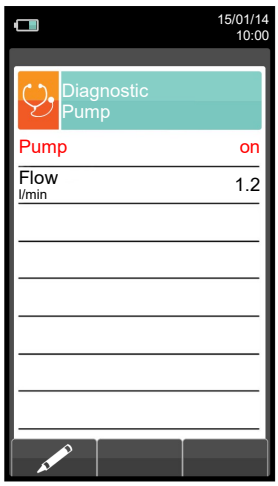
9.7.3 Configuratione→Diagnostic→Hardware

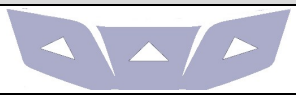


KEY	FUNCTION
	**Activate the context keys shown on the display.**
	**Returns to the previous screen.**

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

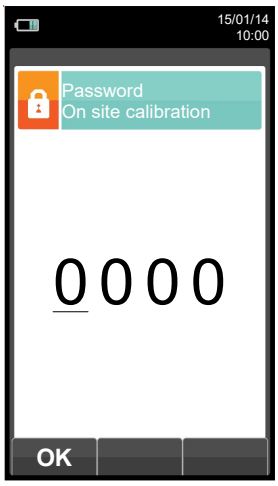
9.7.4 Configuration→Diagnostic→Pump



KEY	FUNCTION
	**Activate the context keys shown on the display.**
	**In edit mode, cycling between on and off.**
	**Enters edit mode of the selected element and then confirms the change.**
	**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.**

9.7.5 Configuration→Diagnostic→On site cal.



KEY	FUNCTION
	Activate the context keys shown on the display.
	Sets the password.
	Selects line; the selected line is evidenced in red. 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. When in modify mode cancels the modification just made.

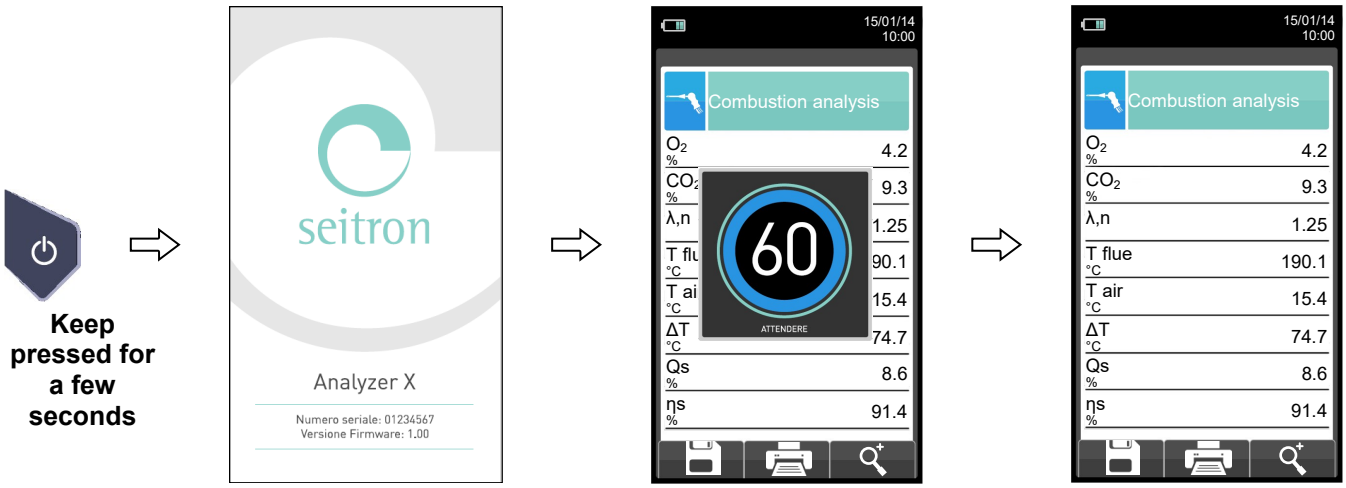
CONTEXT KEY	FUNCTION
OK	Once password is entered, gives access to the 'On site calibration' menu.
	Shows details for the selected sensor.
	Zeroes the timer.
	Enters the modification mode for the selected parameter.

Calibration procedure

To carry on 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.

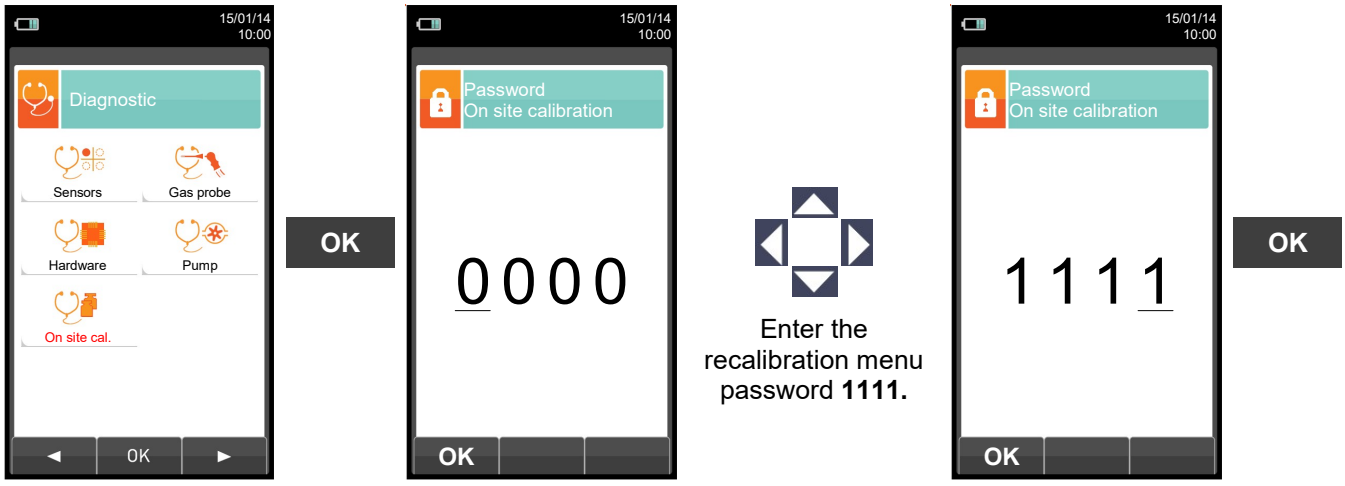
1. Start the instrument

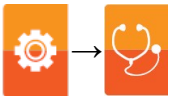


ATTENTION

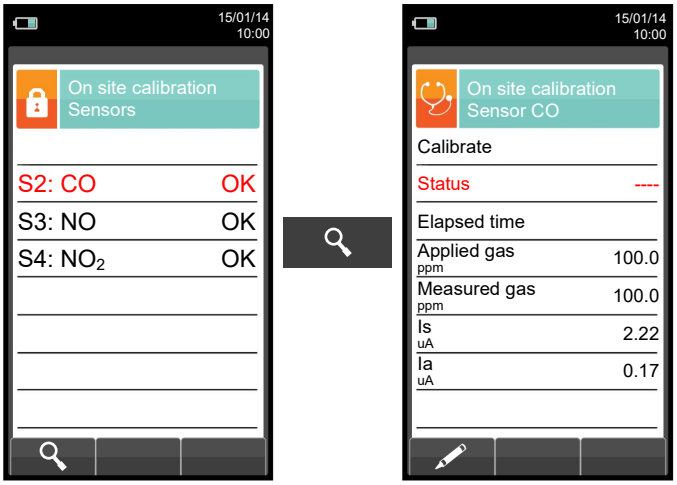
- **Make sure autozero is execute in clean air and terminates correctly.**
- **Do not connect the gas probe to the instrument.**
- **Check the battery charge level or connect the power adapter to avoid data loss during recalibration.**

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





3. **Once in the 'On site calibration' menu, is shown the list of the installed sensors for which the recalibration is available. 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

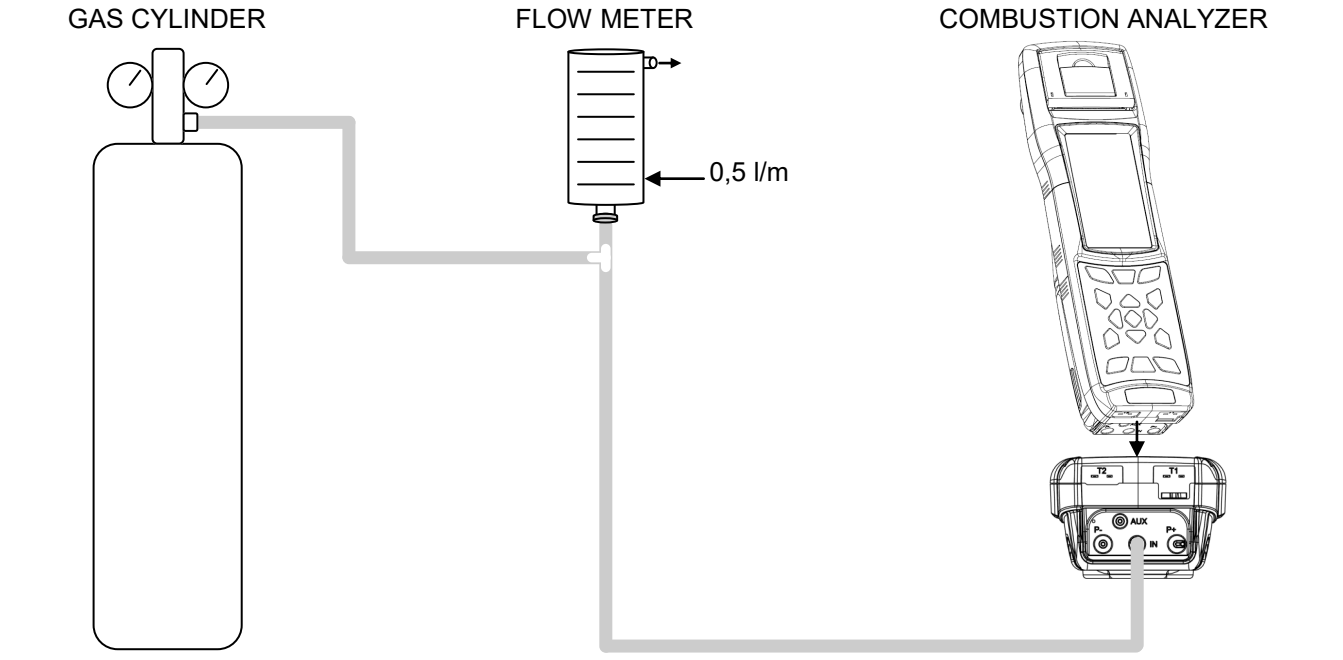
Ia: 'Ia' current from the sensor

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

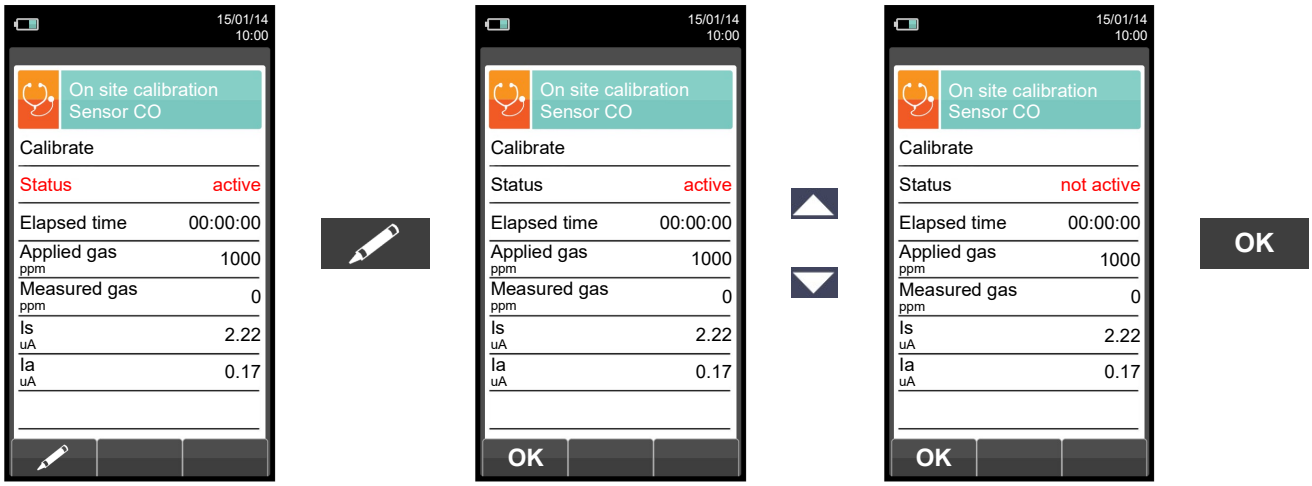
<u>CHOOSE THE SENSOR TO BE RECALIBRATED AND PROCEED AS DESCRIBED (CO SENSOR EXAMPLE)</u>:

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

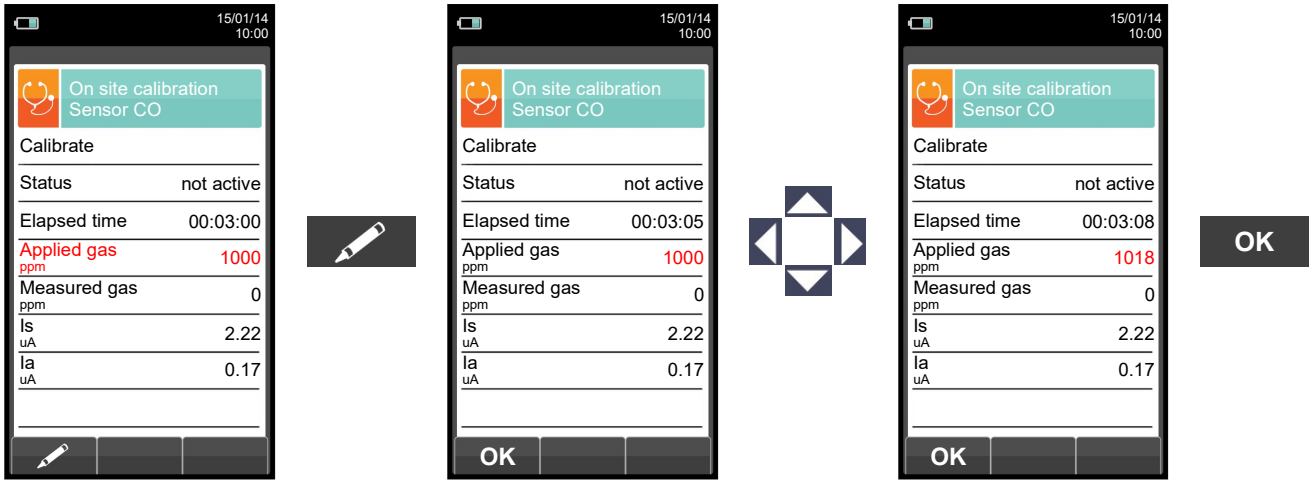
WARNING!
Adequate ventilation must be provided when working with toxic gases, particularly the flow meter and instrument outputs must be evacuated by a ventilation system.



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

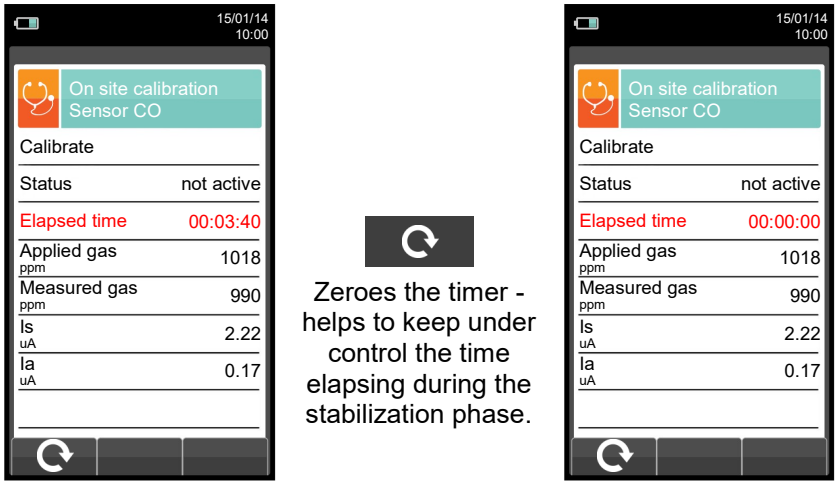


- Enter the value of the concentration of the gas applied.

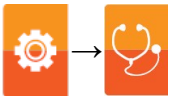


- Apply gas to the instrument and adjust the output pressure of the gas from the cylinder so that the flow meter indicates a minimum flow of 0.5 l/m: this guarantees that the instrument is taking the exact amount of gas required by the internal pump.

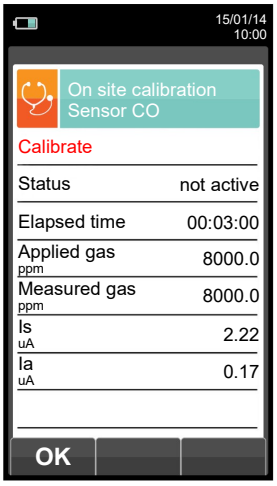
- The instrument measures the concentration of gas applied; wait at least 3 minutes to allow the reading to stabilize. The reading is shown in line 'Gas measured'.



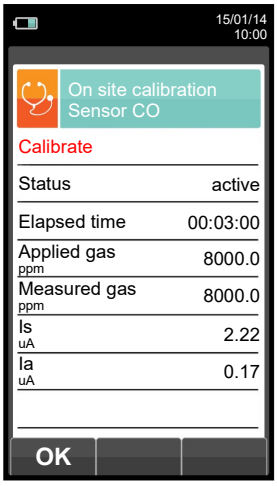
Zeroes the timer - helps to keep under control the time elapsing during the stabilization phase.



• 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.

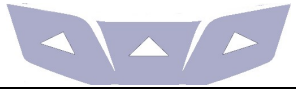
WARNING

At any time the user can restore the factory calibration in the instrument by setting the 'Status' line on 'not active'.

In the following are listed the suggested stabilization times for the 'on site calibration' of the sensors.

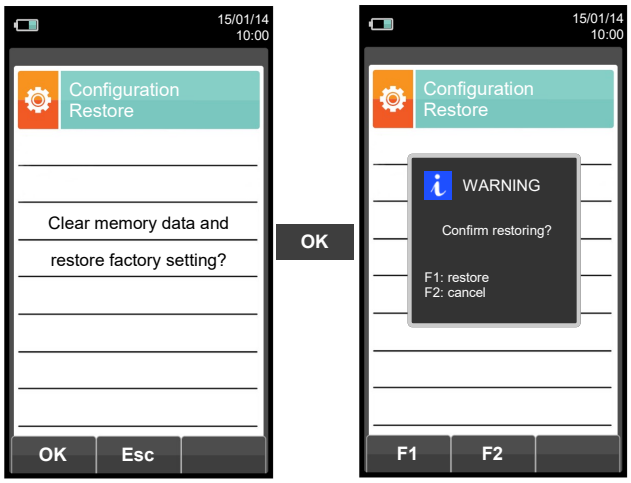
Sensor CO: 3 minutes
Sensor NO: 3 minutes
Sensor SO_2: 10 minutes
Sensor NO_2: 10 minutes
Sensor CxHy: 3 minutes
Sensor CO2: 3 minutes

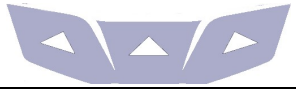
9.8 Configuratione→Language

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.**

9.9 Configuration→Restore

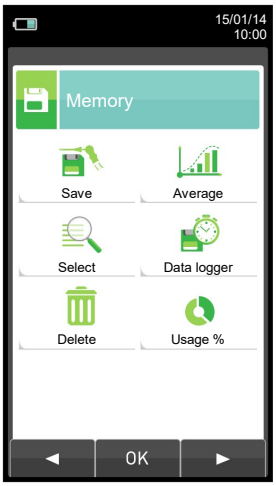


KEY	FUNCTION
	**Activate the context keys shown on the display.**
	**Starts the factory data reset phase.**
	**Exits the current screen without resetting.**

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.**

10.0 MEMORY

10.1 Memory Menu



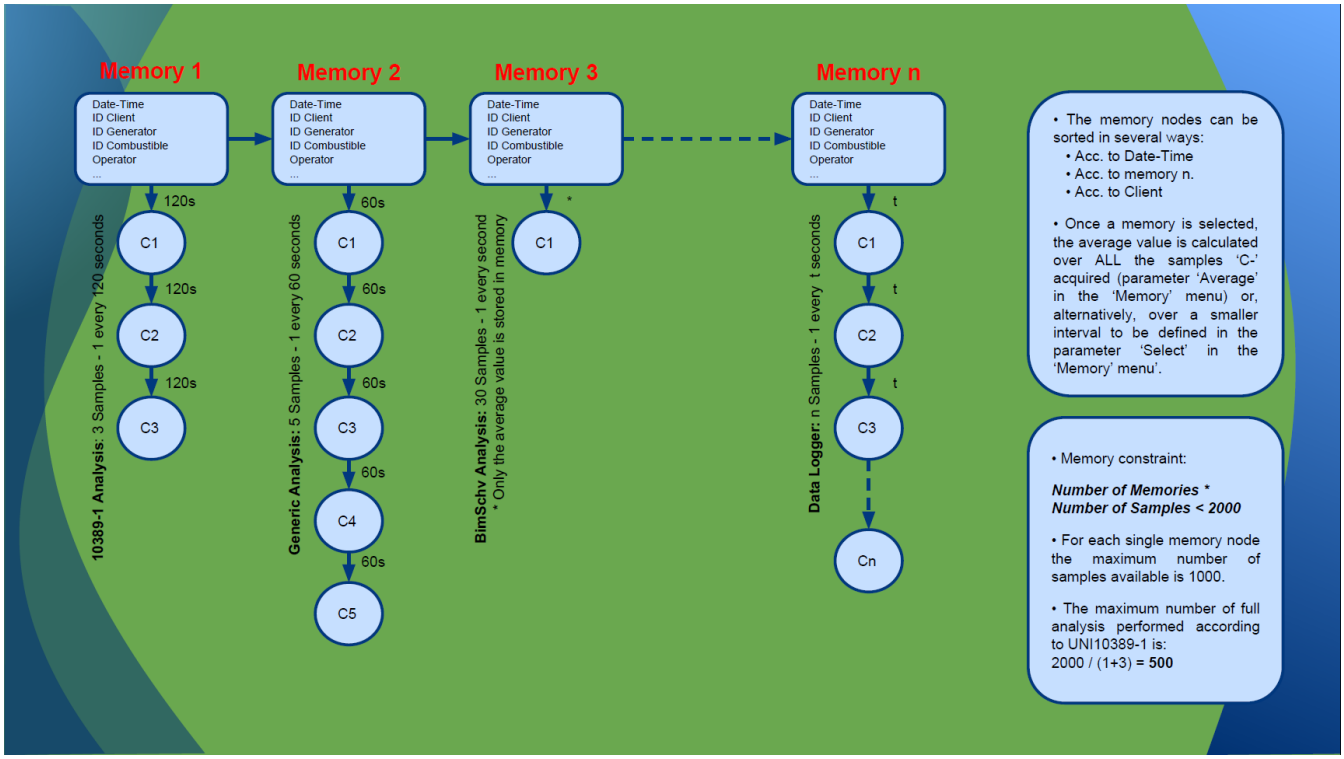
KEY	FUNCTION
	**Activate the context keys shown on the display.**
	**Returns to the previous screen.**

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

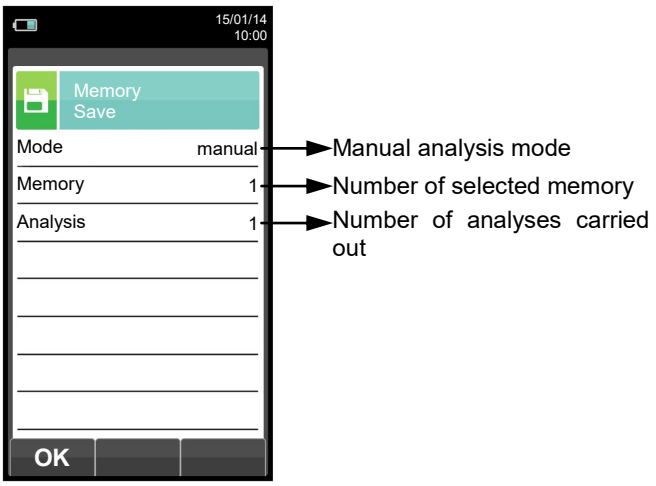
PARAMETER	DESCRIPTION
Save	From this screen the user can start the combustion analysis. The data shown summarizes the mode of analysis and the selected memory. **SEE SECTION 10.2.**
Average	Allows the user to see the average of the analyses contained in the selected memory. **SEE SECTION 10.3.**
Select	- Allows the user to set the number of the memory to be used to save the combustion analysis and/or the measurement of the draught, carbon black, etc. 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.). - 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 draught, carbon black and ambient CO. In the menu "Find Memory" the activation of the Print Memory is enabled only on the page where the analyses or the draught, carbon black and ambient CO data are displayed. **SEE SECTION 10.4.**
Data logger	This submenu allows the user to define the mode of analysis and of memory selection: **Automatic analysis mode:** **UNI 10389** 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. **BImSchV** 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. **data logger** 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). 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. After the combustion analysis (indicated by a beep), it 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, …). 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.

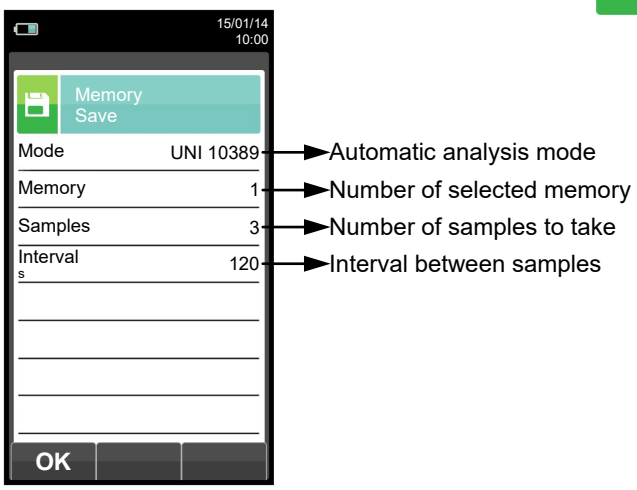
 Data logger	**Warning: in automatic mode, the measurements of carbon black, draught and ambient CO must be taken before starting the combustion analysis.** **Manual analysis mode** If the user chooses the manual mode, he will perform the combustion analysis manually; in this case, the settings regarding printing and duration of the automatic analysis will not be considered. At this point the user can start the manual analysis after waiting two minutes so that the displayed values are stable: then he can proceed to save or directly print the test ticket of the analysis, which will be prepared in accordance with the previously configured settings. 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. In both modes, manual and automatic, the data displayed regarding the pollutants CO / NO / NO_x can be translated into normalized values (with reference to the concentration of O_2 previously set). **Memory selection mode** **Manual**: the memory will have to be selected manually via the parameter "Select" **Auto**: the memory, to which the measurements and combustion analyses will be saved, will be suggested automatically when the device is turned on. **SEE SECTION 10.5.**
 Delete	Allows the user to delete the contents of each memory or of the entire 99 memories. **SEE SECTION 10.6.**
 Usage %	The user, through this menu, can view the percentage of memory usage. **SEE SECTION 10.7.**

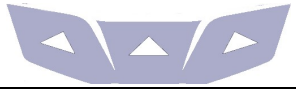
10.1.1 Memory Organization



10.2 Memory Menu→Save

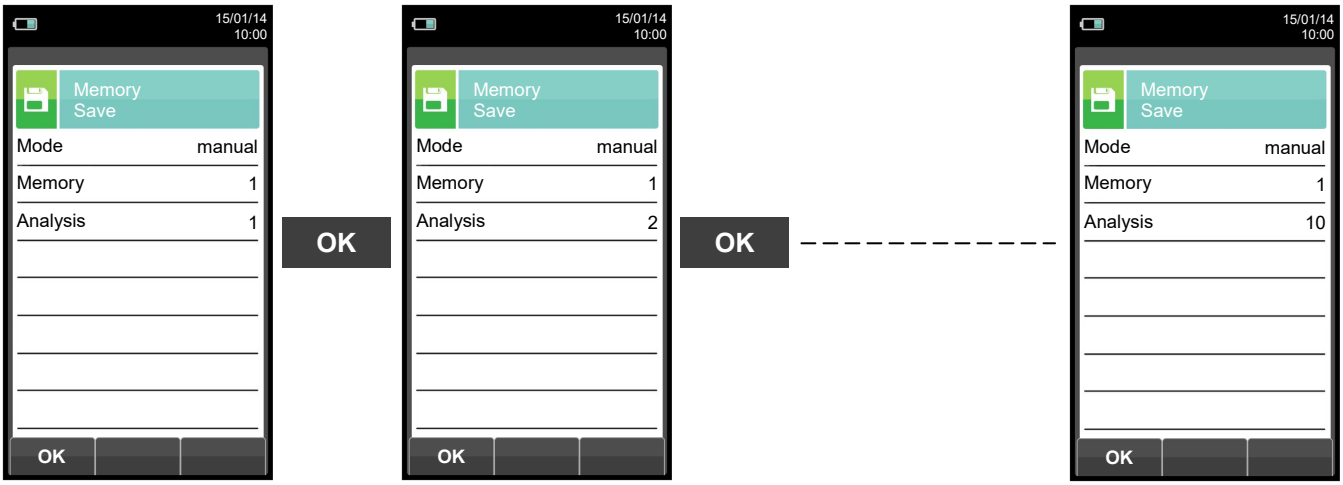




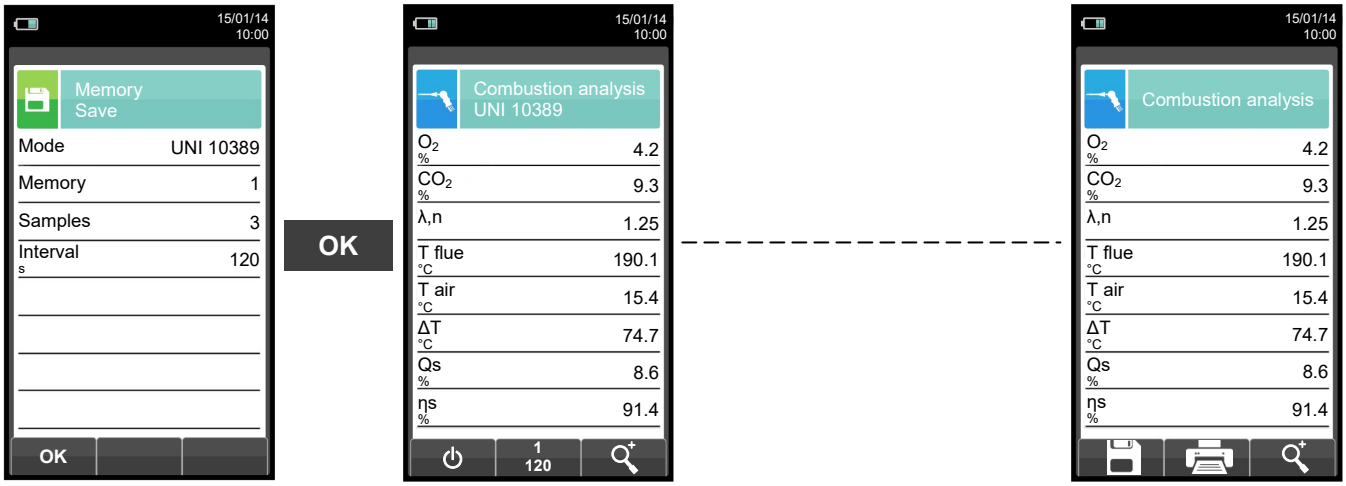
KEY	FUNCTION
	**Activate the context keys shown on the display.**
	**Starts saving the combustion analysis according to the mode set in the parameter 'Data logger'.**
	**Returns to the previous screen.**

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. (Visible when the selected memory contains previous analyses).**
F2	**Cancels the deletion of the contents of the selected memory. (Visible when the selected memory contains previous analyses).**

Example 1: Saving the combustion analysis in manual mode

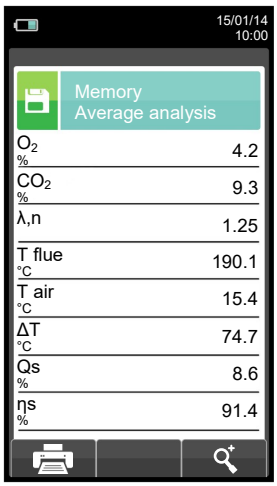


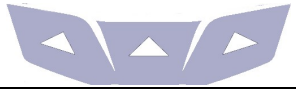
Example 2: Saving the combustion analysis in automatic mode (example UNI 10389)



FOR ANY FURTHER INFORMATION SEE CHAPTER 13 'FLUE GAS ANALYSIS'.

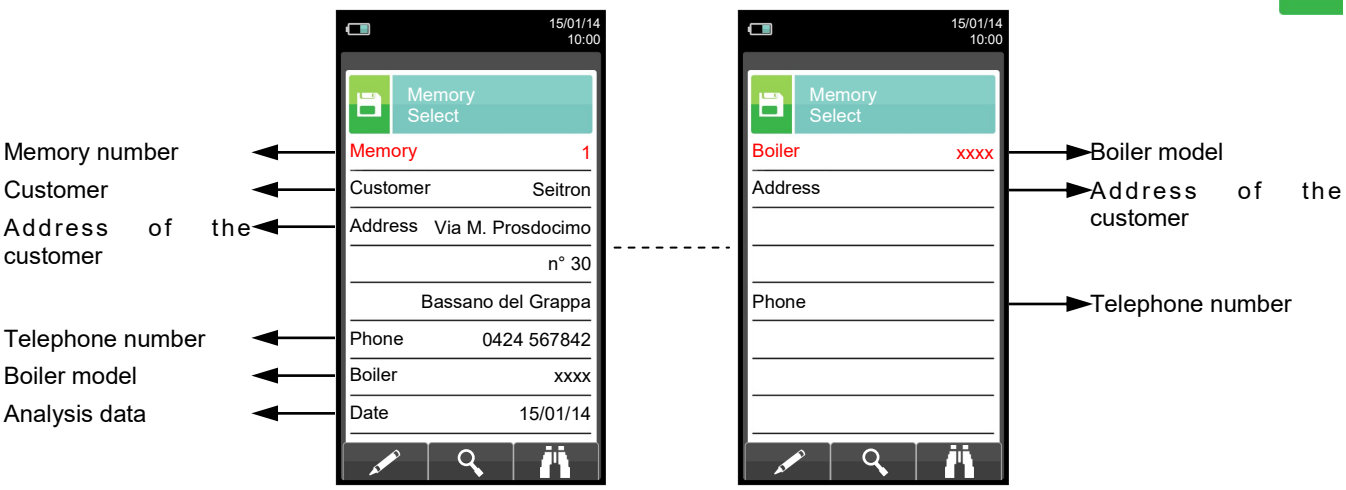
10.3 Memory Menu→Average

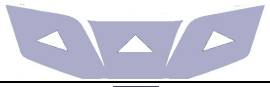
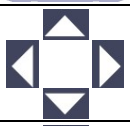


KEY	FUNCTION
	Activate the context keys shown on the display.
	Scrolls through the values of the average analysis.
	Activates the context key located in the left side of the display.
	Returns to the previous screen without saving the changes made.

CONTEXT KEY	FUNCTION
	Zoom. By pressing this interactive key repeatedly, the device displays the following sequence: AAA → **AAA** → **AAA** → AAA
	Starts printing the test ticket. SEE SECTION 11.

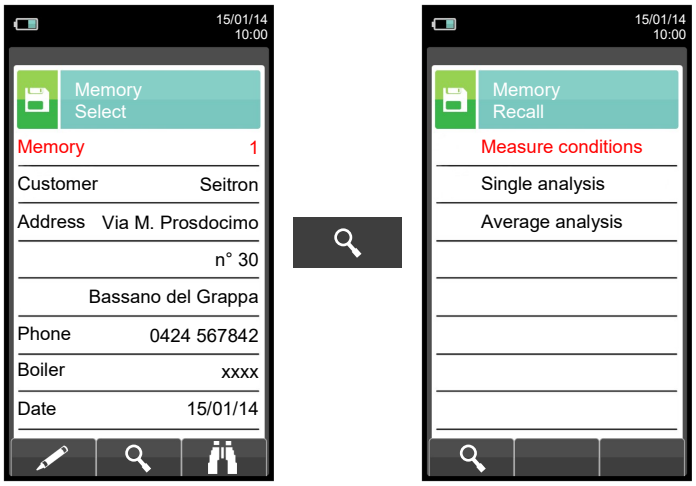
10.4 Memory Menu→Select

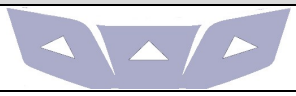


KEY	FUNCTION
	**Activate the context keys shown on the display.**
	**In "edit text"/"search for data"/"search for memory number": it moves the cursor on the box corresponding to the desired letter or number.**
	**Selects line; the selected line is evidenced in red.**
	**Activates the context key located 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.**

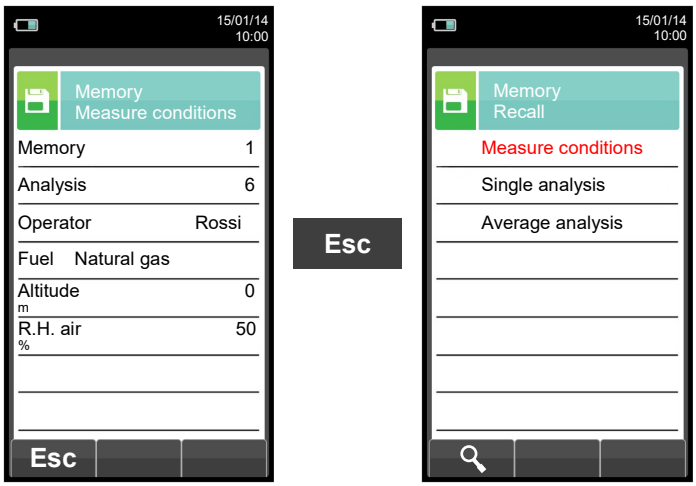
10.4.1 Memory Recall



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

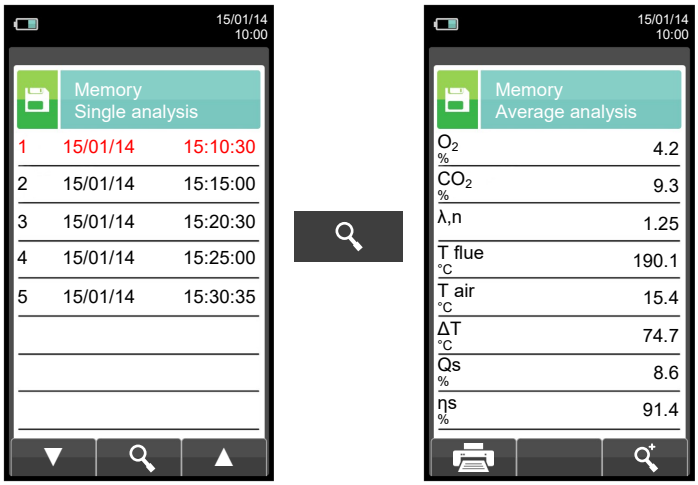
CONTEXT KEY	FUNCTION
	**Displays the details of the selected parameter.**

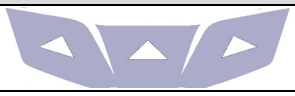
1. Details of measurement conditions



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

2. Details of Single analysis



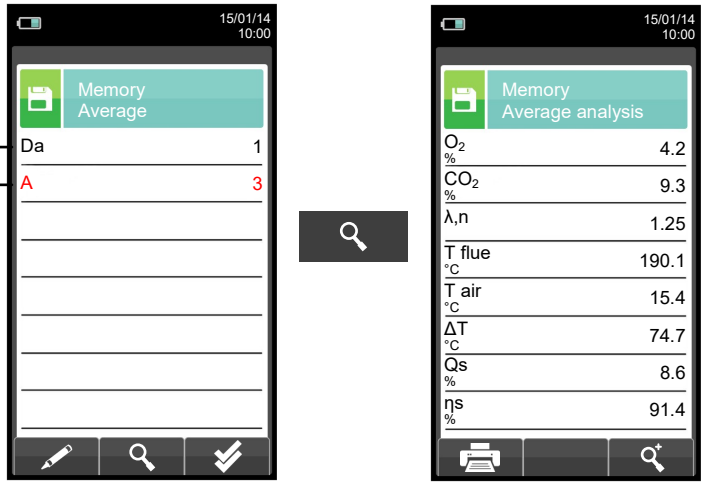
KEY	FUNCTION
	**Activate the context keys shown on the display.**
	**Selects line; the selected line is evidenced in red.** **In "view detail" the previous or next pages are shown.**
	**Views the details of the selected parameter.**
	**Returns to the previous screen.**

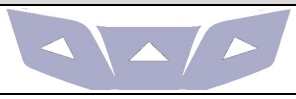
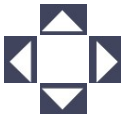
CONTEXT KEY	FUNCTION
	**Selects line; the selected line is evidenced in red.**
	**Views the details of the selected parameter.**
	**Selects line; the selected line is red.**
	**Goes to next page.**
	**Goes to previous page.**
	**Starts printing the test ticket.** **See section 11.**
	**Zoom. By pressing this interactive key repeatedly, the device displays the following sequence:** **AAA → AAA → AAA → AAA**

3. Average interval details

Defines the starting sample to define the analysis average.

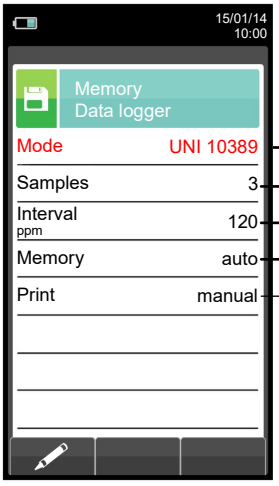
Defines the end sample to define the analysis average.



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 evidenced 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 the test ticket. SEE SECTION 11.**

10.5 Memory Menu→Data logger



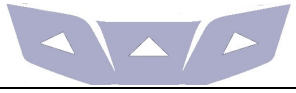
The selectable analysis modes are: **manual** - **UNI 10389** - **BImSchV** - **data logger**

Number of samples to make (parameter not visible in manual analysis mode).

Period of acquisition of each sample (parameter not visible in manual analysis mode).

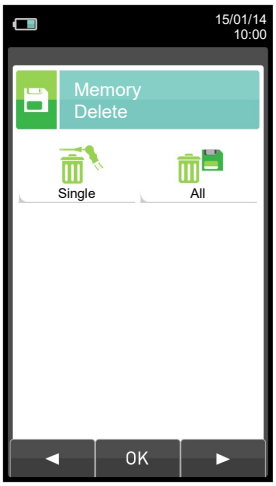
The memory selection modes are: **manual** or **auto**.
If "**auto**" mode has been selected, the research of the available memory will be performed automatically when the device is turned on).

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).

KEY	FUNCTION
	**Activate the context keys shown on the display.**
	**Selects line; the selected line is evidenced in red.**
	**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.**

10.6 Memory→Delete

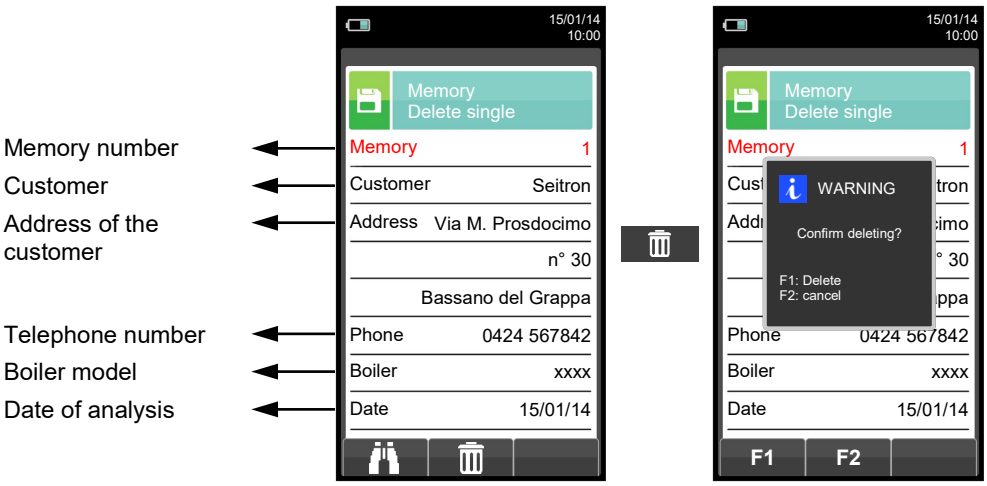


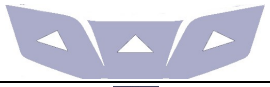
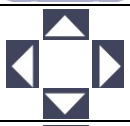
KEY	FUNCTION
	**Activate the context keys shown on the display.**
	**Returns to the previous screen.**

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 the 99 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.

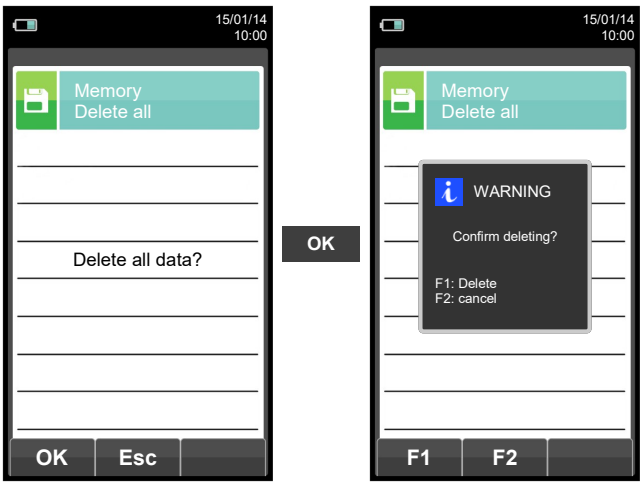
10.6.1 Memory→Delete→Single

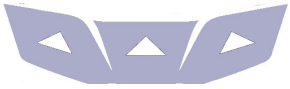


KEY	FUNCTION
	**Activate the context keys shown on the display.**
	**In "edit text"/"search for data"/"search for memory number": it moves the cursor on the box corresponding to the desired letter or number.**
	**Selects line; the selected line is evidenced in red.**
	**Activates the context key located 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.**

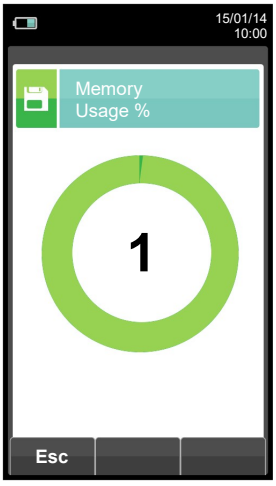
10.6.2 Memory→Delete→All

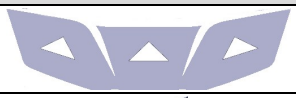


KEY	FUNCTION
	**Activate the context keys shown on the display.**
	**Start erasing all memories.**
	**Returns to the previous screen.**

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.**

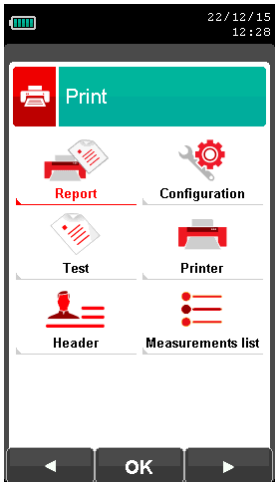
10.7 Memory→Usage %



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

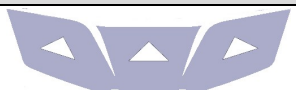


KEY	FUNCTION
	**Activate the context keys shown on the display.**
	**Returns to the previous screen.**

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

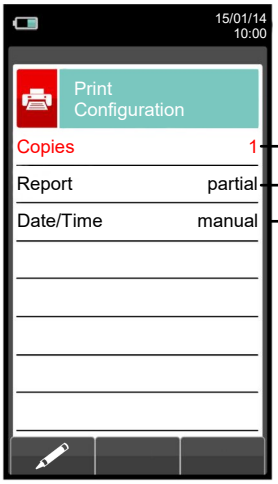
PARAMETER	DESCRIPTION
Report	Enables the Print Menu. Allows to print the combustion analysis data on a paper ticket which reports the measurement values. The printed values are those shown on the display when the menu is enabled. This menu can be used for combustion analysis, even when recalled from the memory, for draught, smoke, ambient gas and for tightness test results. SEE SECTION 11.2.
Configuration	The user, by means of this menu, can confugure the test report format: **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. **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: **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. **Partial:** only reports the combustion analysis measurement values and informations, without any header, comments or blank lines for operator comments. **Total:** prints full print-out of average values with individual test data. **Date/Time**: It allows you to define whether or not to print the date and time at which the combustion analysis was performed. **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. **Auto:** The date and time are printed in the header of the analysis report. SEE SECTION 11.3.
Test	**Paper feed:** Feeds paper in the printer; this function is most useful when replacing the paper roll in the printer. **Print:** Prints a graphical/alphanumeric test ticket for a complete check of the printer operation. SEE SECTION 11.4.
Header	It allows the user to enter, in six lines of 24 characters 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. SEE SECTION 11.5.
Printer	Selects the printer type: internal or Bluetooth. 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. SEE SECTION 11.6.
Measures 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. 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 ticket.**
F1	**Stops printing the test ticket.**

11.3 Print→Configuration



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

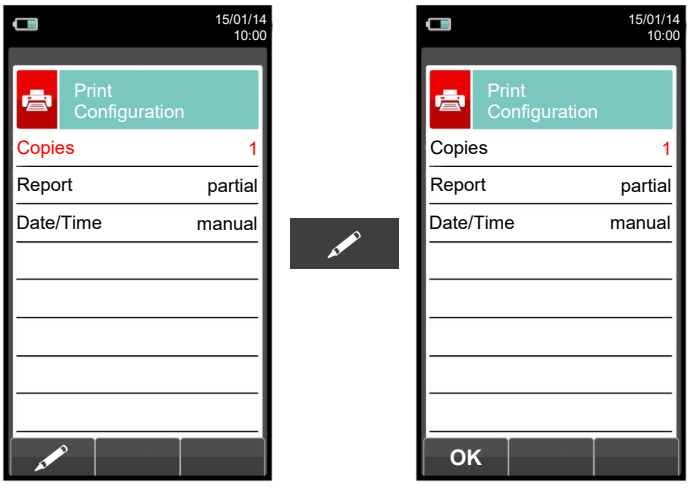
The test ticket models that can be selected are: **partial** - **full** - **total**

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

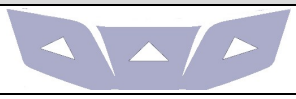
KEY	FUNCTION
	**Activate the context keys shown on the display.**
	**Selects line; the selected line is evidenced in red.** **In modification sets the value or the desired mode.**
	**Activates the context key located in the left side of the display.**
	**Returns to the previous screen.** **When in modify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

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

Example:

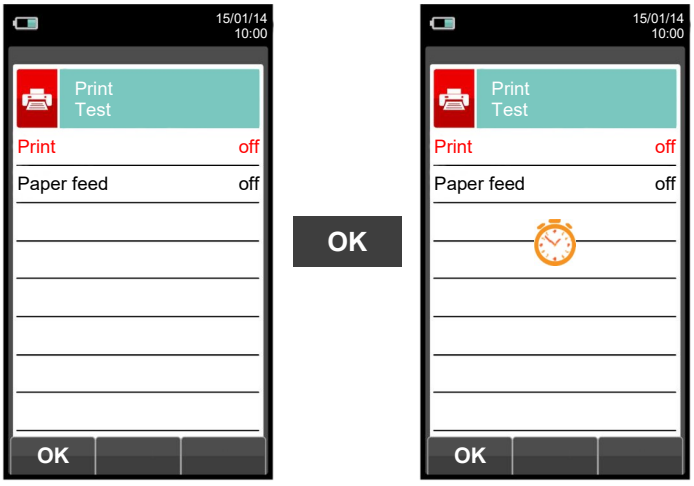


11.4 Print→Test

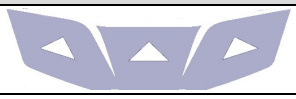
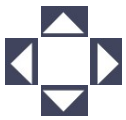
KEY	FUNCTION
	**Activate the context keys shown on the display.**
	**Selects line; the selected line is evidenced in red.** **In modification sets the value or the desired mode.**
	**Activates the context key located in the left side of the display.**
	**Returns to the previous screen.** **When in modify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

CONTEXT KEY	FUNCTION
OK	**Confirms the settings.**

Example:



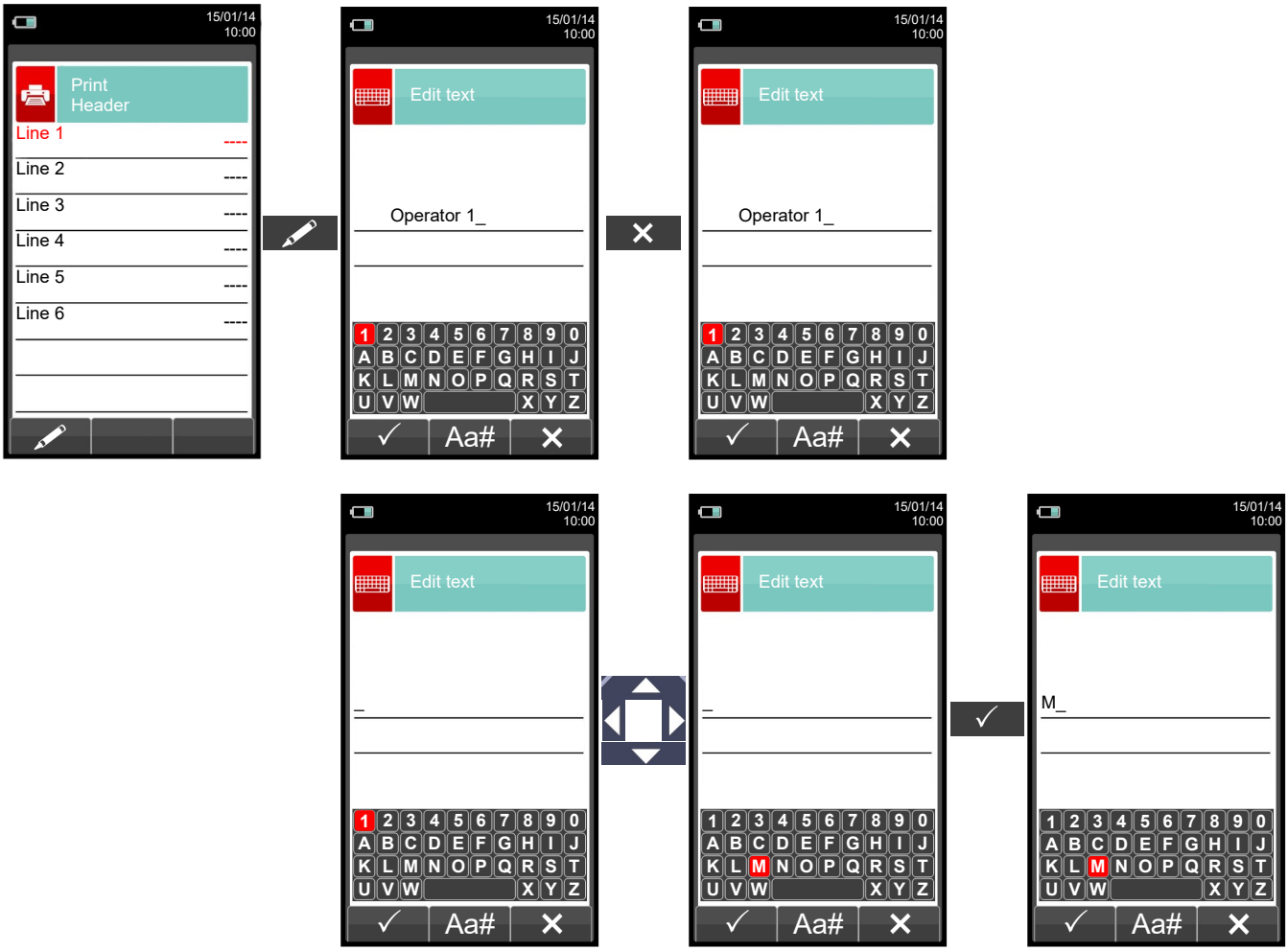
11.5 Print→Header

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.** **In "Print header": It activates the context key displayed on the left.**
	**Returns to the previous screen.** **In "edit text" it goes back to the previous screen without saving the changes made.**

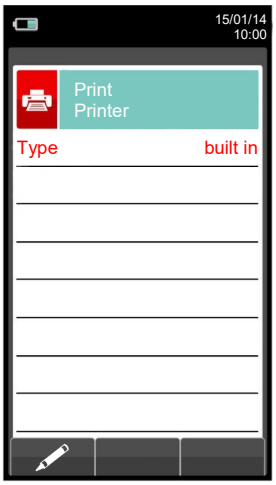
CONTEXT KEY	FUNCTION
	**Enters edit mode of the selected line: it is possible to enter the name of the operator (24 characters available).**
	**Confirms the selected letter or digit.**
	**Cancels the letter or digit before the cursor.**
	**Cycles through uppercase, lowercase, symbols and special characters.**

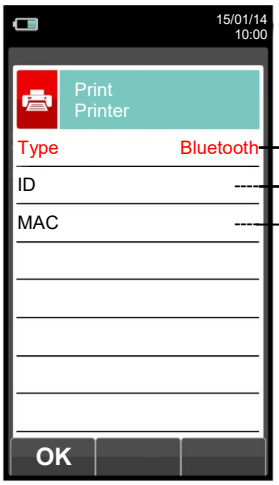
Example:

1. Edit text



11.6 Print→Printer

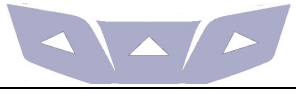




Printer type: **built in (internal) - Bluetooth (external)**.

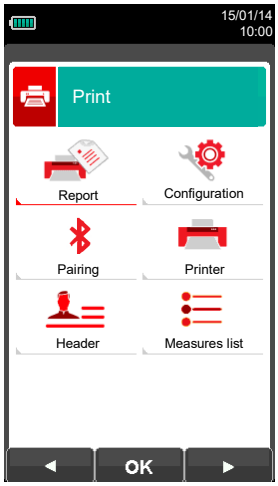
Name of the Bluetooth printer associated with the instrument.

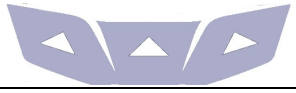
Address of the Bluetooth printer associated with the instrument.

KEY	FUNCTION
	**Activate the context keys shown on the display.**
	**Selects line; the selected line is evidenced in red.** **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.** **When in modify mode cancels the modification just made.**

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

11.6.1 Print→Pairing

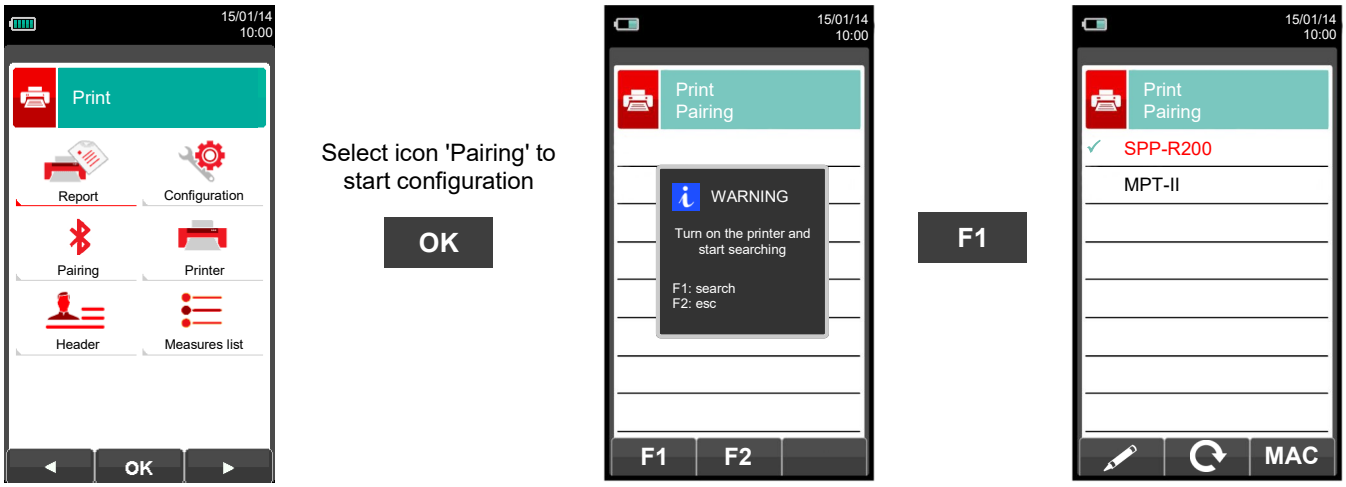


KEY	FUNCTION
	Activate the context keys shown on the display.
	Selects line; the selected line is evidenced in red. In modification sets the value or the desired mode.
	Activates the context key located in the left side of the display.
	Returns to the previous screen. When in modify mode cancels the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

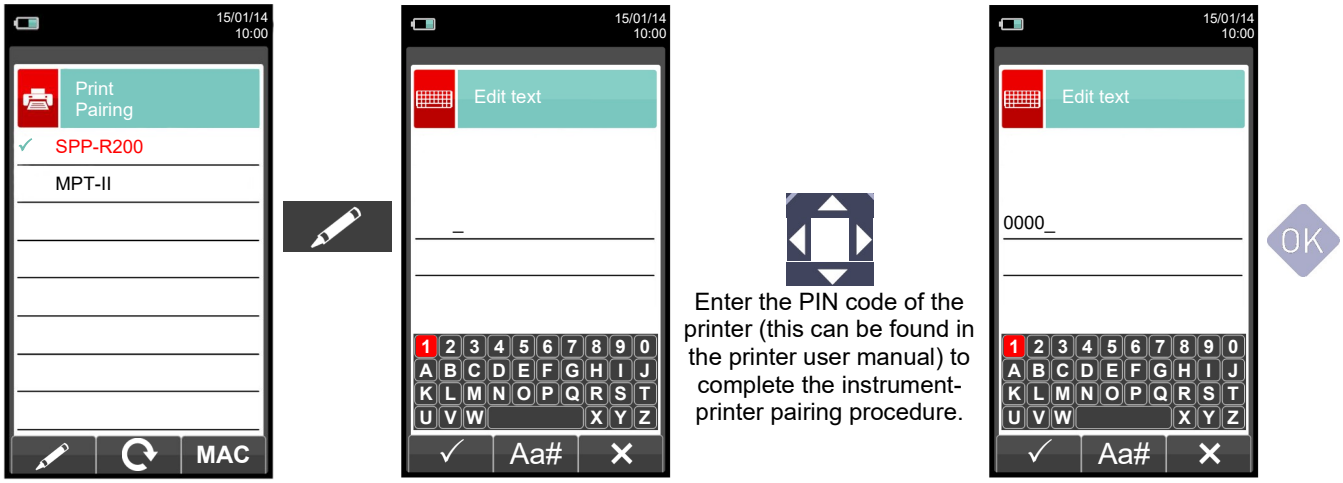
CONTEXT KEY	FUNCTION
◄	Selects the available parameters.
OK	Enters in the selected parameter setting.
►	Selects the available parameters.
F1	Starts the search for Bluetooth devices.
F2	Quits and returns to the previous screen.
	Enters the modification mode for the selected parameter.
	Repeats the pairing 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:**

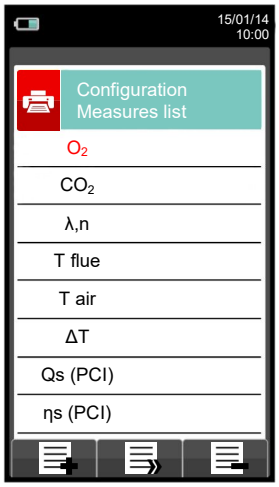


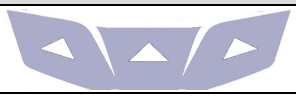
2. **Select the line corresponding to the desired Bluetooth printer, then proceed as follows:**



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

11.7 Print→Measures list

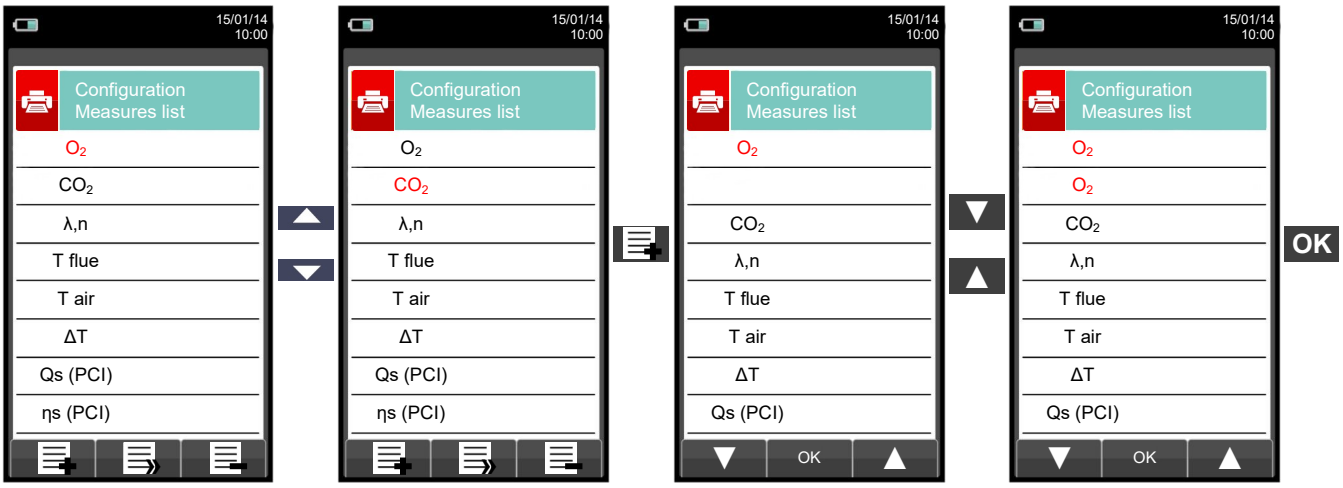


KEY	FUNCTION
	**Activate the context keys shown on the display.**
	**Selects the available measurements from the suggested list. In edit mode, it scrolls through the measurements present.**
	**Confirms the modification.**
	**When pressed in modify mode cancels the selection made, otherwise returns to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

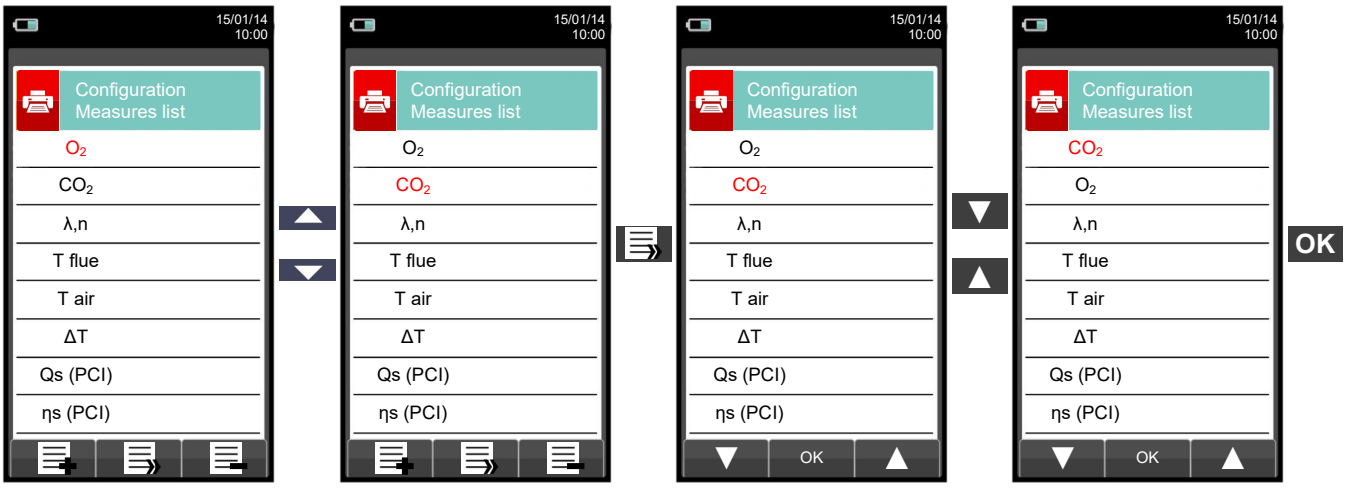
CONTEXT KEY	FUNCTION
	**Adds a measurement.**
	**Moves the position of a measurement.**
	**Delets a measurement from the list.**
	**Scrolls through the available measurements.**
OK	**Confirms the change made.**
	**Scrolls through the available measurements.**
Esc	**Cancels the change made.**

Example:

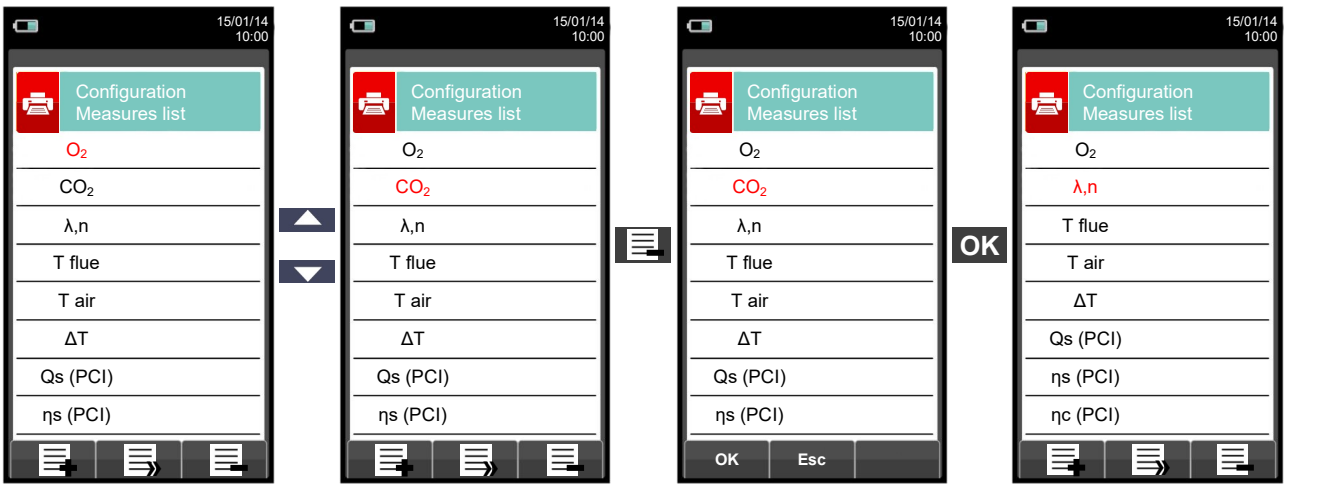
1. Add a measurement to the list



2. Move the position of a measurement



3. Deletes a measurement from the list



12.1 MEASUREMENTS

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

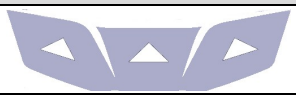
CONTEXT KEY	FUNCTION
◄	**Selects the available parameters.**
OK	**Enters in the selected parameter setting.**
►	**Selects the available parameters.**

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. **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.** **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. 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. These measurements can be either stored in memory together with the combustion analysis data or printed on a ticket. **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: **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). **It is compulsory to perform the autozero in the clean air, 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.** **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. 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 T1. With the function ΔT it is possible to obtain the relative temperature difference. **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. **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. **SEE SECTION 12.7 .. 12.12.**
 Leak detector	THIS MENU IS AVAILABLE ONLY IF THE SENSOR FOR GAS LEAKSISINSTALLED IN THE INSTRUMENT. It allows to identify gas leaks in plants, in pipes and in the devices. To perform the test it is required to have installed the specific internal semiconductor sensor for gas leaks detection and the relevant probe with flexible hose and metal tip, which allows to withdraw the gas in a localised point even in areas with very small leaks. The sensor is sensitive to both CH4 (Methane) and LPG (IsoButane and IsoPropane) as well as several other combustible gases (hydrocarbons). **SEE SECTION 12.13.**
 Aux meas.	Through this menu the user can access additional measures. **SEE SECTION 12.14.**

12.2 Measurements→Draught

To measure the draught 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 draught.
- The draught values to be stored in the memory must be acquired before storing the analysis data.
- To attach the draught value to the readings of the current analysis, activate the "save" function '  '.
- To print the test ticket with the value of the draught, activate the function '  '.
- It is possible to cancel an acquired draught from the memory; to overwrite a new one, activate the "save" function again '  '.
- After saving the draught measurement, to carry out the combustion analysis, press the key '  '.

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 Draught measurement.**
	**Carries out pressure zeroing.**
	**Saves, in the memory selected in the "Memory Select" menu, the value of the draught measured.**
	**Starts printing the test ticket.** **SEE SECTION 11.**

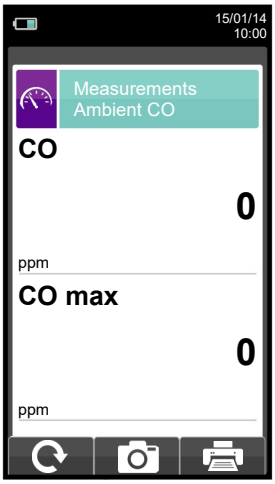
12.3 Measurements→Smoke

- Measure the carbon black using the specific optional kit.
- 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 ticket 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 ' '.

KEY	FUNCTION
	Activate the context keys shown on the display.
	Sets the "soot number" found by the device when measuring the carbon black.
ESC	**Returns to the previous screen.**

CONTEXT KEY	FUNCTION
	Enters the modification mode for the selected parameter.
OK	**Confirms the value entered.**
	Saves, in the memory selected in the "Select Memory" menu, the values entered.
	Starts printing the ticket. **SEE SECTION 11.**

12.4 Measurements→Ambient CO



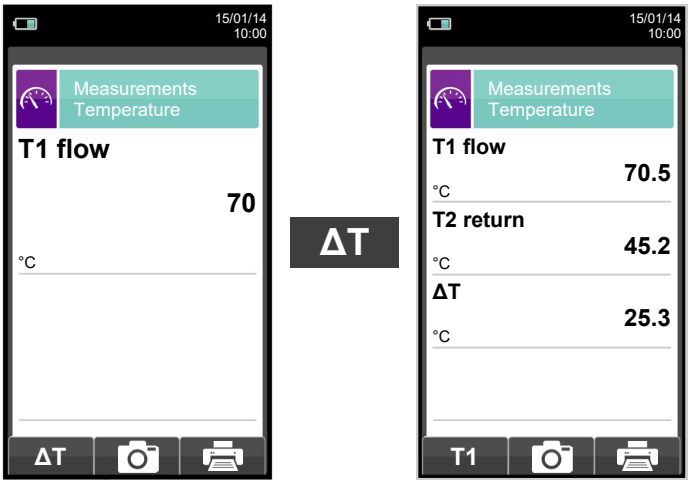
It is compulsory to perform the autozero in the clean air, so that the ambient CO measurement is correct. It is advisable to turn on the instrument and wait for the autozero completion outside the area where the test is being performed.

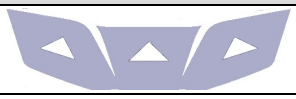
- The values of the ambient CO that you want to save must be acquired before saving the analyses.
- To join the values of the ambient CO to the measurements of the current analysis use the " " function.
- To print the ticket with the measurement of the ambient CO, activate the " " function
- It is possible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

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 ticket. SEE SECTION 11.

12.5 Measurements→Temperature



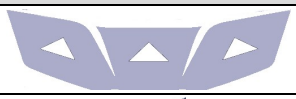
KEY	FUNCTION
	**Activate the context keys shown on the display.**
	**Returns to the previous screen.**

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 ticket. SEE SECTION 11.**

12.6 Measurements→Pressure

Measurement of the differential pressure by means of the internal pressure sensor.

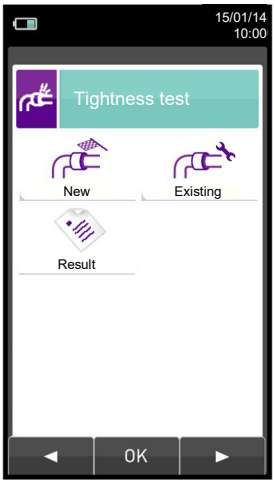
Measurement of the pressure by means of an external draught gauge.

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 ticket.** **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).



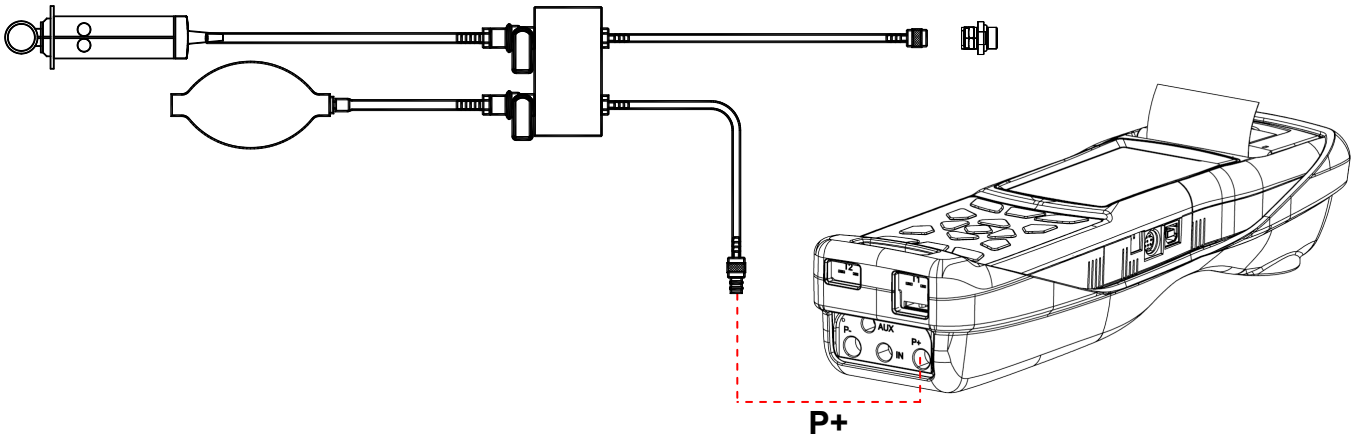
Tightness test according DVGW TRGI (when the instrument version so provides).

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

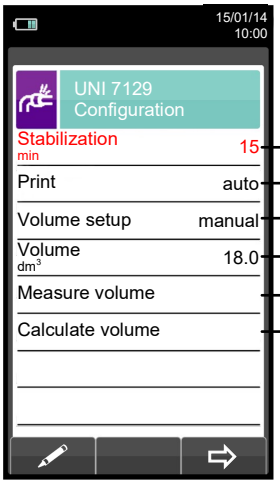
CONTEXT KEY	FUNCTION
◄	**Selects the available parameters.**
OK	**Enters in the selected parameter setting.**
►	**Selects the available parameters.**

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, 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.**

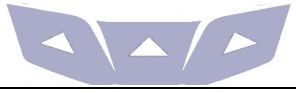
12.7.1 Connecting the tightness test kit to the instrument.



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



- Duration of the stabilisation 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 evidenced in red.** **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.** **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 ticket.**

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 500 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 500 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 500 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 siringe 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 stabilisation 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 stabilisation phase. In the stabilisation 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.

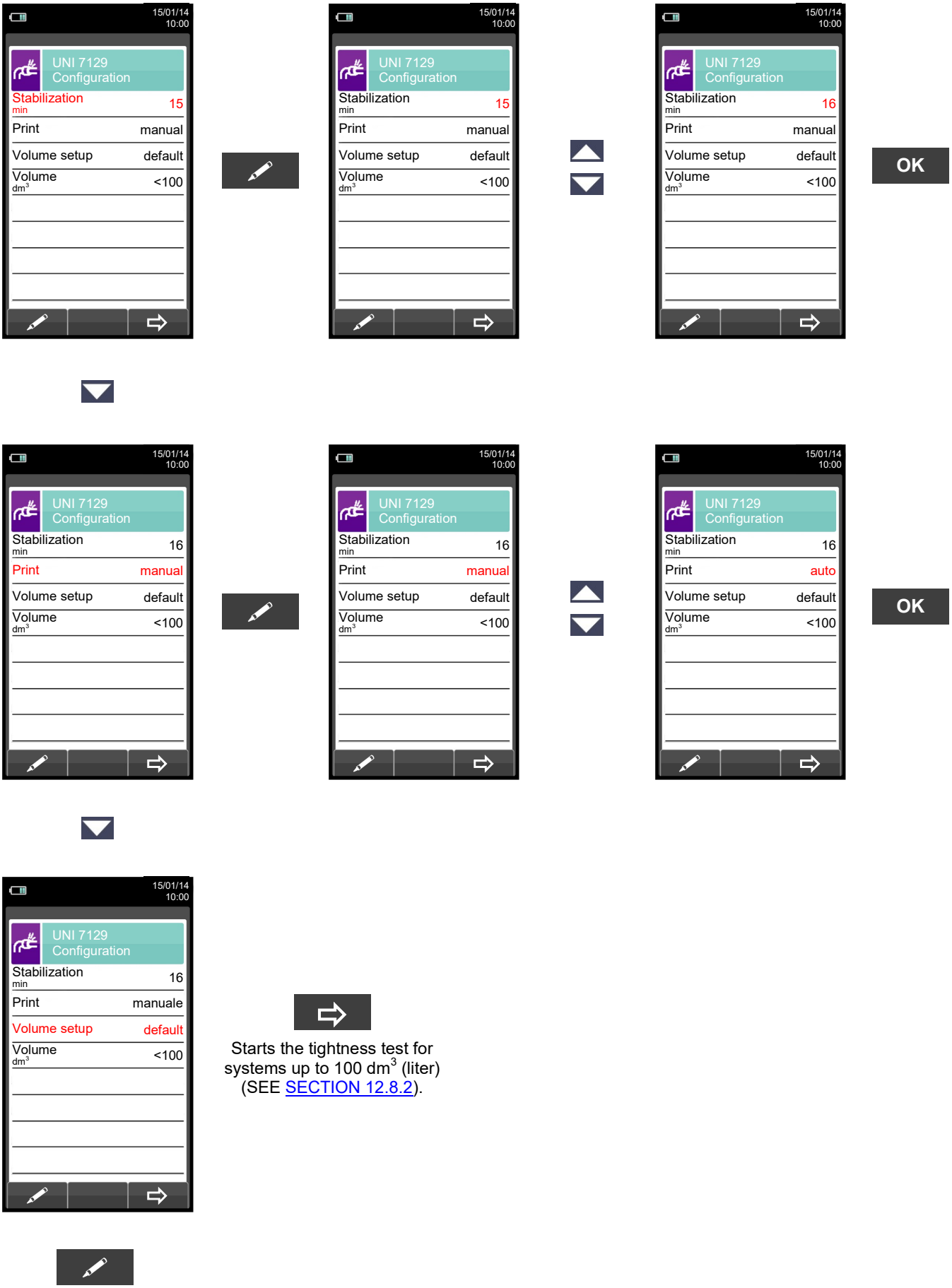
During the tightness test phase the following values are displayed:

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.

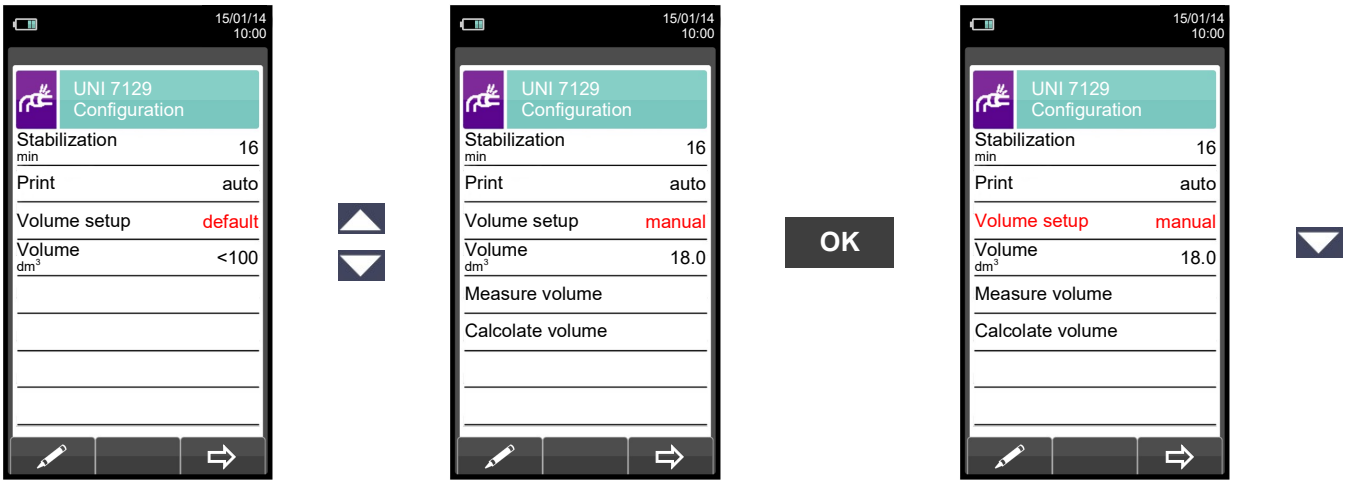
After the tightness test, the results are displayed: the data displayed is as follows:

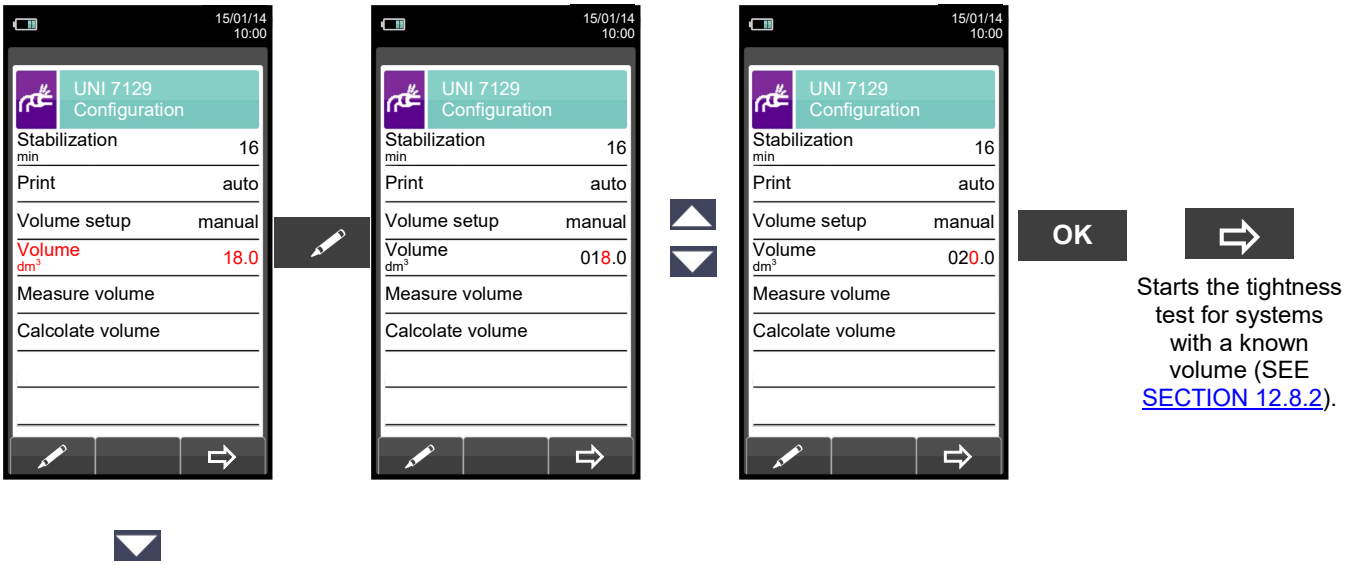
P1: Pressure measured at the beginning of the test.
P2: Pressure measured by the device.
∆**P**: Pressure variation between the last instant and the first instant of the test. If the pressure decreased, it presents a negative value.
Result: Reports the test result:
tight when the pressure is within the 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

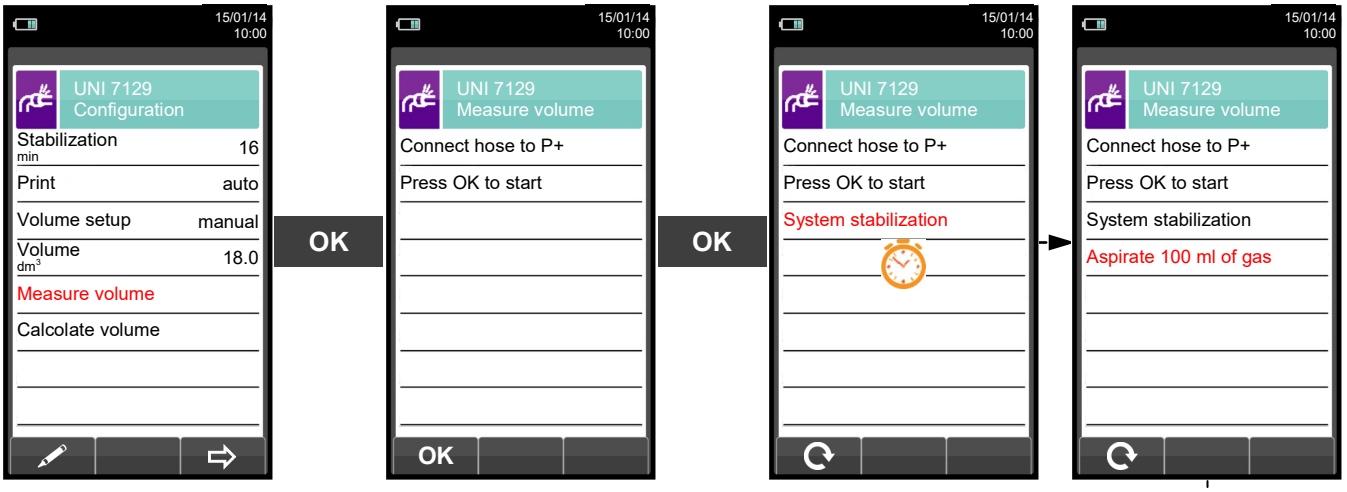


Starts the tightness test for systems up to 100 dm^3 (liter) (SEE SECTION 12.8.2).



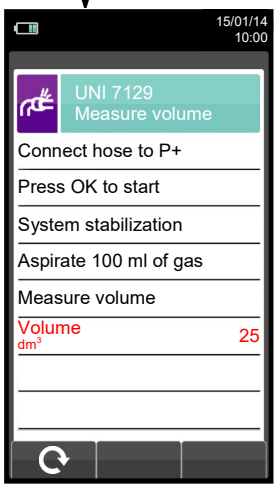


Starts the tightness test for systems with a known volume (SEE SECTION 12.8.2).

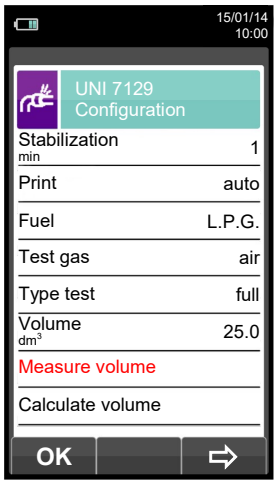


Alternatively

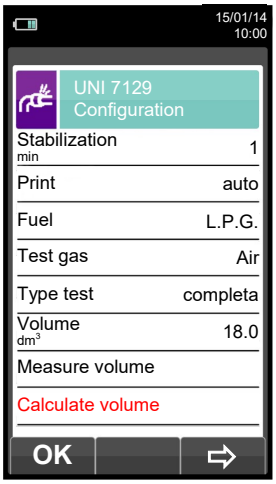
Take, with the syringe (that comes with the tightness test kit), 100 ml of gas.
If the volume measuring procedure of the system ends correctly, CHEMIST 500 automatically displays the measured volume, otherwise it requires another test.



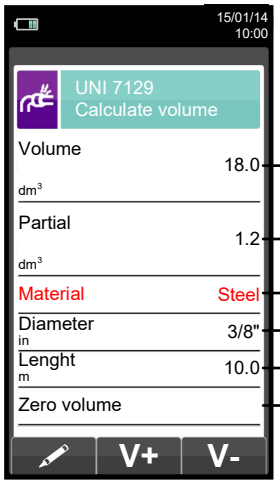
ESC



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

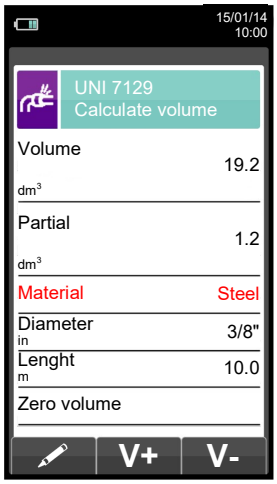


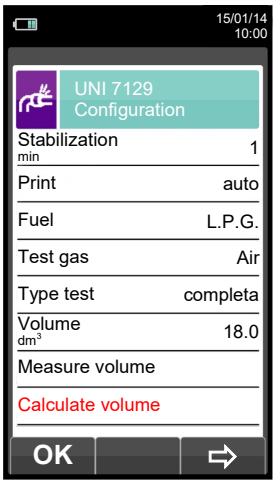
OK



- 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.

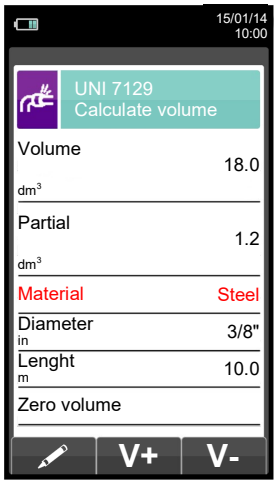
V+ Adds up the volume of the section of piping entered.

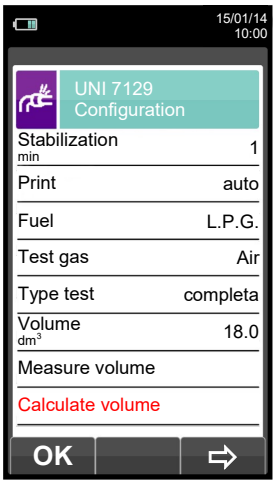




Starts the tightness test (see section 12.9.2).

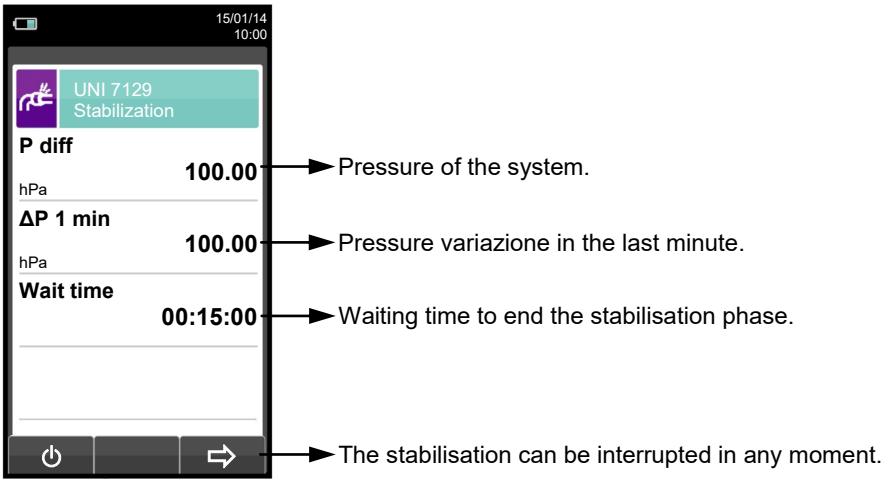
V- Subtracts the volume of the section of piping entered.



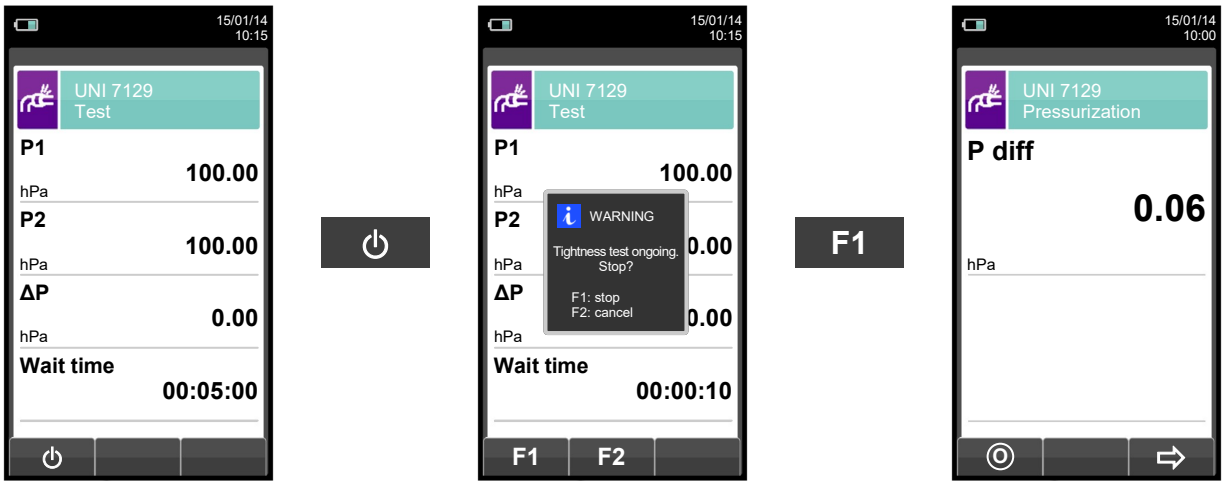


Starts the tightness test (see section 12.9.2).

12.8.2 PERFORMING TIGHTNESS TEST ACCORDING TO UNI 7129



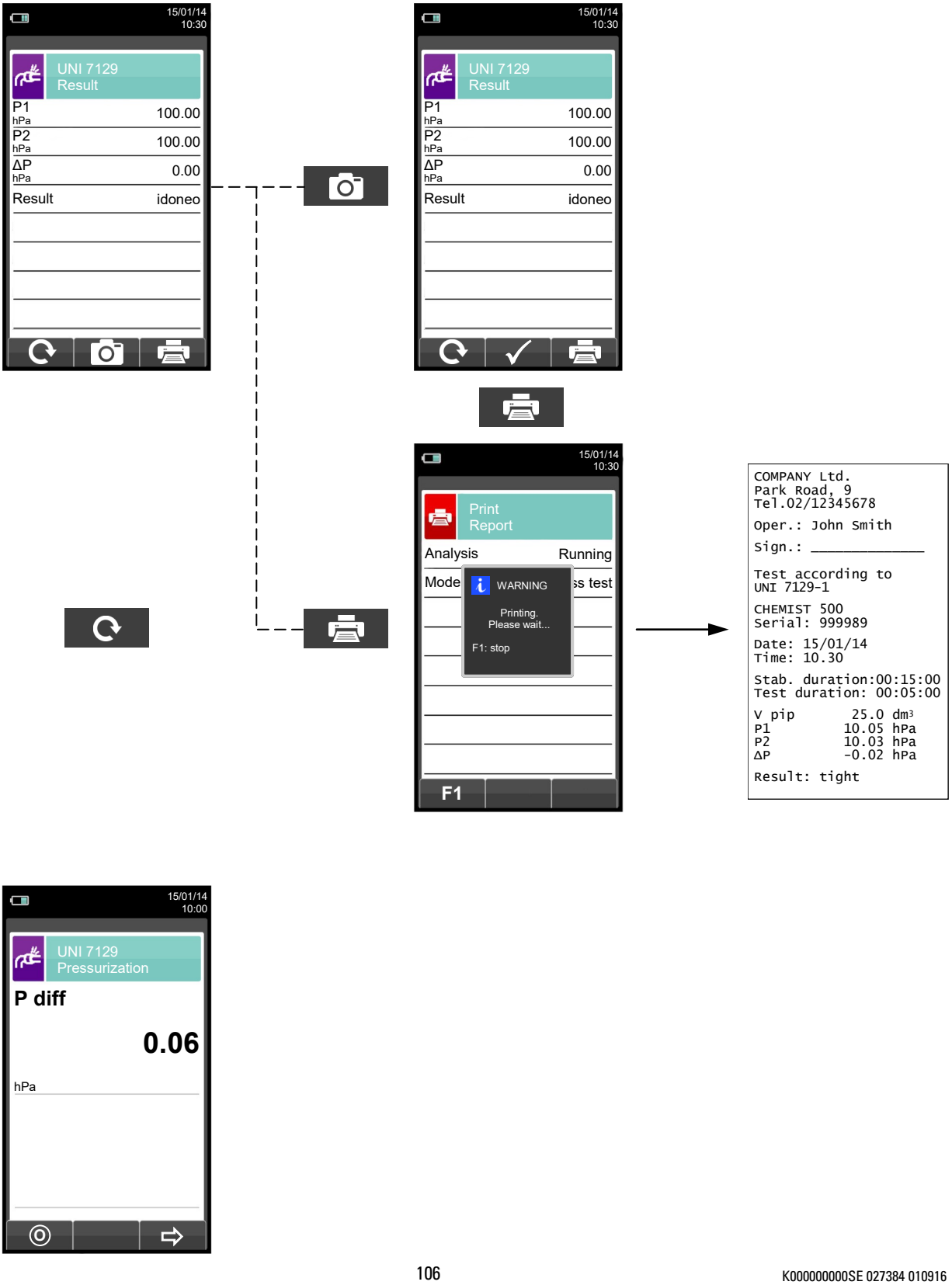
Automatically



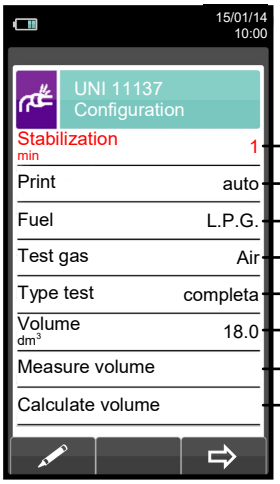
Automatically,
after 5 minutes.

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

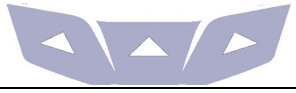
Instead, if the manual printing mode has been selected (exemplified case), at the end of the tightness test the results are displayed and they can be saved and/or printed.
In this case proceed as follows:



12.9 EXISTING PIPING: UNI 11137: 2012 STANDARD
(when the instrument version so provides)



- Duration of the stabilisation 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 evidenced in red.** **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.** **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.** **- in "Measure Volume" it starts the volume measuring procedure.** **- 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.** **- 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 ticket.**

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: Chemist 500 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 500 allows the user to customise the stabilisation phase:

STABILISATION: 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 7129-1: 2015 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, Chemist 500 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. CHEMIST 500 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 siringe 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 stabilisation 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 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.

Once the stabilisation 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 stabilisation phase. In the stabilisation 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.

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.

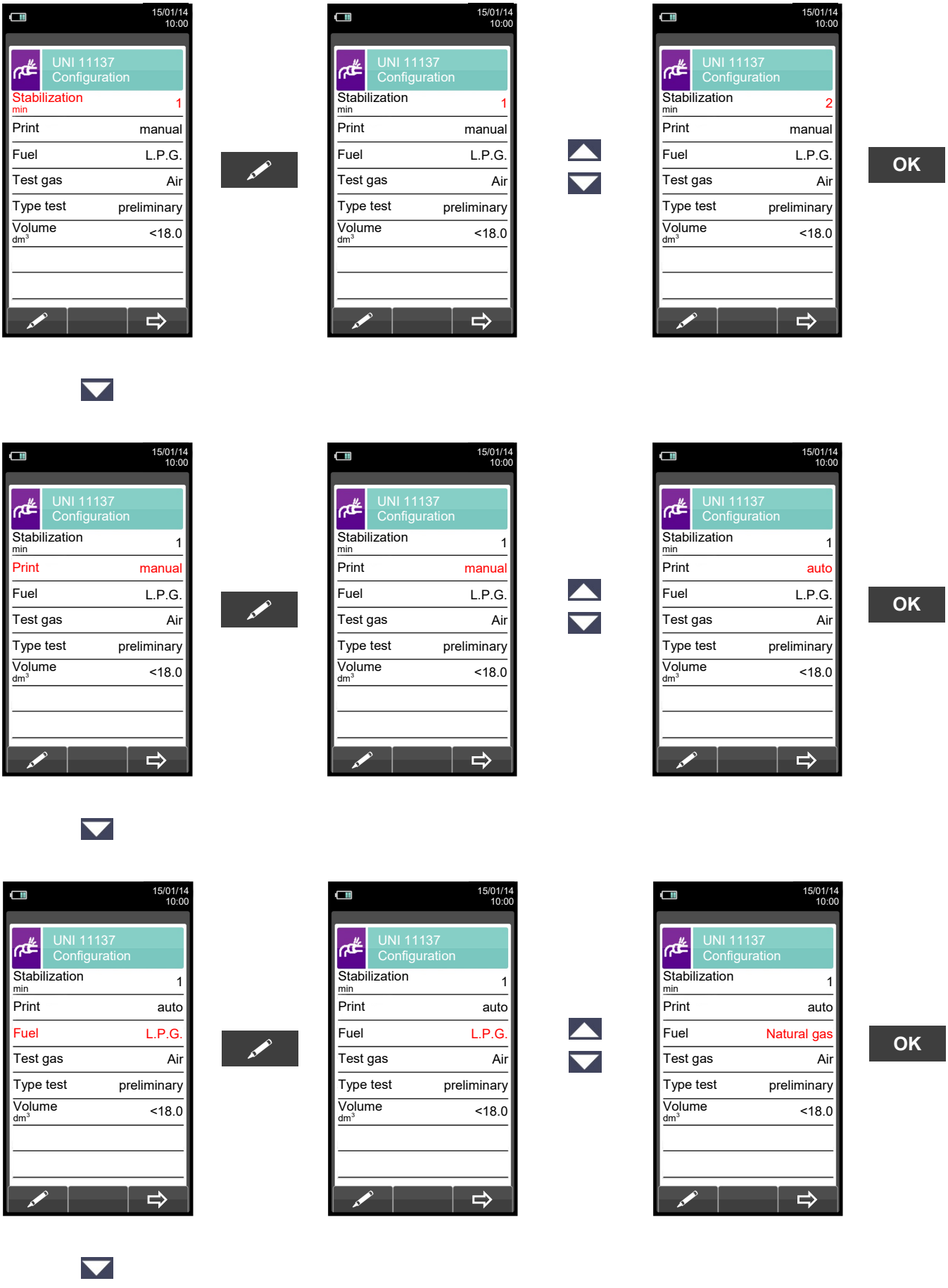
Result: is the result of the tightness test.

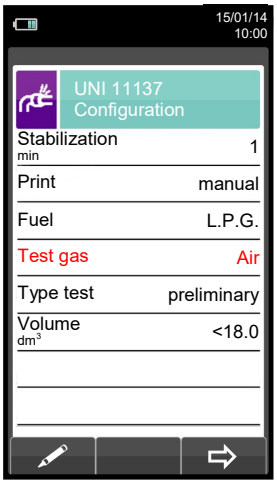
Compliant (piping suitable for operation): when the leakage flow calculated in the reference conditions is not greater than 1 dm^3/h for methane and not greater than 0,4 dm^3/h for LPG the system is authorized to operate without restrictions or intervention.

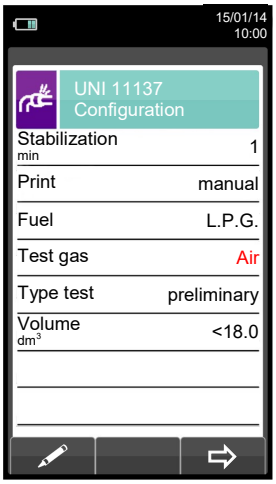
Compl. 30 DD (piping temporarily suitable for operation): when the leakage flow calculated in the reference conditions is included in the range 1 dm^3/h < Qref ≤ 5 dm^3/h for methane and in the range 0,4 dm^3/h < Qref ≤ 2 dm^3/h for LPG. The system is authorized to operate only for the time needed for 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.

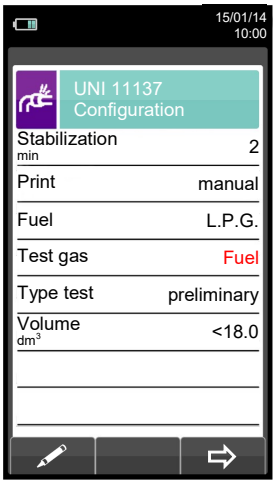
Non compliant (not suitable for operation): when the leakage flow is greater than 5 dm^3/h for methane and greater than 2 dm^3/h for LPG. In this situation the measured leakage is such that the piping is not suitable for operation and must immediately placed out of order. Once the leakage problem has 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

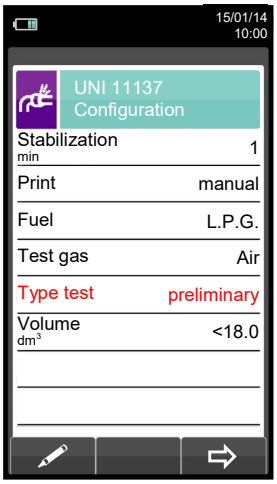




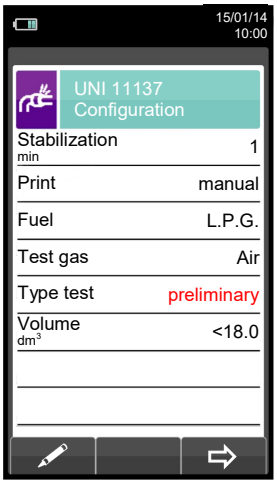


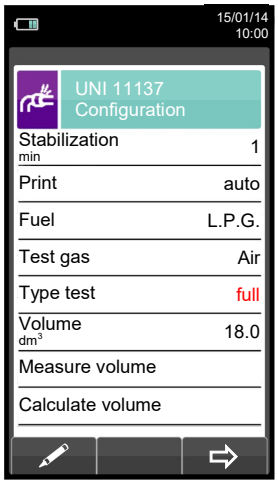


OK

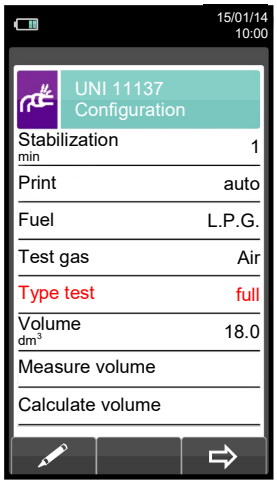


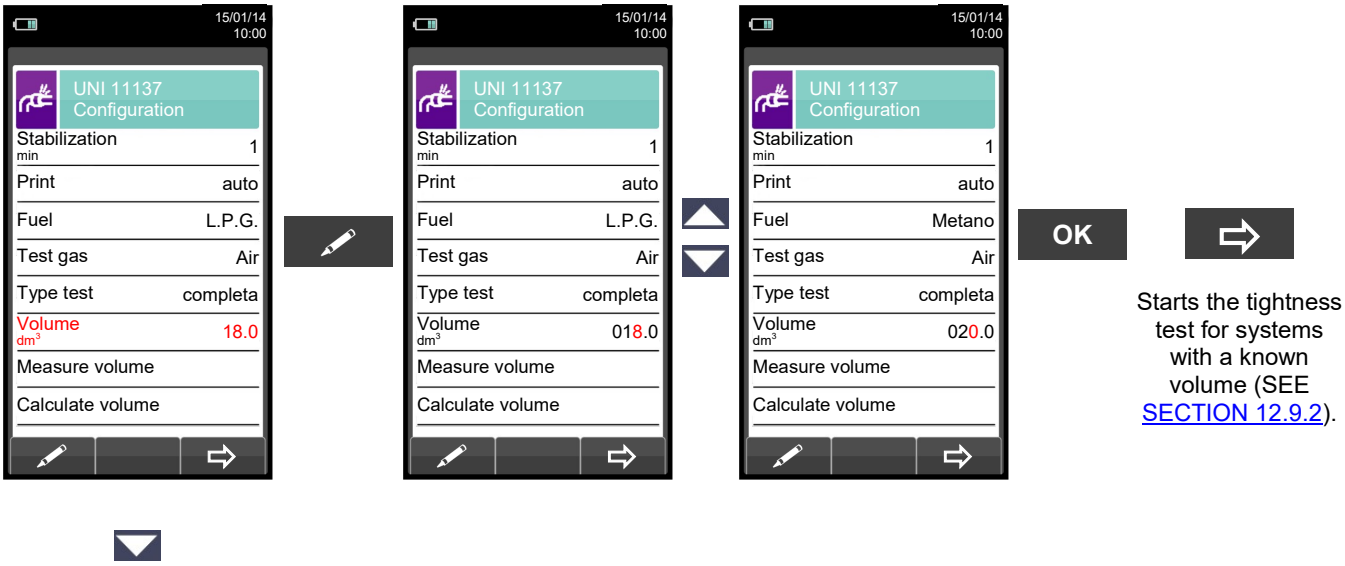
Starts the tightness test for systems up to 18 dm^3 (SEE SECTION 12.9.2).



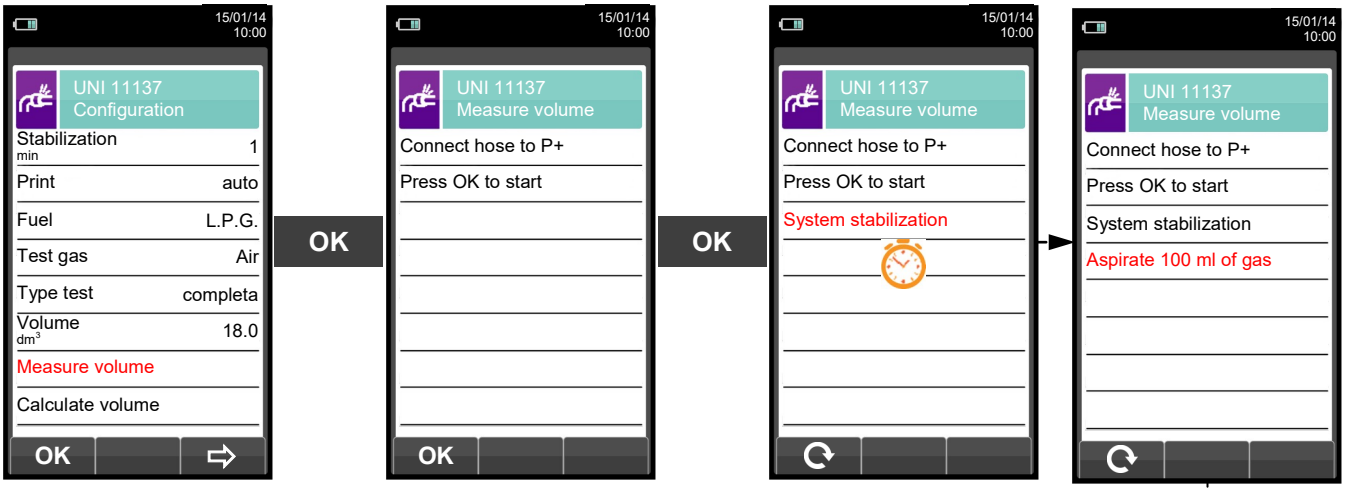


OK



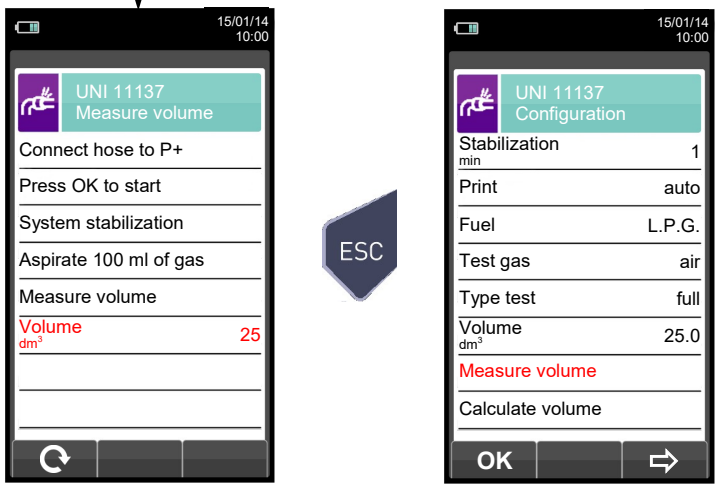


Starts the tightness test for systems with a known volume (SEE SECTION 12.9.2).

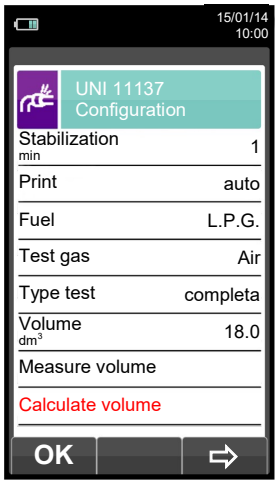


Alternatively

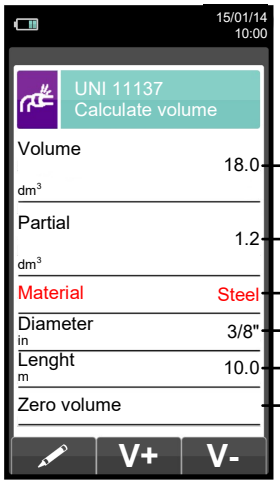
Take, with the syringe (that comes with the tightness test kit), 100 ml of gas.
If the volume measuring procedure of the system ends correctly, CHEMIST 500 automatically displays the measured volume, otherwise it requires another test.



Starts the tightness test after measuring the volume (SEE SECTION 12.9.2).

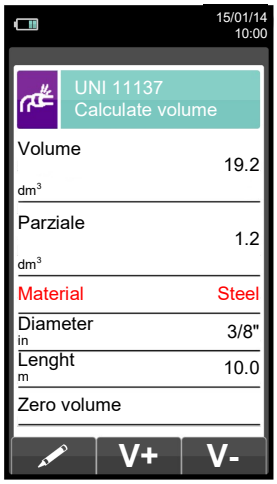


OK

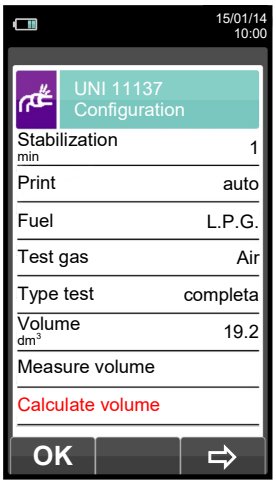


- 18.0 → Total volume acquired.
- 1.2 → Volume of the section of piping set below.
- Steel → Sets the material of the section of piping.
- 3/8" → Sets the nominal diameter of the section of piping.
- 10.0 → Sets the length of the section of piping.
- Zero volume → Zeroes the volume previously acquired.

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

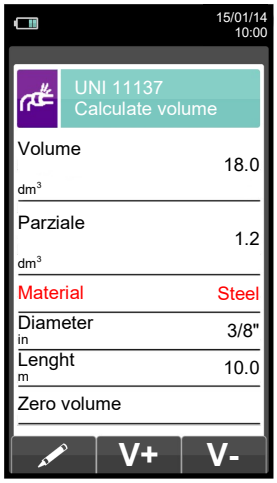


ESC

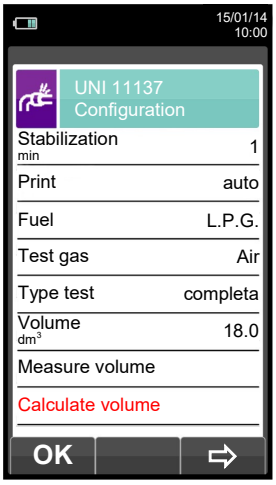


⇨ Starts the tightness test (see section 12.9.2).

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

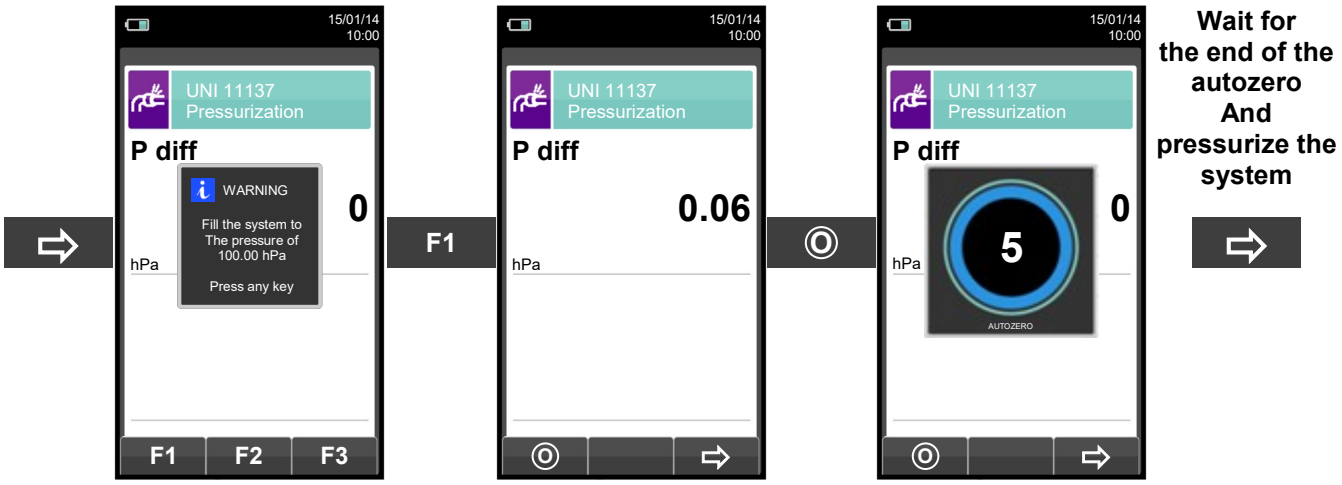


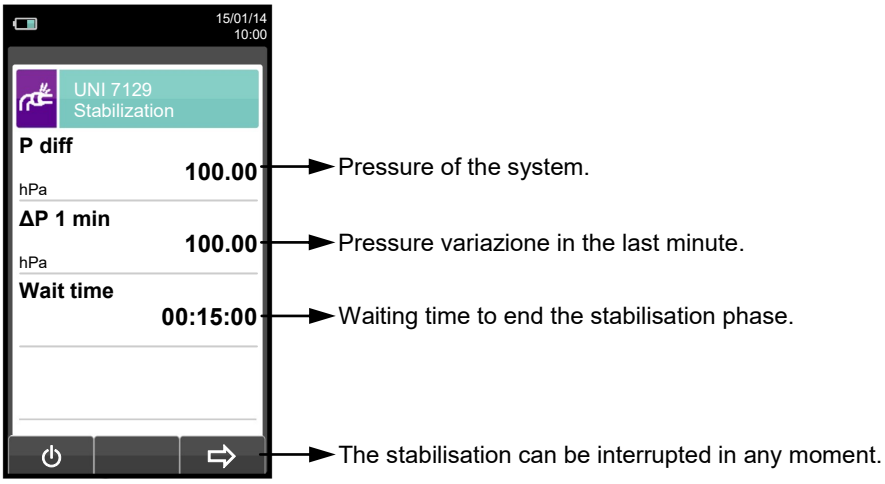
ESC



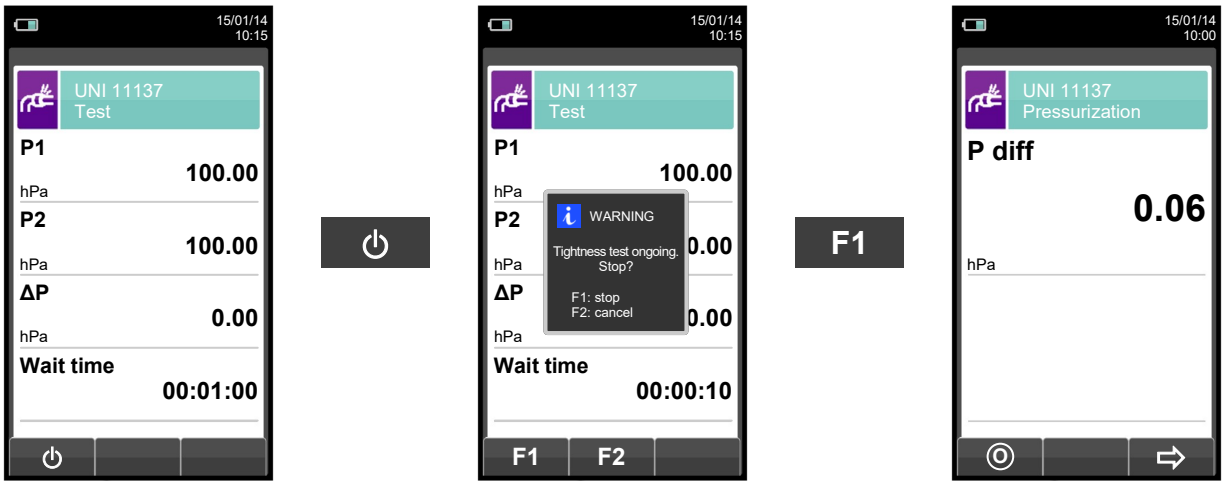
⇨ Starts the tightness test (see section 12.9.2).

12.9.2 PERFORMING THE TIGHTNESS TEST ACCORDING TO UNI 11137





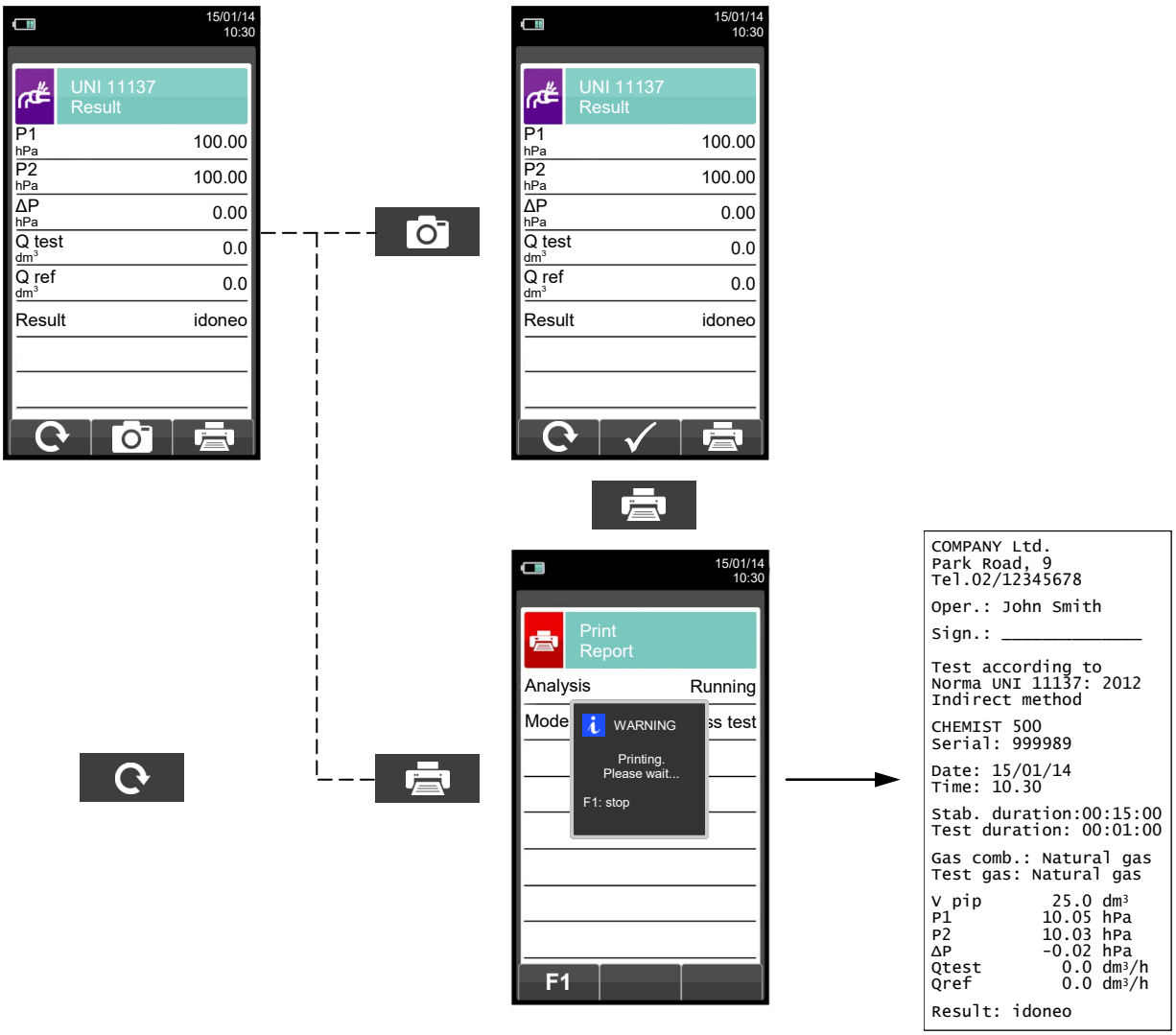
Automatically



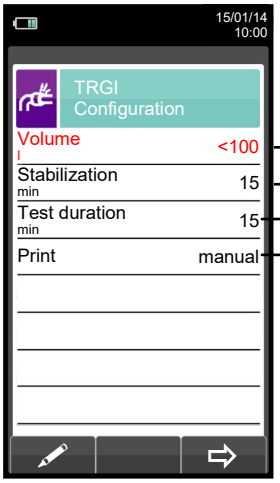
Automatically,
after 1 minute.

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

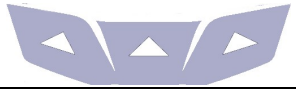
Instead, if the manual printing mode has been selected (exemplified case), at the end of the tightness test the results are displayed and they can be saved and/or printed.
In this case proceed as follows:



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 evidenced in red. In edit mode, it is the desired value.**
	**Enters the selected parameter setting.**
	**Returns to the previous screen. 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 ticket.**

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 servicing 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.**

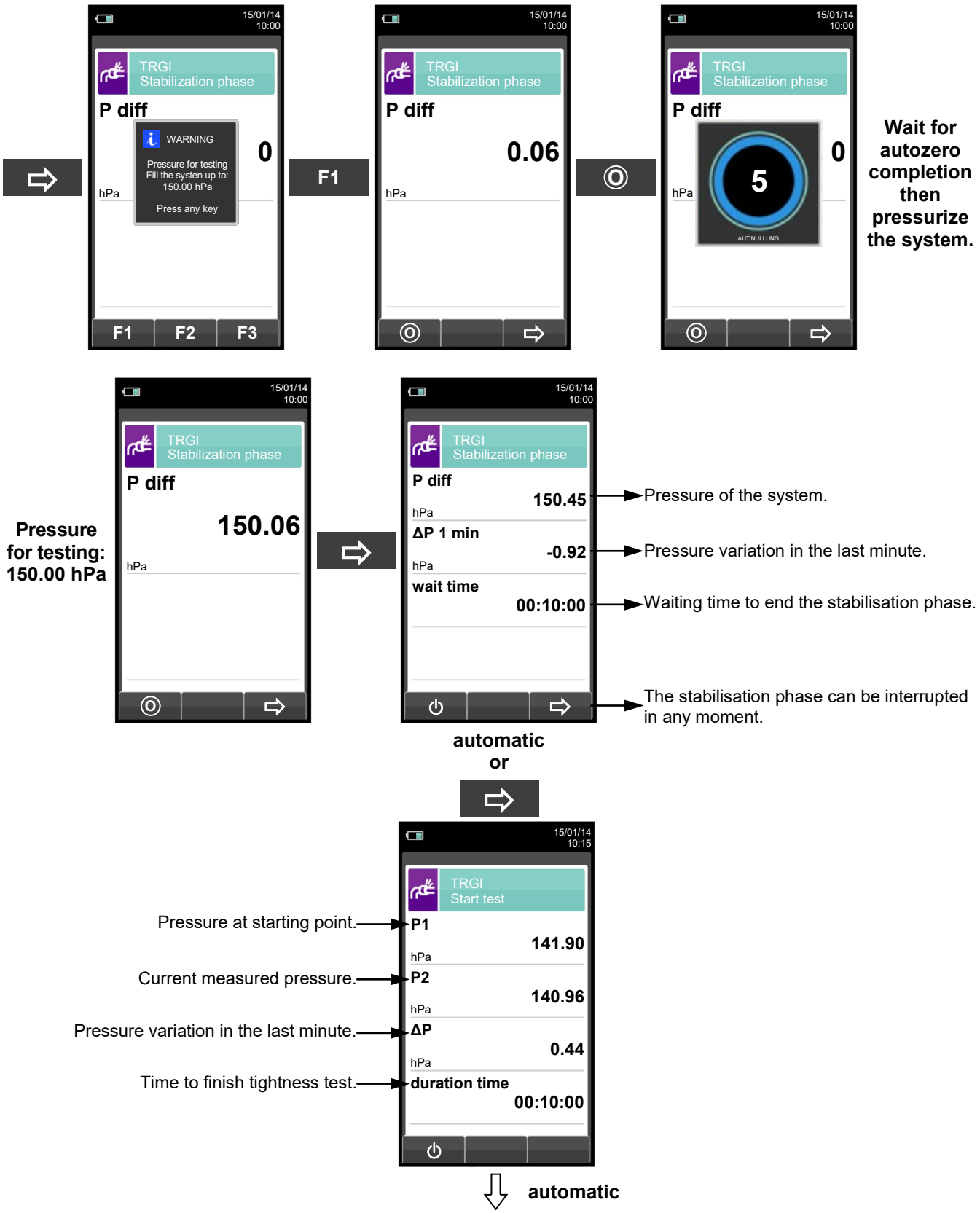
According to DVGW TRGI 2008 - no pressure drop is allowed!

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.

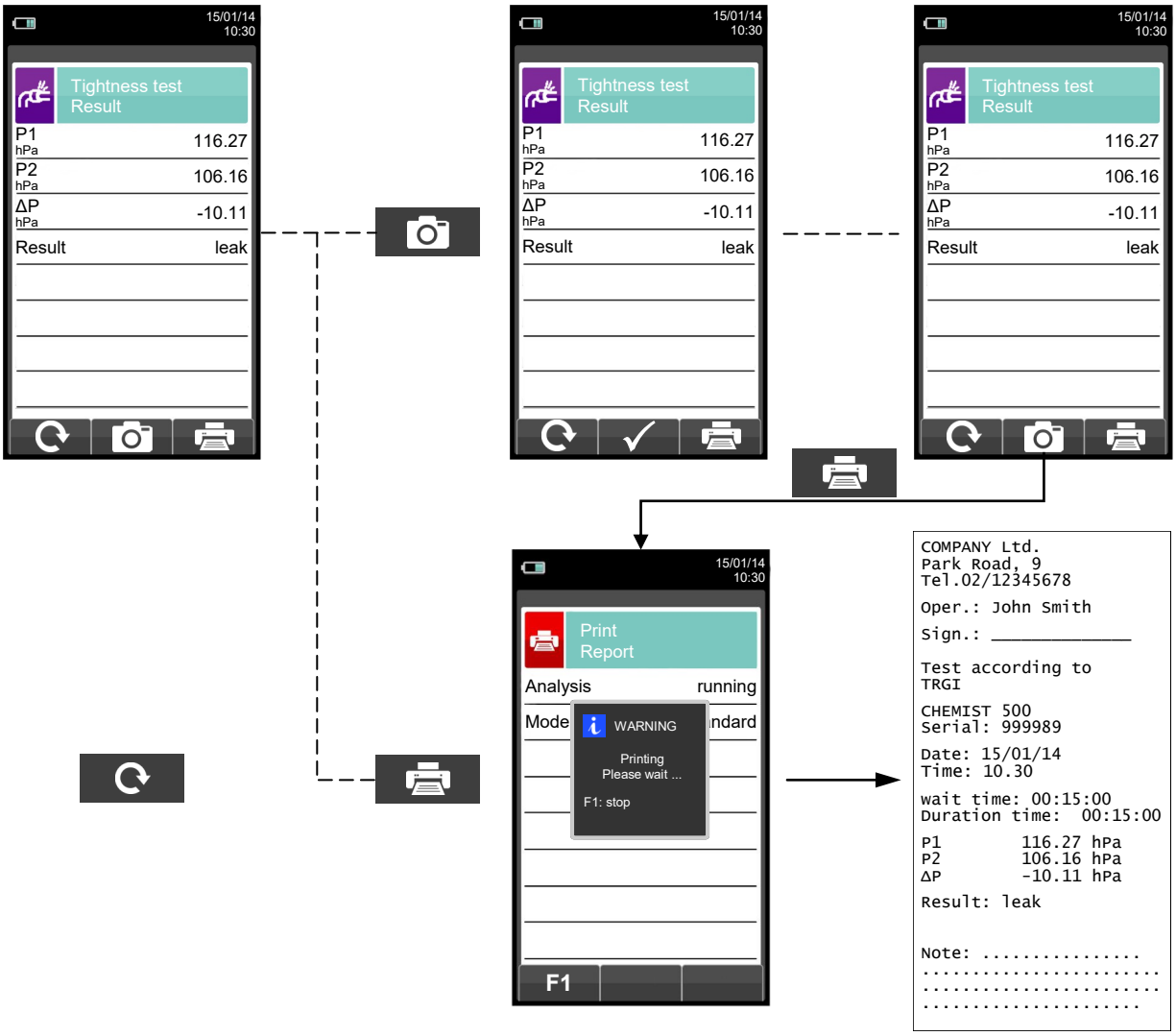
The loading and the serviceability test can not be testetd with the flue gas analyzer CHEMIST 500, you have to use other measuring devices.

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



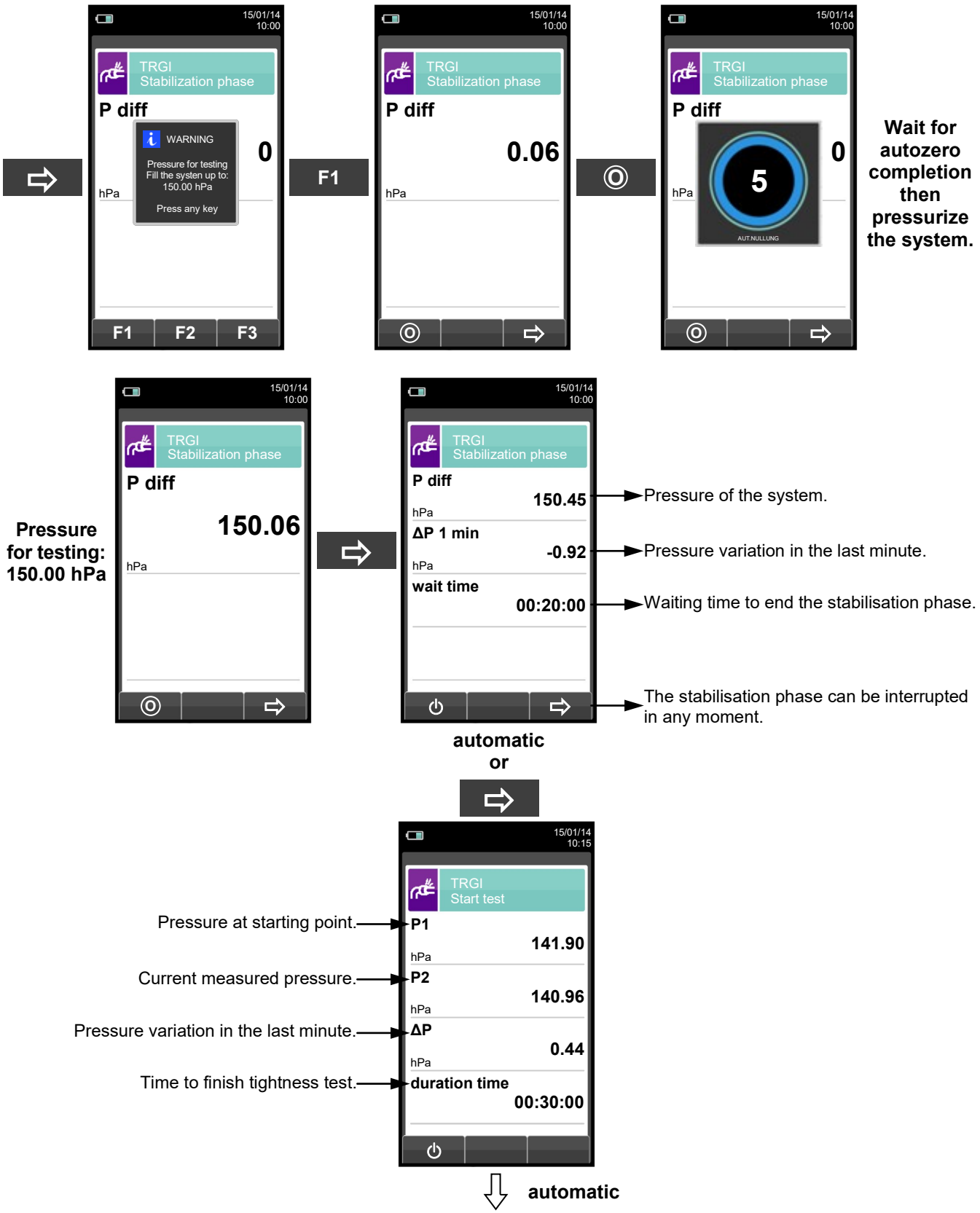
NOTE: If, while configuring the tightness test the automatic printing mode has been selected, the tightness test is printed automatically.

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 500
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: .....
.....
.....
.....

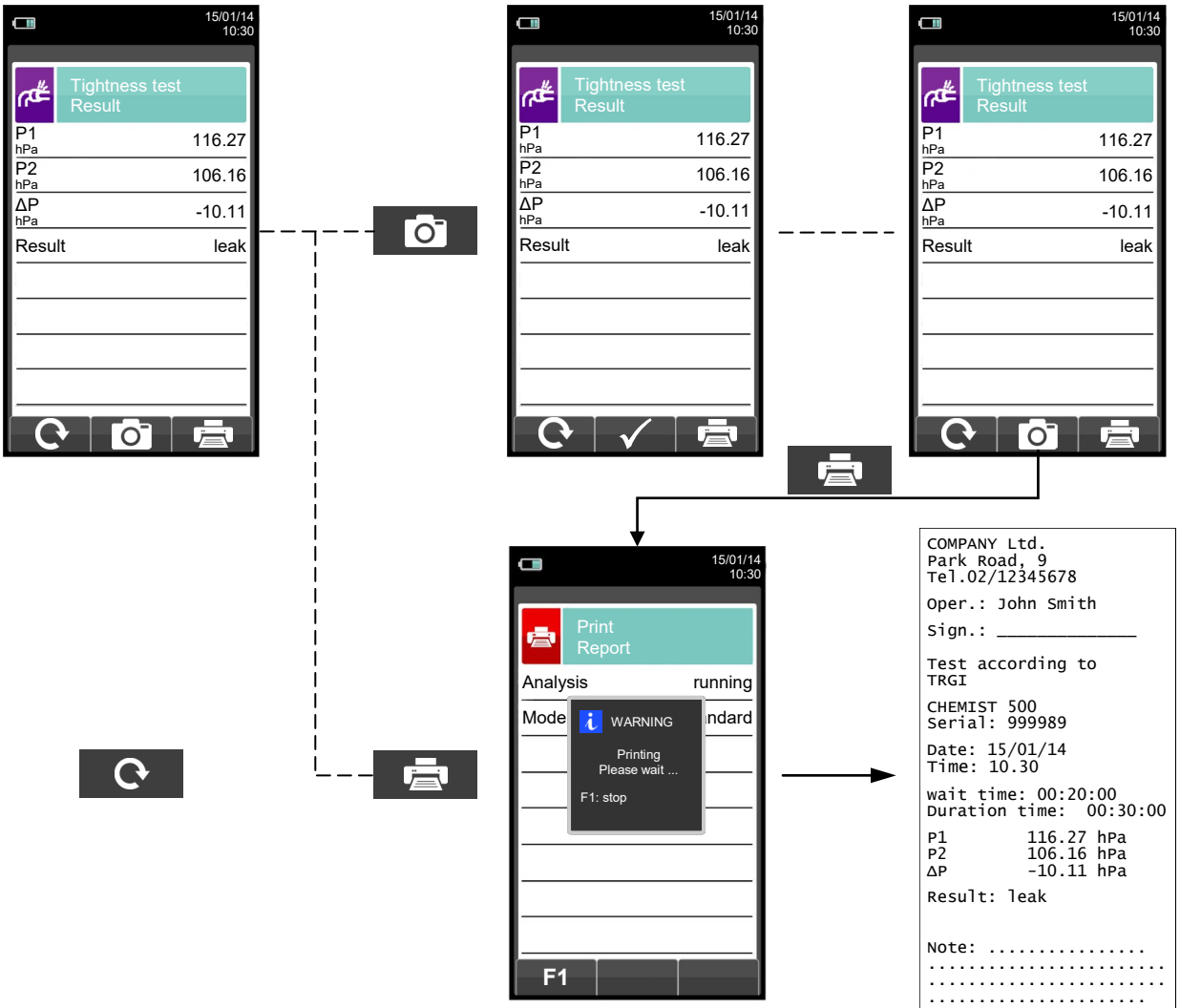

15/01/14
10:00
TRGI
Stabilization phase
P diff
0.06
hPa

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



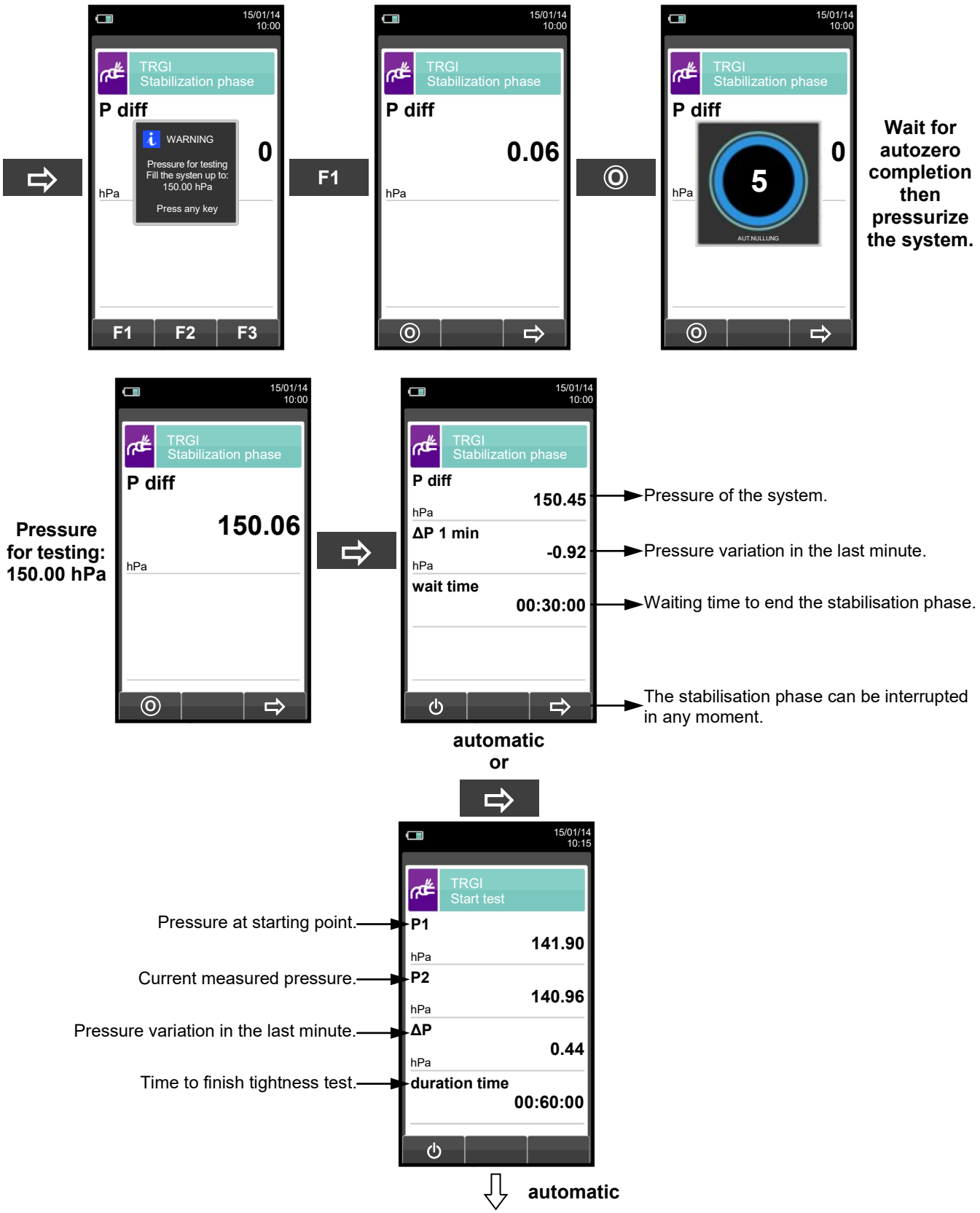
NOTE: If, while configuring the tightness test the automatic printing mode has been selected, the tightness test is printed automatically.

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
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 500
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: .....
.....
.....
.....

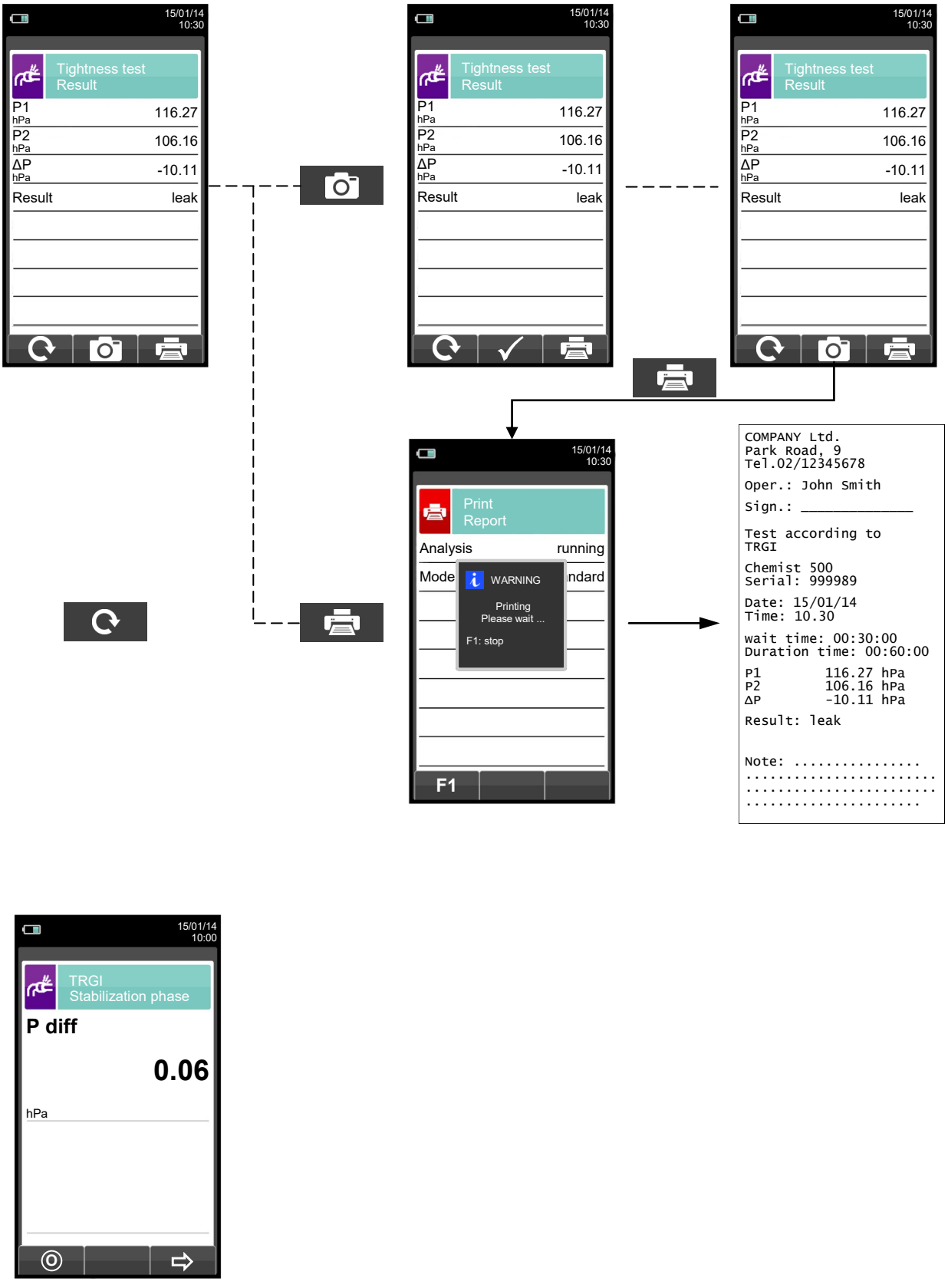

15/01/14
10:00
TRGI
Stabilization phase
P diff
0.06
hPa

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

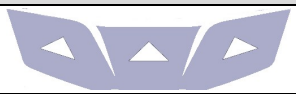


NOTE: If, while configuring the tightness test the automatic printing mode has been selected, the tightness test is printed automatically.

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 500
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

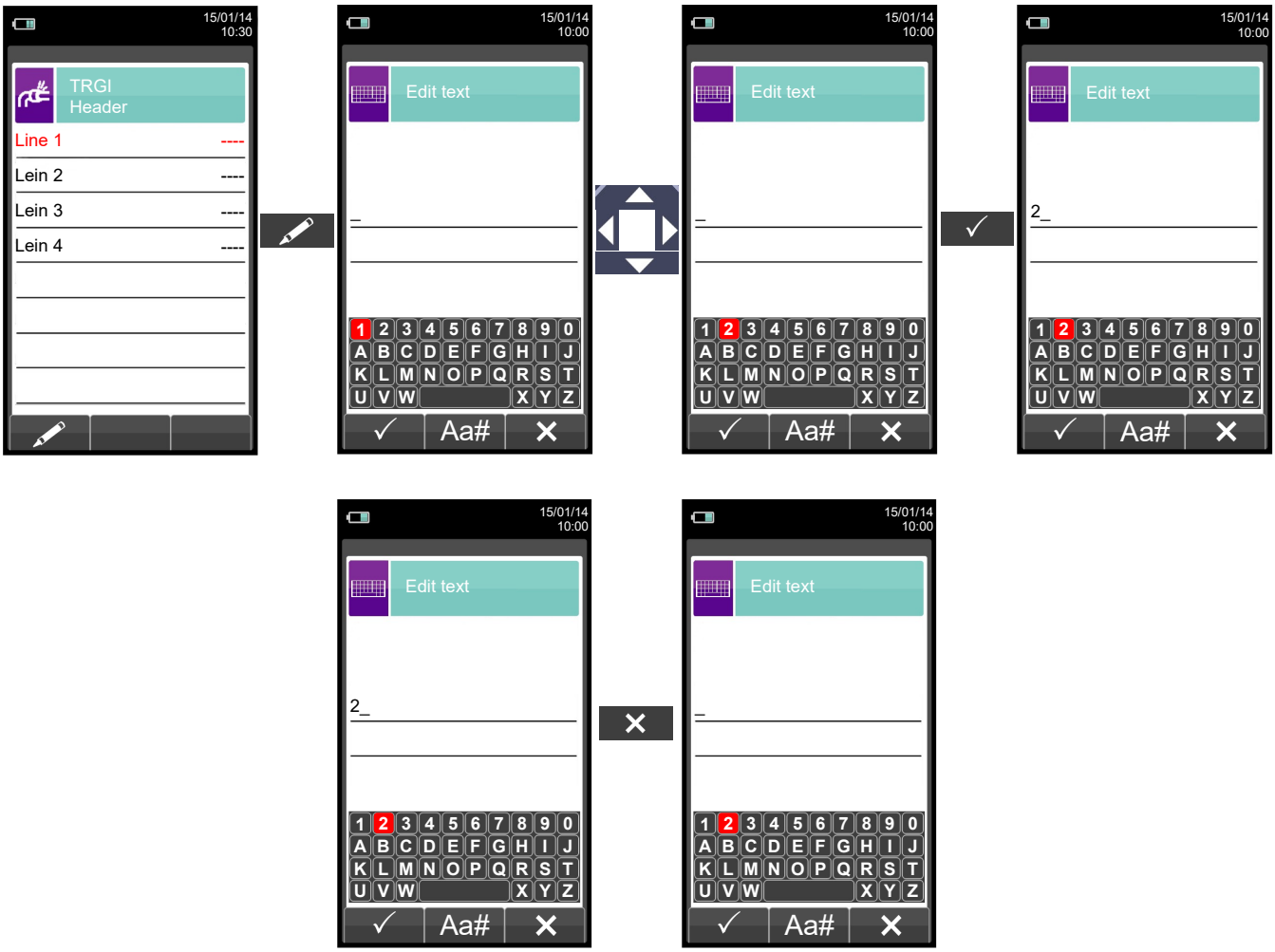
12.11 Measurements → Tightness test → Header

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 evidenced in red.**
	**Activates the context key located in the left side of the display.**
	**Returns to the previous screen. When in modify mode cancels the modification just made.**

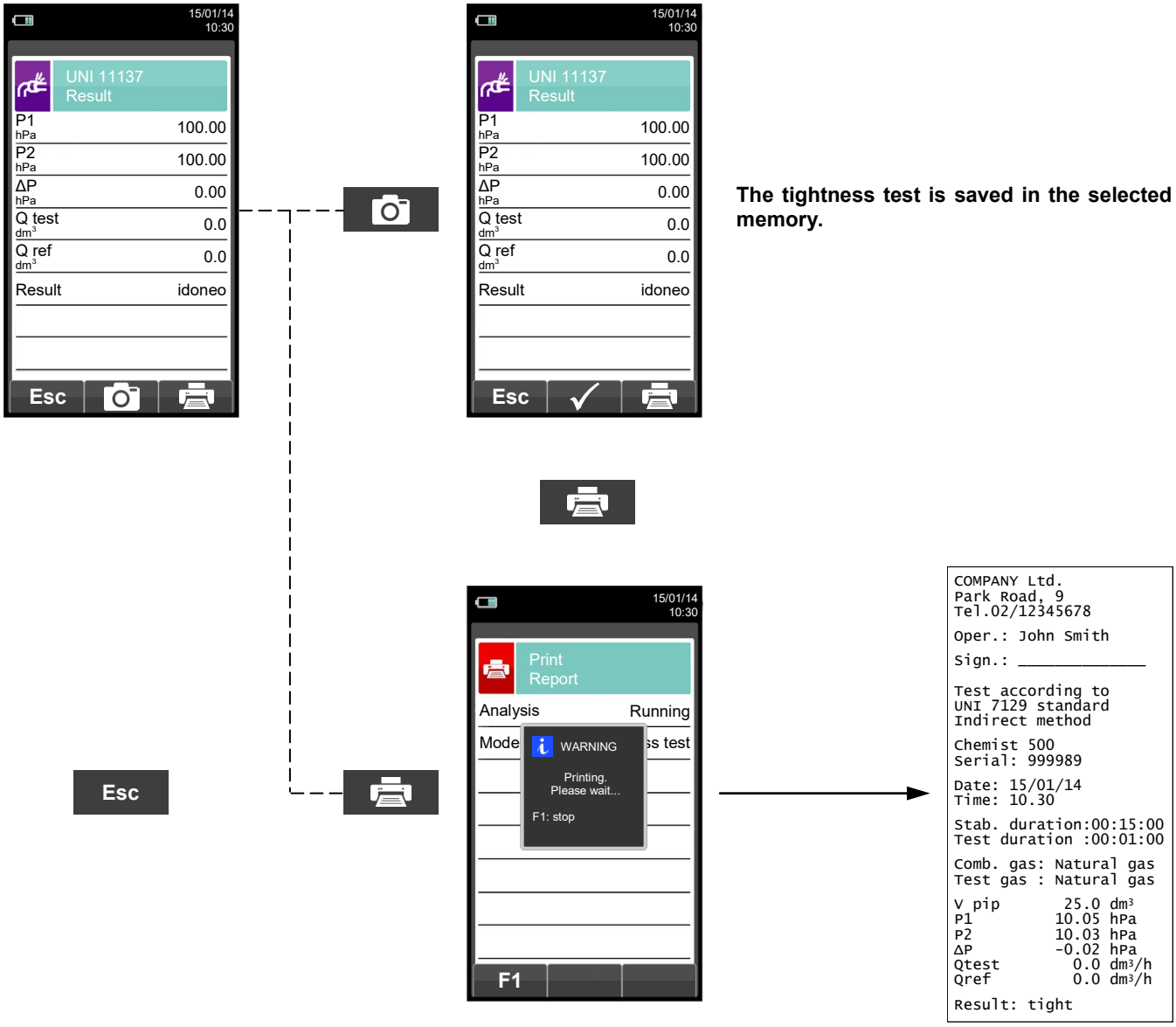
CONTEXT KEY	FUNCTION
	**Enters edit mode of the selected line: it is possible to enter the name of the operator (24 characters available).**
	**Confirms the selected letter or digit.**
	**Cancels the letter or digit before the cursor.**
	**Cycles through uppercase, lowercase, symbols and special characters.**

Example:

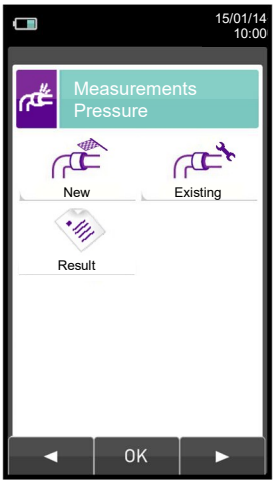
1. Edit text



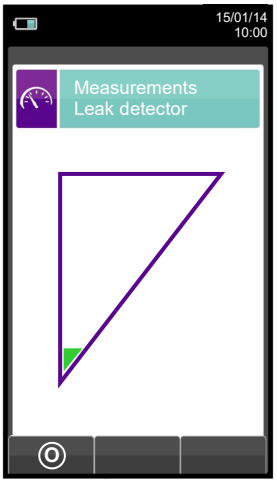
12.12 RESULTS OF THE TIGHTNESS TEST (example)



The tightness test is saved in the selected memory.



12.13 Measurements→Leak detector

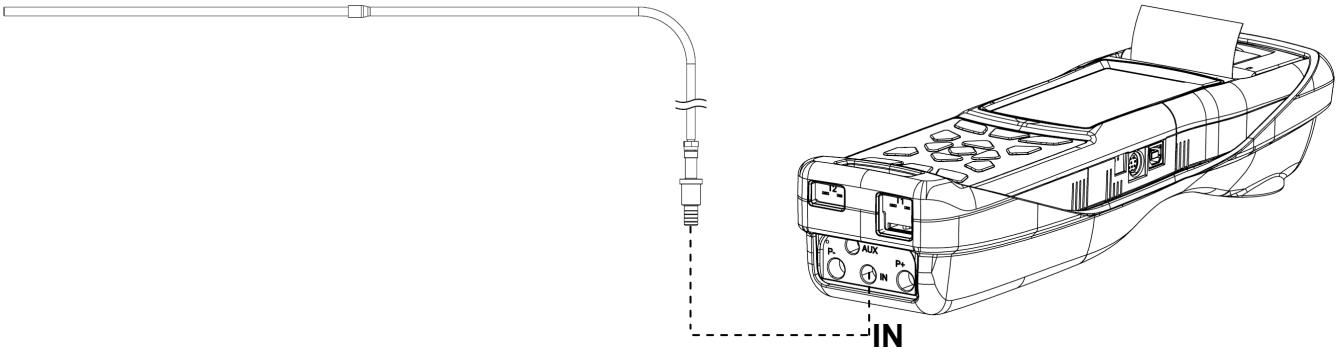


KEY	FUNCTION
	**Activate the context keys shown on the display.**
	**Returns to the previous screen.**

CONTEXT KEY	FUNCTION
	**Make the zero for the measurement.**

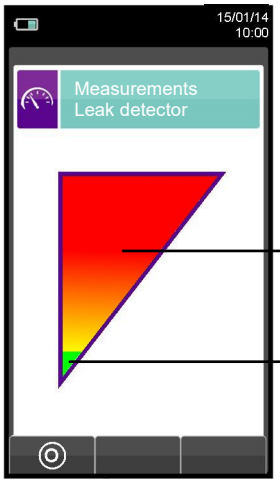
12.13.1 Connecting the probe for gas leak

- Plug the connector of the probe to the IN input of the instrument.



12.13.2 Performing the test

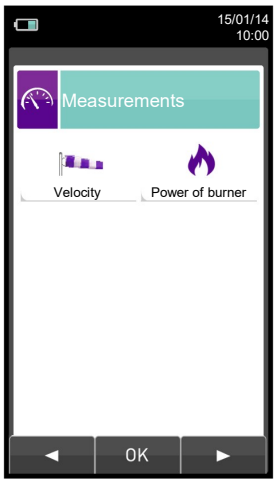
Once the autozero cycle is completed, perform the zero of the measure and proceed with the test.
Outcome:



<u>The instrument has detected the presence of gas</u>.
Audible indication: the frequency of the beep increases as the concentration of gas detected increases.
Visual indication: from yellow to red with increasing concentration of the gas detected.

<u>The tool did not detect the presence of gas</u>.
Audible indication: 1 beep / second
Visual indication: green.

12.14 Measurements→AUX measurements

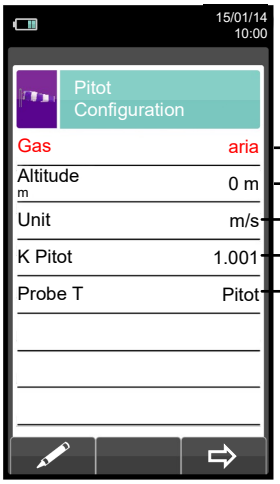


KEY	FUNCTION
	**Activate the context keys shown on the display.**
	**Returns to the previous screen.**

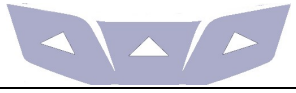
CONTEXT KEY	FUNCTION
◄	**Selects the available parameters.**
OK	**Enters in the selected parameter setting.**
►	**Selects the available parameters.**

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).
Power of burner	**Thermal power of the burner** The measurement of the thermal power at the burner can be performed in different ways, depending on the type of fuel selected. **Boilers using gaseous fuels** FLOW: if the system is equipped with a volumetric flow meter just enter the value of the fuel volume flow (m^3 / h). 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. 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. **Boilers using liquid fuels** FLOW: the value of the mass flow rate (kg / h) of the fuel must be entered. 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.

12.15 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).

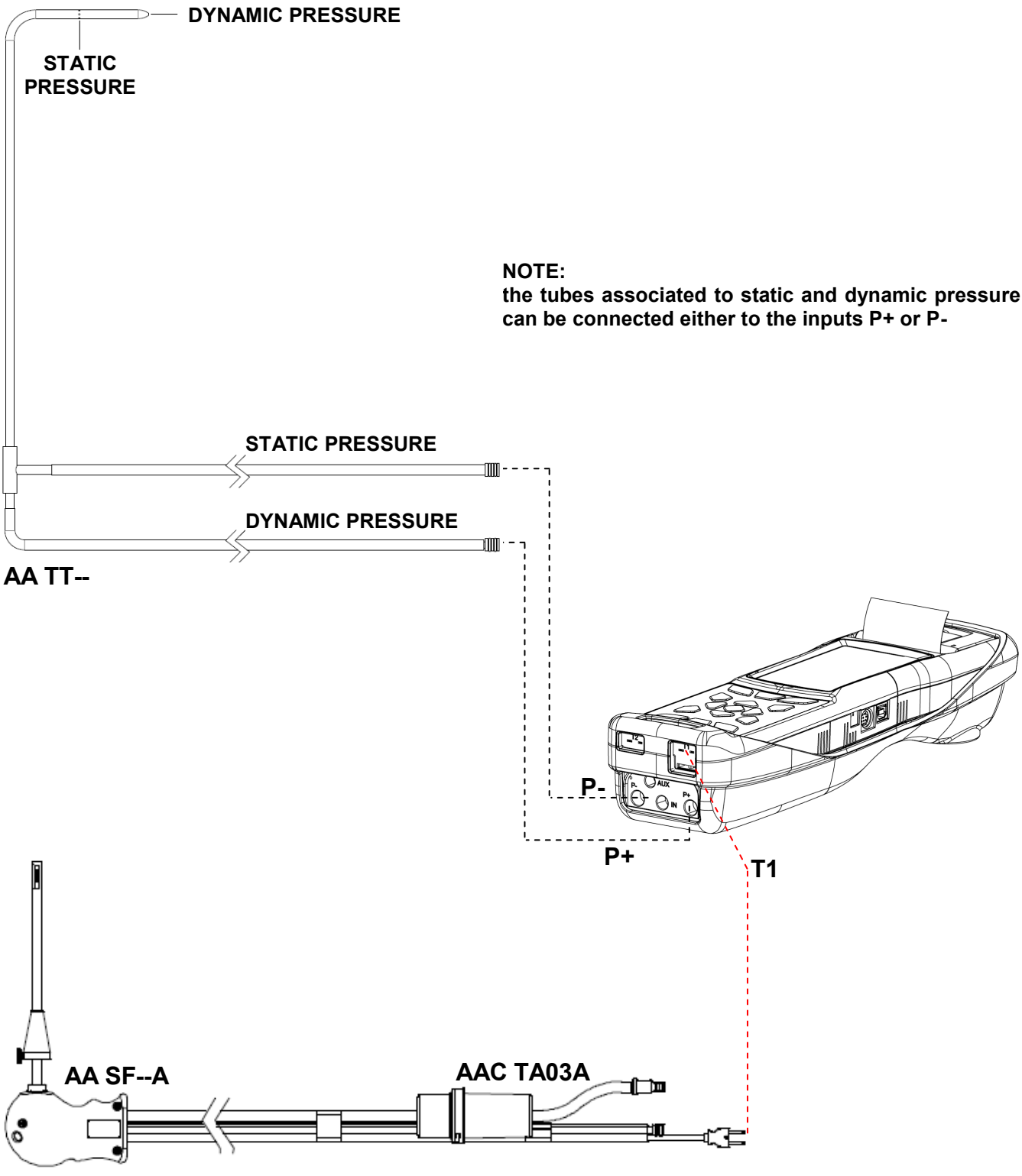
KEY	FUNCTION
	**Activate the context keys shown on the display.**
 	**Selects line; the selected line is evidenced in red.** **In edit mode, it sets the desired value.**
	**Activates the context key located in the left side of the display.**
	**Returns to the previous screen.** **When in modify mode 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 ticket.** **SEE SECTION 11.**

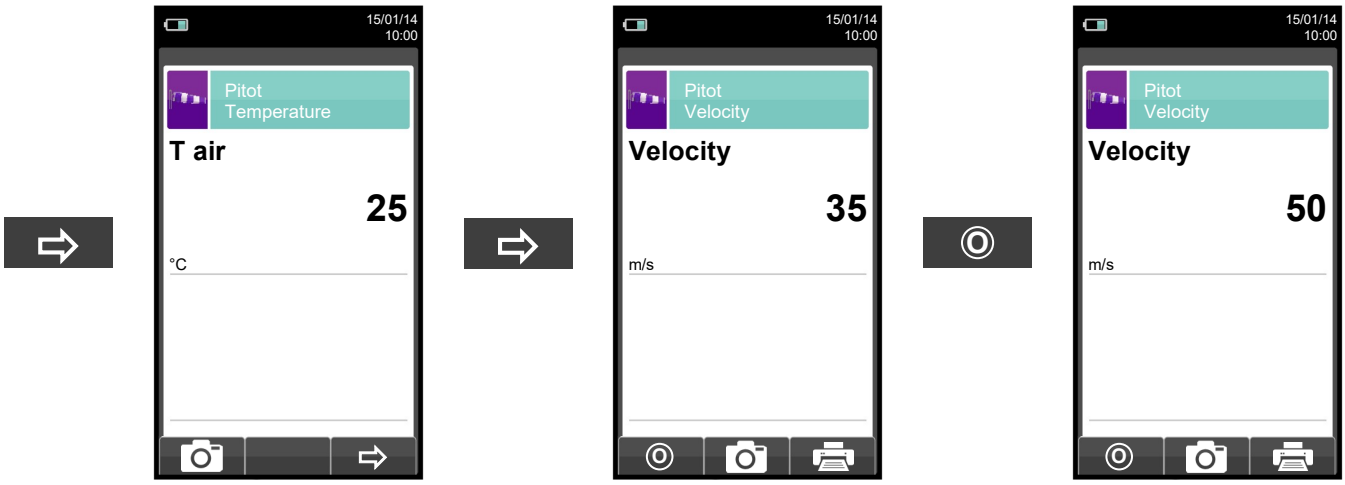
12.15.1 How to connect the Pitot tube to the instrument

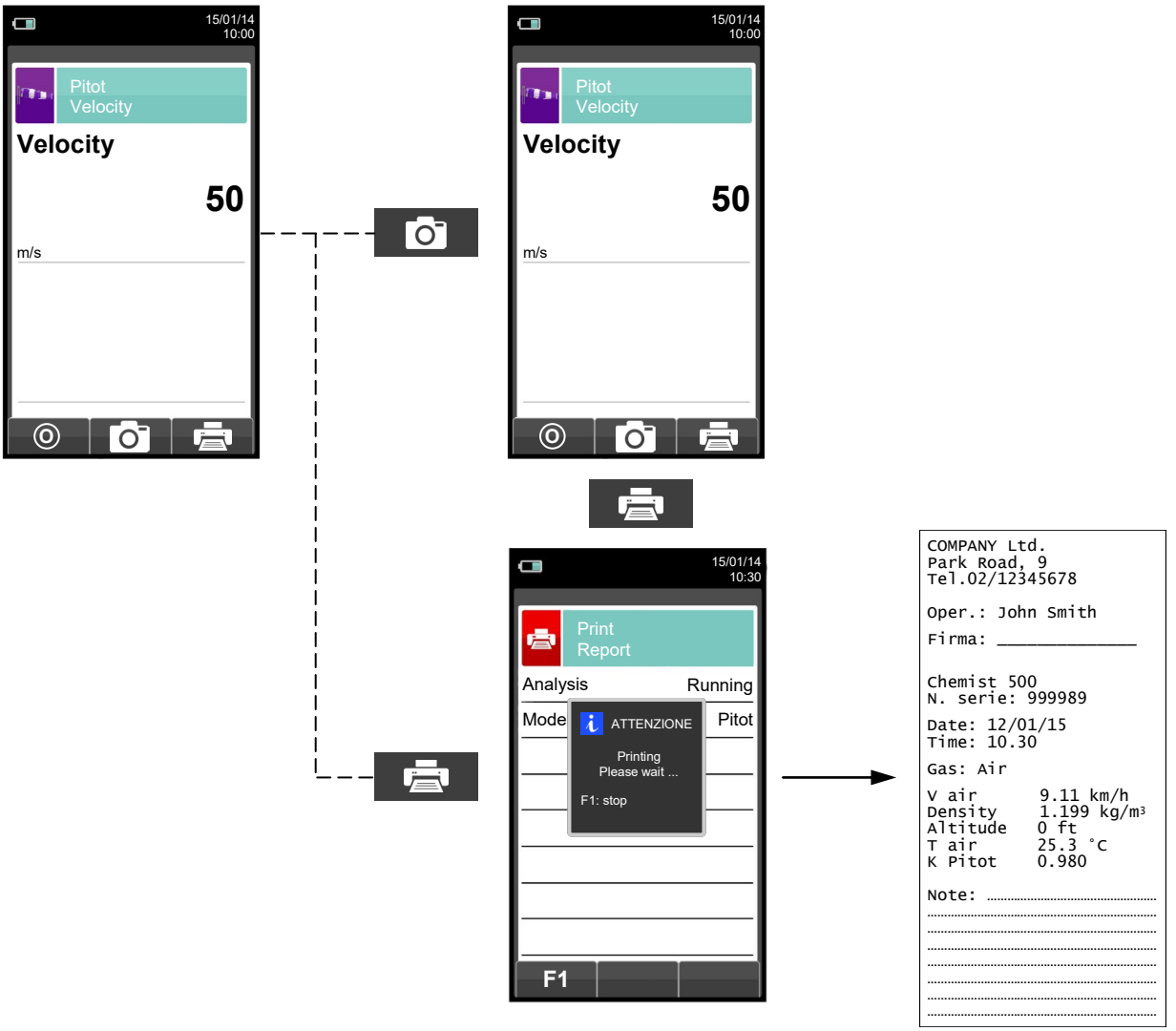
- Connect the Pitot tube (accessory) to inputs P+ and P- (which are normally used for the differential pressure measurement)
- Connect the Tc-K thermocouple cable from the flue gas probe to connector T1 of the instrument.

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.

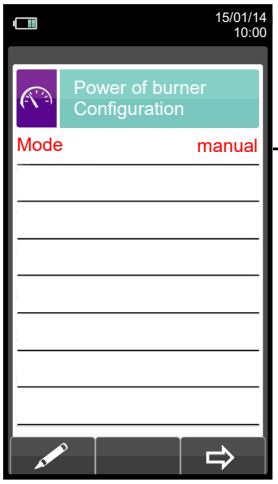


12.15.2 TEST EXECUTION

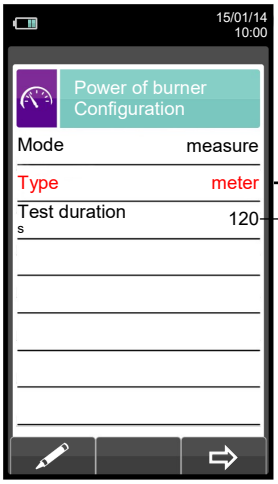




12.16 Measurements→Power of burner

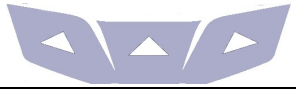


Enter the thermal power value calculated manually by the operator.



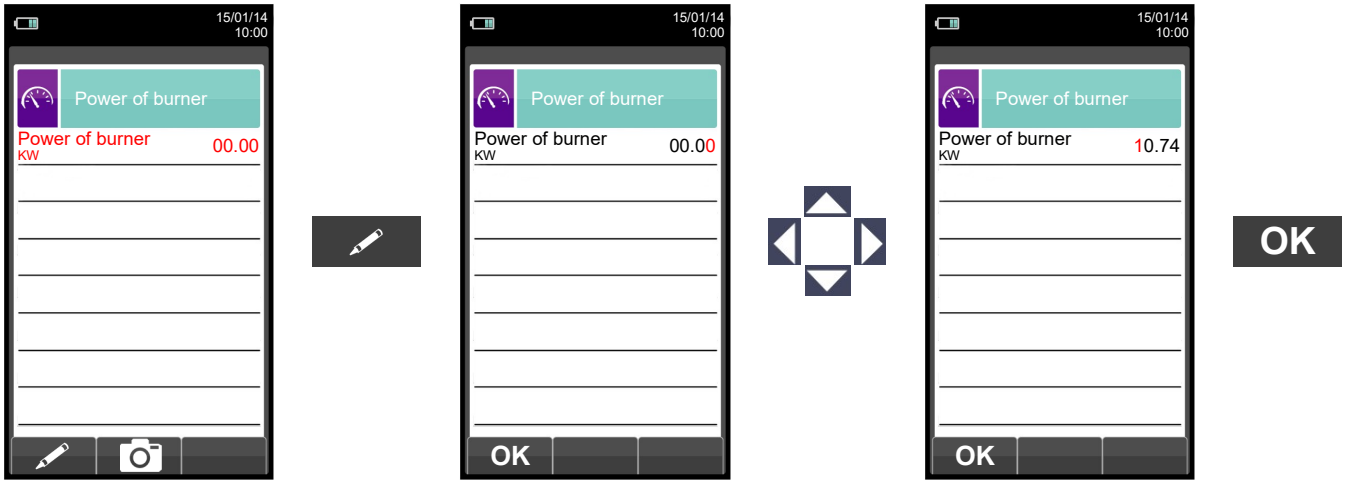
Test mode: you can choose to calculate the thermal power by entering a flow value, or by reading the volumetric counter (gaseous fuels only).

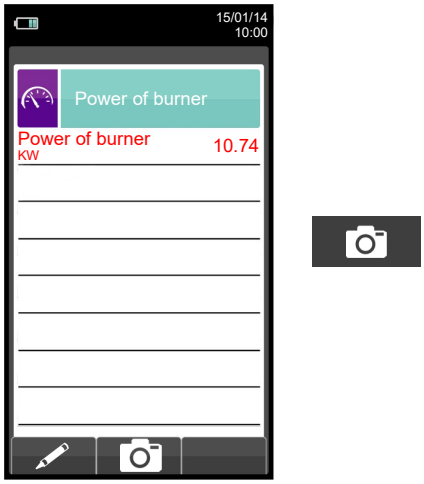
Duration of test: the option is displayed only for the test mode 'COUNTER', available for gaseous fuels. It is possible to enter the number of seconds between the reading of the initial and final gas volume. The minimum time required by law is 120 s.

KEY	FUNCTION
	**Activate the context keys shown on the display.**
	**Selects line; the selected line is evidenced in red.** **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.** **When in modify mode cancels the modification just made.**

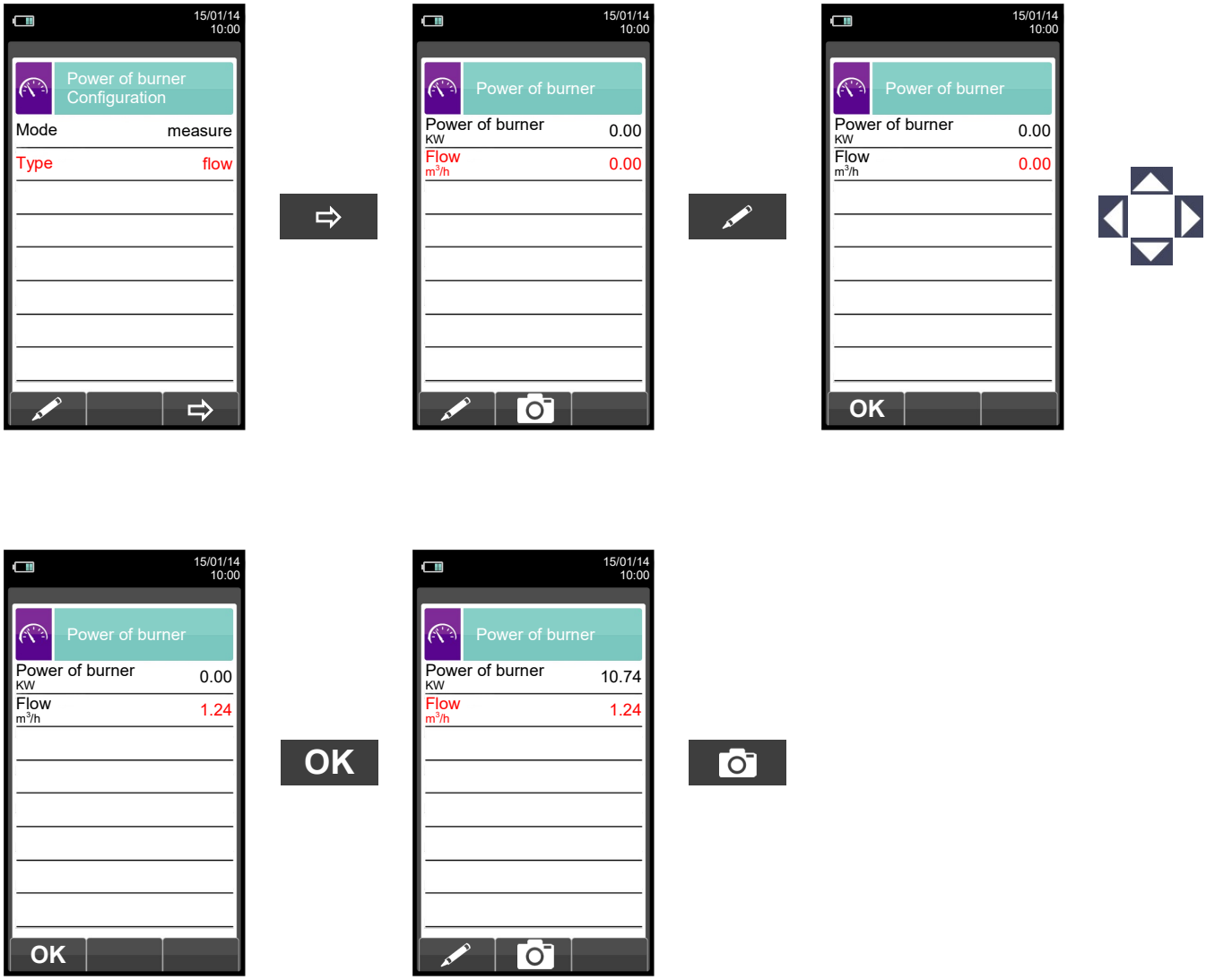
CONTEXT KEY	FUNCTION
	**Enters the modification mode for the selected parameter.**
	**Confirms the settings.**
	**Go to next step.**
	**Saves, in the memory selected in the "Memory Select" menu, the value of the draught measured.**
	**Stops the test.**

12.16.1 TESTING IN 'MANUAL' MODE

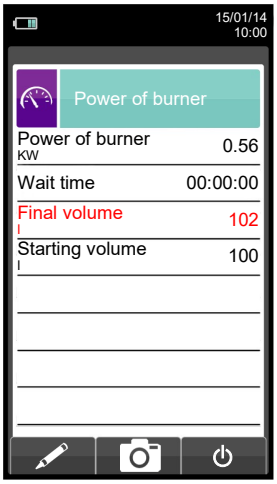




12.16.2 TESTING IN 'MEASURE' MODE (based on Flow rate)



12.16.3 TESTING IN 'MEASURE' MODE (based on meter)


15/01/14
10:00
Power of burner
Power of burner
KW
0.56
Wait time
00:00:00
Final volume
l
102
Starting volume
l
100

13.1 FLUE GAS ANALYSIS

To perform complete 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.

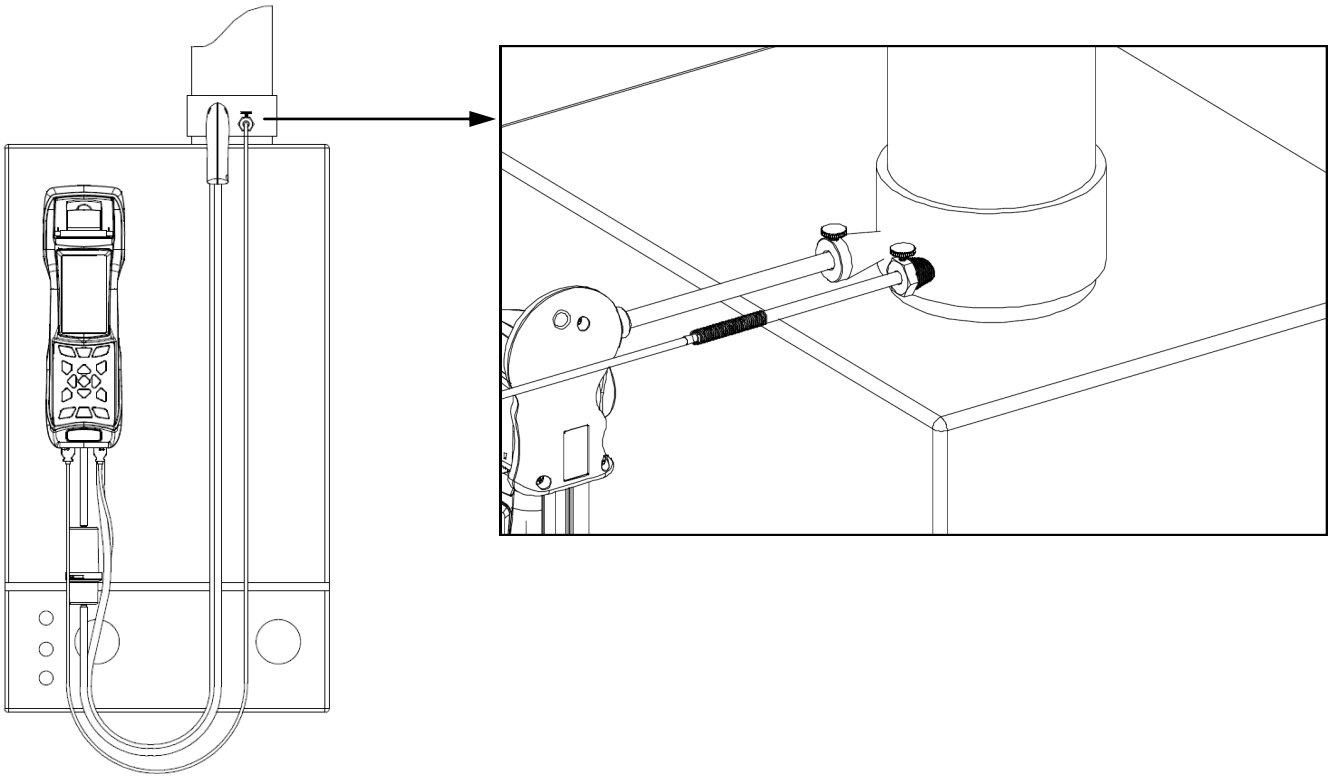
KEEP THE CONDENSATE TRAP IN THE VERTICAL POSITION DURING THE ANALYSIS; A WRONG POSITIONING MAY CAUSE CONDENSATE INFILTRATIONS IN THE INSTRUMENT AND THUS DAMAGE THE SENSORS.

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 memorised and used for reference during the analysis. It is equally important that this phase is performed in a fresh-air environment.
The pressure sensor is also zeroed during auto-calibration.

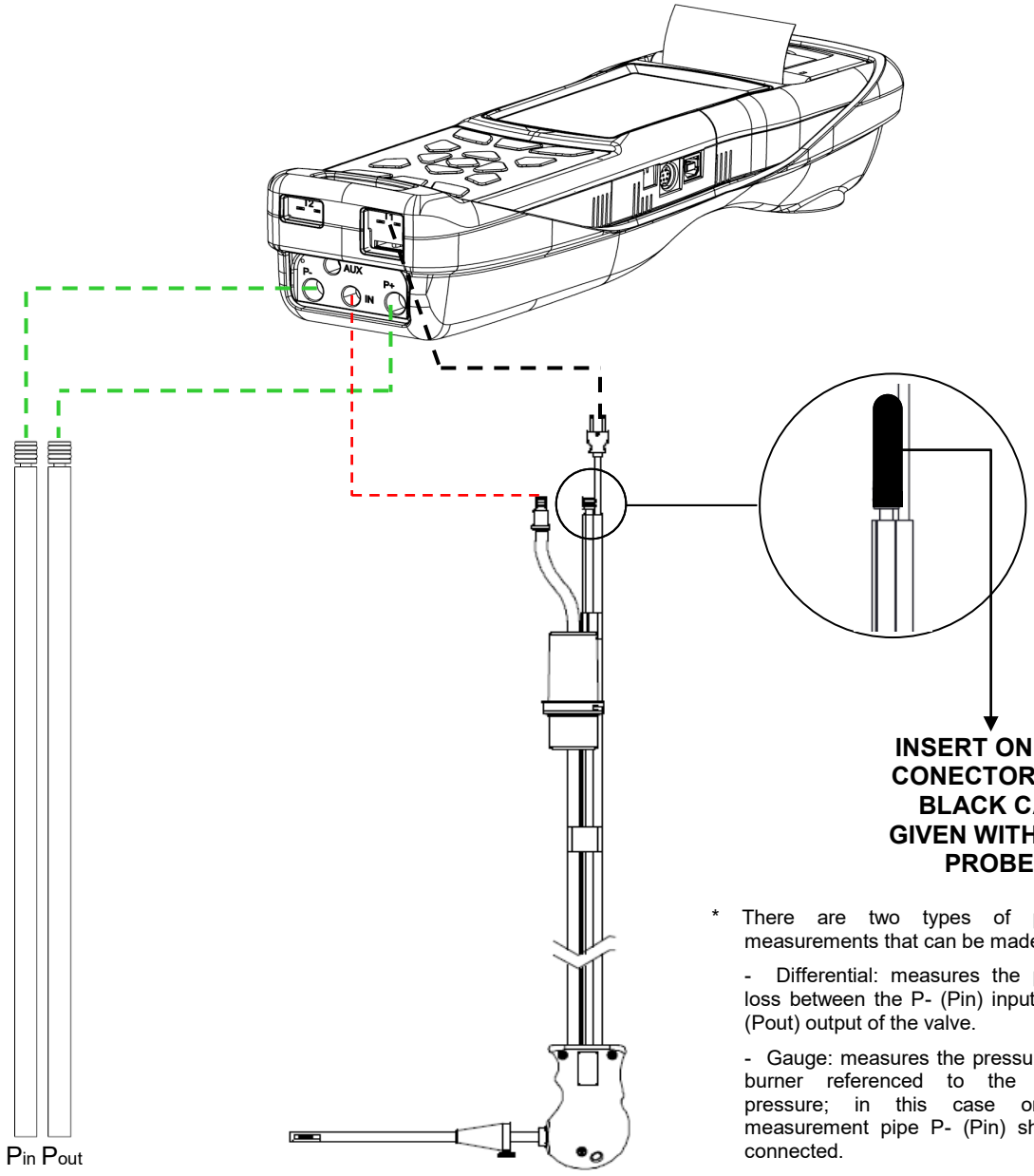
13.1.2 Inserting the probe inside the stack



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 centre 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: the user will be asked to define the type of fuel used by the plant.
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 memorise 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 Draught, 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 stabilise: The user can then proceed with data storage, if required, or print the analysis report directly.
The latter 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.

While in manual analysis, holding pressed both keys ESC and ▼ makes the instrument switch off the suction fumes pump and blocks the refresh of any current measure.
To switch on the suction fumes pump again and reactivate the refresh of the current measure, press again the keys ESC and ▼.

In both modes, automatic and manual, the displayed data of the pollutants CO / NO / NO_x can be translated into normalised 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.
Switch 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

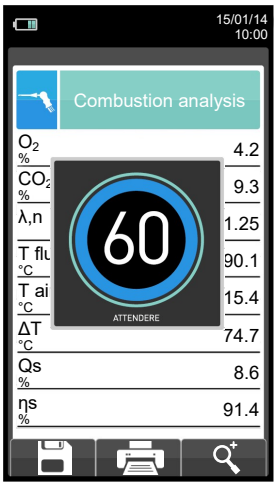
Insert the gas sample probe in the chimney:

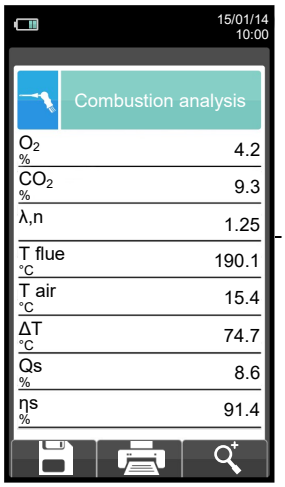
Models (with automatic autozero solenoid) CHEMIST 501 - 502 - 502B - 502C - 503 - 504N - 504S - 500X

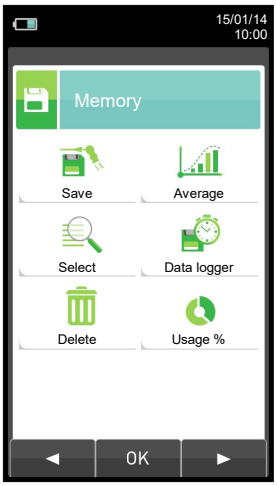
Do not insert the gas sample probe in the chimney:

Models (without solenoid) CHEMIST 500B

Hold down for a few seconds

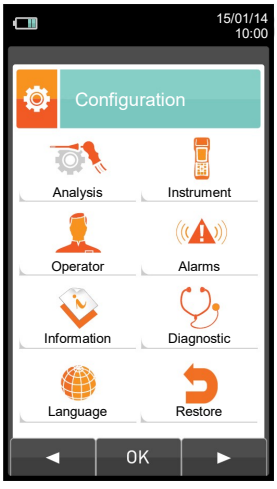






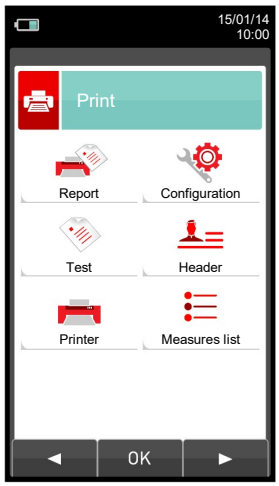
PARAMETERS TO SET BEFORE PROCEEDING (SEE SECTION 10.0):

Select
Data logger



PARAMETERS TO SET BEFORE PROCEEDING (SEE SECTION 9.0):

Analysis
Operator



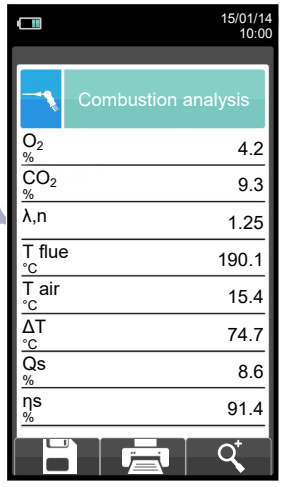
PARAMETERS TO SET BEFORE PROCEEDING (SEE SECTION 11.0):

Configuration
Header
Measures list

ACQUIRE THE FOLLOWING MEASUREMENTS BEFORE PROCEEDING WITH THE COMBUSTION ANALYSIS (Section 12.0):

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

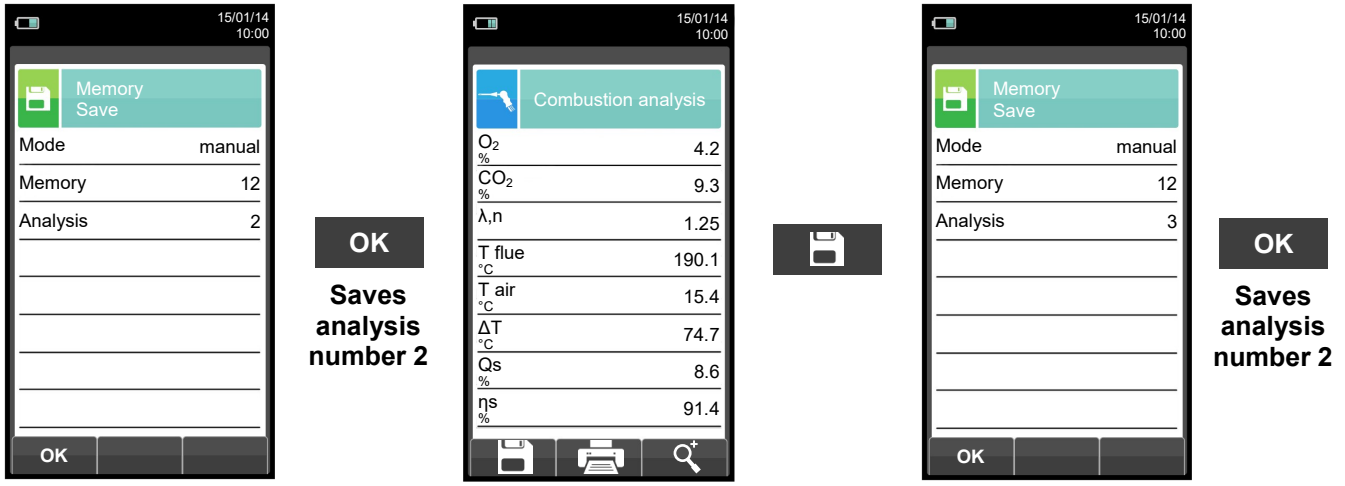
Draft
Smoke
Ambient CO
Temperature
Pressure

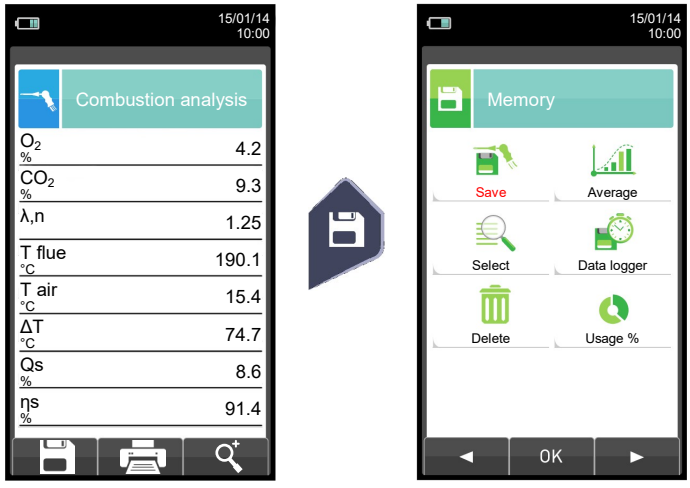


PRESS THE KEY ' ':
It starts saving the current analysis according to the set mode.
- **Manual** See section 13.3
- **UNI 10389** See section 13.4
- **BImSchV** See section 13.5
- **data logger** See section 13.6

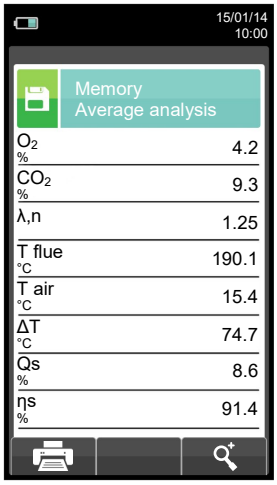
PRESS THE KEY ' ':
It starts the printing on test ticket of the current analysis; additional measuremnets are also printed, if they are present in the memory.

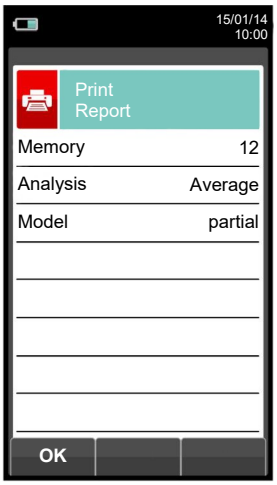
13.3 PERFORMING COMBUSTION ANALYSIS - MANUAL MODE



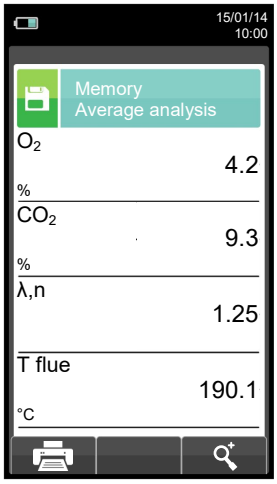


Recalls the average analysis.

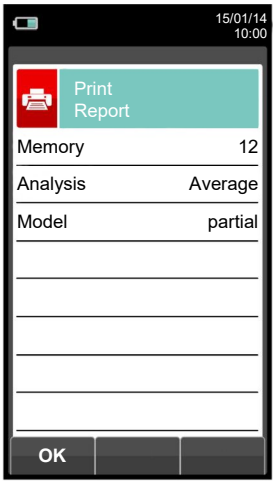




OK

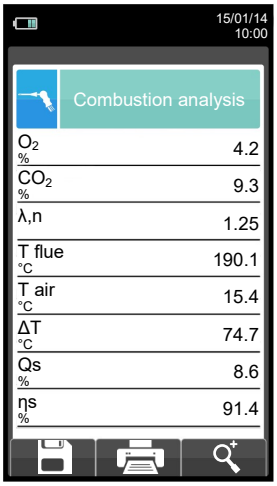


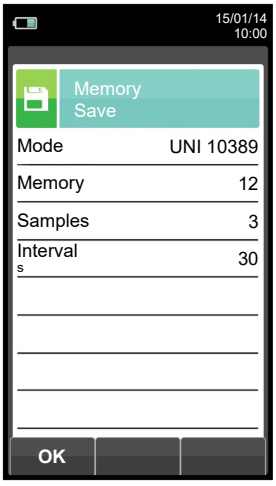

```
Date: 15/01/14
Time: 10.10
Fuel: Natural gas
Altitude: 0 m
R.H. air: 50 %
O2              4.2 %
CO2             9.3 %
λ,n            1.25
T flue       190.2 °C
T air         15.4 °C
ΔT           174.8 °C
QS             8.6 %
ηs            91.4 %
ET             4.9 %
ηt            91.4 %
CO             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
```



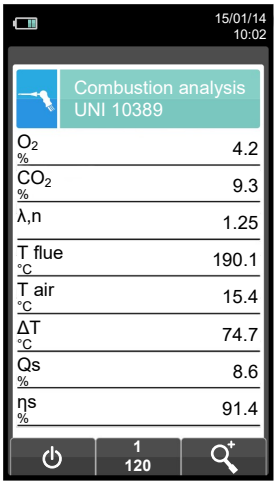
OK

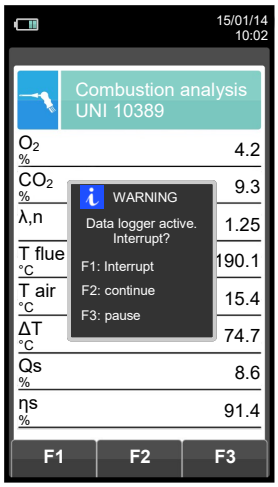
13.4 PERFORMING THE COMBUSTION ANALYSIS- UNI 10389 MODE



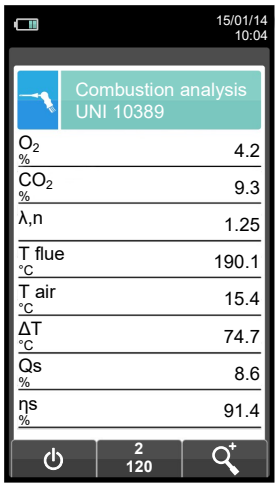


OK

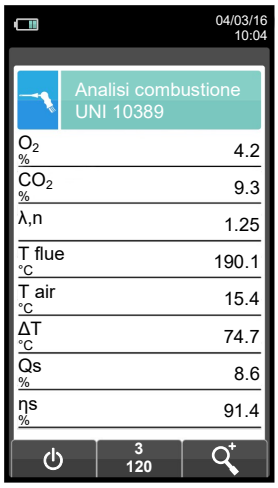




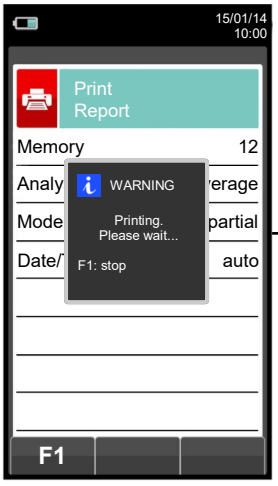
Automatically saves the first sample when the set time is over.



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



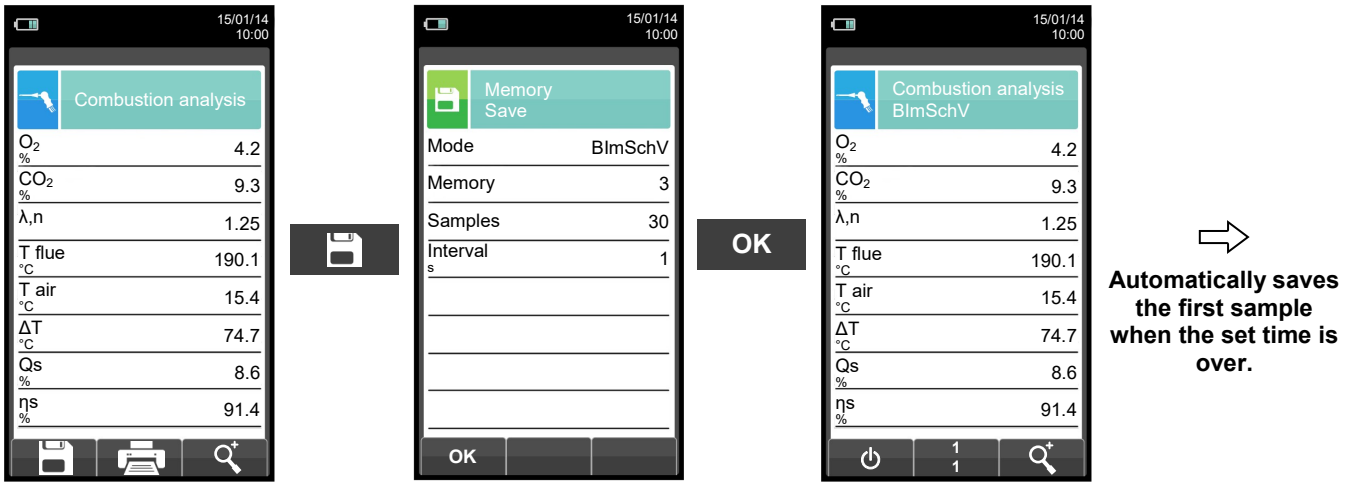
Automatically saves the third sample when the set time is over.

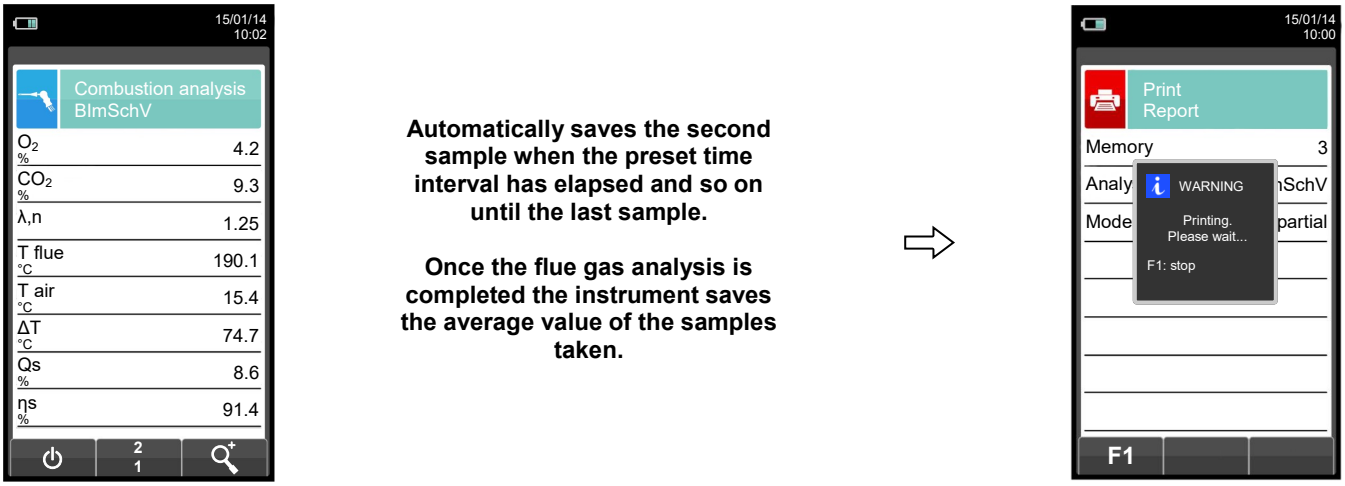


NOTE: If, while configuring the tightness test the automatic printing mode has been selected, the tightness test is printed automatically.

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:

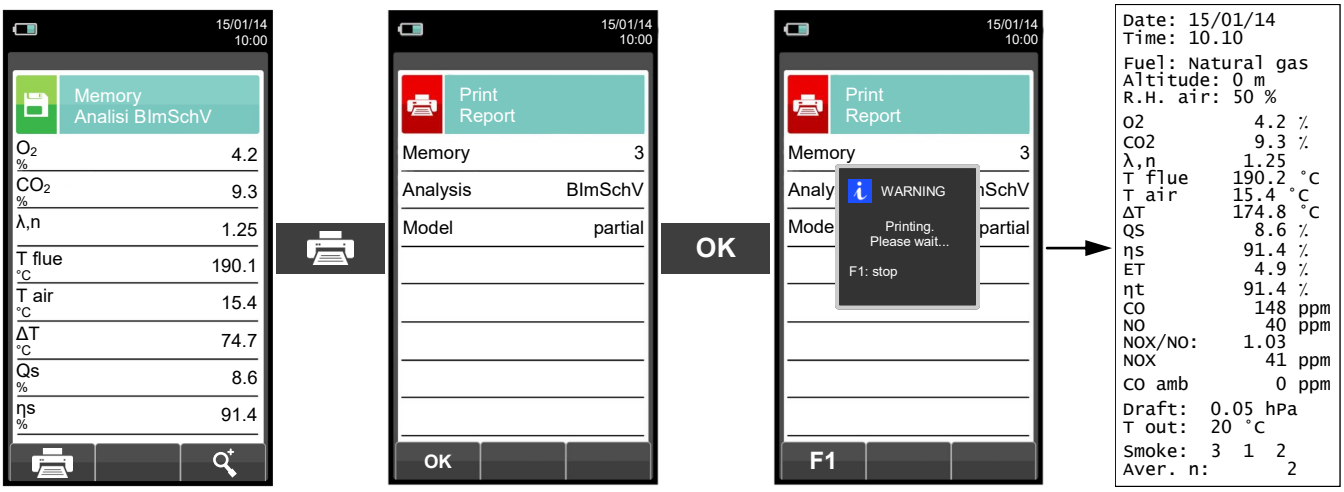
13.5 PERFORMING THE COMBUSTION ANALYSIS - BImSchV MODE



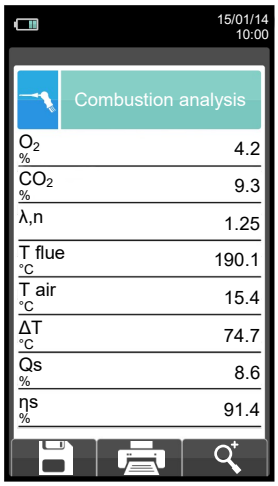


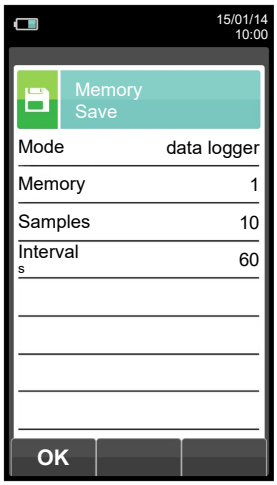
NOTE: If, while configuring the tightness test the automatic printing mode has been selected, the tightness test is printed automatically.

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:

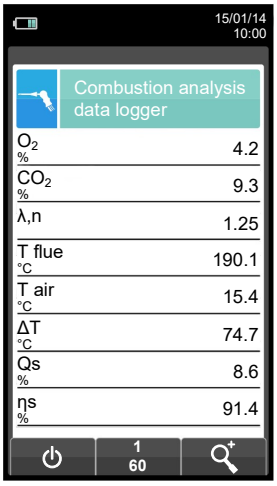


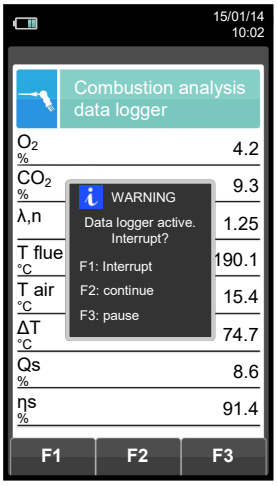
13.6 PERFORMING THE COMBUSTION ANALYSIS - data logger MODE



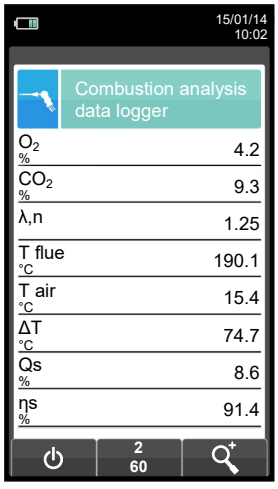


OK

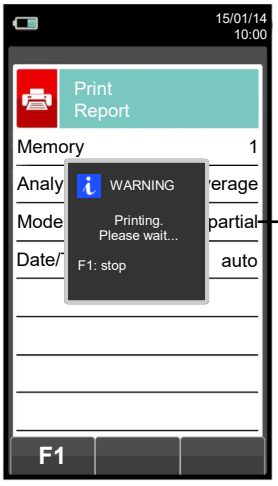




Automatically saves the first sample when the set time is over.

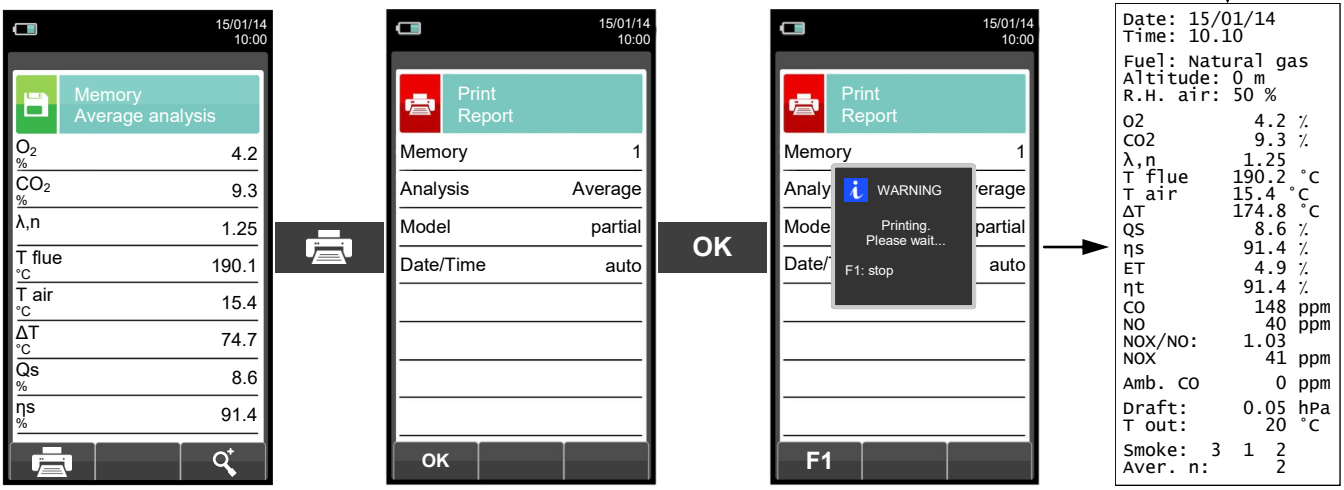


Automatically saves the second sample when the set time is over and so on until the last sample.



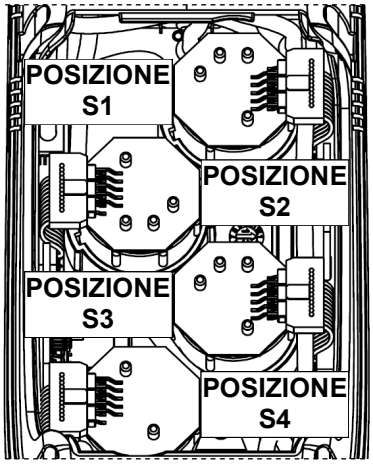
NOTE: If, while configuring the tightness test the automatic printing mode has been selected, the tightness test is printed automatically.

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:

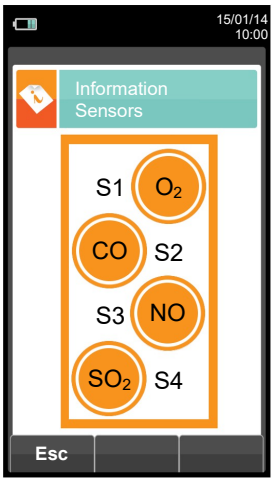


14.1 Sensors arrangement

SENSORS ARRANGEMENT INSIDE THE SENSORS COMPARTMENT



GRAPHICAL DISPLAY OF ARRANGEMENT



14.2 Sensor types and relevant positioning

POSITION / CODE	S1	S2	S3	S4
Flex-Sensor O_2 LL Cod. AACSE43	✓			
Flex-Sensor O_2 Cod. AACSE48	✓			
Flex-Sensor CO+H_2 Cod. AACSE12		✓		
Flex-Sensor CO high immunity H_2 Cod. AACSE20		✓	✓	✓
Flex-Sensor NO Cod. AACSE10			✓	
Flex-Sensor NO_2 Cod. AACSE14		✓	✓	✓
Flex-Sensor SO_2 Cod. AACSE13		✓	✓	✓
Flex-Sensor CO 100.000 ppm Cod. AACSE17		✓	✓	✓
Flex-Sensor CO 20.000 ppm Cod. AACSE18		✓	✓	✓
FLEX-Sensor CxHy 0-5.00% vol. referred to CH4 Cod. AACSE23			✓	✓
Flex-Sensor for gas leaks Cod. AACSE19				✓
Flex-Sensor CO+H_2 low range Cod. AACSE24		✓		
Flex-Sensor NO low range Cod. AACSE25			✓	
Flex-Sensor NO_2 low range Cod. AACSE26		✓	✓	✓
Flex-Sensor SO_2 low range Cod. AACSE28		✓	✓	✓
Flex-Sensor CO_2 0 .. 20% v/v Cod. AACSE21			✓	✓
Flex-Sensor CO_2 0 .. 50% v/v Cod. AACSE47			✓	✓

14.3 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 centre. Chart 14.4 illustrates the characteristics inherent to each sensor.

14.4 Table gas sensors life

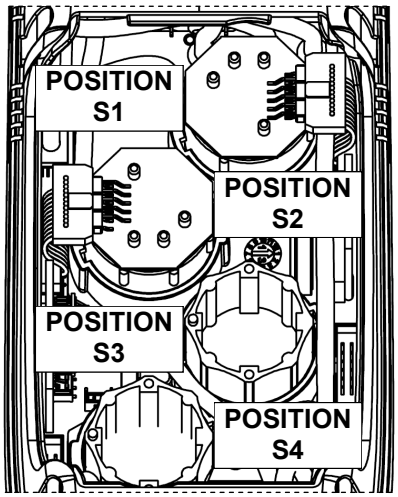
CODE	MEASURED GAS	IDENTIFYING COLOR (1)	AVERAGE LIFE	RECALIBRATION
Flex-Sensor O_2 LL Cod. AACSE43	O_2 Oxygen		48 months	not necessary
Flex-Sensor O_2 Cod. AACSE48	O_2 Oxygen		>48 months	not necessary
Flex-Sensor CO+H_2 Cod. AACSE12	CO Carbon Monoxide	Red	48 months	Yearly (2)
Flex-Sensor CO high immunity H_2 Cod. AACSE20	CO Carbon Monoxide		>36 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	Withe	36 months	Yearly (2)
Flex-Sensor SO_2 Cod. AACSE13	SO_2 Sulphur 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. referred to CH4 Cod. AACSE23	CxHy Unburnt Hydrocarbons		48 months	Yearly (2)
Flex-Sensor for gas leaks Cod. AACSE19	Leak detector Methane / LPG		5 years	not necessary
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	Withe	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% v/v Cod. AACSE21	CO_2 Carbon Dioxide		>48 months	Yearly (2)
Flex-Sensor CO_2 0 .. 50% v/v Cod. AACSE47	CO_2 Carbon Dioxide		>48 months	Yearly (2)

Notes:
(1) Coloured 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 authorised to issue calibration certificates.

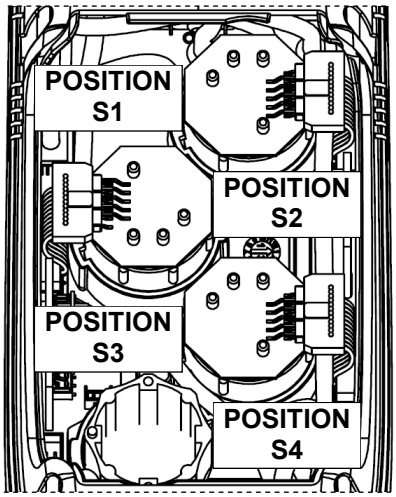
14.5 Expandability to 4 sensors

In the Chemist 500 instruments range, two are the versions which can be expanded:

CHEMIST 502
2 sensors, expandable to 3 or 4 sensors.



CHEMIST 503
3 sensors, expandable to 4 sensors.



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

- Both the expandable instruments are arranged in a way to accept one or two additional sensors in positions S3 and S4.
- Identify, with the help of paragraph 5.2 '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' under '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:

$NO \rightarrow NO_2$ A SENSOR DIFFERENT FROM THE PREVIOUS ONE HAS BEEN DETECTED.

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

$SO_2 \rightarrow \square$ A NEW SENSOR HAS BEEN DETECTED.

14.6 CxHy sensor for measurement of the unburnt hydrocarbons

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 metane): 1.34

Value = reading value x gain adjustment

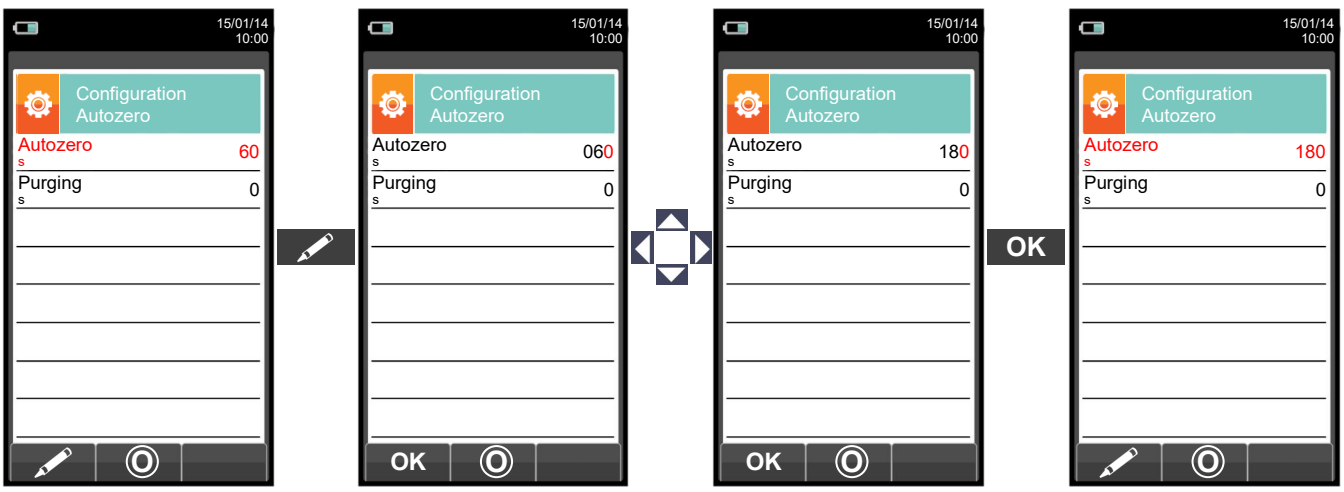
Example: 1.34 x 1.67 = 2.24

WARNING
Gas vapors which containsilicone compounds (HMDS) can irreversibly damage the sensor.

14.6.1 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.
The instrument battery life, once the CxHy is installed, lasts 10 hours, provided no printing is made.

Configuration→Analysis→Autozero (SEE SECTION 9.2.6)



14.7 CO_2 sensor for Carbon Dioxide measurement in combustion processes

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.

14.7.1 Installing the CO_2 sensor

When the CO_2 (position S3/S4) is mounted in the CHEMIST 500, 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 9.2.6)

14.8 Sensor for combustible gas leaks

In order to detect gas leaks in plant, pipes and appliances the CHEMIST 500 requires an internal semiconductor sensor forgas leaks.
This sensor responds to both CH4 (Methane) and LPG (IsoButane and IsoPropane) as well as several other combustible gases (hydrocarbons).

Technical Features

Measuring range:	0 .. 50000 ppm
Warm-up time:	60 seconds
Average life of sensor:	5 years

WARNING
Gas vapors which containsilicone compounds (HMDS) can irreversibly damage the sensor.

14.8.1 Installation of the sensor for combustible gas leaks

The sensor for combustible gas leaksmust be installed inthe instrument only in position S4; perform all the steps described in the chapter " SERVICE " in " gas sensors replacement ".

14.8.2 Performing the test

SEE SECTION 12.0.

15.0 MAINTENANCE

15.1 Routine maintenance

This instrument was designed and manufactured using top-quality components. Proper and systematic maintenance will prevent the onset of malfunctions and will increase instrument life altogether.
The following basic requisites are to be respected:

- Do not expose the instrument to substantial thermal shocks before use. If this happens, wait for the temperature to return to normal working values.
- Do not extract flue gas samples directly without using a particulate/water trap.
- Do not exceed sensor overload thresholds.
- When the analysis is over disconnect the sample probe and let Chemist 500 draw fresh air for a few minutes, or at least until the displayed parameters return to their original values.
- Clean the filter unit when necessary, replacing the particulate filter and applying a jet of air to the sample probe hose to eliminate any condensate that may have formed.

Do not clean the instrument with abrasive cleaners, thinners or other similar detergents.

15.2 Preventive maintenance

At least once a year send the instrument to a SERVICE CENTRE for a complete overhaul and thorough internal cleaning.
SEITRON's highly qualified staff is always at your disposal and will provide you with all the sales, technical, application and maintenance details required.
The service centre will always return the instrument to you as new and in the shortest time possible. Calibration is performed using gases and instruments comparable with National and International Specimens. Annual servicing is accompanied by a specific calibration certificate that is a guarantee of perfect instrument performance as required by UNI 10389-1, besides being indispensable for users wishing to maintain ISO 9000 status.

15.3 Cleaning the sample probe

When you finish using the sample probe clean it thoroughly as described below before returning it to its case:

- Disconnect the sample probe from the instrument and from the water trap (Fig. a-b) then blow a jet of clean air into the hose of the probe (refer to Fig. b) to remove any residual condensate that may have formed within.

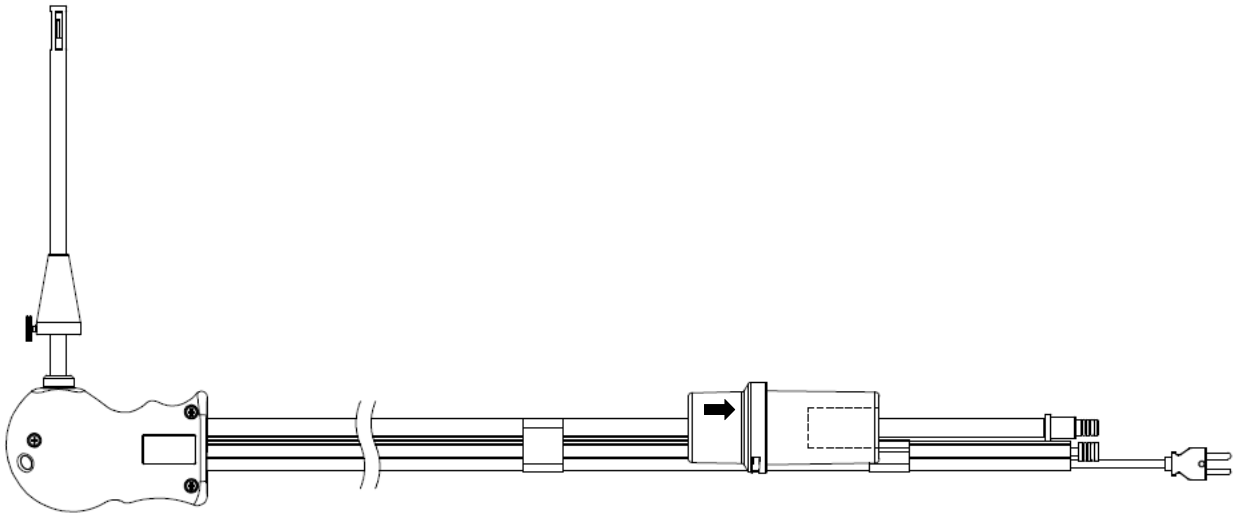


Fig. a

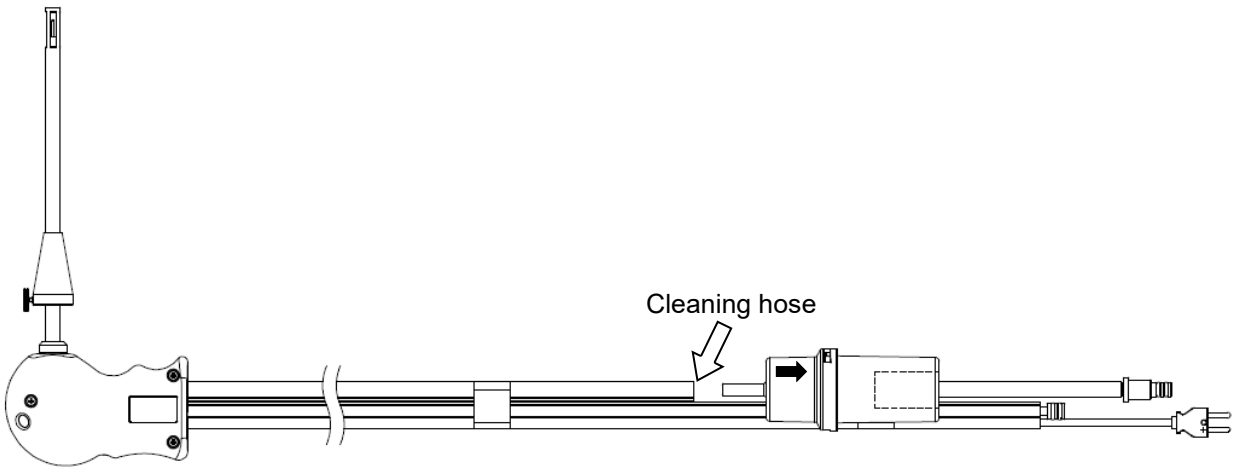
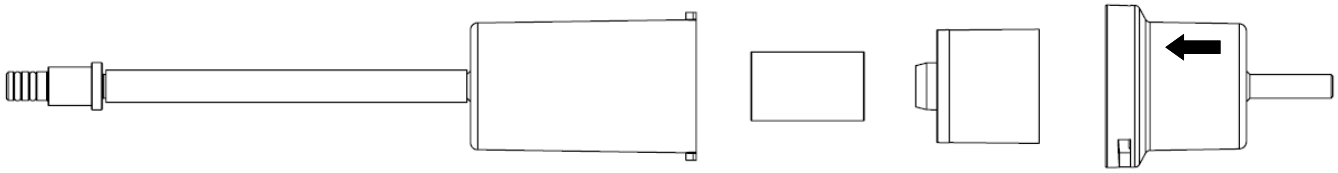


Fig. b

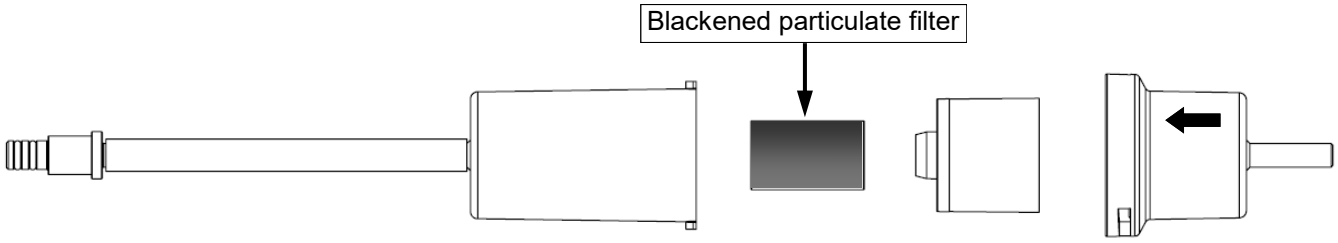
15.4 Maintaining the water trap / filter unit

To remove the water trap, just rotate the cover and unhook the filter holder body; remove the internal cup and then replace the filter (see figure on the side).
Clean all the filter parts using water only, dry the components and reassemble the filter.



15.5 Replacing the particulate filter

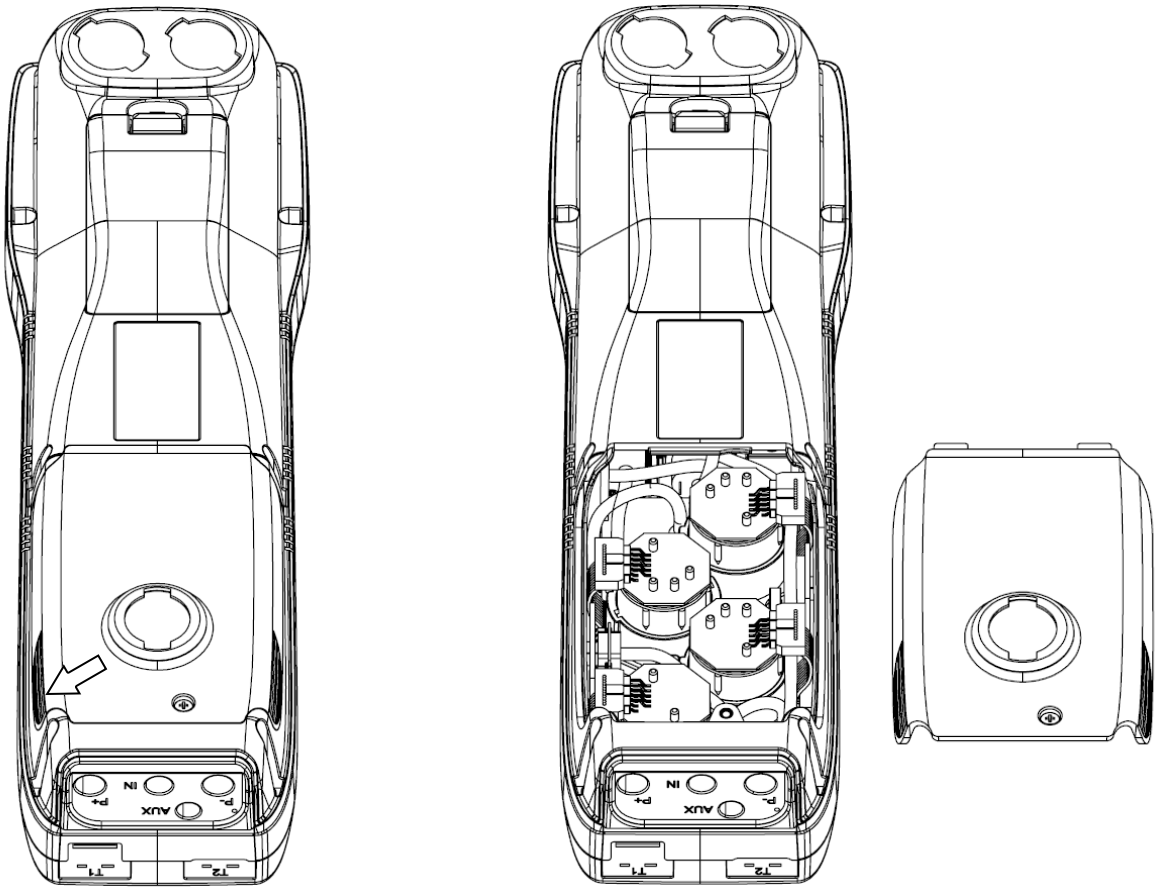
If the particulate filter appears black, especially on the inner surface (see adjacent example), it has to be replaced immediately. In this way gas flow is not obstructed.



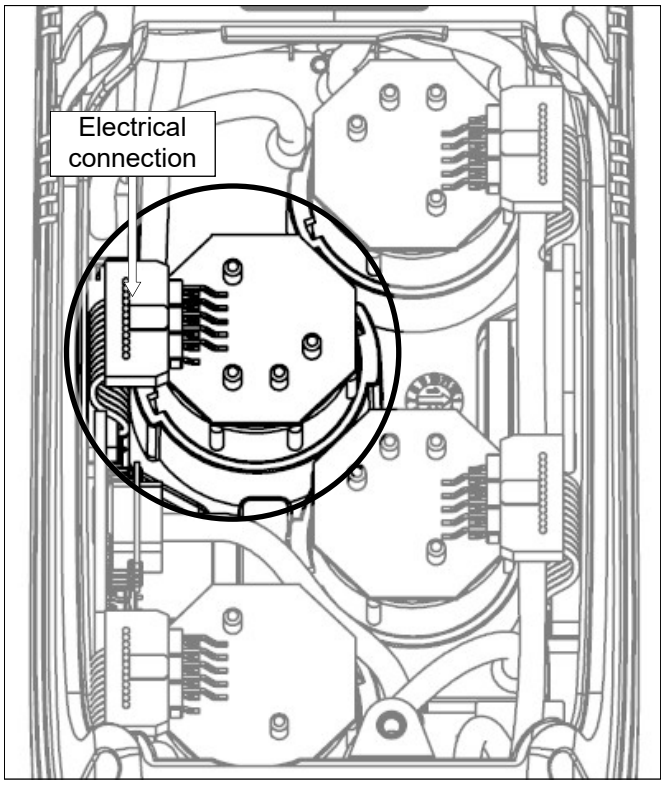
15.6 Replacing the gas sensors

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:

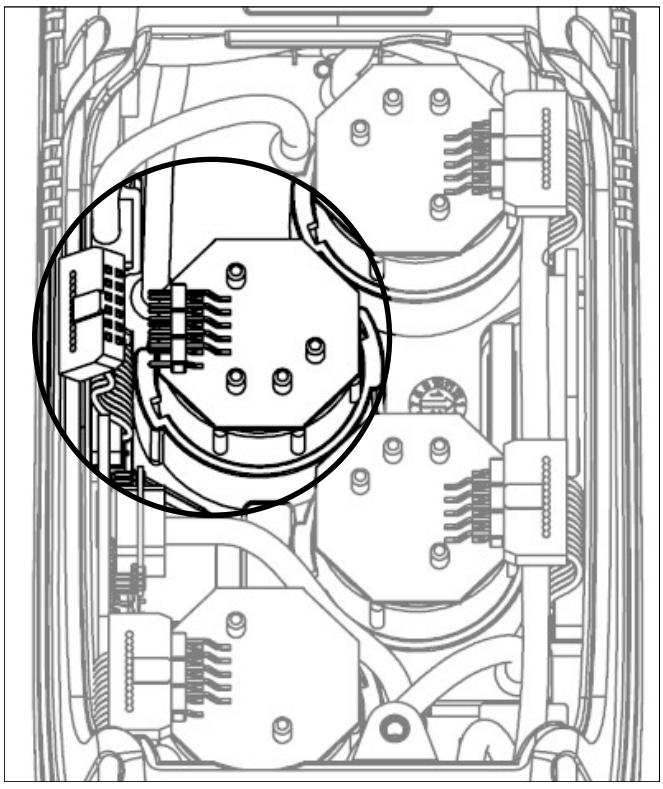
1. Undo the two fixing screws on the sensor compartment cover.
2. Extract the cover to have access to the sensor compartment.



3 Locate the sensor to be replaced; here is an example of a connected sensor to be replaced.

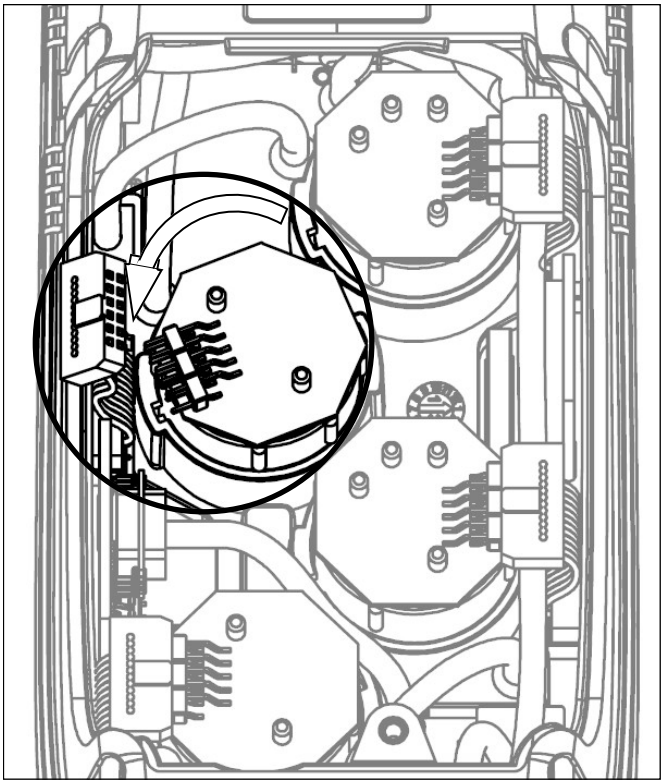


4 Disconnect the sensor to be replaced; here is an example of a disconnected sensor to be replaced.

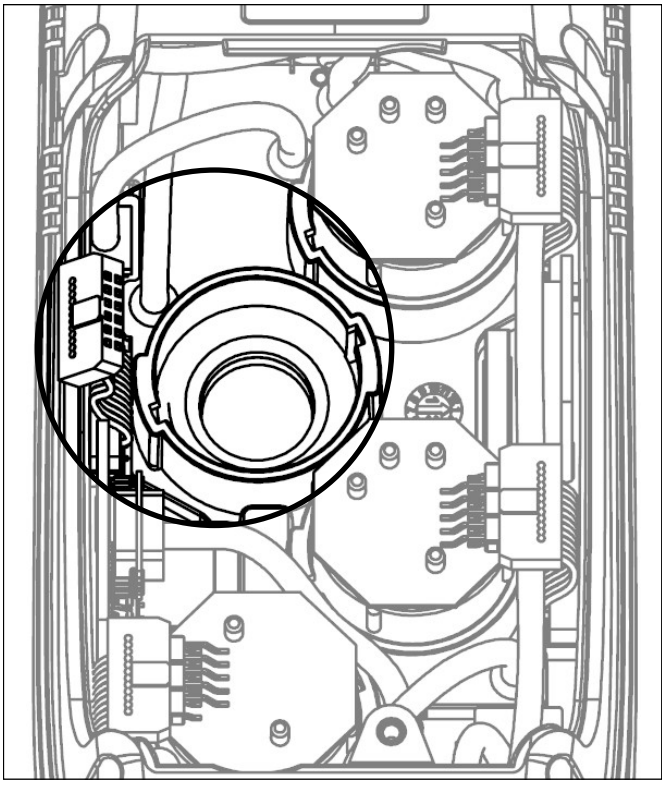


5 The sensor is bayonet-connected to its socket; rotate it anticlockwise to remove it. Here is an example of a rotated sensor.

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



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



7 Fit the sensor again taking care the electric connection is turned outside the instrument, not inside (See point 5).

8 Rotate the sensor clockwise until hearing a click (See point 4).

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

9 Reconnect the sensor (See point 3).

10 Close the back door of the sensor compartment again, and tighten screws again (See point 1).

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.

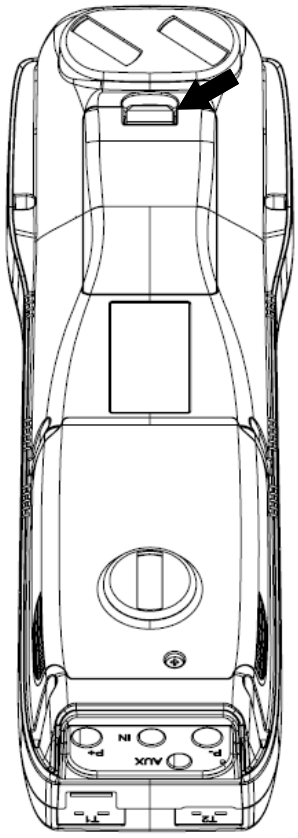
CODE	DETECTED GAS	POSITION	SETTLING TIME
Flex-Sensor O_2 LL Cod. AACSE43	O_2 Oxygen	S1	24 hours (1)
Flex-Sensor O_2 Cod. AACSE48	O_2 Oxygen	S1	2 hours (1)
Flex-Sensor CO+H_2 Cod. AACSE12	CO Carbon Monoxide	S2	2 hours (1)
Flex-Sensor CO high immunity +H_2 Cod. AACSE20	CO Carbon Monoxide	S2/S3/S4	2 hours (1)
Flex-Sensor NO Cod. AACSE10	NO Nitrogen Oxide	S3	48 hours (2)
Flex-Sensor NO_2 Cod. AACSE14	NO_2 Nitrogen Dioxide	S2/S3/S4	2 hours (1)
Flex-Sensor SO_2 Cod. AACSE13	SO_2 Sulphur Dioxide	S2/S3/S4	2 hours (1)
Flex-Sensor CO 100.000 ppm Cod. AACSE17	CO Carbon Monoxide	S2/S3/S4	2 hours (1)
Flex-Sensor CO 20.000 ppm Cod. AACSE18	CO Carbon Monoxide	S2/S3/S4	2 hours (1)
FLEX-Sensor CxHy 0-5.00% vol. referred to CH4 Cod. AACSE23	CxHy unburnt hydrocarbons	S3/S4	1/2 hour (3)
Flex-Sensor for gas leaks Cod. AACSE19	Leak detector Methane / LPG	S4	-
Flex-Sensor CO+H_2 low range Cod. AACSE24	CO Carbon Monoxide	S2	2 hours (1)
Flex-Sensor NO low range Cod. AACSE25	NO Nitrogen Oxide	S3	48 hours (2)
Flex-Sensor NO_2 low range Cod. AACSE26	NO_2 Nitrogen Dioxide	S2/S3/S4	2 hours (1)
Flex-Sensor SO_2 low range Cod. AACSE28	SO_2 Sulphur Dioxide	S2/S3/S4	2 hours (1)
Flex-Sensor CO_2 0 .. 20% v/v Cod. AACSE21	CO_2 Carbon Dioxide	S3/S4	2 hours (1)
Flex-Sensor CO_2 0 .. 50% v/v Cod. AACSE47	CO_2 Carbon Dioxide	S3/S4	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 polarisation battery, the settling time is reduced down to 2 hours.
(3) 1/2-Hour settling time is required.

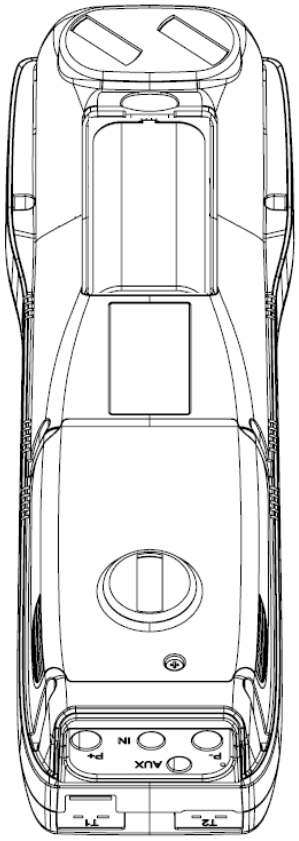
15.7 Replacing the battery pack

Follow these instructions to replace the battery pack:

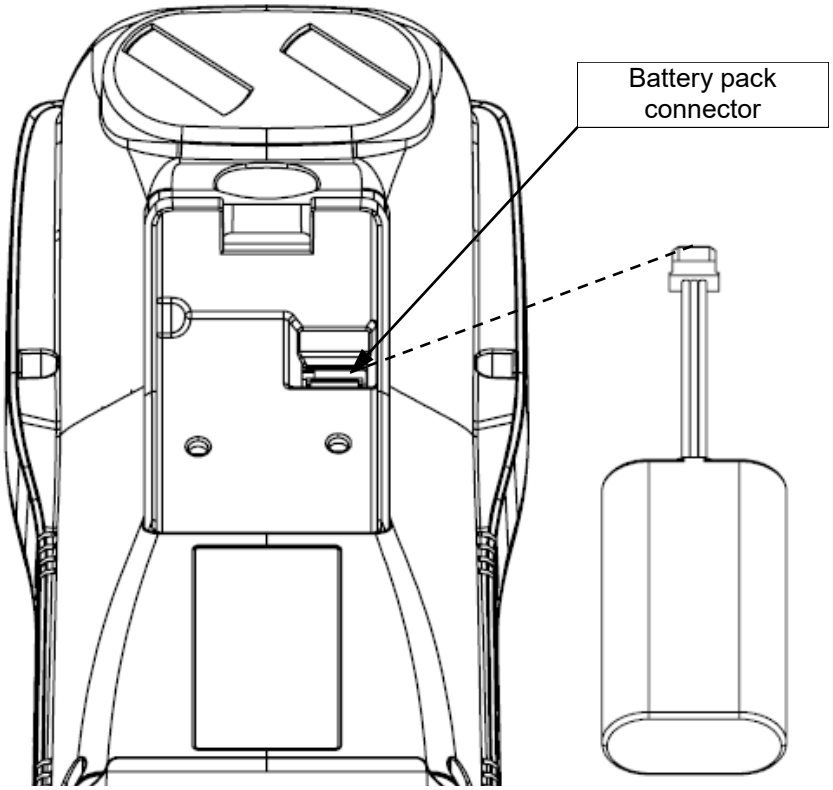
1. Remove the battery compartment cover.



2. Extract the battery pack.



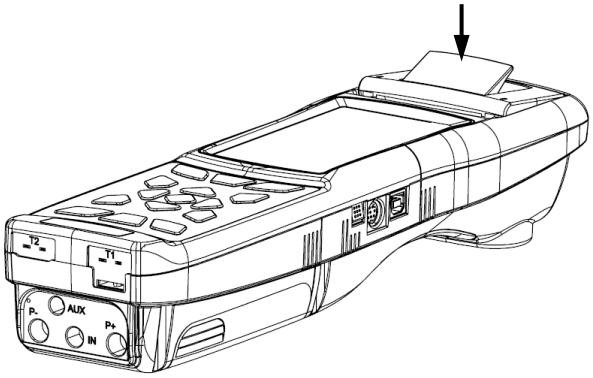
3. Remove the battery pack connector, and replace the pack with a new one following the reverse procedure described above.



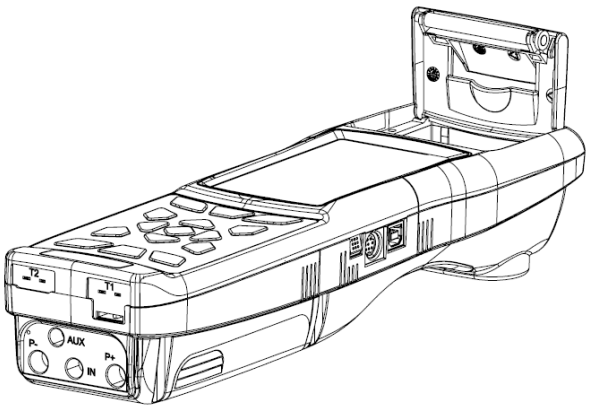
15.8 Replacing the printer paper

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

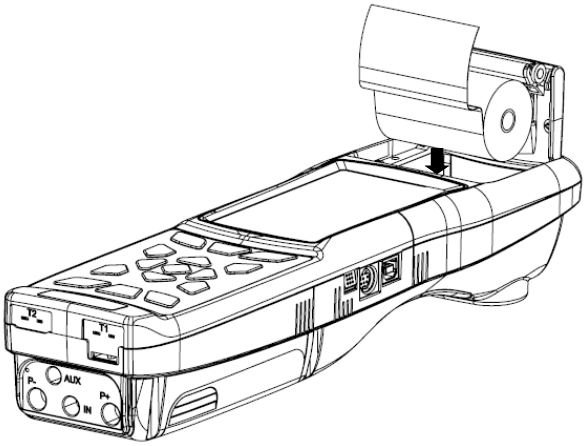
1. Lift the shiny tile, indicated by the arrow.

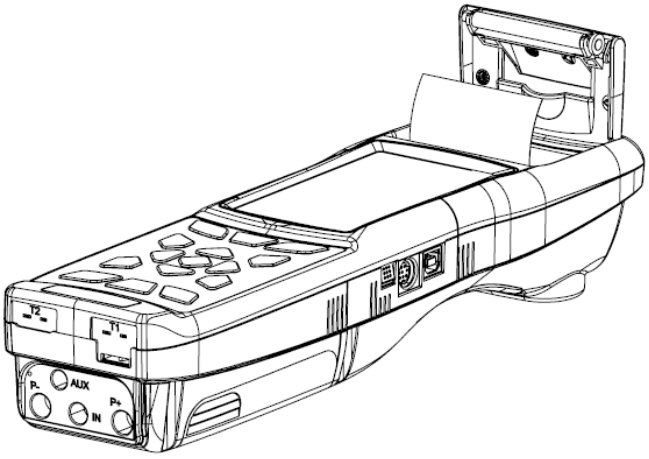


2. Lift the whole block of the lid completely.

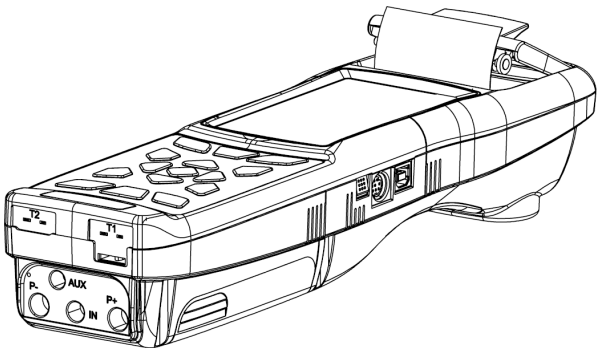


3. Insert the roll of printing paper as shown in the following figures.

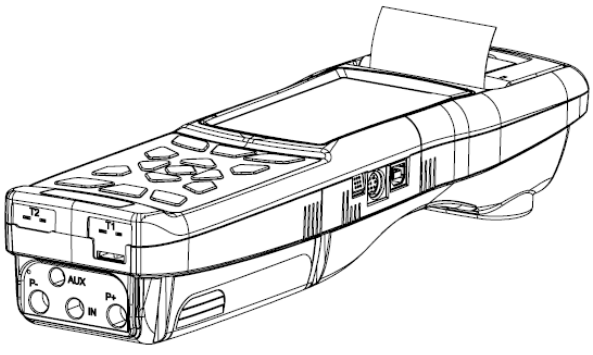




4. Close the whole block of the lid of the printer, pressing it lightly so as to hook it on to the device.



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

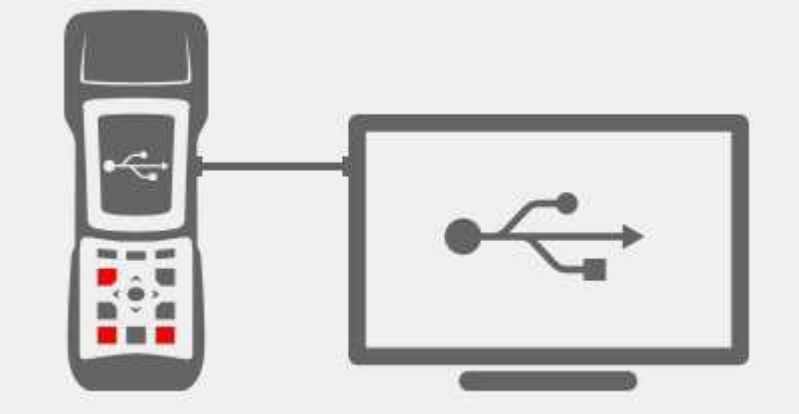


15.9 Firmware Update

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. Hold down the three red buttons on the analyzer for at least 10 seconds
5. Release only the power on/off button
6. The analyzer will be recognized by the operating system as a portable device drive
7. Release the remaining two buttons
8. Copy the firmware file (extension .srec) to the directory of the analyzer
9. Wait till the end of the file copy operation
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

16.1 Troubleshooting guide

SYMPTOM	PROBABLE CAUSES AND REMEDIES
The instrument does not work at all. When the On/Off pushbutton is pressed the instrument does not come on.	**a.** Keep the On/Off key depressed for at least 2 seconds. **b.** The battery is low; connect the battery charger to the instrument. **c.** The battery pack is not connected to the instrument; remove the cover from the battery compartment and connect the connector of the battery pack to the outlet on the printed circuit board. **d.** The instrument is faulty: send it to a service centre.
The battery symbol  is empty on the inside.	The batteries are low. The instrument will remain on for a couple of minutes after which it will switch off; connect the battery charger.
After auto-calibration is complete the sensor diagnostics screen appears and gives an error for one or more cells.	**a.** Auto-calibration took place while the flue gas was being sampled. **b.** The O_2 sensor is faulty, is not connected correctly or is not connected at all. Check the above points, also referring to sections 5.3, 5.4, 6.6. **c.** The sensor was not allowed the necessary adjustment time or the instrument was left with a low battery for too long.
A pressure sensor error is shown in the pressure/ draught screen.	There is a calibration problem. Send the instrument to a service centre.
The analysis screen gives a flue gas temperature (Tf) error.	**a.** The thermocouple is not connected; connect the thermocouple to the analyser. **b.** The sensor has been exposed to temperatures greater or lower than its operating temperature range. **c.** The thermocouple is faulty. Send the complete probe to a service centre.
The following symbol "----" appears on the analysis screen.	The instrument is not able to calculate a numerical value based on the flue gas analysis conducted. The "----" are replaced by numbers when the analyser detects valid combustion data.
"Max. Lim." or "Min. Lim" appears on the analysis screen.	The relative sensor is detecting a value that is beyond the analyser's measuring range. "Max. Lim" or "Min. Lim." are replaced by numbers when the instrument reveals values that are within the measuring range.
The sample pump sounds as though it is running slowly, tends to stop or does not even start.	**a.** Sample flow is obstructed. Check that the water filter is clean and that it is not completely soaked. Also check that the hose connected to the probe is not crushed. **b.** Sample intake flow is obstructed. Check that the particulate filter is clean. **c.** The pump is not connected as it should be. Remove the rear flap and check that the pump's electrical connector is connected to the printed circuit board. **d.** Pump is faulty. Replace the pump unit. **e.** Pump is disabled. The key combination  has been pressed. To re-enable the pump, switch off the instrument and then switch it on again.

Troubleshooting guide

SYMPTOM	PROBABLE CAUSES AND REMEDIES
The rear lighting of the display is not on.	The backlighting LED's are faulty. Contact the nearest service centre to replace the display.
The batteries last less than 9 hours.	**a.** Battery capacity is limited by low temperatures. To achieve a longer battery life it is recommended to store the instrument at higher temperatures. **b.** The battery pack is old. Battery capacity tends to diminish with age. If battery life has become unacceptable, replace the battery pack:
The values shown in the analysis screen are not reliable.	**a.** Sensor/s is/are faulty. Check that the sensors are installed correctly by accessing the sensor diagnostics menu. **b.** The sample probe connection presents a leak. Check all joints and the conditions of the hose. **c.** Pump is faulty. Replace the pump unit. **d.** The instrument is faulty: Send it to a service centre for repair.
During the tightness test a "sensor error" is reported.	Check for the correct connection of the hose to the positive pressure input.

17.0 SPARE PARTS AND SERVICING

17.1 Spare parts

AAC BF01: Sensor junction block
AAC FA01: Particulate filter
AAC PB06: Li-Ion 7,2V 2,4Ah battery pack
AA RC05: Paper roll for printer, h=57mm Diam.=40mm
AAC ADX 005: Dummy sensor
AAC SE43: FLEX-Sensor O_2 long life, pre-calibrated and interchangeable
AAC SE48: FLEX-Sensor O_2, pre-calibrated and interchangeable
AAC SE12: FLEX-Sensor CO+H2, pre-calibrated and interchangeable
AAC SE10: FLEX-Sensor NO/NOx, pre-calibrated and interchangeable
AAC SE14: FLEX-Sensor NO2, pre-calibrated and interchangeable
AAC SE13: FLEX-Sensor SO2, pre-calibrated and interchangeable
AAC SE17: FLEX-Sensor CO 100.000 ppm, pre-calibrated and interchangeable
AAC SE18: FLEX-Sensor CO 20.000 ppm, pre-calibrated and interchangeable
AAC SE19: FLEX-Sensor for leaks detection, pre-calibrated and interchangeable
AAC SE20: FLEX-Sensor CO high immunity H_2, pre-calibrated and interchangeable
AAC SE23: FLEX-Sensor CxHy related to CH4, pre-calibrated and interchangeable
AAC SE24: FLEX-Sensor CO+H2 low range, pre-calibrated and interchangeable
AAC SE25: FLEX-Sensor NO low range, pre-calibrated and interchangeable
AAC SE26: FLEX-Sensor NO2 low range, pre-calibrated and interchangeable
AAC SE28: FLEX-Sensor SO2 low range, pre-calibrated and interchangeable
AAC SE21: FLEX-Sensor CO2 0-20% v/v pre-calibrated and interchangeable
AAC SE47: FLEX-Sensor CO2 0-50% v/v, pre-calibrated and interchangeable

17.2 Accessories

AA AL05: 100-240V~/12 VDC 2A feeder with 2 m cable
AA SI01: Italian plug
AA CA02: Power supply with car adapter
AA CR07: Rigid plastic case
AA ZN01: Back-pack
AAC CT01: Case with shoulder strap
AAC DP02: Deprimometer for Draught test
AAC KP01: Differential pressure kit
AA KT04: Tightness test kit
AA PM02: Manual pump kit for smoke measurement
AA SA08: 200 mm air temperature probe (cable length 2 mt)
AA SF61A: 180 mm. gas probe, 1100°C extended temperature range, with 3 mt cable
AA SF51A: 180 mm. gas probe, 1100°C extended temperature range, with 2 mt cable
AA SF62A: 300 mm. gas probe, 1100°C extended temperature range, with 3 mt cable
AA SF52A: 300 mm. gas probe, 1100°C extended temperature range, with 2 mt cable
AA SF65A: 750 mm. gas probe, 1100°C extended temperature range, with 3 mt cable
AA SF66A: 1000 mm. gas probe, 1100°C extended temperature range, with 3 mt cable
AA SX01: Gas sampling probe for average CO, 300mm with 2 m cable
AA SX02: Probe fo industrial motors, 400mm with 3 m cable
AA SL05A: 220 mm. flexible gas probe, 1100°C extended temperature range, with 2 mt cable
AA SP01: Protective screen for gas sampling probe
AAC EX02S: 3 m extension cable for gas sampling probe
AA SM06: Rubber protecting cover
AAC SO01: Probe for measuring the ionisation current
AA SW08: Configuration software kit (USB + PC cable)
AAC TA03: Particulate/water filter assembly
AAC TA03A: Particulate/water filter assembly with steel pipe and connector
AA UA03: Adapter cable USB-A / mini USB-B
AA TT01: 'L' shaped Pitot Tube (without Tc-K thermocouple): length 300mm - external ø 6 mm. Supplied with two silicone tubes with length 2 meters.
AA TT02: 'L' shaped Pitot Tube (without Tc-K thermocouple): length 800mm - external ø 6 mm. Supplied with two silicone tubes with length 2 meters.
AA SG01: Probe for leaks detection

17.3 Service Centres

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

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 500 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
ΔT	73.6 %
Qs	10.0 %
ηs	90.0 %
ηc	0.0 %
ηt	90.0 %
CO	23 ppm
NO	14 ppm
NOx	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 %
NOx ref.:	60 ppm
Draft	4.5 Pa
T ext.	10.0 °C

Note: ----------

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
ΔT	73.4 °C
QS	10.0 %
ηs	90.0 %
ηc	0.0 %
ηt	90.0 %
CO	23 ppm
NO	14 ppm
NOx	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 %
NOx 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
ΔT	73.6 °C
QS	10.0 %
ηs	90.0 %
ηc	0.0 %
ηt	90.0 %
CO	23 ppm
NO	14 ppm
NOx	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 %
NOx 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
ΔT	73.8 °C
QS	10.1 %
ηs	89.9 %
ηc	0.0 %
ηt	89.9 %
CO	23 ppm
NO	14 ppm
NOx	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 %
NOx 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 500 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
ΔT              53.7 %
Qs              7.6 %
ηs              92.4 %
ηc               0.0 %
ηt              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: ------------------
------------------------
------------------------
------------------------
------------------------
------------------------
------------------------
------------------------
```

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
ΔT              68.5 %
Qs               9.3 %
ηs              90.7 %
ηc               0.0 %
ηt              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 500 X
Serial: 999989
Memory: 01

Date: 04/04/14
Time: 10.30

Draft            4.5 Pa
T ext.          10.0 °C

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

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 500 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: ------------------
------------------------
------------------------
```

Example of Smoke Paper print-out.

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

Oper.: John Smith

Sign.: _______________

Chemist 500 X
Serial: 999989
Memory: 01

Date: 04/04/14
Time: 10.30

Fuel: Diesel

Smoke:    3  1  2
Aver. n°:       2

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

Example of ambient CO Paper print-out.

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

Oper.: John Smith

Sign.: _______________

Chemist 500 X
Serial: 999989
Memory: 01

Date: 04/04/14
Time: 10.30

CO amb            0 ppm

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

Example of Velocity Paper print-out.

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

Oper.: John Smith

Sign.: _______________

Chemist 500 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: ------------------
------------------------
------------------------
------------------------
------------------------
------------------------
------------------------
```

Coefficients of the fuels and Formulas

The following chart, derived from standard UNI 10389-1, lists the coefficients of the memorised 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.

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

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

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

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

- **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 NOx.
- **SO2 conv**: Same as CO conv, but for SO2.
- **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 smokes 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 84 + 2 * log Pn Low temperature boilers 87.5 + 1.5 * log Pn Condensing boilers 91 + 1 * log Pn	around 87 % around 90 % around 92.5 %
After 08/10/2005	Condensing boilers 90 + 2 * log Pn - 1 Other boilers 88 + 2 * log Pn - 1	around 92 % around 90 %

For hot air 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 analyser 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 500 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
ΔT              53.7 %
Qs              7.6 %
ηs              92.4 %
ηc               0.0 %
ηt              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: ------------------
-------------------------
-------------------------
-------------------------
-------------------------
-------------------------
-------------------------
-------------------------
```

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 ηs
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 ηc
Efficiency deriving from the condensation of water vapour contained in flue gasses, calculated according to the UNI 10389-1 standard.

Total efficiency ηt
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 ΔT
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 analyser 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.

seitron
Tel. (+39).0424.567842
Fax. (+39).0424.567849

DICHIARAZIONE DI CONFORMITA' UE
EU DECLARATION OF CONFORMITY

Nr. 027447

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: K0
Product name: Analizzatore di combustione
Combustion analyzer

Versioni del prodotto: Tutte
Product versions: *All*
Nomi commerciali: Chemist 50- -
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 10845, per la misura del tiraggio ed UNI 10389-1, per la misurazione del rendimento di combustione.
Further notes: This instrument is compliant with the requirements of the Italian standard UNI 10845, for draft measurement, and UNI 10389-1, for combustion efficiency measurement.

Bassano del Grappa, li 16/09/16

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

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)
	Cod. AAC SE20 (Mid)
CO:	Cod. AAC SE18 (High)
NO (optional):	Cod. AAC SE10
SO_2 (optional):	Cod. AAC SE13

WARRANTY CERTIFICATE

WARRANTY

The CHEMIST 500 flue gas analyzer is guaranteed for **48 months** from purchasing date including the internal electro-chemical sensors which are also guaranteed for **48 months** from purchasing date.
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 instruction leaflet.
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.:

seitron
Via Prosdocimo, 30 - 36061 - BASSANO DEL GRAPPA (VI) - Tel. (+39).0424.567842 - Fax. (+39).0424.567849

seitron
dispositivi elettronici
di regolazione, misura e controllo

SEITRON S.p.A. a socio unico

Address: Via Prosdocimo, 30
36061 - Bassano del Grappa (VI)
ITALY
Telephone: +39.(0)424.567842
Fax: +39.(0)424.567849
E-mail: info@seitron.it
Website: www.seitron.it