seitron
Innovation Technology

USE AND MAINTENANCE

CHEMIST 600

Combustion Analyzer

TABLE OF CONTENTS

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 600.
- 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.*

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

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.	

2.0 SAFETY

2.1 Intended purpose

This chapter describes the areas of application for which the CHEMIST 600 is intended.

Using the CHEMIST 600 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 600 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
- Draft measurement

2.2 Improper use of the product

The use of CHEMIST 600 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 600 should not be used:

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

3.0 WORKING PRINCIPLE

3.1 General overview of the Analyzer

CHEMIST 600 is a portable analyzer for flue gas and emissions.

The instrument is equipped with:

- Pneumatic circuit which can accommodate up to 6 sensors in the FLEX-sensors series.
- Intuitive user interface: the instrument can be used without the support of the user manual.
- Wide (55x95 mm) and bright TFT color display which delivers great readability thanks to the zoom function and an efficient backlight.
- Single rechargeable 'Li-Ion' battery pack, used to power both the unit and the thermal printer.
- Thermal printer integrated in the instrument.
- Connectivity with a computer through the USB connection and/or Bluetooth ®. Once the special software provided with the instrument is used, this allows for the storage of combustion analysis as well as the configuration of the main parameters.
- Connectivity with a smartphone through Bluetooth®. Once the specific APP 'SEITRON SMART ANALYSIS' available on Google play-store is installed on the device, the user can start remote analysis of combustion and/or view real-time data of the analysis in progress.

Main functions:
- Combustion analysis in manual or automatic mode (UNI 10389-1 or BImSchV or according to the data logger function, user-defined mode).
  - Comes with 15 most used fuel parameters (such as natural gas, LPG, gas oil and fuel oil).
  - Possibility to store in memory the parameters for 32 further fuels, once their chemical composition is known.
- Monitoring of pollutants (emissions).
- Memory capable of storing up to 2,000 full analysis.
- Storing of acquired data and their averaging.

Measurable gases:
- CO, CO_2, CxHy referred to the methane
- O_2
- CO (ambient monitoring)
- CO / H_2
- CO (low, medium, high)
- NO (low, medium)
- NO_2 (low, medium)
- SO_2 (low, medium)
- NOx
- H_2S
- NH_3
- H_2

Measurements:
- Ambient CO (with the internal sensor)
- Draft in the chimney.
- Smoke (with the use of the external manual pump).
- Gas pressure in the piping, pressure in the burning chamber and check of the pressure switches, using the measurement range up to 200hPa.
- Combustion air measurement
- Auxiliary temperatures
- Tightness test according to UNI 7129-1: 2015 and UNI 11137: 2019
- Air speed for air or flue gas leaving the chimney with the use of Pitot tube
- Ionization current measurement (with external auxiliary probe)

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

Certificate of calibration
The instrument is accompanied with a calibration certificate compliant with standard EN 17025.

4.0 DESCRIPTION OF THE PRODUCT

4.1 Working principle

The gas sample is taken in through the gas probe, by a diaphragm suction pump inside the instrument. The measuring probe has a sliding positioning cone that allows the probe to be inserted in holes with a diameter of 11 mm (0.43") to 16 mm (0.65") and to adjust the immersion depth. It is recommended to have the **gas sampling point roughly in the center of the flue/stack.** The gas sample is cleaned of humidity and impurities by a condensate trap and filter positioned along the rubber hose that connects the probe to the analyzer. 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.

4.2 Measurement cells

The instrument takes advantage of pre-calibrated FLEX-series gas sensors for the measurement of Oxygen (O_2), Carbon Monoxide (CO - Hydrogen compensated measurement, Nitrogen Oxide (NO), Nitrogen Dioxide (NO_2), Sulphur Dioxide (SO_2) and hydrogen sulfide (H_2S). The sensors do not need particular maintenance yet they have to be replaced periodically when exhausted. Measurement of the oxygen ($\%O_2$) is carried out with an electrochemical cell that loses sensitivity over time because it is constantly exposed to 20.9% Oxygen in ambient air. 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 analyzed. The gas penetrates the cell through a selective diffusion membrane and generates an electric current proportional to the absorbed gas. Such current is measured, digitalized, temperature-compensated, processed by the microprocessor, and displayed. The gas shall not be at such a pressure to damage or destroy the sensors; for this reason the suction pump is continuously adjusted, in order to ensure an appropriate flow to the sensors. The maximum estimated allowed pressure is ±100hPa gage.

The response times of the measurement cells used in the analyzer are:

O_2	=	20 sec. at 90% of the measured value
$CO(H_2)$	=	50 sec. at 90% of the measured value
CO	=	50 sec. at 90% of the measured value
CO	=	180 sec. at 90% of the measured value
NO	=	40 sec. at 90% of the measured value
NO_2	=	50 sec. at 90% of the measured value
SO_2	=	50 sec. at 90% of the measured value
H_2S	=	50 sec. al 90% of the measured value
NH_3	=	90 sec. al 90% of the measured value
H_2	=	90 sec. al 90% of the measured value
H_2	=	240 sec. at 90% of the measured value
CH_4	=	90 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 analyzer, it is advisable to wait for the measured value be lower than 20ppm by in taking clean air. If there is an automatic calibration solenoid, the device performs an automatic cleaning cycle and it turns off when the sensors return to a value close to zero. The auto-zero solenoid valve allows the operator to turn the instrument on with the probe inserted in the flue. Up to 4 alarm set points are programmable with visual and acoustic signals for the relevant measurement parameters. The UNI 10389-1 standard provides that the instrument must be calibrated by a certified laboratory that is authorized to issue annual calibration certificates. Exhausted cells can be easily replaced by the user without depriving himself of the instrument and without complicated calibration procedures with certified mixtures as they are pre-calibrated before being supplied. Seitron certifies the accuracy of the measurements only upon a calibration certificate issued by its laboratory or other approved laboratory.

WARNING
Some sensors (for example NH3, H2, H2S, SO2,…) are sensible to other gases called interfering gases.
On the analysis phase, the influence of interfering gases is compensated only if on the instrument are installed the correspondent sensors.
If a sensor sensitive to NO and NO2 interfering gases is installed on the instrument, but only the NO sensor is installed in the instrument, NO2 gas compensation is carried out starting from the NOx/NO ratio.

4.3 CO dilution

One of the characteristics of the electrochemical sensor for the measurement of CO is the need to require very long self-calibration time in case it has been in contact with high gas concentration (greater than the full scale) for a long time. The CO sensor is therefore protected in this instrument by an automatic dilution system that allows to extend the measuring range of the sensor without overloading the sensor itself.
The dilution system allows to have the CO sensor efficient any time and ready to perform properly even in case of very high concentration of CO.
The dilution system also allows to extend the measurement range of the CO sensor as follows:
- up to 100,000 ppm for a CO sensor with 8000 ppm full scale
- up to 250,000 ppm for a CO sensor with 20,000 ppm full scale

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

4.4 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 option, it is possible to add fuels and their coefficients in order to define up to a maximum of 32 combustibles, other than the default ones.
For more details see Annex B.

4.5 Pressure sensor, piezoelectric, temperature compensated

The instrument is internally provided with a piezoresistive differential pressure sensor, temperature compensated, for measuring pressure or draft.
This sensor is differential type thus, thanks to the second measurement port, can be used for measuring the draft (depressurization) in the chimney, for the leak test of the pipes, for differential pressure measurement, for measuring the velocity of the flue gas using a Pitot tube, for flow measurement, and possibly for other measurements (pressure of gas in the piping, pressure loss across a filter, etc.).
The measurement range is -10,00 hPa .. +200,00 hPa.
Any potential drift of the sensor are nulled thanks to the autozeroing system which in this instrument can NOT be operated with the flue gas probe inserted in the chimney.

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

4.6 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

4.7 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 14.1.3.

4.8 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 option, must be used to perform this measurement.

4.9 Temperature measurements

CHEMIST 600 can measure several types of temperatures taking advantage of dedicated probes.

4.10 Auxiliary measurements

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

4.11 Pressure decay test

The instrument can perform the tightness test of a piping according to the Italian standards UNI 7129-1: 2015 and UNI 11137: 2019.

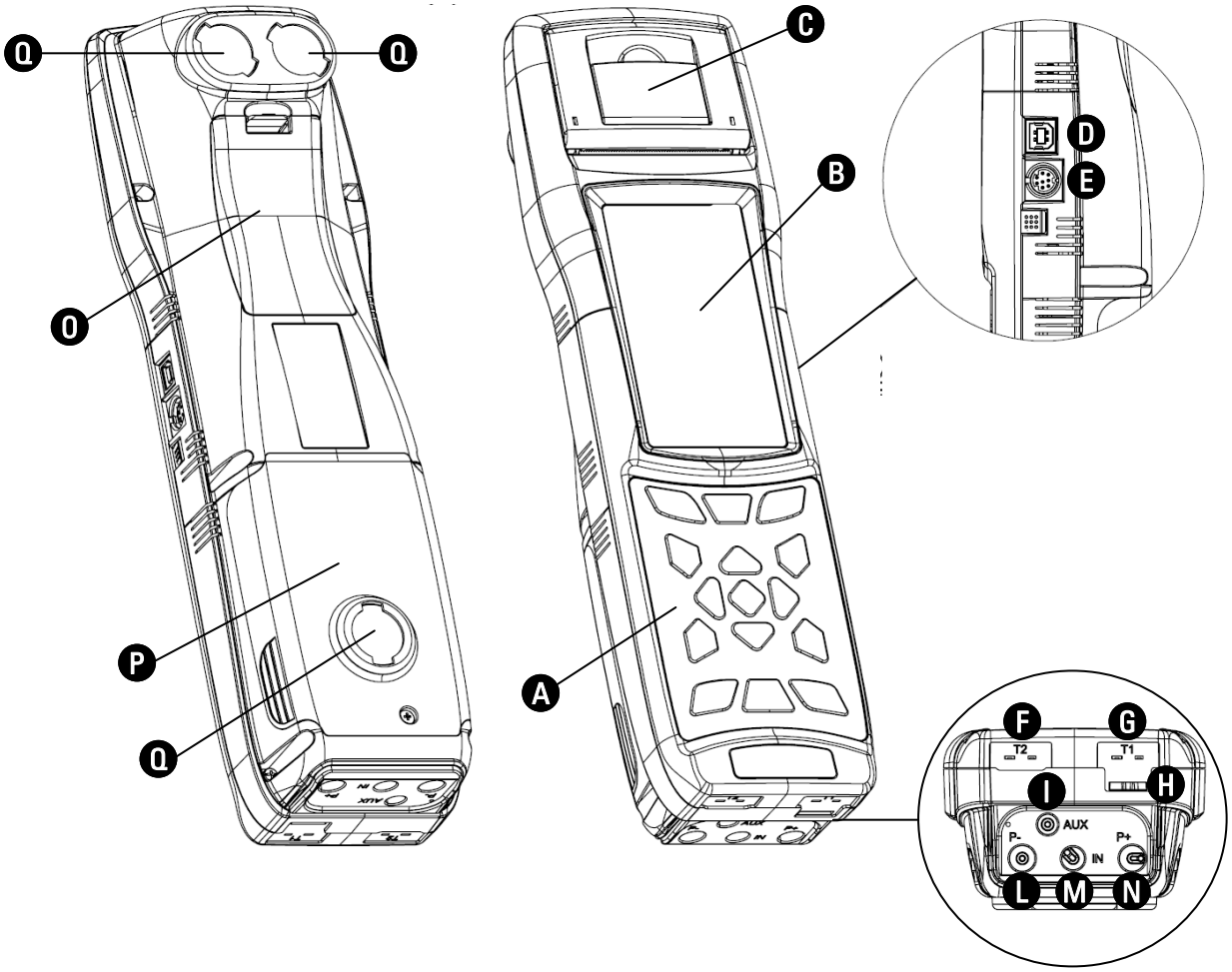
4.12 Bluetooth® connection

The CHEMIST 600 analyzer is internally equipped with a Bluetooth® module, which allows the communication with the following remote devices:

- Remote Bluetooth® printer
- Smartphone or tablet with installed the OS Google Android v.4.1 (Jelly Bean) or later and the proper APP 'SEITRON SMART ANALYSIS' (available on Google Play Store) installed.
- PCs running Microsoft Windows 7 or later and Bluetooth® interface upon installation of the specific software 'SEITRON SMART ANALYSIS' downloadable from the web site www.seitron.com.

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

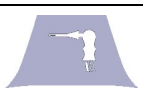
5.0 DESCRIPTION OF COMPONENTS

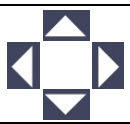
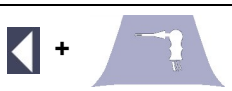


LEGEND:

A keypad

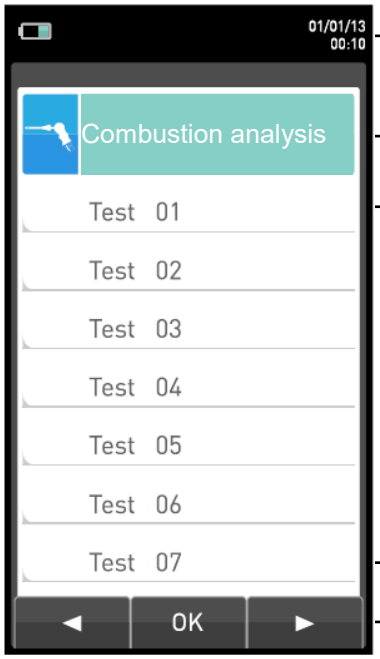
Adhesive polyester keypad with preformed keys featuring main control functions.

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.**

B Display

TFT 272 x 480 pixel backlit color display with 21 characters available and 8 lines. Allows the user to view the measured parameters in the most comfortable format; a Zoom function displays the measured values in magnified form.
CAUTION: If the instrument is exposed to extremely high or extremely low temperatures, the quality of the display may be temporarily impaired. Display appearance may be improved by acting on the contrast key.



Date, time and battery status.

Selected menu.

Parameters relative to the selected menu.

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

Backlight
The backlight can be turned off with the simultaneous pressure on keys  +  .

The backlight is turned on when any key is pressed, except '  ' key.

C Printer

The thermal printer can print on either non-fading polyester paper or regular 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.

D USB connector (type B)

Used to connect the instrument to a personal computer running Microsoft Windows 7 or later upon installation of the specific software 'SEITRON SMART ANALYSIS' scaricabile dal sito web www.seitron.com.

E Connector for the connection of auxiliary probes.

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

F **'T2' Connector**
Used to connect the Tc-K plug of the combustion air temperature probe.

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

H **Gas outlet**

I **'AUX' Connector**
Input for optional external probes.

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

M **Pneumatic connector 'IN'**
input for the connection of the branch of the gas sampling probe with the condensation separating and anti-dust filter assembly.

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

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

O **Cover to access battery compartment.**

P **Cover to access cell compartment.**

Q **Magnets.**

R **Instrument data label.**

6.0 MAIN CONFIGURATIONS

	CHEMIST 604 N	CHEMIST 604 S	CHEMIST 605	CHEMIST 605 HC	CHEMIST 606 HC	CHEMIST 606 CO2	CHEMIST 606 S	CHEMIST 600 X [1]
O2 SENSOR	✓	✓	✓	✓	✓	✓	✓	✓
CO+H2 SENSOR	✓	✓	✓	✓	✓	✓	✓	
CO+H2 SENSOR low range								
CO SENSOR								
CO SENSOR 0 .. 100.000 ppm								
CO SENSOR 0 .. 20000 ppm								
NO SENSOR	✓	✓	✓	✓	✓	✓	✓	
NO SENSOR 5000 ppm								
NO SENSOR low range								
NO2 SENSOR	✓		✓	✓	✓	✓	✓	
NO2 SENSOR low range								
SO2 SENSOR		✓	✓		✓	✓	✓	
SO2 SENSOR low range								
CxHy SENSOR				✓	✓			
CO2 SENSOR 0..20% vol.						✓		
H2S SENSOR 500 ppm							✓	
EXPANDABLE TO 6 SENSORS	✓	✓	✓	✓	✓	✓	✓	✓
CO DILUTION	✓	✓	✓	✓	✓	✓	✓	✓
BLUETOOTH	✓	✓	✓	✓	✓	✓	✓	✓
TIGHTNESS TEST	✓	✓	✓	✓	✓	✓	✓	✓
CALIBRATION CERTIFICATE	✓	✓	✓	✓	✓	✓	✓	✓
QUICK GUIDE	✓	✓	✓	✓	✓	✓	✓	✓
GAS SAMPLE PROBE 300mm	✓	✓	✓	✓	✓	✓	✓	✓
COMBUSTION AIR TEMPERATURE PROBE	✓	✓	✓	✓	✓	✓	✓	✓
CONDENSATE TRAP	✓	✓	✓	✓	✓	✓	✓	✓
DIFFERENTIAL PRESSURE MEASUREMENT KIT	✓	✓	✓	✓	✓	✓	✓	✓
BATTERY CHARGER	✓	✓	✓	✓	✓	✓	✓	✓
EUROPEAN PLUG FOR BATTERY CHARGER	✓	✓	✓	✓	✓	✓	✓	✓
ADAPTER CABLE USB type A / USB type B	✓	✓	✓	✓	✓	✓	✓	✓
PC SOFTWARE	✓	✓	✓	✓	✓	✓	✓	✓
HARD CASE	✓	✓	✓	✓	✓	✓	✓	✓
ROLL OF PAPER PRINTER	✓	✓	✓	✓	✓	✓	✓	✓

1 This model identifies custom configurations different to standard ones.

7.0 TECHNICAL SPECIFICATIONS

7.1 Technical features

Power supply:	Li-Ion battery pack with internal protection circuit, rechargeable.
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 hours.
Instrument working time:	12 hours of non-stop operation (excluding printing).
Display:	4.3” TFT 272x480 pixels graphic color with backlight
Connectivity:	
Communication port:	USB connector type B.
Bluetooth®:	Class 1. Communication distance <100 meters (in open field)
Autozero:	Automatic autozero cycle with the probe not inserted in the chimney.
Dilution:	Widens the CO sensor measurement range up to 100.000ppm (10.00%). Programmable as simple protection of the CO sensor with the intervention level set by the user. Pre-set triggering threshold at 1500 ppm.
Gas measurement sensors:	Up to 6 configurable sensors: electrochemical, NDIR (single cell) and pellistor.
Programmed fuels:	15 factory pre-set plus 32 user-programmable.
Self-diagnosis:	All the functions and internal functions are checked and anomalies signaled.
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.
Printer:	Thermal integrated with easy loading paper and sensor for the presence of paper
Printer powered:	By the analyzer batteries.
Printer autonomy:	Up to 40 analysis reports with the batteries fully charged.
Internal data memory:	2000 complete data analyses, time and name of the customer can be stored.
User data:	8 programmable user names.
Print header:	6 lines x 24 characters user-customized.
Suction pump:	1.0 l/min heads at the flue up to 135mbar.
Condensate trap:	Outside the instrument.
Line filter:	With replaceable cartridge, 99% efficient with 20um particles (inside the condensate trap).
Smoke:	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: 2019 (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.
Draft test:	By using the internal sensor connected to the port P-, resolution 0,1 Pa, accuracy 0,5 Pa. Draft test must be carried out only by means of the AACDP02 external accessory in compliance with UNI 10845 standard.
Operating temperature:	23°F to 113° F (-5 °C to +45 °C)
Storage temperature:	-4°F to 122°F (-20 °C to +50 °C)
Humidity limit:	20% .. 80% RH
IP rating:	IP42

Air pressure:	Atmospheric	
Outer dimensions:	Analyzer Only :	3.5 x 12.2 x 2.4” (9 x 31 x 6 cm) (H x W x D)
Weight:	Analyzer Only :	~2 lbs. (~ 1 Kg)

7.2 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 .. 1000.0 ppm	0.1 ppm	±2 ppm 0 .. 40.0 ppm ±5% measured value 40.1 .. 1000.0 ppm
diluted	Electrochemical sensor	100000 ppm	10 ppm	±20% measured value
CO*2	Electrochemical sensor	0 .. 8000 ppm	0,1 ppm (0..1000ppm) 1 ppm (1001..8000ppm)	±2 ppm 0 .. 40.0 ppm ±5% measured value 40.1 .. 500.0 ppm ±10% measured value 501.0 .. 8000.0 ppm
diluted*2	Electrochemical sensor	100000 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 %
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 (J57-2017)	Electrochemical sensor	0 .. 1000 ppm	0,1 ppm	±2 ppm 0 .. 40 ppm
			1 ppm	±5% measured value 41 .. 1000 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 %
CO_2	NDIR sensor	0 .. 50.0% vol	0.1%	±1% vol 0.00 .. 10.00 % ±2% vol 10.01 .. 50.0 %
CH_4	NDIR sensor	0 .. 100.0% vol	0.01% vol	±0,5% vol 0 .. 10% ±5% measured value 10 .. 100%
H_2S	Electrochemical sensor	0 .. 500 ppm	0.1 ppm	±5 ppm 0 .. 100.0 ppm ±5% measured value 100.1 .. 500.0 ppm
H_2*2 3	Electrochemical sensor	0 .. 2000 ppm	1 ppm	±10 ppm 0 .. 100.0 ppm ±10 % measured value 100.1 .. 2000.0 ppm
H_2*3	Electrochemical sensor	0 .. 40000 ppm	10 ppm	±100 ppm 0 .. 1000 ppm ±10% measured value 1001 .. 40000 ppm
NH_3	Electrochemical sensor	0 .. 500 ppm	0.1 ppm	±10 ppm 0 .. 100.0 ppm ±10% measured value 100.1 .. 500.0 ppm
PI*1 (CO/CO_2 ratio)	Calculated		0.01%	
Air temperature	TcK sensor	-20.0 .. 1250.0 °C	0.1 °C	±0.5 °C 0 .. 100 °C ±0.5% measured value 101 .. 1250 °C
Flue gas temperature	TcK sensor	-20.0 .. 1250.0 °C	0.1 °C	±0.5 °C 0 .. 100 °C ±0.5% measured value 101 .. 1250 °C

MEASUREMENT	SENSOR	RANGE	RESOLUTION	ACCURACY
Pressure (draft & differential)	Piezoelectric sensor	-10.00 .. +200.00 hPa	0.01 hPa	±1% measured value -10.00 .. -2.01 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		

*[1]: The Poison Index ratio (P.I.) is a reliable indicator of a boiler or burner good operation. It only takes a simple flue gas test to determine whether or not a service is needed to fix the system.

*[2]: AACSE79 sensor-the intervention of dilution for CO measurement results in an increase in the measurement range to 100000 ppm, while H2 measurement is decreased by a coefficient of 12.5.

*[3]: If sensor AACSE79 (H2 0 .. 2000 ppm) and sensor AACSE78 (H2 0 .. 40000 ppm) dilution will always be active with fixed threshold at 3000 ppm in order to protect the sensor AACSE79 (H2 0 .. 2000 ppm) from high H2 concentrations measured by the AACSE78 sensor (> 3000 ppm).

8.0 USING THE FLUE GAS ANALYZER

8.1 Preliminary operations

Remove the instrument from its packing and check it for damage. Make sure that the content corresponds to the items ordered. If signs of tampering or damage are noticed, notify the SEITRON service center or distributor immediately and keep the original packing. A label at the rear of the analyzer 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.

8.2 WARNING

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

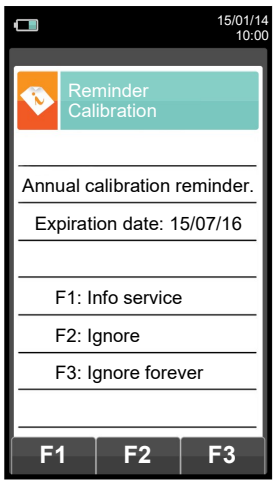
IF THE INSTRUMENT HAS BEEN KEPT AT VERY LOW TEMPERATURES (BELOW OPERATING TEMPERATURES) WE SUGGEST WAITING A WHILE (1 HOUR) BEFORE SWITCHING IT ON TO HELP THE SYSTEM'S THERMAL BALANCE AND TO PREVENT CONDENSATE FORMING IN THE PNEUMATIC CIRCUIT.

- When it has finished being used, before turning the instrument off remove the probe and let is aspirate ambient clean air for at least 5 minutes 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:

Press and hold for a few seconds



CONTEXT KEY	FUNCTION
F1	**Displays the information 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.**

8.3 Analyzer power supply

The instrument contains a high-capacity Li-Ion 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.

WARNING: If the instrument is not going to be used for a long time (e.g. summer) it is advised to store it after a complete charging cycle; furthermore, perform a complete charging cycle once every 4 months.

8.3.1 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 CENTER to carry out the necessary repairs.
The average life of the battery pack is 500 charging/discharging cycles. To exploit this characteristic to the full it is advisable to always use the instrument powered by the internal batteries and to charge it only when it gives the battery flat message.

THE INSTRUMENT IS SHIPPED WITH A BATTERY LEVEL LOWER THAN 30% AS REQUIRED BY CURRENT AIR TRANSPORTATION STANDARDS. BEFORE USE PERFORM A COMPLETE CHARGING CYCLE OF 8 HOURS.

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

The instrument can be left in stock for a period of time depending on the charging level of the battery; below there is a table showing the correlation between stock time and charging level.

BATTERY LEVEL	STOCK TIME
100%	110 days
75%	80 days
50%	45 days
25%	30 days

8.3.2 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.

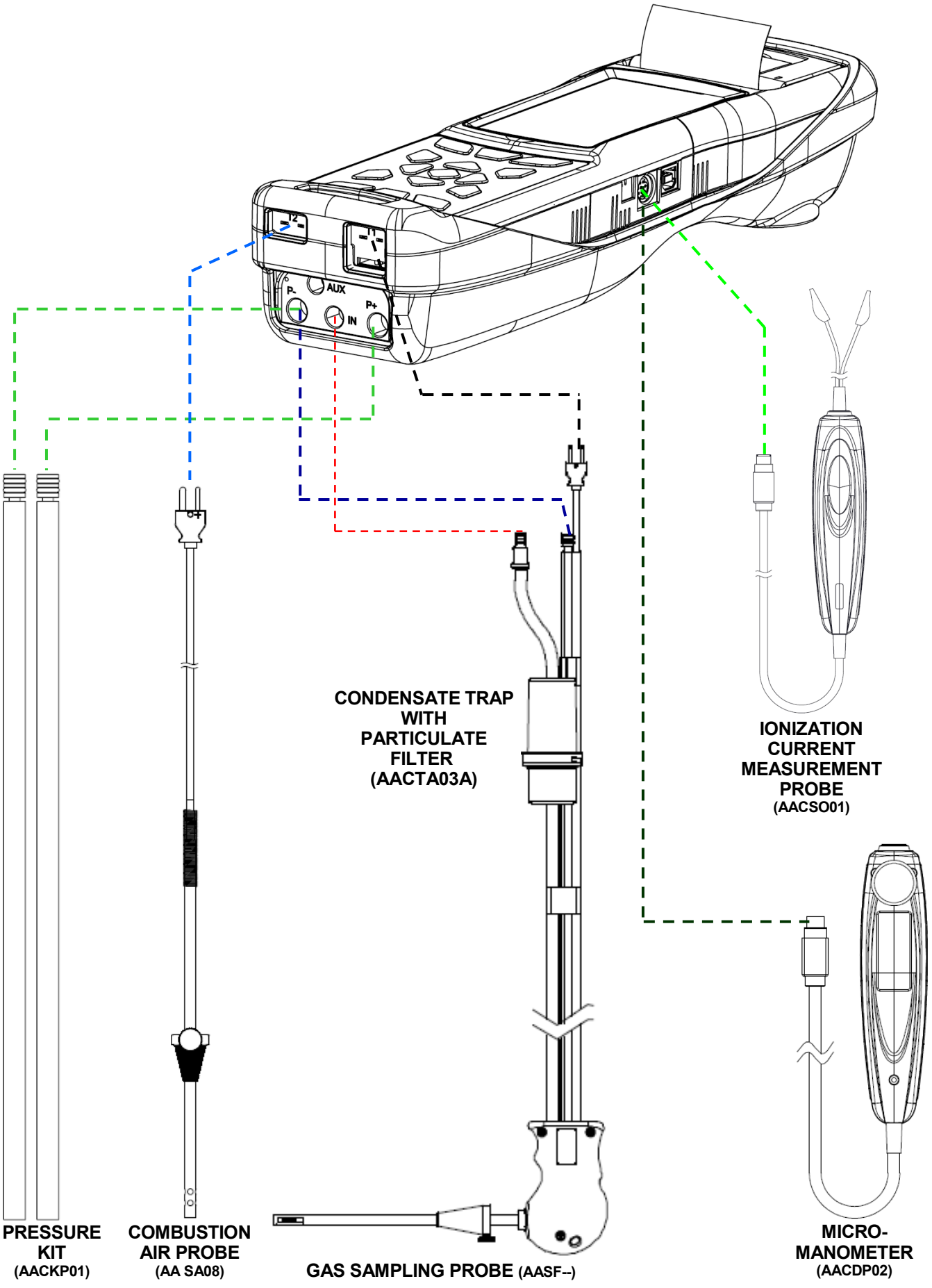
8.4 QR code generation

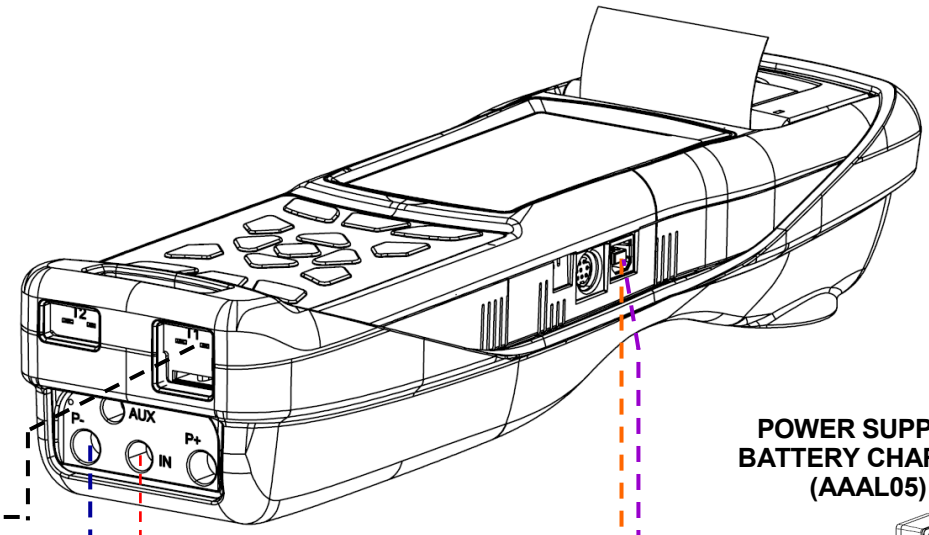
By pushing at the same time the buttons OK + , the instrument generates and shows on the display a QR code to download the data of the performed measures, after installing the App Seitron “SEITRON SMART ANALYSIS APP” downloadable from the AppStore or Google Play Store.

Minimum requirements for installing the App “SEITRON SMART ANALYSIS APP”
Operative systems: Android from version 4.1
Apple (iOS)

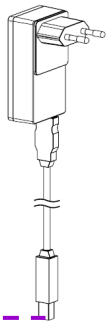
THE INSTRUMENT GENERATES THE QR CODE ONLY WHEN THE INTERACTIVE FUNCTION “ ” IS DISPLAYED ON SCREEN.

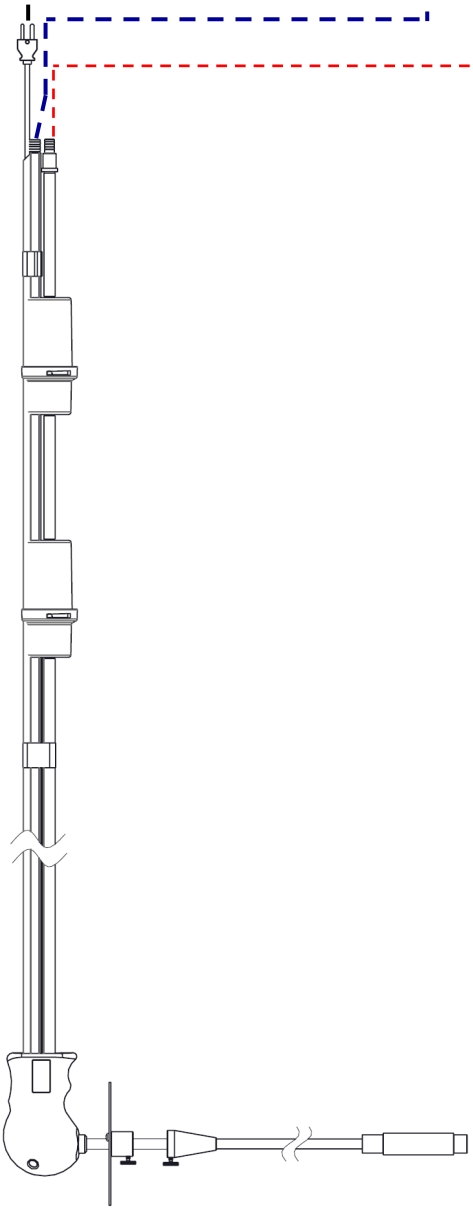
8.5 Connection diagram





POWER SUPPLY / BATTERY CHARGER (AAAL05)





GAS SAMPLING PROBE FOR INDUSTRIAL ENGINES (AASX02)

In order to perform combustion analysis and at the same time carry out the flue gas velocity measurement, it is necessary to connect the flue gas sampling probe and Pitot tube to the instrument at the same time.

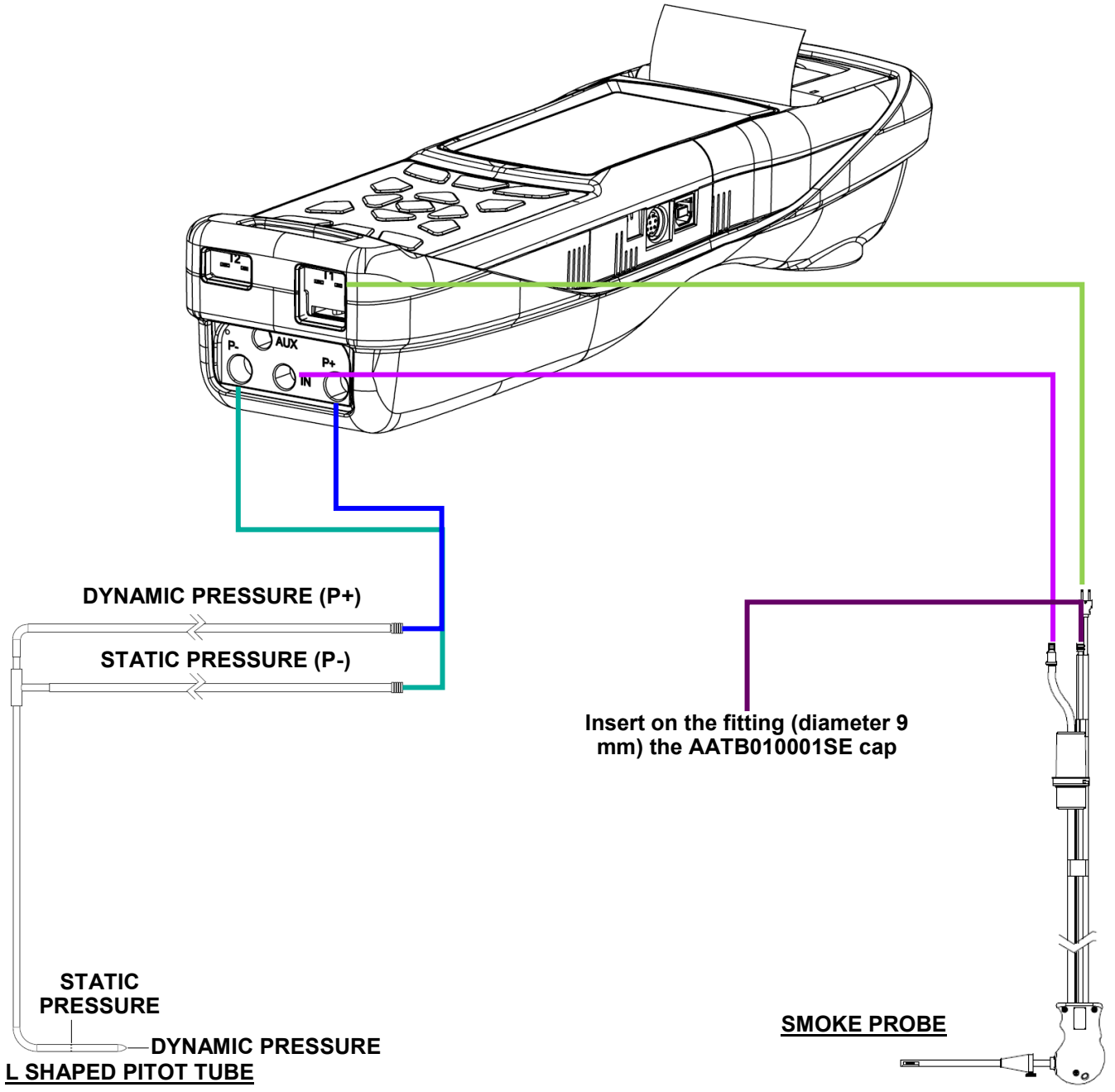
Connecting the pitot tube to the instrument

- Connect the Pitot tube (optional) to the two inputs P + and P- that are normally used for differential pressure measurement:
  Static Pressure Line: P-
  Dynamic Pressure Line: P+

Connecting the flue gas sampling probe to the instrument

- Connect the cable related to the Tc-K thermocouple of the smoke sampling probe to the **T1** instrument connector.
- Connect the fitting related to the flue gas sampling line (8 mm diameter connector) to the "**IN**" connector of the instrument.
- Insert on the fitting related to the line for pressure measurement (diameter 9 mm), **the cap AATB010001SE supplied with the pitot tube**.

WARNING!
In order to perform this connection, if you are using third party pitot tube, it is necessary to purchase the AATB01 cap.



8.5.1 Gas sampling probe

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

Technical features:

Temperature sensor:		K-type thermocouple (Ni-NiCr) - IEC584 - class 1
Pneumatic connectors:	Pressure:	Male - diameter 8.9 mm
	Gas input:	Male - 8mm diameter
Connettore sensore temperatura:		TC-K mignon
Tube:	Material:	EPDM
Adaptor for pockets:	Material:	Galvanized steel
	External diameter:	10 .. 22 mm.
Handle:	Material:	Nylon
	Color:	Black
Tip: Material:		AISI 304 stainless steel
Diameter:		8 mm

CODE	TIP LENGTH	EPDM TUBE LENGTH	MAXIMUM WORKING TEMPERATURE
AASF51A	180 mm	2 m	400°C - immersion depth 100mm
AASF52A	300 mm	3 m	600°C - immersion depth 160mm
AASF62A	300 mm	3 m	600°C - immersion depth 160mm
AASF65A	750 mm	3 m	800°C - immersion depth 500mm
AASF66A	1000 mm	3 m	1200°C - immersion depth 500mm
AASL05A	300 mm	2 m	130°C - immersion depth 160mm

WARNING: in case of measurement of very high temperatures it is recommended to remove the tip slowly in order to let it cool down without suffering heat stress; once extracted from the measurement point do not place it on a cold surface, otherwise this could affect the internal temperature sensor; in case of failure of the thermocouple it is possible to replace the bare element with a compensated cable (see section 18 "Spare parts and servicing").

8.5.2 Smoke sampling probe for average CO measurement

This probe, is made up by an INOX AISI 304 steel multi-perforated stiff tip, provided with a adjustable well adapter, it allows to take the smoke from different spots of the chimney, so to obtain the average CO measure.
The smoke temperature is measured through a thermocouple type K (Ni-NiCr) inserted in the probe tip. This is connected to the instrument through a compensated cable inserted in a proper seat of the smoke sampling probe rubber pipe. Because of the technical construction of the tip, the internal thermocouple does not detect immediately the correct smoke temperature. The compensation of the cold junction is made with a Pt100 thermoresistance which detect the temperature in correspondence of the thermocouple connector. The thermocouple type K (Ni-NiCr) allows continuous measures at high temperatures. This probe can be also used for the combustion analysis.

Technical specifications

Temperature sensor:		Thermocouple type K (Ni-NiCr) - IEC584 - class 1
Pneumatic connectors:		Male- diameter 8,9mm pressure connection
		Male - diameter 8mm gas entrance connection
Temperature sensor connector:		TC-K mignon
Tube:	Material:	EPDM

		Length:	2 m
Well adapter:		Material:	Galvanized steel
		External diameter:	10 .. 22 mm
Handle:		Material:	Nylon
		Color:	Black
Tip:	Material:		Stainless steel AISI 304
	Diameter:		8 mm
	Length:		300 mm
Working temperature:			max. 600°C

8.5.3 Condensate trap and fine dust filter

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

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

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

The sample gas to be analyzed shall reach the measurement cells after being properly dehumidified and purified from the residual combustion products. For 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 vapor 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 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 significantly dirty (see chapter 'MAINTENANCE').

8.5.4 Connecting the gas sampling probe and water-trap assembly

As shown in section 8.5 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 hose of the probe must be inserted in the condensation trap with ant-dust filter (see section 8.5.2).
- The male connector of the filter assembly must be connected to the central female connector of the device marked with "**IN**".
- The longer hose 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.

8.5.5 Gas probe for industrial engines

This type of probe is typically used in processes where the fumes sampled are very dirty and must be pre-filtered directly in the chimney, before entering into the dual-stage condensate trap equipped with a filter with a degree of filtration higher than the one inserted in the chimney.
To preserve the internal system it is mandatory to filter the dust out of the fumes directly on the probe tip, using an AISI 316L stainless steel filter. Condensate and fumes are then separated by means of the two condensate traps connected to the same probe. The probe tip is provided with a flange that acts as a heatsink to make sure that, in case of very high temperature at the chimney, the handle is not damaged by a temperature that might exceed 100 .. 120° C (max. allowed temperature).

Technical features:

Tip:	Material:	AISI 304 stainless steel
	Diameter:	8 mm
	Length:	750mm rigid tip + flange, insertion depth 600 mm
Handle:	Material:	Nylon
	Color:	Black

Hose:	Material:	EPDM
	Length:	3 m
Filter:		AISI 316L sintered stainless steel, washable with ultrasonic bath or with solvents and steel brush.
Temperature sensor:		Type K thermocouple (Ni-NiCr) - IEC584 - Class 1
Pneumatic connectors:		Male - 8.9 mm diameter
		Male - 8.0 mm diameter
Temperature sensor connector:		TcK mignon size
Operating temperature:		max. 800°C

8.5.6 Ambient CO probe

This special probe allows the ambient CO measurement before accessing the boiler room and just then, to measure the CO in the environment while the combustion analysis is performed (as, for example, compelled by the Spanish standard ES.02173.ES, Gas Natural Fenosa), prior entering the data “CO amb. ext.” in the parameter “configuration measurement list”.
The value of the ambient CO can be also printed along with the combustion analysis, if previously selected in the parameter “Print measurement list”.
For further details refer to the probe instruction manual.

8.5.7 Combustion air temperature sensor

This probe is used to measure the temperature of the incoming combustion air.
Use: to be used when the sampling site of the combustion air is located in a different area than the boiler room or the heating plant; when the combustion air sampling site is located in a different place than the boiler room, the temperature of the combustion air can be very different compared with the temperature of the air in the boiler room, generating a less accurate efficiency calculation.

Technical features:

Tip:	Material:	AISI 304 stainless steel
	Diameter:	6 mm
	Length:	200 mm rigid tip
Adapter for thermowells:	Material:	AISI 303 stainless steel
	External diameter:	7,5 .. 17 mm
Temperature sensor:	Sensing element:	Type K thermocouple (Ni-NiCr) - IEC584 - Class 1
	Cable length:	2 m
Connector:	TcK mignon size	
Measurement range:	-20.0°C .. +200.0°C	

Connection
As shown in section 8.5 the probe must be connected to the instrument as follows:
- The polarized male connector of the thermocouple must be connected to the **T2** plug. The improper insertion of the same is not possible thanks to the different length of the tips.

8.5.8 Tc-K temperature measurement probe

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

Connection
As shown in section 8.5 the probe must be connected to the device as follows:
- The polarized male connector of the thermocouple must be connected to the **’T1’** plug. The improper insertion of the same is not possible thanks to the different lengths of the tips.

8.5.9 Ionization current measurement probe

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

Connection
As shown in section 8.5 the probe must be connected to the device as follows:

The 8-poles mini-DIN type connector must be connected to the serial port on the analyzer (E chapter 5).

8.5.10 Draft measurement pressure gauge compliant with UNI 10845 standard.

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

Connection

As shown on the section 8.5 the probe shall be connected to the instrument as follows:

- The draft gauge is provided with a female connector (ø 9mm) of the same type of the one for the pressure inputs on the combustion analyzer. Thanks to this connector the draft gauge can be connected directly to the shorter male connector (ø 9mm) of the flue gas sampling probe supplied.

The 8-pole MiniDin connector shall be connected to the serial port of the analyzer (E chapter 5).

8.5.11 Pressure Test Kit

Two types of pressure measurement kit are available:

1st Kit includes two 1mt hoses and two ø 9mm fittings; to be used for the differential pressure measurement.
2nd Kit includes one 1mt hose and one ø9mm fitting for pressure measurement.

Connection

As shown on section 8.5 the kits shall be connected to the instrument as follows:

1st hose connector shall be connected to the P+ connector, while the other hose connector shall be connected to the analyzer P- connector.
2nd The hose connector shall be connected to the analyzer P+ or P- connector.

8.5.12 Burner pressure verification probe

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

Connection

As shown on section 8.5 the kits shall be connected to the instrument as follows:

The hose connector shall be connected to the analyser P+ connector.

8.5.13 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:

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

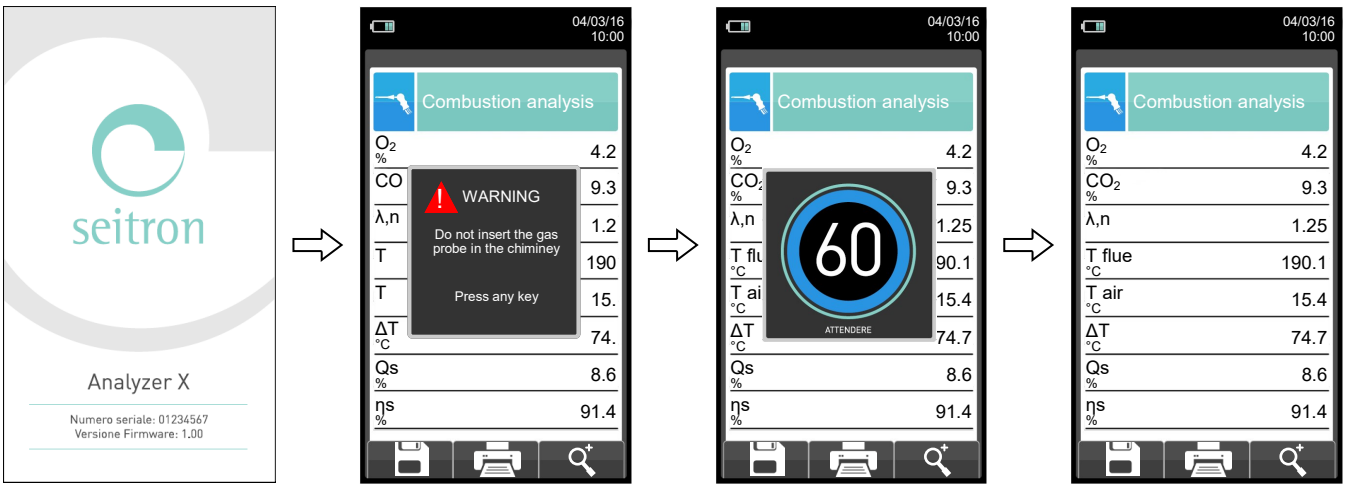
8.5.14 Connection to battery charger

Supplied with the device there is a power plug with output 5V⎓, 2A to charge the internal batteries. In section 5 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.

9.0 POWER ON - OFF

9.1 Starting the device

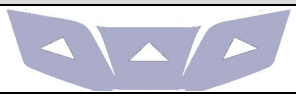
Press and hold for a few seconds.



DURING INSTRUMENT AUTOZERO, THE SAMPLING PROBE MUST NOT BE INSERTED IN THE CHIMNEY.

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

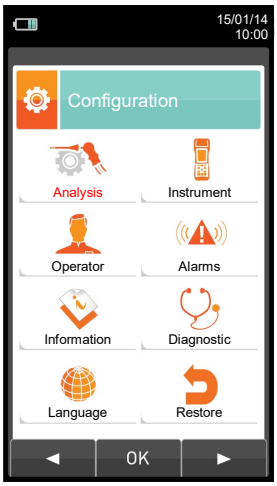
This error message is displayed if the autozero of the device is not successfully completed.

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

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

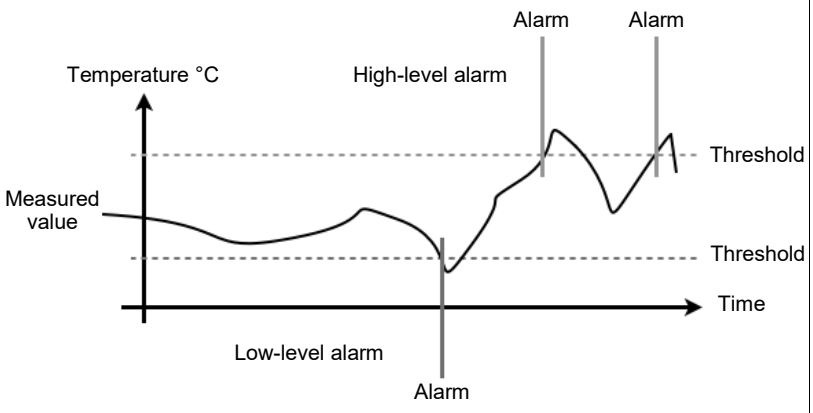
10.0 CONFIGURATION

10.1 Configuration menu



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

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

PARAMETER	FUNCTION
Analysis	Through this menu the user can configure the available parameters for a proper combustion analysis. SEE SECTION 10.2.
Instrument	This menu is used to configure the instrument's reference parameters. SEE SECTION 10.3.
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 10.4.
Alarm	This submenu allows the user to set and memorize 10 alarms, defining the monitored parameter for each (gas, pressure, Ta, Tf), the alarm threshold and 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 in addition to showing a visible alarm wherein the background of the name of the relative reading will start flashing in the analysis screen. SEE SECTION 10.5. 
Information	This menu provides information regarding instrument status. SEE SECTION 10.6.
Diagnostic	The user, with this menu, can check any anomalies of the device. SEE SECTION 10.7.
Language	Set the desired language for the various menus and the paper print-out. SEE SECTION 10.8.
Restore	Restore factory settings. SEE SECTION 10.9.

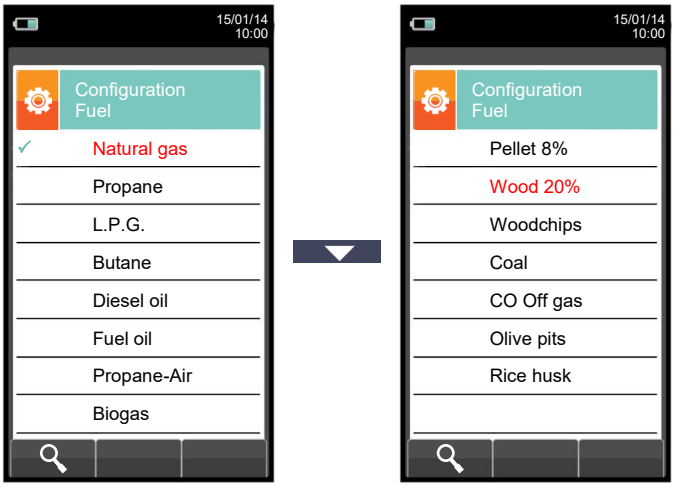
10.2 Configuration→Analysis

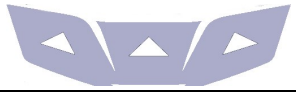
KEY	FUNCTION
	**Activate the context keys shown on the display.**
	**Returns to the previous screen.**

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. Fuel selection can be done 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 10.2.1.
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 unknown the operator is recommended to enter 50% for this value. SEE SECTION 10.2.2.
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 10.2.3.
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 10.2.4.
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 10.2.5.
Autozero	In this sub menu the user can change the length of the autozero cycle of the analyzer, start it manually and set the length of the sensor cleaning cycle that will be performed by the instrument at switch-off. SEE SECTION 10.2.6.
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 10.2.7.
Air temp.	In this submenu there is a possibility to acquire or manually enter the combustion air temperature. SEE CHAPTER 10.2.8.

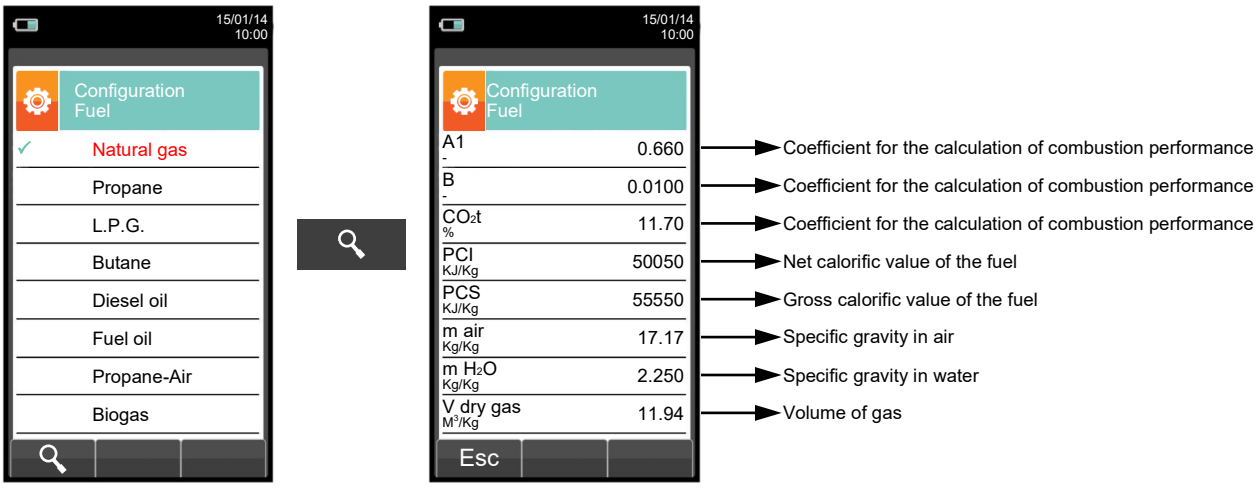
10.2.1 Configuration→Analysis→Fuel



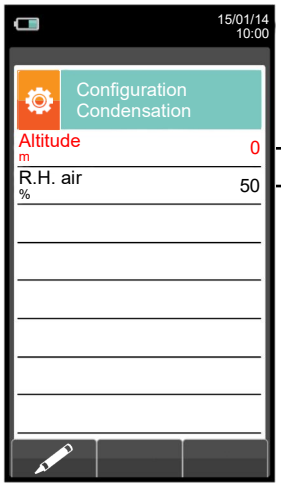
KEY	FUNCTION
	**Activate the context keys shown on the display.**
	**The arrows select each line displayed.**
	**Confirms the choice of fuel to be used during the analysis.**
	**Returns to the previous screen.**

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

Example:



10.2.2 Configuration→Analysis→Condensation



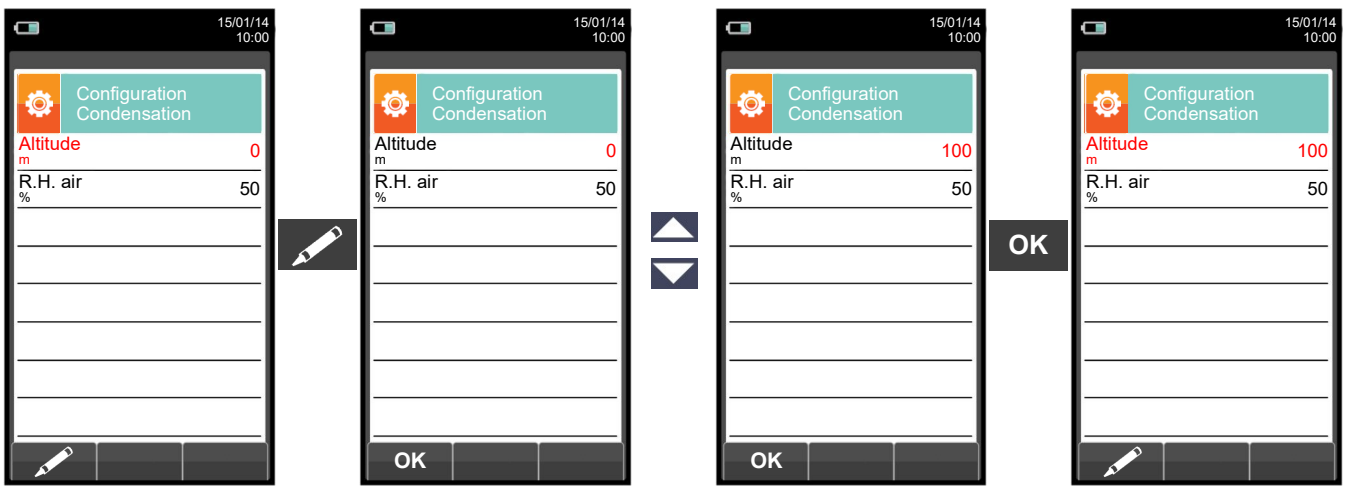
→ Altitude above sea level

→ Relative humidity of air

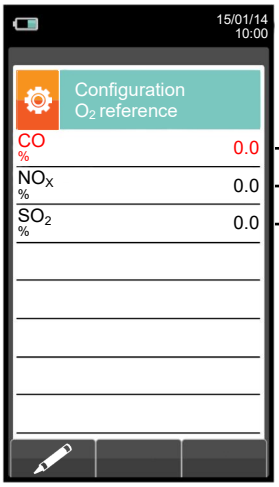
KEY	FUNCTION
	**Activate the context keys shown on the display.**
	**The arrows select each line displayed (the selected line is red).** **In edit mode, it scrolls through the suggested values.**
	**Enters the modify mode for the selected parameter, then confirms the modification.**
	**When pressed in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

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

Example:



10.2.3 Configuration→Analysis→Reference O_2

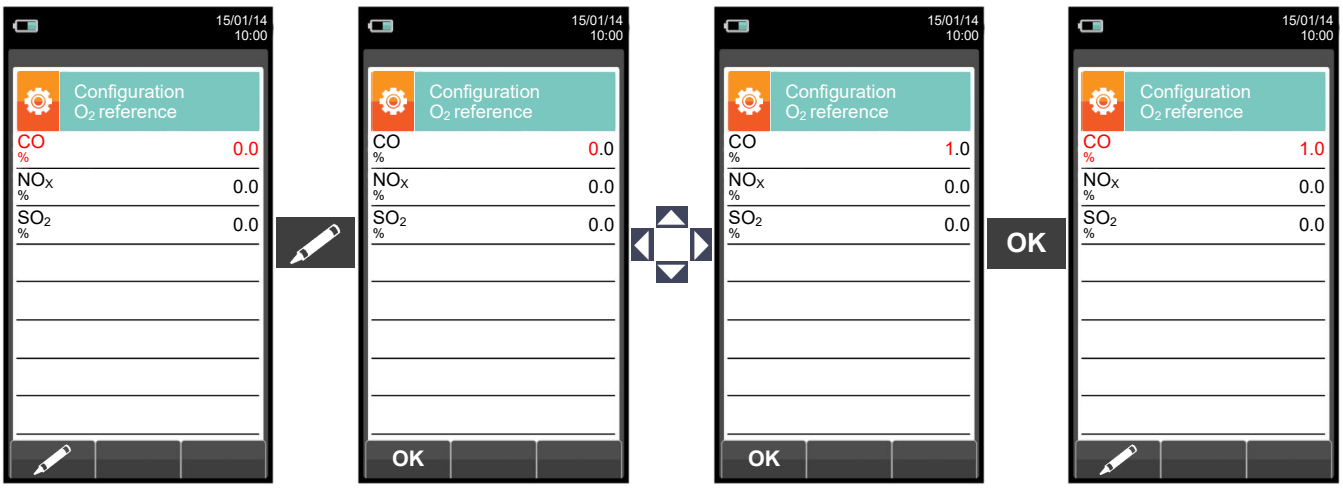


→ Percentage of Oxygen in CO measurement
→ Percentage of Oxygen in NO_X measurement
→ Percentage of Oxygen in SO_2 measurement

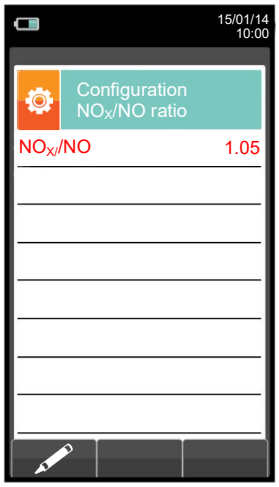
KEY	FUNCTION
	**Activate the context keys shown on the display.**
	**Keys '▲' and '▼' select any line shown on the display (the selected line is displayed in red).** **When in modify mode, sets the desired value.**
	**Enters the modify mode for the selected parameter, then confirms the modification.**
	**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:



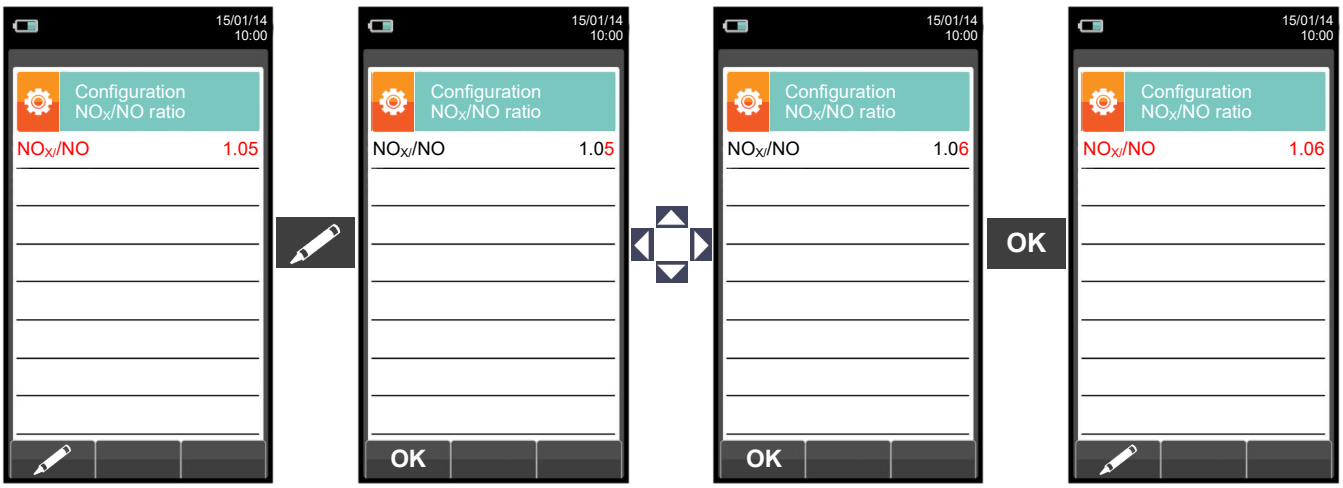
10.2.4 Configuration→Analysis→NO_X/NO ratio



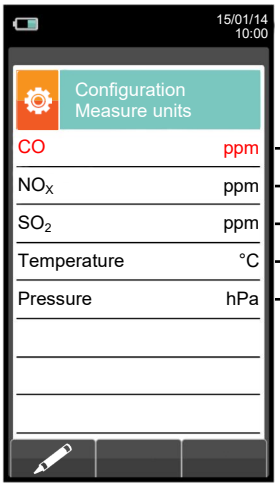
KEY	FUNCTION
	**Activate the context keys shown on the display.**
	**When in modify mode, sets the desired value.**
	**Enters edit mode of the selected element and then confirms the change.**
	**When pressed in modify mode cancels the selection made, otherwise returns to the previous screen.**

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

Example:



10.2.5 Configuration→Analysis→Measurement units



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

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

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

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

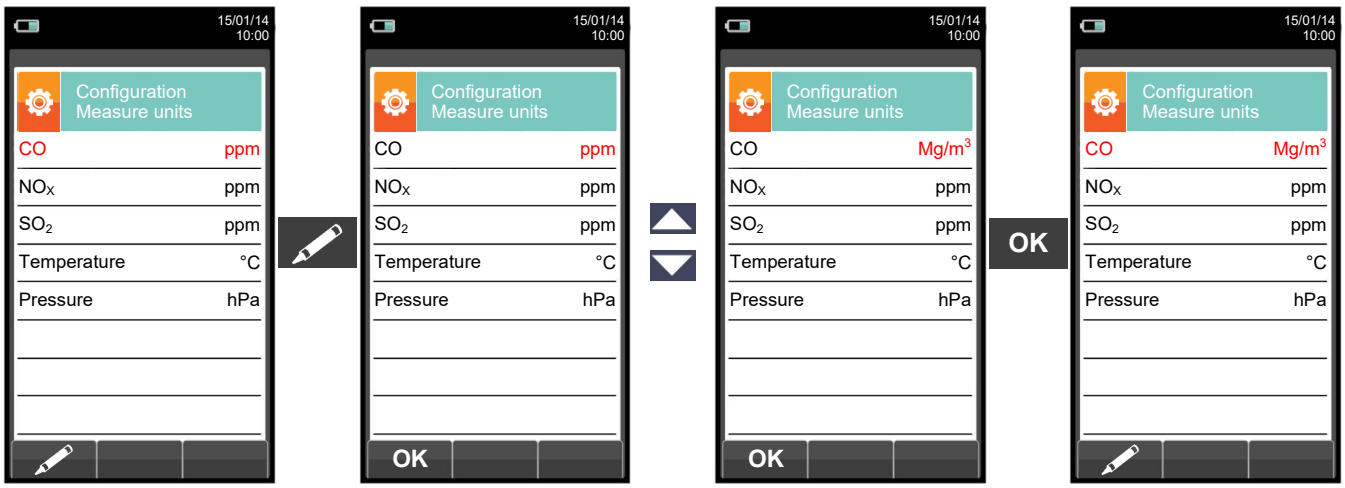
→ Measurement unit can be set as: hPa - Pa - mbar - mmH_2O - mmHg - inH_2O - psi

The measurement units mg/m^3 and g/m^3 are referred to Normal pressure and temperature conditions, P = 101325 Pa and T = 0 °C.

KEY	FUNCTION
	**Activate the context keys shown on the display.**
	**Keys '▲' and '▼' select any line shown on the display (the selected line is displayed in red).** **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.**

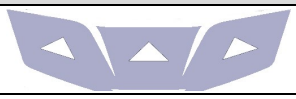
Example:



10.2.6 Configuration→Analysis→Autozero

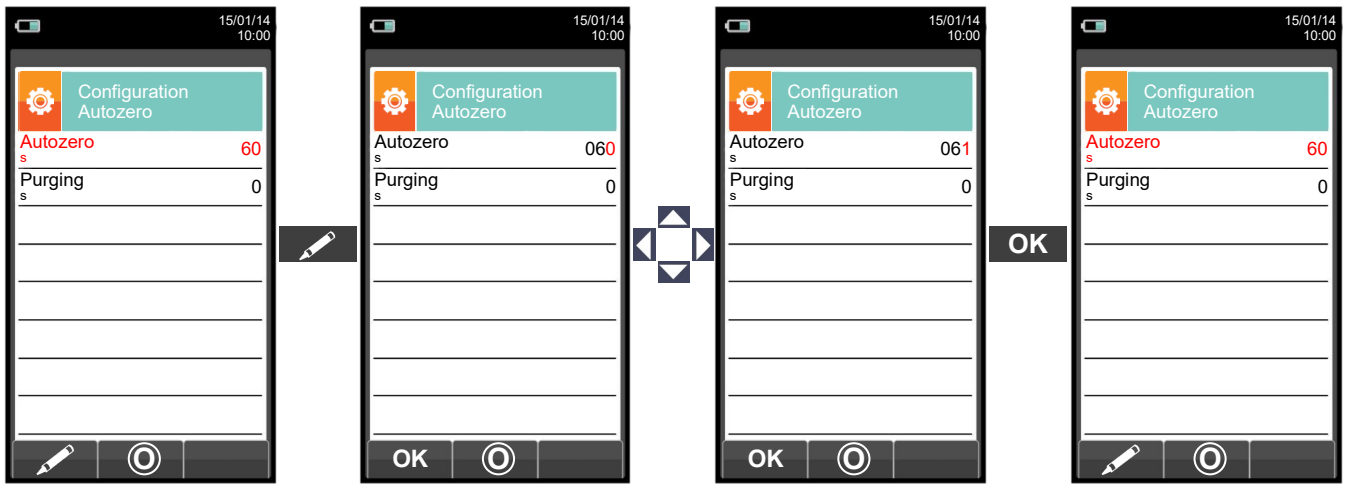
→ Duration of autozero, expressed in seconds.

→ Duration of the cleaning cycle, expressed in seconds.

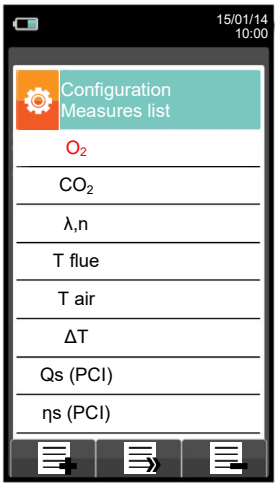
KEY	FUNCTION
	**Activate the context keys shown on the display.**
	**When in modify mode, sets the desired value.**
	**Enters edit mode of the selected element and then confirms the change.**
	**When pressed in modify mode cancels the selection made, otherwise returns to the previous screen.**

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

Example:



10.2.7 Configuration→Analysis→Measures list



FOR FURTHER DETAILS SEE THE ANNEX E

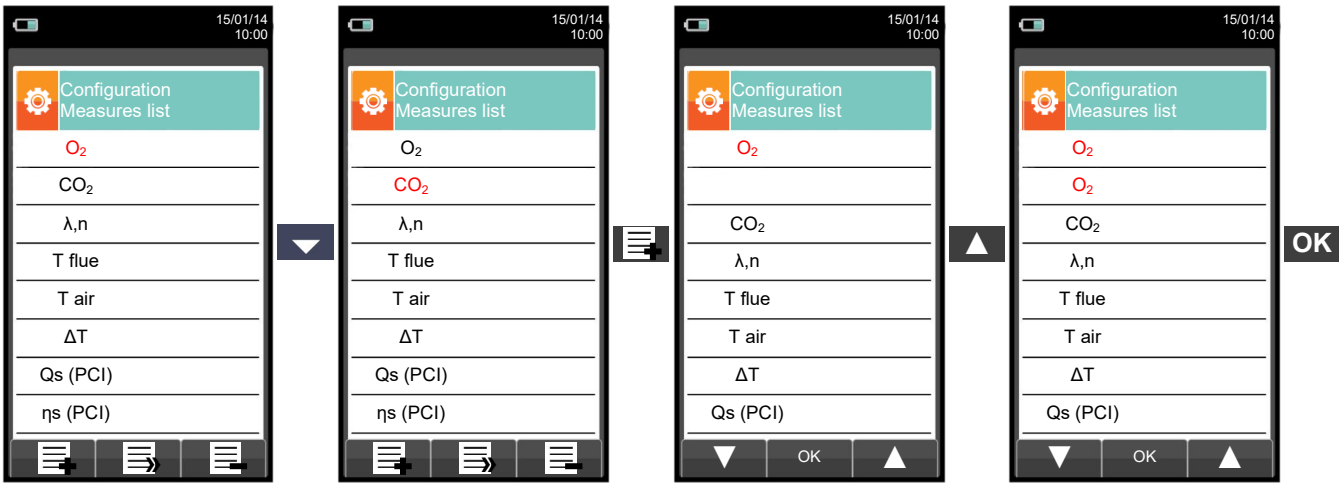
KEY	FUNCTION
	Activate the context keys shown on the display.
	Select each line displayed (the line selected is red). In edit mode, it sets the desired value.
ESC	When pressed in modify mode cancels the selection made, otherwise returns to the previous screen.

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.

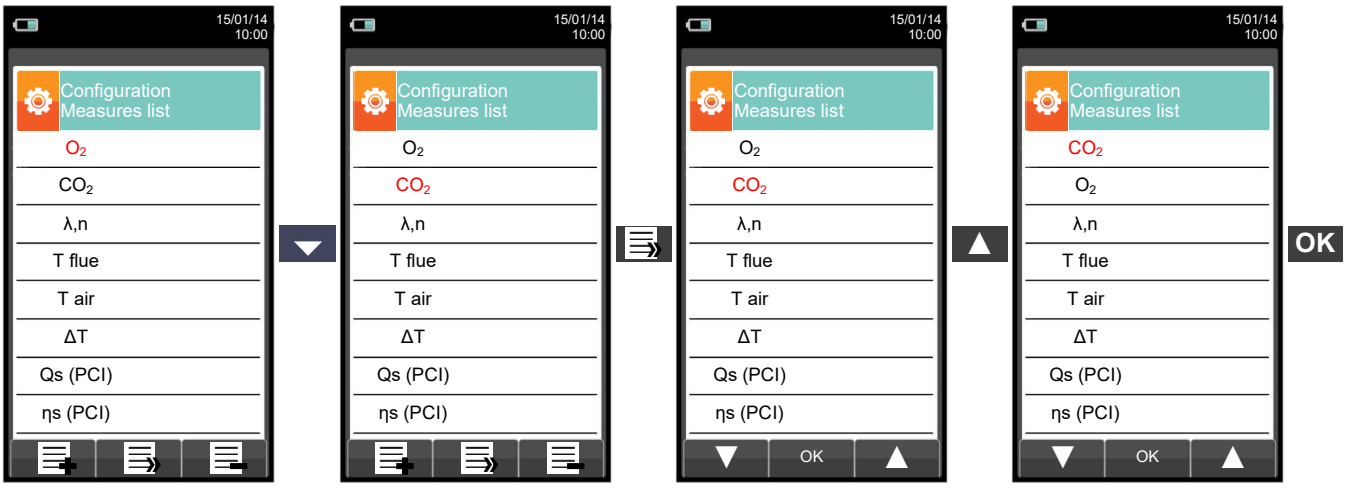
OTHER THAN THE MEASUREMENT LIST ABOVE, IT IS POSSIBLE TO VISUALIZE THE MEASURE OF THE DETECTED GAS ALSO IN PPM, DEPENDING ON THE KIND OF MEASUREMENT CELL IN THE INSTRUMENT. IF IT IS NECESSARY TO MEASURE THE VALUE OF GAS WITH TWO DIFFERENT MEASUREMENT UNITS, SELECT IN THE MEASUREMENTS LIST THE DESIRED GAS IN PPM AND CHANGE THE MEASUREMENT UNIT FOR THE SAME GAS IN THE "CONFIGURATION->ANALYSIS->MEASUREMENT UNIT" SCREEN. NOW THE INSTRUMENT ACQUIRES THE MEASURE WITH TWO DIFFERENT UNITS (PPM AND THE ONE PREVIOUSLY SET)

Example:

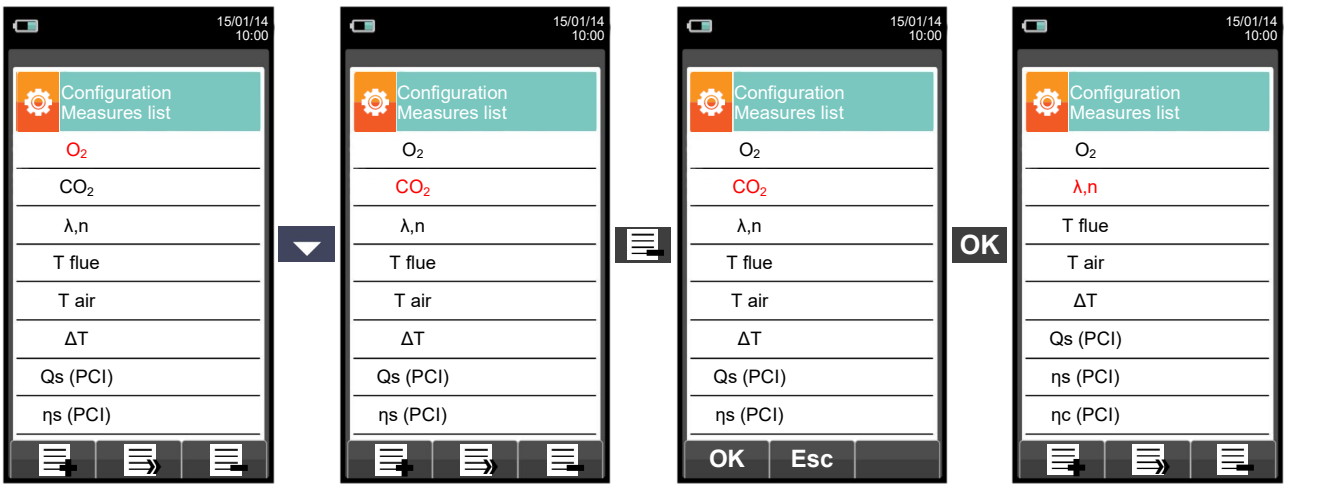
1. Add a measurement to the list - example



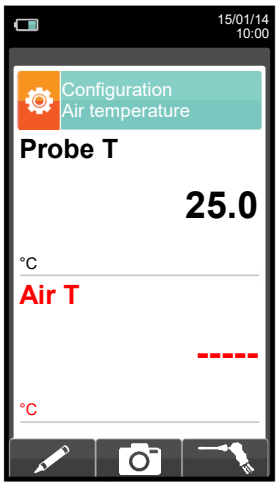
2. Change the position of a measurement - example

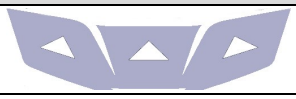


3. Delete a measurement from the list - example



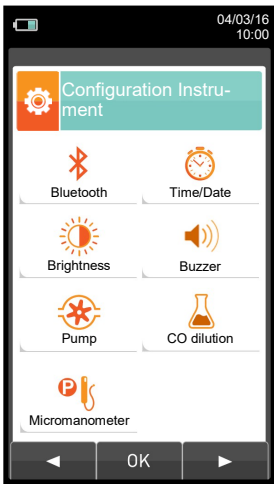
10.2.8 Configuration→Analysis→Air temperature



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.

10.3 Configuration→Instrument

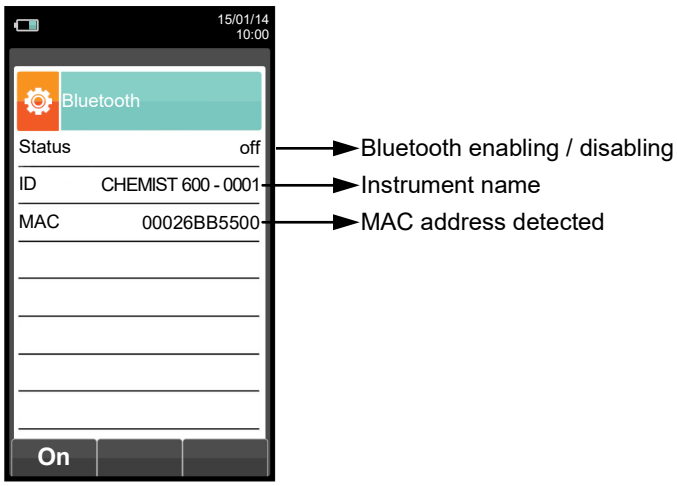


KEY	FUNCTION
	**Activate the context keys shown on the display.**
	**Returns to the previous screen.**

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 10.3.1.
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 10.3.2.
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 10.3.3.
Buzzer	The instrument is fitted with an internal buzzer which is mainly used to signal any faults and/or alarms. In this submenu you can enable or disable the buzzer or enable it and mute the key tones. SEE SECTION 10.3.4.
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 10.3.5.
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. **The main purpose of the CO Auto-Dilution feature is for protection for CO sensor against over-saturation. The accuracy and resolution of the CO measurement is not as great when this feature is enabled.** SEE SECTION 10.3.6.
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 10.3.7.

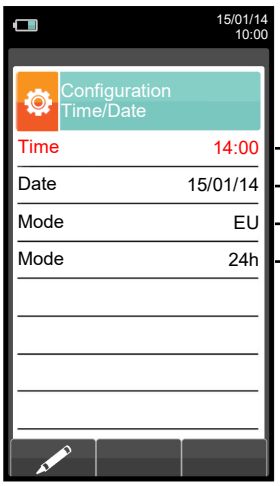
10.3.1 Configuration→Instrument→Bluetooth



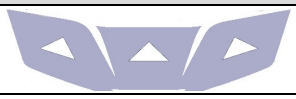
KEY	FUNCTION
	**Activate the context keys shown on the display.**
	**Also activates the context key shown on the display.**
	**Returns to the previous screen.**

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

10.3.2 Configuration→Instrument→Time/Date

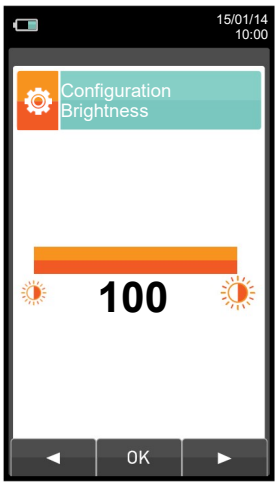


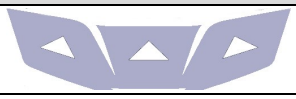
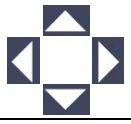
→ Time, in the chosen format
→ Date, in the chosen format
→ Date format: EU (Europe) or USA (America)
→ Time format: 24h or 12h

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.**
OK	**Confirms the modification.**

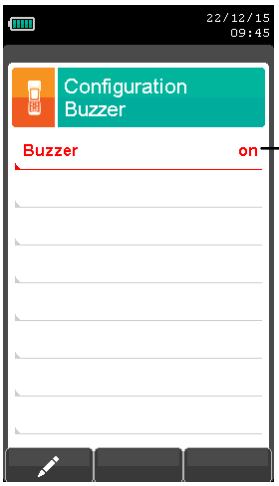
10.3.3 Configuration→Instrument→Brightness



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.**

10.3.4 Configuration→Instrument→Buzzer

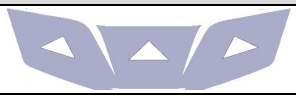


Available settings :

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

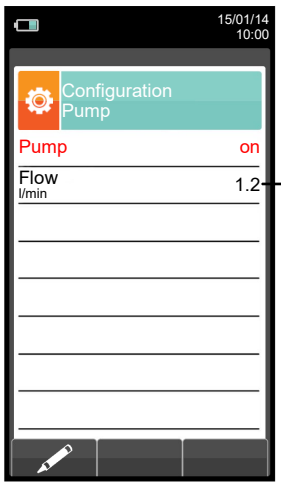
limited: the buzzer is enabled in a limited mode (key tones are disabled, while signalling of faults/alarms is enabled).

off: the buzzer is disabled.

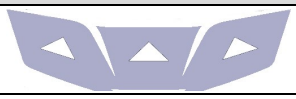
KEY	FUNCTION
	**Activate the context keys shown on the display.**
	**When in modify mode, sets the desired value.**
	**Enters edit mode of the selected element and then confirms the change.**
	**When pressed in modify mode cancels the selection made, otherwise returns to the previous screen.**

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

10.3.5 Configuration→Instrument→Pump

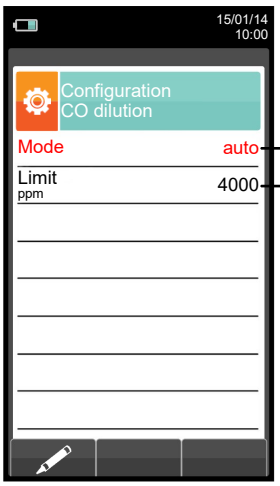


→ Displays the flow of the pump, expressed in litres per minute.

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.**

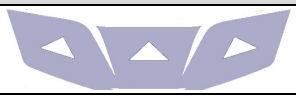
CONTEXT KEY	FUNCTION
	**Enters edit mode: it is possible to turn the gas suction pump on or off.**
	**Confirms the modification.**

10.3.6 Configuration→Instrument→CO dilution



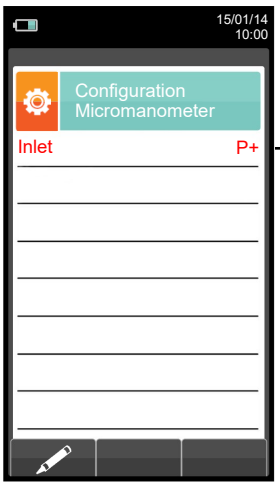
Available settings: auto, on or off

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

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.**

10.3.7 Configuration→Instrument→Micromanometer

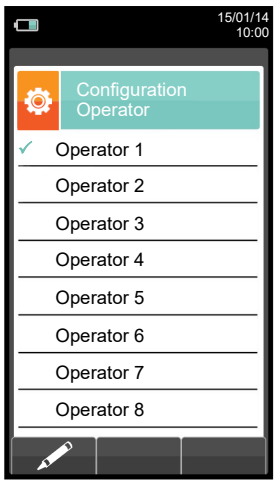


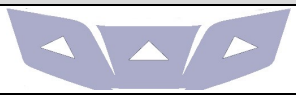
→ Sets the input used for the test: P+ or P-

KEY	FUNCTION
	Activate the context keys shown on the display.
	In edit mode, it sets the desired input.
OK	**Enters edit mode of the selected element and then confirms the change.**
ESC	**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.**

10.4 Configuration→Operator

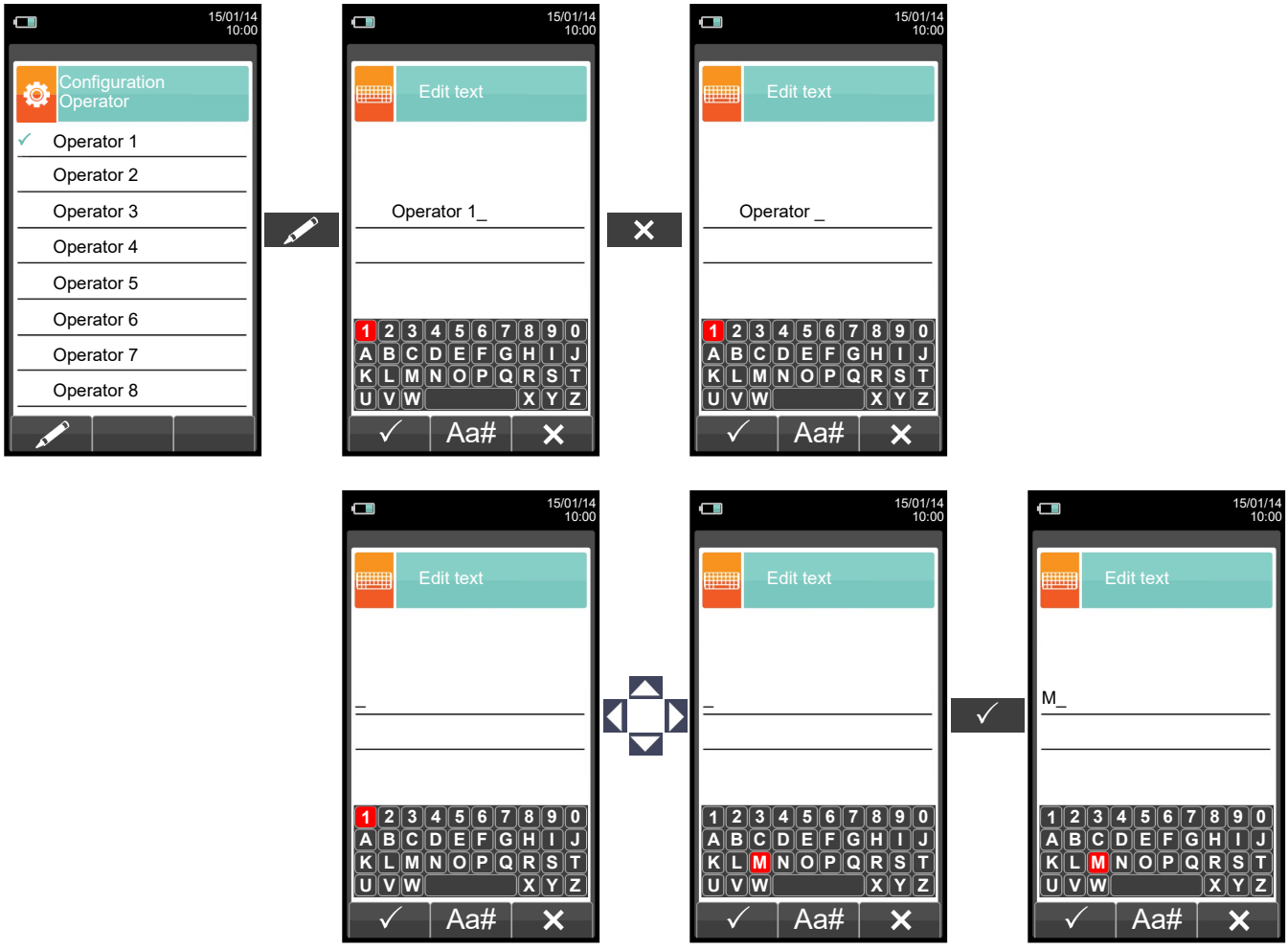


KEY	FUNCTION
	**Activate the context keys shown on the display.**
	**In "edit text": Moves the cursor on the box corresponding to the letter or number required to form the word.**
	**In "Operator Configuration": Scrolls through the available operators.**
	**In "edit text": Confirms text input.** **In "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 text" goes back to the previous screen, without saving any changes.**

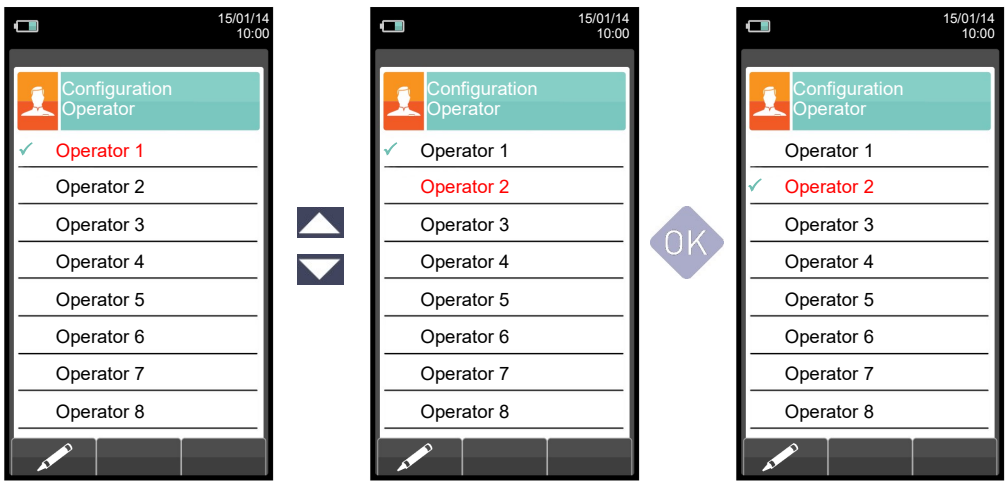
CONTEXT KEY	FUNCTION
	**Enters edit mode of the selected line: it is possible to enter the name of the operator (24 characters available).**
	**Confirms the selected letter or digit.**
	**Cancels the letter or digit before the cursor.**
	**Cycles through uppercase, lowercase, symbols and special characters.**

Example:

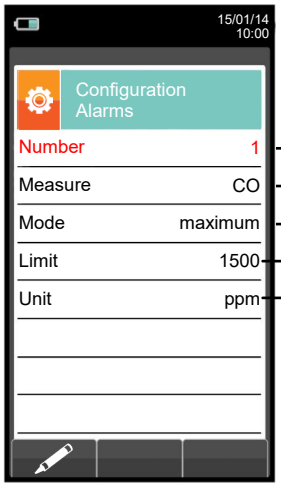
1. Edit text



2. Select the operator who will carry out the analysis



10.5 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: maximum - minimum - off

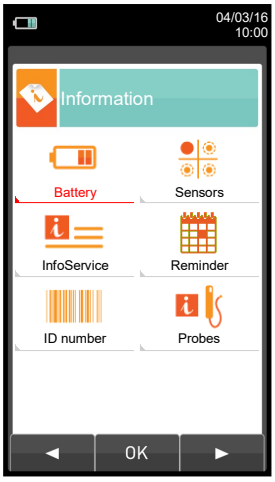
→ Threshold setting for the alarm: ±999999.999

→ Measurement unit for the threshold set: ppm, mg/m^3, mg/kWh, g/GJ, g/m^3, g/kWh, % ng/J

KEY	FUNCTION
	**Activate the context keys shown on the display.**
	**Keys '▲' and '▼' select any line shown on the display (the selected line is displayed in red).** **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.**

10.6 Configuration→Information

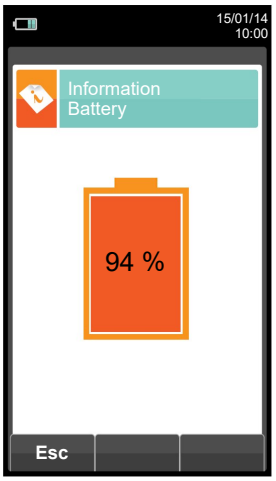


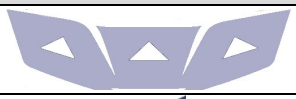
KEY	FUNCTION
	Activate the context keys shown on the display.
ESC	**Returns to the previous screen.**

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

PARAMETER	DESCRIPTION
Battery	Displays the current battery power status in percentage from 0 to 100%, both in text and graphically. **SEE SECTION 10.6.1.**
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 10.6.2.**
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 10.6.3.**
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 CHAPTER 10.6.4.**
ID number	Not available.
Probes	Displays useful information on the probe connected to the serial cable connector visible in **E** in section 5 (Description of the Components of the Combustion Analyzer). **SEE SECTION 10.6.5.**

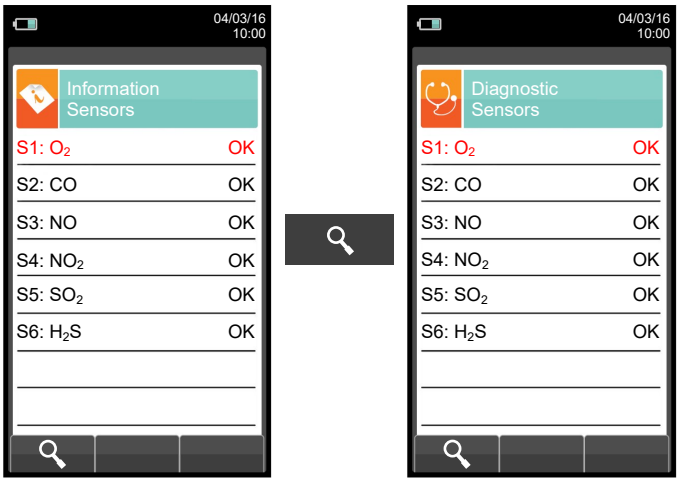
10.6.1 Configuration→Information→Battery



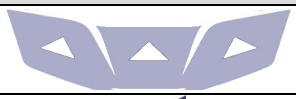
KEY	FUNCTION
	**Activate the context keys shown on the display.**
	**Returns to the previous screen.**

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

10.6.2 Configuration→Information→Sensor



For further information, see section 10.7.1.

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:

MESSAGE	DESCRIPTION
OK	**Sensor configured OK (normal operation).**
-----	**Sensor is not communicating or has been removed.**
The name of the detected gas is flashing	**New sensor detected.**
Pos err	**Detected sensor in wrong position.**
Volt err	**Detected voltage is out of the normal operating range; repeat the autozero.**
Curr err	**Detected current is out of the normal operating range; repeat the autozero.**

Error messages displayed:

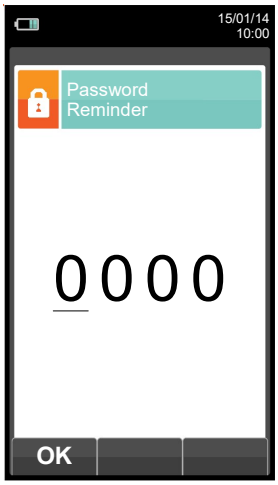
MESSAGE	DESCRIPTION
Cal err	**Calibration error.**
Data err	**Sensor not recognized.**
No cal	**Sensor not calibrated.**

10.6.3 Configuration→Information→InfoService

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

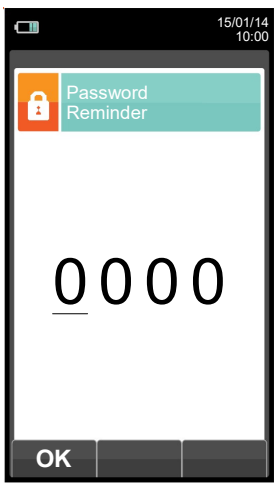
CONTEXT KEY	FUNCTION
Esc	**Returns to the previous screen.**

10.6.4 Configuration→Information→Reminder

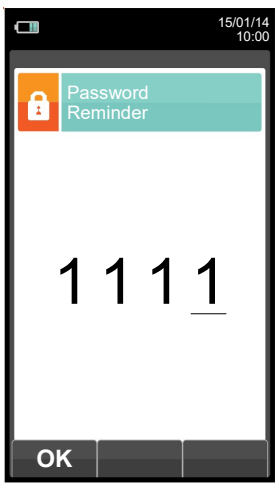


KEY	FUNCTION
	Activate the context keys shown on the display.
	Sets the password. The password is: 1111.
ESC	**Returns to the previous screen.**

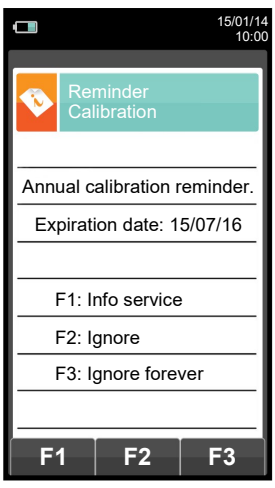
CONTEXT KEY	FUNCTION
OK	**Confirm password and enter the menu “Reminder”.**
Esc	**Returns to the previous screen.**
F1	**Displays the information about the assistance center.**
F2	**Temporarily ignores the message. Next time the instrument will be turned on, the remainder will be displayed again.**
F3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



Enter the recalibration menu password **1111.**



OK

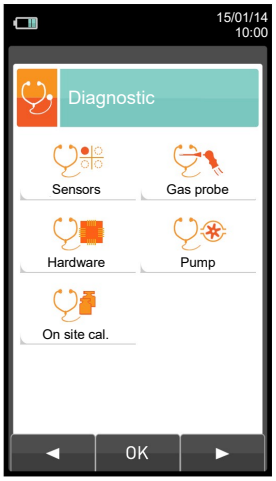


10.6.5 Configuration→Information→Probe

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

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

10.7 Configuration→Diagnostic

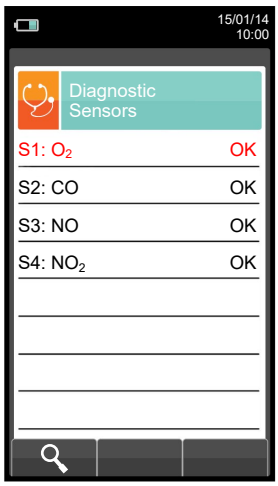


KEY	FUNCTION
	Activate the context keys shown on the display.
ESC	**Returns to the previous screen.**

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 10.7.1.**
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 liters per minute. It will not be possible to turn off the pump during an autozero cycle. **SEE SECTION 10.7.2.**
On site cal.	It is possible to make a recalibration of the instrument's gas sensors with suitable known concentration gas cylinders. For the sensors which are sensitive to other gases, called interfering gases (for example NH_3, H_2, H_2S, SO_2, ...), it is possible to perform the on-site calibration also for the related interfering gas. **The sensor recalibration procedure is protected by password: ask Seitron Assistance center.** **SEE SECTION 10.7.3.**
Gas probe	Tests the tightness of the gas probe pneumatic path. **SEE SECTION 10.7.4.**
Hardware	At instrument turn on the firmware performs a full check on the physical efficiency of all types of HW memories installed on the instrument, as well as on the integrity of the data stored into them. Any issue is displayed in the screen 'Memories Diagnostics'. Should this happen it is advisable to turn the instrument off and then on again. In case the problem is permanent or frequently recurring, the user should contact the Service Center reporting the error code shown by the instrument. **SEE SECTION 10.7.5.**

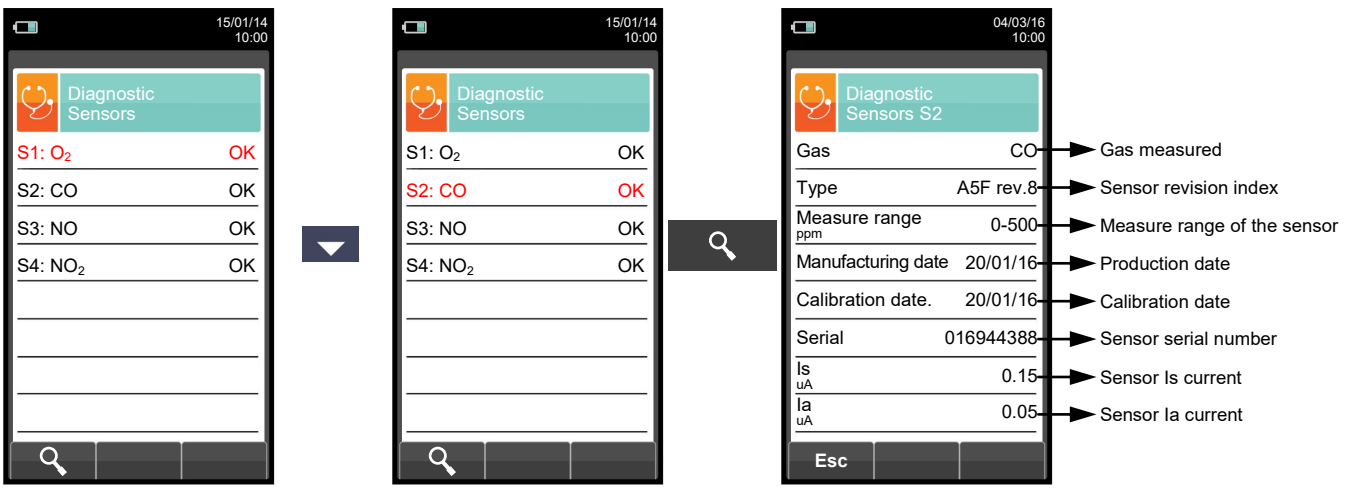
10.7.1 Configuration→Diagnostic→Sensors



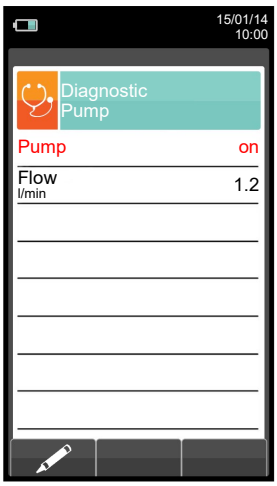
KEY	FUNCTION
	**Activate the context keys shown on the display.**
	**Selects the fuel.**
	**Activates the context keys located in the left side of the display.**
	**Returns to the previous screen.**

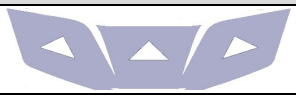
CONTEXT KEY	FUNCTION
	**Displays the details of the selected sensor (see example below).**
	**Returns to the previous screen.**

Example:



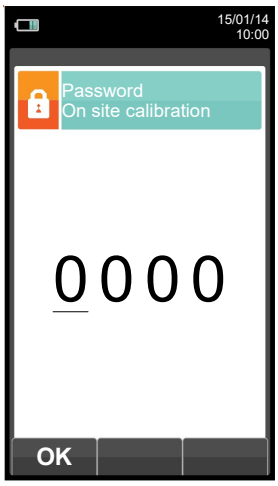
10.7.2 Configuration→Diagnostic→Pump

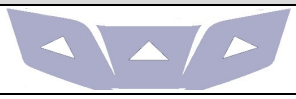


KEY	FUNCTION
	**Activate the context keys shown on the display.**
	**In edit mode, cycling between on and off.**
	**Enters edit mode of the selected element and then confirms the change.**
	**Returns to the previous screen.**

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

10.7.3 Configuration→Diagnostic→On site cal.



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

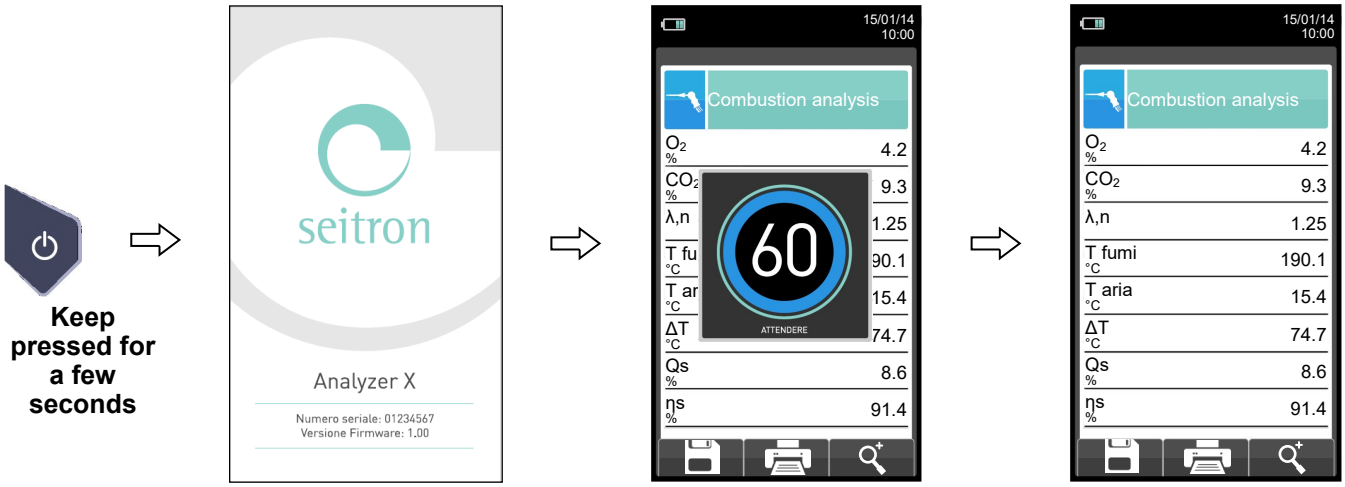
10.7.4 Calibration procedure

In order to perform the calibration, the following tools are needed:
- Test gas cylinder with certified gas concentration suitable for the concerned sensor, equipped with a pressure regulator.
  WARNING!
  For the oxygen sensor on site calibration, the zero value calibration must be carried out with nitrogen or any other gas mixture which DOES NOT contain oxygen.
- Flow meter.
- Hose with ' T ' shaped junction, in order to connect the cylinder to the instrument and the flow meter.

Following, the suggested stabilization times for the sensors on-site calibration.

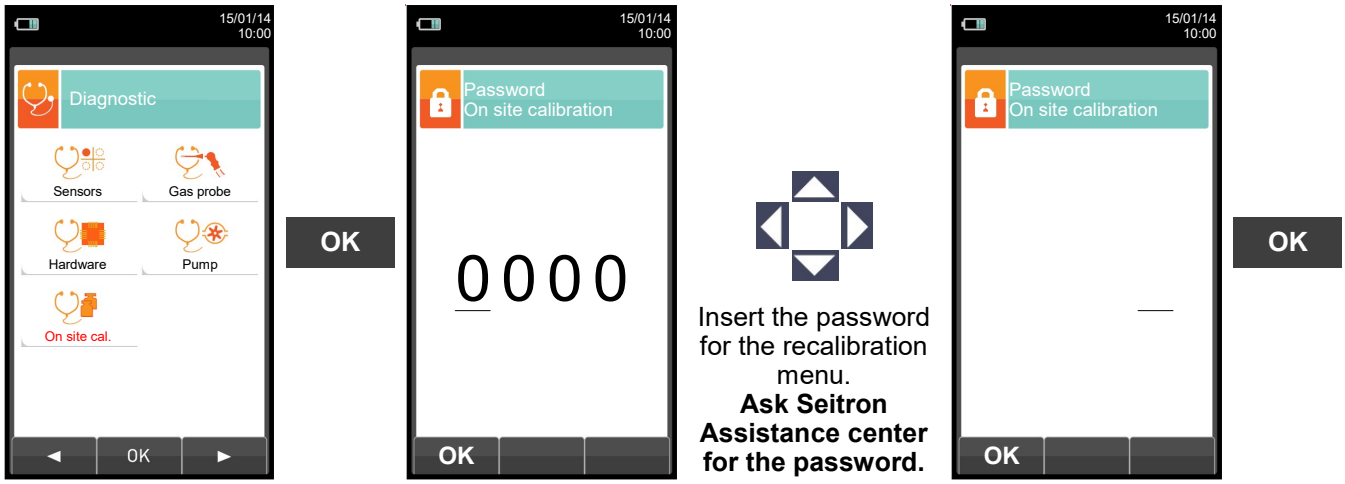
O_2 sensor:	from 3 to 5 minutes
CO sensor:	from 3 to 5 minutes
NO sensor:	from 3 to 5 minutes
SO_2 sensor:	from 5 to 8 minutes
NO_2 sensor:	from 5 to 8 minutes
C_xH_y sensor:	from 3 to 5 minutes
H_2S sensor:	from 3 to 5 minutes
CO_2 sensor:	from 3 to 5 minutes
NH_3 sensor:	from 3 to 5 minutes
H_2 sensor:	from 3 to 5 minutes

1. Start the instrument



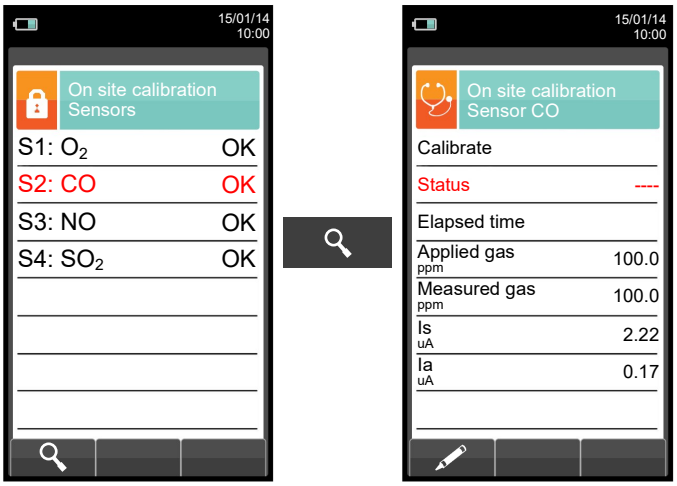
WARNING
- **Make sure autozero is execute in clean air and terminates correctly.**
- **Do not connect the gas probe to the instrument.**
- **Check the battery charge level or connect the power adapter to avoid data loss during recalibration.**

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.**

   By selecting a sensor, on the recalibration screen are shown all the information related to the latest calibration.



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

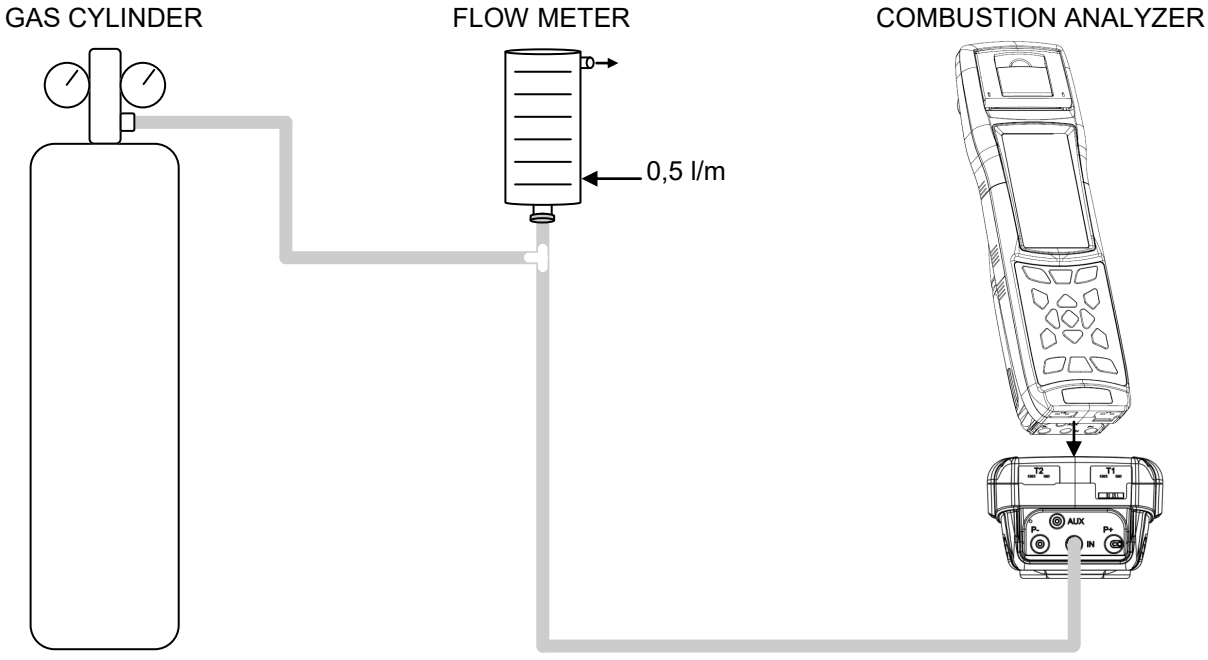
Is: 'Is' current from the sensor

Ia: 'Ia' current from the sensor (available only on the CO sensor calibration)

CHOOSE THE SENSOR TO BE CALIBRATED AND DO AS FOLLOWS

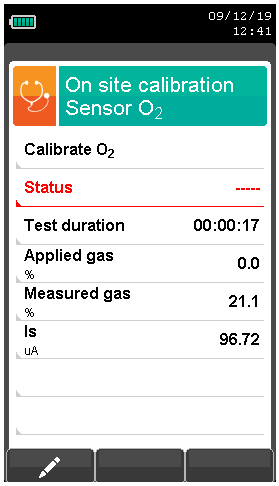
4. Connect the known concentration gas cylinder to the instrument as shown in the following diagram:

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.

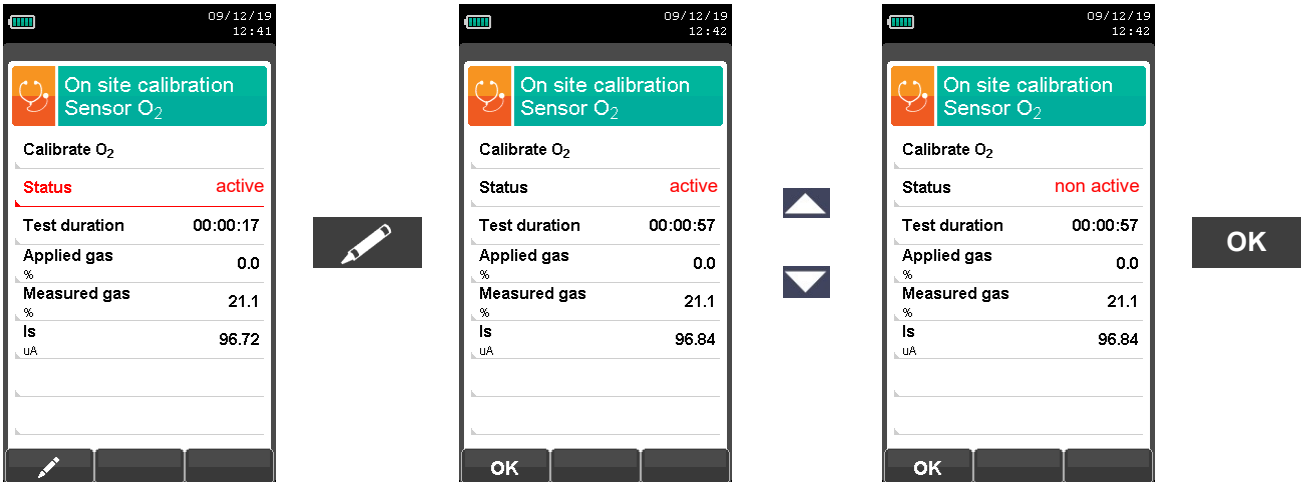


OXIGEN SENSOR (O_2) CALIBRATION DETAIL

- The calibration **is possible** only when the status is set to '**----**' (sensors that have never been calibrated before) otherwise it is necessary to set the status on '**non active**' (see example below).

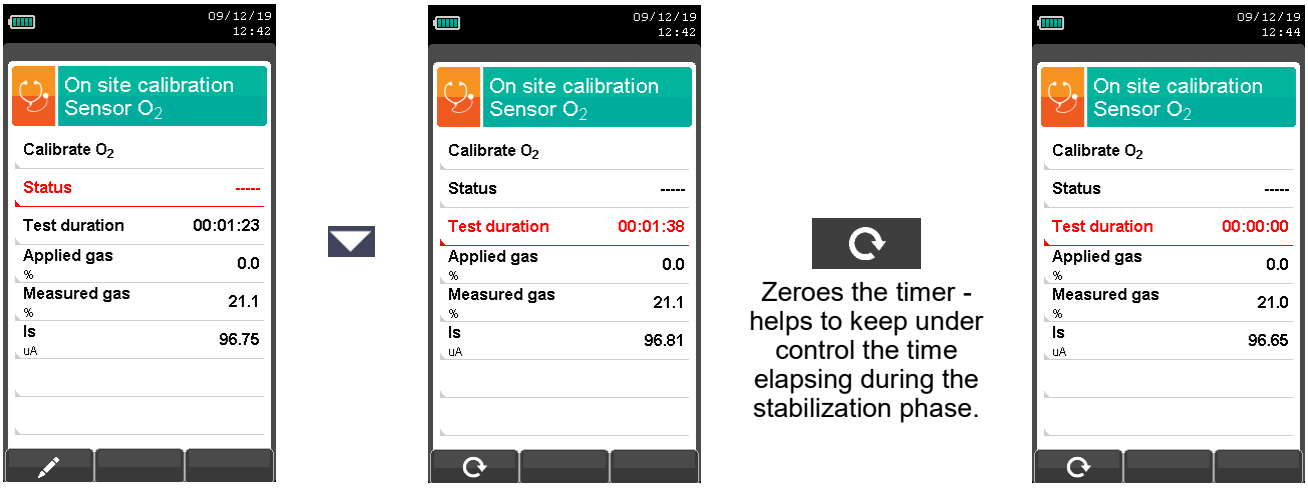


or

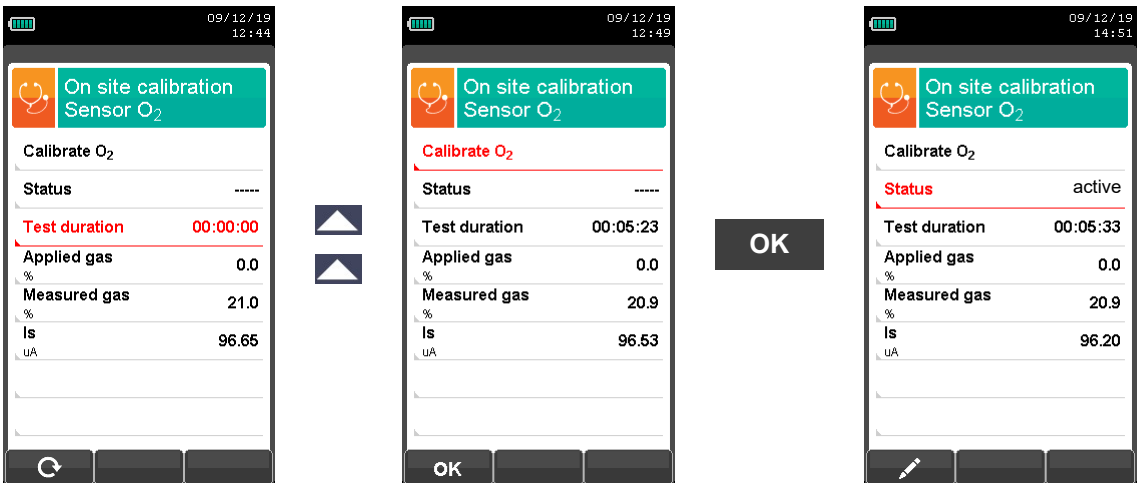


- **Apply gas to the instrument** and adjust the output pressure of the gas from the cylinder so that the flow meter indicates a minimum flow of 0.5 l/m: this guarantees that the instrument is taking the exact amount of gas required by the internal pump.

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



- When the stabilization time is over, select the row 'Calibrate' and store the new calibration.



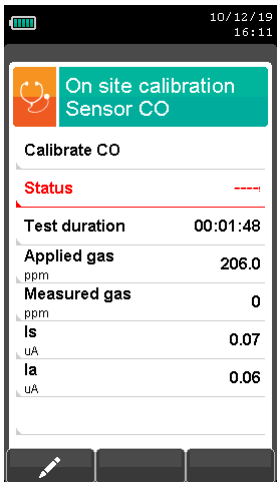
Messages in the 'Status' line:
saving: the instrument is saving the performed calibration
error: the sensor has NOT been recalibrated for any of the following reasons:
- The calibration gas cannot properly reach the instrument.
- Concentration for the calibration gas has not been set in the relevant line ‘Applied gas’.
- The user didn’t allow for the stabilization time to properly elapse.
- The sensor could be damaged or exhausted and must therefore be replaced.

WARNING

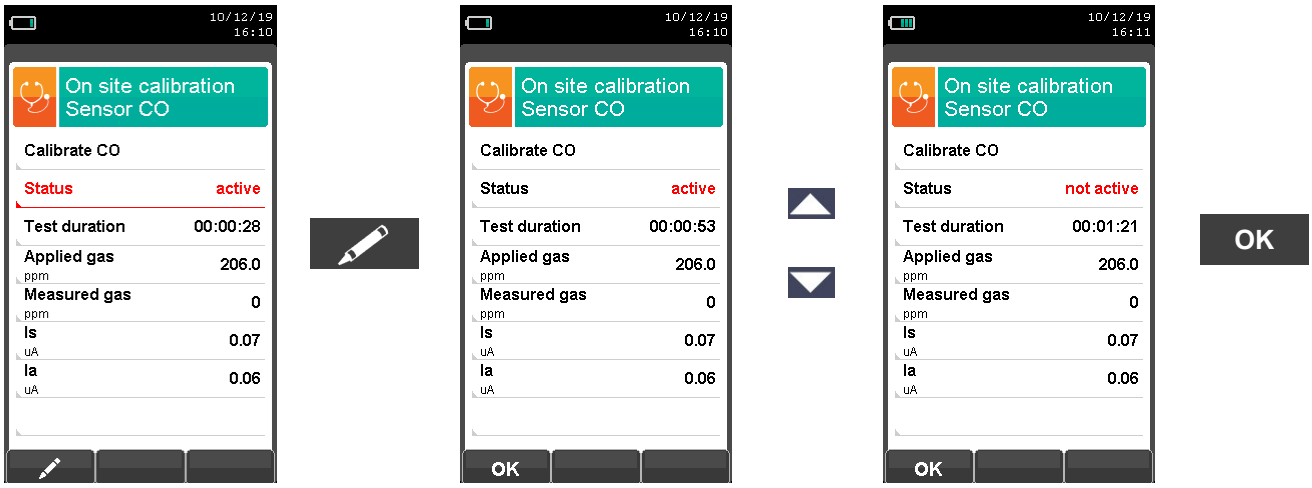
- **At any time the user can restore the factory calibration in the instrument by setting the 'Status' line on 'not active'.**
- **The advised stabilization time for the on-site calibration of the sensors, is 3 minutes. For NO2 and SO2 sensors this time can be up to 5 minutes.**

SENSOR CALIBRATION DETAIL FOR TOXIC GASES (EXAMPLE REFERRED TO CO).

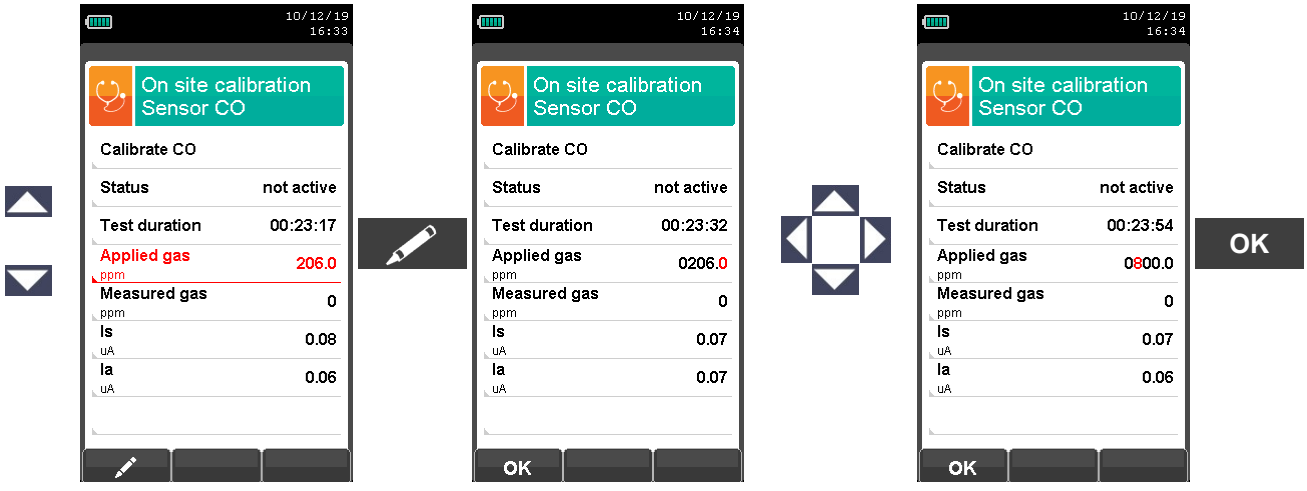
- The calibration **is possible** only when the status is set to '**----**' (sensors that have never been calibrated before) otherwise it is necessary to set the status on '**non active**' (see example below).



or

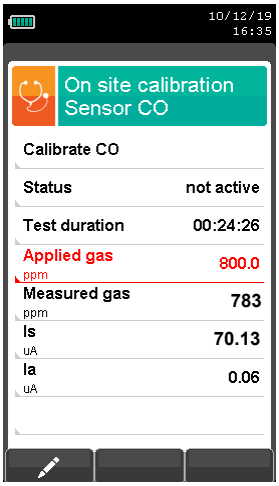


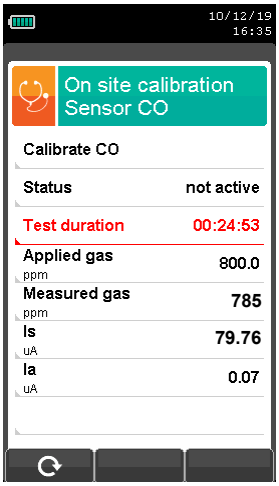
- **Enter the value of the concentration of the gas applied.**



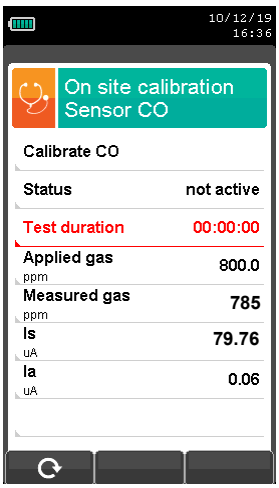
- **Apply gas to the instrument** and adjust the output pressure of the gas from the cylinder so that the flow meter indicates a minimum flow of 0.5 l/m: this guarantees that the instrument is taking the exact amount of gas required by the internal pump.

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

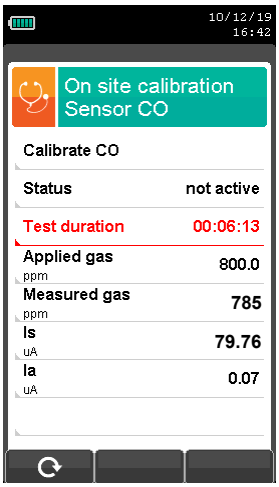


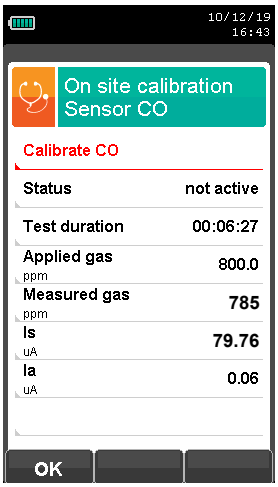


Zeroes the timer - helps to keep under control the time elapsing during the stabilization phase.

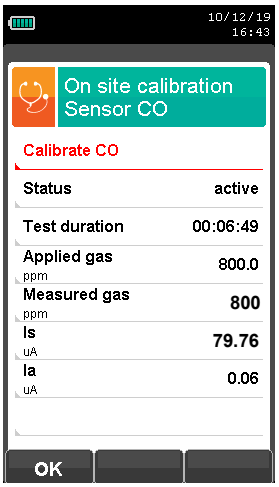


- When the stabilization time is over, select the row 'Calibrate' and store the new calibration.





OK



Messages in the 'Status' line:

saving: the instrument is saving the performed calibration

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

WARNING

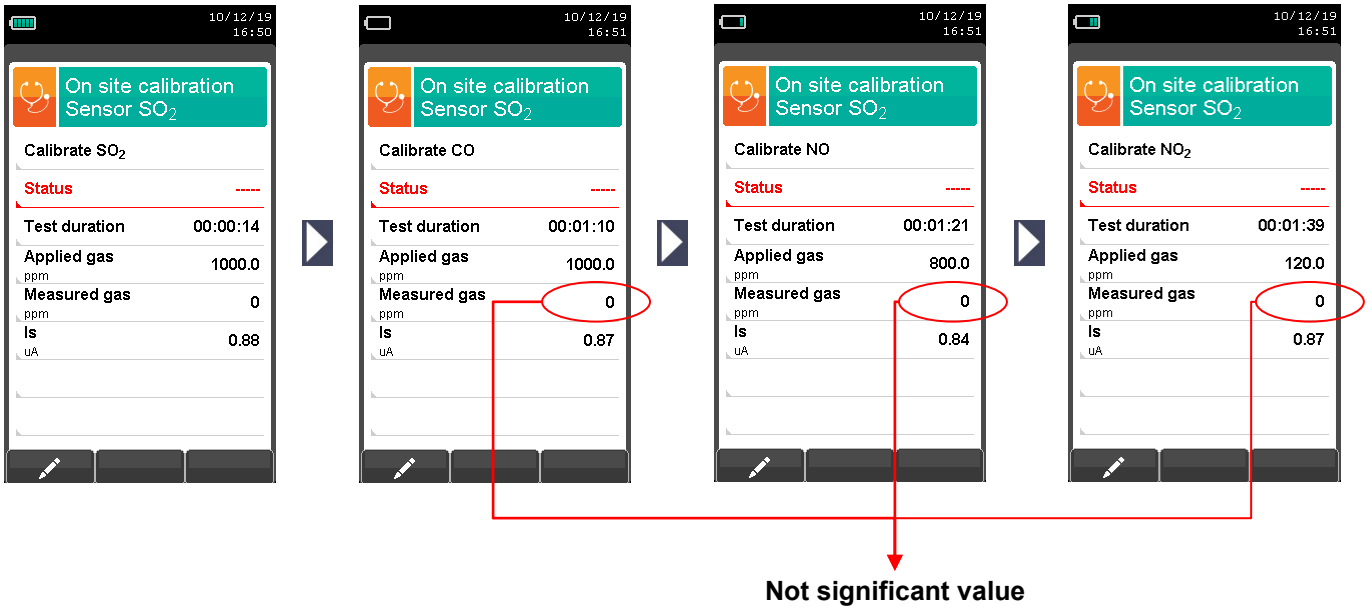
- **At any time the user can restore the factory calibration in the instrument by setting the 'Status' line on 'not active'.**
- **The stabilization time advised for the on site calibration of the sensors, is 3 minutes. For the NO2 and SO2 sensors this stabilization time could reach 5 minutes.**

SENSOR CALIBRATION DETAIL FOR TOXIC GASES WITH INTERFERING GASES

The sensors for toxic gases with interfering gases are those sensors which are sensible to other gases.
The on-site calibration for these sensors allows to calibrate also the interfering gases.

The on-site calibration procedure for these sensors is the same described on the previous pages regarding the toxic gases and can be performed for all the interfering gases of the sensor itself.

The following procedure is for accessing the interfering gases of the sensor that must be recalibrated on-site (example referred to the SO2 sensor).



SENSOR	INTERFERING GASES		
NH_3	H_2S	SO_2	NO
SO_2	CO	NO	NO_2
H_2S	SO_2	NO	NO_2
H2	CO	NO	NO_2

Tab. 1: Interfering gases table.

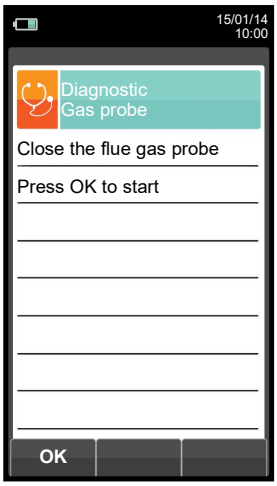
WARNING

The recommended stabilization time for the on-site calibration of these sensors is 5 minutes.

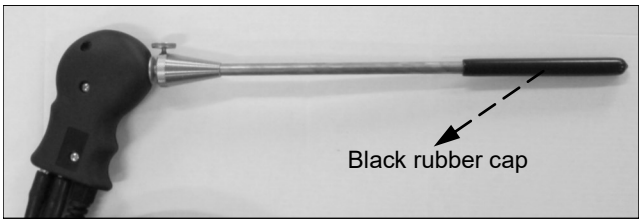
WARNING

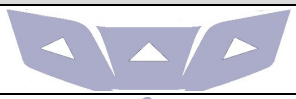
During analysis, the influence of interfering gases is compensated only if the correspondent sensor is installed.

10.7.5 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:



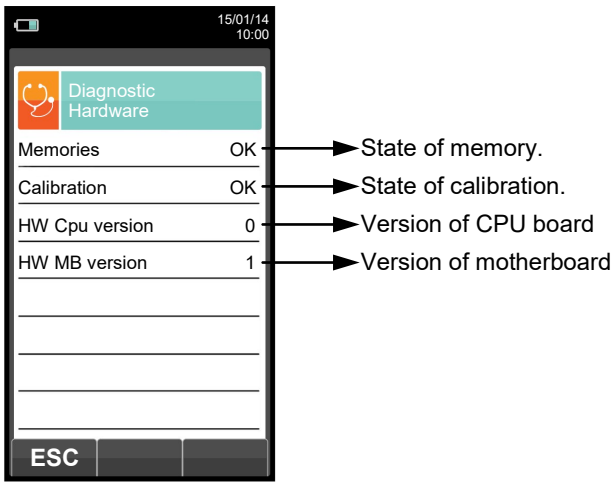
KEY	FUNCTION
	**Activate the context keys shown on the display.**
	**Activates the context key located in the left side of the display.**
	**Returns to the previous screen.**

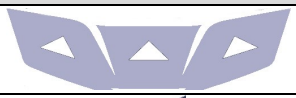
CONTEXT KEY	FUNCTION
OK	**Starts the test to check the tightness of the gas sampling probe.**
	**Starts the test of the gas sampling probe.**

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.**

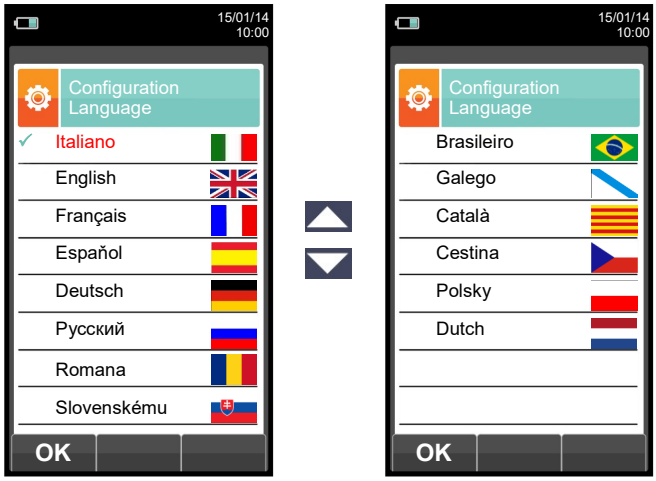
10.7.6 Configuratione→Diagnostic→Hardware

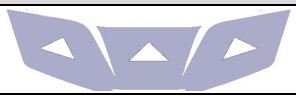


KEY	FUNCTION
	**Activate the context keys shown on the display.**
	**Returns to the previous screen.**

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

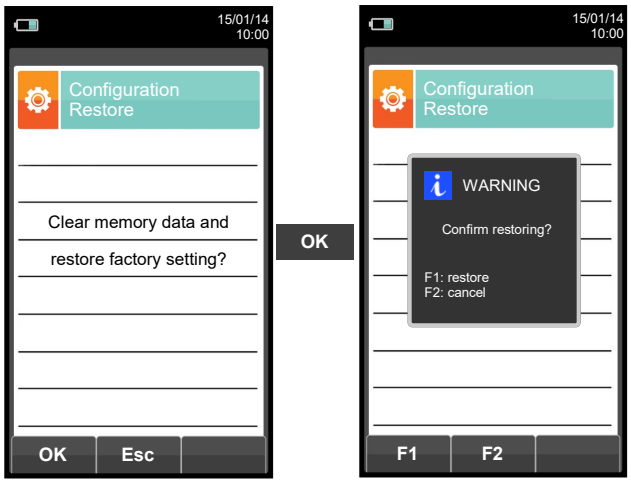
10.8 Configuration→Language



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

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

10.9 Configuration→Restore

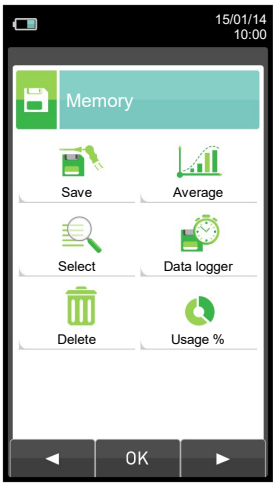


KEY	FUNCTION
	**Activate the context keys shown on the display.**
	**Starts the factory data reset phase.**
	**Exits the current screen without resetting.**

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.**

11.0 MEMORY

11.1 Memory Menu



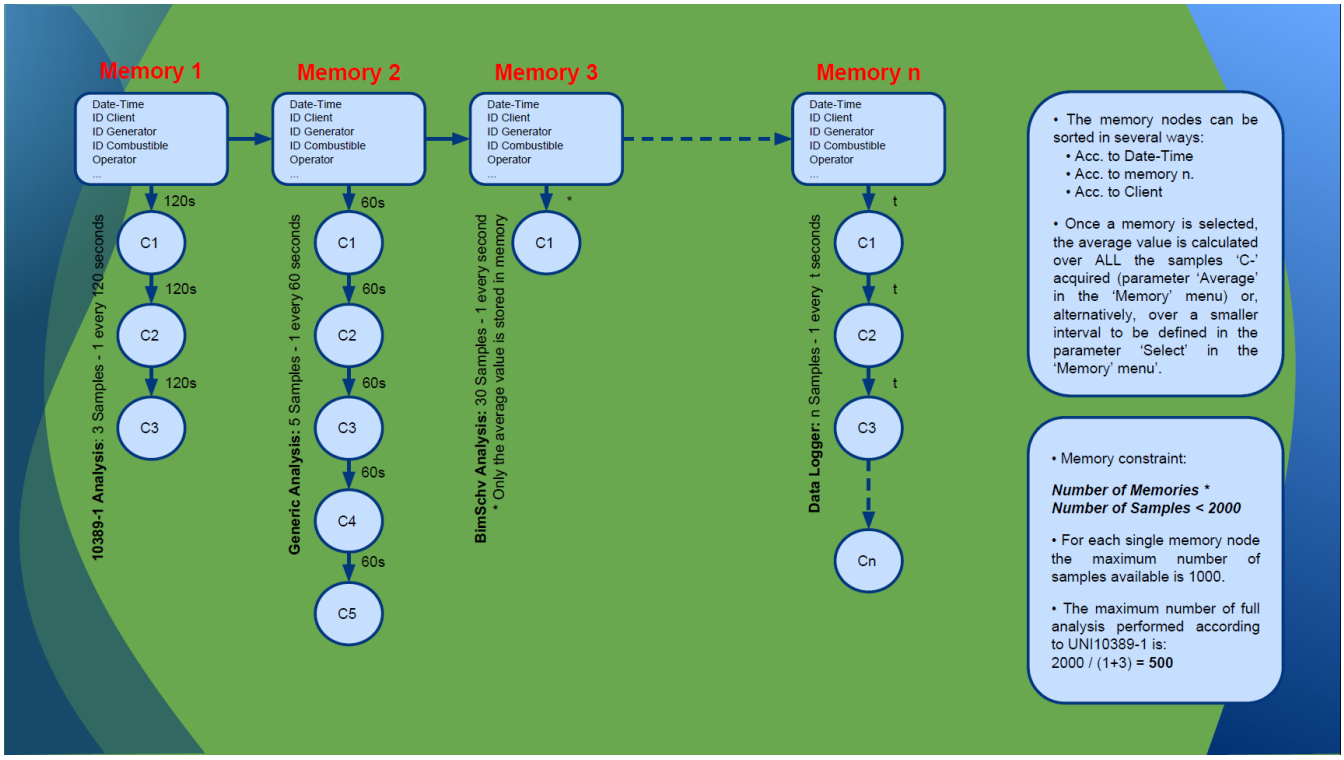
KEY	FUNCTION
	**Activate the context keys shown on the display.**
	**Returns to the previous screen.**

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

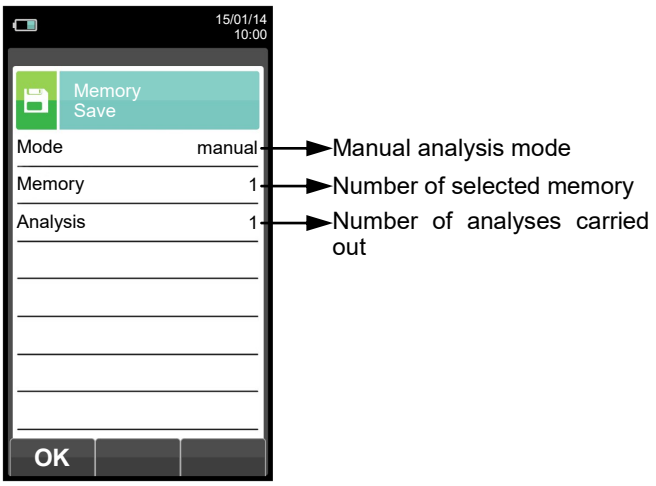
PARAMETER	DESCRIPTION
Save	From this screen the user can start the combustion analysis. The data shown summarizes the mode of analysis and the selected memory. **SEE SECTION 11.2.**
Average	Allows the user to see the average of the analyses contained in the selected memory. **SEE SECTION 11.3.**
Select	- Allows the user to choose the memory position to be used to save the combustion analysis and/or the draft/pressure measurement. 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 draft, smoke 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 draft, smoke and ambient CO data are displayed. **SEE SECTION 11.4.**
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), if the "Manual Print" mode has been selected, the device will display the average of the samples taken with the possibility to recall them individually; the user can then print them (total, complete, …). 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.

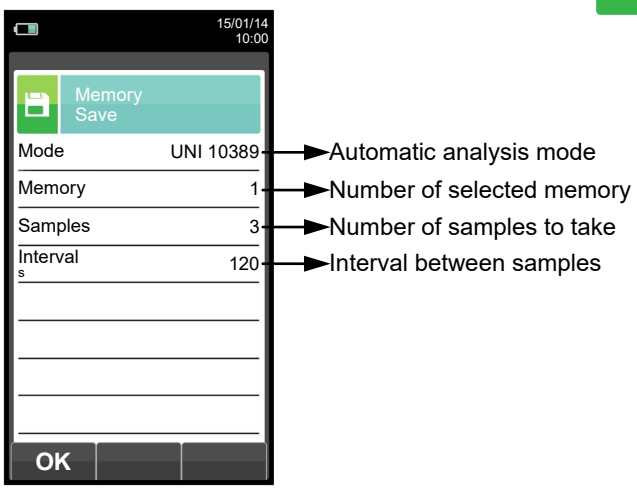
 Data logger	**Warning: in automatic mode, the measurements of smoke, draft and ambient CO must be taken before starting the combustion analysis.** **Manual analysis mode** If the user chooses the manual mode, he will perform the combustion analysis manually; in this case, the settings regarding printing and duration of the automatic analysis will not be considered. At this point the user can start the manual analysis after waiting for the measured displayed to stabilize: then the user can proceed to save or directly print the data, 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. **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 11.5.**
 Delete	Allows the user to delete the contents of each memory or of the entire 99 memories. **SEE SECTION 11.6.**
 Usage %	The user, through this menu, can view the percentage of memory usage. **SEE SECTION 11.7.**

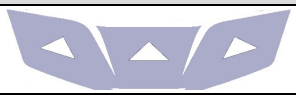
11.1.1 Memory Organization



11.2 Memory Menu→Save

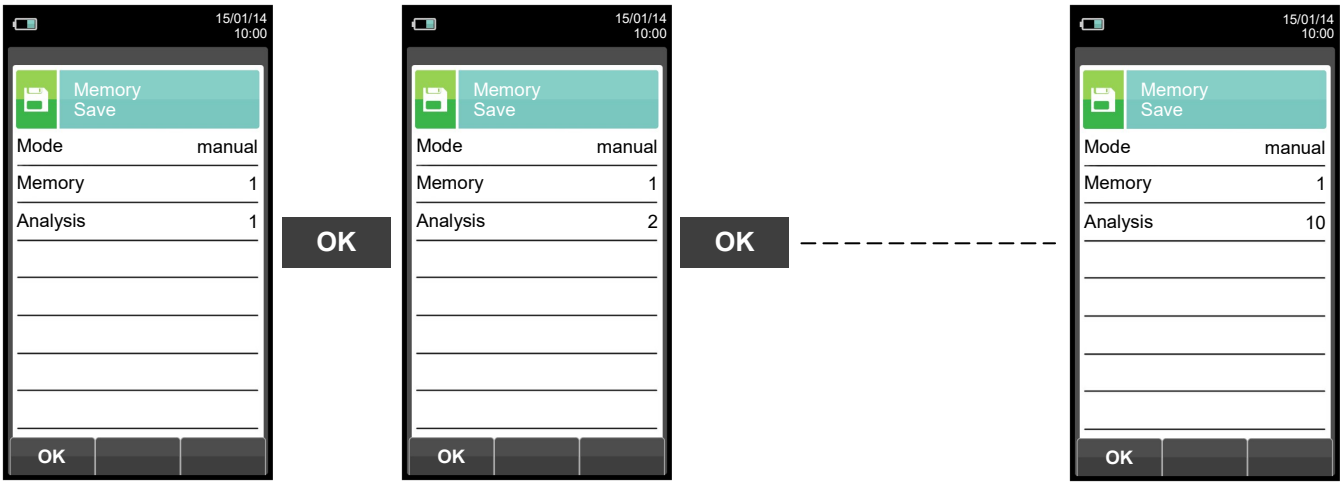




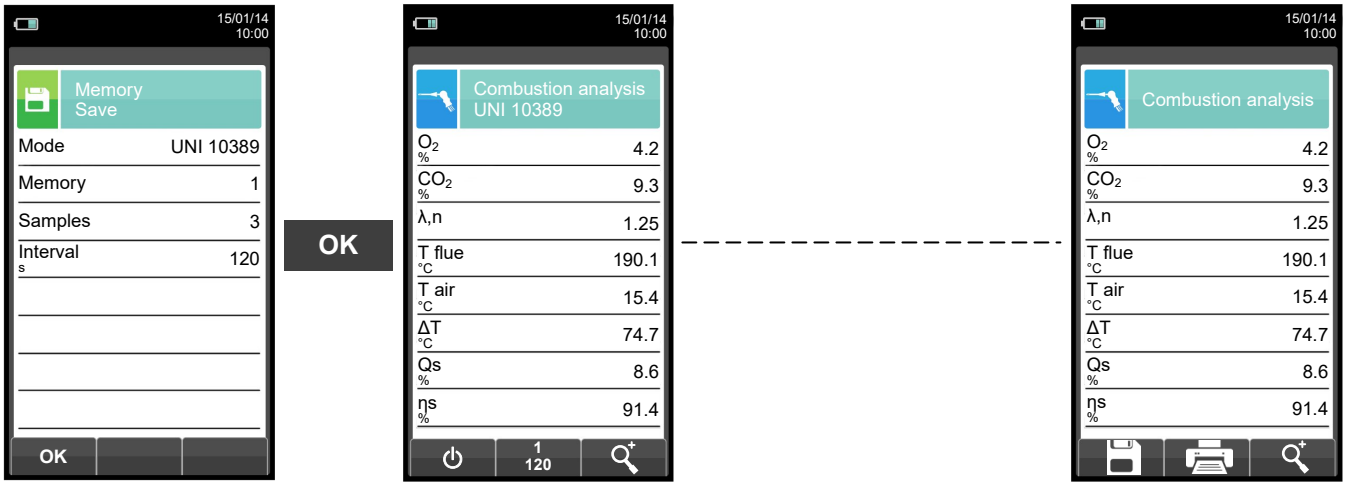
KEY	FUNCTION
	**Activate the context keys shown on the display.**
	**Starts saving the combustion analysis according to the mode set in the parameter 'Data logger'.**
	**Returns to the previous screen.**

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

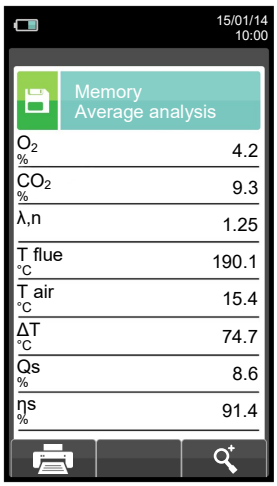


Example 2: Saving the combustion analysis in automatic mode (example UNI 10389)



FOR ANY FURTHER INFORMATION SEE CHAPTER 14 'FLUE GAS ANALYSIS'.

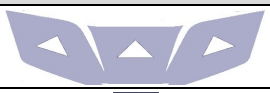
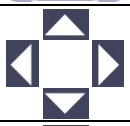
11.3 Memory Menu→Average



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.**

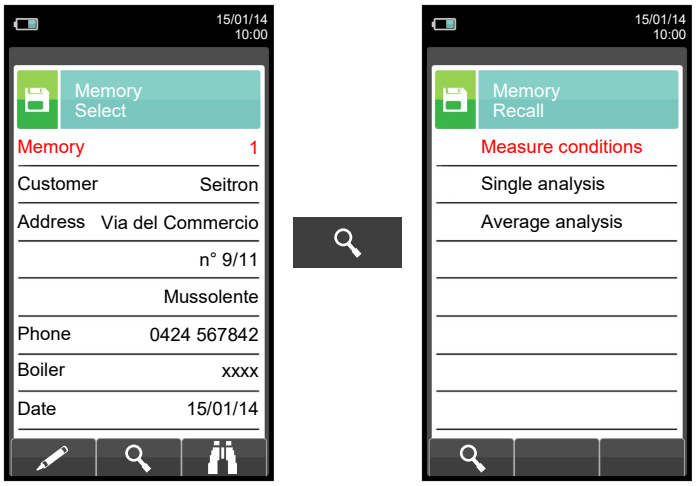
CONTEXT KEY	FUNCTION
	**Zoom. By pressing this interactive key repeatedly, the device displays the following sequence:** **AAA → AAA → AAA → AAA**
	**Starts printing the paper print-out. SEE SECTION 12.**

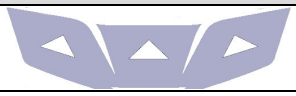
11.4 Memory Menu→Select

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

CONTEXT KEY	FUNCTION
	**Enters the modification mode for the selected parameter. It is possible to select the number of the memory to use for the combustion analysis and/or to enter the information relative to the plant.**
	**Recall memory. By activating this function, the user has the possibility to view the data present in the selected memory.** **SEE SECTION 11.4.1.**
	**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").**
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.**

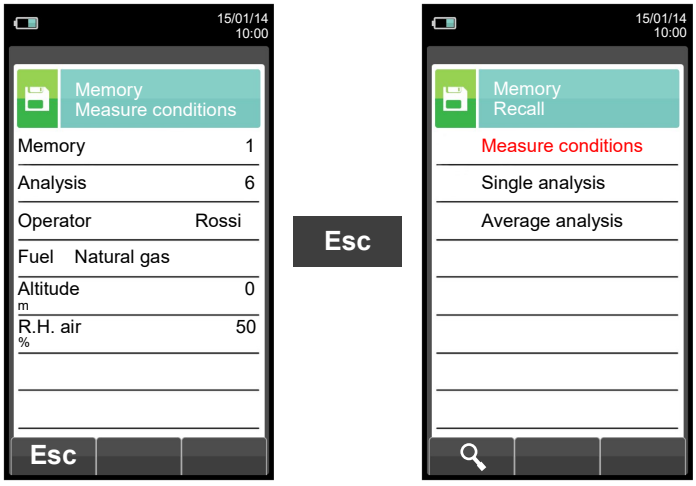
11.4.1 Memory Recall



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

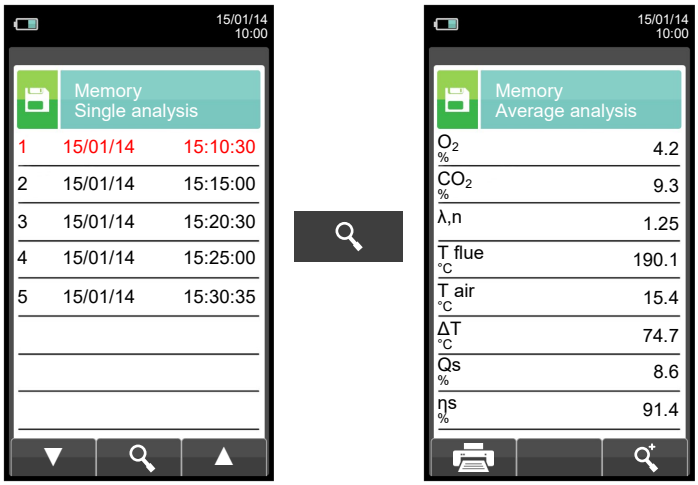
CONTEXT KEY	FUNCTION
	**Displays the details of the selected parameter.**

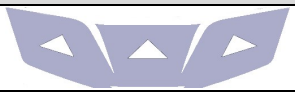
1. Details of measurement conditions



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

2. Details of Single analysis



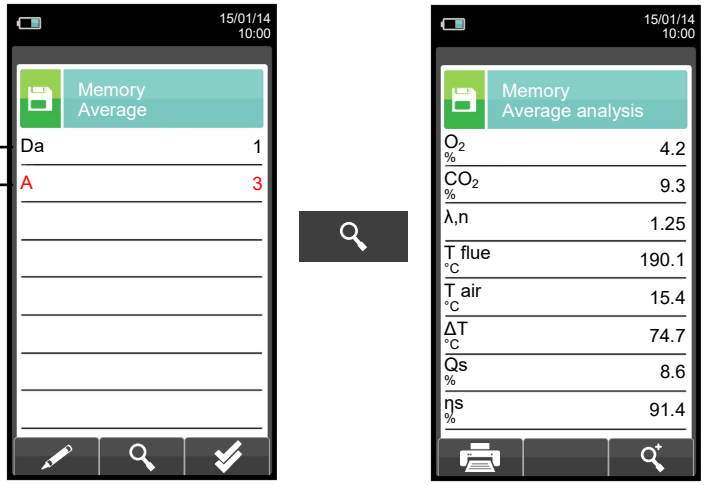
KEY	FUNCTION
	**Activate the context keys shown on the display.**
	**Selects line; the selected line is displayed in red.** **In "view detail" the previous or next pages are shown.**
	**Views the details of the selected parameter.**
	**Returns to the previous screen.**

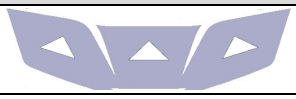
CONTEXT KEY	FUNCTION
	**Selects line; the selected line is displayed in red.**
	**Views the details of the selected parameter.**
	**Selects line; the selected line is red.**
	**Goes to next page.**
	**Goes to previous page.**
	**Starts printing the paper print-out. SEE SECTION 12.**
	**Zoom. By pressing 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.

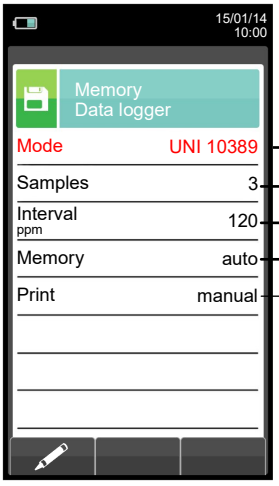
Defines the end sample to define the analysis average.



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 displayed in red.**
	**Activates the context key located in the left side of the display.**
	**Returns to the previous screen without saving the changes made.**

CONTEXT KEY	FUNCTION
	**Enters edit mode: it is possible to select the number of the sample to use to have the average of the analysis carried out.**
	**Shows the average analysis in the interval set.**
	**Zoom. By pressing this interactive key repeatedly, the device displays the following sequence:** **AAA → AAA → AAA → AAA**
	**Sets all the samples of the analyses carried out: From 1 (first sample) To xxx (last sample).**
OK	**Confirms the settings.**
	**Starts printing. SEE SECTION 12.**

11.5 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).

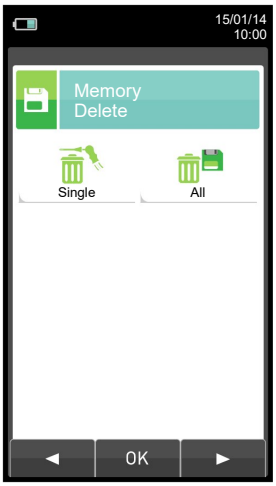
→ The memory selection modes are: **manual** or **auto**.
If "**auto**" mode has been selected, the research of the available memory will be performed automatically when the device is turned on).

→ 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 displayed 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.**

11.6 Memory→Delete

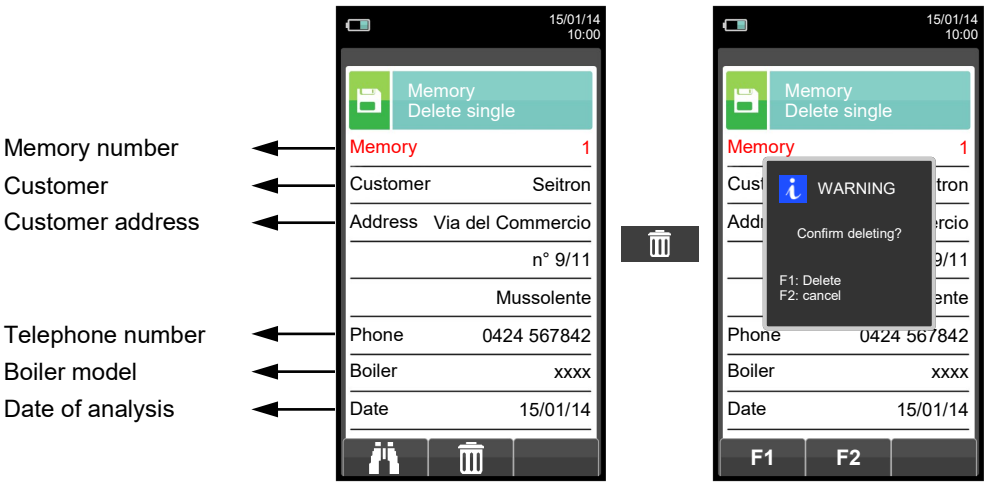


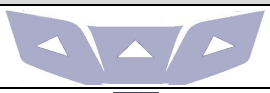
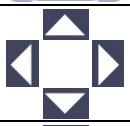
KEY	FUNCTION
	Activate the context keys shown on the display.
ESC	**Returns to the previous screen.**

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

PARAMETER	DESCRIPTION
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 11.6.1**.
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 11.6.2**.

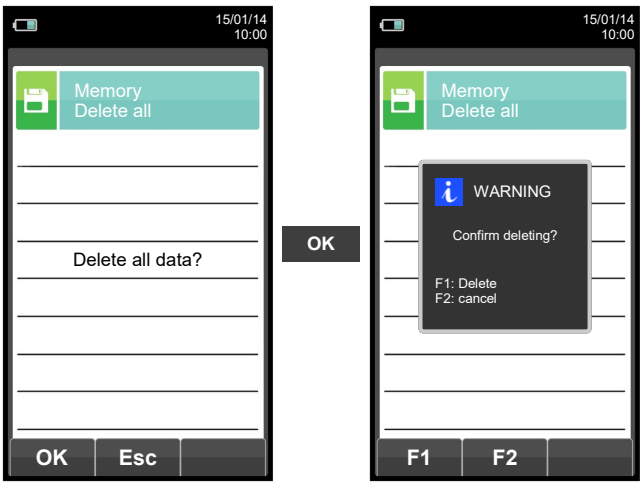
11.6.1 Memory→Delete→Single



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

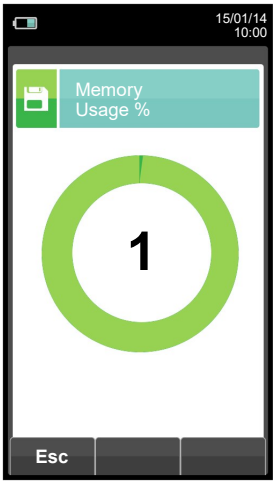
11.6.2 Memory→Delete→All

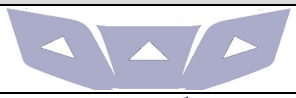


KEY	FUNCTION
	**Activate the context keys shown on the display.**
	**Start erasing all memories.**
	**Returns to the previous screen.**

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.**

11.7 Memory→Usage %

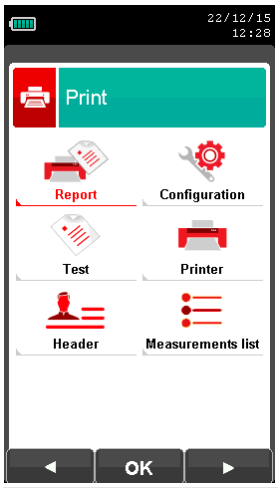


KEY	FUNCTION
	**Activate the context keys shown on the display.**
	**Returns to the previous screen.**

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

12.0 PRINT

12.1 Print Menu



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

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

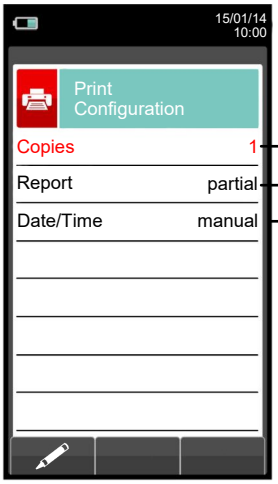
PARAMETER	DESCRIPTION
Report	Enables the Print Menu. A hard copy of the complete combustion analysis can be printed. The printed values are those shown on the display when the menu is enabled. This menu can be used for combustion analysis, even when recalled from the memory, for draft, smoke, ambient gas and for tightness test results. SEE SECTION 12.2.
Configuration	The user, by means of this menu, can configure 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 information 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 tightness 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 information, 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 12.3.
Test	**Print:** Prints a graphical/alphanumeric test paper print-out for a complete check of the printer operation. **Paper feed:** Feeds paper in the printer; this function is most useful when replacing the paper roll in the printer. SEE SECTION 12.4.
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 12.5.
Header	Allows the user to enter, in six lines of 24 characters each the name of the Company or owner of the device or the information regarding the latter (e.g. address, telephone number), which will be printed in the header of the analysis report. SEE SECTION 12.6.
Measurements list	In this submenu the user has the possibility to view the list of measurements that the device performs. With the interactive keys, the user can add, delete or move a selected measurement. SEE SECTION 12.7.

12.2 Print→Report

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

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

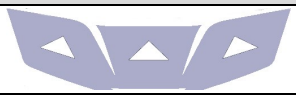
12.3 Print→Configuration



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

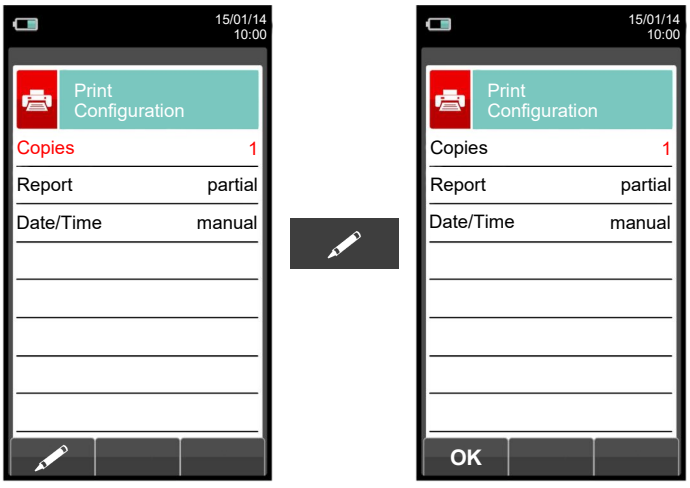
The paper print-out models that can be selected are: **partial** - **full** - **total**

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

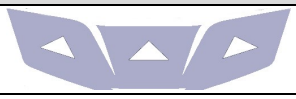
KEY	FUNCTION
	**Activate the context keys shown on the display.**
	**Selects line; the selected line is displayed in red.** **In modification sets the value or the desired mode.**
	**Activates the context key located in the left side of the display.**
	**Returns to the previous screen.** **When in modify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

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

Example:

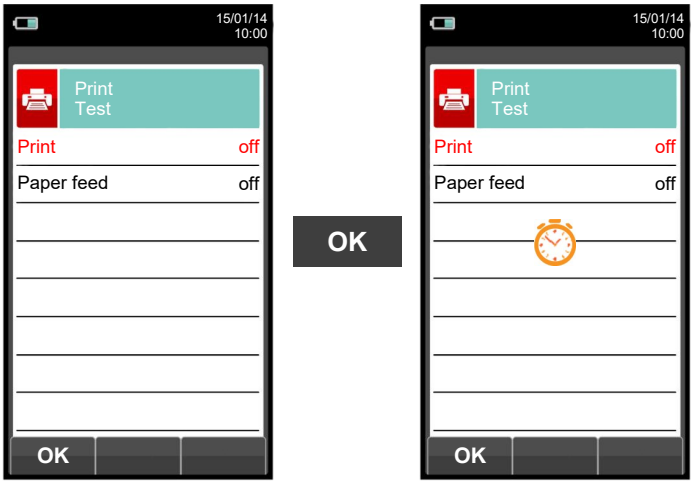


12.4 Print→Test

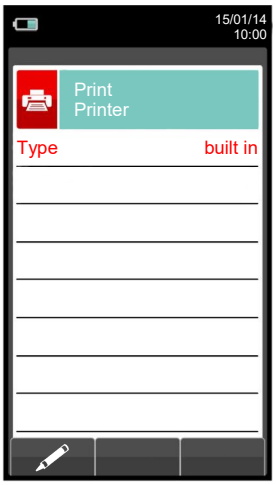
KEY	FUNCTION
	**Activate the context keys shown on the display.**
	**Selects line; the selected line is displayed in red.** **In modification sets the value or the desired mode.**
	**Activates the context key located in the left side of the display.**
	**Returns to the previous screen.** **When in modify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

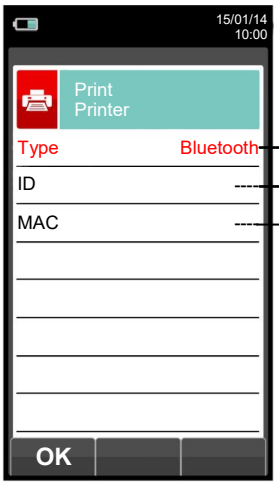
CONTEXT KEY	FUNCTION
OK	**Confirms the settings.**

Example:



12.5 Print→Printer

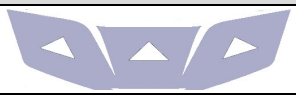




Printer type: **built in (internal) - Bluetooth (external)**.

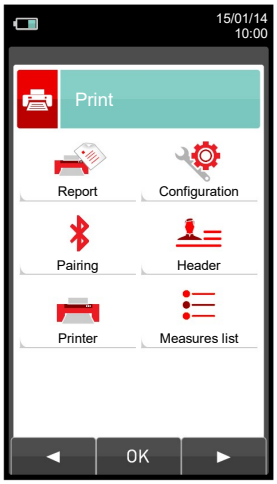
Name of the Bluetooth printer associated with the instrument.

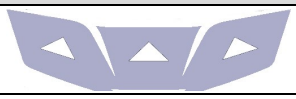
Address of the Bluetooth printer associated with the instrument.

KEY	FUNCTION
	**Activate the context keys shown on the display.**
	**Selects line; the selected line is displayed 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.**
	**Confirms the settings.**

12.5.1 Print→Pairing

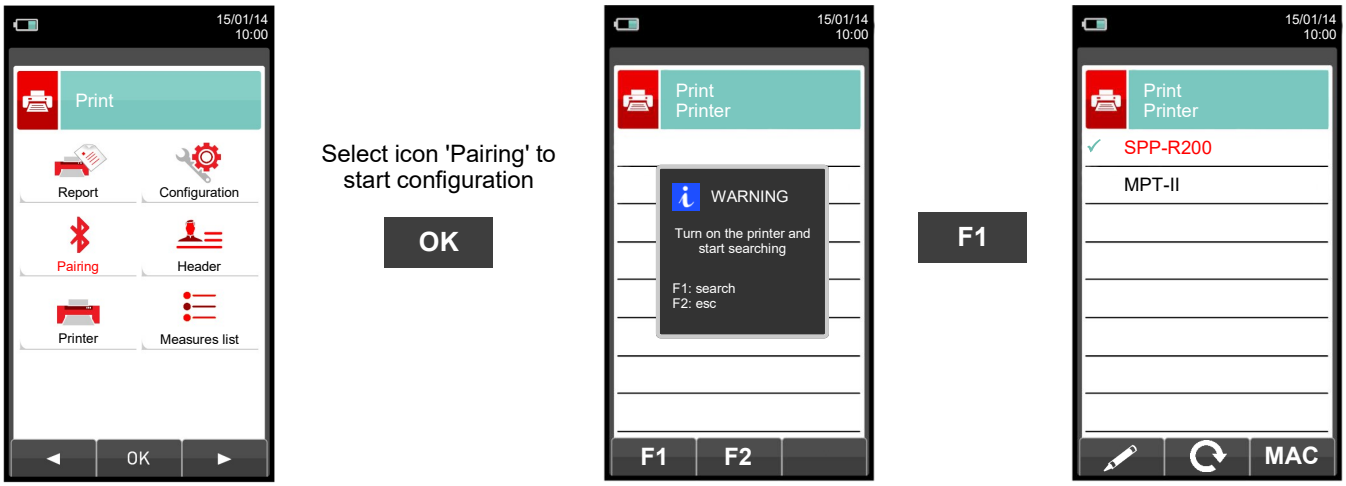


KEY	FUNCTION
	Activate the context keys shown on the display.
	Selects line; the selected line is displayed in red. In modification sets the value or the desired mode.
	Activates the context key located in the left side of the display.
	Returns to the previous screen. When in modify mode cancels the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

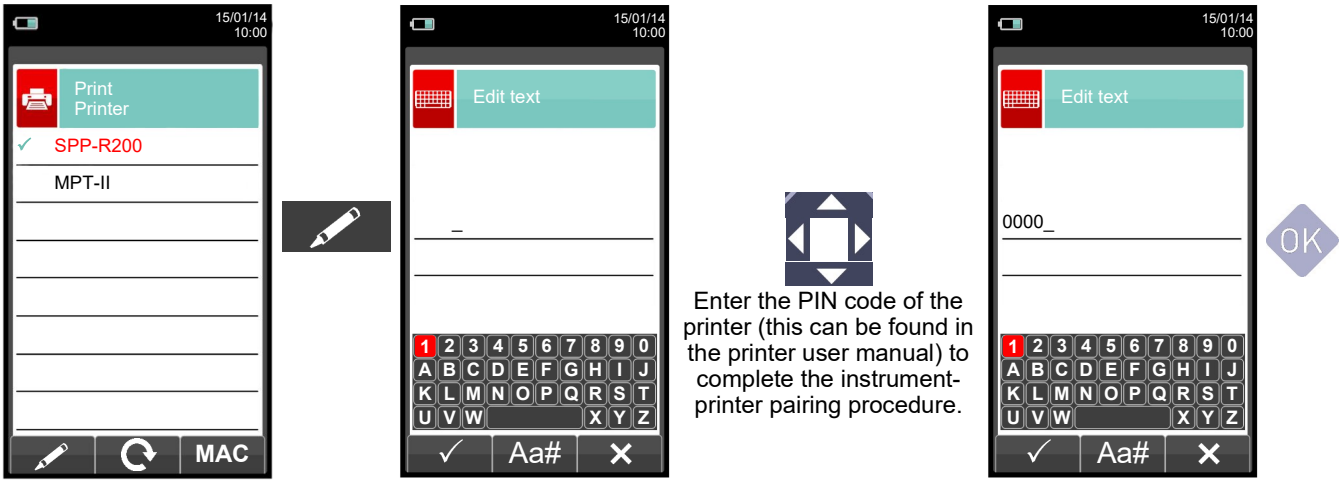
CONTEXT KEY	FUNCTION
◄	Selects the available parameters.
OK	Enters in the selected parameter setting.
►	Selects the available parameters.
F1	Starts the search for Bluetooth devices.
F2	Quits and returns to the previous screen.
	Enters the modification mode for the selected parameter.
	Repeats the pairing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

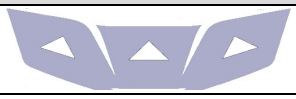
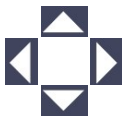


2. **Select the line corresponding to the desired Bluetooth printer, then proceed as follows:**



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

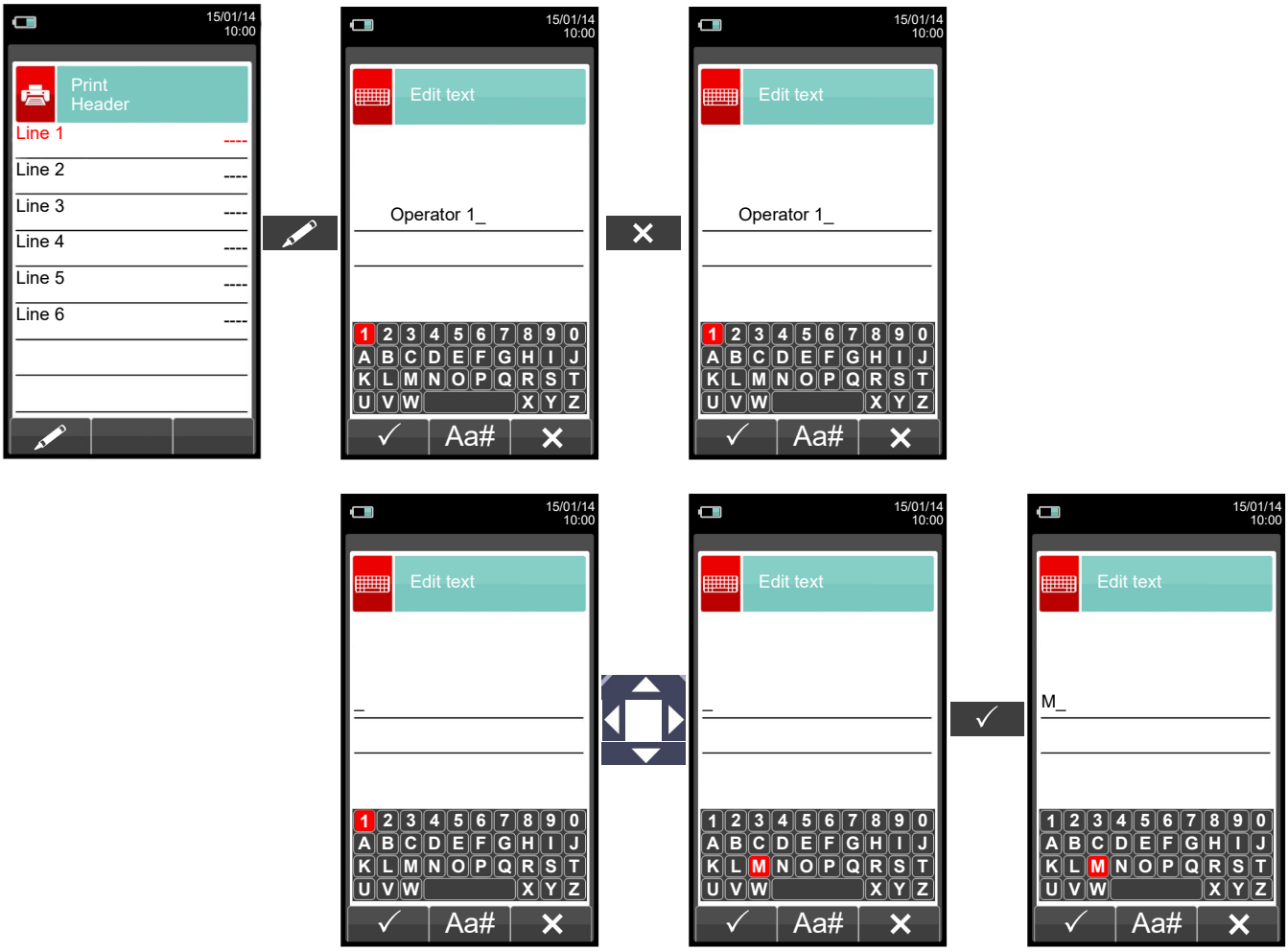
12.6 Print→Header

KEY	FUNCTION
	**Activate the context keys shown on the display.**
	**In "edit text": It moves the cursor on the box corresponding to the letter or number required to form the desired word.**
	**In edit mode it moves the cursor through the available lines.**
	**In "edit text": it confirms the text input.** **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.**

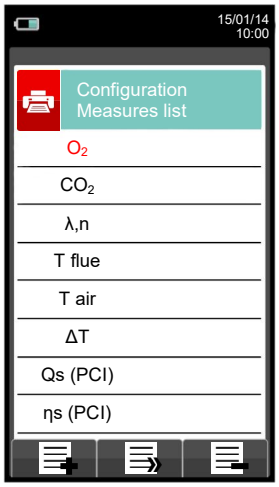
CONTEXT KEY	FUNCTION
	**Enters edit mode of the selected line: it is possible to enter the name of the operator (24 characters available).**
	**Confirms the selected letter or digit.**
	**Cancels the letter or digit before the cursor.**
	**Cycles through uppercase, lowercase, symbols and special characters.**

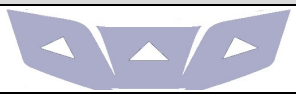
Example:

1. Edit text



12.7 Print→Measures list

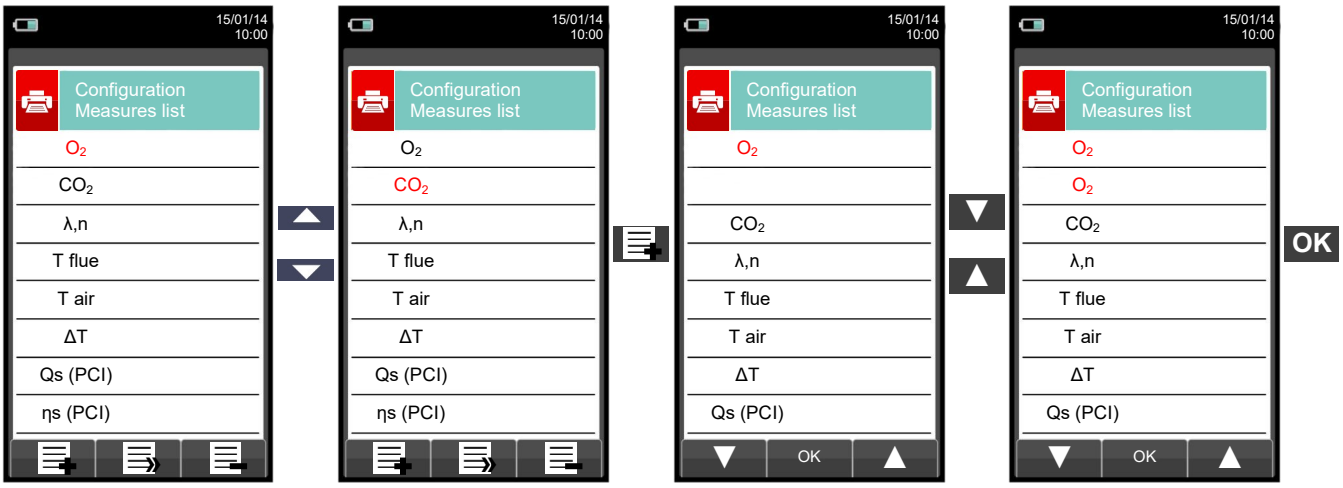


KEY	FUNCTION
	**Activate the context keys shown on the display.**
	**Selects the available measurements from the suggested list. In edit mode, it scrolls through the measurements present.**
	**Confirms the modification.**
	**When pressed in modify mode cancels the selection made, otherwise returns to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

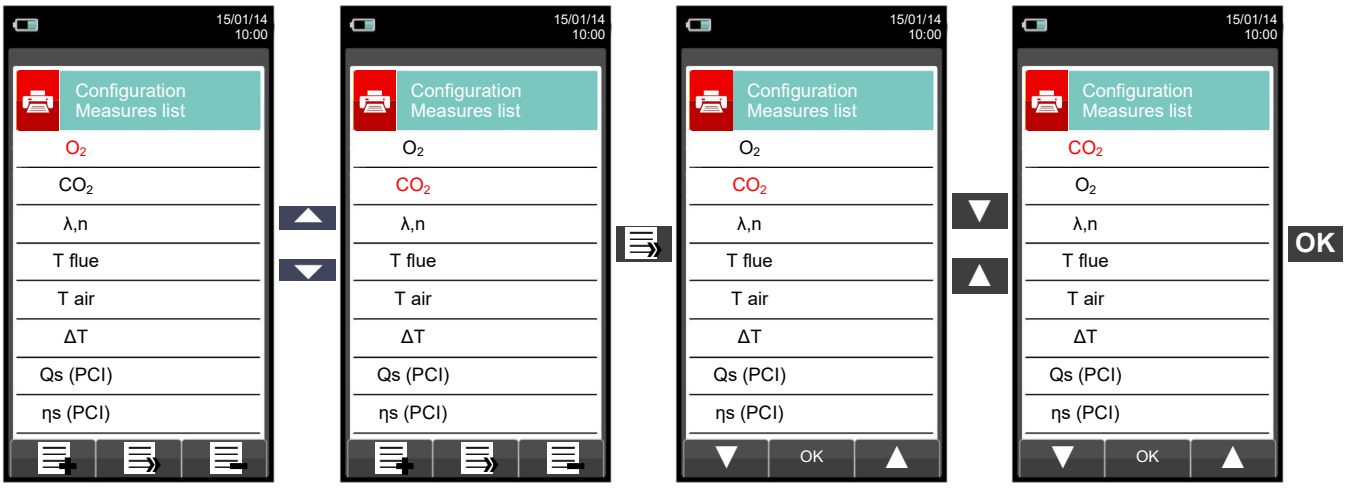
CONTEXT KEY	FUNCTION
	**Adds a measurement.**
	**Moves the position of a measurement.**
	**Deletes a measurement from the list.**
	**Scrolls through the available measurements.**
OK	**Confirms the change made.**
	**Scrolls through the available measurements.**
Esc	**Cancels the change made.**

Example:

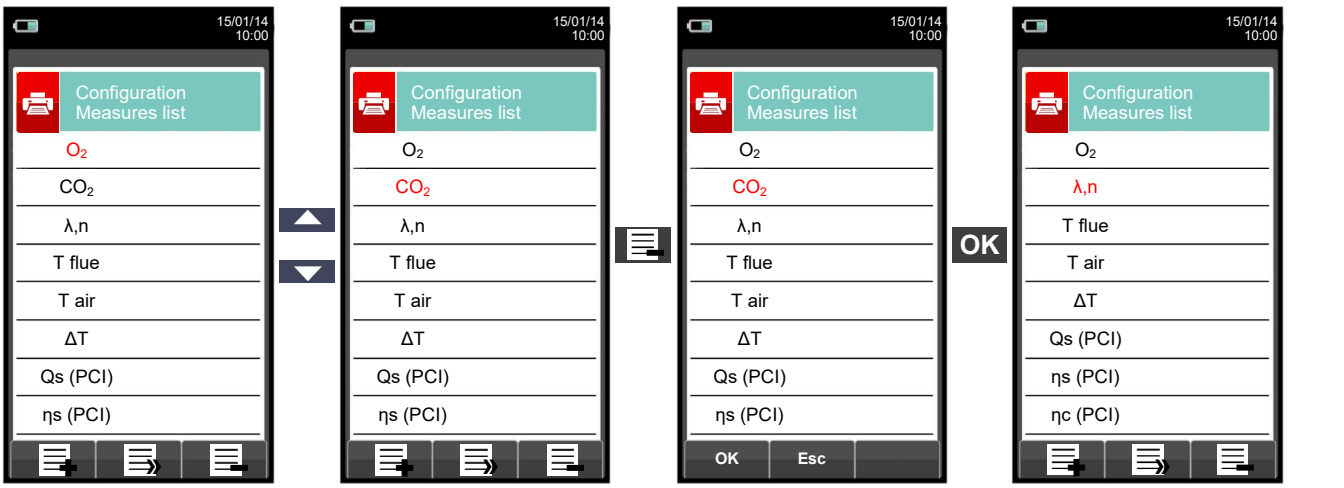
1. Add a measurement to the list



2. Move the position of a measurement



3. Deletes a measurement from the list



13.0 MEASUREMENTS

13.1 MEASUREMENTS

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

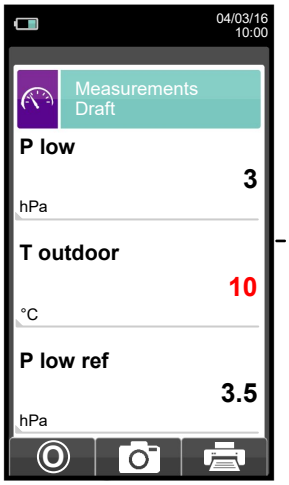
CONTEXT KEY	FUNCTION
◄	**Selects the available parameters.**
OK	**Enters in the selected parameter setting.**
►	**Selects the available parameters.**

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 13.2.**
Smoke	It is possible to enter the data concerning one to three SMOKE measurements taken by means of an optional device (Smoke Pump Kit); 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 smoke stain obtained is compared with the surfaces blackened in a different way according to a comparison scale; it is thus determined the "smoke 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 paper print-out. **SEE SECTION 13.3.**
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 pre-set 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). **Make sure to perform the autozero in a clean environment (preferably outdoors), so that the ambient CO measurement is correct. It is advisable to turn on the instrument and wait for the autozero completion outside the area where the test is being performed.** **SEE SECTION 13.4.**

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 13.5.**
 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 13.6.**
 Tightness test	According to the version, CHEMIST 600 can perform the tightness test on heating plants which use combustible gases according to the standards UNI 7129-1: 2015 and UNI 11137: 2019, respectively applicable to new or renewed piping and to existing piping, 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 13.7.**
 Aux meas.	Through this menu the user can access additional measures. **SEE SECTION 13.13.**

13.2 Measurements→Draft

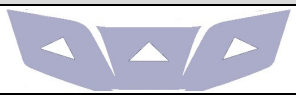
Main screen during draft measurement using the internal pressure sensor located inside the instrument:



If the draft measurement is higher than 200 Pa, the instrument shows the screen below:

Screen when the external micromanometer is used:

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

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

CONTEXT KEY	FUNCTION
F1 F2 F3	**The activation of one of these keys starts the Draft measurement.**
	**Carries out pressure zeroing.**
	**Saves, in the memory selected in the "Memory Select" menu, the value of the draft measured.**
	**Starts printing the paper print-out. SEE SECTION 12.**

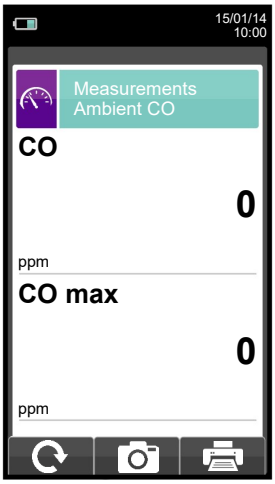
13.3 Measurements→Smoke

- Measure the smoke using the specific optional kit.
- Enter the values found.
- The values of the smoke that you want to save must be acquired before saving the analyses.
- To join the values of the smoke to the measurements of the current analysis use the ' ' function.
- To print the paper print-out with the measurement of the smoke, activate the ' ' function.
- It is possible to delete the values of the smoke acquired in the memory by overwriting them by activating the ' ' function again.
- After saving the smoke values, to carry out the combustion analysis, press the key ' '.

KEY	FUNCTION
	Activate the context keys shown on the display.
	Sets the "smoke number" found by the device when measuring the smoke.
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 paper print-out. **SEE SECTION 12**.

13.4 Measurements→Ambient CO



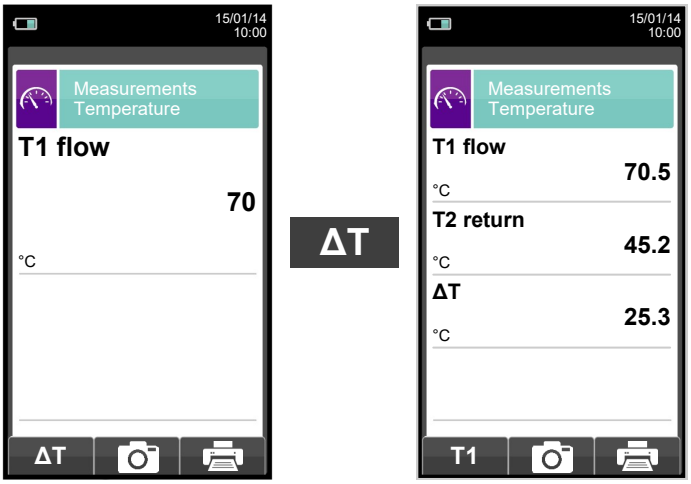
Make sure to perform the autozero in a clean environment (preferably outdoors), so that the ambient CO measurement is correct. It is advisable to turn on the instrument and wait for the autozero completion outside the area where the test is being performed.

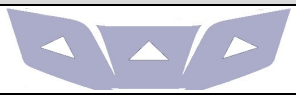
- The values of the ambient CO that you want to save must be acquired before saving the analyses.
- To join the values of the ambient CO to the measurements of the current analysis use the ' ' function.
- To print the paper print-out with the measurement of the ambient CO, activate the ' ' function
-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

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

CONTEXT KEY	FUNCTION
	Updates the measurement.
	Saves, in the memory selected in the "Select Memory" menu, the data acquired.
	Starts printing the paper print-out. SEE SECTION 12.

13.5 Measurements→Temperature

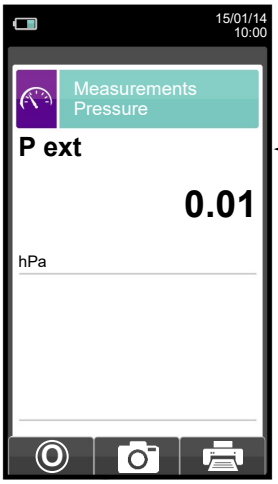


KEY	FUNCTION
	**Activate the context keys shown on the display.**
	**Returns to the previous screen.**

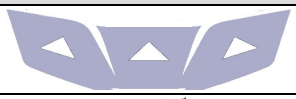
CONTEXT KEY	FUNCTION
ΔT	**Accesses the acquisition of the temperature difference between the supply water (measured by the probe connected to the connector T1 of the device) and the return water (measured by the probe connected to the connector T2 of the device).**
T1	**Goes back to the visualisation of the supply water temperature.**
	**Saves, in the memory selected in the "Select Memory" menu, the data acquired.**
	**Starts printing the paper print-out. SEE SECTION 12.**

13.6 Measurements→Pressure

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



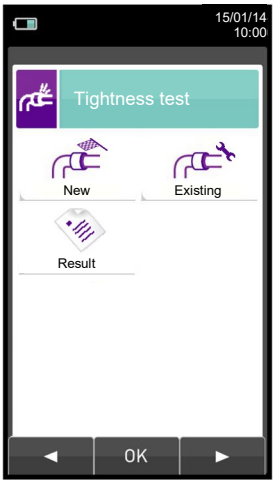
Measurement of the pressure by means of an external draft gauge.

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 paper print-out. SEE SECTION 12.**

13.7 Measurements→Tightness test

Tightness test according UNI 7129-1: 2015 and UNI 11137: 2019 (when the instrument version so provides).



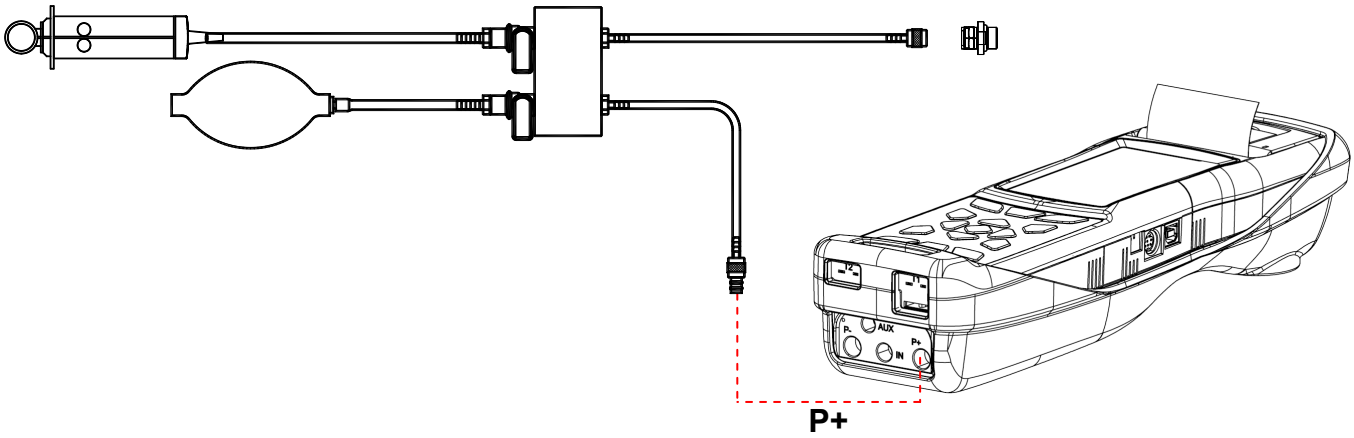
Tightness test according DVGW TRGI (when the instrument version so provides).

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

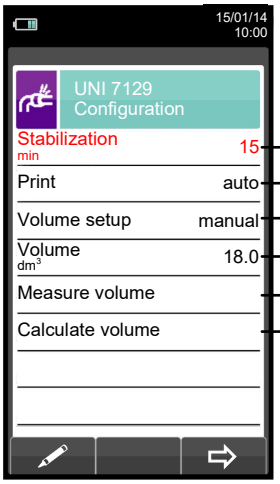
CONTEXT KEY	FUNCTION
◄	**Selects the available parameters.**
OK	**Enters in the selected parameter setting.**
►	**Selects the available parameters.**

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 13.8 or SECTION 13.10.**
 Existing	With this menu it is possible to perform a tightness test, in accordance with UNI 11137, on existing systems. **SEE SECTION 13.9.**
 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 13.11.**
 Result	This menu allows the user to view and/or save the last test carried out. **SEE SECTION 13.12.**

13.7.1 Connecting the tightness test kit to the instrument.



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



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

KEY	FUNCTION
	**Activate the context keys shown on the display.**
	**Selects line; the selected line is displayed in red.** **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 paper print-out.**

Details of the test:

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

The maximum pressure decay measured, expressed 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 600 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 tightness test performed according to the UNI 7129-1: 2015 standard requires to know the piping volume.

Because this data if often unavailable, CHEMIST 600 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 600 calculates the volume of the section ("partial volume") and it adds it up, activating the context key ' V+ ' (sum piping), to the calculation of the volume of the system. To correct any errors of to modify the current calculation, the subtraction operation is also allowed by activating the context key ' V- ' (subtract piping).
When the 'Volume measurement' option is selected instead, the procedure, described also in the flow charts of the tightness test according to UNI 7129-1: 2015, is described in the following steps:

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

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

P: Actual pressure measured by the instrument, in the selected measurement unit.

ΔP1': 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.

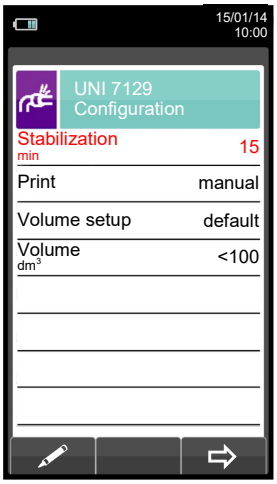
During the tightness test phase the following values are displayed:

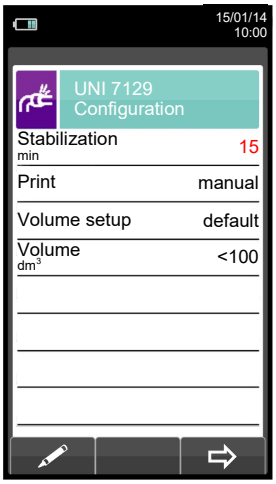
P1: Pressure measured at the beginning of the test.
P2: Pressure actually measured by the instrument.
ΔP: Pressure variation with respect to the initial value. In case the actual pressure is lower than the initial value (pressure is decreasing) this value has a negative sign.
Wait time: Remaining time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

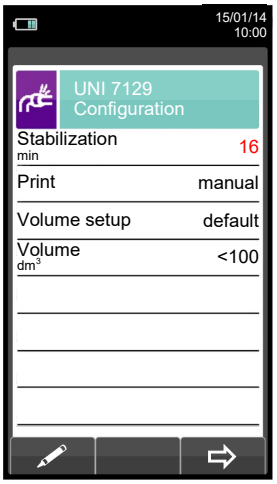
After the tightness test, the results are displayed: the data displayed is as follows:

P1: Pressure measured at the beginning of the test.
P2: Pressure measured by the device.
ΔP: 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.
operator if the Δ pressure is higher than +3 hPa it is operator's discretion whether repeat the test or not because the pressure and/or temperature conditions may have changed during the test.

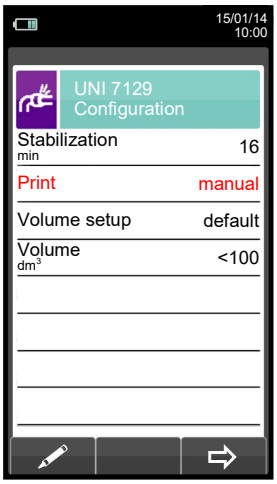
13.8.1 CONFIGURATION OF TIGHTNESS TEST ACCORDING TO UNI 7129-1: 2015

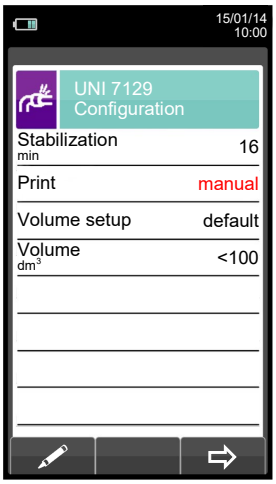


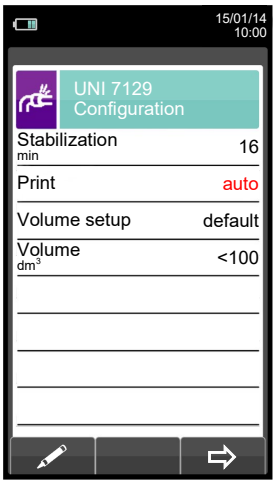




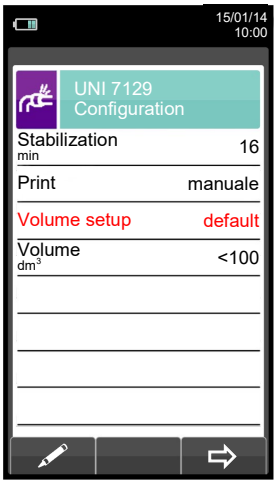
OK





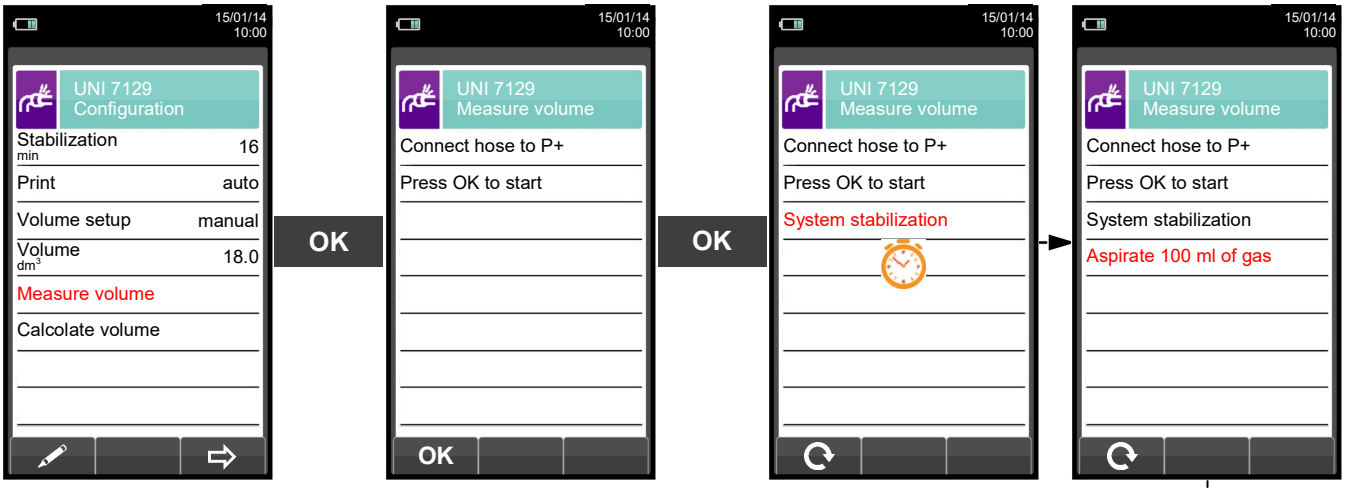


OK



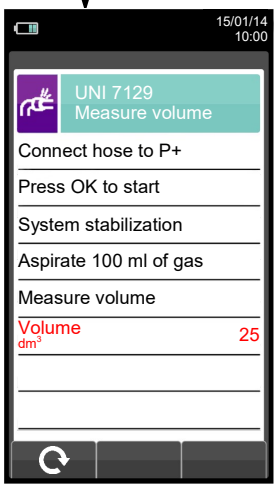
Starts the tightness test for systems up to 100 dm^3 (liter) (SEE SECTION 13.8.2).

Starts the tightness test for systems with a known volume (SEE SECTION 13.8.2).

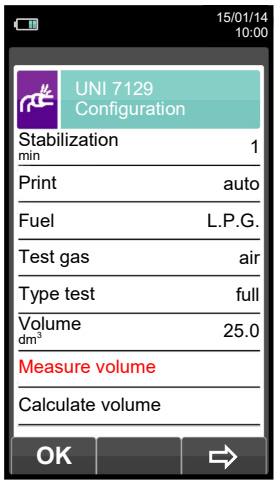


Alternatively

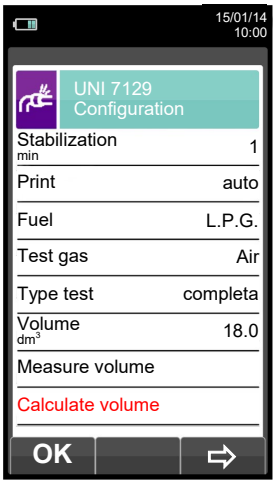
Take, with the syringe (that comes with the tightness test kit), 100 ml of gas.
If the volume measuring procedure of the system ends correctly, CHEMIST 600 automatically displays the measured volume, otherwise it requires another test.



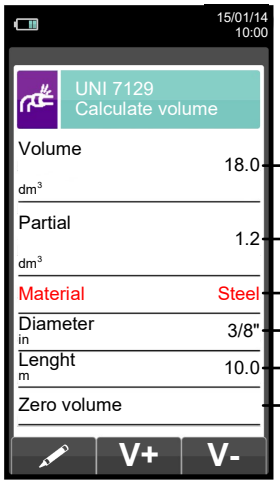
ESC



Starts the tightness test after measuring the volume (SEE SECTION 13.8.2).

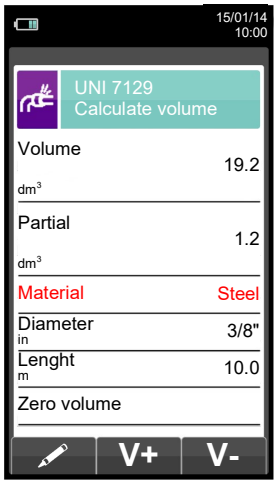


OK

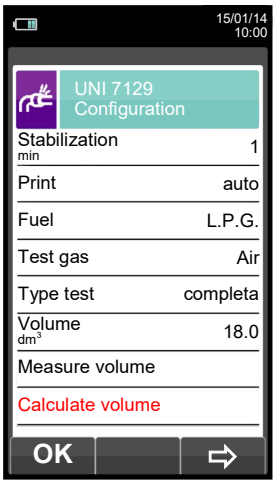


- Total volume acquired.
- Volume of the section of piping set below.
- Sets the material of the section of piping.
- Sets the nominal diameter of the section of piping.
- Sets the length of the section of piping.
- Zeroes the volume previously acquired.

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

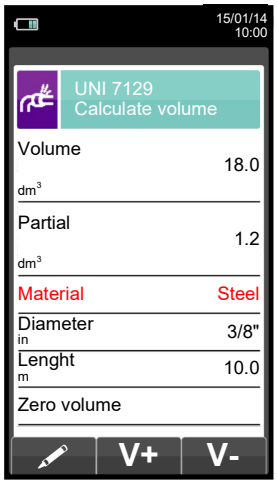


ESC

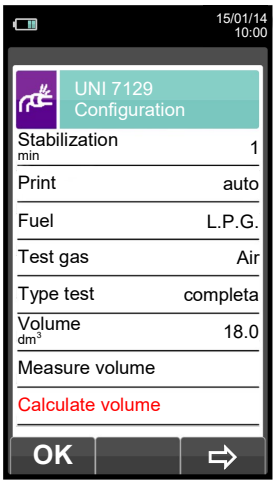


Starts the tightness test (SEE SECTION 13.8.2).

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

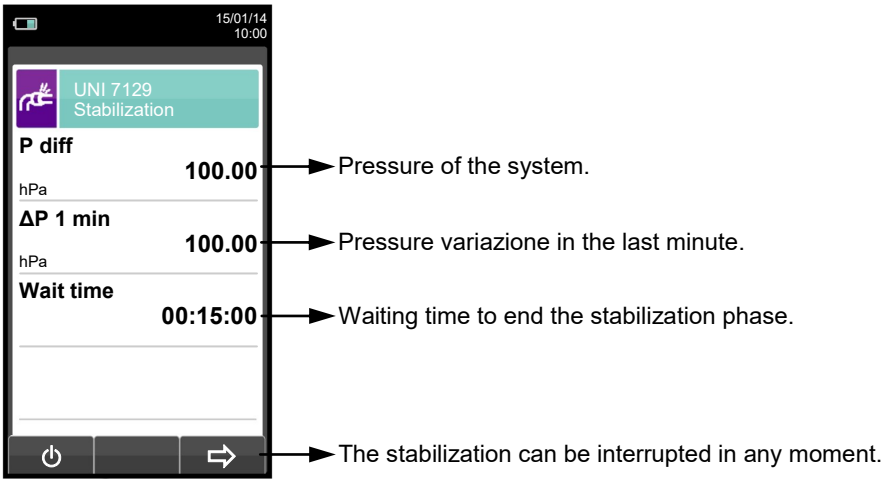


ESC

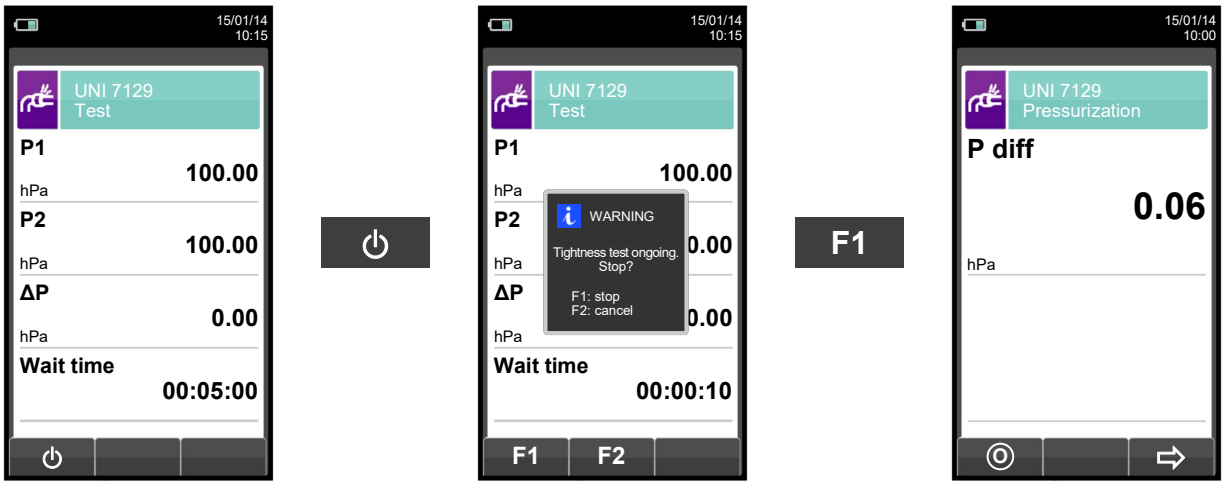


Starts the tightness test (SEE SECTION 13.8.2).

13.8.2 PERFORMING TIGHTNESS TEST ACCORDING TO UNI 7129



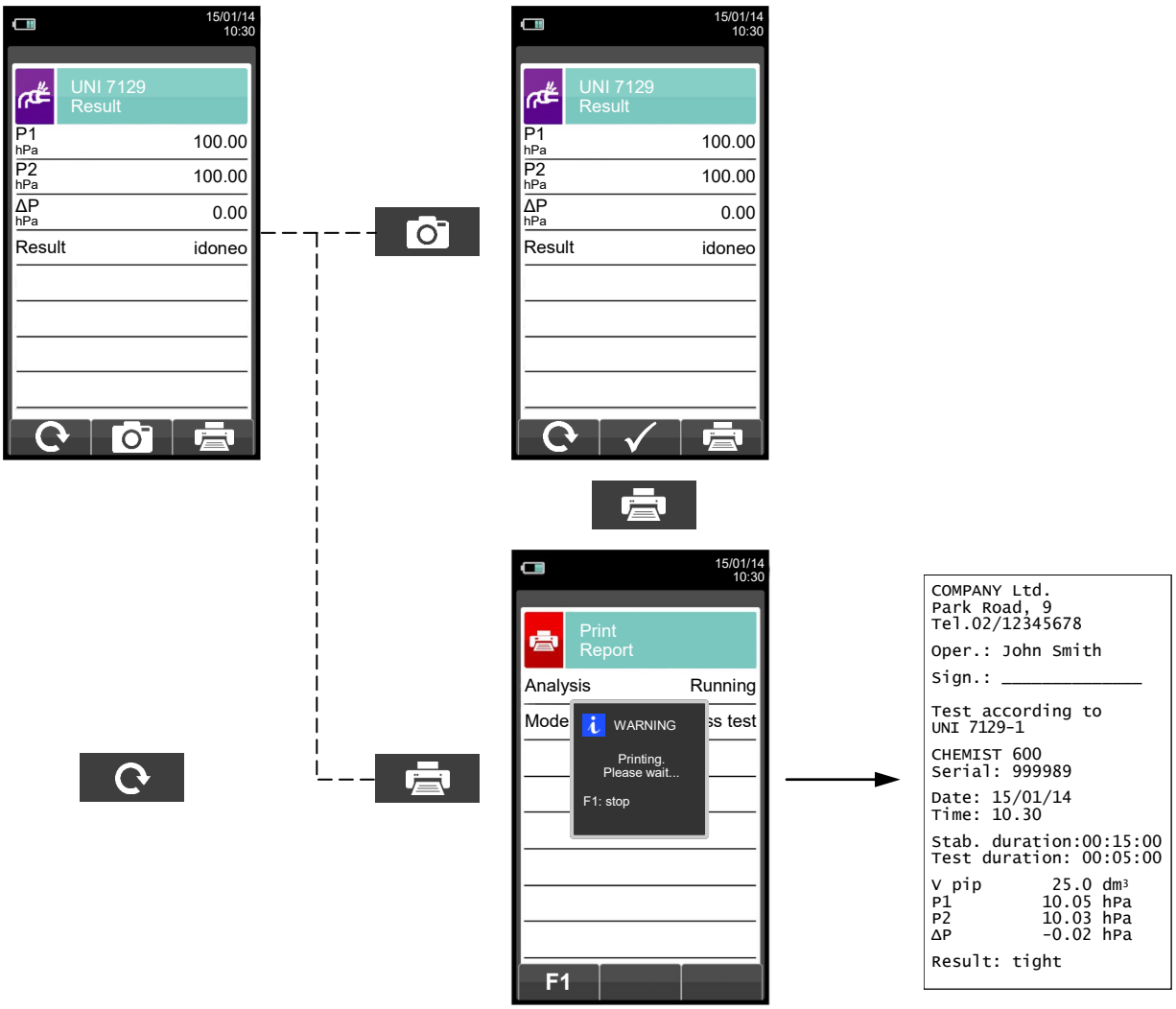
Automatically



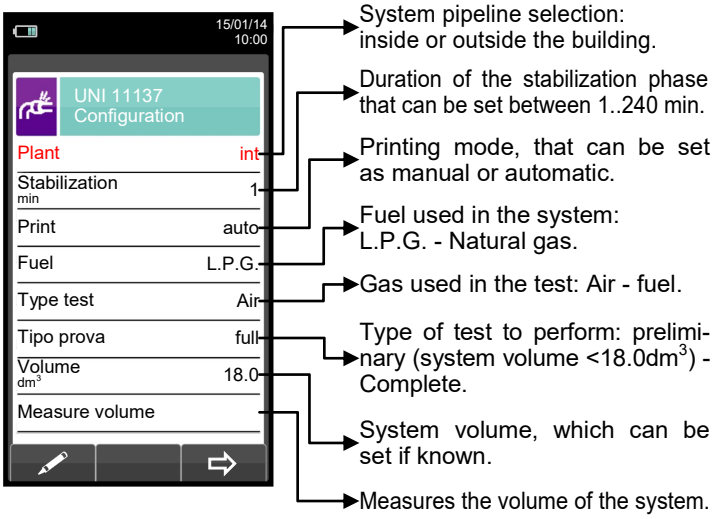
Automatically,
after 5 minutes.

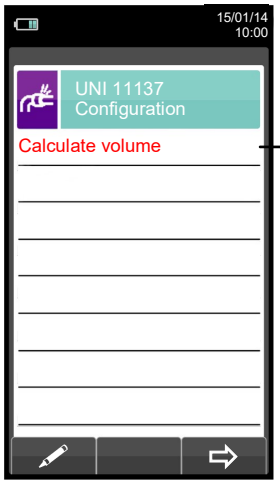
NOTE: If, while configuring the tightness test the automatic printing mode has been selected, the tightness test is printed automatically.

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:



13.9 EXISTING PIPING: UNI 11137: 2019 STANDARD
(when the instrument version so provides)





KEY	FUNCTION
	**Activate the context keys shown on the display.**
	**Selects line; the selected line is displayed 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 paper print-out.**

Details of the test:

The UNI 11137: 2019 standard is applied to the VII species operating systems, defining the leakage limits depending on the fact that the leak is located inside or outside the building

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.
If the preliminary test is performed using LPG test gas and combustible test gas, the evaluation of the leakage entity, performed through the pressure decay measurement, occurs within 2 minutes and 30 seconds.

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

CHEMIST 600 allows the user to customize the stabilization phase:

STABILISATION: the stabilization phase duration can be set in the 1 .. 99 minutes range. As the UNI 11137: 2019 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: 2019 standard requires the input of some data regarding the piping system and the test conditions, as described in the following.

SYSTEM: Performing the tightness test according to UNI 11137: 2019 requires to set the system part which it is intended to verify: Internal or External to the building.

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 tightness test performed according to the UNI 11137: 2019 standard requires to know the piping volume.

Because this data if often unavailable, CHEMIST 600 splits the test from the beginning into two different paths:

Preliminary: valid for systems with a volume under 18 dm^3 (liters), 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 600 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: 2019, is described in the following steps:

- Close both valves of the piping kit supplied for the test.
- Connect the syringe to the kit opposite to the pump.
- Press the key relative to the context key ' **OK** '.
- Open the valve on the side where the syringe is connected, take exactly 100 ml (100 cc) of the gas present in the system.

- Wait for the stabilization of the pressure of the system. After a few seconds, the device displays the measured volume. The suggested value can be accepted by pressing the key ' ESC ' and then modified by selecting, in "UNI 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 stabilization mode has been defined and the required data has been entered, you can proceed with the tightness test. By pressing the key relative to the context key ' ⇨ ', first the test pressure is indicated, as required by law, then you can access a screen which displays the pressure reading of the inputs of the device. After zeroing the device and putting the system under a pressure of at least 100 hPa, it is possible to start the tightness test by pressing the key relative to the context key ' ⇨ ', which starts the stabilization phase. In the stabilization screen, the following values are displayed:

P diff: Actual pressure measured by the instrument, in the selected measurement unit.
∆P 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.

When the stabilization phase is over, the system tightness test evaluation is performed by measuring the pressure decay in a non-editable time interval of 1 minute for each setting, except when the preliminary test with LPG and combustible gas is performed; in this case the time interval is 2 minutes and 30 seconds, as required by the 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 before the Test phase ends.

Once the test has finished, 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.
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): the plant is authorized to operate without restrictions or intervention.

Compl. 30 DD (piping temporarily suitable for operation): 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.

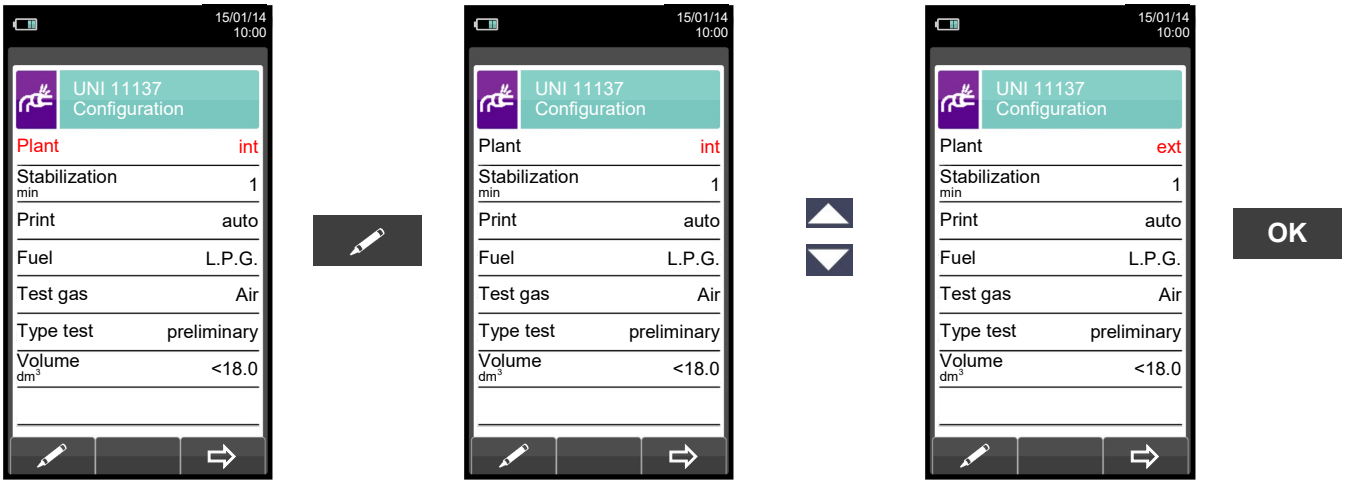
Non compliant (not suitable for operation): in this situation the measured leakage is such that the piping is not suitable for operation and must immediately placed out of order. Once the leakage problem has been fixed the piping must tested again for its tightness according to the UNI 7129 standard.

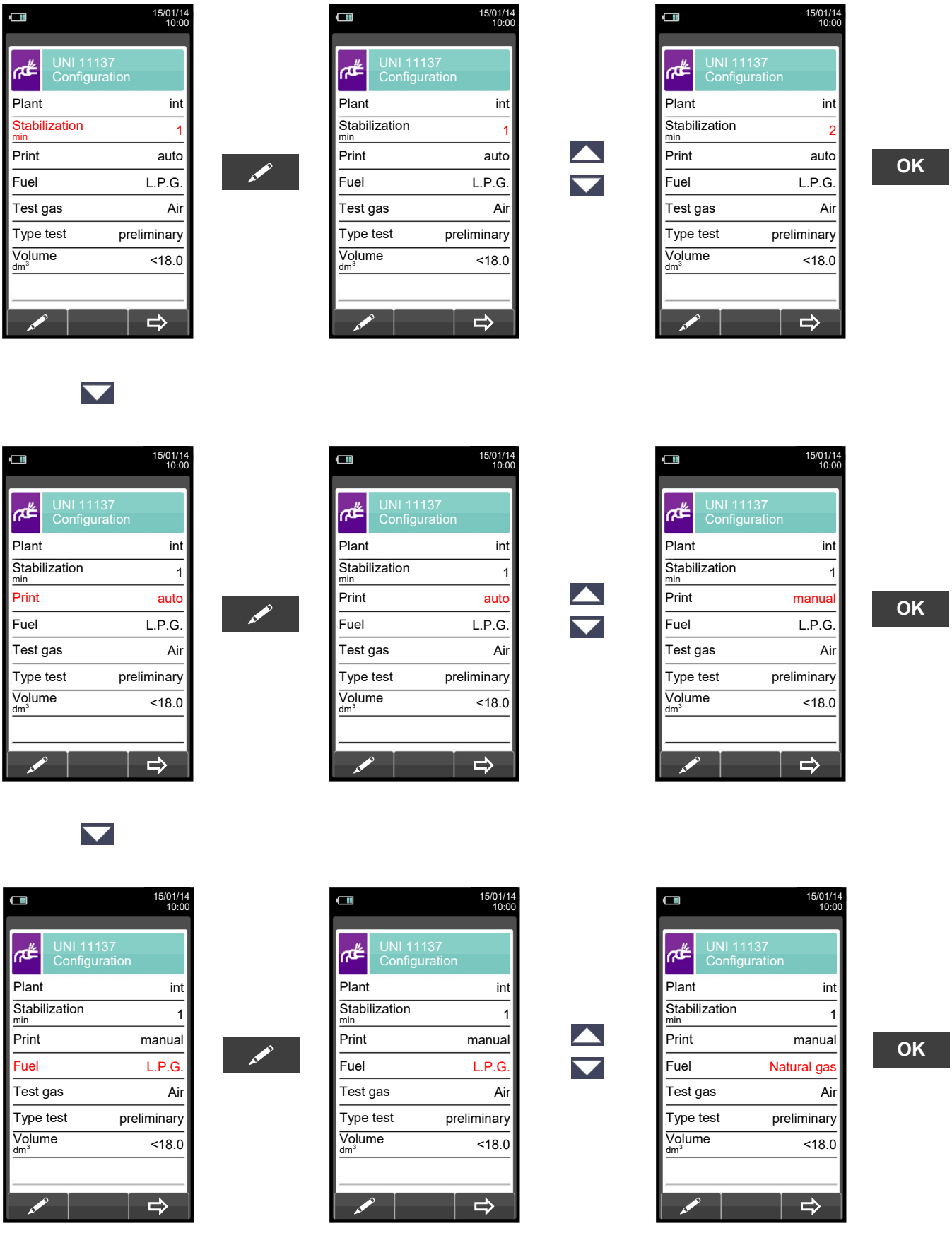
operator if the Δ pressure is higher than +3 hPa it is operator's choice if repeat the test or not because the pressure and/or temperature conditions might have changed during the test.

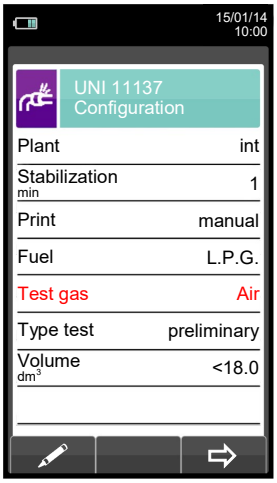
On the table below are shown the leakage limits according to standard UNI 11137: 2019:

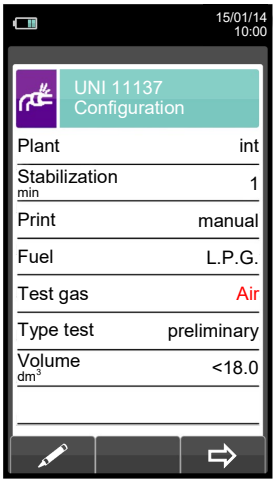
RESULT	LEAKAGE POSITION	METHANE LIMIT	LPG LIMIT
Compliant	Inside and outside of the building	Up to 1 dm^3/h	Up to 0.4 dm^3/h
Compliant 30 days	Inside the building	1 dm^3/h < Qref ≤ 5 dm^3/h	0,4 dm^3/h < Qref ≤ 2 dm^3/h
	Outside the building	1 dm^3/h < Qref ≤ 10 dm^3/h	0,4 dm^3/h < Qref ≤ 4 dm^3/h
Non compliant	Inside the building	≥5 dm^3/h	≥ 2 dm^3/h
	Outside the building	≥ 10 dm^3/h	≥ 4 dm^3/h

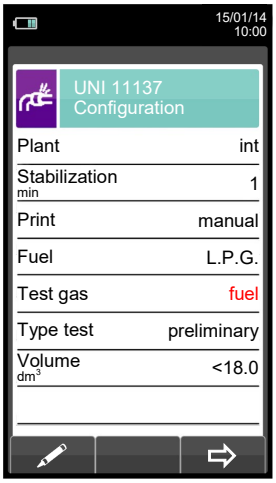
12.9.1 CONFIGURATION OF TIGHTNESS TEST ACCORDING TO UNI 11137

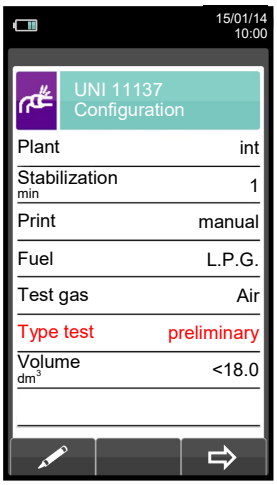



15/01/14
10:00
UNI 11137
Configuration
Plant int
Stabilization min 1
Print auto
Fuel L.P.G.
Test gas Air
Type test preliminary
Volume dm3 <18.0
OK
Stabilization min 2
Print manual
Fuel Natural gas

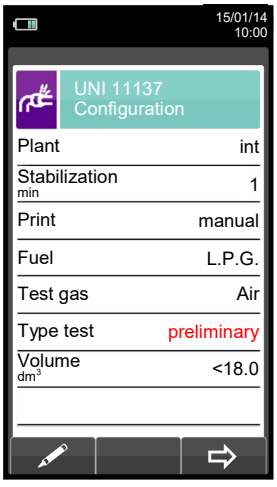


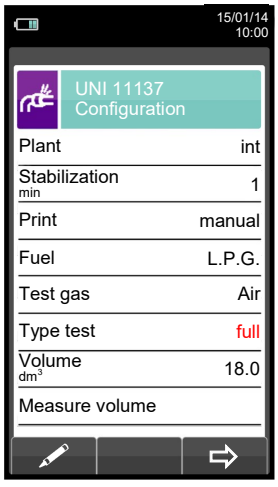


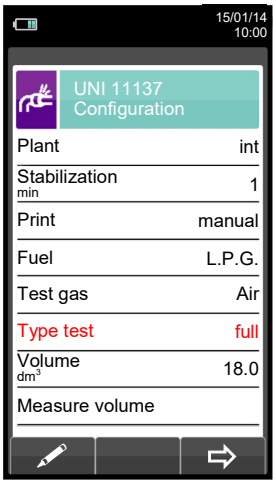


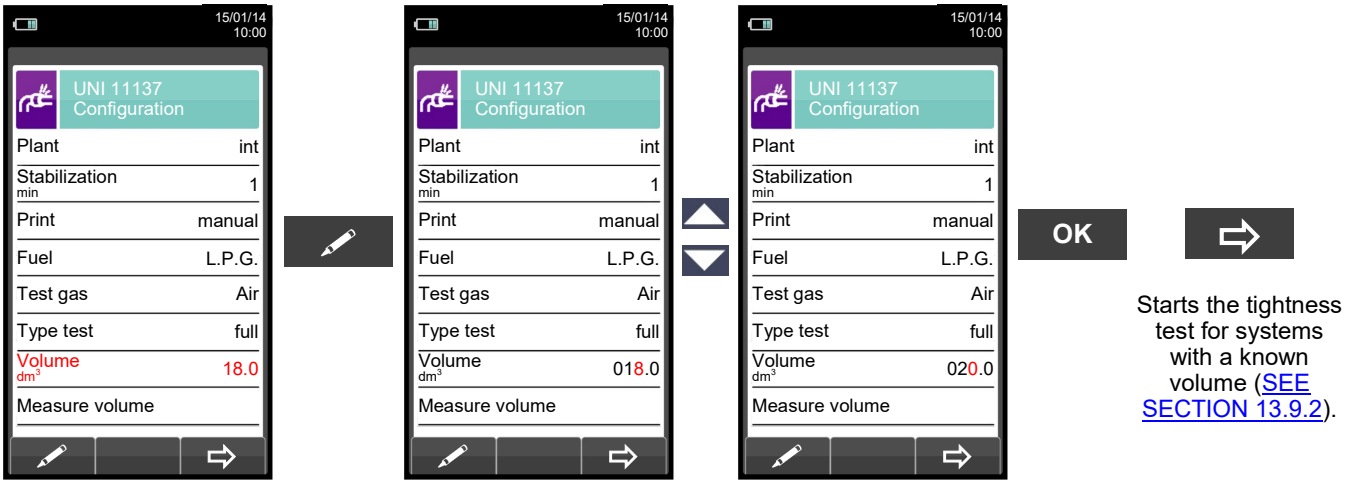


Starts the tightness test for systems up to 18 dm^3 (SEE SECTION 13.9.2).

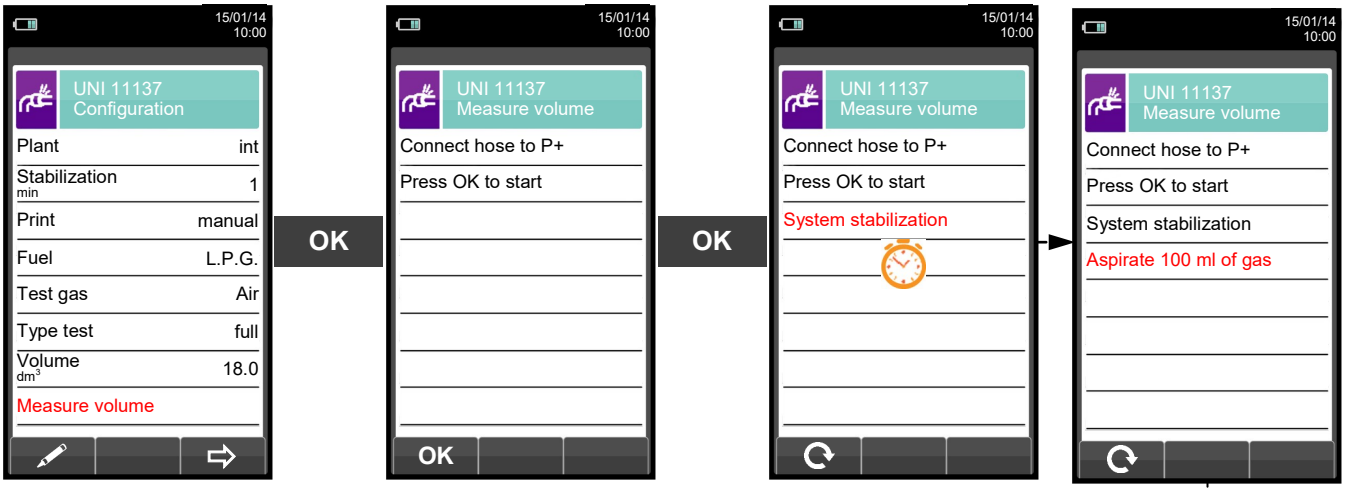






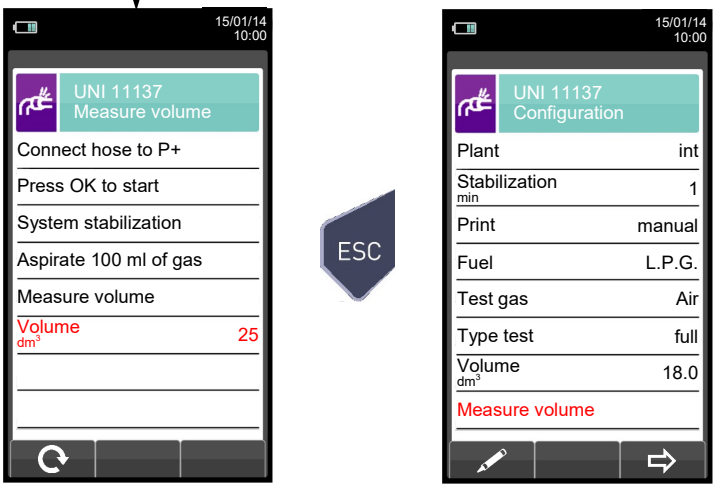


Starts the tightness test for systems with a known volume (SEE SECTION 13.9.2).

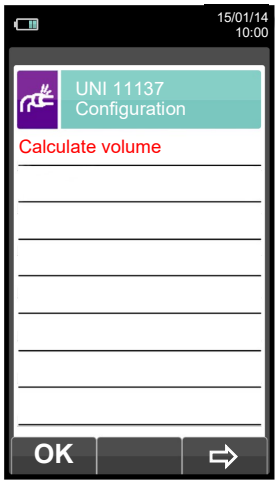


Alternatively

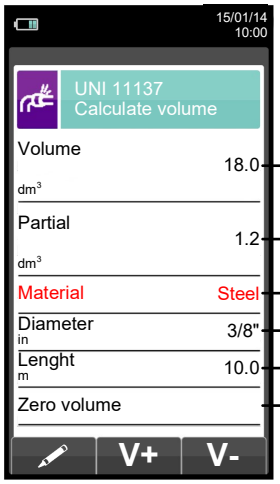
Take, with the syringe (that comes with the tightness test kit), 100 ml of gas.
If the volume measuring procedure of the system ends correctly, CHEMIST 600 automatically displays the measured volume, otherwise it requires another test.



Starts the tightness test after measuring the volume (SEE SECTION 13.9.2).



OK



→ Total volume acquired.

→ Volume of the section of piping set below.

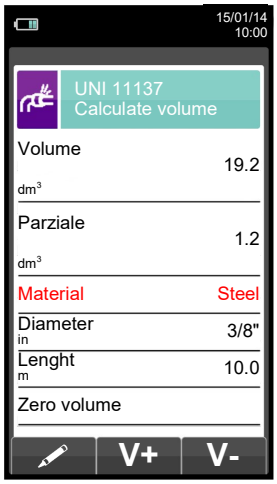
→ Sets the material of the section of piping.

→ Sets the nominal diameter of the section of piping.

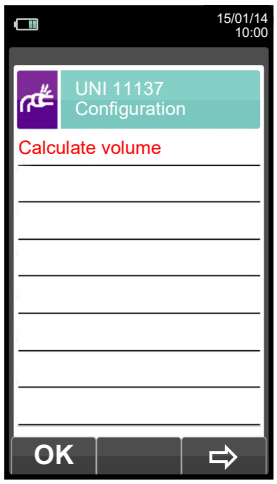
→ Sets the length of the section of piping.

→ Zeroes the volume previously acquired.

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

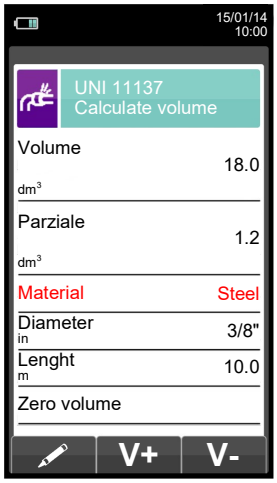


ESC

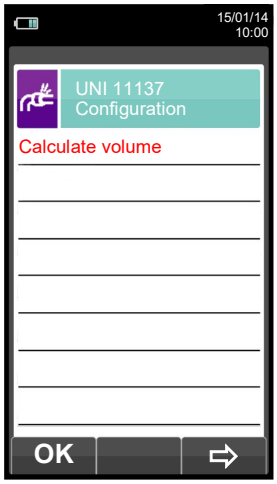


Starts the tightness test (SEE SECTION 13.9.2).

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

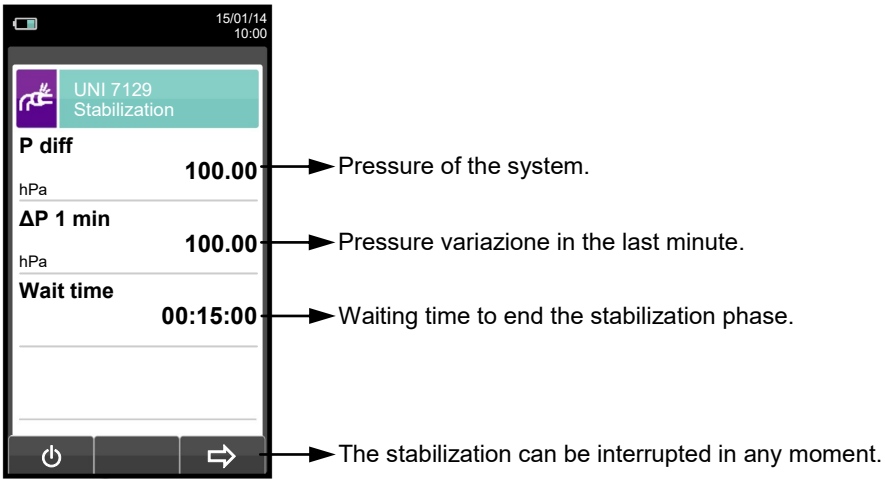


ESC

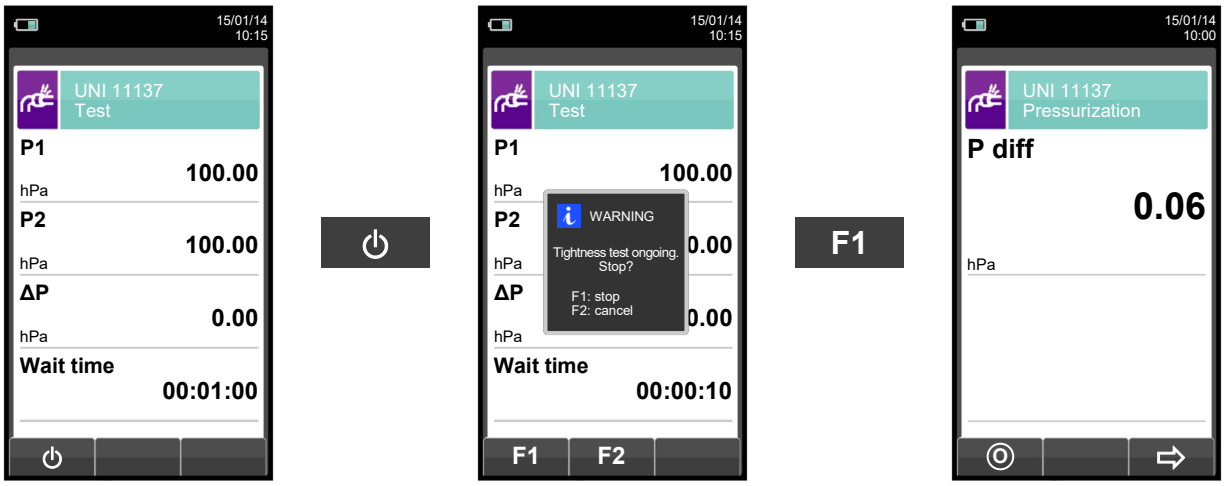


Starts the tightness test (SEE SECTION 13.9.2).

13.9.2 PERFORMING THE TIGHTNESS TEST ACCORDING TO UNI 11137



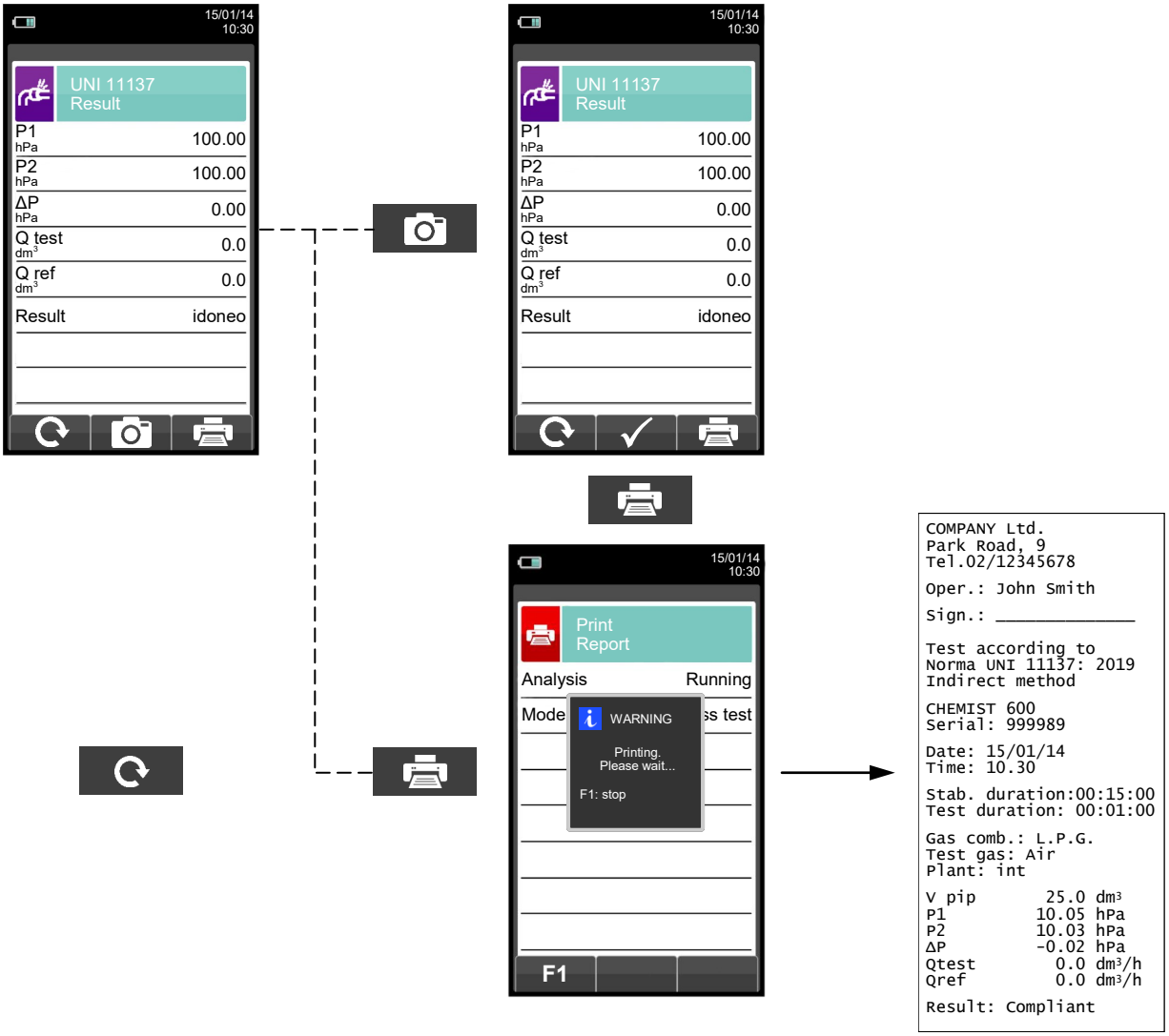
Automatically



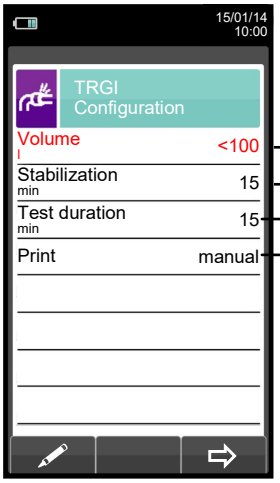
Automatically,
after 1 minute.

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:



13.10 Measurements → Tightness test TRGI → New
(when the instrument version so provides)



- Volume of the gas line <100 or 100..200 or >200 litre.
- Waiting time 15 ... 240 minutes.
- Duration time of test 15 ... 240 minutes.
- Print out test of the result (manual or automatic).

KEY	FUNCTION
	**Activates the context keys shown on the display.**
	**Select line; the selected line is displayed 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.**
	**Performs pressure zeroing.**
	**Interrupts the current phase.**
	**Repeats the tightness test.**
	**Saves, in the memory selected in the "Select Memory" menu, the data acquired.**
	**Tightness test has been saved.**
	**Starts printing the paper print-out.**

Details of the test:

With the flue gas analyzer CHEMIST 600 (according to the model) it is possible 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).

Minimum 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 following 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: Current measured pressure.
∆**P**: Pressure difference between start and finished test; negative value means pressure drop.

Result: **tight or leak.**

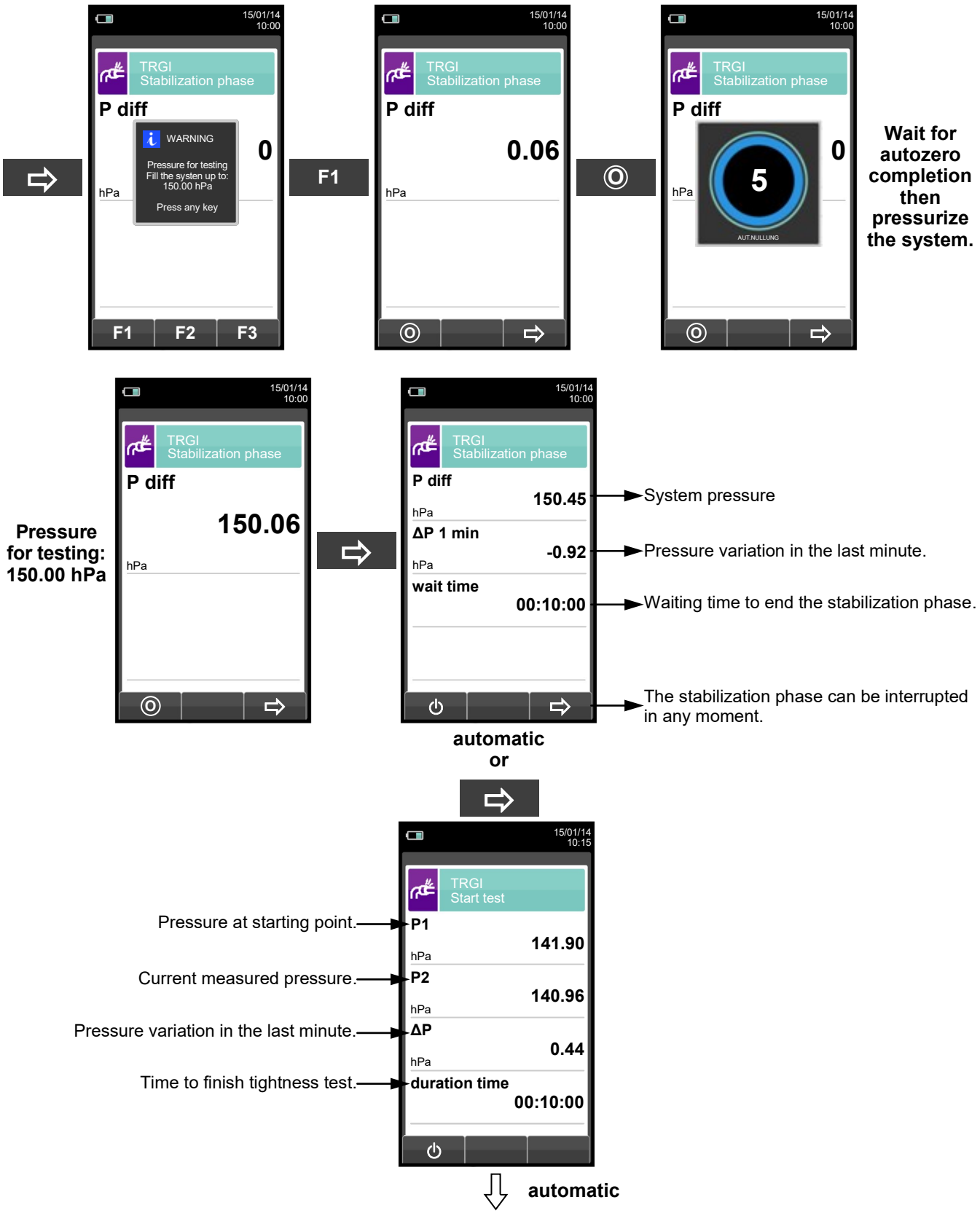
According to DVGW TRGI 2008 - no pressure drop is allowed!

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.

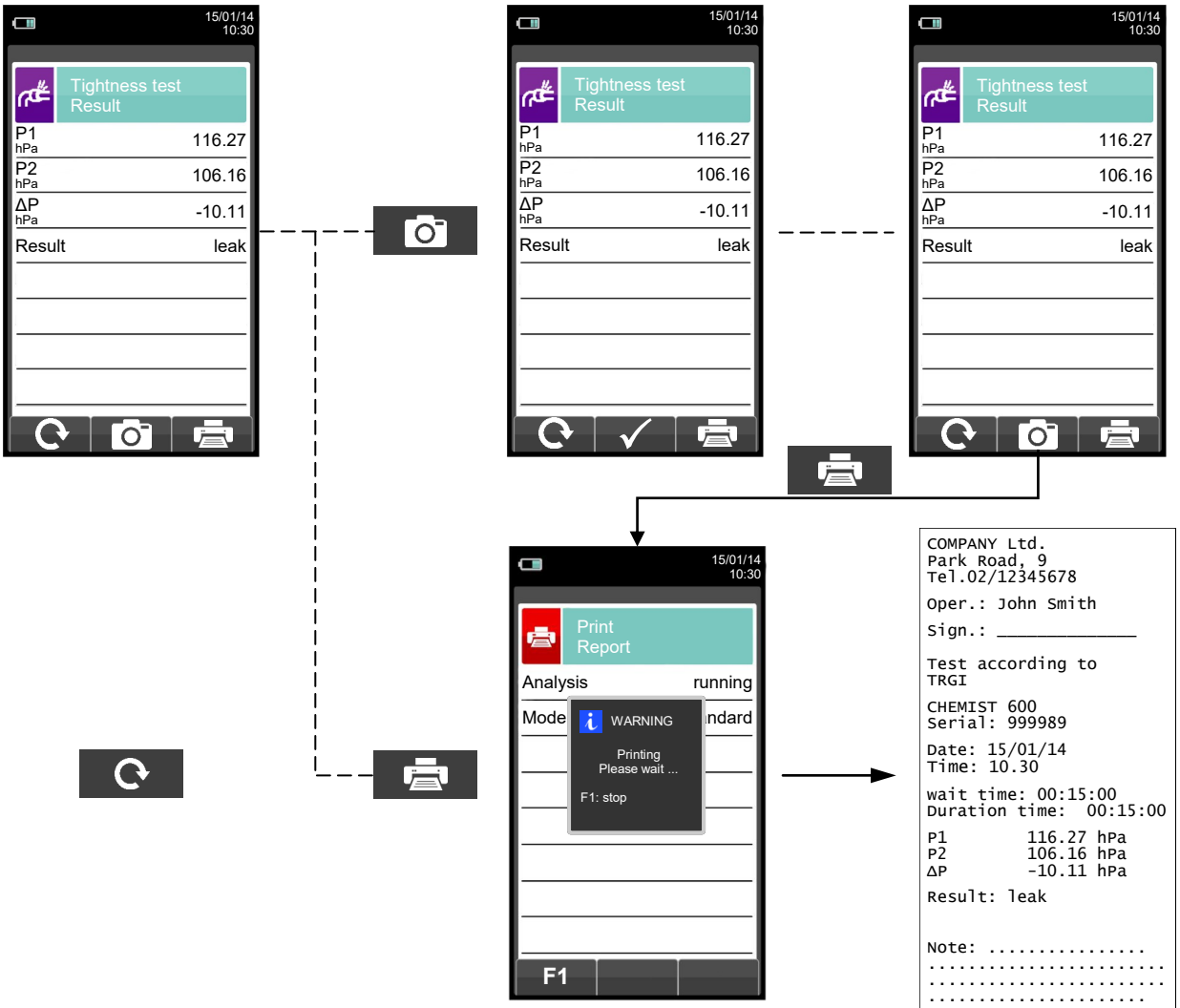
The loading and the serviceability test can not be tested with the flue gas analyser CHEMIST 600, you have to use other measuring devices.

13.10.1 Performing a tightness test for a gas line up to 100 litres.



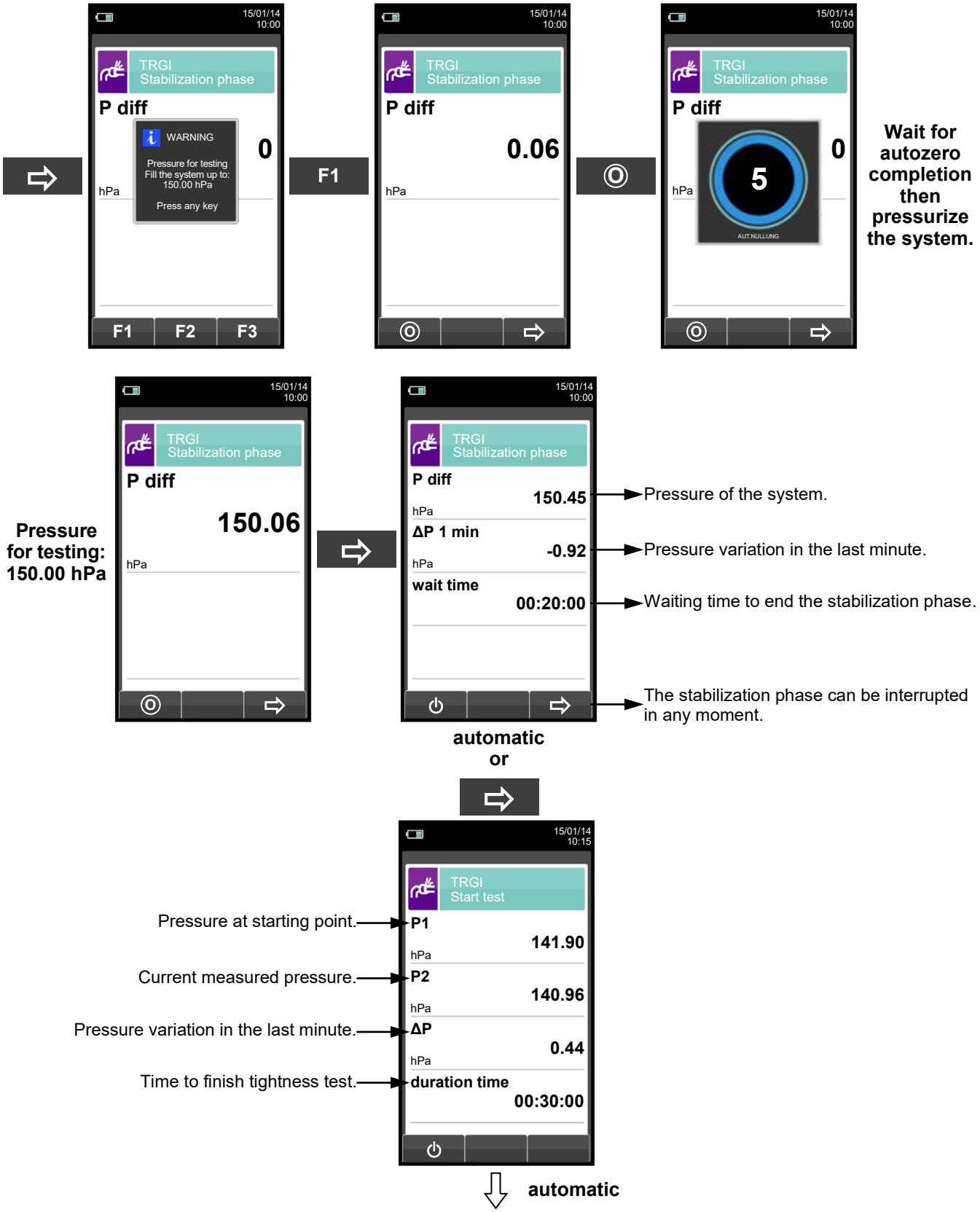
NOTE: If, while configuring the tightness test the automatic printing mode has been selected, the tightness test is printed automatically.

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
WARNING
Printing
Please wait ...
F1: stop
F1
COMPANY Ltd.
Park Road, 9
Tel.02/12345678
Oper.: John Smith
Sign.: _____
Test according to
TRGI
CHEMIST 600
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: .....

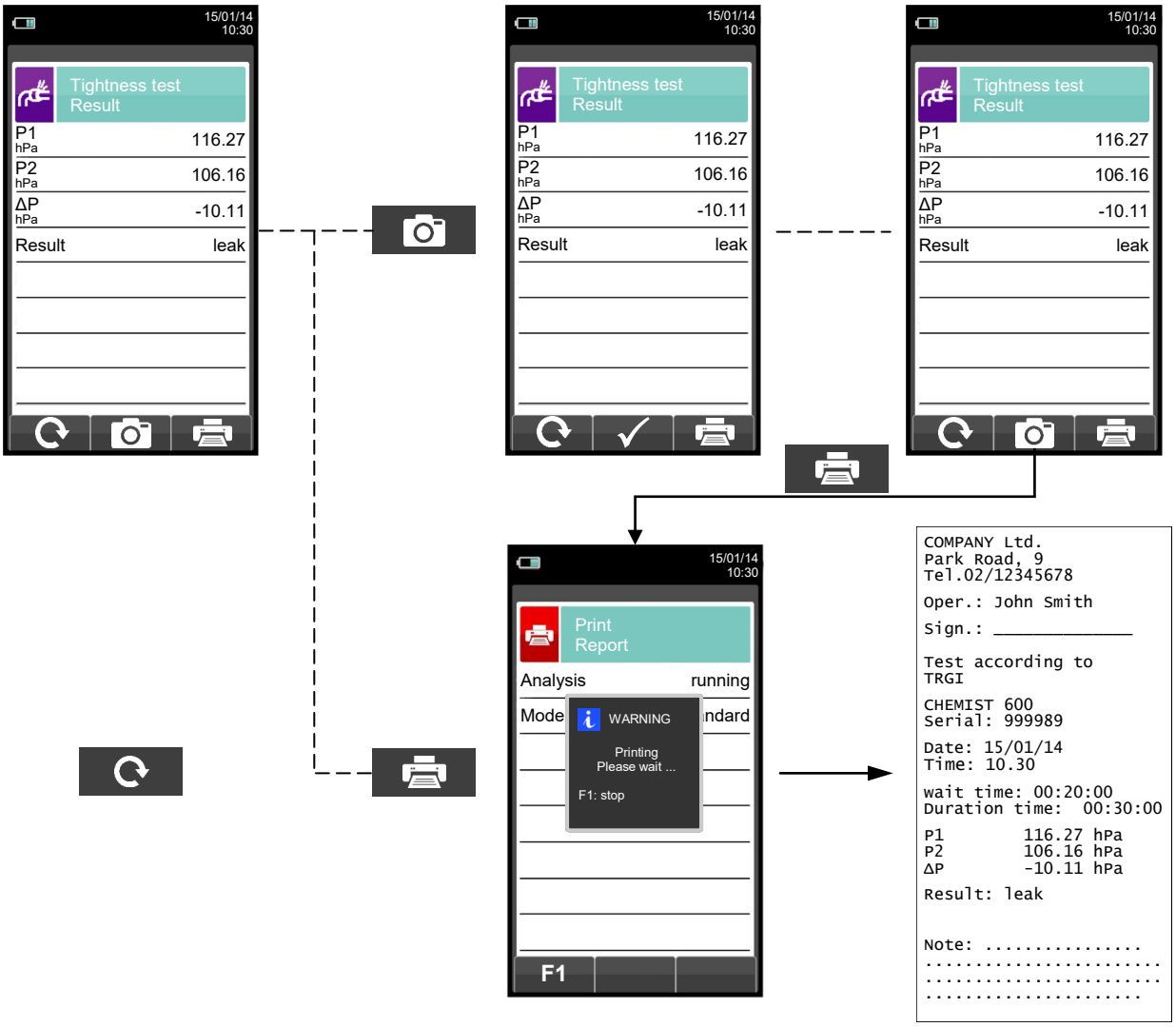

15/01/14
10:00
TRGI
Stabilization phase
P diff
0.06
hPa

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



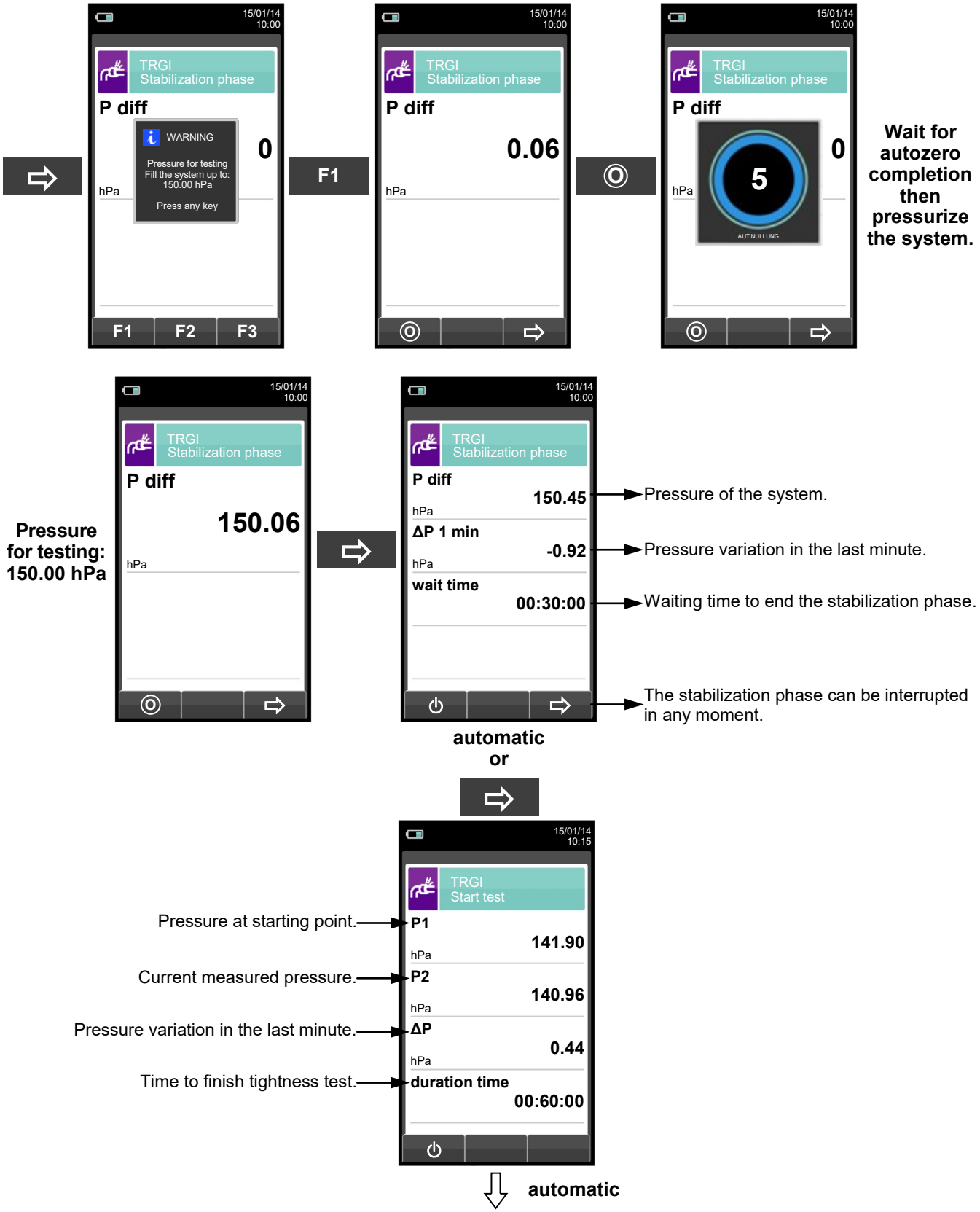
NOTE: If, while configuring the tightness test the automatic printing mode has been selected, the tightness test is printed automatically.

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


15/01/14
10:30
Tightness test
Result
P1
hPa
116.27
P2
hPa
106.16
ΔP
hPa
-10.11
Result
leak
Print
Report
Analysis
running
Mode
WARNING
Printing
Please wait ...
F1: stop
F1
COMPANY Ltd.
Park Road, 9
Tel.02/12345678
Oper.: John Smith
Sign.: _____
Test according to
TRGI
CHEMIST 600
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

13.10.3 Performing a tightness test for a gas line with volume greater 200 litres.



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
WARNING
Printing
Please wait ...
F1: stop
F1
COMPANY Ltd.
Park Road, 9
Tel.02/12345678
Oper.: John Smith
Sign.: _____
Test according to
TRGI
CHEMIST 600
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

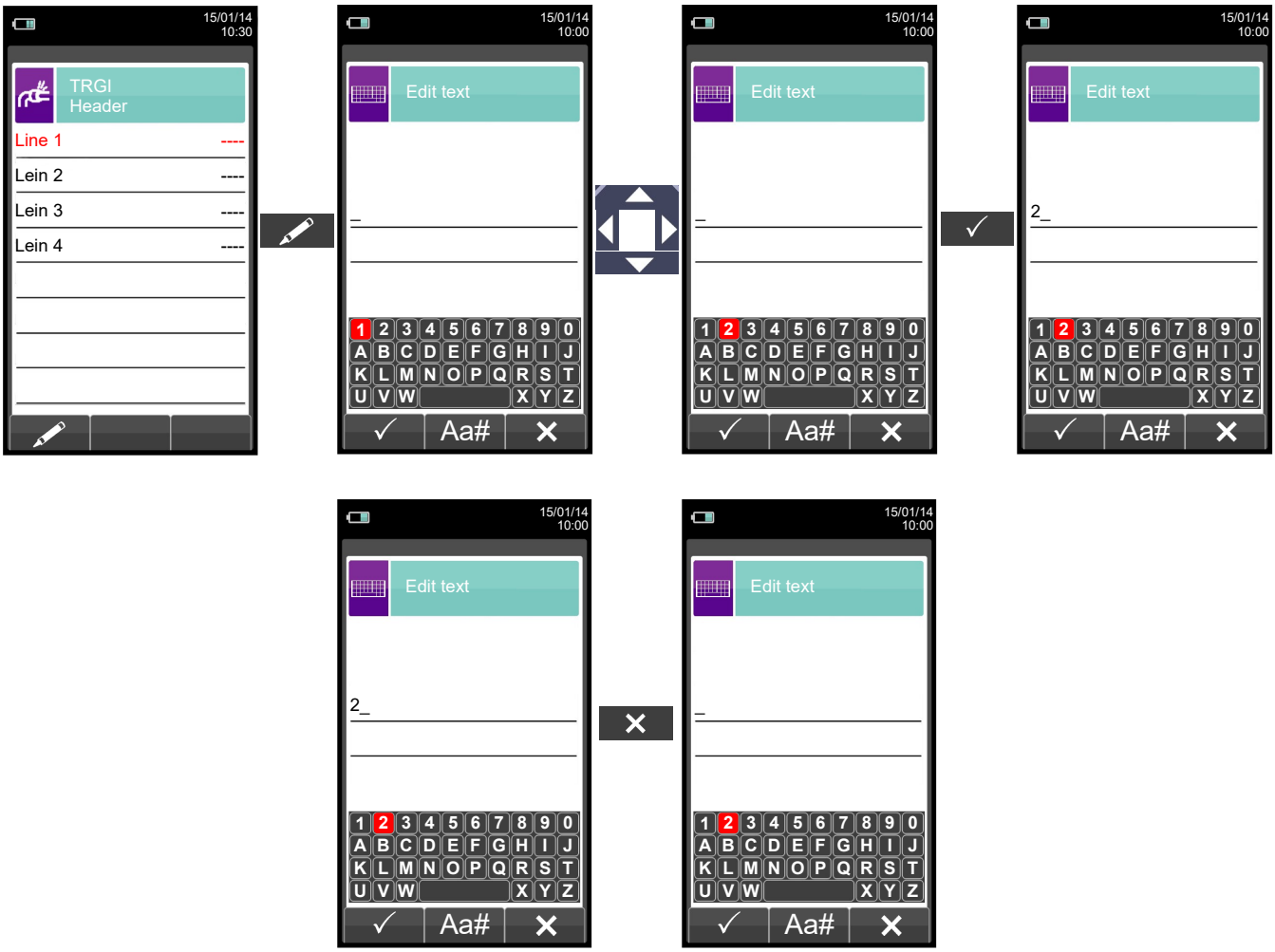
13.11 Measurements → Tightness test → Header

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

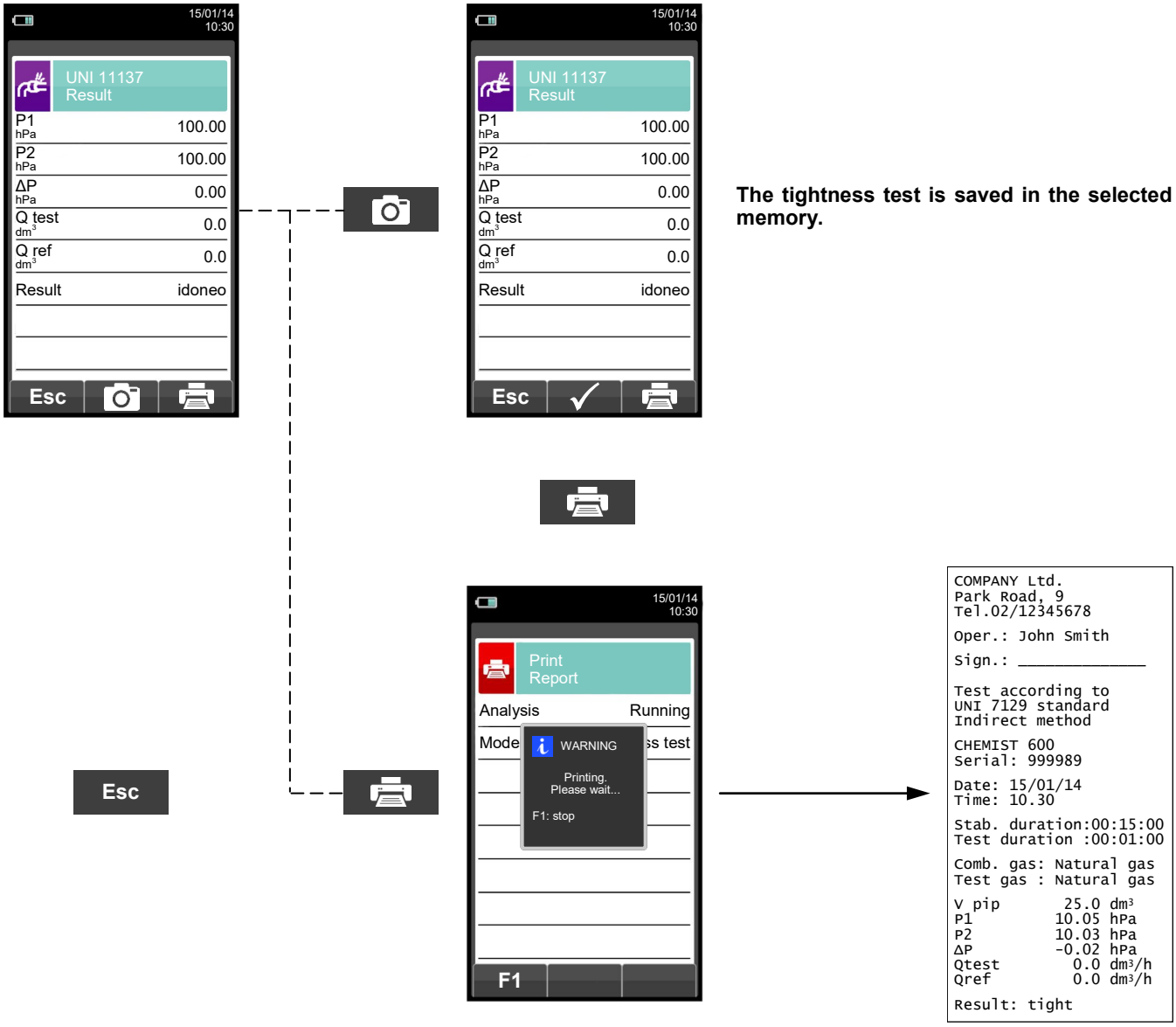
CONTEXT KEY	FUNCTION
	**Enters edit mode of the selected line: it is possible to enter the name of the operator (24 characters available).**
	**Confirms the selected letter or digit.**
	**Cancels the letter or digit before the cursor.**
	**Cycles through uppercase, lowercase, symbols and special characters.**

Example:

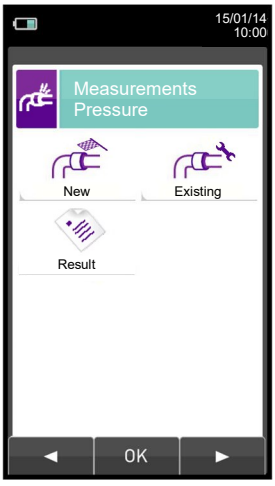
1. Edit text



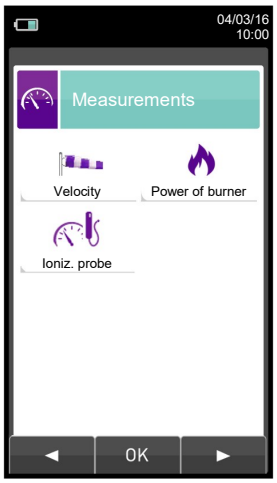
13.12 RESULTS OF THE TIGHTNESS TEST (example)



The tightness test is saved in the selected memory.



13.13 Measurements→AUX measurements

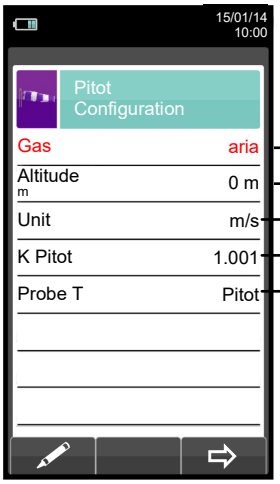


KEY	FUNCTION
	**Activate the context keys shown on the display.**
	**Returns to the previous screen.**

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

PARAMETER	DESCRIPTION
Velocity	When a Pitot tube and a Tc-K thermocouple are connected, the instrument is capable to measure at the same time both temperature and velocity of a gas (air/flue gas). **SEE SECTION 13.14.**
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. **SEE SECTION 13.15.**
Ioniz. probe	You can measure the ionization current of a boiler and test its value based on the technical features of the boiler by connecting the ionization probe (optional) to the serial port (See section 8.4 and/or section 8.4.8). **SEE SECTION 13.16.**

13.14 Measurements→Velocity



→ Measurement: air or flue gas.
→ Altitude above sea level.
→ Measurement unit selectable across m/s, km/h, fpm, mph.
→ Insert the K-factor of the Pitot tube stated by the tube manufacturer.
→ Temperature acquisition mode:
Pitot (with Tc-K thermocouple) or Flue gas probe (or external Tc-K thermocuple).

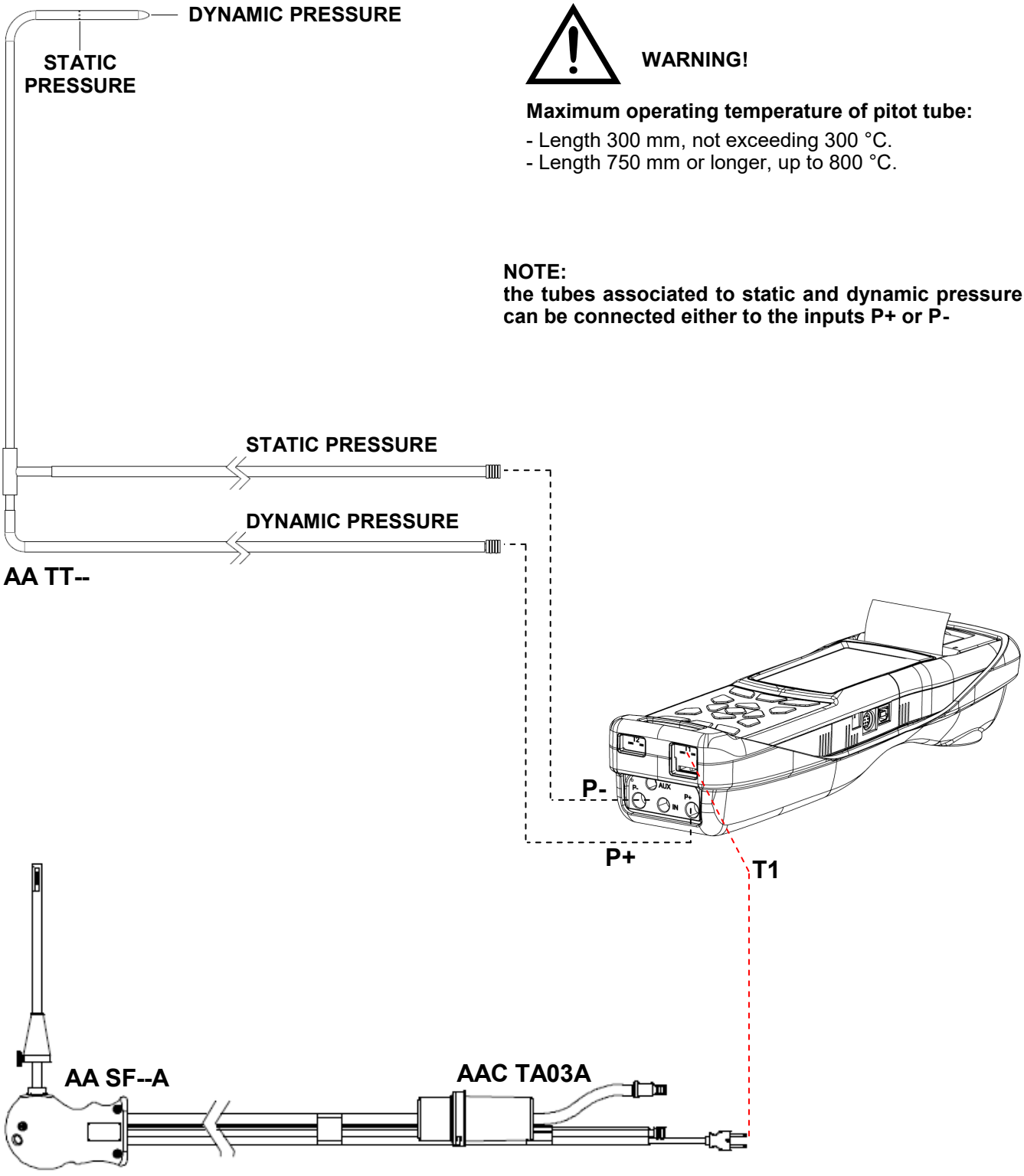
KEY	FUNCTION
	**Activate the context keys shown on the display.**
 	**Selects line; the selected line is displayed in red.** **In edit mode, it sets the desired value.**
	**Activates the context key located in the left side of the display.**
	**Returns to the previous screen.** **When in modify mode 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 paper print-out. SEE SECTION 12.**

13.14.1 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.



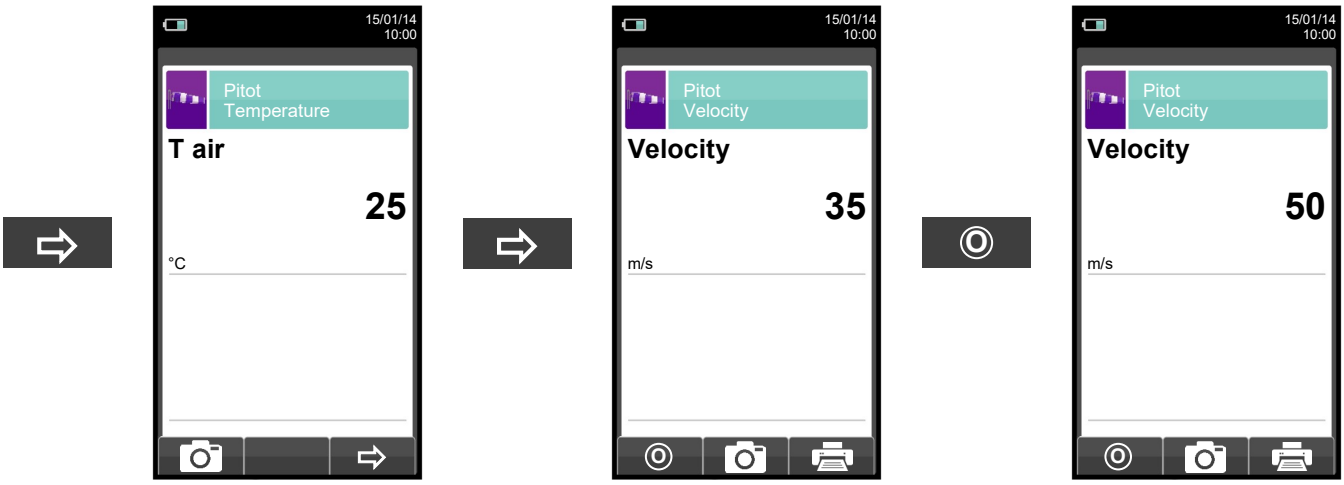
WARNING!

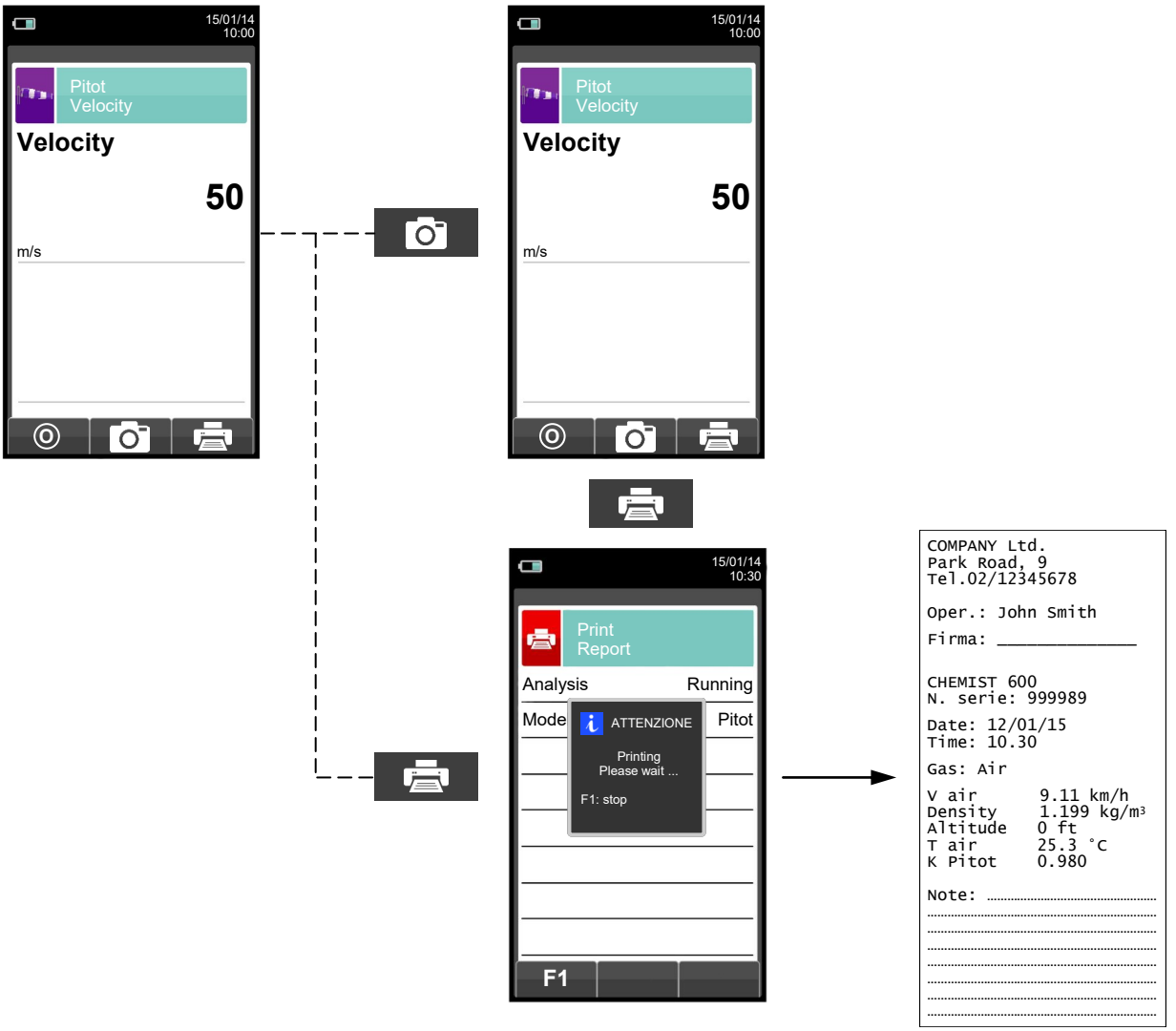
Maximum operating temperature of pitot tube:

- Length 300 mm, not exceeding 300 °C.
- Length 750 mm or longer, up to 800 °C.

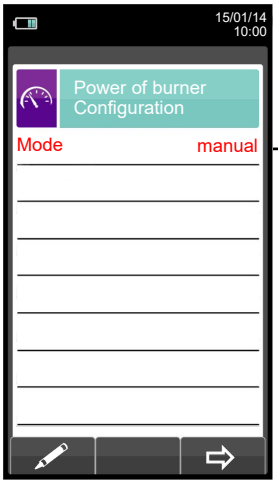
NOTE:
the tubes associated to static and dynamic pressure can be connected either to the inputs P+ or P-

13.14.2 TEST EXECUTION

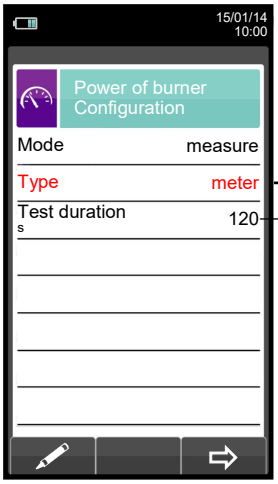




13.15 Measurements→Power of burner



Enter the thermal power value calculated manually by the operator.



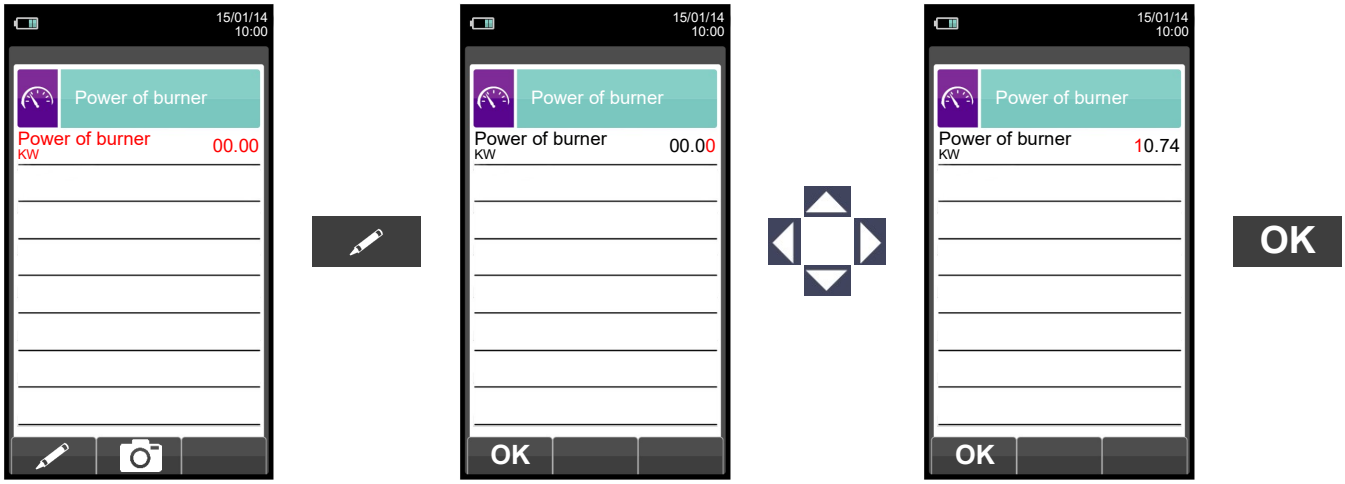
Test mode: you can choose to calculate the thermal power by entering a flow value, or by reading the volumetric counter (gaseous fuels only).

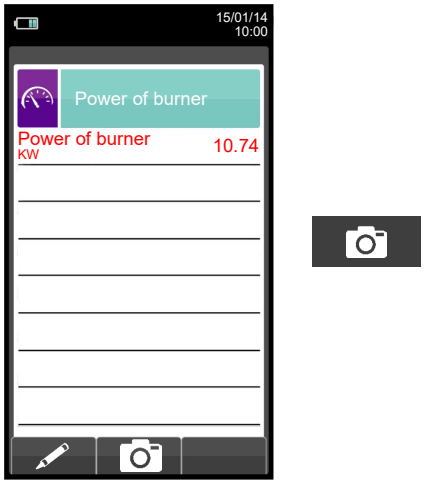
Duration of test: the option is displayed only for the test mode 'COUNTER', available for gaseous fuels. It is possible to enter the number of seconds between the reading of the initial and final gas volume. The minimum time required by law is 120 s.

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

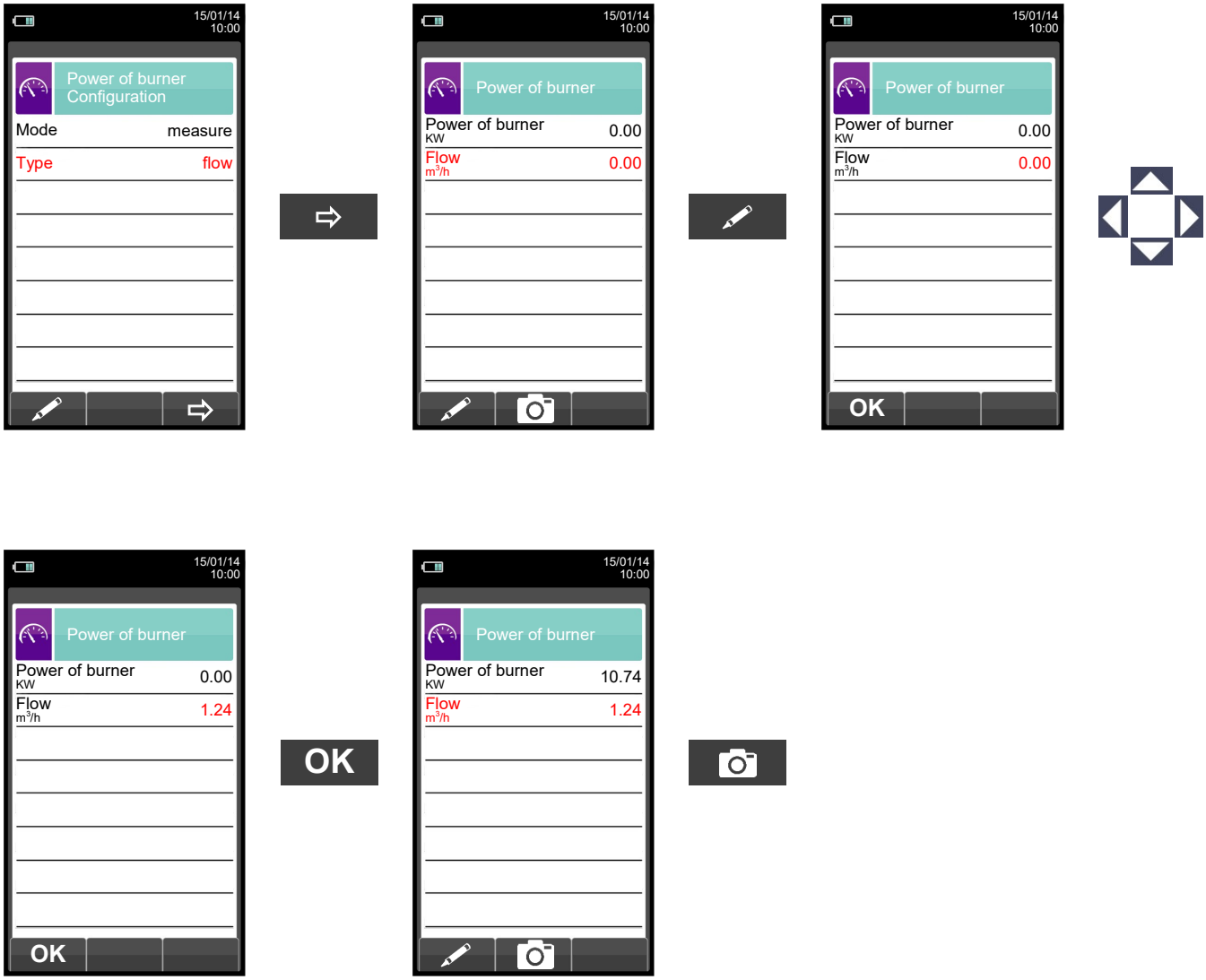
CONTEXT KEY	FUNCTION
	**Enters the modification mode for the selected parameter.**
	**Confirms the settings.**
	**Go to next step.**
	**Saves, in the memory selected in the "Memory Select" menu, the value of the draft measured.**
	**Stops the test.**

13.15.1 TESTING IN 'MANUAL' MODE

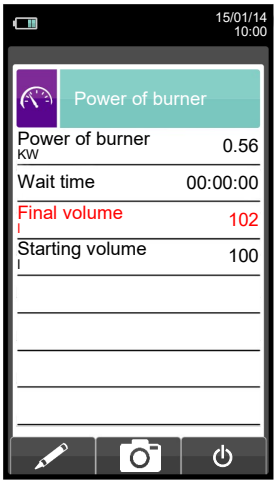




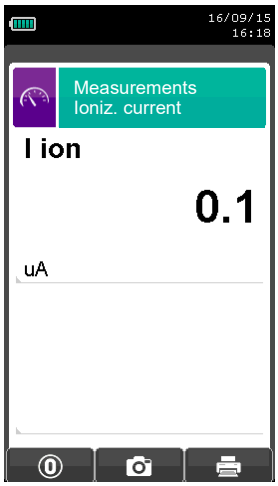
13.15.2 TESTING IN 'MEASURE' MODE (based on Flow rate)



13.15.3 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

13.16 Measurements→Ionization current



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
	Performs current zeroing.
	Saves the acquired current value in the memory selected in the "Select Memory" menu.
	Starts printing the paper print-out. SEE SECTION 12.

14.0 FLUE GAS ANALYSIS

14.1 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.

14.1.1 Switching on the instrument and auto-calibration

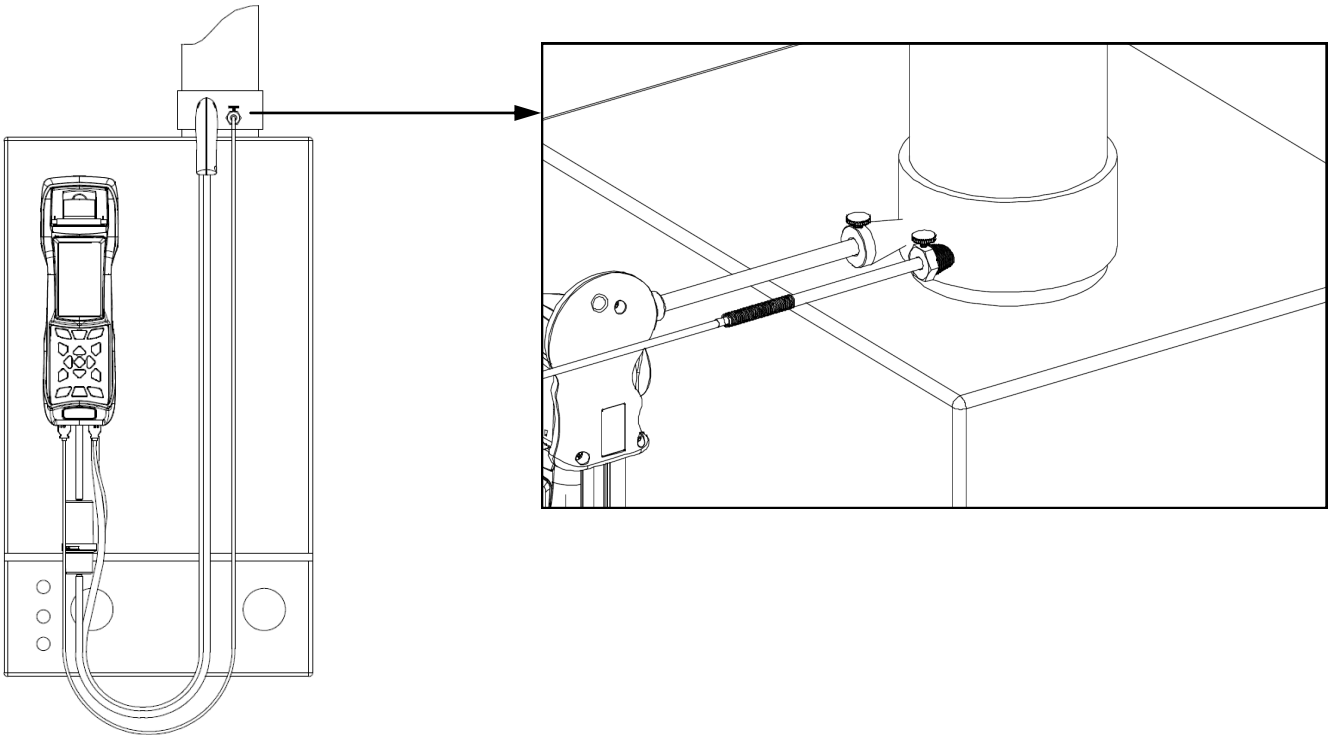
Press the On/Off key to switch on the instrument - an introductory screen will appear. After a couple of moments the instrument will zero itself.

DURING INSTRUMENT AUTOZERO, THE SAMPLING PROBE MUST NOT BE INSERTED IN THE CHIMNEY.

IT IS IMPORTANT THAT THE SAMPLE PROBE IS NOT INSIDE THE CHIMNEY SINCE DURING AUTOZERO PROCESS THE INSTRUMENT DRAWS FRESH AIR FROM THE ENVIRONMENT AND DETECTS THE ZERO VALUE OF SENSORS (O_2, CO, NO, ..) THE DETAILS OF WHICH ARE THEN SAVED AND USED FOR REFERENCE DURING THE ANALYSIS. IT IS EQUALLY IMPORTANT THAT THIS PHASE IS PERFORMED IN A FRESH-AIR ENVIRONMENT.

14.1.2 Inserting the probe inside the stack

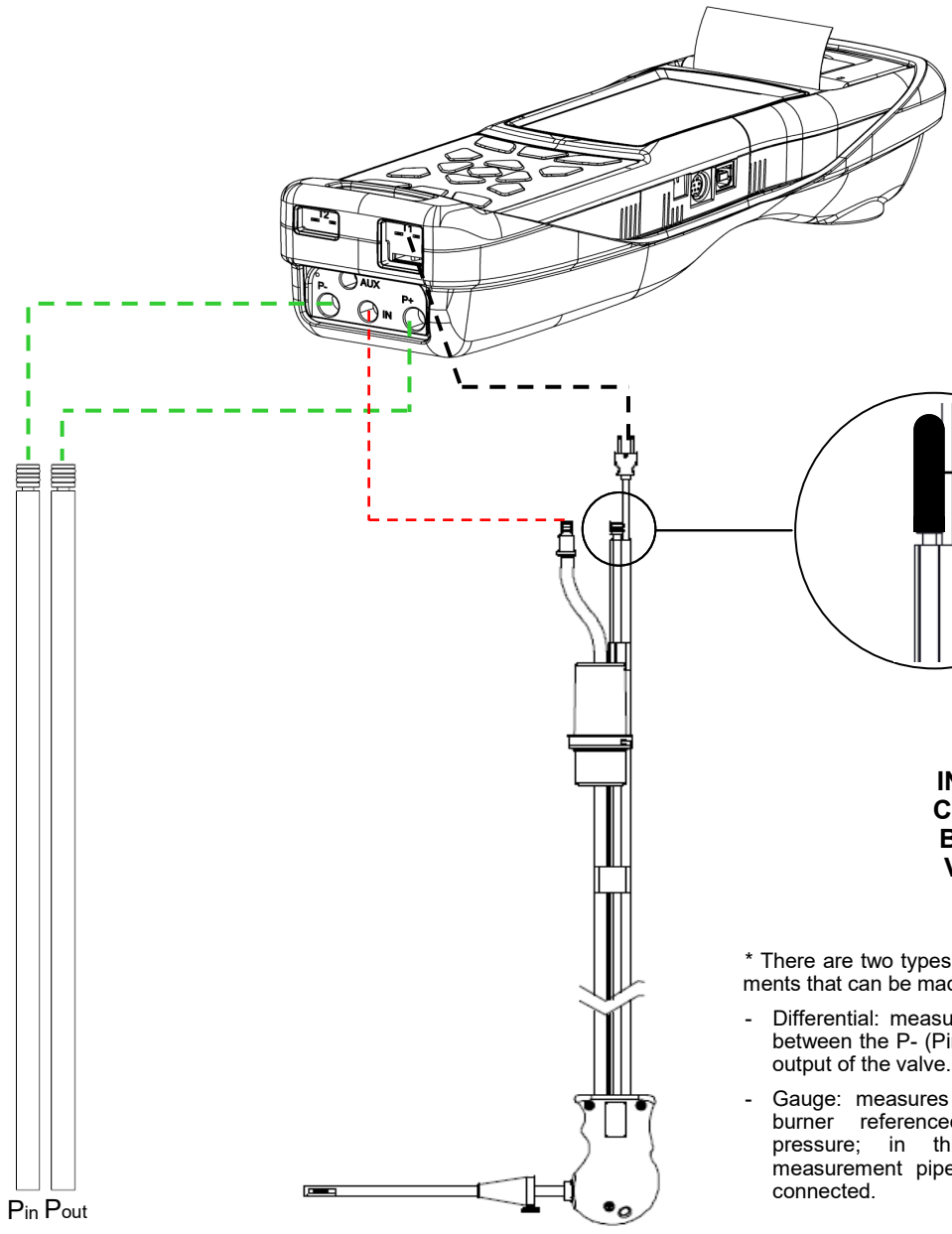
When auto-calibration is complete the instrument will instruct the user to insert in the chimney the sample probe that has been previously connected to the relative input on the instrument, and the analysis screen will appear automatically.



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.

14.1.3 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.

14.1.4 Flue Gas Analysis

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

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

If, on the other hand, manual analysis mode is chosen, flue gas analysis will proceed manually (please see relative Flow Chart). In this case the print settings and automatic test duration will not be considered.
At this point manual analysis may commence, first waiting at least two minutes until the displayed values stabilize: The user can then proceed with data storage, if required, or print the analysis report directly.
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 gas sampling pump and blocks the refresh of any current measure.
To switch on the gas sampling 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 normalized values (with reference to the concentration of O_2 previously set).

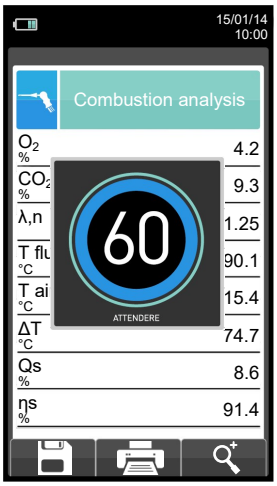
14.1.5 End of Analysis

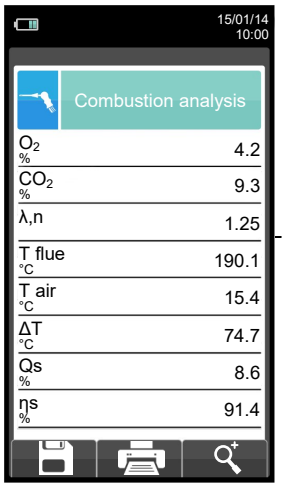
At the end of the combustion analysis, carefully remove the sample probe and remote air temperature probe, if used, from their relative stacks, taking care not to get burnt. It is recommended to purge the analyzer with clean fresh air for at least 5 to 10 minutes before turning off the instrument by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

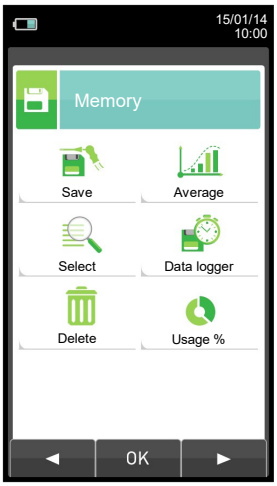
14.2 FLUE GAS ANALYSIS - PRELIMINARY OPERATIONS

DO NOT INSERT THE GAS SAMPLE PROBE IN THE CHIMNEY.

Hold down for a few seconds

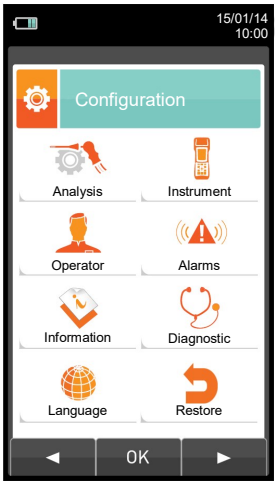






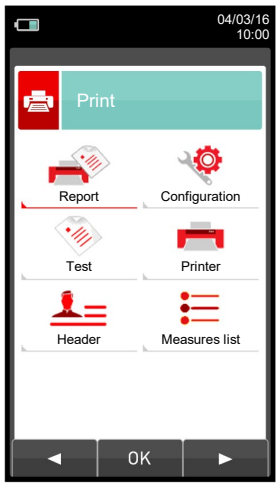
PARAMETERS TO SET BEFORE PROCEEDING (SEE SECTION 11.0):

Select
Data logger



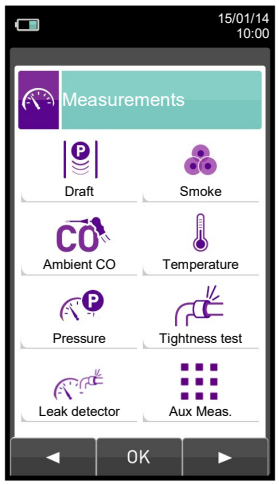
PARAMETERS TO SET BEFORE PROCEEDING (SEE SECTION 10.0):

Analysis
Operator



PARAMETERS TO SET BEFORE PROCEEDING (SEE SECTION 12.0):

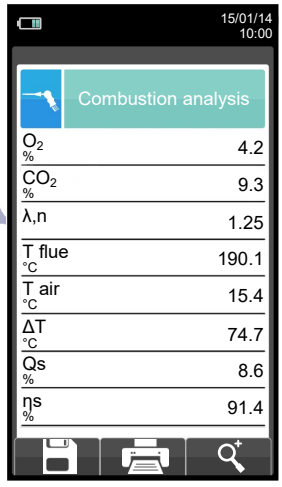
Configuration
Header
Measures list



ACQUIRE THE FOLLOWING MEASUREMENTS BEFORE PROCEEDING WITH THE COMBUSTION ANALYSIS (SE SECTION 13.0):

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

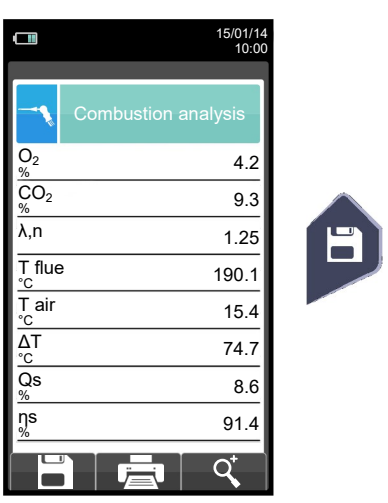
Draft
Smoke
Ambient CO
Temperature
Pressure



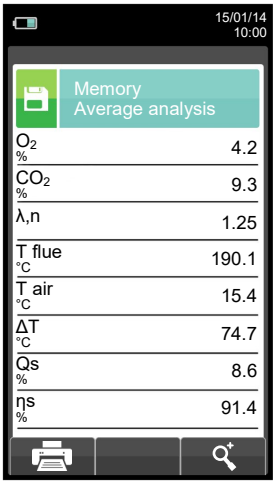
PRESS THE KEY ' ':
It starts saving the current analysis according to the set mode.
- **Manual** See section 14.3
- **UNI 10389** See section 14.4
- **BImSchV** See section 14.5
- **data logger** See section 14.6

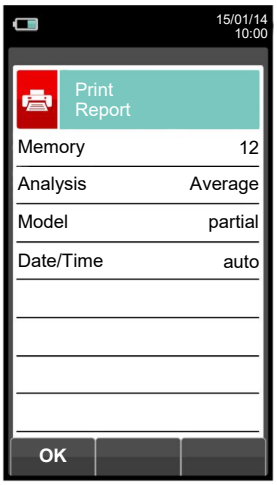
PRESS THE KEY ' ':
It starts the printing on paper print-out of the current analysis; additional measurements are also printed, if they are present in the memory.

14.3 PERFORMING COMBUSTION ANALYSIS - MANUAL MODE

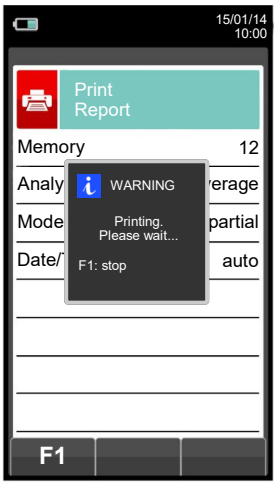


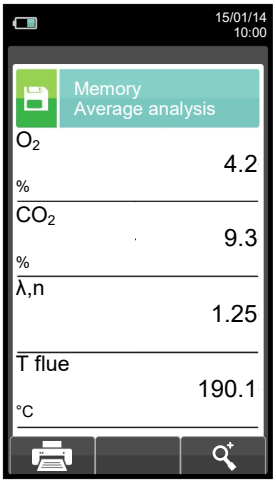
Recalls the average analysis.

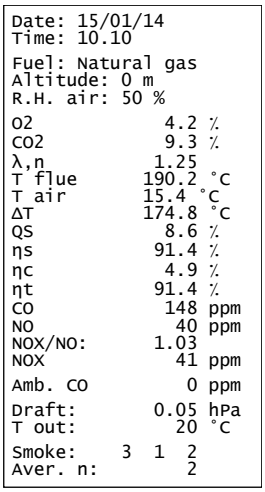

15/01/14
10:00
Memory
Average analysis
O2 % 4.2
CO2 % 9.3
λ,n 1.25
T flue °C 190.1
T air °C 15.4
ΔT °C 74.7
Qs % 8.6
ηs % 91.4

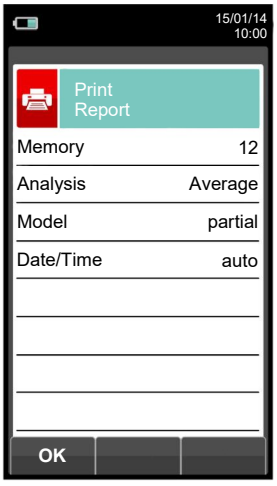

15/01/14
10:00
Print
Report
Memory 12
Analysis Average
Model partial
Date/Time auto
OK

OK

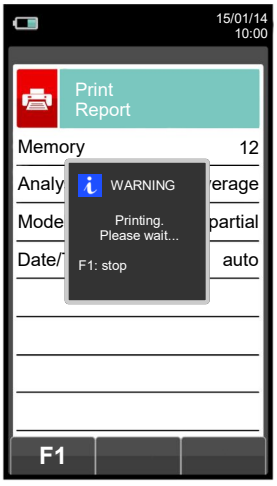

15/01/14
10:00
Print
Report
Memory 12
WARNING
Printing.
Please wait...
F1: stop
F1


15/01/14
10:00
Memory
Average analysis
O2 % 4.2
CO2 % 9.3
λ,n 1.25
T flue °C 190.1

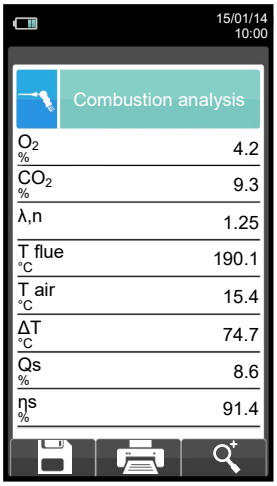

Date: 15/01/14
Time: 10.10
Fuel: Natural gas
Altitude: 0 m
R.H. air: 50 %
O2 4.2 %
CO2 9.3 %
λ,n 1.25
T flue 190.2 °C
T air 15.4 °C
ΔT 174.8 °C
QS 8.6 %
ηs 91.4 %
ηc 4.9 %
ηt 91.4 %
CO 148 ppm
NO 40 ppm
NOX/NO: 1.03
NOX 41 ppm
Amb. CO 0 ppm
Draft: 0.05 hPa
T out: 20 °C
Smoke: 3 1 2
Aver. n: 2

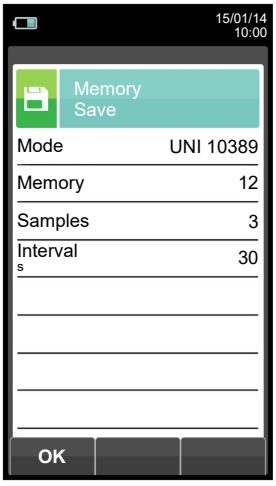

15/01/14
10:00
Print
Report
Memory 12
Analysis Average
Model partial
Date/Time auto
OK

OK

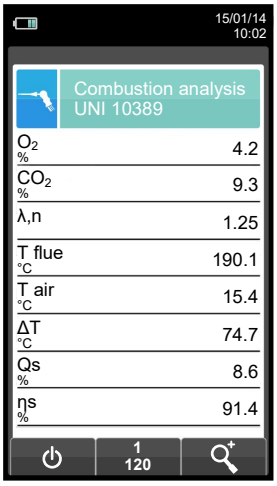

15/01/14
10:00
Print
Report
Memory 12
WARNING
Printing.
Please wait...
F1: stop
F1

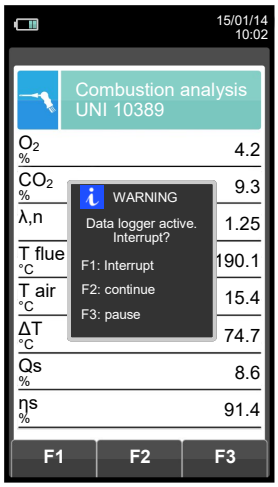
14.4 PERFORMING THE COMBUSTION ANALYSIS- UNI 10389 MODE



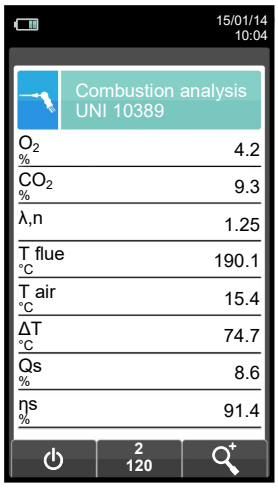


OK

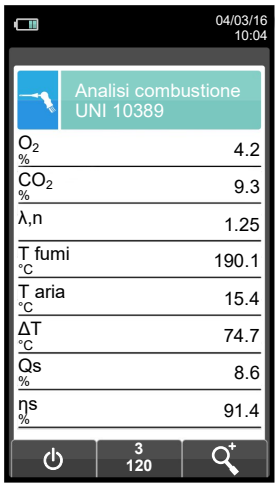




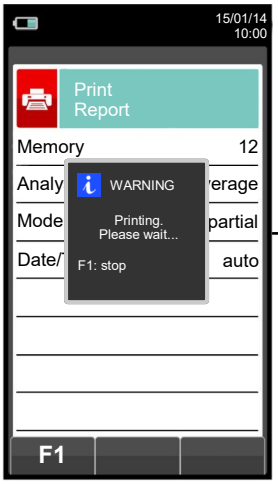
Automatically saves the first sample when the set time is over.



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



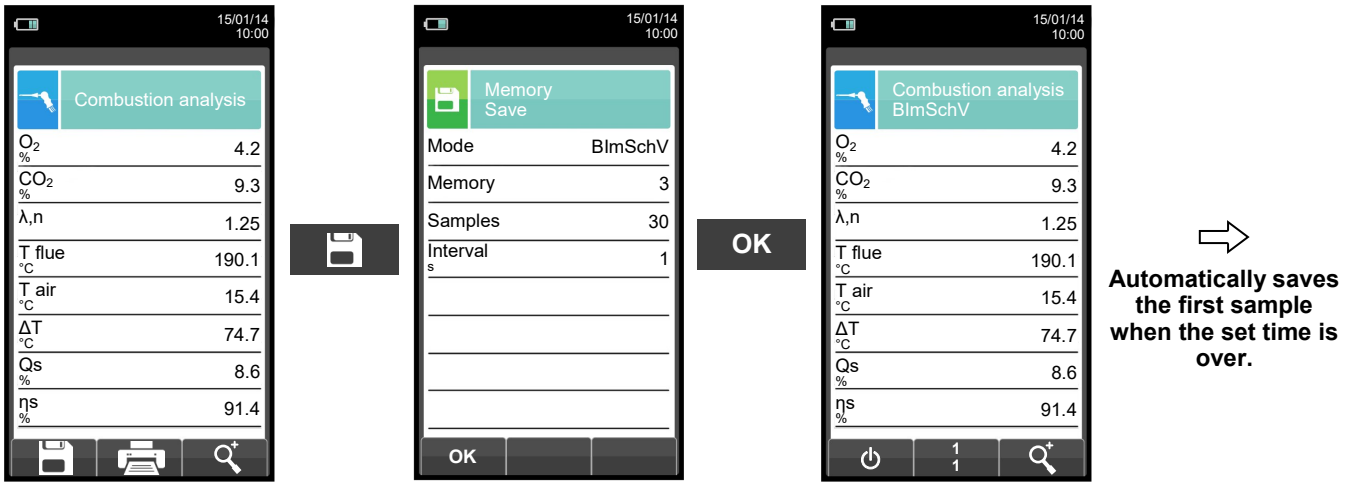
Automatically saves the third sample when the set time is over.

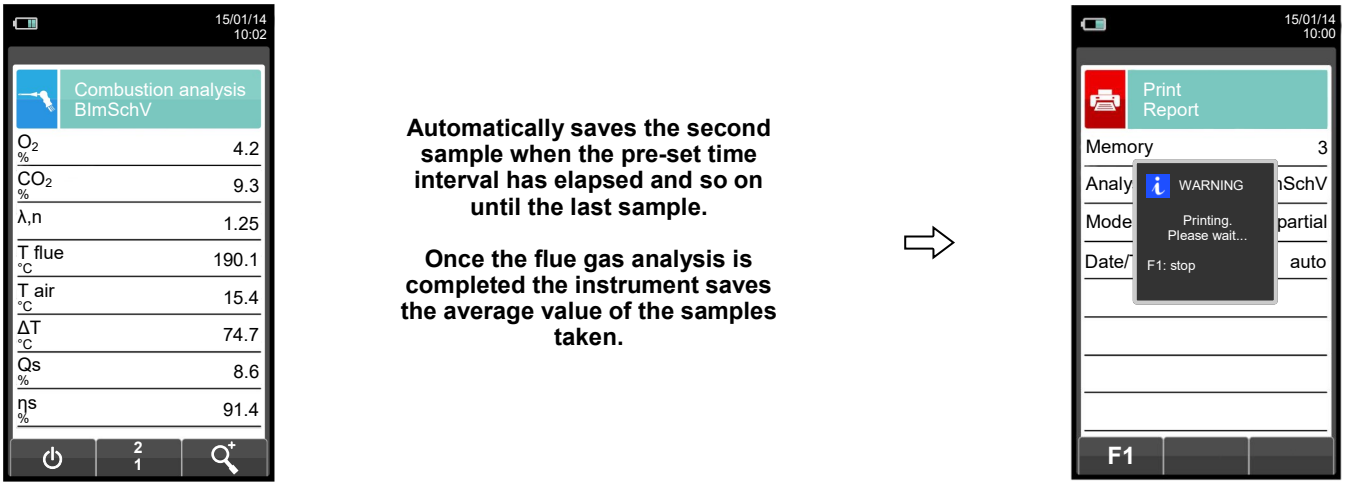


NOTE: If, while configuring the tightness test the automatic printing mode has been selected, the tightness test is printed automatically.

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

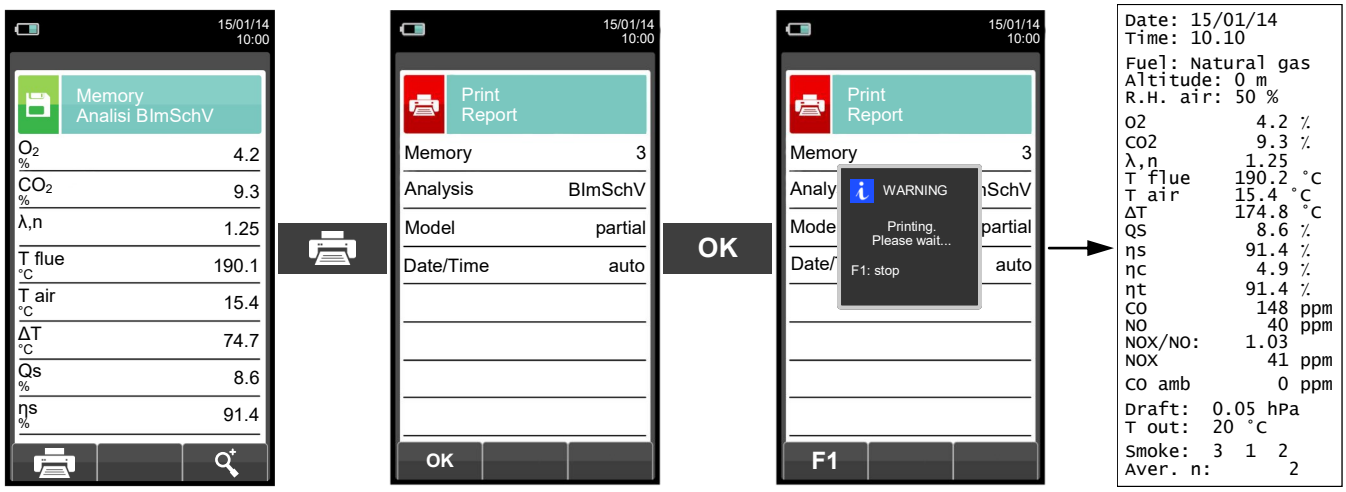
14.5 PERFORMING THE COMBUSTION ANALYSIS - BImSchV MODE



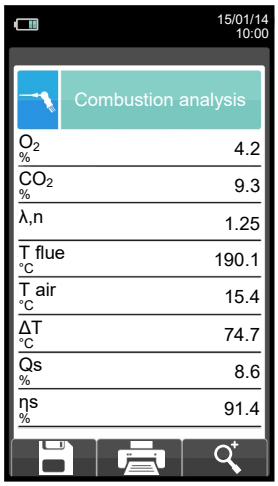


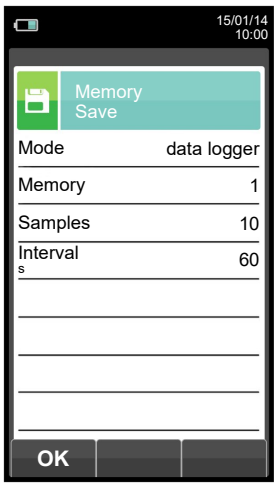
NOTE: If, while configuring the tightness test the automatic printing mode has been selected, the tightness test is printed automatically.

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:

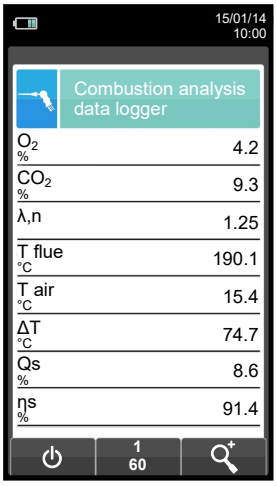


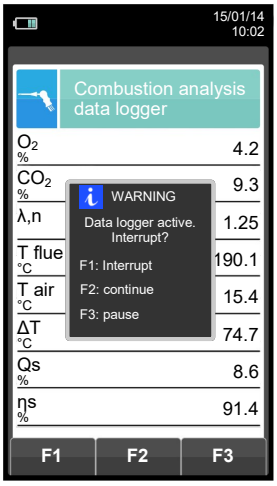
14.6 PERFORMING THE COMBUSTION ANALYSIS - data logger MODE



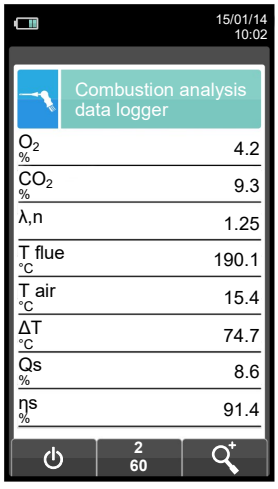


OK

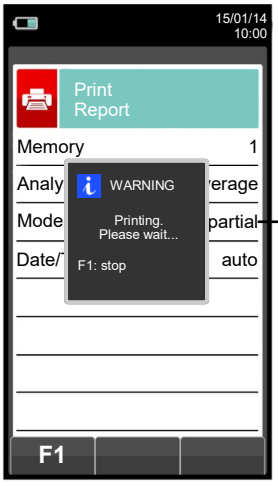




Automatically saves the first sample when the set time is over.

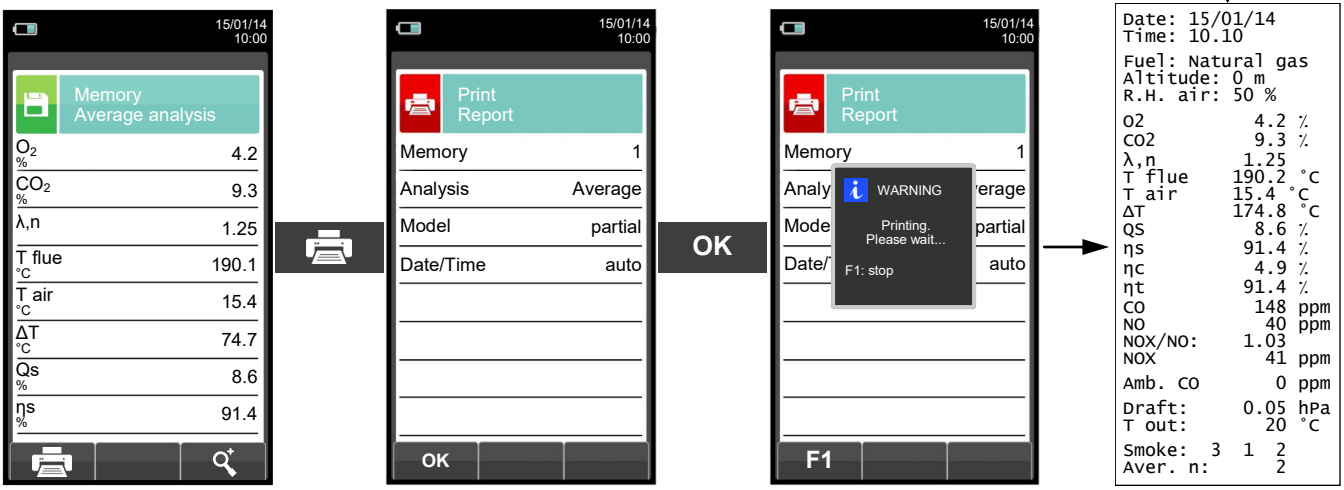


Automatically saves the second sample when the set time is over and so on until the last sample.



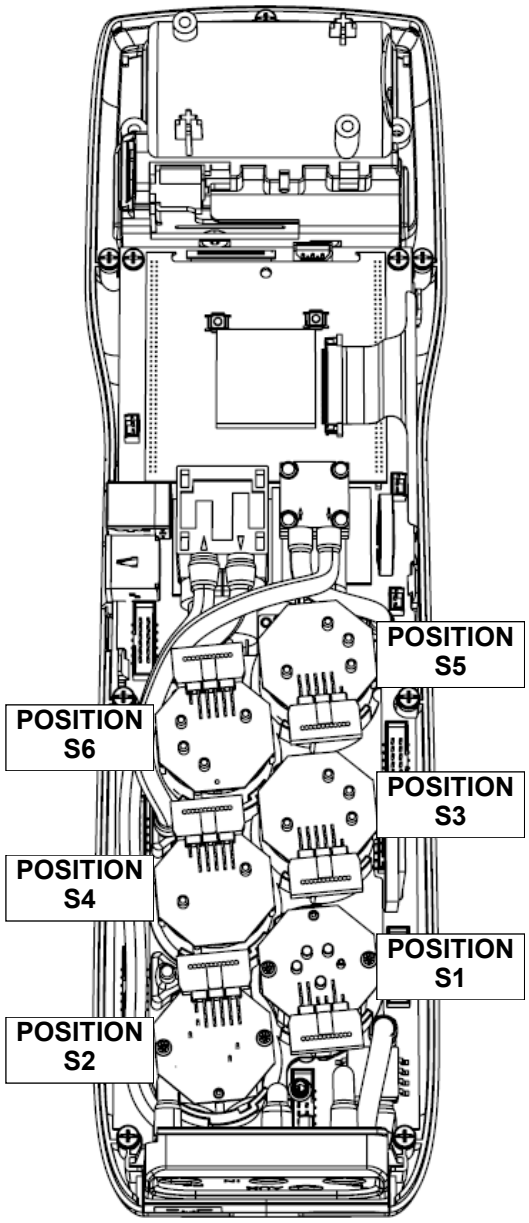
NOTE: If, while configuring the tightness test the automatic printing mode has been selected, the tightness test is printed automatically.

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:

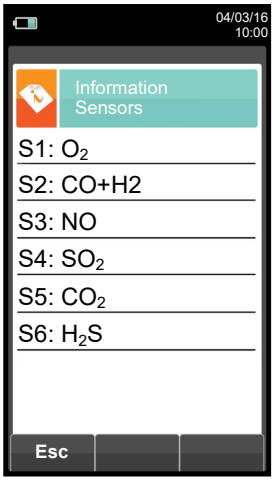


15.1 Sensors arrangement

SENSORS ARRANGEMENT INSIDE THE SENSORS COMPARTMENT



GRAPHICAL DISPLAY OF ARRANGEMENT



15.2 Sensor types and relevant positioning

POSITION / CODE	S1	S2	S3	S4	S5	S6
Flex-Sensor O_2 Cod. AACSE15R	✓	✓	✓			
Flex-Sensor CO+H_2 Cod. AACSE12		✓				
Flex-Sensor CO+H_2 low range Cod. AACSE24		✓				
Flex-Sensor CO 100.000 ppm Cod. AACSE17	✓	✓	✓	✓	✓	✓
Flex-Sensor CO 20.000 ppm Cod. AACSE18	✓	✓	✓	✓	✓	✓
Flex-Sensor NO Cod. AACSE10	✓	✓	✓			
Flex-Sensor NO low range Cod. AACSE25	✓	✓	✓			
Flex-Sensor NO_2 Cod. AACSE14	✓	✓	✓	✓	✓	✓
Flex-Sensor NO_2 low range Cod. AACSE26	✓	✓	✓	✓	✓	✓
Flex-Sensor SO_2 Cod. AACSE13	✓	✓	✓	✓	✓	✓
Flex-Sensor SO_2 1.000 ppm Cod. AACSE77	✓	✓	✓	✓	✓	✓
Flex-Sensor SO_2 low range Cod. AACSE28	✓	✓	✓	✓	✓	✓
Flex-Sensor CxHy 0-5.00% vol. referred to CH4 Cod. AACSE39	✓	✓	✓	✓	✓	✓
Flex-Sensor CO_2 Cod. AACSE41	✓	✓	✓	✓	✓	✓
Flex-Sensor CO_2 Cod. AACSE47	✓	✓	✓	✓	✓	✓
Flex-Sensor H_2S Cod. AACSE35	✓	✓	✓	✓	✓	✓
Flex-Sensor NH_3 Cod. AACSE56	✓	✓	✓	✓	✓	✓
Flex-Sensor Dual CO - H_2 Cod. AACSE79		✓				
Flex-Sensor H_2 Cod. AACSE78	✓	✓	✓	✓	✓	✓
Flex-Sensor CH_4 Cod. AACSE73	✓	✓	✓	✓	✓	✓

15.3 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. Table 15.4 illustrates the characteristics inherent to each sensor.

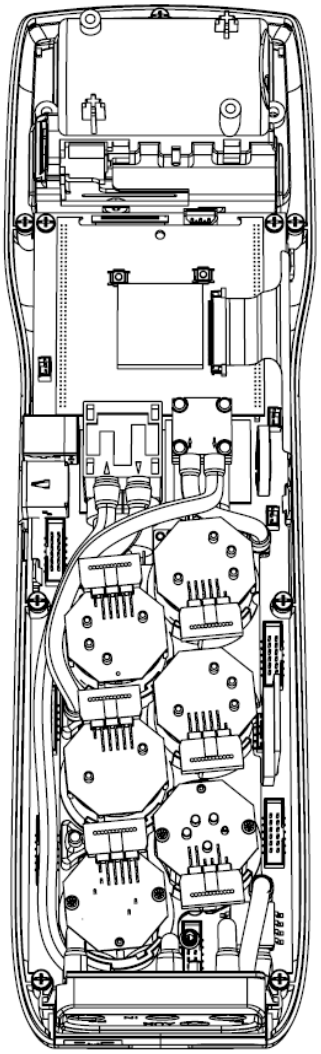
15.4 Table gas sensors life

CODE	MEASURED GAS	IDENTIFYING COLOR	AVERAGE LIFE	RECALIBRATION
Flex-Sensor O_2 Cod. AACSE15R	O_2 Oxygen		>24 months	Not necessary
Flex-Sensor CO+H_2 Cod. AACSE12	CO Carbon Monoxide	Red	48 months	Yearly (2)
Flex-Sensor CO+H_2 low range Cod. AACSE24	CO Carbon Monoxide	Red	48 months	Yearly (2)
Flex-Sensor CO 100.000 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 Dual CO (8000 ppm) - H_2 (2000 ppm) Cod. AACSE79	CO Carbon Monoxide	Red	48 months	Yearly (2)
	H_2 Hydrogen	Red	48 months	Yearly (2)
Flex-Sensor NO low range Cod. AACSE25	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 NO_2 low range Cod. AACSE26	NO_2 Nitrogen Dioxide	Withe	48 months	Yearly (2)
Flex-Sensor SO_2 Cod. AACSE13	SO_2 Sulphur Dioxide	Green	36 months	Yearly (2)
Flex-Sensor SO_2 1.000 ppm Cod. AACSE77	SO_2 Sulphur Dioxide		36 months	Yearly (2)
Flex-Sensor SO_2 low range Cod. AACSE28	SO_2 Sulphur Dioxide	Green	48 months	Yearly (2)
Flex-Sensor CxHy 0-5.00% vol. referred to CH4 Cod. AACSE39	CxHy Unburnt Hydrocarbons		48 months	Yearly (2)
Flex-Sensor CO_2 0-20% Cod. AACSE41	CO_2 Carbon Dioxide		>48 months	Yearly (2)
Flex-Sensor CO_2 0-50% Cod. AACSE47	CO_2 Carbon Dioxide		>48 months	Yearly (2)
Flex-Sensor H_2S Cod. AACSE35	H_2S Hydrogen Sulfide		48 months	Yearly (2)
Flex-Sensor NH_3 Cod. AACSE56	NH_3 Ammonia		48 months	Yearly (2)
Flex-Sensor CH_4 Cod. AACSE73	CH_4 Methane		48 months	Yearly (2)
Flex-Sensor H_2 Cod. AACSE78	H_2 Hydrogen		24 months	Yearly (2)

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

15.5 Expandability to 6 sensors

The CHEMIST 600 Emissions Analyzer can be expanded up to 6 cells.



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

- The expandable instruments are arranged in a way to accept up to a maximum of 6 cells.
- Identify, with the help of paragraph 15.2 '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→NO2 A SENSOR DIFFERENT FROM THE PREVIOUS ONE HAS BEEN DETECTED.

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

SO2→□ A NEW SENSOR HAS BEEN DETECTED.

15.6 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 methane): 1.34

Value = reading value x gain adjustment

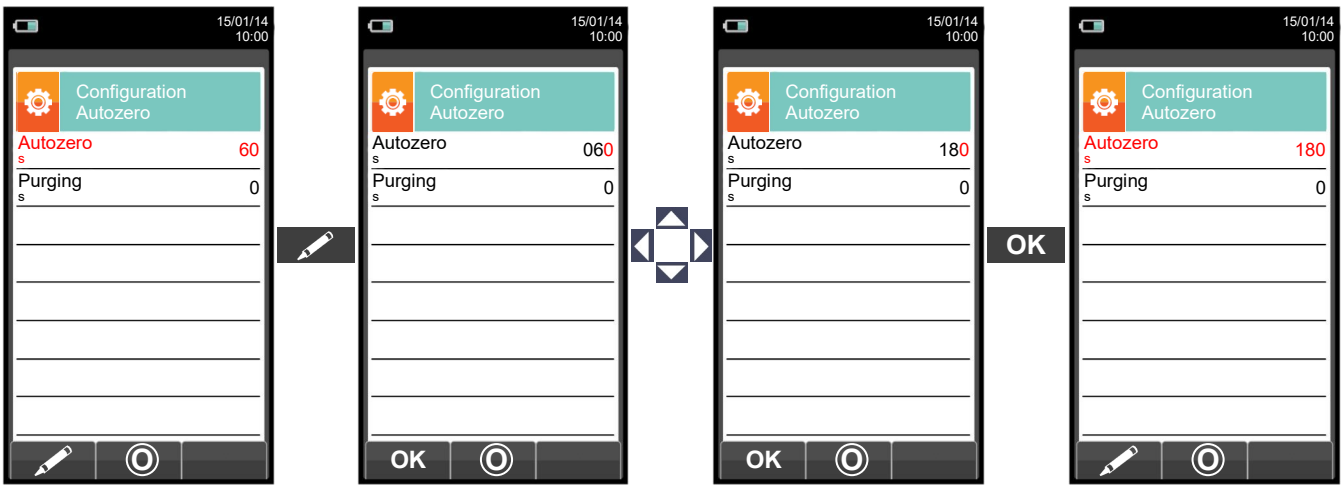
Example: 1.34 x 1.67 = 2.24

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

15.6.1 Installing the CxHy sensor

When the CxHy (position S1 - S6) 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 10.2.6)



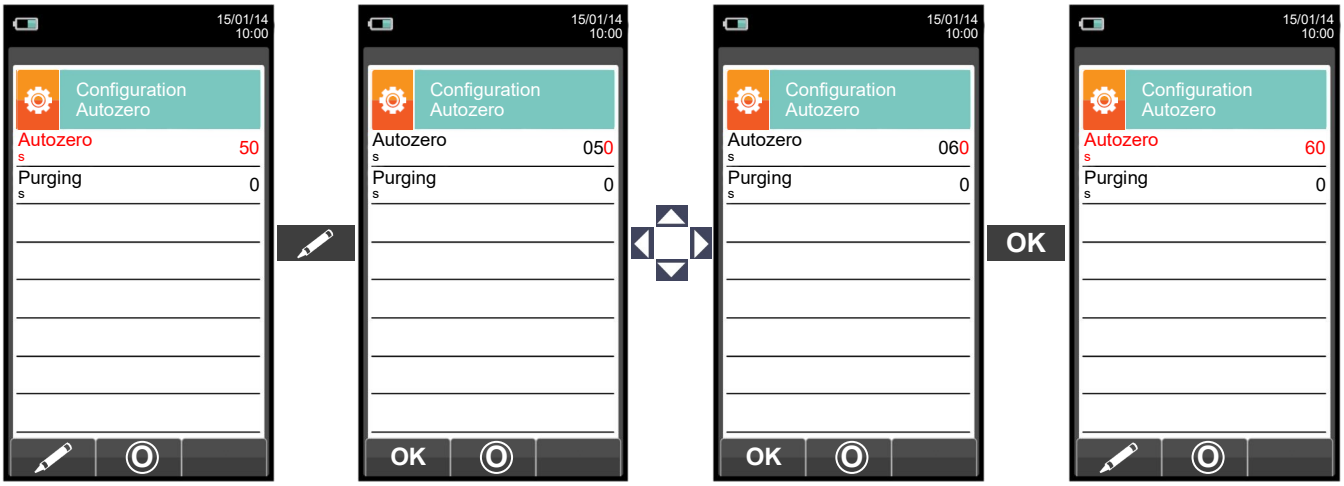
15.7 CO_2 sensor for Carbon Dioxide measurement in combustion processes

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.

15.7.1 Installing the CO_2 sensor

When the CO_2 (position S1 - S6) is mounted in the CHEMIST 600, 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 10.2.6)



15.8 NH_3 sensor for ammonia gas measurement in combustion processes

This sensor measures the presence of ammonia (NH_3) in combustion gases and, since this gas is easily soluble in H_2O, some precautions are necessary; the measure must be performed:

- For short periods of time (1-2 hours).
- Using only the flue gas sampling probe (supplied) with the sintered steel filter (to be purchased separately) mounted on the tip, which is suitable for taking this measurement; alternatively, using the flue gas sampling probe for industrial engines (discontinued item) as it has the sintered steel filter on the tip. This filter creates a dry "pre-filtration" in order to retain the humidity that actually cancels the NH_3 content present in the fumes, making it not measurable.
  The filter being inserted inside the chimney is heated by the fumes and kept warm; the gas that passes through the filter does not form condensation and therefore allows an accurate measurement of ammonia. The filter inserted in the chimney is called "hot filter".
- It is necessary to replace the paper filters on the two anti-condensation traps external from the instrument, with two HDPE filters (to be sold separately), which retains the dust particles but not the residual humidity and therefore ammonia.
  If the process is not particularly dirty, it is possible to make the measurement with only the stainless steel filter mounted on the tip, removing the two filters on the anti-condensation traps increasing the analysis time to 4 continuous hours.

WARNING
The NH_3 sensor is sensitive to other gases called interfering gases:
H_2S >10 ppm
SO_2 >10 ppm
NO >10 ppm
If during analysis the influence of the interfering gases present is greater than the indicated value, compensation is made only if the corresponding sensors are installed on the instrument.

For mounting the sintered steel filter (code AAFS02) on the probe tip, refer to the instructions supplied with the filter.

USE ONLY WITH THE SINTERED STEEL FILTER MOUNTED ON THE SMOKE SAMPLING PROBE TIP AND FILTERED CARTRIDGE IN HDPE IN THE WATER TRAP.

16.0 MAINTENANCE

16.1 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.
General guidelines for operations of the analyzer include the following:

- 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 completed, disconnect the water trap and hoses and let the analyzer purge with clean fresh air for at least 5 to 10 minutes, or at least until the displayed parameters return to their original values in air.
- Clean the filter unit when necessary, replacing the particulate filter and blowing air through 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.

16.2 Preventive maintenance

At least once a year send the instrument to a SERVICE CENTER for a recalibration of the analyzer and maintenance check-up 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 center 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.

16.3 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.

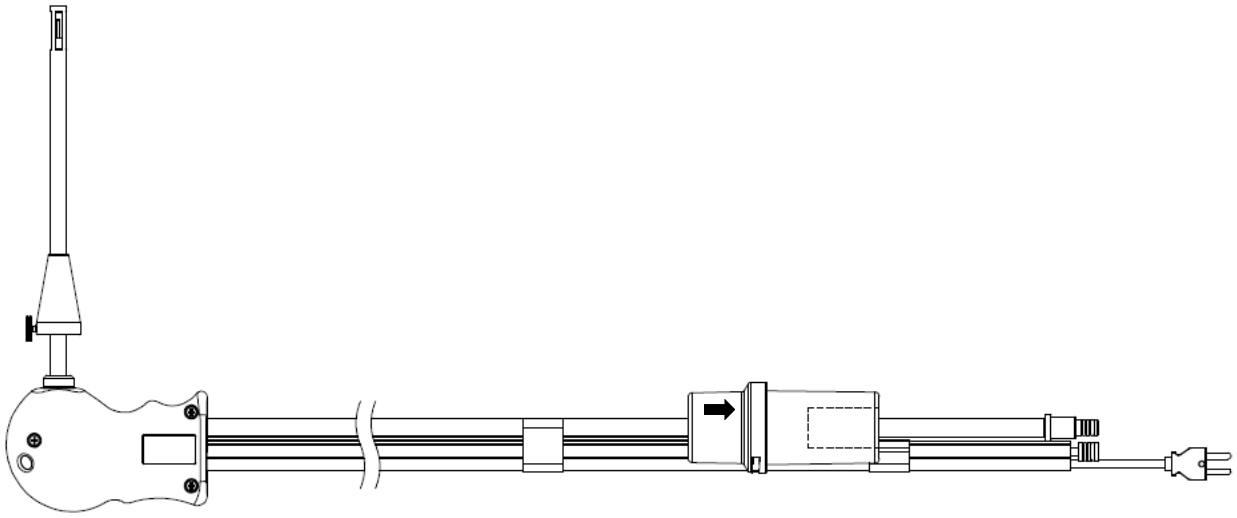


Fig. a

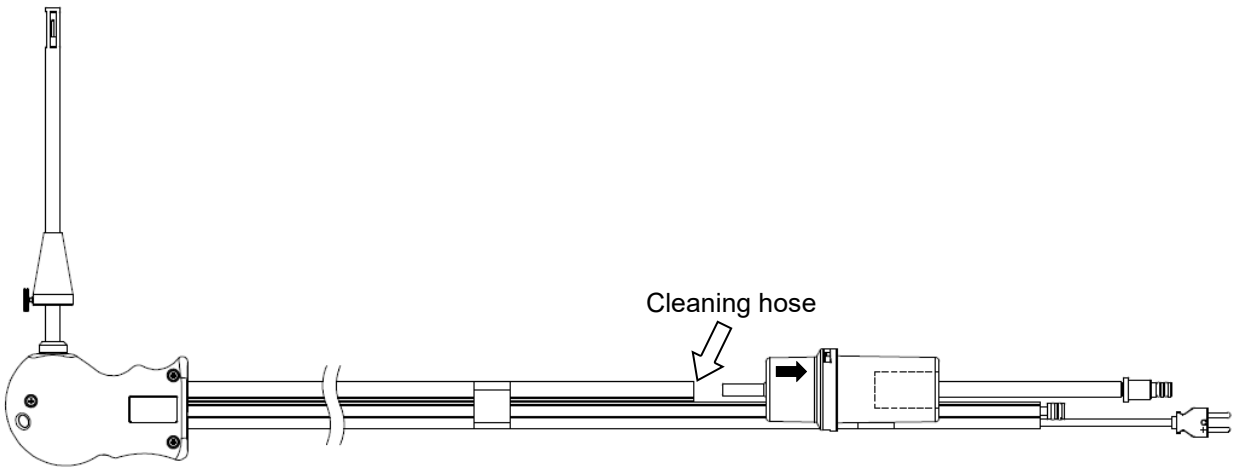
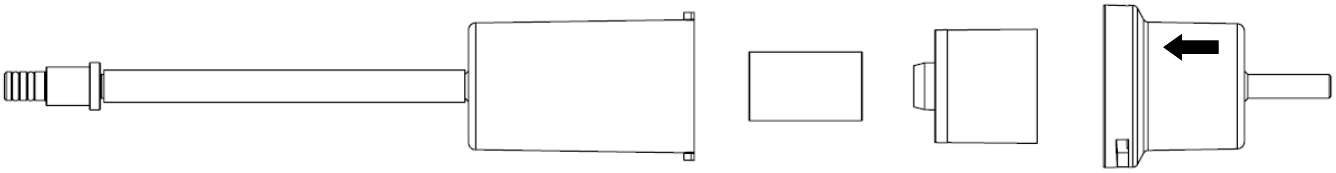


Fig. b

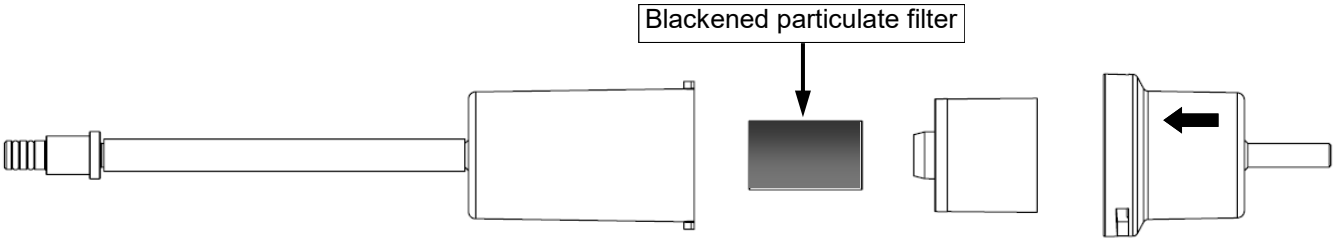
16.4 Maintaining the water trap / filter unit

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.



16.5 Replacing the particulate filter

If the filter is wet or has any cracks or significant build-up of dust/ash/particulates on it, especially on the inner surface (see adjacent example), it has to be replaced immediately. In this way gas flow is not obstructed.

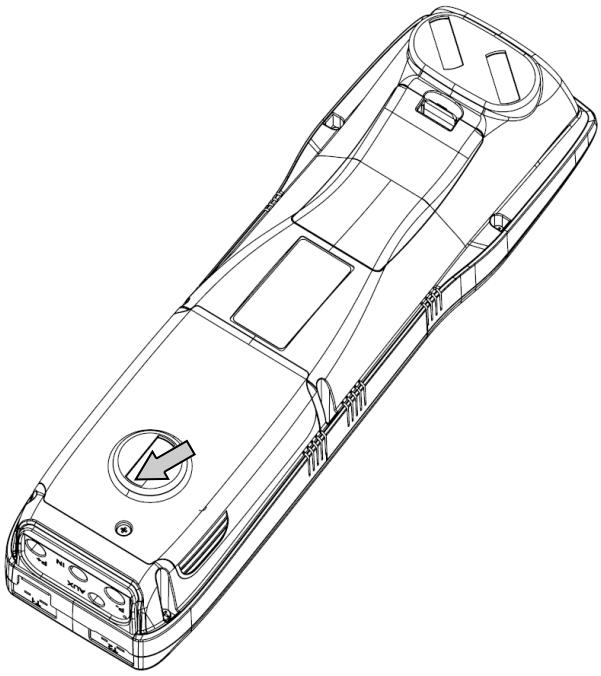


16.6 Replacing the gas sensors

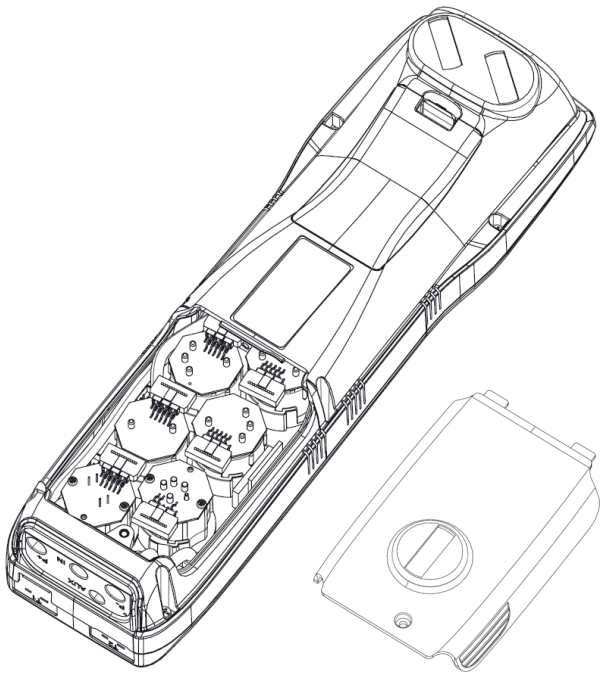
The gas sensors of the instrument shall be periodically replaced (see the following table) with new or recalibrated sensors.
The user can easily perform this replacement operation according to the following instructions.

Access to sensors in positions S1 - S2 - S3 - S4

1. Undo the two fixing screws on the sensor compartment cover.

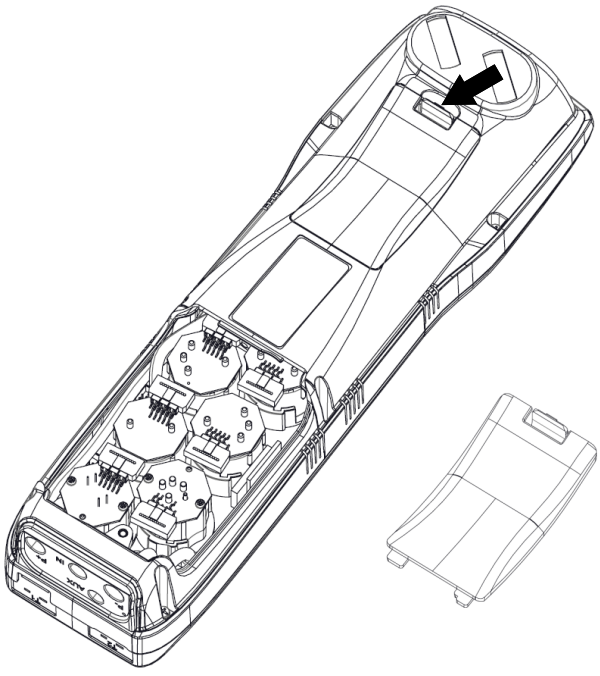


2. Extract the cover to have access to the sensor compartment.

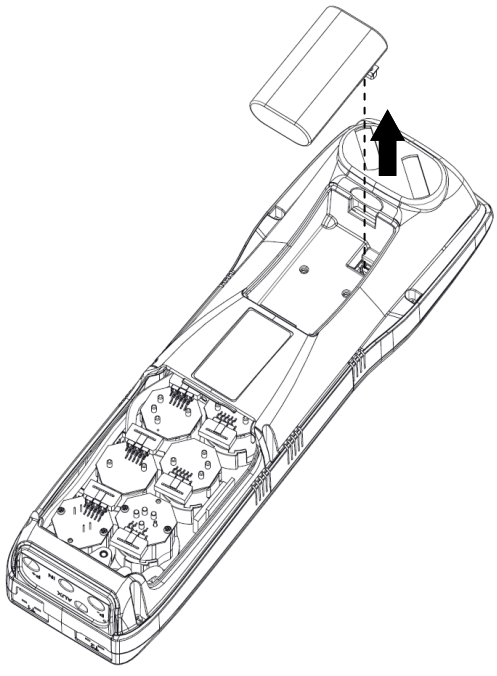


Access to sensors in positions S5 - S6

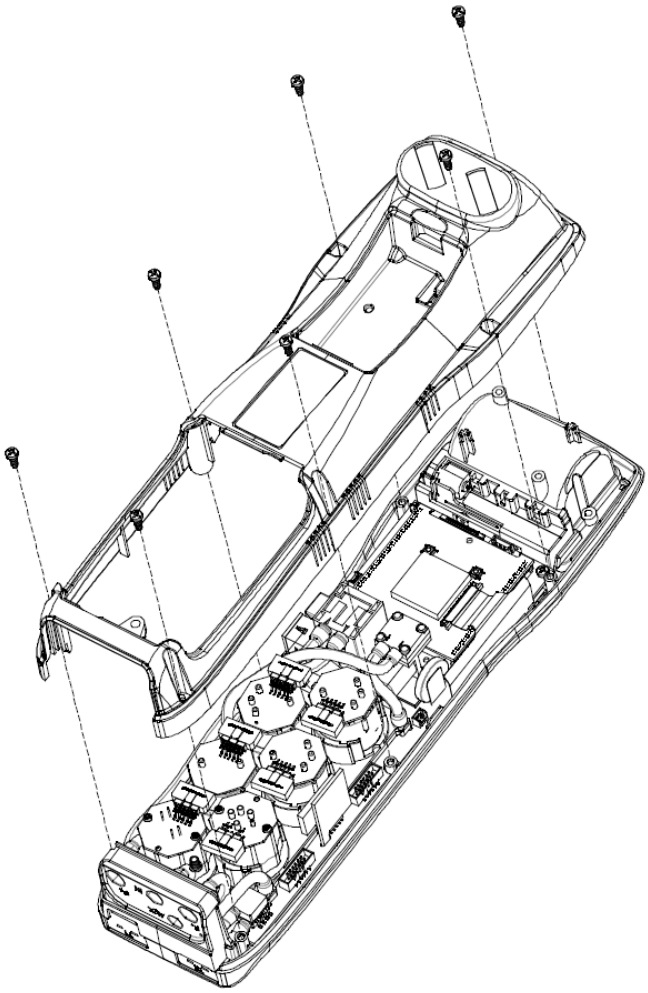
1. Remove the battery compartment cover.

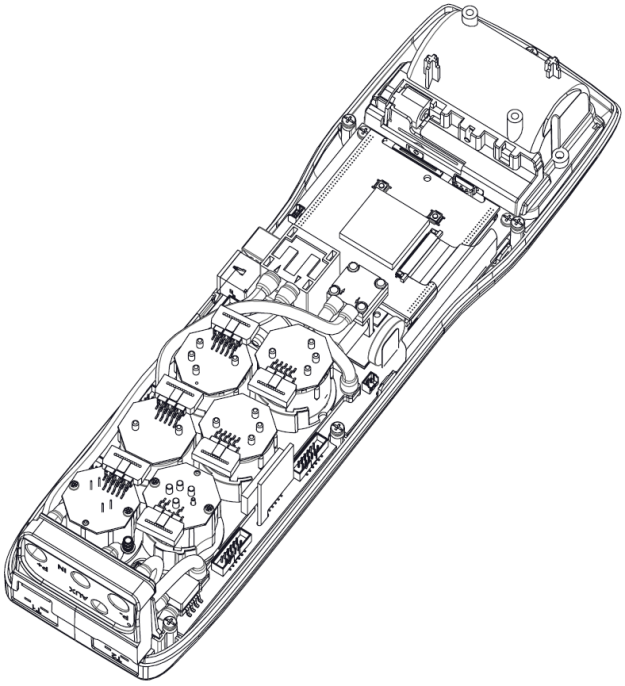


2. Extract the battery pack and remove the connector.

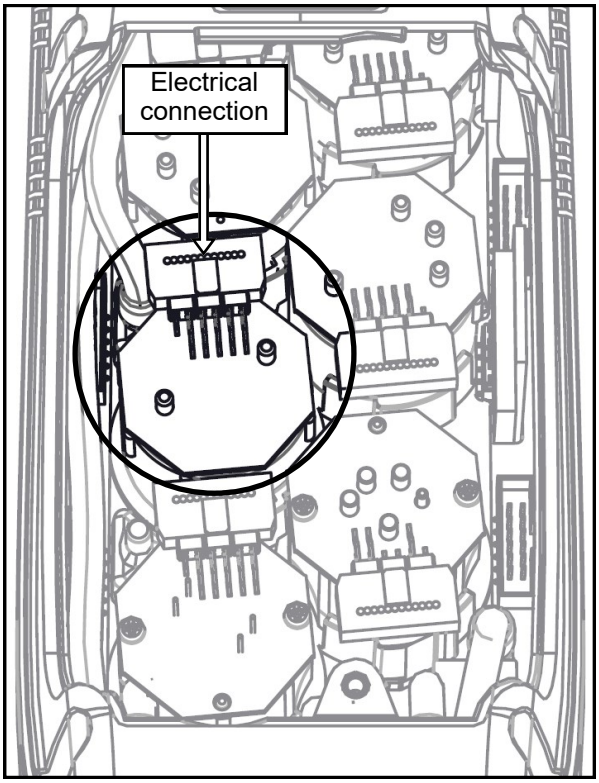


3 Unscrew the instrument base fastening screws and remove the base.

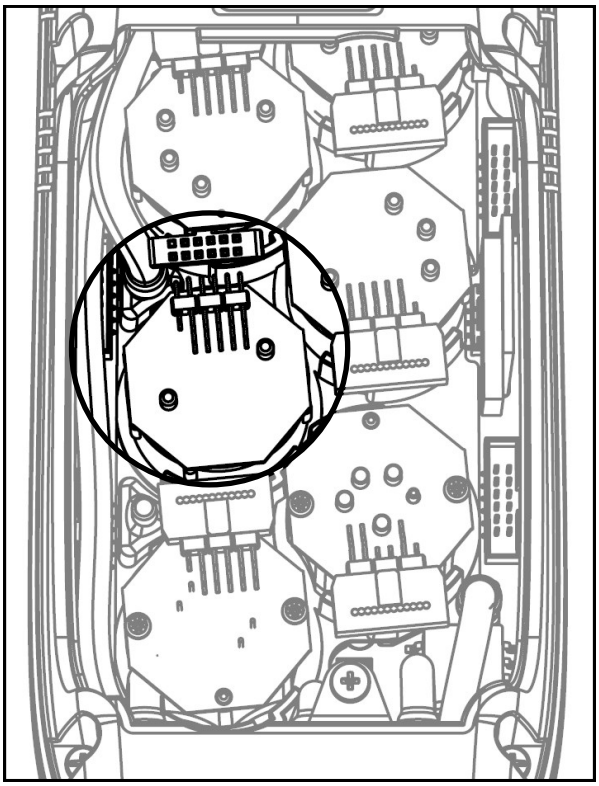




3 Locate the sensor to be replaced; here is an example of a connected sensor to be replaced.

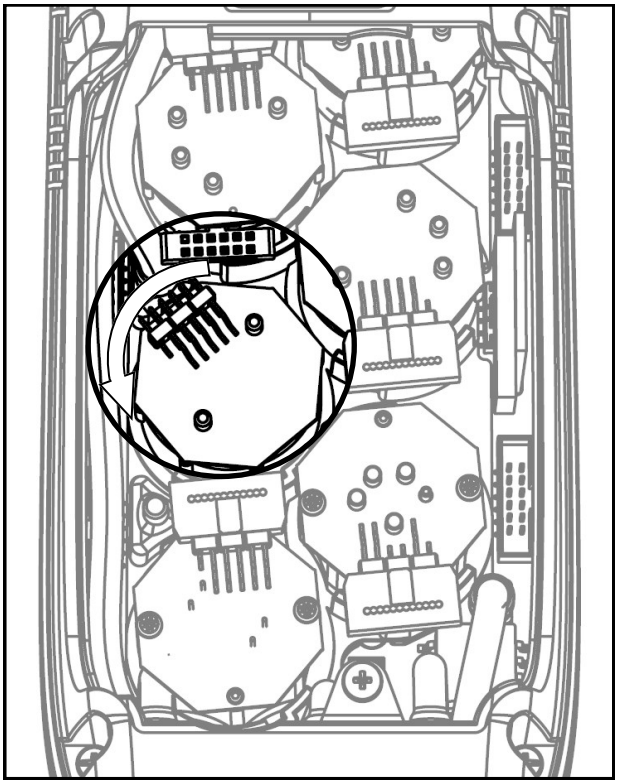


4 Disconnect the sensor to be replaced; here is an example of a disconnected sensor to be replaced.

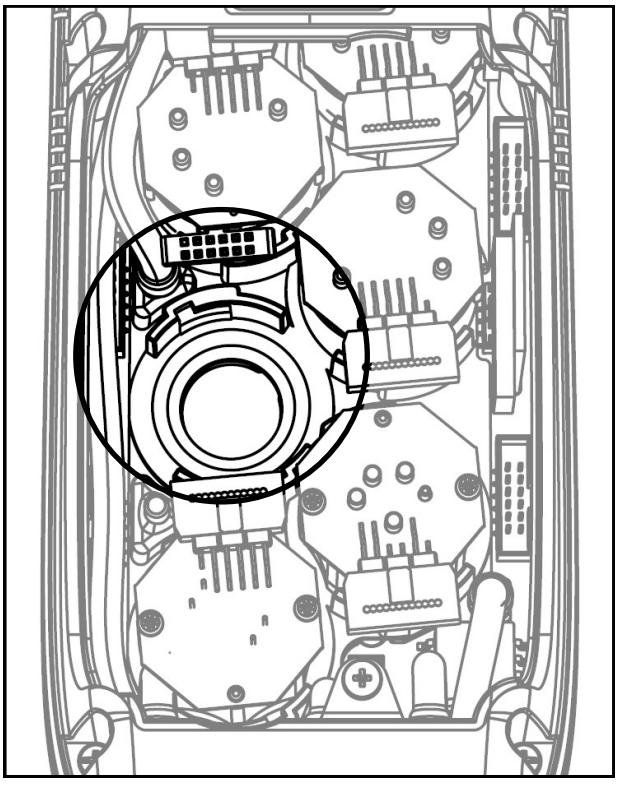


5 The sensor is bayonet-connected to its socket; rotate it counter-clockwise to remove it. Here is an example of a rotated sensor.

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



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 To close the instrument logically reverse the procedure described in the section "Access to sensors in positions S1 - S2 - S3 - S4" or "Access to sensors in positions S5 - S6".

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

The table here below shows the minimum settling time for each sensor.

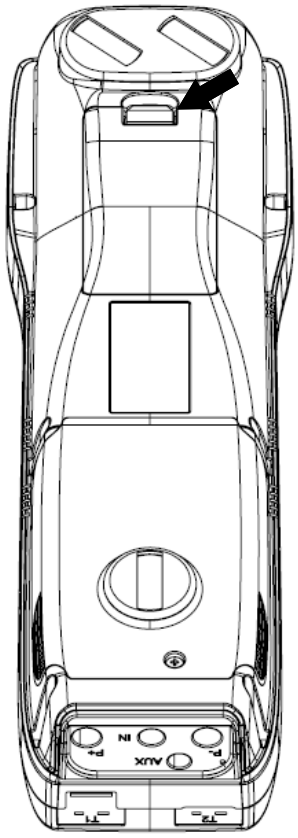
CODE	MEASURED GAS	SETTLING TIME
Flex-Sensor O_2 Cod. AACSE15R	O_2 Oxygen	2 hours (1)
Flex-Sensor CO+H_2 Cod. AACSE12	CO Carbon Monoxide	2 hours (1)
Flex-Sensor CO+H_2 low range Cod. AACSE24	CO Carbon Monoxide	2 hours (1)
Flex-Sensor CO 100.000 ppm Cod. AACSE17	CO Carbon Monoxide	2 hours (1)
Flex-Sensor CO 20.000 ppm Cod. AACSE18	CO Carbon Monoxide	2 hours (1)
Flex-Sensor NO Cod. AACSE10	NO Nitrogen Oxide	48 hours (2)
Flex-Sensor NO low range Cod. AACSE25	NO Nitrogen Oxide	48 hours (2)
Flex-Sensor NO_2 Cod. AACSE14	NO_2 Nitrogen Dioxide	2 hours (1)
Flex-Sensor NO_2 low range Cod. AACSE26	NO_2 Nitrogen Dioxide	2 hours (1)
Flex-Sensor SO_2 Cod. AACSE13	SO_2 Sulphur Dioxide	2 hours (1)
Flex-Sensor SO_2 1.000 ppm Cod. AACSE77	SO_2 Sulphur Dioxide	2 hours (1)
Flex-Sensor SO_2 low range Cod. AACSE28	SO_2 Sulphur Dioxide	2 hours (1)
FLEX-Sensor CxHy 0-5.00% vol. referred to CH4 Cod. AACSE39	CxHy Unburnt Hydrocarbons	1/2 hour (3)
Flex-Sensor CO_2 0 .. 20% vol. Cod. AACSE41	CO_2 Carbon Dioxide	2 hours (1)
Flex-Sensor CO_2 0 .. 50% vol. Cod. AACSE47	CO_2 Carbon Dioxide	2 hours (1)
Flex-Sensor H_2S 500 ppm Cod. AACSE35	H_2S Hydrogen Sulfide	2 hours (1)
Flex-Sensor NH_3 500 ppm Cod. AACSE56	NH_3 Ammonia	24 hours
Flex-Sensor CH_4 0 .. 100% vol. Cod. AACSE73	CH_4 Methane	24 hours
Flex-Sensor H_2 40000 ppm Cod. AACSE78	H_2 Hydrogen	2 hours
Flex-Sensor Dual CO 8000 ppm - H_2 2000 ppm Cod. AACSE79	CO Carbon Monoxide	2 hours
	H_2 Hydrogen	2 hours

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

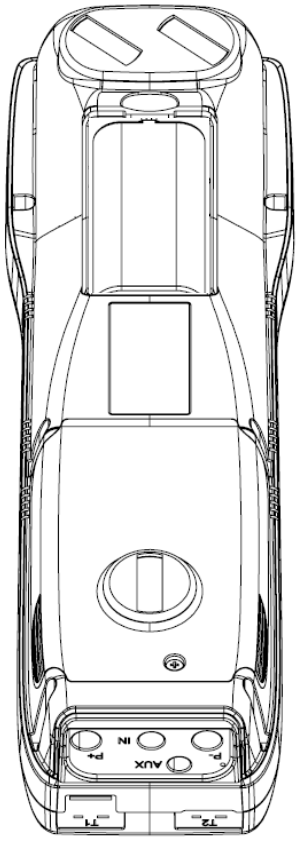
16.7 Replacing the battery pack

Follow these instructions to replace the battery pack:

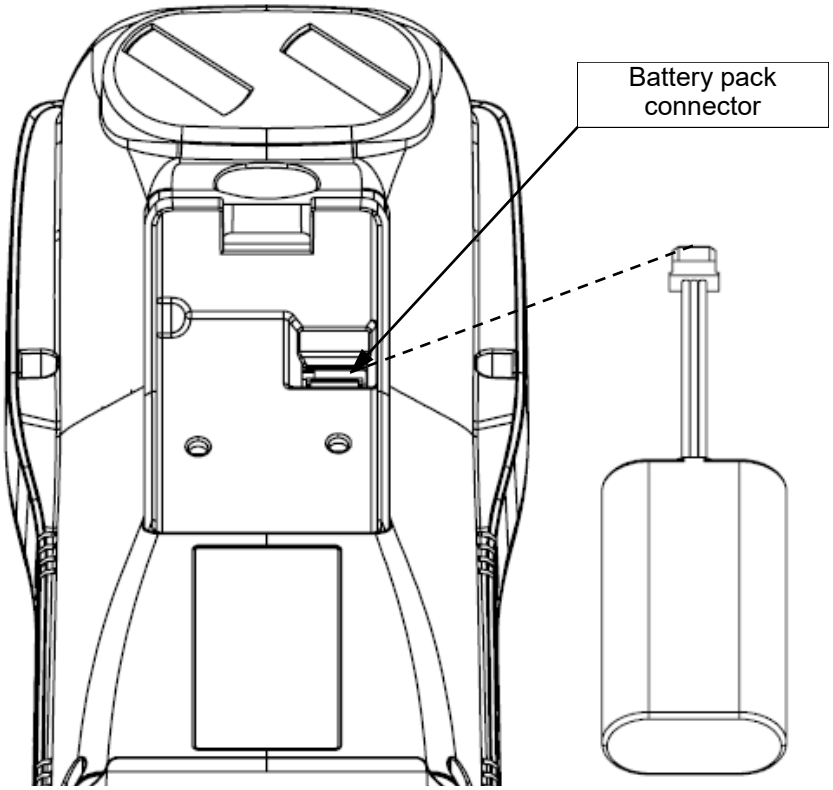
1. Remove the battery compartment cover.



2. Extract the battery pack.



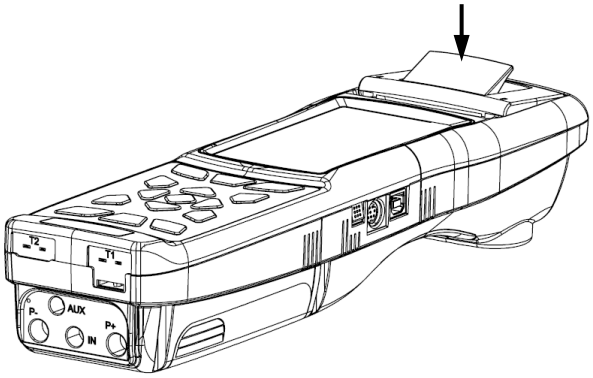
3. Remove the battery pack connector, and replace the pack with a new one following the reverse procedure described above.



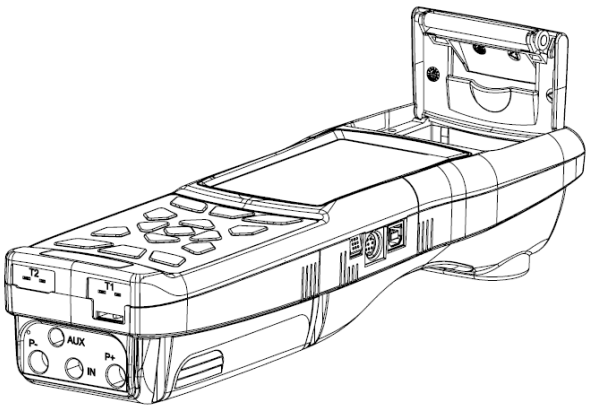
16.8 Replacing the printer paper

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

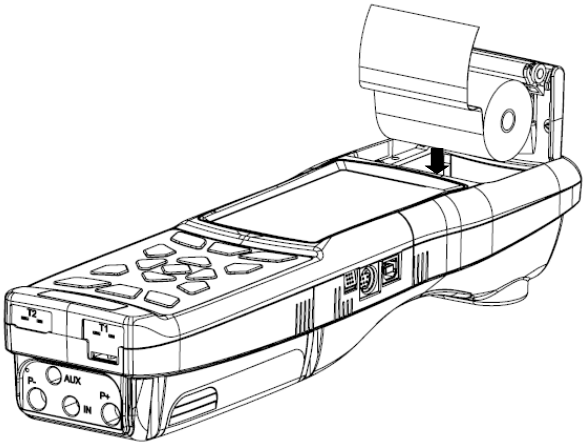
1. Lift the shiny tile, indicated by the arrow.

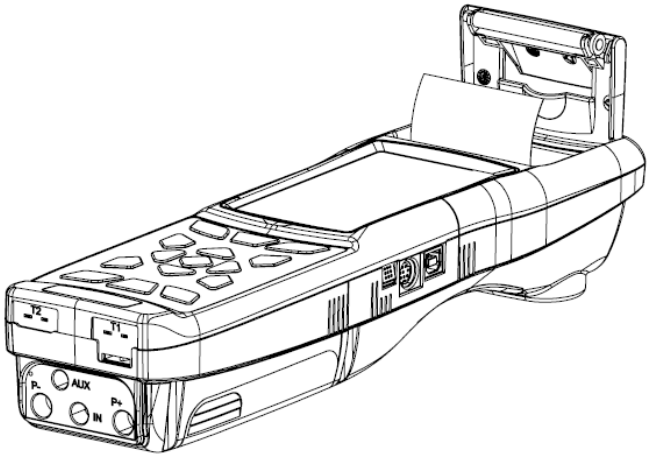


2. Lift the whole block of the lid completely.

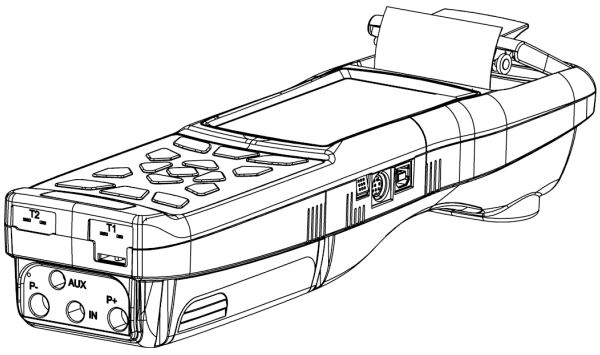


3. Insert the roll of printing paper as shown in the following figures.

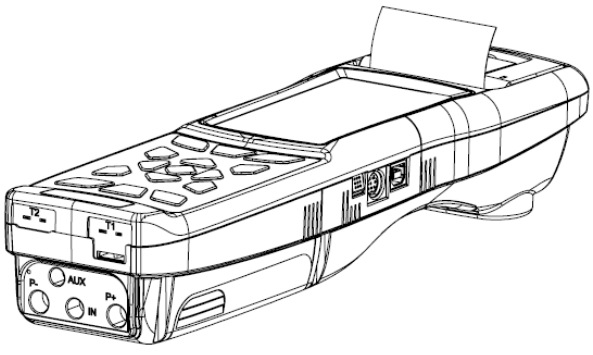




4. Close the whole block of the lid of the printer, pressing it lightly so as to hook it on to the device.



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

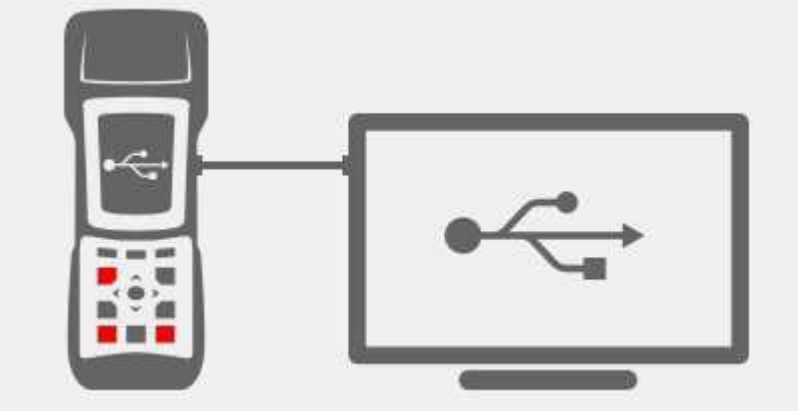


16.9 Firmware Update

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

17.0 TROUBLESHOOTING

17.1 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 center.
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 10.6.2 - 10.7.1 - 15.0. **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/draft screen.	There is a calibration problem. Send the instrument to a service center.
The analysis screen gives a flue gas temperature (Tf) error.	**a.** The thermocouple is not connected; connect the thermocouple to the analyzer. **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 center.
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 analyzer 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 analyzer'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 center to replace the display.
The battery operating time is 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 center for repair. **e.** Analyzer needs to be recalibrated.
During the tightness test a "sensor error" is reported.	Check for the correct connection of the hose to the positive pressure input.

18.0 SPARE PARTS AND SERVICING

18.1 Spare parts

CODE	DESCRIPTION
AACPB06	Li-Ion 7,2V 2,4Ah battery pack
AARC05	Inerasable thermal polyester paper rolls for printer, h=57mm Diam.=35mm
AARC06	Inerasable thermal paper roll for printer, h=58mm Diam.=35mm
AACADX005	Dummy sensor
AACSE15R	FLEX-Sensor O_2, pre-calibrated and interchangeable
AACSE12	FLEX-Sensor CO+H_2, pre-calibrated and interchangeable
AACSE10	FLEX-Sensor NO/NO_x, pre-calibrated and interchangeable
AACSE14	FLEX-Sensor NO_2, pre-calibrated and interchangeable
AACSE13	FLEX-Sensor SO_2, pre-calibrated and interchangeable
AACSE17	FLEX-Sensor CO 100.000 ppm, pre-calibrated and interchangeable
AACSE18	FLEX-Sensor CO 20.000 ppm, pre-calibrated and interchangeable
AACSE39	FLEX-Sensor C_xH_y related to CH_4, pre-calibrated and interchangeable
AACSE24	FLEX-Sensor CO+H_2 low range, pre-calibrated and interchangeable
AACSE25	FLEX-Sensor NO low range, pre-calibrated and interchangeable
AACSE26	FLEX-Sensor NO_2 low range, pre-calibrated and interchangeable
AACSE28	FLEX-Sensor SO_2 low range, pre-calibrated and interchangeable
AACSE41	FLEX-Sensor CO_2 0-20% v/v, pre-calibrated and interchangeable
AACSE47	FLEX-Sensor CO_2 0-50% v/v, pre-calibrated and interchangeable
AACSE35	FLEX-Sensor H_2S, pre-calibrated and interchangeable
AACSE56	FLEX-Sensor HS_3 0-500 ppm, pre-calibrated and interchangeable
AAC SE77	FLEX-Sensor SO_2 compliant with J57-2017, pre-calibrated and interchangeable
AACSE79	Flex-Sensor Dual CO (8000ppm) - H_2 (2000ppm), pre-calibrated and interchangeable
AACSE73	Flex-Sensor CH_4 0 .. 100% vol, pre-calibrated and interchangeable
AACSE78	Flex-Sensor H_2 (40000ppm), pre-calibrated and interchangeable

18.2 Accessories

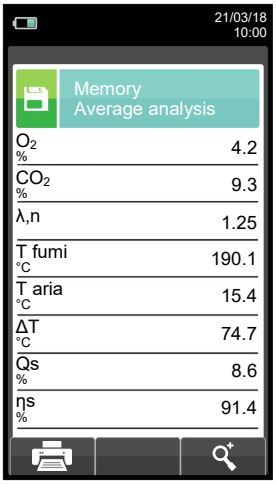
CODE	DESCRIPTION
AAAL05	100-240V~/12 VDC 2A power plug with 2 m cable
AASI01	Italian plug
AACA02	Power supply with car adapter
AACR07	Rigid plastic case
AAZN01	Back-pack
AACCT01	Case with shoulder strap
AACDP02	Deprimometer for Draft test
AACSO01	Probe for measuring the ionization current
AASA08	200 mm air temperature probe (cable length 2 mt)
AASF61A	180 mm. gas probe, 1100°C extended temperature range, with 3 mt cable
AASF51A	180 mm. gas probe, 1100°C extended temperature range, with 2 mt cable
AASF62A	300 mm. gas probe, 1100°C extended temperature range, with 3 mt cable
AASF52A	300 mm. gas probe, 1100°C extended temperature range, with 2 mt cable
AASF65A	750 mm. gas probe, 1100°C extended temperature range, with 3 mt cable
AASF66A	1000 mm. gas probe, 1100°C extended temperature range, with 3 mt cable
AASL05A	300 mm. flexible gas probe, 130°C extended temperature range, with 2 mt cable
AASX01	Gas sampling probe for average CO, 300mm with 2 m cable
AASX02	Probe for industrial motors, 400mm with 3 m cable
AASP01	Protective screen for gas sampling probe
AACTA03	Particulate/water filter assembly
AACTA03A	Particulate/water filter assembly with steel pipe and connector
AACEX02S	3 m extension cable for gas sampling probe
AASM06	Rubber protecting cover.
AATT01	'L' shaped Pitot Tube (without Tc-K thermocouple): length 300mm - external ø 6 mm. Supplied with two silicone tubes with length 2 meters.
AATT02	'L' shaped Pitot Tube (without Tc-K thermocouple): length 800mm - external ø 6 mm. Supplied with two silicone tubes with length 2 meters.
AACKP01	Differential pressure kit.
AAKT04	Tightness test kit.
AAPM02	Manual pump kit for smoke measurement.
AASW08	Configuration software kit (USB + PC cable).
AAUA01	Adapter cable USB-A / USB-B.
AASC01	Ambient CO probe.
AATB01	Cap for the pressure measurement line of the flue gas sampling probe.

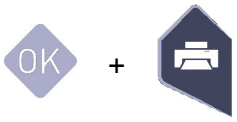
18.3 Service Centers

Headquarters:
Seitron S.p.A.
Via del Commercio, 9/11
36065 Mussolente (VI)
Tel.: +39.0424.567842
Fax.: +39.0424.567849
E-mail: info@seitron.it
http://www.seitron.it

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

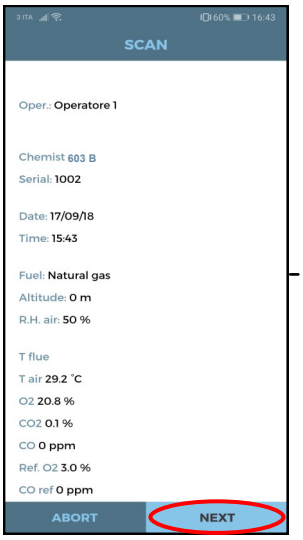
Data Management with “SEITRON SMART ANALYSIS APP” APP

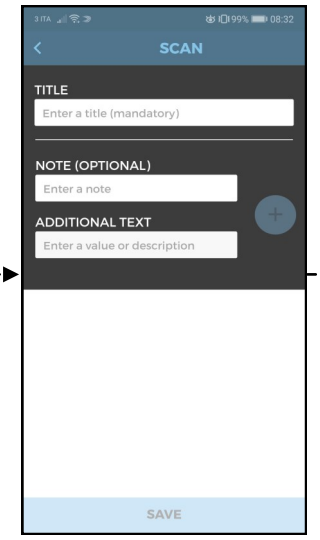


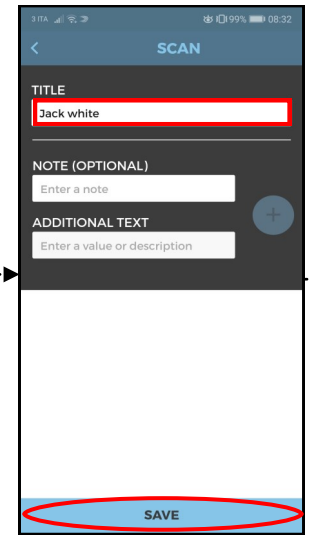


Download all analysis data on the display.

SCAN THE QR CODE USING SEITRON APP “SEITRON SMART ANALYSIS APP”, TO DOWNLOAD THE ACQUIRED DATA.

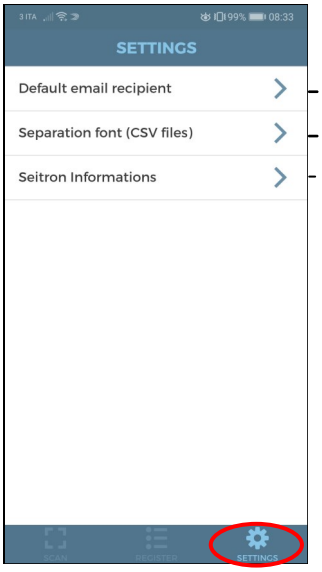




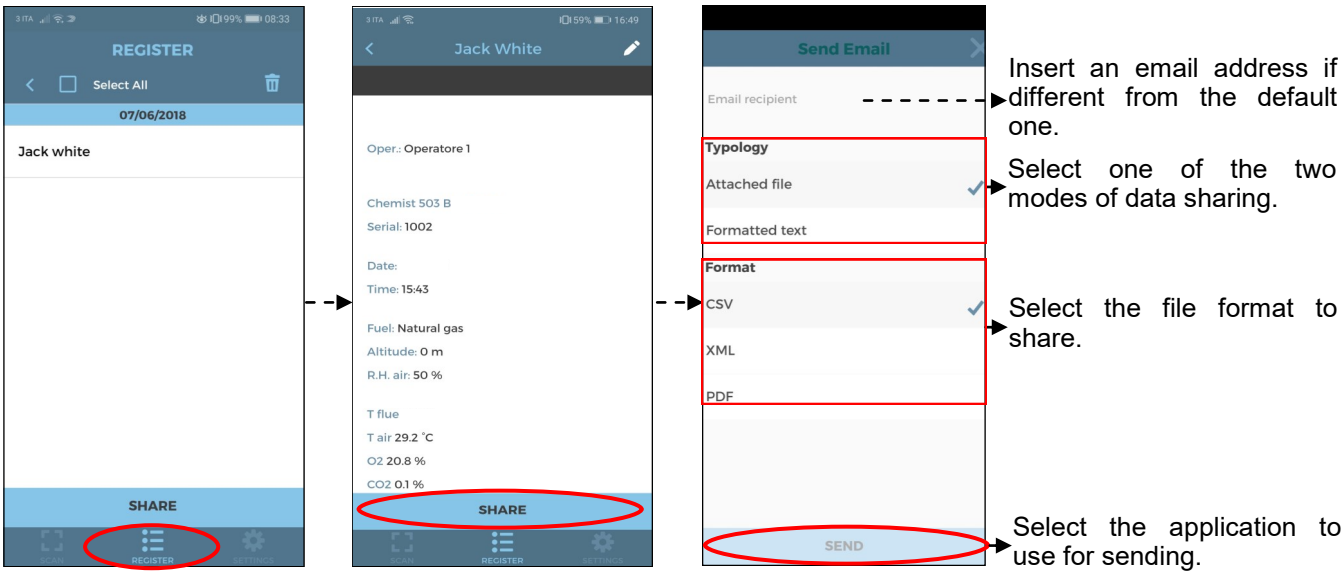


THE ACQUIRED DATA ARE SAVED IN THE INSTRUMENT MEMORY.

APP settings.



- Insert a default email address.
- Select the data separation mode: comma (,) or semicolon (;).
  This setting is useful if it’s needed to import the csv file in an electronic sheet such as Excel or google drive.
- Visualize the version of the APP and Seitron contacts.



Example of the exported csv file and imported in an excel file:

Chemist 600		
Serial number	1100	
Date	15/12/2017	
Time	12:00	
Fuel	Natural gas	
Altitud.	0.000000	m
Air humidity	50	%
O2	15.7	%
CO	23	ppm
CO2	2.9	%
T smoke	100.6	°C
T air	27.0	°C
ηs	90.0	%
NO	0.000	mV
CO-SEN	258.270	mV
O2	1.131.867	mV
I sen	0.000	uA
I sen	0.000	uA
I sen	100.346	uA
T az	22.5	°C
ΔT	73.6	°C
Qs	10.0	%
λ,n	4.01	
Air excess	4.01	
ηc	0.0	%
ηt	90.0	%
Qs (PCS)	10.0	%
Qt (PCS)	10.0	%
ηs (PCS)	90.0	%
ηc (PCS)	0.0	%
ηt (PCS)	90.0	%
NO	0	ppm
NOx	0	ppm
CO (0.0%)	0	ppm
NO (0.0%)	0	ppm
NOx (0.0%)	0	ppm
Draught	4.5	Pa

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 600 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
NO_x	15 ppm
Ref. O_2:	0.0 %
CO ref	92 ppm
Ref. O_2:	0.0 %
NO ref	56 ppm
Ref. O_2:	0.0 %
NO_x ref.:	60 ppm
Draft	4.5 Pa
T ext.	10.0 °C

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

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
NO_x	15 ppm
Ref. O_2:	0.0 %
CO ref	92 ppm
Ref. O_2:	0.0 %
NO ref	52 ppm
Ref. O_2:	0.0 %
NO_x ref.:	56 ppm
Tiraggio	4.5 Pa
T ext.	10.0 °C

Analysis: 2
04/03/16 10.15

O_2	15.7 %
CO_2	2.9 %
λ,n	4.01
T flue	100.6 °C
T air	27.0 °C
ΔT	73.6 °C
QS	10.0 %
ηs	90.0 %
ηc	0.0 %
ηt	90.0 %
CO	23 ppm
NO	14 ppm
NO_x	15 ppm
Ref. O_2:	0.0 %
CO ref	92 ppm
Ref. O_2:	0.0 %
NO ref	56 ppm
Ref. O_2:	0.0 %
NO_x ref.:	60 ppm
Draft	4.5 Pa
T ext.	10.0 °C

Analysis: 3
04/03/16 10.20

O_2	15.7 %
CO_2	2.9 %
λ,n	4.01
T flue	100.8 °C
T air	27.0 °C
ΔT	73.8 °C
QS	10.1 %
ηs	89.9 %
ηc	0.0 %
ηt	89.9 %
CO	23 ppm
NO	14 ppm
NO_x	15 ppm
Ref. O_2:	0.0 %
CO ref	92 ppm
Ref. O_2:	0.0 %
NO ref	56 ppm
Ref. O_2:	0.0 %
NO_x ref.:	60 ppm
Draft	4.5 Pa
T ext.	10.0 °C

Example of Full analysis report.

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

Oper.: John Smith

Sign.: _______________

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

Chemist 600 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: ------------------
------------------------
------------------------
------------------------
------------------------
------------------------
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```

Example of Partial Paper print-out.

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

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

O2              15.7 %
CO2              2.9 ppm
λ,n             4.01
T flue          95.4 °C
T air           26.9 °C
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 600 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: 2019 standard
Indirect method

Chemist 600 X
Serial: 999989
Memory: 01

Date: 03/04/20
Time: 10.30

Stab. duration: 1 min
Test duration: 1 min

Gas comb.: L.P.G.
Test gas: Air
Plant: int

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 ambient CO Paper print-out.

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

Oper.: John Smith

Sign.: _______________

Chemist 600 X
Serial: 999989
Memory: 01

Date: 04/04/14
Time: 10.30

CO amb            0 ppm

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

Example of Smoke Paper print-out.

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

Oper.: John Smith

Sign.: _______________

Chemist 600 X
Serial: 999989
Memory: 01

Date: 04/04/14
Time: 10.30

Fuel: Diesel

Smoke:    3  1  2
Aver. n°:       2

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

Example of Velocity Paper print-out.

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

Oper.: John Smith

Sign.: _______________

Chemist 600 X
Serial: 999989
Memory: 01

Date: 04/04/14
Time: 10.30

Gas: Air

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

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

Coefficients of the fuels and Formulas

The following chart, derived from standard UNI 10389-1, lists the coefficients of the 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
CO Off gas	0,775	1,164	0,0012	31,55	8610	8735	2,21	0,051	2,14
Olive pits	0,749	0,689	0,0065	19,33	18780	20309	6,290	0,626	4,79
Rice husk-Basmati	0,777	0,768	0,007	20,738	12558	13633	4,065	0,440	3,152
B20	0,701	0,518	0,0055	15,52	41806	44620	14,04	1,152	13,89
Digester gas	0,695	0,352	0,0085	10,65	21303	23644	6,93	0,905	7,02

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:

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

Air index is calculated with the formula:

$\lambda = 21/(21-O_2)$, where O_2 is the oxygen residual concentration in the combustion smokes.

Air excess is calculated with the formula:

$e = (\lambda - 1) * 100$

- **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.

ANNEX D

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 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 analyzer during testing.

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

➢ *CO_2 : CARBON DIOXIDE*

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

Fuel	**% max CO_2**
Methane	11.7
Propane	13.9
LPG	13.9
Butane	13.9
Diesel oil	15.1
Fuel oil	15.7

Actually, 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%

Instructions for accurate testing

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

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

Optional measures list:

MEASURE	DEFINITION
λ, n	**Air index** (defined as **λ,** sometimes also indicated as **n**).
e	**Air excess.** Expressed as a percentage according to the formula in the appendix B, is the ratio between the volume of air actually entering the combustion chamber and the one theoretically needed.
ΔT	**Differential temperature:** It is the difference between the smoke temperature and the air combustion temperature.
Qs (LHV)	**Stack losses in relation to the Lower Heating Value:** It is the percentage of dissipated heat through the stack referred to the lower heating value (LHV)
Qs (HHV)	**Stack losses in relation to the Higher Heating Value:** It is the percentage of dissipated heat through the stack referred to the higher heating value (HHV)
ηs (LHV)	**Sensible efficiency in relation to the Lower Heating Value:** 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.
ηs (HHV)	**Sensible efficiency in relation to the Higher Heating Value:** It is the burner efficiency calculated 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 Higher Heating Value (HHV) of the fuel and cannot exceed 100%.The sensible efficiency value is to be compared against minimum efficiency stated for the heating system performances.
ηc (LHV)	**Condensation efficiency in relation to the Lower Heating Value:** Efficiency deriving from the condensation of water vapour contained in flue gases, calculated according to the UNI 10389-1 standard, and it is referred to the LHV.
ηc (HHV)	**Condensation efficiency in relation to the Higher Heating Value:** Efficiency deriving from the condensation of water vapor contained in flue gases and it is referred to the HHV.
ηt (LHV) **ηt = ηs + ηc**	**Total efficiency in relation to the Lower Heating Value:** Total efficiency. It is the sum of sensible efficiency and condensation efficiency. It is referred to LHV (Lower Heating Value) and can exceed 100%.

MEASURE	DEFINITION
ηt (HHV)	**Total efficiency in relation to the Higher Heating Value:** Total efficiency. It is the sum of sensible efficiency and condensation efficiency. It is referred to HHV (Higher Heating Value) and can not exceed 100%.
Qt (HHV)	**Total stack losses:** It is the total heat percentage dissipated through the stack.
NOx	Measure of nitrogen oxides quantity; the measurement unit can be set in the special menu.
NOx ppm *	Measure of nitrogen oxides quantity; the measurement unit can not be set but it is fixed in ppm.
NOx (rif. O2)	Measure of nitrogen oxides quantity referring to O2; the measurement unit can be set in the special menu.
NOx (rif. O2) ppm *	Measure of nitrogen oxides quantity referring to O2; the measurement unit can not be set but it is fixed in ppm.
PI	**Poison Index (CO/CO2 ratio)**: It is defined as the ratio between CO and CO2 useful to determine whether the system needs maintenance.
CO	CO quantity measurement. Measurement units: ppm - mg/m^3 - mg/kWh - g/GJ - g/m^3 - mg/kWh - % - ng/J
CO (RIF)	CO quantity measurement with O2 reference. Measurement units: ppm - mg/m^3 - mg/kWh - g/GJ - g/m^3 - g/kWh - % - ng/J
CO amb. ext.	Measure of the outer CO level when using the external CO probe. Measurement unit: ppm. This is the only measurement unit which is possible to set.
T dew	Flue water condensation temperature (Dew point). This value is calculated.

* : Valid for Piemonte region only (Italy only).

OTHER THAN THE MEASUREMENT LIST ABOVE, IT IS POSSIBLE TO VISUALIZE THE MEASURE OF THE DETECTED GAS ALSO IN PPM, DEPENDING ON THE KIND OF MEASUREMENT CELL IN THE INSTRUMENT. IF IT IS NECESSARY TO MEASURE THE VALUE OF GAS WITH TWO DIFFERENT MEASUREMENT UNITS, SELECT IN THE MEASUREMENTS LIST THE DESIRED GAS IN PPM AND CHANGE THE MEASUREMENT UNIT FOR THE SAME GAS IN THE "CONFIGURATION->ANALYSIS->MEASUREMENT UNIT" SCREEN. NOW THE INSTRUMENT ACQUIRES THE MEASURE WITH TWO DIFFERENT UNITS (PPM AND THE ONE PREVIOUSLY SET)

WARRANTY CERTIFICATE

WARRANTY

The CHEMIST 600 flue gas analyzer is guaranteed for **24 months** from purchasing date including the internal electro-chemical sensors which are also guaranteed for **24 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 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.:

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