USER'S MANUAL

T80xx

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FOREWORD

WE THANK YOU FOR ACQUIRING THE T8000. WITH 'STATE OF THE ART' DESIGN, IT TAKES ADVANTAGE OF THE MOST ADVANCED TECHNOLOGIES, BOTH AT THE SOFTWARE AND AT THE HARDWARE LEVEL, HARNESSING THEM TO SERVE YOUR PRIORITIES: RAPID TESTING, ACCURACY, RELIABILITY AND LONG MAINTENANCE INTERVALS. SPECIFICALLY DESIGNED FOR THE GARAGE AND PERIODIC TESTING (MOT) ENVIRONMENT, IT ALLOWS YOU TO QUICKLY AND EFFECTIVELY MASTER ALL THE FUNCTIONS OFFERED BY THE DEVICE AND TO PROVIDE LONG AND RELIABLE IN-SERVICE PERFORMANCE.

THIS MANUAL EXPLAINS HOW TO USE THE T8000 STATION, FROM INSTALLATION THROUGH TEST MEASUREMENT PROCEDURES, AS WELL AS CHECKS AND ACTIONS TO BE TAKEN IN CASE OF MALFUNCTION. PLEASE READ THIS MANUAL THOROUGHLY BEFORE OPERATING THE DEVICE, IN ORDER TO ENSURE CORRECT AND SAFE OPERATION OF THE UNIT. KEEP THS MANUAL IN A SAFE PLACE TO CONSULT IT WHEN NECESSARY.

NOTICE:

INFORMATION CONTAINED IN THIS DOCUMENT IS SUBJECT TO CHANGE WITHOUT PRIOR NOTICE.

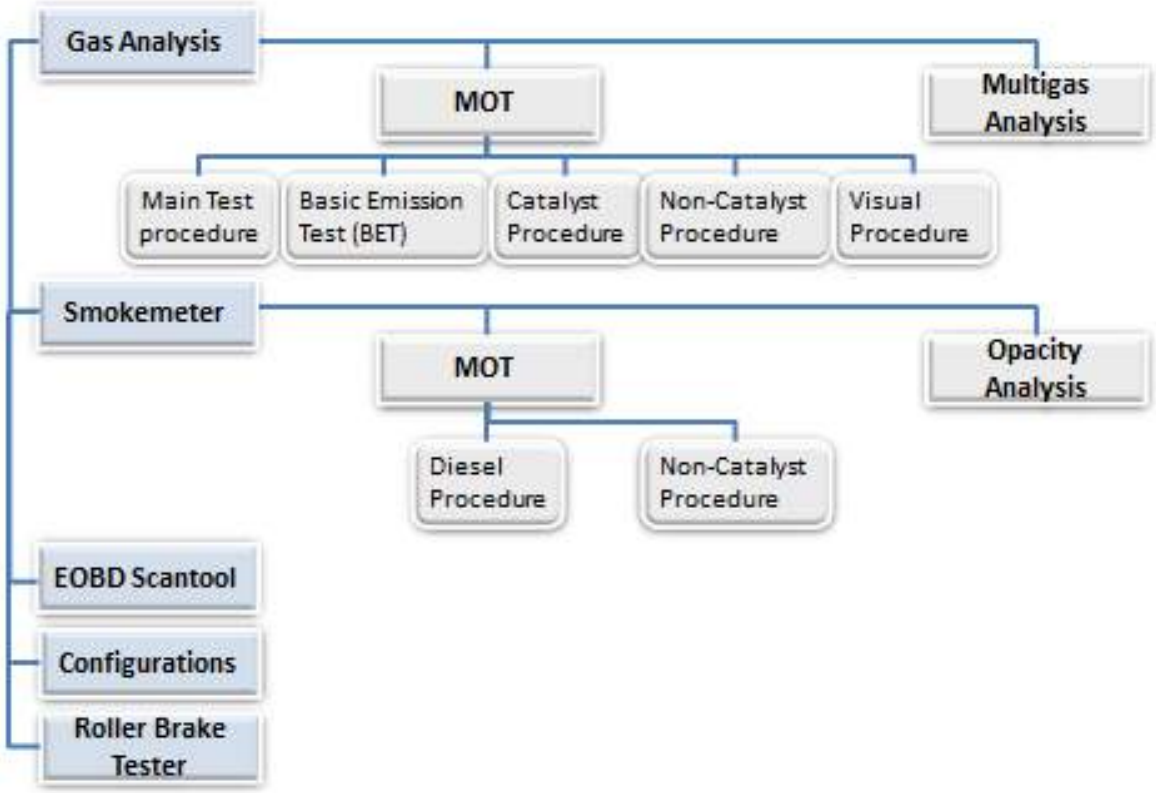
TRADE WILL NOT BE HELD RESPONSIBLE IN ANY CASE FOR ANY DAMAGE, DIRECT OR INDIRECT, OF ANY KIND WHATSOEVER FOR LOSSES OR EXPENSES (DIRECT OR INDIRECT), RESULTING FROM IMPROPER USE.

1 GENERAL DESCRIPTION OF THE STATION

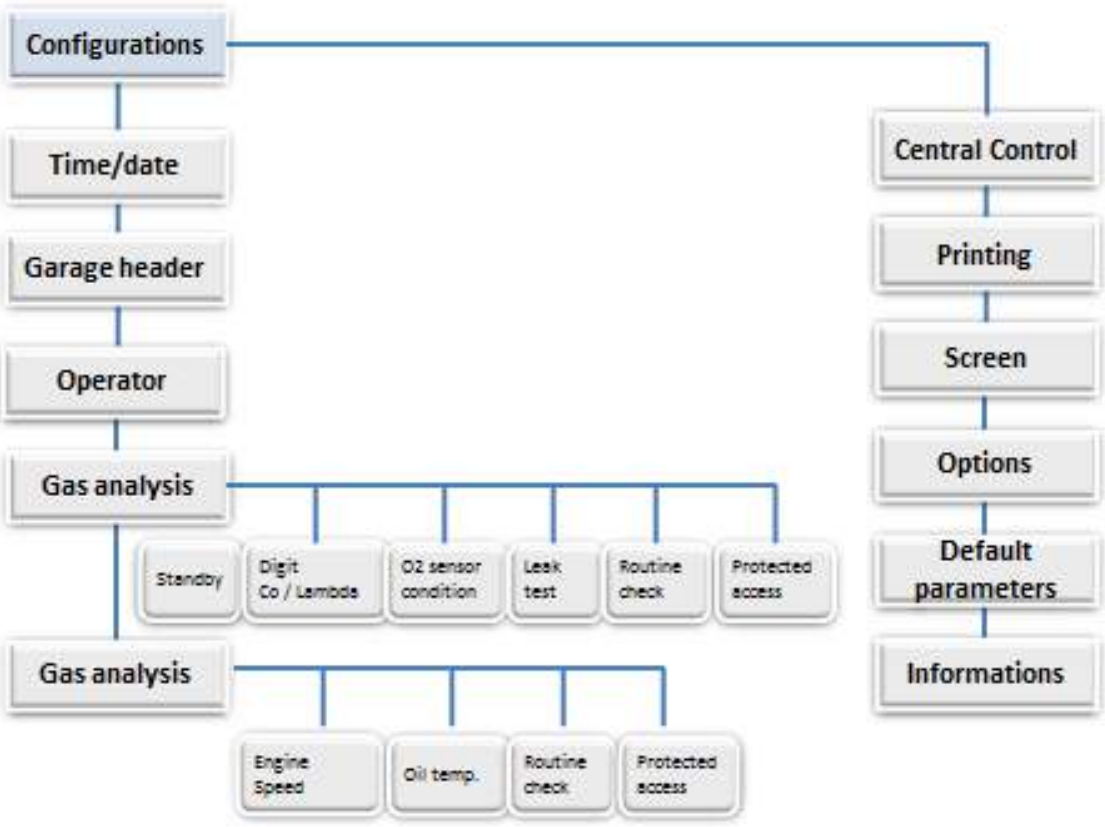
1.1 OVERALL DIAGRAM

The diagrams presented below allow the menu hierarchy to be understood; the user can thus easily follow the sequence of the various sub-parts.

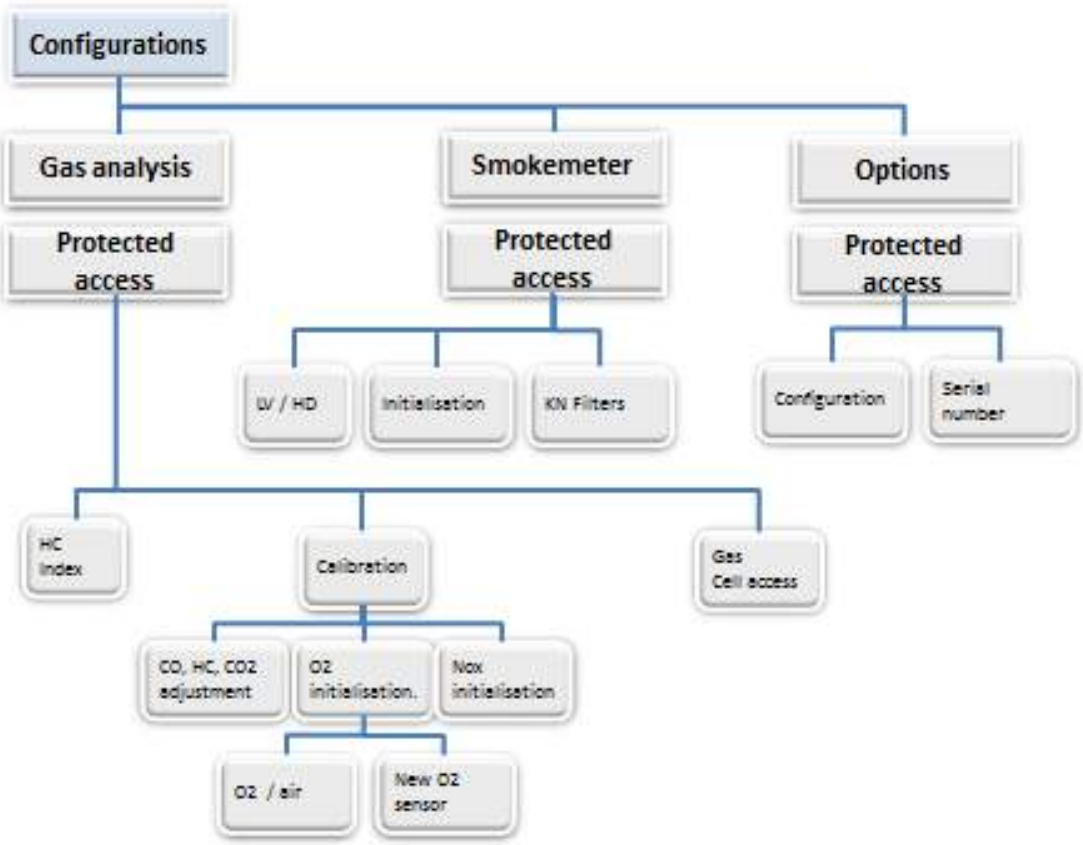
1.1.1 Main menu:



1.1.2 Configurations :



1.1.3 Protected access:



1.2 OVERALL VIEW:

The T8000 station consists of a CAP3010 gas analyser, an opacity measurement cell and a trolley.

The T8000 has an LCD screen, a gas analysis module for petrol vehicles, a keyboard and a printer. The measurement cell is connected to the station by a power supply and data cable. It is packaged in the form of a small metal briefcase mounted on legs.

1.2.1 The Product strucutre

1.2.2 List of components supplied

1 USER MANUAL,

FOR GAS ANALYSIS:

- *GAS ANALYSER*,
- *SAMPLING PROBE*,
- *EXHAUST TUBE*,
- *FILTERS*,
- *OIL TEMPERATURE MEASUREMENT PROBE*,
- *A INDUCTIVE PICK-UP.*

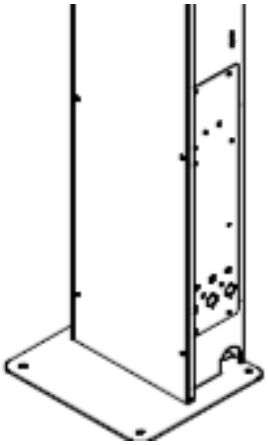
FOR CALCULATING THE OPACITY DIESEL EXHAUST EMISSIONS:

- *OPACITY CELL*,
- *SAMPLING PROBE*,
- *A CELL SUPPORT*,
- *CLEANING BRUSH*,
- *CELL POWER AND DATA CABLE*,
- *A PIEZOELECTRIC SENSOR CABLE.*

OPTIONS :

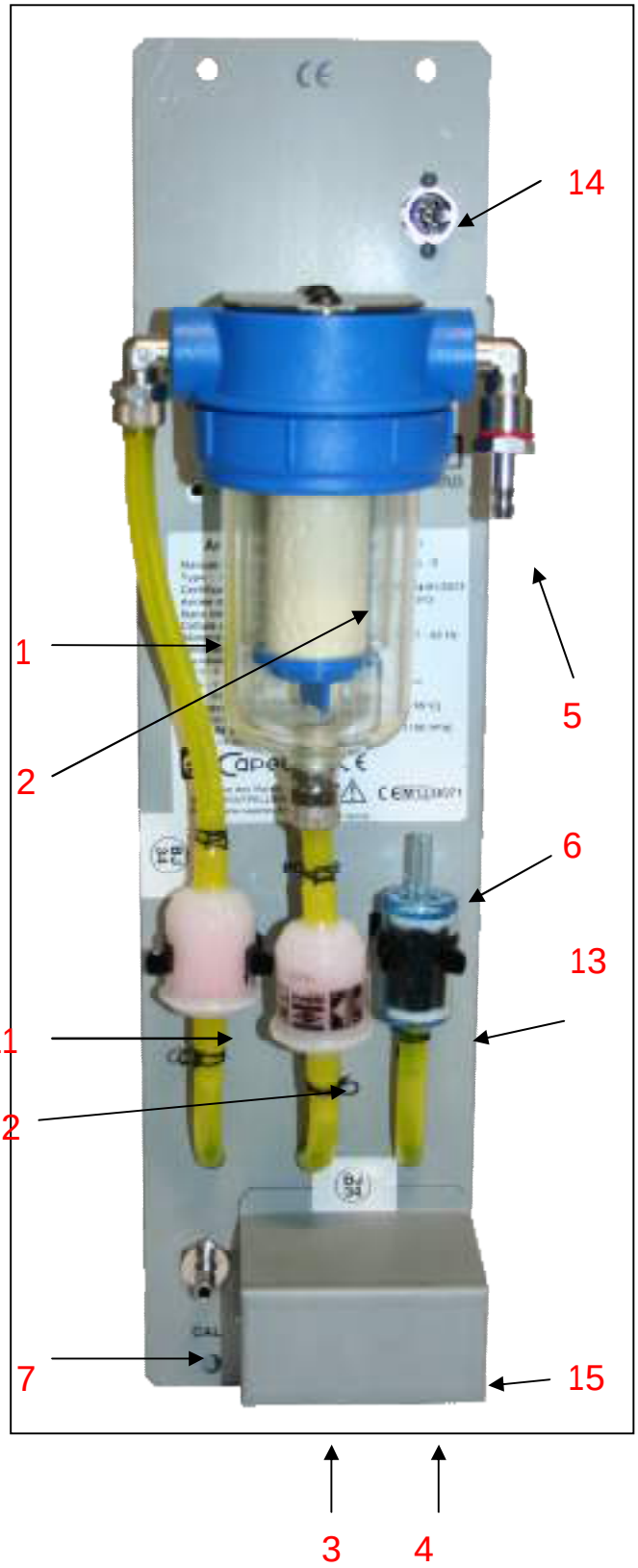
- *EXTERNAL A4 FORMAT PRINTER*,
- *OBD KIT*,
- *VIBRATION RPM DEVICE.*

1.2.3 Totem structure

Totem Gas box slot 	

_1_ Power switch _2_ Keyboard slot _3_ Gas Sampling probe _4_ Exhaust collector attachment grip _5_ _6_ RPM/Oil & OEBD modul craddle _7_ Oil probe	

1.2.4 Gas Analyser Box



_1_ Identification plate

_2_Settling tank filter (***FD***)

_3_Measured gas outlet (***GAS***)

_4_Condensate outlet (C*OND*)

_5_Intake of gas to be measured (***GAS***)

_6_ surrounding air intake for zero setting

_7_Intake of calibration gases **(CAL)**

_8_Ventilator filter (***FV***)

_9_Mains filter with fuse, 230V switch

_10_Serial Port COM1

_11_gas pump protection filter (***FG***)

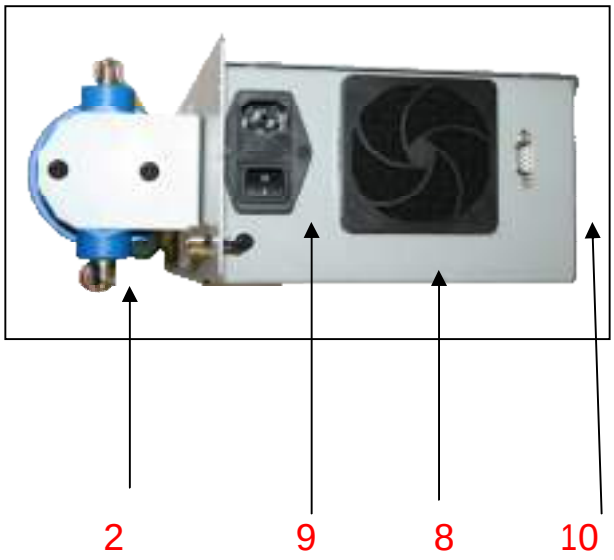
_12_Condensate pump protection filter (***FC***)

_13_Activated carbon filter (***FCC***)

_14_Oil temp connector

_15_Protection box for O2 & NOX sensors

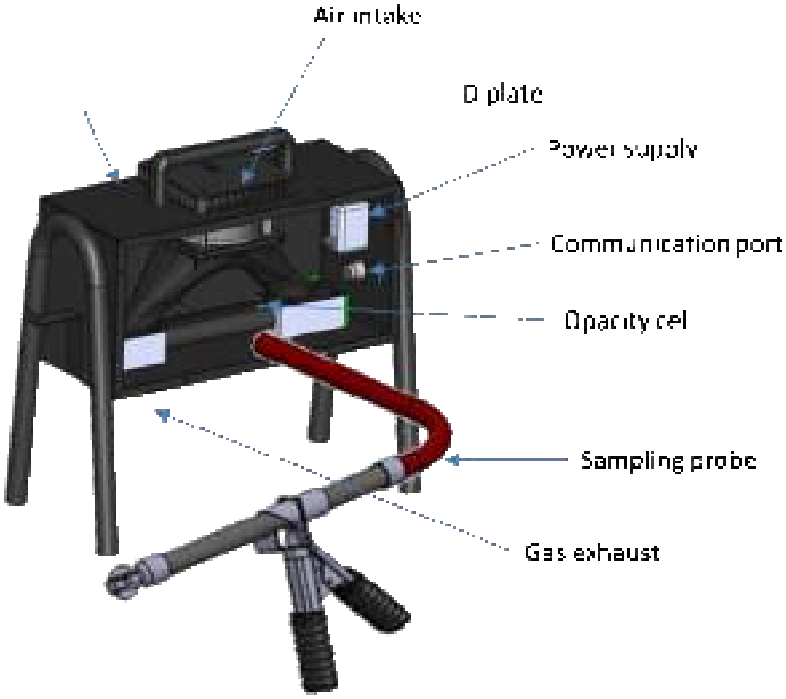
TOP VIEW:



1.2.5 Gas Sampling Probe

Handle / clamp is movable along the probe in order to adjust the length inserted into the exahust pipe, whilst the clamp is propely positioned at the end of the exhust pipe.

1.2.6 Opacity measuring cell



Category A sampling Probe	Caterogy B sampling Probe : 2m long
	

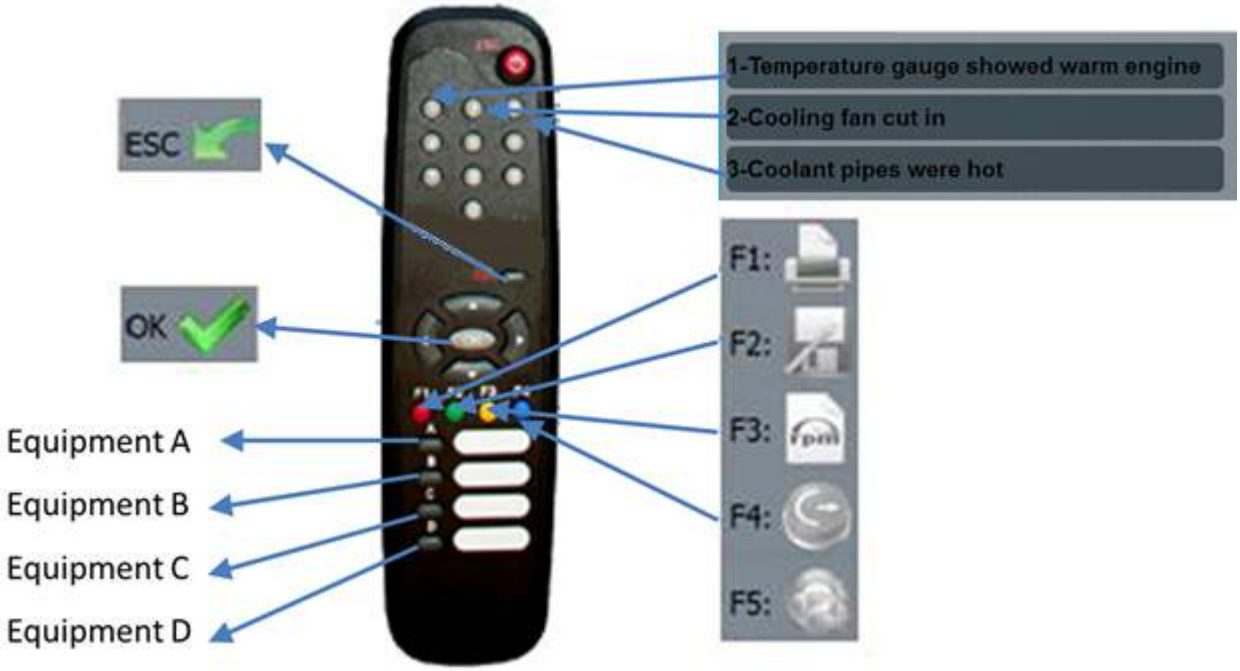
1.2.7 The temperature/tachometer module

Measurement range	400 to 9,999 RPM
Accuracy/Performance	≤ ± 20 RPM from 400 to 2000 RPM ≤ ± 2% from 2001 to 9,999
Resolution	10 RPM
Initialization Time	< 15 seconds
Response **Time**	≤ 0.7 second
Module Bluetooth	Class 1, can communicate upto 100m.

	Temperature probe
	Cigar lighter connector (RPM BAT)

	Battery Clamp (with Female cigar plug connxion) (RPM BAT)

1.2.8 Remote control



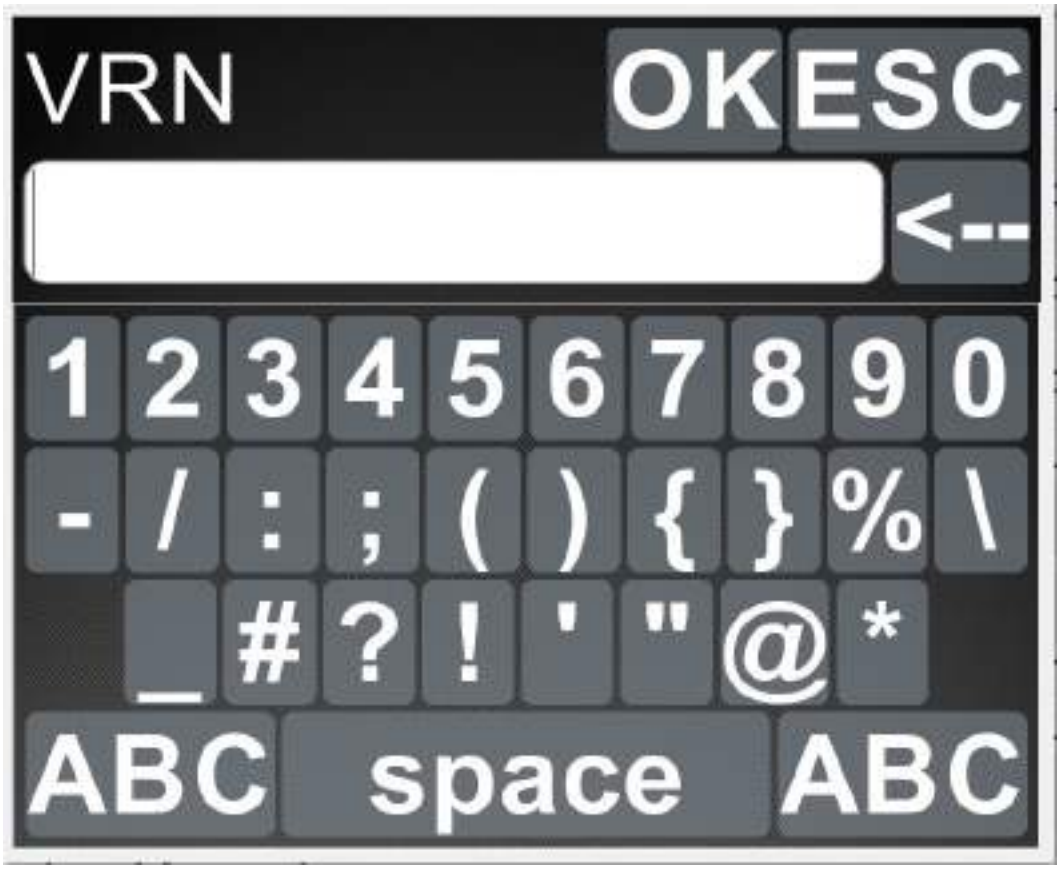
1.2.9 Virtual Keyboard from T8000

Any field requiring keyboard entry automatically opens a virtual keyboard.

Typing on it with the touch screen feature will allow you to enter the data required.

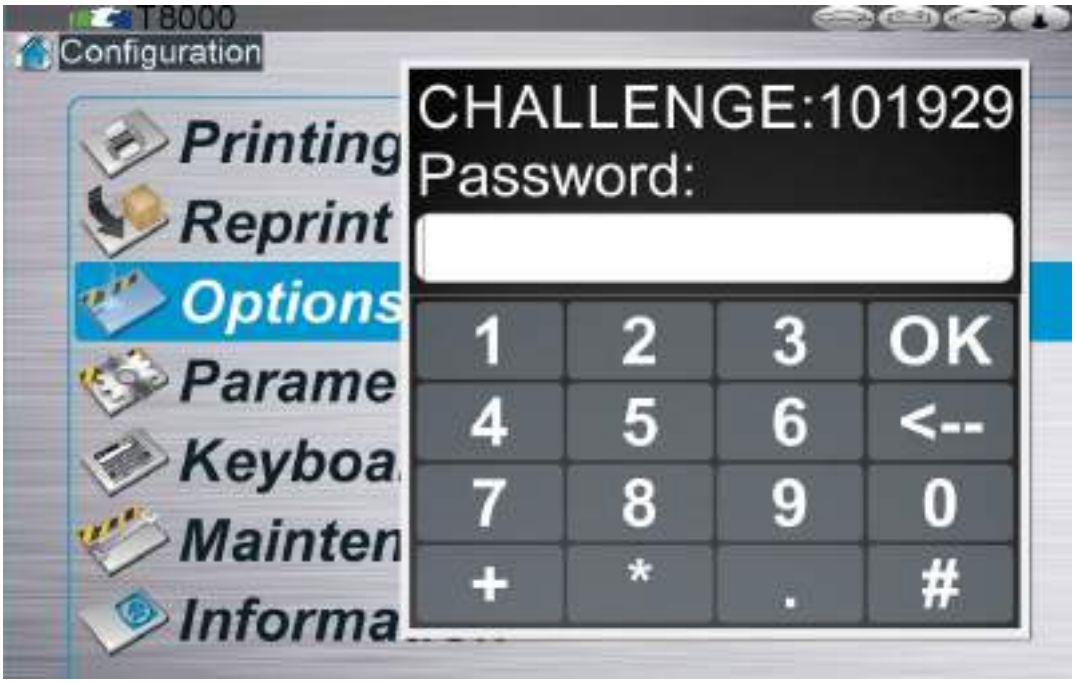
A toggle mode allows the switching between numbers and letters

(key 123 /abc at bottom right)



Or to capital letters (key ABC /abc at bottom left)

ADDITIONAL KEYBOARD EXIST FOR RESTRITED ACCES, WHERE A FIELD NAMED CHALLENGE APPEARS TO GET THE CODE OF MAINTENANCE.



1.2.10 Virtual Keyboard from Windows

The way to enlarge it on the screen: on the left end side, typing will make a small tab appear, typing again will allow the full keybard to be displayed on the screen.

Moving the virtual keybaord: Keep your finger pressed on the screen and then 'drag' the keyboard to the desired position.

Closing the virtual keyboard: by tapping on the upper right cross.

1.2.11 Hardware keyboard

It is a standart keyboard (type : « QWERTY »).

The mains keys are ENTER and ESC.

- Select with arrow (F1, F2, F3, F4, F5) .
- ENTER : Validates your choice
- Esc : Quit and return at the last window.

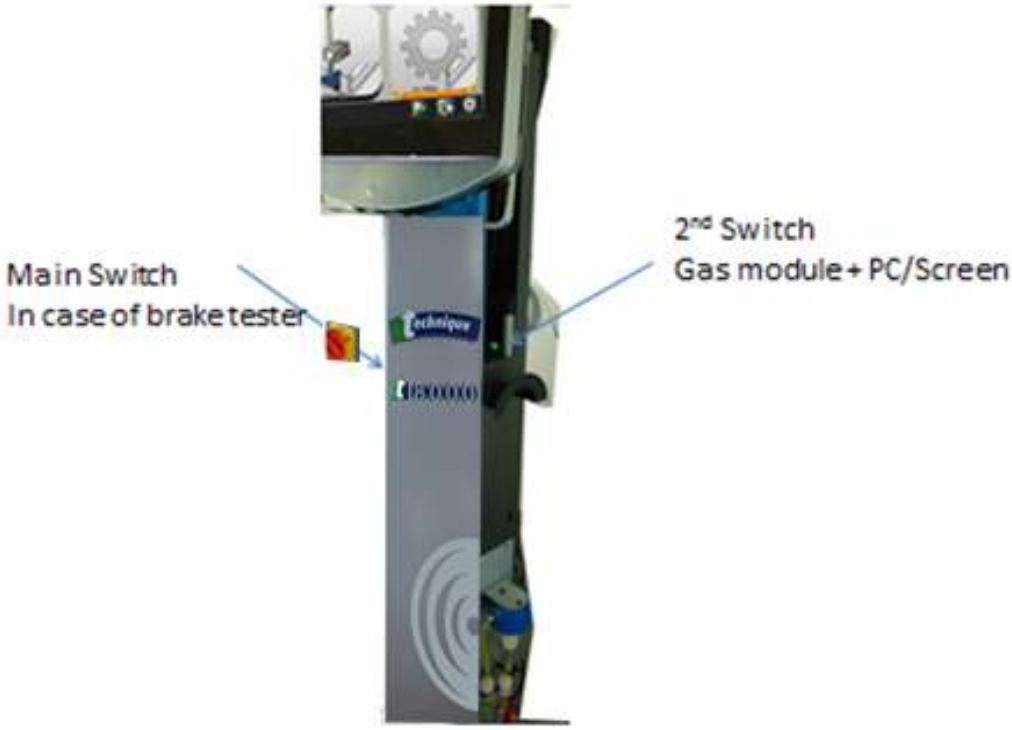
1.3 INSTALLATION, START-UP

1.3.1 Recommendations

THE MACHINE CAN BE LEFT POWERED UP 24 HOURS A DAY. IT IS RECOMMENDED, HOWEVER, THAT THE ELECTRICAL POWER SUPPLY BE TURNED OFF DURING THE NIGHT (ENSURE CORRECT TURN OFF PROCEDURE FOR THE PC). POWERING UP THE MACHINE IN THE MORNING WILL INVOLVE SEVERAL MINUTES' WAIT BEFORE THE GAS ANALYSIS MODULE IS OPERATIONAL. POWERING UP THE CELL INVOLVES A WAITING PERIOD OF AT MOST 5 MINUTES FOR THE CHAMBER TO REACH ITS OPERATING TEMPERATURE (PREHEATING).

1.3.2 Starting

- Connect the station as to be connected to the 230 VAC 50 Hz mains.
- Switch on the station: in case of brake tester: main switch (Red of yellow)
- Make sure the 2nd switch is ON

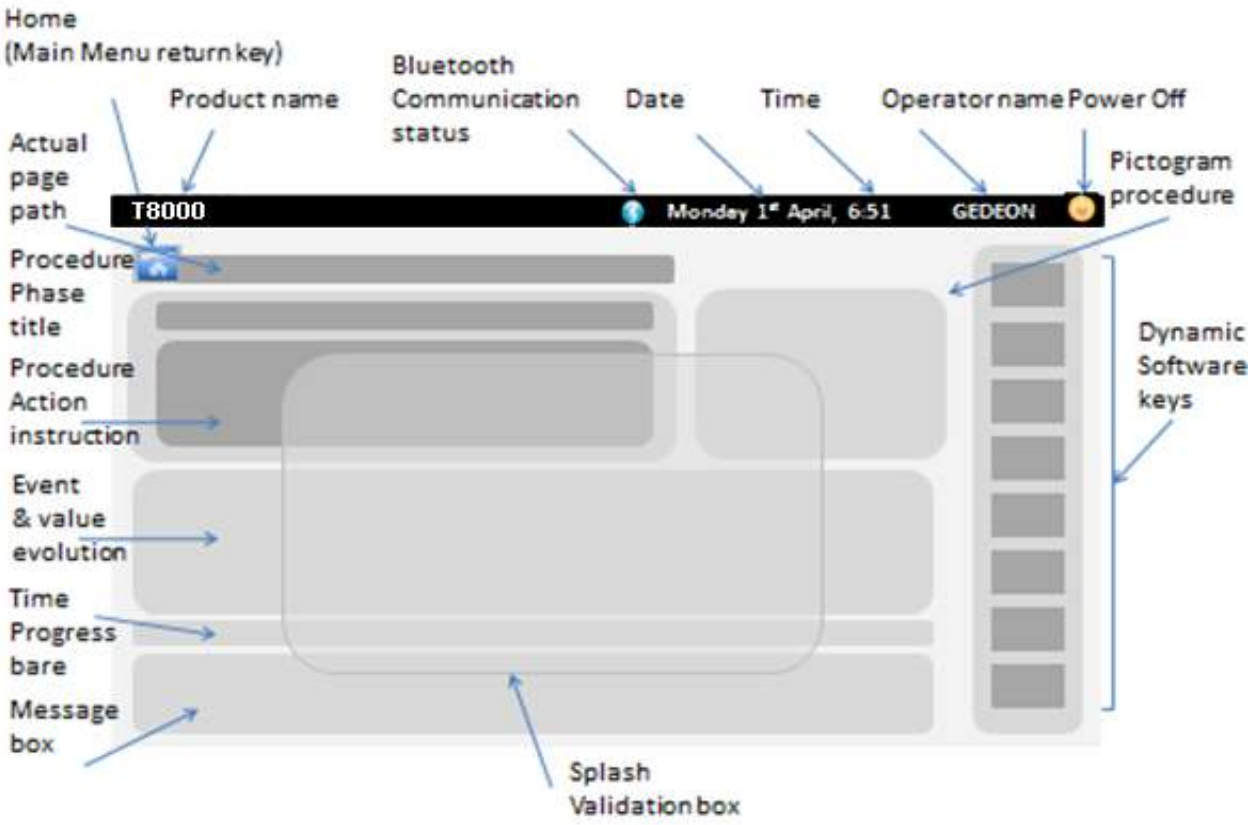


SIGNS OF CORRECT OPERATION:

THE SCREEN LIGHTS UP AND THE COOLING FAN MUST START. THE PRESENTATION PAGE WITH THE TRADE GROUP LOGO APPEARS ON THE GRAPHICS SCREEN.

THE MAIN MENU APPEARS AFTER A FEW SECONDS.

1.3.3 Screen structure



1.4 MAINTENANCE, PRECAUTIONS DURING OPERATION

1.4.1 General

Each T8000 is inspected before delivery by a trained engineer, who affixes a stamp mark on the plate attached to the rear of the machine.

1.4.2 Cleaning cables and surfaces

The station, the screen, the keyboard (optional) and the cables may be cleaned with alcohol on a clean rag. Any other solvent is strongly discouraged as it may cause damage.

2 GAS ANALYSIS: (PETROL VEHICLE)

2.1 PRINCIPLE OF OPERATION

The gas analyser is a module designed for periodic technical inspection (PTI) and automotive workshops. It allows measurement of the carbon monoxide (CO), carbon dioxide (CO2), hydrocarbons (HC - in hexane equivalent C6H14) and oxygen (O2) concentration of the gases from spark-ignition vehicles (petrol, high-octane petrol, CNG and LPG), with or without a catalytic converter. As an option, it can be equipped with an NOx kit allowing nitrogen oxides to be measured.

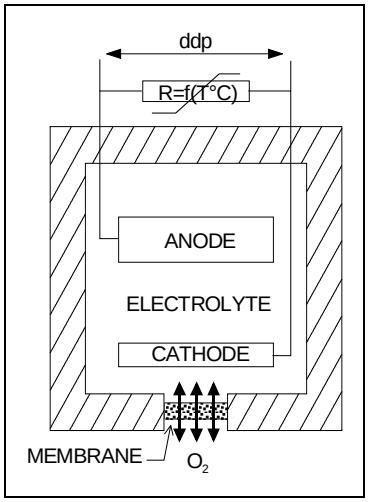
The T8000 also allows the following values to be obtained at any time:

- Calculation of the corrected CO value (balance of the CO and CO2 values)
- Calculation of Lambda value
- The measurement of engine speed (measured by battery input, vibration...)
- Measurement of oil temperature.

The measurement of CO, CO2 and HC is carried out using non-diffusing infrared radiation. The gas passes through a measuring chamber, which uses three light emitters and three infrared detectors. Each emitter emits with a characteristic wavelength associated with one of the three gases.

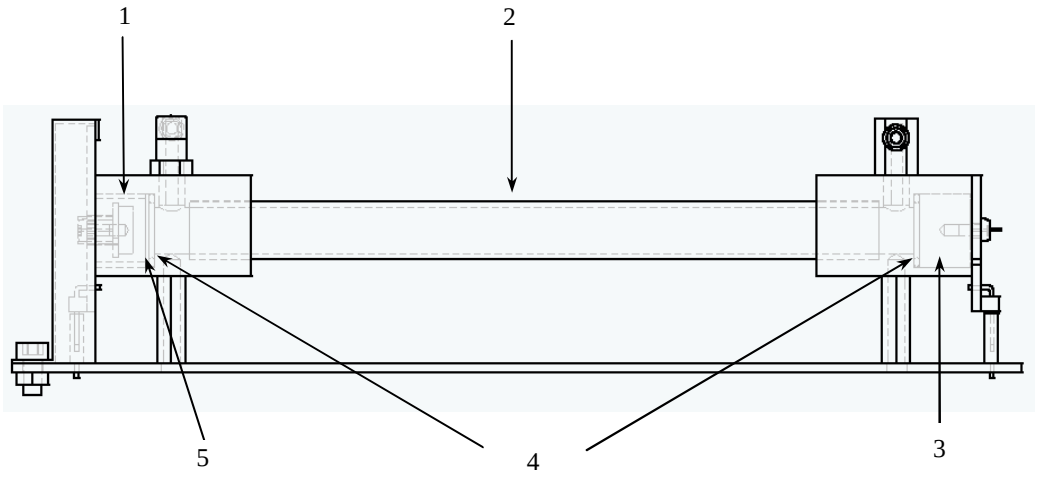
Each of the detectors creates an electrical value corresponding to the intensity of the radiation received.

Measurement of oxygen concentration is carried out by an active chemical sensor.



PRINCIPLE OF OXYGEN MEASUREMENT:

The oxygen sensor is an electrochemical type; it is based on the principle of electrolysis. In the presence of oxygen, an ionic current is created through the cathode, the electrolyte and the anode, giving rise to a potential difference at the terminals of a resistor, which varies as a function of temperature. As a result, the sensor is temperature-compensated.



N°	Descriptions
1	IR detector
2	Sample cell
3	IR emitter
4	O rings
5	Optical window

Principle of NDIR measurement:

The T8000 is based on non-diffusive infrared (NDIR) technology.

NDIR devices are generally used for measuring concentrations of a specific and limited set of gases in mixtures having a known and limited collection of base gases.

It is possible for example to measure the concentration of CO2 of a base gas such as the exhaust gas of an automobile. It is known that gases which might have an absorption spectrum masking that of CO2 are absent.

A specific collection of gases (CO2, C6H14, CO) is measured as follows: a unique range of wavelengths in the infrared spectrum is selected for each gas in order to measure the point where its absorption is high and where there are no other base gases which are equally absorbent.

Optical filters transmitting only the given range of wavelengths are placed in front of the thermocouple detector. When the cell is full of the gas to be analysed, the infrared detector measures the reduction in the infrared energy obtained for the range of wavelengths linked to each gas.

The signal processing electronics then determine the ratio I/Io.

I/IO = DEGREE OF ABSORPTION

I = SIGNAL RECEIVED (SAMPLE) FOR EACH GAS TO BE MEASURED.

IO = REFERENCE SIGNAL

2.1.1 Corrected CO

Corrected CO is calculated as follows:

If (%CO + % CO2) ≥ 15 then corrected CO = CO

If (%CO + % CO2) < 15 then corrected CO = CO x (15 ⁄ (CO+ CO2))

2.1.2 Lambda

It is derived from BRETTSCHNEIDER formula. This coefficient is calculated from the value of CO, CO_2, HC and O_2.

$$\lambda = \frac{CO_2 + \frac{CO}{2} + O_2 + \left(\frac{1,7261}{4} \times \frac{3,5}{3,5 + \frac{CO}{CO_2}} - 0,0088 \right) \times (CO_2 + CO)}{\left(1 + \frac{1,7261}{4} - 0,0088 \right) \times \left(CO_2 + CO + 6 \times HC \times 10^{-4} \right)}$$

(CO, CO_2 and O_2 are given in %, HC in ppm)

This calculation is constantly carried out by the analyser unless CO_2 is equal to 0%. If the vehicle is well tuned, its Lambda will lie between 0.97 and 1.03

CNG, LPG EFFECT (Only on specific vehicles)

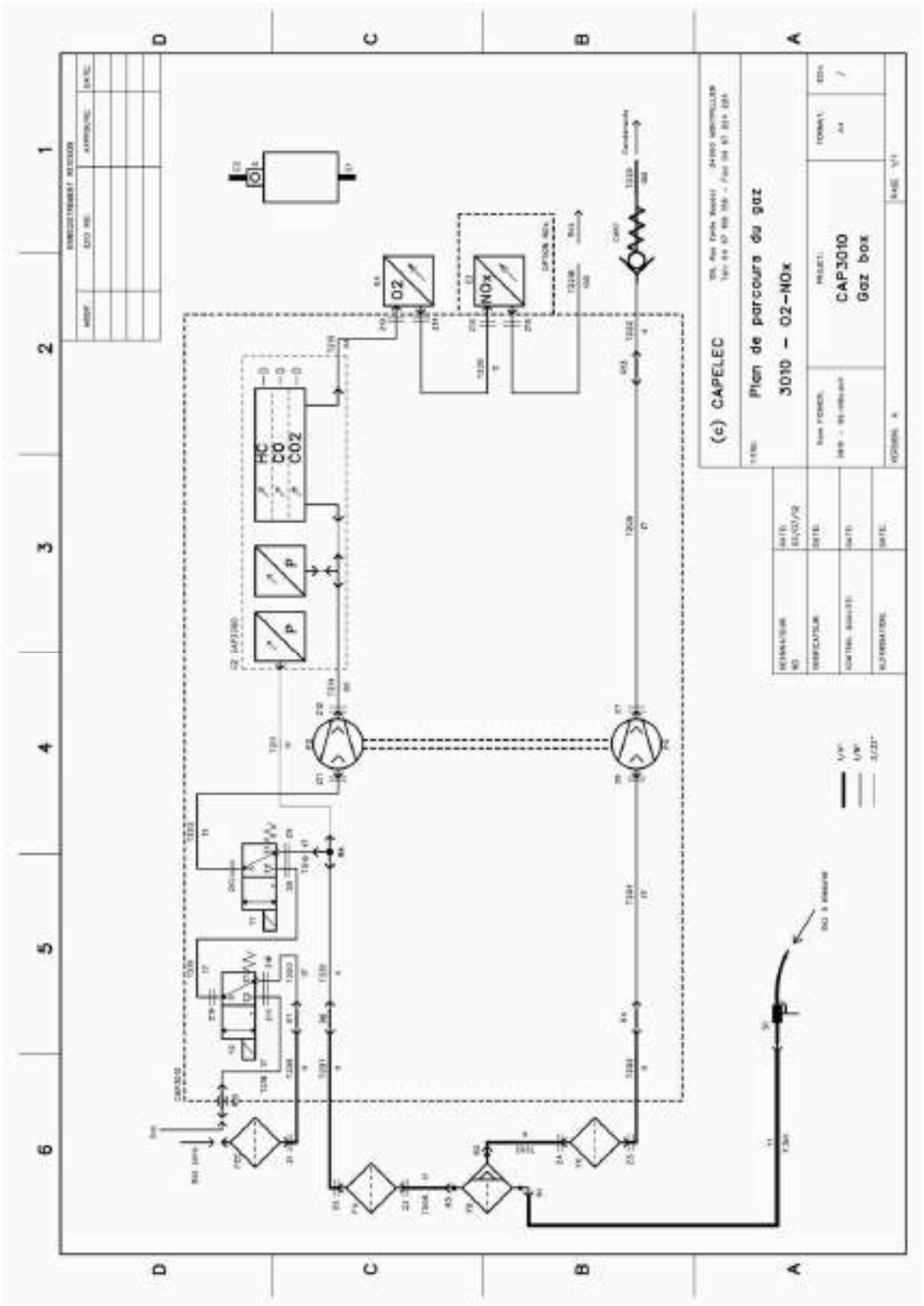
For specific vehicles it is possible to select on the measurement page LPG, CNG or PETROL cars. The only effect is to change the HC calculation:

→ LPG involves HC*0.5

→ CNG involves HC*0.3

→ PETROL involves HC*1.

2.1.3 Pneumatic circuit



2.2 OPERATING CONDITIONS

The gas analyser is equipped with automatic monitoring of parameters that have an influence on measurements. If at least one of these parameters is out of tolerance, hence threatening to metrologically alter the results, the gas analyser disables itself and prevents any measurement from being performed until the correct operating conditions are re-established.

Failure to observe operating conditions may result in degradation of the equipment or temporary disabling of the T8000:

- Atmospheric pressure 1000 mbar +10% -25%
- Mains voltage 230 VAC +10% -15% 50 Hz+-2%
- Ambient temperature: from 5 to 40 °C
- Gas temperature: 200 °C tolerated by the probe
- Storage temperature: -32 to +55 °C
- Relative humidity: <98% non-condensing
- Clean ambient air and a well ventilated environment.

2.3 TECHNICAL CHARACTERISTICS

- Preheating time: < 9 minutes at 0°C (1 minute minimum)
- Response time: 13 seconds for HC, CO, CO2, 28 seconds for oxygen (transition from 20.9% to 0.1% for a gas with 0% O2)
- Nominal pump delivery: 6 l/min.
- Minimum pump delivery: 3.5 l/min.
- Air pressure variation: automatic correction by integrated absolute pressure sensor
- Zero point and sensitivity: automatic compensation
- Automatic pump standby and automatic zeroing.
- Measurement ranges:
  - *HC = NORMAL RESOLUTION : 0 TO 20 000 PPM PROPANE*
  - *CO = 0 TO 15 %*
  - *CO_2 = 0 TO20 %*
  - *O_2 = 0À 25%*
  - *NOX = 0 À 5000 PPM*
  - *ENGINE SPEED = 0 À 9999 RPM*
  - *OIL TEMPERATURE = -5 À 150 °C*
  - *CORRECTED CO = 0 A 10 %*
  - *AIR/FUEL COEFFICIENT (LAMBDA)= 0 TO 9.999*
- Accuracy:
  - *CO: 0.03% VOL. ABSOLUTE OR 3% OF VALUE READ*
  - *CO2: 0.4% VOL. ABSOLUTE OR 4% OF VALUE READ*
  - *HC: 10 PPM ABSOLUTE OR 5% OF VALUE READ*
  - *O2: 0.1% VOL. ABSOLUTE OR 3% OF VALUE READ*
  - *NOX = 1 PPM VOL.*
  - *ENGINE SPEED = +- 10 RPM*
  - *OIL TEMPERATURE = +- 1 °C*
  - *CORRECTED CO = 0,03 %*
  - *AIR/FUEL COEFFICIENT (LAMBDA)= 0,03*
- Resolution:
  - *CO: 0.01% VOL. IF THE BIT CO3DIGITS =0*
  - *CO: 0.001% VOL. IF THE BIT CO3DIGITS =1*
  - *CO2: 0.1% VOL.*
  - *HC: 1 PPM VOL. (10PPM IF HC>2000PPM)*
  - *O2: 0.01% VOL.*
  - *NOX: 1 PPM*
  - *LAMBDA: 0.001*
  - *ENGINE SPEED = 1 REVOLUTIONS/MIN*
  - *OIL TEMPERATURE = 1 °C*

- *CORRECTED CO = 0,01 %*
- *AIR/FUEL COEFFICIENT (LAMBDA)= 0.001 OR 0.01, SELECTABLE*

2.4 EMISSION TEST

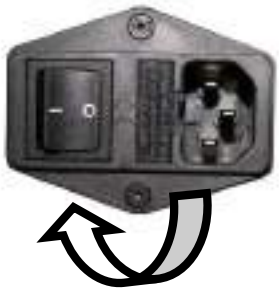
2.4.1 Preliminary checks

- Place the equipment in the designated location. The surface must be horizontal and must not be exposed to excessive vibrations, dust or cold. There must be no petrol vapour in the vicinity of its location.

- *CONNECT THE EXHAUST TUBE AS SHOWN BELOW.*

- *DO NOT INSERT THE PROBE.*

- *SWITCH ON*



2.4.2 Cleaning and precautions during operation

The T8000 is a machine that needs a little maintenance. Only the pneumatic circuit components that carry the gases, located on the outside of the analyser, need to be maintained by the user. However, failure to maintain the machine to these instructions invalidates the warranty.

Depending on the frequency of use, but at least every three months, the condition of the pneumatic circuit including tubing and filters must be inspected.

2.4.2.1 General maintenance

- Change the separator filter FD,
- Change filters FC and FG,
- Visually check the filter connections.
- Visual inspection of the sampling probe - Clean it if necessary.
- Perform a leak test.

2.4.2.2 Maintenance of the separator

The separator includes a filter.

Replace the filter when it has become grey (showing obvious signs of being contaminated).

Filter replacement is carried out in the following manner:

- Turn off the machine to shut off the pumps

- Unscrew the condensation residue collector located at the back of the machine. (FD).

IMPORTANT: The absence of one of the components inside the separator or incorrect reassembly of the filter housing will contaminate the measuring device and the measurements will be prematurely invalidated due to the resulting errors. This condition of the analyser will require an overhaul that will not be covered under warranty.

NOTE: A leak test must be carried out after any maintenance on the pneumatic circuit of the equipment (page 29)

2.4.2.3 Replacing a filter

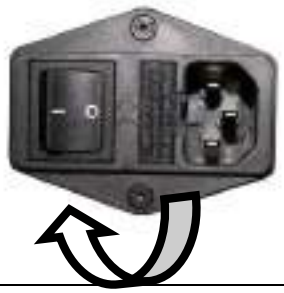
If one of the filters appears to be dirty or if an error message is shown as mentioned in the user manual, then filter replacement is necessary. During this process the following points must be observed:

- *SWITCH OFF*

- *REMOVE THE FILTER TO BE REPLACED (BEHIND THE LOCATION DESIGNATED FOR EACH FILTER, THE REFERENCE IS PRINTED ON THE CASE).*

- *REPLACE THE OLD FILTER WITH THE NEW ONE, MAINTAINING THE CORRECT INSTALLATION ORIENTATION (FLOW DIRECTION)*

- *SWITCH ON*



- *PERFORM A LEAK TEST AS DESCRIBED IN CHAPTER*

IMPORTANT: The absence of one of the components inside the separator or incorrect re-assembly of the gas flow system will contaminate the measuring device and the measurements will be prematurely invalidated due to the resulting errors. This condition of the analyser will require an overhaul that will not be covered under warranty.

NOTE: A leak test must be carried out after any maintenance on the pneumatic circuit of the equipment (paragraph V.5.4.).

2.4.2.4 Replacing a filter

If one of the filters appears to be visually dirty, or if an error message appears that is referred to in the user manual as requiring a filter replacement, the following points must be observed:

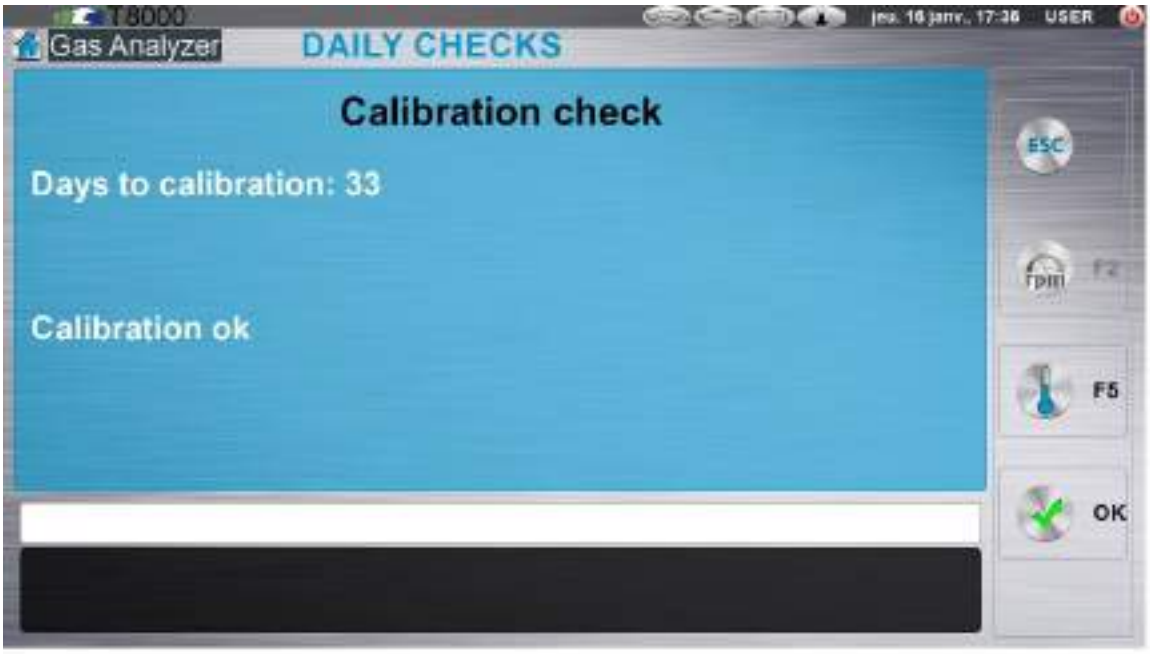
- *TURN OFF THE MACHINE.*
- *REMOVE THE FILTER TO BE REPLACED (BEHIND THE LOCATION DESIGNATED FOR EACH FILTER, THE REFERENCE IS SILKSCREEN PRINTED ON THE CASE).*
- *REPLACE THE OLD FILTER WITH THE NEW ONE, MAINTAINING THE CORRECT INSTALLATION ORIENTATION (SEE SKETCH OF THE REAR SIDE PARAGRAPH I.2.4)*
- *TURN ON THE MACHINE.*

NOTE: A leak test must be carried out after any maintenance on the pneumatic circuit of the equipment, as described in paragraph V.5.4

I.1.1.1. Daily checks

Once a day, when you enter in to the gas analyser mode, the equipment is performing a double check.

- 1st check is the calibration status regarding the remaining time before the next official calibration.
- 2nd check is a leak check:


T8000
Gas Analyzer
DAILY CHECKS
jeu. 16 janv., 17:36
USER
Calibration check
Days to calibration: 33
Calibration ok
ESC
F2
F5
OK


T8000
Gas Analyzer
DAILY CHECKS
jeu. 16 janv., 17:40
USER
Leak check
Seal off sample probe
ESC
OK

Then you need to perform the following task:

You need to block off the end of the sample probe. The gas anlyser will automatically detect the flow blockage and then the following check starts.

Input cloaging is automatically detected by the software. Pumps are turned off and the text message "Test in progess..." is displayed.

It is a must to keep the input block off . This phase takes 20 secondes.

At the end of the test, a result is displayed; If "Leak detected" is displayed, the gas analyser functions are stopped until the problem has been identified and rectified. If the test is passed succesfully, then the message "Leak check pass" is displayed and the user is allowed to use the equipment.

2.5 GAS ANALYSIS

The equipment is designed to minimize the taken to perform an MOT test.

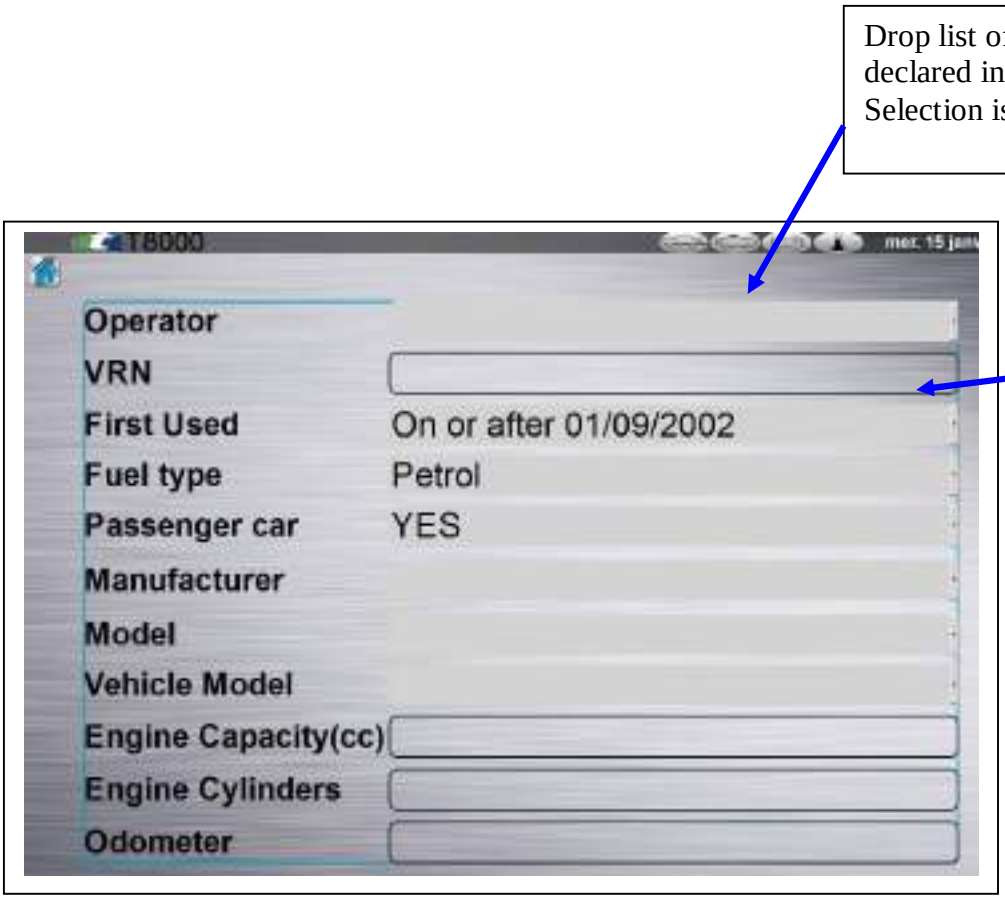
So in order to minimize the number of key strokes/acknowlegdements/clicks, the program is moving directly to the BET procedure if the petrol engine test procedure is selected

2.5.1 Vehicle/Customer information :

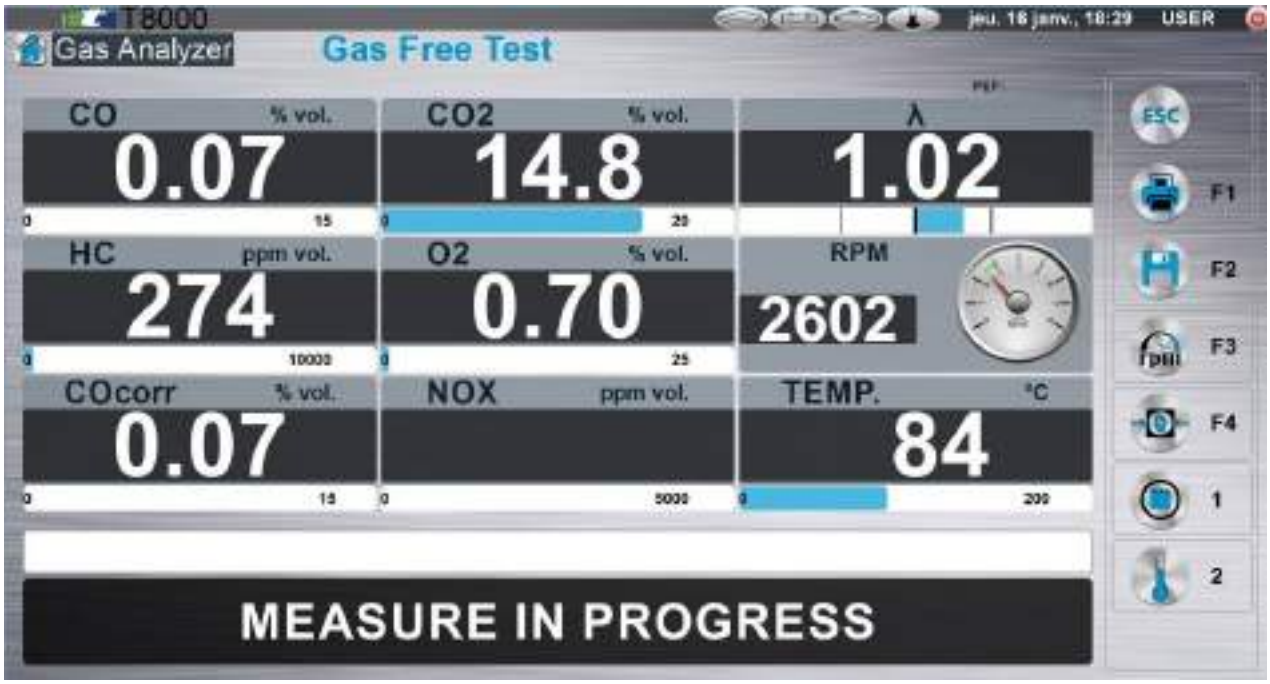
In addition, before any measurement or technical test procedure, the user may, if he desires, enter information about the client and his car (name of client, make of car, mileage and registration plate). This data will then appear on the test report.

The method of data entry is the same as that described for garage entry (see paragraph V.3).

The entry window looks like this:



2.5.2 Description of the graphic interface:



HC = Hydrocarbons expressed as hexane (display as propane is possible: see paragraph II.5.6.1) given in ppm (parts per million).

CO = Carbon monoxide expressed in % by volume.

COcorr. = Corrected CO (paragraph III.I.1).

O_2 = Oxygen expressed in % by volume.

CO_2 = Carbon dioxide given in % by volume.

λ = Displays Lambda value. This value has no particular unit. We say that it is a coefficient or a ratio.

RPM = Engine speed in revolutions per minute.

°C = Oil temperature measurement expressed in degrees Celsius.

The print key: it is displayed only when printing is possible.

Pressing this key will generate a PDF file. This file is printed only if the printer is ready. If the printer is not ready, software will ask if the operator wants to store the result.

The operating/engine speed key: Allows the engine speed to be selected.(II.5.4.).

2.5.3 Preliminary checks

Before undertaking any measurement, the operator must satisfy himself that the engine is operating correctly.

THE FOLLOWING POINTS ARE TO BE OBSERVED:

- *THE VEHICLE EXHAUST SYSTEM MUST BE GAS-TIGHT.*
-  *DRIVE IN NEUTRAL*
- *ACCESSORIES AND OPTIONAL EQUIPMENT THAT CONTROL THE ENGINE IDLE SPEED MUST NOT BE ACTIVATED, UNLESS SPECIFICALLY REQUESTED BY THE MANUFACTURER'S INSTRUCTIONS OR NATIONAL REGULATIONS.*
-  *> 80°C.*

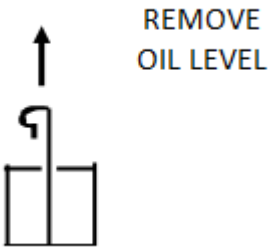
2.5.4 Preparation for measurement

- TACHOMETER

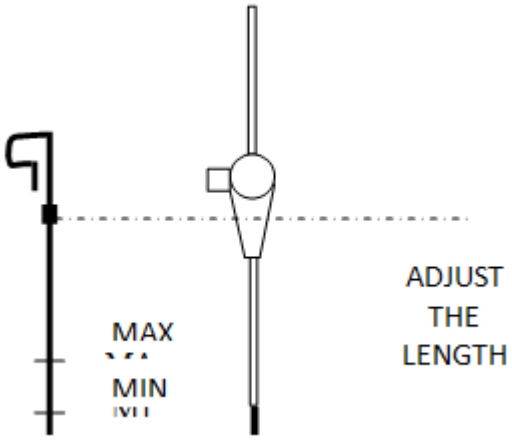
INSTALL THE SENSOR, THEN PRESS THE RPM KEY TO DETERMINE THE APPROPRIATE MODE. THIS MODE IS AUTOMATICALLY SAVED. THE VALUE OF THE RPM SHOULD APPEAR AFTER A SHORT DELAY.

- OIL TEMPERATURE

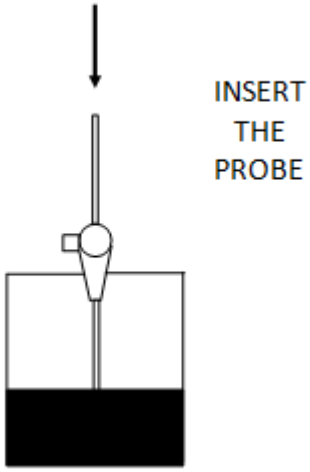
1.



2.



3.



- GAS MEASUREMENT

Insert the sampling probe as far as possible in the exhaust tailpipe. The minimum depth, when the design of the exhaust system allows it, is 30 cm. If this condition cannot be fulfilled, it is necessary to use a collector tube that acts as an exhaust system extension.

If the exhaust system is a single exhaust pipe, but has two tailpipes, it is necessary to use a collector tube into which the probe is inserted.

Start the measurement by pressing the PUMP key (if the pump is not already running).

Start the engine (if the engine is running before the probe is inserted, it is preferable to activate the pumps and to wait for zeroing to finish before inserting the sampling probe as indicated above to allow the gas analyser to adjust to the ambient atmospheric conditions).

2.5.5 Analysis and measurement

Automatic calibration is then activated for a period of 50 seconds. The pump starts running and the following message is displayed on the screen: "ZERO IN PROGRESS".

After this period, the screen contains the message: "Measurement in progress," the results of each measurement appear on the display, the system is ready to carry out a measurement

(concentrations must be similar to those in air: 0% for CO, CO2, 0 ppm vol. for HC, 20.9% for O2.)

2.5.6 RPM:

Pressing this key displays the speed mode currently in use. Alternatively, if the user presses this key again, it displays the new speed mode selection. Unless the key is pressed again, the new speed mode is automatically stored.

- **« E.O.B.D »** : This mode allows the engine speed to be read from the data sent by the engine management computer on board the vehicle (see section IV).

  Connect the cable to the vehicle's 16 pin OBD connector; the plug provided for this purpose is usually located under, or close to the steering wheel. Then connect the other end to the T8000. Select, using the operating speed key, the "E.O.B.D." mode. The engine speed is displayed automatically.

- **« Battery »** : The battery option is composed of an electronic card installed inside the T8000, a cable for data and for power supply from the cigar lighter, plus a cable for data and for power supply from the battery. This option is a battery-driven tachometer which allows operating speed to be measured on **all vehicles - petrol, diesel and LPG by monitoring the alternator ripple frequency.**

Connect the cable on the T8000 (RPM BAT); select the "battery" mode using the operating speed key. After three seconds, the operator must choose and confirm the number of cylinders. If the battery cable is correctly connected, the system carries out an initialization phase. After this phase the operating speed is displayed.

NOTE: In the event of a problem, turn on the heated rear screen and the headlights, but turn everything else off (especially the internal heater fan).

See section VI.

2.5.7 Printing results

Printing of values displayed on screen is done by simply pressing the PRINT key: 

It is possible to print the results of measurements at two test points (for example, idle measurement and measurements during high-speed running).

VRN entry will automatically generate storage of the first series of results made. During printing, both the values retained in the memory and the current values will appear.

Sending the report to a central storage database erases the values stored in memory.

Printing is done by simply pressing the PRINT key while the analyser is in measurement mode (pumps activated and auto-zero complete).

2.6 OFFICIAL MOT TESTING

In an MOT test, the procedure is composed of one or more of the following sequences:

- Main Test procedure (always executed at the beginning of MOT test)
- Basic Emission Test (BET)
- Catalyst Procedure
- Non-Catalyst Procedure
- Visual Procedure

Basic Emission Test (BET)

The Basic Emission Test is used for the following vehicles:

- date first used: on or after 1 September 2002 and fuel type is petrol.
- date first used: between after 1 August 1992 and 31 August 2002, fuel type is petrol and vehicle type is passenger car.
- date first used: on or after 1 August 1994, fuel type is petrol and vehicle type is not passenger car.

BET procedure is quicker than the complete procedure, but the test thresholds are stricter because they are based on basic limits and not vehicle manufacturer model specific limits.
Consequently, the user can save time by using the BET sequence. Indeed, in the case of passing the BET, there is no need to continue to an additional Catalyst procedure which is much longer than the BET procedure.

Catalyst Procedure

The Catalyst Procedure is used for vehicles first used on or after 1st August 1992, but only if the BET is failed. The full catalyst sequence follows a similar sequence to the BET and is used to pass a second attempt with thresholds corresponding to vehicle manufacturer's model specific limits and pre-conditioning phases which lead to a longer, dedicated test rotutine.

Non-Catalyst Procedure

The Non-Catalyst procedure is used for the following vehicles:

- date first used: between 1 August 1992 and 31 July 1994, fuel type is petrol and vehicle type is not a passenger car.
- date first used: between 1 August 1975 and 31 July 1986.

This procedure is more tolerant than the Catalyst procedure. It contains an engine purge sequence to clean the exhaust of the vehicle before the checking sequences. Additionally, there is a smoke level check which consists of a visual assessment of the smoke emitted from the tailpipe.

Visual Procedure

The Visual procedure is used for vehicles first used before 1st August 1975. This procedure is only based on idle speed and smoke level checking. There is no HC residue or idle emissions checking.

2.7 BET PROCEDURE: VEHICLES WITH CATALYTIC CONVERTER

The BET procedure (Basic Emission Test) is the basic procedure applicable to:

- all vehicles first used after 1st September 2002 which use petrol, LPG or CNG as a fuel
- passenger cars first used between 1 august 1992 and 1st September 2002 which use petrol, LPG or CNG as a fuel.
- non-passenger cars first used after 1st august 1994 which use petrol, LPG or CNG as a fuel.

BET is fast procedure and allows the operator to perform a quick emission test on the categories of vehicles shown above.

2.7.1 Starting BET procedure from "MOT TEST"

Among other functions the First Screen is aimed for a quick start of the MOT Gas test. The operator clicks on button "Gas"  to start the BET test procedure (Figure 6.2.4.1-1).

Figure 6.2.4.1-1: MOT Test

2.7.2 Operator's and Vehicle's Data acquisition screen

After starting the BET test (Figure 6.2.4.1-1) application proceeds to data acquisition screen (Figure 6.2.4.1-1).

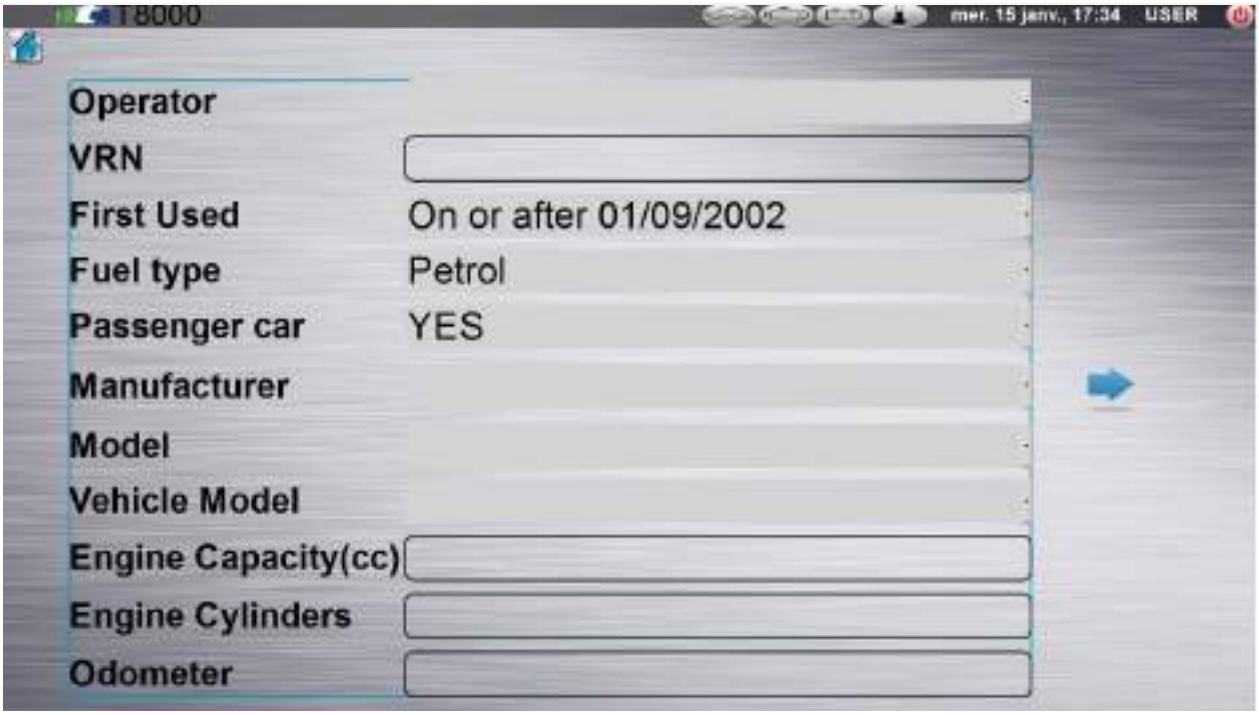


Figure 6.2.4.1-1: AutoZero check is performing in parallel during operator

fills data

In this screen the operator fills in data about himself/herself and the vehicle. The fields are filled by choosing from the drop-down list, where the drop-down list is shown on the right side of the field, or simply by filling the data in the field when a drop-down list is not present.
There are both mandatory and optional fields. Application continues only when mandatory fields are filled. For the first step only the field "First Used" is mandatory. Depending on the contents filled in to this field in the first step, the mandatory field candidates can be:

- Fuel type (Operator can selects: Gas, Compressed Natural Gas(CNG) or Liquid Petroleum Gas (LPG))
- Passenger car (Operator has to select between Passenger and Non-Passenger car)

Other fields are optional and related to the operator and the vehicle.

For operator's convenience (quick testing), some internal tasks can be performed in parallel.
If the AutoZero check has not been done, it goes in parallel with data acquisition.
Bottom part of the screen, also known as the Dynamic information messages area, displays the internal states of the tool (Figure 6.2.4.1-1).

.The operator clicks on the validation button  , or key "F1" to continue with the BET procedure, when the mandatory fields are filled.

Clicking on the "Home" button  will bring you back to the top menu.

2.7.3 Preparation for the BET test

The operator has to confirm that the engine has reached a sufficient temperature to proceed with the test.

6.2.4.1-1: Demand for engine temperature checking

The operator confirms that has checked the engine temperature. This can be done in one of the three ways showed on Figure 6.2.4.1-2. He clicks the corresponding choice button, or presses the key with the corresponding choice number on the keyboard:

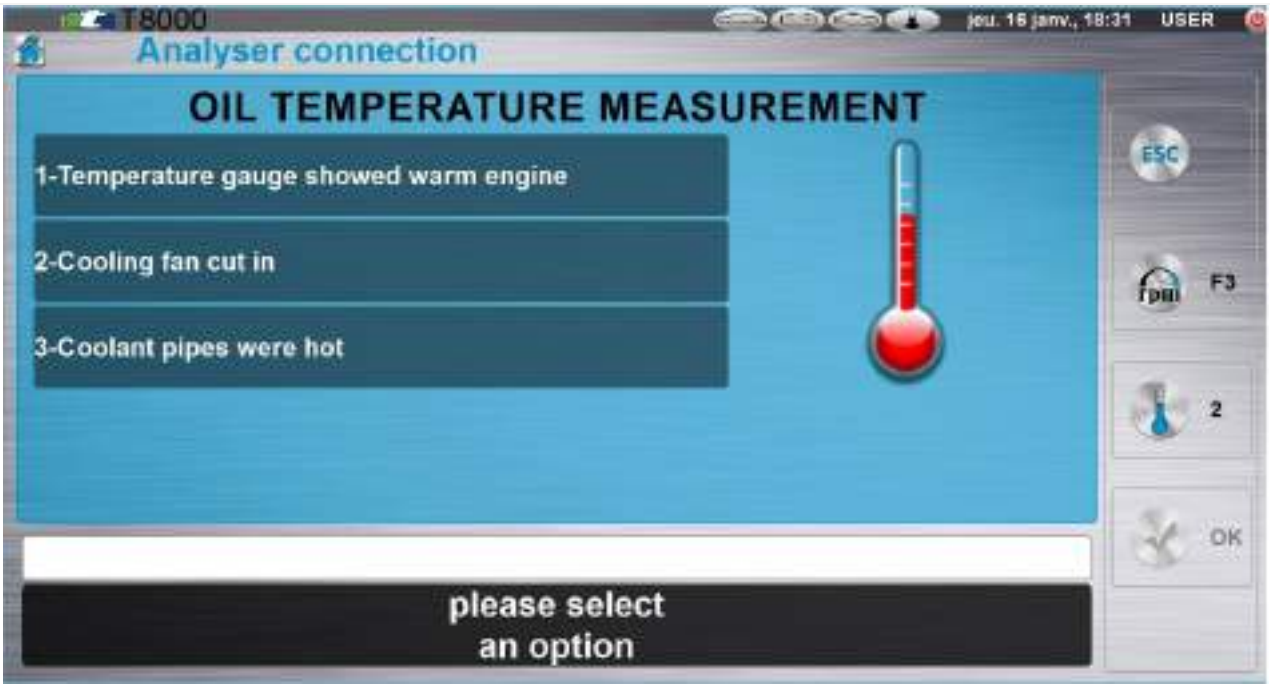


Figure 6.2.4.1-2: Confirming that Engine temperature is OK

The operator is invited to measure the engine speed whenever possible (Figure 6.2.4.1-3).

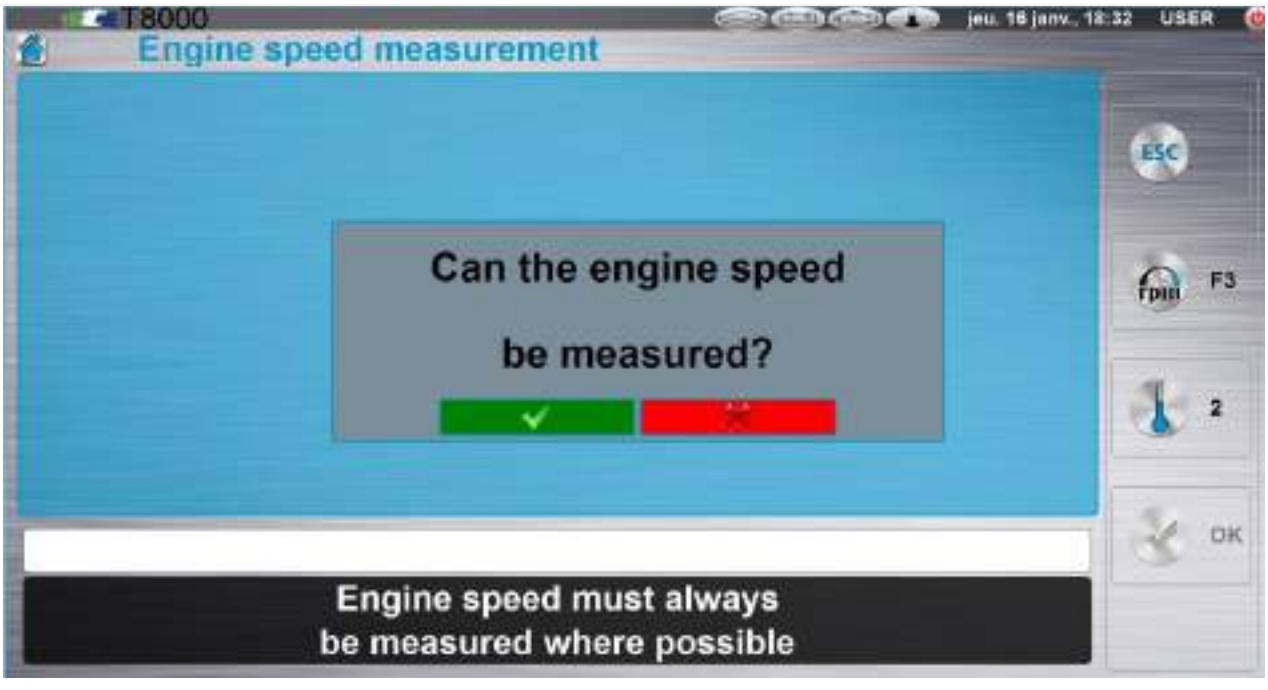


Figure 6.2.4.1-3: Demand for Engine speed measurement

When the engine speed measurement device is available, the operator responds by clicking the Validation icon (Figure 6.2.4.1-3) and chooses YES on the subsequent screen (Figure 6.2.4.1-4).

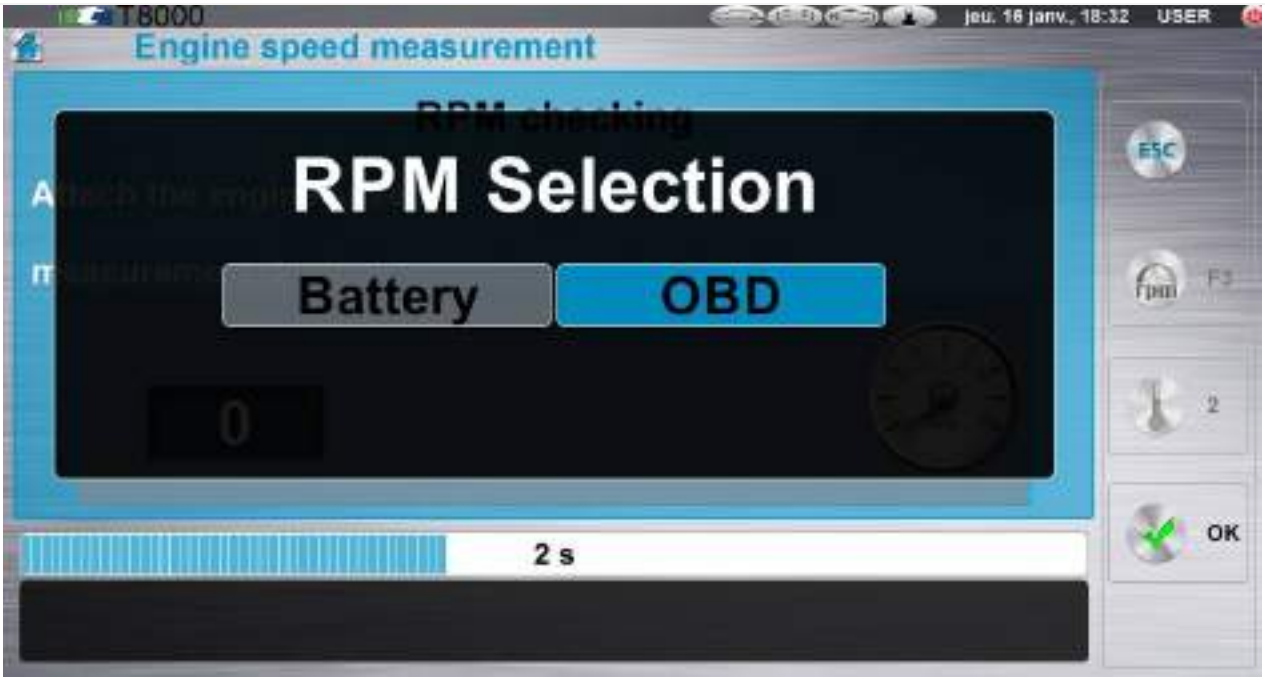


Figure 6.2.4.1-4: Positive response to demand for engine speed measurement and chose the way to measure

If the engine speed measurement device is not available, the operator responds negatively (button NO on Figure 6.2.4.1-4), and he is advised to use the vehicle's tachometer (Figure 6.2.4.1-5).

The operator confirms that he will use the vehicle's own tachometer to check the engine speed (Figure 6.2.4.1-5).

Figure 6.2.4.1-5: Operator confirms using of vehicle tachometer

The Gas analyser continues with the HC residue check (Figure 6.2.4.1-6).

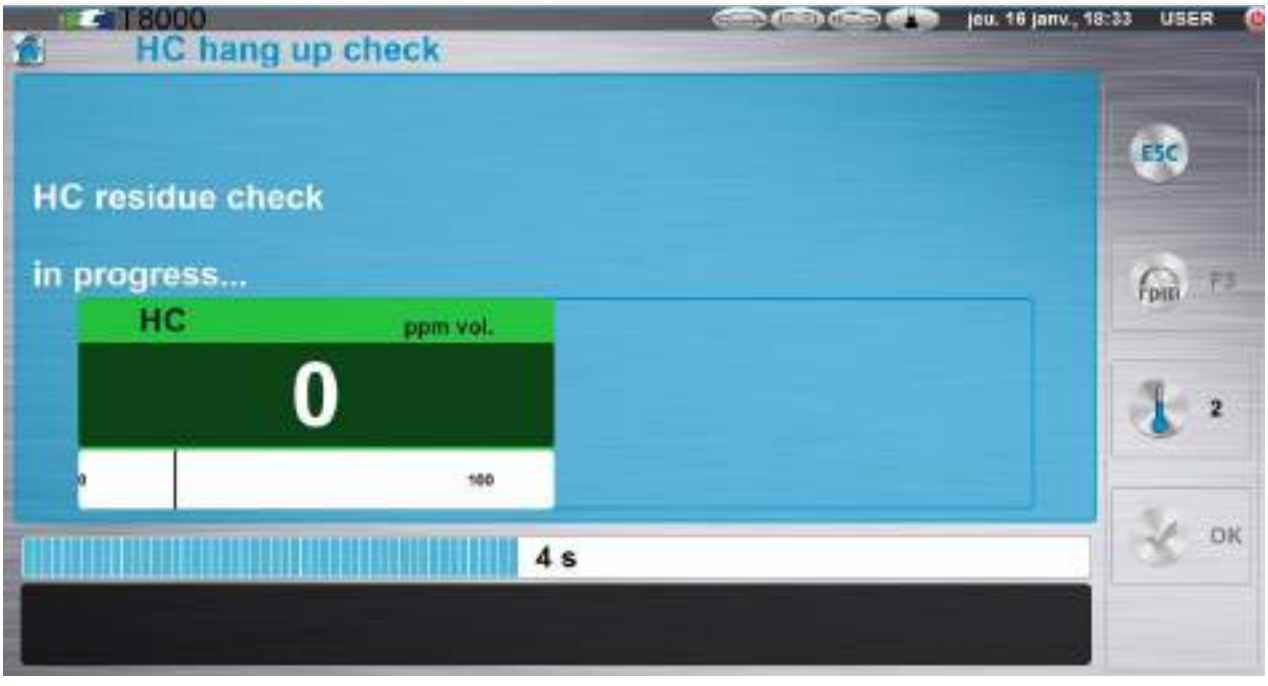


Figure 6.2.4.1-6: Operator is prompted to start HC residue check

HC residue check is going to start (Figure 6.2.4.1-6). The analyser reminds the operator that the exhaust probe needs to be removed from the exhaust pipe. To continue, the operator clicks on Validation.
If the exhaust probe is not removed and operator has clicked Validation, the tool prompts the operator to remove the exhaust probe from the exhaust pipe of the vehicle (Figure 6.2.4.1-7).

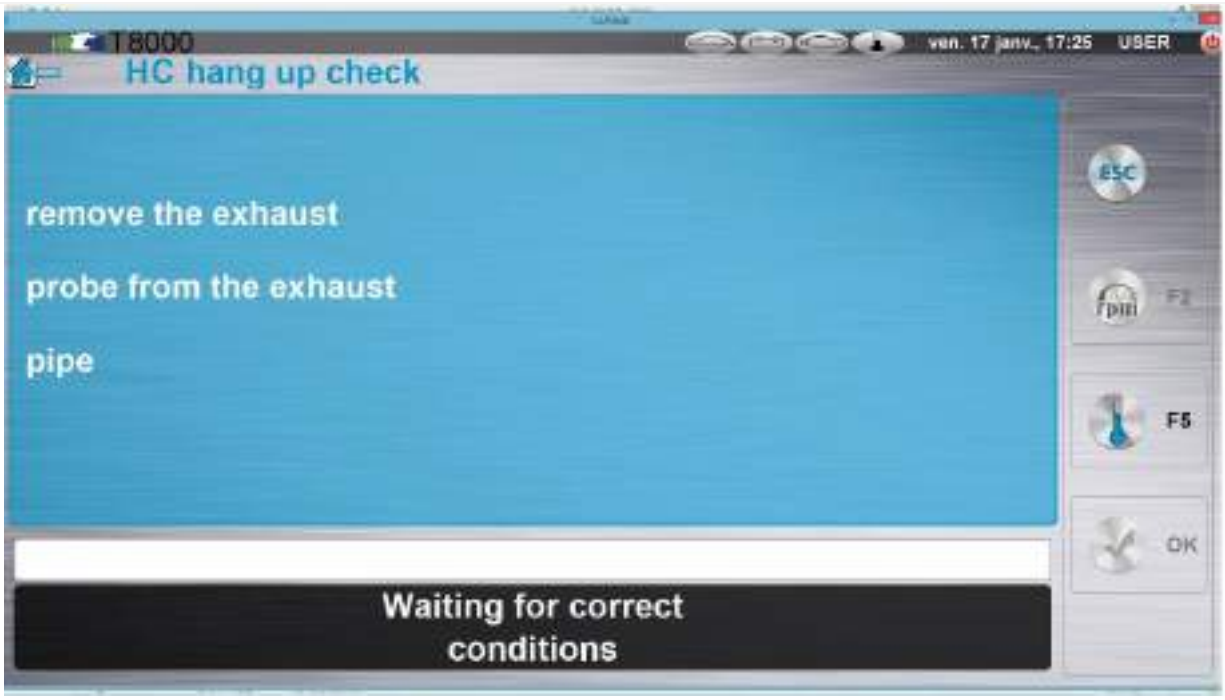


Figure 6.2.4.1-7: Gas analysertool prompts the operator to remove the exhaust probe

When the exhaust probe is removed, the HC residue check starts (Figure 6.2.4.1-8).

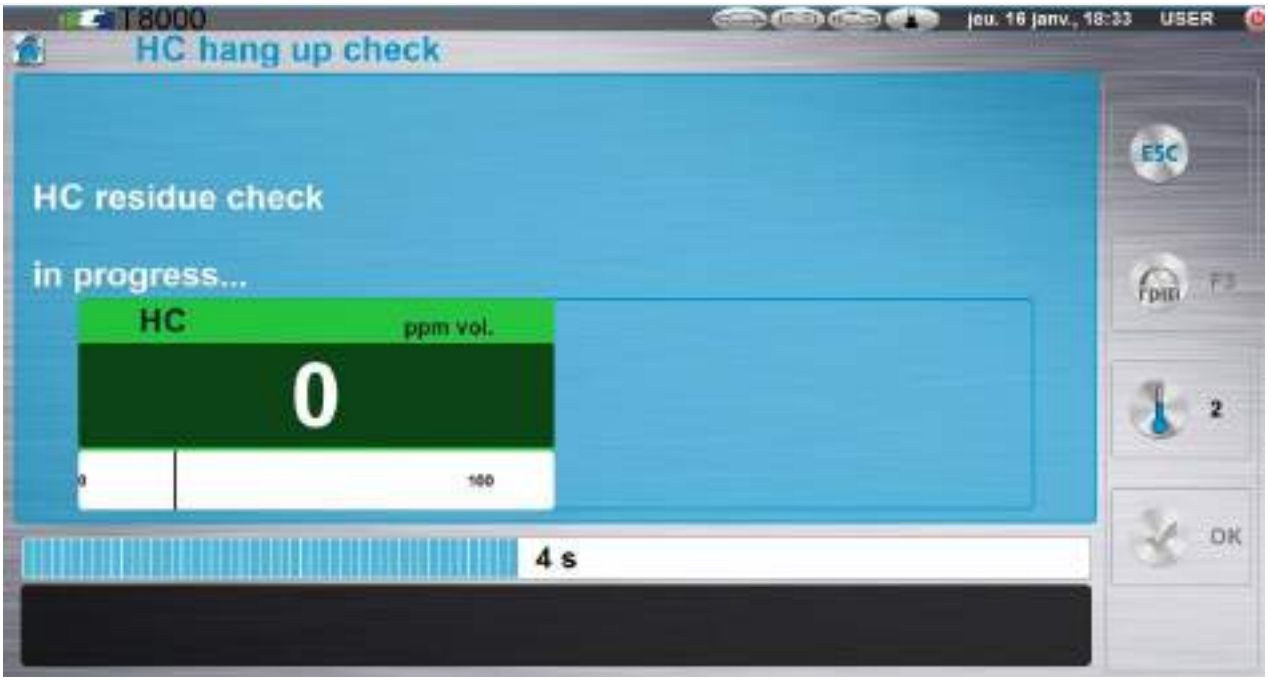


Figure 6.2.4.1-8: HC residue check in progress

The HC residue check passed. The operator is prompted to insert the exhaust probe into the exhaust pipe of the vehicle (Figure 6.2.4.1-9).

The operator is flagged out only if the HC check is failed

Figure 6.2.4.1-9: HC residue check passed

Alternatively, if the HC check is failed, the operator has two choices (Figure 6.2.4.1-10).

1. Re-perform the test
2. Abort the test

In case 1, the Gas analyser re-performs the HC residue check (Figure 6.2.4.1-8).

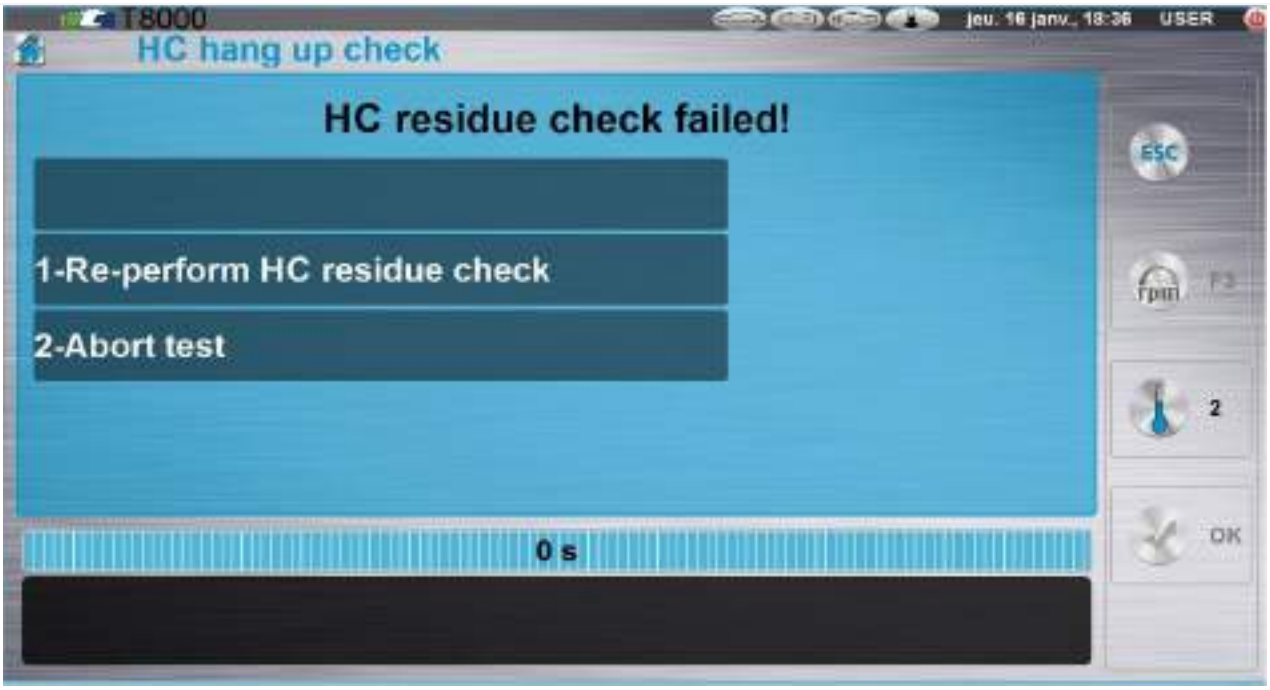


Figure 6.2.4.1-10: HC residue check failed

In case 2 – Abort test, the application advices the operator to restart the process, i.e. to go back to the first MOT test screen (Figure 6.2.4.1-1).

When the HC residue check is complete, the test continuation depends on engine speed measurement.

- If the operator has declared (Figure 6.2.4.1-4) that the engine speed is going to be measured he is prompted to confirm that the engine speed measurement device is attached to the vehicle. (Figure 6.2.4.1-13).
- If the operator has declared (Figure 6.2.4.1-4) that the engine speed is going to be measured, but the measurement device is not attached, he is prompted to do this. (Figure 6.2.4.1-11). The operator is prompted to confirm the attachment of the engine speed measurement device. If he has confirmed that the engine speed measurement device is attached, but the device is still not attached to the vehicle, he has to do this within the next 40 seconds (Figure 6.2.4.1-12). At the end of this countdown time if the engine speed measurement device is not yet attached, the Gas analyser will continue with Fast Idle test as if the engine speed is not measured (Figure 6.2.4.2-1: Gas analysertool waits for validation of the measured values).

Figure 6.2.4.1-11: Operator needs to attach the engine speed measurement device

Operator confirms attachment of the engine speed measurement device with click on Validate button. The gas analyser continues with the Fast Idle test. (Figure 6.2.4.1-1).

2.7.4 Fast Idle test

2.7.4.1 Fast Idle test when the engine speed can be measured

In Fast Idle test (Figure 6.2.4.1-1), the operator first waits for acceptable values. The values may not be acceptable, usually when the engine is cold. So the operator can wait for acceptable values before continuing with test. This allows the operator to run the engine until acceptable values are displayed and then start the test, without wasting time, or starting the test too early and subsequently failing the test.

Figure 6.2.4.1-1: Beginning of Fast Idle test

Next, the operator is prompted to raise the engine speed. The required range is between 2500 and 3000 rpm (Figure 6.2.4.1-2:).

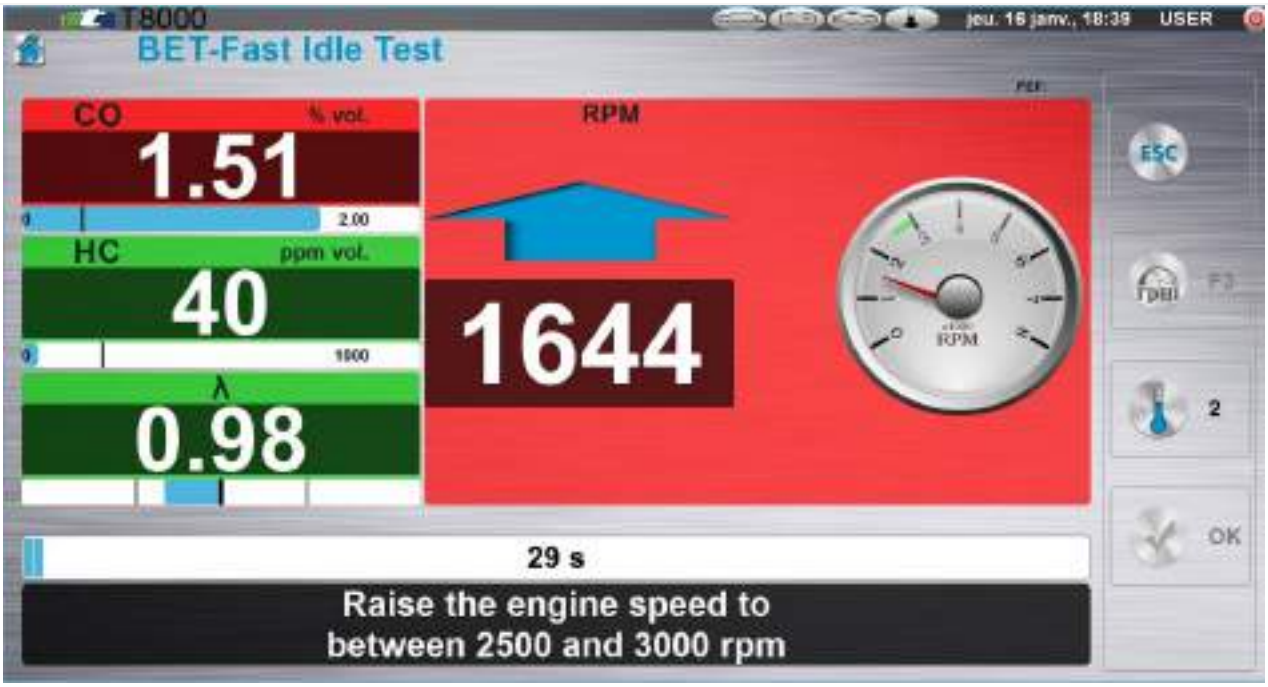


Figure 6.2.4.1-2: Application prompts operator to raise engine speed to Fast idle speed

Fast Idle speed must be maintained for 30 seconds (Figure 6.2.4.1-3:).

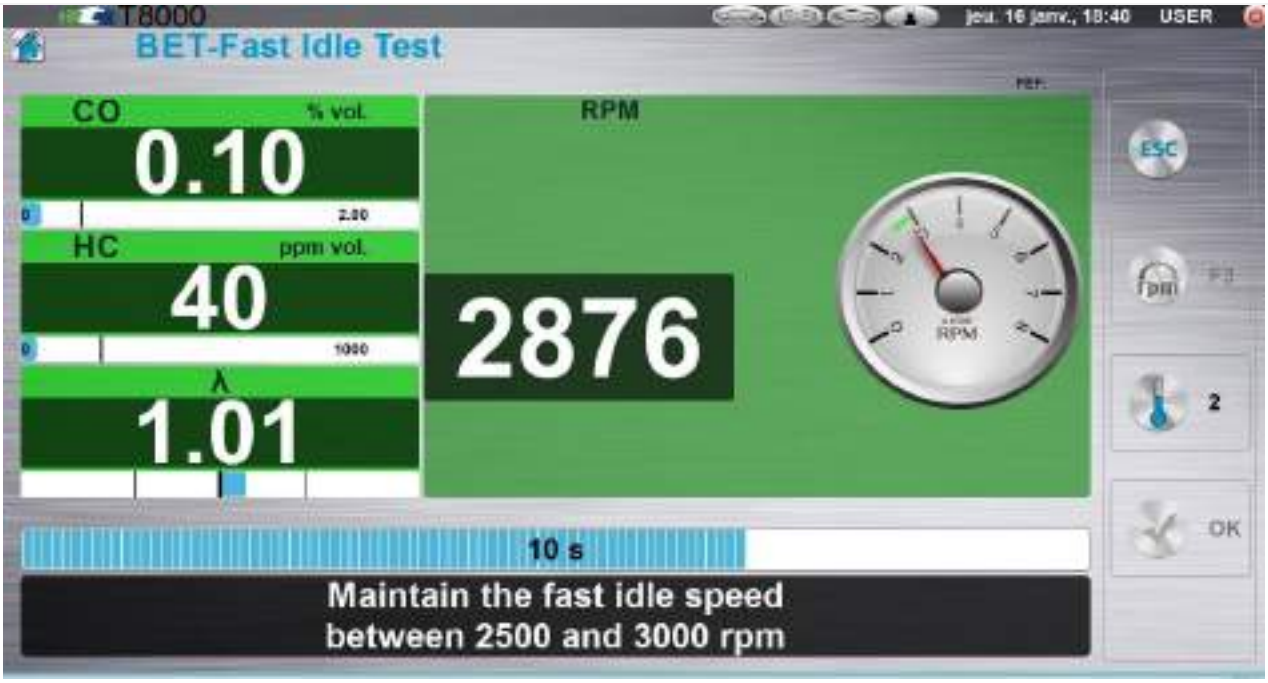


Figure 6.2.4.1-3: Fast Idle speed must be maintain 30 seconds

Fast Idle engine speed must be maintained for 30 seconds. If the engine speed drifts outside the required range or the engine speed signal is lost, a new 30 seconds countdown time begins (Figure 6.2.4.1-2:) and the operator is prompted to adjust the engine speed within the required range.
When the Fast Idle test is finished the Gas analyser continues with the BET-Catalyst Stabilization Phase (Section 6.2.5.1).

2.7.4.2 Fast idle test when the engine speed cannot be measured

If the Fast Idle engine speed cannot be measured, use of the vehicle's own tachometer is strongly recommended.
Sometimes the emission values are not acceptable. This usually happens when the engine is cold. The operator needs to wait for acceptable values before validating the start of the test. (Figure 6.2.4.2-1:).

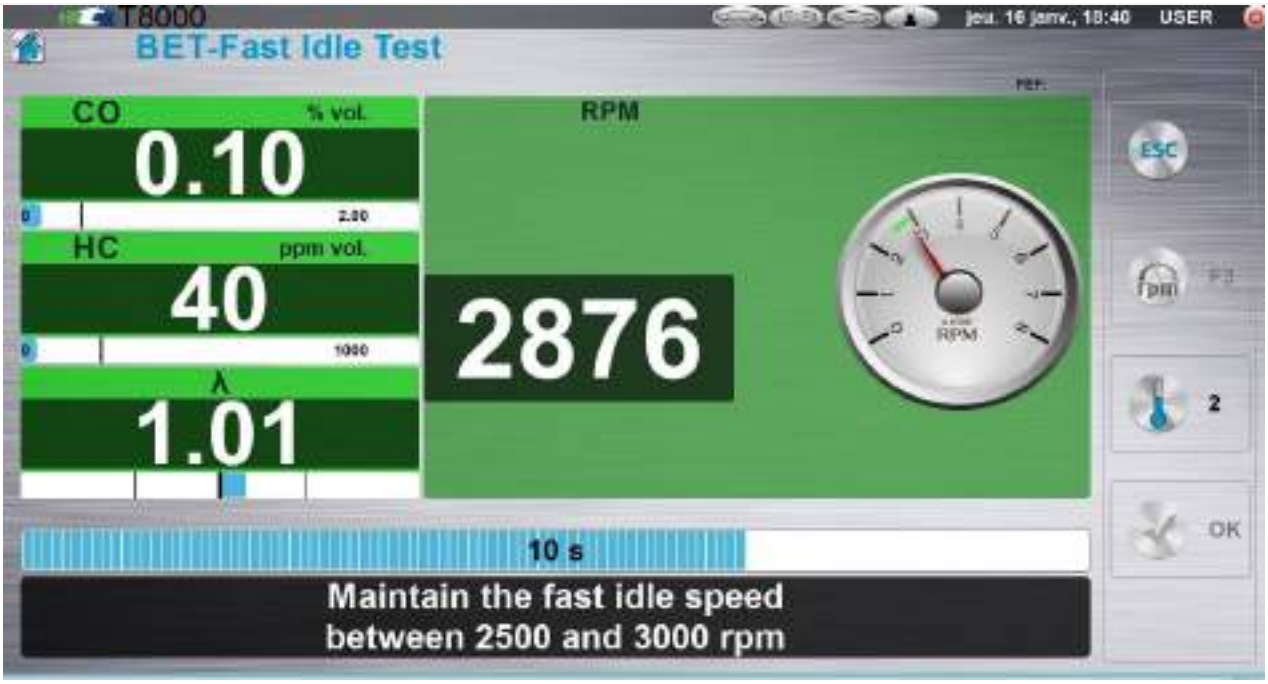


Figure 6.2.4.2-1: Gas analyser tool waits for validation of the measured values

At the start of the Fast Idle test, the operator is prompted to use the vehicle tachometer to check the engine speed. The operator starts the Fast Idle test by clicking Validate.

Figure 6.2.4.2-2: On start of Fast Idle test the operator is prompted to use vehicle tachometer to check the engine speed

Operator is prompted, for 10 seconds, to adjust engine speed to Fast Idle (required range 2500 to 3000 rpm)

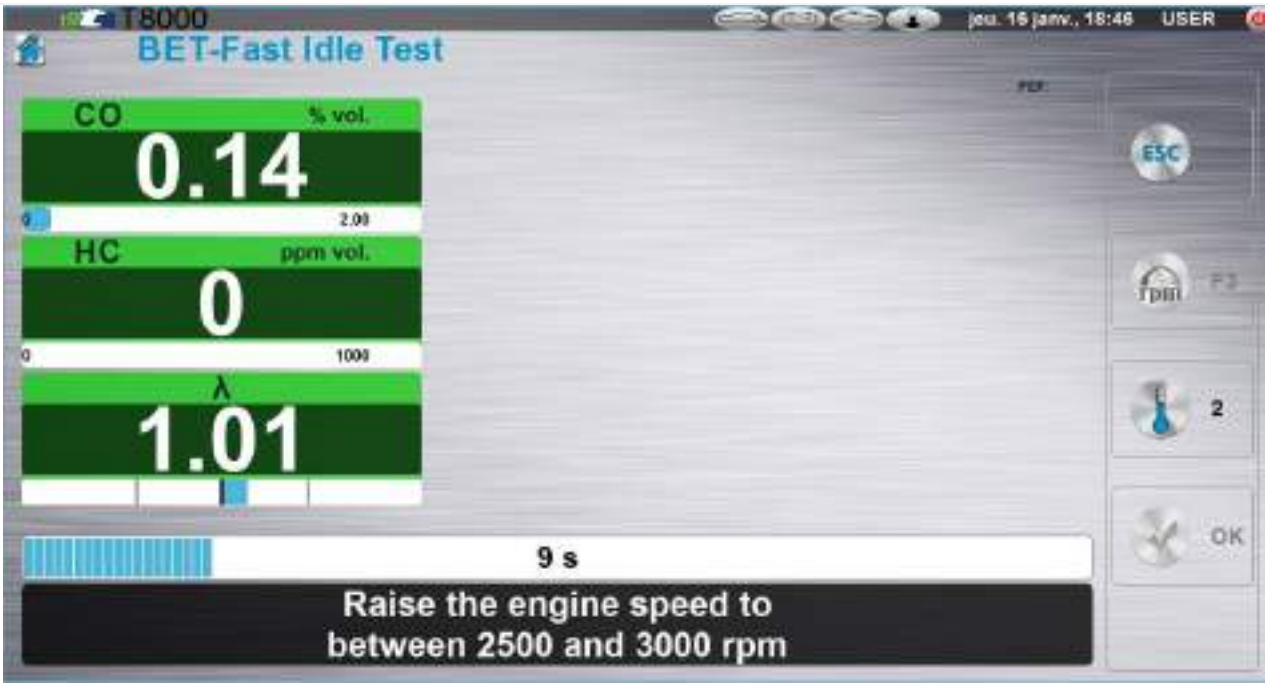


Figure 6.2.4.2-3: Operator is prompted to adjust the engine speed within required range

2.7.5 Catalyst stabilisation phase

Catalyst stabilization phase, applied in both cases when engine speed can or cannot be measured, introduces additional time for engine speed stabilization.

2.7.5.1 Catalyst stabilisation phase when the engine speed can be measured

First the operator is prompted, for 10 seconds to adjust the fast idle speed.

Figure 6.2.5.1-1: Fast Idle speed must be maintain for additional 30 seconds in BET-Catalyst stabilization phase

As soon as the speed is within the required range for fast idling (2500 to 3500 rpm), a 30 second countdown time starts. During this period, the engine speed must be maintained within the fast idle limits. If, for any reason, the engine speed signal is lost or the engine speed drifts outside the required range, the countdown time resets itself to a new 30 second countdown. The operator is prompted to adjust the engine speed so that it is within the required range.

Figure 6.2.5.1-2: Engine speed drifts outside the required range

The gas analyzer will not proceed to the next phase until the 30 seconds countdown has been completed. At the end of the 30 seconds the application continues with Natural Idle test.

2.7.5.2 Catalyst stabilisation phase when the engine speed cannot be measured

Since the engine speed measurement device is not used, at the begining the operator is advised to use vehicle tachometer. He can start this phase by clicking on the Validation button

Figure 6.2.5.2-1: Operator is prompted to start Catalyst stabilization phase

For 10 seconds the operator is prompted to adjust the engine speed within the required range for fast idling (2500 to 3000 rpm),

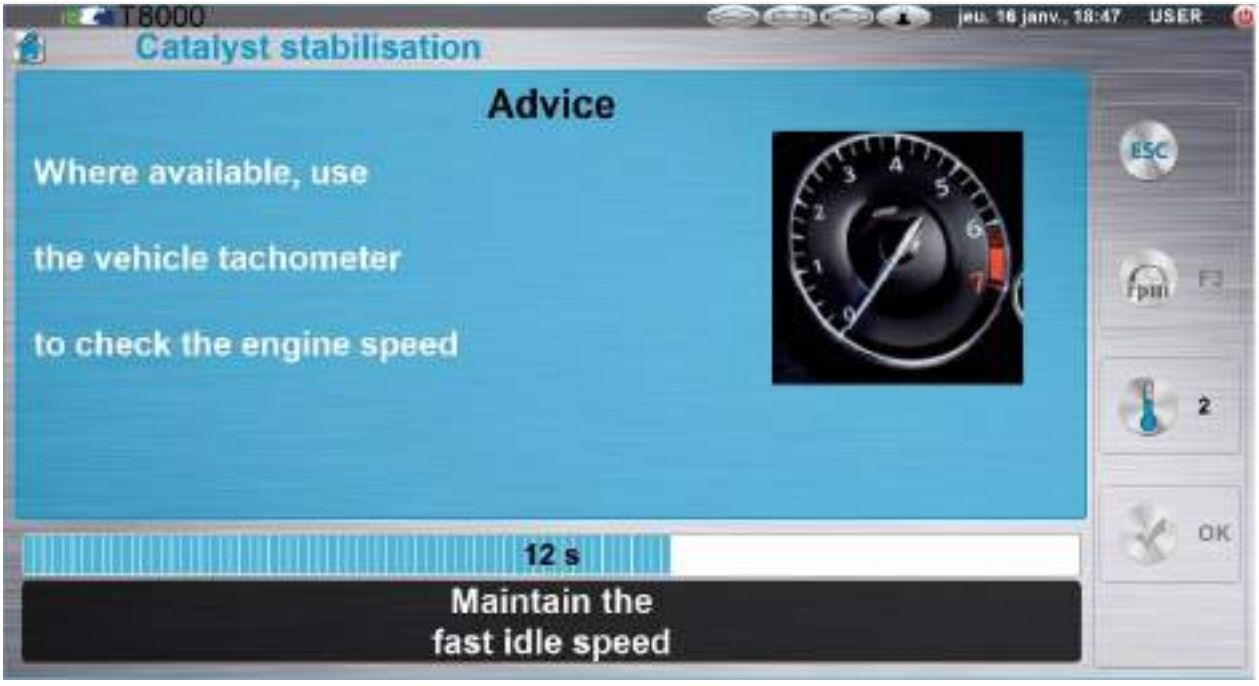


Figure 6.2.5.2-3: Operator is advised to use vehicle tachometer to check the speed

Catalyst stabilization phase means allowing the engine to run at a fast idle speed for 30 seconds. During this time the operator is prompted to maintain fast idle speed.
After the Catalyst stabilization phase, the BET-Natural idle test phase follows. (section 6.2.6.2).

2.7.6 Natural idle test

2.7.6.1 Natural idle test when engine speed can be measured

At the beginning of the Natural Idle test, during 10 seconds, the operator is prompted to allow the engine to idle naturally. The main area on the screen displays the engine speed measured with the engine speed measurement device attached to the vehicle.

Figure 6.2.6.1-1: Natural Idle test begin

During 30 seconds the operator is prompted to maintain the natural idle speed.

2.7.6.2 Natural idle test when engine speed cannot be measured

If engine speed cannot be measured, the operator is prompted for 10 seconds, to allow the engine to run at the natural idle speed. He is advised to use vehicle tachometer to check the engine speed.

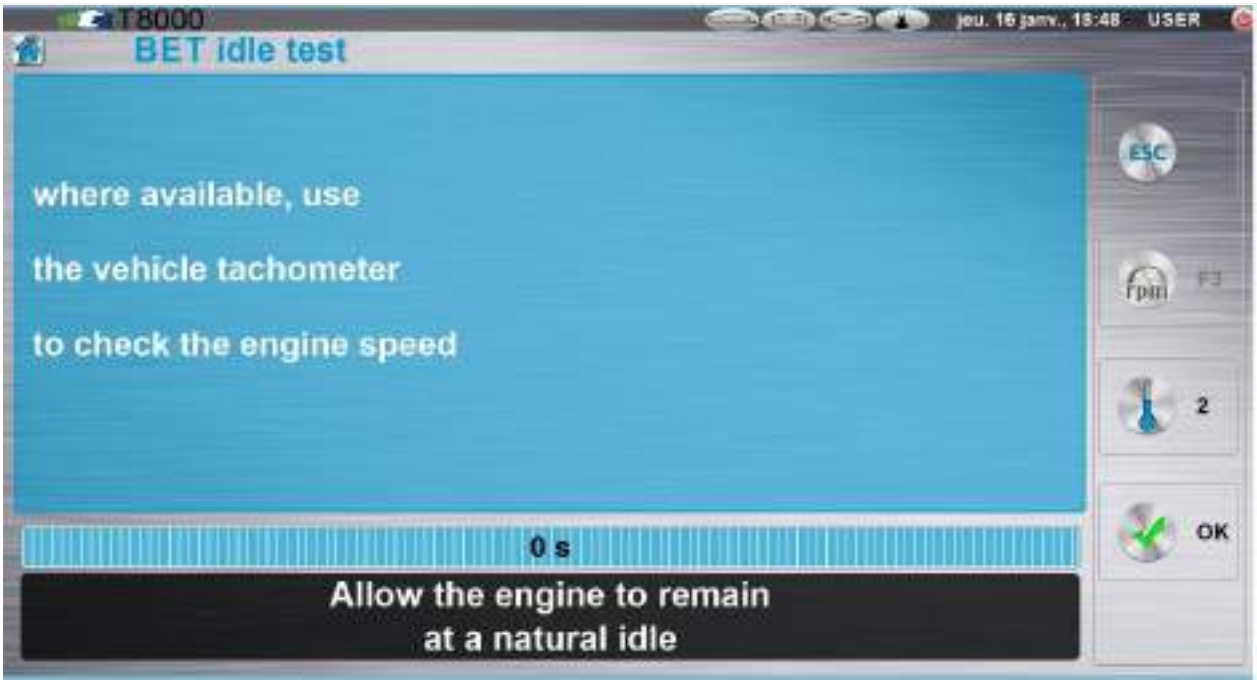


Figure 6.2.6.2-2: Operator needs to allow the engine speed to remain at a natural idle

The natural idle speed needs to be maintained for a period of 30 seconds. The operator is prompted to confirm that the engine speed is the natural idle speed. The operator has to confirm accordingly:

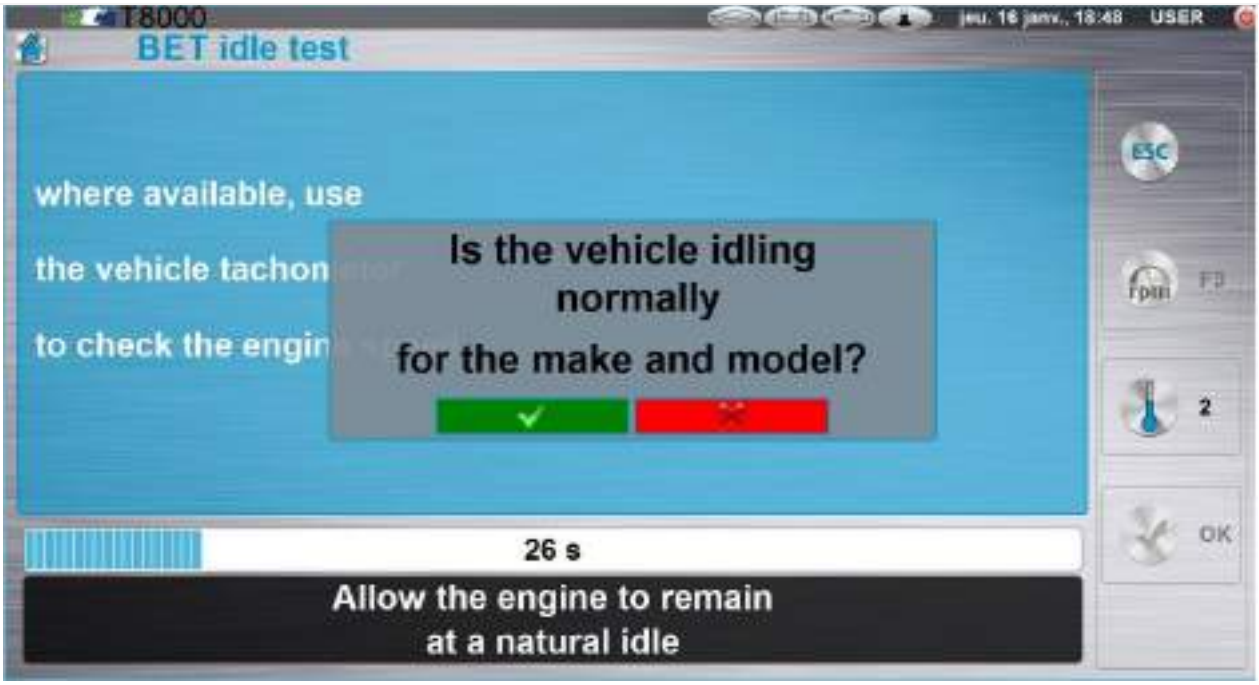


Figure 6.2.6.2-3: Operator has to confirm or deny natural idling

The Natural Idle test is finished when either:

- The CO value is within limits. The application is going to display the results of the test (Figure 6.2.6.2-5).
- The countdown time of 30 seconds. The operator is advised to continue with Catalyst procedure (Section 6.3).
- The natural idle speed cannot be maintained, or the operator confirmed that the natural idle engine speed is not correct. The operator is advised to continue with the Catalyst procedure (Figure 6.2.6.2-4).

Figure 6.2.6.2-4: Natural idle test ends after 30 seconds countdown

2.7.7 Results of the BET test

The BET test procedure is completed. When the engine speed is measured the operator is prompted to remove the engine speed measurement device and the exhaust probe (Figure 6.2.6.2-1) or only the exhaust probe if the engine speed is not measured (Figure 6.2.6.2-2).

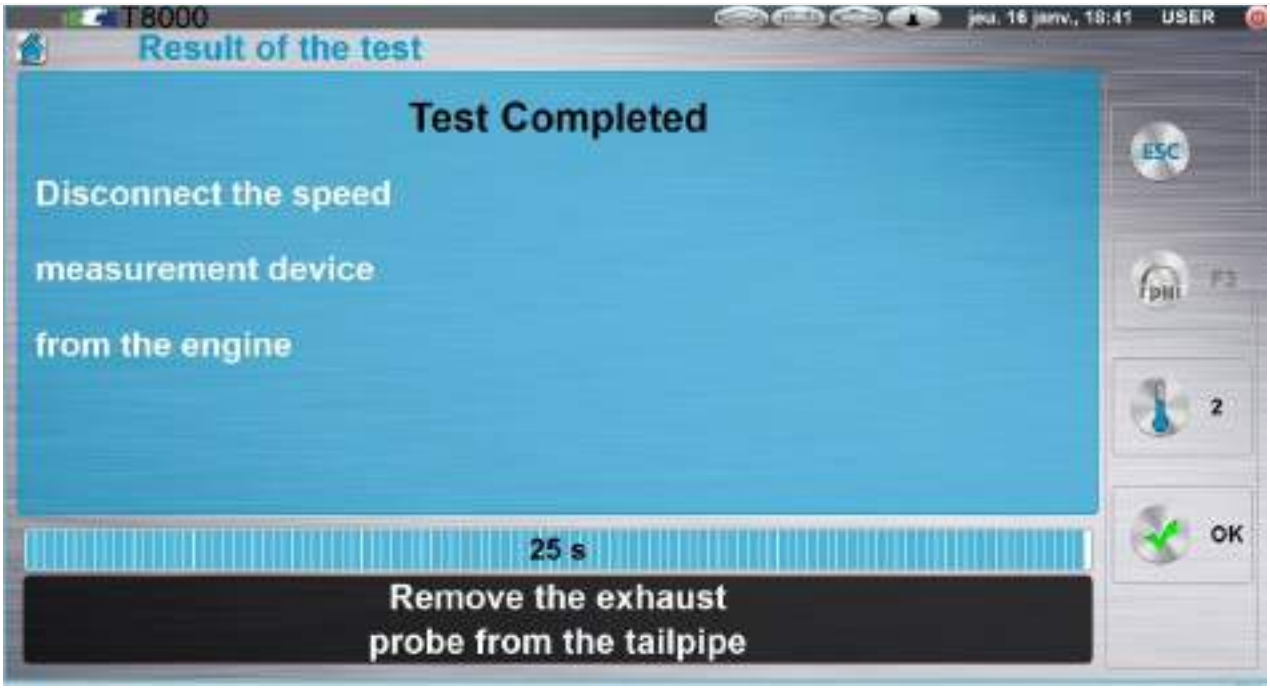


Figure 6.2.6.2-1: Operator confirms BET-procedure completion

The engine speed measurement device is still attached to the vehicle and the exhaust probe is in the exhaust pipe of the vehicle. Operator is prompted to disconnect the engine speed measurement and to remove the exhaust probe.

After disconnecting the engine speed measurement device and removing the exhaust probe from the tailpipe the BET procedure displays the results of the test (Figure 6.2.6.2-5).

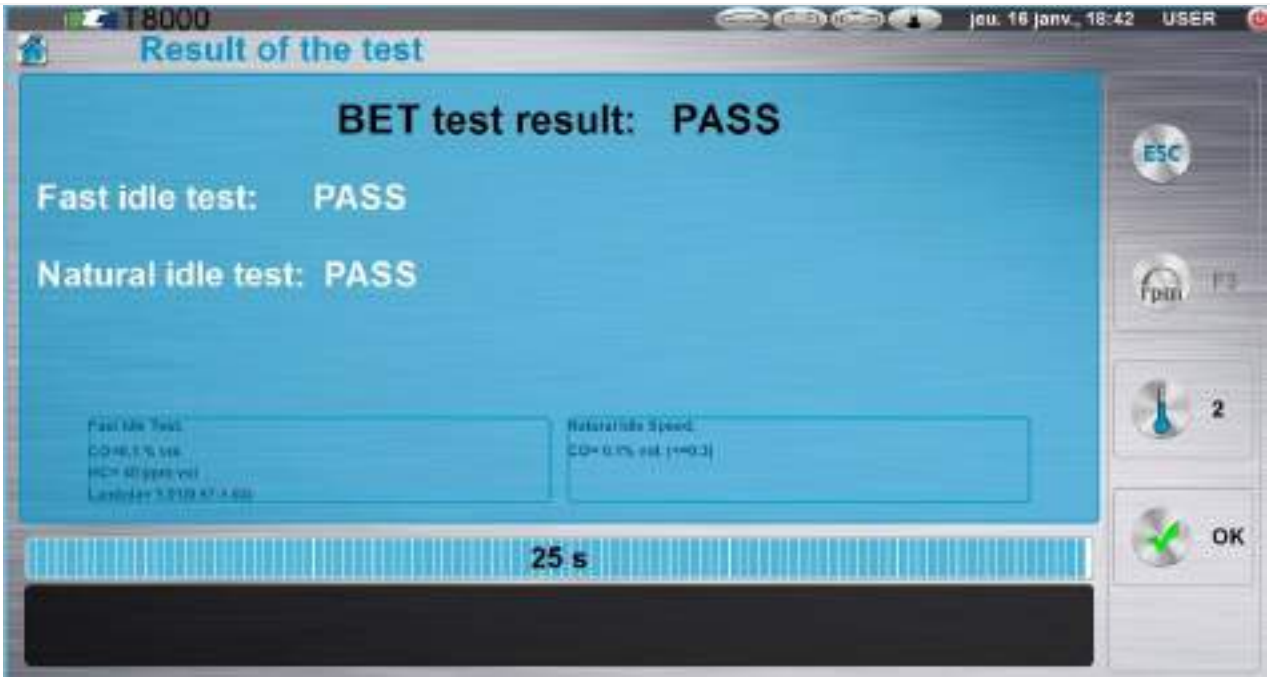


Figure 6.2.6.2-5: Results of the BET test procedure

The results displayed on the screen are also printed in two copies. One copy is for the vehicle's owner and the other for the MOT test station.

If the operator needs an additional copy of the results he can do it by clicking on the Print button 

or answering yes to the splash message.

Figure 6.2.6.2-6: BET test results save options

To finish the test operator needs to click on Validation.
Any how a PDF file is stored on the hard disk with the test result.

2.7.8 BET Test limits not met

If test limits are not met (Figure 6.2.6.2-1), i.e. the Fast Idle test or Natural Idle test has failed, the operator is advised to continue with the Catalyst Procedure (Section 6.3).

Figure 6.2.6.2-1: Operator is adviced to apply Catalyst procedure.

2.8 CATALYST TEST PROCEDURE FOLLOWING BET FAILURE

When the vehicle has not passed the BET procedure, the test continues with the Catalyst procedure.

2.8.1 Data input in Catalyst procedure

First, the gas analyser application prompts the operator to select the vehicle details. (Figure 6.3.1-1).

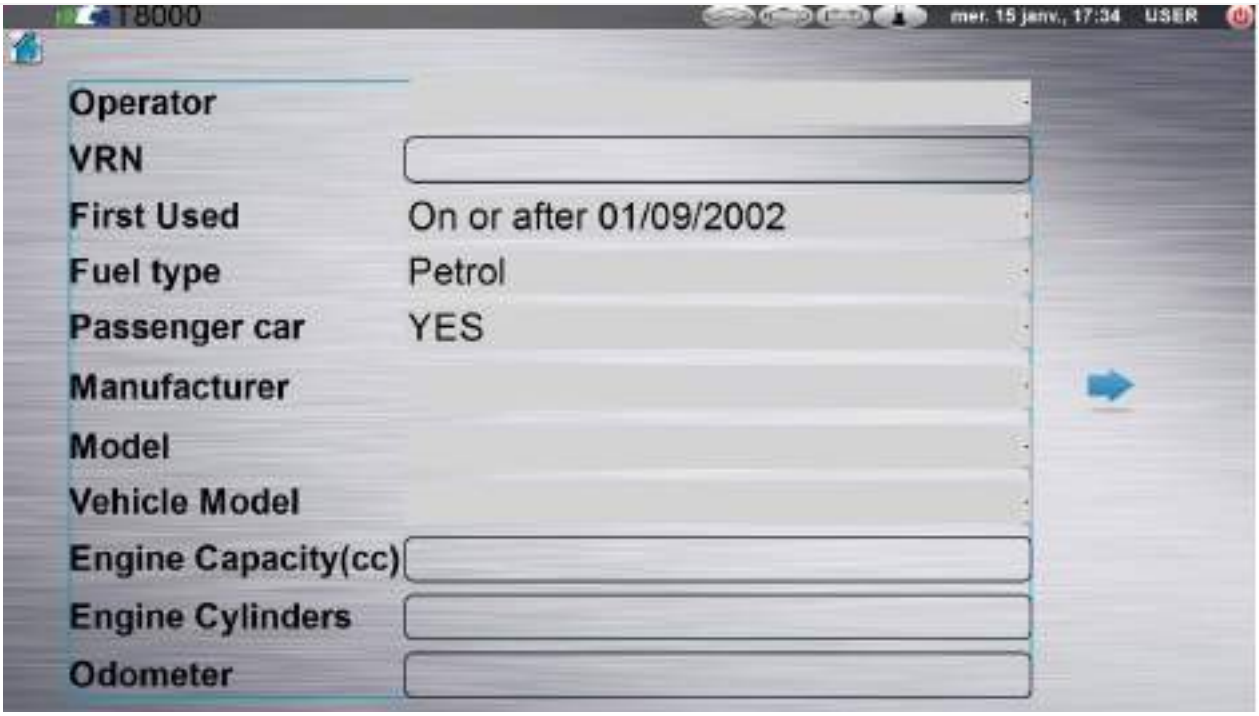


Figure 6.3.1-1: Application prompts the operator to fill in the vehicle data

2.8.2 Analyser connection phase in Catalyst procedure

The operator is prompted to remove the exhaust probe from the exhaust pipe (Figure 6.2.6.2-1). The application continues only when the probe is removed from the exhaust pipe.

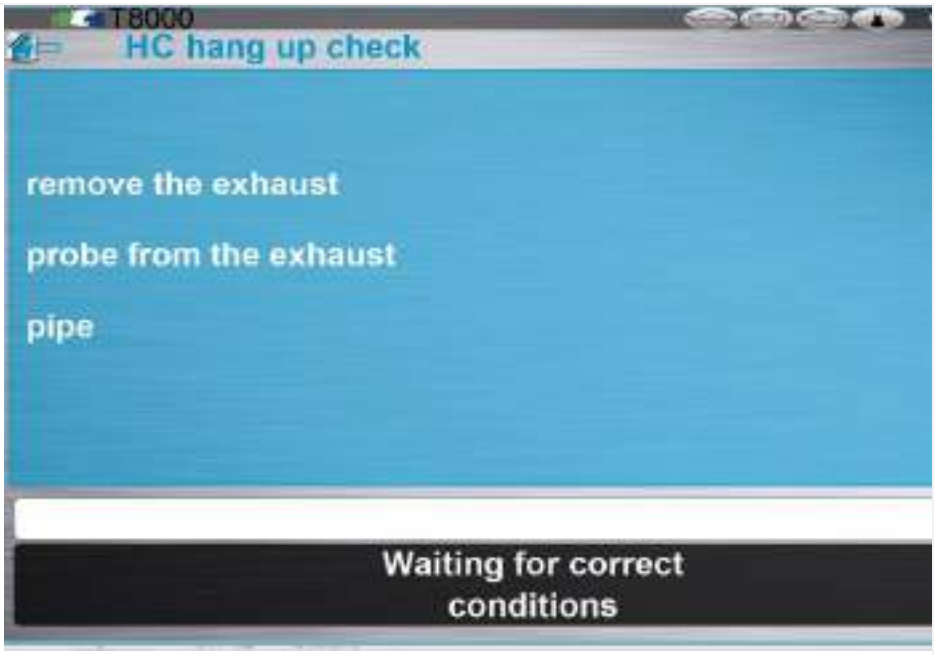


Figure 6.2.6.2-1: Operator is prompted to remove the exhaust probe

The operator is advised to measure the oil temperature where possible. Also he is prompted to check the oil level in the engine before proceeding with catalyst test procedure (Figure 6.2.6.2-2).

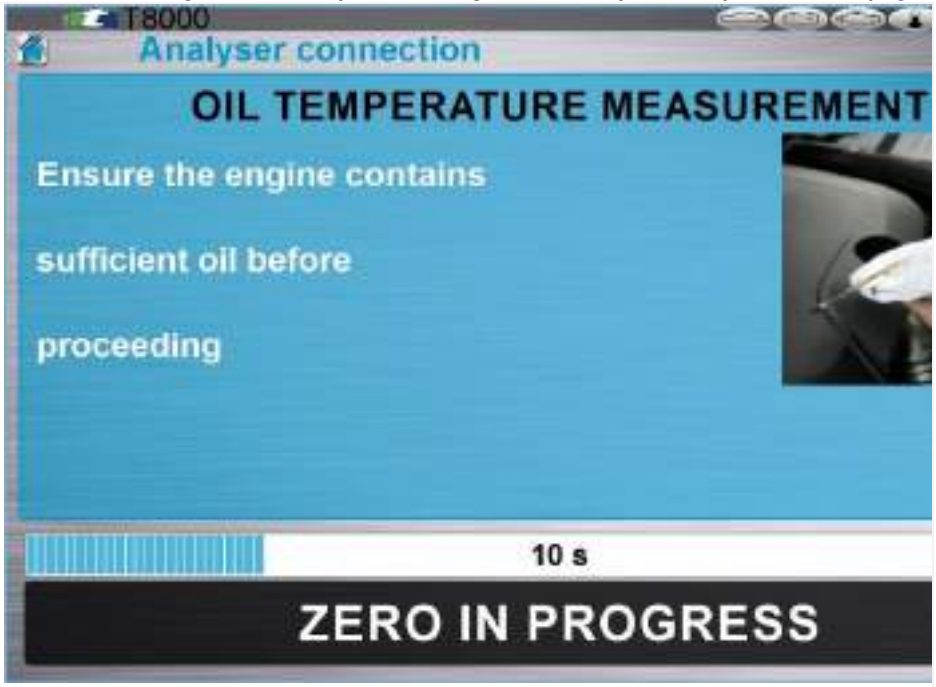


Figure 6.2.6.2-2: Operator is advised to measure the oil temperature

The operator needs to confirm/deny if the oil temperature measurement is possible (Figure 6.2.6.2-3).

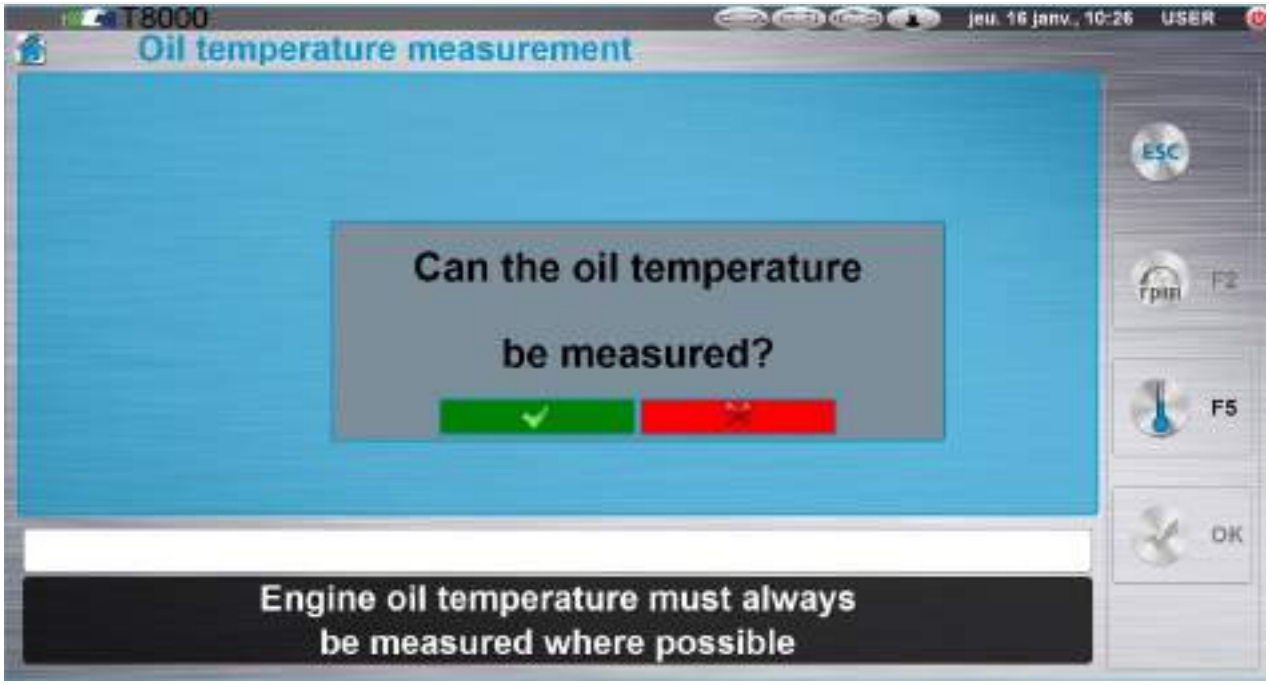


Figure 6.2.6.2-3: Operator needs to confirm the oil temperature measurement

If the oil temperature can be measured, the operator needs to remove the oil dipstick and to insert the probe. (Figure 6.2.6.2-4).

The operator clicks NO (Figure 6.2.6.2-3), he needs to wait for 40 seconds (Figure 6.2.6.2-5).

Figure 6.2.6.2-4: The operator needs to insert the oil temperature measuring probe

The countdown time of 40 seconds allows the operator to attach the engine speed measurement device, if the engine speed can be measured.

The application advices the operator to always measure the engine speed if possible (Figure 6.2.6.2-6).

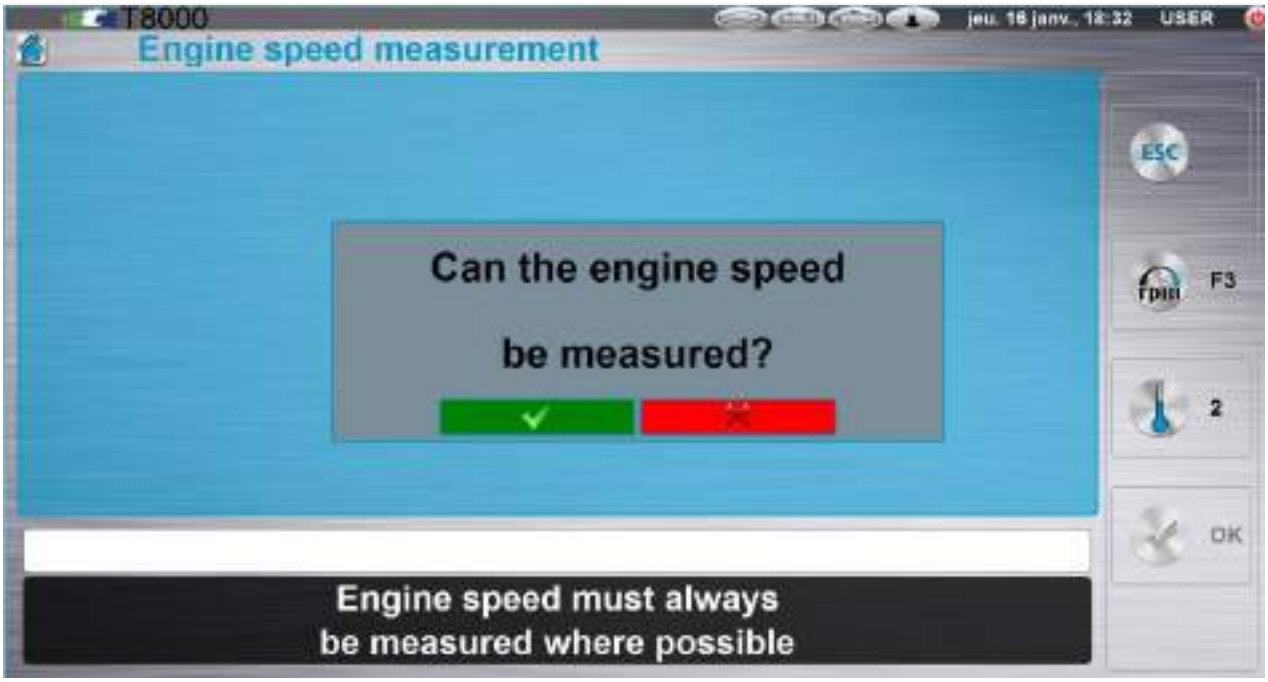


Figure 6.2.6.2-6:Demand for Engine speed measurement

The operator needs to confirm/deny if the engine speed can be measured (Figure 6.2.6.2-7)

The operator responds positively (button YES on Figure 6.2.6.2-7) and the application continues to (Figure 6.2.6.2-9).
If engine speed measurement device is not available, the operator responds negatively (button NO on Figure 6.2.6.2-7), but must then wait for 40 seconds before it is possible to continue. (Figure 6.2.6.2-8).

Figure 6.2.6.2-8:Operator is prompted for patience

To eliminate the influence on the test results from ambient atmosphere, the gas analyser device, periodically, performs an AutoZero check.

During an AutoZero check, the sampling probe should be out of the exhaust pipe. The operator has to check that the exhaust probe is not inserted into the exhaust pipe and to confirm this with the OK button (Figure 6.2.6.2-9).

Figure 6.2.6.2-9: Exhaust probe should be out of the tailpipe

As soon as the operator has confirmed that the exhaust probe is out of the exhaust pipe, the AutoZero check starts (Figure 6.2.6.2-10). Countdown indicates the remaining time before AutoZero check finishes.

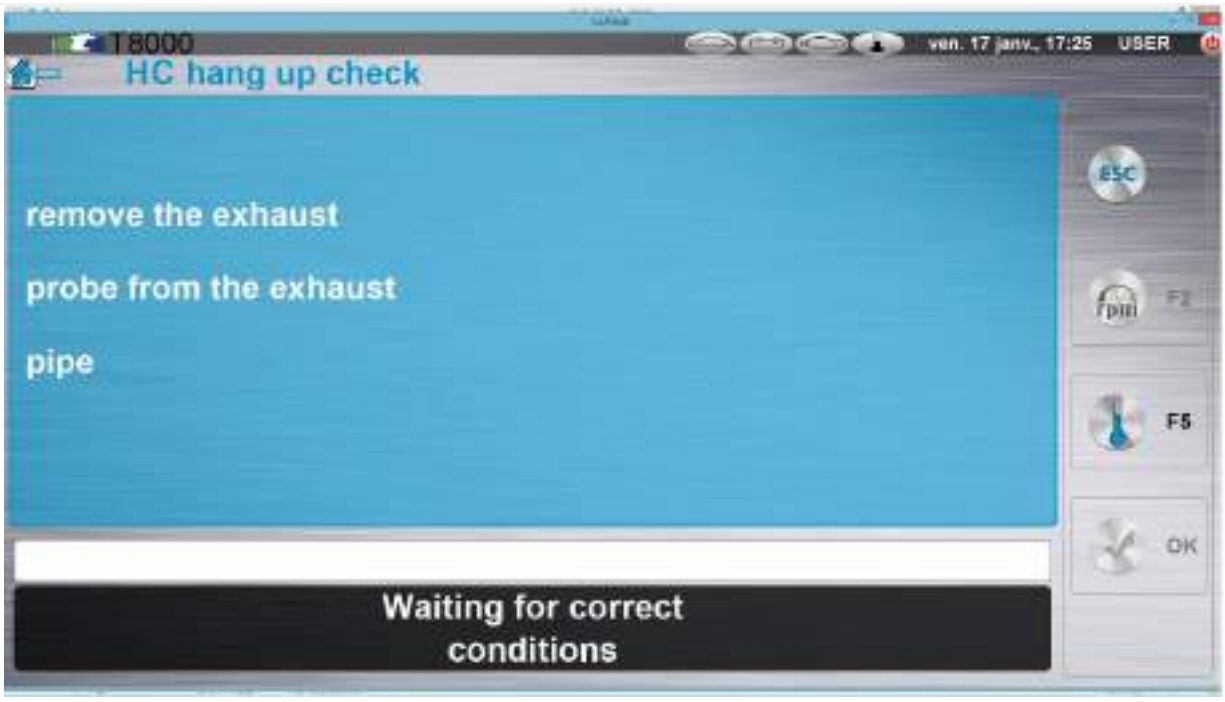


Figure 6.2.6.2-10: AutoZero in progress

2.8.3 Engine Pre-Conditioning during Catalyst procedure

2.8.3.1 Engine pre-conditioning when oil temperature can be measured

The oil temperature has to be normal operating temperature, i.e. above the minimum required value. When this is the case, the application displays the temperature value on the screen and prompts the operator to replace the temperature probe with the dipstick. The application asks him to replace the temperature probe with the dipstick. The operator needs to confirm that the dipstick has been replaced.

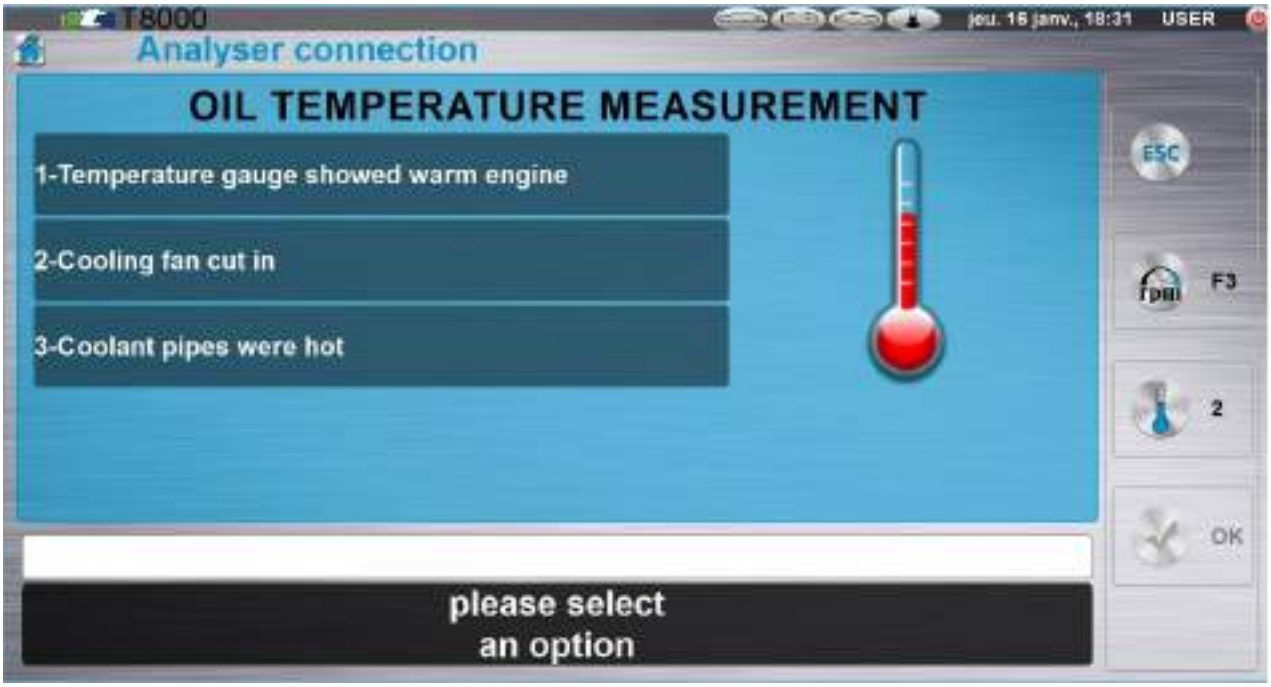


Figure 6.3.3.1-1: The operator is prompted to replace the temperature probe with the dipstick

In case the oil temperature is below the minimum, the operator is advised to run the engine at fast idle until the minimum required oil temperature is reached.

2.8.3.2 Engine pre-conditioning when oil temperature cannot be measured

The operator needs to ensure that the engine is at the normal operating temperature before proceeding with the Catalyst procedure. He has three choices to do this. The gas analyser remembers the operator's choice, which is printed on test results sheet.

NOTE: A selection from one of the three choices must be made.

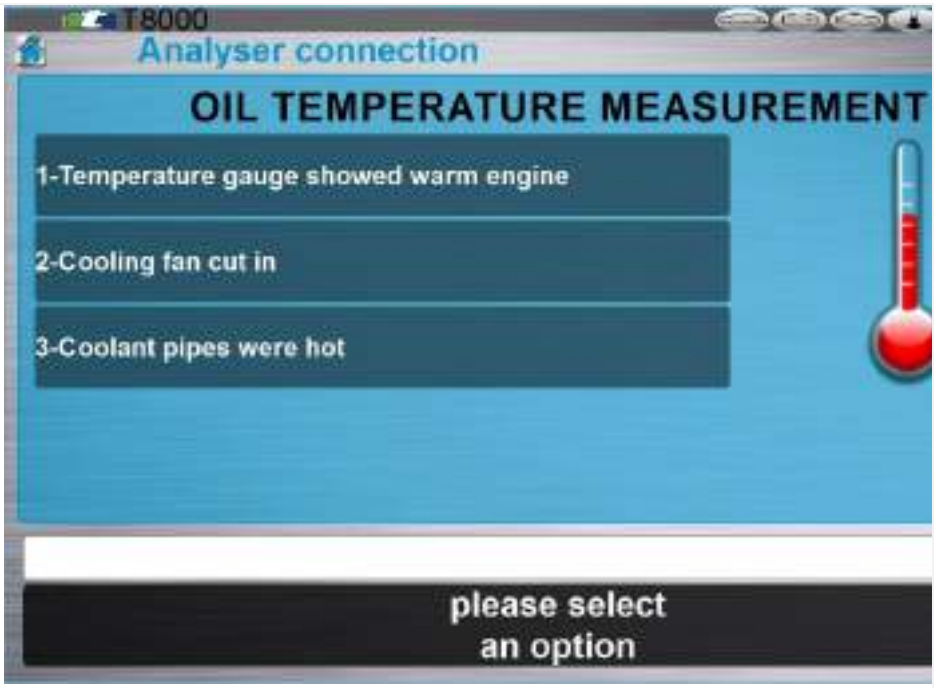


Figure 6.3.3.2-1: Operator needs to be sure that engine has reached normal operating temperature

2.8.4 HC residue check during Catalyst procedure

Before the HC residue check starts (Figure 6.3.3.2-1) the Gas analyser application reminds the operator that the exhaust probe needs to be removed from the exhaust pipe. To continue, the operator clicks on Validation.

Figure 6.3.3.2-1: The HC residue check needs the exhaust pipe to be out of the tailpipe

The exhaust probe is out of the exhaust pipe. The HC residue check is performed (Figure 6.3.3.2-2).

The HC check is passed. The operator is prompted to insert the exhaust probe into the exhaust pipe of the vehicle.
After a successful HC residue check, the application continues with the Fast Idle Test (Section 6.3.5).

Alternatively if the HC check is failed, the operator has two choices (Figure 6.3.3.2-4).

1. Re-perform the test
2. Abort the test

In case 1, the Gas analyser re-performs the HC residue check (Figure 6.3.3.2-2).

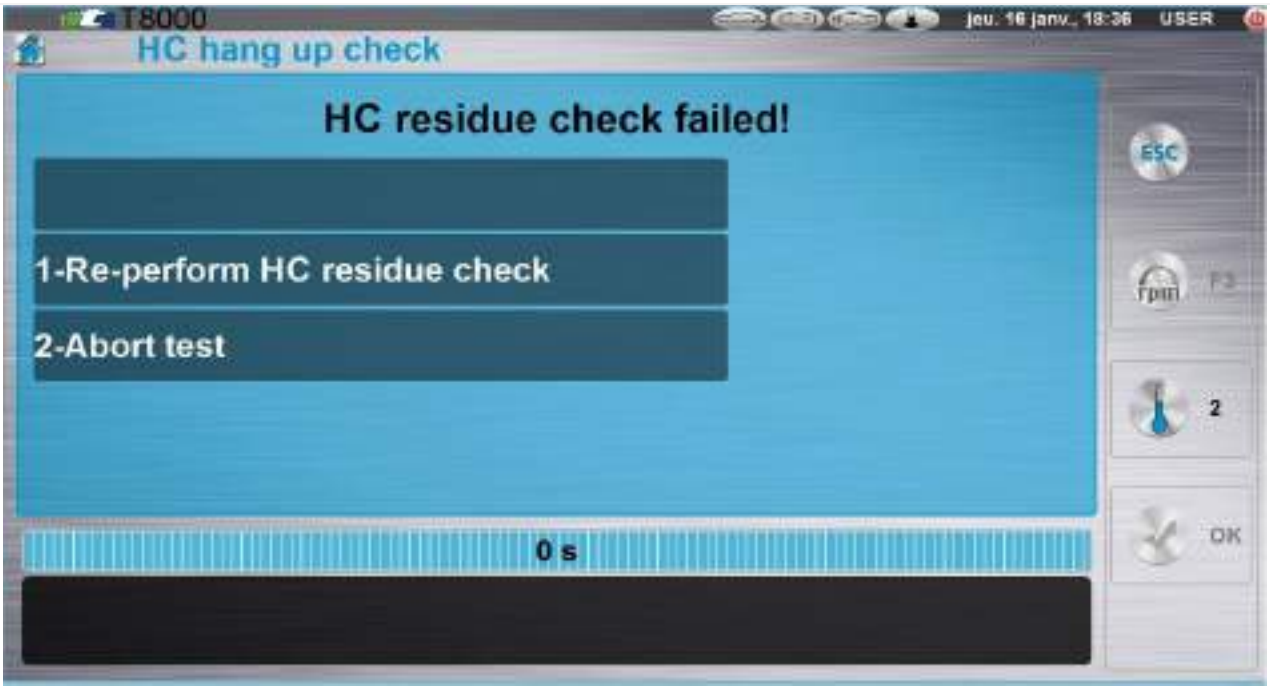


Figure 6.3.3.2-4: HC residue check failed

In case 2 – Abort test, the application advices the operator to restart the process, i.e. to go to home test screen (Figure 6.2.4.1-1).

NOTE: Analyser will not continue until gas requirements are met.

2.8.5 Catalyst procedure – Fast Idle Test

2.8.5.1 Fast Idle Test when engine speed can be measured

The operator is prompted to adjust the engine speed to the required Fast Idle speed

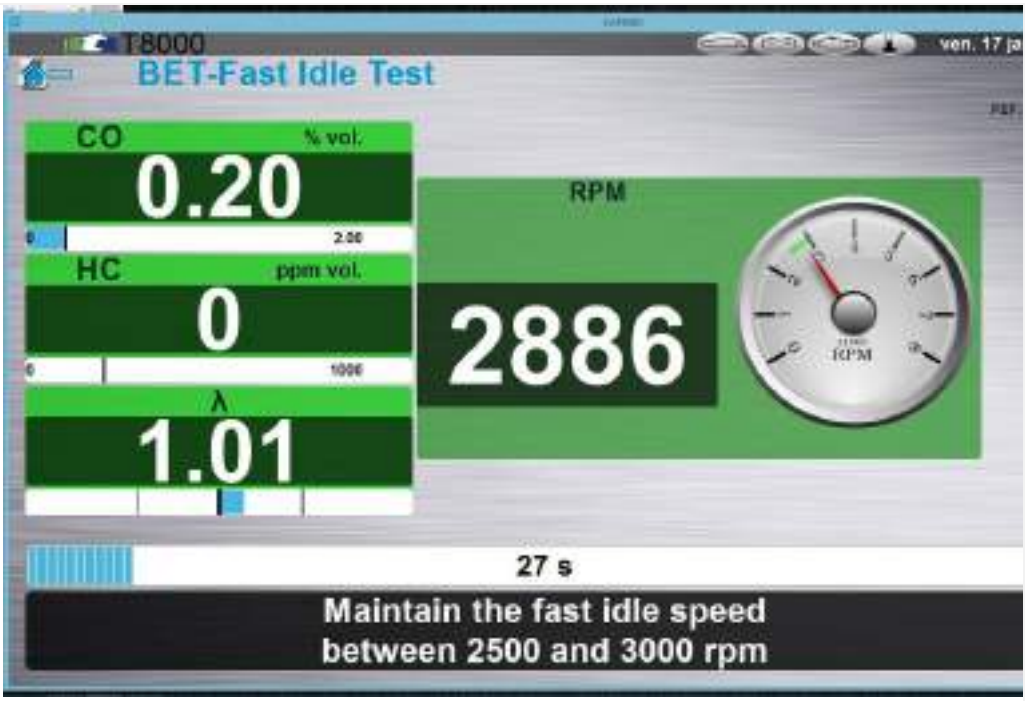


Figure 6.3.5.1-1: The operator is prompted to adjust engine speed to Fast Idle speed.

As soon as the engine speed is within the required range, a 30 seconds countdown begins.

Engine speed must be maintained at the Fast Idle speed for 30 seconds. If the engine speed drifts outside the required range or the engine speed signal is lost, the operator needs to adjust the engine speed to be back within the required range. (A new 30 seconds countdown time begins).

The Fast Idle test finishes when the measured emission values are within the limits or at the end of 30 seconds countdown.
When the measured results are within the required limits the Gas analyzer continues with Catalyst stabilization phase (Section 6.3.7).

If the fast idle test is performed for the first time and the emission values are outside the required limits, additional pre-conditioning is needed (6.3.6)

before continuing with a second fast idle test. After a second fast idle test the analyser proceeds to the Catalyst stabilisation phase (Section6.3.7.1).

Figure 6.3.5.1-3: Second fast Idle test after additional pre-conditioning.

2.8.5.2 Fast Idle Test when engine speed cannot be measured

At the start of the Fast Idle test, the operator is prompted to use the vehicle's own tachometer to check the engine speed. The operator starts the Fast Idle test by clicking on Validate

Figure 6.3.5.2-1: The operator is prompted to use vehicle's own tachometer to check the engine speed

During ten seconds the application prompts the operator to adjust the engine speed to fast idle

During 30 seconds the operator is prompted to maintain the fast idle speed.

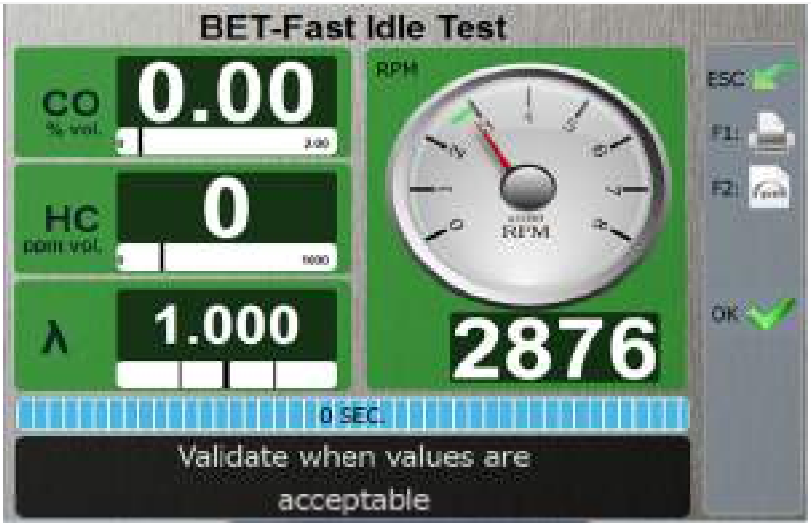


Figure 6.3.5.2-3: Fast Idle speed must be maintained during 30 seconds

The Fast Idle test finishes either when the measured results are within the limits or at the end of the 30 seconds countdown. The analyser continues with Catalyst stabilization phase if the measured values are OK.

If the measured emission values are out of the required limits, and the fast idle test has been performed for the first time, the additional pre-conditioning phase follows (Section 6.3.6).

2.8.6 Catalyst procedure – Additional preconditioning

This phase of the Catalyst procedure follows the First Idle test phase when the gas emission values are out of the required limits. The operator is required to proceed to this phase. When he clicks on Validation (Figure 6.3.5.2-1) the additional pre-conditioning phase begins either when it includes engine speed measurement (Section 6.3.6.1) or when engine speed is not measured (Section 6.3.6.2).

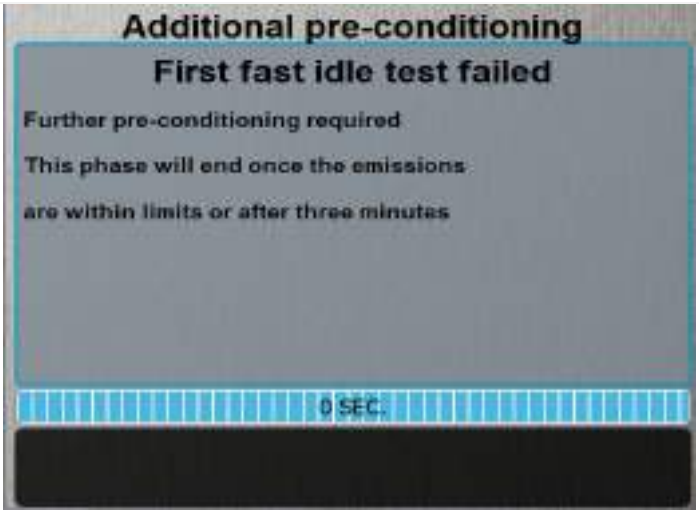


Figure 6.3.5.2-1: Demand for further preconditioning

2.8.6.1 Additional pre-conditioning when the engine speed can be measured

The operator is prompted to adjust the engine speed to the Fast idle values.

As soon as the engine speed is adjusted within the required range (2000 to 3000 rpm), the 3 minutes countdown begins. If at any stage during this countdown, the engine speed drifts outside the required range (or the speed signal is lost) the countdown will be frozen and only continues once the engine speed comes back into the required range.

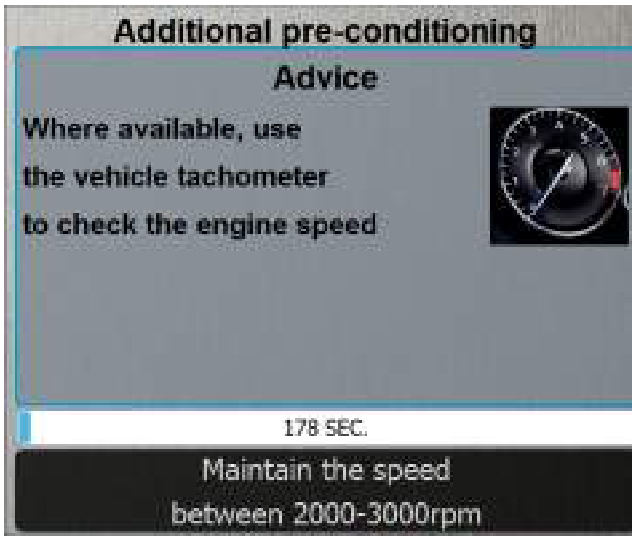
Figure 6.3.6.1-2: Three minutes additional pre-conditioning

The analyser will only proceed to the next stage Second Fast Idle when once either:

- the gas emission limits are within the limits
- the countdown is completed

2.8.6.2 Additional pre-conditioning phase when the engine speed cannot be measured

The operator starts additional an pre-conditioning phase clicking on Validation. Since the engine speed measurement device is not used, at the beginning the operator is advised to use the vehicle's own tachometer.



Operator is advised to use the vehicle's own tachometer.

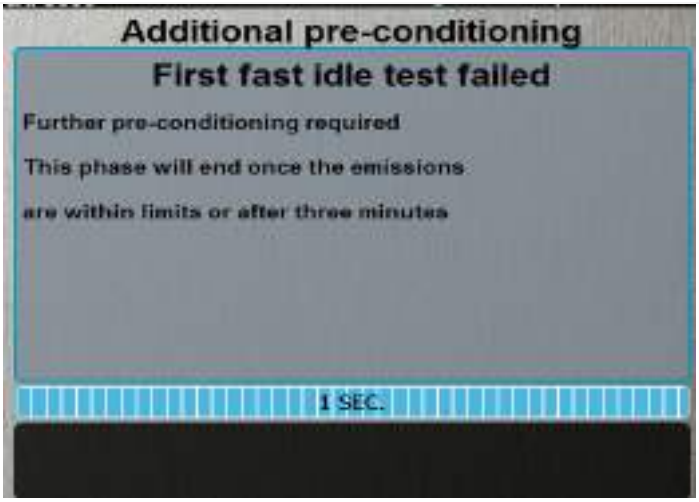
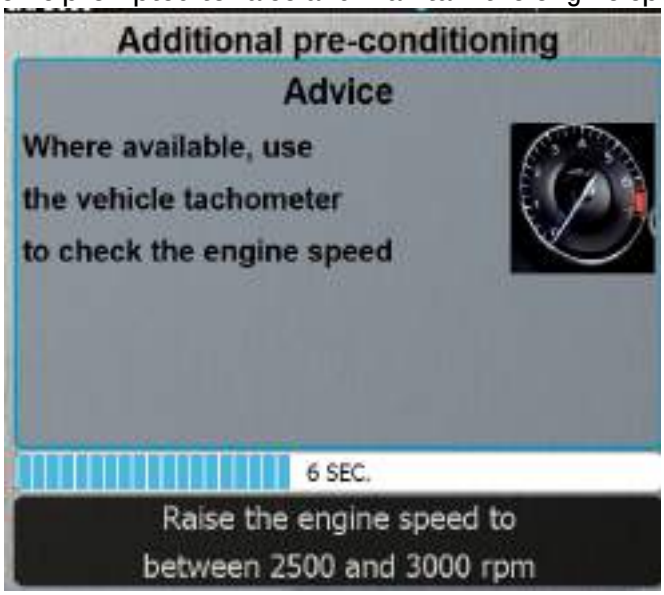


Figure 6.3.6.2-1: Start the additional preconditioning

During 10 seconds the operator is prompted to raise and maintain the engine speed to fast idle.



The operator should maintain the fast idle speed for a 3 minute period.

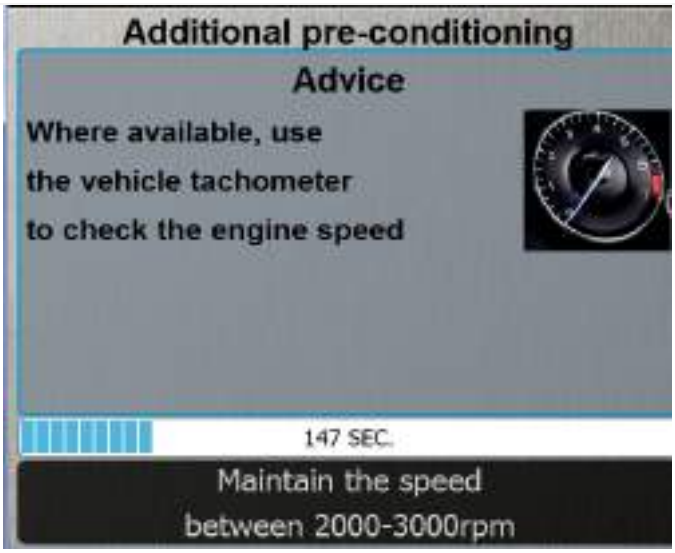


Figure 6.3.6.2-3: Three minutes additional pre-conditioning

The analyser will proceeds to the next, Stabilization phase (Section 6.3.7.2), either:

- As soon as the emission values are within the required limits
- If the fast idle test has been performed for a second time and the three minute countdown finishes.

Otherwise the second fast idle test is performed (Section 6.3.5.2).

2.8.7 Catalyst procedure – Catalyst stabilization phase

2.8.7.1 Catalyst stabilization phase when the engine speed can be measured

As soon as the speed is within the required range for fast idle (2500 to 3500 rpm), a 30 second countdown time starts. During this interval the engine speed must be maintained to fast idle limits. If, for any reason, the engine speed signal is lost or the engine speed drifts outside the required range, the countdown time resets itself to a new 30 second countdown. The operator is prompted to adjust the engine speed so it is within the required range.

Figure 6.3.7.1-1: The operator is prompted to maintain the fast idle engine speed for 30 seconds

NOTE: The analyser will not continue to the next phase (section 6.3.8.1) until the 30 second countdown has been completed.

2.8.7.2 Catalyst stabilisation phase when the engine speed cannot be measured

Since the measuring device is not used for engine speed measurement, the operator is advised to use the vehicle's own tachometer to check the engine speed. He starts this phase by clicking on the Validation button.

For 10 seconds the operator is prompted to adjust the engine speed within required range for fast idling (2500 to 3000 rpm).
As soon the engine speed is in the required range for fast idling a 30 second countdown time begins.
Catalyst stabilization phase means allowing engine to run at fast idle speed for 30 seconds.
During this time the operator is prompted to maintain the fast idle speed.

NOTE: The analyser will not continue to the next phase (section 6.3.8.2) until the 30 second countdown has been completed.

2.8.8 Catalyst procedure – Natural Idle test

In the Natural Idle Test phase of the Catalyst test procedure the operator needs to adjust and maintain the engine speed within the required limits for natural idling. The test can be performed with, or without the engine speed being measured (section 6.3.8.1) or (section 6.3.8.2). The operator is prompted to maintain the natural idle speed.

2.8.8.1 Natural Idle test when the engine speed can be measured

During ten seconds he is prompted to do this.

Figure 6.3.8.1-1: During 10 seconds the operator is prompted to adjust the speed to natural idle

In case the engine speed is higher than the required range for natural idling the operator is asked either to:

1. Correct the engine speed and continue with test
2. Abort the test

Figure 6.3.8.1-2: The operator can continue or abort the Natural Idle test

If the operator chooses to correct the engine speed and continue, a 30 seconds countdown begins. The operator has to maintain the natural engine speed during 30 seconds. If, at any stage during countdown, the engine speed drifts outside the required natural idle range, the countdown will resets itself to 30 seconds.

If the operator selects the second option to abort the test, the results obtained so far are printed and the application goes back to the First Screen (Figure 6.2.1-1).

Figure 6.3.8.1-3: Natural Idle speed needs to be maintained during 30 seconds

The Natural Idle test will end either when the CO value is within limits or at the end of the 30 seconds countdown.

2.8.8.2 Natural Idle test when the engine speed cannot be measured

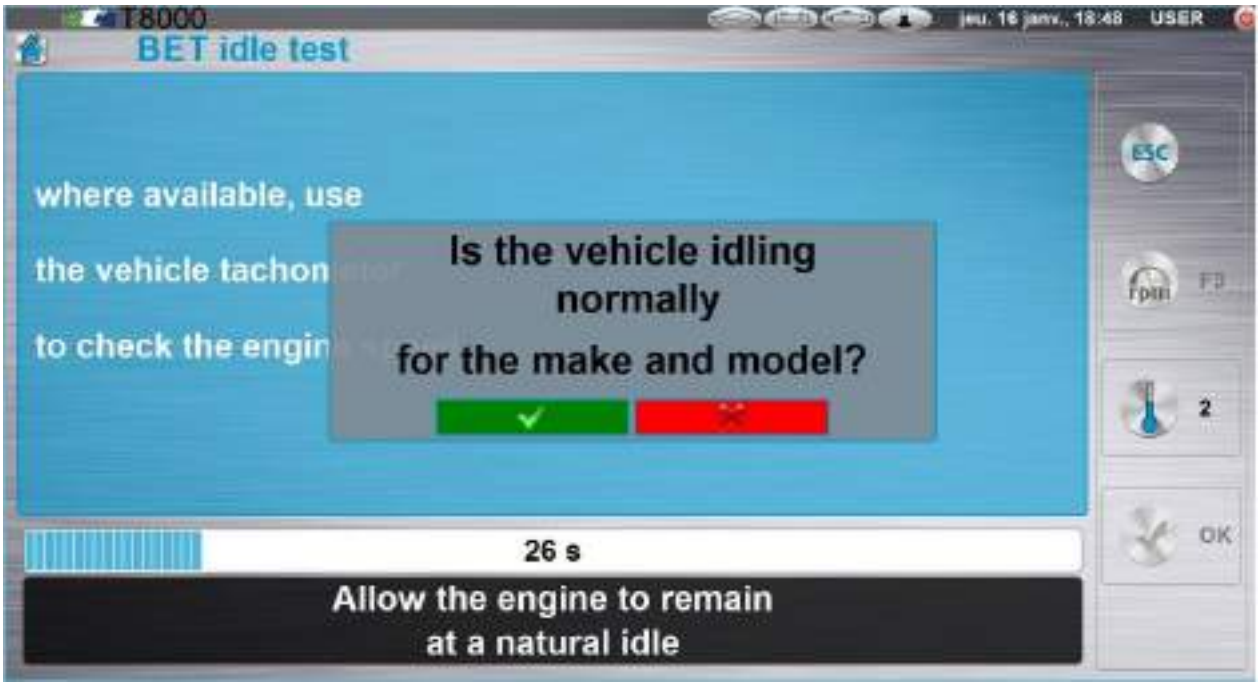


Figure 6.3.8.2-3: Natural idle test ends after 30 seconds countdown

2.8.9 Results of the Catalyst test procedure

At the end of the catalyst procedure, the operator is prompted to remove the exhaust probe from tailpipe, and to disconnect the engine speed measuring device if it has been used. He needs to confirm this with the Validation button (Figure 6.3.8.2-1).

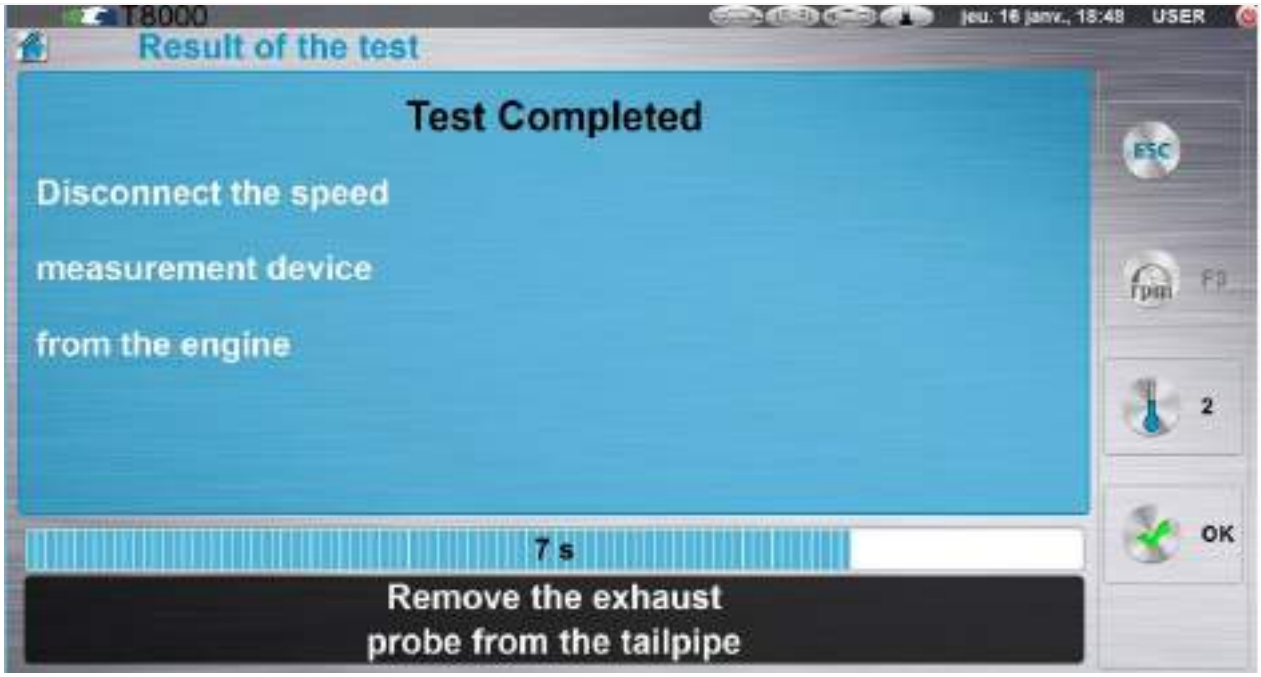


Figure 6.3.8.2-1: The Operator is prompted for Catalyst test completion

When oil temperature is measured, the application warns the operator to also remove the oil temperature probe.

NOTE: The application does not continue with displaying test results unless the probes are removed.

The application shows test results in two different forms, depending on that whether the second Fast Idle test has been performed or not. Figure 6.3.8.2-2 shows test results when the Fast test result passed the first time.

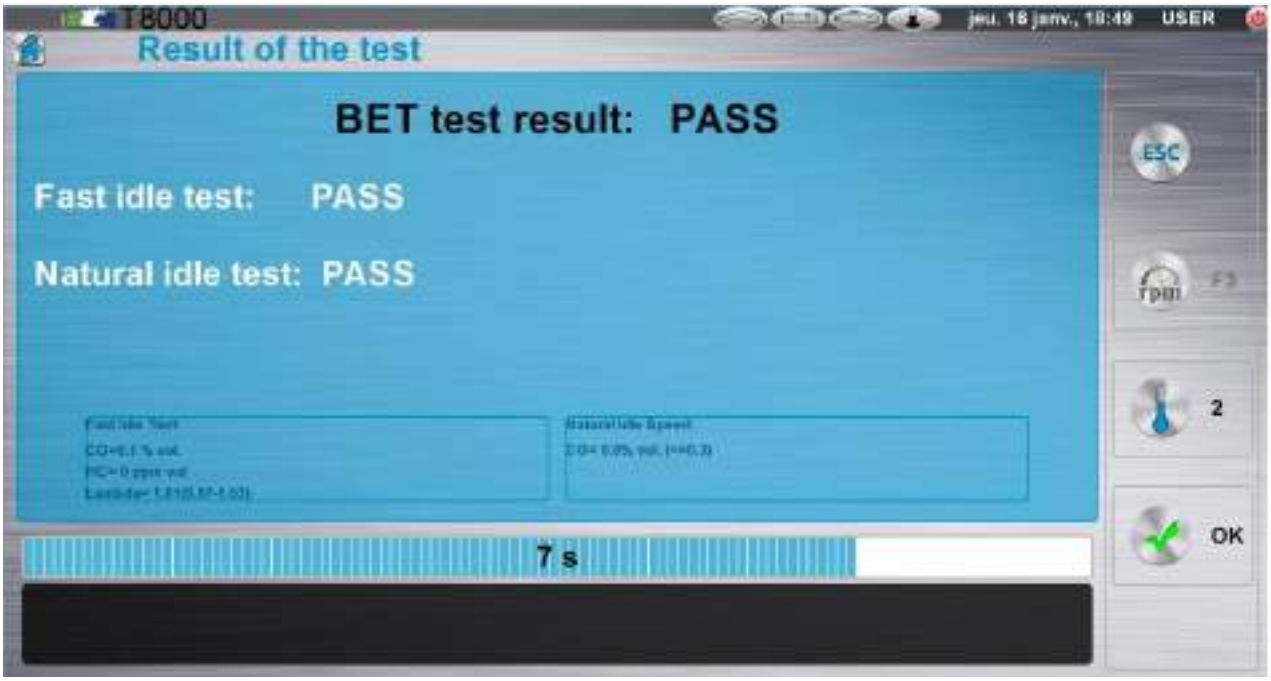


Figure 6.3.8.2-2: Test results if Fast Idle test passed at the first time

The application allows the operator three options on the exit of the test procedure.

When the operator chooses to restart the test he has the option to do this for the same vehicle, for a new vehicle, or to control the vehicle data.

2.9 NON-CATALYST PROCEDURE

The Non-Catalyst procedure is used for the following vehicles:

- Date of first use is between 1 August 1992 and 31 July 1994, fuel type is gas and vehicle type is not passenger car.
- Date of first use is between 1 August 1975 and 31 July 1986.

This procedure is more tolerant than the Catalyst procedure. It contains an engine purge sequence to clean the exhaust of the vehicle before checking commences. Moreover, there is a smoke level check which consists of observing the smoke levels emitted from the tailpipe.

2.9.1 Data input in Non-Catalyst procedure

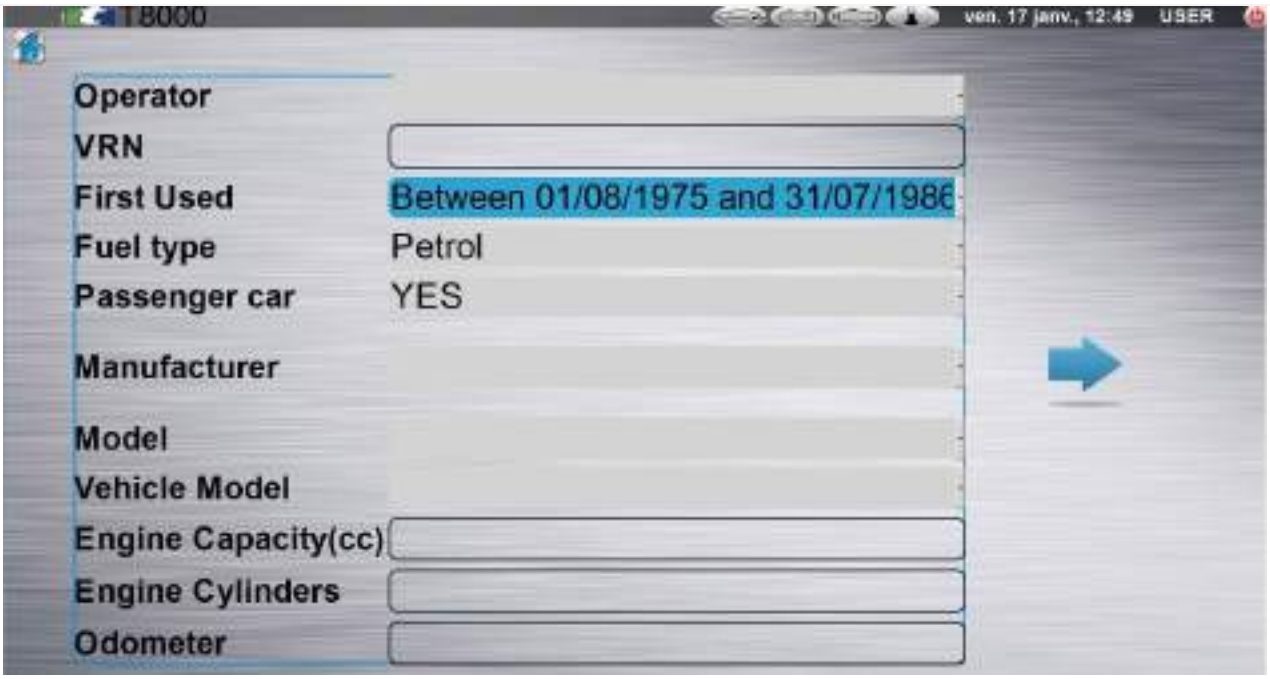


Figure 6.3.8.2-1: Data input screen in Non-Catalyst procedure

6.4.2 Engine up to Temperature

The application advises the operator to start the engine and to run it at the normal idle speed. If the engine speed measuring device is used, the application displays the engine speed value in RPM (revolutions per minute).

NOTE: When engine speed is not measured with an attached engine speed measuring device, the application displays four dashes.

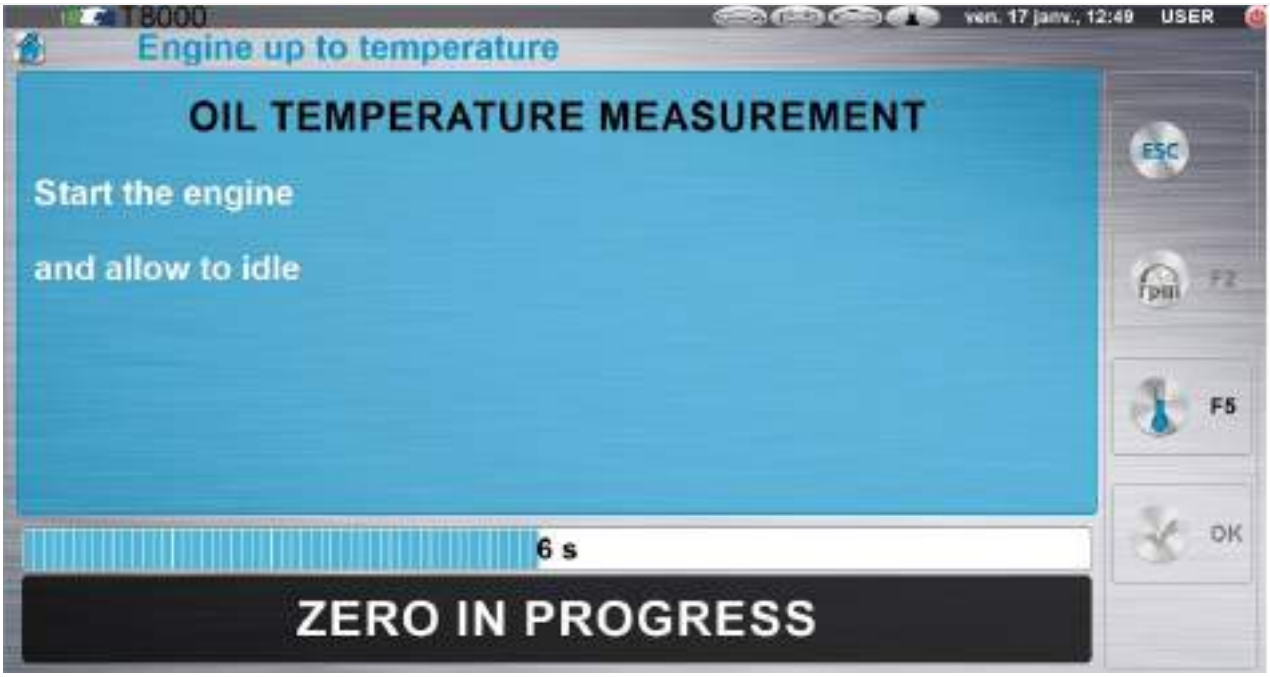


Figure 6.3.8.2-1:The operator has to provide the engine runs idle

The operator confirms that he has checked the engine temperature. This can be done in one of the three ways showed on Figure 6.3.8.2-2. He clicks the corresponding choice button, or presses the key with the corresponding choice number on the keyboard. The system remembers the choice and the information is printed on the test results sheet.

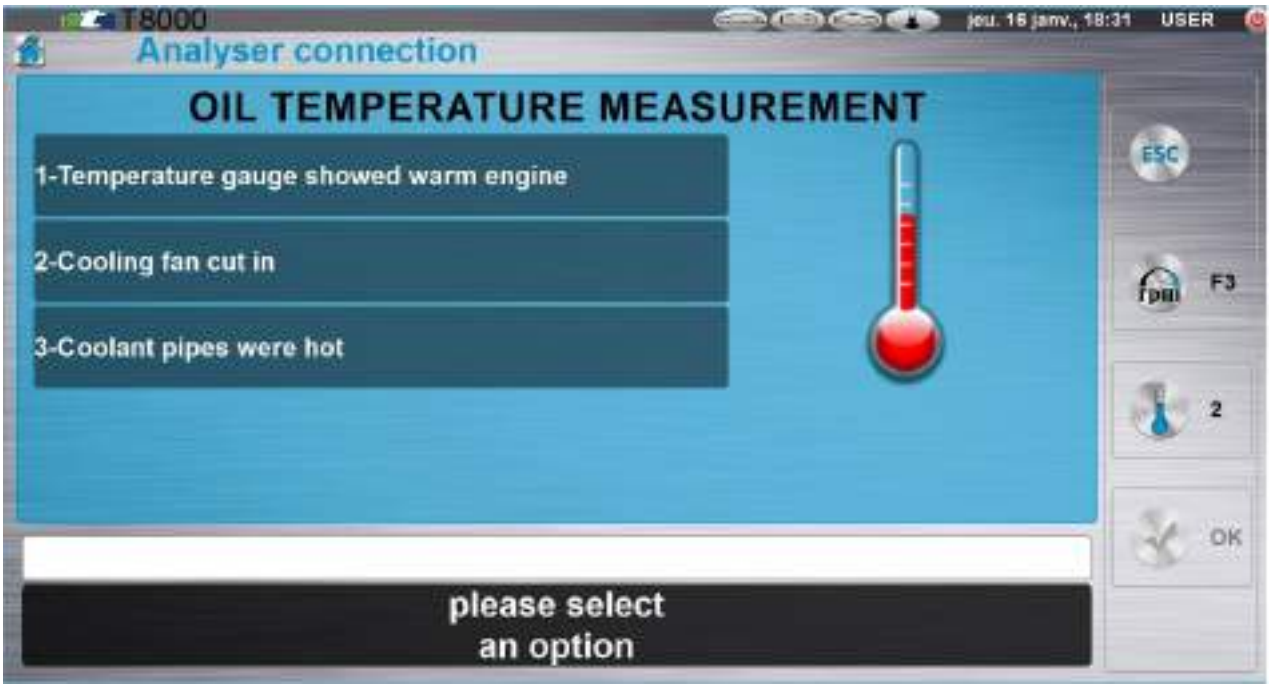


Figure 6.3.8.2-2: The operator confirms that engine is at normal operating temperature

2.9.2 Engine Purge

At this point the analyser checks for the presence of oxygen (or carbon dioxide), warns the operator to remove the probe from the exhaust pipe if necessary (Figure 6.3.8.2-1).

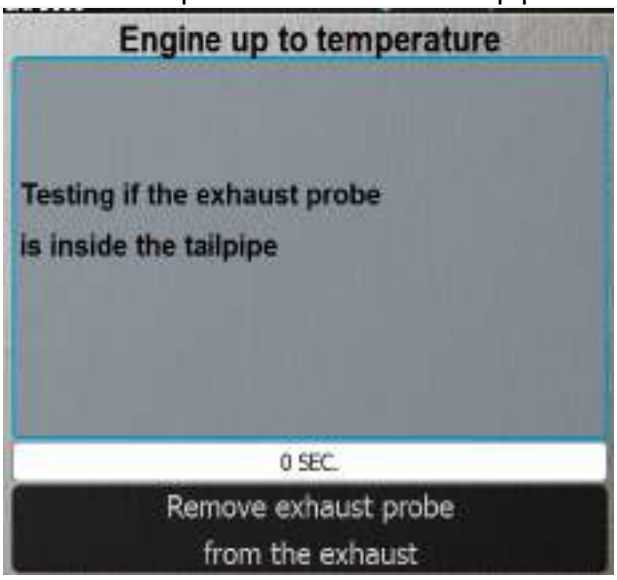


Figure 6.3.8.2-1:Operator needs to remove the probe from exhaust pipe

In Engine purge phase of the Visual procedure the operator is advised to clean the exhaust of the vehicle. The engine needs to be around 2500 rpm or half the maximum engine speed if this is lower. The operator needs to adjust the required engine speed and confirm with the Validation button (Figure 6.3.8.2-2).

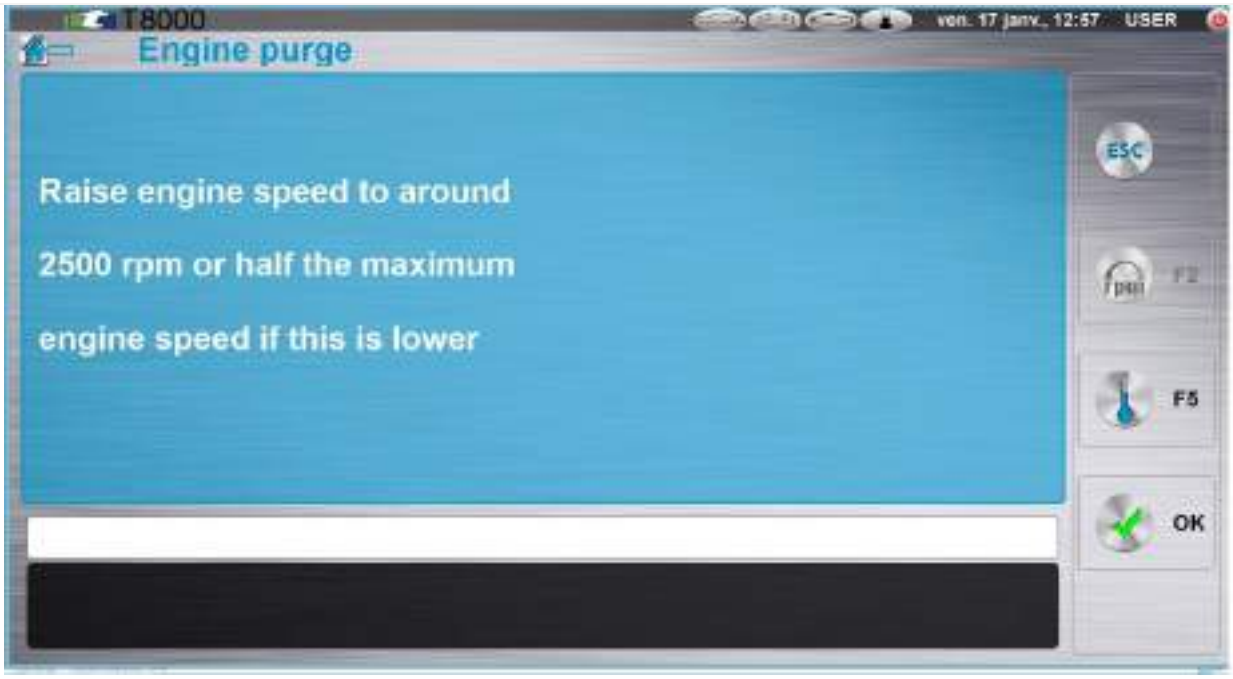


Figure 6.3.8.2-2: The Operator confirms the proper engine speed is reached

The application advises the operator to maintain the required engine speed for 20 seconds (Figure 6.3.8.2-3).

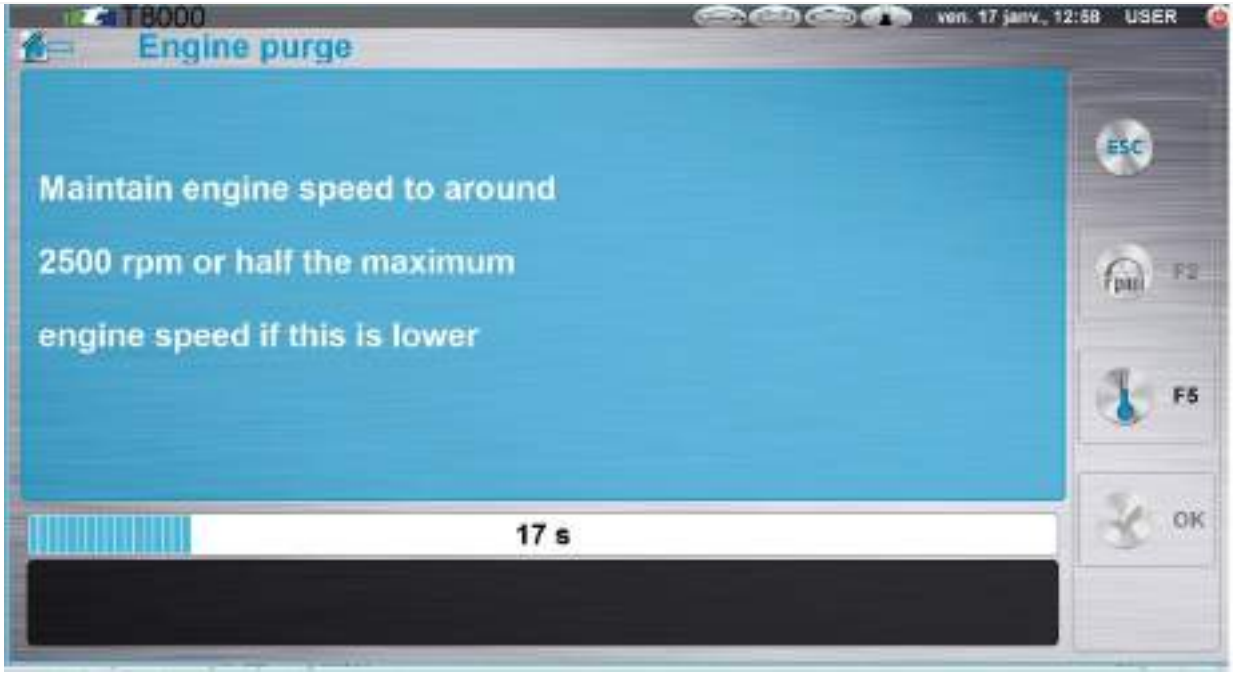


Figure 6.3.8.2-3: The operator is prompted to maintain the engine speed, or half of the maximum engine speed.

At the end of the countdown period the operator is prompted to allow the engine to run at idle. He adjusts the engine speed to natural idle and confirms with Validation button (Figure 6.3.8.2-4).

Figure 6.3.8.2-4: The operator is prompted to allow the engine to return to idle

2.9.3 Idle speed check

During 15 seconds the operator is prompted to allow the engine to run at idle (Figure 6.3.8.2-1). This idling is necessary before the operator accesses the smoke from tailpipe (Section 6.4.5).

Figure 6.3.8.2-1: Engine needs to run idle for 15 seconds

At the end of the countdown the application asks the operator to confirm if the engine idle speed is acceptable. He selects one of two choices displayed on the screen (Figure 6.3.8.2-2). This information is logged by the system and is printed out on the test results sheet.

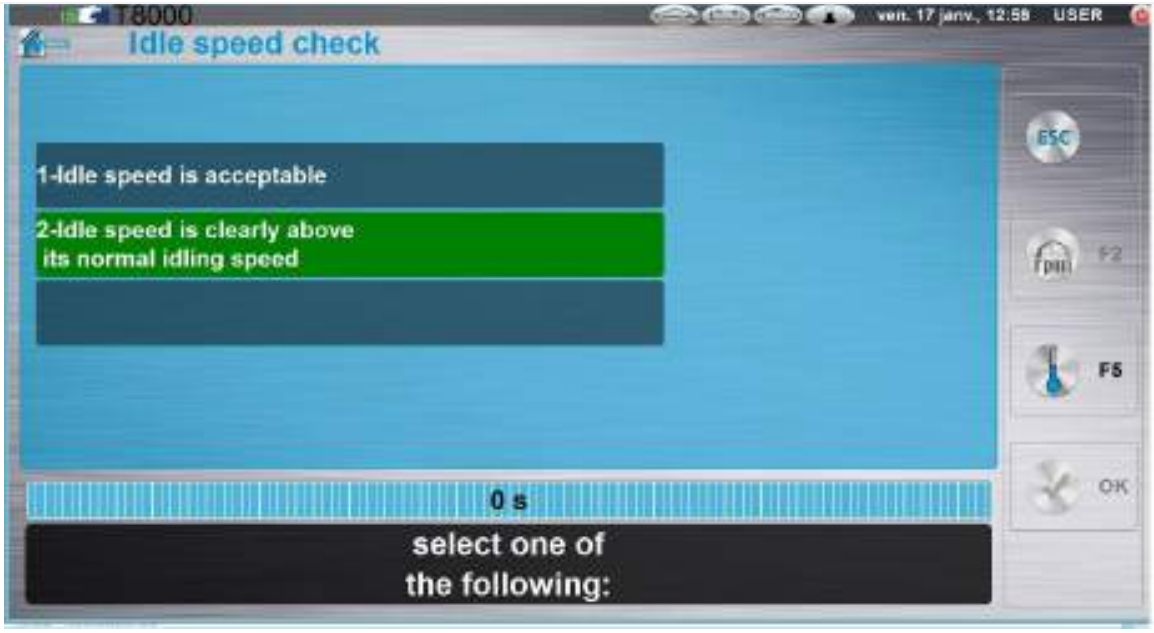


Figure 6.3.8.2-2:

2.9.4 Smoke level check in Non-catalyst procedure

This phase of the Visual procedure consists of a visual imspection of the smoke emitted from the tailpipe. The operator is prompted to assess the smoke level.
Based on his conclusion to this visual check, the operator responds with YES or NO (Figure 6.3.8.2-2).

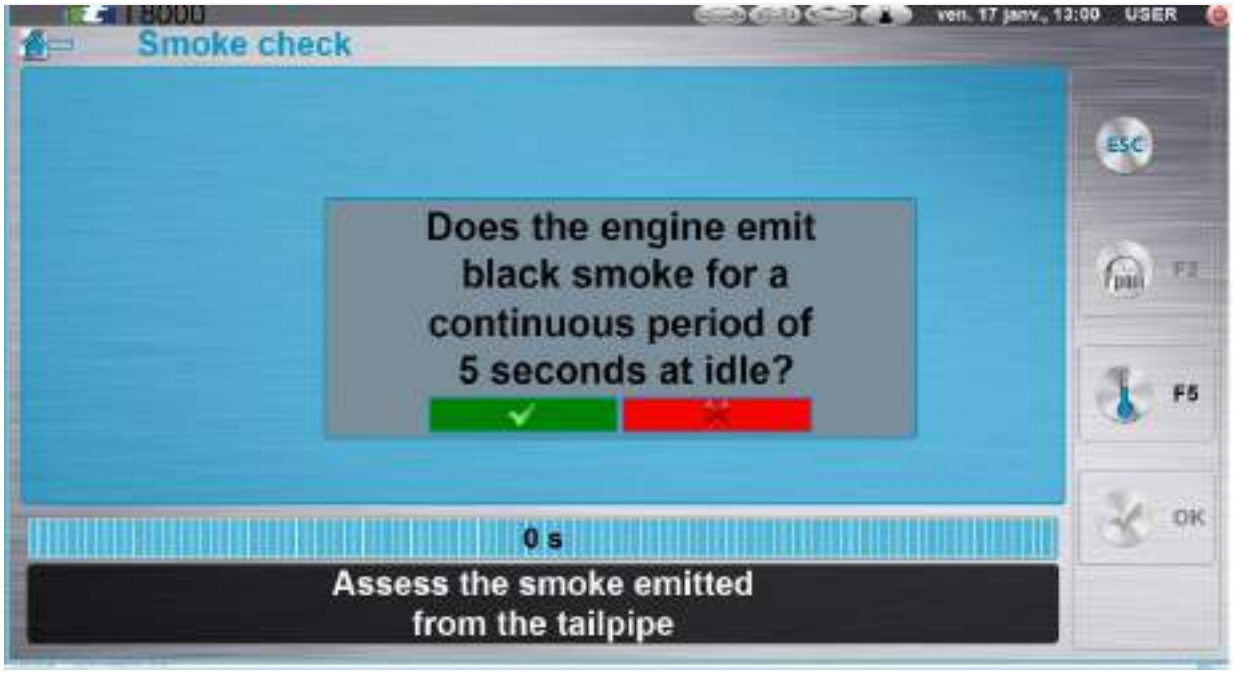


Figure 6.3.8.2-2: The operator qualifies the smoke level

2.9.5 HC residue check

Before the HC residue check starts (Figure 6.3.8.2-1) the Gas analyser application reminds the operator that the exhaust probe needs to be removed from the exhaust pipe. To continue, the operator clicks on Validation.

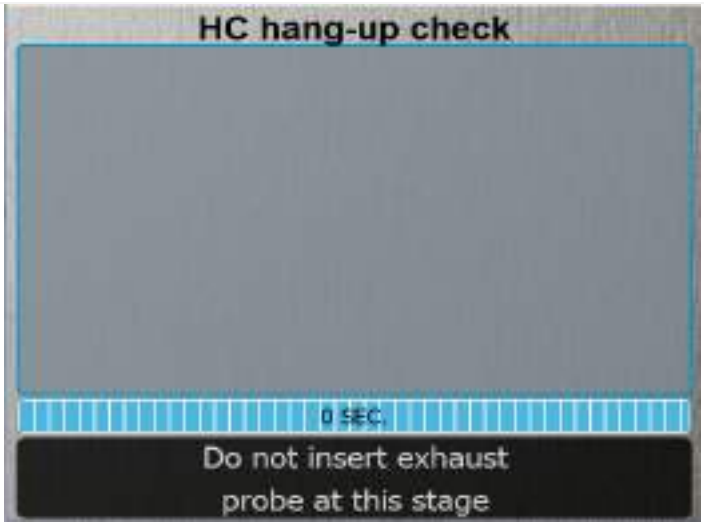
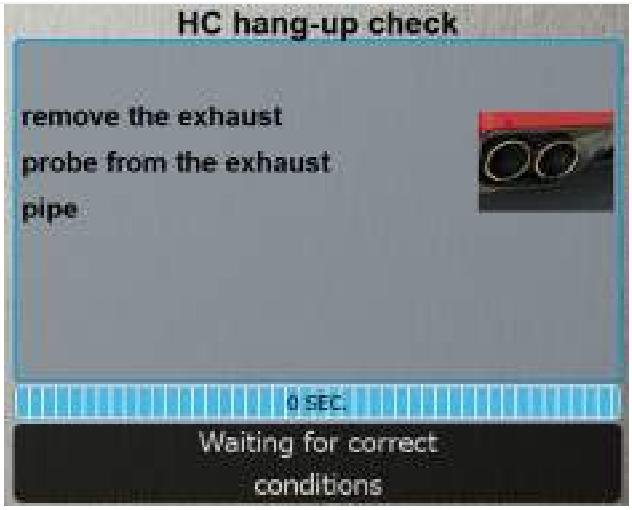


Figure 6.3.8.2-1: HC residue check requires that the exhaust pipe is not in the exhaust tailpipe

The exhaust probe is out of the exhaust pipe. The HC residue check is performed (Figure 6.3.8.2-2).



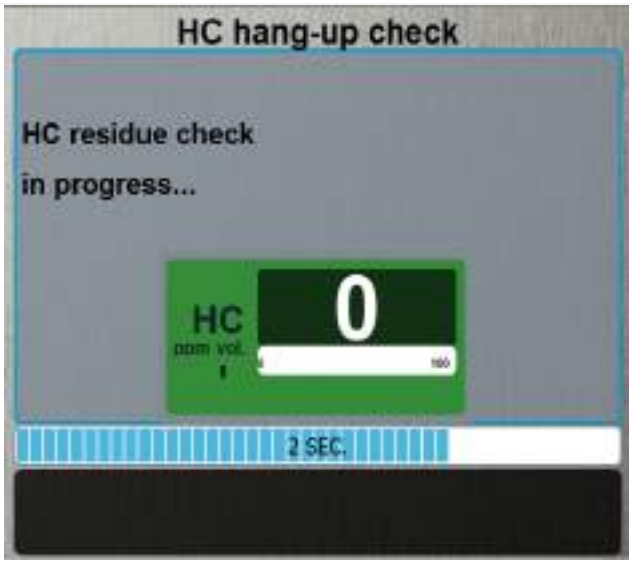
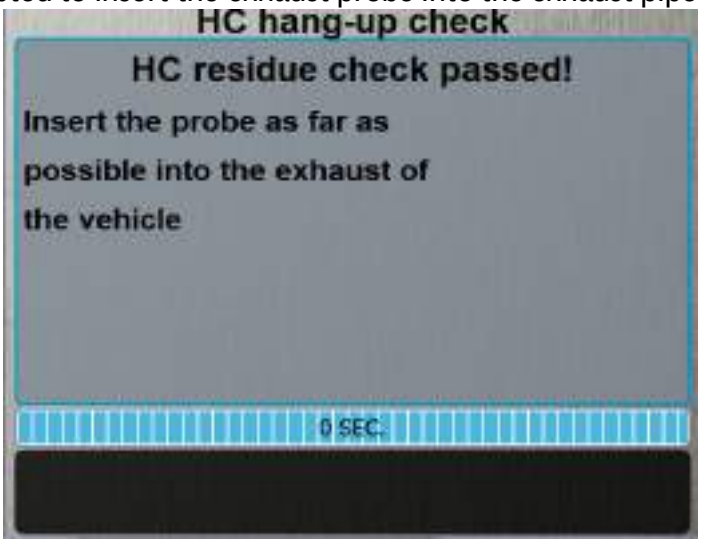


Figure 6.3.8.2-2: HC residue check in progress

The operator is prompted to insert the exhaust probe into the exhaust pipe of the vehicle



Alternatively if the HC check is failed, the operator has two choices (Figure 6.3.8.2-4).

1. Re-perform the test
2. Abort the test

In case 1, the Gas analyser re-performs the HC residue check (Figure 6.3.8.2-2).

In case 2 – Abort test, the application advices the operator to restart the process, i.e. go back to the MOT test screen (Figure 6.2.4.1-1).

After a successful HC residue check, the analyser begins monitoring all emissions.

2.9.6 Idle test

In this phase the analyser prompts the operator to insert the exhaust probe into the exhaust pipe and to allow the engine to run at idle for 20 seconds.
After the the 20 seconds countdown, the analyser records the relevant gas values.

If the HC values are OK, then the analyzer continues to the Results screen (Section 6.4.8). Otherwise the operator needs to raise the engine speed to around 2000 rpm and maintain this speed for 20 seconds.

At the end of 20 seconds countdown the test results are displayed (Section 6.4.8).

2.9.7 Resuts of the Non-Catalyst test

At the end of the test sequence, the application displays the emission results (Figure 6.3.8.2-2). The operator can be prompted to remove the exhaust probe if it is still in the exhaust pipe (Figure 6.2.4.1-1).
NOTE: Non-catalyst procedure will not continue with displaying the test results until the exhaust probe has been removed.

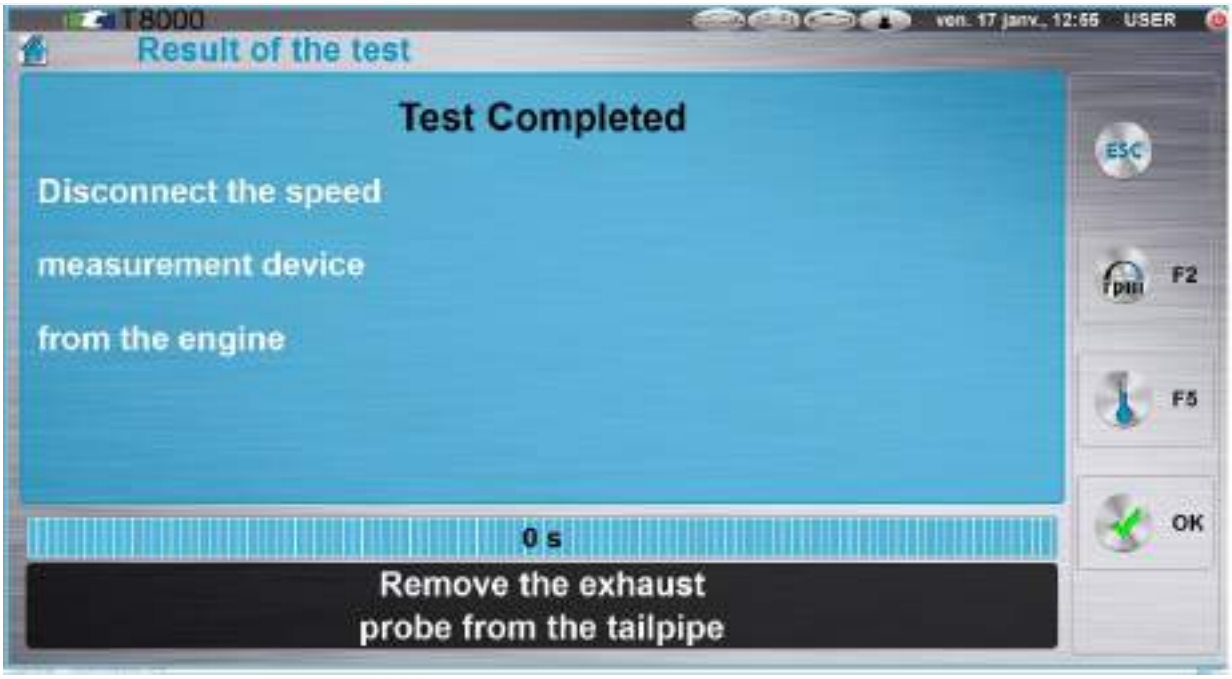


Figure 6.3.8.2-1: The application prompts to remove the exhaust probe.

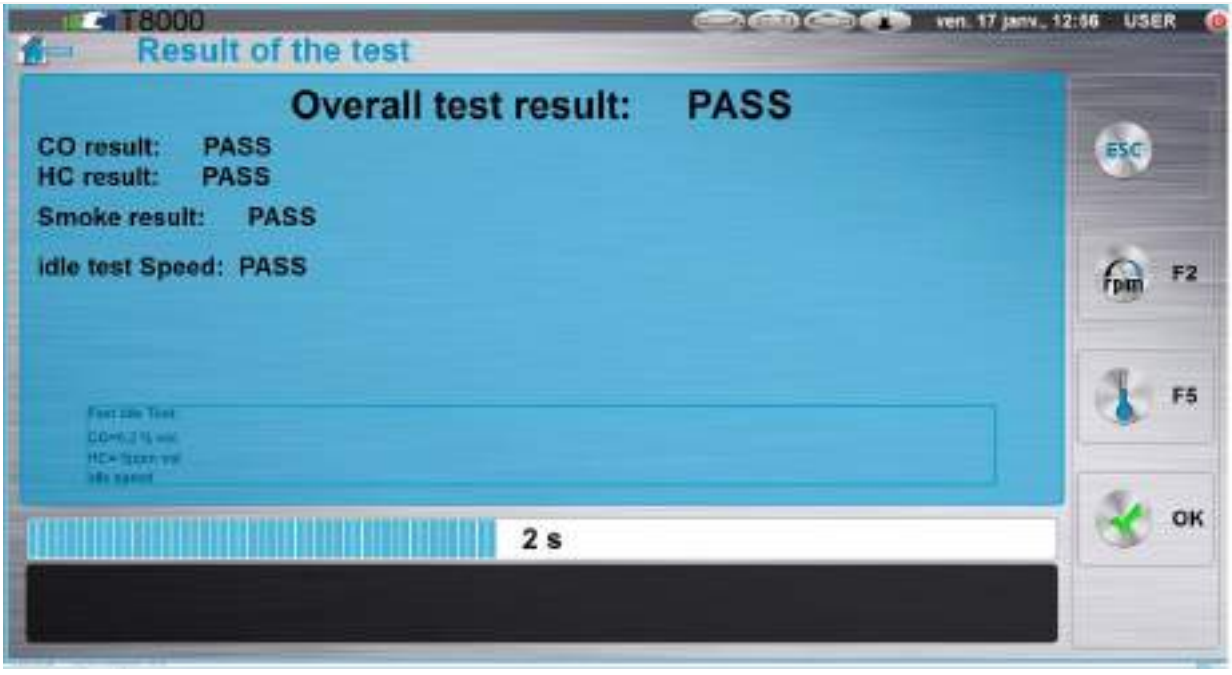


Figure 6.3.8.2-2: Example of the results of the Non-catalyst procedure

2.10 VISUAL PROCEDURE

The Visual procedure is used for vehicles with a first use date before 1st August 1975. This is a subjective test procedure based only on the operator's visual check of smoke level during vehicle idling.

2.10.1 Data input phase of Visual procedure

The application prompts the operator to enter/select/review the data which will be stored for the period of the test (Figure 6.3.8.2-1). Data for review is from a previous test or is manually entered. The previously entered operator's name will be stored until a new name is entered.

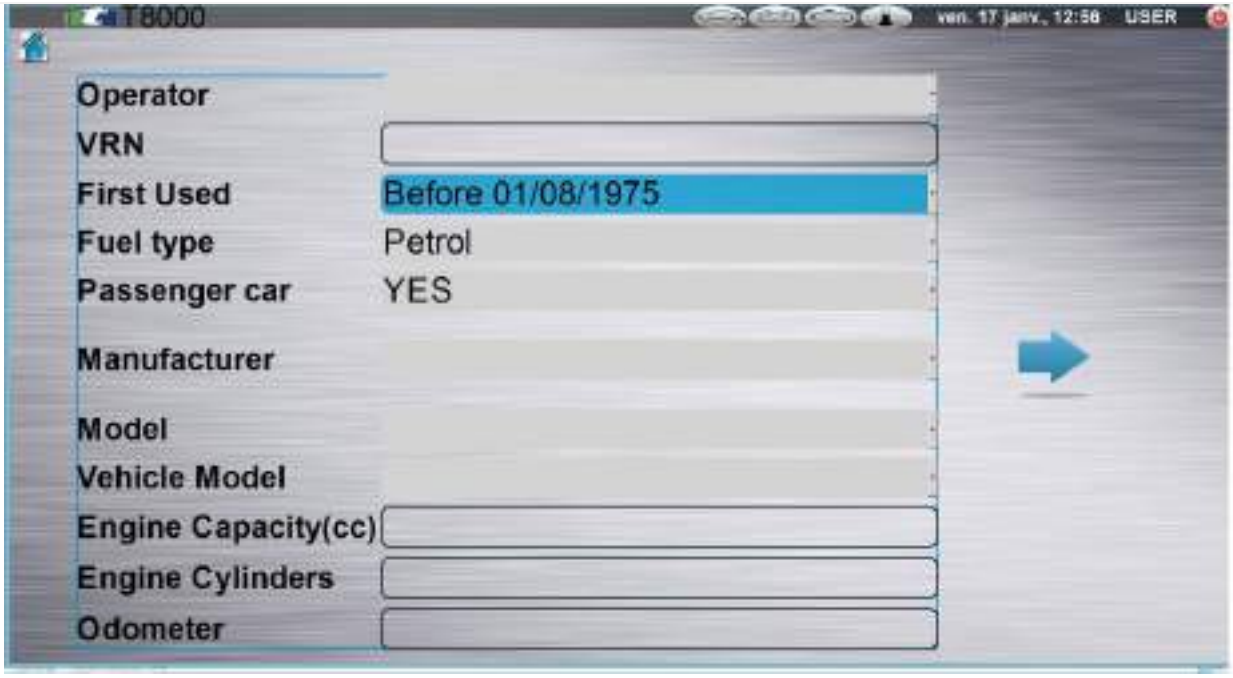


Figure 6.3.8.2-1: Data input screen in Visual Procedure

2.10.2 Engine up to temperature

The application prompts the operator to start the engine and advices him to allow it to run at normal idle speed (Figure 6.3.8.2-1). If the engine speed measuring device is used, the application displays the engine speed value in RPM (revolutions per minute).

NOTE: When engine speed is not measured with attached engine speed measuring device, the application displays four dashes.

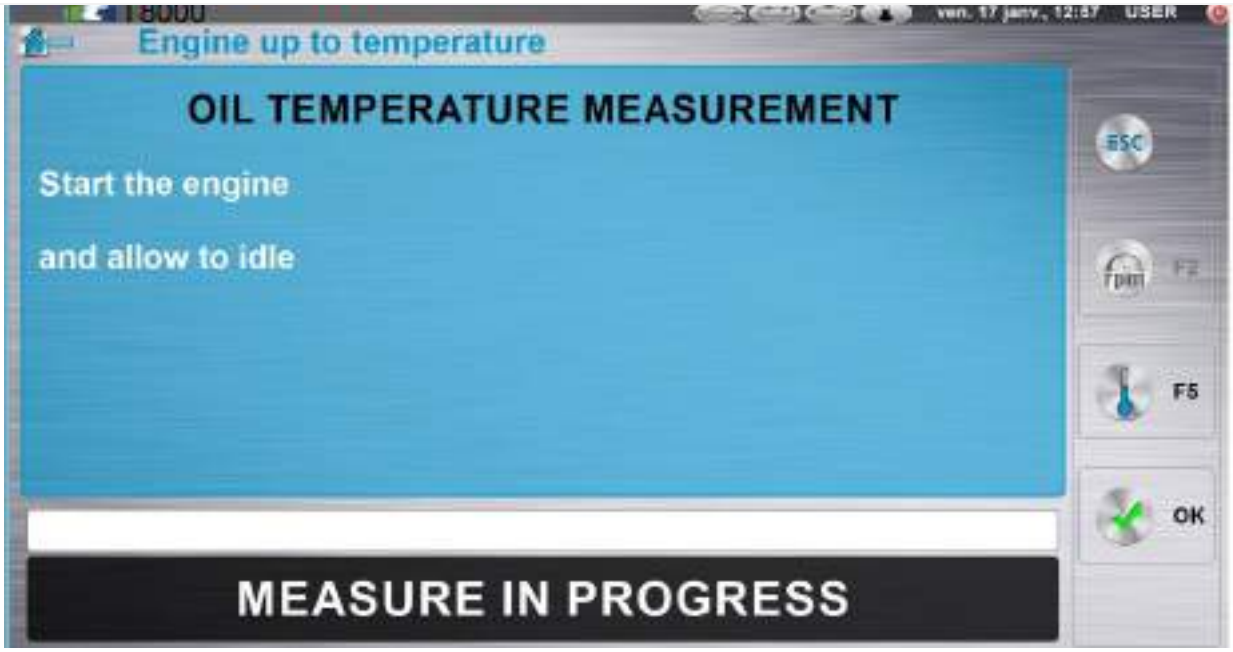


Figure 6.3.8.2-1: At the start of the Visual test procedure the operator is prompted to allow the engine to idle

Test can continue only if the oil is at normal operating temperature. The operator confirms the temperature in one of the three possible ways.

6.5.3 Engine purge

In Engine purge phase of the Visual procedure the operator is advised to clean the exhaust of the vehicle. The engine needs to run around 2500 rpm or half the maximum engine speed if this is lower. The operator needs to adjust the required engine speed and confirms with the Validation button (Figure 6.3.8.2-1).

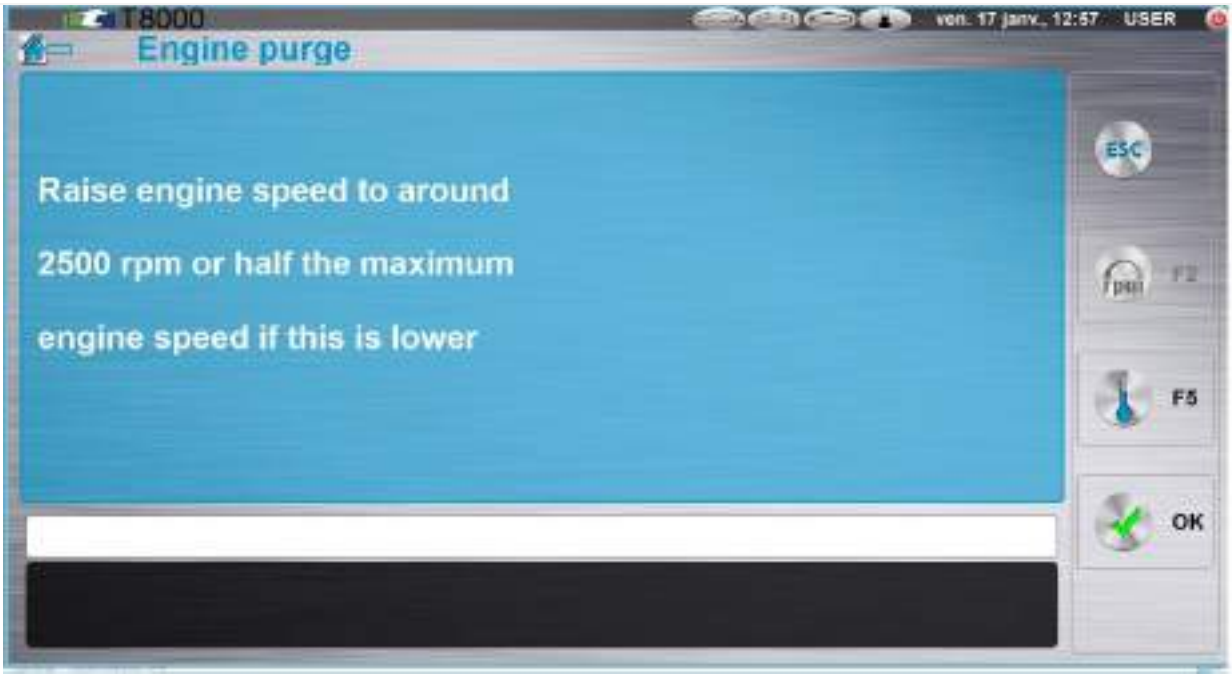


Figure 6.3.8.2-1: The Operator confirms the required engine speed is reached

The application advises the operator to maintain the required engine speed for 20 seconds (Figure 6.3.8.2-2).

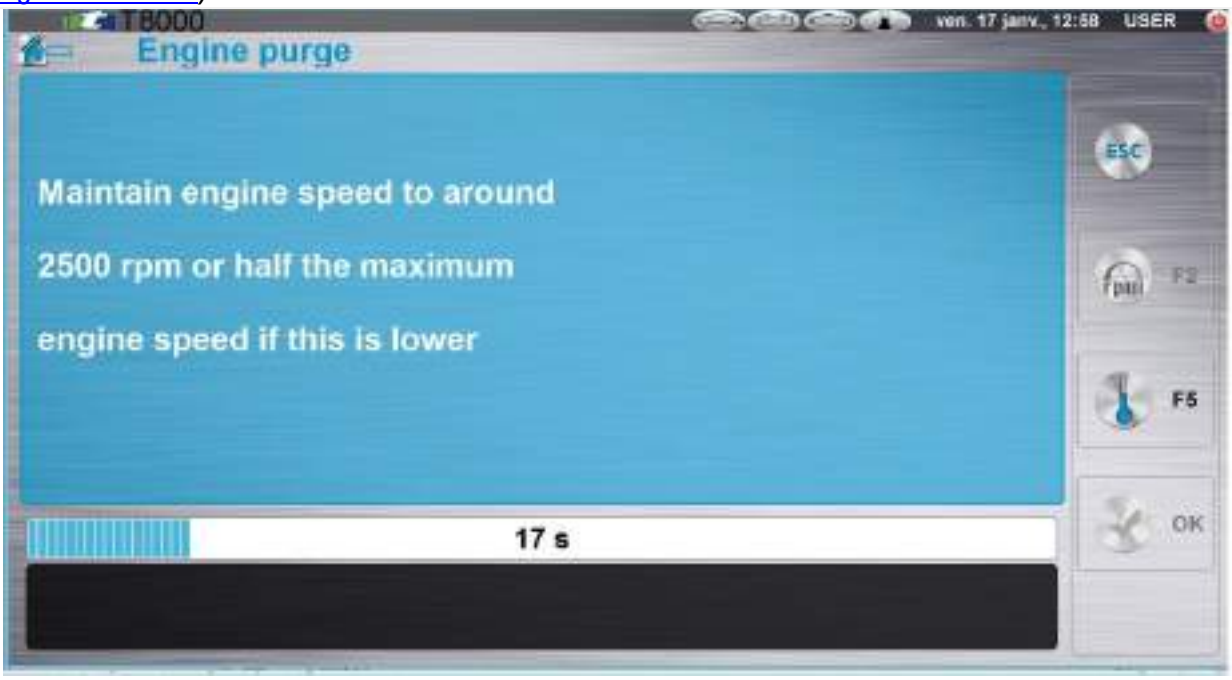


Figure 6.3.8.2-2: The operator is prompted to maintain the required engine speed.

At the end of countdown time the operator is prompted to allow the engine to run at idle. He adjusts the engine speed to natural idle and confirms with the Validation button (Figure 6.3.8.2-3).

Figure 6.3.8.2-3: The operator is prompted to allow the engine to return to idle

2.10.3 Idle speed check

During 15 seconds the operator is prompted to allow the engine to run at idle (Figure 6.3.8.2-1).

Figure 6.3.8.2-1: Engine needs to run at idle for 15 seconds

At the end of the countdown the application asks the operator to confirm the correct engine idle speed. He selects one of the two choices displayed on the screen (Figure 6.3.8.2-2).

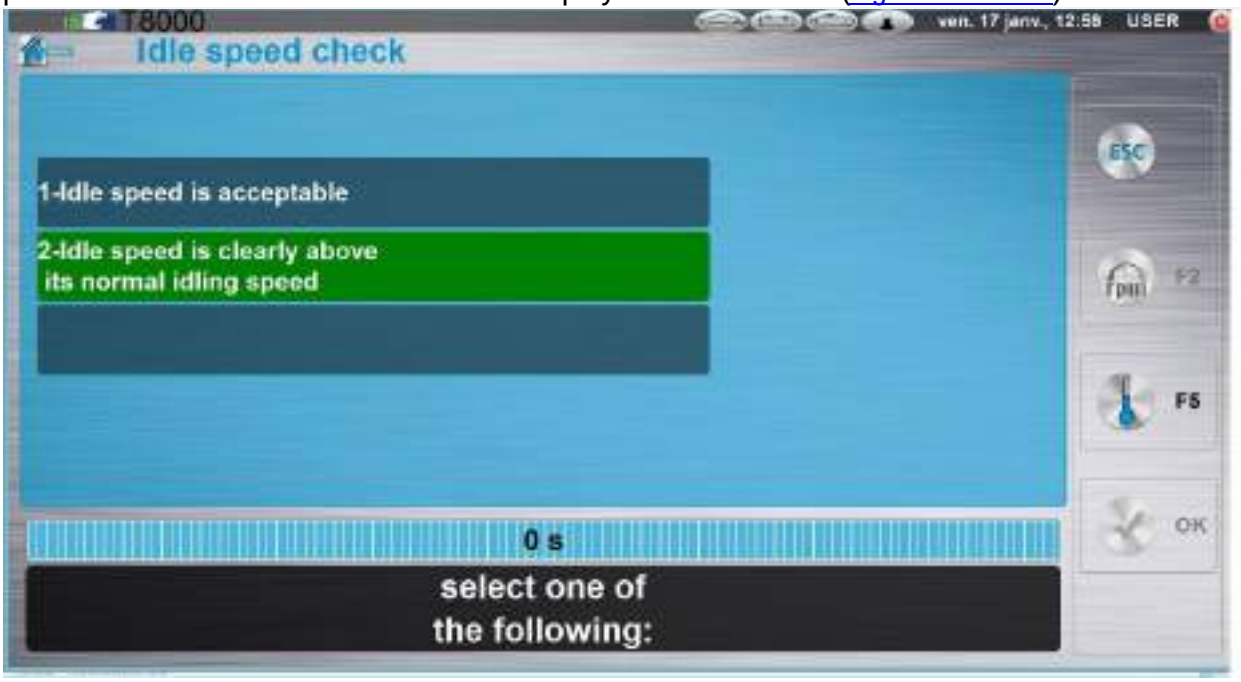
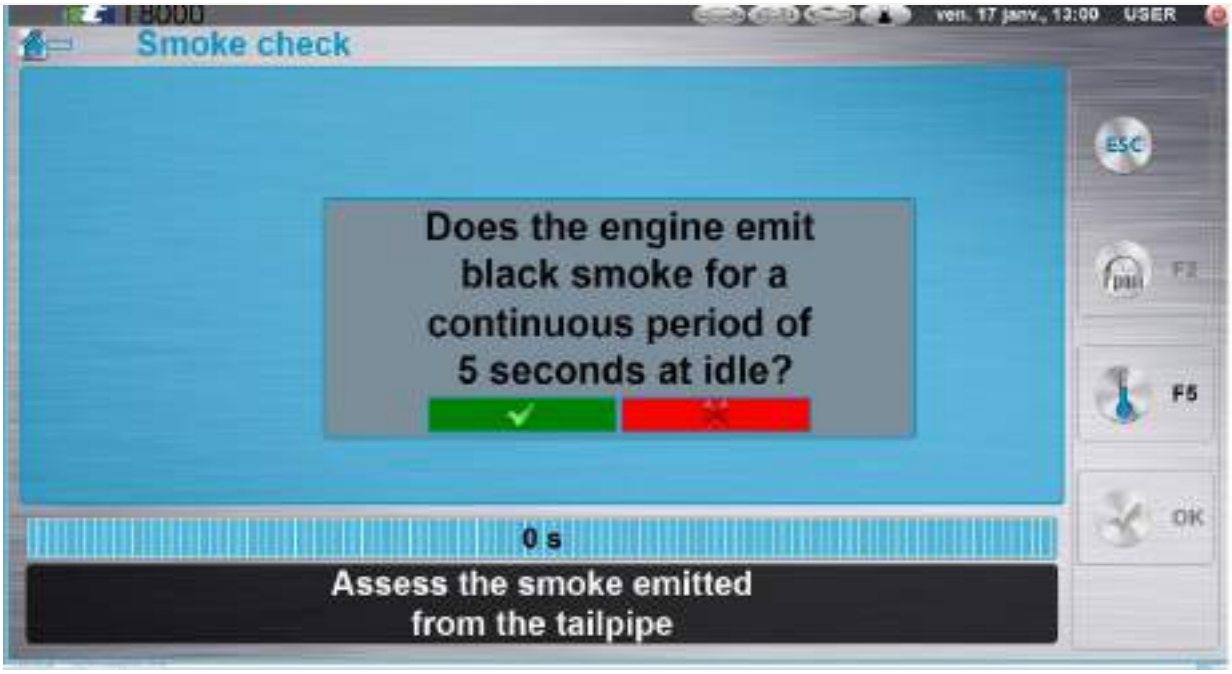


Figure 6.3.8.2-2:

2.10.4 Smoke level check

This phase of the Visual procedure consists of visually assessing the smoke emitted from the tailpipe. The operator is prompted to check the smoke level.
Based on this visual check, the operator answers with YES or NO to the question. (6.3.8.2-2)



6.3.8.2-2: The operator confirms the smoke level

2.10.5 Results of the Visual test procedure

At the end of the procedure, depending on the qualification entered by the operator the application displays the results of the test on the screen (Figure 6.3.8.2-1). To exit the test the operator clicks on Validation.

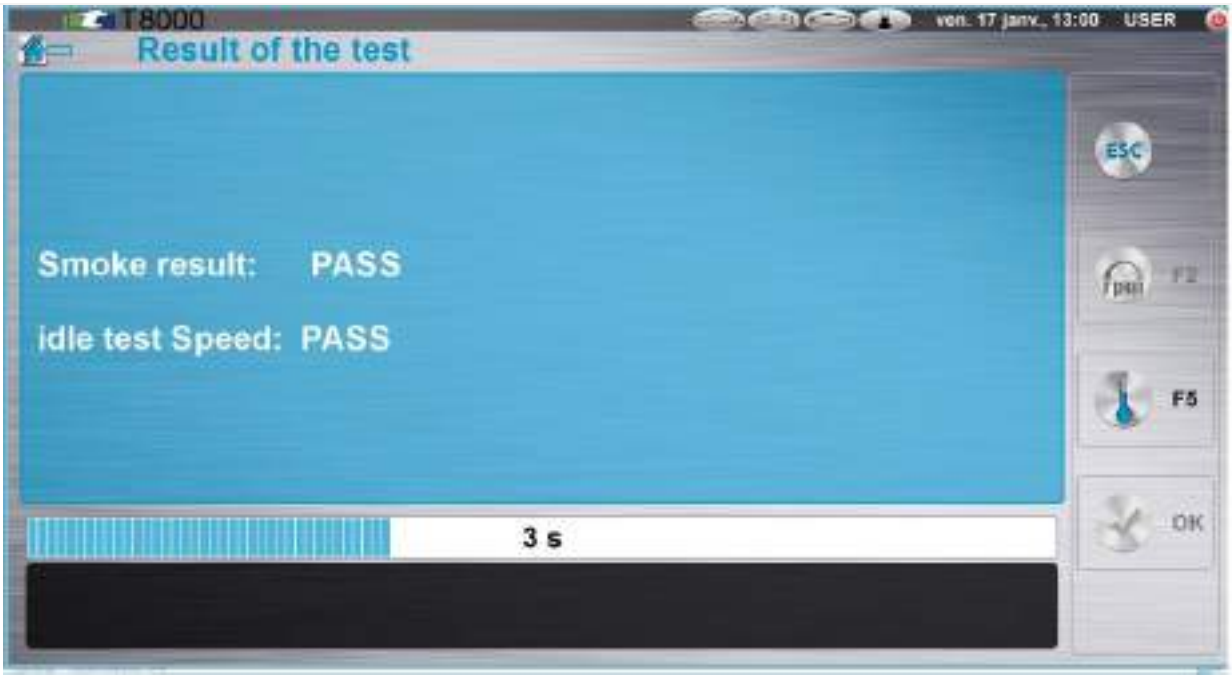


Figure 6.3.8.2-1: Example test results of the Visual procedure

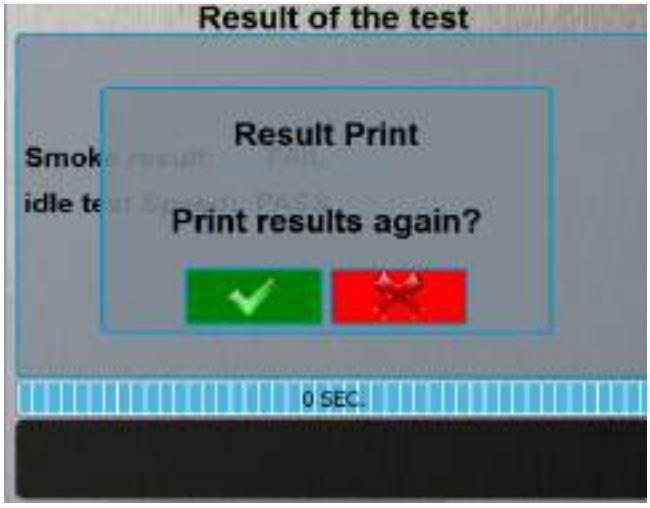


Figure 6.3.8.2-2: Options at the end of Visual procedure

2.11 "MEASURING" MODE

The operator selects "MEASURING" mode from the gas icone free test.
In "MEASURING" the application displays all measured and calculated gas emission values. The operator can also make an AutoZero check and print the measured/calculated emission values (Figure 6.5-2).

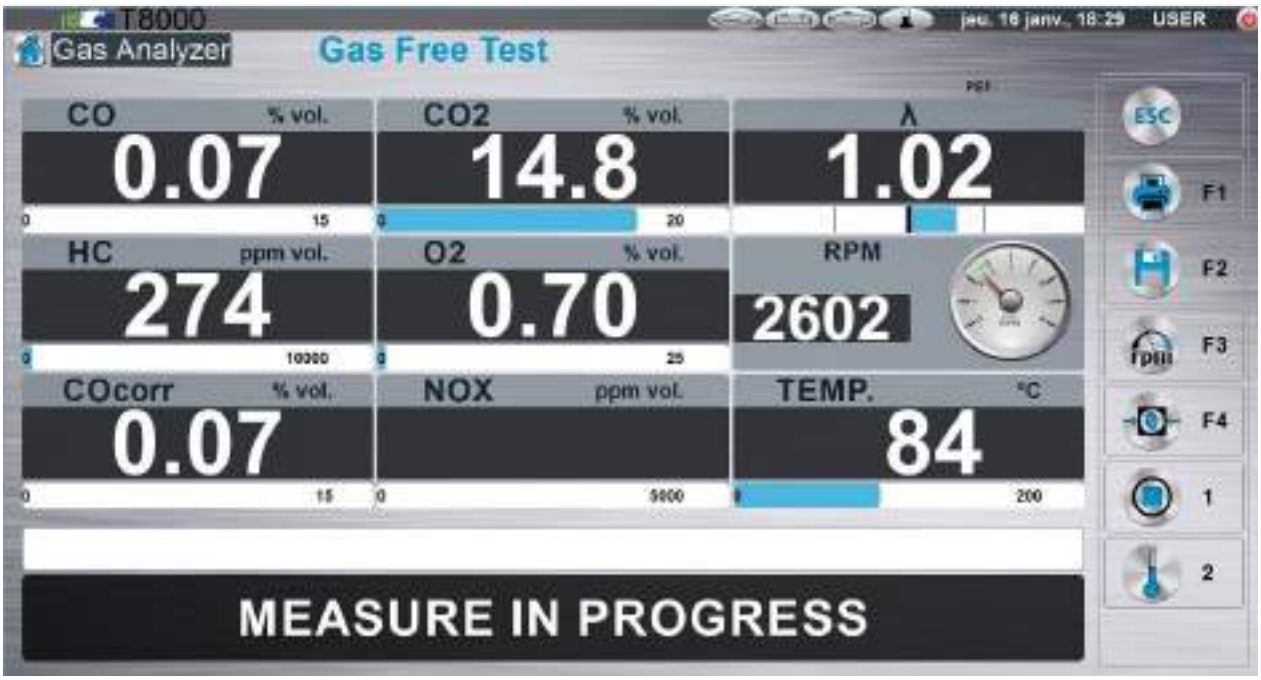


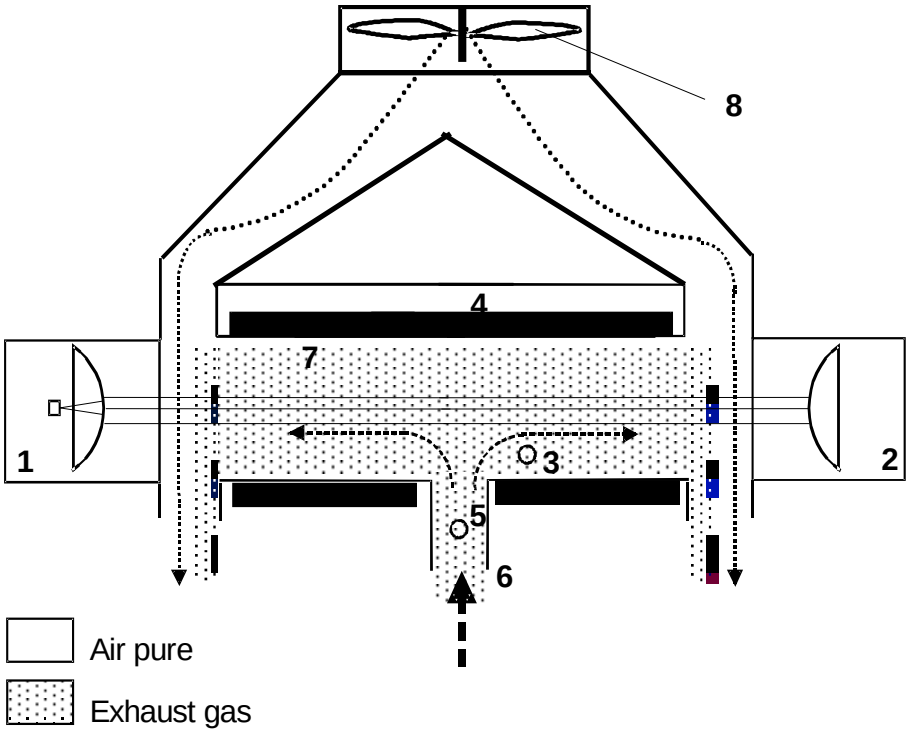
Figure 6.5-1: Gas analyser application in "MEASURING" mode

3 THE OPACIMETER: (DIESEL VEHICLES)

3.1 PRINCIPLE OF OPERATION

In the composition of the exhaust gas emitted by diesel engines, the pollutant component is considered to be carbon in suspension. A polluting vehicle emits on acceleration a puff of gas that is darker (and thus more opaque) than a vehicle in good condition. The partial flow opacimeter is used to establish a measure of this phenomenon based on a given unit of measure, the K(m-1).
The principle of opacity measurement is the following: a beam of light (emitter aimed at a receiver, with a constant distance between the two) is passed through a sample of exhaust gas. The light which reaches the receiver is inversely proportional to the concentration of particles in suspension in the exhaust gas sample.
The measurement obtained is digitally corrected.
The opacity of a vehicle's emissions is the maximum opacity value measured during a free acceleration.
Several accelerations are needed to obtain a reliable measurement. The number of accelerations to be carried out for the opacity measurement of a given vehicle is defined by standard NF R 10-025.

Functional schematic of the measurement chamber.



1- Emitter
2- Receiver
3- Chamber temperature sensor

4- Heating elements
5- Gas temperature sensor
6- Gas inlet
7- Measurement chamber
8- Exhaust fan

The opacimeter depends on the interactive operation of two sub-systems. The first is composed of the cell. This is what establishes the opacity measurement. The electronic system of this cell contains a microprocessor (which uses several temperature and pressure sensors to regulate the system) to detect bad operating conditions and to correct the measurement. All this information is directly taken into account by the central unit which is responsible for detecting maximum opacity, displaying the results on the PC, and guiding the operator throughout the procedure.

3.2 OPERATING CONDITIONS

The opacimeter automatically checks the parameters that have an influence on the measurement. If at least one of these parameters is out limits, hence threatening to metrologically alter the results, the opacimeter disables itself and prevents any measurement from occurring until correct operating conditions have been re-established.

The following problems result in the system being disabled:

- Detector temperature out of limits (limits extending from 41°C to 55°C)
- Chamber temperature out of limits (limits extending from 70°C to 110 C)
- Supply voltage out of limits
- Fan speed too low (limits extending from 2100 rpm to 2900 rpm)
- Computer to cell communication problem
- Optics need to be cleaned
- Problem with a temperature sensor

3.3 TECHNICAL CHARACTERISTICS

- Power supply: 1,5 A / 115 VAC 0,9 A / 230 VAC (+10%-15%) 50-60 Hz (+-2%).
- Effective length of the measuring chamber: 215 mm +-0.05 cm.
- Preheating time: from 3 to 6 min depending on ambient temperature.
- Zero adjustment and calibration before use: automatic.
- Control of zero adjustment: automatic by electrical filter centred at 50%.
- Ambient temperature range for operation: +5 to +40°C.
- Humidity: 30% to 90%.
- Storage temperature: -32°C to +55°C.
- Measurement range of the measured value:
- Opacity: 0.00 to 9.99 m-1.
- Resolution 0.01 m-1.
- Maximum relative error:
- Under standard conditions (temperature +20 °C, atmospheric pressure 1013 hPa, relative humidity 60% +/-15%), opacity error below 0.15 m-1.
- Measurement range of influencing factors (which allow correction of the opacity value):
- Temperature of the gas being measured: 0-256 °C (resolution 1°C)
- Physical response time 10% to 90%: less than 0.2 sec. for gas at 75L/min.
- Electrical response time: 0.9 sec.

3.4 INSTALLATION AND PRECAUTIONS DURING OPERATION

3.4.1 Installation, start-up:

Each T8000 is inspected before delivery by a service engineer who checks and calibrates the equipment (if required).

- *CHECK THAT THE OPACITY CELL IS CORRECTLY CONNECTED TO THE STATION AND CONNECT IT TO THE 230 VAC 50 HZ MAINS.*
- *PRESS THE STOP/START SWITCH ON THE STATION.*
- *PRESS THE STOP/START SWITCH OF THE CELL.*

3.4.2 Cleaning and precautions during operation

The opacity unit is designed to function without maintenance. The only components requiring periodic maintenance are the optics of the cell.

Occasionally, large carbon particles enter the chamber while the engine is being tested. The great inertia of these particles will cause them to be thrown against the glass optics located at either end of the chamber. A periodical (monthly) inspection is recommended to determine whether the two optics have any excessive dirt.

A carbon deposit may also be deposited in the measurement chamber. It is sufficient to sweep out the tube to eliminate the soot using the brush supplied with the opacimeter.

*(**NOTE:** DO NOT USE THE BRUSH TO CLEAN THE ENTRY INTO THE OPACITY CELL FROM THE FLEXIBLE EXHAUST HOSE – THERE IS A TEMPERATURE SENSOR MOUNTED ON THE INLET AND THIS WILL BE DAMAGED IF THE CLEANING BRUSH IS INSERTED)*

WHERE THE OPTICS ARE CONCERNED, USE A DRY COTTON CLOTH TO CLEAN THESE TWO SURFACES. DO NOT USE ANY CLEANING FLUID.

IT IS NOT NECESSARY TO OPEN THE CELL TO CARRY OUT THESE MAINTENANCE OPERATIONS.

3.5 OPACITY TESTING PROCEDURE

This procedure allows an evaluation, for a specific vehicle, whether or not its opacity is lower than the acceptable limit. The Diesel functions can be accessed in two ways. When the Gas analyser is started, the MOT menu is displayed. Here the Diesel MOT test can be started.
To access the other functions for Diesel, the user must return to the Main Menu

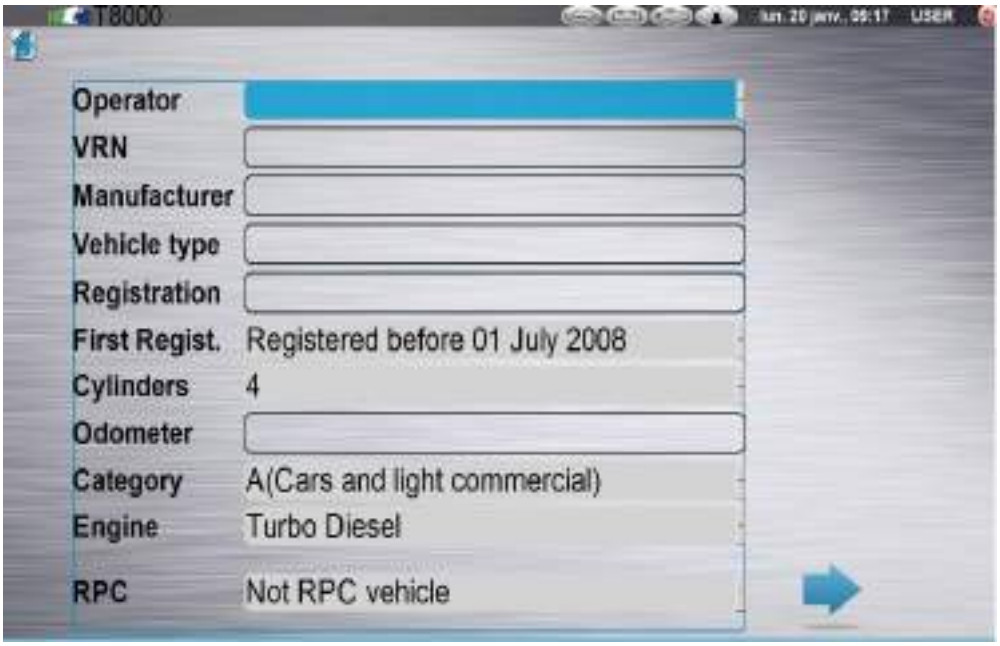
In the main menu, click on the "Diesel" button.

To access the other functions for Diesel (Measurements, Selftest), the user must return to the Main Menu.

3.6 WARM-UP

- Ensure that the sampling probe is outside of the exhaust pipe.

After switching on, the system remains in a WARM-UP status during which time no measurements can be taken. The warm-up screen displays the value of the temperature inside the measuring chamber.



The Warm-up is in the background while Diesel vehicle parameters can be filled in.

Opacimeter pre-heating screen

If the temperature inside the chamber is **less than 75° or 80° depending on the model**, no measurement is possible.
When this temperature is reached, the 2 cell fans start to operate.
At the end of the warm-up phase, the system automatically requests an AutoZero.

3.7 AUTO ZERO

The AutoZero sets the zero measurement with the ambient air. This request takes place:

- Each time the system is switched on after heating the cell.
- At each start of the test and determination procedures (Diagnostics).
- At the request of the operator (by going to the Advanced Functions from the Main menu).

After the AutoZero at the end of the warm-up phase, the system is ready to take a measurement in continuous mode.

IMPORTANT: AutoZero procedure must be carried out if an opacity value above zero is displayed when the probe is not inserted into the exhaust pipe

3.8 TEST MODE

3.9 TEST CONDITIONS

The working area must be level and clean and must not be exposed to rain or snow.

The opacimeter must not be directly exposed:
to the sun,
to significant vibrations,
to a dusty atmosphere which could affect the result of the measurement,
to electro-magnetic interference which could affect the result of the measurement,

The air extraction system in the working area, if there is one, must not have any influence on the operation of the opacimeter or the vehicle to be tested.

Before carrying out any measurements:

- The vehicle exhaust system must not be leaking. This check can be made by partially blocking the exhaust when the engine is running at idle speed. There must be no significant leakage observed.

- For an exhaust system with multiple outlets, these outlets must be connected into one single outlet, unless instructed otherwise by the vehicle manufacturer. (An alternative method could be the calculation the mathematical average of the values of the concentrations measured at each outlet).

- The gearbox must be in neutral with the clutch in for vehicles with a manual or semi-automatic transmission and the selector lever in the neutral position for vehicles with an automatic transmission or in accordance with the vehicle manufacturer's instructions.

- Accessories and options which can affect the rotational frequency of the engine at idle speed must not be activated, except in accordance with instructions by the vehicle manufacturer or regulatory instructions.

- The engine must be at its normal operating temperature.

3.10 DEFINITIONS

FREE ACCELERATION: This is the acceleration obtained, with the engine running at idle speed, by rapidly, but not harshly pressing the accelerator pedal in such a way as to obtain the maximum flow rate from the injection pump. This position is maintained until the maximum engine speed is reached and the engine speed limiter cuts in.
CYCLE: Sequencing allowing a measurement to be taken for a free acceleration.
PHASE: Unitary action requested during a cycle
PROCEDURE: Set of defined actions for measuring and interpreting the results.

Test: TEST PROCEDURE intended for the technical inspection (MOT).
Diagnostic: DETERMINATION PROCEDURE intended for fault-finding and repair.

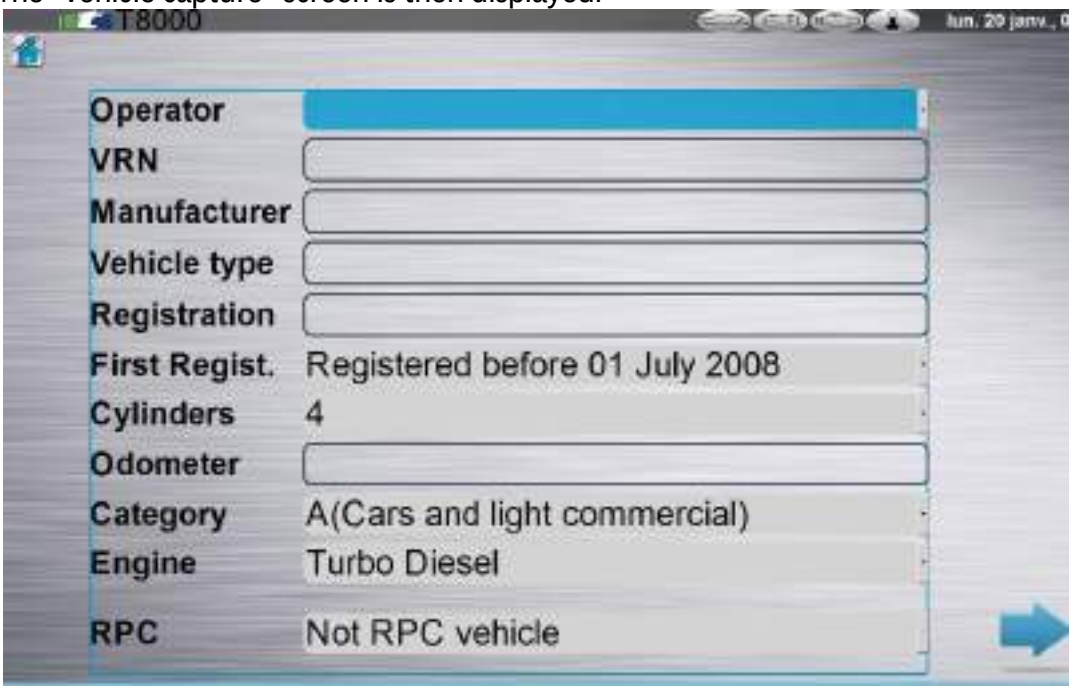
3.11 TABLE LIST OF LIMITS FOR THE OPACIMETER TEST

Diesel	2.5 m-1
Turbo Diesel	3.0 m-1
Fast Pass Test (category A only)	1.5 m-1
RPC 1 (category B only)	0.2 m-1
RPC 2 (category B only)	0.4 m-1
RPC 3 (category B only)	0.8 m-1
RPC 4 (category B only)	1.0 m-1

3.12 SELECTING AND SAVING VEHICLE DATA

Data relating to the vehicle can be entered manually by the operator.

The "vehicle capture" screen is then displayed.



The operator must manually enter the information and then validate.

On this screen, the operator must select the category A or B of the vehicle to be tested.
For category B, the operator is also asked to specify the type of RPC:
- Not RPC vehicle
- RPC1
- RPC2
- RPC3
- RPC4

This information, provided by the manufacturer or the national organisation (VOSA) defines the "k" limit values for the test.
(see table § "Table list of limits for the opacimeter test")

3.13 PREPARATION FOR THE TEST: TEMPERATURE, ENGINE SPEED MEASUREMENT, ACCELERATION PARAMETERS

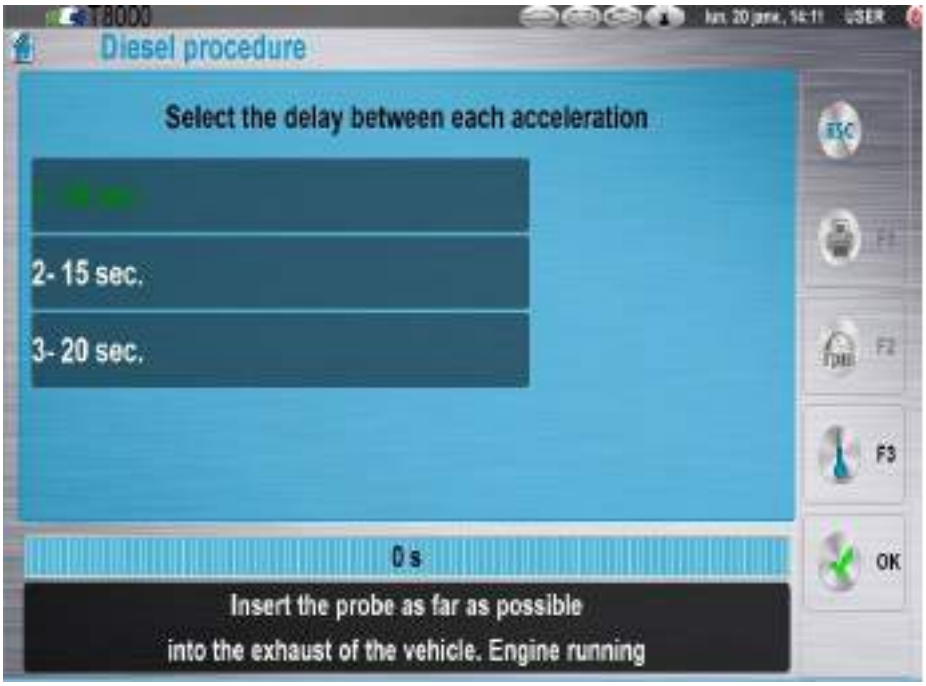
Principle of the preparation phase: The oil temperature must be greater than 80°C in order to automatically go on to the next stage.

The operator is asked whether he has an oil temperature measuring function
When the oil temperature measuring function is available, the operator chooses YES on the subsequent screen.
If oil temperature measuring function is not available/possible, the operator responds by pressing the 'X' button.

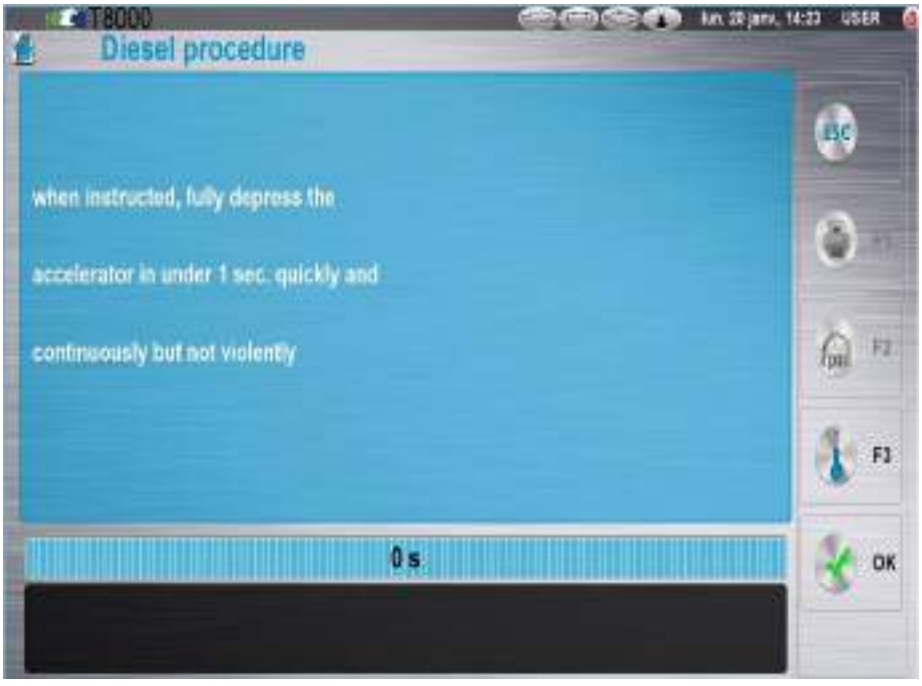
If yes, he is asked to adjust the length of the temperature probe to match the dipstick and insert it into the dipstick tube.
The operator clicks on the button "Validation" to continue with procedure.

The test can only be started if the temperature has reached a minimum of 60°, but ideally 80°.
If the oil temperature cannot be measured, a time delay of 40 seconds follows.

The operator is then asked to connect the engine speed measuring device if he has one and to validate to carry out the procedure.
The operator clicks on the button "Validation" to continue with procedure.



Then the operator selects the time delay between each acceleration:
10, 15 or 20 seconds



When the one of choices is selected, the operator is given the recommended acceleration method in order to carry out the measurements.

3.14 TEST

The measuring principle is as follows:

- A first series of 3 acceleration cycles is started.

Each cycle comprises:
> an acceleration preparation phase (10, 15, 20s depending on the selection made by the operator)
> a 5-second acceleration phase during which the opacity measurement is taken
> a return to idle speed phase and 15-second display of the results

Preparation phase

Acceleration phase
1: indicates the cycle N°

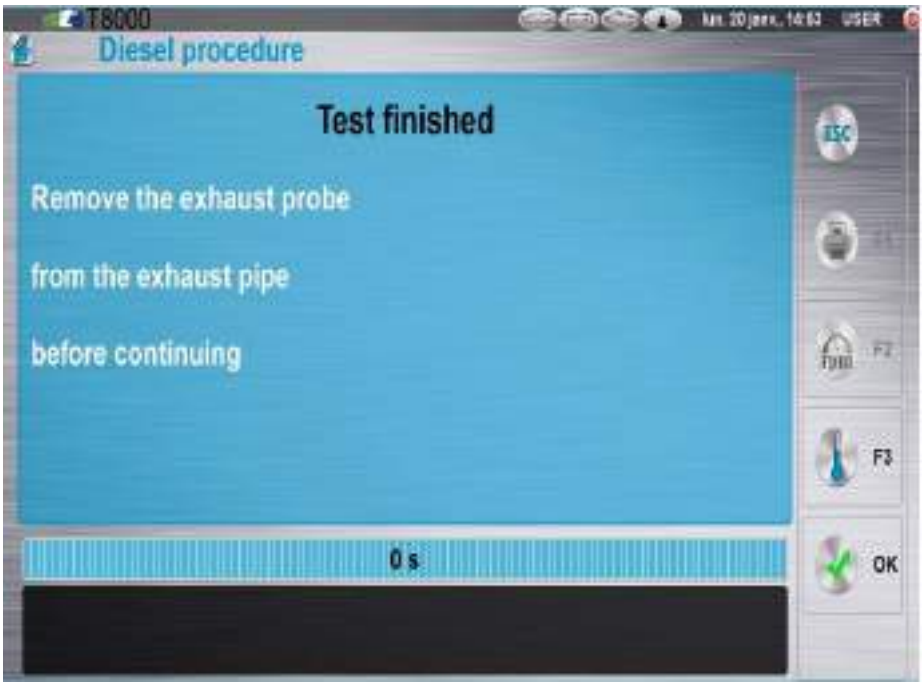
Return to idle speed phase
the screen displays "Release" for 5s
Then, for 10s,
the screen displays "Wait" and indicates the peak value of the opacity measurement just made

Note: Fast pass test
For Category A vehicles, if the opacity measurement result (K) is < 1.5 m-1 at the end of the 1st cycle, the procedure is validated.

The measuring cycle described above is carried out 3 times under the same conditions if the initial value is above 1.5m-1.

At the end of these 3 first cycles, an **average of the 3 measurements** of the "K" opacity peak is taken:

If the result is acceptable (see table of values in section § 1.5.3), the operator is asked to remove the probe from the exhaust pipe.



When the exhaust probe is removed from exhaust pipe, the operator clicks on button OK to continue with procedure.

A calculation of zero-drift* (drift) is then automatically made and included in the overall test result. If this re-calculation gives an acceptable corrected result, the procedure is complete.

* The zero-drift consists of a measurment of the opacimeter cell 'clean air' values between the start of the measurement (during the warm-up) and the end of the cycles.
Permitted tolerance values are: +/- 0.1 m-1, or + 5% of the average.

The average of the 3 measurements gives a result < the maximum permitted value.
The test for this vehicle is accepted

At any time, it is possible to exit the procedure by selecting the exit door.
In this case, a message "Test aborted" is displayed on the screen.

- Next part of the procedure in case of failure

At the end of the first series of 3 cycles, if the average of the three measurements is greater than the expected "K" value (or is more than a 25% variation from the previous value), another acceleration cycle is started at the end of which a new calculation of the average is made. This can continue up to a maximum of 6 accelerations.

Note: The measurements used for this calculation are signified by a * at the time of the final printout of the result.

This procedure is therefore carried out for up to 6 cycles. As soon as the result is correct, the system automatically moves on to the zero-drift measurement.

- Measuring the drift and validating the test:

If the acceleration cycle result is correct, a measurement of the zero-drift is carried out:

If the measurement gives a result that is within the tolerance, the test procedure is complete and is accepted.

If the measurement is outside of the tolerance, another series of acceleration cycles is started (2 x 6 = 12 max.) and the test will only be accepted if the opacity measuring conditions (K) and the drift are satisfied.

If the correct drift measurement cannot be achieved, the procedure is aborted and the following message is displayed:

"ZERO DRIFT DEFAULT"

3.15 "DIAGNOSTIC" MODE

Diagnostic mode allows you to freely continue, with no restrictions on compliance with the pre-defined values, to a series of opacity measurements for a vehicle according to the same principle of successive cycles of accelerations as in the Test mode.
The procedure consists of automatically starting 10 measuring cycles.
The first screen allows you to select vehicle category A or B
The operator select vehicle category A, Turbo Diesel and to validate the selected choices click on Validation button.

After having performed a warm-up procedure, the operator is asked to connect the engine speed measuring device if he has one and to validate to carry out the procedure. The operator clicks on the button "Validation" to continue with procedure.

After the Validation button is clicked, the operator is asked to insert the probe into the exhaust.
Then the operator selects the time delay between each acceleration: 10, 15 or 20 seconds
When the one of choices is selected, the operator is given the recommended method of acceleration to carry out the measurements:

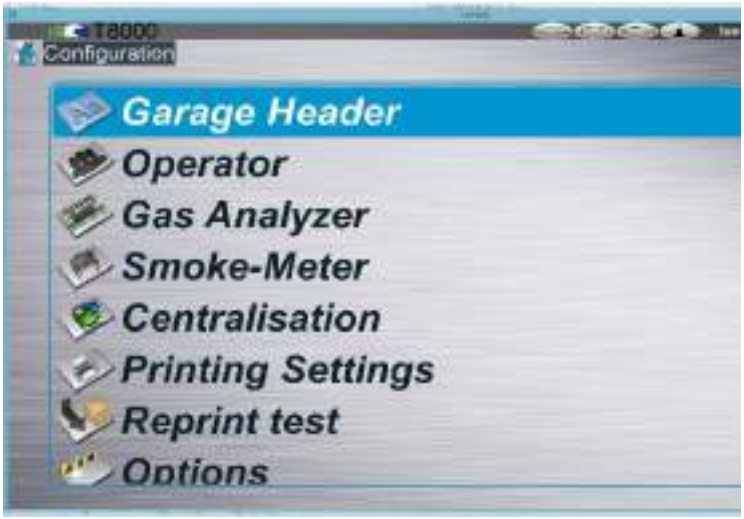
- Preparation phase
- Acceleration phase
- # 1: indicates the cycle N°
- Return to idle phase
- The screen displays "Release" for 5s
- Then, for 10s,
- The screen displays "Wait" and indicates the peak value of the previously measured acceleration
- At the end of the 10 cycles, the operator is invited to remove the probe and the result of the measurements is displayed.

4 GENERAL:

To launch this application, select the "Configuration" line in the main menu.

on icon : 

The following screen appears:



This is a scrolling menu made of several options. Each option allows access to a parameter-setting window.
All such windows are described below.

4.1 GARAGE HEADER:

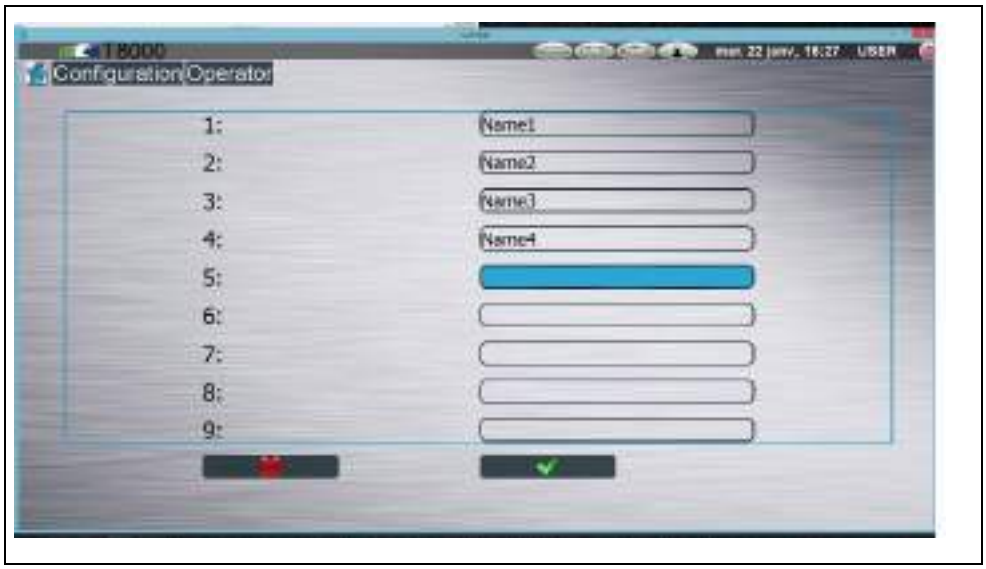
This application allows garage information to be entered and personalized. This information appears at the beginning of the test report. The entry window has the design shown below.

To type the data, one must use either:

- The five keys located below the screen; in case the keyboard option is not installed or non-existent. The UP and DOWN arrows allow rapid scrolling of numbers and figures. The >> button advances to the next character, and conversely << allows a return to the preceeding character. Finally, OK allows a change of entry zone, up to the NOTES zone. After this zone, the program leaves the client entry procedure.
- The alphanumeric keyboard is supplied as an option (see Configurations—Keyboard). The UP, DOWN arrows allow a change of entry zone. To erase a character, use the ⍰⍰key located at the upper right of the keyboard, or the LEFT arrow. To move to the following phase, you need only press the OK key (5-key pad) or type ENTER.

4.2 OPERATOR:

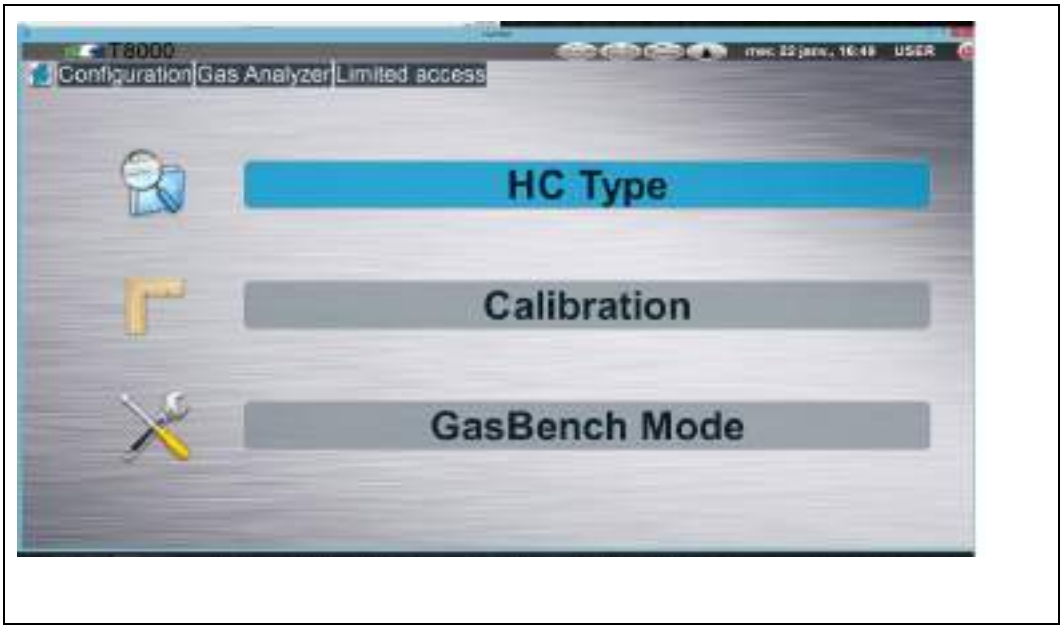
This window allows entry of up to 9 operator names. The principle is identical to the entry of the garage header and client entry.



In the main menu, the name of the current user is displayed; to change it, simply press, **IF THE KEYBOARD OPTION IS ACTIVE**, on the number 1 for the first operator, 2 for the second and so on; if the user **DOES NOT HAVE THE KEYBOARD OPTION** he can change using the "Op+" icon. This name will be inscribed in the test report at the end of a test.

4.3 GAS ANALYSIS

This gives access to a submenu that allows selection of the standby interval of the gas analysis module, display of Lambda and CO to 3 or 2 decimal places; it also allows evaluation of the oxygen sensor's condition, execution of a leak test, display of routine control and access to the service engineer's menu (Password protected).



4.3.1 Standby

For standby, select the standby tab, then press OK. The time remaining until the gas analyser is placed on standby is displayed in the dialog box. Using the UP and DOWN arrow, you can enter the time suited to your needs.

4.3.2 Digit CO, Lambda

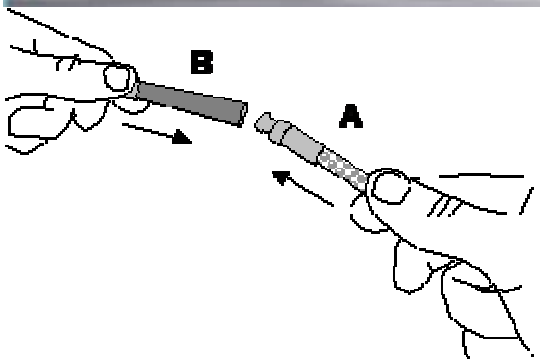
The DIGIT CO and DIGIT LAMBDA submenus allow selection of the number of figures after the decimal that you want to have when CO and LAMBDA are displayed.

IMPORTANT: If you choose CO at 3 DIGITS, the gas analyser is in high resolution for the CO and also for HC. So, the measurement range in high resolution is for the HC to –13 at 2000 ppm with 1 ppm of accuracy and in normal resolution the range resolution is to –13 at 20000 ppm with 10 ppm of accuracy.

4.3.3 O2 sensor condition

This window provides information on the condition of the oxygen sensor. The machine performs a diagnostic on the sensor and its current status/performance. The status is graduated from 0 to 100%:- 100% corresponding to the most satisfactory performance.

4.3.4 Leak test



Figue 6.5.6-2: Gas sampling probe end (**A**) and its sealing sleeve (**B**)

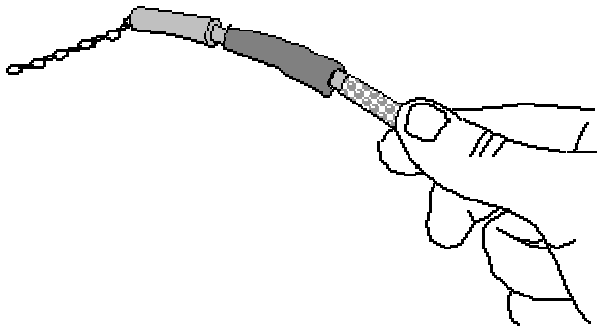


Figure 6.5.6-3: Gas sampling probe closed

The leak test is a procedure allowing the detection of any seal problems that might occur in the pneumatic circuit. It is mandatory every 24 hours as part of an MOT test. The presence of a leak involves immediate investigation and rectification work.

This test guides the operator throughout. The operator must follow the instructions given on the screen.

Test upstream of the pump:

The following message appears: "Plug the inlet". Blocking of the inlet is automatically detected by the analyser. The pumps then shut off and the following message appears: "Test in progress." It is necessary to keep the inlet hermetically sealed.

This phase lasts a maximum of 11 seconds. At the end of this phase, a diagnosis of "Leak present" or "Leak absent" is given.

Test downstream of the pump:

The following message appears: "Plug the exhaust". Blocking of the exhaust is automatically detected by the analyser. The pumps then shut off and the following message appears: "Test in progress." It is necessary to keep the inlet hermetically sealed. This phase lasts at maximum of 8 seconds. At the end of this phase, a diagnosis of "Leak present" or "Leak absent" is given.

Stop test and exit: ESC

The presence of a leak disables all analyser measurement until a new test has been carried out, with a final result of "Leak absent".

4.3.5 Routine check

This window is made up of 2 pages (PG1 and PG2). They provide information in real time on the condition of the gas analyser module, indicate the date and the name of the participants, and finally indicate the BENCH software version and its serial number.

DISPLAY PART :

- Gas values

You can read gas values (CO, CO2, HC, O2 and NOx) in volumic concentration. These values are already compensated for pressure and temperature.

- Pressure values

These values must be equal to the ambient atmospheric pressure when pumps are powered off. The unit used is in mBar.
P. Abs. is the pressure in the sample cell.
P. Flow is the pressure use to detect a low flow.

- Temperature values

The temperatures are display in °C.
T. amb. is the temperature of the gas bench CPU board. It's value depend of the ambient temperature and is generally some degrees higher than the ambient temperature.
T. Det. is the detector temperature and it value must be equal or close to 35°C.

- Real time PEF

The PEF is display in real time depending on the HC value.

- Status bits

All the status bits are active when their lights are on. If their lights are off, they are inactive.

STATUS BITS LIST :

Status bit	1.1.1.1.1	**Set condition**
Zero in progress	Command "ZERO" in progress	Activated after asking a zero with the 'Z' command Wait this bit to be cleared before to go back to measurement mode
Zero required	Execution of the command "ZERO" needed.	This bit is active during the warmup, when a gas is out of range, when the signal levels fluctuate too much or every 30 minutes.
Warmup in progress	Warmup in progress: it is launched after the power on.	Its duration varies from 1 minutes at 9 minutes depending on the time that the IR detector takes to reach its regulation temperature.
Calibration in progress	Calibration in progress	Activated after asking a calibration with the 'C' command. Wait this bit to be cleared before to go back to measurement mode (about 5s).
Calibration required	Execution of the command "CALIBRATION" needed.	This bit is active if the IR source intensity is not sufficient. Wait this bit to be cleared before to go back to measurement mode
Pressure O.O.R	Pressure out of range	Pressure sensor is out of the range 750mBars-1150mBars
Ambiant temp O.O.R	Ambiant temperature out of range	Out of range : -5°C to +70°C
Detector O.O.R	Detector out of range	Out of range : -5°C to +70°C
HC O.O.R	HC out of range	Out of range : -10ppm to 32000ppm as propane
CO O.O.R	CO out of range	Out of range : -0.03% vol. to 15.5% vol.
CO2 O.O.R	CO2 out of range	Out of range : -0.4% vol. to 21% vol.
O2 O.O.R	O2 out of range	Out of range : -0.5% vol. to 25% vol.
NOx O.O.R	NOX out of range	Out of range : -30 ppm to 10000ppm
Oil temp O.O.R	Oil temp out of range	Out of range : 0°C to 150°C
Rpm O.O.R	Rpm out of range	Out of range : 0 tr/min to 9999 tr/min
Vacuum O.O.R	Vacuum out of range	Out of range : 700mBars to 1300mBars
Pump1	Pump 1 is running	
Pump 2	Pump 2 is running	
Solenoid 1	Solenoid 1 is running	
Solenoid 2	Solenoid 2 is running	
Vacuum switch	"LOW FLOW" detected or external vacuum switch detected an low pressure.	This bit is activated if flowpress < (gaspress - ΔP). This switching value can be changed and is stored in the EEPROM.
CO3digits	CO displays with a precision of 3 digits after the comma.	If cleared, CO is displayed with 2 digits
HC propane	HC displays in propane equivalent	If this bit is at 0, it means that HC is displayed in hexane .
Channel error	One or several channel of measurement (CO, CO2, HC or REF) has been found defective at the power on. It means that the setting of a channel is too high or to low. This bit can be also activated if at the power on there is gas (CO, CO2 or HC) in the sample cell.	
EEPROM failed	The EEPROM is failed	DATA lost in the EEPROM (bad checksum)

Bad O2 sensor	The O2 sensor is damaged	Activated when the voltage of the O2 cell during the zero becomes under the limit (default limit is 4.0 mV and can be modified - stored in the EEPROM)
Bad nox sensor	The NOx sensor is damaged	Activated when the voltage of the NOX cell during a calibration becomes under the limit
New gas data	Sampling of new gas data value, temperature and pressure	Activated to inform that new values has been calculated on gas chanels
Initial Zero in progress	Initial Zero in progress	Activated after asking an Initial zero or an Install new IR emitter with the 'D' or 'U' command. Wait this bit to be cleared before to go back to measurement mode
New rpm data	Sampling of new rpm data	Activated to inform that new RPM values has been updated
Detector Low Signal	Normal signal amplitude can not be reached	The signal of the detector is globally too low, coming from a bad detector or, an IR source too low or dirtyness inside the chamber.
Lamp error	Problem linked with the IR source.	This bit is active when the consumption of the IR source exceeds its specifications or when the IR source is dead.

USE OF PUMPS AND SOLENOID VALVES

Every time, you can start or stop pumps and switch on or switch off solenoid valves. You can also select a CO 3 digits accuracy or decide to display HC in HC propane equivalent.

To start a pump or to switch on a solenoid valve, select the box on the left of their name or select directly on their name.

To stop a pump or to switch off a solenoid valve, unselect the box on the left of their name or click again on their name.

To display CO with 3 digits accuracy, you have to select the corresponding box. If you want to display CO with 2 digits accuracy, de-select the corresponding box.

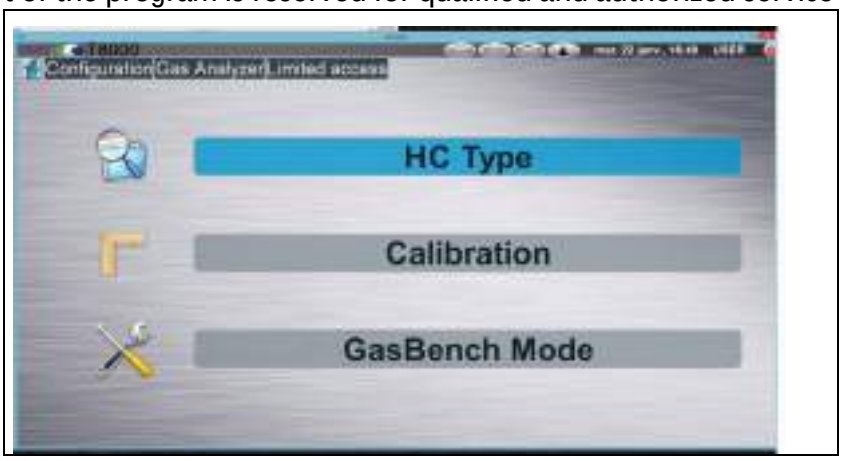
To display HC in HC propane equivalent, you have to select the corresponding box. If you want to display HC in hexane equivalent mode, de-select the corresponding box.

4.3.6 Protected access

Type the 5-digit **SECRET CODE**. Then:

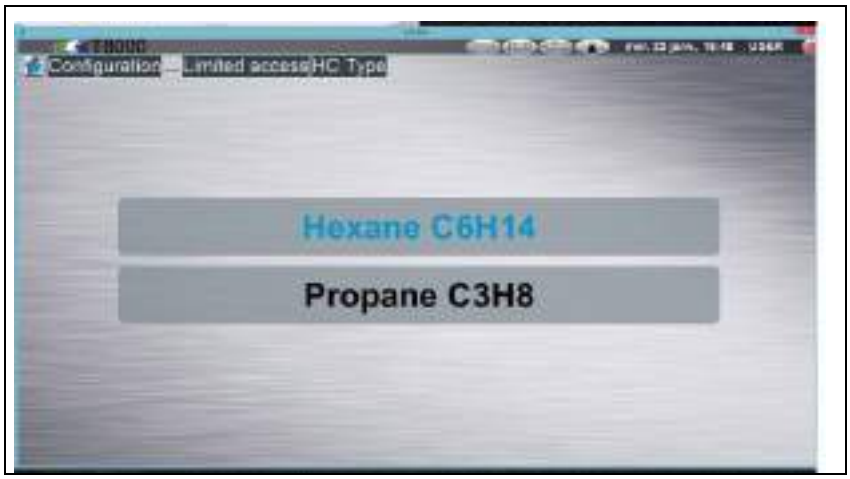
The machine asks for entry of the user name "**CARRIED OUT BY:**"; this name can contain between 3 to 15 characters. This information will be retained in memory and is not erasable.

This part of the program is reserved for qualified and authorized service engineers.



4.3.6.1 HC index:

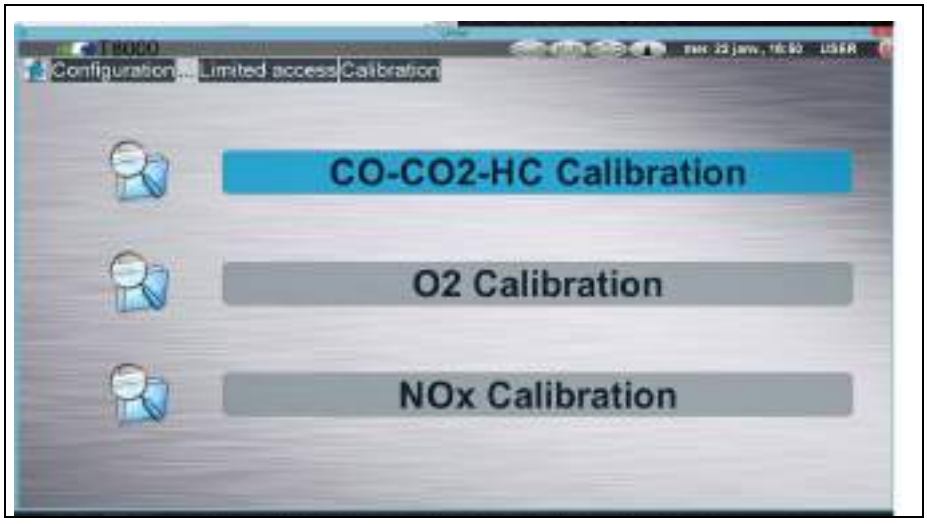
This gives access to a submenu allowing display of HC in propane equivalent or hexane equivalent.



PEF being variable, it is preferable, when calibrating with a cylinder containing propane, to go to propane mode and to read the measured value directly as propane. Note that the PEF displayed by the machine is the PEF for a value of HC propane near 2000 ppm vol.

4.3.6.2 Calibration:

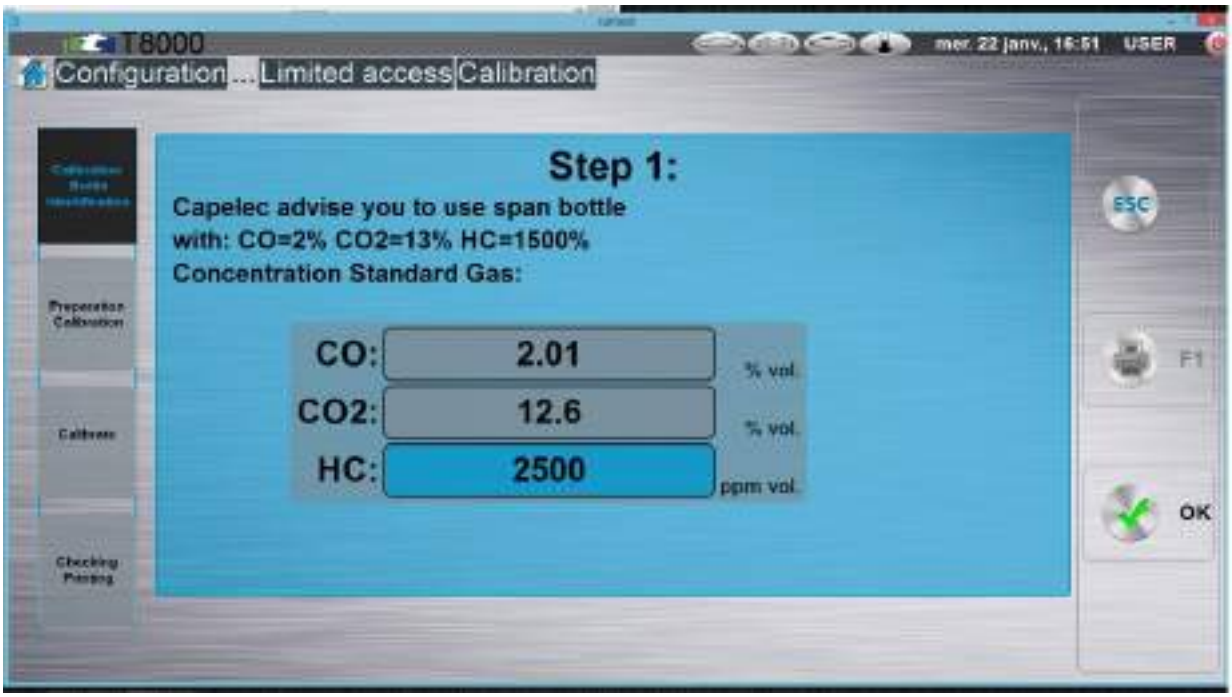
The second menu allows the machine to be calibrated; it is composed of several options:



A) CO, HC, CO2 adjustment procedure:

→ Adjusting calibration gas concentrations:

NOTE that for the oxygen concentration (air/oxygen ratio), it is imperative to leave the value set to 20.90%. This is the value used whenever the machine is re-zeroed. This value has no influence on the per-gas adjustment of the three infrared channels.



IMPORTANT: HC must be entered in propane equivalent.

Recall that the cylinder containing the gas required for analyser adjustment contains the following concentrations:

CO: 3.50 % VOL.

CO_2: 14.0 % VOL.

HC: 2000 PPM PROPANE BY VOL.

BALANCE N_2

The operator must enter the values of the CO, CO2 and HC gas concentrations. To advance to the following step, OK or ENTER must be pressed.

→ Launching the adjustment procedure:

The operator is guided throughout the procedure by messages indicating to him the various steps that the machine carries out during an adjustment procedure.

B) O2 initialization:

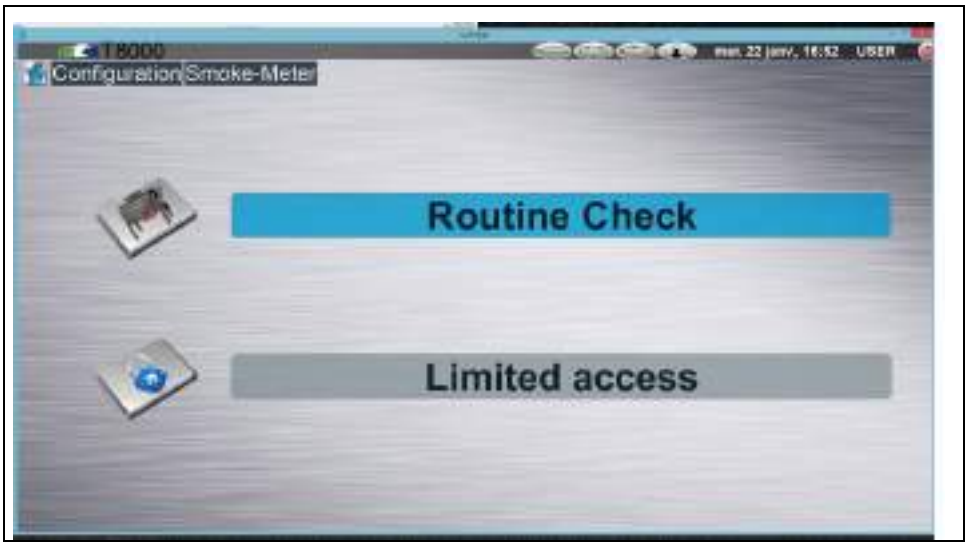
This tab is used for installing a new O2 sensor. It is necessary to follow the procedure, which requires changing the O2 sensor first, then pressing OK. Once this step is completed, the machine initializes the sensor for 1 minute. This consists of recovering the reference voltage of the new sensor.

C) NOx initialization:

Same as O2 initialization.

4.4 SMOKEMETER:

When the user selects "Opacimeter" the following window is activated:



4.4.1 Routine check:

The "routine check" program allows the user to check the opacimeter for correct operation.

This page lists opacimeter faults. It is made of up 3 pages (PG1, PG2 and PG3).

This window shows the current cell data.

Example : the ambient temperature is correct if it is between 0°C and 50°C.

This page gives the last current data:

- Cell currently opacity in % and /m.
- Result of optical calibration filter test.
- A few temperatures, cell power supply, and fan speed.
- CK and CN filters are the electrical filters used by the cell.
- Software version and the serial number

Two functions are also available:

A) Auto-zero: [→0←]

- This key launches the automatic auto-zero procedure.
- As long as the value read in the opacity field is not close to zero, relaunch the auto-zero function.

B) Evaluation of the error in opacity measurement. ***« TEST »***

This is an automatic check by electrical filter centred at 50%, allowing the accuracy of measurements to be verified. The error is considered acceptable if its evaluation gives a result less than 5%. To carry out this evaluation, press the TEST key. The result is displayed on page 2; it shows the measurement obtained, the filter employed and the gap between the two values.

A window appears giving an opinion of the credibility of the measurements carried out. If this opinion is negative "opacimeter out of spec", clean the cell and restart the test.

4.4.2 Protected access:

This part of the program is **RESERVED** for TRADE personnel. It gives access to a submenu that allows the filter coefficients used in carrying out measurements to be selected.

4.5 LIST OF FAULT REPORT MESSAGES AND FAULT TRACING

Error number	Message displayed	Call Maintenance	Do it yourself	Explanation in section
1	Leak present	YES		II.6.1.1
2	Data invalid	YES		II.6.1.2
3	HC out of limits		YES	II.6.1.3
4	CO out of limits		YES	II.6.1.4
5	CO2 out of limits		YES	II.6.1.5
6	O2 out of limits		YES	II.6.1.6
7	NOx out of limits	-	-	II.6.1.7
8	Lowflow detected		YES	II.6.1.8
9	Out of paper		YES	II.6.1.9
10	Lever open		YES	II.6.1.10
11	Printer problem	YES		II.6.1.11
12	HC residue in sample circuit		YES	II.6.1.12
13	MB com. Error	YES		II.6.1.13
14	Adjustment necessary	YES		II.6.1.14
15	Change O2 sensor	YES		II.6.1.15
16	Condensation: wait		YES	II.6.1.16
17	Heating problem	YES		II.6.1.17

4.5.1 Leak present

Repeat the test, disconnecting the probe from the device and plugging the gas entry port on the filter. If the problem disappears, the leak is in the exhaust sample probe or probe tubing.

Otherwise, it affects the machine. Check the filter connections. Check that the filter is correctly installed and adequately/correctly tightened.

Test the various parts of the pneumatic circuit with leak tests, moving the plug progressively upstream, up to the pumps.

You are not permitted to open the machine and perform a visual check of the pneumatic circuit, so if all other checks are OK and you suspect that the leak is internal, you must call the service engineer.

4.5.2 Data invalid

Adjustment necessary.

4.5.3 HC out of limits

Out of range.

Check that the ambient air is not polluted and re-zero the gas analyser.

Perform a further adjustment if the problem persists.

4.5.4 CO out of limits

Out of range.

Check that the ambient air is not polluted and re-zero the gas analyser.

Perform a further adjustment if the problem persists.

4.5.5 CO2 out of limits

Out of range.

Check that the ambient air is not polluted and re-zero the gas analyser.

Perform a further adjustment if the problem persists.

4.5.6 O2 out of limits

Out of range.

Check that the ambient air is not polluted and re-zero.

Check sensor connections.

4.5.7 NOx out of limits

Out of range.

Check NOx sensor connections (optional).

Replace the NOx sensor if the message persists after several attempts to zero.

4.5.8 Flow too low

Check that the flexible tubes located at the rear of the machine are connected in accordance with the diagram in paragraph I.2.4. Check that they are not kinked, twisted or blocked.

Disconnect the sampling probe to see whether the problem is connected with it, or persists.

1) If the probe is disconnected, the message is no longer active:

Check that the sampling tube has not been crushed.

Clean the probe and the flexible sampling tube with compressed air in accordance with paragraph I.4.4.1. (**NOTE:** always blow AWAY from the gas analyser towards the end of the sample probe)

2) If the probe is disconnected, the message remains active:

Check the flow with a flowmeter or call the service engineer.

If the flow is between the minimum flow and the nominal flow, it is necessary for a service engineer to open the machine to check the pressure switch and if necessary calibrate it using a pressure sensor at a trigger pressure of 160 mbar, or even to replace it.

4.5.9 HC residue in gas inlet

When a measurement is carried out on ambient air, if the CO_2 concentration is below 2% by volume for more than twenty seconds while the HC measurement gives more than 20 ppm, it is assumed that hydrocarbon residues are present in the inlet tract.

These residues may also be in the ambient air. One must therefore ensure that the work area is well ventilated. This can ocurr if an engine is running close to where gas analysis tests are being conducted. It may be necessary to clean the probe. If the problem appears again, clean the separator.

If the HC measurement drops back to a level below 20 ppm for more than 20 seconds, this message disappears, a zero operation is carried out and the message "measurement in progress" appears.

4.5.10 com. error

Check that the device is correctly earthed. Extensions for the power supply cable are absolutely required to include a ground connector as well as the power supply plug.

Communication between the main board and the test bench is defective. This is not a user serviceable item and you must call the service engineer.

4.5.11 Adjustment necessary

Call the service engineer - adjustment with the help of a calibration gas is necessary. This message indicates excessive measurement drift in the machine.

4.5.12 Change O2 sensor

During a zero operation, the system associates the oxygen concentration in air (20.9%) with the corresponding potential at the terminals of the oxygen sensor. This potential must lie between –2.15V and –1.95V. If the potential is not in this range, the message "Change O2 sensor" appears. This means that the oxygen sensor is defective or incorrectly connected.

Replace it and follow the procedure indicated by the analyser.

4.5.13 Condensation: wait

This message may appear during the start-up phase. In this case, wait for the machine to be warmed up and ready to carry out measurements.

If on the other hand, if this message appears in the course of a measurement and persists, it is necessary to carry out a check of the following points:

Check that the separator is correctly connected.

Check the flow at the condensate exhaust connector.

Check the internal parameters in the maintenance menu.

Perform a leak test.

Depending on the results obtained, you may need to call the service engineer who replaceme the defective part.

4.5.14 Heating problem

If the estimated start-up time of the machine (elapsed time between the time the machine is turned on and the time when measurements are possible) is greater than 15 minutes, this message appears.

If the temperature is below 5°C, it is necessary to move the machine to a less cold space and restart it.

4.5.15 Other :

1.1.1.1.2 RPM out of range

This is manifested on the screen by a "----" display.

If this message appears, it means that the measurement of operating speed is greater than 9999 rpm. Check that in the Operating Speed menu, the correct sensor has been chosen and the information concerning the engine to be tested are correct and have been entered.

1.1.1.1.3 TMP. Out of range

This is manifested on the screen by a "----" display.

If the ambient temperature is less than 0°C or if a measurement is in progress on a vehicle, this means that the measured value is outside the range 0-150°C.

If neither of these is the case, check that the oil temperature probe is correctly connected to the connector assigned to it. If this is not the case, replace the sampling probe.

5 SERVICE

Versions:	All
Calibration Interval:	12 monthly
Manufacturer:	CAPELEC
Address:	1130, rue des marels 34 000 MONTPELLIER France
Contact:	Philippe Georgeault
Service Company:	TRADE GARAGE EQUIPMENT LIMITED
Address	Refinish House Gelders Hall Industrial Estate Shepshed Leicestershire LE12 9NH UNITED KINGDOM Tél. : 0044 01509 506680
Contact:	Ian Leatherland