

assemblad®

## **SMOKE METER OPA-105 - OPA-105.LCD - OPA-105.PCB**



## **USER MANUAL**

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ASSEMBLAD - Technical office - Automotive Division  
.....\ M105-105LCD-105PCB\_GB301\_01-2010.doc & pdf



Note:

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# 1 GENERAL

The smokemeter OPA-105 is an instrument for the measure of light absorption of diesel engine exhaust fumes.

Before use read carefully this manual and follow the instructions to carry out any kind of measure and in particular for the maintenance operations.

Open the equipment only for operation where it is clearly requested after having switched it off, close the instrument and put it in the original configuration before switch on again, in particular be sure the cover has been locked with the screws.

Pay attention to the correct tubes connection, avoid breathing fumes and make sure they can be dispersed in an open ambient.

The manufacturer decline every responsibility in case of an incorrect use or a use not expressly specified in this manual; the responsibility is anyhow limited to the equipment's repair operation with the exclusion of any other direct or indirect damage.

For more information please read the chapter "Warranty condition".

For technical support or spare parts requests contact Assemblad Technical Support

The smokemeter performs measure of exhaust fumes with a partial flow; the measure bench cell is a "reflection" type.

The equipment performs measure in accordance with the European "Directive 1999/52/CE" and the Italian "D.M. del 7 Agosto 2000" and "Circolare 6902/604 del 4 Agosto 2000".

The smokemeter is approved for the communication protocol defined by the technical specifications MCTCNET version 1.0 dated 23/06/1999 and subsequent integrations.

## 2 TECHNICAL DATA

### 2.1 OPERATIONAL CHARACTERISTIC

Calibration	Automatic at power up
Measures execution	Controlled by microprocessor and PC.
Measure presentation	Monitor or control unit.
Measures range	Opacity %            00.0 – 100    res. 0.1 % Opacity K [1/m]    0.00 - 99.99   res. 0.01 K Fumes Temp.        0.0 – 150.0    res. 0.1 °C Oil Temp.            0.0 – 150.0    res. 0.1 °C Internal Temp.      0.0 – 100.0    res. 0.1 °C RPM                    400 – 9999    res. 1 rpm
Warming time	5 minutes (T.amb = 25 °C)
Operational temperature	0 ÷ +45 °C
Operational humidity	≤ 90 %
Dimensions	263 x 84 x 155 mm OPA-105 (lxwxh) 275 x 166 x 155 mm OPA-105.PCB 344 x 270 x 160 mm OPA-105.LCD
Weight	< 2 Kg (without pipes) < 4,7 Kg OPA-105.PCB (without pipes) < 4.0 Kg OPA-105.LCD (without pipes)
Exhaust pipe connection	Auto adapting with flexible joint
Power supply	-                    10,5 ÷ 15 Vcc max 3A 110 ÷ 220 Vca with external power supply
Power	40 W max

### 2.2 BASIC AND OPTIONAL FUNCTIONS

Controls	through control unit or PC
Oil temperature probe	connected to the equipment
Internal temperature probe	Integrated
Fumes temperature probe	Integrated
Communication Interface	RS232 internal 19200-8-N-1 RS232 external 9600-8-N-1 Bluetooth (optional)
RPM	external RPM connection or piezo sensor (optional)
Continuous measure	for power bench test
Official measure	in accordance with Directive 1999/52/CE

### 2.3 LIGHT REFLECTION SENSOR

Type	reflection
Transmitter	Green Led 550 ÷ 570 nm
Receiver	Photo diode amplified
Function check	Optical filter N.D.

## 2.4 MEASURE BENCH FEATURES

Bench Ventilation	controlled flow
Length of measure bench	120 mm
Internal diameter of measure bench	20 mm
Real length of the exhaust fume sample	240 mm
Fume input	Balanced
Fume output	normal
Pressure sensor	Barometric (solid)
Measure bench	Interchangeable
Bench mechanics	Inspectionable
Bench temp	> 70°C

## 2.5 ACCESSORIES

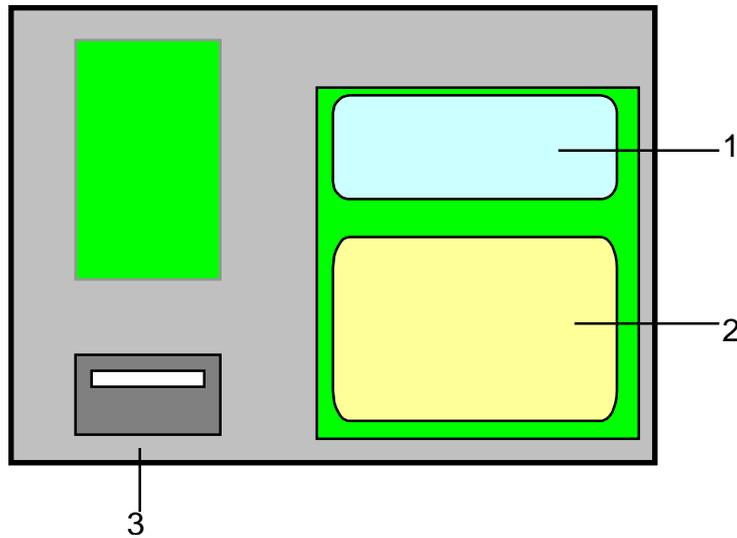
The following accessories are supplied with the smokemeter:

- N°2 reinforced Teflon tubes for fumes input
- N°1 probe terminal for exhaust pipe connection
- N°1 12 Vcc cable with battery clamps
- N°1 serial cable 5 m
- N°2 protection shields
- N°1 optical filter N.D. for function check
- N°1 maintenance and operational manual
- N°1 power supply AC/DC 220/12 Vcc or battery charger

The following optional can be supplied with the smokemeter:

- N°1 external universal RPM counter
- N°1 bluetooth class 1 device
- N°1 battery-pack for OPA-105
- N°1 elbow joint for vertical discharge
- N°1 12 Vcc cable with "cigarette-lighter" plug
- N°1 oil temperature probe AD
- N°1 oil temperature probe for trucks AD
- N°1 RPM probe with piezo sensor

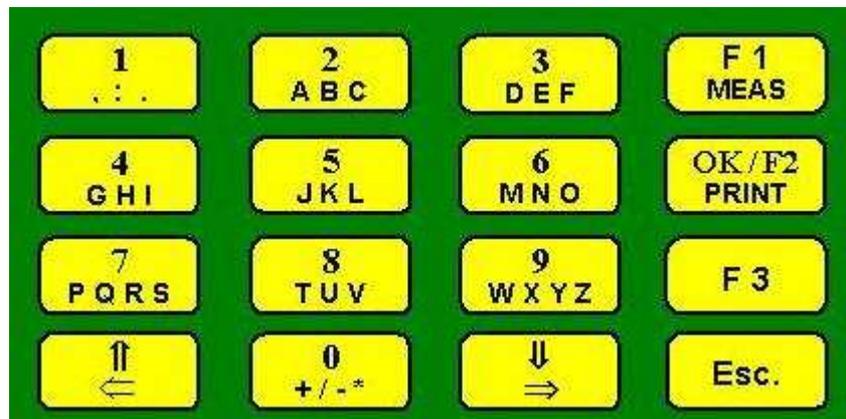
## 2.6 FRONT PANEL OPA-105.LCD



Main items on the front panel of OPA-105.LCD:

- 1) Display LCD
- 2) Keyboard
- 3) Thermal printer.

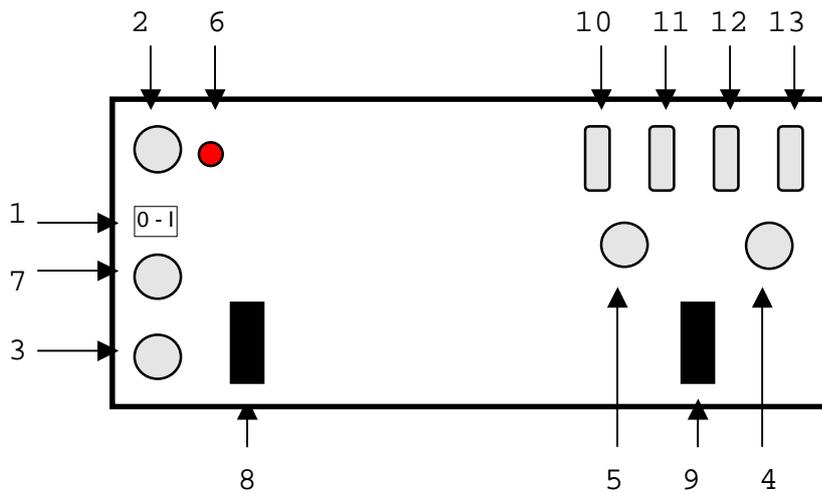
## 2.7 KEYBOARD



Keyboard OPA-105.LCD:

Key MEAS:	Start measure.
Key OK/PRINT:	Confirm entered data. Print results when test is finished.
Key F3:	Force test to continue or end also in case of non positive data.
Key ESC.	Stop test execution and go back to main menu.
Key 0 ÷ 9	Go back of one level when into a menu. Alphanumerical data input (mobile phone style).
Key Arrows	Choice of set-up data. Alphanumerical data cancellation. LCD contrast setting. Choice of data to be displayed.

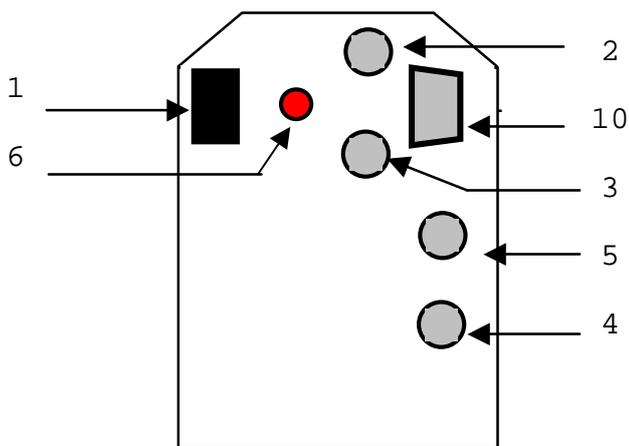
## 2.8 REAR PANEL OPA-105.LCD



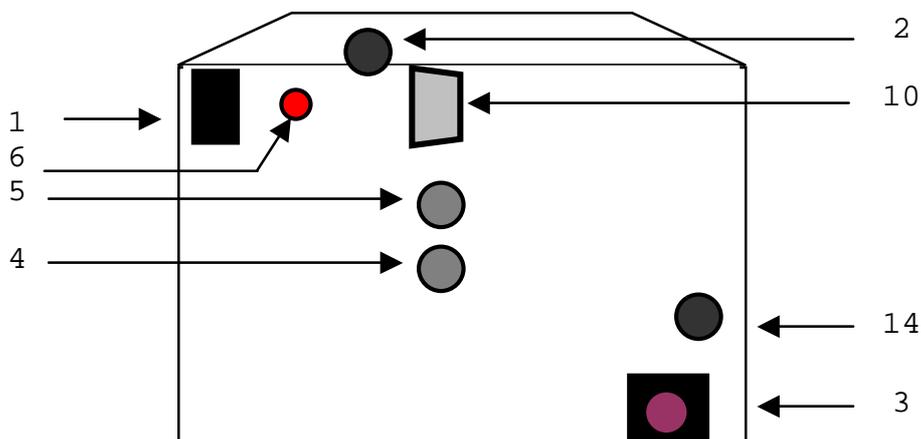
Main items on the rear panel of OPA-105.LCD:

- 1 - Power on switch.
- 2 - Instrument fuse.
- 3 - Power supply plug.
- 4 - External RPM Counter connection.
- 5 - Oil temperature probe connection.
- 6 - Led
- 7 - Gas input.
- 8 - Shield 1
- 9 - Shield 2
- 10 - PC serial connection.
- 11 - Gas analyser serial connection.
- 12 - Speedometer serial connection.
- 13 - Universal RPM counter Serial connection.

## 2.9 CONNECTOR PANEL OPA-105



## 2.10 CONNECTOR PANEL OPA-105.PCB



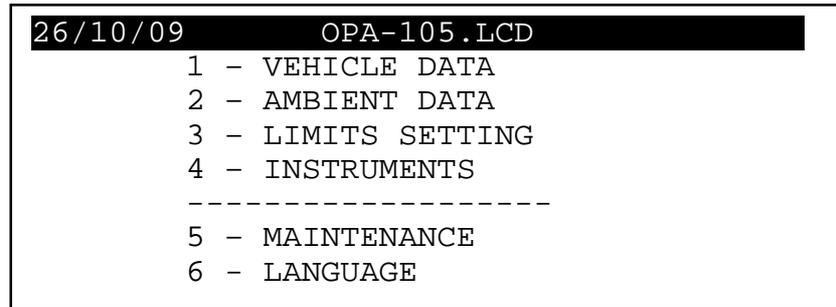
Main items on the connector panel of OPA-105/.PCB:

- 1 - Power on switch.
- 2 - Instrument fuse.
- 3 - Power supply plug.
- 4 - External RPM Counter connection.
- 5 - Oil temperature probe connection.
- 6 - Led
- 10 - PC serial connection.
- 14 - Battery fuse.

## 2.11 DISPLAY AND MENU

The smoke meter OPA-105-LCD has a display to show the menu and the measurement. Some part may be not enabled, some other reserved for technical service. The same menu is present in the gas analyzer INFRAGAS-205 when it is selected the instrument smoke meter.

### MAIN MENU



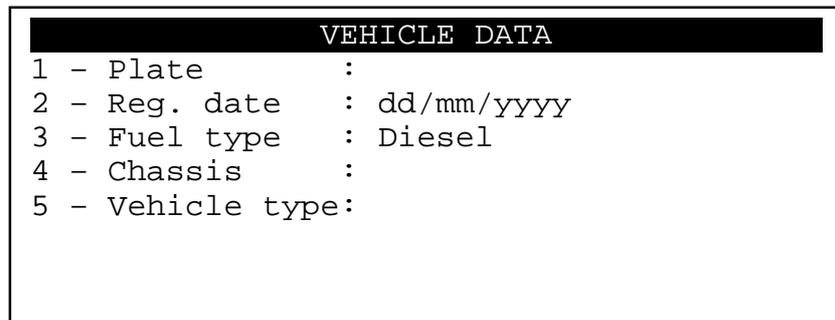
This menu is displayed when we turn on the instrument and when we come-back from other menu.

In the high-left corner is showed the data, in the upper centre is reported the selected instrument, to operate the choice push the key-number.

After a short time the backlight is switched-off, push the ESC key to restore.

Use the arrow keys to set the contrast of the LCD, this function work only in this menu.

### VEHICLE DATA



Press the corresponding key number to select the value you want to set, use the alphanumerical keys to enter a value, then press OK to confirm.

The ← key delete previous character, the ⇒ key insert a space.

Before entering the registration date delete “dd/mm/yyyy”, then enter the correct date. The slash symbol will be automatically entered.

Press ESC to go back to the main menu.

### AMBIENT DATA

AMBIENT DATA	
1 - Temperature	: 20°C
2 - Amb. pressure	: 1000hP
3 - Rel. humidity	: 35%
4 - Wind speed	: 0m/s

Use this menu to enter ambient data.

These data must be read from a dedicated instrument and they will be printed onto the test result report.

Press ESC to go back to the main menu.

### LIMITS SETTING

LIMITS SETTING	
1 - Max RPM at minimum rate:	1000 rpm
2 - Min RPM at accel. rate:	3500 rpm
3 - Min opacity	: 0.15 K
4 - Max opacity	: 2.5 K

Acceptable limits of the test are set in accordance with the vehicle data entered.

It is possible to edit the limits pressing the corresponding key, delete the present limit, enter a new value and press OK to confirm.

The limits 1 and 2 are used in the “RPM test”, the limit 3 is used in the test “Smoke test”.

Press ESC to go back to the main menu.

## INSTRUMENTS

INSTRUMENTS	
1	- ANALYSER
2	- SMOKEMETER
3	- RPM
4	- SPEED TESTER
5	- REMOTE

Press the corresponding numeric key to select the instrument you want to use then press OK to confirm.

If you need to connect and/or control the equipment with a PC you must select 'REMOTE'. With this selection the PC will be able to communicate with the internal gas analyser and with the connected smoke meter and RPM.

## MAINTENANCE

MAINTENANCE	
1	- Date/time setup
2	- Garage data
3	- RPM-meter data
4	- Services
5	- Set-Up
6	- Instrument data
7	- Leak test

From this menu it is possible to enter on assistance and service functions. Assistance and Set-Up are restricted to authorized technical personnel only and the access require a password.

### SET DATE/TIME

DATE-TIME SETUP		
1 - Year	:	6
2 - Month	:	6
3 - Day	:	26
4 - Hour	:	15
5 - Minutes	:	56

Press the corresponding numeric key to modify a value, delete present value using  $\leftarrow$  key, enter a new value and press OK to confirm.  
Press ESC to go back to the previous menu.

### WORKSHOP DATA

GARAGE DATA - OPERATOR		
1 - row1	:	.....
2 - row2	:	.....
3 - row3	:	.....
4 - row4	:	.....
5 - row5	:	.....
6 - Surname	:	.....
7 - Name	:	.....

Press the corresponding numeric key to modify a value, delete present value using  $\leftarrow$  key, enter a new value and press OK to confirm, max 24 character per line.  
Press ESC to go back to the previous menu.

## RPM DATA

RPM METER DATA	
1 - Manuf.	: ASSEMBLAD
2 - Model	: RPM-405
3 - Approv.	: OM00539F/NET
4 - S.N.	: ZA050001
5 - Exp. data:	03/06/2007
6 - RPM Enab.:	Yes
7 - RPM Ext.:	No

In this menu the external RPM counter data will be entered.

Press the corresponding numeric key to modify a value, delete present value using ← key, enter a new value and press OK to confirm.

With the selection RPM Enab. = Yes the measure will go on only if the RPM value is according with the RPM limit setting and the RPM value will be written in the report.

With the selection RPM Ext. = Yes the RPM value is acquired from the RPM meter connected to the serial port on the rear panel, with the selection NO the RPM value is detected from the smoke meter.

Press ESC to go back to the previous menu.

## INSTRUMENT DATA

INSTRUMENT DATA	
1 - Manuf.	: ASSEMBLAD
2 - Model	: OPA-105.LCD
3 - Approv.	: OM00000b/NET
4 - S.N.	: BE070001
5 - Exp data	: 03/06/2007
6 - SW Ver.	: 3.000

In this menu it is possible to read the information of the instrument connected.

Data cannot be modified (read only), they are acquired from the instrument.

Press ESC to go back to the previous menu.

## AUTOZERO SCREEN

In this screen is displayed the vehicle plate and the opacity max from limits setting.

With F3 key is possible to select the follows type of measures:

- Cont. Test
- RPM Test
- Smoke Test
- Manual Test

For detail see the paragraph MEASURE SELECTION.

MEASUREMENT SCREEN

<b>Accelerate!</b>		<b>OPA-105LCD</b>
1-Op K 00.00	2-Op % 00.0	RPM Test
3-Toil 089.2	4-Rpm 0745	K= k rpm
		1- 2- 3- 4- 5- 6- 7- 8-

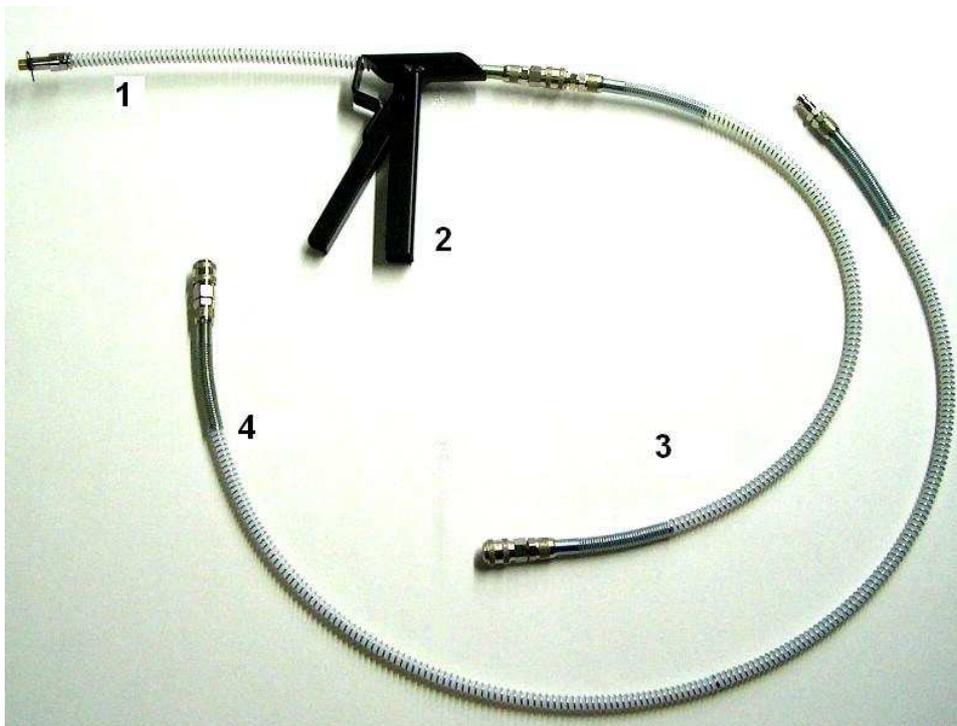
<b>Keep max rate</b>		<b>OPA-105LCD</b>
1-Op K 00.03	2-Op % 00.7	Prova RPM
3-Toil 090.2	4-Rpm 4210	K= k rpm
		1-0.02 4212 2-0.04 4285 3- 4- 5- 6- 7- 8-

<b>TEST OK</b>		<b>OPA-105LCD</b>
1-Op K 00.00	2-Op % 00.0	Prova RPM
3-Toil 090.7	4-Rpm 0792	K= 0.03 k rpm
		1-0.02 4212 2-0.04 4285 3-0.03 4241 4- 5- 6- 7- 8-

During the test phase the following data will be displayed:

- Test type
- 4 windows with measured value. To select different parameters press the numeric key, use arrows keys to select the required parameters, press OK to confirm.
- The measures made during the test and the final result.

## 2.12 THE SMOKE METER PROBE



The smoke meter probe is composed with the follow parts:

- 1 - Terminal probe for exhaust pipe connection
- 2 - Grip
- 3 – Extension probe 60 cm
- 4 – Extension probe 100 cm

The terminal probe (1) must be inserted in the exhaust pipe of the diesel vehicle, in the final side there is a spring to avoid a position near the side of exhaust pipe.

In the other side there is a junction to be connected to the smoke meter.

It is possible prolong the terminal probe with 1 or 2 extension probes (3) (4), the smoke meter is homologated for the use with all the extensions supplied.

The grip (2) is useful to avoid to touch hot and dirty parts, moreover the tongs can be used to close the terminal probe with the exhaust pipe.

### 3 INSTALLATION AND TRANSPORTATION

Installation is easy and can be performed by the user or, if required, by Assemblad authorized personnel.

Due to the small dimensions of the equipment, transportation can be done by hand; pay attention to avoid crashes or falls, damages caused for these reasons are not covered by warranty.

#### 3.1 CONNECTIONS

The smokemeter works with a nominal 12 Vcc power supply. Use the power supply cable to connect it to a battery, or use the external supply to connect it to the power network; a cable with a "cigarette-lighter" plug can be requested as an optional.

If the instrument has a battery, connect this one to the charger, pay attention to don't discharge completely the battery.

Connect the smokemeter to the serial port of a personal computer using the RS232 input, the connection can be replaced with the Bluetooth link, in this case connect the Bluetooth interface to the smokemeter serial port and the Bluetooth key to the PC.

Connect the probe terminal to the smokemeter joint using one or two tubes.

Press the lateral power button to switch on the instrument and verify that the led come on.

#### 3.2 OPERATIONS TO AVOID

Do not bend or stress excessively the fume input tube and avoid any kind of cracks.

Do not leave the instrument directly exposed to the sun light or under the rain.

Do not put the smokemeter over dusty and dirty surfaces or over whatever material can be suctioned by the lower fans.

Avoid crushes, unstable positions, vibrations and falls.

Do not pull probes or connection cables to avoid instrument falls.

Leave the smokemeter in a dry ambient and, if possible, at a normal ambient temperature.

Keep the reference optical filter in the original package and do not get it dirty.

## 4 OPERATION

PUMA smokemeter is an instrument for the measurement of light absorption of Diesel engine emission smokes.

Measurement consists on verifying the attenuation of a light beam due to the absorption of the fume gases concentration in exam.

The smoke enters into the measurement cell (maintained at a constant temperature) where it is analyzed with a reflection transceiver.

The analyzed smoke then goes out through the fans positioned on the bottom part of the equipment.

An optical filter is supplied with the instrument and it can be used to verify the equipment functionality.

The smokemeter performs measure of exhaust fumes taken with the “partial flow” method, connecting the steel probe to the exhaust pipe of the vehicle under test. Make sure that the probe is properly inserted using the dedicated mechanism to avoid it can come out from the exhaust pipe when running the engine.

The probe can be connected to the short probe-instrument interconnecting pipe or to the long one or with a combination of these depending on the needs.

### 4.1 SET-UP VEHICLE

Visual inspect the relevant parts of the motor vehicle's emission system to check that there are no leaks (e.g. cap the exhaust pipe when the engine run at minimum speed to find leaks), verify that the interconnecting pipe from the probe to the instrument has a climbing gradient and it goes straight. Insert the oil temperature probe.

Run the engine. Make the vehicle data registration, verify the K value limit applicable to the vehicle under test.

Disconnect all the devices that can have influence to the engine minimum running speed, except for the ones expressly required by the vehicle manufacturer or by law.

If it is available the external RPM, connect it to the vehicle battery, set the number of cylinders, verify if the RPM value can be detected from battery, otherwise use the vibration sensor, see the RPM chapter for details.

Insert the oil temperature probe, wait for the motor normal operating temperature, typical over 80°C.

Make three or more free accelerations, the throttle pedal must be fully depressed quickly and continuously, wait some seconds from an acceleration to the next one.

Perform the zeroing of the instrument, when it is finished insert the probe into the exhaust pipe for at least 300 mm. In the event that, due to the exhaust pipe shape, this is not possible, extend the exhaust pipe with an additional tube verifying that there are no leaks.

On instruments supplied with the “smoke stop-valve” the probe can be inserted at the beginning of the test setting the smokemeter in standby.

## 4.2 MEASURE

Select the type of measure, if RPM work properly is preferred to select it, so the acquisition of opacity peak will be done in the correct range and the report will have the RPM values.

Otherwise it is possible to select the smoke limits, with this method the acceleration counter will be increased when it is detect an increment of smoke, this mode can have problem with vehicle with very low opacity values.

The time mode is practical but the operator must perform the operations (accelerations and decelerations) exactly when they are requested.

With manual mode the operator must have the PC near the operating site because he increments the acceleration counter with mouse or keyboard.

Engine and any turbocharger fitted, to be at idle before the start of each free acceleration cycle.

Start the test. The throttle pedal must be fully depressed quickly and continuously but not violently (in less than 0,4 second), so as to obtain maximum delivery from the injection pump; maintain that position for a period of 2 sec. (+1,-0) and release; maintain the engine at minimum running speed for a period of 3 sec. (+1,-0). The opacity display will indicate the maximum opacity value reach in this phase.

In the monitor will be show the operation to do.

Repeat the accelerations until a stabilized average has been reached.

At the end of test print the report.

The test is passed when the average of the last 3 measures has a value lower than the K limit inserted; if the average is greater other measures are requested.

The maximum number of tests is 8; for the measures method and data calculation refer to the applicable laws.

If the average of the last 3 measures is greater than the 50% of the limit value inserted the test will be stopped without asking for other cycles and the test will be considered NOT passed.

If the bench cell temperature is lower than 70°C the test will be stopped and the instrument will go in the warm-up status.

The test report will include: smokemeter data, measures performed, calculated average, results, ambient data, vehicle data and RPM data.

### 4.3 TEMPERATURE MEASURE

The smoke temperature sensor is positioned on the "T" joint at the bench cell input. It can be checked by removing the instrument cover.

The bench cell temperature sensor is mounted on the bench itself inside the insulation cover.

The oil temperature sensor is into the oil probe that must be inserted into the dipstick hole and must be connected to the lateral side of the instrument.

If it is used the external RPM it is possible to detect the oil temperature with the sensor of this instrument, to use this sensor enable it in the setup page of the external RPM, after this selection the oil probe connected to the smoke meter will not be read.

### 4.4 RPM

The measure of diesel engine RPM it's a difficult operation due to the fact that electric signals are missing.

The easiest solution is based on a piezoelectric sensor positioned on the fuel supply tube that converts the pressure variation in an electric signal.

The piezo sensor is connected to the connector placed in the smokemeter side.

This system does not guarantee a good result in all the situations for the following reasons:

- The sensor cannot be put on the fuel supply tube because of lack of space
- Excessive engine vibrations that cannot make the signal available
- Engines that do not use a standard injection pump (e.g. common rail).

A better method is to use an external RPM counter (RPM-405) that measures the engine speed through the engine vibration and/or through the alternator voltage residual peak; the system that use these 2 techniques works with almost all vehicles; the battery connection and the positioning of the sensor are very easy and quick operations.

After connection the display will lighting, select the number of strokes and the number of cylinders, verify the correct reading on the display with motor at idle and with the acceleration.

Look for a place on the motor with good vibrations, place the sensor in a steady position, if there are not steel parts use a clamp, verify the correct reading on the display.

Make attention to don't put the vibration sensor in hot places and to don't pull the cable to avoid irreparable damages.

If the sensor don't work properly select the battery impulses with the middle key.

If the rates are not regular try to switch on the lights of the vehicle in order to receive a better signal from battery.

With a little training on different kind of vehicles this operations will be fast and easy.

See the RPM-405 for details.

The RPM-405 is connected with a cable to the input RPM connector of the smoke meter, with the instrument OPA-105.LCD is possible to connect the RPM-405 to the specific serial port.

## 4.5 BLUETOOTH CLASS 1 DEVICE

The smoke meter must be connected to a PC to work, normally this connection is made with a wire (supplied) that connect the RS232 port of the instrument with the one of the computer, this wire connection can be replace with a radio link that works under the standard of blue-tooth, it is composed of two parts:

- the blue-tooth interface is connected to the RS232 port of the OPA-105
- the blue-tooth key is connected to an USB port of the computer

The PC must be setup for the use of the key and it communicates with the smoke-meter like any other blue-tooth instrument, it assign a communication port number that must be reported in the communication setup of the smokemeter program.

The instrument don't need of any initialization

The characteristic and performance of this link are conformed to the blue-tooth class 1.

## 4.6 BATTERY PACK FOR OPA-105 AND OPA-105.LCD

Battery Pack 105 is an optional device that provides power supply to smoke meter OPA-105 in absence of an electrical network in order to use the equipment everywhere.

Usually it is fixed under the smoke meter using 4 screws becoming unique equipment very compact and easy to use.

After use switch off the smokemeter and recharge always the battery.

Fully recharge if not used for a long period, at least once per month.

Read the specific manual for details

## 4.7 GAS ANALYSER

The OPA-105.LCD can manage the measure on vehicle with spark engines with a gas analyzer like INFRAGAS-109.

The gas analyzer can be connected to the specific serial connection, in the main menu select instrument / gas analyzer.

OPA-105.LCD is able to control all the measure and print the report.

## 4.8 MCTC-NET

The smoke meter OPA-105 to communicate with a PC use the protocol MCTCNet RSSE, the default address is "1", if there are some error the instrument sent a COD answer with the following meaning:

- 1 – Measure chamber has not reach the minimum operative temperature
- 2 – Optical length dirty, clean the 2 shields.
- 3 – Irrecoverable error, restart the instrument, if the error repeat call service.
- 4 – Led emitter is off.
- 6 – Command received cannot be executed in the present status.
- 7 – Measure chamber temperature is too high, turn off the smoke meter.

## 5 INFPLUS-WIN SOFTWARE

INFPLUSWIN is a software developed to run on a PC with Windows operative system installed. With Infplus-Win it is possible to control the instrument and create reports.

### 5.1 INSTALLATION

To install the Infplus-Win software, run "**infpluswin.exe**" from the disk and follow the instruction showed.



**Fig. 1** : Setup screen

The software will be copied on the hard disk into the default directory "**InfplusWin**" or in another directory that can be selected during the installation.

Once the installation has been completed run "**InfplusWin161.exe**" in the "**InfplusWin**" directory or click on "**InfplusWin161**" icon on the desktop.

### 5.2 INFPLUS-WIN FUNCTIONS

Before run InfplusWin check that the connection between the serial port COMx of the personal computer and the instrument, make sure the serial port COMx works properly. When InfplusWin start a Main Menu will appear with 4 control keys, the menu selection and the ASSEMBLAD logo.

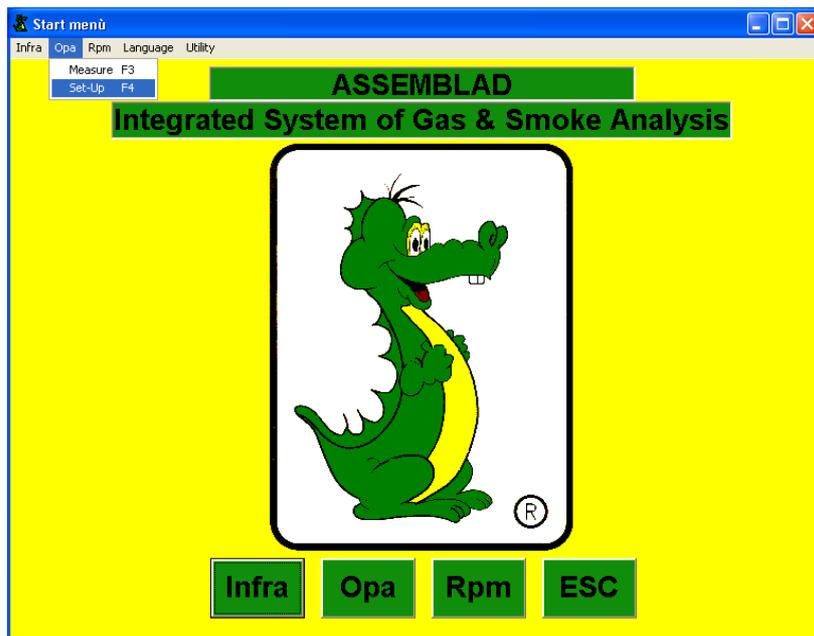


Fig. 3: Main Menu.

InfplusWin has the following default communication parameters set:

**Port : COM1**  
**Baud Rate : 9600**  
**Word : 8 bits**  
**Stop : 1 bit**  
**Parity : None**

If the default serial port number or the baud rate value are not the ones used by the PC serial port, change them entering in the set-up section with the "**F4**" command.

ATTENTION!: other parameters cannot be changed.

It's possible to enter in the smokemeter section with the command **OPA**.

If an error message appears or the system responds very slowly check again the serial connection and the parameters.

### 5.3 MENU SECTION

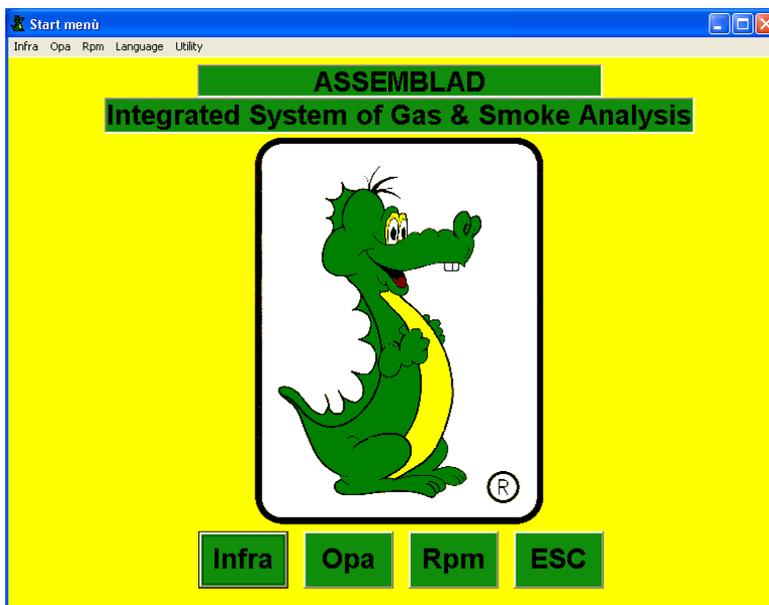


Fig. 4 : Menu section

Selecting Opa you will go to the sub form where it's possible to enter the communication parameters

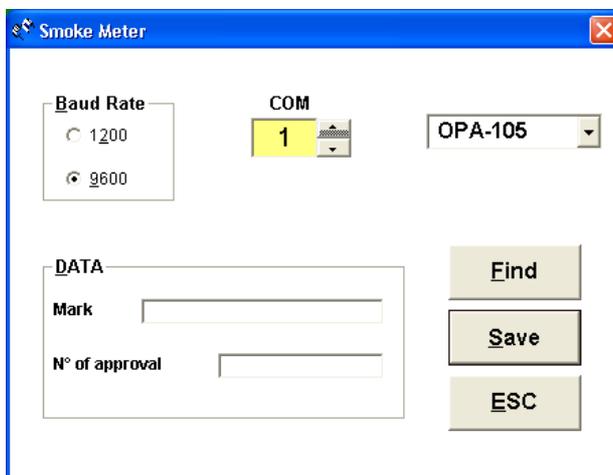
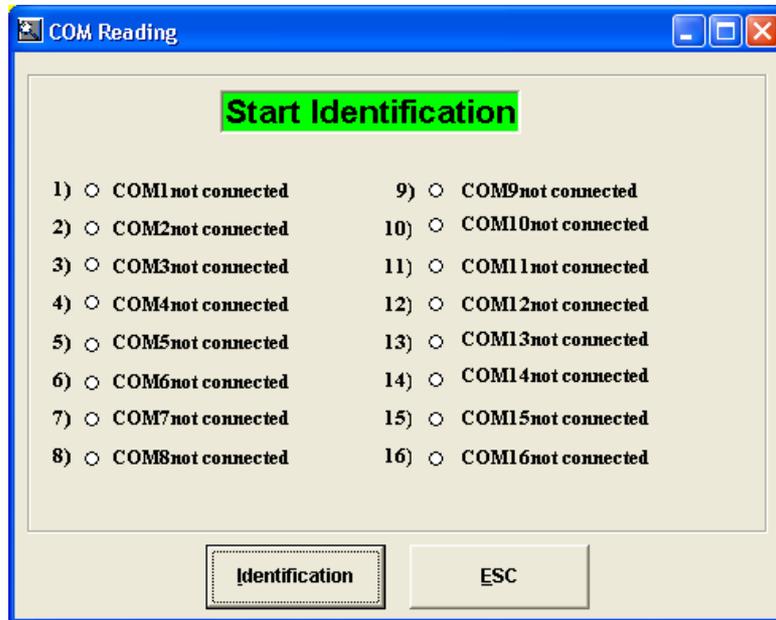


Fig. 5 : Sub form for smokemeter communication

After the selection of the Baud Rate, the COM port number and the instrument model, pressing the button **Find** the data related to the instrument will appear in the text fields (it's also possible to enter these data manually using the PC keyboard), then pressing the button **Save** these data will be saved.

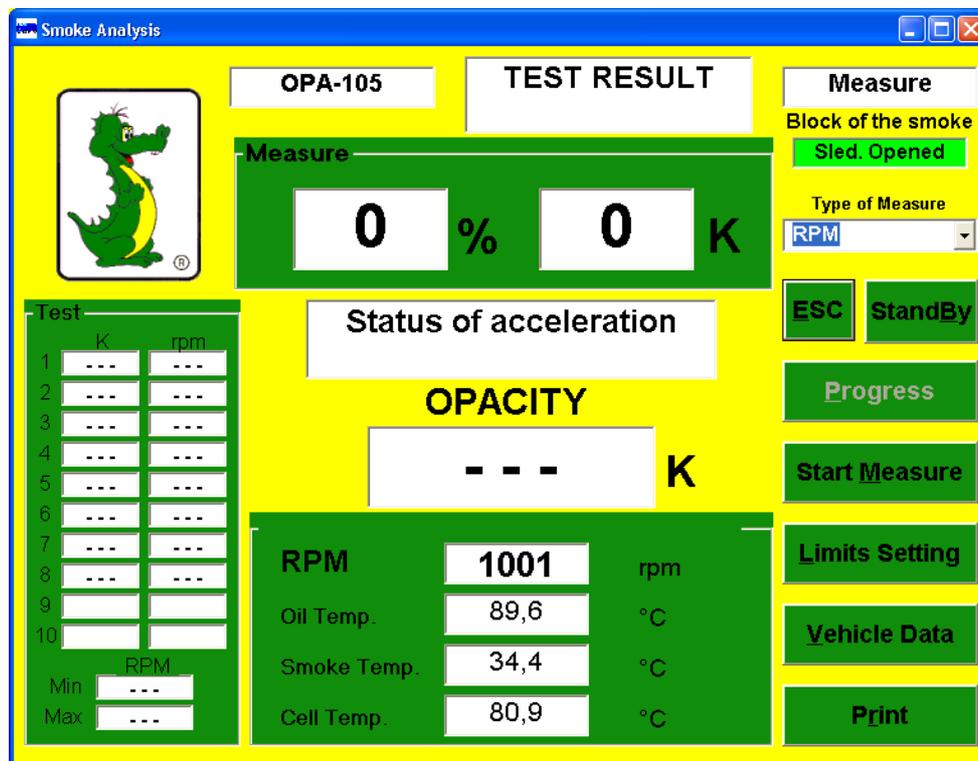
With “RPM”, “User” and “Environmental data” you will enter into the related sub forms to set values and information’s used during the test (and also printed in the final report).  
With the button “COM Reading” you will enter into the utility menu that can be used to scan for Assemblad instruments connected to the PC and the COM ports available.



**Fig. 6:** COM Reading

The Baud Rate for scanning is 9600.

## 5.4 SMOKEMETER SECTION



**Fig. 9: SMOKEMETER SECTION**

In this section the following fields are displayed:

- the model type;
- the smokemeter status;
- the “Smoke-stop” device type;
- a field to select the measure type;
- all the measurements performed by the smokemeter;
- two sub forms with the test limits (through the button “**Limits Setting**”) and the vehicle manufacture data (through the button “**Vehicle Data**”);
- an user messages field;
- a test result field;
- 10 intermediate result fields;
- a final opacity result field;
- a button to switch OPA-105 in the StandBy or in the Measure mode (“**StandBy**”);
- a button to start and stop the measure (“**Start Measure**”);
- a button to proceed with a manual test (“**Progress**”);
- a button to print the test report (“**Print**”);

All functions are available clicking with the **mouse** on the buttons, or through the keyboard pressing **ALT + “the underline letter”** simultaneously. To exit from a section click **“x”** on the right upper corner using the mouse or press **ALT+F4** or **ESC**. To select a different measurement type select the corresponding field with the **mouse** or press **TAB** until the field is selected, select a value using **ARROWS KEYS** and press **SPACE** to confirm.

## INSTRUMENT TYPE

In this field it is showed the smokemeter model connected to the PC.

## SMOKEMETER STATUS

There is a Status field in the upper right side of the window that describes the status of the smokemeter in the following way:

**Heating** : Smokemeter in warming  
**StandBy** : Smokemeter in stand-by  
**Autozero** : Smokemeter in autocalibration  
**Measure** : Smokemeter in measure mode  
**Error** : fatal error in the Smokemeter  
**ERROR X** : error in the Smokemeter (X is a number that identify the error type)  
**ERROR COM** : Communication with the Gas Analyzer not available

## “SMOKE-STOP” DEVICE TYPE

Below the Status field there is an indication of which kind of “Smoke-stop” device is currently used during the auto zeroing phase. The indication depends on the type of device **“Elect. Valve.”** if an electric valve is used, **“Sled Opened”** or **“Sled Close”** if a sledge is present, **“Not Present”** if there’s no device.

## MEASURE SELECTION

With this selection it’s possible to select the type of measure to carry out. There are 5 type of measure:

1. **Continuous**: with this selection is possible to carry out diagnosis on the vehicle.
2. **RPM** : with this selection is possible to carry out a test where each acceleration start when the RPM lower limit (RPMmin) is exceeded, the peak acquisition start when the RPM upper limit (RPMmax) is exceeded and the duration is 4 sec., after 4 sec. the acceleration stops when the RPM come back below RPMmin. Before run a new acceleration RPM must remain at least 3 sec. below RPMmin.

3. **Smoke Limits** : with this selection is possible to carry out a test where each acceleration and peak acquisition start when the Opacity Limit is exceeded, acquisition duration is 4 sec., after that the acceleration stop when go back below the Opacity Limit Before run a new acceleration RPM must remain at least 3 sec. below RPMmin.
4. **Time** : with this selection each acceleration is defined by time. You must remain at minimum RPM for 3 sec., after that you must go to maximum RPM in 1 sec. and remain there for 4 sec., in this period there's the peak acquisition. Then go back to minimum RPM in 1 sec. and maintain it for 3 sec. before run a new acceleration.
5. **Manual** : with this selection you will pass from an acceleration to another with the button "**Progress**";
6. **Single**: with this selection it's possible to run a single acceleration in the same way as in the **RPM** mode and print the result graphic (see picture below).

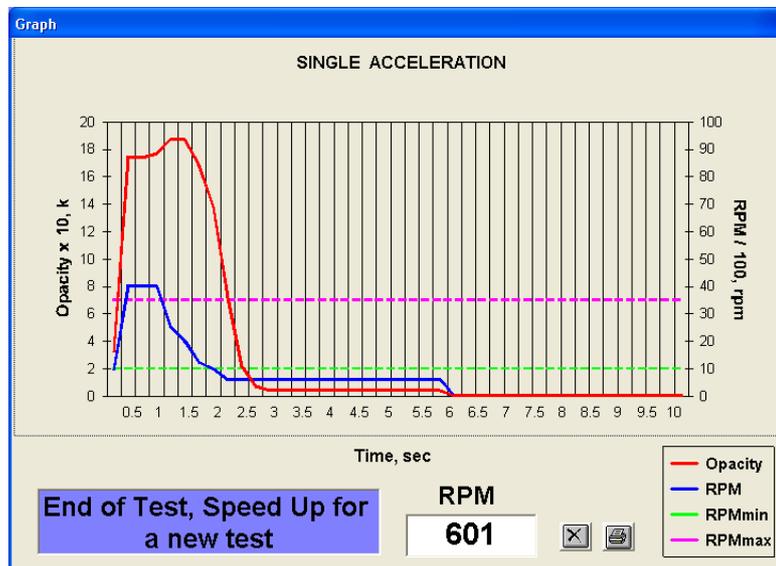


Fig. 10: Single test result graph

Each measure type has a duration that depends on the test result as described in this manual. At the end of each test the result will be displayed in the related field and a final report can be printed.

## MEASURES

In these screen the smokemeter shows the measures performed. The '**Out**' string means that an over-range value has been detected, while '---' means that the data is not available.

If the temperature goes below 70°C the field "Cell Temp" becomes red.

## SUB FORMS LIMITS AND VEIHCLE DATA

The image shows two side-by-side software forms. The left form, titled 'Limits Setting', contains four input fields: 'RPMmin' with the value '1000', 'RPMmax' with '3500', 'Opacity Threshold' with '0,15', and 'Limit Value of K' with '1,5'. A 'Save' button is located at the bottom right of this form. The right form, titled 'Vehicle Data', contains five input fields: 'Factory and Type' with 'ALFA ROMEO 159 2.4 JTD', 'Licence plate' with 'AR159GT', 'Loom' with '1234567890', and 'Year of first registration' with '2007'. A 'Save' button is located at the bottom right of this form.

Fig. 10 : the 2 forms: "Limits setting" and "Vehicle data"

In the form "**Limit setting**" the following values are showed:

- **RPMmin** : is the lower limit of the engine speed in the **RPM** mode;
- **RPMmax**: is the upper limit of the engine speed in the **RPM** mode;
- **Opacity Threshold** : is the opacity limit in the **Smoke Limits** mode to start the peak acquisition;
- **Limit Value of K** : is the maximum K value of the opacity, the average must be lower than this value in order to pass the test;

In the form "**Vehicle data**" the vehicle data can be entered, they will be printed in the final report.

All values and strings can be entered manually selecting the relevant fields with the mouse or with the **TAB** key and using the keyboard.

## MESSAGE WINDOW

In this window both operative and error messages are displayed, they enable the interface between the smokemeter and the user. The user can read there important messages to perform the test.

## TEST RESULT WINDOW

In this window the test result can be read at the end of the measure if the **Continuous** mode has not been selected; if the test is passed the window background becomes green and the label shows "**TEST OK**" while if the test is not passed the window background becomes red and the label shows "**TEST KO**".

## INTERMEDIATE TEST RESULTS WINDOW

The peak values for each acceleration are displayed; in the bottom part the minimum and maximum RPM values measured during the test are displayed.

## FINAL OPACITY VALUE WINDOW

The average value is displayed; it represents the final test result.

## STANDBY

With the button "**StandBy**" the smokemeter goes in the Stand-By mode. To perform the test the smokemeter must not be in the Stand-By mode.

## START MEASURE

Remove the probe from the exhaust pipe, pressing the button "**Start Measure**" the instrument calibration will begin, when the smokemeter goes back in the measure status insert again the probe into the exhaust pipe.

If the "**Continuous**" mode has been selected the instrument will read the values continuously without compare them with the limits entered and without peak detection.

If another mode has been selected, after the calibration, a test will start accordingly with the mode as described in the paragraph MEASURE SELECTION.

## MANUAL MODE

With the button "**Progress**" the test will be carried out manually. This button is not active if the smokemeter is not in active or if another mode has been selected.

## PRINT A TEST REPORT

It's possible to print a test report with the button "**Print**". The printout will be sent to the Windows default printer.

Once the test is finished it's possible to print more than one report until a new test start. It's possible to print 2 different kind of report.

## 6 STANDARD MAINTENANCE

The following maintenance operations can be performed directly by the end user. In case of calibration or non standard maintenance have to be carried out contact an Authorized Technical Service that will fix problems or will give instructions where to send the equipment for repair.

### 6.1 VERIFY MEASURE WITH OPTICAL FILTER

An optical filter, with a certain absorption factor, is supplied with the instrument; it can be used to verify periodically the measures and calibration.

To check opacity values perform the following steps:

- clean the protection screens, insert the one on the connector side only. the probe must be disconnected.
- switch on the smokemeter and wait 5 minutes.
- select the Continua mode and perform an autozeroing by pressing the Start button.
- insert the filter
- read the opacity value and compare it with the one written on the certificate supplied with the filter.
- the difference between the two values must be within  $\pm 0,05$  K; in case the difference is greater than  $\pm 0,05$  K the Technical Service must be contacted to perform an instrument calibration.

### 6.2 INSTRUMENT AND PROBE CLEANING

Before proceeding with the instrument cleaning disconnect the power supply.

Clean external parts using a wet cloth, use water and not solvents or chemical products.

Do not use compressed air.

Remove the probe and using compressed air blow into the probe from the side that is usually connected to the instrument (not into the terminal side).

Water with detergent can be used but make sure the probe is not wet before using it again.

Do not use compressed air into the smokemeter connection joint.

### 6.3 FUSE REPLACEMENT

The fuse is placed on the lateral side, it has a value of 3A (5x20), replace the fuse as follow:

- Disconnect the power supply.
- Unscrew the fuse cap.
- Remove the fuse, replace it and screw the fuse cap.

Do not use fuse with a different value.

If the fuse will burn immediately after the replacement, do not perform any action and contact the Technical Service.

## 7 TROUBLESHOOTING

During start up, calibration and measure phases the smokemeter could detect some faults. The software will display a message to the user and, in case of fatal error, it will stop operations.

In some case the software advise also for the corrective action.

Before carry out a repair switch off the instrument and inspect internally verifying that all cables and plugs are correctly inserted, after that switch on the smokemeter again to check the fault is disappear.

If the fault is still there, follow the specific error instruction (if available) or contact the Technical Service.

The INFPLUSWIN software can display the following error type:

ERROR 1 – the bench cell does not reach the minimum operative temperature.

ERROR 2 – optical path dirty; verify and clean the optical parts in the bench cell.

ERROR 3 – fatal error, switch off the equipment and search for the fault cause.

ERROR 4 – Led switched off or burned.

ERROR 6 – operation not allowed in the present status of the equipment.

ERROR 7 – bench cell temperature > 95°C; switch off the instrument.

## 8 INFORMATION - Directive RAEE (#)



The symbol  stamped on the equipment means that when the product will be at the end of its operative life it shall be consider as a special refusal and shall be a “special dismantle”. For this reason the user shall take it to a Dismantle Center authorized by Local Authority or to an authorized distributor for purchasing a new equivalent equipment.

(#) European Directives 2002/95/CE, 2002/96/CE and 2003/108/CE

## 9 WARRANTY

a) ASSEMBLAD products are manufactured with care and carefully inspected before they left the factory. To have full rights of warranty and avoid the risk of invalidation, the Customer must mail a signed copy of the Warranty Certificate to ASSEMBLAD within 10 days from the receiving of the goods.

b) All items manufactured by ASSEMBLAD will be repaired or replaced, at its irrevocable option, as promptly as possible, when found and proved defective for vice of material or manufacturing or considerably prejudiced in their function within a (1) year from the date of delivery. The defective parts must be returned to ASSEMBLAD factory (or to an authorized service center) entirely at Customer's expenses. Eventual defects must be notified to ASSEMBLAD by letter within 8 (eight) days from their discovery, otherwise any right will be forfeited. In case of apparent defects (the finish, the treating of zinc, colored or anyhow treated surfaces, and all what is apparent) the term of 8 (eight) days will run from the date of receipt of the goods. The parts ASSEMBLAD replaces will become its property. The present warranty does not include consumption parts, i.e. nuts, washers, sleeves, and so on.

c) ASSEMBLAD obligation of warranty service will decay in the following cases:

- whenever the installation has been made improperly or erroneously or not perfectly;
- if the product has been improperly and carelessly used or put under unusual and excessive stress;
- when the defect comes from having used the wrong tools or materials during installation or wrong use of the product, as well as from chemical, electrochemical and electrical effects;
- whenever works, repairs, modifications or tampering have been made without ASSEMBLAD prior written authorization, except for normal maintenance which Customer should get done at regular intervals.

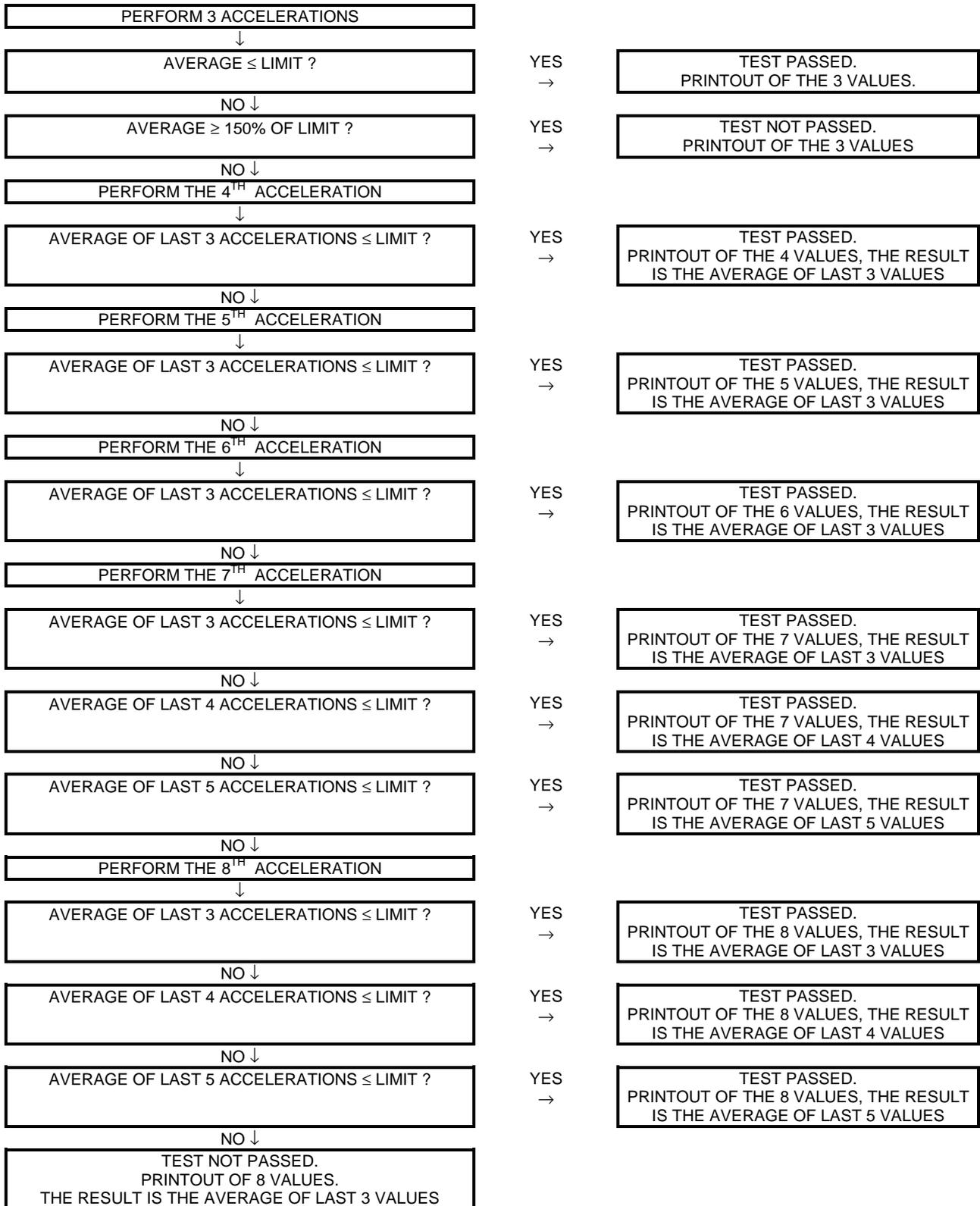
d) ASSEMBLAD can refuse to replace or repair defective parts until the Customer has fulfilled all his obligations as to ASSEMBLAD.

e) All repaired and replaced parts will be guaranteed like any new product.

f) ASSEMBLAD obligation of warranty service is intended only with respect to the repair and/or the replacement of the defective parts and covers only the parts not subject to wear (i.e. the warranty does not cover: external cables, probes, remote control unit, pumps, motors and the external accessories. These items are subject to wear and their efficiency depends on how they are handled or treated). The warranty is in any case limited to the price of the defective part stated on ASSEMBLAD invoice. ASSEMBLAD is absolved from any other liability of any kind and for any reason, unless specifically settled by the Italian Law (D.P.R. 24.05.1988 No. 244) and under the terms set forth by the same Law.

## 10 APPENDIX

### Flow diagram of vehicle test procedure



## CONVERSION TABLE BETWEEN OPACITY VALUES IN PERCENTAGE (%) AND K ABSORPTION FACTOR (1/m)

%	K[1/m]	%	K[1/m]	%	K[1/m]
00,0	= 0,00	21,0	= 0,98	52,0	= 3,06
01,0	= 0,04	22,0	= 1,04	54,0	= 3,24
02,0	= 0,08	23,0	= 1,09	56,0	= 3,42
03,0	= 0,13	24,0	= 1,14	58,0	= 3,61
04,0	= 0,17	25,0	= 1,20	60,0	= 3,82
05,0	= 0,21	26,0	= 1,25	62,0	= 4,03
06,0	= 0,26	27,0	= 1,31	64,0	= 4,26
07,0	= 0,30	28,0	= 1,37	66,0	= 4,50
08,0	= 0,35	29,0	= 1,43	68,0	= 4,75
09,0	= 0,39	30,0	= 1,49	70,0	= 5,02
10,0	= 0,44	31,0	= 1,55	72,0	= 5,30
11,0	= 0,49	32,0	= 1,61	74,0	= 5,61
12,0	= 0,53	34,0	= 1,73	76,0	= 5,95
13,0	= 0,58	36,0	= 1,86	78,0	= 6,31
14,0	= 0,63	38,0	= 1,99	80,0	= 6,71
15,0	= 0,68	40,0	= 2,13	82,0	= 7,14
16,0	= 0,73	42,0	= 2,27	84,0	= 7,64
17,0	= 0,78	44,0	= 2,42	86,0	= 8,19
18,0	= 0,83	46,0	= 2,57	88,0	= 8,83
19,0	= 0,88	48,0	= 2,72	90,0	= 9,59
20,0	= 0,93	50,0	= 2,89	90,9	= 9,99

Formula :  $K = - ( \ln ( 1 - N / 100 ) ) / L$

L = bench optical length = 0,24 m

N = value in %

### TEST AMBIENT CONDITIONS (DM 628 dated 23/10/96)

The barometric pressure variations have influence on smokemeter test results, for this reason it's important to know the real pressure value.

The ambient pressure must be within 850 and 1025 mbar.

When the smokemeter is operated with an ambient pressure between 945 mbar and 850 mbar the measured value is reduced by 0,25 1/m.

This has to be checked, if possible, in absence of wind; in any case the vehicle and the smokemeter exhausts must not be against the wind.

## Note

## Note

## Note

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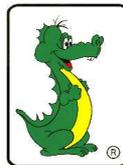
This object is in conformity with the requirements  
of the following documents:

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**2006 / 95 / CE**

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