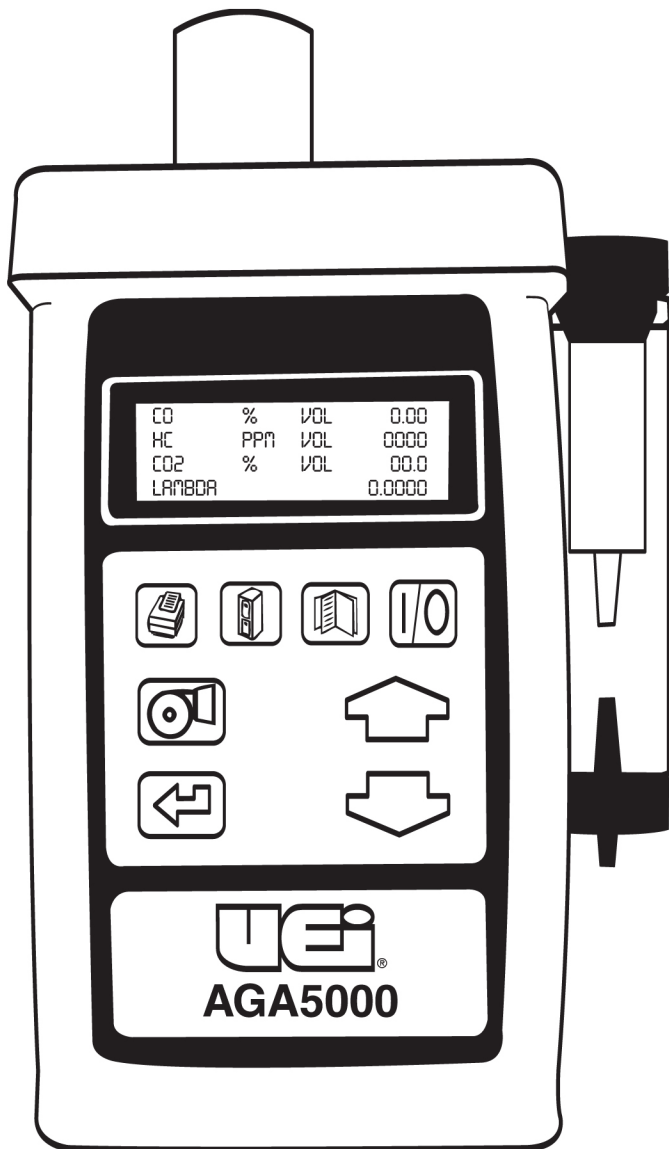




INSTRUCTION MANUAL

Auto 2-2, AUTO 4-2 & AGA5000

Gas Analyzer



1-800-562-7024 • Fax 336-969-2561

www.wagerusa.com

DESCRIPTION

The UEI range of emission analyzers covering the models Auto 2-2, 4-2 and AGA5000 has been designed to be used on petrol, LPG or CNG powered engines*. All models measure carbon monoxide (CO), and unburnt hydrocarbons (HC), with Oxygen (O₂) and carbon dioxide (CO₂) added to four-gas models and nitric oxide (NO) included in five-gas variants. All four-gas analyzers have an upgrade facility for Nitric Oxide (NO).

Using the measured parameters CO, HC, O₂ and CO₂, additional parameters such as Lambda, Air to Fuel ratio and corrected carbon monoxide (COK) can also be calculated and displayed.

All measured and calculated parameters can be printed on the optional infrared printer or saved to the analyzer's memory.

Each analyzer is supplied with an RS232 output enabling communication between the analyzer and a PC. Using the optional auto software kit, live emission data can be displayed, saved directly to the PC or printed to produce high quality test reports. Data stored in the analyzer can also be uploaded, diagnosed graphically and/or converted into spreadsheets for service records.

All models are battery powered to give true portability in the workshop environment. The battery can be charged with the supplied mains adaptor or 12V cable.

** For diesel applications, HC measured in the exhaust gas is indicated in ppm (parts per million) n-hexane.*

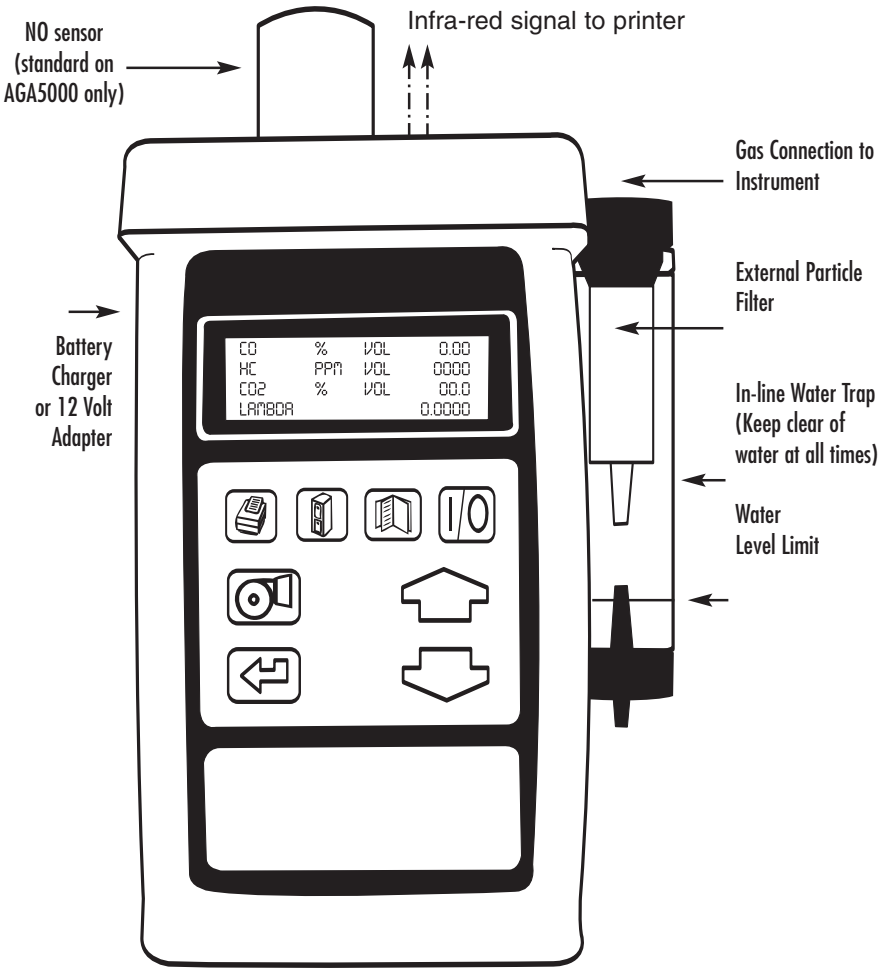
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1. ANALYZER LAYOUT AND FEATURES

1.1 Instrument Features and Keypad



ON/OFF



Scrolls up through options, i.e. Fuel



MENU
Allows access to all menu functions



DOWN
Scrolls down through options



PUMP
Turns pump on and off



STORE
Enters data storage menu



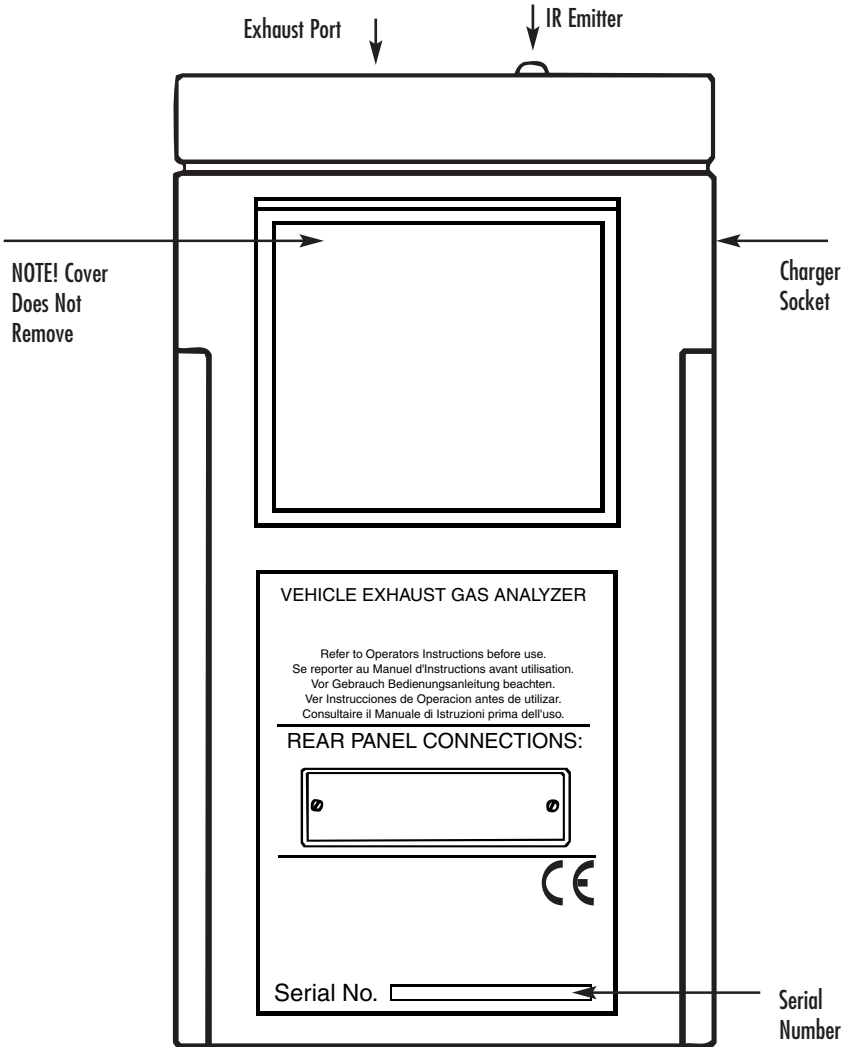
ENTER
Accepts a command,
i.e. enters a menu option
UP



PRINT
Prints current data
Turns on backlight

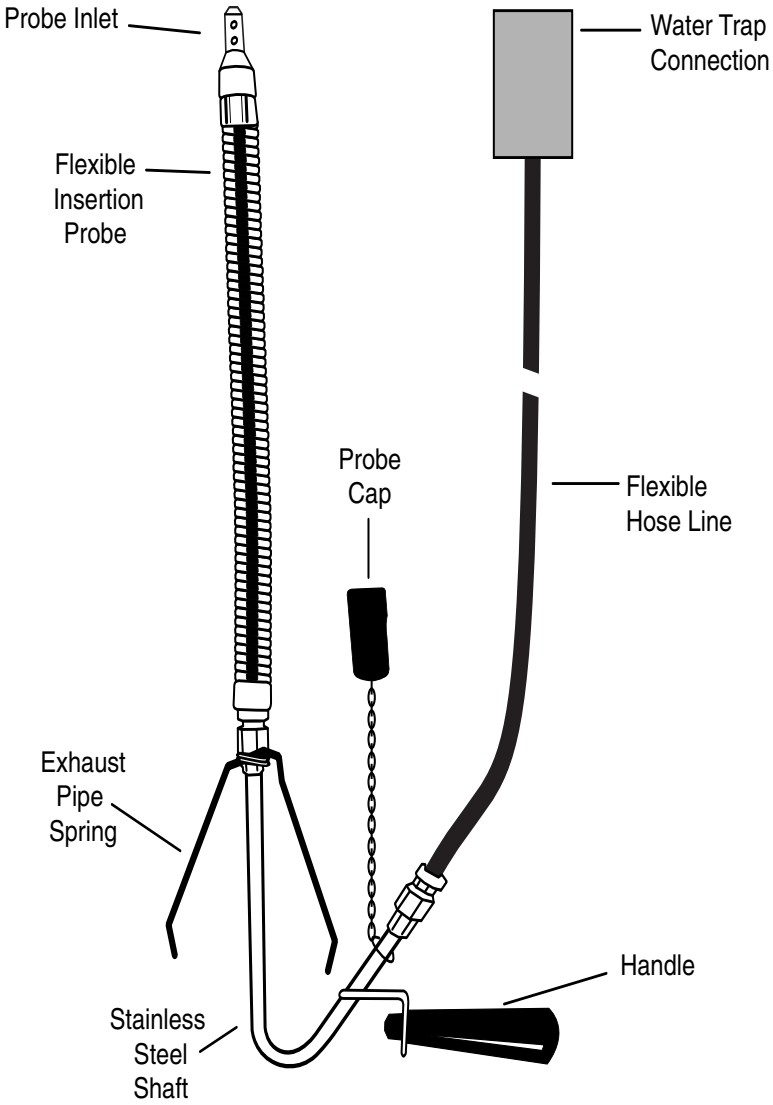
Instrument Layout (Rear)

1.2 Instrument Layout (Rear)



***Note:** DO NOT cover exhaust port as this will severely affect analyzer operation

1.3 Standard Probe Configuration



2. SAFETY WARNING

This analyzer extracts combustion gases that may be toxic in relatively low concentrations. These gases are exhausted from the top of the instrument. This instrument must only be used in well ventilated locations. It must only be used by trained and competent persons after due consideration of all the potential hazards.

Protection Against Electric Shock (in accordance with EN 61010-1: 1993)

This instrument is designated as Class III equipment and should only be connected to SELV circuits. The battery charger is designated as:

Class II equipment

Installation category II

Pollution degree 2

Indoor use only

Altitude to 2000m

Ambient temperature 0°C-45°C

Maximum relative humidity 80% for temperatures up to 31°C decreasing linearly to 50%RH at 45°C

Mains supply fluctuations not to exceed 10% of the nominal voltage.

3. FIRST TIME USE

Charge the battery for 12 hours, following this an overnight charge should be sufficient for an average 8 hour day (turning pump off to save power between tests). See Main Parameter displays for Battery Indicator.

The analyzer has a rechargeable lead acid battery, use only the mains charger or 12 volt adapter supplied or damage may occur to the instrument and battery.

Check that you have all the items you have ordered.

Take time to read this manual fully.

When using the analyzer for the first time you will need to choose from:-

Language selection

Time

Printed header name and telephone number

The Menu Options and Settings (Section 5.2.5) gives details of how to change the above settings.

4. NORMAL START UP SEQUENCE

4.1 Every Time You Use The Analyzer

BEFORE SWITCH-ON CHECK THAT:

- The particle filter is dry and not dirty or damaged
- The water trap and probe line are empty of water
- All hose connections, etc. are properly made
- The probe is sampling CLEAN AMBIENT air
- The water trap is correctly fitted and the instrument upright
- The oil temperature probe is connected if required (Certain analyzers)

*DO NOT RUN ANALYZER WITHOUT WATER TRAP FITTED

Switch ON the instrument by pressing 

4.2 Automatic Zero Calibration

During this sequence the analyzer pumps fresh air into the sensors to allow them to zero and the oxygen sensor to be set to 20.9 %.

After switch-on the analyzer will briefly display header information:



UEI
1-503-644-8723

And then show the initializing screen:



INITIALIZING
TIME: 75
FRESH AIR PURGE

The time will count down in seconds to zero and is pre-set by the instrument. During countdown the instrument will check flow rate and initialize the measuring system, do not block the end of the probe or insert into or near the vehicle exhaust.

Once the initialization time has reached zero an audible beep will be heard and the option to perform a leak test will be given. The following screen will be displayed:



LEAK CHECK?
YES

PRESS ENTER

Press  to select YES and perform a leak test or use  and enter NO to skip.

If YES is selected the following screen will be displayed :

```
LEAK CHECK?
REMOVE EXHAUST PROBE
FIT PROBE SEAL
THEN PRESS ENTER
```

Fit the probe seal as detailed in Section 10.3 and press 

Once the test has PASSED remove the probe seal and press 

If the test fails see Section 10.3.

Once the leak test is completed the instrument will zero the CO, HC and CO2 sensors and set oxygen to 20.9%. Keep the instrument and exhaust probe sampling fresh air.

The instrument will take approximately 75 seconds to set the zero.

```
ZERO CAL
TIME: 75
FRESH AIR PURGE
```

If the readings are outside the allowable zero range as detailed in section 10 it is advisable to perform a manual zero also detailed in section 5.2.2.

A HC residue check may also be requested. See Section 10.2.

The next screen is the **MAIN DISPLAY** of the analyzer:

```
CO    %    VOL    00.00
HC    PPM  VOL    0000
CO2   %    VOL    00.0
O2    %    VOL    20.90
```

Use  to change the display.

```
CO    %    VOL    00.00
HC    PPM  VOL    0000
CO2   %    VOL    00.0
LAMBDA      0.0000
```

All parameters are detailed in Appendix A - MAIN DISPLAY PARAMETERS.

4.3 Main Displays

The main display can be changed to show either 4 or 8 parameters at one time. Two options are available when 4 parameters are selected.

- **Line scroll mode** allows you to customize the display to show the data you require.
- **4 Page Mode** displays 4 lines of data in set format, each page is predefined
- **8 Page Mode** displays 8 parameters on 4 lines in set format, the bottom two can be changed.

Changing between the different modes is detailed in **Display Menu** (Section 5.2.4.)

TIP! To turn the backlight ON in the main display press 

Note: a short press turns the backlight on, a press and hold will print.

To increase battery life do not leave the backlight on.

4.3.1 Line Scroll Mode

Line scroll mode allows you to customize the bottom line of the display. This is the default mode following analyzer turn on.

Use the  key to change the bottom line of the display.

Change bottom line using



CO	%	VOL	00.00
HC	PPM	VOL	0000
CO2	%	VOL	00.0
LAMBDA			0.0000

4.3.2 Page Mode

Use the  key to change the information that is displayed on the screen. The following pages are available, depending on model the sequence of displayed parameters may differ from those in the examples which follow.

GASOLINE			
DATE	.....	07-08-01	
TIME	.....	12:31:35	
BATTERY %	.....	54	

CO	%	VOL	...00.00
HC	PPM	VOL	...0000
CO2	%	VOL	...00.0
O2	%	VOL	...20.90

LAMBDA	.....	0.000
NO PPM	.....	NOT FITTED
TIME TO ZERO	.....	10
OIL	DEG C	.....50

RPM	.....	0000
CO % VOL	.....	00.00
HC PPM VOL	.....	0000
O2 % VOL	.....	20.90

4.3.3 8 Page Mode

Displays 8 parameters on the screen at one time. Symbols used in this mode are different to those used in 4 page and line scroll modes and are detailed in Appendix A - MAIN DISPLAY PARAMETERS.

CO	:00.00	O2	:20.90
HCH	:0000	CO2	:00.0
λ	:0.000	NO	:0000
02-23-01		13:45:22	

The bottom line of the display can be changed to display other parameters.

Use the  keys to change this line.



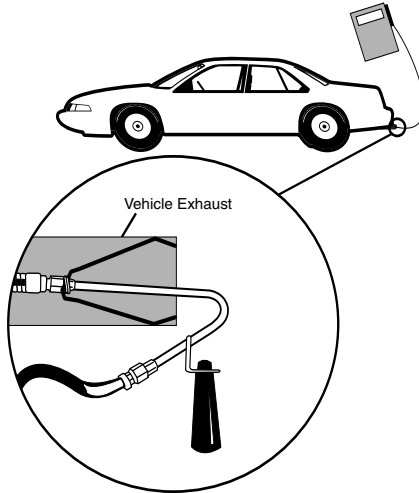
CO	:00.00	O2	:20.90
HCH	:0000	CO2	:00.0
λ	:0.000	NO	:0000
TZ	:30	BAT	:50

CO	:00.00	O2	:20.90
HCH	:0000	CO2	:00.0
λ	:0.000	NO	:0000
FUEL:		GASOLINE	

4.4 Sampling the Exhaust Gas

Once the zero calibration and test procedures have been completed and the fuel has been selected (See Section 5.2.2) the probe can be inserted into the desired vehicle exhaust.

Ensure the probe is inserted into the exhaust pipe so as to not allow air into the probe. The exhaust of a car can pulse, especially at low RPM, drawing air in causing bad readings, ensure the flexible probe is fully inserted and the clip attached to the exhaust pipe.



4.5 Turning the pump ON/OFF

The analyzer is fitted with a pump to draw gas from the vehicle exhaust. To conserve battery power, switch off the pump when you are not taking a measurement. Gas values may drift slightly when the pump is turned off but should return to zero when the pump is turned on again. Manually zero the analyzer if it does not return to zero.

Use the  key to turn ON and OFF the pump.

CERTAIN ANALYZERS ONLY

The analyzer will block readings while the pump is off and display '----' on all gas channels. It will also display PUMP OFF every 30 seconds.

PUMP OFF		
HC	PPM	VOL...----
CO2	%	VOL...----
O2	%	VOL...----

It is recommended that the analyzer samples fresh air for at least 60 seconds before the pump is turned off.

4.6 Taking an oil temperature reading (Certain analyzers only)

Connect the oil temperature probe to the instrument and check it reads ambient temperature. Turn off the vehicle engine. Remove the oil dip stick from the engine and set the depth of the probe to that of the dip stick using the stop. Insert the probe into the engine.

The oil temperature will be displayed :

LAMBDA	0.000
NO PPM	NOT FITTED
TIME TO ZERO .....	.10
OIL DEG C .....	.50

4.7 Reading the engine speed (RPM) (Certain analyzers only)

Connect the induction pickup to one of the spark plug leads ensuring the side indicated by 'SPARK PLUG SIDE' points to the spark plug. Connect the pickup to the instrument ensuring correct polarity, "+" to red and "-" to black. Set 4 cycle/2 cycle or DIS as detailed in section 5.2.2.

RPM	0000
CO % VOL	00.00
HC PPM VOL	0000
O2 % VOL	20.90

NOTE: If the pickup is positioned close to other leads false readings may occur. For some types of ignition system (eg DIS) the probe may need to be fitted "reversed" to produce readings.

4.8 Regular Checks During Sampling

Care must be taken at all times not to exceed the analyzers operating specifications, in particular ensure the following :

- DO NOT PLACE THE INSTRUMENT IN THE ENGINE BAY.
- The analyzer is not exposed to temperatures outside its normal operating range.
- DO NOT PLACE THE INSTRUMENT ON A HOT SURFACE.
- Liquid in the water trap does not go over the level indicator. Note! The indicator only works while the trap is vertical. Water condenses in the probe line and can quickly fill the water trap when the probe is moved. **Take care**, watch the water trap closely and empty any water when it is noticed.
- The in-line particle filter is clean and does not become blocked. If this filter is allowed to become dirty then damage may occur inside the analyzer.
- Do not start up or zero the unit in an area exposed to exhaust gas emissions.

4.8.1 Low Flow

During sampling or at any time the pump is running the screen may display LOW FLOW. This is an indication of the following:

- The particle filter needs replacing (a visual check is also necessary)
- Probe or tubing is blocked.
- Internal filters are blocked (Contact service agent)

WARNING! Under severe conditions of low flow the PUMP will stop and an audible tone will be heard. The following screen shows the action to be taken:

LOW FLOW
EMPTY WATER TRAP
CLEAR HOSE AND PROBE
THEN PRESS ENTER

Check the following for water:-


- Probe line, water trap and particle filter

When the blockage is cleared the instrument should resume normal operation. If it is not possible to clear the problem then internal damage may have occurred and the unit should be returned to a service center.

4.9 Normal Shutdown Sequence

DO THIS EVERY TIME YOU USE THE ANALYZER

Remove the probe from the vehicle exhaust - TAKE CARE ! THE PROBE WILL BE HOT - and allow it to cool naturally. Do not immerse the probe in water as this will be drawn into the analyzer and damage the pump and sensors.

Once the probe is removed from the exhaust allow the readings to return to zero and press  the analyzer will count down from 30 to switch off.

OFF 30
MENU TO ESCAPE

If you have not finished but press  by mistake, you can press  to return to normal operation and not switch OFF.

5. MOVING THROUGH THE MENUS

5.1 Basic Operation

From the MAIN DISPLAY

CO	%	VOL	...	00.00
HC	PPM	VOL	...	0000
CO2	%	VOL	...	00.00
O2	%	VOL	...	20.90

Press  to access the MAIN MENU

MAIN MENU			
1	SELECT	3.	DISPLAY
2.	UNITS	4.	SETUP

Press  and  to move cursor up and down

MAIN MENU			
1.	SELECT	3.	DISPLAY
2.	UNITS	4.	SETUP

Press  to access selected Menu

MAIN MENU			
1	SELECT	3.	DISPLAY
2.	UNITS	4.	SETUP

Press  to access selected Menu

SET	:	ZERO
FUEL	:	GASOLINE
RPM	:	4 CYCLE
CAL	:	CHECK

Press  and  to move cursor up and down

SET	:	ZERO
FUEL	:	GASOLINE
RPM	:	4 CYCLE
CAL	:	CHECK

Press  to enter value and move to next parameter

SET	:	ZERO
FUEL	:	GASOLINE
RPM	:	4 CYCLE
CAL	:	CHECK

Press  to save settings and return to the MAIN MENU

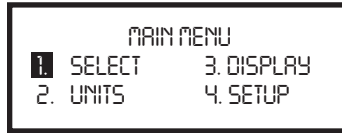
MAIN MENU			
1	SELECT	3.	DISPLAY
2.	UNITS	4.	SETUP

Press  to return to the MAIN DISPLAY

5.2 Menu Options and Settings

5.2.1 Main Menu

The MAIN MENU consists of 4 sub menus which are shown below and detailed on the following pages.

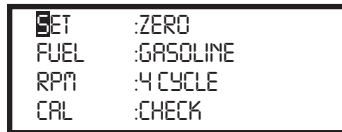


All sub-menus are accessed using  and exited using .

The  and  keys move the cursor within a menu and allow parameters to be changed.

TIP Holding down one of these keys scrolls through the data quicker.

5.2.2 Select Menu



This menu allows selections to be made for the parameters detailed below.

SET:	Allows manual activation of zero setting, HC residue and leak checking functions. More details on these functions can be found in Section 10 - Zero checks and re-calibration	OPTIONS ZERO HC RESIDUE LEAK CHECK
FUEL:	Select the fuel the vehicle is using from a standard fuel stored in the analyzer. Select from:	GASOLINE LPG CNG
RPM:	To allow the analyzer to determine the correct revolutions per minute of the engine it must know if it is a 2 or 4 stroke (use 2 stroke for DIS systems) when using the inductive clamp. Select the number of cylinders if connecting to the low tension side of the coil. Eg. /12 (test leads are optional)	2 STROKE 4 STROKE /12,/8,/6,/5, /4,/3,/2

CAL: Allows the user to check the calibration of the analyzer using precision calibration test gases. It is recommended this is done every 3 months. Test gas is available from your service centre. The following can be performed in this menu:

- Set the calibration test GAS VALUE in the analyzer.
- CHECK the calibration accuracy against the test gas.
- RESET calibration values to factory settings.

Use the  or  to select from the following functions. Press  to select.

**GAS VALUE
CHECK
RESET**

Details for performing the above functions can be found in Section

10.4 – Gas calibration verification.

5.2.3 Units Menu

DATA	:1123 ABC
TEMP	:C
EFF	:LAMBDA
PEF	:0.512

Allows the vehicle registration number to be changed and all displayed units to be changed.

Vehicle Registration Data

DATA	:1123 ABC
TEMP	:C
EFF	:LAMBDA
PEF	:0.512

Allows the vehicle registration number to be entered. The format for the data is 8 characters alphanumeric as follows:

1234567890;.<>?@ABCDEFGHIJKLMNPNRSTUVWXYZ/space/

The cursor **I** indicates this character can be changed. Select the correct character from the list using  and  press  when correct.

Repeat until all the vehicle registration is correct .

TEMP: Choose selections from Centigrade °C or Fahrenheit °F. (Certain analyzers only)

EFF: Changes the calculation used in the Lambda calculation. Change from **LAMBDA** to **AFR**. Formulas used in the analyzer are detailed in appendix B.

PEF: Propane equivalence factor or n-hexane to propane ratio as set in the instrument. This is not a user variable parameter but is displayed for reference.

5.2.4 Display Menu

LIGHT	:OFF
MODE	:8-PAGE
CONTRAST	:DEFAULT
LANGUAGE	:ENGLISH



Allows the configuration of the display to be changed.

LIGHT: Turns the backlight ON or OFF.

ON
OFF

MODE: Select 4 or 8 Page Mode or Line Scroll Mode as detailed in section 4.3 Main Displays.

4 PAGE
8 PAGE
LINE

CONTRAST: The contrast is set to a DEFAULT value or can be adjusted ↑ LIGHTER or ↓ DARKER. Use the  or  key to adjust. Note the display may jump from dark to clear.

LANGUAGE: Changes the analyzers displayed and printed language.

ENGLISH
SPANISH
DUTCH
FRENCH
ITALIAN
GERMAN

5.2.5 Set-Up Menu

The set up menu allows the following parameters to be set / altered.

- Format of the date.
- Time
- Printout Header

FORMAT	:00-00-YY
DATE	:02-03-99
TIME	:09-10-31
HEADER	:NO

FORMAT:

Changes the date format set on the analyzer. Contact your service center if this is incorrect.

DD-MM-YY
MM-DD-YY
YY-MM-DD

DATE:

Allows the user to change the date. Change each number of the day, month and year until correct.

Change each number using
↑ and ↩

TIME:

Allows the user to change the time. Change each number of the hours and minutes until correct, the seconds will reset to zero automatically.

Change each number using
↑ and ↩

HEADER:

Allows two lines of 20 characters to be programmed into the analyzer. The header appears on the top of the standard printout. This can be used to print your company name and/or phone number.

NAME/PHONE
UEI
1-503-644-8723
'LEFT' USE STORE KEY

The screen above shows the standard header setting with the cursor now shown underlining the U in UEI. By using ↓ and ↑ any letter or number can be chosen.

Once the correct character is displayed, use ↩ to move right to the next. Move along until all characters spell the desired name or phone number. If you need to go back and change a character use ⏪ to move left.

Press ⏩ to return to the SET UP menu.


6. PRINTING INFORMATION - OPTIONAL EXTRA ONLY

Supplied as an accessory for the analyzer is an infra-red thermal printer. Read the manual supplied with the printer prior to operation. Connections to the analyzer are detailed below:

- **Infrared thermal printer** - this does not require a cable to transmit the data but uses an infra-red (IR) link similar to a TV remote control. The IR emitter is positioned on the top of the Analyzer and the bottom of the printer. Ensure they are pointing at each other and within 300 mm, with no obstructions in the way. Data may be lost if transmission is interrupted, a black square is evidence of this. Keep the Analyzer pointing at the printer until the printout has finished.

Data can either be printed from a 'live' test or from stored data. Printing of stored data is detailed in STORING AND RETRIEVING DATA.

6.1 Printing a Live Test

During a vehicle test the Analyzer will print data on request. With the analyzer showing the MAIN DISPLAY press  and hold until the second beep. Current data will be sent to the printer. If the print button is held until the third beep, the test results will be printed in duplicate (from software version 4.6).

The display will show the following until data transmission is complete.

6.2 Standard Printout

The standard printout is shown below :

```
*****PRINTING*****
```

```

                UEI
                1-503-644-8723

VEHICLE:        T123 ABC
FUEL:           GASOLINE

DATE: 17-03-99
TIME: 09-10-31

CO % VOL . . .   3.5
HC PPM VOL . . . 1234
CO2 % VOL . . .  14
O2 % VOL . . .   2.1

LAMBDA . . .     1.010
NOX PPM VOL . . . N/F
```

7. STORING AND RETRIEVING DATA

The Analyzer can store up to 255 emissions tests. Once stored, the data can be viewed on the display or downloaded to a printer.

7.1 Storing a Live Test

While performing a test and viewing the data on the MAIN display access the STORE menu as follows:

```
STORE MENU
MODE       : STORE
TEST      : 3
PRESS 'STORE' TO LOG
```

Mode: Select from the following:

- **STORE** - Allows data to be stored in memory.
- **VIEW / PRINT** - Stored data can be viewed or printed.
- **DELETE** - Clears all data in memory.
- **AUTO STORE** – Automatically stores data at a preset interval.

Location: Automatically allocates a location in the memory of the instrument for the next test. On the display shown above the next location will be 3.

To store a test, set MODE to STORE and press . The current readings will be stored in the analyzers memory.



NOTE: The analyzer will stop logging once it has reached 255 readings and will return to the main display if the store key is pressed. Data can still be viewed and printed.

TIP: Make a note of the location number for your particular test as it may be useful when printing.

7.2 Viewing and Printing a Stored Test

Press 
to access the STORE MENU

```
STORE MENU
MODE       : VIEW/PRINT
TEST      : 001 TO 010
PRESS 'ENTER' TO VIEW
```

Move the cursor to Location and press . The cursor will move to the first digit of the first number, use  to select the correct digit and enter when correct. Repeat on the second digit until the location to view from is correct.

Press  to move the cursor to the second number, select the last location to view using the same procedure.

To view the stored data press:

TEST	...	1
VEHICLE		T123 ABC
DATE	...	07-08-96
TIME	...	12:31:35

Use  and  to page through data as in MAIN DISPLAYS.

TEST	...	1
FUEL		
GASOLINE		
CO	% VOL ...	00.00
HC	PPM VOL H ...	0000

TEST	...	1
O2	% VOL ...	20.90
CO2	% VOL ...	00.0
LAMBDA	...	0.000

TEST	...	1
AFR	...	00.00
NO		PPM NOT FITTED

Press  to advance to the next test.

TEST	...	2
VEHICLE		P456 DEF
DATE	...	07-08-96
TIME	...	13:31:10

Press  to go back to the previous test. Press  to return to the MAIN MENU.

A printout of the test being displayed can be obtained by pressing .


TIP: Stored and displayed with the data are actual time and date of the test.

7.3 Deleting Data

To delete the data in stored memory press  to obtain the STORE MENU (as above)

Press  to access the STORE MENU

```
STORE MENU
MODE      : 0 DELETE
TEST      : 3
PRESS 'ENTER' TO DELETE
```

Press  to access delete data screen

```
ENTER TO ERASE DATA
MENU TO ESCAPE
```

Press  to delete data in memory, press  to exit delete data screen.

WARNING! ALL DATA WILL BE REMOVED

Ensure you have printed the data you require before clearing the memory.

7.4 Auto Store

```
STORE MENU
MODE       : AUTO STORE
TEST      : 10 S
PRESS 'ENTER'
```

Press  to enter Auto Store Mode.

```
STORE MENU
MODE       : AUTO STORE
TEST      : 10 S
PRESS 'ENTER'
```

Press  or  to change the interval between Auto Stores (interval can be set between 10 and 99 secs).

Press  to initiate Auto Store sequence.

During the Auto Store sequence the store number appears on the top line of the display, accompanied by a double beep.

To disable Auto Zero store mode:

Press  .

```
STORE MENU
MODE       : STORE
TEST      :
PRESS 'ENTER' TO LOG
```

Then press  .

Press  to escape.

8. MAINTENANCE

8.1 Emptying and Cleaning the In-Line Water Trap

While performing a test and viewing the data on the MAIN display access the STORE menu as follows:
The in-line water trap should be checked and emptied on a regular basis. Water vapor will condense and gather in the probe line. This may move suddenly to the trap when the probe is moved. Care should be taken at all times.

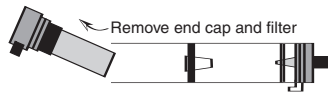
Emptying of the water trap is detailed below:



Carefully remove the end cap from the in-line housing. Dispose of the condensate in a suitable drain. Clean the inside of the water trap using a soft cloth

8.2 Changing the Particle Filter

This is a very important part of the analyzer and should be changed regularly. It prevents dust and dirty particles entering the pump and sensors and hence causing damage. The filter **MUST** be changed when it is discolored or if LOW FLOW is indicated and no obvious fault can be found.



Remove the end cap from the in-line filter housing. Carefully remove the paper filter element and dispose of it. Clean the inside of the filter housing with a suitable soft cloth. Insert a new filter element onto the spigot in the filter housing and carefully replace the end cap.

IF THE FILTER IS NOT CHANGED REGULARLY DAMAGE WILL OCCUR TO THE SENSORS RESULTING IN A CHARGEABLE SERVICE. IT IS EVIDENT FROM AN INTERNAL INSPECTION OF THE INSTRUMENT IF THE FILTER HAS BEEN CHANGED REGULARLY.

9. PROBLEM SOLVING

The following is a list of problems that may occur on the instrument through its operating life. If the cause of the fault is not easy to identify then we advise you contact UEI International Technical Support or an International Distributor for expert advice.

Fault symptom	Causes
<ul style="list-style-type: none"> • Oxygen too high 	<ul style="list-style-type: none"> • Air leaking into probe, tubing, water trap, connector or internal to instrument. • Oxygen cell needs replacing.
<ul style="list-style-type: none"> • Oxygen Error (FAULT) • Infrared gas Error (FAULT) 	<ul style="list-style-type: none"> • Zero calibration fault • Instrument has been stored in a cold environment and is not at normal working temperature. • Oxygen cell or infrared bench needs replacing.
<ul style="list-style-type: none"> • Analyzer not holding charge • Analyzer not charging 	<ul style="list-style-type: none"> • Battery exhausted. • Charger not giving correct output. • Fuse blown in charger plug.
<ul style="list-style-type: none"> • Analyzer does not respond to exhaust gas 	<ul style="list-style-type: none"> • Particle filter blocked. • Probe or tubing blocked. • Pump not working or damaged with contaminant's.
<ul style="list-style-type: none"> • Oil temperature readings erratic 	<ul style="list-style-type: none"> • Temperature plug reversed in socket. • Faulty connection or break in cable or plug.
<ul style="list-style-type: none"> • Analyzer automatically switches off in operation 	<ul style="list-style-type: none"> • Battery below alarm level. • Ambient temperature above 50°C. • Battery quickly discharging and is faulty.

INTERNAL FILTER

To protect the analyzer from water ingress a filter is installed inside the casing to protect the infrared measuring system. This filter will block if care is not taken during sampling:

- Ensure any build-up of water in the probe line and water trap are removed as soon as possible.
- The external particle filter is changed regularly.
- The instrument is allowed to sample fresh air on a regular basis.
- The instrument samples fresh air for 3 minutes before switch off.
- Do not blow smoke from a cigarette into the instrument, the tar will clog the filter and the unit will need to be sent in for service.

If you suspect the internal filter is blocked perform the following:

- Remove the probe connection from the water trap.
- Empty and clean the water trap with a dry cloth.
- Fit a new external particle filter.
- Run the instrument in fresh air (pump ON) for at least one hour.

If the problem does not clear contact a service agent.

10. ZERO CHECKS AND RE-CALIBRATION

During normal operation of the analyzer the following checks may be requested as required:

- Zero setting of all sensors (can also be selected manually)
- HC residue check (automatic) Certain analyzers only.
- Leak test
- Calibration check.
- Re-calibration.


10.1 Zero Setting

The zero setting function sets the working sensors to zero using fresh air. This function is activated as follows:

- Following analyzer switch ON.
- On a timed basis. Following the analyzer first being turned ON a zero will requested automatically at 7, 15 and then 30 minute intervals. Subsequent requests will be every 30 minutes.
- On request by the user from the SELECT MENU

The zero sequence is as follows, ensure the on screen commands are followed or the analyzer may not zero correctly.

ZERO CHECK
REMOVE PROBE
FROM EXHAUST
THEN PRESS ENTER

Ensure the probe is removed from the vehicle exhaust and is sampling fresh air, in the garage environment this should be 45 meters or 18 inches above the ground. Once this is done press  to activate the pump.

WARNING! The sensors will only be reset if the probe is sampling fresh air for at least 60 seconds.

Once the zero is complete the screen will return to the MAIN DISPLAY.


If the analyzer fails to zero it may request a HC residue check. (Certain analyzers only)

10.2 HC residue check (Certain analyzers only)

Hydrocarbon is a very 'sticky' gas and can cling to tubing in the analyzer or probe. If HC % vol reading does not go below 20 ppm when in fresh air following a test then a residue check will be requested. Repeat tests will be carried out until the reading is below 20 ppm.

The HC residue check procedure is as follows:

HC RESIDUE CHECK
REMOVE EXHAUST PROBE
FIT CARBON FILTER
THEN PRESS ENTER

As instructed remove the probe from the exhaust and detach the water trap and particle filter housing from the instrument. Fit the carbon filter element in place of the water trap housing, press  when in place.

NOTE! The analyzer will not continue with the test if it does not detect the carbon filter element is in place. Use of the analyzer is prohibited if the filter is not used and a successful HC residue check not completed.

During this check it is advisable to perform the following maintenance:

- Change the particle filter and clean the inside of the housing.
- Clear the probe line using a compressed air line. Note! This must only be done with the probe removed from both analyzer and vehicle.

If the analyzer cannot detect a reduction in the HC level to within preset limits then it will try again from the screen shown above. If the analyzer continues to fail the test contact your service agent for advice.

If the HC residue check is successful the following screen will be displayed.

HC RESIDUE CHECK
PASSED
REMOVE CARBON FILTER
THEN PRESS ENTER

Once the check is complete the screen will return to the **MAIN DISPLAY**. Remove the carbon filter element and store in the instrument case. Reconnect the water trap housing and probe.

10.3 Leak Check

To ensure the gas sampling system is sealed correctly and not letting in air, the analyzer will perform a leak check. This requires the user to block the probe inlet and perform the test. This check is done every time the analyzer is switched on or as requested by the user. It is also advisable to perform a leak check if the water trap is removed and replaced i.e. for particle filter renewal.

When YES is selected, the leak check procedure is as follows:

LEAK CHECK
REMOVE EXHAUST PROBE
FIT PROBE SEAL
THEN PRESS ENTER

CAUTION! When fitting the SEAL ensure the exhaust probe has been removed from the vehicle for some time and is cool.

Press  when the seal is in place. The check will take a few seconds. Following a successful test the analyzer will return to the MAIN DISPLAY.

LEAK CHECK
PASSED
REMOVE PROBE SEAL
THEN PRESS ENTER

If a leak is detected in the gas system the test will fail.

LEAK CHECK
FAILED
CHECK PROBE & SEAL
THEN PRESS ENTER

Check for the following:

- The seal is correctly positioned over the holes in the end of the probe.
- There are not apparent cracks in the probe or tube.
- The water trap housing is not cracked and the ends are in place.
- All O-rings on the probe connections are in good condition and in place.
- There is no physical damage to the analyzer case.
- The water trap fitting on the analyzer is in good condition.

Once the above has been checked press  to perform the leak test again.

If the analyzer continues to fail, contact your service center.


10.4 Gas Calibration Verification

This section details using precision calibration gases to check the analyzer settings. It does not replace an annual calibration and service by an authorized agent.


Access to the calibration functions are found in menu **1. SELECT**, sub menu **CAL**.

10.4.1 Calibration Gas Values

FUEL	: GASOLINE
RPM	: 4 STROKE
ZERO	: NO
CAL	: GAS VALUE

To allow the analyzer to check its calibration it must know the values of calibration gas contained in the bottle. Select GAS VALUE in the menu shown above. Pressing  will access the following screen:

GAS VALUE	
CO : 3.50	CO2 : 14.0
HC : 2000	NOX : 1000
'LEFT' USE STORE KEY	

Enter the gas values as shown on the calibration gas bottle. Note CO and CO2 are expressed in percentage %, HC is ppm propane and NOx in ppm. Setting each number is as detailed Set Up Menu (Section 5.2.9). Once the values are correct press the  key to save the data and exit.

Note! If you do not have a NOx sensor fitted to your analyzer then you will not need to enter a gas value. N/F will be displayed.

HC - HydroCarbon readings

During the calibration routine HC readings will be expressed as n-hexane even though the gas bottle will contain propane. It is important to understand that when entering the HC gas value into the analyzer the value on the calibration gas bottle is entered. In our example 2000 ppm propane.


When performing a calibration reading or check the analyzer will automatically convert the readings using the PEF and express them as n-hexane.

Using the PEF detailed on page 15 of this manual the analyzer would display:

$$\begin{aligned}\text{HC displayed reading (n-hexane)} &= 2000 \text{ ppm} \times \text{PEF} \\ &= 2000 \times 0.512 = 1024 \text{ ppm}\end{aligned}$$

10.4.2 Calibration Check

FUEL	: GASOLINE
RPM	: 4 STROKE
ZERO	: NO
CAL	: GAS VALUE

You should perform a calibration check when ever you suspect an error or at a minimum of 450 hours. Select CHECK from the screen above and press 

The instrument will request a ZERO CHECK, see Section 10.1, once complete, proceed as follows:

CALIBRATION CHECK
CONNECT CAL GAS
THEN PRESS ENTER

WARNING! Use calibration gas in well ventilated areas. Fumes may cause nausea and headaches.

Connect the calibration gas to the water trap connection on the analyzer using the hose provided.

Important: To prevent damage to the analyzer, be sure to use the pressure regulator between the analyzer and the gas bottle. Read the instructions supplied with the calibration gas carefully.

Open the gas valve on the calibration bottle. The following screen will display the change in gas values as the analyzer detects the calibration gas.

CALIBRATION CHECK	
CO : 3.50	CO2 : 14.0
HC : 2000	NOX : 1000
CONNECT GAS 30	

The instrument will automatically perform a gas check within 60 seconds. The number 30 will countdown to give an indication of calibration status. Messages on the screen as follows:

- **CONNECT GAS** when the analyzer is waiting for calibration gas to be applied.
- **NO GAS DETECTED** will be displayed after 30 seconds if the instrument does not see changes in the gas values. Check the gas valve has been opened, the fittings are secure and that there is sufficient pressure in the bottle. Fails test and returns to main screen.
- **DETECTING GAS** when the analyzer has started to read calibration gas and is stabilizing – normally within about 5-10 seconds.
- **GAS UNSTABLE** message is displayed after the instrument has detected gas for 30 seconds but readings fluctuate. Fails test and returns to main screen.

Once the analyzer has detected a stable gas supply it will check that all the gas readings are within the allowable deviation from the factory calibration. If the readings are within these limits it will proceed to the next section **10.4.3 User Re-calibration**.

Note! Disconnect gas at this time.

If the analyzer falls outside these limits it is in need of repair and should be returned to an approved service agent. The following screen will be displayed.

```
FAILED FACTORY
CALIBRATION CHECK
UNIT MAY NEED REPAIR
PRINT REPORT  NO
```

The analyzer checks all measured gases and if one or more fail it will indicate a fault. An option to print a calibration report is given at this time.

10.4.3 User Re-calibration

Following a successful calibration check you will be informed of the following:

Gas calibration is within specification.

```
DISCONNECT GAS
CALIBRATION VERIFIED

PRINT REPORT  NO
```

A printed report can be obtained.

Gas calibration is outside specification and need adjustment.

```
DISCONNECT GAS
CALIBRATION ADVISED

PRINT REPORT  NO
```

Following both options detailed above you will be allowed to reset the analyzer calibration constants:

```
CALIBRATE:  NO
```

Selecting NO keeps the last calibration and returns to the main menu. To alter the calibration constants select YES to access the following screen.

```
ENTER SERVICE CODE
  0 0 0
```

Before the new calibration can be accepted an authorization code is required.
Enter each number of the code 5128.

ENTER SERVICE CODE
5128

Once the last digit has been entered the analyzer will store the new settings into its memory, this may take a few seconds and you will be asked to PLEASE WAIT. Once the memory settings have been checked the analyzer will display:

CALIBRATION RESET
PRINT REPORT NO

Select to either run a final calibration report or not before returning to the main menu.

If in any doubt about the calibration of the analyzer contact a service centre.

10.4.4 Printed Calibration Report

During all stages of the calibration routine you will be asked if you would like to print a calibration report. See section 6.1 for details on printing.

The calibration report is shown below

UEi Calibration Report	
Version	2.4
Date:	07-08-01
Time:	09:10:31
Max:	14.7
CO2 % vol:	13.6
Min:	13.3
Max:	3.68
CO % vol:	3.63
Min:	3.32
HC CAL Gas:	2000
PEF:	0.512
Max:	1075
CO2 % vol:	1024
Min:	973
Max:	1050
CO2 % vol:	1006
Min:	950
AMB deg:	24.4
PRS mbar:	1068

Information contained on the calibration report is as follows:

- **VERSION:** Analyzer software version
- **CO, CO2, HC, O2, NO:** Gas readings as measured during check.
- **MAX / MIN:** Upper and lower limits at which calibration check fails and re-calibration is advised.
- **AMB deg:** Ambient temperature reading during calibration
- **PRS mbar:** Ambient Pressure reading during calibration

If the gas reading does not fall between the MAX and MIN limits then the analyzer has failed a calibration check.

AMB and PRS can be used when discussing problems with a service agent.

10.4.5 Reset Instrument Calibration

This feature allows the analyzer to be reset to the factory setting if an error occurs during a user calibration. This may occur, for example, if the calibration gas bottle runs out during calibration or the instrument stores the values incorrectly. Note this routine should only be used if a calibration failure is suspected.

FUEL	: GASOLINE
RPM	: 4 STROKE
ZERO	: NO
CAL	: RESET

Select RESET from the screen above and press 

CALIBRATION RESET
ENTER SERVICE CODE
0 0 0

To reset the calibration values to those originally set in the factory or at the last analyzer service the correct code needs to be entered.

DO NOT ENTER THIS CODE UNLESS YOU SUSPECT THE ANALYZER CALIBRATION SETTINGS HAVE BEEN LOST OR CORRUPTED.

FACTORY CALIBRATION RESET CODE: 7378

CALIBRATION RESET
ENTER SERVICE CODE
7 3 7 8

Enter each digit of the code as explained in Set Up Menu (Section 5.2.5). Once the last digit has been entered the factory settings will be restored and the analyzer will return to the main display. A calibration check should now be performed.

If the wrong code is entered the analyzer will exit to the previous menu without restoring the factory settings.

11. PRODUCT SPECIFICATION FOR AUTO2-2

Parameter	Resolution	Accuracy	Range
Carbon Monoxide (CO)(Infrared - NDIR)	0.01 %	+/- 10 % of reading ⁻¹ +/- 0.2 % volume ⁻¹	0-10 % Over-range 20 %
Hydrocarbon (HC - hexane)(NDIR)	1 ppm	+/- 10 % of reading ⁻¹ +/- 30 ppm volume ⁻¹	0-5000 ppm Over-range: 10,000 ppm
CO & HC		OIML R99 Class 2	
Oil Temperature	0.1 °C/F	±2.0°C ±0.3% or reading ±3.6°F ±0.3% of reading	0-150°C 32-302°F
RPM	1 rpm	50 rpm	200-6,000 rpm. 2 or 4 stroke engines. Inductive clamp or low tension connections.
Additional features		Specifications	
Sensor response T ₉₅		Nominal response time of 20 seconds	
Warm up		Less than 3 minutes	
Pre-programmed Fuels		Gasoline, LPG and CNG	
Data-Logging		255 Snap Shots	
PC Connections		Via RS 232 port	
Dimensions			
Weight		1Kg	
Handset		220mm x 55mm x 120mm	
Probe		Insertion depth 350mm x Diameter 15mm Clip handle to secure to exhaust, 4m long hose Various probes available including high temperature	
Ambient Operating Range		+5°C to 45°C/10% to 90% RH non condensing	
Storage temperature		Minimum: 0°C Maximum: +50°C	
Battery Charger		Input: 110 Vac/230 Vac nominal Output: 10 Vac off load	
Analyzer battery run time		>4 hours from full charge with the pump running	

⁻¹ Using dry gases at STP

To obtain the quoted specification an instrument should be calibrated with clean ambient air (normally outside the workshop) at standard temperature and pressure (STP).

Note: The analyzer is not for use with a Dynamometer, unless the high temperature probe is fitted.
NDIR means by non-dispersive infrared principle.

PRODUCT SPECIFICATION FOR HANDHELD AUTO4-2 AND AGA5000

Parameter	Resolution	Accuracy	Range
Carbon Monoxide (Infrared)	0.01 %	+/- 5 % of reading ¹ +/- 0.5 % volume ¹	0-10 % Over-range: 20 %
Oxygen (fuel cell)	0.01%	+/- 5 % of reading ¹ +/- 0.1 % of reading ¹	0-21% Over-range: 48%
Hydrocarbon (Infrared)	1 ppm	+/- 5 % of reading ¹ +/- 12 ppm volume ¹	0-5000 ppm Over-range: 10,000 ppm
Carbon Dioxide (Infrared)	0.1%	+/- 5% of reading ¹ +/- 0.5% ppm volume ¹	0-16% Over-range: 25%
Nitric Oxide* ₂ (fuel cell)	1 ppm	0-4000 ppm +/-4% or 25 ppm; 4000-5000 ppm +/-5%	0-5000 ppm
Oil Temperature	1.0°C/F	±2.0°C ±0.3% of reading ±3.6°F ±0.3% of reading	0-150°C 32-302°F
RPM	1 rpm	50 rpm	200-6,000 rpm
Carbon Monoxide Corrected CO	0.01%	Calculated	0-15%
Lambda	0.001		0.8 - 1.2
AFR (Gasoline)	00.01		11.76 - 17.64
(LPG)	00.01		12.48 - 18.72
Sensor response T ₉₅		Nominal 20 seconds Auto4-2 and AGA5000	
Warm Up		Less than 3 minutes	
Pre-programmed Fuels		Gasoline, LPG and CNG	
PC connection		Via RS 232 port	
Data-Logging		255 Tests	
Dimensions			
Weight		1kg	
Handset		220mm x 55mm x 120mm	
Probe		Insertion depth 35mm x Diameter 15mm Clip handle to secure to exhaust, 4m long hose Various probes available including high temperature	
Ambient Operating Range		+5°C to +45°C/10% to 90% RH non condensing	
Storage temperature		Minimum: 0°C Maximum: +50°C	
Battery Charger		Input: 110 Vac/230 Vac nominal Output: 10 Vac off load	
Analyzer battery run time		>4 hours form full charge with the pump running	

¹ Using dry gases at STP

* Standard on models AGA5000 only

To obtain the quoted specification an instrument should be calibrated with clean ambient air (normally outside the workshop) at standard temperature and pressure (STP).

Note: The analyzer is not for use with a Dynamometer, unless the high temperature probe is fitted.

APPENDICES

A - Main Display Parameters

The parameters and their meanings are detailed as follows:

FUEL: The selected fuel will be displayed, i.e. GASOLINE. See **Select menu** section 5.2.2 to change.

- GASOLINE – Leaded or Unleaded gasoline/gasoline.
- LPG – Liquid Petroleum Gas
- CNG – Compressed Natural Gas

DATE: Analyzer date. See **Set-Up menu** section 5.2.5 to change.

TIME: Analyzer time. Use **Set-Up menu** section 5.2.5 to change.

BATTERY: Displays the battery level from 0-100%. The analyzer will flash
(BAT) RECHARGE BATTERY at less than 10 % of charge. With the charger connected the display shows **AC ON**.

NOTE! Allowing the battery to discharge fully may destroy it.

O2: Oxygen measured in the exhaust gas indicated in percentage %. With the pump off the analyzer will display - - - -. If there is a fault with the oxygen sensor then **FLT** will be displayed.

CO: Carbon monoxide measured in the exhaust gas indicated in percentage %. With the pump off the analyzer will display - - - -. If there is a fault with the CO reading then **FLT** will be displayed.

CO2: Carbon dioxide measured in the exhaust gas in percentage %. With the pump off the analyzer will display - - - -. If there is a fault with the CO2 reading then **FLT** will be displayed.

HC: Hydrocarbons measured in the exhaust gas indicated in ppm (parts per million) n-hexane (gasoline). With the pump off the analyzer will display - - - -. If there is a fault with the HC reading then **FLT** will be displayed.

COK: Generally known as corrected CO. This value is calculated and used for comparison with the actual infra-red measured CO value. $COK = (CO \times 15) / (CO + CO_2)$, for normal car exhaust CO + CO₂ = about 15%. In this case CO is approximately equal to COK. If COK is clearly higher than CO this indicates defects such as exhaust leaks. At near zero COK is not valid.

OIL: Oil temperature as measured by the dip stick probe. Displays in either °C (deg C) or °F (deg F) and will display N/F if the probe is not connected.

RPM: Revolutions per minute of the engine as detected by the induction pickup clamp. This probe is plugged into the two connector on the bottom of the instrument case, ensure correct polarity. NOT FITTED (N/F) will be displayed if the probe is not connected.

LAMBDA: The value of Lambda gives an indication of the burning efficiency of the engine. This can be replaced with the Air Fuel Ratio (AFR) below. See Units Menu (Section 5.2.3) to change between displays. Appendix B gives the formula used.

When sampling fresh air and lambda is outside operation range this indication will show '-----'.

AFR: Air Fuel Ratio is another method for displaying the efficiency of an engine. The calculation for the AFR is Lambda multiplied by 14.7 for Gasoline and 15.6 for LPG (typically). When sampling fresh air this indication will show '-----'.

NO: Nitric oxide reading in ppm (parts per millions) of the exhaust gas. Displayed when Nitric oxide sensor fitted, indicated on the rear label. Displays NOT FITTED or N/F when sensor not fitted and FAULT or FLT if failed.

NOx: A calculated value based on the measured level of Nitric Oxide to display total oxides of Nitrogen.

LOW FLOW: During sampling or at any time the pump is running the screen may display LOW FLOW.

PUMP OFF: Indicates the pump has been manually turned off using the  key.

TIME TO: The analyzer requires to regularly zero the sensors. Once a zero has been performed the time to the next zero is displayed in minutes. Check there is sufficient time remaining before starting a test and perform a manual zero if not.

B - LAMBDA CALCULATIONS

The value for Lambda is a determinant for the burning efficiency of an engine. The value depends on the composition of the fuel, the air that is used for the combustion and on the combustion products as found in the exhaust gases.

This formula takes into account the following:

- Components of the fuel: carbon, hydrogen, oxygen and water content;
- Water content of the air;
- Components of the exhaust gases: carbon dioxide, carbon monoxide, hydrocarbons and nitrogen oxide;

Developed by J. Brettschneider and published in Bosh Technische Berichte, Volume 6 (1979), No. 4, page 177-186.

A simplified formula, derived from the basic formula, and based upon the assumption that the water content of the fuel and air and the NOx content in the exhaust gases are negligible, allows the computation of Lambda when certain components of the exhaust are measured.

B.1 Oxygen balance formula

For Lambda calculation, based upon measurements of CO, CO₂, HC and O₂, the following formula is standardized: Displayed on the instrument as LAMBDA (O)

$$\gamma = \frac{\text{CO}_2 + (\text{CO}/2) + \text{O}_2 + [\text{H}_{\text{cv}}/4 \times \{3.5 / (3.5 + \text{CO}/\text{CO}_2)\} - \text{O}_{\text{cv}}/2] \times (\text{CO}_2 + \text{CO})}{(1 + \text{H}_{\text{cv}}/4 - \text{O}_{\text{cv}}/2) \times \{(\text{CO}_2 + \text{CO}) + (\text{K}_1 \times \text{HC})\}}$$

Where:

CO = Carbon monoxide % volume measured.

CO₂ = Carbon dioxide % volume measured.

HC = Hydrocarbon ppm volume measured.

O₂ = Oxygen % volume measured.

K₁ = Conversion factor for HC is expressed in ppm vol n-hexane (C₆H₁₄) equivalent. Its value in this formula is 6.10⁻⁴

H_{cv} = Atomic ratio hydrogen to carbon in the fuel. Nominal value is 1.7261

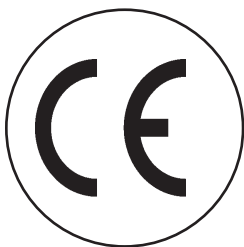
O_{cv} = Atomic ratio oxygen to carbon in the fuel. Nominal value is 0.0176

C - Procedures for changing Oxygen fuel cell

The Oxygen fuel cell is housed within the case of the instrument. It should be changed at an approved service centre when readings of oxygen are erratic or when the unit will not set to 20.9% following a zero.

Note! The oxygen reading in fresh air may drift between 20.7 and 21 % this is normal.

D - Electromagnetic Compatibility (CE) Statement



This product has been tested for compliance with the following generic standards:

EN 50081-1

EN 50082-1

and is certified to be compliant



Auto 2-2, Auto 4-2 & AGA5000

Gas Analyzer

Limited Warranty

The Auto 4-2 is warranted to be free from defects in materials and workmanship for a period of one year from the date of purchase. If within the warranty period your instrument should become inoperative from such defects, the unit will be repaired or replaced at UEi's option. This warranty covers normal use and does not cover damage which occurs in shipment or failure which results from alteration, tampering, accident, misuse, abuse, neglect or improper maintenance. Batteries and consequential damage resulting from failed batteries are not covered by warranty.

Any implied warranties, including but not limited to implied warranties of merchantability and fitness for a particular purpose, are limited to the express warranty. UEi shall not be liable for loss of use of the instrument or other incidental or consequential damages, expenses, or economic loss, or for any claim or claims for such damage, expenses or economic loss. A purchase receipt or other proof of original purchase date will be required before warranty repairs will be rendered. Instruments out of warranty will be repaired (when repairable) for a service charge. Return the unit postage paid and insured to:

1-800-547-5740 • FAX: (503) 643-6322

Service: (800) 308-7709

www.ueitest.com • Email: info@ueitest.com

This warranty gives you specific legal rights. You may also have other rights which vary from state to state.