Kane Automotive

Gas Analyser
Manual for models;
Auto 2-2; 4-2 & 5-2;
Auto 4-1 & 5-1

Description

The Kane Automotive range of emission analysers covering the models Auto 2-2, 4-2, 5-2, 4-1 & 5-1 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 analysers 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 analyser's memory.

Each analyser is supplied with an RS232 output enabling communication between the analyser 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 analyser can also be uploaded, diagnosed graphically and/or converted into spreadsheets for service records.

From October 2002, all models are equipped to measure oil temperature and engine speed in revolutions per minute (RPM).

Both the Auto 4-1 and Auto 5-1 analysers carry a declaration of conformity to OIML R99, Edition 1998 (E), Class 1.

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

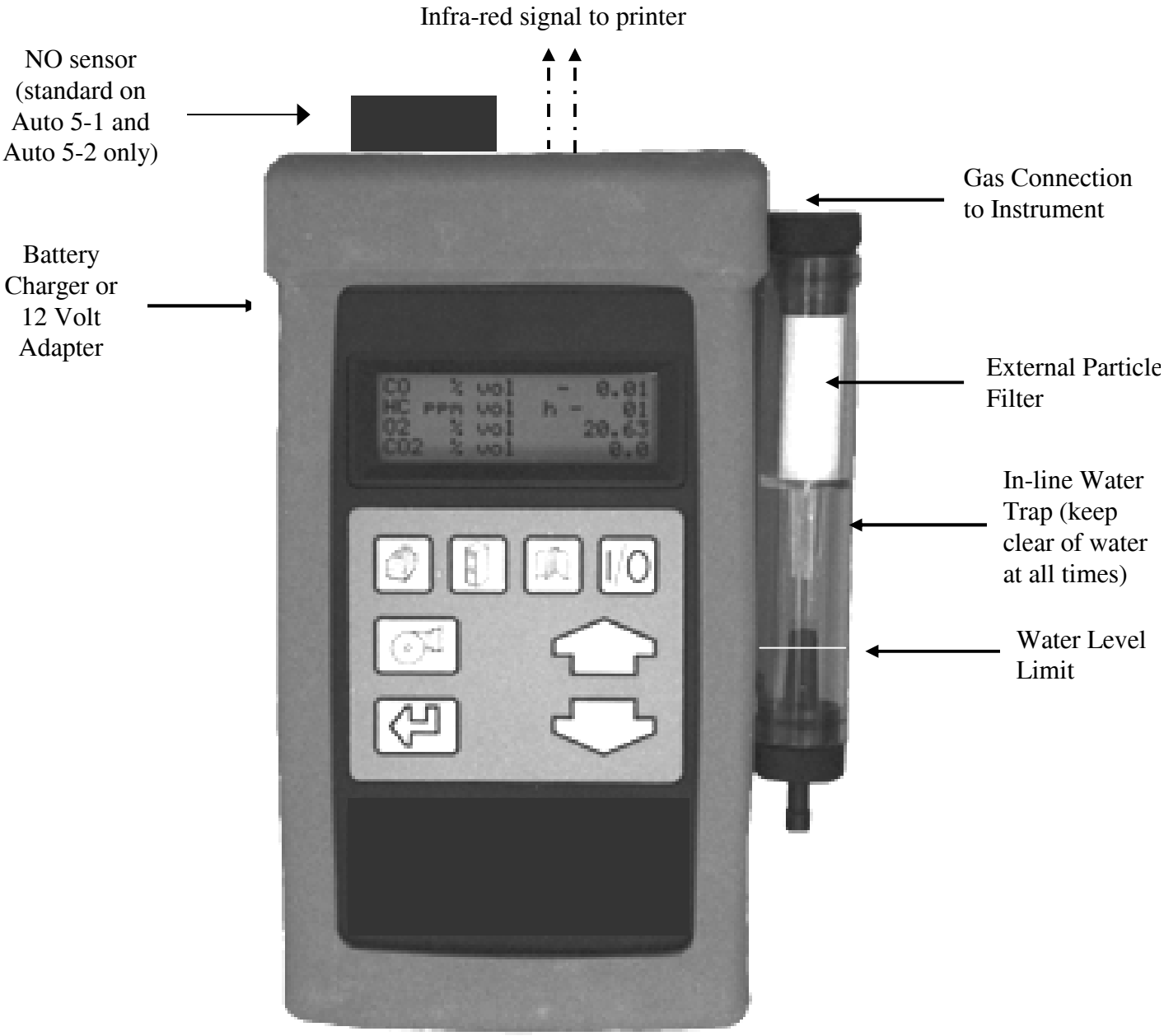
* For diesel applications, HC measured in the exhaust gas is indicated in ppm (parts per million) n-hexane.

CONTENTS

APPENDICES

1. ANALYSER LAYOUT AND FEATURES

1.1 Instrument Features and Keypad



ON/OFF

MENU
Allows access to all menu functions

PUMP
Turns pump on and off

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

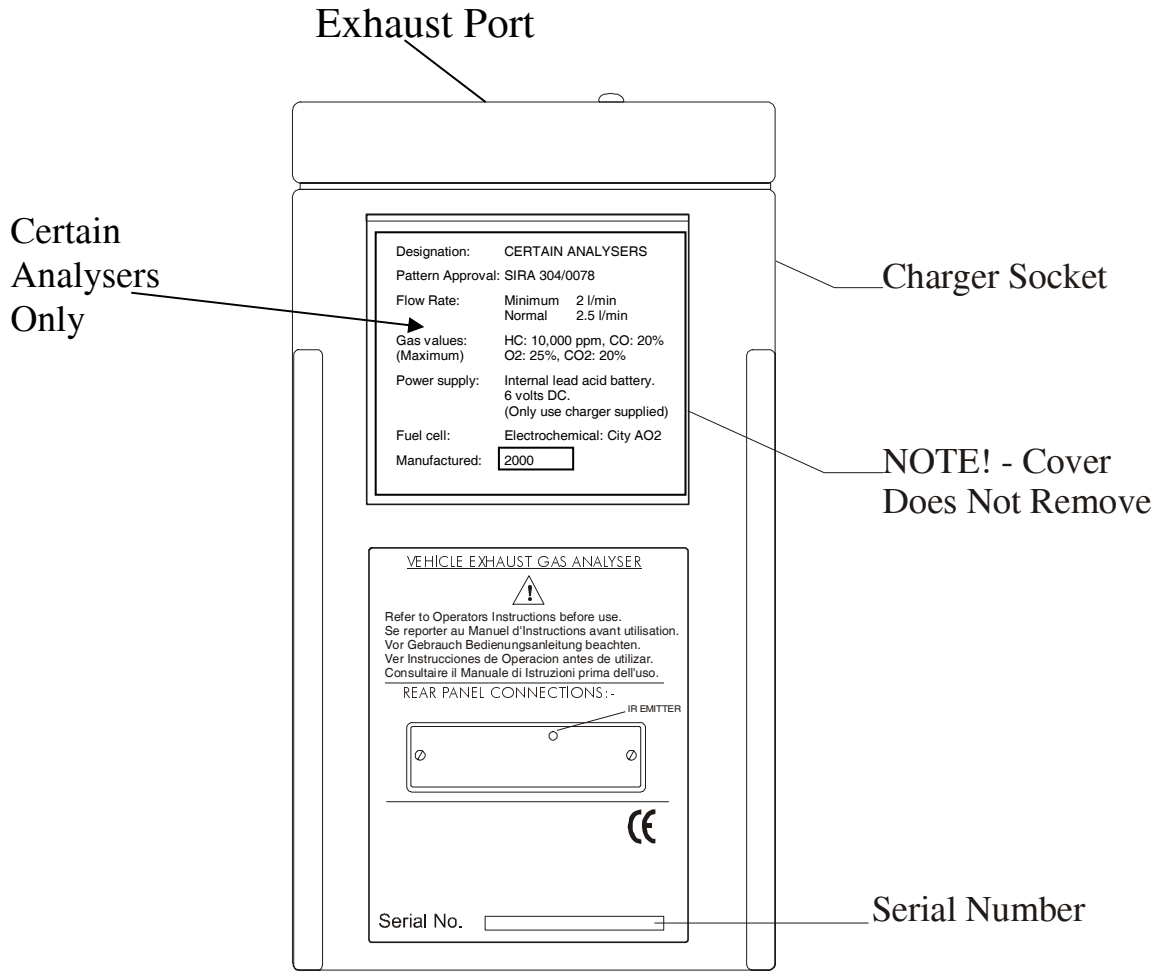
UP
Scrolls up through options, ie Fuel

DOWN
Scrolls down through options

STORE
Enters data storage menu

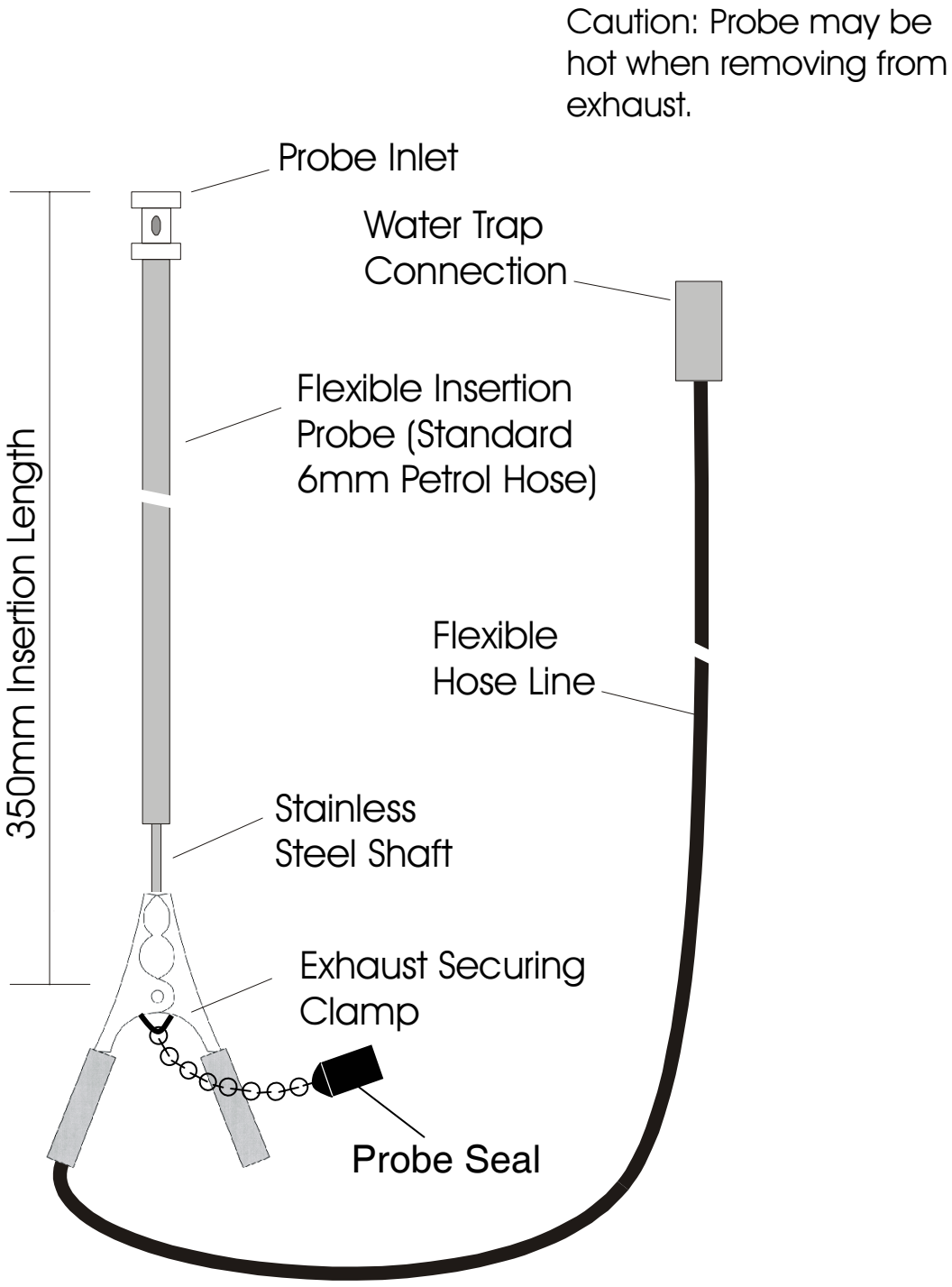
PRINT
Prints current data

1.2 Instrument Layout (Rear)



*NOTE! Do not cover exhaust port as this will severely affect analyser operation

1.3 Standard Probe Configuration



Note: A variety of probes are available, including high temperature probes necessary for on-road / rolling road vehicle testing when the temperature of the emission gases increase. Please request further details from your distributor or contact Kane International Ltd directly.

2. SAFETY WARNING

This analyser 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-40°C
Maximum relative humidity 80% for temperatures up to 31°C decreasing linearly to 50%RH at 40°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 analyser 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 analyser for the first time you will need to choose from:-

Language selection
Time
Printed header name and telephone number

The SET UP MENU (Section 5.2.) gives details of how to change the above settings.

4. NORMAL START UP SEQUENCE

4.1 Every Time You Use The Analyser

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 analysers)

* DO NOT RUN ANALYSER WITHOUT WATER TRAP FITTED *

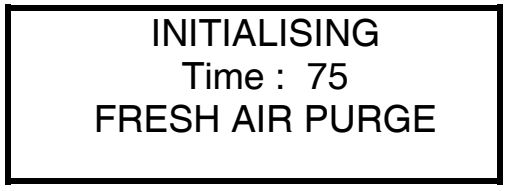
Switch ON the instrument by pressing 

4.2 Automatic Zero Calibration

During this sequence the analyser 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 analyser will briefly display header information:

And then show the initialising screen:



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 initialise the measuring system, do not block the end of the probe or insert into or near the vehicle exhaust.

Once the initialisation 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 CO_2 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 analyser:-

```
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	. . . . .	0.000

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 customise 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.

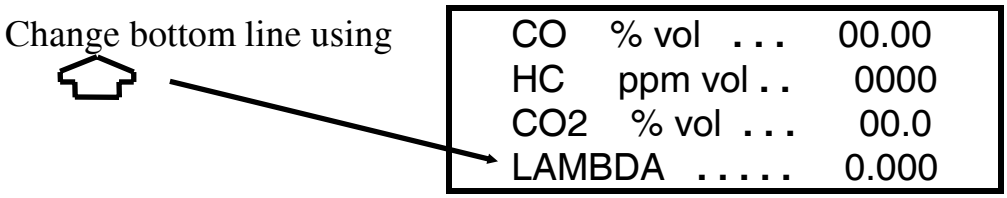
Changing between the different modes is detailed in **Display Menu Section 5.2.4**.

TIP! To increase battery life do not leave the backlight on.

4.3.1 Line Scroll Mode

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

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



4.3.2 4 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.

```
PETROL
DATE      . . .  07-08-96
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
23-02-00		13:45:22	

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

Use the ⌂ keys to change this line.

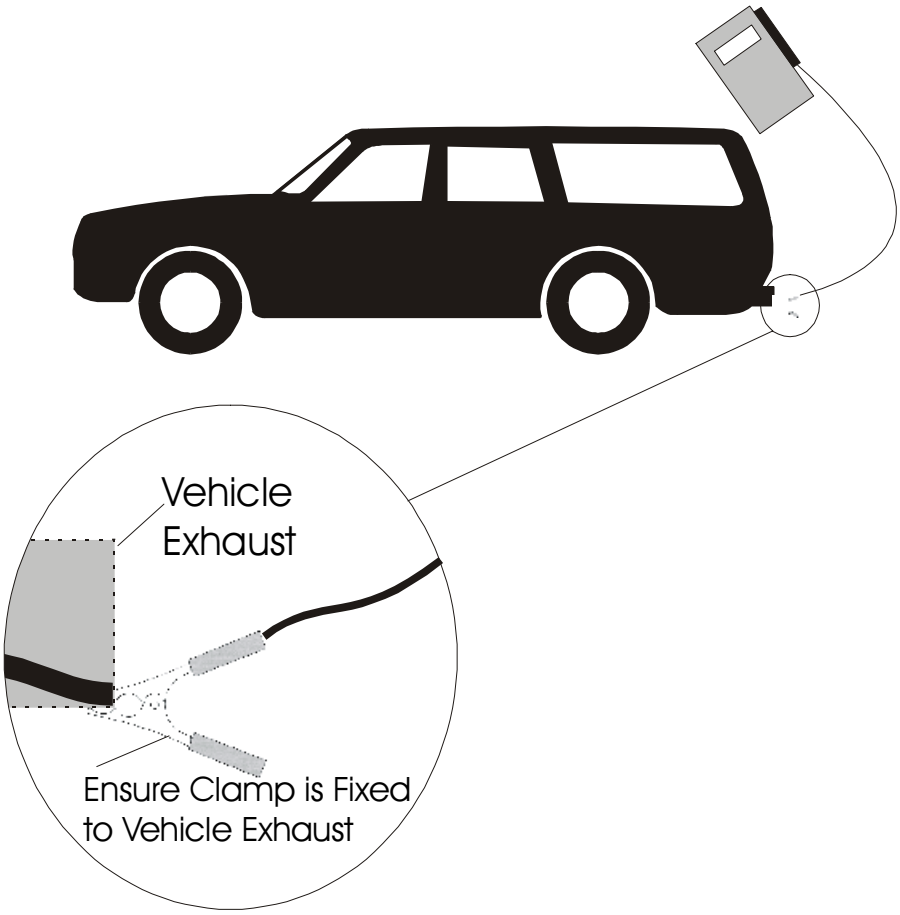
CO	:00.00	O2	:20.90
HCh	:0000	CO2	:00.0
λ	:00.00	NO	: 0000
Tz	:30	BAT	:50

CO	:00.00	O2	:20.90
HCh	:0000	CO2	:00.0
λ	:0.000	NO	:0000
FUEL:		PETROL	

4.4 Sampling the Exhaust Gas

Once the zero calibration and test procedures have been completed and the fuel has been selected (See SELECT menu) 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 analyser 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 analyser if it does not return to zero.

Use the  key to turn ON and OFF the pump.

CERTAIN ANALYSERS ONLY
The analyser 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 analyser samples fresh air for 60 seconds before the pump is turned off.

4.6 Taking an oil temperature reading (Certain analysers 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 analysers 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          . . . . .   1000
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 analysers operating specifications, in particular ensure the following :-

- DO NOT PLACE THE INSTRUMENT IN THE ENGINE BAY.
- The analyser is not exposed to temperatures outside its normal operating range.
- DO NOT PLACE THE INSTRUMENT ON A HOT SURFACE.

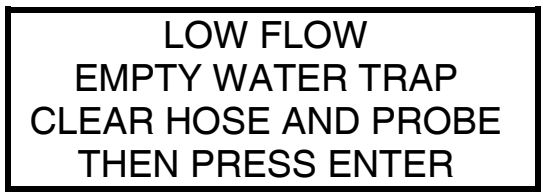
- Liquid in the water trap does not go over the level indicator. Note! The indicator only works while the trap is vertical. Water condenses in the probe line and can quickly fill the water trap when the probe is moved. **Take care,** watch the water trap closely and empty any water when it is noticed.
- 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 analyser.

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:



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 not possible to clear the problem then internal damage may have occurred and the unit should be returned to a service centre.

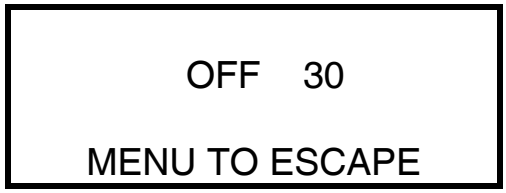
4.9 Normal Shutdown Sequence

DO THIS EVERY TIME YOU USE THE ANALYSER

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 analyser and damage the pump and sensors.

Once the probe is removed from the exhaust allow the readings to return to zero and press 

the analyser will count down from 30 to switch off.



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  . . .   00.0
O2   % vol  . . .  20.90
```

Press 
to access the MAIN MENU

```
          MAIN MENU

 1. SELECT     3. DISPLAY
 2. UNITS      4. SETUP
```

Press 
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 select parameter

```
SET      : ZERO
FUEL     : PETROL
RPM      : 4 CYCLE
CAL      : CHECK
```

Use  and 
to change setting i.e. fuel selected

```
SET      : ZERO
FUEL     : PETROL
RPM      : 4 CYCLE
CAL      : CHECK
```

Press 
to enter value and move to next parameter

```
SET      : ZERO
FUEL     : PETROL
RPM      : 4 CYCLE
CAL      : CHECK
```

Press 
to save settings and return to the MAIN MENU

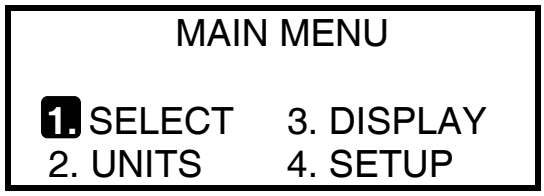
```
          MAIN MENU

 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.

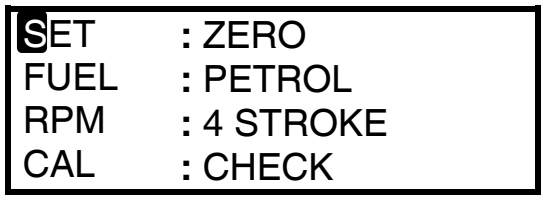


All sub-menus are accessed using  and exited using 

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.

		OPTIONS
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 recalibration.	**ZERO** **HC RESIDUE** **LEAK CHECK**
FUEL :	Select the fuel the vehicle is using from a standard fuel stored in the analyser. Select from:	**PETROL** **LPG** **CNG**
RPM : (Certain analysers only)	To allow the analyser 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 analyser 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 analyser.
- **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	: T123 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	: T123 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:;<>?@ABCDEFGHIJKLMNOPQRSTUVWXYZ/space/

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

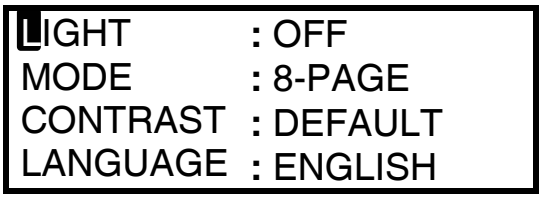
Repeat until all the vehicle registration is correct .

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

EFF : Changes the calculation used in the Lambda calculation. Change from **LAMBDA** to **AFR.** Formulas used in the analyser 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



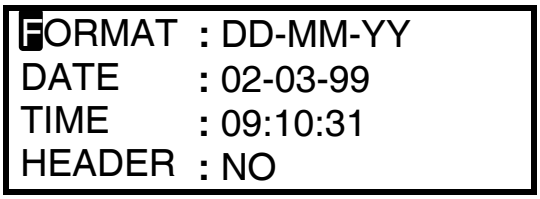
Allows the configuration of the display to be changed.

		OPTIONS
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 analysers 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 : Changes the date format set on the analyser. Contact your service centre 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 analyser. The header appears on the top of the standard printout. This can be used to print your company name and/or phone number.

The screen above shows the standard header setting with the cursor now shown underlining the K in KANE. 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 analyser is an infra-red thermal printer. Read the manual supplied with the printer prior to operation. Connections to the analyser are detailed below :

- **Infra-red 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 Analyser 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 Analyser 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 RETREIVING DATA.

6.1 Printing a 'Live' Test

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

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

```
***** Printing *****
```

6.2 Standard Printout

The standard printout is shown below :-

```
        Kane Automotive


VEHICLE: T123 ABC

FUEL:        PETROL

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 Analyser 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 :-

Press 
to access the STORE MENU

```
      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 analysers memory.

NOTE: The analyser 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            PETROL
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      : 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 'STORE' TO LOG
```

Then press  .

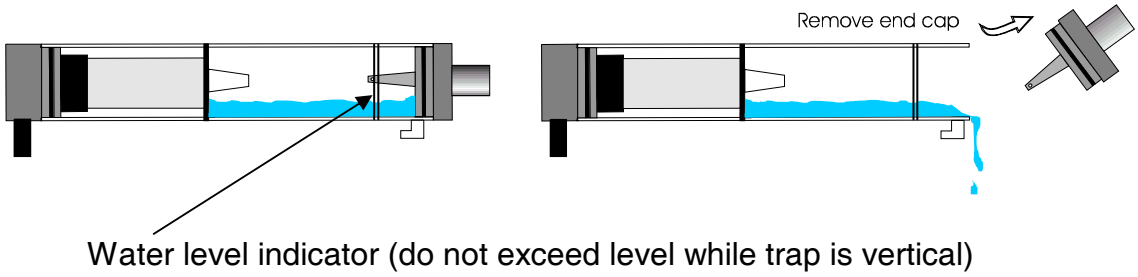
Press  to escape.

8. MAINTENANCE

8.1 Emptying and Cleaning the In-line Water Trap

The in-line water trap should be checked and emptied on a regular basis. Water vapour 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.

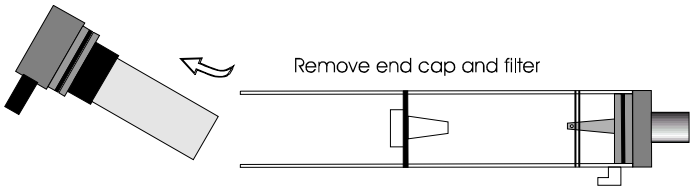
Emptying of the water trap is detailed below :-



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 analyser 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 discoloured 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 Kane International Technical Support or an International Distributor for expert advice.

Fault symptom	Causes
• Oxygen too high	• Air leaking into probe, tubing, water trap, connectors or internal to instrument. • Oxygen cell needs replacing.
• Oxygen Error (FAULT) • Infrared gas Error (FAULT)	• 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.
• Analyser not holding charge • Analyser not charging	• Battery exhausted. • Charger not giving correct output. • Fuse blown in charger plug.
• Analyser does not respond to exhaust gas	• Particle filter blocked. • Probe or tubing blocked. • Pump not working or damaged with contaminants.
• Oil temperature readings erratic	• Temperature plug reversed in socket. • Faulty connection or break in cable or plug.
• Analyser automatically switches off in operation	• Battery below alarm level. • Ambient temperature above 50°C. • Battery quickly discharging and is faulty.

INTERNAL FILTER

To protect the analyser 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.

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 analyser the following checks may be requested as required:

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

10.1 Zero setting

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

- Following analyser switch ON.
- On a timed basis. Following the analyser 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 analyser 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 ½ metre 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 analyser fails to zero it may request a HC residue check. (Certain analysers only)

10.2 HC residue check (Certain analysers only)

Hydrocarbon is a very 'sticky' gas and can cling to tubing in the analyser 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 analyser will not continue with the test if it does not detect the carbon filter element is in place. Use of the analyser 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 analyser and vehicle.

If the analyser cannot detect a reduction in the HC level to within preset limits then it will try again from the screen shown above. If the analyser 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

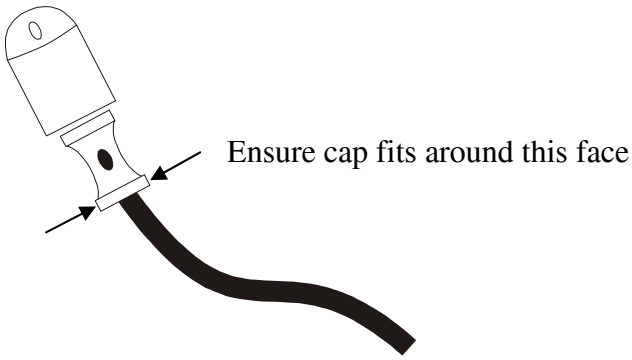
To ensure the gas sampling system is sealed correctly and not letting in air, the analyser will perform a leak check. This requires the user to block the probe inlet and perform the test. This check is done every time the analyser is switched on or as requested by the user. It is also advisable to perform 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.

When fitting the SEAL ensure the two inlet holes at the end of the probe are covered and are gas tight. If air leaks in at this point the test will fail.



Press  when the seal is in place. The check will take a few seconds. Following a successful test the analyser 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 analyser case.
- The water trap fitting on the analyser is in good condition.

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

If the analyser continues to fail contact your service centre.

10.4 Gas Calibration Verification

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

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

10.4.1 Calibration Gas Values

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

To allow the analyser 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 in Section 5.2.5. setting the time. 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 analyser 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 analyser the value on the calibration gas bottle is entered. In our example 2000 ppm propane.

When performing a calibration reading or check the analyser 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 analyser would display:

HC displayed reading (n-hexane) = 2000 ppm x PEF

= 2000 x 0.512 = 1024 ppm

10.4.2 Calibration Check

FUEL	: PETROL
RPM	: 4 STROKE
ZERO	: NO
CAL	: CHECK

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 analyser using the hose provided. **Important: To prevent damage to the analyser, be sure to use the pressure regulator between the analyser 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 analyser detects the calibration gas.

CALIBRATION CHECK

CO	: 3.50	CO2	: 14.0
HC	: 1000	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 analyser 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 analyser has started to read calibration gas and is stabilising – 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 analyser 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 Recalibration.**

Note ! Disconnect gas at this time.

If the analyser 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 analyser 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.

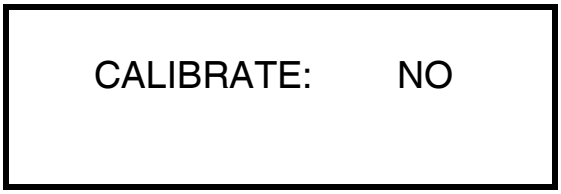
A printed report can be obtained.

DISCONNECT GAS
CALIBRATION VERIFIED
PRINT REPORT NO

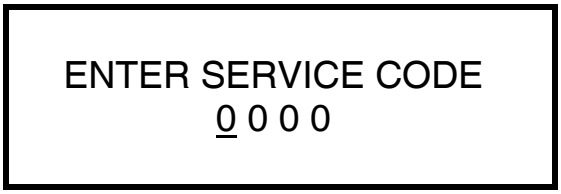
Gas calibration is outside specification and need adjustment.

DISCONNECT GAS
CALIBRATION ADVISED
PRINT REPORT NO

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



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



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

Once the last digit has been entered the analyser 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 analyser will display:

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 the analyser 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 :-

```
   KANE AUTOMOTIVE
CALIBRATION REPORT

     VERSION      2.4

DATE:       17-03-99
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
HC    ppm vol:     1024
      MIN:          973

      MAX:         1050
NO    % vol        1006
      MIN:          950

AMB deg:           24.4
PRS mbar:          1068
```

Information contained on the calibration report is as follows:

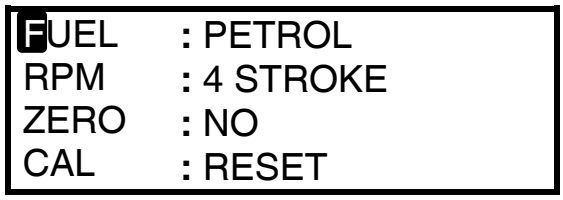
- **VERSION:** Analyser software version
- **CO, CO2, HC, O2, NO:** Gas readings as measured during check.
- **MAX / MIN:** Upper and lower limits at which calibration check fails and re-calibration is advised.
- **AMB deg:** Ambient temperature reading during calibration
- **PRS mbar:** Ambient Pressure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

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

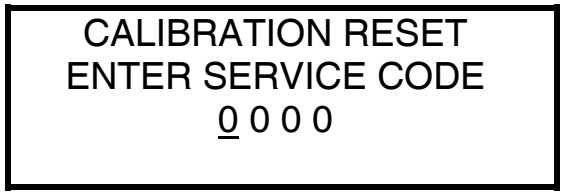
AMB and PRS can be used when discussing problems with a service agent.

10.4.5 Reset Instrument Calibration

This feature allows the analyser 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.



Select RESET from the screen above and press 



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

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

FACTORY CALIBRATION RESET CODE: 7378

Enter each digit of the code as explained in the section Time and Date. Once the last digit has been entered the factory settings will be restored and the analyser will return to the main display. A calibration check should now be performed.

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

11. PRODUCT SPECIFICATION FOR AUTO 2-2

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% of 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		Petrol, LPG and CNG.	
Data-Logging		255 Snap Shots	
PC Connections		Via RS 232 port	
Dimensions Weight Handset Probe		1kg 220mm x 55mm x 120mm 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 +40°C/10% to 90% RH non condensing	
Storage temperature		Minimum: 0°C Maximum: +50°C	
Battery Charger		Input: 110Vac/230 Vac nominal Output: 10 Vac off load	
Analyser 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 analyser is not for use with a Dynamometer, unless the high temperature probe is fitted.
NDIR means by non dispersive infra-red principle.

PRODUCT SPECIFICATION FOR HANDHELD AUTO 4-2; 5-2; 4-1; 5-1 AND PORTABLE BOX TYPE 4-3 & 5-3

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 % volume *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 % volume *1	0-16 % Over-range: 25%
Nitric Oxide*2 (fuel cell)	1 ppm	0-4000ppm +/-4% or 25ppm; 4000-5000 ppm +/-5%	0-5000ppm
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 AFR (Petrol) (LPG)	0.001 00.01		0.8 – 1.2 11.76 – 17.64 12.48 – 18.72
Sensor response T_{95}		15 seconds for Auto 4-1, 5-1 Nominal 20 seconds Auto 4-2, 5-2, 4-3 & 5-3	
Warm up		Less than 3 minutes	
Pre-programmed Fuels		Petrol, LPG and CNG.	
PC connection		Via RS 232 port	
Data-Logging		255 Tests	
Dimensions Weight Handset Probe		 1kg 220mm x 55mm x 120mm 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 +40°C/10% to 90% RH non condensing	
Storage temperature		Minimum: 0°C Maximum: +50°C	
Battery Charger		Input: 110Vac/230 Vac nominal Output: 10 Vac off load	
Analyser battery run time		>4 hours from full charge with the pump running	

*1 Using dry gases at STP

*2 Standard on models Auto 5-2 and 5-1 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 analyser is not for use with a Dynometer, 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. PETROL. See **Select menu** section 5.2.2 to change.
- PETROL – Leaded or Unleaded petrol/gasoline.
- LPG – Liquid Petroleum Gas
- CNG – Compressed Natural Gas

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

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

BATTERY : (BAT) Displays the battery level from 0-100%. The analyser will flash **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 analyser 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 analyser 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 analyser will display - - - -. If there is a fault with the CO_2 reading then **FLT** will be displayed.

HC : Hydrocarbons measured in the exhaust gas indicated in ppm (parts per million) n-hexane (petrol). With the pump off the analyser 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 = (Cox15)/(CO + CO2), 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 connectors on the bottom of the instrument case, ensure correct polarity. NOT FITTED (N/F) will be displayed if the probe is not connected.

LAMBDA : (λ) 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 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 Petrol 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: ZERO The analyser 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 CALCULATION

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.

A basic formula, taking into account:

- 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;

has been developed by J. Brettschneider and published in Bosh Technishe 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 standardised: Displayed on the instrument as LAMBDA (O)

$$\lambda = \frac{CO_2 + (CO/2) + O_2 + [H_{CV}/4 \times \{3.5 / (3.5 + CO/CO_2)\} - O_{CV}/2] \times (CO_2 + CO)}{(1 + H_{CV}/4 - O_{CV}/2) \times \{(CO_2 + CO) + (K_1 \times HC)\}}$$

Where:

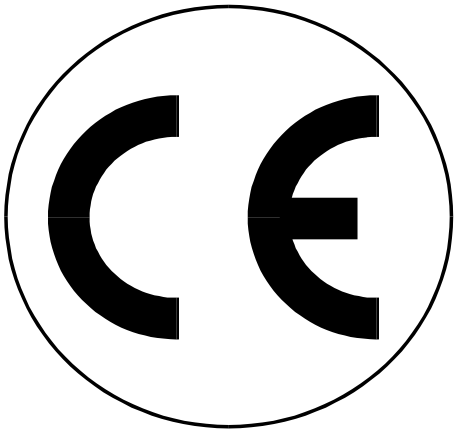
CO = Carbon monoxide % volume measured.
CO_2 = Carbon dioxide % volume measured.
HC = Hydrocarbon ppm volume measured.
O_2 = Oxygen % volume measured.
K_1 = Conversion factor for HC is expressed in ppm vol n-hexane (C_6H_{14}) equivalent. Its value in this formula is 6.10^{-4}
H_{cv} = Atomic ratio hydrogen 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. Procedure 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 COMPATABILITY (CE) STATEMENT



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

EN 61000-6-3
EN 61000-6-1

and is certified to be compliant

Specification EC/EMC/KI/AutoAnalyser details the specific test configuration, performance and conditions of use.

Please Note: Batteries used in this instrument should be disposed of in accordance with current legislation and local guidelines.

Thank you for reading this data sheet.

For pricing or for further information, please contact us at our UK Office, using the details below.

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