KANE945

Industrial Flue Gas Analyser

Stock No: 19823 May 2016

CONTENTS

1. ANALYSER LAYOUT AND FEATURES

KEY FEATURES

Measures Temperature, Pressure, O_2 and CO as standard.

Stores 150 sets of test results.

Output to IR Printer (optional).

OPTIONS

(CO & any two other sensors)

High Range CO sensor

Low Range NO sensor

High Range NO sensor

NO_2 sensor

SO_2 sensor

Wireless upgrade (2.1)

Teflon Hose

INSTRUMENT FEATURES AND KEYPAD

ON/OFF

UP
Scrolls up through options ie Fuel

MENU
Allows access to all menu functions

DOWN
Scrolls down through options

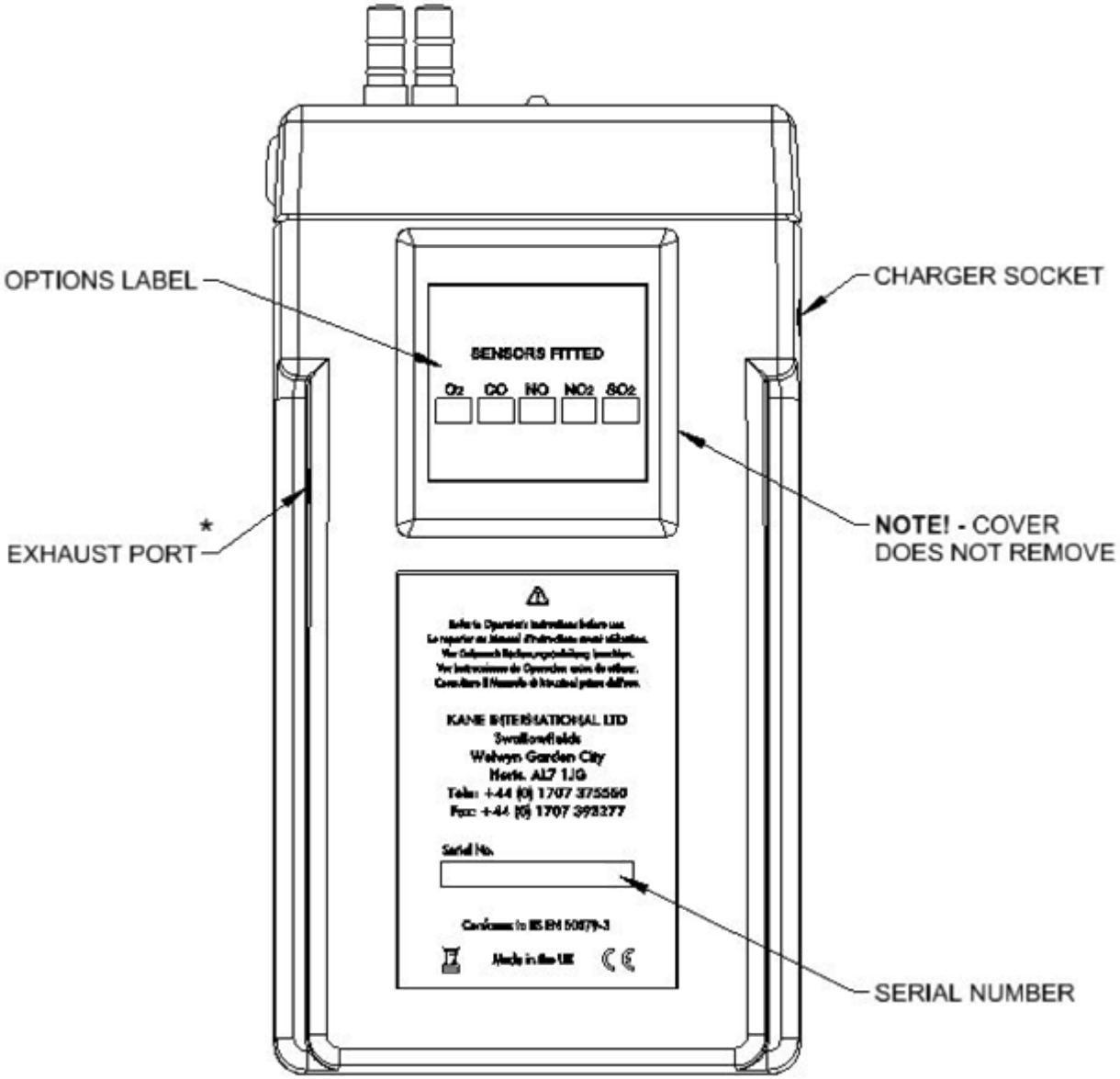
PUMP
Turns pump on and off

STORE
Enters data storage menu

ENTER
Accepts a command ie enters a menu option

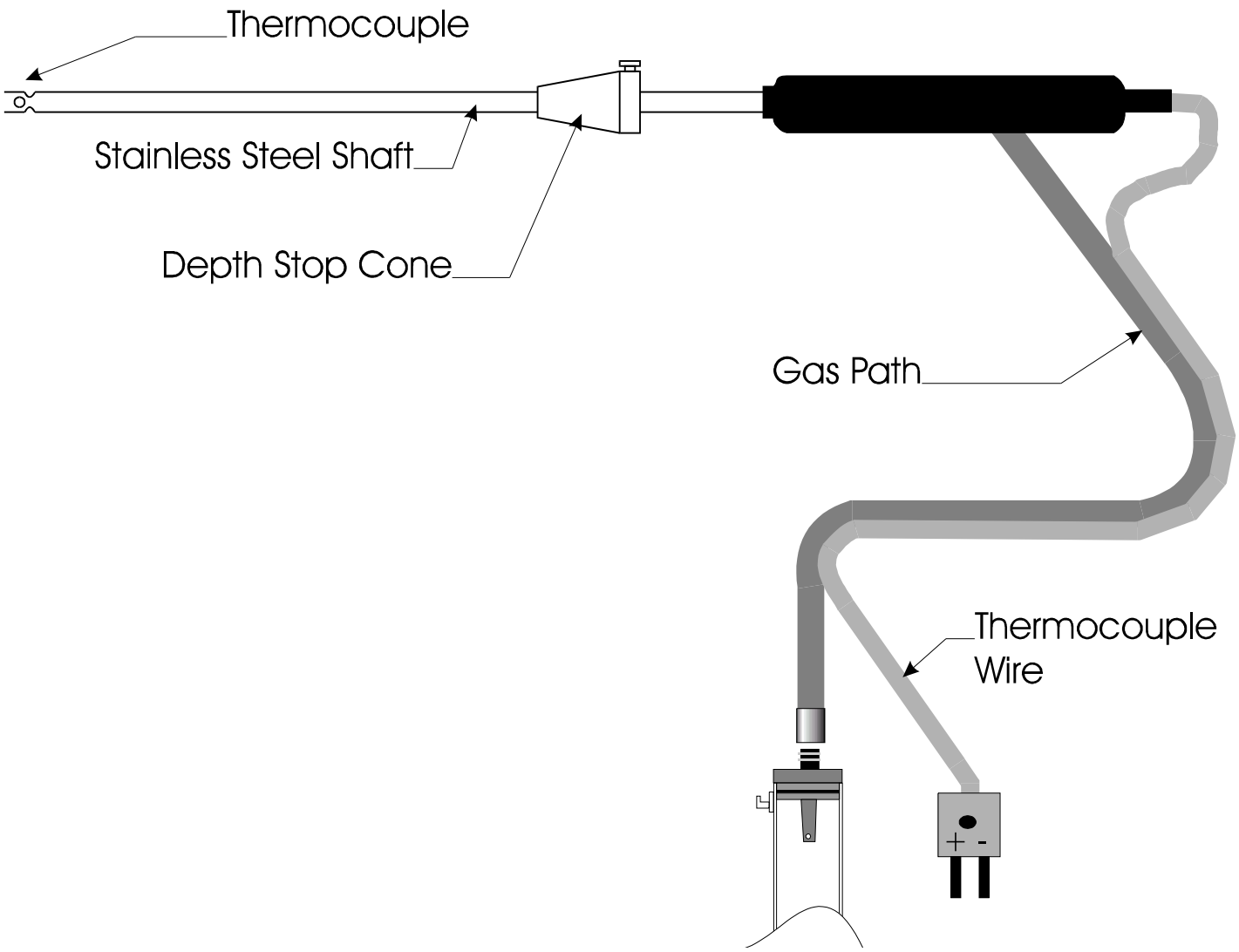
PRINT
Prints current data

INSTRUMENT LAYOUT (REAR)



NOTE: Do NOT cover exhaust port as this will severely affect analyser operation

STANDARD PROBE CONFIGURATION



ANALYSER CONNECTIONS

2. SAFETY WARNING ⚠

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

Users of portable gas detectors are recommended to conduct a “bump” check before relying on the unit to verify an atmosphere is free from hazard.

A “bump” test is a means of verifying that an instrument is working within acceptable limits by briefly exposing to a known gas mixture formulated to change the output of all the sensors present. (This is different from a calibration where the instrument is also exposed to a known gas mixture but is allowed to settle to a steady figure and the reading adjusted to the stated gas concentration of the test gas).

Protection Against Electric Shock (in accordance with EN 61010-1 : 2010)

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. See Main Parameter displays for Battery Indicator.

The KANE945 has a rechargeable NiMh battery which uses a different charger than other Kane analysers. ***Ensure the correct charger is used or damage may occur to the instrument.***

Check that you have all the items you have ordered.

Take time to read this manual fully. ***Be aware that the analyser configuration that you have purchased may not support all the features detailed in this manual.***

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

Language selection
Calibration countdown time
CO gas alarm
NOx percentage for calculation
Time and Date
Printed header name and telephone number

The SET UP MENU gives details of how to change the above settings.

4. NORMAL START UP SEQUENCE

EVERY TIME YOU USE THE ANALYSER

BEFORE SWITCH-ON CHECK THAT:

the particle filter is not dirty

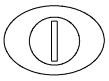
the water trap and probe line are empty of water

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 flue temperature is connected

Switch ON the instrument by pressing 

AUTOMATIC CALIBRATION

During this sequence the analyser pumps fresh air into the sensors to allow toxic sensors (if fitted) to be set to zero and the Oxygen sensor to be set to 20.9 %.

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

Kane International **KANE945** **SW19604 Version: 1.02**

And then show the countdown screen :-

ZERO CAL **Time: 180** **FRESH AIR PURGE**

The calibration time will count down in seconds to zero. Calibration time may be changed to 90, 120, 180, 300 seconds. See **SET-UP MENU**.

Note! Three minutes is recommended to allow the sensors to stabilise fully. Anything less than this may result in drift of the toxic and oxygen sensors in clean ambient air.

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

Once the time has reached zero an audible beep will be heard and will show the selected fuel on the following display:-

NATURAL GAS
*** PRESS – MENU – KEY ***

Press 

This zeros the toxic sensor and sets Oxygen to 20.9%. The next screen is the **MAIN DISPLAY** of the analyser:

NETT	**C**	**0.0**
O2	**%**	**20.9**
CO	**ppm**	**0000**
EFF (G)	**%**	**0.0**

Use  and  to change the display.

CO2	**%**	**0.0**
FLUE	**C**	**0.0**
INLT		**NOT FITTED**
AMBIENT	**C**	**21.5**

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

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.

- **4 Page Mode** displays 4 lines of data in set format, each page is predefined.
- **Line scroll mode** allows you to customise the display to show the data you require.
- **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** .

4 PAGE MODE

Use the  and  keys to change the information that is displayed on the screen. The following pages are available:

1.

NATURAL GAS		
DATE		23-05-15
TIME		12:31:35
BATTERY	%	54

2.

NETT	C	0.0
O2	%	20.9
CO	ppm	0000
EFF (G)	%	0.0

3.

CO2	%	0.0
FLUE	C	0.0
INLT	NOT FITTED	
AMBIENT	C	21.5

4.

CO/CO2	R	0.0001
P INDEX	%	0.01
XAIR	%	0.0
Prs	mbar	0.00

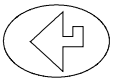
Screens 5 and 6 will vary dependent on sensors fitted:

5.

COn
LOSSES
NO2
NO2n

6.

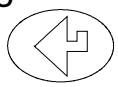
NO
NOx
NOn
NOxn

TIP - In 4 page mode only  turns the backlight ON and OFF.

LINE SCROLL MODE

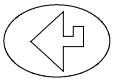
Line scroll mode allows you to customise the display.

Use the  and  keys to change the bottom line of the display.

Once the correct line is displayed press  to confirm and move the line up. Select the next parameter and repeat until all lines display the desired parameters.

Change bottom line using  and 

NETT	**C**		**0.0**
O2	**%**		**20.9**
CO	**ppm**		**0000**
CO2	**%**		**0.0**

 to select and move parameter up

O2	**%**	**…**	**20.9**
CO	**ppm**	**…**	**0000**
CO2	**%**	**…**	**0.0**
CO2	**%**	**…**	**0.0**

Select next parameter.
Repeat above until
display reads desired data

O2:	**%**	**…**	**20.9**
CO:	**ppm**	**…**	**0000**
CO2:	**%**	**…**	**0.0**
CO/CO2	**R**	**…**	**0.0001**

8 PAGE MODE

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

O2 :	**20.9%**	**CO2:**	**20.9**
CO :	**0ppm**	**Eff:**	**0000**
PI :		ΔT:	**0.0**
λ :		**Tf:**	**0.0001**

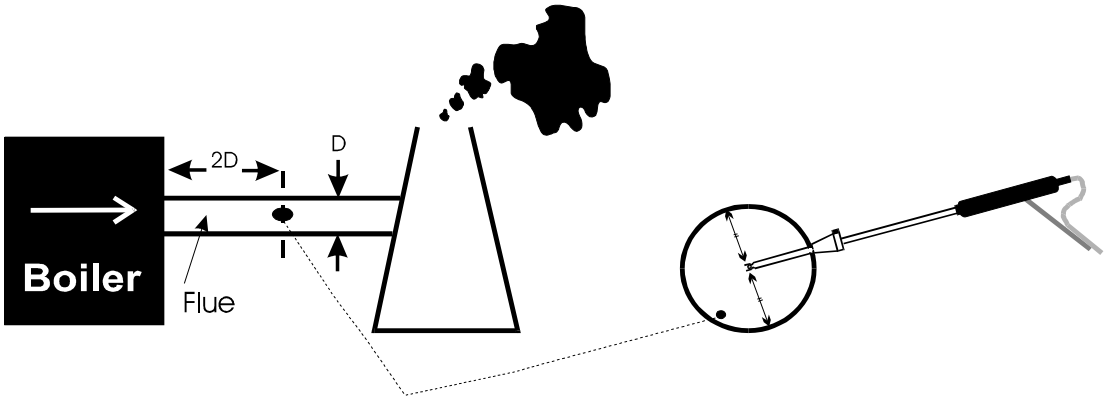
The bottom line of the display can be changed to display other parameters.

Use the  and  keys to change this line.

SAMPLING THE FLUE GAS

Once the automatic calibration procedure has been completed and the specific fuel has been selected (See SELECT menu) the probe can be inserted into the desired sampling point.

It is recommended that the sampling point be located at least two flue diameters downstream of any bend and that the probe tip is in the centre of the flue. With balanced flues and other domestic units the probe should be positioned far enough into the flue so that no air can 'back flush' into the probe. This will be indicated by a low oxygen reading and/or a low 'Poison Index' reading.



The probe depth stop cone provided with the instrument allows the probe to be used in holes whose diameters range from 8 mm to 21 mm ($^{5}/_{16}$ to $^{13}/_{16}$ inch).

The standard probe is rated at 650°C (1202°F). Temperatures of up to 1200°C (2200°F) can be accommodated using an optional high temperature probe.

TIP: To conserve battery power, switch off the pump when you are not taking a measurement. Use the  key to turn ON and OFF the pump.

TAKING A PRESSURE READING

A flue draught measurement can be made at any time.

Connect the standard probe to the pressure sensor inlet and the probe in the flue.

The pressure reading will be displayed :

CO/CO2	**R**	**0.0000**
P INDEX	**%**	**0.00**
XAIR	**%**	**0.0**
Prs	**mbar**	**2.00**

To perform a combustion test and display draught pressure at the same time a special probe is required. Contact Kane International or Authorised Distributor for details.

TAKING A FLOW READING

In the UNITS menu set the pressure units to metres/sec (m/sec). These are the only units available for flow measurement.

This also set the pressure display to Pascal (Pa). There is a range limit for the Pitot calculation of15Pa to 4600Pa (0.15mbar to 46mbar).

For most accurate flow measurement the flue gas temperature should also be measured. If a flue temperature probe is not fitted then the internal ambient measurement is used. 'Flue' temperature must be between -10°C to +650°C.

REGULAR CHECKS DURING SAMPLING

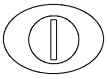
Care must be taken at all times not to exceed the analysers operating specifications, in particular ensure the following :-

- Do not exceed the maximum temperature of the flue probe.
- The analyser internal temperature does not exceed normal operating range, typically 0-50°C.
- DO NOT PLACE THE INSTRUMENT ON A HOT SURFACE.
- The water trap is vertical at all times. Water condenses in the probe line and can quickly fill the water trap when the probe is moved. Take care and watch the water trap closely.
- The in-line particle filter is clean and does not become blocked.

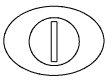
NORMAL SHUTDOWN SEQUENCE

DO THIS EVERY TIME YOU USE THE ANALYSER

Remove the probe from the flue **- 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 flue press  and the analyser 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

THE MENU STRUCTURE

MENU:	SELECT	→	FUEL
			O2 REF
			SMOKE
			RESET
			PITOT
	UNITS	→	TEMP
			GAS
			PRS
			EFF
	DISPLAY	→	LIGHT
			MODE
			CONTRAST
	SETUP	→	LANG
			CO MENU
			CALENDAR
			ZERO
			NOX %
			HEADER
			PRINT

BASIC OPERATION

From the MAIN DISPLAY

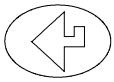
NETT	**C**	**0.0**
O2	**%**	**20.9**
CO	**ppm**	**0000**
EFF(G)	**%**	**0.0**

Press 
to access the MAIN MENU

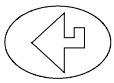
MAIN MENU	
1. SELECT	**3. DISPLAY**
2. UNITS	**4. SETUP**

Press  and  to move cursor up and down

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

Press  to access selected Menu

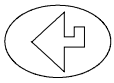
```
MAIN MENU

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

Press  to select parameter

```
FUEL      : LIGHT OIL
O2 Ref    : OFF
SMOKE     : OFF
RESET     : NO          ↓
```

Use  and  to change setting i.e. fuel selected

```
FUEL      : NATURAL GAS
O2 Ref    : OFF
SMOKE     : OFF
RESET     : NO          ↓
```

Press  to enter value and move to next parameter

```
FUEL      : LIGHT OIL
O2 Ref    : OFF
SMOKE     : OFF
RESET     : NO          ↓
```

Press  to save settings and return to the MAIN MENU

```
MAIN MENU

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

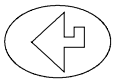
Press  to return to the MAIN DISPLAY.

6. MENU OPTIONS AND SETTINGS

MAIN MENU

The MAIN MENU consists of 4 sub menus:

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

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.

SUB MENU - **1. SELECT**

Page 1:

FUEL	: NATURAL GAS
O2 Ref	: OFF
SMOKE	: OFF
RESET	: NO ↓

Page 2:

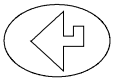
PITOT	: 1.00 ↑

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

FUEL : Select the fuel being used by the boiler from either a standard fuel stored in the analyser or by entering the user fuel. Once the correct fuel has been selected press  to view the fuel constants.

NATURAL GAS			
K1g	: 0.350	K1n	: 0.390
K_2	: 11.89	K_3	: 9.83
K_4	: 32	O2r	: 3.0

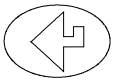
Calculation of fuel constants are detailed in the APPENDIX. Fuel constants will have to be calculated before a user fuel can be entered.

To enter the user fuel select 'User Fuel' and Press 

USER FUEL			
K1g	: 0.000	K1n	: 0.000
K_2	: 0.00	K_3	: 0.00
K_4	: 00	O2r	: 00

Use  and  to select the correct value.

USER FUEL			
K1g	: 0.350	K1n	: 0.000
K_2	: 0.00	K_3	: 0.00
K_4	: 00	O2r	: 00

Use  to move to the next parameter, repeat above until all parameters are correct. Press  to return to SELECT menu.

O2 Ref : Toxic gas measurements can be referenced to defined oxygen levels. Reference values can be set from 1-20%, to AUTO or more normally to the default value - OFF. Setting to AUTO uses the figure in the FUEL constants data.

Once AUTO is set it remains active until O2 Ref is set to OFF or a user value. This means that if the fuel type is changed the O2 Ref will always be set by the value stored in FUEL Type.

Oxygen referencing is required by some regulations such as TA-LUFT. If a reference value is selected then toxic gas measurements will be displayed with the symbol **(n)** attached to the reading. i.e. CO(n)

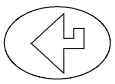
What does Oxygen reference mean ?

If 3 % O_2 reference is selected and 5 % O_2 is measured in the flue then toxic gas values will be recalculated as if 3 % were measured. The equation for referencing is detailed in the Appendix.

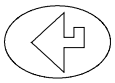
Oxygen referencing prevents false readings being submitted, e.g. allowing more air into the boiler will increase the oxygen level in the flue and hence dilute any toxic gas reading. Oxygen referencing gives readings as if they were undiluted.

SMOKE: Allows the user to enter a smoke test number from 0-9. This value will be printed on the standard printout. Default value is OFF.

RESET : Allows the user set the Oxygen to 20.9% and zero the toxic sensors without turning the analyser off.

Selecting YES and  will display the following screen.

RESET SENSORS
O2 % : 20.9 CO & NO = 0
PRESS ENTER
MENU TO ESCAPE

After pressing  the analyser will count down for 10 seconds and then return to the main display.

WARNING: The sensors must only be reset if you are sure they have been sampling fresh air for at least 3 minutes. Errors in measurement will occur if the sensors are reset during or just after sampling.

PITOT: When pressure units set to m/s Pitot Mode is active, adjust the PITOT setting/value here.

SUB MENU - **2. UNITS**

TEMP	: C
GAS	: ppm
PRESS.	: mbar
EFF.	: GROSS

Allows all displayed units to be changed.

TEMP: Choose from Centigrade, °C, or Fahrenheit, °F.

GAS: Changes the toxic gas measurement units. Select from volumetric readings, parts per million (ppm) or mass flow reading milligrams per cubic meter (mg/m^3). When set to m/s. Pitot flow mode is active. FLOW will show on measure screen instead of XAIR.

PRESS.: Flue draught can be displayed in millibar (mbar), hectaPascals (hPa), millimeters water gauge (mmWG) or inches water gauge (in WG).

EFF.: Efficiency can be selected for gross or net values. Gross efficiency assumes latent heat of vaporisation is lost in the boiler and hence will be lower than net efficiency. For natural gas the difference will be approximately 11%.

Efficiency is displayed as EFF (G) or EFF (N) respectively. Should the instrument detect that a condensing boiler is under test then it automatically switches to a third mode that is displayed as EFF (C).

SUB MENU - **3. DISPLAY**

LIGHT	**: OFF**
MODE	**: 8-PAGE**
CONTRAST	**: DEFAULT**

Allows the configuration of the display to be changed.

LIGHT: Choose from ON or OFF.

MODE: Select 4 or 8 Page Mode or Line Scroll Mode as detailed in section MAIN DISPLAYS.

CONTRAST: The contrast is set to a DEFAULT value or can be adjusted ↑ LIGHTER or ↓ DARKER. Use the  and  keys to adjust.

SUB MENU - **4. SET UP**

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

- Language.
- Automatic calibration time
- CO gas alarm
- NOx percentage for calculation
- Date and time
- Printout header
- Printer type

Page 1:

LANG	: ENGLISH	
CO MENU	:	
CALENDAR	:	
ZERO	: 90	↓

Page 2:

NOx%	: -	↑
HEADER		
PRINT	: KANE IRP2	

Parameter	Description	Settings
LANG:	Changes the analysers displayed and printed language.	**ENGLISH** **SPANISH** **DUTCH** **FRENCH** **ITALIAN**
ZERO:	Allows setting of the Autocalibration time in minutes. Care must be taken when changing this parameter as sensors may drift from zero if too short a time is used. Kane International advise 3 minute countdown.	**90 seconds** **120 seconds** **180 seconds** **300 seconds**
NO REF:	Displayed on the Nitric Oxide unit only. Allows the percentage P in the following calculation to be set. The default value set is 5%. Note the percentage allows for NO_2 in a typical boiler.	**OFF** **1-9%**
CALENDAR:	Allows the user to change the date and time. (24 hour clock).	

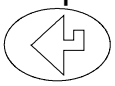
$NO_x = NO + P\%\ NO$

This screen will be shown once the parameter is entered:

	hh : mm : ss
TIME	**13 : 53 : 26**
FORMAT	**dd : mm : yy**
DATE	**23 07 : 15**

FORMAT: Changes the date format for display and printing.

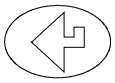
dd : mm : yy
yy : mm : dd
mm : dd : yy

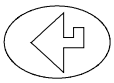
To change the time position the cursor on TIME and press  .

The cursor will now be to the left of the 13:

	hh : mm : ss
TIME	13 : 53 : 26
FORMAT	dd : mm : yy
DATE	23 07 : 15

Using  and  scroll through the setting options i.e. 0-23.

Once the correct hour is set press  to move to the next parameter, the cursor will move to the left of minutes (53). Move to each parameter until the correct time is set.

Pressing  after setting the seconds will return the cursor to the left of the screen.

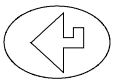
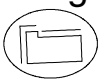
Format and Date are set in a similar manner.

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.

This screen shows the standard header setting with the cursor now shown underlining the K in Kane:

KANE945
YOUR COMPANY NAME &
PHONE NUMBER HERE
LEFT KEY USE STORE

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.

CO MENU: Once an alarm has been exceeded the display will flash every two minutes warning the user of an alarm state and display the gas concentration.

```
-- -- -- -- -- -- -- -- -- -- -- -- -- -- -- -- --
              CO ALARM
              1010 ppm
-- -- -- -- -- -- -- -- -- -- -- -- -- -- -- -- --
```

A similar display will be shown during a RECHARGE BATTERY and PUMP OFF alarms.

Press  to return to the SET UP menu.

CO ALARM: Allows an alarm level to be set on for the CO reading. This is set as a default at 1000ppm.

OFF
0-4000ppm

PRINT: Allows printer type to be changed.

Note: Wireless passkey is 1111

KMIRP (default)

KMIRP2

WIRELESS (if fitted)

7. PRINTING INFORMATION

Supplied as accessories for the KANE945 are infra-red thermal printers. Read the manual supplied with each printer prior to operation. Connections to the KANE945 are detailed below:

OPTIONAL 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 KANE945 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 interupted. Keep the KANE945 pointing at the printer until the printout has finished.

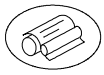
OPTIONAL WIRELESS MODULE

The KANE945 can communicate with a PC and mobile devices.

Compatibility with 2.1 for Android / PC.

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

PRINTING A 'LIVE' TEST

During a combustion test the KANE945 will print data on request. With the analyser showing the MAIN DISPLAY press  and current data will be sent to the printer.

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

* * * * * **PRINTING** * * * * *

STANDARD PRINTOUT

The standard printout is:

KANE945

YOUR COMPANY NAME &
PHONE NUMBER HERE

SERIAL:	123456789	
DATE:	27-07-2015	
TIME:	10:26:12	

NATURAL GAS		
O2	20.7	%
CO	--------	ppm
CO2	02>20	%
CO/CO2	0.0000	R
COn	--------	ppm
P INDEX	0.00	%
FLUE	--------	°C
INLT	--------	°C
NETT	--------	°C
AMBIENT	28.1	°C
Prs	0.5	mbar
FLOW	--------	m/s
XAir	02>20	%
EFF (G)	02>20	%
EFF (N)	02>20	%
LOSSES	02>20	%
O2 Ref	OFF	

SOFTWARE COMPATIBILITY

The KANE945 when fitted with the 2.1 module is compatible with:

ANDROID: Printer App

PC: KANE LIVE

8. STORING AND RETRIEVING DATA

The KANE945 can store combustion tests. Once stored, the data can be viewed on the display or downloaded to a PC or printer.

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
LOCATION      : 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.

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.

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

VIEWING AND PRINTING A 'STORED' TEST

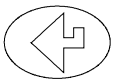
Multiple tests can be printed easily with the KANE945.

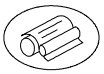
Select PRINT under MODE in the STORE menu. This feature is in addition to the VIEW/PRINT, STORE and DELETE options.

Press to access the STORE MENU

```
        STORE MENU
MODE          : PRINT
LOCATION      : 1 TO 10
      PRESS 'PRINT'
```

The cursor will move to the first number, use the  and  to select the location and start printing.

Press  to move the cursor to the second number, select the last location to print.

To print the data press  . In the screen shown above locations 1 to 10 will be printed.

During printing the following will be shown:

PRINT TESTS **1 TO 10** **PRINTING TEST 1**

NOTE: While the display above is shown (i.e. the instrument is printing a test) the keypad is disabled. To exit from printing wait until the current test has finished and the display below is shown:

Press  to exit the print routine. The instrument will return to main display:

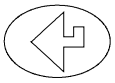
PRINT TESTS **1 TO 10** **PLEASE WAIT** **MENU TO ESCAPE**

DELETING DATA

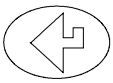
To delete the data in stored memory press  to obtain the STORE MENU (as above) :-

Press  to access the STORE MENU

STORE MENU **MODE : DELETE** **LOCATION : 3** **PRESS 'ENTER' TO DELETE**

Press  to access delete data screen

ENTER TO ERASE DATA **MENU TO ESCAPE**

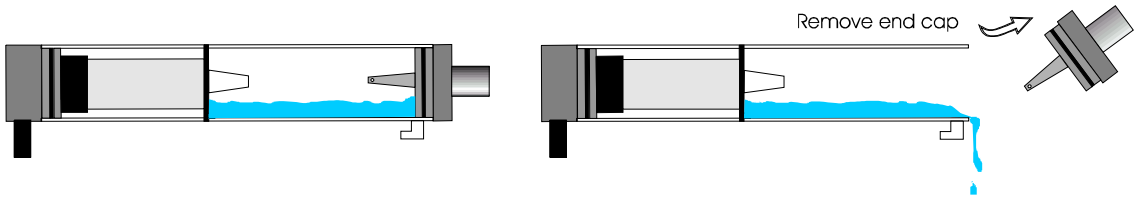
Press  to delete data in memory, press  to exit delete data screen.

9. MAINTENANCE

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.

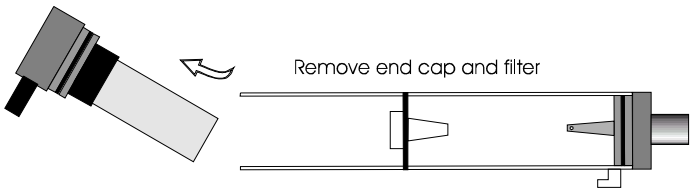
Emptying of the water trap is detailed below :-



Carefully remove the end cap from the in-line housing. Dispose of the condensate in a suitable drain, care must be taken as it could be acidic. If condensate spills onto the skin or clothing, clean off immediately using fresh water, seek medical advice if problems occur.

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.



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.

10. 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 Service Department or an International Distributor for expert advice.

Fault symptom	Causes
• Oxygen too high • CO_2 too low	• Air leaking into probe, tubing, water trap, connectors or internal to instrument. • Oxygen cell needs replacing.
• Oxygen Error (FAULT) • Toxic sensor Error (FAULT)	• Calibration time set too short and instrument not allowed to stabilise • Instrument has been stored in a cold environment and is not at normal working temperature. • Oxygen cell or toxic sensors needs replacing.
• Analyser not holding charge • Analyser not charging	• Battery exhausted. • AC charger not giving correct output. • Fuse blown in charger plug.
• Analyser does not respond to flue gas	• Particle filter blocked. • Probe or tubing blocked. • Pump not working or damaged with contaminants. • Probe connected to pressure connector.
• Flue 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.
• Display shows dark lines and no response from ON/OFF key.	• Fault has occurred on the instrument electronics and requires resetting. Contact Kane International or Distributor.

12. PRODUCT SPECIFICATION

Parameter	Resolution	Accuracy	Range
Temp Measurement Flue Temperature Inlet Temperature	 0.1°C/F 0.1°C/F	 ±2.0°C ±0.3% reading ±1°C ±0.3% reading	 0-1200°C/32 -2200°F with suitable probe 0-50°C/32-122°F
Gas Measurement Oxygen	 0.1%	 ±0.2%[*1]	 0-25%
Carbon Monoxide H_2 compensated	1ppm	±5ppm <100ppm ±20ppm <400ppm[*1] ±5% >400ppm	0-4000ppm
Carbon Monoxide,	1ppm	±20ppm <400ppm[*1] ±5% <5000ppm ±10% >5000ppm	0-100000ppm
Nitric Oxide Low range	1ppm	±3ppm <20ppm ±5ppm<100ppm	0-100ppm
Nitric Oxide (optional)	1ppm	±5ppm <100ppm[*1] ±5% >100ppm	0-5000ppm
Nitrogen Dioxide (optional)	1ppm	±3ppm<20ppm ±5ppm<100ppm	100ppm
Sulphur Dioxide (optional)	1ppm	±5ppm<100ppm +5%>100ppm	0-5000ppm
Pressure	0.1mbar	±0.5% full scale	150 mbar
Carbon Dioxide[*2]	0.1%	±0.3% reading	0-99.9%
Losses[*2]	0.1%	±1.0% reading	0-99.9%
Efficiency[*2]	0.1%	±1.0% reading	0-99.9%
Excess Air[*2]	0.1%	±0.2%	0-2885.0%
Temp (Nett) [*2]	1.0°C/F	±2°C ±0.3% reading	0-1200°C/32-2200°F
CO/CO_2 ratio[*2]	0.0001	±0.0001	0-0.9999
Poison Index [*2]	0.01%	±0.01	0-99.99
Pre-programmed Fuels		Natural gas, Town gas, Gascor, Light Oil, Heavy Oil, Propane, Butane, Anthracite, Coke, Coal, Kinsale Gas.	
Dimensions Weight Handset Probe		 1kg 220mm x 55mm x 120mm L240mm x Dia8mm with 285mm long stainless steel shaft, type K thermocouple and 1.5m long neoprene hose	
Ambient Operating Range		-5°C to +50°C/10% to 90% RH non condensing	
Power Supply (battery charger)		Input: 110Vac/220 Vac nominal Output: 12 Vac off load	
Battery Life		>8 hours from full charge	

[*1] Using dry gases at STP
[*2] Calculated

APPENDICES

A. MAIN DISPLAY PARAMETERS

The parameters and their meanings are detailed as follows : -

DATE: Analyser date. See **SET UP MENU** to change

TIME: Analyser time. Use **SET UP MENU** 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**.

NETT: (ΔT) Nett temperature calculated by deducting the internal AMBIENT temperature from the measured FLUE temperature. Displays in either °C (C) or °F (F) and will display NOT FITTED (N/F) if flue probe is not connected.

If an external INLET probe is used then INLET is deducted from FLUE.

O2: Oxygen reading in percentage %.

CO: Carbon Monoxide reading indicated in ppm or mg/m3. If the figures are referenced to oxygen then the display will show **CO(n)**. See SELECT menu 5.2.2 for oxygen reference. The display will read 'O2 > 20%' if referenced values selected and instrument is in clean ambient air.

EFF (G): Combustion Efficiency calculation displayed in percentage. Gross G or Net N can be set see SELECT menu 5.2.3. The calculation is determined by fuel type see Appendix B for calculation. The efficiency is displayed during a combustion test, '- -' is displayed while in fresh air.

CO2: Carbon Dioxide calculation determined by the type of fuel. This only shows a reading when a combustion test is being carried out. '- -' is displayed while in fresh air.

FLUE: (Tf) Temperature measured by flue gas probe in Centigrade or Fahrenheit. Will show ambient temperature after fresh air calibration and **NOT FITTED (N/F)** or **FAULT (FLT)** if probe disconnected.

INLET: (Ti) Temperature measured by the optional inlet air probe. This probe is plugged into the instrument through the RS232 socket. This figure is used to calculate the NET temperature instead of AMBIENT when fitted.

AMBIENT: (Ta) Temperature measured by the internal sensor, used in the NET temperaturecalculation if an INLET probe is not fitted.

CO/CO2 R : The CO/CO_2 ratio, is the ratio of measured CO divided by calculated CO_2.

It gives an indication of the following :-

How good a gas sample the instrument is reading.
How clean the boiler is running.

For example:

A new or clean domestic boiler will display a ratio of less than 0.0040, a unit in need of cleaning 0.0040-0.0080 and a unit in need of major overhaul will show greater than 0.0080.

This only shows a reading when a combustion test is being carried out. '- -' is displayed while in clean ambient air.

P INDEX: (PI) The CO/CO_2 ratio expressed as a percentage %, called the 'Poison Index' i.e. P INDEX % = 100 x CO/CO_2. '- -' is displayed while in clean ambient air.

XAIR %: (λ) Excess air calculated from the measured oxygen and type of fuel used. During a combustion test 'O2 > 20%' will be displayed while in clean ambient air.

FLOW: Pitot Flow Rate in m/s when m/s selected in pressure units

Prs: Flue draught pressure reading. Displayed when pressure sensor fitted. See UNITS menu for scales.

NO: Nitric Oxide reading in ppm or mg/m3. Displayed when Nitric Oxide sensor fitted. Also displayed as **NO (n)** when referenced to oxygen. The display will read 'O2 > 20%' if referenced values selected and instrument is in clean ambient air.

NOx: Calculated total Nitric oxides displayed in ppm or mg/m3. Where NOx = NO + P%NO, note P can be set from 0-9%, default = 5%. See SELECT menu 5.2.2. Also displayed as **NOx (n)** referenced to oxygen. The display will read 'O2 > 20%' if referenced values are selected and instrument is sampling clean ambient air.

SO2 : Sulphur Dioxide reading in ppm or mg/m3. Displayed when Sulphur Dioxide sensor fitted. Also displayed as **SO2 (n)** referenced to oxygen. The display will read 'O2 > 20%' if referenced values selected and instrument is in clean ambient air.

O2 ref %: (O2r) Toxic gas measurements can be referenced to defined oxygen levels. See SELECT menu for details.

B. COMBUSTION EFFICIENCY CALCULATION

The efficiency calculation is based upon British Standard BS845.

This identifies three sources of loss associated with fuel burning:

Losses due to flue gasses:	Dry Flue gas loss, Moisture and hydrogen Sensible heat of water vapour Unburned gas
Losses due to refuse:	Combustible in ash Combustible in riddlings Combustible in dust
Other losses:	radiation convection conduction other unmeasured losses

Net efficiency calculations assume that the energy contained in the water vapour (formed as a product of combustion and from wet fuel) is recovered and the wet loss term is zero. Gross efficiency calculations assume that the energy contained in the water vapour is not recovered.

Since the fuel air mixture is never consistent there is the possibility of unburned/partially unburned fuel passing through the flue. This is represented by the unburned carbon loss.

Losses due to combustible matter in ashes, riddlings, dust and grit, radiation, convection and conduction are not included.

Efficiency Calculation:

Known Data - Fuel:

Qgr = Gross Calorific Value (kJ/kg)
Qnet = Net Calorific Value (kJ/kg)
K1 = Constant based on Gross or Net Calorific Value:
K1g = (255 x %Carbon in fuel)/Q_{gr}
K1n = (255 x %Carbon in fuel)/Q_{net}
K2 = % max theoretical CO_2 (dry basis)
K3 = % Wet Loss
H_2 = % Hydrogen
H_2O = % Water

Measured Data: Tf = Flue Temperature
Ti = Inlet Temperature
O_2m = % Oxygen in flue gas
O_2r = Oxygen reference %

Calculated data: Tnet = Net Temperature
% CO_2 content in flue gas
% Dry Flue Gas losses
% Wet losses
% Unburned carbon loss
% Efficiency

Tnet = Flue Temperature - Inlet Temperature

Dry flue gas loss % = 20.9 x K1 x (Tnet) / K2 x (20.9 - O_2m)

Wet loss % = 9 x H_2 + H_2O / Qgr x [2488 + 2.1Tf - 4.2 Ti]

simplified = [(9 x H_2 + H_2O) / Qgr] x 2425 x [1 + 0.001 Tnet]

Wet loss % = K3(1+0.001xTnet)

Where K3 = [(9 x H_2 + H_2O) / Qgr] x 2425

Net Efficiency % = 100 - dry flue gas losses

= 100 - 20.9 x K1n x (Tnet) / K2 x (20.9 - O_2m)

Gross Efficiency % = 100 - {dry flue gas losses + wet losses}

= 100 – {[20.9 x K1g x (Tnet) / K2 x (20.9 - O_2m)]+ [K3 x (1 + 0.001 x Tnett)]}

Excess Air = [(20.9% / (20.9% - 0_2m%)) – 1] x 100%

CO_2% = [(20.9 - O_2m) x K2 / 20.9]

Unburned fuel Loss % = K4 x CO / (CO + CO_2)
Note: CO scaled in %

Where K4 = 70 for coke
= 65 for anthracite
= 63 for Bituminous coal
= 62 for coal tar fuel
= 48 for liquid petroleum fuel
= 32 for natural gas

The formula for K4 is based on the gross calorific value Qgr. To obtain the loss based on net calorific value multiply by Qgr/Qnet. Since this loss is usually small this conversion has been ignored. This loss is subtracted from the efficiency.

Oxygen Reference $CO(n) = CO \times \frac{(20.9 - O_2r)}{(20.9 - O_2m)}$

C. CALCULATION OF FUEL DATA

For any fuel not specified by Kane International the net calorific value, gross calorific value and composition should be obtained from the fuel supplier.

The following fuel data has been calculated with reference to the efficiency calculation.

Example 1:

Chemical composition:	C	25%
	H_2	3%
	H_2O	50%
	Q_{net}	8.35 MJ/kg
	Q_g	9.3 MJ/kg *
	Max CO_2	20.4%

K1n = (255 x % carbon in fuel) / Q_{net} (kJ/Kg)
= (255 x 25) / 8350 = **0.763**

K1g = (255 x % carbon in fuel) / Q_g (kJ/Kg)
= (255 x 25) / 9300 = **0.685**

K2 = Max % CO_2 = **20.40**

K3 = Wet Loss = [(9 x %H_2 + %H_2O) / 9300] x 2425
= [(9 x 3 + 50) / 9300] x 2425
= (77 / 9300) x 2425 = **20.08**

K4 = **65** (an approximation for wood) *

The fuel values to program into the Analyser are as follows:

NATURAL GAS			
K1g	**: 0.763**	**K1n**	**: 0.685**
K_2	**: 20.4**	**K_3**	**: 20.08**
K_4	**: 65**	**O2r**	**: 8.0**

* Assumed values in the absence of supplied data.
See previous appendix for other fuels.

D. ELECTROMAGNETIC COMPATIBILITY (CE) STATEMENT

European Council Directive 89/336/EEC requires electronic equipment not to generate electromagnetic disturbances exceeding defined levels and have adequate immunity levels for normal operation. Specific standards applicable to this meter are stated below.

As there are electrical products in use pre-dating this Directive, they may emit excess electromagnetic radiation levels and, occasionally, it may be appropriate to check the meter before use by:

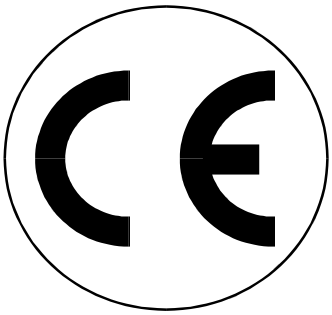
Use the normal start up sequence in the location where the meter will be used.

Switch on all localized electrical equipment capable of causing interference.

Check all readings are as expected. A level of disturbance is acceptable.

If not acceptable, adjust the meter's position to minimize interference or switch off, if possible, the offending equipment during your test.

At the time of writing this manual (May 2016) Kane International Ltd are not aware of any field based situation where such interference has occurred and this advice is only given to satisfy the requirements of the Directive.



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

EN 61000-6-3 : 2011

EN 61000-6-1 : 2007

and is certified to be compliant

Specification EC/EMC/KI/KANE945/1 details the specific test configuration, performance and conditions of use.