

KM800
Compact
Combustion
Analyser

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Stock No 17149 July 98

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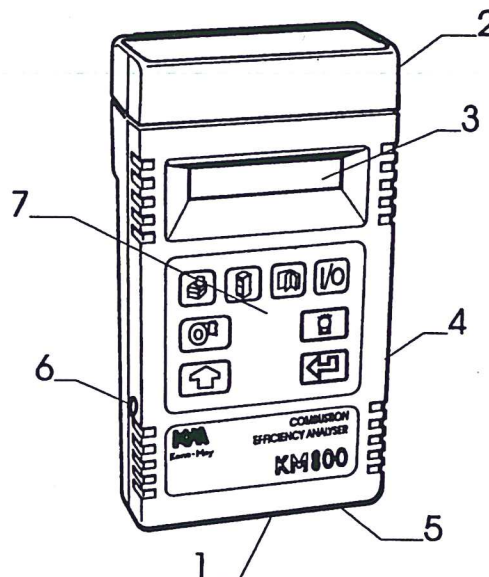
CONTENTS

	Page No:
1. ANALYSER LAYOUT AND FEATURES.....	1
1.1 Instrument Features And Keypad.....	1
1.2 Standard Probe Configuration.....	2
1.3 Analyser Connections	3
2. SAFETY WARNING.....	4
3. FIRST TIME USE.....	4
3.1 Fitting Batteries.....	4
4. NORMAL START UP SEQUENCE	5
4.1 Every Time You Use The Analyser	5
4.2 Automatic Calibration	5
4.3 Changing The Main Display	6
4.4 Setting Ambient Temperature	6
4.5 Sampling The Flue Gas	7
4.6 Regular Checks During Sampling.....	7
4.7 Normal Shutdown Sequence	8
4.8 Electromagnetic Compatibility	8
5. MOVING THROUGH THE MENU.....	9
5.1 Basic Operation	9
5.2 Menu Options And Settings.....	10
5.2.1 Menu Options.....	10
Fuel	10
SET 20.9% O ₂	10
REF O ₂	11
Time.....	11
Date.....	11
Contrast.....	12
C <-> F Temperature.....	12
NETT <-> GROSS Efficiency	12
Header.....	12
Select Language.....	13









6. PRINTING INFORMATION.....	14
6.1 Printing a 'Live' Test	14
6.2 Standard Printout.....	14
7. STORING AND RETRIEVING DATA	15
7.1 Storing a 'Live' Test.....	15
7.2 Viewing and Printing a 'Stored' Test	15
7.3 Clearing Logged Data	16
8. MAINTENANCE	17
8.1 Emptying And Cleaning The In-Line Water Trap.....	17
8.2 Changing The Particle Filter	17
9. PROBLEM SOLVING.....	18
10. CALIBRATION	18
11. PRODUCT SPECIFICATION	19
APPENDICES:	
A. MAIN DISPLAY PARAMETERS	20
B. COMBUSTION EFFICIENCY CALCULATION	22
C. OXYGEN REFERENCE.....	24
D. ELECTROMAGNETIC CAPATIBILITY STATEMENT.....	25

1 ANALYSER LAYOUT AND FEATURES

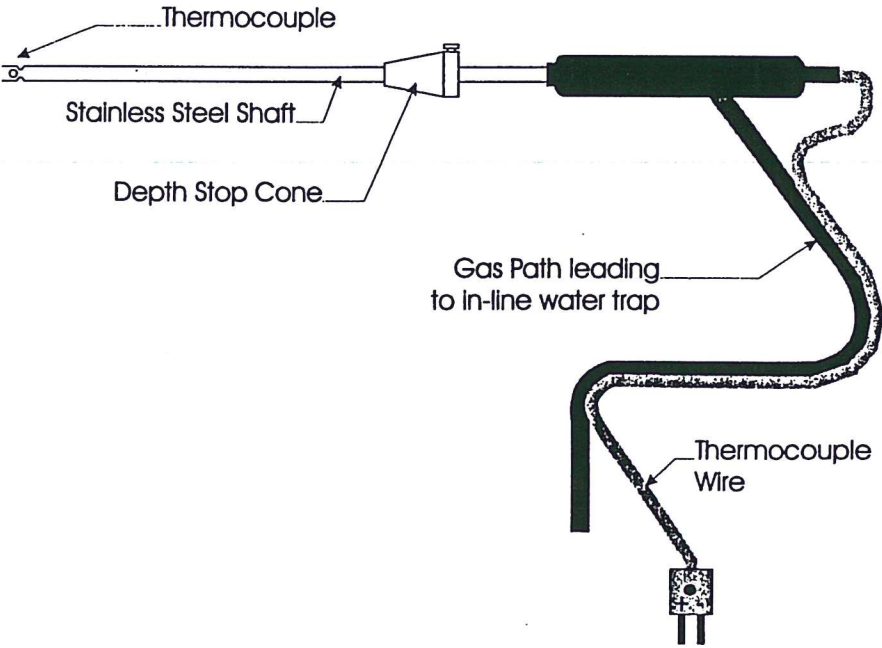
1.1 Instrument Features and Keypad



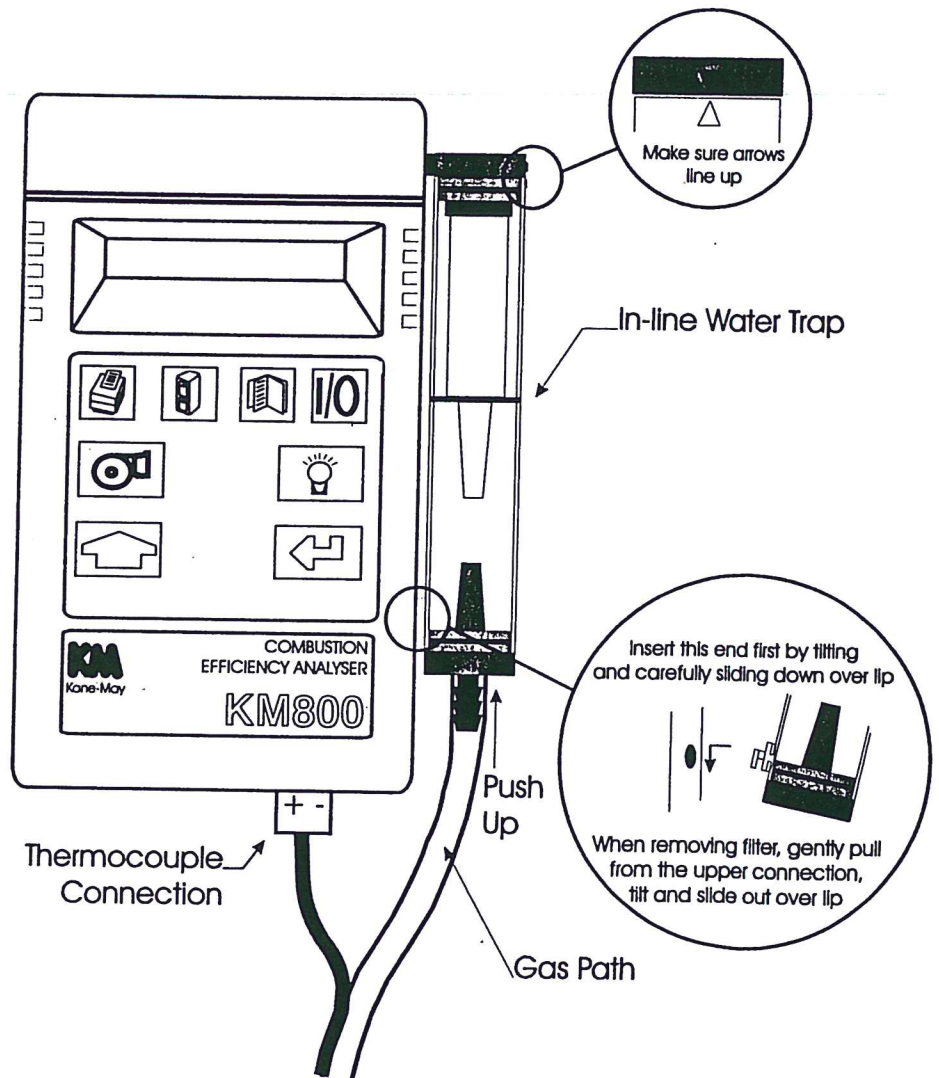
- | | |
|--------------------------|----------------------------|
| 1. Exhaust Port | 5. Thermocouple Connection |
| 2. Gas Inlet | 6. Charger Socket |
| 3. Display | 7. Keypad |
| 4. Water Trap Attachment | |

- | | |
|---|--|
|  ON / OFF
Turns analyser ON and OFF |  MENU
Allows access to all menu functions |
|  PRINT
Print 'live' or stored data |  STORE
Access the data logging menu |
|  BACKLIGHT
Turns backlight ON and OFF |  PUMP
Turns pump ON and OFF |
|  UP
Changes TOP line of display.
See also Section 5.1 |  ENTER
Changes BOTTOM line of display.
See also Section 5.1 |

1.2 Standard Probe Configuration



1.3 Analyser Connections





2. SAFETY WARNING

This analyser extracts combustion gases that may be toxic in relatively low concentrations. These gases are exhausted from the bottom 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.***

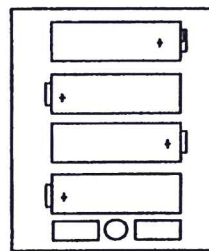
3. FIRST TIME USE

Check that you have all the items you have ordered.

Take time to read this manual fully.

3.1 Fitting Batteries

The KM800 is supplied with 4 AA size alkaline batteries. These should be fitted into the instrument as shown below :-



Battery compartment

Note ! Rechargeable batteries can be used in this instrument.

See Appendix A - Main Parameters for the Battery Level Indicator.

An optional AC adapter can be supplied to charge rechargeable batteries. ***Ensure the correct charger is used or damage may occur to the instrument.***

4. NORMAL START UP SEQUENCE

4.1 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 flue gas probe is sampling ambient FRESH air

the water trap is fitted correctly to the instrument

the flue temperature plug is connected

Switch ON the instrument by pressing



4.2 Automatic Calibration

During this sequence the analyser pumps fresh air into the Oxygen and CO sensors to allow them to be set to 20.9 % and zero respectively. If the flue probe is connected then the temperature of the probe tip is set as ambient in the instrument. See **Section 4.4. - Setting Ambient Temperature** detailed below.

After switch-on the analyser will briefly display:-

KANE - MAY LTD
* KM800 *

And then show the countdown screen :-

ZERO CAL
TIME : 180

The calibration time will count down in seconds to zero and is preset to 180 seconds.

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  to access the **MAIN DISPLAY** and automatically set Oxygen to 20.9% and CO to zero.

O2	%	20.9
FLUE	. . C	25

MAIN DISPLAY

4.3 Changing the Main Display

The Main Display can be configured to read any two parameters shown in **Appendix A - Main Display Parameters**. Each line is changed independently as follows :-

To change the TOP line
use 

CO2	%	0.0
FLUE	. . C	25

To change the BOTTOM line
use 

CO2	%	0.0
CO	PPM	00

4.4 Setting Ambient Temperature

During the Automatic calibration sequence the AMBIENT temperature used in the NETT temperature calculation is stored in the analyser. There are two methods of storing the AMBIENT temperature.

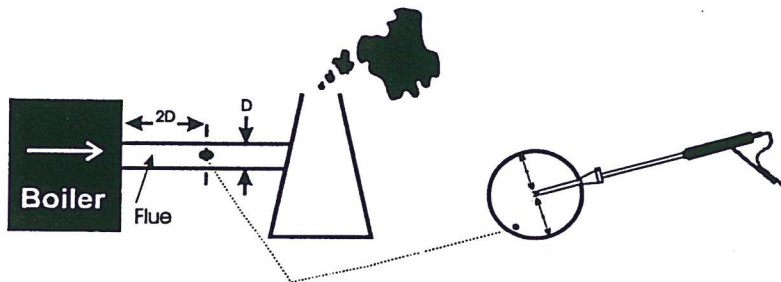
- A. Without the flue probe connected the analyser temperature is taken
- B. If the flue probe is connected then the temperature of the probe tip is taken. This can be used when the temperature of the air entering the burner is higher than the ambient temperature of the boiler house. i.e. on pre-heated air burners

WARNING If the AMBIENT temperature is set incorrectly then errors will be made in the calculation of the Nett temperature and Efficiency.

4.5 Sampling the Flue Gas

Once the automatic calibration procedure has been completed and the specific fuel has been selected (See MENU options) 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. A low Oxygen reading will indicate this.



The probe depth stop cone provided with the instrument allows the probe to be used in holes whose diameters range from 8 mm ($5/16$ to $4/5$ inch).

The standard probe is rated at 600°C (1112°F).

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




4.6 Regular Checks During Sampling

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

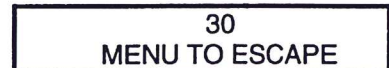
- Do not exceed the maximum temperature of the flue probe.
- The analyser internal temperature does not exceed normal operating range.
- DO NOT PLACE THE INSTRUMENT ON A HOT SURFACE.
- The water trap is correctly attached at all times. Water condenses in the probe line and can quickly fill the water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

4.7 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 and the readings have returned to ambient levels hold down  and switch off the analyser.

The instrument will count down from 30 to switch off and display the following screen.



If you press  by mistake  will return you to normal operation.

4.8 Electromagnetic Compatibility

The European Council Directive 89/336/EEC requires that electronic equipment does not generate electromagnetic disturbances that exceed defined levels and has an adequate level of immunity to enable it to be operated as intended. The specific standards applicable to this product are detailed in the appendices.

Since there are many electrical products in use that pre-date this Directive and may emit electromagnetic radiation in excess of the standards defined in the Directive there may be occasions where it would be appropriate to check the analyser prior to use. The following procedure should be adopted:

Go through the normal start up sequence in the location where the equipment is to be used.

Switch on all localised electrical equipment that might be capable of causing interference.

Check that all readings are as expected. (A level of disturbance in the readings is acceptable).

If not, adjust the position of the instrument to minimise interference or switch off, if possible, the offending equipment for the duration of the test.

At the time of writing this manual (July, 1998) Kane International Ltd is not aware of any field based situation where such interference has ever occurred and this advice is only given to satisfy the requirements of the Directive.

5. MOVING THROUGH THE MENU

5.1 Basic Operation

From the MAIN DISPLAY

O2 %.....	20.9
EFF (G) %.....	0.0

Press  to access the MAIN MENU

MAIN MENU
FUEL

Use  to scroll through the options

MAIN MENU
CONTRAST

Press  to access selected Function

FUEL
NATURAL GAS

Use  to scroll through the options

FUEL
BUTANE

Press  or  to return to the Menu

MAIN MENU
CONTRAST


Press  to return to the MAIN DISPLAY

O2 %.....	20.9
EFF (G) %.....	0.0

5.2 Menu Options and Settings

MAIN MENU
FUEL

All functions are accessed using  and exited using 

 scrolls either options in the menu or a parameter to be changed.

5.2.1 Menu Options

OPTION	DESCRIPTION	CHOOSE
FUEL	Select the fuel being used by the boiler from list of standard fuels.	NATURAL GAS TOWN GAS LIGHT OIL PROPANE BUTANE GASCOR LPG KINSALE GAS
SET O2 %	Sets the instrument sensors to autozero values i.e. 20.9 % Oxygen and zero Carbon Monoxide. Note the probe must be in fresh air for 2 to 3 minutes	ENTER TO SET MENU TO ESCAPE

Pressing  will start the pump running if turned off and display the ZERO CAL screen:-

ZERO CAL
TIME : 5

The instrument will countdown from 5 seconds and revert to the main display.



REF O2 ..

Toxic gas measurements can be referenced to defined oxygen levels. Reference values can be set from 1-20% or turned OFF as default. Oxygen Referencing is detailed in Appendix C.

YES
NO

If YES is selected then the following screen will be displayed :-

REF O2 ..
REF O2 .. 20.9

To enter the reference value use  to change the first number and press  when correct. Repeat until the value is set i.e. 3 % oxygen reference in the display below:-

REF O2 ..
REF O2 .. 03.0

TIME

Input the time in hours and minutes. **ENTER** to change

MAIN MENU
TIME

As with changing numbers for setting REF O2 set each number until the time is set correctly.

TIME
10 : 19

DATE

Alter the order of the day, month and year then:
Input the today's date.

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

MAIN MENU
DATE

As with changing numbers for setting TIME set each number until the date is set correctly.

DATE
15 - 06 - 98

CONTRAST

The contrast is set to a default value or can be adjusted. Note the screen may jump from dark to clear.

To adjust, hold



C <--> F

Temperature readings displayed in either Centigrade C or Fahrenheit F.

CENTIGRADE
FAHRENHEIT

NETT <--> GROSS


Efficiency can be selected for Gross or Nett values. Gross efficiency assumes latent heat of vapourisation is lost in the boiler and hence will be lower than Nett efficiency. For Natural Gas the difference will be approximately 11%.

GROSS
NETT

HEADER


Allows two lines of 16 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. By using  any letter or number can be chosen from the following list :-

ABCDEFGHIJKLMNOPQRSTUVWXYZ[¥] ^ _ `
abcdefghijklmnopqrstuvwxyz { | } → ! " # \$ %
& ' () * + , - . / 0123456789 : ; < = > ? @

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.

TIP Take time to select each letter as it can be easy to miss one and you will have to go around the whole list again.

SELECT LANGUAGE

Changes the analysers displayed and printed language.

ENGLISH
ITALIAN
FRENCH
DUTCH
SPANISH

6. PRINTING INFORMATION



Supplied as an accessory for the KM800 is an infra-red thermal printer. Read the manual supplied with the printer prior to operation. Connection to the KM800 is 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 KM800 and the bottom of the printer. Ensure they are pointing at each other and within 1 metre, with no obstructions in the way. Data may be lost if transmission is interrupted. Keep the KM800 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 combustion test the KM800 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 *****

6.2 Standard Printout

The standard printout is shown below :-

KM800		
26 - 06 - 98		14:27
SMOKE :		
NATURAL GAS		
O2	%	20.9
CO2	%	0.0
CO	PPM	00
EFF% (G)	----	
NETT .	C	----
FLUE .	C	----
AMBIENT	C	21
PI	%	0.00
CO/CO2R		0.0000
XAIR	%	----
O2 REF ..	%	3.0

7. STORING AND RETRIEVING DATA



The KM800 can store up to 15 combustion tests. Once stored, the data can be viewed on the display or downloaded to the infra-red 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
* STORE * TO LOG

Select from the following :-

- * STORE * TO LOG - Allows data to be stored in memory.
- VIEW / PRINT - Stored data can be viewed or printed.
- DATA - Clears all data in memory.


To store a test set to 'STORE' TO LOG and press . The current readings will be stored in the analysers memory.

Displayed when logging data


LOG NUMBER 02

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 select the following :-

STORE MENU
VIEW/PRINT


 to access the location selection screen.


VIEW/PRINT
LOCATION 01

Use  to select the location in memory to view or print. Once the correct location is selected press  to view the data.

Use  to change the bottom line and view data stored →

VIEW/PRINT	01
FLUE . . . C	25

To print the data press .

Press  to return to the MAIN MENU.

TIP : To change the location being viewed press .

7.3 Clearing Logged Data



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

Use  to select DELETE DATA

STORE MENU DELETE DATA

Press  to access delete data screen

ENTER to ERASE MENU to ESCAPE

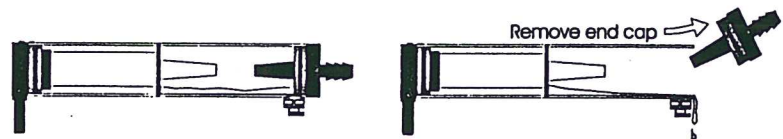
Press  to delete data in memory, press  to exit delete data screen.

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 in the probe line, which may cause the water trap to fill suddenly if the probe is moved. Care should be taken at all times.

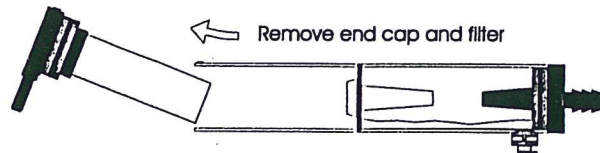
Emptying of the water trap is detailed below :-



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.

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 appears 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.

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 Service Department or an International Distributor for expert advice.

Fault symptom	Causes
<ul style="list-style-type: none"> • Oxygen too high • CO₂ too low 	<ul style="list-style-type: none"> • Air leaking into probe, tubing, water trap, connectors or internal to instrument. • Oxygen cell needs replacing.
<ul style="list-style-type: none"> • Oxygen Error (FAULT) • CO sensor Error (FAULT) 	<ul style="list-style-type: none"> • Instrument has been stored in a cold environment and is not at normal working temperature. • Oxygen cell or CO sensor needs replacing.
<ul style="list-style-type: none"> • Batteries not holding charge • Analyser not running on mains adapter. 	<ul style="list-style-type: none"> • Batteries exhausted. • AC charger not giving correct output. • Fuse blown in charger plug.
<ul style="list-style-type: none"> • Analyser does not respond to flue gas 	<ul style="list-style-type: none"> • Particle filter blocked. • Probe or tubing blocked. • Pump not working or damaged with contaminants.
<ul style="list-style-type: none"> • Nett temperature or Efficiency calculation incorrect. 	<ul style="list-style-type: none"> • Ambient temperature set wrong during Automatic Calibration.
<ul style="list-style-type: none"> • Flue temperature readings erratic 	<ul style="list-style-type: none"> • Temperature plug reversed in socket. • Faulty connection or break in cable or plug.

10. ANNUAL RE-CALIBRATION

Whilst the sensor has an expected life of more than two years in normal use it is recommended that the analyser is re-calibrated at least annually. This is so that long term drift on the sensor and electronics can be eliminated. Local regulations may require more frequent re-calibration and users should check with appropriate authorities to ensure they comply with relevant guidelines.

11. PRODUCT SPECIFICATION

Parameter	Resolution	Accuracy	Range
Temp Measurement Flue Temperature	1.0°C/F	±2.0°C (5°F) ±0.3% reading	0-600°C/32-1112°F
Gas Measurement Oxygen Carbon Monoxide	0.1% 1ppm	±0.3% ^{*1} ±10ppm <100ppm ^{*1} ±5% of reading	0-21% 0-4000ppm
Carbon Dioxide ^{*2} Efficiency ^{*2} Excess Air ^{*2} Poison Index ^{*2} CO/CO ₂ ratio ^{*2}	0.1% 0.1% 0.1% 0.1% 0.0001	±1.0% reading ±1.0% reading ±0.2% ±5% reading ±5% reading	0-30% 0-99.9% 0-250% 0-99.9% 0-1.000
Temp (Nett) ^{*2}	1.0°C/F	±2°C (5°F) ±0.3% reading	0-600°C (32-1112°F)
Pre-programmed Fuels		Natural gas, Town gas, Light Oil, Propane, Butane, Gascor, LPG, Kinsale Gas	
Dimensions Weight Handset Probe		1kg (2.2lb) 220mm (8.66") x 55mm (2.17") x 120mm (4.7") L240mm (9.45") x Dia 8mm (0.31") with 285mm (11.22") long stainless steel shaft, type K thermocouple and 3m (6ft) long neoprene hose	
Ambient Operating Range		+0°C to +40°C(32-104°F)/20% to 80% RH non- condensing	
Power Supply (battery charger)		Input: 110Vac/220 Vac nominal Output: 10 Vac off load	
Battery Life		>6 hours using Alkaline AA cells	

^{*1} Using dry gases at STP

^{*2} Calculated

APPENDICES

A. MAIN PARAMETERS

The following section gives details of the main display parameters.

- O2 :** Oxygen reading in percentage (%)
- FLUE :** Temperature is measured by the flue gas probe in Centigrade or Fahrenheit. Will show ambient temperature after fresh air calibration and '-----' if the flue probe is disconnected.
- CO:** Carbon Monoxide reading displayed in ppm (parts per million). **FAULT** is displayed if there is a fault with the CO sensor or the instrument has not set to zero correctly, switch off instrument and try again.
- 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.
- NETT :** Nett temperature calculated by deducting the **AMBIENT** temperature from the measured **FLUE** temperature. Displays in either Centigrade (°C) or Fahrenheit (°F) and will display '-----' if the flue probe is not connected.
- EFF (G) :** Combustion efficiency calculation displayed in percentage. Gross (G) or Nett (N) can be set (see **MENU**). The calculation is determined by the fuel type and uses the calculation in British Standard BS845. The efficiency is displayed during a combustion test, '-----' is displayed while in fresh air.
- FUEL :** Fuel displayed as set in the **MENU**.
- XAIR % :** Excess air calculated from the measured oxygen and type of fuel used. Displays reading during a combustion test. '-----' is displayed while in fresh air.
- AMBIENT :** Temperature measured by the sensor, used to calculate the **NETT** temperature.

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

It gives an indication of:-

- 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 0.004, a unit in need of cleaning 0.004-0.008 and a unit in need of major overhaul will show greater than 0.008.

This only shows a reading when a combustion test is being carried out.

'----' is displayed while in fresh air.

PI : The CO/CO₂ ratio expressed as a percentage %, called the 'Poison Index', i.e. $PI \% = 100 \times CO/CO_2$. '----' is displayed while in fresh air.

BATTERY %: Displays the battery level from 0-100%. Recharge when showing lower than 10%

DATE/TIME: Date shown as day, month and year. The order can be changed using the menu function. The time is shown in hours and minutes, these details are stored with each combustion test. When changing the batteries on the instrument the memory will store the date and time for up to one minute, if outside this time it may be necessary to re-enter the 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, riddlings and dust
Other losses:	radiation, convection, conduction other unmeasured losses

Nett 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:	Q_{gr} = Gross Calorific Value (kJ/kg)
	Q_{net} = Net Calorific Value (kJ/kg)
	K_1 = Constant based on Gross or Net Calorific Value:
	$K_{1g} = (255 \times \% \text{Carbon in fuel}) / Q_{gr}$
	$K_{1n} = (255 \times \% \text{Carbon in fuel}) / Q_{net}$
	$K_2 = \% \text{ max theoretical CO}_2 \text{ (dry basis)}$
	$K_3 = \% \text{ Wet Loss}$
	$H_2 = \% \text{ Hydrogen}$
$H_2O = \% \text{ Water}$	

Measured Data:	T_f = Flue Temperature
	T_i = Inlet Temperature
	$O_{2m} = \% \text{ Oxygen in flue gas}$
	$O_{2r} = \text{Oxygen reference } \%$

C. OXYGEN REFERENCE

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

What does Oxygen reference mean ?

If 3 % O₂ reference (O_{2r}) is selected and 5 % O₂ is measured (O_{2m}) in the flue then the CO gas value will be recalculated as if 3 % were measured. The equation for referencing is as follows :-

$$\text{CO PPMn} = \text{CO PPM} \times (20.9 - \text{O}_{2r}) / (20.9 - \text{O}_{2m})$$

In our example if a reading of 95 PPM were measured then the referenced value would be calculated as follows :-

$$\text{CO PPMn} = 95 \text{ PPM} \times (20.9 - 3) / (20.9 - 5)$$

$$\text{CO PPMn} = 95 \text{ PPM} \times (17.9) / (15.9)$$

$$\text{CO PPMn} = 107$$

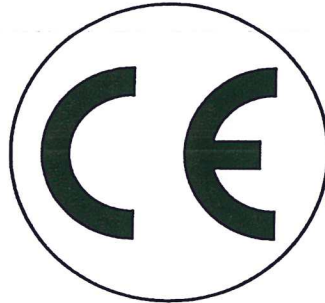
We may be given a limit on our boiler by the local authority which stated that we must not emit more than 100 PPM Carbon Monoxide referenced to 3 % Oxygen. In the example we would be breaking the limit and corrective action should be taken to reduce the level of CO.

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.

Oxygen referencing is also referred to as :-

- Normalising
- Diluted and Undiluted readings
- 'Air Free' measurements when referenced to zero % oxygen.

D. ELECTROMAGNETIC COMPATABILITY (EMC) STATEMENT



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

EN 50081-1
EN 50082-1

and is certified to be compliant

Specification EC/EMC/KI/KM800 details the specific test configuration, performance and conditions of use.