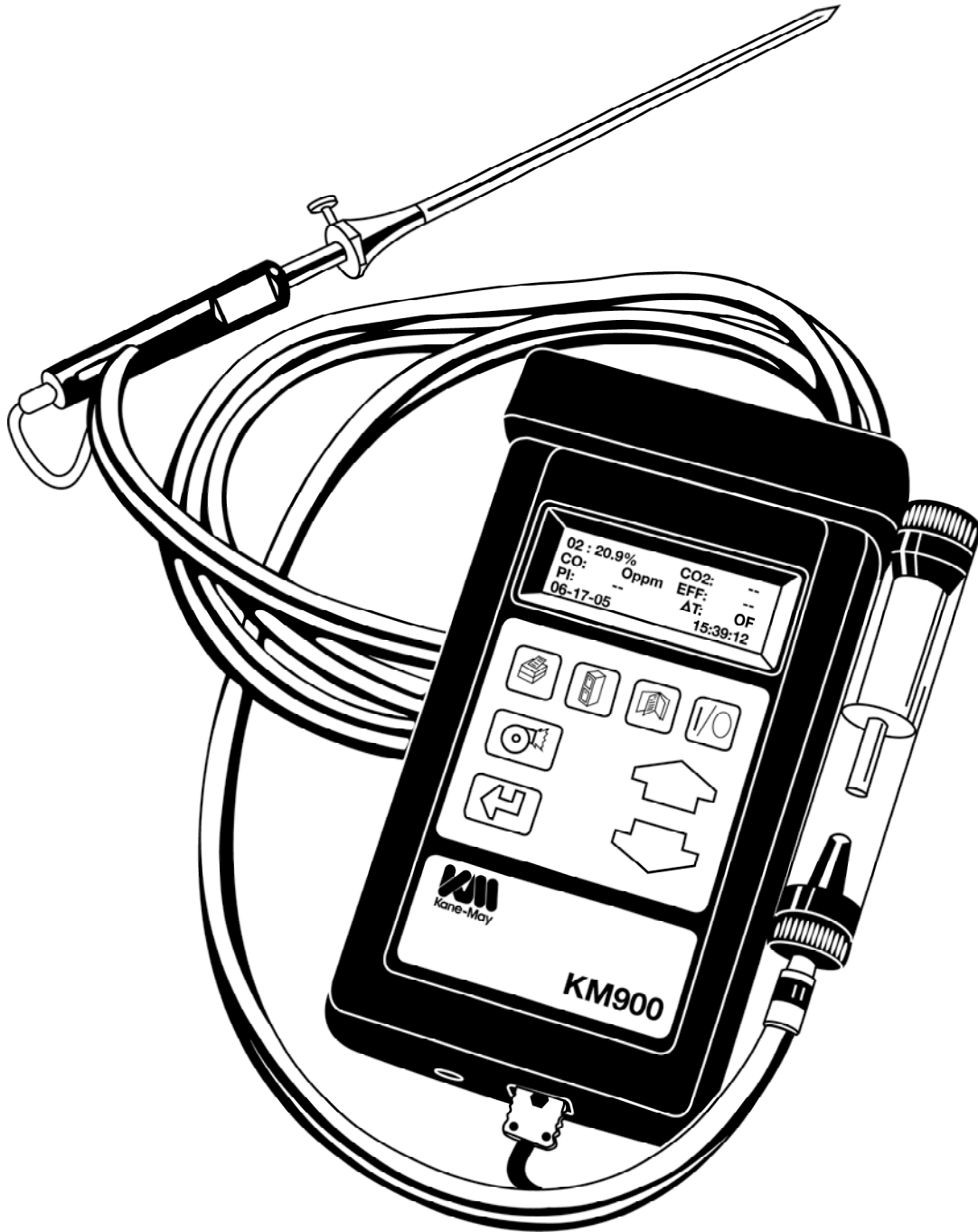




INSTRUCTION MANUAL

KM900CO/P

Combustion Efficiency Analyzer



1-800-547-5740 • Fax: (503) 643-6322
www.ueitest.com • email: info@ueitest.com

Introduction

The KM900CO/P is designed for commercial and light industrial contractors and technicians. Includes seven preprogrammed fuels with two positions for user-specified fuels. With 150 memory locations, tests can be stored and downloaded to the optional IR printer through the infrared port or to a PC through the RS232 port utilizing the optional Fireworks™ software package. The unit comes complete with a large carrying case, 12" 1200°F probe and battery charger.

Features include

- Measures O₂ and CO
- Calculates CO₂, efficiency and excess air
- 0 to 10,000 ppm H₂ compensated CO sensor
- Large 4 line display
- Long life rechargeable battery
- Large cordura case
- 150 memory positions
- Upgrades available include NO_x, SO₂ and Draft

Safety Notes

Before using this instrument, read all safety information carefully. In this manual the word "**WARNING**" is used to indicate conditions or actions that may pose physical hazards to the user. The word "**CAUTION**" is used to indicate conditions or actions that may damage this instrument.



WARNING!

Exceeding the specified limits of this instrument is dangerous and can expose the user to serious or possibly fatal injury.



WARNING!

This analyzer extracts combustion gases that may be toxic in relatively low concentrations. These gases are exhausted from the side 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.



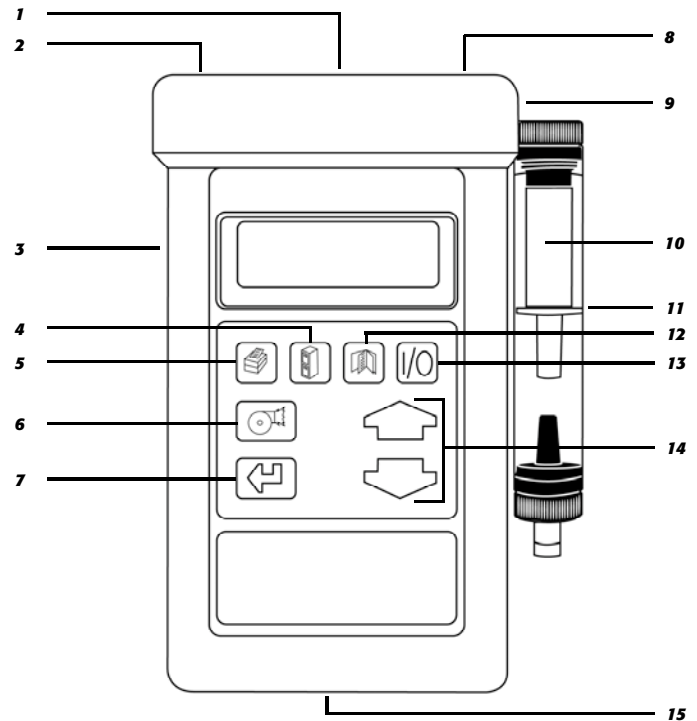
WARNING!








This instrument is designed as Class III equipment and should only be connected to SELV circuits. Protection against electrical shock in accordance with EN 61010-1 : 1993.

The battery charger is designated as:

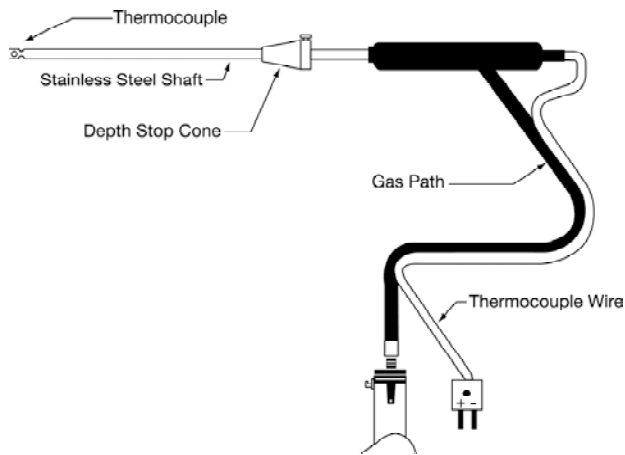
- Class II equipment
- Installation category II
- Pollution degree 2
- Indoor use only
- Altitude to 2000m
- Ambient temperature 0° to 40°C
- Maximum relative humidity 80% for temperatures up to 31°C linearly to 50% RH at 40°C
- Mains supply functions no to exceed 10% of the nominal voltage.

Controls and Indicators



1. **Infra-Red Emitter**
2. **RS232 (8 pin din)**
3. **Charger Socket**
4.  **Store:** Enters data storage menu.
5.  **Print:** Prints current data.
6.  **Pump:** Turns pump on and off.
7.  **Enter:** Accepts a command which enters a menu option.
8. **Pressure Inlet**
9. **Inlet Port**
10. **Particle Filter**
11. **In-Line Water Trap**
12.  **Menu:** Allows access to all menu functions.
13.  **On/Off:** Powers instrument on and off.
14.  **Up/Down:** Scrolls up or down through option menus.
15. **Flue Temperature Connector**

Thermocouple Probe Description



1. **Stainless Steel Shaft**
2. **Depth Stop Cone**
3. **Gas Path**
4. **Thermocouple Wire**

Operating Instructions

If you are using this instrument for the very first time be sure to charge the battery for a period of 12 hours.

Before every use, check for the following:

- The particle filter is not dirty
- The water trap and probe line are empty of water
- All hose connections are properly connected
- The probe is sampling clean ambient air
- The water trap is correctly fitted and the instrument is upright
- The flue temperature is connected

Automatic Calibration

Turn on instrument. During this sequence the analyzer 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 switching on the analyzer, it will briefly display header information:

Kane International
(44)-1707-37550

It will then show the count-down screen:

ZERO CAL
Time : 180
FRESH AIR PURGE

The calibration time will count down in seconds to zero. Calibration time may be changed from 2 to 6 minutes. See SET-UP MENU section.

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

To obtain the quoted specification the 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 analyzer.

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

All parameters are detailed in the glossary.

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 customize the display to show the data you require.
- **8 Page Mode:** Displays 8 parameters on 4 line in set format, the bottom two can be changed.

Changing between the different modes is detailed under **Display Menu Section**

Page Mode

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

NATURAL GAS			
DATE	...		07-08-96
TIME	...		12:31:35
BATTERY %	..		54

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

CO2	%	...	0.0
FLUE	F	...	0.0
INLT	NOT FITTED		
AMBIENT	F	...	72

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

NOTE: This screen only displayed on an analyzer fitted with an NO sensor.

NO	ppm	...	0000
NOx	ppm	...	0000
NOx calc	%	...	5
O2 ref	%	...	3.0

NOTE: In 4 page mode only "⏠" turns the backlight **ON** or **OFF**.

Line Scroll Mode

Line scroll mode allows you to customize the display.

Use the "⏠" and "⏡" keys to change the bottom 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 "⏡" keys.

NETT	F	...	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

O2	%	...	20.9
CO	ppm	...	0000
CO2	%	...	0.0
CO/CO2	R	...	0.0001

Select next parameter. Repeat above until display reads desired data.

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 Mode and line scroll modes and are detailed in "MAIN DISPLAY PARAMETERS".

Main Display Parameters

O2	:20.9%	CO2	:--
CO	: 0ppm	Eff	:--
PI	:--	ΔT	: 0F
	:--	Tf	: 73F

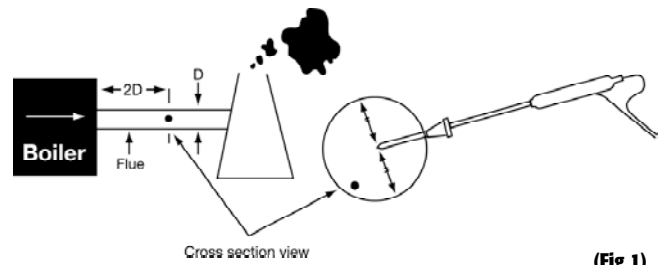
The bottom line of the display can be changed to display other parameters.

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 the probe can be inserted into the desired sampling point.

It is recommended that the sampling point be located at least two diameters downstream of any bend and that the probe tip is in the center of the flue. With balanced flue 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. (Fig 1).



(Fig 1)

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 1200°F. Temperature of up to 2012°F (1100°C) can be accommodated using an optional high temperature probe.

NOTE: 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

With the optional pressure module fitted a flue draft 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	...	0.0001
P INDEX	%	...	0.01
XAIR	%	...	0.0
Prs	inWG		0.00

To perform a combustion test and display draft pressure at the same time a special probe is required. Please contact Uei for service information.

Regular Checks During Sampling

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

- Do not exceed the maximum temperature of the flue probe.
- The analyzer internal temperature does not exceed normal operating range, typically 32° to 104°F (0° to 40°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



CAUTION!

Do this every time you use the analyzer.

Remove the probe from the flue (**CAUTION! The probe will be HOT**) and allow it to cool naturally. Do not immerse the probe in water as this will be drawn into the analyzer and damage the pump and sensors.

Once the probe is removed from the flue and readings have returned to zero, press "I/O" and the analyzer will count down from 30 to switch off.

OFF 30
MENU TO ESCAPE

If you have not finished but pressed "I/O" by mistake, you can press "HOME" to return to normal operation and not switch **OFF**.

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 **MAIN DISPLAY PARAMETERS**.

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 analyzer prior to use.

The following procedure should be adopted:

1. Go through the normal start up sequence in the location where the equipment is to be used.
2. Switch on all localized electrical equipment that might be capable of causing interference.
3. 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 minimize interference or switch off, if possible, the offending equipment for the duration of the test.
4. N.B. Maximum cable lengths must be less than 3 meters.

NOTE: At the time of writing this manual (January 1997) 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.

Moving Through The Menus

Basic Operation:

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

From the "MAIN DISPLAY"

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

Press "HOME" to access the "MAIN MENU"

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

Press "UP" and "DOWN" to move cursor up and down

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


Press "LEFT" to access selected menu

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


Press "LEFT" to access select parameter

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


Press "UP" and "DOWN" to change setting i.e. fuel selected

Press " " to enter value and move to next parameter

FUEL	:	LIGHT OIL
O ₂ 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 save settings and return to the "MAIN DISPLAY"

Main Menu

The **MAIN MENU** consists of 4 sub menus which are shown below and detailed in the following sections.

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.

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

Select Menu


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

FUEL	:	LIGHT OIL
O ₂ Ref	:	OFF
SMOKE	:	OFF
RESET	:	NO



FUEL: Select the fuel being used by the boiler from either a standard fuel stored in the analyzer 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

Calculations of fuel constants are detailed in the glossary. 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 measurement 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.

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. Example: CO(n).

What does Oxygen reference mean?

If 3% O₂ reference is selected and 5% O₂ 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 glossary.


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 analyzer off.

Selecting "YES" and " " will display the following screen:

RESET SENSORS			
O ₂ %	:	20.9	CO & NO = 0
PRESS ENTER			
MENU TO ESCAPE			

After pressing " " the analyzer will count down for 5 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.

Units Menu

Allows all displayed units to be changed.

TEMP	:	C
GAS	:	ppm
PRESS	:	MBAR
EFF	:	GROSS

TEMP: Choose selections 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/m³).

PRESS: Flue draft 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 vaporization is lost in the boiler and hence will be lower than Net efficiency. For Natural Gas the difference will be approximately 11%.

Display Menu

Allows the configuration of the display to be changed.

LIGHT	:	OFF
MODE	:	8-PAGE
CONTRAST	:	DEFAULT

LIGHT: Choose from "ON" or "OFF".

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

CONTRAST: The contrast is set to a DEFAULT value or can be adjusted lighter or darker. use the "⏏" and "⏏" keys to adjust.

Set-Up Menu

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

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

LANG	:	ENGLISH	ZERO	:	3
CO ALARM	:	400	NOx%	:	5
CALENDAR	:		HEADER	:	

Parameter	Description	Settings
LANG:	Changes the analyzer 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. 3 minute countdown is advised.	2-6 minutes
CO ALARM:	Allows an alarm level to be set on for the CO reading. This is set as a default at 1000 ppm.	OFF 0-4000 ppm
	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. A similar display will be shown during a "RECHARGE BATTERY" and "PUMP OFF" alarms.	
<div style="border: 1px solid black; padding: 10px; width: fit-content; margin: auto;"> <p>-----</p> <p style="text-align: center;">CO ALARM</p> <p style="text-align: center;">1010 ppm</p> <p>-----</p> </div>		
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. NO₂ = NO + P% NO	OFF 1-9%

CALENDAR: Allows the user to change the date and time. (24 hour clock). The following screen will be shown once the parameter is entered:



	hh	:	mm	:	ss
TIME:	13	:	53	:	26
FORMAT:	dd	:	mm	:	yy
DATE:	03	:	01	:	96

FORMAT: Changes the date format for display and printing.

To change the time position the cursor on "TIME" and press "⏏". The cursor will now be to the left of the 13 as shown below:

	hh	:	mm	:	ss
TIME:	13	:	53	:	26
FORMAT:	dd	:	mm	:	yy
DATE:	03	:	01	:	96

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 analyzer. The header appears on the top of the standard printout. This can be used to print your company name and/or phone number.

```

Name/Phone
Kane International
(44)-1707-375550
'LEFT' USE STORE KEY
    
```

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.


Printing Information

Supplied as accessories for the KM900CO/P is an infra-red thermal printer. Read the manual supplied with the printer prior to operation. Connection to the KM900CO/P 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 KM900CO/P and the bottom of the printer. Ensure they are pointing at each other and within 1 foot, with no obstructions in the way. Data may be lost if transmission is interrupted. Keep the KM900CO/P pointing at the printer until the printout has finished.

Data can either be printed from a live test or from stored data. Printing of stored data is detailed in "Storing and Retrieving Data".

Printing a "LIVE" Test

During a combustion test the KM900CO/P will print data on request. With the analyzer 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 shown below:

```

KM900

Kane International
(44)-1707-375550

TEST 36

DATE:      01-01-96
TIME:      15:46:52

NATURAL GAS

NET F .....2
O2 % .....20.3
CO ppmn O2 > .....20%
EFF % (G) .....87.8

CO2 % . ° .....0.3
FLUE F . ° .....78
INTL F . ° .....NOT FITTED
AMBIENT C .....76.2

CO/Cl2 R .....0.0000
P INDEX % .....0.00
XAIR % .....02 > 20%
Prs inWG .....0.0
    
```

Storing and Retrieving Data


The KM900CO/P can store up to 150 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 :  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 in 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.

Main Display Parameters

The parameters and their meanings are detailed as follows:

DATE: Analyzer date. (see "**SET-UP MENU**" to change)

TIME: Analyzer time. (see "**SET-UP MENU**" to change)

BATTERY (BAT): Displays the battery level from 0-100%. The analyzer 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 °F or °C 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**" 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**". The calculation is determined by fuel type 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 temperature after fresh air 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 temperature calculation if an INLET probe is not fitted.

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

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 0.004, 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 clean ambient air.

P INDEX (Pi): The CO/CO2 ratio expressed as a percentage %, called the "**Poison Index**" i.e. P INDEX % = 100 x CO/CO2. "--" is displayed while in clean ambient air.

XAIR %: 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.

Prs: Flue draft 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**". 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%: Toxic gas measurements can be referenced to defined oxygen levels. See "**SELECT MENU**" for details.

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 vapor
Unburned gas

Losses due to refuse: Combustible in ash
Combustible in riddling
Combustible in dust

Other losses: Radiation
Convection
Conduction
Other unmeasured losses

Net efficiency calculations assume that the energy contained in the water vapor (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 vapor is not recovered.

Since the fuel to combustible matter in ashes, riddling, 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)/Qgr
K1n = (255 x %Carbon in fuel)/Qnet
K2 = % max theoretical CO₂ (dry basis)
K3 = % Wet Loss
H₂ = % Hydrogen
H₂O = % Water

Measured Data:
Tf = Flue Temperature
Ti = Inlet Temperature
O_{2m} = % Oxygen in flue gas
O_{2r} = Oxygen reference %

Calculated Data:
Tnet = Net Temperature
% CO₂ 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 H₂ + H₂O/Qgr x [2488 + 2.1Tf - 4.2 Ti]

Simplified = [(9 x H₂ + H₂O)/Qgr] x 24.25 x [1 + 0.001 Tnet]

Wet loss % = K3(1 + 0.001 x Tent)

Where K3 = [(9 x H₂ + H₂O)/Qgr] x 24.25

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%)/(20.9 x K1g x (Tnet)/K2 x (20.9 - O_{2m}))] + [K3 x (1 + 0.001 x Tnet)]

Excess Air = [(20.9%)/(20.9% - O_{2m}%) - 1] x 100%

CO₂% = [(20.9 - O_{2m}) x K2/20.9]

Unburned fuel loss% = K4 x CO/(CO + CO₂)
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 $CO(n) = CO \times \frac{(20.9 - O_{2r})}{(20.9 - O_{2m})}$

Calculation of Fuel Data

For any fuel not specified by UEi 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:

Chemical composition:	C	25%
	H ₂	3%
	H ₂ O	50%
	Q _{net}	8.35 MJ/kg
	Q _g	9.3 MJ/kg
	Max CO ₂	20.4%

$$K1n = (255 \times \% \text{ carbon in fuel}) / Q_{net} \text{ (kJ/Kg)}$$

$$= (255 \times 25) / 8350 = 0.763$$

$$K1g = (255 \times \% \text{ carbon in fuel}) / Q_g \text{ (kJ/Kg)}$$

$$= (255 \times 25) / 9300 = 0.685$$

$$K2 = \text{Max \% CO}_2 = 20.40$$

$$K3 = \text{Wet Loss} = [(9 \times \% \text{H}_2 + \% \text{H}_2\text{O}) / 9300] \times 2425$$

$$= [(9 \times 3 + 50) / 9300] \times 2425$$

$$= (77 / 9300) \times 2425 = 20.08$$

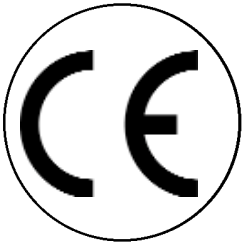
$$K4 = 65 \text{ (an approximation for wood)*}$$

The fuel values to program into the analyzer 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.

Electromagnetic Compatibility (CE) Statement



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

EN 50081-1
EN 50082-1

and is certified to be compliant

Specifications EC/EMC/KI/KM900 details the specific test configuration, performance and conditions of use.

Maintenance

Periodic service



WARNING!

Repair and service of this instrument is to be performed by qualified personnel only. Improper repair or service could result in physical degradation of this instrument. This could alter the protection from electrical shock and personal injury this instrument provides to the operator. Perform only those maintenance tasks that you are qualified to do.

These guidelines will help you attain long and reliable service from your instrument

1. Calibrate your instrument annually to ensure it meets original performance specifications.
2. Keep your instrument dry. If it gets wet, wipe it dry immediately. Liquids damage electronic circuits.
3. Whenever practical, keep the instrument away from dust and dirt, which can cause premature wear.
4. Although your instrument is built to withstand the rigors of daily use, it can be damaged by severe impacts. Use reasonable caution when using and storing the instrument.

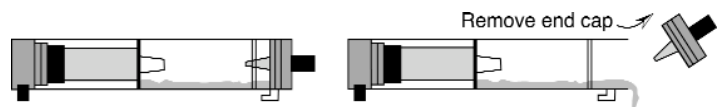
Cleaning and Decontamination

Periodically clean your meter's case using a damp cloth. **DO NOT** use abrasives, cleaning solvents or strong detergents, as they may damage the finish or affect the reliability of the structural components.

Emptying and Cleaning The In-line Water Trap

The in-line water trap should be checked and emptied on a regular basis. Water vapor will condense and gather in the probe line. This may move suddenly to the trap when the probe is moved. Care should be taken at all times.

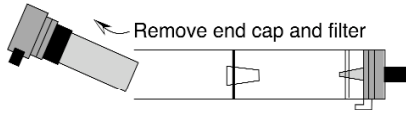
Emptying of the water trap is detailed below:



Carefully remove the end cap from the in-line housing. Dispose of the condensate in a suitable drain, 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 analyzer and should be changed regularly. If prevents dust and dirty particles entering the pump and sensors and hence causing damage. The filter MUST be changed when it is discolored.



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.

Annual Re-calibration

While the sensors have an expected life of more than two years in normal use it is recommended that the analyzer is re-calibrated at least annually. This is so that long term drift on the sensors 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.

Troubleshooting

The following is a list of problems that may occur on the instrument through it operating life. If the cause of the fault is not easy to identify then we advise you contact UEI service department for expert advice.

Symptom	Cause
Oxygen too high or CO ₂ too low	Air leaking into probe, tubing, water trap, connectors or internal to instrument Oxygen cell needs replacing
Oxygen Error (FAULT) or Toxic sensor Error (FAULT)	Calibration time set too short and instrument not allowed to stabilize Instrument has been stored in a cold environment and is not at normal working temperature Oxygen cell or toxic sensors needs replacing
Analyzer not holding charge or Analyzer not charging	Battery exhausted AC charger not giving correct output Fuse blown in charger plug
Analyzer 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 reading erratic	Temperature plug reversed in socket Faulty connection or break in cable or plug
Analyzer 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

Specifications

Parameter	Resolution	Accuracy	Range
Temp Measurement			
Flue Temperature	1.0°C/F	±2.0°C±0.3% reading	32-1112°F (0-600°C)
Inlet Temperature	0.1°C/F	±1°C±0.3% reading	32-122°F (0-50°C)
Gas Measurement			
Oxygen	0.1%	±0.2%* ¹	0-21%
Carbon Monoxide	1 ppm, mg/m ³	±20 ppm<400 ppm* ¹ ±5%>400 ppm	0-4000 ppm 0-5000 mg/m ³
Carbon Monoxide, H2 compensated	1 ppm, mg/m ³	±20 ppm<400 ppm* ¹ ±5%>5000 ppm ±10%>5000 ppm	0-10,000 ppm 0-12,000 mg/m ³
Nitric Oxide (optional)	1 ppm, mg/m ³	±5 ppm<100 ppm* ¹ ±5%>100 ppm	0-5000 ppm 0-6700 mg/m ³
Pressure (optional)	0.1 mbar	±5.0% 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	32-1112°F (0-600°C)
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	2.2 lbs. (1kg)		
Handset	220 mm x 55 mm x 120 mm		
Probe	(L) 240 mm x (Dia) 8 mm with 285 mm long stainless steel shaft, type-K thermocouple and 1.5 m long neoprene hose		
Ambient operating range	32° to 104°F (0° to 40°C) 10% to 90% RH non condensing		
Power supply (battery charger)	Input: 110V AC/220V AC nominal Output: 12V AC off load		
Battery life	>8 hours from full charge		
Dimensions	8.7" x 2.2" x 4.7" (220mm x 55mm x 120mm)		

*¹ Using dry gases at STP

*² Calculated



KM900CO/P

Combustion Efficiency Analyzer

Limited Warranty

The KM900CO/P is warranted to be free from defects in materials and workmanship for a period of one year (two year on sensors) from the date of purchase. If within the warranty period your instrument should become inoperative from such defects, the unit will be repaired or replaced at UEi's option. This warranty covers normal use and does not cover damage which occurs in shipment or failure which results from alteration, tampering, accident, misuse, abuse, neglect or improper maintenance. Batteries and consequential damage resulting from failed batteries are not covered by warranty.

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

1-800-547-5740 • FAX: (503) 643-6322
www.ueitest.com • Email: info@ueitest.com

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

