DWYER 1207A

Flue Gas Analyzer

Dwyer Instruments Inc
P.O. Box 373
Michigan City
INDIANA, H6361
USA

Tel: 219 879 8868
Fax: 219 872 9057

Stock No: 18744-2 September 2009

CONTENTS

Page No:

DWYER 1207A
User Guide

The **DWYER 1207A** Combustion Analyzer measures O_2, differential temperature, differential pressure and CO.

It calculates efficiency (Nett, Gross or Condensing), losses, the CO/CO_2 ratio, Poison Index, excess air and CO air free in ppm only.

The analyzer can be upgraded with the addition of a Nitric Oxide sensor either on initial purchase or as a retrofit as part of an annual service procedure.

In addition the DWYER 1207A Combustion Analyzer's CO sensor checks carbon monoxide levels in ambient air - useful when a CO Alarm is triggered and tests the safety of appliances.

The CO and NO readings can be referenced to the oxygen reading in ppm or mg/m^3.

It has a protective rubber sleeve with a magnet for "hands–free" operation and their flue probes work on all combustion appliances and take ambient air measurements.

The large display shows 4 readings at a time and all data can be printed via an optional infrared printer. The printed data can be 'live' data, 'frozen' data or 'stored' data. 255 sets of tests can be stored. Note: stored data is lost if the batteries are removed or are exhausted. Two lines of 16 characters can be added to the header of printouts.

The analyzer is controlled using 4 buttons and a rotary dial.

The four buttons (from left to right) switch on and off the analyzer, print actual or frozen data/ switch on and off the backlight, switch on and off the pump and "freeze"/ hold data. The buttons with △ , ▽ and ⏎ arrows also change settings such as date, time, fuel source, etc. when in MENU mode.

The rotary dial changes the LED indicated display line and selects access to the menu to make changes to the date, time, fuel, etc.

1. ANALYZER FEATURES AND KEYPAD

ON / OFF

Turns the analyzer ON / OFF

PUMP / CAL PRESSURE

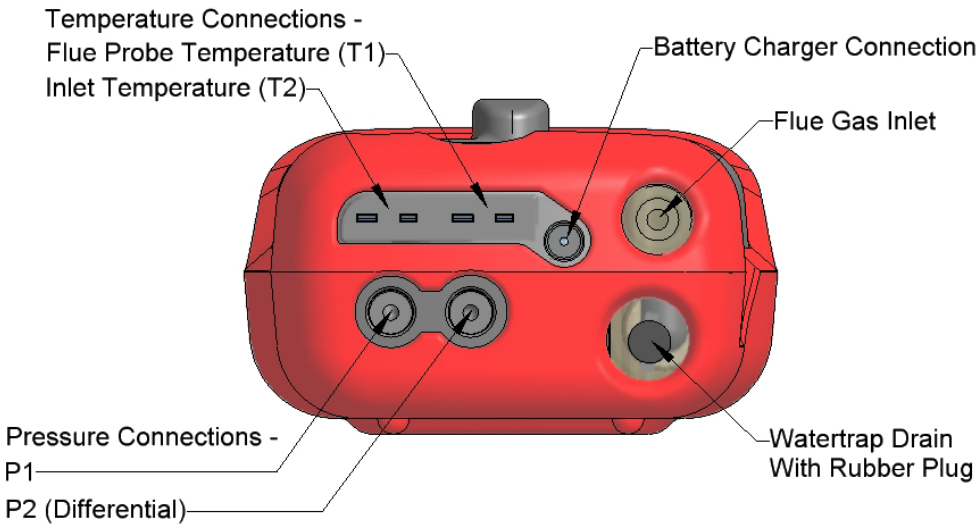
Turns the pump ON / OFF
Press for 2+ seconds to zero the pressure sensor

PRINT / BACKLIGHT

Press to print “live” or “frozen” data. Press again to abort.
Press for 2+ seconds to switch backlight & torch ON / OFF

LINE SELECT / FREEZE

Press to select active line on display as indicated by LED’s
Press for 2 seconds to “HOLD”
Press longer to “LOG”


Temperature Connections -
Flue Probe Temperature (T1)
Inlet Temperature (T2)
Battery Charger Connection
Flue Gas Inlet
Pressure Connections -
P1
P2 (Differential)
Watertrap Drain
With Rubber Plug

2. BEFORE USING THE ANALYZER FOR THE FIRST TIME:

Turn over the analyzer, remove its' protective rubber sleeve and fit 4 "AA" batteries in the battery compartment. **Take great care to ensure they are fitted with the correct battery polarity.** Then replace the battery cover and protective rubber sleeve. Always check that the analyzer is working correctly after replacing batteries.

Set the analyzer's correct time, date, fuel source, etc., after it is switched on and calibrated – See **USING THE ROTARY DIAL** below. These settings are stored when the analyzer is switched off.

Using Re-Chargeable Batteries.

This analyzer has been designed for use with both alkaline and rechargeable Nickel Metal Hydride (NMiH). No other battery types are recommended.

WARNING

The battery charger unit must only be used when NMiH batteries are fitted.

NMiH batteries are entirely suitable for top up charging at any time, even for shorts periods.

Alkaline batteries are not re-chargeable. Attempting to recharge Alkaline batteries may result in damage to the product and may create a fire risk.

Ensure the batteries are fitted in the correct manner.

Charger

Ensure that you use the correct charger. The part number is KMCU450/US.

An in-vehicle adapter can be used to top up the analyzer's batteries from a 12 volt vehicle battery. The part number is KMCU450/ 12.

Trickle Charging: On first charging, charge for at least 12 hours continuously, subsequently charge overnight for approx. 8 hours.

Fast Charging: With the analyzer switched on connect the charger and then switch the analyzer off. The display will then show "BATTERY CHARGING".

Battery Disposal

Always dispose of depleted batteries using approved disposal methods that protect the environment.

3. BEFORE USING THE ANALYZER EVERY TIME:

Check the water trap is empty and the particle filter is not dirty:

- To empty water trap, unplug its' rubber stopper and re-plug once it is empty.

- To change the filter, remove protective rubber sleeve, pull out the water trap unit from the analyzer, remove the water trap's particle filter from its' spigot and replace. Reconnect the water trap and rubber protective sleeve.

Connect the flue probe into the bottom of the analyzer's water trap and connect the probe's temperature plug to the socket next to the water trap – check the plug's orientation is correct otherwise incorrect temperature measurements will occur.

After switch on, check fuel source, date and time are correct and battery power is sufficient.

SAFETY WARNING

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

Sensor manufacturers recommend users of portable gas detectors containing electrochemical sensors 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.)

For Oxygen monitors a level of confidence that the unit is working adequately may be gained by exhaling over the sensor inlet and viewing the reduction in reading obtained.

4. USING THE ANALYZER AND ITS FOUR BUTTONS:

Switching ON the Analyzer	Press  to switch the unit ON in fresh air outside the property about to be tested. This lets the analyzer auto calibrate its' sensors properly. On switch on, the analyzer beeps four times and displays the fuel previously selected, the date and time and model number. Its' bottom line counts down from 60 until the sensors are ready to use – This normally takes 20 - 30 seconds but may take longer as sensors get older. If the analyzer will not auto calibrate, its' sensors need to be replaced or recalibrated by an authorized repair center. If the inlet probe is connected to the analyzer during its' countdown the measured temperature from the inlet probe will be used as the inlet temperature. If the inlet probe is not connected and you connect the flue probe's temperature plug to the analyzer during countdown the measured temperature from the flue probe will be used as the inlet temperature. If neither probe is connected during countdown the analyzer's internal ambient temperature will be used as the inlet temperature.
Switching OFF the Analyzer	Press  to switch the analyzer OFF. The display counts down from 30 with the pump on to clean the sensors with fresh air – If the probe is still connected, make sure analyzer and probe are in fresh air. Press  /  if you want to stop the countdown and return to making measurements. **Note: the analyzer will not switch off until the CO reading is below 20 ppm.**
Using UP / DOWN / ENTER Buttons	Use the  /  /  keys to change settings (such as time, date and fuel) when the rotary dial is turned to MENU.
Printing Data	Press and **quickly** release the key to start the analyzer printing. The analyzer displays "PRINTING" until this is completed. Press and release the key again to abort printing. Make sure the printer is switched on, ready to accept data and its' infrared receiver is in line with the analyzer's emitter (on top of the analyzer).

Backlight	Press and hold  to toggle the display's backlight. **Note: use of the backlight increases the current drain on the batteries.**
Tasklight	Comes on with the display's backlight... see above.
Switching PUMP on / off	The analyzer normally operates with the pump on. Press  **quickly** to switch the pump off and on. When the pump is switched off, the analyzer displays "PUMP OFF" approx every 30 seconds. **NOTE: the pump will not switch off if the CO reading is above 20 ppm.** This helps to protect the CO sensor from damage. NOTE: the pump cannot be switched off with the rotor set to ----------MENU.
Zeroing the pressure sensor	Press and hold the  key until the top line display shows ZERO CAL.
"Freezing" the display	Press and hold the  /  key until a second beep is heard to freeze all readings. The display flashes and readings can be printed by pressing  key. Press and hold the  /  key again until a second beep is heard to go back to "live" measurements. The  function is inhibited when the display LEDs are flashing.
Storing a set of readings	Press and hold the  /  key for approx. 4 seconds. Note: this STORE function is inhibited if the display LEDs are flashing. Note: this STORE function is inhibited in normal operation if the pump is switched off.
Changing the display's active line	Press and release the  /  key until the illuminated LEDs point at the display line that you wish to change. While the LEDs are flashing turn the rotary dial to display the parameter that you want. If the rotary dial is not turned the active line will go back to its previous setting after approx. 5 secs.

5. USING THE DWYER 1207A AS A THERMOMETER OR PRESSURE METER

With the analyzer switched off, press and hold down the  button and then press and release the  button, then release the  button.

The DWYER 1207A will now operate as a fixed display pressure meter/thermometer with the pump off and inhibited.

The display will show: pressure
flue temp
inlet temp
differential temp

The rotary dial display indications will now be locked apart from MENU. Readings can be held and logged in the normal way. Up to 8 sets of readings can be logged.

Exit this mode by switching the DWYER 1207A off.

The standard printout for this mode is as follows:

```
DWYER 1207A        1.0
Serial No.      123456789


DATE            11/01/09
TIME            09:53:23

.....


PRS    INWG          0.001
T1                   48
T2                   15
ΔT                   33
```

6. USING THE ROTARY DIAL (starting from Menu):

Rotating the dial selects the displayed parameter, unless MENU is selected or the pressure/temperature mode has been selected.

	ROTARY DIAL POSITIONS
MENU	Switches to MENU function.
BAT	Displays estimated battery life. If battery voltage falls below a pre-set limit, the display flashes "LOW BAT" every 10 seconds. See Page 6 to change the batteries or re-charge, if applicable.
TIME	Displays Time.
LOSS	Displays calculated losses when O_2 values are less than 18%.
CO/CO_2 ratio	Measured CO divided by calculated CO_2 when O_2 values are less than 18%.
CO_2	Displays calculated Carbon Dioxide values once O_2 values are below 18%.
O_2	Displays Oxygen values in %.
T inlet	Displays the inlet probe temperature.
T Flue	Displays flue probe temperature. If the flue probe's temperature sensor is broken or open circuit it displays - OC -.

T Nett	Displays the difference between flue and inlet / ambient temperatures. If the flue probe's temperature sensor is broken or open circuit it displays - OC -.
CO	Displays Carbon Monoxide values in PPM as CO in ppm normalized ac COn Display value in mg/m^3 as COm in mg/m3 normalized as COH
NO (if fitted)	Displays Nitric Oxide values in PPM as NO in ppm normalized as NOn Display value in mg/m^3 as NOm in mg/m3 normalized as NOH
PRS	Display the measured pressure or draft value in user selected units.
X AIR	Displays calculated excess air when O_2 values are less than 18%.
EFF	Displays calculated efficiency when O_2 values are less than 18% EFFn, EFFg or EFFc as selected by the user.
AUX	Addition user selectable displays.

Rotate the dial to MENU and use the △ or ▽ buttons to select the following function for change:

When you have selected the function to change, press ⏎ to select.
Repeat this to scroll through the menu and select (using the ⏎ key) and change (using the △ / ▽ keys) the function.
The final, logical ⏎ returns you to the main menu display.

To exit the Menu function you can normally rotate the dial to another position - Unless the final logical ⏎ is pressed, no changes are made.

The exception is:

STORE DELETE where the ⏎ key must be pressed to confirm the change and exit. If you rotate the dial before pressing ⏎ the instrument will beep continuously. You must rotate the dial back to MENU and press ⏎ before you can continue.

In STORE View mode the rotary dial is used to select the saved parameter to be displayed. Use the △ / ▽ keys to change the Test number. To exit the View mode press ⏎ .

7. MAIN MENU FUNCTIONS

There are six menu headings each with its own sub-menu

SETUP	Fuel selection Efficiency calculation Time and date setting Temperature unit Gas units Oxygen referencing Language Exit
PRESSURE	Smoothing Resolve (number of decimal points resolution) Number of decimal points resolution Units Time Exit
STORE	View Auto store Delete Exit
REPORTS	Pressure Temperature Room CO Draught Exit
SCREEN	Contrast Auxiliary display Header Exit
SERVICE	Password protected

SETUP

SET FUEL	NATU GAS L OIL PROPANE BUTANE L.P.G. PELLETS	Set fuel type
N < -C- > G	N C G	Nett Condensing Gross efficiency calculation
SET TIME	xx: yy: zz HH: MM: SS	Set time values
SET DATE	MM- DD- YY DD- MM- YY YY- MM- DD	Choose date format then set date values
C <---> F	F C	Fahrenheit Centigrade
PPM < - > MG	ppm MG/M3	Parts per million Milligrams per cubic meter
O2 REF	NO YES	Set reference value
LANGUAGE	English French Italian German Spanish Dutch Swedish	Set language

PRESSURE

SMOOTH	OFF ON	Select smoothing
POINTS	LOW HIGH	Select decimal point resolution
PS UNITS	inH2O mBAR mmH2O Pa kPa PSI mmHg hPa	Select pressure units

STORE up to 255 sets of combustion test results can be stored

VIEW	TEST xxx	Enter test number to be viewed then use rotary dial to select display. If less than 9 set of readings are stored rotate the dial then use the up/down buttons to change the LOG number.
AUTO STO	YES/NO	If YES set logging time interval in minutes.
DEL ALL	YES/NO	Clears stored values.

REPORT

There are dedicated report formats for the following tests:

Pressure
Temperature
Room CO
Draught

All report menus follow the format TEST / VIEW / DEL ALL.

The TEST functions are described later.

SCREEN

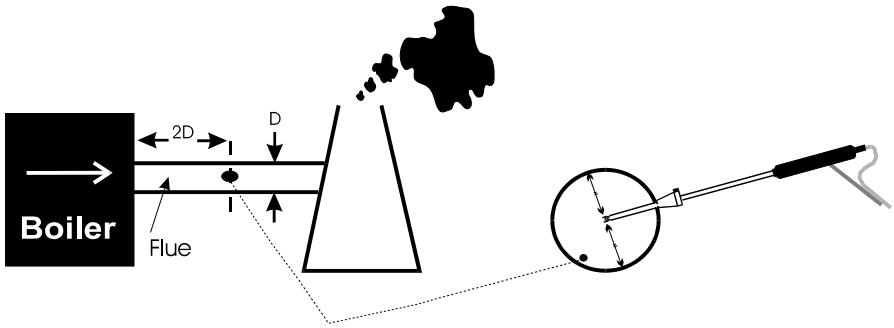
CONTRAST	SET xx	Lighten or darken the display
AUX	Selected Fuel Pressure units COM Date CO air free O_2 Reference value	**Assign the AUX rotary dial position**
HEADER	Header 1 Header 2	2 lines each of 20 characters

8. MEASURING MODES

MEASURING FLUE GASES

After the countdown is finished and the analyzer is correctly set up, put its' flue probe into the appliance's sampling point. The ideal sampling point is at least two flue diameters downstream of any bend.

Put the probe tip in the flue center. With balanced flues, make sure the probe is positioned far enough into the flue so no air can 'back flush' into the probe.



Use the probe's depth stop cone to fix it in flue diameters from $^{1}/_{4}$ to $^{4}/_{5}$ inch, 6 to 21 mm. Its maximum operating temperature is 1112°F / 600°C.

Make sure you do not exceed the analyzer's operating specifications. In particular:

- Do not exceed the flue probe's maximum temperature
- Do not exceed the analyzer's internal temperature operating range
- Do not put the analyzer on a hot surface
- Do not exceed the water trap's levels
- Do not let the analyzer's particle filter become dirty and blocked

View the displayed data to ensure that stable operating conditions have been achieved and the readings are within the expected range.

Press PRINT or press HOLD first to "freeze" or store the readings before printing.

STANDARD COMBUSTION PRINTOUT

DWYER 1207A 1.0	/product code
Serial No. 123456789	/serial number
	/user header 1
	/user header 2
DATE 11/01/09	
TIME 09:53:23	
.....	
FUEL NATU GAS	
O2 % 5.1	
CO2 % 9.0	
CO ppm 400	
NO ppm n/f	/NO sensor not fitted
FLUE °F 48	
INLT °F 15	
NETT °F 33	
EFF (C) 102.1	/condensing efficiency
PRS INWG 0.001	
Losses % -2.1	
XAIR % 32.1	
CO/CO2 0.0044	
PI 0.44	
O2 ref % 0.0	
SMOKE.....	
.....	

STORING A DRAUGHT MEASUREMENT TO PRINT WITH A COMBUSTION TEST

Rather than print a draught test report and then a combustion test report it is possible to combine the two sets of results on one printout by taking a draught reading first and storing it for printing later.

The following sequence must be followed:

With PRESSURE on the top line and with the rotary dial pointing to Prs... and with the pump off..... then if LOG is activated the current pressure reading will be stored in the draught register with its current scaling. All the conditions must be met and no other values will be logged. As this occurs the top line display briefly shows "DRAUGHT".

While the instrument is in this mode activating LOG again will overwrite the stored reading.

The stored reading is cleared whenever the analyzer is switched off or by entering any REPORT menu.

Resuming normal operation adds the stored DRAUGHT reading to any combustion printout or any combustion log. In such cases the printout changes so instead of "PRS" being printed "DRGT" is printed instead.

NOTE: Whenever there is a stored DRAUGHT reading the current pressure reading is ignored and the stored reading is always used.

WARNING: This means that if a user stores a draught reading from one appliance and goes to another appliance without switching off or re-entering the reports menu his printouts and logs will show the last stored draught reading and its scaling.

MEASURING PRESSURE

The analyzer can be used to measure pressure by connecting tubing to the appropriate ports.

Standard Pressure Report .... this mode is accessed via the MENU function.

This mode allows a tightness test to be carried out automatically.

The times for the test can be set by the user.

From the start of the test the analyzer waits 60 secs to allow temperature stabilization, then records and displays the pressure reading at the start of a 120 second countdown. The live pressure reading is displayed during the 120 second countdown and then locked at the end of the countdown. The display then shows start pressure and finish pressure. The summary results can then be printed as below:

Pressure Test Printout

DWYER 1207A 1.0
Serial No. 123456789

.....

Tightness Test
.....

LOG 03
TIME 14:58 11/01/09

PRS_1 INWG 20.110
PRS_2 INWG 19.998
Duration mins 2:00

.....
customer

.....
appliance

.....
Ref:

.....

MEASURING TEMPERATURE

The analyzer can be used as a normal single input or differential thermometer, ideal for measuring flow and return temperatures or for setting up hot water temperature/flow on a combi boiler.

Standard Temperature Report .... this mode is accessed via the MENU function.

DWYER 1207A 1.0
Serial No. 123456789

.....
Temp Test
.....

LOG 05
TIME 10:15 11/01/09

T1 °F 54.1
T2 °F 24.1
ΔT °F 30.0
.....
Customer

.....
Appliance

.....
Ref:

.....

MEASURING AMBIENT AIR (ROOM CO)

The analyzer's CO sensor can be used to detect spillage from appliances. A standard spillage test can be conducted where the analyzer automatically records 16 sets of 1 minute samples and prints the results as below:

Standard Room CO Report .... this mode is accessed via the MENU function.

DWYER 1207A 1.0
Serial No. 123456789

.....
Room CO Test
.....
LOG 05
TIME 16:58 11/01/09

TEST	CO ppm
0	1
1	5
2	7
3	9
4	10
5	13
6	16
7	24
8	30
9	28
10	18
11	14
12	10
13	6
14	4
15	3

.....
MAXIMUM CO 30

.....
Customer

.....
Appliance

.....
Ref:

.....

MEASURING FLUE DRAUGHT

STANDARD DRAUGHT REPORT

DWYER 1207A 1.0
Serial No. 123456789

.....
Draught
.....

TIME 15:58 11/01/09

PRS INWG 0.54

.....
customer

.....
appliance

.....
Ref:

.....

9. WHEN YOU FINISH A COMBUSTION TEST

Remove its' probe from the flue **- THE PROBE WILL BE HOT -** and let it cool. Do not put the probe in water which will be sucked into the analyzer, damaging its' pump and sensors.

When the analyzer's readings return to ambient levels, switch it off. The analyzer counts down from 30 before switch off with the pump running to self clean its sensors.

10. ANALYZER PROBLEM SOLVING

If any problems are not solved with these solutions, contact us or an authorized repair center.

Fault symptom	**Causes / Solutions**
• Oxygen too high • CO_2 too low	• Air leaking into probe, tubing, water trap, connectors or internal to analyzer. • Oxygen cell needs replacing.
• Oxygen reading (- - - -) • CO reading (- - - -)	• Analyzer was stored in a cold environment and is not at normal working temperature. • Oxygen cell or CO sensor needs replacing. • Pump is switched off.
• Batteries not holding charge • Analyzer not running on mains adapter	• Batteries 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.
• Net temperature or Efficiency calculation incorrect	• Ambient temperature set wrong during Automatic Calibration.
• Flue temperature readings erratic	• Temperature plug reversed in socket. • Faulty connection or break in cable or plug.
• T flue or T nett displays (- - - -)	• Probe not connected.
• X-Air, EFF, COa or CO2 display (- - - -)	• Oxygen reading is above 18%.
• Analyzer just continually beeps	• Turn dial back to MENU and press ⇦ .
• BAT only shows 65 with fully charged NiMh batteries fitted	• This is not a problem and is to be expected as NiMh batteries only deliver 1.25 V per cell whereas Alkalines deliver 1.5 V per cell. Fresh alkalines might give a BAT value of 80 or so.

11. ANALYZER ANNUAL RECALIBRATION AND SERVICE

Although sensor life is typically more than two years, the analyzer should be re-calibrated and serviced annually to stop any long-term sensor or electronics drift or accidental damage.

Local regulations may require more frequent re-calibration.

Contact us or an authorized repair center for more information.

12. ANALYZER SPECIFICATION

(NOTE MAY BE SUBJECT TO CHANGE)

Parameter	Resolution	Accuracy	Range
Temp Measurement			
Flue Temperature	0.1°C/F	±2.0°C ±0.3% reading	0-600°C / 32-1112°F
Inlet Temperature (Internal Sensor)	0.1°C/F	±1.0°C ±0.3% reading	0-50°C / 32-122°F
Inlet Temperature (External Sensor)	0.1°C/F	±2.0°C ±0.3% reading	0-600°C / 32-1112°F
Pressure Measurement	0.1 Pa	±0.5 Pa	±20 Pa
	0.1 Pa	±3 Pa	±100 Pa
	1 Pa	±3% of reading	±2000 Pa
	0.01 hPa	±3% of reading	±80 hPa
Gas Measurement			
Oxygen	0.1%	±0.2%[*1]	0-21%
Carbon Monoxide (CO) (low range)	1 ppm	±10 ppm <100 ppm [*1] ±5% reading	0-2000 ppm nom 4000 ppm max for 15 minutes
Carbon Monoxide (CO) (high range)	1 ppm	±10 ppm <100 ppm ±5% reading >100 ppm	0-4,000 ppm
Nitric Oxide (NO) (low range)	1 ppm	±2 ppm <30 ppm[*1] ±5 ppm > 30 ppm	0 to 100 ppm
Nitric Oxide (NO) (high range)	1 ppm	±5 ppm <100 ppm ±5% reading >100 ppm	0 to 1000 ppm
Carbon Dioxide[*2] Efficiency[*2] Excess Air[*2]	0.1% 0.1% 0.1%	±0.3% reading ±1.0% reading ±0.2%	0-30% 0-99.9% 0-250%

Pre-programmed Fuels	Natural gas, Light Oil, Propane, Butane, LPG, Wood Pellets.
Dimensions Weight Handset Probe	 0.77kg / 2.2lb handset with protective cover 200mm / 7.9” x 45mm / 1.8” x 90mm / 3.5” L300mm / 11.8” x Dia 6mm / 0.25” with 200mm / 7.8” long stainless steel shaft, type K thermocouple and 3m / 10ft long neoprene hose
Ambient Operating Range	+0°C to +40°C / 32-104°F 10% to 90% RH non-condensing
Storage Capacity	99 Combustion tests 20 Pressure tests 20 Tightness tests 20 Temperature tests 20 Room CO tests
Battery Life	4 AA cells >12 hours using Alkaline AA cells
AC Battery Charger (optional)	Input: 110VAC/220 VAC nominal Output: 10 VAC off load

*1 Using dry gases at STP

*2 Calculated

13. ELECTROMAGNETIC COMPATIBILITY

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 analyzer 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 analyzer before use by:

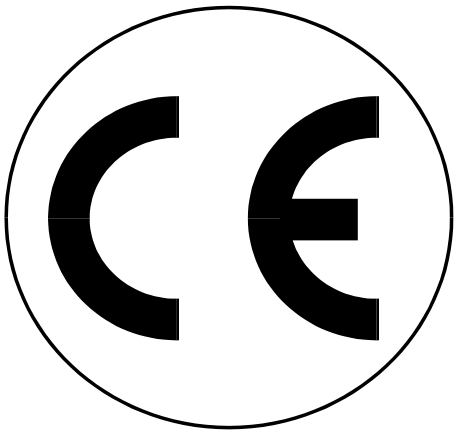
Use the normal start up sequence in the location where the analyzer will be used.

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 analyzer's position to minimize interference or switch off, if possible, the offending equipment during your test.

At the time of writing this manual (February 2009) we 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
EN 61000-6-1

and is certified to be compliant

Specification EC/EMC/KI/K450 details the specific test configuration, performance and conditions of use.

Please Note:

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

At the end of the product's life it should be re-cycled in accordance with current legislation and local guidelines.

Appendix 1 - Main Parameter:

Here are the legends used and what they mean:

O_2 : Oxygen reading in percentage (%).

O2R: Oxygen reference setting. '----' means switched off or set to 0%.

T Flue: Temperature measured by the flue gas probe in Centigrade or Fahrenheit. It displays '**- OC -'** if the flue probe is disconnected.

T Nett : Nett temperature calculated by deducting the **AMBIENT** or **INLET** temperature from the measured **FLUE** temperature. Displays in either Fahrenheit (°F) or Centigrade (°C) or and will display '**- OC -**' if the flue probe is not connected.

T inlet: Temperature measured by the inlet temperature probe in Centigrade or Fahrenheit. It displays '**- OC -'** if the flue probe is disconnected.

CO: Carbon Monoxide reading displayed in ppm (parts per million). '**- - -'** 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.

COm: Carbon Monoxide displayed in mg/m^3.

COn: Carbon Monoxide in ppm normalized to the O2R value.

COH: Carbon Monoxide in mg/m^3 normalized to the O2R value.

COa Carbon Monoxide calculation as if there were 0% Oxygen present. This is only displayed in ppm.

CO_2 : Carbon Dioxide calculation determined by fuel type. This is only displayed when a combustion test is being carried out. '**-O>-**' is displayed while in fresh air.

EFF : Combustion efficiency calculation displayed in percentage either as Gross (G) or Nett (N) or Condensing Nett (C) - Use **MENU** to change. The calculation is determined by fuel type and uses the calculation in British Standard BS845. The efficiency is displayed during a combustion test, '**-O>-**' is displayed while in fresh air.

X - AIR : Excess air calculated from the measured oxygen and type of fuel used. Displays reading during a combustion test. '**-O>-**' is displayed while in fresh air.

Loss : Losses calculated from Oxygen and type of fuel. Displays reading during a combustion test. '**-O>-**' is displayed while in fresh air.

BAT Displays the Battery power available in %.

When the LO BAT symbol appears this indicates the batteries are at less than 10% of charge and should be replaced, readings may be affected if used with low power batteries. Warning: all stored readings are lost when the batteries are removed or become exhausted.

DATE : Date shown as day, month and year. The order can be changed using the menu function. Date is recorded when each combustion test is printed.

TIME : The time is shown in hours and minutes, expressed in "Military" time or the 24hr clock. Time is recorded when each combustion test is printed.

Note! 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.
Date and time may also need to be reset if re-chargeable batteries are allowed to totally discharge.

SYMBOLS used on the display:

P	Poison Index: measured CO divided by calculated CO_2 multiplied by 100
R	CO/CO_2 Ratio: measured CO divided by calculated CO_2
lambda	Excess Air
AMB	Either the internal temperature of the analyzer or the inlet temperature as measured during the start up sequence
loss triangle	Loss%: losses = 100 minus efficiency %
delta T	Nett Temperature
TF	Flue Temperature
eff symbol	Efficiency %
Ħ	mg/m^3 normalized
PO	Pump off
-O>-	Oxygen greater than 18% so calculation is disabled
-OC-	Open circuit temperature input