



FIRETRON® FT900 HAND HELD COMBUSTION ANALYZER

DESCRIPTION

The Firetron Pro series of portable hand held combustion analyzers offer the commercial and industrial combustion technician a fast, accurate and easy to use method to determine the performance level of any typical fuel burning system. The Firetron utilizes highly accurate long lasting electro-chemical cells with Hydrogen compensated CO cell for increased accuracy. Each Firetron comes equipped with a draft sensor. Each draft sensor has a range of - 20 to +35 in wc.

The display is user configurable to show up to eight parameters simultaneously showing measurements and calculations of boiler efficiency. Seven built in fuel selections means the Firetron Pro will handle just about every scenario the combustion technician is likely to encounter. Up to 150 complete sets of reading can be stored for printing or downloading (with optional software) to a PC. Printing is via a separate IR impact printer thus reducing the possibility of printer damage while taking measurements and loss of data due to thermal paper washout.

The flue probe measures 11.5 inches (292mm) and has a 12-foot neoprene hose. The probe includes an insertion stop, which makes this analyzer suitable for boilers with breechings up to 24 inches in diameter. The 12-foot hose and powerful pump result in almost immediate response to adjustments of the combustion equipment.

Two models of the Firetron Pro are available, the FT-900 and FT-900N. Both measure O₂, CO, flue temperature, net temperature and draft with calculations for CO₂, efficiency, excess air and losses. The FT-900N includes an NO sensor and calculates NO_x. Oxygen reference can be set to assure an accurate indication of combustion performance. All Firetron Pro analyzers include; heavy duty rubber protective sleeve, long life sealed lead acid battery, charger, soft carrying case with room for additional accessories.

Optional equipment includes IR Impact Printer and Window software.



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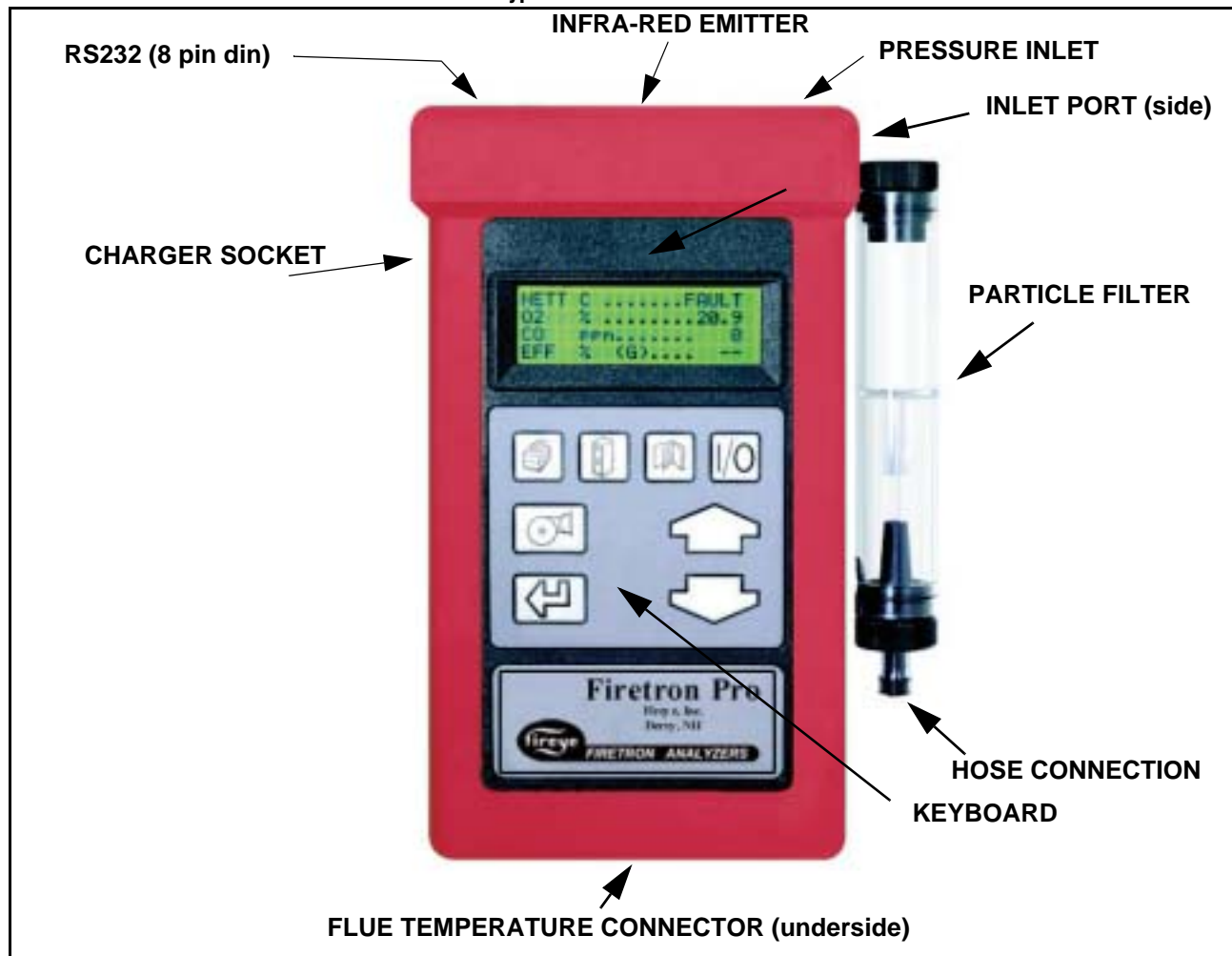
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ANALYZER LAYOUT AND FEATURES

Instrument Features and Keypad



ON/OFF



UP
 Scrolls up through options,
 i.e. Fuel



MENU
 Allows access to all menu
 functions



DOWN
 Scrolls down through options



PUMP
 Turns pump on and off



STORE
 Enters data storage menu

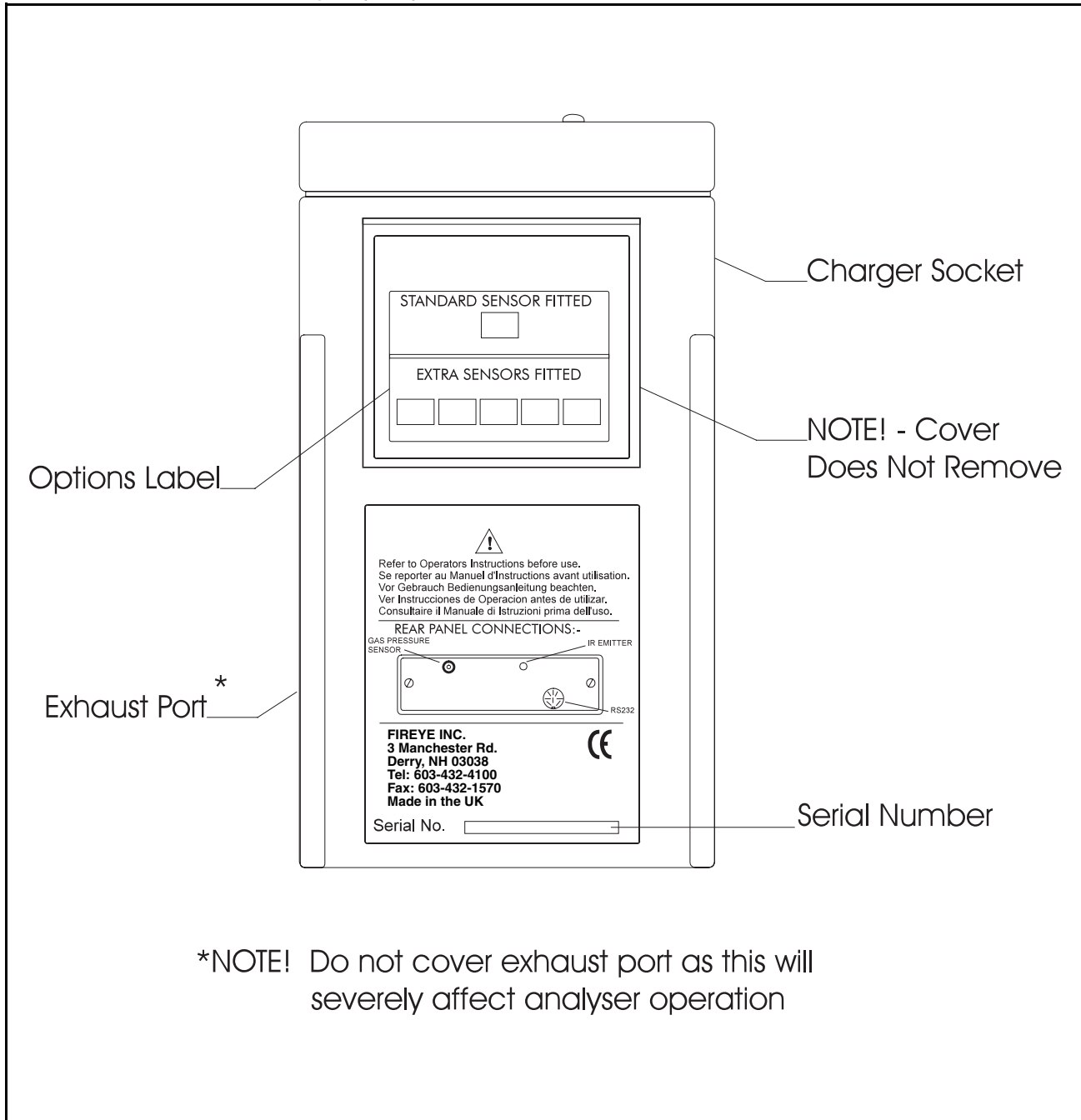


ENTER
 Accepts a command, i.e. enters
 a menu option



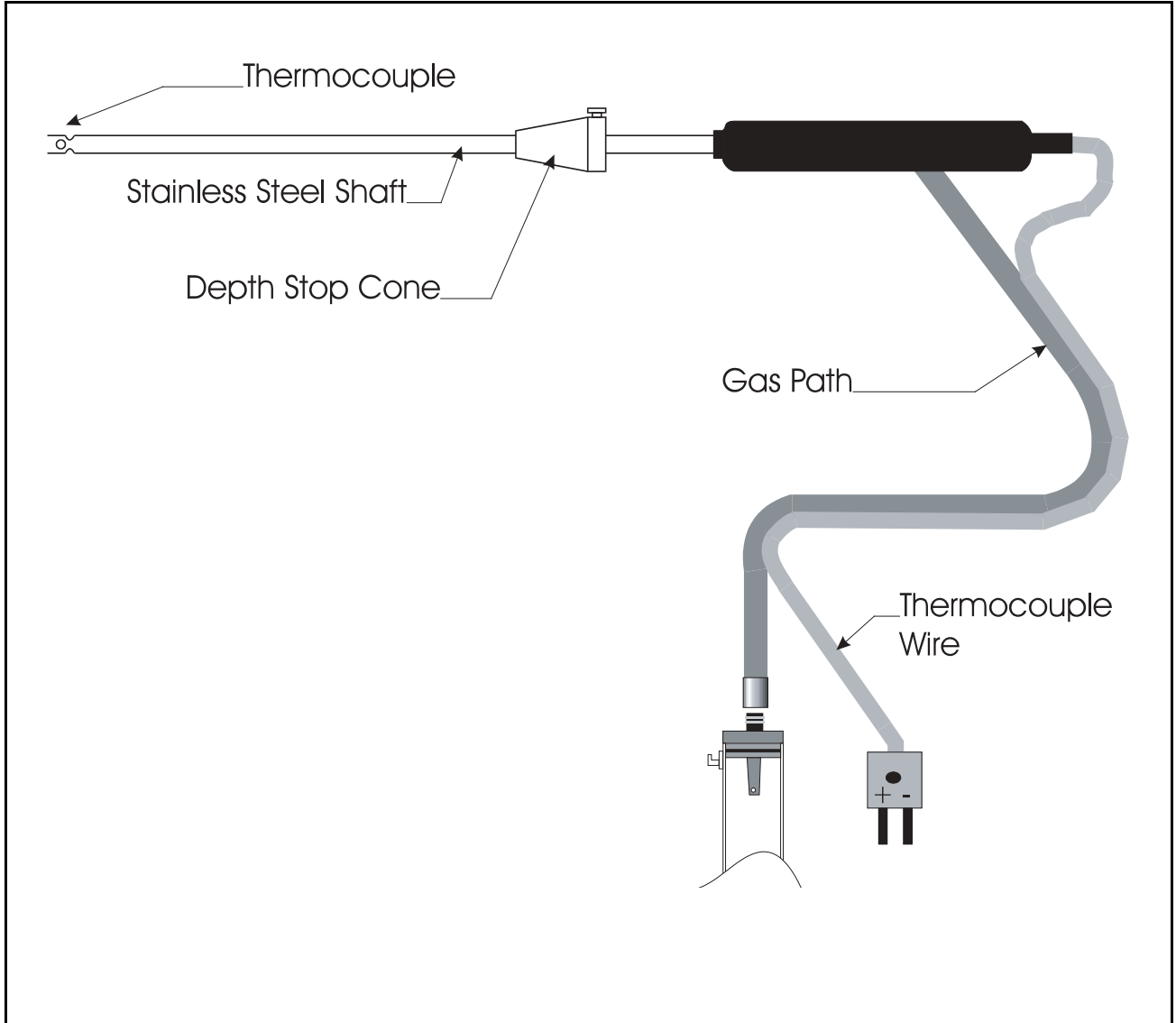
PRINT
 Prints current data

Instrument Layout (Rear)

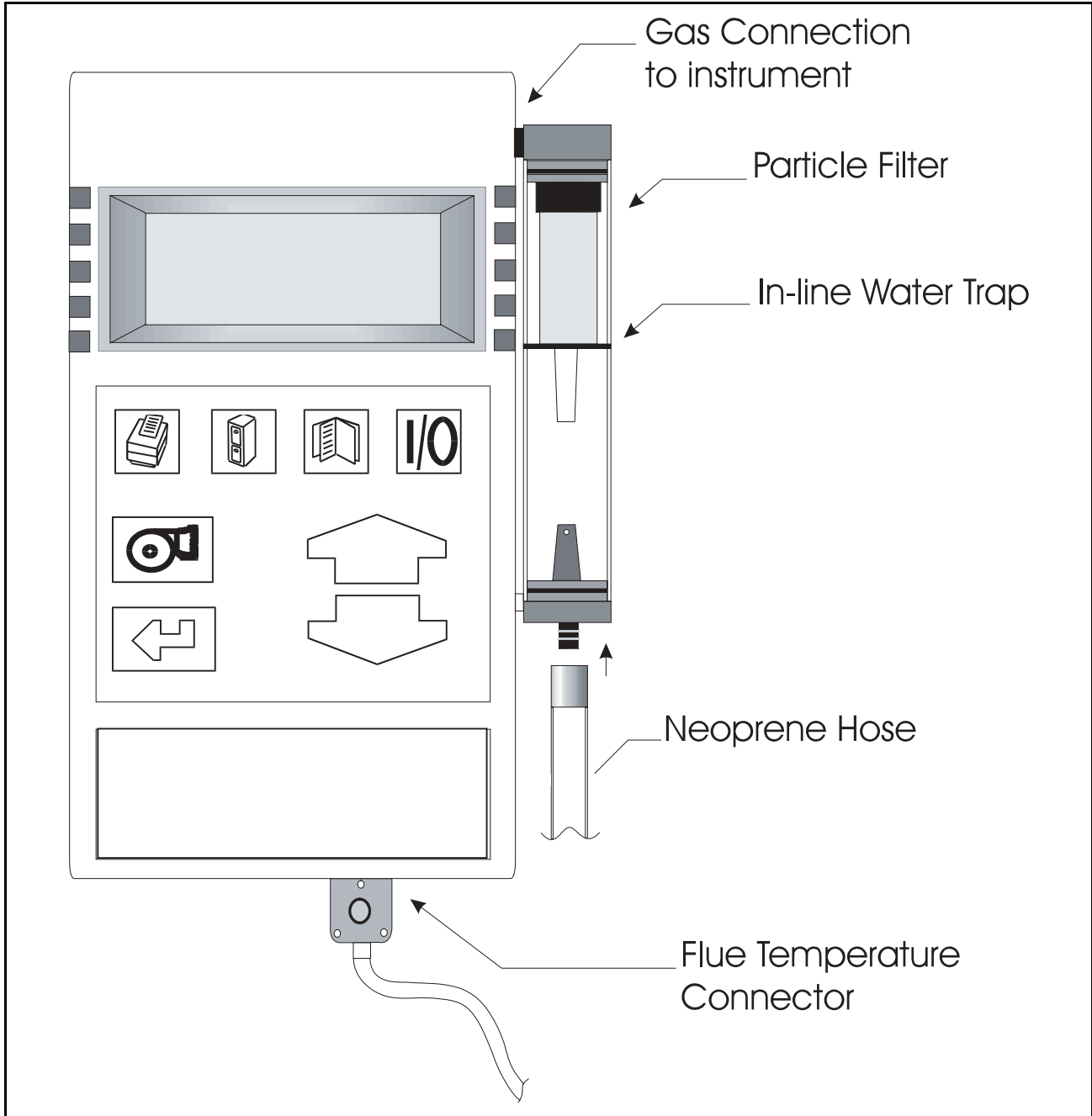


*NOTE! Do not cover exhaust port as this will severely affect analyser operation

Standard Probe Configuration



Analyzer Connections



SAFETY 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.

Protection Against Electric Shock (in accordance with EN 61010-1: 1993)

This instrument is designated as Class III equipment and should only be connected to SELV circuits. The battery charger is designated as:

Class II equipment

Installation category II

Pollution degree 2

Indoor use only

Altitude to 2000m

Ambient temperature: 32°F-104°F (0°C-40°C)

Maximum relative humidity 80% for temperatures up to 87°F (31°C) decreasing linearly to 50% RH at 104°F (40°C)

Mains supply fluctuations not to exceed 10% of the nominal voltage.

FIRST TIME USE

Charge the battery for 12 hours, following this an overnight charge should be sufficient for an average eight hour day. See Main Parameter displays for Battery Indicator.

The FT900 has a rechargeable lead acid battery, which uses a different charger than other analyzer. Ensure the correct charger is used or damage may occur to the instrument.

Check that you have all the items you have ordered.

Take time to read this manual fully.

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

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

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

NORMAL START UP SEQUENCE

Every Time You Use The analyzer

BEFORE SWITCH-ON CHECK THAT:

- the particle filter is not dirty
- the water trap and probe line are empty of water
- all hose connections, etc., are properly made
- the probe is sampling CLEAN AMBIENT air

- the water trap is correctly fitted and the instrument upright
- the flue temperature is connected

Switch ON the instrument by pressing



Automatic Calibration

During this sequence the 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 switch-on the analyzer will briefly display header information:

**Fireeye
(603) 432-4100**

And then show the countdown screen:

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

The calibration time will count down in seconds to zero. Calibration time may be changed from 2 to 6 minutes. See Set-Up menu section 5.2.5.

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 an instrument should be calibrated with clean ambient air at standard temperature and pressure (STP).

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



**NATURAL GAS
*PRESS -MENU KEY***

Press



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

**NET C0.0
O2 %20.9
CO ppm0000
EFF (G) %.....0.0**

Use  and  to change the display.

**O2 %20.9
FLUE C0.0
INLT.....NOT FITTED
AMBIENT C21**

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



Main Displays

The main display can be changed to show either four or eight parameters at one time. Two options are available when four parameters are selected.

- **Four Page Mode** displays four 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.
- **Eight Page Mode** displays eight parameters on four lines in set format, the bottom two can be changed.

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

Four Page Mode

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

NATURAL GAS
DATE.....007-08-96
TIME.....12:31:35
BATTERY.....54

NET C0.0
O2 %20.9
CO ppm ...0000
EFF (G) %.....0.0

O2 %20.9
FLUE C0.0
INLT....NOT FITTED
AMBIENT C21




CO/CO2 R....0.0001
P INDEX %.....0.01
XAIR %.....00
Prs mbar.....3.0



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


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

Line Scroll Mode

Line scroll mode allows you to customize the display.

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

Change bottom line using  and 	NET	C 0.0
	O2	%..... 20.9
	CO	ppm..... 0000
	CO2	%..... 0.0

 to select and move the parameter up	O2	% 20.9
	CO	ppm..... 0000
	CO	% 0.0
	CO	%..... 0.0


Select next parameter. Repeat above until display reads desired data.	O2	% 20.9
	CO	ppm..... 0000
	CO2	% 0000
	CO/CO2 R.... 0.0001	

Eight Page Mode

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

	O2	:20.9 %	CO2	: - -
	CO	: 0ppm	Eff	: - -
	PI	: - -	÷T	: 0C
	ς	: - -	Tf	: 21C

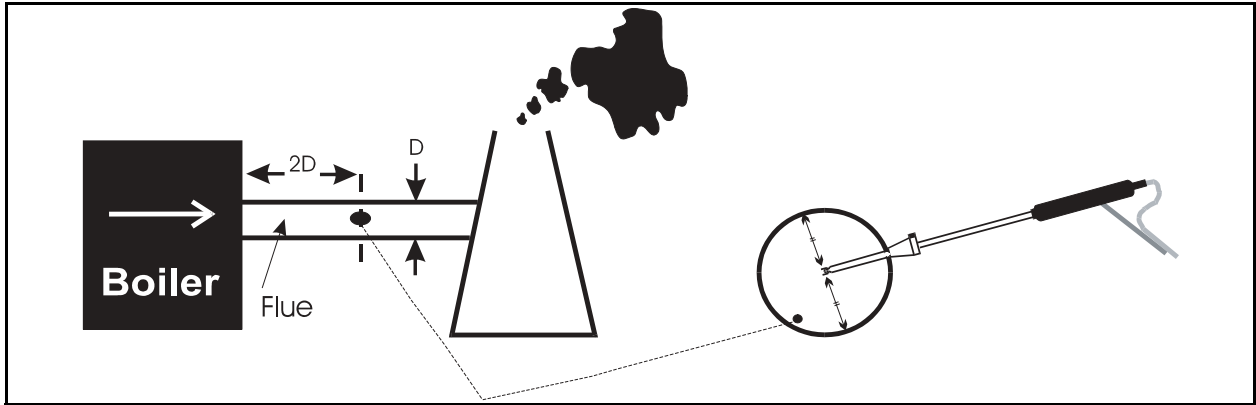
The bottom line of the display can be changed to display other parameters.

Use the  and  keys to change this line.

Sampling the Flue Gas


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

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



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

The standard probe is rated at 650°C / 1112°F. Temperatures of up to 1100°C / 2012°F can be accommodated using an optional high temperature probe.

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

Taking a Pressure Reading

With the optional pressure module fitted a flue draught measurement can be made at any time. Connect the standard probe to the pressure sensor inlet and the probe in the flue. The pressure reading will be displayed:

CO/CO2	R...0.0001
P INDEX	%.....0.01
XAIR	%.....00
Prs	mbar...0.00

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

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°F-104°F (0-40°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

 **IMPORTANT: DO THIS EVERY TIME YOU USE THE ANALYZER**

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 analyzer and damage the pump and sensors. Allow analyzer to purge until O₂ reads 20.0 and CO reads < 5.

Once the probe is removed from the flue press  and the analyzer will count down from 30 to switch off.

**OFF 30
MENU TO ESCAPE**

If you have not finished but press  by mistake, you can press  to return to normal operation and not switch OFF.

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 analyzer 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 localized 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 minimize interference or switch off, if possible, the offending equipment for the duration of the test.



NOTE: Maximum cable lengths must be less than 3 meters (9 ft.).

At the time of writing this manual Fireye 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


Press		NET	C0.0
		O2	%20.9
		CO	ppm ...0000
		CO2	%.....0.0



Press	MAIN MENU
 and 	1 SELECT 3. DISPLAY
to move cursor up and down	2. UNITS 4. SETUP


<p>Press </p> <p>to access selected Menu</p>	<p>MAIN MENU</p> <p>1. SELECT 3. DISPLAY</p> <p>2. UNITS 4. SETUP</p>
---	--

<p>Press </p> <p>to select parameter</p>	<p>FUEL : LIGHT OIL</p> <p>O2 Ref : OFF</p> <p>SMOKE : OFF</p> <p>RESET : NO</p>
---	--

<p>Use  and </p> <p>to change setting i.e. fuel selected</p>	<p>FUEL : NATURAL GAS</p> <p>O2 Ref : OFF</p> <p>SMOKE : OFF</p> <p>RESET : NO</p>
--	--

<p>Press </p> <p>to select parameter</p>	<p>FUEL : LIGHT OIL</p> <p>O2 Ref : OFF</p> <p>SMOKE : OFF</p> <p>RESET : NO</p>
---	--

<p>Press  and </p> <p>to save settings and return to the MAIN MENU</p>	<p>MAIN MENU</p> <p>1. SELECT 3. DISPLAY</p> <p>2. UNITS 4. SETUP</p>
--	--



Press  to return to the MAIN DISPLAY



Menu Options and Settings

Main Menu

The MAIN MENU consists of 4 sub menus which are shown below and detailed on the following pages.

<p>MAIN MENU</p> <p>1. SELECT 3. DISPLAY</p> <p>2. UNITS 4. SETUP</p>
--

All sub-menus are accessed using  and exited using 

The  and  keys move the cursor within a menu and allow parameters to be changed.


TIP - Holding down one of these keys scrolls through the data quicker.

Select Menu

Use	FUEL :NATURAL GAS
 and 	O2 Ref : OFF
to change setting i.e. fuel selected	SMOKE : OFF
	RESET : NO


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

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


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


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

USER FUEL	
K1g 0.000	K1n : 0.000
K_2 : 0.00	K_3 : 0.00
K_4 : 0	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 : 0	O2r : 00

Use  to move to the next parameter, repeat above until all parameters are correct.

Press  to return to SELECT menu.

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

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


What does Oxygen reference mean?

If 3% 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 Appendix.


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

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

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

Selecting YES and  will display the following screen.

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

After pressing  the 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

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

Allows all displayed units to be changed.

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

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

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

L	LIGHT	: OFF
	MODE	: 8 PAGE
	CONTRAST	: DEFAULT

Allows the configuration of the display to be changed.

LIGHT: Choose from ON or OFF.

MODE: Select 4 or 8 Page Mode or Line Scroll Mode as detailed in section 4.3 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 / altered.

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


L	ANG	: ENGLISH	: 3
	ZERO CO ALARM	: 400	NOx% : 5
	CALENDER HEADER		

Parameter	Description	Settings
LANG:	Changes the analyzers displayed and printed language	ENGLISH SPANISH FRENCH DUTCH 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. Fireye advise 3 minute countdown.	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.



<p>-----</p> <p>CO ALARM</p> <p>1010 ppm</p> <p>-----</p>

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. NO _x = 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:	<table border="0"> <tr><td>TIME:</td><td>hh: mm: ss</td></tr> <tr><td>FORMAT:</td><td>13: 53: 26</td></tr> <tr><td>DATE:</td><td>mm: dd: yy</td></tr> <tr><td></td><td>03: 01: 03</td></tr> <tr><td></td><td>mm: dd: yy</td></tr> <tr><td></td><td>dd: mm: yy</td></tr> <tr><td></td><td>yy: mm: dd</td></tr> </table>	TIME:	hh: mm: ss	FORMAT:	13: 53: 26	DATE:	mm: dd: yy		03: 01: 03		mm: dd: yy		dd: mm: yy		yy: mm: dd
TIME:	hh: mm: ss															
FORMAT:	13: 53: 26															
DATE:	mm: dd: yy															
	03: 01: 03															
	mm: dd: yy															
	dd: mm: yy															
	yy: mm: dd															
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:	mm: dd: 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 Fireye Inc. (603) 432-4100 “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 FT900 are an infra-red thermal printer or a dot matrix serial printer. Read the manual supplied with each printer prior to operation. Connections to the FT900 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 FT900 and the bottom of the printer. Ensure they are pointing at each other and within 300 mm, with no obstructions in the way. Data may be lost if transmission is interrupted. Keep the FT900 pointing at the printer until the printout has finished.
- Dot matrix serial printer - requires the supplied serial cable to transmit data. Connect the cable to the 8 pin DIN socket on the top of the FT900 and the 25 pin D-connector on the printer.

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

Printing a "Live" Test

During a combustion test the FT900 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:

```
TEST 36
DATE:      01-01-96
TIME:      15:46:52
NATURAL GAS

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

CO2 % ° . . . . . 0.3
FLUE C. ° . . . . . 24
INTL C ° NOT FITTED
AMBIENT C. . . . . 22.6

CO/CO2 R . . . . 0.0000
P INDEX % . . . . 0.00
XAIR % O2 > 20%
Prs mbar . . . . 0.0
```


STORING AND RETRIEVING DATA



The FT900 can store up to 100 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 MODE

STORE MENU
MENU : STORE
LOCATION : 3
PRESS "STORE" TO LOG

Mode: Select from the following:

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

Location: Automatically allocates a location in the memory of the instrument for the next test. On the display shown above the next location will be 3.

To store a test set **MODE** to **STORE** and press . The current readings will be stored in the analyzers memory.

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



Viewing and Printing a ‘Stored’ Test


Multiple tests can be printed easily with the FT900.


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

Press  to access the STORE MENU MODE

STORE MENU
MENU: PRINT
LOCATION : 1 TO 10
PRESS "STORE" TO LOG

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


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

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

During printing the following will be shown.

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


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

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


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

Deleting Data



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

Press  to access the STORE MENU

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

Press  to access delete data screen

**ENTER TO ERASE DATA
MENU TO ESCAPE**

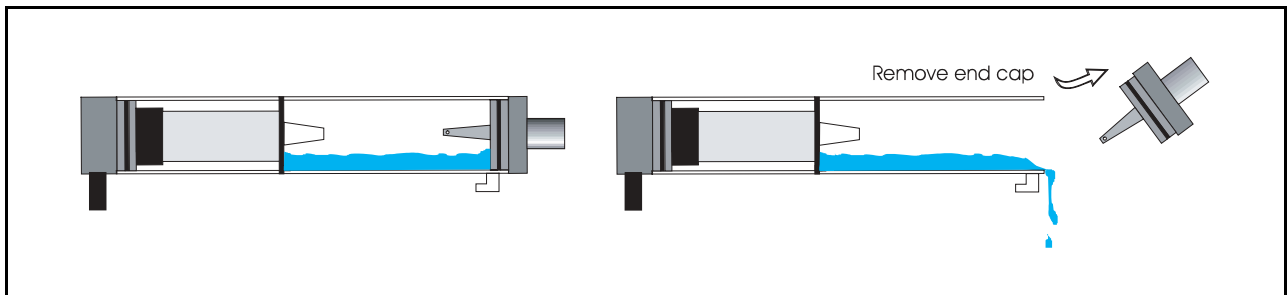
Press  to delete data in memory, press  to exit delete data screen.

MAINTENANCE

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.

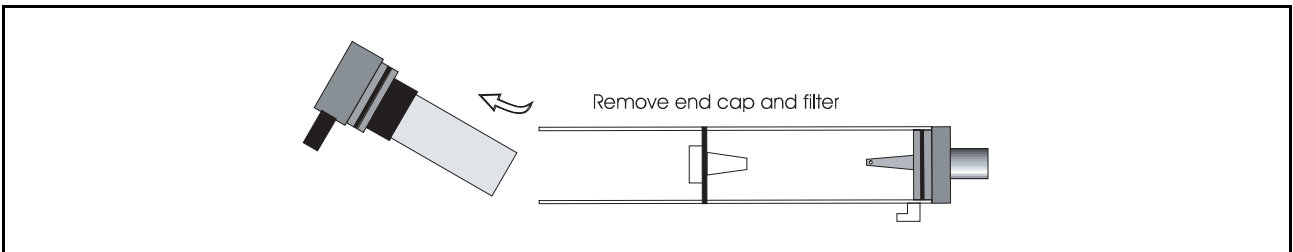
Emptying of the water trap is detailed below:



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. It 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.

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 Fireye Service Department or an Authorized 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) • Toxic sensor Error (FAULT) 	<ul style="list-style-type: none"> • 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.
<ul style="list-style-type: none"> • Analyzer not holding charge • Analyzer not charging 	<ul style="list-style-type: none"> • Battery exhausted. • AC charger not giving correct output. • Fuse blown in charger plug.
<ul style="list-style-type: none"> • Analyzer 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. • Probe connected to pressure connector.
<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.
<ul style="list-style-type: none"> • Analyzer automatically switches off in operation. 	<ul style="list-style-type: none"> • Battery below alarm level. • Ambient temperature above 50°C (122°F). • Battery quickly discharging and is faulty.
<ul style="list-style-type: none"> • Display shows dark lines and no response from ON/OFF key 	<ul style="list-style-type: none"> • Fault has occurred on the instrument electronics and requires resetting. • Contact Fireye or Authorized Distributor.

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 regulation may require more frequent re-calibration and users should check with appropriate authorities to ensure they comply with relevant guidelines.



PRODUCT SPECIFICATION

PARAMETER	RESOLUTION	ACCURACY	RANGE
Temp Measurement			
Flue Temperature	1.0°C/F	±2.0°C ±0.3% reading	0-600°C/32-1112°F
Inlet Temperature	0.1°C/F	±1°C ±0.3% reading	0-50°C/32-122°F
Gas Measurement			
Oxygen	0.1%	±0.2% * ¹	0-21%
Carbon Monoxide	1ppm,mg/m ³	±20ppm <400ppm* ¹ ±5% >400ppm	0-4000ppm, 0-5000mg/m ³
Carbon Monoxide, H2 compensated	1ppm,mg/m ³	±20ppm <400ppm* ¹ ±5% <5000ppm ±10% >5000ppm	0-10,000ppm, 0-12,000mg/m ³
Nitric Oxide (optional)	1ppm,mg/m ³	±5ppm <100ppm* ¹ ±5% >100ppm	0-5000ppm, 0-6700mg/m ³
Pressure (optional)	0.1mbar	±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 (Net) * ²	1.0°C/F	±2°C ±0.3% reading	0-600°C/32-1112°F
CO/CO2 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	2.2lb (1kg)		
Weight	8.7in x 2.2in x 4.7in (220mm x 55mm x 120mm)		
Handset	L 16.5in x Dia 0.3in (L420mm x Dia8mm) with		
Probe	11.2in (285mm) long stainless steel shaft, type K thermocouple and 9.5ft (3m) long neoprene hose		
Ambient Operating Range	(+0°C to +40°C (+32°F to +104°F) /10% to 90% RH non condensing		
Power Supply (battery charger)	Input: 110Vac/220 Vac nominal Output: 12 Vac off load		
Battery Life	8 hours from full charge		

*¹Using dry gases at STP

*²Calculated

APPENDICES

Main Display Parameters

The parameters and their meanings are detailed as follows:

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

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

BATTERY: Displays the battery level from 0-100%.

The analyzer will flash (BAT)**RECHARGE BATTERY** at less than 10% of charge. With the charger connected the display shows **AC ON**.

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

(±T)

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

O2: Oxygen reading in percentage%.

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

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

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

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

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

AMBIENT: Temperature measured by the internal sensor, used in the NET (Ta) 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: The CO/CO2 ratio expressed as a percentage%, called the "Poison (PI)Index" i.e. P (PI)

INDEX% = 100 x CO/CO2. "-" is displayed while in clean ambient air.

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

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

- NO:** Nitric Oxide reading in ppm or mg/m³. Displayed when Nitric Oxide sensor fitted. Also displayed as NO (n) when referenced to oxygen. The display will read 'O₂ > 20%' if referenced values selected and instrument is in clean ambient air.
- NO_x:** Calculated total Nitric oxides displayed in ppm or mg/m³. Where NO_x = NO + P%NO, note P can be set from 0-9%, default = 5%. See SELECT menu 5.2.2. Also displayed as NO_x (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.
- (O₂r):** 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 riddlings
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 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)

K₁ = Constant based on Gross or Net Calorific Value:

K_{1g} = (255 x%Carbon in fuel)/Q_{gr}

K_{1n} = (255 x%Carbon in fuel)/Q_{net}

K₂ = % max theoretical CO₂ (dry basis)

K₃ = % Wet Loss

H₂ = % Hydrogen

H₂O = % Water

Measured Data:

Tf = Flue Temperature
 Ti = Inlet Temperature
 O2m = % Oxygen in flue gas
 O2r = 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% = $20.9 \times K1 \times (Tnet) / K2 \times (20.9 - O2m)$

Wet loss% = $9 \times H2 + H2O / Qgr \times [2488 + 2.1Tf - 4.2 Ti]$

simplified = $[(9 \times H2 + H2O) / Qgr] \times 2425 \times [1 + 0.001 Tnet]$

Wet loss% = $K3(1+0.001 \times Tnet)$

Where K3 = $[(9 \times H2 + H2O) / Qgr] \times 2425$

Net Efficiency% = 100 - dry flue gas losses

= $100 - 20.9 \times K1n \times (Tnet) / K2 \times (20.9 - O2m)$

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

= $100 - \{[20.9 \times K1g \times (Tnet) / K2 \times (20.9 - O2m)] + [K3 \times (1 + 0.001 \times Tnet)]\}$

Excess Air = $[(20.9\% / (20.9\% - O2m\%)) - 1] \times 100\%$

CO2% = $[(20.9 - O2m) \times K2 / 20.9]$

Unburned fuel Loss% = $K4 \times CO / (CO + CO2)$ 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) = $CO \times \frac{(20.9 - O2r)}{(20.9 - O2m)}$

CALCULATION OF FUEL DATA

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

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

Example 1:

Chemical composition:	C	25%
	H2	3%
	H2O	50%
	Qnet	8.35 MJ/kg
	Qg	9.3 MJ/kg*
	Max CO2	20.4%

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

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

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

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

$$K2 = \text{Max\% CO2} = 20.40$$

$$K3 = \text{Wet Loss} = [(9 \times \% H2 + \% H2O) / 9300] \times 2425$$

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

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

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


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. See previous appendix for other fuels.

ELECTROMAGNETIC COMPATABILITY (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.

Specification EC/EMC/KI/FT900 details the specific test configuration, performance and conditions of use.



NOTICE

When Fireeye products are combined with equipment manufactured by others and/or integrated into systems designed or manufactured by others, the Fireeye warranty, as stated in its General Terms and Conditions of Sale, pertains only to the Fireeye products and not to any other equipment or to the combined system or its overall performance.

WARRANTIES

FIREYE guarantees for *one year from the date of installation or 18 months from date of manufacture* of its products to replace, or, at its option, to repair any product or part thereof (except lamps, electronic tubes and photocells) which is found defective in material or workmanship or which otherwise fails to conform to the description of the product on the face of its sales order. **THE FOREGOING IS IN LIEU OF ALL OTHER WARRANTIES AND FIREYE MAKES NO WARRANTY OF MERCHANTABILITY OR ANY OTHER WARRANTY, EXPRESS OR IMPLIED.** Except as specifically stated in these general terms and conditions of sale, remedies with respect to any product or part number manufactured or sold by Fireeye shall be limited exclusively to the right to replacement or repair as above provided. In no event shall Fireeye be liable for consequential or special damages of any nature that may arise in connection with such product or part.



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FIREYE™
3 Manchester Road
Derry, New Hampshire 03038 USA
www.fireeye.com

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