® fireye

Fireye®
Series 1000
FIRETRON® Analyzer
Models Available
FT1200-1
FT1220-2A
FT1300-1

1.0 PREFACE

1.1 TECHNICAL SPECIFICATION

Fuels: Wood   Light Fuel Oil   Heavy Fuel Oil   Natural Gas

      Propane   Coal   4 - User definable fuels

Accuracy: O_2 - Better than 1% vol.   Other gases - Better than 4% of reading

Display: 40 x 8 Matrix Liquid Crystal, electroluminescent backlighting when in use

Keyboard: Tactile membrane (integral with display) function keys and cursors

Printer: External Serial Printer (Optional on all 1000 Series).

Indicators: LED type for ON (Power), Stand-by, Service, Charge, Low Batt., Fault

Power Supply: 95 - 265V a.c. +10%, 50-60Hz, 30 Watts. Rechargeable battery 2 x 6V Ampere hours. Typical 8 hr. operation typical.

Sensor type:

O_2, CO,	Electrochemical Cells
NO (FT1300-1 only)	Electrochemical Cell
SO_2 (FT1200-2A only)	Electrochemical Cell
Flue Gas Temp.:	Type K Thermocouple
Ambient Temp.:	Solid State Sensor
Draft:	Pressure Transducer

Calibration Check Program: 3 minute zero calibration check on all cells (O_2 check 20.9).

Gas cells	Range	Accuracy % full scale	Resolution
Oxygen, O_2	0 to 25.0% Vol.	±1%	±0.1% of volume
Carbon Monoxide, CO	0 to 2000ppm	±4%	±1ppm
Nitrogen Monoxide, NO (FT1300-1 only)	0 to 1000ppm	±4%	±1ppm
Sulfur Dioxide, SO_2 (FT1200-2A)	0 to 2000ppm	±4%	±1ppm
Ambient Temp	-5 to 50°C/+23 to 122°F		
Draft	±20″ Water Gauge		
Carbon Dioxide, CO_2	Calculated		
NOx	Calculated (FT1300-1 only)		
Efficiency	Calculated		
Excess air	Calculated		
Loss	Calculated		
Special ranges:			
Carbon Monoxide, CO	0 to 500ppm	±4%	±1ppm
	0 to 1000ppm	±4%	±1ppm
	0 to 10%		±100ppm
Nitrogen Monoxide, NO (FT1300-1 only)	0 to 500ppm	±4%	±1ppm
	0 to 2000ppm	±4%	±1ppm
	0 to 4000ppm	±4%	±1ppm

Special ranges are determined before purchase. These ranges only apply where requests have been made at the time of purchase.

Firetron Series 1000 Models Available

Part Number	Description
FT1200-1	Two Gas Unit: O_2, CO Draft Measurement, No Internal Printer, Output Serial Output for External Serial Printer standard.
FT1200-2A	Two Gas Unit: O_2, SO_2, No Draft, No Internal Printer, Output Serial Output for External Serial Printer standard.
FT1300-1	Three Gas Unit: O_2, CO, NO and Draft Measurement, No Internal Printer, Serial Output for External Serial Printer standard.

Standard Accessories:	• "Duo" probe (300mm/12")
	• Integral water catchpot & filter
	• Rechargeable lead acid battery (internal)
	• RS232 Serial Connection
	• Firetron "CAPTURE" software
	• Data Logger (1000 pt)
	• Draft measurement (FT1200-1, FT1300-1)
Max Probe Temp:	600°C/1112°F continuous; 800°C/1470°F intermittent.
Gas Tubing:	Silicon rubber hose
Case:	Medium density blended polyethylene.
Weight:	5.3Kg/11.2 lbs (analyzer only)
	133.2 lbs (case and accessories)
Dimensions:	453mm(W) x 120 mm(D) x 245 mm(H)+20 mm.
	Stand 17.8"(W) x 4.7" (D) x 9.6" (H)
Options:	Fireton Pistol Grip Probe and Hose Assembly
	• 3m/10 ft.
	• 10m/32 ft.
	Probe Length Options:
	• 1m/39.4"
	• 1.5/60"
	• 3m/118"
	Serial printer (separate)

Continuous product development may make it necessary to change these details without notice.

1.3 UNPACKING

Check all packages for external signs of damage. Check the contents against the packing note and identify them against the System Description.

⚠️ **IMPORTANT: If any item has been damaged in transit, this should be reported to the carrier and to the supplier immediately. DO NOT RETURN a damaged instrument to the sender as the carrier will not then consider a claim. Save the packaging with the damaged article for inspection by the carrier.**

1.4   SAFETY ASPECTS

The Firetron 1000 portable flue gas monitor is a safety Class 2 instrument.

1. Before switching on the apparatus make sure that the power supply is suitable for the instrument.

2. The main power plug shall only be inserted in a socket outlet provided with a protective earth contact. The protective action must not be negated by the use of an extension cord without a protective conductor.

3. **WARNING! Any interruption of the protective conductor inside or outside the instrument or disconnection of the protective earth terminal is likely to make the apparatus dangerous. Intentional interruption is prohibited.**

4. When the apparatus is connected to its supply, terminals may be live, and the opening of covers or removal of parts (except those to which access can be gained by hand) is likely to expose live parts.

5. Any adjustment, maintenance and repair of the opened apparatus under voltage shall be avoided as far as possible and, if inevitable, shall be carried out only by a skilled person who is aware of the hazard involved.

6. Make sure that only fuses with the required rated current and of the specified type are used for replacement. The use of makeshift fuses and the short-circuiting of fuse holders are prohibited.

7. Whenever it is likely that the protection has been impaired, the apparatus shall be made inoperative and be secured against any unintended operation.

The protection is likely to be impaired if, for example, the apparatus:

- shows visible damage

- fails to perform the intended measurements

- has been subjected to prolonged storage under unfavorable conditions

- has been subjected to severe transport stresses.

⚠ **CAUTION: Due caution should be exercised when installing, operating and servicing this equipment. Attention is drawn to the following safety points:**

POWER: Ensure that main supplies are isolated when making access to the equipment for maintenance or servicing purposes. Read the instructions carefully to ensure correct connection of all mains, signal leads and probe connections.

EYE PROTECTION: Eyes and face should be suitably protected by goggles when looking into hot furnaces. Precautions should also be taken when removing instruments from pressurized ducts.

PROTECTIVE CLOTHING: When working in the vicinity of hot boilers and furnaces protective clothing should be worn at all times, particularly protection of the hands.

⚠ **CAUTION: FAULT FINDING: The instrument must be fully isolated from the power supply before internal, electrical maintenance or servicing work, and should only be undertaken by a suitably authorized/qualified engineer.**

STATIC DISCHARGE

Under certain boiler conditions a high static charge may build up. With non conductive stack entry points the normal procedure to avoid damage to the instrument or person, is to make a connection from the probe extension to ground /earth before inserting into stack. With conductive (metallic) entry points the metal surround should be grounded.

Situations may occur, for instance where the sampled hot gases have just passed through electrostatic precipitators, where a high static charge would build up on the instrument probe if ungrounded. Further contact by any grounded object, i.e. a person touching the keyboard and forming a discharge path, may then result in damage to the instrument.

> ⚠ **HAZARDOUS GASES: All recognized safety procedures should be used when operating with hazardous gases. Fireye accepts no responsibility for damage to the instrument, or injury to the person while following procedures, nor will the company accept liability for failure to comply with safety precautions.**

1.5   DESCRIPTION OF INSTRUMENT

The Firetron 1000 Portable Gas Analyzer has been designed to give maximum choice to the customer within a single instrument.

The Firetron Series 1000 is a portable 2 or 3 gas flue gas combustion analyzer with draft measurement standard. CO_2, Excess Air, Loss and Efficiency are all calculated from appropriate cells via computed calculation. Flue gas and ambient temperature measurement are standard. The Firetron 1000 is **not intended** to be used as a continuous gas monitor.

The carrying case holds any accessories and the 12" Duo probe and sample hose. The water catchpot is contained in the side of the instrument case and is easily accessible for emptying.

The sealed lead acid battery will maintain the operation of the instrument for a full working day when fully charged. The instrument accepts is a wide range of power supplies (90 to 265V, 50/60Hz).

Operational procedure is carried out by following the user friendly menu on the liquid crystal display and using the keyboard on the same front panel. Simultaneous display of all measured and calculated values gives a complete overview of the combustion situation. Every menu incorporates a "HELP" facility for use if any difficulty is found during operation.

A printer (not supplied) can be connected through the RS232 serial interface.

A facility for automatic air purging of the sensors occurs every time the instrument is switched off. This ensures accuracy of readings and conserves the sensor life.

System Components
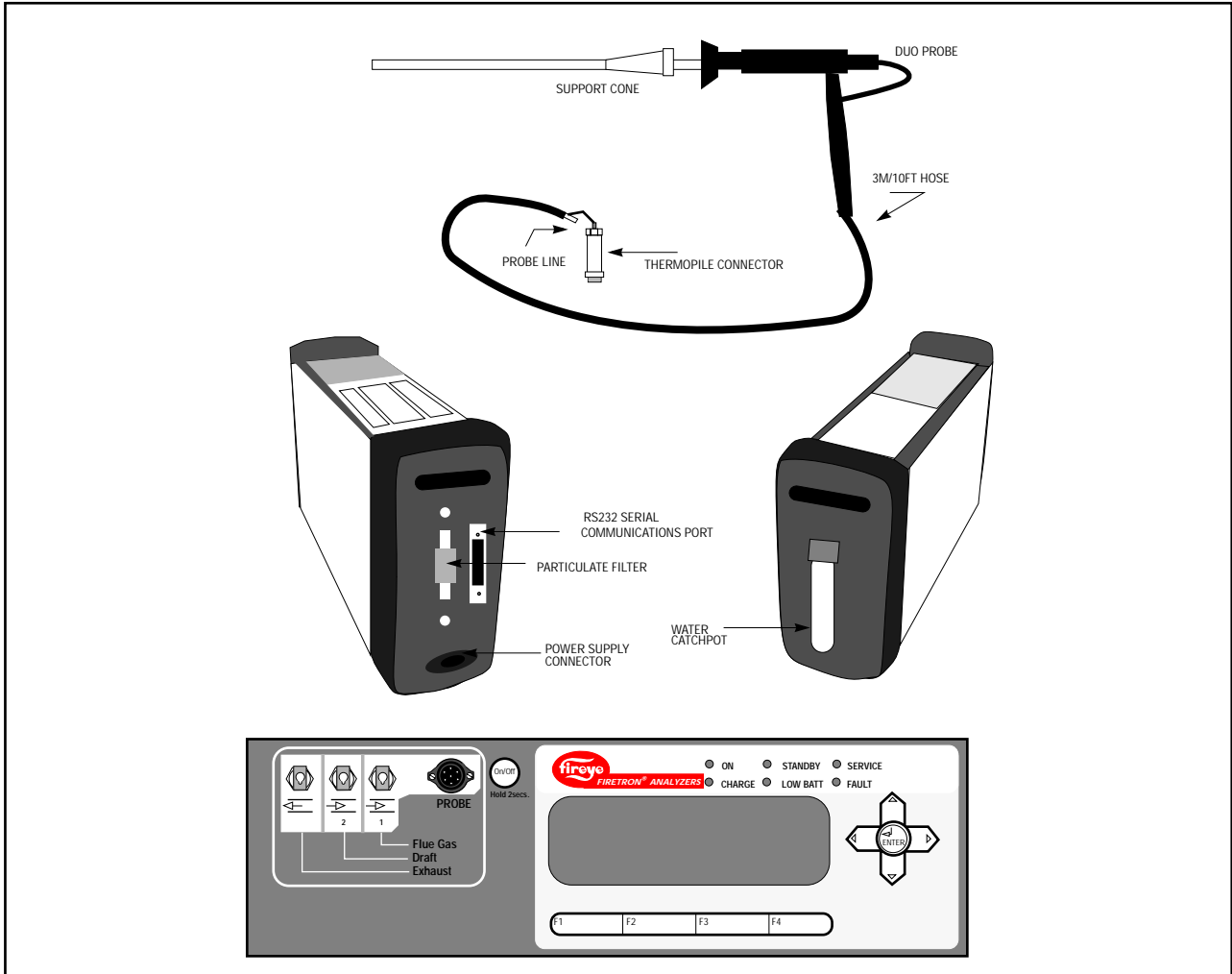
2.0 GETTING STARTED

2.1   PREPARATIONS FOR USE

Essential User Information: The instrument can be operated while still in its shoulder bag.

Check all equipment is fully functioning and all parts present.

- Firetron 1000 instrument
- "Duo" Probe handle and 3m/10 ft. hose
- Probe tube
- Carrying strap
- Power Supply lead
- Firetron "CAPTURE" software
- plus any options ordered

Water Catchpot - refer to Section 2.2.9

Check the water container is secure, air leaks will result if loose, resulting in incorrect readings. To remove or empty the water container, pull the bottom of the container out from the securing clip, the unit is hinged and will swing out to about 45°. Unscrew the container and empty out any water.

NOTE: Do not force the hinge beyond 45•, otherwise damage to the hinge may occur. Do not over-tighten.

Probe Assembly: Connect the probe line and thermocouple connector as shown.

NOTE: Probe and Thermocouple must be connected before unit is started up and until it is completely shut down.
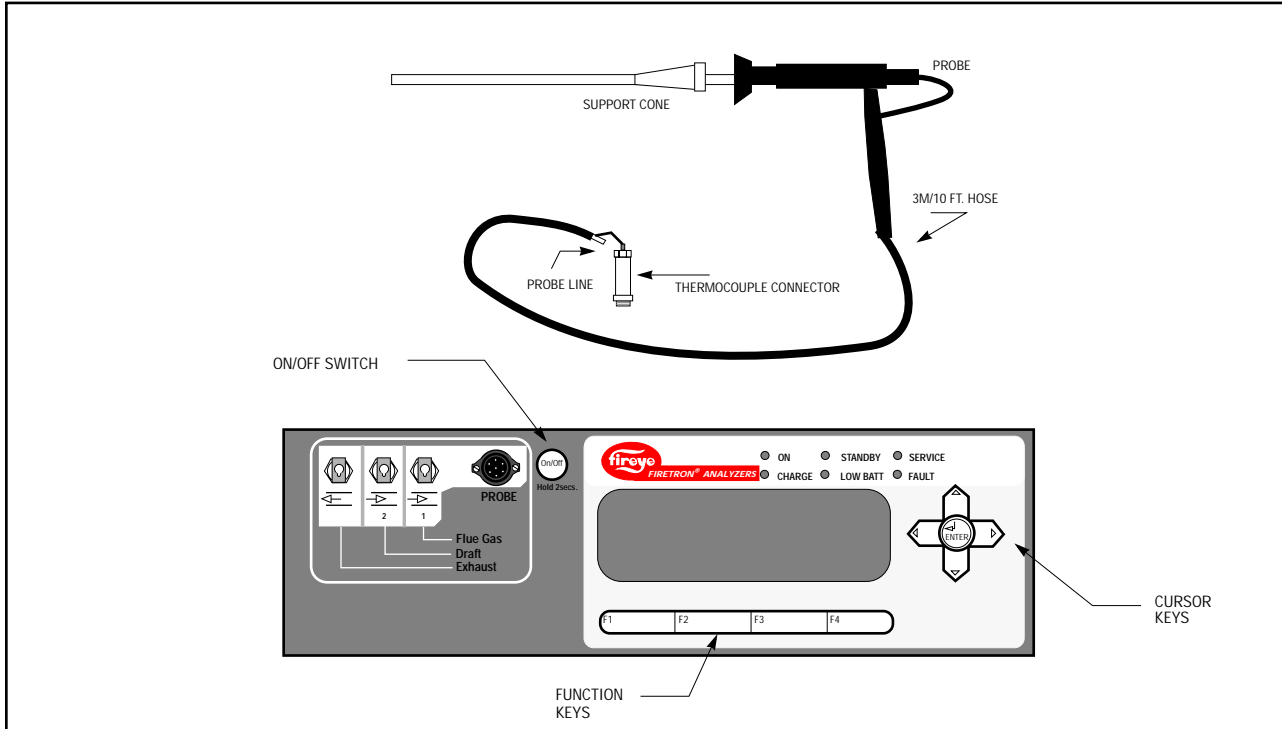
POWER SUPPLY LEAD AND BATTERY CHARGING

Power Supply Lead: The main power lead (supplied) connects into the inlet socket on the side of the instrument.(See Section 1.4 - Description of Instrument).

Battery Charging: The integral battery charger is universal and operates from a wide range of mains supplies (95 - 265V 50 - 60Hz).

When the instrument is being charged, by plugging in the power supply lead and switching on, the front panel' CHARGE' LED will illuminate and continue to trickle charge even while in use.

The instrument may be operated on either the internal batteries or direct from the power supply. Two re-chargeable 6V 4 ampere hour batteries are fitted within the case. A half charge can be achieved in 3 - 4 hours. The instrument will operate for approximately 8 hours after a full charge.

'ON/OFF' SWITCH

This switch is located on the upper part of the front panel and powers up the instrument. Pressing and holding down the button for 2-3 seconds will switch the instrument - On or Off. When system switch is on, the instrument will start through a 180 second calibration period. When the instrument is switched off it will perform a 30 second purge - the display will show 'SYSTEM CLOSING DOWN PURGING'. After completion of the purging cycle the instrument will then be completely shut down.

ON/OFF SWITCH   FUNCTION KEYS   CURSOR KEYS
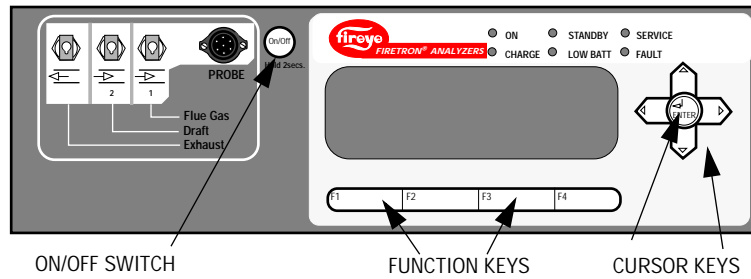
Cursor and Enter Keys: The instrument is totally menu operated. There are 4 cursor keys and 1 Enter key for scrolling and selection of displayed items.

The Enter key is normally used for selecting the item required, but on some displays, where the requests are more complex, the Enter key may have a different function.

Function Keys: Four function buttons are located underneath the display. Their specific functions change dependent upon the menu selected i.e. HELP, MENU, EXIT, NEXT etc.

Help Facility: All displays have individual 'HELP' related information.

LEDS Display Panel: The LED panel indicates certain operating conditions of the instrument. When switching ON only the 'ON' LED should illuminate. The 'LOW BATT' LED will indicate if the battery requires charging. If the 'FAULT' LED is illuminated, check for faults at the diagnostics ->FAULT MENU.

2.5 QUICK START PROCEDURE

The operator may require to have the instrument functional immediately to read gas readings. The following procedure will have the instrument operational in a few minutes.

1. The instrument may be run direct from the power supply or internal battery.
2. Connect power supply (if required).
3. **CONNECT THE PROBE.**
4. Press and hold the On/Off button for approximately 2-3 secs.
5. Wait for the calibration to finish, the display will show the time progress of the calibration.
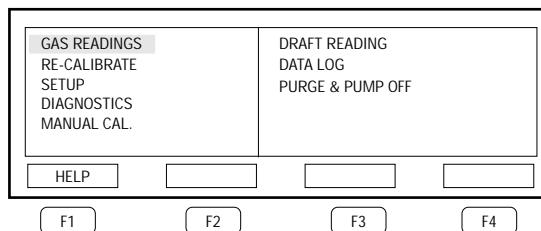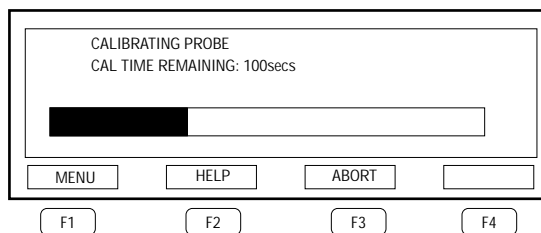
6. After 3 minutes the main menu display will appear with GAS READINGS menu highlighted.

7. Press ENTER on the front panel cursor keys, then the function key. The display will show which gas readings will be measured, i.e. Natural Gas, Light Fuel Oil, etc. To change from a different desired fuel from this, go to MENU/SETUP/FUEL TYPE.

8. The display will prompt for 'GO'. Press the F3 key. The display will show gas readings.

9. Insert probe into the sample measurement point.

10. To switch the instrument off, remove probe from sample point, press and hold the ON/OFF button for approximately 2-3 seconds. The instrument will purge the gas sensors with fresh air for 30 seconds, then completely shut down.

Probe Insertion: Loosen the support cone on the probe to allow free movement. (See Description of Instrument).

The probe should be inserted in to the sample area carrying the gas flow through a 11mm to 16mm / 7/16" to 5/8" sampling hole.

The probe insertion length can then be adjusted and the support cone re-tightened when the tip of the probe is in contact with the main stream of the gas flow. The thermocouple measurement reading may assist in determining the best position.

⚠ **Avoid the infiltration of air at the sampling point.**

⚠ **Static Discharge - refer to Section 1.3, Page 5 for details.**

High Gas Concentrations: Measurement periods are only restricted by the concentration of the gases being measured. i.e. Low concentrations in 10 or 20 ppms will not effect the continuous operation. High concentrations in 10,000 ppms will quickly saturate the sensors.

Water Catchpot: The other limiting factor of the sampling period is water filling the catchpot. The catchpot should be periodically checked and emptied before it overflows into the pump.

To empty the water catchpot.

1. Unclip the container and pull out the bottom. **The container is hinged at the top and must not be over extended, more than 45°.**

2. Unscrew the catchpot, remove and empty out water.

Replace in reverse and ensure the catchpot makes a good seal. **Do not over-tighten.** Air leakage will cause errors in gas readings.

3. Make sure O-ring seal is in place prior to replacing water catch-pot.
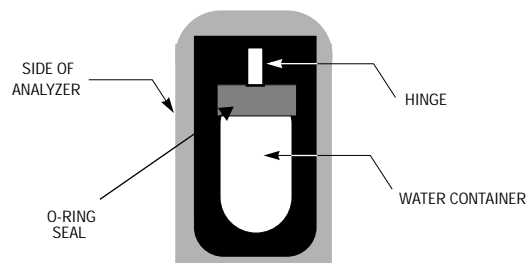
3.0 SOFTWARE DESCRIPTION

3.1   MAIN MENU

The information contained in this manual is provided for an instrument fitted with all sensors and available options. Therefore, some menus and associated options will not be available on individual instruments.
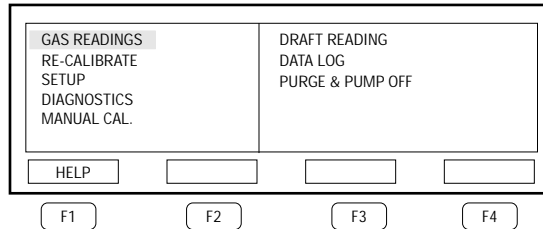
NOTE: Gas readings cannot be accessed during re-calibration. When initiating the gas readings mode, a confirmation of FUEL TYPE display will appear.

The main menu provides access to all other display menus. This is undertaken by using the keypad and cursor keys.

1.   ON/OFF KEY: Switch between ON/OFF

2.   CURSOR KEYS: Scrolls up and down menus and also for selecting arithmetic values or other options.

3.   ENTER KEY: Confirms selection.

4.   FUNCTION KEY: F1 selects HELP.
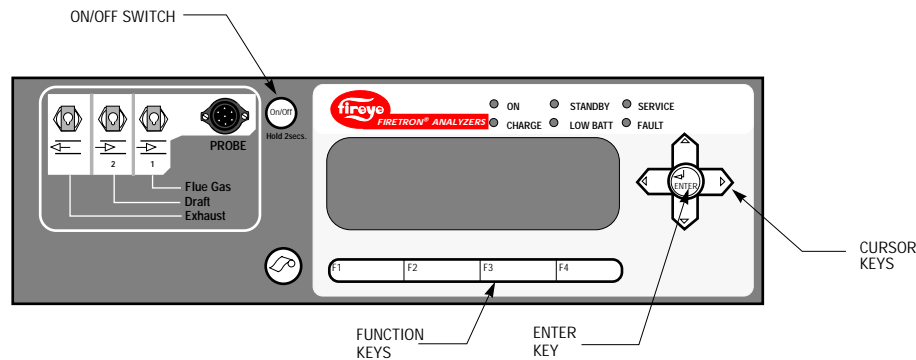
Gas Reading: This menu and sub-menus provide access to all information regarding the measurement of the gases.

Explanation of Terms: The following represents detailed explanations about the information presented on screen.

Unit #: The unique identification number of the instrument which applies to the measurement of gases in a particular location. Any number between 0 and 99 can be used, to provide up to 99 unique measurement locations.

To change this unique identification number requires access to the Setup menu, Section 3.4.

Fuel Type: This represents the fuel type used at the specific location. This refers to the original fuel used by the burner or furnace all of which have different burning characteristics and emission properties.The user definable options are: Wood, Light Fuel Oil, Heavy Fuel Oil, Natural Gas, Propane, Coal and four alternative fuel option choices. To change the Fuel type refer to the Setup menu, Section 3.4.

Analysis: The Firetron 1000 would normally display analysis type as dry. The conversion to wet analysis requires information on the % water content of the flue gas. Where the analysis is wet, the water content in % terms is also displayed.

The formula for wet analysis is as follows:

$$ppm \text{ (wet)} = \frac{(1 - H_2O) \text{ (ppm) dry}}{100}$$

where H_2O = % water content

To change the analysis from wet to dry refer to the Setup menu.

3.2 MAKING THE GAS MEASUREMENT

If an attempt is made to make a gas measurement prior to connecting the sample probe, the following message will be displayed. It will also reflect the settings used the last time the instrument was used.

```
UNIT NO:      1
FUEL TYPE:    NATURAL GAS
ANALYSIS:     DRY

  CONNECT SAMPLE PROBE...

   MENU         HELP         GO
   F1           F2           F3           F4
```

NOTE: Gas concentration measurements will only be shown for gases where the cell is fitted. To make a Gas measurement reading press 'GO'.

Example: FT1200-1 O_2, CO

FT1200-2A O_2, SO_2

FT1300-1 O_2, CO & NO

Measurement units can be changed. Refer to the Setup menu, Section 3.4.Gas Measurement Display. The measurement display is shown below. Gas measurements are displayed in their respective units, i.e ppm or %.

```
CO   XXXppm          ENTER: NEXT SCREEN
O2   XXX%
NO   XXX ppm

   MENU        FLOW        PRINT        LOG
   F1          F2          F3           F4
```

NOTE: This menu will display "O_2 norm. on" if Oxygen normalization is selected.

WET/DRY MEASUREMENT - CALCULATED VALUES

The display is shown below.

```
DRY                          ENTER: NEXT SCREEN
                     FUEL EFF      XX.X%
NOx      XXX ppm     LOSS          XXX ppm
         (FT1300-1)  EXCESS AIR    XX.X%

   MENU        HELP        ZOOM         LOG
   F1          F2          F3           F4
```

No_x is determined by the NO measured concentration plus the NO_2 factor on the FT1300-1.

*No_2 factor is menu entered percentage. The units of concentration are SET in the SETUP> SYSTEM, MENU.

Note: NO_x is "NOT" available on FT1200-1, or FT1200-2A since the NO cell is not available for these models.

Fuel Efficiency: This is displayed as a% and indicates how efficient the burner system operates with the fuel being burnt. This calculation is performed within the instrument and is determined by various factors including: maximum amount of CO_2 in a given fuel; K1 and K2 factors; Vo (dry)/Ao and the F factor. Each fuel has pre-determined characteristics which have been pre-programmed into the Firetron 1000. Where user defined fuels are used these factors may be changed in the SETUP MENU.

A Fuel Type Must be selected in order for the analyzer to calculate values. SETUP> Fuel Type.

NOTE: Fuel 1, 2, 3 and 4 are user defined - By selecting these fuels you must first enter values under FUEL DATA. Otherwise, all calculated values derived by formulas will not calculate correctly.

Loss: The loss indicates the inefficiency of the burners and is displayed as a percentage.

Excess Air: This indicates the amount of air not being burnt in the process. This calculation is performed by the instrument and is determined as with Fuel Efficiency, by the use of various factors.

T_Ambient: The probe has in-built ambient temperature sensors. The units i.e °C/°F can be changed in the Setup menu.

T_Gas: The probe has a type K thermocouple which when inserted into the flue gas can determine the exact temperature of the gas. The units i.e °C/°F can be changed in the SETUP/SYSTEM MENU.

Tg - Ta: A calculation of the temperature rise in the combustion process. The units, i.e °C/°F can be changed in the SETUP/SYSTEM MENU.

```
 _____
| DRY                  | ENTER: NEXT SCREEN |
|                      | FLUE TEMP.:  28°C   |
| T. AMBIENT  XXX°ppm  |                     |
| T - GAS              |                     |
| TG - TA              |                     |
|                      |                     |
|_____|_____|
|  MENU  |   FLOW   |   PRINT   |    GO    |
 _____
   ( F1 )     ( F2 )     ( F3 )     ( F4 )
```

O_2 Normalization: To comply with certain environmental legislation, readings of flue gases are required to be given in relationship to a specific oxygen content (normalization).

Oxygen normalization may be selected through the Setup menu. The Oxygen normalization factor may be entered as a percentage through this same menu option.

The formula for Oxygen normalization is:

$$Go = G \frac{(20.9 - 0c)}{(20.9 - 0a)}$$

where   Go = normalized gas readings

         G = gas reading

         Oc = O_2 normalization factor (%)

         Oa= O_2 reading (%)

Wet Measurement: The display for measurements using wet analysis are identical as for dry. The water content in the flue gas will have to be determined and entered for reading accuracy. Refer to Setup Menu.

```
┌──────────────────────────────────────────────────┐
│  WET          O2NORM ON    │  ENTER: NEXT SCREEN   │
│                            │  FUEL EFF    XX.X%     │
│  NOx        XXX ppm        │  LOSS        XXX %     │
│  CO2        XXX %          │  EXCESS AIR  XX.X%     │
│                            │                        │
│   ┌──────────┐  ┌────────┐   ┌────────┐  ┌────────┐ │
│   │  MENU    │  │  HELP  │   │  ZOOM  │  │  LOG   │ │
│   └──────────┘  └────────┘   └────────┘  └────────┘ │
└──────────────────────────────────────────────────┘
      ┌────┐        ┌────┐        ┌────┐      ┌────┐
      │ F1 │        │ F2 │        │ F3 │      │ F4 │
      └────┘        └────┘        └────┘      └────┘
```
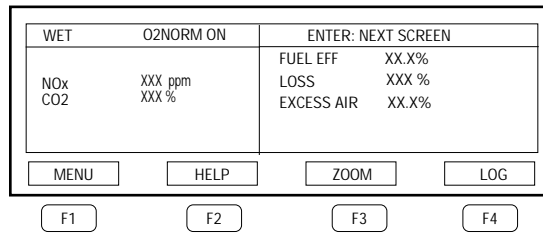
3.3   RECALIBRATE

When the Firetron 1000 is first switched on, it automatically performs a zero calibration. A zero calibration may be initiated manually by selecting recalibrate at the main menu. The ABORT function key allows early termination of the zero cal cycle **(Note: Aborting the recalibration cycle may cause incorrect gas readings).** The completion or abortion (defaults to previous calibration) of a zero calibration cycle records the voltage outputs of the cells as exposed to fresh air. The cell zero values are displayed under: DIAGNOSTICS -> CELL ZEROS, or may be printed out using the DIAGNOSTICS -> REPORT facility.

NOTE: Cell zeros are normally 0.0v (offset should be less than ±20mV), except for: O_2 (span value) which should be around 1.6V TO 2.0V. Refer to section 3.5.2 diagnostic cell zeros.

```
┌──────────────────────────────────────────────────┐
│               CALIBRATING PROBE                    │
│           CAL TIME REMAINING: 180 SEC.             │
│                                                    │
│   ████████████████████████████████                │
│                                                    │
│   ┌──────┐    ┌──────┐    ┌──────┐    ┌──────┐     │
│   │ MENU │    │ HELP │    │ ABORT│    │      │     │
│   └──────┘    └──────┘    └──────┘    └──────┘     │
└──────────────────────────────────────────────────┘
      ┌────┐        ┌────┐        ┌────┐      ┌────┐
      │ F1 │        │ F2 │        │ F3 │      │ F4 │
      └────┘        └────┘        └────┘      └────┘
```
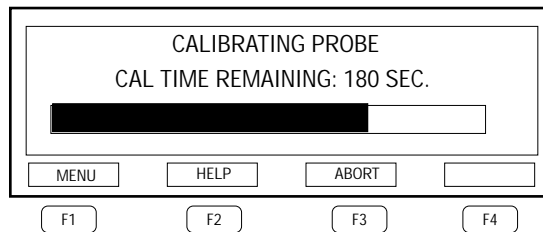
3.4   SETUP

The Setup menu enables both essential measurement parameters and units to be setup. See display below.

```
┌──────────────────────────────────────────────────┐
│  SYSTEM                 PASSWORD                   │
│  FUEL TYPE              PRINTER                    │
│  FUEL DATA              SERIAL PORT                │
│  DATE AND TIME                                     │
│  GAINS & CONSTANTS                                 │
│                                                    │
│   ┌──────┐    ┌──────┐    ┌──────┐    ┌──────┐     │
│   │ MENU │    │ HELP │    │ GASES│    │      │     │
│   └──────┘    └──────┘    └──────┘    └──────┘     │
└──────────────────────────────────────────────────┘
      ┌────┐        ┌────┐        ┌────┐      ┌────┐
      │ F1 │        │ F2 │        │ F3 │      │ F4 │
      └────┘        └────┘        └────┘      └────┘
```
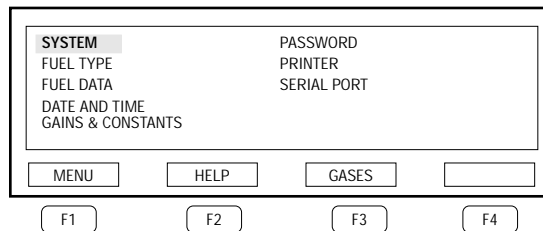
System: Within the system sub-menu are the following displays:

```
┌──────────────────────────────────────────────┐
│  CLEAR FAULTS              NO/YES              │
│                                               │
│                                               │
│                                   MORE...     │
│  ┌────────┐  ┌────────┐  ┌────────┐  ┌──────┐ │
│  │  MENU  │  │  HELP  │  │ ABORT  │  │ NEXT │ │
│  └────────┘  └────────┘  └────────┘  └──────┘ │
└──────────────────────────────────────────────┘
      ( F1 )      ( F2 )       ( F3 )      ( F4 )
```
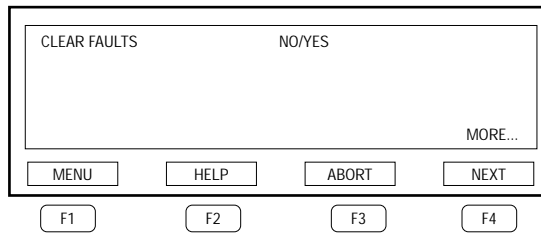
Clear Faults: If the 'Fault' LED is lit - selecting the 'Yes' option will attempt to clear the indicated faults.

Analysis: Switches between wet or dry analysis. See 'Making the Gas Measurement' (3.2.2) for explanation of Wet and Dry measurement.

```
┌──────────────────────────────────────────────┐
│  ANALYSIS:                DRY/WET             │
│  O2 NORMALIZATION:        NO/YES              │
│  WATER:                   X.X%                │
│  O2 FACTOR:               X.X%                │
│  NO2 FACTOR               X.X%                │
│                                   MORE...     │
│  ┌────────┐  ┌────────┐  ┌────────┐  ┌──────┐ │
│  │  MENU  │  │  HELP  │  │ ABORT  │  │ NEXT │ │
│  └────────┘  └────────┘  └────────┘  └──────┘ │
└──────────────────────────────────────────────┘
      ( F1 )      ( F2 )       ( F3 )      ( F4 )
```
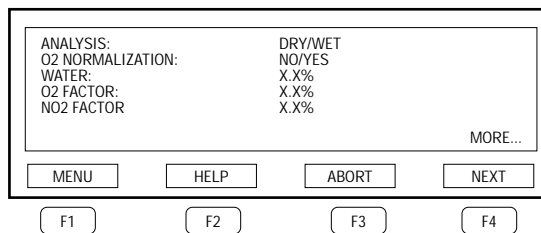
Water: This represents the % of water contained in the flue gas when undertaking 'WET' analysis. The amount for coal is typically 6 - 8%.

Where the analysis is wet, the water content in% terms is also displayed.

The formula for wet analysis is as follows:

$$ppm \ (wet) = \frac{(1 - H_2O) \ (ppm) \ dry}{100} \quad where \ H_2O = \% \ water \ content$$

Normalization Factor: See Oxygen normalization for method of calculating the O_2 factor.

NO_x Factor: The concentration of NO_x is determined according to which sensors are fitted. i.e NO and NO_2.

*NOTE: The NO_2 cell is **NOT** available on the 1000 Series line. If required see Firetron 2000 Series line.*

The following example demonstrates how the NO_x concentration is determined on the FT1300-1 only.

FT1300-1 only
NO + NO_2 Factor = NO_x
The NO_2 factor is entered under SETUP > SYSTEM > NO_2 Factor

The NO_2 Factor is a percentage correction required for NO_x readings when the NO_2 sensor is not fitted. This is typically less than 5%. On the Series 1000, NO_2 is not available, therefore NO_x is calculated. It is also worth noting that 95% of the total Nox is formulated from NO %.

```
UNIT NO:                  XXX
TEMPERATURE               C/F
DISPLAY UNITS             lb/mmBtu, mg, ppm, mg/J
LANGUAGE                  English
UNITS OF PRESSURE          wgc/hPa


  MENU         HELP         ABORT        NEXT

   F1           F2           F3           F4
```
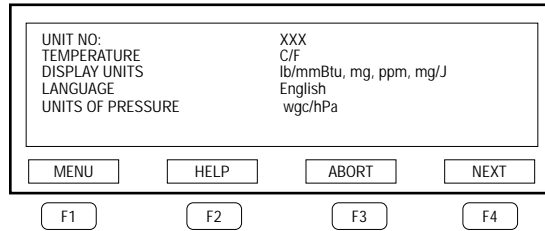
Unit No.: The unique identification number assigned to the instrument which represents the measurement of gases in a particular location. Any number between 0 and 99 can be used, to provide up to 99 unique measurement locations.

Temperature: User selectable units of temperature measurement. Degrees Celsius or Fahrenheit

Display Units: User selectable measurement units - ppm; mg.; lb/mmBtu or ng/J

Units of Pressure: User selectable pressure units - hPA or wgc

```
BACKLIGHT STATUS          AUTO/OFF/ON
BACKLIGHT TIMEOUT:        XX min
PUMP SPEED:               7500



  MENU         HELP         ABORT        NEXT

   F1           F2           F3           F4
```
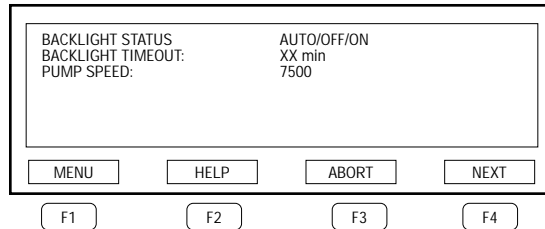
Backlight Status: User selectable - Automatic; ON or OFF.

Automatic: After any key press on the instrument the display backlight will be illuminated for the time period set in 'Backlight Timeout', after which it will switch off automatically. The 'Timeout' period is user selectable.

On/Off: This will enable the backlight permanently On or Off.

NOTE: Selecting Backlight Status to either ON or Automatic with a high Backlight Timeout period will reduce battery operating life.

Backlight Timeout: User selectable - Range 1 to 180 minutes.

Fuel Type: The following display shows the options available. Select from the list the appropriate type of fuel being burned.

```
WOOD                      COAL
LIGHT FUEL OIL            FUEL 1
HEAVY FUEL OIL            FUEL 2
NATURAL GAS               FUEL 3
PROPANE                   FUEL 4


  EXIT         HELP         GASES        ABORT

   F1           F2           F3           F4
```
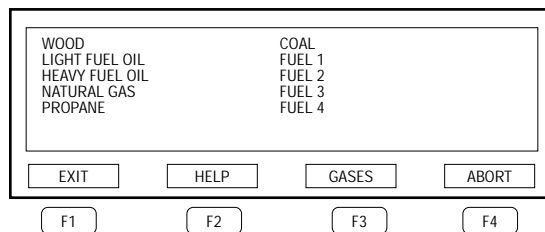
NOTE: To select a fuel, move the highlighted cursor to the appropriate fuel to be measured.

NOTE: If fuel 1, 2, 3 or 4 are selected, it is important to enter all information in the FUEL DATA MENU before selection. Failure to comply may result in reading inaccuracy. EG: CO_2, excess air, loss and combustion efficiency will not calculate correctly.

Fuel Data: *The pre-programmed fuels all have corresponding fuel data pre-determined.*

```
┌──────────────────────────────────────────────┐
│ WOOD                                           │
│                                                │
│ CO2 max:   20.4%         K1 Factor: 0.74       │
│ V0 (dry) A0: 0.96%       K2 Factor: 0.000      │
│ F Factor    9670         K3 Factor: 65         │
│                                                │
│                                                │
├──────────────────────────────────────────────┤
│  ┌──────┐   ┌──────┐   ┌──────┐   ┌──────┐     │
│  │ EXIT │   │ HELP │   │ GASES│   │ ABORT│     │
│  └──────┘   └──────┘   └──────┘   └──────┘     │
└──────────────────────────────────────────────┘
     ( F1 )      ( F2 )      ( F3 )      ( F4 )
```

NOTE: Displays similar to the above for Wood are also available for Light Fuel Oil, Heavy Fuel Oil, Natural Gas, Propane and Coal.

Calculation of the maximum CO_2 value: The CO_2 max. value is that proportion of CO_2 in the flue gas, in percentage terms, that would result from the stochiometric oxidation of the fuel. In general, for hydrocarbon fuel, the flue gas will consist of the combustion products - water and CO_2 plus the balance of nitrogen from the combustion air. If it is assumed that efficient combustion takes place, then any oxygen present in the flue is due to excess air being supplied to the combustion process. Thus, a linear relationship exists between the amount of oxygen in the flue, and the amount of dilution of the theoretical maximum value.

NOTE: Where a CO_2 sensor is fitted to the instrument a direct gas measurement is made in place of the calculated method.

$$CO_2 = \frac{CO_2 \text{ max} \times (20.9 - O_2)}{20.9}$$

where CO_2 is the calculated value in %, O_2 is the measured oxygen concentration. Ambient oxygen concentration is assumed to be 20.9%.

For simple hydrocarbon fuels, CO_2 max. can be calculated:

For a fuel containing 'c' carbon atoms and 'h' hydrogen atoms per molecule, it will take:

$c + \dfrac{h}{4}$ oxygen molecules to fully oxidize producing:

c - CO_2 molecules and h/2 water molecules.

For stochiometric conditions, the volume ratio of combustion products to inlet oxygen is thus:

$$VR = \frac{c + h/2}{c + h/4}$$

The maximum CO_2 concentration is therefore:

$$CO_2 \text{ max}(\%) = \frac{c}{c + h/2} * \frac{VR*20.9}{(VR*20.9) + 79.1}$$

The calculated CO_2 max value is only valid for perfect conditions in the combustion process. It must be assumed that:

— The fuel is dry. Any water present in the fuel will represent a further dilution factor on the maximum value.

— The Oxygen measurement from which the CO_2 is calculated is a true wet measurement. i.e. all the water produced by combustion is present as steam, and hasn't condensed out.

— There is no further dilution of the flue gas, for example from air leaks in the flue.

Where one or more of these factors is undetermined, it may be better to use a maximum CO_2 value determined from actual measurements on the process.

CO$_2$ MAX VALUES	
FUEL	**CO$_2$ Max(%)**
Wood	20.4
Natural Gas	12.1
Light Fuel Oil	15.6
Heavy Fuel Oil	15.9
Propane	13.5
Anthracite Coal	18.6
Lignite (Peat)	18.6
Bituminous Coal	18.6
Coke Oven Gas	8.97
Enriched B.F.	15.06
Lean B.F.	15.77
BOS Gas	28.6

Vo (dry)/Ao: This is pre-determined for all pre-programmed fuel types and represents the gross calorific value of the fuel. It will have to be calculated for Fuel types 1 - 4. Most fuel types have known gross calorific values.

F Factor: This is pre-determined for all pre-programmed fuel types. It will have to be calculated for Fuel types 1 - 4.

The fuel efficiency calculation is: Efficiency = 100 -% loss due to carbon -% loss due to hydrogen and water -% loss from unburned fuel.

Loss due to Carbon:

$$\% \text{ loss} = K1 \, (T\_stack - T\_ ambient/CO_2\%$$

where $K1 = (253 \times C)/Qgr$

         C = % carbon by weight in fuel

         Qgr = gross calorific value of fuel in KJ/kg

Loss due to Hydrogen and Water:

$$\% \text{ loss} = K2(1185 - 2 \, T\_ambient + T\_stack)$$

where $K2 = 2.1(\%wt.H_2O + 9 \times \%wt.H)/Qgr$

         Qgr = gross calorific value of fuel in KJ/kg

Loss due to Unburned Fuel:

$$\% \text{ loss} = \frac{K3 \, (CO + H_xCy)}{CO_2 + (CO + H_xCy)}$$

where: K3 = a fuel dependent constant

         CO = carbon monoxide %

         HxCy = Hydrocarbons %

K1 Factor: This is pre-determined for all pre-programmed fuel types. It will have to be calculated for Fuel types 1 - 4.

K2 Factor: This is pre-determined for all pre-programmed fuel types. It will have to be calculated for Fuel types 1 - 4.

K3 Factor: This is pre-determined for all pre-programmed fuel types. It will have to be calculated for Fuel types 1 - 4.

DATE AND TIME

The following display is shown when this sub-menu is entered.

```
┌─────────────────────────────────────────────┐
│                      │                        │
│  DATE: 1/03/98       │   TIME: 10:55:23       │
│                      │                        │
│──────────────────────│────────────────────────│
│                      │                        │
│   NEWDATE: 1/22/98   │   NEW TIME: 11:07:15   │
│                      │                        │
│──────────────────────┴────────────────────────│
│  ┌──────┐   ┌──────┐   ┌──────┐   ┌──────┐    │
│  │ EXIT │   │ HELP │   │ GASES│   │ ABORT│    │
│  └──────┘   └──────┘   └──────┘   └──────┘    │
└─────────────────────────────────────────────┘
   ┌────┐     ┌────┐     ┌────┐     ┌────┐
   │ F1 │     │ F2 │     │ F3 │     │ F4 │
   └────┘     └────┘     └────┘     └────┘
```

Used for setting of the exact date and time.

Please note order of day:month:year

GAINS AND CONSTANTS (SERVICE INFORMATION ONLY)

NOTE: This menu is password protected. Enter the code 417 to gain entry.

```
┌─────────────────────────────────────────────┐
│                                              │
│                                              │
│  ENTER PASSWORD    ▐█████  ◖ ▌               │
│                                              │
│                                              │
│  ┌──────┐   ┌──────┐   ┌──────┐   ┌──────┐   │
│  │ EXIT │   │      │   │      │   │      │   │
│  └──────┘   └──────┘   └──────┘   └──────┘   │
└─────────────────────────────────────────────┘
   ┌────┐     ┌────┐     ┌────┐     ┌────┐
   │ F1 │     │ F2 │     │ F3 │     │ F4 │
   └────┘     └────┘     └────┘     └────┘
```

```
┌─────────────────────────────────────────────┐
│                                              │
│   CO LOW    1                                │
│   NO        1                                │
│   SO₂       1                                │
│                                              │
│  ┌──────┐   ┌──────┐   ┌──────┐   ┌──────┐   │
│  │ EXIT │   │ HELP │   │ GASES│   │ NEXT │   │
│  └──────┘   └──────┘   └──────┘   └──────┘   │
└─────────────────────────────────────────────┘
   ┌────┐     ┌────┐     ┌────┐     ┌────┐
   │ F1 │     │ F2 │     │ F3 │     │ F4 │
   └────┘     └────┘     └────┘     └────┘
```

The Gains and Constants correspond to the individual sensors fitted to the Firetron 1000. The values are entered during the factory calibration. The menu is password protected to prevent unauthorized actions resulting in the need for a complete sensor re-calibration.

Replacing a Gas Sensor: When the life of a sensor has expired and requires replacement, the new sensor will have to be manually calibrated. The gains and constants information will then be automatically updated and stored here.

NOTE: Sensors can be pre-calibrated at the factory and sent to a customer. Once the sensor is received and installed on the manifold, the gain number sent with the sensor must be entered here.

Draft Gain: The Draft sensor has a gain factor, which is only adjusted when a new sensor is fitted. The gain value has to be entered.

The values are expressed as ppm/volts.

```
┌─────────────────────────────────────────┐
│                                         │
│   DRAFT GAIN      XX                     │
│                                         │
│                                         │
│  ┌──────┐   ┌──────┐   ┌──────┐  ┌──────┐│
│  │ EXIT │   │ HELP │   │ GASES│  │ NEXT ││
│  └──────┘   └──────┘   └──────┘  └──────┘│
└─────────────────────────────────────────┘
     ( F1 )      ( F2 )     ( F3 )   ( F4 )
```
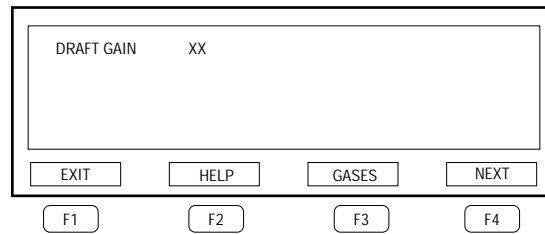
Password: This options permits the user to set up a unique password or 'entry code'. This is to prevent unauthorized adjustment of instrument settings.

The Firetron 1000 password is factory set at 417

```
┌─────────────────────────────────────────┐
│                                         │
│                                         │
│   ENTER  OLD PASSWORD  ▮▮▮▮● │           │
│                                         │
│  ┌──────┐  ┌──────┐  ┌──────┐  ┌──────┐ │
│  │ EXIT │  │      │  │      │  │      │ │
│  └──────┘  └──────┘  └──────┘  └──────┘ │
└─────────────────────────────────────────┘
     ( F1 )     ( F2 )    ( F3 )    ( F4 )
```
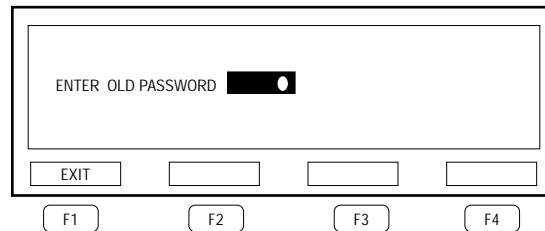
Simply enter the old password i.e. 417, by holding down the "up" arrow key until the number is reached. Press "ENTER" and you will be asked to enter the new password.

```
┌─────────────────────────────────────────┐
│                                         │
│                                         │
│   ENTER  NEW PASSWORD ▮▮▮▮●  │          │
│                                         │
│  ┌──────┐  ┌──────┐  ┌──────┐  ┌──────┐ │
│  │ EXIT │  │      │  │      │  │      │ │
│  └──────┘  └──────┘  └──────┘  └──────┘ │
└─────────────────────────────────────────┘
     ( F1 )     ( F2 )    ( F3 )    ( F4 )
```

```
┌─────────────────────────────────────────┐
│                                         │
│   CURRENT HEADER:                        │
│                                         │
│   FIREYE                                 │
│   603 432 4100                           │
│                                         │
│  ┌──────┐   ┌──────┐   ┌──────┐  ┌──────┐│
│  │ EXIT │   │ HELP │   │ GASES│  │ NEXT ││
│  └──────┘   └──────┘   └──────┘  └──────┘│
└─────────────────────────────────────────┘
     ( F1 )      ( F2 )     ( F3 )   ( F4 )
```
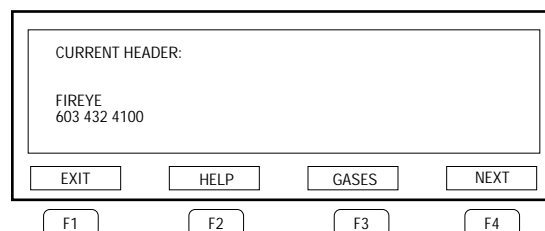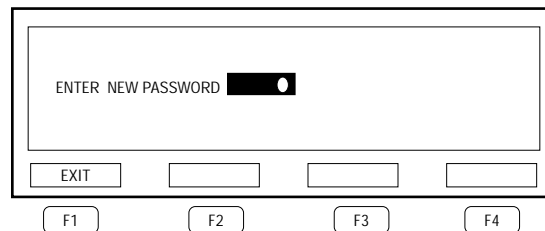
Press "NEXT" and the footer will be displayed
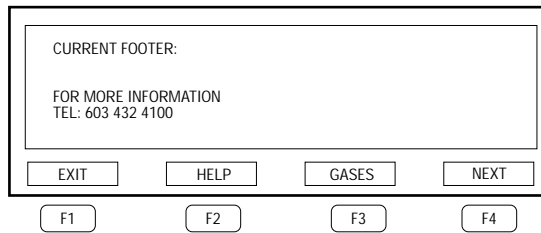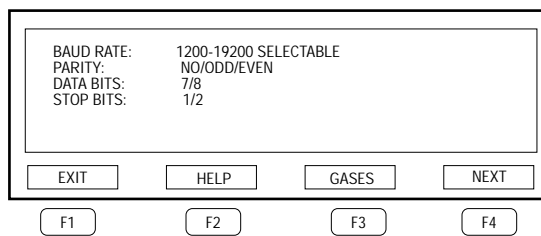
```
CURRENT FOOTER:

FOR MORE INFORMATION
TEL: 603 432 4100


  EXIT        HELP        GASES        NEXT
   F1          F2          F3          F4
```

Serial Port

```
BAUD RATE:      1200-19200 SELECTABLE
PARITY:         NO/ODD/EVEN
DATA BITS:      7/8
STOP BITS:      1/2


  EXIT        HELP        GASES        NEXT
   F1          F2          F3          F4
```

NOTE: The Serial Port on the Firetron 1000 must be set for:

9600 baud; no parity; eight bits; one stop bit

There are user selectable options also available. These are available for future system expansion only and should only be set as for the Firetron 1000 shown above. Adjustment of the default values may cause problems when the instrument is used with a PC.

Baud Rate: 1200 - 19200

Parity: No/Odd/Even

Data Bits: 7/8

Stop Bits: 1/2

3.5   DIAGNOSTICS

The Diagnostics menu provides analysis of system performance with reference to individual cells, filters etc.

```
DIAGNOSTICS

CELL EMFS      SYSTEM
CELL ZEROS      REPORT
CELL LIFE

  EXIT        HELP        SETUP        GASES
   F1          F2          F3          F4
```

Cell EMFs: This is maintenance information which indicates the current output from each gas sensor in volts. This is specifically of use when the product is being serviced and is a diagnostic tool only.

```
┌─────────────────────────────────────────────────┐
│  CELL EMFS (Volts)                                │
│  ─────────────────────────────────────────────   │
│  CO        XXX XXX                                │
│  O₂        XXX XX                                 │
│  N0        XXX XXX   (FT1300-1 ONLY)              │
│  S0₂       XXX XXX   (FT1200-2 A ONLY)            │
│  ─────────────────────────────────────────────   │
│  ┌───────┐    ┌────────┐   ┌───────┐   ┌───────┐ │
│  │ EXIT  │    │  HELP  │   │ EXIT  │   │ GASES │ │
│  └───────┘    └────────┘   └───────┘   └───────┘ │
└─────────────────────────────────────────────────┘
      ( F1 )        ( F2 )       ( F3 )      ( F4 )
```

Cell Zeros: Indicates the zero calibration voltage of the cells after the last calibration was completed. The value for O_2 represents the span voltage (V).

```
┌─────────────────────────────────────────────────┐
│  CELL ZEROS (Volts)                               │
│  ─────────────────────────────────────────────   │
│  CO        XXX XXX                                │
│  O₂        XXX XX                                 │
│  N0        XXX XXX   (FT1300-1 ONLY)              │
│  S0₂       XXX XXX   (FT1200-2 A ONLY)            │
│  ─────────────────────────────────────────────   │
│  ┌───────┐    ┌────────┐   ┌───────┐   ┌───────┐ │
│  │ MENU  │    │  HELP  │   │ EXIT  │   │ GASES │ │
│  └───────┘    └────────┘   └───────┘   └───────┘ │
└─────────────────────────────────────────────────┘
      ( F1 )        ( F2 )       ( F3 )      ( F4 )
```

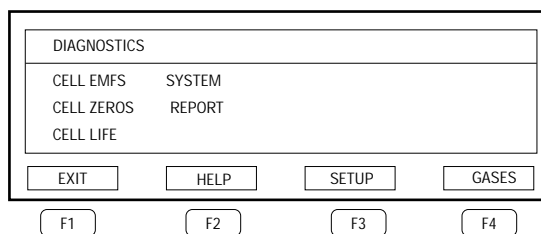**Cell Life:** Indicates the total amount of gas through the cell in ppm days. Each count may be individually cleared from within the menu.

```
┌─────────────────────────────────────────────────┐
│  CELL LIFE (ppm. days)                            │
│  ─────────────────────────────────────────────   │
│  CO        XXX XXX                                │
│  O₂        XXX XX                                 │
│  N0        XXX XXX   (FT1300-1 ONLY)              │
│  S0₂       XXX XXX   (FT1200-2 A ONLY)            │
│  ─────────────────────────────────────────────   │
│  ┌───────┐    ┌────────┐   ┌───────┐   ┌───────┐ │
│  │ EXIT  │    │  HELP  │   │       │   │       │ │
│  └───────┘    └────────┘   └───────┘   └───────┘ │
└─────────────────────────────────────────────────┘
      ( F1 )        ( F2 )       ( F3 )      ( F4 )
```

NOTE: The count must be set to zero whenever a sensor is replaced.

System: This provides a system overview of the instrument.

```
┌─────────────────────────────────────────────────┐
│                                    ┌──────────┐   │
│                                    │  MORE... │   │
│                                    └──────────┘   │
│  VERSION NO:       V1.00H                         │
│  MAIN BATTERY:    11.6V                           │
│                                                   │
│  ┌───────┐    ┌────────┐   ┌───────┐   ┌───────┐ │
│  │ EXIT  │    │  HELP  │   │ GASES │   │ NEXT  │ │
│  └───────┘    └────────┘   └───────┘   └───────┘ │
└─────────────────────────────────────────────────┘
      ( F1 )        ( F2 )       ( F3 )      ( F4 )
```

Version No.: Indicates the version of software installed in the instrument.

Main Battery: Indicates the current battery output voltage. When running directly off the main adapter the voltage will be between 12.5 and 12.9V. When the battery voltage falls below an acceptable level (11.5V) to maintain optimum performance the 'LOW BATT' indicator LED will light.

Options: This indicates the options fitted to the instrument.

```
┌─────────────────────────────────────────────────┐
│                                      ┌─────────┐ │
│  OPTIONS:  SERIAL PORT               │ MORE... │ │
│            DATA LOG                  └─────────┘ │
│            PRESSURE TRANSDUCER                   │
│            Ect.                                  │
│                                                 │
│  ┌────────┐   ┌────────┐  ┌────────┐  ┌────────┐ │
│  │  EXIT  │   │  HELP  │  │ GASES  │  │  NEXT  │ │
│  └────────┘   └────────┘  └────────┘  └────────┘ │
└─────────────────────────────────────────────────┘
      F1            F2          F3          F4
```
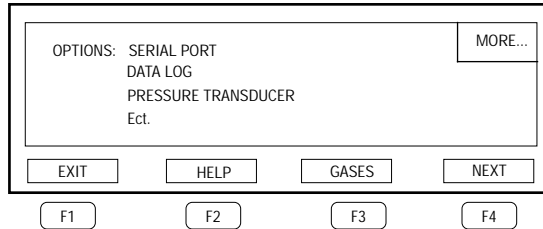
Ranges: This indicates the measurement range capability of the individual cells., i.e. CO 0-2000 ppm.

```
┌─────────────────────────────────────────────────┐
│  RANGES  CO      XXX XXX              ┌─────────┐ │
│          O2      XXX XX               │ MORE... │ │
│          N0      XXX XXX  (FT1300-1 ONLY) └─────┘ │
│          S02     XXX XXX  (FT1200-2 A ONLY)      │
│                                                 │
│  ┌────────┐   ┌────────┐  ┌────────┐  ┌────────┐ │
│  │  EXIT  │   │  HELP  │  │ GASES  │  │  NEXT  │ │
│  └────────┘   └────────┘  └────────┘  └────────┘ │
└─────────────────────────────────────────────────┘
      F1            F2          F3          F4
```
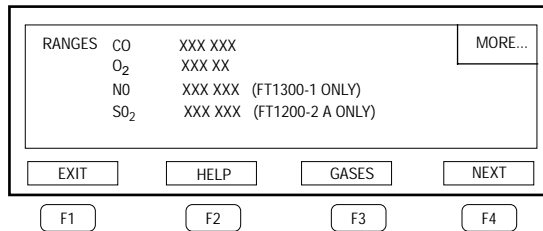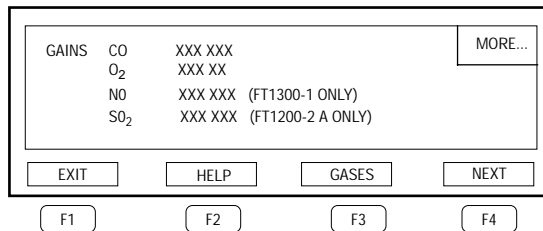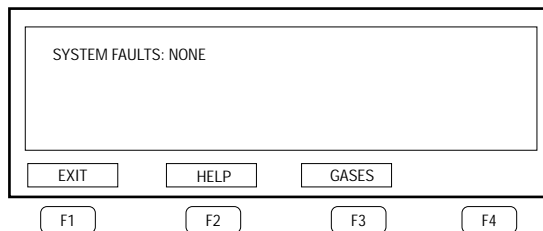
Gains: This indicates the working gain settings for the individual cells.

```
┌─────────────────────────────────────────────────┐
│  GAINS   CO      XXX XXX              ┌─────────┐ │
│          O2      XXX XX               │ MORE... │ │
│          N0      XXX XXX  (FT1300-1 ONLY) └─────┘ │
│          S02     XXX XXX  (FT1200-2 A ONLY)      │
│                                                 │
│  ┌────────┐   ┌────────┐  ┌────────┐  ┌────────┐ │
│  │  EXIT  │   │  HELP  │  │ GASES  │  │  NEXT  │ │
│  └────────┘   └────────┘  └────────┘  └────────┘ │
└─────────────────────────────────────────────────┘
      F1            F2          F3          F4
```

System Faults: This indicates any faults that the system will detect automatically.

```
┌─────────────────────────────────────────────────┐
│                                                 │
│  SYSTEM FAULTS: NONE                            │
│                                                 │
│                                                 │
│                                                 │
│  ┌────────┐   ┌────────┐  ┌────────┐            │
│  │  EXIT  │   │  HELP  │  │ GASES  │            │
│  └────────┘   └────────┘  └────────┘            │
└─────────────────────────────────────────────────┘
      F1            F2          F3          F4
```

Report: A diagnostic report can be output to either the serial port or to the serial printer (sold separately), which summarizes the information contained within the Diagnostics menu. See below for an example report.
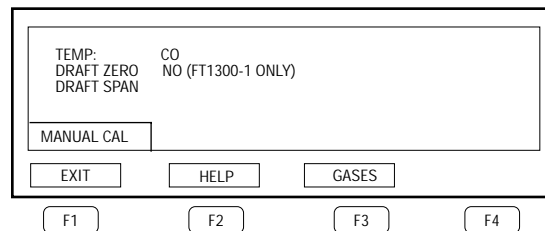
```
┌─────────────────────────────────────────────┐
│ SYSTEM REPORT                               │
├─────────────────────────────────────────────┤
│ SYSTEM OUTPUT DEVICE: SERIAL PORT           │
├─────────────────────────────────────────────┤
│  EXIT      HELP       GASES      REPORT      │
└─────────────────────────────────────────────┘
    F1         F2          F3          F4
```
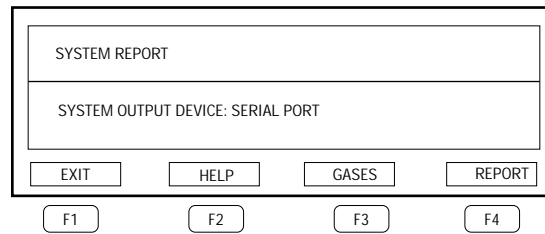
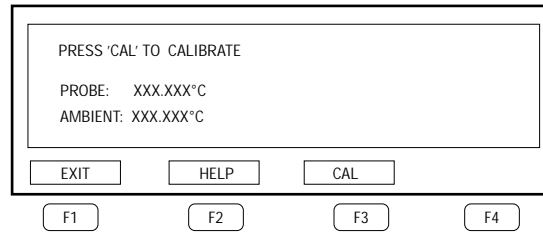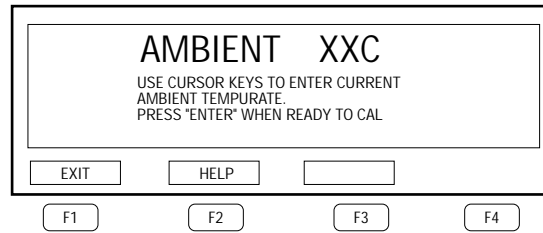| Version No. V1.00H		
Options	Serial Port	
	Data Log	
	Pressure Transducer	
Ranges	CO	2000
	O_2	2.5
	NO (FT 1300-1 Only)	4000
	SO_2 (FT1200-2A Only)	2000
Gains	CO	-2500
	NO(FT 1300-1 Only)	-3750
	SO_2 (FT1200-2A Only)	593.54
Draft	4.5	
Zeros:	CO	-0.010V
	O_2	-0.004V
	NO (FT 1300-1 Only)	0.000V
	SO_2 (FT1200-2A Only)	0.000V
ppm. days:	CO	0
	NO (FT 1300-1 Only)	0
	SO_2 (FT1200-2A Only)	0

3.6 MANUAL CALIBRATION

The information contained in this section refers to the Manual Calibration section of the software. To complete a full manual calibration refer to Section 7.

Enter Password: Prior to performing any calibration on the instrument it is necessary to enter the password (417). This is to prevent unauthorized access which may result in a reduction in performance of the instrument.

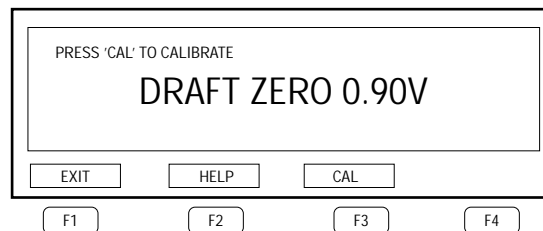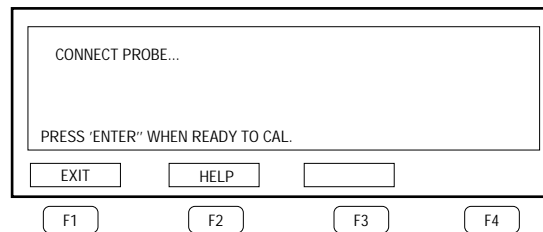Refer to Section 6.2, Manual Calibration - Ambient Temperature

```
┌─────────────────────────────────────────────┐
│ TEMP:          CO                           │
│ DRAFT ZERO     NO (FT1300-1 ONLY)           │
│ DRAFT SPAN                                  │
│                                             │
│ MANUAL CAL                                  │
│  EXIT      HELP       GASES                  │
└─────────────────────────────────────────────┘
    F1         F2          F3          F4
```

Temp.: Calibration of the Temperature sensor. This is normally factory set and should not require any adjustment

```
┌─────────────────────────────────────────┐
│                                         │
│         AMBIENT    XXC                   │
│      USE CURSOR KEYS TO ENTER CURRENT    │
│      AMBIENT TEMPURATE.                  │
│      PRESS "ENTER" WHEN READY TO CAL     │
│                                         │
│  ┌────────┐  ┌────────┐  ┌────────┐      │
│  │  EXIT  │  │  HELP  │  │        │      │
│  └────────┘  └────────┘  └────────┘      │
└─────────────────────────────────────────┘
   ┌────┐      ┌────┐      ┌────┐      ┌────┐
   │ F1 │      │ F2 │      │ F3 │      │ F4 │
   └────┘      └────┘      └────┘      └────┘
```

```
┌─────────────────────────────────────────┐
│                                         │
│  PRESS 'CAL' TO  CALIBRATE               │
│                                         │
│    PROBE:     XXX.XXX°C                   │
│    AMBIENT:  XXX.XXX°C                    │
│                                         │
│  ┌────────┐  ┌────────┐  ┌────────┐      │
│  │  EXIT  │  │  HELP  │  │  CAL   │      │
│  └────────┘  └────────┘  └────────┘      │
└─────────────────────────────────────────┘
   ┌────┐      ┌────┐      ┌────┐      ┌────┐
   │ F1 │      │ F2 │      │ F3 │      │ F4 │
   └────┘      └────┘      └────┘      └────┘
```
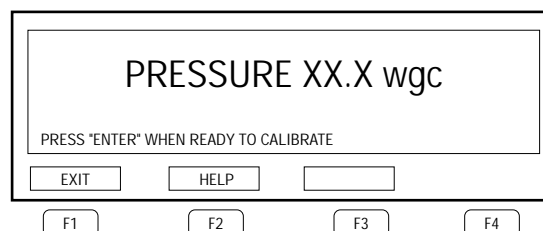
Both the probe and ambient temperatures are displayed and should indicate the entered ambient temperature following calibration.

NOTE: The probe should be at ambient temperature when calibrated.

Draft Zero: The Draft Sensor is standard on the Firetron FT-1200-1 and FT-1300-1. The Draft sensor is pre-calibrated at the factory. This menu option is used where the sensor requires re-calibration. Draft Zero is a measure of ambient air pressure, with an output displayed in Volts. For details on how to complete a Draft calibration refer to Section 6.6, Calibrating the Draft Sensor.
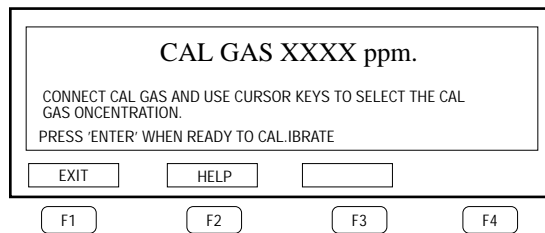
```
┌─────────────────────────────────────────┐
│                                         │
│  CONNECT PROBE...                        │
│                                         │
│                                         │
│  PRESS 'ENTER'' WHEN READY TO CAL.       │
│  ┌────────┐  ┌────────┐  ┌────────┐      │
│  │  EXIT  │  │  HELP  │  │        │      │
│  └────────┘  └────────┘  └────────┘      │
└─────────────────────────────────────────┘
   ┌────┐      ┌────┐      ┌────┐      ┌────┐
   │ F1 │      │ F2 │      │ F3 │      │ F4 │
   └────┘      └────┘      └────┘      └────┘
```

```
┌─────────────────────────────────────────┐
│  PRESS 'CAL' TO CALIBRATE                │
│                                         │
│        DRAFT ZERO 0.90V                  │
│                                         │
│  ┌────────┐  ┌────────┐  ┌────────┐      │
│  │  EXIT  │  │  HELP  │  │  CAL   │      │
│  └────────┘  └────────┘  └────────┘      │
└─────────────────────────────────────────┘
   ┌────┐      ┌────┐      ┌────┐      ┌────┐
   │ F1 │      │ F2 │      │ F3 │      │ F4 │
   └────┘      └────┘      └────┘      └────┘
```

Draft Span: The Draft Sensor is standard on the Firetron 1000 Series. A Draft Span calibration involves the use of a monometer and squeeze bulb. Refer to Section 6.6, Calibrating the Draft Sensor. A differential pressure reading will be made (FT1200-1, FT1300-1 only).
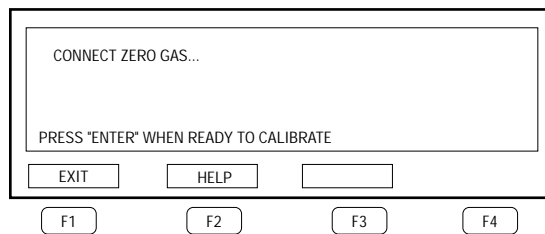
```
┌─────────────────────────────────────────┐
│                                         │
│        PRESSURE XX.X wgc                 │
│                                         │
│  PRESS "ENTER" WHEN READY TO CALIBRATE   │
│  ┌────────┐  ┌────────┐  ┌────────┐      │
│  │  EXIT  │  │  HELP  │  │        │      │
│  └────────┘  └────────┘  └────────┘      │
└─────────────────────────────────────────┘
   ┌────┐      ┌────┐      ┌────┐      ┌────┐
   │ F1 │      │ F2 │      │ F3 │      │ F4 │
   └────┘      └────┘      └────┘      └────┘
```

```
PRESS 'CAL' TO CALIBRATE

        DRAFT   X.XXX wgc


EXIT          HELP          CAL
  F1            F2            F3            F4
```

Calibrating the Gas Sensors: The individual gas sensors can be calibrated using the appropriate calibration gas. This applies to all gases except Oxygen. For details of how to carry out a full calibration see page 24.

```
           CAL GAS XXXX ppm.

  CONNECT CAL GAS AND USE CURSOR KEYS TO SELECT THE CAL
  GAS ONCENTRATION.
  PRESS 'ENTER' WHEN READY TO CAL.IBRATE
  EXIT          HELP
    F1            F2            F3            F4
```

It is necessary to have information on the individual calibration gases i.e. type and concentrations. This information has to be entered to perform an accurate calibration of the sensors. It is recommended that a zero calibration i.e.a recalibrate function, is performed immediately prior to performing a gas span calibration.

```
  CONNECT ZERO GAS...



  PRESS "ENTER" WHEN READY TO CALIBRATE
  EXIT          HELP
    F1            F2            F3            F4
```

3.7   DRAFT READING

The Draft Reading indicates the internal stack pressure in water gauge column inches of water in the column or hPa. The figure represents a differential pressure between the stack pressure at the probe tip and the ambient pressure. It enables the flow rate of the chimney/stack to be determined. For details of how to perform a calibration of the draft sensor refer to Section 6.6, Calibrating the Draft Sensor.

```
        DRAFT       XXX wgc


  EXIT          HELP          GASES
    F1            F2            F3            F4
```

3.8   DATA LOG

The Firetron 1000 Series has a standard 1000 point data logger. It provides the means of storing measurement data samples for recording or printing, and subsequent analysis.

The menu options permit the user to configure the data log to meet individual requirements.

```
┌─────────────────────────────────────────────────┐
│ DATA LOG                    NO. OF LOG RECORDS: 2 │
│                                                   │
│    SETUP                     OUTPUT TO PRINTER    │
│    CLEAR LOG                  OUTPUT TO RS232      │
│                              ABORT OUTPUT         │
│                                                   │
│  ┌────────┐   ┌────────┐   ┌────────┐            │
│  │  EXIT  │   │  HELP  │   │  GASES │            │
│  └────────┘   └────────┘   └────────┘            │
└─────────────────────────────────────────────────┘
     ┌────┐        ┌────┐       ┌────┐       ┌────┐
     │ F1 │        │ F2 │       │ F3 │       │ F4 │
     └────┘        └────┘       └────┘       └────┘
```

Data Log Setup

There are four parameters to set up before data logging can begin.

```
┌─────────────────────────────────────────────────┐
│ DATA LOG SETUP                                    │
│                                                   │
│    LOG TYPE:              MANUAL/AUTO             │
│    LOG TO:                MEMORY/RS232/PRINTER    │
│    LOG PERIOD:            XX mins.                │
│    LOG INTERNAL:          XX secs.               │
│  ┌────────┐  ┌────────┐  ┌────────┐  ┌────────┐ │
│  │  EXIT  │  │  HELP  │  │  GASES │  │  ABORT │ │
│  └────────┘  └────────┘  └────────┘  └────────┘ │
└─────────────────────────────────────────────────┘
    ┌────┐       ┌────┐       ┌────┐       ┌────┐
    │ F1 │       │ F2 │       │ F3 │       │ F4 │
    └────┘       └────┘       └────┘       └────┘
```

LOG TYPE: There are two options: Manual or Automatic

Manual: The manual data log provides an instantaneous log of data. This can be undertaken by pressing the 'LOG' key in the Gas Readings Display.

Automatic: The automatic data log enables data to be logged at specific time intervals for a specified time period of logging, e.g. Log Period 2 mins, Log Interval 10 secs.

— The 'Log Period' has a range 2 - 60 mins.

— The 'Log Interval' has a range 10 -1800 secs

NOTE: Although the log interval may be set as low as 10 seconds, the system response to changes in gas concentrations is not less than 1 minute.

Starting the AUTO log: Auto Data Logging does not commence until the 'AUTOLOG' key is pressed in Gas Readings Display.

NOTE: The 'AUTOLOG' key does not appear in Gas Readings Display until Auto Data Logging is selected. Once the Auto Log is initiated the Firetron 1000 will place a log record to the selected output device at the interval specified by the system parameter 'LOG INTERVAL'. Auto Logging will stop when the specified log period is completed.

Aborting the Auto Log: Auto Data Logging may be aborted before the completion of the Auto Data Log period by pressing the 'STOPLOG' key in Gas Readings Display.

NOTE: The 'STOPLOG' key does not appear in Gas Readings Display until the Auto Data Log has been started.

Log To: There are three options available to enable data logging storage/output - Memory, RS232.

Log to Memory: The Firetron 1000 can log up to approx. 963 log records of data in non-volatile system memory.

NOTE: When the log memory is full no subsequent logs are recorded.

Log to Printer: Log records may be output as ascii text to a serial printer.

NOTE: Due to the limitations of printer speed the Firetron 1000 will not allow a log interval of less than 2 minutes when outputting data direct to the printer.

Log to RS232: Each log record may be output to the RS232 channel. The data is output as ascii data which may be received by the Fireye CAPTURE PROGRAM for use with a spreadsheet. See Fireye CAPTURE PROGRAM Section 10.

Clearing the Log Memory: The non-volatile system memory used for data logging may be cleared by the DATA LOG->CLEAR LOG menu option.

Outputting the Data Log from the Data Log Memory: There are three methods of outputting the log records in system memory. Each method will output ALL the records in the log memory.

NOTE: The data log memory is NOT automatically cleared following a log output.

Output to a Printer: The data log records in system memory may be output to serial printer. The DATA LOG->OUTPUT TO PRINTER menu option provides this selection.

Output to RS232: The data log records in system memory may be output to the optional RS232 port. The output is in ascii text to provide a hard copy report to a serial printer with XON / OFF protocol, or to a computer running t he Firetron CAPTURE Program. The DATA LOG->OUTPUT TO RS232 menu option provides this selection.

NOTE: This method does not present the logged data in a format directly suitable for inclusion in a spreadsheet package (see Fireye CAPTURE PROGRAM Section 10).

Fireye CAPTURE Program: The Fireye CAPTURE program may be used to transfer data from the Firetron 1000 system memory to a dBaseIII type file, for use with spreadsheets.(See Fireye CAPTURE PROGRAM Section 11).

Aborting the Output: The output of data from the data log system memory may be aborted at any time by selecting the DATA LOG->ABORT OUTPUT menu option

3.9 PURGE & PUMP OFF

The PURGE selection will allow air to be drawn through the system for 30 seconds in order to purge the cells. The pump will then be switched off.

NOTE: Remove Probe from sample before switching the unit off.

No other menu items are available during the 30 second purge cycle.

NOTE: This function occurs automatically when the instrument is switched off.

```
┌─────────────────────────────────────────┐
│   ┌─────────────────────────────────┐    │
│   │       PURGING SYSTEM...         │    │
│   └─────────────────────────────────┘    │
│  ┌──────┐  ┌──────┐  ┌──────┐  ┌──────┐  │
│  │ABORT │  │      │  │      │  │      │  │
│  └──────┘  └──────┘  └──────┘  └──────┘  │
└─────────────────────────────────────────┘
     ( F1 )    ( F2 )    ( F3 )    ( F4 )
```

4.0 OUTPUTS

4.1   PRINTING

The Firetron has no integral printer, but can output single printouts to a remote serial printer (not supplied) using the serial communications port on the side of the instrument.

Header and Footer Displays

CURSOR KEYS:

> LEFT/RIGHT move cursor
>
> UP/DOWN change character under cursor.

ENTER: Move to next line.

FUNCTION KEYS:

F1 EXIT: Return to SETUP menu saving changes.

F2 HELP: Information on how to use display.

F3 ABORT: Return to SETUP menu abandoning changes.

F4 NEXT: Moves between HEADER & FOOTER displays.

4.2   PRINTER READ-OUT

Three line headers and two line footers may be customer defined. Each line can support up to 24 characters.

Entries are made by the Set Up menu, scrolling the characters and numbers, then selecting by use of the cursor keys.

Sample Printout

```
        FIREYE
      BOILER TEST
      ON MAIN SITE
   _ _ _ _ _ _

      Type of Fuel:

      Light Fuel Oil

      Dry Analysis

   O2 Normalization: Off


   _ _ _ _ _ _

      Date: 4.4.97

      Time: 10:23

   _ _ _ _ _ _

   T ambient   : 25°C
   T gas       : 266°C
   Tg - Ta     : 241°C
   CO          : 2055 ppm
   NO          : 272 ppm
               (FT1300-1 only)
   SO2         : 200 ppm
               (FT1200-2A only)
   O2          : 1.71%
   Efficiency  : 90.2%
   Loss        : 9.8%
   Excess air  : 10.8%
   Water       : 0.0%
   O2 norm     : 0.0%

   _ _ _ _ _ _
   FOR MORE INFORMATION

     TEL 603 432 4100
```

HEADER

FOOTER

4.3   DATA LOGGING

Data Logging Options

Log Type - Manual or Automatic

Log Storage - Memory, RS232

Log Output - RS232

Log Type: There are two options: Manual or Automatic

Manual: The manual data log provides an instantaneous log of data at that precise time. This can be undertaken by pressing the 'LOG' key in the Gas Readings Display.

Automatic: The automatic data log enables data to be logged at specific time intervals for a specified time period of logging i.e. Log Period 2 mins, Log Interval 10 secs.

— The 'Log Period' has a range 2 - 60 mins.

— The 'Log Interval' has a range 10 -1800 secs

NOTE: Although the sample interval may be set as low as 10 seconds, the system response to changes in gas concentrations is not less than 1 minute.

Log Storage: There are three options available to enable data logging storage/output - Memory, Printer or RS232.

Log to Memory: The Firetron 1000 can log up to 963 log records of data in non-volatile system memory.

NOTE: When the log memory is full no subsequent logs are recorded.

Log to Printer: Log records may be output as ascii text to a serial printer.

NOTE: Due to the limitations of a specific printer type, the number of continuous printouts is limited by the buffer size - e.g. by dumping the data log memory.

If the serial printer has only a small internal buffer, it may overflow and the number of printouts may be limited.

If the requirement is for multiple printouts and the buffer is insufficient in size, then two options are available.

1. Send the print/serial output to a file using something similar to a Windows Hyperterminal. The information can then be printed using standard Windows print facilities.
2. Use the Fireye CAPTURE Program to CAPTURE the data in the spreadsheet format and use a standard spreadsheet program to manipulate and print the data.

Log to RS232: Each log record may be output to the RS232 channel. The data is output as ascii data which may be received by the Fireye CAPTURE PROGRAM for use with a spreadsheet.

See Fireye CAPTURE PROGRAM Section 10.

Log Output

RS232 OUTPUT: When the 'LOG TO' parameter is selected as RS232 this parameter determines the output format of the data.

ASCII Text: Data is output as ascii text.

A serial printer with XON / XOFF protocol may be connected to the serial channel for a hard copy report of the samples. Alternately a PC with a suitable communications package could CAPTURE the data for output to a disk-based data file.

NOTE: Data in this format may not be directly incorporated into a spreadsheet package.

ASCII Data: Data is output as ascii data in a format which may be received by the Fireye CAP-TURE   SOFTWARE for use with a suitable spreadsheet package.

The Log Record: The Firetron 1000 Data Logging provides a means of storing data samples for recording or analysis. The display menu options allow the user to configure the data log to a convenient format (See Operating Procedure -Data Logging).

Each data log record contains the following data:

Fuel Type

Unit No.

Wet/Dry Analysis

O_2 Normalization ON/OFF

Date

Time

Ambient Probe Temperature

Probe Temperature

Up to 3 Gas Readings (where applicable)

NO_x Concentration (where applicable)

CO_2 Concentration

Fuel Efficiency

Excess Air

Percent Water

O2 Normalization Factor

4.4   SERIAL PORT

```
┌─────────────────────────────────────────────────────┐
│  BAUD RATE:              1200-19200 SELECTABLE        │
│  PARITY:                 NO/ODD/EVEN                  │
│  DATA BITS:              7/8                          │
│  STOP BITS:              1/2                          │
│                                                       │
├─────────────────────────────────────────────────────┤
│   [ EXIT ]      [ HELP ]     [ GASES ]    [ ABORT ]   │
└─────────────────────────────────────────────────────┘
     ( F1 )        ( F2 )        ( F3 )       ( F4 )
```

NOTE: The Serial Port on the Firetron 1000 must be set for:9600 baud; no parity; eight bits; one stop bit.

NOTE: Failure to enter the values as above will render the serial port useless when running the Fireye CAPTURE program.

Baud Rate: 1200 - 19200

Parity: No/Odd/Even

Data Bits: 7/8

Stop Bits 1/2

RS232 Serial Output

The serial output is user configured from the menu for baud rate, stop bits etc.

This port has 2 functions;

1.   To send data to a serial printer. For example an Epson printer (printer must have XON/XOFF protocol).

2. For communicating to a personal computer running the Fireye CAPTURE program or a suitable communications package in terminal mode.

4.5   SERIAL PORT CONNECTIONS

9 Pin D type connector fitted to side panel of the instrument.

RS232

Rx= pin 2A = pin 7

Tx= pin 3B = pin 8

Common = pin 5
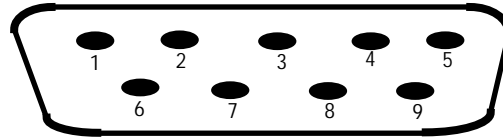
FRONT VIEW OF 9 PIN D CONNECTOR
ON SIDE PANEL

Fireye CAPTURE Program: The CAPTURE Program interfaces with the Firetron 1000 via the instrument's serial port and the computer's COM1: or COM2: serial port. The CAPTURE Program will work in either of two modes:

1. The CAPTURE Program requests data packages from the Firetron 1000 and places them in a dBASE III type data file on disk. When all the logged data is received the program terminates.

2. The CAPTURE Program runs continuously until stopped via the computer keyboard. It receives data packages from a Firetron 1000 running in auto data logging mode. Data packages are written to a dBASE III type file on disk.

NOTE: The CAPTURE Program is designed to work with LOTUS 1-2-3 (Release 3), Quattro Pro and Microsoft Excel but should work with any spreadsheet package which can read in dBASE III type (.dbf) data files.

The Fireye Firetron CAPTURE software is standard and is supplied with unit. Information on using the CAPTURE Program is given in Section 10 of this manual.

Computer Serial Port: (When used with the Fireye CAPTURE program). Two versions of the CAPTURE program are provided, which will use either serial port COM1 or COM2. The software automatically configures the port for 9600 baud, 8 data bits, one stop bit and no parity.

Firetron 1000 Serial Port: (When used with the Fireye CAPTURE program).

The serial port on the Firetron 1000 instrument must be set for:

9600 baud, no parity, eight bits, one stop bit. (See Section 4.4)

For more information on the Fireye CAPTURE Program refer to Section 10 of this manual.

RS232 Serial Output - Cable Connections: The following cable connections are used for connecting external hardware to the Firetron 1000 serial port when configured for RS232.

4.6   SERIAL PRINTER

To connect a serial printer to the RS232 serial port, the following connections are required:

9 Pin (Serial Port)   **25 Pin (Serial Printer)**

(Firetron)   (Printer)

Pin 2 -->Pin 2

Pin 3 -->Pin 3

Pin 5 -->Pin 7

HOST COMPUTER

To communicate between the Firetron 1000 and a host computer for using the CAPTURE program or other applications, the following connections are required:

Serial Port	**9 Pin or**	**25 Pin**
(Firetron)	(Computer)	(Computer)
Pins 1, 6 & 7 linked	Pins 8, 6 & 4 linked	Pins 8 & 4 linked
		Pins 5 & 20 linked

Pin 5 -->Pin 5 ----------------------->Pin 7

Pin 2 -->Pin 3 ----------------------->Pin 2

Pin 3 -->Pin 2 ----------------------->Pin 3

5.0 MAINTENANCE

The instrument normally requires little maintenance, providing it is used as described in this operating manual, however, to ensure accurate and reliable operation we recommend calibration once every 6 months (depending on use) at a minimum of once each year.

Points to remember:

• Empty the water catchpot frequently.

• Avoid long sample periods of high gas concentrations. **(Do not continuously monitor).**

• Avoid air leaks, these will result in inaccurate readings.

 Storage: If the instrument is unused for long periods, it is recommended that the power supply is connected periodically (every 4 weeks) to recharge the batteries. The sensor storage life may also be sustained by the automatic flushing of air through the sensors.

5.1   FILTER CLEANING AND REPLACEMENT

The particulate filter located at one end of the instrument should be replaced when it has visible signs of contamination. Unclip the filter and unplug, when replacing check that the filter casing is not damaged and no air leaks exist or errors in readings will occur.

To replace the particulate filter:

1. Unclip and remove old filter; replace with new filter.

FILTER FITTED
WITH SPACE
AT THE TOP

GAS PRE FILTER
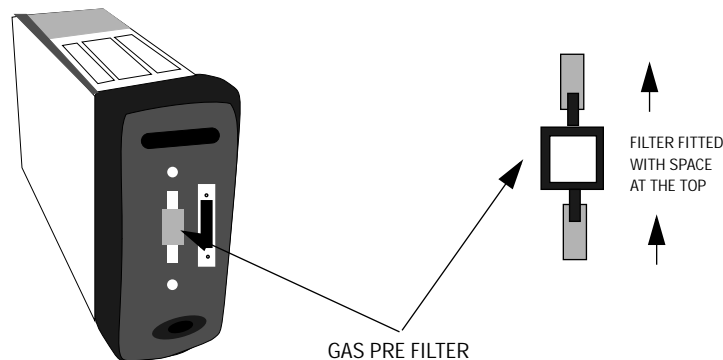
5.2   WATER CATCHPOT

Points to remember:

• The water container should be removed after completion of operations and emptied

• Ensure when replacing that a complete air seal is **maintained**. Check the rubber gasket.

Check the water container is secure, air leaks will result if loose resulting in incorrect readings. To remove or empty the water container, pull the bottom of the container out from the securing clip, the unit is hinged and will swing out to about 45°. Unscrew the container and empty out any water.

NOTE: Do not force the hinge beyond 45°, otherwise damage to the hinge may occur. Do not over-tighten.

WATER
CATCHPOT

5.3   PUMP SERVICING

Ensure the power supply is isolated before removing any panels to gain access to the instrument.

If the water catchpot does fill and enter into the pump, then it will be necessary to clean and dry the pump out. Care should be taken when dismantling the pump diaphragm not to damage the surfaces and replace them in the same order. (See illustration below).

To dismantle the pump

1.   Remove the 4 screws securing the pump diaphragm assembly.
2.   Carefully remove cover plate and pump inlet /outlet section.
3.   Unscrew diaphragm screw, remove diaphragm, clean and dry.

Key
1.4 x securing screws
2.Cover plate
3.Inlet/outlet section
4.Diaphram
5.Pump - main body

5.4 FUSE REPLACEMENT

Ensure the power supply is completely isolated before proceeding.

Fuses should always be replaced with the same type and rating.

Replacement of the fuse should only be carried out when the cause of failure has been rectified. Substitution of larger ratings or alternative forms of conductor may result in damage to the instrument.

Battery Fuse: A 20 mm 2A antisurge fuse protects the batteries. The fuseholder is located on the battery wiring harness.

Main Power Fuse: A 20 mm 3A 230V slow blow, glass fuse soldered into the main power supply card. This fuse will only be damaged when a serious fault occurs. Failure should only be investigated by a service engineer.

NOTE: Unit should be returned to Fireye for determination of failure. Field replacement not recommended.

⚠ **Before attempting to change fuses the instrument must be disconnected from the main power supply.**
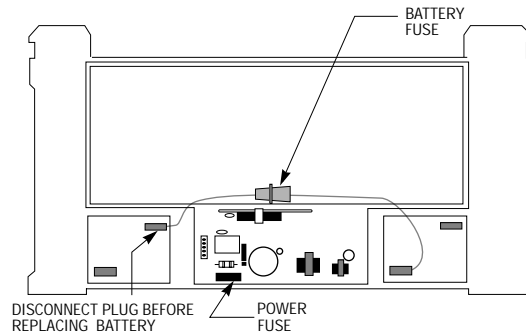
5.5   BATTERY CHARGING/REPLACEMENT

The Firetron 1000 can operate for up to 8 hours continuously depending upon which facilities are being used. After this time period has elapsed the batteries have to be re-charged. This is undertaken by connecting the main power supply cable to the side mounted socket (See Description of instrument). The Firetron 1000 is fitted with an on-board battery charger. The unit will recharge the batteries overnight.

⚠ **If the Firetron 1000 is not used for extended periods i.e. 1-2 months, it is advisable to re-charge the batteries at this interval or alternatively disconnect the terminal connectors to the battery.**

Battery Replacement

If the batteries need replacement, follow the procedure given below:

1. **Ensure the Power Supply is completely isolated.**
2. Remove side panel by release of retaining screws.
3. Disconnect the two spade terminal connectors per battery i.e. red and black per battery.
4. Remove the battery by pulling outwards.

5. Before fitting the new battery it is important to ensure that foam padding is attached to the sides of the battery. This should have been completed in the factory; if not attach new foam strips as per the battery that has been removed.

6. Push new battery into holder.

7. Re-attach spade terminal connectors.

8. Re-attach side panels.

DISCONNECT PLUG BEFORE
REPLACING BATTERY — BATTERIES
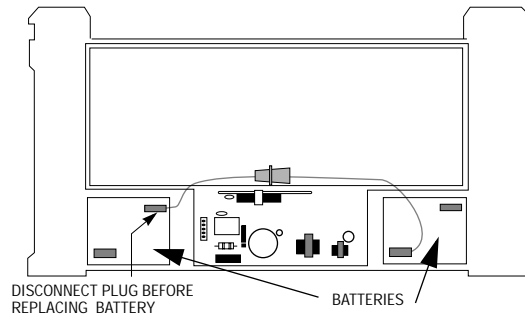
6.0 SYSTEM CALIBRATION AND SENSOR REPLACEMENT

WARNING:IF A MANUAL CALIBRATION IS PERFORMED WHEN NO CALIBRA-TION GAS OR THE WRONG CALIBRATION GAS IS PRESENT, THEN THE INSTRU-MENT WILL PRODUCE INCORRECT GAS READINGS. THIS MAY ALSO CORRUPT THE ORIGINAL GAS SENSOR CONSTANTS IN MEMORY. REPEAT WITH COR-RECT CAL PROCEDURE.

6.1   PREPARATION FOR CALIBRATION

Hazardous Gases: All recognized safety procedures should be used when operating with hazardous gases.

Fireye Inc. accepts no responsibility for damage to the instrument, or injury to the person while fol-lowing procedures, nor will the company accept liability for failure to comply with safety precau-tions.

Calibration Gas Concentrations: It is important to use concentrations of certified calibration gas which represent between 70 and 100% of the working range of the instrument.

6.2   MANUAL CALIBRATION - AMBIENT TEMPERATURE

The Firetron 1000 contains an ambient temperature sensor to enable the probe temperature to be cal-ibrated against the ambient air temperature. This should not normally need adjusting, as the instru-ment has been factory calibrated.

1. From the main menu, select 'Manual Cal'.

2. Selectemperature.

3. Enter the ambient air temperature using the cursor keys.

4. Both the probe and ambient air temperatures are displayed prior to calibration.

```
┌─────────────────────────────────────────┐
│                                          │
│            AMBIENT XXC                    │
│                                          │
│         Use cursor keys to enter current  │
│         ambient temperature              │
│         Press "ENTER' when readly to cal. │
│                                          │
│  ┌───────┐  ┌───────┐  ┌───────┐ ┌──────┐│
│  │ EXIT  │  │       │  │       │ │      ││
│  └───────┘  └───────┘  └───────┘ └──────┘│
└─────────────────────────────────────────┘
      ( F1 )      ( F2 )      ( F3 )     ( F4 )
```
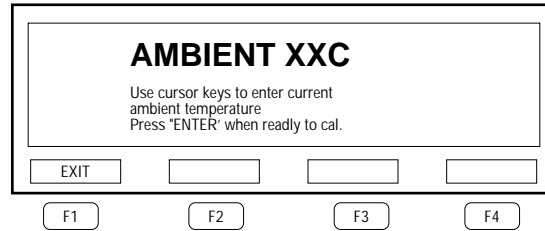
5.   Press 'CAL' to calibrate.

 Calibration is now complete.
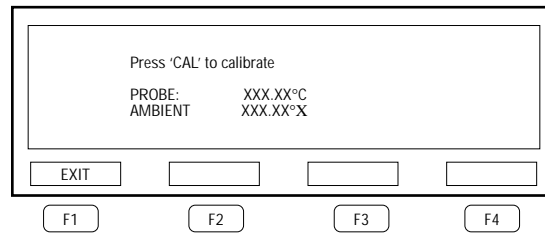
```
┌─────────────────────────────────────────┐
│                                          │
│         Press 'CAL' to calibrate          │
│                                          │
│         PROBE:        XXX.XX°C            │
│         AMBIENT       XXX.XX°X            │
│                                          │
│  ┌───────┐  ┌───────┐  ┌───────┐ ┌──────┐│
│  │ EXIT  │  │       │  │       │ │      ││
│  └───────┘  └───────┘  └───────┘ └──────┘│
└─────────────────────────────────────────┘
      ( F1 )      ( F2 )      ( F3 )     ( F4 )
```

Tg - Ta: A calculation of the temperature rise in the combustion process. The units i.e °C/°F can be changed in the Setup menu.

6.3   METHOD FOR ZERO CALIBRATION

The Firetron 1000 automatically performs a zero calibration each time it is switched on. A zero calibration may also be initiated by manually selecting the 'Recalibrate' option from the main menu. The ABORT function key allows early termination of the Zero calibration cycle. The completion or abortion of this cycle records the voltage outputs of the cells as exposed to fresh air. The cell zero values are displayed under the 'Diagnostics' menu.

⚠️ **IMPORTANT: The fresh air used for zero calibration is drawn through the sample probe. Remove the probe from the flue gas stream before any recalibration is undertaken. The cell zero values are displayed under the Diagnostics menu.**

NOTE: Cell zeros should be virtually 0.0V (offset should be less than $+20mV$) except: the Oxygen sensor (span value) which should be around 1.6V to 2.0V.

6.4   SUGGESTED METHOD FOR SPAN CALIBRATION

The individual gas sensors can be calibrated using the appropriate calibration gas. This applies to all gases except Oxygen. It is necessary to have information on the individual calibration gases i.e. type and concentrations. This information has to be entered to perform an accurate calibration of the sensors. It is recommended that a zero calibration (Refer to Section 6.3) is performed immediately prior to performing a gas span calibration.

1.   Follow all precautions for using hazardous gases.

2.   Assemble the following equipment: Certified Calibration Gas with Pressure regulator; Suitable gas pipe; 'T' junction connector; Bubbler or water-filled beaker or similar.

3.   On the Firetron 1000 select 'Manual Cal'.

4. Connect the Firetron 1000 to the Calibration Gas and Bubbler as indicated in the diagram. Set bottle regulator to 10 psi output pressure. With the Firetron 1000 drawing sample gas, adjust needle valve to get slight overflow of gas, as indicated by bubbles in the overflow pipe.

5. Enter the concentration of the calibration gas and press enter.

6. Wait for the gas reading to stabilize before pressing the 'CAL' key.

7. Press 'CAL' to begin calibration.

8. Use the 'EXIT' key to return to the gas selection display. Turn off calibration gas and remove connecting pipe.
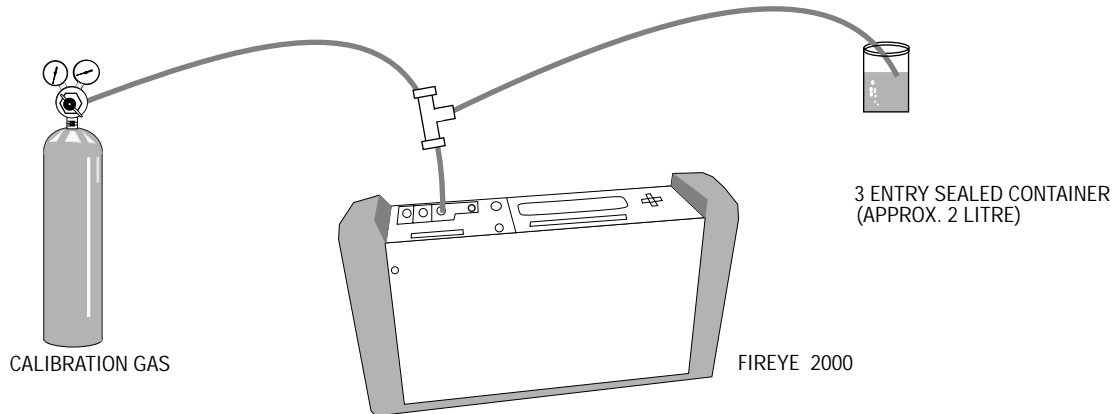
3 ENTRY SEALED CONTAINER
(APPROX. 2 LITRE)

CALIBRATION GAS

FIREYE 2000

NOTE: This arrangement enables the pressure at the gas inlet on the Firetron 1000 to be controlled.

6.5 CALIBRATION USING A FLOWMETER (not supplied)

As an alternative indication of gas overflow, the beaker in the Section 6.4 can be replaced with a flowmeter. Adjust the needle valve in the flowmeter to indicate a positive flow.

⚠ **Calibration gas can be poisonous. Only use the unit in areas that have adequate ventilation. If you begin to feel dizzy or lightheaded, immediately turn off your calibration gas supply and seek out an area of fresh air.**
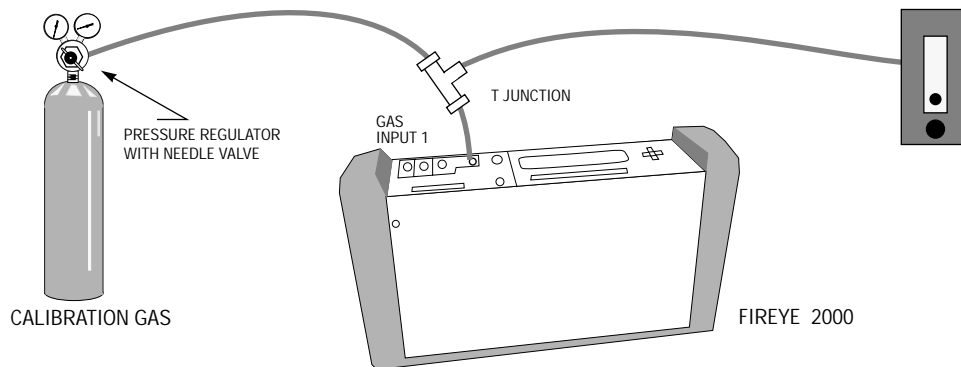
T JUNCTION

GAS
INPUT 1

PRESSURE REGULATOR
WITH NEEDLE VALVE

CALIBRATION GAS

FIREYE 2000

NOTE: This arrangement enables the pressure at the gas inlet on the Firetron 1000 to be controlled.

Use a concentration of certified gas that is in the range required for your application. The gas ordered should be a mixture of the gas desired with a balance of nitrogen (N_2), i.e. 100 ppm NO bal N_2. Your gas bottle should have a pressure regulator that can be adjusted to the 30 psi range.

6.6 CALIBRATING THE DRAFT SENSOR

The Draft Reading indicates the internal stack pressure in water gauge column inches or hPa. The figure represents a differential pressure between the stack pressure and the ambient pressure. It enables the flow rate of the chimney/stack to be determined.

The Draft sensor is pre-calibrated at the factory. If however the sensor requires re-calibration the following procedure must be adhered to.

1. Connect the probe
2. Go to 'Manual Cal' in the main menu.
3. Select 'Draft zero'. Since the probe is of ambient pressure, press 'Cal' then 'Exit'.
4. Select 'Draft span'.
5. Arrange for a calibration pressure to be applied to the probe inlet. This is done in the   factory as illustrated below.
6. Dial in the calibration pressure. Press 'Enter'. Press 'Cal' when ready.
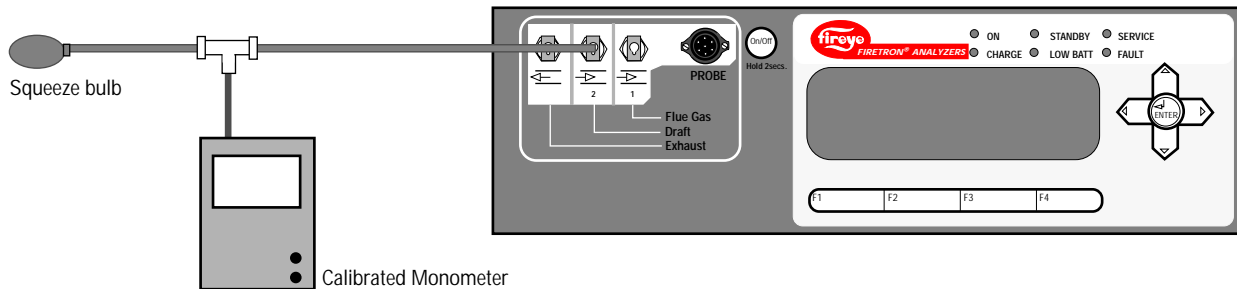
6.7   REPLACING GAS SENSORS

> ⚠ **Unplug the unit from the power supply**

Replacement of gas sensors is extremely simple. Undo the 2 back panel retaining screws and remove the panel. (Spare calibrated sensors may be quickly substituted).

The oxygen sensor is a bayonet fitting. Replacement is made by simply unplugging the old sensor and replacing with a new one. The replacement Oxygen sensor does not require calibration.

All other gas sensors are replaced by removing the 3 retaining screws, removing the old sensor and replacing with a new pre-calibrated one-securing with the same 3 screws and replacing the back panel. The connectors from the sensors must be attached to the relevant 'CONN' position. See diagram below for 'CONN' positions for each sensor.

FT1200-1 & FT1300-1

FT1300-1 ONLY

FT1200-2A ONLY

GAS MAINFOLD

ALWAYS FITTED
ON ALL MODELS

CO   O2   NO   SO$_2$

CONN16   CONN15   CONN14   CONN13   CONN12   DCONN11   CONN10   CONN9   C ONN8   C ONN7
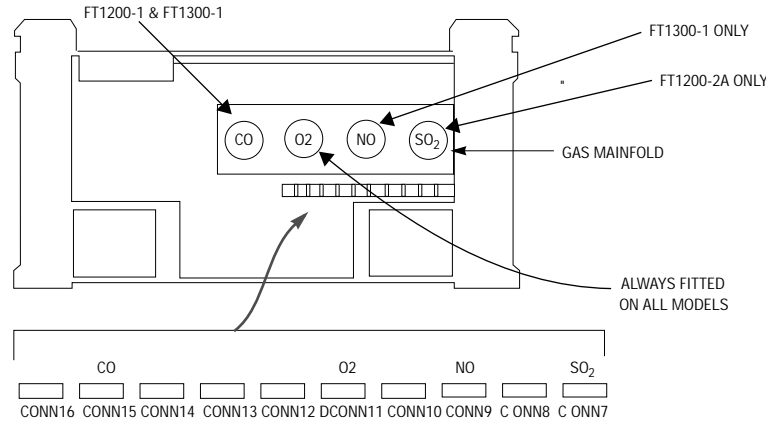
Gas Modules are positioned a indicated in the diagram above.

7.0 SYSTEM DIAGNOSTICS

7.1   STATUS LEDS

Situated on the keyboard display panel are 6 LED status indicators:-

ON: This is illuminated when the instrument is switched on.

LOW BATT: This is illuminated when the main battery requires re-charging.

SERVICE: This is illuminated when the particle filter requires replacing.

FAULT: This is illuminated when a fault or warning situation arises, for further detail see the DIAG-NOSTICS -> SYSTEM menu option

IMPORTANT: Certain faults remain indicated even after the condition has been cleared. These may be manually cleared through the SETUP->SYSTEM->CLEAR FAULTS menu option.

STAND BY: This LED indicates sleep and wake facility is active.

CHARGE: This LED indicates instrument battery is being charged.
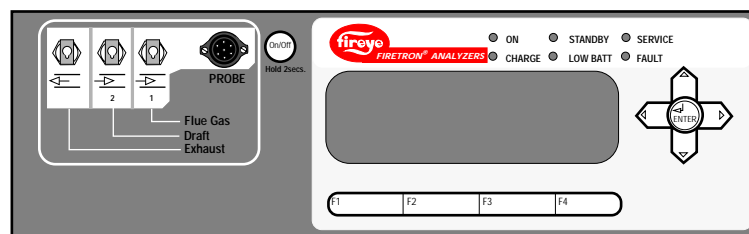
7.2   DIAGNOSTIC MENU

The Diagnostics menu provides analysis of system performance with reference to individual cells, filters etc.

Cell EMFs: This is maintenance information which indicates the true state of the cells and electronic system. This is specifically of use when the product is being serviced.

Cell Zeros: Indicates the zero calibration voltage of the cells after the last calibration was completed. The value for O_2 represents the span voltage (V).

Cell Life: Indicates the cell life in ppm days. Indicates the history of usage of the cell. This information is useful when a product is being serviced.

System: This provides a 'system overview' of the Firetron 1000.

Version No.: Indicates the version of software installed in the instrument.

Main Battery: Indicates battery output voltage. When running directly off the mains adaptor the voltage will be between 12.5 and 12.9V. When the battery voltage falls below an acceptable level (11.5V) to maintain optimum performance the 'LOW BATT' indicator light will show.

Options: This indicates the options fitted to the instrument.

Ranges: This indicates the measurement range capability of the individual cells. i.e CO Low 0 - 2000ppm.

Gains: This indicates the gain settings available for the individual cells.

System Faults: This indicates the gain settings available for the individual cells.

Report: A diagnostic report can be output to either the serial port or to the printer which summarizes the information contained within the Diagnostics menu. For example, see Report under Section 3.5.4.

8.0 MODEM SUPPORT

8.1 MODEM COMMUNICATIONS FOR REMOTE CONFIGURATION

The remote configuration system for the Firetron 1000 enables Fireye personnel to interrogate the instrument, without having to return the instrument to the factory. In this way configuration changes and elementary diagnostics which would normally be performed on the test bench can be performed at a remote site.

NOTE: This activity should only be performed by Fireye personnel. The information detailed here enables the user to make preparations for remote configuration of their instrument by use of a PC, modem and telephone connection.

System Requirements: The P.C. must be equipped with a Hayes compatible modem connected to its COM1:serial port (see next page for connection details). It must be running the latest version of the Firetron 1000 monitor software.

The Firetron 1000 must be from the serial port, connected to a Hayes compatible modem. (See below for connection details).

This allows Firetron 1000 configuration and elementary diagnostics (as currently performed on the test bench) to be performed over the phone line, from the office to a Firetron 1000 on site anywhere in the world.

Operation

Firetron 1000: To operate correctly, the modem must be correctly connected to the telephone line and the Firetron 1000, and both must be switched on.

The modem must be configured to 'auto-answer' i.e. to automatically pick up the line when it rings. This configuration can be done automatically with the Firetron 1000 software, simply by switching on the modem before the instrument: version x.xx software sends out a Hayes compatible 'auto-answer' command when it is powered up.

PC/monitor: Call up the monitor software by typing 'monitor' in the usual way. Ensure that the modem is connected to the COM1 serial port, the telephone line, and is powered up. Select function F2 'Control Modem'. If all is well, it will respond by requesting the number to dial. Enter this number, including any local exchange access numbers. The modem will then dial out, and await connection with the remote modem. When connection is established, the program will report this, and return to the main menu. At this point the operator can select function F1 'Set Monitor' and proceed just as if the Firetron 1000 were connected directly to the P.C.
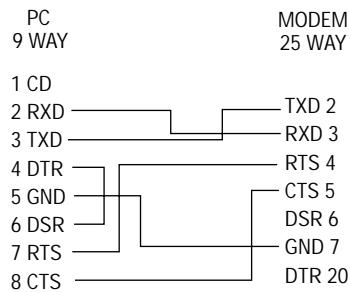
When the configuration session is finished, return to the main menu and select function F2 'Control modem' again. The program will prompt 'Disconnect line', and will do so if this is confirmed.
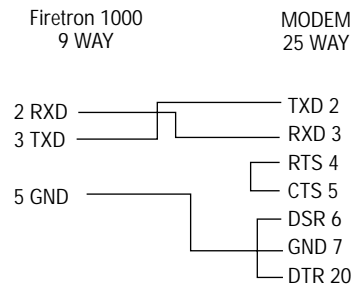
8.2 FUNCTIONS AVAILABLE

The functions available over the modem link are all of those currently available in the Firetron 1000 monitor software: Adjustment of sensor calibration parameters, changes to text headers, installation of sensors, and recalculation of EEPROM checksum. In addition, the instrument settings and parameters can be downloaded and saved to disk.

There is currently no facility for uploading instrument readings, or for directly controlling the instrument. However, modem control will be added to the existing data CAPTURE program in the near future.

PC to MODEM connections

```
   PC                        MODEM
 9 WAY                       25 WAY

1 CD
2 RXD ─────────────┐   ┌───── TXD 2
3 TXD ───────────┐ └───┼───── RXD 3
4 DTR ─┐         └──────┐      RTS 4
5 GND ─┼─┐               │     CTS 5
6 DSR ─┘ │               │     DSR 6
7 RTS ───┼──────────────┘      GND 7
8 CTS ───┘                     DTR 20
```

Firetron 1000 to MODEM Connections

```
 Firetron 1000               MODEM
   9 WAY                      25 WAY

2 RXD ────────────┐   ┌────── TXD 2
3 TXD ──────────┐ └───┼────── RXD 3
                └──────┐       RTS 4
5 GND ─────────────┐   └────── CTS 5
                   │           DSR 6
                   └────────── GND 7
                               DTR 20
```

9.0 SPARE PARTS

Description	Part No
Particulate Filter	317-430
Firetron "Duo" Probe with 300mm/12" hose	703-514
Probe Locator (Support Cone)	318-433
Barbed Nylon Hose Fitting	317-109
Sampling Pump	703-164
Rechargeable Battery	403-415
Mains Lead & Plug	406-460
2A Anti-Surge Fuse	404-536
Water Catch-Pot Assembly	701-828

9.2 REPLACEMENT SENSORS

Description	Part No
O_2 Cell	703-238
CO Cell	703-236
NO Cell (FT1300-1 only)	703-239
SO_2 Cell (FT1200-2A only)	703-241
Draft Sensor	405-405

9.3 OPTIONS

Description	Part No
Carrying Case	703-181

9.4 ALTERNATIVE PROBES/HANDLES & HOSES

Description	Part No
Firetron Pistol Grip Probe with 3m /10 ft. Sample Hose	703-128
Firetron Pistol Grip Probe with 10m/32 ft. Sample Hose	317-109
Probe (300mm/12 inches)	702-141
Probe (.5/20 inches)	702-205
Probe (1.0m/39.4 inches)	702-206
Probe (1.5m/ 60 inches)	702-440
Probe (3.0/ 118 inches)	703-207
"O" Ring	319-211
Sinter Filter	702-182

USE ONLY WITH A PISTOL GRIP FIRETRON PROBE WILL NOT WORK WITH A "DUO" PROBE

10.0 CAPTURE SOFTWARE PROGRAM

10.1   INTRODUCTION

The Fireye Firetron CAPTURE software is provided by FIREYE to run on PC compatible machines with EGA or VGA graphics.

The software program is used in conjunction with the Data Log feature of the Firetron 1000.

The software was designed to allow data logged during operation to be downloaded into a spreadsheet for analysis.

10.2   THE CAPTURE PROGRAM

The Fireye software is provided on a 3.5" floppy disk for use with PC compatible computers with EGA or VGA.

The CAPTURE software (2 versions are supplied on disk) uses the computer's serial port (COM1 or COM2) and the Firetron 1000 serial port which has to be set as follows:

9600 Baud   8 data bits   One stop bit   No parity

The software automatically configures the computer's serial port for the correct transmission settings.

The CAPTURE program may run in either of two modes:

Capturing Data from the Firetron 1000 Data Log memory: Data which is logged into the Firetron 1000's data log memory may be captured and placed in a dBASE III type record file.

NOTE: The Firetron 1000 data log memory is NOT erased once the data is captured. This must be done from the instrument itself.

Capturing Continuous Data Transmission: When the Firetron 1000 is set up for data logging or continual monitoring with the RS232 serial port as the output option for the logged data, then the CAPTURE software can run in continuous mode accessing each data transmission from the Firetron 1000 and placing it in a dBASE III type record file.

10.3   SPREADSHEET

The Fireye CAPTURE Program was written and developed for LOTUS 1-2-3 (Release 3) and is not guaranteed to work with all existing spreadsheets. However, if your spreadsheet will access external dBASE III type database files then you may access the data captured by FIREYE'S CAPTURE program.

10.4   SERIAL PORTS

The Computer: The CAPTURE program assumes the first serial port (COM1 or COM2). It automatically configures this port for 9600 baud, 8 data bits, one stop bit and no parity.

The Firetron 1000: The serial port on the Firetron 1000 must be set for:

9600 baud, no parity, eight bits, one stop bit.

Cables: For cabling information refer to Section 10.8.

10.5   THE LOG RECORDS

DATA AS SENT FROM THE FIRETRON 1000

Each log record is 107 bytes long. There are 21 fields. Each field is 6 bytes long except unit number is 2 bytes, the wet/dry and Oxygen normalization flags, the unit number and fuel type which are each one byte long. Values are sent right-justified within the fields and are padded with spaces. Data is sent as ASCII. The CAPTURE program converts the wet/dry analysis flag to the text 'WET' or 'DRY' and the Oxygen normalization flag to 'ON' or 'OFF' for the dBASE III type output file.

The following table gives an example of the data as sent from the Firetron 1000, including a description of the field.

Sample Data	Field Description
071091	[DATE: yy/mm/dd]
151559	[TIME: hh/mm/ss]
23	[Ambient Probe Temperature °C]
227	[Probe Temperature °C]
1150	[CO ppm]
1.52	[O_2 %]
91	[NO ppm] FT1300-1 Only
14.46	[CO_2 %]
168	[NO_x ppm] FT1300-1 Only
83.8	[Fuel Efficiency %]
10.7	[Excess Air %]
0.0	[% Water]
0.0	[% O_2]
1	[Wet/dry flag 1 - dry 0 - wet]
0	[O_2 normalization flag 1 - ON 0 - OFF]
7	[Unit No.]
2	[Fuel type]

NOTE: The gas readings are NOT adjusted for wet/dry analysis or O_2 normalization. The state of these options at the time that each log record is made is included in the database. This allows for these calculations to be made by the spreadsheet.

dBASE III TABLE

The following table shows the field names within type dBASE III database table generated by the CAPTURE program along with the field types and field widths.

Field name	Data Type	Field Width
Date	Date	8
Hours	Numeric	2,0
Minutes	Numeric	2,0
Seconds	Numeric	2,0
T_AMB	Numeric	6,0
T_GAS	Numeric	6,0
CO	Numeric	6,0
O_2	Numeric	6,2
NO	Numeric	6,0 (FT1300-1 Only)
CO_2	Numeric	6,2
NOx	Numeric	6,0 (FT1300-1 Only)
EFF	Numeric	6,1
XS_AIR	Numeric	6,1
WATER	Numeric	6,1
NORM_VAL	Numeric	6,1
ANALYSIS	Character	3
O_2_NORM	Character	3
UNIT NO.	Numeric	2,0
FUEL	Numeric	1,0

10.6   FAULT DIAGNOSIS

If the CAPTURE software generates a fault message indicating that no data was received then the following table is a list of the possible cause of failure and the recommended action to be taken.

Fault Description

The CAPTURE program fails to receive the logged data.

CAUSE	ACTION
The serial port is already in use	Wait until the port is free
The serial port on the Series 1000 is not setup correctly	Check under Setup Serial Port
The serial cable is wired incorrectly	Check
The wrong PC port is being used.	Use COMI (or COM2)
There is no logged data on the Firetron 1000.	Check under DATA LOG on the main menu
You are using the continuous CAPTURE mode an the Firetron 1000 is not set up for transmission to the RS232 Port	Check under DATA LOG or Continual Monitoring set up

10.7 HOW TO INSTALL AND RUN THE FIRETRON 1000 CAPTURE PROGRAM

These instructions assume some familiarity with computers, disk drives and disk directories.

1. Insert the floppy disk into your disk drive.

2. You may run the CAPTURE program from the floppy disk or alternatively copy the following files to where you wish them to reside on your hard disk:

    CAPTURE.EXE

    DB_TABLE

NOTE: Both files should reside in the same directory.

3. Set your current path to be in the same directory as the files you have just copied.

4. Make sure that you have the correct serial cable connecting COM1: on your computer to the serial port on the Firetron 1000.

5. Make sure that there is data in the log on the Firetron 1000 and that the serial port is set for 9600 baud, no parity, 8 data bits and 1 stop bit.

6. Run CAPTURE.EXE. It will prompt you with the following options:-

    1- CAPTURE data from instrument data log memory

    2- CAPTURE continuous data

7. Enter the number of the option you require.

8. The program will then prompt for a file name; this will be where the data is placed.

    You can specify a path, e.g. C:\L12R3\DATA.DBF

    or just a file name, e.g. DATA.DBF

    If the file already exists then you will be warned:-

    "File exists! Overwrite?"

    You have the option of overwriting the existing file.

    If you type 'Y' then the file will be overwritten.

    If you type 'N' then you will be prompted again for a file name.

    If the program puts up the message:-

    "Could not find template file 'DB_TABLE'!!!"

    then the file DB_TABLE is not resident in your current directory - it should be!

9. The software will then attempt to CAPTURE the logged data from the Firetron 1000. It will either return a failure message or the number of log records successfully received. If you are running in continuous mode then the program will continue to receive data until you type 'Esc' or 'Ctrl C'.

10. Hit any key to exit the CAPTURE program.

10.8 SERIAL PORT COMMUNICATIONS CABLES

The following cable connections have been shown to work for connecting external hardware to the Firetron 1000 serial port when configured for RS232.

Host Computer - Firetron 1000: To communicate with a host computer for the Fireye CAPTURE program or other applications, the following connections are required:

Firetron 1000 Serial Port	Computer 9 Pin	Computer 25 Pin
	Pin1,6 & 7 tied back	Pin 8, 6 & 4 tie back
	Pin 8 & 4 tied back	Pin 5 & 20 tied back
Pin 5	Pin 5	Pin 7
Pin 2	Pin 3	Pin 2
Pin 3	Pin 2	Pin 3

11.0 FIREYE CALIBRATION AND REPAIR FACILITY

In order to maintain peak performance, your Firetron Analyzer is recommended to undergo a complete calibration every six months.

Fireye's manufacturing plant in Derry, New Hampshire, has a complete facility to service this need. Fireye also stocks a variety of common spare parts should your unit need repair.

11.1 RETURN PROCEDURE

Prior to returning your unit to Derry, you must call Fireye's Order Services Department for a RETURN AUTHORIZATION (RA) number. Once the RA is received the unit can be returned to Fireye under normal return procedures.

If your unit requires repairs a detailed estimate will be returned to you prior to any work being completed.