



Fyrite[®] INSIGHT

Combustion Gas Analyzer

(Siegert Version)

Instruction 0024-9461
Operation & Maintenance
Rev. 4 – October 2011



Product Leadership • Training • Service • Reliability

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1.0 INTRODUCTION

1.1 The Fyrite® INSIGHT

The Fyrite® INSIGHT is a hand-held residential and commercial grade portable combustion analyzer that is designed for on-demand sampling of light industrial combustion equipment, residential furnaces, and appliances.

The following conventions are used in this manual:



WARNING: A warning statement denotes a potential hazard associated with the use of this equipment. Failure to follow this information could result in serious personal injury or death.



CAUTION: A caution statement indicates a potentially hazardous situation which, if not avoided, may result in minor or moderate injury. Caution statements may also be used to alert against unsafe practices.

To assure operator safety and the proper use of the Fyrite INSIGHT, please read the contents of this manual for important information on the operation and maintenance of the analyzer. This manual contains information on all models of the Fyrite INSIGHT. Please disregard any information that does not pertain to your model.



WARNINGS!

- *This analyzer should not be used on a continuous basis.*
- *This analyzer should not be used as a safety device.*
- *Except for sensor and battery replacement, this analyzer should only be opened and serviced by authorized personnel.*
- *When testing an appliance, a full visual inspection of the appliance should be carried out to ensure its safe operation.*
- **HAZARDOUS AREA WARNING:** *This instrument has not been designed to be intrinsically safe for use in areas classified as hazardous locations. For your safety, DO NOT use it in hazardous (classified) locations.*

 **CAUTIONS!**

- *When the instrument is used in an inefficient furnace or boiler application where there is a high emission of soot, probe sample filter may become clogged. Check filter before every use to confirm that it is clean for use or replace with a new filter. To prevent this from occurring, a smoke test should be performed before operating under such conditions to ensure that the furnace is burning at a level appropriate for the use of this instrument.*
- *Use only the Bacharach AC Adapter. Failure to do so could result in damage to the unit and void the warranty.*
- *Do not store instrument or its sensors with solvents or products that contain solvents.*

1.2 Fyrite[®] INSIGHT Features & Benefits

AUTO/MANUAL ZERO - In automatic mode, the instrument automatically zeroes all sensing channels on ambient air when it is powered on. If a particular sensor is in error during warm-up, the instrument automatically displays the error and continues to operate with the sensor in error. However, all information dependent on the sensor in error will not be presented. When the CO channel is set to manual zero, the analyzer does not zero the CO sensor to ambient conditions during start up. In this mode, the “fresh air zero” established during manual mode setup is stored in memory and used during the measurement of CO.

TEMPERATURE UNITS - Temperatures can be displayed in Centigrade or Fahrenheit.

PRESSURE UNITS - Pressures can be displayed in milliBar (mB), Pascal (Pa), hectoPascal (hPa), Millimeters of Water Column (mmwc), or Inches of Water Column (inwc).

LANGUAGE - The display options are English, French, Spanish, German, Italian, Danish, Polish and Dutch.

MEMORY - The Fyrite[®] INSIGHT has the ability to store, recall to display, and print a minimum of 100 sets of time and date coded combustion, differential pressure, or differential temperature test records. This includes manually entered Smoke Numbers, Oil Derivatives, and Boiler

Temperatures.

AVERAGING - The Fyrite® INSIGHT can average 3 like records and print out the information.

DOWNLOAD - Test records can be downloaded to a personal computer via the USB port. Saved records are transferred using PC based software and will be automatically loaded into an Excel spreadsheet. PC based software will also have the capability to update the instrument time and date and upload custom fuels, username, customer logo, and future code updates. The INSIGHT can also be set up from PC software.

USER INFORMATION - The instrument will accept up to three lines of 20 characters of user information. This information will appear with the test records when they are printed or downloaded.

CALIBRATION - Calibration can be performed by applying gas and entering calibration gas concentrations through software menu selections.

SMART SENSORS - B-Smart sensor technology is employed for the CO channel. CO sensors are calibrated prior to shipment and provide data that can be entered through the software menu selections for easy calibration without applying gas.

CALIBRATION REMINDERS - Calibration reminders can be set for Never, 6, 8, 10, 12, or 15 months.

DISPLAY FORMAT - The Run/Hold display format can be presented in default or custom ordered for specific needs. Up to 8 lines can be customized in the Run/Hold screen.

DISPLAY ZOOM - Combustion test data in the Run/Hold screens can be shown with enlarged characters to make viewing easier. The complete list of Run/Hold data can be scrolled through for all zoom levels. Available zoom levels and information display are as follows:

- Standard - 4 lines of information
- 2X - 3 lines of enlarged characters
- 3X - 2 lines of enlarged characters

STATUS - A status menu displays the instrument software version, boot version, model number, and serial number.

DIAGNOSTICS - The diagnostics menu displays the O₂ sensor life, CO sensor information, and hours of operation for the instrument and the pump.

KEYPAD SOUND - Keypad sounds can be enabled or disabled with software menu selections.

LOW BATTERY - A tone will sound every 10 seconds when a low battery condition exists. A low battery message will also be displayed.

AUTOMATIC POWER DOWN - The instrument can be set to automatically power off after a period of inactivity unless the user presses any button; the CO is greater than 50 ppm, or the O₂ is less than 16.0%. Automatic power down can be set for None, 30, or 60 minutes.

PURGE - The sensors will be purged when the instrument is shutdown until sensor outputs indicate that they have been exposed to fresh air. Pressing the On/Off key a seconds time can defeat the purge routine. The minimum purge time can be set to None, 5 seconds, 1, 5, or 10 minutes.

SENSOR ACCESS - Sensor replacement can be accomplished in the field. Easy access to the O₂ and CO sensors is provided through the back of the instrument.

POWER - The Fyrite® INSIGHT is powered by 4 AA alkaline batteries. A new set of alkaline batteries will provide a minimum of 20 hours of continuous operation with the pump running and the back light on. Optionally, the analyzer can operate with a universal AC adapter. When the AC adapter is plugged into the unit, batteries do not have to be removed.

PRINT MEMORY RANGE FEATURE - The print memory function permits the printing of a range of memory locations (versus printing the value of a single memory location). To access this feature, press F2 then Memory then Print Multiple.

	INSIGHT	INSIGHT Kit
	0024-8252	0024-8253
Hard Carry Case	X	X
Probe Assembly	X	X
Printer IRDA		X
Boot	X	X
PC Software	X	X
USB Cable	X	X
Batteries	X	X

Features Matrix for Models 0024-8252 and 0024-8253

1.3 Operational Overview

Pressing the **PWR** button turns the analyzer ON. Note that there is a warm-up period of 60 seconds that must elapse before the analyzer can be used.

To perform a combustion test, choose a fuel code that corresponds to the fuel being burned by the appliance being tested (Section 4.3), and then press the **RUN/HOLD** button to place the analyzer into its Run Mode. Begin testing by inserting the analyzer's probe tube into the flue-gas stream of the appliance under test. The analyzer will monitor the flue gas and display measured and calculated values that are relative to the combustion process. These values are displayed on the analyzer's LCD, and are chosen for display by pressing the Increment (**▲**) and Decrement (**▼**) buttons. The recommended time required to achieve a stable measurement is a minimum of 3 minutes.

Pressing the **RUN/HOLD** button during a test will freeze all measured and calculated values at their current levels. Pressing the **RUN/HOLD** button again resumes testing.

A backlight enables an operator to read the display in dimly-lit areas. Pressing the **PWR** button turns the backlight ON and OFF.

An optional power saver function will shut the analyzer OFF after a set time period of inactivity. This feature is disabled if the CO value is greater than 50 ppm or the O₂ value is less than 16.0%.

Press the **PWR** button for at least two seconds to power the analyzer OFF. Note that there is a 5 second delay before the analyzer actually turns OFF, during which time the unit can be kept ON by pressing the **RUN/HOLD** button. There is a CO purge feature that keeps the analyzer's pump running until the measured CO level drops below 50 ppm.

2.0 Technical Characteristics

The Analyzer Measures & Displays:	
Oxygen	0.1 to 20.9% O ₂
Carbon Monoxide	0 to 2000 ppm
Stack Temperature	-20 to 650 °C (-4 to 1202 °F)
Primary/Ambient Air Temperature	-20 to 316°C (-4 to 600 °F) CO
Differential Pressure/Draft	± 249 mB (± 100 inwc)
The Analyzer Computes & Displays:	
qA	0.1 to 100%
ETA	0.1 to 111.2%
EFF	0.1 to 100%
CO/CO ₂ Ratio	0.0001 to a fuel dependent maximum value in %
Carbon Dioxide	0.1 to a fuel dependent maximum value in %
CO referenced to %O ₂	0 to 9,999 ppm
LAMBDA	1 to 9.95%
Fuel Selection:	
<ul style="list-style-type: none"> • Natural Gas • LEG • Oil #2 • Oil #6 • KOKS 	<ul style="list-style-type: none"> • Propane • Coal • Biofuel • LPG • Butane
Normal Operating Conditions:	
Temperature <ul style="list-style-type: none"> • Analyzer • Probe 	0 to 40 °C (32 to 104 °F) 538 °C max (1,000 °F) at 5" insertion
Humidity	15 to 90% RH, Non-Condensing
Dimensions	Weight
20.1 cm (7.9 in) Height 9.1 cm (3.6 in) Width 5.8 cm (2.3 in) Depth	0.45 kg (1 lb.)

General Characteristics:	
Power Requirements	Four disposable 'AA' Alkaline batteries (optional AC adapter is available)
Operating Time	Minimum of 20 hours continuous operation (pump running and backlight ON)
Warm Up Time	60 seconds
Memory	Up to 100 complete sets of combustion, temperature, & pressure tests can be saved in memory.
Display	128 x 64, LCD Graphic Display
Front Panel Controls	Eleven front panel push buttons (Refer to Section 3.4)
Interfaces	IrDA printer & USB connectivity
Accuracy:	
Oxygen	$\pm 0.3\%$ O ₂ with a typical flue gas concentration of CO ₂
Carbon Monoxide	$\pm 5\%$ of reading or ± 10 ppm, whichever is greater*, in the range of 0 to 1000 ppm.
Flue Gas Temperature	± 2 °C between 0 & 124 °C (± 4 °F between 32 & 255 °F) ± 3 °C between 125 & 249 °C (± 6 °F between 256 & 480 °F) ± 4 °C between 250 & 400 °C (± 8 °F between 481 & 752 °F)
Ambient/Primary Temperature	± 1 °C between 0 & 100 °C (± 2 °F between 32 & 212 °F)
Draft	$\pm 2\%$ of reading or ± 0.05 mB, whichever is greater in the range of -25 to +25 mB $\pm 3\%$ in the range of -25 to -100 mB $\pm 3\%$ in the range of 25 to 100 mB
* Tighter CO accuracy in the lower ranges, up to ± 2 ppm, may be attained if a lower range calibration gas (e.g. 100 ppm CO) is used.	

3.0 SETTING UP THE ANALYZER

3.1 Preliminary Steps

Before using the analyzer . . .

- Check batteries (Section 3.2)
- Connect probe to analyzer (Section 3.3)
- Check setup (Section 3.6)

3.2 Power

3.2.1 Installing or Replacing Batteries

Install fresh batteries as described below. Check the analyzer for sufficient charge prior to each use. Replace the batteries if the low-battery symbol appears in the upper right corner of the screen. To replace the batteries:

1. Remove battery cover from back of analyzer.
2. If old batteries are installed, remove them and properly discard.
3. Observing the polarity markings inside the battery compartment, install four 'AA' Alkaline batteries.
4. Replace battery cover.

3.2.2 Using the AC Power Adapter

The optional AC power adapter is capable of powering the analyzer on a continuous basis. The adapter plugs into an appropriate 100-240 VAC, 50/60 Hz wall outlet and produces an output of +5 VDC. The adapter's output connector plugs into the analyzer's POWER jack located on the bottom of the unit. The batteries do not need to be removed when using the AC adapter.



CAUTION: *Use only the Bacharach AC Adapter (P/N 24-1254). Failure to do so could damage the unit and will void the warranty.*

3.3 Connecting the Probe Hose & Thermocouple

A rigid stainless steel probe with handle is connected to a flexible hose with integral water-trap / filter used to draw a gas sample into the analyzer from the room, grilles, diffusers, and furnace flues.

Inspect the flue-gas hose for cracks. If a hose is defective, replace the entire probe assembly.

Before using the analyzer, check that the Water Trap / Filter is dry and not dirty. If necessary, dry out the trap and replace the filter element per Section 6.2.

Perform the following steps to connect the probe assembly to the Fyrite INSIGHT:

1. Push the probe's sample-gas hose onto the GAS inlet fitting.
2. Push the probe's draft hose onto the "+" pressure fitting.
3. Push the probe's thermocouple into the T-STACK jack

IMPORTANT: *DO NOT force the thermocouple connector into its jack. The connection tabs are different sizes, allowing the connector to fit in only one way.*

4. Push the optional ambient/primary-air thermocouple into the T-AIR jack.

Fyrite® INSIGHT Connectors

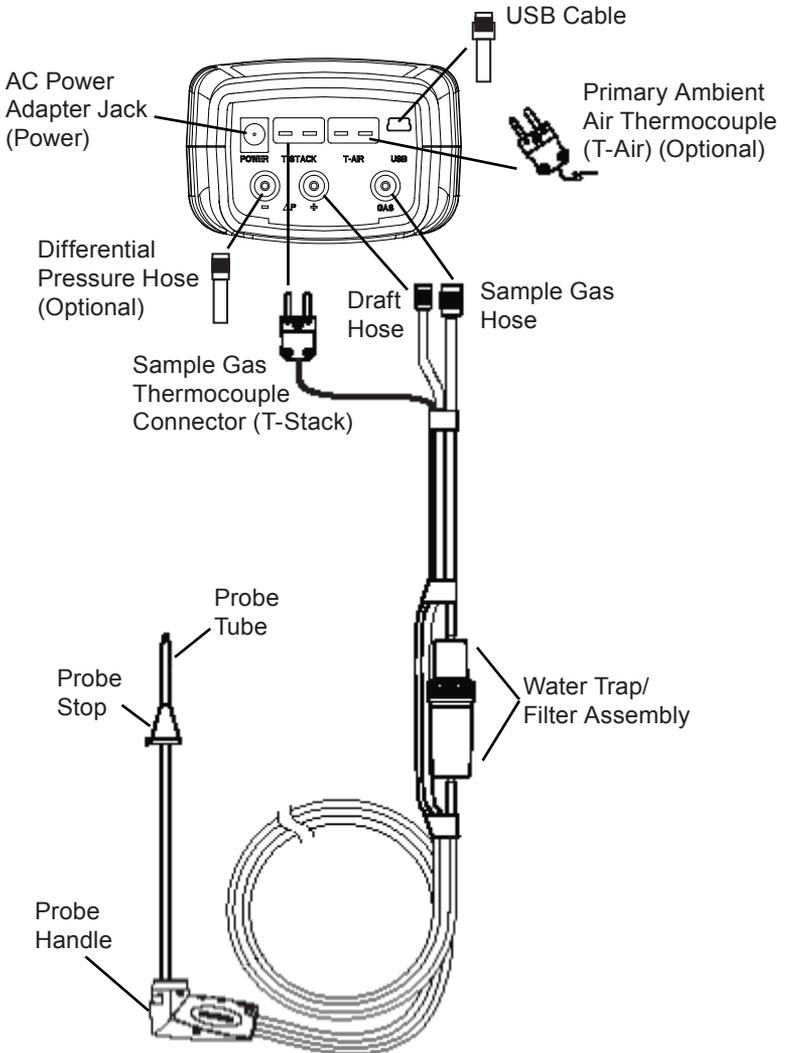


Fig. 3.1

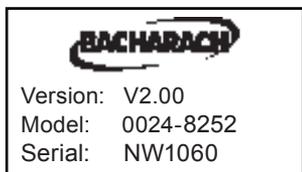
3.4 Front Panel Push Buttons



Note that a push button may perform several functions, depending on the analyzer's model number and the screen that is displayed.

	<ul style="list-style-type: none"> Pressing function keys accepts the corresponding function defined at the bottom of the display, including PRINT, SAVE, MENU, differential pressure ZERO, differential temperature ZERO, PAGE UP, PAGE DOWN and CLEAR data.
	<ul style="list-style-type: none"> Scrolls up, down, left, and right through the display screen options. Up and Down arrows cause the displayed value to increase or decrease correspondingly.
	<ul style="list-style-type: none"> Acts as an ENTER button. Performs the action selected.
	<ul style="list-style-type: none"> While in the HOLD screen, turns the sample pump on, displays the RUN screen, and begins a combustion test. While in the RUN screen, turns the sample pump off, displays the HOLD screen and the last set of combustion data. Displays the HOLD screen while pressing it from most menus. Return the display to the HOLD screen while pressing it during the 5 second power down sequence.
	<ul style="list-style-type: none"> Cancels most operations and displays the previous screen.
	<ul style="list-style-type: none"> Powers the analyzer ON and OFF. Hold this button down for at least 2 seconds to turn the power OFF. Toggles the backlight ON and OFF while the analyzer is turned ON.

3.5 Power-Up & Run/Hold Screen Overview

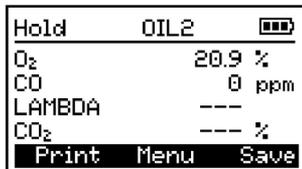


Press the **PWR** button to power up the analyzer. Information about the device’s software version, model number and serial number will be displayed briefly.



A warm up screen, displaying a 60 second count-down, will then appear.

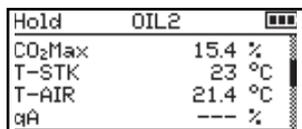
After the countdown, the Run/Hold screen will appear in Hold mode. This screen displays a list of information relative to the combustion process.



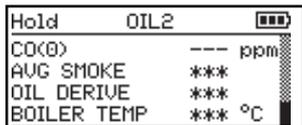
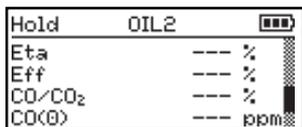
The ▲▼ up/down arrow keys permit scrolling through the list, as displayed in the illustration.

NOTE:

The following sections, **3.6 Setup Mode** and **3.7 Setup Menu**, explain how to access Setup menus and how to make modifications to preset parameters.



If you wish to use the analyzer without making setup modifications, go to section **4.0 Operation**.



3.6 Setup Mode

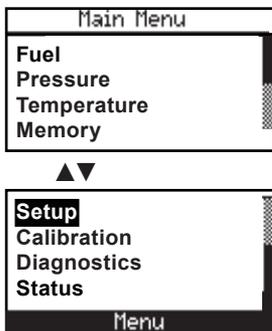
The analyzer is preset at the factory with the parameters displayed below, but can be modified as described in their corresponding sections.

Function	Parameter	To modify, refer to:
Fuel	Natural Gas	Section 4.3
Temperature Unit	°C	Section 3.7.1
Pressure Unit	mB	Section 3.7.2
Clock	Not Initialized	Section 3.7.6
O ₂ Reference	0%	Section 3.7.7
Zoom	Standard	Section 3.7.9
Language	English	Section 3.7.12
Button Sound	On	Section 3.7.13
CAL Reminder	Never	Section 3.7.14
Inactivity Timeout	None	Section 3.7.15
Post-Purge Period	None	Section 3.7.16

- Press ▲▼ buttons to scroll/highlight options.
- Press  (ENTER) to select or save.
- Press **ESC** to go back.

3.7 The Setup Menu

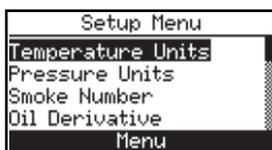
1. Press the **MENU (F2)** button to access the Main Menu.
2. Scroll to Setup. Press **ENTER**.



3.7.1 Temperature Units

Use this menu to display temperature in °C or °F.

1. Access the Setup Menu per Section 3.7
2. Select **Temperature Units**.



3. Press **ENTER** to access the Temperature Units menu. Select the desired temperature unit.



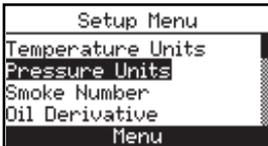
4. Press **ENTER** to save and return to the Setup Menu. Press **ESC** to cancel.

- Press ▲▼ buttons to scroll/highlight options.
- Press  (ENTER) to select or save.
- Press **ESC** to go back.

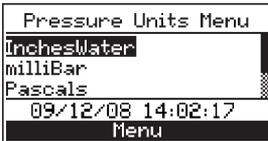
3.7.2 Pressure Units

Select to display pressure in inches of water column (inwc), millibar (mb), Pascals (Pa), hectoPascals (hPa), or millimeter of water column (mmwc) as follows:

1. Access the Setup Menu per Section 3.7.
2. Select **Pressure Units**.



3. The Pressure Units Menu will be displayed.

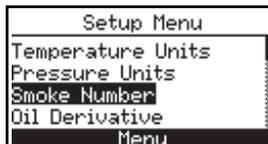


4. Select the desired pressure unit from the list.
5. Save and return to the Setup Menu or press **ESC** to cancel.

3.7.3 Smoke Number

Three smoke numbers, as measured by the Bacharach True Spot Smoke tester, can be manually entered into the analyzer and their average automatically calculated. The average smoke number will be displayed on the combustion test Run/Hold screen. Enter smoke numbers as follows:

1. Access the Setup Menu per Section 3.7 .
2. Select **Smoke Number**.



- Press ▲▼ buttons to scroll/highlight options.
- Press  (ENTER) to select or save.
- Press **ESC** to go back.

3. Use the ◀▶ buttons to enter the desired smoke number for the options in the list.

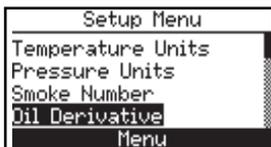


4. Save and return to the Setup Menu or press **ESC** to cancel.

3.7.4 Oil Derivative

Use the Oil Derivatives screen to manually enter Yes or No in response to if oil derivatives were present during the smoke test. Oil derivatives will be displayed on the combustion test Run/Hold screen. Enter an oil derivative as follows:

1. Access the Setup Menu per Section 3.7 .
2. Select **Oil Derivative**.



3. Select Yes or No.



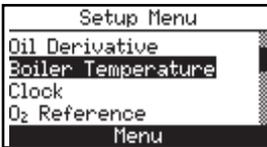
4. Save and return to the Setup Menu or press **ESC** to cancel.

- Press ▲▼ buttons to scroll/highlight options.
- Press  (ENTER) to select or save.
- Press **ESC** to go back.

3.7.5 Boiler Temperature

Use the Boiler Temperature screen to manually enter a boiler temperature as measured by an external thermocouple. Boiler temperature information will be displayed on the combustion test Run/Hold screen. Enter the boiler temperature as follows:

1. Access the Setup Menu per Section 3.7.
2. Select **Boiler Temperature**.



4. Use the ◀▶ buttons to move the cursor. Use the ▲▼ buttons to increment and decrement the number value.



5. Save and return to the Setup Menu or press **ESC** to cancel.

3.7.6 Clock

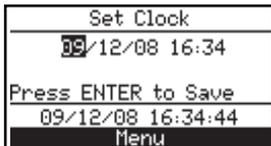
The Set Clock screen permits entry of time and date.

1. Access the Setup Menu per Section 3.7.
2. Select **Clock**.



3. Select numbers for the current date and time. Use the ◀▶ buttons to move the cursor.

- Press ▲▼ buttons to scroll/highlight options.
- Press  (ENTER) to select or save.
- Press **ESC** to go back.



4. Save and return to the Setup Menu or press **ESC** to cancel.

3.7.7 O₂ Reference

The measured value of CO can be referenced to a specific O₂ percentage of 0% to 15%. Set up the reference value as follows:

1. Access the Setup Menu per Section 3.7.
2. Select O₂ Reference.



3. Select the O₂ reference value. Range: 0-15.



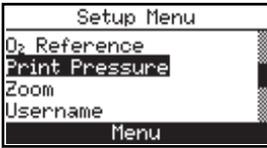
4. Save and return to the Setup Menu or use **ESC** to cancel.

3.7.8 Print Pressure

Select whether to print or not print the pressure measurement on the combustion test printout as follows:

1. Access the Setup Menu per Section 3.7.
2. Select **Print Pressure**.

- Press ▲▼ buttons to scroll/highlight options.
- Press  (ENTER) to select or save.
- Press **ESC** to go back.



3. Select Yes or No in regard to printing the pressure measurement.



4. Save and return to the Setup Menu or use **ESC** to cancel.

3.7.9 Zoom

Combustion test data in the Run/Hold screen can be shown with enlarged characters to make viewing easier. The operator can set zoom levels to Standard, 2X or 3X. The Standard zoom setting will display 4 lines of combustion test data at one time; 2X will display 3 lines of data with enlarged characters; 3X will display 2 lines of data with enlarged characters. The operator can scroll through the complete list of measured and calculated data no matter what zoom level has been selected. Select the desired zoom level as follows:

1. Access the Setup Menu per Section 3.7.
2. Select **Zoom**.



3. Select the desired zoom level.



- Press ▲▼ buttons to scroll/highlight options.
- Press  (**ENTER**) to select or save.
- Press **ESC** to go back.

4. Save and return to the Setup Menu or use **ESC** to cancel.

3.7.10 Username

The name of the user or owner (e.g. company name, address, phone number) can be stored in system memory. Up to three lines of text may be entered. Each line may contain up to 20 alphanumeric and symbol characters. This information will appear at the top of each printout until it is cleared or new information is entered.

Username information entry:

1. Access the Setup Menu per Section 3.7.
2. Select **Username**. The Edit Username screen will display with the first line highlighted.



3. Press **ENTER**. Only the first character space will be highlighted. Use the ▲▼ buttons to make selections for each character space.

When the ▲▼ buttons are pressed, symbols (/,#,&, etc.) display first. The ▲▼ keys permit continuous scrolling in either direction to access the other options. Press and hold the ▲▼ buttons for rapid scrolling.

4. Use the ◀▶ buttons to move the cursor to the next space. When a line is completed, press the **ENTER** key to confirm, then use the ▲▼ buttons to navigate to another line, if desired.



- Press ▲▼ buttons to scroll/highlight options.
- Press  (ENTER) to select or save.
- Press **ESC** to go back.

5. Save the information by selecting Edit Complete.

Clearing a Username:

The CLEAR option will appear (above the F3 button) when an entire line is selected. To delete all characters on the line, press F3 while the line is highlighted.



6. Repeat Steps 3-5 to edit remaining lines.
7. When all input is completed, select **Edit Complete** or **ESC** to cancel the edits and return to the Setup Menu.

Helpful Hint: Use the Fyrite® user software to upload this information from your computer.

3.7.11 Run/Hold Format

Fyrite INSIGHT test data is displayed on the Run/Hold screen. The **RUN/HOLD** button is used to toggle between Run and Hold.

Press the **RUN/HOLD** button to start the pump. While it is running, the word **Run** will appear in the upper-left corner of the display. The instrument continuously measures and calculates the data displayed in the Run/ Hold screen.

When the **RUN/HOLD** button is pressed again, the pump will stop. The word **Hold** will appear in the upper-left corner of the display. The instrument will now show the last measured and calculated data taken before the instrument was placed in Hold. Use the ▲▼ buttons to scroll through the complete list of measured and calculated values when in RUN or in the HOLD mode.

- Press ▲▼ buttons to scroll/highlight options.
- Press  (ENTER) to select or save.
- Press **ESC** to go back.

The default order in which data is displayed is listed below.

O ₂	=	Oxygen
CO	=	Carbon Monoxide
LAMBDA	=	Excess air
CO ₂	=	Carbon Dioxide
CO ₂ Max	=	% CO ₂ in flue gas assuming perfect combustion
T-STK	=	Stack Temperature
T-AIR	=	Ambient/Primary Air Temperature
qA	=	Stack loss
Eta	=	Efficiency referenced to the lower heating value
Eff	=	Efficiency referenced to the higher heating value
CO/CO ₂	=	Carbon Monoxide/Carbon Dioxide
CO(n)	=	Carbon Monoxide content referenced to % O ₂
AVG SMOKE	=	Average of 3 manually entered smoke numbers
OIL DERIVE	=	Manually entered Yes or No
BOILER TEMP	=	Boiler temperature manually entered

NOTE: (n) is the current O₂ Reference selected.

Changing the data display order:

1. Access the Setup Menu per Section 3.7.
2. Select **Run/Hold Format**.



A screen will appear that displays the Edit Format and Reset Format options.



- Press ▲▼ buttons to scroll/highlight options.
- Press  (ENTER) to select or save.
- Press **ESC** to go back.

3. Select to display the current format.



4. Scroll to the item in the list to be modified and press the **ENTER** button. The cursor will begin to flash.
5. With each press of the ▲▼ buttons, another option from the data list will be displayed within the flashing cursor field. Scroll through the options and select the desired data to appear in that location.
6. Press **ENTER** to save the selection. The cursor will stop flashing.
7. Change the data displayed at other locations by repeating steps 4 through 6.
8. When finished, scroll to the bottom of the list to select **Edit Complete**.
9. Press **ENTER** to save the new display format and return to the Edit Format or Reset Format option screen.

Resetting Display Format to Factory Default Settings

1. Access the Setup Menu per Section 3.7.
2. Select **Run/Hold Format**.



A screen will appear that displays the Edit Format and Reset Format options.

- Press ▲▼ buttons to scroll/highlight options.
- Press  (ENTER) to select or save.
- Press **ESC** to go back.



3. Select **Reset Format**.



4. Select **Yes**. Press the **ENTER** button to reset the format and return to the Run/Hold format options.

5. Press **ESC** to go to the Setup Menu.

3.7.12 Language Selection

The display screen text can be in English, French, Spanish, German, Italian, Danish, Polish or Dutch.

Select the desired language as follows:

1. Access the Setup Menu per Section 3.7.
2. Select **Language Selection**.



A screen will appear that displays the language options.

3. Scroll through the list and select the desired language.

- Press ▲▼ buttons to scroll/highlight options.
- Press  (ENTER) to select or save.
- Press **ESC** to go back.

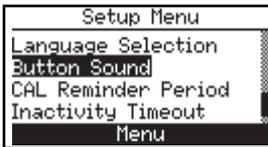


4. Press **ENTER** to activate the selection and return to the Setup Menu or press **ESC** to cancel.

3.7.13 Button Sound

The audible sound used to signal when a button is pressed can be turned OFF and ON as follows:

1. Access the Setup Menu per Section 3.7.
2. Select **Button Sound**.



3. Select **Off** or **On**.



4. Press **ENTER** to save the selection and return to the Setup Menu or **ESC** to cancel.

3.7.14 CAL Reminder Period

The analyzer can be set to indicate a calibration reminder during the 60 second warm-up. Calibration reminders can be preset to occur: Never, 6, 8, 10, 12, or 15 months after the last calibration. When the preset period is exceeded, the instrument will display the reminder and how long it has been since the sensors were last calibrated. If a calibration reminder is displayed, the operator can press the **RUN/HOLD** key to go to the Run/Hold

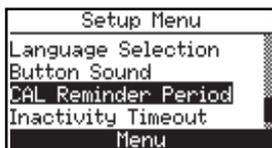
- Press ▲▼ buttons to scroll/highlight options.
- Press  (ENTER) to select or save.
- Press **ESC** to go back.

Screen for normal operation. Regular calibration periods of 6 months to 1 year are recommended.

NOTE: *The default CAL Reminder period is **Never**.*

Set the calibration reminder period as follows:

1. Enter the Setup Menu per Section 3.7.
2. Select **CAL Reminder Period**.



3. Select the desired time period.



4. Press **ENTER** to save selection and return to the Setup Menu or **ESC** to cancel.

NOTE: *The date and time settings must be correct to get accurate calibration reminders.*

3.7.15 Inactivity Timeout

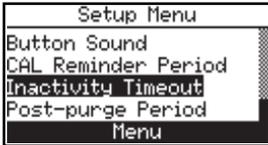
This is the selected amount of time that will elapse before the analyzer automatically powers down due to inactivity from the user. The timeout periods available are: None, 30 or 60 minutes. However, if the CO value is greater than 50 ppm or the O₂ value is less than 16.0%, this feature is disabled and power down will not occur.

NOTE: The default set time is **None**. This selection will prevent the analyzer from automatically powering off.

- Press ▲▼ buttons to scroll/highlight options.
- Press  (ENTER) to select or save.
- Press **ESC** to go back.

Set the Inactivity Timeout Period as follows:

1. Access the Setup Menu per Section 3.7.
2. Select **Inactivity Timeout**.



3. Select the desired timeout period.



4. Save the selection and return to the Setup Menu or **ESC** to cancel.

3.7.16 Post-Purge Period

The analyzer can be setup to purge the sensors following the combustion test. It can be programmed to purge for None, 5 seconds, 1, 5, or 10 minutes.

Set the **Post-Purge Period** as follows:

1. Access the Setup Menu per Section 3.7.
2. Select **Post-Purge Period**.



3. Select the desired time period.

- Press ▲▼ buttons to scroll/highlight options.
- Press  (ENTER) to select or save.
- Press **ESC** to go back.



4. Save the selection and return to the Setup Menu or **ESC** to cancel.

3.7.17 Auto/Manual Zero Feature

Manual Zero: When the CO channel is set to manual zero, the analyzer does not zero the CO sensor to ambient conditions during start up. In this mode, the “fresh air zero” established during manual mode setup is stored in memory and used during the measurement of CO.



Auto Zero: When the CO channel is set to auto zero, the CO sensor is zeroed to the ambient CO level during start up.

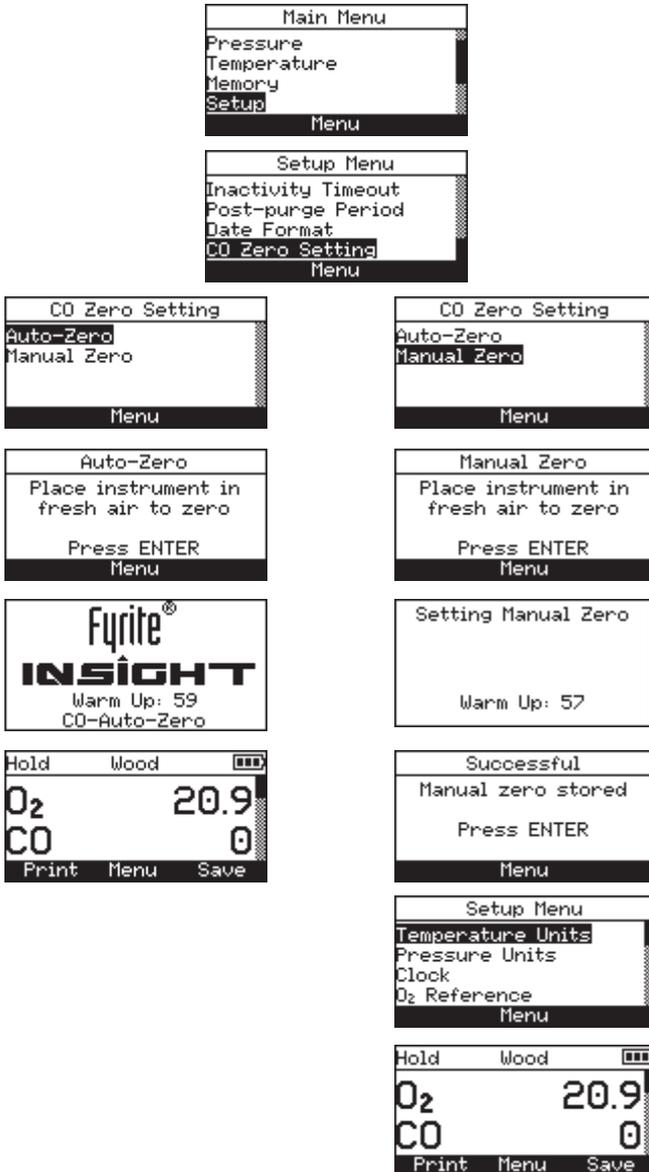


IMPORTANT: When using this mode, the analyzer must be turned ON in fresh air; otherwise, incorrect CO readings will occur.

Auto Zero determines the zero reading of the CO channel in fresh air and provides an offset for the CO measurements. Manual zero is used to detect CO that may be present during start-up. The auto/manual zeroing option allows the operator to select the start-up mode. It is selectable from the CO Zero Setting of the Setup Menu.

1. From the SETUP MENU, use the ▲▼ buttons to highlight CO Zero Setting, and then press ENT to display the CO ZERO SETTING MENU.
2. Use the ▲▼ buttons to highlight the desired option (Manual or Auto Zero), and press ENT to save the selection and re-display the SETUP MENU.

Both methods take the user through a 60-second count down to establish a new zero. The manual mode establishes a fresh air zero and stores it for use during instrument startup.



Auto-Zero versus Manual Zero

4.0 OPERATION

4.1 Operating Tips

- When an analyzer is brought in from a cold vehicle, let it warm up slowly to minimize condensation. Temperatures below freezing will not damage the analyzer; however, bringing a cold analyzer into a warm, humid environment may cause condensation to form inside the case.



Caution: Although the analyzer itself is not damaged by an extremely cold environment, the electrochemical sensors may be damaged. The O₂ sensor's electrolyte will freeze at approximately -25 °C and the CO sensor's at approximately -70 °C. If the analyzer is exposed to an extremely cold condition, it is strongly suggested that the sensor housings be examined for hairline cracks. Be aware that a leaking sensor can cause chemical burns to the skin and possibly damage the PCB assemblies.

- Ensure that the analyzer is sampling fresh air when turned ON. Pulling a stack-gas sample through the analyzer during its warm-up period will not damage the analyzer, but it will result in incorrect sensor readings, and may result in sensor error messages appearing after the warm-up cycle completes.
- Note that flue-gas condensate is acidic and very corrosive. It is important not to allow the analyzer's internal components to come in contact with condensate for long periods of time.
- Before each use, inspect the filter element of the water-trap / filter assembly. Replace the filter if it looks dirty.
- When sampling flue-gas, keep the analyzer above the water-trap, and keep the trap in a vertical position. This will maximize the effectiveness of the trap and keep liquid from being drawn directly into the analyzer.
- When liquid condensate is seen inside the water trap, empty the trap before it becomes full.
- When storing the analyzer, empty the water trap and leave it open to further dry it out.
- Calibrate the analyzer every 6 months to 1 year to assure its accuracy.
- The recommended time required to achieve a stable measurement is a minimum of 3 minutes.

4.2 Analyzer Power On & Warm Up

1. Connect the probe and make sure that the analyzer is properly set up per Section 3.

IMPORTANT! DO NOT insert probe into stack before powering on the analyzer.

2. Place the probe in an area that contains fresh air. This ensures that the sensors will be properly zeroed during the warm-up cycle.
3. Power up the analyzer by pressing the **PWR** button for at least 1 second, or until a single beep is heard.

Observe that the analyzer's firmware version, model and serial numbers are briefly displayed, followed by the Warm Up screen.



4. After the 60 second warm-up period is completed, the instrument will display the Combustion Test HOLD screen.

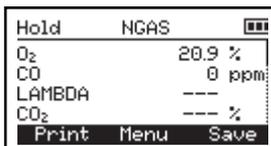
If, however, any errors are detected during warm-up, the message “ERRORS DETECTED” will be displayed along with a list of those errors. In this example, the O₂ sensor is missing and the T-Stack thermocouple is not connected.



Refer to Section 6.7 for a listing and possible remedy for the errors displayed.

4.3 Fuel Selection

The top line of Combustion Test HOLD screen shows the fuel currently selected.

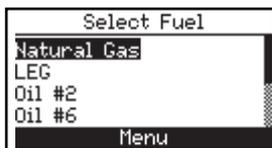


If necessary, change the fuel as follows:

1. Press **F2** to access the Setup Menu (per Section 3.7.)
2. Select FUEL. Press **ENTER** to display the Fuel Selection screen.



3. Select the desired fuel.



4. Press **ENTER** to view the default value; select Adjust to modify the default value.



5. Save the selection and return to the Combustion Test HOLD screen or **ESC** to cancel and return to the select Fuel Menu. From the Fuel Menu, press **ESC** again to return to the Main Menu.

4.4 Sampling Point (See Fig. 4.1)

Forced Air Furnace – When testing atmospheric burner or gravity vented, forced air heating equipment with a clamshell or sectional heat exchanger design, test each of the exhaust ports at the top of the heat exchanger. The probe should be inserted back into each of the exhaust ports to obtain a flue gas sample, before any dilution air is mixed in.

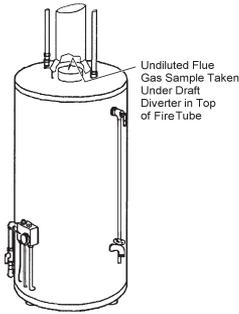
Hot Water Tank – Domestic hot water tanks with the ‘bell’ shaped draft diverter on top can be accurately tested by inserting the probe tip directly into the top of the fire tube below the diverter.

80% Efficiency Fan Assist or Power Vented – Combustion testing of fan assist or power vented, furnaces/boilers should be done through a hole drilled in the vent approximately 12 inches above the inducer fan.

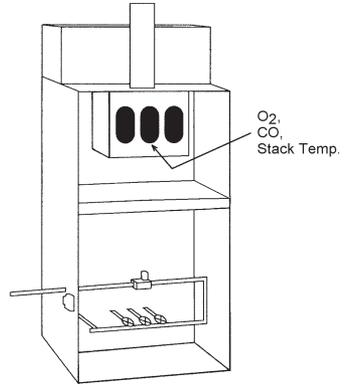
90% Efficiency Condensing – Condensing furnaces/boilers can be tested through a hole drilled in the plastic vent pipe (when allowed by the manufacturer or local authority of jurisdiction) or taken from the exhaust termination. After testing, the hole should be sealed with high temperature silicon.

Atmospheric or Gravity Vented Boiler – Boilers, which have a ‘bell’ shaped draft diverter directly on top, should be tested directly below the diverter through a hole drilled in the vent connector.

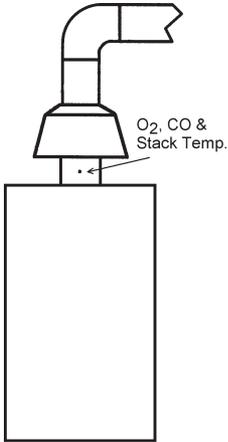
NOTE: Seal all drill holes upon completion of combustion testing.



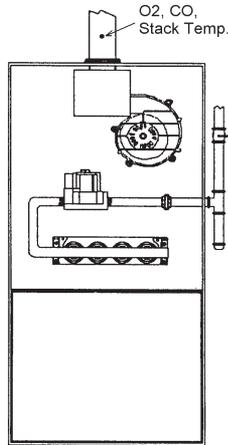
Hot Water Tank



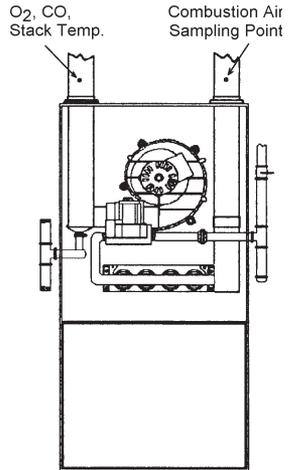
Atmospheric Burner or Gravity Vented Forced Air



Atmospheric or Gravity Vented Boiler



80% Eff. Fan Assist or Power Vented Furnace/Boiler



90% Eff. Condensing Furnace/Boiler

Fig. 4.1

4.5 Performing a Combustion Test

Ensure that the following has been completed, and then proceed with the combustion test as described below:

- Power on the analyzer and allow it to warm up (Section 4.2).
 - Select fuel being burned (Section 4.3).
 - Inset probe into proper sample location (Section 4.4).
 - If necessary, insert optional primary air thermocouple into combustion-air stream of burners that use an outside source of combustion air.
1. Press the **RUN/HOLD** button to start the test. The pump will start running and the word RUN will appear at the top of the Combustion Test screen.

Sensor Indicators: The following indicators appear in the sensor's data field depending on certain conditions:

- (* * *) Sensor that is not calibrated or installed.
 - (XXX) Sensor overrange
 - (- - -) The calculated data cannot be displayed because the measured data necessary to make the calculation is out of range (i.e., oxygen level above 18.8%).
2. Scroll to the T-STK reading. Loosen the thumbscrew on probe stop and move probe in and out of the stack until the stack's core temperature (**hot spot**) is located as indicated by the highest T-STK reading; then tighten thumbscrew to prevent further probe movement. *Locating the highest stack temperature is very important for accurate efficiency calculations. Note that the recommended time to achieve a stable reading is a minimum of 3 minutes.*
 3. You can now begin burner-service procedures. The analyzer readings will change quickly to show changes in burner performance.



CAUTION: *Position the water trap with its gas-flow arrow pointing upward. Do not allow water condensate above the tip of the riser tube. The sensors could be damaged if water would enter the analyzer. Empty the water trap after every combustion test (refer to Section 4.10)*

- Pressing the **RUN/HOLD** button freezes all readings, stops the pump and displays the Combustion-Test HOLD screen. Scroll to view all test values at the moment the **RUN/HOLD** button was pressed. Pressing **RUN/HOLD** again restarts the pump and resumes testing.

Display Name	Description of Measurement or Calculation
O ₂	% Oxygen
CO	ppm Carbon Monoxide
LAMBDA	Excess air
CO ₂	% Carbon Dioxide
CO ₂ Max	% CO ₂ in flue gas assuming perfect combustion
T-STK	Stack Temperature
T-AIR	Primary/Ambient Air Temperature
qA	Stack loss
Eta	Efficiency referenced to the lower heating value
Eff	% Efficiency referenced to the higher heating value
CO/CO ₂	Carbon Monoxide/Carbon Dioxide ratio
CO(n)	Carbon Monoxide content referenced to % of O ₂ concentration
AVG SMOKE	Average of 3 manually entered smoke numbers
OIL DERIVE	Manually entered Yes or No
BOILER TEMP	Boiler temperature manually entered

4.6 Making a Draft / Pressure Measurement

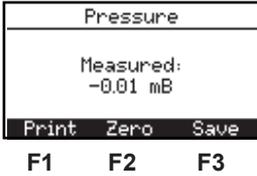
The difference in pressure (ΔP) between two areas can be measured by using the analyzer’s two pressure ports and the Pressure screen. By using the $-\Delta P$ port as the reference, the pressure applied to the $+\Delta P$ port will be displayed on the Pressure screen as the differential pressure between the two ports. Perform a draft / pressure measurement as follows:

- Power on the analyzer and allow it to complete its warm-up cycle.
- Press the **MENU (F2)** button to access the Main Menu.
- Use the **▲▼** buttons to select Pressure. Press **ENTER** to display the Pressure screen.

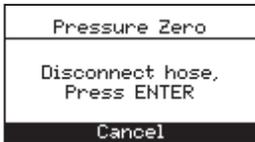


4. Before taking a measurement, the pressure sensor may need to be re-zeroed if it is not already displaying zero with both pressure ports open to the atmosphere. If necessary, zero the pressure sensor as follows:

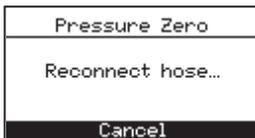
- Press the **ZERO (F2)** button.



- Disconnect any hoses connected to the + Δ P and - Δ P ports, and then press **ENTER** to zero the pressure sensor



- Reconnect any hoses. When measuring draft, leave the - Δ P port open to the atmosphere and connect the probe's draft hose to the + Δ P port.



5. Do one of the following to measure draft or differential pressure:

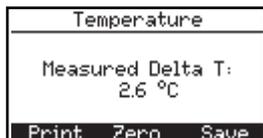
- To measure draft, insert the probe into the stack and observe the draft reading on the Pressure screen.
- To measure differential pressure, connect two sampling hoses to the + Δ P and - Δ P ports, and place the open end of each hose into the areas being measured. The differential pressure between the two areas is now displayed on the Pressure screen. If the pressure at the + Δ P port is higher than the - Δ P port, the pressure reading will be positive. If it is lower, the reading will be negative.

4.7 Temperature Measurement

The difference in temperature between two areas can be measured by using the analyzer’s two temperature channels and the Temperature Screen. By using the T-Air channel as a reference, the temperature applied to the T-Stack channel will be displayed on the Temperature Measurement screen as differential temperature between the two channels.

Perform a differential temperature measurement as follows:

1. Press the **MENU (F2)** button to display the Main Menu.
2. Use the **▲▼** buttons to scroll to Temperature. Press **ENTER** to display the Temperature Measurement screen.

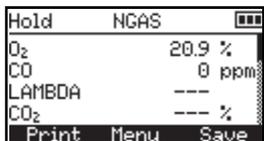


3. Install thermocouples in both temperature channel connectors.
4. Before taking a measurement, the temperature channels may need to be zeroed, if not already displaying zero with both thermocouples exposed to the same condition. Press **ZERO (F2)** if necessary.

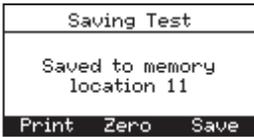
4.8 Saving Test Data

Up to 100 sets (“snap shots”) of combustion test, pressure, or temperature data can be saved in memory, which can later be recalled for viewing from the Memory Directory.

1. First, display the screen that contains the data to be saved. In the example below, all data associated with the Combustion Test RUN screen will be saved.



2. Press the **Save (F3)** button to save the test data in the next available memory location.



NOTE: When memory is full, the next reading will not be saved until space is made available by clearing previously saved data. (Section 4.13)

4.9 Ending a Combustion Test

 **WARNING! Burn Hazard.** Do not touch the probe after removing it from the stack. Allow the probe to cool before handling (about 5 minutes).

1. Remove probe from the flue-gas stream.
2. Allow the pump to run until all combustion gases are flushed from the analyzer as indicated by the O₂ reading returning to 20.9%.

4.10 Emptying the Water Trap

The Water Trap / Filter Assembly removes stack-gas condensate, and also prevents soot from contaminating the internal components of the analyzer.

IMPORTANT! Use the Water Trap / Filter Assembly in a vertical position with the gas-flow arrow pointing up.

Empty the water trap chamber after each combustion test, or stop the test and empty the chamber if the liquid condensate level approaches the tip of the riser tube.

To empty the trap, first pull apart the two halves of the Water Trap using a slight twisting motion; empty the water trap chamber, and then reassemble the trap.

After each combustion test, also check the Water Trap's filter element. If it looks dirty, replace the filter per Section 6.2.

4.11 Powering Off the Analyzer & Purging

Power off the analyzer by pressing the **PWR** button for at least 2 seconds, or until two beeps are heard. The unit will count down 5 seconds before shutting down. Pressing the **RUN/HOLD** button during this time will stop the countdown and the analyzer will remain powered on.



If the analyzer was not purged with fresh air then the analyzer may remain ON with its pump running and display the message “PURGING SENSORS” as the result of combustion gases still being present inside the analyzer. At this time the operator should ensure that the probe is removed from the stack, allowing the analyzer to purge itself with fresh air. The 5-second-shutdown sequence will not begin until the gas levels inside the analyzer drop below predetermined levels.

TIP: Although not recommended, the purging process can be bypassed by pressing the **PWR** button a second time.

4.12 Low Battery Alarm

When the batteries are nearly depleted, an empty battery icon appears in the upper-right corner of the display, and a short beep is sounded every 10 seconds.

After a low battery alarm occurs, the analyzer will continue to operate for only a few minutes. The operating time that remains depends on many factors (e.g., pump and backlight powered on or off and the type and condition of the batteries).

4.13 Memory

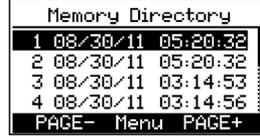
All saved data can be retrieved for viewing through the **Memory** option.

To open and view saved test data:

1. Press the **MENU (F2)** button to access Main Menu.
2. Select **Memory** to view the Memory Options menu.



3. Select Memory Directory. Press **ENTER** to display the data saved in the Memory Directory.



TIP: In the memory directory, quickly page through the screens by pressing the **PAGE-** (F1) and **PAGE+** (F3) buttons. Move to the first or last memory location by pressing the ◀▶ buttons, respectively.

To Clear Test Data:

1. Press the **MENU (F2)** button to access Main Menu.
2. Use the ▲▼ buttons to scroll to Memory. Press **ENTER** to display the Memory Menu.



3. Select Clear Memory. Select Yes and press **ENTER**.



A confirmation that the memory has been cleared will be briefly displayed.



4.13.1 Averaging Stored Test Data

The Fyrite INSIGHT will provide data averages for 3 consecutive combustion records that are also printable. The combustion tests must first be stored in program memory (After running a test, press the F3 key to save the results).

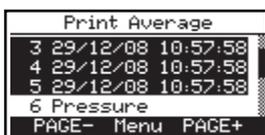
- From the Main Menu, select Memory. The Memory Options screen will be displayed.



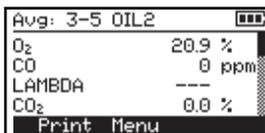
- Select Print Average.



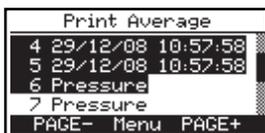
- The saved tests will be displayed, with the first 3 tests highlighted. Select the 3 combustion tests to be averaged from the list by using the ▲▼ buttons.



- Press the **ENT** key. The average test results will be displayed.



All 3 tests that are selected must be combustion tests. If any other kind of test is selected with combustion tests, as in the example below, an error message, “Inconsistent data” will be displayed. An average will not be calculated.



4.14 Printing Test Data

Combustion, pressure, smoke number or temperature data that is currently being displayed can be sent to a printer using IrDA protocol as described below.

Data that is stored in memory can also be printed by first displaying the stored test data as described in Section 4.1.3.

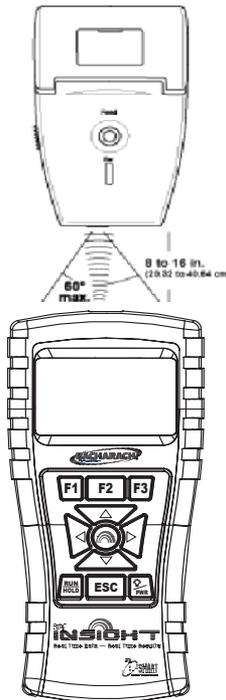
In addition to printing combustion, pressure, and temperature data, the contents of any screen that shows the label “PRINT” above the **F1** button can be printed. For example, the information shown in the DIAGNOSTIC screen can be printed.

1. Power up the printer. Refer to the printer’s instruction manual for detailed operating information. If not previously done, select the following for the printer for:

- 8 bit
- No parity
- 9600 baud
- IrDA is set to IrDA-SIR
- DTR handshaking

2. Align the printer with the top of the analyzer.

3. Press the **PRINT (F1)** button to begin printing.





BACHARACH, INC.
Fyrite Insight
SN: 1234-5678

Time: 10:28:38
Date: 09/01/09

Fuel
NGAS

O ₂	4.0 %
CO	11 ppm
LAMBDA	1.23 %
CO ₂	9.5 %
CO ₂ Max	11.8 %
T-STK	190 °C
T-AIR	22.3 °C
qA	8.0 %
Eta	92.0%
Eff	82.4%
CO/CO ₂	0.0001%
CO(O)	13 ppm
AVG SMOKE	***
OIL DERIVE	***
BOILER TEMP	*** °C

Comments:

Fig. 4.2

4.15 Fyrite[®] User Software

For information on the installation of the Fyrite[®] User Software, refer to the installation document (provided in .PDF format) on the software disk. The Fyrite[®] User Software installation manual may also be downloaded from the Fyrite[®] Insight page of the Bacharach website (www.MyBacharach.com). Refer to manual 0024-9465. Minimum computer requirements for installation and use of the Fyrite[®] User Software are shown below.

Fyrite[®] User Software Minimum Requirements	
Operating System	Windows XP or higher
Drive	CD ROM Drive
Access Port	USB port (USB 1.1, 2.0, or 3.0)
Hard Drive Space	Software: 205 MB for the Fyrite User Software Date: Add 350 KB for each downloaded file

5.0 CALIBRATION & MAINTENANCE

IMPORTANT: *Before performing any calibration procedure, ensure that fresh batteries are installed or use the optional AC power adapter. Also, ensure that the analyzer is at room temperature and will be sampling fresh air when powered ON.*

IMPORTANT: *To maintain accuracy as listed in the Technical Characteristics Section of this manual, the standards used must be at least four times as accurate as the stated accuracy of the Fyrite® INSIGHT.*

5.1 B-Smart™ Sensors

The Fyrite® INSIGHT utilizes Bacharach's new B-Smart™ Sensor technology for its CO sensor. The B-Smart™ sensor is marked with a 10-digit calibration code that can be entered in the instrument's memory via the keypad, or with Fyrite user software.

Benefits of B-Smart™ Sensors:

- New sensors can be installed without applying gas for calibration.
- Sensors can be pre-calibrated and installed when needed.
- Sensors can be moved from one analyzer to another.

The B-Smart™ sensors should be calibrated by an authorized Bacharach Service Center every 6 to 12 months to assure that the analyzer continues to meet its published accuracy specifications. The B-Smart™ sensors, however, can be calibrated in the field if your facility has the necessary equipment and qualified personnel to perform the procedures described in the following sections of this instruction manual.

5.2 Starting a Calibration

Start any calibration by performing the following:

1. With the analyzer power off, place the unit in fresh, ambient air; then power on the analyzer.

2. Allow the analyzer to cycle through its 60 second warm-up period. During warm-up, the analyzer's operation is checked and the sensors are set to the following ambient conditions:

- Oxygen sensor spanned to 20.9%
- CO sensor zeroed
- Pressure sensor zeroed

Any errors detected during warm-up will be listed on the display immediately following warm-up, as displayed below.



Correct any errors before proceeding. Refer to Section 6.7 for a list of error messages and their meanings.

3. Press the **MENU (F2)** button to access the Main Menu.
4. Use the **▲▼** buttons to select Calibration. Press **ENTER** to display the Calibration Password screen.



5. Before calibration can begin a 4-place numeric password must be entered. Use the **▲▼** and **◀▶** buttons to enter the password. (Note that the default password is 1111)
6. Press the **ENTER** button to accept the password. If the correct password was entered, the Calibration Menu will be displayed.



7. Use the **▲▼** buttons to select the desired sensor channel to be calibrated, and then perform the calibration procedure for that sensor as described in the following sections.

5.3 B-Smart™ Sensor Replacement & Calibration

To replace a B-Smart™ sensor and calibrate do the following:

1. Enter the CALIBRATION MENU per Section 5.2.
2. Use the ▲▼ buttons to select B-SMART. Press **ENTER** to display the B-Smart code screen.



3. Use the ▲▼ buttons to enter the 10 digit alphanumeric code supplied with the B-Smart sensor. Use the ◀▶ buttons to move the cursor across the screen. Press **ENTER**.

NOTE: If the correct code was entered, the analyzer accepts it and returns to the CALIBRATION MENU. If an incorrect code was entered, the screen will display “Invalid Code”. Check to make sure the correct code has been entered. If problem persists, contact your nearest Bacharach Service Provider.

Bacharach also offers a convenient Exchange Program that allows the customer to regularly send in old sensors and, as scheduled, receive new replacements that are already calibrated and that include a code that can be entered into the analyzer for a quick, convenient setup. Contact Bacharach customer service for more details about this program.

5.4 Pressure Sensor Calibration

This procedure calibrates the pressure sensor to a known pressure value.

Materials Required:

- Bellows
- Manometer
 - Range: ± 20 mB (± 8 inwc)
 - Accuracy: ± 0.025 mB (± 0.01 inwc)

Procedure:

NOTE: *The unit-of-measure for pressure is selected per Section 3.7.2. In the following procedure mB is selected, but note that any unit-of-measure can be used for calibration purposes.*

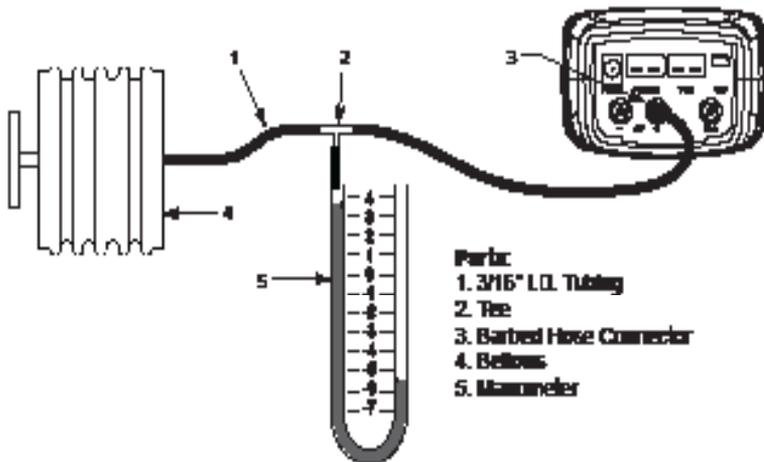
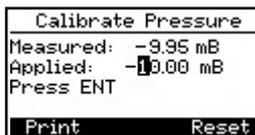


Figure 5-1 Pressure Sensor Calibration Equipment

1. Assemble the pressure sensor calibration equipment as shown in Figure 5.1, but **DO NOT** connect the analyzer to the calibration equipment at this time.
2. If not already done, power on the analyzer and display the Calibration List per Section 5.2.
3. Use the ▲▼ buttons to select Pressure. Press **ENTER** to display the Calibrate Pressure screen.



“Measured” is the pressure value currently detected by the pressure sensor. “Applied” is a known value of pressure that will be applied for calibration purposes.

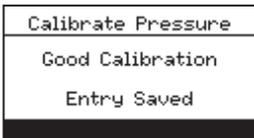
4. With both the $-\Delta P$ and $+\Delta P$ ports open to the atmosphere, observe that the current Measured pressure reading should be 0.00 ± 0.01

mB. If necessary, zero the pressure sensor per Section 4.6 then repeat steps 2 through 4.

5. Connect the hose from the manometer to the $+\Delta P$ port and apply a *negative* pressure to this port by adjusting the bellows for a manometer reading of -10.00 mB.
6. Use the ▲▼ buttons to enter an Applied value that exactly equals the manometer reading.

The calibration range is from -15 to -5 mB (-6 to -2 inwc). An attempt to calibrate outside this range will cause the message “Applied Value High” (or Low) to appear at the bottom of the screen.

7. Wait until the Measured reading stabilizes, and then press **ENTER** to calibrate the pressure sensor’s Measured value to that of the Applied value. The message, “Good Calibration” should briefly appear, followed by the Calibration List screen.



8. Remove calibration equipment.

Resetting the Calibration Pressure Gain

NOTE: This feature resets the calibration to the default value and should be done under the direction of an authorized Bacharach service function. Reset is available in all calibration screens.

5.5 T-Stack Calibration

This procedure first *zeroes* and then *spans* the stack-temperature channel to known temperature values.

The use of an electronic thermocouple simulator is the preferred method of producing the desired calibration temperatures. Alternatively, ice and boiling water baths can be used.

Materials Required:

- Thermocouple simulator (K-type)

- Range: 0 to 300 °C
- Accuracy: ± 0.3 °C
- (Alternatively) ice-water, boiling water, thermometer

TS-Zero Procedure:

1. Set the thermocouple simulator to room temperature and plug its output into the T-STACK connector located at the bottom of the analyzer.

Alternatively: Plug the probe's thermocouple into the T-STACK connector located at the bottom of the analyzer. **DO NOT attach the probe's gas hose to the analyzer's GAS port; otherwise water will be drawn into the analyzer!**

2. If not already done, power up the analyzer and display the CALIBRATION LIST screen per Section 5.2.
3. Use the **▲▼** buttons to highlight T-Stack, and then press **ENTER** to display the CALIBRATE TS-ZERO screen.



“Measured” is the current temperature reading, while “Applied” is a known temperature that will be applied for calibration purposes.

4. Set thermocouple simulator to 0 °C (32 °F), and then use the **▲▼** and **◀▶** buttons to enter an Applied value that exactly equals the setting of the simulator.

Alternatively: Submerge probe tip into an ice-water bath with a thermometer, wait several minutes, and then use the **▲▼** and **◀▶** buttons to enter an Applied value that exactly equals the thermometer reading.

The calibration range is from 0 to 5 °C (32 to 41 °F). An attempt to calibrate outside this range will cause the message “Applied Value High” (or Low) to appear at the bottom of the screen.

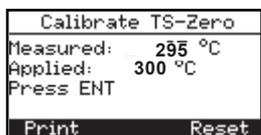
5. Wait until the Measured reading stabilizes, and then press **ENTER** to calibrate the TS-Zero Measured value to that of the Applied

value.

The message “Good Calibration” should briefly appear, followed by the Calibrate TS-Span screen.

TS-Span Procedure:

6. Set thermocouple simulator to 300 °C (572 °F), and then use the ▲▼ and ◀▶ buttons to enter an Applied value that exactly equals the setting of the simulator.



Alternatively: Submerge probe tip into a container of boiling water with a thermometer, wait several minutes, and then use the ▲▼ and ◀▶ buttons to enter an Applied value that exactly equals the thermometer reading.

The calibration range is from 80 to 330 °C (175 to 625 °F). An attempt to calibrate outside this range will cause the message “Applied Value High” (or Low) to appear at the bottom of the screen.

7. Wait until the Measured reading stabilizes, and then press **ENTER** to calibrate the TS-Span Measured value to that of the Applied value. The message “Good Calibration” should briefly appear, followed by the re-display of the Calibration List screen.

5.6 T-Air Calibration

This procedure first *zeros* and then *spans* the ambient-temperature channel to known temperature values.

The use of an electronic thermocouple simulator is the preferred method of producing the desired calibration temperatures. Alternatively, ice and boil-

ing water baths can be used.

Material Required:

- Thermocouple simulator (K-type)
 - Range: 0 to 300 °C
 - Accuracy: ± 0.3 °C
- (Alternatively) Ice-water, boiling water, thermometer

TA-Zero Procedure:

1. Set thermocouple simulator to room temperature and plug its output into the T-AIR connector located at the bottom of the analyzer.

Alternatively: Plug the probe's thermocouple into the T-AIR connector located at the bottom of the analyzer. **DO NOT attach the probe's gas hose to the analyzer's GAS port; otherwise water will be drawn into the analyzer!**

2. If not already done, power up the analyzer and display the CALIBRATION LIST screen per Section 5.2.
3. Use the \blacktriangle / \blacktriangledown buttons to highlight T-Air, and then press **ENTER** to display the Calibrate TA-Zero screen.



“Measured” is the current temperature reading, while “Applied” is a known temperature that will be applied for calibration purposes.

4. Set thermocouple simulator to 0 °C (32 °F), and then use the \blacktriangle / \blacktriangledown and \blacktriangleleft / \blacktriangleright buttons to enter an Applied value that exactly equals the setting of the simulator.

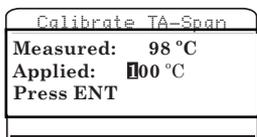
Alternatively: Submerge probe tip into an ice-water bath with a thermometer, wait several minutes, and then use the \blacktriangle / \blacktriangledown and \blacktriangleleft / \blacktriangleright buttons to enter an Applied value that exactly equals the thermometer reading.

The calibration range is from 0 to 5 °C (32 to 41 °F). An attempt to calibrate outside this range will cause the message “Applied Value High” (or Low) to appear at the bottom of the screen.

- Wait until the Measured reading stabilizes, and then press **ENTER** to calibrate the TA-Zero Measured value to that of the Applied value. The message “Good Calibration” should briefly appear, followed by the Calibrate TA-Span screen.

TA-Span Procedure:

- Set thermocouple simulator to 100 °C (212 °F), and then use the ▲ ▼ and ◀▶ buttons to enter an Applied value that exactly equals the setting of the simulator.



Alternatively: Submerge probe tip into a container of boiling water with a thermometer, wait several minutes, and then use the ▲▼ and ◀▶ buttons to enter an Applied value that exactly equals the thermometer reading.

The calibration range is from 90 to 110 °C (194 to 230 °F). An attempt to calibrate outside this range will cause the message “Bad Calibration Wrong CAL Entry” to appear in the following step.

- Wait until the Measured reading stabilizes, and then press **ENTER** to calibrate the TA-Span Measured value to that of the Applied value. The message “Good Calibration” should briefly appear, followed by the re-display of the Calibration List screen.

5.7 CO Sensor Calibration

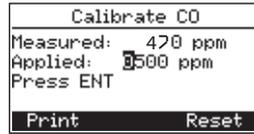
Material required:

- Calibration kit, P/N 0024-7059
- Gas cylinder: 500 ppm CO in air, P/N 0024-0492

To improve the accuracy of the CO reading, we suggest that if the analyzer will be primarily used for flue gas testing, then calibrate using 500 ppm CO. If the analyzer, however, will be primarily used for ambient testing, then calibrate using 100 ppm CO.

Procedure:

1. If not already done, power up the analyzer and display the Calibration List screen per Section 5.2.
2. Use the ▲▼ buttons to highlight CO, and then press **ENTER** to display the Calibrate CO screen.



“Measured” is the current CO reading, while “Applied” is a known CO level that will be applied for calibration purposes.

3. Attach a 500 ppm CO cylinder to the regulator of the calibration fixture.
4. Use the ▲▼ and ◀▶ buttons to enter an Applied value that exactly equals the concentration stamped on the CO cylinder.

The calibration range is from 20 to 1,000 ppm. An attempt to

Fyrite® INSIGHT Components

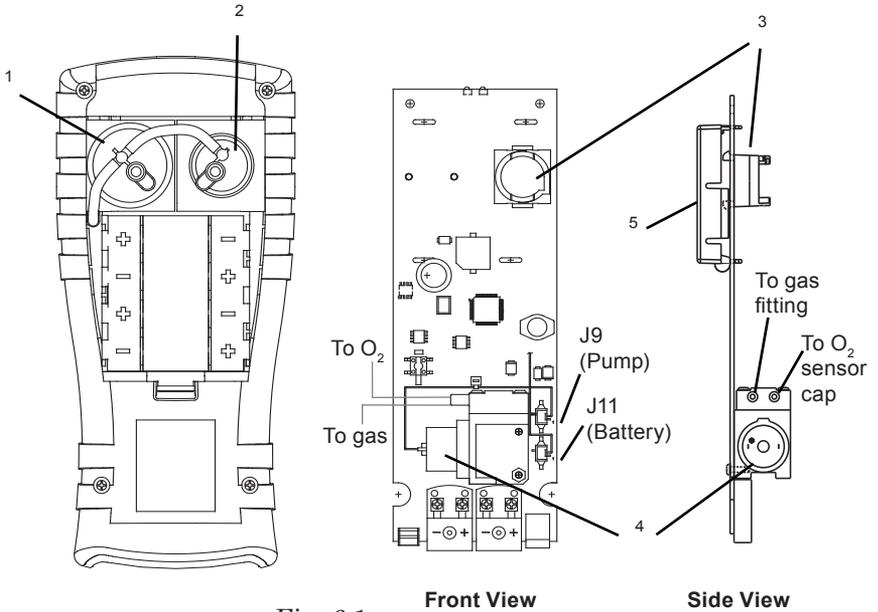
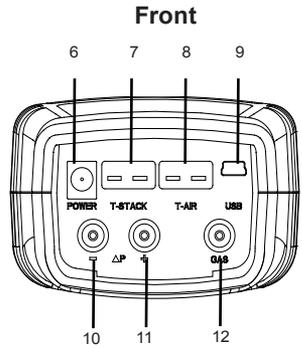


Fig. 6.1

- | | |
|-------------------|----------------|
| 1. O2 Sensor | 4. Sample Pump |
| 2. CO Sensor | 5. LCD Screen |
| 3. CO Sensor Base | |

Fyrite® INSIGHT End Plate Connectors

- | |
|--|
| 6. AC Power Adapter Jack (Power) |
| 7. Sample Gas Thermocouple Connector (T-Stack) |
| 8. Primary Air Thermocouple (T-Air) |
| 9. USB Connector |
| 10. Differential Pressure Hose (Optional) |
| 11. Draft Hose |
| 12. Sample Gas Hose |



Back

Fig. 6.2

calibrate outside this range will cause the message “Applied Value High” (or Low) to appear at the bottom of the screen.

5. Wait until the Measured reading stabilizes and then press **ENTER** to calibrate the CO Measured value to that of the Applied value. The message “Good Calibration” should briefly appear.

*If the sensor’s output is low, but still usable, the message “Good Calibration WARNING Low Sensor” will appear. The sensor will now be marked as **Low** in the Diagnostics screen.*

*If the sensor’s output is too low to be used, the message “Bad Calibration Sensor End of Life, Entry Not Saved” will appear. The sensor will now be marked as **BAD** in the Diagnostics screen.*

6. Turn off the gas and remove the CO cylinder.

6.0 MAINTENANCE

6.1 Fyrite® INSIGHT Disassembly

The following section describes how to disassemble the Fyrite INSIGHT to perform necessary periodic maintenance. (See Figure 6.1 for diagram.)

Tools Required:

- Medium Phillips screwdriver

Procedure:

1. Unplug all thermocouples from bottom of analyzer.
2. Remove battery cover and then remove batteries.
3. Remove sensor caps, disconnect tubing, and then unplug all sensors.
4. Place the analyzer face down on a padded work surface. Remove the unit’s four rear-case screws with a medium Phillips screwdriver,.
5. Lift rear case from analyzer and set aside.
6. Unplug electrical connector J11 from printed circuit board.

7. Lift printed circuit board from analyzer.

6.2 Water Trap / Filter

6.2.1 Emptying the Water Trap Chamber

The water trap chamber should be emptied after every test, or when the water condensate approaches the tip of the riser tube.

1. Remove water trap chamber per Figure 6.3.
2. Pour out liquid condensate, and then reassemble trap.

6.2.2 Replacing the Filter Element

Replace the filter element when it becomes visibly dirty or becomes saturated with water.

Material Required:

- Filter element, P/N 0007-1644
- Small flat blade screwdriver

1. Remove water trap chamber per Figure 6.3.
2. Pry apart filter chamber using a small flat-blade screwdriver. Remove and discard old filter.
3. Install new filter and reassemble filter chamber, making sure that surfaces “A” and “B” contact each other.
4. Reassemble trap.

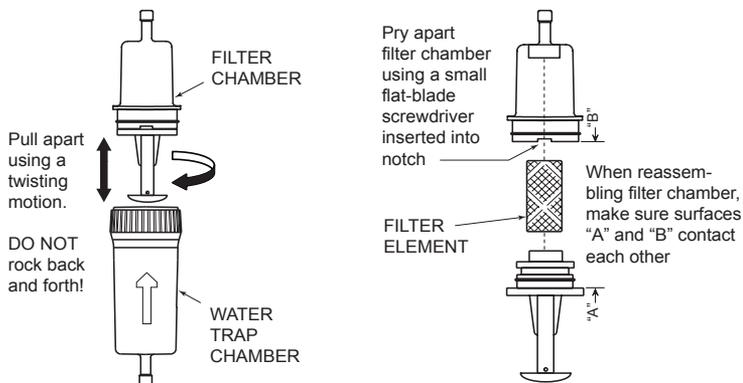


Fig. 6.3

6.3 O₂ & CO Sensor Replacement

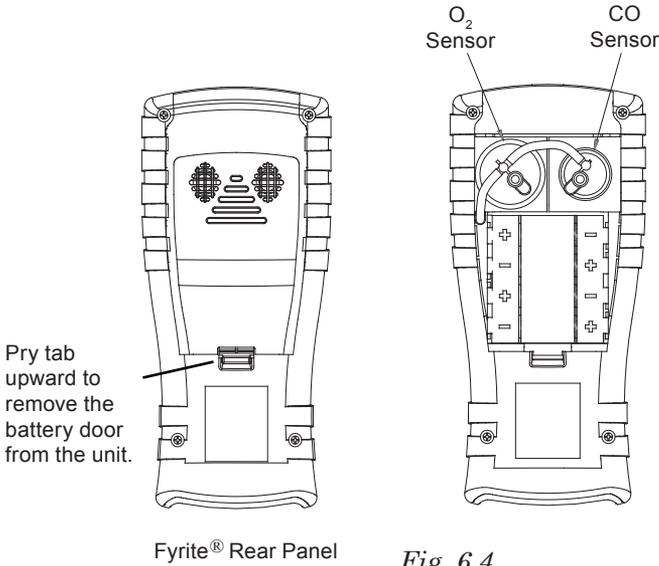


Fig. 6.4

6.3.1 O₂ Sensor

Note: *The O₂ sensor life is approximately 2 years and the CO sensor life is greater than 3 years.*

Material Required:

- O₂ Sensor (P/N 0024-0788)

Procedure:

1. After battery door is removed, remove connector tubing from both sensors.
2. Pull O₂ sensor from its socket and remove the O₂ cap.
3. Properly dispose of the old sensor. Engage the bayonet on the new sensor within the slot on the cap's side and twist to secure the cap and sensor together.

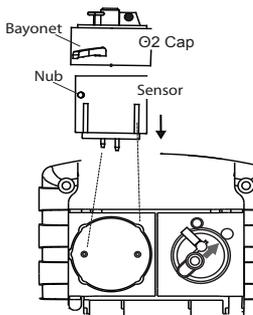


Fig. 6.5

4. Install the cap and sensor unit by
 - Aligning the ribs on the sides of the sensor with the corresponding shape in the base.
 - Inserting the pins into the connectors in the base.
5. Reattach tubing.

6.3.2 CO Sensor

Material Required:

- CO Sensor (P/N 0024-7265) or B-Smart sensor (P/N 0024-1467)

Procedure:

1. After battery door is removed, remove the connector tubing from the CO sensor.
2. Remove CO cap by twisting counter clockwise. Gently pull CO sensor out of its socket.

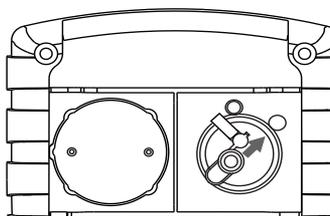
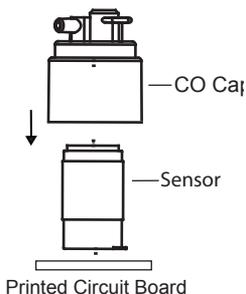


Fig. 6.6

3. Properly dispose of the old CO sensor.
4. Plug the new CO sensor into its socket.
5. Install the CO cap by aligning the arrow on the cap with the “OPEN” marker, then twisting to the “CLOSED” marker. Reattach tubing.

6.4 Thermocouple Replacement

Replace the probe's thermocouple as follows:

Replacement kit contains a thermocouple assembly, two O-rings, and two wire-splice connectors.

Tools Required:

- Small flat blade screwdriver
- Wire cutter
- Wire stripper
- Slip joint pliers

Procedure:

1. Gain access to the thermocouple connections by first removing three screws from probe handle, and then separating the two handle pieces.
2. Cut wires attached to old crimp connectors, leaving behind as much of the probe's thermocouple-connector wire as possible

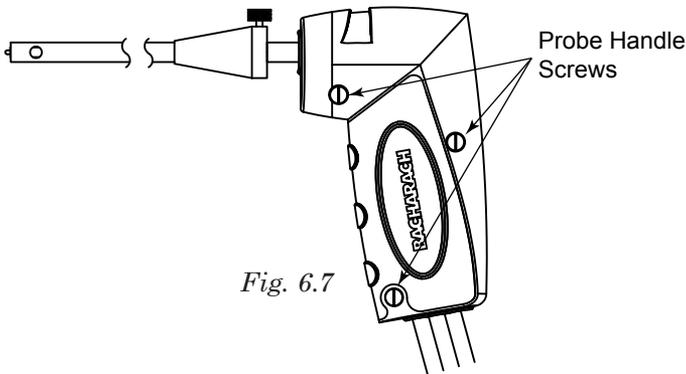


Fig. 6.7

3. Pull old thermocouple from probe body and discard.

4. The new thermocouple has been coiled for shipping purposes. Straighten the thermocouple using your thumb and index finger.
5. If not already done, install supplied O-Rings onto thermocouple.
6. Insert thermocouple into probe body until it “bottoms out.”
7. Strip $\frac{1}{4}$ inch of insulation from each of the probe’s thermocouple connector wires.

IMPORTANT: *In Step 8, the thermocouple wires must first be twisted together and then crimped.*

8. **Twist** both red thermocouple wires together; insert them into the supplied wire-splice connector; and then crimp the connector using a pair of pliers. Repeat this step for the yellow thermocouple wires.
9. Reassemble the probe handle, being careful not to pinch the thermocouple wires between the handle pieces. In addition, ensure that the end of the thermocouple is in front of the rib molded into the bottom handle piece; otherwise, the handle pieces will not fit tightly together.

6.5 Gas Pump Replacement

Ordering Replacement Parts:

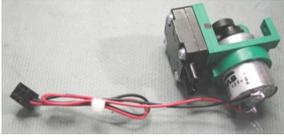
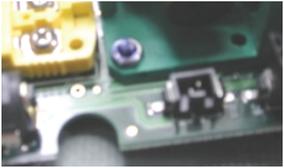
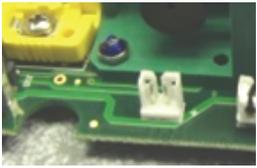
Two replacement pumps are available based on the revision of the printed circuit board (PCB) inside your Insight. Proper PCB version identification ensures that you order and receive the correct replacement pump. Use the serial number of your analyzer to determine which PCB revision it has.

1. Locate the serial number on the back of your Insight analyzer.
2. Compare your serial number with transition serial number RU1025. If your serial number is RU1025 or newer, you have a Revision 1 PCB. If your serial number is older than RU1025, you have a Revision 0 PCB.

NOTE: Bacharach serial numbers contain a mix of alphabetic and numeric characters. The first two most significant positions are represented by sequential characters A-Z (where “A” is earlier than “Z”). The last four least significant positions are each represented by digits 0-9 (where “0” is earlier than “9”). For example, serial number AZ9999 is older (i.e., was assigned earlier) than serial number ZA0000.

NOTE: During certain Insight repairs (for example, the replacement

of a battery wiring harness), service personnel may also need to replace the pump wiring harness. This is performed only by Bacharach service personnel. In such cases, wiring harness part numbers are listed in the following table for service personnel reference. For standard pump replacement orders, however, customers must use the combination pump/harness part number. Refer to the table below.

Item	PCB Rev 0	PCB Rev 1
Serial # (Back of Instrument)	< RU1025 (= Rev 0)	≥ RU1025 (= Rev 1)
PCB Label (To Confirm Rev #)	0024-1450 0 xxxxxxxx	0024-1450 1 xxxxxxxx
Pump/Harness Part Number	Order P/N: 0024-3049 	Order P/N: 0024-3073 
Connector Style on Pump Wiring Harness (Colors May Vary)		
PCB Header Style		
Wiring Harness Only (Reference P/N for Service Personnel Only)	 P/N: 0024-1410	 P/N: 0024-1521

Parts & Tools Required:

- Replacement pump (P/N 0024-3049 or P/N 0024-3073)
- Medium phillips screwdriver

Procedure:

1. Gain access to the gas pump by removing the rear case. Refer to Section 6.1.
2. Disconnect J9 (pump) and J11 (Battery) connectors.
3. Lift the circuit board out of the unit.
4. Remove the screw that secures the pump to the board in order to separate the pump from the board.
5. Remove tubing from pump.
6. Install new pump by reversing this procedure.

6.6 Cleaning the Probe

The probe tube and gas-sample hose will become dirty under normal use. Note that the water trap's filter element should prevent soot from reaching the analyzer's internal components. If the probe is not kept clean, it could become clogged and restrict the flow of gas into the analyzer, resulting in incorrect combustion test readings and calculations.

NOTE: *An analyzer that is used to test natural gas furnaces normally requires less frequent cleaning than an analyzer used for testing coal or oil fired furnaces.*

Equipment Required:

- Alcohol
- Aerosol can of automotive carburetor cleaner
- Clean rag
- Source of compressed air (optional)

Procedure:

1. Remove gas-sample hose from top of water trap.



CAUTION: *Carburetor cleaner attacks plastic components! Take precautions not to spray cleaner onto the probe handle or analyzer.*

2. Insert the plastic-spray tube of the carburetor cleaner into the gas-sample hose, and then liberally spray carburetor cleaner through the hose and out the probe tube.
3. After spraying, remove all the residual cleaner by repeatedly flush-

ing the gas hose and probe tube with alcohol.

4. Wipe off the surfaces of the probe and tubing with a clean rag.
5. Allow the parts to dry completely. If available, blow compressed air through the probe to expedite the drying process.
6. Reconnect gas-sample hose to top of water trap.

6.7 Error Messages

Bad Sensor - O₂ sensor is too low and can not be calibrated in the instrument and needs replaced.

Low Battery - Battery voltage is low. Replace the batteries.

Low Sensor- O₂ or CO sensor outputs were low but still usable. Sensor(s) may need to be replaced in the near future. Message will indicate which sensor(s) were in warning.

O₂ Sensor Missing - The O₂ sensor is not installed.

T-STK Disconnected - The probe thermocouple is not connected to the analyzer's T-Stack connector. Plug the probe thermocouple plug into the T-Stack connector at the bottom of the instrument.

Warmup Sensor Error -

- CO sensor was not zeroed at warmup because of high output. Run instrument on fresh air then restart instrument to re-zero sensor. If message persists, CO sensor may need to be replaced.
- Stack or Air temperature channel is measuring temperature outside the range of -20 to 100 °C at startup. Make sure that the Stack and Air thermocouples are sampling ambient room air within the temperature range at startup.
- Pressure sensor is measuring pressure outside the range of ± 7.5 mB at startup. Ensure that the analyzer is sampling atmospheric pressure and restart the instrument.
- The analyzer was turned on with the probe sampling flue gas. Move the probe to fresh air and restart the instrument.

- Message will indicate which channel is in error.

XXXX - Occurs in the number fields of sensors that have achieved over-range condition.

******** - Occurs in the number fields of sensors and the calculated values that depend on the sensors that were in error coming out or warmup.

--- - Occurs in the number fields of calculated values when Oxygen is above 18.8%.

6.8 Diagnostics Screen

The DIAGNOSTICS menu provides information regarding the operation of the analyzer. Information includes the following:

Time Meters - Displays the run time of the analyzer and sample pump in hours of operation.

Main Diagnostics - Lists the current status of the Stack and Air Thermo-

couple channels, Reference Temperature channel, Pressure channel, CO channel, O₂ channel and Battery.

O2 Sensor Life - Displays the approximate remaining life of the Oxygen sensor.

Fresh Air Diagnostics - Fresh air diagnostics will cycle the instrument through the 60 second warm-up to check on the status of the sensors. The probe must be in fresh air to perform a valid check.

Access the Diagnostic menu as follows:

1. Display the Main Menu by pressing the **MENU (F2)** button. If necessary, press **ESC** until Menu appears above **F2**.
2. Use the **▲▼** buttons to highlight Diagnostics and then press **ENT** to display the Diagnostic Menu.
3. Use the **▲▼** buttons to highlight the desired diagnostic topic and then press **ENT** to display the information under that topic.
4. Press the **ESC** key to exit back to the Diagnostic Menu or the **MENU (F2)** key to exit back to the Main Menu.

6.9 Status Screen

The Status Screen provides a quick reference to key items when troubleshooting:

- Version
- Built
- ADC Version
- Boot Version
- Model
- SN

Access the Status menu as follows:

1. Display the Main Menu by pressing the **MENU (F2)** button.
2. Use the **▲▼** buttons to highlight Status and then press **ENT** to display the Device Status screen.
3. Press the **ESC** key to exit back to the Main Menu.

7.0 PARTS & SERVICE

7.1 Replacement Parts

Description	Part Number
Battery / Sensor Cover	0024-1453
B-Smart CO Sensor	0024-1467
Carry Case	0024-0865
Connector Plate Assembly	0024-1483
CO Sensor	0024-7265
CO Sensor Cover Assembly	0024-1484
Draft Connector	0024-0878
Filter (pkg of 3), Water Trap	0007-1644
Gas Connector	0024-0877
O-Ring Kit (2 sets)	0024-1471
O2 Sensor	0024-0788
O2 Sensor Cover	0024-1421
PC Software	0024-1470
Probe & Hose Assembly	0024-3053
Probe Stop	0019-3037
Replacement Pump	0024-3049 or 0024-3073 (see Section 6.5)
Thermocouple Replacement (30.48 cm)	0024-8390
USB cable	0104-4032
Water Trap	0019-3265
NO _x Filter	0024-1505

7.2 Accessories

Description	Part Number
AC Adapter	0024-1254
Boot	0024-1461
Calibration Gas, 100 ppm CO	0051-1994
Calibration Gas, 500 ppm CO	0024-0492

Calibration Kit	0024-7059
Differential Pressure & Temperature Kit	0024-8242
IrDA Printer	0024-1400
Printer Paper (pkg of 1)	0006-8733
Printer Paper (pkg of 5)	0024-1310
Smoke Kit	0021-7006
Thermocouple, 2.5 cm	0104-1798
Thermocouple, 3.0 m	0104-1797

7.3 Service Centers

Replacement parts and service can be obtained by contacting one of the following Bacharach Service Centers:

United States

621 Hunt Valley Circle
 New Kensington, PA 15068
 Phone: 724-334-5051
 Fax: 724-334-5723
 Email: help@MyBacharach.com

Canada

Bacharach of Canada, Inc.
 20 Amber St. Unit #7
 Markham, Ontario L3R 5P4
 Canada
 Phone: 905-470-8985
 Fax: 905-470-8963
 Email: bachcan@idirect.com

8.0 DECLARATION OF CONFORMITY



DECLARATION OF CONFORMITY

The manufacturer of the products covered by this declaration:	Bacharach, Inc. 621 Hunt Valley Circle New Kensington, PA 15068
Year conformity is declared:	2010
Product(s):	Combustion Analyzer
Model(s):	Fyrite [®] INSIGHT (Siebert)

The undersigned hereby declares that the above referenced products are in conformity with the provisions of the following standard(s) and is in accordance with the following directive(s).

Standard(s):

EN 50379-1 Part 1	General Requirements and Test Methods	Specifications for Portable Electrical Apparatus Designed to Measure Combustion Flue Gas Parameters of Heating Appliances
EN 50379-3 Part 3	Performance Requirements	Performance Requirements for Apparatus Used in Non-Statutory Servicing of Gas-Fired Heating Appliances
EN 50270:2006	Electromagnetic Compatibility	Electrical Apparatus for the Detection and Measurement of Combustible Gases, Toxic Gases, or Oxygen

Directive(s):

2004/108/EC	EMC Directive
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Signature: 

Name: Doug Keeperts
Title: VP of Product Development
Date: 18 October 2010

The technical documentation file required by this directive is maintained at the corporate headquarters of Bacharach, Inc.

Appendix A- Formulas & Tables

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

$$qA = (TA - TL) \times \left(\frac{A2}{20.9 - O_2} + B \right)$$

$$\lambda \text{ (Excess Air)} = \frac{20.9}{20.9 - O_2}$$

$$\text{Eta} = (100\% - qA) + [K_f, \text{ if } TA < (T_0 - 1.2 \times O_2)]$$

$$\text{Efficiency} = \text{Eta} - K_f$$

$$\text{CO Air Free (Undilute)} = \text{CO} \times \lambda$$

$$CO/CO_2 = \frac{CO_{\text{ppm}} \times 10^{-6}}{CO_2\% \times 10^{-2}}$$

Where:

- O_2 = Measured Oxygen in percent
- TA = Measured stack temperature in $^{\circ}C$
- TL = Measured combustion air temperature in $^{\circ}C$
- CO = Measured carbon monoxide level in ppm
- CO_2 = Calculated carbon dioxide level in percent
- qA = Calculated stack loss in percent
- λ = Calculated LAMBDA

$A2$, B , $CO_2 \text{ max}$, T_0 , and K_f are constants (see table below):

Fuel	A2	B	CO ₂ Max	T ₀	K _f
Natural Gas	0.66	0.009	11.8	58 °C	9.6%
Propane	0.63	0.008	13.8	54 °C	7.6%
Oil #2	0.68	0.007	15.4	51 °C	5.3%
LEG	0.63	0.011	13.1	61 °C	10.3%



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