

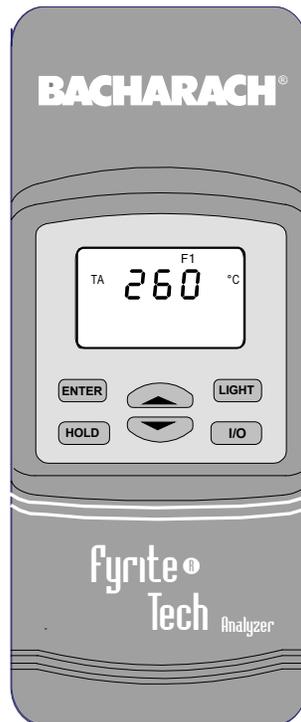


Fyrite® Tech Model 50 & 60

Combustion Gas Analyzer

Instruction 24-9435
Operation & Maintenance
Rev. 1 – August 2009

CE



Product Leadership • Training • Service • Reliability

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Ordering Information

Model No. Part No.	Fyrite Tech 50 24-7233P	Fyrite Tech 60 24-7234P
Measurements:		
Oxygen	X	X
Stack Temperature	X	X
Ambient Temperature	X	X
Carbon Monoxide		X
Calculations:		
Stack Loss (qA)	X	X
Efficiency & ETa	X	X
Excess Air (Lambda)	X	X
Carbon Dioxide	X	X
CO air free		X
Ratio of CO/CO ₂		X
Accessories:		
4 'AA' Batteries	X	X
Instruction Manual	X	X
Probe & Hose Assembly	X	X
Quick Reference Guide	X	X

Notes:

1.0 INTRODUCTION

1.1 The Fyrite Tech

Available in two models, the Fyrite Tech 50 and 60 are hand-held analyzers that are designed to calculate the efficiency of residential furnaces and combustion appliances by measuring the stack temperature and the percent oxygen level in the flue-gas stream.

While both analyzers are capable of combustion testing, the Fyrite Tech 60 has the added capability of measuring CO, calculating CO air-free, and calculating the ratio of CO/CO₂.

Fyrite Tech 50	Fyrite Tech 60
Measures: <ul style="list-style-type: none">• Oxygen (O₂)• Stack Temperature (TA)• Ambient Temperature (TL)	Measures: <ul style="list-style-type: none">• Oxygen (O₂)• Stack temperature (TA)• Ambient Temperature (TL)• Carbon Monoxide (CO)
Calculates: <ul style="list-style-type: none">• Stack Loss (qA)• Efficiency & ETa• Carbon Dioxide (CO₂)• Excess Air (Lambda)	Calculates: <ul style="list-style-type: none">• Stack Loss (qA)• Efficiency & ETa• Carbon Dioxide (CO₂)• Excess Air (Lambda)• CO air-free• Ratio of CO/CO₂



WARNINGS!

This analyzer is not intended to be used on a continuous basis.

The analyzer does not have an audible alarm, and is not intended to be used as a safety device.

Except for 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.

1.2 Operation Overview

Pressing the **I/O** button turns the analyzer ON and OFF. Note that there is a 60 second warm-up period and a 5 second delay before the analyzer turns OFF, during which time the unit can be kept ON by pressing the **ENTER** button.

After warm-up is complete, choose the fuel code that corresponds to the fuel being burned by the appliance being tested; then press the **ENTER** button to place the analyzer into its Run Mode and begin the combustion testing process.

Begin testing by inserting the analyzer's probe tube into the flue-gas stream of the appliance under test. Each analyzer model will continuously 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.

Pressing the **HOLD** button during a test will freeze all measured and calculated combustion parameters at their current values. Pressing the **ENTER** button resumes testing.

A backlight enables an operator to read the display in dimly-lit areas. Pressing the **LIGHT** button turns the backlight ON and OFF. The backlight will automatically turn OFF after 10 minutes of keyboard inactivity.

A power saver function will shut the analyzer OFF after 20 minutes of keyboard inactivity. The power saver function, however, is disabled if the detected O₂ value is less than 17.9% or the CO value is more than 50 ppm.

2.0 TECHNICAL CHARACTERISTICS

The Analyzer Directly Measures and Displays:

- Flue Gas O₂ content 0.0 to 20.9% O₂
- Stack Temperature..... -18 to 537 °C (0 to 999 °F)
- Ambient Temperature..... 0 to 40 °C (32 to 104 °F)
- Flue Gas CO content (Model 60) 0 to 2000 ppm CO

The Analyzer Computes and Displays:

(when the measured oxygen level is below 17.9 %)

- ETa 0 to 99%
- Stack Loss (qA)..... 0.0 to 100.0%
- Efficiency (EFF) 0.1 to 99.9%
- Flue Gas CO₂ content..... 0.0 to a fuel dependent
maximum value in %
- Excess Air (Lambda)..... 0 to 9.55
- Flue Gas CO air-free content (Model 60) 0 to 9999 ppm
- Ratio of CO/CO₂..... 0 to 0.9999

Fuel Selection:

(F1 thru F4 denotes the fuel selected as displayed on the LCD)

- Natural Gas (F1)
- LPG (F2)
- Light Oil (F3)
- City Gas (F4)

Normal Operating Conditions:

Temperature:

- Analyzer 0 to 40 °C (32 to 104 °F)
- Probe..... 538 °C max. (1,000 °F) at
127 mm insertion

Humidity..... 15 to 90% RH,
Non-Condensing

Power Requirements	Four 'AA' Alkaline batteries
Operating Time	24 hours continuous (pump running and backlight off)
Warm Up Time	60 seconds
Display	4 Digit, 2 Line, 7-segment Liquid Crystal Display
Front Panel Controls	Six pushbutton switches (Refer to Section 3.4)

Accuracy:

- Oxygen..... $\pm 0.3\%$ O₂ w/typical flue gas concentration of CO₂
- Carbon Monoxide (Model 60) $\pm 5\%$ of reading or ± 10 ppm, whichever is greater*
- Stack 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)

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* *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 Scope

Before using the analyzer. . .

- Check batteries (Section 3.2)
- Connect probe to analyzer (Section 3.3)
- Check setup (Section 3.5)

3.2 Checking & Replacing the 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 lower 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 as shown in Figure 3-1.
4. Replace battery cover.

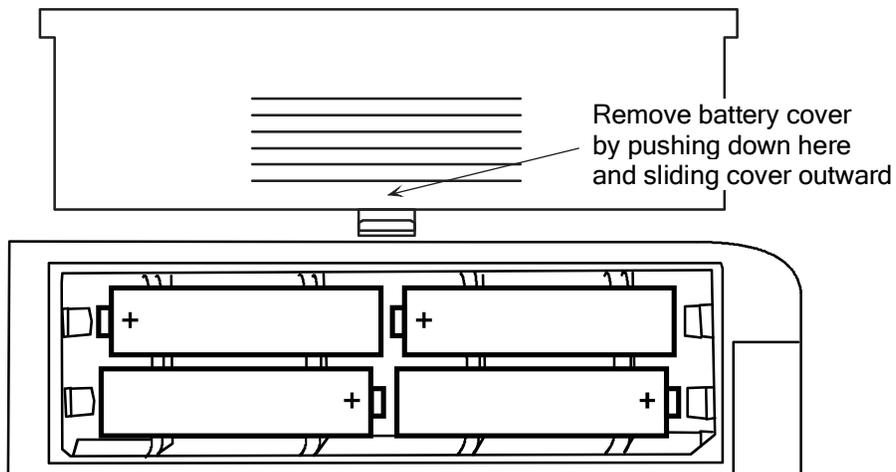


Figure 3-1. Battery Installation

3.3 Connecting the Probe

Connect the probe assembly's flue-gas hose and thermocouple connector to the analyzer as follows (see Figure 3-2):

1. Push the flue gas hose onto the analyzer's GAS inlet fitting.
2. Push the flue gas thermocouple into the T-STACK jack

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

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 5.7.

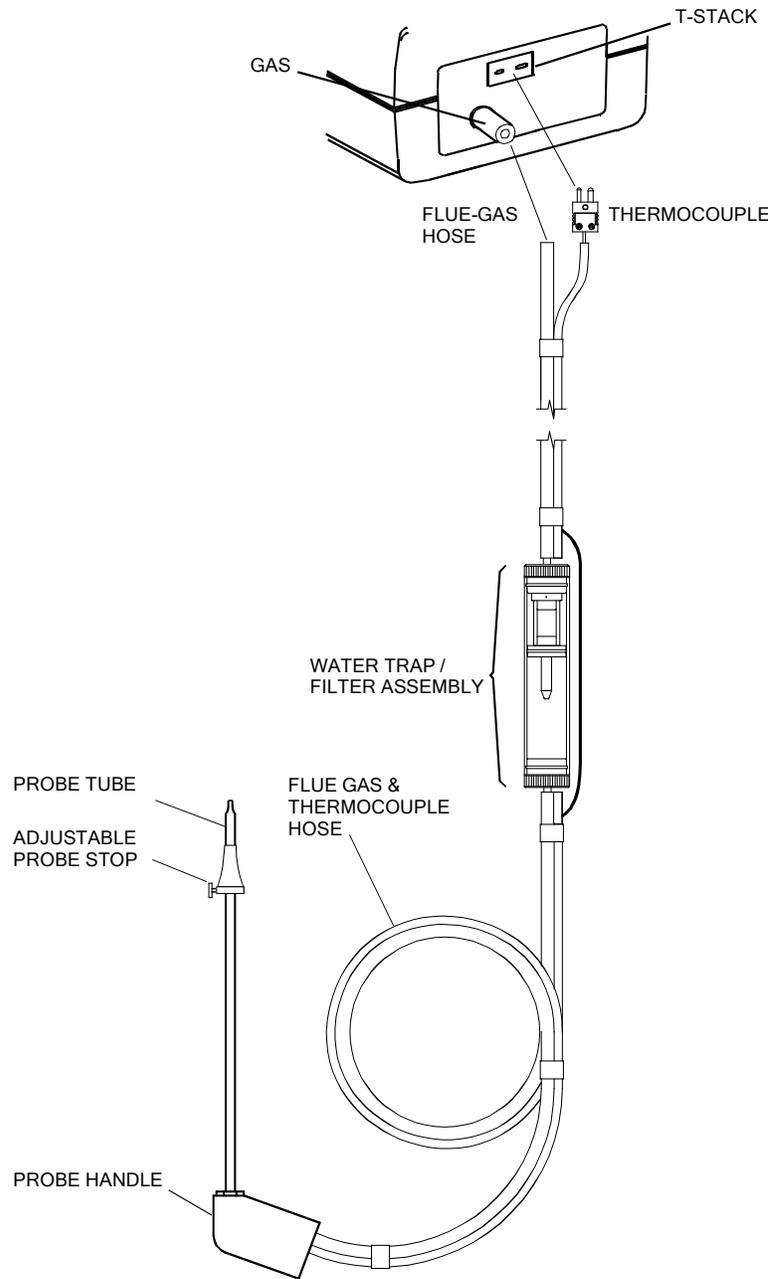


Figure 3-2. Connecting the Probe

3.4 Front Panel Pushbuttons

Note that a pushbutton may perform several functions, depending on what screen is being displayed at the time.

- I/O**
 - Turns analyzer ON/OFF. There is a 60 second warm-up and a 5 second turn-off-delay period.
 - Places the analyzer into either its Setup or Calibration Mode when used in conjunction with the **ENTER** or **HOLD** button.

- ▲**
 - Scrolls up through the display screens during a test.
 - Causes the displayed value to increase or change while in the Calibration or Setup Mode.

- ▼**
 - Scrolls down through the display screens during a test.
 - Causes the displayed value to decrease or change while in the Calibration or Setup Mode.

- ENTER**
 - Enters the Run Mode (starts a combustion test) from the Fuel Select Screen.
 - Displays the Fuel Select Screen when held down for 2 seconds while in the Run Mode.
 - Stores the displayed value and automatically steps to the next screen when pressed during calibration or setup.
 - Sets up the analyzer to be placed into its Calibration Mode when held down with the analyzer OFF. (Used in conjunction with the **I/O** button.)
 - Places the unit into its Run Mode when held down for 2 seconds while in the Calibration Mode.
 - Aborts turn-off and keeps the analyzer turned ON when pressed during the 5 second turn-off-delay period.

- HOLD**
 - Freezes the display during a test, allowing the operator to scroll through the displays and view all test values at that point in time.
 - Sets up the analyzer to be placed into its Setup Mode when held down with the analyzer OFF. (Used in conjunction with the **I/O** button.)

- LIGHT** Toggles the backlight ON and OFF.

3.5 Setup Mode

The analyzer is preset at the factory for the parameters shown below, but can be changed as described in their associated sections.

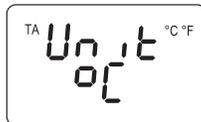
Function	Parameter	To Change
Fuel	Natural Gas (F1)	Section 4.3
Temperature Unit	°C	Section 3.5.2
CO Channel	Auto Zero (A2)	Section 3.5.3

3.5.1 Entering Setup

1. With the analyzer turned OFF, press and hold down the **HOLD** button.
2. Press the **I/O** button.
3. Release both buttons.
4. The analyzer is now in its Setup Mode. Refer to Sections 3.5.2 thru 3.5.4.

3.5.2 Selecting Temperature Units

The Temperature Setup Screen is labeled “Unit.”



1. Enter the Setup Mode per Section 3.5.1. If necessary, repeatedly press the **ENTER** button until “Unit” is displayed.
2. Press the **▲** or **▼** button until the desired temperature unit (°F or °C) is displayed.
3. Press **ENTER** to move to the next Setup Screen, or press **I/O** to exit setup.

3.5.3 CO Channel Setup (Model 60 only)

The CO Channel Setup Screen is labeled “CO.”



1. Enter the Setup Mode per Section 3.5.1. If necessary, repeatedly press the **ENTER** button until “CO” is displayed.
2. Press the ▲ or ▼ button until the desired parameter is displayed.
 - no Sensor disabled. Use this function to turn off the CO channel if the sensor is bad or missing to avoid the CO sensor error message from appearing.
 - 2Ero 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.
 - A2 Auto Zero. With the CO channel 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.
3. Press **ENTER** to move to the next Setup Screen, or press **I/O** to exit setup.

3.5.4 Exiting the Setup Mode

Press the **I/O** button at any time to exit the Setup Mode and turn OFF the analyzer. Note that the last displayed parameter is automatically saved in memory.

4.0 OPERATION

4.1 Starting a Combustion Test

4.1.1 Analyzer Turn On and Warm Up

Important: *The probe must be at room temperature before performing the following steps.*

1. Make sure that the analyzer is properly set up per Section 3.0.
2. During warm-up, the analyzer's probe must be located in the area containing the burner's combustion-air supply. If the burner is using room air, simply place the probe within the room. In the case of a high-efficiency furnace where combustion air is drawn in from an outside source, place the probe within that area with the burner operating. After the probe is properly positioned, turn ON the analyzer by pressing its **I/O** button.
3. Wait for the analyzer to complete its 60 second warm-up period; after which, the Fuel Screen is displayed. Note that if errors were detected during warm-up, the Sensor Error Screen will be displayed. If this occurs, refer to Section 4.11 to correct the cause of the error.

4.1.2 Selecting a Fuel

1. With Fuel Screen displayed (refer to Section 4.3), use the **▲** or **▼** button to step through the fuels codes until the proper fuel is selected. The analyzer defaults to the most recently selected fuel.

F1 = Natural Gas
F2 = LPG

F3 = Light Oil
F4 = City Gas

2. Press the **ENTER** button to select the displayed fuel code and enter the Run Mode.

4.1.3 Manual Zero of the CO Channel (Model 60 only)

If the CO channel is set up for manual calibration (refer to Section 3.5.3), and if the CO Screen shows a value other than zero in fresh air, then before proceeding with a test manually zero the CO channel per Section 5.5.

4.1.4 Sampling Point

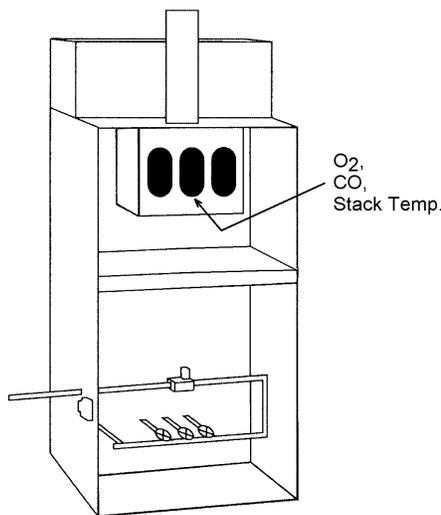
Forced Air Furnace – When testing atmospheric burner or gravity vented, forced air heating equipment with a clamshell or sectional heat exchanger design, test each of the exhaust ports at the top of the heat exchanger. The probe should be inserted back into each of the exhaust ports to obtain a flue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

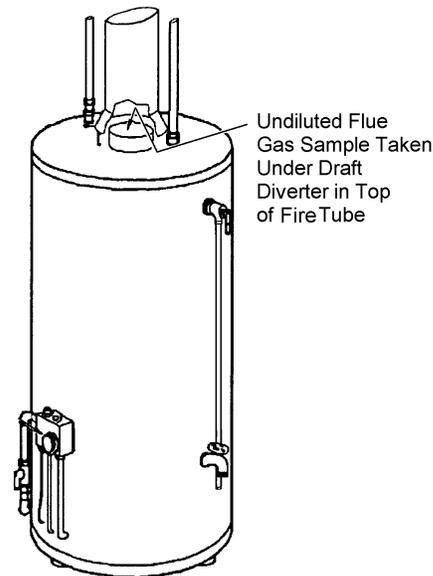
80% Efficiency Fan Assist or Power Vented – Combustion testing of fan assist or power vented, furnaces/boilers should be done through a hole drilled in the vent immediately above the inducer fan.

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.

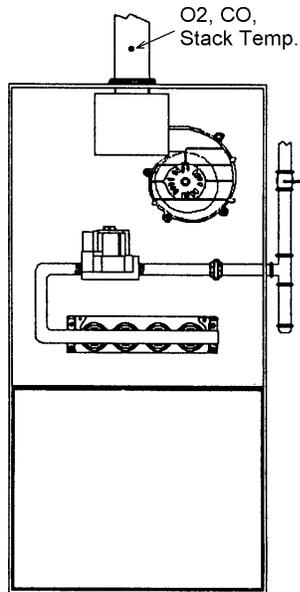
Atmospheric or Gravity Vented Boiler – Boilers, which have a ‘bell’ shaped draft diverter directly on top, should be tested directly below the diverter through a hole drilled in the vent connector.



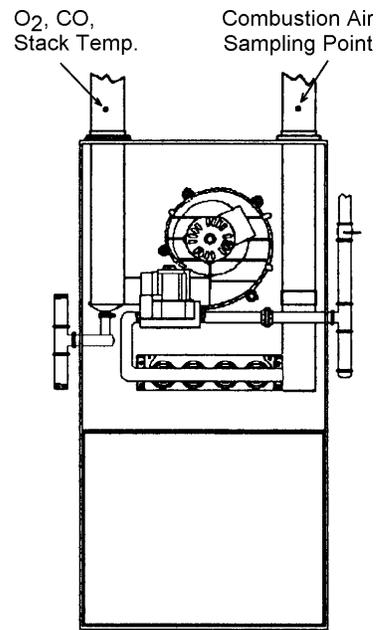
Atmospheric Burner or Gravity Vented Forced Air



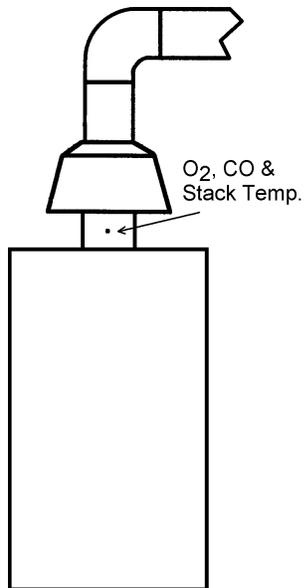
Hot Water Tank



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



**90% Eff. Condensing
Furnace/Boiler**



**Atmospheric or
Gravity Vented Boiler**

4.1.5 Performing a Combustion Efficiency Test

1. After turning ON the analyzer and selecting the appropriate fuel, the TA Screen should be displayed (refer to Section 4.4).



2. Position the probe in the flue-gas stream to obtain the highest temperature reading. *Locating the highest stack temperature is very important for accurate efficiency calculations.*
3. You can now begin burner-service procedures. Use ▲ and ▼ buttons to scroll through the analyzer's other display screens (refer to Section 4.1.3). The analyzer readings will update continuously showing changes in burner performance.
4. Pressing the **HOLD** button will freeze all readings and stop the pump. Press **ENTER** to restart the pump and resume testing.

4.1.6 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 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%.

4.1.7 Turning OFF the Analyzer

After the analyzer has been purged with fresh air, turn it OFF by pressing the **I/O** button. The unit will count down from 5 before turning OFF. Pressing the **ENTER** button will stop the count down and keep the unit ON.



4.2 Warm-Up Screens



As soon as the analyzer is turned ON, a series of Warm-Up Screens are displayed. These screens show the analyzer's model number (Tech E050 or Tech E060), the unit's software revision, and finally the remaining warm-up time counted down from 60 seconds. At the end of warm-up, the analyzer displays the Fuel Screen (refer to Section 4.3).

Note: *If any errors were detected during warm-up, the Sensor Error Screen (refer to Section 4.11) is displayed.*

4.3 Fuel Screen



The Fuel Screen is displayed after warm-up, and is where an operator chooses which fuel is to be used by the analyzer to calculate efficiency and stack loss. Pressing the ▲ or ▼ button scrolls the display through the fuel codes. After selecting the fuel, press **ENTER** to select the displayed fuel and place the analyzer into its Run Mode. Note that the fuel code will be displayed in the top right corner of all screens while in the Run Mode.

Fuel Codes:

F1 = Natural Gas
 F2 = LPG
 F3 = Light Oil
 F4 = City Gas

Front Panel Button Functions:

- ▲ – Displays next fuel code
- ▼ – Displays previous fuel code
- ENTER** – Go to Run Mode (refer to Section 4.13)
- HOLD** – No effect
- LIGHT** – Toggles backlight ON/OFF
- I/O** – Turns analyzer OFF (with a 5 second delay)

4.4 TA Screen



This screen displays the flue gas temperature in either °C or °F as measured at the tip of the probe.

Front Panel Button Functions:

- ▲ – Displays next screen (refer to Section 4.13)
- ▼ – Displays previous screen (refer to Section 4.13)
- ENTER** – Hold for 2 seconds to display Fuel Screen
- HOLD** – Freezes display (press **ENTER** to unfreeze)
- LIGHT** – Toggles backlight ON/OFF
- I/O** – Turns analyzer OFF (with a 5 second delay)

4.5 CO₂ & O₂ Screen



This screen displays the calculated % CO₂ and the measured % O₂ in the flue gas stream.

Front Panel Button Functions:

- ▲ – Displays next screen (refer to Section 4.13)
- ▼ – Displays previous screen (refer to Section 4.13)
- ENTER** – Hold for 2 seconds to display Fuel Screen
- HOLD** – Freezes display (press **ENTER** to unfreeze)
- LIGHT** – Toggles backlight ON/OFF
- I/O** – Turns analyzer OFF (with a 5 second delay)

4.6 CO & Air Free Screen (Model 60 only)



The CO reading is the measured amount of ppm carbon monoxide that is present in the flue gas stream.

The CO AIR FREE reading is a calculation of the exact ppm concentration of carbon monoxide at the flame if oxygen were 0.0% in accordance with ANSI standard Z21.1. As Eq. 1 shows, the CO AIR FREE reading will be the same as the measured CO reading if there is no oxygen in the flue gas stream, and will increase as the O₂ level increases.

$$\text{CO}_{\text{Air Free}} = \frac{\text{CO} \times 20.9}{20.9 - \text{O}_2} \quad \text{Eq. 1}$$

Front Panel Button Functions:

- ▲ – Displays next screen (refer to Section 4.13)
- ▼ – Displays previous screen (refer to Section 4.13)
- ENTER** – Hold for 2 seconds to display Fuel Screen
- HOLD** – Freezes display (press **ENTER** to unfreeze)
- LIGHT** – Toggles backlight ON/OFF
- I/O** – Turns analyzer OFF (with a 5 second delay)

4.7 TL & ETa Screen



The TL reading is the ambient room temperature in either °C or °F as measured by a temperature sensor located inside the analyzer.

The ETa reading is the calculated combustion efficiency percentage (lower heating value) of the burner.

Front Panel Button Functions:

- ▲ – Displays next screen (refer to Section 4.13)
- ▼ – Displays previous screen (refer to Section 4.13)
- ENTER** – Hold for 2 seconds to display Fuel Screen
- HOLD** – Freezes display (press **ENTER** to unfreeze)
- LIGHT** – Toggles backlight ON/OFF
- I/O** – Turns analyzer OFF (with a 5 second delay)

4.8 qA & Excess Air Screen



The qA reading is the calculated stack loss value in percent.

Excess air (or Lambda) is a calculated air factor that represents an amount of air that is in excess of the theoretical amount needed for perfect combustion.

Front Panel Button Functions:

- ▲ – Displays next screen (refer to Section 4.13)
- ▼ – Displays previous screen (refer to Section 4.13)
- ENTER** – Hold for 2 seconds to display Fuel Screen
- HOLD** – Freezes display (press **ENTER** to unfreeze)
- LIGHT** – Toggles backlight ON/OFF
- I/O** – Turns analyzer OFF (with a 5 second delay)

4.9 COC2 Screen (Model 60 only)



The COC2 reading is the ratio of CO divided by CO₂.

Note: *The display does not show a decimal point in front of the reading. In the example above, the actual reading is 0.0018.*

Front Panel Button Functions:

- ▲ – Displays next screen (refer to Section 4.13)
- ▼ – Displays previous screen (refer to Section 4.13)
- ENTER** – Hold for 2 seconds to display Fuel Screen
- HOLD** – Freezes display (press **ENTER** to unfreeze)
- LIGHT** – Toggles backlight ON/OFF
- I/O** – Turns analyzer OFF (with a 5 second delay)

4.10 Stack & EFF Screen



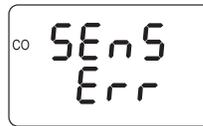
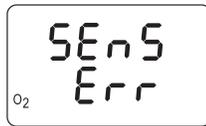
The STACK reading is the flue gas temperature in either °C or °F as measured at the tip of the probe.

The EFF (Efficiency) reading is a calculation (non Seigert) of what percentage of energy present in the fuel was converted into usable heat.

Front Panel Button Functions:

- ▲ – Displays next screen (refer to Section 4.13)
- ▼ – Displays previous screen (refer to Section 4.13)
- ENTER** – Hold for 2 seconds to display Fuel Screen
- HOLD** – Freezes display (press **ENTER** to unfreeze)
- LIGHT** – Toggles backlight ON/OFF
- I/O** – Turns analyzer OFF (with a 5 second delay)

4.11 Sensor Error Screen



An O₂ sensor error is displayed if the analyzer determines during the warm-up cycle that the oxygen sensor's output is too low for it to be usable. However, in the extreme condition when the O₂ sensor has *no output*, a sensor error will not occur. Instead, the O₂ reading will be 0.0 as displayed in the CO₂ & O₂ Screen (refer to Section 4.5).

When the CO channel (Model 60 only) is set up for Auto Zero (refer to Section 3.5.3), a CO sensor error will occur if the detected CO level is above 50 ppm during the warm-up cycle. Note that if the CO channel is set up for manual calibration, the analyzer does not auto-zero the CO sensor during warm-up, and thus does not generate a CO sensor error when the analyzer is turned ON in an atmosphere containing a high background level of CO.

Do the following before replacing a suspected spent or defective sensor:

1. Turn OFF the analyzer and turn it back ON in an area of fresh air (containing 20.9% O₂ and no CO).

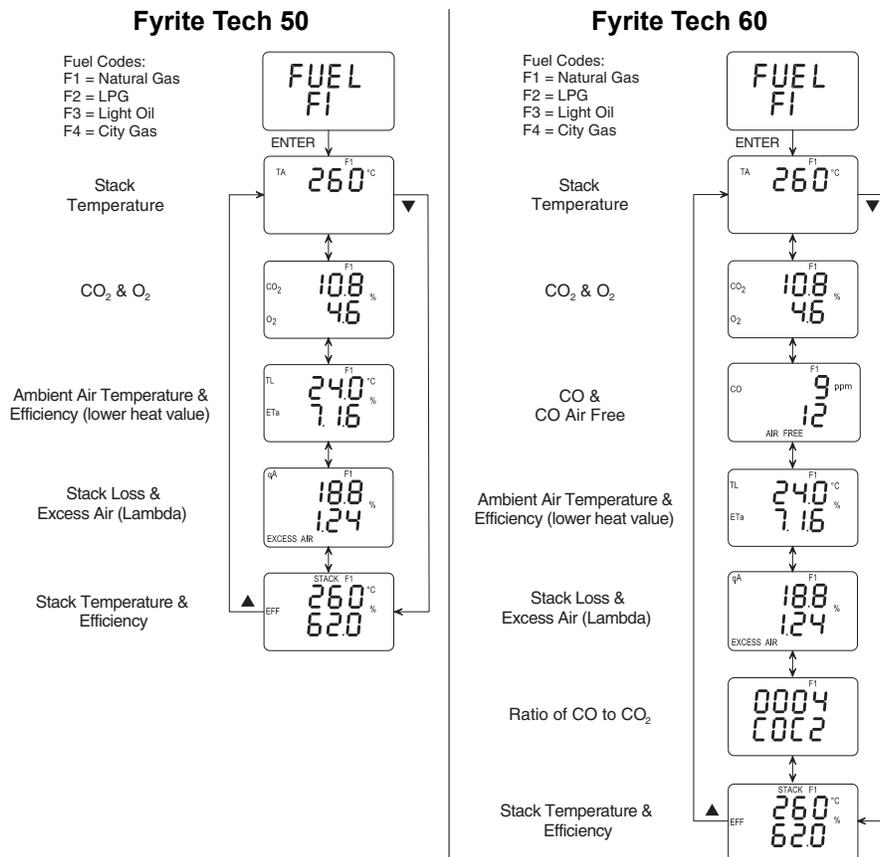
2. Perform the Oxygen Sensor Zero procedure (Section 5.4) and, if applicable, the CO Sensor Zero & Calibration procedure (Section 5.5).
3. If Steps 1 & 2 do not eliminate the error condition, replace the sensor(s) (refer to Sections 5.8 and 5.9).

4.12 Resetting the Microprocessor

If the analyzer 'locks-up' and cannot be turned OFF, reset the microprocessor by removing one of the batteries for 5 seconds.

4.13 Run Mode Screens

The following diagrams show the order in which the screens are displayed by pressing the ▲ and ▼ buttons while in the Run Mode.

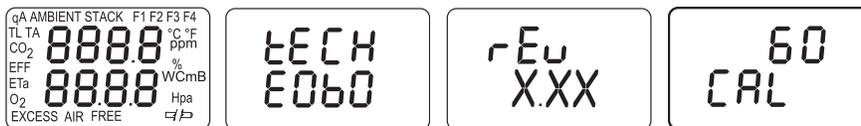


5.0 CALIBRATION & MAINTENANCE

Important: *Fresh batteries should be installed, and the unit allowed to stabilize at room temperature for at least two hours before proceeding with calibration. 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 stated accuracy of the Fyrite Tech.*

5.1 Entering the Calibration Mode and Testing the Display Segments

1. With the analyzer turned OFF, place the unit in fresh, ambient air; then press and hold down the **ENTER** button.
2. Press the **I/O** button and release it. Observe that all LCD segments are turned ON.
3. Release the **ENTER** button. Observe the unit's model number and software version are displayed. The word "CAL" is then displayed while the unit counts down from 60 seconds.



At the end of 60 seconds, the first calibration screen is automatically displayed.

Note: *During calibration, the ▲ and ▼ buttons are used to increase or decrease a displayed calibration value. **ENTER** is used to store the new value and move to the next screen. Hold **ENTER** down for 2 seconds to exit the Calibration Mode and directly enter the Run Mode.*

5.2 Ambient Temperature Calibration

Material Required: Calibrated Thermometer

Procedure:

1. Enter the Calibration Mode as described in Section 5.1. Then repeatedly press the **ENTER** button until “AMBIENT” appears at the top of the display.



2. Use the ▲ and ▼ buttons to set the displayed value to match the reading of a calibrated thermometer at room temperature.
3. Press **ENTER** to store the displayed value and move to the next calibration screen, or hold down **ENTER** for 2 seconds to store the displayed value and enter the Run Mode, or press the **I/O** button to exit the Calibration Mode and turn OFF the analyzer without saving the changes.

5.3 TA (Stack Temperature) Thermocouple Channel Calibration

Material Required: Thermocouple Simulator

Procedure:

1. Attach the thermocouple simulator to the Stack Thermocouple connector on the analyzer (T-STACK, see Figure 3-2).
2. Enter the Calibration Mode as described in Section 5.1. Then repeatedly press the **ENTER** button until “TA” appears in the top left side of the display.



3. Set the simulator to 0 °C (32 °F); then use the ▲ and ▼ buttons to set the displayed value to match the simulator's value.
4. Set the simulator to 300 °C (572 °F); then use the ▲ and ▼ buttons to set the displayed value to match simulator's value.
5. Repeat Steps 3 and 4 as necessary until the analyzer is reading correctly at both temperatures.
6. Press **ENTER** to store these calibration values and move to the next calibration screen, or hold down **ENTER** for 2 seconds to store these calibration values and enter the Run Mode, or press the **I/O** button to exit the Calibration Mode and turn OFF the analyzer without saving the changes.
7. Remove thermocouple simulator from analyzer.

5.4 Oxygen Sensor Zero

Material Required:

- Cylinder of 100% Nitrogen, P/N 9550-0049
- Calibration Kit, P/N 24-7059

Procedure:

1. With the analyzer sampling fresh air, enter the Calibration Mode as described in Section 5.1. Then repeatedly press the **ENTER** button until "O₂" appears in the lower left side of the display.



2. Allow pump to run and sample fresh air for at least 1 minute.
3. Use the ▲ and ▼ buttons to set the displayed value to 20.9%.
4. Set up the Calibration Kit with 100% N₂ as described in the instructions supplied with the kit.
5. Connect the tubing of the Calibration Kit to the inlet of the analyzer; then adjust the regulator for approximately 2 SCFH of excess flow (see Figure 5-1).

6. After the analyzer has stabilized (2 to 3 minutes), use the ▲ and ▼ buttons to set the displayed value to 0.0%.
7. Disconnect tubing from analyzer and turn off gas flow.
8. Allow the pump to run until the O₂ reading returns to 20.9%. If necessary, use the ▲ and ▼ buttons to readjust the reading to 20.9%. Repeat Steps 3 thru 7 to verify the zero adjustment.
9. Press **ENTER** to store the new calibration values and move to the next calibration screen, or hold down **ENTER** for 2 seconds to store the new calibration values and enter the Run Mode, or press the **I/O** button to exit the Calibration Mode and turn OFF the analyzer without saving the changes.

5.5 CO Sensor Zero & Calibration (Model 60 only)

- Material Required:**
- Cylinder of 100 ppm (P/N 51-1994) or 500 ppm (P/N 24-0492) CO calibration gas
 - Calibration Kit, P/N 24-7059

If the analyzer will be primarily used for flue gas testing, we suggest that you calibrate your Fyrite Tech 60 with 500 ppm CO calibration gas. If the analyzer will be primarily used for ambient testing, then you may wish to consider 100 ppm CO calibration gas.

Procedure:

1. With the analyzer sampling fresh air, enter the Calibration Mode as described in Section 5.1. Then repeatedly press the **ENTER** button until “CO” appears in the upper left side of the display.



2. Allow the pump to run and sample fresh air for at least 1 minute.
3. Use the ▲ and ▼ buttons to set the displayed value to 0 ppm.

4. Do one of the following:
 - a. End this procedure and save the new zero value by holding down the **ENTER** button for 2 seconds; after which, the analyzer enters the Run Mode.
 - b. Continue with Step 5 to span the CO sensor to a known concentration of carbon monoxide.
5. Set up the Calibration Kit with 100 or 500 ppm CO as described in the instructions supplied with the kit.
6. Connect the tubing of the Calibration Kit to the inlet of the analyzer; then adjust the regulator for approximately 2 SCFH of excess flow (see Figure 5.1).
7. After the analyzer has stabilized (2 to 3 minutes), use the ▲ and ▼ buttons to set the displayed value to match the CO concentration stamped on the gas cylinder.
8. Press **ENTER** to store the new calibration values and move to the next calibration screen, or hold down **ENTER** for 2 seconds to store the new calibration values and enter the Run Mode, or press the **I/O** button to exit the Calibration Mode and turn OFF the analyzer without saving the changes.
9. Disconnect tubing from analyzer and turn off gas flow.

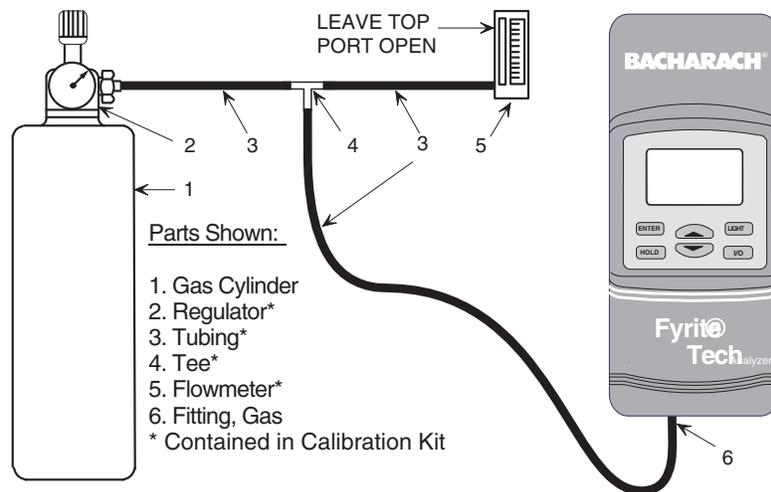


Figure 5-1. Calibration Kit Hookup

5.6 Particulate Filter Replacement

The particulate filter (found inside the case, between the gas inlet and pump, see Figure 5-3) may clog up with soot depending on the cleanliness of the areas being sampled. If replacement is needed:

Material Required:

- Filter Element, P/N 07-1600
- #1 Phillips Screwdriver

Procedure:

1. Disassemble the analyzer as follows:
 - a. Remove the battery cover and the batteries, uncovering one of the cover hold-down screws.
 - b. Remove and set aside all four cover hold-down screws.
 - c. With the analyzer on its back, remove the front cover, laying it face down to the left of the body.
 - d. Carefully remove the circuit board, slipping off the battery connector on top, and then laying the circuit board face down in the top cover.
2. Twist off the Particulate Filter Inlet Connector (see Figure 5-3).
3. Remove Particulate Filter Element from the tubing connected to the pump.
4. If necessary, remove and clean all tubing with warm soapy water; then rinse well and allow to dry. Reinstall tubing.
5. Insert the new Particulate Filter Element into the tubing connected to the pump; then twist back on the filter's Inlet Connector.
6. Reassemble the analyzer.

5.7 Water Trap / Filter Maintenance

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

Drain the water condensate after every test.

Procedure:

1. Pull off the end-cap from the inlet end of the Water Trap / Filter Assembly (see Figure 5-2).
2. Pour out all water condensate; then replace end-cap.

Replace the filter element when dirty.

Material Required: Filter Element, P/N 07-1644

Procedure:

1. Pull off the end-cap from the outlet end of the Water Trap / Filter Assembly (see Figure 5-2).
2. Remove and discard the old filter element.
3. Install new filter; then replace end-cap.

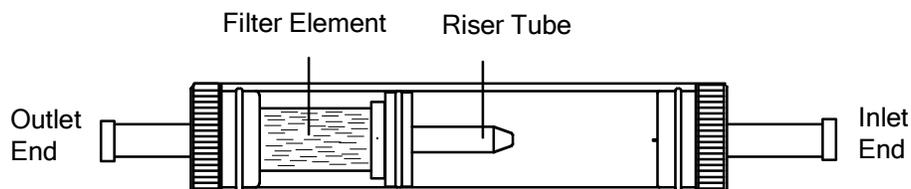


Figure 5-2. Water Trap / Filter Assembly

5.8 O₂ Sensor Replacement

Be sure to perform all of the checks listed in Section 4.11 to ensure that the oxygen sensor needs to be replaced.

Material Required:

- Oxygen Sensor with Gasket, P/N 24-8106G
- #1 Phillips Screwdriver

Procedure:

1. Disassemble the analyzer as follows:
 - a. Remove the battery cover and the batteries, uncovering one of the cover hold-down screws.
 - b. Remove and set aside all four cover hold-down screws.
 - c. With the analyzer on its back, remove the front cover, laying it face down to the left of the body.
 - d. Carefully remove the circuit board, slipping off the battery connector on top, and then laying the circuit board face down in the top cover.
2. Slip off the oxygen sensor's electrical connector from the circuit board. Then push down; twist counterclockwise; then pull the oxygen sensor out of its socket (see Figure 5-3).
3. Using the old sensor as a guide, remove the paper backing from the new sensor gasket contained in the replacement kit, and adhere it to the new sensor.
4. Properly dispose of the old oxygen sensor (see the instruction sheet that comes with the new sensor).
5. Mount the new oxygen sensor in its socket.
6. Reassemble the analyzer.

Note: *The sensor may take several hours to stabilize after being connected to the printed circuit board.*

5.9 CO Sensor Replacement (Model 60 only)

Be sure to perform all of the checks listed in Section 4.11 to ensure that the CO sensor needs to be replaced.

Material Required:

- CO Sensor, P/N 54-0164
- CO Sensor Gasket, P/N 24-1112
- #1 Phillips Screwdriver

Procedure:

1. Disassemble the analyzer as follows:
 - a. Remove the battery cover and the batteries, uncovering one of the cover hold-down screws.
 - b. Remove and set aside all four cover hold-down screws.
 - c. With the analyzer on its back, remove the front cover, laying it face down to the left of the body.
 - d. Carefully remove the circuit board, slipping off the battery connector on top, and then laying the circuit board face down in the top cover.
2. Gently pull CO sensor out of its socket (see Figure 5-4).
3. Properly dispose of the old CO sensor (see the instruction sheet that comes with the new sensor).
4. It is recommended that the CO sensor gasket be replaced at the same time as the sensor. Remove the old gasket and discard. Remove the paper backing from the new gasket and adhere it to the case in the same position as the old one.

Important: *Ensure that the new gasket does not restrict the inlet and exhaust holes in the case.*

5. Plug the new CO sensor into its socket.
6. Reassemble the analyzer.

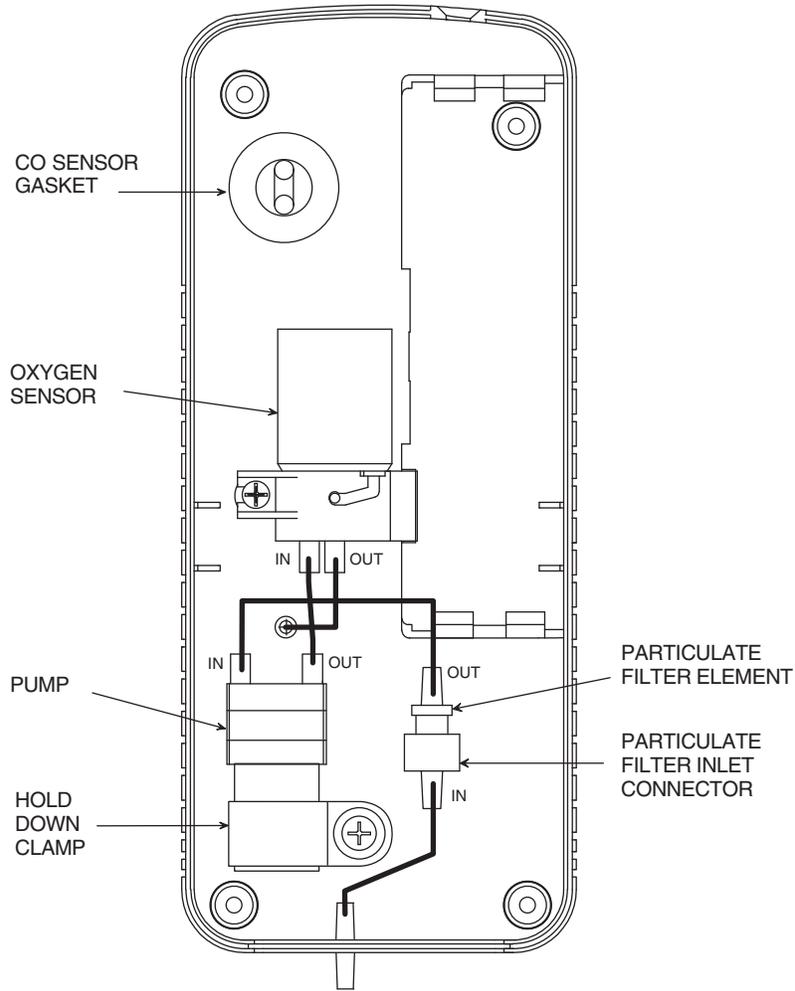


Figure 5-3. Back Case Component Locations

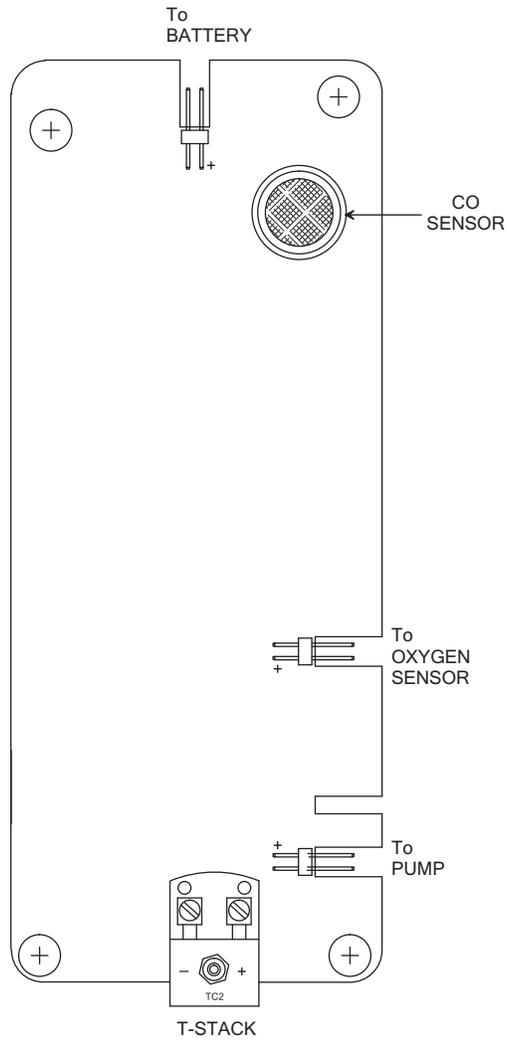


Figure 5-4. CO Sensor Location

5.10 Pump Assembly Replacement

Material Required:

- Pump, P/N 24-3048
- #1 Phillips Screwdriver

Procedure:

1. Disassemble the analyzer as follows:
 - a. Remove the battery cover and the batteries, uncovering one of the cover hold-down screws.
 - b. Remove and set aside all four cover hold-down screws.
 - c. With the analyzer on its back, remove the front cover, laying it face down to the left of the body.
 - d. Carefully remove the circuit board, slipping off the battery connector on top, and then laying the circuit board face down in the top cover.
2. Slip off the pump motor's electrical connector from the circuit board.
3. Unscrew the pump's hold down clamp and remove it from the pump (see Figure 5-3). Make note of how the pump wiring is routed.
4. Make note of how the tubing connects to the pump; then carefully remove tubing from pump.
5. Remove the old pump and discard.
6. Install the new pump and reinstall the tubing, taking care not to pinch or crimp the tubing. Also be sure pump wiring is routed as was noted in Step 3.
7. Reassemble the analyzer.

6.0 PARTS & SERVICE

6.1 Replacement Parts

Description	Part No.
Carbon Monoxide Sensor (Model 60 only).....	54-0164
Carbon Monoxide Sensor Gasket (Model 60 only)	24-1112
Oxygen Sensor w/ Gasket	24-8106G
Oxygen Sensor Gasket	24-1111
Pump Assembly	24-3048
Particulate Filter Element, for inside-case filter.....	07-1600
Particulate Filter Fitting, for inside-case filter	103-5267

6.2 Accessories

STANDARD ACCESSORIES:

Battery, "AA" Alkaline	204-0004
Instruction Manual	24-9435
Probe, Hose, and Water Trap / Filter Assembly	24-7290
Filter (pack of 3).....	07-1644
Probe Stop	19-3037
Thumb Screw	102-0875
Water Trap / Filter Assembly	24-1107
Quick Reference Guide.....	24-9436

OPTIONAL ACCESSORIES:

Calibration Kit	24-7059
Gas Cylinder, 100 ppm CO	51-1994
Gas Cylinder, 500 ppm CO	24-0492
Gas Cylinder, 100% Nitrogen	9550-0049
Hard Carrying Case	24-0865
Protective Rubber Boot w/Magnets.....	24-1127
Power Supply	061056
True Spot Smoke Test Set	21-7006
Filter Paper, True Spot (40 strips)	21-0019

6.3 Service Centers

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

United States

Bacharach Inc.
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.
250 Shields Court Unit #3
Markham, Ontario L3R 9W7
Canada
Phone: 905-470-8985
Fax: 905-470-8963
Email: bachcan@idirect.com

México

Bacharach de México
Playa Regatas No. 473 Tercer Piso
Col. Militar Marte
Delegación Iztacalco, 08830
México D.F.
México
Phones: +52-555-634-7740
 +52-555-634-7741
Fax: +52-555-634-7738
Email: bacharachservicio@bacharach.com.mx
Website: www.bacharach-mexico.com

Appendix A - Formulas and Tables

$$\text{CO}_2\text{-Wert: } \text{CO}_2 = \frac{\text{CO}_2\text{MAX} (20.9 - \text{O}_2\%)}{20.9}$$

$$\text{Abgasverlust: } q_A = [(T_A - T_L) \left\{ \frac{A_2}{20.9 - \text{O}_2} + B \right\}]$$

$$\text{Luftüberschuß-} \quad \lambda = \frac{20.9}{(20.9 - \text{O}_2)}$$

zahl λ :

$$\text{Eta} = (100\% - q_A) + [K_f \text{ If } T_A < (T_0 + 2.3 \times \text{O}_2)]$$

$$\text{CO}_{\text{AirFree}} = \text{CO} \times \lambda$$

$$\text{CO/CO}_2 = \frac{(\text{COppm}) \times 10^{-6}}{(\text{CO}_2\%) \times 10^{-2}} \quad (\text{LCD will not show decimal point})$$

	Fuel	A2	B	CO ₂ max	T ₀	K _f
F1	Natural Gas	0.66	0.009	11.8	58°C	9.6%
F2	LPG	0.63	0.008	13.8	54°C	7.6%
F3	Light Oil	0.68	0.007	15.6	51°C	5.3%
F4	City Gas	0.63	0.011	13.1	00°C	0.0%

Notes:

Notes:



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