

ABB MEASUREMENT & ANALYTICS | OPERATING INSTRUCTION

PGC5007 Total sulfur analyzer

Process gas chromatograph



Measurement made easy

Further information

Additional documentation on the PGC5007 total sulfur analyzer is available for download at www.abb.com/analytical. Alternatively simply scan this code.



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Such information necessitates the proper marking of Electrical and Electronic Equipment (EEE), referred to herein as the product, which could end up in rubbish bins or similar means of municipal waste collection. The product displays the crossed-out wheeled bin symbol, indicating a separate collection for the EEE and that the product conforms to the directive for Waste of Electrical and Electronic Equipment (WEEE). End of life disposal of the product is not intended for general household waste. Disposing of this product correctly will help save valuable resources and prevent any potential negative effects on human health and the environment.

Regarding our sustainability strategy, the course of action when developing new products is to ensure wherever possible that any and all national and international legal requirements, directives and standards of environmental protection and occupational safety are complied with, even if the regulatory requirement does not apply to the respective product. Our products are designed to ensure that with proper use of the product, there are no health hazards for the user nor any risk to the environment according to present knowledge.

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Information for treatment facilities shall be provided by ABB regarding the preparation for re-use and treatment of new EEE placed for the first time on the European Union market. Such information may identify the different EEE components and materials, as well as the location of dangerous substances and mixtures. This information shall be made available by ABB to centers which prepare for re-use and treatment, and recycling facilities listed on the ABB website. Further information may be obtained through the local business unit of ABB.

This document shall serve for informational purposes only, no legal obligations are substantiated by any regulations.

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1 Safety and symbols

The following symbols are used in this manual to alert the user to possible hazards and to provide additional information.



Indicates that the referred item can be hot and should not be touched without care.



Indicates that a risk of electrical shock and/or electrocution exists.



Indicates a potential hazard which could cause serious injury and/or death, or indicates the presence of a hazard which could result in corruption of software or damage to equipment or property.



Indicates that referenced items are susceptible to Electrostatic Discharge (ESD) damage and should not be touched without ESD safe handling tools.



Alerts the user to pertinent facts and conditions.

2 Description

2.1 General

The Process Gas Chromatograph, Total Fuel Sulfur PGC5007 (Fuel Sulfur Analyzer), performs total sulfur measurements for various hydrocarbon blends. It operates the same as the standard Process Gas Chromatograph PGC5000 described in Operations Guide 9AKK104295F4814 and Technical Service Guide 9AKK104295D4816. It differs from the PGC5000 in having a furnace contained within the isothermal Smart Oven™ and in how some of the operating features are utilized. Figure 2.1 shows the liquid and vapor versions of the PGC5007.



Liquid Version



Vapor Version

Fig. 2.1. Oven Compartment

The standard detector for the Fuel Sulfur Analyzer is the flame photometric detector (FPD). The detector, located in the isothermal section of the oven compartment, is explosion proof by design and is designed according to applicable standards. This detector is the same as that used in the basic PGC5000 series B-Class and C-Class ovens.

The Digital Temperature Controller (DTC) controls the temperature of the liquid sample valve, the furnace, the detector, and the isothermal oven. Temperatures are verified and set on the Master Controller's Setup Tab. Refer to the Setup Tab in Section 6 of the PGC5000 Operations Guide.

2.2 Liquid version

The liquid version incorporates a liquid sample valve (LSV) as the input to the analysis. A total sulfur analysis cycle takes about six minutes to complete, depending on the application, and consists of the following:

- The liquid sample valve injects a fixed volume of sample into a vaporizing chamber.
- "Sweep gas" transports sample out of the vaporizing chamber.
- Carrier transports the sample into the furnace, where it oxidizes.

- A packed column then separates the components and passes them into the flame photometric detector (FPD).

The FPD then measures total sulfur as SO_2 across the range of high ppm to low ppm.

The liquid sample valve is externally mounted on the right side of the oven compartment and extends through the isothermal oven directly into the fuel sulfur furnace housing, allowing direct injection. It is actuated by a solenoid valve located in the electronics housing. The liquid sample valve captures a specific volume of liquid sample below its bubble point, injects it into a temperature controlled (vaporizing) chamber of the sample valve, which sends the vaporized sample into the furnace.

Using air as the carrier, the furnace oxidizes the sample into carbon dioxide, sulfur dioxide and water, and passes them through the column to the detector for measurement of the total sulfur, as sulfur dioxide (SO_2).

2.3 Vapor version

The vapor version has a vapor input to the analysis, and does not require a liquid sample valve. A total sulfur analysis cycle takes about six minutes to complete, depending on the application, and consists of the following:

- "Sweep gas" transports sample out of the vaporizing chamber.
- Air transports the sample into the furnace, where it oxidizes.
- A packed column then separates the components and passes them into the flame photometric detector (FPD).
- The FPD then measures total sulfur as SO_2 across the range of high ppm to low ppm.

Using air as the carrier, the furnace oxidizes the sample into carbon dioxide, sulfur dioxide and water, and passes them through the column to the detector for measurement of the total sulfur, as sulfur dioxide (SO_2).

3 Operation

3.1 Startup

When the power is applied to the Smart Oven™, all components receive power.

Temperature settings are application dependent and are determined by the factory. Temperature settings for heated component zones can be found in the Data Package shipped with the analyzer. This information should be used as a reference during setup and startup, and when troubleshooting and calibration are performed. If adjustments need to be made, they should be made according to the information in the Data Package.

Allow adequate time for the isothermal oven and furnace to heat to the proper temperature levels. Check the oven temperature at the Setup Tab screen. The FPD will not ignite unless it is at operating temperature.

When you perform the time cycle check, verify isothermal oven, furnace, liquid sample valve (if applicable), and detector temperatures on the Setup Tab screen with Data Package information. (These temperature settings are made in the factory and should not need adjustment.)

3.2 Setting flows

When making any flow adjustments, allow time for the system to respond to the change and stabilize. It is recommended that no measurement be taken for 30 seconds after any flow adjustment. Three consecutive measurements should be taken at 30-second intervals to verify flow stability.

Sample splitters are employed when the volume of the injected sample is so large that it might overload the column or the detector. To overcome this, the amount of sample is reduced by a sample splitter tee. By adjusting the flow of the carrier gas from the splitter, the amount of sample entering the column is reduced



Before applying heat to the oven and oven components, ensure carrier is turned on to allow flow through the columns while they are heating to prevent damage to the columns.

Analytical valves are controlled using the valve button under the Setup Tab (see Figure 3.1). Refer to the Data Package for flow rates and pressures applicable to your analyzer.



Fig. 3.1. Analytical Valve Control Screen

Select applicable valves from the list on the left side of the folder display. Adjust as necessary for the application.

When you are matching column flows, refer to the Data Package for flow rates and valve configurations. Figure 3.2 illustrates a typical flow diagram for the liquid version of the PGC5007.

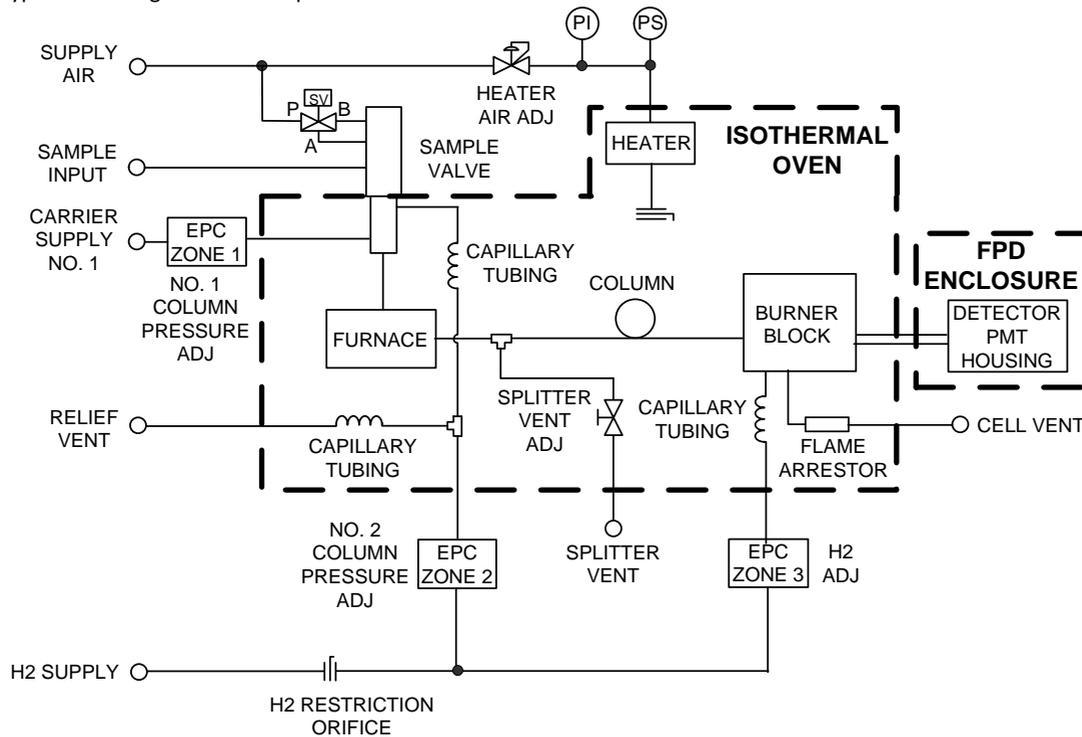


Fig. 3.2. Liquid Version Flow Diagram

Figure 3.3 illustrates a typical flow diagram for the standard vapor version.

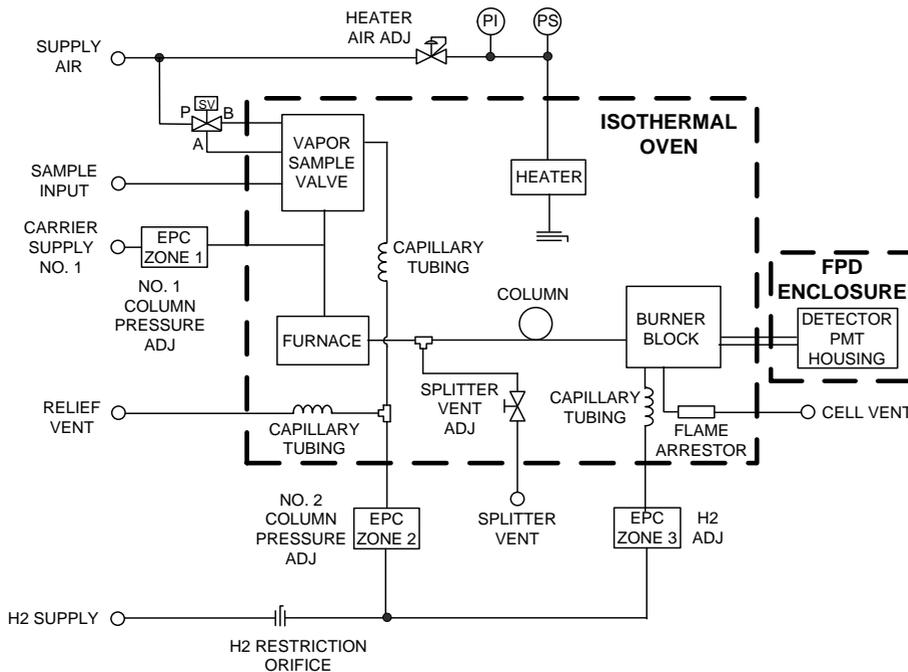


Fig. 3.3. Standard Vapor Version Flow Diagram

Figure 3.4 illustrates a typical flow diagram for the dual vapor version.

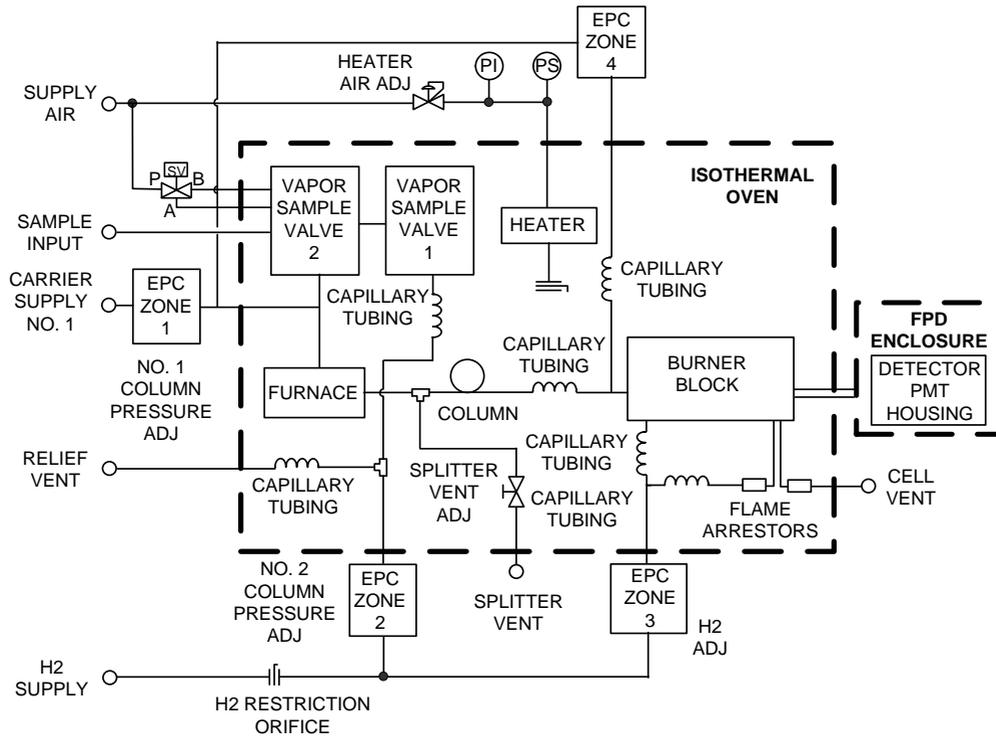


Fig. 3.4. Dual Vapor Version Flow Diagram

3.3 Power distribution

The Fuel Sulfur Analyzer utilizes the same power distribution circuits as the standard PGC5000 analyzer. In addition, the PGC5007 has an autoformer to provide 40 VAC power to the furnace located within the furnace Exd enclosure in the oven section of the analyzer (see Figure 3.5).

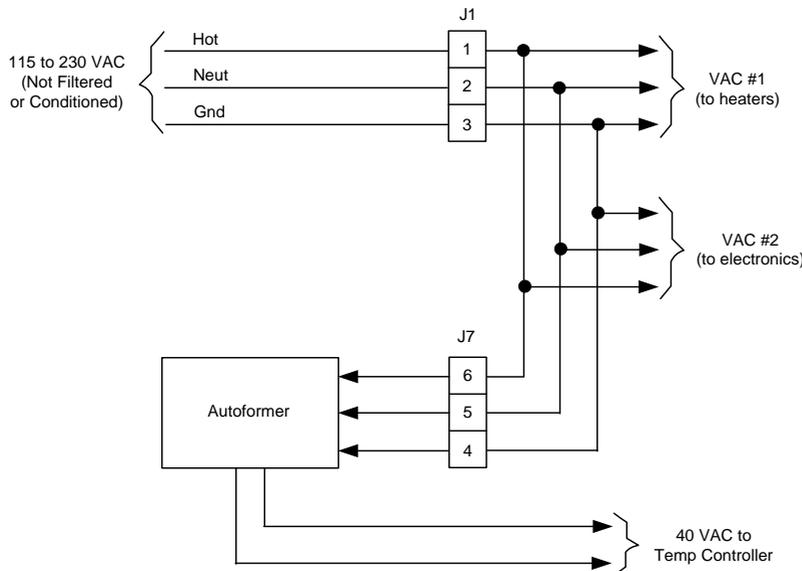


Fig. 3.5. Input Power Distribution

3.4 Detector

The detector for the Fuel Sulfur Analyzer is the flame photometric detector (FPD). The detector cell is located in the electronics housing and the burner block is located in the oven.

Flame photometric detection works on the principle that when sulfur is burned in a hydrogen-rich atmosphere, luminescence (light) characteristic to sulfur is produced. The FPD cell consists of a burner chamber equipped with a spark ignition system, and a photomultiplier tube which is thermoelectrically temperature controlled. A narrow bandpass filter optically connects the burner chamber and the photomultiplier tube. An exponential amplifier conditions and amplifies the photomultiplier tube output to provide a linear output over a wide dynamic range. Sulfur addition permits accurate measurement of low-level sulfur compounds. Figure 3.6 shows a typical FPD cell.

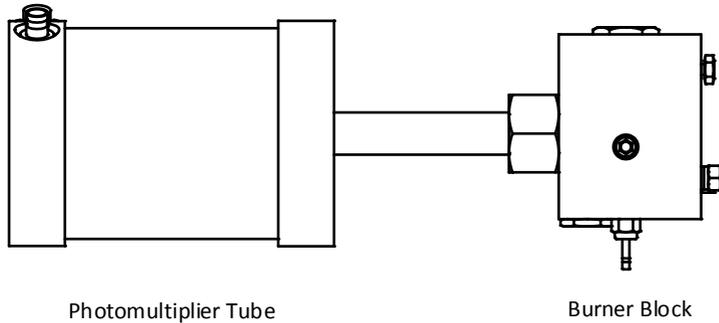


Fig. 3.6. Flame Photometric Detector

When a sulfur compound passes through the hydrogen-rich flame, strong luminescence occurs between 320 and 460 nm. The narrow band-pass filter allows a sulfur spectra-centered transmission at $394 \text{ nm} \pm 5 \text{ nm}$ to achieve a specific ratio of sulfur to non-sulfur compounds between 10,000 and 30,000:1. A photomultiplier tube views the filtered light and outputs a voltage proportional to the intensity of the filtered luminescence. For maximum sensitivity, the detector is optimized with respect to temperature, gas flow rates, and bias voltage on the photomultiplier tube.

Because the amount of sulfur in the sample is very small, a sulfur addition module provides a standard level of sulfur. This keeps the sulfur readings above the noise level of the method. When the analyzer processes a sulfur compound, the sulfur in the sample adds to the standard sulfur, providing a level more easily measured by the photomultiplier tube.

The FPD Electrometer PCB, located inside the Electronics compartment of the isothermal oven, digitizes the detector output signal for processing. This assembly also provides energy for FPD flame sensing and ignition.

4 Maintenance information

4.1 Preventive maintenance

The table below provides the preventive maintenance checks and intervals recommended to ensure continued satisfactory performance of the analyzer.

MTBR = Mean Time Before Replacement

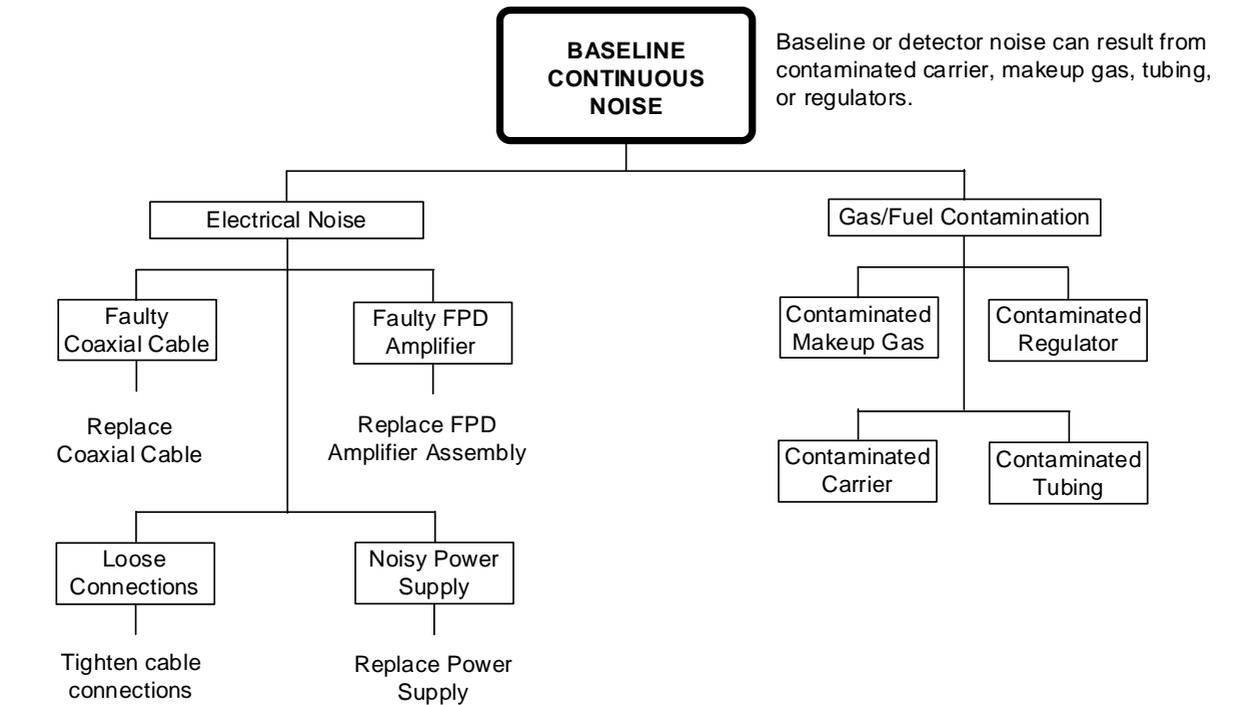
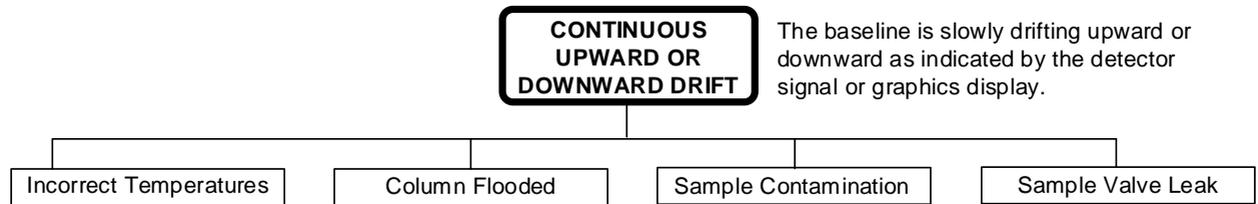
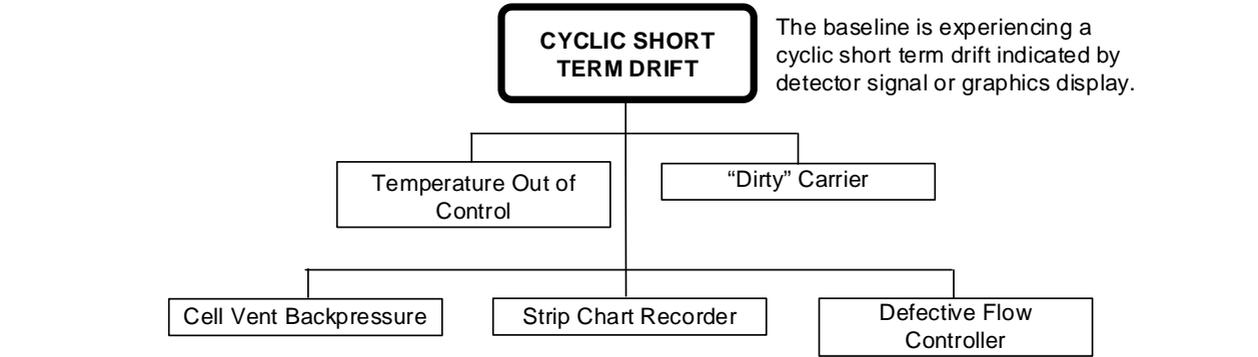
MTTR = Mean Time to Replace

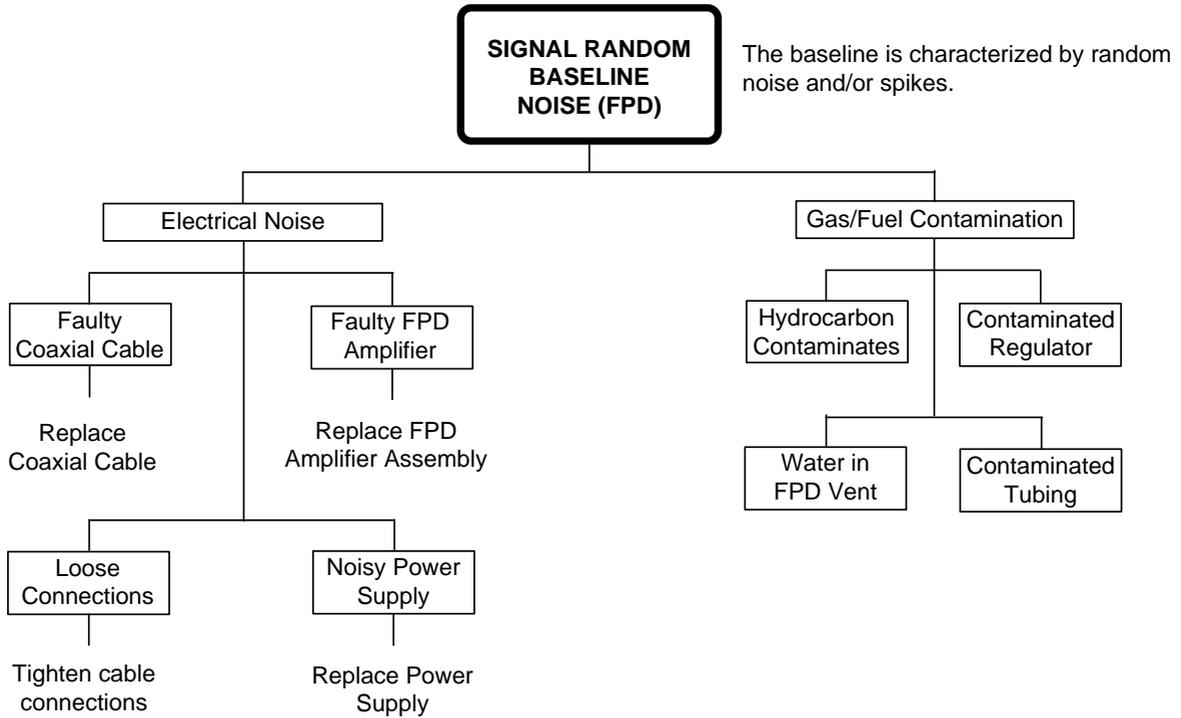
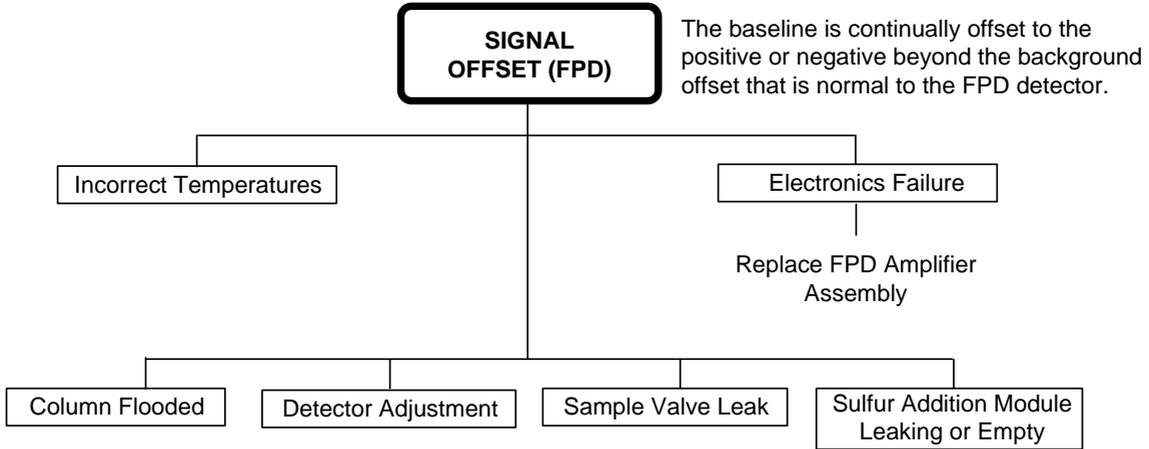
Item	Comment	MTBR	MTTR
Liquid Sample Valve (LSV)	Liquid Sample Valve seals require changing about every six months (under most service conditions).	6 months	30 minutes
Furnace Quartz Tube	The conversion furnace quartz tube should last from 8 to 12 months. Frequent cycling of the AC power puts significant stress on the tube, since it normally runs at 900 deg C.	10 months	4 to 8 hours
Separation Columns		1 year	30 minutes
Sulfur Addition Module	This permeation wafer is located in the Flame Photometric Detector's Burner Block.	3 years	30 minutes

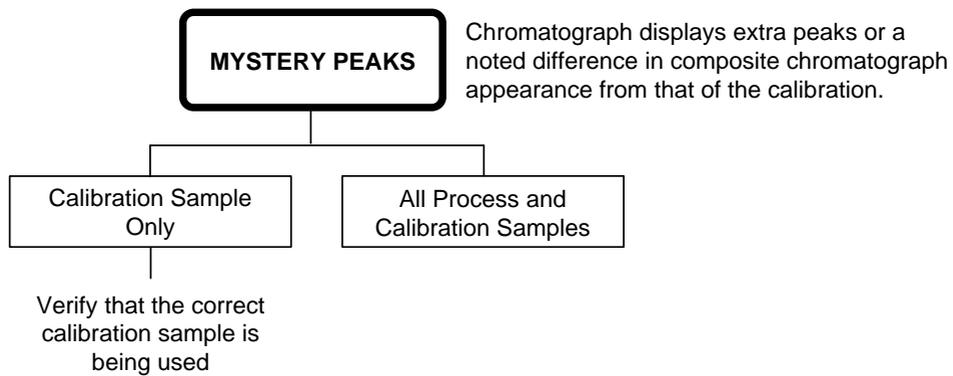
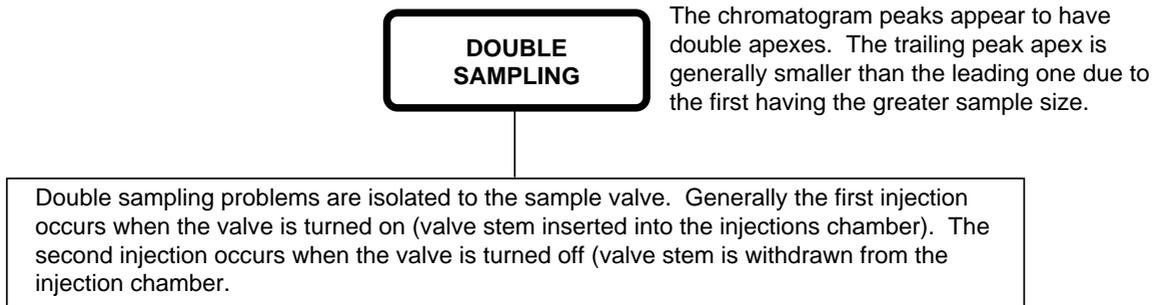
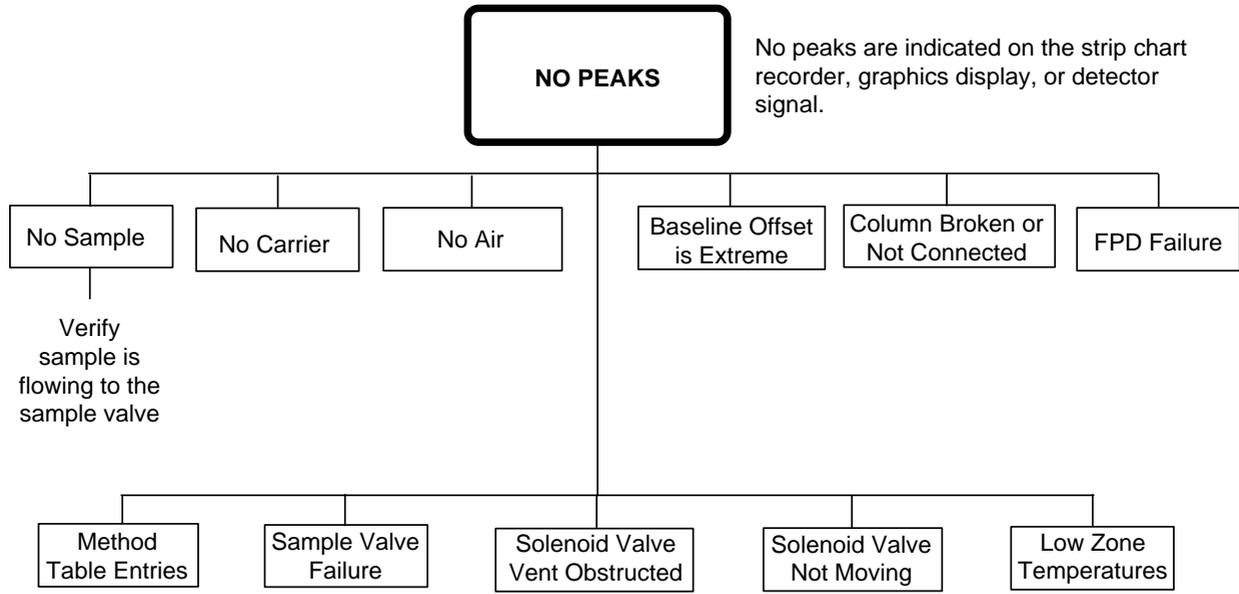
4.2 PGC5007 troubleshooting guide

This subsection provides troubleshooting information by category. Use the listing below to determine the desired troubleshooting category and its location in the manual.

Description	Page
Cyclic Short Term Drift	13
Continuous Upward or Downward Drift	13
Baseline Continuous Noise	13
Signal Offset (FPD)	14
Signal Random Baseline Noise (FPD)	14
No Peaks	15
Double Sampling	15
Mystery Peaks	15
Variable Sample Size	16
Variable Retention Times	16
Individual Peak Missing on Report	16
Chromatogram Oversize or Off Scale	17
Reduced Detector Sensitivity	17
Peak Discrimination	17
Temperature Probe Open	18
Temperature Probe Shorted	18
Isothermal Oven Heater Thermocouple Faulty	18
Loss of Oven Air	18
Open or Shorted Heater	19
Low Oven Temperature	19
High Oven Temperature	19
Trend Output Not Functioning Correctly	19
No Analyzer Keypad Response	20
Flame Out LED On	20
Flame Will Not Ignite	20
Low Carrier Pressure Hardware Alarm	21
Loss of Purge Air	21
Stream Not Selected	21
Analyzer Will Not Power Up (X-Purge)	22
Short Quartz Tube Life	22
Repeated Column Failures	22







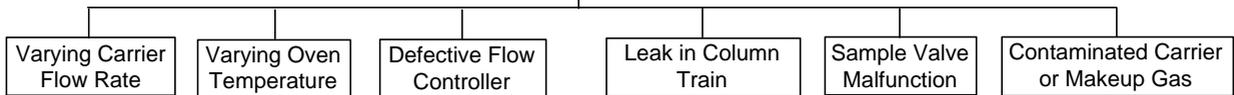
**VARIABLE
SAMPLE SIZE**

Variable sample size can cause a nonrepeatability of peak concentrations if the peak area is varying.

Hydrocarbon
Contaminates

**VARIABLE
RETENTION TIMES**

Variable retention times can result in nonrepeatability.

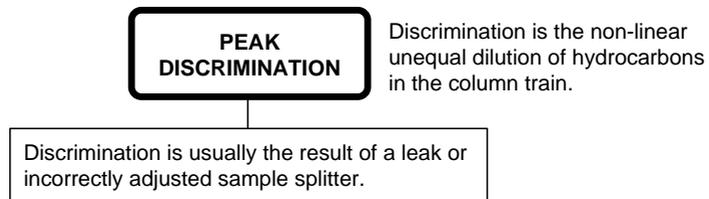
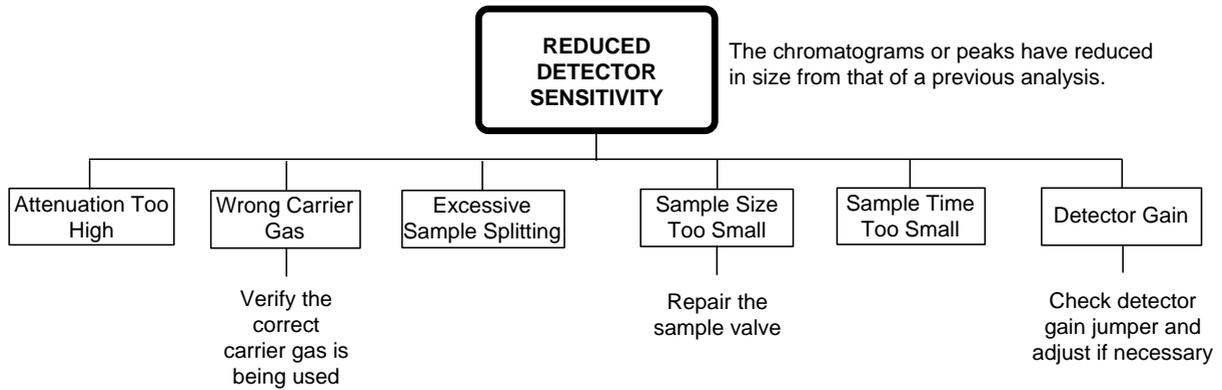
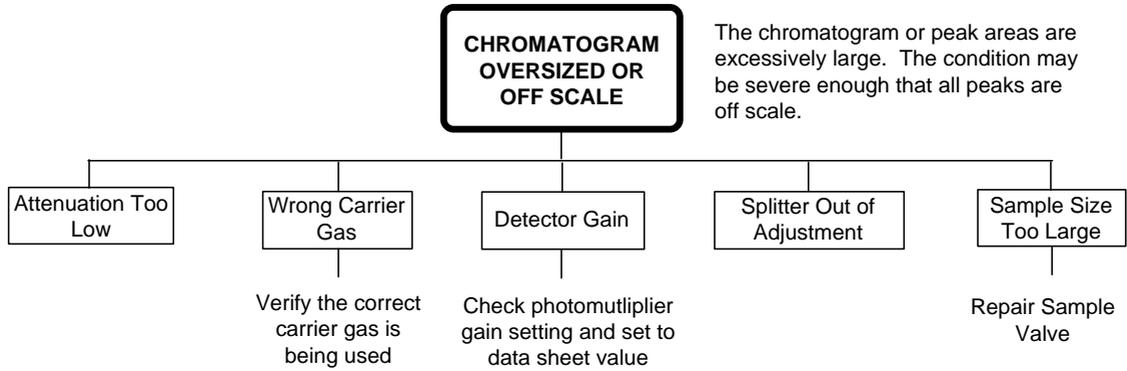


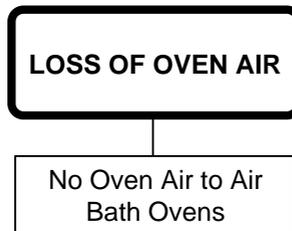
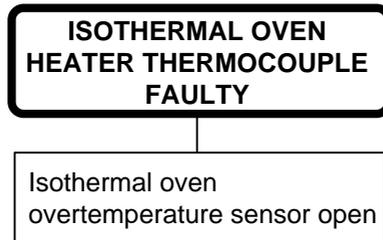
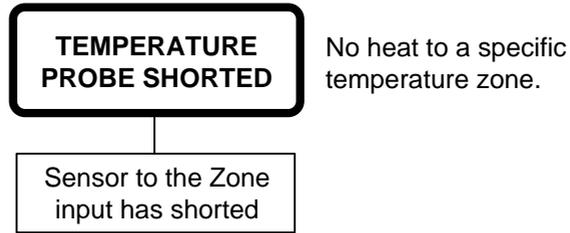
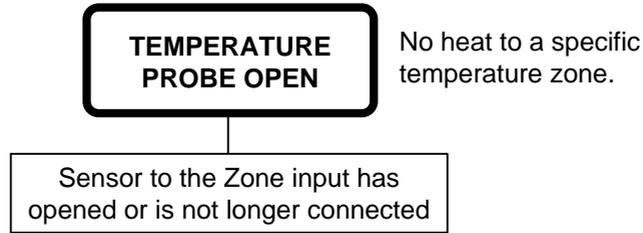
**INDIVIDUAL PEAK
MISSING ON
REPORT**

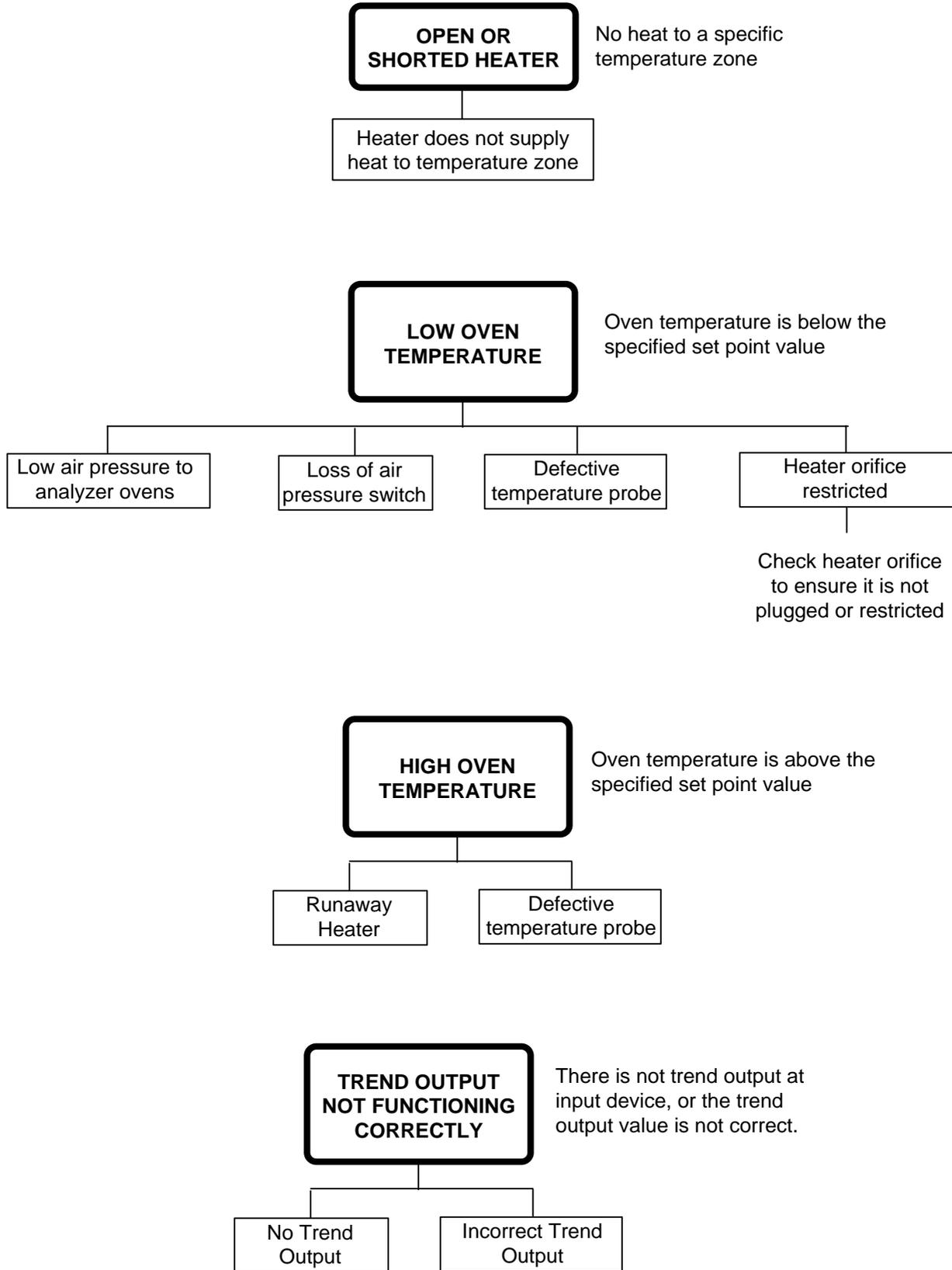
Chromatogram indicates all peaks are present, but the data report shows the peak to be nonexistent or unknown.

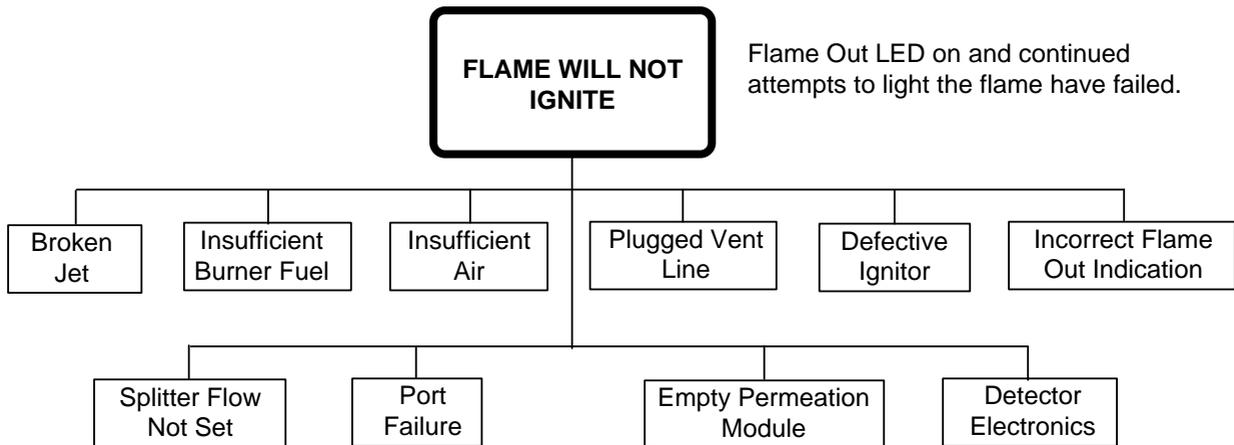
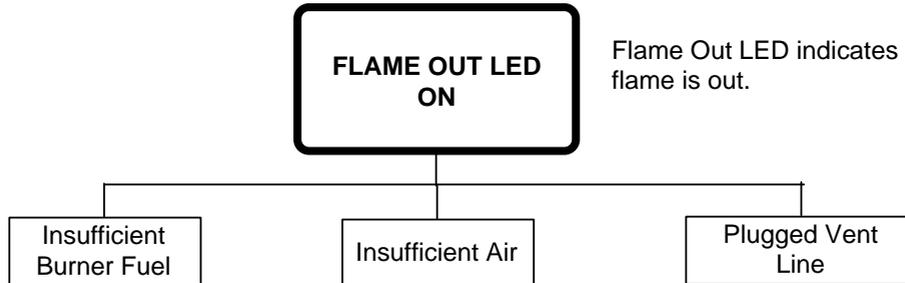
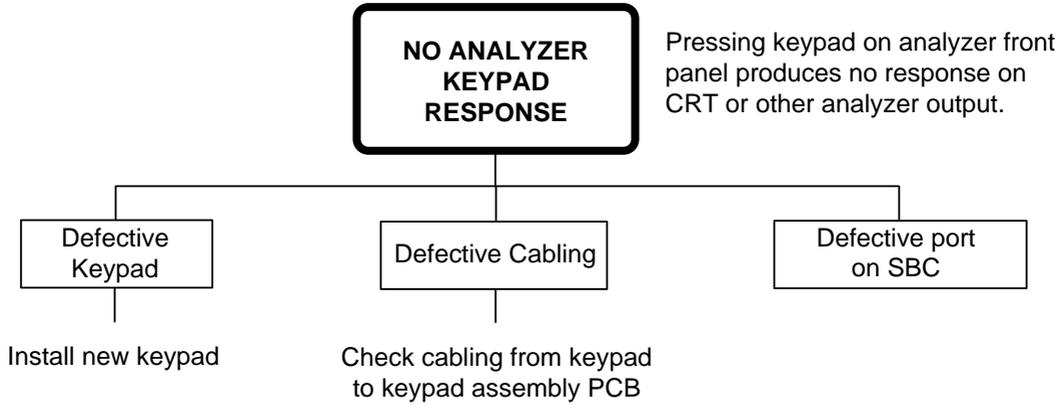
Gating in the method needs to be modified to ensure gating of the missing peak in the report

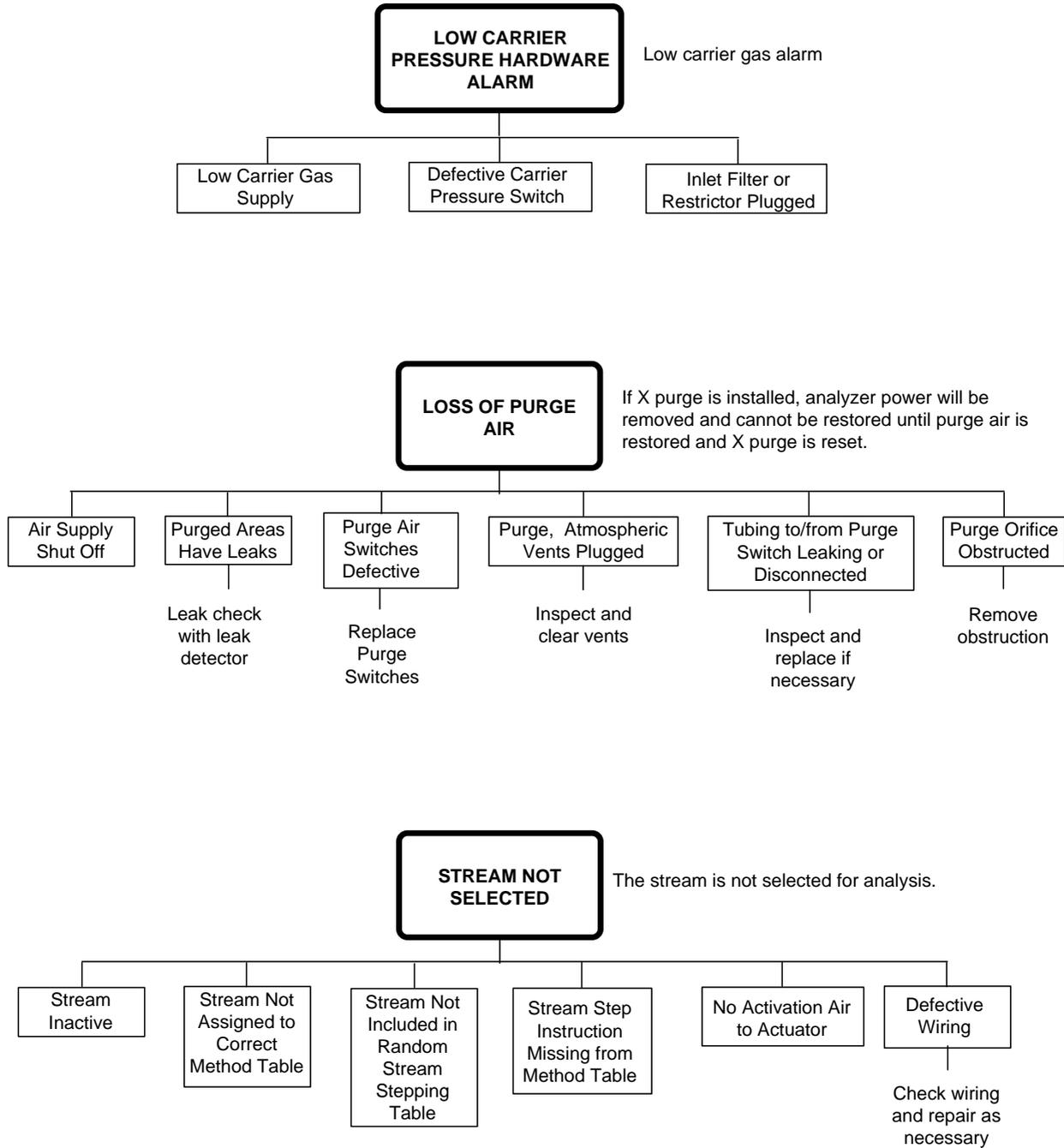
Modify the gate ON/OFF time in the method table

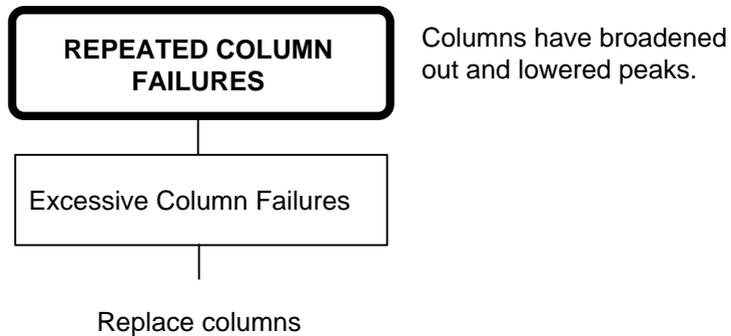
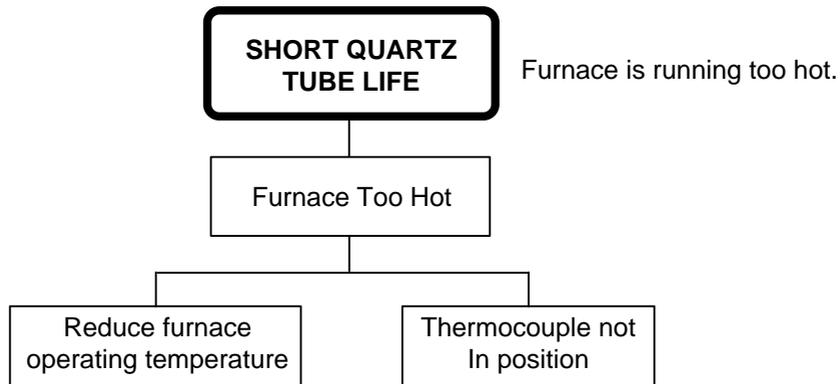
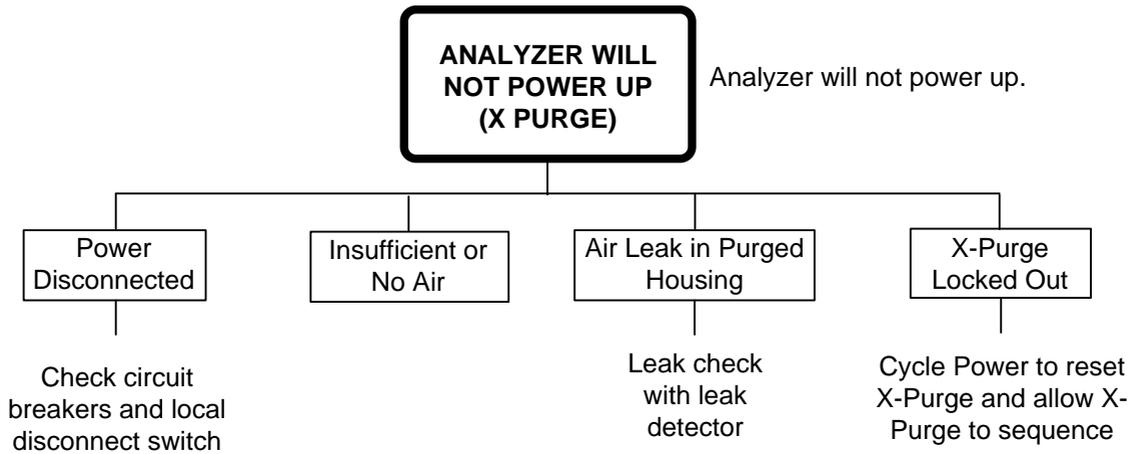












5 Furnace repair

This procedure explains how to remove and replace the furnace inside the isothermal oven. It also explains how to remove and replace the furnace tube within the furnace assembly, and how to replace the thermocouple.

5.1 Removing the furnace cover

1. Verify that the area is non-hazardous.
2. Turn off all power to the analyzer.



Parts of this assembly may be hot to the touch.

3. Allow furnace to cool before proceeding (at least 30 minutes).



Analyzer should be allowed to cool before removing all flows from the columns.

4. Shut off all flows.
5. Open the Isothermal Oven door.
6. Remove the Isothermal Oven door by lifting the door off the hinges, to provide more access room.
7. If the diaphragm valves are on a slider (see Figure 5.1), you will have to move them up to allow removal of the furnace housing cover.

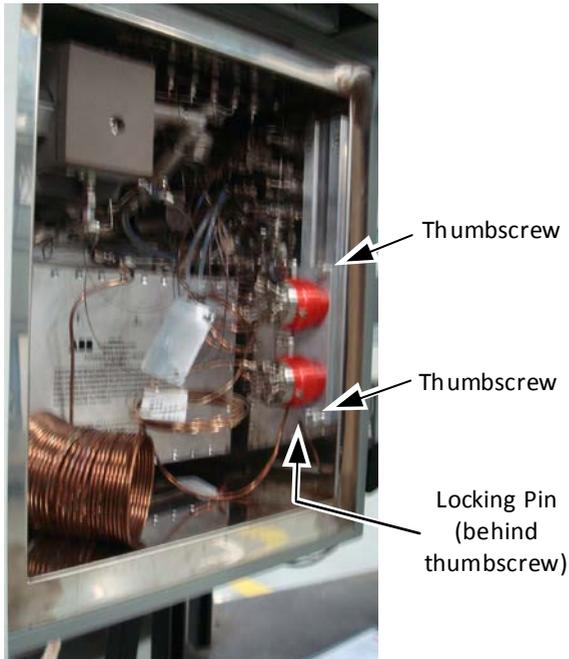


Fig. 7.1. Valves on Slider

8. To move the sliders (see Figure 7.2):
 - a. Loosen the two thumbscrews.
 - b. Pull out the locking pin just far enough to allow you to move the slider.
 - c. Slide the assembly up until the locking pin snaps into place.

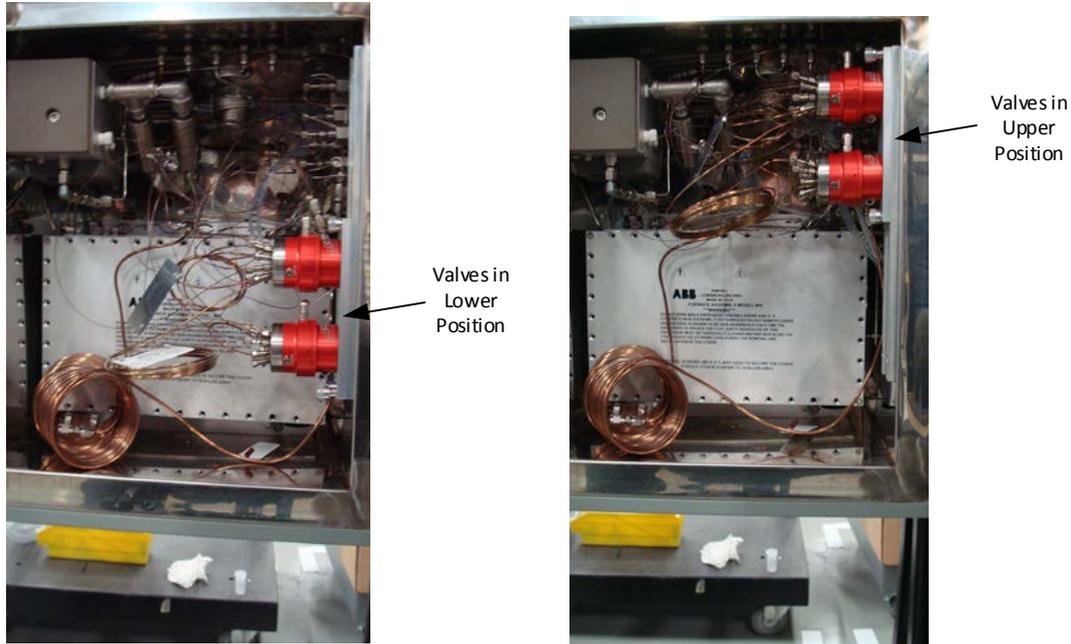


Fig. 7.2. Moving the Valves

9. If the column is in front of the furnace, back out the two screws holding the column mounting bracket in place and slide the bracket toward the furnace.
10. Lift the bracket with the column up and let the column hang down in front of the oven to allow access to the furnace housing cover.
11. Remove the 40 M3 hex socket screws that hold the furnace housing cover (see Figure 5.3). The cover temperature must be below 40° C before you remove the screws.



Fig. 5.3. Furnace Housing

12. Remove the furnace housing cover.

5.2 Removing the furnace

1. Remove the four screws and lockwashers holding the internal heat shield in place and retain them for later use.
2. Remove the heat shield from the furnace housing.
3. Locate the connections to the furnace (see Figure 5.4).

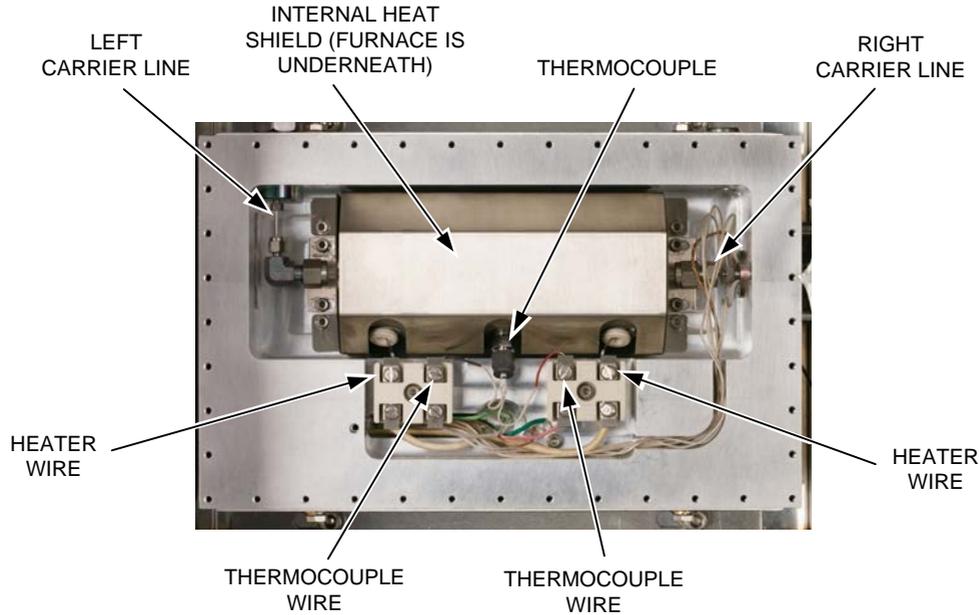


Fig. 5.4. Furnace Housing with Cover Removed

4. Remove the left-side carrier line as follows (see Figure 5.5):
 - a. Use the ABB Tee Wrench to hold the elbow.
 - b. Using a 9/16-inch wrench, disconnect the line just outside the furnace on the quartz tube.
 - c. Using a 1/4-inch wrench, disconnect the line at the top left.
 - d. Using a 5/16-inch wrench, loosen the line just above the elbow.
 - e. Remove this piece and retain it for re-installation.

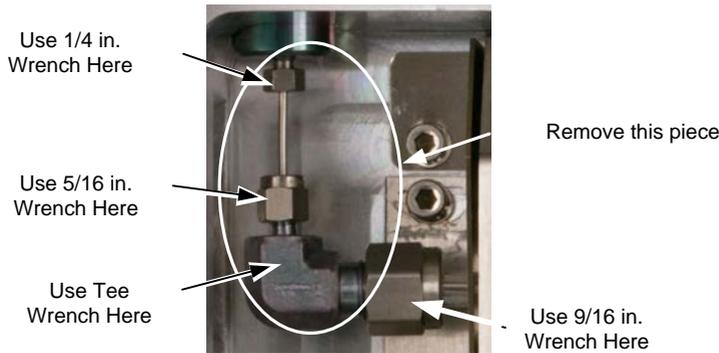


Fig. 5.5. Left-Side Carrier Connections

5. If this is the vapor version of the PGC5007, the right-side carrier line is a mirror image of the left-side carrier line. Remove the right-side carrier line as follows:
 - a. Use the ABB Tee Wrench to hold the elbow.
 - b. Using a 9/16-inch wrench, disconnect the line just outside the furnace on the quartz tube.
 - c. Using a 1/4-inch wrench, disconnect the line at the top left.

- d. Using a 5/16-inch wrench, loosen the line just above the elbow.
- e. Remove this piece and retain it for re-installation.
6. If this is the liquid version, remove the right-side carrier line as follows (see Figure 5.6):
 - a. Use the ABB Tee Wrench to hold the nut as shown in Figure 5.5.
 - b. Using a 9/16-inch wrench, disconnect the line just outside the furnace on the quartz tube.

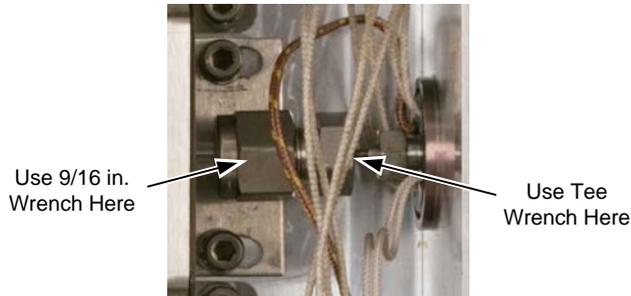


Fig. 5.6. Right-Side Carrier Connections

7. Tag the thermocouple wires for identification. They must be returned to the same location to ensure proper operation of the furnace.
8. Disconnect the thermocouple wires at the terminal blocks.
9. Disconnect the heater wires at the terminal blocks.
10. Remove the four screws holding the furnace in place and retain them for later use.
11. Remove the furnace from the furnace housing.

5.3 Installing the furnace (liquid version)

1. Install the furnace and insert the screws to hold the furnace in place. Do not tighten the screws at this time.
2. Reconnect the right-side carrier lines to the furnace (see Figure 5.6) as follows, but do not tighten the connections:
 - a. Use the ABB Tee Wrench to hold the nut.
 - b. Connect the 9/16-inch line just outside the furnace, finger tight.
3. Reconnect the left-side carrier lines to the furnace (see Figure 5.5) as follows, but do not tighten the connections:
 - a. Hold the piece disconnected earlier approximately in place.
 - b. Connect the 1/4-inch reverse tube nut at the top left, finger tight.
 - c. Connect the 5/16-inch line just above the elbow, finger tight.
 - d. Connect the 9/16-inch line just outside the furnace, finger tight.
4. Position the furnace so that the furnace tube is centered in the furnace end cap.
5. Tighten the screws holding the furnace.
6. On the left-side carrier line:
 - a. Use the ABB Tee Wrench to hold the elbow in place.
 - b. Tighten the 1/4-inch fitting.
 - c. Tighten the 5/16-inch fitting.
 - d. Tighten the 9/16-inch fitting.
7. On the right-side carrier line:
 - a. Use the ABB Tee Wrench to hold the nut in place.
 - b. Tighten the 3/8-inch fitting on the vaporizer, if necessary.
 - c. Tighten the 9/16-inch fitting.



The thermocouple wires are polarity sensitive. They must be re-connected to the same terminals from which they were removed.

8. Connect the thermocouple wires to the inside terminals as shown in Figure 5.4. Hold the terminal as you tighten the screws holding the wires in place, to prevent damage to the terminal block.



The heater wires are flat conductors as opposed to the usual round conductors. The heater wires must be kept flat (not twisted or turned) when inserting them between the terminal plates.

9. Connect the heater wires to the outside terminals as shown in Figure 5.4. Hold the terminal as you tighten the screw holding the wire in place, to prevent damage to the terminal block.
10. Place the heat shield over the furnace housing.
11. Insert and tighten the four screws holding the internal heat shield in place.

5.4 Installing the furnace (vapor version)

1. Install the furnace and insert the screws to hold the furnace in place. Do not tighten the screws at this time.
 2. Reconnect the right-side carrier lines to the furnace (see Figure 5.4) as follows, but do not tighten the connections:
 - a. Hold the piece disconnected earlier approximately in place.
 - b. Connect the 1/4-inch reverse tube nut at the top right, finger tight.
 - c. Connect the 5/16-inch line just outside the furnace, finger tight.
 - d. Connect the 9/16-inch line just above the elbow, finger tight.
 3. Reconnect the left-side carrier lines to the furnace (see Figure 5.4) as follows, but do not tighten the connections:
 - a. Hold the piece disconnected earlier approximately in place.
 - b. Connect the 1/4-inch reverse tube nut at the top left, finger tight.
 - c. Connect the 5/16-inch line just outside the furnace, finger tight.
 - d. Connect the 9/16-inch line just above the elbow, finger tight.
 4. Position the furnace so that the furnace tube is centered in the furnace end cap.
 5. Tighten the screws holding the furnace.
 6. On the right-side carrier line:
 - a. Use the ABB Tee Wrench to hold the elbow in place.
 - b. Tighten the 1/4-inch fitting.
 - c. Tighten the 5/16-inch fitting.
 - d. Tighten the 9/16-inch fitting.
 7. On the left-side carrier line:
 - a. Use the ABB Tee Wrench to hold the elbow in place.
 - b. Tighten the 1/4-inch fitting.
 - c. Tighten the 5/16-inch fitting.
 - d. Tighten the 9/16-inch fitting.
-



The thermocouple wires are polarity sensitive. They must be re-connected to the same terminals from which they were removed.

8. Connect the thermocouple wires to the inside terminals as shown in Figure 5.4. Hold the terminal as you tighten the screws holding the wires in place, to prevent damage to the terminal block.
-



The heater wires are flat conductors as opposed to the usual round conductors. The heater wires must be kept flat (not twisted or turned) when inserting them between the terminal plates.

9. Connect the heater wires to the outside terminals as shown in Figure 5.4. Hold the terminal as you tighten the screw holding the wire in place, to prevent damage to the terminal block.
10. Place the heat shield over the furnace housing.
11. Insert and tighten the four screws holding the internal heat shield in place.

5.5 Removing the sulfur furnace tube

1. Remove the furnace cover as described in "Removing the Furnace Cover."
 2. Remove the furnace from the explosion-proof housing as described in "Removing the Furnace."
-



The thermocouple probe is very close to the sulfur furnace tube. Be careful not to contact the thermocouple probe when you are removing the furnace tube.

3. Remove the fitting nuts on one end of the sulfur furnace tube.
4. Remove the old sulfur furnace tube by pulling it through the furnace heater assembly at the other end.

5.6 Installing a new sulfur furnace tube



The new quartz sulfur furnace tube must never be touched with bare hands. Always wear rubber gloves when installing or handling the quartz sulfur furnace tube.

1. Clean the new sulfur furnace tube with acetone, inside and out.
2. Wipe the tube with a clean, absorbent, non-abrasive, lint-free wipe.
3. Clean the new sulfur furnace tube again, with methanol, inside and out.
4. Wipe the tube with a clean, absorbent, non-abrasive, lint-free wipe.



The thermocouple probe is very close to the sulfur furnace tube. Be careful not to contact the thermocouple tube when you are installing the furnace tube. Refer to "Installing a new thermocouple" for additional information.

5. Install the new sulfur furnace tube into the furnace heater assembly by inserting the tube into one end and sliding it through until an equal portion protrudes from each end.
6. Using new nuts and graphite ferrules supplied in the furnace tube kit, place a nut and a ferrule on each end of the furnace tube. The ferrules should be approximately 1/16-inch from the end of the furnace tube.
7. Install the furnace into the explosion-proof housing as described in "Installing the Furnace."
8. With the nuts and ferrules still loose, be sure that the tubing is centered in the furnace..
9. Tighten the fittings finger tight and then tighten them one additional complete turn. Be sure not to overtighten the fittings as damage to the tube may result.



When a compression fitting is tightening, the tubing that it is sealing will be forced towards the tube stop. With most tubing materials this is not a problem. Quartz, however, will crush at the tips if the tube is not backed off the tube stop. You must take care to see that the ferrules make proper engagement on the tube to prevent leaks.

10. If this completes the furnace work, install the furnace cover as described in "Installing the Furnace Cover."

5.7 Removing the thermocouple

The thermocouple is part of the furnace assembly. This procedure explains how to replace the thermocouple when the furnace does not need to be replaced.

1. Remove the furnace cover as described in "Removing the Furnace Cover."
2. Disconnect the thermocouple connections on the furnace side of the terminals (see Figure 5.3).
3. Place one wrench on the 1/8-inch fitting and a second wrench (backup wrench) on the 3/16-inch tube fitting, and remove the tube fitting and its ferrule from the furnace.
4. Remove the old thermocouple from the furnace.

5.8 Installing a new thermocouple

1. Ensure that the 1/8-inch fitting on the furnace is tight.
2. Assemble the tube nut, graphite ferrule and new thermocouple.
3. Insert the new thermocouple assembly into the furnace until the tip touches the furnace tube.
4. Tighten the tube nut slightly but still allowing the thermocouple to be moved.

5. Withdraw the thermocouple 1/32 inch (maximum) from the furnace tube. It must be very close to the tube without actually touching the furnace tube.
6. Hold the thermocouple in place and tighten the tube nut finger tight.
7. Place one wrench on the 1/8-inch fitting and a second wrench (backup wrench) on the 3/16-inch tube fitting, and tighten the tube fitting 1/4-turn. The tube nut should be just tight enough to ensure the thermocouple cannot move. It does not have to be a gas-tight fitting.
8. Verify that the thermocouple cannot move in the fitting.
9. Slide the insulating tubes over the thermocouple wires.
10. Restore the thermocouple wires to their original connections on the terminal block.
11. Verify that the thermocouple wires are not shorted to each other.
12. If this completes the furnace work, install the furnace cover as described in "Installing the Furnace Cover."

5.9 Installing the furnace cover

1. Verify that the internal heat shield is in place.
2. Apply low-sodium lubricant ABB P/N 3617948-1 to all 40 cover bolts.
3. Place the cover onto the housing.
4. Install the 40 cover bolts and torque all cover bolts to 16 in-lbs.
5. If the column was moved, restore it to its original position and install and tighten the two mounting screws.
6. If the diaphragm valves are on a slider, move them back to their original location and tighten the thumbscrews.
7. Install the isothermal oven door on its hinges.
8. Close the isothermal oven door.

6 Liquid sample valve repair

6.1 Introduction

The analyzer's sample lines are connected to the liquid sample valve as shown in Figure 6.1.

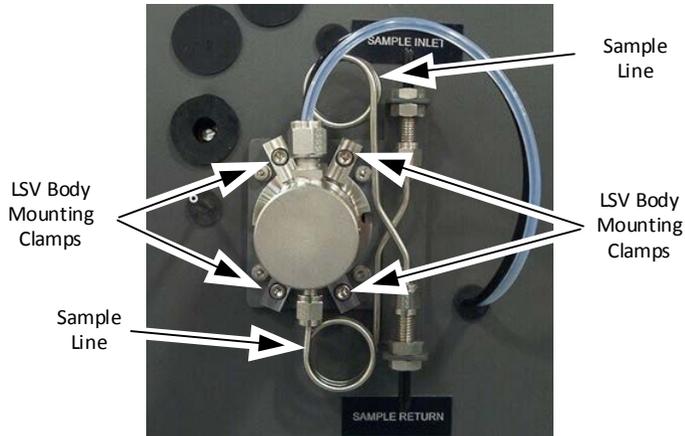


Fig. 6.1. Liquid Sample Valve

It is important to use two wrenches when tightening the sample line connections. One wrench must be used to back up the force applied to tighten the fitting. Direct wrench force (not using a back-up wrench) will damage the seals and possibly bend the stem.

Sample will spill or leak out during this procedure. Consult MSDS sheets on file at your location for safety requirements.



Sample valve repair may necessitate the venting of flammable substances into the atmosphere surrounding the analyzer. Remove power from all sources of ignition in the immediate area. Do not open any purged enclosures that remain powered.

Ensure proper safety equipment is worn, such as rubber gloves and face shield or safety glasses.

It is the customer's responsibility to ensure that the area is safe and hazard-free, and will remain so the entire time the analyzer is open. This responsibility includes ensuring adequate ventilation in analyzer shelter and obtaining proper work permits, etc.



To ensure the integrity of the components within the Liquid Sample Valve (LSV), use the tools in LSV Tool Kit 791K009-1 when assembling or disassembling the LSV.

6.2 LSV disassembly on the analyzer

See Figure 6.2 for typical sample valve component location.

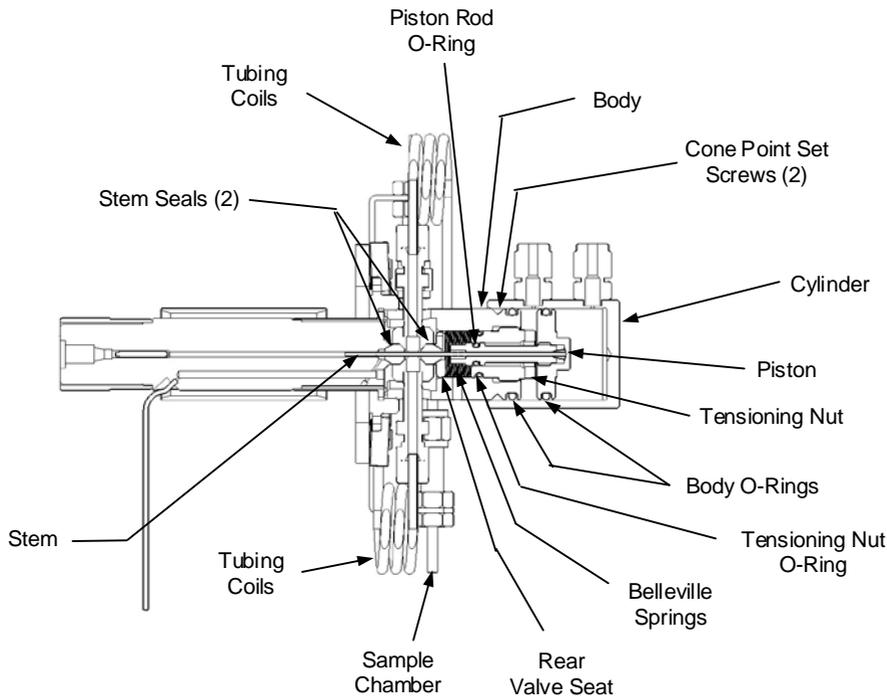


Fig. 6.2. Liquid Sample Valve Component Location

1. Stop the analysis at the end of a cycle.
2. Remove power from the analyzer.
3. Allow all temperature zones to cool, maintaining flow while the columns are cooling.
4. Turn off carrier, sample and air to the analyzer.
5. Open the isothermal oven door.
6. Verify that the bolt keeping the vaporizer from turning is tightened to 25 in-lb.
7. Disconnect the tubing coils from the Liquid Sample Valve.
8. Remove the two **cone point set screws** from the **cylinder**.
9. Slide the **cylinder** off the **piston** and **body**.
10. Using a hex key wrench, rotate the **tensioning nut** counterclockwise until the assembly is loose.
11. Unscrew the **body** from the **flange** and **vaporizer chamber**.
12. Withdraw the **piston** and the **piston rod** from the **tensioning nut**.
13. This will free the **seals** from the **stem**.
14. Replace the **seals**.
15. Inspect the stem for visible imperfections. If imperfections are found, replace the stem.
16. Remove the **rear valve seat** from the **body**.
17. Remove the 15 **Belleville springs** from the **body**.
18. Inspect the **body O-rings** for visible imperfections. If imperfections are found, remove the **body O-rings** from the **body** and **piston**.
19. Unscrew the **piston rod** from the **piston** and extract the **stem assembly** from the **piston rod**.
20. Inspect the **piston rod O-ring** for visible imperfections. If imperfections are found, remove the **piston rod O-ring** from the **piston rod**.
21. Unscrew the **tensioning nut** from the **body**.
22. Inspect the **tensioning nut O-ring** for visible imperfections. If imperfections are found, remove the **O-ring** from the **tensioning nut**.

6.3 LSV reassembly on the analyzer



In all steps the lubricant used is High Vacuum Grease, ABB part number 006904-1.

1. Clean the **seals** with acetone and air dry them.
2. Clean the **sample chamber** with acetone and air dry it.
3. Lightly lubricate the **tensioning nut O-Ring** and the Tensioning Nut threads, internal threads and bore of the **body** with High Vacuum Grease.
4. Install the **O-ring** onto the **Tensioning Nut**.
5. Screw the **tensioning nut** into the **body** until the bottom of the nut grooves is approximately flush with the ears on the back of the body.
6. Lightly lubricate the **piston rod O-ring** and the threads of the **piston rod**.
7. Install the **piston rod O-ring** onto the **piston rod**. Do not allow grease to enter the small hole through the center of the piston.
8. Insert the **stem** into the rear of the **piston rod**.
9. Screw the **piston rod** into the **piston** and tighten to 27-30 in-lb. Do not overtighten or bend the rod or stem! Do not allow grease to contact the stem.
10. Lightly lubricate the **body O-rings**.
11. Install the **body O-rings** onto the **body** and the **piston**.
12. Insert the **piston** and the **piston rod** into the **sleeve**, being careful not to cut the O-ring. Fully insert the **piston** until it contacts the stops.
13. Stack the **15 Belleville springs** onto the 1/4-inch thin wall plastic tubing, as shown in Figure 6.3.

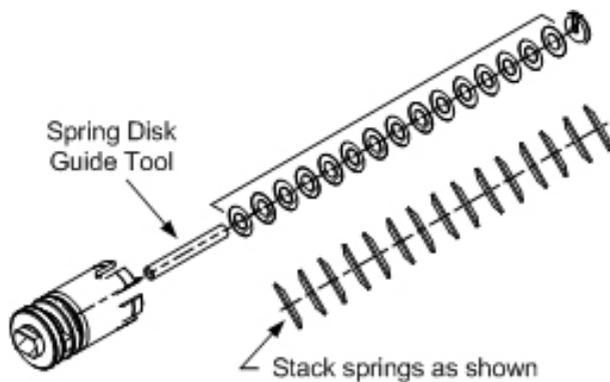


Fig. 6.3. Stacking The Belleville Springs

14. Using the tubing only as a guide, slide the **Belleville springs** over the **stem** into the bore of the **body**.
15. Install the **rear valve seat** over the **stem** and let it rest against the **Belleville springs**. Do not allow the seat to scratch the stem.
16. Clean all the exposed area of the **stem** with acetone to ensure the stem and groove are free of grease and contamination.

17. Slide the first cleaned **seal** over the **stem** using the "A" end of Seal Insertion Tool TL-791A006B. The 30° angle (pointed end) of the **seal** must face the **Belleville springs**. Figure 6.4 shows the orientation of the seal.

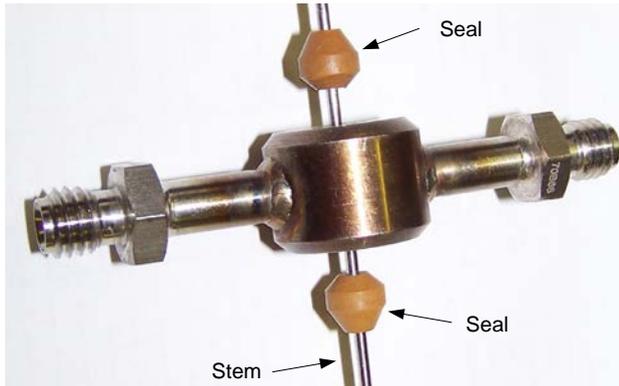


Figure 6.4. Installing the Stem Seals

18. Slide the cleaned **sample chamber** over the **stem** onto the **seal**.
19. Slide the second cleaned **seal** over the **stem** using the "B" end of Seal Insertion Tool TL-791A006B. The 30° angled (pointed end) of the **seal** faces out, away from the **sample chamber**. Figure A-14 shows the orientation of the seal.
20. Lightly lubricate the threads on the **body**.
21. Retract the **stem** until it is flush with the front of the **seal**.
22. Screw the **body** into the **flange** against the **vaporizer chamber** until tight.
23. Push the **stem** into place.
24. The **sample chamber** should be loose in the assembly at this point. If not, back out the **tensioning nut** until the **sample chamber** is loose. Use the end of a 0.156 Allen wrench in the slot of the tensioning nut to adjust to the point of eliminating the longitudinal play of the sample chamber.
25. Tighten the **tensioning nut** in 24 1/4-turn increments (6 turns total) to load the **seals**.
26. Lightly lubricate the inside bore of the **cylinder**.
27. Align the fittings on the **cylinder** with the **sample chamber** tubes, or with air lines if servicing.
28. Slide the **cylinder** onto the **piston** and the **body**.
29. Install two **cone point set screws** into the **cylinder** and tighten into the groove on the **body**.
30. Reinstall tubing to the LSV, being careful to connect each line to the proper connection on the LSV.
31. Close the isothermal oven door.

6.4 Removing the LSV from the analyzer

1. Remove power from the analyzer.
2. Allow all temperature zones to cool, maintaining flow while the columns are cooling.
3. Turn off carrier, sample, and air to the analyzer.
4. Open the isothermal oven door.
5. Remove the furnace cover as described in "Removing the Furnace Cover."
6. At the right side of the furnace, remove the carrier line as follows (reference Figures 5.3 and 5.4):
 - a. Use the ABB Tee wrench to hold the nut.
 - b. Using a 9/16-inch wrench, disconnect the line just outside the furnace tube.
7. Loosen the nut, on the furnace housing, that retains the vaporizer
8. Label all connections to the Liquid Sample Valve.
9. Disconnect all tubing from the Liquid Sample Valve.
10. Mark the analyzer and flange to ensure the flange is reinstalled in the correct orientation.
11. Remove the four screws holding the flange to the side of the analyzer.
12. Remove the Liquid Sample Valve from the analyzer. The insulation and insulation retainer may move during LSV removal; retain them for later installation.
13. Close the isothermal oven door.

6.5 Installing the LSV on the analyzer

1. Open the isothermal oven door.

2. Install the Liquid Sample Valve on the analyzer, making sure the insulation and insulation retainer are in the proper location around the vaporizer.
3. Orient the flange so that the marks made at valve removal are lined up. This should have the sample chamber vertical, with the air connections at the top of the valve and the connection of the vaporizer chamber at the top.
4. Install the four screws holding the flange to the side of the analyzer and tighten the screws.
5. At the right side of the furnace reconnect the carrier line as follows (reference Figures 5.3 and 5.4):
 - a. Use the ABB Tee wrench to hold the nut.
 - b. Connect the 9/16-inch line just outside the furnace tube.
6. Reconnect all tubing on the Liquid Sample Valve.
7. Close the isothermal oven door.

7 Detector repair



It is the customer's responsibility to ensure that the area is safe and hazard-free, and will remain so the entire time the analyzer is open. This responsibility includes ensuring adequate ventilation in analyzer shelter and obtaining proper work permits, etc.

7.1 Replacing the photomultiplier assembly

1. Remove power from the analyzer.
2. Allow all temperature zones to cool, maintaining flow while the columns are cooling.
3. Turn off carrier, sample and air to the analyzer.
4. Open the side door of the Electronics Enclosure.
5. Disconnect the cables to the Photomultiplier Assembly (see Figure 7.1) and set them aside.



Fig. 7.1. Electronics Enclosure

6. Remove the four bolts securing the Photomultiplier Assembly (PMT) to the analyzer, being careful to retain the bolts to reinstall the PMT.
7. Carefully pull the PMT straight out of the analyzer, supporting the Burner Block to allow you to remove the PMT.
8. To reinstall the PMT, slide the PMT so that the tube just enters the oven.
9. Place the Burner Block so that its tubing nut aligns with the PMT light pipe. The Burner Block nut must form a straight line with the PMT light pipe to allow them to fit together.
10. Support the Burner Block and slide the PMT the rest of the way into place.
11. Install and tighten the four screws holding the PMT in place.
12. Reconnect the cables to the PMT.
13. Close the Electronics Enclosure door.

7.2 Replacing the burner block

1. Remove power from the analyzer.
2. Allow all temperature zones to cool, maintaining flow while the columns are cooling.
3. Turn off carrier, sample, and air to the analyzer.
4. Open the Electronics Enclosure side door.
5. Locate the DTC PCB (see Figure 7.1).

6. Disconnect the heater, thermocouple and temperature sensor leads from the DTC PCB (see Figure 7.2).

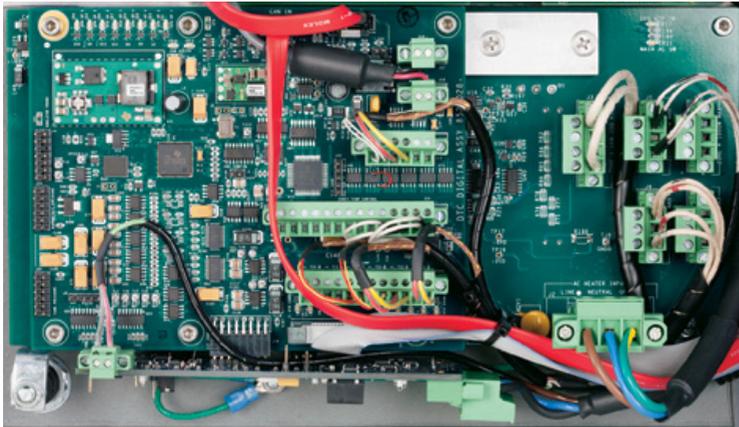


Fig. 7.2. DTC PCB Connections

7. Untie the cabling to ensure it can be removed from the Electronics Enclosure.
8. Open the isothermal oven door.
9. Disconnect the sample line from the Burner Block (see Figure 7.3).

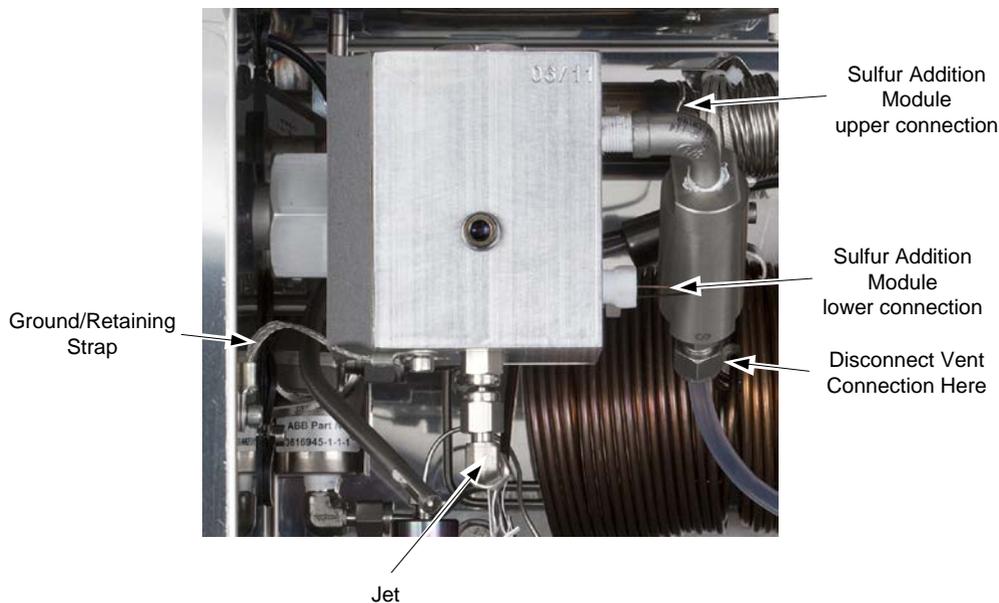


Fig. 7.3. Burner Block

10. Disconnect the vent line from the Burner Block breather.
11. Disconnect the hydrogen (H₂) and carrier lines from the Burner Block.
12. Disconnect the Ground/Retaining Strap from the Burner Block.
13. Slide the Burner Block off the Photomultiplier Assembly light tube (at the same time, the conduit will slide out of the Electronics Enclosure) and remove the Burner Block from the oven. You may need to assist the wiring through the enclosure.
14. When you install the new Burner Block, support the block and pass the wiring through the opening into the Electronics Enclosure.
15. Carefully align the Burner Block and conduit, and slide the tubing nut over the light tube from the PMT.
16. Reconnect the Ground/Retaining Strap.
17. Reconnect all lines removed when you removed the Burner Block.
18. Route the cabling through the Electronics Enclosure and reconnect the wires to the appropriate terminals on the DTC PCB.

19. Close the isothermal oven door.
20. Close the Electronics Enclosure side door.

7.3 Replacing the burner block wiring

1. Perform steps 1 through 13 of "Replacing the Burner Block."
2. Remove the heater, thermocouple and temperature sensor leads, and the internal ground wire from the Burner Block.
3. Unscrew the cable conduit from the Burner Block.
4. Thread the new leads into the Burner Block.
5. Screw the new cable conduit onto the Burner Block.
6. Insert the heater, thermocouple and temperature sensor leads into the appropriate places in the Burner Block.
7. Install the Burner Block, following steps 14 through 20 of "Replacing the Burner Block."

7.4 Replacing the burner block o-rings

1. Perform steps 1 through 13 of "Replacing the Burner Block."
2. To remove a particular O-Ring, carefully remove the associated connector and then remove the O-Ring (see Figure 7.4).

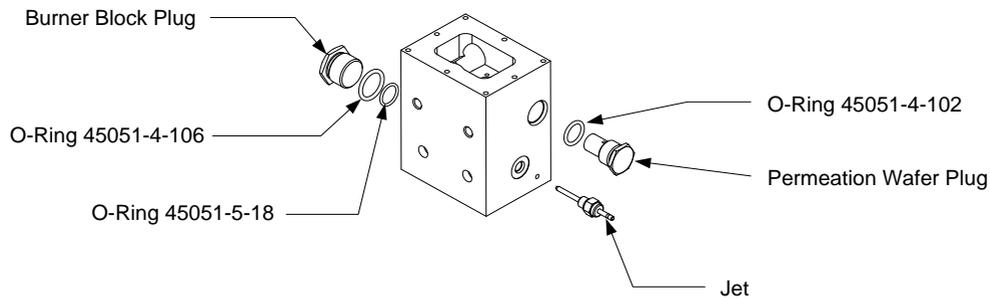


Fig. 7.4. Burner Block, Showing O-Rings

3. Lubricate the new O-Ring with a slight film of silicone grease.
4. Insert the new O-Ring and reinstall the connector.
5. Install the Burner Block, following steps 14 through 20 of "Replacing the Burner Block."

7.5 Replacing the jet

1. Remove power from the analyzer.
2. Allow all temperature zones to cool, maintaining flow while the columns are cooling.
3. Turn off carrier, sample, and air to the analyzer.
4. Open the isothermal oven door.
5. Carefully remove the Jet Nut and O-Ring (see Figure 7.4).
6. If the Jet came out with the nut, carefully remove the Jet from the nut.
7. If the Jet did not come out with the nut, carefully remove the Jet from the Burner Block by pulling it straight down.
8. Separate the O-ring from the Jet.
9. Insert the new Jet and O-Ring into the nut until it seats fully.
10. Carefully install and tighten the nut for the Jet assembly.
11. Reconnect carrier, gas and air lines.
12. Close the isothermal oven door.

8 Replacement parts

8.1 Ordering information

The replacement parts listed in this section are specific to the PGC5007. For all other replacement parts in the analyzer, you must refer to the Recommended Spare Parts Lists in the Data Package.



Since the component parts specific to any given system are defined by the particular application, you should refer to the “Recommended Spare Parts Lists” in the Data Package supplied with the analyzer, to obtain the full and correct part number for the desired part or assembly.

8.2 Equipment identification

Include the following information, found in the Data Package and on the analyzer nameplate, in any communication concerning replacement parts or components:

- ABB Sales Order Number.
- Analyzer Model Number.
- Analyzer Part Number (P/N) and serial number.
- Serial number and part number (including dash number and revision letter) for serial numbered subassemblies such as printed circuit boards.
- Applicable references from the “Recommended Spare Parts List” of the Data Package, included with each analyzer.
- Description of part.

8.3 How to order

Please contact your local ABB sales or service representative for specific instructions on ordering parts. Always include the information listed in Equipment Identification and Configuration Identification in your request.

8.4 Replacement parts listing (see Figure 8.1)

Description	Name	Part Number
Furnace Replacement Kit	Kit, 796 Furnace Replacement	868K002-1
Furnace Tube Kit	Kit, Furnace Tube	868K003-1
Thermocouple Kit	Kit, Thermocouple Replacement	807K005-1
Liquid Sample Valve	Valve Assembly Liquid Sample High Heat	791A024-__
LSV Seals	Seal, Liquid Sample Valve, 0.062 i.d.	791M028B-__
LSV Stems	Stem, sample assembly	791A009B-__
Ceramic Connector	Connector, Ceramic	3617509-1
Low-Sodium Lubricant	Lubricant, Low-Sodium	3617948-1

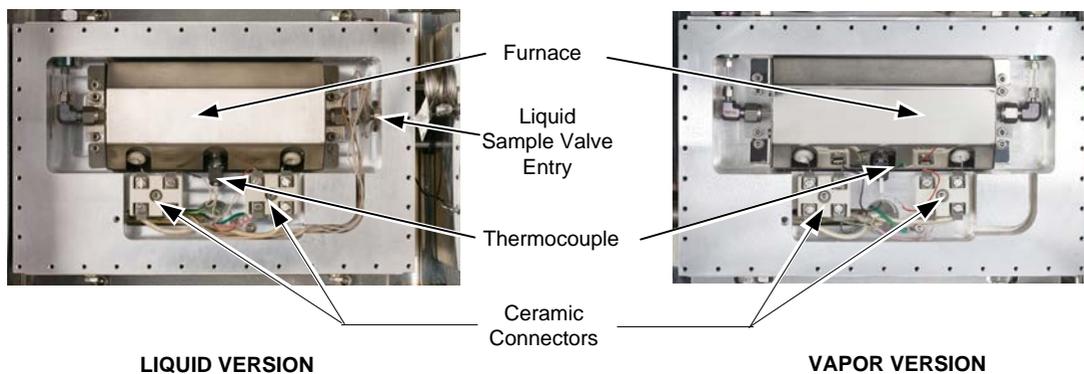


Fig. 8.1. Oven Compartment

NOTES

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