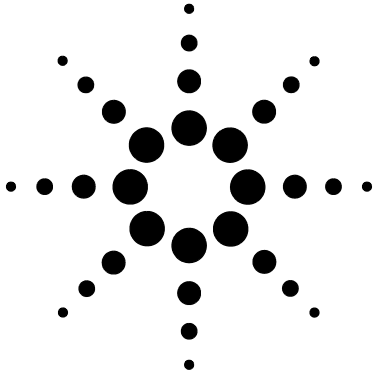

Agilent G2647A (Single) and G2648A (Dual) Flame Photometric Detector Update Kits

For Agilent 6850 and 6890 GCs

Update, Operation and Maintenance

Agilent Technologies

Notices

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A WARNING notice denotes a hazard. It calls attention to an operating procedure, practice, or the like that, if not correctly performed or adhered to, could result in personal injury or death. Do not proceed beyond a WARNING notice until the indicated conditions are fully understood and met.

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1
Updating the FPD

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The G2647A and G2648A kits contain parts for upgrading an existing flame photometric detector (FPD) on an Agilent 6850 or 6890 Series gas chromatograph (GC) to the high-sensitivity version introduced in April 2005. Table 1 describes each kit further.

Table 1 FPD update kits

Kit	Description
G2647A	Contains parts for a single-wavelength FPD, which requires you to change the wavelength filter when switching between sulphur and phosphorous detection modes.
G2648A	Contains parts for a dual-wavelength FPD, which enables you to collect both sulfur and phosphorous data at the same time.

Kit Contents

The contents of the kits are identical except for the detector body assembly. Table 2 lists the contents.

Table 2 Parts list

Description	Kit G2647A Single-wavelength	Kit G2648A Dual-wavelength
FPD single-wavelength body assembly	1	–
FPD dual-wavelength body assembly	–	1
1/8-inch brass nut	1	1
No-hole ferrule	1	1
Column nut	1	1
1/8-inch ferrule	1	1
Sulfur filter	1	1
Filter spacer (used with sulfur filter)	1	2
Exit tube assembly	1	1
Capillary adapter	1	1
1/4-inch packed column adapter	1	1
Column measuring tool	1	1

Required Tools

- T-20 Torx® screwdriver
- Clean, lint-free gloves
- Screwdriver
- 5/16-inch open-end wrench or an 8-mm nut driver
- White typewriter correction fluid
- Column cutter
- Isopropanol
- Grounded wrist strap

Overview

CAUTION This update procedure involves taking your current FPD apart. Perform this procedure only if you are experienced in GC maintenance. If not, trained Agilent personnel can update your FPD for you.

Before you begin, ensure that the present FPD is operating correctly. You will be reusing many of its parts with the update.

6850 GC

The detector body (lens holder, chimney, and PMT bracket) is replaced. The PMT housing, detector board, ignitor cable, and flow module are reused.

The update body contains a 6890-type heater/sensor cable. It must be removed and replaced with the heater/sensor cable from the present detector.

6890 GC

The detector body (lens holder(s), chimney, and PMT bracket(s)) is replaced. The PMT housing, detector board, and flow module are reused.

Procedure

1. Compare the contents of the kit to the list on page 8.
2. Prepare the GC. (See page 11).
3. Remove the current FPD body from the GC. (See page 13).
4. **6850 only!** Remove the heater/sensor cable from the update body. Replace it with the heater/sensor cable from the present FPD. (See page 17).
5. Install the new FPD body onto the GC. (See page 19).
6. Return the GC to operating condition. (See page 21).
7. Test the FPD (see Chapter 2, “Checkout Procedure”).

Prepare the GC

1 Turn off the GC and unplug the power cord.

WARNING **Hazardous voltages are present in the instrument whenever the power cord is connected. Avoid a potentially dangerous shock hazard by disconnecting the power cord before working on the instrument.**

2 Turn off all gases at their sources.

WARNING **Hydrogen gas is flammable and potentially explosive. Before installing the detector, turn off the hydrogen gas at the source.**

CAUTION Use clean, lint-free gloves when handling internal parts of the FPD.

3 Remove the column and any adapter inside the oven.

4 Remove covers and panels as described below.

For 6850

Remove the lid top cover(s). If the plastic vent tubing interferes with lid removal, remove it. Loosen the thumb screw at the front of the detector cover and remove the remaining lid mounting screws.

For 6890

Remove the covers and panels as indicated in Figure 1.

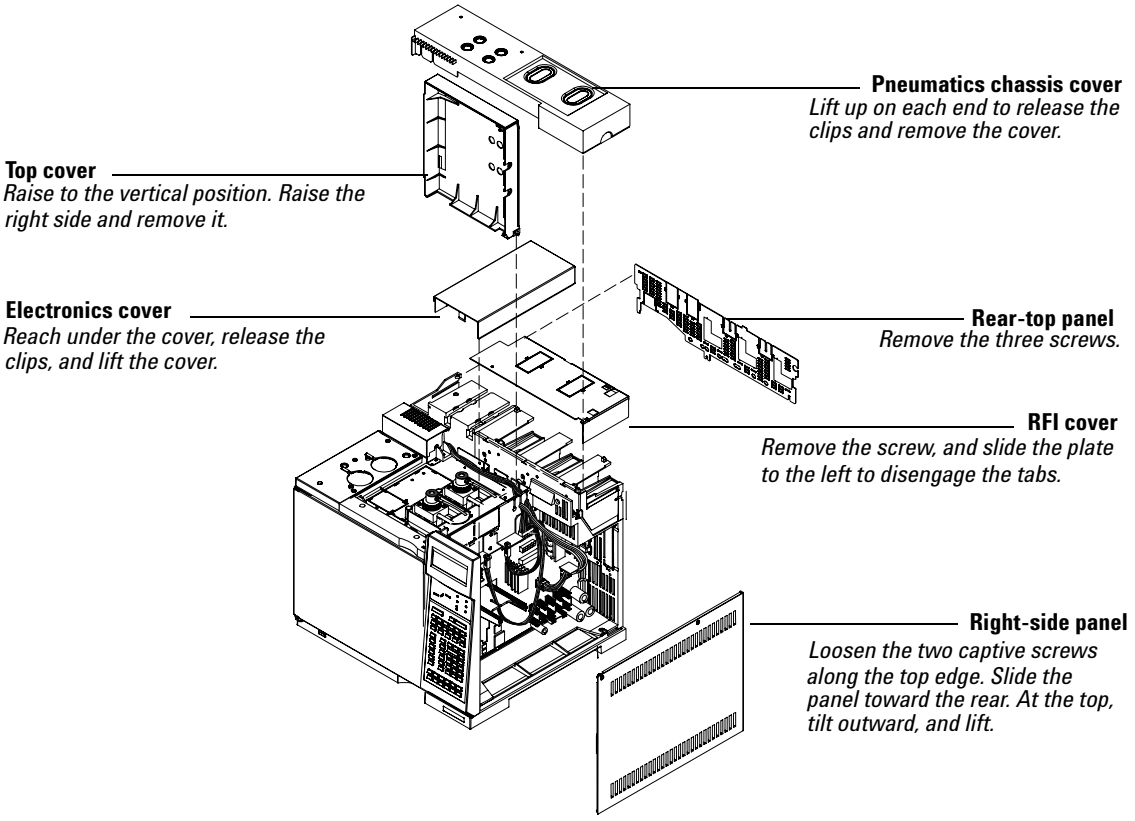

Figure 1 Removing covers and panels of the 6890 GC

Remove the Present FPD Body from the GC

WARNING **To avoid damaging the printed circuit board electronics, use a grounded wrist strap (part number 9300-1408) and connect it to a bare metal surface of the GC.**

Disconnect the gas lines

6850 GC

1 Trace the gas lines from the detector to the manifold block on the flow module. Disconnect the manifold block. Save the screw. (See Figure 2).

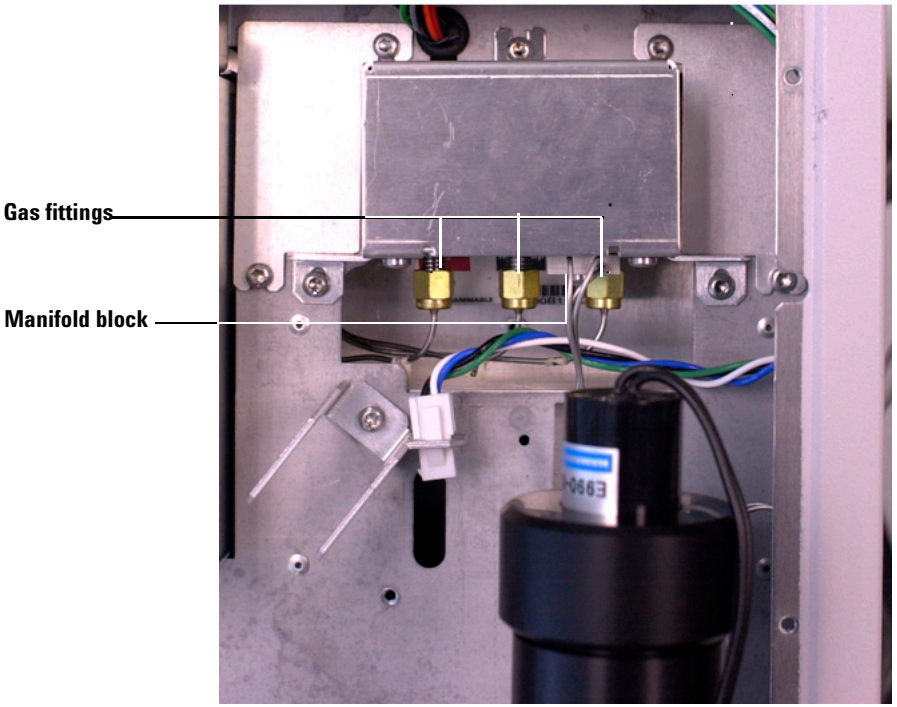

Figure 2 Disconnecting the gas lines on a 6850 GC

6890 GC

1 At the back of the GC, remove the screw attaching the manifold block to the FPD flow module. Save the screw. See Figure 3.

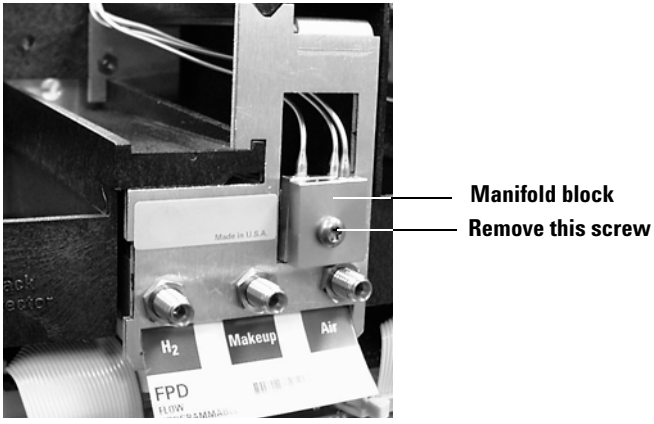

Figure 3 Disconnecting the manifold block on a 6890 GC

2 Free the manifold block and tubing from the GC.

Remove the PMT assemblies from the detector

1 Release the photomultiplier retainer spring(s) from the bracket(s).

2 Cables from the PMT are secured by a clip on the side of the bracket. Release them from the clip. (See Figure 4).

CAUTION To avoid damaging the tube, be sure the GC is off before removing the PMT housing.

3 Remove the PMT housing(s) from the detector body (Figure 4). Use a gentle twisting motion.

Set the housing(s) in a safe place. Cover the open end of the PMT(s) to avoid light damage to the tube. It should not be necessary to disconnect any cables.

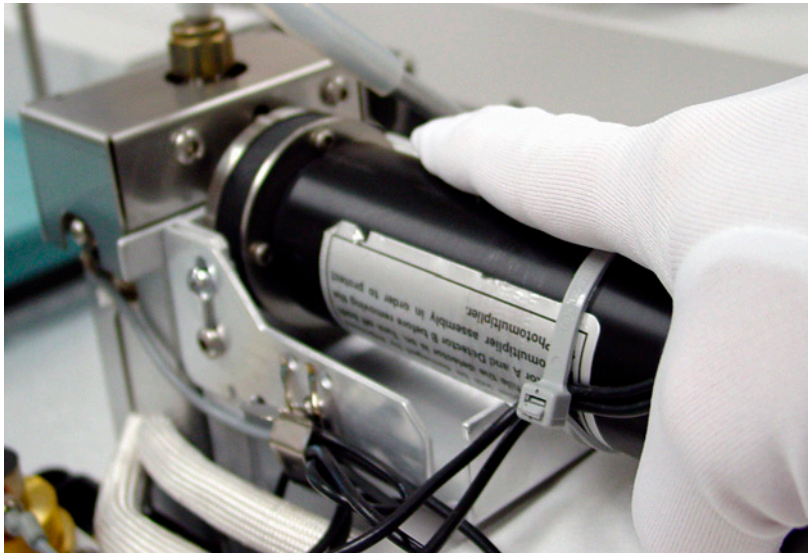

Figure 4 Removing the PMT

Disconnect the cables

1 Disconnect the ignitor cable.

For 6850 Disconnect the ignitor collar from the glow plug.

For 6890 Trace the gray ignitor cable from the side of the detector body to its connector on the detector board. Disconnect it.

NOTE In the next step, be sure to note where the cables are presently connected. You will use the same connection points for the updated FPD.

2 Disconnect the braid-sheathed heater/sensor cable or cables. A 6850 GC has one cable; a 6890 has two.

3 The detector body is held to the GC top by four screws. Remove them. Lift out the detector body. Set the screws and insulation aside to reuse.

Replace the Heater/Sensor Assembly (6850 GC Only)

If updating an FPD on a 6890 GC, skip this section.

The FPD update body assembly contains a heater/sensor assembly for the 6890 GC. For a 6850 GC, these must be replaced with the heater/sensor cable from the present detector.

From the present detector

1. Remove the four screws holding the chimney back cover in place over the emissions block assembly. Remove the cover.
2. Remove the upper heater/sensor from the emission block assembly. (See Figure 5).

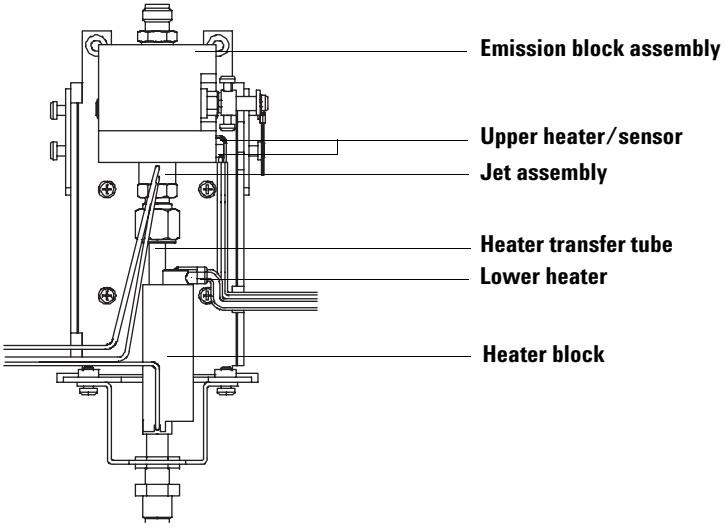

Figure 5 Removing the present 6850 FPD heater/sensor

3 Remove the lower heater from the heater block.

a Loosen the three screws in the flange adapter that secure the detector body to the support bracket clamp. Separate the emissions block assembly and the heated transfer tube by twisting and pulling.

b Disconnect the heater block from the transfer line at the Swagelok fitting, then gently lift the block and set aside.

c Remove the lower heater.

To the new detector

Install the heater/sensor in the update FPD body as described on page 55.

Install the New FPD Body

Detector body and gases

1 Install the new detector body on the GC. Insert the four screws that hold it and tighten them evenly.

2 Route the gas tubing and manifold block to the flow module.

3 Connect the manifold block to the flow module.

NOTE The new manifold block has only two tubes. (See Figure 6).

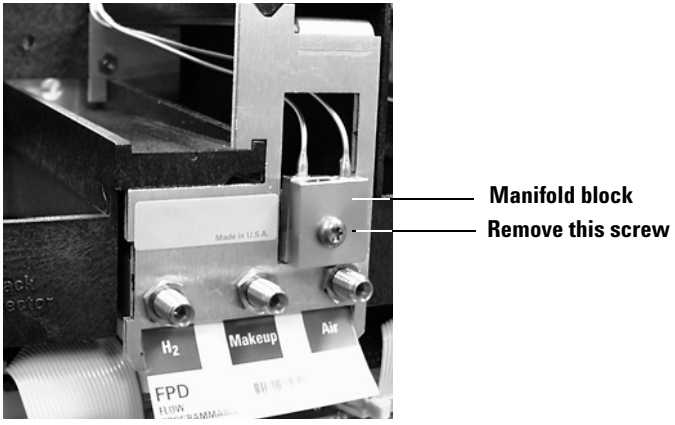

Figure 6 New manifold connected (6890)

4 Restore gas flows and check for leaks.

Filters

1 Save the filters from the present FPD. You will reuse the phosphorus filter(s) and may need the “old” sulfur filter(s) if you must desensitize the FPD.

2 Install the appropriate filter(s) in the new lens housing(s). Note that the new sulfur filter requires the use of a spacer. See “Changing the Wavelength Filter” on page 48, which applies to both the 6850 and 6890 GCs.

PMT housings

1 Connect the PMT housing(s) to the detector body and secure with the bracket spring(s).

2 Run the cables from the PMT housings through the bracket clips.

Cables

6850 GC Plug the heater/sensor cable into the connector under the inlet cooling fan.

6890 GC

1 Connect the long heater/sensor cable to the auxiliary heating bracket on the main board.

2 Connect the short heater/sensor cable to the plug above the main board on the right side.

Return the GC to Operating Condition

1. Install the plastic drain tube extension to the vent tube assembly.
2. Replace the covers of the GC.
3. Restore power.
4. Restore normal operating conditions.
5. Let the detector heat for 20 minutes before igniting the flame. This avoids problems that may occur due to water condensation when the vent tube is cold.

1 Updating the FPD

2
Checkout Procedure

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When you have installed the FPD, you should test it to verify that it works correctly. This chapter describes a test protocol for running sulfur and phosphorus samples through the GC and examining the results.

The protocol will differ depending on the equipment you have. This chapter describes the protocol in terms of a ChemStation, but contains sufficient information so that the chromatogram (but not the performance tests) can be run with just a strip-chart recorder.

Overview

NOTE This procedure assumes that the tester is familiar with the safe operation and maintenance of the gas chromatography system, including the automatic liquid sampler, GC, and data handling device.

This is the recommended sequence of steps for running the checkout.

1. Install the column.
2. Create and save the phosphorus and sulfur methods.
3. Load the phosphorus method, turn off the electrometer.
4. Install the phosphorus filter.
5. Set inlet, oven, and detector to 250 °C to bake out for 15 minutes.
6. Reload the phosphorus method. Monitor signal output. This output typically runs between 40 and 55 but can be as high as 70.
7. When it levels off, run one sample. Interpret the results.
8. Turn off the electrometer. Install the sulfur filter and retaining ring.
9. Load the sulfur method. Monitor signal output. The output typically runs between 50 and 60 but can be as high as 70.
10. When it levels off, run one sample. Interpret the results.

Materials needed

For the 6850 GC

- Column: HP-1 Capillary 30.0 m × 0.32 mm × 0.25 µm (part number 19091Z-413E)
  For Japan only, HP-5MS, 30.0 m × 0.32 mm × 0.50 µm (part number 19091S-113E)

For the 6890 GC

- Column: HP-1 Capillary 30.0 m × 0.32 mm × 0.25 µm (part number 19091J-413)
  For Japan only, HP-5MS, 30.0 m × 0.32 mm × 0.50 µm (part number 19091S-113)

For both GCs

- Checkout sample, part number 5188-5953.
  For Japan only, part number 5188-5245.
- For cool on-column inlet use: 5-mm septa (part number 5183-4758, 50/pk), 5-µL on-column syringe for 320-µm column (part number 5182-0836), and needle for 320 µm column (5182-0831).
- For split/splitless inlet use: 11-mm septa (part number 5183-4757 50/pk), 10-µL syringe (part number 5181-1267), or equivalent, and a liner. The liner can be general purpose (part number 5183-4711) or single-taper deactivated with (part number 5062-3587) or without (part number 5181-3316) glass wool.

  For Japan only: 11-mm septa (part number 5183-4757 50/pk), 10-µL syringe (part number 5181-1267), or equivalent, and a single-taper liner deactivated without (part number 5181-3316) glass wool.
- Chromatographic-grade isooctane for syringe wash solvent.
- Chromatographic-grade 99.9995% purity gas: helium as carrier, nitrogen as makeup, hydrogen and air.
- 4-mL solvent and waste bottles or equivalent for autoinjector.
- 2-mL sample bottles or equivalent for sample.

Creating Methods

Create the test methods using these steps:

1. Create a phosphorus method (Table 3).
2. Save it using a name that identifies it as the phosphorus method (such as **P_Ckout.m**).
3. Make a copy and modify the detector flow parameters in the copy to change it to a sulfur method (page 29).
4. Save the copy using a distinctive name that identifies it as a sulfur method (such as **S_Ckout.m**).

Phosphorus method

Table 3 contains the parameters for the phosphorus method. Give the method a meaningful name that allows you to distinguish it from the sulfur method.

Table 3 Phosphorus checkout method default parameters

Parameter/Setting	Sample 5188-5953	Sample 5188-5245
Oven		
Initial temp, °C	70	70
Initial time, min	0.00 min	0.00 min
Rate 1, °C/min	25.00	10
Final temp 1, °C	150	105
Final time 1, min	0	0
Rate 2, °C/min	5	20
Final temp 2, °C	190	190
Final time 2, min	4	1
Column for 6850 GC	Agilent 19091Z-413E, HP-1, 30.0 m × 320 µm × 0.25 µm	Agilent 19091S-113E, HP-5MS, 30.0 m × 320 µm × 0.50 µm
Column for 6890 GC	Agilent 19091J-413, HP-1, 30.0 m × 320 µm × 0.25 µm	Agilent 19091S-113, HP-5MS, 30.0 m × 320 µm × 0.50 µm
Mode	Constant pressure	Constant pressure
Pressure	25 psi	25 psi

Table 3 Phosphorus checkout method default parameters (continued)

Parameter/Setting	Sample 5188-5953	Sample 5188-5245
Detector		
Temperature, °C	200 (on)	200 (on)
Hydrogen flow	75.0 mL/min (on)	75.0 mL/min (on)
Air (Oxidizer) flow	100.0 mL/min (On)	100.0 mL/min (On)
Mode	Constant makeup flow OFF	Constant makeup flow OFF
Makeup flow	60.0 mL/min (On)	60.0 mL/min (On)
Makeup Gas Type	Nitrogen	Nitrogen
Flame	On	On
Lit offset	2.00	2.00
Electrometer	On	On
Signal		
Data rate	5 Hz	5 Hz
Type	Front or back detector	Front or back detector
Save Data	On	On
Zero	0.0 (Off)	0.0 (Off)
Range	0	0
Fast Peaks	Off	Off
Attenuation	0	0
Column Comp 1	Derive from detector	Derive from detector
Inlet		
Temperature, °C	200 (Split/Splitless inlet, and see below) Oven track (Cool On-Column inlet)	250, Split/splitless Oven track (Cool On-Column inlet)
Init pressure	25.00 psi (On)	25.00 psi (On)
Gas Saver	Off	Off
Split/Splitless inlet		
Mode	Splitless	Splitless
Total flow	69.5 mL/min	69.5 mL/min
Purge flow to split vent	50 mL/min @ 0.75 min	50 mL/min @ 0.75 min

Table 3 Phosphorus checkout method default parameters (continued)

Parameter/Setting	Sample 5188-5953	Sample 5188-5245
Injector (if installed)		
Sample Washes	2	2
Sample Pumps	8	8
Injection Volume	1.0 µL	1.0 µL
Syringe Size	5.0 or 10 µL	5.0 or 10 µL
PreInj Solvent A Washes	0	0
PreInj Solvent B Washes	0	0
PostInj Solvent A Washes	4	4
PostInj Solvent B Washes	4	4
Viscosity Delay	OFF	OFF
Plunger Speed	Fast	Fast
PreInjection Dwell	0.00	0.00
PostInjection Dwell	0.00	0.00
Sample	Part number 5188-5953	Part number 5188-5245
Injection volume	1.0 µL	1.0 µL

Additional settings applicable to Agilent data systems are listed in Table 4. The settings available are for the GC ChemStation. Other data systems vary.

Table 4 Additional settings for Agilent Data Systems

Parameter/Setting	Value
Report Settings	
Report style	Short or None
Destination	None

Sulfur method

Make a copy (Save As in ChemStation) of the phosphorus method. Rename the copy to indicate that it is a sulfur method. Edit it as indicated in Table 5.

Table 5 Sulfur method parameters

Parameter	Value, mL/min
H_2 flow	50
Air flow	60

Using ChemStation macros

There are two macros designed for ChemStation that you use to interpret and analyze the data collected from the sulfur and phosphorus tests. Table 6 lists the macros. They can be downloaded from **www.chem.agilent.com/cag/servsup/usersoft/files/ChemStation_Macros_Collection.htm**. Look for Data Systems, then Downloads and Utilities.

Table 6 ChemStation macros

Macro name	Description
MEPCK_S.MAC Japan only: fpds_xls.mac	Processes data collected from sulfur tests.
MEPCK_P.MAC Japan only: fpdp_xls.mac	Processes data collected from phosphorus tests.

These macros calculate the area counts, MDL, and noise, and print a report to the printer set up in the ChemStation. The report includes the chromatogram, the noise plot, and several calculations.

Place the macros in the appropriate subdirectory (Table 7) where ChemStation can find them.

Table 7 Macro subdirectories

Software rev.	Macro location	Summary result log location
B.01.xx or later	CHEM32\CORE	CHEM32\n*
A.10.xx or earlier	HPCHEM\CORE	HPCHEM\n*

* n is the instrument number.

The macro can be set to run automatically as part of the method as a post-run program, or can be run on a loaded data file from the ChemStation Data Analysis view.

Running the Tests

After setting the conditions, wait for the baseline to stabilize (about 2 hours) before running samples.

6850 GC

Figures 7 and 8 show typical online plots for sulfur and phosphorus tests using the checkout methods described in “Creating Methods” on page 26.

Figures 9 and 10 show the same plots for the Japan-only samples.

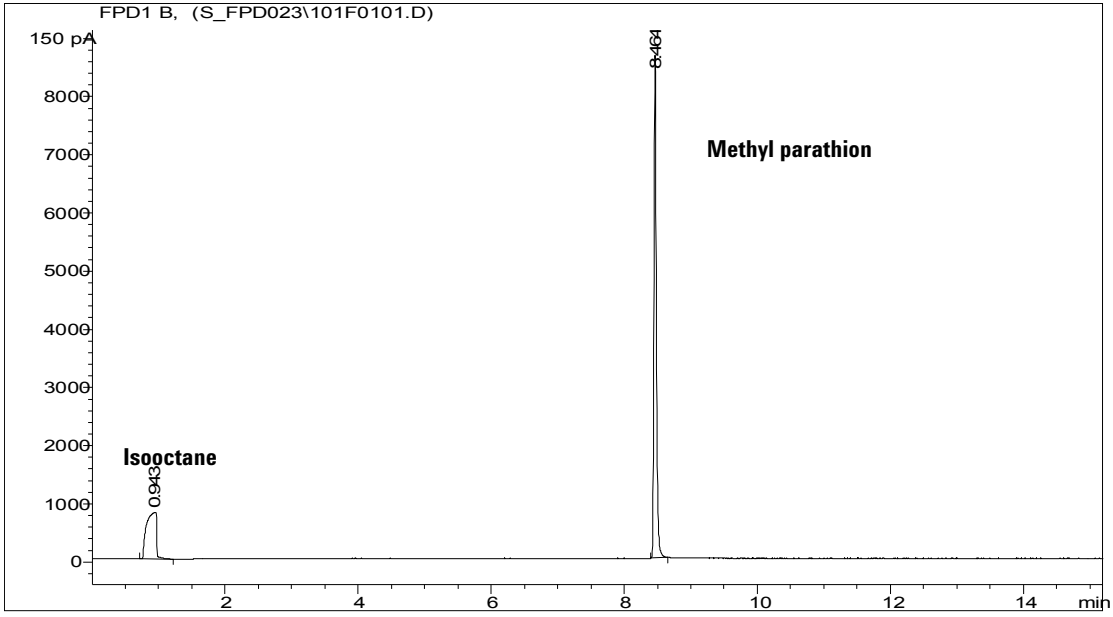

Figure 7 6850 GC, sample 5188-5953, typical chromatogram for sulfur tests

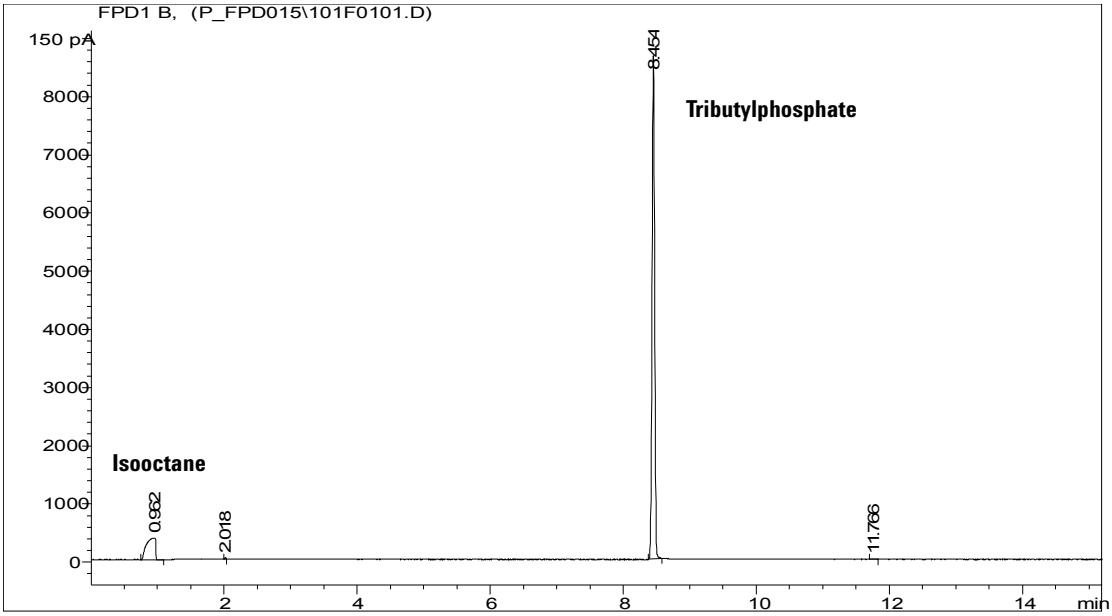

Figure 8 6850 GC, sample 5188-5953, typical chromatogram for phosphorus tests

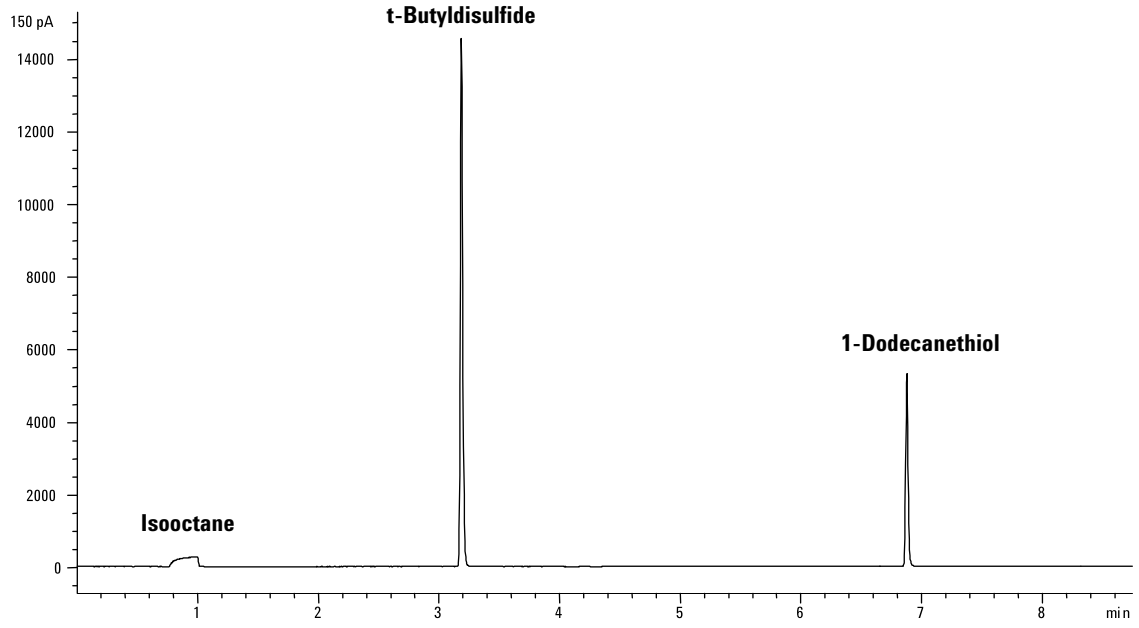

Figure 9 6850 GC, sample 5188-5245 (Japan only), typical chromatogram for sulfur tests

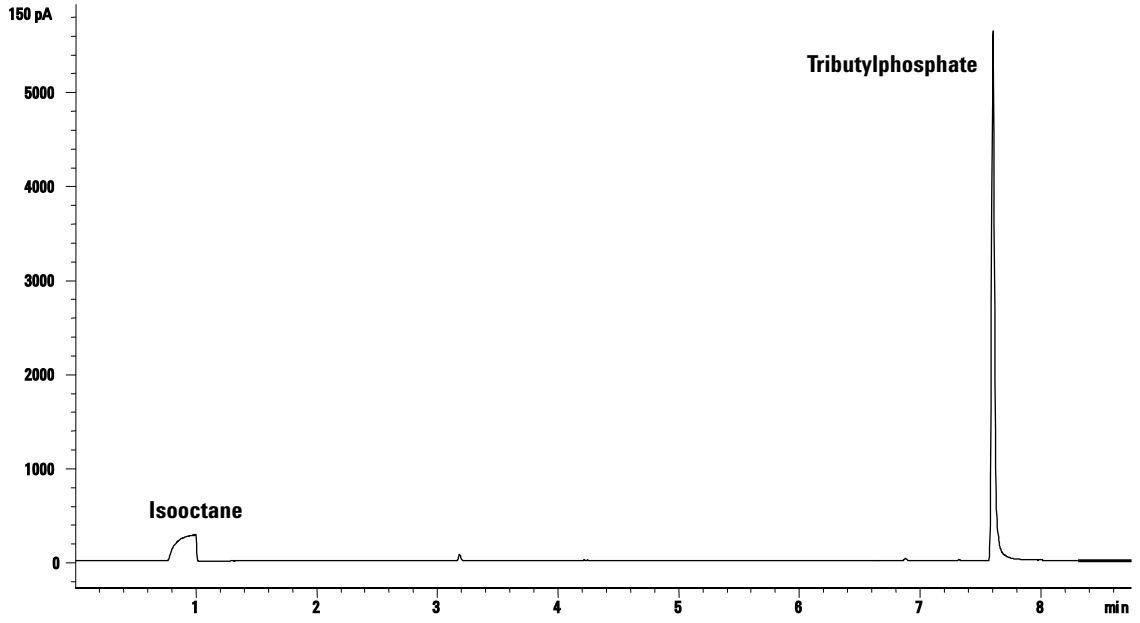

Figure 10 6850 GC, sample 5188-5245 (Japan only), typical chromatogram for phosphorus tests

6890 GC

Figures 11 and 12 show typical online plots for sulfur and phosphorus tests using the checkout methods described in “Creating Methods” on page 26.

Figures 13 and 14 show the same plots for the Japan-only samples.

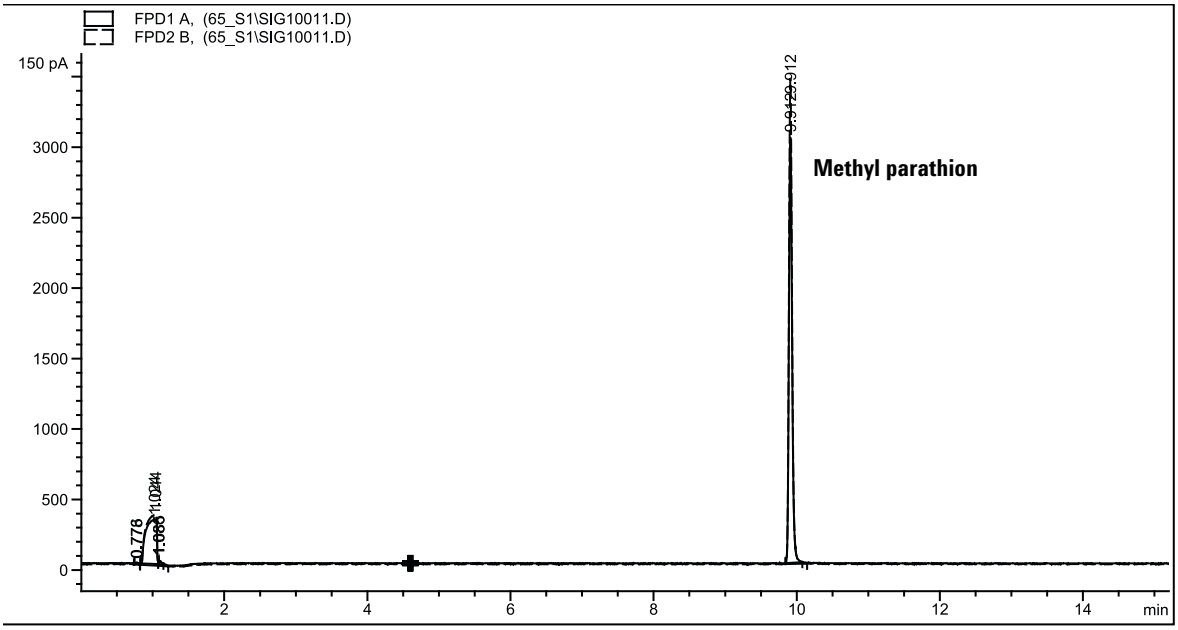

Figure 11 6890 GC, sample 5188-5953. Typical chromatogram for sulfur tests

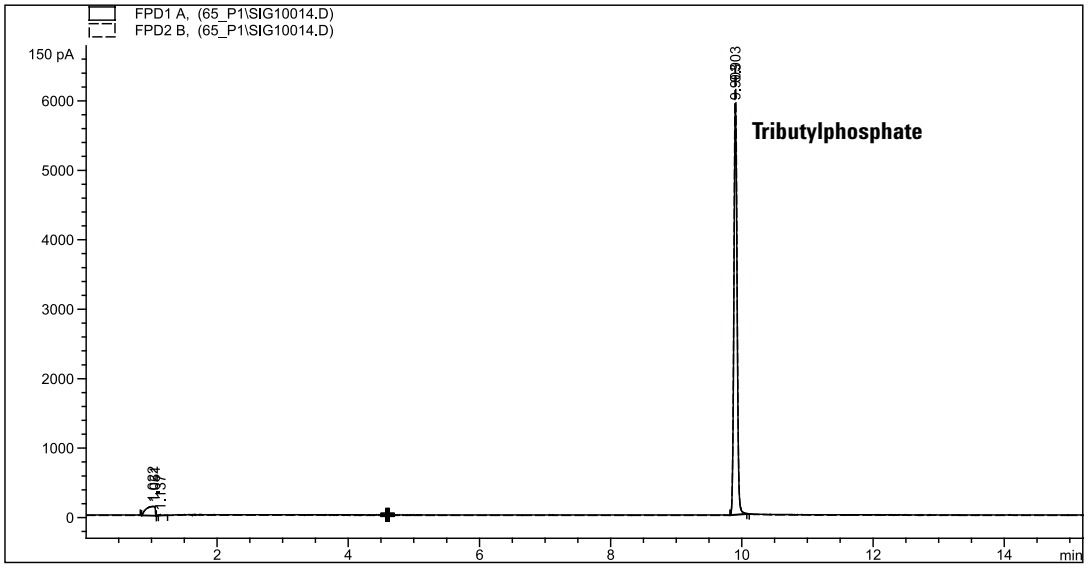

Figure 12 6890 GC, sample 5188-5953, typical chromatogram for phosphorus tests

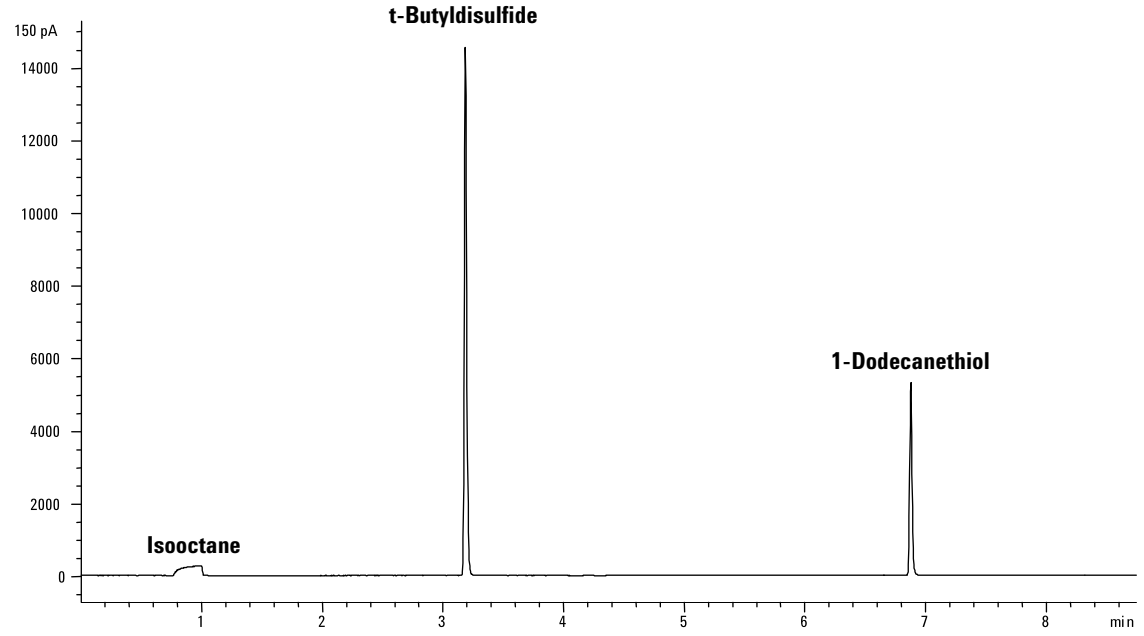

Figure 13 6890 GC, sample 5188-5245 (Japan only), typical chromatogram for sulfur tests

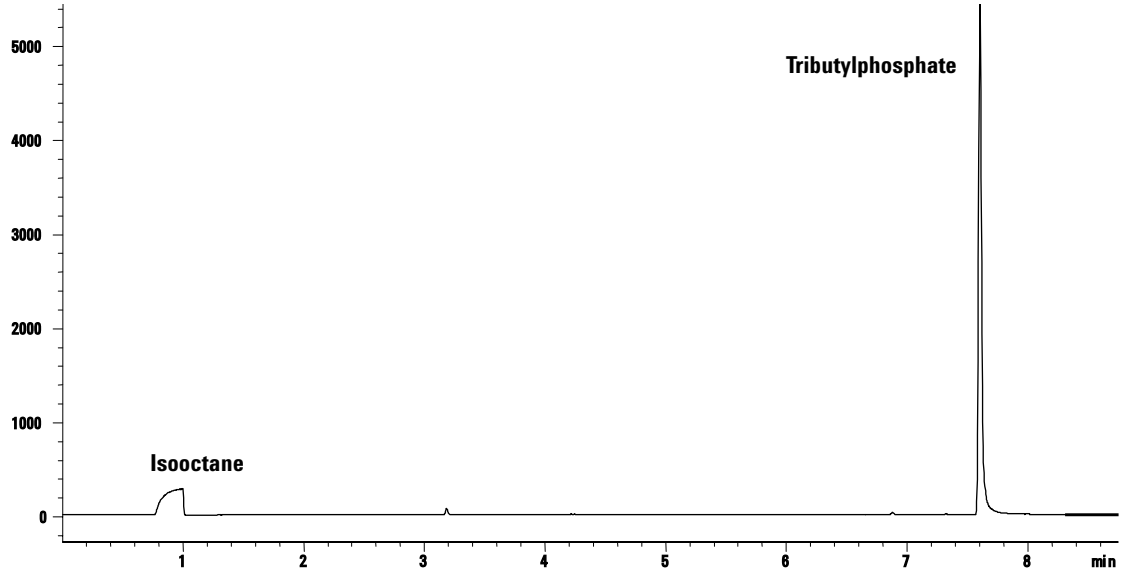

Figure 14 6890 GC, sample 5188-5245 (Japan only), typical chromatogram for phosphorus tests

CAUTION

If you receive a message like the following, check your printer setup and make any corrections.

... has problems. , with page file:
C:\WINNT\TEMP\~P3D042A.TMP
Initial printing problem, 202.
System resources are low and/or device has problems.

NOTE

Depending on the column length, the sulfur chromatograph may contain a contaminate peak during the noise measurement. Reprocess the run by loading the signal and typing

macro mepck_s.mac,go,3

in the command line. This starts the noise measurement at 3 minutes instead of the default 3.8 minutes.

Interpreting Results

Compare the reported output against the values listed in Table 8 and Table 9.

For phosphorus

Table 8 Evaluating checkout runs

FPD P filter	Typical range after 24 hours	Limits at installation
MDL (pg/s)	0.06 to 0.08	≤0.10
Peak area	19000 to 32000	≥19000
Signal height	5000 to 11000	—
Noise	1.6 to 3.0	≤4
Half-width (min)	0.05 to 0.07	—
Signal offset	34 to 80	≤80

For sulfur

Table 9 Evaluating checkout runs

FPD P filter	Typical range after 24 hours	Limits at installation
MDL (pg/s)	3.8 to 5	≤6
Peak area	8000 to 19000	≥8000
Signal height	2500 to 6000	—
Noise	2 to 4	≤5
Half-width (min)	0.06 to 0.08	—
Signal offset	34 to 65	≤70

3
Operation

General Rules 42
Installing Columns 44

This chapter describes **new** or **changed** operating information (at the time of this printing) that updates the information found in the GC user documentation. **Refer to the GC user information for any topics not covered here.**

General Rules

Starting up

The FPD creates a great deal of water vapor when the flame is on. This could condense in the vent tube on top of the detector and drop onto the flame, possibly extinguishing it. To avoid this, turn the heaters on, wait 20 minutes for the vent to heat up, and then ignite the flame. Water vapor will now make it over the top of the vent tube before condensing.

Shutting down

For similar reasons, extinguish the flame before turning the heaters off.

Photomultiplier (PMT) protection

The PMT is extremely sensitive to light. Always turn the electrometer off (which turns off the high voltage to the PMT) before removing the PMT housing or opening the emissions chamber. Failing to do this can destroy the PMT.

Even with the electrometer off, protect the PMT from room light. Cap the housing when removed, place it end down to exclude light, reduce room light level before exposing the PMT, and so on. A brief exposure (always with the electrometer turned off) will not damage it but prolonged exposure will cause a gradual loss of sensitivity.

Lit Offset

The default Lit Offset is 2.0 pA.

High-purity gases

High-purity gases have a lower sulfur content. Standard purity gases have a higher sulfur content which impairs sulfur detection in the compound being studied. Instrument or Chromatographic grades work well.

Agilent recommends using helium carrier, nitrogen makeup gas, and air with 99.9995% purity or better. Use carbon, oxygen, and moisture traps. Select traps to remove sulfur compounds from detector air and nitrogen gases. A helium getter is also recommended.

Inlet liners

Compounds containing sulfur may adsorb to an inlet liner and degrade the GC's performance. Use deactivated, clean liners or a cool on-column inlet, which injects directly onto the column.

For best results with splitless injection, use liner 5181-3316.

Installing Columns

Capillary columns

CAUTION Wear safety glasses while handling, cutting, or installing fused silica capillary columns. To prevent puncture wounds, use care when handling these columns.

The following procedure ensures that the FPD works efficiently. A special tool is used to cut the column to the correct length.

Swage the column ferrule

1. Install a column nut and ferrule on the end of the column.
2. Insert the end of the column through the column measuring tool (19256-80640) so that the end protrudes beyond the tool (Figure 15).

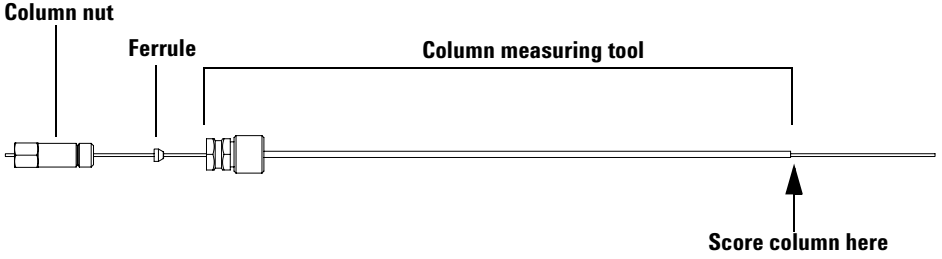

Figure 15 Cutting the column to length

3. Tighten the column nut until it grips the column. Use a pair of wrenches to tighten it an additional 1/8 to 1/4 turn.
4. Use a wafer cutter at 45° to score the column.
5. Snap off the column end.
6. The column may protrude 1 to 2 mm beyond the end of the tool.
7. Remove the column, nut, and swaged ferrule from the tool.

Install the column

1 Install the capillary adapter in the detector fitting (Figure 16).

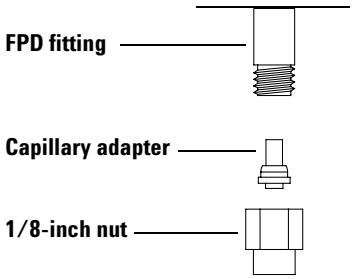

Figure 16 Capillary adapter

2 Carefully thread the swaged column up into the adapter. Finger-tighten the column nut, then tighten an additional 1/8-turn with a wrench.

Packed columns, 1/8-inch

A Type B 1/8-inch column connects directly to the fitting on the bottom of the FPD. No adapter is required.

Packed columns, 1/4-inch

1 Install the adapter in the detector fitting (Figure 17). Place the ferrule and nut on the adapter, insert the adapter into the FPD fitting, and tighten the nut.

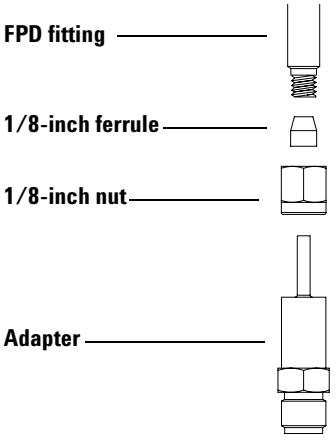

Figure 17 1/4-inch column adapter

2 Connect the 1/4-inch column to the adapter in the usual way. Use Type B glass columns.

4
6850 GC: Maintenance, Troubleshooting and Parts

Changing the Wavelength Filter 48
Accessing Heaters and Ignitor 51
Replacing the Heater/Sensor Assemblies 55
Replacing the Ignitor 59
Replacing the Inert Transfer Line 63
Troubleshooting 66
Replacement Parts 70

This chapter describes procedures for maintaining an FPD mounted on an Agilent 6850 GC. If you are using a 6890 GC, see the next chapter.

Changing the Wavelength Filter

Changing the wavelength filter takes about 5 minutes. It requires you to turn off the electrometer, remove the photomultiplier tube housing, and change the filter.

CAUTION Do not touch the filters with your bare hands. For optimum performance and to avoid scratches, use lint free gloves for assembling and inserting the filters into the housing.

Materials needed

- 1000-1437 Sulfur filter and 19256-20910 filter spacer
- 19256-80010 Phosphorus filter
- 5080-5400 Cotton swabs
- Toothpick or cotton swab
- Lens tissue
- 8650-0030 (large) or 8650-0029 (small) Nylon lint-free gloves

Procedure

1. Turn off the detector electrometer.
2. Loosen the thumbscrew and raise the detector cover.

3 Disconnect the retaining spring that holds the photomultiplier tube housing (PMT) to the bracket. With a rotating motion, pull the PMT away from the filter housing (Figure 18).

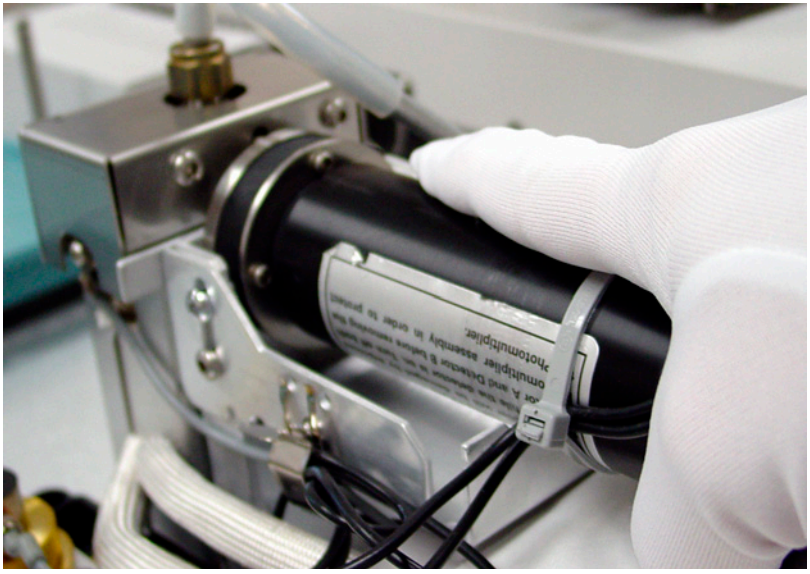

Figure 18 Removing the PMT housing

4 To prevent light from damaging the PMT, immediately cap the end or place it face down (Figure 19).

Figure 19 Protecting the PMT

5 Place a clean cloth under the filter housing to catch the filter.
Phosphorus filter: Use the sharpened wooden tip of a toothpick or cotton swab to dislodge the filter from the housing.
Sulfur filter: Use the wooden tip of the cotton swab to remove the filter spacer. Then remove the filter as above.

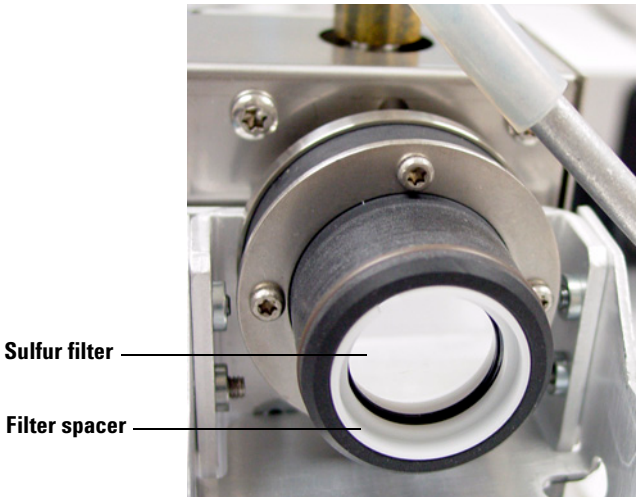

Figure 20 Sulfur filter and spacer

6 Use lens tissue to clean the new filter. Install it in the filter housing. If you are installing a sulfur filter, add the filter spacer (Figure 20).

CAUTION Do not use cleaning fluids. Cleaning fluids will damage lens coatings.

CAUTION Filters are designed for the light from the flame to pass through in a specific direction. There is a triangle on the edge of the phosphorus filter, There is an arrow on the edge of the sulfur filter. These should face *away* from the flame and *toward* the PMT.

7 Install the PMT housings and secure them with the springs.

8 Restore the operating conditions.

Accessing Heaters and Ignitor

Removing the vent and cover to access the heaters or ignitor takes about 5 minutes. It requires you to turn off the GC.

CAUTION When turning the GC off, turn off the flame first to prevent condensation from dripping into the jet and column.

You may wish to access this area for the following reasons:

- Replace the ignitor.
- Replace seals and O-rings.
- Replace the transfer line assembly.
- Replace or check the heater and PRT sensors.

Materials needed

- 8710-0803 9/16-inch wrench.
- 8710-1807 T-20 Torx driver.

Procedure

To remove the vent tube and cover

1. Turn off the flame.
2. Turn off the GC.
3. Wait until the detector cools.
4. Loosen the thumbscrew and raise the detector cover.
5. Remove the drain tubing from the vent tube.

6 Use a wrench to loosen and remove the vent tube assembly (Figure 21).

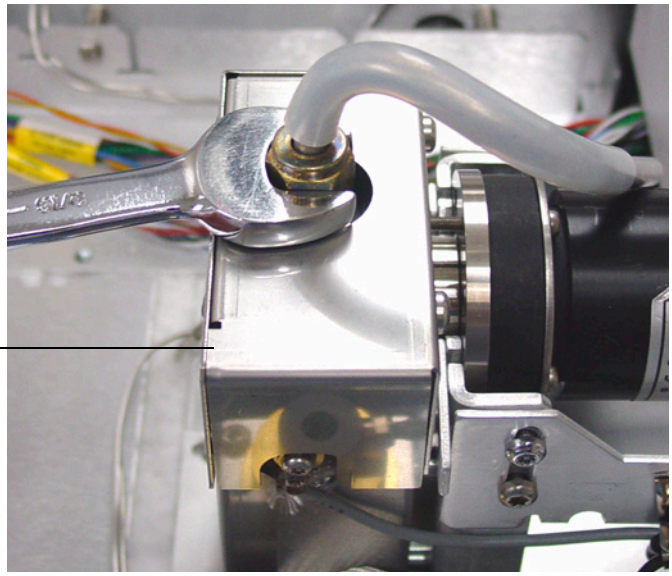

Figure 21 Removing the vent tube

7 Use a Torx T-20 driver to remove the screws securing the FPD cover. There are two screws at the bottom of the front side and two screws at the top of the rear side (Figures 22 and 23).

8 Lift the cover off the detector.

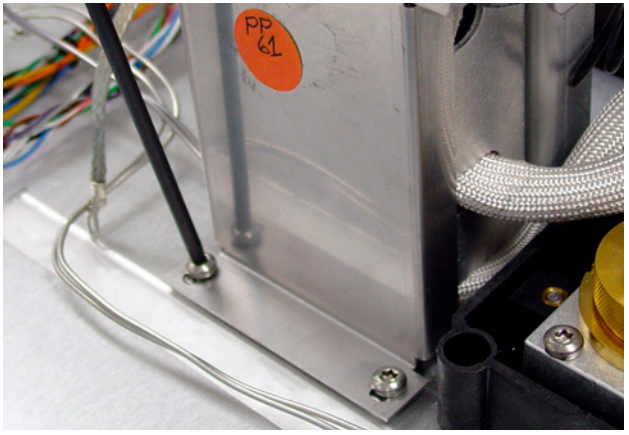

Figure 22 Cover screws, front side

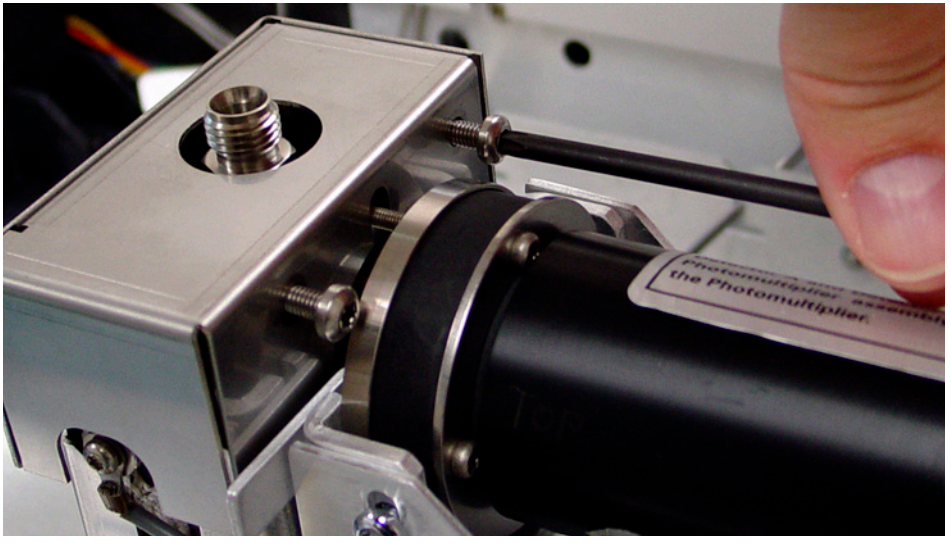

Figure 23 Cover screws, rear side

To reinstall the vent tube and cover

1. Start the two screws on the rear side of the cover.
2. Start and tighten the screws at the base on the front side.
3. Tighten the screws on the rear side.
4. Replace the vent tube assembly and connect the drain tube.
5. Turn on the GC. Confirm that the flame is off.
6. Restore the operating conditions.
7. Wait 20 minutes for the detector to heat up, then ignite the flame.

Replacing the Heater/Sensor Assemblies

Replacing the heater/sensor assemblies takes about 30 minutes. It requires you to turn off the GC, remove the vent tube, and remove some covers.

CAUTION When turning the GC off, turn off the flame first to prevent condensation from dripping into the jet and column.

You may wish to replace or check the FPD heater/sensor assemblies for the following reasons:

- One or both of the heaters or the sensor are defective.
- The actual temperature reading on the display of the heaters is cycling more than 1 °C.

Materials needed

- Heater/sensor assembly
- ESD protection: For example, a wrist strap
- Wrenches: 8710-0803 (9/16-inch), 8720-0010 (5/8-inch), 1/4-inch × 3/8-inch
- Torx drivers: 8710-2140 T-10 and 8710-1807 T-20

Procedure

1. Turn off the flame.
2. Turn off the GC.
3. Remove the vent assembly, drain tubing, and the detector cover. See “Accessing Heaters and Ignitor" on page 51.
4. Remove enough of the lid top covers to expose the detector and the braided heater/sensor cabling.
5. Put on an ESD wrist strap. Disconnect the heater/sensor leads from the plug near the inlet cooling fan.

Transfer line

1 Use a Torx T-10 driver to remove the screw and retainer clip holding the lower heater. Remove the heater from the transfer line (Figure 24).

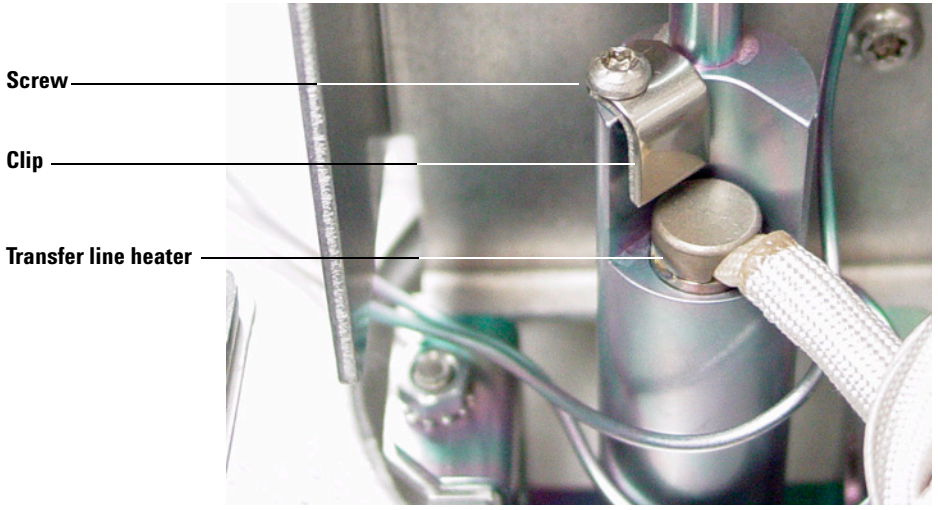

Figure 24 Replacing the transfer line heater

2 Insert the new heater with the shorter leads into the transfer line. Position the retainer clip over the heater and install the screw.

Emissions assembly

1 Remove the protective cap from the sensor of the heater/sensor assembly.

2 Install the remaining heater and the sensor in the emissions block assembly (Figure 25). Push them in as far as they will go.

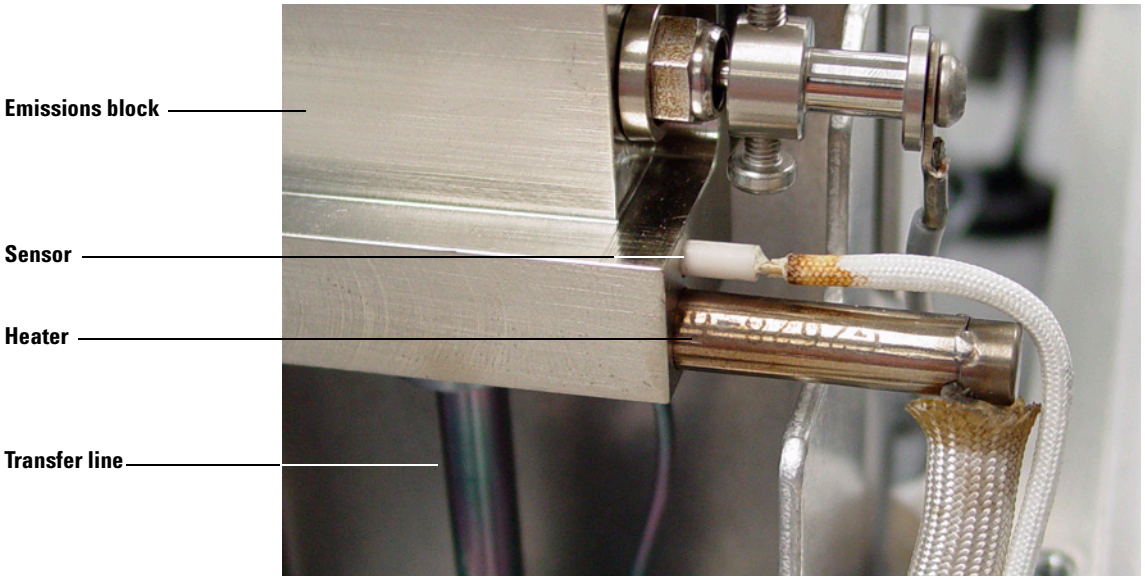

Figure 25 Install the upper heater and sensor

Closing up

1 Route the combined heater/sensor cables out the right side of the detector body, around behind it, and plug it into the connector under the inlet cooling fan (Figure 26).

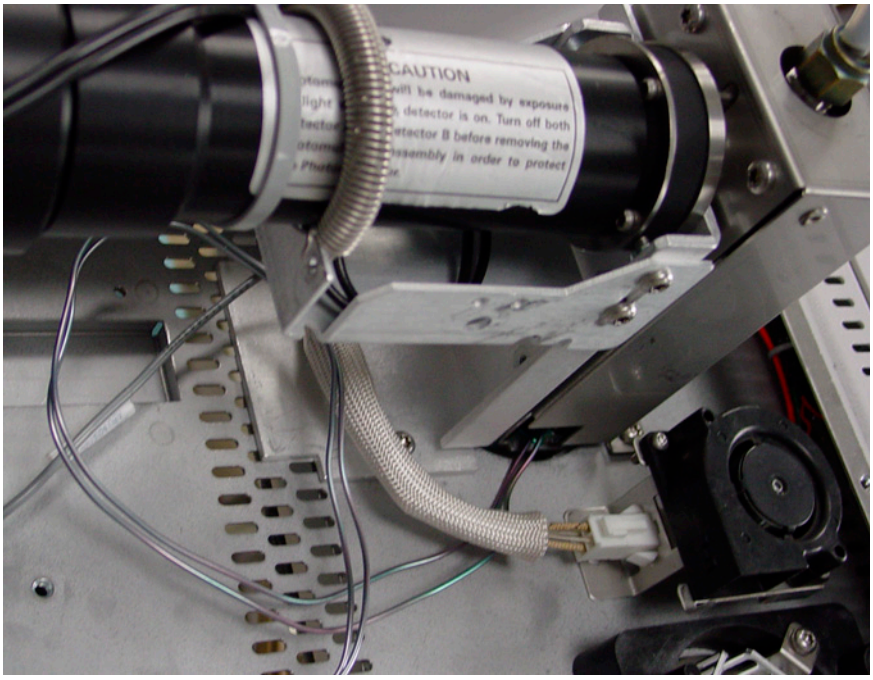

Figure 26 Routing the cables

2 Replace the cover and vent assembly. See “Accessing Heaters and Ignitor" on page 51.

3 Turn on the GC. Confirm that the flame is off.

4 Restore the operating conditions.

5 Wait 20 minutes for the detector to heat up, then ignite the flame.

Replacing the Ignitor

Replacing the ignitor takes about 20 minutes. It requires you to turn off the GC and remove the vent. Agilent recommends that you do not touch these parts with your bare hands. For optimum performance use lint-free gloves for assembling and inserting the new parts into the emissions assembly.

You may wish to replace the FPD ignitor for the following reasons:

- After the detector reaches operating temperatures, the FPD will not light.
- Baseline increase indicates dirt buildup.

Materials needed

- 19256-60800 Ignitor replacement kit
- Wrenches: 1/4-inch × 5/16-inch (8710-0510)
- Torx driver: T-10 (8710-2140)
- 8650-0030 (large) or 8650-0029 (small) Nylon lint-free gloves

The FPD Ignitor replacement kit includes a glow plug, a spacer, and an O-ring. Do not use the copper ring that ships with the glow plug.

Procedure

1. Turn off the flame.
2. Turn off the GC.
3. Remove the vent assembly and cover. Refer to “Accessing Heaters and Ignitor" on page 51.

4 Use a Torx T-10 driver to loosen the collar screw holding the cable assembly to the ignitor (Figure 27). Remove the collar and cable assembly. Some FPDs have a version of the collar with two screws.

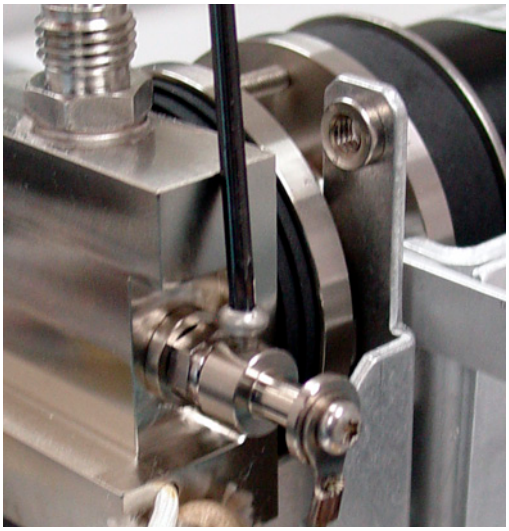

Figure 27 Removing the ignitor cable

5 Use a wrench to loosen and remove the glow plug. Use a tweezers to remove the O-ring.

6 Assemble the parts for the new ignitor (Figure 28).

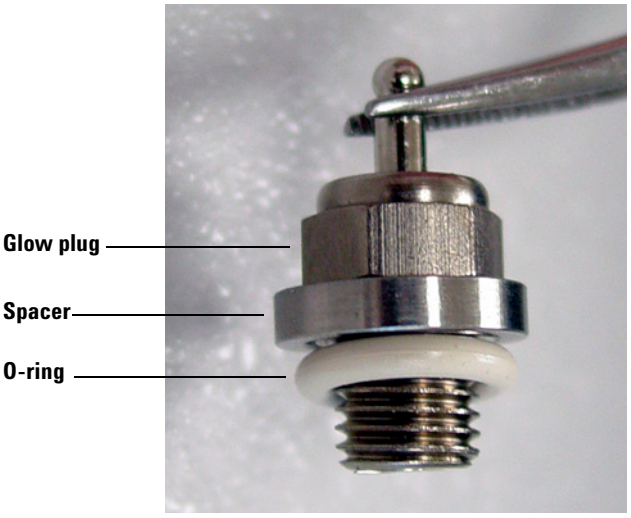

Figure 28 Ignitor parts assembled

7 Insert and tighten the parts.

8 Replace the ignitor collar and cable assembly (some collars have two screws). See Figure 29.

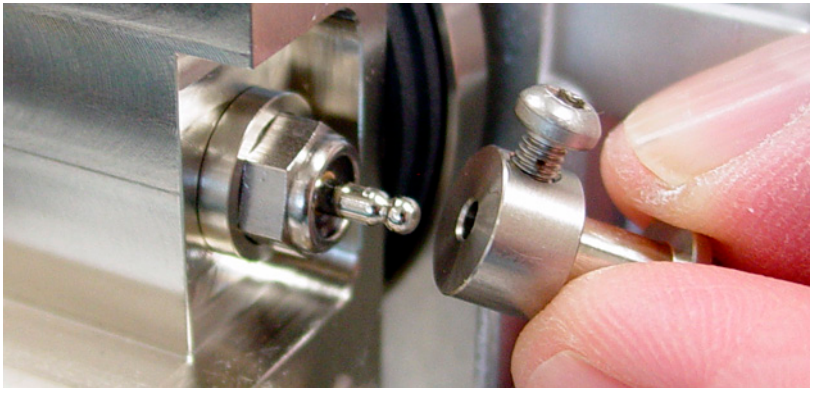

Figure 29 Connecting the ignitor cable

9 Replace the cover and the vent tube assembly.

10 Turn on the GC. Confirm that the flame is off.

11 Restore the operating conditions.

12 Wait 20 minutes for the detector to heat up, then ignite the flame.

Replacing the Inert Transfer Line

Occasionally, the inert transfer line between the column and the emissions assembly must be inspected, cleaned, and/or replaced. Figure 30 shows an installed inert transfer line.

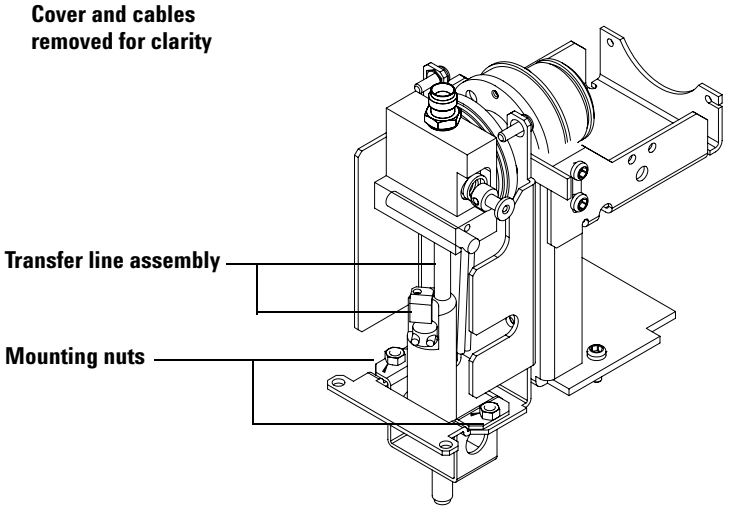

Figure 30 Left side of the detector

Removing the transfer line

1 Turn off the flame.

2 Turn off the GC and unplug the power cord. Let the GC cool.

CAUTION To avoid damaging the photomultiplier tube, always turn the GC or electrometer off before removing the PMT housing.

3 Inside the oven, remove the column and adapter (if installed) to the FPD.

4 Locate the gray ignitor cable attached to the side of the detector. Loosen the one (two, on some models) screw holding the collar to the glow plug. Remove the cable. See “Replacing the Ignitor" on page 59.

5 Remove the vent tubing and the sheet metal cover. The cover is held by two screws at the right-side top and two at the left-side bottom.

6 Remove the PMT housing (release the spring, then twist and pull). It is not necessary to disconnect any cables; just place the housing on top of the GC and cover it to protect it from light.

7 Remove the two mounting nuts that hold the transfer line assembly (Figure 30).

8 Three screws connect the lens holder to the rear face of the emissions assembly (Figure 31). Loosen, but do not remove, the screws on the bottom and the two sides.

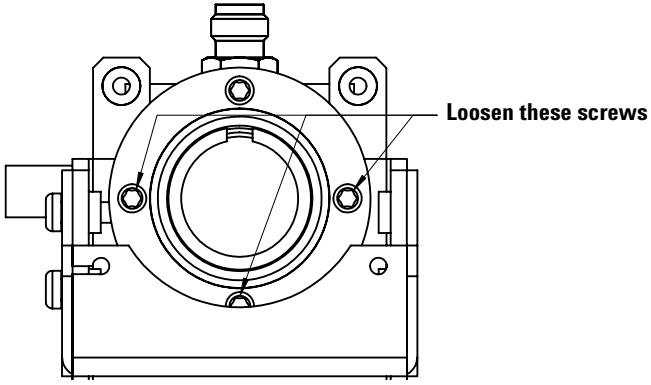

Figure 31 Lens holder and screws

9 Grasp the emissions assembly and *carefully* lift it straight up. The transfer line will come with it. Twist and pull to separate the two parts.

If the emissions assembly/transfer line will not lift free of the detector bracket, check for tubing or cables catching on the sheet metal.

10 If you will be installing a new transfer line assembly:

   a Trace the gas tubing to the manifold block on the flow module (Figure 2 on page 13). Remove the single screw that holds the fitting. Install new O-rings.

   b Transfer the heater/sensor assembly from the old transfer line to the new one. See “Replacing the Heater/Sensor Assemblies" on page 55

Reassembly

1 Connect the transfer line to the bottom of the emissions assembly.

2 Slide the combined parts onto the detector bracket. The semicircular plate that the three screws connect to goes into the gap between the two parts of the bracket.

3 Install the two mounting nuts that hold the transfer line.

4 Check that the emissions assembly is fully seated on the transfer line and that all of the cables and tubing are properly placed.

5 Tighten the 3 screws that secure the lens holder.

6 Install the PMT housing(s).

7 Reconnect the ignitor cable.

8 Install the cover and the vent tube.

9 If necessary, connect the gas lines to the flow module.

10 Restore operating conditions.

11 Wait 20 minutes for the vent tube to heat up, then ignite the flame.

Troubleshooting

Offset or detector output too high or too low

Using a filter with flows optimized for the other filter type can cause unexpected output levels.

Monitor the FPD output. Table 10 provides examples of detector output when the filter installed in the detector and the gas flows in use do not match.

Table 10 Filter/Flows mismatch

	Outputs	
Gas flows optimized for	**With sulfur filter**	**With phosphorus filter**
Sulfur	30 to 50	10 to 12 (low)
Phosphorus	240 to 250 (high)	30 to 50

Besides having the wrong filter for a particular set of gas flows, also consider:

- If the Lit Offset is 0.5 to 3.0, check that the flame is ON.
- If the Lit Offset is 0, check if the electrometer is turned OFF or the signal cable is disconnected.
- If the Lit Offset <30, the flame may be in the wrong position. Check detector flows, column flow, and column position.

MDL too high

Table 11 lists typical MDL values for a checkout.

Table 11 Typical MDL values for a checkout

	Typical range after 24 hours	Limits at installation
P filter	0.060 to 0.080	≤0.100
S filter	3.8 to 5	≤6

The MDL is dependent on the peak area and the detector noise. The relationship is: the smaller the peak area and the larger the noise measurement, the larger the MDL. If the MDL is high, check under the “High noise level" on page 67 and “Small peak area" on page 67.

High noise level

Table 12 lists typical noise values for a checkout.

Table 12 Typical noise values for a checkout

	Typical range after 24 hours	Limits at installation
P filter	1.6 to 3.0	≤4
S filter	2 to 4	≤5

Higher than expected noise is caused by:

- Low purity or contaminated source gases.
- Unconditioned column or ferrules.
- Dirty or contaminated inlet components, such as the liner.
- Dirty or contaminated detector parts, such as the ignitor.
- Light leak at PMT or Vent tube. Turn the flame off and check the output. If the output is above 10 or 20 pA you probably have a light leak.

Small peak area

Table 13 lists typical peak area values for a checkout.

Table 13 Typical peak area values for a checkout

	Typical range after 24 hours	Limits at installation
P filter	19000 to 32000	≥19000
S filter	8000 to 19000	≥8000

Small peak area is caused by:

- End of column extends too far into the detector. Sample not burned in flame.
- Sample lost in inlet or at column connections. Check your GC method split or splitless setpoints. Check the inlet septum, liner O-ring, and seal.
- Photo-multiplier tube defective.
- Incorrect filter or detector flows.

Large peak width at half-height

Table 14 lists typical peak width values for a checkout.

Table 14 Typical peak width values for a checkout

	Typical range after 24 hours
P filter	0.05 to 0.07
S filter	0.06 to 0.08

Large peak width is caused by:

- Activity in the inlet or column.
- Injection volume too large for inlet, liner, or inlet conditions.

Clipped peaks

If you have an application at the upper limit of the dynamic range (especially with sulfur), you may have to desensitize your instrument. Replace the 1000-1437 sulfur filter with filter part number 19256-80000. Then set the detector gas flows to the values used in the phosphorus checkout method. This raises the baseline but with some loss in the signal-to-noise ratio.

There should be no problems with either solution and the use of hydrogen. However, please note the following warning.

WARNING **Hydrogen gas is flammable and potentially explosive. Be sure to turn off the hydrogen gas at the source until connections are made. Also, leak test connections, lines and valves before operating or servicing the instrument.**

Data lost because detector tries to re-ignite during a run

Controlling Flame Auto-Ignition

Certain environmental conditions, such as

- Strong electromagnetic fields
- Large ambient temperature swings
- Large atmospheric pressure swings

can cause an artificially low signal in the GC, incorrectly indicating that the flame has gone out. As a result, the run aborts and the GC tries to relight an already-lit flame.

You can verify that the flame is lit by holding a cold, shiny surface (such as a mirror or a wrench) over the exit tube. Condensation on the surface indicates that the flame is lit.

Reset the Lit Offset to 2.0.

CAUTION An attempt to relight an already-lit flame corrupts any chromatograms created and shuts down the GC.

Flame extinguishes after ignition

Condensation in the vent tube because the detector was too cool when the flame was ignited.

Flame going out is caused by:

- Incorrect detector gas flows for a mix of air and hydrogen.
- Restriction to detector gas flows.

Replacement Parts

Inert transfer line

Table 15 Inert transfer line parts (Figure 32)

Item	Description	Part number
1	O-ring, FPD jet seal, white	0905-1608
2	Inert transfer line	19256-60555
3	Heater/Sensor assembly	G2628-60610
4	Capillary adapter seat	19256-21140
5	Capillary adapter nut	19256-21150
6	1/8-inch ferrule	0100-1332
7	1/8-inch nut	5180-4103
8	1/4-inch packed adapter	G1532-20710
9	Retainer clip	19256-00340
10	Screw, M3 × 12 mm	0515-1084

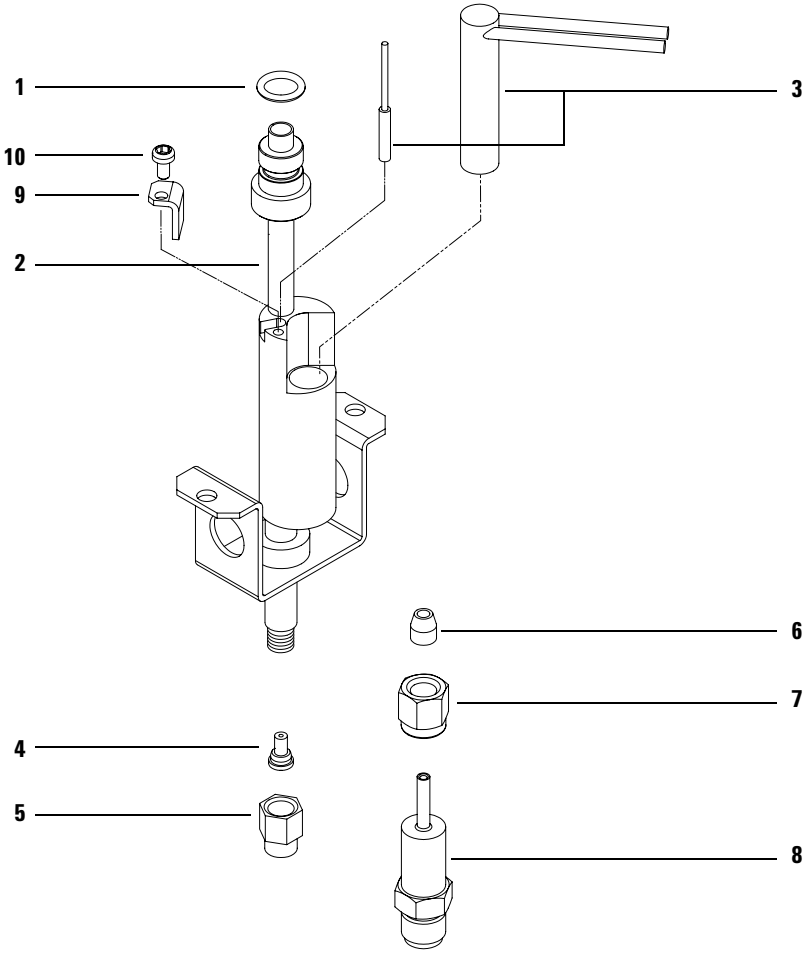

Figure 32 Inert transfer line

FPD ignitor and heat shield assembly

Table 16 FPD ignitor and heat shield assembly parts (Figure 33)

Item	Description	Part number
1	**FPD tube assembly** Aluminum Stainless steel	 19256-60700 19256-20705
2	Vespel ferrule, 1/4-inch ID	0100-1061
3	Block weldment	19256-80560
4	**Ignitor replacement kit** A. O-ring B. Spacer C. Glow plug	19256-60800
5	Ignitor cable assembly	G1535-60600
6	Heat shield gasket, white	19256-80045
7	Heat shield window	19256-80030
8	Heat shield disk	19256-20580
9	Stainless steel coupling	19256-20550
10	Lock washer (4 required)	2190-0584
11	Screw, M3 × 12 mm (4 required), T-10	0515-1084
12	Collar	19256-20690
13	Screw, M3 × 6 mm	0515-0680

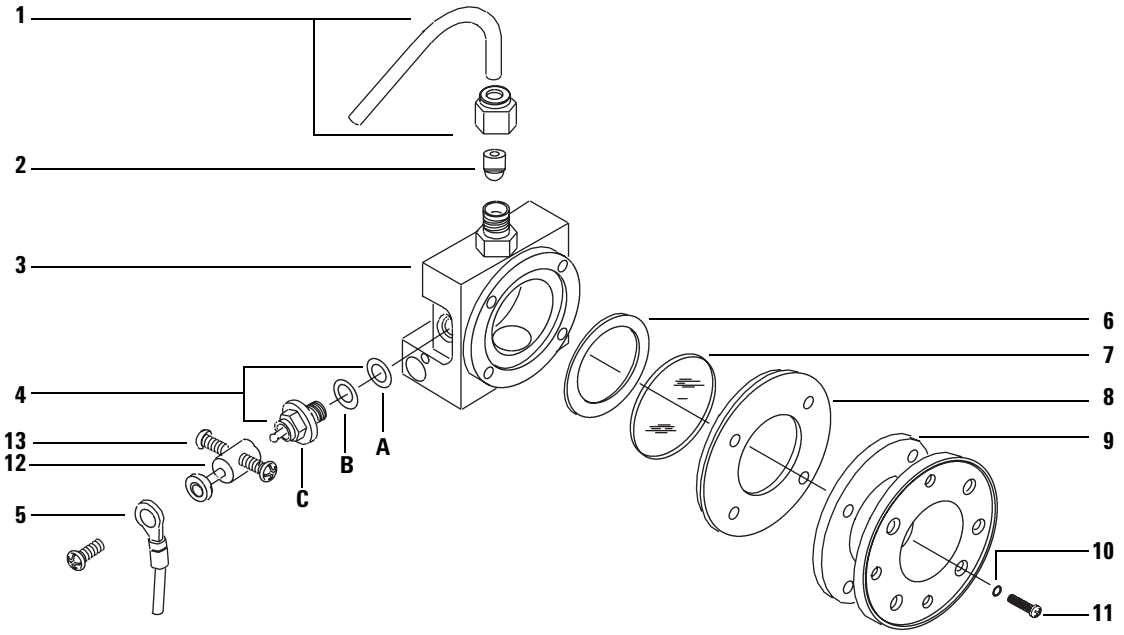

Figure 33 FPD ignitor and heat shield assembly

FPD lens assembly

Table 17 FPD lens assembly parts (Figure 34)

Item	Description	Part number
1	Clamp	19256-00090
2	Screw, M3 × 25 (4 required) - T10	0515-0683
3	Silicone O-ring.926-in ID (orange)	0905-0955
4	Convex lens	1000-1438
5	Lens housing	19256-20900
6	Flange ring	19256-00200
7	O-ring, Viton, 1.239-in ID (brown)	0905-1100

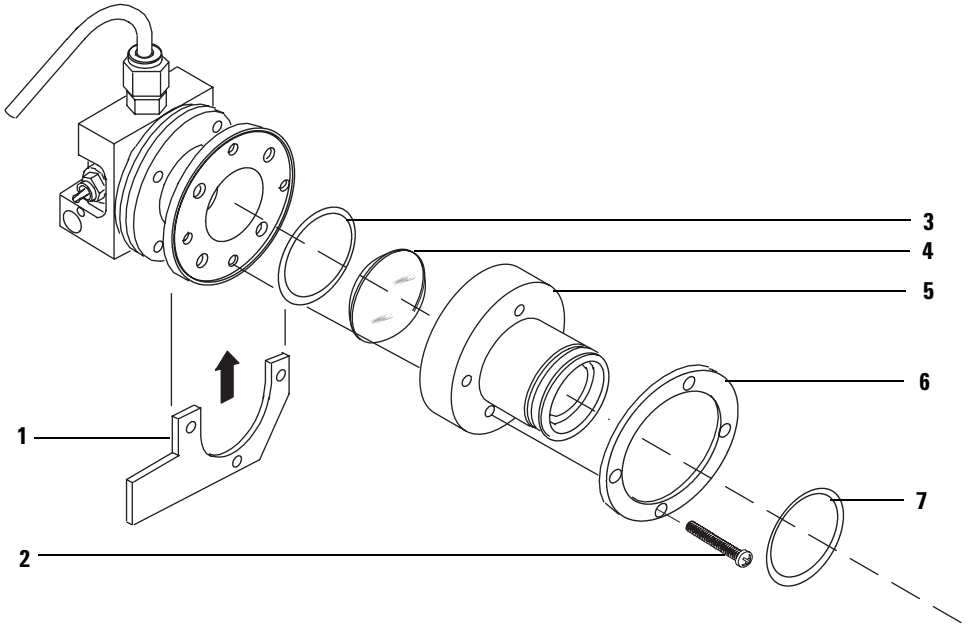

Figure 34 FPD lens assembly

PMT and bracket assemblies

Table 18 PMT and bracket assemblies parts (Figure 35)

Item	Description	Part number
1	Chimney back cover	G1535-80520
2	Heater/sensor assembly	G2628-60610
3	Transfer line support bracket	19256-00320
4	Bracket/support	G1535-00010
5	PMT housing assembly	19256-60510
6	**Filters** Sulfur Phosphorus	 1000-1437 19256-80010
7	Spacer, used with sulfur filter	19256-20910
8	Emissions block assembly, single	19256-60650

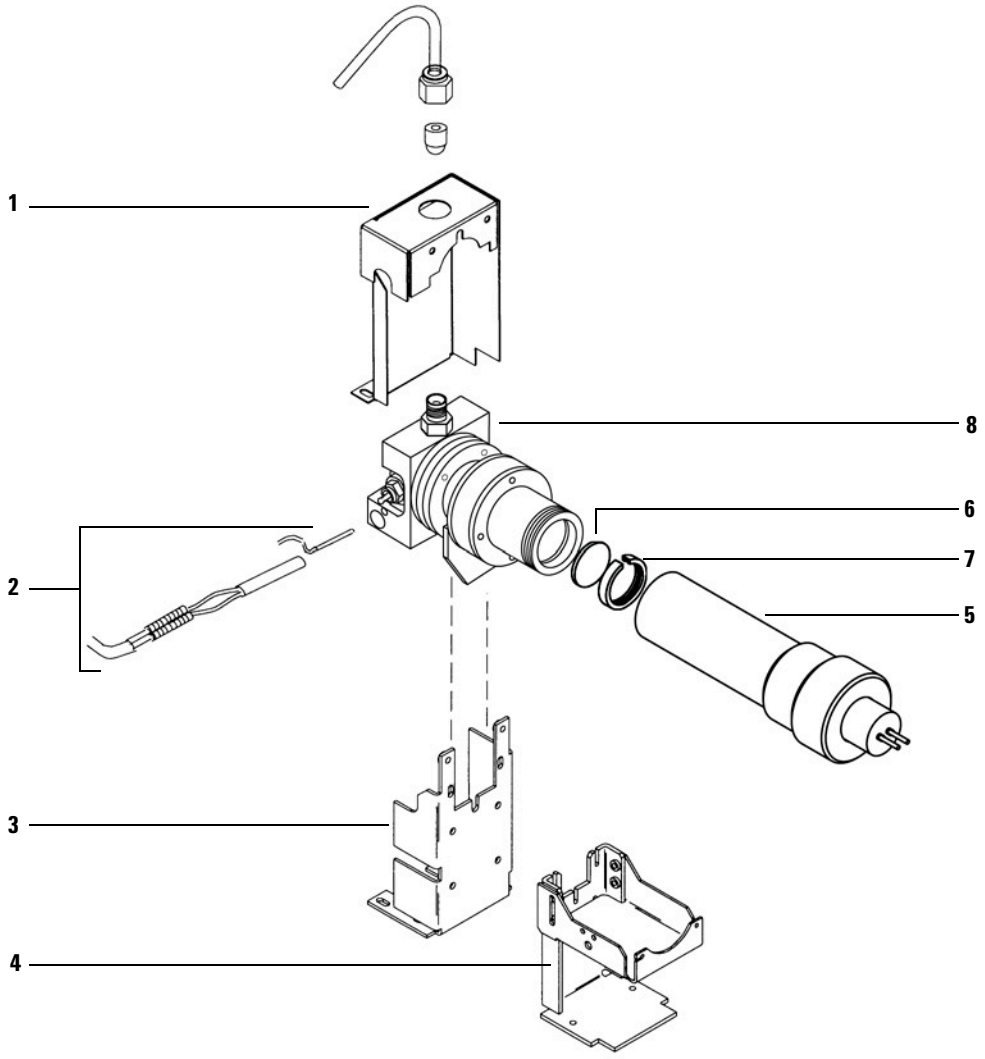

Figure 35 PMT and bracket assemblies

Covers and miscellaneous parts

Table 19 Covers and miscellaneous parts (Figure 36)

Item	Description	Part number
1	FPD cover	G2649-00010
2	FPD hinge plate	G2649-00020
3	FPD top plate	G2649-00030
4	FPD front plate	G2649-00040
5	FPD back plate	G2649-00050
NS	Detector board	G2628-60010
NS	Nut, hex, 7 mm	0535-0043
NS	FPD preventive maintenance kit, single	G2647-60510
NS	Column measuring tool	19256-80640
NS	FPD flow module kit*	G1535-60720
NS	Screw, M4 × 12 mm (3 required)	0515-2496
NS	Nut, hex, 5/16-inch (3 required)	2950-0232
NS	Flow module cover, front	G2630-00410
NS	Flow module cover, back	G2630-00420

* The flow module must be enclosed in the front and back covers, listed below. They are not included in the kit. They may be salvaged from the old flow module or purchased using the next four items

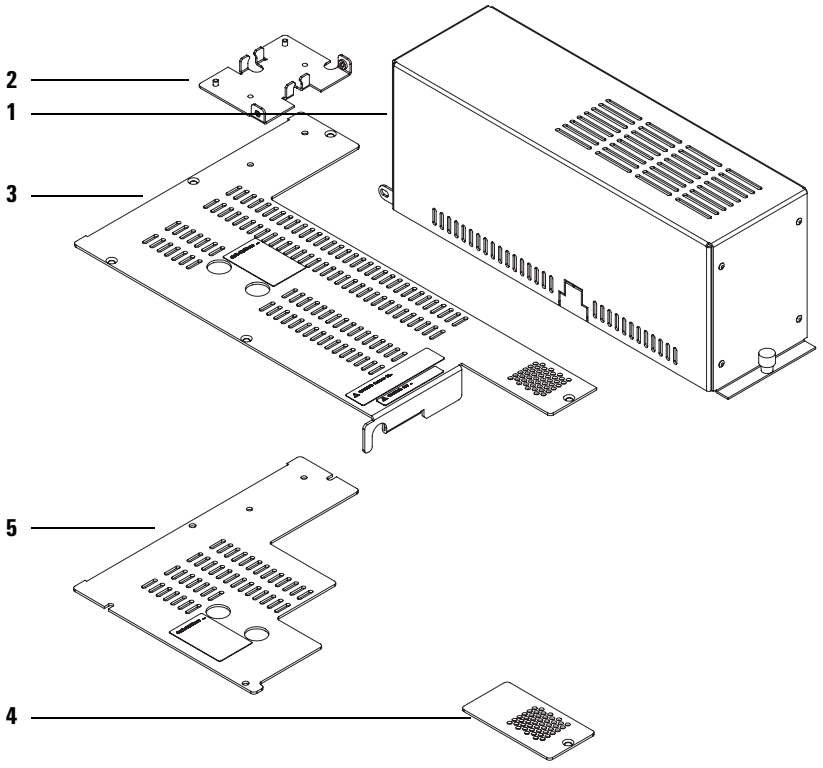

Figure 36 Covers

5
6890 GC: Maintenance, Troubleshooting and Replacement Parts

Changing the Wavelength Filter 82
Accessing Heaters and Ignitor 86
Replacing the Heater/Sensor Assemblies 90
Replacing the Ignitor 97
Replacing the Inert Transfer Line 101
Troubleshooting 104
Replacement Parts 110

This chapter describes procedures for maintaining an FPD mounted on an Agilent 6890 GC. If you are using a 6850 GC, see the previous chapter.

Changing the Wavelength Filter

Changing the wavelength filter takes about 5 minutes. It requires you to turn off the electrometer, remove the photomultiplier tube assembly, and change the filter.

CAUTION Do not touch the filters with your bare hands. For optimum performance and to avoid scratches, use lint free gloves for assembling and inserting the filters into the assembly.

Materials needed

- 1000-1437 Sulfur filter and 19256-20910 filter spacer
- 19256-80010 Phosphorus filter
- 5080-5400 Cotton swabs
- Toothpick or cotton swab
- Lens tissue
- 8650-0030 (large) or 8650-0029 (small) Nylon lint-free gloves

Procedure

1 Turn off the detector electrometer.

2 Disconnect the retaining spring that holds the PMT assembly to the bracket. With a rotating motion, pull the assembly away from the filter housing (Figure 37).

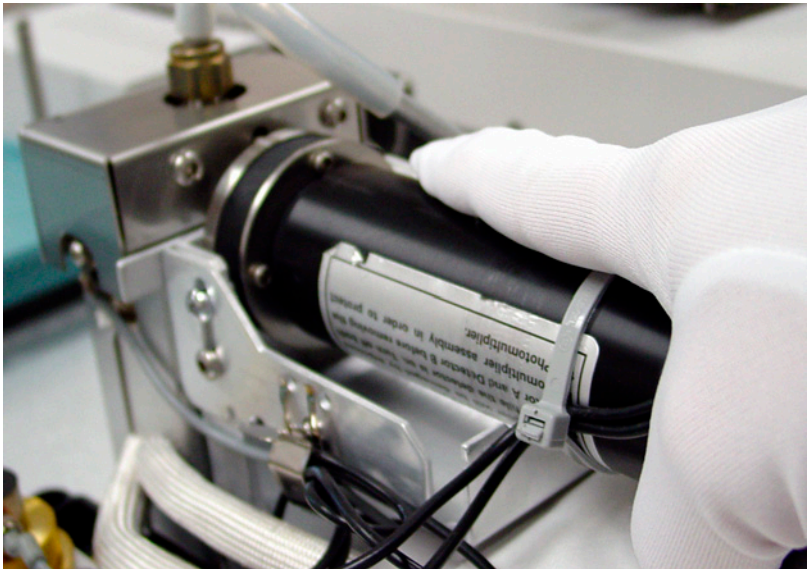

Figure 37 Removing the PMT assembly

3 To prevent light from damaging the PMT, immediately cap the end or place it face down (Figure 38).

Figure 38 Protecting the PMT

4 Place a clean cloth under the filter housing to catch the filter.
Phosphorus filter: use the sharpened wooden tip of a toothpick or cotton swab to dislodge the filter from the housing.
Sulfur filter: (Figure 39) use the wooden tip of the cotton swab to remove the filter spacer. Then remove the filter as above.

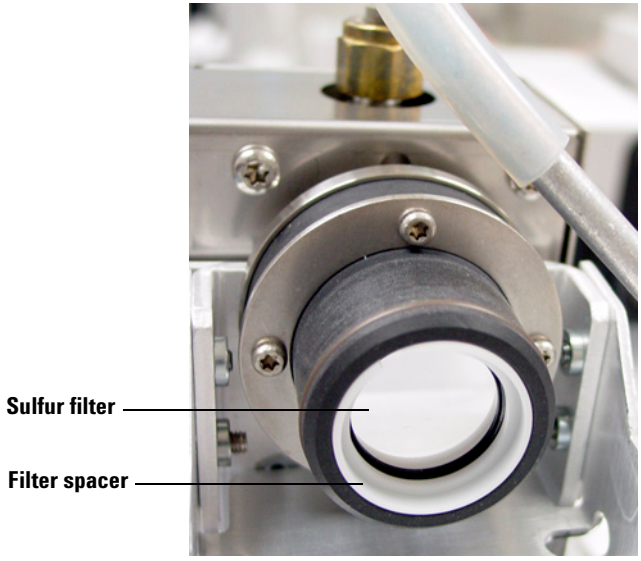

Figure 39 Sulfur filter and spacer

5 Use lens tissue to clean the new filter. Install it in the filter housing. If you are installing a sulfur filter, add the filter spacer.

CAUTION Do not use cleaning fluids. Cleaning fluids will damage lens coatings.

CAUTION Filters are designed for the light from the flame to pass through in a specific direction. On the edge of the phosphorus filter, there is a triangle. On the edge of the sulfur filter, there is an arrow. These should face *away* from the flame and *toward* the PMT.

6 Replace the PMT assemblies and secure them with the springs.

7 Restore the operating conditions.

Accessing Heaters and Ignitor

Removing the vent and cover and, on the dual-wavelength detector, the left PMT assembly to access the heaters or ignitor takes about 5 minutes. It requires you to turn off the GC.

CAUTION When turning the GC off, turn off the flame first to prevent condensation from dripping into the jet and column.

You may wish to access this area for the following reasons:

- Replace the ignitor.
- Replace seals and O-rings.
- Replace the transfer line assembly.
- Replace or check the heater and PRT sensors.

Materials needed

- 8710-0803 9/16-inch wrench
- 8710-1807 T-20 Torx driver

Procedure

To remove the vent tube and cover

1. Turn off the flame.
2. Turn off the GC.
3. Wait until the detector cools.

4 Use a wrench to loosen and remove the vent tube assembly (Figure 40).

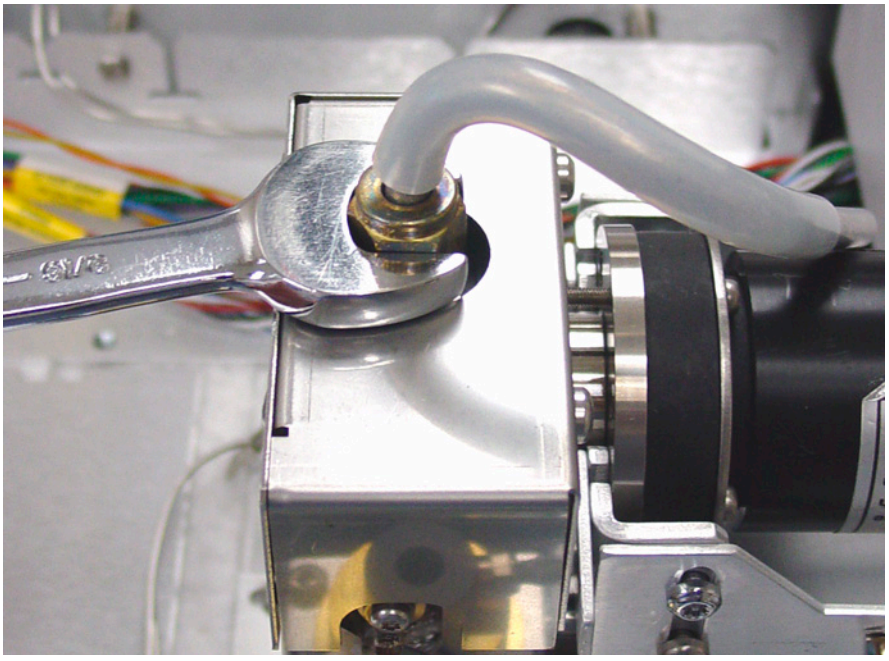

Figure 40 Removing the vent tube

5 **Single-wavelength detector**. Use a Torx T-20 driver to remove the screws securing the FPD cover. There are two screws at the bottom of the left side (Figure 41) and two screws at the top of the right side (Figure 42).

Dual-wavelength detector. Use a Torx T-20 driver to remove the screws securing the FPD cover. There are two screws at the top of the right side (Figure 42).

Lift the cover off the detector.

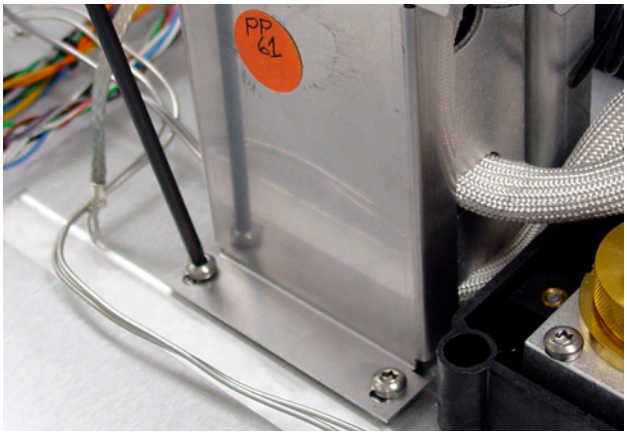

Figure 41 Cover screws, left side (single-wavelength FPD)

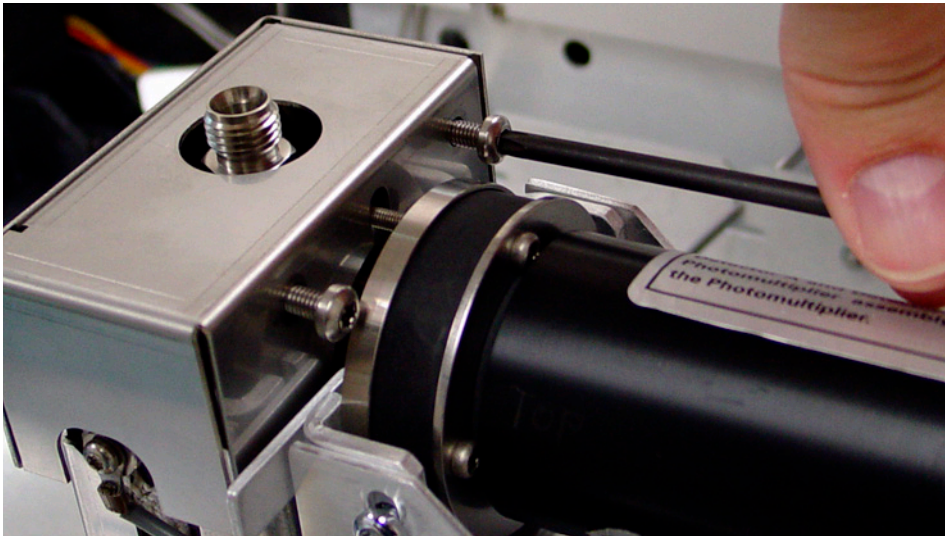

Figure 42 Cover screws, right side (both FPDs)

6 **Dual-wavelength detector only.** Remove the four screws securing the Dual FPD chimney front (with the attached dual main bracket and PMT

assembly). Remove the entire left part of the detector. Follow the order of operations in Figure 43. Cover the open end of the PMT assembly to protect the tube from light.

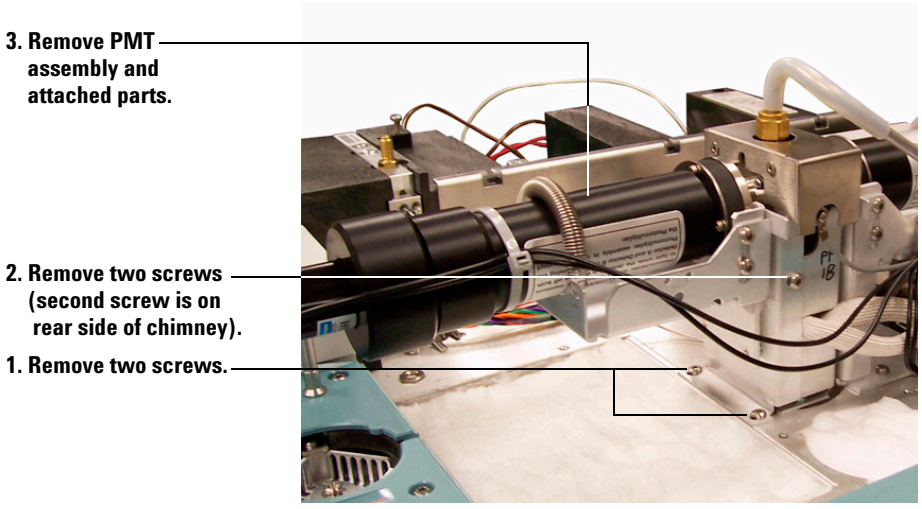

Figure 43 Removing the left PMT assembly

To reinstall the vent tube and cover

1 Single-wavelength detector
   - **a** Start the two screws on the right side of the cover.
   - **b** Start and tighten the screws at the base on the left side.
   - **c** Tighten the screws on the right side.

2 Dual-wavelength detector
   - **a** Place and support the PMT assembly so that the screw holes line up.
   - **b** Install and tighten the four screws.
   - **c** Install the cover (two screws).

3 Replace the vent tube assembly.

4 Turn on the GC. Confirm that the flame is off.

5 Restore the operating conditions.

6 Wait 20 minutes for the detector to heat up, then ignite the flame.

Replacing the Heater/Sensor Assemblies

Replacing the heater/sensor assemblies takes about 30 minutes. It requires you to turn off the GC, remove the vent, the detector cover, and, on the dual-wavelength detector, the left PMT assembly.

CAUTION When turning the GC off, turn off the flame first to prevent condensation from dripping into the jet and column.

You may wish to replace or check the FPD heater/sensor assemblies for the following reasons:

- One or both of the heaters or sensors are defective.
- The actual temperature reading on the display of the heaters is cycling more than 1 °C.

Materials needed

- G1535-60610 Heater/Sensor assembly with short lead for the emissions block assembly.
- G1535-60620 Heater/Sensor assembly with long lead for the transfer line.
- ESD protection: For example, a wrist strap
- Wrenches: 8710-0803 (9/16-inch), 8720-0010 (5/8-inch), 1/4-inch × 3/8-inch
- Torx drivers: 8710-2140 T-10 and 8710-1807 T-20.

Procedure

1. Turn off the flame.
2. Turn off the GC.
3. Remove the vent assembly and cover. Refer to “Accessing Heaters and Ignitor” on page 86.
4. Put on an ESD wrist strap. Remove the right-side cover to access the GC electronics. Disconnect the heater/sensor leads from the auxiliary heater board and the connectors above the main board.
5. Carefully pull the cables up onto the top of the GC.

Transfer line

1 Use a Torx T-10 driver to remove the screw and retainer clip holding the lower heater/sensor assembly (Figure 44). Remove the heater and sensor from the transfer line.

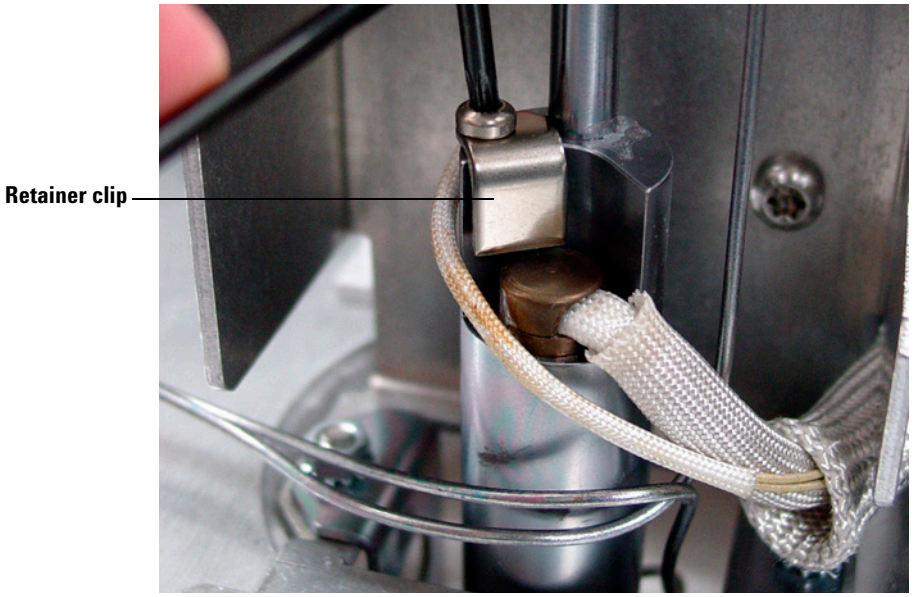

Figure 44 Transfer line heater/sensor

2 Remove the protective cap from the temperature sensor of the heater/sensor assembly with the short cable.

3 Insert the heater and sensor into the transfer line (Figure 45). Make sure the sensor is seated at the bottom of the hole. If not, the AUX temperature will wander above and below the detector setpoint.

Figure 45 Install the transfer line heater/sensor

4 Position the retainer clip over the heater/sensor assembly and install the screw (Figure 46).

Figure 46 Install the retainer clip

Emissions block assembly

1 Remove the upper heater and temperature sensor from the emissions block assembly.

2 Remove the protective cap from the sensor of the heater/sensor assembly with the long cable.

3 Install the upper heater and sensor in the emissions block assembly (Figure 47).

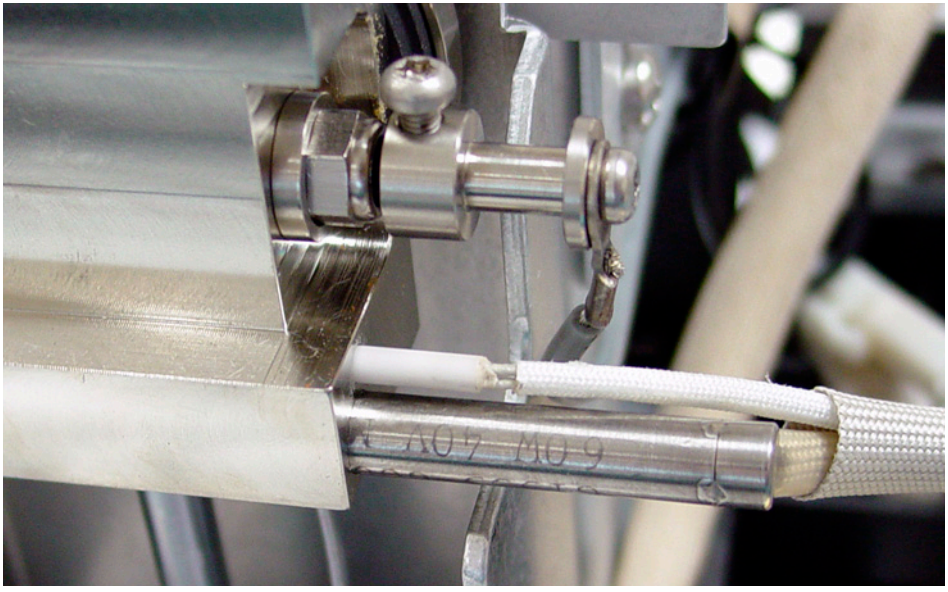

Figure 47 Install the upper heater and sensor

Closing up

1 Route the heater/sensor cables out of the bracket (Figure 48).

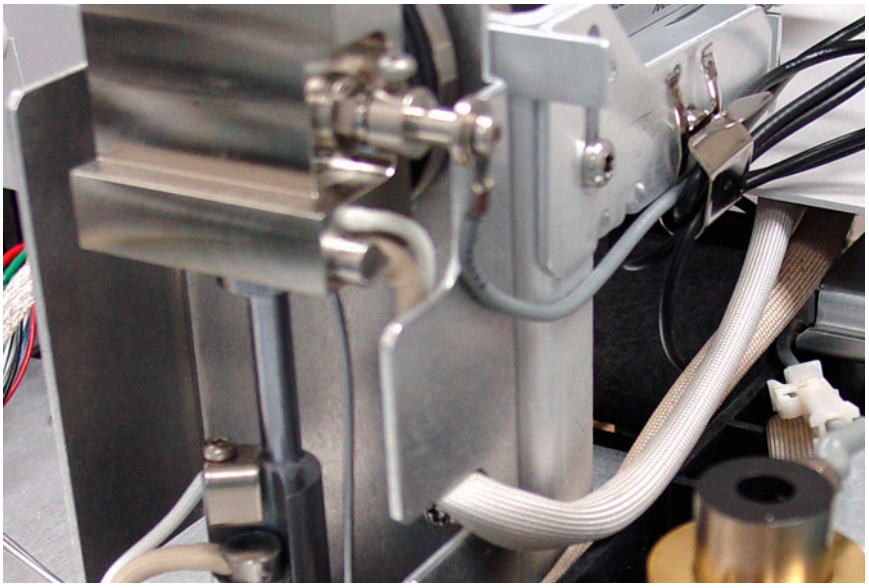

Figure 48 Route the heater/sensor cables

2 Replace the cover, vent assembly, and, on the dual-wavelength detector, the left PMT assembly. Refer to “Accessing Heaters and Ignitor” on page 86.

3 Carefully thread the heater/sensor cables into the electronics compartment.

4 Put on an ESD wrist strap. Connect the short cable as shown in Figure 5 on page 17. Connect the long cable to the auxiliary heater board (Table 20).

Table 20 Connectors and leads

Detector type	Location	Connector
Single-wavelength	Front	A1
Single-wavelength	Back	A2
Dual-wavelength	Back	A2

5 Replace the right-side cover to the GC electronics compartment.
6 Turn on the GC. Confirm that the flame is off.
7 Restore the operating conditions.
8 Wait 20 minutes for the detector to heat up, then ignite the flame.

Replacing the Ignitor

Replacing the ignitor takes about 20 minutes. It requires you to turn off the GC, remove the vent and cover, and, on the dual-wavelength detector, the left OMT assembly. Agilent recommends that you do not touch these parts with your bare hands. For optimum performance use lint-free gloves for assembling and inserting the new parts into the emissions block assembly.

You may wish to replace the FPD ignitor for the following reasons:

- After the detector reaches operating temperatures, the FPD will not light.
- Baseline increase indicates dirt buildup.

Materials needed

- 19256-60800 Ignitor replacement kit
- Wrenches: 1/4-inch × 5/16-inch (8710-0510)
- Torx driver: T-10 (8710-2140)
- 8650-0030 (large) or 8650-0029 (small) Nylon lint-free gloves

The FPD Ignitor replacement kit includes a glow plug, a spacer, and an O-ring. Do not use the copper ring that ships with the glow plug.

Procedure

1. Turn off the flame.
2. Turn off the GC.
3. Remove the vent assembly, cover, and, on the dual-wavelength detector, the left PMT assembly. Refer to “Accessing Heaters and Ignitor” on page 86.

4 Use a Torx T-10 driver to loosen the collar screw holding the cable assembly to the ignitor (Figure 49). Remove the collar and cable assembly. Some FPDs have a version of the collar with two screws.

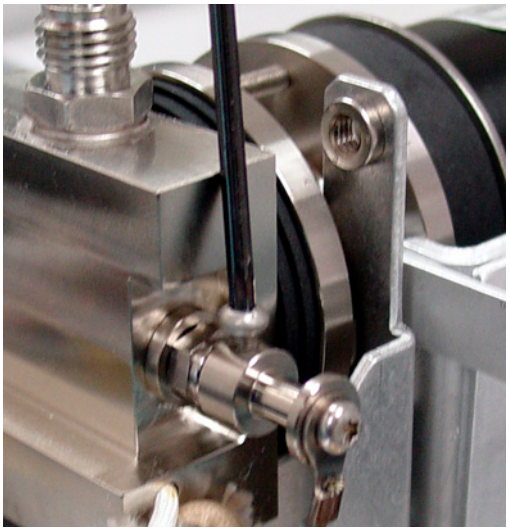

Figure 49 Removing the ignitor cable

5 Use a wrench to loosen and remove the glow plug. Use tweezers to remove the O-ring.

6 Assemble the parts for the new ignitor (Figure 50).

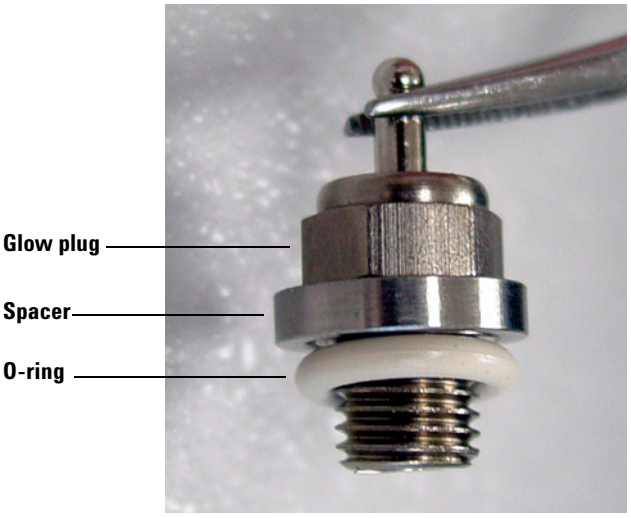

Figure 50 Ignitor parts assembled

7 Insert and tighten the parts.

8 Replace the ignitor collar and cable assembly (Figure 51). Some collars have two screws.

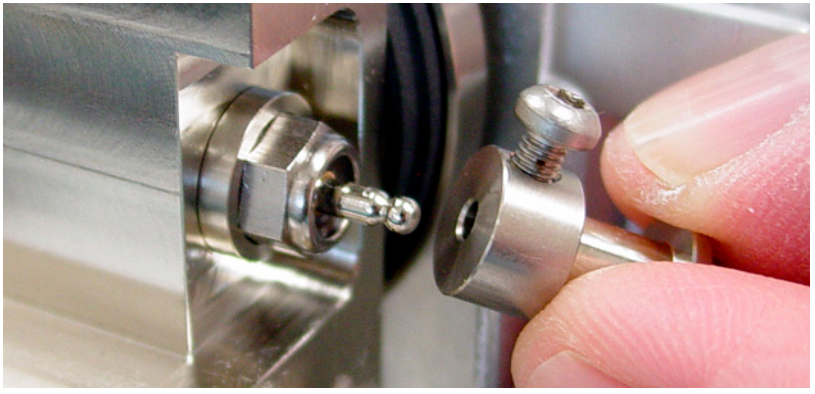

Figure 51 Connecting the ignitor cable

9 Replace the cover, the vent tube assembly, and, on the dual-wavelength detector, the left PMT assembly.

10 Turn on the GC. Confirm that the flame is off.

11 Restore the operating conditions.

12 Wait 20 minutes for the detector to heat up, then ignite the flame.

Replacing the Inert Transfer Line

Occasionally, the inert transfer line between the column and the emissions block must be inspected, cleaned, and/or replaced. Figure 52 shows an installed inert transfer line.

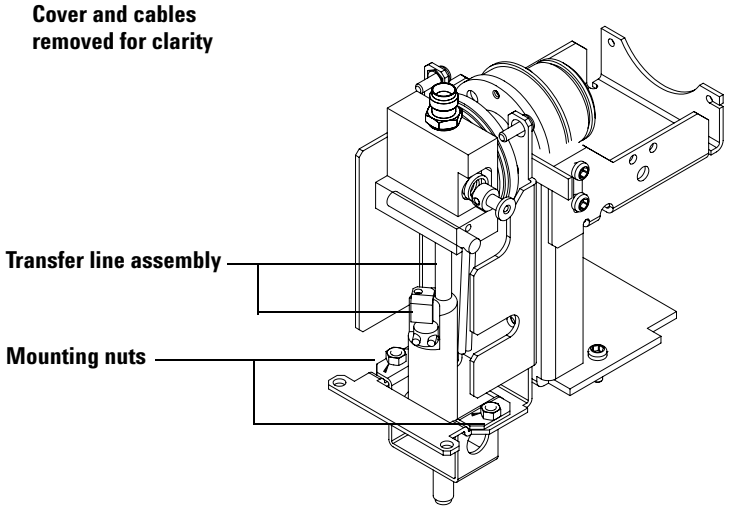

Figure 52 Left side of the detector

Removing the transfer line

1 Turn off the flame.

2 Turn off the GC and unplug the power cord. Let the GC cool.

CAUTION To avoid damaging the photomultiplier tube, always turn the GC or electrometer off before removing the PMT assembly.

3 Inside the oven, remove the column and adapter (if installed) to the FPD.

4 Locate the gray ignitor cable attached to the side of the detector. Trace the cable to the signal board and disconnect it there.

5 Remove the vent tubing and the sheet metal cover.
Single-wavelength: two screws at the right-side top and two at the left-side bottom.
Dual-wavelength: two screws at the right-side top.

6 Remove the PMT assemblies (release the spring, then twist and pull). It is not necessary to disconnect any cables; just place the assemblies on top of the GC and cover them to protect them from light.

7 Remove the two mounting nuts that hold the transfer line assembly (Figure 52).

8 Four screws connect the lens holder to the right face of the emissions block assembly (Figure 53). Loosen, but do not remove, the screws on the bottom and the two sides.

Similarly, loosen the screws on the left side the lens holder, if present.

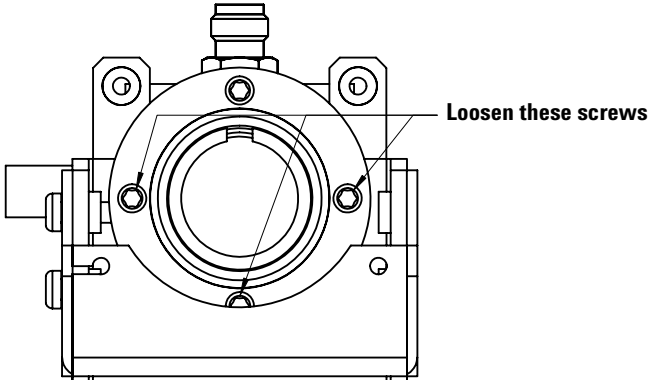

Figure 53 Lens holder and screws.

9 Grasp the emissions block assembly and *carefully* lift it straight up. The transfer line will come with it. Twist and pull to separate the two parts.

If the emissions block assembly/transfer line will not lift free of the detector bracket, check for tubing or cables catching on the sheet metal.

10 If you will be installing a new transfer line assembly, trace the gas tubing to the manifold block on the flow module. Remove the single screw that holds the fitting. Install new O-rings.

Reassembly

1. Insert the transfer line into the bottom of the emissions block assembly.
2. Slide the combined parts into the detector body. The semicircular plates that the three screws connect to go into the gap between the two parts of the bracket.
3. Install the two mounting nuts that hold the transfer line.
4. Check that the emissions block assembly is fully seated on the transfer line and that all of the cables and tubing are properly placed.
5. Tighten the screws that secure the lens holders.
6. Install the PMT assemblies).
7. Reconnect the ignitor cable.
8. Install the cover and the vent tube.
9. If necessary, connect the gas lines to the flow module.
10. Restore operating conditions.
11. Wait 20 minutes for the vent tube to heat up, then ignite the flame.

Troubleshooting

Offset or detector output too high or too low

Using a filter with flows optimized for the other filter type can cause unexpected output levels.

Monitor the FPD output. Table 21 provides examples of detector output when the filter installed in the detector and the gas flows in use do not match.

Table 21 Filter/Flow mismatch

	Outputs	
Gas flows optimized for	**With sulfur filter**	**With phosphorus filter**
Sulfur	30 to 50	10 to 12 (low)
Phosphorus	240 to 250 (high)	30 to 50

Besides having the wrong filter for a particular set of gas flows, also consider:

- If the Lit Offset is 0.5 to 3.0, check that the flame is ON.
- If the Lit Offset is 0, check if the electrometer is turned OFF or the signal cable is disconnected.
- If the Lit Offset <30, the flame may be in the wrong position. Check detector flows, column flow, and column position.

MDL too high

Table 22 lists typical MDL values for a checkout.

Table 22 Typical MDL values for a checkout

	Typical range after 24 hours	Limits at installation
P filter	0.060 to 0.080	≤0.100
S filter	3.8 to 5	≤6

The MDL is dependent on the peak area and the detector noise. The relationship is: the smaller the peak area and the larger the noise measurement, the larger the MDL. If the MDL is high, check under the “High noise level” on page 105 and “Small peak area” on page 105.

High noise level

Table 23 lists typical noise values for a checkout.

Table 23 Typical range of values for a checkout

	Typical range after 24 hours	Limits at installation
P filter	1.6 to 3.0	≤4
S filter	2 to 4	≤5

Higher than expected noise is caused by:

- Low purity or contaminated source gases.
- Unconditioned column or ferrules.
- Dirty or contaminated inlet components, such as the liner.
- Dirty or contaminated detector parts, such as the ignitor.
- Light leak at PMT or Vent tube. Turn the flame off and check the output. If the output is above 10 or 20 pA you probably have a light leak.

Small peak area

Table 24 lists typical peak area values for a checkout.

Table 24 Typical peak area values for a checkout

	Typical range after 24 hours	Limits at installation
P filter	19000 to 32000	≥19000
S filter	8000 to 19000	≥8000

Small peak area is caused by:

- End of column extends too far into the detector. Sample not burned in flame.
- Sample lost in inlet or at column connections. Check your GC method split or splitless setpoints. Check the inlet septum, liner O-ring, and seal.
- Photo-multiplier tube defective.
- Incorrect filter or detector flows.

Large peak width at half-height

Table 25 lists typical peak width values for a checkout.

Table 25 Typical peak width values for a checkout

	Typical range after 24 hours
P filter	0.05 to 0.07
S filter	0.06 to 0.08

Large peak width is caused by:

- Activity in the inlet or column.
- Injection volume too large for inlet, liner, or inlet conditions.

Detector Temperature Not Ready

The performance of the AUX heater is affected by the placement of the PRT sensor. If it is not seated completely into the transfer line, the temperature will wander above and below the set point and the GC will be Not Ready. See Table 26.

Table 26 Detector temperature range and duty cycle

PRT location	Setpoint	Duty cycle	Temperature range
Detector	200 °C	16 to 17%	200.02 to 199.98 °C
AUX Seated	200 °C	16 to 24%	200.20 to 199.8 °C
AUX not seated	200 °C	50 to 100%	205.00 to 195.00 °C

If the AUX temperature for the FPD is cycling or wandering, view the PID thermal diagnostic for the AUX heater by:

1 On the keypad, press Options.

2 Scroll to and select Diagnostics.

3 Scroll to and select Thermal PID control.

4 Scroll to and select AUX 1 or 2. This allows you to view the temperature range and duty cycle. Check the table above for normal ranges.

Clipped peaks

If you have an application at the upper limit of the dynamic range (especially with sulfur), you may have to desensitize your instrument. Replace the 1000-1437 sulfur filter with filter part number 19256-80000. Than set the detector gas flows to the values used in the phophorus checkout method. This raises the baseline but with some loss in the signal-to-noise ratio.

There should be no problems with either solution and the use of hydrogen. However, please note the following warning.

WARNING **Hydrogen gas is flammable and potentially explosive. Be sure to turn off the hydrogen gas at the source until connections are made. Also, leak test connections, lines and valves before operating or servicing the instrument.**

Data lost because detector tries to reignite during a run

Controlling Flame Auto-Ignition

Certain environmental conditions, such as

- Strong electromagnetic fields
- Large ambient temperature swings
- Large atmospheric pressure swings

can cause an artificially low signal in the GC, incorrectly indicating that the flame has gone out. As a result, the run aborts and the GC tries to relight an already-lit flame.

You can verify that the flame is lit by holding a cold, shiny surface (such as a mirror or a wrench) over the exit tube. Condensation on the surface indicates that the flame is lit.

Reset the Lit Offset to 2.0.

CAUTION An attempt to relight an already-lit flame corrupts any chromatograms created and shuts down the GC.

Flame extinguishes after ignition

Condensation in the vent tube because the detector was too cool when the flame was ignited.

Flame going out is caused by:

- Incorrect detector gas flows for a mix of air and hydrogen.
- Restriction to detector gas flows.

- Leak at detector EPC module.
- Condensation dripping onto flame. Prevent this by turning the flame off until detector is at temperature for 15 minutes.

Replacement Parts

Inert transfer line

Table 27 Inert transfer line parts (Figure 54)

Item	Description	Part number
1	O-ring, FPD jet seal, white	0905-1608
2	Inert transfer line	19256-60555
3	Heater/Sensor assembly	G1535-60620
4	Capillary adapter seat	19256-21140
5	Capillary adapter nut	19256-21150
6	1/8-inch ferrule	0100-1332
7	1/8-inch nut	5180-4103
8	1/4-inch packed adapter	G1532-20710
9	Screw, M3 × 12 mm	0515-1084
10	Retaining clip	19256-00340

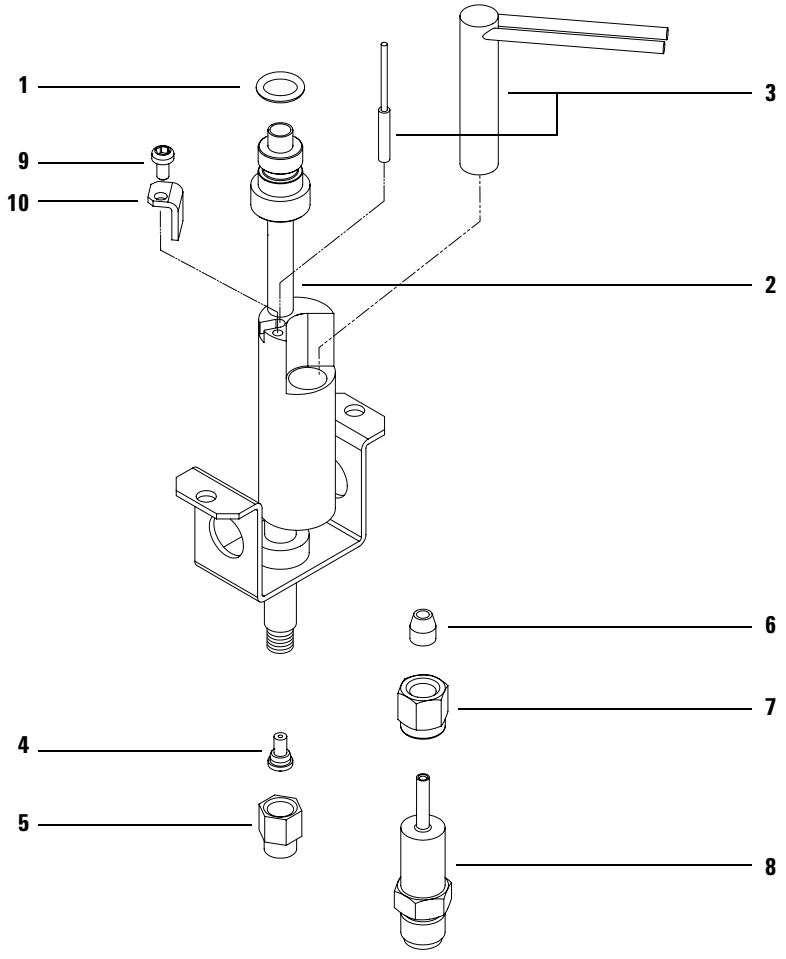

Figure 54 Inert transfer line

FPD ignitor and heat shield assembly

Table 28 FPD ignitor and heat shield assembly parts (Figure 55)

Item	Description	Part number
1	**FPD tube assembly** Aluminum Stainless Steel	 19256-60700 19256-20705
2	Vespel ferrule, 1/4-in ID	0100-1061
3	Emissions block assembly FPD, single FPD, dual (not shown)	 19256-80560 19256-80600
4	**Ignitor replacement kit** A. O-ring B. Spacer C. Glow plug	19256-60800
5	Ignitor cable assembly	G1535-60600
6	Heat shield gasket, white	19256-80045
7	First heat shield window	19256-80030
8	Heat shield disk	19256-20580
9	Stainless steel coupling	19256-20550
10	Lock washer (4 required)	2190-0584
11	Screw, M3 × 12 (4 required) - T10	0515-1084
12	Collar	19256-20690
13	Screw, M3 × 66 mm, T-10	0515-0680

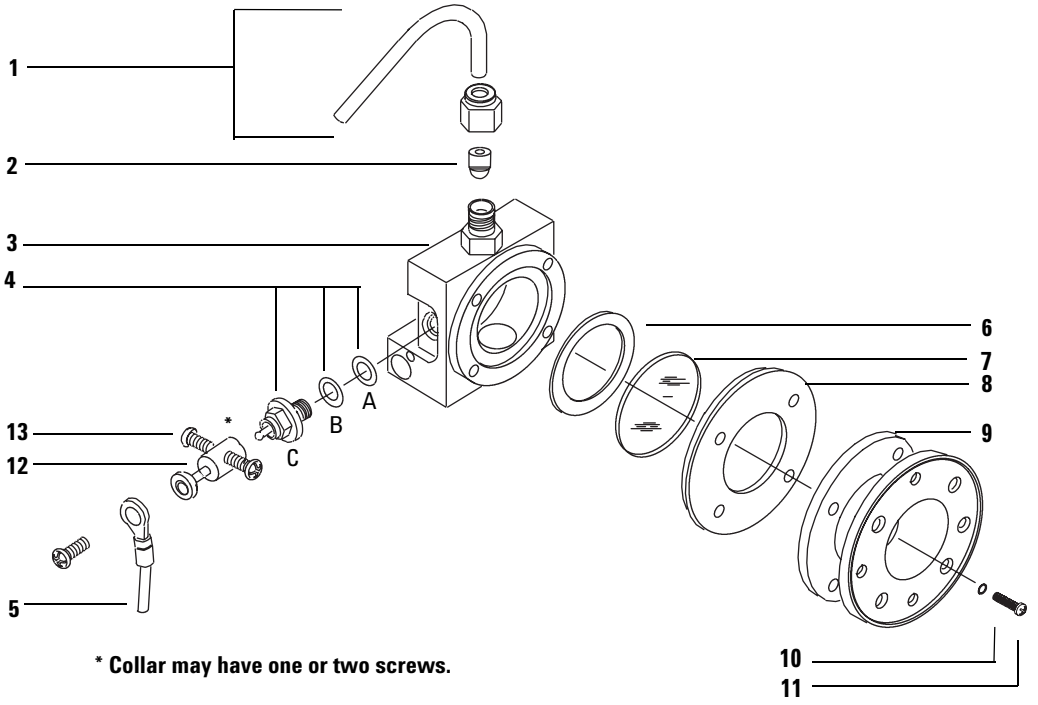

Figure 55 FPD ignitor and heat shield assembly

FPD lens assembly

Table 29 FPD lens assembly parts (Figure 56)

Item	Description	Part number
1	Clamp	19256-00090
2	Screw, M3 × 25 (4 required)	0515-0683
3	Silicone O-ring, 0.926-in ID (orange)	0905-0955
4	Convex lens	1000-1438
5	Lens housing	19256-20900
6	Flange ring	19256-00200
7	O-ring, Viton, 1.239-in ID (brown), for lens housing	0905-1100

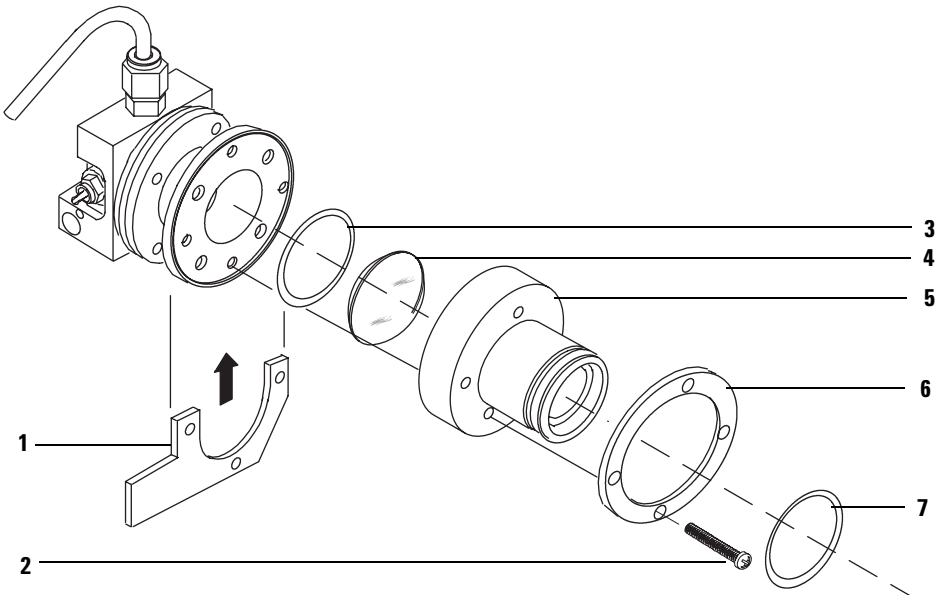

Figure 56 FPD lens assembly

PMT and bracket assemblies

Table 30 PMT and Bracket Assemblies Parts (Figure 57)

Item	Description	Part number
1	Chimney back cover	G1535-80520
2	Heater/Sensor assembly	G1535-60610
3	Transfer line support bracket	19256-00320
4	Bracket/Support	G1535-00010
5 5b	Emissions block assembly, single Emissions block assembly, dual	19256-60650 19256-60690
6	**Filters** Sulfur Phosphorus	 1000-1437 19256-80010
7	Filter spacer (used only with sulfur filter)	19256-20910
8	PMT housing assembly	19256-60510
9	Dual FPD chimney front	G1535-00030
10	Dual cover assembly	G1535-80530
11	Dual FPD chimney back	19256-00330
12	Dual main bracket	G1535-00040

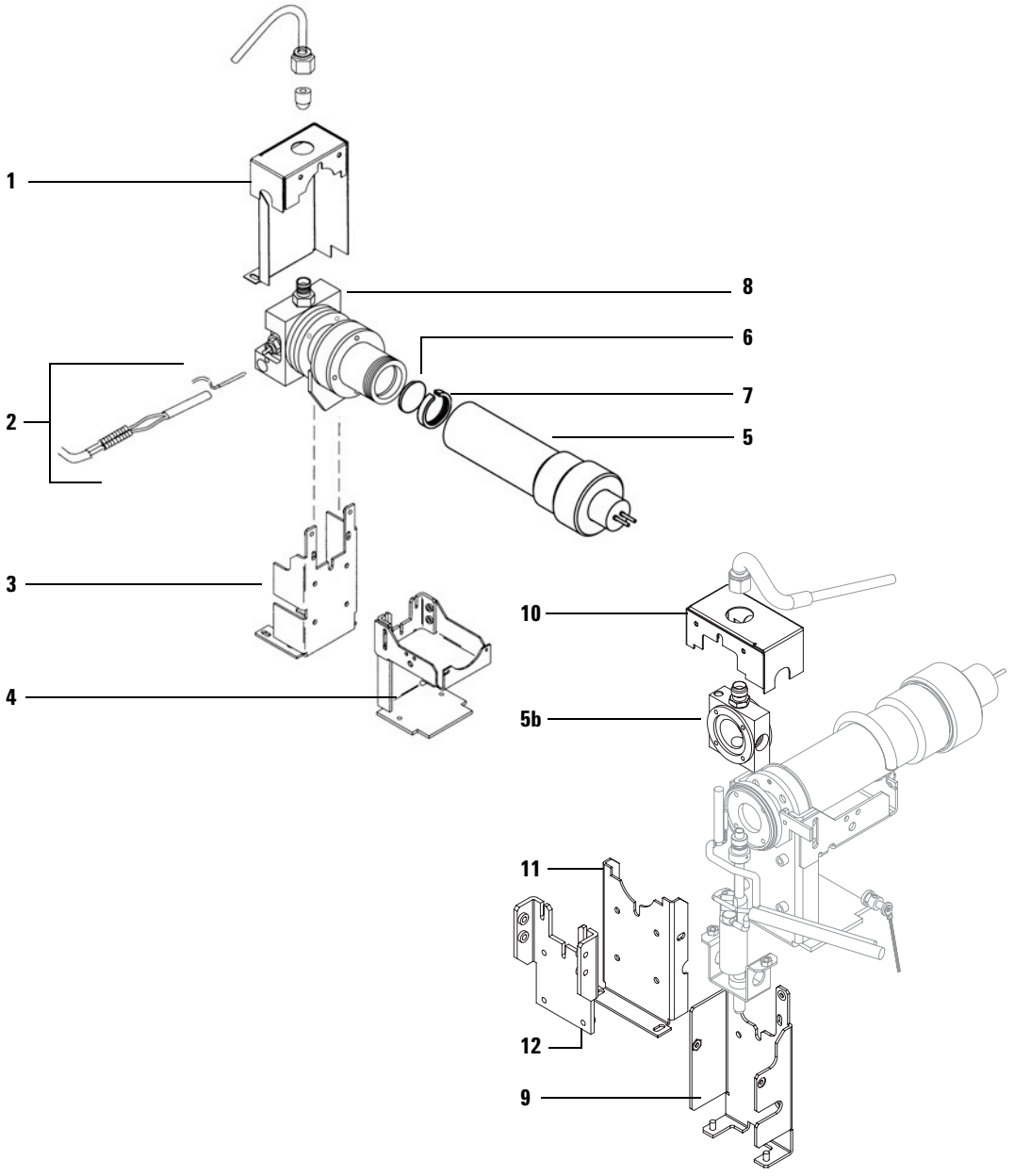

Figure 57 PMT and bracket assemblies

Covers, flow modules, and electronics

Table 31 Covers, manifolds, and electronics parts (Figure 58)

Item	Description	Part number
1	**FPD assembly**	
	Single wavelength	G1535-61555
	Dual wavelength (not shown)	G1535-61565
2	**Top cover**	
	Single wavelength	G1535-80555
	Dual wavelength	G1535-80560
3	Flow module kit	G1535-60720
4	Electronics cover pan	G1535-00120
5	Electronics top cover	G1535-80520
6A	Solenoid valve bracket	G1580-00070
6B	Aux zone/valve box cable	G1530-60660
6C	Screw, M4 × 12 mm (2)	1390-1023
7	Signal board	G1535-60010
8	Ground strap	19256-60730
NS	Spring to secure PMT	1460-1160
NS	FPD update kit, single wavelength	G2647A
	FPD update kit, dual wavelength	G2648A
	FPD PM kit, single wavelength	G2647-60510
	FPD PM kit, dual wavelength	G2648-60510
NS	Column measuring tool (see Figure 15 on page 44)	19256-80640

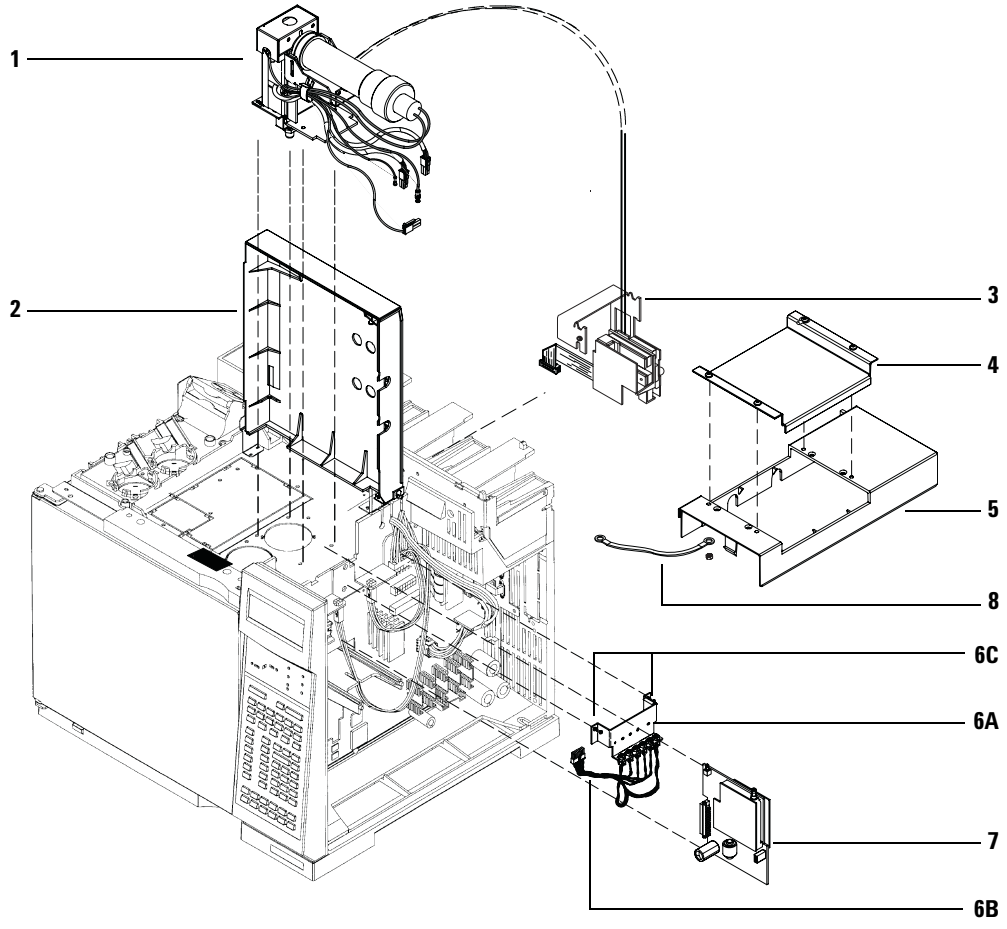

Figure 58 Covers, manifolds, and electronics

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