

# 240 Programmed Temperature Vaporization Inlet (PTV)

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## Theory of operation

The Programmed Temperature Vaporization (PTV) Inlet collects each portion of an injected sample inside a 120 microliter liner until the entire quantity of sample is obtained. During the hold, the sample is held at a programmable temperature as low as  $-60^{\circ}\text{C}$  using  $\text{CO}_2$  cooling, or as low as  $-160^{\circ}\text{C}$  using liquid nitrogen. When the complete sample is collected, the PTV heats and delivers the sample onto the column.

The PTV can be used with either a septum or septumless head, operating in either split, splitless, or solvent vent modes.

In the solvent vent mode, analytes are thermally trapped in the liner while the solvent is removed. With the solvent gone, the liner volume can be used for another injection. Injection can be repeated several times to concentrate the analytes from a large sample volume. After injection and solvent removal, the analytes are transferred to the column. This can replace the need for offline reconcentrating and minimize loss of sample.

## Operating modes

The Agilent Programmed Temperature Vaporization (PTV) Inlet System has five operating modes:

- The *split mode* is generally used for major component analyses.
- The *pulsed split mode* is like the split mode, but applies a pressure pulse to the inlet during sample introduction to speed the transfer of material onto the column.
- The *splitless mode* is used for trace analyses.
- The *pulsed splitless mode* provides a pressure pulse during sample introduction.
- The *solvent vent mode* collects analyte in the liner while venting solvent, and is used for large volume injection. Either single or multiple injections can be made for each run.

### **Sampling heads**

The septum head uses either a regular septum or a Merlin microseal to seal the syringe passage. A stream of gas sweeps the inner side of the septum and exits through the septum purge vent on the pneumatics module. It may be used with either automatic or manual injection.

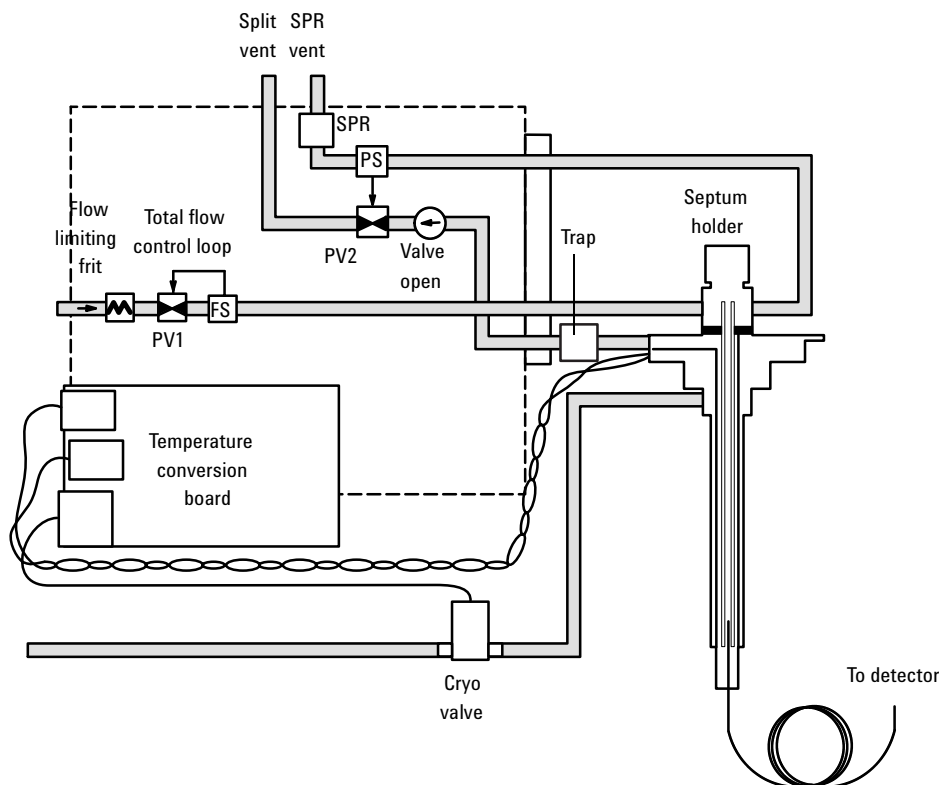
The septumless head uses a check valve instead of a septum to seal the syringe entrance passage. It may be used with either automatic or manual injection.

## Split modes

### Septum head installed

In the two split modes—with or without a pressure pulse—the solenoid valve is open and divides the gas stream entering the inlet between the column flow, the split vent flow through the solenoid valve, and the septum purge flow. The ratio of the split vent flow to the column flow is called the split ratio.

Figure 240-1 shows the inlet flow control. Overall carrier and sample gas flow is controlled by the first proportional valve and the flow sensor. The solenoid valve is open, and proportional valve 2 acts as a back pressure regulator controlled by the pressure sensor on the septum purge vent line.

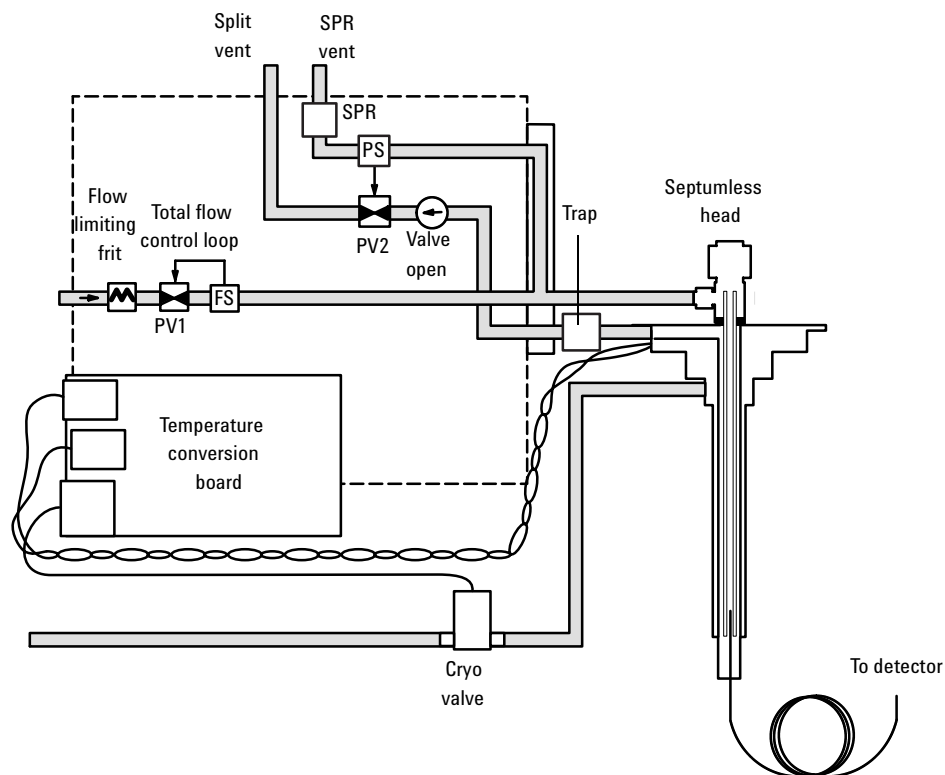


**Figure 240-1 Split mode flow control diagram (septum head installed)**

The temperature of the liner can be held below or above the boiling point of the carrier solvent.

### Septumless head installed

In the septumless head, the flows are the same as in the septum head, except the septum purge vent is bypassed directly to the carrier flow through the gang fitting on the flow manifold. Flow control is the same as for the septum head. See Figure 240-2.



**Figure 240-2** Split mode flow control diagram (septumless head installed)

### **Pulsed split modes**

The pressure pulse modes (using the septum- or septumless head) increase inlet pressure just before the beginning of a run and return it to the normal value after a specified time. The pulse sweeps the sample out of the inlet and into the column faster, reducing the chance for sample decomposition in the inlet.

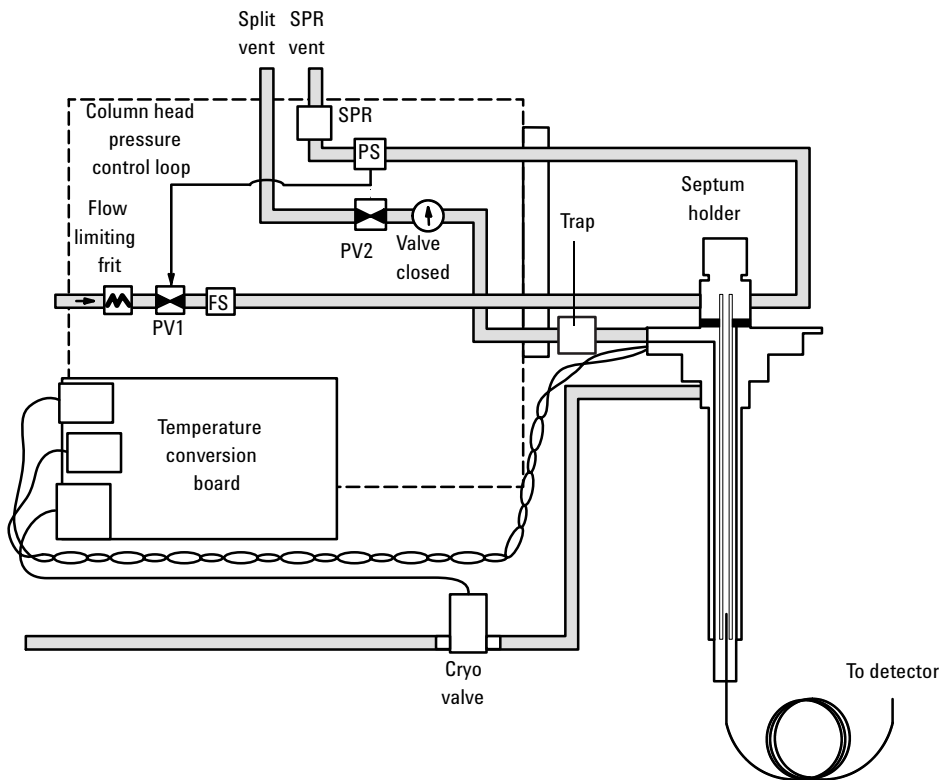
## Splitless modes

In splitless mode—with or without a pressure pulse—the solenoid valve is closed during injection and vaporization of the sample and while the sample transfers to the column. At a specified time after injection, the valve opens to sweep vapors left in the liner out the split vent to prevent solvent tailing due to the large inlet volume and small column flow rate.

Figure 240-3 shows the inlet flow control during injection and sample transfer with the septum head installed. The flow sensor measures the flow rate, but the pressure sensor on the septum purge line controls the column head pressure using proportional valve 1.

In the septumless head, the flows are the same as in the septum head except the septum purge vent is bypassed directly to the carrier flow through the

gang fitting on the flow manifold. Flow control is the same as for the septum head.



**Figure 240-3 Splitless mode flow control diagram: sample injection**

After the injection, the solenoid valve opens and the flow control is the same as during split mode operation. See Figure 240-1 (or Figure 240-2).

### **Pulsed splitless mode**

The pressure pulse modes (using the septum- or septumless head) increase inlet pressure just before the beginning of a run and return it to the normal value after a specified amount of time. The pressure pulse sweeps the sample out of the inlet and into the column faster, reducing the chance for sample decomposition in the inlet.



## **Solvent vent mode**

### **Stage 1: Sample and vent**

In solvent vent mode, the sample is injected into a cold inlet. During sampling, and for the duration of the venting, the solenoid valve is open. The solvent vaporizes and is swept out the vent, while the sample deposits on the liner walls or packing. If conditions are properly chosen and the sample is suitable, analytes deposit in the inlet liner while the solvent evaporates and is swept out. Large or multiple injections can be used to concentrate sample in the inlet before transferring it to the column for analysis. Figure 240-4 shows the inlet flow control with the septum head installed.

In the septumless head, the flows are the same as in the septum head except the septum purge vent is bypassed directly to the carrier flow through the

gang fitting on the flow manifold. Flow control is the same as for the septum head.

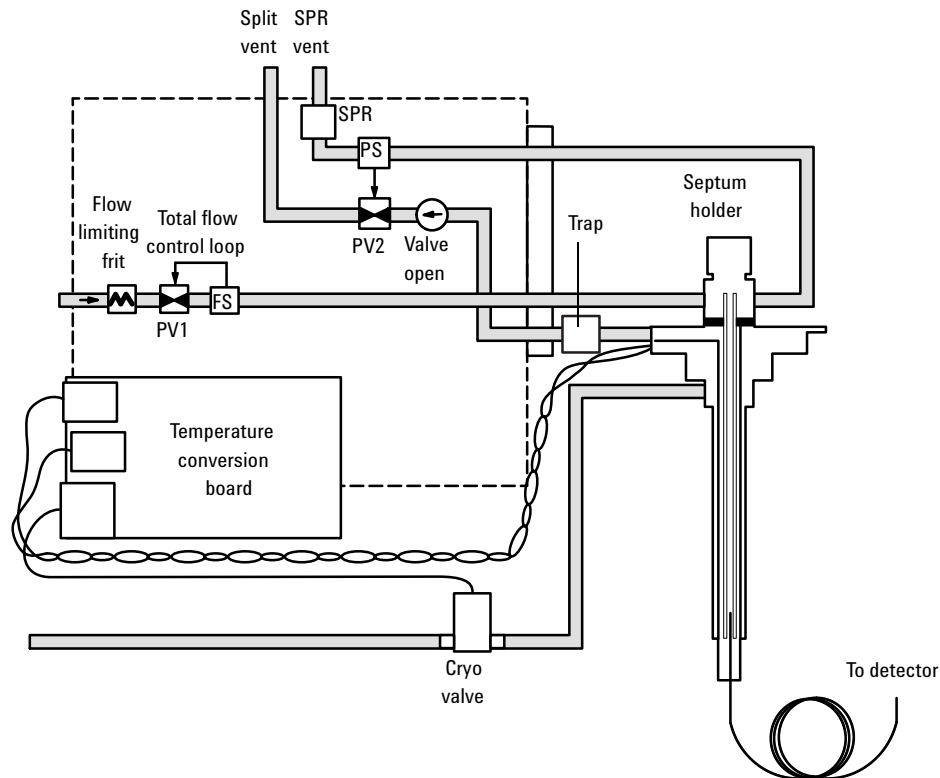
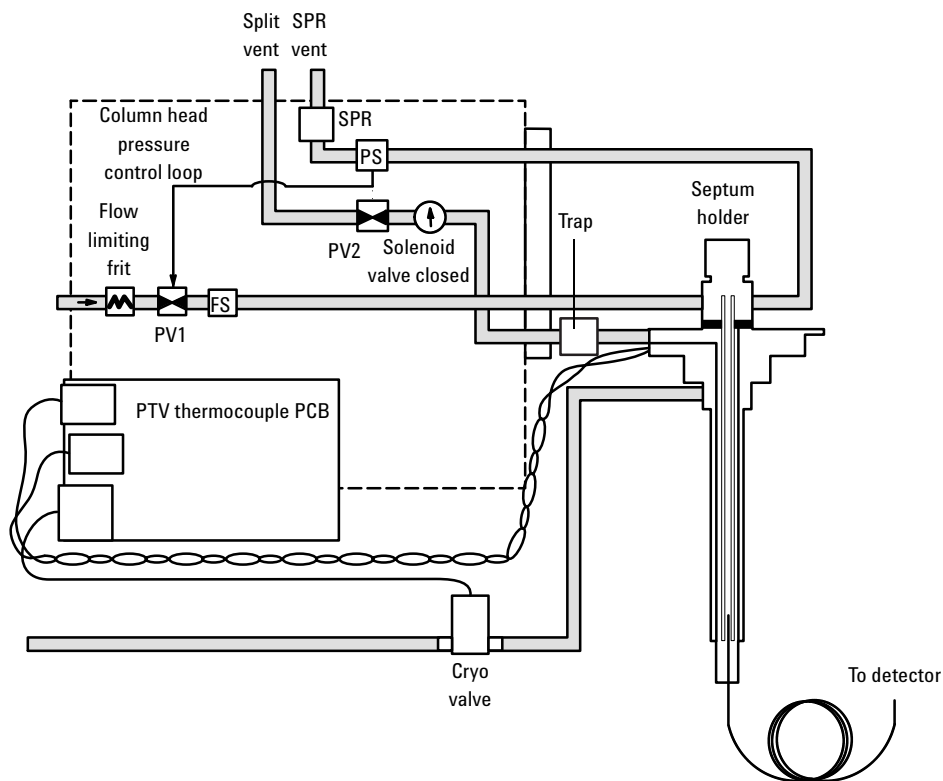


Figure 240-4 Solvent vent mode flow control diagram: sample and vent

**Stage 2: Sample transfer**

When solvent venting ends, the solenoid valve closes and the inlet heats to the final temperature. The sample transfers onto the capillary column.



**Figure 240-5 Solvent vent mode flow control diagram: sample transfer**

### Stage 3: Purge and cleanup

The solenoid valve opens again and the system returns to the Stage 1 configuration but with different setpoints. The PTV inlet is flushed through the split vent.

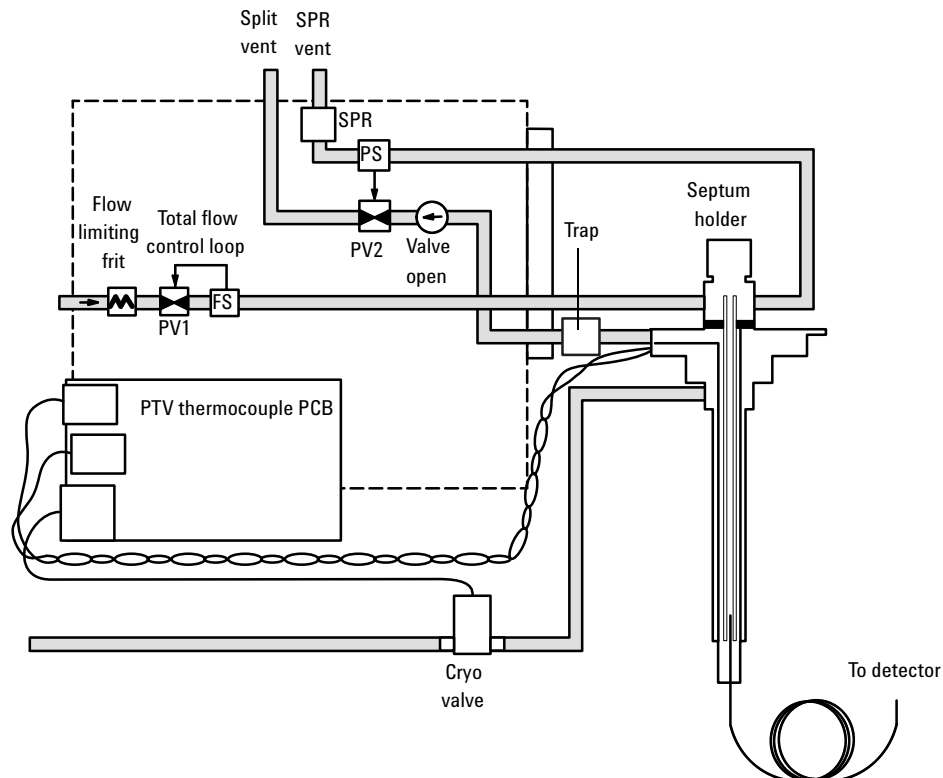


Figure 240-6 Solvent vent mode flow control diagram: purge and cleanup

## Replacement procedures

In addition to the PTV consumables (inlet adapters, columns, Teflon ferrules, and septa), the replacement parts in the PTV inlet assembly are:

- The entire PTV inlet, pneumatics, and manifold assembly
- The PTV manifold assembly
- PTV gang weldment and front trap assemblies
- The filter
- The head assembly (septum or septumless)
- The cryo shroud on the inlet body (CO<sub>2</sub> or liquid nitrogen)
- The PTV thermocouple PCB
- The O-rings and restrictors in the gang fitting assembly.

### Replacing the PTV inlet, pneumatics, and manifold

The entire PTV assembly can be easily replaced.

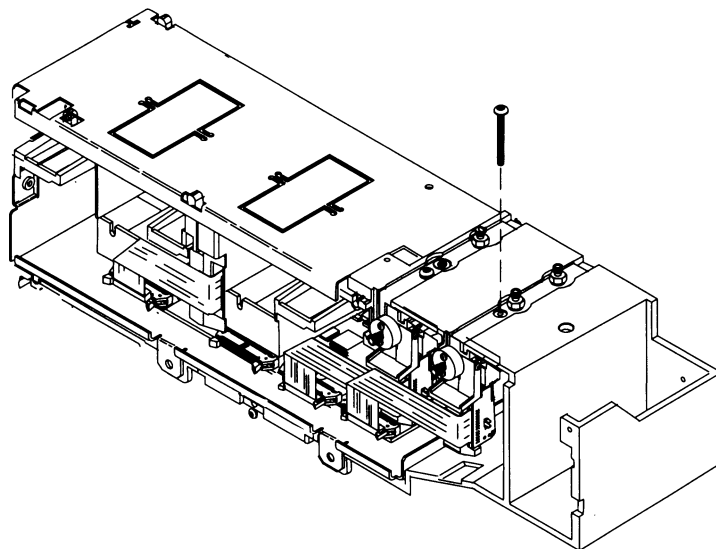
1. Turn off the oven and the inlet and allow them to cool.

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**WARNING** Turn off the oven and the inlet and allow them to cool. Turn off all flows at the initial gas supply. Then turn off the main power switch and unplug the power cord.

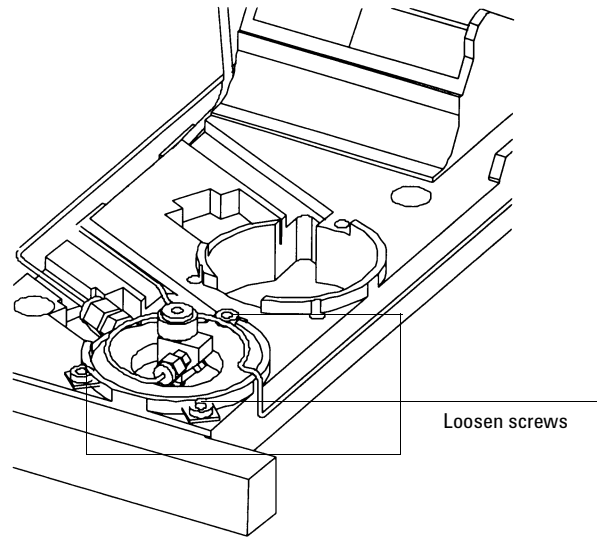
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2. Remove the top cover, the inlet fan cover, the inlet cover, the left side panel, the top rear panel, the pneumatics chassis cover, and the RFI cover.
3. Remove the top mounting screw in the PTV manifold assembly.



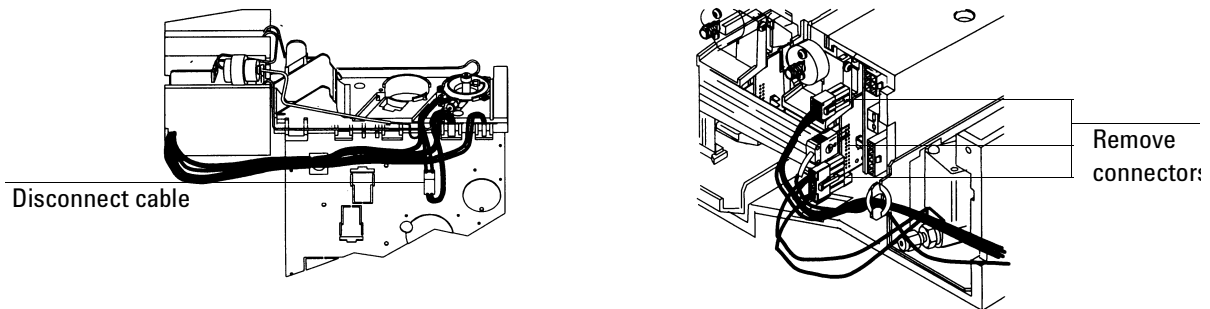
**Figure 240-7** Removing the PTV manifold assembly

4. Remove the column.
5. Loosen the three captive Torx screws which secure the inlet to the oven, and lift the PTV inlet out of the oven.



**Figure 240-8 Removing the PTV inlet**

6. Remove the heater connector from the side panel.

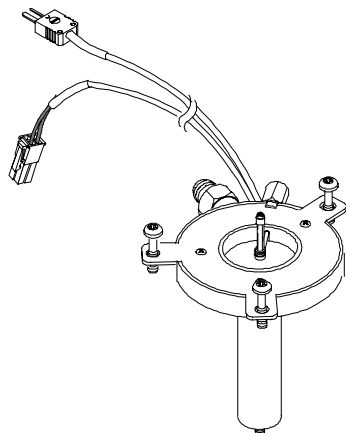


**Figure 240-9 PTV electrical connectors**

7. Disconnect the power cable, thermocouple connector, and cryo connector from the flow module and board. Disconnect the module ribbon cable from the pneumatics board.
8. Slide the flow module out of the chassis, remove the chemical trap assembly from the mounting bracket, and remove the PTV assembly from the GC.
9. Removing the entire PTV assembly.
10. Replace the PTV assembly and flow module and re-assemble in reverse order.

### **Replacing the PTV with cooling assembly**

The PTV with cooling assembly, shown in Figure 240-10, is generally the lowest level replacement part.



**Figure 240-10 PTV with cooling assembly**

1. Turn off the inlet and allow the inlet to cool.



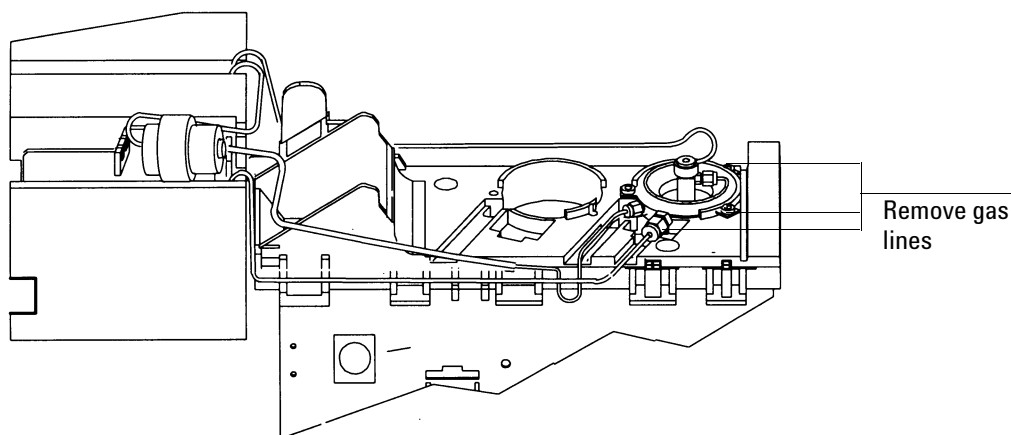
**WARNING** Turn off the oven and the interface and allow them to cool. Turn off all flows at the initial gas supply. Then turn off the main power switch and unplug the power cord.

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2. Remove the top cover, the inlet fan cover, the inlet cover, the left side panel, the top rear panel, the pneumatics chassis cover.
3. Remove the column.
4. Loosen the three captive Torx screws which secure the inlet to the oven, and lift the PTV inlet out of the oven.

**Caution** When removing/attaching the inlet cryo line, use one wrench to support the cryo line fitting on the inlet body and one to tighten the nut. Failure to do this could break the fitting on the inlet.

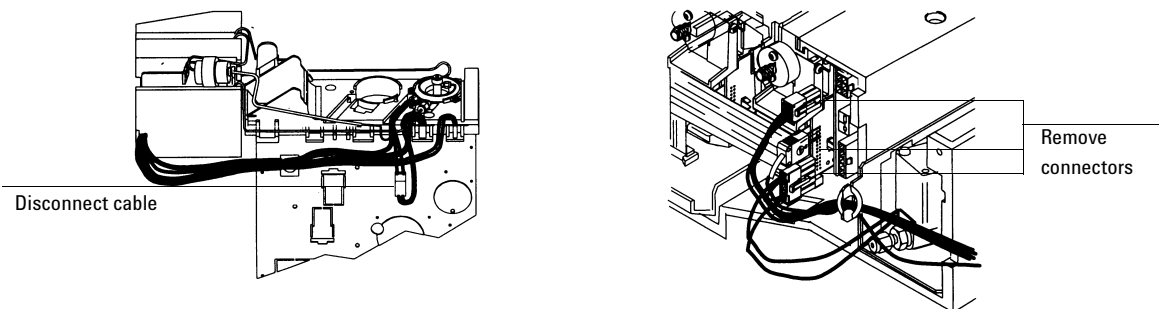
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**Figure 240-11 Removing the gas lines from the inlet**

5. Disconnect the carrier gas line to the inlet at the inlet. Remove the split vent gas line, and the septum purge line (as applicable). Using **two** wrenches, remove the cryo fitting from the inlet.

6. Remove (unscrew) the head from the inlet.
7. Remove the heater connector from the side panel, and remove the cryo connector from the thermocouple conversion board at the back of the GC.

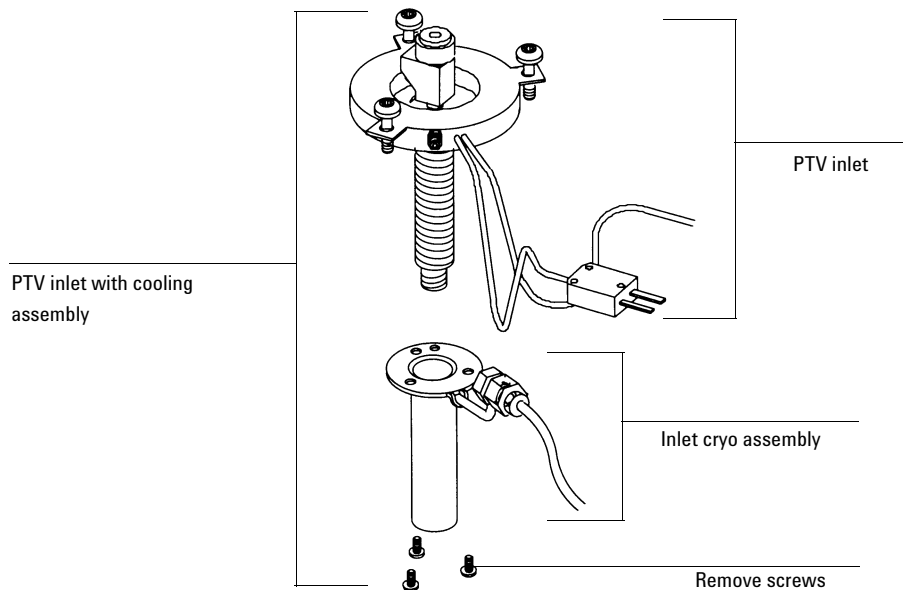


**Figure 240-12 PTV electrical connections**

8. Replace the PTV inlet assembly and reassemble in reverse order. To attach the cryo line to the new inlet assembly, tighten the nut finger tight, then 1/4 turn more using **two** open end wrenches.
9. Check the system for leaks.

### **Replacing the CO<sub>2</sub> or LN<sub>2</sub> inlet cryo assembly**

1. Once the PTV with cooling assembly is removed, the cryo assembly on the inlet can be replaced.
2. Remove the PTV inlet as described under Replacing the PTV with cooling assembly.
3. Remove the three screws on the cryo assembly from the PTV inlet, and remove the cryo assembly.



**Figure 240-13 Removing the inlet cryo assembly**

4. Install the new cryo assembly over the inlet body. Be sure to align the assembly so that the fitting is closest to the wires, as shown in Figure 240-12.
5. Reassemble in reverse order.
6. Check for leaks.

### **Replacing the PTV manifold assembly**

The PTV manifold assembly is available as a replacement part with or without the connected plumbing. When replacing just the manifold, the plumbing is removed at the manifold outlet block. When replacing the plumbing and manifold, the plumbing is disconnected from the inlet.

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*Note* When installing a new PTV manifold assembly and plumbing, it is not necessary or recommended to disconnect the plumbing from the module. The system is leak tested at the factory.

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**Caution** Follow ESD precautions when performing this procedure.

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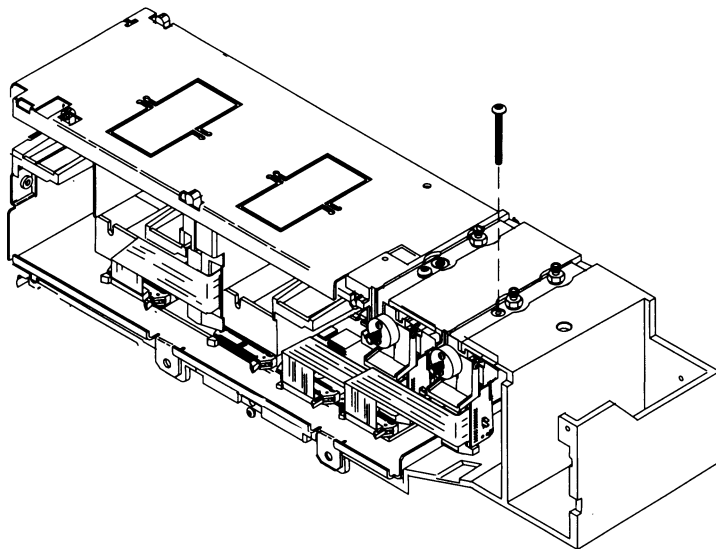
1. Turn off the oven and the inlet and allow them to cool.

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**WARNING** Turn off the oven and the inlet and allow them to cool. Turn off all flows at the initial gas supply. Then turn off the main power switch and unplug the power cord.

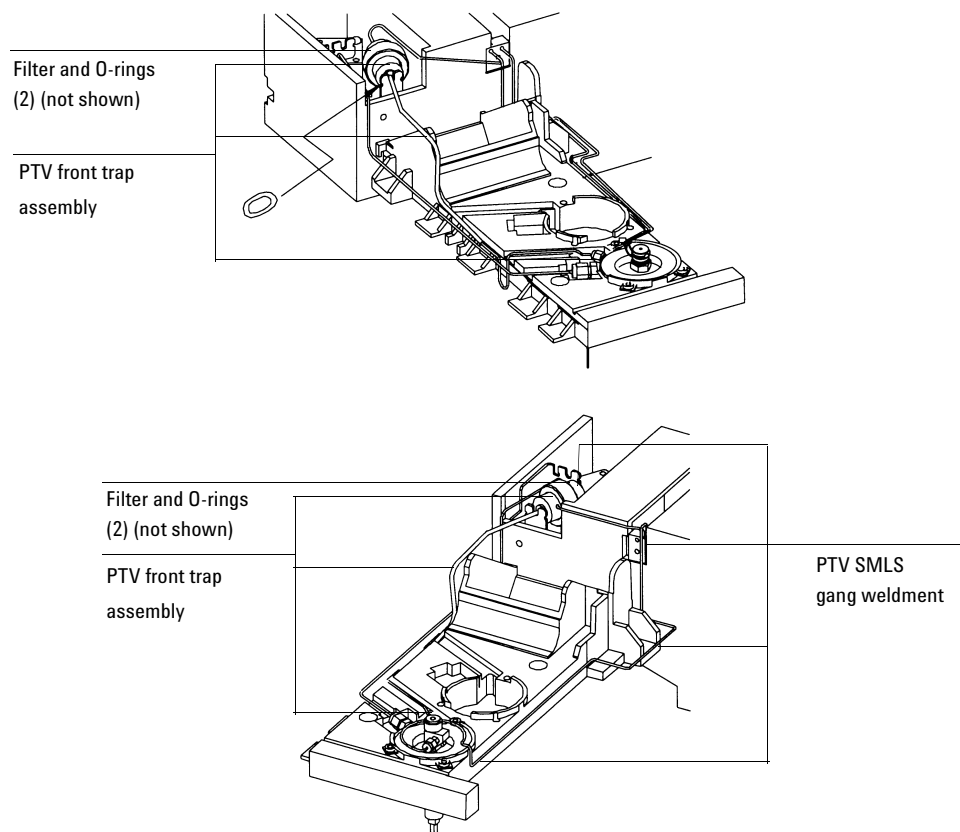
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2. Remove the top cover, the inlet fan cover, the inlet cover, the left side panel, the top rear panel, the pneumatics chassis cover, and the RFI cover.
3. Remove the column.
4. Remove the mounting screw in the top of the PTV manifold.



**Figure 240-14** Removing the manifold mounting screw

5. Disconnect the manifold ribbon cable from the pneumatics PCB. Disconnect the cryo cable, power cable, and thermocouple cable connectors from the PTV thermocouple PCB on the manifold.



**Figure 240-15 PTV plumbing assemblies**

### **Removing both the manifold and plumbing assemblies**

1. Loosen the three captive Torx screws which secure the inlet to the oven, and lift the PTV inlet out of the oven.
2. Disconnect the carrier gas supply line, split vent line, and septum purge line (for the septum head) from the inlet. Straighten the tubing at the manifold so that the manifold can be easily removed from the chassis.

3. Lift the filter trap from the LCO<sub>2</sub> bracket and then slide the manifold assembly out of the chassis.
4. Replace the manifold assembly and plumbing and reassemble in reverse order.
5. Check the system for leaks.

#### **Removing the PTV manifold only**

1. Remove the plumbing block from the front of the manifold by removing the screws.
2. Inspect the O-rings in the block for damage and replace if necessary.
3. Slide the manifold from the chassis and replace.
4. Installation is the reverse of removal.
5. Check the system for leaks.

#### **Replacing the plumbing assemblies**

1. Turn off the oven and the inlet and allow them to cool.

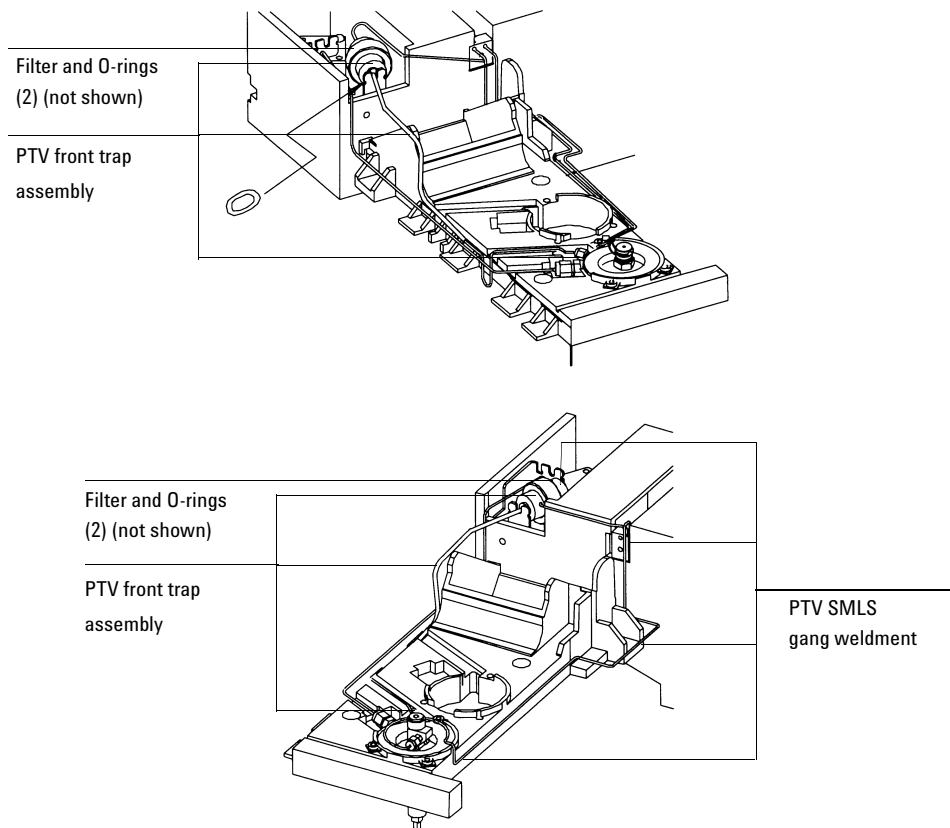
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**WARNING** Turn off the oven and the inlet and allow them to cool. Turn off all flows at the initial gas supply. Then turn off the main power switch and unplug the power cord.

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2. Remove the top cover, the inlet fan cover, the inlet cover, the top rear panel, and the pneumatics chassis cover.
3. Remove the column.
4. Loosen the three captive Torx screws which secure the inlet to the oven, and lift the PTV inlet out of the oven.
5. To replace the PTV gang weldment, disconnect the plumbing block from the PTV manifold assembly. Then, disconnect the carrier gas line and the septum purge line (septum head only) from the inlet. Unscrew the filter trap assembly and remove the PTV gang weldment assembly.

6. To replace the PTV front trap assembly, disconnect the split vent line from the inlet. Unscrew the filter assembly and remove the PTV front trap assembly.



**Figure 240-16 PTV plumbing assemblies (septumless head shown)**

7. Inspect the O-rings and filter in the filter trap, and replace if necessary.
8. If replacing the PTV gang weldment, install new O-rings in the manifold plumbing block.



9. Replace the gang weldment or front trap assembly and reassemble in reverse order.
10. Check the system for leaks.

### **Replacing a gang fitting restrictor or O-ring**

1. Turn off the oven and the inlet and allow them to cool.

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**WARNING** Turn off the oven and the inlet and allow them to cool. Turn off all flows at the initial gas supply. Then turn off the main power switch and unplug the power cord.

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2. Remove the top cover, the inlet fan cover, the inlet cover, and the pneumatics chassis cover.
3. Remove the screw in the gang fitting. Gently tap the fitting to remove the restrictor for cleaning/replacement. Inspect the O-rings and replace if necessary.
4. Reassemble in reverse order.

Check the plumbing for leaks.

### **Replacing the PTV thermocouple PCB**

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**Caution** Follow ESD precautions when performing this procedure.

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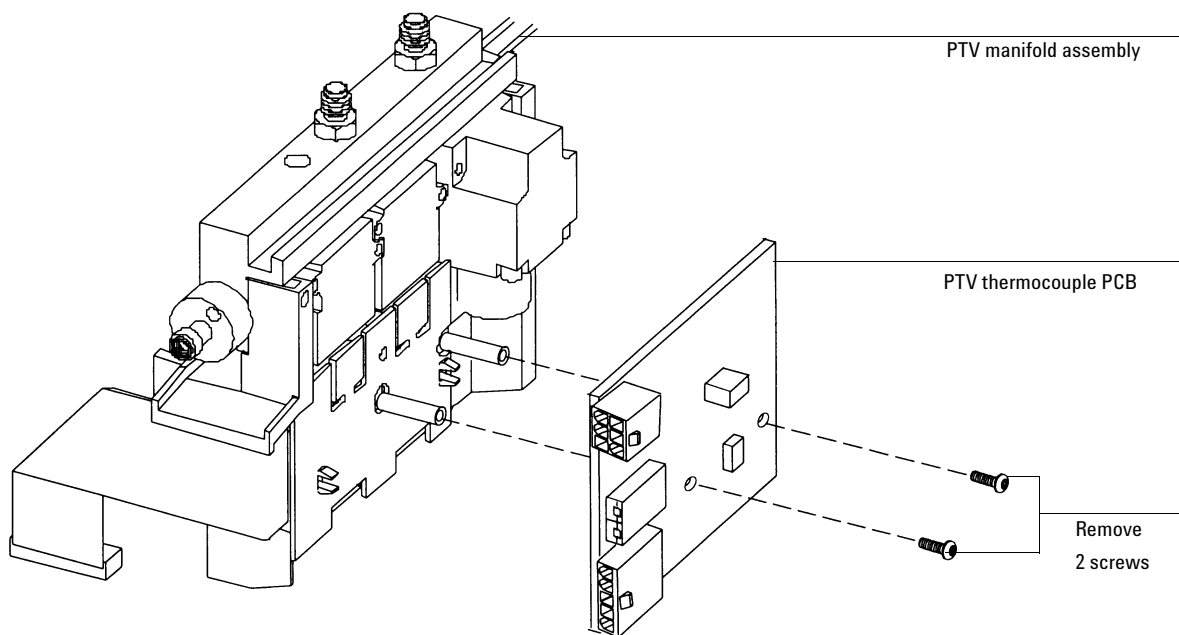
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**WARNING** Turn off the oven and the inlet and allow them to cool. Turn off all flows at the initial gas supply. Then turn off the main power switch and unplug the power cord.

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1. Remove the top cover, the inlet fan cover, the inlet cover, the left side panel, the top rear panel, the RFI cover, and the pneumatics chassis cover.
2. Remove the PTV manifold as described in Replacing the PTV manifold assembly.

3. Once the PTV manifold is removed, remove the two mounting screws that secure the thermocouple conversion board onto the pneumatics board, and remove the board.



**Figure 240-17 Replacing the PTV thermocouple PCB**

4. Replace the board and reassemble in reverse order.
5. Check the system for leaks.

### **Replacing the filter**

1. Turn off the GC oven and the inlet and allow them to cool.
2. Set all GC flows to zero.
3. Remove the pneumatics cover.

4. Lift the filter trap from the mounting bracket and unscrew the filter trap assembly.
5. Remove the old filter and O-rings and replace them.
6. Reassemble the trap.

### Replacing the inlet adapter

The Graphpack–2M connector (the inlet adapter) at the bottom of the inlet is sized to the column diameter. When installing a different diameter column, change the adapter.

The adapter number is stamped on the side of the adapters. Select the smallest hole diameter that will accept the column.

Column ID	Inlet adapter number	Quantity	Part no.
200 mm	31	1	5182-9754
250 mm	45	1	5182-9761
320 mm	45	1	5182-9761
530 mm	70	1	5182-9762

1. Unscrew the column nut from the adapter. Remove the nut and the column from the inlet.
2. With a 6 mm wrench, remove the inlet adapter, being careful not to lose the silver seal inside. Save the adapter for later use.
3. Select the appropriate inlet adapter for the column to be installed. Insert a new silver seal (part no. 5182-9763, package of five) into the adapter and screw the adapter onto the inlet fingertight. Tighten the adapter an additional 1/16 to 1/8 turn.

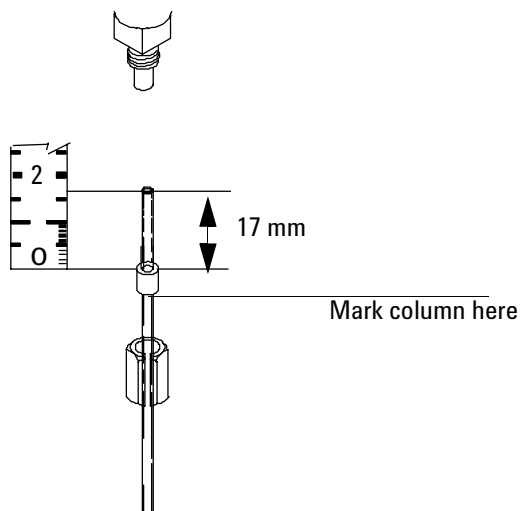
Be careful not to overtighten the adapter. The inlet can be damaged if the adapter is forced. If the adapter leaks, check the silver seal and replace it if necessary.

### Installing the column

Graphpack-2M ferrules are sized to the column outer diameter.

<b>Column ID</b>	<b>Graphpack ferrule hole ID</b>	<b>Quantity</b>	<b>Part no.</b>
200 mm	0.31 mm	10	5182-9756
250 mm	0.40 mm	10	5182-9768
320 mm	0.45 mm	10	5182-9769
530 mm	0.70 mm	10	5182-9770

1. Place the appropriate Graphpack ferrule onto the column inlet end and pull it at least 30 mm from the end.
2. With a glass knife or other fused silica cutter, remove approximately 10 mm from the column end to eliminate graphite contamination.
3. Position the ferrule so that it is 17 mm from the column end. Place a small mark (typewriter correction fluid is useful) at the back of the ferrule and, making sure that the column is correctly positioned, insert the column end into the adapter.

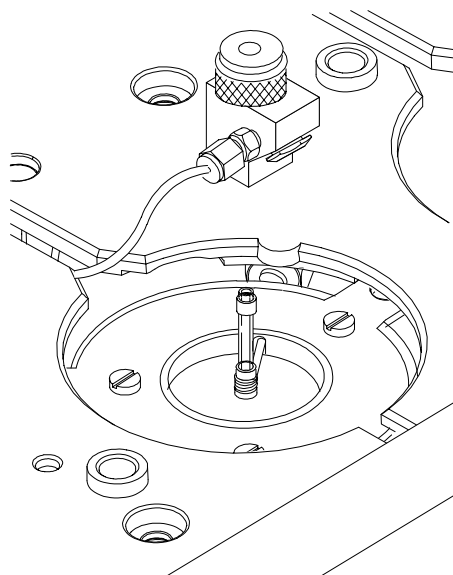


**Figure 240-18 Column installation**

4. Screw the column nut on fingertight. Use a wrench to tighten the column nut 1/8 to 1/4 turn. Be careful not to overtighten.

### **Removing the septumless head**

1. Cool the inlet to room temperature.
2. Disconnect the carrier gas line.
3. Unscrew the septumless head counterclockwise from the inlet.
4. Screw the new head onto the inlet. Tighten it 1/8 turn past finger tight.



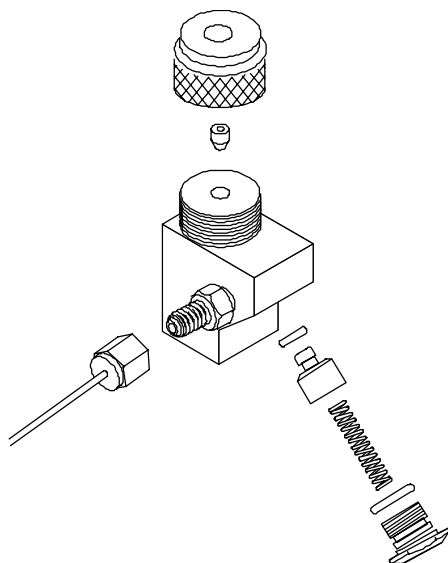
**Figure 240-19 Removing the carrier gas line**

5. Reconnect the carrier gas line.
6. Check all connections on the sampling head for leaks. If necessary, tighten them again by hand.

### **Cleaning the septumless head**

Minor deposits from sample mixtures can collect in the head. Dust and abraded material particles can enter together with the syringe needle, eventually causing leaks.

1. Disconnect the carrier gas line and unscrew the head from the inlet.
2. Unscrew the sealing element from the head. Carefully remove the Viton seal and the pressure spring. Do *not* use a sharp object to extract the valve body—this can leave scratches that cause leaks.



**Figure 240-20 Disassembling the septumless head**

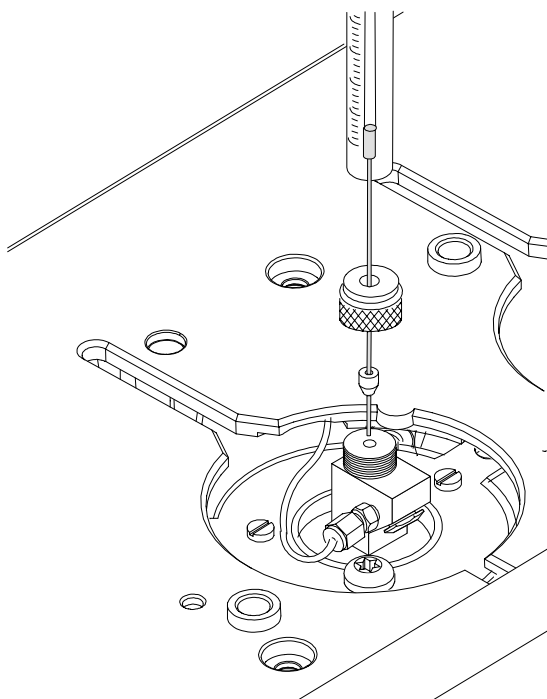
3. Unscrew the guide cap from the head and remove the Teflon ferrule.
4. Carefully insert a syringe with a 23 gauge needle into the head to press the valve body (with the Kalrez seal) slightly out of the head. Carefully tap the head on a soft smooth surface so that the valve body falls out completely or slips out far enough to grasp it with your fingers.
5. Remove the seal from the valve body.
6. Carefully clean all components in hexane.
7. Inspect the Teflon ferrule, seals, and valve body for damage, and replace if necessary.
8. Assemble the head in reverse order. Make sure that you work absolutely lint-free and that the seals and the pressure spring are not damaged.

9. Check the entire system again for leaks; if necessary, carefully retighten the guide cap with the syringe needle inserted slightly more and/or replace the Kalrez seal.

If the head leaks when a syringe is inserted, the Teflon ferrule is the problem. If the head leaks without a syringe inserted, the seals may need to be replaced.

### **Replacing the Teflon ferrule**

1. Unscrew the guide cap from the septumless head and remove the Teflon ferrule.



**Figure 240-21 Installing a Teflon ferrule**

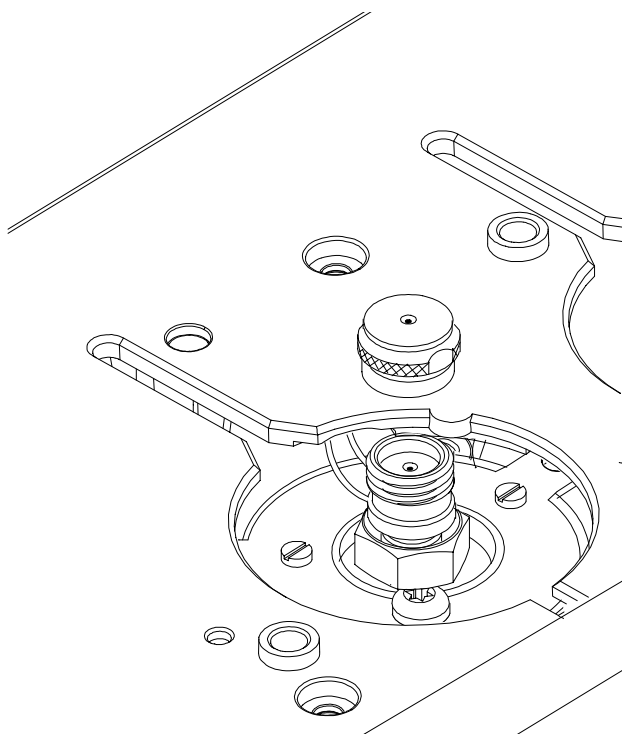


2. Push the guide cap and the new Teflon ferrule over the syringe needle so that at least 10 mm of the needle tip is exposed.
3. Guide the end of the syringe needle into the septumless head until the ferrule meets the septumless head.
4. Tighten the guide cap until resistance is first felt.
5. Check for leaks when the syringe needle has been fully introduced.
6. If necessary, carefully tighten the guide cap until the inlet stops leaking.

### **Removing/replacing the septum head**

The septum head connects to the inlet via a free-spinning retaining nut.

1. Turn off the inlet heater and allow it cool.
2. If replacing the septum head, disconnect the split vent and septum purge lines.
3. Use a 5/8-inch wrench to loosen the retaining nut on the septum head.



**Figure 240-22 Removing the septum head**

4. Gently remove the septum head assembly from the inlet. Be careful not to excessively bend the 1/16-inch lines. For best results, lift the head to clear the inlet and then push it to either side to allow access.
5. To reinstall the septum head, gently align the head with the inlet and manually engage the free-spinning nut to the inlet.

The nut should thread easily onto the inlet. If resistance is felt, unscrew the nut and retry. Excessive force can irreparably damage the inlet.

6. Tighten the retaining nut 1/2 turn past finger tight.
7. If the carrier gas and septum purge lines were removed, reinstall them.

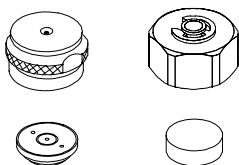
8. Check all connections for leaks. If necessary, the retaining nut can be tightened an additional 1/4 turn to eliminate leaks.

### **Replacing the septum**

Either a regular septum or a Merlin microseal can be used with the septum head.

If the inlet temperature is set below 40°C, the Merlin microseal may not seal effectively. For inlet temperatures below 40°C, use a regular septum for the inlet seal.

1. To replace the septum, cool the inlet to ambient temperature.
2. Unscrew (counterclockwise) the septum cap or Merlin cap.
3. Remove the septum or Merlin microseal, taking care not to scratch the interior of the septum head.
4. Install a new septum or Merlin microseal and the correct cap. When installing a Merlin microseal, note that the side with the visible metal parts faces the oven.



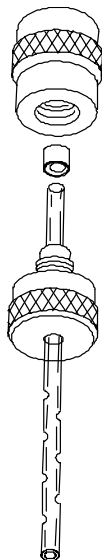
**Figure 240-23 PTV septa**

5. Check for leaks out of the cap and tighten the cap if necessary.

### **Replacing the liner**

1. Remove the head from the inlet.
2. Grasp the liner by the Graphpack ferrule. Remove the liner and ferrule.

3. Unscrew the assembly tool (part no. 5182-9750) the ferrule guide from the compression fitting.



**Figure 240-24** Installing the ferrule onto the new liner

4. Slide the compression fitting onto the longer straight end of the new liner with the threads pointing toward the end of the liner.
5. Place a Graphpack-3D ferrule over the end of the liner with the recessed end towards the compression fitting. See Figure 240-24. Slide the ferrule towards the fitting until about 2 mm of liner is exposed beyond the ferrule.
6. Slide the compression fitting up to the ferrule. Screw the ferrule guide gently onto the compression fitting until it is fingertight.
7. Remove the ferrule guide, then slide the compression fitting. The ferrule should now be set with 1 mm of liner exposed. Check that the graphite within the ferrule is flush with the top of the metal collar.

8. Insert the liner into the inlet from above until the unpacked side of the ferrule rests on the top of the inlet.
9. Replace the sampling head and reconnect the lines, if necessary.
10. Check all connections for leaks. If necessary, tighten them again by hand.

## Diagnostics

**Cryo timeout**—When a run does not start within a specified time after the oven equilibrates, cryo timeout occurs and the inlet temperature shuts down.

**Cryo fault**—Shuts down the inlet temperature if it does not reach setpoint in 16 minutes of continuous cryo operation. Note that this is the time to *reach* the setpoint, not the time to stabilize and become ready at the setpoint.

### Shutdown behavior

Both Cryo timeout and Cryo fault can cause cryo shutdown. If this happens, the inlet heater is turned off and the cryo valve closes. The GC beeps and displays this message:

```
SHUTDOWN (#18):  
Front inlet cryo  
shutdown
```

The inlet heater is monitored to avoid overheating. If the heater remains on at full power for more than 2 minutes, the heater is shut down. The GC beeps and displays this message:

```
SHUTDOWN (#22):  
Front inlet heating  
too slowly;  
temperature shut off
```

To recover from either condition, turn the GC off, then on, or enter a new setpoint.

## Leak testing

### Preparation

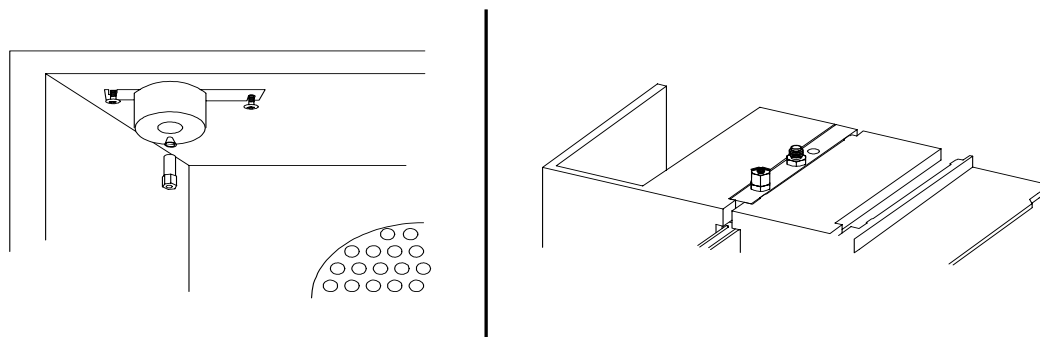
1. Cool the column to ambient, and cool inlets to below 75°C to avoid damage to deactivated glass liners.
2. Remove the column from the inlet fitting on the inside of the oven.
3. If a septum head is installed, and the quality of the septum (or microseal) and Graphpack-3D ferrule on the glass liner are unknown, replace them now.
4. Cap the inlet's column fitting and the septum purge vent (septum head only). Use solid (no hole) Vespel type ferrules 1/8-inch (part no. 0100-1372) and 1/16-inch (part no. 5181-7458) with a 1/8-inch Swagelok nut (part no. 5180-4103) and a capillary column nut.

---

*Note*

As alternate capping devices, a 1/8-inch Swagelok cap can be used for the septum purge vent. A capillary column nut with a solid piece of wire the size of a paper clip and a 0.5 mm ID graphite ferrule may be used for the inlet column fitting.

---



**Figure 240-25 Capping the bottom of the inlet and septum purge vent**

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*Note* Make sure that the carrier gas source pressure is at least 35 psi. Carrier source pressure should always be at least 10 psi greater than the desired inlet pressure.

---

### **Performing the leak test**

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*Note* Be sure to complete all of the preparation steps on page 39 before continuing.

---

1. Set the inlet to “Split Mode.”
2. Configure the column as 0 length.

Press [Config] [Column 1] or [Config] [Column 2] and enter “0” in the first column of the “Dim” field.

3. Set the inlet’s Total Flow to 60 mL/min.

Press [Front Inlet] (or [Back Inlet]) and enter “60” in the “Tot flow” field.



4. Set the pressure to 25 psi.

Scroll to Pressure and enter “25” in the “Pressure” field.

5. Wait approximately 15 seconds for equilibration.

If pressure cannot be achieved, either a very large leak is present in the system, or the supply pressure is not high enough.

6. Turn the inlet pressure “Off.”

Press [Front Inlet] (or [Back Inlet]), scroll to the “Pressure” field, and press [Off]. Both the flow controller and the back pressure valves will close.

---

*Note*

When the inlet pressure or flow is turned off, the safety shutdown feature, including the audible alarm, is not functional. The inlet will not automatically shut down. This will provide you with unlimited time to locate leaks.

---

7. Note the “Actual” reading on the display and monitor the pressure for 10 minutes.

You can use the stopwatch feature of the 6890 GC to monitor the time. Press [Time] and then [Enter] to start timing, then toggle between the time and the pressure reading with the [Time] and the [Front Inlet]/[Back Inlet] keys.

- If there is less than 0.5 psi pressure loss, consider the system leak tight.
- If pressure loss is much greater than 0.5 psi, there is a leak that must be found and corrected. Note, however, that you may want to slightly decrease the leak test time based on the internal inlet volume which changes with the liner type used (smaller volumes = shorter acceptable leak test times). See Correcting leaks later in this section.

8. When the system is considered leak tight, the caps may be removed, the column reinstalled, its dimensions configured at keyboard, and the desired pressure and flow rate set.

## Leak testing the PTV module only

Occasionally, to locate small leaks, you will need to isolate the EPC module from the inlet weldment and leak test the EPC module separately.

1. On the keyboard, turn off pressure to the inlet being tested.  
  
Press [Front Inlet] or [Back Inlet], scroll to the Pressure field and press [Off].
2. Use a Torx T-10 screwdriver to remove the screw in the plumbing block on the front of the module. Remove the plumbing block from the EPC module, being careful not to lose the O-rings between the block and the module.
3. Replace the inlet's plumbing block with the leak test block (part no. G1530-20660) from the leak test kit (part no. G1530-60960). Make sure you install O-rings (if needed) between the block and the EPC module to create a seal.

The leak test block is a special fitting that plumbs the carrier gas coming out of the module directly back into the septum purge and split vent flow paths on the module. It allows the carrier gas, septum purge, and split vent line to function normally as if an inlet were present.

4. Perform the normal leak test for the EPC inlet as described previously in this section. With the inlet removed, the internal volume is quite small and a pressure loss of 0.5 psi or less in 5 minutes time is considered to be leak free.
5. If there is a leak, you will probably need to remove the flow manifold to try to isolate the leak as described in the following Locating leaks on the flow manifold procedure.
6. If there is an *increase* in pressure, see the following Forward pressure valve leaks procedure.

### **Forward pressure valve leaks**

Occasionally an increase in pressure, rather than a decrease may be observed. This is usually due to slight leakage into the module across the forward pressure control proportional valve. Although slight leaks of this nature do not create chromatographic problems, they may obscure other small leaks that do cause problems by allowing air into the system. The valves can leak at about 0.2 mL/min and be within specification.

To check for internal valve leakage (when leak testing the EPC module only):

1. Remove the supply pressure at the carrier inlet fitting, and quickly cap the fitting with a solid 1/8-inch Vespel plug and a Swagelok nut.
2. Check the actual pressure on the display and monitor it for 5 minutes. Pressure loss should not be greater than 0.5 psi.

### **Locating leaks on the flow manifold**

If the EPC module appears to have a leak, you can remove it to locate the leaky component. The leak test kit (part no. G1530-60960) contains a longer ribbon cable to allow you to lay the EPC module on the benchtop for testing.

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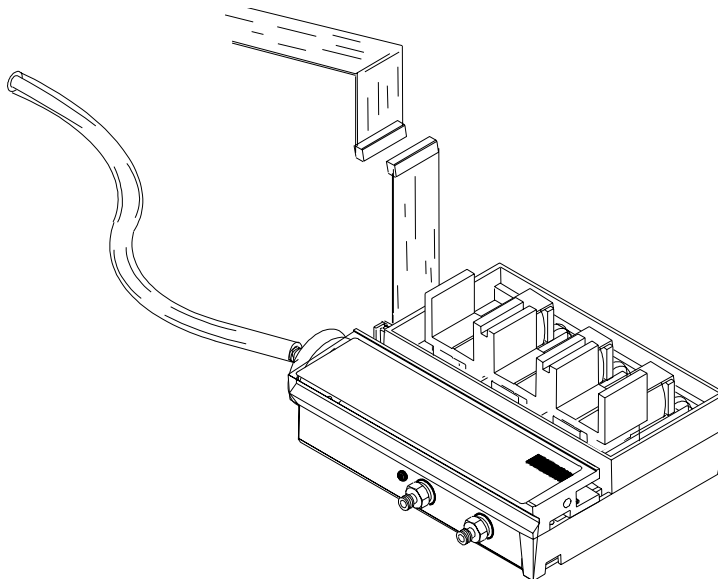
**Caution** Be sure to wear an ESD strap grounded to the 6890 GC chassis while performing this procedure.

---

1. Turn off the main power switch.
2. Remove the top plastic pneumatics cover and the detector cover.
3. Remove the top rear cover on the GC.
4. Disconnect the ribbon cable for the module from the main EPC board. You may have to remove the adjacent ribbon cable also.
5. Use a Torx T-20 screwdriver to remove the screw from the top of the module and slide the module out of the back of the GC.
6. Connect one end of the leak test ribbon cable (G1530-61370) to the ribbon cable connector on the EPC module and connect the other end to the

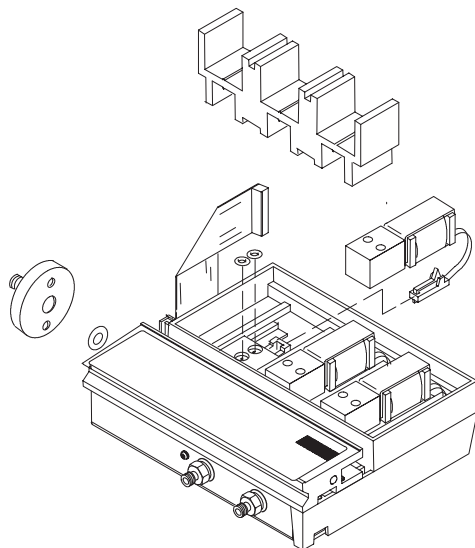
appropriate connector on the EPC board. Reconnect the gas supply and turn on the main power switch. Set the pressure to 25 psi and the flow to 60 mL/min.

7. Lay the EPC module on the lab bench and use an electronic leak detector to locate the leaky component on the module.



**Figure 240-26 Leak testing the EPC module on the lab bench**

8. If the leaky component is serviceable, such as a vent/inlet fitting (see diagram of serviceable parts, Figure 240-27), replace it. Otherwise, replace the EPC module.



**Figure 240-27 EPC module serviceable parts**

### **Correcting leaks**

1. Use an electronic leak detector to check all areas of the inlet and plumbing that are potential sources of a leak.
2. Tighten loose connections to correct leaks, if necessary. You may need to repeat the leak test.
3. If the pressure drop is now 0.5 psi or less, you can consider the inlet system leak-free. If the pressure drops faster than the acceptable rate, continue to search for leaks and repeat the pressure test.

### **Potential leak points**

Check the following areas when checking an inlet system for leaks.

#### **In the oven**

Make sure the bottom of the inlet is correctly capped.

**On the inlet**

- Septum (septum head only)
- Lower inlet seal at bottom of inlet
- Ferrule on inlet liner
- Connections for carrier gas, septum purge (septum head only)

**At EPC module**

- O-rings behind the block where the inlet's pneumatic lines enter the module
- Two O-rings for each valve
- Septum purge cap (septum head only)
- Chemical trap O-rings
- O-rings in gang fitting