

6890 Series Gas Chromatograph

Service Manual



Agilent Technologies

6890 Series Gas Chromatograph

Service Manual

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Safety Information

The 6890 Gas Chromatograph (GC) meets the following IEC (International Electrotechnical Commission) classifications: Safety Class 1, Transient Overvoltage Category II, and Pollution Degree 2.

This unit has been designed and tested in accordance with recognized safety standards and designed for use indoors. If the instrument is used in a manner not specified by the manufacturer, the protection provided by the instrument may be impaired. Whenever the safety protection of the 6890 GC has been compromised, disconnect the unit from all power sources and secure the unit against unintended operation.

Refer servicing to qualified service personnel. Substituting parts or performing any unauthorized modification to the instrument may result in a safety hazard. Disconnect the AC power cord before removing covers. The customer should not attempt to replace the battery or fuses in this instrument. The battery contained in this instrument is recyclable.

Safety Symbols

Warnings in the manual or on the instrument must be observed during all phases of operation, service, and repair of this instrument. Failure to comply with these precautions violates safety standards of design and the intended use of the instrument. Agilent Technologies assumes no liability for the customer's failure to comply with these requirements.

WARNING

A warning calls attention to a condition or possible situation that could cause injury to the user.

CAUTION

A caution calls attention to a condition or possible situation that could damage or destroy the product or the user's work.



See accompanying
instructions for
more information.



Indicates a hot
surface.



Indicates hazardous
voltages.



Indicates earth
(ground) terminal.



Indicates radio-
active hazard.



Indicates explosion
hazard.

6. Consult your equipment
dealer, Agilent
Technologies, or an
experienced technician for
assistance.

7. Changes or modifications
not expressly approved by
Agilent Technologies could
void the user's authority to
operate the equipment.

Sound Emission Certification for Federal Republic of Germany Sound Pressure

Sound pressure Lp < 65 dB(A)
according to DIN-EN 27779.

When operating the 6890 with
cryo valve option, the sound
pressure is approximately 74.6
dB(A) during cryo valve
operation for short burst
pulses.

Schalldruckpegel

Schalldruckpegel LP < 65
dB(A) nach DIN-EN 27779.

Bei Betrieb des 6890 mit Cryo
Venti Option treten beim
Oeffnen des Ventils kurzfristig
Impulse bis zu einem
Schalldruckpegel Lp von
ca.74.6 dB(A) auf.

Electromagnetic compatibility

This device complies with the
requirements of CISPRII.
Operation is subject to the
following two conditions:

1. This device may not cause
harmful interference.
2. This device must accept any
interference received,
including interference that
may cause undesired
operation.

If this equipment does cause
harmful interference to radio
or television reception, which
can be determined by turning
the equipment off and on, the
user is encouraged to try one
or more of the following
measures:

1. Relocate the radio or
television antenna.
2. Move the device away from
the radio or television.
3. Plug the device into a
different electrical outlet, so
that the device and the
radio or television are on
separate electrical circuits.
4. Make sure that all
peripheral devices are also
certified.
5. Make sure that appropriate
cables are used to connect
the device to peripheral
equipment.

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Safety precautions, prerequisites to service, and calibration information.

110 Safety

Before servicing the various components of the 6890 GC, observe the following safety precautions.

Cautions

Follow the precautions below when servicing the instrument to avoid data loss or damage to the instrument.

Printed circuit boards

When storing or in between handling PCBs (Printed Circuit Boards), always place them in static control envelopes or enclosures.

Always make sure you are properly grounded (e.g., wearing an ESD strap) before handling electro-static sensitive components such as printed circuit boards.

Voltage carrying components

When disconnecting plugs, pull on the plug, not its wires. Pulling on the wires may cause breakage.

Columns

Do not shut off column flow when the oven temperature is high or you may damage the column.

TCD Detector

Do not turn off carrier flow to a TCD detector while the detector is still on or you risk damaging the filament.

Warnings

The following are potential hazards that can cause personal injury.

Heated components

Turn off the oven and inlet/detector heated zones and allow them sufficient time to cool before servicing those areas. If you must perform service on components that have not fully cooled, wear protective gloves.

Voltage carrying components

Whenever possible, disconnect the 6890 GC from its power source before working on or near voltage carrying components of the GC.

The following components carry voltage when the GC is plugged in even if the power switch is off:

- The AC power cord
- The AC power supply

When the power to the GC is turned on, potentially dangerous voltages exist on these additional components:

- The power transformer
- All electronics boards
- All internal wires and cables connected to these boards

Insulation

The inlets and detectors are insulated with a fibrous material that can cause irritation to the skin, eyes, and mucous membranes. Always wear gloves when working with the insulation. Additionally, if the insulation is flaky/crumbly, wear protective eyewear and a respirator.

Gases

Turn off all gas supplies (especially hydrogen) before working on pneumatic areas of the instrument.

Wear eye protection when using compressed gases to dry or clean GC components.

Hydrogen gas is flammable and potentially explosive. When possible, turn off hydrogen gas when servicing detectors that use it. If this is not possible, make sure that either a column is installed in the oven or that the detector column fitting is capped. Otherwise the GC oven may fill with hydrogen and create an explosion hazard.

Do not use hydrogen to condition a column, it could vent into the oven and present an explosion hazard. Helium is preferred; however, nitrogen is adequate for packed columns.

120 Tools Required

Tools required

The following tools are required to perform the service procedures described in this manual.

Basic

Electrostatic discharge (ESD) protective wrist strap

T-10 – Torx screwdriver

T-20 – Torx screwdriver

1/4-inch hex nut driver

Open end wrenches:

5/16-inch x 1/4-inch

1/2-inch x 7/16-inch

9/16-inch x 7/16-inch

7-mm hex nut driver

Tweezers

Specialized

Volt/Ohm meter

Electronic leak detector

Electronic flow meter

ROM Puller, 44 pos., (AMP part no. 821903-1), (Agilent part no. 8710-2303)

EPC Leak Test kit (part no. G1530-60960)

Consisting of:

- EPC inlet jumper block G1530-80800
- EPC detector plug block G1530-80810
- FID/NPD jet plug G1530-20610
- Module extender cable G1530-61370
- Torx T-10 screws, M3 x 25 mm 0515-0683
- Solid Vespel plugs, 1/16-inch
- Solid Vespel plugs, 1/8-inch
- Capillary column nuts
- Non-greased O-rings
- TCD/ECD exit fitting plug
- 1/8-inch Swagelok nuts

Calibrating the 6890 GC

Press the [Options] key on the GC keypad and select the Calibration option to access a list of the 6890 Series GC parameters that can be calibrated.

Calibration options

The following GC parameters can be calibrated:

- The GC oven temperature can be corrected to actual measured temperature.
- We do not recommend field calibration of flows and pressures, other than zeroing. A full calibration requires establishing flows and pressures that are comparable in accuracy to the NIST-traceable factory equipment.
- Flow sensors can be zeroed. The Auto flow zero function, when turned on, automatically zeroes flow after each run. To use this feature, select Calibration on the OPTIONS menu, then choose either Front inlet or Back inlet, and turn Auto flow zero on. After the end of a run, Auto flow zero shuts down the flow of gases to an inlet, waits for the flow to drop to zero, measures and stores the flow sensor output, and turns the gas back on. This takes about two seconds. The zero offset is used to correct future flow measurements.
- Pressure sensors can be zeroed by fully depressurizing the system, inlets or detectors. Open appropriate fittings to ensure that there is no residual or trapped pressure, then select Pressure Zeroing and press the On key.
- Capillary columns can be calibrated. Length and internal diameter can be estimated using data from an isothermal run. This is useful when such data were not provided with the column or if trimming has reduced the length of the column.
- Additional information regarding each individual inlet, detector, make-up gas or Aux Pressure/Flow Calibration Ranges can be obtained by scrolling to the task and pressing the Info key. Typically a calibrated flow of greater than 50% of the EPC module's flow range is required to calibrate. A pressure greater than 70% of an EPC pressure range is required to calibrate it.

Factory calibrations

Whenever a user-calibrated value is used, the time and date of calibration is listed rather than the factory calibration message. To return to factory calibrations, the user calibration can be either completely deleted using the Delete: key, or can simply be turned Off to retain it in memory. Recovery of user calibrations can be obtained by pressing the On key.

200 Inlets

- 210 Split/Splitless Inlet**
- 220 Purged/Packed Inlet**
- 230 Cool On-Column Inlet**
- 240 Programmed Temperature Vaporization Inlet
(PTV)**
- 250 Volatiles Interface**
- 260 Solvent Vapor Exit Accessory**
- 270 Pneumatics Control Module**

How to install, test, and operate both
electronic and manual inlets on the 6890
gas chromatograph

210 Split/Splitless Inlet

The theory and procedures described in this section apply to both the standard (10 to 30 psig) split/splitless inlet and the high-pressure (0 to 100 psig) split/splitless inlet.

Theory of operation

The split mode of operation is used when small quantities of sample need to be introduced into a capillary column. The injected sample is vaporized and then split between the column and an inlet vent. Typical split ratios used are 20:1 up to 500:1, where the majority of sample is vented out the inlet split vent.

The splitless mode of operation is generally used for trace analysis. In trace analysis, sample splitting would further dilute the amount of analyte entering the column and is not desired. In splitless mode, nearly all the analyte and solvent enter the column.

To avoid solvent interferences, an initial column temperature of 25 to 30° C below the solvent boiling point is recommended and an inlet purge time of 0.5 to 1.0 minute time be used. This splitless mode of operation is best for compounds with a retention index greater than 600.

EPC inlet

Split mode operation

For an EPC inlet in split mode, the proportional valve, PV1, is a mass flow controller for the total inlet flow as measured by the flow sensor, FS. V is an on/off valve which is turned on to allow flow out of the split vent. PV2 is a back pressure regulator controlling the inlet pressure as measured by the pressure sensor, PS. SPR is a calibrated regulator/frit which is used to control the septum purge flow.

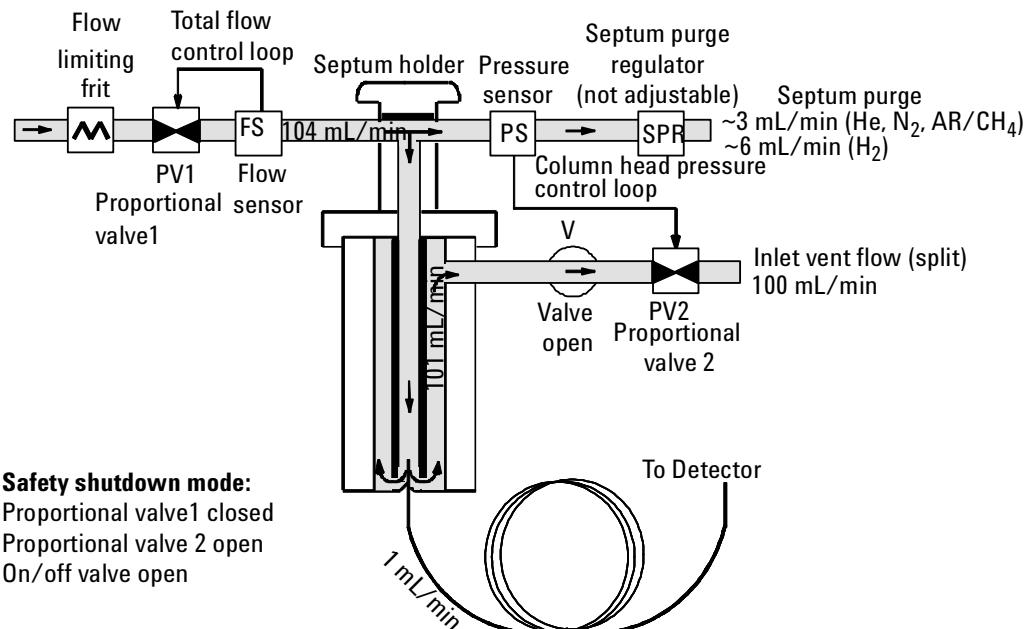


Figure 210-1 EPC control split mode flow diagram. 100:1 split ratio

Pulsed split mode

For EPC inlets in this configuration, the split flow and the column pressure (flow) are programmed up to a higher value prior to sample injection. The

split ratio remains constant due to electronic control. The actual flow rate through the inlet is much higher during the injection period, transferring the analytes quickly onto the column which minimizes sample losses that can occur in glass inlet liners. After the pulsed time expires, the split flow and column flow are returned to the lower flows selected for best chromatography.

Splitless mode

For an EPC inlet during splitless injections, PV1 is used to control the inlet pressure as measured by PS. V is an on/off valve which is turned off so there is no flow out of the split vent. PV2 is turned on at a nominal value so that there is no back pressure on V. FS will still be measuring flow, but it is no longer used to control PV1. In this configuration, the total flow into the inlet is the column flow + septum purge flow. At the user specified purge time, the inlet control is returned to split mode (see Figure 210-1) to allow the inlet to be purged.

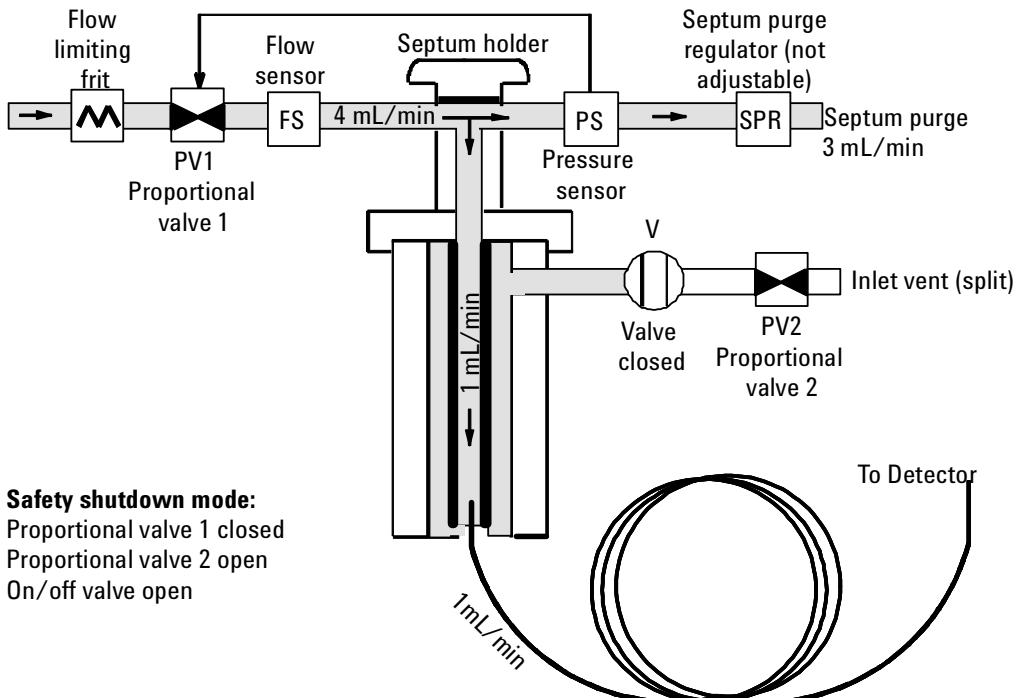


Figure 210-2 EPC control splitless mode flow diagram (pre-run to purge time).

Pulsed splitless mode

For EPC inlets set to pulsed splitless mode, the column head pressure is increased to some selected value and selected time period prior to sample introduction. Like the split mode, the increased flow through the column during the injection period minimizes sample losses in glass liners.

Gas saver mode

For EPC inlets, Gas Saver mode may be used in splitless or split mode of operation for conservation of split and inlet purge flows when not in use or in between runs. A gas saver flow rate and start time can be set independently of normal flow rates being used.

Manually controlled inlet

Split mode

For a manual inlet in split mode, V1 is a manually regulated mass flow controller that controls total inlet flow. PCV is a three-way purge control valve that remains in the normally open position to allow flow out of the split vent. V2 is a manually controlled back pressure regulator in the split vent path controlling the inlet pressure and thus, flow through the column. SPR is a manually controlled septum purge regulator used to control the septum purge flow. This flow is set to approximately 3.0 mL/minute for operation.

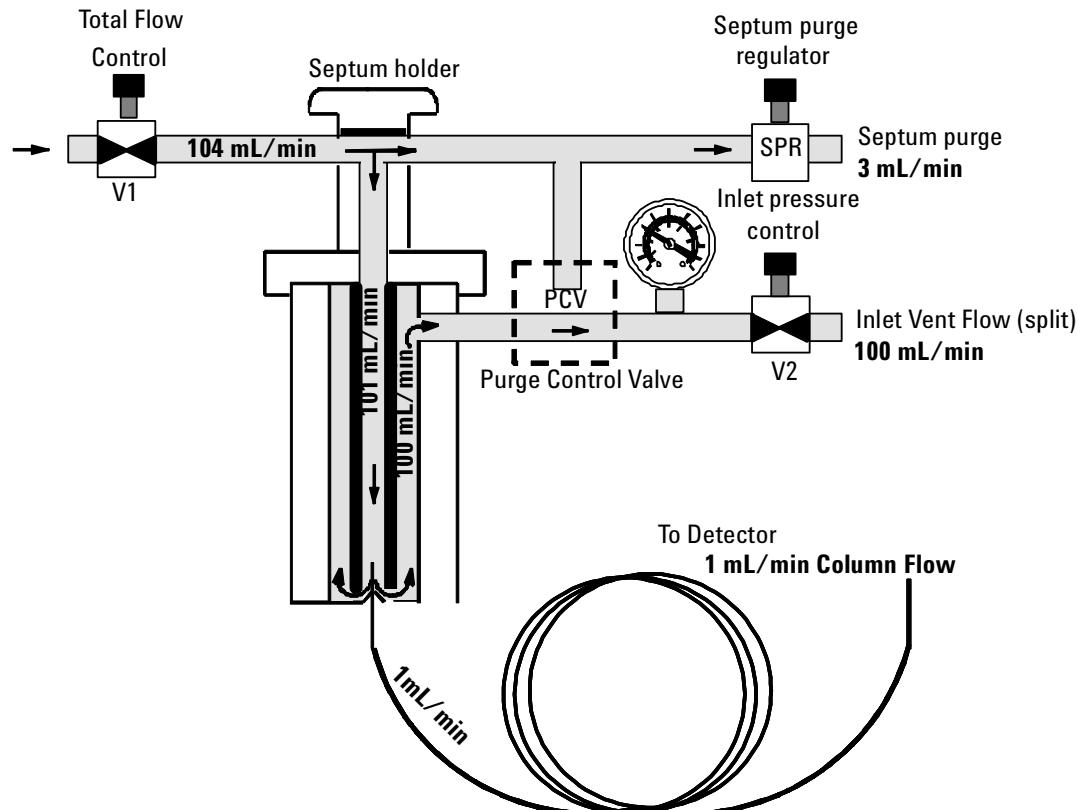


Figure 210-3 Manual control split mode flow diagram. 100:1 split ratio

Splitless mode

For a manual inlet in splitless mode, V1 is a manually regulated mass flow controller that controls total inlet flow. The Purge Control Valve (PCV) is a three-way solenoid valve that switches prior to injection to divert the higher part of the flow across the top of the liner, through the PCV and out the inlet split vent. At a user specified time after injection, the valve switches back to split mode (see Split mode) to purge remaining sample vapor out of the inlet split vent. V2 is a manually controlled back pressure regulator in the split vent path controlling the inlet pressure and thus, flow through the column. SPR is a manually controlled septum purge regulator used to control the septum purge flow.

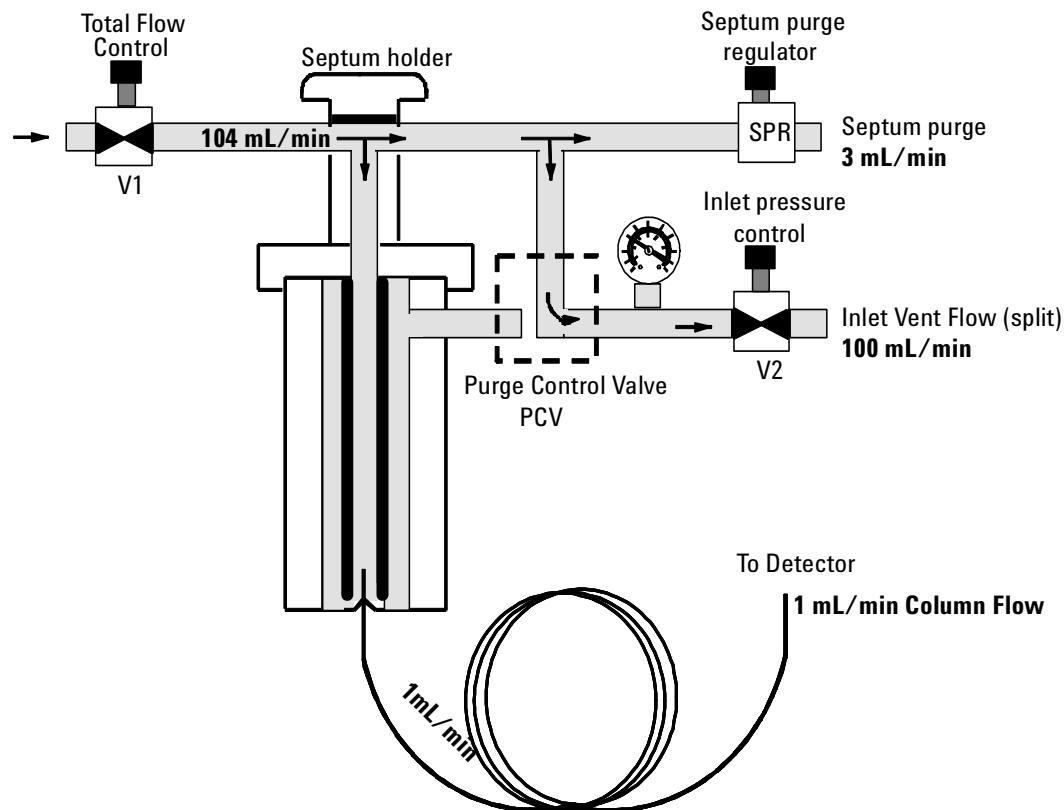


Figure 210-4 Manual control splitless mode flow diagram (pre-run to purge time).

Replacement procedures

Removing the inlet

WARNING Turn off the oven and turn off the heater of the inlet you are replacing and let them cool down. Turn off all detector flows. Turn off the carrier gas supply pressure, then turn off the main power switch and unplug the power cord.

1. From inside the oven, remove the column and column fitting from the bottom of the inlet.
2. Remove the left side cover from the GC.
3. From the top of the 6890 GC, remove the blue inlet carrier cover (or the tray bracket, if installed).
4. Unclip the heater/sensor leads from the connector to the left of the inlet carrier.
5. Unscrew the top insert assembly (large inlet nut and flow lines on the top of the inlet) that has the carrier gas and septum purge lines plumbed to it.
6. Raise this assembly up and away from the inlet

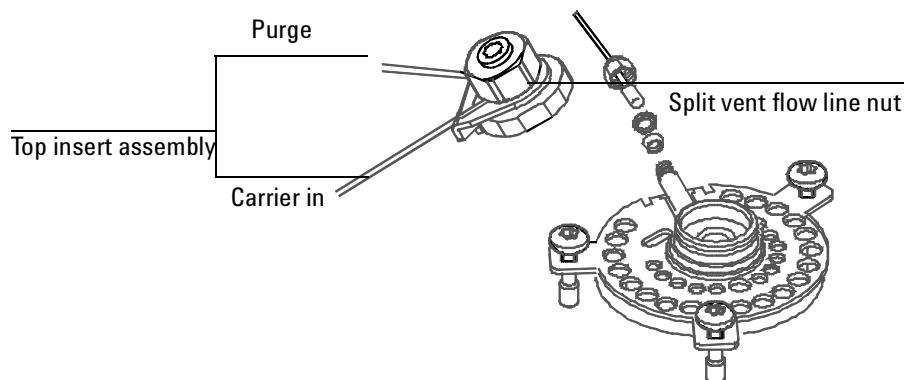


Figure 210-5 Removing the inlet

7. Remove the 1/8-inch Swagelok nut using a 7/16-inch open end wrench.
8. Use a Torx T-20 screwdriver to loosen the three captive screws that attach the inlet weldment plate to the top of the inlet carrier.
9. Pull the inlet up out of the inlet carrier. If necessary, you can also slide the insulation sleeve off of the bottom of the inlet.

Top insert assembly replacement

1. The top insert assembly is replaced as one assembly if required.

For EPC inlets:

- a. Disconnect the pneumatics block from the front of the EPC module (one Torx T-10 screw). Be careful not to lose the three O-rings from the pneumatics module.
- b. Follow the split vent flow line back from the pneumatics block and disconnect the line from the split vent trap.
- c. Remove the carrier and septum purge lines from the left side of the GC.

For non-EPC inlets:

- a. Unscrew the top insert assembly (large inlet nut and flow lines on the top of the inlet) that has the carrier gas and septum purge lines plumbed to it. Raise this assembly up and away from the inlet.
- b. Follow the split vent flow line back from the pneumatics block attached to the top insert assembly and disconnect the line from the split vent trap.
- c. Remove the carrier and septum purge lines from under the plastic tabs on the left side of the GC.
2. Use a 7/16-inch wrench to unscrew the split vent flow line nut from the Swagelok fitting at the top of the inlet.
3. Use a Torx T-20 screwdriver to loosen the three captive screws that attach the inlet weldment plate to the top of the inlet carrier.

4. Pull the inlet up out of the inlet carrier. If necessary, you can also slide the insulation sleeve off of the bottom of the inlet.

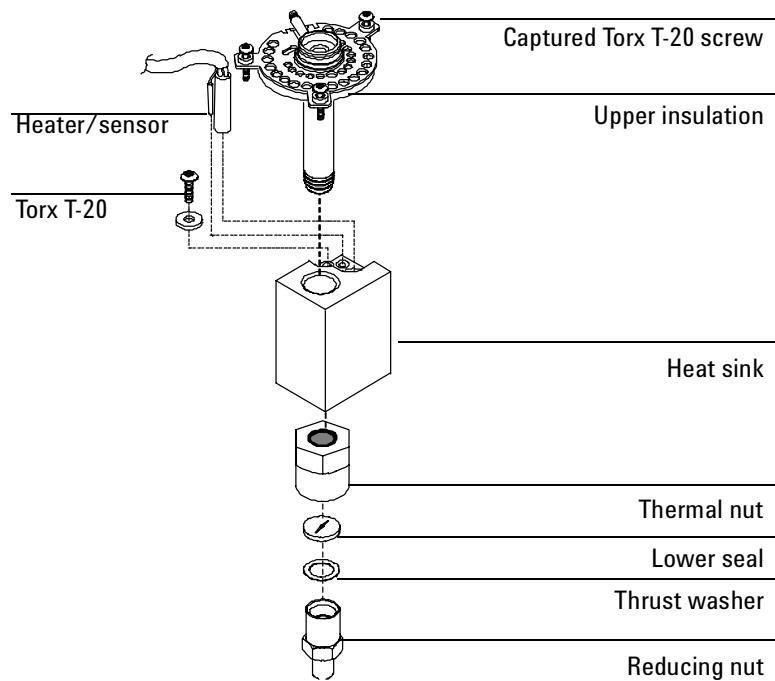


Figure 210-6 Removing the heater/sensor assembly

Heater/sensor assembly replacement

1. Follow the Removing the inlet procedure described previously in this section.
2. Remove both the bottom reducing nut (1/2-inch) and the larger thermal nut (3/4-inch) from the bottom of the inlet. Be careful not to lose the lower inlet seal and thrust washer inside the reducing nut.

Note You may want to use a vise to hold the heat sink when removing the thermal nut.

3. Slide the aluminum heat sink off of the inlet weldment.
4. Remove the Torx T-20 screw and washer from the top of the heat sink and slide the heater/sensor elements out of the heat sink.
5. Replace the heater/sensor assembly, being careful not to damage the sensor. Replace the washer/T-20 screw and reassemble the rest of the inlet.

Reinstalling the inlet

1. Make sure the heater/sensor assembly is installed and the inlet insulation sleeve is in place.
2. Install a column nut and blank ferrule on the bottom of the inlet to prevent insulation contamination, and place the inlet into the inlet carrier.

Note Make sure the insulation is properly seated around the inlet and that the heater/sensor wiring harness insulation sleeve is tucked under the top inlet plate.

3. Retighten the three screws (Torx T-20) to secure the top inlet weldment plate to the inlet carrier.
4. Reconnect the split vent flow line.

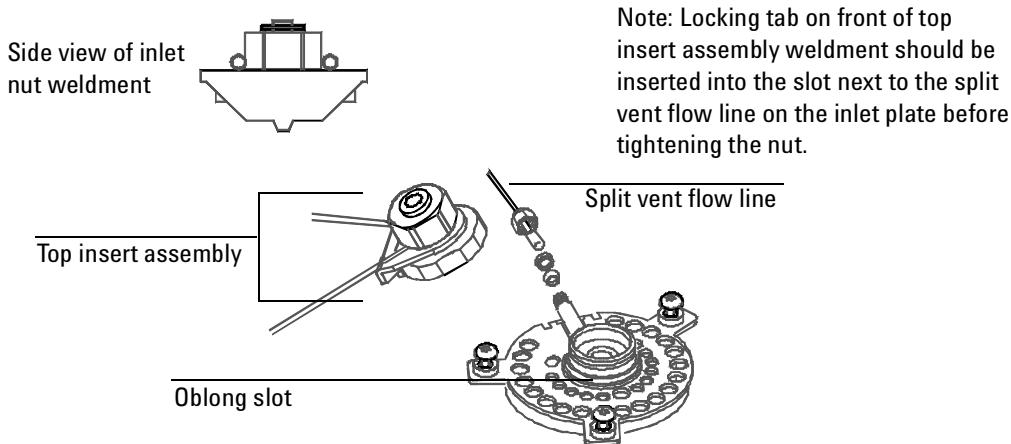


Figure 210-7 Reinstalling the inlet

5. Reinstall the top insert assembly (with septum and carrier lines attached). Make it finger tight plus a quarter turn with the inlet wrench provided in the ship kit (part number 19251-00100).

Note Make sure the locking tab fits into the oblong slot on the left side of the inlet weldment plate.

6. Tuck the "service loop" of the septum purge and carrier gas lines under the tabs on the left side of the GC.
7. Seat the heater/sensor leads into the channel on the inlet carrier.
8. Reconnect the heater/sensor assembly into the provided connector (front or back) on the left side of the GC.
9. Reinstall the insulated thermal cup and insulation in the GC oven.

10. Reinstall the blue inlet plastic cover or tray bracket to the top of the inlet area.

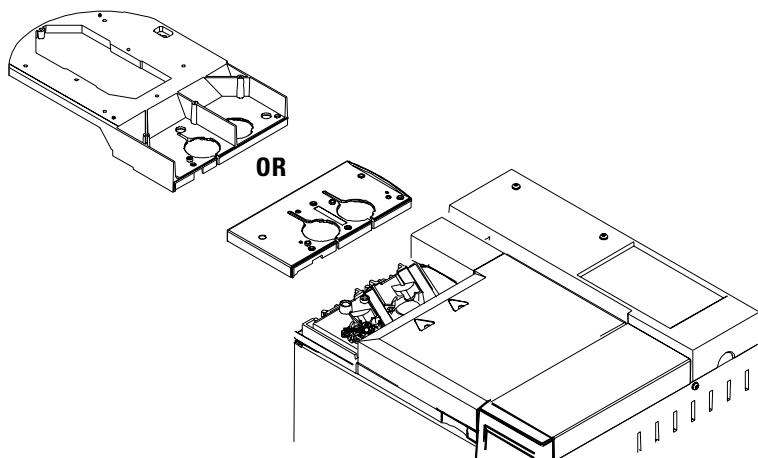


Figure 210-8 Reinstalling the inlet cover or tray bracket

Replacing the split vent trap

For GCs manufactured before May 1997, the split vent trap (part no. G1544-80550) or EPC units can be replaced by the Replacement Split Vent Trap kit, part no. G1544-60610. The new split vent trap uses a replaceable filter cartridge, which is sold in a package of 2 each (part no. G1544-80530).

To replace the filter cartridge in the trap, see *Replacing the split vent trap filter cartridge* below.

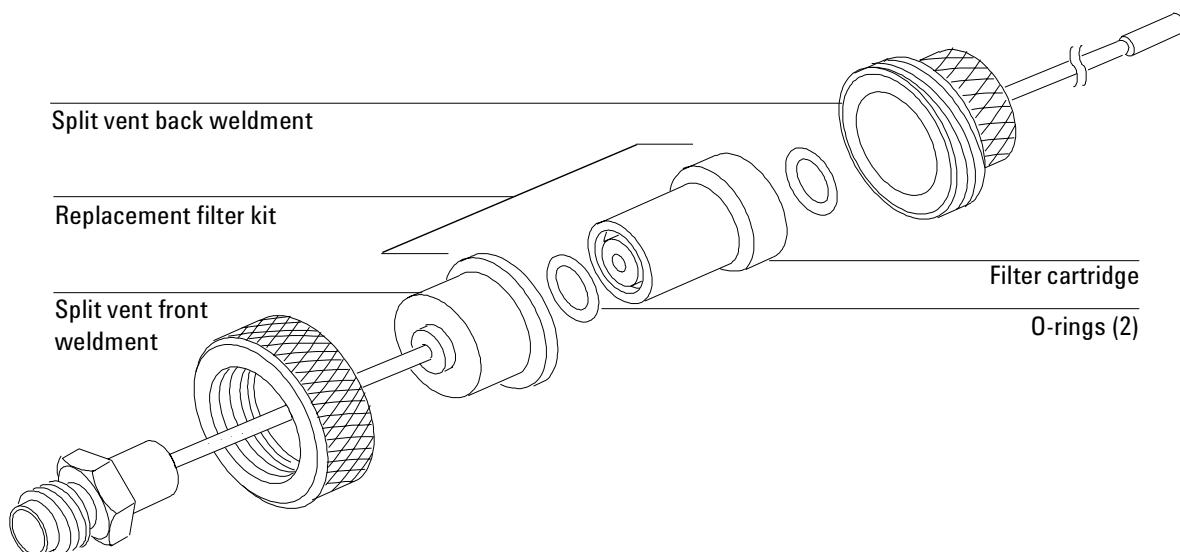


Figure 210-9 Replacement split vent filter trap kit, part no. G1544-60610

WARNING Turn off the oven and turn off the heater of the inlet you are replacing and let them cool down. Turn off all detector flows. Turn off the carrier gas supply pressure, then turn off the main power switch and unplug the power cord.

1. Disconnect the spit vent trap line from the inlet assembly.

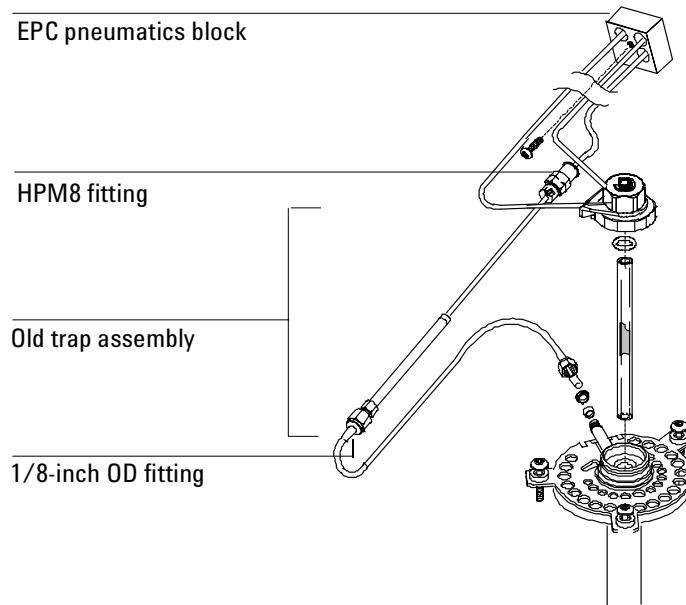


Figure 210-10 EPC manifold configuration

2. For EPC inlets, follow the split vent line from the trap to the HPM8 connector from the pneumatics block on the EPC manifold. Disconnect the plastic fitting and remove the old trap assembly and connected plumbing.

Replacing the split vent trap filter cartridge

1. Turn off the inlet and the oven and allow to cool.
2. Set all GC flows to zero.
3. Remove the pneumatics cover.
4. Lift the filter trap assembly form the mounting bracket and unscrew the filter trap assembly.
5. Remove the old filter cartridge and O-rings and replace them.

6. Reassemble the trap.

Replacing the inlet EPC flow manifold

WARNING Before proceeding, cool the heated zones, then turn off the main power switch. Set pressure/flow to 0.0. Follow ESD precautions.

All EPC inlets (and the ECD detector) in the 6890 GC use Type 1 flow manifolds.

1. Shut off the main gas supply to the manifold and remove the 1/8-inch Swagelok fitting for the gas supply.
2. Remove the plastic detector cover and the plastic pneumatics cover.
3. Remove the metal RFI shield and the rear top cover on the back of the GC.
4. Disconnect the ribbon cable for the module from the main EPC board. The adjacent ribbon cable may have to be disconnected as well.

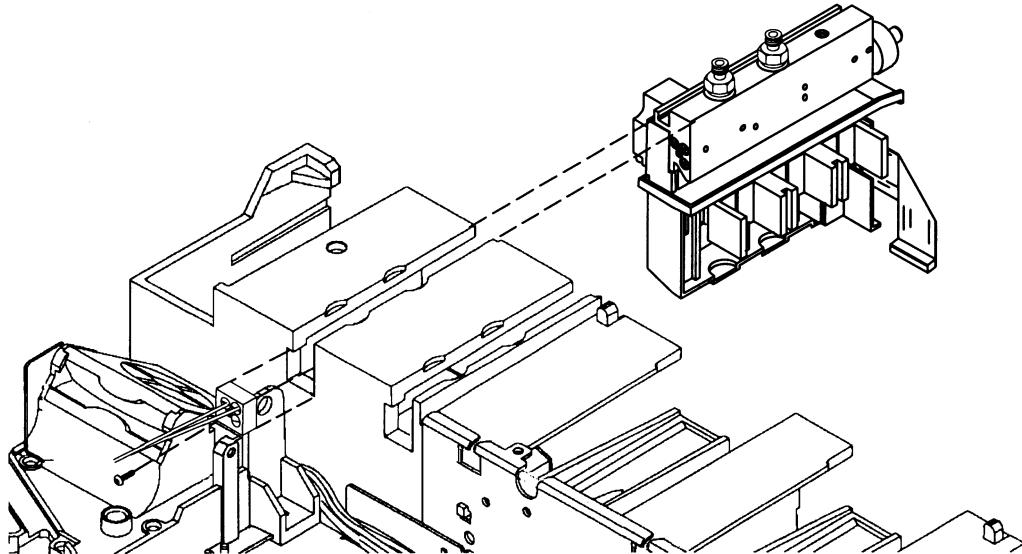


Figure 210-11 Removing the Type 1 EPC flow manifold

5. Remove the plumbing block from the front of the manifold (one captured Torx T-10 screw). Replace the three rubber O-rings behind the block if they are worn or damaged.
6. Remove the long screw (Torx T-20) from the top of the manifold and slide the manifold out of the back of the GC.
7. Reinstallation is the reverse of removal.

Replacing the supply fitting on a Type 1 flow manifold

Carrier gas enters an inlet EPC flow manifold through a fritted, stainless steel fitting. If the frit in this fitting clogs and cannot be cleaned, replace the assembly as a whole. Remove the two screws attaching the fitting to the manifold, replace the O-ring behind the fitting, and install a new fitting.

To clean the supply fitting frit, use solvents and/or an ultrasonic bath, then, dry the supply fitting with an N₂ or air stream.

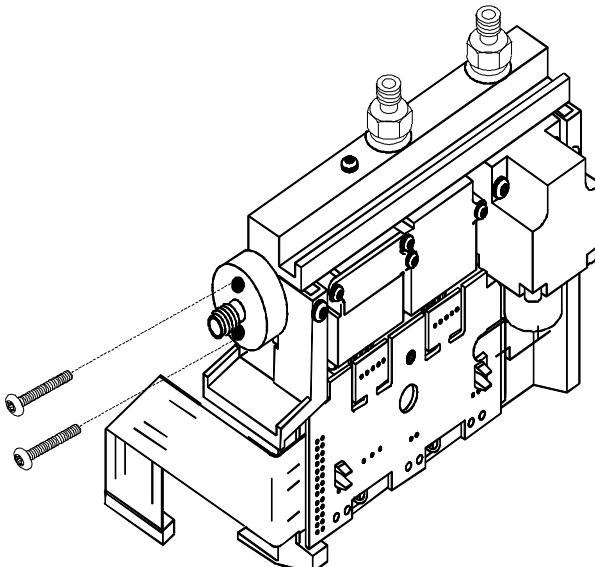


Figure 210-12 Replacing the supply fitting

Leak testing—EPC and manual inlets

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 the quality of the septum, the O-ring on the glass liner and the lower inlet seal are unknown, replace them now.

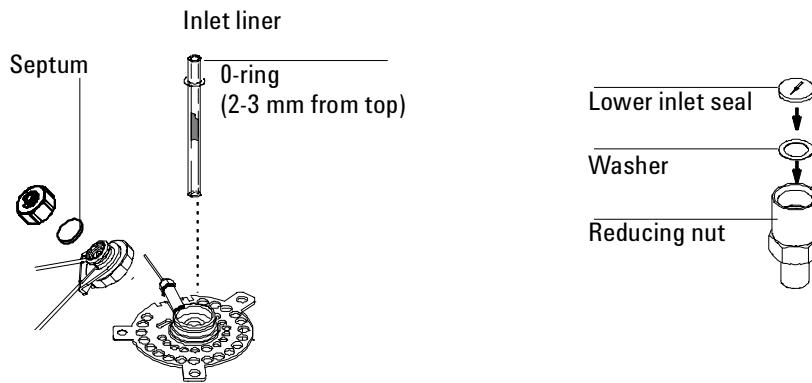


Figure 210-13 Location of septum, liner, O-ring, and lower inlet seal

4. Cap the septum purge vent and the inlet's column fitting. 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.

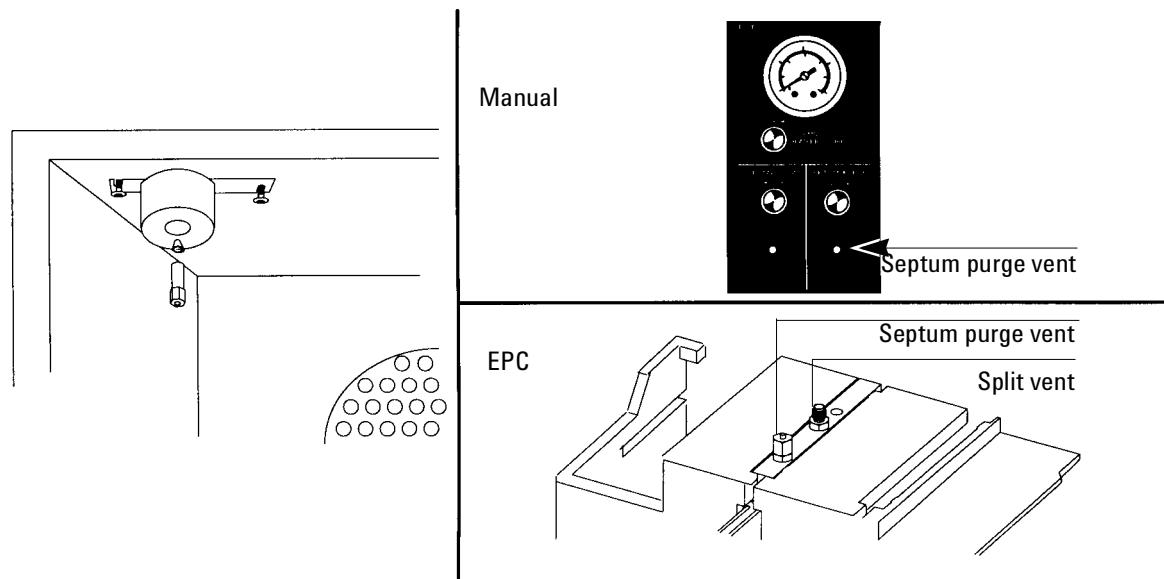


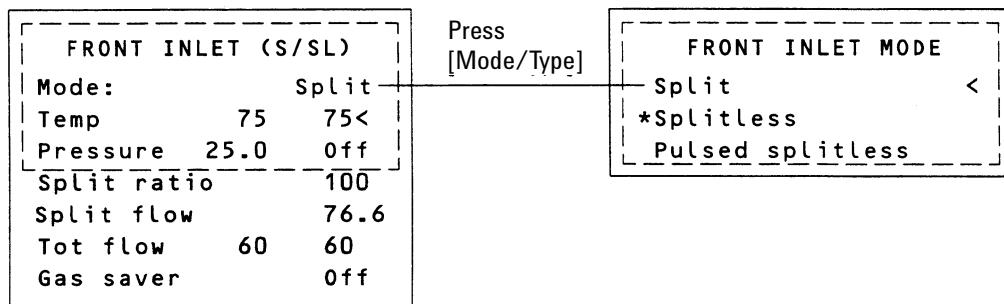
Figure 210-14 Capping the bottom of the inlet and septum purge vent

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—EPC inlets

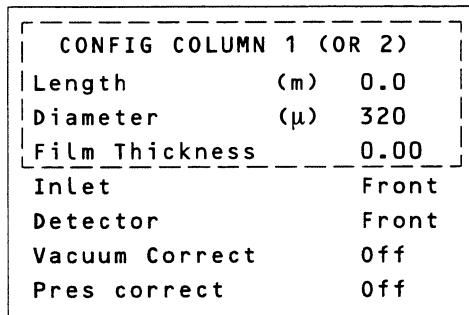
Note Be sure to complete all of the preparation steps on pages 20 and 21 before continuing.

1. Set the inlet to “Split Mode.”



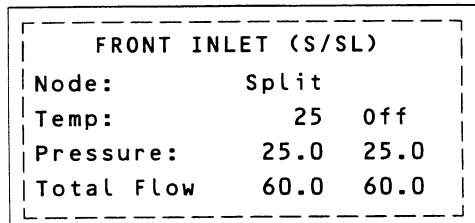
2. Configure the column as 0 length.

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 10 minutes for pressure 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. After 10 minutes, 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 (approximately 0.05 psi/min), 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.
 - If there is a rise in pressure, see Forward pressure valve leaks below.
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.

Performing the leak test—manual inlets

Note Be sure to complete all of the preparation steps on pages 18 and 19 before continuing.

1. Turn the Total Flow controller counter-clockwise to obtain approximately 60 mL/min. flow at the split vent. Use a flow meter to verify this flow rate.
2. Turn the column head pressure controller clockwise until the column head pressure reaches 25 psi.

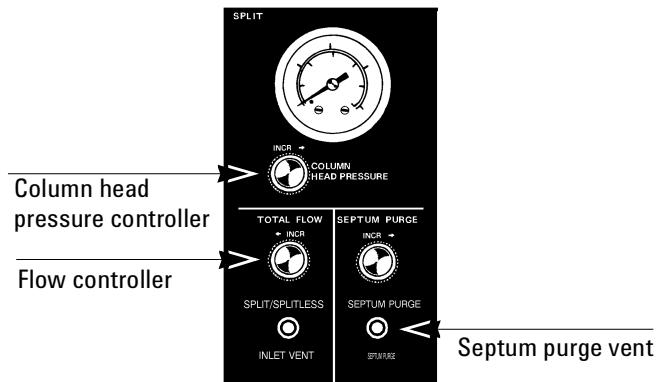


Figure 210-15 Manual flow panel

3. 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.

4. Shut off the flow controller by turning it fully clockwise. Do not overtighten. Use a flow meter to verify that the split flow is off.

5. Turn the column head pressure controller an additional half turn clockwise to assure that it will be closed and monitor the column head pressure gauge for 10 minutes.
 - If there is less than 0.5 psi pressure loss (approximately 0.05 psi/min), 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. See Correcting leaks later in this section.
6. When the system is considered leak tight, the caps may be removed, the column reinstalled, and the split flow and column pressure may be set.

Leak testing the EPC 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 1.0 psi or less in 10 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.

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.

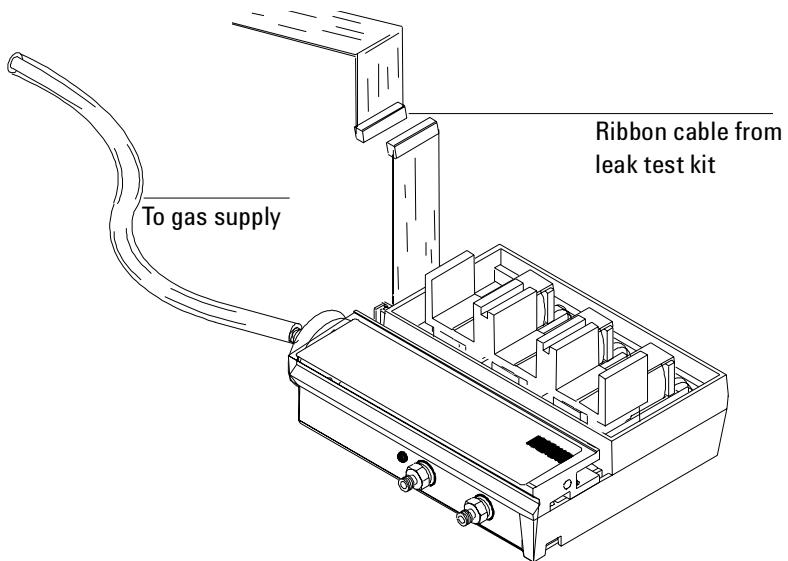


Figure 210-16 Leak testing the EPC module on the lab bench

8. If the leaky component is serviceable, such as a vent/inlet fitting (see diagram of serviceable parts, Figure 210-17), replace it. Otherwise, replace the EPC module.

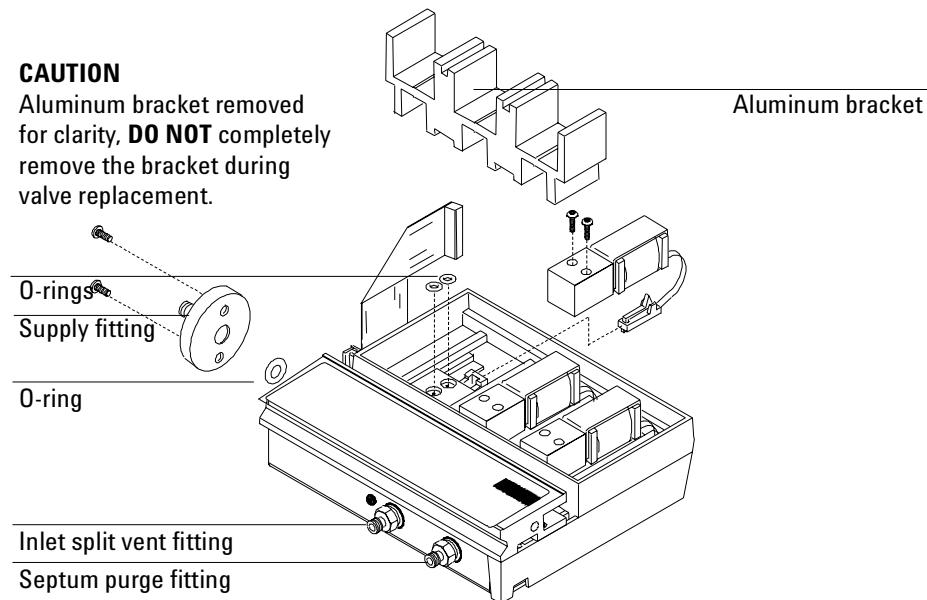


Figure 210-17 EPC module serviceable parts

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 1.0 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
- O-ring in top of inlet
- Lower inlet seal at bottom of inlet

At EPC module

- Three O-rings behind block where the inlet's pneumatic lines enter module
- Two O-rings for each valve
- Septum purge cap

220 Purged/Packed Inlet

The septum purged/packed column inlet contains a mass flow controller to control the flow stream into the inlet and a forward pressure regulator to control flow out the septum purge vent. The inlet can be used for packed or capillary columns. Based on the column you have configured, the inlet can be operated in either a mass flow controlled mode or a pressure controlled mode.

Theory of operation

At injection, liquid sample is introduced with a syringe into the hot inlet where it is flash vaporized in the liner. For both manual and EPC inlets, the flow paths are the same; the flow is divided into two streams.

- **The major portion of the stream** enters the inlet insert and is transferred into the column.
- **The remaining small portion of the flow stream** is vented out the purge vent flow line.

EPC purged packed inlets can be either flow controlled or pressure controlled depending on whether a capillary column's dimensions are configured within the instrument. If configured with a capillary column dimension, the column is pressure controlled and flows are calculated values.

EPC inlet

Carrier gas flow enters into the top of the inlet through a flow-limiting frit and then a proportional valve (PV1) in the carrier gas feed line. This valve is either controlled by the flow sensor (flow-controlled mode) or the pressure sensor (pressure-controlled mode) also in the carrier gas feed line. A fraction is split off to purge the septum. 1.0 mL/min flows out the purge vent and the rest of the stream enters the inlet insert and flows through the column.

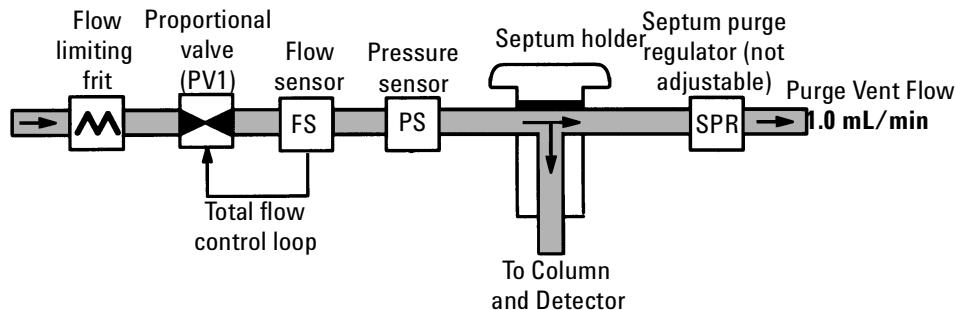


Figure 220-1 EPC control packed column inlet (flow control mode — recommended for packed columns)

The flow controlled mode shown above is used when no column dimensions are configured in the 6890 GC.

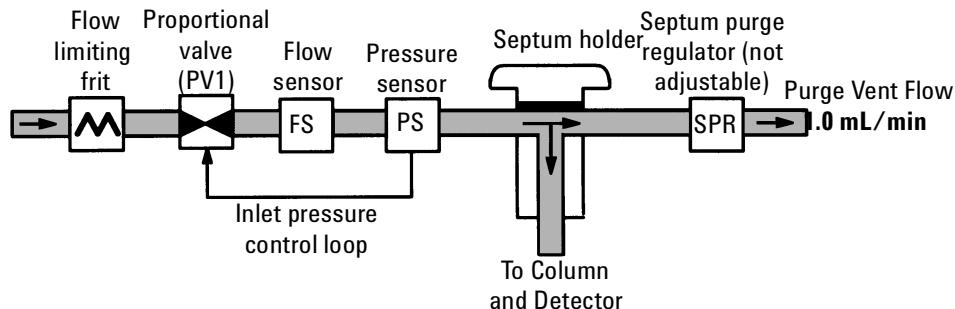


Figure 220-2 EPC control packed column inlet (pressure control mode — recommended for capillary columns)

The pressure controlled mode shown above is used when capillary column dimensions are configured in the 6890 GC.

Manually controlled inlet

In a manually controlled purged packed inlet, carrier gas flow enters through the mass flow controller, into the top of the inlet. The septum purge regulator (SPR) in the septum purge line, determines the fraction of the stream that is split off to purge the septum. This fraction of the stream then flows out through the purge vent. The majority of the carrier stream enters the inlet insert and then the column.

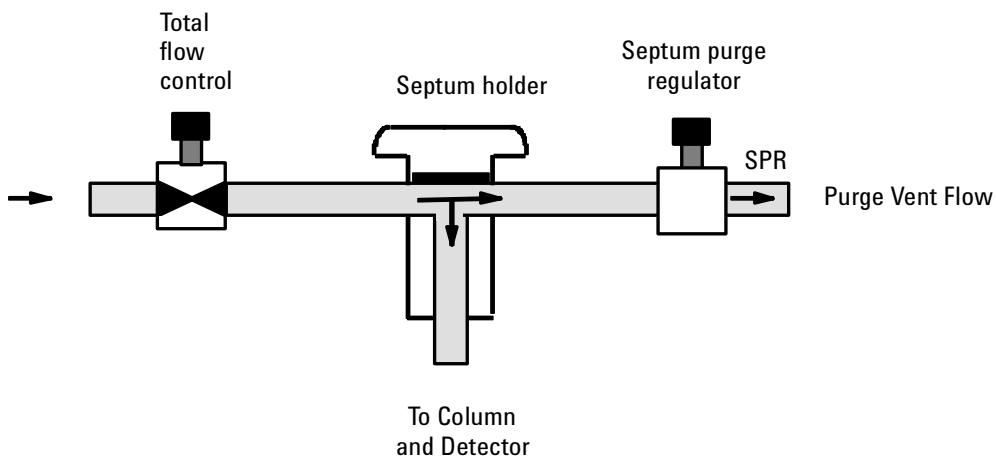


Figure 220-3 Manual control packed column inlet (flow control mode)

Replacement procedures

Replacing the inlet

WARNING Turn off the oven and turn off the inlet you are replacing and let them cool down. Turn off the carrier gas supply pressure. Then turn off the main power switch and unplug the power cord.

1. Disconnect the column from the bottom of the inlet.
2. Remove the thermal cup and insulation from the bottom of the inlet column fitting.
3. Remove the inlet liner/insert by loosening the 1/4-inch nut on the inlet liner. The metal bottom plate on the oven ceiling does not need to be removed.

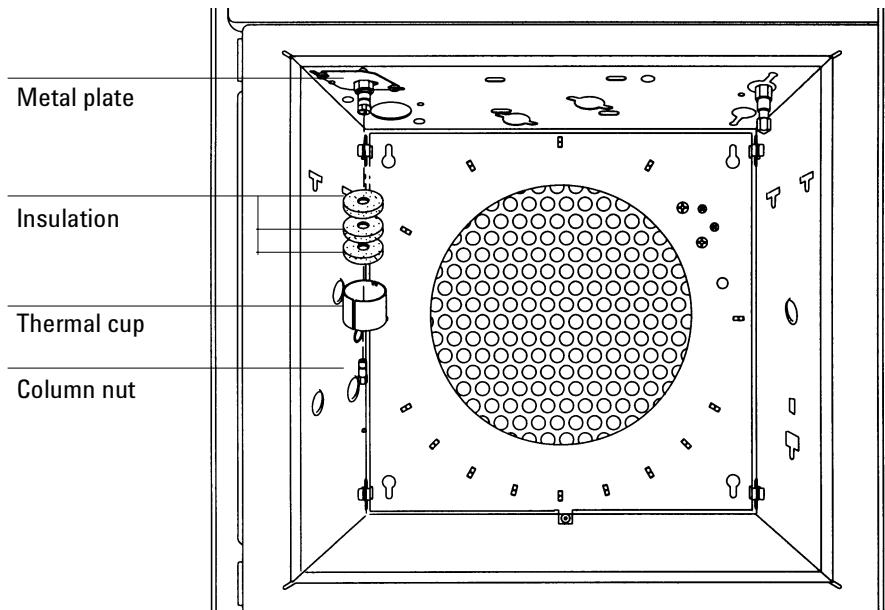


Figure 220-4 Removing the column and the thermal cup (inside oven)

4. From the top of the 6890 GC, remove the blue inlet carrier cover (or tray bracket, if installed) and the left side cover.
5. Disconnect the inlet plumbing and reroute the plumbing from underneath the tabs on the left side of the instrument.

EPC inlets: The inlet plumbing terminates in a pneumatics block connected to the EPC flow manifold with one Torx T-10 screw.

Non-EPC inlets: The inlet plumbing terminates in a pneumatics block connected with a Torx T-10 screw to a similar mating block on the left side of the instrument.

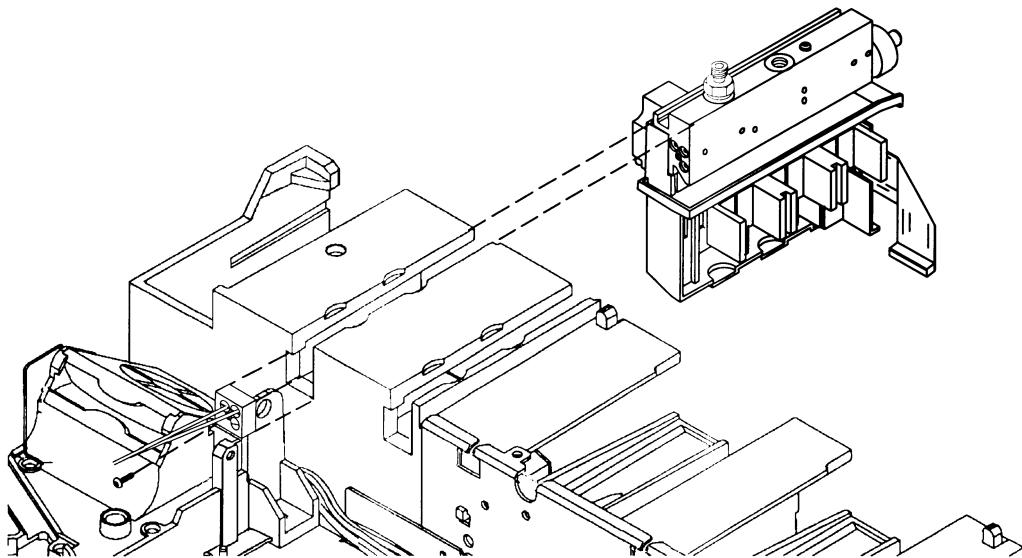


Figure 220-5 Disconnecting the inlet plumbing block (EPC inlet)

6. Remove the top inlet plate (three Torx T-20 screws) and the insulation underneath.
7. Unplug the heater/sensor leads from their connector to the left of the inlet.

8. Lift the inlet out of the instrument.

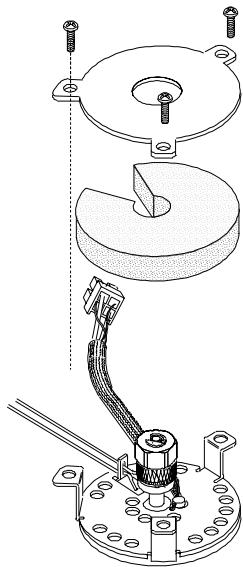


Figure 220-6 Removing the top inlet plate

9. If you need to remove the thermal block, slide off the insulation sleeve and use a wrench to remove the bottom nut. Slide the thermal block off the inlet weldment.

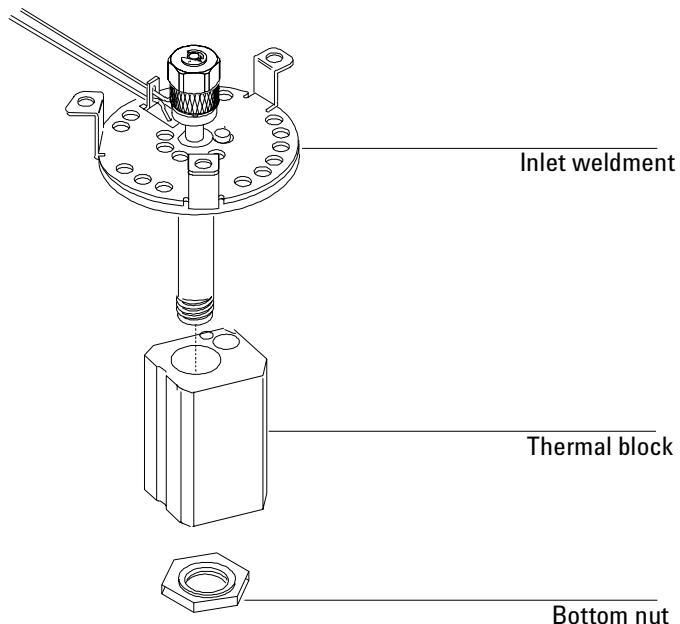


Figure 220-7 Removing the thermal block

10. Reinstallation is the reverse of removal.

Replacing an EPC flow manifold

WARNING Before proceeding, turn off the main power switch and let the heated zones cool. Follow ESD precautions.

All EPC inlets and the ECD detector in the 6890 GC use Type 1 flow modules.

1. Shut off the main gas supply to the manifold and remove the 1/8-inch Swagelok fitting for the gas supply.
2. Remove the plastic detector cover and the plastic pneumatics cover.
3. Remove the metal RFI shield, and the rear cover on the back of the GC.
4. Disconnect the ribbon cable for the manifold from the main EPC board. You may have to remove the adjacent ribbon cable also.

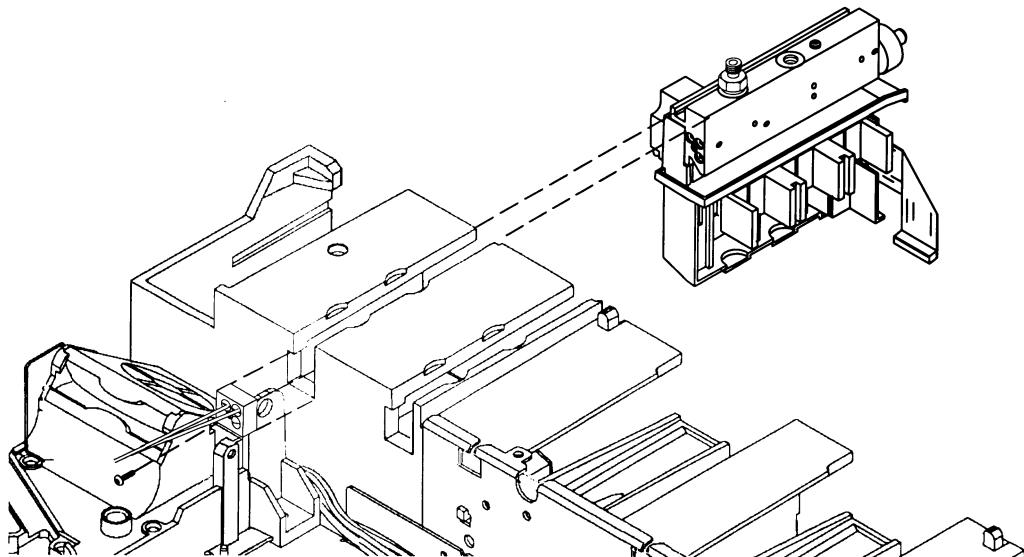


Figure 220-8 Removing the EPC flow manifold

5. Remove the plumbing block from the front of the manifold (one Torx T-10 screw).
6. Remove the long screw (Torx T-20) from the top of the manifold and slide the manifold out of the back of the GC.
7. Reinstallation is the reverse of removal.

Replacing the supply fitting on a Type 1 EPC manifold

The same replacement procedure is used to replace the supply fitting on any of the inlet flow inlet manifolds used in the 6890 GC. See Split/Splitless Inlet for the detailed procedure.

Leak testing—EPC and manual inlets

Preparation

1. Cool the column to ambient, and cool inlets to below 75° C to avoid damage to deactivated glass inserts.
2. Remove the column from the inlet fitting on the inside of the oven.
3. If the quality of the septum, metal liner seal and the O-ring on the top inlet fitting are unknown, replace them now.

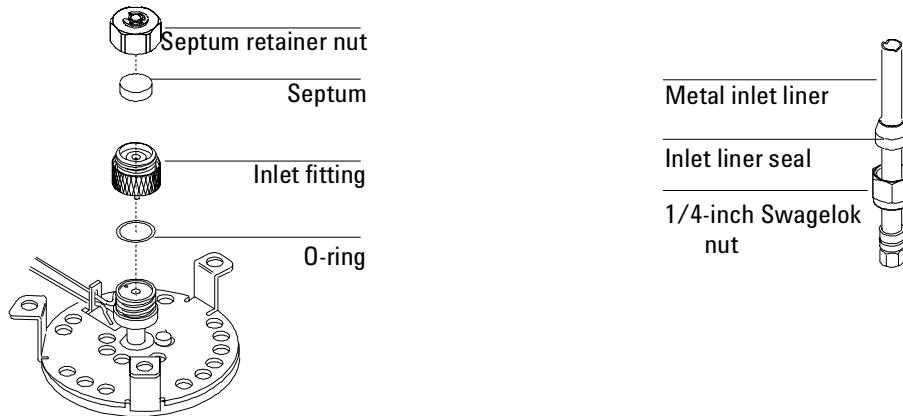


Figure 220-9 Location of septum, liner, O-ring, and lower inlet seal

4. Cap the septum purge vent and the inlet's column fitting. 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 and 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.

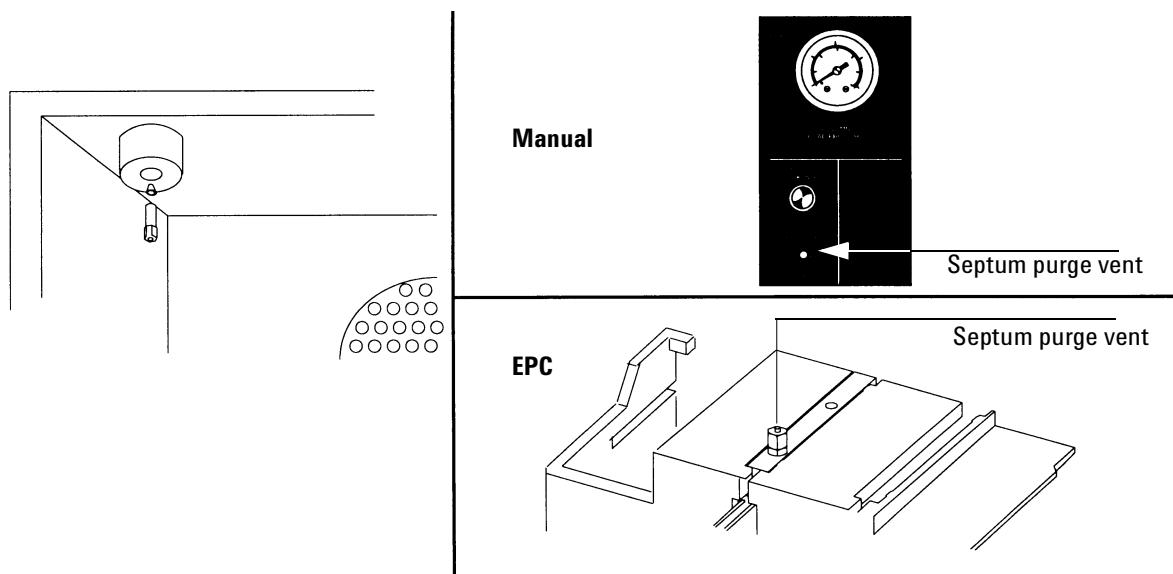


Figure 220-10 Capping the bottom of the inlet and septum purge vent

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—EPC inlets

Note Be sure to complete all of the preparation steps on pages 10 and 11 before continuing.

1. Make sure a length and diameter for a capillary column are entered for the inlet you are testing.

Press [Column 1] (or [Column 2]) and enter a length and diameter in the “Dim” row. This places the system in pressure control mode rather than in flow control mode.

CONFIG COLUMN 1 (OR 2)		
Length	(m)	0.0
Diameter	(μ)	320
Film Thickness		0.00
Inlet		Front
Detector		Front
Vacuum Correct		Off
Pres correct		Off

2. Set the pressure to 25 psi on the keypad.

Press [Front Inlet] or [Back Inlet] and enter “25” in the “Pressure” field.

3. 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.

4. Turn the inlet pressure “Off.”

Press [Front Inlet] (or [Back Inlet]), scroll to the “Pressure” field, and press [Off].

-
5. 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 0.7 psi pressure loss (0.07 psi/min.), consider the system leak tight.
 - If pressure loss is much greater than 0.7 psi, there is a leak that must be found and corrected. See Correcting leaks later in this section.
6. When the system is considered leak tight, the caps may be removed, the column reinstalled, its dimensions configured at keyboard, and the desired pressure or flow rate set.

Performing the leak test—manual inlets

Note

Be sure to complete all of the preparation steps on pages 10 and 11 before continuing.

1. Set the carrier supply pressure to 30 psi.
2. Turn the flow controller about six turns counter-clockwise. The pressure gauge will increase to a value less than the supply pressure.
3. Wait 10 minutes for pressure equilibration. The gauge on the front panel should be stable.
4. After 10 minutes, shut off the column head pressure by turning the flow controller full clockwise. Do not overtighten or you will damage the valve seat.

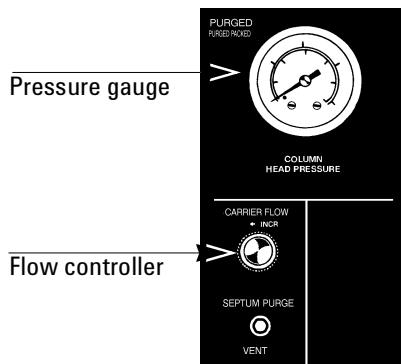


Figure 220-11 Inlet manifold

5. Monitor the pressure gauge for 10 minutes.
 - If there is less than 0.7 psi pressure loss (0.07 psi/min), consider the system leak tight.

- If pressure loss is much greater than 0.7 psi, there is a leak that must be found and corrected. See *Correcting leaks later in this section*.
6. When the system is considered leak tight, the caps may be removed, the column reinstalled, and the desired flow rate set.

Leak testing the EPC module only

Occasionally, to track down 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 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 (if present) flow paths on the module. It allows the carrier gas, septum purge, and split vent line (if present), 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 smaller, and a pressure loss of 1.0 psi in 10 minutes 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.

To check for internal valve leakage:

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 10 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.

Caution	Be sure to wear an ESD strap grounded to the 6890 GC chassis while performing this procedure.
	<ol style="list-style-type: none">1. Turn off the main power switch.2. Remove the top plastic pneumatics cover and the detector cover.3. Remove the RFI shield and 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.

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

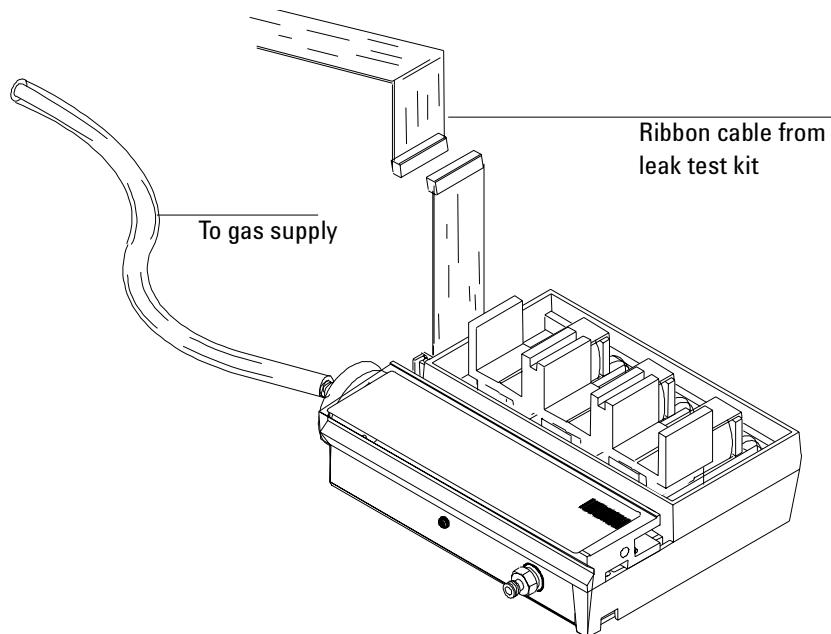


Figure 220-12 Leak testing the EPC module on the lab bench

8. If the leaky component is serviceable, such as vent/inlet fittings (see Figure 220-13) swap it out. Otherwise, replace the EPC module.

Caution

Aluminum bracket removed for clarity, **DO NOT** completely remove the bracket during valve replacement.

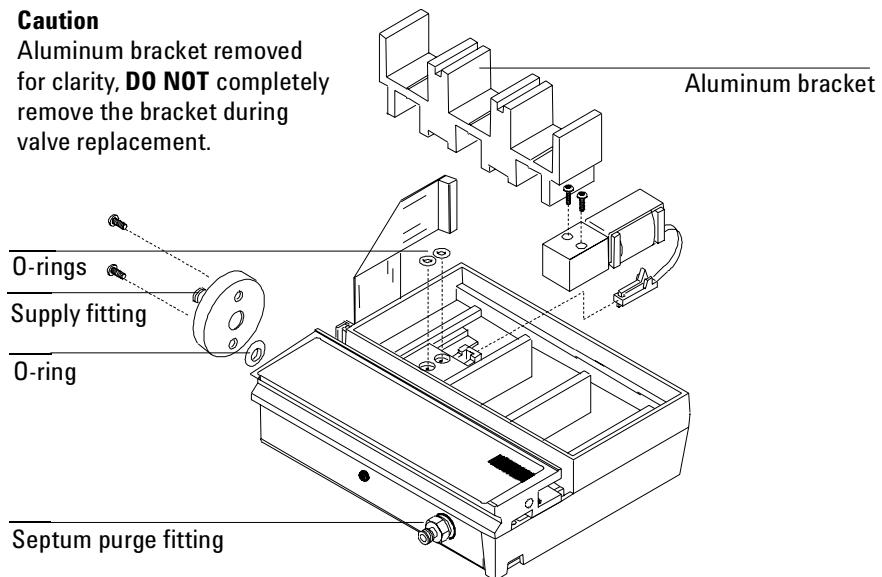


Figure 220-13 EPC module serviceable parts

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 1.0 psi or less, you can consider the inlet system leak-free. If the pressure drop is much greater than this, 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
- O-ring under inlet septum fitting at top of inlet
- Liner ferrule seal at bottom of inlet

At EPC module

- Three O-rings behind block where inlet pneumatic lines enter module
- Two O-rings for each valve
- Septum purge cap

230 Cool On-Column Inlet

Programmable Cool On-Column (PCOC) inlets are designed to allow the injection syringe to deposit the liquid sample directly into the capillary column. This is accomplished by the use of an insert which serves to align the syringe with the capillary column and the syringe needle.

Theory of operation

At injection, liquid sample is introduced directly into the column.

- For manual injections, a duckbill valve (isolation valve) uses inlet pressure to create a pneumatic seal around the needle.
- For automatic injections, the duckbill valve is replaced with a septum and nut and the septum maintains the pressure seal.

For both manual and EPC inlets, the flow paths are the same; the flow is divided into two streams. The carrier gas enters the inlet and flows into the column and additionally provides for a constant septum purge flow regardless of the column flow rate you use.

EPC inlet

An EPC controlled PCOC inlet is a forward pressure regulated system that provides flow to the column. A pressure sensor is located just ahead of the inlet and with the proportional valve forms a closed loop electronically controlled system. In addition, a flow limiting frit (750 mL/min at 50 psi) is located at the pneumatics entrance. A septum purge regulator (SPR) maintains septum purge flow between 7 and 15 mL/min.

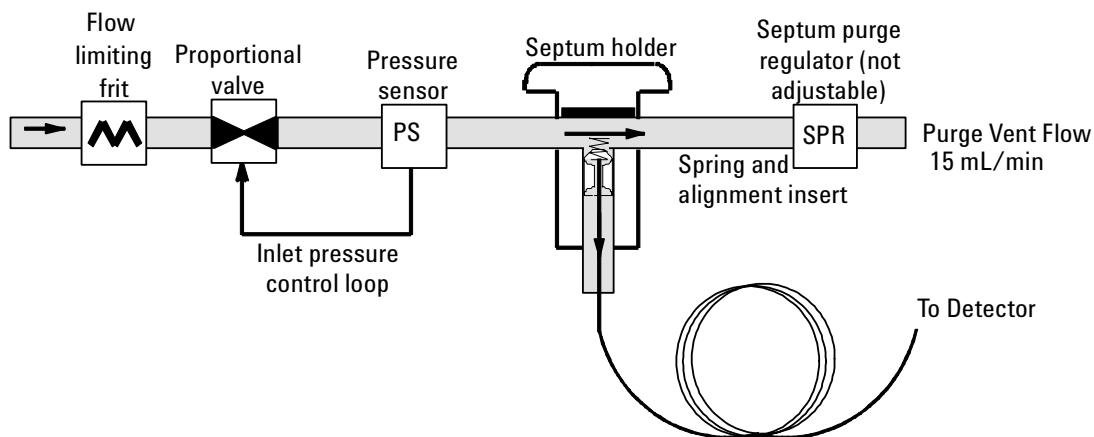


Figure 230-1 EPC control

Manually controlled inlet

The manually controlled PCOC inlet has a forward pressure regulator (FPR) that controls the column flow rate. In addition, a forward pressure regulator with a fixed restrictor (SPR) is used to provide a nominal septum purge flow rate of 15.0 mL/min. The sample is deposited directly into a capillary column for analysis.

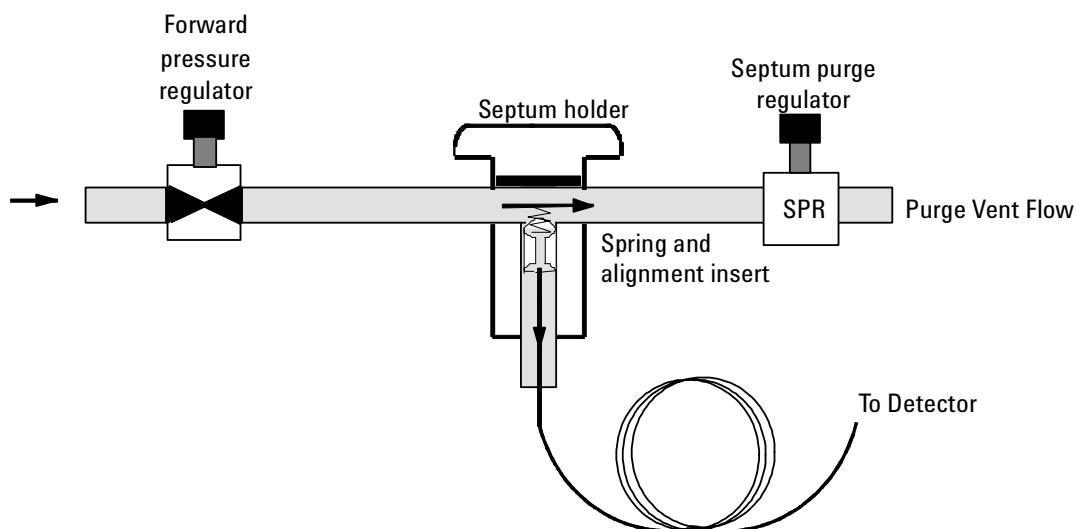


Figure 230-2 Manual control

Replacement procedures

Replacing the inlet

WARNING Turn off the oven and turn off the inlet you are replacing and let them cool down. Turn off the carrier gas supply pressure, then turn off the main power switch and unplug the power cord.

1. From inside the oven, remove the column from the inlet fitting.
2. From the top of the 6890 GC, remove the blue inlet carrier cover (or the tray bracket, if installed) and the left side cover.
3. Unclip the heater/sensor leads from the connector to the left of the inlet carrier.
4. Disconnect the inlet plumbing and reroute the plumbing from underneath the tabs on the left side of the instrument.

EPC inlets: The inlet plumbing terminates in a pneumatics block connected to the EPC flow manifold with one Torx T-10 screw.

Non-EPC inlets: The inlet plumbing is located in the manual inlet side carrier. The tubing labelled "C" is connected to the Forward Pressure Regulator. The line labelled "P" is connected to the septum purge regulator.

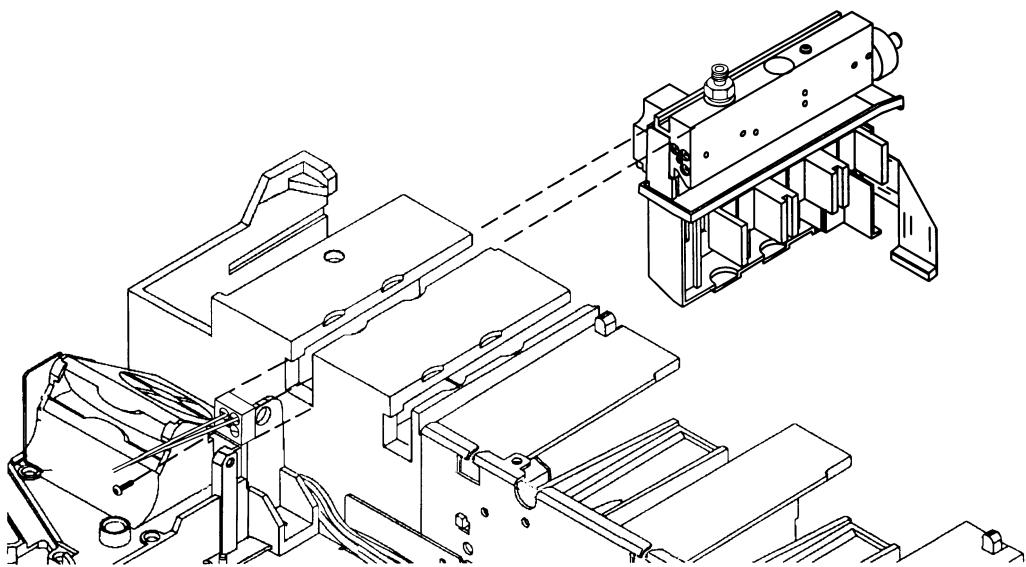


Figure 230-3 Disconnecting the inlet plumbing block (EPC inlets)

5. Use a Torx T-20 screwdriver to loosen the three captive screws that attach the inlet weldment to the top of the inlet carrier.

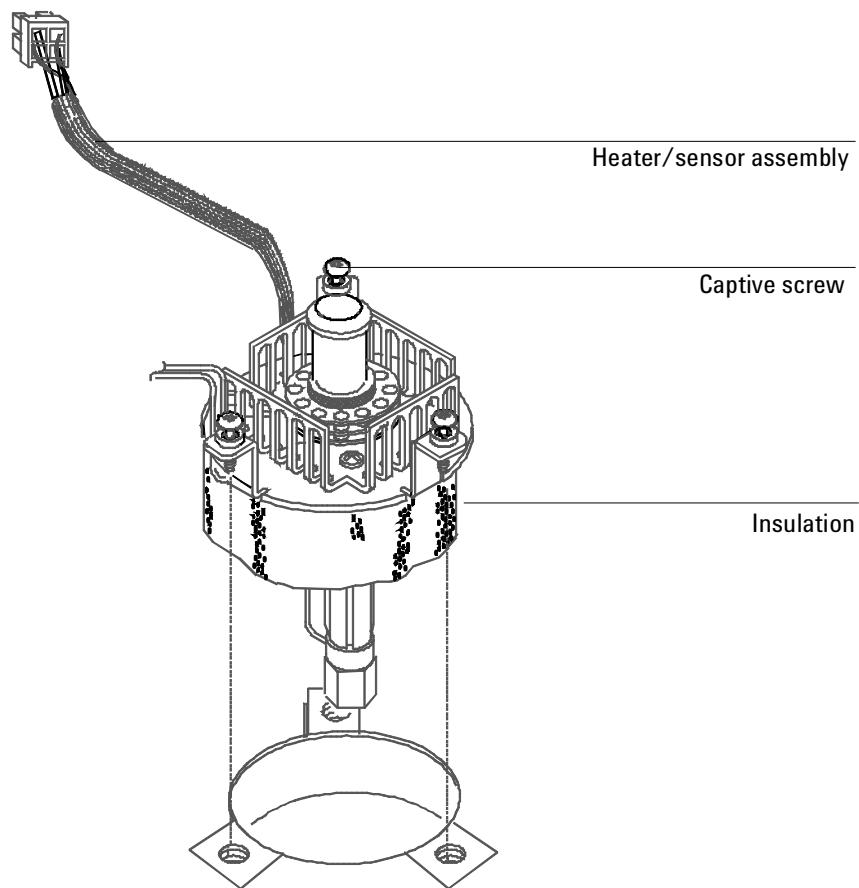


Figure 230-4 Removing the inlet from the top of the GC

6. Slide the inlet up out of the inlet carrier. If necessary, you can also slide the insulation sleeve off of the bottom of the inlet.
7. Reinstallation is the reverse of removal.

Replacing the heater/sensor assembly

WARNING Turn off the oven and turn off the inlet you are working on and let them cool down. Turn off the carrier gas supply pressure, then turn off the main power switch and unplug the power cord.

1. If necessary, remove the septum nut, cooling tower and/or needle guide to provide access to the two screws in the top of the cooling fin.

Note If desired, you can remove the entire inlet for better access.

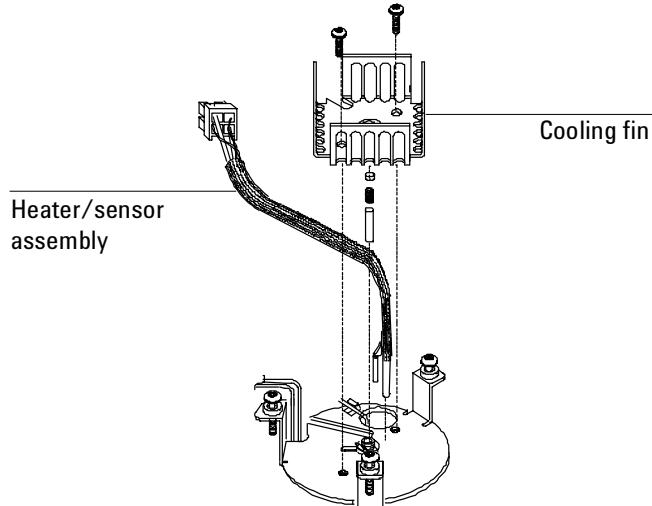


Figure 230-5 Removing the heater/sensor assembly from the top of the GC

2. Remove the two Torx T-20 screws securing the cooling fin to the inlet weldment and remove the fin.

3. Lift the heater/sensor leads out of the weldment channel and lift the assembly out of the inlet.
4. Install the new heater/sensor assembly and reassemble the inlet. You may need to use tweezers to seat the cable back in the channel and fully seat the heater/sensor in the weldment.

Replacing the inlet EPC flow manifold

WARNING Turn off the oven and turn off the inlet you are replacing and let them cool down. Turn off the carrier gas supply pressure, then turn off the main power switch and unplug the power cord.

All EPC inlets and the ECD detector in the 6890 GC use Type 1 flow manifolds.

1. Remove the plastic detector cover and the plastic pneumatics cover.
2. Remove the metal RFI shield and the rear top cover on the back of the GC.
3. Disconnect the ribbon cable for the manifold from the EPC board. You may have to remove the adjacent ribbon cable also.

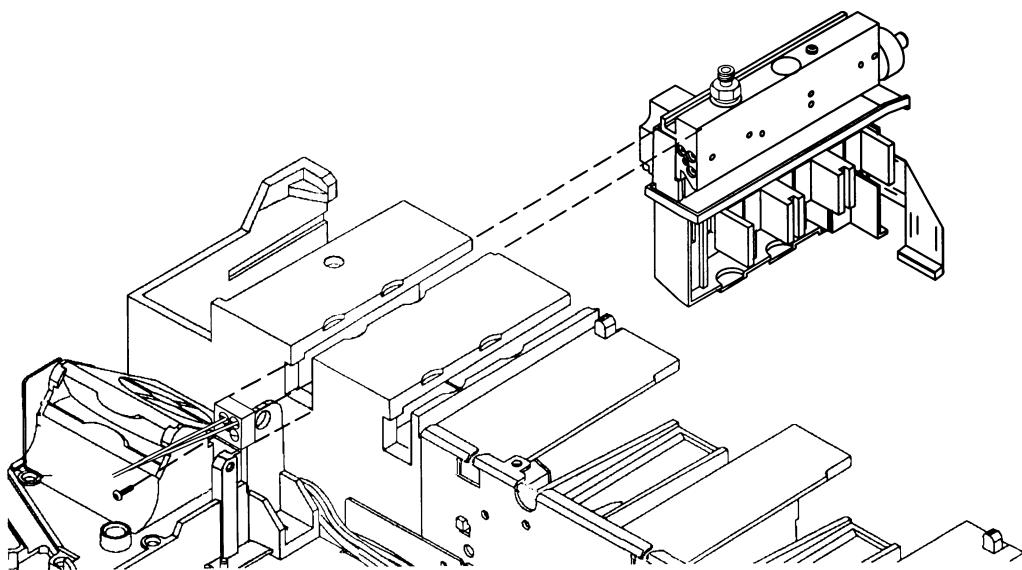


Figure 230-6 Removing the EPC flow manifold

4. Remove the 1/8-inch Swagelok fitting for the gas supply.
5. Remove the plumbing block from the front of the manifold (one Torx T-10 screw).
6. Remove the long screw (Torx T-20) from the top of the manifold and slide the manifold out of the back of the GC.
7. Reinstallation is the reverse of removal.

Replacing the supply fitting on a Type 1 EPC flow manifold

See Split/Splitless Inlet for the detailed procedure.

Leak testing EPC and manual inlets

Preparation

1. Cool the column to ambient.
2. Remove the column from the inlet fitting on the inside of the oven.
3. If the quality of the septum is unknown, replace it now.

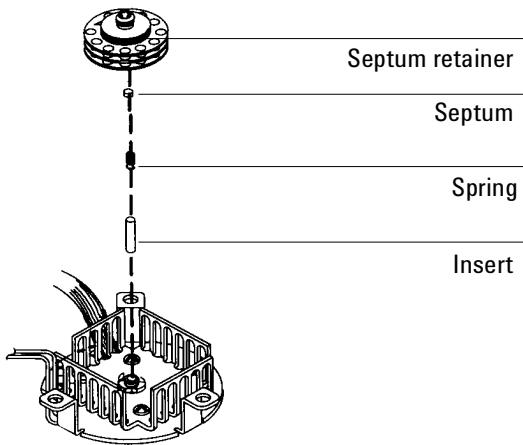


Figure 230-7 Location of septum

4. Cap the septum purge vent and the inlet's column fitting. 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 and 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.

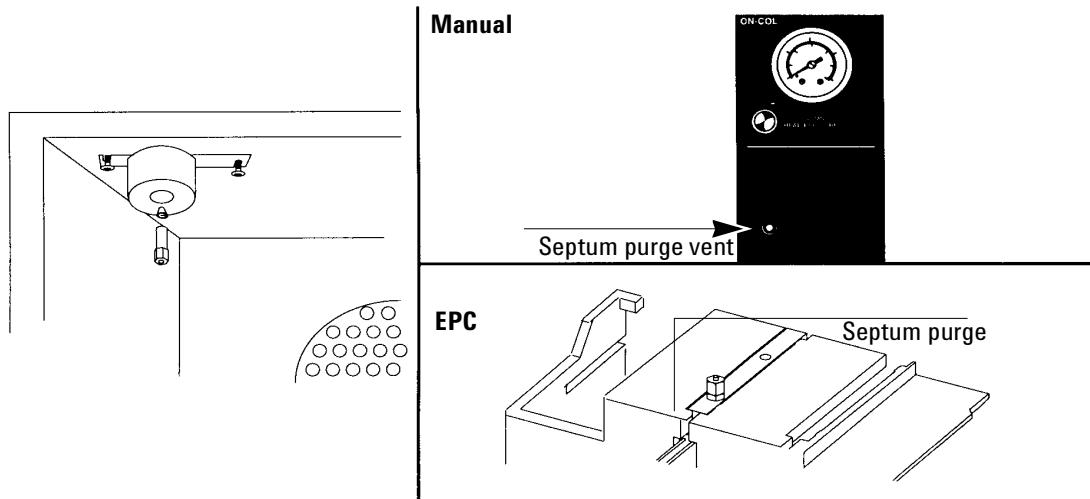


Figure 230-8 Capping the bottom of the inlet and septum purge vent

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—EPC inlets

Note Be sure that the preparation steps on pages 10 and 11 are complete before proceeding with this test.

1. Set the inlet pressure to 25 psi on the keypad.

Press [Front Inlet] or [Back Inlet]. Move to the "Pressure" field and enter "25".

FRONT INLET (coc)		
Mode:	Track oven	
Temp	150	150
Pressure	25.0	25.0<

2. 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.

3. Turn the inlet pressure "Off."

Press [Front Inlet] or [Back Inlet], scroll to the "Pressure" field, and press [OFF]

FRONT INLET (coc)		
Mode:	Track oven	
Temp	150	150
Pressure	24.6	Off<

4. 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 1.0 psi pressure loss (approximately 0.1 psi/min.), consider the system leak tight.
 - If pressure loss is much greater than 1.0 psi, there is a leak that must be found and corrected. See Correcting leaks later in this section.
5. When the system is considered leak tight, the caps may be removed, the column reinstalled, its dimensions configured at keyboard, and the desired pressure set.

Performing the leak test—manual inlets

Note

Be sure that the preparation steps on pages 10 and 11 are complete before proceeding with this test.

1. Turn the pressure controller clockwise until the column head pressure reaches 25 psi.
2. Wait 10 minutes for pressure equilibration. The gauge on the front panel should be stable.
3. After 10 minutes, shut off the column head pressure by turning the pressure controller full counter-clockwise.

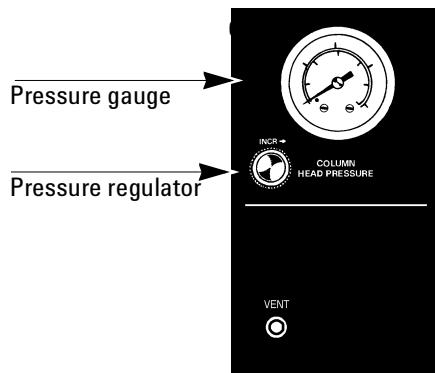


Figure 230-9 Inlet manifold

4. Monitor the pressure gauge for 5 minutes.
 - If there is less than 0.5 psi pressure loss (approximately 0.1 psi/min.), 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. See Correcting leaks later in this section.
5. When the system is considered leak tight, the caps may be removed, the column reinstalled, and the desired pressure set.

Leak testing the EPC module only

Occasionally, to track down 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 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 flow path on the module. It allows the carrier gas and septum purge 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 smaller and a pressure loss of 1.0 psi in 10 minutes is considered leak-free.

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.

To check for internal valve leakage:

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 10 minutes. Pressure loss should not be greater than 0.5 psi.

Locating leaks

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.

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. Disconnect the carrier supply tubing on the inlet fitting.
3. Remove the top plastic pneumatics cover and the detector cover.
4. Remove the RFI shield and the top rear cover on the GC.
5. Disconnect the ribbon cable for the module from the main EPC board. You may have to remove the adjacent ribbon cable also.
6. 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.
7. 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.
8. Reconnect the carrier supply fitting and set pressures as used in the leak test.
9. Lay the EPC module on the lab bench and use an electronic leak detector to locate the leaky component on the module.

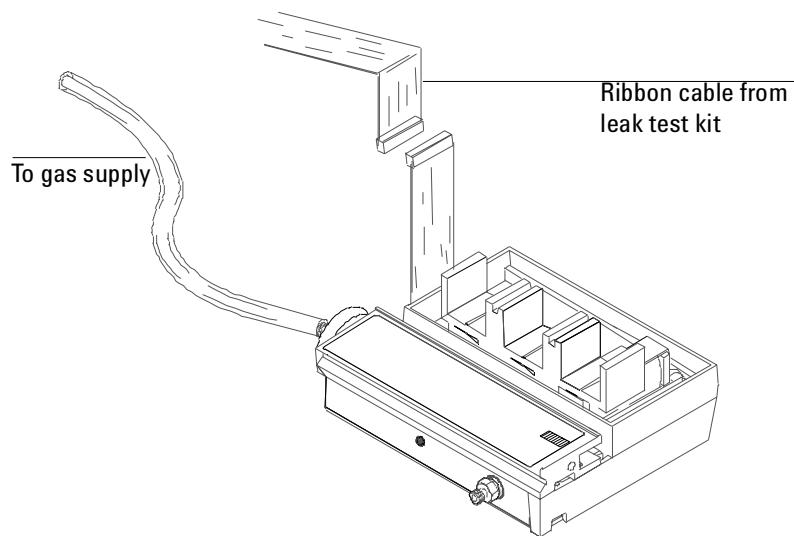


Figure 230-10 Leak testing the EPC module on the lab bench

10. If the leaky component is serviceable, such as vent/inlet fittings (see the following diagram of serviceable parts, Figure 230-11), replace them. Otherwise, replace the EPC module.

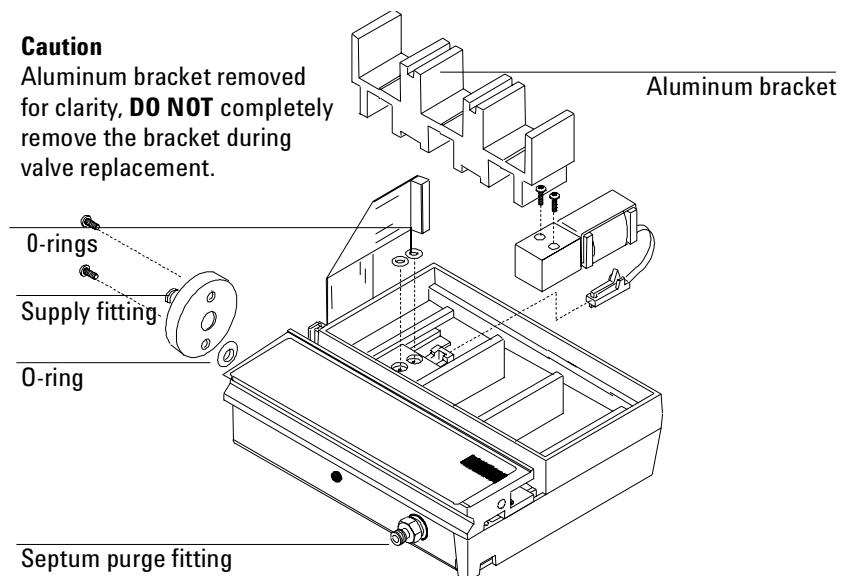


Figure 230-11 EPC module serviceable parts

Correcting leaks

1. Use an electronic leak detector to check all areas of the inlet 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

At EPC module

- Three O-rings behind block where pneumatic lines enter module
- Two O-rings for each valve
- Septum purge cap
- Inlet fitting

240 Programmed Temperature Vaporization Inlet (PTV)

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°C using CO₂ cooling, or as low as -160°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.

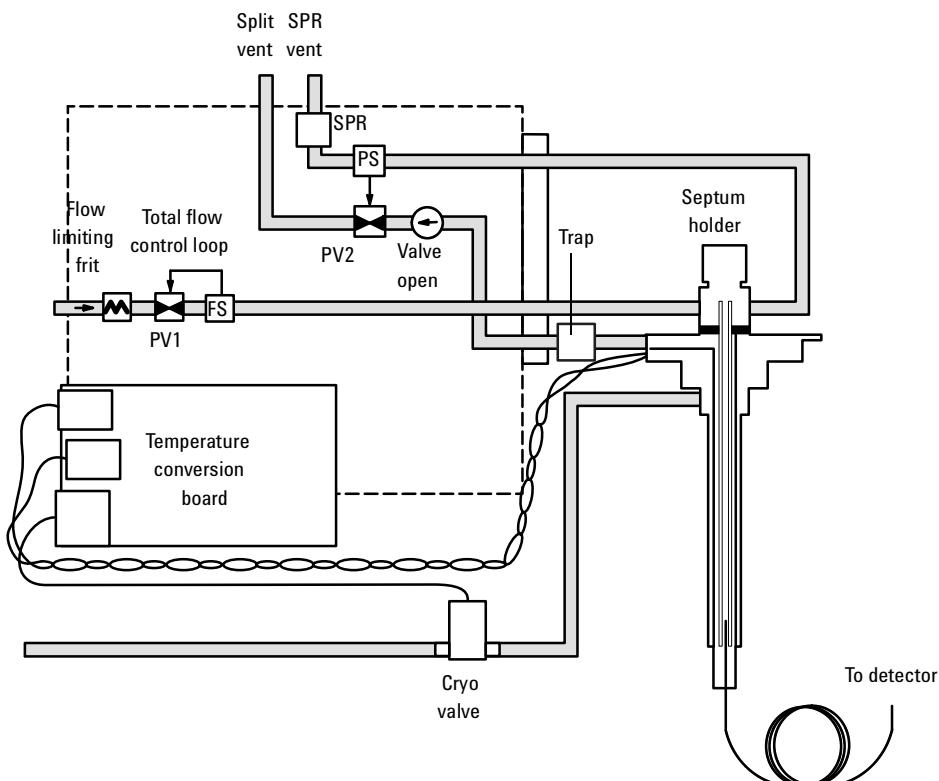


Figure 240-1 Split mode flow control diagram (septum head installed)

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.

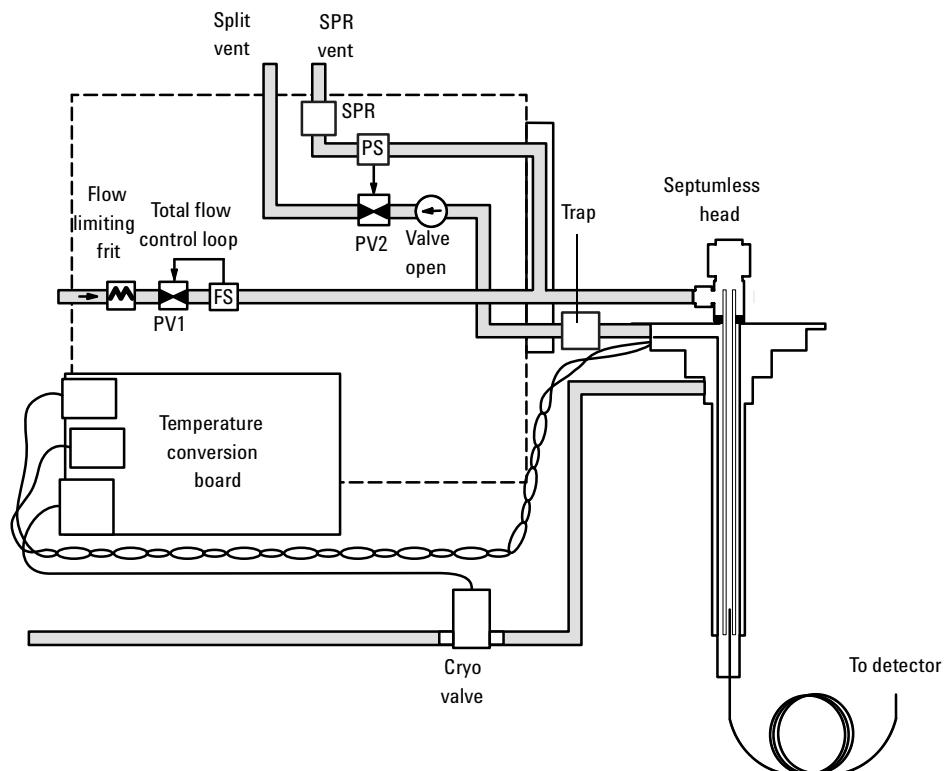


Figure 240-2 Split mode flow control diagram (septumless head installed)

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.

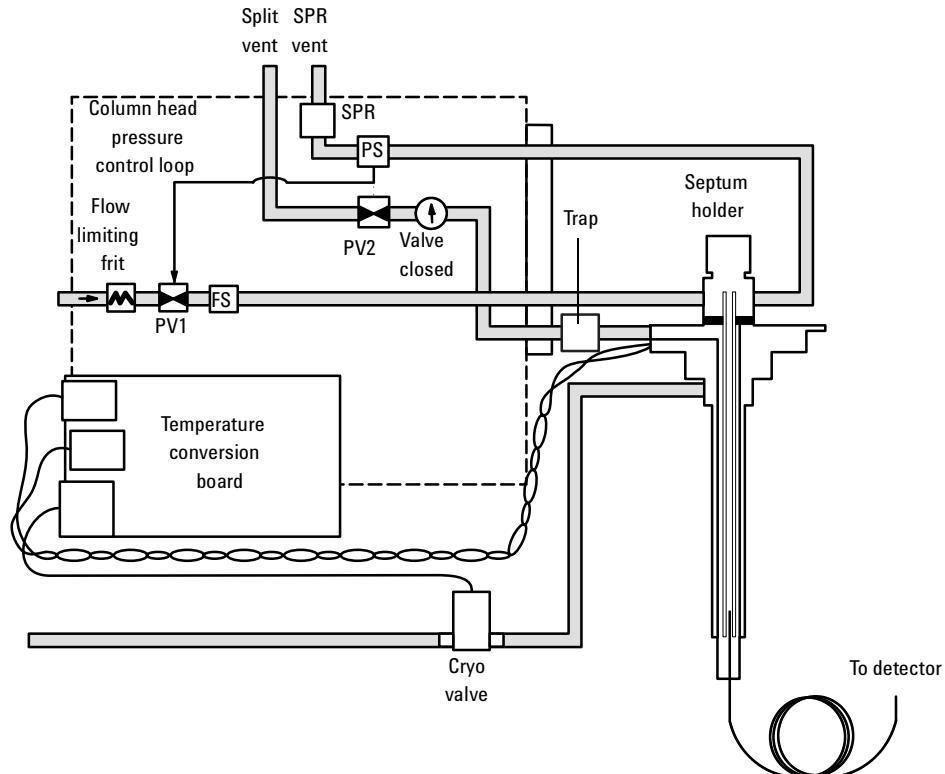


Figure 240-3 Splitless mode flow control diagram: sample injection

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.

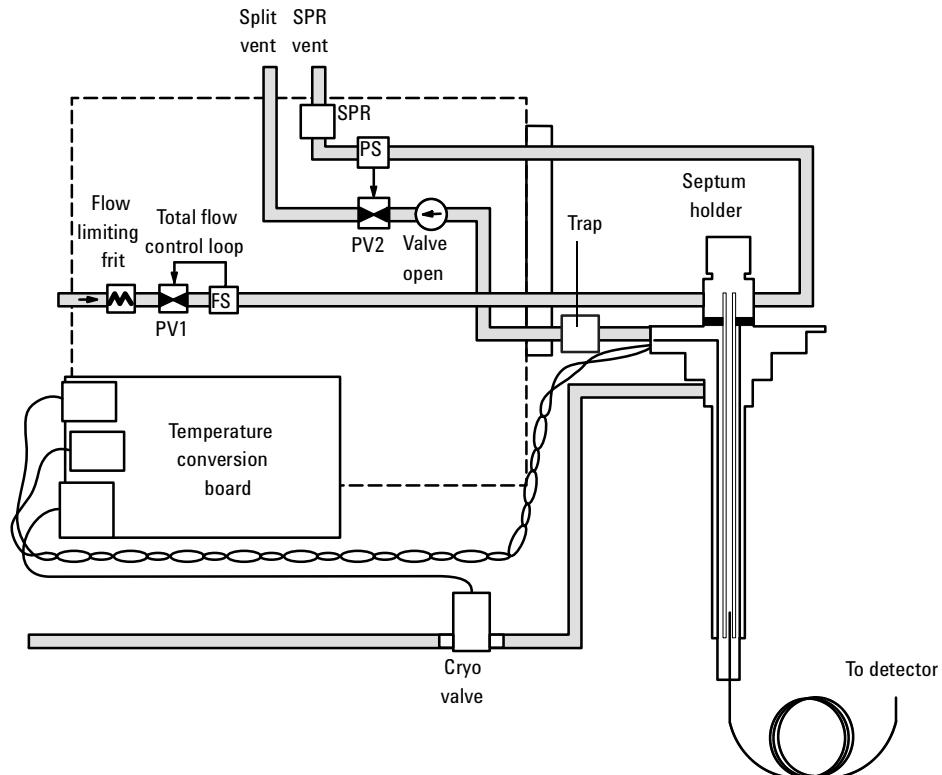


Figure 240-4 Solvent vent mode flow control diagram: sample and vent

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.

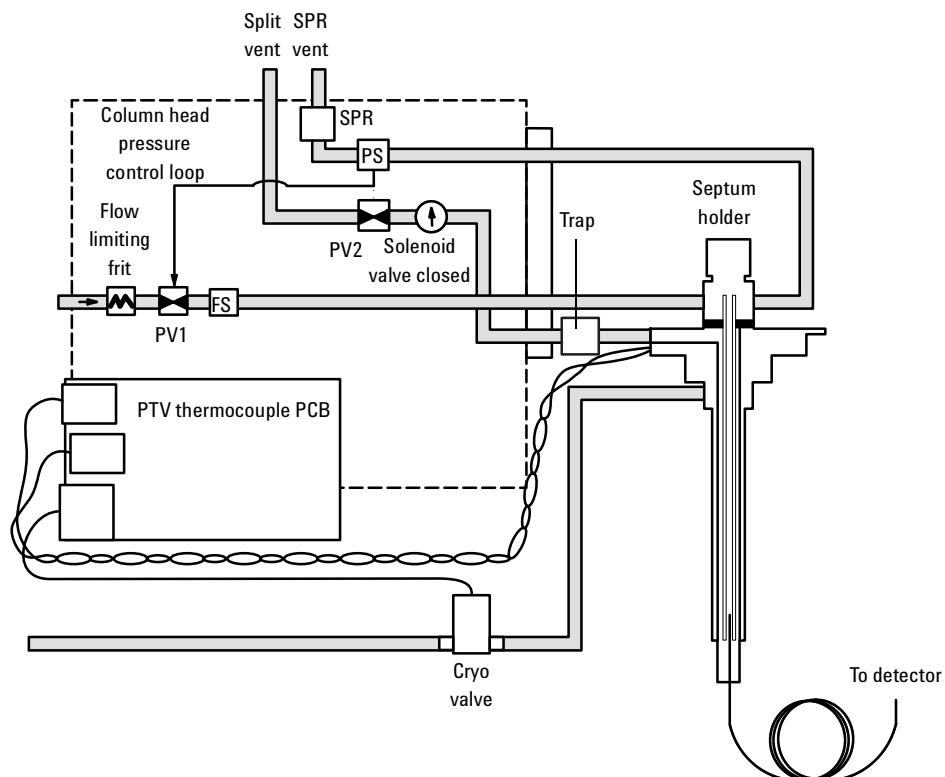


Figure 240-5 Solvent vent mode flow control diagram: sample transfer

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.

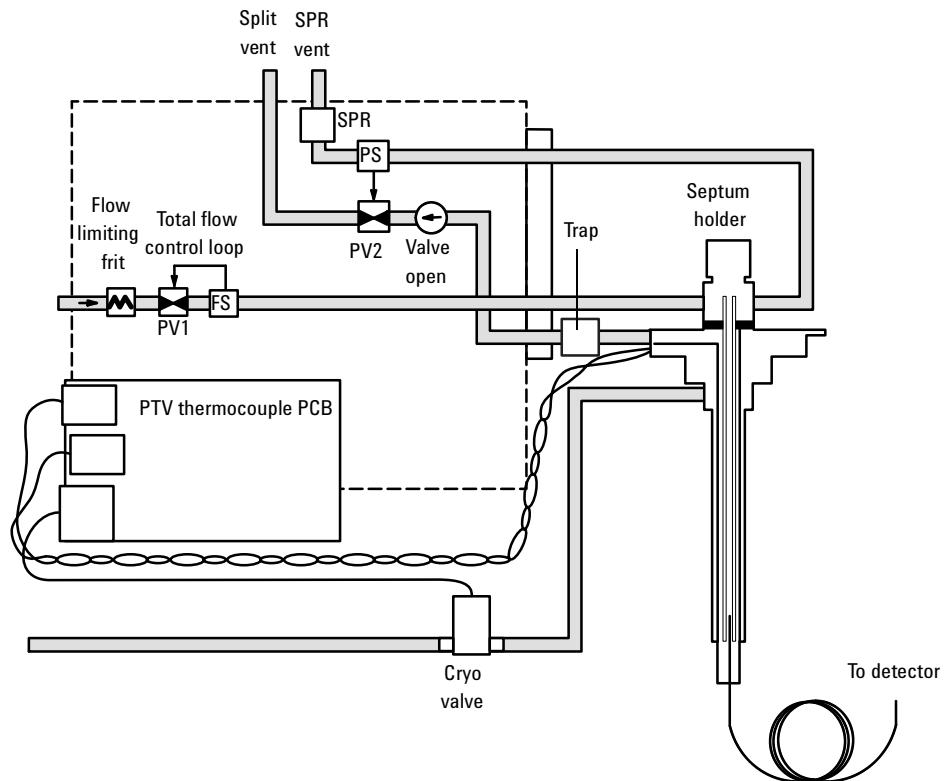


Figure 240-6 Solvent vent mode flow control diagram: purge and cleanup

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 (CO₂ 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.

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.

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.

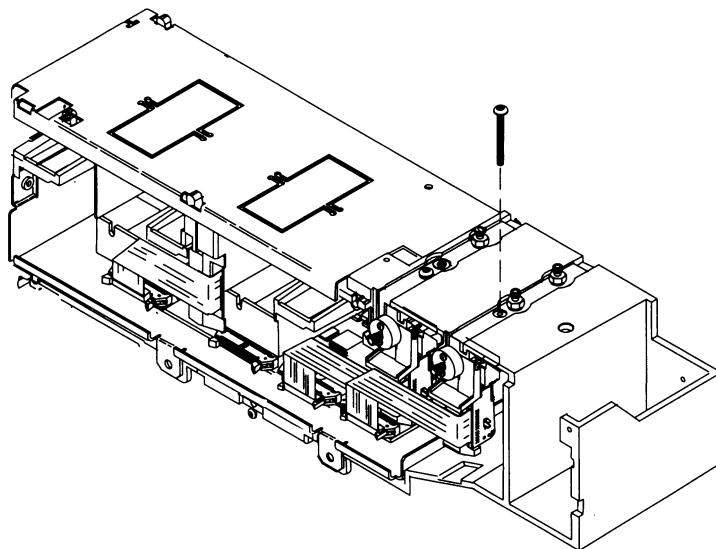


Figure 240-7 Removing the PTV manifold assembly

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.

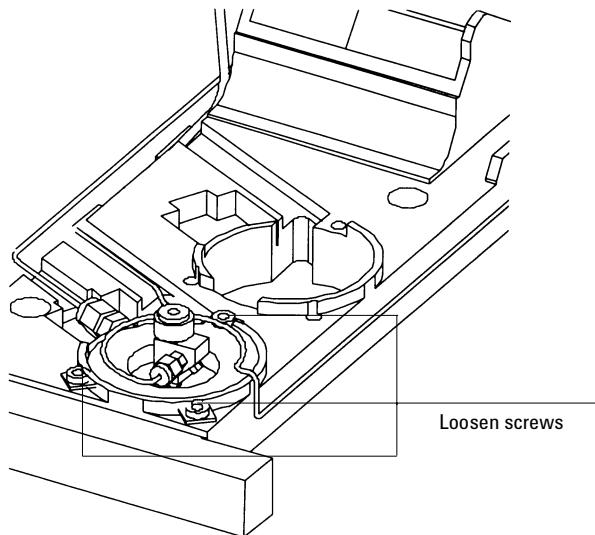


Figure 240-8 Removing the PTV inlet

6. Remove the heater connector from the side panel.

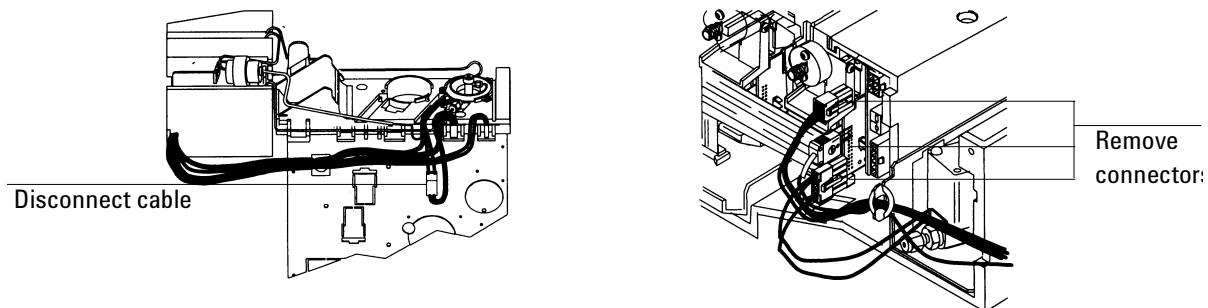


Figure 240-9 PTV electrical connectors

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.

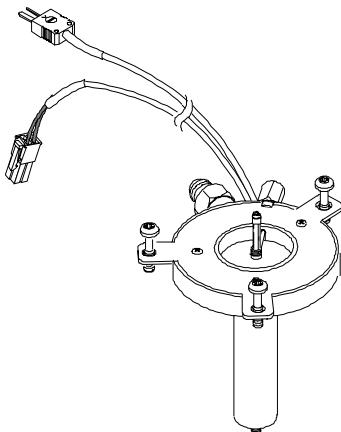


Figure 240-10 PTV with cooling assembly

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.

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.

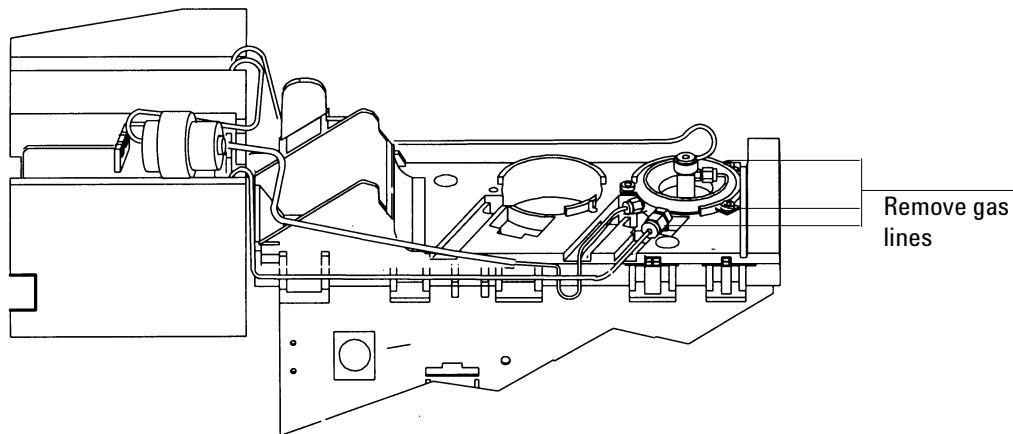


Figure 240-11 Removing the gas lines from the inlet

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.

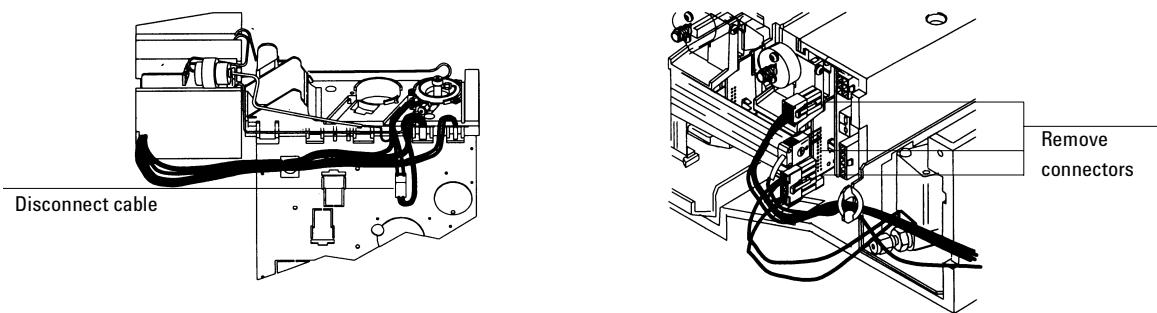


Figure 240-12 PTV electrical connections

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 $\frac{1}{4}$ turn more using **two** open end wrenches.
9. Check the system for leaks.

Replacing the CO₂ or LN₂ 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.

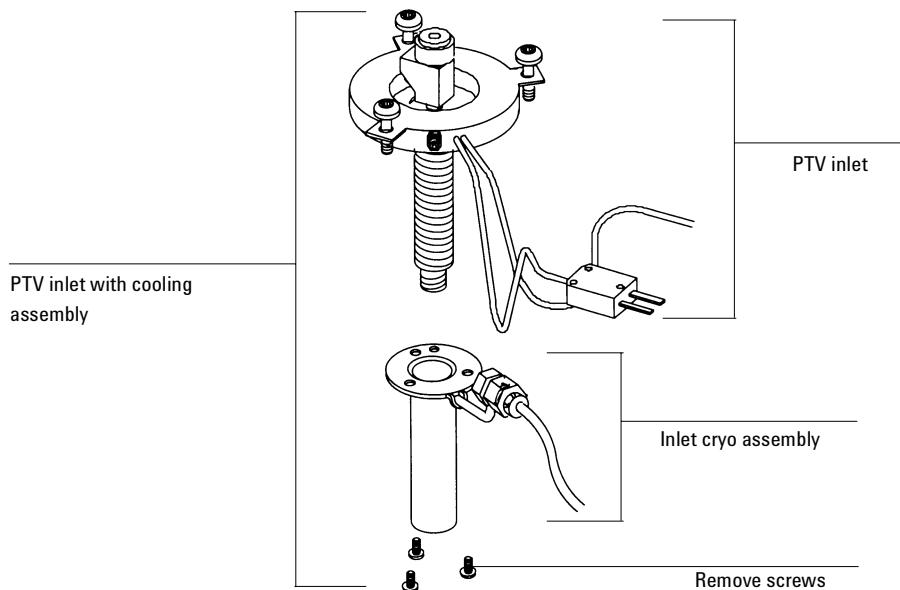


Figure 240-13 Removing the inlet cryo assembly

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.

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.

Caution Follow ESD precautions when performing this procedure.

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

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.

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.

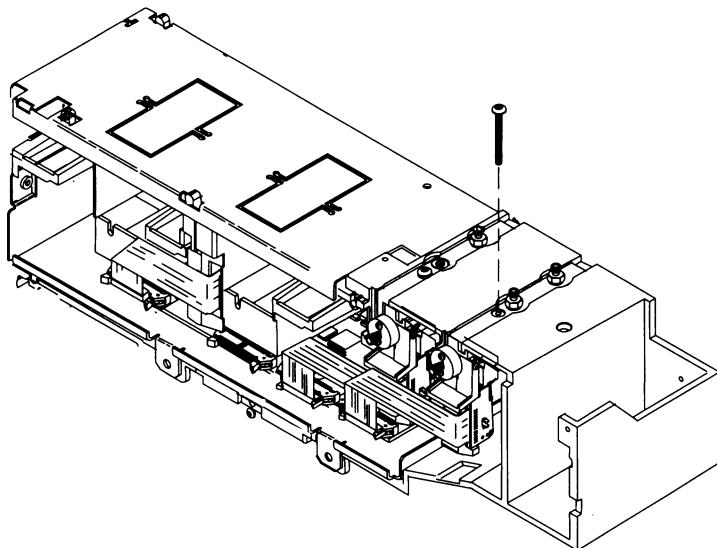


Figure 240-14 Removing the manifold mounting screw

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.

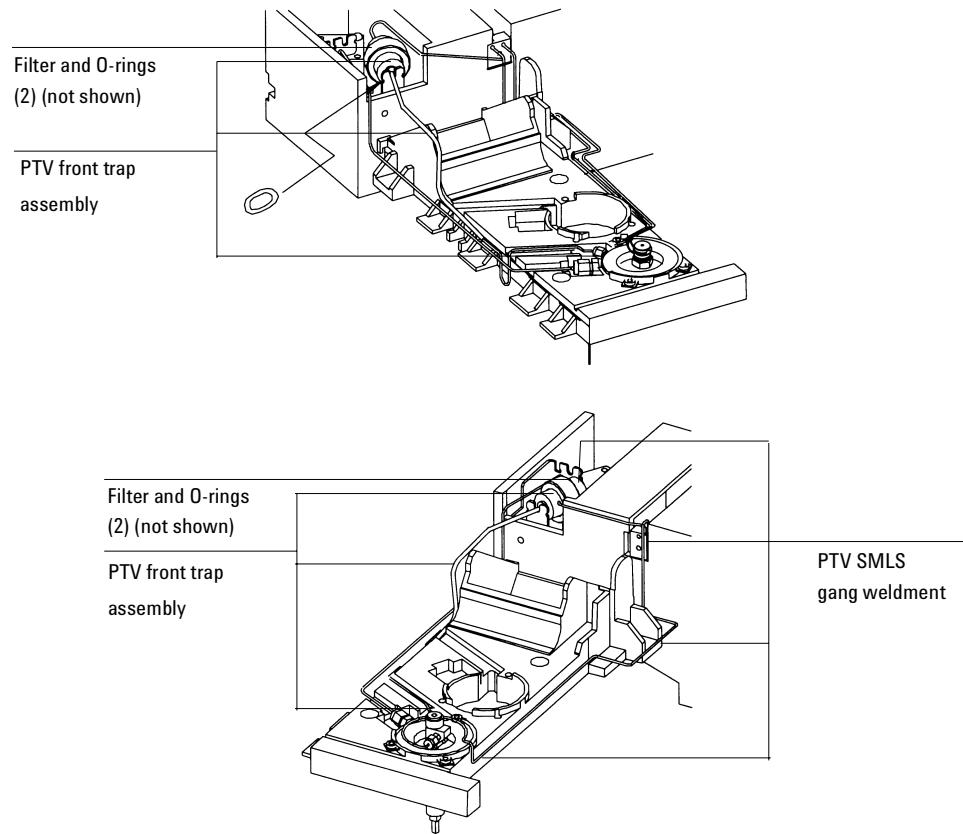


Figure 240-15 PTV plumbing assemblies

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 LCO₂ 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.

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.

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.

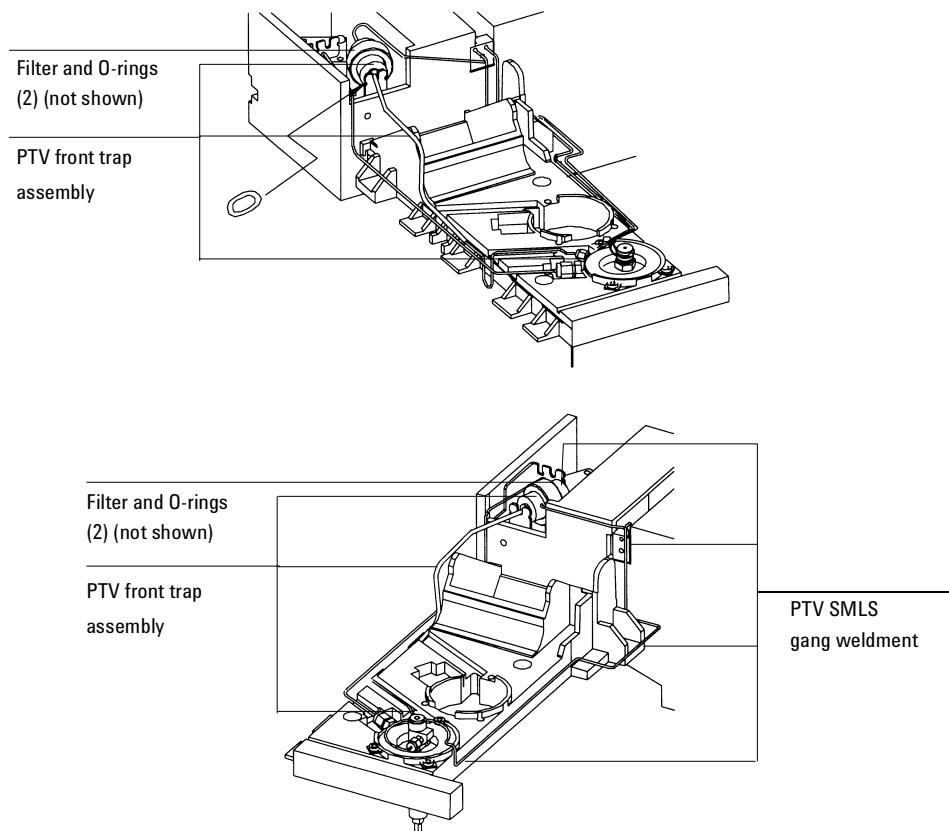


Figure 240-16 PTV plumbing assemblies (septumless head shown)

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.

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.

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

Caution Follow ESD precautions when performing this procedure.

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.

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.

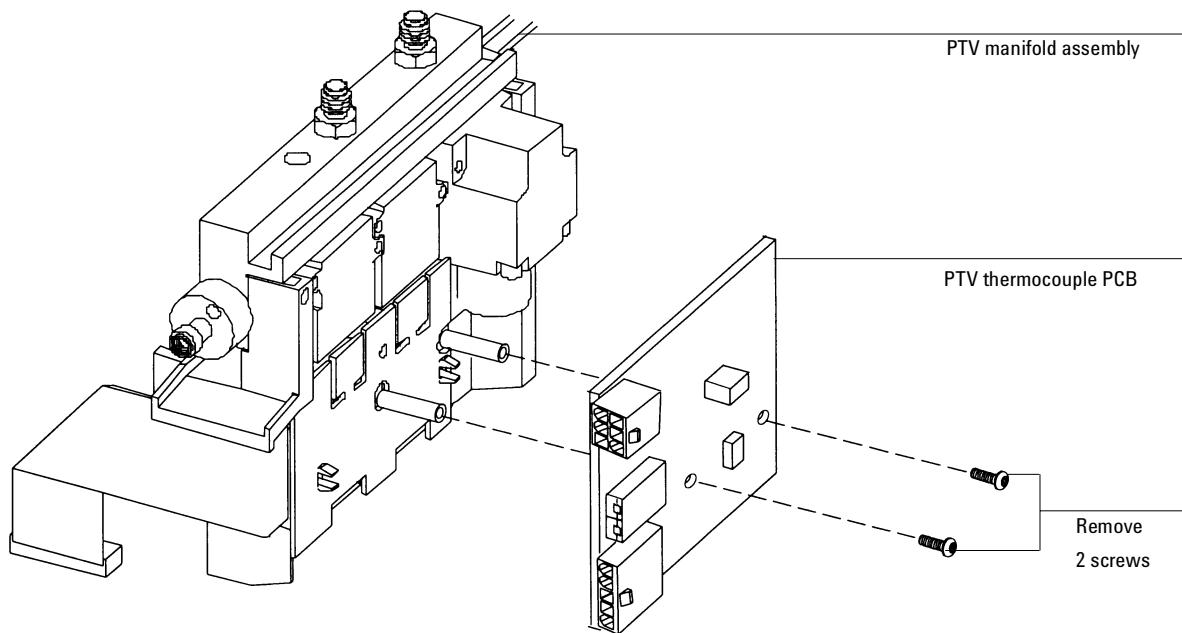


Figure 240-17 Replacing the PTV thermocouple PCB

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.

Column ID	Graphpack ferrule hole ID	Quantity	Part no.
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.

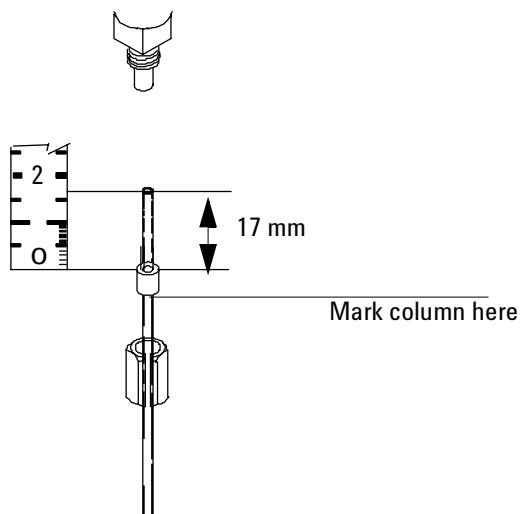


Figure 240-18 Column installation

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.

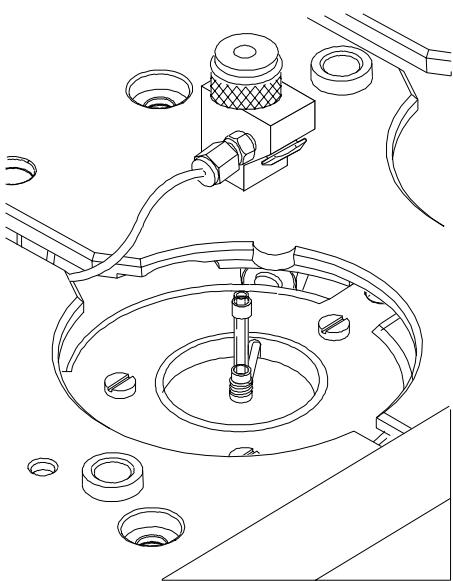


Figure 240-19 Removing the carrier gas line

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.

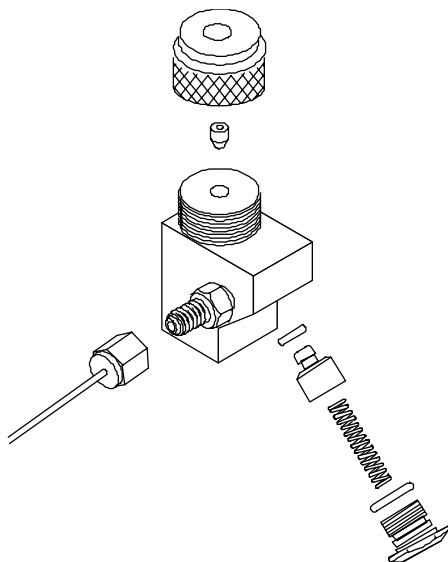


Figure 240-20 Disassembling the septumless head

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.

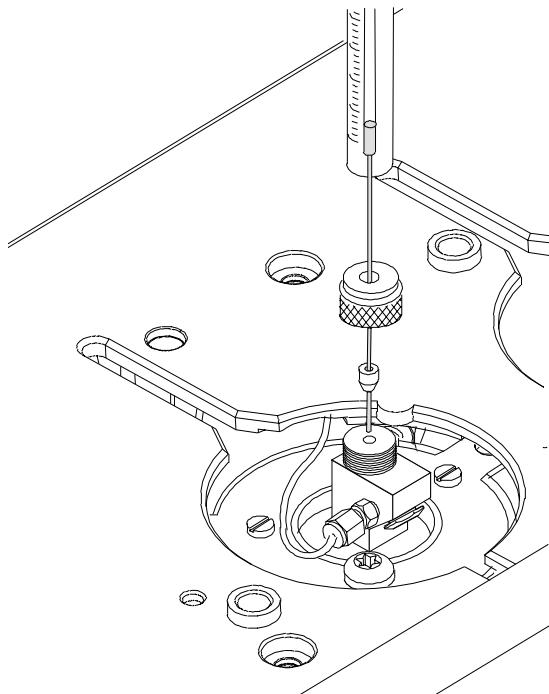


Figure 240-21 Installing a Teflon ferrule

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.

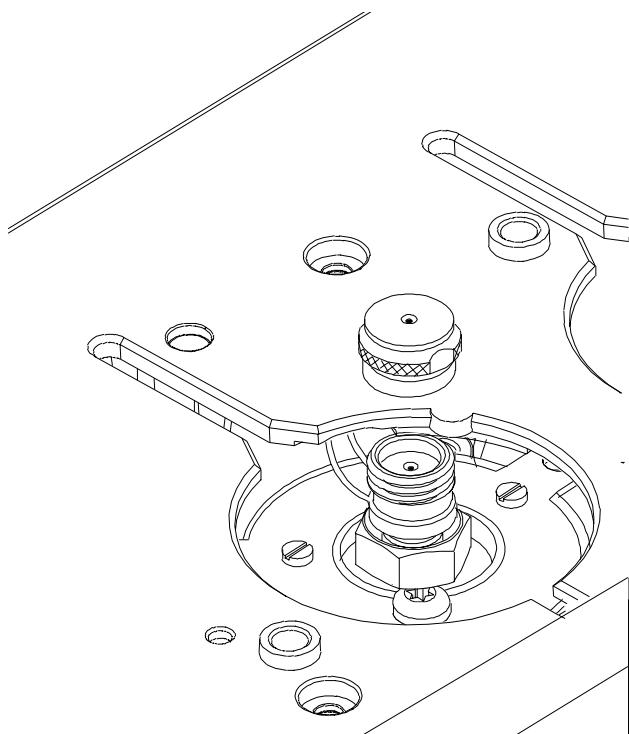


Figure 240-22 Removing the septum head

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.

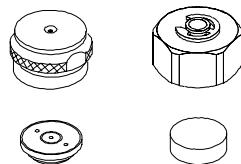


Figure 240-23 PTV septa

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.

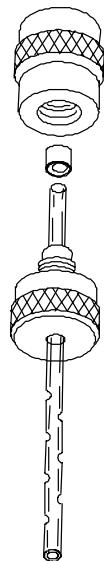


Figure 240-24 Installing the ferrule onto the new liner

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.

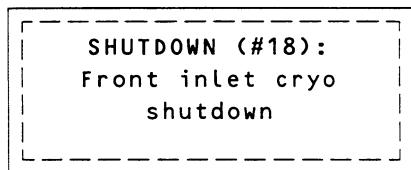
Diagnostics

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.

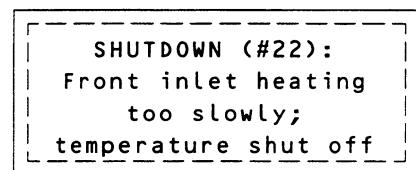
Cryo fault—Shuts down the inlet temperature if it does not reach setpoint in 16 minutes of continuous cryo operation. Note that this is the time to *reach* the setpoint, not the time to stabilize and become ready at the setpoint.

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:



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:



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.

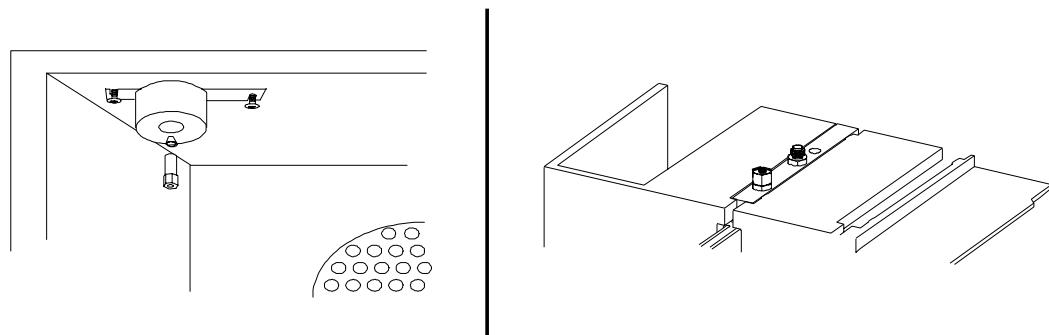


Figure 240-25 Capping the bottom of the inlet and septum purge vent

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

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.

-
- | | |
|----------------|---|
| 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.

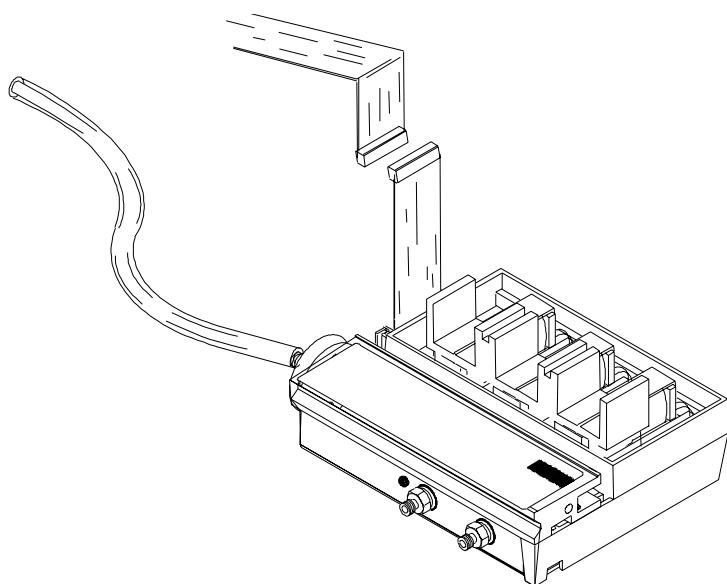


Figure 240-26 Leak testing the EPC module on the lab bench

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.

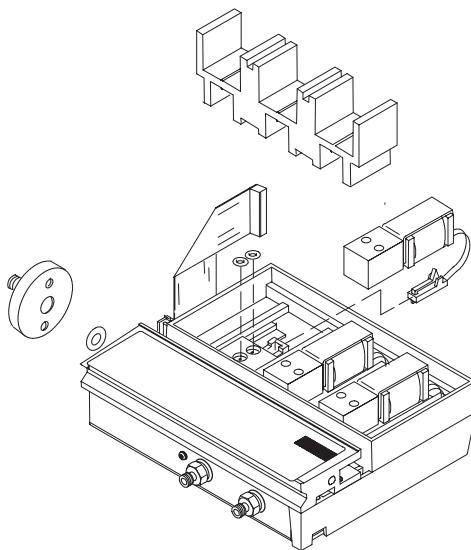


Figure 240-27 EPC module serviceable parts

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

Theory of operation

The volatiles interface (VI) introduces a gas sample into the gas chromatograph (GC) from an external device such as the headspace, purge and trap, or air toxics samplers. The interface has a small volume and is highly inert, thus ensuring high sensitivity and resolution for applications requiring trace level detection.

Total flow to the interface is measured by a flow sensor and is divided into two streams. One stream connects to the purge regulator; the other connects to a frit block. At the frit block, the flow is further divided. The first stream goes to the gas-phase sampler and from there is introduced into the interface. The second stream, called the pressure sensing line, passes through the frit block and is measured by a pressure sensor. This stream also provides a trickle flow to the interface.

There are three modes of operation available—split, splitless, and direct. The pneumatics vary for each operating mode and are discussed in more detail later in this chapter. The volatiles interface is not supplied with manual pressure control.

Split mode

When you introduce a sample in the split mode, a small amount of the sample enters the column while the major portion exits from the split vent. The ratio of split flow to column flow is controlled by the user. The split mode is primarily used for high concentration samples when you can afford to lose most of the sample out the split vent and for samples that cannot be diluted.

During Pre Run, during sampling, and after sampling, total flow to the interface is measured by a flow sensor and controlled by a proportional valve. Flow at the head of the column is back-pressure regulated. Pressure is sensed upstream from the proportional valve.

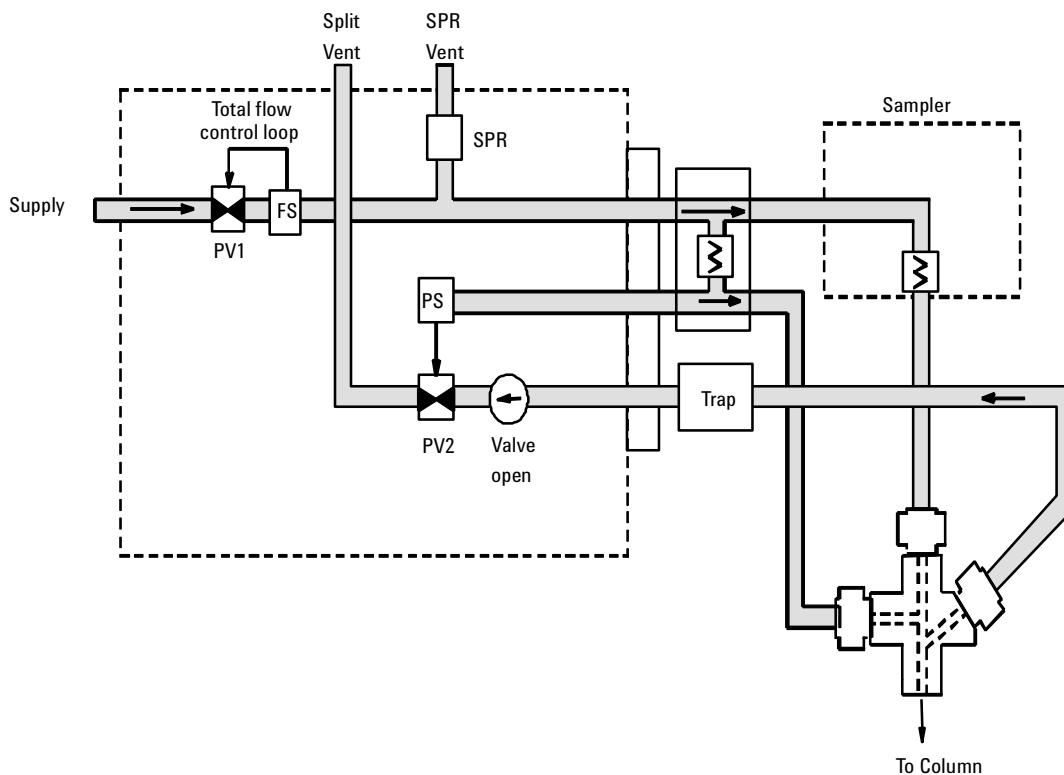


Figure 250-1 VI flow control diagram: split mode splitless mode (Idle or after sampling end)

Splitless mode

When you introduce a sample, the solenoid valve remains closed while the sample enters the interface and is transferred to the column. At a specified time after the sample is introduced, the solenoid valve opens.

Before Pre Run, when the GC is preparing for sample introduction, total flow to the interface is measured by a flow sensor and controlled by a proportional valve. Column flow is controlled via back-pressure regulation. See Figure 250-1.

During sampling, pressure upsets caused by switching valves in the external sampling device can cause fluctuations in column flow rates. To compensate for this, the interface is flow controlled during sampling time. The sampling flow rate is calculated from the pressure setpoint that is active when sample introduction begins. This flow control starts when the GC goes into the Pre Run state (when your system is automated and the Pre Run light is on or during manual operation when you press [Prep Run]) and ends after the interface's Sampling end setpoint expires.

During this user-specified sampling period, the solenoid valve is closed. Flow to the interface is measured by a flow sensor and controlled by a proportional valve. See Figure 250-2.

After sampling end, the solenoid valve opens. Flow to the interface is again measured by a flow sensor and controlled by a proportional valve while column flow is controlled via back-pressure regulation. The purge flow is controlled by the user. If desired, gas saver can be turned on at the end of the run. See Figure 250-1.

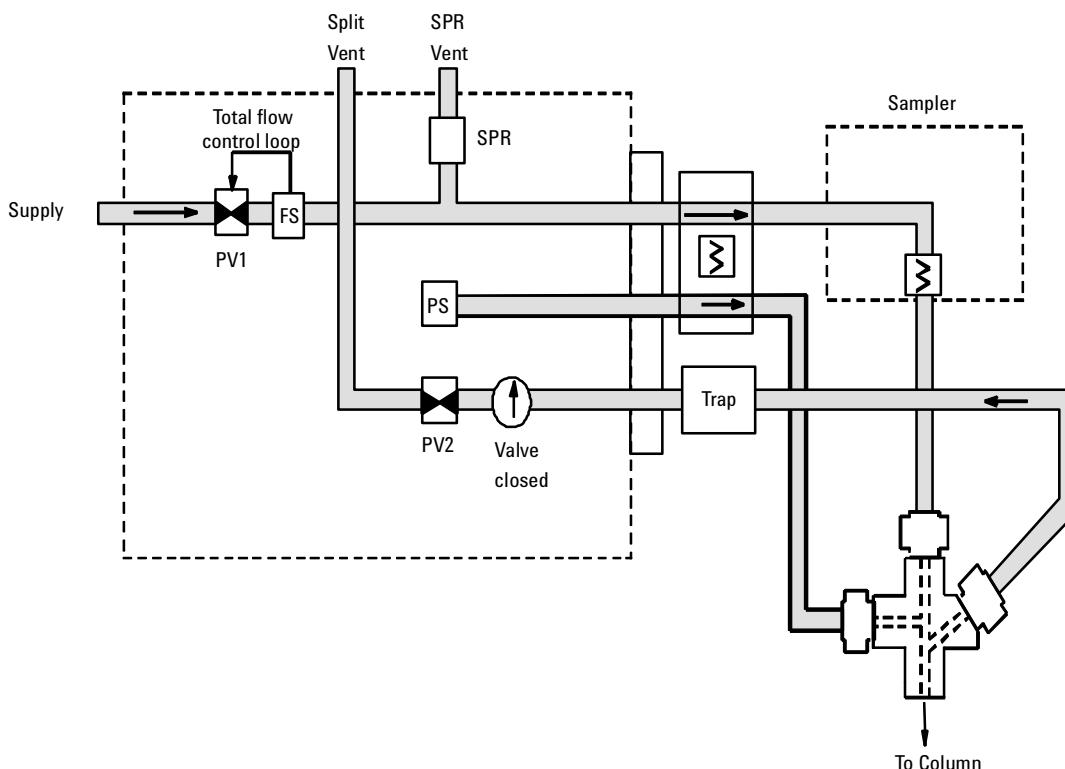


Figure 250-2 VI flow control diagram: splitless mode pneumatics (beginning of pre run to sampling end- sample introduction in progress)

Direct mode

Direct sample introduction permits a quantitative transfer of analyte without risking contamination to the pneumatic system. It provides the sensitivity required for air toxics analyses. The interface's minimal dead volume also eliminates the potential interaction of solutes with poorly swept, active surfaces.

In direct mode, the split vent is physically disconnected and the GC reconfigured.

Before Pre Run, the interface is forward pressure controlled; pressure is sensed downstream from the flow proportional valve. See Figure 250-4.

During sampling, pressure upsets caused by switching valves in the external sampler can cause fluctuations in column flow rates. To compensate for this, the interface is flow controlled during sampling time. The sampling flow rate is calculated from the pressure setpoint that is active when sample introduction begins. This flow control starts when the GC goes into the Pre Run state (when your system is automated and the Pre Run light is on or during manual operation when you press [Prep Run]) and ends after the interface's Sampling end setpoint expires.

Flow to the interface is measured by a flow sensor and controlled by a proportional valve. See Figure 250-3.

After sampling end, the interface is forward pressure controlled; pressure is sensed downstream from the proportional valve. See Figure 250-4.

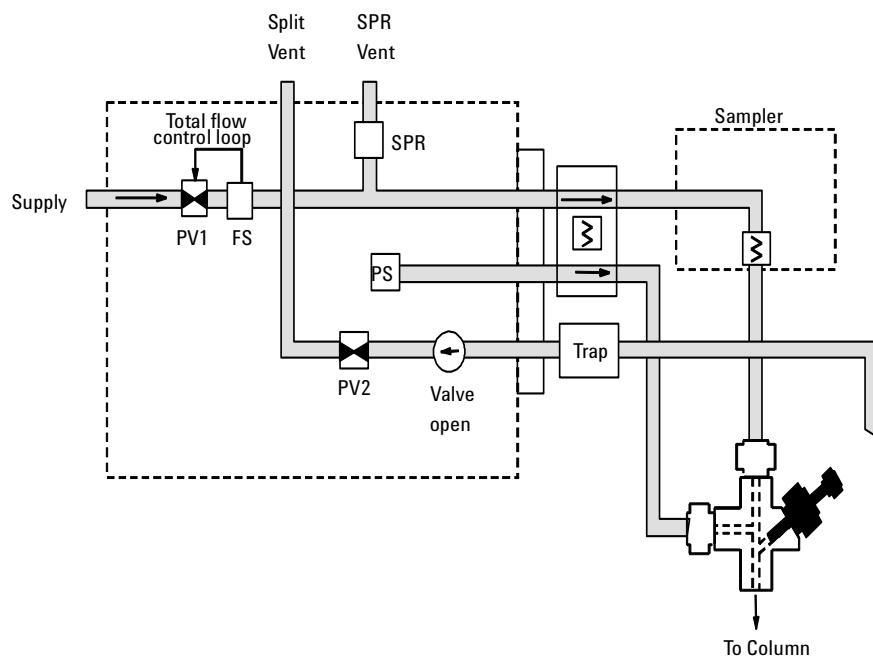


Figure 250-3 VI flow control diagram: direct mode (sample introduction)

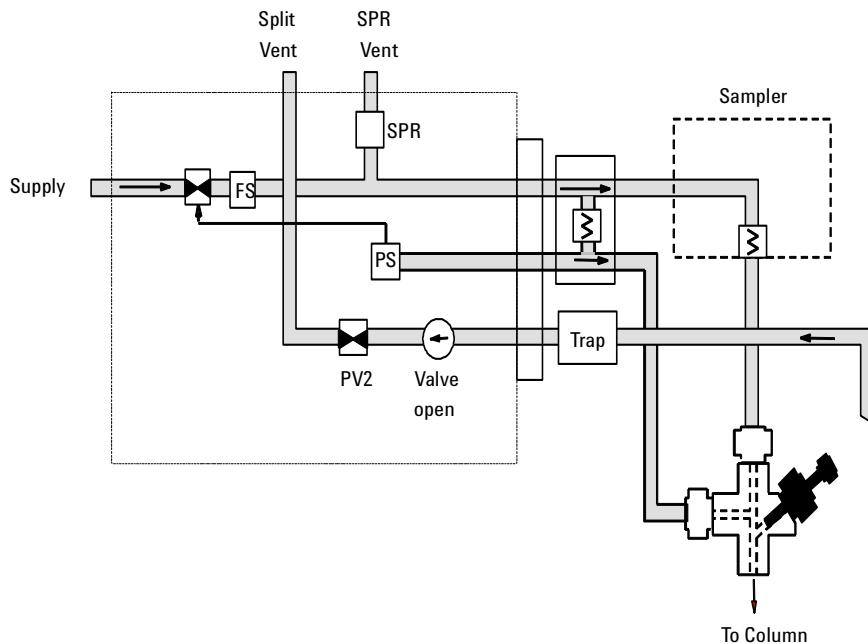


Figure 250-4 VI flow control diagram: direct mode (idle or after sampling end)

Gas saver

Gas saver mode may be used in split or splitless operation mode. Gas saver reduces the carrier gas flow from the split vent after the sample is on the column. Column head pressure and the column flow rate are maintained, while split vent flow decreases. Flows remain at the reduced level until the beginning of the next run.

Replacement procedures

Replacing or cleaning the interface

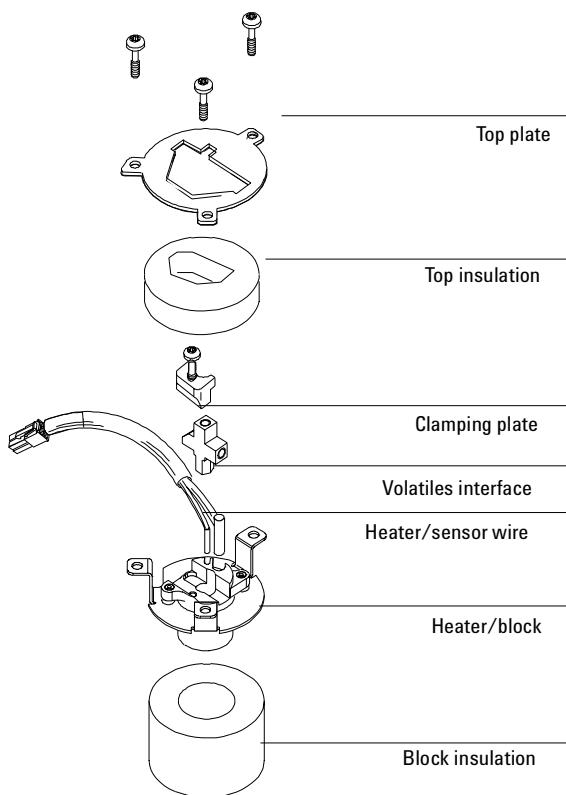


Figure 250-5 The volatiles interface

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.

1. Disconnect the transfer line. Loosen the nut with a 1/4-inch wrench and remove the line. Remove the clamping plate from the interface by loosening the captive screw with a T-20 Torx screwdriver. Put the plate in a safe place.

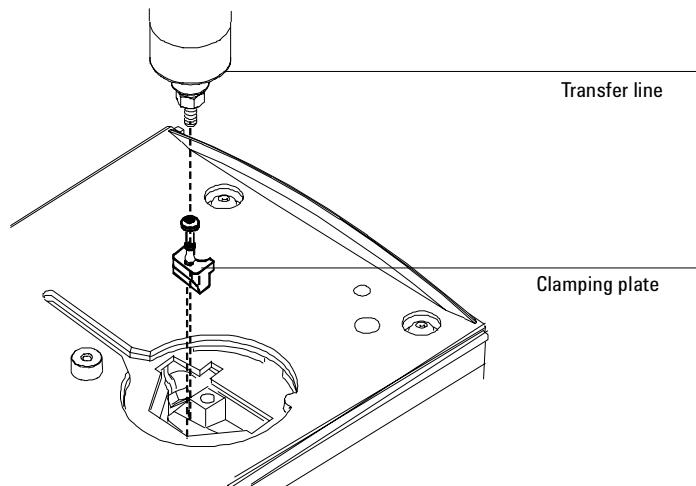


Figure 250-6 Removing the transfer line

2. Lift the interface out of the heater block.

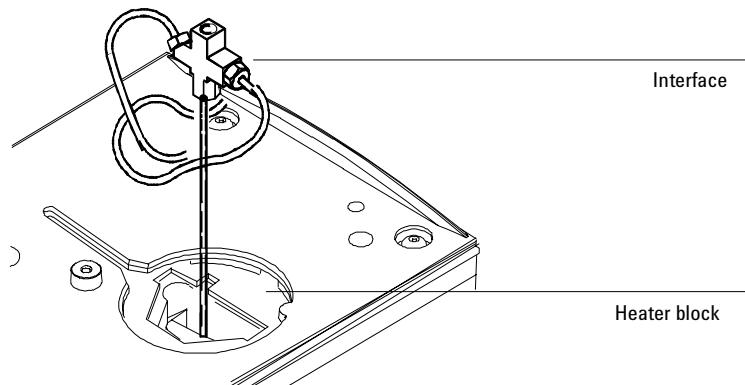


Figure 250-7 Removing the interface

3. If a column is installed, remove it.
4. Remove the split and pressure sensing lines by loosening the hex nuts with the wrench.
5. Clean or replace the interface. If cleaning the interface, sonicate it twice and then rinse.
6. Reinstall the split line and pressure sensing lines and finger tighten the hex nuts. Tighten the hex nuts an additional 1/4 turn with the wrench.
7. Reinstall the column in the interface.
8. Place the interface in the heater block. Replace the clamping plate and tighten the screw until snug. Do not overtighten.
9. Reinstall the transfer line. Finger tighten the nut and then tighten an additional 1/4 turn with the wrench.

Note

If the transfer line is from a G1900A Purge and Trap, install the transfer line support nut assembly up and inside the metal sleeve of the heated line assembly to prevent damage to the fused silica line.

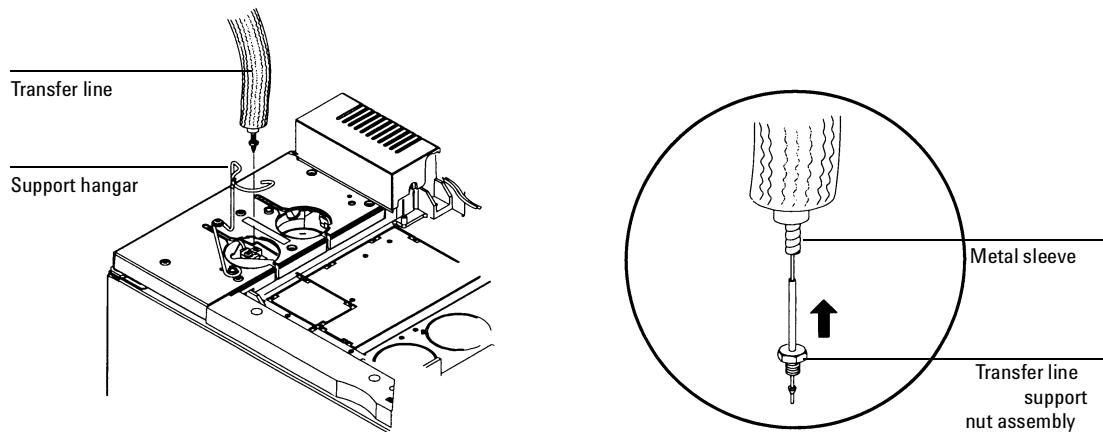


Figure 250-8 Installing the G1900A Purge and Trap transfer line

10. After the column is installed at both the interface and the detector, establish a flow of carrier gas through the interface and maintain it for 10 to 15 minutes. Check for leaks. Heat the interface to operating temperatures and retighten the fittings, if necessary.

Replacing the heater/sensor assembly

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.

1. Disconnect the transfer line. Loosen the nut with a 1/4-inch wrench and remove the line.

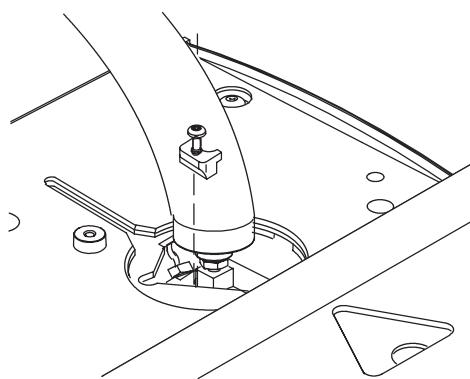


Figure 250-9 Removing the transfer line

2. Remove the heater/sensor wire connector from the GC connection.

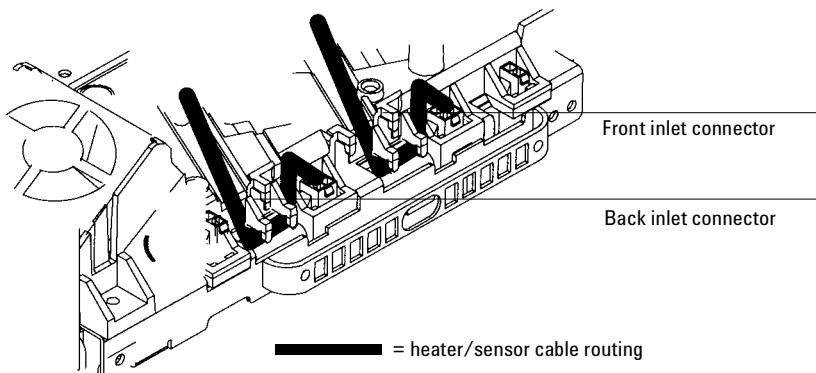


Figure 250-10 Heater/sensor cable routing

3. Remove the three screws in the top plate of the volatiles assembly which mount it in the GC using a T-20 torx screwdriver. Loosen each screw a little at a time.

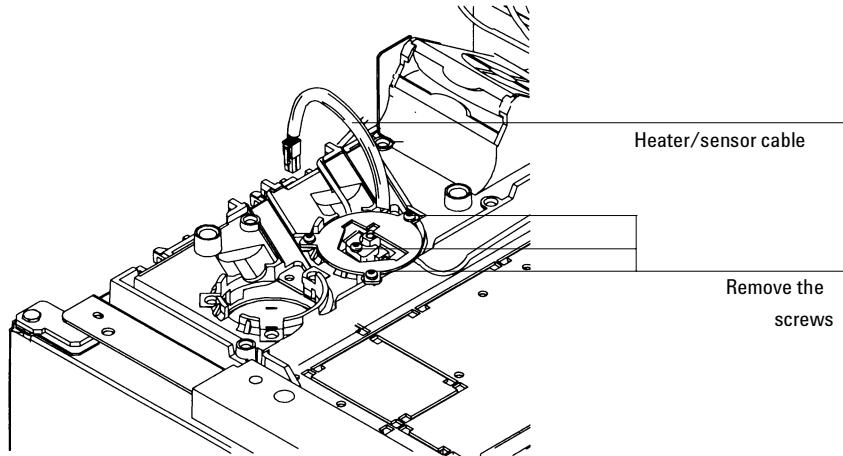


Figure 250-11 Removing the volatiles interface assembly.

4. Remove the top plate and the top insulation from the GC.
5. Remove the heater/sensor assembly and replace.
6. Reinstall the top insulation and the top plate. Align the volatiles interface with the mounting holes.
7. Reinstall the three Torx screws. Tighten each screw once with the T-20 Torx screwdriver until the interface is properly aligned. Tighten each screw again until snug.
8. Reinstall the heater/sensor wire connector in the GC. Route the wire as shown above.
9. Reinstall the transfer line using a 1/4-inch wrench and check for leaks.

Note If the transfer line is from a G1900A Purge and Trap, install the transfer line support nut assembly up and inside the metal sleeve of the heated line assembly to prevent damage to the fused silica line.

Replacing the EPC manifold

WARNING Hazardous voltages are present in the mainframe when the GC power cord is plugged in. Avoid a potentially dangerous shock hazard by unplugging the power cord before removing the side panels.

1. Turn off the GC and unplug the power cord. Allow time for all heated zones to cool and then turn off supply gases at their sources.
2. Unsnap and lift off the pneumatics top cover.
3. Remove the RFI cover. Remove the screw with a T-20 Torx screwdriver, slide the cover to the left until it disengages from the top rear panel, and remove it.
4. Remove the inlet cover plate from the front or back position by loosening the two screws with a T-20 Torx screwdriver and sliding the plate up and off.
5. Loosen the five screws in the top rear panel with a T-20 Torx screwdriver.
6. Grasp the panel at each end and gently lift it up and then away from the GC. Be careful not to disrupt the supply tubing. Do not retighten the screws.
7. Remove the detector cover. Lift the cover as shown and locate the hinge in the right, rear corner.
8. Remove the left side cover by loosening the two screws with a T-20 Torx screwdriver, sliding the cover to the rear of the GC, and lifting it up and off.
9. Remove the fan cover.

10. Loosen the screw on the right side of the fan cover. Slide the cover to the right to disengage it from the left mounting post. Lift the cover up and off.
11. Remove the injection port cover. Loosen the 6 captive screws with a T-20 Torx screwdriver until you are able to lift off the cover.
or
Remove the tray mounting bracket by removing three screws and loosening the three captive screws at the top of the bracket.

Caution Board components can be damaged by static electricity; use a properly grounded static control wrist strap when installing the flow module.

The gas lines from the flow module to the Volatiles Interface are assembled at the factory. Do not disconnect them.

12. From the back of GC, locate the pneumatics carrier.
13. If you are replacing a volatiles interface in the back position and there is an inlet in the front position, unplug the ribbon cable from the pneumatic control board. Unlock the connector by pushing the tabs away from the center.

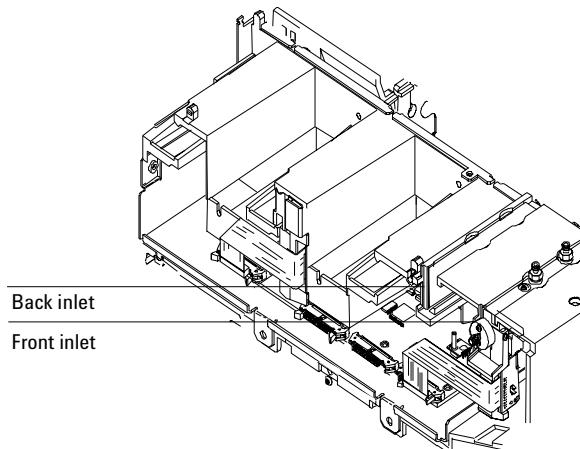


Figure 250-12 Pneumatics carrier

14. Remove the screw at the top of the module as shown using a T-20 Torx screw driver.

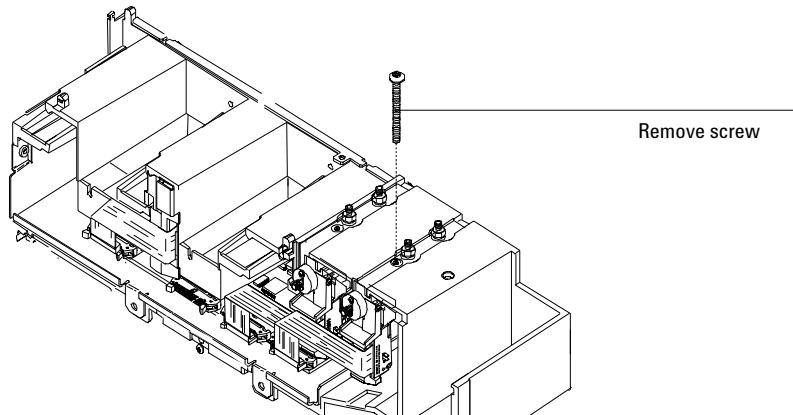


Figure 250-13 Removing the EPC inlet mounting screw.

15. Unlock the folded ribbon cable and remove from the connector.

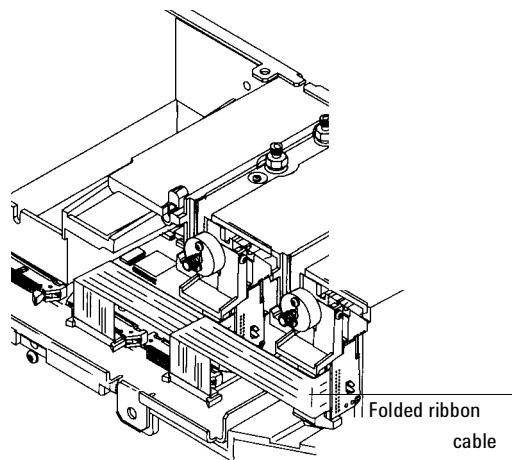


Figure 250-14 The ribbon cable

16. Slide the flow module out of the carrier. Guide the gas lines through the slot in the front of the carrier.

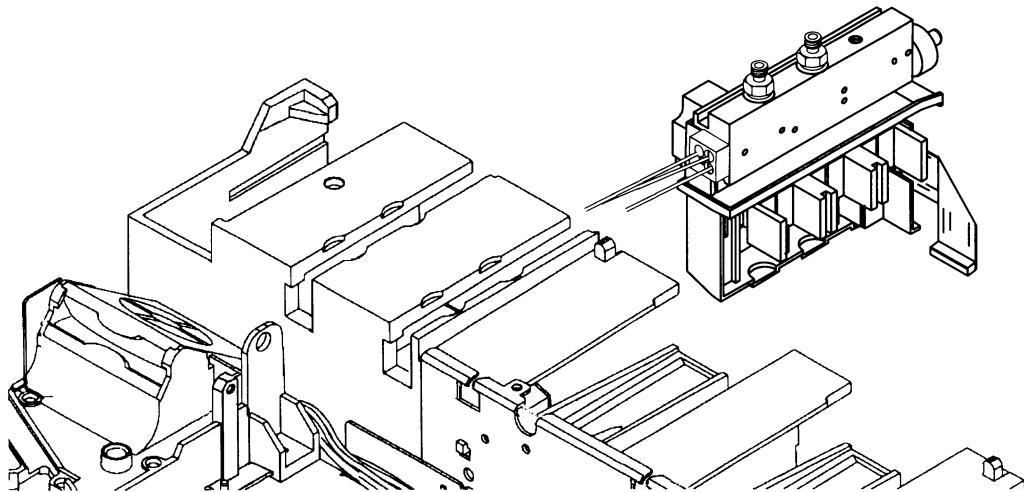


Figure 250-15 Replacing the EPC flow module.

17. Replace the EPC flow module.
18. Reassemble in reverse order. Remember to fold the module ribbon cable and reconnect the ribbon cable from the front inlet, if applicable.

Calibrating your interface

Your interface's flow module contains a pressure sensor that must be zeroed after it is installed on your GC. This calibration procedure ensures an accurate interface pressure display.

Do not connect the carrier gas to your flow module until you have zeroed your interface's pressure sensor.

1. Plug in your GC and turn it on, if you haven't already done so.
2. Wait 15 minutes. This allows your GC to reach thermal equilibrium.
3. Zero the interface's pressure sensor:
 - a. Press [Options], scroll to Calibration and press [Enter].
 - b. Scroll to Front inlet or Back inlet and press [Enter].
 - c. Scroll to Pressure Zero.
 - d. Press [On] to zero the pressure sensor.
4. Turn off your GC.
5. Plumb the carrier gas to your flow module. If you need help with this step, see the 6890 GC Site Preparation and Installation Manual/CD-ROM.
6. Turn on the GC.
7. Configure your GC's column and carrier gas. See the 6890 Series Operating Manual/CD-ROM for details.

Replacing the filter

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.

1. Remove the pneumatics top cover.
2. Unscrew the knurled trap nut on the filter assembly.
3. Remove and replace the filter inside the housing.
4. Reassemble in reverse order.

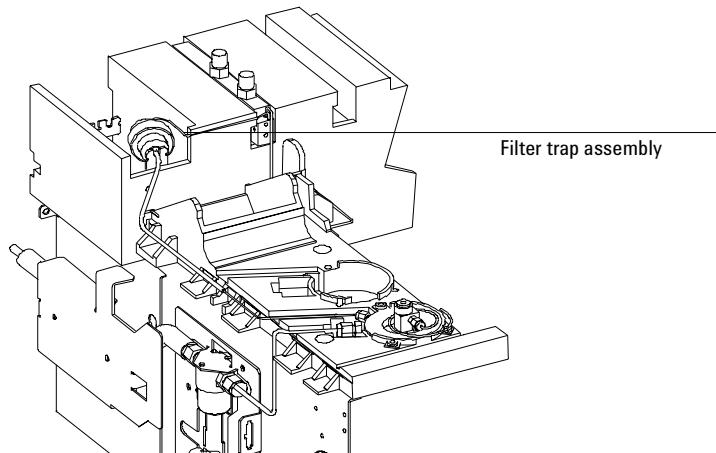


Figure 250-16 Filter trap assembly

Replacing or cleaning restrictors

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.

1. Remove the detector cover, the inlet fan cover, and the pneumatics top cover.

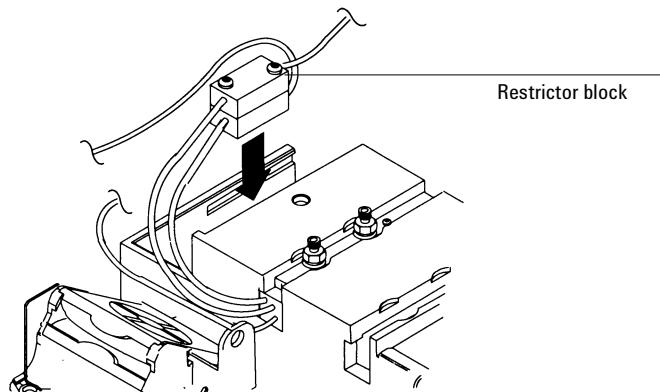


Figure 250-17 Replacing the restrictor in the restrictor block

2. Remove the Torx screws in the restrictor block and remove the restrictor.
3. Clean and/or replace. Inspect the O-rings. Replace if necessary.
4. Leak check the assembly. See Leak testing the volatiles interface.

Replacing the gang fitting

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.

1. Remove the detector cover, the inlet fan cover, and the pneumatics top cover.
2. Disconnect the transfer line. Loosen the nut with a 1/4-inch wrench and remove the line.
3. Remove the plumbing from the gang fitting to the volatiles interface at the interface.
4. Disconnect the plumbing from the gang fitting to the filter trap at the trap.
5. Remove the plumbing block from the EPC manifold.
6. Replace the gang fitting and reassemble in reverse order.
7. Leak check the assembly. See Leak testing the volatiles interface.

Leak testing the volatiles interface

Perform a leak test after breaking the pneumatic seal in the system (for example, after replacing a restrictor or removing a gas line) and when isolating a performance problem where a leak is suspected.

When checking for leaks after maintenance, check only the parts of the assembly which have been unsealed and reassembled. When checking for leaks to improve system performance, first check the plumbing, then check the volatiles interface.

Use an electronic leak detector capable of detecting the gas being used. Liquid leak detectors are not recommended, especially in areas where cleanliness is very important. If using leak detection fluid, immediately rinse the fluid off to remove the soapy film.

WARNING To avoid a potential shock hazard when using liquid detection fluid, be careful not to spill leak solution on electrical leads, especially the detector heater leads.

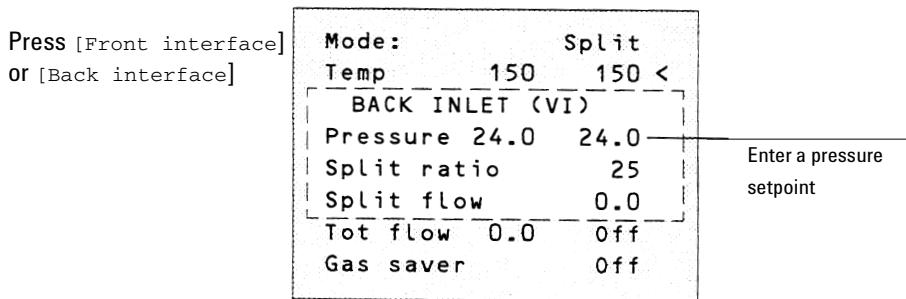
Leak checking

WARNING Be careful! The oven and interface may be hot enough to cause burns.

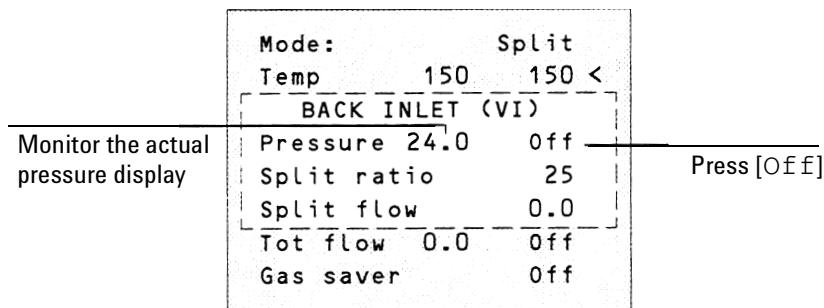
Materials needed:

- Electronic leak detector capable of detecting the gas type or leak detection fluid.
- No-hole ferrule
- 7/16-inch wrench
- Two 1/8-inch SWAGELOK caps
- Gloves (if the interface is hot)
- 1/4-inch or 7 mm wrench

1. Use the leak detector to check the plumbing lines for leaks. Check each fitting, including the gang fitting and the filter trap assembly. If a leak is found, correct it and check the performance of the GC. If the problem is not solved, continue with the leak test.
2. Cool the oven to room temperature and then turn it off.
3. When the oven is cool, turn off the interface pressure from the keyboard.
4. Remove the column, if one is installed, and plug the column fitting with the column nut and a no-hole ferrule.
5. Cap the septum purge and split vent fittings located on the flow module with 1/8-inch Swagelok caps.
6. Enter a pressure setpoint between 20 and 25 psi, or enter the normal operating pressure if it is greater. Make sure that the pressure at the initial gas supply is at least 10 psi higher than the interface pressure. Wait a few minutes for the pressure to equilibrate.



7. Turn the pressure off from the inlet control table. Because the septum purge, split vent, and column fittings are capped, gas should be trapped in the system and the pressure should remain fairly constant. If desired, turn the pressure off at the source to isolate the pneumatic system completely.



Because the pneumatics have been turned off, the alarm does not sound even though there is no flow through the column.

8. Continue to monitor pressure for 10 to 15 minutes. The pressure should drop approximately 1 psi during the first 1 to 2 minutes. After an initial pressure drop of about 1 psi, the pressure should not drop more than 0.03 psi/min.

If the pressure drop is 0.03 psi/min or less, consider the interface-gas sampler system leak-free.

If the pressure drops faster than the acceptable rate, check the interface and sampler systems separately to determine the source of the leak. See Preparing the interface for a leak test to create a closed flow system, then return to this section and complete steps 5 to 7 again.

If you find a leak in the interface, refer to Correcting leaks in this section.

If the interface is leak-free, pressure check the sampling device. See the operating manual for your sampler for instructions.

Preparing the interface for a leak test

To leak check the interface independently of the gas sampling device, you must disconnect the sampler from the interface to isolate the interface flow system from the sampler.

WARNING Be careful! The oven and interface may be hot enough to cause burns.

1. Disconnect the transfer line from the interface.
2. Disconnect the carrier line from the sampler.
3. Prepare the end of the carrier line using the 1/16-inch male GC nut and a graphite/Vespel ferrule.
4. Connect the carrier line to the interface where you removed the transfer line and tighten the nut finger tight and then tighten 1/4 to 1/2 turn with the 1/4-inch wrench.
5. Return to “Leak checking” in this section and repeat steps 5 to 7.

Leak testing the EPC 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.

-
- | | |
|----------------|---|
| 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.

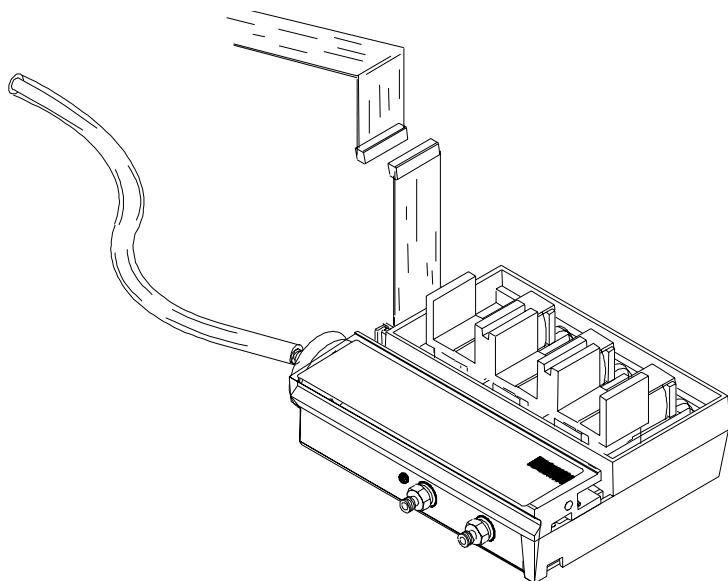


Figure 250-18 Leak testing the EPC module on the lab bench

8. If the leaky component is serviceable, such as a vent/inlet fitting (see diagram of serviceable parts, Figure 250-19), replace it. Otherwise, replace the EPC module.

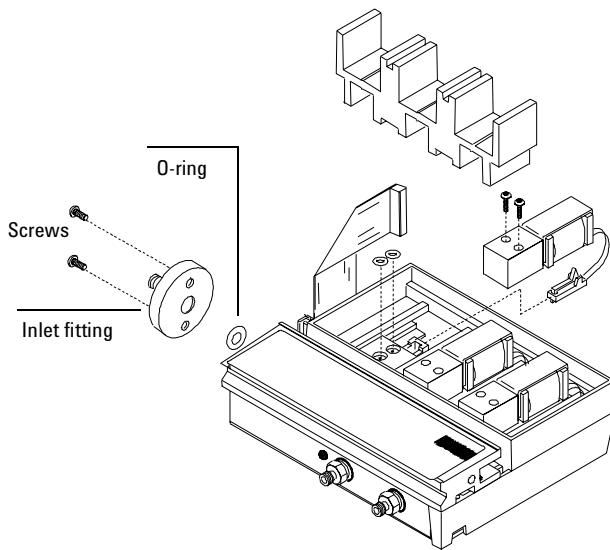


Figure 250-19 EPC module serviceable parts

Correcting leaks

1. Use the electronic leak detector to check all areas of the interface that are potential sources of a leak.
2. Tighten any connections which are leaking and re-test.

Note

Overtightened Vespel ferrules can sometimes get stuck in the interface. If stuck, try to remove the ferrule carefully to avoid damaging the sealing surfaces. Otherwise, replace the interface.

3. If the pressure drop is now 0.03 psi/min or less, you can consider the interface system leak-free.
If the interface still leaks, continue to check for and correct leaks.
4. If the interface still leaks and cannot be fixed, depressurize the system.

Disconnect the plumbing at the leaking seal on the interface and examine the sealing surfaces. Replace the interface if the surface is damaged or otherwise unable to maintain a good seal. Reassemble and test for leaks.

Potential leak areas

Check the following areas when checking for leaks in the volatiles interface system.

- The capped purge vent
- The capped split vent
- The plugged column connection
- The sealing surfaces where the gas lines are plumbed to the interface
- Three O-rings behind the block where the pneumatic lines enter the EPC module
- Two O-rings for each valve in the EPC module

260 Solvent Vapor Exit Accessory

Theory of operation

The Solvent Vapor Exit (SVE) is a GC accessory for performing large volume injections with a Cool On-Column inlet (COC). At the start of the run, the SVE solenoid valve is open as the large volume sample is injected into the cool on-column inlet and moves into the retention gap. The precolumn separates most of the solvent from the analytes and vents it through the open valve. At a time specified by the user to optimize the analysis, the valve closes, the oven temperature program begins, and the retained solvent and analytes move onto the analytical column for separation.

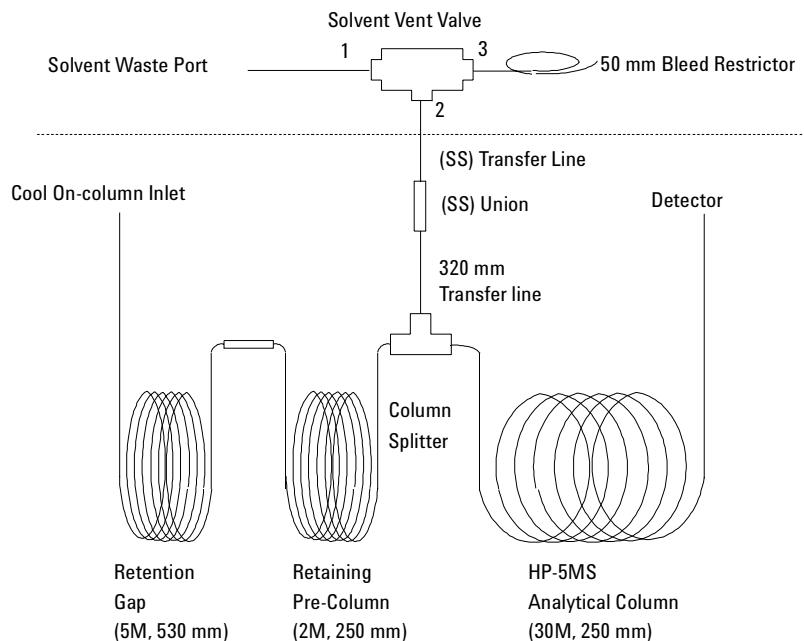


Figure 260-1 Solvent vapor exit accessory flow diagram

Replacement procedures

Replacing the valve/fitting assembly

WARNING Hazardous voltages are present in the mainframe when the GC power cord is plugged in. Avoid a potentially dangerous shock hazard by unplugging the power cord before removing the side panels.

Caution Prevent electrostatic voltages from damaging the GC by using precautions such as an ESD wriststrap.

1. Turn off the GC and unplug the power cord. Allow time for all heated zones to cool and then turn off supply gases at their sources.
2. Remove the top cover, the pneumatics cover, the electronics carrier cover, and the right side cover.
3. Remove the bleed restrictor column and the solvent vent waste line from the valve fitting assembly.

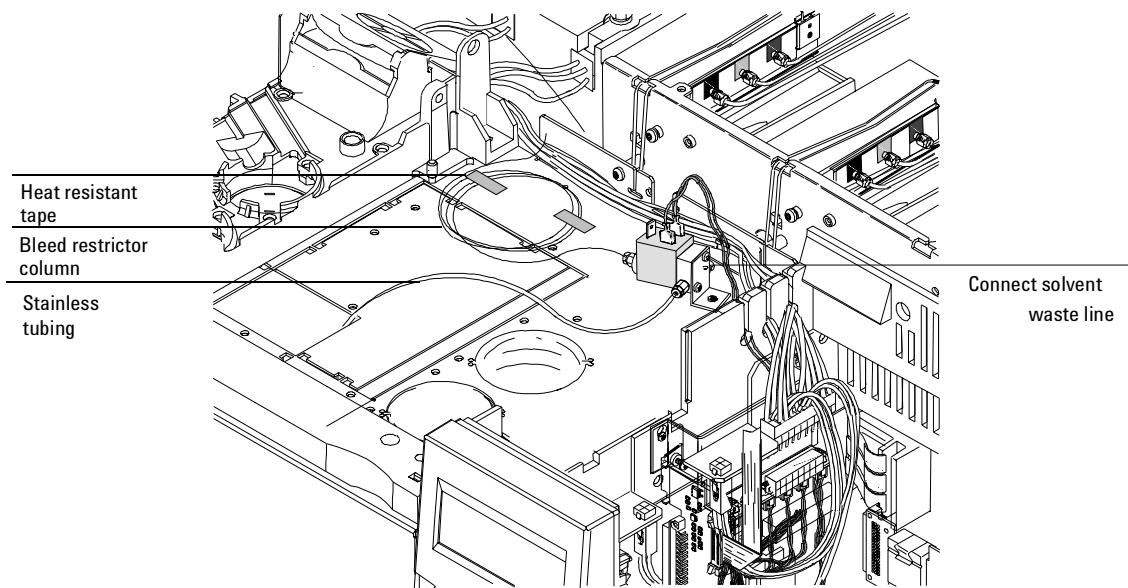


Figure 260-2 Removing the valve/fitting assembly (shown with valve driver bracket installed)

4. Inside the oven, disconnect the 320 μm transfer line from the stainless union on the 1/16-inch stainless steel tubing. Carefully remove the tubing from the oven through the cutout in the top of the oven.
5. Disconnect the valve driver cable from the valve jumper cable or valve driver assembly, as applicable.
6. Remove the mounting screw in the valve/fitting assembly and remove the assembly from the GC.

7. Replace the valve/fitting assembly and mount it to the GC oven with the screw. Cover the open end of the union to avoid contamination and route the 1/16-inch stainless steel tubing and union into the oven. Repack the insulation around the tabling. Connect the valve driver cable to the valve jumper cable or valve driver assembly, as applicable.
8. Use a new graphite/Vespel ferrule to reconnect the 320 μm transfer line to the union.
9. Examine the bleed restrictor column. If the column is damaged, replace it with a new 0.5 m length of 50 m column, installing a new fitting and ferrule. Be sure to trim 5 to 10 mm off the end of the new column after installing the new fitting and ferrule.
10. Reattach the solvent waste vent line.

WARNING Because a significant amount of solvent is vented through the SVE valve assembly, it is important that the bleed restrictor and the solvent vent are connected to an appropriate laboratory ventilation system.

11. Check for leaks.

Replacing the bleed restrictor column

1. Turn off the GC and unplug the power cord. Allow time for all heated zones to cool and then turn off supply gases at their sources.
2. Remove the top cover and the right side cover. If necessary, also remove the pneumatics cover and the electronics carrier cover.
3. Using a wrench, remove the old bleed restrictor column.
4. Cut a 0.5 m section off of the new 50 μm bleed column for use as the restrictor.
5. Attach a male fitting and ferrule to the restrictor column, then trim 5 to 10 mm from that end of the column.
6. Connect the 0.5 m 50 μm bleed restrictor to the SVE valve.

7. Make a loop (or loops) in the excess column protruding from the valve and move it to an unobstructive position.
 - Coil it in a loose coil (approximately 6 inch diameter).
 - Secure the coil with heat resistant tape or equivalent.

Replacing the tri-column assembly

1. Cool the inlet and detector.
2. Turn inlet and detector gases off.
3. Disconnect the Tri-column assembly from the COC inlet, detector and (SS) union and remove the column assembly from the GC oven.
4. Install the new SVE Tri-column assembly onto a column hanger and hang the assembly inside the GC oven. Position the column assembly so that the end of the retention gap (530 μm) is located under the COC inlet and the end of the analytical column (250 μm) is under the detector.
5. Connect the retention gap to the COC inlet using a graphite ferrule and a column nut.
6. If using a MSD, connect the analytical column (HP-5MS) to the MSD using a column nut (part no. 05988-20066) and a graphite/Vespel ferrule (part no. 5062-3508). If using any other type of detector, connect the analytical column (HP-5MS) to the GC detector using a column nut (part no. 5181-8830) and a graphite/Vespel ferrule (part no. 5062-9527).
7. Remove the stainless ferrules from the union. Use a graphite/Vespel ferrule to connect the 0.5 m \times 320 mm transfer line from the quartz Y-splitter of the Tri-column assembly to the unused end of the stainless union located inside the GC oven.
8. Check all of the connections for leaks using an electronic leak detector.

Replacing the pre-column assembly

1. Cool the inlet and detector.
2. Turn inlet and detector gases off.
3. Disconnect the Tri-column assembly from the COC inlet, the detector and the (SS) union and remove the column assembly from the GC oven.
4. Using a column cutter, cut the transfer column and the analytical columns as close to the quartz Y-splitter as possible. Be sure to cut the columns straight.
5. Using the column cutter, trim the ends of the tri-column assembly ensuring that the cuts are straight. Then use a lint free wipe and methanol to clean any dirt and finger prints from approximately three to four centimeters from each of the five column ends.
6. Being careful not to touch the ends of the columns, insert them into the quartz splitter as far as possible, making sure that the column ends are making contact with the inside walls of the splitter. Sufficient pressure should be applied to give a good seal. Too much pressure, on the other hand, can damage the polyimide layer or even the column and result in leakage. Test to see that the column has been installed correctly by trying to pull the column out of the splitter using medium force. If the column comes out easily, trim the end and insert again.

Note

A concentric circle inside the splitter should result if the column is installed correctly.

7. After connecting the column ends into the quartz splitter, reconnect the tri-column assembly inside the GC oven and increase the column head pressure incrementally to the desired pressure. An incremental increase is better than immediately applying the total column head pressure to avoid a “shock” that can loosen the connection.

Leak testing

When checking the solvent vapor exit assembly for leaks, first check the tri-column assembly. If the tri-column assembly is not leaking, check the valve/fitting assembly (which includes the stainless steel union, tubing, and fitting on the solenoid).

Potential leak points

- Tri-column assembly
- Quartz column connector
- Quartz Y splitter
- Connection to the inlet
- Valve/fitting assembly
- Solenoid valve
- S/S union
- Inlet fitting on the valve/fitting assembly

Note that there are no replacement parts on the valve/fitting assembly. If the valve fails or the fitting cannot be tightened, replace the assembly.

Leak testing the tri-column assembly

Tools Required

The following tools (not supplied in the SVE Kit) are required to perform the leak check procedure of the tri-column assembly.

- 1/16-inch (SS) union (part no. 0100-0124)
- Vespel/graphite ferrules:
 - For 250 µm column (part no. 5062-3508)
 - For 320 µm column (part no. 5062-3506)
- 1/8-inch Swagelok nut (part no. 5180-4103)
- 1/8-inch solid (no hole) vespel ferrule (part no. 0100-1372) or 1/8-inch Swagelok cap
- Electronic leak detector (optional)

1. Replace the septum of the Cool On-column inlet.
2. Using a 1/16-inch (SS) union and the appropriate graphite/Vespel ferrules, connect the detector end (250 µm) of the tri-column assembly and the transfer line (320 µm) together.
3. From the 6890 GC keyboard, set the inlet pressure to 50 psi and wait approximately 15 seconds for equilibration.

Note If pressure can not be reached, either a very large leak is present or the supply pressure is not high enough (at least 10 psi greater than desired pressure).

4. Cap the septum purge vent of the Cool On-column flow module using a solid (no-hole) 1/8-inch Vespel ferrule (part no. 0100-1372) and a 1/8-inch Swagelok nut (part no. 5180-4103). As an alternative a 1/8-inch Swagelok cap can be used.
5. From the GC keyboard, turn the inlet pressure “OFF”.
6. Note the “Actual” reading on the display and monitor for 10 minutes. You can use the stopwatch feature of the 6890 GC to monitor the time by pressing [Time] and then [Enter] to start timing.
7. If there is less than 1.5 psi pressure loss, consider the system to be leak tight.
8. If pressure loss is much greater than 1.5 psi, there is a leak that must be found and corrected.

Leak testing the SVE assembly

1. Cool the oven and inlet.
2. With only the carrier gas flowing through the GC and column, close the SVE solenoid valve.
3. Use an electronic leak detector to check for leaks. Detection fluid may be used on the valve assembly, but be sure to avoid contaminating the oven or electrical connections. Clean up any fluid after use.
4. If a leak is found at a connection, tighten the fitting or replace the seals. If there is a leak through the valve, replace the valve/fitting assembly.

Theory of operation

The PCM provides one channel of flow or pressure control, replacing the standard electronic flow control module (ECM) for that channel. It does not need to be connected to any particular type of inlet.

The PCM can control gas flows and pressures for a number of applications including:

- Non-Agilent standard inlets. For example, the SIMDIS application which uses a proprietary PTV inlet by one of Agilent's channel partners.
- Any valve application where no inlet is required. For example, the PCM can provide flow or pressure to a column connected to a gas sampling valve. Other valving applications may involve providing auxiliary gas flow; especially when using packed columns.
- Sample preparation devices such as the Headspace Sampler and the Purge and Trap, which often require a controlled source of purge gas.
- Catalyst tubes or other conversion devices, which often require a controlled source of makeup or reagent gas. The nickel catalyst tube is an example of such a device.

Replacement procedures

Replacing the PCM

WARNING Hazardous voltages are present in the mainframe when the GC power cord is plugged in. Avoid a potentially dangerous shock hazard by unplugging the power cord before removing the side panels.

Caution Prevent electrostatic voltages from damaging the GC by using precautions such as an ESD wrist strap.

1. Turn off the GC and unplug the power cord. Allow time for all heated zones to cool and then turn off supply gases at their sources.
2. Remove the gas supply line to the manifold.
3. Remove the injector, tray, and bracket (if present).
4. Remove the top cover, the pneumatics top cover, the RFI cover, the inlet fan cover, the inlet cover (or tray mounting bracket, as applicable), the left side panel, and the top rear panel.

Caution Board components can be damaged by static electricity; use a properly grounded static control wrist strap when installing the flow module.

5. Remove the PCM ribbon cable from the pneumatics control board. If the PCM is in the back position and there is an inlet in the front position, also unplug the front inlet's ribbon cable from the pneumatic control board.

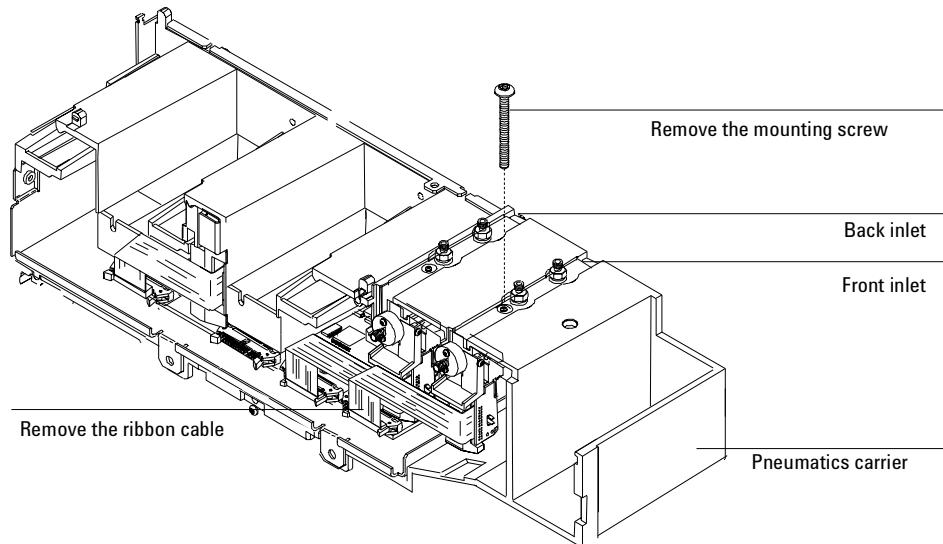


Figure 270-1 Removing the ribbon cable and mounting screw

6. Remove the screw at the top of the module as shown using a T-20 Torx screw driver.
7. Remove the gang fitting on the front of the manifold. Check the O-rings in the plumbing block for damage and replace them if necessary.
8. Slide the PCM out of the carrier.

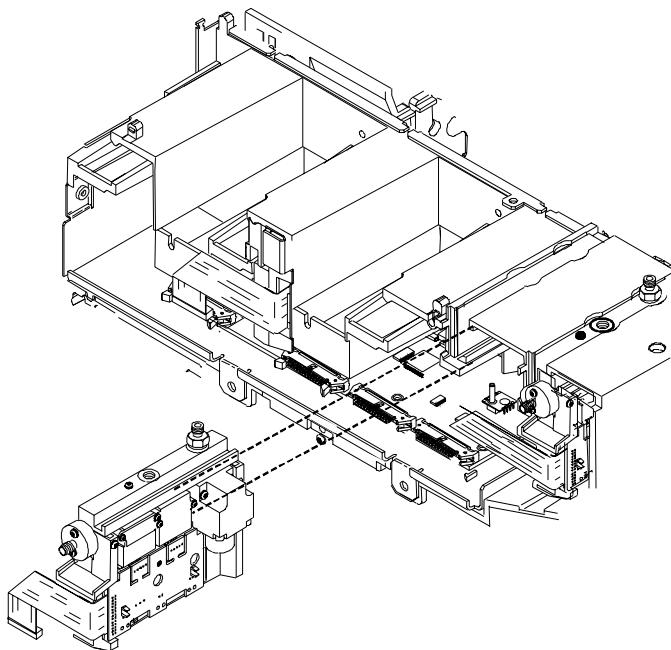


Figure 270-2 Removing the PCM

9. Install the replacement PCM. Remember to fold the module ribbon cable and reconnect the ribbon cable from the front inlet, if applicable.
10. Reinstall the pneumatics block gang fitting onto the flow module.
11. Calibrate the interface as described in Calibrating the PCM interface below.

Replacing the PCM gang weldment

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

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.

2. Remove the detector cover, the pneumatics cover, the inlet fan cover, the inlet cover (or tray mounting bracket), and the left side cover.
3. Starting at the PCM, trace each line of the gang weldment from the pneumatics block to the end connector. Disconnect each line.
4. Remove the screw in the plumbing block and remove the gang weldment from the PCM.
5. Replace the gang weldment and O-rings. Reassemble in reverse order.
6. Check for leaks.

Calibrating the PCM interface

The interface's flow module contains a pressure sensor that must be zeroed after it is installed on the GC. Calibration ensures an accurate interface pressure display.

Do not connect the carrier gas to the flow module until you have zeroed the interface's pressure sensor.

1. If the gas supply is connected to the GC, turn off the supply at the source, then disconnect the supply line from the PCM inlet fitting.
2. Turn on the GC and wait 15 minutes to allow it to reach thermal equilibrium.
3. When the GC has reached thermal equilibrium, press [Options], scroll to Calibration and press [Enter].
4. Scroll to Front inlet or Back inlet and press [Enter].
5. Scroll to Pressure Zero.
6. Press [On] to zero the pressure sensor.
7. Turn off the GC.
8. Plumb the carrier gas to the flow module.
9. Turn on the GC.

10. If you were calibrating the flow sensor after replacing the PCM, check for leaks.

Leak testing the PCM

Use an electronic leak detector capable of detecting the gas being used. Liquid leak detectors are not recommended, especially in areas where cleanliness is very important. If using leak detection fluid, immediately rinse the fluid off to remove the soapy film.

WARNING To avoid a potential shock hazard when using liquid detection fluid, be careful not to spill leak solution on electrical leads, especially the detector heater leads.

WARNING Be careful! The oven and interface may be hot enough to cause burns.

Occasionally, to locate small leaks, you will need to isolate the PCM module from the inlet weldment and leak test the PCM 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 PCM. Remove the plumbing block from the PCM, 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 PCM 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 and septum purge line to function normally as if an inlet were present.

4. Perform the normal leak test 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 (approximately 0.1 psi/minute) is considered to be leak free.

5. If there is a leak, remove the PCM from the GC and isolate the leak as described in Locating leaks on the flow manifold.
6. If there is an *increase* in pressure, see Forward pressure valve leaks.

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 PCM 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 PCM appears to have a leak, 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 PCM on the benchtop for testing.

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 panel on the GC.

4. Disconnect the ribbon cable for the module from the pneumatics board. You may also have to remove the adjacent ribbon cable.
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 PCM and connect the other end to the appropriate connector on the pneumatics 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 PCM on the lab bench and use an electronic leak detector to locate the leaky component on the module.

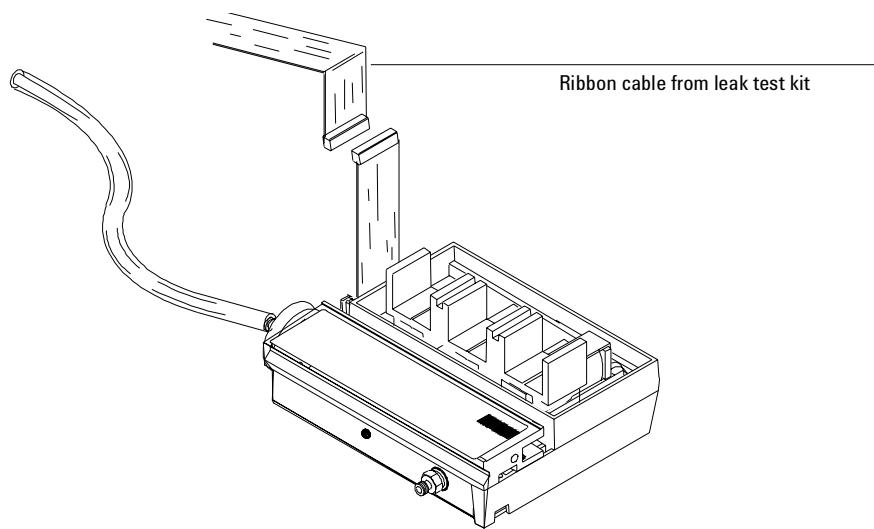
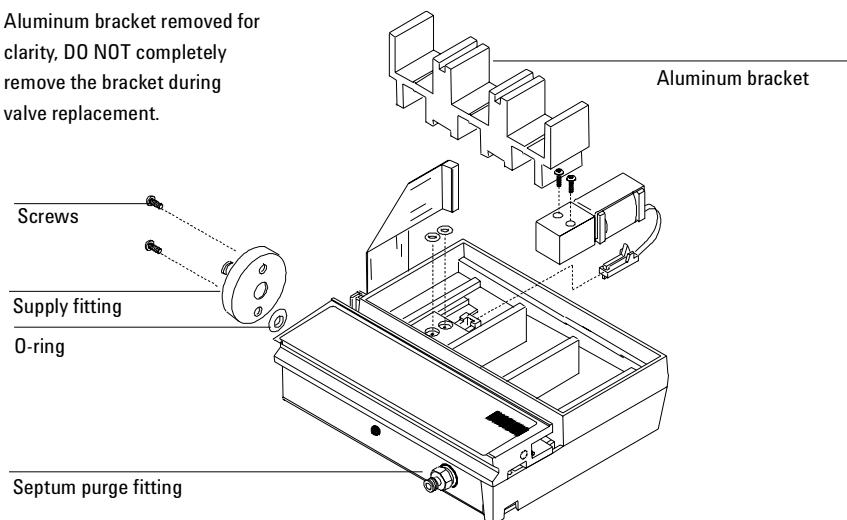


Figure 270-3 Leak testing the PCM on the lab bench

8. If the leaky component is serviceable, such as a vent/inlet fitting (see the diagram of serviceable parts, Figure 270-4), replace it. Otherwise, replace the PCM.

Caution

Aluminum bracket removed for clarity, DO NOT completely remove the bracket during valve replacement.

**Figure 270-4 PCM serviceable parts****Correcting leaks**

1. Use the electronic leak detector to check all areas of the PCM that are potential sources of a leak.
2. Tighten any connections which are leaking and re-test.

Note

If the pressure drop is now 0.05 psi/min or less, you can consider the interface system leak-free.

3. If the interface still leaks, continue to check for and correct leaks.

Potential leak areas

Check the following areas when checking for leaks in the PCM.

- The capped purge vent
- Three O-rings behind the block where the pneumatic lines enter the PCM
- Two O-rings for each valve in the PCM

300 Detectors

- 310 Flame Ionization Detector (FID)**
- 320 Nitrogen Phosphorus Detector (NPD)**
- 330 Thermal Conductivity Detector (TCD)**
- 341 Micro-cell Electron Capture Detector (μ -ECD)**
- 350 Flame Photometric Detector (FPD)**
- 360 Auxiliary EPC**

How to install, test, and operate both electronic and manual detectors on the 6890 gas chromatograph.

310 Flame Ionization Detector (FID)

Theory of operation

The FID uses a flame produced by the combustion of hydrogen and air. Few ions are formed until an organic compound elutes into the flame. Then a large increase in ions occurs. A collector with a polarizing voltage is applied near the flame, attracting the ions and producing a current, which is proportional to the amount of sample present in the flame.

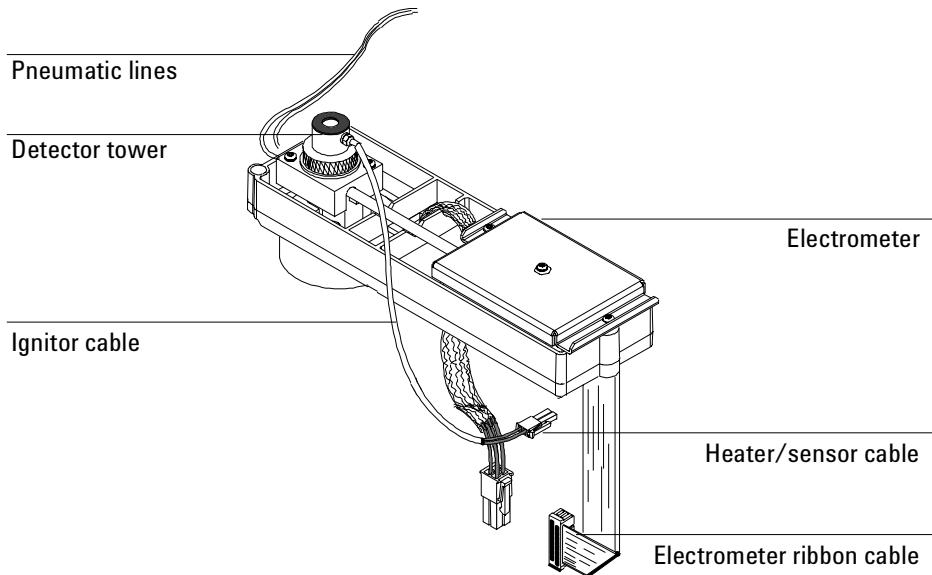


Figure 310-1 The Flame Ionization Detector (FID)

EPC detector

The EPC FID has three pneumatic supply lines for air, hydrogen and makeup gas. Each line has a filter frit, a proportional valve controlled by a pressure

sensor, and a non-adjustable restrictor frit. The makeup gas and hydrogen lines merge before entering the detector.

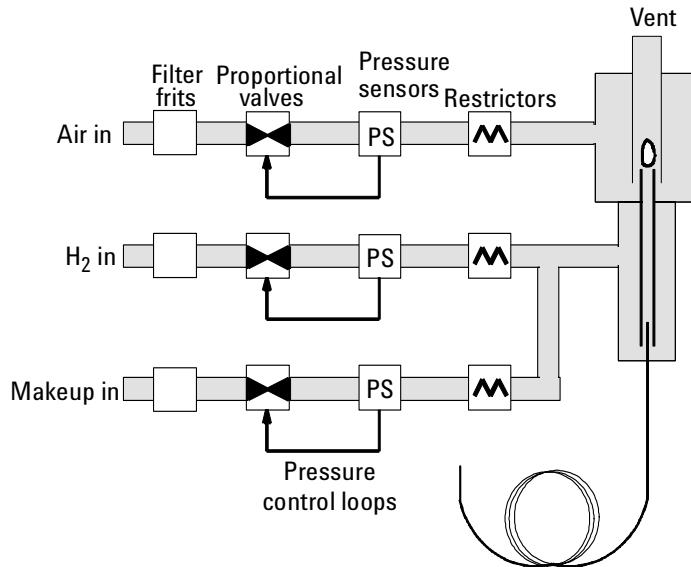


Figure 310-2 EPC detector flow

Manually controlled detector

The manually controlled FID has three pneumatic supply lines for air, hydrogen and makeup gas. All three lines have an on/off solenoid valve and a non-adjustable restrictor frit. In addition, the makeup gas line has a pressure regulator to change flow without changing supply pressure. The makeup gas and hydrogen lines merge before entering the detector.

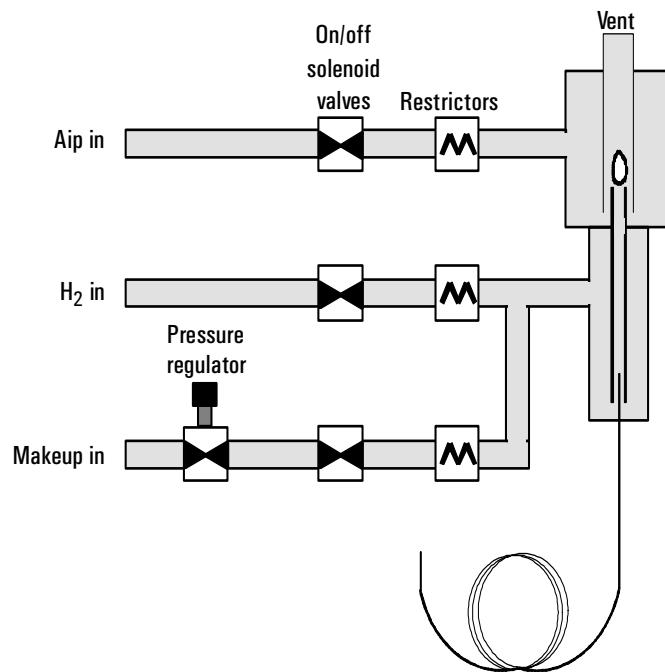


Figure 310-3 Manual detector flow

Replacement procedures

The detector is located underneath the plastic detector cover on the top of the instrument. This section describes how to remove the entire detector as well as how to remove individual parts.

Replacing the entire detector

WARNING Before proceeding, turn off the oven and any heated zones and let them cool down. Turn off any detector gases at their supply. Then turn off the main power switch and unplug the power cord.

Caution Make sure you are properly grounded with an ESD strap before continuing.

1. Shut off the detector and the detector gases and let the detector cool.
2. Remove the right side mainframe panel by loosening the two Torx T-20 captive screws.
3. Disconnect the column from the bottom of the detector.

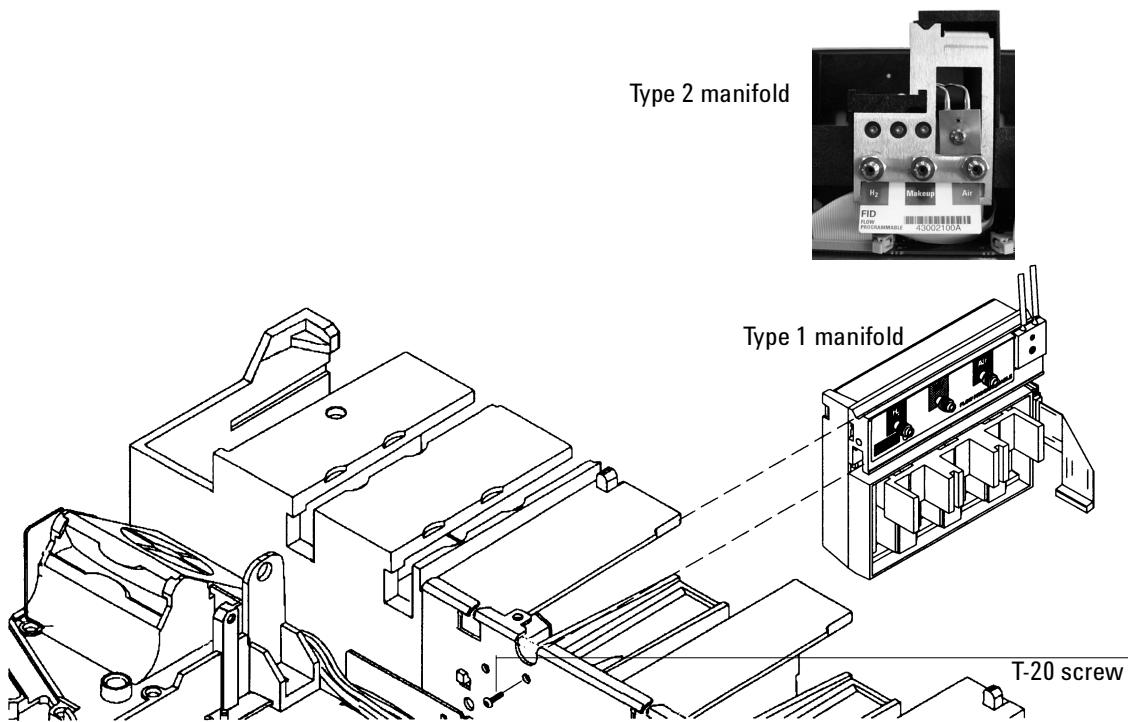


Figure 310-4 Disconnecting the detector flow lines

4. The pneumatics block is on the rear face of the manifold. If you do not intend to remove the manifold, remove the screw holding the pneumatics block. Remove the T-20 screw on the front only if you intend to remove the manifold.
5. Unlock the detector manifold ribbon cable from the EPC board and detach the connector. The adjacent ribbon cable may have to be removed as well. Slide the manifold out of the back of the GC. You will need to remove the two 1/16-inch tubes from the sheet metal and straighten them.
6. Unclip the ignitor cable and the electrometer's ribbon cable from the detector's interface board on the right side of the instrument.

7. Follow the heater/sensor cables back to their connector to the right of the detector interface card and disconnect them.

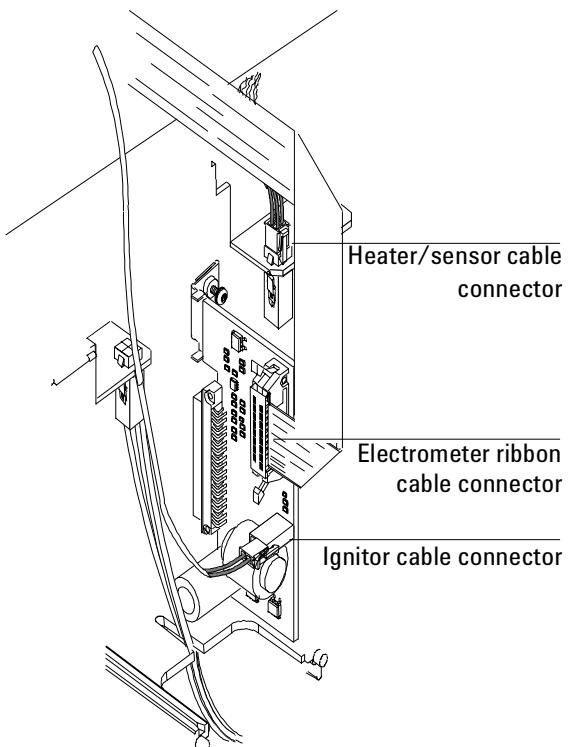


Figure 310-5 Location of FID connectors

8. Loosen the four captive Torx T-20 screws from the top of the detector pallet and remove the detector from the instrument.

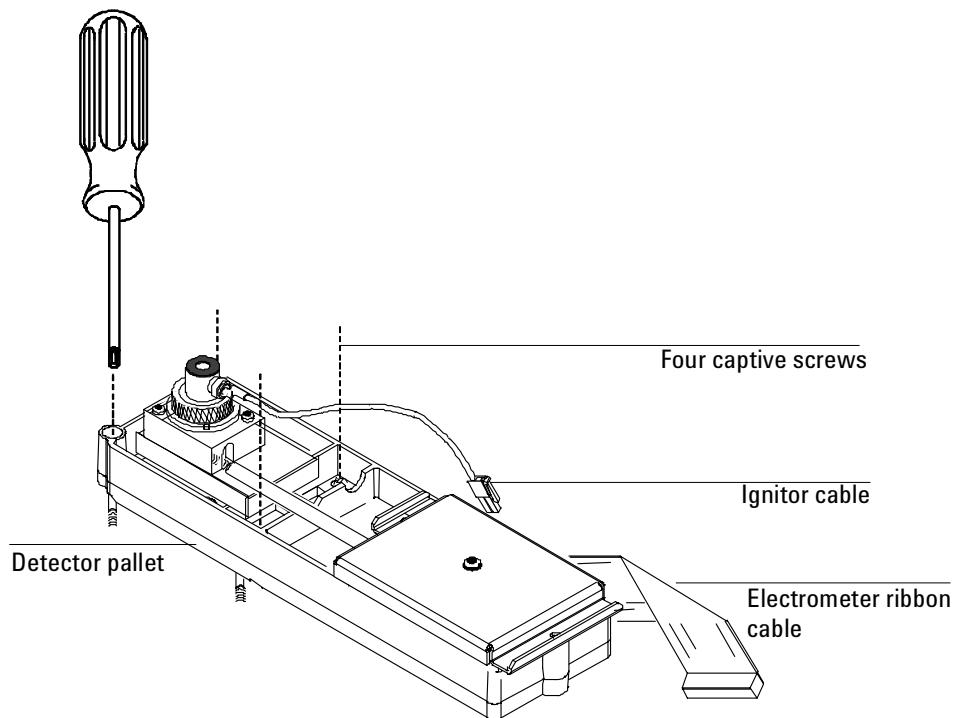


Figure 310-6 Removing the detector

Replacing the detector weldment

WARNING Before proceeding, turn off the oven and any heated zones and let them cool down. Turn off any detector gases at their supply. Then turn off the main power switch and unplug the power cord.

1. Remove the entire detector as described in this section.
2. Remove the collector assembly and the detector's electrometer as described in the Removing the electrometer procedure in this section.
3. Remove the 1 1/4-inch brass hex nut from the detector.

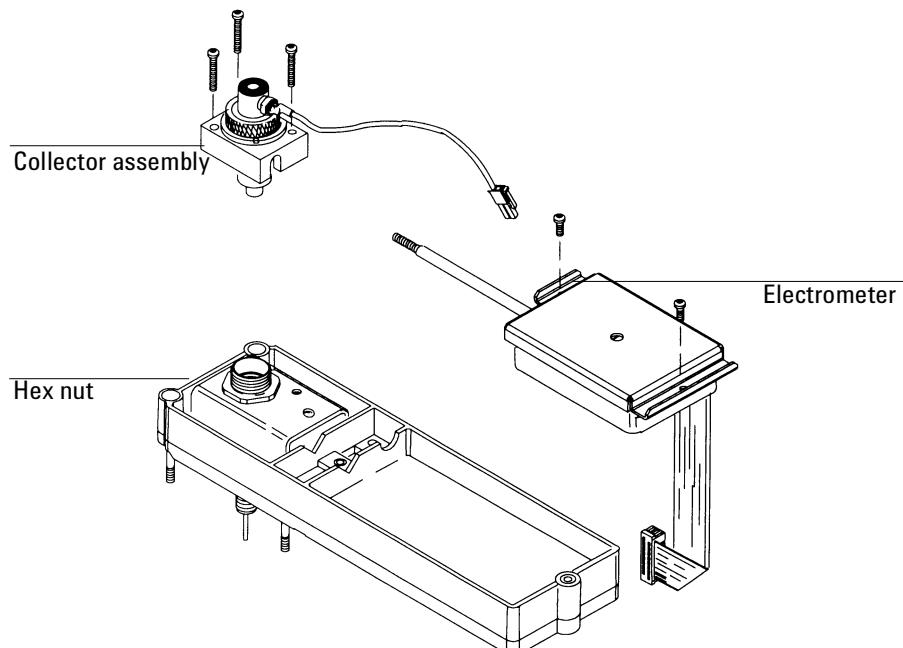


Figure 310-7 Replacing the detector weldment

4. Remove the thermal strap and weldment from the detector pallet. Disconnect the strap from the weldment (two M7 hex nuts).

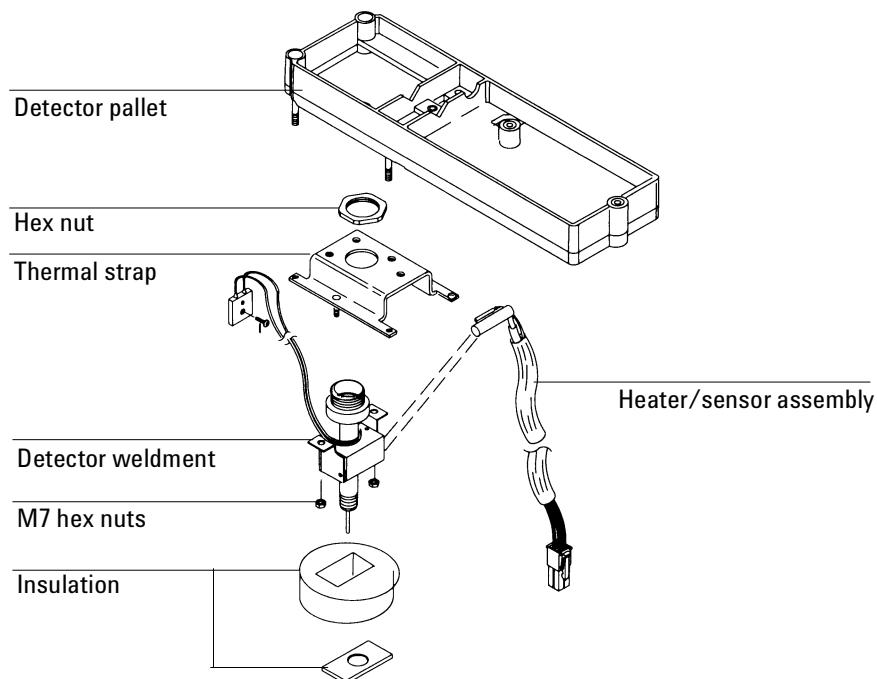


Figure 310-8 Removing the detector block

Replacing the collector assembly

WARNING Before proceeding, turn off the oven and any heated zones and let them cool down. Turn off any detector gases at their supply. Then turn off the main power switch and unplug the power cord.

1. Remove the right side cover of the instrument.

Caution Make sure you are properly grounded with an ESD strap before continuing.

2. Unclip the ignitor cable from the detector's interface board on the right side of the instrument.

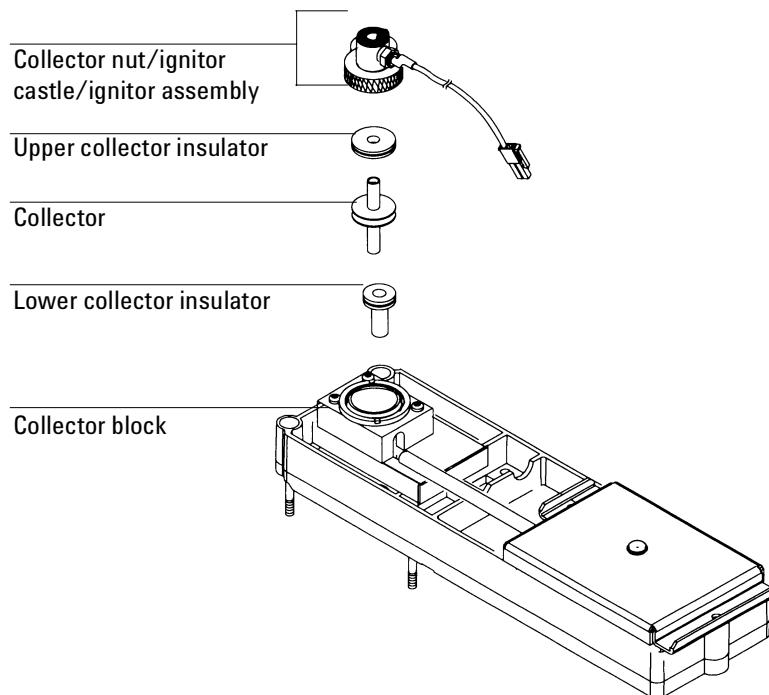


Figure 310-9 Collector assembly (exploded diagram)

3. Unscrew the knurled collector nut from the collector block.
4. Lift the collector nut, ignitor castle and ignitor cable assembly off of the collector body.
5. Lift the collector from the collector housing. The upper insulator will be on top of it.
6. If desired, remove the lower collector insulator with tweezers.
7. Reassembly is reverse of removal.

When replacing the collector body, make sure the longer shaft on the collector with the cone-shaped indentation rests on top of the FID jet and make sure the contact spring makes good contact with the groove on the collector.

The collector nut should be finger-tight.

Note The collector insulators should be clean to avoid current leakage. Washing them with a high quality grade methyl alcohol and drying them under moderate heat ($\leq 100^{\circ}$ C) prior to reinstallation is recommended.

Replacing the FID jet

WARNING Before proceeding, turn off the oven and any heated zones and let them cool down. Turn off any detector gases at their supply, then turn off the main power switch and unplug the power cord.

1. From inside the oven, remove the column and column nut.
2. On top of the GC, use a Torx T-20 screwdriver to remove the three screws on top of the collector block and remove the block.
3. Use a 1/4-inch FID nut driver to remove the jet from the collector weldment. You may need a pair of tweezers to lift the jet out.

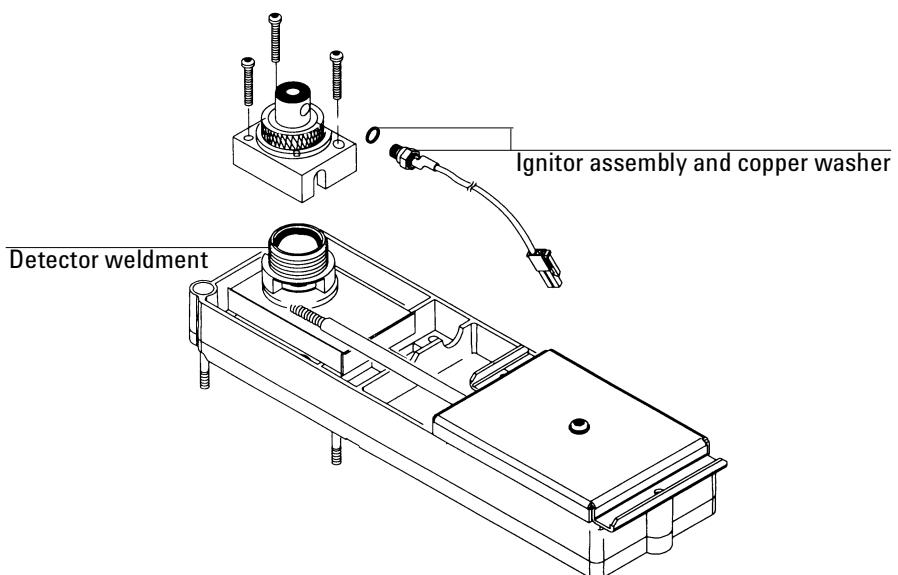


Figure 310-10 Removing the collector block

4. Use an inert gas to blow any debris out of the detector weldment.
5. Replace the jet with a new jet. (Although replacement is highly recommended, the jet may be cleaned and reinstalled at the operator's discretion. Use an approved solvent and a cleaning wire to clean the jet.)
6. Install the replacement jet finger-tight. (Use two fingers on the nut driver to obtain this tightness.) Then, tighten the jet 1/8 turn past finger tight using the nut driver.
7. Reinstall the collector block so that it seats flush on the detector base. If the block does not seat flush, the electrometer spring is not seated properly and will cause a short circuit if it is not corrected.
8. Reinstall the column and column nut. When installing the column, push it up until it touches the top of the inside of the FID jet. Gently hold the column in this position while you tighten the column nut.

Removing the electrometer

WARNING Before proceeding, turn off the oven and any heated zones and let them cool down. Turn off any detector gases at their supply. Then turn off the main power switch and unplug the power cord.

1. Remove the right side cover of the instrument.

Caution Make sure you are properly grounded with an ESD strap before continuing.

2. Disconnect the electrometer's ribbon cable from the detector's interface board.
3. Remove the collector block (three Torx T-20 screws).
4. Remove the two Torx T-20 screws and the corresponding clamps on the electrical interconnect.
5. Remove the Torx T-20 screw from each end of the electrometer and remove the electrometer. (Do not remove the screw on the top of the electrometer that holds the cover on.)

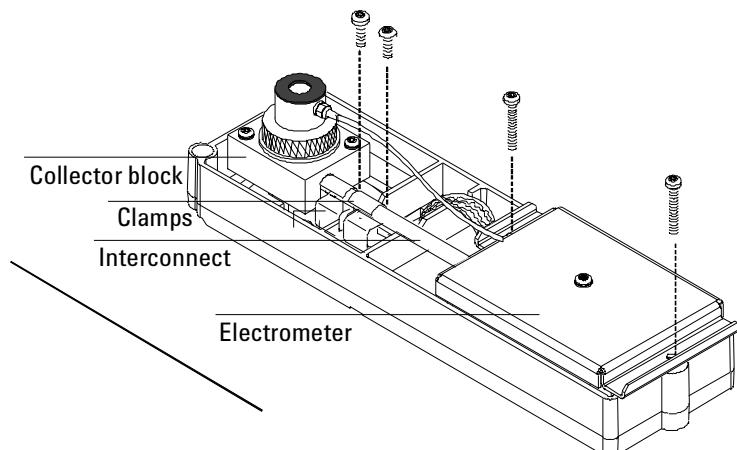


Figure 310-11 Removing the FID electrometer

Removing a flow manifold

WARNING Before proceeding, turn off the oven and any heated zones and let them cool down. Turn off any detector gases at their supply, then turn off the main power switch and unplug the power cord.

1. Remove the Torx T-20 screw that holds the manifold in its slot from the front of the manifold.
2. Remove the gas supply fittings from the side (Type 1) or the rear (Type 2) of the manifold.
3. Disengage the detector tubing from the slots in the chassis so that the gang fitting on the manifold can be removed easily.
4. Remove the Torx T-20 screw holding the pneumatics block to the manifold and remove the block. On Type 1 manifolds, slide the manifold slightly to the rear to reach the screw.

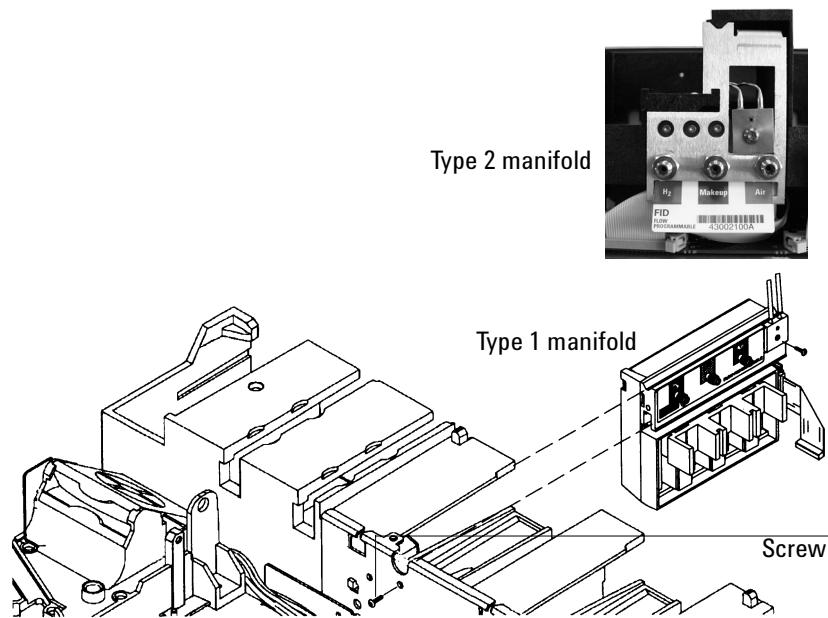


Figure 310-12 Removing the detector flow manifold

Caution Make sure you are properly grounded with an ESD strap before continuing.

5. Unlock the detector manifold's ribbon cable from the EPC board and detach the connector. The adjacent ribbon cable may have to be removed as well.

Caution Always hold the manifold by its support bracket to avoid damaging board components.

6. Slide the manifold from its slot.

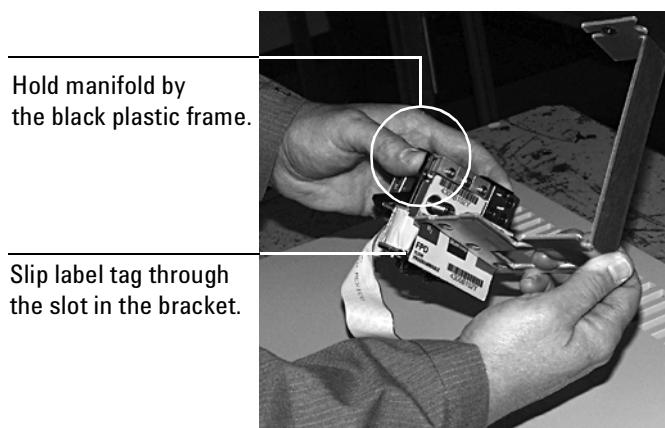
Installing a manifold

WARNING Hydrogen gas is flammable and potentially explosive. Before replacing the manifold, turn off the hydrogen gas at the source.

WARNING Before proceeding, turn off the oven and any heated zones and let them cool down. Turn off all detector gases at their supply, then turn off the main power switch and unplug the power cord.

Caution Always hold the manifold as shown below to avoid damaging board components.

1. While holding the manifold by the black plastic frame as shown below, slip the label through the slot in the mounting bracket, and align the bracket holes over the gas fittings.



(FPD shown)

2. Finger-tighten three 7/16-inch hex nuts over the fittings to hold the bracket in place. It is **very important** that you do **not** tighten the nuts yet.

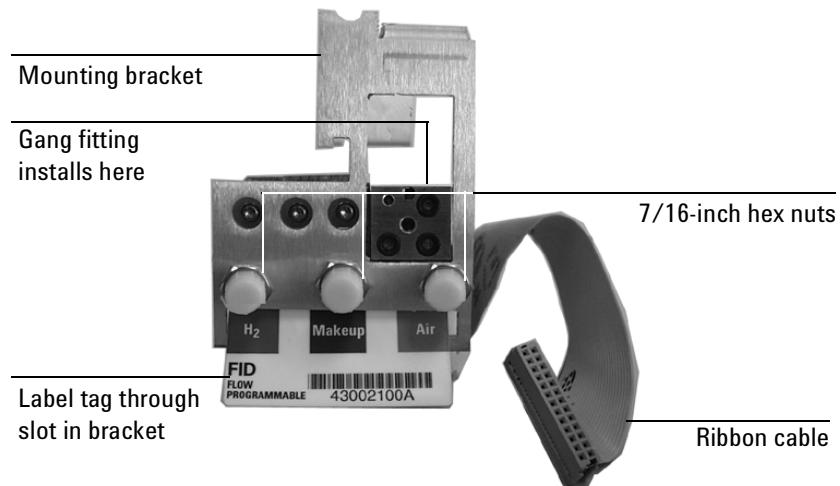
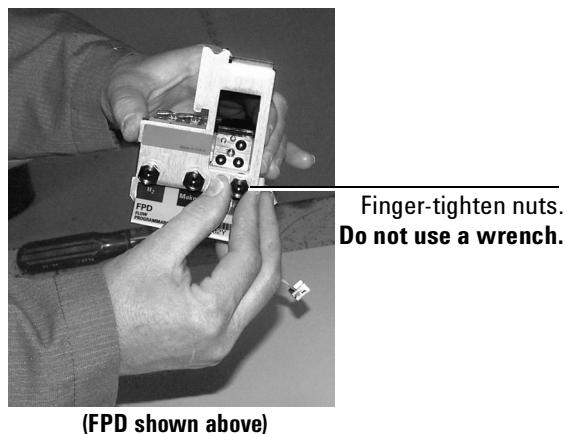
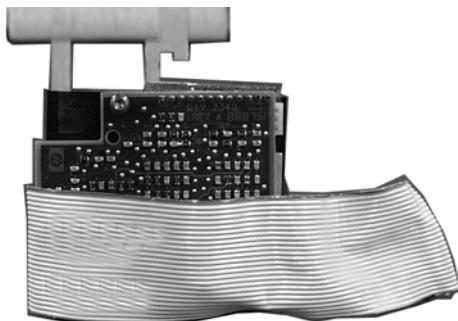


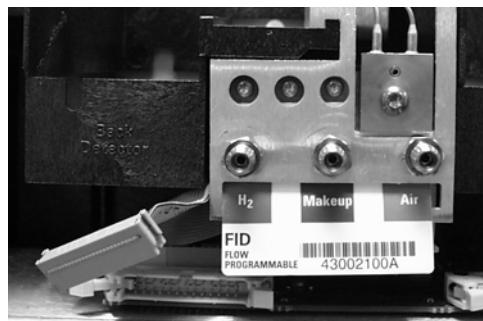
Figure 310-13 Bracket mounted onto the manifold

3. If the tubing from the gang fitting bends directly to the left, re-shape it so that it bends up and away from the block as shown in Figure 310-15.
4. Insert the gang fitting through the cutout in the manifold bracket and install it onto the new manifold assembly so that the tubing runs back and away from the fitting. Be sure the left tube clears the inner edge of the bracket. See Figure 310-13 and Figure 310-15.

5. Route the ribbon cable behind the manifold assembly as shown in Figure 310-14. Then, slide the manifold and bracket assembly into the slot until the bracket seats flush against the end of the rails. See Figure 310-15.



Back view of manifold



Manifold installed with cable routed to left

Figure 310-14 Routing the ribbon cable

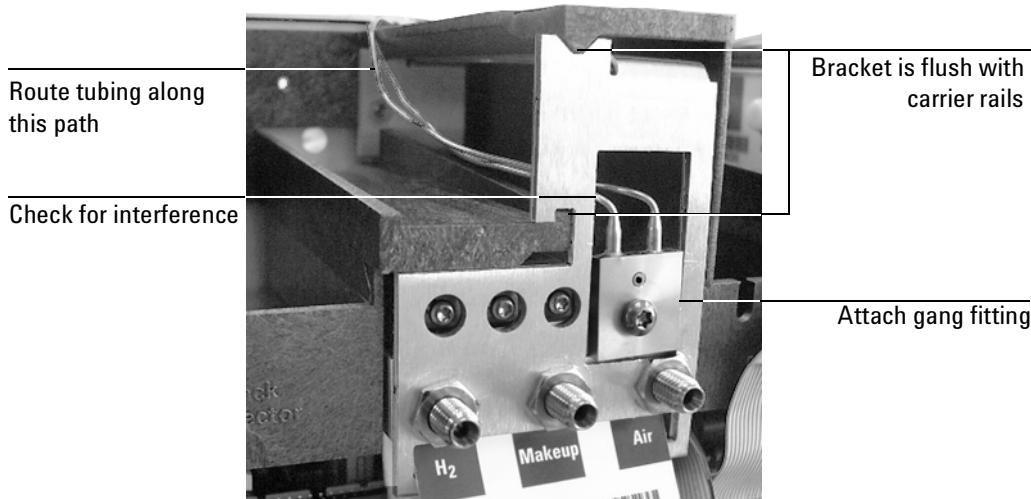


Figure 310-15 Manifold, after installation

6. Secure the manifold in place using the Torx T-20 screw. See Figure 310-13.
7. Route the gas tubing behind the manifold, over the top of the chassis, and through the slots as shown in Figure 310-15.
8. Connect the ribbon cable to the mating connector on the pneumatics board. Arrange the cable to keep it away from the valves and keep it from being pinched against the manifold.

For the back detector, you may want to loosen the manifold and slide it out of the carrier a few centimeters to connect the cable to the pneumatics board. Then, reinstall the manifold.

9. Using a pair of needle-nosed pliers, remove the appropriate top rear panel detector cutout for the FID. Also remove any cutouts needed to access other manifolds or accessories installed in the GC. See Figure 310-16.

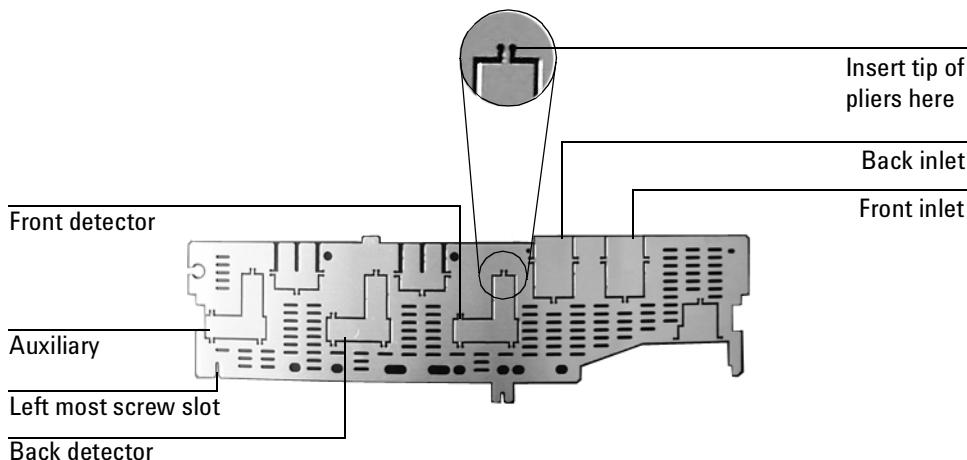


Figure 310-16 Top rear panel cutouts

10. Place the new top rear panel on its left-most mounting screw. Use the screw as a hinge and angle the panel while sliding each manifold tag through its cutout in the panel, working from left to right. When all the tags are through the panel, finish installing the panel on the GC.

11. Install the RFI shield, the pneumatics cover, and the detector top cover.
12. Connect the source gas lines to the manifold. See Figure 310-17.



Figure 310-17 Gas line connections

Removing the FID interface board

The FID detector has an interface board on the main board as shown on the following page.

WARNING Before proceeding, turn off the oven and any heated zones and let them cool down. Turn off any detector gases at their supply, then turn off the main power switch and unplug the power cord.

Caution Make sure you are properly grounded with an ESD strap before continuing.

1. Unlock and unclip the ribbon cable from the interface board.
2. Unclip the FID ignitor from the interface board.
3. Remove the screw at the top of the card where it mounts to the main board and pull the card out.
4. Reassembly is the reverse of removal.

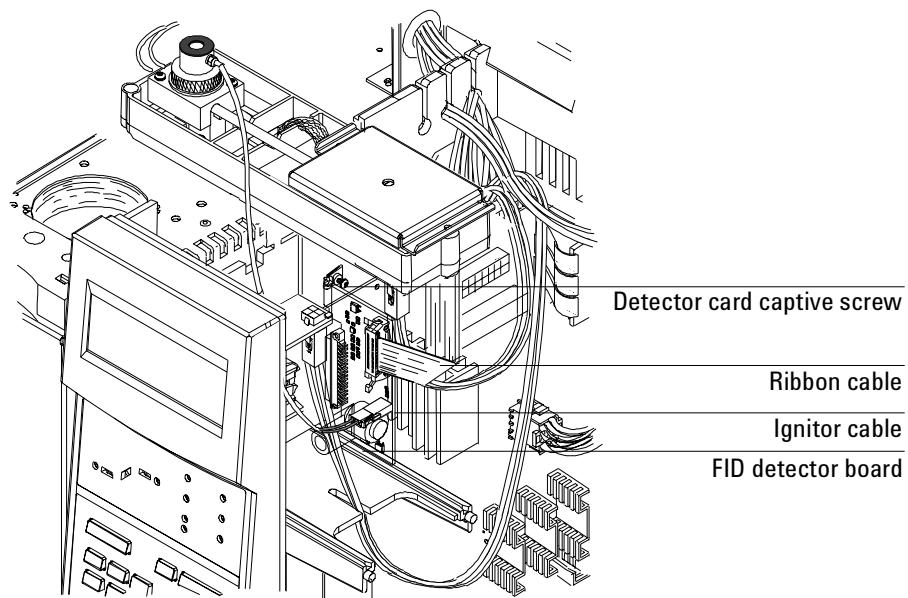


Figure 310-18 Detector interface board and connections

Diagnostics

FID ignition problems

If your FID detector is not igniting properly, check the following:

- The gases are plumbed correctly.
- The system is leak free.
- The flow rates are set correctly.
- External lines have been well purged.
- The detector is contaminant free.
- The ignitor is operational.
- The jet is not damaged (check for scores, galls, a crimped tube) or plugged.

Cleaning an FID jet and collector

Both the jet and collector bore require occasional cleaning to remove deposits (usually consisting of white silica from column bleed or black, carbonaceous soot). Such deposits reduce sensitivity and cause chromatographic noise and spikes.

Cleaning the collector

Turn off the detector and its heated zone; also turn off gases to the detector (particularly hydrogen). Allow time for the detector zone to cool.

1. Remove the collector as described in this chapter.
2. Use a cleaning brush (part no. 8710-1346) to scrub the interior of the collector.
3. Use compressed air or nitrogen to blow out loose material from inside the collector.
4. Wash the collector in distilled water, hexane and/or methanol. Dry in an oven at 70° C for at least 1/2-hour.

Cleaning the jet

Turn off the detector and its heated zone; also turn off gases to the detector (particularly hydrogen). Allow time for the detector zone to cool.

1. Remove the jet as described in this chapter.
2. Use a cleaning wire (0.016-inch od, 12 inch length, part no. 18765-20070) to loosen/remove internal deposits.
3. Wash both the internal bore and exterior of the jet with a 1:1 (V/V) solution of methanol and acetone.
4. Clean the detector base cavity using solvents, a swab and compressed air or nitrogen.

320 Nitrogen Phosphorus Detector (NPD)

Theory of operation

The NPD (also called a thermionic detector) uses a jet and collector similar in appearance to a Flame Ionization Detector. In an NPD, however, ions of alkali metal are introduced into a flame where hydrogen and air flows are less than those for an FID, minimizing the normal hydrocarbon ionizations, and increasing the ionization of nitrogen or phosphorous compounds. This causes the NPD to be both sensitive and selective for organic compounds containing nitrogen and/or phosphorous. This thermionic source efficiently ionizes nitrogen and phosphorous containing organic molecules. Ions are collected and the resulting current measured for the chromatogram.

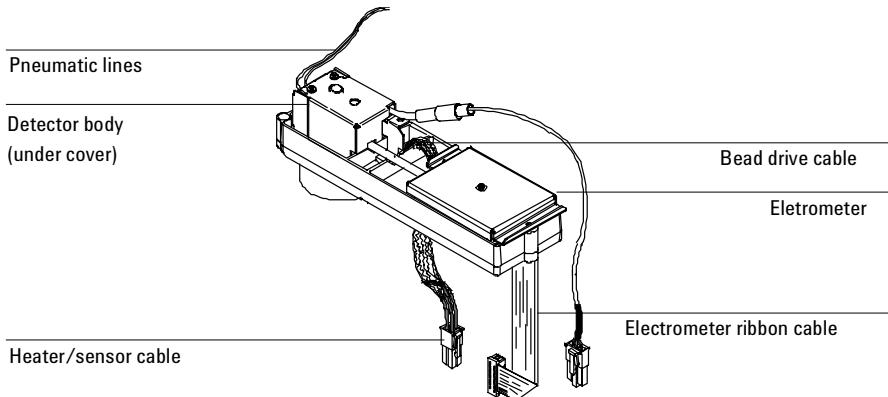


Figure 320-1 The Nitrogen Phosphorus Detector (NPD)

EPC detector

The EPC NPD has three pneumatic supply lines for air, hydrogen and makeup gas. Each line has a filter frit, a proportional valve controlled by a pressure

sensor, and a non-adjustable restrictor frit. The makeup gas and hydrogen lines merge before entering the detector.

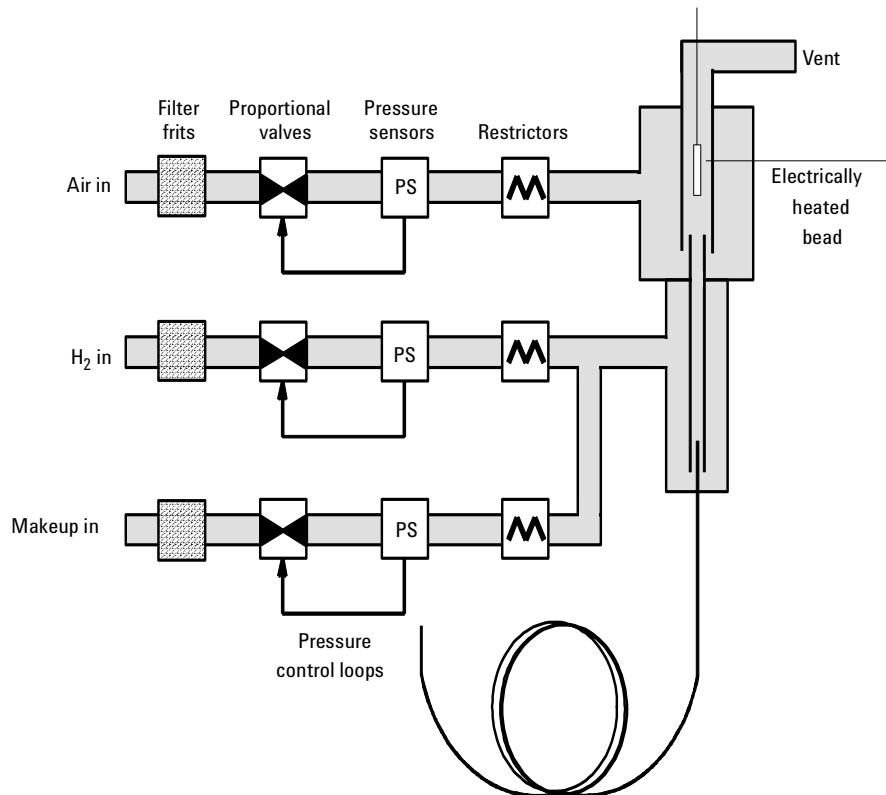


Figure 320-2 EPC detector flow

Manually controlled detector

The manually controlled NPD has three pneumatic supply lines for air, hydrogen and makeup gas. All three lines have an on/off solenoid valve and a non-adjustable restrictor frit. In addition, the makeup gas line has a pressure regulator to change flow without changing supply pressure. The makeup gas and hydrogen lines merge before entering the detector.

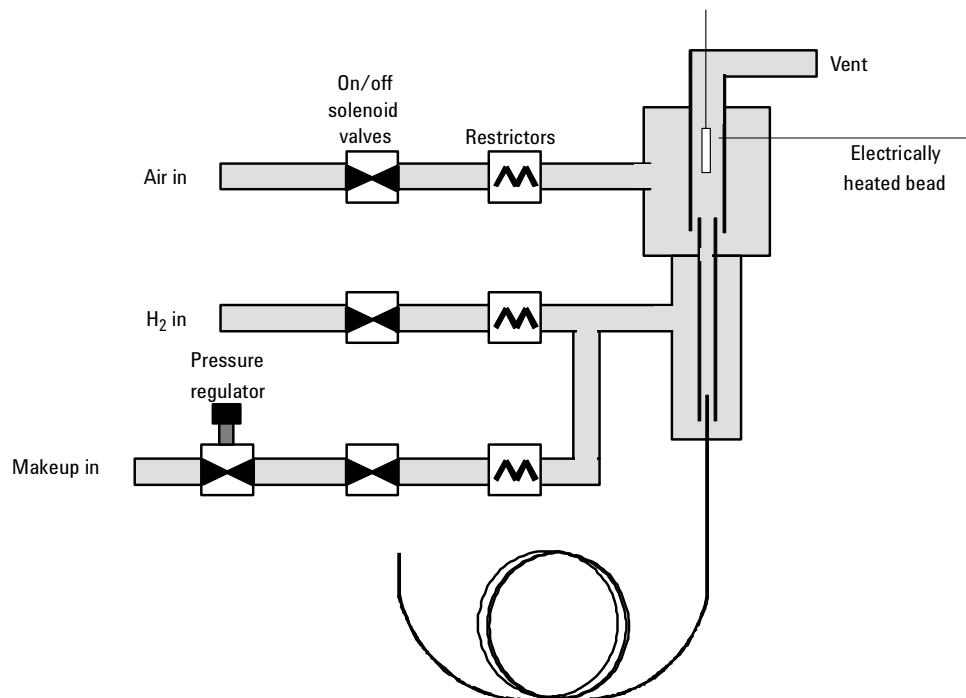


Figure 320-3 Manual detector flow

Recommended settings

Equilibration time

We recommend an equilibration time of 0.0 minutes and the automatic Adjust offset process. Some beads do not respond well to the automatic process. For these, start at 2.0 volts and bring up the bead voltage gradually, 10 mV at a time, until the desired offset is reached.

Turning hydrogen off during a solvent peak

The baseline shifts after a solvent peak and can take some time to stabilize, especially with chlorinated solvents. To minimize this, turn off the hydrogen flow during the solvent peak and turn it back on after the solvent elutes. With this technique, the baseline recovers to its original value in less than 30 seconds. This also extends the life of the bead. The hydrogen can be turned on and off automatically as part of a Run Table.

Turning hydrogen off between runs

To extend bead life, turn off the hydrogen flow between runs. Leave all other flows and the detector temperature on. Turn on the hydrogen flow for the next run; the bead will ignite almost immediately. The process can be automated with Run Table entries.

Bead voltage

Typical voltages for new beads range from 2.5 to 3.7 volts. Higher values reduce bead life.

Extending the life of the bead

- Use the lowest practical adjust offset or bead voltage.
- Run clean samples.
- Turn the bead off when not in use.
- Keep the detector temperature high (320 to 335°C).

- Turn the hydrogen flow off during solvent peaks and between runs.
- If your NPD is Off for a long time in a high-humidity environment, water may accumulate in your detector. To remove it:
 - a. Set the detector temperature at 100°C and maintain it for 30 minutes.
 - b. Set the detector temperature to 150°C and maintain it for another 30 minutes.

Temperature programming

The NPD is flow sensitive. If you are using temperature programming, in which the column flow resistance changes with temperature, set up the instrument as follows:

- With an EPC inlet, set the carrier gas in the Constant flow mode. Set EPC detector makeup gas to Const makeup. NonEPC detectors provide constant makeup gas flow.
- If you have an EPC inlet and an EPC detector and choose to work in the constant pressure mode, the makeup gas should be set in the Col+mkup=const mode.

Jets and collectors

The *capillary optimized* NPD is only used with capillary columns. It is shipped with the standard jet and collector.

Table 320-1 Jets and Collectors for the Capillary-Optimized NPD

Type	Part no.	id	Use with
Standard jet	G1531-80560	0.29 mm	Either collector
Extended jet (optional)	G1534-80580		Either collector
Standard collector	G1534-20530	7 mm	
Small id collector (optional)	G1534-20660	5 mm	

The *adaptable* NPD fits packed columns and can be adapted to fit capillary columns. It is shipped with the capillary column jet and standard collector. You must change the jet to use packed columns. Instructions appear later in this chapter.

Table 320-2 Jets and Collectors for the Adaptable NPD

Type	Part no.	id	Use with
Capillary column jet	19244-80560	0.29 mm	Either collector
Extended jet	G1534-80590		Either collector
Standard collector	G1534-20530	7 mm	
Small id collector	G1534-20660	5 mm	

The extended jets, used with the small id collectors, reduce the exposure of the sample to heated metal and reduce tailing of some very polar components.

Correcting NPD hardware problems

No detector response to injected sample

- A solvent peak has extinguished the hydrogen/air plasma. Increase the bead voltage. Run the detector at a higher offset (for example, 40 to 50 pA), or use makeup gas at a flow rate of 5 mL/min.
- Check that hydrogen is flowing to the detector. The flow rate should be between 1.0 and 5.5 mL/min.
- The bead is not activated. Look through the vent hole on the detector lid to see if the bead is glowing orange. If not, check that there is enough current reaching the bead. Check the detector background signal. Reduce the bead voltage to zero to establish a reference level, then look for a sudden sharp increase in output as the bead voltage increases, which indicates that plasma ignition occurred. If 4 V are being supplied to the bead but it is not igniting, the bead is probably burned out. Replace the bead.
- The bead power cable is bad.
- A contaminated upper ceramic insulator will cause a high offset (2 to 15 pA or more) when the bead voltage is off. This directly affects sensitivity. Replace the ceramic insulator. Minimize the problem by running the detector hot (320 to 335°C).

No baseline; output signal exceeds 8 million

- The electrometer ribbon cable is not attached to the PC board properly. Be sure to turn the GC off before reattaching the cable! If the signal does not drop to a normal level (<3 pA), replace the electrometer.
- The collector is shorted to the detector housing. Check the insulators.

Baseline level is 0.0

- Broken electrometer

Baseline does not recover after solvent peak

- Create a time table that turns hydrogen off at the time of injection. When the solvent has passed through the detector, restore the hydrogen flow to the operating level. The NPD will usually recover rapidly to a stable baseline.

Add makeup gas at a flow rate of 5 mL/min.

A large solvent peak has extinguished the hydrogen/air plasma. Increase the bead voltage. Run the detector at a higher offset (for example, 40 to 50 pA).

Adjust offset does not function properly (it is either too high or too low by hundreds of pA)

- A flame is burning at the top of the jet. If the hydrogen flow is too high, the flame at the tip of the jet will continue burning. Turn off the hydrogen flow completely and decrease the flow rate. The hydrogen flow should never be higher than 4.0 mL/min.

Large solvent signal with very small NPD signal

- Check the hydrogen flow rate. If it is too high, a flame could be burning at the tip of the jet. Turn off the hydrogen flow completely and decrease the flow rate. The hydrogen flow should never be higher than 4.0 mL/min.
- The collector may be contaminated. Change the collector and ceramic insulators.

Peak tailing

- Verify that a good liner and column are being used.
- Some polar compounds tail due to contact with the metal collector. The optional extended jets are recommended.
- Some compounds cause peak tailing, especially those containing phosphorus. The optional black ceramic bead is recommended for phosphorus.

The baseline drifts (upward) significantly during an oven program

- If the oven temperature is increasing dramatically during a run (for example, from 50 to 350°C) a change of between 10 and 15 pA is normal. However, if you suspect that the baseline drift is excessive, heat the inlets and oven to a temperature above 300°C for 60 minutes to eliminate excess baseline drift during oven programs.
- Verify that the detector insulation is not cracked or damaged.

High detector baseline of GC at room temperature

- Moisture in the detector can cause the baseline to be at 10s or even 100s of pA when the detector is at a low (such as room) temperature. Set the detector temperature to 150°C with the detector gases on. The baseline should drop below 1 pA in approximately 10 minutes.

The signal baseline does not fall below 3 pA when the bead voltage is 0

- The ceramic insulators may be dirty. The insulators must be very clean for NPD performance to be satisfactory.

Replacement procedures

Software

Important changes were made to the original NPD software/firmware to improve bead life. If the GC or ChemStation has older software, upgrade it as shown here.

Product	Software/firmware revision
6890A GC	A.03.03 or higher
GC ChemStation	A.05.02 or higher
MSD ChemStation	G1701AA or higher

Software/firmware with numbers less than shown in the table will cause reduced bead lifetime.

Replacing the entire detector

WARNING Before proceeding, turn off the oven and any heated zones and let them cool down. Turn off any detector gases at their supply. Then turn off the main power switch and unplug the power cord. Remove the side mainframe side panel by loosening the two T-20 captive screws.

1. Shut off the detector and the detector gases and let the detector cool.
2. Remove the right side mainframe panel by loosening the two Torx T-20 captive screws.
3. Disconnect the column and insulation cup from the bottom of the detector.

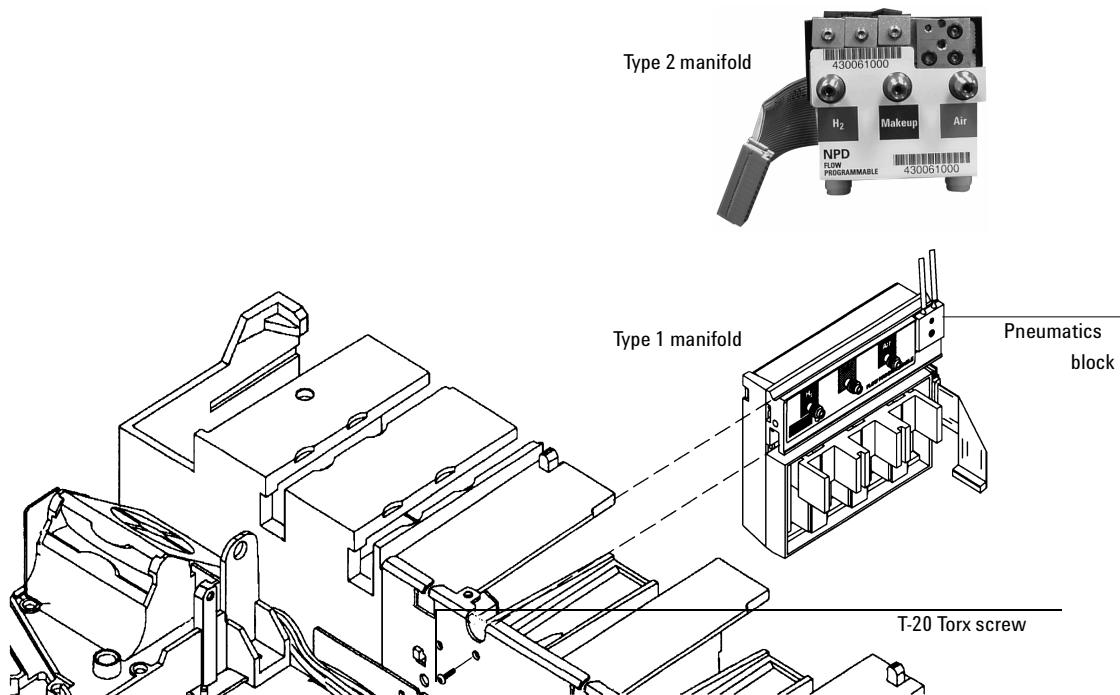


Figure 320-4 Disconnecting the detector flow lines

4. Type 1 manifold

Remove the Torx T-20 screw from the front of the manifold as shown. If you do not intend to remove the manifold, slide it to the rear enough to remove the screw holding the pneumatics block, then return it to position and insert the screw in the front to secure it.

5. Type 2 manifold

The pneumatics block is on the rear (rather than the side) of the manifold. If you do not intend to remove the manifold, remove the screw holding the pneumatics block. Remove the T-20 screw on the front only if you intend to remove the manifold.

Caution Make sure you are properly grounded with an ESD strap before continuing.

6. Unclip the bead drive cable and the electrometer ribbon cable from the detector's interface board on the right side of the instrument.

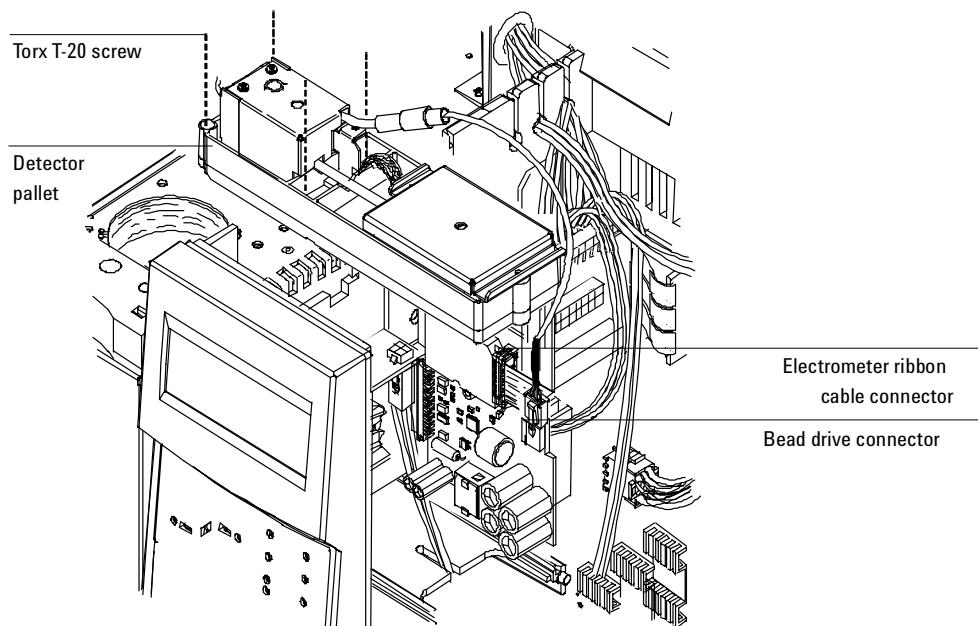


Figure 320-5 Location of the detector pallet screws and the NPD interface board connectors

7. Follow the heater/sensor cables back to their connector to the right of the detector interface card and disconnect them.
8. Loosen the four captive Torx T-20 screws from the top of the detector pallet and remove the detector from the instrument.
9. Reassembly is the reverse of removal.

When reinstalling the detector pallet, make sure that the detector board seats in the slot on the bottom of the pallet.

Replacing the active element (bead)

WARNING Before proceeding, turn off the oven and any heated zones and let them cool down. Turn off any hydrogen gas at its supply. Then turn off the main power switch and unplug the power cord.

Caution To avoid detector contamination, use clean lint-free gloves when handling the internal detector components. The detector bead is fragile, avoid touching the bead or letting it touch other surfaces.

While performing this procedure, do the following:

- Leave all detector gasses, except hydrogen, turned on to purge contamination. Turn hydrogen off.
- Make sure the detector has cooled to(<150°C) before beginning, or the bead may be damaged by exposure to air.

Two ceramic beads are available:

Bead color	Part no.	Advantages	Disadvantages
White	G1530-60570	Standard	Phosphorus tails
Black	5183-2007	Durable, no phosphorus tailing	Lower nitrogen sensitivity, about 40%

1. Turn off the detector active element through the keyboard.

2. Detach the bead drive cable by twisting the metal connector and pulling it out.

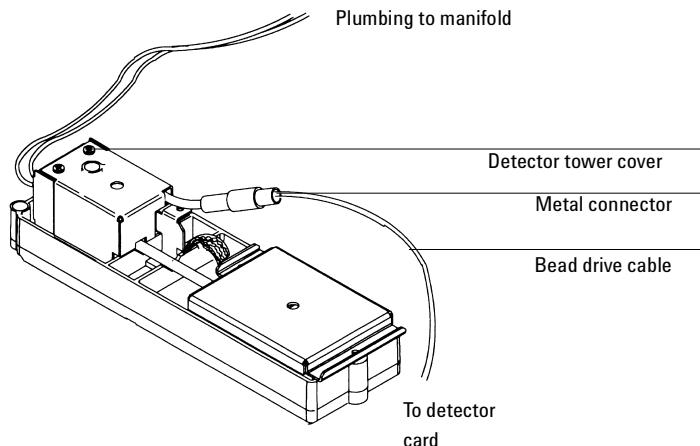


Figure 320-6 NPD detector cable and tower cover

3. Lift up the hinged metal cover.

4. Remove the three Torx T-10 screws from the large hex-shaped source assembly on the top of the detector tower.

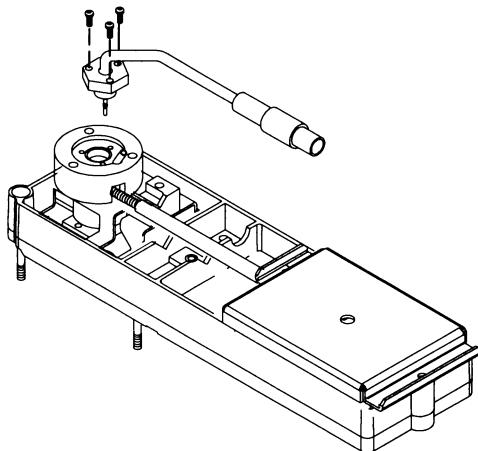


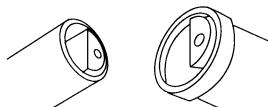
Figure 320-7 NPD source assembly

5. Carefully lift the source assembly/bead from the detector.

Caution The active element is fragile. Do not handle it or allow it to strike hard surfaces. Handle the active element assembly only by the cable or the hex nut.

6. Reassembly is the reverse of removal with the following provisions:

- When you tighten the three screws on the source assembly nut, tighten one screw about finger tight and then tighten the remaining two screws firmly. This will sufficiently tighten the first screw.
- When reconnecting the bayonet style detector cable, first line up the white hemispherical tabs in the connectors, as shown:



When the detector is reassembled, and ready for use:

1. Heat the detector to 150°C for about 15 minutes. Then increase the temperature to the operating value (325 to 335°C recommended). Allow 15 minutes for equilibration.
2. Set Equilibration time to 0.0. Either start *Adjust offset* or gradually raise the bead voltage, about 0.01 volts at a time, until the baseline increases to the desired offset.

Removing the collector assembly

You can remove the collector for cleaning or replacement without removing the active element. Replace the collector C-rings periodically and the alumina insulators upon contamination.

WARNING Before proceeding, turn off the oven and any heated zones and let them cool down. Turn off any detector gases at their supply, then turn off the main power switch and unplug the power cord.

Caution To avoid detector contamination, use clean lint-free gloves when handling the internal detector components. The detector bead is fragile, avoid touching the bead or letting it touch other surfaces.

1. Lift up the hinged metal cover.
2. Fully loosen the three captive Torx T-20 screws on the lid weldment and remove the lid. You may want to remove the metal standoffs also.

Note The metal C-ring removed in the next step may be stuck to the bottom of the lid weldment when you lift it out.

3. Remove the metal C-ring (size 19) from the top of the collector assembly.
4. Lift out the collector funnel and alumina insulator.

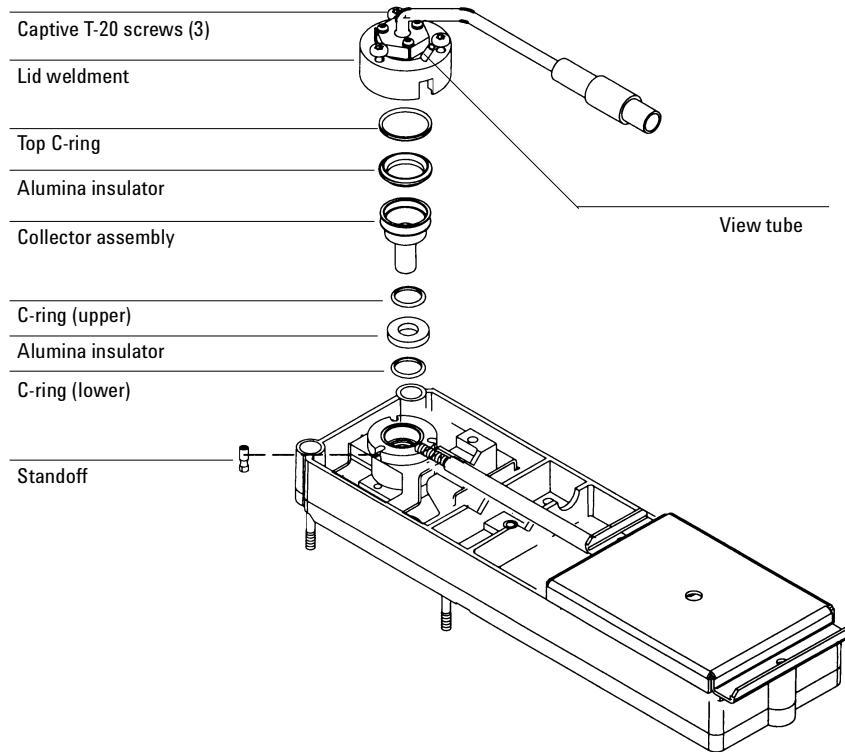


Figure 320-8 NPD detector collector

5. Use a pair of tweezers to lift out the metal C-ring (size 14), the alumina insulator, and another metal C-ring (size 14).
6. Reassembly is the reverse of removal. Note that when replacing the lid weldment, make sure the view tube on top of the weldment faces the electrometer.

Replacing the jet

After removing the collector assembly, you can replace the jet. If contamination is present in the detector, replacement of the jet is recommended. However, the jet can be cleaned as described in the Cleaning the jet procedure in this section.

WARNING Before proceeding, turn off the oven and any heated zones and let them cool down. Turn off any detector gases at their supply. Then turn off the main power switch and unplug the power cord.

Caution To avoid detector contamination, use clean lint-free gloves when handling the internal detector components. The detector bead is fragile, avoid touching the bead or letting it touch other surfaces.

1. Remove the collector as described in the Removing the collector assembly procedure.
2. Use a 1/4-inch deep-socket nut driver to unscrew the jet.
3. Use slight side pressure on the nut driver to drag the jet up out of the detector weldment and then use tweezers to grasp and remove the jet.

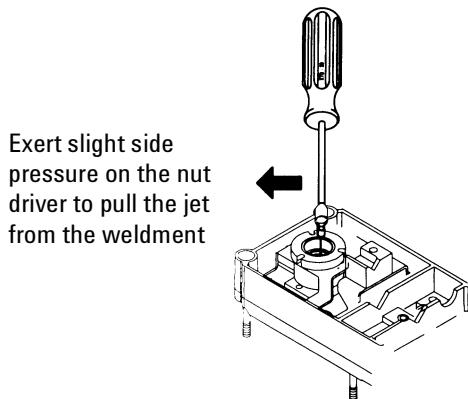


Figure 320-9 Removing the jet

Removing the electrometer

WARNING Before proceeding, turn off the oven and any heated zones and let them cool down. Turn off any detector gases at their supply, then turn off the main power switch and unplug the power cord.

Caution Make sure you are properly grounded with an ESD strap before continuing.

1. Remove both the electronics top cover and the right side cover.
2. Lift up the hinged detector tower cover and remove the Torx T-20 screw and the clamp on the electrical interconnect.

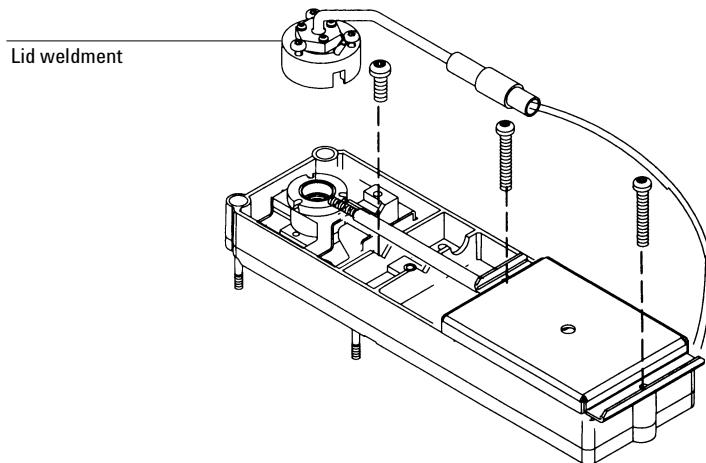


Figure 320-10 Removing the NPD electrometer

3. Loosen the three Torx T-10 screws on the lid weldment and remove the lid.
4. Remove one Torx T-20 screw from each end of the electrometer. (You do not need to remove the screw on the top of the electrometer that holds the cover on.)
5. Unlock and detach the electrometer's ribbon cable from the detector's interface board and lift the electrometer from the detector pallet.
6. Reassembly is the reverse of removal.

Removing an EPC flow manifold

WARNING Before proceeding, turn off the detector and any detector gases at their supply. Then turn off the main power switch and unplug the power cord.

Early models of the 6890 GC used Type 1 EPC flow manifolds. Later models use the Type 2 manifold. Both types are discussed here.

1. At the front of the manifold, remove the Torx T-20 screw that holds the manifold in its slot.
2. Remove the following covers: plastic detector and pneumatics covers, metal pneumatics RFI cover, rear top metal cover.
3. Remove the gas supply fittings from the side (Type 1) or rear (Type 2) of the manifold.
4. Disengage the detector tubing from the slots in the chassis so that the gang fitting on the manifold can be removed easily.
5. Remove the Torx T-20 screw holding the pneumatics block to the manifold and remove the block. On Type 1 manifolds, slide the manifold slightly to the rear to reach the screw.

Caution Make sure you are properly grounded with an ESD strap before continuing.

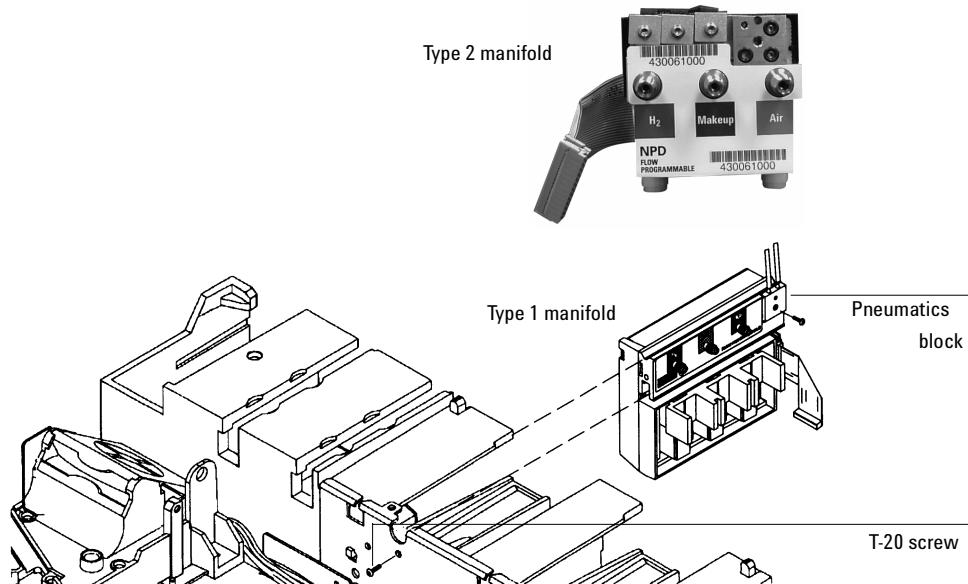


Figure 320-11 Removing the detector EPC flow manifold

6. Unlock the detector manifold's ribbon cable from the EPC board and detach the connector. The adjacent ribbon cable may have to be removed as well.

Caution Always hold the Type 2 manifold by its support bracket to avoid damaging board components.

7. Slide the manifold from its slot.

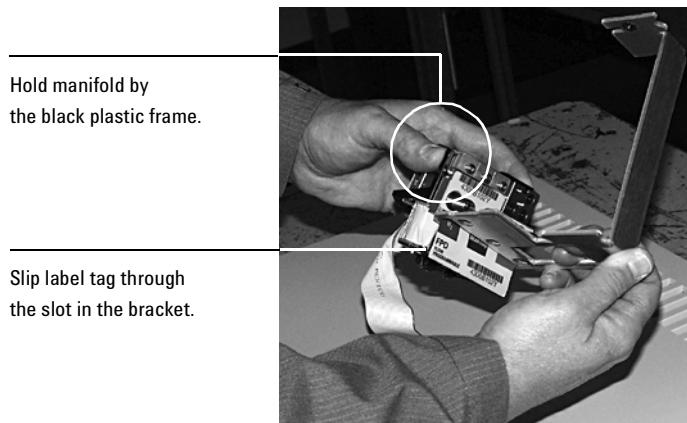
Installing a Type 2 manifold

WARNING Hydrogen gas is flammable and potentially explosive. Before replacing the manifold, turn off the hydrogen gas at the source.

WARNING Before proceeding, turn off the oven and any heated zones and let them cool down. Turn off all detector gases at their supply, then turn off the main power switch and unplug the power cord.

Caution Always hold the manifold as shown below to avoid damaging board components.

1. While holding the manifold by the black plastic frame as shown below, slip the label through the slot in the mounting bracket, and align the bracket holes over the gas fittings.



2. Finger-tighten three 7/16-inch hex nuts over the fittings to hold the bracket in place. It is **very important** that you do **not** tighten the nuts yet.



Finger-tighten nuts.
Do not use a wrench.

(FPD shown above)

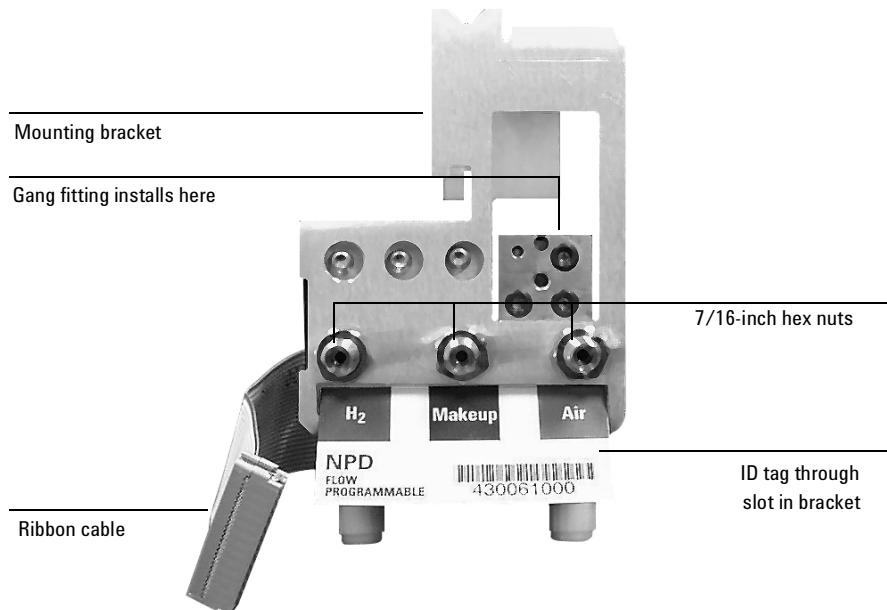


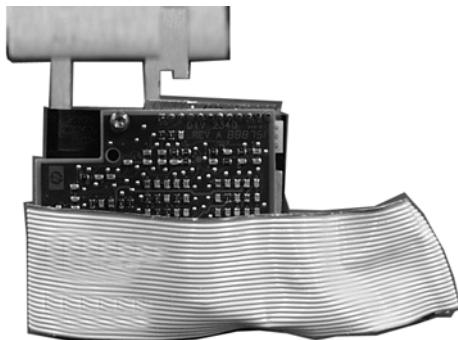
Figure 320-12 Bracket mounted onto the manifold

3. Peel the blank label from its backing and paste it on the mounting bracket over the screw heads. See Figure 320-12.

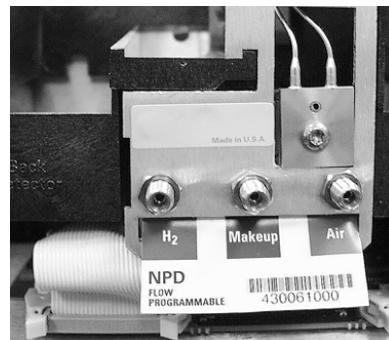
4. If the tubing from the gang fitting bends to the left, reshape it so that it bends up and back from the block as shown in Figure 320-14.
5. Insert the gang fitting through the cutout in the manifold bracket and install it onto the new manifold assembly so that the tubing runs back and away from the fitting.
 - Be sure the left tube clears the inner edge of the bracket. See Figure 320-14.
 - Be sure that the O-rings are in place.

Tighten the gang fitting screw firmly to compress the O-rings.

6. Route the ribbon cable behind the manifold assembly as shown in Figure 320-13. Then, slide the manifold and bracket assembly into the slot until the bracket seats flush against the end of the rails. See Figure 320-14.



Back view of manifold



Manifold installed with cable routed to left

Figure 320-13 Routing the ribbon cable

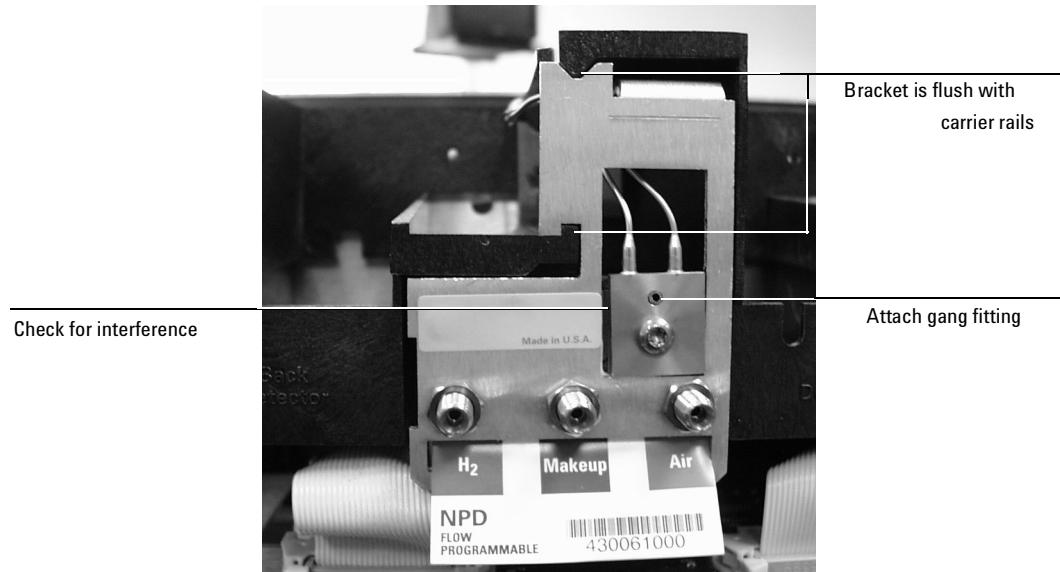


Figure 320-14 Manifold, after installation

7. Route the gas tubing behind the manifold, over the top of the chassis, and through the slots.
8. Connect the ribbon cable to the mating connector on the pneumatics board. Arrange the cable to keep it away from the valves and keep it from being pinched against the manifold.

For the back detector, you may want to loosen the manifold and slide it out of the carrier a few centimeters to connect the cable to the pneumatics board. Then, reinstall the manifold.
9. Secure the manifold in place using the Torx T-20 screw.
10. Using a pair of needle-nosed pliers, remove the appropriate top rear panel detector cutout for the NPD. Also remove any cutouts needed to access other manifolds or accessories installed in the GC. See Figure 320-15.

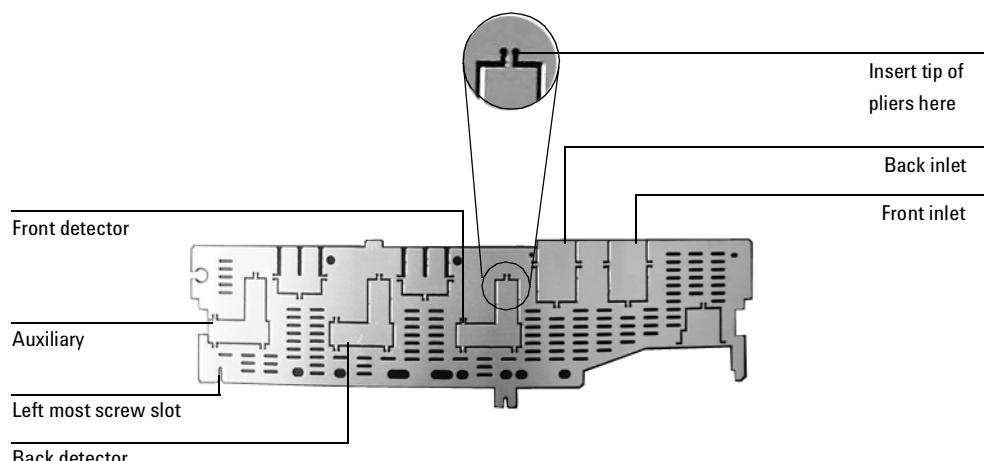


Figure 320-15 Top rear panel cutouts

11. Place the new top rear panel on its left-most mounting screw. Work from left to right and use the screw as a hinge, slide each manifold ID tag through its cutout in the panel. When all the tags are through the panel, finish installing the panel on the GC.
12. Install the RFI shield, the pneumatics cover, and the detector top cover.
13. Connect the source gas lines to the manifold. See Figure 320-16.



Figure 320-16 Gas line connections

14. Restore gas pressures and leak test the fittings.

Replacing the detector interface board

The NPD detector has an interface board on the main board.

WARNING Before proceeding, turn off the detector and any detector gases at their supply. Then turn off the main power switch and unplug the power cord.

Caution Make sure you are properly grounded with an ESD strap before continuing.

1. Remove the right side cover and the top electronics cover.
2. Unlock and unclip the electrometer ribbon cable from the NPD interface board.
3. Disconnect the bead drive cable from the board.

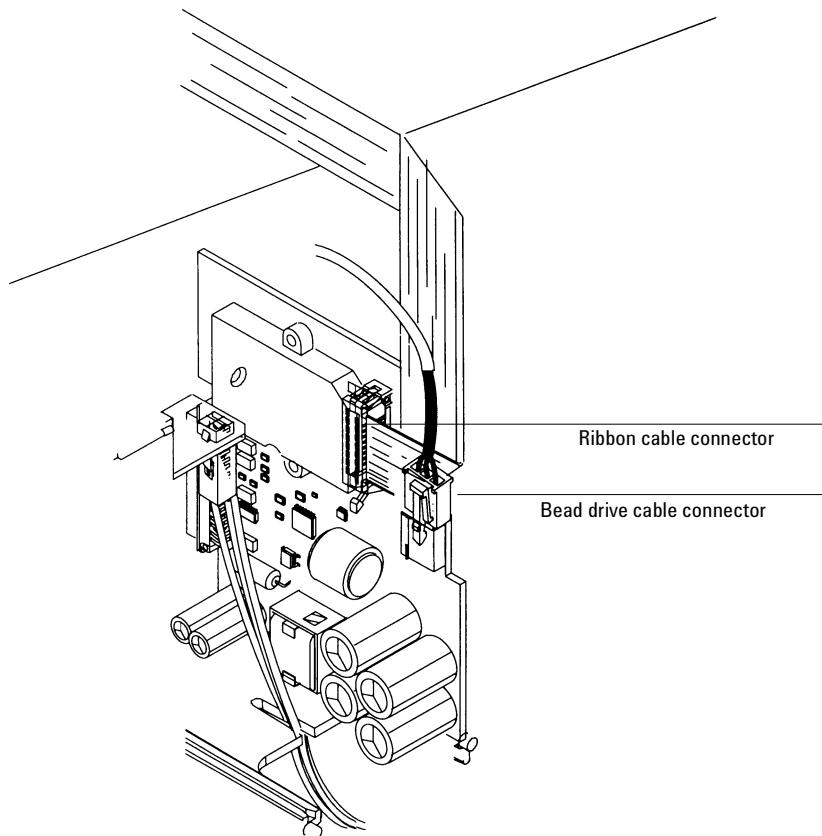


Figure 320-17 Location of NPD interface board connectors

4. Pull the NPD board directly out from the instrument.

Cleaning the NPD jet and collector

Both the jet and collector bore require occasional cleaning to remove deposits (usually consisting of white silica from column bleed). Such deposits reduce sensitivity and cause chromatographic noise and spikes.

Cleaning the collector

Turn off the detector and its heated zone; also turn off gases to the detector (particularly hydrogen). Allow time for the detector zone to cool.

1. Remove the collector as described in this chapter.
2. Use compressed air or nitrogen to blow out loose material from inside the collector. Do this carefully so as not to disturb the active element.
3. Wash the collector in **hexane** or **isooctane**. Then carefully dry the collector using compressed air or nitrogen.

Caution Avoid polar solvents, especially water; polar solvents may dissolve the rubidium salt coating on the active element.

Cleaning the jet

Turn off the detector and its heated zone; also turn off gases to the detector (particularly hydrogen). Allow time for the detector zone to cool.

1. Remove the jet as described in the NPD detector chapter.
2. Use a cleaning wire (0.016-inch od, 12-inch length, part no. 18765-20070) to loosen/remove internal deposits.
3. Wash both the internal bore and exterior of the jet with a 1:1 (V/V) solution of methanol and acetone. The jet may also be cleaned in an ultrasonic bath in the same solution.

Dry the jet with compressed clean air or nitrogen and heat in an oven at 70°C for at least 1/2-hour.

4. Clean the detector base cavity using solvents, a swab or wire brush, and low-pressure compressed air.

330 Thermal Conductivity Detector (TCD)

Theory of operation

The TCD responds to any compounds whose thermal conductivity is different from the thermal conductivity of the carrier gas alone. The TCD cell is a dual channel device, with an empty flow path and a path containing a detector filament. A switching valve alternates between sending the column effluent (containing analytes) through the empty and the active flow paths. When the column effluent flows through the empty channel, a pure stream of reference gas maintains an equilibrium through the filament path. The reference gas is used to compare thermal conductivity changes caused by the column effluent. A gas with high thermal conductivity, such as helium, is used as the carrier/make-up/reference gas. When the analyte is present in the gas stream, the thermal conductivity drops, and less heat is lost to the cavity wall. Under constant applied voltage, a silicon nitride coated filament in the TCD cell will heat up and its resistance will increase. This change is what is recorded and measured for the chromatogram.

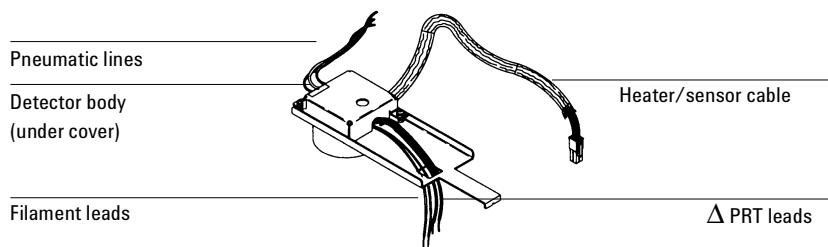


Figure 330-1 The Thermal Conductivity Detector (TCD)

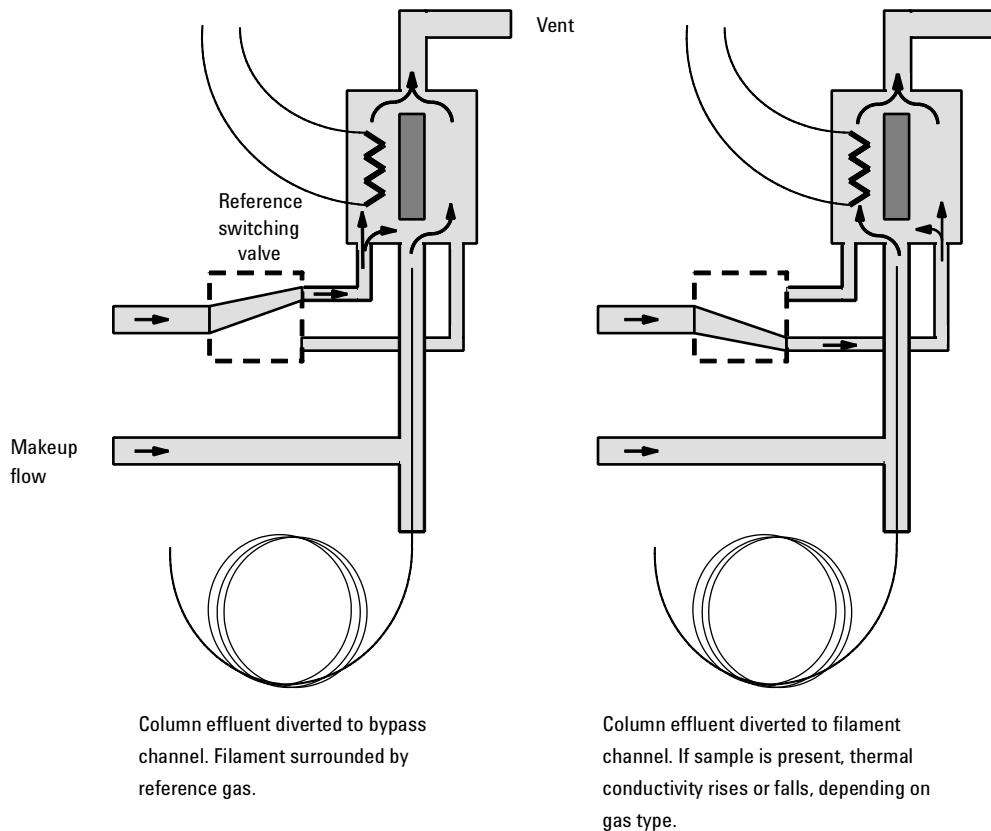


Figure 330-2 TCD flow path switching

Delta PRT

TCDs manufactured after April 1997 use a second temperature sensor in the detector block to increase filament life.

The temperature sensor installed with the TCD heater sends data only to the main board, which shuts down the detector if the amount of voltage applied to the heater does not correspond to the actual temperature reading from the sensor. In TCDs without a Δ PRT, the filament temperature is set at one of two setpoints, 310°C or 440°C, depending on the whether the detector block setpoint is above or below 200°C. In TCDs with a Δ PRT, the Δ PRT sends block temperature data directly to the detector interface card, which then automatically adjusts the filament voltage. Filament temperature is maintained at a relatively constant difference above detector operating temperature. See Figure 330-3 below. This adjustment increases filament life and minimizes changes in detector sensitivity based on the filament/detector block temperature difference.

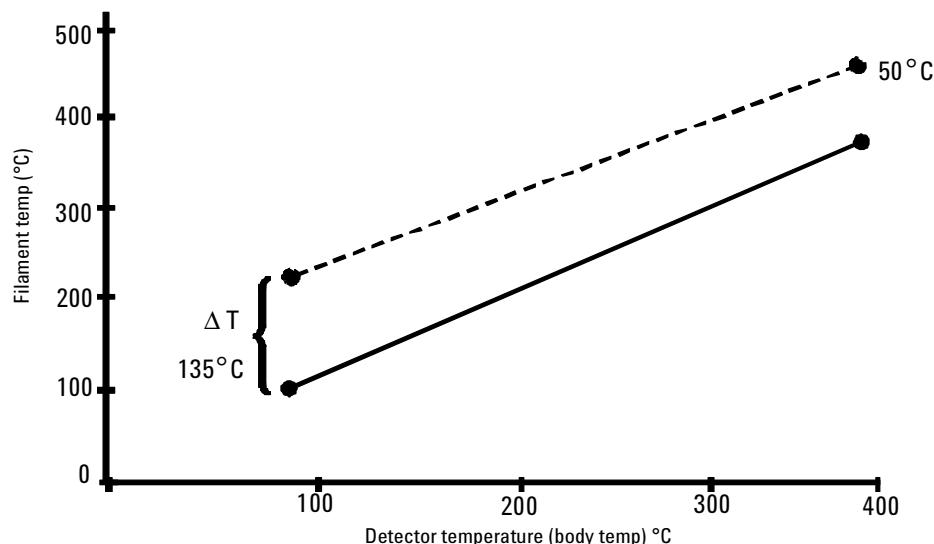


Figure 330-3 Filament temperature versus detector block temperature

Note If the Δ PRT is not properly connected to the detector interface card, filament burnout can occur.

Error messages

The main board will deliver a Fault 216/217 error, Front/Back TCD filament open, if the Δ PRT is shorted out. With a shorted Δ PRT, the block temperature will appear to be very low, and so the filament temperature will be increased until the main board senses excessive filament resistance and shuts the detector down, or the filament fails.

The main board will deliver a Fault 218/219, F/B TCD filament shorted, if the Δ PRT fails open. The detector card will sense infinite temperature in the block and not power the filament.

EPC detector

The EPC TCD has one flow line for the makeup/reference gas. After an initial filter frit, it splits into two paths. Each line has a proportional valve controlled by a pressure sensor, and a non-adjustable restrictor frit. In addition, the switching gas line has a switching valve that switches paths through the TCD cell several times a second. The switching line oscillates between two flowpaths, one for each channel of the TCD cell. The makeup gas line sweeps past the end of the column and carries the column effluent into the TCD cell.

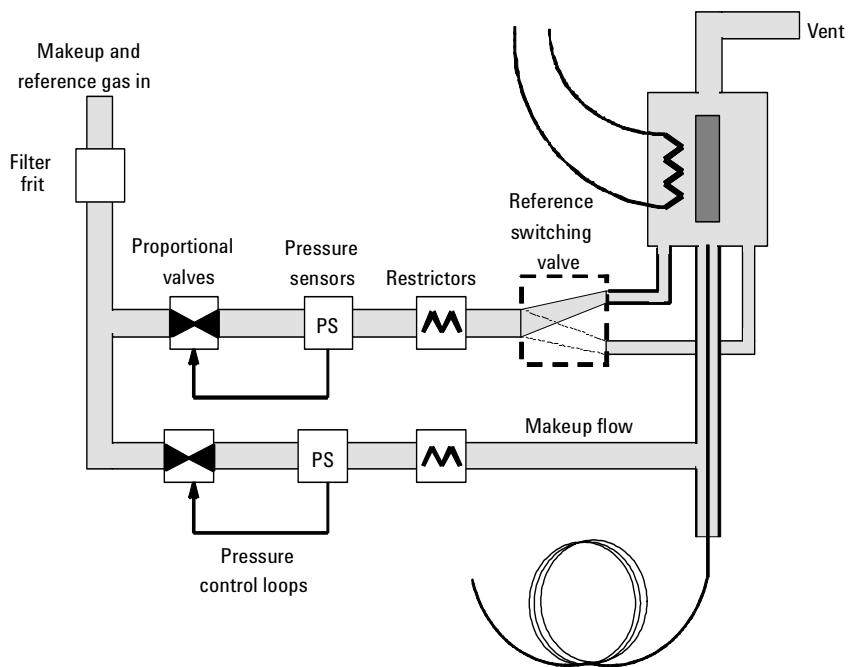


Figure 330-4 EPC TCD flow diagram

Manually controlled detector

The manually controlled TCD has a pneumatic supply line for the switching gas (also called modulating or reference gas) flow and one for the makeup gas. Both of the lines have pressure regulators, an on/off solenoid valve and a non-adjustable restrictor frit. In addition, the switching gas line has a

switching valve that switches paths through the TCD cell several times a second. The switching valve oscillates between two flowpaths, one for each channel of the TCD cell. The makeup gas line sweeps past the end of the column and carries the column effluent into the TCD cell.

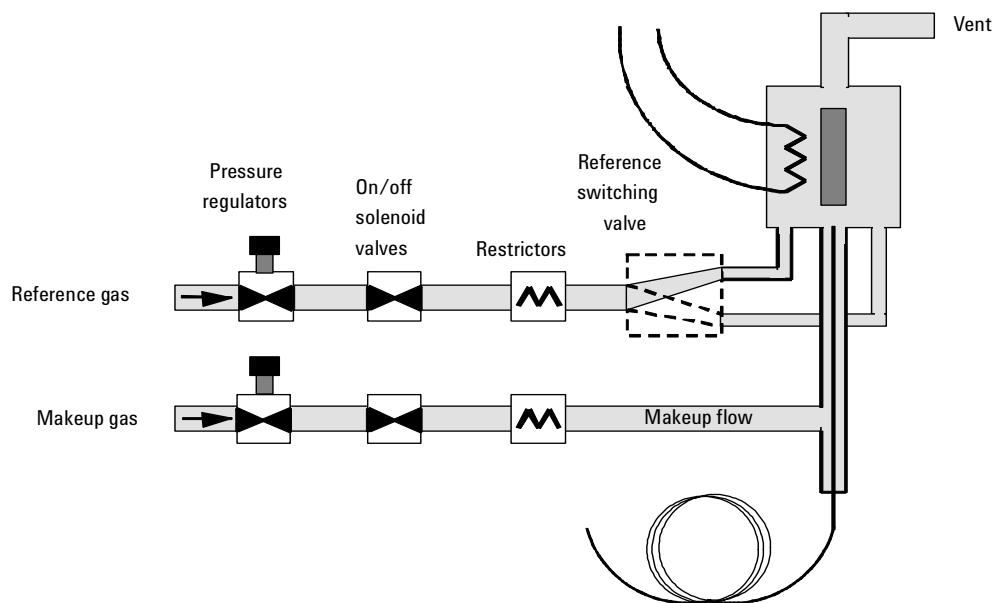


Figure 330-5 Manual TCD flow diagram

Replacement procedures

Replacing the entire detector

WARNING Before proceeding, turn off the oven and any heated zones and let them cool down. Turn off any detector gases at their supply, then turn off the main power switch and unplug the power cord.

Caution Make sure you are properly grounded with an ESD strap before continuing.

1. Shut off the detector and the detector gases, and let the detector cool.
2. Remove the detector cover, the electronics cover, the right side cover, the RFI shield, and the rear top panel.
3. Disconnect the column from the bottom of the detector.

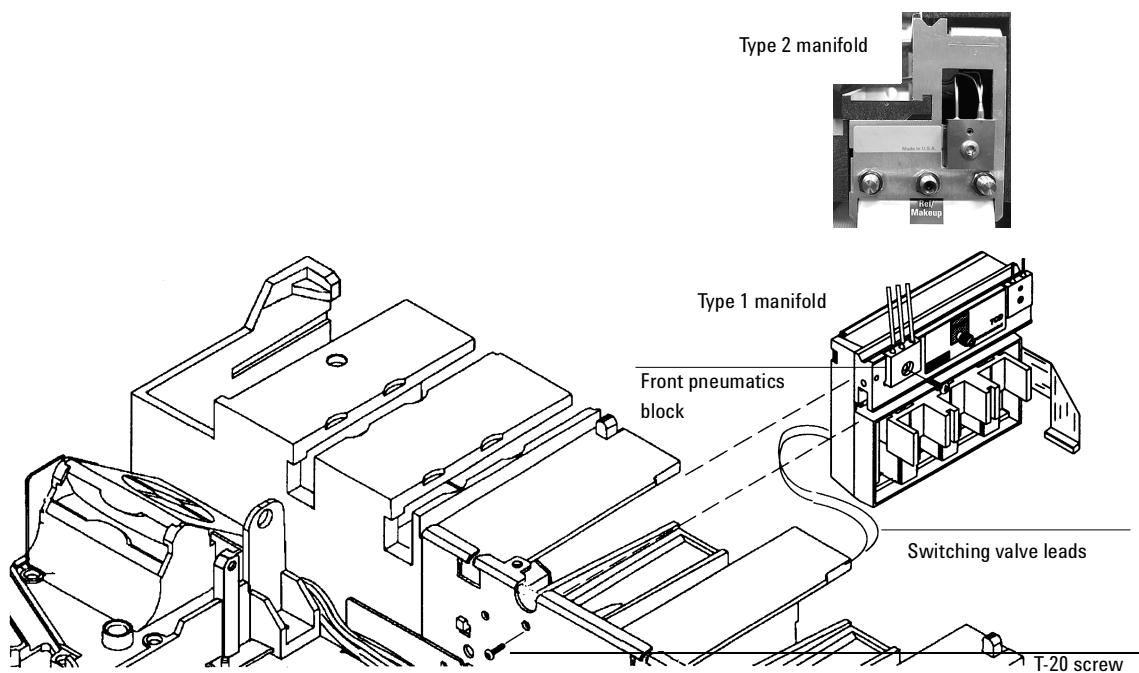


Figure 330-6 Disconnecting the detector flow lines

4. Type 1 manifold

Remove the Torx T-20 screw from the front of the manifold as shown. If you do not intend to remove the manifold, slide it to the rear so that you can remove the screw holding the front pneumatic block, then return it to position and insert the screw to secure it.

5. Type 2 manifold

The pneumatics block is on the rear face of the manifold. If you do not intend to remove the manifold, remove the screw holding the pneumatics block. Remove the T-20 screw on the front only if you intend to remove the manifold.

- a. Remove the Torx T-20 screw from the front of the manifold as shown.

6. Unlock the detector manifold's ribbon cable from the EPC board and detach the connector. The adjacent ribbon cable may have to be removed as well.
7. Trace the flow manifold's switching valve leads to the detector interface card, disconnect them there, and route them back through the mainframe to the pneumatics carrier.
8. Slide the manifold out of the back of the GC. You will need to remove the two 1/16-inch tubes from the sheet metal and straighten them.
9. Disconnect the TCD filament leads which run from the detector to the detector interface card. Disconnect the wires from the detector interface card using a small flat blade screwdriver to push down on the connector tabs while you pull out the wires.

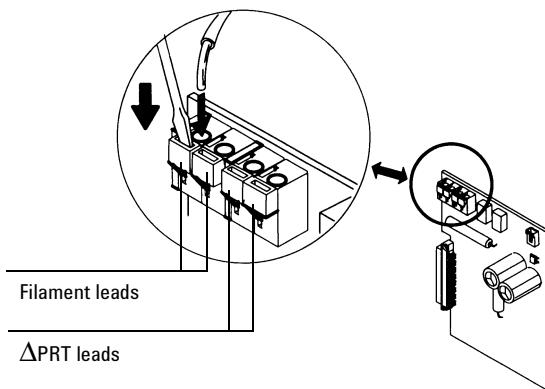


Figure 330-7 Disconnecting the TCD filament and PRT leads

10. If your TCD uses a second ΔPRT disconnect the leads from the detector card. Use a flat bladed screw driver to push down on the connector tabs while removing the wires.
11. Unclip the heater/sensor leads. Follow the leads from the detector back to the connector mounted on a bracket near the detector card.

12. Use a T-20 Torx screwdriver to remove the four screws securing the aluminum detector carrier bracket to the instrument. (Note that two of the screws secure the cover to the bracket.) Lift the detector from the instrument.

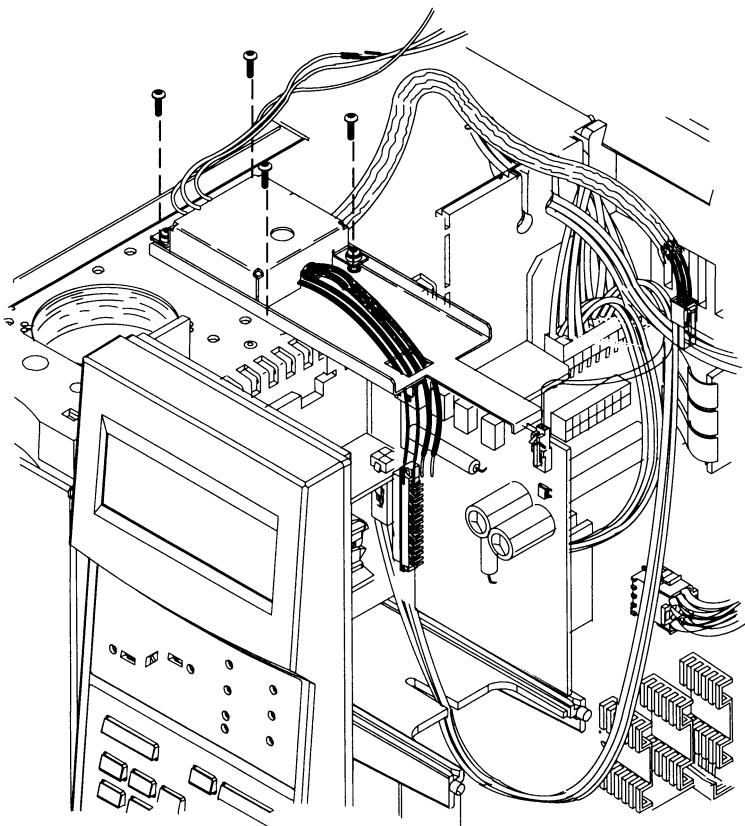


Figure 330-8 Removing the screws from the carrier bracket

Replacing the detector cell

WARNING Before proceeding, turn off the oven and any heated zones, and let them cool down. Turn off any detector gases at their supply. Then turn off the main power switch and unplug the power cord.

1. Remove the detector carrier bracket and detector cell as described in the Replacing the entire detector procedure.
2. Remove the cover and the insulation.
3. Use a T-20 Torx screwdriver to remove the two screws securing the detector cell to the aluminum detector carrier bracket and lift the cell from the bracket.

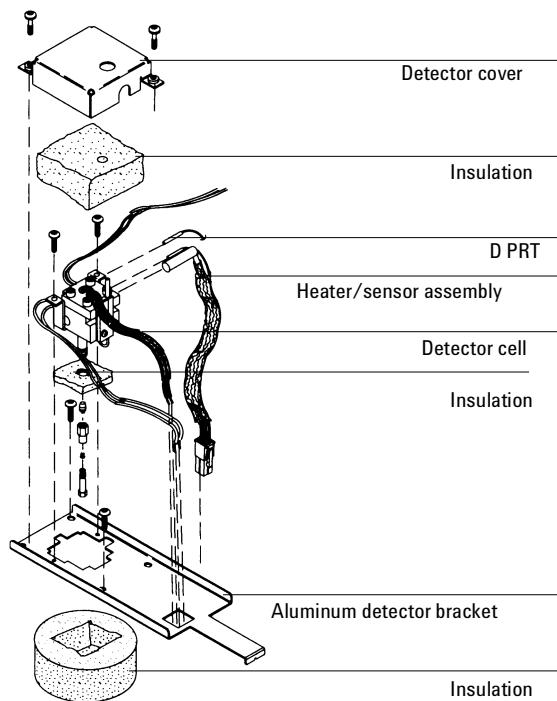


Figure 330-9 Removing the detector cell from the carrier bracket

4. Slide the heater/sensor assembly from the detector cell.
5. If your TCD uses a Δ PRT, slide it out of the detector cell.

6. Install the new cell and reassemble the detector. Reassembly is the reverse of removal with the following additional considerations:
 - Before replacing the insulation, place the cap that came with your detector over the detector vent to prevent plugging the vent with insulation. Remove the cap once the insulation is in place.
7. When replacing the detector cover, make sure that the hole in the top of the cover is positioned over the detector vent and that the filaments, plumbing and heater/sensor leads including the ΔPRT leads, if used on the TCD) are positioned under the appropriate cut-outs on the sides of the cover.
 - Make sure that only the filament wire is inserted into the connector, not the insulation sleeve. Then, check the filaments by tugging slightly on them.
 - If your TCD uses a ΔPRT, check the sensor lead connections to the detector card by tugging slightly on them.
 - Replace the heater/sensor and ΔPRT. In the sensor holes as shown below.

Caution If your detector card uses a ΔPRT, make sure the ΔPRT leads are properly installed. If the ΔPRT leads are not properly installed in the detector card, filament burnout can occur.

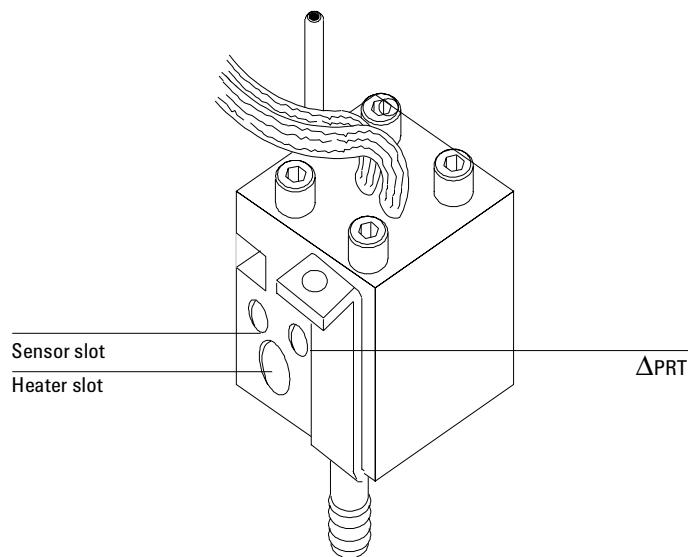


Figure 330-10 Sensor placement in the TCD cell

Removing an EPC flow manifold

Early models of the 6890 GC used Type 1 EPC flow manifolds. Later models use Type 2 manifolds. Both types are covered here.

The TCD detector EPC flow manifold contains one inlet fitting for reference and makeup gases. There are three tubes on the pneumatics block fitting going to the TCD. One is the makeup gas and two are the reference gas.

WARNING Before proceeding, turn off the detector and any detector gases at their supply. Then turn off the main power switch and unplug the power cord.

Caution Make sure you are properly grounded with an ESD strap before continuing.

1. Remove the detector cover, the pneumatics cover, metal RFI shield and the rear top panel.

2. Remove the gas supply line from the fitting from the side (Type 1) or the rear (Type 2) of the manifold.
3. Disengage the detector tubing from the slots in the chassis so that the gang fitting on the manifold can be removed easily.
4. At the front of the manifold, remove the Torx T-20 screw that holds the manifold in its slot.

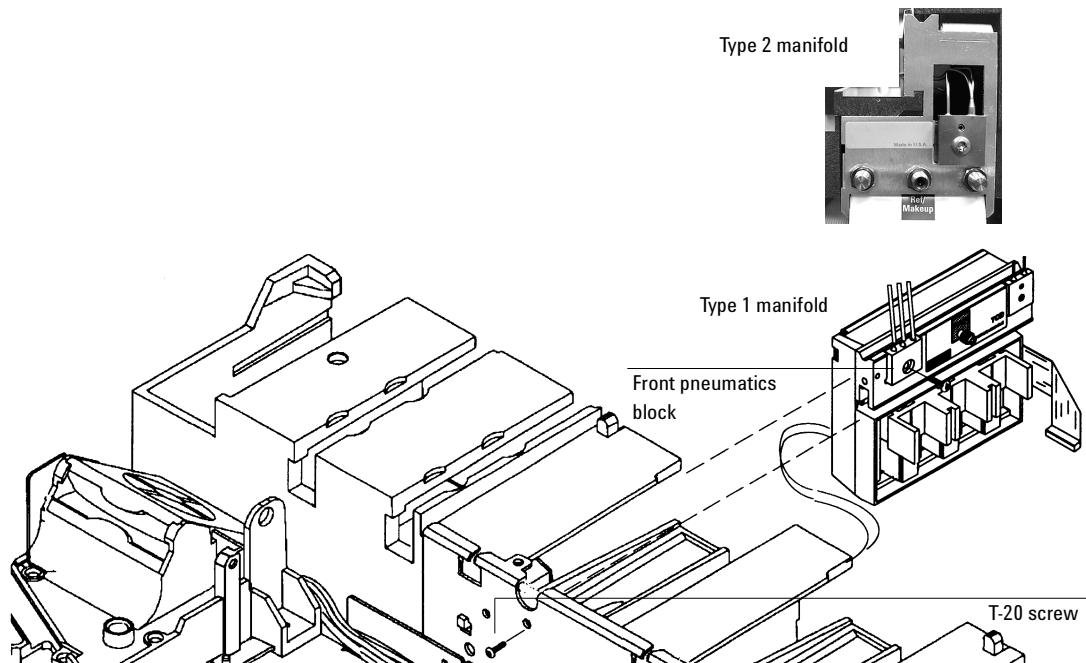


Figure 330-11 Removing an EPC flow manifold

5. Remove the screw holding the pneumatics block to the manifold. On Type 1 manifolds, slide the manifold to the rear to reach the screw.
6. Unlock the detector manifold's ribbon cable from the EPC board and detach the connector. The adjacent ribbon cable may have to be removed as well.

7. Unclip the switching valve connector from the detector interface board (Type 1 manifold) or the in-line connector (Type 2 manifold), and thread it back up through the mainframe to the pneumatics carrier.

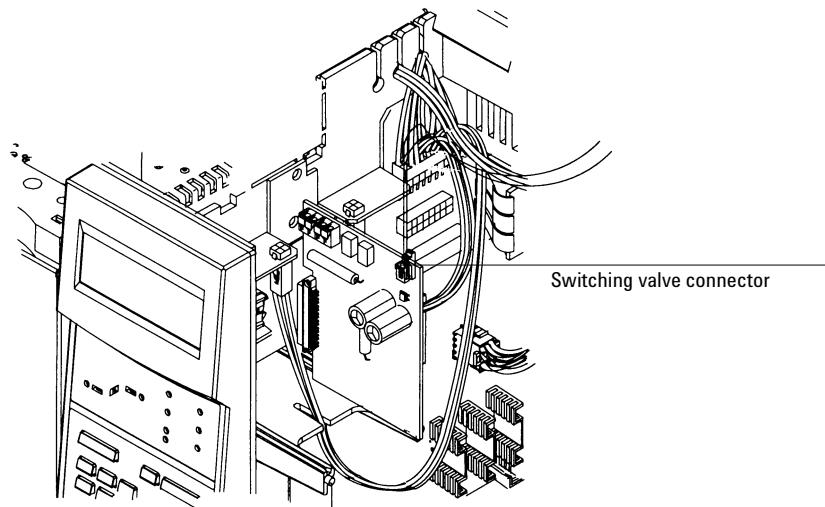


Figure 330-12 Removing the detector interface card

Caution Always hold the Type 2 manifold by its support bracket to avoid damaging board components.

8. Slide the manifold from its slot.

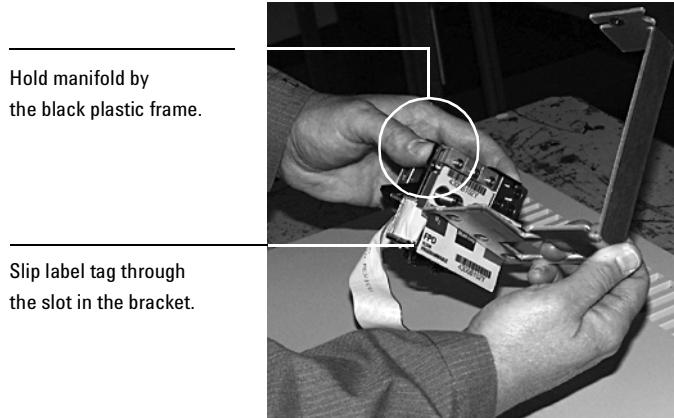
Installing a Type 2 manifold

WARNING Hydrogen gas is flammable and potentially explosive. Before replacing the manifold, turn off the hydrogen gas at the source.

WARNING Before proceeding, turn off the oven and any heated zones and let them cool down. Turn off all detector gases at their supply, then turn off the main power switch and unplug the power cord.

Caution Always hold the manifold as shown below to avoid damaging board components.

1. While holding the manifold by the black plastic frame as shown below, slip the label through the slot in the mounting bracket, and align the bracket holes over the gas fittings.



(FPD shown)

2. Finger-tighten three 7/16-inch hex nuts over the fittings to hold the bracket in place. It is **very important** that you do **not** tighten the nuts yet.

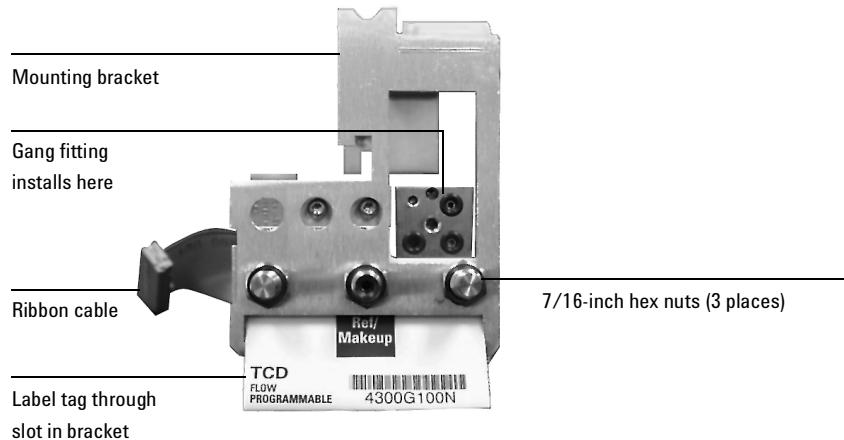
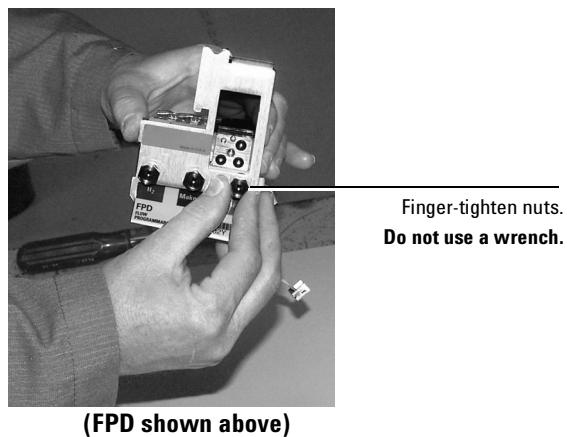


Figure 330-13 Bracket mounted onto the manifold

3. Peel the blank label from its backing and paste it on the mounting bracket over the screw heads.
4. If the original tubing from the gang fitting is not long enough to reach the new manifold, install the TCD adapter weldment between the gang fitting and the manifold and shape the tubing so that it bends up and back from the block as shown in Figure 330-14.

- If replacing a Type 2 manifold, the TCD adapter weldment should not be needed.
- Be sure the left tube clears the inner edge of the bracket. See Figure 330-16.
- Be sure all O-rings are in place.
- Be sure that the hole patterns between the mating pieces are aligned.

Tighten the gang fitting screw firmly to compress the O-rings.

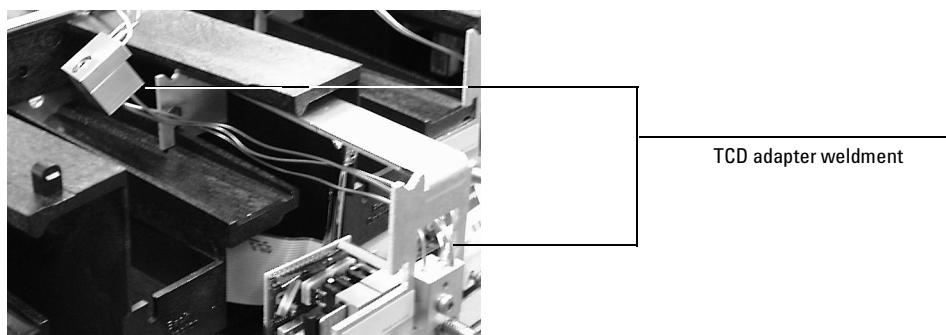
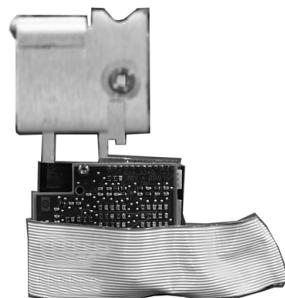


Figure 330-14 Installing the TCD adapter weldment

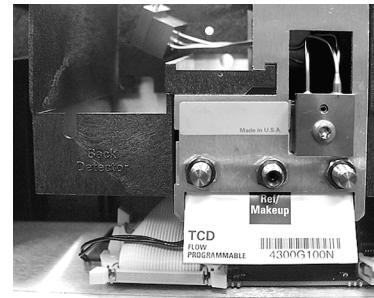
5. If replacing a Type 1 manifold, feed the 3-way switching valve cable through the chassis to the detector interface board. Connect it to the top edge of the board. The connector only goes on one way.

If replacing a Type 2 manifold, connect the switching valve wires to the existing cable.

6. Route the ribbon cable behind the manifold assembly as shown in Figure 330-15. Then, slide the manifold and bracket assembly into the slot until the bracket seats flush against the end of the rails. See Figure 330-16.



Back view of manifold



Manifold installed with cable routed to left

Figure 330-15 Routing the ribbon cable

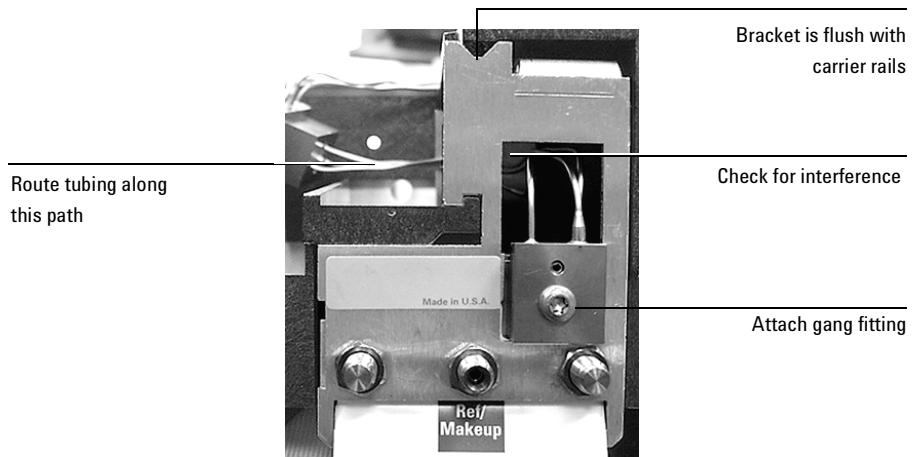


Figure 330-16 Manifold, after installation

7. Secure the manifold in place using the Torx T-20 screw.
8. Route the gas tubing behind the manifold, over the top of the chassis, and through the slots as shown in Figure 330-16.

9. Connect the ribbon cable to the mating connector on the pneumatics board. Arrange the cable to keep it away from the valves and keep it from being pinched between board components and the manifold.

For the back detector, you may want to loosen the manifold and slide it out of the carrier a few centimeters to connect the cable to the pneumatics board. Then, reinstall the manifold.

10. Using a pair of needle-nosed pliers, remove the appropriate top rear panel detector cutout for the TCD. Also remove any cutouts needed to access other manifolds or accessories installed in the GC. See Figure 330-17.

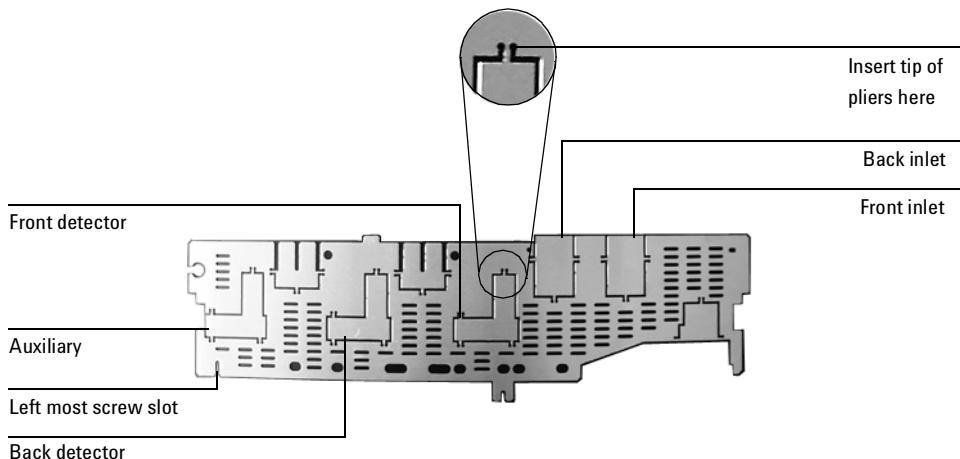


Figure 330-17 Top rear panel cutouts

11. Place the new top rear panel on its left-most mounting screw. Use the screw as a hinge and angle the panel while sliding each manifold ID tag through its cutout in the panel, working from left to right. When all the tags are through the panel, finish installing the panel on the GC.
12. Install the RFI shield, the pneumatics cover, and the detector top cover.
13. Connect the source gas lines to the manifold. See Figure 330-18.



Figure 330-18 Gas line connections

14. Restore gas pressures and leak check all fittings.

Replacing the detector interface card

WARNING Before proceeding, turn off the detector and any detector gases at their supply. Then turn off the main power switch and unplug the power cord.

Caution Make sure you are properly grounded with an ESD strap before continuing.

1. Unplug the switching valve lead from the P1 connector on the interface card.
2. Disconnect the TCD filament lead wires. The TCD filament leads run from the detector to the detector interface card. Disconnect the filament leads from the detector interface card by using a small flat blade screwdriver to push down on the connector tabs while you pull out the filament leads.
3. If your card has a ΔPRT installed, disconnect the sensor leads from the card. Use a small flat blade screwdriver to push down on the connector tabs while you pull out the leads.
4. Pull the card directly out from the main board.

Caution If your detector card uses a Δ PRT, make sure the Δ PRT leads are properly installed. If the Δ PRT leads are not properly installed in the detector card, filament burnout can occur. Check the leads by tugging slightly on each one.

5. Reassembly is the reverse of removal. When reinstalling the card, align the top edge of the interface card with the notch of the TCD metal pallet.

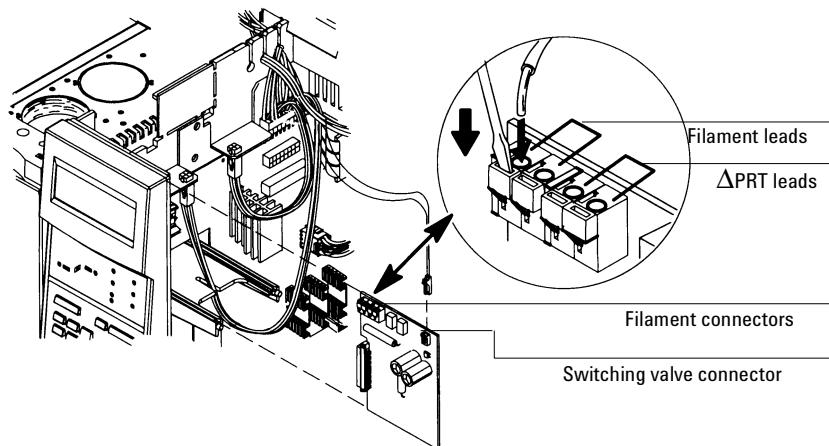


Figure 330-19 Removing the detector interface card

Cleaning the Thermal Conductivity Detector

After verifying that the carrier supply gas and flow system components are leak- and contaminant-free, you can clean the detector by bakeout.

1. Turn off the detector.
2. Remove the column from the detector, then cap the detector column fitting.
3. Establish a normal reference gas flow rate (20 to 30 mL/min) through the detector (set oven temperature to 250°C).
4. Heat the detector to 400°C. Allow thermal cleaning to continue for several hours.

340 Electron Capture Detector (ECD)

Theory of operation

The ECD is based on the phenomenon that electronegative species can react with thermal electrons present to form negatively charged ions. The loss of such electrons is related to the quantity of analyte in the sample. In order to produce capturable (low energy) thermal electrons, the carrier gas is ionized by beta particles from a radioactive source in the cell. This electron flow produces a current, which is collected and measured. When the sample molecule is introduced into the cell, electrons which would otherwise be captured at the electrode are captured by the sample, resulting in decreased current. This change is what is recorded and measured for the chromatogram.

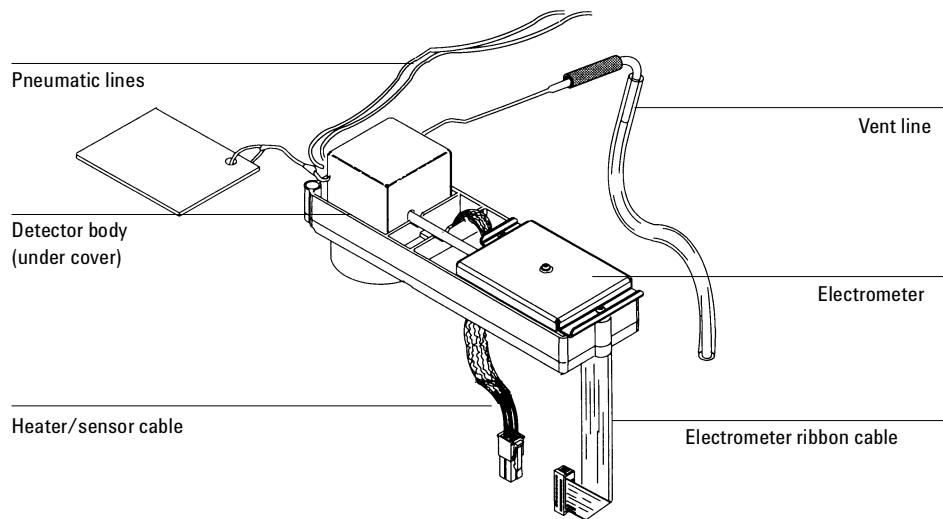


Figure 340-1 The Electron Capture Detector (ECD)

EPC detector

The EPC version of the ECD detector has one flow line for the anode purge/makeup gas. After an initial filter frit, it splits into two paths. Each line has a proportional valve controlled by a pressure sensor, and a non-adjustable restrictor frit. The makeup gas line sweeps past the end of the column and carries the column effluent into the ECD cell. The anode purge flow sweeps the upper part of the ECD and cleans sample deposition from the detector.

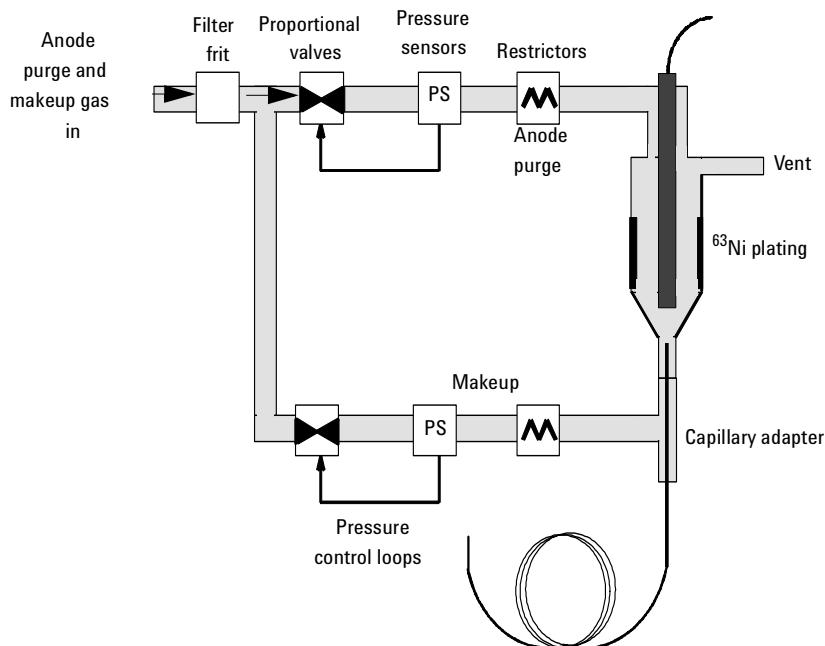


Figure 340-2 EPC ECD flow diagram

Manually controlled detector

The manually controlled ECD has a pneumatic supply line for the anode purge gas and for the makeup gas. Both lines have an on/off solenoid valve and a nonadjustable restrictor frit. A pressure regulator allows for adjusting the

makeup gas and anode purge flows. The makeup gas line sweeps past the end of the column and carries the column effluent into the ECD cell.

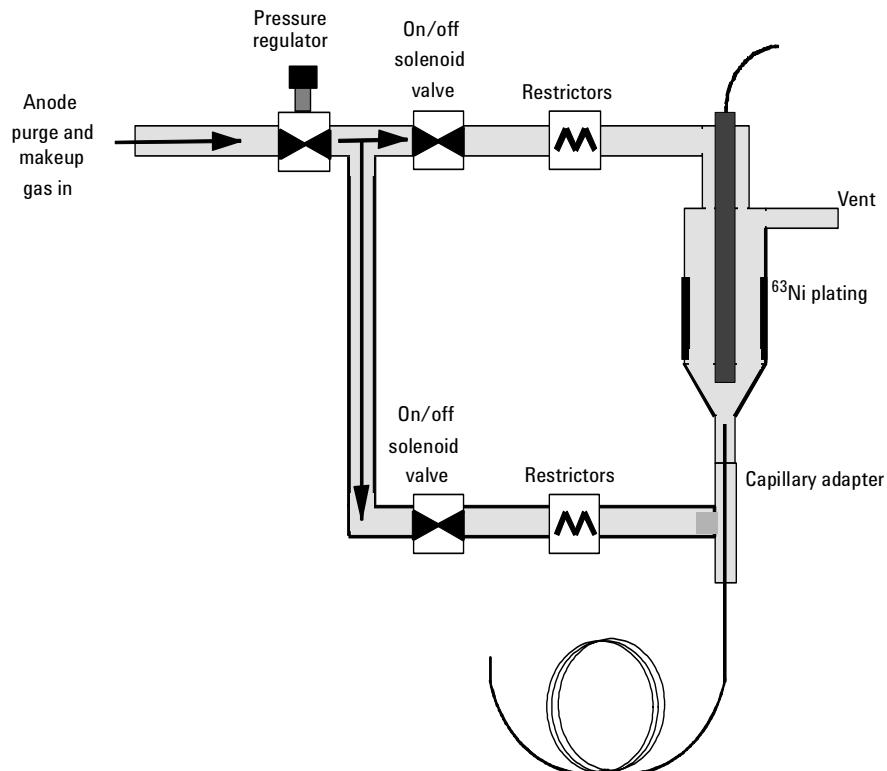


Figure 340-3 Manual ECD flow diagram

Replacement procedures

Replacing the entire detector/detector cell

WARNING Before proceeding, turn off the oven and any heated zones and let them cool down. Turn off any detector gases at their supply, then turn off the main power switch and unplug the power cord.

WARNING The ECD cell contains radioactive ^{63}Ni . To reduce the risk of exposure, wear disposable gloves while handling the ECD cell. When you are finished, dispose of the gloves and wash your hands with soap and water.

1. Remove the detector cover, the electronics carrier cover and the right side cover.

Caution Make sure you are properly grounded with an ESD strap before continuing.

2. Disconnect the electrometer ribbon cable from the ECD interface card.
3. Disconnect the heater/sensor leads from the connector on the right side of the GC.

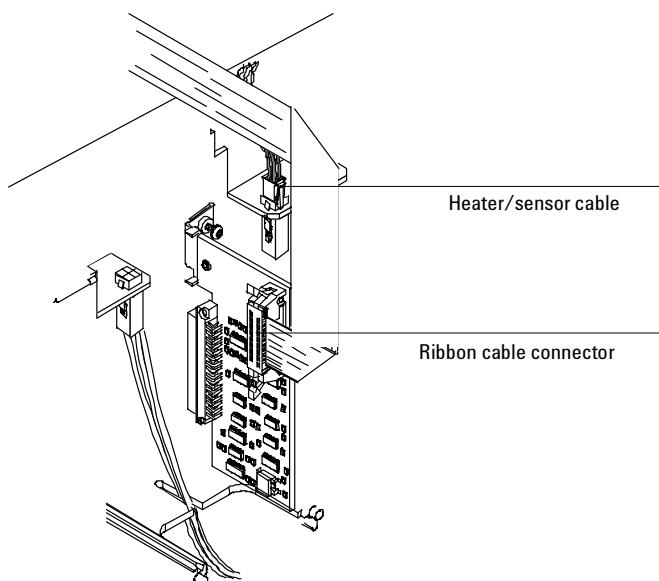


Figure 340-4 Disconnecting the ECD cables

4. Inside the oven, remove the insulation cup and disconnect the column from the makeup gas adapter.
5. Use a 9/16-inch wrench to loosen the 1/4-inch Swagelok nut on the makeup gas adapter from the bottom of the detector. Slide the makeup gas adapter out of the bottom of the detector.

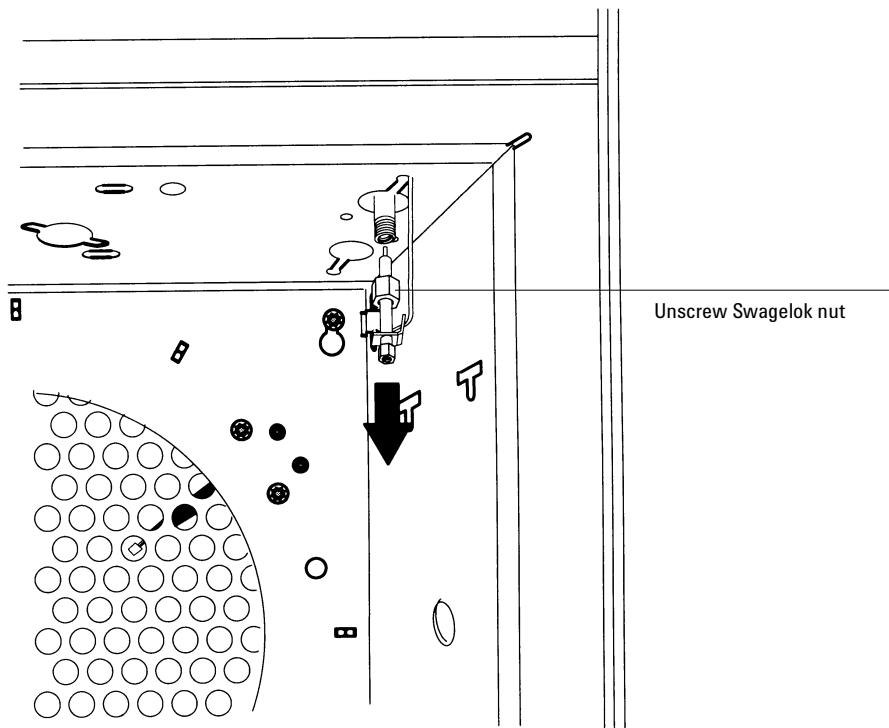


Figure 340-5 Disconnecting the makeup gas adapter

6. Disconnect the ECD vent tube at the rubber sleeve.
7. Use a 5/16-inch wrench to disconnect the 1/16-inch Swagelok union on the anode purge line.
8. Remove the one Torx T-20 screw securing the top ECD detector cover to the detector pallet and remove the cover.
9. Disconnect the anode signal wire from the detector.

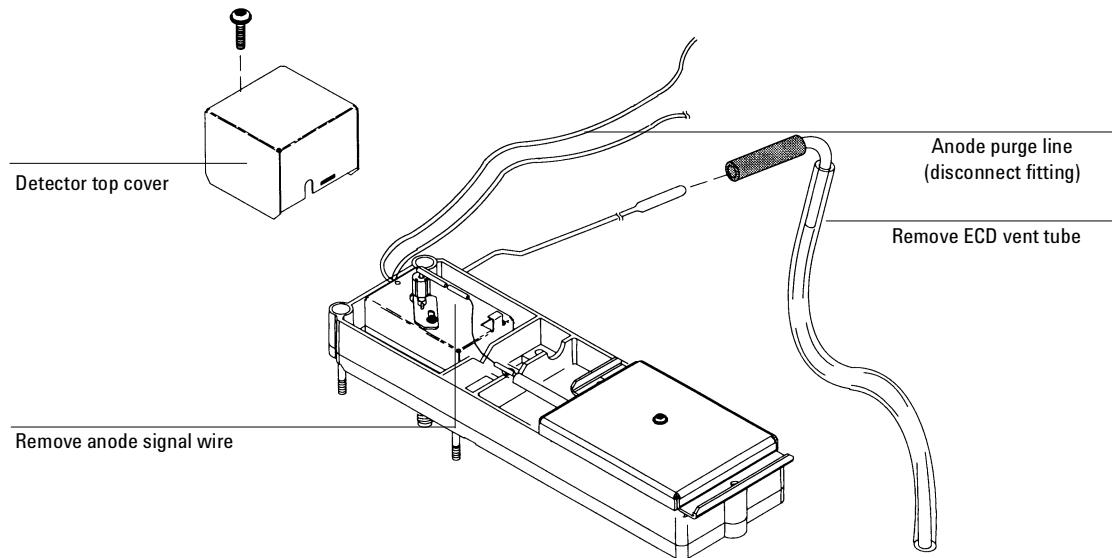


Figure 340-6 Removing the cover, anode purge fitting, vent tube, and anode signal wire

10. Fully loosen the four Torx T-20 screws on the detector pallet and lift the pallet and detector from the GC.
11. Thread the heater/sensor leads out of the detector pallet and remove the detector from the pallet.

The ECD detector is now properly disassembled for replacement or exchange. DO NOT remove the inner thermal cover if you are replacing the entire detector assembly.

Replacing the heater/sensor assembly

After removing the ECD detector from the GC, you can further disassemble it to replace the heater/sensor assembly.

WARNING The ECD cell contains radioactive ^{63}Ni . To reduce the risk of exposure, wear disposable gloves while handling the ECD cell. When you are finished, dispose of the gloves and wash your hands with soap and water.

1. Remove the detector as described in the Replacing the entire detector/detector cell procedure in this section.
2. Loosen the locking tab screw on top of the detector, slide the locking tab back, and pivot it out of the way.

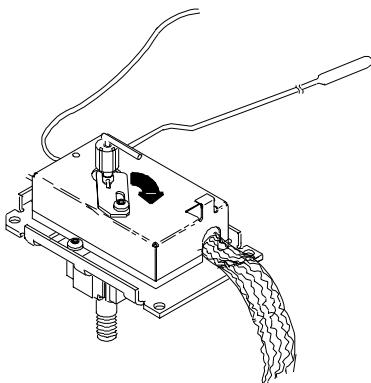


Figure 340-7 Unlocking the thermal cover

3. Lift the thermal cover up and carefully slide it off of the anode assembly.

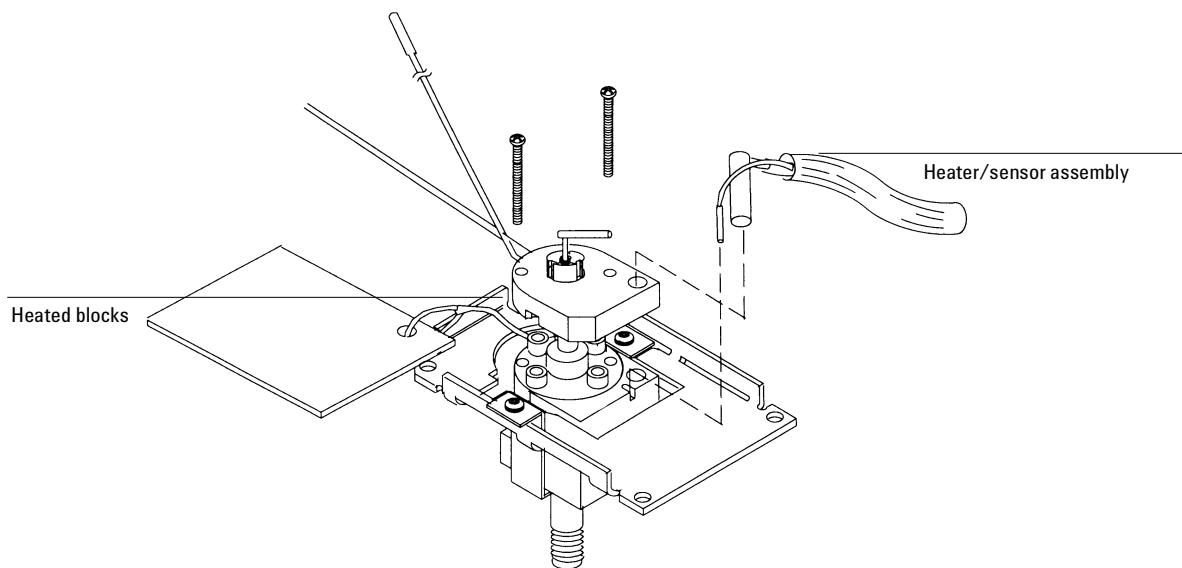


Figure 340-8 Removing the heater/sensor

4. Slide the heater and sensor out of the heated blocks.

Replacing the makeup gas adapter

After removing the ECD detector from the GC, you can further disassemble it to replace the makeup gas adapter. The makeup gas adapter consists of a line from the detector pneumatics manifold that carries makeup gas to a weldment that screws into the bottom of the ECD detector. From there, the makeup gas sweeps past the end of the column and carries the column effluent into the ECD cell.

1. Remove the detector as described in the Replacing the entire detector/detector cell procedure in this section.
2. Remove the Torx T-20 screw holding the pneumatics block(s) to the detector manifold.

Note

There are two pneumatics blocks on the EPC version of the ECD pneumatics manifold. The outside block is the anode purge gas line and the inside block is the makeup gas line.

3. Slide the makeup gas adapter up and out of the GC.
4. When reinstalling the makeup gas adapter, ensure the following:
 - Approximately 6 inches of the makeup gas line should reside in the oven after installation.
 - The makeup gas line should be bent into a coil that loops around the bottom of the detector weldment and makeup gas adapter.

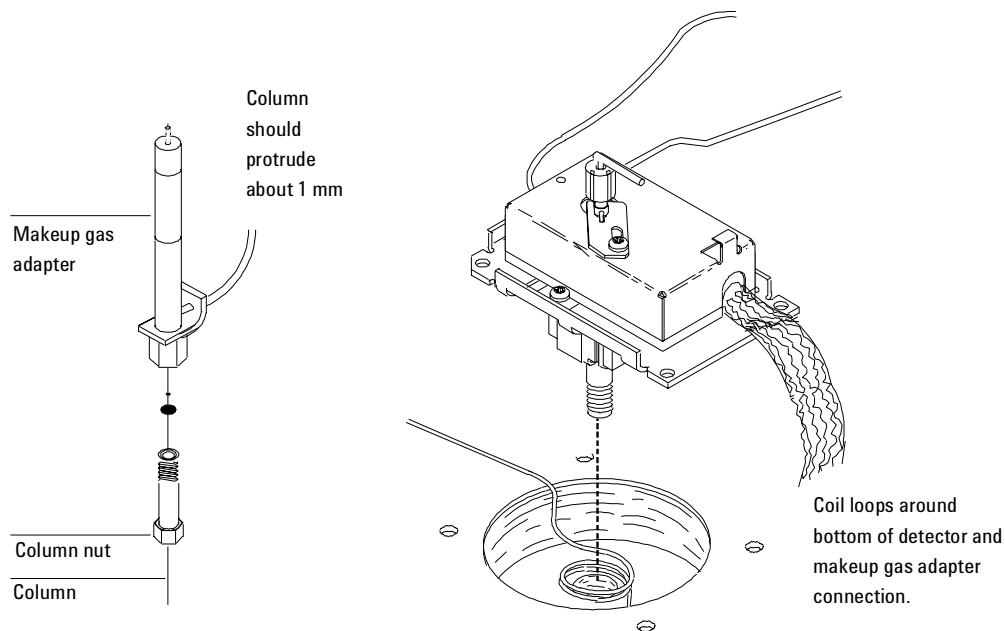


Figure 340-9 Proper configuration of the column and makeup gas tubing

- The end of the column should protrude about 1 mm from the top of the makeup gas adapter. The total dimension from the back of the column nut to the end of the column will be about 75 to 76 mm.

Removing the EPC flow manifold

The ECD detector uses a Type 1 EPC flow manifold that contains one inlet supply fitting for a purge/makeup gas.

WARNING Before proceeding, turn off the oven and any heated zones and let them cool down. Turn off any detector gases at their supply, then turn off the main power switch and unplug the power cord.

1. Remove the top plastic covers from the detector and pneumatics areas. Also remove the RFI metal shield and the top rear metal cover.

2. Remove the gas supply fitting from the side of the manifold.
3. At the front of the manifold, remove the Torx T-20 screw that holds the manifold in its slot.

Caution Make sure you are properly grounded with an ESD strap before continuing.

4. Unlock the detector manifold's ribbon cable from the EPC board and detach the connector. The adjacent ribbon cable may have to be removed as well.
5. Remove the Torx T-20 screw holding the output pneumatics block(s) to the manifold and remove the block.
6. Slide the manifold from its slot.

Note There are two pneumatics blocks on the EPC version of the ECD pneumatics manifold. The outside block is the anode purge line and the inside block is the makeup gas line.

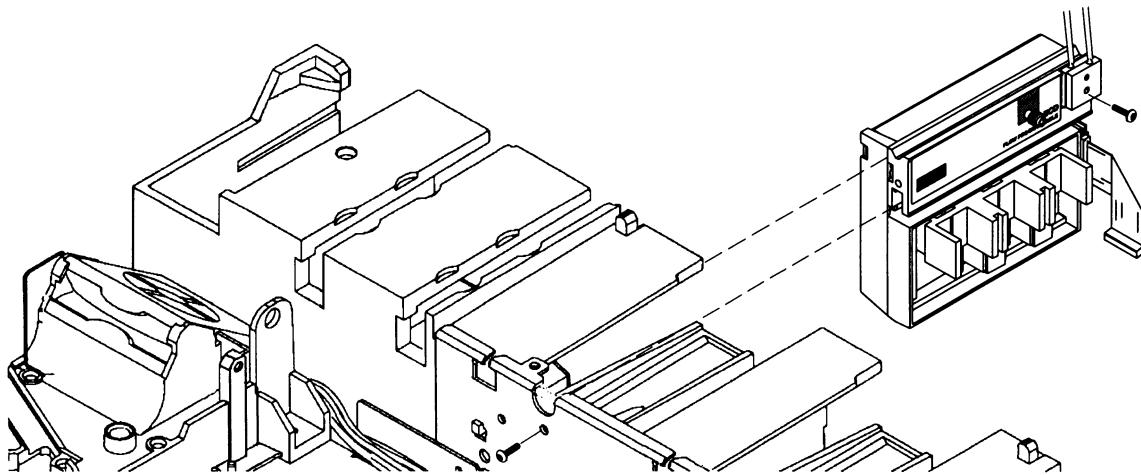


Figure 340-10 Removing the detector flow manifold

Removing the signal board

1. Remove both the electronics top cover and the right side cover.
2. Remove the Torx T-20 screw securing the top cover and remove the cover.
3. Disconnect the signal wire from the signal board interconnect.

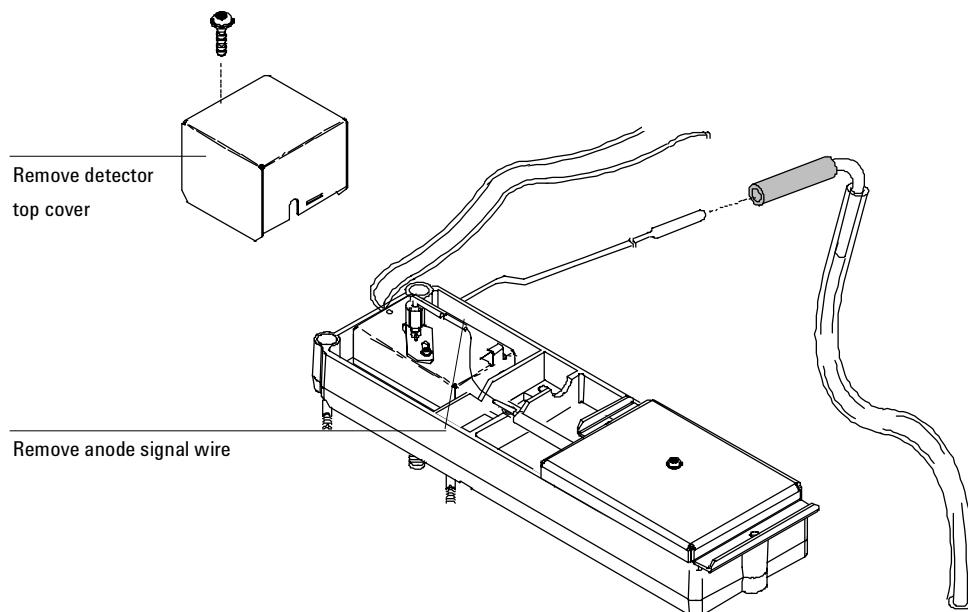


Figure 340-11 Removing the top cover and anode signal wire

4. Remove the screw and clamp on the electrical interconnect.
5. Remove one Torx T-20 screw from each end of the signal board. (Do not remove the screw on the top of the cover.)

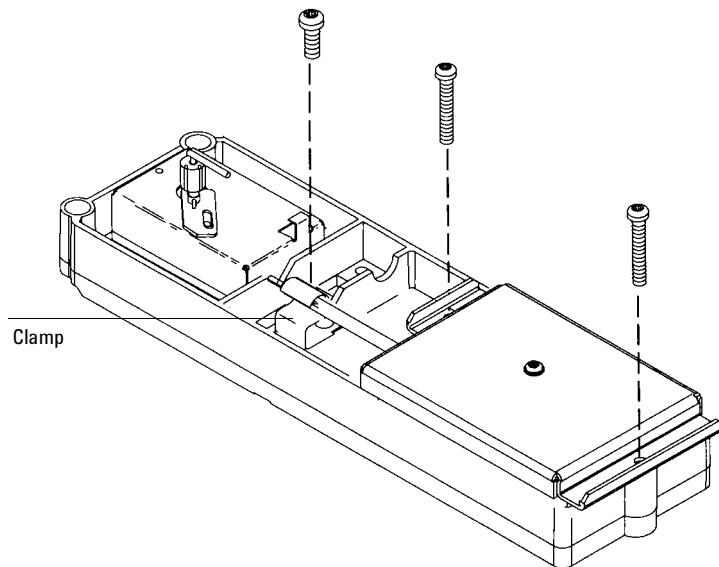


Figure 340-12 Removing the ECD signal board

6. Unlock and detach the ECD signal board's ribbon cable from the detector's interface board and lift the signal board from the detector pallet.
7. Reassembly is the reverse of removal.

Replacing the detector interface card

The ECD detector interface board plugs into the main board as shown below.

1. Unlock and unclip the ribbon cable from the interface board.
2. Remove the screw at the top of the card where it mounts to the main board and pull the card out.

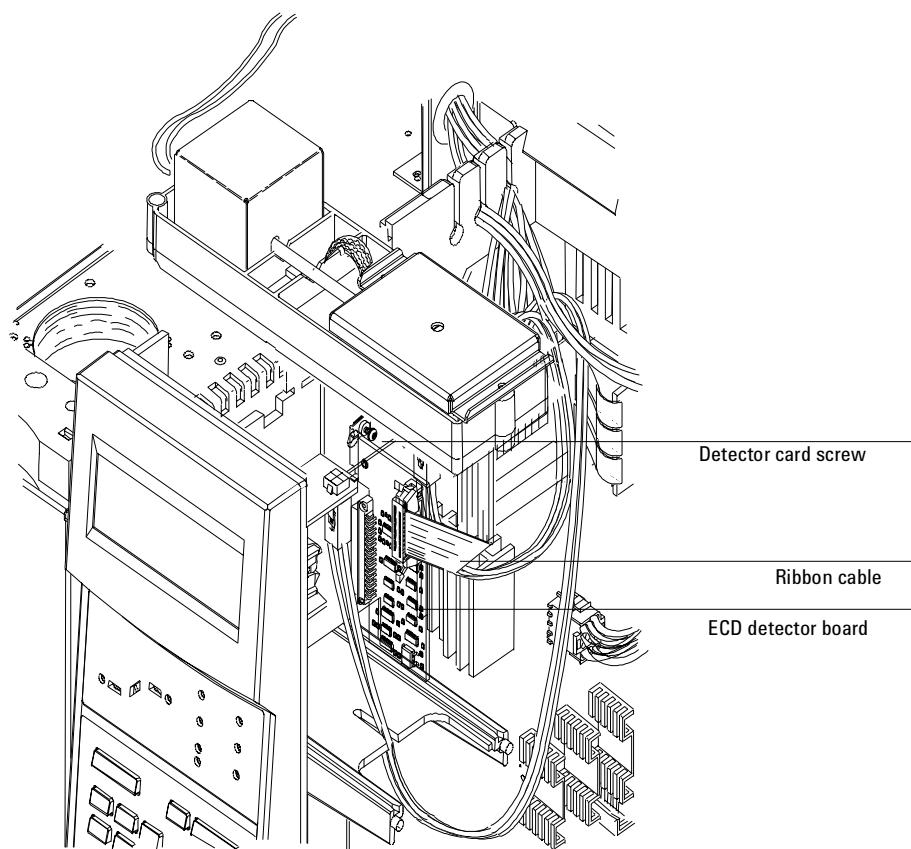


Figure 340-13 Detector interface board installed in back detector position

Diagnostics

Frequency test

Perform this test to make sure that the base frequency for the ECD during a blank run indicates a relatively contaminant-free system.

Note

It may take 24 hours for the ECD baseline to completely stabilize, especially if you are starting with a cold system and want to assure high-sensitivity operation.

Therefore, for the most accurate results, run the detector at normal operating conditions for as long as possible (at least 2 hours and up to 24 hours) before running the frequency test.

If you will be injecting into an unused inlet, you must use low-bleed septa. Make sure to condition new septa before use in an inlet for several hours with 1 to 5 mL/min carrier flow.

1. Make sure you are using normal operating conditions and that *at least* two hours have elapsed since the last run.
2. Turn on the ECD and the corresponding signal.
3. Check the displayed “Output”:
 - <100 = ECD frequency is acceptable
 - ≥ 100 = Contaminants in system

Note

Each display count equals a frequency of 5 Hertz (e.g., a display reading of 100 = 500 Hz.).

4. If the ECD frequency indicates contamination (≥ 100) check for the following:
 - Contaminated carrier gas trap(s) and or supply—replace carrier gas supply tank and any traps on the carrier supply line.
 - Insufficient column conditioning—fully condition the column.
 - Contaminated detector—bake out the detector.
 - Column, inlet and/or septum bleed—clean the inlet/replace the septum with a conditioned, low bleed septum.
 - Leaks—perform leak tests on both the inlet and detector systems.
 - Anode current leakage—make sure the anode contacts are clean. Make sure the anode nut is tight.

Leak test

Note

Once you have determined that the flow system components upstream from the detector (gas supply tubing, inlet, column fittings) are leak free, perform the following ECD detector leak test.

1. With the GC on and operating normally, set the oven, detector, and inlet temperatures to ambient.
2. Turn off the ECD and then turn off the inlet pressure.
3. Turn off the anode and makeup gas flows.
4. Cap the ECD exhaust vent with a vent plug (part no. 5060-9055).
5. Set carrier gas pressure at the inlet corresponding to the ECD to 15 psi (103 kPa).
6. Wait until the system reaches the setpoint pressure and then turn off the pressure and monitor the actual pressure value for at least 10 minutes.

7. Check for pressure drop:

- If the pressure stays stable or drops only 0.5 psi, you can consider the ECD leak-free.
- If the pressure drops more than 0.5 psi, you have a leak.

If you are sure none of the upstream flow system components are leaking, check for leaks at the column fitting and plugged inlet. If you find leaks, tighten the fittings and repeat the leak test.

Note

If you can find no other leaks, the ECD itself is probably leaking. The ECD cannot be disassembled without special license from the Nuclear Regulatory Commission or Agreement State Licensing Agency (USA only).

Troubleshooting contamination problems

Persistent problems with high background or ghost peaks with temperature programming are almost always due to contamination from dirty samples, consumables, or the carrier/makeup gas systems.

Begin with the procedure in chapter 5, Volume 3, of the Operating Manual. If this procedure, which can be performed by the user, does not solve the problem, perform the following steps.

Ensure clean gas supplies

Before continuing, verify that the supply gases are of adequate purity.

1. Carrier and makeup purity must be >99.999%.
2. After confirming purity, verify that the tank regulators have stainless steel diaphragms (equivalent to Agilent part no. 8507-0407).
3. Install new 1/8-inch copper supply tubing—part no. 5180-4196. Many times "clean" tubing from other sources has caused high ECD background.

At the same time, install new traps in both the carrier and makeup supplies. Place the moisture trap (part no. 5060-9084) closest to the tank and the indicating oxygen trap (part no. 3150-0528) closest to the GC. Leak test the entire plumbing setup very carefully.

Isolate problem to carrier or makeup gas supplies

Determine what components of the apparent contamination are from the carrier vs. makeup systems in the GC. Sharp, well-resolved peaks that elute during a temperature program *with no injection* are from the carrier/inlet system. Broader "humps" in the baseline are usually from the makeup system. Overall high background (>500 Hz) can be contaminated gas from either the carrier or makeup supply or a contaminated detector cell.

Remove the column from the detector and inspect the installation of the makeup gas adapter. It is quite common for the adapter to be installed too low. To check this, measure from the bottom of the 1/4-inch Swagelok nut to

the bottom of the hex of the makeup gas adapter. The measurement should be 19 to 20 mm. If it exceeds 22 mm, the adapter is installed incorrectly.

A ridge inside the cell can prevent the adapter from easily seating all the way. Wiggle the adapter while installing to allow it to go all the way in. Always check the nut to hex measurement to be sure.

Evaluate the makeup side

1. Remove the makeup adapter from the detector. Unscrew the tip and remove the Gigabore liner. Inspect the adapter body for carbon (graphite) deposits. Remove all graphite deposits and clean the adapter thoroughly with methanol. Soak the removable tip in methanol.
2. Reassemble the adapter *without* the gigabore liner. Install a 5-inch length of narrow bore column, capped with a new septum, so that the other end extends 1 mm past the tip of the adapter. Use a Vespel column ferrule rather than graphite. Tighten the tip just past finger tight with *clean* pliers. Clean the whole assembly with methanol before installing.
3. Install the capped-off makeup adapter, using a new 1/4-inch Vespel ferrule. Be sure it is fully seated—check the measurement. Retighten after the detector has been heated.
4. Set the makeup flow to the original setpoint and bake out the detector at 350°C for 1 hour. During this time, put the inlet in split mode with 200 to 300 mL/min split vent flow (gas saver off) and bakeout the inlet at 275°C. Bakeout the column at its appropriate temperature.
5. When bakeout is done, *do not* reconnect the column to the detector. Make a series of blank runs with the user's method. If the baseline is acceptable—free of peaks and humps and under 1000 Hz throughout a temperature program—then the detector and makeup system are clean.

Any unacceptable baseline problems could indicate contaminated makeup gas, EPC module, makeup adapter, or detector. These must be addressed before continuing.

If the 6890 GC was manufactured before 6/97, the EPC modules may have O-ring contamination. See Service Note G1530-14 and follow the procedure given. Replace the EPC module.

Evaluate the carrier side

After the detector and the makeup system have been determined to be clean, evaluate the carrier, inlet, and column.

1. Remove the makeup adapter and capped-off column from the detector. Discard the "cap". Place a new ferrule on the column, trim the column end, and install it so that 1 to 2 mm extends past the adapter tip.

It is best not to use the gigabore liner. A better solution is the mixing liner (part no. G2397-20540) for the μ -ECD. Use the column installation instructions for the μ -ECD in Volume 1 of the Operating Manual.

2. Wipe off the entire makeup adapter with methanol. Install it fully—check the measurement to be sure.
3. Bake out the entire system for another hour at these conditions:
 - Detector 350°C
 - Inlet Split mode, 275°C
 - Column An appropriate temperature
4. Reload the user's method and make a series of blank (no injection) runs to see if the problem has been cured. Note that a single, well-resolved peak could be due to the O-ring contamination problem, mentioned earlier. Address per service note.
5. If the contamination persists, perform a complete inlet maintenance, including thorough cleaning of the shell weldment. Replace the gold seal and liner. Install a known good 30 m/320 μ m HP5 checkout column to rule out column contamination.
6. Peaks from the inlet side are usually due to contaminated carrier gas supply, EPC module, insert weldment, inlet or liner, or column.

Maintaining an ECD detector

ECD bakeout

If your ECD baseline is noisy or the display frequency is too high (i.e., ≥ 100), you should perform a thermal cleaning (also called a “bakeout”) of the detector. Before performing a bakeout, verify that the carrier supply gas and flow system are leak- and contaminant-free.

Caution Detector disassembly and/or cleaning procedures other than thermal should be performed only by personnel trained and licensed appropriately to handle radioactive materials. Trace amounts of radioactive ^{63}Ni may be removed during these other procedures, causing possible hazardous exposure to β - and x-radiation (bremsstrahlung).

WARNING To prevent possible hazardous contamination of the area with radioactive material, the detector exhaust vent must always be connected to a fume hood, or otherwise vented in compliance with the latest revision of Title 10, CFR, Part 20, or with state regulations with which the Nuclear Regulatory Commission has entered into an agreement (USA only). For other countries, consult with the appropriate agency for equivalent requirements.

1. Record the ECD “Output” value from the GC display. If the number is equal to or greater than 100, continue with this procedure.
2. Turn off the anode purge and makeup gas flows.
3. Remove the column from the detector.
4. Cap the bottom of the makeup gas adapter with a blank column ferrule and column nut.
5. Set the makeup gas flow rate between 50 and 60 mL/min. Set the detector temperature between 350 and 375°C.

6. Set the oven temperature to 250°C.
7. Allow thermal cleaning to continue for several hours, and then cool the system to normal operating temperatures.

Performing a radioactivity leak test (wipe test)

ECDs must be tested for radioactive leakage at least every six months. Records of tests and results must be maintained for possible inspection by the Nuclear Regulatory Commission and/or responsible state agency. More frequent tests may be conducted when necessary.

The procedure used is the wipe test. A Wipe Test Kit (part no. 18713-60050) is supplied with each new ECD. Refer to the information card supplied in the Wipe Test Kit for instructions on performing the wipe test.

341 Micro-cell Electron Capture Detector (μ -ECD)

Theory of operation

The Micro-cell Electron Capture Detector (μ -ECD), G2397A, is based on the phenomenon that electronegative species can react with thermal electrons present to form negatively charged ions. The loss of such electrons is related to the quantity of analyte in the sample. In order to produce capturable (low energy) thermal electrons, the carrier gas is ionized by beta particles from a radioactive source in the cell. This electron flow produces a current, which is collected and measured. When the sample molecule is introduced into the cell, electrons which would otherwise be captured at the electrode are captured by the sample, resulting in decreased current. This change is recorded and measured for the chromatogram.

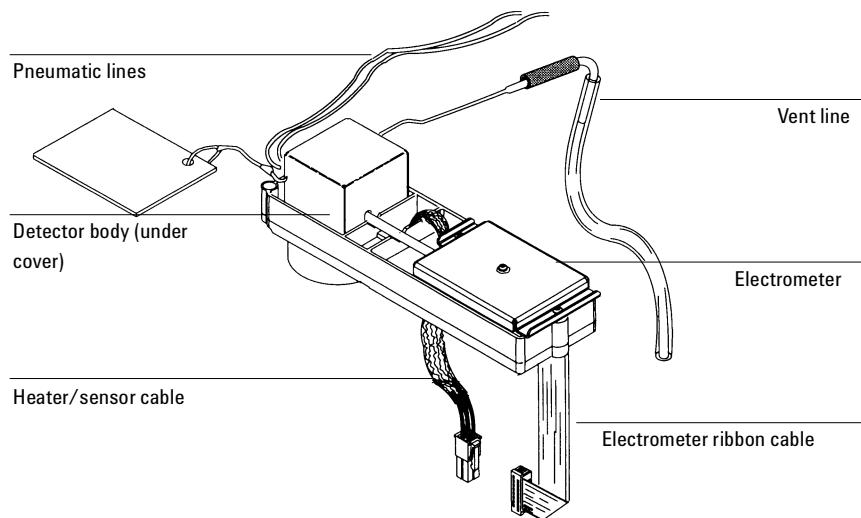


Figure 341-1 The Micro-cell Electron Capture Detector (μ -ECD)

EPC detector

The EPC version of the μ -ECD detector has one flow line for the anode purge/makeup gas. After an initial filter frit, the line has a proportional valve controlled by a pressure sensor. The line splits into two paths, each containing a non-adjustable restrictor frit. The makeup gas line sweeps past the end of the column and carries the column effluent into the ECD micro-cell. The anode purge flow sweeps the upper part of the μ -ECD and cleans sample deposition from the detector.

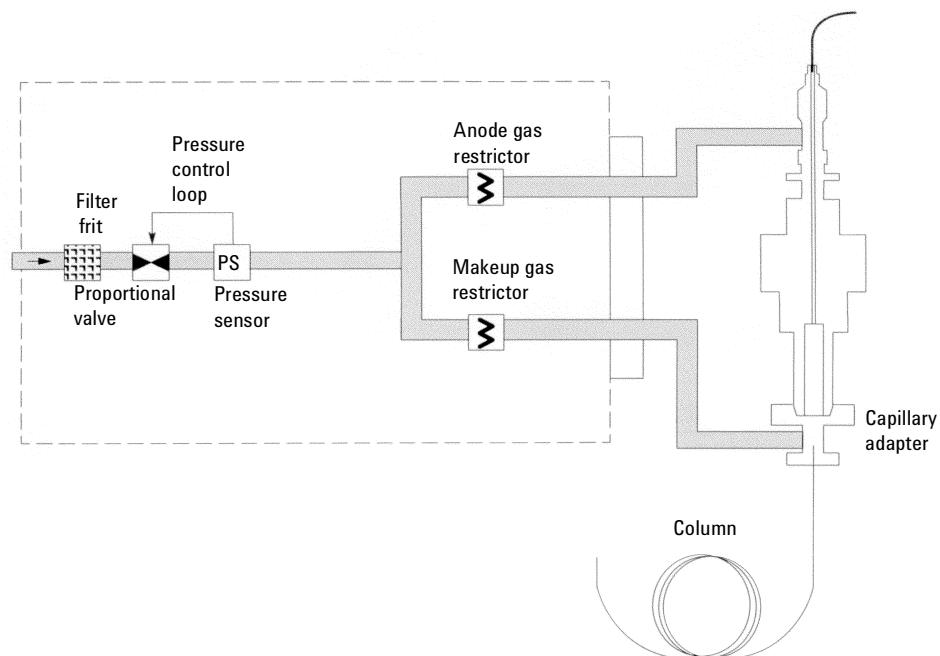


Figure 341-2 EPC μ -ECD flow diagram

Replacement procedures

Replacing the entire detector/detector cell

WARNING Before proceeding, turn off the oven and any heated zones and let them cool. Turn off any detector gases at their supply, then turn off the main power switch and unplug the power cord.

WARNING The ECD micro-cell contains radioactive ^{63}Ni . To reduce the risk of exposure, wear disposable gloves while handling the ECD micro-cell. When you are finished, dispose of the gloves and wash your hands with soap and water.

1. Remove the detector cover, the electronics carrier cover and the right side cover.

Caution Make sure you are properly grounded with an ESD strap before continuing.

2. Disconnect the electrometer ribbon cable from the μ -ECD interface card.
3. Disconnect the heater/sensor leads from the connector on the right side of the GC.

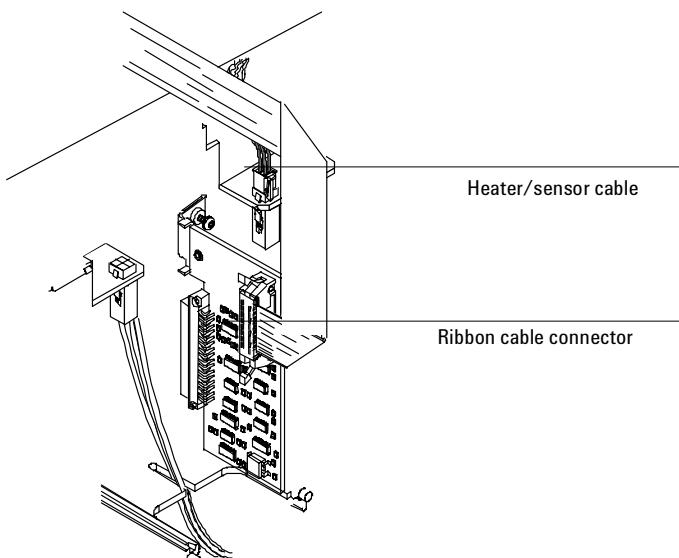


Figure 341-3 Disconnecting the μ -ECD cables

4. Inside the oven, remove the insulation cup and disconnect the column from the makeup gas adapter.
5. Use a 9/16-inch wrench to loosen the 1/4-inch Swagelok nut on the makeup gas adapter from the bottom of the detector. Slide the makeup gas adapter out of the bottom of the detector.

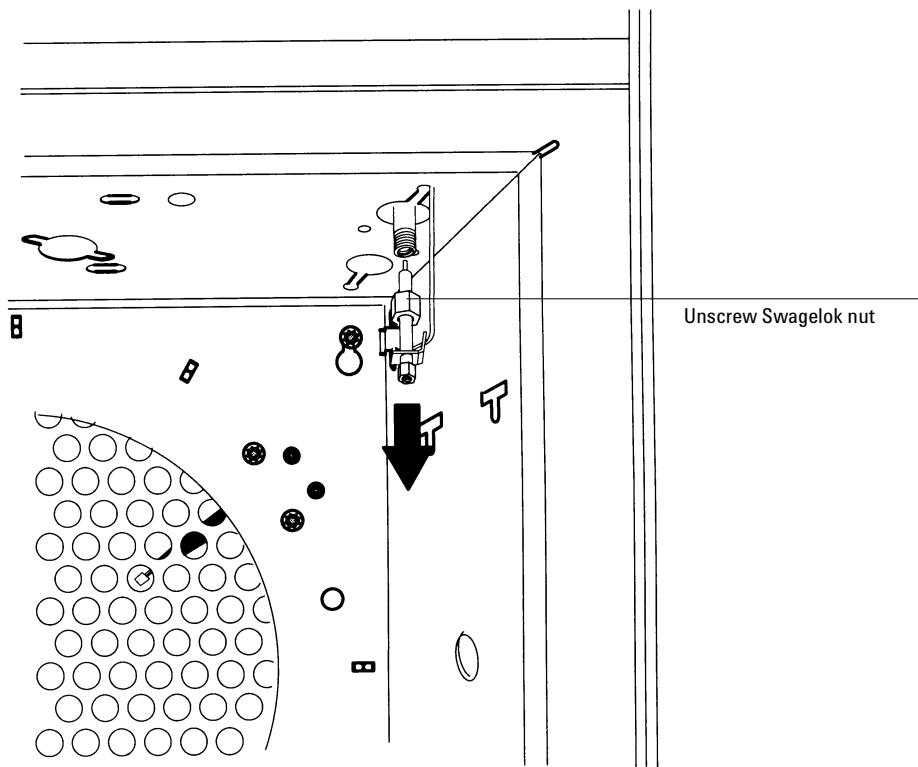


Figure 341-4 Disconnecting the make-up gas adapter

6. Disconnect the μ -ECD vent tube at the rubber sleeve.
7. Remove the Torx screw holding the gang fitting onto the detector manifold, and remove the gang fitting.
8. Remove the one Torx T-20 screw securing the top μ -ECD detector cover to the detector pallet and remove the cover.
9. Disconnect the anode signal wire from the detector.

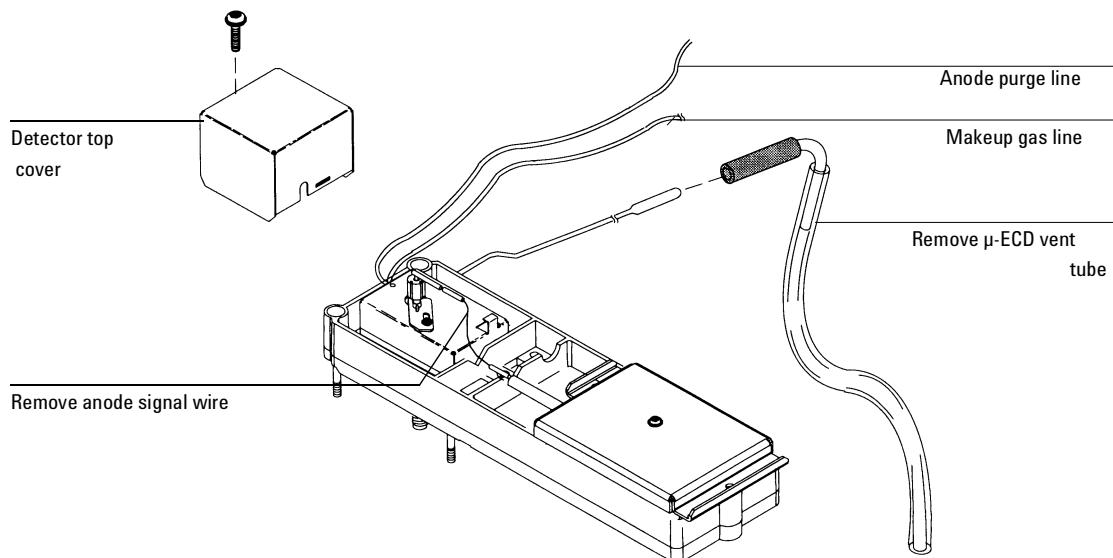


Figure 341-5 Removing the cover, anode purge fitting, vent tube, and anode signal wire

10. Fully loosen the four Torx T-20 screws on the detector pallet and lift the pallet and detector from the GC.
11. Thread the heater/sensor leads out of the detector pallet and remove the detector from the pallet.

The μ -ECD detector is now properly disassembled for replacement or exchange. DO NOT remove the inner thermal cover if you are replacing the entire detector assembly.

Replacing the heater/sensor assembly

After removing the μ -ECD detector from the GC, you can further disassemble it to replace the heater/sensor assembly.

WARNING The ECD micro-cell contains radioactive ^{63}Ni . To reduce the risk of exposure, wear disposable gloves while handling the ECD micro-cell. When you are finished, dispose of the gloves and wash your hands with soap and water.

1. Remove the detector as described in the Replacing the entire detector/detector cell procedure in this section.
2. Loosen the locking tab screw on top of the detector, slide the locking tab back, and pivot it out of the way.

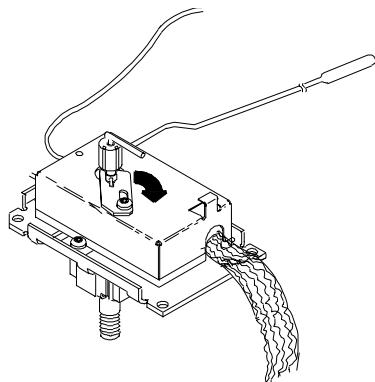


Figure 341-6 Unlocking the thermal cover

3. Lift the thermal cover up and carefully slide it off of the anode assembly.

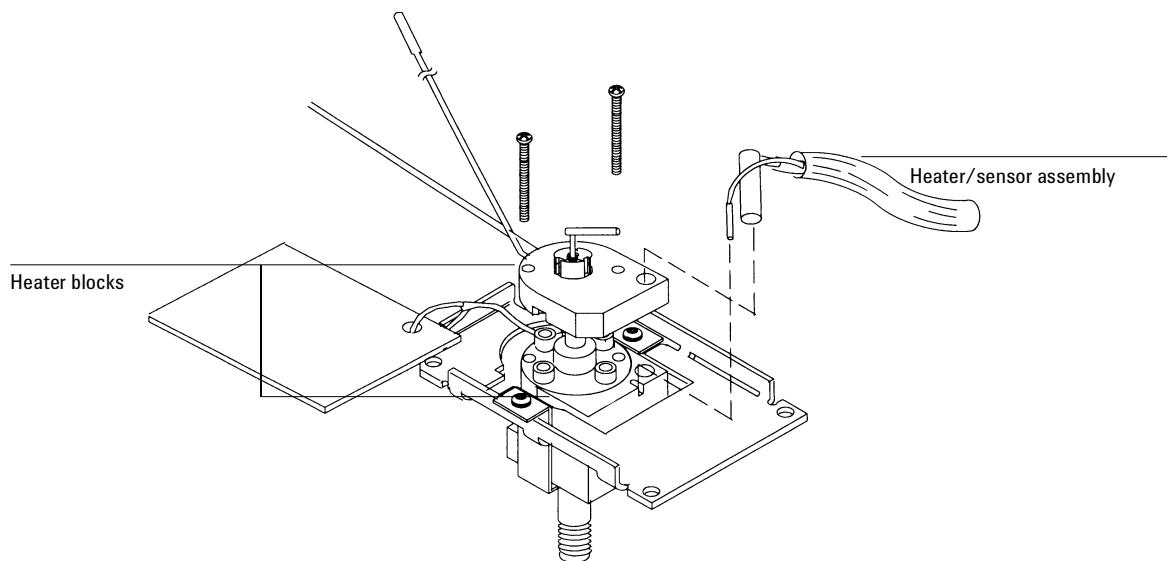


Figure 341-7 Removing the heater/sensor

4. Remove the two screws holding the upper heated block onto the assembly.
Carefully lift the block over the anode lead and remove.
5. Slide the heater and sensor out of the lower heated block.

Replacing the makeup gas adapter

After removing the μ -ECD detector from the GC, you can further disassemble it to replace the makeup gas adapter. The makeup gas adapter consists of a line from the detector pneumatics manifold that carries makeup gas to a weldment that screws into the bottom of the μ -ECD detector. From there, the makeup gas sweeps past the end of the column and carries the column effluent into the μ -ECD cell.

1. Remove the detector as described in the Replacing the entire detector/detector cell procedure in this section.
2. Remove the Torx T-20 screw holding the pneumatics block(s) to the detector manifold.

Note There are two pneumatics blocks on the EPC version of the μ -ECD pneumatics manifold. The outside block is the anode purge gas line and the inside block is the make-up gas line.

3. Slide the makeup gas adapter up and out of the GC.
4. When re-installing the makeup gas adapter, ensure the following:
 - Approximately 6 inches of the makeup gas line resides in the oven after installation.
 - The makeup gas line is bent into a coil or loop (inside the oven) that loops around the bottom of the detector weldment and makeup gas adapter.

341 Micro-cell Electron Capture Detector (μ -ECD)
Replacement procedures

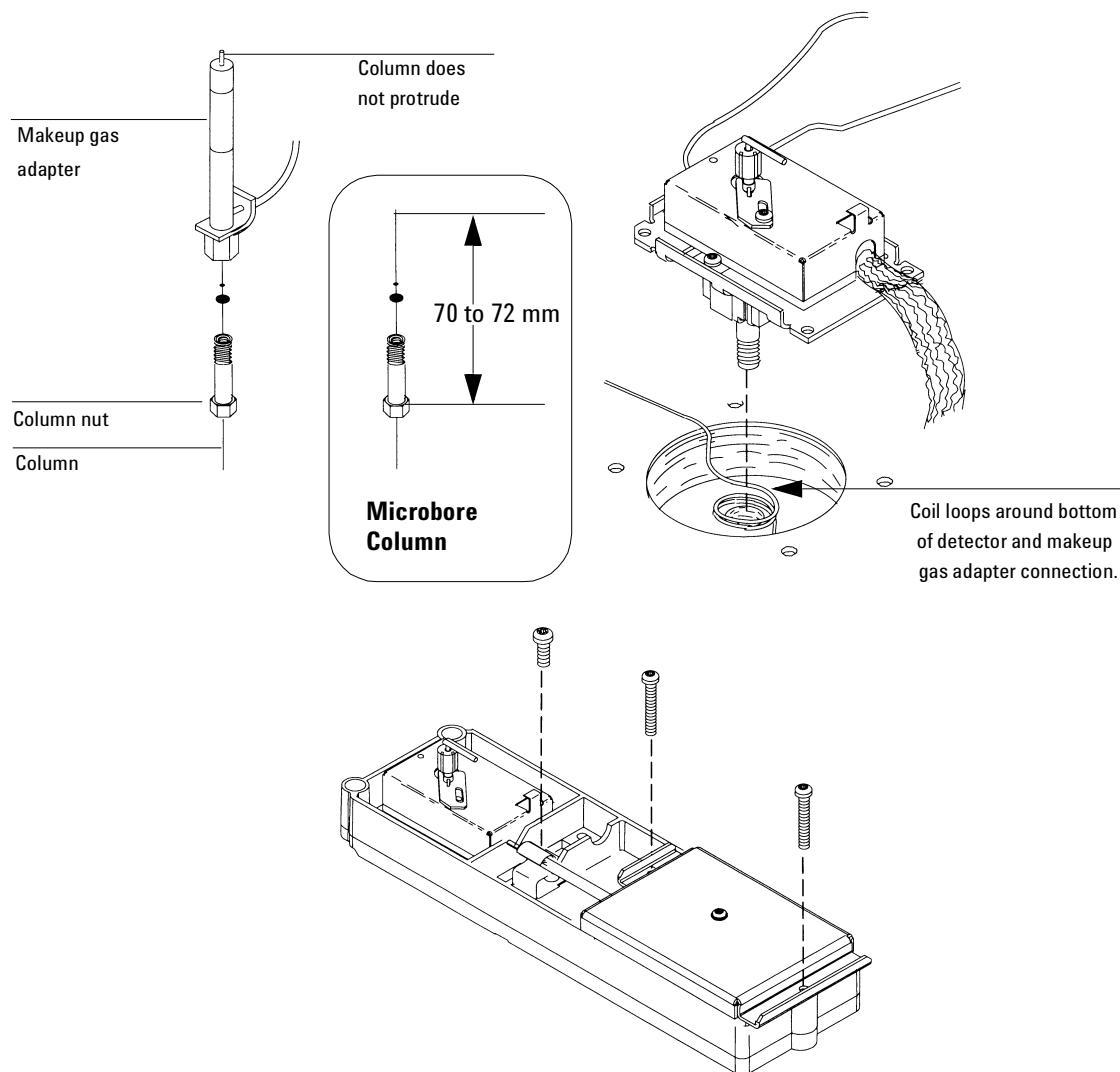


Figure 341-8 Proper configuration of the column and makeup gas tubing

- The end of the column does not protrude from the top of the makeup gas adapter. For most columns (outer diameter > 0.15 mm), insert the column as far as it will go into the gigabore liner. If using a microbore column that passes completely through the liner, position the column so that the total length from the back of the capillary nut to the end of the column is about 70 to 72 mm.

Removing an EPC flow manifold

Early models of the 6890 GC used Type 1 EPC flow manifolds. Later models use Type 2 manifolds. Both types are covered here.

The μ -ECD detector EPC flow manifold contains one inlet supply fitting for a purge/make-up gas.

WARNING Before proceeding, turn off the oven and any heated zones and let them cool down. Turn off any detector gases at their supply, then turn off the main power switch and unplug the power cord.

1. Remove the top plastic covers from the detector and pneumatics areas. Also remove the RFI metal shield and the top rear metal cover.
2. Remove the gas supply fitting from the side (Type 1) or rear (Type 2) of the manifold.
3. At the front of the manifold, remove the Torx T-20 screw that holds the manifold in its slot.
4. Disengage the detector tubing from the slots in the chassis so that the gang fitting on the manifold can be removed easily.

Caution Make sure you are properly grounded with an ESD strap before continuing.

5. Unlock the detector manifold's ribbon cable from the EPC board and detach the connector. The adjacent ribbon cable may have to be removed as well.

6. Remove the Torx T-20 screw holding the output pneumatics block(s) to the manifold and remove the block.

Caution Always hold the Type 2 manifold by its support bracket to avoid damaging board components.

7. Slide the manifold from its slot.

Note There are two pneumatics blocks on the EPC version of the μ -ECD pneumatics manifold. The outside block is the anode purge line and the inside block is the makeup gas line.

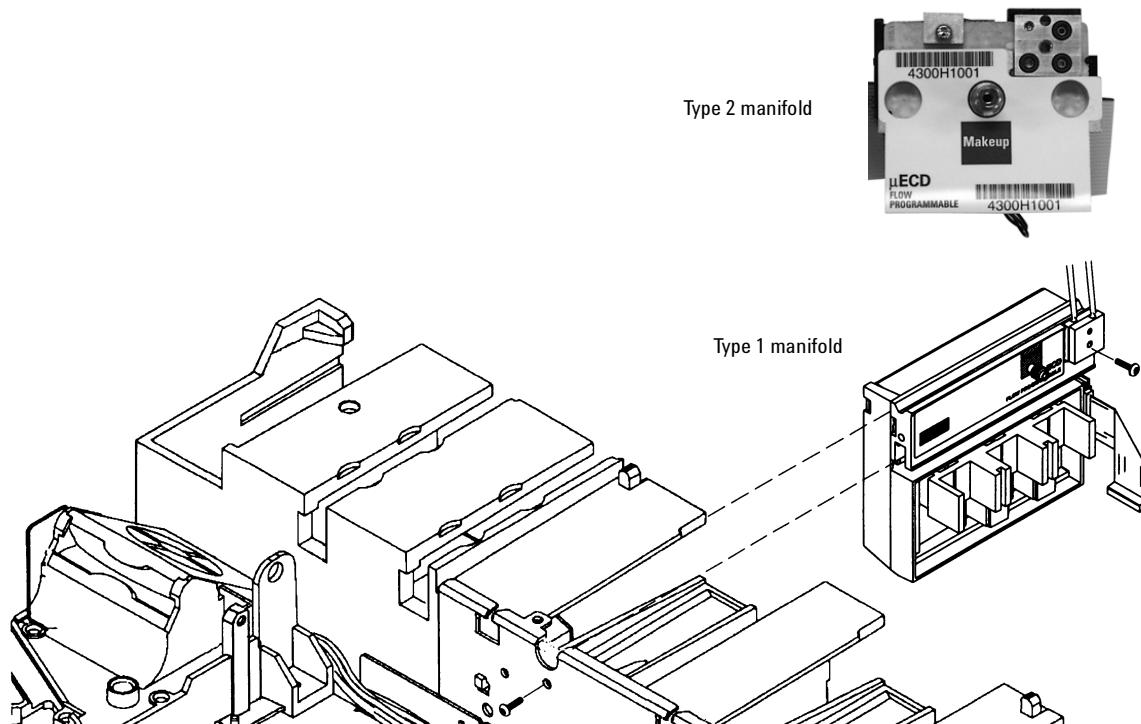


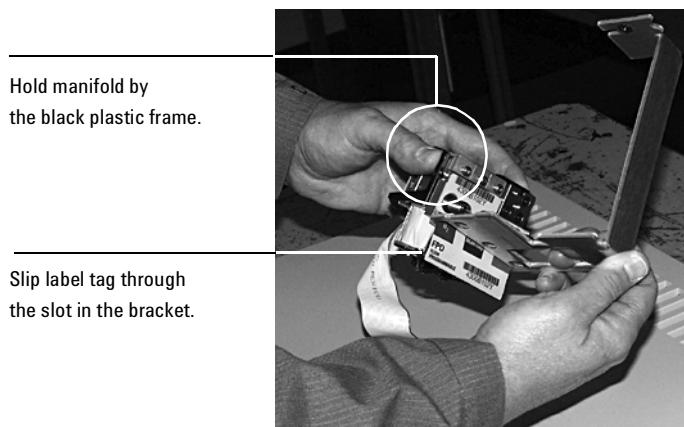
Figure 341-9 Removing an EPC detector flow manifold

Installing a Type 2 manifold

WARNING Before proceeding, turn off the oven and any heated zones and let them cool down. Turn off all detector gases at their supply, then turn off the main power switch and unplug the power cord.

Caution Always hold the manifold as shown below to avoid damaging board components.

1. While holding the manifold by the black plastic frame as shown below, slip the label through the slot in the mounting bracket, and align the bracket holes over the gas fittings.



(FPD shown)

2. Finger-tighten three 7/16-inch hex nuts over the fittings to hold the bracket in place. It is **very important** that you do **not** tighten the nuts yet.



Finger-tighten nuts.
Do not use a wrench.

(FPD shown above)

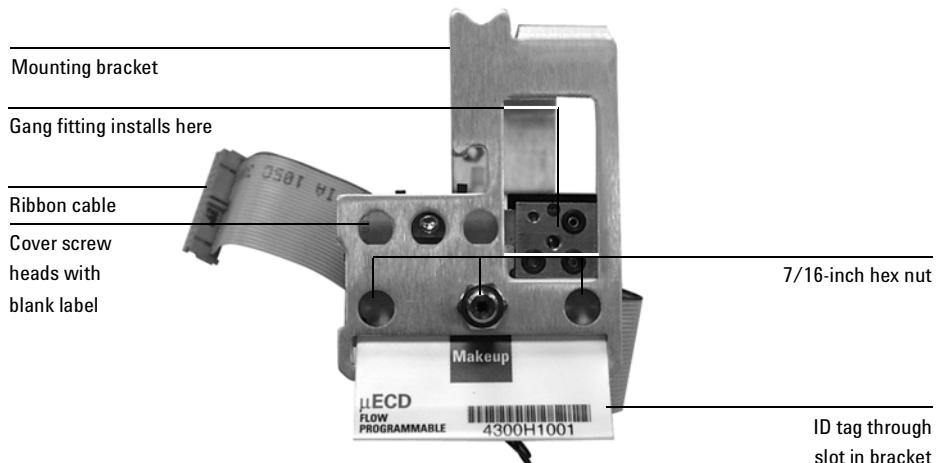


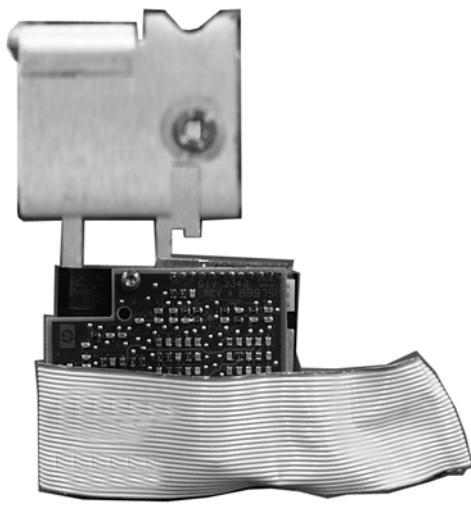
Figure 341-10 Bracket mounted onto the manifold

3. Peel the blank label from its backing and paste it on the mounting bracket over the screw heads.
4. If the tubing from the gang fitting bends to the left, reshape it so that it bends up and back from the block as shown in Figure 341-12.

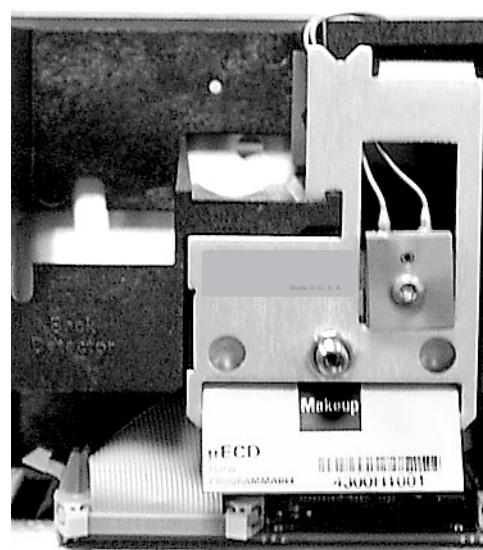
5. Insert the gang fitting through the cutout in the manifold bracket and install it onto the new manifold assembly so that the tubing runs back and away from the fitting.
 - Be sure the left tube clears the inner edge of the bracket. See Figure 341-12.
 - Be sure that the O-rings are in place.

Tighten the gang fitting screw firmly to compress the O-rings.

6. Route the ribbon cable behind the manifold assembly as shown in Figure 341-11. Then, slide the manifold and bracket assembly into the slot until the bracket seats flush against the end of the rails. See Figure 341-12.



Back view of manifold



Manifold installed with cable routed to left

Figure 341-11 Routing the ribbon cable

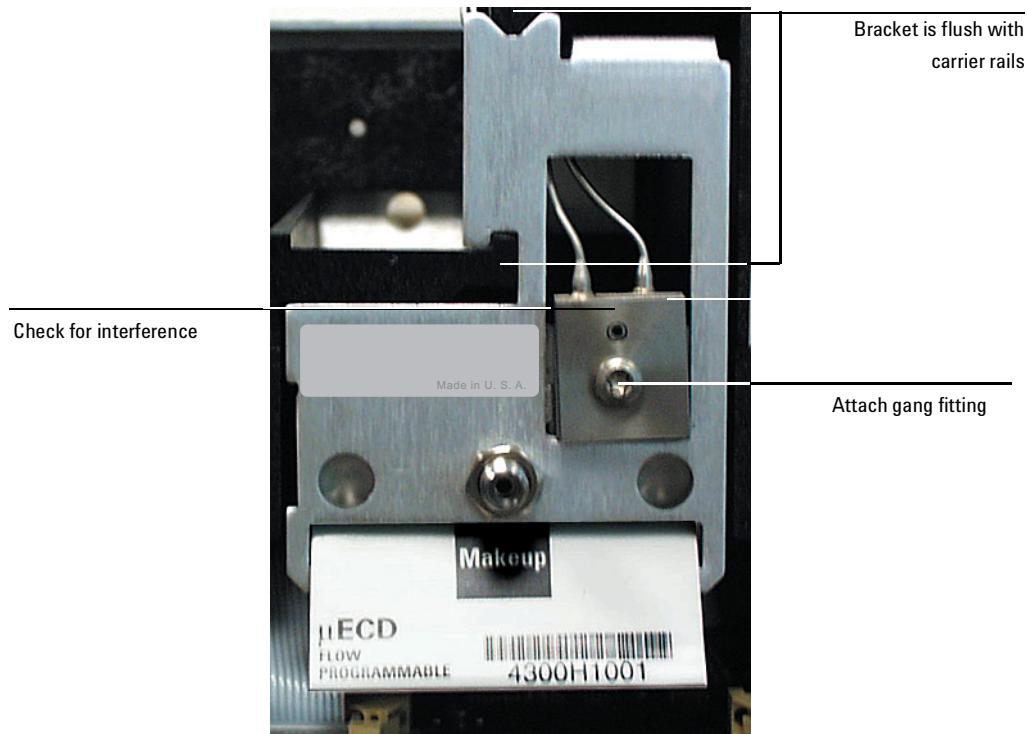


Figure 341-12 Manifold, after installation

7. Route the gas tubing behind the manifold, over the top of the chassis, and through the slots as shown in Figure 341-12.
8. Connect the ribbon cable to the mating connector on the pneumatics board. Arrange the cable to keep it away from the valves and keep it from being pinched between board components and the manifold.

For the back detector, you may want to loosen the manifold and slide it out of the carrier a few centimeters to connect the cable to the pneumatics board. Then, reinstall the manifold.

9. Secure the manifold in place using the Torx T-20 screw.

10. Using a pair of needle-nosed pliers, remove the appropriate top rear panel detector cutout for the μ -ECD. Also remove any cutouts needed to access other manifolds or accessories installed in the GC. See Figure 341-13.

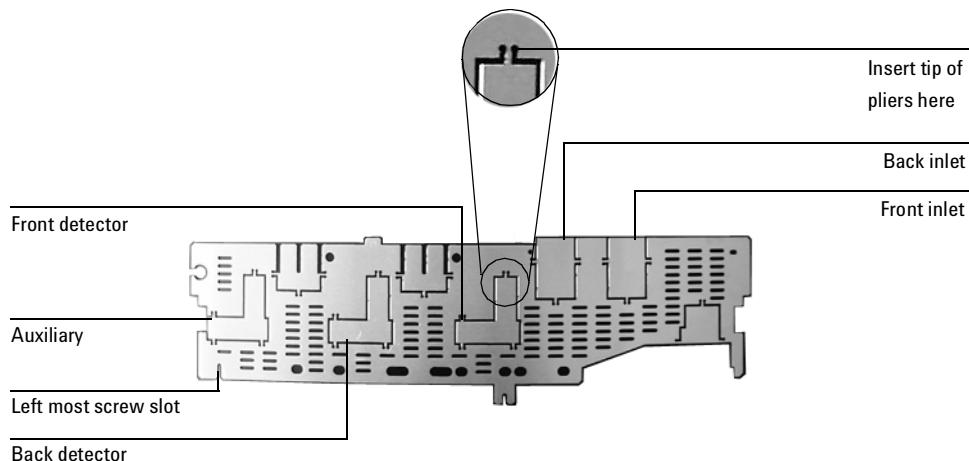


Figure 341-13 Top rear panel cutouts

11. Place the new top rear panel on its left-most mounting screw. Working from left to right and using the screw as a hinge, slide each manifold ID tag through its cutout in the panel. When all the tags are through the panel, finish installing the panel on the GC.
12. Install the RFI shield, the pneumatics cover, and the detector top cover.

13. Connect the source gas line to the manifold. See Figure 341-14.



Figure 341-14 Gas line connection

14. Restore gas pressures and leak test the fittings.

Removing the signal board

Caution Make sure you are properly grounded with an ESD strap before continuing.

1. Remove both the electronics top cover and the right side cover.
2. Remove the Torx T-20 screw securing the top cover and remove the cover.
3. Disconnect the signal wire from the signal board interconnect.

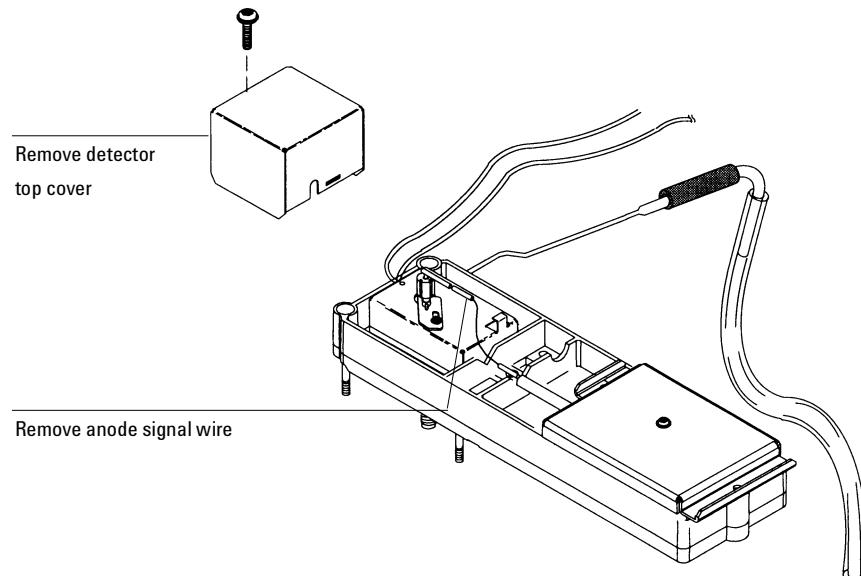


Figure 341-15 Removing the top cover and anode signal wire

4. Remove the screw and clamp on the electrical interconnect.
5. Remove one Torx T-20 screw from each end of the signal board. (Do not remove the screw on the top of the cover.)

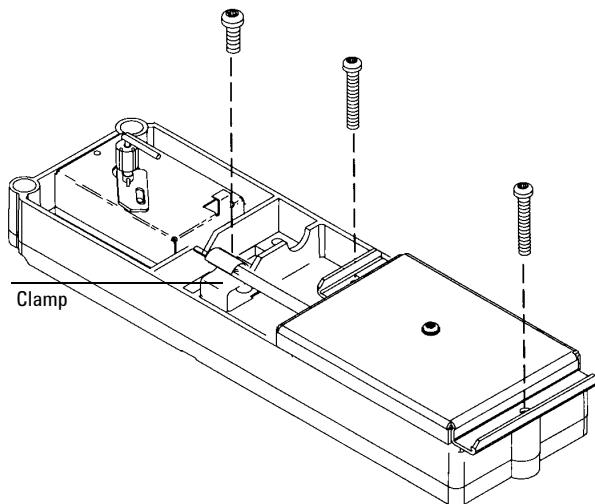


Figure 341-16 Removing the μ -ECD signal board

6. Unlock and detach the μ -ECD signal board's ribbon cable from the detector's interface board and lift the signal board from the detector pallet.
7. Reassembly is the reverse of removal.

Replacing the detector interface card

The μ -ECD detector has an interface board off of the main board as shown below.

Caution Make sure you are properly grounded with an ESD strap before continuing.

1. Unlock and unclip the ribbon cable from the interface board.
2. Remove the screw at the top of the card where it mounts to the main board and pull the card out.

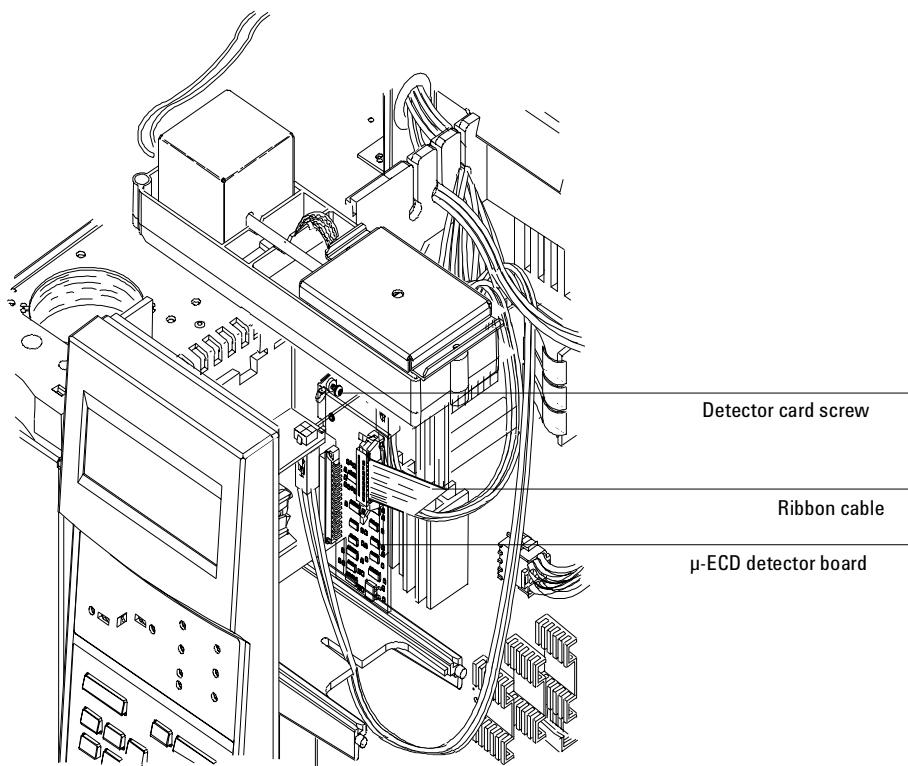


Figure 341-17 Location of detector interface board (board installed in back detector position)

Diagnostics

Frequency test

Perform this test to make sure that the base frequency for the μ -ECD during a blank run indicates a relatively contaminant-free system.

Note It may take 24 hours for the μ -ECD baseline to completely stabilize, especially if you are starting with a cold system and want to assure high-sensitivity operation.

Therefore, for the most accurate results, run the detector at normal operating conditions for as long as possible (at least 2 hours and up to 24 hours) before running the frequency test.

If you will be injecting into an unused inlet, you must use low-bleed septa. Make sure to condition new septa before use in an inlet for several hours with 1 to 5 mL/min carrier flow.

1. Make sure you are using normal operating conditions and that *at least* 2 hours have elapsed since the last run.
2. Turn on the μ -ECD and the corresponding signal.
3. Check the displayed “Output”:
 - <25 = μ -ECD frequency is acceptable
 - ≥ 1000 = Contaminants in system

Note Each display count equals a frequency of 1 Hertz (e.g., a display reading of 100 = 100 Hz.).

4. If the μ -ECD frequency indicates contamination (≥ 1000) check for the following:
 - Contaminated carrier gas trap(s) and or supply—replace carrier gas supply tank and any traps on the carrier supply line.

- Insufficient column conditioning—fully condition the column.
- Contaminated detector—bake out the detector.
- Column, inlet and/or septum bleed—clean the inlet/replace the septum with a conditioned, low bleed septum.
- Leaks—perform leak tests on both the inlet and detector systems.
- Anode current leakage—make sure the anode contacts are clean. Make sure the anode nut is tight.

Leak test

Note

Once you have determined that the flow system components upstream from the detector (gas supply tubing, inlet, column fittings) are leak free, perform the following μ -ECD detector leak test.

1. With the GC on and operating normally, set the oven, detector, and inlet temperatures to ambient.
2. Turn off the μ -ECD and then turn off the inlet pressure.
3. Turn off the anode and makeup gas flows.
4. Cap the μ -ECD exhaust vent with a vent plug (part no. 5060-9055).
5. Set carrier gas pressure at the inlet corresponding to the μ -ECD to 15 psi (103 kPa).
6. Wait until the system reaches the setpoint pressure and then turn off the pressure and monitor the actual pressure value for at least 10 minutes.
7. Check for pressure drop:
 - If the pressure stays stable or drops only 0.5 psi, you can consider the μ -ECD leak-free.
 - If the pressure drops more than 0.5 psi, you have a leak.

If you are sure none of the upstream flow system components are leaking, check for leaks at the column fitting and plugged inlet. If you find leaks, tighten the fittings and repeat the leak test.

Note If you can find no other leaks, the μ -ECD itself is probably leaking. The μ -ECD cannot be disassembled without special license from the Nuclear Regulatory Commission or Agreement State Licensing Agency (USA only).

Maintaining a μ -ECD detector

μ -ECD bakeout (thermal cleaning)

If your μ -ECD baseline is noisy or the display frequency is too high (i.e., ≥ 1000), you should perform a thermal cleaning (also called a “bakeout”) of the detector. Before performing a bakeout, verify that the carrier supply gas and flow system are leak- and contaminant-free.

Caution Detector disassembly and/or cleaning procedures other than thermal should be performed only by personnel trained and licensed appropriately to handle radioactive materials. Trace amounts of radioactive ^{63}Ni may be removed during these other procedures, causing possible hazardous exposure to β - and x-radiation (bremsstrahlung).

WARNING To prevent possible hazardous contamination of the area with radioactive material, the detector exhaust vent must always be connected to a fume hood, or otherwise vented in compliance with the latest revision of Title 10, CFR, Part 20, or with state regulations with which the Nuclear Regulatory Commission has entered into an agreement (USA only). For other countries, consult with the appropriate agency for equivalent requirements.

1. Record the μ -ECD “Output” value from GC display. If the number is equal to or greater than 1000, you should continue with this procedure.
2. Remove the column from the detector.
3. Cap the bottom of the makeup gas adapter with a blank column ferrule and column nut.
4. Set the makeup gas flow rate to 60 mL/min. Set the detector temperature between 350 and 375°C.
5. Set the oven temperature to 250°C.
6. Allow thermal cleaning to continue for several hours, and then cool the system to normal operating temperatures.

It is good practice to monitor the progress of the thermal cleaning by plotting the μ -ECD signal. Over time, the signal baseline signal should change as shown in Figure 341-18.

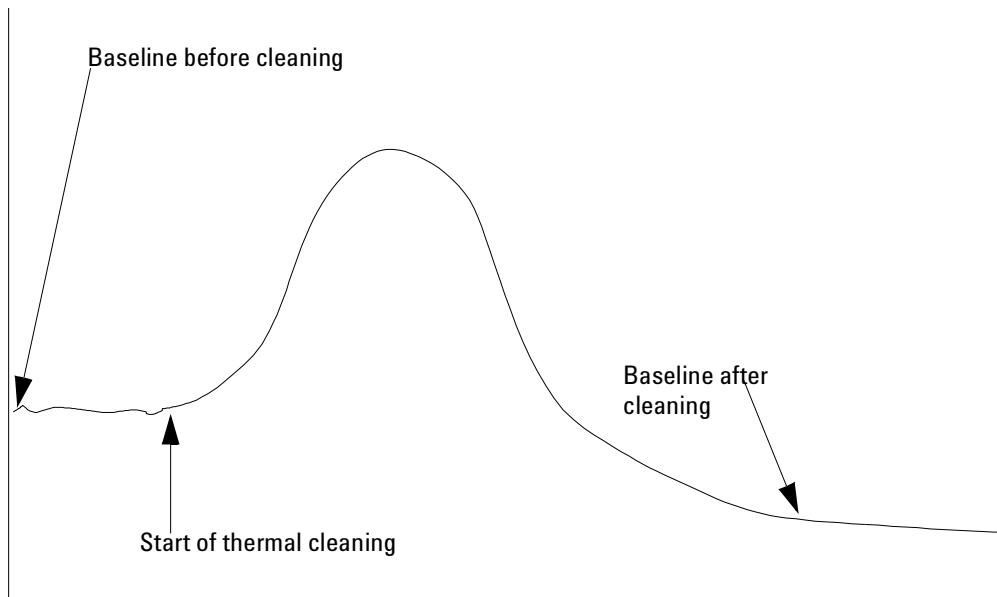


Figure 341-18 Time

7. Check the ECD "output" value from the GC display. It should be lower than the first reading.

Performing a radioactivity leak test (wipe test)

Micro-cell ECDs must be tested for radioactive leakage at least every 6 months. Records of tests and results must be maintained for possible inspection by the Nuclear Regulatory Commission and/or responsible state agency. More frequent tests may be conducted when necessary.

The procedure used is the wipe test. A Wipe Test Kit (part no. 18713-60050) is supplied with each new μ -ECD. Refer to the information card supplied in the Wipe Test Kit for instructions on performing the wipe test.

350 Flame Photometric Detector (FPD)

Theory of operation

In the Flame Photometric Detector (FPD), the sample burns in a hydrogen-rich flame, where some species are reduced and excited. The gas flow moves the excited species to a cooler emission zone above the flame where they decay and emit light. A narrow bandpass filter selects light unique to one species, while a shield prevents intense carbon emission from reaching the photomultiplier tube (PMT).

The light strikes a photosensitive surface in the PMT where a light photon knocks loose an electron. The electron is amplified inside the PMT for an overall gain of up to a million.

The current from the PMT is amplified and digitized by the FPD electronics board. The signal is available either as a digital signal on the communications output or as a voltage signal on the analog output.

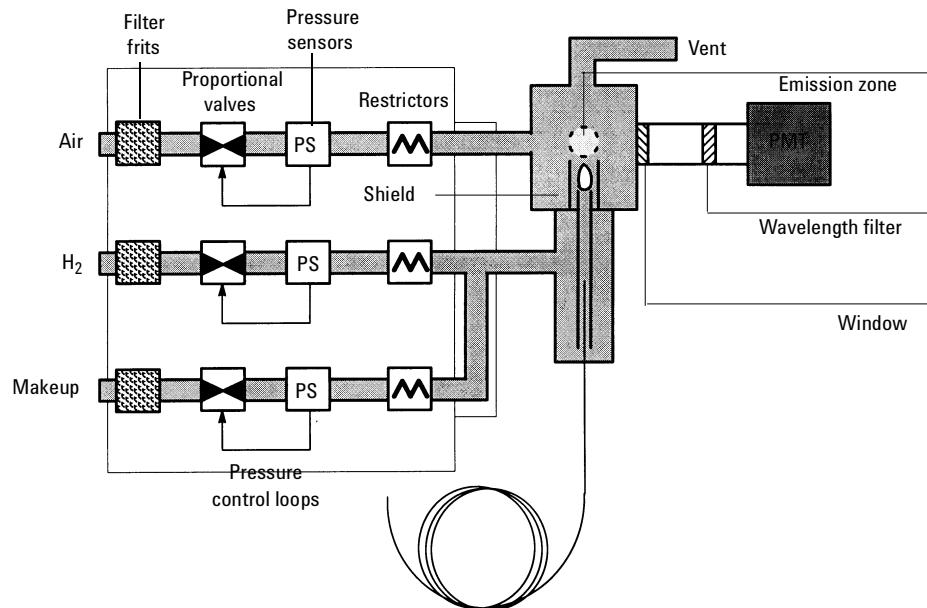


Figure 350-1 Schematic of a flame photometric detector

Single wavelength FPD

The single wavelength FPD is a single burner module with one PMT housing. Either sulfur or phosphorus can be detected by installing an appropriate optical filter in the PMT housing.

The sulfur filter is blue/purple and transmits at 393 nanometers.

The phosphorus filter is yellow/green and transmits at 525 nanometers.

Dual wavelength FPD

The dual wavelength FPD is a single burner module with two PMT housings, one with a sulfur filter and the other with a phosphorus filter. Because the optimum gas flows for these elements are quite different, performance of this detector is necessarily a compromise.

Two signal channels and two electrometer boards are used, one for each PMT. The Back Det control table runs the detector, while the Front Det operates in a special “signal only” mode.

Operating conditions

In order for the FPD to operate properly, the temperature must be set above 120°C, and the air and hydrogen flows must be On.

Replacement procedures

Replacing the entire detector

1. Turn off power to the gas chromatograph and disconnect the main power cord. Remove the detector cover, the right side cover, the RFI cover, and the top rear panel.

Caution Always turn the main power off before replacing the entire detector assembly.

2. Allow time for heated zones to cool to safe temperatures.
3. Turn off all gas flows at the source.
4. Inside the oven, remove the column to the FPD.

Caution To avoid damaging the printed circuit board electronics, use a grounded wrist strap (part no. 9300-1408) and connect it to a bare metal surface of the GC.

5. Trace the wires from the heater/sensor cables to their connections on the GC. Note these locations, then remove the heater/sensor connectors from the GC. If the actuator solenoid bracket is to be removed, remove the two mounting screws, disconnect the connector from the main board, and remove the bracket.

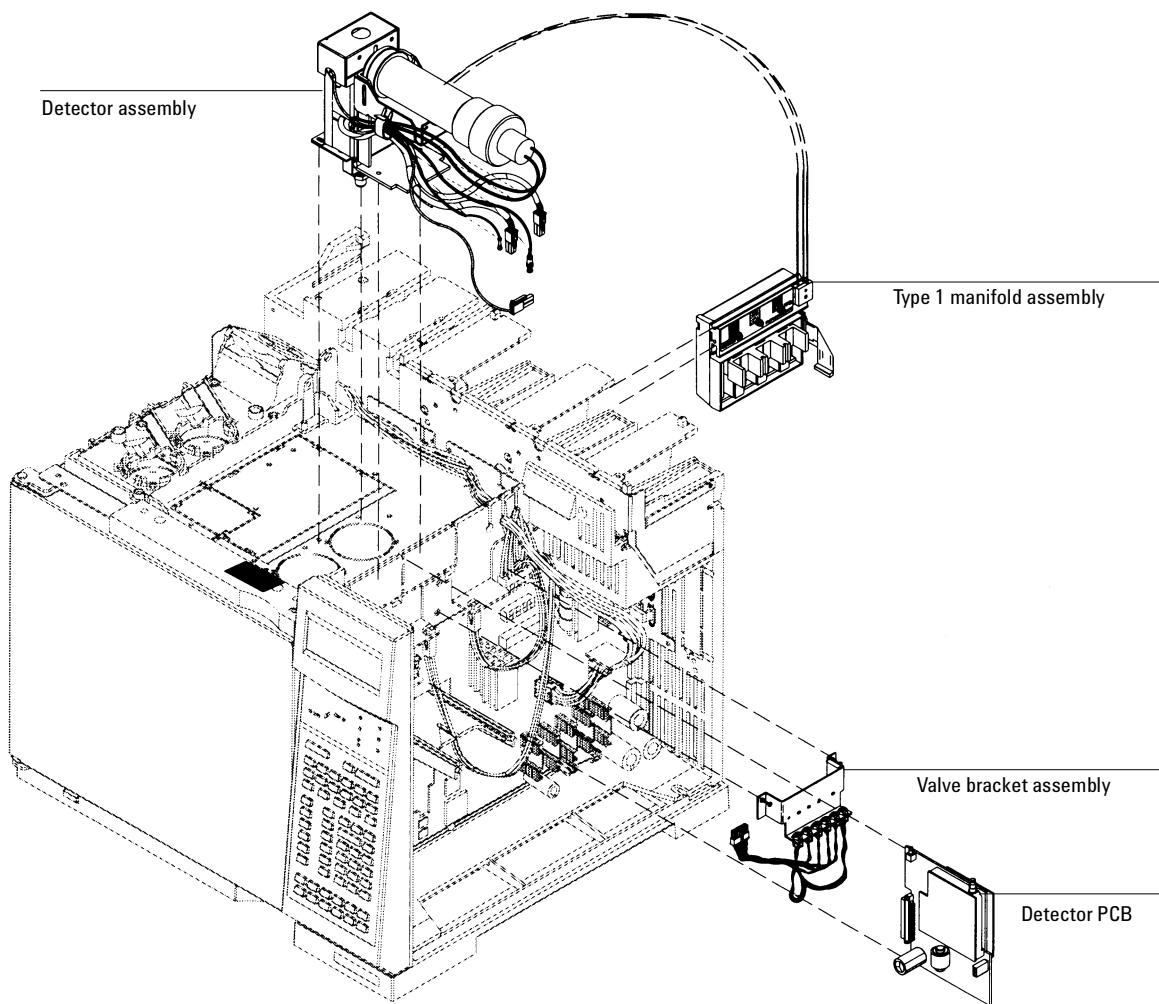


Figure 350-2 Replacing the FPD assemblies

6. Trace the ignitor cable from the FPD to its source on the detector board, and disconnect it. Note the locations of the signal and high voltage cables, then remove them from the board.

7. If removing the detector board(s), loosen the captive mounting screw in each board bracket and remove each board from the GC.
8. If removing the EPC flow module, disconnect the ribbon cable from the pneumatics PCB and remove the mounting screw in the top of the module. If not removing the EPC flow module, disconnect the gang fitting at the module. Inspect the O-rings in the gang fitting and replace if damaged. Straighten the tubing from the gang fitting and slide the module out of the GC.
9. Remove the four mounting screws in the FPD bracket and remove the FPD.
10. Reassemble in reverse order.

Column installation

Special FPD adapters

The FPD uses special adapters for capillary columns and 1/8-inch OD PTFE columns. The FPD Capillary Adapter allows fused silica columns as large as 530 µm ID to be run right to the base of the FPD flame, minimizing sample tailing or loss of chemically active sites. The FPD 1/8-inch OD Adapter allows installation of PTFE columns concentrically around the FPD fused silica liner, eliminating exposed hot stainless steel.

Capillary column installation

With the FPD capillary adapter installed, fused silica columns as large as 530 µm ID may be installed up through the FPD Fused Silica Insert to the base of the flame as follows:

1. Install a column nut and graphite ferrule on the column.
2. Cut off a short piece of the column end.
3. Position the column so it extends about 153 mm from the end of the ferrule. (The optimum height may be higher or lower, depending on sample type and detector flow rates. If the column is too high, it can be exposed to the detector flame. If the column is too low, the sample may be exposed to hot stainless steel which can result in slight peak tailing.)
Mark the column at a point even with the bottom of the nut. White typewriter correction fluid makes a good marking material. See Figure 350-2 for details.
4. Install the column in the GC and detector.

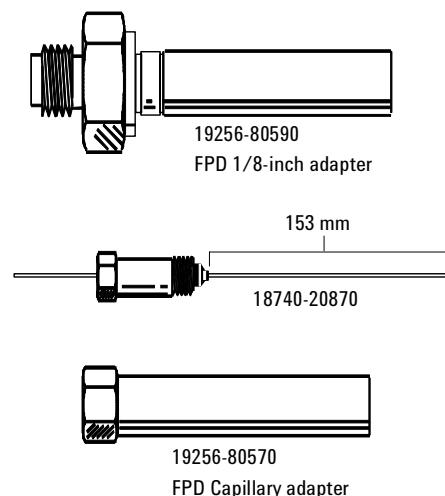


Figure 350-3 Column adapters and capillary column installation

Cleaning/replacing windows, filters, and seals

Column bleed and/or effluent can contaminate the first quartz window (heat shield) nearest the detector module. Dust, fingerprints, atmospheric contaminants can dirty both quartz windows, the filter, and/or the photomultiplier tube window. Contamination anywhere along the light path between flame and PMT can reduce detector sensitivity.

1. Turn the electrometer off.
2. Turn hydrogen, air, and auxiliary gas supplies to the detector off. Turn the heaters off. Wait for the detector to cool.

Caution Always turn the electrometer off before removing the PMT housing to avoid destroying the tube.

3. Release the retaining spring around the photomultiplier housing.

4. Pull the PMT housing off the detector module and remove the filter from the detector. Use lint-free lens tissue to clean the filter on both sides. Also clean the window in the PMT tube. Be careful to not scratch the surfaces; do not use a cleaning fluid that might leave a film upon drying. Keep the open end of the PMT covered whenever practical to avoid light damage to the tube.

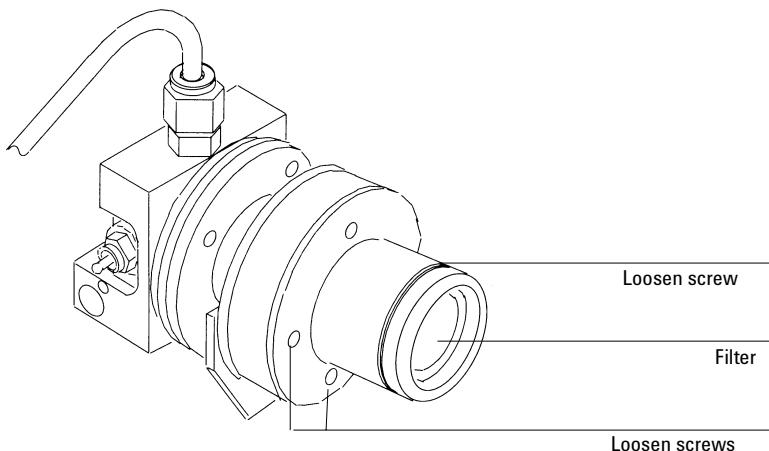


Figure 350-4 Removing the PMT filter

5. Inspect the filter: chips, scratches, and/or cracks in the light path scatter light, reducing detector sensitivity. Replace filters as necessary.

Inspect the PMT window for damage; if necessary, replace the PMT. See *Replacing the photomultiplier tube*.

6. Remove the four screws in the PMT adapter flange and remove the flange. Use care as a quartz window is exposed and may fall out. Clean the window using lens tissue.

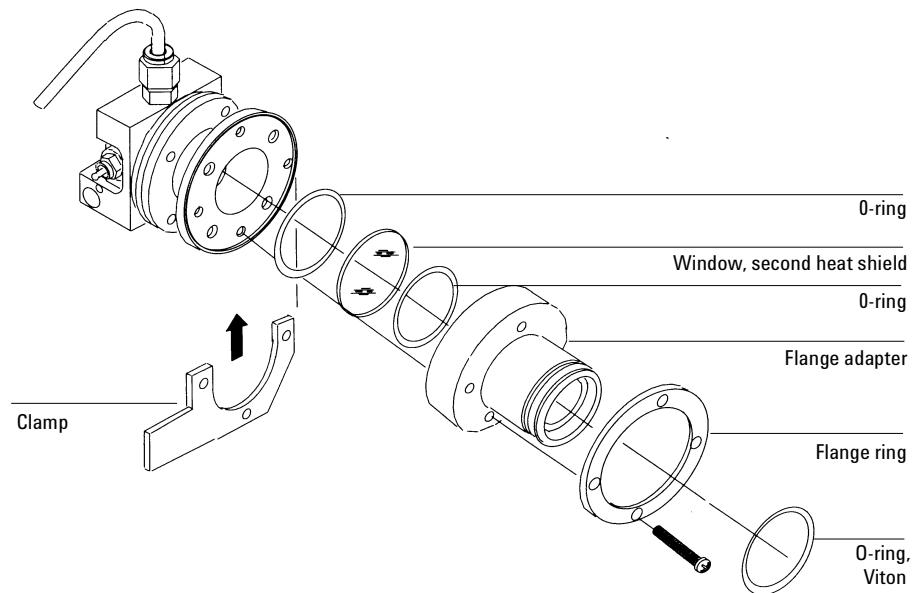


Figure 350-5 FPD disassembly

7. Remove the four screws in the stainless steel coupling and carefully remove the coupling as the remaining quartz window may fall out. Clean the window using lens tissue.

Caution This window—the one closest to the flame—may stick when the detector is cold. It is easier to remove when the detector is warm, but be careful to avoid burns.

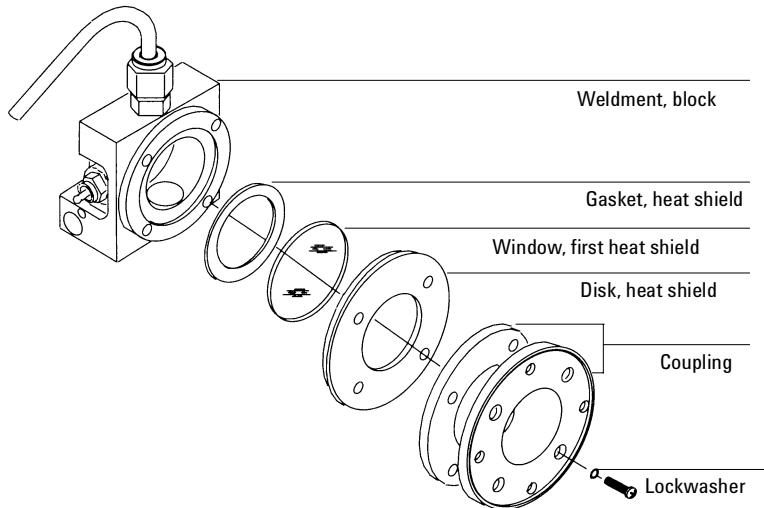


Figure 350-6 Removing the first heatshield window.

8. Note the placement and types of seals found on the disassembled parts. Seals should be replaced with new parts on reassembly.
9. Inspect the windows: chips, scratches, cracks or fogging in the light path scatter light, reducing sensitivity. Replace windows if necessary.

10. Reassemble the parts in reverse order, making sure all seals are of the proper type and in their proper locations. Tighten screws evenly and firmly to ensure gas- and light-tight seals. If the filter has a silvered side, it should face the flame (indicator arrows > on edge of filter should point toward the PMT).

Cleaning/replacing the jet

If a response problem is encountered (sensitivity, noise, selectivity) the FPD jet should be inspected for deposits and, if necessary, cleaned or replaced. To properly service the jet, the detector module should be removed from the instrument, followed by appropriate service:

1. Turn off power to the gas chromatograph and disconnect the main power cord. Remove the detector covers.
2. Allow time for heated zones to cool to safe temperatures.

Caution Always turn the electrometer or the main power off before removing the PMT housing to avoid destroying the tube.

3. Pull the PMT housing off the detector module and remove the filter from the detector. Set both in a safe place. Keep the open end of the PMT covered whenever practical to avoid light damage to the tube.
4. Remove the exhaust tubing.
5. Remove the sheet metal cover—on the single wavelength detector, it is held by two screws at the top and two at the bottom; on the dual wavelength detector it is held by two screws at the top.

6. Loosen the three screws that secure the detector to the clamp and the sheet metal.

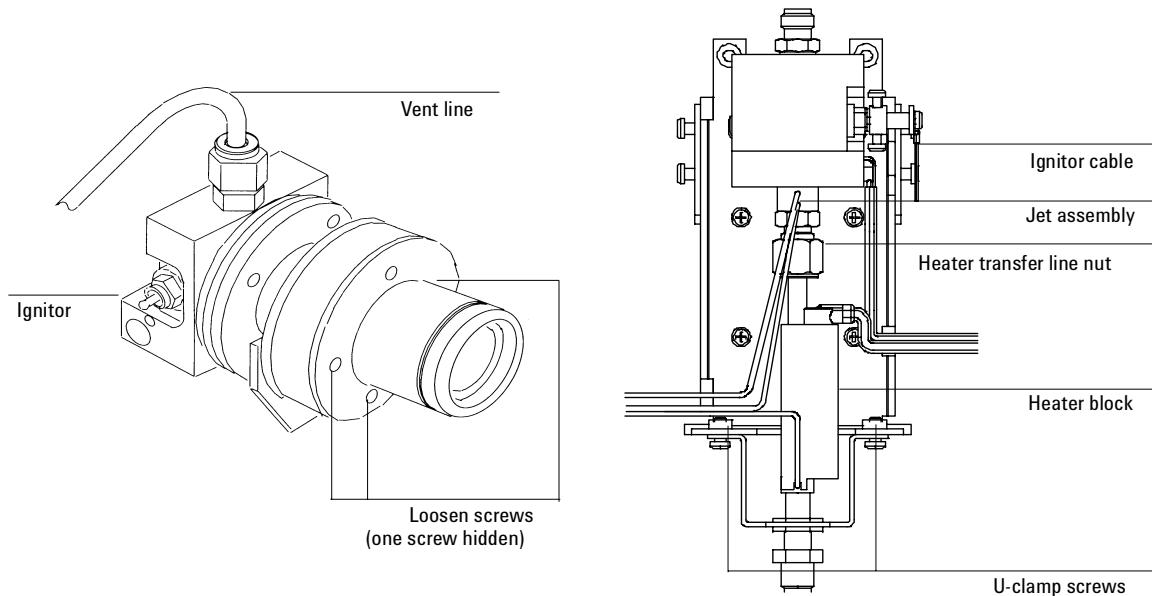


Figure 350-7 Removing the FPD housing from the support bracket.

7. Use two wrenches to loosen the Swagelok connection between the jet assembly and the heated transfer tube.
8. Carefully lift the detector module and jet assembly off of the transfer tube and out of the GC. Be careful not to damage the fused silica gigabore liner.

When cleaning or replacing the jet, it is not necessary to disconnect any plumbing, ignitor leads or the heater/sensor. Leave all attached and disconnect the detector block from the transfer line at the Swagelok fitting, then gently lift the block and rotate it enough to access the jet.

9. Remove and inspect the jet assembly. It can be pulled straight out but rotating it slightly helps to free it. The jet assembly slips out of the FPD block more easily if the block is still warm. Use a wire or brush to remove any deposits.
10. Use compressed air or nitrogen to blow out loose particles from the jet and/or detector module body.
11. Inspect and clean deposits from the jet bore using a suitable wire. If the jet is damaged in any way, it should be replaced. It is good practice to replace the jet, rather than try to clean it, particularly when extremely high sensitivity is required.
12. A new O-ring seal must be used when reinstalling the jet into the burner chamber.

Caution Be careful not to crush or side-load the fused silica liner when reinstalling the detector.

13. Reassemble all parts of the detector module; reassemble the module onto the instrument. A new Vespel ferrule should be used to seal the detector module to the transfer line.
14. Reinstall the PMT assembly on the detector module; restore instrument gases and power.

Replacing the transfer line fused silica liner

Occasionally the transfer line fused silica liner between the column and FPD module must be inspected, cleaned, and/or replaced.

1. Turn off power to the gas chromatograph and disconnect the main power cord. Remove the detector covers.
2. Allow time for heated zones to cool to safe temperatures.
3. Inside the oven, remove the column to the FPD.

Caution Always turn the electrometer or the main power off before removing the PMT housing to avoid destroying the tube.

4. Remove the photomultiplier tube assembly—or assemblies—from the detector module; also remove the filter(s). Set them in a safe place. Keep the open end of the PMT covered whenever practical to avoid light damage to the tube.
5. Locate the ignitor cable attached to the side of the detector. Trace the cable back to the printed circuit board and disconnect it there.
6. Remove the exhaust tubing and the sheet metal cover—on the single wavelength detector, it is held by two screws on the top and two at the bottom; on the dual wavelength detector, it is held by two screws at the top.
7. Remove the four screws that attach the detector to the top of the oven (one at each corner). Remove the detector from the GC.
8. Loosen the transfer line nut. Remove the two screws that secure the U-clamp to the detector frame. Remove the U-clamp and the attached parts from the bottom of the detector.

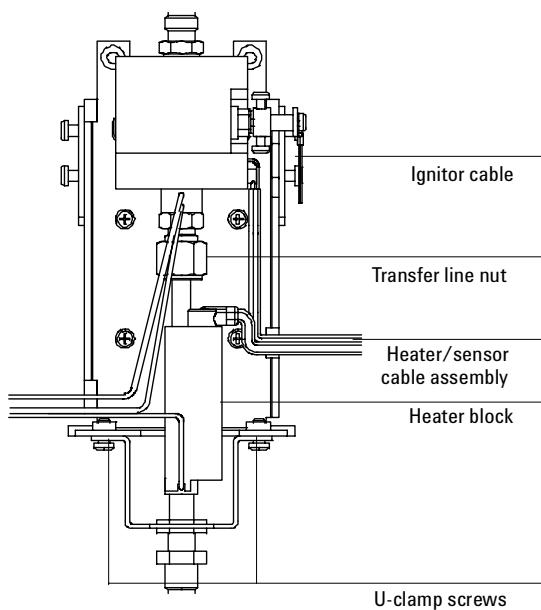


Figure 350-8 Replacing the transfer line fused silica liner

9. Remove the transfer line nut and its ferrule, the heater/sensor cable assembly, and the heated block.

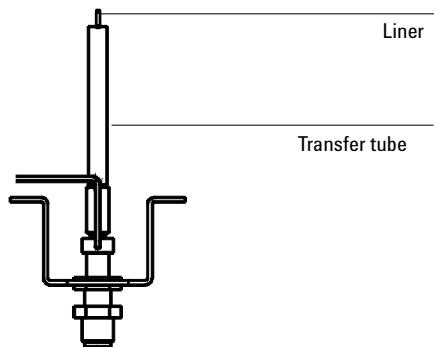


Figure 350-9 Removing the transfer tube

10. With an open end wrench, unscrew the transfer tube from the detector base. Lift the transfer tube—containing the fused silica liner—vertically off the instrument. Remove the fused silica liner and the 1/16-inch Vespel ferrule by pulling the fused silica liner and ferrule out from the bottom. Inspect for damage.

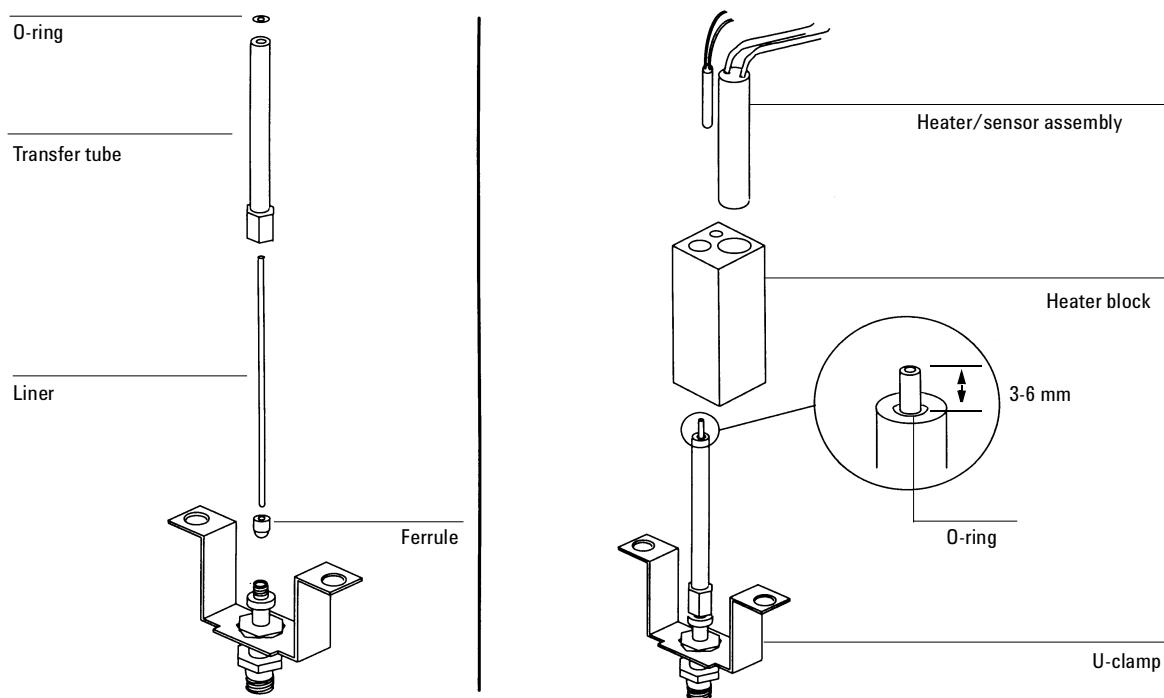


Figure 350-10 Replacing the fused silica gigabore liner

11. If necessary, install a new fused silica liner and Vespel ferrule. When doing so, carefully feed the fused silica liner through the O-ring at the top of the transfer line so as not to damage the O-ring.

12. Carefully replace the fused silica liner, ferrule and tube onto the detector base. The fused silica liner should be positioned so that it protrudes 3 to 6 mm (1/4-inch) above the top of the transfer tube weldment. With a wrench, firmly tighten the transfer tube 1/2-turn past finger-tight.
13. Reinstall the heated block, the heater/sensor cable assembly, the nut, and the ferrule. The notch in the bottom of the block fits over the tubing coming from the detector fitting.
14. Tighten the U-clamp screws, then tighten the nut on the transfer tube.
15. Place the detector on top of the instrument, orient it properly, and install the four screws to hold it. Install the top cover and the exhaust tubing.
16. Connect the ignitor cable to the printed circuit board.
17. Install the PMT assembly (or assemblies).
18. Restore normal operating conditions.

Replacing the photomultiplier tube

If the PMT is defective (high voltage on and the flame lit: low or no signal and/or high noise not attributed to any other source such as bad cables, light leaks, high temperature, defective signal board, etc.), it must be replaced.

1. Turn off power to the gas chromatograph and disconnect the main power cord.

Caution Turn the electrometer or main power off before opening the PMT housing to avoid destroying the tube.

2. Free the cables to the PMT from the clip on the support. Pull a few inches of the cables through the cable tie toward the end cap. Unscrew the end cap from the PMT assembly. Slide the cap away from the assembly.

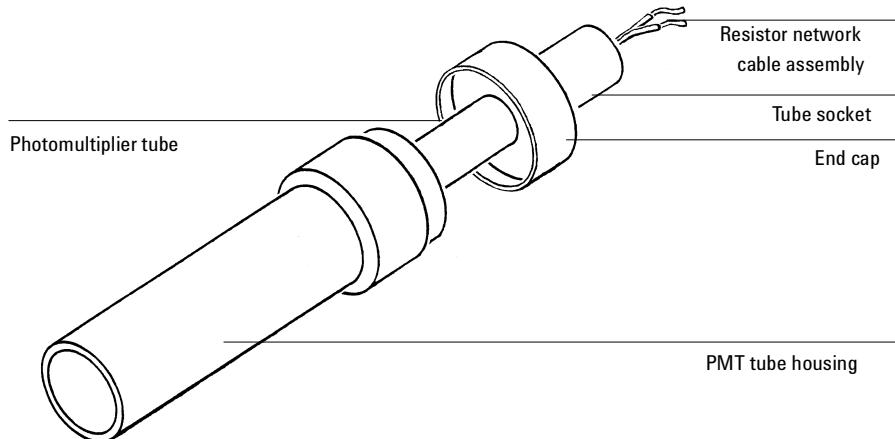


Figure 350-11 FPD Photomultiplier Tube (PMT) Replacement

3. Slide the resistor network cable assembly and the photomultiplier tube and socket out of the housing until about 1 inch of the tube is exposed.
4. Pull the socket off the PMT. Remove the PMT and replace with a new tube.
5. When seating the socket on the new tube, be certain that the missing pin on the tube base is lined up with the gap in the socket contacts.
6. Reassemble in the reverse order. Make sure grease, fingerprints, dust, etc. are removed from the PMT window facing the detector module. Be sure that the O-ring is in place on the PMT/resistor bridge network assembly, as this is a critical light seal. If the O-ring is lost or damaged, replace it.
7. Screw the end cap onto the PMT assembly. Pull the cables through the cable tie to eliminate slack at the end of the assembly. Place the cables in the clip on the side of the PMT housing support.

Replacing the heater/sensor assemblies

1. Turn off power to the gas chromatograph and disconnect the main power cord. Remove the detector covers.

WARNING Always turn off power to the gas chromatograph and allow the heated zones to cool. Unplug the power cord.

2. Allow time for heated zones to cool to safe temperatures.

Caution Always turn the electrometer or the main power off before removing the PMT housing to avoid destroying the tube.

3. Pull the PMT housing off the detector module and remove the filter from the detector. Set both in a safe place. Keep the open end of the PMT covered whenever practical to avoid light damage to the tube.
4. Remove the exhaust tubing.
5. Remove the sheet metal cover. On the single wavelength detector, it is held by two screws at the top and two at the bottom, while on the dual wavelength detector it is held by two screws at the top.
6. If replacing the upper (FRONT) heater/sensor, remove it from the detector module. Install a new heater/sensor. If not replacing the AUX1 heater, reassemble in reverse order.

7. To replace the lower (AUX1) heater/sensor assembly, loosen the three screws in the flange adapter that secure the detector body to the support bracket clamp.

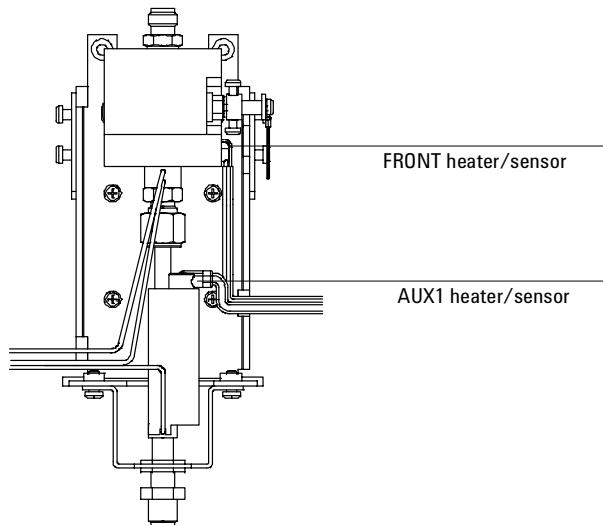


Figure 350-12 Heater/sensors

8. Use two wrenches to loosen the Swagelok connection between the jet assembly and the heated transfer tube.
9. Carefully lift the detector module and jet assembly off of the transfer tube and out of the GC. Be careful not to damage the fused silica gigabore liner.
It is not necessary to disconnect any plumbing or ignitor leads. Leave all attached and disconnect the detector block from the transfer line at the Swagelok fitting, then gently lift the block and set aside.
10. Remove the heater/sensor assembly and install a new one.
11. Reassemble in reverse order.

Replacing the ignitor glow plug

1. Turn off power to the gas chromatograph and disconnect the main power cord. Remove the detector covers.
2. Allow time for heated zones to cool to safe temperatures.

Caution Always turn the electrometer or the main power off before removing the PMT housing to avoid destroying the tube.

3. Pull the PMT housing off the detector module and remove the filter from the detector. Set both in a safe place. Keep the open end of the PMT covered whenever practical to avoid light damage to the tube.
4. Remove the exhaust tubing.
5. Remove the sheet metal cover. On the single wavelength detector, it is held by two screws at the top and two at the bottom, while on the dual wavelength detector it is held by two screws at the top.

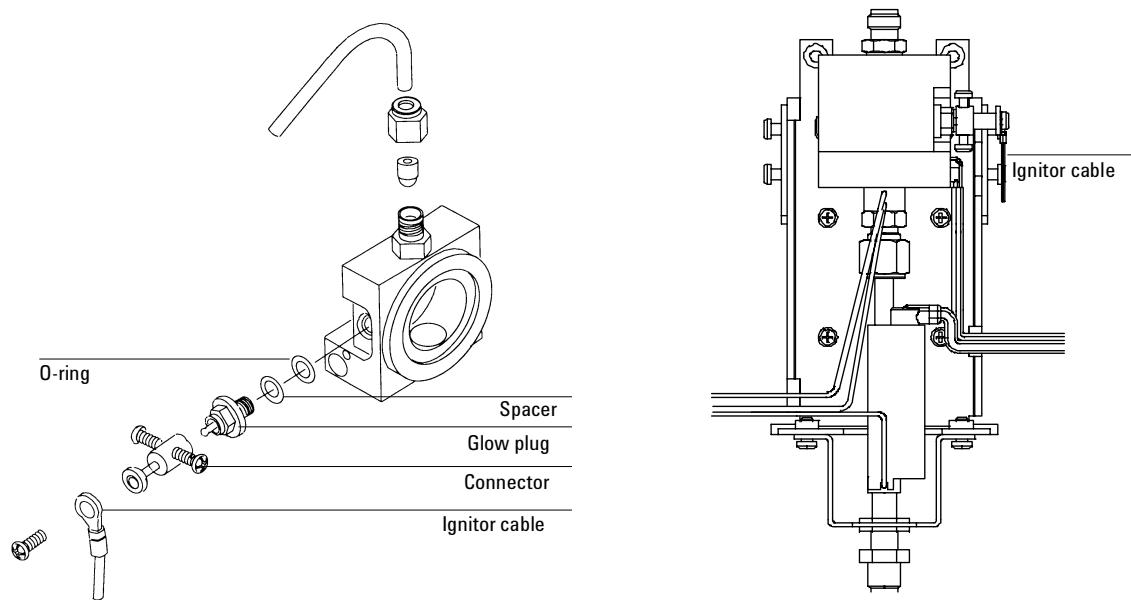


Figure 350-13 Replacing the ignitor glow plug

6. Remove the ignitor cable.
7. Unscrew the connector and ignitor assembly from the detector module.
8. Remove the O-ring, ignitor spacer, and glow plug from the ignitor assembly. Replace the glow plug. Inspect the O-ring and spacer, and replace if needed.
9. Reassemble in reverse order.

Removing an FPD flow manifold

Early models of the 6890 GC used Type 1 EPC flow manifolds. Later models use Type 2 manifolds. Both types are covered here.

WARNING Before proceeding, turn off the oven and any heated zones and let them cool down. Turn off any detector gases at their supply, then turn off the main power switch and unplug the power cord.

1. Remove the top plastic covers from the detector and pneumatics areas. Also remove the RFI metal shield and the top rear metal cover.
2. Remove the gas supply fittings from the manifold.
3. At the front of the manifold, remove the Torx T-20 screw that holds the manifold in its slot.
4. Disengage the detector tubing from the slots in the chassis so that the gang fitting on the manifold can be removed easily.

Caution Make sure you are properly grounded with an ESD strap before continuing.

5. Unlock the detector manifold's ribbon cable from the EPC board and detach the connector. The adjacent ribbon cable may have to be removed as well.

6. Type 1 manifold

Slide the manifold to the rear to reach the screw holding the gang block fitting. Remove the screw and the fitting.

Type 2 manifold

Remove the gang block fitting from the rear of the manifold.

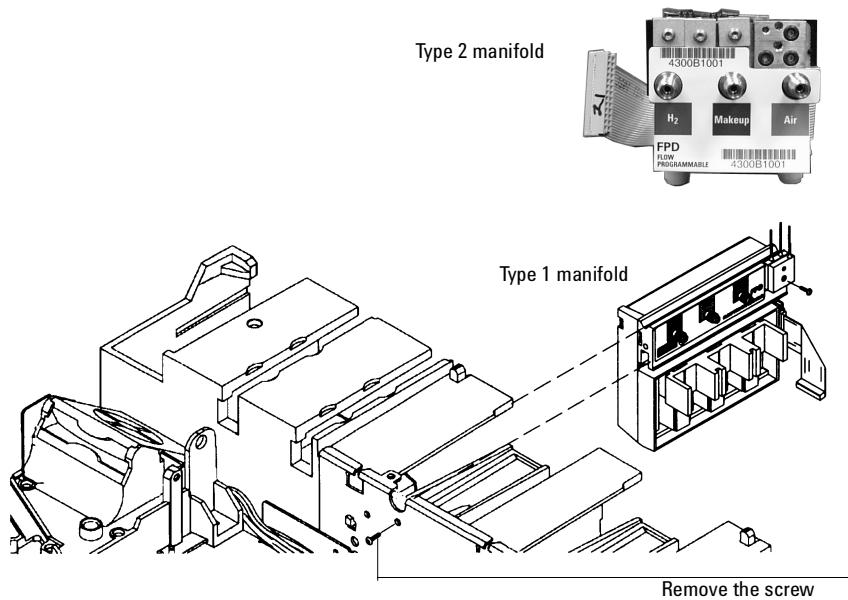


Figure 350-14 Removing an FPD flow manifold

Caution Always hold the Type 2 manifold by its support bracket to avoid damaging board components.

7. Remove the manifold from its slot.

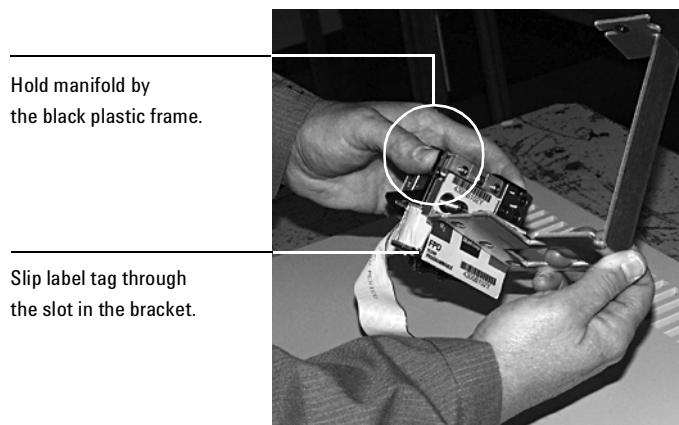
Installing a Type 2 manifold

WARNING Hydrogen gas is flammable and potentially explosive. Before replacing the manifold, turn off the hydrogen gas at the source.

WARNING Before proceeding, turn off the oven and any heated zones and let them cool down. Turn off all detector gases at their supply, then turn off the main power switch and unplug the power cord.

Caution Always hold the manifold as shown below to avoid damaging board components.

1. While holding the manifold by the black plastic frame as shown below, slip the label through the slot in the mounting bracket, and align the bracket holes over the gas fittings.



2. Finger-tighten three 7/16-inch hex nuts over the fittings to hold the bracket in place. It is **very important** that you do **not** tighten the nuts yet.

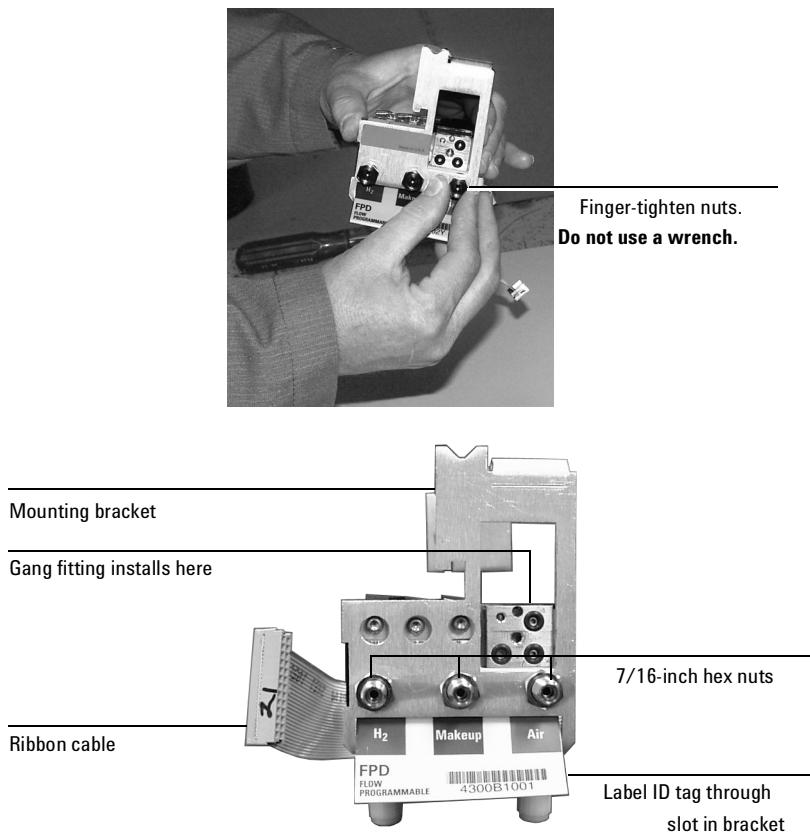


Figure 350-15 Bracket mounted onto the manifold

3. Peel the blank label from its backing and paste it on the mounting bracket over the screw heads. See Figure 350-16.
4. If the tubing from the gang fitting bends to the left, reshape it so that it bends up and back from the block as shown in Figure 350-17.
5. Insert the gang fitting through the cutout in the manifold bracket and install it onto the new manifold assembly so that the tubing runs back and away from the fitting.

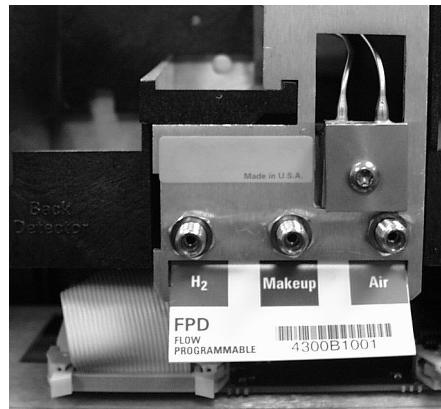
- Be sure the left tube clears the inner edge of the bracket. See Figure 350-17.
- Be sure that the O-rings are in place.

Tighten the gang fitting screw firmly to compress the O-rings.

6. Route the ribbon cable behind the manifold assembly as shown in Figure 350-16. Then, slide the manifold and bracket assembly into the slot until the bracket seats flush against the end of the rails. See Figure 350-17.



Back view of manifold



Manifold installed with cable routed to left

Figure 350-16 Routing the ribbon cable

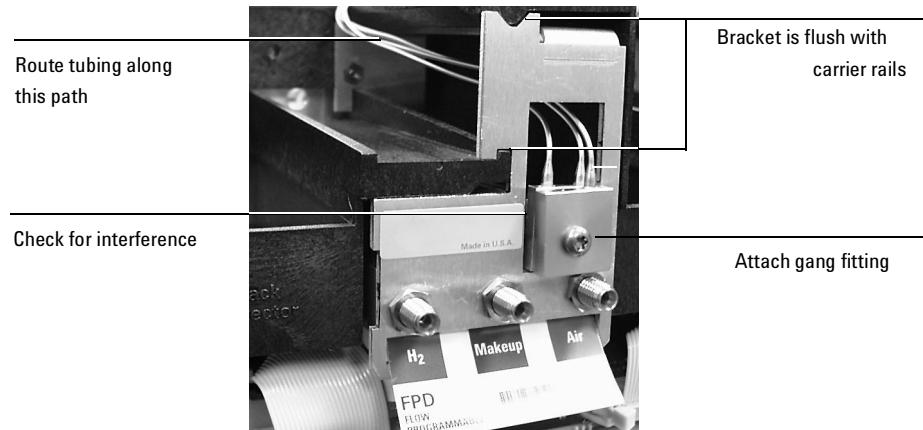


Figure 350-17 Manifold, after installation

7. Route the gas tubing:
 - If the detector is installed in the **back** position, route the tubing behind the manifold, over the top of the chassis, and through the slots as shown in Figure 350-17.
 - If the detector is installed in the **front** position, route the tubing behind the manifold and over the top of the chassis. Run it directly to the detector; do not run it through the slots.
8. Connect the ribbon cable to the mating connector on the pneumatics board. Arrange the cable to keep it away from the valves and keep it from being pinched against the manifold.

For the back detector, you may want to loosen the manifold and slide it out of the carrier a few centimeters to connect the cable to the pneumatics board. Then reinstall the manifold.
9. Secure the manifold in place using the Torx T-20 mounting screw.

10. Using a pair of needle-nosed pliers, remove the appropriate top rear panel detector cutout for the FPD. Also remove any cutouts needed to access other manifolds or accessories installed in the GC. See Figure 350-18.

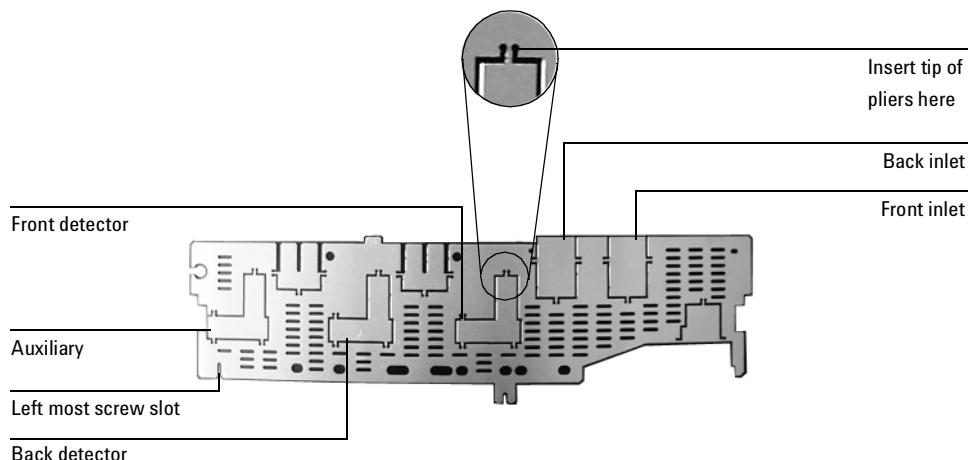


Figure 350-18 Top rear panel cutouts

11. Place the new top rear panel on its left-most mounting screw. Use the screw as a hinge and angle the panel while sliding each manifold ID tag through its cutout in the panel, working from left to right. When all the tags are through the panel, finish installing the panel on the GC.
12. Install the RFI shield, the pneumatics cover, and the detector top cover.
13. Connect the source gas lines to the manifold. See Figure 350-19.



Figure 350-19 Gas line connections

14. Restore gas pressures and leak check all fittings.

Diagnostics

Quenching effects

Hydrocarbon quenching occurs when a high concentration of carbon dioxide from a hydrocarbon peak is in the flame at the same time as the sulfur species. Part of the light emitted by the sulfur species is absorbed by some CO₂ species.

Self-quenching occurs at high concentrations of the heteroatom species. Some other ground state (inactivated) species reabsorbs the emitted photon, preventing it from reaching the PMT.

These effects are reduced by good chromatographic practices. The column should provide good separation of the compounds, those that contain sulfur or phosphorus as well as those that do not but may absorb light. A careful, multilevel calibration is well worth the investment!

Detector and gas cleanliness must be maintained to have consistent responses. Since most sulfur and phosphorus compounds contain chemically active sites, the injection and column systems must be kept very clean.

PMT saturation

The photomultiplier tube may saturate if light intensity is too high. When this happens, increasing concentration produces little or no increase in signal and peak tops are rounded or flattened. The sample must be diluted to prevent saturation.

Detector temperature considerations

The FPD flame produces considerable water vapor. The detector must be operated above 120°C to prevent condensation.

Unnecessarily high temperatures can cause thermal decomposition of many thermally labile phosphorus and sulfur compounds.

Detector temperature can have a significant effect on sulfur sensitivity. If analyzing compounds with high boiling points, the detector temperature should be set to 25°C above the final oven temperature—if allowed by the temperature limit of 250°C.

Flame ignition problems

Note

The flame is easier to light at higher detector temperatures.

If the flame doesn't light at all, be sure the glow plug circuit is working. Try to ignite the flame while watching the visual display. If the display does not momentarily go to greater than 65500 counts, the glow plug is either damaged or not receiving power. Check the pin connections at the printed circuit board, the lead connection on the glow plug and the appropriate 5A fuse on the GC main circuit board. If the glow plug has failed, replace it.

If the FPD flame won't light or stay lit, check/do the following:

1. Be sure there is a problem. The flame normally does not make any sound when it ignites and the increase in signal offset on the visual display is often only a few counts. To verify flame ignition, remove the vent line from the top of the detector and hold a mirror or shiny surface near the aluminum exhaust tube. If the flame is lit, condensation will form on the mirror.

Check the displayed air flow rate. The display should go to 200 mL/min while trying to ignite to flame. If not, there is insufficient supply pressure.

2. Check the `Lit_offset` value. If it is zero, autoignition is turned off. If it is too large, the software will not recognize that the flame is lit and will shut the detector down.
3. Increase the air supply pressure to the pneumatics module. This makes the flame easier to light but does not affect the air flow rate setpoint.
4. Under some operating conditions, the flame may be more easily lit with the rubber drip tube removed. After lighting the flame, reinstall the drip tube.
5. If the flame still won't light, there may be a large leak in the system. This results in measured flow rates very different from actual flow rates. Thoroughly leak check the whole system.

6. The sulfur mode can be particularly hard to light. Try changing to the phosphorus mode flows, lighting the flame, and gradually alter the flows to the sulfur values.

Leak testing

Follow the steps below to leak test the FPD system.

1. Turn off all supply gases. Cap the detector exhaust tube with a 1/4-inch Swagelok plug (part no. 0100-0196) and a 40% graphitized Vespel ferrule (part no. 0100-1061).

Caution When testing the flow system under pressure, do not exceed 210 kpa (30 psig). Higher pressures may damage the detector block window or seals.

2. Turn one of the gases on for a few seconds and then turn it off. The indicated flow pressure should remain constant or drop slowly. If not, there is a leak in the system. Begin checking possible leak sources and monitor the flow number to determine when the leak has been eliminated.

Potential leaks areas

Possible leak sources, in order of decreasing probability, are:

- Septum
- Column fittings
- Supply line swage-type plumbing connections
- Detector block O-ring or Vespel seals
- Other system plumbing

360 Auxiliary EPC

Theory of operation

The auxiliary EPC channels are controlled by a pressure setpoint. To work properly, there must be adequate flow resistance downstream of the pressure sensor. The auxiliary channel pneumatics manifold provides a frit-type restrictor for each channel. Four frits are available:

Frit Marking	Flow Resistance	Part no.
Blue Dot	High	19234-60660
Red Dot	Medium	19231-60770
Brown Dot	Low	19231-60610
None (brass tube)	Zero	G1570-20540

The Red Dot frit is in all three channels when the instrument is shipped.

The figures on the next two pages show approximate pressure/flow relationships for the three Dot frits, assuming there is no significant additional resistance downstream of the frits.

If the Zero resistance frit is installed, the user must provide flow resistance downstream and generate the pressure/flow relationships.

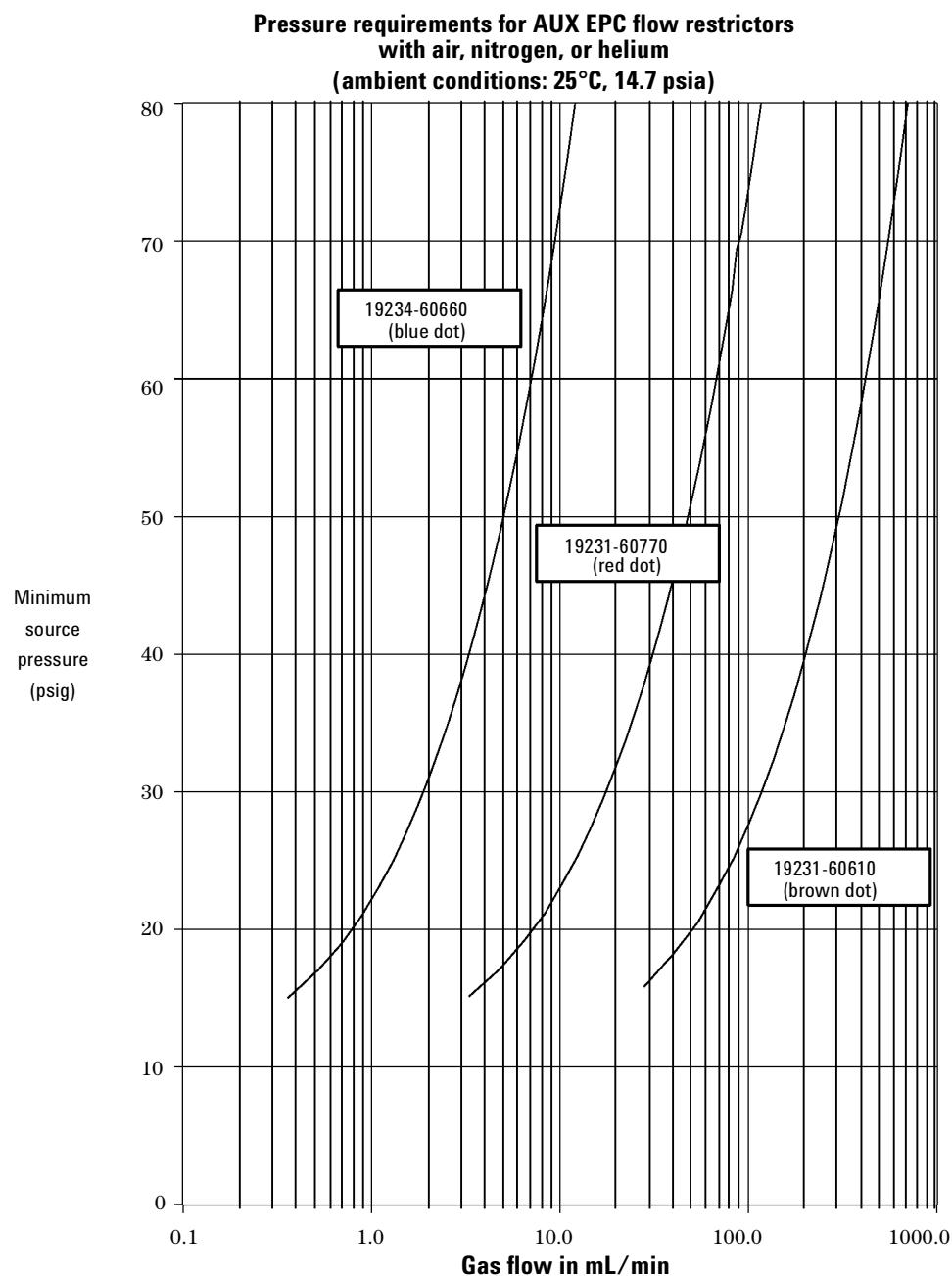
WARNING When hydrogen is used, dangerously high flows are possible if insufficient flow resistance is provided downstream of the supply tube. Always use either the High (Blue Dot) or Medium (Red Dot) frit with hydrogen.

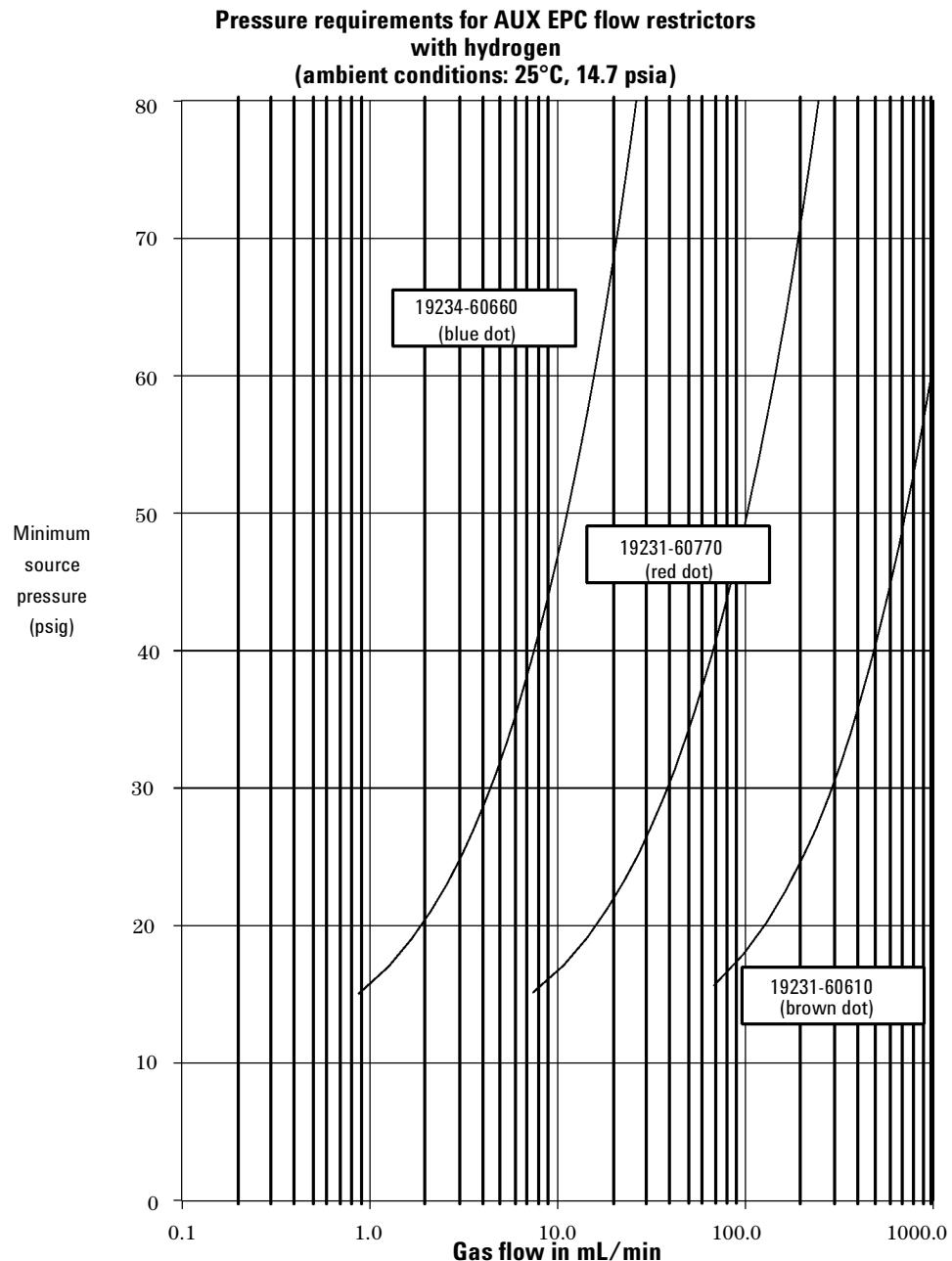
External flow restrictor (Type 2 manifold)

Use an external flow restrictor (part no. G1530-80380) on each auxiliary EPC channel to be used for a flammable gas (i.e., hydrogen). The restrictor prevents excessive gas flow in the event of a leak in the manifold or its input fitting.



External flow restrictor





Replacement procedures

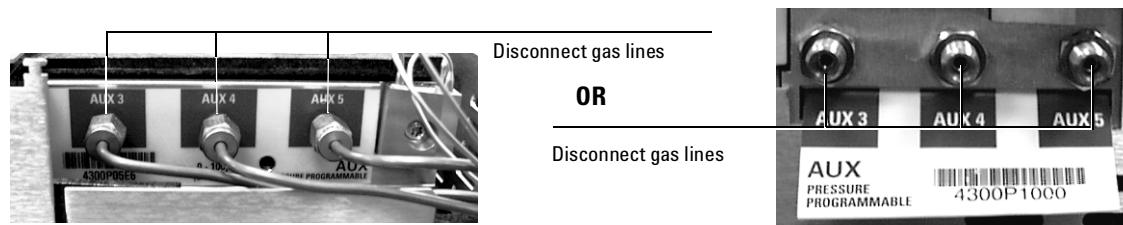
For general replacement procedures for a Type 1 manifold, see Pneumatics Control Module.

Removing the auxiliary manifold (type 1 or type 2)

WARNING Hydrogen gas is flammable and potentially explosive. Before replacing the manifold, turn off the hydrogen gas at the source.

WARNING Before proceeding, turn off the oven and any heated zones and let them cool down. Turn off all detector gases at their supply, then turn off the main power switch and unplug the power cord.

1. Remove the pneumatics cover, the RFI shield, the detector cover, the electronics cover, the right side cover, and the top rear panel.
2. Remove the gas supply tubing from the present manifold. See Figure 360-1.



Type 1 manifold, installed before January 1999

Type 2 manifold, installed after January 1999

99

Figure 360-1 Remove the gas connections

3. Remove the Torx T-20 mounting screw from the front of the manifold. See Figure 360-2.

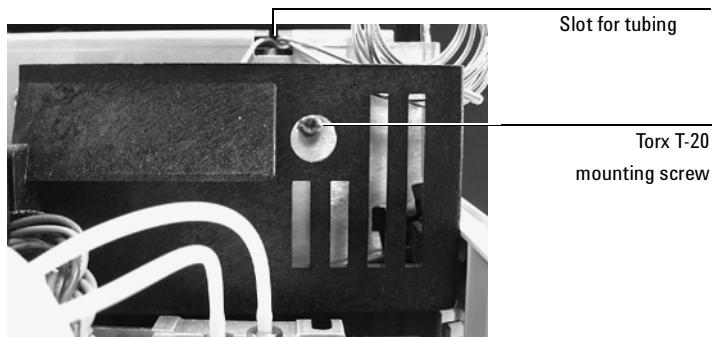


Figure 360-2 Removing the auxiliary flow manifold

4. Disengage the tubing from the slots in the chassis so that the gang fitting on the manifold can be removed easily. See Figure 360-2.

Caution Always hold the Type 2 manifold by its support bracket to avoid damaging board components.

5. Unlock the manifold's ribbon cable from the pneumatics control board and detach the connector. The adjacent ribbon cable may have to be removed as well.
6. Remove the one Torx T-20 screw holding the gang fitting on the manifold. See Figure 360-3.

Caution Do not lose the O-rings when you remove the gang fitting.

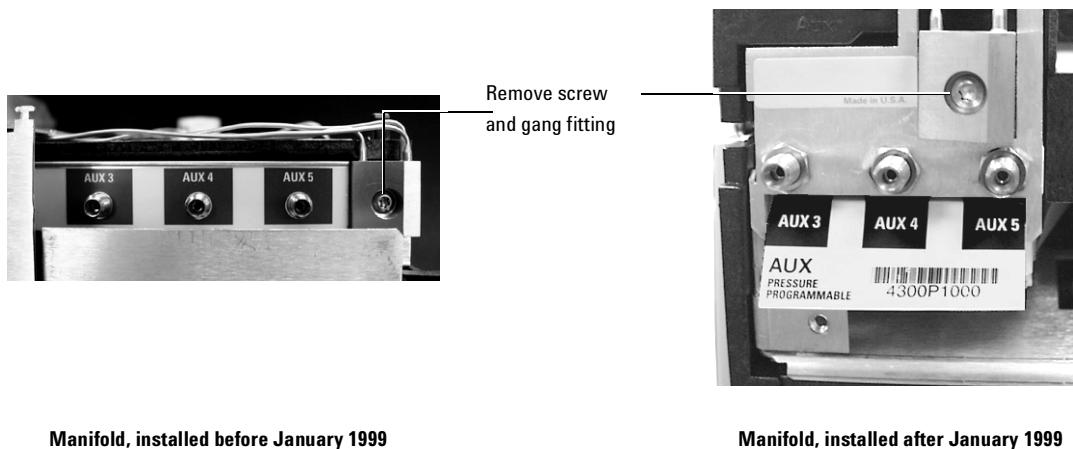


Figure 360-3 Removing the gang fitting

Installing a type 2 manifold

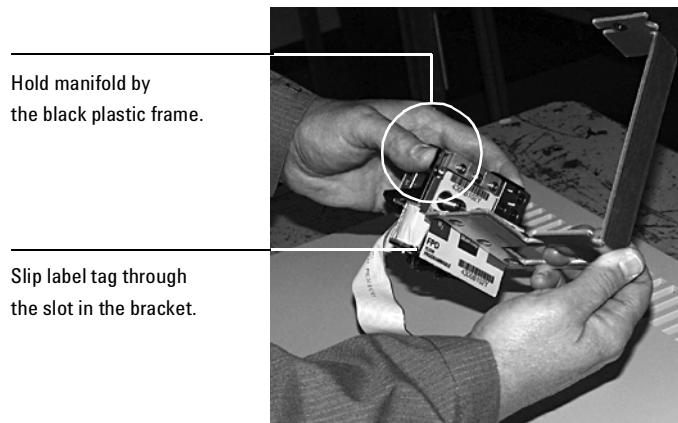
If you are replacing a Type 1 manifold with a Type 2 manifold, order the accessory kit, G1570-60720. This kit contains a new pneumatics control board bracket that is required for the Type 2 manifold. See also Replacing the PCB bracket.

WARNING Hydrogen gas is flammable and potentially explosive. Before replacing the manifold, turn off the hydrogen gas at the source.

WARNING Before proceeding, turn off the oven and any heated zones and let them cool down. Turn off all detector gases at their supply, then turn off the main power switch and unplug the power cord.

Caution Always hold the manifold as shown below to avoid damaging board components.

1. While holding the manifold by the black plastic frame as shown below, slip the label through the slot in the mounting bracket, and align the bracket holes over the gas fittings.



(FPD shown)

2. Finger-tighten three 7/16-inch hex nuts over the fittings to hold the bracket in place. It is **very important** that you do **not** tighten the nuts yet. See Figure 360-4.



Finger-tighten nuts.
Do not use a wrench.

(FPD shown above)

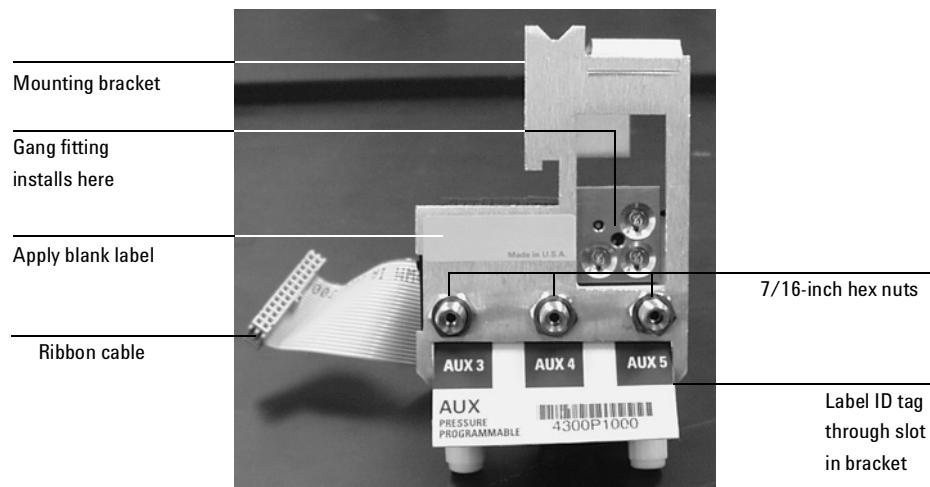


Figure 360-4 Bracket mounted onto the manifold

3. Peel the blank label from its backing and paste it on the mounting bracket over the screw heads. See Figure 360-4.
4. If you need to change one or more auxiliary channel frits, do so now. See the Agilent 6890 GC Operating Manual/CD-ROM.

5. If the tubing from the gang fitting bends to the left, reshape it so that it bends up and back from the block as shown in Figure 360-6.
6. Insert the gang fitting through the cutout in the manifold bracket and install it onto the new manifold assembly so that the tubing runs back and away from the fitting.
 - Be sure that the three O-rings are in place.
 - Be sure the left tube clears the inner edge of the bracket. See Figure 360-6.

Tighten the screw on the gang fitting until the gang fitting touches the manifold.

7. Route the ribbon cable to the right side of the manifold assembly as shown in Figure 360-5. Then, slide the manifold and bracket assembly into the Aux slot until the bracket seats flush against the end of the rails. See Figure 360-6.

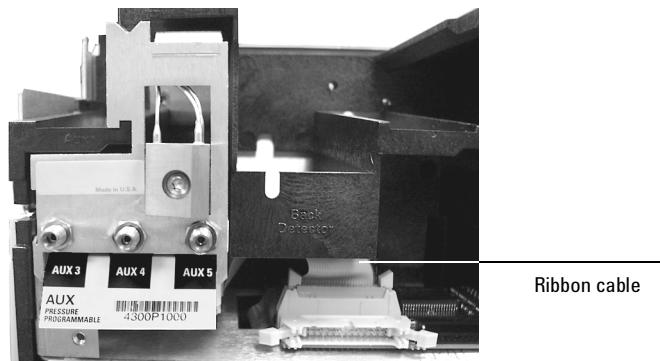


Figure 360-5 Routing the ribbon cable

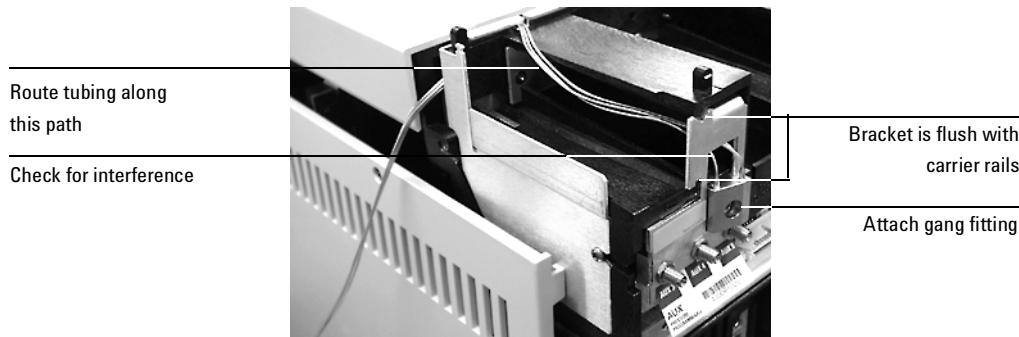


Figure 360-6 Manifold, after installation

8. Route the gas tubing behind the manifold, over the top of the chassis, and through the slots as shown in Figure 360-2 and Figure 360-6.
9. Connect the ribbon cable to the mating connector on the pneumatics board. This is behind the connector for the back detector and faces up. See Figure 360-7.
10. Secure the manifold in place using the Torx T-20 mounting screw. See Figure 360-2.

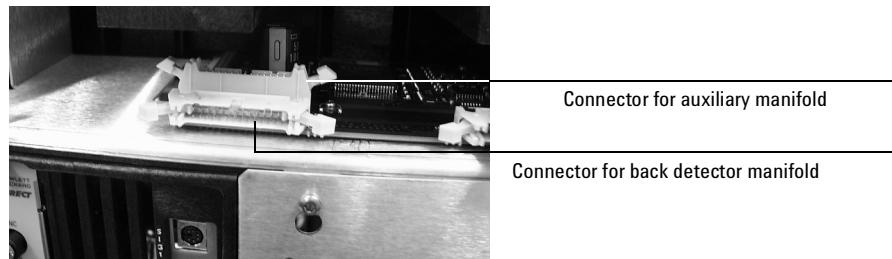


Figure 360-7 Auxiliary and back detector connectors

11. If the detector cable is in the way, remove it temporarily while you connect the Aux cable. Arrange the cable to keep it away from the valves and keep it from being pinched against the manifold.

Caution Overtightening may cause hazardous leaks. Tighten the hex nuts exactly as described below.

12. Use a wrench to tighten the 7/16-inch hex nuts 3/4 turn only.
13. Using a pair of needle-nosed pliers, remove the top rear panel cutout for Auxiliary. Also remove any cutouts needed to access other manifolds or accessories installed in the GC. See Figure 360-8.

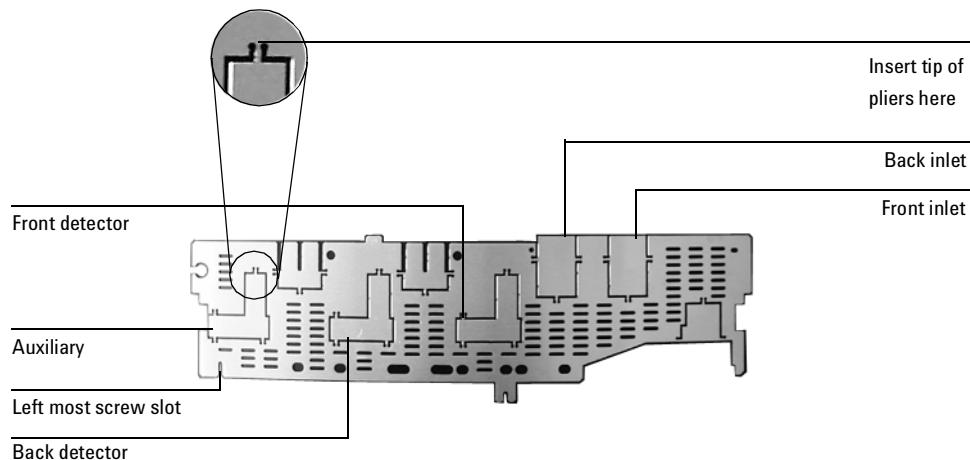


Figure 360-8 Top rear panel cutouts

14. Place the new top rear panel on its left-most mounting screw. Use the screw as a hinge and angle the panel while sliding each manifold ID tag through its cutout in the panel, working from left to right. When all the tags are through the panel, finish installing the panel on the GC.

15. Attach the Aux EPC label to the top of the pneumatics chassis as shown in Figure 360-9 below.

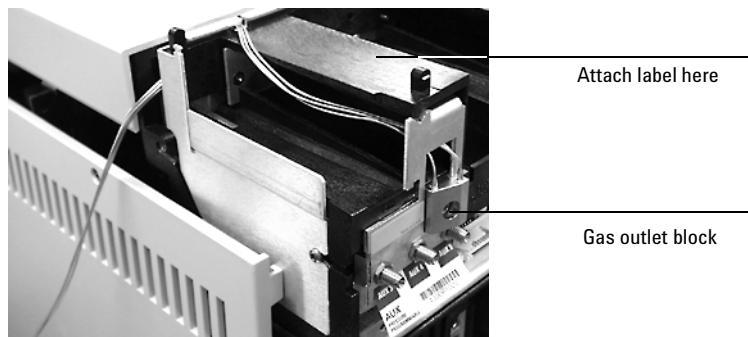
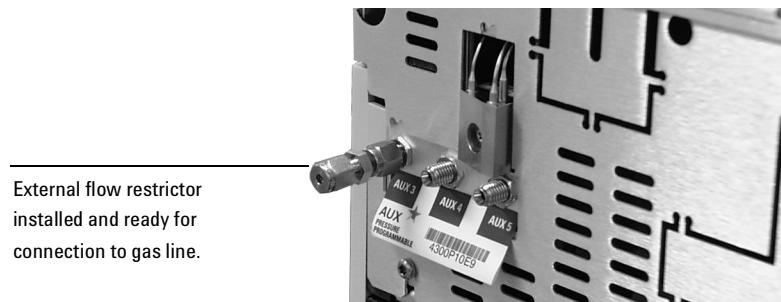


Figure 360-9 Attaching the Aux EPC label

16. Install the RFI shield, the pneumatics cover, and the detector top cover.
17. If using hydrogen or other flammable gases, install an external flow restrictor, part no. G1530-80380, on each fitting that will be used for a flammable gas.

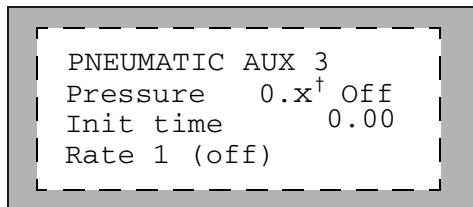


18. Check for leaks.

Restore the GC to operating condition

1. Plug in the GC and turn it on.

2. Press [Aux #][3], [Aux #][4], or [Aux #][5] to access the desired channel. If your manifold is correctly installed, you will see the following display:



† An actual flow value is displayed when the gases are off or not connected. This is not an error. After the gases are connected and the detector is operational, the actual flow values will be equal to the setpoint values.

3. If the display reads Aux not installed, recheck your cable connections.
4. Zero the pressure sensors:
 - a. Make certain that no gases are connected to your manifold.
 - b. Press [Options] and scroll to Calibration →Aux pressure.
 - c. Scroll to Aux 3 zero and press [On].
 - d. Scroll to Aux 4 zero and press [On].
 - e. Scroll to Aux 5 zero and press [On].

5. Connect the source gas lines to the manifold. See Figure 360-10.

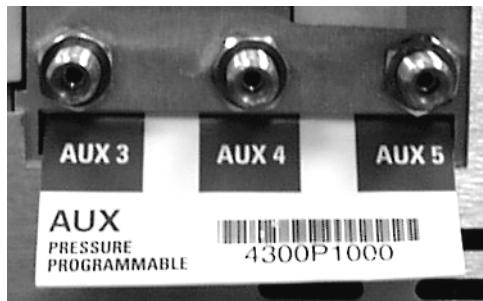
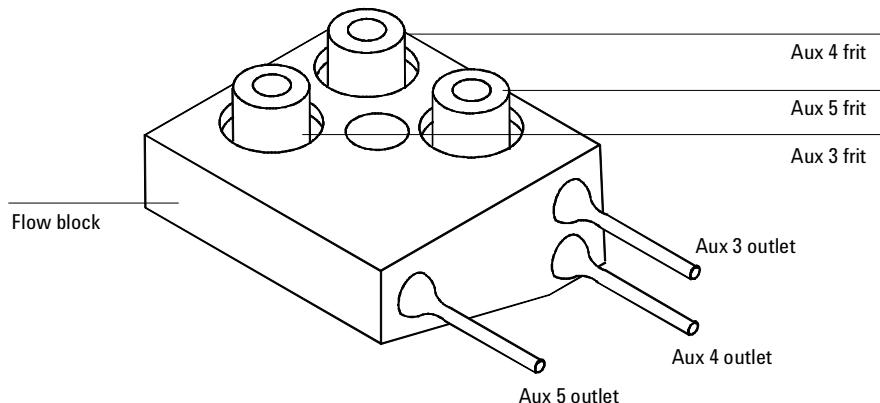


Figure 360-10 Gas line connections

6. Restore gas pressures and leak check all fittings.

Changing an auxiliary channel frit

1. Locate the block that connects the three gas outlet tubes for the auxiliary channels to the pneumatics module.
2. Remove the screw that holds the block to the pneumatics module. Pull the block free of the module and rotate it so that the frits are on top.



3. Pull the frit to be changed out of the block. Also remove the O-ring that seals it.
4. Place an O-ring on the new frit. Place the O-ring/frit combination in the block.
5. Reconnect the block to the pneumatics module. Tighten the screw firmly.

400 Mainframe

410 Covers and Fans

420 Oven and Temperature Control

430 Power/Electronics Replacement

How to maintain and replace the major components on the 6890 instrument.

410 Covers and Fans

Plastic covers

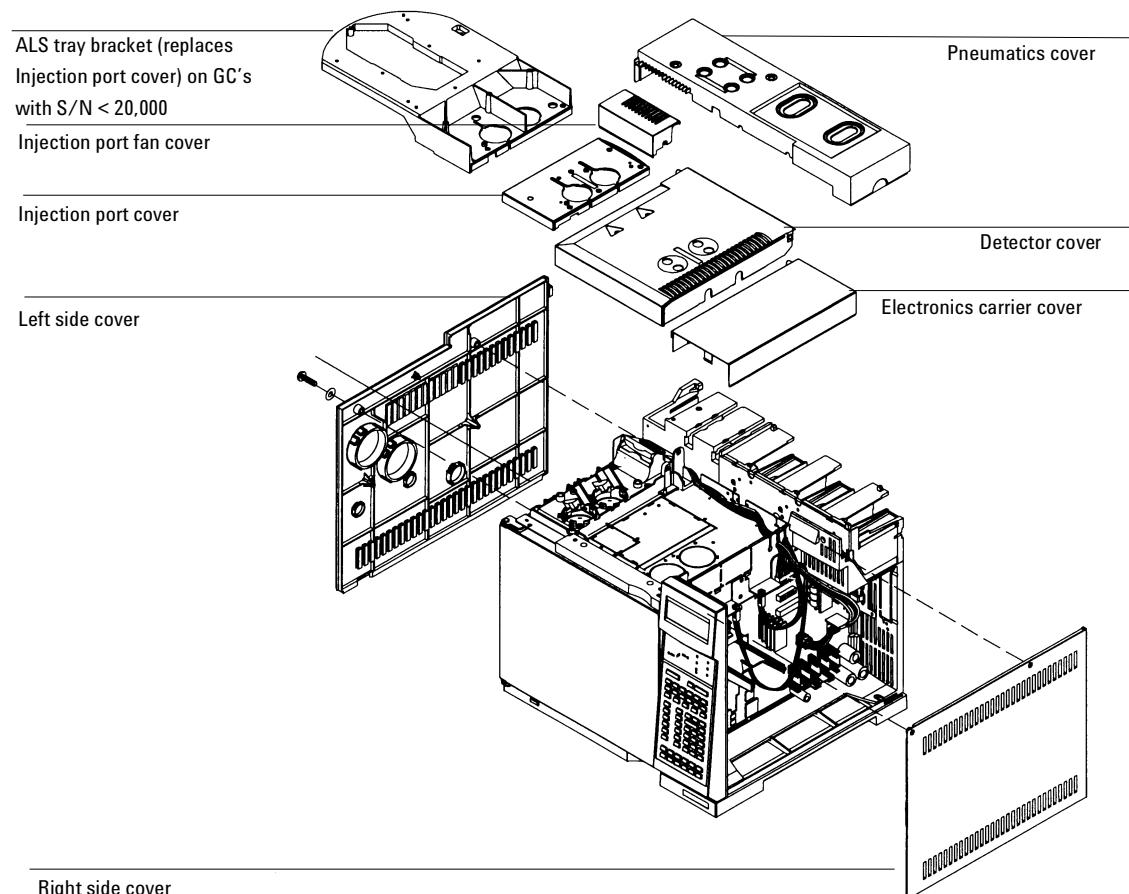


Figure 410-1 Plastic covers

Metal covers

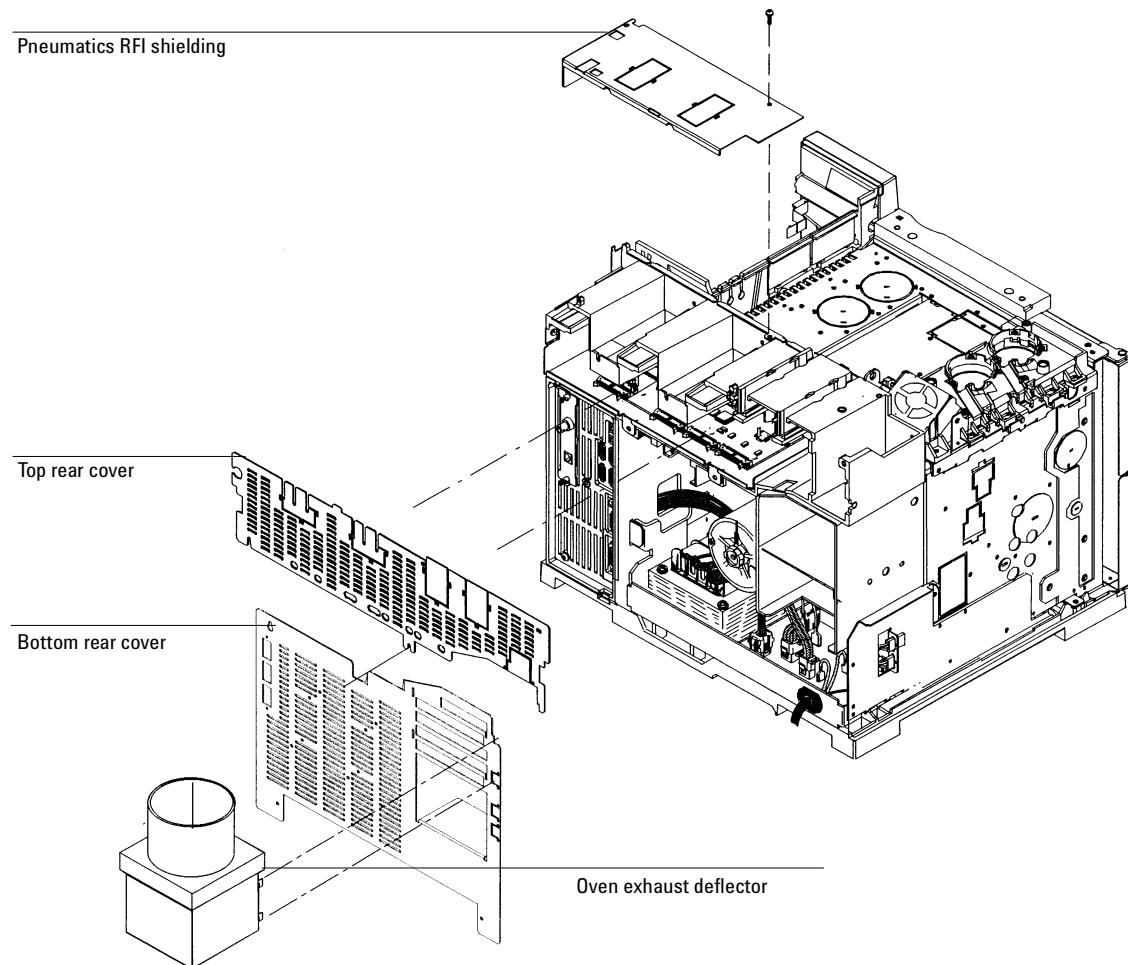


Figure 410-2 Metal covers

Removing the electronics cover

The electronics carrier cover is located on the right, top side of the 6890 GC.

WARNING The electronics carrier cover shields the high voltage components on the main board. Turn off the main power switch and unplug the power cord before removing this cover.

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

1. Remove the GC's right side cover.
2. Reach under the electronics carrier cover and depress the rear locking tab towards the front of the instrument.

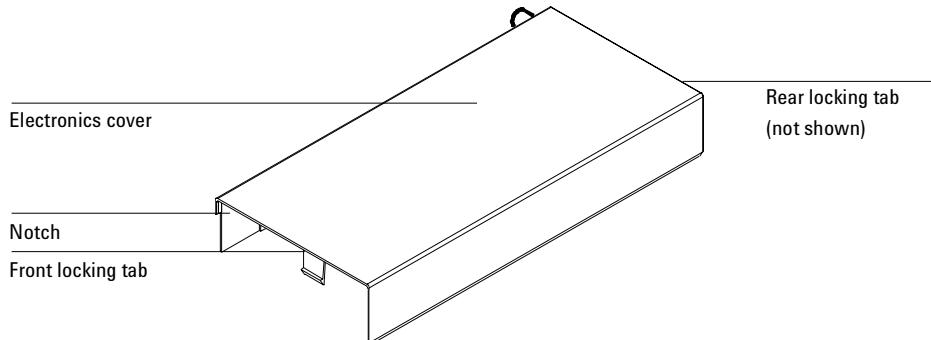


Figure 410-3 Removing the electronics cover

3. While depressing the tab, lift up on the back of the electronics carrier cover and slide the cover back, up, and out of the instrument.
4. To reinstall the cover, make sure that notched edge of the cover faces the front, left side of the instrument and snap it back into place.

Removing the detector cover

The top cover protects the detectors, valve box, and valve assembly.

If your detector cover mounts in a bracket on the GC oven:

1. Tilt the front cover up.
2. Squeeze the clip on the right hinge, pull the clip toward you and pivot it up.

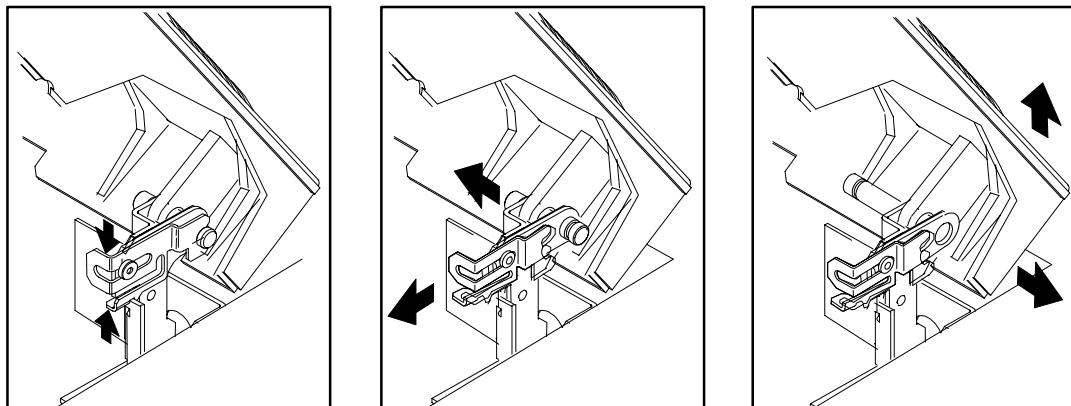


Figure 410-4 Removing the detector cover

3. Push the metal pin behind the clip to the left.
4. Slide the detector cover to the right and lift it off.
5. To replace the top cover:
 - a. Slide the plastic post on the left side of the cover into the hole on the injection port fan cover.
 - b. Line up the hole in the tab on the right side of the cover with the metal pin and push the pin to the right, through the hole.
 - c. Pivot the clip back down and snap it back over the metal pin.

If your detector cover rests on a post on the electronic cover

If your detector cover rests on a post on the electronic cover

1. Raise the detector cover to the straight-up position.
2. Tilt the cover to the left to remove it.

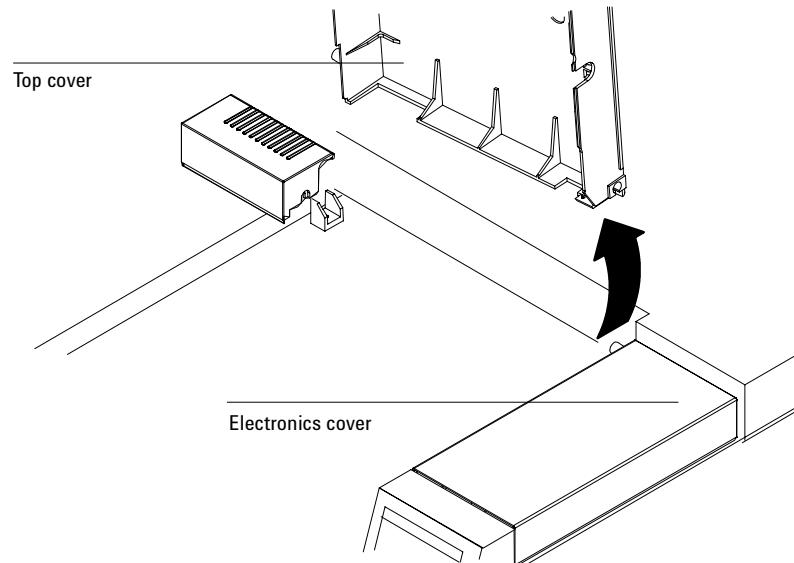


Figure 410-5 Removing the detector cover

Replacing the detector top cover

If your detector top cover currently mounts on a metal hinge, the hinge must be removed before a new detector top cover can be installed. Examine the area behind the detector locations. If there is a metal hinge present, it must be removed so that the new detector top cover can be installed.

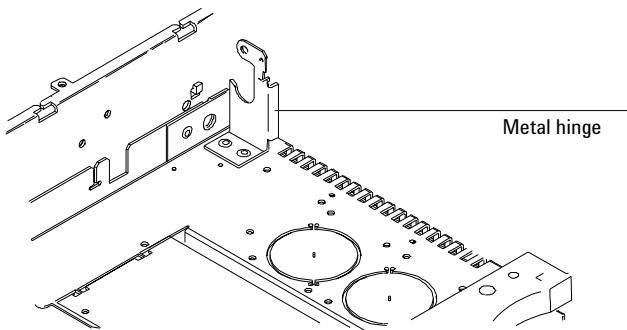


Figure 410-6 Locating the metal hinge, if present

1. The hinge, if present, is held to the oven top by two rivets and to the bracket behind it by one rivet. Use a 1/4-inch bit in an electric drill to remove the three rivets. Discard the hinge.

Caution

Be careful not to drill too deep. Remove only the rivet heads.

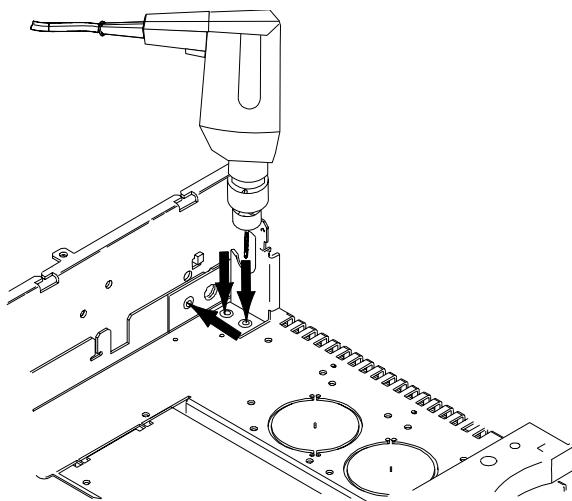


Figure 410-7 Removing the hinge

2. Install the new electronic carrier cover. Holding the detector cover upright, tilt it to the left, and insert the left hand pin of the into the hole in the inlet fan cover. Rest the right side hinge on the electronics carrier cover pin. See Removing the detector cover for more details.

Removing the pneumatics top cover

The large plastic cover over the pneumatics area on the top, rear of the GC simply lifts off. To replace the cover, line up the holes in the top of the cover with any pneumatics fittings and regulator dials and snap it back into place.

Removing the pneumatics RFI shielding

An aluminum cover shields the top of the pneumatics area at the top, rear of the instrument.

1. Remove the plastic pneumatics cover and remove the one Torx T-20 screw from the top of the metal RFI shielding.
2. From the rear of the GC, slide the RFI shielding to the left, out from under the locking tabs, and lift it off.

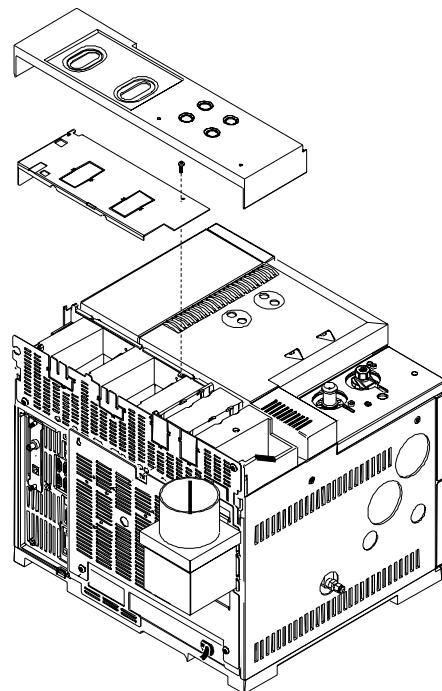


Figure 410-8 Removing the RFI shielding

Removing the left side cover

1. Fully loosen the two captive screws (Torx T-20) at the top of the cover.

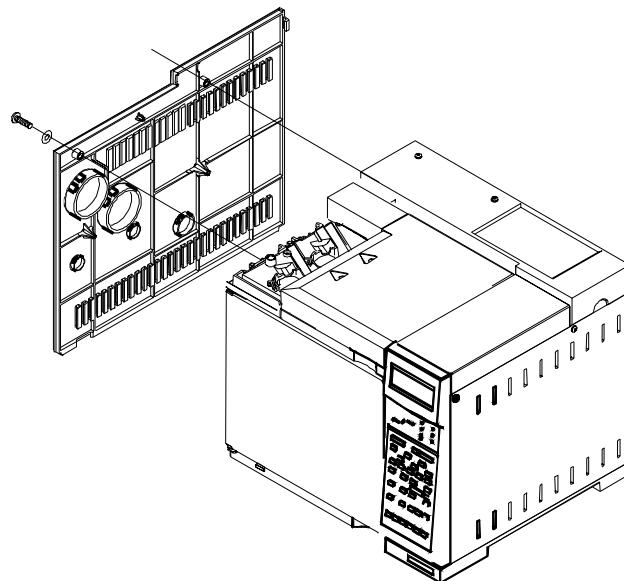


Figure 410-9 Removing the left side cover

2. Slide the side cover slightly to the rear of the GC and lift the cover out of the slot in the bottom of the chassis to remove it.

When replacing the cover, be sure any wires or pneumatic lines are properly routed so that they are not pinched by the cover.

Removing the right side cover

1. Fully loosen the two captive screws (Torx T-20) at the top of the cover.

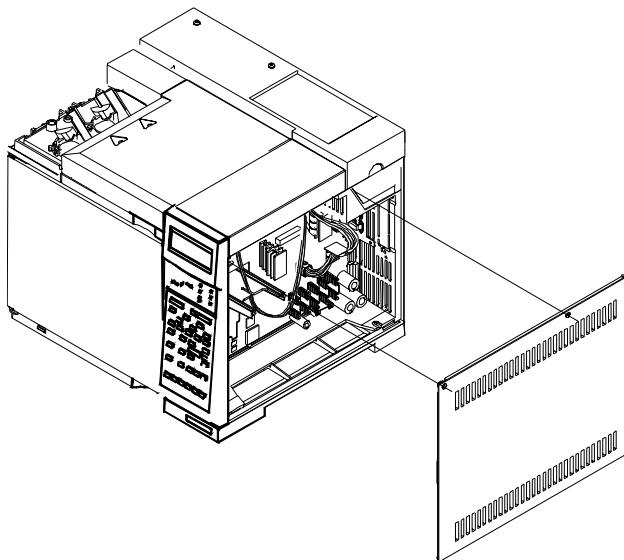


Figure 410-10 Removing the right side cover

2. Slide the side cover slightly to the rear of the GC and lift the cover out of the slot in the bottom of the chassis to remove it.

Removing the ALS tray bracket

When a 7673 Automatic Liquid Sampler is installed on a 6890 GC (serial number < 20,000), a large plastic tray bracket replaces the blue inlet carrier cover. Follow the procedure below to remove this bracket.

1. Remove the two screws located on the under side of the rounded end of the tray bracket assembly using a T-20 Torx driver.
2. Remove the two screws at either end of the tray mounting strap using a T-20 Torx driver.
3. Remove six screws attaching the bracket assembly to the inlet chassis using a T-20 Torx driver. Lift the assembly straight up.

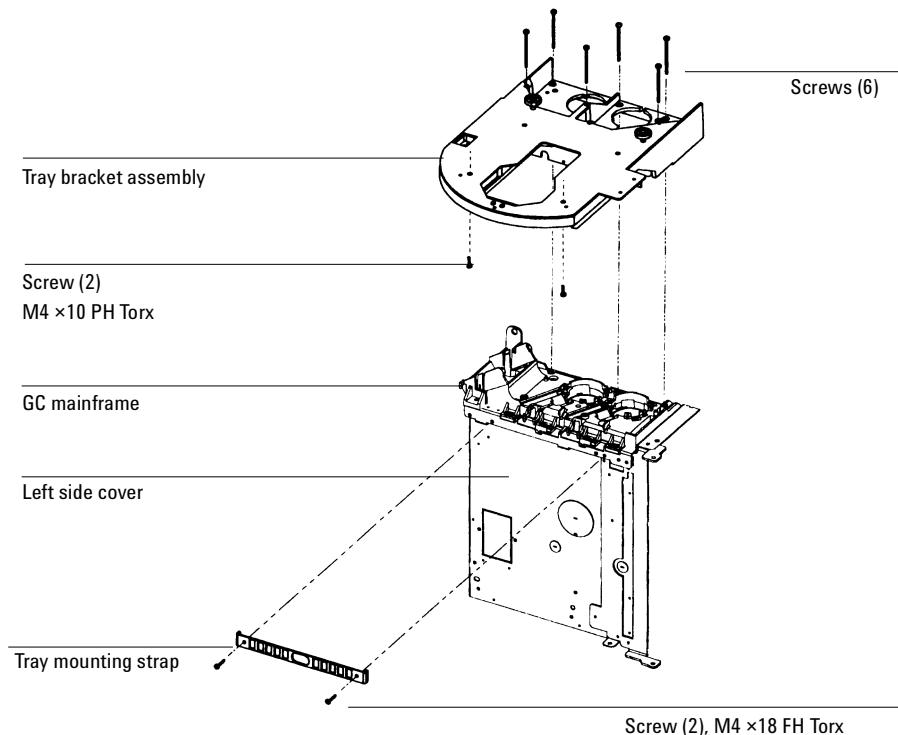


Figure 410-11 Removing the ALS tray bracket

Removing the inlet carrier cover

The inlet carrier cover is the blue plastic cover mounted over the two inlet ports. To remove the cover, fully loosen the six Torx T-20 screws on the top of the cover and lift off the cover. Some or all the screws are captive in the cover.

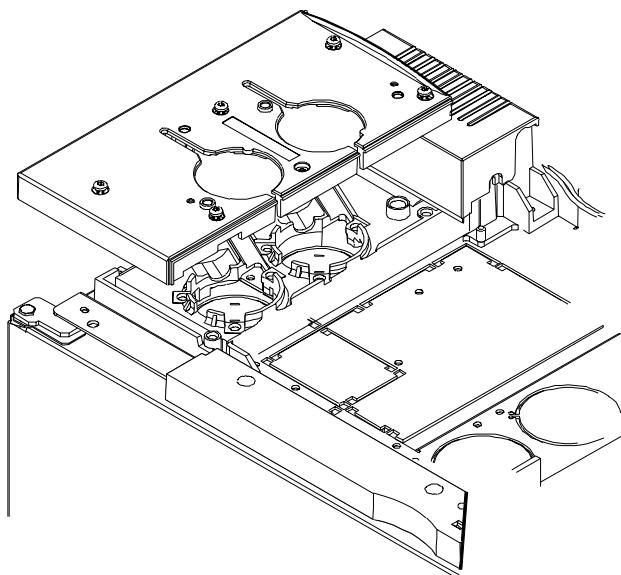


Figure 410-12 Removing the inlet carrier cover

When re-installing the cover, make sure that all plumbing and wires are properly routed in their channels.

Removing the inlet carrier

The inlet carrier is the black, molded, plastic pallet mounted over the two inlet ports underneath the blue cover.

1. Remove the left side cover.
2. Remove the blue cover from the inlet carrier.
3. Unclip the four wiring harnesses from the left side of the inlet carrier.

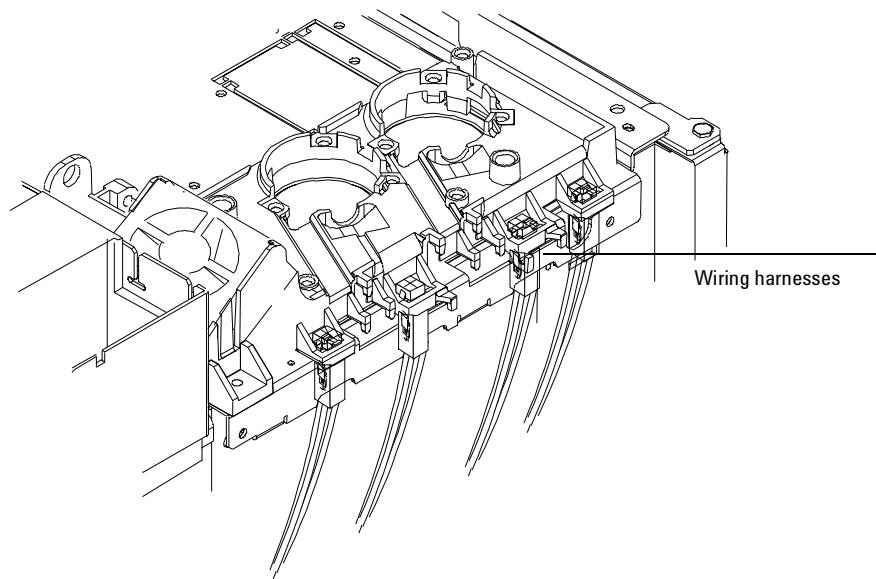


Figure 410-13 Removing the inlet carrier

4. Disconnect the fan from the connector to the right of the fan on the oven top.
5. Remove any installed inlets.
6. Remove the four screws (Torx T-20) from the top of the carrier and remove the carrier.

Removing the rear covers

There are two covers on the rear of the 6890 GC. The top cover shields the EPC board and any inlet, detector and auxiliary pneumatics modules. The bottom cover shields the oven fan motor, oven damper, the transformer and the AC power board.

Removing the top rear cover

1. Remove the plastic pneumatics top cover and the metal RFI shielding cover over the auxiliary and detector pneumatic slots as described in this section.
2. Loosen the four Torx T-20 screws on the top, rear cover.

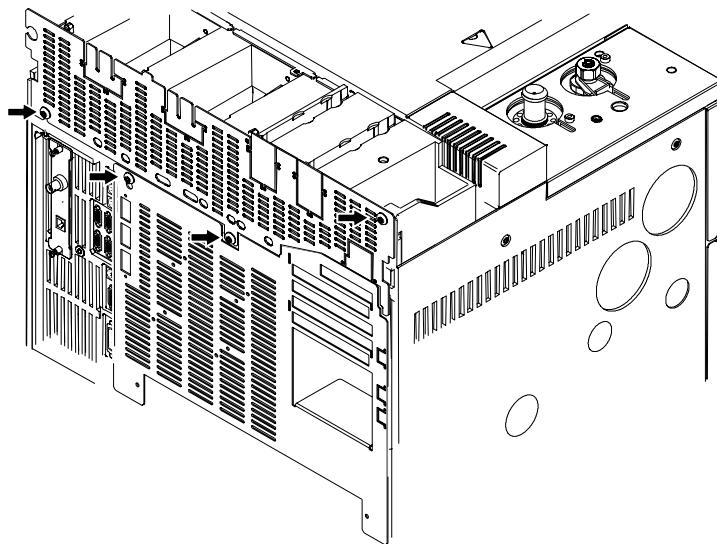


Figure 410-14 Loosening the screws on the top rear cover

3. Slide the cover slightly up until it is free from the screws and then slide the cover down and away from the GC. Carefully guide any installed inlet plumbing out of the slots in the top of the cover.

Removing the bottom rear cover

1. Remove the top, rear cover (and RFI shielding) as described in the previous procedure.
2. Remove the two Torx T-20 screws (and washers) on the bottom of the cover.

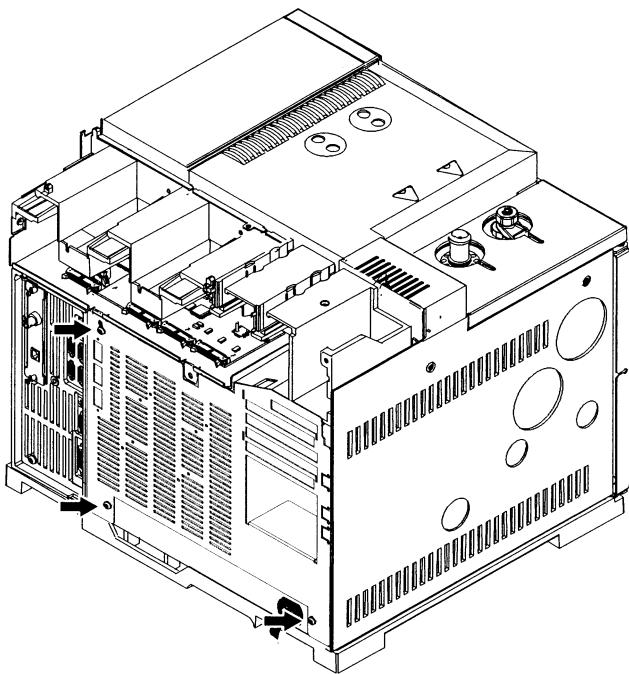


Figure 410-15 Removing the screws on the bottom rear cover

3. Slide the cover slightly up until it is free from the top screws. Pull the cover straight off the GC.
4. When replacing the bottom rear cover, be sure to reinstall the two lock washers on the bottom screws.

Removing the injection port fan cover

The injection port fan cover encloses the fan that draws air through the 6890 GC injection ports.

1. Loosen the Torx T-20 screw on the right side of the fan cover.
2. Slide the cover slightly to the right to disengage it from the left mounting post and lift the cover up and off.
3. Reassembly is the reverse of removal.

Removing the injection port fan

The injection port fan cools the injection ports by drawing air from under the inlet carrier, across the installed inlets.

1. Remove the injection port fan cover as described in this section.
2. Disconnect the fan's wiring harness from the main wiring harness, to right of the fan on top of the oven.
3. Grasp the fan and snap it up and out of the inlet carrier.

Note

When installing a new fan, be sure to install it so that it draws air from the front of the GC, through the inlet carrier and out towards the rear of the GC. The fan has raised arrows on its side indicating the direction of fan rotation and the direction of air flow. On a correctly installed fan, one arrow should point up and one to the right (when facing the front of the GC).

Removing the keyboard

WARNING High voltage components are exposed when servicing the instrument with the covers removed. Turn off the main power switch and unplug the power cord before proceeding.

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

1. Remove the right side cover from the instrument.
2. Disconnect the display and keyboard ribbon cables from the main board (P11, P12, P13).

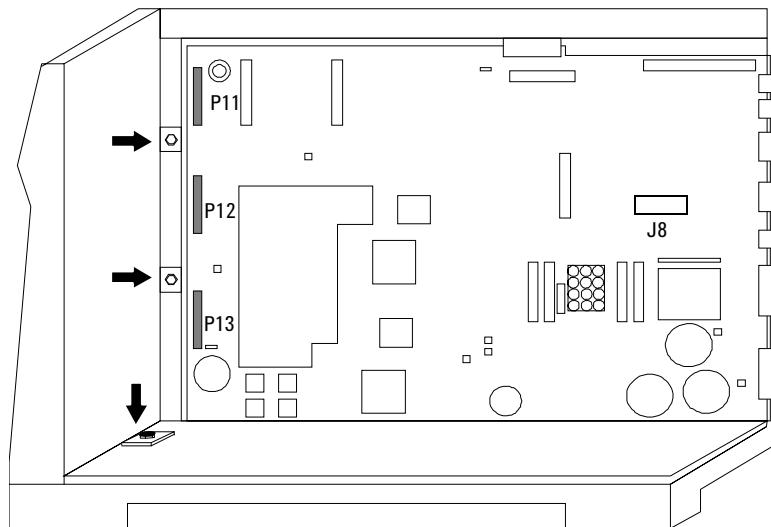


Figure 410-16 Screw and keyboard/display connector locations

3. Remove the three 1/4-inch screws attaching the keyboard to the chassis. There are two on the side of the GC near the main board and one at the bottom of the main board carrier.

4. Slide the keyboard assembly away from the main board and then pull it out towards the front of the GC.
5. Reassembly is the reverse of removal.

Removing the pneumatics area fan

This fan cools the area containing the EPC board and flow manifolds by drawing air down through the pneumatics area. The fan mounts either directly into the pneumatics chassis, or into a bracket which mounts into the chassis. Examine your GC to determine the type of pneumatics fan installed.

Chassis mounted fan

1. Remove the pneumatics cover, the top rear panel, and the bottom rear panel. (You may need to remove the RFI cover.)
2. Disconnect the fan's connector from the main wiring harness.
3. Remove the tie-wrap that secures the fan in the chassis.
4. Slide the fan out and replace. Orient the new fan so that the wiring is on the right side and the arrow indicator on the side of the fan points down.

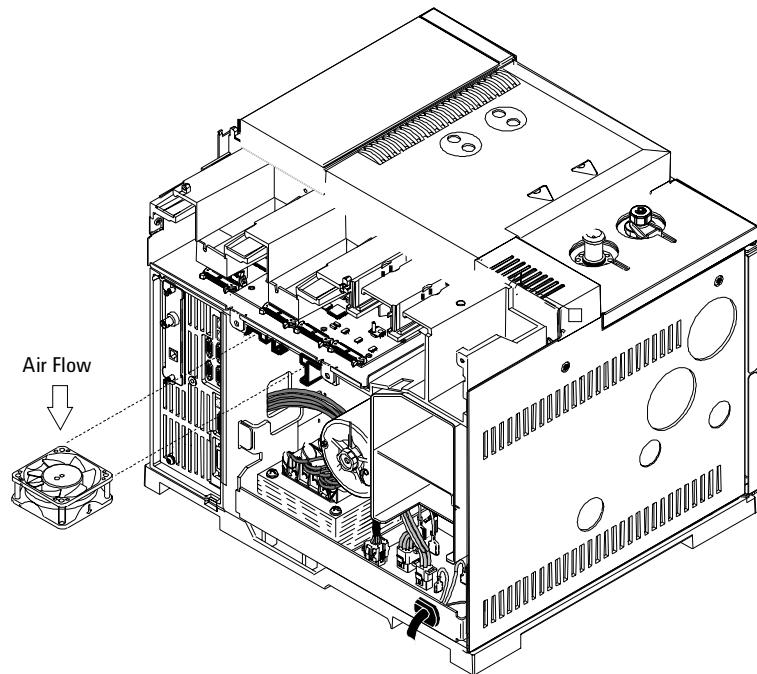


Figure 410-17 Replacing the pneumatics area fan

Bracket mounted fan

1. Remove the pneumatics cover, the top rear panel, and the bottom rear panel. (You may need to remove the RFI cover.)
2. Disconnect the fan's connector from the main wiring harness.

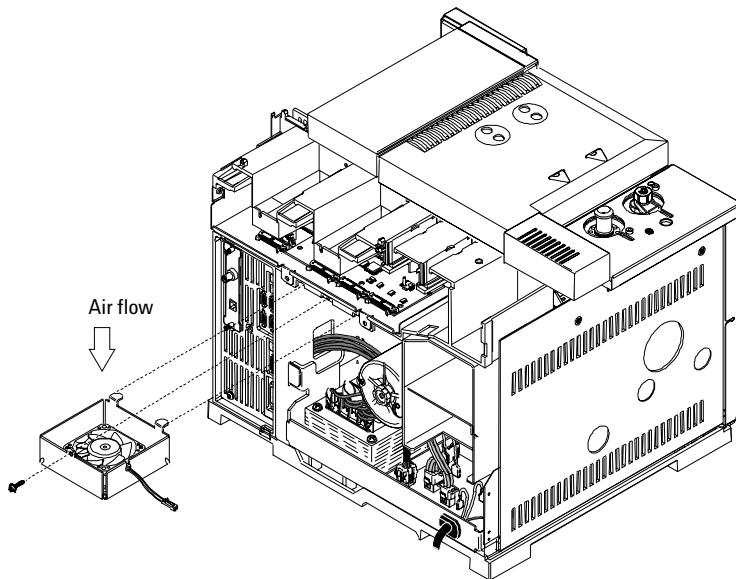


Figure 410-18 Removing the pneumatics area fan

3. Remove the Torx T-20 screw from the bracket and slide the bracket out of the back of the instrument
4. Lift the retaining clip securing the fan in the bracket and slide the fan out of the two retaining tabs. Remove the old fan.
5. Lift the retaining tab and insert the new fan. Be sure to orient the fan so that the arrow points downward when installed and the wires are on the right side. Slide the fan under the retaining tabs until it snaps into place.
6. Slide the tabs on the back of the fan bracket into the corresponding slots underneath the EPC board area and reinstall the screw.

420 Oven and Temperature Control

Heated zones

In addition to the oven, the 6890 GC has six small heated zones. To reduce the chance of hazardous electrical shocks, all are powered with 40 volt full wave rectified current instead of 120 volt AC. A total of 440 watts is available for the zones. This accommodates six 70 watt heaters. It is also possible to have up to two 150 watt heaters. Adding a 150 watt heater reduces the maximum number of heaters by one.

Heaters allowed	
70 Watt	150 Watt
5–6	–
3–4	1
1–2	2

These further wattage restrictions/rules apply:

- Six 70 watt heaters are allowed.
- Any combination of heaters < 225 watts per chromatographic channel (i.e., Front Inj., Front Det., and Aux 1 OR Back Inj., Back Det., and Aux 2).
- Any single zone can be 150 watts or less.

The 6890 GC will not allow configurations over 440 watts to operate. The detector zones can only be temperature programmed from a ChemStation. There are two auxiliary zones (Aux 1 and 2) and each supports three temperature ramps. There is no cooling provided for ramped zones except the oven and cool on-column inlet.

Oven ramp rates

To use the fast oven ramp rates (a 240 V power option is required), your electric service must be able to supply $\geq 200\text{V}$ at $\geq 15\text{ Amp}$.

The highest rate that you can achieve depends on many factors, including the room temperature, temperatures of the inlets and detectors, the amount of material inside the oven (columns, valves, etc.), and whether or not this is

the first run of the day. The optional oven insert for fast chromatography increases oven ramp rates for the back column. Table 420-1 lists typical oven ramp rates.

Table 420-1 Oven Ramp Rates

Temperature range (°C)	100/120 V oven ramp rate (°C/minute)		200/220/230/240 V oven ramp rate (°C/minute)	
	Without insert	With optional insert	Without insert	With optional insert
50 to 70	75	120	120	120
70 to 115	45	95	95	120
115 to 175	40	65	65	110
175 to 300	30	45	45	80
300 to 450	20	35	35	65

Configuring the GC for an MSD

If you are installing an Agilent Mass Selective Detector, you must configure the GC to properly control the heated transfer line.

1. Press [Config][Aux], and select [1] if the MSD is installed in the front position or [2] for the back position.
2. Press [Mode/Type].
3. Use the scroll keys to select **MSD** as the Aux zone type. Press [Enter].

If you do not configure the Aux zone for MSD, Warning 101, *Invalid heater power for front (back) detector, inlet, and aux 1(2)*, will appear on the GC display, and the heated zones will be set to *not installed*.

Oven temperature troubleshooting

For each problem below, the probable causes and corrective actions are listed in order of complexity/expense. The cheapest, most common, easiest to check causes are listed first with the more complex, expensive causes following.

After identifying the problem, test for the probable causes in order from top to bottom.

Problem	Probable cause	Corrective action
Oven does not heat.	Faulty fuse F1 or F2 on power supply PCB. Oven heater is open. Faulty power supply PCB. Faulty fuse F1 or F2 on main PCB. Faulty main PCB.	Check/replace both fuses. Check resistance of oven heater. Replace power supply PCB. Check/replace both fuses. Replace main PCB.
Oven does not control	Fast oven but GC configuration is for regular oven. Oven flap stuck. Faulty main PCB.	Check oven configuration. Check oven flap. Replace main PCB.
Oven temperature runs away.	Oven heater partially grounded. Faulty main PCB.	Ensure that the oven heater is not coming in contact with the oven shell or other nearby components. Replace main PCB.
Oven temperature will not go to maximum.	Fast oven but power is 208 V rather than 240 V.	Correct power wiring in lab.

Testing resistance of the heater coil

If you believe that your heater coil is cracked or otherwise damaged and has caused an open circuit, you can check it by measuring its resistance.

To measure the resistance

WARNING Before proceeding, turn off the main power switch and unplug the power cord.

Caution Make sure you are properly grounded with an ESD strap before continuing.

1. Turn the instrument power off.
2. Disconnect the oven heater leads (P3, P4) from the AC power board.
3. Use an ohmmeter to measure resistance at the **connectors**.

Acceptable resistance ranges

Acceptable resistance ranges (in ohms) are given below. Acceptable resistances range from the nominal value for a new, cold heater to +5% from the nominal value.

Note Resistance goes up approximately 3% after heating the coil.

Nominal cold heater resistances		
	Standard oven	Fast-ramp oven
120 V	9.07–9.52 Ω	n/a
200 V	n/a	17.78–18.7 Ω
220 V	n/a	21.51–22.6 Ω
230 V	33.06–34.71 Ω	23.51–24.7 Ω
240 V	n/a	25.60–26.9 Ω
n/a = not available		

Cryo valve installation/replacement

A cryogenic valve allows liquid nitrogen or CO₂ to be dispersed in between the double-walled plenum of the GC oven where the fan blows the vapors into the oven itself. Follow the procedures below to install a new cryogenic valve or to replace an existing cryogenic valve or nozzle.

Installing a new cryo valve

WARNING Before proceeding, turn off the oven and let it and any heated zones cool down. Turn off the main power switch and unplug the power cord.

1. Remove the left side cover on the instrument and remove the plug for the cryo valve.
If a manual inlet carrier is installed on the left side of the instrument, remove its left cover by removing the two bottom thumb screws, sliding the panel towards the back of the instrument and lifting it off.
2. Remove the knockout on the left side of the instrument. Use a screwdriver to pry it out.
3. Insert the cryogenic valve probe through the insulation into the oven plenum.
4. Screw the valve to the side of the GC oven using the two Torx T-20 screws provided.

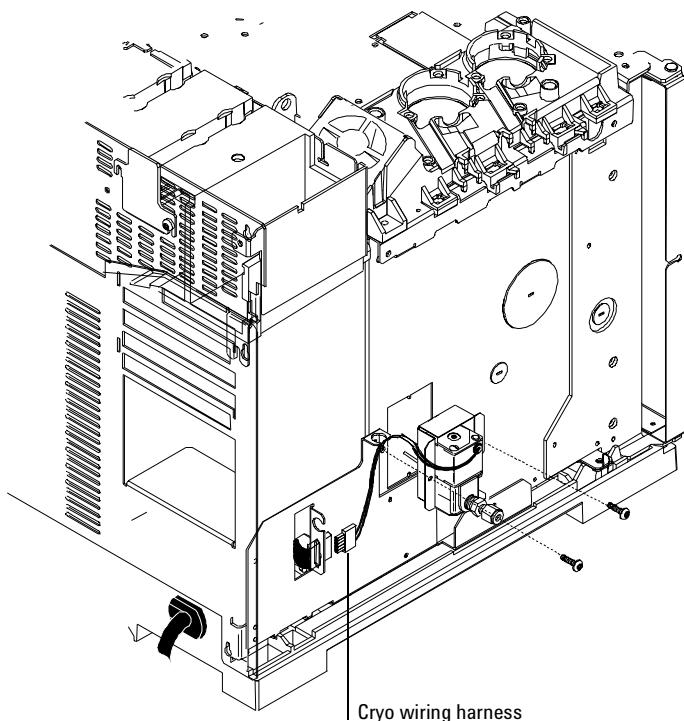


Figure 420-1 Attaching the valve box to the side of the GC (CO₂ valve shown)

5. Plumb the valve to the liquid nitrogen or carbon dioxide source.
6. Plug the cryo valve's wiring harness into the five pin connector to the left of the valve.
7. Route the cryo tubing through the cutout in the GC's side cover and reinstall the cover.

If a manual inlet carrier is installed, route the cryo tubing out of the slot in the back of the carrier.

Replacing an existing cryo valve

WARNING Before proceeding, turn off the oven and let it and any heated zones cool down. Turn off the main power switch and unplug the power cord.

1. Remove the left side cover on the instrument.

If a manual inlet carrier is installed on the left side of the instrument, remove its left cover by removing the two bottom thumb screws, sliding the panel towards the back of the instrument and lifting it off.

2. Shut off the cryo fluid supply and crack the valve at the supply to release any residual pressure.
3. Use a 9/16-inch wrench to disconnect the cryogenic fluid supply tube at the cryo valve.
4. Disconnect the cryo valve's wiring harness from the connector to the left of the valve (see Figure 420-1).
5. Remove the two Torx T-20 screws holding the old cryo valve and pull it straight out from the instrument (see Figure 420-1).

6. To remove the valve from the bracket, disconnect any cryo blast plumbing from the valve at the Swagelok tee. Remove the two Torx T-20 screws on the bottom of the bracket.
7. To replace the cryogenic nozzle, proceed as follows:
 - a. Use a 9/16-inch wrench to unscrew the old nozzle. Discard the nozzle.
 - b. Wrap the threads of the new nozzle with Teflon tape, being careful not to cover the first two threads of the nozzle.
 - c. Screw on the new nozzle and tighten firmly with a 9/16-inch wrench.

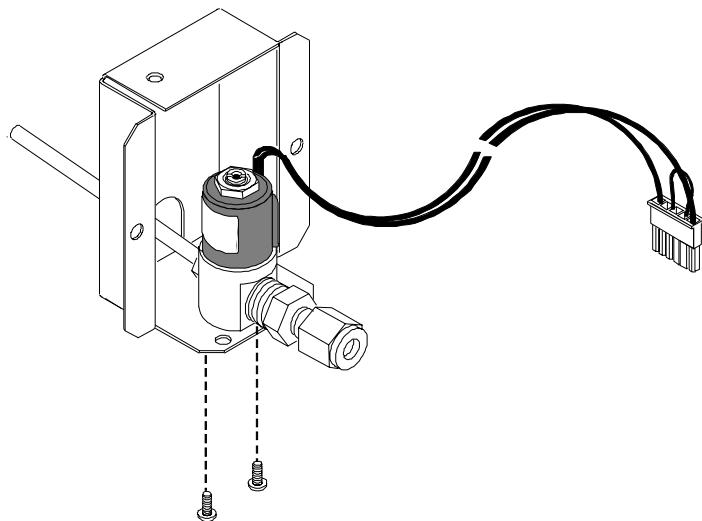


Figure 420-2 Removing the valve from the valve bracket (N₂ valve shown)

8. Insert the cryogenic valve probe through the insulation into the oven plenum.
9. Screw the valve assembly back on to the side of the GC oven using the two Torx T-20 screws.

10. If you are installing PCOC cryo blast for the front and/or rear inlet(s), connect it at this time.

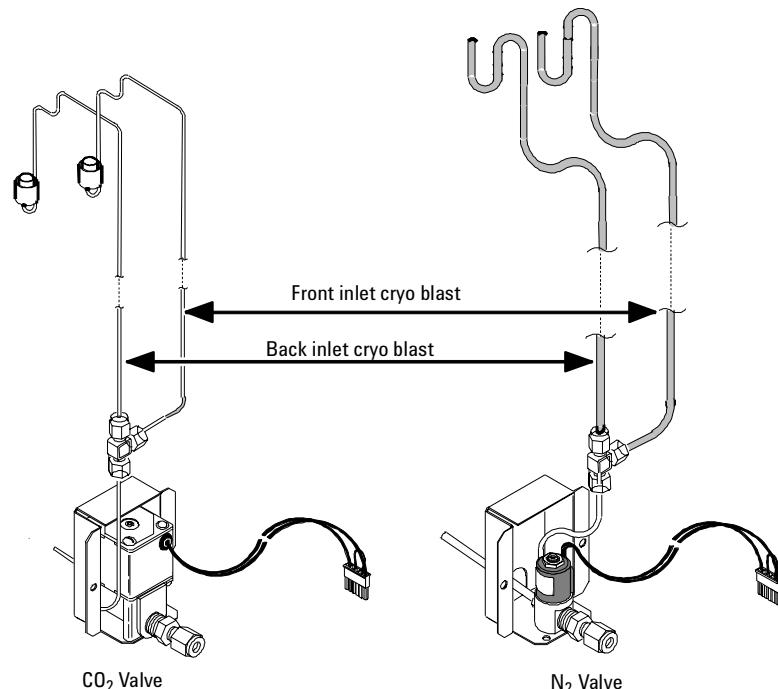


Figure 420-3 Cryo blast attachments

11. Plumb the valve to the liquid nitrogen or carbon dioxide source.
12. Plug the cryo valve's wiring harness into the connector to the left of the valve.
13. Route the cryo tubing through the cutout in the GC's side cover and reinstall the cover.
If a manual inlet carrier is installed, route the cryo tubing out of the slot in the back of the carrier.

Replacing the oven shroud assembly

The oven heater is replaced as part of the oven shroud assembly. The oven sensor may be replaced separately.

WARNING Before proceeding, turn off the oven and let it and any heated zones cool down. Turn off the main power switch and unplug the power cord.

Caution Make sure you are properly grounded with an ESD strap before continuing.

1. Remove the GC's rear covers.
2. Disconnect the two oven heater leads (P3, P4) from the AC power board.

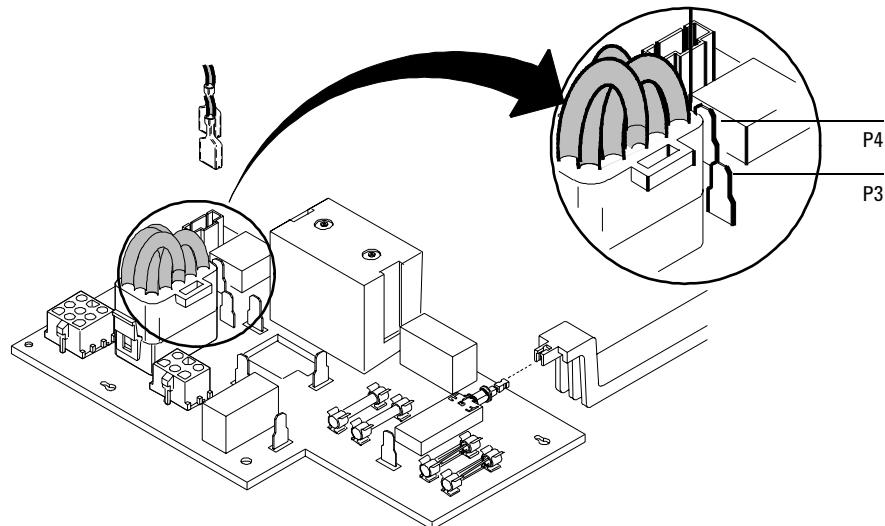


Figure 420-4 Disconnecting the oven heater leads on the AC board

3. Disconnect the sensor leads (P16) from the main PCB.

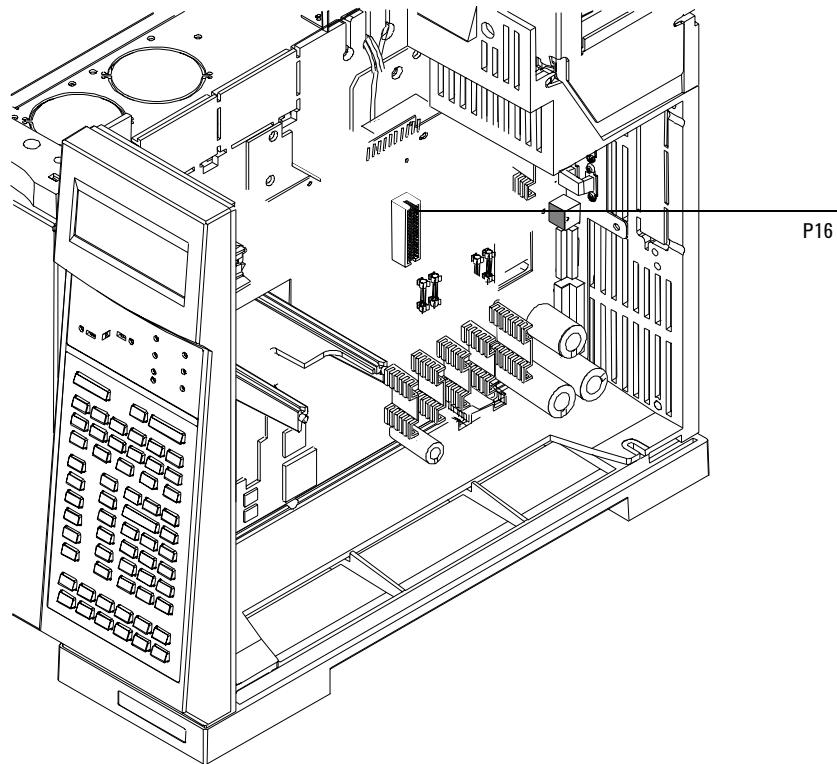


Figure 420-5 Disconnecting the sensor lead on the main board

4. From inside the oven, remove the columns, column nuts, detector fittings and other hardware preventing access to the shroud.
5. Remove the bottom two screws and loosen the top two screws on the corners of the shroud (Torx T-20). Slide the shroud down and tilt the top out and remove the shroud from the oven.

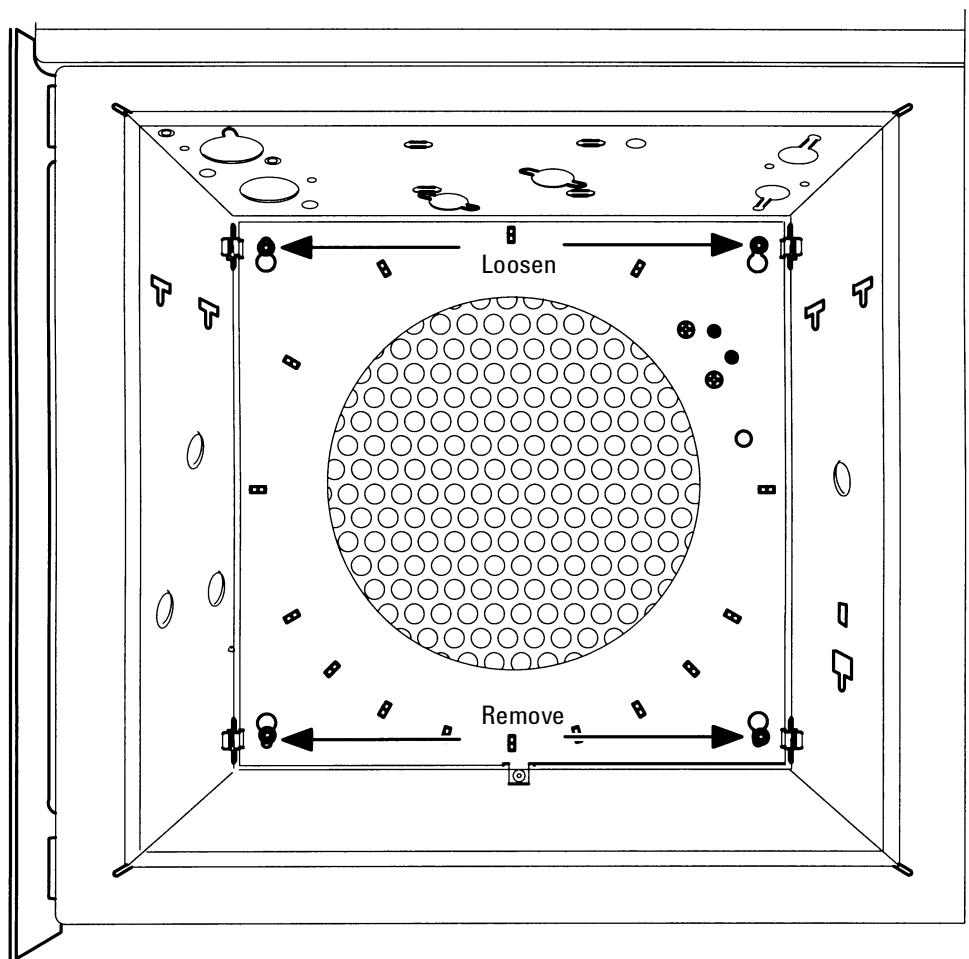


Figure 420-6 Removing the shroud

6. From inside the oven, draw the heater and sensor leads into the oven and remove the fan shroud.
7. Reassembly is the reverse of removal. Note that when reconnecting the heater leads to P3 and P4 on the AC board, either of the leads may be connected to either of the connectors.

Replacing the oven sensor

The oven temperature sensor can be replaced after removing the oven shroud.

WARNING Before proceeding, turn off the oven and let it and any heated zones cool down. Turn off the main power switch and unplug the power cord.

1. Remove the oven shroud as described in the Replacing the oven shroud assembly procedure in this section.
2. Loosen the two Torx T-20 screws securing the sensor retainer to the back of the shroud.

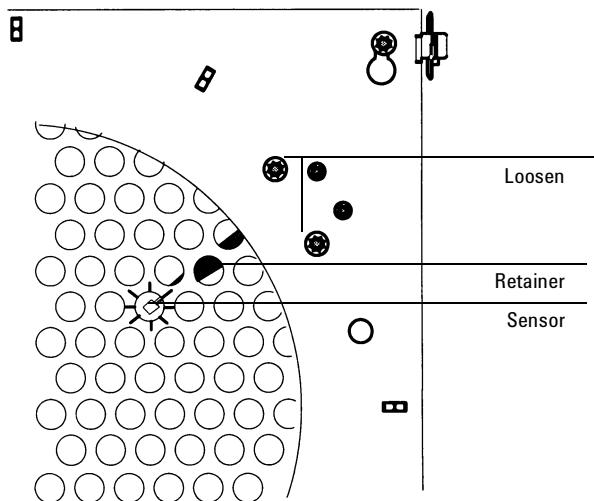


Figure 420-7 Removing the shroud

3. Slide the old sensor out of the retainer. Thread a new sensor through the opening in the rear of the oven.
4. Slide the new sensor under the retainer. One of the grill holes on the front of the shroud is stamped. Make sure that the end of the sensor is positioned behind the stamped hole before tightening the retainer.

Replacing the oven fan

WARNING Before proceeding, turn off the oven and let it and any heated zones cool down. Turn off the main power switch and unplug the power cord.

1. Remove the columns, column nuts and other hardware preventing access to the fan.
2. Remove the four Torx T-20 screws securing the fan shroud to the instrument and swing the left side of the shroud out towards you.

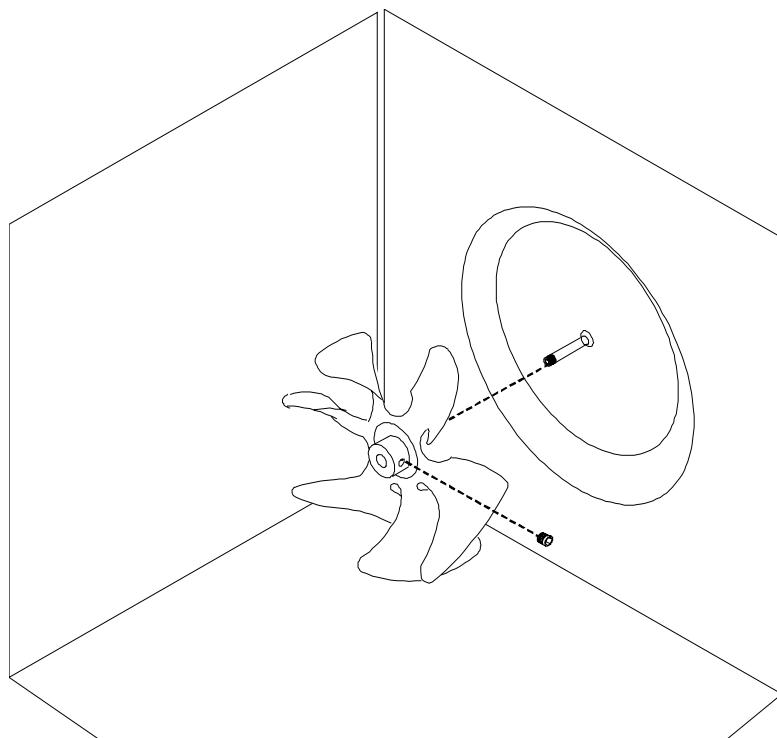


Figure 420-8 Removing the set screw on the oven fan shaft (inside oven)

3. Use a hex wrench to remove the set screw securing the fan to the motor shaft and carefully slide the fan off the shaft.
4. Reassembly is the reverse of removal.

When installing the fan, position it so it is flush with the end of the shaft and the set screw seats on the flat part of the shaft. Check to make sure that the fan does not touch anything when rotated. If it does, reposition the fan on the shaft until the problem is corrected.

Replacing the oven fan motor

WARNING Before proceeding, turn off the oven and let it and any heated zones cool down. Turn off the main power switch and unplug the power cord.

Caution Make sure you are properly grounded with an ESD strap before continuing.

1. Turn off the GC and unplug the power cable.
2. Remove the fan as described in the Replacing the oven fan procedure earlier in this chapter.
3. Remove the rear covers from the instrument.
4. Unplug the fan motor wiring harness (P7) from the AC power board. Squeeze the tabs on the sides of the connector and pull directly up.
5. Locate and detach the fan motor ground wire using a 7 mm nut driver. It is secured to the chassis on the left side and below the fan motor as you face the rear of the instrument.
6. Use a 7 mm nut driver to remove the three nuts (and six associated washers) securing the motor to the oven.

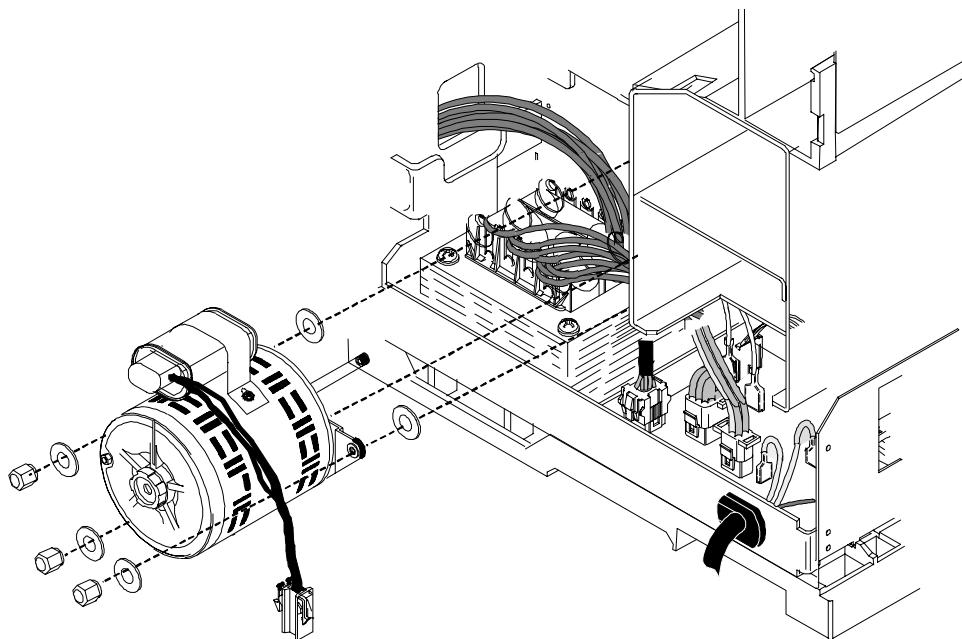


Figure 420-9 Removing the oven fan motor

7. Remove the fan motor.
8. Reassembly is the reverse of removal.

Replacing the oven flap motor

The oven flap motor regulates air flow out of the oven.

WARNING Before proceeding, turn off the oven and let it and any heated zones cool down. Turn off the main power switch and unplug the power cord.

1. Remove the left side cover and the rear covers to the instrument.
2. On the left side of the GC (when facing its front), disconnect the oven flap motor wiring harness from the main wiring harness.
3. Loosen the three Torx T-20 screws securing the flapper bracket to the instrument and lift it and the motor up and off the instrument.

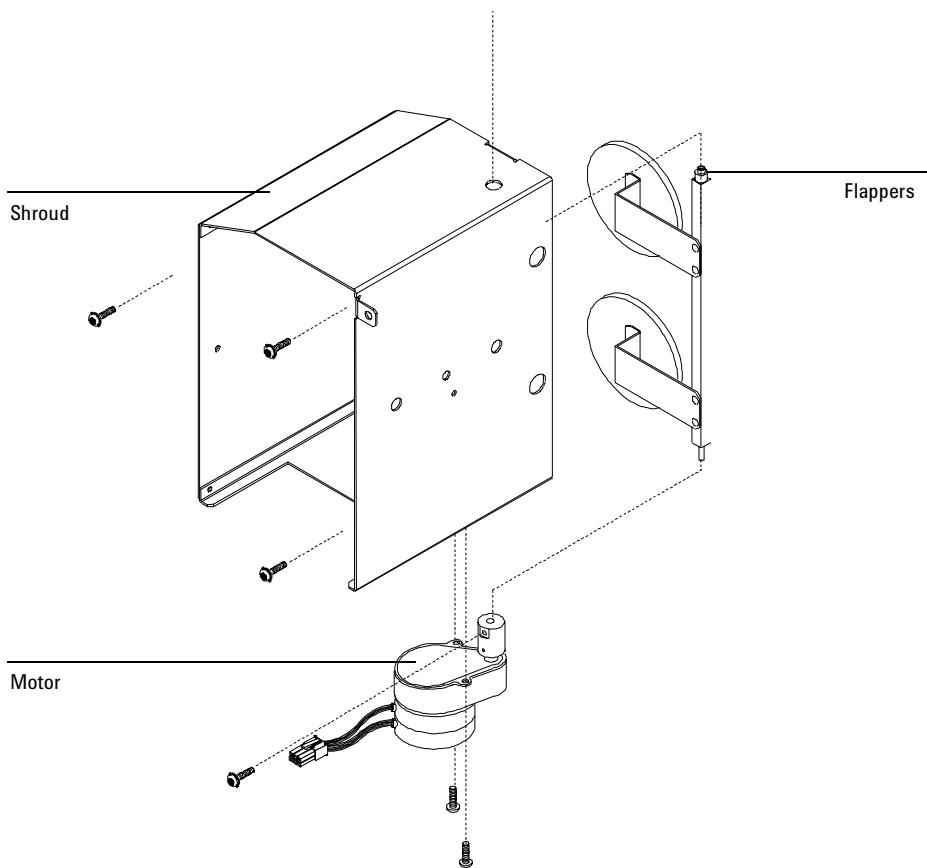


Figure 420-10 Removing the flapper assembly

4. Remove the two Torx T-10 screws securing the motor and flapper assembly to the bracket and remove the motor/flappers from the bracket.
5. Remove the Torx T-20 screw at the bottom of the flapper shaft near the flap motor and disconnect the motor from the flappers.
6. Reassembly is the reverse of removal.

Converting the oven type

A fast heating oven is standard with most 200–240 V power option GCs. A GC ordered for the United States, Canada, Switzerland, China, or Australia has the regular oven, unless it is ordered with the fast heating oven option.

The basic requirements for use of the fast heating oven are:

- The electric service must be capable of providing ≥ 200 V at ≥ 15 amperes.
- In the United States, the electric service must be 240 V.

To convert from a regular oven to a fast heating oven, or the reverse, these components must be changed:

- The oven heater (see Configuring the oven)
- Internal fuses (see section 1230)
- Power circuitry (see section 1230)

Configuring the oven

GC oven type will be properly configured at the factory. If you convert a regular oven to a fast-heating oven (or the reverse), and have the correct electric service installed, you must reconfigure the GC to use the new oven heater properly.

WARNING Do not perform this procedure unless your GC meets **all** of the criteria above. Changing the oven configuration at the keypad without making the proper hardware changes can damage your instrument and may create a fire hazard.

1. Press [Config], scroll to [Instrument], and press [Enter].
2. To change the oven type, press [.][.], then [Mode/Type].
3. Select the correct oven type (fast or regular), then press [Enter]

430 Power/Electronics Replacement

Replacing the main board

WARNING Before proceeding, turn off the main power switch and unplug the power cord.

Caution Make sure you are properly grounded with an ESD strap before continuing.

The main printed circuit board in the 6890 GC is mounted on a metal carrier bracket on the right side of the instrument. The board and the bracket are replaced as an assembly.

1. If any external detectors are installed on the right side of the instrument through the large cut out on the main board, disconnect them now.
2. Remove any detector interface boards (P1, P2) from the main board.
3. Disconnect the cables from the following connectors:

J7	AC Power
J8	Integrated ALS PCB (6890 Plus only)
P3	EPC Board
P11	Display
P12	Keyboard
P13	Keyboard
P16	Oven sensor
P17	Oven door switch
P18	Inlet fan, oven flap, oven cryo

P19 AC board control

P21 Inlet/Detector heated zones – Remove the Inlet/
Detector wiring harness connectors from the
main board sheet metal bracket.

P22 Valve box and aux heated zones

After disconnecting the EPC ribbon cable (P3) and AC Power harness
(J7), pull them back through their slots and out of the way.

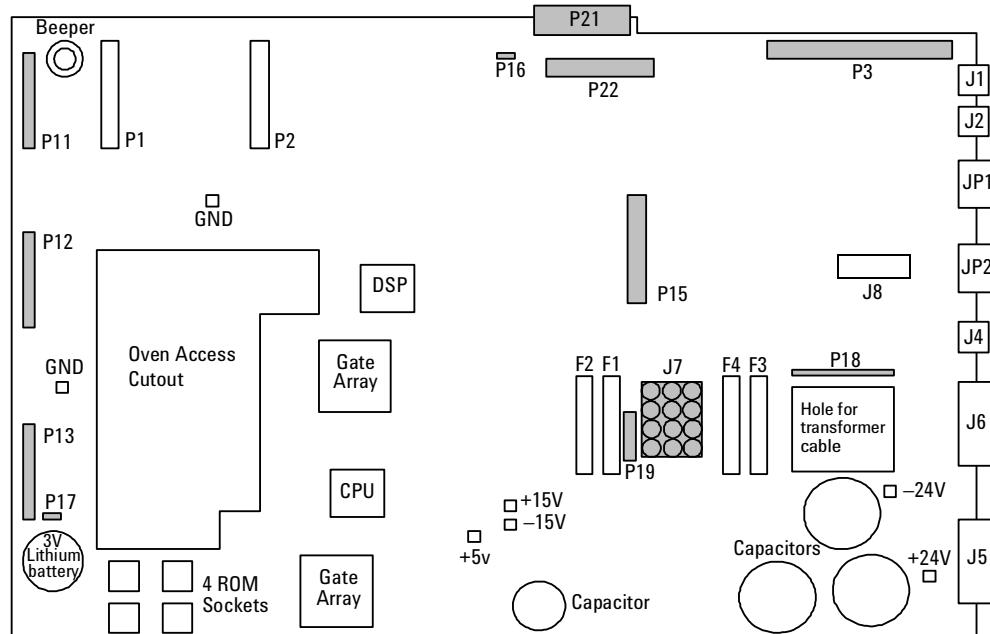


Figure 430-1 Main board connectors, 6890A and 6890 Plus

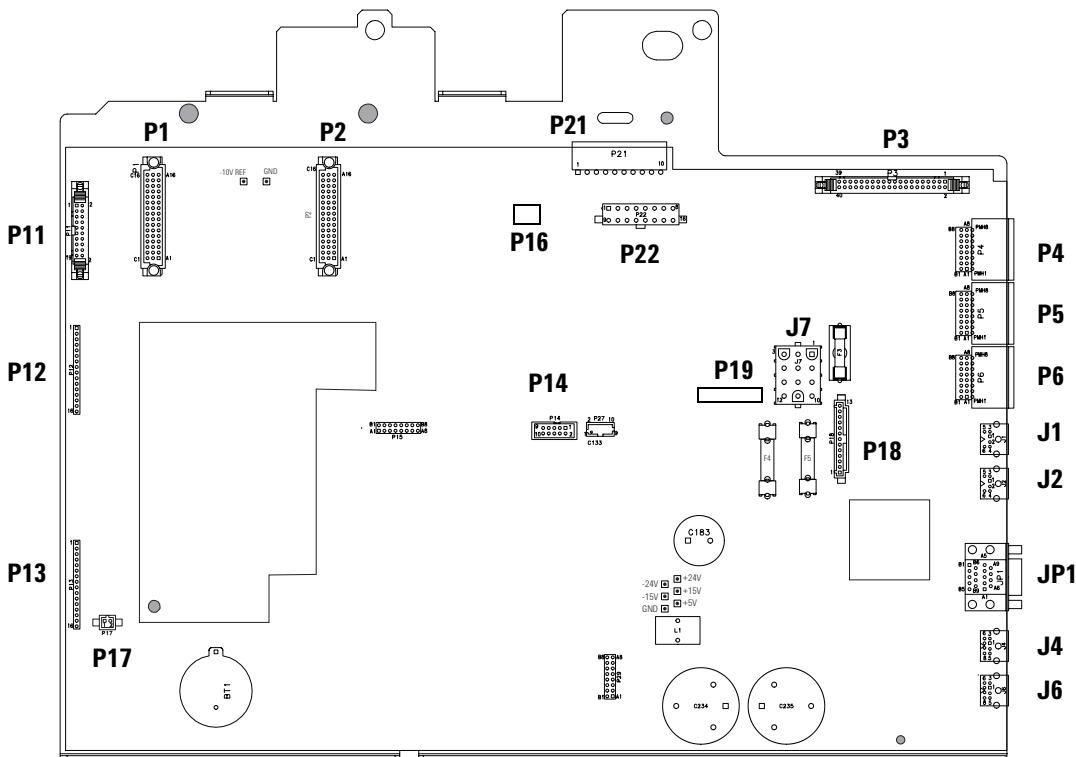


Figure 430-2 Main board connectors, 6890N

4. Unplug any cables from the connectors on the back of the instrument.
5. If any valve actuators were installed, unclip the wiring harness from each actuator and pull the connectors out of the actuator bracket.
6. Remove the two screws securing the actuator bracket and remove the bracket.

7. If an MIO card is installed, remove the card and the support bracket as described below:
 - a. Loosen the two spring-loaded captivated screws on the back of the instrument and slide the card out.
 - b. Remove the MIO support bracket.
 - c. Remove the three screws on the back of the instrument and the one screw in the standoff on the side of the instrument.

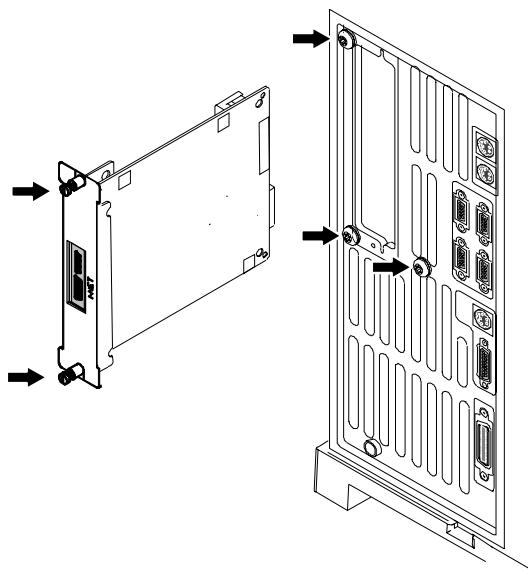


Figure 430-3 Removing the card and three screws on the back of the GC

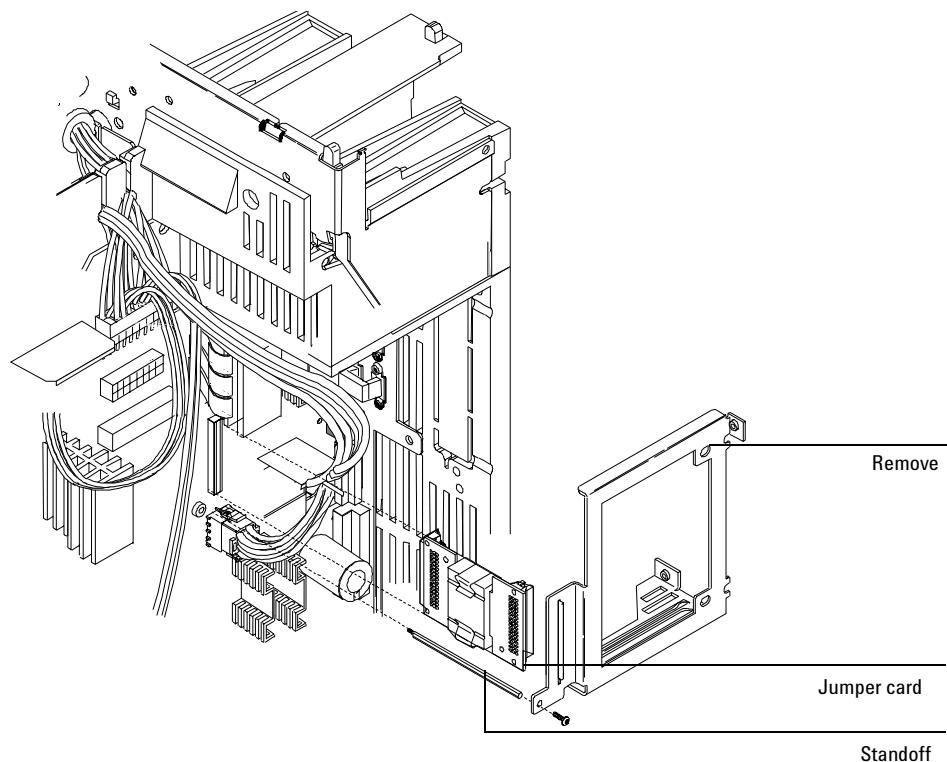
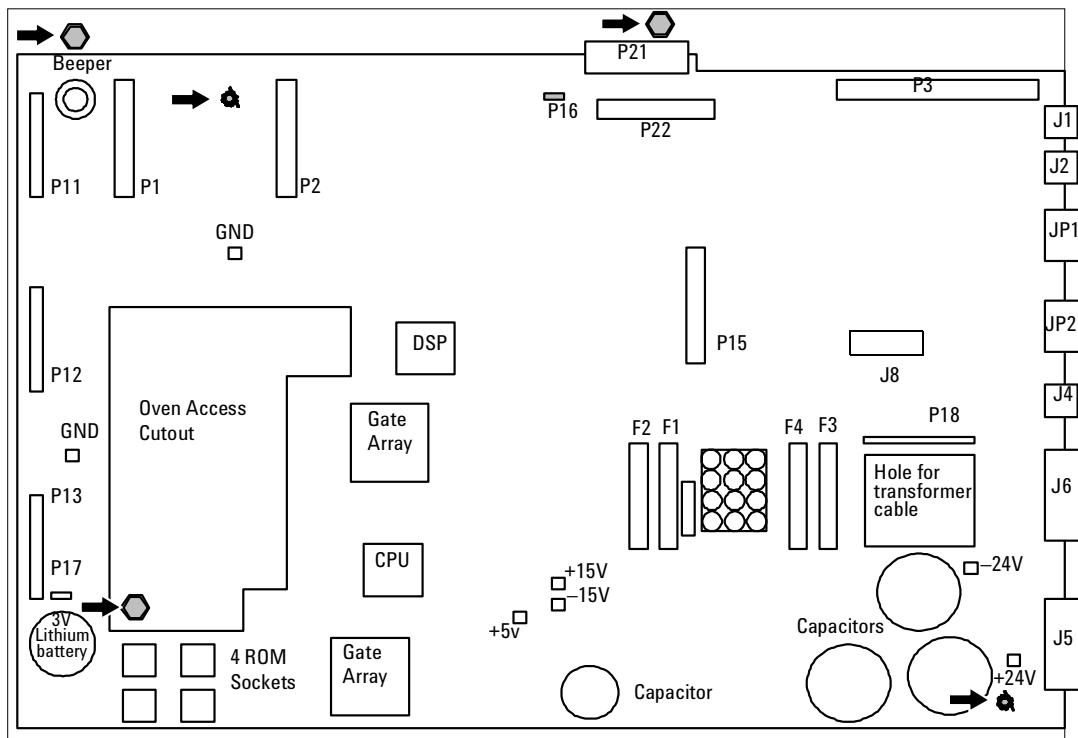


Figure 430-4 Removing the MIO support bracket and jumper card

- d. Pull out the MIO jumper card (P15) from the main board.
8. Remove the three 1/4-inch hex screws and the two Torx T-20 grounding screws holding the board to the instrument body.



**Figure 430-5 Screw locations on the main board (6890A/Plus board shown.
6890N is the same.)**

9. Holding the main board by the metal bracket at the top left and the capacitors at the bottom right, slide it slightly to the left and pull it out of the instrument being careful not to catch the board on any wiring harnesses.
10. Installation of the new board is the reverse of this procedure.

Caution Changing the board loses the GC serial number.

11. Re-configure the GC serial number. Press [Options], then select Diagnostic Instrument Status. Press [\bullet][\bullet], type in the GC serial number (shown below the GC keypad), and press [Enter].

Installing an MIO card (6890A and 6890 Plus)

Two Modular Input/Output (MIO) cards are available for the 6890 GC. The INET card allows the 6890 GC to communicate and transmit data over an INET network to a Chemserver. The LAN communications interface card allows the 6890 GC to communicate and transmit data over a LAN to a Chemserver. While only one card can be installed at a time, the installation procedure is similar for either type of MIO card.

WARNING Before proceeding, turn off the main power switch and unplug the power cord.

Caution Make sure you are properly grounded with an ESD strap before continuing.

Follow the procedure below to install an MIO card:

1. Remove the electronics cover and the right side cover.
2. On the back of the GC, snip out the plastic plate that covers the MIO card slot. Discard the plate.
3. Remove the Torx T-10 screw located over the F2 fuse on the main board.

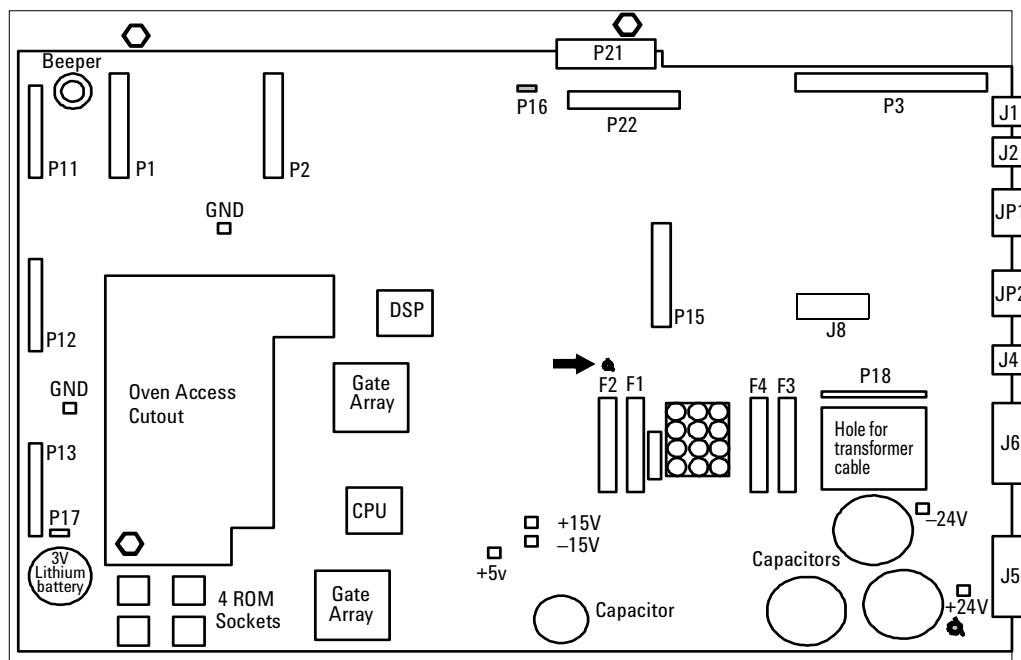


Figure 430-6 Location for MIO bracket standoff

4. Screw the hexagonal metal standoff provided with the MIO kit into the hole vacated by the T-10 screw. Use a 3/16-inch nut driver to tighten the standoff 1/8 turn past finger-tight.
5. Route the oven sensor wires (P16) and the main power wire harness (J7) underneath the standoff.
6. Plug the jumper board from the MIO kit into the P15 socket on the main board. Make sure the P7 connector on the jumper card points toward the back of the instrument.
7. From the back of the instrument, insert the metal bracket into the MIO card slot.

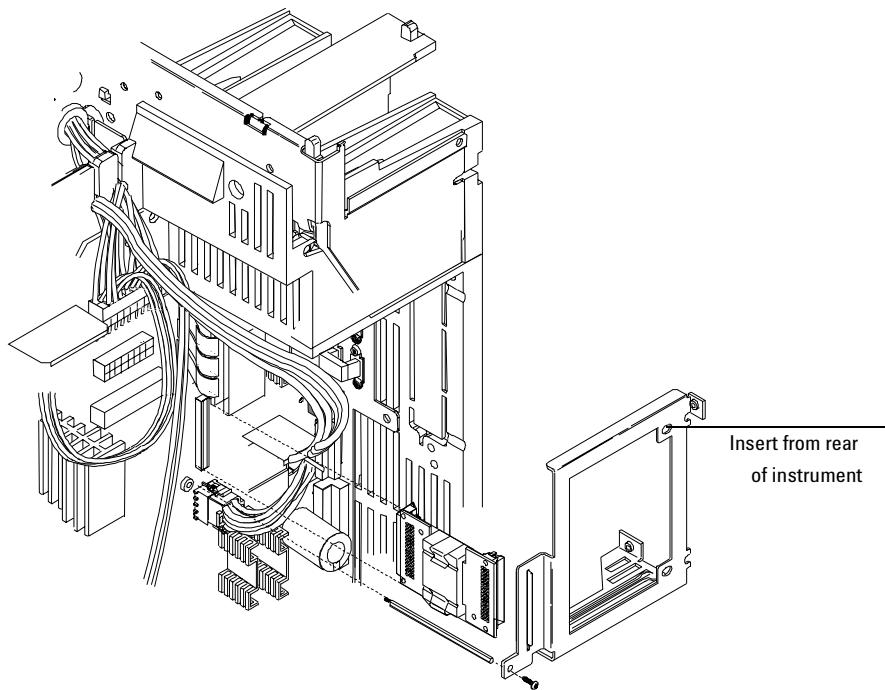


Figure 430-7 Installing the MIO support bracket and jumper card

8. Screw the bracket onto the standoff using a Torx T-10 screw. Do not fully tighten this screw yet.
9. From the back of the instrument, secure the bracket with three T-20 screws, starting with the bottom right screw.

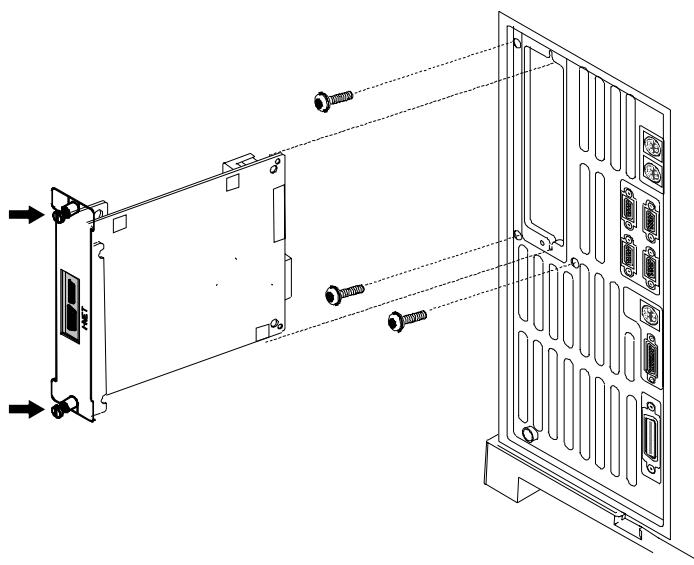


Figure 430-8 Securing the MIO support bracket (INET card shown)

10. Insert the MIO card into the track on the bracket and secure it with the captive thumb screws on the card.

Replacing ROMs on the main board (6890A and 6890 Plus)

WARNING Before proceeding, turn off the main power switch and unplug the power cord.

Caution Make sure you are properly grounded with an ESD strap before continuing.

There are four ROM sockets on the lower left corner of the main board numbered 0 to 3. Only sockets 0 and 1 (unshaded) are currently used.

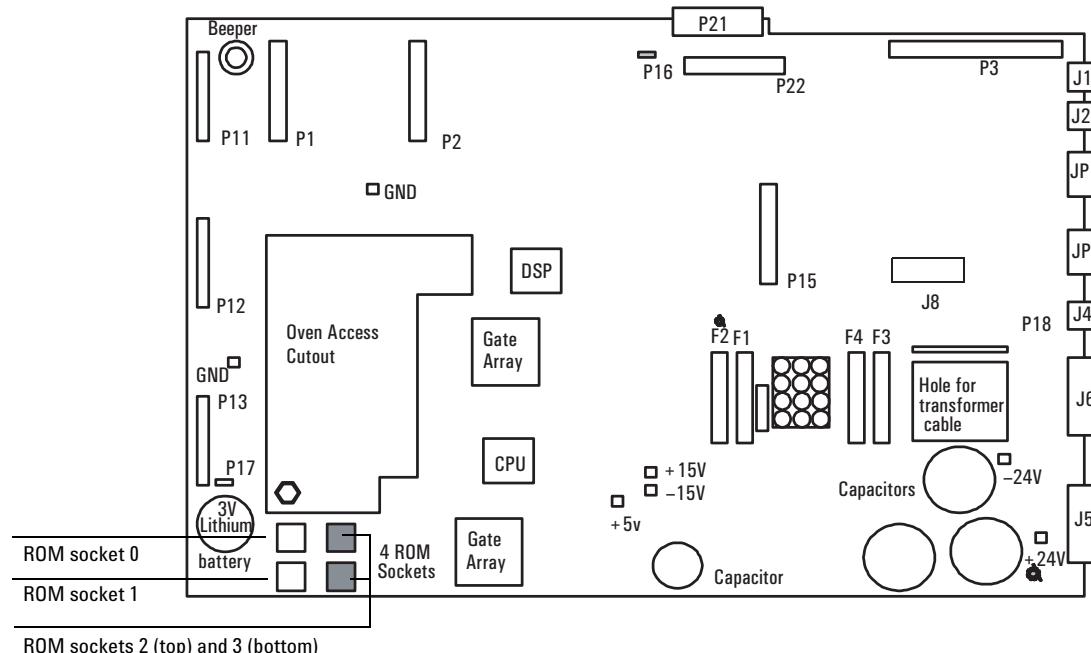


Figure 430-9 Location of the ROM sockets on the main board

Removing a ROM

Insert the prongs of an AMP IC puller, part no. 8710-2303 (AMP part no. 821903-1), in the small slots in the upper left and lower right corners of the socket and pull directly out.

Inserting a ROM

Caution Before inserting a ROM (new or used), make sure that all of the prongs are straight. Straighten any bent prongs with a small flat-blade screwdriver or a small pair of needle nosed pliers before continuing.

ROMs are supplied in sets of two:

- The lower part number goes in socket 0.
- The higher part number ROM goes in socket 1.

If the positions are reversed, the system will not boot up.

To insert a ROM, align the flattened corner of the chip with the upper right corner of the socket (a small dot and the word AMP mark it). Check to make sure all the prongs are aligned with their appropriate slots, then push the chip into the socket until it is firmly seated and level.

Replacing the battery

WARNING Before proceeding, turn off the main power switch.

Caution Make sure you are properly grounded with an ESD strap before continuing. Removing the battery while the instrument is unplugged erases all user entered setpoints, methods and sequences.

The 3V battery for the 6890 GC supplies the power to retain user entries in memory, such as programmed methods and sequences, in the event of a power failure or when the instrument is unplugged. The battery is located in the lower left corner of the main board.

To replace the battery, slide the battery down and pull the battery out of the bottom first.

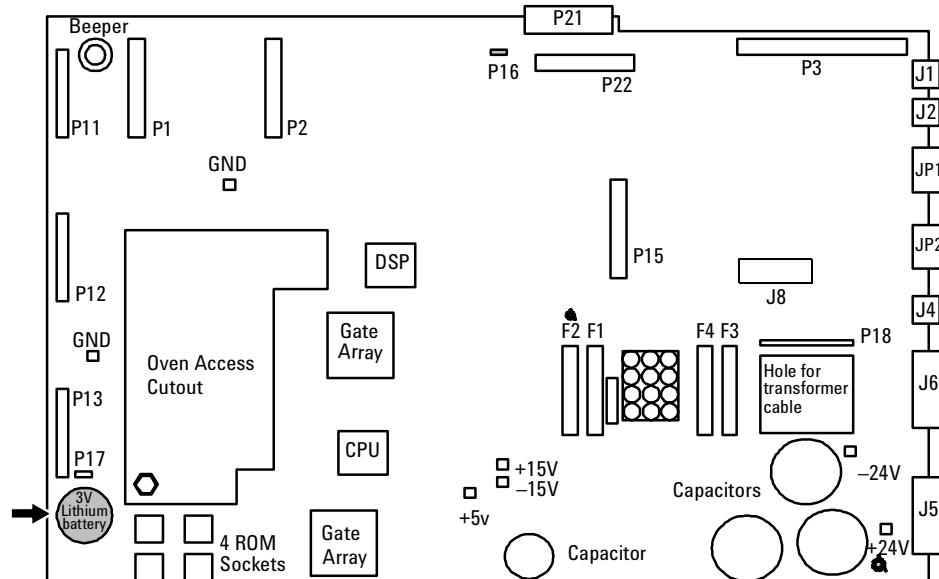


Figure 430-10 Location of the battery on the main board

Replacing the pneumatics board

WARNING Before proceeding, turn off the main power switch and unplug the power cord.

Caution Make sure you are properly grounded with an ESD strap before continuing.

The electronic pneumatic controller printed circuit board is located on the back of the instrument underneath the inlet and detector pneumatics modules.

1. Unclip any inlet/detector module connectors from the EPC board.
2. Unclip the ribbon cable from the main board and thread it back up through the slot towards the EPC board.
3. Unscrew the two Torx T-20 screws on the EPC board bracket and slide the bracket and board out of the GC.

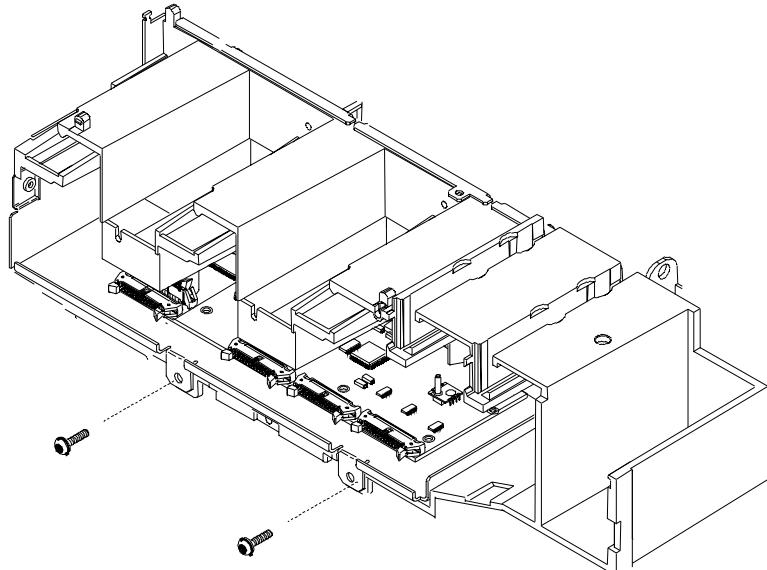


Figure 430-11 Removing the screws from the EPC board bracket

4. Reassembly is the reverse of removal.

Replacing the PCB bracket

The PCB bracket must be replaced when changing from a Type 1 auxiliary manifold to a Type 2 auxiliary manifold. See [Installing a type 2 manifold](#), for more information.

1. Compare the PCB bracket under the pneumatics PC board with the one included in the accessory kit. Check for the differences in the three mounting screw tabs. If they are the same, proceed to the next section. If they are different, the existing bracket must be replaced with the new one.

WARNING Before proceeding, turn off the main power switch and unplug the power cord.

2. Remove the GC lower back panel.

Caution Make sure you are properly grounded with an ESD strap before continuing.

3. If an MIO card is present, remove it and the jumper card.
4. Disconnect all cables from the pneumatics PC board.
5. Trace the ribbon cable on the end of the board to the main board and disconnect it there. Feed the cable up through the PCB bracket to the top.
6. Remove the screws holding the PCB bracket and slide it and the board out of the GC.
7. Remove the eight screws that fasten the board to the PCB bracket. Transfer the board to the new bracket and secure it with the eight screws.
8. Slide the board and bracket assembly back into the GC. Use the 10 mm screw provided in the kit for the left-most position, on the side of the GC. Use the screws removed earlier for the other positions.
9. Pass the ribbon cable down through the slot in the PCB bracket and connect it to the main board. Reconnect all cables to the pneumatics board.

10. Re-install the MIO card and the jumper card.
11. Re-install the lower back panel.

Replacing the transformer—GC serial number < 10225

WARNING Before proceeding, turn off the main power switch and unplug the power cord.

Caution Make sure you are properly grounded with an ESD strap before continuing.

When you are facing the back of the instrument, you will see the transformer on the bottom, left side.

1. Unclip the transformer wiring harness from connector J7 on the main board.
2. Unclip the transformer wiring harness from connector J1 on the AC power board.
3. Unclip the connector from P9 on the AC power board and move the wires out of the way of the transformer.

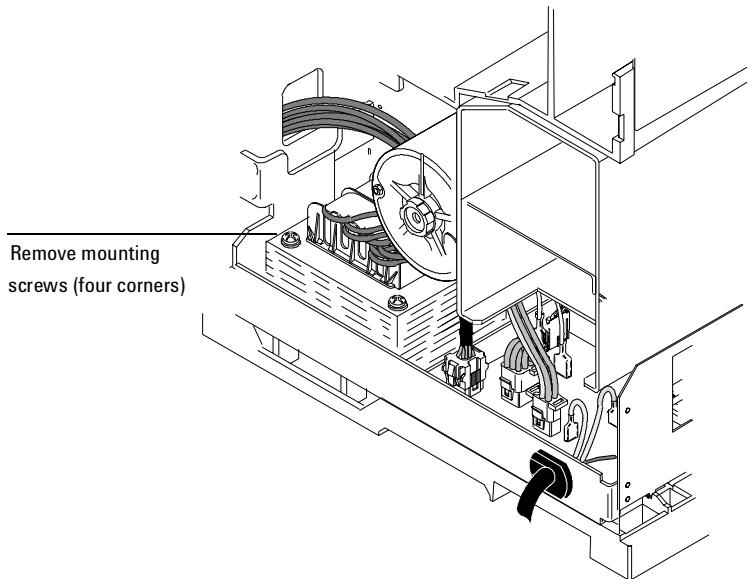


Figure 430-12 Removing the transformer

4. Remove the four No. 2 Pozidriv screws from the top corners of the transformer.

WARNING The transformer is very heavy! Make sure you have a firm grip on the transformer before lifting it out of the instrument.

5. Lift out the transformer.

Replacing the transformer—GC serial number \geq 10225

WARNING Before proceeding, turn off the main power switch and unplug the power cord.

Caution Make sure you are properly grounded with an ESD strap before continuing.

When you are facing the back of the instrument, you will see the transformer on the bottom, left side.

1. Unclip the transformer wiring harness from connector J7 on the main board.
2. **6890A and 6890 Plus.** Unclip the wires from J5 on the ALS Interface PCB, if installed.

6890N. Most 6890N transformers have a single cable going to connector J7 on the main board. A few early models have two cables; one goes to J7 and the other to an adapter (G1530-61590 Conversion Cable) that goes to the back of P1, the cable-end plug that connects to J7.

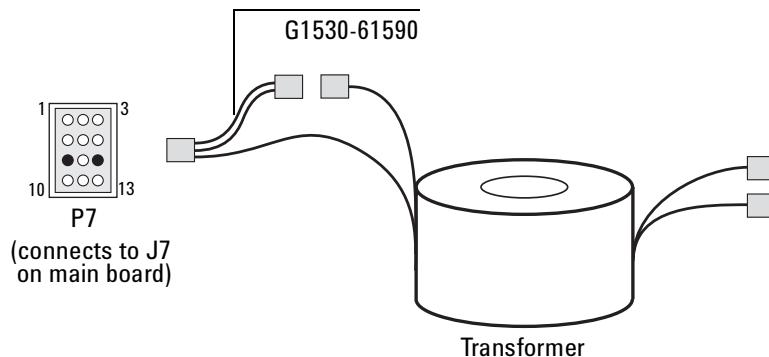


Figure 430-13 Some early 6890N transformers require a conversion cable for autosampler power

3. Unclip the transformer wiring harness from connector J1 on the AC power board.
4. Unclip the connector from P9 on the AC power board and move the wires out of the way of the transformer.

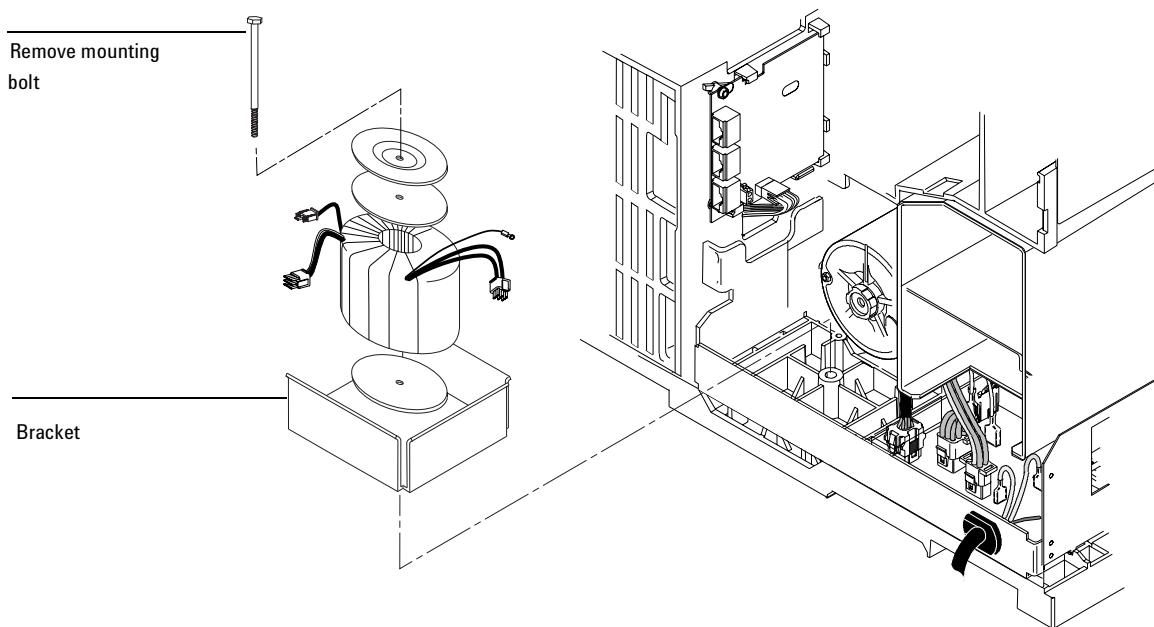


Figure 430-14 Removing the transformer

5. Remove the long bolt that secures the transformer.

WARNING The transformer is very heavy! Make sure you have a firm grip on the transformer before lifting it out of the instrument.

6. Lift out the transformer, gaskets, and plate. Save the gaskets.

To install a new transformer:

1. If you removed the bracket, install it over the PEM in the base of the GC. The open side of the bracket should face left, towards the main board.
2. Lay a gasket over the PEM, then loosely install the mounting bolt. Tighten only a few turns.
3. Install the transformer over the bolt. Once the transformer is in place, remove the bolt.

4. Install the remaining gasket onto the transformer, then install the plate on the gasket.
5. Install the bolt and tighten.

Replacing the ALS Interface Board

The G2612A ALS Interface board is required to operate the 7683 Automatic Liquid Sampler. It can only be installed in a 6890 Plus Gas Chromatograph with a serial number >20,000. While an ALS Interface Board is installed in the GC, the GC can use only the 7683 ALS.

WARNING Before proceeding, turn off the main power switch and unplug the power cord.

Caution Make sure you are properly grounded with an ESD strap before continuing.

Follow the procedure below to replace the G2612A ALS Interface board.

1. Remove the GC rear panels and the right side cover.
2. If an MIO card (LAN card) is installed, loosen its two mounting screws and slide the card out of the instrument as shown below.

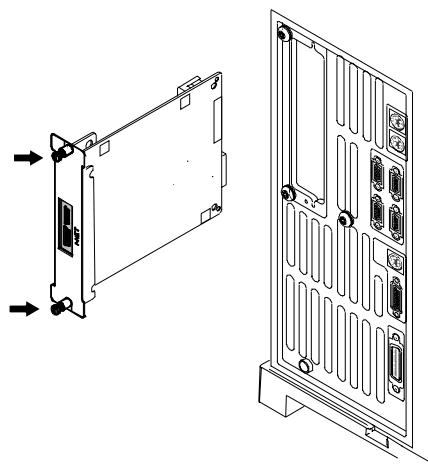


Figure 430-15 Removing the card from the GC

3. Disconnect the 6890 Controller PCB Cable, part no. G2612-60510, from the ALS Interface board at P5. See Figure 430-16 and Figure 430-17. If you are replacing this cable, disconnect it from the main board at J8.

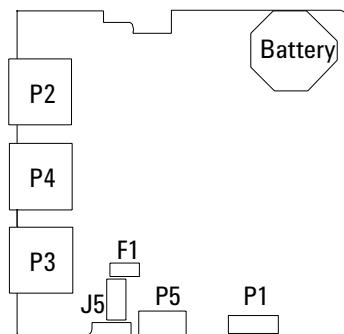


Figure 430-16 ALS Interface board connectors

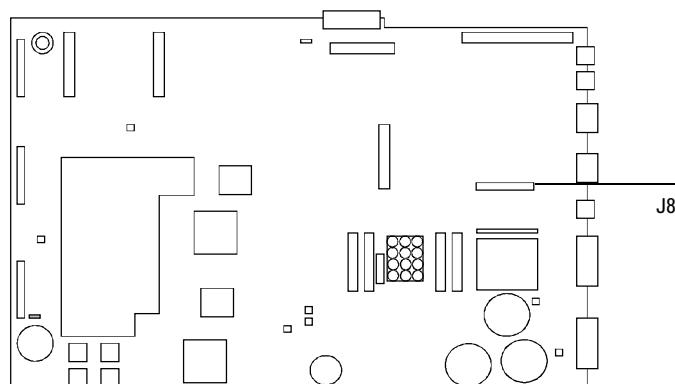


Figure 430-17 GC Main board

4. Remove the two screws that secure the board to the chassis. See Figure 430-18.
5. Gently pull the board out of the GC until the cutouts in the board line up with the locking tabs in the bracket. Tilt the board away from the GC until clear of the tabs, then remove. See Figure 430-18.

To re-install the board:

Caution Attempting to slide the entire board under the locking tab will damage the board's components.

1. Hold the board upright and slightly angled as shown in Figure 430-18.
2. Place the board onto the mounting bracket.
3. Slide it into the bracket until the cutouts in the board are aligned with the locking tabs in the bracket.
4. Lay the board against the chassis then slide it in until it stops. The locking tabs should hold the board in place.

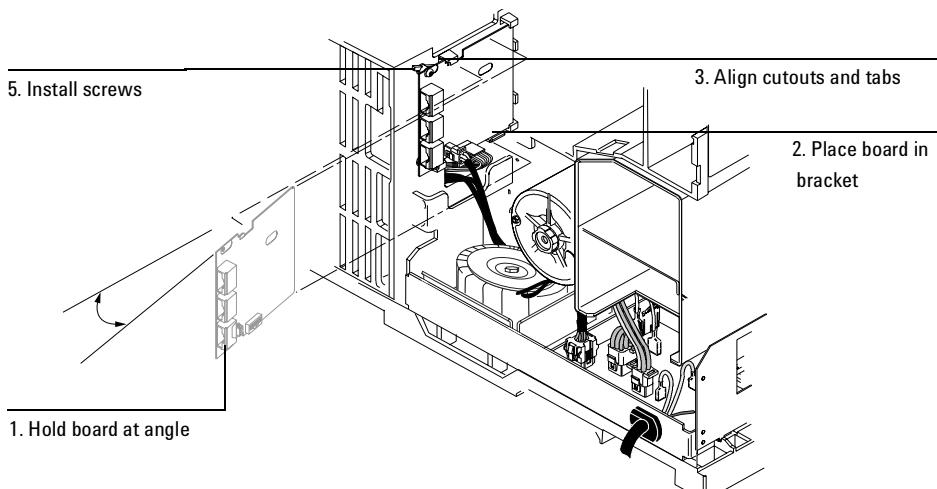


Figure 430-18 Install the ALS Interface board

5. Secure the board to the chassis using the two mounting screws. The board should not be stressed or bowed against the locking tab. See Figure 430-18.
6. Locate the 2-wire cable leading from the transformer and connect it to the ALS Interface board at J5. See Figure 430-18 and Figure 430-16.
7. Connect the 6890 Controller PCB Cable, part no. G2612-60510, to the ALS Interface board at P5. If replacing the cable, route the new cable through the cutout in the main board and connect it to J8. See Figure 430-16 and Figure 430-17.
8. If an MIO card was removed from the GC, re-install it.
9. Re-install the GC covers.
10. Restore power to the GC.

500 Site Preparation

510 Environmental

520 Gases

530 Power

540 Instrument Specifications

Required environmental conditions for operation
of the 6890 instrument.

510 Environmental

Temperature and humidity ranges

Operating the GC within the recommended ranges insures optimum instrument performance and lifetime.

Recommended temperature range	Temperature range
--------------------------------------	--------------------------

20 to 27° C	5 to 40° C
-------------	------------

Recommended humidity range	Humidity range
-----------------------------------	-----------------------

50 to 60%	Up to 31° C, 5 to 80%
	At 40° C, 5 to 50%

Recommended altitude range

Up to 2000 m

After exposing the GC to extremes of temperature or humidity, allow 15 minutes for it to return to the recommended ranges.

Ventilation requirements

The GC is cooled by convection: air enters vents in the side panels and underneath the instrument. Warmed air exits through slots in the top, rear, and side panels. Do not obstruct air flow around the instrument.

Caution For proper cooling and general safety, always operate the instrument with cover panels properly installed.

Venting oven exhaust

Hot air (up to 450°C) from the oven exits through a vent in the rear. Allow at least 20 cm (10 inches) clearance behind the instrument to dissipate this air.

WARNING Do not place temperature-sensitive items (for example, gas cylinders, chemicals, regulators, and plastic tubing) in the path of the heated exhaust. These items will be damaged and plastic tubing will melt. Be careful when working behind the instrument during cool-down cycles to avoid burns from the hot exhaust.

If space is limited, the Oven Exhaust Deflector (part no. 19247-60510) may improve oven cooling. It diverts exhaust air up and away from the instrument. You can connect it to a 10.2-cm (4-inch) exhaust-duct system, route the exhaust to a fume hood, or vent the exhaust outside the building with 10.2-cm diameter (4-inch diameter) furnace duct.

Venting toxic or noxious gases

During normal operation of the GC with many detectors and inlets, some of the carrier gas and sample vents outside the instrument. If any sample components are toxic or noxious, or if hydrogen is used as the carrier gas, the exhaust must be vented to a fume hood. Place the GC in the hood or attach a large diameter venting tube to the outlet for proper ventilation.

To further prevent contamination from noxious gases, you can attach a chemical trap (part no. G1544-60610) to the split vent.

Benchtop space requirements

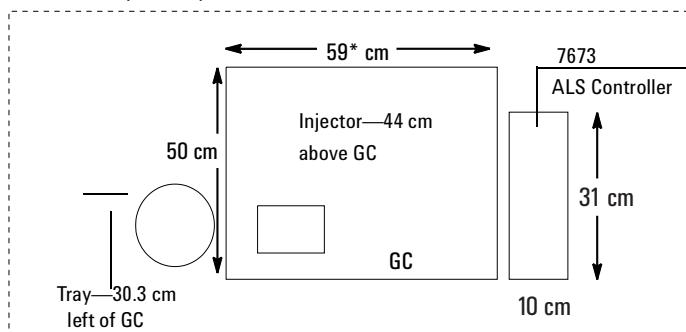
The GC with electronic pneumatics control (EPC) is 59 cm (23 inches) wide. The nonEPC model is 68 cm (26.7 inches) wide. Both are 50 cm (21 inches) high and 50 cm (21 inches) deep.

The area above the GC should be clear, with no shelves or overhanging obstructions that limit access to the top of the instrument and interfere with cooling. You may need additional space for other instruments used with your GC. Figure 510-1 shows some common system configurations.

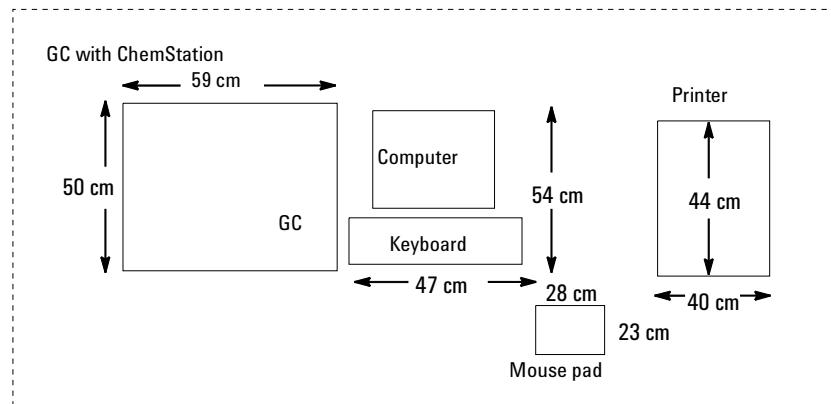
Table 510-1 presents the dimensions, power requirements, heat production, and weight of the GC and other Agilent instruments often used with it. Use this table to insure that you have adequate space and power for the entire

system. Allow at least 10.2 cm (4 inches) space between instruments for ventilation.

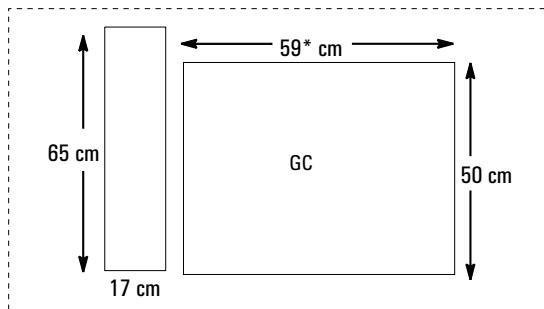
GC with Automatic Liquid Sampler



GC with ChemStation



GC with 5972A Mass Selective Detector



*68 cm for non-EPC version.

Figure 510-1 Common GC-system configurations—top view

Table 510-1 Dimensions, Power, Heat Production, and Weight

Instrument	Height	Width	Depth	Power (VA)	Heat	Weight
6890 Gas Chromatograph						
EPC version	50 cm 20 inches	59 cm 23 inches	54 cm 21 inches	2,250	8,100 KJoules 7,681 Btu/hr	50 kg 112 lb
Non-EPC version	50 cm 20 inches	68 cm 27 inches	54 cm 21 inches	2,250	8,100 KJoules 7,681 Btu/hr	56.8 kg 125 lb
Fast heating oven, same for EPC and non-EPC	—	—	—	2,950	10,620 KJoules 10,071 Btu/hr	—
Automatic Liquid Sampler						
G1512A Controller (7673)	10 cm 4 inches	33 cm 13 inches	38 cm 15 inches	320 max	545 KJoules 515 Btu/Hr	7.3 kg 16.0 lb
G1513A or G2613A Injector	44 cm above GC 17 inches above GC					
18596 or G2614A Tray	31 cm left of GC 9 inches left of GC					
Computer*						
Computer with monitor	54 cm 21 inches	42 cm 17 inches	39 cm 15 inches	N/A	N/A	N/A
Keyboard	5 cm 2 inches	47 cm 18 inches	18 cm 7 inches	N/A	N/A	N/A
5972A Mass Selective Detector	35 cm 14 inches	17 cm 7 inches	65 cm 26 inches	254 max	3,158 Btu/hr, 3,000 with GC	22.7 kg 50.0 lb
7694 Headspace Sampler	31 cm 16 inches	56 cm 22 inches	39 cm 22 inches	420 max	2,215 KJoules 2,100 Btu/hr	35.8 kg 79.0 lb
Printer**	30 cm 12 inches	42 cm 16 inches	40 cm 16 inches	300 max	N/A	16.8 kg 37.0 lb
Integrators						
3397 Series, 3396 Series III and, 3395 Integrators	13 cm 5 inches	46 cm 18 inches	46 cm 18 inches	50	135 KJoules 120 Btu/hr	4.3 kg 9.5 lb
35900C/D/E Analog-to- Digital Converter	11 cm 4 inches	33 cm 13 inches	29 cm 11 inches	40	216 KJoules 205 Btu/hr	4.1 kg 9.0 lb

*General specifications for a mid-size, desktop computer

** General specifications for a typical printer

520 Gases

Gas requirements

Gases for packed columns

The carrier gas you use depends upon the type of detector and the performance requirements. Table 520-1 lists gas recommendations for packed column use. In general, makeup gases are not required with packed columns.

Table 520-1 Gas Recommendations for Packed Columns

Detector	Carrier Gas	Comments	Detector anode purge or reference gas
Electron Capture	Nitrogen	Maximum sensitivity	Nitrogen
	Argon/ Methane	Maximum dynamic range	Argon/Methane
Flame Ionization	Nitrogen	Maximum sensitivity	Hydrogen and air for detector
	Helium	Acceptable alternative	
Flame Photometric	Hydrogen		Hydrogen and air for detector
	Helium		
	Nitrogen		
	Argon		
Nitrogen- Phosphorus	Helium	Optimum performance	Hydrogen and air for detector
	Nitrogen	Acceptable alternative	
Thermal Conductivity	Helium	General use	Reference must be same as carrier
	Hydrogen	Maximum sensitivity (Note A)	
	Nitrogen	Hydrogen detection (Note B)	
	Argon	Maximum hydrogen sensitivity (Note B)	

Note A: Slightly greater sensitivity than helium. Incompatible with some compounds.

Note B: For analysis of hydrogen or helium. Greatly reduces sensitivity for other compounds.

Gases for capillary columns

When used with capillary columns, GC detectors require a separate makeup gas for optimum sensitivity. For each detector and carrier gas, there is a preferred choice for makeup gas. Table 520-2 lists gas recommendations for capillary columns.

Table 520-2 Gas Recommendations for Capillary Columns

Detector	Carrier gas	Preferred makeup gas	Second choice	Detector anode purge or reference gas
Electron Capture	Hydrogen	Argon/Methane	Nitrogen	Anode purge must be same as makeup
	Helium	Argon/Methane	Nitrogen	
	Nitrogen	Nitrogen	Argon/Methane	
	Argon/Methane	Argon/Methane	Nitrogen	
Flame Ionization	Hydrogen	Nitrogen	Helium	Hydrogen and air for detector
	Helium	Nitrogen	Helium	
	Nitrogen	Nitrogen	Helium	
Flame Photometric	Hydrogen	Nitrogen		Hydrogen and air for detector
	Helium	Nitrogen		
	Nitrogen	Nitrogen		
	Argon	Nitrogen		
Nitrogen-Phosphorus	Helium	Nitrogen	Helium**	Hydrogen and air for detector
	Nitrogen	Nitrogen	Helium**	
Thermal Conductivity	Hydrogen*	Must be same as carrier and reference gas	Must be same as carrier and reference gas	Reference must be same as carrier and makeup
	Helium			
	Nitrogen			

* When using hydrogen with a thermal conductivity detector, vent the detector exhaust to a fume hood or a dedicated exhaust to avoid buildup of hydrogen gas.

**Helium is not recommended as a makeup gas at flow rate > 5 mL/min. Flow rates above 5 mL/min shorten detector life.

Gas purity

Some gas suppliers furnish “instrument” or “chromatographic” purity grades of gas that are specifically intended for chromatographic use. We recommend these grades for use with the GC.

Generally, all gas supplies used should be in the 99.995% to 99.9995% purity range. Only very low levels (≤ 0.5 ppm) of oxygen and total hydrocarbons should be present. Oil-pumped air supplies are not recommended because they may contain large amounts of hydrocarbons.

The addition of high-quality moisture and hydrocarbon traps immediately after the main tank pressure regulator is highly recommended. Refer to the next section, The gas plumbing, for more information on using traps.

Table 520-3 Gas Purity Recommendations

Carrier gases and capillary makeup gases	
Helium	99.9995%
Nitrogen	99.9995%
Hydrogen	99.9995%
Argon/Methane	99.9995%
Detector support gases	
Hydrogen	99.9995%
Air (dry)	Zero-grade or better

The gas plumbing

WARNING All compressed gas cylinders should be securely fastened to an immovable structure or permanent wall. Compressed gases should be stored and handled in accordance with the relevant safety codes.

Gas cylinders should not be located in the path of heated oven exhaust.

To avoid possible eye injury, wear eye protection when using compressed gas.

Follow the general plumbing diagram when preparing gas supply plumbing.

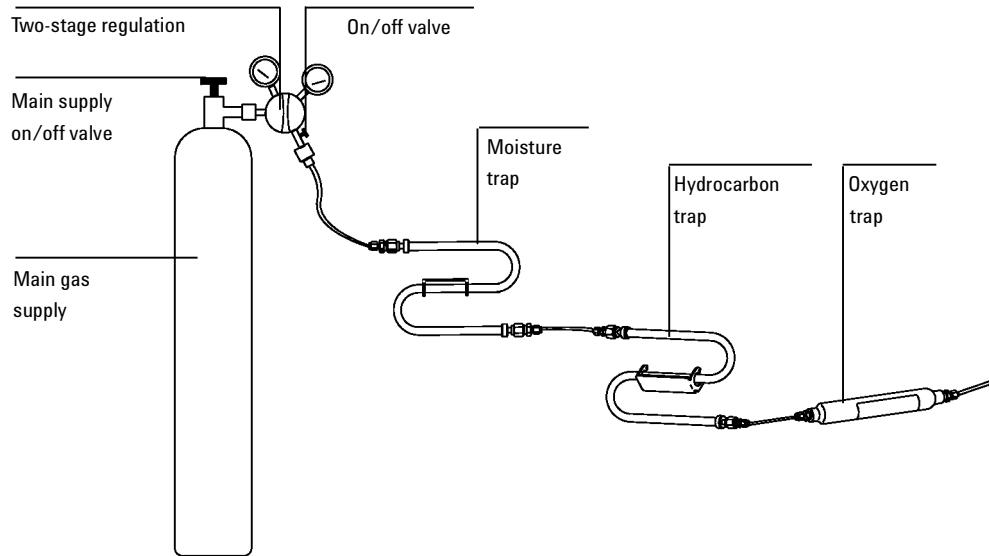


Figure 520-1 General plumbing diagram

- Two-stage regulators are strongly recommended to eliminate pressure surges. High-quality, stainless-steel diaphragm-type regulators are especially recommended.

- On/off valves mounted on the outlet fitting of the two-stage regulator are not essential but are very useful. Be sure the valves have stainless-steel, packless diaphragms.
- FID, FPD, and NPD detectors require a dedicated air supply. Operation may be affected by pressure pulses in air lines shared with other devices.
- Flow- and pressure-controlling devices require at least 10 psi (138 kPa) pressure differential across them to operate properly. Source pressures and capacities must be high enough to ensure this.
- Auxiliary pressure regulators should be located close to the GC inlet fittings. This insures that the supply pressure is measured at the instrument rather than at the source; pressure at the source may be different if the gas supply lines are long or narrow.

Supply tubing for carrier and detector gases

Caution Do not use methylene chloride or other halogenated solvent to clean tubing that will be used with an electron capture detector. They will cause elevated baselines and detector noise until they are completely flushed out of the system.

Gases should be supplied to the instrument only through preconditioned copper tubing (part no. 5180-4196). Do not use ordinary copper tubing—it contains oils and contaminants.

Caution Do not use plastic tubing to supply detector and inlet gases to the GC. It is permeable to oxygen and other contaminants that can damage columns and detectors, and can melt if near hot exhaust or components.

The tubing diameter depends upon the distance between the supply gas and the GC and the total flow rate for the particular gas. One-eighth-inch tubing is adequate when the supply line is less than 15 feet (4.6 m) long.

Use larger diameter tubing (1/4-inch) for distances greater than 15 feet (4.6 m) or when multiple instruments are connected to the same source. You should also use larger diameter tubing if high demand is anticipated (for example, air for an FID).

Be generous when cutting tubing for local supply lines—a coil of flexible tubing between the supply and the instrument lets you move the GC without moving the gas supply. Take this extra length into account when choosing the tubing diameter.

Two-stage pressure regulators

To eliminate pressure surges, use a two-stage regulator with each gas tank. Stainless steel, diaphragm-type regulators are recommended.

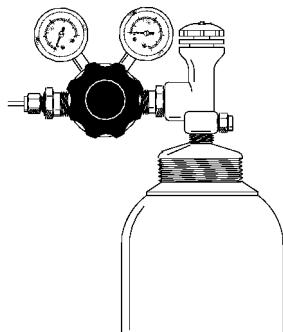


Figure 520-2 Two-stage pressure regulator

The type of regulator you use depends upon gas type and supplier. The *Chemical Analysis Consumables and Accessories* catalog contains information to help you identify the correct regulator, as determined by the Compressed Gas Association (CGA). Agilent Technologies offers pressure-regulator kits that contain all the materials needed to install regulators properly.

Pressure regulator-gas supply tubing connections

The pipe-thread connection between the pressure regulator outlet and the fitting to which you connect the gas tubing must be sealed with Teflon tape. **Instrument grade** Teflon tape (part no. 0460-1266), from which volatiles have been removed, is recommended for all fittings. Do not use **pipe dope** to seal the threads; it contains volatile materials that will contaminate the tubing.

Traps

Using chromatographic-grade gases insures that the gas in your system is pure. However, for optimum sensitivity, it is highly recommended that you install high-quality traps to remove traces of water or other contaminants. After installing a trap, check the gas supply lines for leaks.

Table 520-4 Recommended Traps

Description	Part No.
Preconditioned moisture trap: metal casing, s-shaped trap for carrier gas cleanup. Contains Molecular Sieve 5A, 45/60 mesh, and 1/8-inch fittings.	5060-9084
Hydrocarbon trap: metal casing, s-shaped trap filled with 40/60 mesh activated charcoal, and 1/8-inch fittings	5060-9096
Oxygen trap (for carrier and ECD gases): metal casing, and 1/8-inch brass fittings. Oxygen trap cannot be reconditioned.	3150-0414

Moisture in carrier gas damages columns. We recommend a type 5A Molecular Sieve trap after the source regulator and before any other traps.

A hydrocarbon trap removes organics from gases. It should be placed after a molecular sieve trap and before an oxygen trap, if they are present.

An oxygen trap removes 99% of the oxygen from a gas plus traces of water. It should be last in a series of traps. Because trace amounts of oxygen can damage columns and degrade ECD performance, use an oxygen trap with carrier and ECD gases. Do not use it with FID, FPD, or NPD fuel gases.

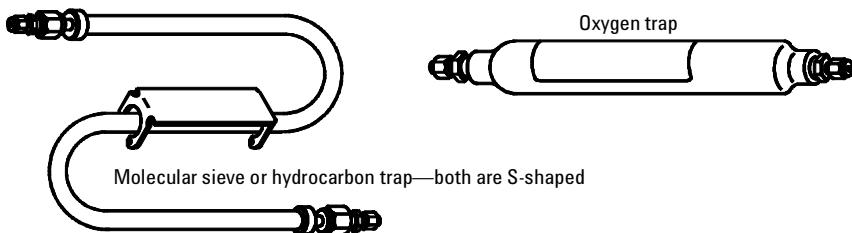


Figure 520-3 Traps

Cryogenic cooling requirements

Cryogenic cooling allows you to cool the oven below ambient temperature. A solenoid valve introduces liquid coolant, either carbon dioxide (CO₂) or nitrogen (N₂), to cool the oven to the desired temperature.

CO₂ and N₂ require different hardware. You must replace the entire valve assembly if you want to change coolants. The liquid CO₂ valve kit is part no. G1565-65510 and the liquid N₂ kit is part no. G1566-65517.

Choosing a coolant

When selecting a coolant, consider these points:

- The lowest temperature you need to reach
- How frequently you will use cryogenic cooling
- The availability and price of coolant
- The size of the tanks in relation to the size of the laboratory
- Liquid N₂ cools reliably to -80°C
- Liquid CO₂ cools reliably to -40°C

CO₂ is the choice for *infrequent* cryogenic cooling because it does not evaporate and is less expensive than N₂. However, a tank of CO₂ contains much less coolant than a tank of N₂ and more CO₂ is used for the same amount of cooling.

Although liquid N₂ evaporates from the tank regardless of frequency of use, N₂ tanks contain more coolant than do CO₂ tanks and therefore may be better for frequent use.

Using carbon dioxide

WARNING Pressurized liquid CO₂ is a hazardous material. If CO₂ escapes its container, it exits at high pressure and low temperatures that can be dangerous to personnel. CO₂ in high concentrations is toxic to humans. Consult your local supplier for recommended safety precautions and delivery system design.

Caution Liquid CO₂ should not be used as a coolant for temperatures below -40°C because the expanding liquid may form solid CO₂—dry ice—in the GC oven. If dry ice builds up in the oven, it can seriously damage the GC.

Liquid CO₂ is available in high-pressure tanks containing 50 pounds of liquid. The CO₂ should be free of particulate material, oil, and other contaminants. These contaminants could clog the expansion orifice or affect the proper operation of the GC.

Additional requirements for the liquid CO₂ system include:

- The tank must have an internal dip tube or eductor tube to deliver liquid CO₂ instead of gas (see Figure 520-4).
- The liquid CO₂ must be provided to the GC at a pressure of 700 to 1,000 psi at a temperature of 25°C.
- Use 1/8-inch diameter heavy-wall stainless steel tubing for supply tubing. The tubing should be between 5 to 50 feet long.
- Coil and fasten the ends of the tubing to prevent it from “whipping” if it breaks.
- Do not install a pressure regulator on the CO₂ tank, as vaporization and cooling would occur in the regulator instead of the oven.
- Do not use a padded tank (one to which another gas is added to increase the pressure).

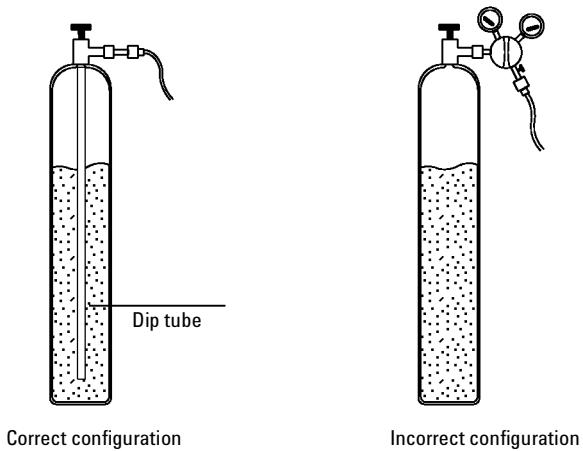


Figure 520-4 Correct and incorrect liquid CO₂ tank configuration

WARNING Do not use copper tubing or thin-wall stainless steel tubing with liquid CO₂. Both harden at stress points and may explode.

Using liquid nitrogen

WARNING Liquid nitrogen is a hazard because of the extremely low temperatures and high pressures that may occur in improperly designed supply systems.

Liquid nitrogen can present an asphyxiant hazard if vaporizing nitrogen displaces oxygen in the air. Consult local suppliers for safety precautions and design information.

Liquid nitrogen is supplied in insulated Dewar tanks. The correct type for cooling purposes is a *low-pressure* Dewar equipped with a dip tube—to deliver liquid rather than gas—and a safety relief valve to prevent pressure build-up. The relief valve is set by the supplier at 20 to 25 psi.

WARNING If liquid nitrogen is trapped between a closed tank valve and the cryo valve on the GC, tremendous pressure will develop and may cause an explosion. For this reason, keep the delivery valve on the tank open so that the entire system is protected by the pressure relief valve.

To move or replace a tank, close the delivery valve and carefully disconnect the line at either end to let residual nitrogen escape.

Additional requirements for the liquid N₂ system include:

- Nitrogen must be provided to the GC as a liquid at 20 to 30 psi.
- The supply tubing for liquid N₂ must be *insulated*. Foam tubing used for refrigeration and air-conditioning lines is suitable for insulation. Since pressures are low, *insulated* copper tubing is adequate.
- The liquid nitrogen tank should be close (only 5 to 10 feet) to the GC to insure that liquid, not gas, is supplied to the inlet.

Supplying valve actuator air

Some valves use pressurized air for actuation (others are electrically or manually driven). Actuator air must be free of oil, moisture, and particulates. It can be supplied from a dried regulated cylinder, although "house" air supplies or air from a compressor are acceptable.

Most valves require 20 to 40 psi of pressure to operate. High-pressure valves may require 65 to 70 psi.

Valves require a dedicated air supply. Do not share valve air supplies with detectors.

See "Valve Control" in the Agilent 6890 GC Operating Manual/CD-ROM for more valve requirements.

530 Power

Grounding

Caution A proper earth ground is required for GC operations.

To protect users, the metal instrument panels and cabinet are grounded through the three-conductor power line cord in accordance with International Electrotechnical Commission (IEC) requirements.

The three-conductor power line cord, when plugged into a properly grounded receptacle, grounds the instrument and minimizes shock hazard. A properly grounded receptacle is one that is connected to a suitable earth ground. Proper receptacle grounding should be verified.

Make sure the GC is connected to a dedicated receptacle. Use of a dedicater receptacle reduces interference.

Caution Any interruption of the grounding conductor or disconnection of the power cord could cause a shock that could result in personal injury.

Line voltage

The GC operates from one of the AC voltage supplies listed in Table 530-1, depending on the standard voltage of the country from which it was ordered. GCs are designed to work with a specific voltage; make sure your GC voltage option is appropriate for your lab. The voltage requirements for your GC are printed near the power cord attachment.

Table 530-1 Line Voltage Requirements

Voltage	Maximum power consumption (VA)	Power line requirement	Oven type
120 V ($\pm 5\%$)	2,250	20-amp dedicated	Slow-heating
200 V ($\pm 5\%$)	2,950	15-amp dedicated	Fast-heating
220 V ($\pm 5\%$)	2,950	15-amp dedicated	Fast-heating
230 V ($\pm 5\%$)	2,950	16-amp dedicated	Fast-heating
230 V ($\pm 5\%$)	2,250	10-amp dedicated	Slow-heating
(Switzerland or Denmark with 10-amp maximum service)			
240 V ($\pm 5\%$)	2,950	13- or 16-amp dedicated	Fast-heating

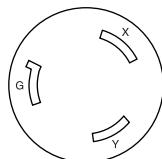
Frequency range for all voltages is 48 to 66 Hz.

The fast-heating oven requires at least 200 V. Most countries' standard voltage meets this requirement. GCs for use in the USA, Denmark, and Switzerland will be equipped with a slow-heating oven unless they are ordered with power option 002, which specifies a fast-heating oven.

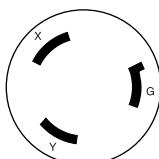
Although your GC should arrive ready for operation in your country, compare its voltage requirements with those listed in Table 530-2. If the voltage option you ordered is not suitable for your installation, contact Agilent Technologies.

USA fast heating oven

The fast heating oven requires 240 V/15A power. Do not use 208 V power. Lower voltage causes slow oven ramps and prevents proper temperature control. The power cord supplied with your GC is rated for 250 V/15A, and is a two pole, three wire cord with grounding (type L6-15R/L6-15P).



Receptacle
L6-15R



Plug
L6-15P

The fast-heating oven requires at least 200 V. Most countries' standard voltage meets this requirement. GCs intended for use in the USA, Denmark and Switzerland will be equipped with a slow-heating oven unless they are ordered with power option 002, which equips the GC with a fast-heating oven.

Canadian installation

When installing a GC in Canada, make sure your GC's power supply circuit meets the following additional requirements:

- The circuit breaker for the branch circuit, which is dedicated to the instrument, must be rated for continuous operation.
- The service box branch circuit must be marked as a "Dedicated Circuit."

Table 530-2 Voltages and Line Cord Terminations by Country

Country	Power cord termination	Voltage	Oven type
Australia, 10 amp		240 V	Regular
Australia, 15 amp		240 V	Fast
China, 10 amp		220 V	Regular
China, 16 amp		220 V	Fast
Continental Europe		220 V	Fast
Continental Europe		230 V	Fast
Denmark, 10 amp		230 V	Regular
Denmark and Switzerland, 16 amp		230 V	Fast
Switzerland, 10 amp		230 V	Regular
Hong Kong		220 V	Fast
India, South Africa		240 V	Fast
Israel		230 V	Fast
Japan		200 V	Fast

United Kingdom		240 V	Fast
USA		120 V	Regular
USA		240 V	Fast

540 Instrument Specifications

Specifications are subject to change without notice. The latest revision can be obtained from an Agilent Technologies Sales Office.

Physical specifications

Dimensions and average weight

- Height: 50 cm (20 inches)
- Width: 58 cm (23 inches) with EPC inlets; 68 cm (27 inches) with manual inlets
- Depth: 54 cm (22 inches)
- Average weight: 49 kg (108 lbs)

Laboratory environmental conditions

- Storage extremes: -40° C, 65° C
- Recommended ambient temperature: 15 to 35° C
- Recommended ambient humidity: 5 to 95%

Safety certifications

- CSA certified and NRTL listed
- IEC self-certified

Data communications

- GPIB, RS-232-C, and two analog output channels (1 mV, 1 V, and 10 V output available) as standard
- INET interface optional

Heated zones

- Independent heated zones, not including oven: six (two inlets, two detectors, and two auxiliary)
- Maximum operating temperatures for auxiliary zones: 400° C

Column oven

- Dimensions: $28 \times 31 \times 16$ cm
- Operating temperature: 4°C above ambient to 450°C
 - with LN_2 cryo: -80°C to 450°C
 - with CO_2 cryo: -55°C to 450°C
- Temperature setpoint resolution: 1°C
- Maximum setpoint temperature rate: $120^\circ\text{C}/\text{min}$
- Actual programming rate: see Figure 540-1
- Cool-down rates: see Figure 540-2. Rates are greater when using the optional oven exhaust deflector or cryogenic cooling.
- Maximum run time: 999.99 min
- Programming ramps/plateaus: 6/7
- Ambient rejection: $<0.01^\circ\text{C}$ per 1°C
- Column bleed compensation standard for two channels

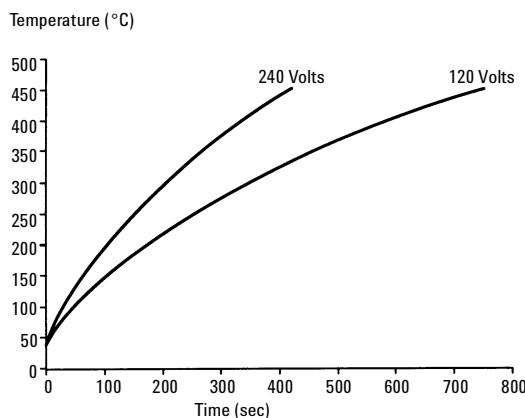


Figure 540-1 Typical oven heatup rates,
6890 Series GC

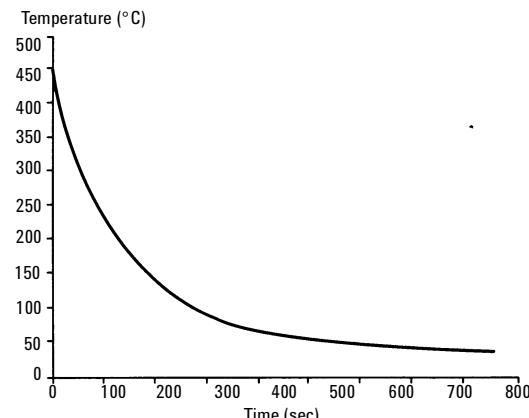


Figure 540-2 Typical oven cool-down
rates, 6890 Series GC

Inlets

- Maximum inlets installed: two
- All inlets include septum purge
- Inlets available:
 - Packed: electronic or manual pressure/flow, 400° C max
 - Split/splitless: electronic or manual pressure/flow, 400° C max, electronic entry of pressure or flow and split ratio with electronic version
 - Temperature-programmable cool on-column: electronic pressure/flow, 450° C max
 - Programmable temperature vaporizer, 450° C max
 - Volatiles interface, 400° C max
- For electronic inlets:
 - Pressure setting range: 0 to 100 psi
 - Total flow setting range: split/splitless, 0 to 200 mL/min nitrogen, 0 to 1000 mL/ min hydrogen or helium
 - Packed: 0 to 100 mL/min

Detectors

- All detectors are available with electronic control of gases.
- All detectors except the μ -ECD are available with manual control of gases.
- All detectors (manual or electronic) include electronic on/off of all gases.
- Detectors available:
 - Flame ionization detector (FID) for packed or capillary columns
 - Flame ionization detector (FID) optimized for capillary columns
 - Thermal conductivity detector (TCD)
 - Electron capture detector (ECD)
 - Micro-cell electron capture detector (μ -ECD)
 - Nitrogen-phosphorus detector (NPD) for packed or capillary columns
 - Nitrogen-phosphorus detector (NPD) optimized for capillary columns
 - Flame photometric detector (FPD), single or dual wavelength
 - Atomic emission detector (AED)
 - Mass selective detector (MSD)

FID

- 450°C maximum operating temperature
- Automatic flame ignition from the keypad or ChemStation
- Flame out detection
- MDL: <5 pg carbon/s as propane using nitrogen carrier and 0.29 mm jet
- Linear dynamic range: 10^7 (\pm 10%) with nitrogen carrier and 0.29 mm jet

NPD

- 400°C maximum operating temperature
- Automatic baseline adjusting via keypad or ChemStation
- MDL: <0.4 pg N/s, <0.2 pg P/s with azobenzene/malathion mixture

- Selectivity: 25000 to 1 gN/gC, 75000 to 1 gP/gC with azobenzene/malathion/octadecane
- Dynamic range: $>10^5$ N, $>10^5$ P with azobenzene/malathion mixture

TCD

- 400°C maximum operating temperature
- Single filament with microcell
- MDL: <400 pg propane/mL helium carrier (MDL may be affected by laboratory environment.)
- Linear dynamic range: 10^5 ($\pm 5\%$)

ECD

- Equipped with anode purge for contamination resistance
- 400°C maximum operating temperature
- Makeup gas types: argon/5% methane, nitrogen
- Radioactive source: 15 mCi ^{63}Ni plated
- MDL: <0.04 pg/s lindane
- Dynamic range: $>10^4$ with lindane

μ -ECD

- Radioactive source: 15 mCi ^{63}Ni plated

FPD

- Range: 10^3 (S), 10^4 (P)
- Selectivity: 10^5 to 1 gS/gC, 10^6 to 1 gP/gC

AED

See the specification guide for AED.

MSD

See the specification guide for MSD.

600 Performance Verification

610 Checkout Chromatograms

How to check the performance of
the 6890 instrument.

610 Checkout Chromatograms

This section contains typical examples of test sample chromatograms. They may be used as a general guide to instrument performance.

Injection volumes listed with operating conditions in the following chromatograms do not necessarily indicate total absolute volume injected. Volume given is simply the graduation (plunger position) read from a standard 10 mL syringe. For a heated inlet, actual sample volume injected will also include an additional 0.4 to 0.7 mL, the volume of sample volatilized from inside the syringe needle. For the dedicated, on-column inlet (unheated), the syringe plunger position more accurately reflects the true injected volume.

Also note that the following procedures and results are intended only to provide evidence of a properly functioning inlet and/or detector system; they are not necessarily suitable to test a given system against its specification limits.

For more detailed information about instrument specifications, see the *Standard Operating Procedures Kit*, Part No. G1530-61210.

Note: 30 m × 0.32 × 0.25 µm columns may be substituted. Slight elution time differences can be expected but the order of elution will remain the same.

FID checkout conditions and chromatogram

Column and sample

Type	HP-5 30 m × 0.32 mm × 0.25 µm PN 19091J-413
Sample	FID Checkout PN 18710-60170
Injection volume	1 µL

Inlet

Temperature	250°C	Purged/Packed or Split/Splitless
Oven Track	Cool On-Column	
Inlet pressure	25 psi	(Constant pressure for EPC inlets, helium)

Split/Splitless Only

Mode	Splitless
Purge flow	60 mL/min
Purge time	0.75 min

PTV—Splitless Mode

Inlet temperature	40°C	
Initial time	0.1 min	
Rate 1		720°C/min
Final temp 1	350°C	
Final time 1	2 min	
Rate 2		100°C/min
Final temp 2	250°C	
Final time 2	0 min	

Inlet pressure	25 psi (const. press. for EPC inlets)
Mode	Splitless
Purge time	0.75 min
Purge flow	60 mL/min

Detector

Temperature	300°C
H ₂ flow	30 mL/min
Air flow	400 mL/min
Makeup flow, N ₂	25 mL/min
Offset	Should be < 20 pA

Oven

Initial temp	40°C
Initial time	0 min
Rate 1	25°C/min
Final temp	90°C
Final time	0 min
Rate 2	15°C/min
Final temp	170°C
Final time	2 min

610 Checkout Chromatograms
FID checkout conditions and chromatogram

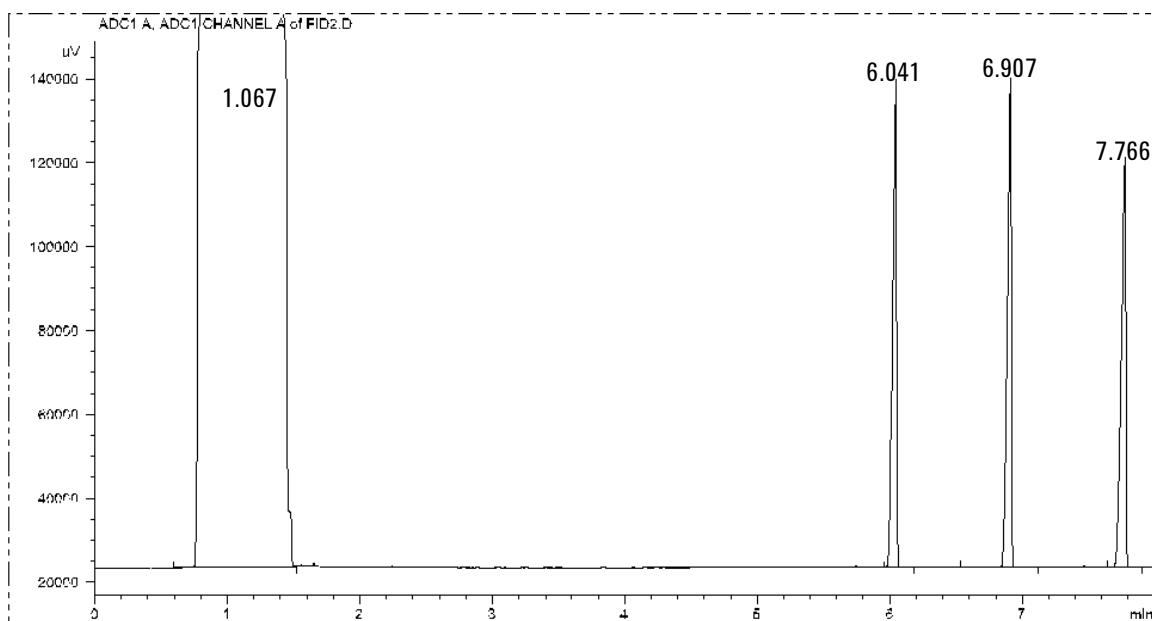


Figure 610-1 FID checkout chromatogram

Typical values

3396B or 3396C or 3397A integrator sample conditions with analog input [6890 Analog output, Range 8]

>>Set DATE and TIME<<

Zero	10	Pk wd	0.04
Att 2^	4	Thresh	3
Cht sp	1	Stop time	8.75

		SS/COC/PTV	PPIP
Sensitivity	C ₁₄ , C ₁₅ , C ₁₆ area counts	125,000	125,000
Discrimination	C ₁₄ /C ₁₆ area ratio	1.00±0.05	1.00±0.10

3396B or 3396C or 3397A integrator sample conditions with INET input [6890 INET output, Range 8, 3396 Range 5]

>>Set DATE and TIME<<

Zero	10	Pk wd	0.04
Att 2^	4	Thresh	3
Cht sp	1	Stop time	8.75

		SS/COC/PTV	PPIP
Sensitivity	C ₁₄ , C ₁₅ , C ₁₆ area counts	1,250,000	1,250,000
Discrimination	C ₁₄ /C ₁₆ area ratio	1.00±0.05	1.00±0.10

Agilent ChemStation

		SS/COC/PTV	PPIP
Sensitivity	C ₁₄ , C ₁₅ , C ₁₆ area counts	4,000	4,000
Discrimination	C ₁₄ /C ₁₆ area ratio	1.00±0.05	1.00±0.10

Agilent Chemstation—ASTM noise

- Measured with 6890 isothermal @ 100°C
- 10 minute blank run, noise range(s) >1 minute
- Performance + noise report

FID ASTM noise ≤0382 pA

NPD checkout conditions and chromatogram

Column and sample

Type	HP-5 30 m × 0.32 mm × 0.25-µm PN 19091J-413
Sample	NPD Checkout PN 18789-60060
Injection volume	1 µL

Inlet

Temperature	200°C Purged/Packed or Split/Splitless Oven TrackCool On-Column 60°C PTV (see below)
Inlet pressure	25 psi (Constant pressure for EPC inlets, helium)

Split/Splitless Only

Mode	Splitless
Purge flow	60 mL/min
Purge time	0.75 min

PTV—Splitless Mode

Inlet temperature	60°C
Initial time	0.1 min
Rate 1	720°C/min
Final temp 1	350°C
Final time 1	2 min
Rate 2	100°C/min
Final temp 2	250°C
Final time 2	0 min
Inlet pressure	25 psi (const. press. for EPC inlets)
Mode	Splitless
Purge time	0.75 min
Purge flow	60 mL/min

Detector

Temperature	325°C
H ₂ flow	3 mL/min
Air flow	60 mL/min
Makeup+column flow	10 mL/min, nitrogen
*Offset	50 pA

Oven

Initial temp	60°C
Initial time	0 min
Rate 1	20°C/min
Final temp	200°C
Final time	3 min

*Note: 6890 firmware A.03.03 or greater is recommended for slower bead activation. Usually, an NP bead offset of 30 pA is sufficient. Higher offsets reduce bead life.

Note: Always cool the detector below 150°C before changing a bead. The offset, with the bead off but at temperature and all gases on, should be less than 0.9 pA.

610 Checkout Chromatograms
NPD checkout conditions and chromatogram

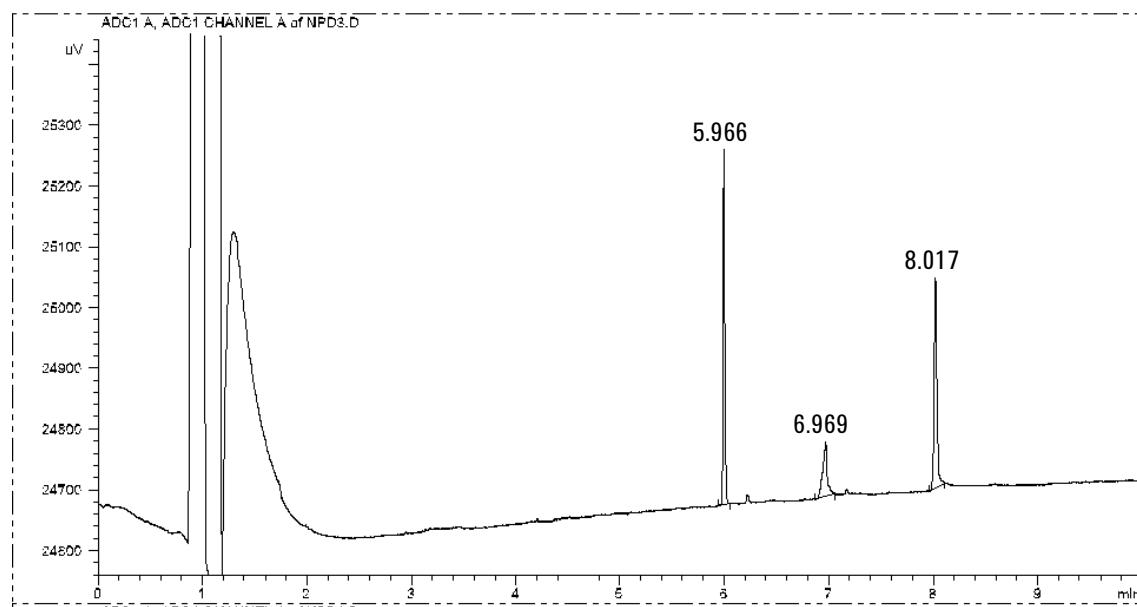


Figure 610-2 NPD checkout chromatogram

Typical values

3396B or 3396C or 3397A integrator sample conditions with analog input [6890 Analog output, Range 0]

>>Set DATE and TIME<<

Zero	10	Pk wd	0.04
Att 2^	7	Thresh	7
Cht sp	1	[Stop time 12.0]	
Ar Rej	1000		

Sensitivity	Azobenzene area counts	306,000	SS/COC/PTV/PPIP
	Malathion area counts	575,000	

3396B or 3396C or 3397A integrator sample conditions with INET input [6890 INET output, Range 0]

>>Set DATE and TIME<<

Zero	10	Pk wd	0.04
Att 2^	7	Thresh	7
Cht sp	1	[Stop time 12.0]	
Ar Rej	1000		

Sensitivity	Azobenzene area counts	12,000	SS/COC/PTV/PPIP
	Malathion area counts	22,500	

Agilent ChemStation

Sensitivity	Azobenzene area counts	38	SS/COC/PTV/PPIP
	Malathion area counts	71	

Agilent Chemstation—ASTM noise

- Measured with 6890 isothermal @ 100°C
- 10 minute blank run, noise range(s) >1 minute
- Performance + noise report

NPD ASTM noise ≤.0765 pA

TCD checkout conditions and chromatogram

Column and sample

Type	HP-5 30 m × 0.32 mm × 0.25 µm	PN 19091J-413
Sample	FID Checkout	PN 18710-60170
Injection volume	1 µL	

Inlet

Temperature	250°C	Purged/Packed or Split/Splitless
Oven Track	Cool On-Column	
40°C	PTV (see below)	
Inlet pressure	25 psi	(Constant pressure for EPC inlets, helium)

Split/Splitless Only

Mode	Splitless
Purge flow	60 mL/min
Purge time	0.75 min

PTV—Splitless Mode

Inlet temperature	40°C	
Initial time	0.1 min	
Rate 1		720°C/min
Final temp 1	350°C	
Final time 1	2 min	
Rate 2		100°C/min
Final temp 2	250°C	
Final time 2	0 min	
Inlet pressure		25 psi (const. press. for EPC inlets)
Mode		Splitless
Purge time	0.75 min	
Purge flow	60 mL/min	

Detector

Temperature	300°C
Reference flow (He)	20 mL/min
Makeup flow (He)	2 mL/min
Offset	Should be ≤30 display counts

Oven

Initial temp	40°C
Initial time	0 min
Rate 1	25°C/min
Final temp	90°C
Final time	0 min
Rate 2	15°C/min
Final temp	170°C
Final time	2 min

610 Checkout Chromatograms
TCD checkout conditions and chromatogram

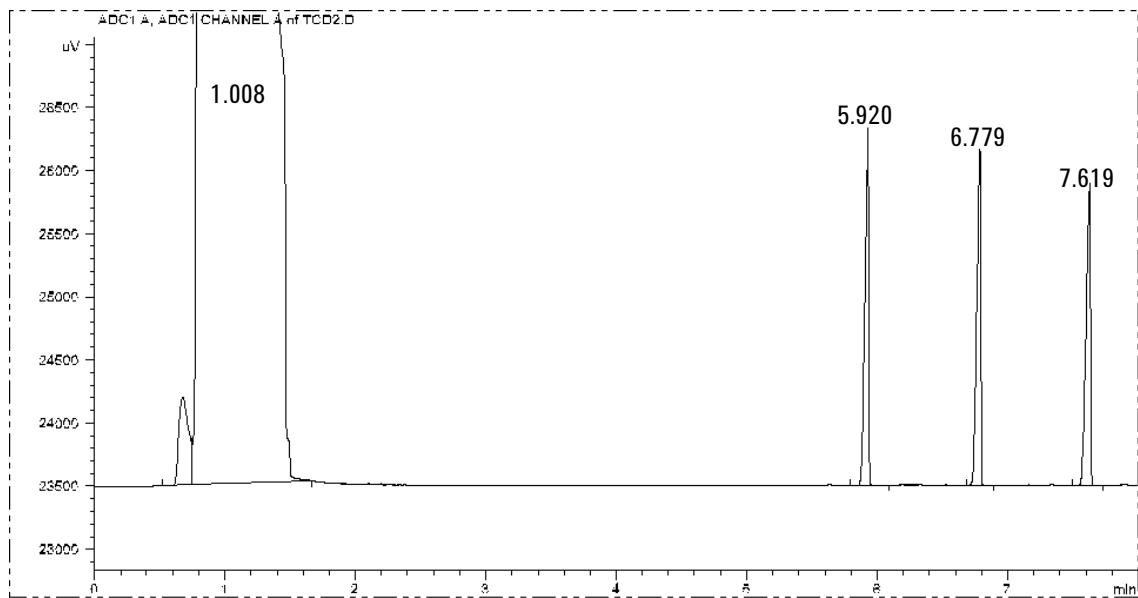


Figure 610-3 TCD checkout chromatogram

Typical values

3396B or 3396C or 3397A integrator sample conditions with analog input [6890 Analog output, Range 0]

>>Set DATE and TIME<<

Zero	10	Pk wd	0.04
Att 2^	7	Thresh	5
Cht sp	1	Stop time	8.75
Ar Rej	1000		

		SS/COC/PTV PPIP	
Sensitivity	C ₁₄ , C ₁₅ , C ₁₆ area counts	585,000	515,000
Discrimination	C ₁₄ /C ₁₆ area ratio	1.00±0.10	1.00±0.10

3396B or 3396C or 3397A integrator sample conditions with INET input [6890 INET output, Range 0]

>>Set DATE and TIME<<

Zero	10	Pk wd	0.04
Att 2^	7	Thresh	5
Cht sp	1	Stop time	8.75
Ar Rej	100		

		SS/COC/PTV PPIP	
Sensitivity	C ₁₄ , C ₁₅ , C ₁₆ area counts	23,000	20,130
Discrimination	C ₁₄ /C ₁₆ area ratio	1.00±0.10	1.00±0.10

Agilent ChemStation

		SS/COC/PTV PPIP	
Sensitivity	C ₁₄ , C ₁₅ , C ₁₆ area counts	73	65
Discrimination	C ₁₄ /C ₁₆ area ratio	1.00±0.10	1.00±0.10

Agilent Chemstation—ASTM noise

- Measured with 6890 isothermal @ 100°C
- 10 minute blank run, noise range(s) >1 minute
- Performance + noise report
- TCD ASTM noise ≤0.05733 display units (25 µV/display unit)
- Detector signal set to 5 Hertz

ECD checkout conditions and chromatogram

Column and sample

Type	HP-5 30m × 0.32 mm × 0.25 µm	PN 19091J-413
Sample	ECD Checkout	PN 18713-60040
Injection volume	1 µL	

Inlet

Temperature	200°C Purged/Packed or Split/Splitless
	Oven TrackCool On-Column
Inlet pressure	80°C PTV (see below) 25 psi (Constant pressure for EPC inlets, helium)

Split/Splitless Only

Mode	Splitless
Purge flow	60 mL/min
Purge time	0.75 min

PTV—Splitless Mode

Inlet temperature	80°C
Initial time	0.1 min
Rate 1	720°C/min
Final temp 1	350°C
Final time 1	2 min
Rate 2	100°C/min
Final temp 2	250°C
Final time 2	0 min
Inlet pressure	25 psi (const. press. for EPC inlets)
Mode	Splitless
Purge time	0.75 min
Purge flow	60 mL/min

Detector

Temperature	300°C
Anode purge, N ₂	60 mL/min
Makeup	6 mL/min
Offset	Should be < 70 display counts

Oven

Initial temp	80°C
Initial time	0 min
Rate 1	15°C/min
Final temp	180°C
Final time	10 min

Note: 1 display count = 5 Hertz

610 Checkout Chromatograms
ECD checkout conditions and chromatogram

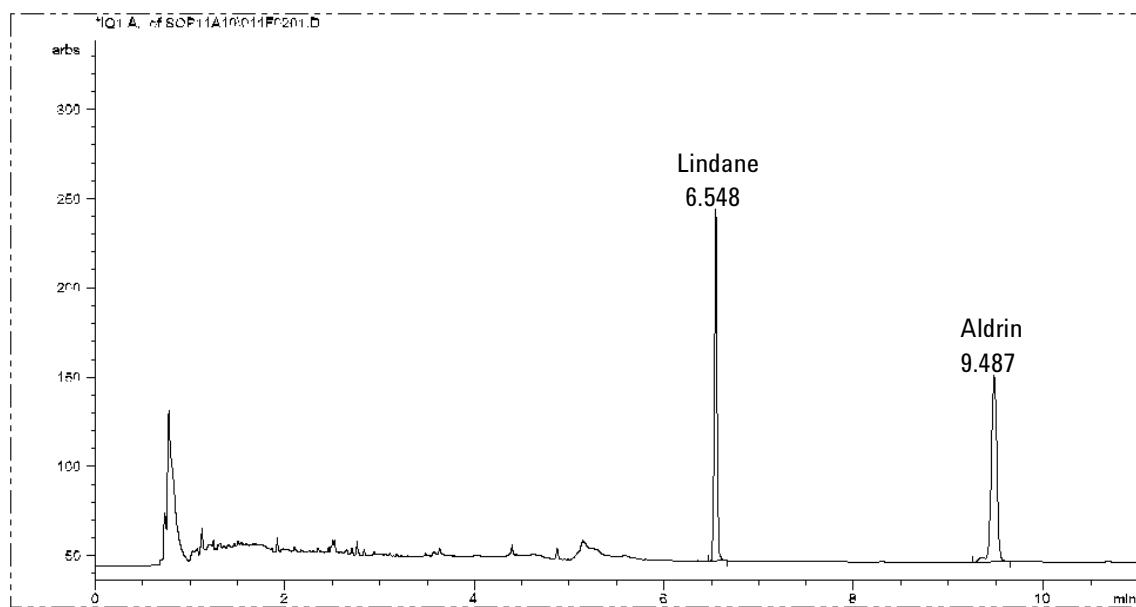


Figure 610-4 ECD checkout chromatogram

Typical values

3396B or 3396C or 3397A integrator sample conditions with analog input [6890 Analog output, Range 0]

>>Set DATE and TIME<<

Noise ([N1])

Measured at Attn. 0, Chart speed 1 [N1] <9 mm for 1 min. measurement

Signal

Zero	10	Pk wd	0.04
Att 2^	7	Thresh	7
Cht sp	1	[Stop time]	11.0]
Ar Rej			

Area, Lindane peak 84150× [N1]

3396B or 3396C or 3397A integrator sample conditions with INET input [6890 INET output, Range 0]

>>Set DATE and TIME<<

Noise ([N2])

Measured at Attn. (-5), Chart speed 1 [N2] 11.25 mm for 1 min. measurement

Signal

Zero	10	Pk wd	0.04
Att 2^	7	Thresh	7
Cht sp	1	[Stop time]	12.0]
Ar Rej			

Area, Lindane peak 2627 × [N2]

Agilent ChemStation

Noise ([N3])

Measured by ChemStation, ASTM noise [N3] <0.05733 display units (5 Hz/display unit)

Signal

Area, Lindane peak 1650 × [N3]

Microcell ECD checkout conditions and chromatogram**Column and sample**

Type	HP-5 30m × 0.32 mm × 0.25 µm	PN 19091J-413
Sample	ECD Checkout	PN 18713-60040
Injection volume	1 µL	

Inlet

Temperature	200°C Purged/Packed
	250°C Split/Splitless
	Oven TrackCool On-Column
	80°C PTV (see below)

Inlet pressure	25 psi (Constant pressure for EPC inlets, helium)
----------------	--

Split/Splitless Only

Mode	Splitless
Purge flow	60 mL/min
Purge time	0.75 min

PTV—Splitless Mode

Inlet temperature	80°C
Initial time	0.1 min
Rate 1	720°C/min
Final temp 1	350°C
Final time 1	2 min
Rate 2	100°C/min
Final temp 2	250°C
Final time 2	0 min

Inlet pressure	25 psi (const. press. for EPC inlets)
Purge time	0.75 min
Purge flow	60 mL/min

Detector

Temperature	300°C
Const. Makeup Flow, N ₂	30 mL/min
Offset	Should be <400 display units

Oven

Initial temp	80°C
Initial time	0 min
Rate 1	15°C/min
Final temp	180°C
Final time	10 min

Note: 1 display unit = 1 Hertz

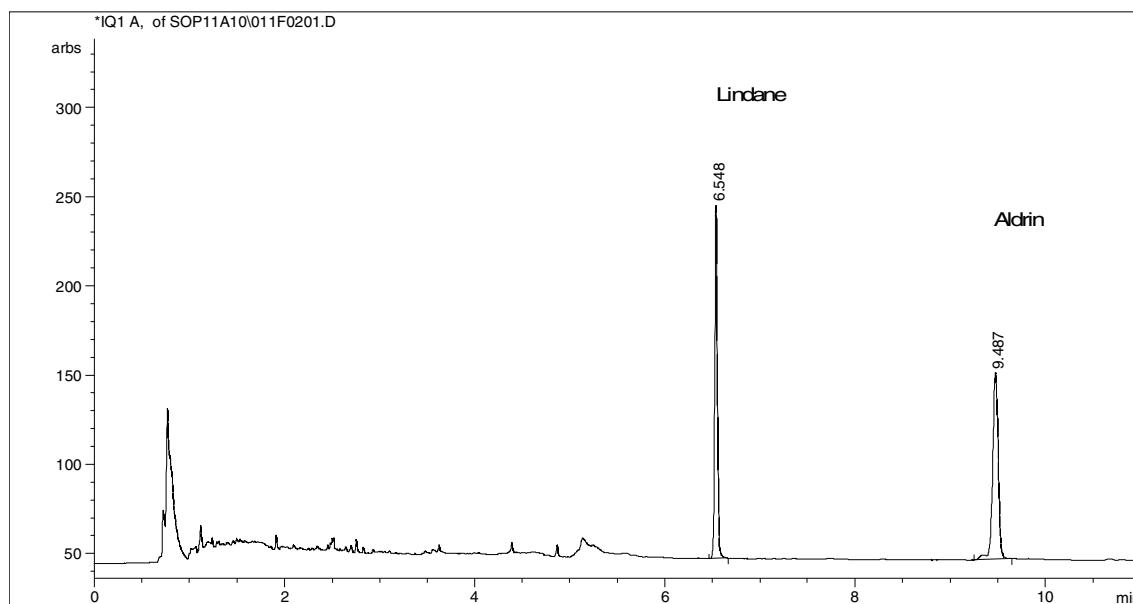


Figure 610-5 μECD checkout chromatogram

Typical values

3396B or 3396C or 3397A integrator sample conditions with analog input [6890 Analog output, Range 0]

>>Set DATE and TIME<<

6890 Analog output

Noise ([N1])

Measured at [6890 Range 0],

[3396 Attn. 3, Chart speed 1, zero 50] <37 mm for 1 min. measurement

Signal

6890 Range 6

3396

Zero	10	Pk wd	0.04
Att 2^	5	Thresh	5
Cht sp	1	Stop time	11.0
Ar Rej	100000		

Area, Lindane peak 47,950 × [N1]

Agilent ChemStation

Noise ([N3])

Measured by ChemStation, ASTM [N3] < 3 Hz

Signal

Area, Lindane peak 7500 × [N3]

FPD checkout conditions and chromatogram

Column and sample

Type HP-5 30m × 0.32 mm × 0.25 µm PN 19091J-413
Sample FPD Checkout PN 8500-3697
Injection volume 1 µL

Inlet

Temperature 250°C Purged/Packed
 250°C Split/Splitless
 Oven TrackCool On-Column
 80°C PTV (see below)

Inlet pressure 25 psi (Constant pressure for EPC inlets,
 helium)

Split/Splitless Only

Mode Splitless
Purge flow 60 mL/min
Purge time 0.75 min

PTV—Splitless Mode

Inlet temperature	80°C
Initial time	0.1 min
Rate 1	720°C/min
Final temp 1	350°C
Final time 1	2 min
Rate 2	100°C/min
Final temp 2	250°C
Final time 2	0 min

Inlet pressure 25 psi (const. press. for EPC inlets)
Purge time 0.75 min
Purge flow 60 mL/min

Detector

Temperature	200°C
Hydrogen flow	75±2 mL/min
Air flow	100±2 mL/min
Const. Makeup Flow, N ₂	60±2 mL/min
Offset, flow off (O-fa)	Should be <40 display units
Offset, flame on (O+fb)	<[(O-fa) + 85 display units]

Oven

Initial temp	60°C
Initial time	0 min
Rate 1	25°C/min
Final temp	110°C
Final time	0 min
Rate 2	10°C/min
Final temp 2	170°C
Final time 1	3 min

610 Checkout Chromatograms
FPD checkout conditions and chromatogram

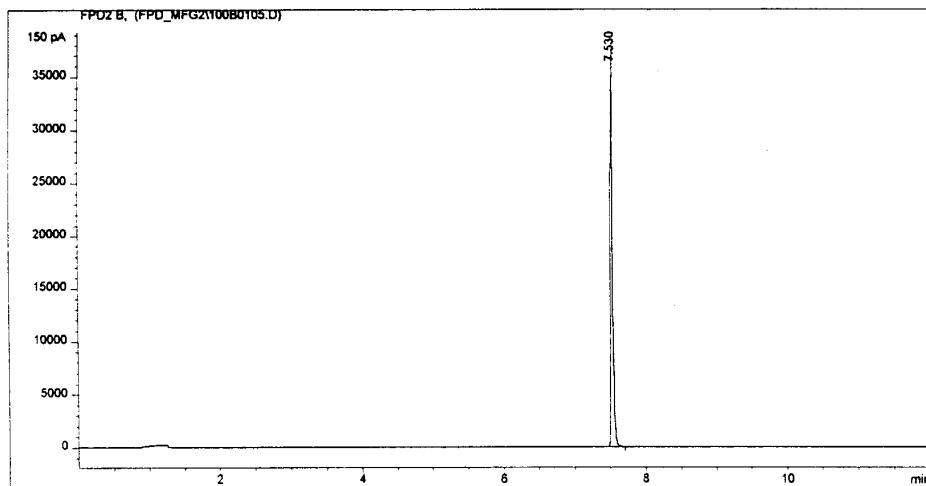


Figure 610-6 FPD checkout chromatogram—sulfur channel

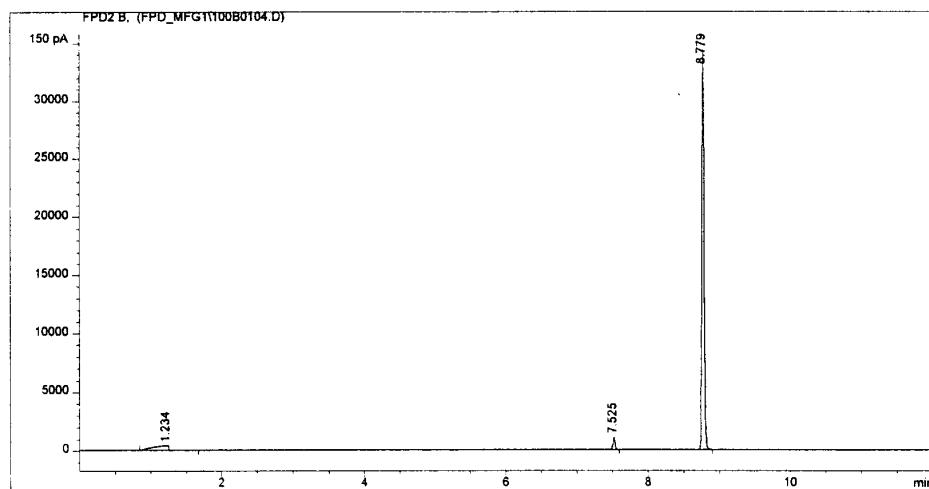


Figure 610-7 FPD checkout chromatogram—phosphorus channel

Typical values

3396B or 3396C or 3397A integrator sample conditions with analog input [6890 Analog output, Range 5]

>>Set DATE and TIME<<

6890 Analog output

Noise ([N1])

Measured at [6890 Range 5],
[Attn. 0, Chart speed 1, zero 50] ~30 mm for 1 min. measurement

Signal

6890 Range 5

3396

Zero	10	Pk wd	0.04
Att 2^	9	Thresh	3
Cht sp	1	Stop time	11.0
Ar Rej	100000		

Area, Sulfur mode $\geq 7,000,000$

Agilent ChemStation

[6890 GPIB output]

Noise ([N3])

Measured by ChemStation, ASTM [N3] ≤ 5 display units (150 pA/display units)

Signal

Area, Sulfur mode $\geq 26,000$

700 Preventive Maintenance

Preventive Maintenance
information was not
available for this printing.

Procedures to prolong the life of the
6890 instrument.

800 Error Codes and Internal Diagnostics

- 810 Overview**
- 820 Not Ready Messages**
- 830 Warning Codes**
- 840 Shutdowns**
- 850 Faults**
- 860 Bad Mainboard and Fatal Errors**

How to use error messages to diagnose and correct internal problems with the 6890 instrument.

810 Overview

The 6890 GC displays numerous warning and error messages. It monitors the state of its detectors, pneumatics, oven, PC boards and other components. If a problem exists, the 6890 GC displays a message, beeps or activates an LED, and puts itself in a “safe state,” as determined by the nature of the error.

The 6890 GC has six types of error messages. All are described below. The following sections of this chapter contain details for most of the error types.

The 6890 GC also displays messages from equipment controlled by it, such as an automatic sampler. If a message is not in these lists, see the manuals for the attached equipment.

Error message types

Not ready

Not Ready means that some component of the 6890 GC has not yet reached its setpoint and the instrument is not ready to begin a run. When the 6890 GC is in a not ready state, the Not Ready LED lights up but a message does not appear on the display. You can press the [STATUS] button to view a message that explains why the 6890 GC is not ready to begin the run. Not ready messages are recorded in the run log.

Method mismatch

Method Mismatch occurs when you load a method containing parameters that do not match the 6890 GC current configuration. One of two things occur:

- If the parameter that does not match is set from the keyboard, the method overwrites the current parameter and a message tells you that the current parameter has been replaced. For example, if the gas type currently configured differs from the one in the method, the current gas type is overwritten with that of the method.
- If the parameter that does not match depends on hardware, the method is ignored and the current setpoints remain; a message tells you that the method parameter is being ignored. For example, if the method says the front detector is an NPD but you have replaced it with an FID, the method NPD information is ignored and the current FID parameters remain.

Warnings

A Warning means that a problem exists but that the problem will not prevent the instrument from making a run. The 6890 GC emits one beep and a Warning message appears. The 6890 GC can still start the run and the warning disappears when it does. The warning is not recorded in the run log.

Shutdowns

A shutdown occurs when there is a hardware problem that could compromise the safety of the user or damage the instrument. When this occurs, the GC emits a series of warning beeps. After two minutes elapse, the component with the problem shuts down, the 6890 GC emits one beep and a warning message appears. The GC will still be in a ready state. No additional information appears under the [STATUS] key, and the error is not recorded in the run log.

Faults

A Fault message indicates a hardware problem that requires user intervention. Depending on the type of error, the GC will emit no beep or a single beep. The Not Ready LED will light because the GC will not be able to begin the run and an error message will appear. Press the [STATUS] button for more information about the error. The error is also recorded in the run log.

Two special fault messages exist for the following circumstances:

- A pneumatics problem exists for a component configured for hydrogen gas.
- A “thermal runaway” condition exists for the GC oven.

These faults cause the 6890 GC to shut down and beep continuously until you press [Clear].

Bad mainboard and fatal errors

These messages almost always indicate that the mainboard is malfunctioning and must be replaced. These messages are not numbered and usually appear when the instrument is first turned on.

820 Not Ready Messages

This section lists Not Ready messages according to the type of condition the GC has detected. The GC does not provide a popup message when a component is not ready; instead, the not ready LED blinks and the run simply does not begin. The messages discussed in this section correspond to those you see when you press the [Status] key. Not Ready messages fall into these categories:

- Oven temperature not ready
- Temperature zones not ready
- Pressure or flow not ready
- Detector not ready
- GC in diagnostic mode
- Inlet purging
- Valves not ready
- External devices not ready
- Power failure

Oven temperature not ready

Status message: Oven temp

The GC will become ready to begin a run when the oven temperature remains within 1°C of the setpoint for the equilibration time. The oven must be turned on.

- The instrument is not ready until the oven is turned on and reaches its setpoint. If the oven is unable to reach the setpoint, the GC will remain not ready indefinitely unless the oven temperature is out of the oven range, which will cause a shutdown.

Temperature zone not ready

The GC has a number of heated zones in addition to the oven. These are inlets, detectors and auxiliary, or “aux,” zones. The GC is ready to start a run when all the zones are within 1°C of the setpoint *and* have maintained the setpoint temperature for 30 seconds. A zone that is turned off is considered ready.

If a temperature zone is unable to reach the setpoint, the GC will remain not ready indefinitely. The instrument will not shut down unless a temperature is out of the range for the zone.

Temperature Zone Not Ready status messages:

- Front inlet temp
- Back inlet temp
- Front det temp
- Back det temp
- Aux 1 temp
- Aux 2 temp

Pressure and/or flow not ready

A run will not start until all pressurized areas have reached their setpoints and maintained them for 6 seconds. The acceptable pressure range of a pressurized area will be between 0.05 and 0.5 psi, depending on its type of sensor.

Similarly, the GC will not be ready to begin a run until flows are within 1 mL/min of the setpoint range and remain in the range for 6 seconds. Pressure zones that are turned off are considered ready.

If the zone does not become ready within a specified time, the GC goes into the shutdown mode. See Section 840, Shutdowns, for more information.

Table 820-1 Pressure and/or Flow Not Ready Messages

Status message	Comments
Front/Back inlet pressure	Pressure not at setpoint
Front/Back inlet flow	Flow not at setpoint
Front/Back det air flow	For FID, NPD or PFP—Gas supply turned off (manual) or not at setpoint (EPC)
Front/Back det ref flow	For TCD—Gas supply turned off (manual) or not at setpoint (EPC)
Front/Back det anode gas	For ECD or μ -ECD—Gas supply turned off (manual) or not at setpoint (EPC)
F/B det makeup gas	Gas supply turned off
Front/Back det H ₂ flow	Gas supply turned off
Aux 3/4/5 pressure	Pressure not at setpoint
Gas saver	One of the inlets is in gas saver mode. Press Prep Run to clear.

Detector not ready

Some not ready conditions are specific to detectors. These are:

- The detector temperature is below the minimum temperature for igniting.
- The detector is igniting.
- The detector offset is adjusting.
- The detector is equilibrating.
- The detector's pneumatics failed.

Front det waiting

Back det waiting

Status message: Front det waiting or Back det waiting

To prevent condensation, the FID and FPD temperatures must be at least 150°C before they can ignite. The NPD must be at least 150°C before the bead voltage is applied. The TCD must be at 100°C to turn on the filament, because at lower temperatures the filament sags. If the temperatures are below the minimum, the GC will not be ready.

Usually, the detector will reach the setpoint temperature and become ready. However, if the detector is unable to reach a temperature high enough for ignition or turn on, the instrument will remain not ready indefinitely.

- Make sure that the detector temperature setpoint is high enough. Raise it if it is too low.
- If the detector temperature setpoint is high enough but the detector is unable to reach it, the detector heater may have failed or the sensor or mainboard may be bad.

Front det igniting **Back det igniting**

Status message: Front det igniting or Back det igniting

The GC is not ready while the FID or FPD is going through the flame ignition sequence. The messages will clear if the detector is turned off.

If the FID is unable to ignite, there may be a problem, and the detector may eventually shutdown.

Front det adjusting **Back det adjusting**

Status message: Front det adjusting or Back det adjusting

The GC will be not ready because the NPD or ECD is adjusting its baseline to reach the offset (NPD) or output (ECD) setpoint. The ECD's adjustment is usually complete in 30 seconds. The NPD may take longer.

It is possible that the NPD will be unable to reach the setpoint if there is contamination in the system (for example, if the gas is not pure enough or the bead is damp) or if the bead is worn out. If the NPD cannot reach the setpoint, you will not receive an error message; the GC will simply not become ready.

Turn the detector off to clear the message.

Front det equib time **Back det equib time**

Status message: Front det equib time or Back det equib time

The NPD has completed adjusting the offset and is now waiting for the value to remain at the setpoint for the equilibration time. Equilibration time can be changed from the Detector control menu.

The NPD may not be able to equilibrate if the system is contaminated or the bead is worn out. In addition, changes in the room temperature could prevent equilibration. The GC will become ready if the detector is turned off.

Front detector shutdown**Back detector shutdown**

Status message: Front det shutdown or Back det shutdown

The detectors will shut down if they experience a pneumatics failure or if the TCD experiences a filament failure.

The GC will not be ready until the detector with the failure is turned off.

Turning off the FID or FPD turns off the igniter, hydrogen flow, and air flow.

Turning off the NPD turns off bead voltage, hydrogen flow, and air flow.

Turning off the TCD turns off filament voltage and reference flow.

Valve not ready

Some valve conditions can put the GC in a not ready state.

Multiposition valve

Status message: Multiposition valve

The multiposition valve is causing the GC to be in a not ready state for one of the following reasons:

- The multiposition valve is not at the setpoint position. The instrument will be not ready until the valve reaches the setpoint.
- The BCD cable is missing or not plugged into the receptacle. If the cable is missing, the valve will never become ready.
- The BCD setpoint is incorrect for the valve's BCD output polarity. The valve will most likely shutdown with Illegal Position or Not Switching shutdown errors.
- If the valve is plugged or the sample is viscous, the switching time may not allow adequate time for the valve to switch. Increase the switching time.

24 volt valve drive

Status message: 24 V pneu valve drive

This Not Ready state indicates that the +24 V supply to the pneumatics valves is actually less than +16.5 V. All the valves are disabled to prevent improper operation. When the full voltage is restored, the GC will become ready.

This Not Ready state could indicate a hardware problem.

Gas sampling valve n

Status message: Gas sampling valve n

The GC is not ready because the inject time or load time has not elapsed.

- The GC will become ready as soon as the specified load or inject time has passed.

Miscellaneous messages

GC in diagnostics mode

Status message: Diagnostics mode

The GC is not ready when it is in diagnostics mode. The instrument will be in diagnostics mode whenever a Diagnostics control table has been accessed through the [Options] key.

You must exit the Diagnostics section for the GC to become ready.

Inlet purging

Status message: Front inlet purging or Back inlet purging

This condition applies only if you have a split/splitless inlet. The message appears if you try to start a run while the inlet purge valve is still in the split mode.

The inlet will remain not ready and continue purging until you press the Prep Run key. Pressing Prep Run closes the valve (it also turns off the gas saver mode and increases pressure for a pressure pulse, if selected).

Host system not ready

Status message: Host system

The GC will be in a Not Ready state if the integrator, ChemStation, or another controlling device is not ready to begin a run.

External device not ready

Status message: External device

An instrument that is part of the start/stop bus is not ready. For example, the automatic liquid sampler is not ready to begin injecting.

- The GC becomes ready when the other instruments on the bus are ready.

Power failure

Status message: Power on in progress

This message appears when power is:

- Restored after the GC experiences a power failure during a run or while the oven was turned on while the GC was not performing a run.
- Turned on again after a user turned it off.

The GC will heat all the other thermal zones and then heat the oven. When the oven temperature stays at the setpoint for the equilibration time, the GC will become ready.

If the power failure occurred during a run, upon power restoration the GC will heat all the thermal zones and oven and then automatically perform a blank run. When the blank run is completed, the GC will become ready.

830 Warning Codes

A Warning message alerts the operator that a problem exists, but that the problem will not prevent the instrument from executing the run. The 6890 GC emits one beep and a Warning message appears on the display. The 6890 GC can still start the run, and the warning disappears when a run starts. The warning is not recorded in the run log.

The tables present the messages numerically according to the popup message number. Warning conditions generate additional information that appears in the Status table. Press the [STATUS] button to view the message.

Warning 100—Oven sensor missing

Status message: Oven sensor missing

The oven sensor is not being detected because it is unconnected or is malfunctioning. The oven will be shut off, and the GC will be not ready.

- Connect or replace the oven sensor.

Warning 101—Invalid heater power for front detector, inlet, and aux 1

Warning 102—Invalid heater power for back detector, inlet, and aux 2

Status message: Invalid heater power

The total wattage for the front or back detector, front or back inlet, and aux 1 or aux 2 heated zones exceeds the maximum wattage allowed (220 Watts). This is only checked at power on. Either there is an invalid heater wattage combination or the wattage sense circuit on the main board is defective.

It is unlikely that this error will occur unless a mass selective detector or other add-on instrument is being used with the 6890 GC.

A warning is issued and the three heated zones are set to not installed.

Warning 103—Signal 1 buffer full**Warning 104—Signal 2 buffer full**

Status message: Signal 1 buffer full or Signal 2 buffer full

This error could occur if you are using a data collection device, such as an integrator or ChemStation. If the data collection device goes off line during a run, signal data will be stored in the 6890 GC signal buffer. The buffer holds 400 Kilobyte of data; if the amount of data exceeds the buffer's storage limit, this warning will appear. No new data is stored after the buffer is full.

- There is a problem with the PC, the cabling to the PC, or the local network that links the GC to the PC. Check the PC, cabling, and network.
- The PC was turned off without closing the ChemStation instrument session. The GC collects and stores real-time plot data until the buffer overflows and the warning appears. Next time, close the instrument session before turning off the PC so that the GC stops collecting data.
- The PC entered power saver mode. When the PC enters power saver mode, its processor slows down and cannot collect data fast enough for normal communications, eventually causing the warning to appear. If the PC stays in power saver mode overnight, for example, there will be an error on the GC but the ChemStation will show a Ready status. Close and restart the instrument session, and disable the PC's power saver feature.
- There was a software problem on the PC that stops data collection.
- There is a hardware problem in the GC. If the problem persists, contact Agilent Technologies for service.

Warning 105—Analog out data loss

Status message: Analog out data loss

The 6890 GC analog processors are not communicating with each other correctly. Analog data will be lost; digital data should be all right.

Although the problem could be caused by a bad power supply or a radio frequency interference, both are improbable. The most likely cause is a malfunction on the main PC board.

Warning 106—Non-recoverable data loss. Data corrupt.

Status message: Signal data loss

The 6890 GC digital processors are not communicating with each other correctly. Both analog and digital data will be lost.

Although the problem could be caused by a bad power supply or a radio frequency interference, both are improbable. The most likely cause is a malfunction on the main PC board.

Warning 107—Front det: config changed, method defaulted**Warning 108—Back det: config changed, method defaulted**

Status message: F det config changed or B det config changed

This warning appears when the 6890 GC is turned on after a different detector has been installed, or when a method is loaded that calls for a different type of detector than the one that is currently installed.

The following will occur:

- If a new detector was installed, the 6890 GC will enter the default setpoints for the new type of detector.
- If a method was loaded with a different detector specified, the 6890 GC will not change the method but will flash the warning message.

Warning 109—Front inlet: config changed, method defaulted**Warning 110—Back inlet: config changed, method defaulted**

Status message: F inl config changed or B inl config changed

This message appears when:

- The 6890 GC is turned on after a new inlet has been installed.
- The 6890 GC is turned on and senses that the inlet has a different type of sensor than was there when the instrument was turned off.
- A method is loaded that calls for a different type of inlet than the one currently installed.

The following will occur:

- If a new inlet or sensor was installed, the 6890 GC will enter the default setpoints for the new type of inlet.
- If a method was loaded with a different inlet specified, the 6890 GC will not change the method but will flash the warning message.

Warning 111—Column 1: config changed, method defaulted**Warning 112—Column 2: config changed, method defaulted**

Status message: Col 1 config changed or Col 2 config changed

This message appears when:

- The 6890 GC is turned on after a different column has been installed.
- You load a method that calls for a different type of column than the one currently installed in the oven.

The following will occur:

- If a new column was installed, the 6890 GC will enter the column default setpoints.
- If a method was loaded for a different type of column than the one installed, the 6890 GC will not change the method but will flash the warning message.

Warning 113—Aux 3 config changed, method defaulted**Warning 114—Aux 4 config changed, method defaulted****Warning 115—Aux 5 configuration changed, method defaulted**

Status message: Aux 3 method changed or Aux 4 method changed or Aux 5 method changed

This message appears when the 6890 GC is turned on and one of the auxiliary pressure channels has changed. Either the type, sensor range, length, diameter or something else has changed.

- Default setpoints for the aux module will be loaded.

Warning 116—Run log full

Status message: None

The run log can hold 50 lines of information. When it reaches the maximum, no more information can be stored in the log and this warning will appear.

- Remove some information from the run log.

Warning 117—F inl calib deleted**Warning 118—B inl calib deleted**

Status message: F inl calib deleted or B inl calib deleted

If you were entering a new inlet calibration for the front or the back inlet and the 6890 GC crashed or encountered a power failure before the recalibration was complete, this warning will appear when the instrument is turned on again.

- The calibration for the module will return to the default.

Warning 119—F det calib deleted**Warning 120—B det calib deleted**

Status message: F det calib deleted or B det calib deleted

If you were entering a new calibration for the front or the back detector and the 6890 GC crashed or encountered a power failure before the recalibration was complete, this warning will appear when the instrument is turned on again.

- The calibration for the module will return to the default.

Warning 121—P aux calib deleted

Status message: P aux calib deleted

If you were entering a new calibration for an aux module and the 6890 GC crashed or encountered a power failure before the recalibration was complete, this warning will appear when the instrument is turned on again.

- The calibration for the module will return to the default.

Warning 122—Host communication: data overrun

Status message: Comm data overrun

The 6890 GC received data from a computer or workstation faster than it could process it. The data may be lost

- Lower the baud rate or turn on handshake mode. You can adjust both of these parameters from the Communications control table, which is accessed from the Options control table.

Warning 123—Host communication: data error

Status message: Comm data error

The 6890 GC received bad data from a PC or workstation. The data may be lost.

- The data bits or parity may be set incorrectly. You can adjust both of these parameters from the Communications control table, which is accessed from the Options control table.

Warning 124—Host communications: abnormal break

Status message: Comm abnormal break

There is an interruption in communication between the 6890 GC and a PC or workstation. This could be caused by a LAN disturbance or a bad cable connection. Data may be lost

- If you are connected to the LAN, check to see if it is down or there is a problem with your connection to it.
- Check the cable connection between the GC and the computer or workstation.

Warning 125—Sampler communications: data overrun

Status message: Sampler data overrun

The 6890 GC received information from the 7673 ALS quicker than it could process it. The data may be lost.

- Verify that the sampler settings are adjusted correctly.

Warning 126—Sampler communications: data error

Status message: Sampler data error

The 6890 GC received bad information from the 7673 ALS. For example, there may be a framing or parity error.

- Verify that the sampler settings are adjusted correctly.

Warning 127—Sampler communications: abnormal break

Status message: Sampler abnormal com

There is an interruption in communication between the 6890 GC and the 7673 ALS. This could be caused by a bad cable connection. Data may be lost.

- Check the cable connections on the GC and the sampler.

Warning 128—Front inlet sensor auto zero calib failed**Warning 129—Back inlet sensor auto zero calib failed**

Status message: F inl flow cal fail or B inl flow cal fail

An attempted auto calibration of the flow sensor offset for the front or back inlet exceeded the allowable calibration range. The previous calibration setpoints remain in memory.

Warning 130—Aux 1 and front inlet on same cryo valve**Warning 131—Aux 2 and back inlet on same cryo valve**

Status message: Aux 1 cryo disabled or Aux 2 cryo disabled

The same cryo valve is specified for and inlet and an auxiliary zone. The aux cryo is declared not installed.

- Check the hardware to see where the valve is really installed. Fix the configuration accordingly.

Warning 132—Col 1 Init time changed**Warning 133—Col 2 Init time changed**

Status message: None

While using a Volatiles Interface inlet, the Sample End time is set greater than the oven Init time. The Init time has been changed to the Sample End time to avoid the conflict.

Warning 134—Front inlet title mismatch**Warning 135—Back inlet title mismatch**

The title for the inlet does not match the title stored in its pneumatics module. No action is taken. If the inlet is a different type from that stored in the pneumatics module, a hardware error will be declared.

Warning 136—Front detector title mismatch**Warning 137—Back detector title mismatch**

The title for the detector does not match the title stored in its pneumatics module. No action is taken. If the detector is a different type from that stored in the pneumatics module, a hardware error will be declared.

Warning 138—Front injector/inlet mismatch**Warning 139—Back injector/inlet mismatch**

The injector is not compatible with the inlet it is intended to use.

Warning 140—Front inlet Saver time changed**Warning 141—Back inlet Saver time changed**

While using a Volatiles Interface inlet, the Sample End time is set less than the inlet purge time. The purge time has been changed to the Sample End time + 1 to avoid the conflict.

Warning 142—Front inlet Purge time changed**Warning 143—Back inlet Purge time changed**

While using a Volatiles Interface inlet, the Sample End time is set greater than the inlet gas saver time. The gas saver time has been changed to the Sample End time + 1 to avoid the conflict.

Warning 144—OEM Config error(s)

One or both detectors installed are not the same as the one(s) in the method.

When your 6890 GC encounters a Shutdown condition, a popup message appears on the display. The popup message is numbered and contains a brief description of the nature of the problem. This chapter provides more thorough information about the problems that cause the GC or a component of the GC to shut down.

The chapter presents the messages numerically according to the popup message number.

Shutdown 1—Oven shut off

The amount of power required to keep the oven at setpoint exceeds the expected power for that temperature. This error puts the 6890 GC in a not ready state. The oven flaps open half way (if they are operating correctly). You must turn the 6890 GC off and then on again or change the oven temperature to restore operation.

The following may be causing the error:

- Check the oven flap on the back of the 6890 GC.
The oven flap should be open when cooling (for temperatures ranging between 50 and 250°C) or closed completely to reach temperature setpoints. If the oven flap is stuck open completely or partially, it is not operating correctly.
- Check for a leak source in the oven (for example, missing insulation around an inlet or detector location or a leak in the door).
- Check for excessive load in the oven (for example, a very large packed column).
- The oven heater or the heater electronics are not operating correctly.

Shutdown 2—Oven cryo shutdown

Cryogenic shutdowns prevent liquid coolant from being wasted when the GC is unable to start a run. A cryo shutdown does not indicate that the cryogenic cooling system is malfunctioning. Instead, one of the following could be the cause:

- A “cryo timeout” has occurred.

A timeout occurs if the GC oven has reached its temperature setpoint but the amount of time you specified for the cryo timeout setpoint has elapsed without a run beginning.

Turn the oven off and then on again or change the setpoint to restore normal operation. Then, turn the timeout option off to prevent the shutoff from reoccurring, or lengthen the timeout period.

- A “cryo fault” has occurred.

Cryogenic cooling has been on for over 16 minutes, but the oven has not reached its temperature setpoint.

Check the level of the cryogenic fluid, and replace the supply if it is too low for proper cooling.

The cryo valve may be stuck open or closed. If your fluid supply is adequate, the valve may be broken or the electronics driving it may be malfunctioning (this is a less likely cause).

Shutdown 3—Front inlet pressure shutdown

This message indicates the inlet failed to reach its setpoint in the allotted time or cannot maintain its pressure setpoint. The inlet's flows shut off (split/splitless inlets go to purge mode) and the instrument goes to a not ready state until the problem is corrected and the inlet reaches the pressure setpoint.

For EPC inlets, the allotted time to reach the pressure setpoint before the inlet shuts down varies with the type of inlet as shown in the following table.

Type of inlet	Lapse in time before shutdown
Purged packed, cool on-column	2 minutes
Split/splitless	5.5 minutes
Auxiliary	4 minutes

The following may be causing the error:

- The initial gas supply pressure is too low to reach the setpoint.

Make sure that the initial gas supplies are high enough to support the pressure and flow setpoints. The pressure at the initial supply should be at least 5 psi (10 psi for the split/splitless inlet) greater than the desired setpoint.
- A large leak is present somewhere in the system.

Use an electronic leak detector to find leaks; correct them. Refer to chapter 200 for the leak test procedure for your inlet. In addition to checking the gas supply connections and the inlet, remember that the column could be broken, which would cause a large leak.
- If you are using the gas saver, make sure that the gas saver flow rate is high enough to maintain the highest column-head pressure during a run.
- The flow is too low for the column in use.

Make sure that the flow is adequate for the column you are using.

- The column is plugged or not installed correctly.

Check the column and the column installation.

- The inlet's pressure sensor is not operating correctly.

If you are using a split/splitless inlet:

- The split ratio is too low. Increase the amount of split flow.
- The inlet's proportional control valve is stuck open or closed because of contamination or another fault.

If you are using a purged packed or cool on-column inlet:

- The inlet's control valve is stuck closed because of contamination or another fault.

Shutdown 4—Front inlet flow shutdown

This message indicates the front inlet failed to reach its flow setpoint in the allotted time or cannot maintain its flow setpoint. When you are operating in flow-control mode, the inlet has 2 minutes to reach the setpoint before shutdown. The instrument will be not ready until the problem is corrected and the inlet reaches the flow setpoint.

See Shutdown 3—Front inlet pressure shutdown for a list of potential causes and solutions.

Shutdown 5—Back inlet pressure shutdown

See Shutdown 3—Front inlet pressure shutdown for a list of potential causes and solutions.

Shutdown 6—Back inlet flow shutdown

See Shutdown 4—Front inlet flow shutdown for a list of potential causes and solutions.

Shutdown 7—Front detector fuel gas shutdown

The front detector's (EPC version) fuel gas was unable to reach or maintain the pressure setpoint in the allotted 2 minutes. The detector gases are shut off and the instrument will be not ready until the problem is corrected and the detector reaches the pressure setpoint.

The following may be causing the error:

- The initial gas supply pressure is too low to reach the setpoint.
Make sure that the initial gas supplies are high enough to support the pressure and flow setpoints.
- A leak is present somewhere in the system.
Use an electronic leak detector to find leaks; correct them. In addition to checking the gas supply connections and the inlet, remember that the column could be broken, which would cause a large leak. It is unlikely that the detector itself is the source of the leak.
- The detector's proportional control valve is stuck open or closed because of contamination or other fault.

Shutdown 8—Front detector air/ref shutdown

The front detector's (EPC version) air/reference gas is unable to reach or maintain the pressure setpoint. All the detector gases will shut off, and the instrument goes not ready.

See Shutdown 7—Front detector fuel gas shutdown for a list of potential causes and solutions.

Shutdown 9—Front detector makeup shutdown

The front detector's (EPC version) makeup gas is unable to reach or maintain the pressure setpoint. All the detector gases will shut off, and the instrument goes not ready.

See Shutdown 7—Front detector fuel gas shutdown for a list of potential causes and solutions.

Shutdown 10—Back detector fuel gas shutdown

See Shutdown 7—Front detector fuel gas shutdown for a list of potential causes and solutions.

Shutdown 11—Back detector air/ref shutdown

See Shutdown 7—Front detector fuel gas shutdown for a list of potential causes and solutions.

Shutdown 12—Back detector makeup shutdown

See Shutdown 7—Front detector fuel gas shutdown for a list of potential causes and solutions.

Shutdown 13—Pres aux 3 shutdown**Shutdown 14—Pres aux 4 shutdown****Shutdown 15—Pres aux 5 shutdown**

The specified pneumatics aux module cannot maintain the pressure setpoint. All the detector gases shut off, and the instrument goes not ready.

See Shutdown 3—Front inlet pressure shutdown for a list of possible causes and solutions.

Shutdown 16—Multiposition valve not switching

This message appears when the multiposition valve has tried to switch twice without success.

The valve will shutdown and report that it is not ready (not at setpoint). Clear the shutdown by entering a new setpoint.

The following may be causing the error.

- The valve is not connected to the correct valve driver or is not connected at all. Connect the valve to the correct valve driver.
- The valve is stuck.
- The switching time is too short for the speed of the valve.

Shutdown 16—Multiposition valve not switching

The valve could be switching more slowly than usual because it is sticking slightly or the sample is viscous. Increase the length of the switching time.

Shutdown 17—Can't reach setpoint of multipos valve

The valve is switching to the wrong position or is unable to switch to the setpoint position. The valve will shut down and report that it is not ready (not at setpoint). Clear the shutdown by entering a new setpoint.

The following may be causing the error.

- The valve position is incorrect.

A setpoint was entered that the valve is unable to reach. For example, position ten was entered for an eight-port valve. Enter a correct valve position setpoint.

- The Invert BCD setpoint is incorrect.

With most valves, the invert should be On. If the BCD setpoint is already On and you experience a shutdown, set it to Off.

Shutdown 18—Front inlet cryo shutdown**Shutdown 19—Back inlet cryo shutdown**

Either a cryo timeout (zone has been waiting at setpoint longer than the timeout setpoint) or a cryo fault (zone has not reached setpoint in 16 minutes) has occurred. The zone is turned off and the actual temperature display flashes OFF. To reset, cycle the zone power or change the setpoint.

Shutdown 20—Aux 1 cryo shutdown**Shutdown 21—Aux 2 cryo shutdown**

See Shutdown 18—Front inlet cryo shutdown.

Shutdown 22—Front inlet heating too slowly; temperature shut off**Shutdown 23—Back inlet heating too slowly; temperature shut off**

The inlet has been heating longer than the allowable time without reaching the setpoint. The zone is shut down and the actual temperature display flashes OFF. To rest, cycle the zone power or change the setpoint.

- This could be a bad thermal sensor, where the reading is incorrect but the value is within the valid temperature range.
- A failed or defective heater can cause this condition.

850 Faults

Fault 200—Pneumatics shutdown: faulty pneumatics board

Status message: Pneu board FPGA

The pneumatics control board is unable to control the instrument's pneumatics.

- The pneumatics control board is not functioning properly and will need to be replaced.

Fault 201—Pneumatics shutdown: faulty pneumatics board

Status message: Pneumatics board

The pneumatics control board is not functioning properly for a non-specific reason.

- The pneumatics control board will need to be replaced.

Fault 202—Hydrogen safety shutdown

Status message: Hydrogen shutdown

An inlet configured for hydrogen gas did not reach the pressure setpoint within 2 minutes. Because hydrogen presents an explosion hazard, the following occurred: The GC oven fan and heaters are turned off.

- The oven flaps are fully opened.
- Both pressure and flow controls are turned off and the control parameters are flashing when viewed.
- The small zone heaters for inlets and detectors are turned off and the control parameters are flashing when viewed.
- The warning beep continues until the [Clear] key on the keypad is depressed.
- The oven cannot be turned on unless the instrument is power failed. Turn the GC power off and on again to restore operation.

The sequence would continue until the fault is fixed. To find the fault, check for the following possible causes:

- Check the gas supply pressure. Increase the pressure at the initial supply if it is too low to reach the setpoint.
- Check for a leak somewhere in the system. Leak test the gas supply tubing, the inlet, and the inlet column fittings. Leak test procedures are found with each inlet section.
- The column may be broken. Use the leak detector to check the column for leaks and replace the broken column or break off the cracked portion.
- An inlet proportional control valve may be stuck open or closed because of contamination or other fault. Contact your Agilent Technologies service representative.

Fault 203—Signal DSP faulty

Status message: Signal DSP faulty

The detector's signal processing electronics are not functioning correctly. This indicates a malfunction with the 6890 GC main PC board. The signal path will not function.

- Turn the instrument on and then off at least one time. If the error still occurs, the mainboard must be replaced.

Fault 204—Signal DSP ROM broken

Status message: Sig DSP ROM broken

The detector's signal processing electronics are not functioning correctly. This indicates a malfunction with the 6890 GC main PC board. The signal path will not function.

- Turn the instrument on and then off at least one time. If the error still occurs, the mainboard must be replaced.

Fault 205—Signal DSP RAM broken

Status message: Sig DSP RAM broken

The detector's signal processing electronics are not functioning correctly. This indicates a malfunction with the 6890 GC main PC board. The signal path will not function.

- Turn the instrument on and then off at least one time. If the error still occurs, the mainboard must be replaced.

Fault 206—Signal DSP registers

Status message: Sig DSP registers

The detector's signal processing electronics are not functioning correctly. This indicates a malfunction with the 6890 GC main PC board. The signal path will not function.

- Turn the instrument on and then off at least one time. If the error still occurs, the mainboard must be replaced.

Fault 207—Sig DSP data corrupt

Status message: Sig DSP data corrupt

The detector's signal processing electronics are not functioning correctly. This indicates a malfunction with the 6890 GC main PC board.

- Turn the instrument on and then off at least one time. If the error still occurs, the mainboard must be replaced.

Fault 208—Signal path test failed**Fault 209—Signal path test failed**

Status message: 0-1 mV out # 1 or 0-1 mV out # 2

- This error indicates that the signal that the 6890 GC is sending to a strip-chart recording device in position 1 or 2 is not within the acceptable range. The 6890 GC will not be ready.
- Turn the instrument on and then off at least one time. If the error still occurs, the mainboard must be replaced.

Fault 210—Signal path test failed**Fault 211—Signal path test failed**

Status message: Analog out # 1 or Analog out # 2

This error indicates that the signal that the 6890 GC is sending to an integrator in position 1 or 2 is not within the acceptable range. The 6890 GC will not be ready

- Turn the instrument on and then off at least one time. If the error still occurs, the mainboard must be replaced.

Fault 212—Front detector electrometer out of specification**Fault 213—Back detector electrometer out of specification**

Status message: F det electrometer or B det electrometer

The FID, NPD, TCD, and ECD all have an electrometer. The electrometer, which is inside the detector, measures and amplifies the signal from the detector, which it then converts to a digital form. Two things could cause the detector electrometer to be out of specification:

- The communication cable between the FID, NPD, or ECD detector board and the detector is not connected properly.
- The electrometer is broken, or the detector board is bad.

If the electrometer is out of specification, the detector will never reach a ready state.

- Check that the cable that connects the detector to the board is connected properly.
- If the boards are connected properly but the electrometer is still out of specification, the electrometer or detector board is broken.

Fault 214—Front detector flame out

Fault 215—Back detector flame out

Status message: Front det flame out or Back det flame out

This message appears when the FID is not able to ignite or if the flame goes out during a run. During the ignition process or the run, the detector will try to ignite the flame twice; if both attempts fail, the hydrogen, air, and ignitor will shut off, and the error message will appear. The detector will be in a not ready state.

Check the following:

- Make sure the hydrogen and air are turned on and that the flow rates are high enough for the flame to ignite.
- Use an electronic leak detector to search for and correct leaks around the detector column fitting.
- Check that you are using the correct jet for your column.
- Change the Lit Offset to 0.5 (the default value).

Fault 216—Front TCD filament open

Fault 217—Back TCD filament open

Status message: F TCD filament open or B TCD filament open

The TCD filament bridge voltage indicates that the filament resistance is too high. The resistance may be too high because the filament is broken or worn thin from use, or the wires from the TCD are not connected on the detector

board, or the ΔPRT is shorted. (Units made before April 1997 may not use a ΔPRT.)

The detector will not be ready until the condition is corrected.

- Check that the wires from the detector are connected on the detector board.
- Check that the ΔPRT is properly installed and not damaged. Replace if damaged.
- The TCD's cell must be replaced.

Fault 218—F TCD filament shorted

Fault 219—B TCD filament shorted

Status message: F TCD filament short or B TCD filament short

The TCD filament bridge voltage indicates that the resistance of the filament is too low, which indicates a potentially shorted filament. This condition could be caused by a worn or sagging filament, or if the wires from the TCD are not connected properly to the detector board or are touching each other, or if the wires from the ΔPRT are not properly connected to the detector board. (Units made before April 1997 may not use a ΔPRT.)

The detector will not be ready until the condition is corrected.

- Check that the filament and ΔPRT wires from the cell are connected on the detector board properly.
- The TCD's cell must be replaced.

Fault 220—Heater over current. Thermal shutdown

Status message: Heater overcurrent

This message appears when there is a short in the heater of a heated zone, or when a heated zone's electronics are defective. This error does *not* indicate a problem with the oven.

Power to the small zones is disabled. To clear the error message, turn off all the heated zones and turn the GC off and then on again.

Fault 220—Heater over current. Thermal shutdown

- The fault could be caused by a malfunction in the heater sensor or the heater electronics.
- See *Fault 221—Thermal shutdown (status message)*.

Fault 221—Thermal shutdown (status message)

This fault has no popup display message, only a status message.

This fault causes the GC to shut down entirely. A thermal fault is detected if the oven or another heated zone is not within its allowable temperature range (lower than minimum temperature or greater than maximum temperature by 25° C). Several things could cause this error:

- A problem with the electrical supply to the instrument
- A malfunction of the zone control electronics
- A shorted temperature sensor
- A shorted heater

No power will reach the oven and other heated zones. The 6890 GC will be not ready.

Any of the following components can experience a thermal shutdown: the oven, the inlets, the detectors, and the aux zones. In addition, problems with electronics on the main PC board can cause a thermal shutdown.

- If you see any thermal shutdown message, first turn the GC off and on. If the error was caused by a power supply problem, the error will disappear and the instrument will become ready. If the error reappears, the main board, or one or more of the heater/sensor assemblies, must be replaced.

Fault 222—Oven thermal shutdown

Status message: Oven temp too hot

The oven temperature reading indicates the oven is above its maximum allowable temperature by at least 25° C. This indicates a defective oven heater drive or a defective oven sensor.

No power will reach the oven and other heated zones. The 6890 GC will be not ready.

- To determine if the oven sensor is broken, its resistance must be tested. The resistance will be 100 ohms if the sensor is working correctly; a much larger value indicates a faulty sensor.

- If the oven sensor is operating correctly and the error persists, the main board must be replaced.
- See *Fault 221—Thermal shutdown (status message)*.

Fault 223—Oven thermal shutdown

Status message: Oven temp too cool

The oven temperature reading indicates the oven is less than its minimum allowable temperature. This indicates a stuck open cryo valve or a shorted oven sensor.

Power to the small zones is disabled. To clear the error message, turn off all the heated zones and turn the GC off and then on again.

- See *Fault 221—Thermal shutdown (status message)*.

Fault 224—Oven thermal shutdown

Status message: Oven temp sensor

The oven temperature reading reports the oven's temperature is lower than expected, which indicates a shorted oven sensor. Power will be turned off for all the heated zones.

- The sensor must be replaced.
- See *Fault 221—Thermal shutdown (status message)*.

Fault 225—Front detector thermal shutdown

Status message: F det temp too hot

The front detector's temperature is higher than the maximum allowable temperature (detector type maximum temperature plus an additional 25°C). This indicates a defective heater drive on the mainboard or a defective sensor.

Power is disabled to all the heated zones. This fault can only be cleared by turning off all the heated zones and turning the instrument off and on again.

- The problem could be caused by a defective sensor or defective heater driver on the mainboard.
- See *Fault 221—Thermal shutdown (status message)*.

Fault 226—Front detector thermal shutdown

Status message: F det temp sensor

The front detector temperature reading reports the detector's temperature is lower than expected, which indicates a shorted sensor. Power will be turned off for the detector.

- The sensor must be replaced.
- See *Fault 221—Thermal shutdown (status message)*.

Fault 227—Back detector thermal shutdown

Status message: B det temp too hot

The back detector's temperature is higher than the maximum allowable temperature (detector type maximum temperature plus an additional 25°C). This indicates a defective heater drive on the mainboard or a defective sensor.

Power is disabled to the small zones and the oven. This fault can only be cleared by turning off all the heated zones and turning the instrument off and on again.

- The problem could be caused by a defective sensor or defective heater driver on the mainboard.
- See *Fault 221—Thermal shutdown (status message)*.

Fault 228—Back detector thermal shutdown

Status message: B det temp sensor

The back detector temperature reading reports the detector's temperature is lower than expected, which indicates a shorted sensor. Power will be turned off for detector.

- The sensor must be replaced.
- See *Fault 221—Thermal shutdown (status message)*.

Fault 229—Front inlet thermal shutdown

Status message: F inl temp too hot

Fault 230—Front inlet thermal shutdown

The front inlet's temperature is higher than the maximum allowable temperature (detector type maximum temperature plus an additional 25°C). This indicates a defective heater drive on the mainboard or a defective sensor.

Power is disabled to the small zones and the oven. This fault can only be cleared by turning off all the heated zones and turning the instrument off and on again.

- The problem could be caused by a defective sensor or defective heater driver on the mainboard.
- See *Fault 221—Thermal shutdown (status message)*.

Fault 230—Front inlet thermal shutdown

Status message: F inl temp sensor

The front inlet temperature reading reports the inlet's temperature is lower than expected, which indicates a shorted sensor. Power will be turned off for inlet.

- The sensor must be replaced.
- See *Fault 221—Thermal shutdown (status message)*.

Fault 231—Back inlet thermal shutdown

Status message: B inl temp too hot

The back inlet's temperature is higher than the maximum allowable temperature (detector type maximum temperature plus an additional 25°C). This indicates a defective heater drive on the mainboard or a defective sensor.

Power is disabled to the small zones and the oven. This fault can only be cleared by turning off all the heated zones and turning the instrument off and on again.

- The problem could be caused by a defective sensor or defective heater driver on the mainboard.
- See *Fault 221—Thermal shutdown (status message)*.

Fault 232—Back inlet thermal shutdown

Status message: B inl temp sensor

The back inlet temperature reading reports the inlet's temperature is lower than expected, which indicates a shorted sensor. Power will be turned off for inlet.

- The sensor must be replaced.
- See *Fault 221—Thermal shutdown (status message)*.

Fault 233—Aux 1 thermal shutdown

Status message: Aux 1 temp too hot

The aux zone's temperature is higher than the maximum allowable temperature (detector type maximum temperature plus an additional 25° C). This indicates a defective heater drive on the mainboard or a defective sensor.

Power is disabled to the small zones and the oven. This fault can only be cleared by turning off all the heated zones and turning the instrument off and on again.

- The problem could be caused by a defective sensor or defective heater driver on the mainboard.
- See *Fault 221—Thermal shutdown (status message)*.

Fault 234—Aux zone 1 thermal shutdown

Status message: Aux 1 temp sensor

Aux zone 1's temperature reading reports that its temperature is lower than expected, which indicates a shorted sensor. Power will be turned off for the zone.

- The sensor must be replaced.
- See *Fault 221—Thermal shutdown (status message)*.

Fault 235—Aux 2 thermal shutdown

Status message: Aux 2 temp too hot

The aux zone's temperature is higher than the maximum allowable temperature (detector type maximum temperature plus an additional 25° C). This indicates a defective heater drive on the mainboard or a defective sensor.

Power is disabled to the small zones and the oven. This fault can only be cleared by turning off all the heated zones and turning the instrument off and on again.

- The problem could be caused by a defective sensor or defective heater driver on the mainboard.
- See *Fault 221—Thermal shutdown (status message)*.

Fault 236—Aux 2 thermal shutdown

Status message: Aux 2 temp sensor

Aux zone 2's temperature reading reports that its temperature is lower than expected, which indicates a shorted sensor. Power will be turned off for the zone.

- The sensor must be replaced.
- See *Fault 221—Thermal shutdown (status message)*.

Fault 237—No line interrupt. Thermal shutdown.

Status message: No line interrupt

The electronics on the main board are not functioning correctly. Power will be shut off to the oven and other heated zones. The 6890 GC will not be ready.

- The main board must be replaced.
- See *Fault 221—Thermal shutdown (status message)*.

Fault 238—Faulty line interrupt. Thermal shutdown.

Status message: Line interrupt

The electronics on the main board are not functioning correctly or there is an excessive amount of noise in the power supply to the instrument. Power will be shut off to the oven and other heated zones. The 6890 GC will not be ready.

- Turn the 6890 GC off and then on again. If the problem was caused by noise in the power supply, the instrument will operate normally again. If the error persists, the main board must be replaced.
- See *Fault 221—Thermal shutdown (status message)*.

Fault 239—Mux ADC thermal shutdown

Status message: No mux ADC response

The multiplexor, which processes the 6890 GC electronic signals, is not functioning. Most likely, the multiplexor's circuitry is defective. Power will be shut off to the oven and other heated zones. The 6890 GC will not be ready.

- The main board must be replaced.
- See *Fault 221—Thermal shutdown (status message)*.

Fault 240—Mux ADC thermal shutdown

Status message: Mux ADC offset value

The multiplexor, which processes the 6890 GC electronic signals, is not functioning. Most likely, the multiplexor's circuitry is defective. Power will be shut off to the oven and other heated zones. The 6890 GC will not be ready.

- The main board must be replaced.
- See *Fault 221—Thermal shutdown (status message)*.

Fault 241—Line sense reading thermal shutdown

Status message: Invalid line sense

The line sense circuitry on the mainboard is not measuring the line power correctly. Since it is indicating the power supply is not within acceptable limits, the power to the heated zones is disabled. Turn the zones off to clear the error.

- Most likely, the main board must be replaced.
- See *Fault 221—Thermal shutdown (status message)*.

Fault 242—Pneu aux module invalid constants

Fault 243—Pneu aux module invalid constants

Fault 244—Pneu aux module invalid constants

Status message: Aux 3 faulty fact cal or Aux 4 faulty fact cal or Aux 5 faulty fact cal

Two conditions could cause this error:

- The module installed in the aux position is not an aux module.
- The aux module is not working correctly; for example, the EEPROM could be an unsupported version.

Module will not be usable.

- Remove the module from the aux position and install the correct module.

Fault 245—Front det module: obsolete EEPROM

Fault 246—Back det module: obsolete EEPROM

Status message: F det module rev or B det module rev

The front or back detector's EEPROM is not recognized by the 6890 GC. The module is unusable.

- The version of the module is not compatible with the version of the 6890 GC.

Fault 247—Front inlet module: obsolete EEPROM**Fault 248—Back inlet module: obsolete EEPROM**

Status message: F inlet module rev or B inlet module rev

The front or back inlet's EEPROM is not recognized by the 6890 GC. The module is unusable.

- The version of the module is not compatible with the version of the 6890 GC.

Fault 249—Pres aux module: obsolete EEPROM

Status message: Aux module rev

The aux pressure's EEPROM is not recognized by the 6890 GC. The module is unusable.

- The version of the module is not compatible with the version of the 6890 GC.

Fault 250—Front det: non-det module**Fault 251—Back det: non-det module**

Status message: F det wrong module or B det wrong module

The module installed in an inlet slot is unusable. Two things could cause this condition:

- The module is installed in the wrong position. For example, a detector module might be installed in the inlet position.
 - If the correct module is installed, it may be malfunctioning or its EEPROM may be unrecognized by the 6890 GC.
- Make sure that the correct type of module is installed.

Fault 252—Front inlet: non-inlet module**Fault 253—Back inlet: non-inlet module**

Status message: F inlet wrong module or B inlet wrong module

The module installed in a detector slot is unusable. Two things could cause this condition:

- The module is installed in the wrong position. For example, an inlet module might be installed in the detector position.
- If the correct module is installed, it may be malfunctioning or its EEPROM may be unrecognized by the 6890 GC.
 - Make sure that the correct type of module is installed.

Fault 254—Non-aux module in pneu aux position

Status message: Aux wrong module

The module installed in aux slot is unusable. Two things could cause this condition:

- The module is installed in the wrong position. For example, an inlet module might be installed in the aux position.
- If the correct module is installed, it may be malfunctioning or its EEPROM may be unrecognized by the 6890 GC.
 - Make sure that the correct type of module is installed.

Fault 255—Front detector: invalid det module**Fault 256—Back detector: invalid det module**

Status message: F det invalid type or B det invalid type

The front or back detector module is not supported by the firmware installed in the 6890 GC.

Fault 257—Front inlet: invalid inlet module**Fault 258—Back inlet: invalid inlet module**

Status message: F inlet invalid type or B inlet invalid type

The front or back inlet module is not supported by the firmware installed in the 6890 GC.

Fault 259—Front detector: det board not the same as module**Fault 260—Back detector: det board not the same as module**

Status message: F det type mismatch or B det type mismatch

The detector module does not match the installed detector electronics board.

- The position of the detector pneumatics module and detectors were changed, but the detector board was not. Change the detector boards.

Fault 261—Host communications: MIO board defective

Status message: MIO board defective

The connection between the MIO PC board and the mainboard could be faulty or the MIO board is defective. Communication between the 6890 GC and the host will halt.

- Reseat the MIO card.
- If reseating did not correct the problem, the MIO PC board is defective.

Fault 262—Host communications: RS232 defective

Status message: RS232 defective

The communications between the RS232 chip and the mainboard are faulty. Most likely, the mainboard is faulty. Communication between the GC and the other device will halt.

Fault 263—Host communications: GPIB (or HPIB)defective

Status message: GPIB (or HP-IB) defective

The communications between the GPIB (or HP-IB) chip and the mainboard are faulty. Most likely, the mainboard is faulty. Communication between the GC and the other device will halt.

Fault 264—Sampler communications: RS232 defective

Status message: Sampler RS232 defect

The communications between the RS232 chip and the mainboard are faulty. Most likely, the mainboard is faulty. Communication between the GC and the other device will halt.

Fault 265—Front inlet: invalid pids**Fault 266—Back inlet: invalid pids**

Status message: F inlet invalid pid or B inlet invalid pid

pid is an abbreviation for the constants used in the algorithm that controls temperature. This fault means that the module calibration is no longer valid.

Fault 267—Front detector: invalid pids**Fault 268—Back detector: invalid pids**

Status message: F detector invalid pid or B detector invalid pid

pid is an abbreviation for the constants used in the algorithm that controls temperature. This fault means that the module calibration is no longer valid.

Fault 269—Pneu aux module: invalid pids

Status message: Pneu aux invalid pid

pid is an abbreviation for the constants used in the algorithm that controls temperature. This fault means that the module calibration is no longer valid.

Fault 270—Front inlet: invalid module checksum**Fault 271—Back inlet: invalid module checksum**

Status message: F inlet bad cksum or B inlet bad cksum

The inlet module's calibration is no longer valid.

Fault 272—Front detector: invalid module checksum**Fault 273—Back detector: invalid module checksum**

Status message: F det bad cksum or B det bad cksum

The detector module's calibration is no longer valid.

Fault 274—Pneu aux module: invalid module checksum

Status message: Pneu aux bad cksum

The aux pneumatics module's calibration is no longer valid.

Fault 275—Front inlet: invalid constants from factory**Fault 276—Back inlet: invalid constants from factory**

Status message: F inlet bad fact cal or B inlet bad fact cal

The inlet module's calibration is invalid.

Fault 277—Front detector: invalid constants from factory**Fault 278—Back detector: invalid constants from factory**

Status message: F det bad fact cal or B det bad fact cal

The detector module's calibration is invalid.

Status message: P aux bad fact cal

The aux pneumatics module's calibration is invalid.

Fault 280—F inlet read/write failure. Module is unusable.**Fault 281—B inlet read/write failure. Module is unusable.**

Status message: F inlet i/o failure or B inlet i/o failure

The EPC module is malfunctioning. Replace the module.

Fault 282—F det read/write failure. Module is unusable.**Fault 283—B det read/write failure. Module is unusable.**

Status message: F det i/o failure or B det i/o failure

The EPC module is malfunctioning. Replace the module.

Fault 284—Pneu aux read/write failure. Module is unusable.

Status message: Pneu aux i/o failure

The EPC module is malfunctioning. Replace the module.

Fault 285—Front detector offset adjustment failed**Fault 286—Back detector offset adjustment failed**

Status message: F det adjust failure or B det adjust failure

An ECD or NPD detector has failed to successfully achieve the target offset setpoint within the adjustment range. The instrument will not be ready until "Adjust Offset" is turned Off or On.

Fault 287—F OIM not installed**Fault 288—B OIM not installed**

The OIM module is required by the method but is not present.

860 Bad Mainboard and Fatal Errors

These messages almost always indicate that the mainboard is malfunctioning and must be replaced. These messages are not numbered and usually appear when the instrument is first turned on. Refer to the following table for a list of messages.

Table 860-1 Bad Mainboard and Fatal Error Messages

Pop-up message	Comments
BAD MAINBOARD	
Main FPGA Failure	Replace mainboard
Static RAM Failure	Replace mainboard
Boot ROM Checksum	Replace mainboard
ROM #2 Checksum	Replace EEPROM 2.
ROM #3 Checksum	Replace EEPROM 3.
Incorrect ROM #2	EEPROM 2 or 3 is installed in the wrong position. Change the position the EEPROM is installed in.
Incorrect ROM #3	
ROM #2 wrong version	The version of either EEPROM 2 or 3 is different than that of the other EEPROMs.
ROM #3 wrong version	
DMA FPGA Failure	Replace mainboard
DRAM Failure	Replace mainboard
FATAL ERROR	
Replace mainboard for all of the following errors.	
Exception Vector	
Bus Error	
Address Error	
Illegal Instruction	
Divide by Zero	
No 512Hz Interrupt	

900 Remote Access

Remote Access information was not available for this printing.
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1000 Cabling Configuration and Electronics

1010 Cabling Diagrams, 6890A and 6890 Plus

1015 Cabling Diagrams, 6890N

1020 Cable Electronics

Connecting the 6890 gas chromatograph with other analytical instruments and pinouts for the cable used.

1010 Cabling Diagrams, 6890A and 6890 Plus

Overview of 6890 GC cable connections

There are numerous system configurations available with the 6890 GC, and your cabling requirements will be determined by the system's components. In the figures that follow, refer to the configuration most closely resembling your system.

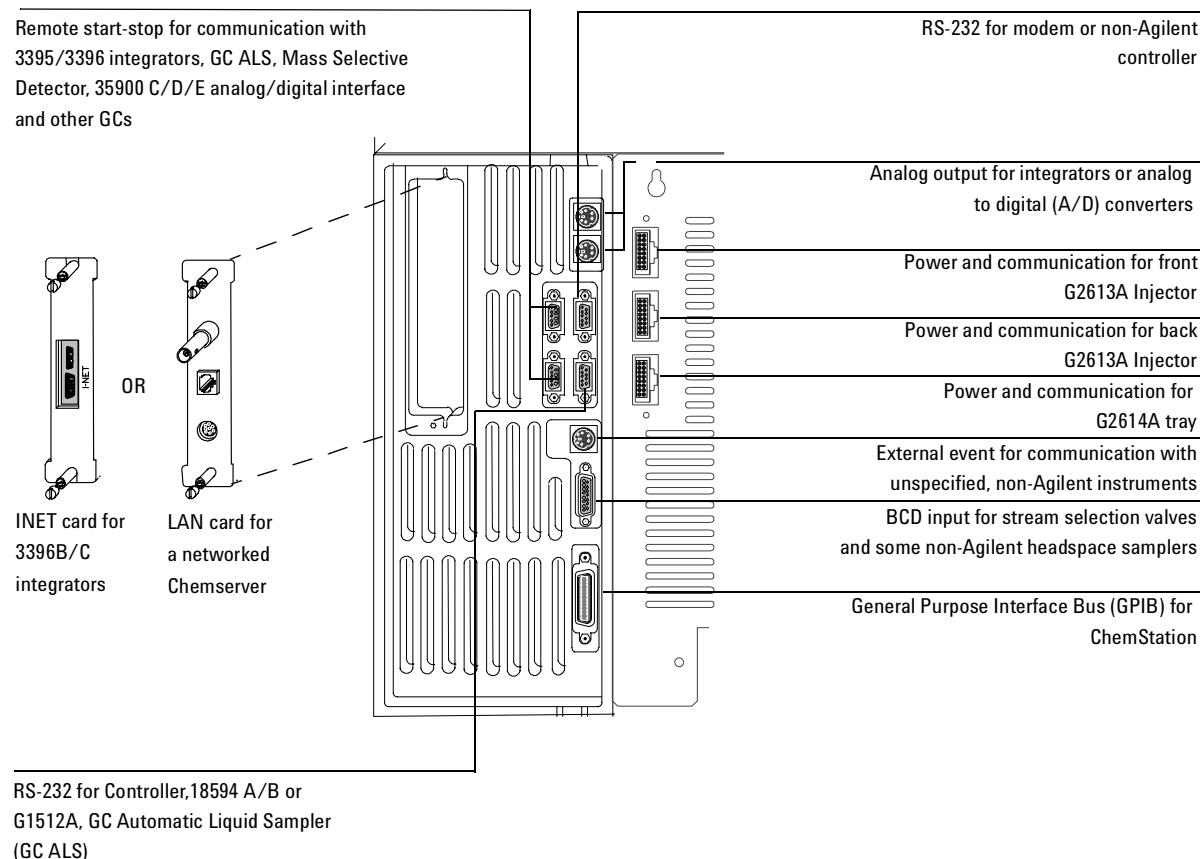
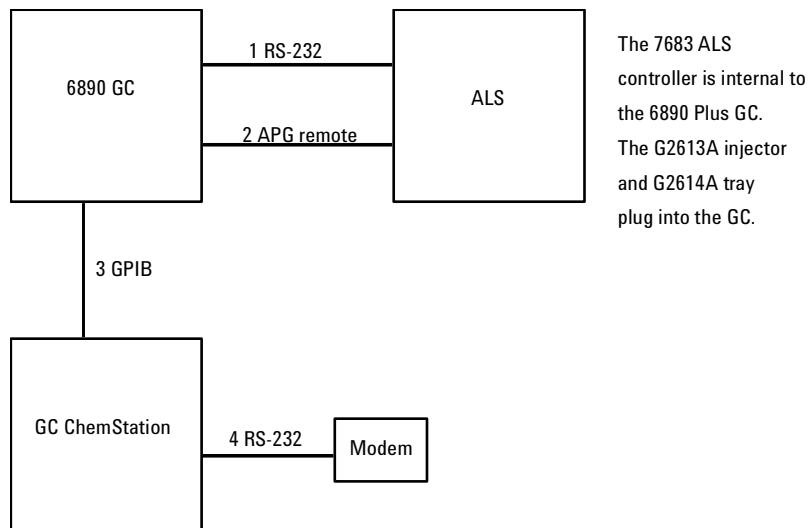


Figure 1010-1 Connectors on the back of the GC

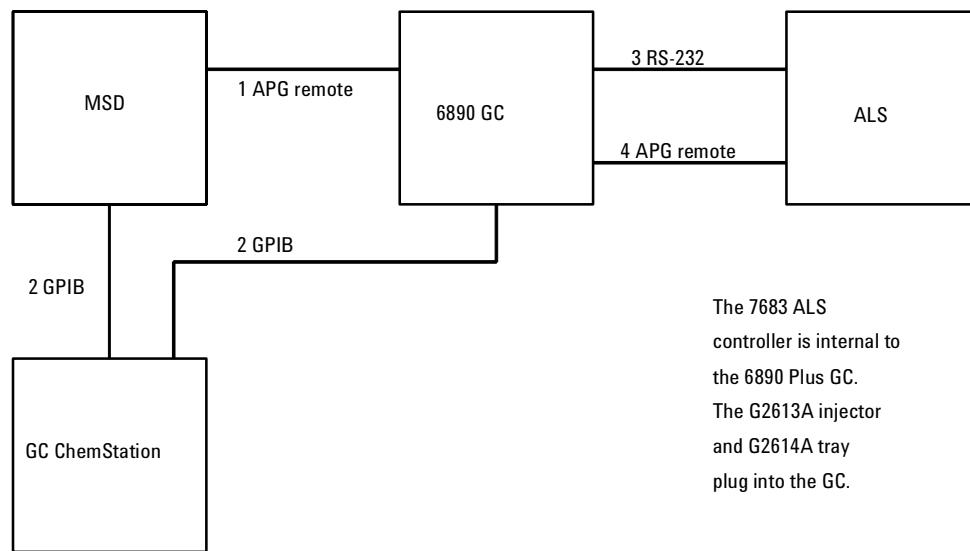
6890 GC

GC ChemStation GC Automatic Liquid Sampler



Number	Part no. and description
1	G1530-60600, RS-232 cable, 9-pin female/9-pin female
2	G1530-60930, 2-m APG remote cable, 9-pin male/9-pin male
3	8120-3446, 2-m GPIB cable
4	24542M (also 24540-80012), RS-232 cable

Figure 1010-2

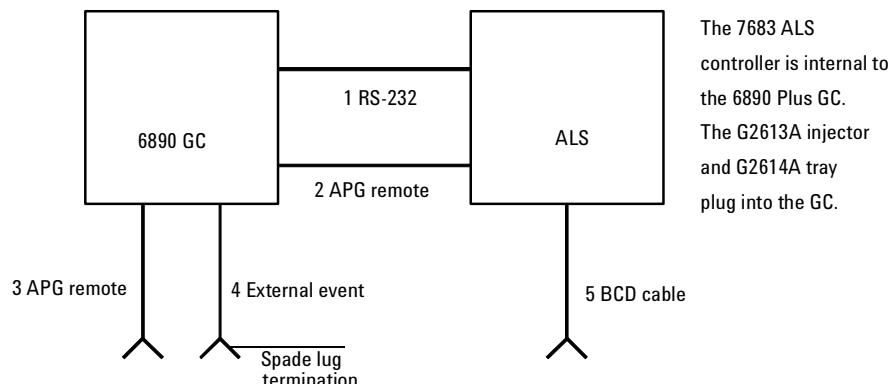
6890 GC**Mass Selective Detector
GC ChemStation
GC Automatic Liquid Sampler**

Number	Part no. and description
1	G1530-60930, 2-m APG remote cable, 9-pin male/9-pin male
2	8120-3446, 2-m GPIB cable
3	G1530-60600, 2-m RS-232 cable, 9-pin female/9-pin female
4	G1530-60930, 2-m APG remote cable, 9-pin male/9-pin male

Figure 1010-3

6890 GC

GC Automatic Liquid Sampler Non-Agilent Data System



Number	Part no. and description
1	G1530-60600, 2-m RS-232 cable, 9-pin female/9-pin female
2	G1530-60930, 2-m APG remote cable, 9-pin male/9-pin male
3	35900-60670, General use APG remote cable, 9-pin male/spade lug
4	G1530-60590, External event cable, 8-pin/spade lugs
5	G1530-60630, General purpose BCD cable

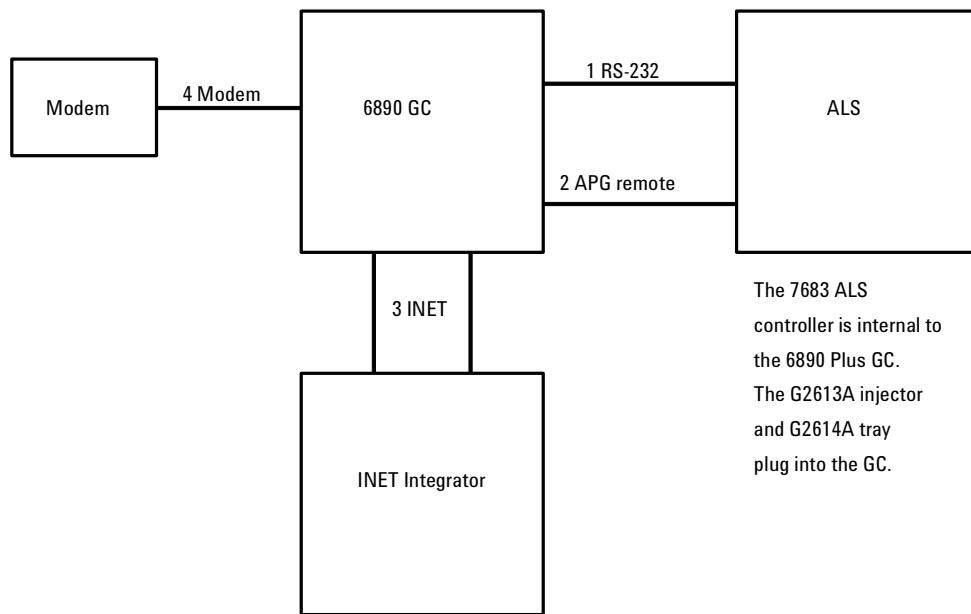
35900-60670 APG remote cable spade lug identification

Connect 1 9 pin (male)	Signal name	Connector 2 spade lugs
1	GND	Black
2	Prepare	White
3	Start	Red
4	Shut down	Green
5	Reserved	Brown
6	Power on	Blue
7	Ready	Orange
8	Stop	Yellow
9	Start Request	Violet

G1530-60590 External event cable spade lug identification

Pin	Color	Signal
1	Yellow	24 V Out 1
2	Black	24 V Out 2
3	Red	Ground
4	White	Ground
5	Orange	Contact 1
6	Green	Contact 1
7	Brown	Contact 2
8	Blue	Contact 2

Figure 1010-4

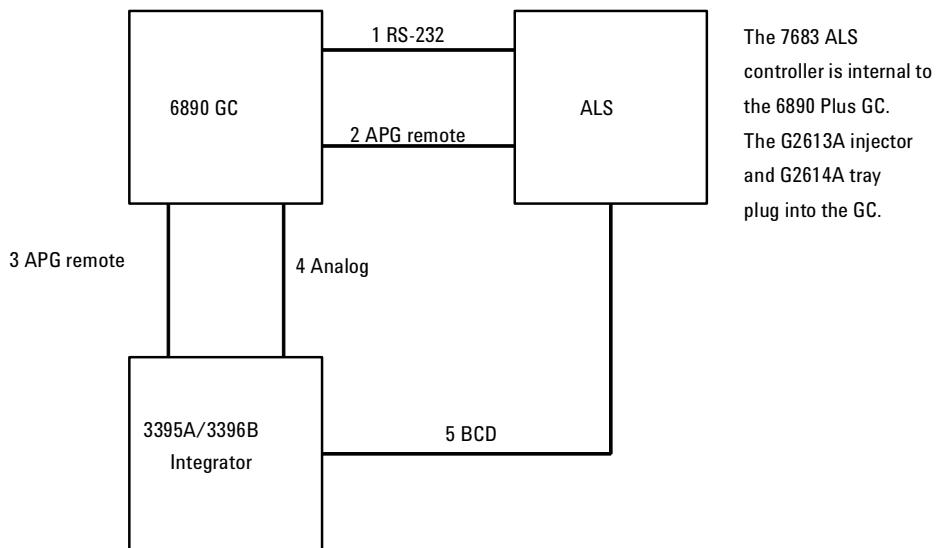
6890 GC**3396B/C INET Integrator
GC Automatic Liquid Sampler
Modem**

Number	Part no. and description
1	G1530-60600, 2-m RS-232 cable, 9-pin female/9-pin female
2	G1530-60930, 2-m APG remote cable, 9-pin male/9-pin male
3	Two 82167-60003, 5-m INET cables
4	G1530-61120, Modem cable, 9-pin female/9-pin male OR 24540-80012 (also 24542M), Modem cable 9-pin female/25-pin male

Figure 1010-5

6890 GC

3395A/3396B Integrator GC Automatic Liquid Sampler

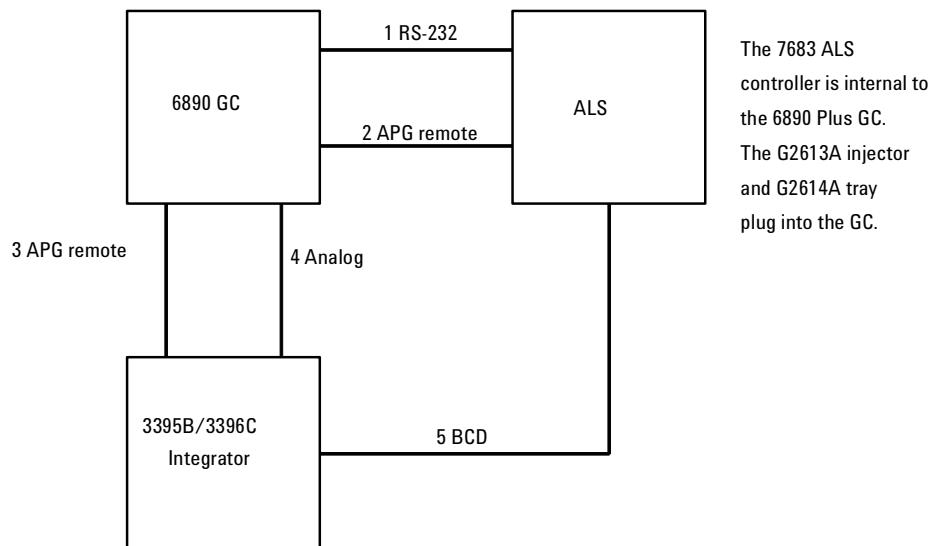


Number	Part no. and description
1	G1530-60600, 2-m RS-232 cable, 9-pin female/9-pin female
2	G1530-60930, 2-m APG remote cable, 9-pin male/9-pin male
3	03396-61020, 2-m APG remote cable, 9-pin/15-pin
4	G1530-60570, 2-m Analog cable, 6-pin
5	03396-60560, BCD cable

Figure 1010-6

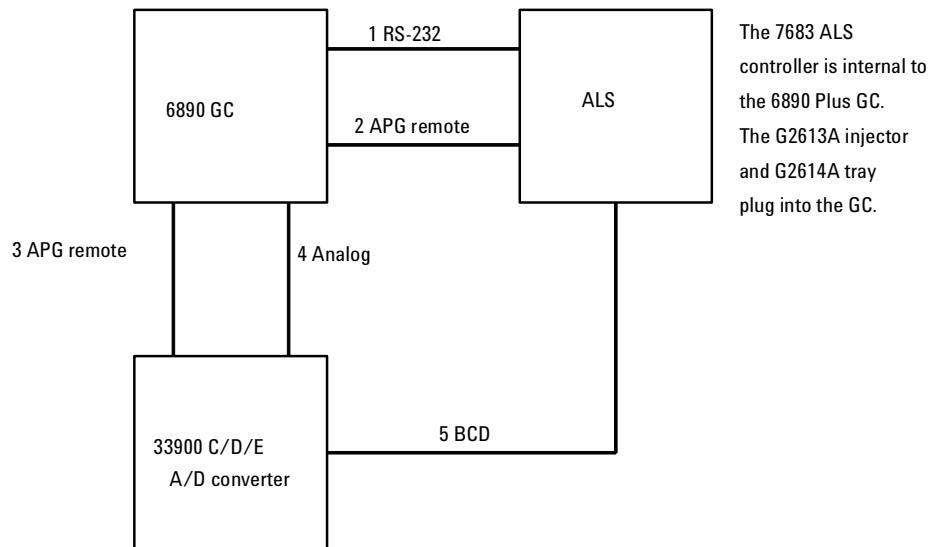
6890 GC

3395B/3396C Integrator GC Automatic Liquid Sampler



Number	Part no. and description
1	G1530-60600, 2-m RS-232 cable, 9-pin female/9-pin female
2	G1530-60930, 2-m APG remote cable, 9-pin male/9-pin male
3	03396-61010, APG remote cable, 9-pin/15-pin
4	G1530-60570, 2-m Analog cable, 6-pin
5	03396-60560, BCD cable

Figure 1010-7

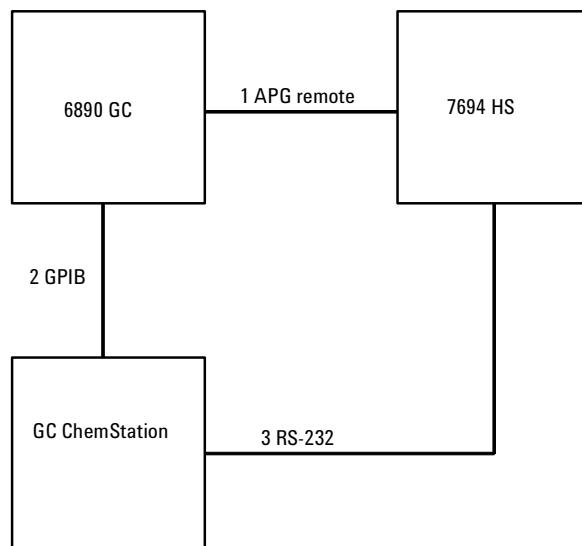
6890 GC**35900C/D/E Analog-to-Digital Converter
GC Automatic Liquid Sampler**

Number	Part no. and description
1	G1530-60600, 2-m RS-232 cable, 9-pin female/9-pin female
2	G1530-60930, 2-m APG remote cable, 9-pin male/9-pin male
3	G1530-60930, 2-m APG remote cable, 9-pin male/9-pin male
4	G1530-60570, 2-m Analog cable, 6-pin
5	35900-60850, BCD cable

Figure 1010-8

6890 GC

7694 Headspace Sampler GC ChemStation

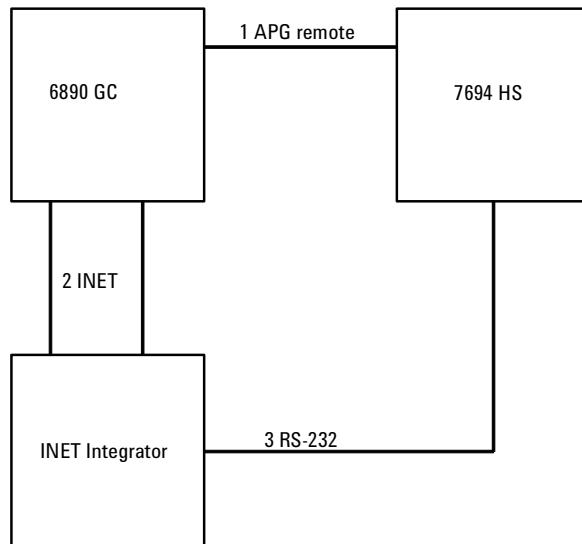


Number	Part no. and description
1	G1290-60575, APG remote cable, 3-pin male/4-pin male
2	8120-3446, 2-m GPIB cable
3	24542U, RS-232 cable, 9-pin female/9-pin female

Figure 1010-9

6890 GC

7694 Headspace Sampler 3396B/C INET Integrator

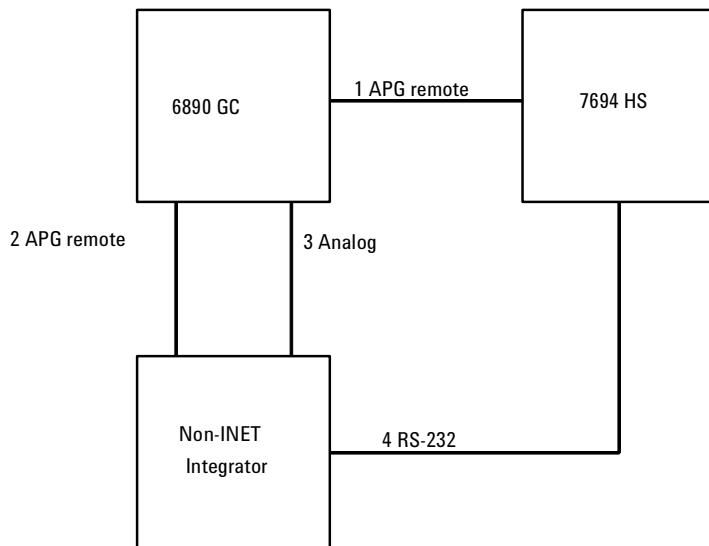


Number	Part no. and description
1	G1290-60575, APG remote cable, 3-pin male/4-pin male
2	Two 82167-60003, 5-m INET cables
3	03396-60530, RS-232 cable, 15-pin male/9-pin female

Figure 1010-10

6890 GC

7694 Headspace Sampler Non-INET Integrator

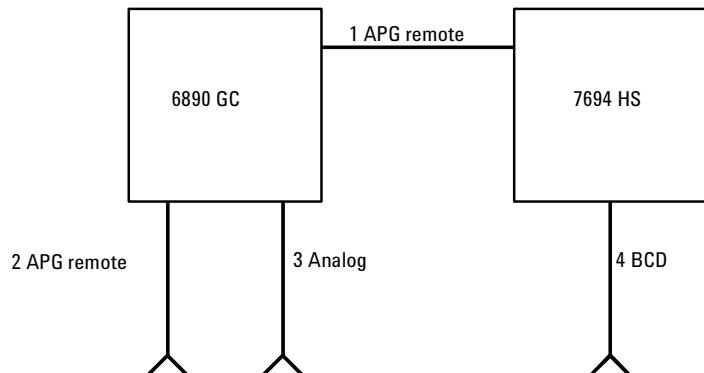


Number	Part no. and description
1	G1290-60575, APG remote cable, 3-pin male/4-pin male
2	03396-61010, APG remote cable, 9-pin/15-pin (for 3395B/ 3396C) OR 03396-61020, APG remote cable, 9-pin/15-pin (for 3395A/ 3396B)
3	G1530-60570, 2-m Analog cable, 6-pin
4	03396-60530, RS-232 cable, 15-pin male/9-pin female

Figure 1010-11

6890 GC

7694 Headspace Sampler



Number	Part no. and description
1	G1290-60575, APG remote cable, 3-pin male/4-pin male
2	35900-60670, 2-m APG remote cable, 9-pin male/spade lugs
3	G1530-60560, Analog cable, 6-pin/spade lugs
4	03396-60570, Binary-coded decimal cable

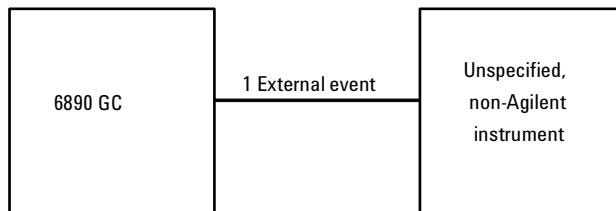
G1530-60560 analog cable spade lug identification

Pin	Color	Signal
1	Black	1 mV COM
2	Red	1 V and 1 DV COM
3	White	1 mV
4	Orange	1 V
5	Brown	Chassis ground
6	Blue	1 DV

Figure 1010-12

6890 GC

External Events (an unspecified, non-Agilent instrument)

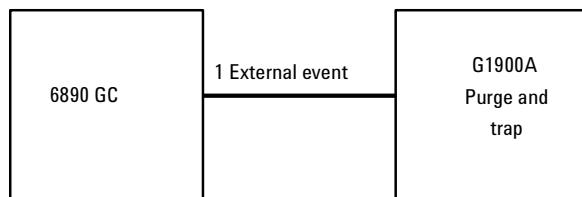


Number	Part no. and description
1	G1530-60590, External events cable, 8-pin/spade lugs

Part no. G1530-60590 external event cable spade lug identification

Pin	Color	Signal
1	Yellow	24 V Out 1
2	Black	24 V Out 2
3	Red	Ground
4	White	Ground
5	Orange	Contact 1
6	Green	Contact 1
7	Brown	Contact 2
6	Blue	Contact 2

Figure 1010-13

6890 GC**G1900A Purge and Trap**

Number	Part no. and description
1	G1900-60820, APG remote cable

Figure 1010-14

1015 Cabling Diagrams, 6890N

Overview of 6890N GC cable connections

There are numerous system configurations available with the 6890N GC, and your cabling requirements will be determined by the system's components. In the figures that follow, refer to the configuration most closely resembling your system. Note that the 6890N does not support GPIB or INET protocols.

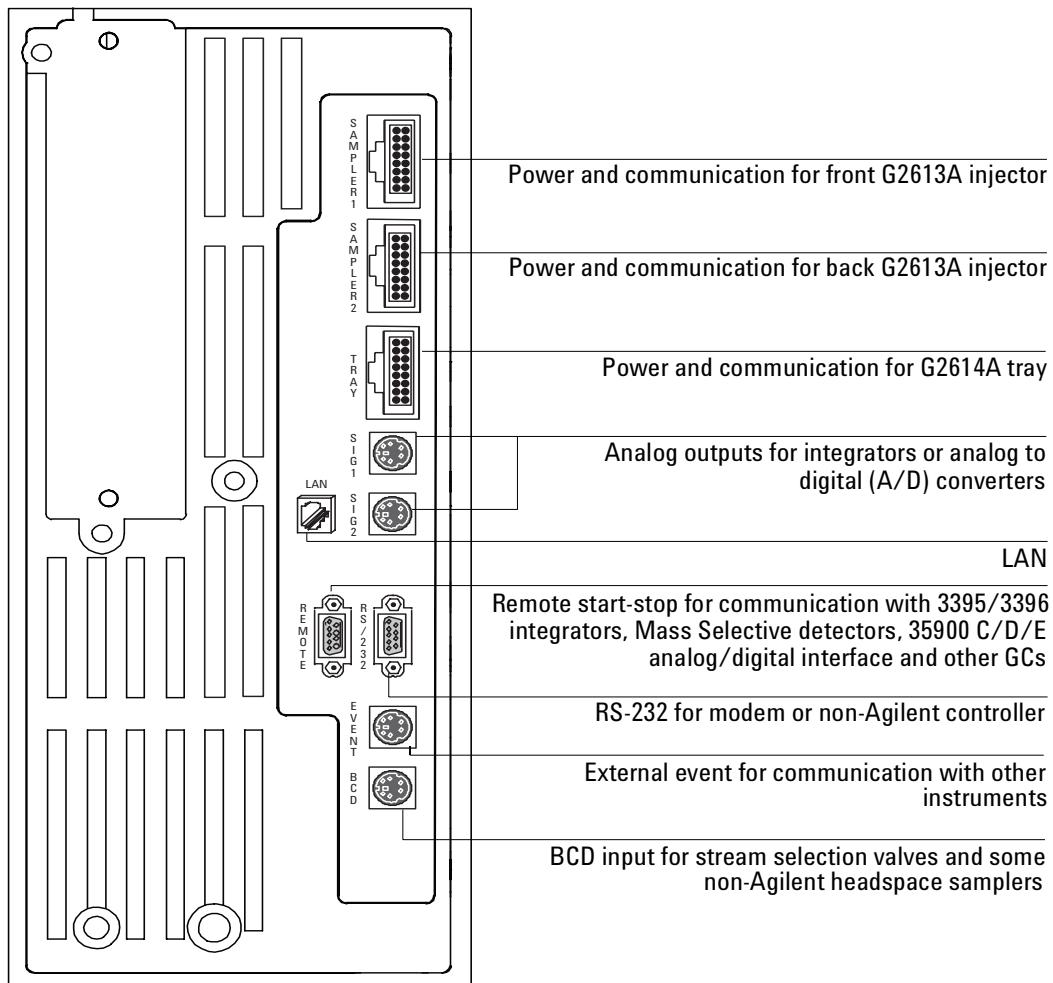
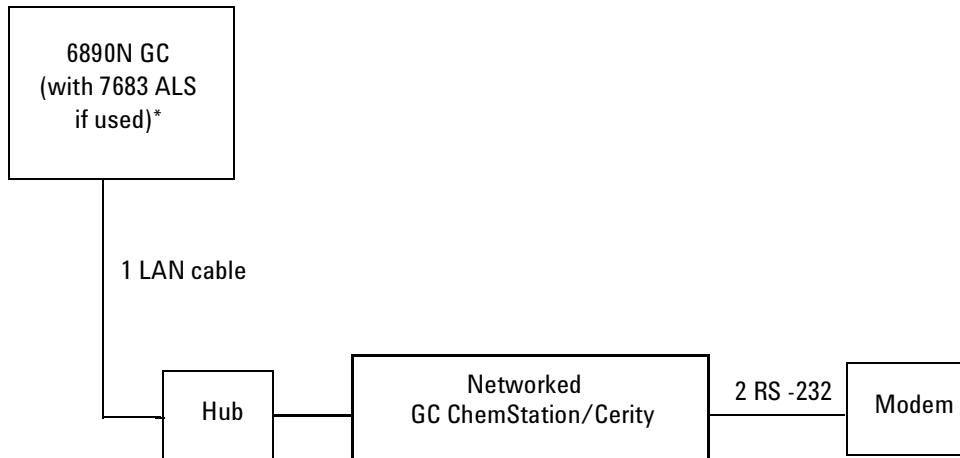


Figure 1015-1 Connectors on the back of the GC

6890N GC

GC ChemStation/Cerity GC Automatic Liquid Sampler



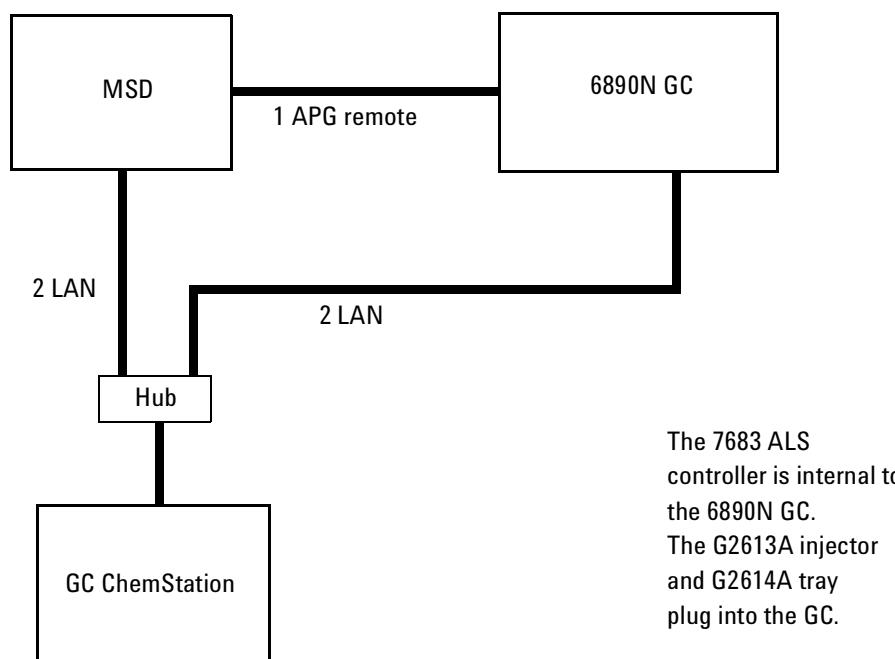
* The 7683 controller is internal to the 6890N GC. The G2613A Injector and the G2614A tray plug directly into the GC.

Number	Part no. and description
1	G1530-61485, Cable, 100 Base T-LAN
2	G1530-61120, RS-232/modem cable or 24540-80012, RS-232/modem cable

Figure 1015-2 GC-networked-GC ChemStation/Cerity-GC ALS

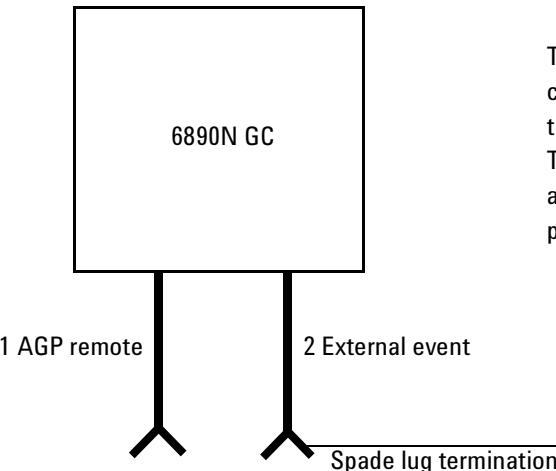
6890N GC

Mass Selective Detector GC ChemStation GC Automatic Liquid Sampler



Number	Part no. and description
1	G1530-60930, 2-m APG remote cable, 9-pin male/9-pin male
2	G1530-61485, Cable, 100 Base T-LAN

Figure 1015-3

6890N GC**GC Automatic Liquid Sampler
Non-Agilent Data System**

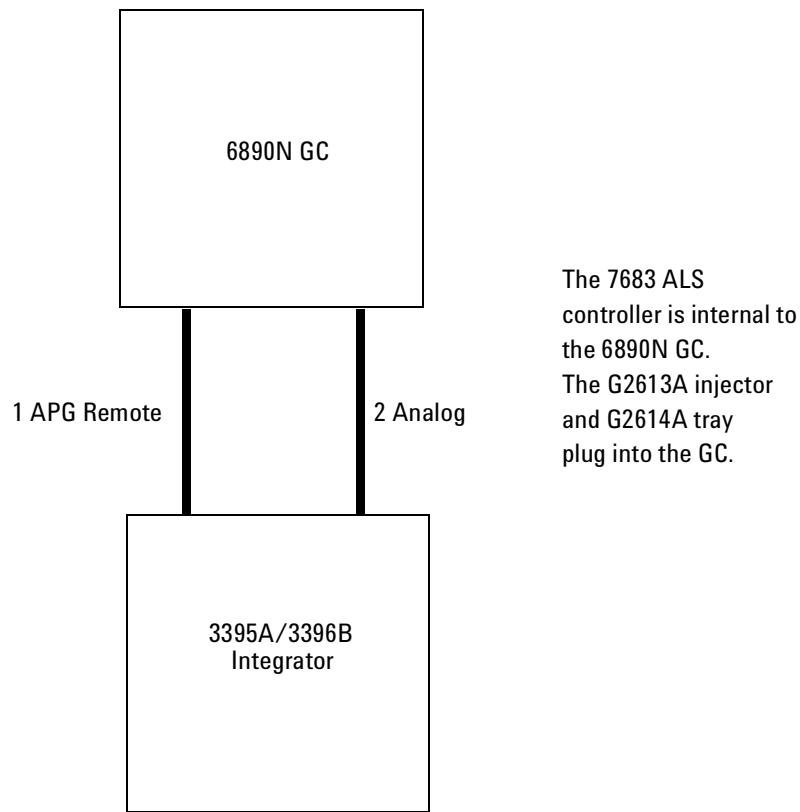
Number	Part no. and description
1	35900-60670, General use APG remote cable, 9-pin male/spade lug (2m) 35900-60920, General use APG remote cable, 9-pin male/spade lug (5m) 35900-60930, General use APG remote cable, 9-pin male/spade lug (0.5m)
2	G1530-60590, External event cable, 8-pin/spade lugs

35900-60670 APG remote cable spade lug identification

Connect 1 9 pin (male)	Signal name	Connector 2 spade lugs
1	GND	Black
2	Prepare	White
3	Start	Red
4	Shut down	Green
5	Reserved	Brown
6	Power on	Blue
7	Ready	Orange
8	Stop	Yellow
9	Start Request	Violet

G1530-60590 External event cable spade lug identification

Pin	Color	Signal
1	Yellow	24 V Out 1
2	Black	24 V Out 2
3	Red	Ground
4	White	Ground
5	Orange	Contact 1
6	Green	Contact 1
7	Brown	Contact 2
8	Blue	Contact 2

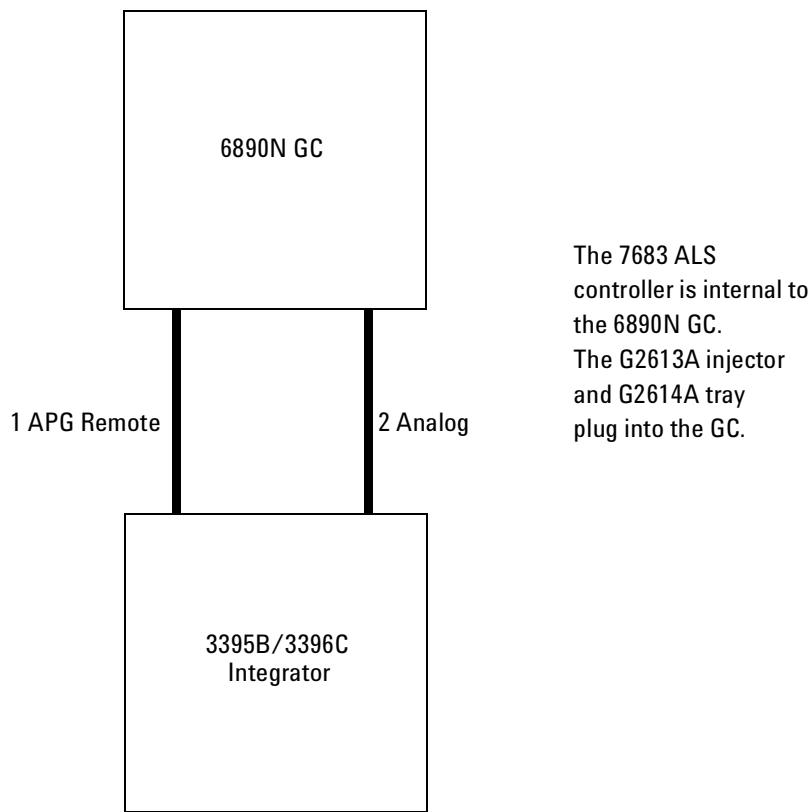
6890N GC**3395A/3396B Integrator
GC Automatic Liquid Sampler**

Number	Part no. and description
1	03396-61020, 2-m APG remote cable, 9-pin/15-pin
2	G1530-60570, 2-m Analog cable, 6-pin

Figure 1015-4

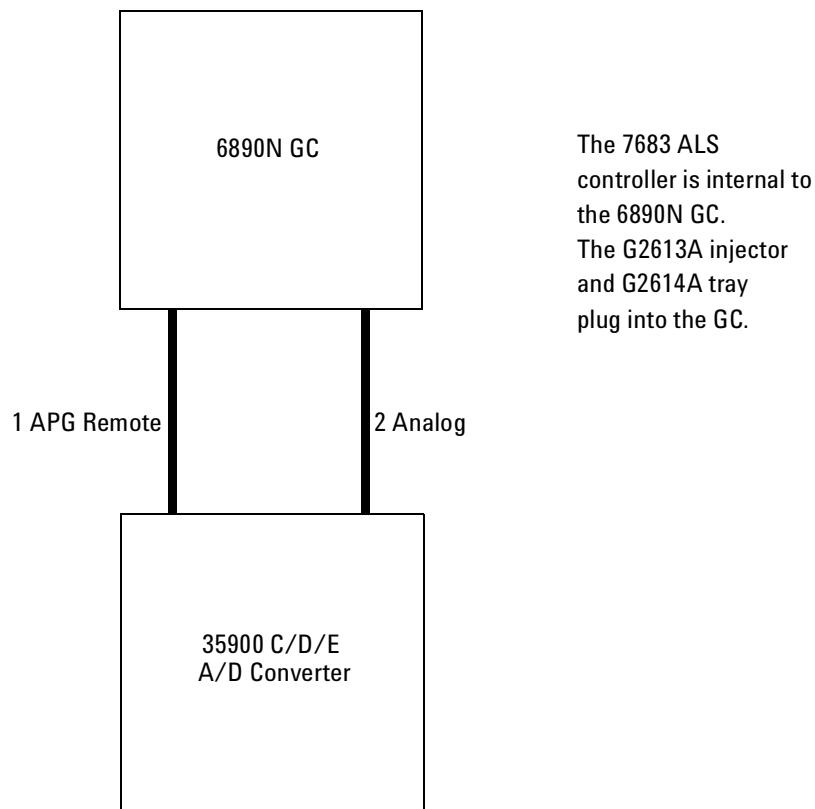
6890N GC

3395B/3396C Integrator GC Automatic Liquid Sampler



Number	Part no. and description
1	03396-61010, APG remote cable, 9-pin/15-pin
2	G1530-60570, 2-m Analog cable, 6-pin

Figure 1015-5

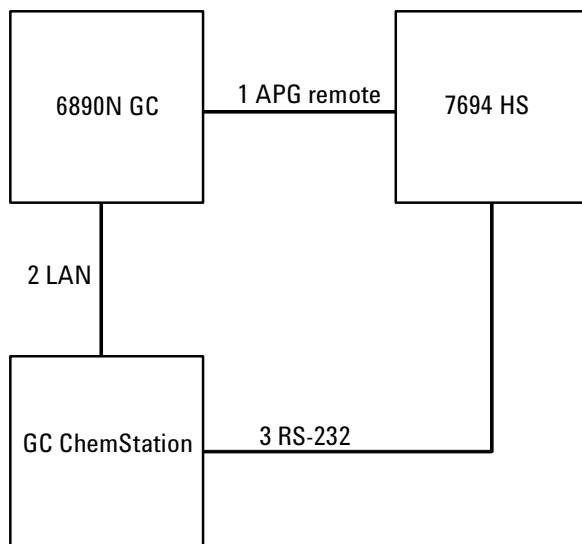
6890N GC**35900C/D/E Analog-to-Digital Converter
GC Automatic Liquid Sampler**

Number	Part no. and description
1	G1530-60930, 2-m APG remote cable, 9-pin male/9-pin male
2	G1530-60570, 2-m Analog cable, 6-pin

Figure 1015-6

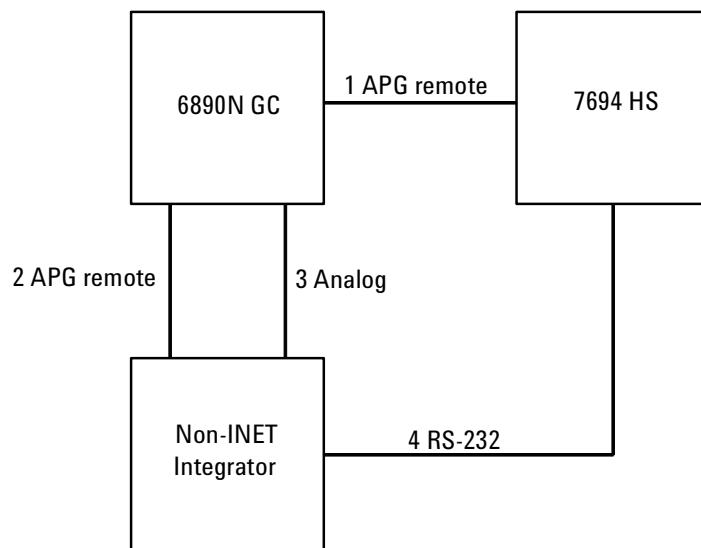
6890N GC

7694 Headspace Sampler GC ChemStation



Number	Part no. and description
1	G1290-60575, APG remote cable, 3-pin male/4-pin male
2	G1530-61485, Cable, 100 Base T-LAN
3	G1290-60650, RS-232 cable, 9-pin female/9-pin female

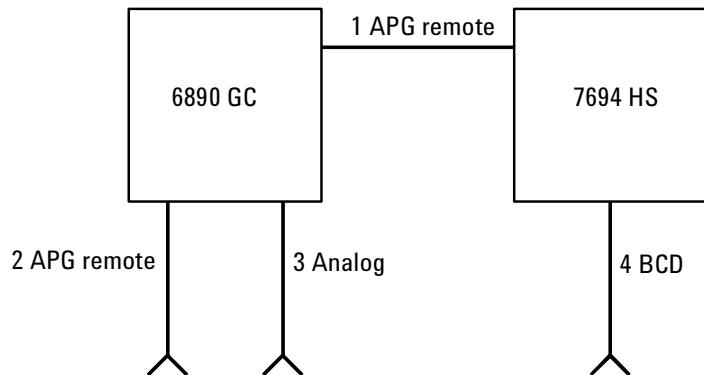
Figure 1015-7

6890N GC**7694 Headspace Sampler
Non-INET Integrator**

Number	Part no. and description
1	G1290-60575, APG remote cable, 3-pin male/4-pin male
2	03396-61010, APG remote cable, 9-pin/15-pin (for 3395B/ 3396C) OR 03396-61020, APG remote cable, 9-pin/15-pin (for 3395A/ 3396B)
3	G1530-60570, 2-m Analog cable, 6-pin
4	03396-60530, RS-232 cable, 15-pin male/9-pin female

Figure 1015-8

6890N GC **7694 Headspace Sampler**

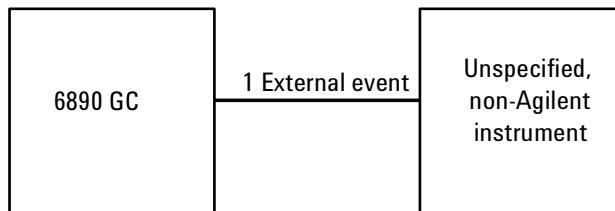


Number	Part no. and description
1	G1290-60575, APG remote cable, 3-pin male/4-pin male
2	35900-60670, 2-m APG remote cable, 9-pin male/spade lugs
3	G1530-60560, Analog cable, 6-pin/spade lugs
4	03396-60570, Binary-coded decimal cable

G1530-60560 analog cable spade lug identification

Pin	Color	Signal
1	Black	1 mV COM
2	Red	1 V and 1 DV COM
3	White	1 mV
4	Orange	1 V
5	Brown	Chassis ground
6	Blue	1 DV

Figure 1015-9

6890N GC**External Events
(an unspecified, non-Agilent instrument)**

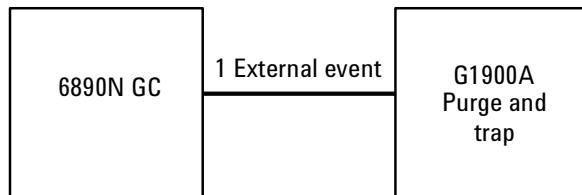
Number	Part no. and description
1	G1530-60590, External events cable, 8-pin/spade lugs

Connector	Signal name	Maximum rating	Wire terminations	Corresponds to valve #
24 volt control output				
1	24 volt output 1	75 mA output	Yellow	5
2	24 volt output 2	75 mA output	Black	6
3	Ground		Red	
4	Ground		White	
Relay contact closures (normally open)				
5	Contact closure 1	48V AC/DC, 250 mA	Orange	7
6	Contact closure 1		Green	7
7	Contact closure 2	48 V AC/DC, 250 mA	Brown or violet	8
8	Contact closure 2		Blue	8

Figure 1015-10 External event connections

6890N GC

G1900A Purge and Trap

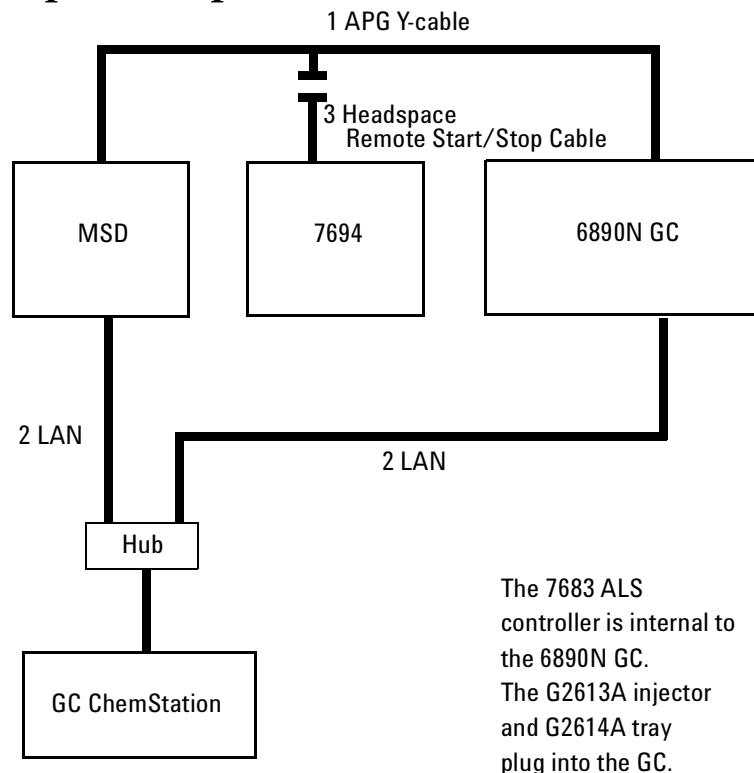


Number	Part no. and description
1	G1900-60820, APG remote cable

Figure 1015-11

6890N GC

**Mass Selective Detector
GC ChemStation/Cerity
Headspace Sampler**



Number	Part no. and description
1	G1530-61200, 2m APG Y-cable
2	G1530-61485, Cable, 100 Base T-LAN
3	G1290-60575, Headspace Remote Start/Stop cable

Figure 1015-12

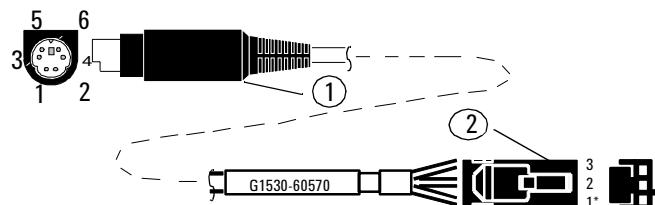
1020 Cable Electronics

Analog signal outputs

There are two channels of analog output available on the back panel, labeled *Sig 1* and *Sig 2*. Two cables are available – one for 3395/6 series integrators and one for general use.

Analog cable – GC to 3395A/B or 3396B/C Integrators and 35900 C/D/E Analog to Digital Interface instrument

Part no. G1530-60570

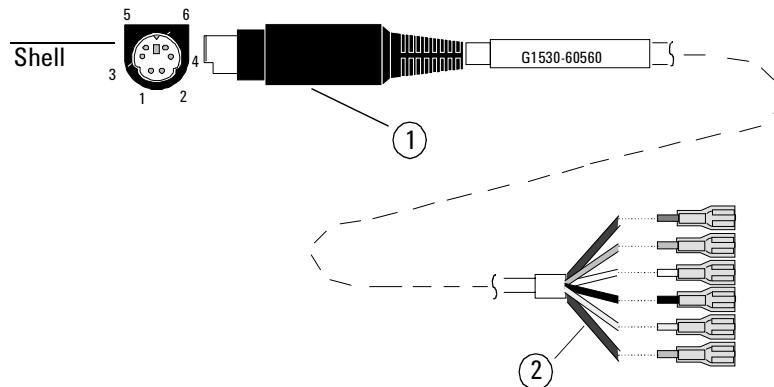


*1 next to triangle etched on connector

Connector 1	Signal Name	Color	Connector 2
4	1 V	Black	3
2	Common	White	2
Shell	Ground	Orange	1

Analog cable – general use

Part no. G1530-60560



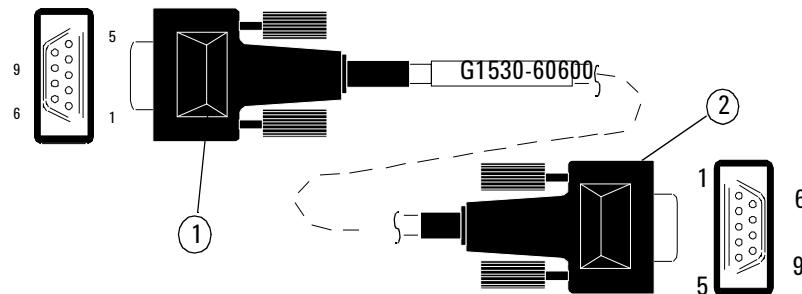
Connector 1	Signal name	Connector 2 — quick disconnects
1	0 to 1 mV (-)	Brown
2	0 to 1 V, 0 to 10 V(-)	White
3	0 to 1 mV (+)	Red
4	1 V (+)	Black
6	10 V (+)	Blue
Shell	Ground	Orange

Automatic sampler, 6890A GC

This RS-232C serial port (labeled *sampler* on the back of the GC) is preconfigured to connect the GC to an Automatic Liquid Sampler.

Cable pinouts, 6890 GC to Automatic Liquid Sampler

Part no. G1530-60600



Connector 1 — 9 pin (female)	Connector 2 — 9 pin (female)
1 — DCD	4 — DTR
6 — DSR	
2 — Rx	3 — Tx
3 — Tx	2 — Rx
4 — DTR	6 — DSR
5 — Ground	1 — DCD
7 — RTS	5 — Ground
8 — CTS	8 — CTS
9 — RI	7 — RTS

Automatic sampler, 6890 Plus and 6890N GCs

6890 Plus

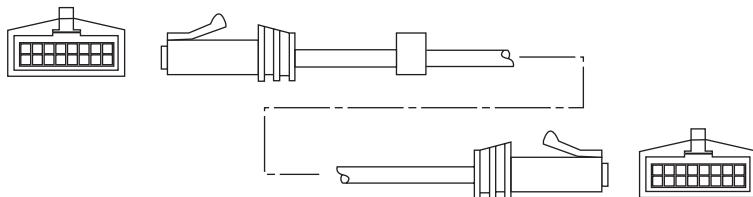
GC's with serial numbers > 20,000 require an additional PCB for use with an automatic liquid sampler. When an ALS Interface PCB is installed, three connectors are available for the 7683 Autosampler system.

6890N

There are three connectors, Sampler 1, Sampler 2, and Tray, for the 7683 Autosampler system.

Cable pinouts, 6890 Plus/6890N GC to G2613A Injector

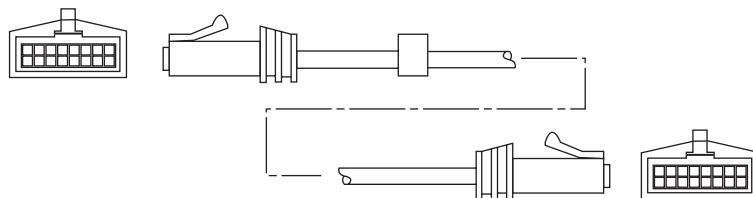
Part no. G2613-60590



Connector 1 — 16 pin (female)		Connector 2 — 16 pin (female)	
A1	RXD	A1	TXD
A2	CTS	A2	RTS
A3	DSR	A3	DTR
A4	NCTL Reset	A4	NCTL Reset
A5	GND	A5	GND
A6	VAC 1	A6	VAC 1
A7	GND	A7	GND
A8	VAC 2	A8	VAC 2
B1	TXD	B1	RXD
B2	RTS	B2	CTS
B3	DTR	B3	DSR
B4	GND	B4	GND
B5	GND	B5	GND
B6	VAC 1	B6	VAC 1
B7	GND	B7	GND
B8	VAC 2	B8	VAC 2

Cable pinouts, 6890 Plus/6890N to G2614A Tray

Part no. G2614-60610



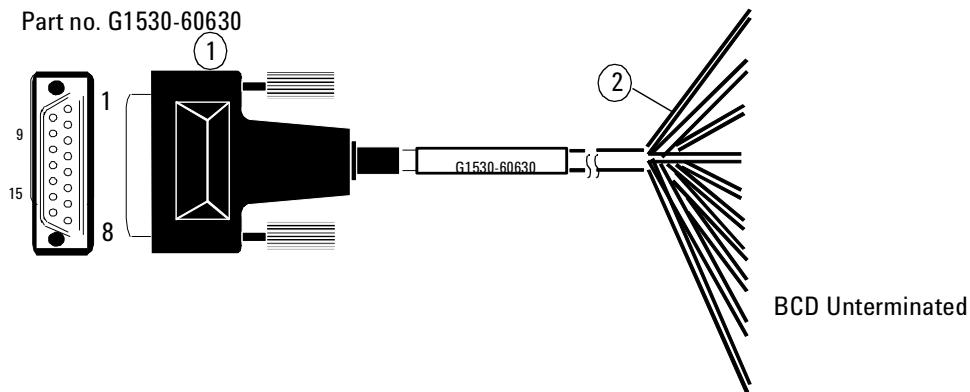
Connector 1 — 16 pin (female)		Connector 2 — 16 pin (female)	
A1	RXD	A1	TXD
A2	CTS	A2	RTS
A3	DSR	A3	DTR
A4	M Reset	A4	M Reset
A5	GND	A5	GND
A6	VAC 1	A6	VAC 1
A7	GND	A7	GND
A8	VAC 2	A8	VAC 2
B1	TXD	B1	RXD
B2	RTS	B2	CTS
B3	DTR	B3	DSR
B4	GND	B4	GND
B5	GND	B5	GND
B6	VAC 1	B6	VAC 1
B7	GND	B7	GND
B8	VAC 2	B8	VAC 2

BCD Inputs

6890A and 6890 Plus

The BCD cable is used to read the position of a stream selection valve, headspace sampler, or other device. It consists of eight passive inputs that sense open/closed contacts.

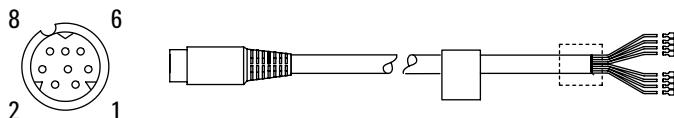
If you are using a multiposition (stream selection) valve, you must also have an external event cable.



Connector 1 15 pin (male)	Signal name	Logic	Color
1	LS digit 0	Low (true)	Black
2	LS digit 1	Low (true)	Brown
3	LS digit 2	Low (true)	Red
4	LS digit 3	Low (true)	Orange
5, 6, 7	Unused		
8	Ground		Gray
9, 10, 11	Unused		
12	MS digit 0	Low (true)	Yellow
13	MS digit 1	Low (true)	Green
14	MS digit 2	Low (true)	Blue
15	MS digit 3	Low (true)	Violet

6890N

The connector provides the control relays and a BCD input for a stream selector Multi Valve.

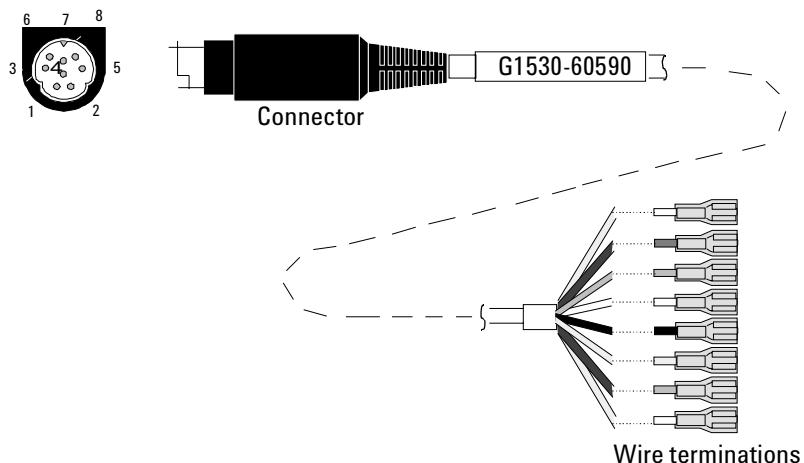
**BCD Connector**

Pin	Function	Color	Maximum rating
1	Relay	Yellow	48 V AC/DC, 250 mA
2	Relay	Black	48 V AC/DC, 250 mA
3	LS digit 0	Red	
4	LS digit 1	White	
5	LS digit 2	Orange	
6	LS digit 3	Green	
7	MS digit 0	Brown or Violet	
8	GND	Blue	
Shield	Chassis GND		

External event

Two passive relay contact closures and two 24-volt control outputs are available for controlling external devices. Devices connected to the passive contact closures must be connected to their own power source.

Part no. G1530-60590

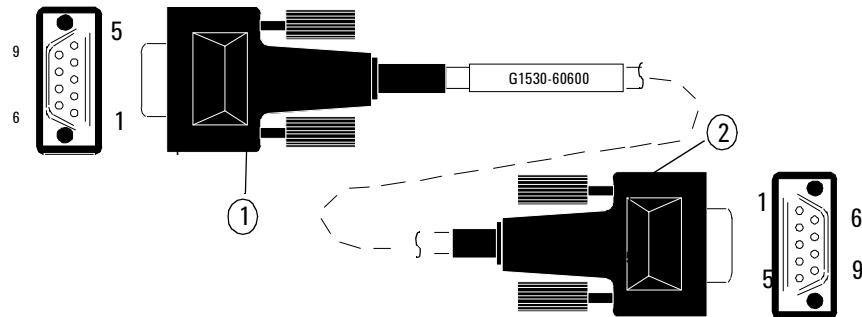


Connector	Signal name	Maximum rating	Wire terminations	Corresponds to valve #
24 volt control output				
1	24 volt output 1	75 mA	Yellow	5
2	24 volt output 2	75 mA	Black	6
3	Ground		Red	
4	Ground		White	
Relay contact closures (Normally open)				
5	Contact closure 1	48V ac/dc, 250 mA	Orange	7
6	Contact closure 1		Green	7
7	Contact closure 2	48 V ac/dc, 250 mA	Brown or Violet	8
8	Contact closure 2		Blue	8

Modem/RS-232C

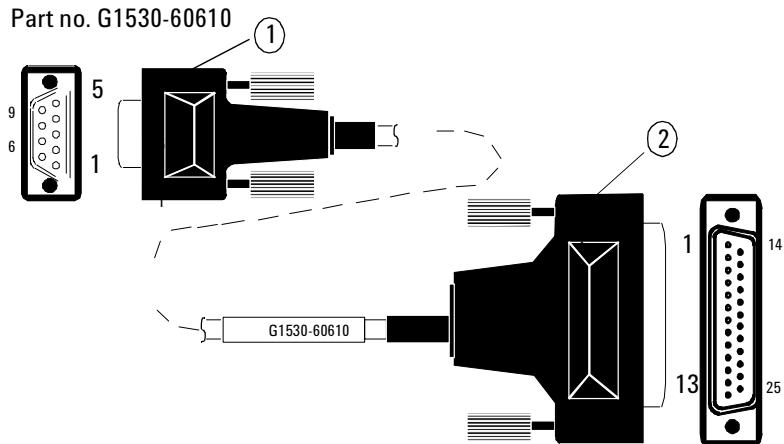
Cable pinouts, 6890 GC to Computer via RS-232, 9-pin/9-pin

Part no. G1530-60600



Connector 1 — 9 pin (female)	Connector 2 — 9 pin (female)
1 — DCD	4 — DTR
6 — DSR	
2 — Rx	3 — Tx
3 — Tx	2 — Rx
4 — DTR	6 — DSR
	1 — DCD
5 — Ground	5 — Ground
7 — RTS	8 — CTS
8 — CTS	7 — RTS
9 — RI	

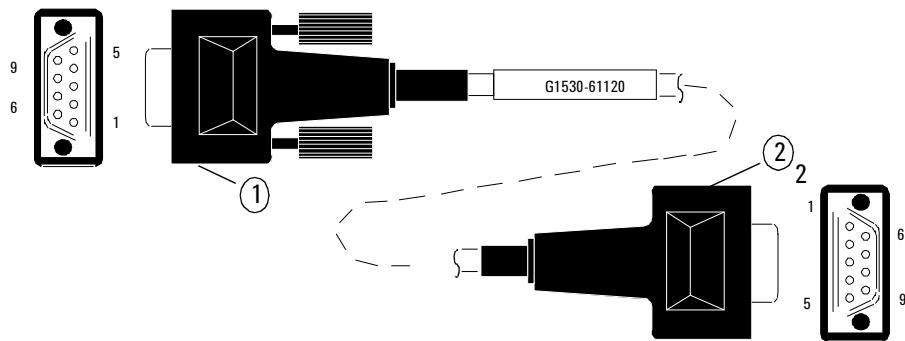
Cable pinouts, 6890 GC to Computer via RS-232, 9-pin/25-pin



Connector 1 — 9 pin (female)	Connector 2 — 25 pin (male)
1 — DCD	20 — DTR
6 — DSR	
2 — Rx	2 — Tx
3 — Tx	3 — Rx
4 — DTR	6 — DSR
5 — Ground	7 — Ground
7 — RTS	5 — CTS
8 — CTS	4 — RTS
9 — RI	

Cable pinouts, 6890 GC to Modem, 9 pin/9-pin

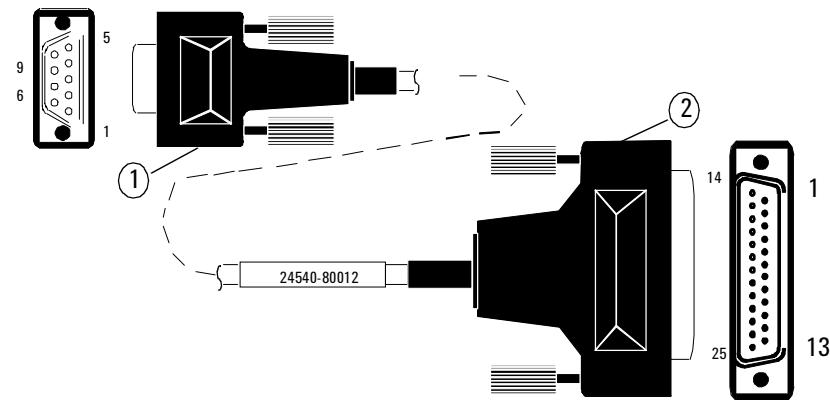
Part no. G1530-61120



Connector 1 — 9 pin (female)	Signal name	Connector 2 — 9 pin (male)
1	DEC	1
2	RxD	2
3	TxD	3
4	DTR	4
5	GND	5
6	DSR	6
7	RTS	7
8	CTS	8
9	RI (Unused)	9

Cable pinouts, 6890 GC to Modem, 9-pin/25-pin

Part no. 24540-80012 or 24542M

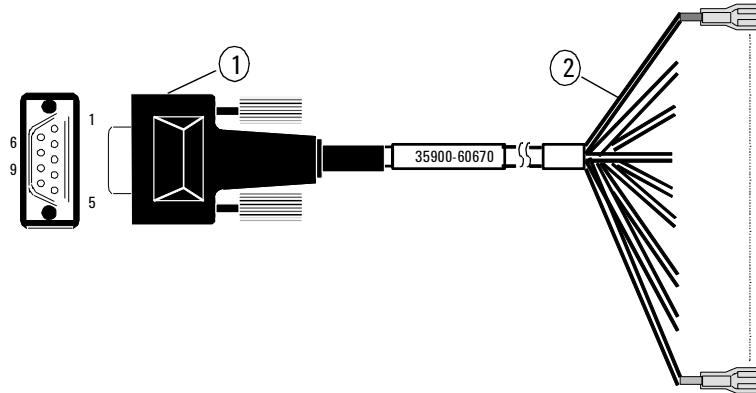


Connector 1 — 9 pin (female)	Signal name	Connector 2 — 25 pin (male)
1	DCD	8
2	RxD	3
3	TxD	2
4	DTR	20
5	GND	7
6	DSR	6
7	RTS	4
8	CTS	5
9	(Unused)	22

Remote

Cable pinouts, remote start/stop, general use

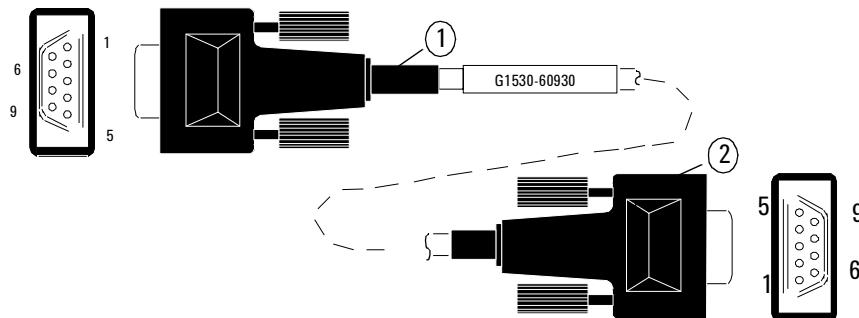
Part no. 35900-60670



Connector 1 9 pin (male)	Signal name	Connector 2 (spade lugs)
1	GND	Black
2	Prepare (low true)	White
3	Start (low true)	Red
4	Shut down (6890A/Plus); start relay (6890N)	Green
5	Reserved (6890A/Plus); start relay (6890N)	Brown
6	Power on (6890A/Plus); no connection (6890N)	Blue
7	Ready (high true input)	Orange
8	Stop (low true)	Yellow
9	Start request (6890A/Plus); no connection (6890N)	Violet

Cable pinouts, GC to 35900C, D, E/MSD/Sampler, 2 meters

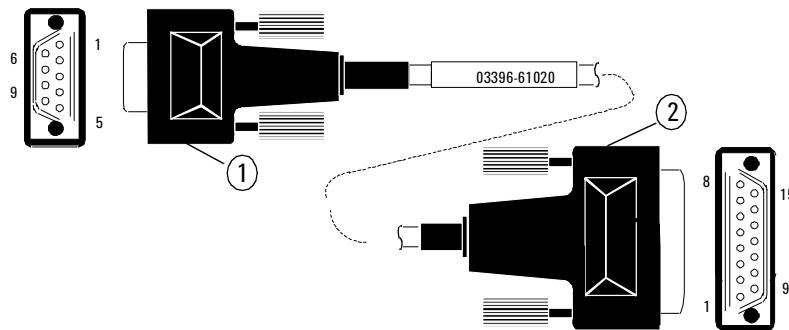
Part no. G1530-60930



Connector 1 (male)	Signal name	Connector 2 (male)
1	GND	1
2	Prepare	2
3	Start	3
4	Shut down (6890A/Plus); start relay (6890N)	4
5	Reserved (6890A/Plus); start relay (6890N)	5
6	Power on (6890A/Plus); no connection (6890N)	6
7	Ready	7
8	Stop	8
9	Start request (6890A/Plus); no connection (6890N)	9

Cable pinouts, 6890 GC to 3395A/3396B Integrator

Part no. 03396-61020

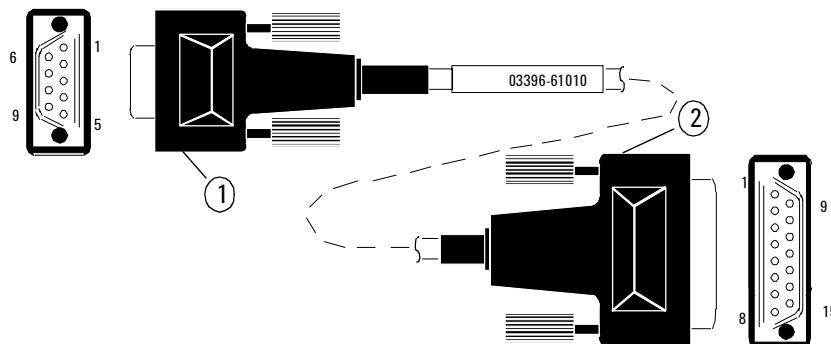


Connector 1 9 pin (male)	Signal name	Connector 2 15 pin (male)
1	GND	9 — Ground
2	Prepare	NC*
3	Start	3 — Start in
4	Shut down (6890A/Plus); start relay (6890N)	NC*
5	Reserved (6890A/Plus); start relay (6890N)	NC*
6	Power on (6890A/Plus); no connection (6890N)	NC*
7	Ready	14 — Ready out
8	Stop	NC*
9	Start request (6890A/Plus); no connection (6890N)	NC*

*NC = no connection

Cable pinouts, 6890 GC to 3395B/3396C Integrator

Part no. 03396-61010

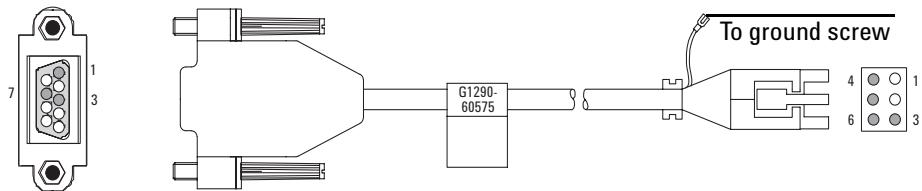


Connector 1 9 pin (male)	Signal name	Connector 2 15 pin (male)
1	GND	9 — Ground
2	Prepare	NC*
3	Start	3 — Start in
4	Shut down (6890A/Plus); start relay (6890N)	NC*
5	Reserved (6890A/Plus); start relay (6890N)	NC*
6	Power on (6890A/Plus); no connection (6890N)	NC*
7	Ready	14 — Ready out
8	Stop	4 — STOP2 In
9	Start request (6890A/Plus); no connection (6890N)	NC*

*NC = no connect

Cable pinouts, 6890 GC to 7694 Headspace Sampler

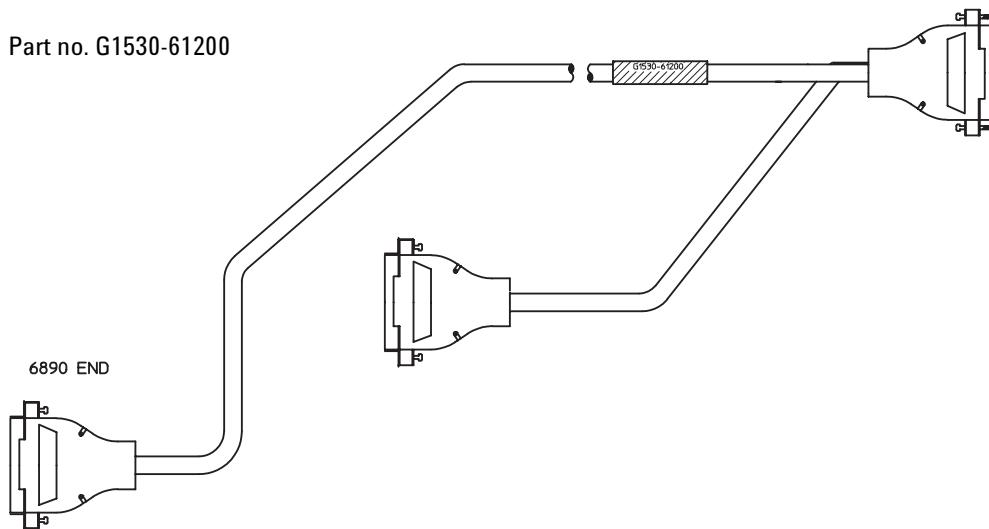
Part no. G1290-60575



Connector 1 3-pin male	Signal name	Connector 4-pin male
1	GND	4, 5
3	Start	6
7	Ready	3

Cable pinouts, APG Remote Y-cable

Part no. G1530-61200



Connector 1 9 pin (male)	Signal name
1	GND
2	Prepare
3	Start
4	Shut down (6890A/Plus); start relay (6890N)
5	Reserved (6890A/Plus); start relay (6890N)
6	Power on (6890A/Plus); no connection (6890N)
7	Ready
8	Stop
9	Start request (6890A/Plus); no connection (6890N)

1100 Valves

1110 Valves

1120 Valve Box

1130 Actuators

1140 Typical Valve Configurations

1150 Troubleshooting

Maintaining the valves in the 6890 instrument.

1110 Valves

Introduction

Specific part numbers are not given in this portion of the service manual. For all replacement part numbers, refer to the IPB portion of this document.

This document does not provide instruction for first time installation of any of the options discussed. The add-on sheets, which accompany the various options, exist for just this purpose, and should be referenced when performing a first time installation.

The valves described in this manual are W-series minivalves, manufactured by VALCO Instruments Co, Houston, Texas. The valve body is made of Nitronic-60 nickel steel with 1/16-inch fittings.

Proper instrument operation will prolong the life of the valve system. Read all the accompanying information and avoid the following operational abuses:

- Exceeding the specified temperature and pressure ranges
- Plugging a valve with column packing or sample precipitation
- Scoring valve surfaces with column packing or particulates in liquid or gas sample
- Contaminating the system with samples (non-eluting materials) or poor quality support gases

Because valves operate best at a constant temperature, the 6890 GC places valves in their own heated compartment.

WARNING To reduce the fire hazard when sampling flammable gases or liquids under pressure, operators should routinely make pressure-leak tests of the plumbing, fitting and valves. Both valve positions should be checked. Depending on the nature and pressure of the sample stream, periodic pressure leak test and visual inspection should be made since wear or use could cause leaks to develop. Leaks may occur inside the valve box and be concealed from the operators view.

Valco W-series minivalves

Valves consist of a driver, valve body, rotor, and preload assembly.

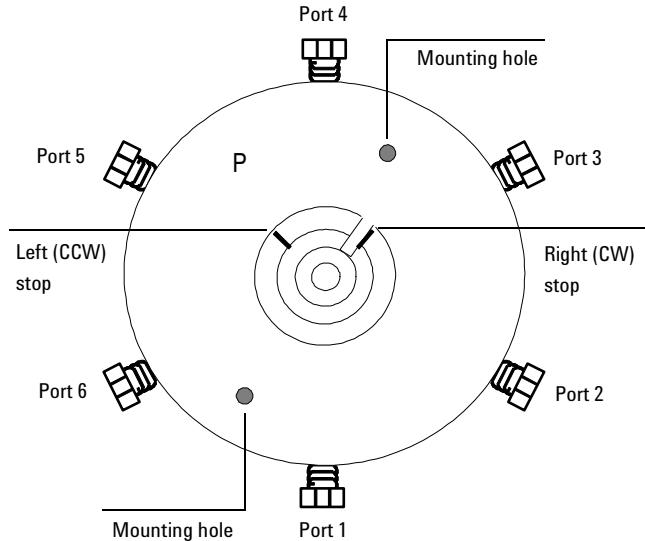


Figure 1110-1 Valco W-series minivalve

Table 1110-1 Part Numbers for 6890 Valves

General purpose (Gas Sample) valves			
Ports	Low temp	High temp	
6	5062-9508	0101-0584	
10	5062-9510	0101-0585	
Liquid sampling valves			
Ports	Volume	Pressure	Valve
4	0.2 µL	1000	0101-0636
4	0.5 µL	1000	0101-0637
4	1.0 µL	1000	0101-0638
4	0.5 µL	5000	0101-0639

Valve bodies

Body parts are made from Nitronics 60 nickel steel. If required, the valve may also be produced from Hastelloy C. External tubing (plumbing) is connected to the valve body ports by ferrules and fittings provided with the instrument.

The left (CCW, counterclockwise) and right (CW, clockwise) stops on general purpose valve bodies limit rotor rotation so the correct flow path results when the index pin is close to or against either stop of the index lip.

Caution	Intermediate positions of the rotor may result in an interrupted flow path which could cause damage to the valve or other components in the chromatograph.
----------------	--

Valve rotors

Rotor type can be identified by color:

- An **off-white** rotor is made of a PTFE composite and may be used from room temperature to 200°C.
- A **black** rotor is made of polyimide and may be used from 100 to 350°C.

Caution	The life of a valve is shortened if used outside its specified temperature range Do not mix rotor types in the same system.
----------------	--

The rotor seats on a highly polished conical surface. When properly seated, the polished surface prevents leakage around the rotor and between non-selected ports. The finish precludes adsorption of most GC samples.

The rotor assembly is a one-piece part with an integral molded and machined conical hub and the parts necessary for proper seating. The sample contacts only the PTFE composite (low temperature) or polyimide (high temperature) as well as the stainless steel of the valve.

Grooves in the rotor surface form the paths between specific ports. The index pin prevents rotation beyond either stop of the index lip. Valve ports are connected by the grooves only when the index pin is close to or against either stop. Intermediate positions result in flow shutoff through the valve and possible damage if left in this position.

General purpose valves

The 6- and 10-port general purpose valves are suitable for column switching, isolation, backflushing, and other uses as well as gas sampling.

Gas sample valves

The standard gas sample valves have 1/16-inch zero dead volume fittings and an internal port diameter of 0.016-inch.

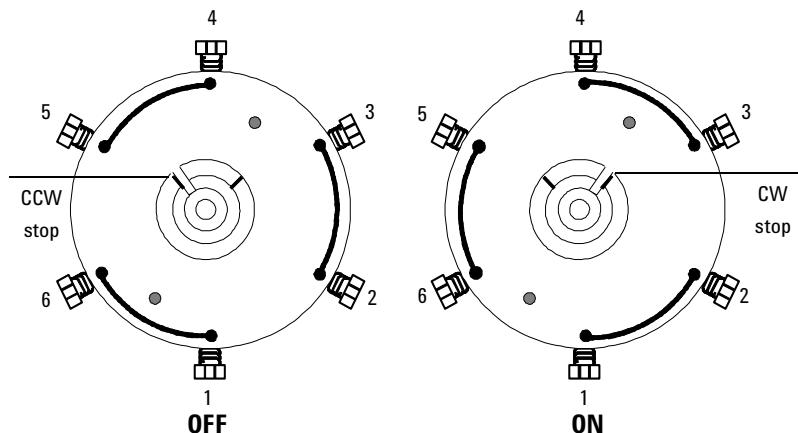


Figure 1110-2 6-port valve (actuator side view) showing flow path grooves

Gas sample loops

A 0.25 mL sample loop is included with all gas sampling valve systems. 10 mL and 5 mL loops occupy one valve position, limiting the number of valves that can be housed in a valve compartment.

Adjustable restrictor valves

Adjustable restrictors are used to balance flow resistance between the two valve positions. They are available with ambient to 225°C (part no. 0101-0633) or ambient to 350°C (part no. 0101-0948) operating ranges.

Liquid sample valves

Agilent Technologies offers 4-port LSVs with 0.2, 0.5, or 1 μL internal loops.

These valves are designed for liquefied gases under pressure such as ethane, propane, butane, LNG, etc. They are not intended for nonvolatile liquids (at room conditions) where a concealed leak could allow an accumulation or pool of liquid to form that may present a significant fire hazard.

All liquid sample valves have 1/16-inch fittings. The 0.5 μL size is available in low- (1000 psig limit) and high-pressure (5000 psig) versions; the other sizes are low-pressure (1000 psig) only.

An adjustable restrictor may be used on the sample outlet line to maintain internal sample pressure to keep a compressed gas liquefied.

Temperature ranges

1/16-inch Teflon rotor valves 0 to 200°C

Adjustable restrictor valves Ambient to 225°C

Caution The life of an LSV is shortened if used outside its specified pressure and temperature ranges. Highly dangerous leaks can occur if the valve box temperature ever exceeds the specified temperature limits.

Adjustable restrictor valve

The adjustable restrictor supplied with a liquid sample valve is designed for temperatures up to 225°C; it is NOT compatible with high-temperature valves.

1120 Valve Box

Installing the valve box

The valve box sits on top of the 6890 GC and contains the valves and plumbing, heated zones and sensors, and the insulation.

1. Use a pair of diagonal cutters to remove the metal cutout on the top of the GC.

WARNING Be careful of sharp edges!

Cut toward the outside edge of the tabs so that the valve box will fit correctly.

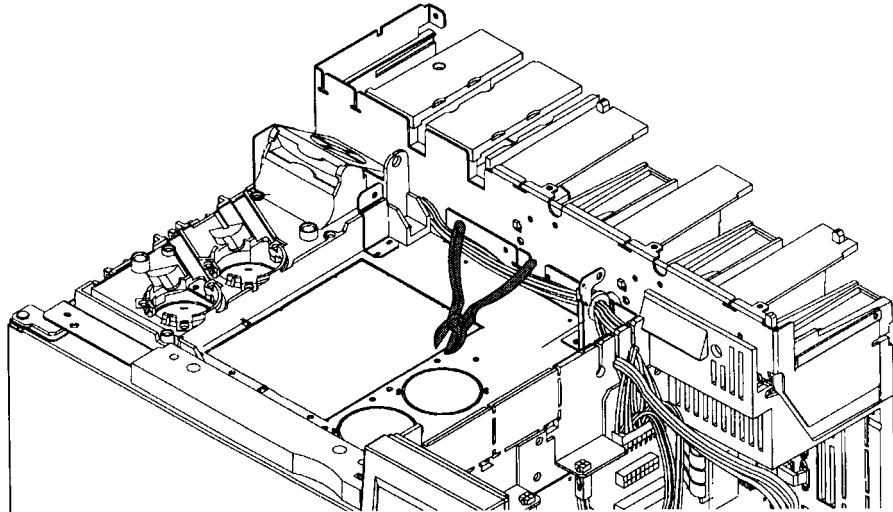


Figure 1120-1 Removing the sheet metal cutout

2. Screw the aluminum standoffs into the valve box bottom plate using one Torx T-20 screw for each standoff.

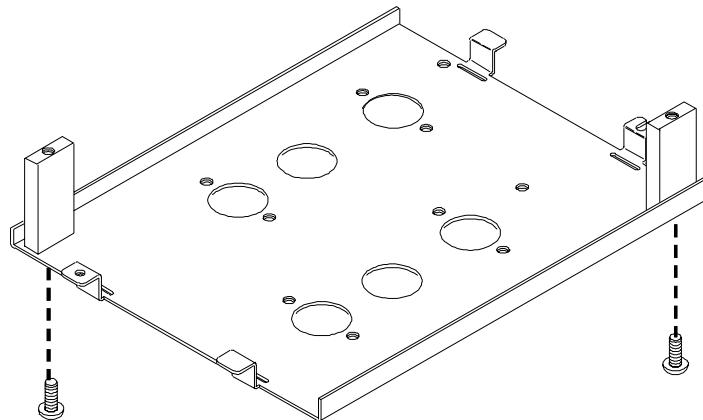


Figure 1120-2 Attaching the standoffs to the bottom plate

3. Screw the valve box bottom plate onto the top of the GC using three Torx T-20 screws.

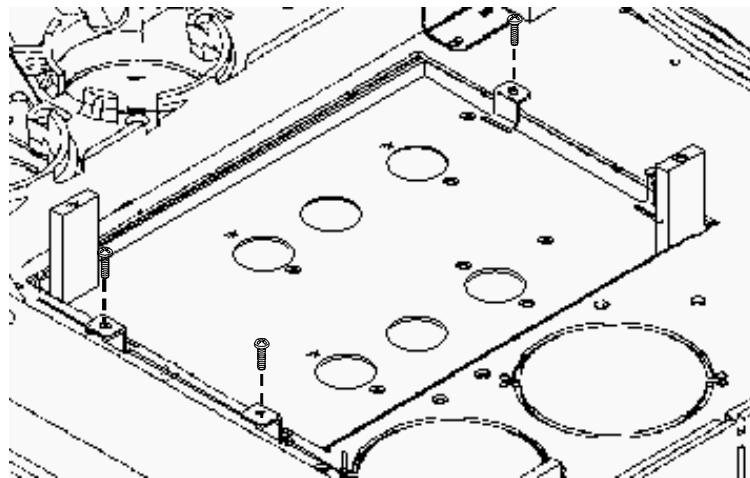


Figure 1120-3 Attaching the bottom plate to the 6890 GC

4. There are six holes in the plate for up to four valves. The outside holes on each side of the plate are for valves and the inside holes are for plumbing into the GC. Punch out the pre-perforated insulation from the holes you plan to use.
5. Use two Torx T-20 screws to mount the heater block(s) on the valve box bottom plate.
6. Install the heater/sensor into the heater block(s) and secure the leads to the valve box bottom plate with the U-clamp and two Torx T-10 screws.

Note

Make sure that the sensor is seated all the way in the heater block.

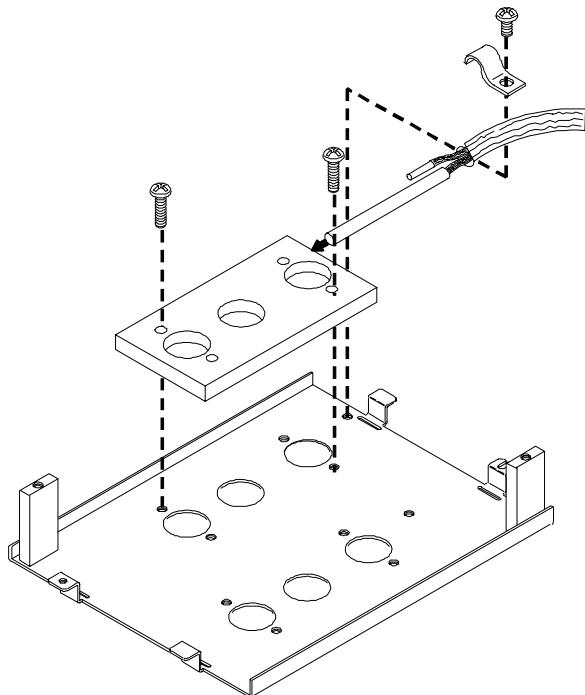


Figure 1120-4 Attaching heater block to the bottom plate

7. Insert the valve(s) into the appropriate hole(s) in the heater block and secure each valve with two long Torx T-10 screws.

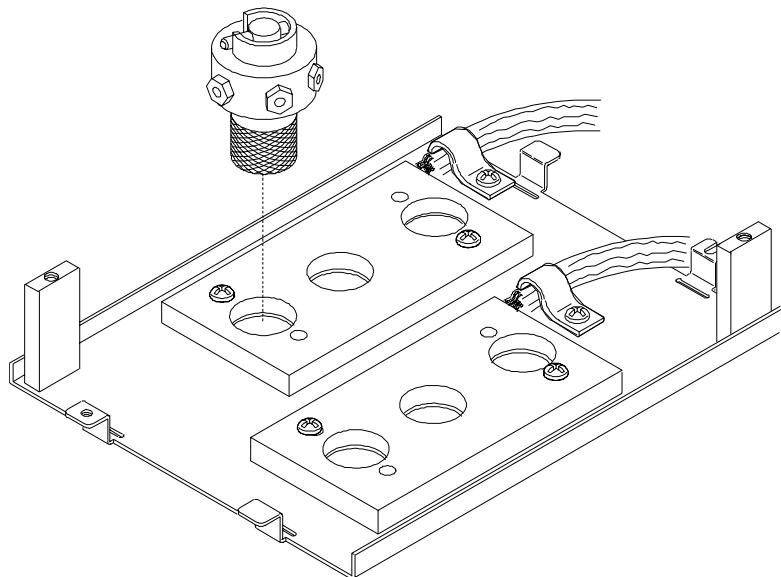


Figure 1120-5 Installing valves

8. Plumb the valves in the appropriate configuration. A variety of valve configurations are diagrammed in the *Typical Valve Configurations* section in this chapter.
9. Orient all of the valves in the OFF (CCW) position.

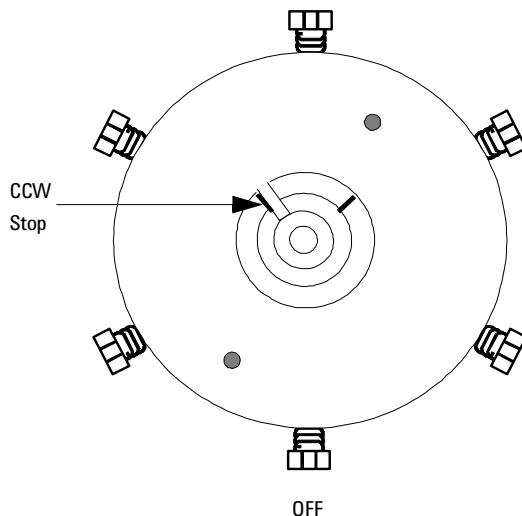


Figure 1120-6 Valve in the OFF position (top view)

10. Place the valve box insulation in the valve box top. Make sure the perforations in the insulation line up properly with the valve box top.
11. Insert the insulation retainer plate in the bottom of the valve box top and secure it to the threaded studs using the two 5.5-mm nuts.

Tighten the nuts until they are flush with the top of the stud. Make sure the holes in the retainer plate line up with the perforations in the insulation.

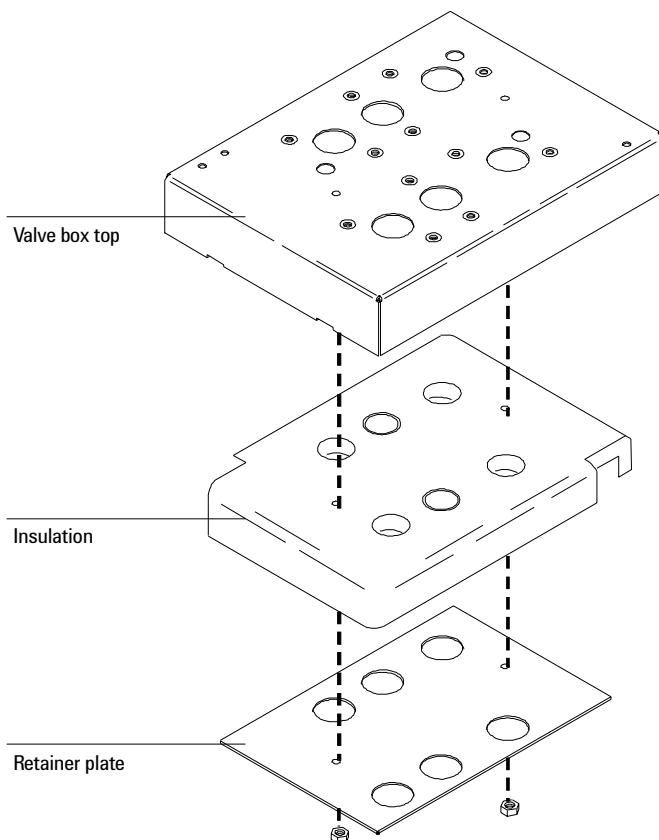


Figure 1120-7 Assembling the valve box top

12. While wearing a pair of protective gloves and holding the valve box top over a waste receptacle, punch or cut out the insulation from the appropriate holes.
13. Use two Torx T-20 screws to secure the valve box top over the installed valves, making sure the heater/sensor leads are routed under the appropriate cutout(s).

Make sure the valve box top is oriented correctly with holes punched out over the installed valves.

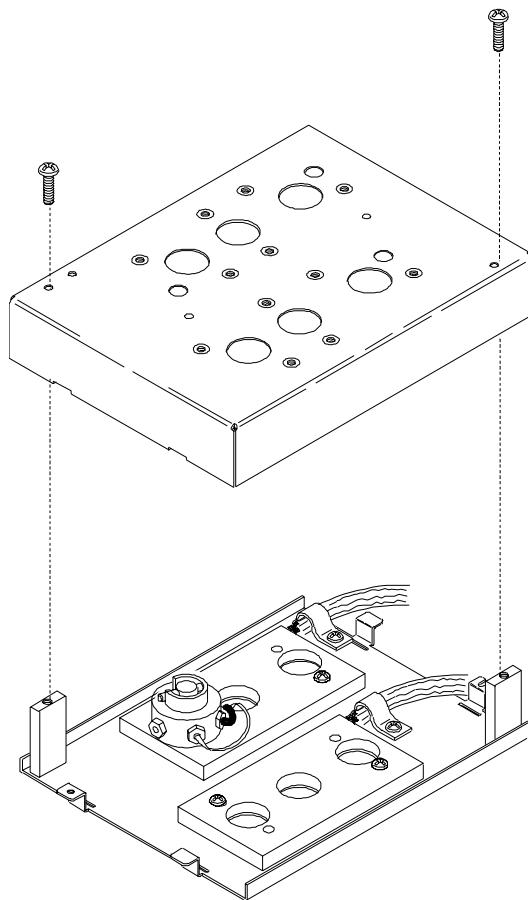


Figure 1120-8 Installing the valve box top assembly

14. Install the actuators as described in the *Actuators* section of this chapter.

Removing the valve box assembly

1. Place the main power switch in the off position.

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

2. Unplug the line power cord from its receptacle.
3. Allow some time for the oven and heated zones to cool.
4. When the oven has cooled, turn off all gas supplies.
5. Switch the solenoid valve off so the actuator is in its fully extended position (piston rod extended as shown).

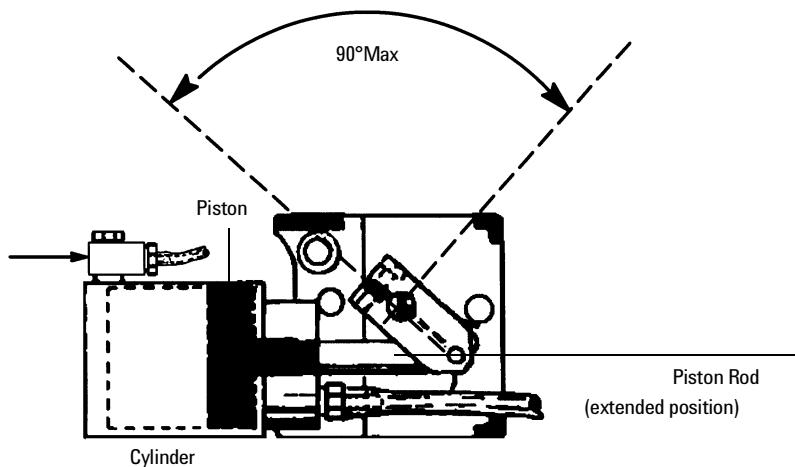


Figure 1120-9 Actuator in the fully extended position

6. If variable restrictors are present, remove their mounting hardware in the following order: two Torx T-20 screws, hex nut, and mounting bracket for each restrictor valve.

-
7. Remove the two Torx T-20 screws securing the valve box top assembly to the standoffs. Lift the valve box top assembly straight off the valve box. Be careful not to move the valve rotor index pin from its "at rest" position.

Note

If valve/actuator alignment is to be made, see *Valve/Actuator Alignment* in this section.

8. To reassemble: Align the two mounting holes in the valve box top assembly with the standoffs in the valve box. Lower the box top assembly until it rests on the standoffs.
9. Secure the valve box top assembly with two Torx T-20 mounting screws. Tighten these screws firmly. Reinstall hardware for variable restrictors if present.
10. Exercise the valve(s) on and off a few times to verify operation.

1130 Actuators

Installing the actuators

The actuators use pneumatic pressure (40 to 70 psi) to switch the valves between their two positions.

1. After installing the valves and valve box as described in the *Valve Box* section, you can install the valve actuators.
2. Set each actuator to the appropriate degree of rotation. Move the grenade style pin to the hole on the actuator marked with the correct degree of rotation, as shown below:
 - Four port valves—Place the pin in the 90° hole
 - Six port valves—Place the pin in the 60° hole
 - Ten port valves—Same as six port valves, but with the tubular 36° actuator limiter on the pin.

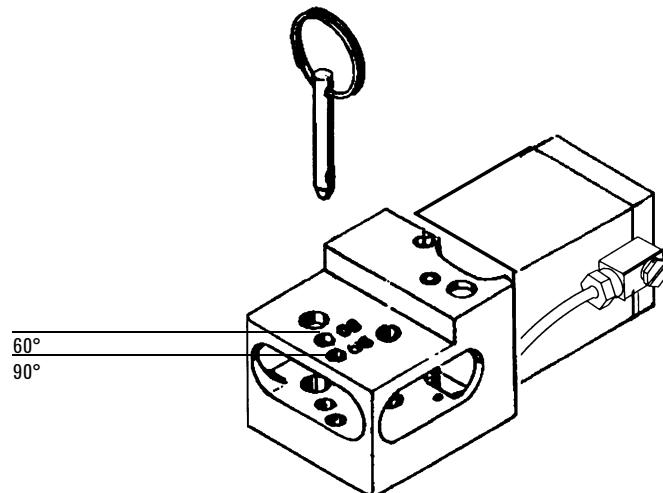


Figure 1130-1 Setting the actuator's degree of rotation

3. Mount an actuator over each valve installed using two Torx T-20 screws.

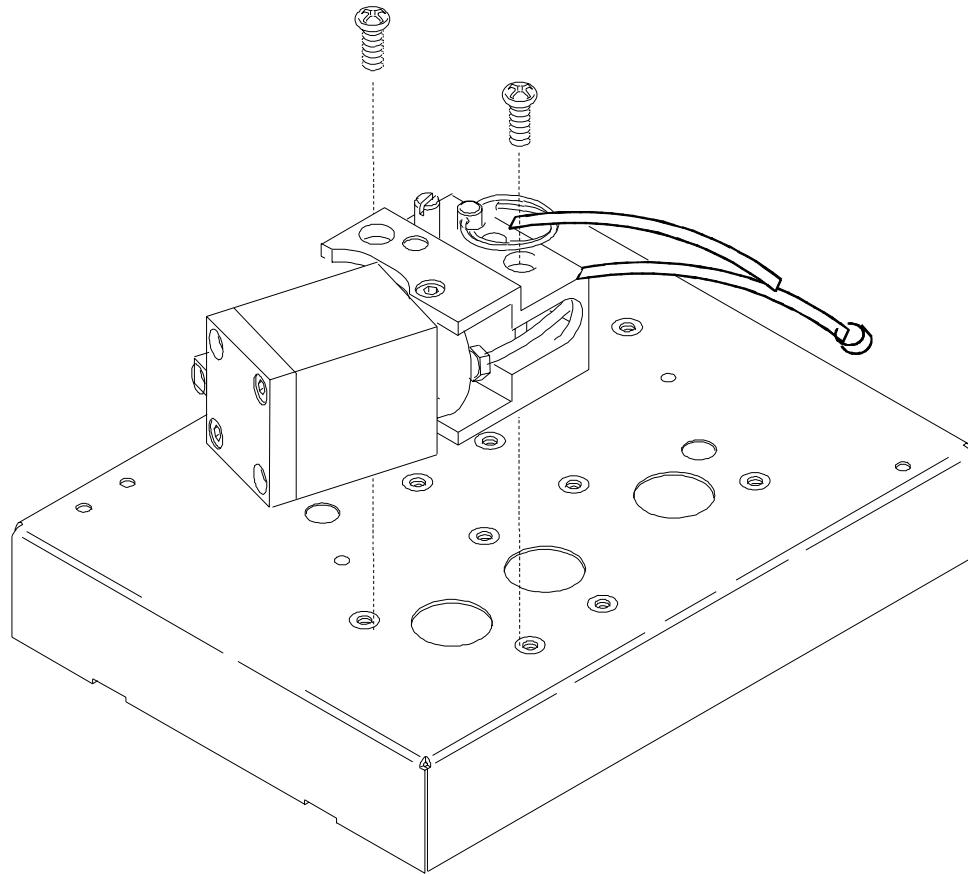


Figure 1130-2 Mounting the actuator on the valve box

4. Engage the actuator drive shaft coupler with the valve.
 - a. Loosen the hex nut on the actuator near the drive shaft.
 - b. Slide the shaft down.
 - c. Insert a flat bladed screw driver in the slot on the top of the actuator and turn the shaft back and forth until you feel the coupler engage the valve.
 - d. Tighten the set screw.

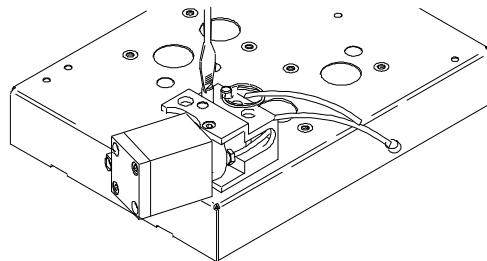


Figure 1130-3 Engaging the actuator drive shaft with the valve

5. Install the valve actuator drivers as described in the following section.

Valve drivers

The 6890 GC provides keyboard control for up to eight valve drivers which are named Valve 1 through Valve 8.

Table 1130-1 6890 GC Valve Designations

Valve	Driver	Purpose
Valves 1–4	24 volt, 13 watt	Normal valve operation
Valves 5–6	24 volt, 100 mA	Relays/low power devices
Valves 7–8	48 Vdc or 48 Vac rms	Contact closures

There is a BCD input for controlling a multiposition valve. If a valve is configured as a multiposition valve and the BCD is connected to this valve, a position can be selected directly from the keyboard.

Installing the valve actuator drivers

The valve actuators are driven by solenoid drivers which, when activated, send high pressure air to the actuator to switch the valve.

Assemble the valve driver block

The valve driver block accommodates up to four valve drivers. A valve driver must be installed for each valve/actuator installed.

Assemble the valve driver block as in Figure 1130-4. The example in this procedure shows a valve driver block parts breakdown for a two valve system.

1. Install two mounting posts on the intake/exhaust endplate (two large threaded holes). Install an O-ring in the supply/exhaust ports on the inside of the plate.
2. Slide a valve driver over the mounting posts in the orientation shown. Install two O-rings in the valve driver supply/exhaust ports as shown.

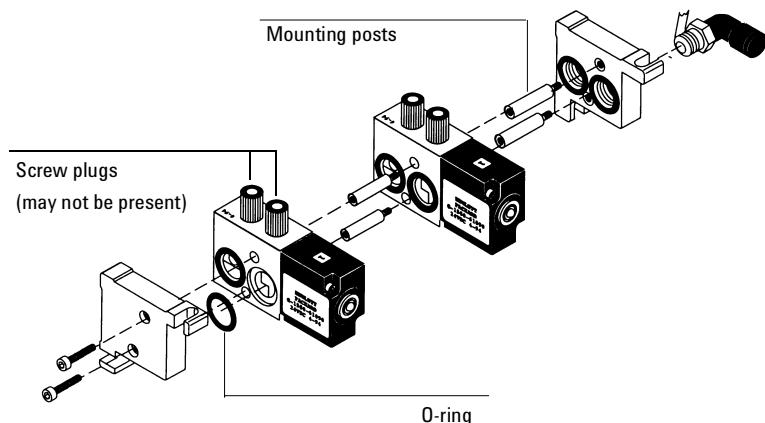


Figure 1130-4 Assembling the valve driver block

3. For each additional valve installed, install two more mounting posts and a valve driver with O-rings in the same manner as the first.
4. When all the drivers have been installed, screw on the other end plate with the two hex screws as shown.

Install the bracket and cabling

1. Install the valve actuators as described earlier in this section before installing the valve actuator drivers.
2. Screw the valve driver bracket into the right side of the GC using the two captive screws.

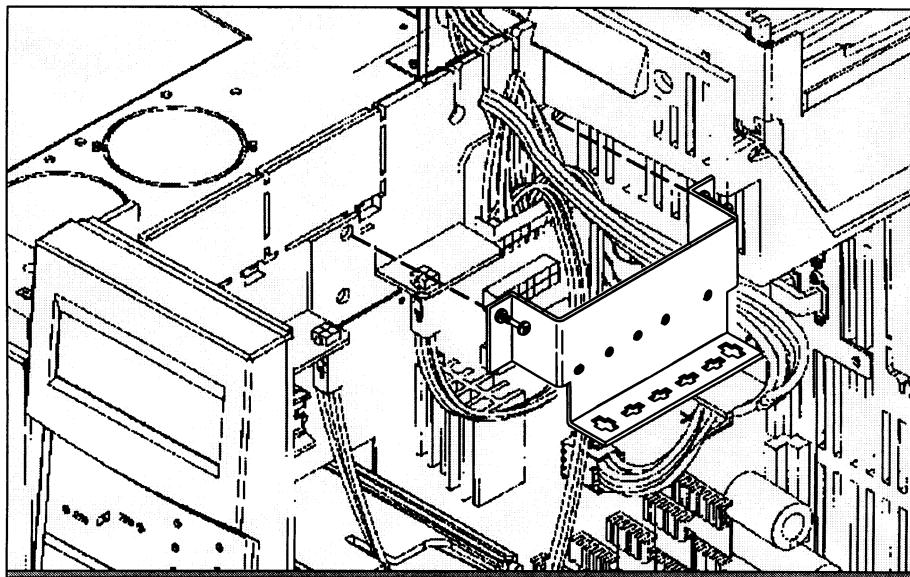


Figure 1130-5 Assembling the valve driver block

3. Plug the connectors on the valve driver cable harness up through the slots on the valve driver bracket.

Plug the larger 2×2 heater sensor connectors (P1, P2) into the outside slots and the smaller 1×2 valve driver connectors (P3 to P6) into the four middle slots.

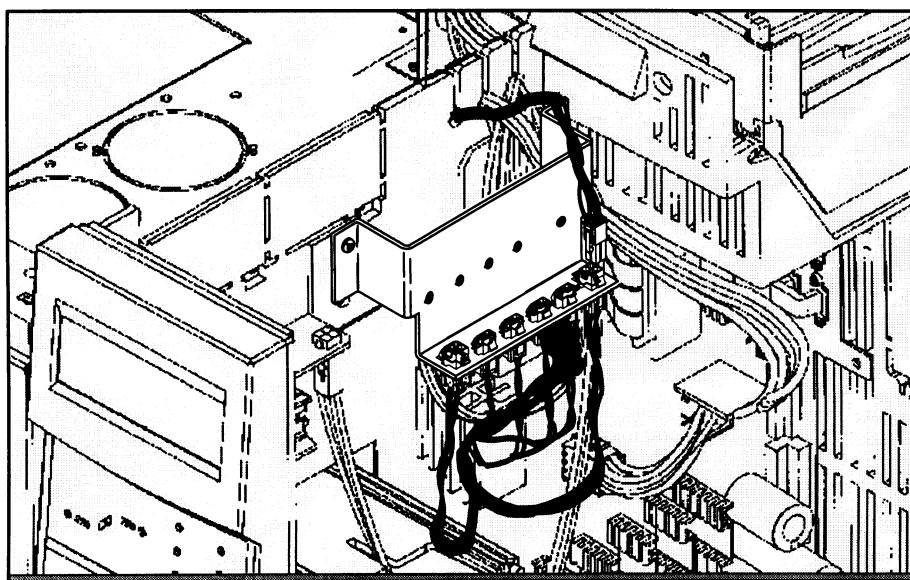


Figure 1130-6 Installing the cabling

4. Plug in the heater/sensor lead(s) from the valve heater blocks on top of the GC. Thread the heater/sensor lead(s) to the right side of the instrument, through one of the keyhole wiring slots and into the P1 or P2 detector on the actuator bracket.

Install the valve driver block

1. Slide the valve driver block down into the driver bracket until the drivers plug into the connectors.

Note

To remove drivers from the driver block, use a hex wrench to unscrew the two hex screws on the left side of the block. Remove the driver, collapse the block to the width of the remaining drivers and reinstall the hex screws.

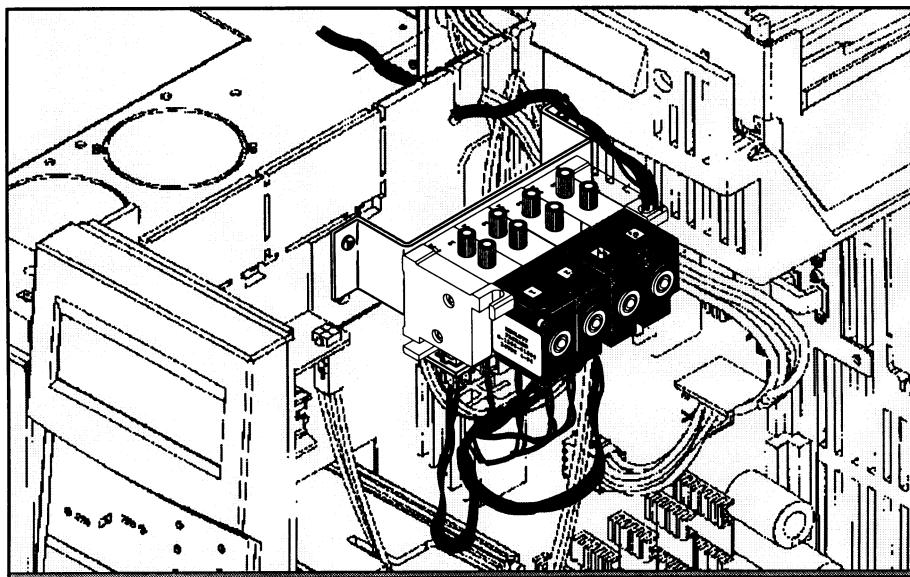


Figure 1130-7 Installing the valve driver block

2. Plug the other end of the valve driver cable harness into the P22 connector on the main board.
3. Wrap the threaded ends of the 90° elbow fitting in Teflon® pipe tape. Screw the fitting into the air supply intake on the side of the valve driver block facing the rear of the GC.

The supply intake is the outside threaded hole, the one farthest from the main board.

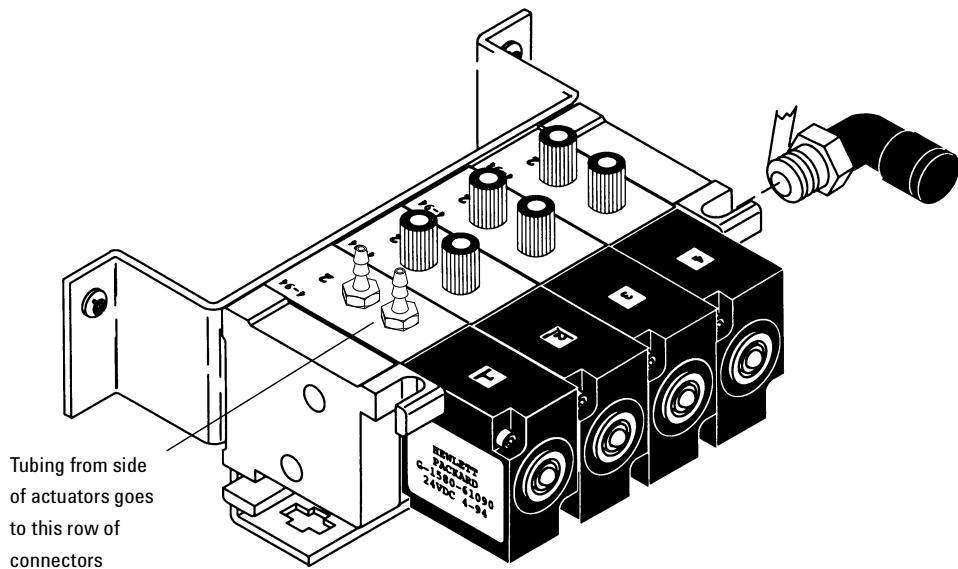


Figure 1130-8 Installing the supply fitting, tubing connectors, and actuator tubing

4. Run a length of 1/4-inch tubing out the hole on the rear of the GC in the lower left corner (when facing the rear of the instrument). Connect this tubing to your air supply.
5. Unscrew the screw plugs (if present) on the top of each driver you are using. Replace the screw plugs with tubing connectors.
6. Plumb the tubing from each installed actuator to the tubing connectors on the corresponding driver. The tubing from the side of the actuator goes to the connector farthest from the main board. Grip the tubing with a piece of sandpaper and push it onto the tubing connector.

Valve actuator alignment

1. Remove the valve box top assembly. See steps 1 through 3 of Installing the valve box in section 1120 for the procedure.

2. Loosen the actuator link arm lock screw at each actuator with a 3 mm hex key wrench so that the coupling/shaft assembly is free to rotate. Push the coupling shaft fully into the actuator.
3. Turn the valve rotor index pin of each valve counterclockwise (CCW) until it is 0.010-inch (0.25 mm) from the counterclockwise (left-hand) valve stop.
4. Reinstall the valve box top assembly.
5. Gently rotate and push the coupling/shaft assembly with a blade-type screwdriver until the slot on the coupling fully engages the valve rotor index pin. Repeat this procedure for each valve installed.

Caution Use care in performing the following operation so as not to accidentally turn the valve rotor away from its preset (step 3) position.

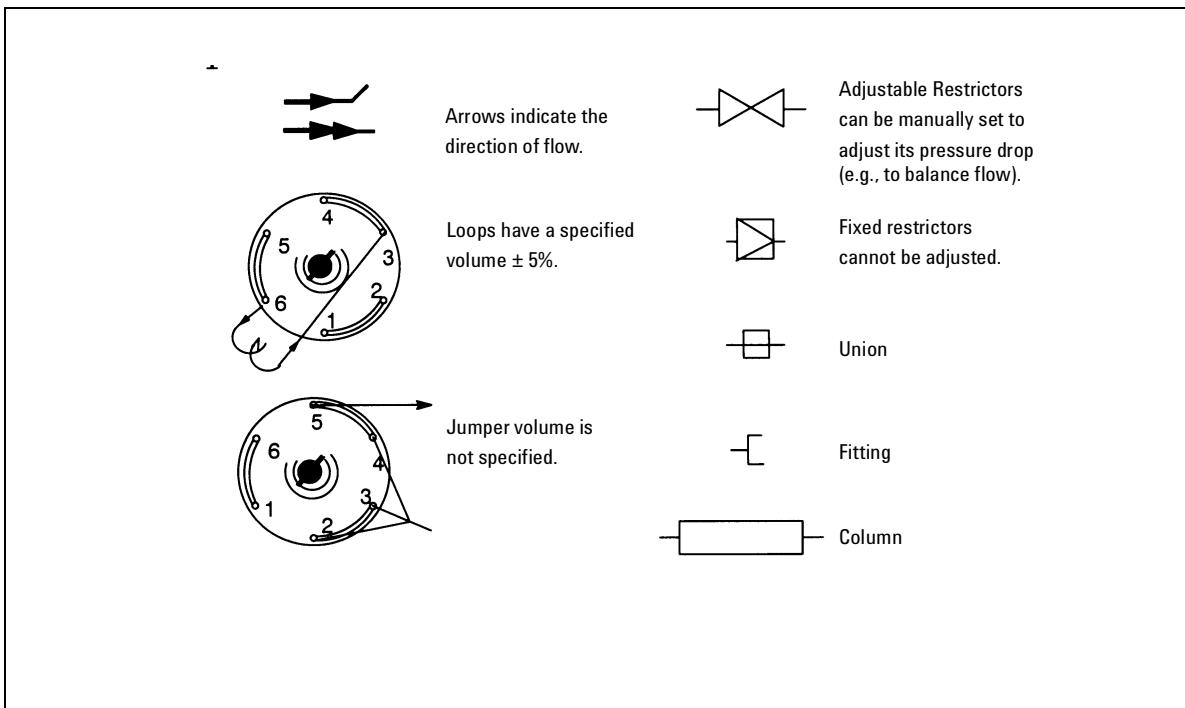
6. Make sure that all solenoid valves are turned “off” by the appropriate valve controller. Turn on the air supply to the solenoid valve(s). The piston rod of each actuator will move all the way out to the extended (OFF) position. Very firmly tighten the link arm lock screw for each actuator.
7. Install the hardware for any variable restrictors present.

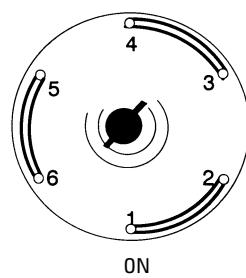
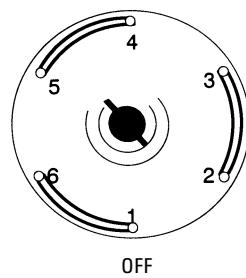
1140 Typical Valve Configurations

Valve configuration diagrams

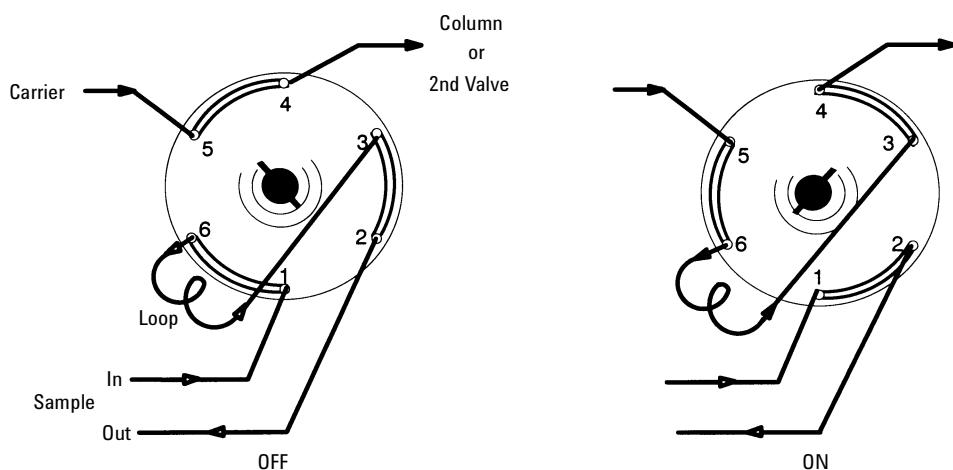
The diagrams in this section show various valving configurations possible with the 6890 gas chromatograph. The symbols used in these diagrams are explained in the legend below.

Legend

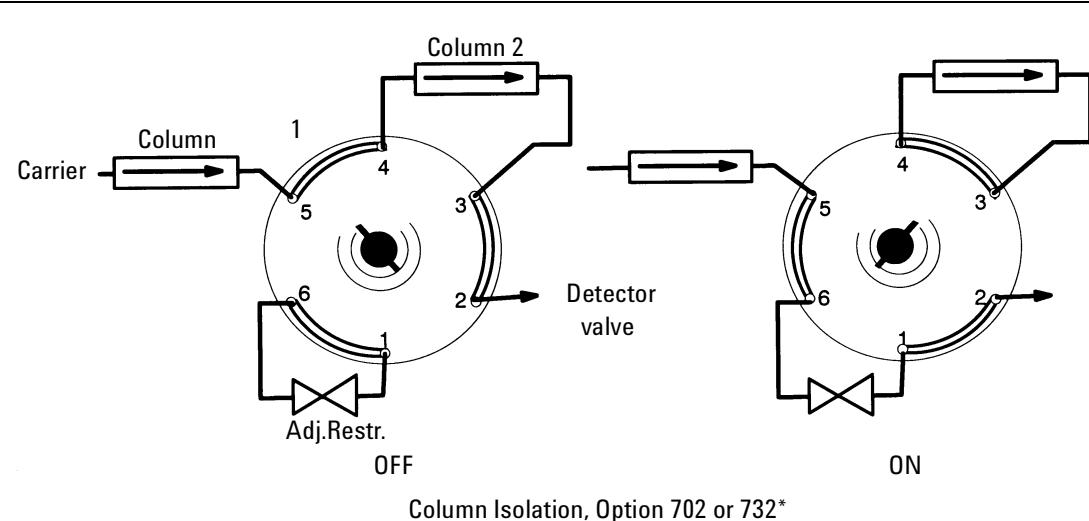




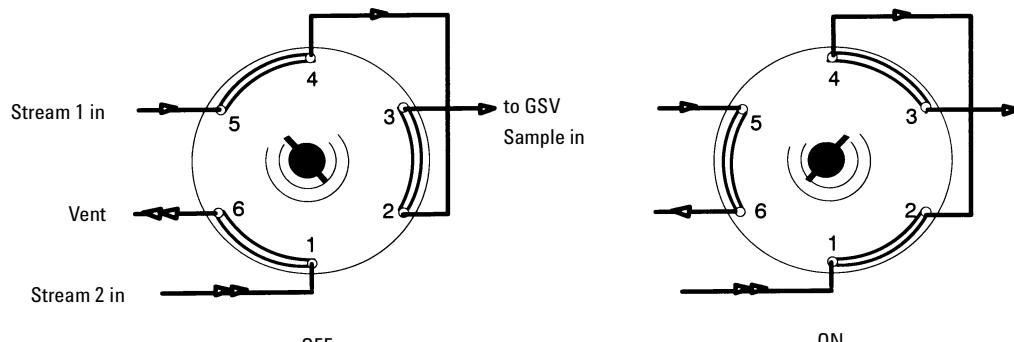
Custom Plumbing (diagram Required), Option 700 or 730



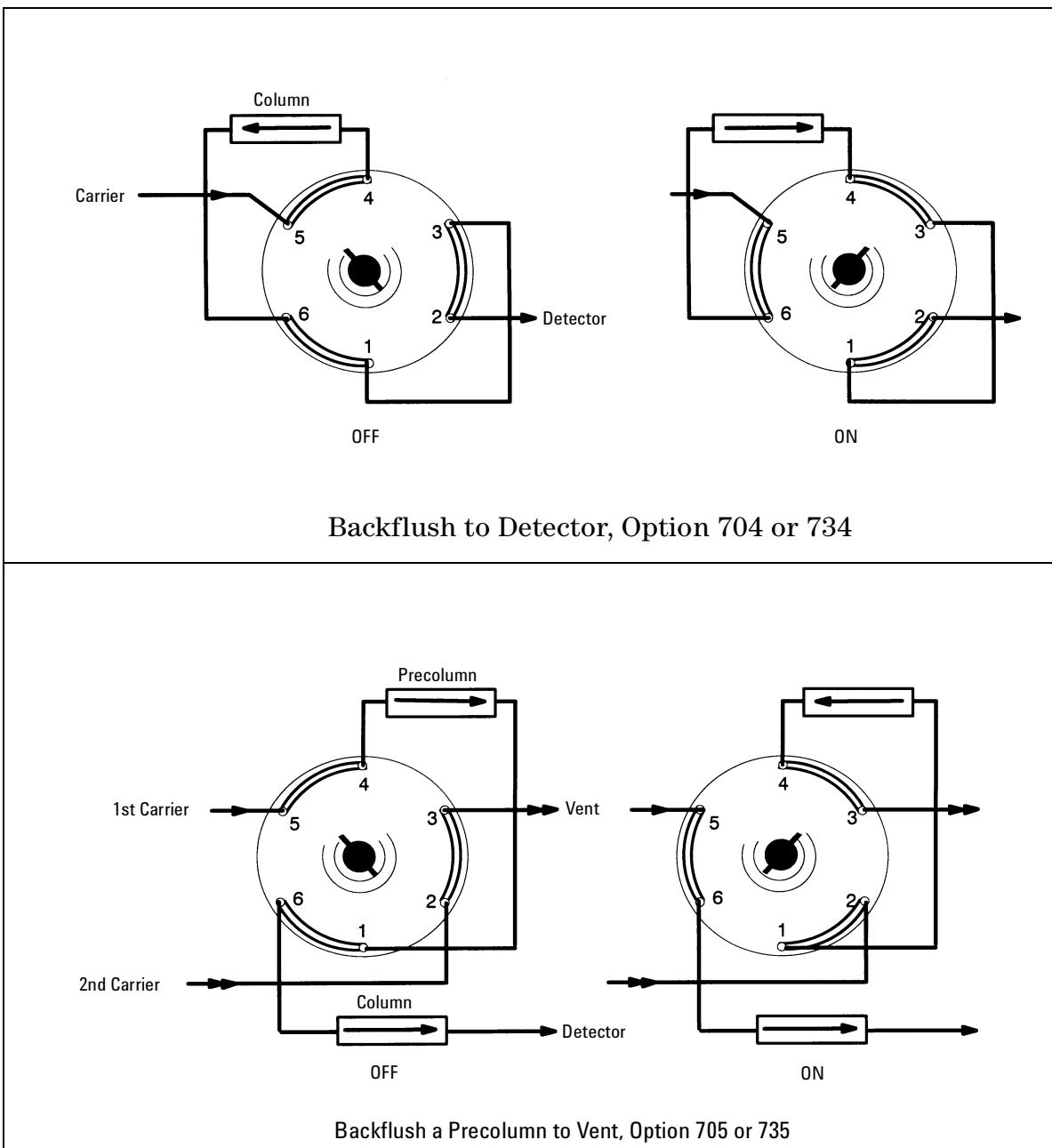
Gas Sampling Option, Option 701 or 731

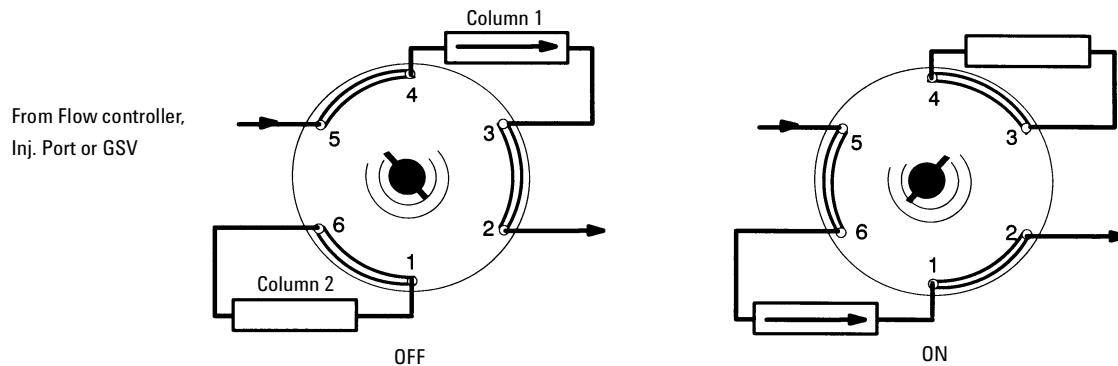


*High temperature needle valve supplied with option 732

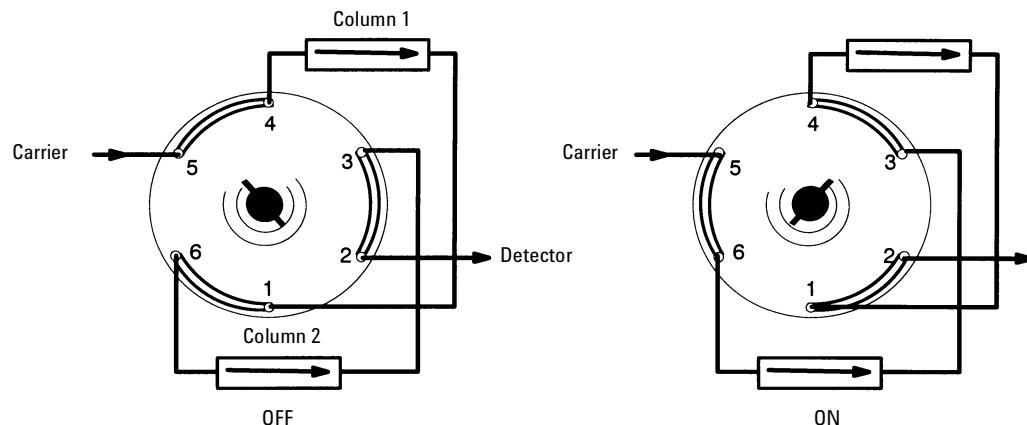


Two Stream Selection (Requires Gas Sampling), Option 703 or 733

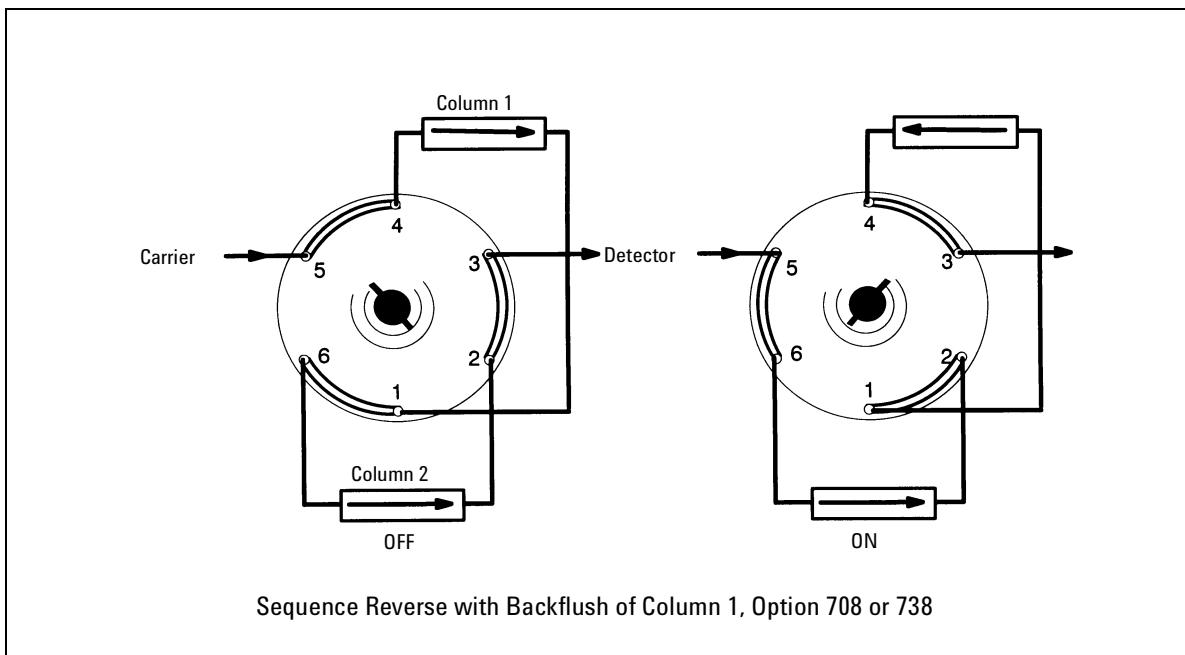


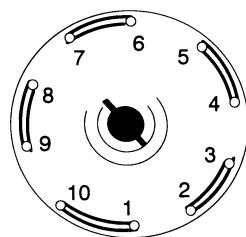


Column Selection (Unused Column Isolated), Option 706 or 736

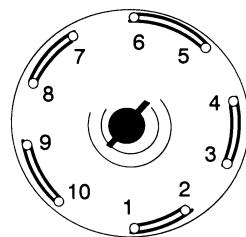


Sequence Reverse, Option 707 or 737



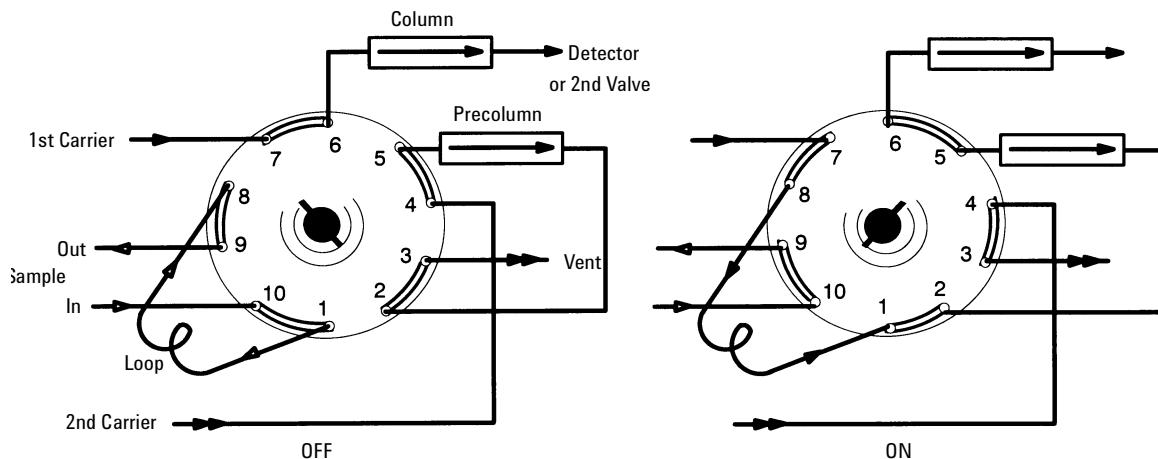


OFF

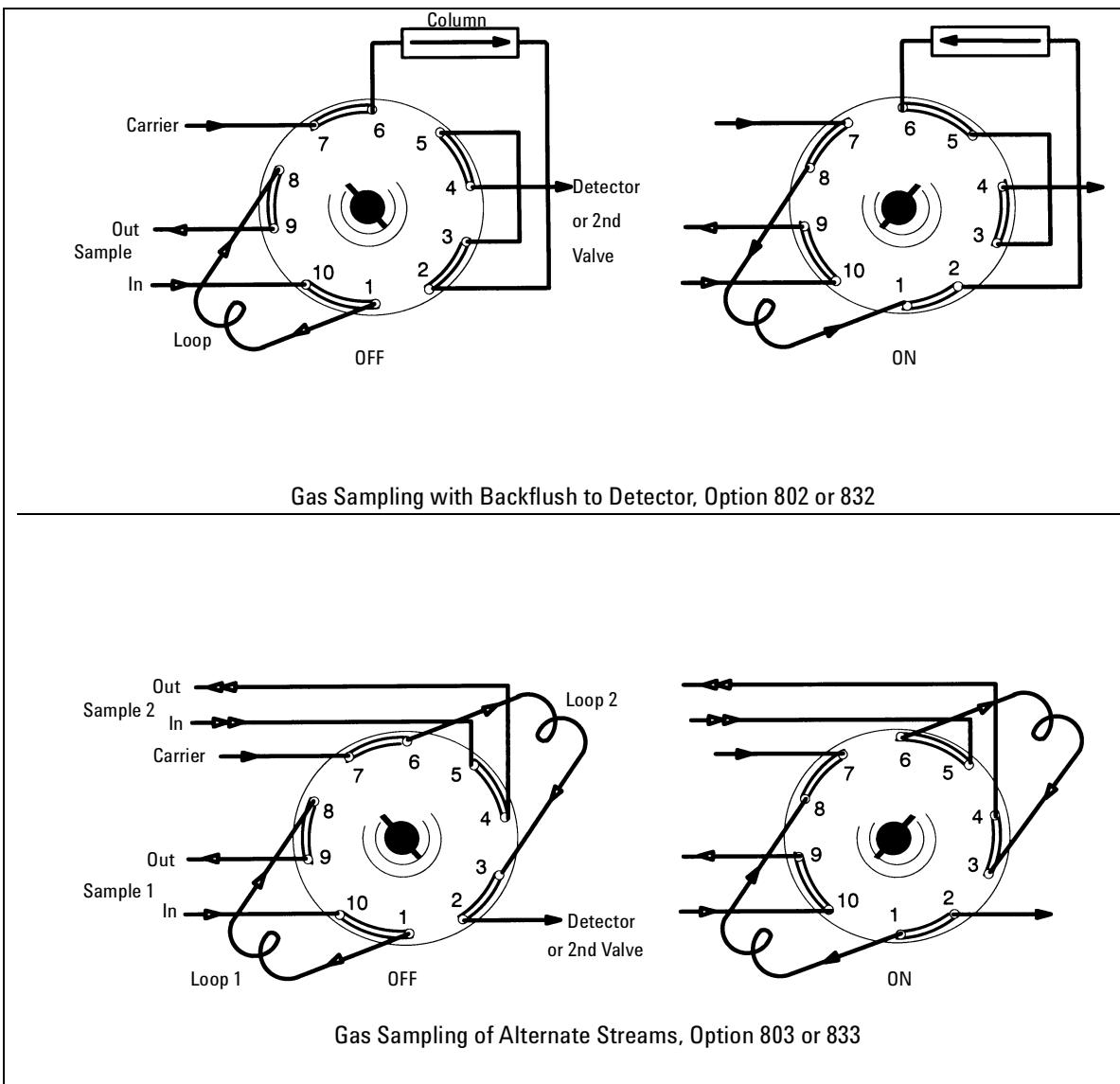


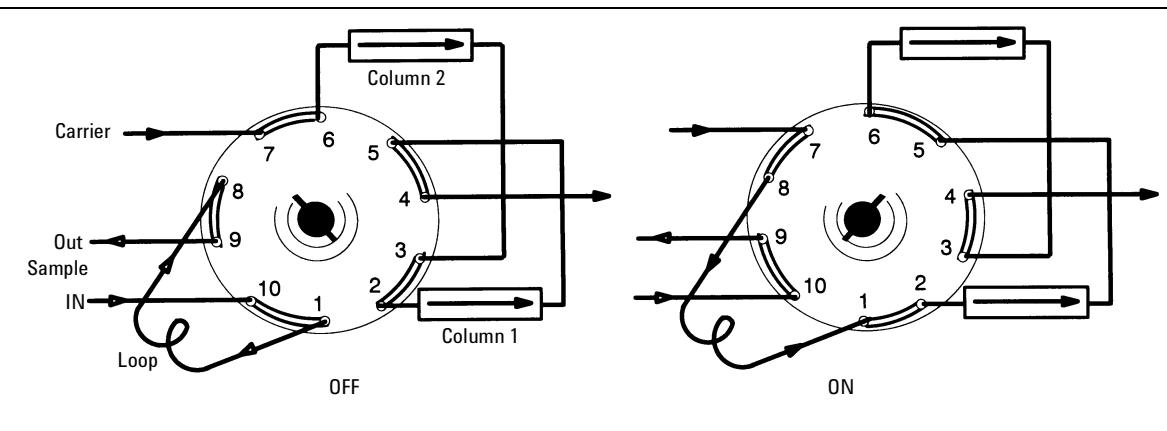
ON

Custom Plumbing (Diagram Required), Option 800 or 830

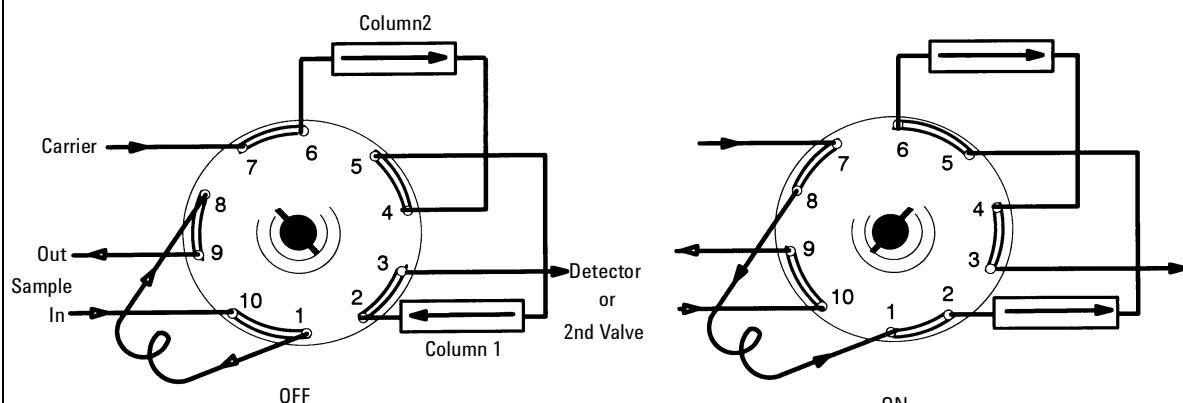


Gas Sampling with Backflush of Precolumn to Vent, Option 801 or 831

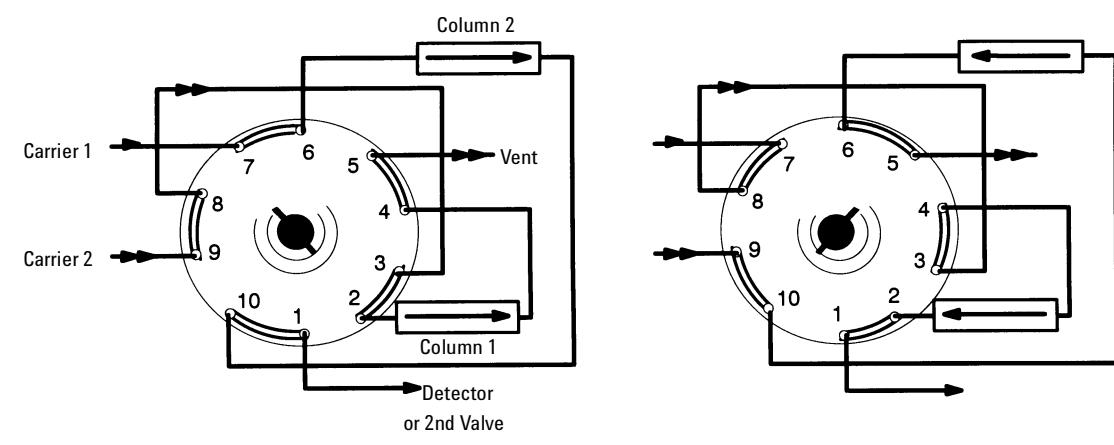




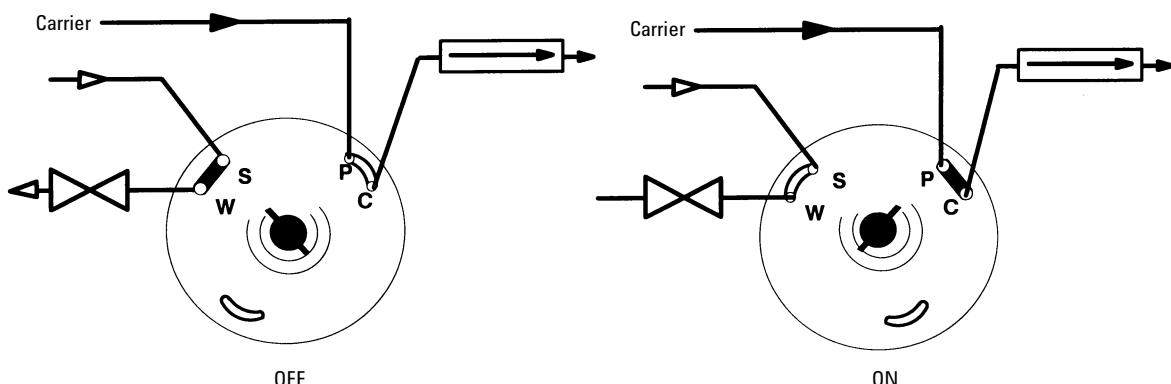
Gas Sampling with Sequence Reverse, Option 804 or 834



Gas Sampling with Sequence Reverse and Backflush of Column 1, Option 805 or 835



Column Selection with Backflush to Vent, Option 806 or 836



Liquid Sampling, Options 850, 852, 854, and 856

1150 Troubleshooting

Most of the problems associated with sampling valves are related to peak broadening in transfer lines and inlets, sample adsorption by the valve or transfer lines, leaks, and perturbations in the baseline.

Chromatographic symptoms

Troubleshooting valves and their related plumbing is primarily a matter of systematic checking and verification of unimpaired mechanical operation of any moving part. This requires an understanding of how the valve functions internally and how the plumbing is configured. A plumbing diagram is essential for effective troubleshooting.

The following “symptom-cause” list gives the most commonly encountered problems found with valves and their solution.

Table 1150-1 Troubleshooting valve related chromatographic problems

Symptom	Possible cause	Solution
Lost peaks (degradation)	Valve or transfer lines too hot	Reduce temperature 50°C, reevaluate
	Transfer line activity	Use nickel or Hastelloy tubing
Lost or tailing peaks	Valve or transfer line too cold	Increase temperatures 50°C, reevaluate
Baseline perturbation	Slow valve rotation	Increase actuator pressure
	Rotor distorted	Replace rotor
	Sample/column pressure too different	Add back-pressure regulator to sample drain
Peak tailing broad peaks	Column overload	Use smaller sample loop Increase split flow
	Flow too slow	Increase column flow Increase split flow
	System voids	Check connections Reduce volume of connecting tubing

Loss of sensitivity or excessive drift

Several possible causes exist for overall deterioration of the chromatogram.

- Contamination in the valve requires a thorough cleaning.
- Internal leakage requires a complete disassembly and inspection of the mating surfaces.
- Poor temperature control may require a full check of electronic and thermal components.
- Lack of proper conditioning techniques, columns, etc.
- Failure or deterioration of other components (columns, detectors, etc.).

Loss of peaks in specific areas of the chromatogram

Entire sections of chromatographic data can be lost due to a valve that does not rotate or one that rotates improperly. Other than obvious component failures (solenoid, actuator, etc.), improper adjustments and misalignments cause most problems.

- Check that adequate air (about 482 kPa or 70 psi) is supplied.
- Check the valve. Is it rotating?
- If the valve rotates, check for proper alignment of the actuator, mechanical binding or slippage of connecting parts.
- Check for blocked flow paths with valve in both positions.

Extraneous peaks

Air peaks are sometimes seen in a chromatogram when leakage occurs because the valve rotor does not seal properly. These leaks may not be detectable using the soap-bubble method.

If a leak is suspected but cannot be located with soap bubbles, a pressure check will determine definitely if a leak exists. Extraneous peaks can occur due to contamination or improper conditioning of the valve. If leaks are not apparent, clean or condition the valve.

Other causes, totally unrelated to the valve, may produce similar symptoms. Impure carrier gas (i.e., containing water) can cause extraneous peaks.

Peak broadening and tailing

Voids in the flow system (valve and connecting tubing) cause tailing and peak broadening. Use inlets and liners with small internal diameters and connect the valve to the inlet or column with short lengths of connecting tubing of narrow inner diameter.

If early-eluting peaks are too broad, stationary phase or thermal focusing effects should be used with packed-column ports or increased split flows when capillary split inlets are used. Inlets should be equipped with narrow inner diameter liners, and narrow-bore connecting tubing should be used between the valve and inlet.

Baseline shifts

Baseline perturbations are caused by changes in column flow as the valve is rotated and as the sample loop equilibrates to system pressure. Slow valve rotation momentarily stops carrier gas flow and, when the valve stops rotating, a sudden increase in flow occurs which slowly returns to the set point. Check actuator pressure (usually 40 to 75 psi), valve rotor tension, and valve temperature to ensure that the valve rotates as quickly as possible. A restrictor or backpressure regulator can be added to the sample vent line to maintain the sample loop at system pressure. This will reduce the time it takes for the flow to stabilize after the valve is switched.

Baseline upsets

Frequently, baseline upsets may be seen on chromatograms when valves are switched. These upsets are caused by pressure changes within the system, injections of large volume samples, or by changing the amount of restriction in the flow path. These upsets will become more of a problem when high sensitivity is required. Addition of a fixed restriction downstream from the valve may help minimize the upset. Changes in column length may also help reduce the upsets.

Fixed restrictors are used immediately before flame detectors to prevent flameout and are used in some instances to prevent pressure surges from damaging TCD filaments. An adjustable restrictor (needle valve) can also be used where a matched restriction is desired but not for preventing pressure or flow surges.

Often confused with baseline upsets, an offset is a shift in the baseline that does not return quickly to the original level. Baseline offsets may be caused by air leaks but more commonly are due to a change in gas purity or flow rate in the detector. Poor carrier gas or improperly conditioned filters and traps should be suspected whenever offsets occur.

Variation in peak area and retention time

The amount of sample contained in the loop and, therefore, the amount injected onto the column is affected by loop pressure and temperature. Variations in pressure and temperature lead to variability in peak areas. Flow restrictors or back-pressure regulators help to maintain constant loop pressure, and valve boxes help maintain temperature.

Leaks can occur in the valve itself or at any of the connecting points with transfer lines. Leaks usually cause area irreproducibility, retention times changes, and increases in the area of air peaks (with thermal conductivity detectors). Leaks in rotors can sometimes be fixed by tightening the nuts holding the rotor in the valve body. Leaks in connections are usually found with an electronic leak detector or with a liquid leak detection fluid (e.g., Snoop).

Pressure check

Leak checking the plumbing involved in a valve system must be done carefully and methodically. The pressure check method below will indicate, but sometimes not isolate, a leak in the flow path. Since this method does not necessarily isolate the leak, other leak check methods may be needed to locate the leak specifically.

Note Each valve in a system has two flow paths, ON and OFF. A leak sometimes occurs in only one of these two positions. Check both.

1. Disconnect the detector from the valve system.
2. Cap the valve system at its outlet and pressurize to 689 kPa (100 psi). Allow 2 to 5 minutes for pressure to equilibrate. If your instrument has flow control, it should read zero flow.
3. Turn off the gas supply at the source.
4. Generally, the pressure will drop quickly for approximately 30 to 60 seconds, then stabilize. After this initial pressure drop, the gauge should not indicate more than a 7 to 14 kPa (1 to 2 psi) drop during a 10 minute period.
- 5a. If no leak is indicated, actuate all valves and repeat steps 2 to 4.
- 5b. If a leak does show up, try to pinpoint the source using a soap bubble meter. Do not assume that the leak exists only at the valve. Often plumbing connections such as unions or bulkhead fittings are at fault. See Valve Box should it become necessary to expose the valve system.
6. If the leak cannot be found easily, divide the system in half and repeat the pressure check. Continue dividing in halves, and pressure check until the leak is isolated.

1200 Electrical

- 1210 External Connectors, 6890A and 6890 Plus**
- 1215 External Connectors, 6890N**
- 1220 Main Board, 6890A and 6890 Plus**
- 1225 Main Board, 6890N**
- 1230 Power Supply**
- 1240 Wiring Harnesses**

Electrical diagrams, wiring, connector pinouts.

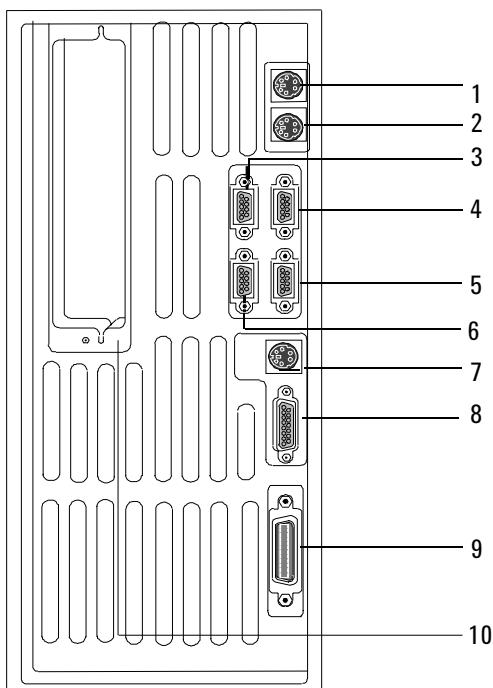
1210 External Connectors, 6890A and 6890 Plus

Overview

This section shows the pinouts for the external connectors on the back of the Agilent 6890A and 6890 Plus instruments. See section External Connectors, 6890N for the 6890N instrument.

These connectors are used for communications with external instruments.

Back of 6890 GC



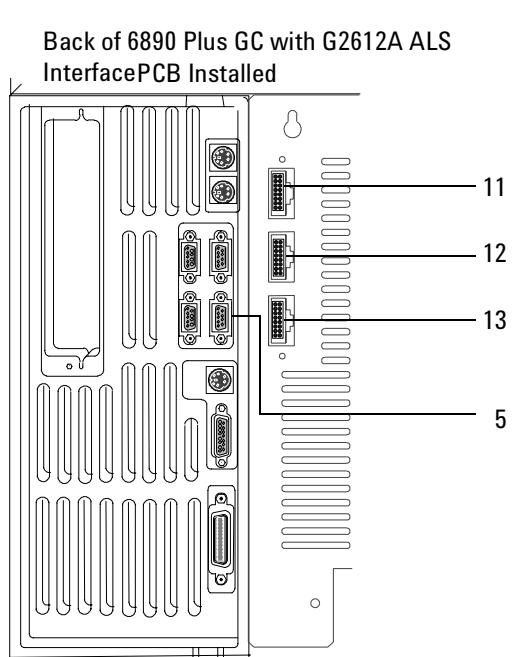
Number	Description	Connector ID
1	Signal 1 – Analog output for integrators or A/D converters	J1
2	Signal 2 – Analog output for integrators or A/D converters	J2
3/6	Remote start-stop for synchronizing GC, integrators, automatic samplers, MSD, and other GCs	JP1/JP2
4	Modem – RS-232 for modem, computer, or controller devices	JP1
5	Sampler-RS-232 for 7673 Automatic Liquid Sampler	JP2
7	External event contact closures and 24 volt outputs for valve control	J4
8	BCD input for stream selection valves, headspace sampler, or other device	J6
9	GPIB for ChemStation and/or MSD	J5
10	Modular Input/Output (MIO) slot for INET card	

Figure 1210-1 6890 GC external connections

The table details the additional external connectors used on the 6890 Plus GC.

Note

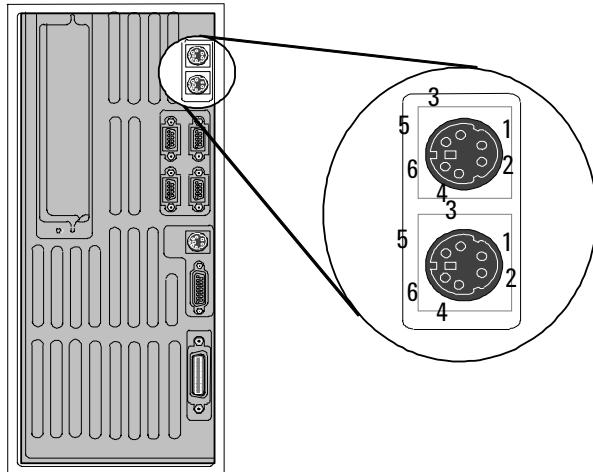
The external RS-232 connector for the sampler is not used on this model.



Number	Description	Connector ID
5	Not used for 6890 Plus GC's	JP2
11	Sampler—G2613A Automatic Liquid Sampler, front injector*	P2
12	Sampler—G2613A Automatic Liquid Sampler, back injector*	P4
13	Sampler—G2614ATray	P3

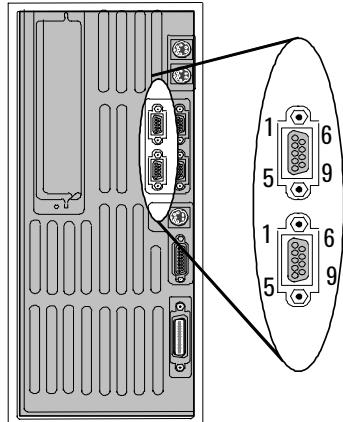
* Default configuration

Figure 1210-2 6890 Plus GC external connections

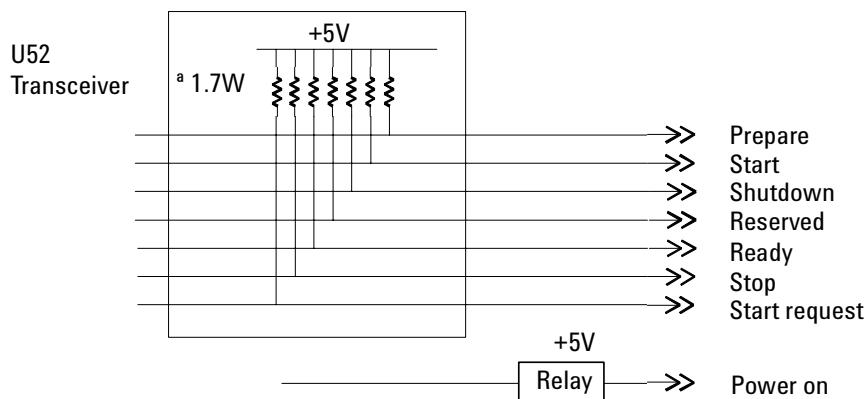
Signal 1/Signal 2 analog out

J1, J2	
Analog out	
Pin	Function
1	1 mV COM
2	1 V & 10 V COM
3	1 mV
4	1 V
5	Chassis GND
6	10V

APG remote start/stop



JP1, JP2 APG Bus		
Pin	Function	Logic
1	Digital ground	LOW true
2	Prepare	LOW true
3	Start	LOW true (input)
4	Shutdown	LOW true
5	Reserved	
6	Power on	HIGH true
7	Ready	HIGH true (output)
8	Stop	LOW true
9	Start request	LOW true (input)



Signal descriptions

Prepare (low)—Request to prepare for analysis. Receiver is any module performing pre-analysis activities.

Start (low)—Request to start run/timetable. Receiver is any module performing runtime-controlled activities.

Shutdown (low)—System has serious problem. Receiver is any module capable to reduce safety risk.

Power On (high)—All modules connected to system are switched on. Receiver is any module relying on operation of others.

Ready (high)—System is ready for next analysis. Receiver is any sequence controller.

Stop (low)—Request to reach system ready state as soon as possible (for example, stop run, abort or finish, and stop injection). Receiver is any module performing runtime-controlled activities.

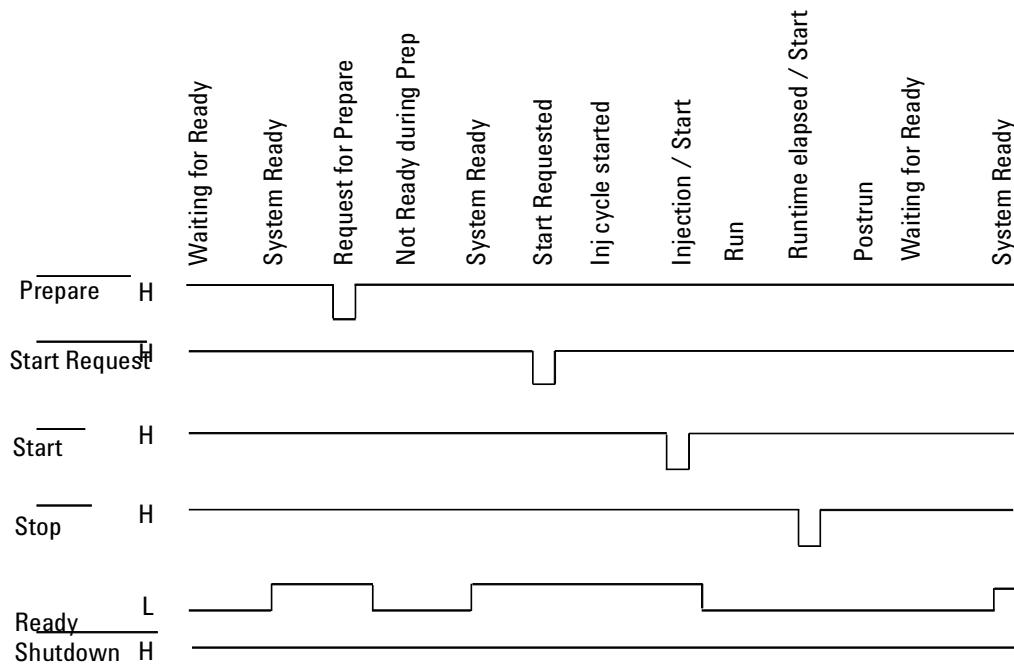
Start Request (low)—Request to start injection cycle (for example, by a **Start** key on any module). Receiver is the automatic liquid sampler.

APG remote control

Remote control allows easy connection between single instruments or systems to ensure coordinated analysis with simple coupling requirements.

To provide maximum safety within a distributed analysis system, one line is dedicated to SHUTDOWN the system's critical parts in case any module detects a serious problem.

To detect whether all participating modules are switched on or properly powered, one line is defined to summarize the POWER ON state of all connected modules.

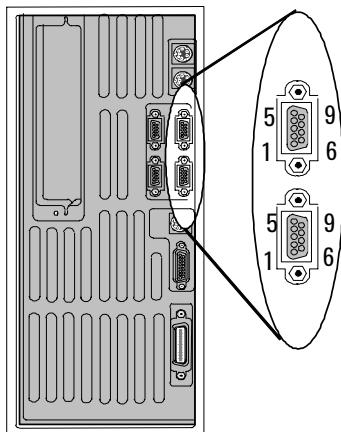
**Figure 1210-3 Remote control analysis.**

Control of analysis is maintained by signal readiness READY for next analysis, followed by START of run and optional STOP of run triggered on the respective lines. In addition, PREPARE and START REQUEST may be issued.

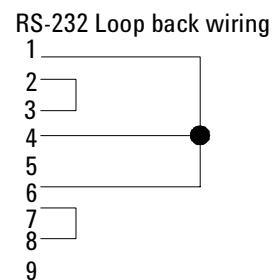
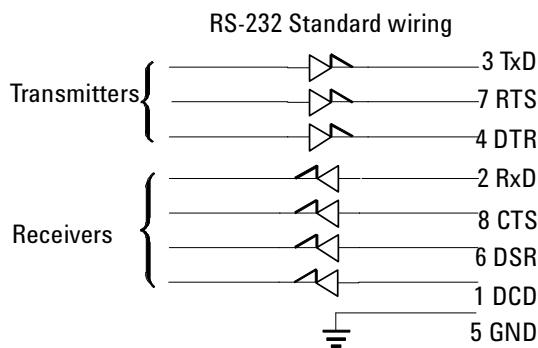
The signal levels are defined as standard TTL levels (0 V is logic true, +5 V is logic false).

Input Load \geq 2.2 kOhm against +5 V

Output type is open collector.

RS-232

JP1 (Host/Modem), JP2 (Sampler)		
RS-232		
Pin	Function	In/Out
1	DCD	INPUT
2	RxD	INPUT
3	TxD	OUTPUT
4	DTR	OUTPUT
5	GND	
6	DSR	INPUT
7	RTS	OUTPUT
8	CTS	INPUT
9	unused	INPUT (No Connect)



Signal descriptions

Data Carrier Detect—is connected to a general purpose input on the SC26C92. Currently, there are no plans to use this signal.

Receive Data

Transmit Data

Data Terminal Ready—will be set ON when the 6890 GC is ready for communications (self-test complete).

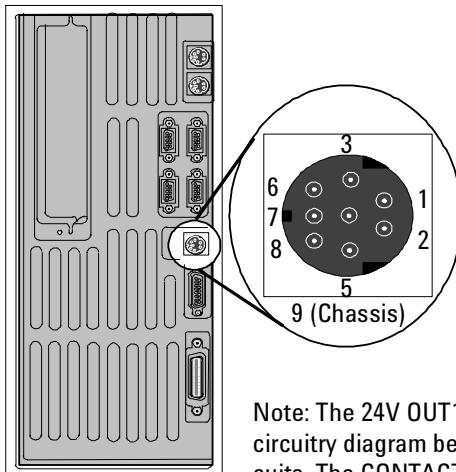
Digital Ground—is tied to the digital signal ground on the mainboard.

Data Set Ready—is connected to the SC26C92. Not currently used.

Request to Send—is set ON when the 6890 GC to the host when HARDWARE flow control is set. If flow control is configured for XON/XOFF or NONE, RTS will stay ON. If HARDWARE handshake is configured, RTS is used to inform the host that the 6890 GC is ready to communicate and there is room in the data buffer for data. RTS will follow the same logic as XON/XOFF for pacing data.

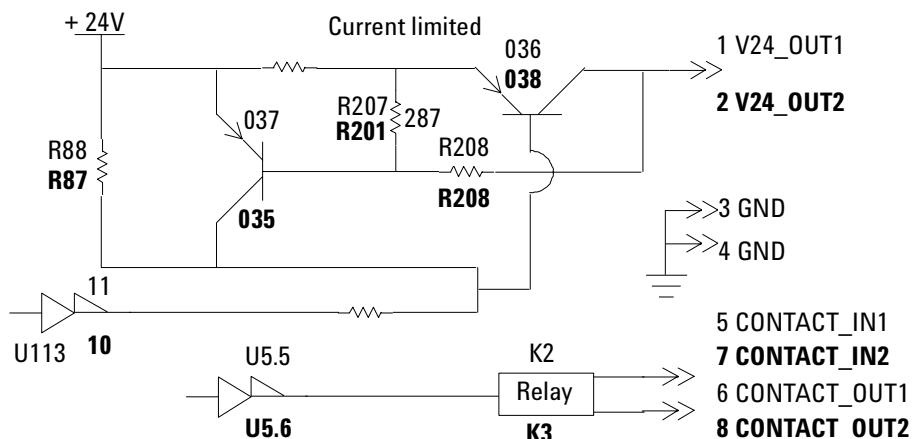
Clear to Send—is used for pacing data from the 6890 GC to the host when HARDWARE flow control is set. When CTS is sensed in the OFF state, transmission will be suspended. If flow control is set to XON/XOFF or NONE, DSR will be ignored.

Clear to Send—Not currently used.

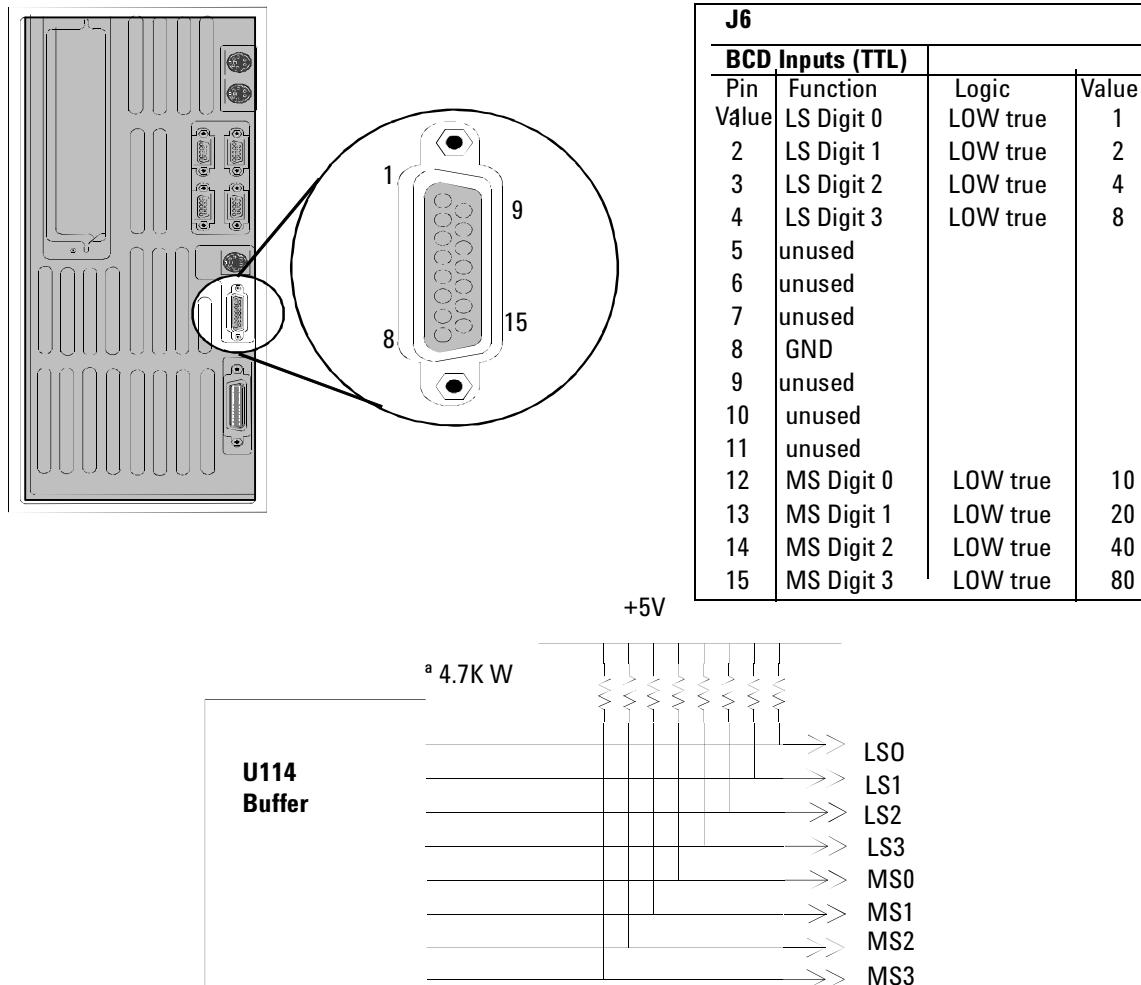
External event

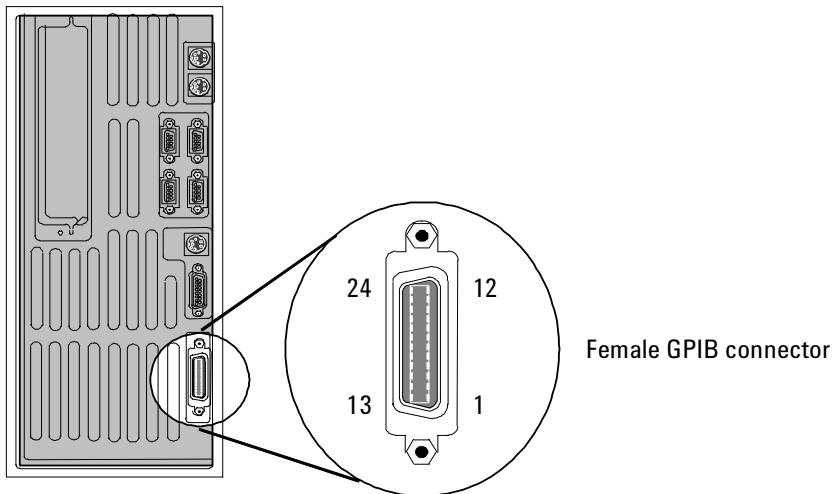
J4 External event			
Pin	Function	Max. rating	Valve
1	24 V Out 1	75 mA output	5
2	24 V Out 2	75 mA output	6
3	GND		
4	GND		
5	Contact 1	48V ac/dc, 250 mA	7
6	Contact 1		7
7	Contact 2	48V ac/dc, 250 mA	8
8	Contact 2		8
9	Chassis GND		

Note: The 24V OUT1 and 24V OUT2 signals are shown on the same circuitry diagram below, however they each have their own distinct circuits. The CONTACT1 and CONTACT2 signals are presented in the same manner. Bold designators refer to the bold signal to the right.

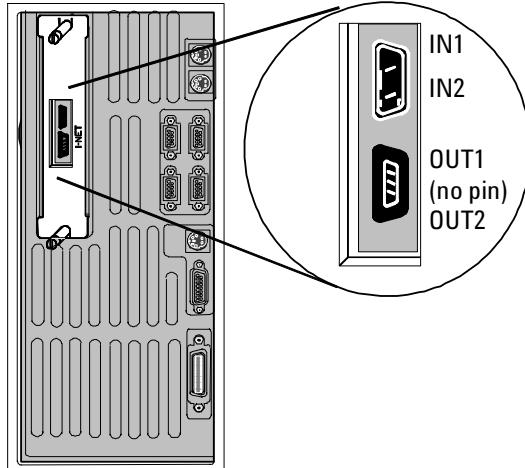


BCD inputs



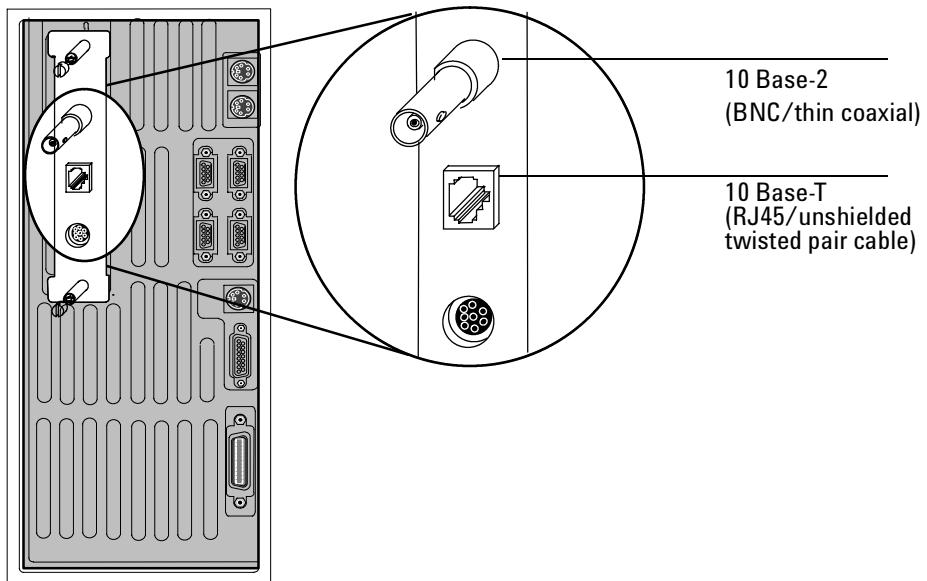
GPIB

Modular Input/Output (MIO) INET



ET Input connector		
Pin	Function	In/Out
1	IN1	INPUT
2	IN2	INPUT

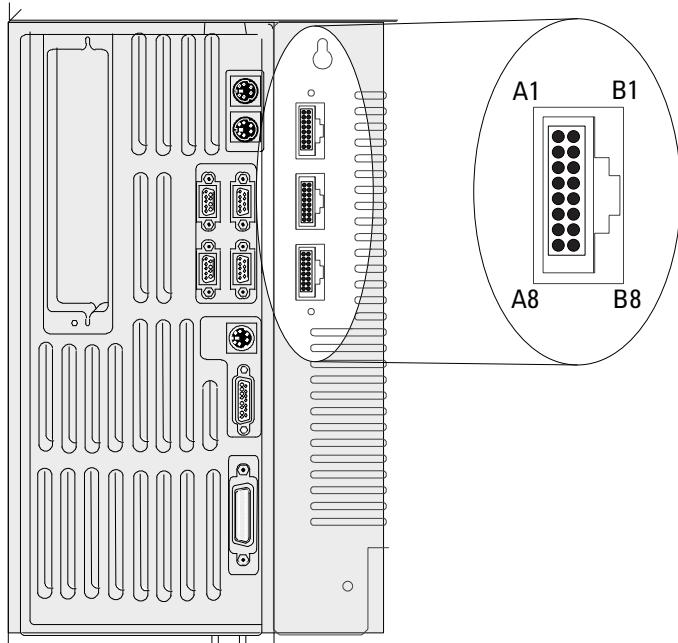
INET Output connector		
Pin	Function	In/Out
1	OUT1	OUTPUT
2	OUT2	OUTPUT

Modular Input/Output (MIO) LAN

10 Base-2
(BNC/thin coaxial)

10 Base-T
(RJ45/unshielded
twisted pair cable)

Sampler injector or tray



Injector or tray	
Pin	Function
A1	RXD
A2	CTS
A3	DSR
A4	*RESET
A5	GND
A6	VAC1
A7	GND
A8	VAC2
B1	TXD
B2	RTS
B3	DTR
B4	GND
B5	GND
B6	VAC1
B7	GND
B8	VAC2

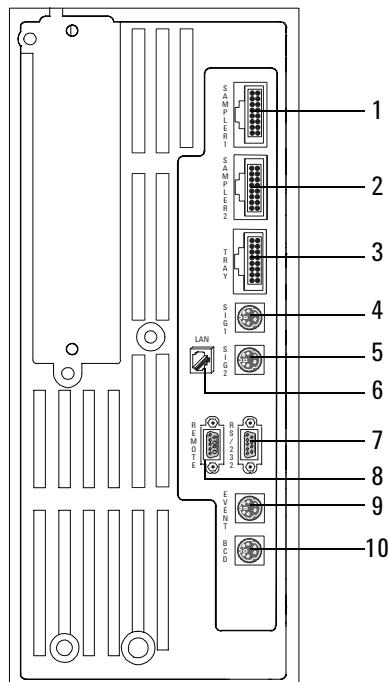
1215 External Connectors, 6890N

Overview

This section shows the pinouts for the external connectors on the back of the Agilent 6890N instrument. See section External Connectors, 6890A and 6890 Plus for the 6890A and 6890 Plus instruments.

These connectors are used for communications with external instruments.

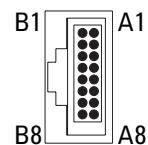
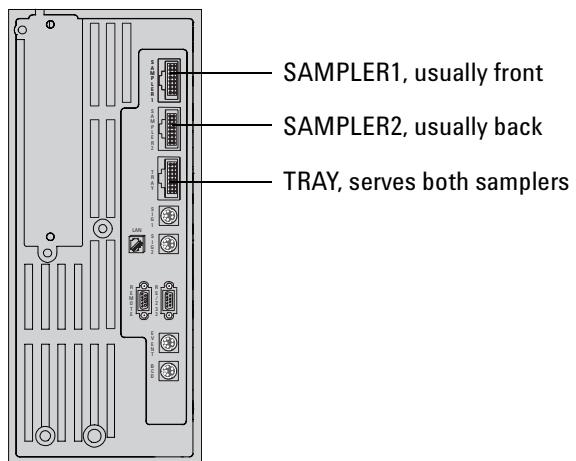
Back of 6890N GC



Number	Description	Connector
1	Sampler 1 – Communications and power for the front injection tower	P4
2	Sampler 2 – Communications and power for the back injection tower	P5
3	Tray – Communications and power for the sample tray	P6
4	Signal 1 – Analog output for integrators or A/D converters	J1
5	Signal 2 – Analog output for integrators or A/D converters	J2
6	LAN – Local Area Network	
7	RS-232 – For modem or non-Agilent controller	JP1
8	Remote – Start/stop signals for use with integrators, Mass Sensitive detectors, and other sampling devices (e.g. headspace)	JP1
9	Event – Contact closures and 24V outputs for valve control	J4
10	BCD input for stream selection valve	J5

Figure 1215-1 6890N GC external connections

Samplers and Tray



Injector or tray	
Pin	Function
A1	RXD
A2	CTS
A3	DSR
A4	*RESET
A5	GND
A6	VAC1
A7	GND
A8	VAC2
B1	TXD
B2	RTS
B3	DTR
B4	GND
B5	GND
B6	VAC1
B7	GND
B8	VAC2

Figure 1215-2 Sampler and tray connections

Signal 1/Signal 2 analog out

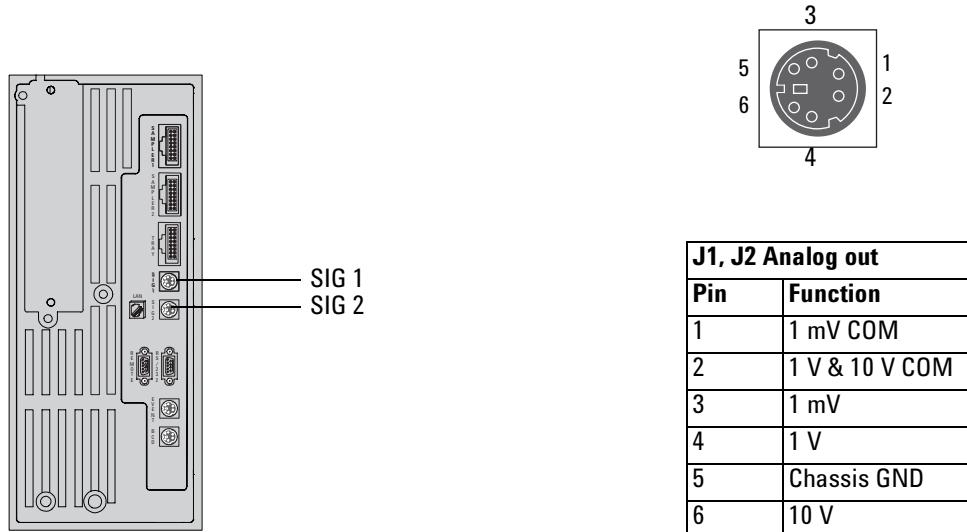


Figure 1215-3 Analog signal connections

Local Area Network (LAN)

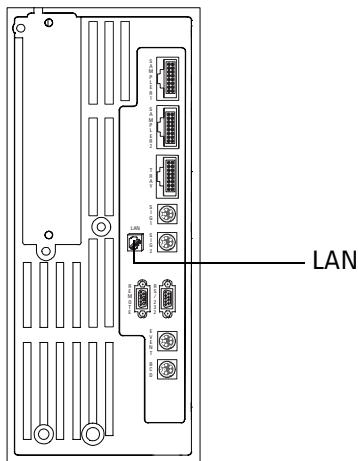
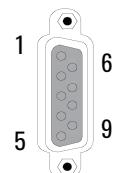
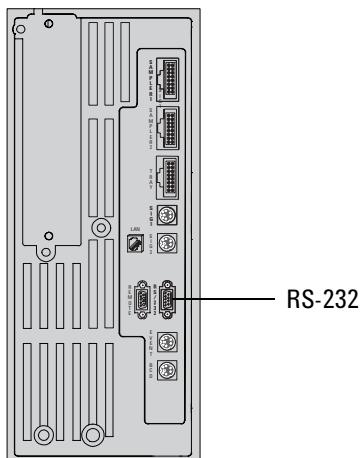
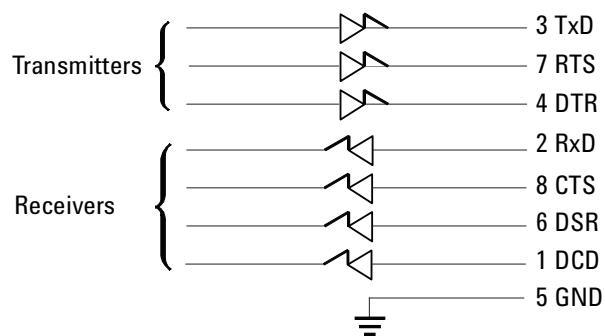
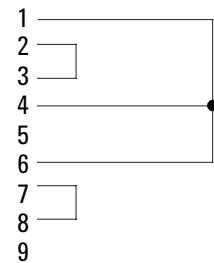


Figure 1215-4 LAN connection

RS-232**JP1, RS-232**

Pin	Function
1	DCD
2	RxD
3	TxD
4	DTR
5	GND
6	DSR
7	RTS
8	CTS
9	unused

RS-232 Standard wiring**RS-232 Loop back wiring****Figure 1215-5 RS-232 connection**

Signal descriptions

Data Carrier Detect—is connected to a general purpose input on the SC26C92. Currently, there are no plans to use this signal.

Receive Data

Transmit Data

Data Terminal Ready—will be set ON when the 6890 GC is ready for communications (self-test complete).

Digital Ground—is tied to the digital signal ground on the mainboard.

Data Set Ready—is connected to the SC26C92. Not currently used.

Request to Send—is set ON when the 6890 GC to the host when HARDWARE flow control is set. If flow control is configured for XON/XOFF or NONE, RTS will stay ON. If HARDWARE handshake is configured, RTS is used to inform the host that the 6890 GC is ready to communicate and there is room in the data buffer for data. RTS will follow the same logic as XON/XOFF for pacing data.

Clear to Send—is used for pacing data from the 6890 GC to the host when HARDWARE flow control is set. When CTS is sensed in the OFF state, transmission will be suspended. If flow control is set to XON/XOFF or NONE, DSR will be ignored.

Clear to Send—Not currently used.

Remote start/stop

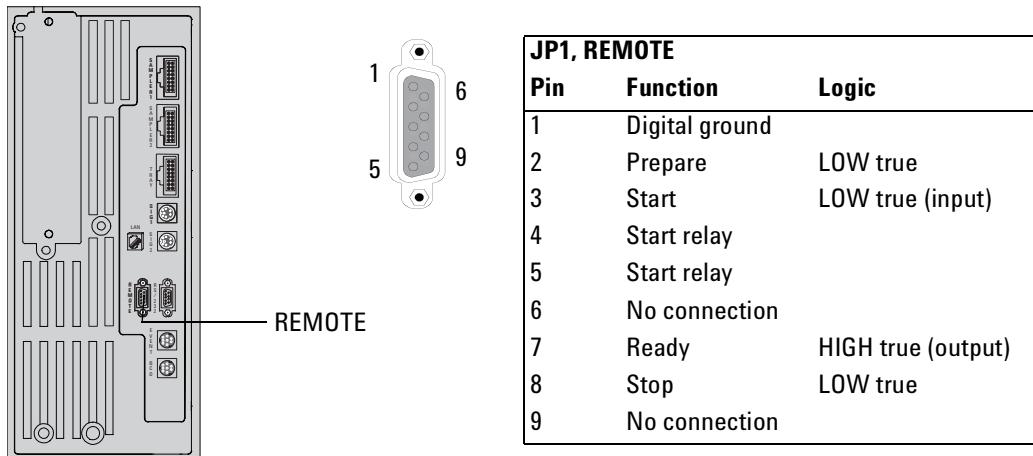


Figure 1215-6 Remote start/stop connection

Signal descriptions

Prepare (low)—Request to prepare for analysis. Receiver is any module performing pre-analysis activities.

Start (low)—Request to start run/timetable. Receiver is any module performing runtime-controlled activities.

Ready (high)—System is ready for next analysis. Receiver is any sequence controller.

Stop (low)—Request to reach system ready state as soon as possible (for example, stop run, abort or finish, and stop injection). Receiver is any module performing runtime-controlled activities.

Remote control

Remote control allows easy connection between single instruments or systems to ensure coordinated analysis with simple coupling requirements.

Start Relay—A 120 millisecond contact closure

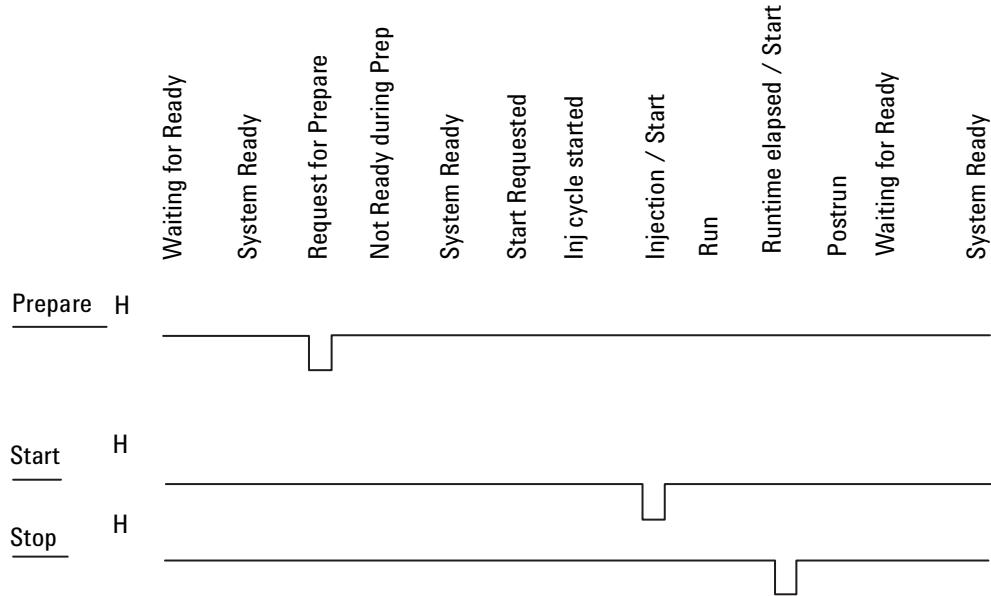


Figure 1215-7 Remote control analysis

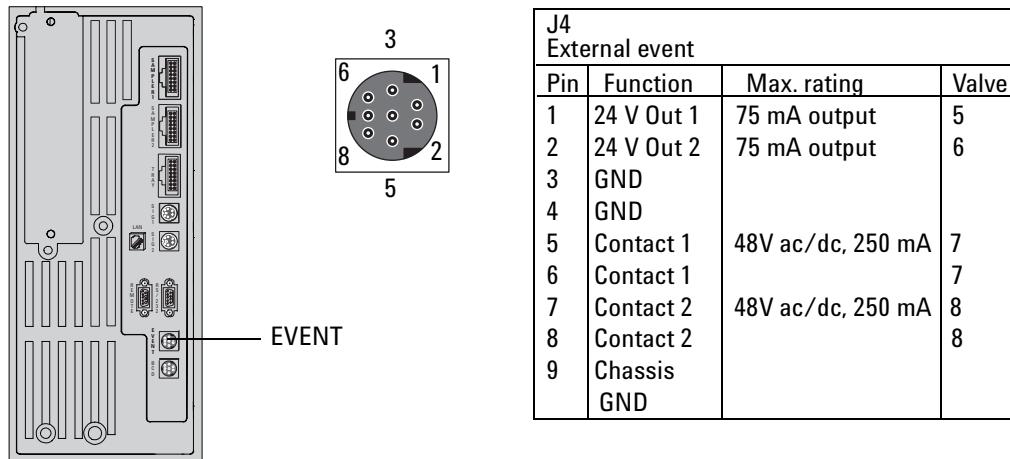
Control of analysis is maintained by signal readiness READY for next analysis, followed by START of run and optional STOP of run triggered on the respective lines. In addition, PREPARE and START REQUEST may be issued.

The signal levels are defined as standard TTL levels (0 V is logic true, +5 V is logic false).

Input Load \geq 2.2 kOhm against +5 V

Output type is open collector.

External event



Note: The 24V OUT1 and 24V OUT2 signals are shown on the same circuitry diagram below, however they each have their own distinct circuits. The CONTACT1 and CONTACT2 signals are presented in the same manner. Bold designators refer to the bold signal to the right.

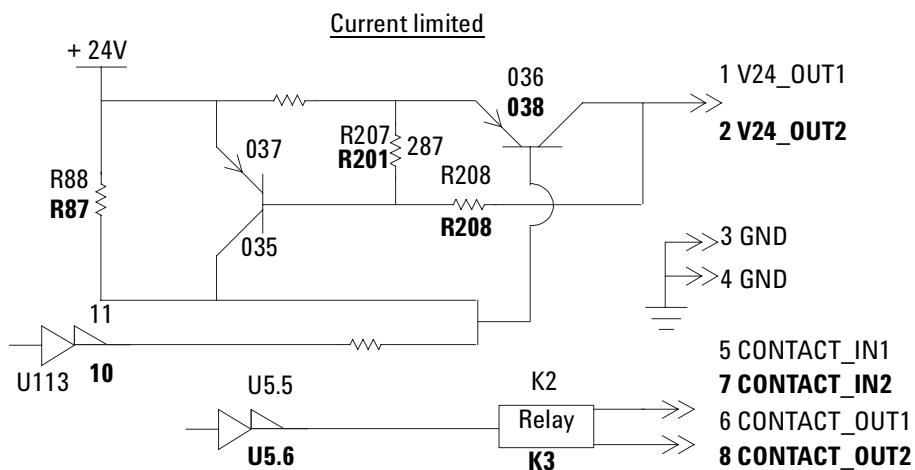
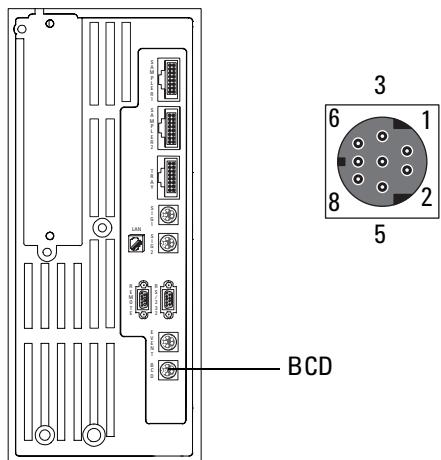


Figure 1215-8 External event connection

BCD inputs



The diagram shows a top-down view of the 6890N circuit board. A callout points from the label "BCD" to a circular connector located on the right side of the board. This connector has eight pins numbered 1 through 8 around its perimeter, with a central pin labeled "Shield".

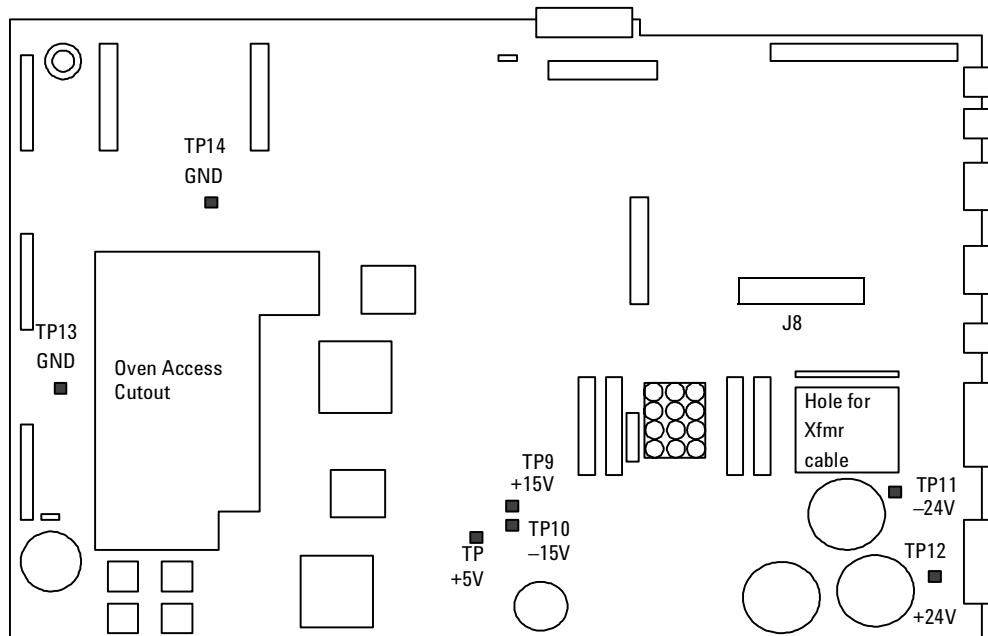
Pin	Function	Maximum rating
1	Relay	48 V AC/DC, 250 mA
2	Relay	48 V AC/DC, 250 mA
3	LS digit 0	
4	LS digit 1	
5	LS digit 2	
6	LS digit 3	
7	MS digit 0	
8	GND	
Shield	Chassis GND	

Figure 1215-9 BCD input connection

1220 Main Board, 6890A and 6890 Plus

Test points

There are seven test pads on the main board that allow you to test the GC's regulated DC supplies (+24V, -24V, +15V, -15V, +5V) and to test the ground. The test pads are located on the main board as shown below:



General specifications

Supply	% tol	Rated I(FL)	System PARD V pp
+24*	±10%	4.75 A	<1 V
-24*	±10%	0.75 A	<1 V
+15	±5%	0.40 A	<250 mV
-15	±5%	0.30 A	<250 mV
5	±2%	4.5 A	<150 mV
40*	±10%	11.25 A	(1)

Figure 1220-1 Mainboard test pads

Connector electronics

The table on the following page shows the pinouts for some of the internal connectors on the main circuit board that can be probed for diagnostic purposes. These connectors are shaded on the diagram below. These connectors are used for communications within the instrument. All connector pinout drawings are viewed from the component side of the board.

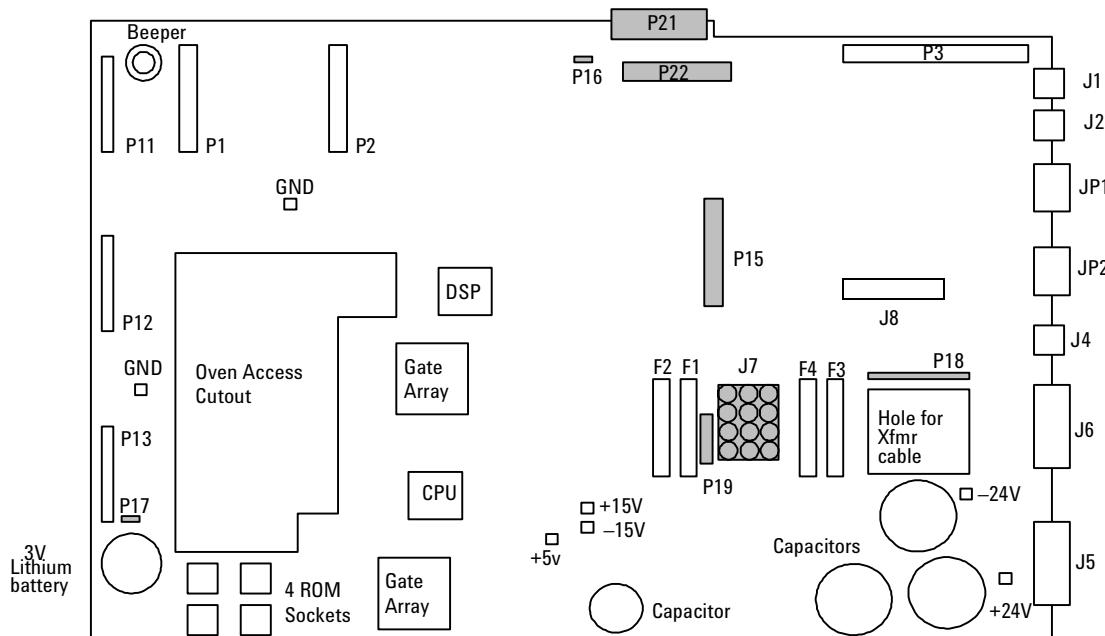


Figure 1220-2 Main board connectors

Table 1220-1 Main Circuit Board Pinouts

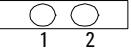
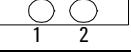
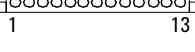
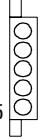
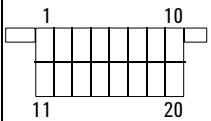
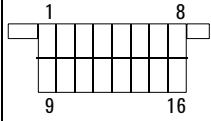
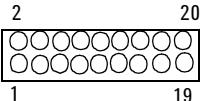
J7—AC Power		P21—Inl/Det Htd Zones, man split valves
1	Heater 40 VAC (VIOLET)	
2	unused	
3	Heater 40 VAC (ORANGE)	
4	unused	
5	Heater Center Tap (GRAY)	
6	unused	
7	unused	
8	Heater Center Tap (WHITE)	
9	unused	
10	20 VAC (YELLOW)	
11	20 VAC Center Tap (BLUE)	
12	20 VAC (YELLOW)	
P16—Oven sensor		
1	Oven sense	
2	Ground	
P17—Oven door switch		
1	Oven door	
2	Ground	
P18—Inlet fan, oven flap, oven cryo		
1	Oven Flap Drive (WHITE)	
2	Oven Flap Drive (BLACK)	
3	Oven FLAP +24 V (WHT/BLU)	
4	Oven FLAP +24 V (WHT/BLK)	
5	Oven Flap Drive (BLUE)	
6	Oven Flap Drive (RED)	
7	Inlet Fan +24 V (ORANGE)	
8	Inlet Fan Drive (YELLOW)	
9	Oven Cryo +24 V (GRAY)	
10	CO2 Cryo Installed (VIOLET)	
11	N2 Cryo Installed (GREEN)	
12	GND	
13	Oven Cryo Drive (WHT/RED)	
P19—AC board control		
1	Oven Relay Drive	
2	Oven Triac Drive	
3	+24 Volts	
4	common w/ pin 2	
5	common w/ pin 1	
P21—Inl/Det Htd Zones, man split valves		
1	Sensor GND	
2	Sensor GND	
3	Sensor GND	
4	Sensor GND	
5	Heater GND	
6	Heater GND	
7	Heater GND	
8	Heater GND	
9	+24 Volts	
10	+24 Volts	
11	FRONT INJ SENSOR	
12	BACK INJ SENSOR	
13	FRONT DET SENSOR	
14	BACK DET SENSOR	
15	FRONT INJ HEATER	
16	BACK INJ HEATER	
17	FRONT DET HEATER	
18	BACK DET HEATER	
19	FRONT INJ +24V VALVE	
20	BACK INJ +24V VALVE	
P22—Valve box, Aux heated zones		
1	AUX 1 SENSOR	
2	AUX 2 SENSOR	
3	HEATER GND	
4	HEATER GND	
5	+24 Volts	
6	+24 Volts	
7	+24 Volts	
8	+24 Volts	
9	SENSOR GND	
10	SENSOR GND	
11	AUX 1 HEATER	
12	AUX 2 HEATER	
13	VALVE #1	
14	VALVE #2	
15	VALVE #2	
16	VALVE #4	
		
		Connects to: G1530-60640 (Inlet/Detector harness)
		Connects to: G1530-60660 (Auxiliary Zone/Valve Box harness)

Table 1220-1 Main Circuit Board Pinouts (continued)

J8—ALS Interfaceboard	
1	+5V
2	-15V
3	+5
4	DSRB
5	GND
6	+5V
7	GND
8	NC
9	GND
10	GND
11	GND
12	GND
13	APG[1]
14	NC
15	RXD
16	+15V
17	TXD
18	DTR
19	CTS
20	RTS



Connects to:
G2612-60510
(6890 ALS Controller Bd
cable)

Fuses

There are four identical glass fuses on the main board.

Table 1220-2 Replaceable fuses on the AC power board

I.D.	Description	System	Power Rating	Part no.
F1	Glass/Type F	Zone	8A/250 V	2110-0036
F2	Glass/Type F	Zone	8A/250 V	"
F3	Glass/Type F	± 24 Volt	8A/250 V	"
F4	Glass/Type F	± 24 Volt	8A/250 V	"

Circuitry diagrams

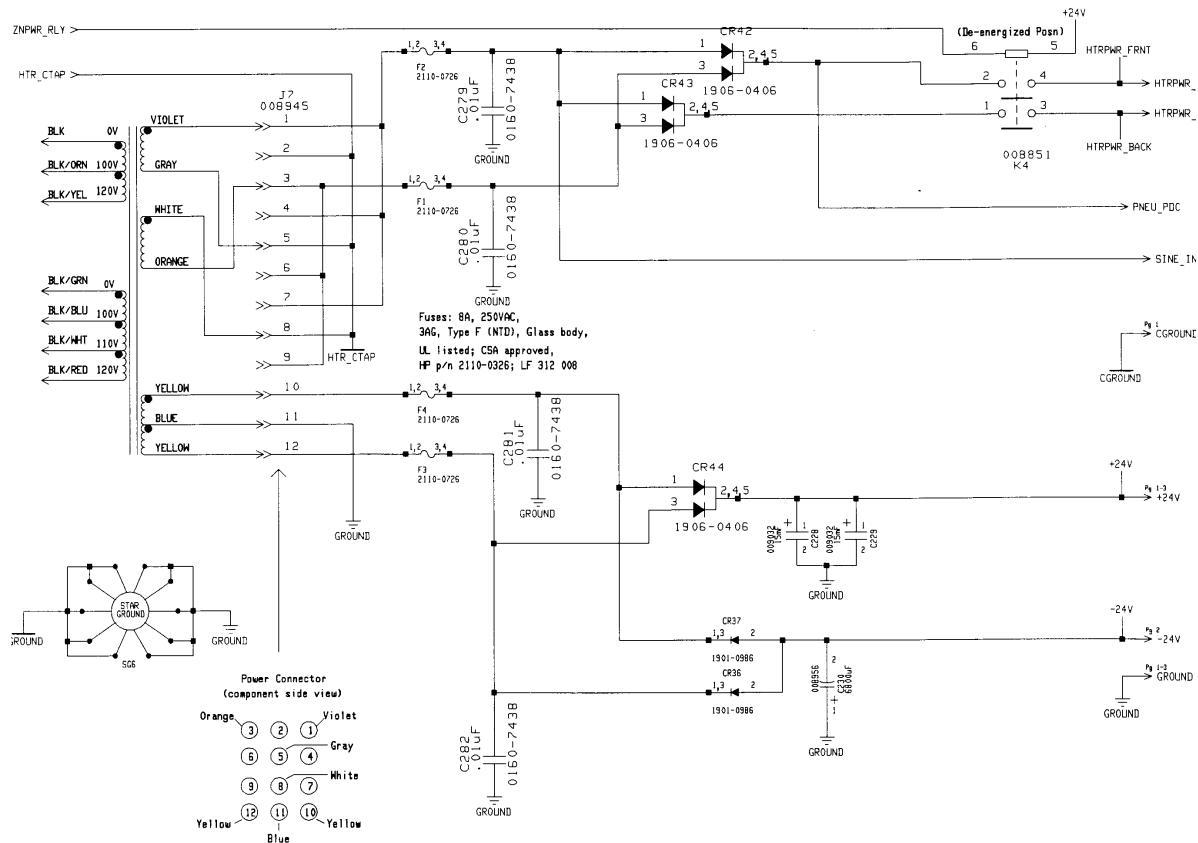


Figure 1220-3 Main board connector circuitry (unregulated power supplies)

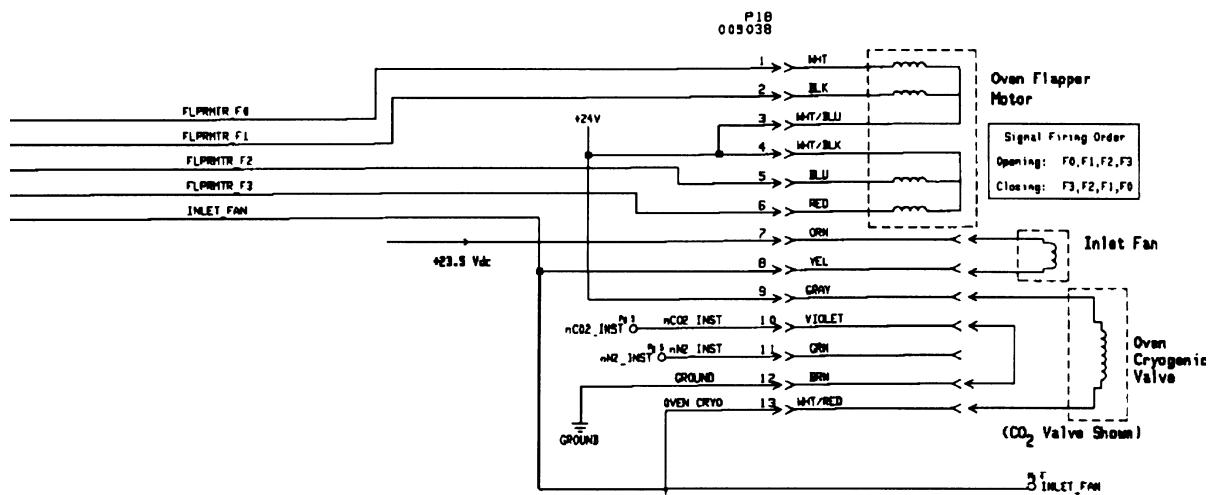


Figure 1220-4 Inlet fan, oven flap, oven cryo circuitry

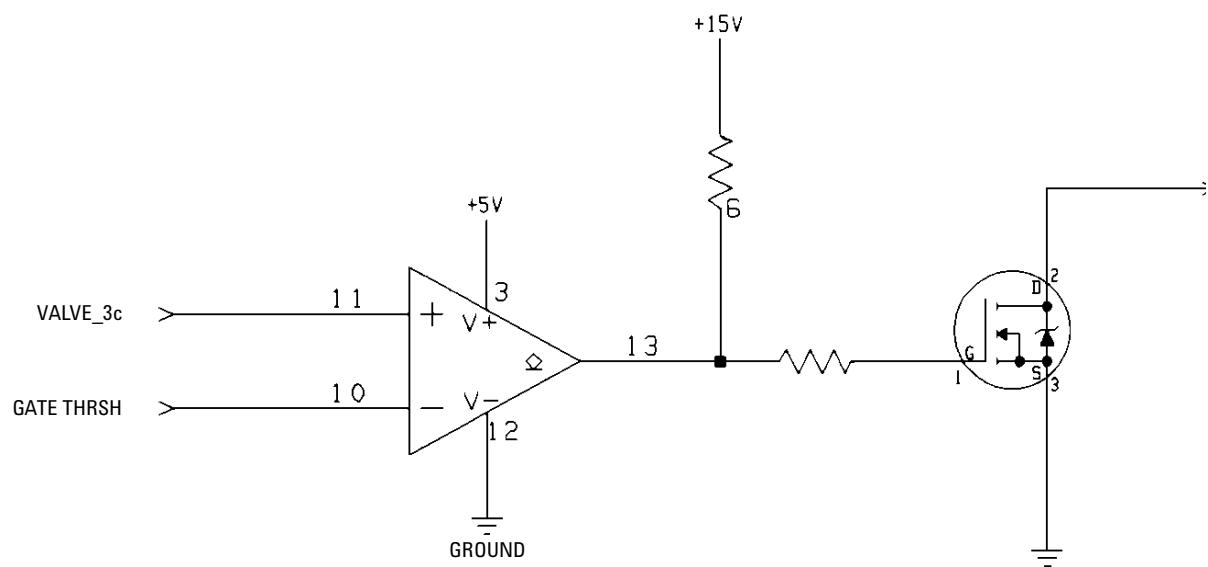


Figure 1220-5 Valve driver circuitry

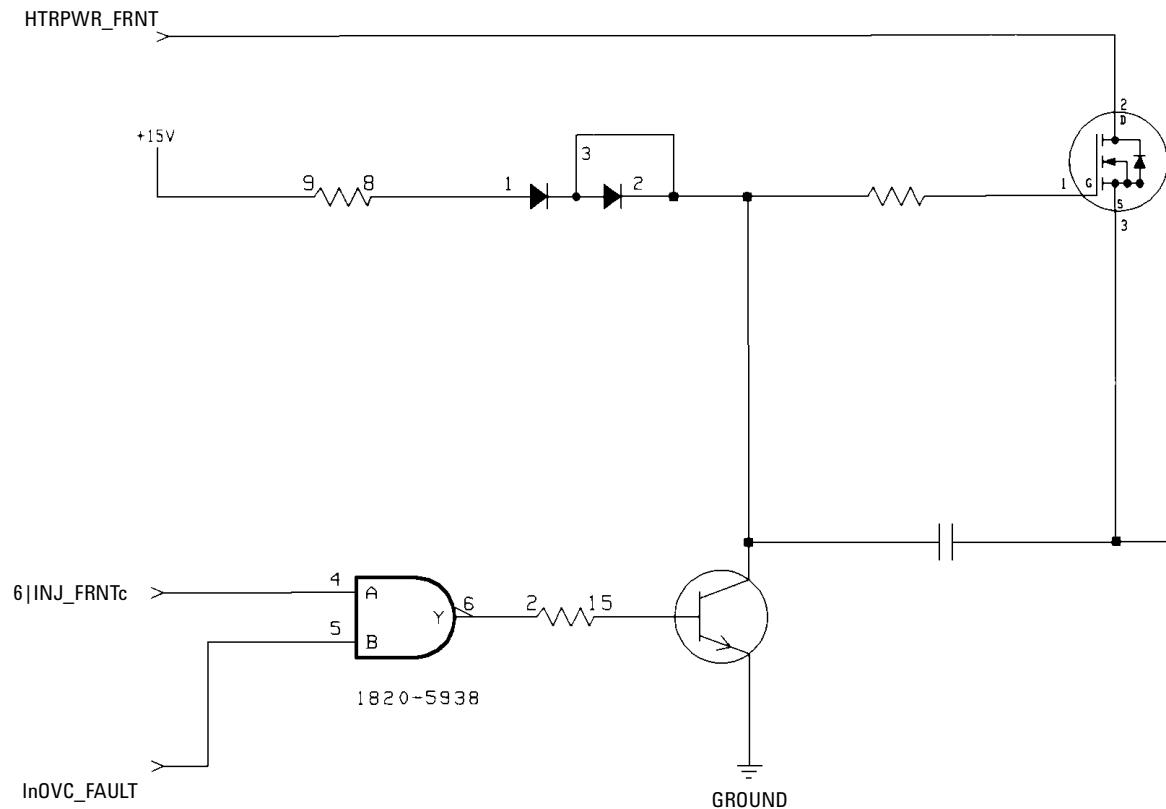


Figure 1220-6 Heater driver circuitry

1220 Main Board, 6890A and 6890 Plus
Circuitry diagrams

1225 Main Board, 6890N

General board layout

The test points on the G1530-60200 main board are shown in Figure 1225-1. Some additional parts are included to assist in locating the test points.

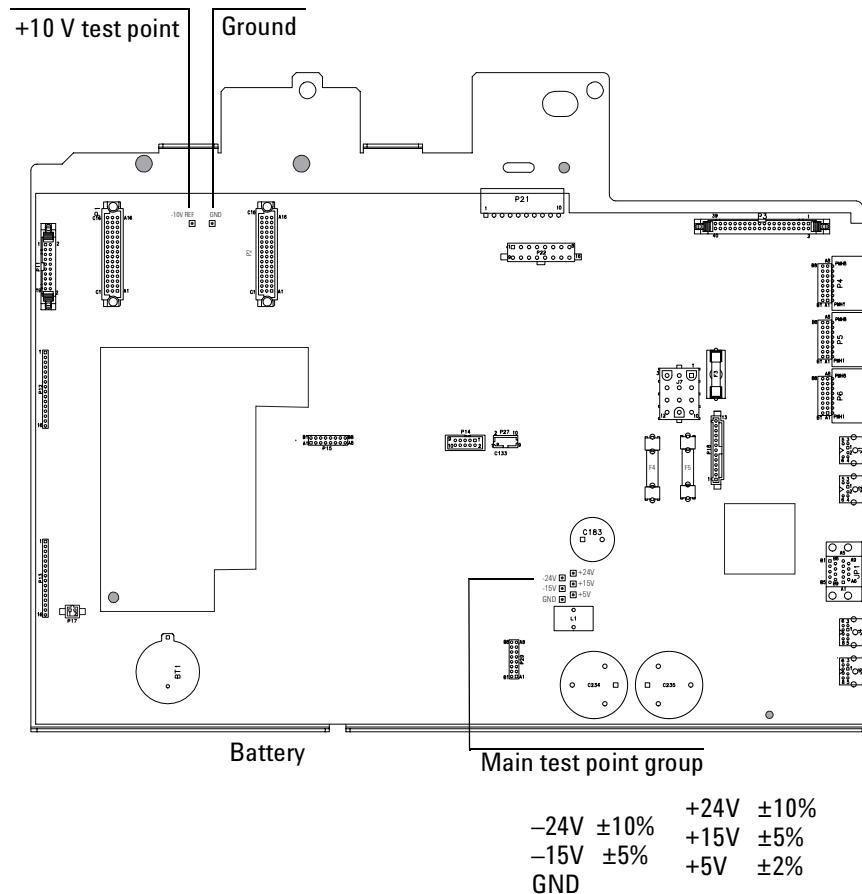


Figure 1225-1 Main board test points and battery, 6890N

Check the +10 V test point to determine if detector, A/D, and D/A circuitry is operating.

If the instrument appears dead and there is no 24 V voltage:

1. Check AC power
2. Check fuses at F4 and F5.

If thermal shutdown occurs or if the detectors are not working:

1. Check the -15 V voltage. If not present, A/D functionality will not work.
2. Unplug the detectors and the EPC board.
3. Recheck the -15 V voltage. If it returns, the problem may be in the detector or EPC board.

Connectors

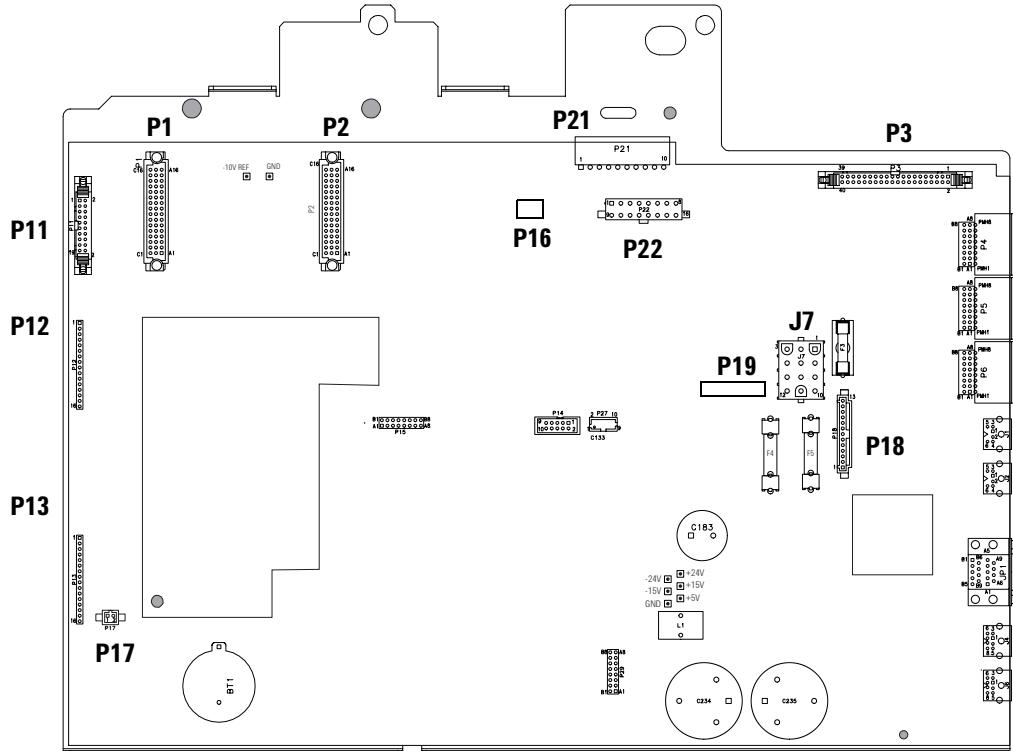


Figure 1225-2 Main board connectors, 6890N

Table 1225-3 Main Circuit Board Pinouts

J7-AC Power			P21-Inl/Det Htd Zones, man split valves		
1	Heater 40 VAC (VIOLET)		1	Sensor GND	
2	unused		2	Sensor GND	
3	Heater 40 VAC (ORANGE)		3	Sensor GND	
4	unused		4	Sensor GND	
5	Heater Center Tap (GRAY)		5	Heater GND	
6	unused		6	Heater GND	
7	ALS power 24 VAC (RED)		7	Heater GND	
8	Heater Center Tap (WHITE)		8	Heater GND	
9	ALS power 24 VAC (RED)		9	+24 Volts	
10	20 VAC (YELLOW)		10	+24 Volts	
11	20 VAC Center Tap (BLUE)		11	FRONT INJ SENSOR	
12	20 VAC (YELLOW)		12	BACK INJ SENSOR	
P16-Oven sensor			13	FRONT DET SENSOR	Connects to: G1530-60640 (Inlet/Detector harness)
1	Oven sense		14	BACK DET SENSOR	
2	Ground		15	FRONT INJ HEATER	
P17-Oven door switch			16	BACK INJ HEATER	
1	Oven door		17	FRONT DET HEATER	
2	Ground		18	BACK DET HEATER	
P18-Inlet fan, oven flap, oven cryo			19	FRONT INJ +24V VALVE	
1	Oven Flap Drive (WHITE)		20	BACK INJ +24V VALVE	
2	Oven Flap Drive (BLACK)		P22-Valve box, Aux heated zones		
3	Oven FLAP +24 V (WHT/BLU)		1	AUX 1 SENSOR	
4	Oven FLAP +24 V (WHT/BLK)		2	AUX 2 SENSOR	
5	Oven Flap Drive (BLUE)		3	HEATER GND	
6	Oven Flap Drive (RED)		4	HEATER GND	
7	Inlet Fan +24 V (ORANGE)		5	+24 Volts	
8	Inlet Fan Drive (YELLOW)		6	+24 Volts	
9	Oven Cryo +24 V (GRAY)		7	+24 Volts	
10	CO2 Cryo Installed (VIOLET)		8	+24 Volts	
11	N2 Cryo Installed (GREEN)		9	SENSOR GND	
12	GND		10	SENSOR GND	
13	Oven Cryo Drive (WHT/RED)		11	AUX 1 HEATER	
P19-AC board control			12	AUX 2 HEATER	
1	Oven Relay Drive		13	VALVE #1	Connects to: G1530-60660 (Auxiliary Zone/Valve Box harness)
2	Oven Triac Drive		14	VALVE #2	
3	+24 Volts		15	VALVE #2	
4	common w/ pin 2		16	VALVE #4	
5	common w/ pin 1				

Fuses

There are three replaceable fuses:

I.D.	Description	System	Power rating	Part no.
F3	Ceramic	Autosampler	5A/250V	2110-0709
F4	Glass/Type F	± 24 Volt	8A/250 V	2110-0036
F5	Glass/Type F	± 24 Volt	8A/250 V	2110-0036

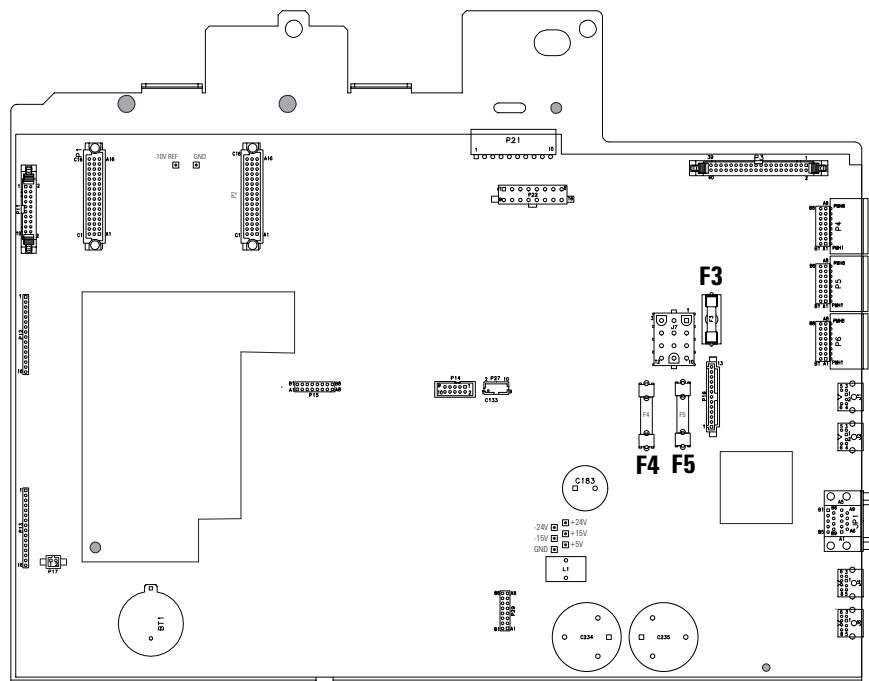


Figure 1225-3 Fuse locations, G1530-90200

1230 Power Supply

Setting the instrument power configuration

There are seven possible line voltage power configurations for the 6890 GC.

Table 1230-1 Voltage Configuration Information

Voltage (-10%, +5%)	Frequency (Hz)	Maximum power consumption (VA)	Power line requirement	Oven type
120 V	48-66	2,250	20-amp dedicated receptacle	Regular
200 V	48-66	2,950	15-amp dedicated receptacle	Fast-heating
208 V	48-66	2,950	15-amp dedicated receptacle	Fast-heating
220 V	48-66	2,950	15-amp dedicated receptacle	Fast-heating
230 V	48-66	2,250	10-amp dedicated receptacle	Regular
230 V	48-66	2,950	16-amp dedicated receptacle	Fast-heating
240 V	48-66	2,950	13- or 16-amp dedicated receptacle	Fast-heating

To change the power configuration for the instrument, you must install the appropriate types of the following components:

- Line voltage configuration plug
- Ceramic fuses on the AC power board
- Oven shroud assembly

These three components are explained in the following topics.

Line voltage configuration plug

There is a different line voltage configuration plug on the AC power board for each power configuration. Each configuration uses three or five jumper wires, each connecting to two different pins on the plug. The 120 VAC configuration uses five jumper wires and all other configurations use three jumper wires.

Table 1230-2 Line Voltage Configuration Plugs (P8 on AC board) by Power Option and Diagram of Pinouts from the Top of the Plug

Jumper locations for power configuration plug					
	120 VAC	200 VAC	208/220 VAC	230 VAC	240 VAC
Transformer	3 ↔ 13	2 ↔ 13	3 ↔ 13	5 ↔ 13	3 ↔ 13
	6 ↔ 15	6 ↔ 12	6 ↔ 12	6 ↔ 9	6 ↔ 9
	9 ↔ 14				
Oven fan	1 ↔ 10 4 ↔ 8	1 ↔ 4	1 ↔ 4	1 ↔ 4	1 ↔ 4

Ceramic fuses

The two ceramic oven heater fuses on the AC power board (F1, F2) will be one of two types, depending on the line voltage:

- One for the 120 V power option
- One for all other power options.

These fuses should always be **replaced as a pair**.

Power option	Fuse rating
120 V	20A/250 V (Type F)
200 V-240 V	15A/250 V (Type F)

Oven shroud

There are two different oven shrouds depending on the power option used. The oven shroud contains the oven heater and sensor as part of the assembly. If you need to replace the heater or sensor, you should replace the entire shroud assembly. See Replacing the oven shroud assembly in the Oven and Temperature Control chapter for more details.

Table 1230-3 Part Numbers for Oven Shrouds and Configuration Plugs

Regular oven shrouds		
Voltage	Shroud part no.	Configuration plug part no.
120 V	G1530-61610	G1530-60690
230 V	G1530-61670	G1530-60720
Fast ramping oven shrouds		
Voltage	Shroud part no.	Configuration plug part no.
200 V	G1530-61620	G1530-60700
208 V	G1530-61630	G1530-60710
220 V	G1530-61630	G1530-60710
230 V	G1530-61650	G1530-60720
240 V	G1530-61640	G1530-60730

Replaceable AC board fuses

There are four fuses on the AC power board.

- **The two glass fuses** are identical for all power options.
- **The two ceramic fuses** come in two types: one for the 120 V power option and another type for all other power options.

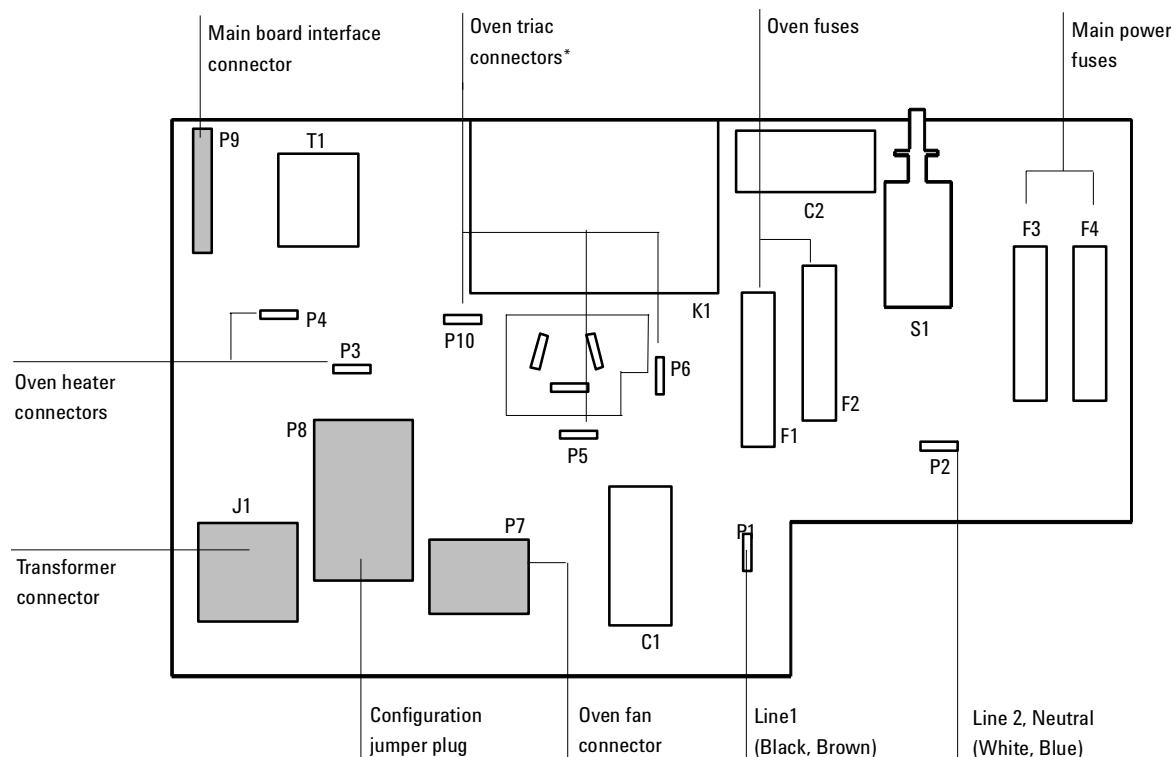
When replacing both the glass and ceramic fuse types, **always replace them in pairs.**

Table 1230-4 Replaceable Fuses on the AC Power Board

I.D.	Description	System	Power rating	Part no.
F1	Ceramic/Type F	Oven heater	120 V systems: 20A/250 V 200 V–240 V systems: 15A/250 V	2110-0098 2110-0054
F2	Ceramic/Type F	Oven heater	120 V systems: 20A/250 V 200 V–240V systems: 15A/250 V	2110-0098 2110-0054
F3	Glass/Type F	All other systems except heater	8A/250 V	2110-0036
F4	Glass/Type F	All other systems except heater	8A/250 V	2110-0036

AC power board connectors

The following tables are the pinouts for the internal connectors on the main circuit boards in the instrument. These connectors are used for communications within the instrument. All connector pinout drawings are viewed from the component side of the board.



*On some AC power boards, the oven triac is mounted directly onto the AC board while on others it mounts on the GC through a cutout in the AC board. Both configurations are the same electrically.

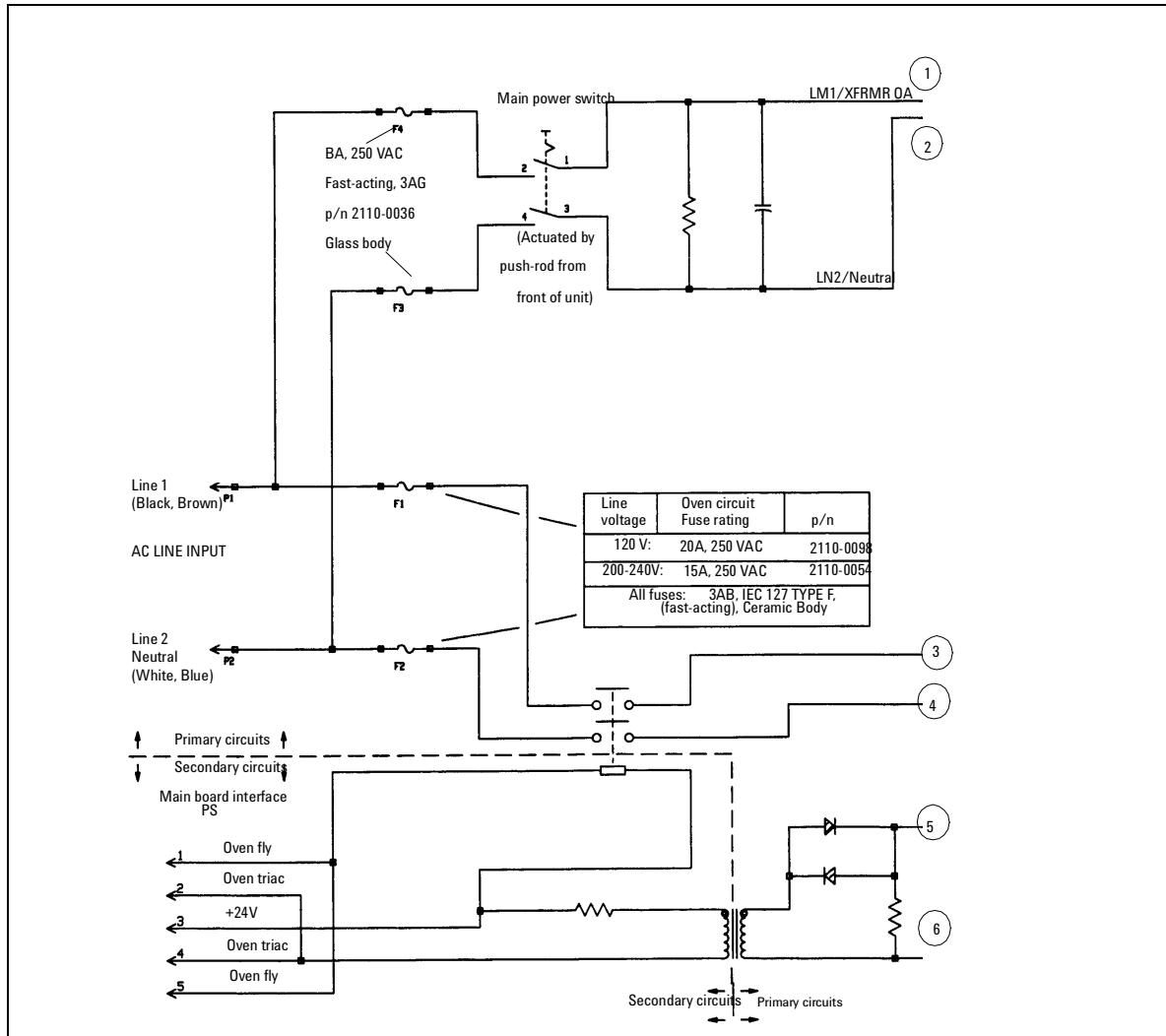
Figure 1230-1 AC power board overlay (part no. G1530-60050)

J1 Power transformer connector		Transformer assembly
Pin	Function	Wire color
1	NC	NC
2	Line 1/Transformer 0A	Black/Orange
3	Transformer 100A	Black/Yellow
4	Transformer 120A	Black
5	NC	NC
6	Transformer 0B	Black/Green
7	Transformer 100B	Black/Blue
8	Transformer 110B	Black/White
9	Transformer 120B	Black/Red

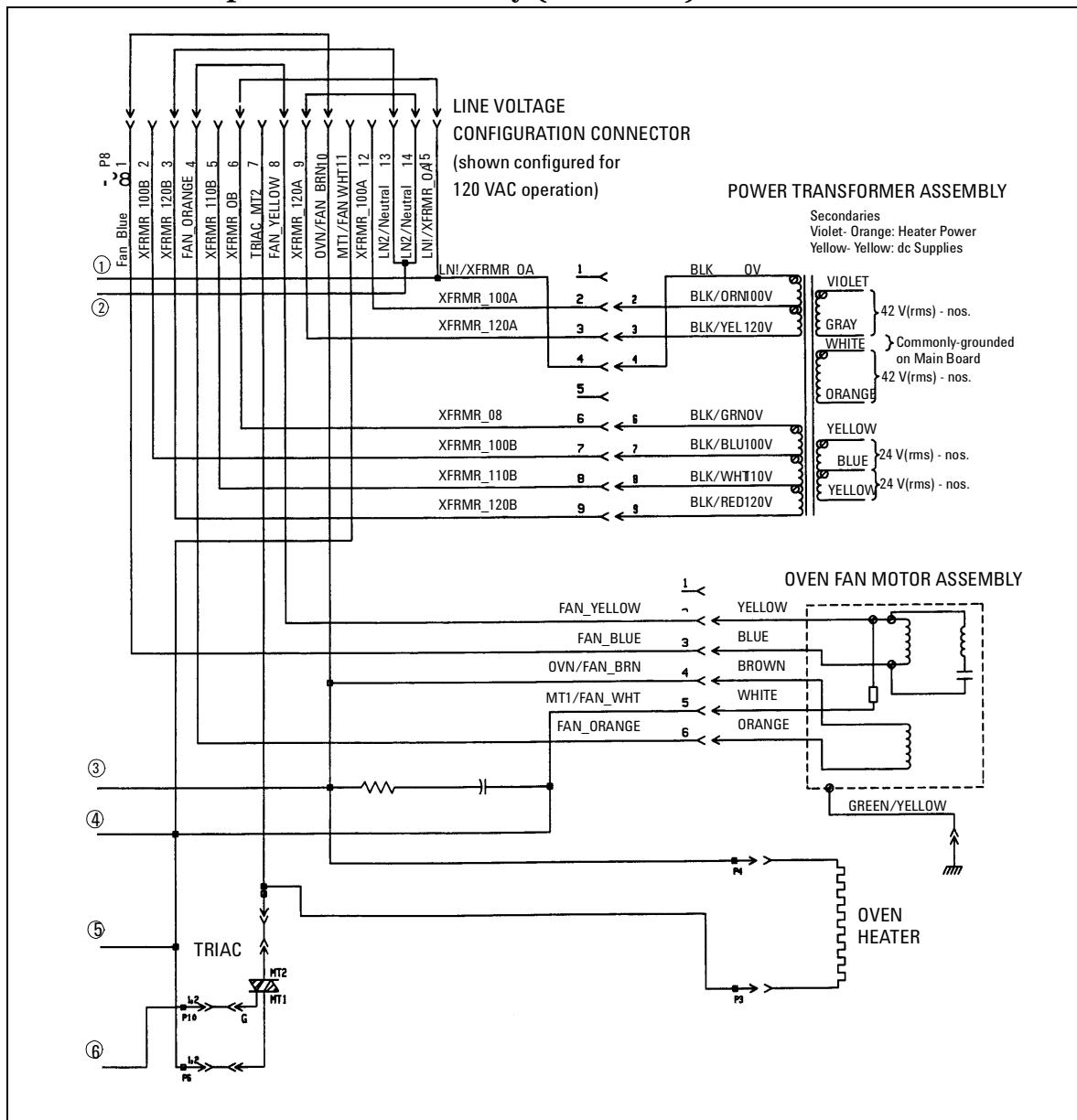
P7 Oven fan connector		Motor assembly
Pin	Function	Wire color
1	NC	NC
2	Fan	Yellow
3	Fan	Blue
4	Oven/Fan	Brown
5	MT1/Fan	White
6	Fan	Orange

P9 Main board interface connector	
Pin	Function
1	Oven relay
2	Oven triac
3	+24V
4	Oven triac
5	Oven relay

AC power board circuitry



AC power board circuitry (continued)



Testing resistance of the heater coil

If you believe that your heater coil is cracked or otherwise damaged and has caused an open circuit, you can check it by measuring its resistance.

To measure the resistance:

1. Turn the instrument power off.
2. Disconnect the oven heater leads (P3, P4) from the AC power board.
3. Use an ohmmeter to measure resistance at the **connectors**.

Acceptable resistance ranges (in ohms) are given below. Acceptable resistances range from the nominal value for a new, cold heater to +5% from the nominal value.

Note

Resistance goes up approximately +3% after heating the coil.

Table 1230-5 Resistances of the Heater Coil

Nominal cold heater resistances		
	Standard oven (1600 VA)	Fast-ramp oven (2250 VA)
120 V	9.07 – 9.52 Ω	n/a
200 V	n/a	17.78 – 18.7 Ω
220 V	n/a	21.51 – 22.6 Ω
230 V	33.06 – 34.71 Ω	23.51 – 24.7 Ω
240 V	n/a	25.60 – 26.9 Ω

n/a = not available

1230 Power Supply
Testing resistance of the heater coil

1240 Wiring Harnesses

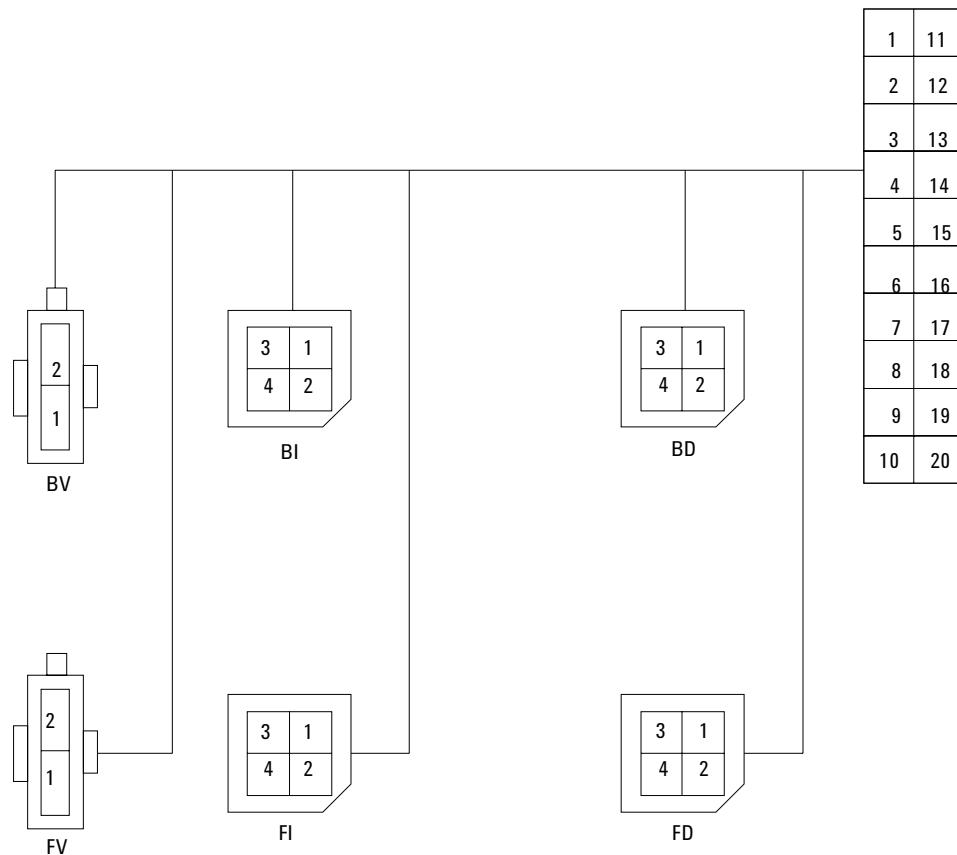
This section covers wiring harnesses in the 6890 gas chromatograph. The following wiring harnesses are described:

- Inlet/Detector harness
- Auxiliary Zone/Valve Box harness
- PTV TC-PCB cable assembly

Inlet/Detector harness (G1530-60640)

The Inlet/Detector harness runs from connector P21 on the main board to the front and back inlets and detectors on top of the instrument. It powers the inlet/detector heater and sensors and the +24 V valve on a manual split/splitless inlet

Wire color	Pin # on P21	Signal name	Destination (and Pin #)
Black	1	Sensor GND	FI (3)
	2	Sensor GND	BI (3)
	3	Sensor GND	FDI (3)
	4	Sensor GND	BDI (3)
Green	5	Heater GND	FI (4)
	6	Heater GND	BI (4)
	7	Heater GND	FD (4)
	8	Heater GND	BD (4)
Yellow	9	+24 Volts	FV (1)
	10	+24 Volts	BV (1)
Violet	11	Frnt Inj Sense	FI (2)
Gray w/ stripe	12	Back Inj Sense	BI (2)
Violet stripe	13	Frnt Det Sense	FD (2)
Gray	14	Back Det Sense	BD (2)
Red	15	Frnt Inj Htr	FI (1)
Redw/Orange stripe	16	Back Inj Htr	BI (1)
Orange	17	Frnt Det Htr	FD (1)
Blue	18	Back Det Htr	BD (1)
White	19	Frnt Inj +24 Vlv	FV (2)
White	20	Back Inj +24 Vlv	BV (2)



**Figure 1240-1 Inlet/Detector wiring harness-view from top of GC
(G1530-60640)**

Auxiliary Zone/Valve Box Harness (G1530-60660)

The Auxiliary Zone/Valve Box harness runs from connector P22 on the main board to the valve driver bracket screwed on to the right side of the GC above the main board. It powers the valve actuator drivers and two auxiliary heater/sensors.

Wire color	Pin # on P21	Signal name	Destination (and Pin #)
Violet	1	Aux 1 Sense	A1 (2)
	2	Aux 2 Sense	A2 (2)
Green	3	Heater GND	A1 (4)
	4	Heater GND	A2 (4)
Yellow	5	+24 Volts	V1 (1)
	6	+24 Volts	V2 (1)
	7	+24 Volts	V3 (1)
	8	+24 Volts	V4 (1)
Black	9	Sensor GND	A1 (3)
	10	Sensor GND	A2 (3)
Red	11	Aux 1 Heater	A1 (1)
Orange	12	Aux 2 Heater	A2 (1)
Brown	13	Valve #1	V1 (2)
Blue	14	Valve #2	V2 (2)
Gray	15	Valve #3	V3 (2)
White	16	Valve #4	V4 (2)

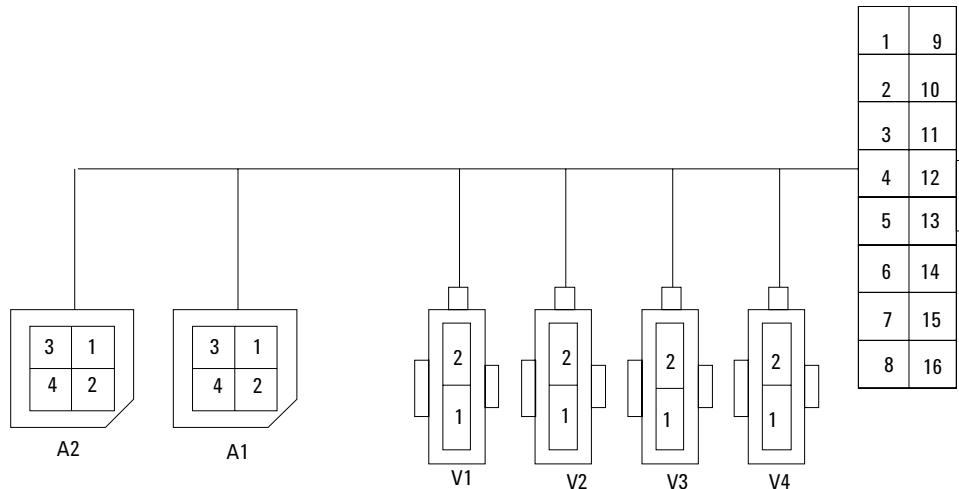


Figure 1240-2 Auxiliary Zone/Valve Box wiring harness (G1530-60660)

PTV TC-PCB Cable Assembly

The PTV TC-PCB Cable Assembly connects the PTV "TCB" to the PTV inlet heater/sensor cable, and to the valve and power connectors on the inlet/detector wiring harness.

Temperature sensor resistance

The approximate resistance of a temperature sensor is:

$$R = 100 + (.35 \times t)$$

where R is resistance in ohms and t is sensor temperature in °C.

Table 1240-1 Temperature Sensor Resistance by Heater Temperature

°C	+0°	+10°	+20°	+30°	+40°	+50°	+60°	+70°	+80°	+90°	+100°
0°	100.00	103.90	107.79	111.67	115.54	119.40	123.24	127.07	130.89	134.70	138.50
100°	138.50	142.28	146.06	149.82	153.57	157.32	161.04	164.76	168.47	172.16	175.84
200°	175.84	179.51	183.17	186.82	190.46	194.08	197.70	201.30	204.88	208.46	212.03
300°	212.03	215.58	219.13	222.66	226.18	229.69	233.19	236.67	240.15	243.61	247.06
400°	247.06	250.50	253.34	257.34	260.75	264.14	267.52	270.89	274.25	277.60	280.93

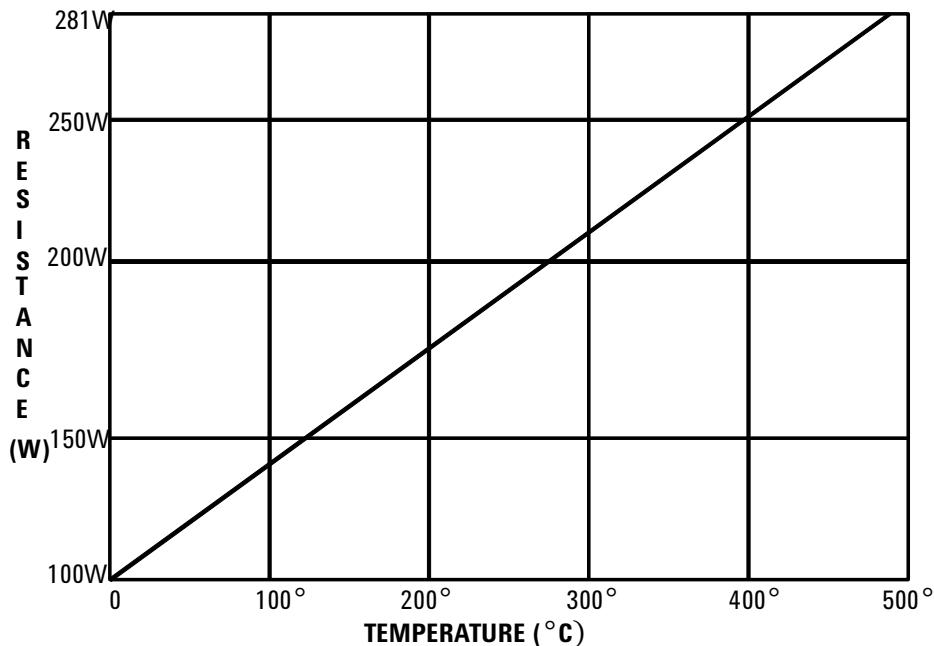


Figure 1240-3 Chart of temperature sensor resistances by heater temperature

1300 Illustrated Parts Breakdown

- 1310 Inlets**
- 1320 Detectors**
- 1330 Covers**
- 1340 Oven**
- 1350 Valves**
- 1360 Electrical**

Illustrations and part numbers for the components that make up the 6890 instrument.

1310 Inlets

This section contains illustrated parts breakdowns for 6890 GC inlets and related components.

- Split/Splitless Inlet
- Split/Splitless Inlet Column Liners
- Split/Splitless Inlet EPC Pneumatic Module
- Flow Carrier Assembly
- Split/Splitless Inlet Manual Pneumatic Module
- Capillary Injection Port (0 to 30 psig)
- Capillary Injection Port Sub-Assembly (0 to 30 psig)
- Purged/Packed Inlet
- Purged/Packed Inlet EPC Pneumatic Module
- Purged/Packed Inlet Manual Pneumatic Module
- Packed Column Injection Port Supplies
- Programmable Cool On-Column Capillary Inlet
- Programmable Cool On-Column EPC Pneumatic Module
- Programmed Temperature Vaporization Inlet
- Programmed Temperature Vaporization Inlet EPC Pneumatic Module
- Volatiles Interface Assembly
- Volatiles Interface EPC Pneumatics Module
- Solvent Vapor Exit Assembly
- Pneumatics Control Module

Split/splitless inlet

Description	Part no.	Qty.
1. O-rings HPM8 (10/pkg)	5180-4181	1
2. Septum nut	18740-60835	1
3. Septum, 11 mm, solid, (25/pkg)*	5181-1263	1
4. Nut, Merlin Microseal	5182-3445	—
5. Septum, Merlin Microseal	5182-8815	—
6. Top insert assembly (EPC), original New insert assembly (EPC, new trap) (Manual assy)	G1544-60575 G1544-60585 19251-60575 G1580-60585	1 1 1 1
New sampling valve/Split-Splitless insert assembly		
7. O-ring, *.239-inch (Order No. 5180-4182, 12/pkg)	0905-1014	1
8. Inlet liner, split mode, standard**	5183-4647	1
9. Split vent flow line (14.2-inch long x 0.125-inch id)	G1544-20620	1
10. Split vent trap assembly*** Replacement filter cartridge kit (2/pkg)	G1544-80550 G1544-80530	1 —
11. Swagelok nut, 1/8-inch brass (10/pkg)	5180-4103	1
12. Swagelok back ferrule, 1/8-inch brass (10/pkg)	5180-4115	1
13. Swagelok front ferrule, 1/8-inch brass (10/pkg)	5180-4109	1
14. Screw, M4 x 12 mm, Torx T-20 (Captive)	1390-1023	3
15. Inlet weldment	G1544-80570	1
16. Heater/Sensor assembly	G1544-61140	1
17. Screw, M4 x 8 mm, Torx T-20, chromeplated	0515-2711	3
18. Top insulation	G1544-00010	1
19. Washer, 12/pkg	5061-5869	1
20. Thermal block	G1544-20570	1
21. Block insulation	G1544-00020	1
22. Thermal nut	G1544-20590	1
23. Lower inlet seal, gold plated Also in stainless steel (optional)	18740-20885 18740-20880	1 —
24. Flat thrust washer (Order no. 5061-5869, 12/pkg)	2190-0464	1
25. Reducing nut	18740-20800	1
26. Insulation, (lower)	G1544-00030	1
27. Insulation, order qty 3	19243-00067	3
28. Bottom insulation cover	19243-00070	1
29. Ferrules (identify by internal diameter):*		
Solid (no hole) ferrule plug	5181-7458	1
Graphite ferrule 0.5 mm id (10/pkg)	5080-8853	
Graphite ferrule 1.0 mm id (10/pkg)	5080-8773	
30. Column nut* (Order no. 5181-8830, 2/pkg)	18740-20870	1
31. Screw, M3 x 16 mm, Torx T-10	1390-1022	1
32. Plastic fitting, HPM8, (10/pkg)	5181-3394	1

- * Also refer to the Agilent chemical analysis consumables and accessories catalog.
- ** See the Column Liners table for more liners, or the Agilent chemical analysis consumables and accessories catalog. Two recommended liners are part no. 5183-4647, deactivated split liner, and part no. 5062-3587, deactivated splitless liner.
- *** Order the Replacement Split Vent Trap kit, part no. G1544-60610, to replace the Split vent trap assembly, part no. G1544-80500.

1310 Inlets
Split/splitless inlet

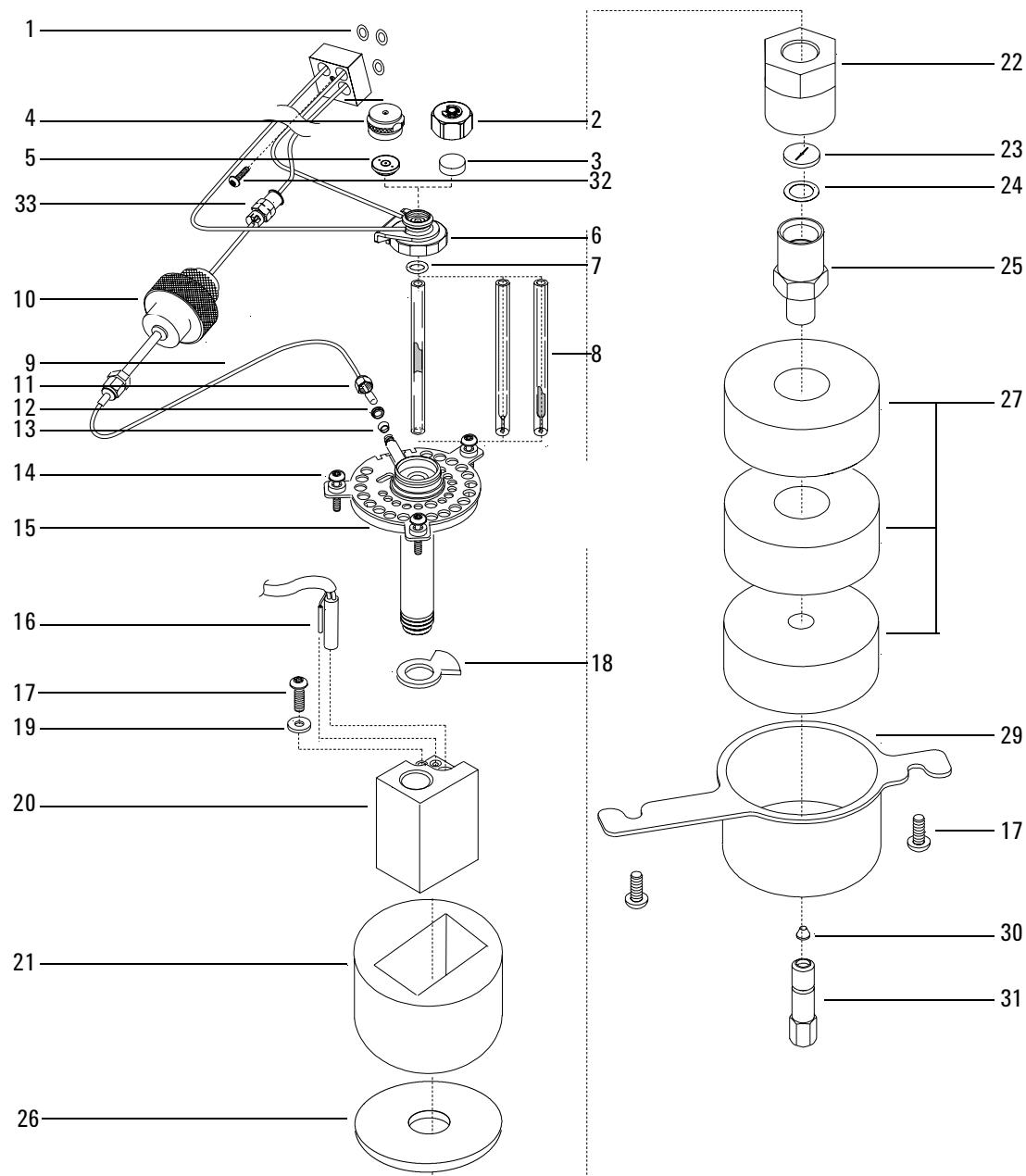


Figure 1310-1 Split/Splitless Inlet

Split/splitless inlet column liners

The table below lists some of the liners available for the split/splitless column. Refer to the Agilent chemical analysis consumables and accessories catalog for a complete list of liners and the specifications for each.

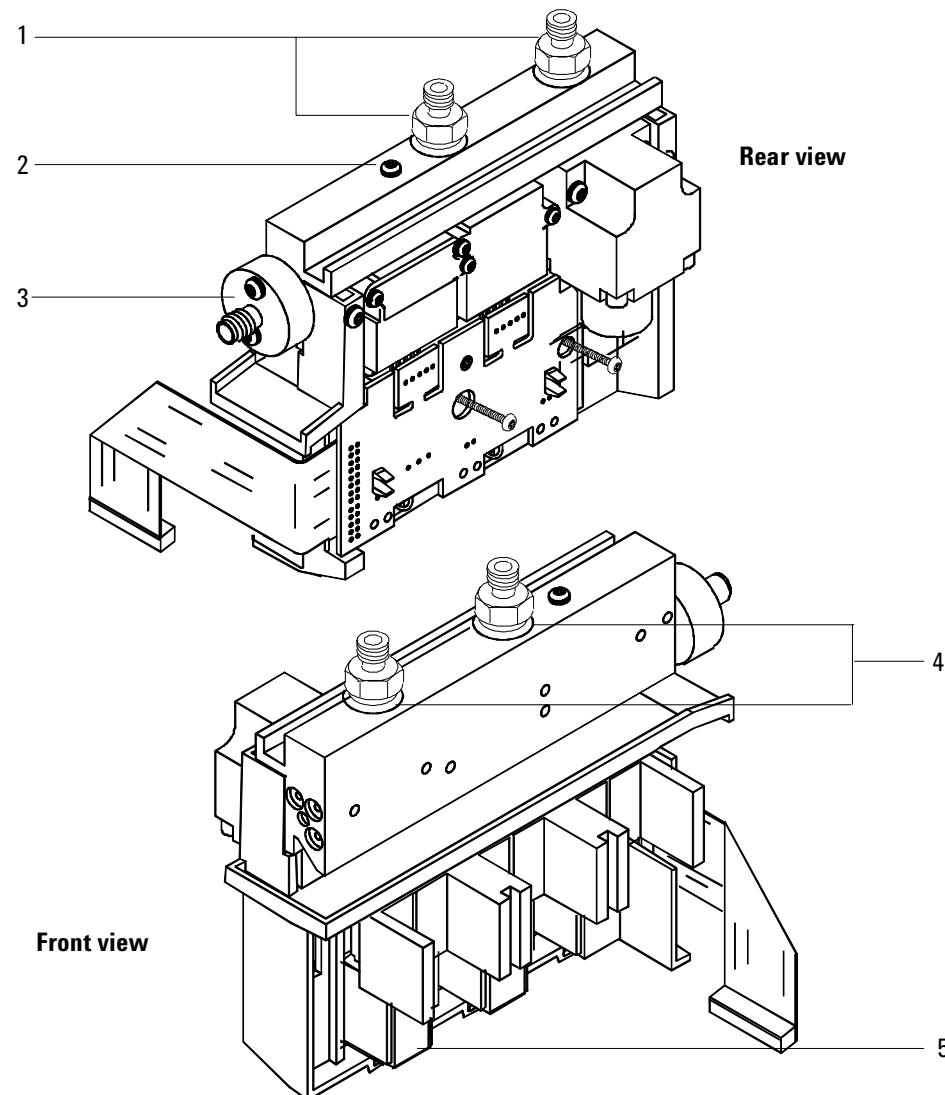
Description	Part no.	Qty.
Single-taper liner with glass wool packing, deactivated (recommended)	5062-3587	1
Single-taper liner without glass wool packing, deactivated	5181-3316	1
Split/Splitless liner	19251-60540	1
Split liner, deactivated (recommended)	5183-4647	1

Split/splitless inlet EPC pneumatic module

(Part no. G1544-60500, 0 to 100 psig or G1544-60540, 0 to 150 psig)

Description	Part no.	Qty.
1. Male connectors 1/8-inch Swagelok	G1543-80030	2
2. Screw, M4 x 45 mm, Torx T20	0515-2484	1
3. Inlet supply fitting	G1543-20610	1
4. Screw, M3 x 12 mm, Torx T10	0515-1084	2
5. O-rings, under connectors and fitting (12/pkg)	5180-4182	1
6. Split vent On/Off valve	G1544-60580	1

For diagram of screw and O-ring placement in pneumatic modules see Figure 1310-7 on page 15 of this section.

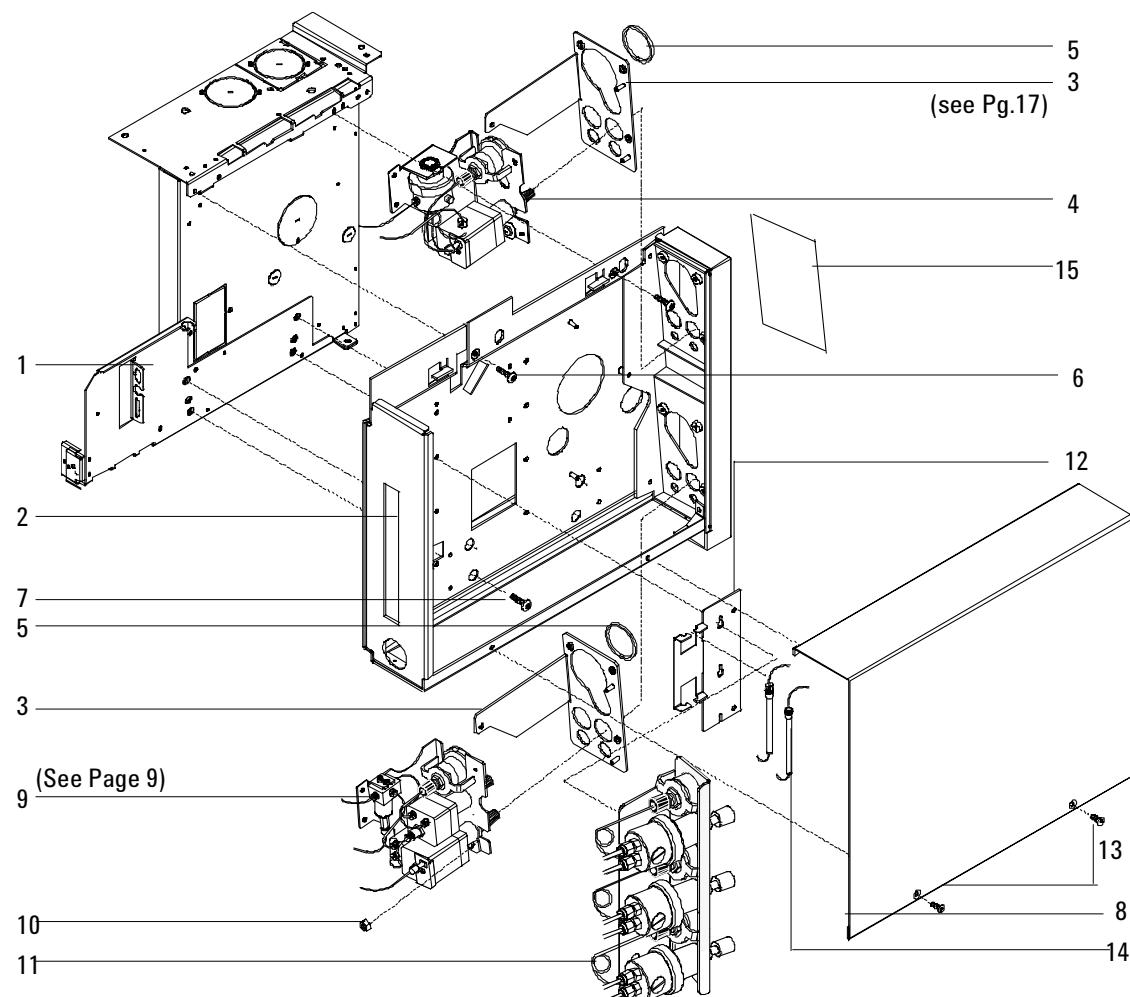
**Figure 1310-2 Split/Splitless inlet EPC pneumatic module**

Pneumatic carrier assembly G1585A

Description	Part no.	Qty.
1. Flow support bracket	G1530-01220	1
2. Flow module back-up plate	G1530-00580	1
3. Flow carrier assy.	G1530-80790	2
4. PPIP manifold assy, 0 to 100 psi (with inlet)	G1543-60500	1
5. Spacer, pressure gauge	19243-40010	2
6. Screw, M4 × 25 mm, Torx T-20	0515-2712	2
7. Screw, M4 × 12 mm, Torx T-20	0515-2496	12
8. Flow cover	G1530-01240	1
9. S/SL manifold assy., 0 to 30 psi	G1544-60500	1
10. Nut, hex w/lkwr	0535-0043	2
11. Reg/Gauge assy. (order part no. G1577A)	19246-60640	1
12. Chemical trap bracket	05890-00810	1
13. Screw, machine, flat head, M4 × 10, Torx T-20	0515-2725	2
14. Chemical trap assy.	05890-80710	2
15. Label plate, blank	G1530-90705	1
Label plate, PPIP	G1530-90740	NS
Label plate, S/SL	G1530-90720	NS

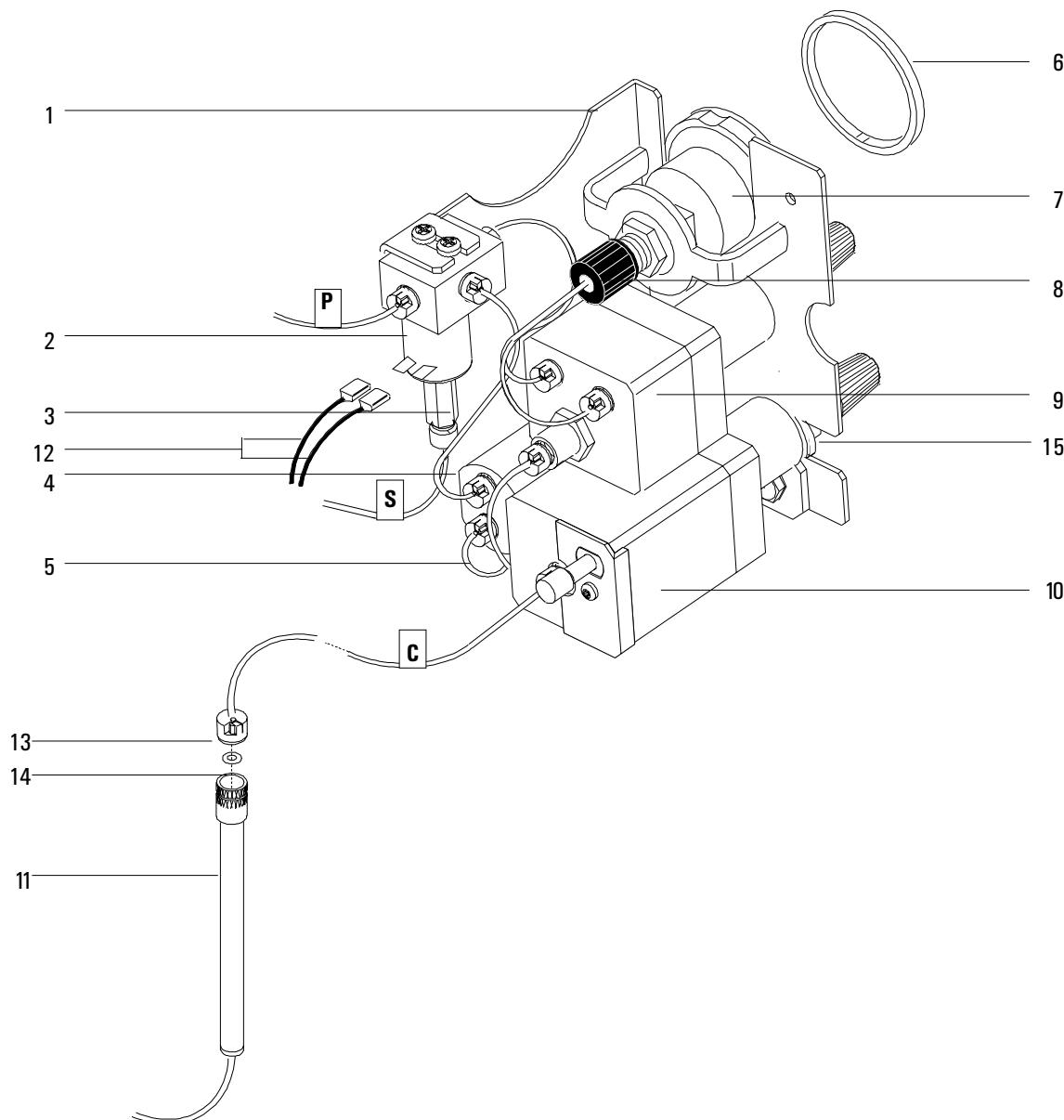
Note

Minimum Replacement Level is G1530-80790

Pneumatic carrier assembly**Figure 1310-3 Pneumatic carrier assembly**

Split/splitless inlet manual pneumatic module**(Module and Inlet Assy. part no. G1544-65500)**

Description	Part no.	Qty.
1. Flow module bracket	19243-00045	1
2. Solenoid valve assembly, 3-way, 24Vdc	G1544-60560	1
3. Jumper weldment	19243-80550	2
4. Purge pressure regulator (septum)	19246-60530	1
5. Vent tube weldment	19244-80580	1
6. Pressure gauge spacer	19243-40010	1
7. Pressure gauge, 0 to 30 psi	19320-60655	1
8. Gauge jumper weldment	19243-80555	1
9. Backpressure regulator, 0 to 30 psi	19246-60570	1
10. Mass flow controller, 0 to 400 mL/min.	19362-60575	1
11. Chemical trap assembly	05890-80710	1
12. Solenoid valve cable assembly	G1544-60520	1
13. HPM8 plastic fitting	5181-3394	10 pk
14. M8 O-ring	5180-4181	12 pk
15. Hex nut, 5/16-inch	2950-0203	2
NS Blank label plate	G1530-90705	—
NS S/SL label plate	G1530-90720	—

**Figure 1310-4 Split/Splitless inlet manual pneumatic module**

Capillary injection port (0 to 30 psig)

Description	Part no.	Qty.
1. SCR-Mach M4 × 0.7 × 8 mm LG	0515-0106	2
2. SCR-Mach M4 × 12 mm, T-20 Torx	1390-1023	3
3. Thread cutting screw	0624-0665	2

Capillary injection port subassembly (0 to 30 psig)

(Part no. G1544-65500)

Description	Part no.	Qty.
1. O-ring, .239-inch (Order no. 5180-4182 12/pkg)	0905-1014	1
2. SCR-M4 × 8 T-20 Torx-chrm plt	0515-2711	2
3. Reducing nut	18740-20800	1
4. Column nut	5181-8830	2/pk
5. Gold plated seal	18740-20885	1
6. Septum nut assembly	18740-60835	1
7. Vent torque plate	19244-00030	1
8. Purge regulator	19246-60530	1
9. Insert assembly series II	19251-60575	1
10. Washer, flat SS	5061-5869	12/pk
11. 11-mm Sorsept (Order no. 5182-0739)		50/pkg
12. Ferrule, no hole	5181-7458	1
13. Cap top insulation	G1544-00010	1
14. Flow controller inlet fitting-replacement	0100-1595	1
15. Cap inlet block insulation	G1544-00020	1
16. Cap bottom insulation	G1544-00030	1
17. Cap heated block	G1544-20570	1
18. Cap thread insert	G1544-20580	1
19. Cap thermal nut	G1544-20590	1
20. S/S Solenoid cable assembly	G1544-60520	1
21. Cap solenoid valve	G1544-60560	1
22. Cap inj. heater/sensor assembly	G1544-61140	1
23. Cap shell weldment	G1544-80570	1
NS Replacement flow controller O-ring kit	0905-1251	—

See also the parts list for the Split/Splitless Inlet with EPC.

Purged/packed inlet

Description	Part no.	Qty.
1. Screws, Torx T20, M4 × 12 mm	0515-2496	3
2. Top cover plate	G1543-00085	1
3. Top insulation	G1543-00100	1
4. Septum nut	18740-60835	1
5. Septum, 11 mm, low bleed (50/pkg)	5182-0739	—
6. Nut, Merlin Microseal	5182-3445	—
7. Septum, Merlin Microseal	5182-8815	—
8. Top insert weldment	19243-80570	1
9. Viton O-ring (Pkg/12)	5080-8898	1
10. Heater/Sensor assembly	G1543-61540	1
11. Screw, Torx T10, M3 × 16 mm	1390-1022	1
12. Inlet weldment	G1543-80580	1
13. Top gasket insulation (not shown)	G1543-00155	1
14. Thermal block	G1543-20765	1
15. Bottom nut	G1543-20580	1
16. PPIP insulation	G1543-00030	1
17. PPIP bottom insulation	G1543-00070	1
18. Glass insert (pkg/25)	5080-8732	1
19. Vespel ferrule (pkg/10)	5080-8774	1
20. Tubing nut (1/4-inch brass)	5180-4105	10/pkg
21. 530 μ Column liner (see the Agilent chemical analysis consumables and accessories catalog)	19244-80540	1
1/8-inch Column adapter (optional)	19243-80510	—
22. Nut warmer insulation	19234-60715	3
23. Nut warmer cup	19234-60700	1
24. Ferrules (identify by internal diameter):		
Solid ferrule plug (no hole)	5181-7458	1
Graphite ferrule 0.5 mm ID	5080-8853	10/pkg
Graphite ferrule 1.0 mm ID	5080-8773	1
25. Column nut (Order no. 5180-8830 2/pkg)	18740-20870	1

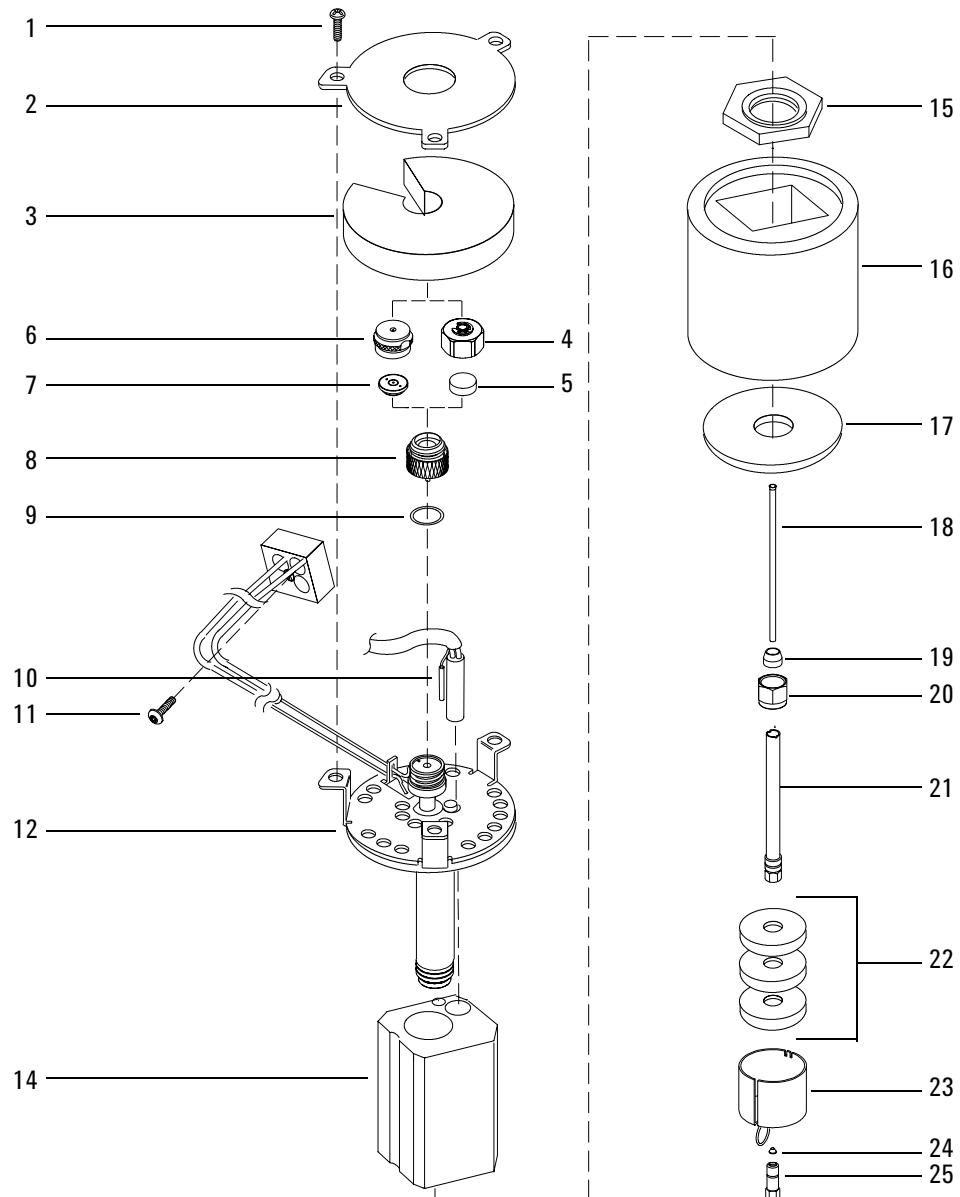


Figure 1310-5 Exploded diagram of the purged packed inlet

Purged/packed inlet EPC pneumatic module

(Part no. G1543-60500)

Description	Part no.	Qty.
1. 1/8-inch Swagelok male connector SAE, brass	G1543-80030	1
2. Inlet fitting	G1543-20610	1
3. Screw, M4 × 45 mm, Torx T-20	0515-2484	1
4. O-rings,.239 id (order part no. 5180-4182, 12/pkg)		1
5. PPIP/EPC inlet manifold kit, not shown	G1543-65520	

For diagram of screw and O-ring placement in pneumatic modules see Figure 1310-7 on page 15 of this section.

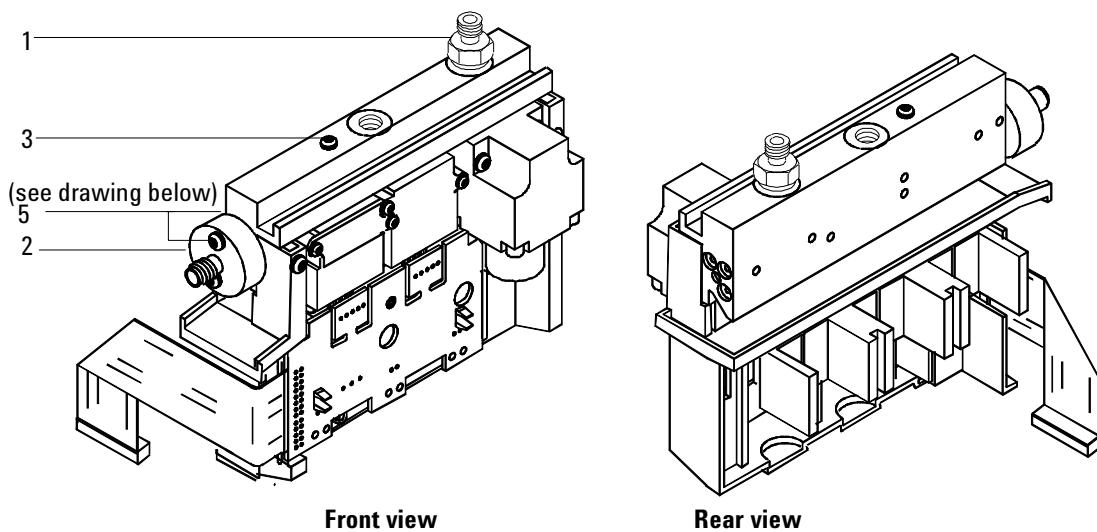


Figure 1310-6 Purged/Packed inlet EPC pneumatic module

Caution

Aluminum bracket removed for clarity, DO NOT completely remove the bracket during valve replacement.

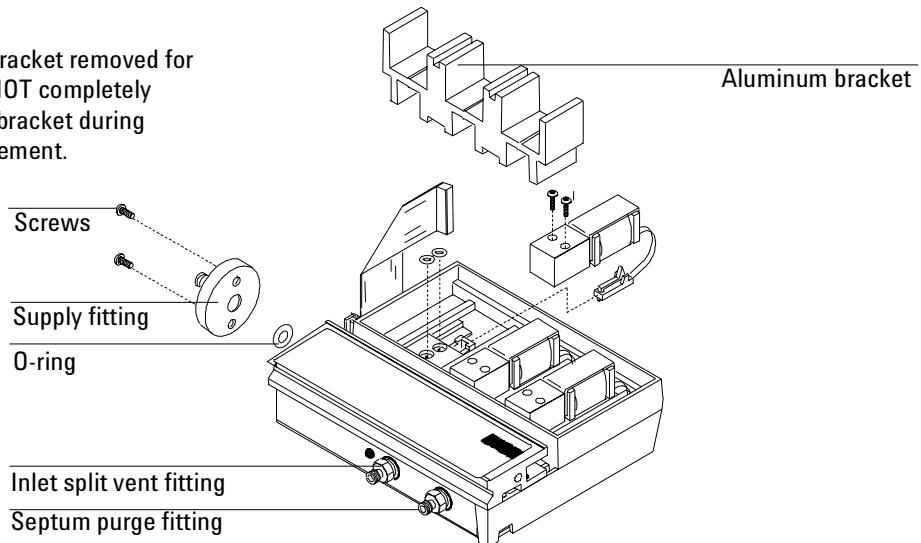


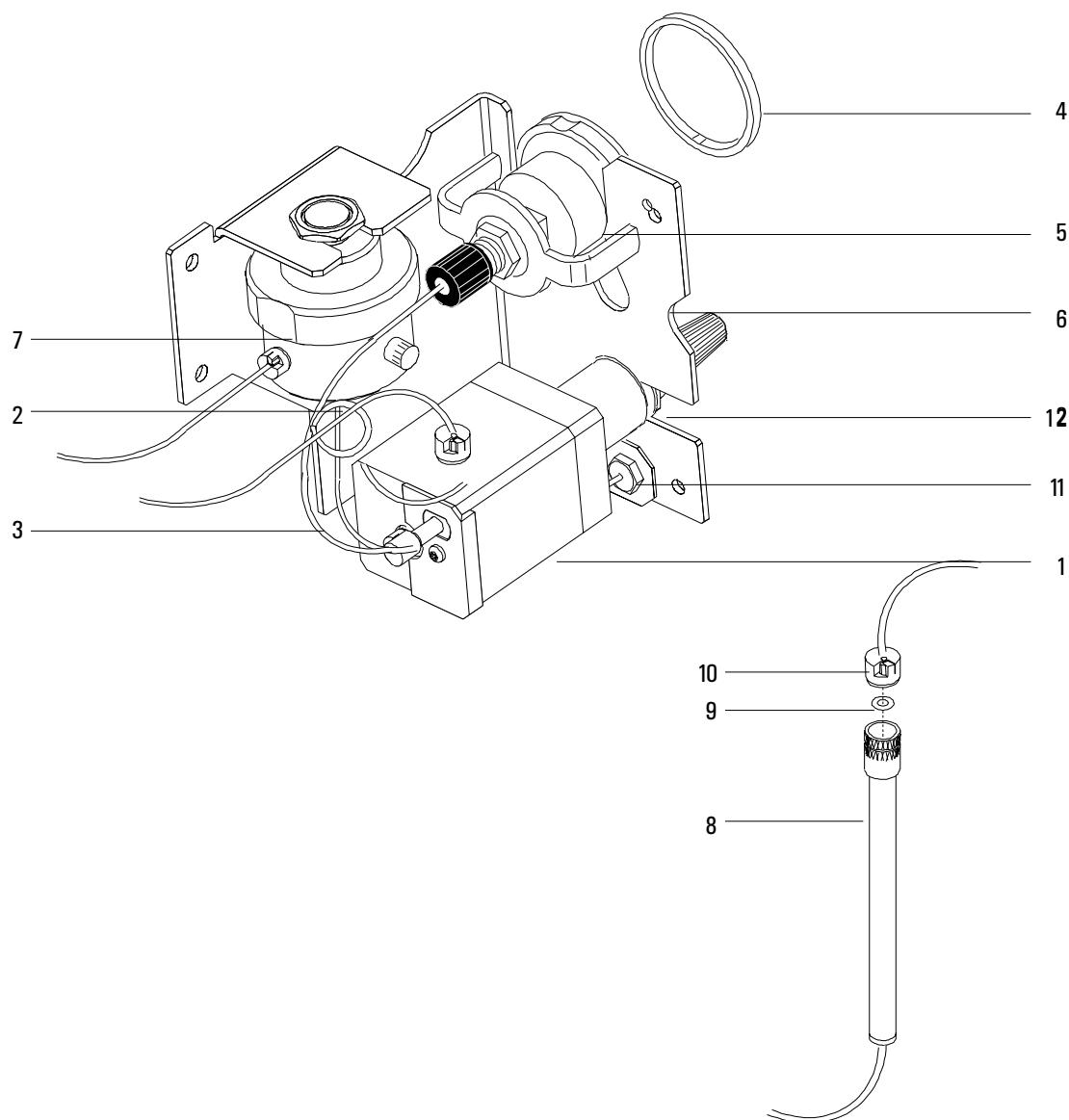
Figure 1310-7 Serviceable parts drawing for any EPC pneumatic module

Purged/packed inlet manual pneumatic module and inlet**(Part no. G1543-65505)**

Description	Part no.	Qty.
1. Mass flow controller, 0 to 20 mL/min	19362-60565	1
2. Gauge jumper weldment	19243-80555	1
3. Purge vent tube weldment	19244-80580	1
4. Pressure gauge spacer	19243-40010	1
5. Pressure gauge (0 to 100 psi)	19361-60565	1
6. Flow module bracket	19245-00105	1
7. Septum purge regulator	19243-60650	1
8. Chemical trap assembly	05980-80710	1
9. M8 O-ring, ungreased	5180-4181	10
10. M8 plastic fitting	5181-3394	10
11. Vent torque plate	19244-00030	1
12. Hex nut, 5/16-inch	2950-0203	1
NS Fitting, MFC/PPIP adapter	G1543-20540	1
NS PPIP/PCOC MNL-EPC adapter assy	G1545-80510	1
NS Blank label plate	G1530-90705	1
NS PPIP label plate	G1530-90740	1
NS Torx screw, M3 × 16, T-10	1390-1022	1
NS Torx screw, M4 × 12, T-20	1390-1023	3

Packed Inlet Optional Flow Restrictors

Colored dot code	Supply pressure	Flow range (mL/min)	Part no.
Red and purple	50	0 to 20	19362-60515
Blue and purple	50	0 to 60	19362-60525
Green and purple	50	0 to 110	19362-60535

Purged/packed inlet manual pneumatic module and inlet**Figure 1310-8 Purged/Packed inlet manual pneumatic module**

Packed column injection port supplies

Description	Part no.	Qty.
Purged packed column injection port kit	5181-8837	
Contains:		
11-mm septa; Graphite/Vespel ferrules; Viton O-rings		
Deactivated disposable glass inserts		

Description	Part no.	Qty.
Septum-purged packed column port		
1. Septum nut	18740-60835	
Headspace retainer nut	18740-60830	
Merlin microseal	5181-8816	
Nonpurging septum nut assembly for manual flow control only		
	19243-60570	
2. Septa, 11-mm OD, no-hole	5181-1263	25/pkg
3. Top insert weldment	19243-80570	
4. Viton O-rings	5080-8898	12/pkg
5. Vespel ferrules	5080-8774	10/pkg
6. Nut, 1/4-inch brass	5180-4105	10/pkg
7. Liners without glass inserts:		
1/8-inch column liner	19243-80510	
1/4-inch column liner	19243-80520	
Liners with glass inserts:		
Series 530- μ column liner	19244-80540	
1/8-inch column liner	19243-80530	
1/4-inch column liner	19243-80540	
Disposable glass inserts	5080-8732	25/pkg
Disposable glass inserts (deactivated)	5181-3382	5/pkg

Programmable cool on-column capillary inlet

Description	Part no.	Qty.
1. Needle guide top (optional)	19245-20670	0
2. Septum nut base assembly (short)	19245-80521	1
3. Septum nut base	G1545-80520	1
4. Manual cooling tower assembly (optional)	19320-80625	1
5. Duckbill (for use with cooling tower, above)	19245-40050	10/pkg
6. Screw M4 × 8 Torx T20 chromeplate	0515-2711	3
7. Heatsink fin	G1545-00010	1
8. Heater/Sensor assembly	G1545-60520	1
9. Septa		
-Solid	5181-1261	25/pkg
-Thru-hole	5181-1260	25/pkg
10. Insert spring	19245-60760	1
11. Inserts (identify by number of rings on insert):		
-Narrow bore insert; 200 μ – 1 silver ring	19245-20510	0
-Wide bore insert; 320 μ – 5 silver rings	19245-20525	1
-Megabore insert; 530 μ – 0 rings	19245-20580	1
-Capillary Insert (glass columns) – 3 silver rings	19245-20550	0
-AL megabore – 4 rings	19245-20780	0
-250 μ bore insert – 6 rings	19245-20515	1
12. T-20 screws (captive) M4 × 12 mm	1390-1023	3
13. T-10 Torx M3 × 16-mm screw	1390-1022	1
14. Inlet weldment	G1545-80507	1
15. Inlet weldment insulation	G1545-20630	1
16. Cavity sleeve	19245-00060	1
17. Ferrules (identify by internal diameter):		
Solid ferrule plug (no hole)	5181-7458	1
Graphite ferrule 0.5 mm ID	5080-8853	10/pkg
Graphite ferrule 1.0 mm ID	5080-8773	10/pkg
18. Column nut (Order no. 5181-8830 2/pkg)	18740-20870	1

1310 Inlets
Programmable cool on-column capillary inlet

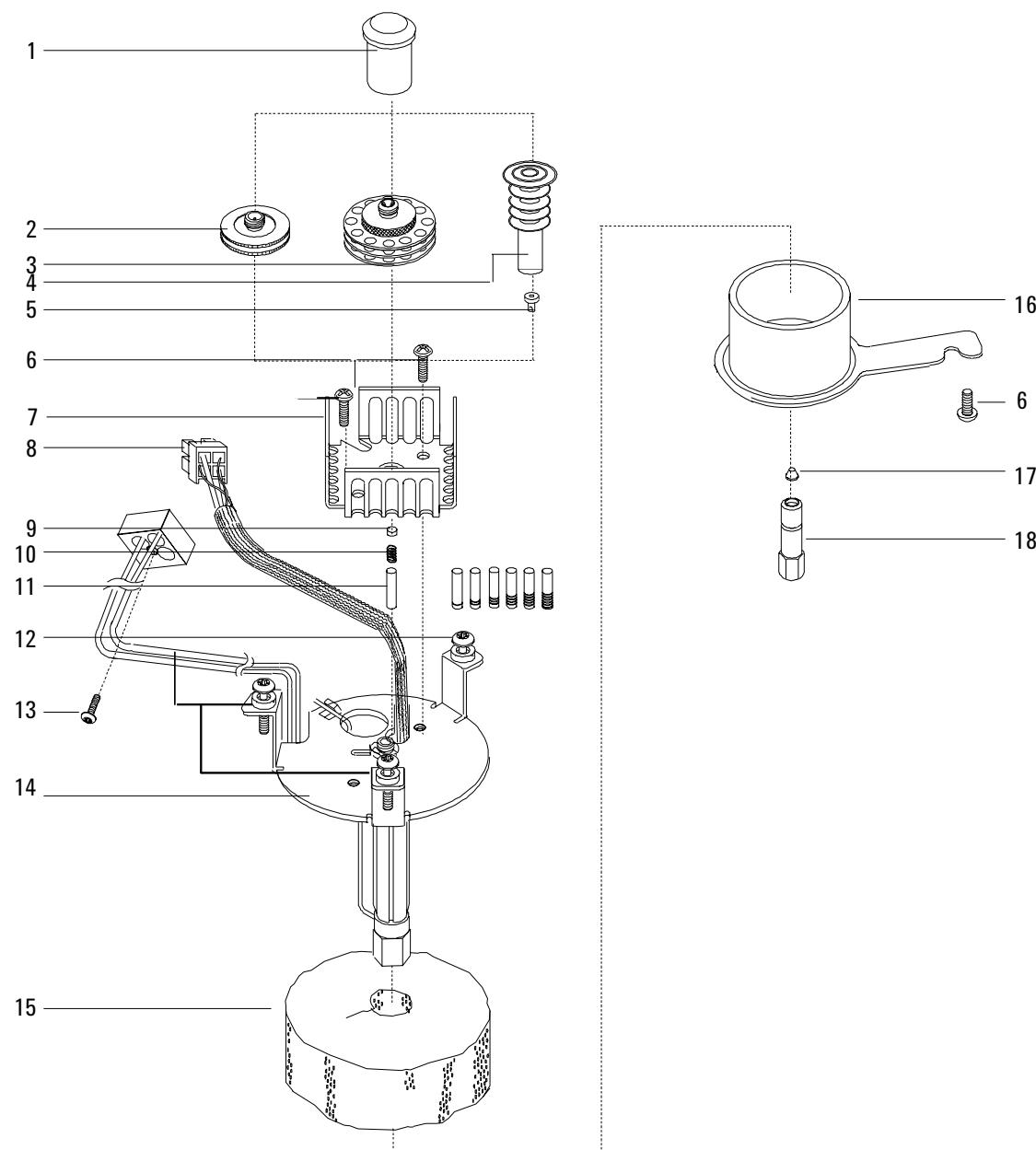
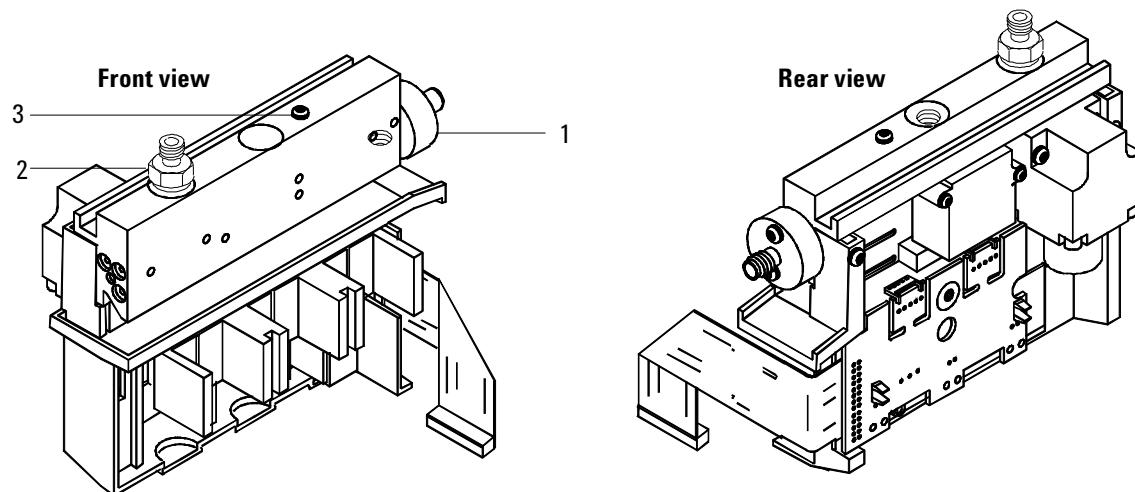


Figure 1310-9 Exploded diagram of the programmable cool on-column inlet

Programmable cool on-column EPC pneumatic module**0 to 100 psig (part no. G1545-60500)**

Description	Part no.	Qty.
1. Male connect 1/8-inch Swagelok	0100-1346	1
2. Inlet block fitting	G1543-20610	1
3. EPC valve replacement kit	G1531-60610	1
4. Screws, inlet block, M3 × 12 mm, not shown	0515-1084	

For diagram of screw and O-ring placement in pneumatic modules see Figure 1310-7 on page 15 of this section.

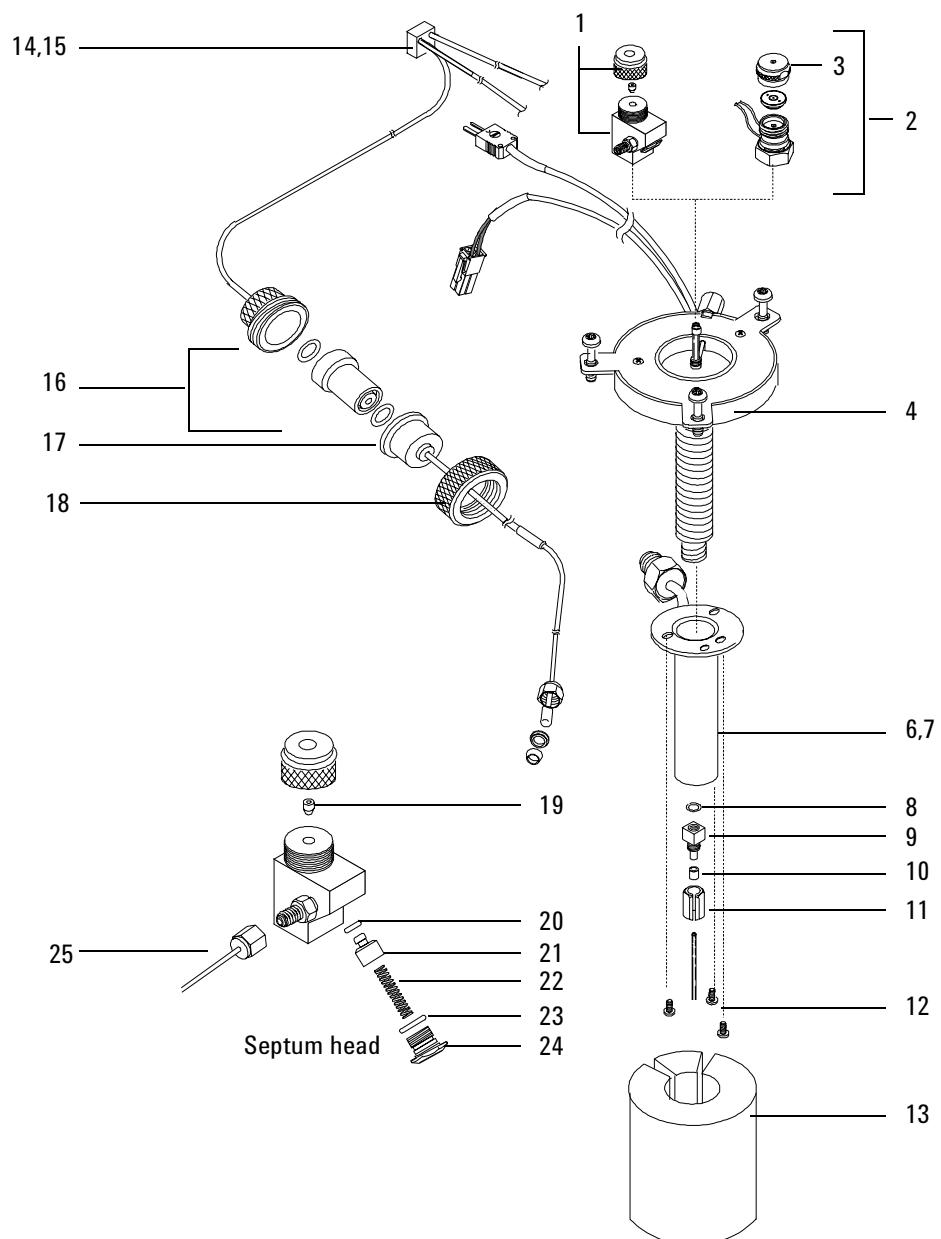
**Figure 1310-10 Programmable cool on-column pneumatic module**

Programmed temperature vaporization inlet

Description	Part no.	Qty.
1. Septumless head	G2617-60507	1
2. Septum head*	G2618-80500	1
3. Septum nut*	18740-60835	1
4. PTV inlet assy	G2617-60506	1
5. PTV cryo insulator (not shown)	G2617-60510	1
6. PTV LCO ₂ cooling jacket	G2617-60508	1
7. PTV LN ₂ cooling jacket	G2619-60501	1
8. Silver seal (5/pk)	5182-9763	1
9. Graphpac inlet adapter		1
0.2 mm Column ID	5182-9754	
0.25–0.33 mm Column ID	5182-9761	
0.53 mm Column ID	5182-9762	
10. Ferrules for graphpac inlet		1
0.2 mm Column ID (10/pk)	5182-9756	
0.25 mm Column ID (10/pk)	5182-9768	
0.32 mm Column ID (10/pk)	5182-9769	
0.53 mm Column ID (10/pk)	5182-9770	
11. Split nut for inlet adapters	5062-3525	1
12. Screws, M3 × 0.5 × 3 mm		3
13. PTV insulation block	G2617-20510	1
14. PTV septumless gang weldment	G2617-80500	1
15. PTV septum gang FTG weldment	G2618-80500	1
16. Replacement filter kit	G1544-80530	1
17. PTV front trap assy	G2617-80520	1
18. Trap nut	G1544-20650	1
19. Teflon ferrule (needle seal)	5182-9748	1
20. Kalrez seal**	5182-9759	1
21. Valve body**	5182-9757	1
22. Pressure spring**	5182-9758	1
23. Viton seal	5182-9775	1
24. Sealing element	5182-9760	1
25. PTV column adapter tube	G2617-80550	
26. 3-D Graphpac ferrules, not shown (5/pkg)	5182-9749	
27. 3-D Graphpac assembly Tool, not shown	G2617-80540	

*See the Agilent chemical analysis consumables and accessories catalog for Merlin assemblies.

**Service kit, part no. 5182-9747, consists of items 20, 21, and 22.

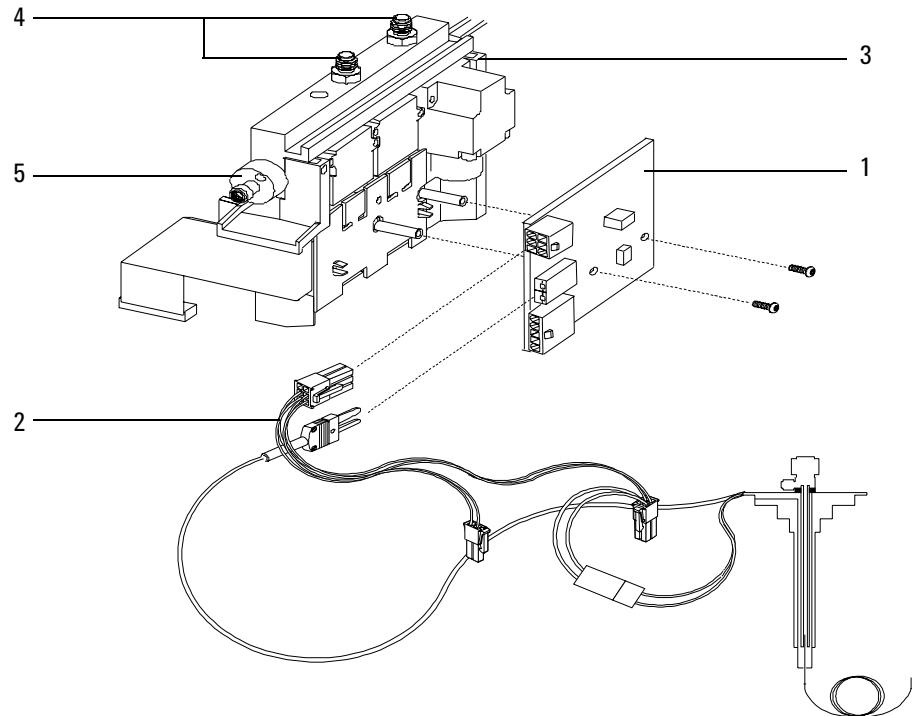
Programmed temperature vaporization inlet**Figure 1310-11 Exploded diagram of the programmed temperature vaporization inlet**

Programmed temperature vaporization inlet calibrated manifold assembly

(part no. G2617-60500)

Description	Part no.	Qty.
1. PTV thermocouple PCB	G2617-60010	1
2. PTV thermocouple PCB cable	G2617-60505	1
3. Calibrated manifold assembly	G2617-60500	1
4. Male connectors 1/8-inch Swagelok	G1543-80030	2
5. Inlet fitting block	G1543-20510	1

For diagram of screw and O-ring placement in pneumatic modules see Figure 1310-7 on page 15 of this section.

Programmed temperature vaporization inlet calibrated manifold assembly**Figure 1310-12 PTV flow module**

PTV LCO₂ cryo assembly

(part no. G2617-60514)
(Recommended replacement level)

Description	Part no.	Qty.
1. PTV LCO ₂ brazement (valve to IP tube)	G2617-80510	1
2. PTV LCO ₂ valve bracket	G2617-00010	1
3. CO ₂ cryo valve	G1565-60545	1
4. Cap prot W/O Flg	1401-0044	1
5. Scr-mach 8-32.375-inch	2510-0102	2
6. 1/8-inch male conn W/O O-ring	G1543-80025	1
7. Gland seal LCO ₂	G1565-20590	1
8. TFE seal	G1565-20840	1

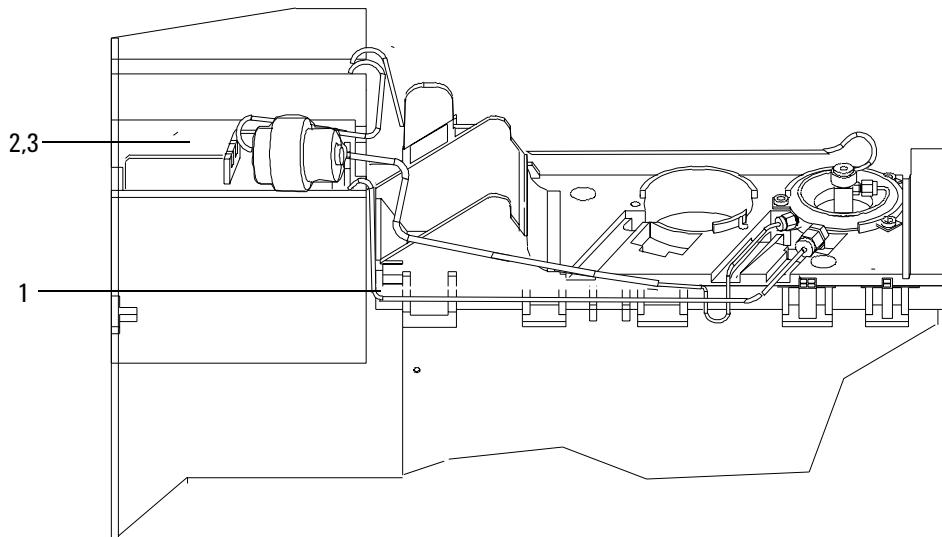


Figure 1310-13 PTV LCO₂ cryo assembly

PTV LN₂ cryo assembly

(part no. G2619-60504)
(Recommended replacement level)

Description	Part no.	Qty.
1. PTV LN ₂ nut plate	G2619-00040	1
2. PTV LN ₂ supply tube	G2619-20520	1
3. PTV/CFO LN ₂ insulation cover	G2619-00030	1
4. PTV LN ₂ -cell inlet tube	G2619-20510	1
5. Cryo valve	G1566-60557	1
6. PTV inlet tube insulation	G2619-00010	1
7. PTV solenoid bracket	G2619-00020	1
8. PTV jumper cable	G2619-60502	1
9. Nut 1/4-inch tubing SS	0100-0055	1
10. Connector	0100-0112	1
11. Connector—male	0100-0208	1
12. 1/4-inch ferrule set SST	0100-1827	1
13. Tape—industrial	—	—
14. Cap—protective	—	—
15. MS 8-32.312 LG	2510-0043	2

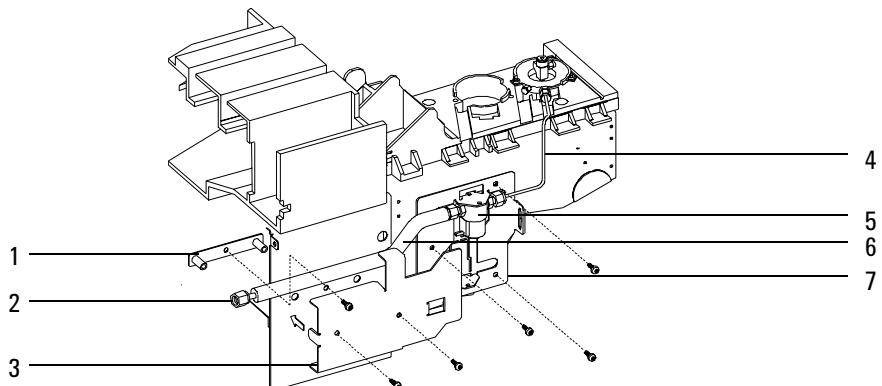


Figure 1310-14 PTV LN₂ cryo assembly

Volatiles interface

Description	Part no.	Qty.
1. VI top cover	G2319-00020	1
2. Top insulation	G2319-20580	1
3. Screw, M4 x 12	1390-1023	4
4. Clamping plate	G2319-20540	1
5. Volatiles interface	G2319-60505	1
NS Ferrule, 1/16-inch, (10/pk)	0100-1333	
NS Blanking nut 1/16-inch SS	01080-83202	
NS Male nut, 1/16-inch	0100-0929	
6. VI heater/sensor assy	G2319-60503	1
7. Heater block assy	G2319-60507	1
8. VI insulation htr block	G2319-20530	1
9. Pneumatic gang fitting assy	G2319-60501	1
Contains:		
Gen. make-up restrictor	19243-60540	1
O-ring	0905-1014	1
Torx screw	1390-1024	2
Replacement filter kit	G1544-80530	—
or		
10. Filter trap assy (not shown)	G2319-80530	1
11. RP filter	G1544-80530	2/pk
12. Nut, male 1/16-inch swage	0100-0929	3
13. Vol. front trap assy	G2319-80530	1
14. Trap nut	G1544-20650	1

*Also refer to the Agilent chemical analysis consumables and accessories catalog.

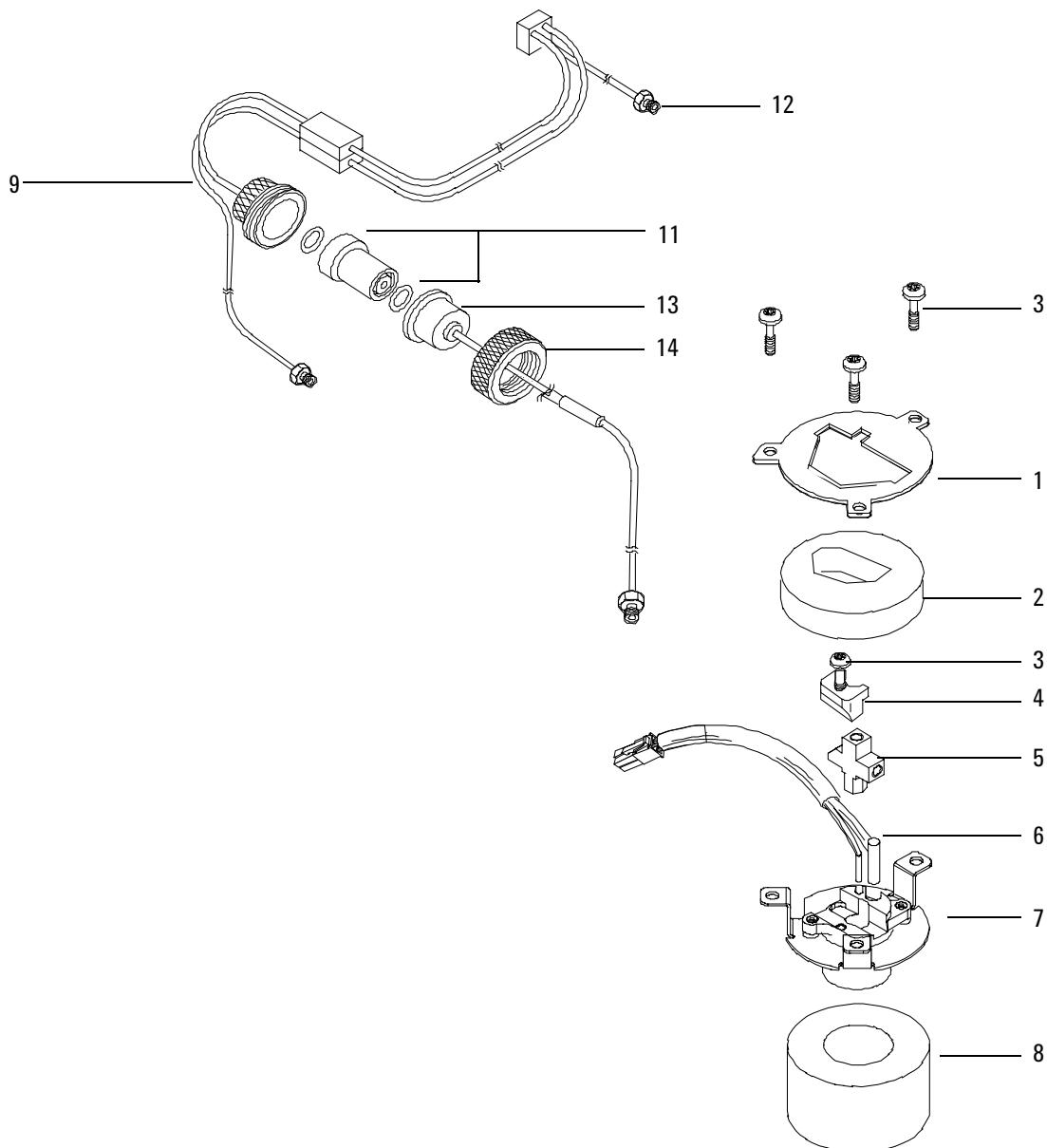


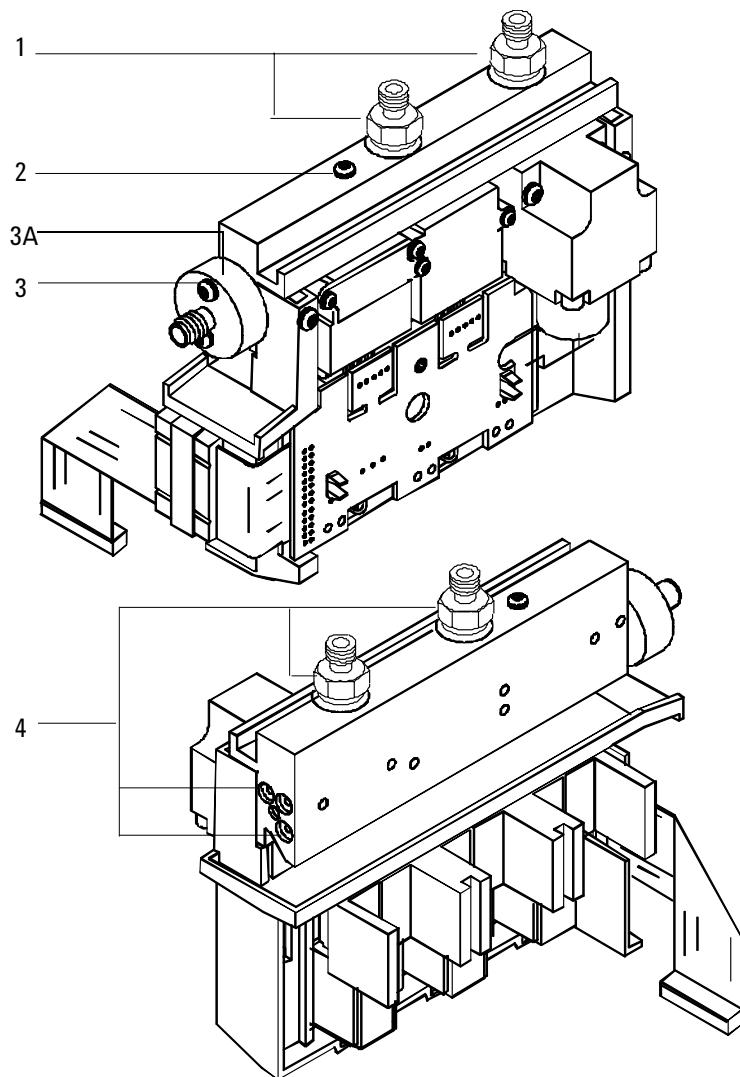
Figure 1310-15 VI manifold assembly 0 to 100 psig

Volatiles interface calibrated manifold assembly

(part no. G2319-60500)

Description	Part no.	Qty.
1. Male connectors 1/8-inch Swagelok	G1543-80030	2
2. Screw, M4 × 45 mm, Torx T-20	0515-2484	1
3. Inlet supply fitting	G1543-20510	1
4. Screw, M3 × 20 mm, Torx T-10	0515-1319	8
5. O-rings, under connectors and fitting (12/pkg)	5180-4182	1

For diagram of screw and O-ring placement in pneumatic modules see Figure 1310-7 on page 15 of this section.

Volatiles interface calibrated manifold assembly**Figure 1310-16 Volatiles interface flow module**

Solvent vapor exit accessory

(part no. G2399-60500)

Description	Part no.	Qty.
1. SVE valve/fitting assembly	G2399-60570	1
2. Valve jumper cable	G2399-60530	1
3. Mach. screw, M4 x 0.7	0515-2755	1
NS SVE software kit	G2399-60580	1
NS SVE calculator SW disk	G2399-80010	1
NS SVE manual-Installation and Operation	G2399-90110	1
NS SVE Tri-column assembly	G2399-60520	1
NS Union SS 1/16-inch tubing	0100-0124	1
NS Chemical sample ECD kit	18713-20400	1
NS 1/16-inch tube SS 560 mm	18900-20400	1
NS Graphite ferrule (2/pk)	(5062-3505 2/pk)	1
NS 320 μm graphite/vespel ferrule	(5062-9525 1/ea.)	1
NS 0.4 mm, 200, 250 μm ferrule	(5062-9526 1/ea.)	1
NS Bleed column, 50 μm , 2M	G2399-20510	1
NS Valve driver cable	G2399-60530	1
NS Unboxed HP-5MS 30 m, 0.25 mm, 0.2	19191S-433A	1
NS Column nut	5181-8830	1
NS SVE pre-column assembly	G2399-60510	1

*Also refer to the *Chemical Analysis Consumables and Accessories Catalog*.

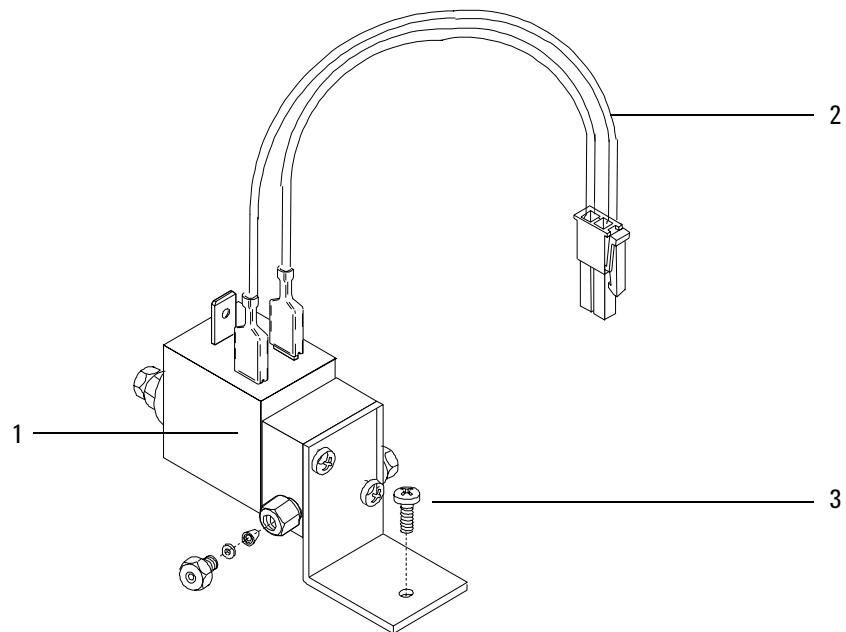
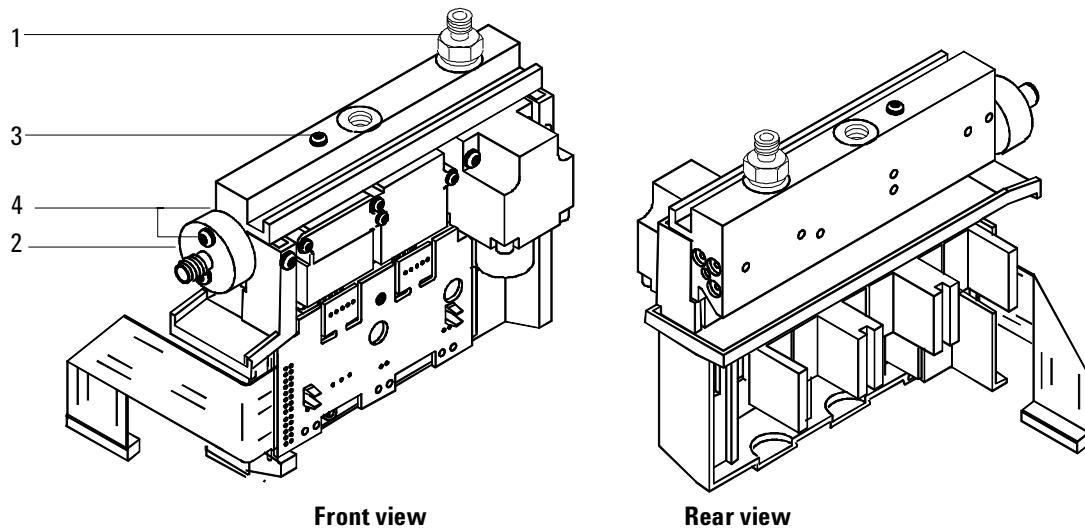


Figure 1310-17 Solvent vapor exit accessory

Pneumatics control module

(part no. G2317-65500)

Description	Part no.	Qty.
1. 1/8-inch SwageLok male connector, SAE, brass	G1543-80030	1
2. 100 PSIG inlet supply fitting	G1543-20510	1
3. Screw, M4 × 45 mm, Torx T-20	0515-2484	1
4. O-rings,.239 ID (Order part no. 5180-4182, 12/pkg)		1
NS PCM gang weldment	G2319-80500	1

**Figure 1310-18 Pneumatics control module**

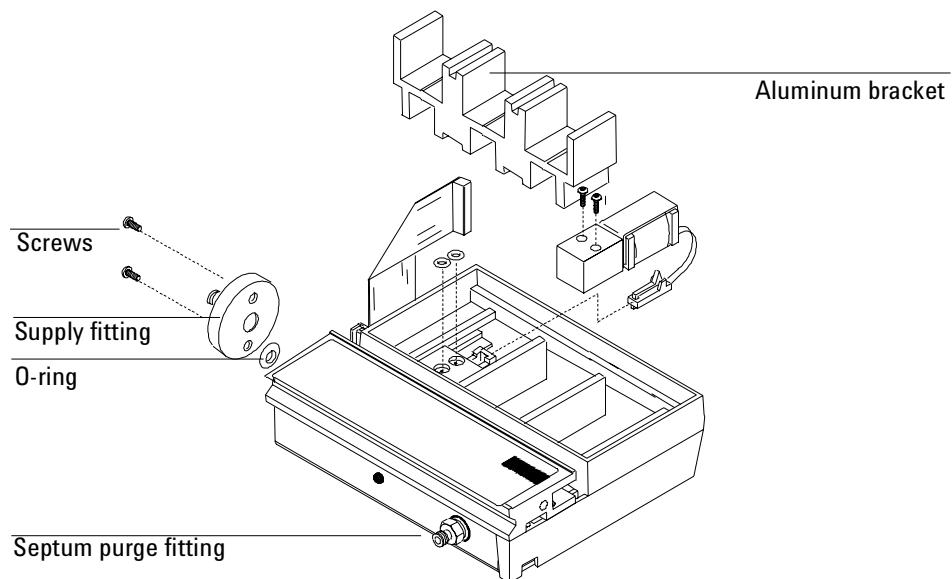


Figure 1310-19 Serviceable parts drawing pneumatic control module

1320 Detectors

This section contains an illustrated parts breakdown for each of the following 6890 GC detectors and related components.

- Electron Capture Detector (ECD)
- Flame Ionization Detector (FID)
- Nitrogen Phosphorus Detector (NPD)
- Thermal Conductivity Detector (TCD)
- Microcell Electron Capture Detector (μ ECD)
- Flame Photometric Detector (FPD)
- Auxiliary EPC flow block

Electron Capture Detector (ECD)

Description	Part no.	Qty
1. ECD top cover	G1533-00040	1
2. ECD signal wire assembly	19233-60635	1
3. Anode/Ferrule/Nut assembly (specific license required)	19233-67010	1
4. ECD thermal cover	G1533-00030	1
5. Thermal cover clip	19233-00095	1
6. Top cover insulation	G1533-00020	1
7. Screw, M4 × 10 mm, Torx T20	0515-2495	3
8. Clamp, interconnect	19231-00040	1
9. Captive screw, detector pallet, M4 × 20 mm, T20, Torx	1390-1024	4
10. Detector pallet	G1531-40020	1
11. Screw, M4 × 45 mm, Torx T20	0515-2484	2
12. Electron Capture Detector assembly:		1
– General licensed ECD, new	G1533-60576	-
– General licensed ECD, rebuilt	G1533-69576	-
– Japan only ECD, new	G1533-60730	-
– Japan only ECD, rebuilt	G1533-69730	-
13. Detector block insulation	G1533-00010	1
14. Lower seal insulation	G1533-00080	1
15. Screw, M4 × 12 mm, Torx T20	0515-2496	1
16. ECD make-up gas adapter weldment:	G1533-80565	1
– Gigabore liner	19233-20625	-
– End cap	19233-20755	-
17. Ferrules, capillary columns:		1
– No hole (plug), graphitized-vespel	5181-7458	1
– Graphite, 0.5 mm id (10/pkg)	5080-8853	-
– Graphite, 1.0 mm id (10/pkg)	5080-8773	-
18. Capillary column nut (2/pkg)	5181-8830	1
19. Screw, M4 × 12 mm, Torx T20, chromeplate	0515-2711	3
20. ECD interconnect assembly	G1533-60510	1
21. ECD signal board	G1533-60010	1
22. ECD interface board	G1533-60020	1
23. Heater/Sensor assembly	G1533-60625	1
24. Upper heated block	G1533-20525	1
25. Lower heated block	19233-20515	1
26. ECD mounting plate	G1533-00050	1
27. Nut warmer insulation assembly	19234-60715	3
28. Nut warmer cup assembly	19234-60700	1
29. Tubing tygon, (order 30 inches)	0890-0934	30 inches
30. Vent elbow	19303-20590	1
31. Tubing adapter	5020-8231	1

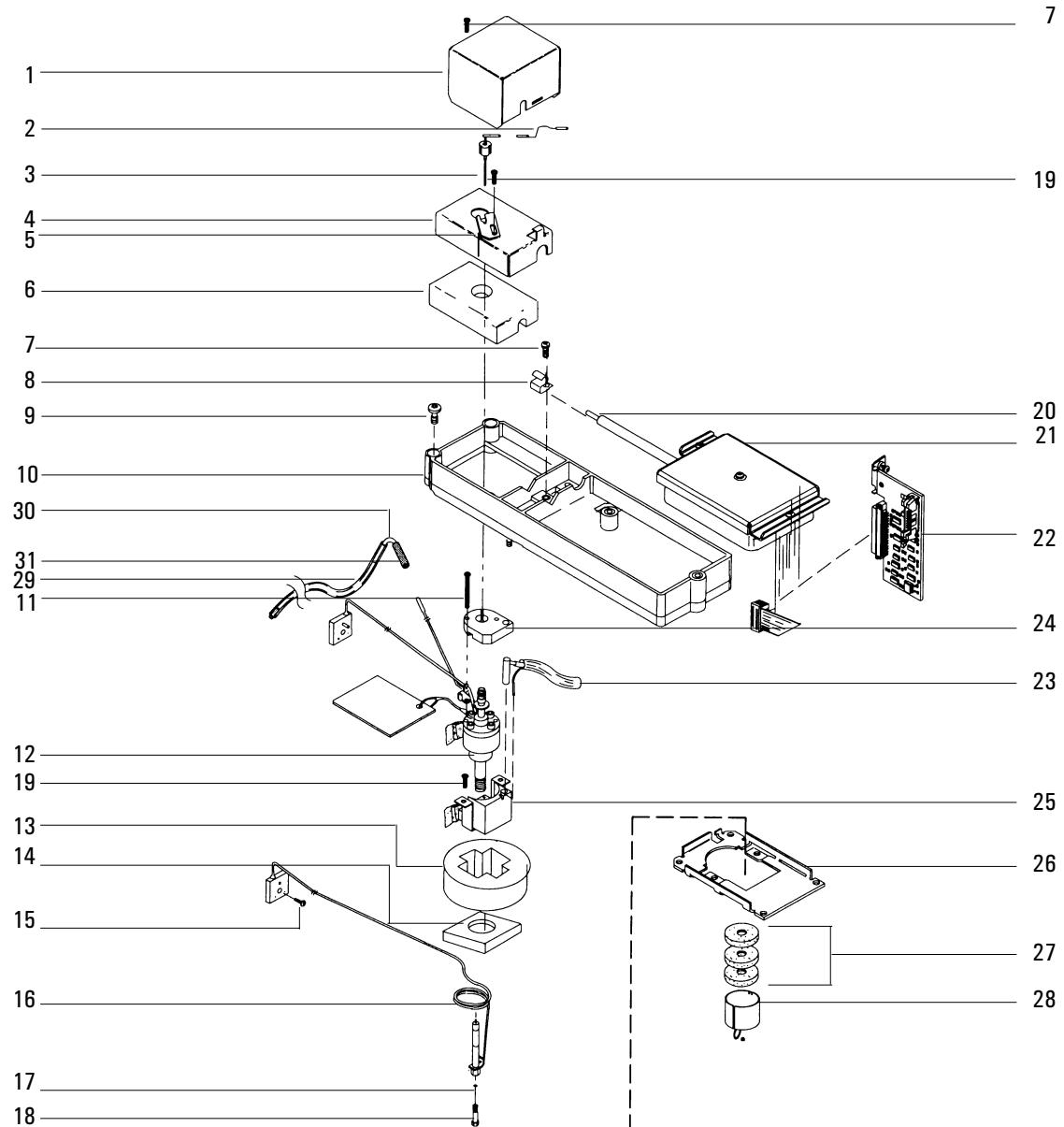


Figure 1320-1 Electron Capture Detector (ECD)

Electron Capture Detector manifold assembly

Description	Part no.	Qty
1. EPC ECD manifold assembly	G1533-60520	1
2. Non-EPC ECD manifold assembly	G1533-60500	1
3. Screw, M3 × 25 mm, Torx, T10	0515-0683	6
4. Screw, M3 × .5 × 8 mm, Torx, T10	0515-0655	2
5. ECD make-up gas assembly (Manual ECD)	G1533-60600	1
5A. Pressure regulator, 0-100 psi (Manual ECD)	G1531-60630	1
5B. ECD manifold regulator brazement (Manual ECD)	G1533-80530	1
NS Chemical traps (Manual ECD)	G1533-80540	2

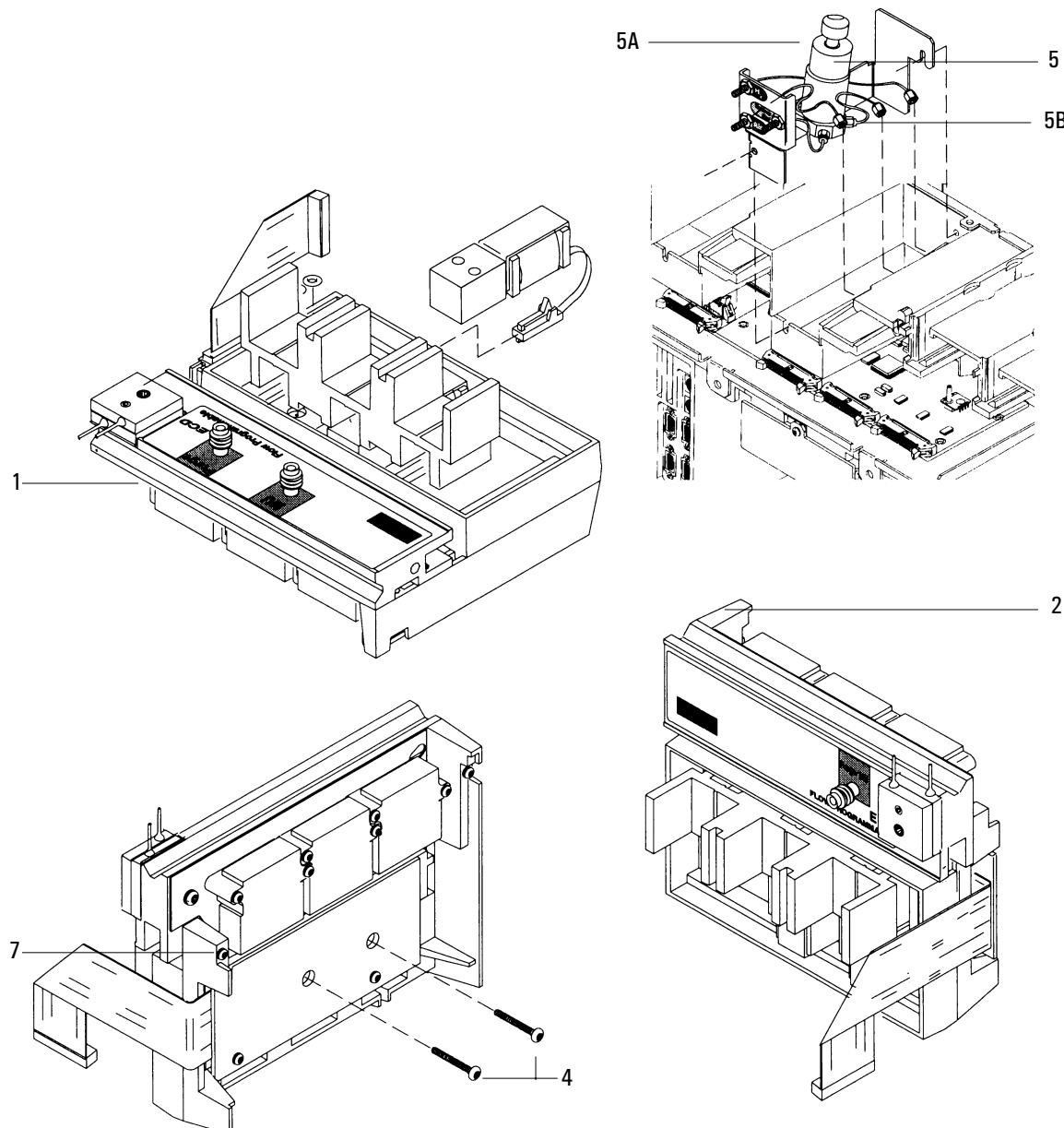


Figure 1320-2 Electron Capture Detector (ECD) manifold assembly

Flame Ionization Detector (FID)

Description	Part no.	Qty
1. Collector assembly:	G1531-60690	1
2. PTFE chimney (optional)	19231-21050	—
3. Collector nut	19231-20940	1
4. Spring washer	3050-1246	1
5. Ignitor castle or optional hastelloy component	19231-20910 19231-21060	1 1
6. Ignitor (glow plug) assembly	19231-60680	1
6A. Ignitor cable assembly	G1531-60680	
7. Upper/Lower collector insulator	G1531-20700	2
8. Collector body	G1531-20690	1
9. Spanner nut (collector)	19231-20980	1
10. Collector mount	G1531-20550	1
11. Collector housing	G1531-20740	1
12. Gasket	0905-0915	1
13. Screw, M4 × 25 mm, Torx, T20	0515-2712	3
14. Screw, M4 × 10 mm, Torx, T20	0515-2495	5
15. Interconnect clamp	19231-00040	2
16. FID interconnect assembly	G1531-60715	1
17. FID signal board	G1531-60010	1
18. FID interface board	G1531-60020	1
19. Screw (captive) M4 × 20 mm, Torx, T20	1390-1024	4
20. Mounting pallet	G1531-40020	1
21. Base spanner nut	19231-20990	1
22. Thermal strap	G1531-00100	1
23. Jets: Packed column FID – Capillary column (0.011-inch id) – Packed column (0.018-inch id) – High temp (for use in simulated distillation, 0.018-inch id)	19244-80560 18710-20119 19244-80620	1 — —
Capillary only FID – Fused silica capillary/530 μ (0.011-inch id) – High temp jet (0.018-inch id)	G1531-80560 G1531-80620	1 —
24. Base weldments: Packed column FID	G1531-80580	1 —
Capillary column FID (not shown)	G1531-80630	—
25. Heater/Sensor assembly	G1531-61140	1
26. Nut w/lock washer	0535-0043	2
27. FID block insulation	G1531-00030	1
28. FID seal insulation – Capillary – Packed	G1531-00130 G1531-00160	1 1
29. Packed FID column adapters: – FID/NPD capillary column – FID/NPD 1/8-inch packed column – FID/NPD 1/4-inch packed column	19244-80610 19231-80520 19231-80530	— — —
30. Nut warmer insulation, (order qty 3)	19234-60715	3
31. Nut warmer cup assembly	19234-60700	1

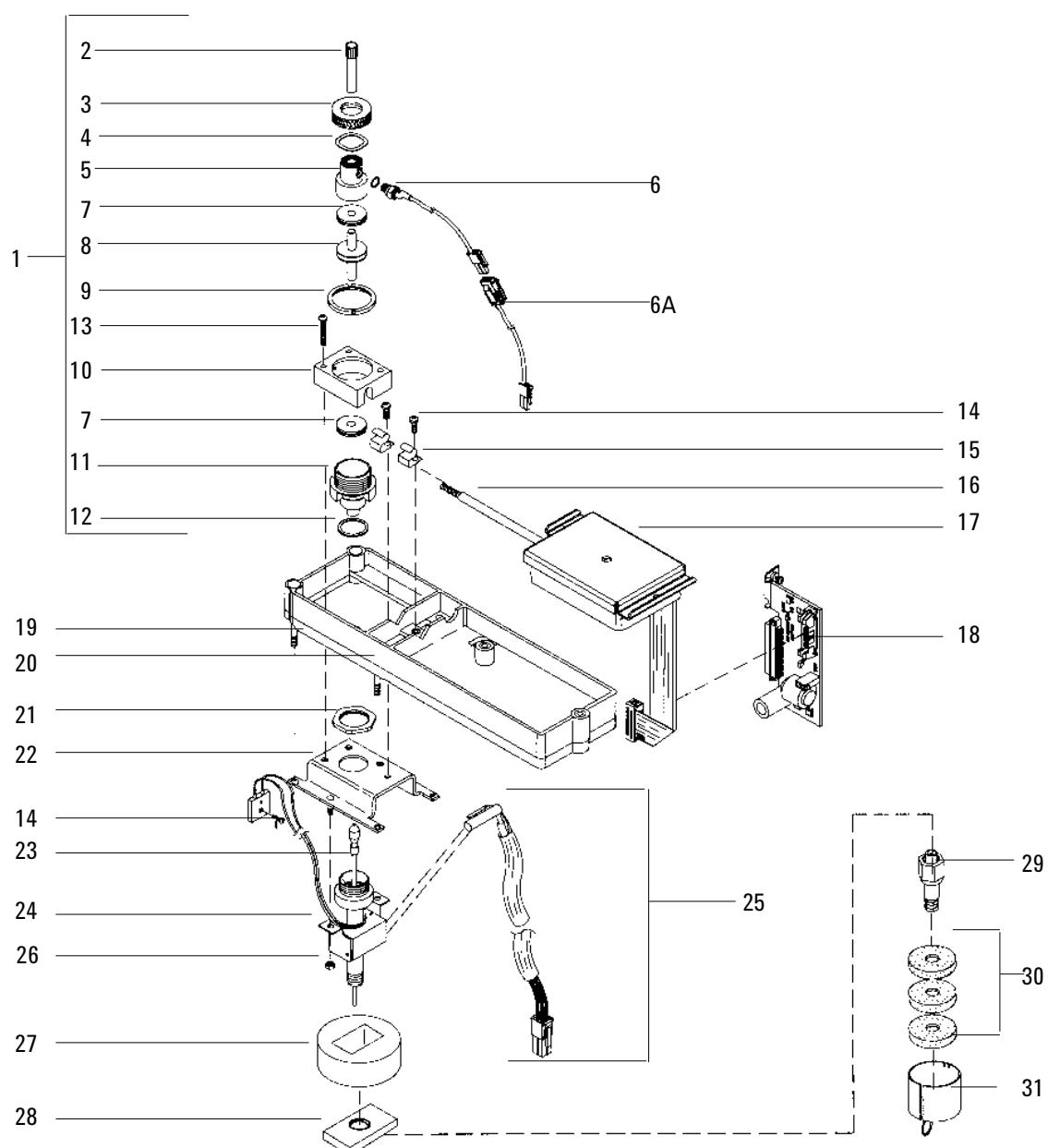


Figure 1320-3 Exploded diagram of the Flame Ionization Detector.

Flame Ionization Detector manifold assemblies

Description	Part no.	Qty
Type 1 Manifold		
1. Non-EPC 2 way valve	G1531-60530	3
2. O-Rings HPM8 (Order no. 5180-4181, 12/pkg)	0905-1039	10
3. Screw, M4 × 10 mm, Torx, T20	0515-2495	1
4. EPC control module assembly	G1531-60520	1
5. Non-EPC control module assembly	G1531-60500	1
6. Screw, M3 × 25 mm, Torx T10	0515-0683	6
7. Screw, M3 × 8 mm, Torx, T10	0515-0655	2
8. Make-up gas, manual forward pressure regulator assembly	G1531-60570	1
8A. Pressure regulator, 0 to 100 psi	G1531-60630	1
8B. FID manifold regulator brazement	G1531-80520	1
8C. Supply gas jumper weldment	G1531-80550	1
Type 2 Manifold		
9. Replacement EPC manifold assembly (replaces either type)	G1531-60720	1

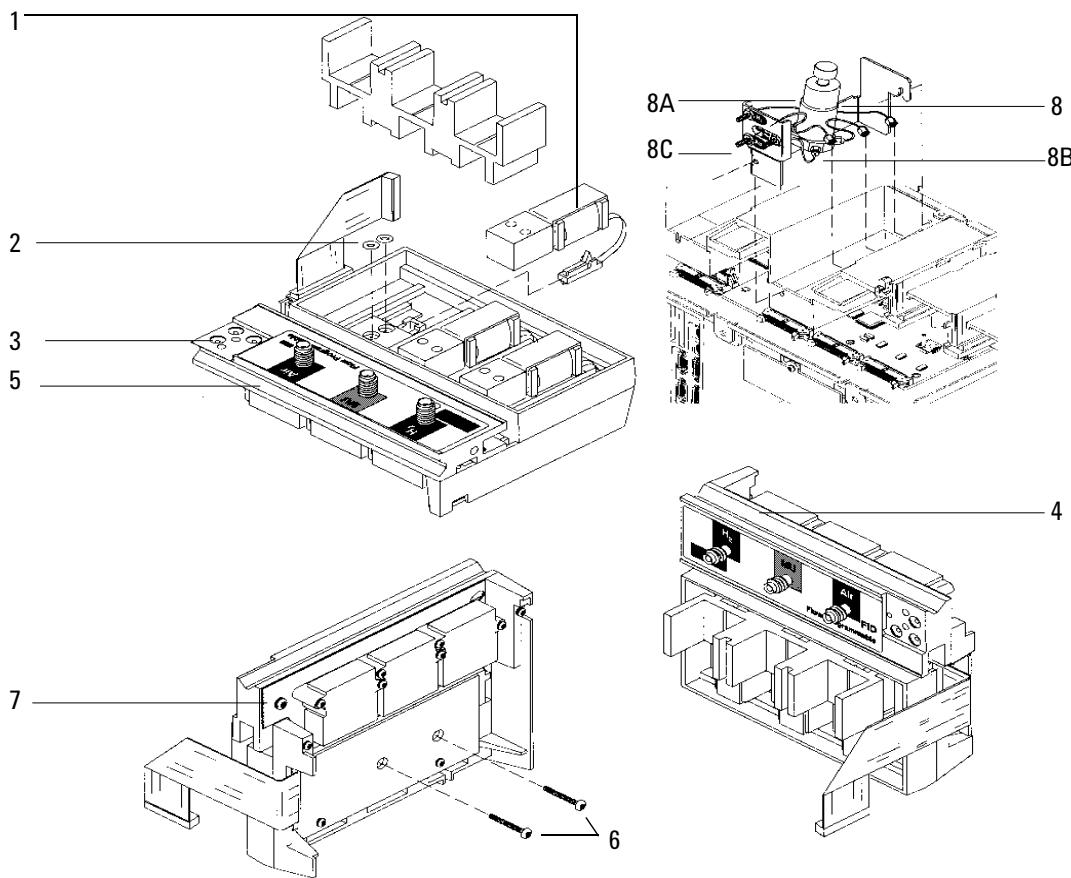
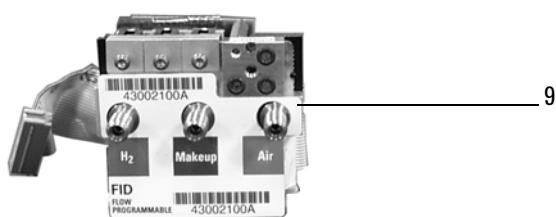
Type 1**Type 2**

Figure 1320-4 FID Manifold assembly

Nitrogen Phosphorus Detector (NPD)

Description	Part no.	Qty
1. Screw, M4 × 10 mm, Torx, T20	0515-2495	1
2. Hinged cover assembly	G1534-80520	1
3. Screws, M3 × .5 × 8 mm Torx, T10	0515-0655	3
4. NPD bead assembly, white	G1534-60570	1
4A. NPD bead assembly, black (optional, not shown)	5183-2007	
5. Screw, M4, Torx, T20	0515-2495	3
6. Power cable assembly	G1534-60600	1
7. Lid weldment	G1534-80510	1
8. Collector funnel, standard	G1534-20530	1
8A. Collector funnel, small id (optional, not shown)	G1534-20660	
9. NPC ceramic replacement kit, includes:	5182-9722	—
9A. Metal C-ring — 019	0905-2580	1
9B. Alumina insulator, upper	G1534-40020	1
9C. Alumina insulator, lower	G1534-40030	1
9D. Metal C-ring — 014	0905-1284	2
10. Screw, M4 × 10 mm	0515-2495	1
11. J-clamp	1400-0015	1
12. Screw, M4 × 10 mm	0515-2495	2
13. NPD interconnect assembly	G1534-60610	1
14. NPD signal board	G1534-60010	1
15. NPD interface board	G1534-60020	1
16. Pallet captive screws	1390-1024	4
17. O-Rings, HPM8 (Order no. 5180-4181, 12/pkg)	0905-1039	3
18. Screw, M4 × 10 mm, Torx, T20	0515-2495	1
19. Mounting pallet	G1531-40020	1
20. Jets: Packed column NPD – Capillary column (0.011-inch id) – Extended jet (optional, not shown)	19244-80560 G1534-80590	1 —
Capillary only NPD – Fused silica capillary (0.011-inch id) – Extended jet, capillary only (optional, not shown) – High temp jet (0.018-inch id)	G1531-80560 G1534-80580 G1531-80620	1 — —
21. Heater/Sensor assembly	G1531-61140	1
22. Base weldment: – Capillary column NPD – Packed column NPD	G1534-80500 G1534-80540	— —
23. Lid stop	G1534-20590	3
24. NPD block insulation	G1531-00030	1
25. Column adapters for packed NPD: – Capillary column – 1/8-inch packed column – 1/4-inch packed column	19244-80610 19231-80520 19231-80530	— — —
26. Nut warmer insulation (order qty 3)	19234-60715	3
27. Nut warmer cup	19234-60700	1
28. Flow measurement adapter (not shown)	G1534-60640	—

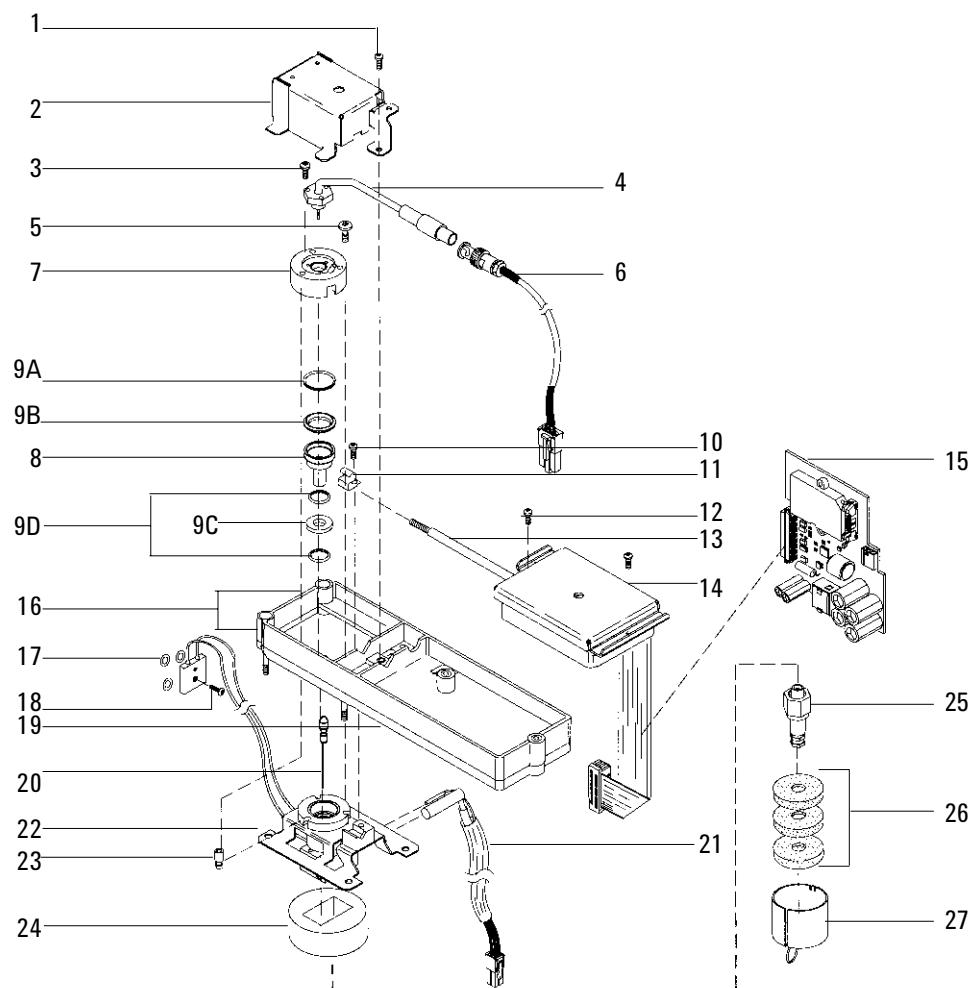
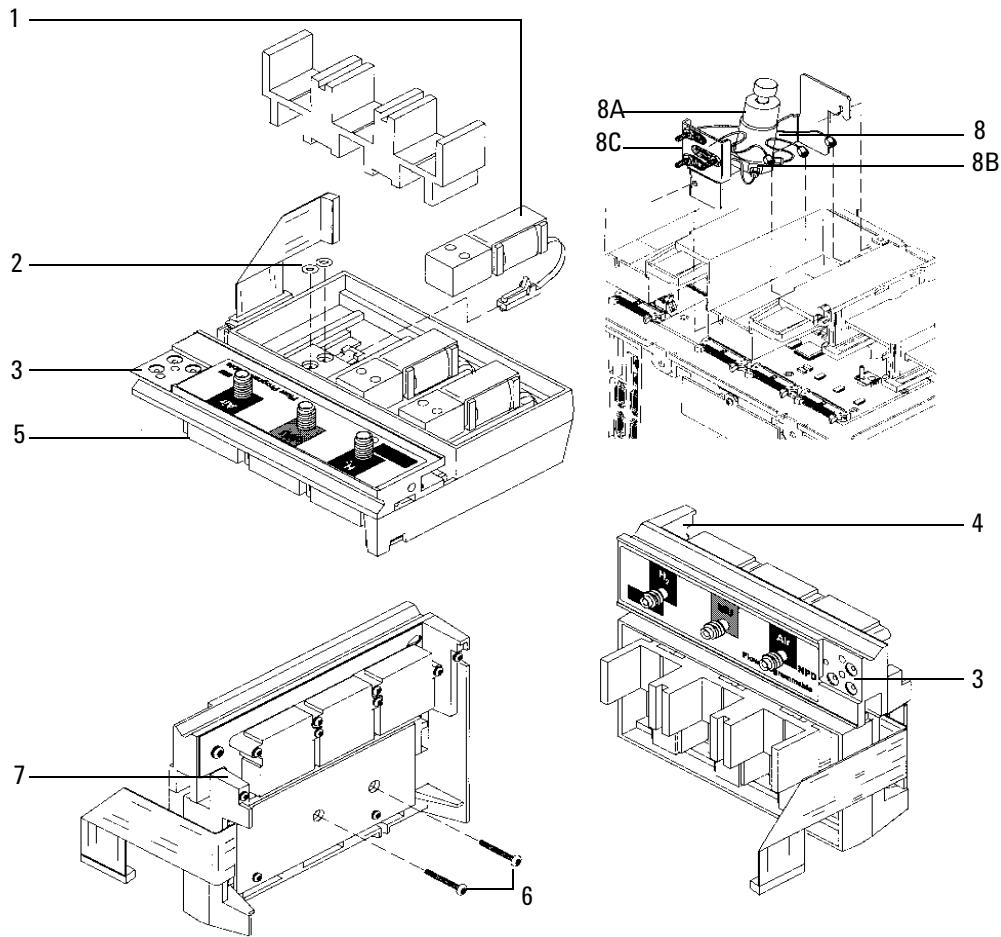
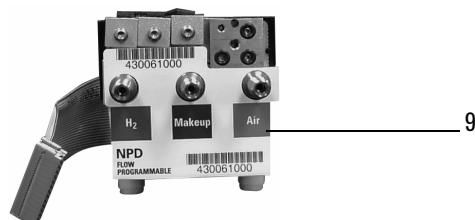


Figure 1320-5 Exploded diagram of the Nitrogen Phosphorus Detector

Nitrogen Phosphorus Detector manifold assembly

Description	Part no.	Qty
Type 1 Manifold		
1. Non-EPC 2 way valve	G1531-60530	3
2. O-rings HPM8 (Order no. 5180-4181, 12/pkg)	0905-1039	9
3. Screw, M4 x 6 mm, Torx, T20	0515-2832	1
4. EPC control module assembly	G1534-60520	1
5. Non-EPC control module	G1534-60500	1
6. Screw, M3 x 25 mm, Torx T10	0515-0683	6
7. Screw, M3 x 8 mm, Torx, T10	0515-0655	2
8. Make-up Gas, manual forward pressure regulator assembly	G1531-60570	1
8A. Pressure regulator, 0 to 100 psi	G1531-60630	1
8B. NPD manifold regulator brazement	G1531-80520	1
8C. Supply gas jumper brazement	G1531-80550	1
Type 2 Manifold		
9. Replacement EPC manifold assembly	G1534-60720	1

Type 1**Type 2****Figure 1320-6 NPD manifold assembly**

Thermal Conductivity Detector (TCD)

Description	Part no.	Qty
1. Screw, M4 × 12 mm, captive Torx, T20	0515-2496	2
2. Thermal cover	G1532-00040	1
3. Top insulation	G1532-00020	1
4. Screw, M4 × 0.7 × 8 mm, chrome plated	0515-2711	2
5. O-rings, HPM8 (Order no. 5180-4181, 12/pkg)	0905-1039	3
6. Screw, M4 × 10 mm, Torx, T20	0515-2495	1
7. TCD assembly	G1532-60675	1
8. Column adapters:		1
TCD capillary	G1532-80540	—
– 1/8-inch nut (10/pkg)	5180-4103	—
– 1/8-inch vespel ferrule, graphitized (10/pkg)	0100-1332	—
TCD packed, 1/8-inch Tube to 1/4-inch Female (not shown)	G1532-20710	—
– 1/8-inch nut (10/pkg)	5180-4103	—
– 1/8-inch vespel ferrule (10/pkg)	0100-1332	—
9. Column ferrules:		
– Graphite, 0.5 mm id (10/pkg)	5080-8853	—
– Graphite, 1.0 mm id (10/pkg)	5080-8773	—
10. Column nut (2/pkg)	5181-8830	1
11. TCD signal board*	G1532-60015	1
12. Heater/Sensor assembly	G1531-61140	1
13. PRT	G1531-60660	1
14. TCD mounting pallet	G1532-00030	1
15. Bottom insulation	G1532-00010	1
16. TCD seal insulation	G1532-00080	1
17. TCD vent restrictor kit (not shown)	G1532-60700	

* For TCDs manufactured before June 1997, order upgrade kit G1532-60540 to replace TCD signal board part no. G1532-60010.

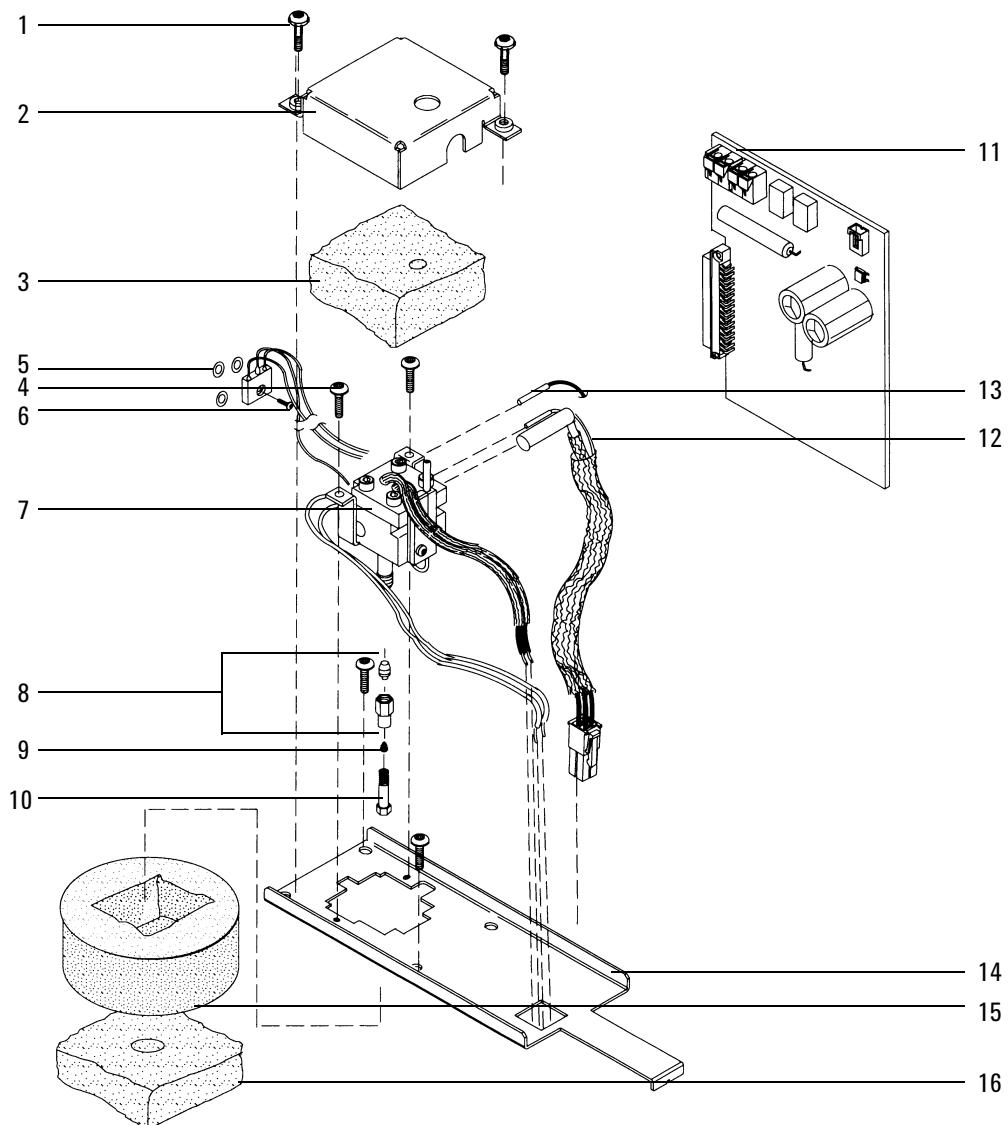


Figure 1320-7 Exploded diagram of the Thermal Conductivity Detector

Thermal Conductivity Detector manifold assembly

Description	Part no.	Qty
Type 1 Manifold		
1. Non-EPC detector on-off valve	G1531-60530	2
2. O-rings HPM8 Order no. 5180-4181, 12/pkg	0905-1039	9
3. Screw, M4 × 6 mm, Torx, T20	0515-2832	2
4. EPC control module assembly	G1532-60720	1
5. Non-EPC control module assembly	G1532-60500	1
6. Screw, M3 × 8 mm, Torx T10	0515-0655	2
7. Make-up gas, manual forward pressure regulator assembly	G1532-60530	1
7A. Pressure regulator, 0 to 100 psi	G1531-60630	1
7B. TCD Manifold regulator brazement	G1532-80530	1
8. TCD 3-Way switching valve	G1532-60570	1
Type 2 Manifold		
9. Replacement EPC manifold assembly (replaces either type)	G1532-60720	1

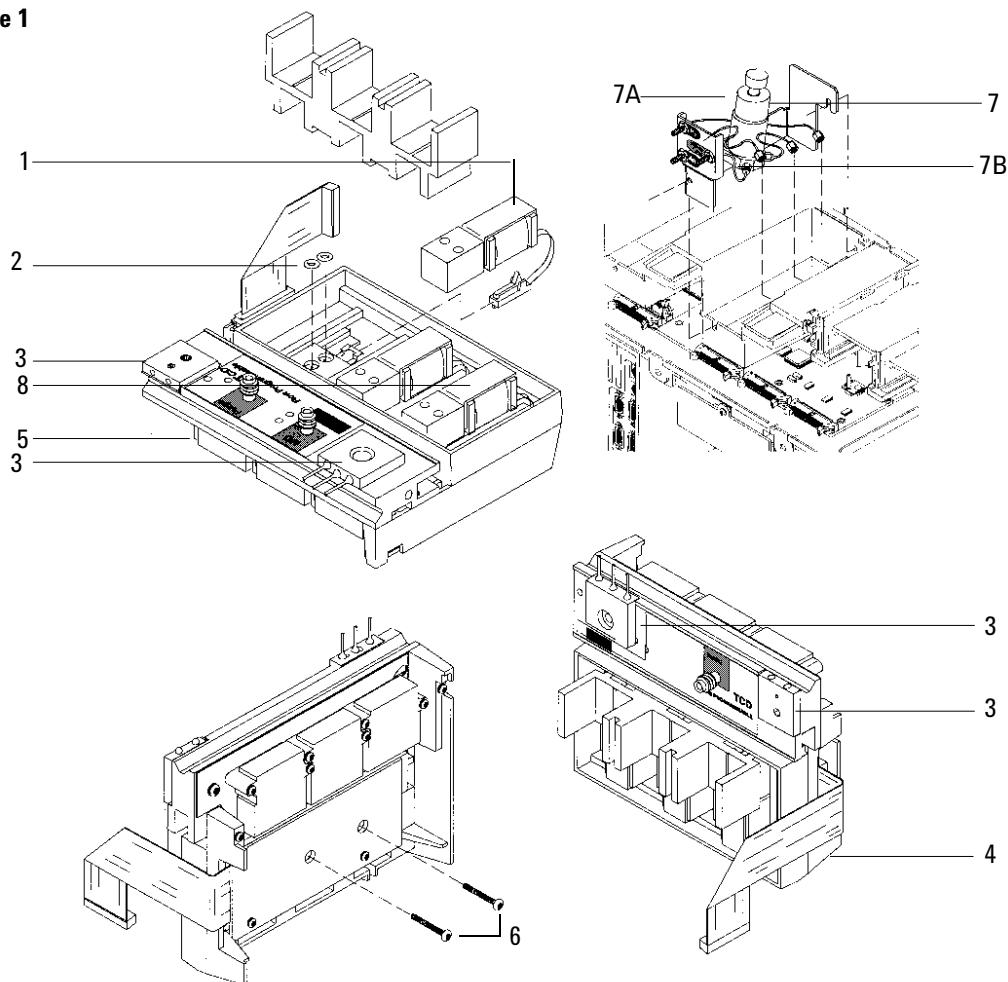
Type 1**Type 2**

Figure 1320-8 TCD manifold assembly

Microcell Electron Capture Detector (μ ECD)

Description	Part no.	Qty
1. Micro ECD top cover	G2397-00011	1
2. ECD signal wire assembly	19233-60635	1
3. Anode/Ferrule/Nut assembly (specific license required)	G2397-60540	1
4. ECD thermal cover	G1533-00030	1
5. Thermal cover clip	19233-00095	1
6. ECD top insulation	G1533-00020	1
7. Screw, M4 × 10 mm, Torx T20	0515-2495	3
8. Clamp, interconnect	19231-00040	1
9. Captive screw, detector pallet, M4 × 20 mm, T20, Torx	1390-1024	4
10. FID pallet	G1531-40020	1
11. Screw, M4 × 45 mm, Torx T20	0515-2484	2
12. Microcell Electron Capture Detector assembly:		1
– General licensed ECD, new	G2397-65500	–
– General licensed ECD, rebuilt	G2397-69900	–
13. ECD block insulation	G1533-00010	1
14. ECD seal insulation	G1533-00080	1
15. Screw, M4 × 12 mm, Torx T20	0515-2496	1
16. ECD make-up gas adapter weldment assembly:	G2397-80520	1
– Gigabore liner	G2397-20540	–
– End cap	19233-20755	–
17. Ferrules, capillary columns:		1
– No hole (plug), graphitized-vespel	5181-7458	–
– Graphite 0.5 mm id (10/pkg)	5080-8853	–
– Graphite 1.0 mm id (10/pkg)	5080-8773	–
18. Capillary column nut (2/pkg)	5181-8830	1
19. Screw, M4 × 12 mm, Torx T20, chromeplate	0515-2711	2
20. ECD interconnect assembly	G1533-60510	1
21. Micro ECD signal PCB assembly	G2397-60010	1
22. Micro ECD interface PCB assembly	G2397-60020	1
23. Heater/Sensor assembly	G1533-60625	1
24. Upper heated block	G1533-20525	1
25. Lower heated block	19233-20515	1
26. ecd mounting plate	G1533-00050	1
NS Nut warmer assembly	19234-60720	1
27. Nut warmer insulation	19234-60715	1
28. Nut warmer cup assembly	19234-60700	1
29. Tubing tygon (30 in.)	0890-0934	1
30. Vent elbow (if present)	19303-20590	1
31. Tubing adapter (if present)	5020-8231	1

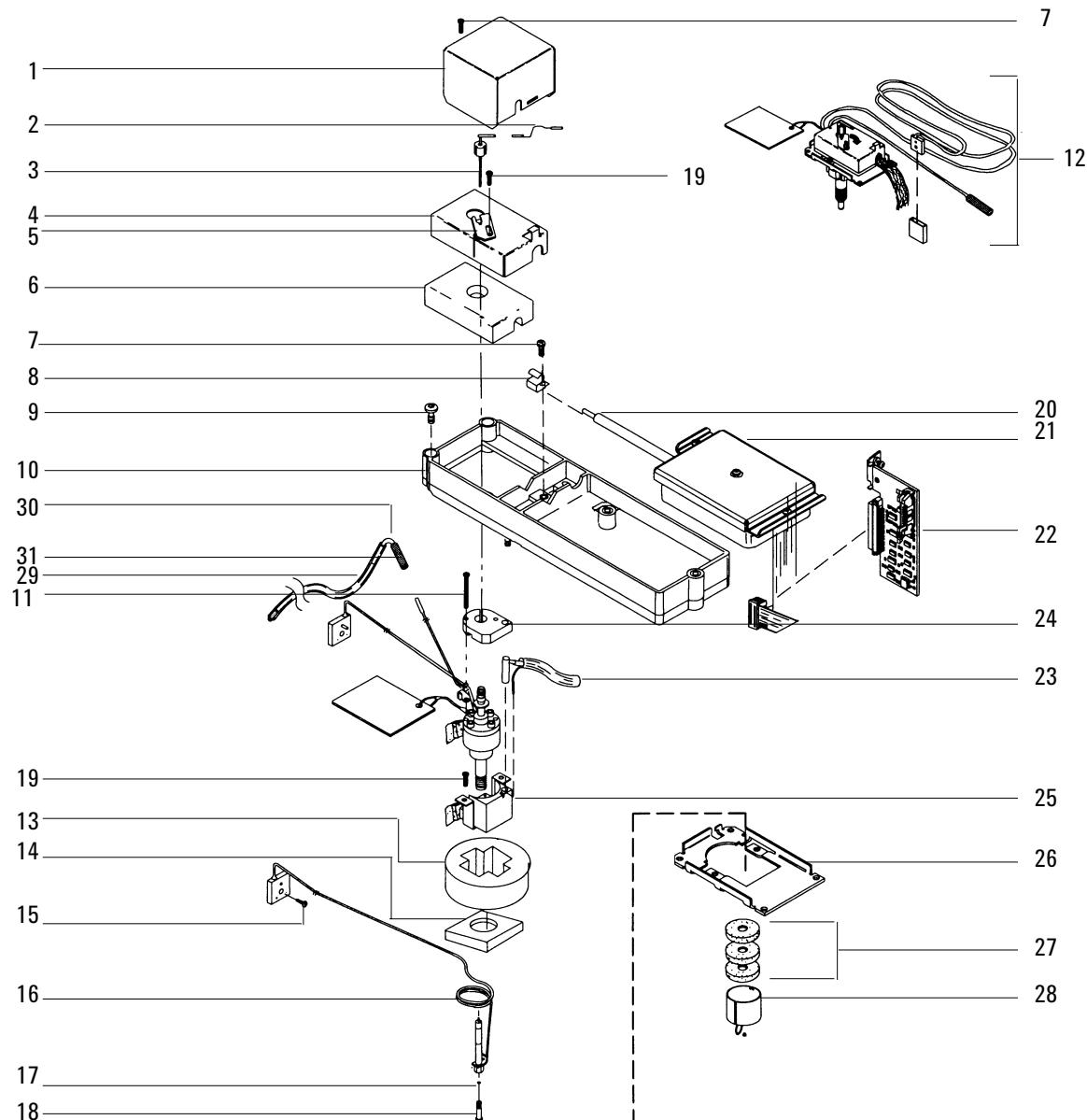
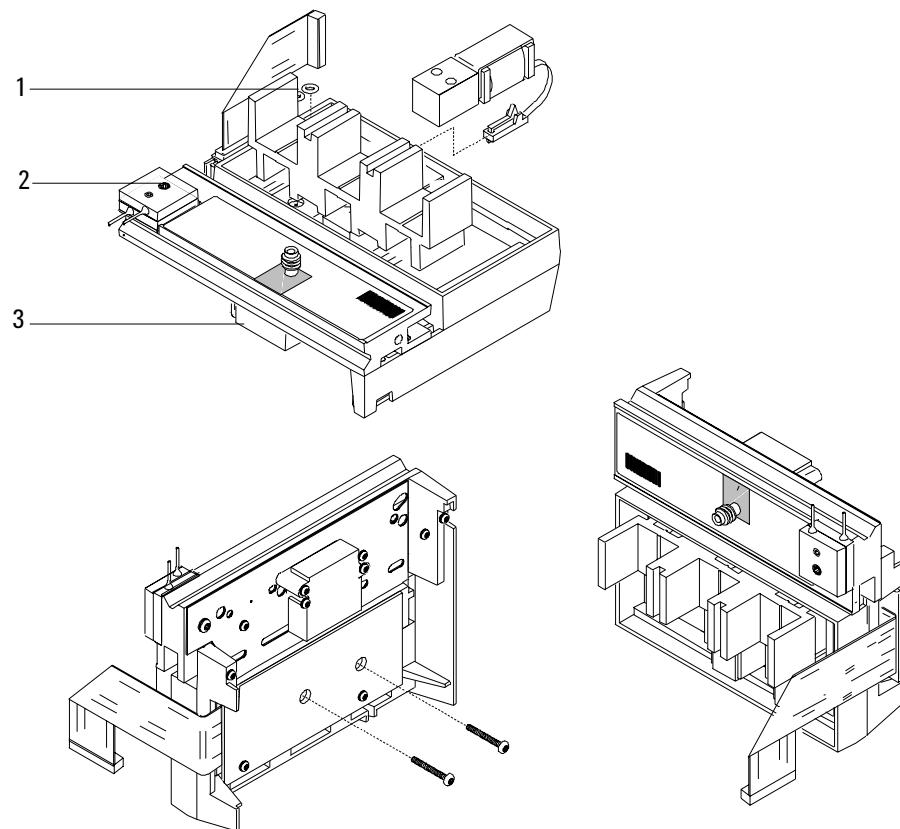
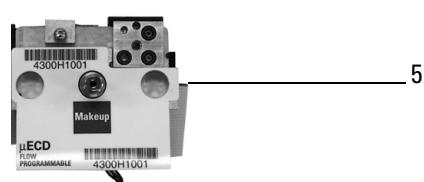


Figure 1320-9 Exploded diagram of the Microcell Electron Capture Detector

Microcell Electron Capture Detector manifold assembly

Description	Part no.	Qty
Type 1 Manifold		
1. O-rings HPM8	0905-1493	13
2. Screw, M4 × 8 mm, Torx, T20	0515-0910	1
3. EPC Micro ECD manifold assembly	G2397-60550	1
NS Screw, M3 × 25 mm, Torx, T10	0515-0683	8
NS Screw, M3 × .5 × 8 mm, Torx, T10	0515-0655	2
4. ECD make-up gas assembly	G2397-20540	1
Chemical traps	G1533-80540	2
Type 2 Manifold		
5. Replacement EPC manifold assembly (replaces either type)	G2397-60720	1

Type 1**Type 2****Figure 1320-10 μECD manifold assemblies**

Flame Photometric Detector (FPD)

Description	Part no.	Qty.
1. Exit tube assembly-A1	19256-20700	1
1A. Exit tube assembly-SST	19256-20705	1
2. Nut, brass, 1/4-inch	0100-0056	1
3. Ferrule, Vespel, 1/4-inch ID (order no. 5080-8774)	0100-1061	1
4. Weldment, block	19256-80560	1
5. O-ring (Kalrez) ignitor	0905-1102	1
6. Spacer, ignitor	19256-20590	1
7. Glow plug	0854-0141	1
8. Ignitor cable assembly	G1535-60600	—
9. Gasket, heat shield	19256-80040	1
10. Window, first heat shield	19256-80030	1
11. Disk, heat shield	19256-20580	1
12. Coupling, stainless steel	19256-20550	1
13. Lockwasher (4 required)	2190-0108	4
14. Screw, M3 × 12 (4 required)	0515-0911	4
15. Clamp	19256-00090	1
16. O-ring, silicone, 0.926-inch ID (orange)	0905-0955	1
17. Window, second heat shield	19256-80060	1
18. O-ring, silicone, 1.05-inch ID (orange)	0905-1104	1
19. Flange adapter	19256-20510	1
20. Flange ring	19256-00200	1
21. Screw, M3 × 25 (4 required)	0515-0065	4
22. O-ring, Viton, 1.239-inch ID (brown)	0905-1100	1

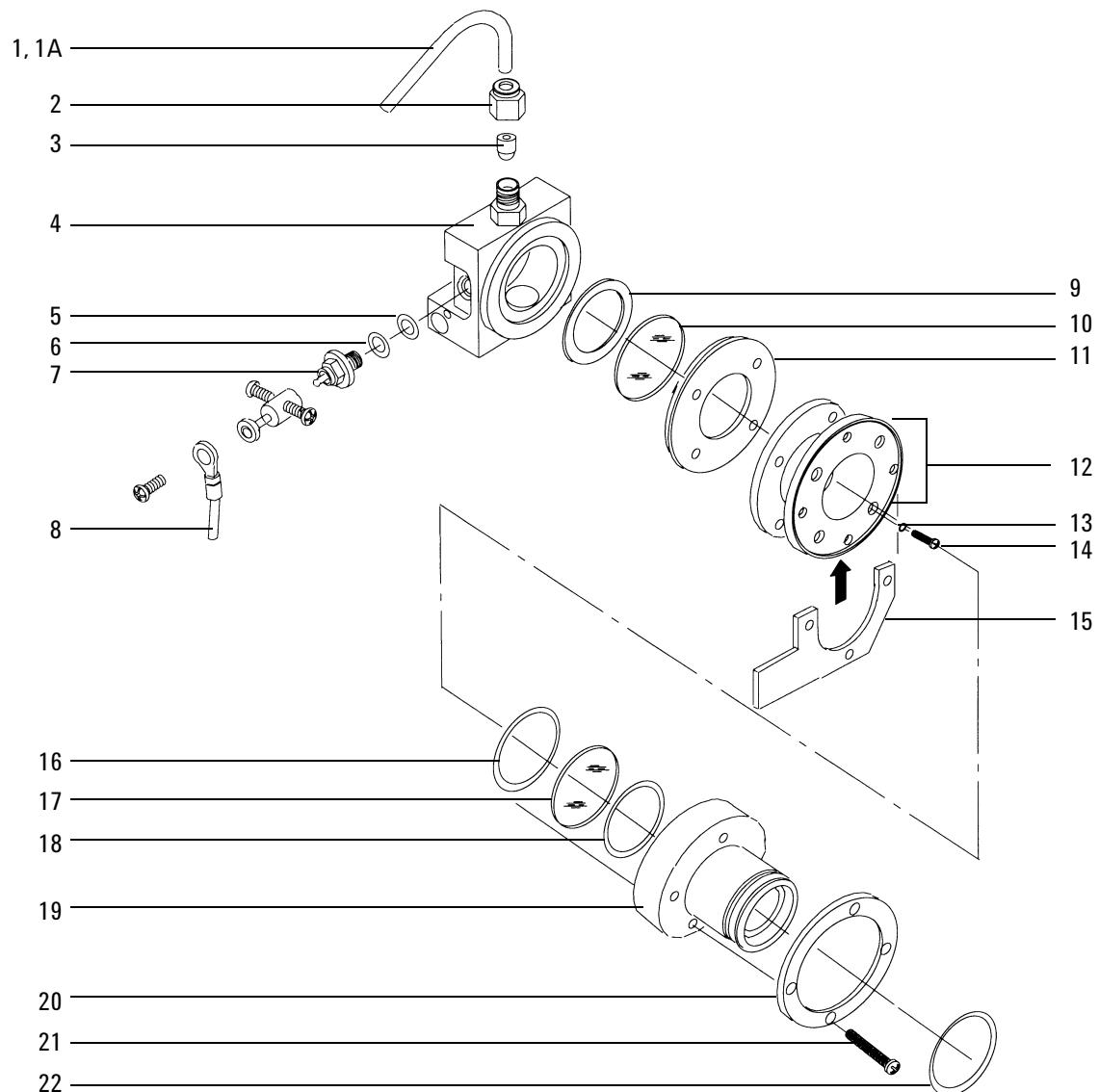


Figure 1320-11 Exploded diagram of the Flame Photometric Detector

Flame Photometric Detector jet and transfer tube assemblies

Description	Part no.	Qty.
1. O-ring, Kalrez, transfer tube	0905-1101	1
2. Transfer tube	19256-80550	1
3. Gigabore liner/ferrule assembly	19256-60590	1
4. Base assy, weldment	G1535-80510	1
5. Heater/sensor assembly	G1535-60620	1
6. Lower heater block	19256-20500	1
7. O-ring (Kalrez), jet cartridge	0905-1103	1
8. Jet cartridge	G1535-80500	1
9. Ferrule, Vespel, 1/4-inch ID (Order no. 5080-8774)	0100-1061	1
10. Nut, brass, 1/4-inch	0100-0056	1

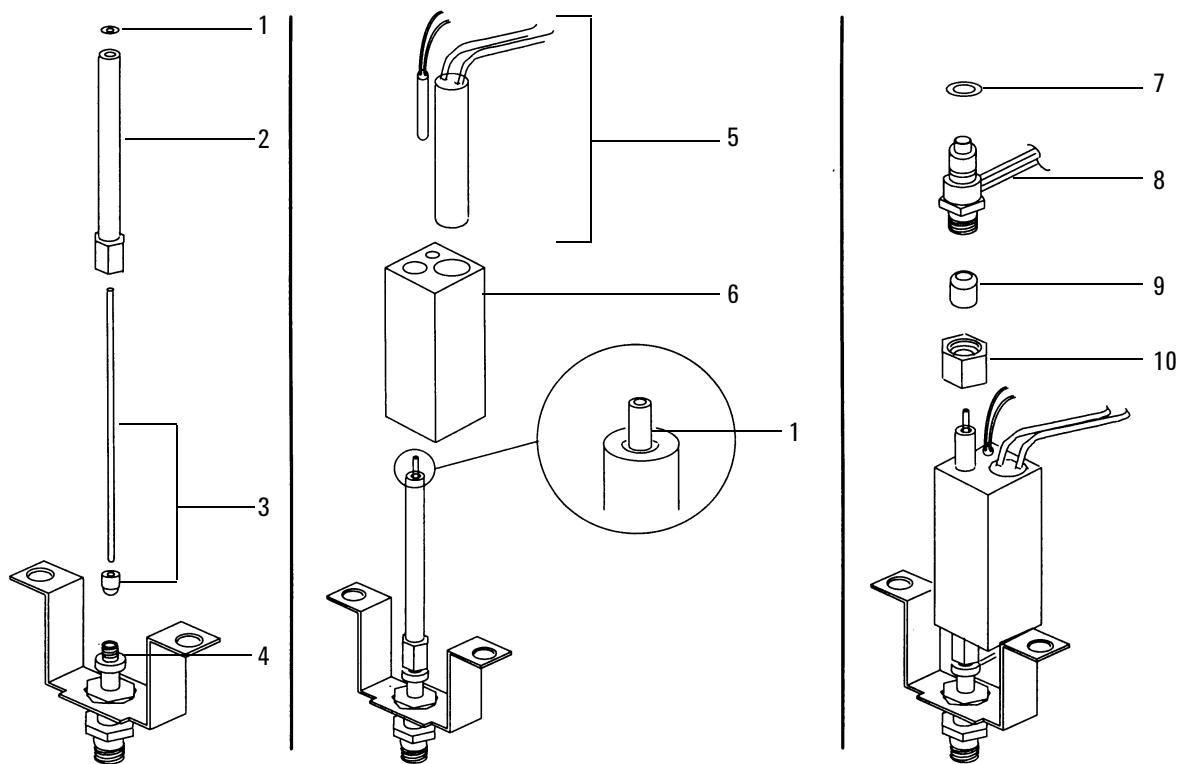


Figure 1320-12 Exploded diagram of the jet and transfer tube assemblies

Flame Photometric Detector PMT and bracket assemblies

Description	Part no.	Qty.
1. Heater/sensor assembly	G1535-60610	1
2. Photomultiplier Tube (PMT)	G1535-80050	—
3. O-ring	0905-1099	—
4. PM tube and housing assembly	19256-60510	1
5. Main bracket	G1535-00010	1
6. Chimney, back	G1535-00020	1
7. Chimney, front	G1535-00030	1
Filters		1
Sulfur mode (not shown)	19256-80000	
Phosphorus mode (not shown)	19256-80010	

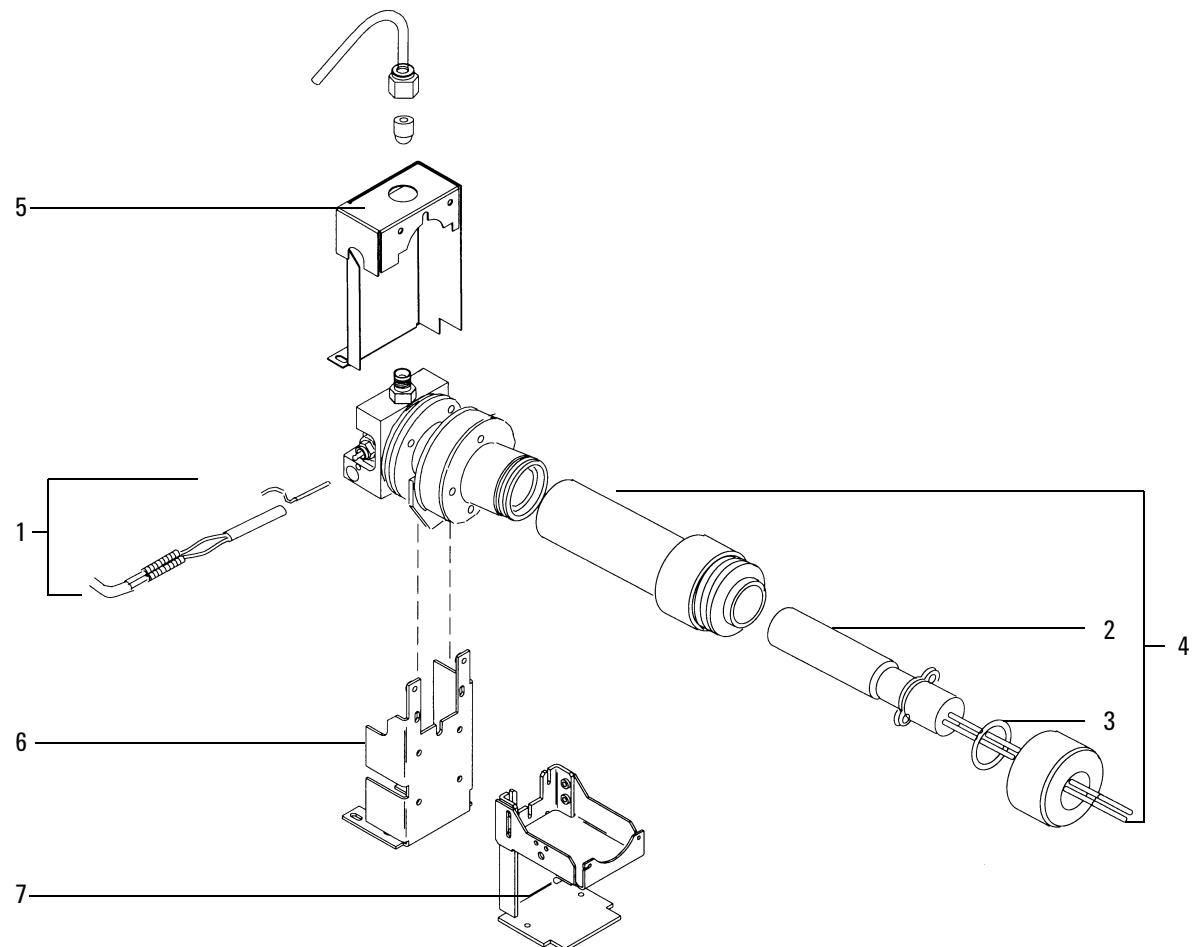


Figure 1320-13 Exploded diagram of the PMT and bracket assemblies

Flame Photometric Detector covers, manifolds, and electronics

Description	Part no.	Qty.
Covers and electronics		
1. Flame photometric detector assembly		1
Single wavelength FPD	G1535-60555	
Dual wavelength FPD (not shown)	G1535-60565	
2. Detector top cover, single FPD (not shown)	G1535-80550	1
2A. Detector top cover, dual FPDs	G1535-80560	1
3. Electronics cover pan	G1535-00120	1
4. Electronics top cover	G1535-80540	1
Cover assembly (6890 GC) (not shown)	G1535-80520	1
5. Actuator solenoid bracket (optional)	G1580-00070	—
6. Printed circuit board	G1535-60010	1
Spring (not shown)	1460-1160	1
Manifolds		
7. Replacement FPD manifold	G1535-60720	
8. Replacement EPC FPD manifold, Type 2, Kit (replaces either type)	G1535-60720	

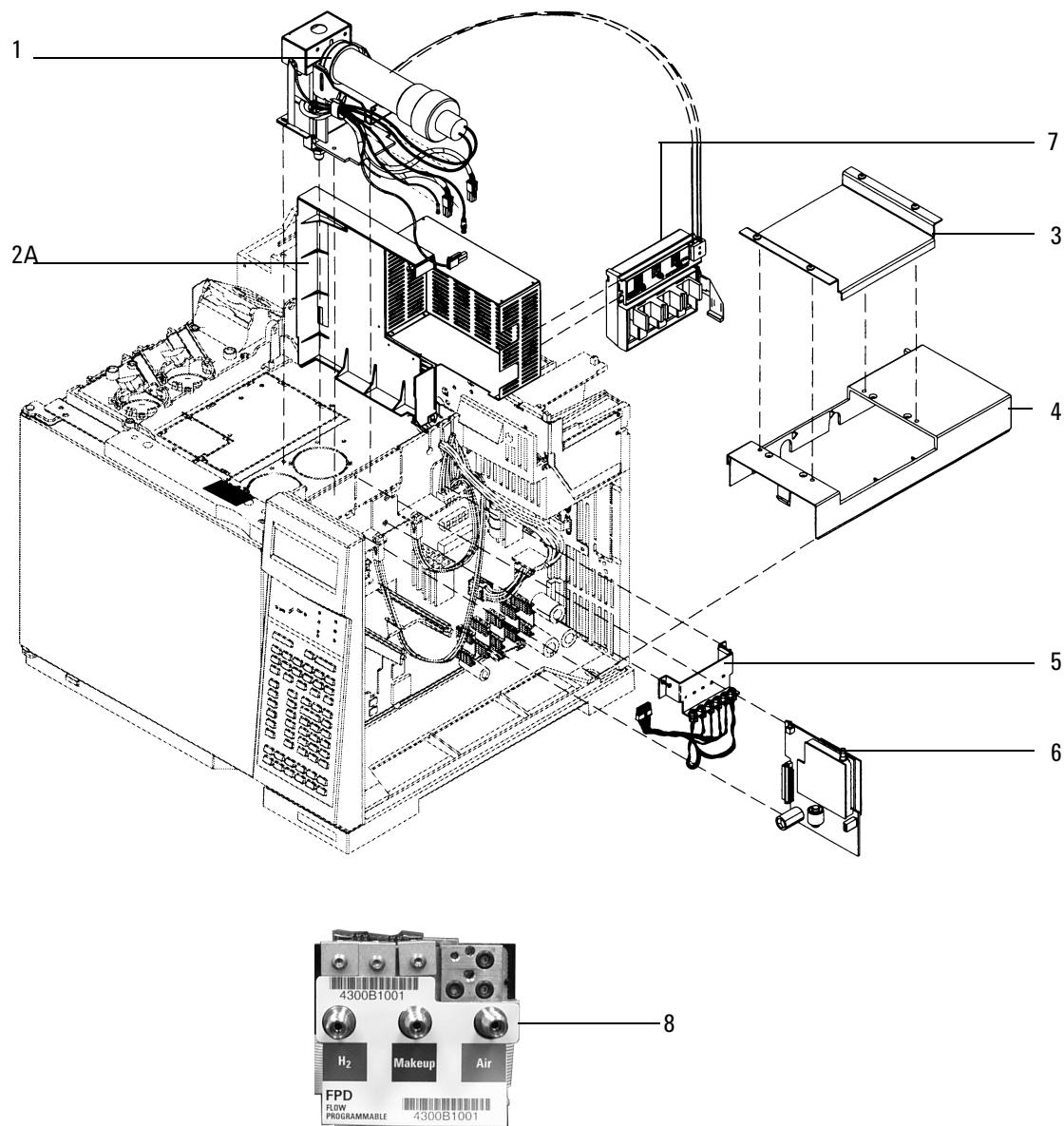


Figure 1320-14 Exploded diagram of the FPD covers, manifolds, and electronics

Auxiliary flow block

Description	Part no.	Qty.
1. Exit fitting weldment	G1570-80500	1
2. Restrictors kit*, includes:	G1570-60540	1
FID H ₂ (red dot)	19231-60770	
FID air (brown dot)	19231-60610	
NPD HYD (blue dot)	19234-60660	
Zero resistance tube (brass tube)	G1570-20540	
3. External flow restrictor (2/pk)	G1530-XXXXX	
4. Replacement Aux EPC Manifold, Type 2, kit (replaces either type)	G1570-64000	1
NS O-ring, 239-inch (part no. 5181-3345, 6/pk)	0905-1014	3
NS Aux EPC manifold only assy (Type 1)	G1570-60520	
NS Aux EPC kit	G1570-60500	
NS Aux EPC replacement kit	G1570-64000	
NS AED/AUX EPC (G2606A)	G1570-60560	

*Refer to 360 Auxiliary EPC, for more information

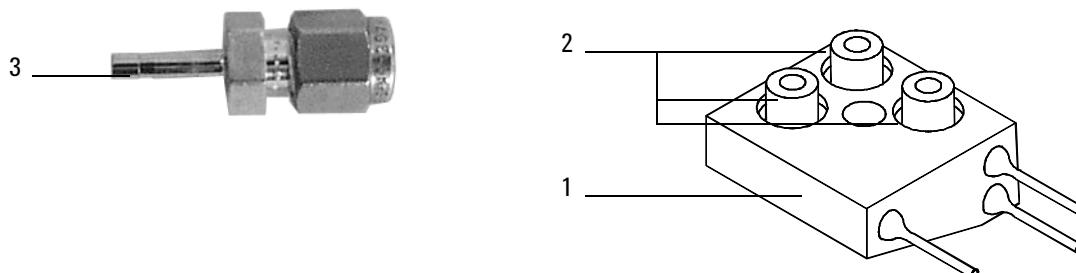


Figure 1320-15 Auxiliary flow block

1330 Covers

This section contains illustrated parts breakdowns for the following 6890 GC covers and related components:

- Metal Covers
- Plastic Covers
- Manual Inlet Flow Manifold Carrier

Metal covers

Description	Part no.	Qty.
1. Screw, M4 × 12 mm, Torx T20	0515-2496	8
2. Manifold, RFI plate	G1530-00470	1
3. Rear top panel	G1530-00225	1
4. Rear bottom panel	G1530-00035	1
5. Oven exhaust deflector (optional)	G1530-80650	1
6. Inlet chassis (PTV)	G2517-20550	–
7. Detector blank cover/insul. kit (not shown)	G1530-67040	–
8. Inlet blank cover/insul. kit (not shown)	G1530-67050	–
9. MIO/INET blank cover plate (not shown)	G1530-00610	–
10. Shipping container for 6890 GC mainframe (not shown)	G1530-80075	–
11. Panel for ALS slots (not shown)	G1530-00710	

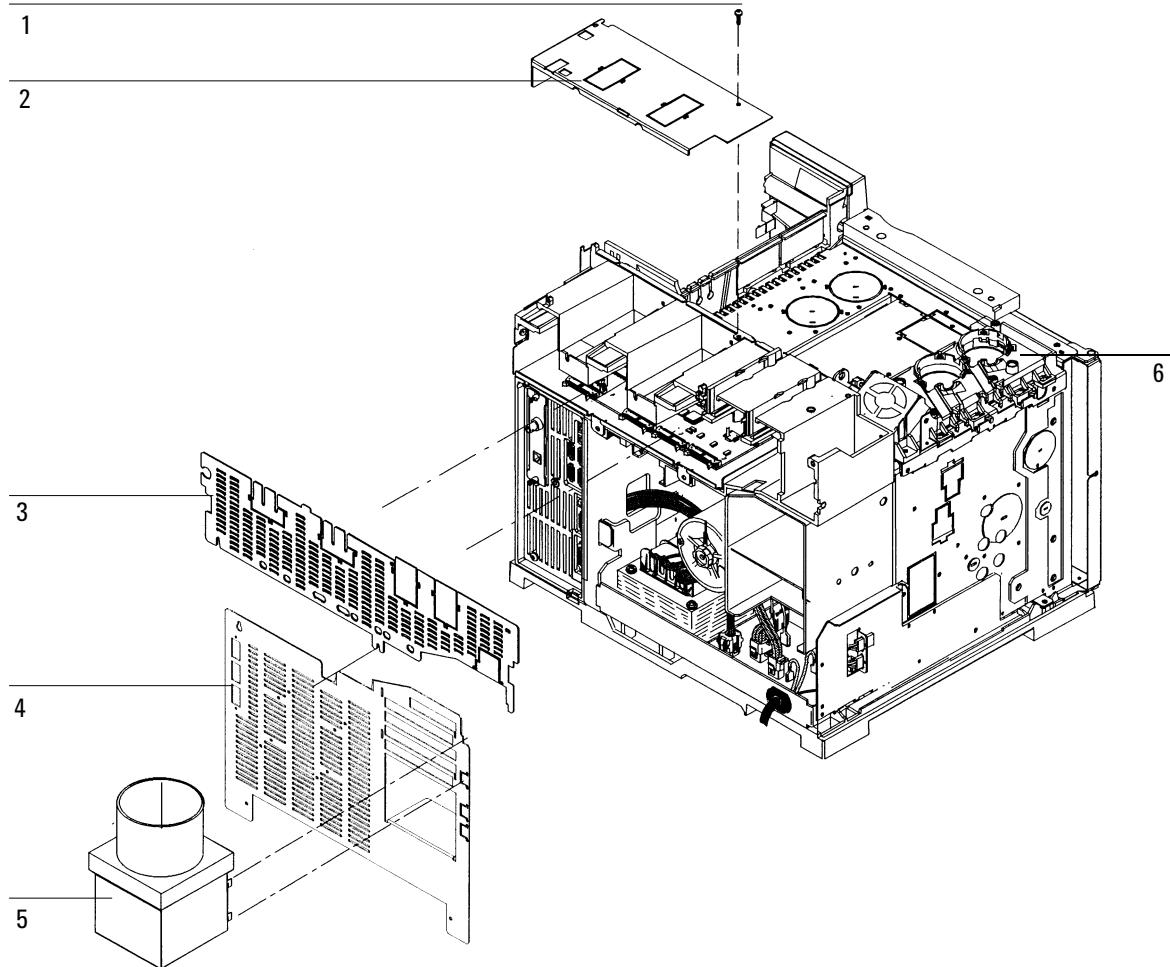


Figure 1330-1 Exploded diagram of the metal exterior components

Plastic covers

Description	Part no.	Qty.
1. Automated Liquid Sampler tray bracket* (optional)	18597-60875	1
2. Injection port fan cover	G1530-40200	1
3. Injection port top cover	G1530-40070	1
4. Pneumatics cover	G1530-40040	1
5. Detector top cover**	G1530-40130	1
6. Electronics top cover**	G1530-40125	1
7. Left side cover	G1530-40050	1
8. Screw, M4 × 12 mm, Torx, T10	1390-1023	10
9. Electronics side cover	G1530-40115	1
10. 3-inch hole plug	6960-0162	2
11. 1-inch hole plug	6960-0163	2
12. 1 1/2-inch hole plug	6960-0164	1
13. Circular plug label	G1530-90870	4
14. Oval plug label	G1530-90880	2
NS. Injector mounting post, 7683	07673-21140	1
NS. Injector mounting post, G2613A	G2613-20500	1

* Note: If your GC uses a metal hinge for the detector top cover, you must replace items 5 and 6 together. Order kit number G1530-67075. For more information, see Replacing the detector top cover.

** Bracket used for 18596 A/B tray only. Not used for G2614 tray on the 6890 Plus GC.

See also Figure 1320-14 for ordering covers for GCs with 1 (or 2) flame photometric detector(s).

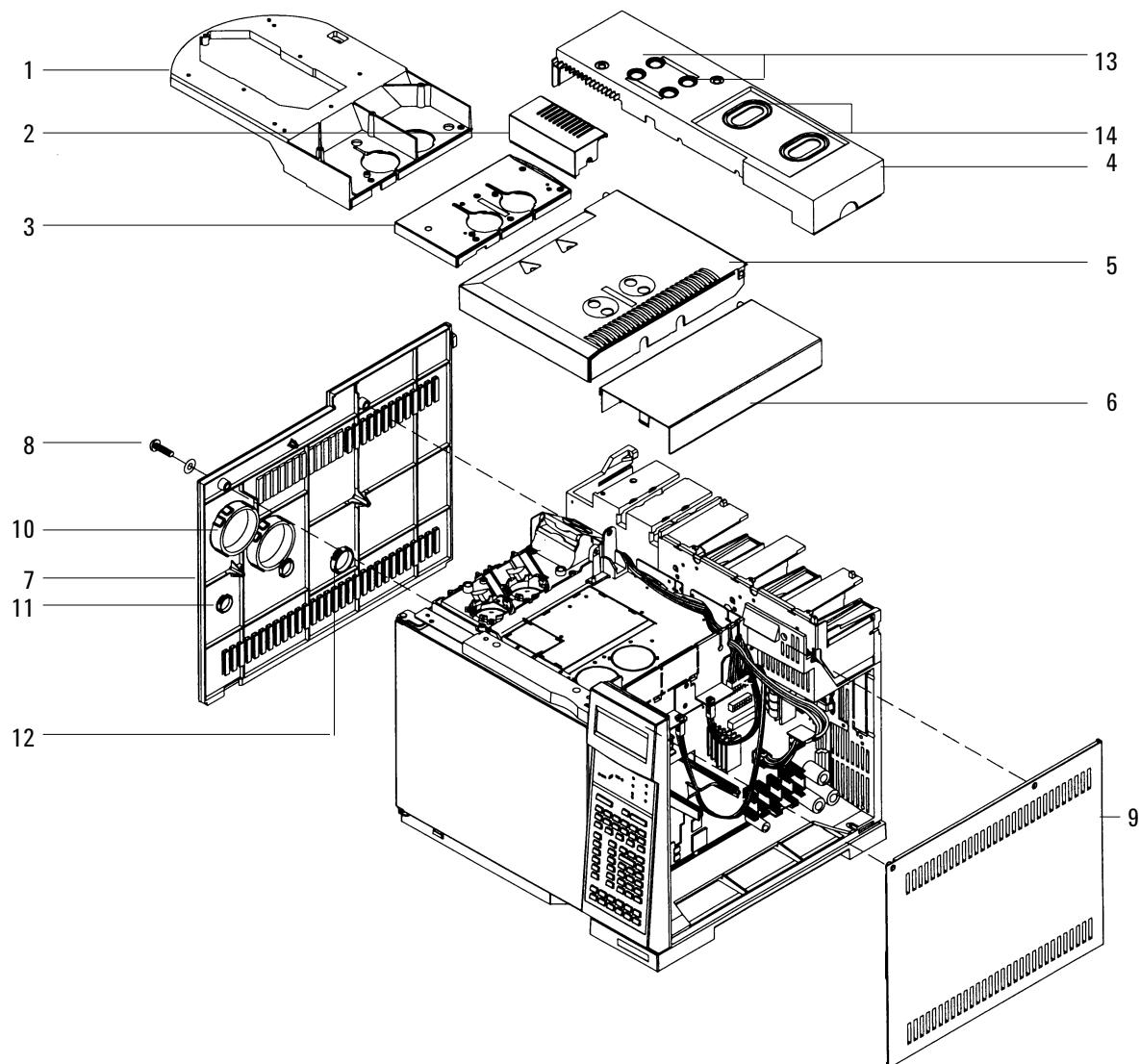


Figure 1330-2 Exploded diagram of the plastic exterior components

Manual inlet flow manifold carrier (G1585A accessory)

Description	Part no.	Qty.
1. Pneumatic carrier assembly	G1530-60950	1
2. Screw, M4 × 25 mm, Torx T-20	0515-2712	2
3. Screw, M4 × 12 mm, Torx T-20	0515-2496	4
4. Chemical trap bracket	05890-00810	1
5. Screw, M4 × 10 mm, Torx T-20, flathead	0515-2725	2
6. Flow side cover	G1530-01240	1

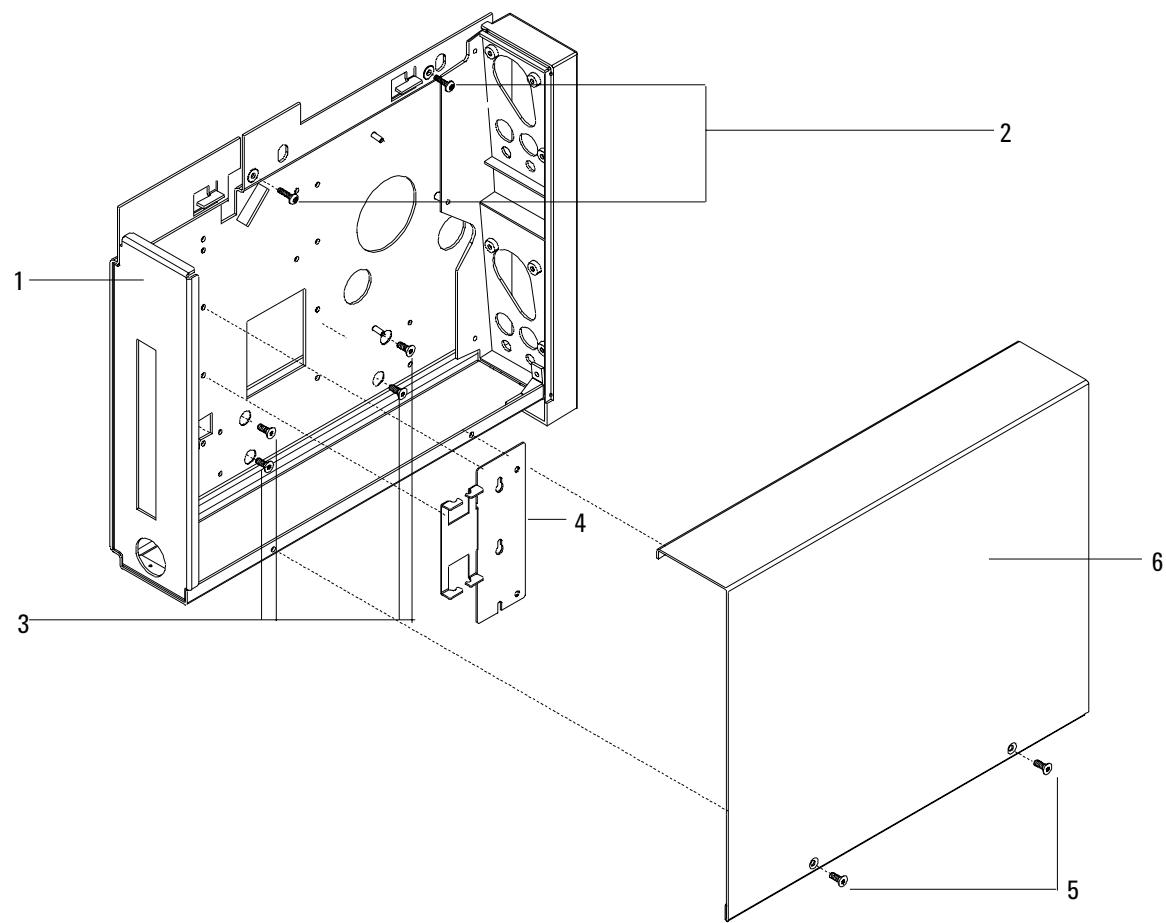


Figure 1330-3 Manual inlet flow manifold carrier

1340 Oven

This section contains illustrated parts breakdowns for the following 6890 GC components:

- Oven
- Oven flapper assembly
- CO₂ cryogenic cooling
- Liquid nitrogen cryogenic cooling

Oven assembly

Description	Part no.	Qty.
1. Oven door	G1530-60815	1
2. Fan blade, stainless steel, and set screw	05890-80270	1
3. Oven heater shroud assemblies:		1
-120V USA power	G1530-61610	
-200V Japan power	G1530-61620	
-220V Single phase power, Europe, and 208V USA power, single phase	G1530-61630	
-220V Single phase power, Hong Kong	G1530-61630	
-220V Single phase power, China	G1530-61630	
-220V China power, slow ramp	G1530-61230	
-220V Israel power	G1530-61630	
-230V Single phase power, Switzerland, 10 amp	G1530-61670	
-230V Denmark power, 10 amp	G1530-61670	
-230V Denmark/Switzerland power, 16 amp	G1530-61650	
-230V Continental Europe power	G1530-61650	
-240V Australia power	G1530-61640	
-240V South Africa/India power	G1530-61640	
-240V Great Britain/Ireland power	G1530-61640	
-240V USA power	G1530-61640	
-240V Australia power, slow ramp	G1530-61640	
4. Screws, M4 × 0.7, Torx T-20, chrome plated	0515-2711	4
5. Hex nut	0535-0043	3
6. Washer	2190-0712	6
7. Sensor door assembly	G1530-80670	1
8. Hinge pin	G1530-20685	1
9. Oven motor assembly	G1530-61310	1
10. On/Off switch rod	G1530-40010	1
11. Keyboard bezel assembly	G1530-60745	1
NS Rubber keypad	G1530-40095	1
NS Keyboard flex membrane assembly	G1530-80590	1
NS Keyboard display cable	G1530-60540	1
12. Keyboard display 4 × 20 UF	G1530-80000	1
13. Keyboard window bezel (plastics)	G1530-61320	1
NS Glacier grey touch-up paint	6010-1497	—
NS Oven sensor	G1530-61030	
NS Column hanger	1460-1919	

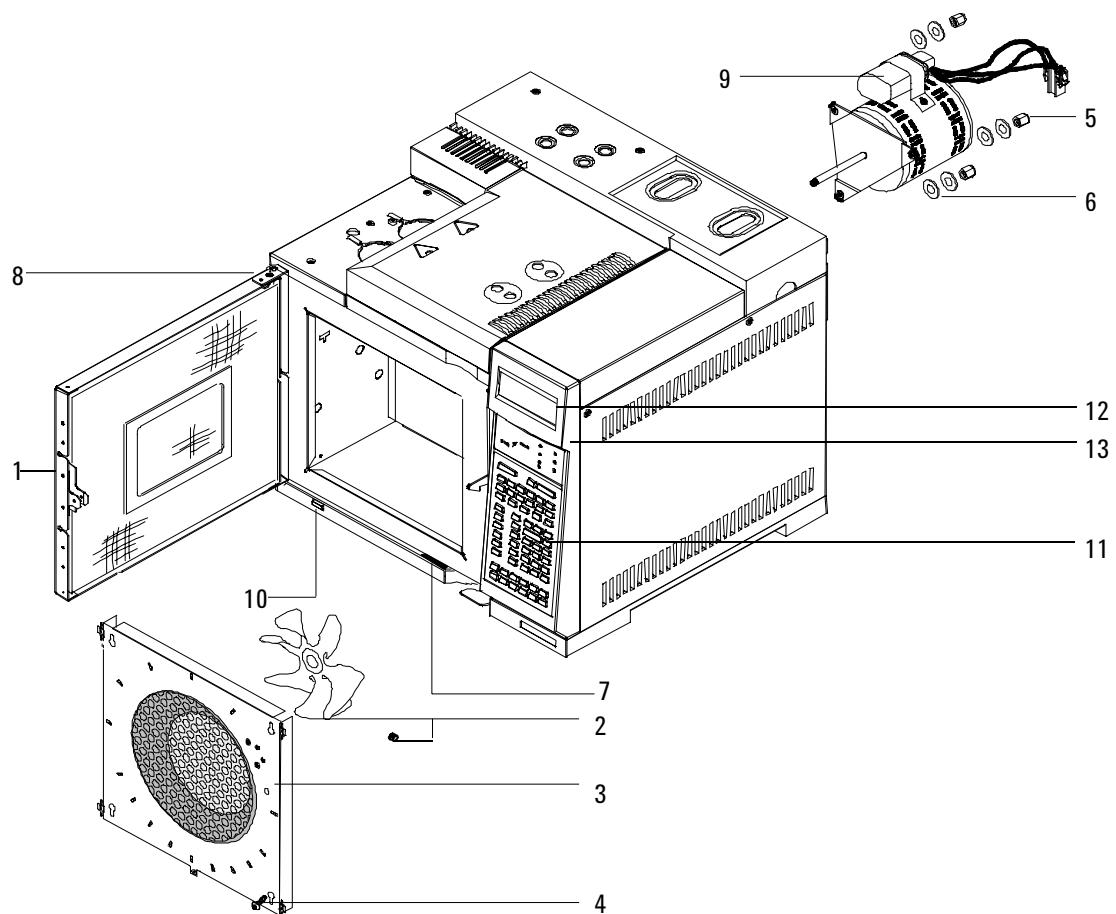


Figure 1340-1 Oven

Oven flapper assembly

Part no. G1530-60770

Description	Part no.	Qty.
1. Dual duct assembly	G1530-80680	1
2. Flapper shaft assembly	G1530-80560	1
3. Screw, Torx T20, M4 × 12 mm	0515-2496	4
4. Stepper motor assembly	G1530-60940	1
5. Screw, Torx T10, M3 × 8 mm	0515-0655	2

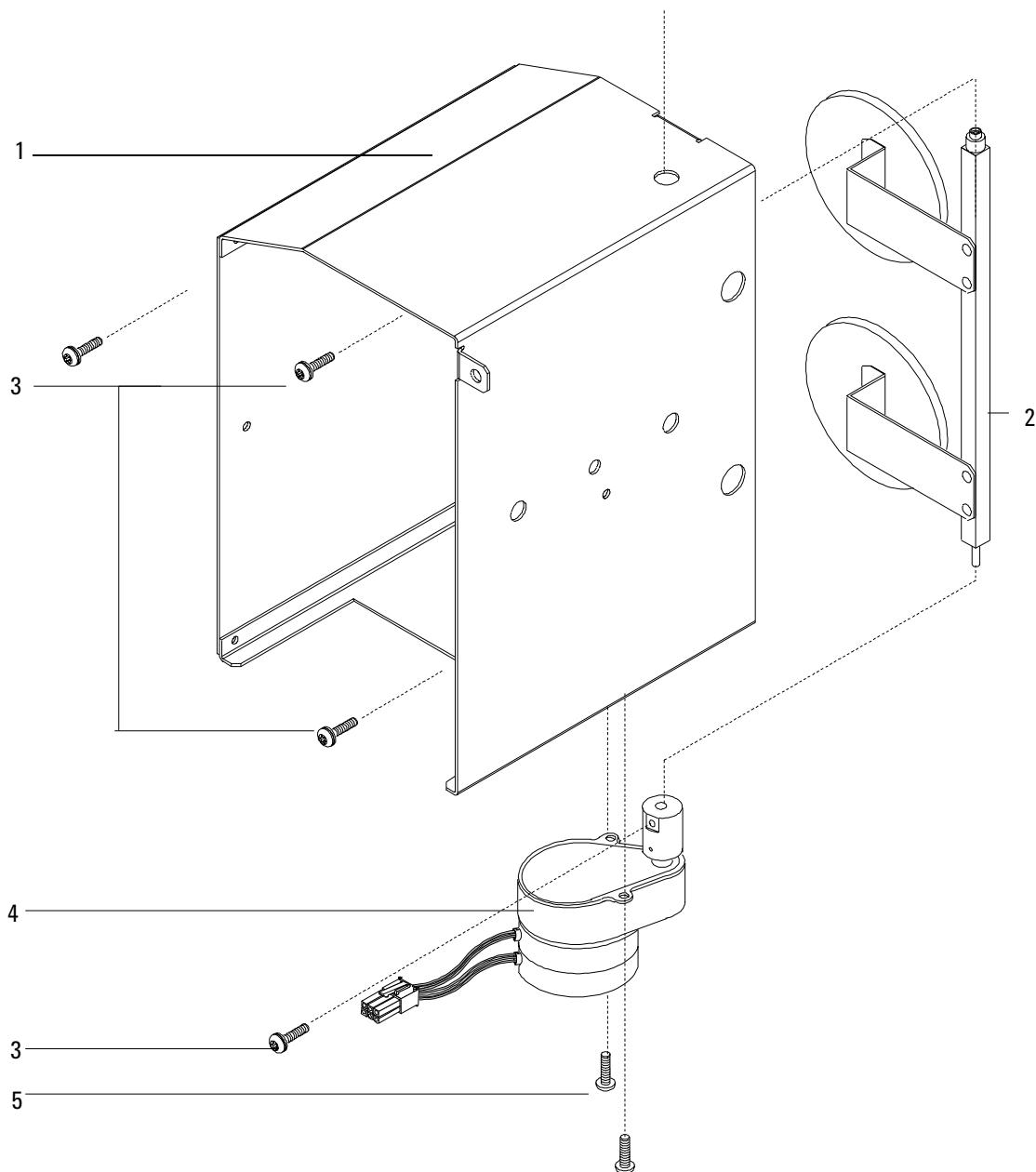


Figure 1340-2 Oven flapper assembly

CO₂ cryogenic cooling

Description	Part no.	Qty.
1. LCO ₂ blast brazement	G1535-80550	1
2. Tee-union, brass	0100-0090	1
3. 1/8-inch Male conn. w/o O-ring	G1543-80025	1
4. Screw, MS 8-32,.312 LG	2510-0043	2
5. Cryo bracket	G1565-00010	1
6. Gland seal, LCO ₂	G1565-20590	1
7. CO ₂ cryo valve	G1565-60545	1
8. CO ₂ cryo inline filter	3150-0602	1
9. CO ₂ inlet tube	G1565-20600	1
10. Cryo blast restrictor weldment	G1565-80590	1
11. LCO ₂ weldment	G1565-80505	1
12. Clamp screw	G1565-20560	1
NS Scr-mach T-20, Torx, M4 × 12 mm	0515-2496	2
NS TFE seal	G1565-20840	1
NS CO ₂ cryogenic kit	G1565-65510	—
NS LCO ₂ cryo blast kit	G1565-65520	—
NS CO ₂ cryo VLV/Dual blast assembly	G1565-65521	—

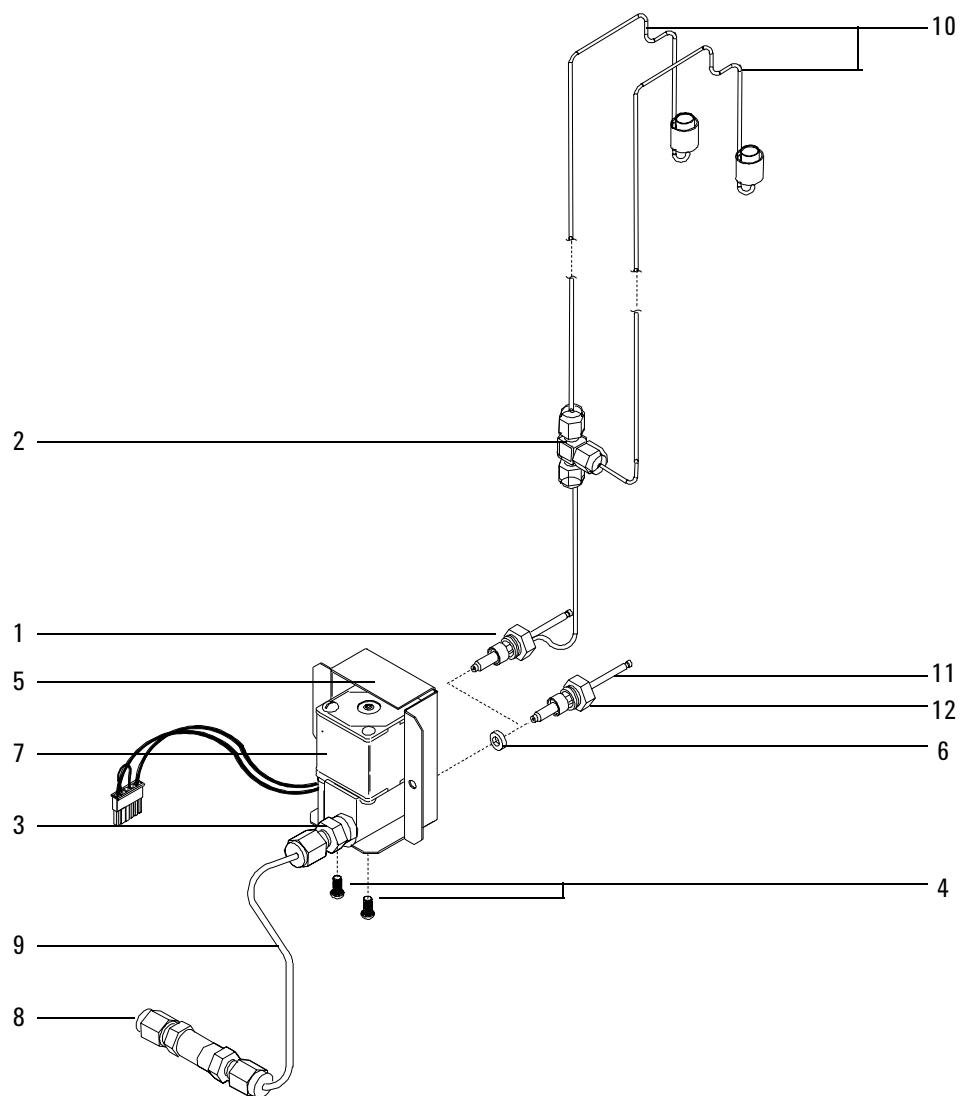


Figure 1340-3 CO₂ cryogenic cooling

Liquid nitrogen cryogenic cooling

Description	Part no.	Qty.
1. LN ₂ blast brazement	G1566-80535	1
2. Tee-union, brass	0100-0090	1
3. Connector – male	0100-0208	1
4. Screw, MS 8-32,.312 LG	2510-0043	2
5. Cryo bracket	G1565-00010	1
6. LN ₂ restrictor tube	G1566-20575	2
7. N ₂ cryo valve	G1566-60557	1
8. Liquid N ₂ nozzle	19310-20500	1
NS Scr-mach T-20, Torx, M4 × 12 mm	0515-2496	2
NS Tape – Industrial	0460-0016	–
NS N ₂ cryo blast	G1566-65507	–
NS N ₂ cryo VLV/Dual blast assembly	G1566-65508	–
NS N ₂ cryogenic kit	G1566-65517	–

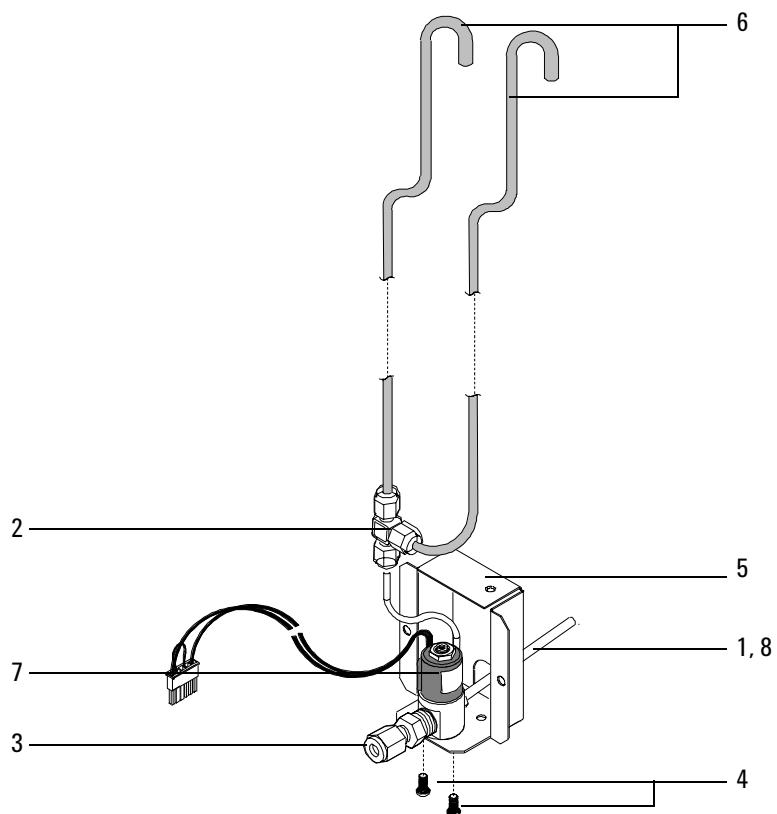


Figure 1340-4 Liquid nitrogen cryogenic cooling

1350 Valves

This section contains illustrated parts breakdowns for the following 6890 GC valves and related components:

- Valve Box Assembly
- Valve Driver Assembly
- Valve Actuator Assembly
- Valco W-series Minivalve
- Nickel Catalyst Assembly

Valve box assembly

Description	Part no.	Qty.
1. Screw, M4 × 8 mm, Torx T-20, chromeplated	0515-2711	6
2. Valve box cover	G1580-00030	1
3. Valve box insulation, top	G1580-00050	1
4. Insulation retainer plate	G1580-00040	1
5. Hex nut, insulation plate	0535-0025	2
6. Screw, M3 × 30 mm, Torx T-10, chromeplated htr (blk)	0515-2525	4
7. Heater block	G1580-20520	2
8. Standoff, valve box	G1580-20500	2
9. Valve box bottom plate	G1580-00010	1
10. Screw, M3 × 8 mm, Torx T-10, chromeplated	0515-2726	2
11. Heater/Sensor harness cable clamp	1400-0015	2
12. Heater/Sensor assembly	G1580-61140	2
13. Cable-tie strap (not shown)	1400-0249	4
14. Aluminum tube (split/splitless inlet only) (not shown)	18900-20320	1
15. In-line filter (sample in line) (not shown)	0101-0532	1

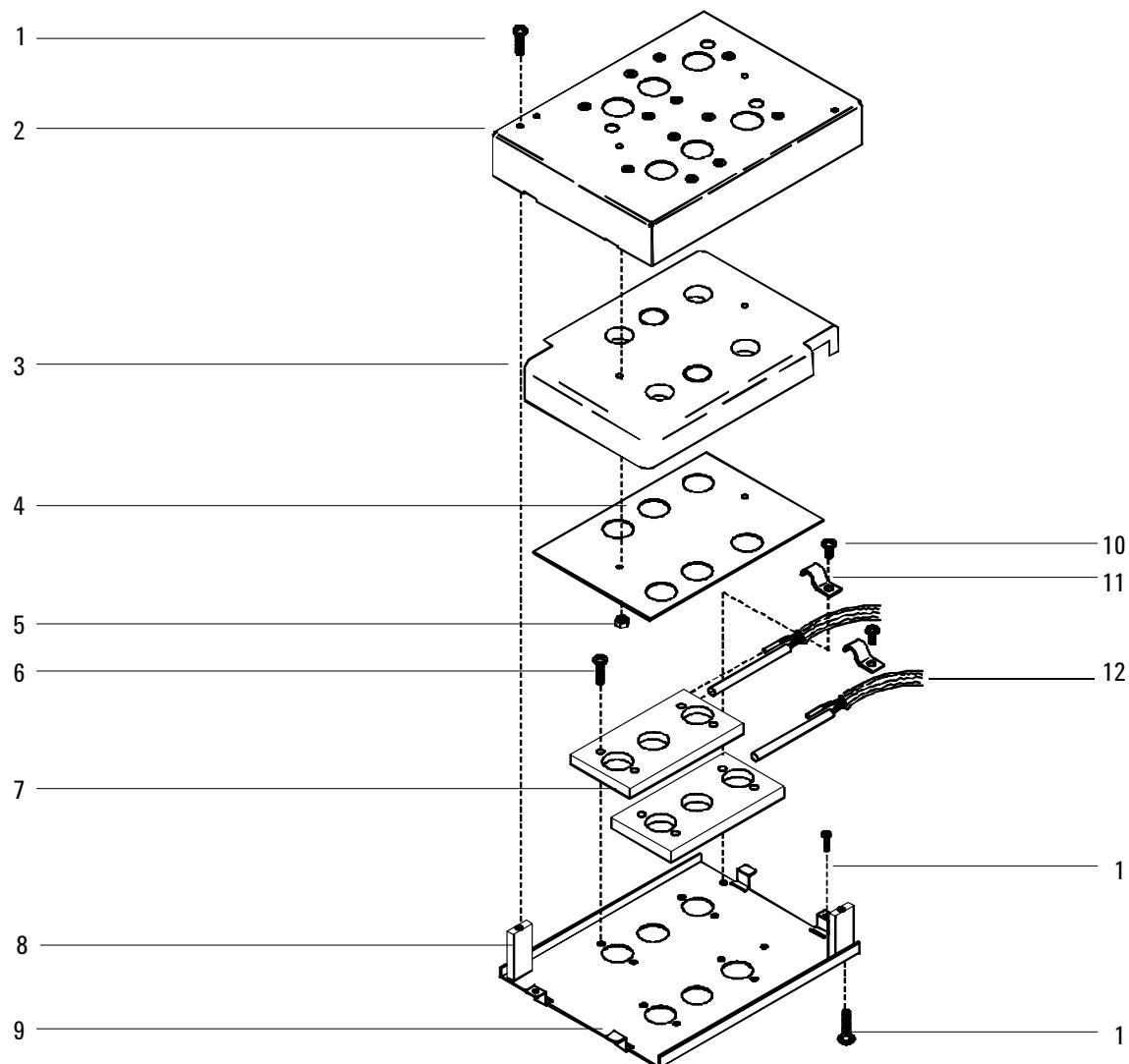


Figure 1350-1 Valve box assembly

Valve driver assembly

Description	Part no.	Qty.
1. Valve driver bracket	G1580-00070	1
2. Captured screw, M4 × 12 mm, Torx T-20	1390-1023	2
3. Valve driver wiring harness	G1530-60660	1
4. Pneumatic tubing, 1/8-inch OD, Teflon	0890-0746	8
5. Adapter fitting, 10/32 × 1/16-inch hose barb	0100-1205	8
6. Standoff (included with valves)	—	8
7. 4-way Solenoid valves	G1580-61090	4
8. O-ring (with valves and end plate kit)	—	10
9. Solenoid valve end plate kit	05890-61097	1
10. Screw, skt hd cap	0515-1214	2
11. Elbow fitting, 1/4-inch, male	0100-1632	2
12. Exhaust tubing, 1/4-inch OD, 120 inch	0890-1489	1
13. Heater cable assembly (not shown)	G1530-60790	1

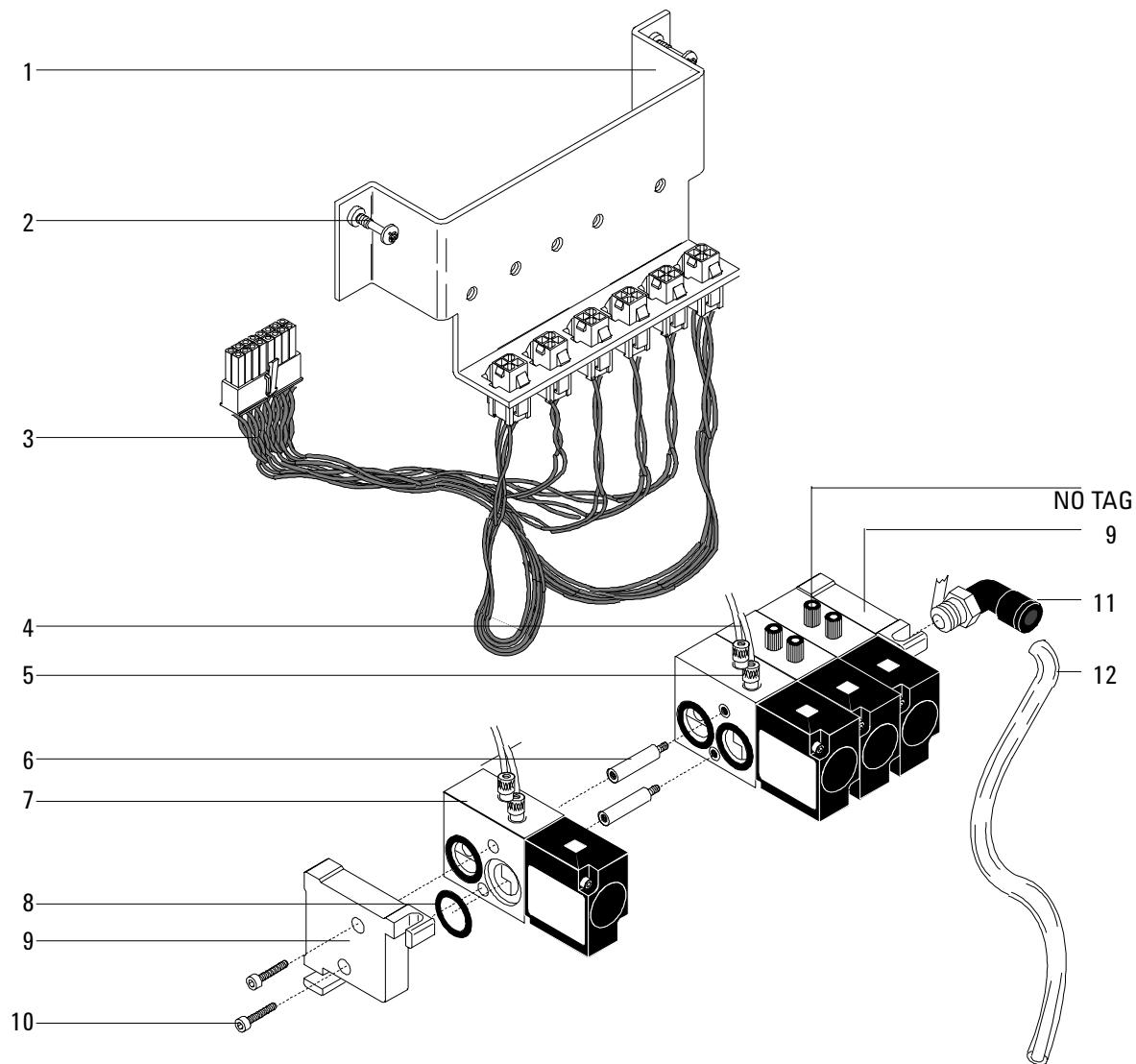


Figure 1350-2 Valve driver assembly

Valve actuator assembly (1 of 2)

Description	Part no.	Qty.
1. Valve actuator assembly	G1580-60660	1
2. Modified screw	19325-80030	2
3. Quick-release pin	1480-0632	1
4. 1/8-inch Hose fitting, 10-32 × 1/16-inch ID, hose barb	0100-1205	2
5. Teflon tubing 1/8-inch od (order by the inch; 42 inches for each actuator)	0890-0746	
6. 36° Actuator limiter	18900-21000	1
7. End cap	19325-20680	1
8. Elbow fitting, 10 to 32	0100-1220	1
9. Coupler/Shft assembly	G1580-60640	1
NS Hex key, 3 mm (not shown)	8710-0911	—

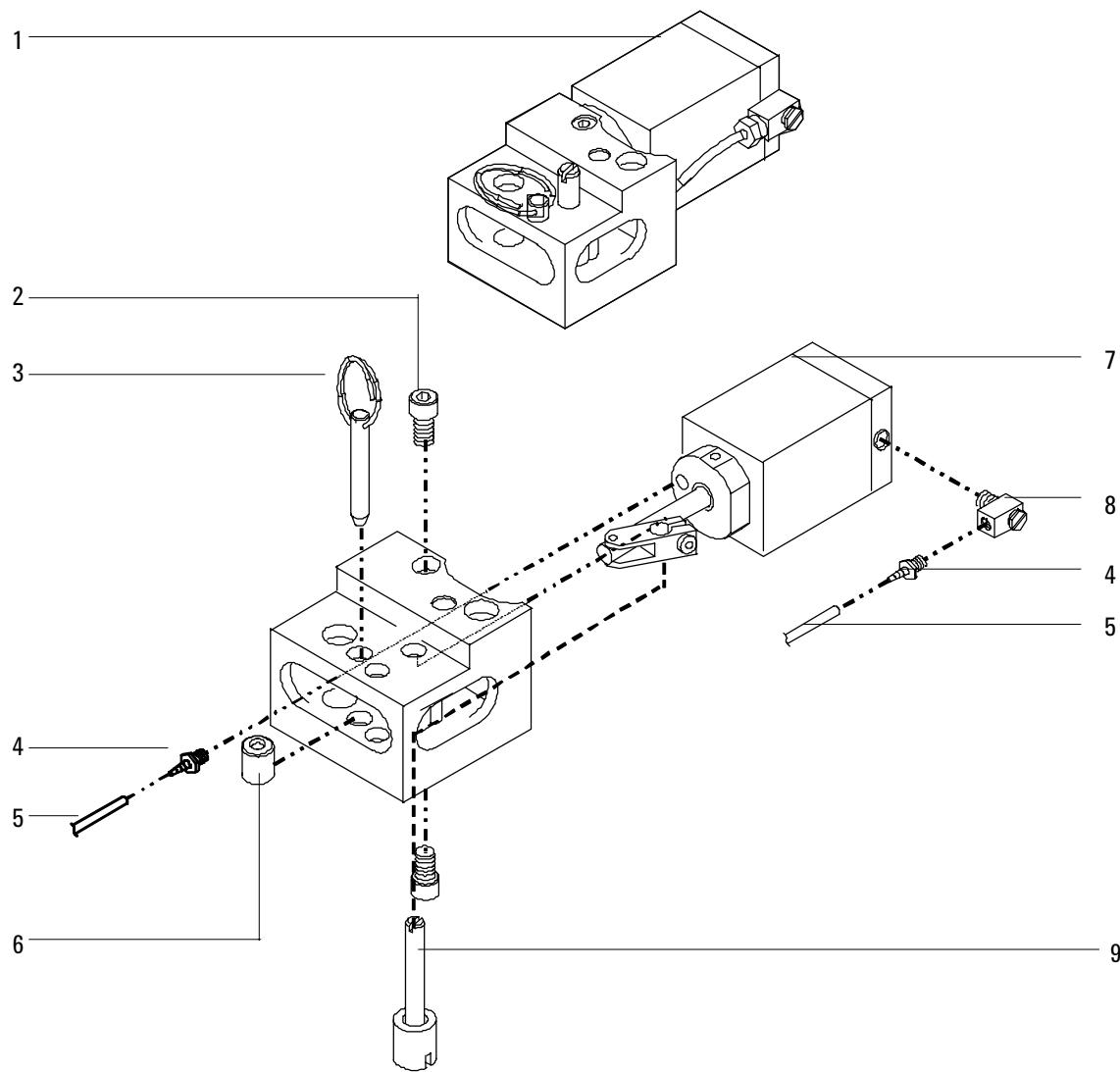


Figure 1350-3 Valve actuator assembly (1 of 2)

Valve actuator assembly (2 of 2)

Description	Part no.	Qty.
1. Dowel pin	1480-0017	1
2. Socket head screw, M4 x 8-mm	0515-0153	3
3. Link	19325-80010	1
4. Piston rod	19325-20650	1
5. Teflon tubing, 1/8-inch o.d. x 42-inch for actuators	0890-0746	1
6. Hose fitting	0100-1205	2
7. O-ring, 0.239-inch ID	0905-0103	1
8. Actuator cylinder	19325-20630	1
9. Piston	19325-20640	2
10. O-ring, 1.046-inch ID	0905-0463	1
11. O-ring, 1.176-inch ID	0905-1405	1
12. Cylinder end cap	19325-20680	1
13. Elbow fitting	0100-1220	1

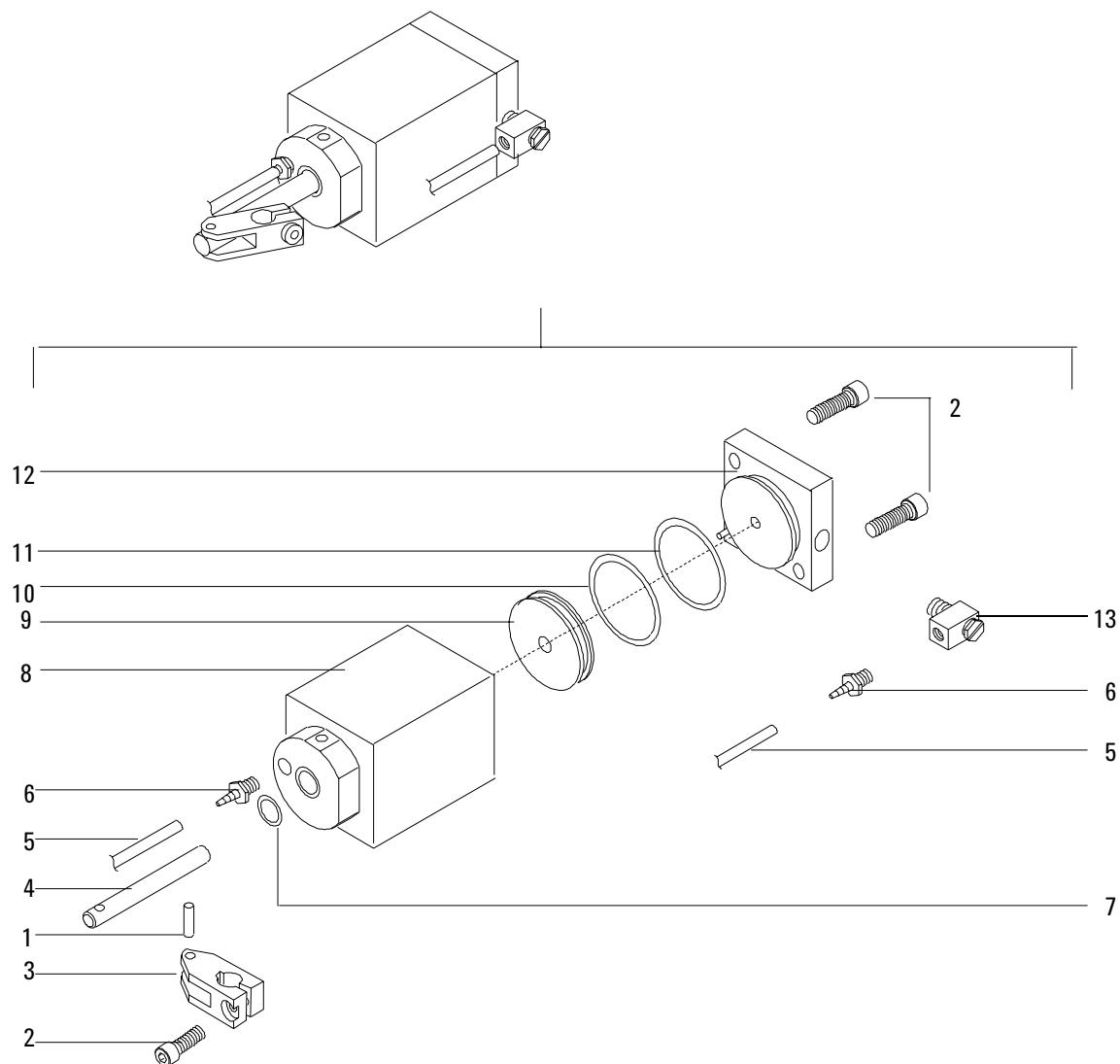


Figure 1350-4 Valve actuator assembly (2 of 2)

Valco W-series minivalve

Description	Part no.	Qty.
1. Valve		
Gas sampling valves		
– 6-port valve (225° C max)	5062-9508	
– 6-port valve (350° C max)	0101-0584	
– 6-port valve (Hastelloy, 225° C max)	5062-9509	
– 10-port valve (225° C max)	5062-9510	
– 10-port valve (350° C max)	0101-0585	
– 10-port valve (Hastelloy, 225° C max)	5062-9511	
Liquid sampling valves		
– 4-port valve (internal sample injector) (0.2 µl, 1000 psi, Option 850)	0101-0636	
– 4-port valve (internal sample injector) (0.5 µl, 1000 psi, Option 852)	0101-0637	
– 4-port valve (internal sample injector) (1.0 µl, 1000 psi, Option 854)	0101-0638	
– 4-port valve (internal sample injector) (0.5 µl, 5000 psi, Option 856)	0101-0639	
2. Ferrule	0100-1022	
3. Nut	0100-0791	
4. Rotors:		
General purpose valve rotors		
– 6-port valve (225° C max)	5181-7459	
– 10-port valve (225° C max)	5181-7460	
– 6-port valve (350° C max)	1535-4952	
– 10-port valve (350° C max)	1535-4954	
Standard pressure liquid sample valve rotors		
– 0.2 µl 4-port (1000 psig max)	5062-3563	
– 0.5 µl 4-port (1000 psig max)	5062-3562	
– 1.0 µl 4-port (1000 psig max)	5062-3559	

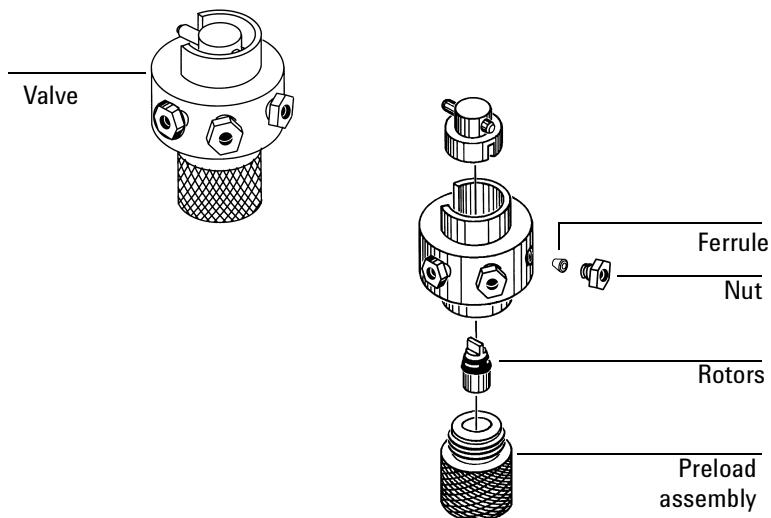


Figure 1350-5 Valco W-series minivalve

Gas sample valve loops

Loop volume mL	Part no.	
	Stainless steel	Nickel
0.25	0101-0303	0101-0956
0.5	0101-0282	0101-0957
1.0	0101-0299	0101-0954
2.0	0101-0300	0101-0955
5.0	0101-0301	-
10.0	0101-0302	-

Capillary tubing (0.031-inch x 0.063-inch od)

Stainless steel		Nickel	
Length, mm	Part no.	Length, mm	Part no.
318	18900-20260	525	18900-21110
559	18900-20300	1061	18900-21120
3658	5021-7199	2132	18900-21130
See the Agilent chemical analysis consumables and accessories catalog for more lengths		4274	18900-21140

Nickel catalyst assembly

Description	Part no.	Qty.
1. Nickel catalyst assembly	G1580-61020	1
2. Screw—socket M4 × 20	0515-0038	2
3. Nickel catalyst heater/sensor assembly	G1580-61160	1
4. Nickel catalyst H ₂ mix FTG weldment	G1580-80500	1
5. Nickel catalyst heater block	18900-20835	1
6. Nut—hex with lockwasher	0535-0043	2
7. Screws, Torx T20, M4 × 12 mm (captive)	1390-1023	3
8. Top cover plate	G1543-00085	1
9. Top insulation	G1543-00100	1
10. PPIP Insulation	G1543-00030	1
11. PPIP Bottom insulation	G1543-00070	1
12. Nut warmer insulation	19234-60715	3
13. Nut warmer Cup	19234-60700	1

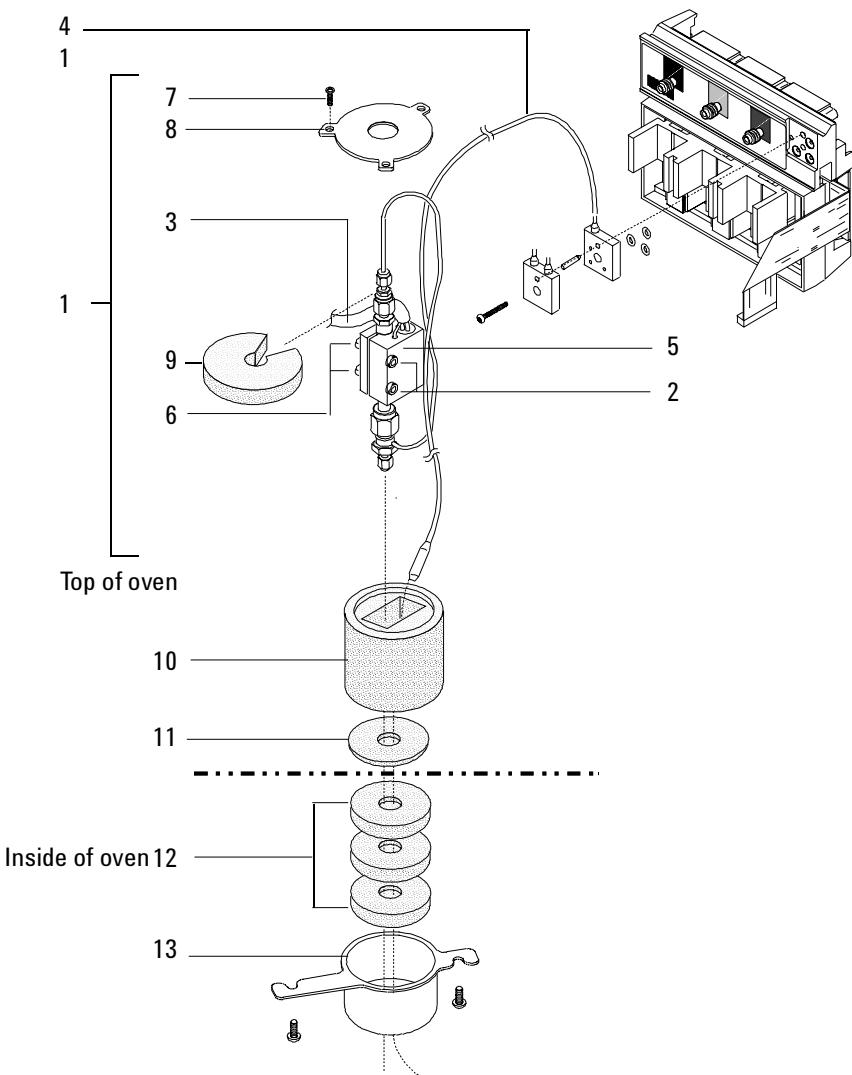


Figure 1350-6 Nickel catalyst assembly

1360 Electrical

This section contains illustrated parts breakdowns for the following 6890 GC electrical components.

- AC Power Components
- AC Power Circuit Board
- Main Circuit Board, 6890A and 6890 Plus
- Main Circuit Board, 6890N
- Modular Input/Output (MIO) Components
- Pneumatics Circuit Boards
- Analog Input Board (G1556A Accessory)
- LAN Board, 6890N
- Chassis Fans
- ALS Interface Board (G2612A Accessory)

AC Power components

Description	Part no.	Qty.
1. Transformer, universal*	G1530-60970	1
2. Screw, MS M5 × 0.8 Torx, T25*	0515-1538	4
3. AC printed circuit board assembly** (See Figure 1360-2)	G1530-60050	1
4. Power cable assemblies:		1
– USA and Canada 120V	G1530-60870	
– Japan 200V	G1530-60920	
– USA 208V	8121-0075	
– Continental Europe, 220V single phase power	G1530-60885	
– Hong Kong, 220V, single phase	G1530-67505	
– China 220V	G1530-67506	
– China 220V, 10 amp slow ramp	G1530-61180	
– Israel 220V	G1530-67507	
– Switzerland/Denmark, 230V, 16A	G1530-67503	
– Switzerland power cable, 230V, 10A	G1530-67500	
– Denmark, 230V, 10A	G1530-67502	
– Continental Europe, 230V	G1530-60880	
– Australia, 240V	G1530-60910	
– South Africa/India, 240V	G1530-67501	
– United Kingdom/Ireland, 240V	G1530-60890	
– USA and Canada, 240V	G1530-60900	
– Australia, 240V	G1530-61170	
5. AC control cable	G1530-60760	1
6. On/Off rod	G1530-40010	1
7. Hex nut/lock washer	0535-0043	1
8. Hexbolt, M6 × 1 × 100 mm	0515-2667	1
9. Transformer, universal	G1530-60975	1
10. Transformer bracket	G1530-00730	1
11. Cable, pigtail, 6890N ALS power***	G1530-61590**	1**

* For GC's with serial number <10225

** Order AC Printed Circuit Board replacement kit G1530-61350.
The kit contains one AC board one triac, and required hardware.
See Figure 1360-1.

*** Cable used only on early model 6890N GCs to patch sampler power from transformer into J7 on main board.

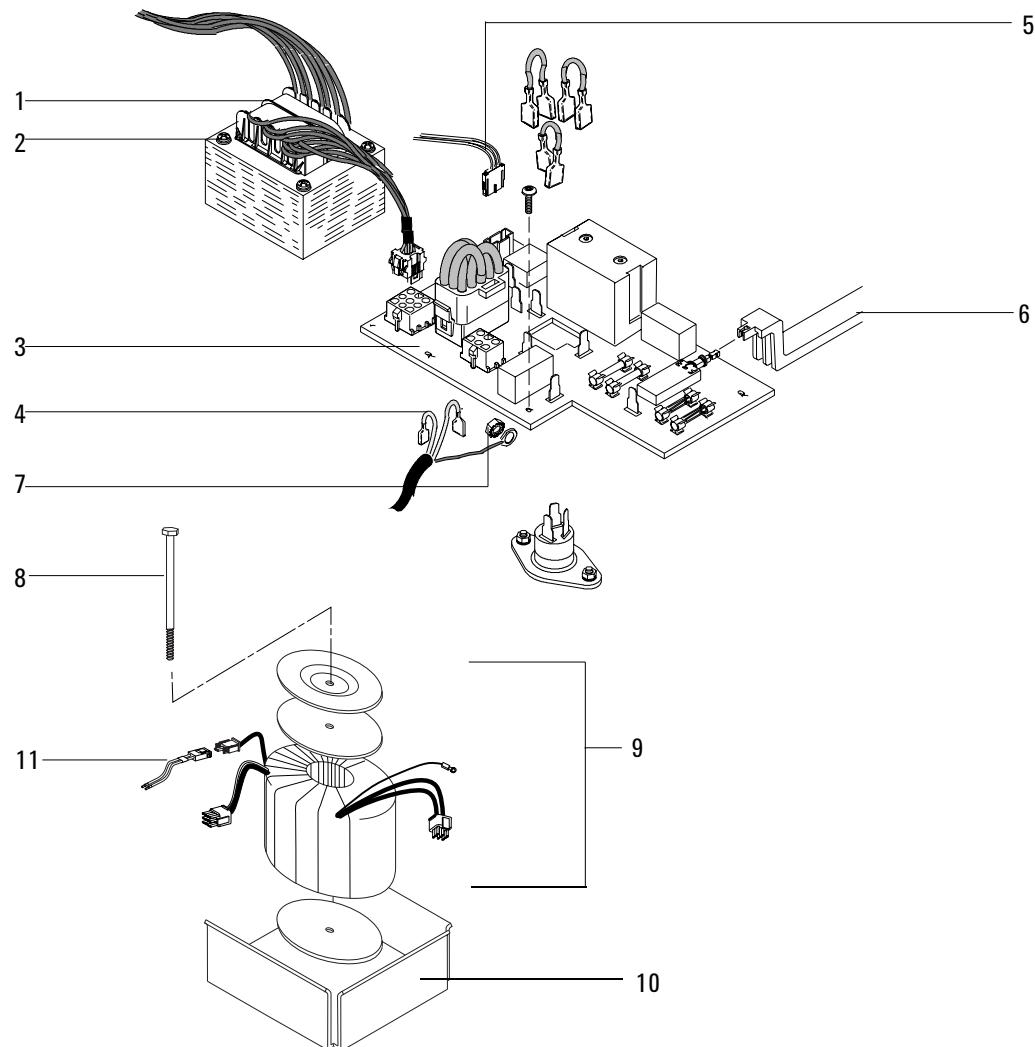


Figure 1360-1 AC Power components

AC Power circuit board

Description	Part no.	Qty.
1. AC Power board assembly*	G1530-60050	1
2. Triac cable assy (3 Jumpers)	G1530-60750	1
3. AC configuration plug		1
- USA and Canada 120V	G1530-60690	
- Japan 200V	G1530-60700	
- Continental Europe, 220V single phase power	G1530-60710	
- Hong Kong, 220V, single phase	G1530-60710	
- China 220V	G1530-60710	
- China 220V, 10 amp slow ramp	G1530-60710	
- Israel 220V	G1530-60710	
- Switzerland/Denmark, 230V, 16A	G1530-60720	
- Switzerland power cable, 230V, 10A	G1530-60720	
- Denmark, 230V, 10A	G1530-60720	
- Continental Europe, 230V	G1530-60720	
- Australia, 240V	G1530-60730	
- South Africa/India, 240V	G1530-60730	
- United Kingdom/Ireland, 240V	G1530-60730	
- USA and Canada, 240V	G1530-60730	
- Australia 240V, slow ramp	G1530-60730	
4. Mounting screw, M4 × 25 mm, Torx, T20	0515-2712	1
5. Fuses (not shown):		2
- Fuse 20A 250V (USA and Canada 120V)	2110-0098	
- Fuse 15 amp (Japan 200V)	2110-0054	
- Fuse 15 amp (Cont. Eur. 220V single phase)	2110-0054	
- Fuse 15 amp (Hong Kong 220V single phase)	2110-0054	
- Fuse 15 amp (China 220V)	2110-0054	
- Fuse 15 amp (China 220V slow ramp)	2110-0054	
- Fuse 15 amp (Israel 220V)	2110-0054	
- Fuse 15 amp (Switzerland 230V 10A single phase)	2110-0054	
- Fuse 15 amp (Denmark/Switzerland 230V 16A)	2110-0054	
- Fuse 15 amp (Denmark 10 amp)	2110-0054	
- Fuse 15 amp (Continental Europe 230V)	2110-0054	
- Fuse 15 amp (Australia 240V)	2110-0054	
- Fuse 15 amp (South Africa/India 240V)	2110-0054	
- Fuse 15 amp (United Kingdom/Ireland 240V)	2110-0054	
- Fuse 15 amp (USA and Canada 240V)	2110-0054	
- Fuse 15 amp (Australia 240V, slow ramp)	2110-0054	
6. Lock washer	2190-0321	3
7. Glass fuse, type F, 8A/250V	2110-0036	2

* Order AC Printed Circuit Board replacement kit G1530-61350. The kit contains one AC board, one triac, and required hardware. See Figure 1360-2.

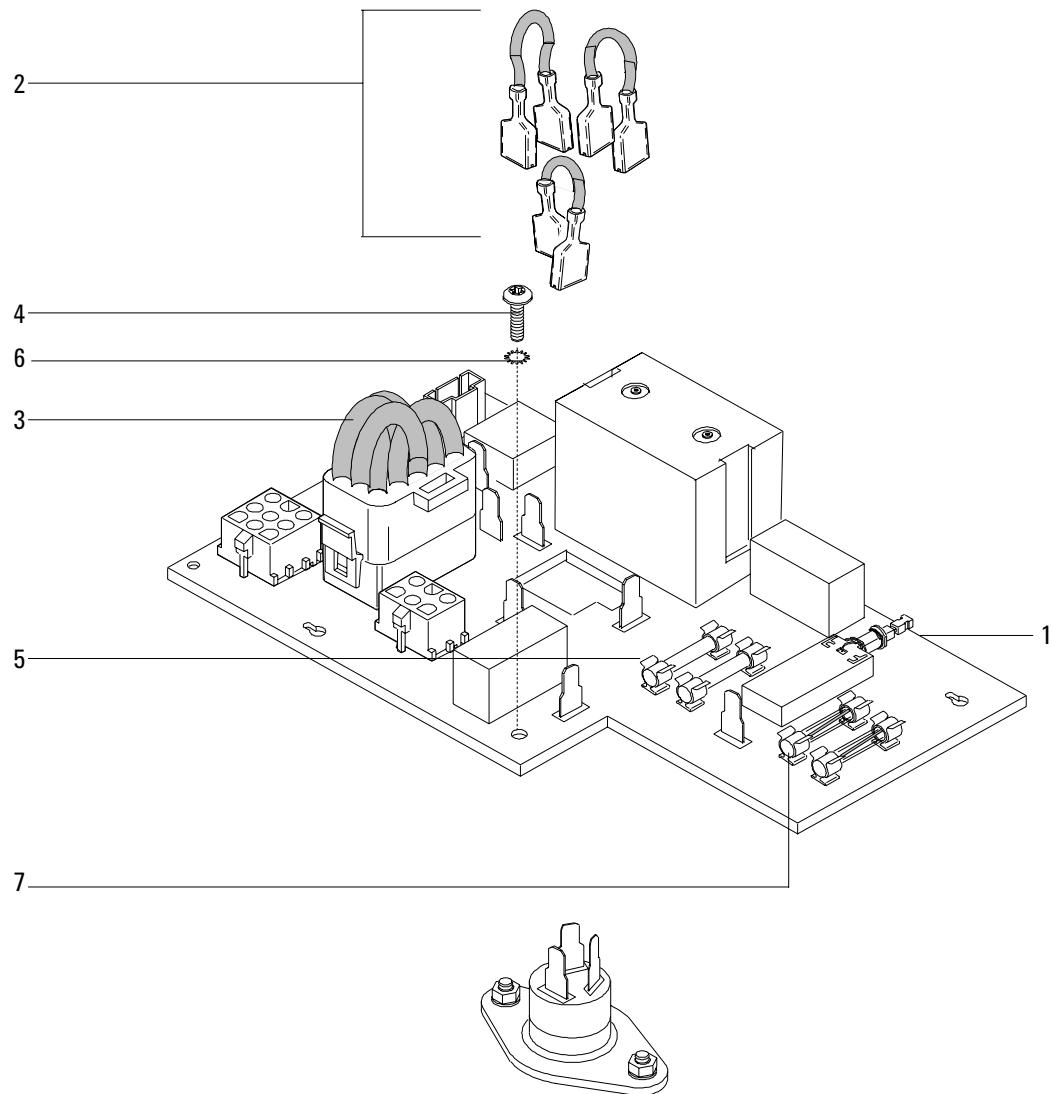


Figure 1360-2 AC Power circuit board

Main circuit board, 6890A and 6890 Plus

Description	Part no.	Qty.
1. Main board assembly	G1530-60011	1
2. Hex screw, self-tapping	0624-0665	3
3. Grounding screw, M4 × 25 mm, Torx, T20	0515-2712	2
4. Glass fuse, type F, 8A/250V	2110-0036	4
5. Battery, 3V	1420-0523	1
6. ROM kit, rev. A.03.08	G1530-61706	1
7. ROM puller (not shown)	8710-2303	—

Only ROM sockets 0 and 1 are used.

- ROM G1530-80906 Socket 0
- ROM G1530-80926 Socket 1

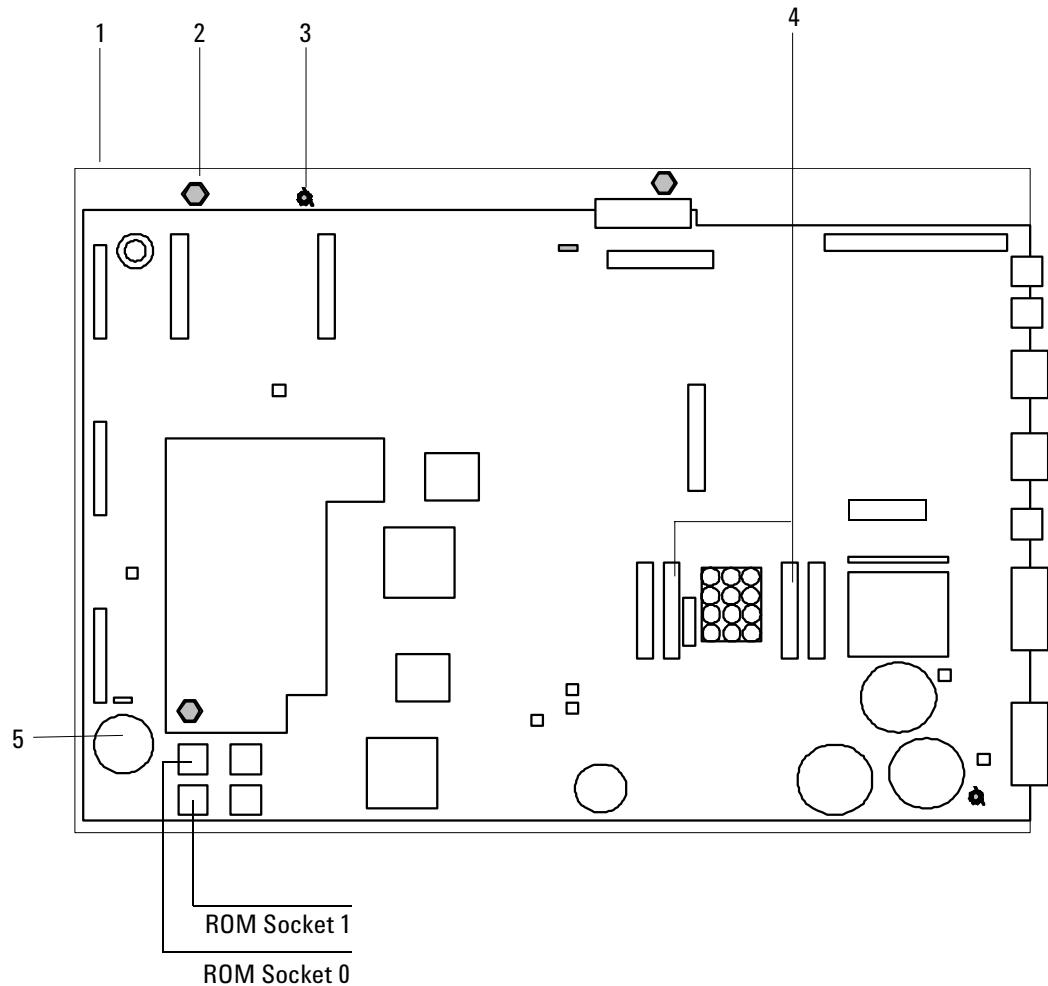


Figure 1360-3 Main circuit board, 6890A and 6890 Plus

Main circuit board, 6890N

Description	Part no.	Qty.
1. Main board assembly	G1530-62000	1
2. Hex screw, self-tapping	0624-0665	3
3. Grounding screw, M4 × 25 mm, Torx, T-20	0515-2712	2
4. Glass fuse, type F, 8A/250V	2110-0036	2
5. Ceramic fuse, E 5A 250V F	2110-0709	1
6. Battery, 3V	1420-0523	1
NS Connector plate, 6890N	G1530-01320	1

Download firmware upgrades from www.agilent.com.

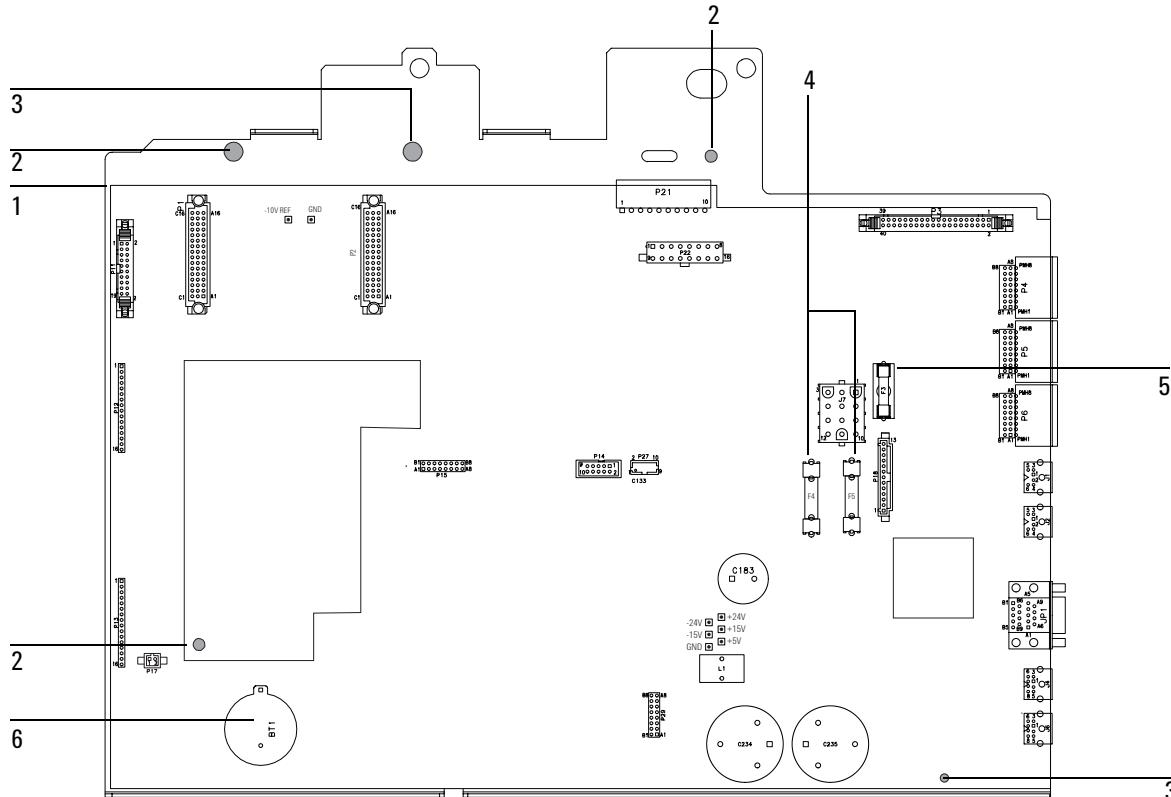


Figure 1360-4 Main circuit board, 6890N

Modular input/output (MIO) components (6890A and 6890 Plus)

INET components

Description	Part no.	Qty.
1. INET MIO card assy	G1553-60015	1
2. MIO support bracket	G1530-00320	1
3. MIO connector assy	G1553-60100	1
4. Support bracket standoff, M3 male/female	G1530-20570	1
5. Screw, Torx T10, M3 × 6 mm	0515-0680	1
6. Screw, Torx T20, M4 × 12 mm	0515-2496	3
7. 5 Meter HP-IL cable (not shown)	82167-60003	1
8. INET cover plate	G1530-00610	1

LAN components

Description	Part no.	Qty.
1A. LAN card assy (J2552B)	J2552-69013	1
2. MIO support bracket	G1550-00320	1
3. MIO connector assy	G1553-60100	1
4. Support bracket standoff, M3 male/female	G1530-20570	1
5. Screw, Torx T10, M3 × 6 mm	0515-0680	1
6. Screw, Torx T20, M4 × 12 mm	0515-2496	3
7A. 8 Meter thin LAN cable (not shown)	92227-60004	1
8. Loopback connector (not shown)	92227Q	1
9. Replacement LAN card (not shown)	J2552-69013	–
10. LAN cable, black crossover PC to 1 GC (not for use on hub) (Not shown)	5183-4649	

The JetDirect cards (LAN card assy), part no. J2552-69013, were modified to add additional capabilities in early 1998. New cards should have the new firmware; older cards should not be used. For a first-time installation into a 6890 GC, purchase G2335A to receive all necessary mounting hardware and GC firmware. The G1530A option #500 is the factory-installed version.

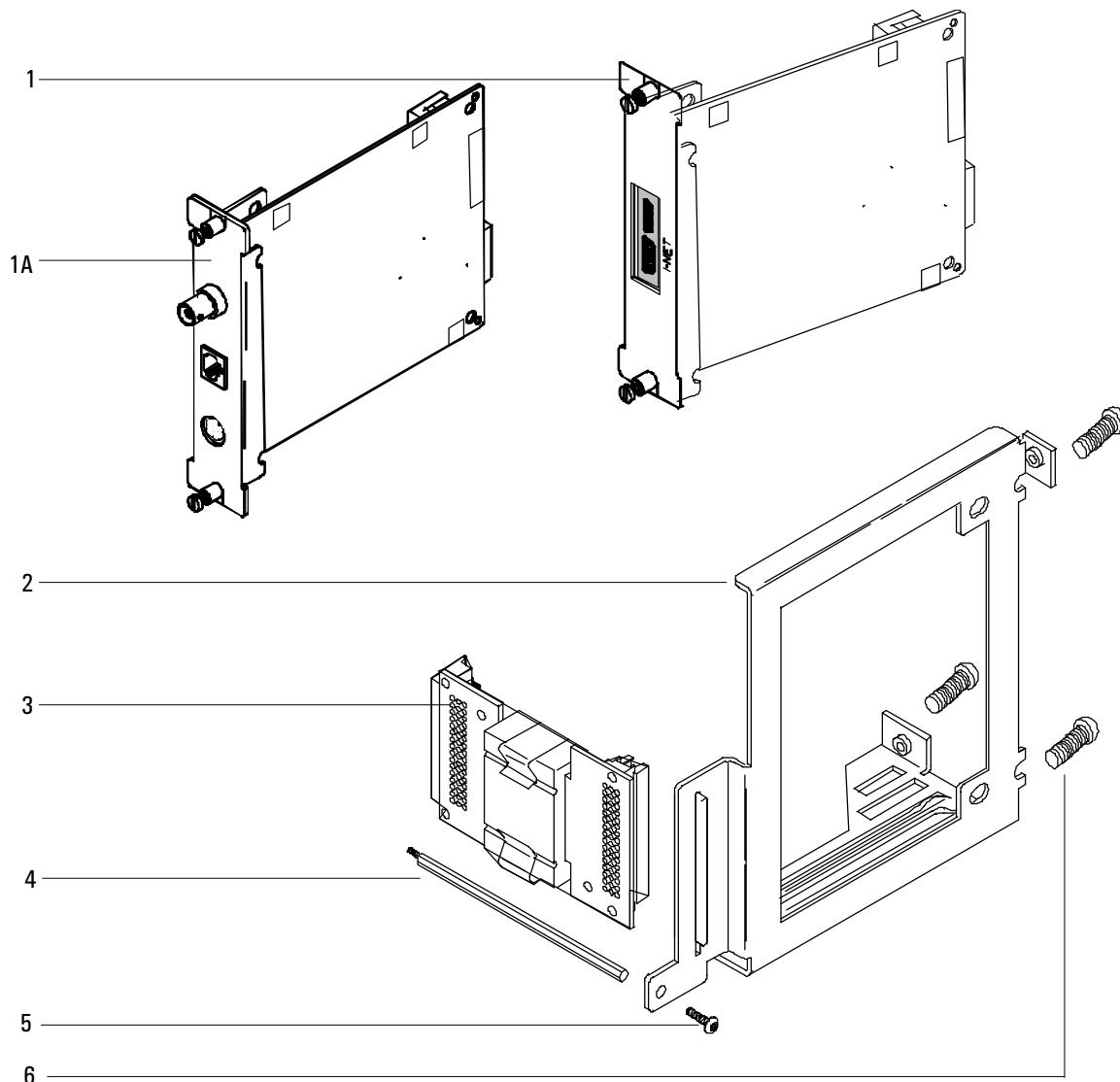


Figure 1360-5 Modular Input/Output (MIO) components

Pneumatics circuit boards

Description	Part no.	Qty.
1. EPC pneumatics board assembly for 6890A and 6890 Plus for 6890N	G1575-60010 G1530-60015	1
2. EPC pneumatics board metal carrier (included with replacement EPC board)	-----	1
3. Screw, Torx T20	0515-2496	3

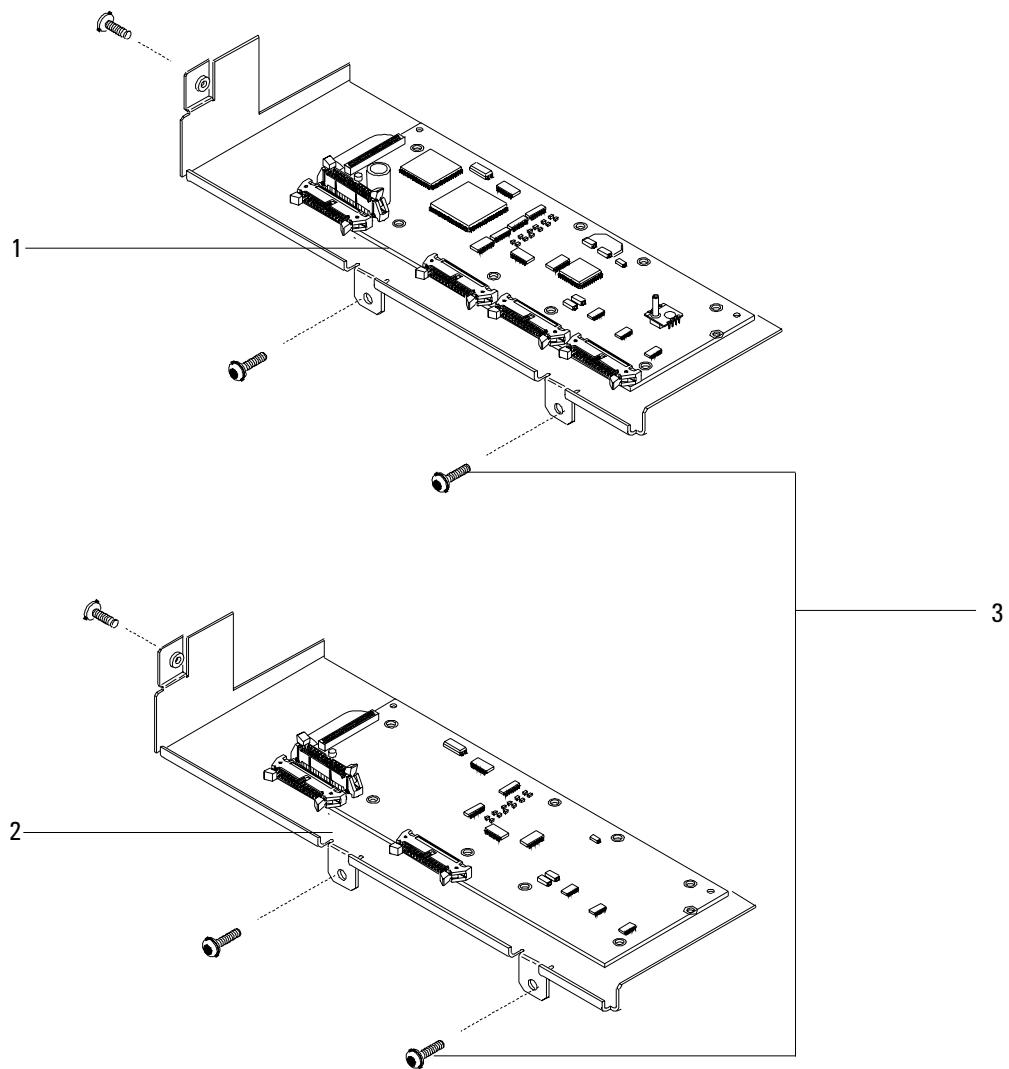
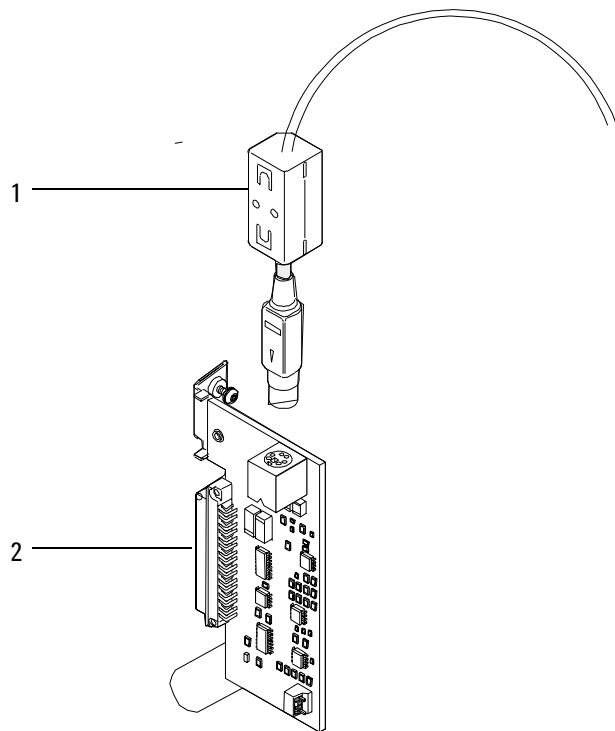


Figure 1360-6 Pneumatics circuit boards

Analog input board (G1556A accessory)

Description	Part no.	Qty.
1. Analog input PCB	G1556-60010	1
2. GP analog output cable assy	G1553-60560	1

**Figure 1360-7 Analog input board**

LAN board, 6890N

Description	Part no.	Qty.
1. LAN replacement kit, 6890N	G1530-62010	1
2. LAN patch cable	8121-0600	1
3. Connector, 10BASE-T LAN	1252-6152	1
4. Connector plate, 6890N	G1530-01320	1

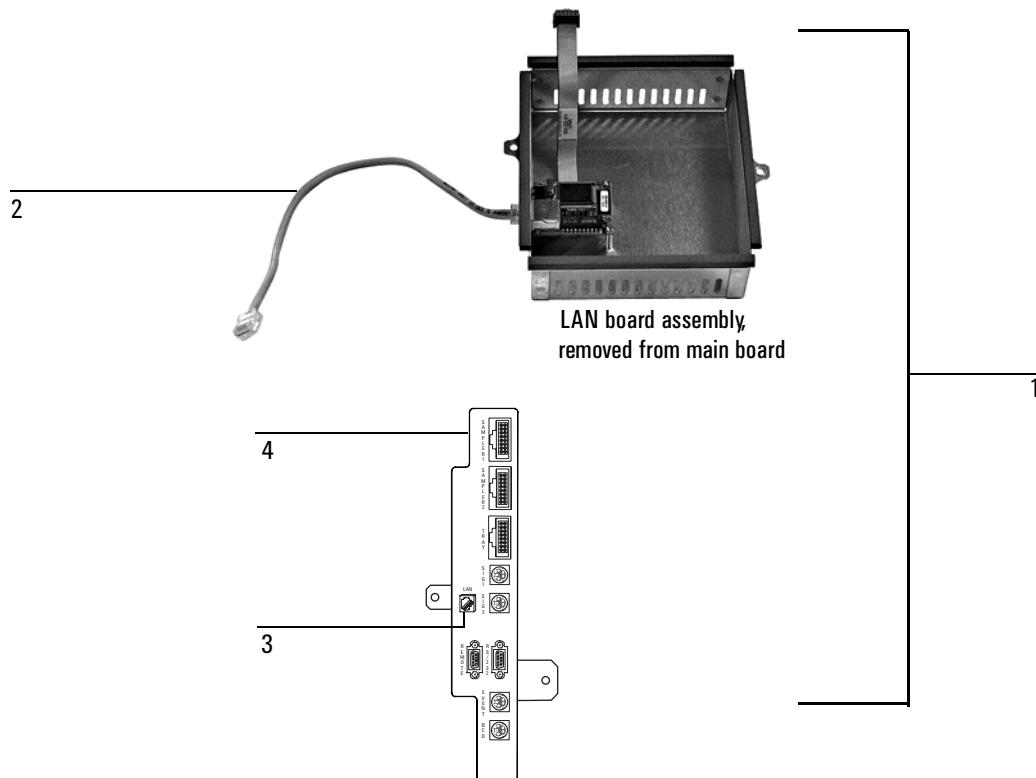


Figure 1360-8 LAN board, 6890N

Chassis fans

Chassis fans

Description	Part no.	Qty.
1. Replacement pneumatics area fan	G1530-60550	1
2. Inlet fan assembly	G1530-60510	1

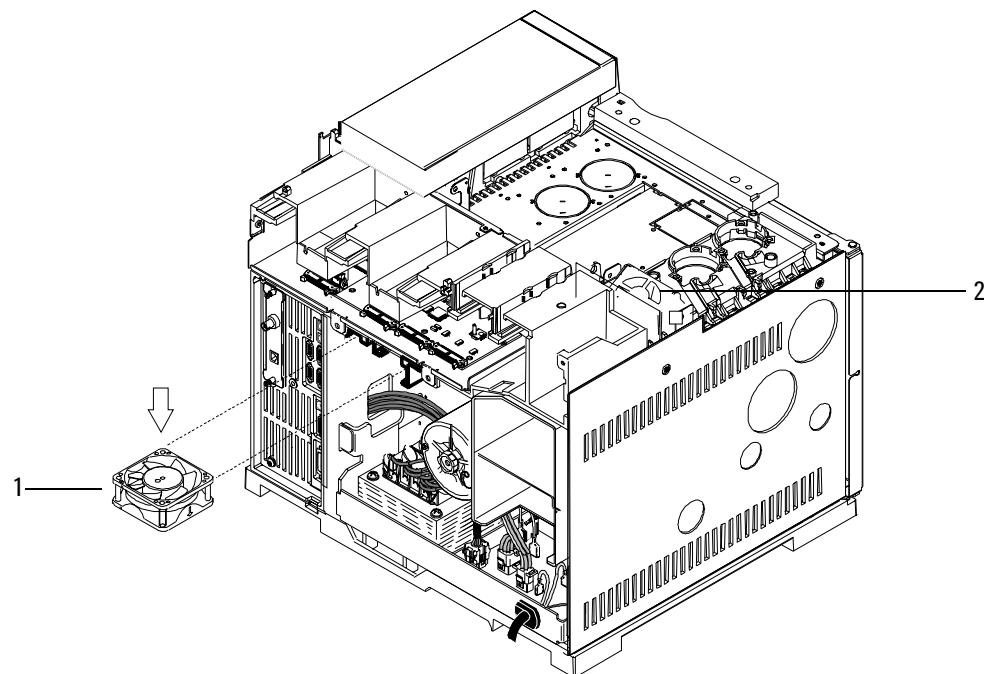


Figure 1360-9 Chassis fans

ALS interface board (G2612A accessory, 6890 Plus only)

Description	Part no.	Qty.
1. ALS interface board	G2612-60010	1
2. 6890 ALS controller bd cable	G2612-60510	1
3. Screw—Tpg 6-19	0624-0403	2
NS Installation instructions, G2612A	G2612-90195	—
NS Label, GC door	G2612-90700	1

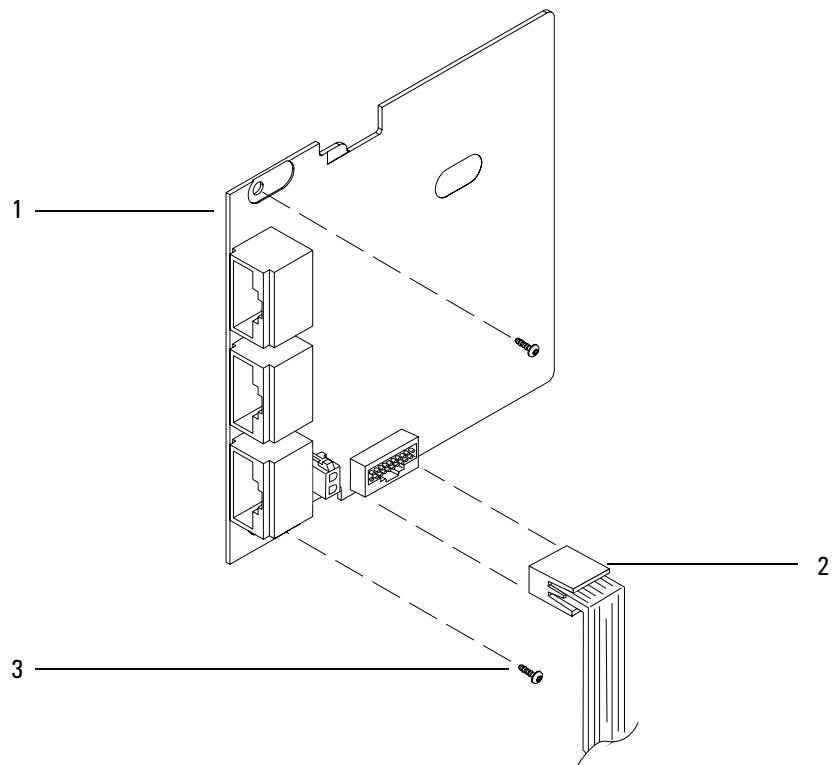


Figure 1360-10 ALS Interface board

Numerics

- 6890 GC
 Communication with 3395A/3396B
 Integrator, 1010-6, 1010-11, 1015-5, 1015-9
 Communication with 3395B/3396B
 Integrator, 1010-7, 1015-6
 Communication with 3396B/C INET
 Integrator, 1010-5, 1010-10
 Communication with Automatic Liquid Sampler, 1010-2, 1010-3, 1010-4, 1010-5, 1010-6, 1010-7, 1010-8, 1015-2, 1015-3, 1015-4, 1015-5, 1015-6, 1015-7, 1015-14
 Communication with A/D converter, 1010-8, 1015-7
 Communication with ChemStation, 1010-2, 1010-3, 1010-9, 1015-2, 1015-3, 1015-8, 1015-14
 Communication with Headspace sampler 7694, 1010-9, 1010-10, 1010-11, 1010-12, 1015-8, 1015-9, 1015-10
 Communication with Mass Selective Detector, 1010-3, 1015-3, 1015-14
 Communication with Modem, 1010-5
 Communication with Non-Agilent data system, 1010-4, 1015-4
 Communication with other instruments, 1010-13, 1015-11
G1900A Purge and Tap, 1010-14, 1015-13
GPIB cables, 8120-3446, 1010-2, 1010-3, 1010-9
Grounding, 530-1
- Alignment, 1130-10
Driver installation, 1130-5
Drivers, 1130-4
Installation, 1130-1
IPB, 1350-6
Address Error, 860-1
ALS interface board, 430-23
Analog
 Cable, 1020-1
 Connector, 1210-2
Analog cables
 03396-60530,, 1010-10
 G1530-60560, 1010-12, 1015-10
 G1530-60570, 1010-6, 1010-7, 1010-8, 1010-11, 1015-5, 1015-6, 1015-7, 1015-9
Analog out data loss, 830-3
Analog out #1, 850-4
Analog out #2, 850-4
Analog-to-Digital Converter, 35900, 510-5
 Communication with 6890 GC, 1010-8, 1015-7
 Communication with ALS, 1010-8, 1015-7
APG remote cables
 03396-61010, 1010-7, 1010-11, 1015-6, 1015-9
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