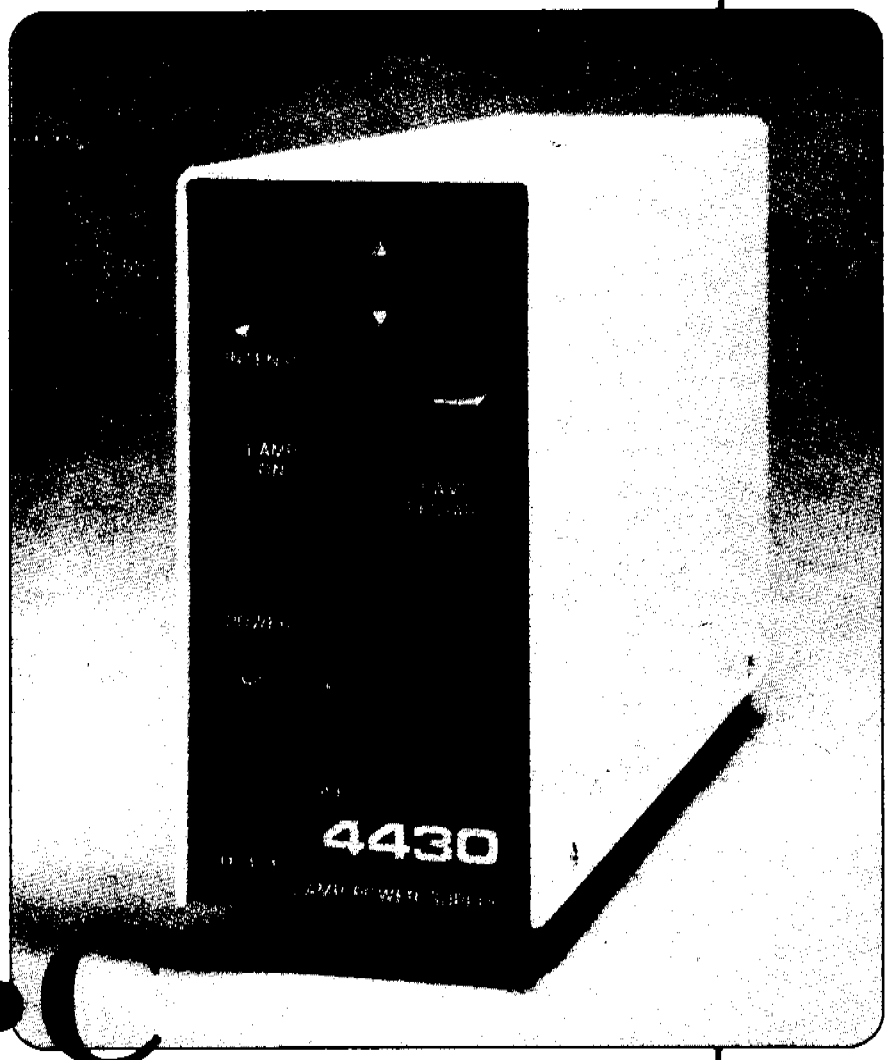
4430

PHOTOIONIZATION DETECTOR



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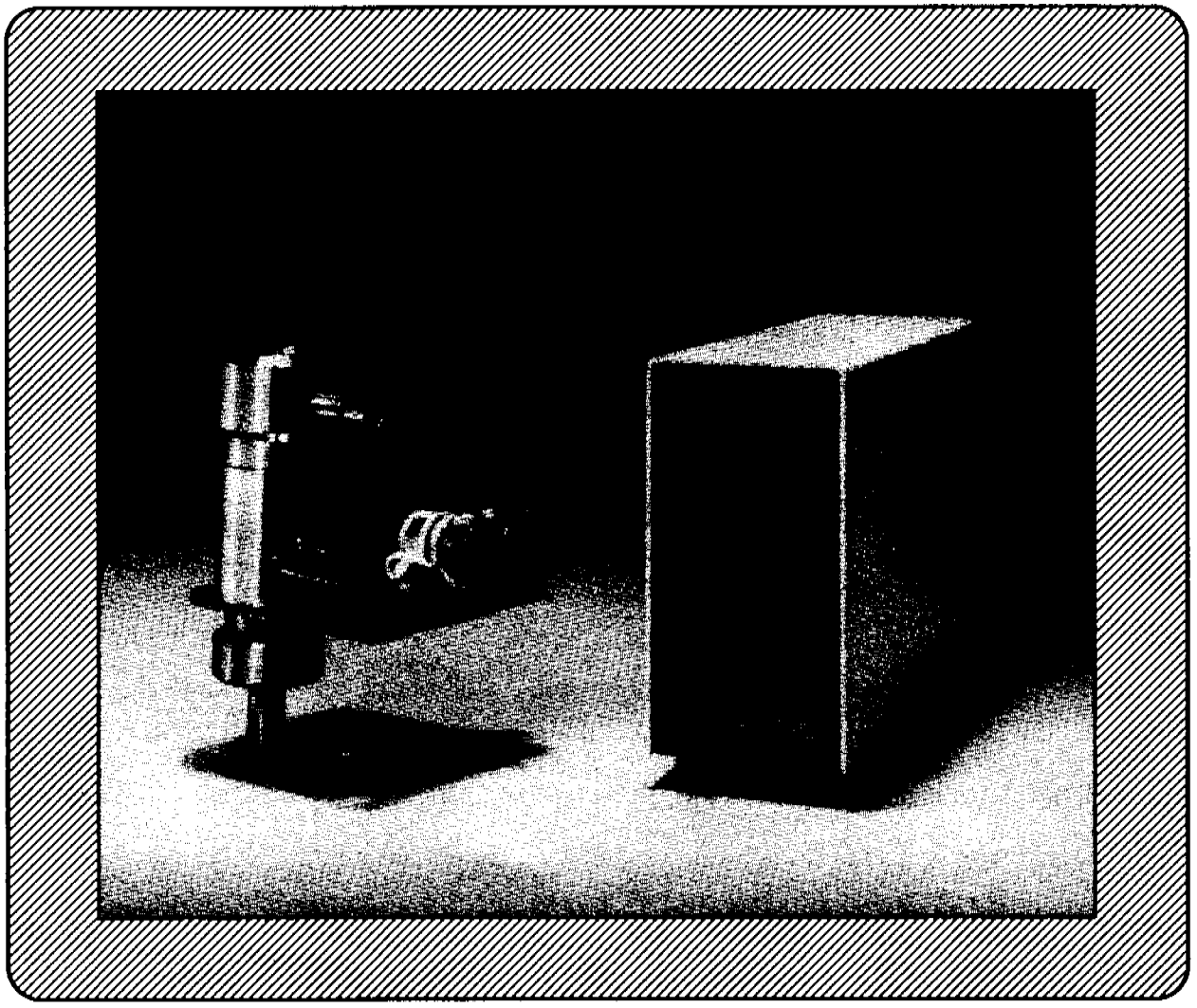
4430 Photoionization Detector

Operating and Service Procedures



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Limited Warranty

O.I. Corporation warrants each Model 4430 Photoionization Detector and its optional equipment against defects in materials and workmanship under normal use and service for a period of ninety (90) days. Equipment installed by O.I. Corporation is warranted from the installation date, all other from the ship date. If purchaser schedules or delays installation more than 90 days after delivery, then warranty period starts on the 91st day from date of shipment. This warranty extends only to the original purchaser. O.I. Corporation will, at its option, repair or replace equipment that proves to be defective during the warranty period, provided the equipment is returned to O.I. Corporation at the expense of the purchaser. Parts, labor and return shipment to the customer shall be at the expense of O.I. Corporation. Parts used and labor performed during on-site warranty service requested by the purchaser shall be at the expense of O.I. Corporation. Travel costs shall be at the expense of the purchaser.

As a condition of warranty, the purchaser shall regularly maintain the equipment as specified in the Model 4430 Photoionization Detector Operating and Service Manual provided with the equipment. Evidence of such maintenance in the form of a maintenance log book is recommended. Expendable components which are to be replaced regularly according to the manual are not covered under this warranty.

THE FOREGOING WARRANTY IS IN LIEU OF ALL OTHER WARRANTIES, EXPRESS OR IMPLIED, INCLUDING BUT NOT LIMITED TO ANY WARRANTY OR MERCHANTABILITY, FITNESS OR ADEQUACY FOR ANY PARTICULAR PURPOSE OR USE. O.I. CORPORATION SHALL NOT BE LIABLE FOR ANY SPECIAL, INCIDENTAL, OR CONSEQUENTIAL DAMAGES, WHETHER IN CONTRACT, TORT, OR OTHERWISE.

Any service requests or questions should be directed to the Customer Service Department 409-690-1711.

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Chapter 1
Model 4430
Photoionization Detector

The Model 4430 Photoionization Detector is designed to be installed in a standard detector port of a Hewlett Packard 5890A or Varian 3300/3400 gas chromatograph. It is integrated into the GC by using the GC's electrometer, signal output circuit, hydrogen and makeup gas flow restrictors, detector base heater, and external event relay for the vent valve. The detector consists of an ionizing chamber, a UV lamp, and a column interface snout as an assembly mounted on the GC, and a stand-alone high voltage power supply for the lamp.

The lamp produces radiation in the UV spectrum (typically 10.0 eV) which ionizes certain molecules eluting from the GC column into the chamber. The detector can be made selective by use of a lamp which outputs light at an energy level which is sufficient only to ionize components with ionization potentials below that energy level. Ions produced by the UV light are accelerated by a polarizing voltage onto a collector and the resulting current flow is measured by an electrometer. The detector is typically used to selectively detect aromatic and olefinic hydrocarbons in the presence of alkanes and other saturated hydrocarbons.

Features

- The 4430 is custom engineered to fit the Hewlett Packard 5890A and Varian 3300/3400 gas chromatographs.
- It is fully integrated into the gas chromatograph by using existing GC components and features.
- It is designed to be operated in combination with the Model 4420 Electrolytic Conductivity detector (ELCD) as a dual detector set, while occupying only one detector port. In addition:
    - Either detector can be mounted and operated separately from the other,
    - Each can be operated independently of the other when both are mounted together,
    - Each can operate with or without the other when they are mounted in separate detector ports.
- A unique UV-lamp window sweep gas feature minimizes window surface contamination from column conditioning and bleed from ramping to high column temperatures. This sweep gas also prevents polymerization reactions involving certain GC eluents from occuring on the lamp window.
- Custom GC interfaces are provided for each GC model, making installation quick and simple and enhancing compatibility of components.
- Use of GC-supplied electronics enhances compatibility of components as a system.
- Mounting the PID and the ELCD reactor together enhances capillary perform-

ance by minimizing dead volume and interfacing between detectors. This unique combination also allows use of the ELCD reaction gas as a PID sweep gas and allows venting of the injection solvent and column bakeout from the PID as well as from the ELCD.

- The 4430 is designed to be compatible with megabore capillary column efficiencies and capacities without makeup gas.
- A 10.0 eV lamp is standard, and others are available for universal or selective response.
- An exclusive Lampsaver circuit is featured to turn the lamp off if desired when not in use to improve lamp life. The lamp can be automatically restarted with a manual or remote signal.
- Lamp current can be set from the front panel as one of 10 settings. Lamp current is proportional to lamp output intensity.

Specifications

Principle of Operation:

The sample stream flows through the detector's ionization chamber where it is continuously irradiated with high energy ultraviolet light. When compounds are present which have lower ionization potentials than that of the irradiation energy they are ionized. The ions formed are collected in an electric field, producing an ion current proportional to compound mass. The ion current is amplified and output by the chromatograph's electrometer.

Linear Range:

Greater than 10^6

Sensitivity:

2 picograms benzene

Maximum Operating Temperature:

300°C

Detector Volume:

Less than 90 microliters

Materials of Construction:

Inlet - Glass-lined stainless steel
Ion Chamber - Gold-plated stainless steel

Vent:

Remotely controlled

Lamp Current:

.40 mA - 1.60 mA in nine .15 mA steps

Lampsaver Time:

0.5 - 2 hrs., reset by external contact

Power:

105 - 125 VAC, 25 VA

Dimensions (Power Supply):

5 3/4 inches (14.5 cm) high x 2 3/4 inches (6.9 cm) wide x 9.0 inches (23 cm) deep

Weight: 5.5 lbs (3 kg)

Chapter 2 Description of Components

In **Chapter 1** some basic concepts of 4430 operation, as well as its features and specifications are outlined. **Chapter 2** deals with what we have named the various components of the 4430 and what the function of each is. Each significant component is pointed out and named on a photograph of one of the various views of the detector. The function of each named component is also described, along with pertinent notes and cautions. The names are printed in **boldface type** in this chapter and are useful to know when you are trying to identify a part for ordering replacements.

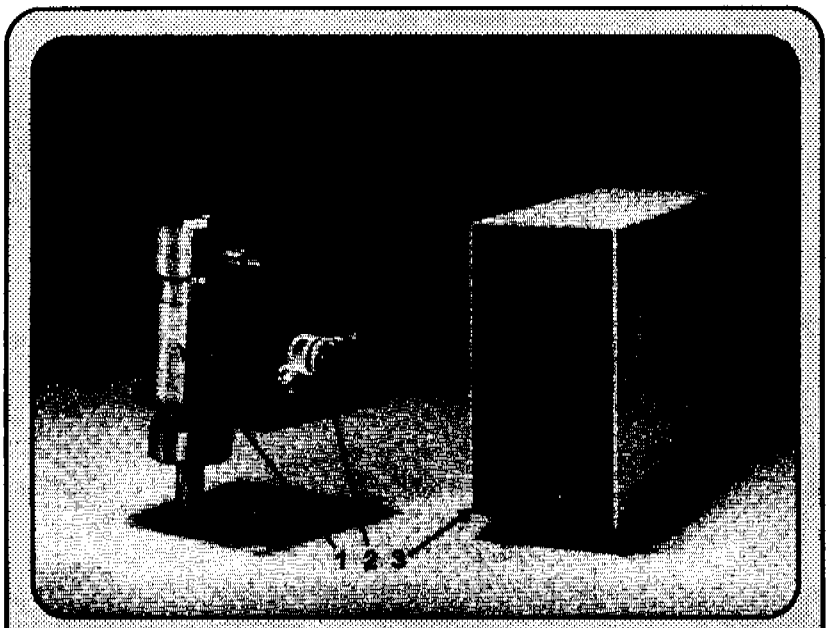
Main Detector Components

Sensor

This PID **sensor** assembly houses the **lamp**, the **ionization chamber**, the **ion collector**, and the ports for the various gas inputs. It is designed specifically to mount on an available GC detector port quickly and easily without modification of the GC.

Vent Valve

This valve is supplied with the detector to allow venting of unwanted column effluents before they move into the ionization chamber the **vent valve** is useful when conditioning new columns, for venting solvent peaks, and for selecting against components eluting within specific retention time windows.



1. Sensor
2. Vent Valve
3. Lamp Power Supply

Lamp Power Supply

This module provides current by means of high voltage DC power to the UV lamp for its proper operation. Lamp current is adjustable in steps. The **lamp power supply** also houses the **Lampsaver** circuit, which can be set to automatically turn the lamp on and off under its own or remote control.

Power Supply - Front Panel

Power Switch

Lamp power is turned on by pressing in the top of this key. Power status is indicated by a neon lamp on the **power switch.**

LAMP ON Indicator

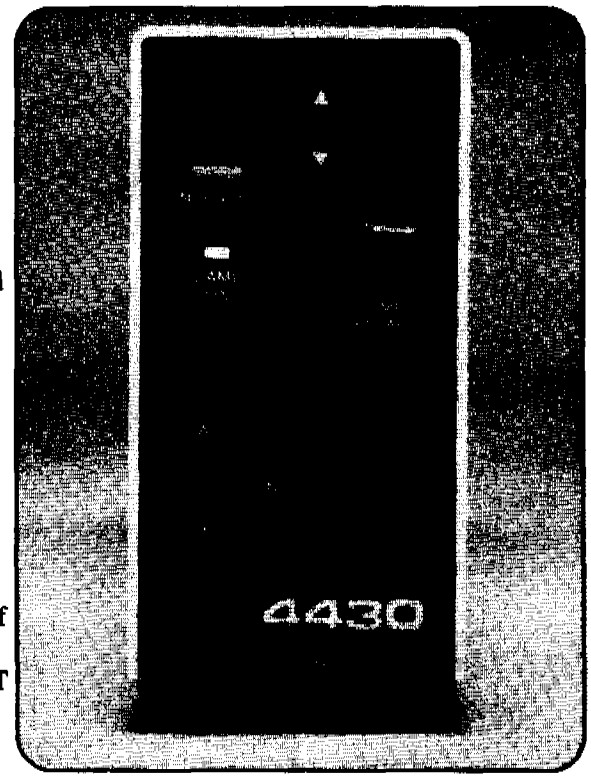
This LED comes on when the voltage and current to the UV lamp are within its operating window, thus indicating that the lamp is on. This **LAMP ON indicator** will go off in the case of an open or shorted circuit, or a failed lamp.

INTENSITY Display

This indicator displays the setting of lamp current in steps from 0 to 9. The 0 setting applies no power and each successive step increases the lamp current by 0.15 mA, so that the range of current which can be applied to the lamp is 0 - 1.35 mA. The lamp intensity is proportional to the lamp current, so higher settings as shown in the **INTENSITY display** yield higher detector response and a higher baseline.

Lamp Intensity Switches

These two push-switches are used to increment the lamp intensity up or down in steps from 0 to 9, as indicated by the **INTENSITY display.** The intensity setting will "roll through" 9 and 0 with continued stepping of either of the **lamp intensity switches.**



LAMP RESTART Switch

This switch is part of the **Lampsaver** feature described under **Power Supply - Rear Panel.** It is used to restart the **lamp** once it has been turned off by the Lampsaver timer circuit. Pressing this **LAMP RESTART** switch restarts the lamp and the Lampsaver timer.

Power Supply - Rear Panel

CAUTION:
Voltage requirement is in the range of 105-120VAC, 50-60 Hz only.

WARNING:
Up to 2000 VDC is present at this connector and its cable.

CAUTION:
Always match the polarity of all inputs of devices controlled by the same event signal. Typically, a single event signal is used to simultaneously restart this timer, the GC, and the data system.

AC Power Fuse

This fuse provides overall protection to the **lamp power supply** against damage due to electrical malfunction. Use a 1/2 amp fast-blow as a replacement fuse.

AC Power Receptacle

This receptacle receives 115 VAC power, by means of a modular power cord, for operation of the **lamp power supply**.

LAMP High Voltage Output Connector

Through this BNC connector passes the power for the **lamp**. Its cable connects to the top BNC connector on the PID **sensor**.

Lampsaver ON/BYPASS Switch

When this switch is set to ON, the **Lampsaver** circuit is active. In this case, the **lamp** will stay on only for the time controlled by its internal timer, then it will automatically turn off to extend lamp life. The time the lamp stays on is adjustable using the **ON TIME adjustment**. The lamp can be restarted by an external signal to the **START connector** or by pressing the **LAMP RESTART switch** on the front panel. When either of these "restarts" is used, the timer restarts as well as the lamp, so the lamp will remain on as long as the power supply gets another restart signal before the Lampsaver times out.

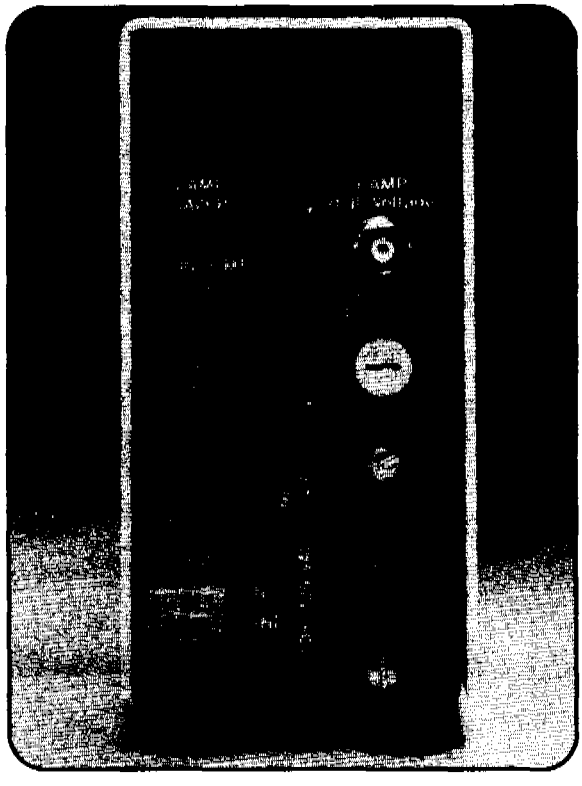
When the **Lampsaver ON/BYPASS switch** is set to **BYPASS**, the Lampsaver circuit does not function, and the lamp will stay on indefinitely.

ON TIME Adjustment

This potentiometric adjustment is used to set the amount of time the **Lampsaver** timer will run before it turns off the lamp. It is continuously adjustable between 0.5 and 2 hours.

START Connector

This connector accepts a switch or relay closure, as well as an active-low TTL, 12 VDC, or 24 VDC event signal, to restart the **lamp** and **Lampsaver** timer by remote control. The **START connector** is a screw-clamp type which accepts bare, tinned wires.



Sensor - For HP5890

Tower

This is the main body of the PID **sensor**. It houses the **lamp** and **ionization chamber**, and **ion collector**. The top half of the **tower** is removable for quick lamp changing.

Lamp

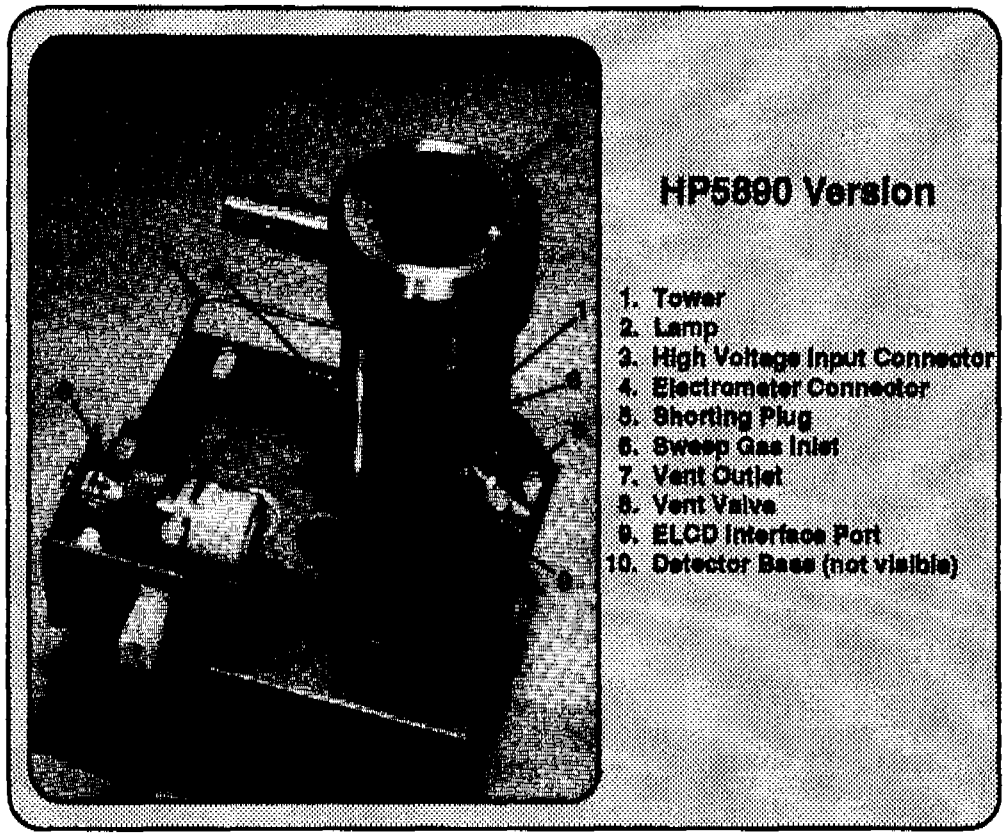
This **lamp** emits high energy ultraviolet light for the ionization of specific molecules. The standard lamp puts out an energy of 10.0 eV, which makes the detector selective for aromatics and other unsaturated hydrocarbons. Other lamp energies are available.

High Voltage Input Connector

Through this BNC connector passes power for the **lamp**. Its cable connects to the BNC connector on the **lamp power supply**.

Electrometer Connector

Through this connector passes the ion current to the electrometer installed in the GC by means of a coaxial cable. It is electrically connected to the **ion collector** inside the **sensor**.



Shorting Plug

This plug holds specific components of the **sensor** at the ground potential necessary for proper operation using the HP5890 electrometer.

Sweep Gas Inlet

This inlet port uses a 1/16-in. Valco-type compression seal for the sweep gas to enter the **ionization chamber**. The sweep gas acts to "hide" the lamp window from the GC effluent so that its surface does not accumulate contaminants or participate in polymerization reactions of certain compounds eluting from the column.

Vent Outlet

This line connects the base of the ionization chamber to a **vent valve** so that unwanted solvent, components, or column bleed can be vented instead of being detected.

Vent Valve

This valve opens on command from the GC to vent unwanted effluents as described above. When the **vent valve** is open, flow can be measured through its barbed outlet fitting.

ELCD Interface Port

This port can receive the reactor of an **OIC Model 4420 Electrolytic Conductivity Detector** so that the resulting dual detector set can be used with a single column. The PID is non-destructive so that it can operate as the "upstream" detector in the series. In this case, the PID sweep gas is used as the ELCD reaction gas and the vent works for both detectors.

Detector Base (Not Visible)

The **detector base** beneath the mounting plate houses the **heater cartridge** and **temperature sensor** for heating the detector. At its bottom is a **snout** which protrudes into the GC oven to accept the column. The snout uses a 1/4-in. Swagelok-type compression seal for connecting the column or a column adaptor.

Sensor - For Varian 3300/3400

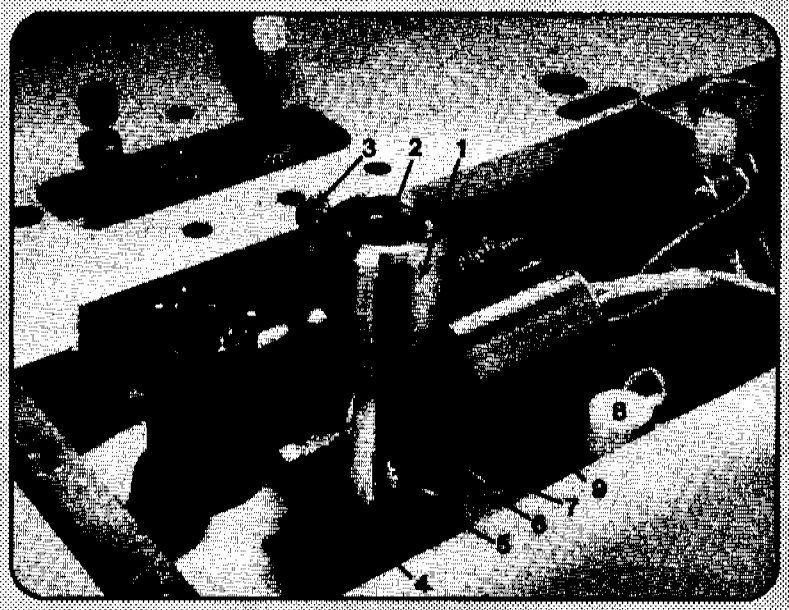
The components of the **Varian-style sensor** are identical in function to those of the HP-style with the exception that the **shorting plug** is turned into a **polarizing voltage input connector.**

Polarizing Voltage Input Connector

Through this connector passes the polarizing voltage provided by the GC for proper operation of the **sensor** with a Varian electrometer.

Other Components

Other components are identified in this section's photograph. The function of each is outlined in the previous section. The **Varian-style sensor** uses the heated detector plate provided by the GC to heat the detector base, so it incorporates no internal heater or temperature sensor.



Varian 3300/3400 Version

1. Tower
2. Lamp
3. High Voltage Input Connector
4. Electrometer Connector
5. Polarizing Voltage Input Connector
6. Sweep Gas Inlet
7. Vent Outlet
8. Vent Valve
9. ELCD Interface Port
10. Detector Base (not visible)

Chapter 3
Installation

In **Chapter 2** the names and functions of the various components of the 4430 were outlined. Names of components were printed in boldface type to highlight them. These names are used here to refer to components involved in the installation of the detector onto a gas chromatograph.

The 4430 is custom engineered to fit neatly on a **Hewlett Packard Model 5890A** or a **Varian Model 3300/3400** gas chromatograph. In each case, the detector makes use of the electrometer supplied for use with these GCs. Installation of the 4430 on other models of gas chromatographs is possible, but its installation and operation are not guaranteed by OIC.

Installation on HP5890

Preparing GC

- Turn off GC power.
- Remove GC oven top, top right, right side, and rear covers.
- Remove rear (B) detector port cover and insulation plug.
- Remove electrometer board to be used with the PID from the GC if necessary, and remove its FID interconnect tube by loosening the three mounting nuts.
- Replace this interconnect tube with the electrometer input cable provided with the 4430.
- On the GC motherboard (GC right side), disconnect brown plug J10 and remove clear plastic housing.
- Now plug J9 is exposed. Unplug it by squeezing its two locking levers.
- Unplug plugs J7and J8.

Installing PID

- For capillary columns, a make-up gas line should be supplied to the detector using a 20" length of 1/16" OD stainless steel tubing. Route the line from the flow control area on the left side of the 5890, through cut outs in the plastic at the top of the instrument, and across the top of the oven to the area of the detector. Insert 4 1/2" of line through a hole near the B port as shown in Figure 3.1, through the insulation, and through the underside make-up gas hole between the two detector ports in the top of the oven.
- After confirming that the heater cartridge and temperature sensor are fully inserted in the detector base, orient the 4430 sensor in the detector port so that its ELCD interface port points rearward and the detector base snout protrudes into the oven.

Caution:
When inserting tubing through insulation, take precautions to prevent clogging the tube end with fibers.

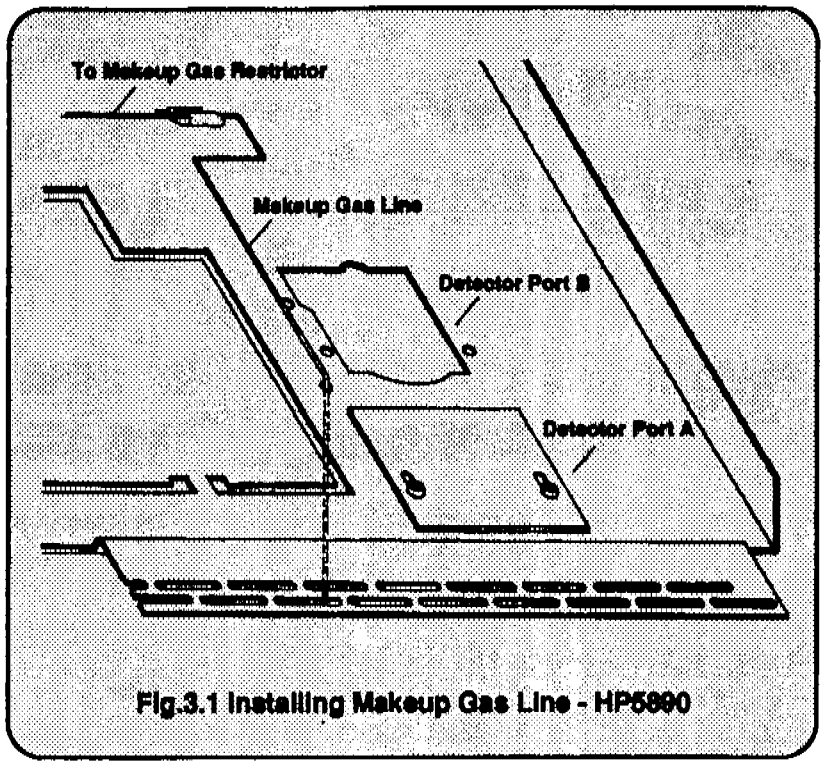


Fig.3.1 Installing Makeup Gas Line - HP5890

- Insert the electrometer into its slot in the GC, while guiding the electrometer input cable into its mating receptacle on the sensor. Tighten the threaded connector, then secure the sensor mounting plate with three mounting screws.

- Route the base heater cable bundle from the sensor rearward through the GC cable tray and over to the motherboard on the GC right side.

- Press the heater pins (large diameter) into the GC receptacles labeled **DET B** on plug J9 which was removed earlier.

- Press the PRT sensor pins (small diameter) into the GC receptacles labeled **DET B** plug J7 which was removed earlier.

- Return connectors J7 and J9 to their receptacles. Replace the clear plastic cover and brown connector J10.

- Using the 1/4" graphite ferrule and 1/4" Swagelok nut, install the desired column adapter into the detector snout.

- Connect the sweep gas line by tightening its Valco tube nut and ferrule into its port on the sensor. Route this line to a restrictor valve in the flow control area of the GC or to another means of providing gas flow in the 80-100 ml/min range.

- Route the vent valve power cable to the motherboard along the other cable bundles to the GC motherboard, and press the two pins into the receptacles labeled **PRG B** on plug J8.

- Connect the lamp high voltage input cable to its connector on the tower, and route rearward and over to the PID lamp supply. Connect it to the power supply connector.

Corresponding pinouts for detector A and B heaters and PRT sensors are marked on the motherboard. Refer to the GC manual for more information as needed.

CAUTION:
Always match the polarity of all inputs of devices controlled by the same event signal. Typically, a single event signal is used to simultaneously restart this Lampsaver timer, the GC, and the data system.

- Connect the power cord to the power supply and to a source of 115 VAC power.
- If the Lampsaver circuit is to be used, connect the cable providing the restart signal to the START connector on the power supply.
- Set the ON/BYPASS switch, and the ON TIME adjustment as desired, according to their functions described in **Chapter 2.**
- Reinstall all GC covers, then turn on GC power.

Installation on Varian 3300/3400

Preparing GC

- Turn off GC power.
- Remove GC top covers.
- Remove any cover from the detector port in which the 4430 will be mounted.
- Remove the electrometer board to be used with the PID if necessary, and remove its two cables.

Installing PID

- Connect the polarizing voltage cable and the electrometer input cable provided with the 4430 to the electrometer board in place of the two removed cables.
- Insure that the FID/PID (or FID/TSD) switch on the electrometer board is set to PID, then reinstall the board in the GC.
- For capillary columns, a make-up gas line should be supplied to the detector using a 36'' length of 1/16" OD stainless steel tubing. Route the line from a makeup gas restrictor valve in the flow control area on the left side of the GC, over to the detector port, down the side-slot in the port hole, and leave extended 4 1/2" into the GC oven.
- Remove the sensor tower top-half by pressing in on its two locking pins with a pointed object and pulling the top-half up. Remove the lamp and o-ring now exposed.
- Orient the sensor in the detector port so that the ELCD interface port points rearward and the snout protrudes into the oven.
- Tighten the two hex-head mounting screws so that the sensor is secure in the port, then reinstall the o-ring and lamp.
- Reinstall the tower top-half making sure that the two locking pins pop into their alignment holes.
- Connect the electrometer input cable and the polarizing voltage cable according to the color codes on the sensors connectors.

CAUTION:
Be sure that the o-ring is positioned concentric in its sealing area before placing the lamp on top of it. Reference Figure 5.1 if necessary for re-installation.

See the GC manual for more information on operation of external devices such as the vent valve.

- Connect the sweep gas line by tightening its Valco tube nut and ferrule into its port on the sensor. Route this line to a restrictor valve in the flow control area of the GC or to another means of providing gas flow in the 80-100 ml/min range.
- Connect the vent outlet line to the sensor and the vent valve, then mount the vent valve with its bracket onto an existing threaded hole in the oven top.
- Connect the vent valve power wires to a set of 24VDC output terminals on the GC relay board, as desired, for remote vent control.
- Connect the lamp high voltage input cable to its connector on the tower, and route rearward and over to the PID lamp power supply. Connect it to the power supply connector.
- Connect the power cord to the power supply and to a source of 115 VAC power.
- If the Lampsaver circuit is to be used, connect the cable providing the restart signal to the START connector on the power supply.
- Set the ON/BYPASS switch and the ON TIME adjustment as desired according to their functions described in **Chapter 2.**
- Reinstall GC covers, then turn on GC power.

Chapter 4
Operation

In the last chapter, installation of the 4430 was described. This chapter deals with the operation of the detector. Because the detector electronics are so integrated into the existing GC components, operation of this PID closely resembles operation of the GC's standard flame ionization detector (FID). For this reason, we recommend that you review the operation of the FID in the respective GC manual. Of particular importance is an understanding of:

- how to heat the detector base and display its temperature,
- how to turn on the detector electronics and display its output.
- how to get a signal output from the detector to a recorder or data system, and
- how to control a solenoid valve (in this case the PID vent valve), if desired, from a 24 VDC output within the GC.

Each of these aspects of detector operation is covered in the GC manual and should be understood before you proceed.

Recommended Settings for General Operation

Typical Settings with the HP5890

- Base Temperature: 200°C or 20° above the highest column temperature. 300°C maximum.
- Range on GC: 2^8
- Attenuation on GC: 2^0 (does not affect output used)
- Zero Offset on GC: 0.0
- Signal Output Scale: 0-1 volt
- Lamp Intensity Setting: 5
- Sweep Gas Flow: H_2 or He at 80-100 ml/min
- Makeup Gas Flow: He at 20 ml/min (if column flow less than 10 ml/min)

Typical Settings with the Varian 3300/3400

- Base Temperature: 200°C or 20° above highest column temperature. 300°C maximum.
- Range on GC: 10^{10}
- Attenuation on GC: 1 (does not affect output used)

- Zero Offset on GC: 0.0
- Signal Output Scale: 0-1 volt
- Lamp Intensity Setting: 5
- Sweep Gas Flow: H_2 or He at 80-100 ml/min
- Makeup Gas Flow: He at 20 ml/min (if column flow less than 10 ml/min)

General Operation

Refer to *Chapter 5, Troubleshooting*, to resolve any problems encountered with operation of the detector.

- Verify that column, sweep gas, and any makeup gas flows are set.
- Turn on lamp power and confirm that the lamp "fires".
- Note the baseline to confirm that it is at an acceptable level.
- Proceed with the chromatographic analysis.

Chapter 5
Maintenance and Troubleshooting

In the last chapter, a guide to the operation of the 4430 was given. This chapter discusses the maintenance of the detector and some diagnostics guides.

The 4430 is a very simple detector with little that can go wrong or fall out of adjustment. The only component which has a finite expected life is the lamp. The sweep gas and Lampsaver features aid in extending lamp life and performance, and the lamp window can be cleaned and repolished, but a spare lamp should be kept on hand in case of irreversible lamp failure. This known, good lamp is also useful in troubleshooting.

Maintenance

Replacing a Lamp

CAUTION:
If the ELCD reactor stays hot while the lamp is replaced, air introduced may foul the catalytic surface of the reaction tube. If the ELCD pump remains on, solvent may be pumped back into the reaction tube.

- Turn off the lamp high voltage power.
- If a Model 4420 ELCD is connected and operating, turn of its reactor and pump.
- Turn off the detector base heater if the tower top-half is uncomfortably hot, but the lamp can be changed with the base hot without damaging the detector.
- Press in the two locking pins retaining the lower top-half with a sharp object, and remove the top-half.
- Remove the lamp and o-ring assembly.
- Refer to Figure 5.1 if necessary, to insert a new lamp, first placing the o-ring in the sensor.
- Reinstall the tower top-half, being sure that the two locking pins pop back into their alignment holes.
- Repower the lamp, watching for it to "fire" while turning on the lamp power supply.

CAUTION:
Be sure that the o-ring is in place concentric with the sensor sealing surface, so that the concave ring on the bottom of the lamp mates with it.

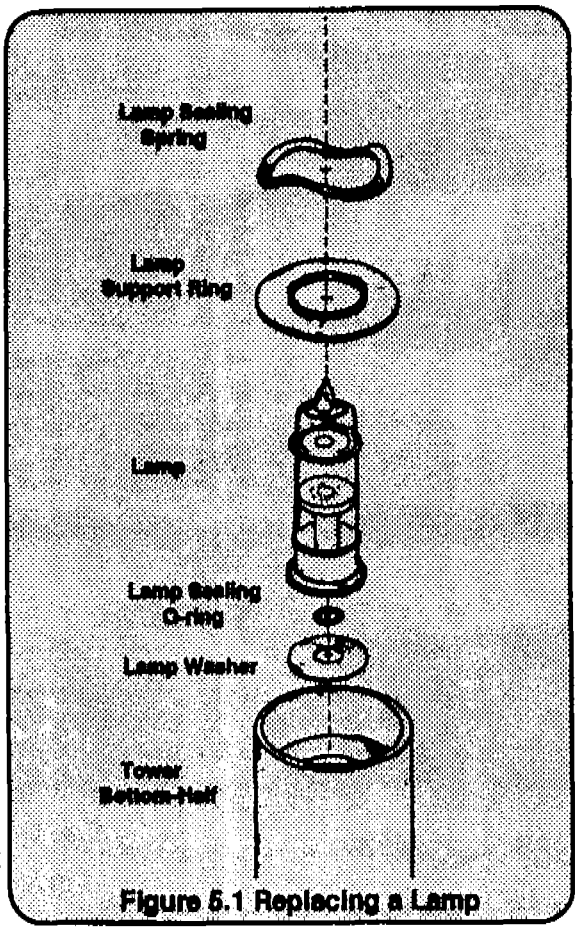


Figure 5.1 Replacing a Lamp

- If necessary, repower the detector base heater, the ELCD reactor, and the ELCD pump.

Cleaning a Lamp Window

The lamp window can be polished using jeweler's rouge or toothpaste and water. Dilute acids may also be used for dissolving specific contaminants if necessary.

Troubleshooting

Once the 4430 is installed and operating properly, make note of the signal display, if possible, and a typical baseline on the recorder or data system with no zero offset. A typical chromatogram for comparing response is also handy to save.

Baseline Too High

Turn off the lamp and watch the baseline. If it remains high (or does not decrease significantly) there is extraneous ion current through the sensor. In this case, remove the column, cap the resulting opening, and bake the detector at 300° C with sweep and makeup gas flow while monitoring the baseline for cleanup of contamination.

If the baseline drops significantly when the lamp goes off, a contaminant is likely in the column effluent, sweep gas, or makeup gas. Turn each gas off in succession, leaving the others on, to isolate the source.

Baseline Too Low

The detector will get cleaner and cleaner (baseline will decrease) over the first few months of operation, but if the output signal gets to be abnormally low and turning off the lamp does not decrease it much, the lamp window is fogged or the lamp has failed. Check the response to a standard as compared to that with a fresh lamp.

Response Too Low

The lamp window is fogged, the sensor has a leak, or the sweep or makeup gases are way too high. Check response with a fresh lamp, watching for proper positioning of the sealing o-ring (reference Figure 5.1). Recheck gas flows to detector.

No Response

Check to see if detector is turned on at the GC. Check to see if the lamp is lit. Check baseline to see if it is normal. If it is, a lamp failure is likely.

Chapter 6
Replacement Parts

In Chapter 2, the various components of the 4430 were identified and named. This chapter is simply a listing of the order numbers for some of these components and for other replacement parts and support items.

Parts for 4430

PART NAME	PART #	U/M
Adaptor - BR/NI 1/16 Tube x 10-32	179010	ea
Ferrule - BR 1/16 Tube Back	176314	ea
Ferrule - BR 1/16 Tube Front	177156	ea
Ferrule - GRF 1/4 Tube	174144	ea
Ferrule - SS 1/16 Tube	112433	ea
Fuse - 0.5 amp	115469	ea
Lamp - 10.0 eV	181180	ea
Lamp High Voltage Cable	181750	ea
Lamp Power Supply	181727	ea
Lamp Power Supply Front Panel Board	180497	ea
Lamp Power Supply Main Board	180620	ea
Lamp Sealing O-Ring	180927	ea
Lamp Sealing Spring	180901	ea
Lamp Support Ring	180919	ea
Manual - Operating and Service Procedures	186678	ea
Nut - BR/NI 1/16 Male	176306	ea
Nut - SS 1/4 Tube Female	169682	ea
Nut - SS 1/8 Tube Male	112458	ea
Nut - SS 1/16 Tube Male	169640	ea
Nut - SS Outlet	188490	ea
Power Cord	116038	ea
Startup Kit	181776	ea
Tube - SS Outlet	188482	ea
Tubing - CU 1/8 x .080 ID	111427	ea
Tubing - SS 1/16 x .020 ID	111732	ea
Vent Valve Assembly, 24 VDC	182154	ea
Vent Outlet Restrictor	168220	ea
Vent Valve - 24 VDC	183939	ea

Specific to HP5890

PART NAME	PART #	U/M
Analog Signal Cable (0-1 V)	185850	ea
Electrometer Input Cable	181792	ea
Makeup Gas Column Adaptor	186338	ea
Nut - Hex SS M4	186163	ea
Sensor Assembly	181768	ea
Shorting Plug	183921	ea

Vent Outlet Tube	181826	ea
Vent Valve Cable	185967	ea

Specific to Varian 3400

PART NAME	*PART #*	*U/M*
Analog Signal Cable	186668	ea
Electrometer Input Cable	181859	ea
Makeup Gas Column Adaptor	186346	ea
Polarizing Voltage Cable	184036	ea
Sensor Assembly	183954	ea
Vent Valve Assembly	184853	ea
Vent Valve Cable	186650	ea
Vent Valve Mounting Bracket	182923	ea