Agilent Technologies

Chemical Analysis Group

Agilent 6890 Gas Chromatograph

6890 Site Prep and Installation

Document A15283

Site Preparation and Installation Manual

HP 6890 Series Gas Chromatograph

HP part number G1530-90300

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Warranty

The information contained in this document is subject to change without notice.

Hewlett-Packard makes no warranty of any kind with regard to this material, including, but not limited to, the implied warranties of merchantability and fitness for a particular purpose. Hewlett-Packard shall not be liable for errors contained herein or for incidental or consequential damages in connection with the furnishing, performance, or use of this material.

Safety Information

The HP 6890 Gas Chromatograph 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 HP 6890 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. Hewlett-Packard Company 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-activity hazard.


Indicates explosion hazard.

Important User Information for In Vitro Diagnostic Applications

This is a multipurpose product that may be used for qualitative or quantitative analyses in many applications. If used in conjunction with proven procedures (methodology) by qualified operator, one of these applications may be In Vitro Diagnostic Procedures.

Generalized instrument performance characteristics and instructions are included in this manual. Specific In Vitro Diagnostic procedures and methodology remain the choice and the responsibility of the user, and are not included.

Sound Emission Certification for Federal Republic of Germany

Sound pressure Lp
< 65 dB(A)

During normal operation

At the operator position

According to ISO 7779 (Type Test)

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

Schallemission

Schalldruckpegel LP
< 65 dB(A)

Am Arbeitsplatz

Normaler Betrieb

Nach DIN 45635 T. 19 (Typprüfung)

Bei Betrieb des HP 6890 mit Cryo Ventil Option treten beim Oeffnen des Ventils impulsfoermig Schalldrucke Lp bis ca. 74.6 dB(A) auf.

Little Falls Operation
Hewlett-Packard Company
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Site Preparation

How to prepare your laboratory for installation and use of the GC.

Site preparation at a glance

Before the GC arrives, make sure your laboratory meets the following environmental, weight, power, and gas requirements. You should also refer to this checklist for supplies that you need to operate your GC, such as traps and tubing. You can find more site preparation information in this chapter.

Site Preparation Checklist

- ❑ The site is well ventilated and free of corrosive materials and overhanging obstacles.
- ❑ Site temperature is within the recommended range of 20 to 27°C.
- ❑ Site humidity is within the recommended range of 50 to 60%.
- ❑ Bench space is adequate for the GC with EPC: 50 cm x 58.5 cm x 50 cm (21 in. x 23 in. x 21 in.)
  Bench space is adequate for the GC without EPC: 50 cm x 68 cm x 50 cm (21 in. x 26.7 in. x 21 in.)
- ❑ Bench can support the weight of the HP 6890 system.
- ❑ Power receptacle is earth grounded.
- ❑ Electrical supply meets all GC's power requirements; see page 10.
- ❑ Voltage supply is adequate for oven type. **Regular oven:** 2,250 VA. **Fast-heating oven:** 2,950 VA.
- ❑ Gas supplies meet the requirements of your columns and detectors; see page 12.
- ❑ Gases meet purity requirements. All should be chromatographic-grade—99.9995% pure or better. Air should be zero-grade or better.
- ❑ Obtained precleaned, 1/8-inch copper tubing for inlet and detector gas supplies.

Optional supplies:

- ❑ Inlet and detector gas supplies have two-stage pressure regulators installed (optional).
- ❑ Obtained traps for inlet and detector gas supplies—molecular sieve trap, hydrocarbon trap, and/or oxygen trap.
- ❑ Obtained liquid N_2 or liquid CO_2 (depending on requirements) for cryogenic cooling.
- ❑ Obtained 1/4-inch insulated copper tubing for liquid N_2 supplies **OR** 1/8-inch heavy-walled, stainless steel tubing for liquid CO_2 supplies.
- ❑ Obtained insulation for liquid N_2 tubing.
- ❑ Obtained air for valve actuation.

Site Preparation

Site preparation involves two general steps: insuring that your laboratory is capable of supporting the operation of the GC and obtaining supplies and tools you will need to install the instrument. A list of the necessary tools and supplies appears at the beginning of the “Installation” chapter. Most supplies are available from Hewlett-Packard. See the HP Analytical Direct Analytical Columns and Supplies catalog for descriptions and ordering information. You can obtain a copy of the catalog from your local sales office.

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 in.) clearance behind the instrument to dissipate this air.

WARNING Do not place temperature-sensitive items (for example, gas cylinders, chemicals, or regulators) in the path of the heated exhaust. 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 (HP 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-in.) 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 to the split vent.

Benchtop space requirements

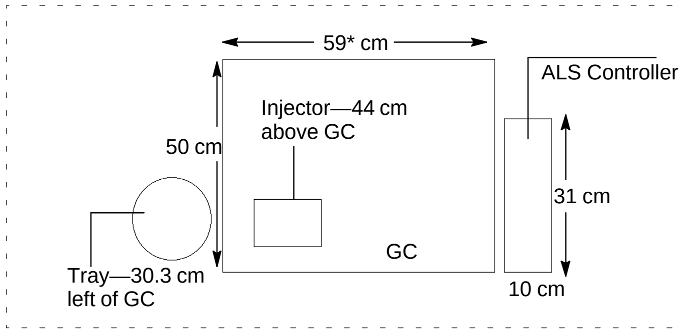
The GC with electronic pneumatics control (EPC) is 59 cm (23 in.) wide. The nonEPC model is 68 cm (26.7 in.) wide. Both are 50 cm (21 in.) high and 50 cm (21 in.) deep.

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 1 shows some common system configurations.

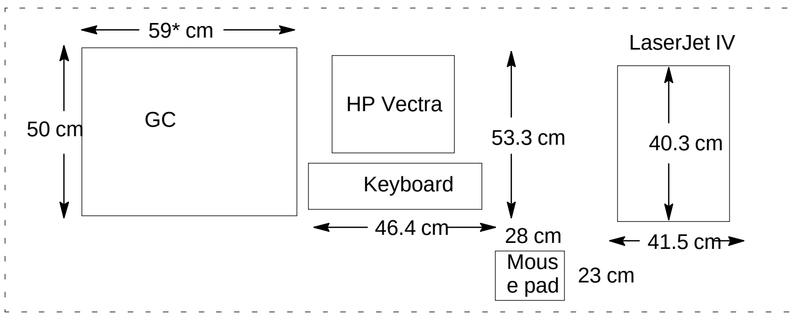
Table 1 presents the dimensions, voltage requirements, heat production, and weight of the GC and other Hewlett-Packard instruments often used with it. Use this table to insure that you have adequate space and power for the entire system. Allow at least 10.2 cm (4 in.) space between instruments for ventilation.

Figure 1. Common GC System Configurations—Top Views

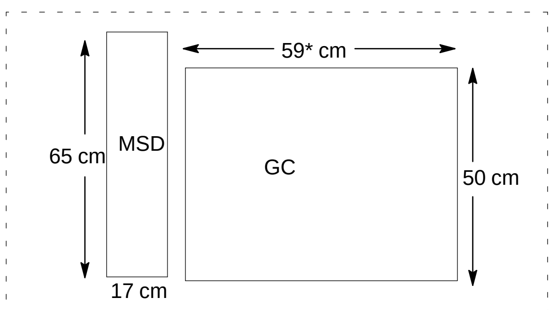
GC with HP Automatic Liquid Sampler



GC with HP ChemStation



GC with HP 5972A Mass Selective Detector



*68 cm for non-EPC version.

Table 1. Dimensions, Power, Heat Production, and Weight

Instrument	Height	Width	Depth	Power (VA)	Heat	Weight
HP 6890 Gas Chromatograph						
EPC version	50 cm 21 in.	59 cm 23 in.	50 cm 21 in.	2,250	8,100 KJoules 7,681 Btu/hr	50 kg 110 lb
Non-EPC version	50 cm 20 in.	68 cm 26.7 in	50 cm 21 in.	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	—
GC Automatic Liquid Sampler						
G 1512A Controller	10 cm 4 in.	33 cm 13 in.	38 cm 12 in.	320 max	545 KJoules 515 Btu/Hr	7.3 kg 16.0 lb
18593 Injector	44 cm above GC 17 in. above GC					
18596 Tray	30.3 cm left of GC 9 in. left of GC					
Computer*						
Computer with monitor	21 cm 53.3 in.	17 cm 42.0 in.	15 cm 39.0 in.	N/A	N/A	N/A
Keyboard	5.1 cm 2.0 in.	47 cm 18.3 in.	18 cm 7.0 in.	N/A	N/A	N/A
HP 5972A Mass Selective Detector	35 cm 13.6 in.	17 cm 6.7 in.	65 cm 25.6 in.	254 max	3,158 Btu/hr, 3,000 with GC	22.7 kg 50.0 lb
HP 7694 Headspace Sampler	31 cm 16 in.	56 cm 22 in.	39 cm 22 in.	420 max	2,215 KJoules 2,100 Btu/hr	35.8 kg 79.0 lb
Printers						
LaserJet Series 4Plus	30 cm 11.7 in.	42 cm 16.4 in.	40 cm 15.9 in.	300 max	N/A	16.8 kg 37.0 lb
Integrators						
HP 3396 Series III Integrator, HP 3395 Integrator	13 cm 4.5 in.	46 cm 18 in.	46 cm 18 in.	50	135 KJoule 120 Btu/hr	4.3 kg 9.5 lb
HP 35900C/D/E Analog-to-Digital Converter	104 cm 4 in.	325 cm 13 in.	290 cm 11 in.	40	216 KJoules 205 Btu/hr	4.1 kg 9.0 lb

* General specifications for a mid-size, desktop computer.

Electrical requirements

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.

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 2, 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 2. Line Voltage Requirements

Voltage	Maximum Power Consumption (VA)	Power Line Requirement	Oven Type
120 V (+5, -10%	2,250	20-amp dedicated	Slow-heating
200 V (+5, -10%	2,950	15-amp dedicated	Fast-heating
220 V (+5, -10%)	2,950	15-amp dedicated	Fast-heating
230 V (+5, -10%)	2,950	16-amp dedicated	Fast-heating
230 V (+5, -10%) (Switzerland or Denmark with 10-amp maximum service)	2,250	10-amp dedicated	Slow-heating
240 V (+5, -10%)	2,950	13- or 16-amp dedicated	Fast-heating

Frequency range for all voltages is 47 to 63 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 3.

Table 3. Voltage Requirements by Country

Country	Voltage	Oven Type
USA	120 V	Slow
USA	240 V	Fast
Continental Europe	220 V or 230 V	Fast
United Kingdom	240 V	Fast
Denmark, Switzerland, 10 amp	230 V	Slow
Denmark, Switzerland, 16 amp	230 V	Fast
China, Hong Kong	220 V	Fast
Japan	200 V	Fast
Australia, India, South Africa	240 V	Fast

Gas requirements

Gases for packed columns

The carrier gas you use depends upon the type of detector and the performance requirements. Table 4 lists gas recommendations for packed column use. In general, makeup gases are not required with packed columns.

Table 4. Gas Recommendations for Packed Columns

Detector	Carrier Gas	Comments	Detector, Anode Purge, or Reference Gas
Electron Capture (ECD)	Nitrogen	Maximum sensitivity.	Nitrogen
	Argon/Methane	Maximum dynamic range.	Argon/Methane
Flame Ionization (FID)	Nitrogen	Maximum sensitivity.	Hydrogen and air for detector
	Helium	Acceptable alternative.	
Nitrogen-Phosphorus (NPD)	Helium	Optimum performance.	Hydrogen and air for detector
	Nitrogen	Acceptable alternative	
Thermal Conductivity (TCD)	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 5 lists gas recommendations for capillary columns.

Table 5. 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	
Nitrogen-Phosphorus	Helium	Helium		Hydrogen and air for detector
	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			

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, “Assembling the Gas Plumbing,” for more information on using traps.

Table 6. 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

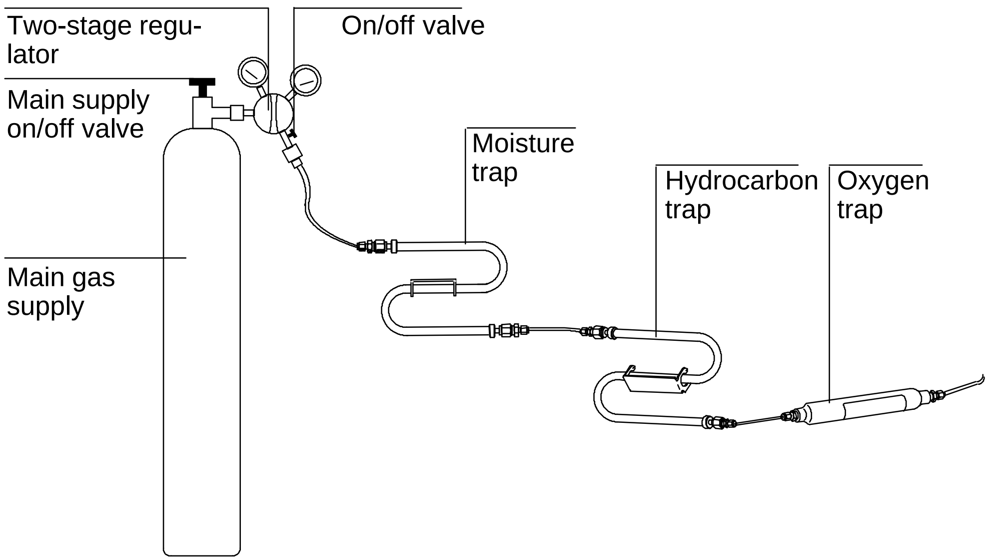
WARNING All compressed gas cylinders should be securely fastened to an immovable structure or permanent wall. Compressed gases should be stored and handled in accordance with the relevant safety codes.

WARNING Gas cylinders should not be located in the path of heated oven exhaust.

WARNING To avoid possible eye injury, wear eye protection when using compressed gas.

Follow the general plumbing diagram in Figure 2 when preparing gas supply plumbing.

Figure 2. 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 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 (HP part no. 5180-4196). Do not use ordinary copper tubing—it contains oils and contaminants.

Plastic tubing is permeable to oxygen and other contaminants that can damage columns and detectors. It is not recommended for GC use.

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.

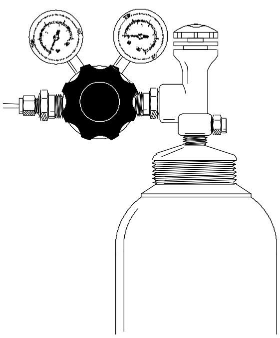
Use larger diameter tubing (1/4-inch) for distances greater then 15 feet (4.6 m) or when multiple instruments are connected to the same source. You should also use larger diameter tubing if high demand is anticipated (for example, air for an FID).

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 3. Two-stage pressure regulator



The type of regulator you use depends upon gas type and supplier. The HP Analytical Direct Analytical Columns and Supplies catalog contains information to help you identify the correct regulator, as determined by the Compressed Gas Association (CGA). Hewlett-Packard offers pressure-regulator kits that contain all the materials needed to install regulators properly.

Pressure regulatorgas 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 (HP 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, if you are doing high-sensitivity work, you may want to add traps to remove traces of water or other contaminants.

Table 7. Recommended Traps

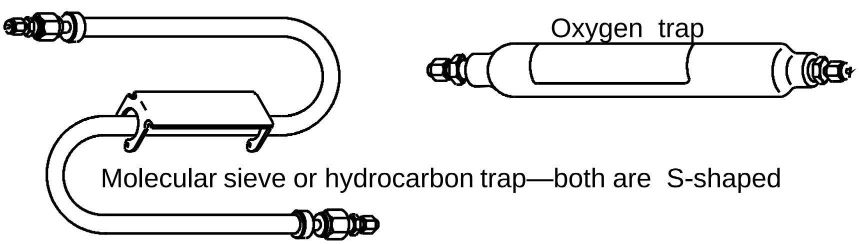
Description	HP Part No.
Preconditioned moisture trap: metal casing, s-shaped trap for carrier gas cleanup. Contains Molecular Sieve 5A, 45/60 mesh, and 1/8-in. fittings.	5060-9084
Hydrocarbon trap: metal casing, s-shaped trap filled with 40/60 mesh activated charcoal, and 1/8-in. fittings	5060-9096
Oxygen trap (for carrier and ECD gases): metal casing, and 1/8-in. 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 or NPD fuel gases.

Figure 4. Traps



Cryogenic cooling requirements

Cryogenic cooling allows you to cool the oven below ambient temperature. A solenoid valve introduces liquid coolant, either carbon dioxide (CO_2) or nitrogen (N_2), to cool the oven to the desired temperature.

CO_2 and N_2 require different hardware. You must replace the entire valve assembly if you want to change coolants. The liquid CO_2 valve kit is HP part no. G1565-65510 and the liquid N_2 kit is HP 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 N_2 cools reliably to 80°C
- Liquid CO_2 cools reliably to 40°C

CO_2 is the choice for infrequent cryogenic cooling because it does not evaporate and is less expensive than N_2. However, a tank of CO_2 contains much less coolant than a tank of N_2 and more CO_2 is used for the same amount of cooling.

Although liquid N_2 evaporates from the tank regardless of frequency of use, N_2 tanks contain more coolant than do CO_2 tanks and therefore may be better for frequent use.

Using carbon dioxide

WARNING

Pressurized liquid CO_2 is a hazardous material. Take precautions to protect personnel from high pressures and low temperatures. CO_2 in high concentrations is toxic to humans; take precautions to prevent hazardous concentrations. Consult your local supplier for recommended safety precautions and delivery system design.

Caution

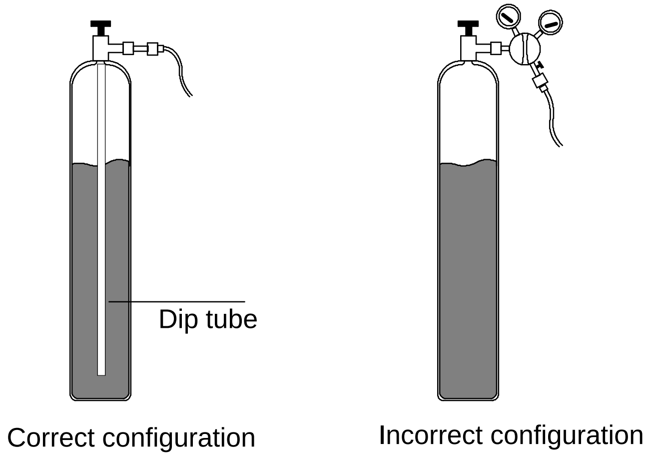
Liquid CO_2 should not be used as a coolant for temperatures below 40°C because the expanding liquid may form solid CO_2—dry ice—in the GC oven. If dry ice builds up in the oven, it can seriously damage the GC.

Liquid CO_2 is available in high-pressure tanks containing 50 pounds of liquid. The CO_2 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 CO_2 system include:

- The tank must have an internal dip tube or eductor tube to deliver liquid CO_2 instead of gas (see Figure 5).
- The liquid CO_2 must be provided to the GC at a pressure of 700 to 1,000 psi at a temperature of 25°C.
- Use 1/8-in. diameter heavy-wall stainless steel tubing for supply tubing. The tubing should be between 5 and 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 CO_2 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 5. Correct and Incorrect Liquid CO_2 Tank Configuration



WARNING Do not use copper tubing or thin-wall stainless steel tubing with liquid CO_2. 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 N_2 system include:

- Nitrogen must be provided to the GC as a liquid at 20 to 30 psi.
- The supply tubing for liquid N_2 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.

See the “Controlling Valves” chapter in the General Information volume for more valve requirements.

2

Installation

Step-by-step instructions for installing the GC.

Tools and supplies for installation

Make sure you have the tools and supplies you need before starting the installation.

Wrenches

- ❑ One 5/16-inch
- ❑ One 3/8-inch
- ❑ Two 7/16-inch
- ❑ One 9/16-inch

Screwdrivers

- ❑ T10 Torx screwdriver
- ❑ T 20 Torx screwdriver

Tubing

- ❑ Copper tubing, 1/8-inch diameter
- ❑ Heavy wall, 1/8-inch stainless steel (for liquid CO_2)
- ❑ Heavy wall, 1/4-inch stainless steel insulated (for liquid N_2)
- ❑ Tubing cutter

Fittings

- ❑ 1/8-inch SWAGELOK fittings
- ❑ 1/4-inch SWAGELOK fittings (for liquid nitrogen and valve actuator air tubing)
- ❑ 1/8-inch SWAGELOK Tees
- ❑ Nuts and ferrules

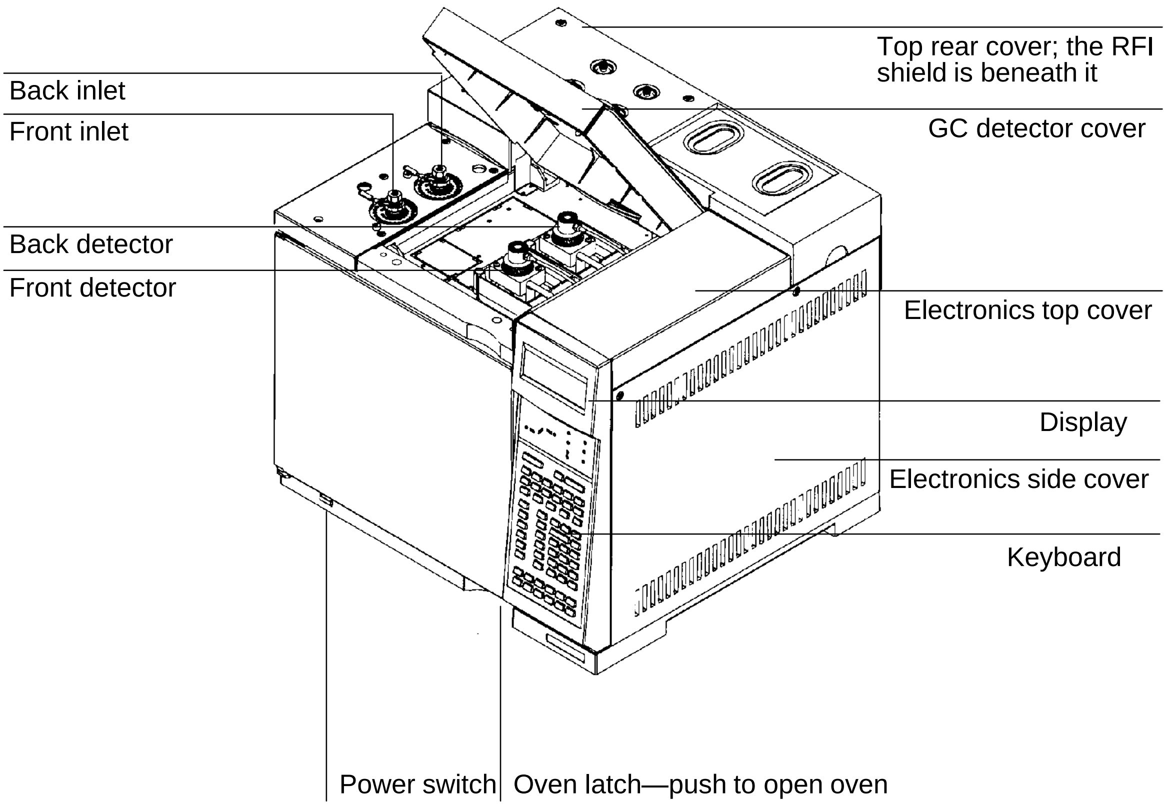
Traps (optional)

- ❑ Molecular Sieve 5A moisture trap
- ❑ Hydrocarbon trap
- ❑ Oxygen trap

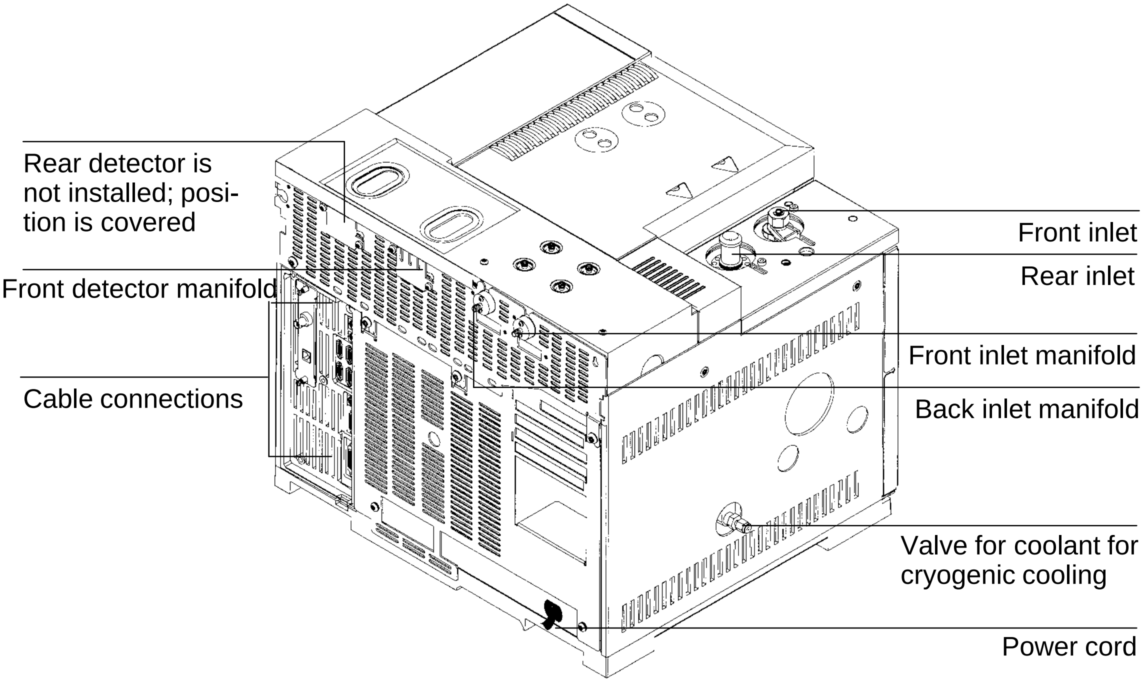
Other

- ❑ Small, flat-blade screwdriver
- ❑ High-quality electronic leak detector
- ❑ Insulating material (for liquid nitrogen tubing only)

Front View of GC



Rear View of GC



Installation

This chapter contains installation procedures for the GC. Most of the installation steps apply to all GC systems—some are optional, such as plumbing for cryogenic cooling and valve actuator air. Instructions are provided for connecting cables from the GC to other instruments in a typical HP 6890 system. In addition, information about configuring the GC and other instruments is provided.

Most of installation involves plumbing gas to tanks, traps, and manifolds. SWAGELOK fittings are used to make leak-tight connections. If you are not sure how to make a SWAGELOK connection, see Appendix A for instruction.

DANGER Hydrogen is a flammable gas. If hydrogen or any other flammable gas is used, periodic leak tests should be performed. Be sure that the hydrogen supply is off until all connections are made, and insure that the inlet fittings are either connected to a column or capped at all times when hydrogen gas is present in the instrument.

WARNING Substituting parts or performing any unauthorized modification to the instrument may result in a safety hazard.

WARNING The insulation around the inlets, detectors, valve box, and the insulation cups is made of refractory ceramic fibers (RCF). To avoid inhaling RCF particles, we recommend thesw safety procedures: ventilate your work area; wear long sleeves, gloves, safety glasses, and a disposable dust/mist respirator; dispose of insulation in a sealed plastic bag; wash your hands with mild soap and cold water after handling RCFs.

Step 1 Unpacking the GC

1. Inspect the shipping containers for damage. If a container is damaged or shows signs of stress, notify both the carrier and your local Hewlett-Packard office.

   Keep all shipping materials for inspection by the carrier.

2. Check the items received against the packing lists. If there are discrepancies, notify your local Hewlett-Packard office immediately.

   Keep the shipping containers until you have checked their contents for completeness and verified instrument performance.

Step 2 Placing the GC system on the benchtop

The GC requires a benchtop that can support its weight plus that of other equipment you will use with it. Table 1 on page 7 lists some such information. The area must be free of overhanging obstructions that might interfere with cooling and limit access to the top of the instrument.

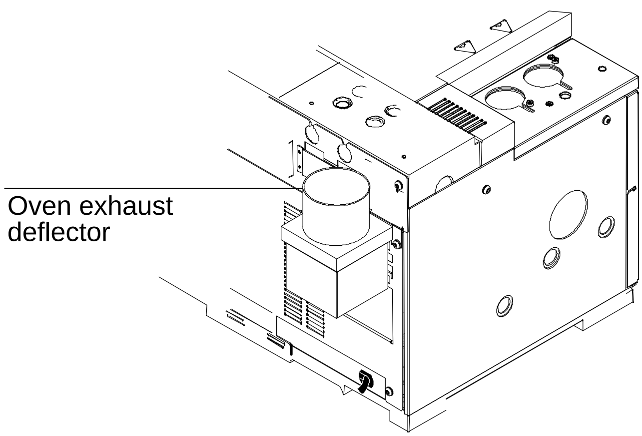
WARNING Be careful when lifting the GC. Because it is heavy, two people should lift it. When moving the GC, be aware that the back is heavier than the front.

Materials needed:

☐ Oven exhaust deflector, HP part no. 19247-60510 (optional)

1. Remove the GC from its shipping box.
2. Place the GC on the benchtop. Make sure gas and power supplies are accessible. Place other pieces of equipment near the GC as appropriate. See Table 1 on page 7 for suggested benchtop layouts.
3. If space is limited, attach the oven exhaust deflector to the back of the GC as shown below. The deflector hangs from the exhaust vents on four hooks.

Figure 6. Correct Position of the Oven Exhaust Deflector

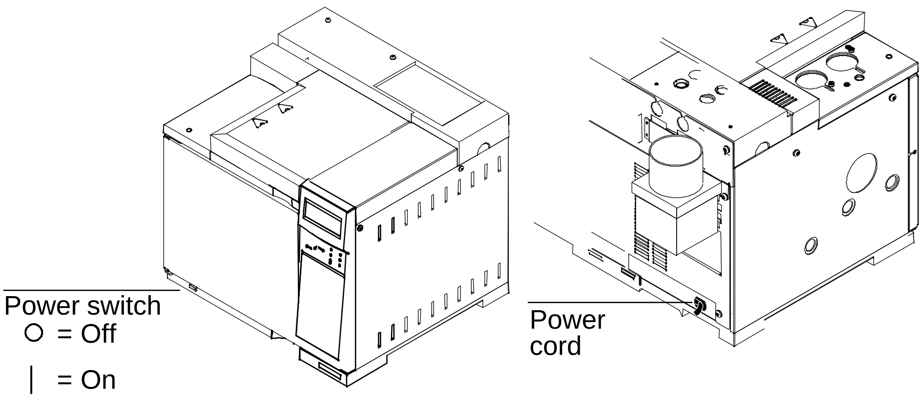


Step 3 Turning the power on

When you turn the GC on, it runs a series of self-test diagnostics. Run the diagnostics before continuing with the installation to be sure that the instrument electronics are working properly.

1. Verify that the power switch is in the off position.

Figure 7. Power switch and power cord locations



2. Plug the power cord into the power receptacle and the GC (if the cord is separate). Turn the GC on.
3. The self-test diagnostic tests run automatically. To see the pass/fail message, wait for the test to end and press

   [Oven] [Temp] [On]

   If the screen displays Power on successful, turn the GC off and continue with the installation procedure.

   If you do not see this message, turn the GC off and call Hewlett-Packard service.

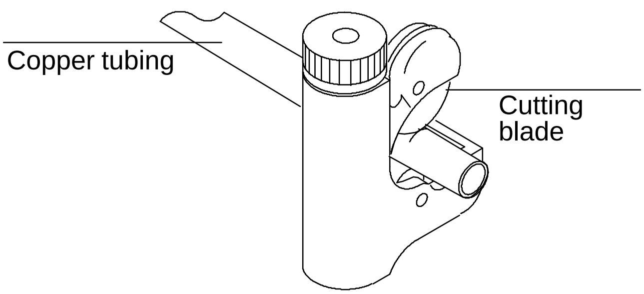
Step 4 Connecting tubing to the gas supply tank

Materials needed:

- ☐ 1/8-in. preconditioned copper tubing
- ☐ Tubing cutter (HP part no. 8710-1709)
- ☐ 1/8-in. SWAGELOK nuts, front, and back ferrules
- ☐ Two 7/16-in. wrenches

1. Turn off all gases at the source. Determine the length of tubing you need to reach from the gas supply outlet to the inlet manifold on the GC. Take into account any traps or Tee connections you will need.
2. Cut the tubing to length, preferably using a tubing cutter.

Figure 8. Tubing Cutter



3. Connect the tubing to the gas outlet with a SWAGELOK fitting. See Appendix A for information on making SWAGELOK connections.

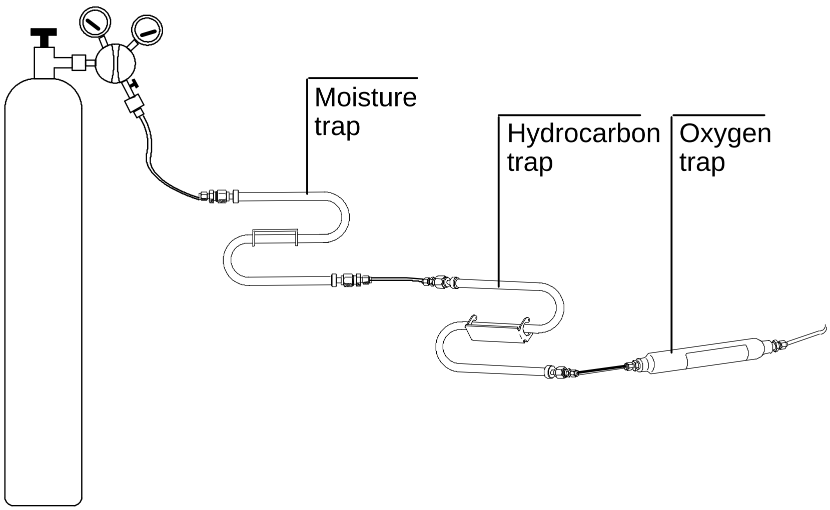
Step 5 Attaching traps to the gas supply tubing

Materials needed:

- ☐ 1/8-in. preconditioned copper tubing
- ☐ Tubing cutter
- ☐ 1/8-in. SWAGELOK fittings, nuts, and ferrules
- ☐ Two 7/16-in. wrenches and one 1/2-in. wrench
- ☐ Traps

1. Determine where you will install the trap in your supply tubing line. See Figure 9 for the recommended trap order.

Figure 9. Plumbing Diagram



2. Cut the tubing to length using a tubing cutter.

3. Connect the traps and tubing.

Step 6 Attaching a SWAGELOK tee to tubing

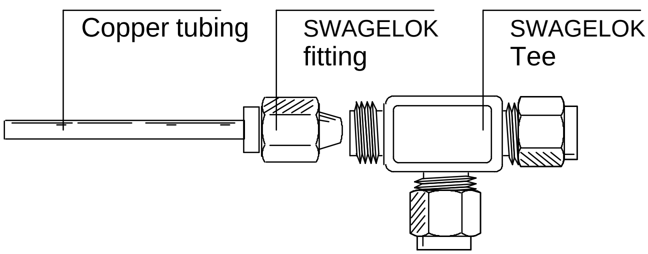
If you need to supply gas to more than one inlet or detector module from a single source, use a SWAGELOK Tee near the inlet or detector manifolds.

Materials needed:

- ☐ 1/8-in. preconditioned copper tubing
- ☐ Tubing cutter
- ☐ 1/8-in. SWAGELOK nuts, and front and back ferrules
- ☐ 1/8-in. SWAGELOK Tee
- ☐ Two 7/16-in. wrenches
- ☐ 1/8-in. SWAGELOK cap

1. Cut the tubing where you want to install the Tee. Connect the tubing and Tee with a SWAGELOK fitting.

Figure 10. Attaching a SWAGELOK Tee



2. Measure the distance from the Tee to the GC inlets and then attach copper tubing to the open Tee ends with SWAGELOK fittings.

3. You can install a SWAGELOK cap to the open end of a Tee if you do not plan to connect tubing to it immediately.

Step 7 Attaching tubing to the inlet manifold

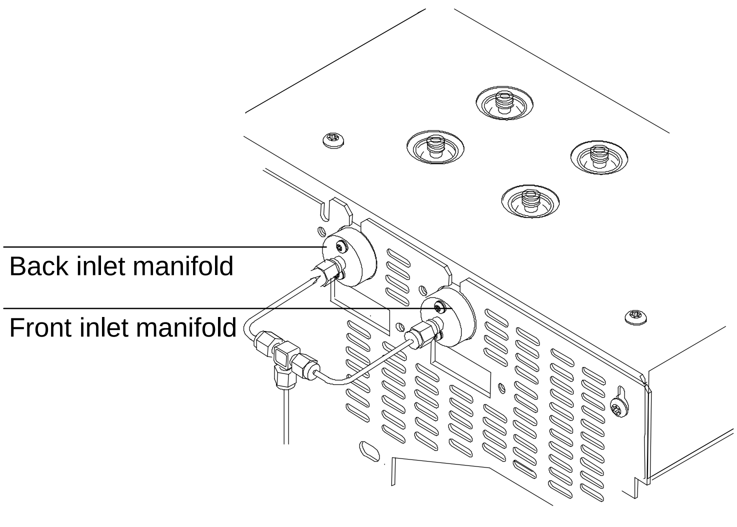
If your GC has EPC inlets, attach the tubing for the gas supply to the inlets on the manifolds on the rear of the instrument. Plumbing for nonEPC inlets connects inside the pneumatics carrier on the left side of the GC.

Materials needed:

- ☐ 1/8-in. preconditioned copper tubing
- ☐ 1/8-in. SWAGELOK nuts, and front and back ferrules
- ☐ Two 7/16-in. wrenches

1. Turn the carrier gas off at its source.
2. Connect the gas supply tubing to the inlet carrier gas manifold with a SWAGELOK nut.

Figure 11. Plumbing the Inlet Manifolds. The GC in this figure has the front and back inlets plumbed with the same carrier gas.



Step 8 Attaching tubing to detector manifolds

The gases you connect to a detector depend on the type of detector. The manifolds clearly indicate what types of gas the detectors require and where you should attach the tubing. See the tables on pages 10 and 11 for alternative gases for the detector.

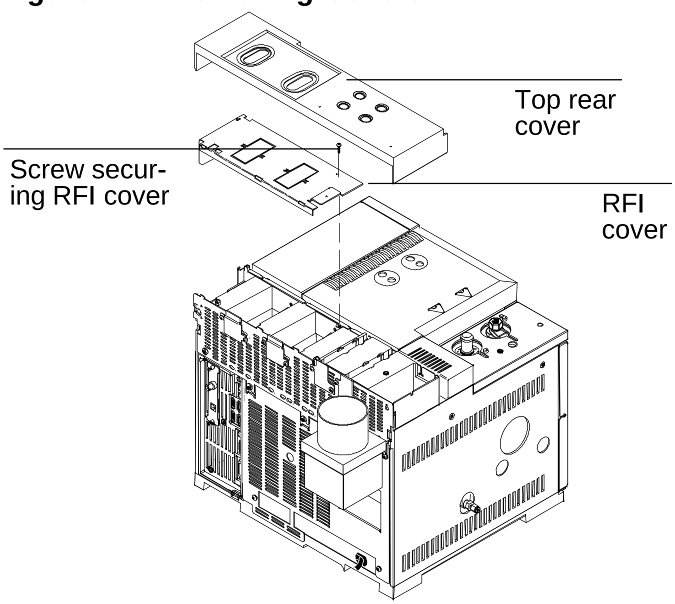
This procedure explains how to install gases to the FID. Gases are plumbed to all the detectors in a similar way.

Materials needed:

- ☐ 1/8-in. preconditioned copper tubing
- ☐ Three 1/8-in. SWAGELOK nuts and back and front ferrules sets
- ☐ Two 7/16-in. wrenches

1. Turn the gas supplies to be connected at their sources.
2. Remove the top rear cover by lifting it up. Remove the screw securing the RFI cover and remove the RFI cover.

Figure 12. Removing Covers



3. A slot on the back of the GC, just left of the back inlet manifold, can be used to bend copper tubing to the right angle for connection. Insert the tubing until you feel resistance and bend it upward.

4. The FID uses hydrogen, air, and a makeup gas. The inlets are labeled; connect the tubing to the appropriate inlet with a SWAGELOK nut. If you have a nonEPC detector, connect the makeup gas to the fitting on the regulator. The other gases are connected to the labeled fittings on the manifold.

Figure 13. Connecting Tubing to an EPC Detector

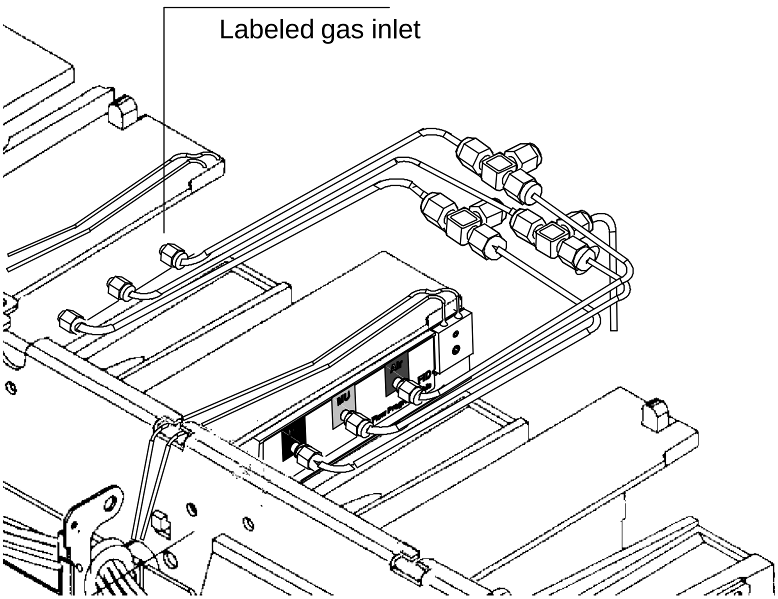
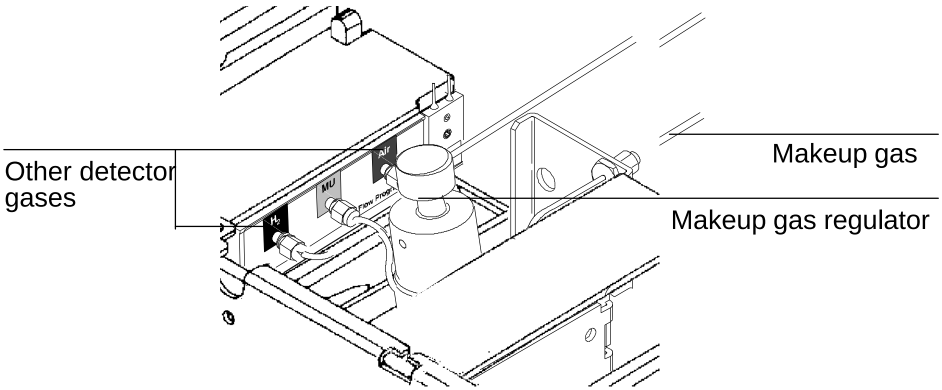


Figure 14. Connecting Tubing to a NonEPC Detector



Step 9 Checking for leaks

Liquid leak detectors (Snoop is a common one) are not recommended, especially in areas where cleanliness is very important. If you do use 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, turn the GC off and disconnect the main power cord. Be careful not to spill leak solution on electrical leads.

Materials needed:

- ☐ Electronic leak detector (preferred)
- ☐ Leak detection fluid

1. Set the carrier gas pressure at the source (usually tank) regulator to approximately 50 psi.
2. Set the detector gas pressures to the following:
   - Makeup = 50 psi
   - Hydrogen = 50 psi
   - Air = 50 psi
   - TCD reference gas = 50 psi
3. Using the leak detector, check each fitting for leaks.
4. Correct leaks by tightening the connections. Retest the connections; continue tightening until all connections are leak-free.
5. Turn off the inlet and detector gases at the initial supply.

Step 10 Attaching cryogenic liquid supplies

Cryogenic cooling allows you to operate the GC below ambient temperature. A solenoid valve introduces liquid coolant, either CO_2 or N_2, at a rate appropriate to cool the oven to the desired temperature.

The choice of coolant depends largely on how frequently you use cryogenic cooling. You cannot use CO_2 and N_2 interchangeably because they require different valve assemblies. For more information on choosing cryogenic coolant, see “Cryogenic Cooling Requirements” on page 17.

Flared or AN tubing fittings are commonly used to connect the liquid supply tubing to the cryo coolant tank. Check with the supplier of the coolant before plumbing to be sure you have the correct fittings.

Attaching liquid carbon dioxide

WARNING Do not use copper or thin-wall stainless steel tubing! Either presents an explosion hazard.

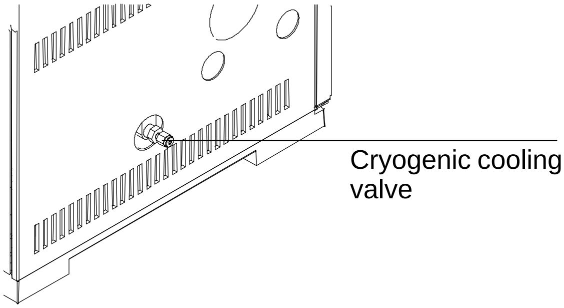
Caution Do not use padded tanks for CO_2 supplies. The cryogenic valve is not designed to handle the higher pressures padded tanks generate.

Materials needed:

- ☐ 1/8-in. heavy-wall, stainless steel tubing
- ☐ Tubing cutter
- ☐ 1/8-in. SWAGELOK nuts and ferrules
- ☐ Two 7/16-in. wrenches

1. Locate the inlet for liquid CO_2 on the left side of the GC. Prepare enough tubing to reach from the supply tank to this fitting.

Figure 15. Location of Cryogenic Cooling Valve



2. Connect the supply tubing to the liquid CO_2 tank's outlet with the fitting recommended by the supplier.

3. Use a SWAGELOK fitting to connect the supply tubing to the cryogenic valve inlet.

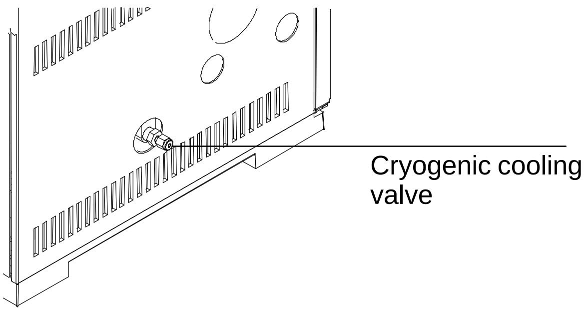
Attaching liquid nitrogen

Materials needed:

- ☐ 1/4-in. insulated copper tubing
- ☐ Tubing cutter
- ☐ 1/4-in. SWAGELOK fittings, nuts, and ferrules
- ☐ Two 9/16-in. wrenches

1. Position the nitrogen tank as close to the GC as possible to insure that liquid and not gas is delivered to the inlet.
2. Locate the inlet for coolant on the left-hand side of the GC. Prepare enough tubing to reach from the supply tank to this outlet.

Figure 16. Location of Cryogenic Cooling Valve



3. Connect the supply tubing to the liquid N_2 tank's outlet with the fitting recommended by the supplier.
4. Use a SWAGELOK fitting to connect the supply tubing to the GC's cryogenic valve inlet.

Step 11 Attaching valve actuator air

Valves require air to actuate. Valves should have a dedicated air source; they cannot share detector air supplies.

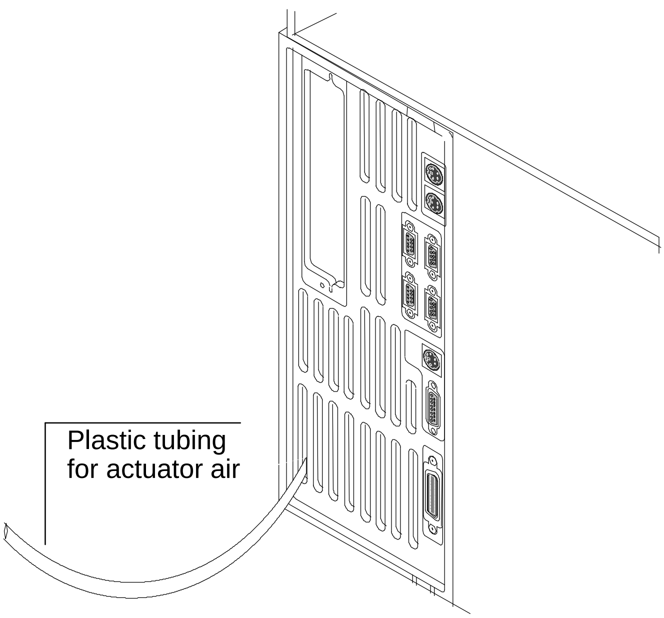
Valve actuator air is supplied through 1/4-in. plastic tubing. If your GC has valves, the plastic tubing will already be attached to the actuators, and will extend from the back of the GC.

Materials needed:

- ☐ 1/4-in. SWAGELOK fittings and front and back ferrule
- ☐ Two 9/16-in. wrenches

Turn the air off at the source. Use a sharp knife if you need to shorten the tubing. Connect the tubing to the air source using a 1/4-in. SWAGELOK nut.

Figure 17. Location of Valve Actuator Air Tubing



Step 12 Setting source pressures

The pressure set at a tank regulator depends on these factors:

- The pressure needed to achieve the highest flow rate you intend to use.

  The pressure/flow relationship depends on the column or device involved. The best way to address this is to begin at a moderate pressure level and adjust upward as needed.

- A pressure difference of about 20 psi (270 kPa) across pressure and flow sensing and controlling devices to enable them to work properly.

  This pressure difference requirement is much the same for all sensors and controllers, including flow controllers and pressure regulators.

- The pressure limit of the weakest part of the supply system.

  Swagelok fittings and copper tubing are more than adequate for the highest gas pressures encountered in gas chromatography.

  The pneumatics modules of the GC will stand over 250 psi pressure, but may not function reliably. We recommend a maximum continuous operating pressure of 170 psi to avoid excessive wear and leaks.

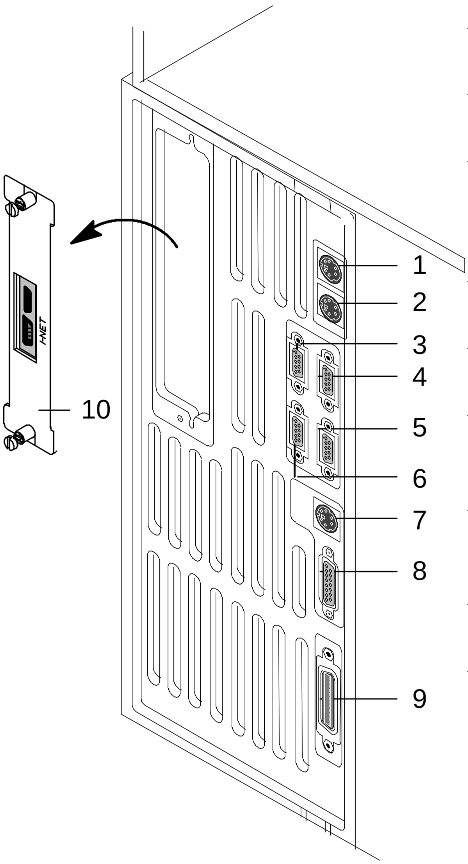
  Traps are often the weakest part of the system. They should be labeled, either on the trap itself or in accompanying literature, with a maximum operating pressure. Source pressure must not exceed the lowest maximum operating pressure in the supply system.

Suggested starting values of source pressure are:

Gas	Use	Source pressure
Carrier	Packed columns	410 kPa (60 psi)
	Capillary columns	550 kPa (80 psi)
Air	Detectors	550 kPa (80 psi)
Hydrogen	Detectors	410 kPa (60 psi)

Step 13 Connecting cables

Figure 18. Overview of Cable Connections on the back of the GC



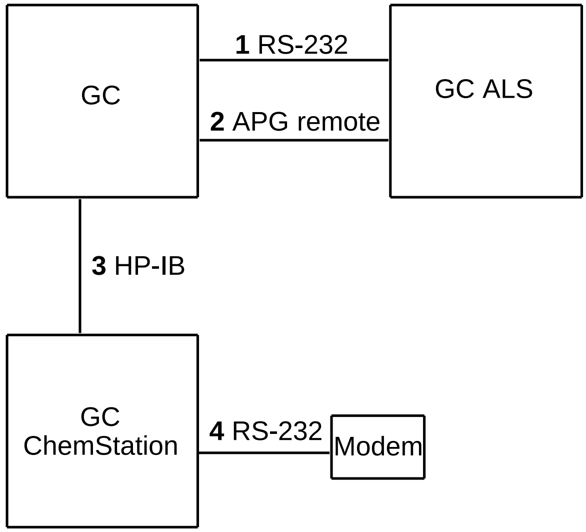
Number	Description
1	Signal 1 — Analog output for integrators or A/D converters
2	Signal 2 — Analog output for integrators or A/D converters
3 and 6	Remote start-stop for synchronizing the GC, integrators, automatic samplers, HP MSD, and other GCs
4	Modem — RS-232 for modem, computer, or controller devices
5	Sampler — Control for HP Automatic Liquid Sampler
7	External event contact closures and 24-volt outputs for valve control
8	BCD input for stream selection valves, headspace sampler, or other device
9	HP-IB for HP ChemStation and/or MSD
10	Optional MIO INET card for HP 3396B/C or 3397 integrators

The GC has an extensive set of communication tools:

- 1, 2 Analog signal outputs Two channels of analog data output for use with external signal processors. Each analog output has three voltage ranges.
- 3, 6 Remote Two remote ports (3, 6) that can be used to synchronize up to ten instruments.
- 4 Modem/RS-232C For use with modems, computers, and other controller devices.
- 5 Sampler An RS-232C port (5) dedicated to control the HP Automatic Liquid Sampler.
- 7 External event control Two passive contact closures and two 24-volt control outputs for controlling external devices. Connected to valve drivers 5 through 8 on the GC.
- 8 BCD (binary-coded decimal) inputs Reads the position of a stream selection valve or other device. Consists of eight passive inputs that sense open/closed contacts.
- 9 HP-IB Connects the GC to an HP ChemStation. This is Hewlett-Packard's implementation of the IEEE 488 standard for data communications. High-speed data transfer over a short distance.
- 10 INET Instrument Network, a proprietary communications scheme that connects a Hewlett-Packard integrator and various Hewlett-Packard analytical instruments.

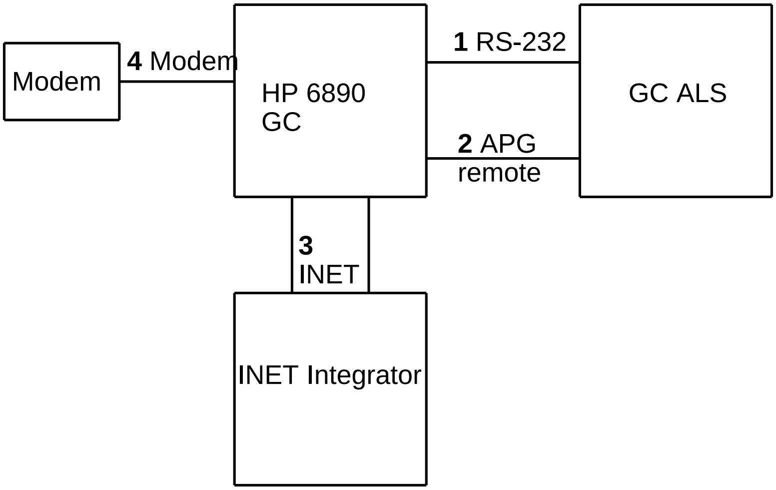
There are many system configurations possible with the GC. The figures show two common configurations. See Table 8 and Table 9 for cabling requirements for other combinations.

Figure 19. GC−GC ChemStation−GC Automatic Liquid Sampler



Number	HP part no. and description
1	G1530-60600, RS-232 cable, 9-pin female/9-pin female
2	G1530-60930, Remote start/stop cable, 2-m, 9-pin male/9-pin male
3	10833B-2310, 2-m HP-IB cable
4	G1530-61120, RS-232/modem cable or 24540-80012,RS-232/modem cable

Figure 20. GCHP 3396B/C INET Integrator GC Automatic Liquid SamplerModem



Number	HP 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, start−stop function
3	Two 82167-60003, 5-m INET cables
4	G1530-61120, RS-232/Modem cable, 9-pin female/9-pin male **OR** 24540-80012, RS-232/Modem cable 9-pin female/25-pin male

Table 8. Cabling Requirements

Instrument Connected to	Required Cable(s)	HP Part Number
Automatic Liquid Sampler	RS 232, 9-pin female/9-pin male Remote, 2-m 9-pin male/9-pin female	G1530-60600 G1530-60930
GC ChemStation	HP-IB, 2 m	10833B-2310
HP 7694 Headspace Sampler	Remote, 9-pin male/6-pin connector	G1290-60570
HP 7695 Purge and Trap Sampler	Remote, 25-pin male/9-pin male	G1500-60820
INET Integrator. Use two cables for an INET loop	Two 5-m INET cables	82167-60003
HP 3395A Integrator	Remote, 9 pin/15 pin Analog, 2 m, 6 pin	03396-61020 G1530-60570
HP 3395B Integrator	Remote, 9 pin/15 pin Analog, 2 m, 6 pin	03396-61010 G1530-60570
HP 3396B Integrator	Remote, 9 pin/15 pin Analog, 2 m, 6 pin	03396-61020 G1530-60570
HP 3396C Integrator	Remote, 9 pin/15 pin Analog, 2 m, 6 pin	03396-61010 G1530-60570
Non-HP integrator	Analog, 2 m, 6 pin	G1530-60560
HP 35900 C/D/E A/D Converter	Remote, 9-pin male/9-pin male Analog, 2 m, 6 pin	G1530-60930 G1530-60570
Mass Selective Detector	Remote, 2-m 9-pin male/9-pin male	G1530-60930
Modem	Modem, 9-pin female/9-pin male, or Modem, 9-pin female/25-pin male	G1530-61120 , or 24540-80012
Non-Hewlett-Packard data system	General use remote, 9-pin male/spade lugs External event, 8-pin/spade lugs	35900-60670 (2 m), 35900-60920 (5 m), 35900-60930 (0.5 m) G1530-60590
Non-Hewlett-Packard instrument, unspecified	External event, 8 pin/spade lugs	G1530-60590
Stream selection valves Gas sampling valves	See documentation accompanying the valve	

Table 9. Cabling for Other Instruments in an HP 6890 System

Instrument 1	Instrument 2	Type of cable	HP part number
Mass Selective Detector	GC ChemStation	HP-IB	10833A
GC Automatic Liquid Sample	Non-HP data system	BCD	G1530-60630 18594-60520
GC Automatic Liquid Sampler	HP 3395A Integrator HP 3396B Integrator	BCD	03396-60560
GC Automatic Liquid Sampler	HP 3395B Integrator HP 3396C Integrator	BCD	03396-60560
GC Automatic Liquid Sampler	HP 35900 C/D/E A/D Converter	BCD	35900-60850
GC ChemStation	Modem	RS-232	24540-80012 or G1530-61120
HP 7694 Headspace Sampler	GC ChemStation	RS-232, 9-pin female/ 9-pin male	HP 24542U
HP 7694 Headspace Sampler	INET Integrator	RS-232, 15-pin male/ 9-pin female	03396-60530
HP 7694 Headspace Sampler	HP non-INET Integrator	RS-232, 15-pin male/ 9-pin female	03396-60530
HP 7694 Headspace Sampler	Unspecified, non-HP instrument	Binary-coded decimal cable	03396-60570

Cable diagrams

If you connect the GC to a non-HP instrument or to the HP 35900 A-to-D Converter, you must know the function of each wire in the cable.

Analog cable, general use

The GC uses the general use analog cable to communicate with a non-HP integrator. The general use cable is also used with non-HP detectors.

Figure 21. Analog Cable, General Use (HP Part No. G1530-60560)

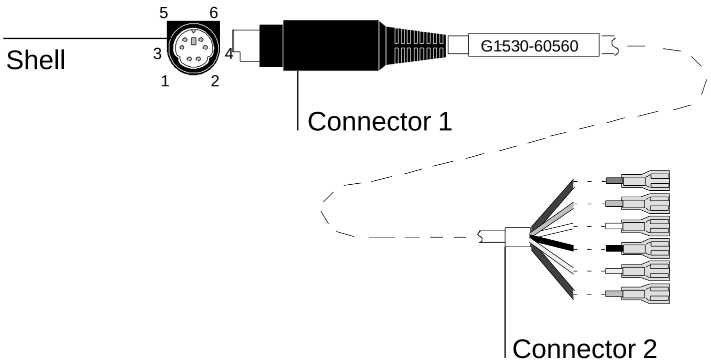


Table 10. Analog Cable, General Use Output Connections

Connector 1	Connector 2—Quick connects	Signal
1	Brown or violet	0 to 1 mV (-)
2	White	0 to 1 V, 0 to 10V(−)
3	Red	0 to 1 mV (+)
4	Black	1 V (+)
6	Blue	10 V (+)
Shell	Orange	Ground

Remote start/stop cable

Two ports are available to remotely start and stop instruments in a loop. For example, you might have an integrator, automatic sampler, and a gas chromatograph connected with Remote cables. You can synchronize a maximum of ten instruments using Remote cables.

Figure 22. Remote Start/Stop Cable Pin-outs, General Use (Hp Part No. 35900-60670)

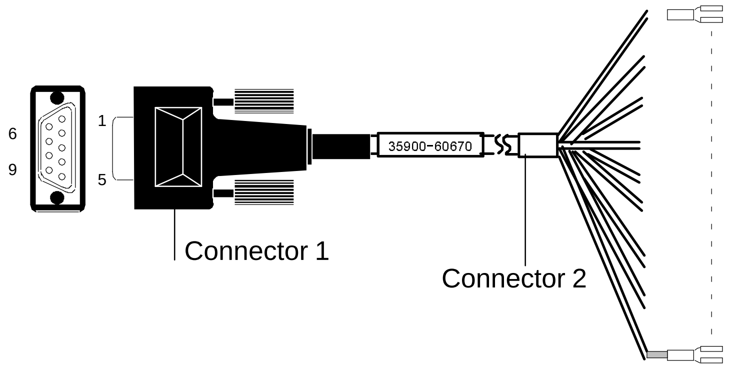


Table 11. Remote Start/Stop Connections

Connector 1 9 pin male	Connector 2 spade lugs	Signal Name
1	Black	GND
2	White	Prepare
3	Red	Start
4	Green	Shut down
5	Brown	Reserved
6	Blue	Power on
7	Orange	Ready
8	Yellow	Stop
9	Violet	Start request

Binary-coded decimal cable

The BCD cable contains eight passive inputs that sense total binary-coded decimal levels.

Figure 23. BCD Input Cable, Hp Part No. G1530-60630

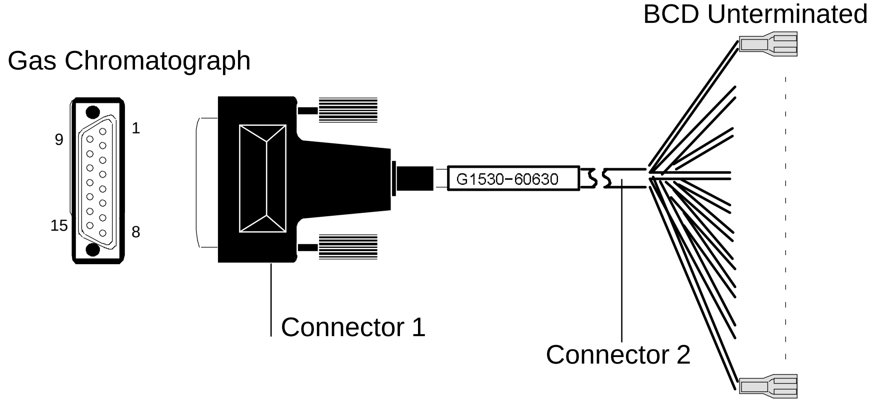


Table 12. BCD Input Connections

Connector 1 15 pin male	Color	Signal Name	Logic
1	Black	LS digit 0 (1)	Low true
2	Brown	LS digit 1 (2)	Low true
3	Red	LS digit 2 (4)	Low true
4	Orange	LS digit 3 (8)	Low true
5 through 7		unused	Low true
8	Gray	ground	Low true
9 through 11		unused	Low true
12	Yellow	MS digit 0 (1)	Low true
13	Green	MS digit 1 (2)	Low true
14	Blue	MS digit 2 (4)	Low true
15	Violet	MS digit 3 (8)	Low true

External event cable

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.

Figure 24. External Event Cable (Hp Part No. G1530-60590)

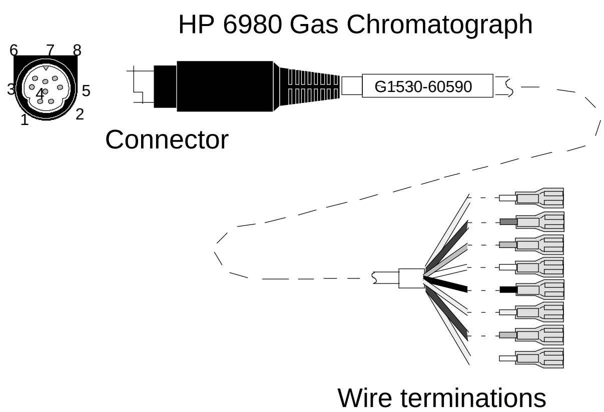


Table 13. External Event Connections

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, 250mA	Brown or violet	8
8	Contact closure 2		Blue	8

Step 14 Setting the GC Automatic Liquid Sampler switches

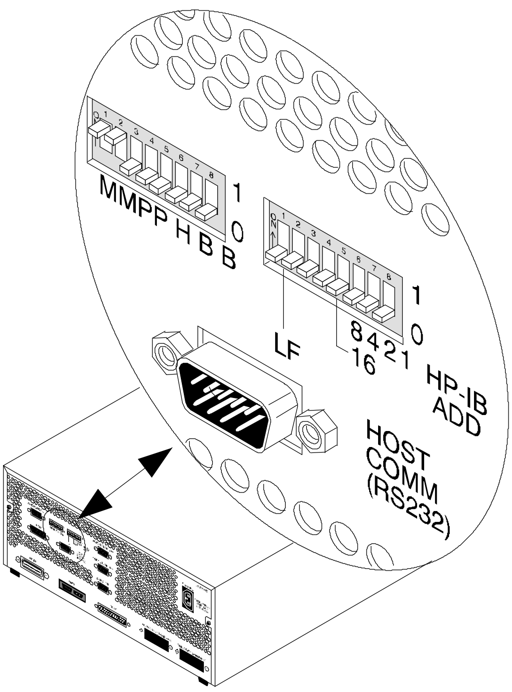
The GC Automatic Liquid Sampler (GC ALS) has a series of switches on the back panel of the controller that must be set properly.

Materials needed:

- ☐ A tool with a small point to move the switches (for example, a pencil with a sharp point)

Locate the switches on the back of the GC ALS controller. Set the first two switches on the left to “1”. Set all the other switches to “0”. See Figure 25.

Figure 25. GC ALS Switch Location And Correct Configuration



Step 15 Configuring the GC

For some operations, you must configure the GC to communicate correctly with another instrument. These operations require configuration:

- Using an HP ChemStation.
- Using an HP INET integrator.
- Using the modem for remote diagnostics.

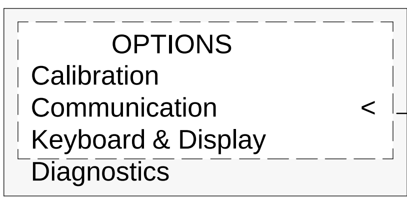
ChemStation and modem configurations are done at the GC keyboard. The INET integrator is configured at the integrator keyboard.

Configuring for the HP ChemStation

The GC and HP ChemStation communicate via an HP-IB cable (HP part no. 10833B-2310). Connect the cable before configuring.

Each instrument connected to the ChemStation needs an address. There are 31 addresses available (0 to 30). To assign an address to your GC:

1. Press [Options]



2. Scroll to Communication and press [Enter]

3. Enter a number between 0 and 30 and press [Enter]

You can connect a maximum of 15 devices with HP-IB cables. You are limited to 2 meters of cable for each device connected up to a maximum of 20 meters. If you have three devices connected with HP-IB cables, you can only use a total of six meters of cable. This can be in any combination; it’s the total length that matters. Do not stack more than three connector blocks on top of one another.

Configuring for the HP INET integrator

If you are using an INET integrator, you need to configure the signal range and the GC's INET address from the integrator keyboard. You must first connect the GC and integrator with the two INET cables.

When an INET connection is being used, the GC sends digital data and methods setpoints to the integrator. Although the GC produces data that is 37 points wide, the integrator can only accept 32 points of data. Because of this, you must determine and configure the data range.

Range values can be between 0 and 5. A range of 0 gives the integrator the greatest sensitivity. Range values are actually powers of 2 that the signal is attenuated by, so range 1 is half as sensitive as 0, and range 4 is 1/16 as sensitive as 0. Five, the least sensitive range, is the default.

If you are using an HP 3396 Series III INET integrator, refer to the manual for information on assigning the GC address and setting the range. If you are using an earlier version of the HP INET integrator, use the following procedure (the `computer font` indicates text you type at the keyboard):

1. Verify the INET address of the GC. At the integrator keyboard, press: `[I] [N] [Enter]`

   Usually, the address is 8.

2. Use the OP( ) 6 dialog to configure the integrator. Press: `[OP ()] [6] [Enter]`.

3. Enter the following dialog at the prompt:

   `8` (Or the GC INET address you received in step 1)
   `SIG1RANGE n [Enter]` (n = the value of the range)
   `SIG2RANGE n [Enter]` (if you have an HP 3396B integrator)
   `[BREAK]` (to exit the dialog)

Configuring for remote access

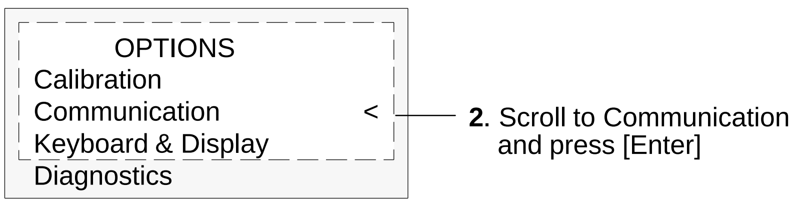
This serial port (labeled modem on the back of the GC) lets you connect the GC to a modem to provide remote diagnostic capability for Hewlett-Packard service personnel. You must configure the GC so that it communicates through the modem correctly.

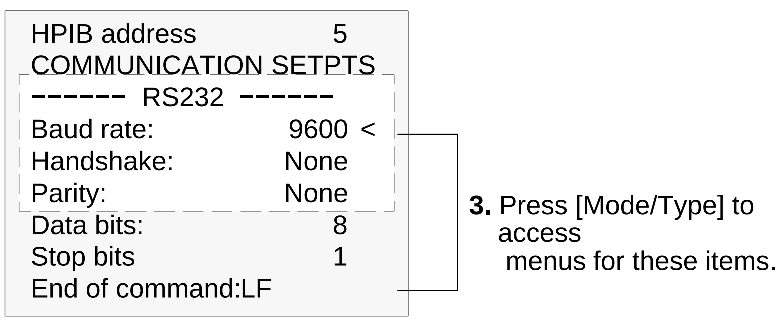
Before configuring, you must connect the GC and modem with the appropriate modem cable:

- HP part no. G1530-61120, 9-pin female/9-pin male
- HP part no. 24540-80012, 9-pin female/25-pin male

It is also recommended that the modem used for diagnostics be attached to a dedicated phone line.

1. Press [Options]





Baud rate: Specify the data transfer rate of your modem. The GC and modem or other communicating device must use the same baud rate.

```
 300
 120
   BAUD RATE MODE
 2400
 4800
*9600                  <
 19200
```

Handshake: Specify the action to be taken if either communicating device needs to pause data transfer from the other device.

```
   HANDSHAKE MODE
*None                  <
 XonXoff
 Hardware (CTS/RTS)
 Hardware (UART)
```

- None: No data flow control
- XonXoff: Software controls data flow (Also called software handshaking)
- Hardware (CTS/RTS): Uses hardware lines CTS and RTS for data flow control
- Hardware (UART): Stops data transfer immediately. Allows use of higher data rates, but may cause data loss.

Parity: Specify the parity mode for error checking.

```
   PARITY MODE
*None                  <
 Odd
 Even
 Mark
 Space
```

Data bits: Specify the number of data bits in each data packet sent between the two devices.

```
   DATA BITS MODE
*7 Data bits
 8 Data bits                    <
```

Stop bits: Insert a delay between the transmission of each data byte.

```
   STOP BITS MODE
*1 Stop bit                     <
 1.5 Stop bits
 2 Stop bits
```

Default — fastest rate

Use one of these settings if data transmission errors occur.

End of command: Specify the character used to indicate the end of a message over the RS232 port.

```
   END OF COMMAND
MODE
*LF (line feed)              <
 CR (carriage rtn)
```

Making SWAGE-LOK Connections

Step-by-step instructions for making SWAGELOK connections between gas supply tubing and components of the GC system.

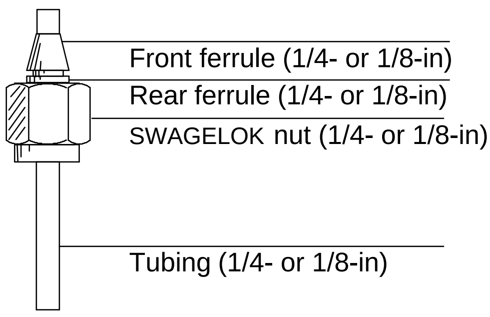
Appendix—Making SWAGELOK Connections

The gas supply tubing is attached with SWAGELOK fittings. If you are not familiar with making SWAGELOK connections, review the following procedure. The procedure explains how to connect tubing to a fitting, such as inlet and detector manifolds or the gas supply tank.

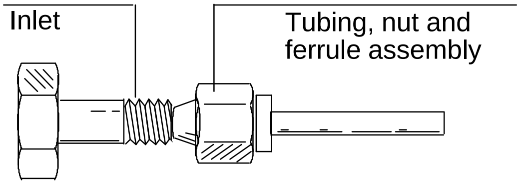
Materials needed:

- ☐ 1/8-in. preconditioned copper tubing
- ☐ 1/8-in. SWAGELOK nuts, and front and back ferrules
- ☐ Two 7/16-in. wrenches

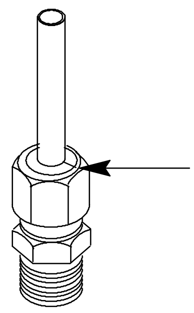
1. Attach a 1/8-in. SWAGELOK nut, back ferrule, and front ferrule to the tubing.



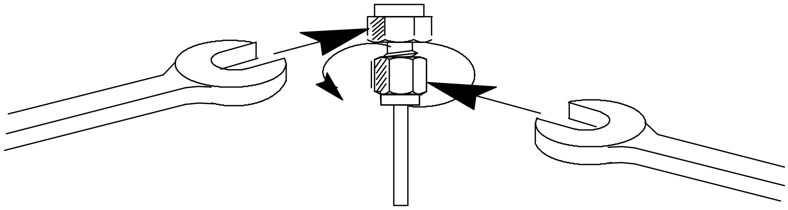
2. Make sure that the ferrule is touching the inlet, and then slide the SWAGELOK nut over the ferrule and tighten it finger-tight.



3. Mark the SWAGELOK fitting with a pencil line.



4. If you are using 1/8-in. SWAGELOK fittings, while holding the fitting steady with the other 7/16-in. wrench, tighten the fitting 3/4 of a turn. If you are using 1/4-in. fittings, tighten them 1 and 1/4 turn.



Tightening SWAGELOK nuts by this procedure provides a leak-proof, torque-free seal at all tubing connections.

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