

Agilent Intuvo 9000 Gas Chromatograph

Installation and First Startup



Agilent Technologies

Notices

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Agilent Technologies, Inc.
2850 Centerville Road
Wilmington, DE 19808-1610 USA

安捷伦科技（上海）有限公司
上海市浦东新区外高桥保税区
英伦路 412 号
联系电话：（800）820 3278

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CAUTION

CAUTION

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WARNING

WARNING

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

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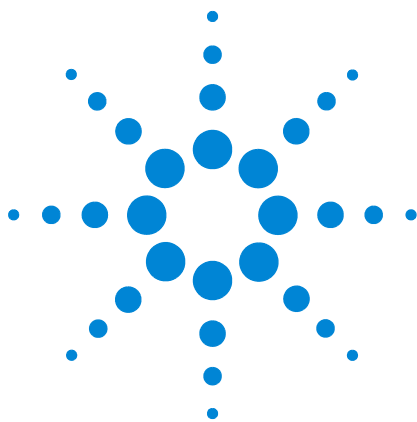
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Installing the GC

This section contains installation procedures for the Agilent Intuvo 9000 GC. Some of the steps in this procedure are optional based on your installed components, such as plumbing cryogenic cooling or valve actuator air.

Instructions for connecting cables from the GC to other instruments in a typical Intuvo 9000 system are included here and in [Appendix B, "Cable Diagrams."](#)



Overview of Installation

Before installing the GC, read the important safety information in the Agilent *Intuvo 9000 Gas Chromatograph Safety Information* manual (provided with the GC) and the *Safety* manual (available from the Agilent *GC and GC/MS User Manuals & Tools* DVDs).

Purpose of this procedure

This procedure ensures that instruments and systems are installed and functioning as designed. Correct installation is the first step in ensuring that instruments and systems operate reliably over their lifetimes.

Customer responsibilities

- 1 Make sure your site meets the basic requirements, including the necessary space, electrical outlets, gases, tubing, operating supplies, consumables and other usage-dependent items required for a successful installation. Refer to the Agilent *Intuvo 9000 GC, GC/MS, and ALS Site Preparation Guide*.
- 2 If Agilent is delivering installation and familiarization services, users of the instrument should be present throughout these services; otherwise, these users will miss important operational, maintenance, and safety information.

Additional information is available via the GC Touchscreen, Browser Interface help & information suite, and the Agilent *GC and GC/MS User Manuals & Tools* DVDs and through the instrument's website.

Once the GC is turned on, open a browser and connect to the instrument's help and information system.

If your site complies with all site preparation specifications, the average installation time for the GC is about 2 hours. Allow more time for any additional products (for example, an ALS), add-ons, and software.

About Agilent's installation service

The installation service does not include:

- Network setup with other computers or to the site or building LAN.

- Customization of the system.
- Method development and testing.
- Analysis of customer standards or samples.
- Testing against the instrument performance specification. (Operational qualification and performance verification services, OQ/PV, can be purchased separately.)

If you need assistance beyond this installation service, please contact your local Agilent Technologies office. Assistance with installation and with user-specific services and applications is available and will be contracted separately.

Tools and additional parts required

Installation requires the following tools, fittings, and hardware. **These items are not included with the instrument.**

- Preecleaned copper tubing, 1/8-inch or 1/4-inch od.
- Fittings.
- Tubing cutter.
- Filters for gas supplies.
- 7/16-inch and 9/16-inch open-end wrenches for assembling Swagelok fittings.
- Carrier and other gas supplies.
- Pressure regulator for each gas supply.
- A computer, tablet, or other LAN-capable device (for accessing GC user information and for firmware updates).
- Any additional LAN components, such as cables and a switch or hub, for connection to the site LAN (not included in Agilent installation services).

The *Agilent Intuvo 9000 GC, GC/MS, and ALS Site Preparation Guide* contains a listing of Agilent installation kits and a description of parts included with each. These kits contain filters, fittings, tubing, tools (wrenches, tubing cutter, drivers, and so on), and other required parts for installing a GC.)

Performing checkout

If using an Agilent data system, you can use it to perform the checkout procedure. Read these GC installation instructions and the instructions for installing the data system.

System installation

If installing an ALS, the ALS can be used for checkout. Also refer to the ALS installation documentation.

When installed as part of a complete system including an Agilent data system, first install the GC up to the checkout step. Configure the new GC in the data system and open an online instrument session. Use the data system to perform the checkout test.

When installed as part of other complete systems, for example in an Agilent GC/MSD or GC/MS system, see the installation instructions for that system.

Ship kit contents

Several ship kits will arrive with the GC. Most parts needed for installation will be found in the 9000 GC System Ship Kit. Ship kits for the ordered inlet and detector will include the inlet- and detector-specific parts needed for checkout and maintenance, for example, the inlet checkout liner, inlet wrench, septa, detector checkout sample, and typical cleaning tools (varies by inlet and detector type).

Syringe and plunger button, for manual injection

1/8-in Nut and ferrule set, brass, 10/pk

Certified vial sample pack

LAN cable

Intuvo Torque Driver handle and extension

Torx keys, T10 and T20

Gas line ID labels

Agilent *Intuvo 9000 Gas Chromatograph Safety Information* manual

MSD Cover insert assembly

Intuvo inlet chip, G4581-60031

Bus front door assembly, G4581-60207

Compression bolts (2), G4581-60260

Intuvo gaskets, polyimide, 2/pk

The Intuvo 9000 GC

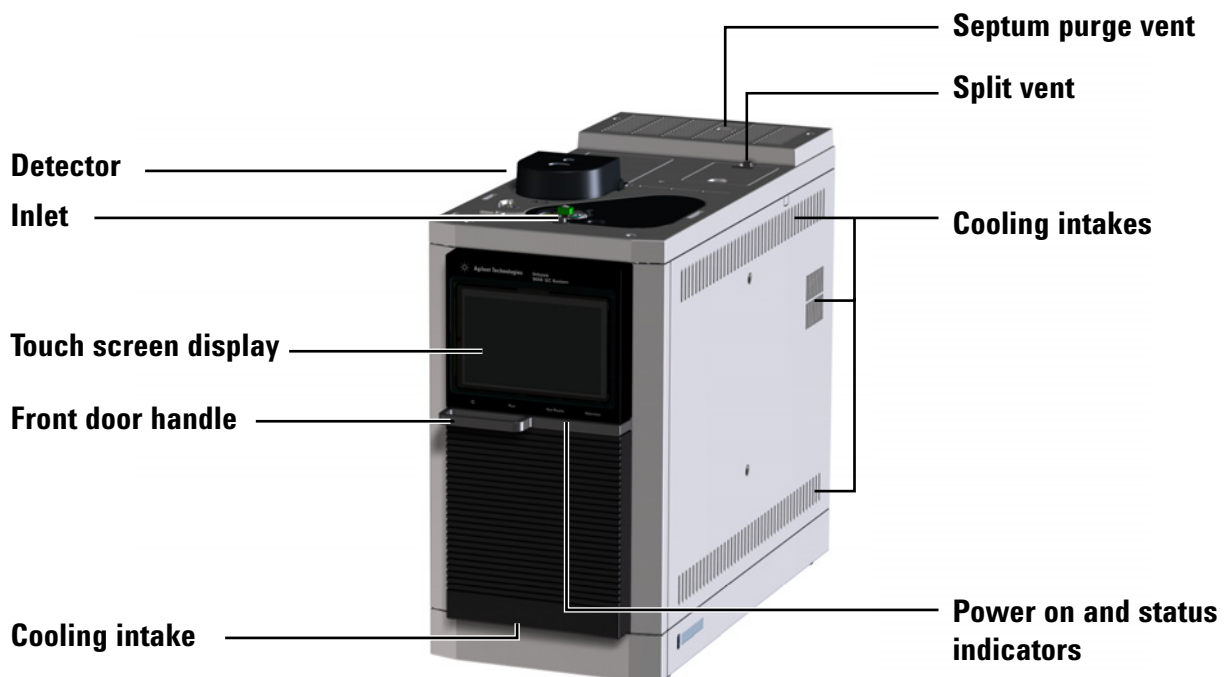


Figure 1 Front of the Intuvo 9000 GC

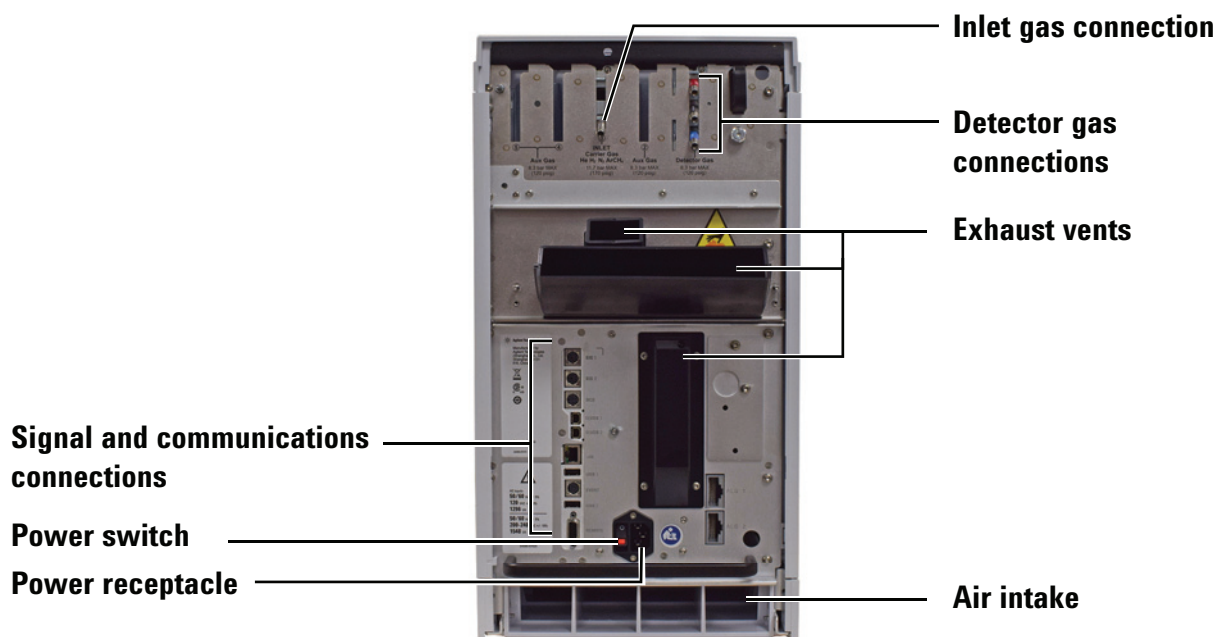


Figure 2 Back of the Intuvo 9000 GC

Unpacking

The GC is heavy. To avoid injury use a two-person lift.



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

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

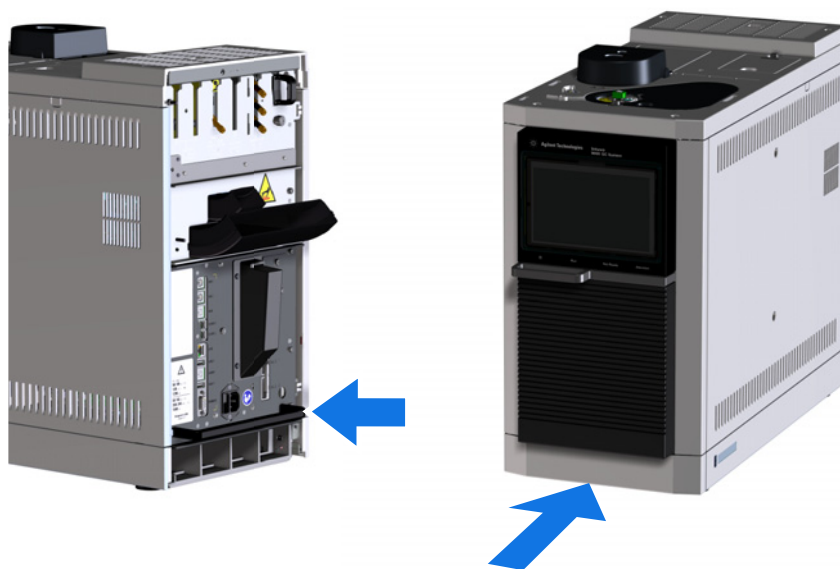
Place the GC on the bench.

The GC requires a bench that can support its weight plus that of other equipment you will use with it. The area must be free of overhanging obstructions that might interfere with autosamplers, or that limit access to the top of the instrument. The area must include sufficient space behind the GC to allow for cooling.

WARNING

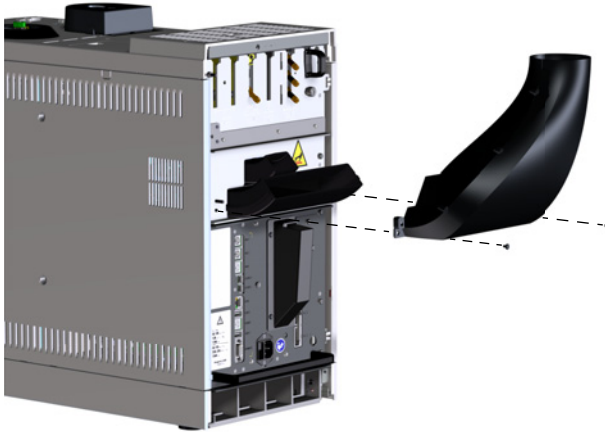
The GC is heavy. To avoid injury use a two-person lift.

- 1 Remove the GC from its shipping box. Lift using the handle on the back panel and the flat area beneath the GC front. Avoid lifting by the door handle or the front air intake grill.



- 2 Place the GC on the bench top. Make sure gas and power supplies are accessible. Place related equipment near the GC.
- 3 If space is limited behind the GC, attach the optional oven exhaust deflector to the back of the GC as shown below.

1 Installing the GC



The oven exhaust deflector accepts a 7.62 cm (3 in.) diameter exhaust duct, and adds about 7.6 cm to the depth of the GC, but this additional depth does not increase the depth required for proper ventilation. You will only need 20.3 cm (8 in) from the GC back panel.

Verify line voltage and power cord.

- 1 Verify that the power cord is correct for the voltage and location. See “Power cords available” on page 15.

The power cord termination is determined by the country where the GC is ordered.

WARNING

Electrical shock hazard. To avoid injury, only a qualified person should measure line voltage.

- 2 Have a qualified person measure the actual power outlet voltage and verify it meets the tolerance requirements listed in Table 1 on page 15. See also “Grounding” on page 18.

The next sections detail the power specifications and requirements for reference.

Power consumption

The number and type of electrical outlets required for installation depends on the size and complexity of your system. A GC system with a computer, monitor, printer, and hub requires five outlets. **The GC does not require a dedicated ground, but since the GC can draw up to 12 A maximum, depending on the line voltage, you may not want other devices on the same circuit.**

Table 1 GC power requirements

Line voltage [*]	Frequency	Current	Maximum continuous power consumption (VA)	Power outlet current rating
120 single phase*(-10% / +10%)	50/60 (-5% / +5%)	12 A	1296	15 A
200–240 V single/split phase, +10 to -10%	50/60 (-5% / +5%)	7.7 / 6.5	1548	10 A

* Users of 100 V power (Japan) receive the 120 V US power option with a 100 V/120 V step up transformer.

Power line conditioners should not be used with the GC.

Power cords available

Table 2 lists the power cords available for the GC. If your power cord is incorrect, order the cord appropriate for the country.

1 Installing the GC

Table 2 Power cords and terminations

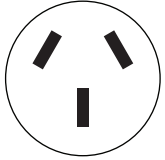
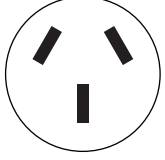
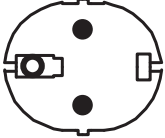
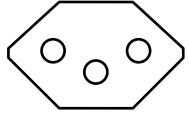
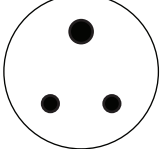
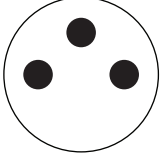
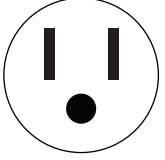
Country	Line Voltage	Amp Rating	Cable length (m)	Termination type	Plug Termination
Australia	240	10	2.5	AS 3112	
China	220	10	4.5	GB 1002	
Europe, Korea	220 / 230 / 240	10	2.5	CEE 7/7 Type F	
Switzerland	220	16	2.5	SEC Type 12	
India, South Africa	220 / 230 / 240	10	4.5	IEC 83-B1	
Israel	230	10	2.5	Israeli SI32	
Japan	120*	15	2.5	NEMA 5-15P	

Table 2 Power cords and terminations (continued)

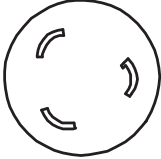

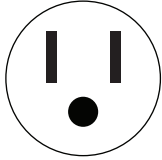
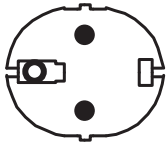
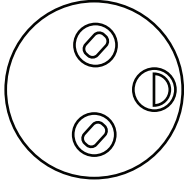
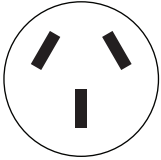
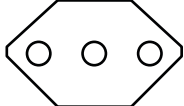
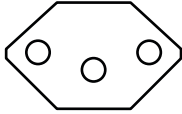
Country	Line Voltage	Amp Rating	Cable length (m)	Termination type	Plug Termination
Japan	200	20	2.5	NEMA L6-20P	
United Kingdom, Hong Kong, Singapore, Malaysia	240	10	2.5	BS89/13	
United States	120	15	2.5	NEMA 5-15P	
Europe	220 / 230 / 240	10	2.5	CEE 7/7 Type F	
Denmark / Greenland	220	10	2.5	SR 107-2-D1 DK2-5A	
Argentina	220	10		Type I	
Chile	220	10		CEI 23-16 Type L	

Table 2 Power cords and terminations (continued)

Country	Line Voltage	Amp Rating	Cable length (m)	Termination type	Plug Termination
Brazil	230	10		NBR 14136 Type N	

* Users of 100 V power (Japan) receive the 120 V US power option with a 100 V/120 V step up transformer.

Grounding

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 (outlet).

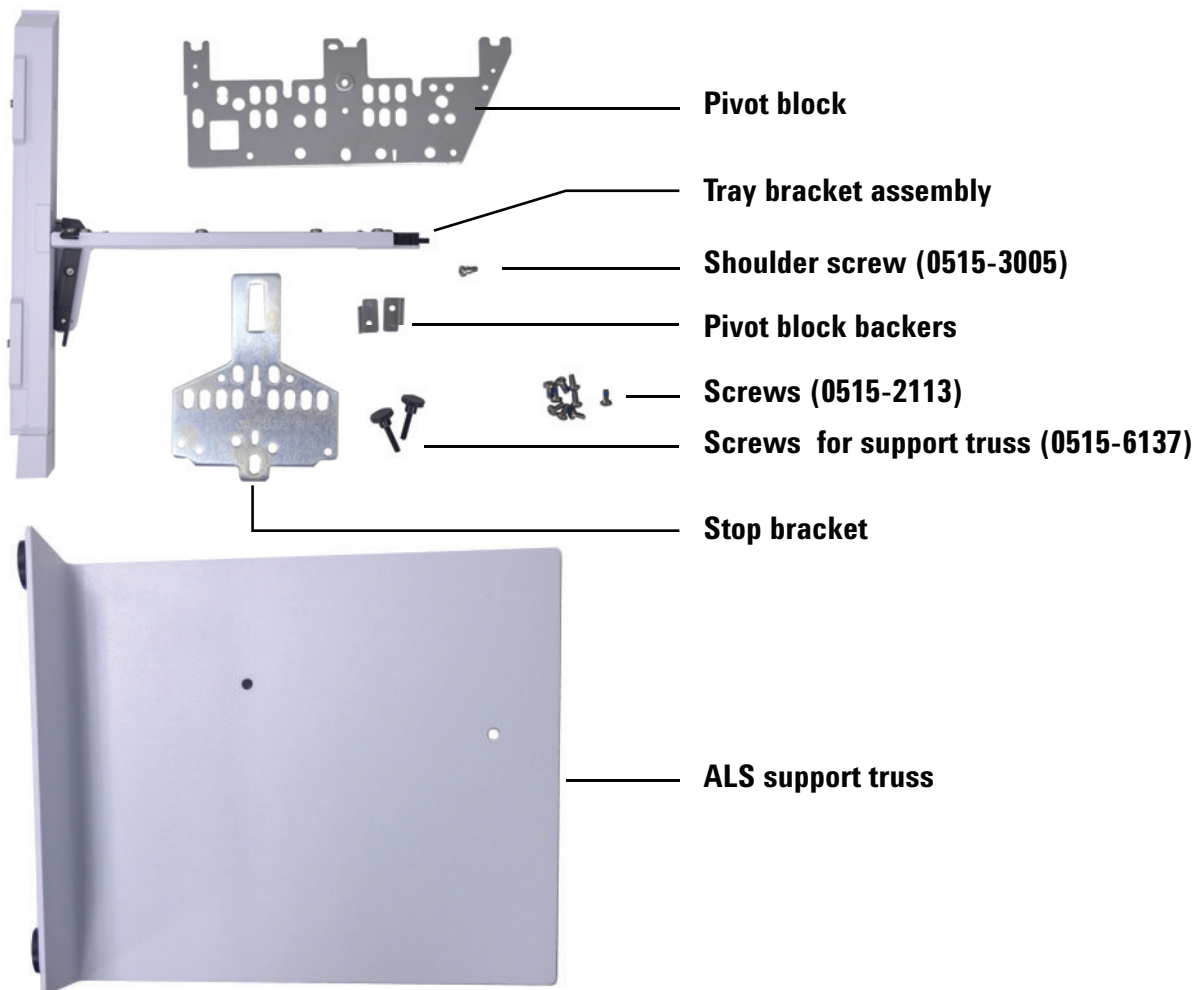
WARNING

Appliance Coupler (mains input power cord) is the power disconnect device. Do not position the instrument such that access to the coupler is impaired.

If purchased, install the ALS tray support brackets.

If installing a 7693A ALS tray with this Intuvo 9000 GC, install the pivot block, support bracket, and support truss now. (Refer to the Intuvo 9000 7693A Tray Support Assembly, accessory G7390A).

Intuvo 9000 7693A Tray Support Assembly kit contents



Install the pivot block and stop bracket



1 Installing the GC

Install pivot block

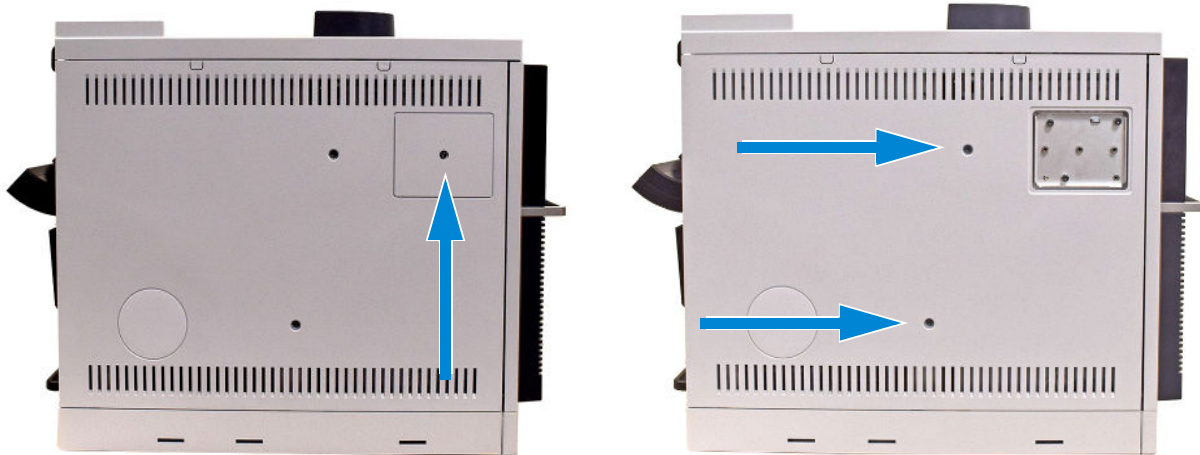
- 1 Remove the GC top cover.



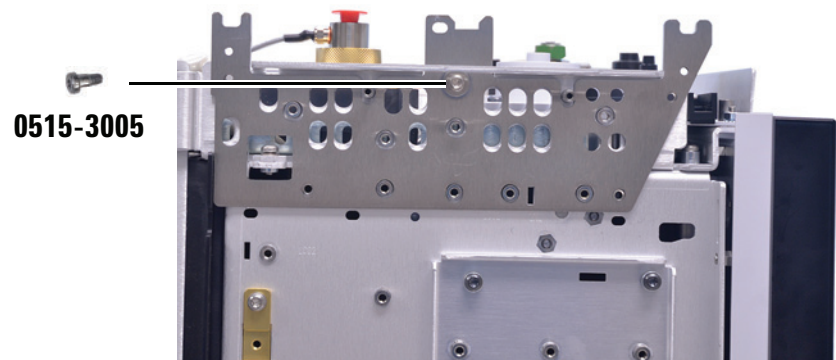
- 2 Remove the GC right side panel.



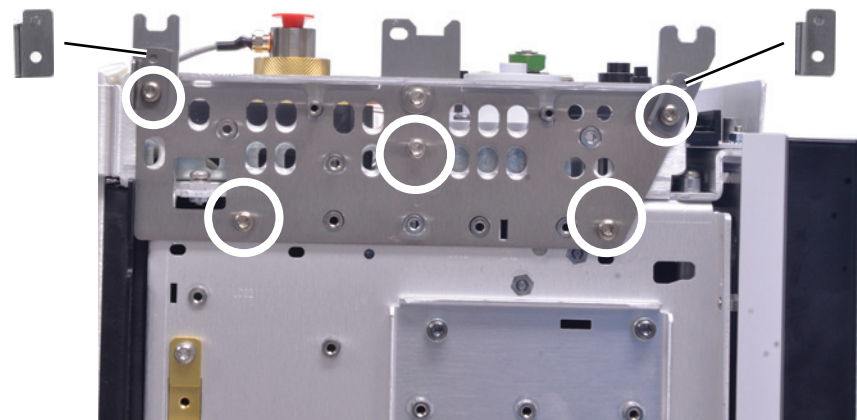
- 3 Remove left side panel.



4 Install pivot block with shoulder screw (0515-3005).



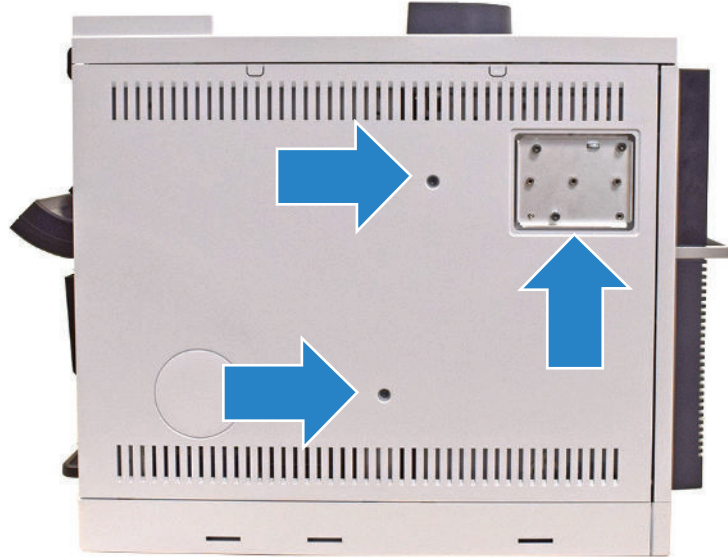
5 Install the two pivot block backers (G4580-00272) with two screws (0515-2113), then attach three screws (0515-2113) to the bottom three holes of the pivot block.



6 If **not** using a D2 or MSD, remove the two captive screws in the left-side panel. Install the left side panel onto the GC

1 Installing the GC

(without screws – you will install two new screws in a later step). Install the MSD frame cover.



- 7 **If using a D2 or MSD**, install the left side panel onto the GC. (Do not install the MSD frame cover.)
 - 8 **If not using a D2 or MSD**, install the MSD cover insert, then attach the support truss (G4580-60517) to left side of GC.
- If using a D2 configuration or MSD**, you will not have a support truss. Skip this step.



a Match the slots on the left side of the GC.



b Secure the support truss with two thumbscrews (0515-6137).

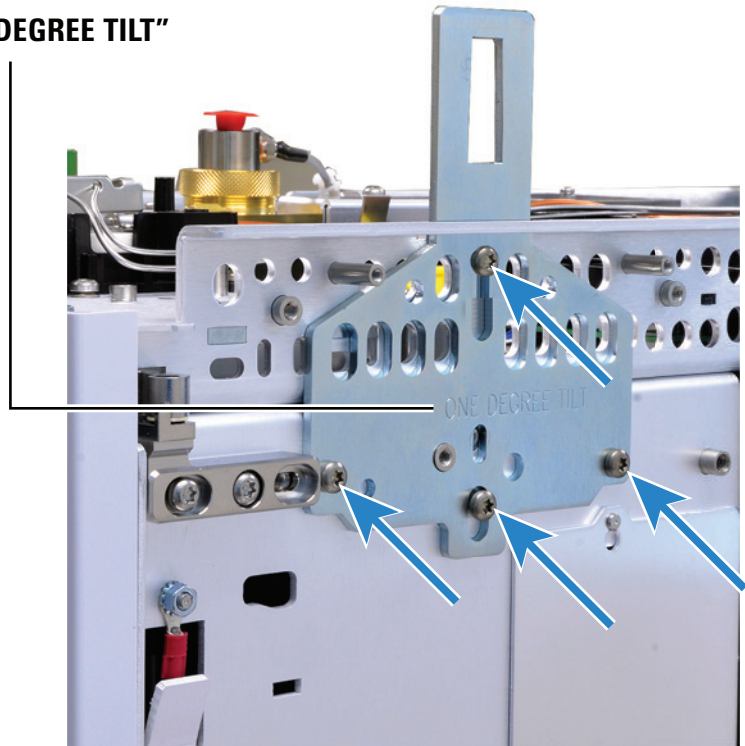


1 Installing the GC

Install the stop bracket on the right side of the GC

- 1 Install the stop bracket with four screws (0515-2113). The label “ONE DEGREE TILT” should face outward.

“ONE DEGREE TILT”



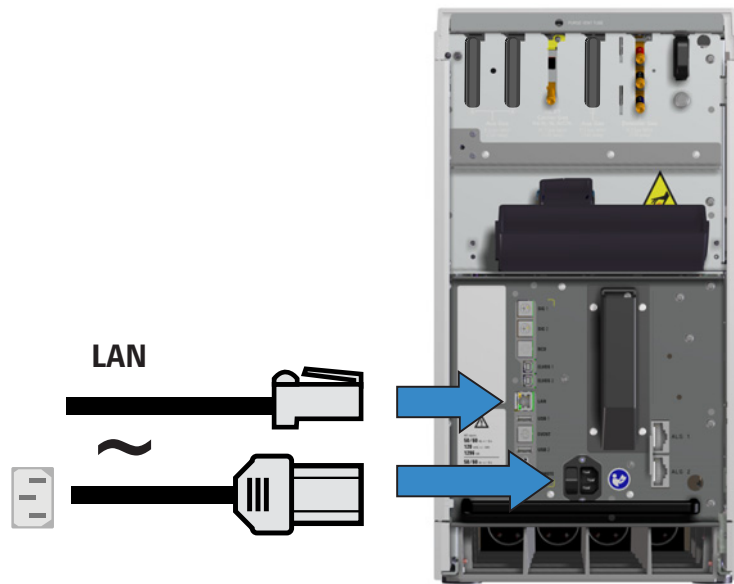
- 2 Install the right-side cover.



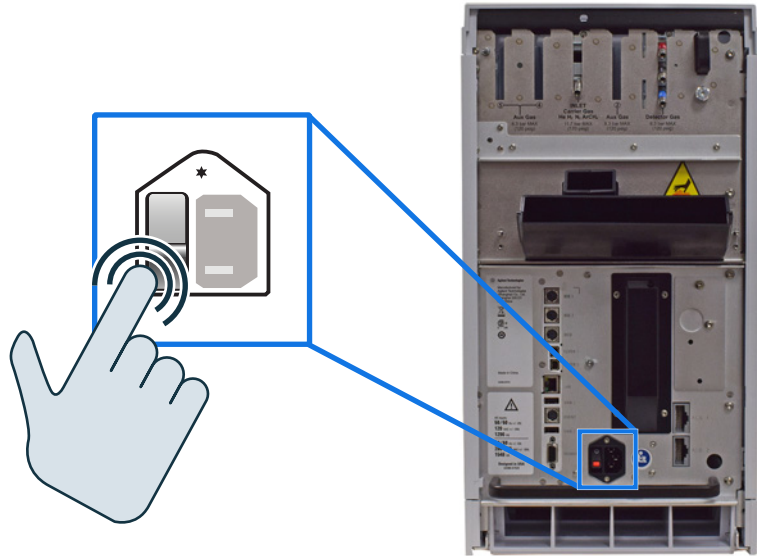
3 Reinstall the GC covers.

1 Installing the GC

Connect the power cord and LAN cable.



Turn on the GC.



View the feature tour.

The Feature Tour displays automatically each time the GC is turned on, and quickly introduces the GC touch screen and how to navigate through it to make settings and perform tasks on the GC. Use the navigation arrows to view each screen. Touch **Cancel** when done.



To skip displaying the Feature Tour each time the GC is turned on, select **Don't show again**.

The **Feature Tour** can be viewed from the help at any time.
Touch ? > **Help and Information** > **Familiarization** > **Feature Tour**.



View the System Setup wizard.

When the Feature Tour ends, the GC next launches the system setup wizard. The system setup wizard walks through the most important steps needed to install and configure the GC. It provides a way to enter only the critical settings needed to get started quickly, leaving all other configuration settings at their default values. These steps include:

- Unpacking
- Setting the system date, time, and IP address
- Setting the gas units, gas types, and similar choices
- Connecting gases and checking for leaks
- Installing a sampler, if available
- Running a checkout sample



If a setting is correct as shown, or when a task is complete, touch **Next**.

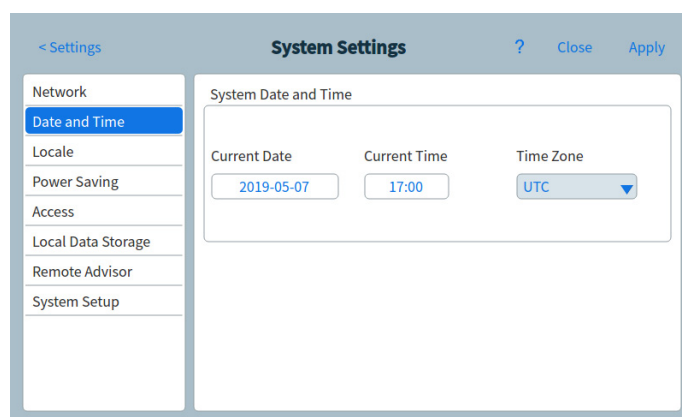
You can follow the system setup wizard, or cancel it and follow the procedures here instead. Whether using the wizard or not, this guide provides all of the supporting information needed for installation.

After exiting the system setup wizard, you can re-launch it at any time. On the GC touch screen, navigate to **Settings > System Setup** and touch **Run System Setup**.

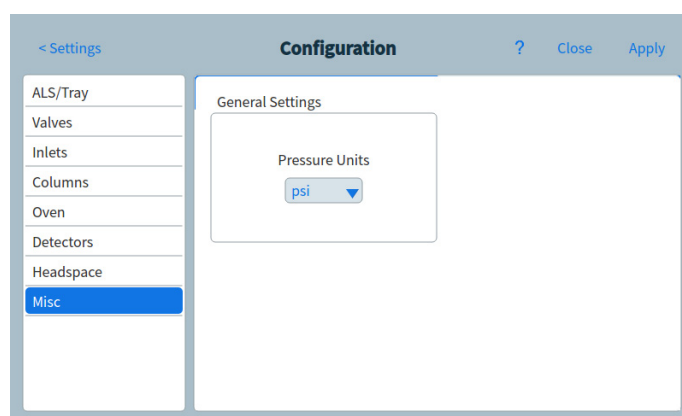
Set the system time zone, date, time, and pressure units.

Touch **Settings** > **System Settings** > **Date and Time** and set the GC clock.

- The **Current Time** is based on a 24 hour clock.
- The time set here is important for the time and date stamps used when collecting data and recording log entries (such as maintenance tasks and errors). The GC time also controls resource conservation for connected samplers.

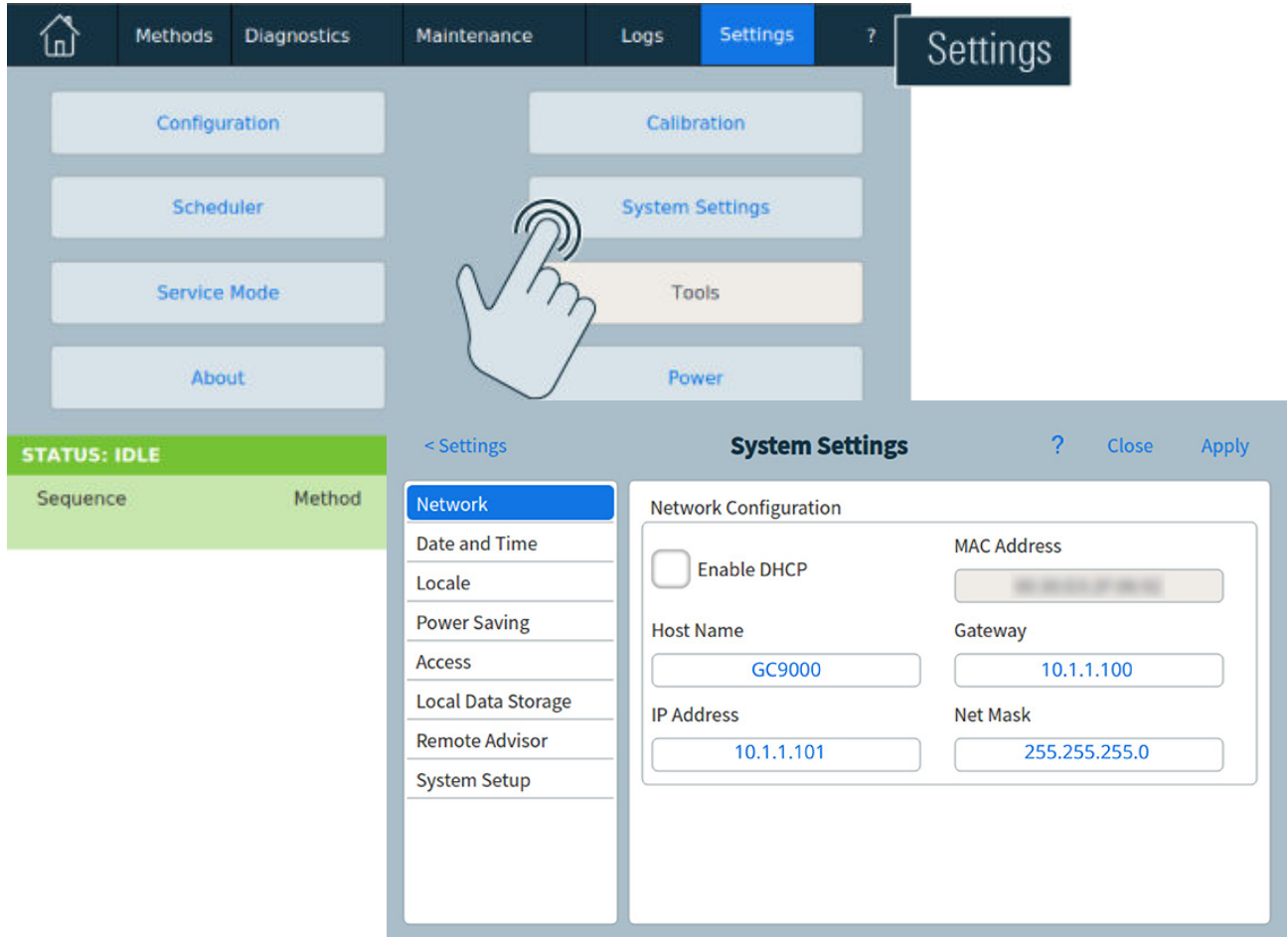


Touch **Settings** > **Configuration** > **Misc** and select the desired pressure units to use in methods.



Configure the GC IP address.

Touch **Settings** > **System Settings** > **Network**.



Enter the GC **Host Name** or **IP address**, **Gateway**, and **Net Mask** (subnet mask).

For an isolated LAN installation, see [Table 3](#) for typical IP

addresses.

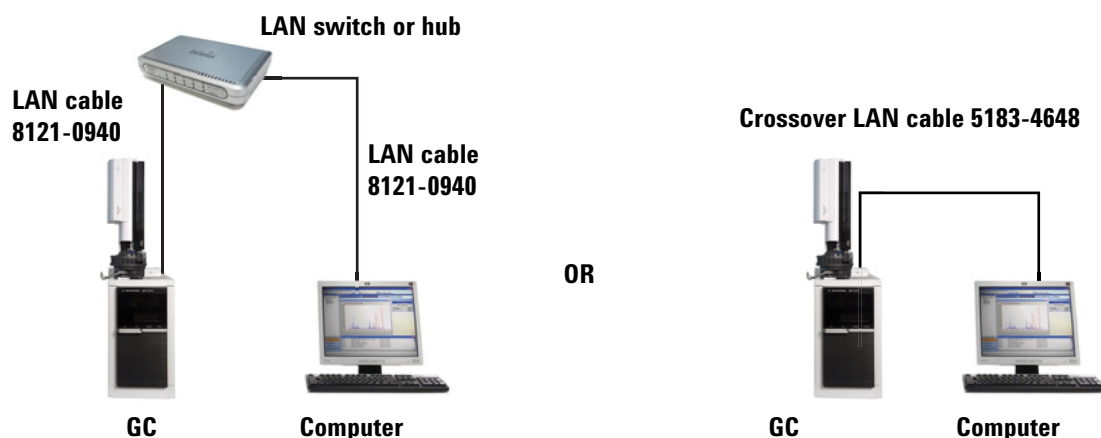


Figure 3 Simple supported LAN configurations: LAN switch or hub (left) and direct connection (right)

Table 3 Typical IP addresses for an isolated LAN

	GC	Computer
IP address	10.1.1.101	10.1.1.100
Subnet mask	255.255.255.0	255.255.255.0

A single LAN communications cable is supplied with the GC. The switch (or hub) and other cables must be ordered separately, if needed. See [Table 3](#) and [Table 4](#) for cabling requirements for other configurations.

Table 4 Cabling requirements

9000 GC connected to:	Required Cable(s)	Part number
Samplers		
7693A Automatic Liquid Sampler	Injector cable or tray cable	G4514-60610
7650 Automatic Liquid Sampler	Injector cable	G4514-60610
7697A Headspace Sampler	Remote, 9-pin male/6-pin connector	G1530-60930
G1289B/G1290B Headspace Sampler	Remote, 9-pin male/6-pin connector	G1530-60930
PAL automatic sampler	Cable, 4 conductor, remote start	G6500-82013
Mass Spectrometers and MS systems		
Mass Selective Detector	Remote, 2-m, 9-pin male/9-pin male	G1530-60930
Integrators		

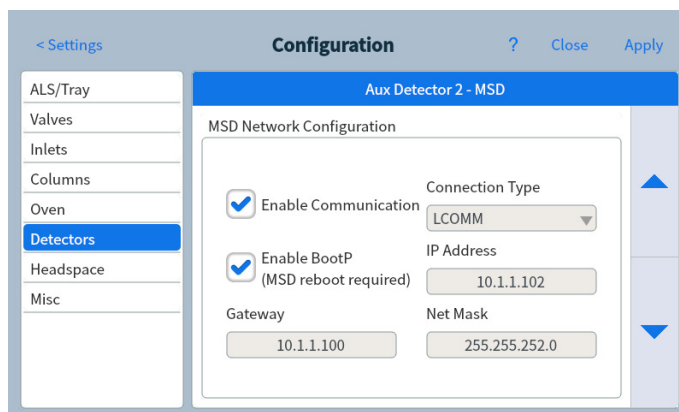
1 Installing the GC

Table 4 Cabling requirements (continued)

9000 GC connected to:	Required Cable(s)	Part number
3395B/3396C Integrator	Remote, 9 pin/15 pin Analog, 2 m, 6 pin	03396-61010 G1530-60570
Non-Agilent Integrator	General purpose analog signal cable 2 m, 6 pin	G1530-60560
Non-Agilent data system	General use remote, 9-pin male/spade lugs (various lengths)	35900-60670 (2 m), 35900-60920 (5 m), 35900-60930 (0.5 m)
Other devices		
Non-Agilent instrument, unspecified	External event, 8 pin/spade lugs (No label. See “Labeling BCD and EVENT cables”.)	G1530-60590
Stream selection valves Gas sampling valves (external)	See documentation accompanying the valve External valve cable (includes green EVENT label)	 G1580-60710
LAN		
LAN	Cable, networking CAT 5, 25 feet Cable, LAN, crossover	8121-0940 5183-4648

Configure the 5977B MS

If connected to a 5977B MS, use the GC touch screen to provide the MS with its IP address, and to select the part information (for example, source type and pump type). Touch **Settings > Configuration > Detectors**, then select the tab for the MSD.



Scroll to the **MSD Network Configuration** settings to enter the MSD IP address and related settings. The MSD IP address entered here must exactly match the IP address entered in the data system.

The GC already knows most details about the MSD, however,

you can scroll through the screens to select the consumables data (source type, pump type, and so on).

Configure another MS type

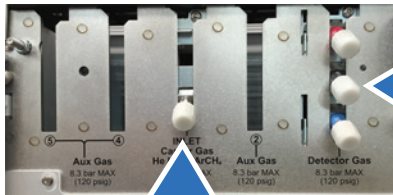
If connected to an MS such as 5977A or 7000C/D, use the GC touch screen to identify the connected MS's IP address and to select the part information (for example, source type and pump type). Touch **Settings > Configuration > Detectors**, then select the tab for the MSD. The MSD IP address entered here must exactly match the IP address entered in the data system and at the MSD keyboard.

1 Installing the GC

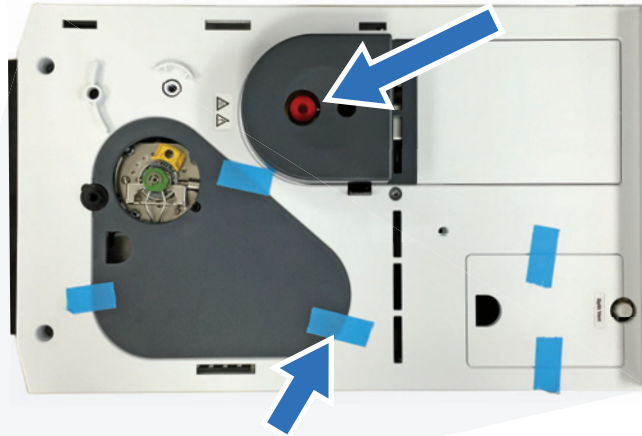
Prepare the GC.

- 1 Remove protective packing used for shipment.
 - On the back of the GC, remove the caps from the inlet and detector gas fittings.
 - Remove any cap from the cryogenic coolant fitting, if present.
 - Remove any protective cap from the detector exhaust port or exhaust tubing.
 - On the top of the GC, remove any tape used to secure covers, and remove any protective caps placed on detector exhaust port.

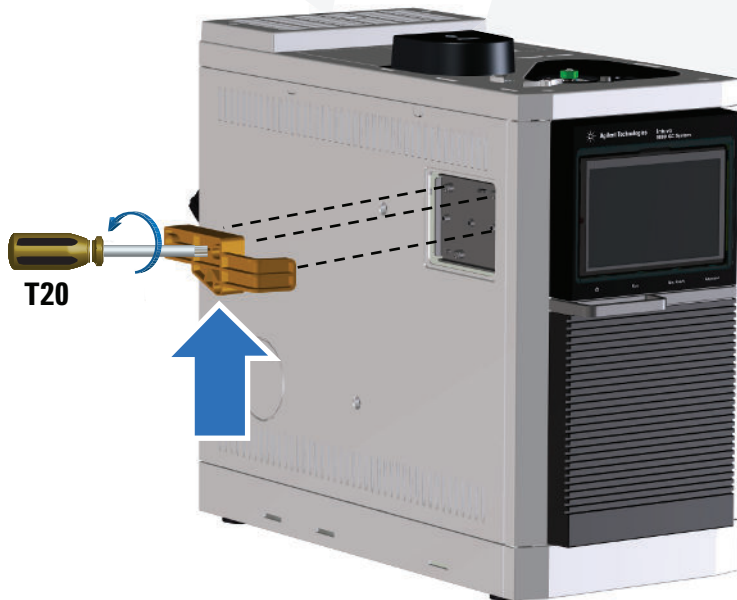
Back panel caps



Tape and detector exhaust cap



Door clamp



Cryo coolant fitting cap (if present)

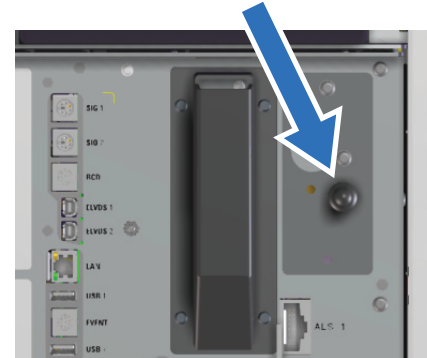
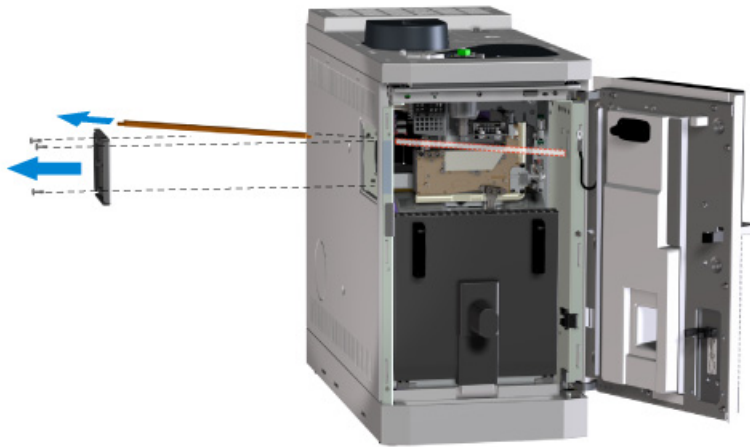
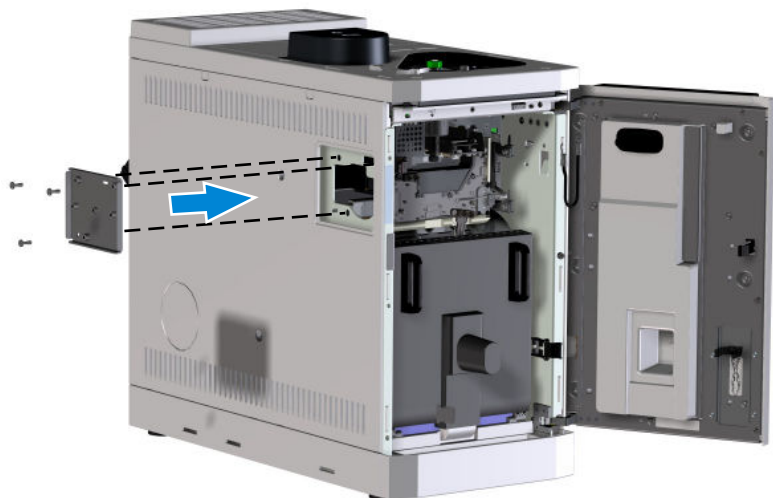


Figure 4 Remove exterior protective packaging

- 2 Loosen the captive screws in the shipping door clamp and remove the clamp. See [Figure 4](#) above.
- 3 Remove the detector tail brace.
 - a Use a T20 Torx driver to remove the screws that secure the MSD frame cover and remove the cover.
 - b Slide the detector tail brace out of the side of the GC.



- c Reinstall the MSD frame cover.
 - If installing a 7693A tray assembly, you can skip this step and install the MSD frame cover after installing the tray mounting hardware.
 - If installing an MSD or D2 assembly, skip this step.



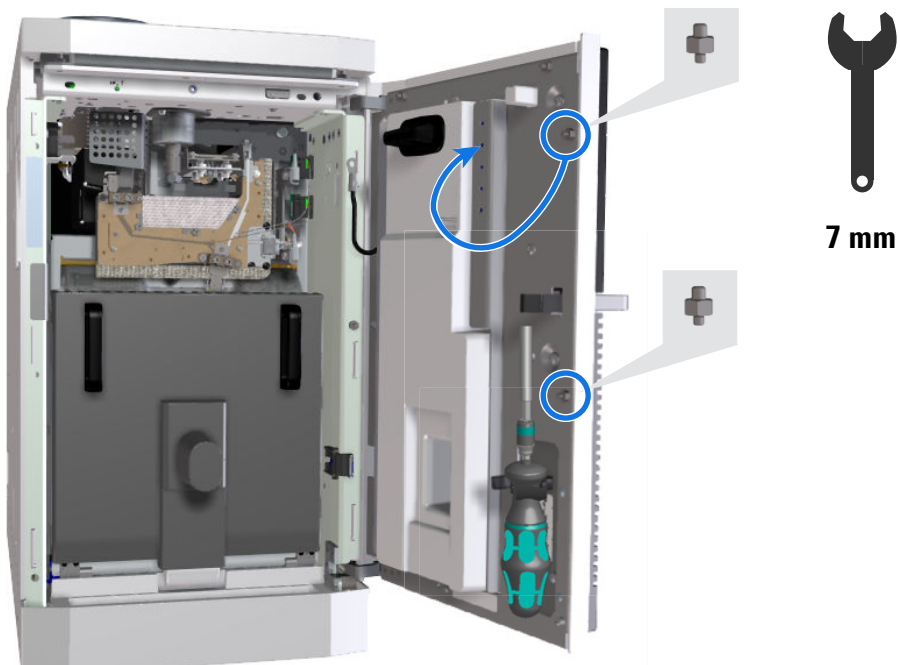
- 4 Assemble the Intuvo Torque Driver and attach it to the GC front door. The calibrated torque driver handle (8710-2790)

1 Installing the GC

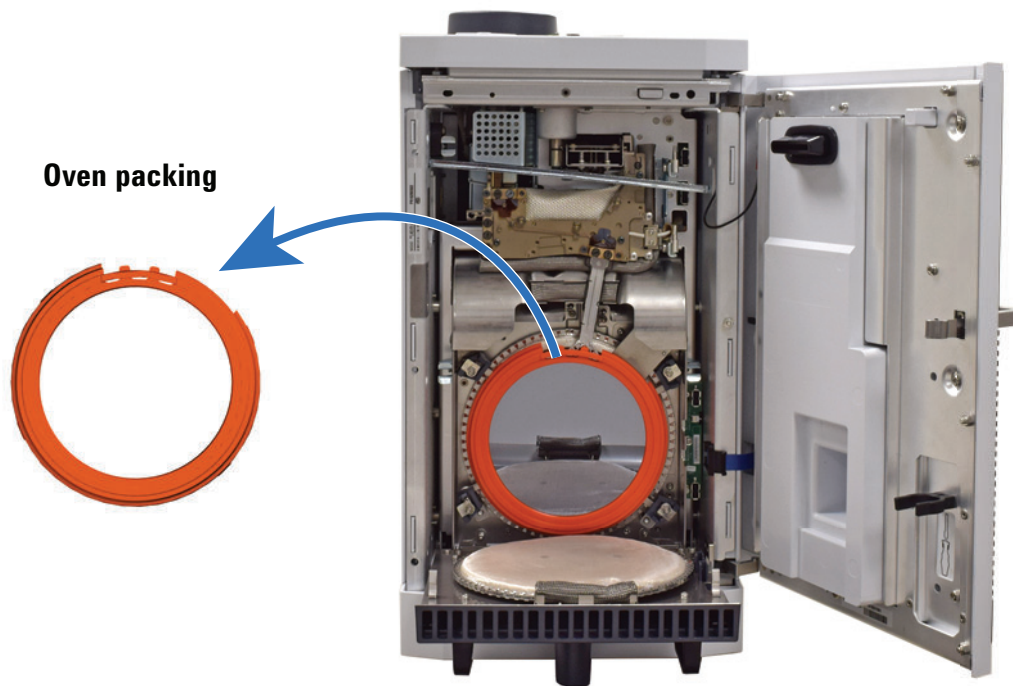
and extension (G4581-20522) can be found in the 9000 GC System Ship kit, G3950-68000.



5 Remove protective packaging.

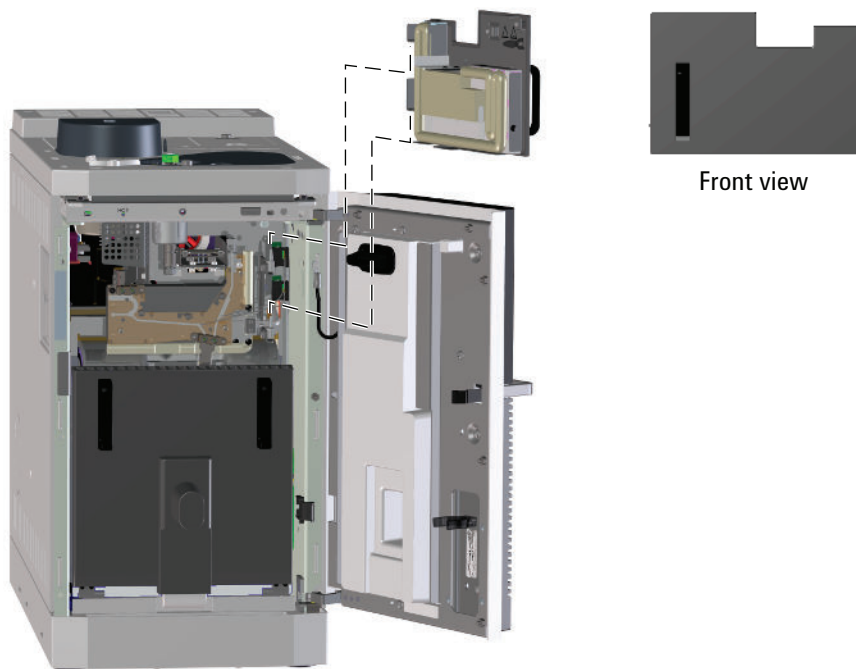


6 Open the oven door. Loosen any ties that secure the oven packing in place, and remove the oven packing.



7 Install the bus door, G4581-60207. The door rests on two hinge pins in the GC.

Bus door



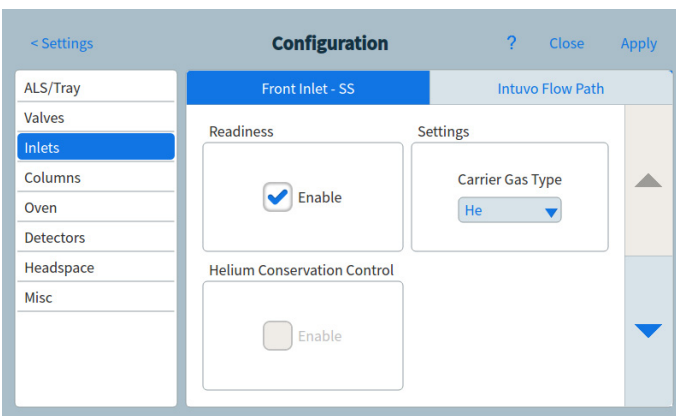
8 If you are not installing a tray, MSD, or D2, install the MSD cover insert assembly.

Configure gases and detector-specific settings.

Select the gas types that will be connected to the GC.

If your GC detector includes other settings, for example a **Lit Offset** value for a flame ionization detector (FID), accept the default value for installation and checkout.

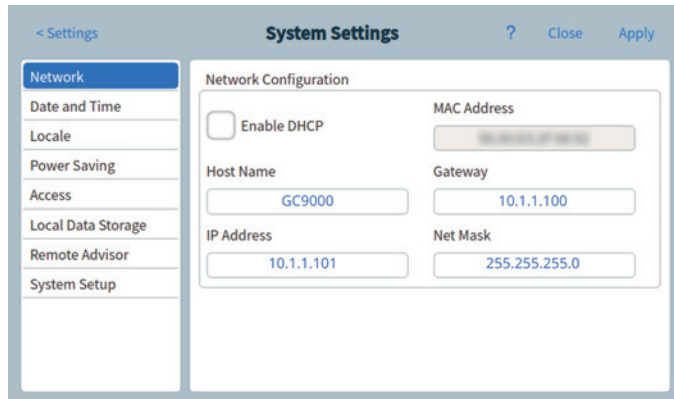
Touch **Settings > Configuration > Inlet** to set the inlet carrier gas type and, for a multimode inlet, to select the cryo gas type.



Touch **Settings > Configuration > Detectors** to set the detector gas type or types.

Connect to the GC and view the complete installation guide.

Open the complete installation instructions by browsing to the GC in a web browser. This connection requires only that the device and the GC connect to the same LAN. No Internet connection is required. (A direct connection using a LAN cable between the GC and a PC will also work.)



[http:// 10.1.1.101 /install](http://10.1.1.101/install)



Prepare gas supplies.

Most of installation involves plumbing gas to tanks, filters, and flow modules. Swagelok fittings are used to make leak-tight connections. If you are not sure how to make a Swagelok connection, see [Appendix A](#) for instructions.

WARNING

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.

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

Install the gas regulators

- 1 Select the appropriate CGA regulator for each gas type. (In other countries, refer to local standards. See the Agilent *Intuvo 9000 GC, GC/MS, and ALS Site Preparation Guide* for requirements.)

Table 5 Gas regulators, 1/8-inch, U.S. only *

Description	Part number
CGA 346, 125 psig max (8.6 bar), Air	5183-4641
CGA 350, 125 psig max (8.6 bar), H ₂ , Ar/Me	5183-4642
CGA 540, 125 psig max (8.6 bar), O ₂	5183-4643
CGA 580, 125 psig max (8.6 bar), He, Ar, N ₂	5183-4644
CGA 590, 125 psig max (8.6 bar), Air	5183-4645

* For 1/4-inch tubing, purchase a 1/4-inch to 1/8-inch adapter, U.S. only.

- 2 Confirm that the outlet fitting of the regulator is 1/8-inch Swagelok. If not, install the appropriate adapter fitting. Wrap the fitting threads using PTFE tape. Wrap the tape in a clockwise direction so that the adapter threads do not unwrap the tape. Be careful to keep the tape away from the end of the fitting. Two to three tightly wound wraps are sufficient. **Never use a liquid thread sealant.** Liquid thread sealants introduce contamination into the GC plumbing system. Tighten the Swagelok adapter fitting securely to the NPT pipe thread fitting.



3 Install the regulator onto the compressed gas cylinder main fitting.

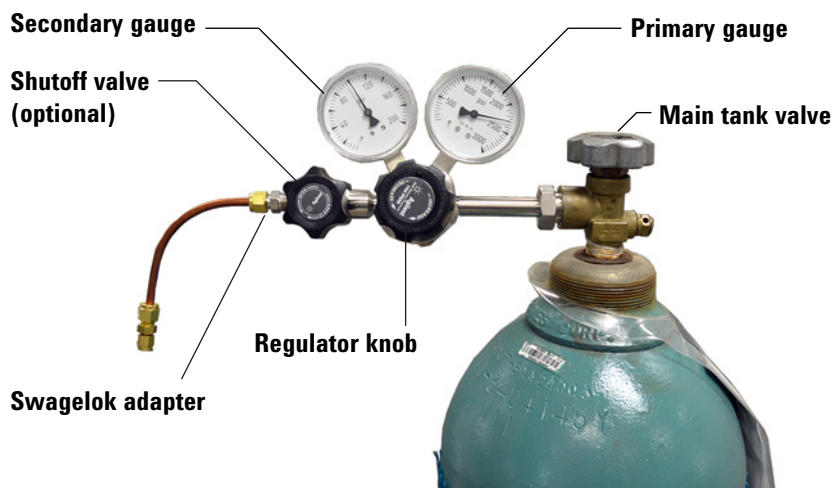
- Check the thread type. Some regulators use left-hand thread fittings. For left-handed threads, the nut will have a groove in it.



1 Installing the GC

- 4 Purge the air from the regulator by repeating the following procedure 5 times:
 - a Fully close the regulator knob, then open the main tank valve.
 - b Turn the regulator knob fully counter-clockwise to open the tank main valve, pressurizing the primary side of the regulator.
 - c Turn OFF the tank main valve.
 - d Slowly turn the regulator knob clockwise to release (“bleed off”) the gas pressure.
 - e Close the regulator knob.

The image below illustrates a typical pressure regulator installation. In the example shown below, which uses an optional shutoff valve, open the shutoff valve and leave open during purging.



Connect tubing to gas supplies and purge.

Connect the tubing to the gas source

NOTE

If you need more than 4.5 m (15 feet) supply tubing for a gas source, use 1/4-inch tubing with appropriate hardware. See the *Agilent Intuvo 9000 GC, GC/MS, and ALS Site Preparation Guide* for part numbers.

- 1 Turn off all gases at their sources. Measure the length of tubing needed to connect the gas supply outlet to the inlet fitting on the GC. Take into account any traps or tees you will need.
- 2 Cut the tubing to length with a tubing cutter (Figure 5).

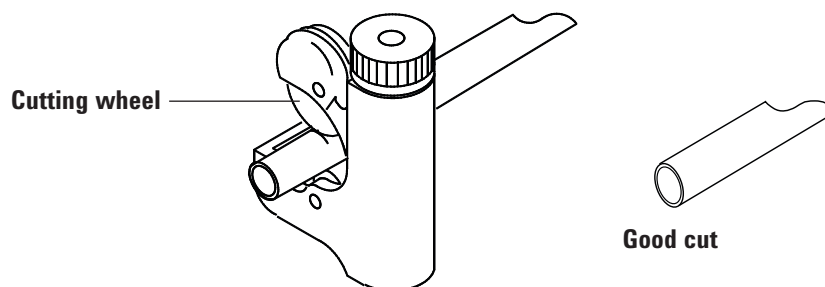


Figure 5 Typical tubing cutter

- 3 Connect the tubing to the gas source with a Swagelok fitting. See [Appendix A](#), “Making Swagelok Connections.”
- 4 Purge the supply lines for a few minutes before connecting them to the GC flow modules.

Install filters and traps, then purge.

This section describes the general installation of traps to a typical GC. Refer to the installation instructions provided with the traps for more details.

Install traps

- 1 Determine where you will install the traps in your supply tubing line. **Figure 6** shows the recommended trap order for the carrier gas and the recommended locations for On/Off valves. See also the *Site Preparation Guide*.

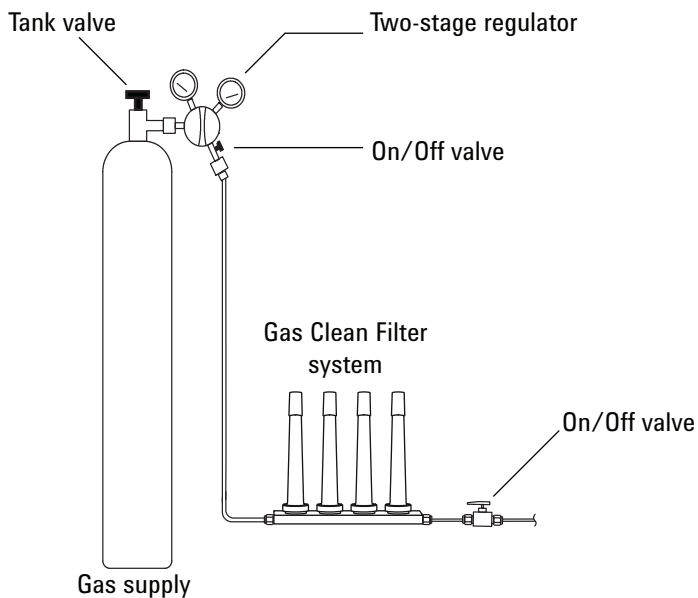
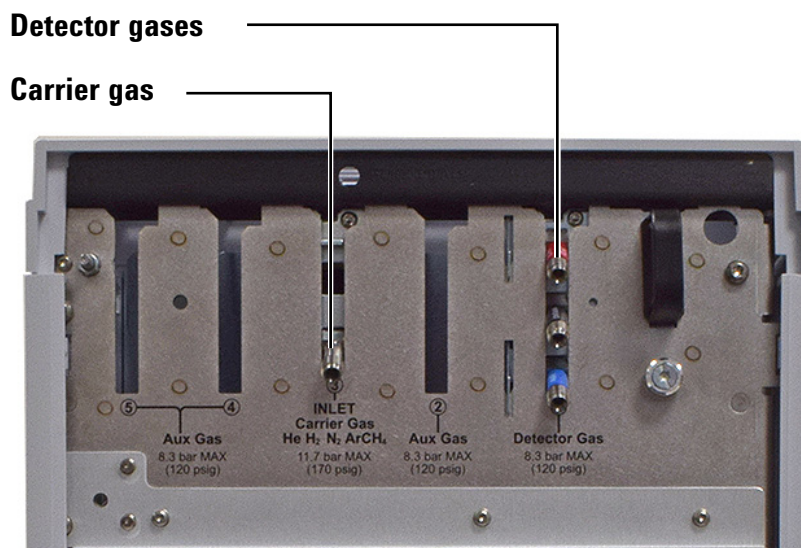


Figure 6 Plumbing the gas supplies

- 2 Cut the tubing to length with a tubing cutter.
- 3 Connect the traps and tubing. On/Off valves are not essential, but are very useful when a tank or trap must be changed. (If purchasing Agilent compliance services, install an on/off valve for the inlet gas supply.)

Connect gases to the GC.

Plumb to EPC flow modules



Purge the supply lines for a few minutes before connecting them to the GC flow modules.

If sharing carrier gas between an inlet and a detector, we recommend using a Tee fitting that includes shutoff valves for performing leak tests.

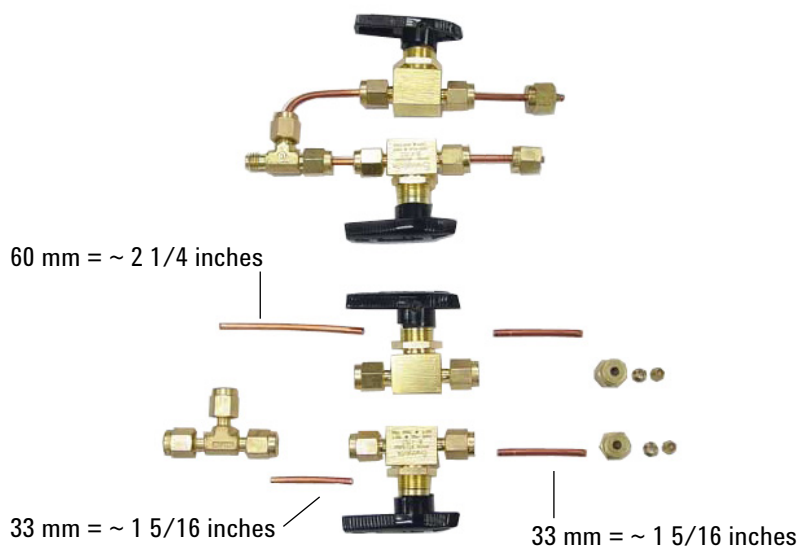


Figure 7 Example Tee with shutoff valves

When two detectors use the same gases, we recommend using a Tee fitting. Shutoff valves are not required.

TCD connections

The carrier gas and reference gas must come from the same source. Use a Tee fitting.

Leak test all connections and set source pressures.

Liquid leak detectors, such as soapy water, are not recommended, especially in areas where cleanliness is very important. If there is a leak, these liquids can contaminate the plumbing and affect your analyses. If you do use leak detection fluid, immediately rinse the fitting to remove the soapy film.

When checking for leaks of hydrogen or helium, Agilent recommends the G3388B leak detector, or similar.

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.

Perform a pressure drop test.

- 1 Set the regulator pressure to 415 kPa (60 psi).
- 2 Fully turn the regulator pressure adjustment knob counterclockwise to shut the valve.
- 3 Wait 10 min. If there is a pressure loss greater than 7 kPa (1 psi), there is a leak in the external connections. Use the leak detector to check each fitting for leaks.

Correct leaks by tightening the connections. Retest the connections; continue tightening until all connections are leak-free.

Set source gas pressures

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

- The inlet pressure needed to achieve the highest column flow rate required by your method.

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 170 kPa (25 psi) across flow controlling devices enables them to work properly.
- The pressure limit of the weakest part of the supply system determines the maximum supply pressure available.

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

We recommend a maximum continuous operating pressure of 1170 kPa (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.

Table 6 suggests starting values of source pressure.

Table 6 Suggested starting pressures

Gas	Use	Source pressure
Carrier	Capillary columns	550 kPa (80 psi)
Air for FID, FPD	Detectors	550 kPa (80 psi)
Hydrogen	Detectors	410 kPa (60 psi)
Makeup gas	Detectors	410 kPa (60 psi)
TCD Reference	TCD	410 kPa (60 psi)
Air for valve actuators	Valves	345 kPa (50 psi)

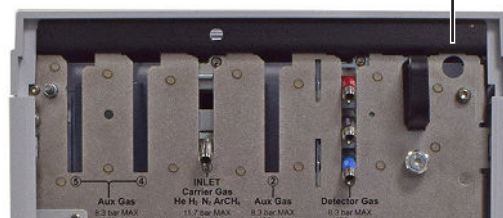
Vent hazardous gases to a fume hood.

Hazardous sample gases or uncombusted hydrogen gas can exit the GC from ECD exhaust, split vent and septum purge exhausts, and the TCD exhaust. Such gases must be safely vented in accordance with local safety procedures and standards.

If using an ECD, or if using hydrogen carrier gas that will be uncombusted, you must either safely vent the exhaust or operate the GC inside a fume hood. For example, if using hydrogen carrier gas, the GC would vent uncombusted hydrogen from a thermal conductivity detector (TCD) and from the inlet split vent and septum purge vent.

The ECD exhaust vents through a coiled tube. Connect tubing from the tube fitting at the end of this tubing to an exhaust hood via a hole in the back panel.

Detector exhaust vents here



For a TCD, you must supply vent tubing and fittings to connect to the detector exhaust tube on the top of the detector. Route the tubing out the back of the GC, following the same path as for the ECD vent tubing.

The other detectors (FID and FPD) combust any hydrogen carrier gas.

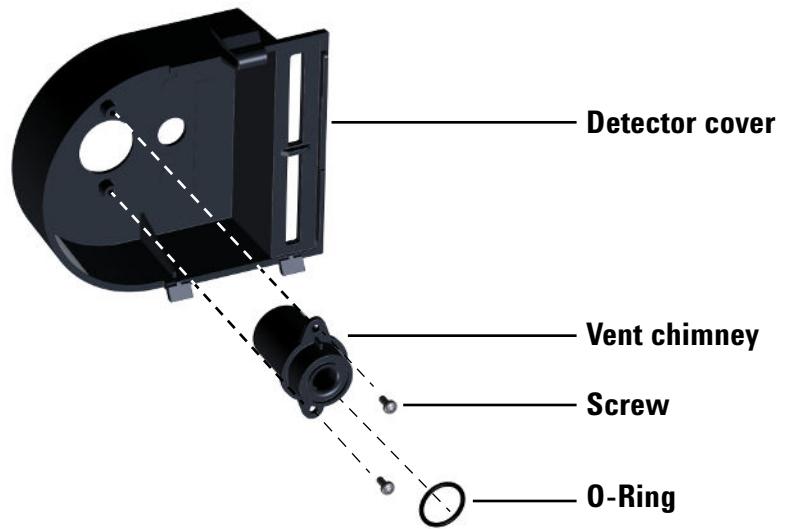
Install FID vent chimney

CAUTION

Combustion of methylene chloride in the FID creates corrosive gases that can damage the GC. If FID combustion will create corrosive gases, install the FID vent chimney.

If FID combustion will create corrosive gases, such as the HCl produced during the combustion of methylene chloride solvent, install the FID vent chimney. Connect the exhaust to a fume hood as needed.

1 Installing the GC



Connect cryogenic cooling (if present).

Cryogenic cooling allows you to cool the MMI inlet, including cooling to setpoints below ambient temperature. A solenoid valve controls the flow of coolant to the inlet. The inlet can use either liquid carbon dioxide (CO₂), liquid nitrogen (N₂), or compressed air as a coolant.

CO₂ and N₂ coolants require different hardware on the GC. (You can use air cooling on a multimode inlet, with the N₂ solenoid valves and hardware.)

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.

Connecting liquid carbon dioxide

WARNING

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

WARNING

Pressurized liquid CO₂ is a hazardous material. Take precautions to protect personnel from high pressures and low temperatures. CO₂ 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.

See the *Intuvo 9000 GC, GC/MS, and ALS Site Preparation Guide* for important requirements for tubing.

CAUTION

Do not use padded tanks for CO₂ supplies. The cryogenic valve is not designed to handle the higher pressures padded tanks generate.

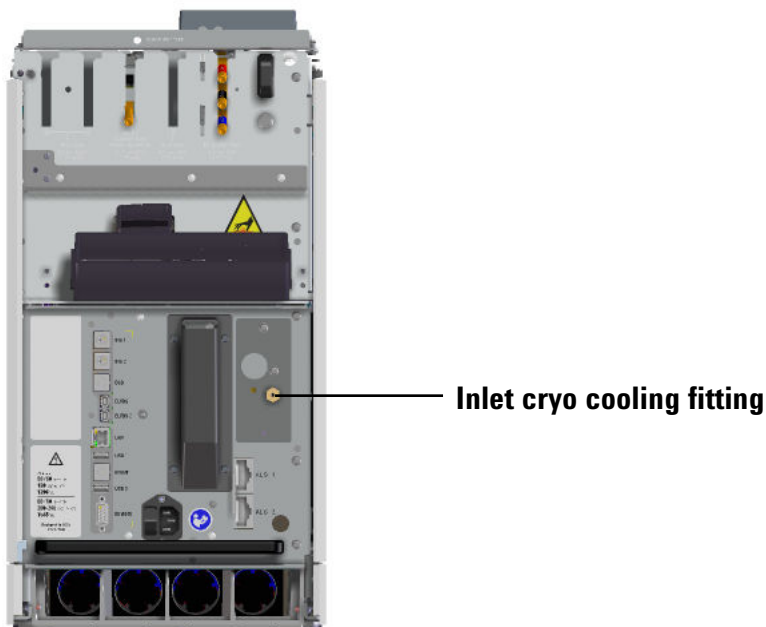
The tank must be equipped with an eductor tube (dip tube) that reaches to the bottom of the tank, so that liquid (rather than gaseous) CO₂ is drawn.

Materials needed:

- 1/8-inch heavy-wall, stainless steel tubing

Procedure:

- 1 Locate the inlet for liquid CO₂ on the back of the GC.



- 2 Prepare enough tubing to reach from the supply tank to this fitting.
- 3 Connect the supply tubing to the liquid CO₂ tank outlet with the fitting recommended by the supplier.
- 4 Use a Swagelok fitting to connect the supply tubing to the cryogenic valve inlet.

Connecting 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 asphyxiation hazard if vaporizing nitrogen displaces oxygen in the air. Consult local suppliers for safety precautions and design information.

See the *Intuvo 9000 GC, GC/MS, and ALS Site Preparation Guide* for important requirements for tubing.

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.

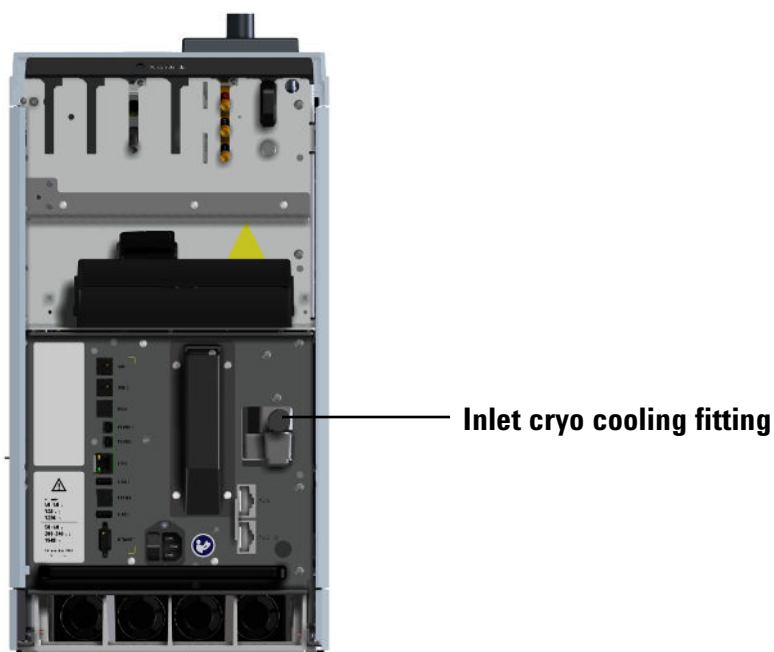
To move or replace a tank, close the delivery valve and carefully disconnect the line at either end to let residual nitrogen escape.

Materials needed:

- 1/4-inch insulated copper tubing

Procedure:

- 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 back of the GC. Prepare enough tubing to reach from the supply tank to this outlet.



- 3 Connect the supply tubing to the liquid N₂ tank outlet with the fitting recommended by the supplier.
- 4 Use a Swagelok fitting to connect the supply tubing to the cryogenic valve inlet.

Connecting air to the multimode inlet

The multimode inlet can also use compressed air cooling with the liquid N₂ inlet cooling option. Requirements for compressed air cooling:

- The compressed air should be free of particulate material, oil, and other contaminants. These contaminants could clog the inlet's cryo valve and expansion orifice or impact the proper operation of the GC.
- Set the air supply pressure to 138 to 276 kPa (20 and 40 psig).

While air supplied from tanks can meet these criteria, the consumption rate of air can be 80 L/min, varying based on supply pressure.

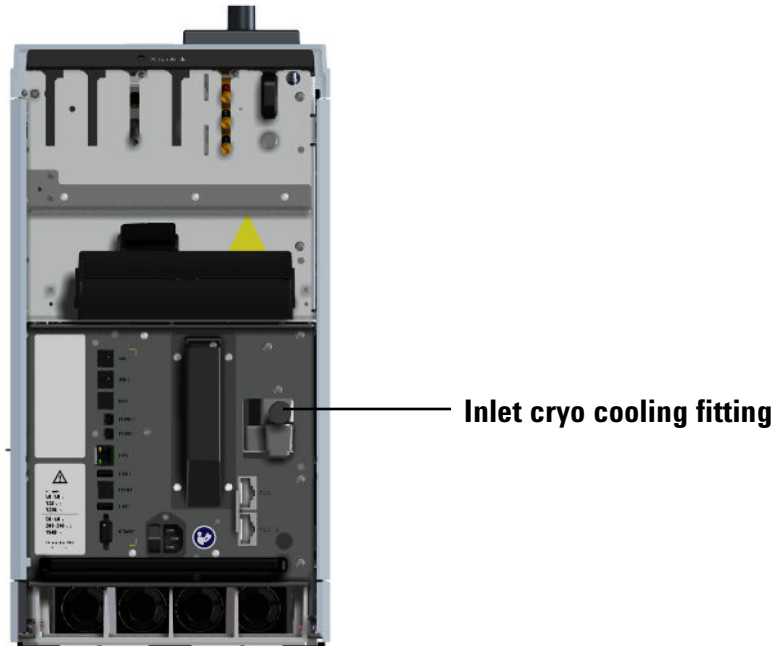
Materials needed:

Installation of a compressed air line to the inlet cryo coolant valve requires the hardware (and appropriate fittings) noted below:

- Use 1/4-inch copper or stainless steel tubing for supply tubing to the N₂ valve.

Procedure:

- 1 Locate the input fitting for inlet coolant on the back of the GC. Prepare enough tubing to reach from the supply to this outlet.



- 2 Connect the supply tubing to the air supply outlet with the fitting recommended by the supplier.
- 3 Use a Swagelok fitting to connect the supply tubing to the cryogenic valve input fitting.

Connect valve actuator air (if present).

Valves are driven by air actuators. Valves should have a dedicated air source; they cannot share detector air supplies.

CAUTION

Do not share air between a detector and valves.

Valves can use nitrogen as an alternate supply. In this case, the nitrogen does not have to be chromatographic grade but must be free from contaminants.

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

CAUTION

Route the tubing away from the GC hot air exhausts. The hot air will melt the plastic tubing.

Turn off the air supply at the source. If needed, shorten the supplied plastic tubing using a sharp knife. Connect the tubing to the air source using a 1/4-inch Swagelok nut and ferrules.

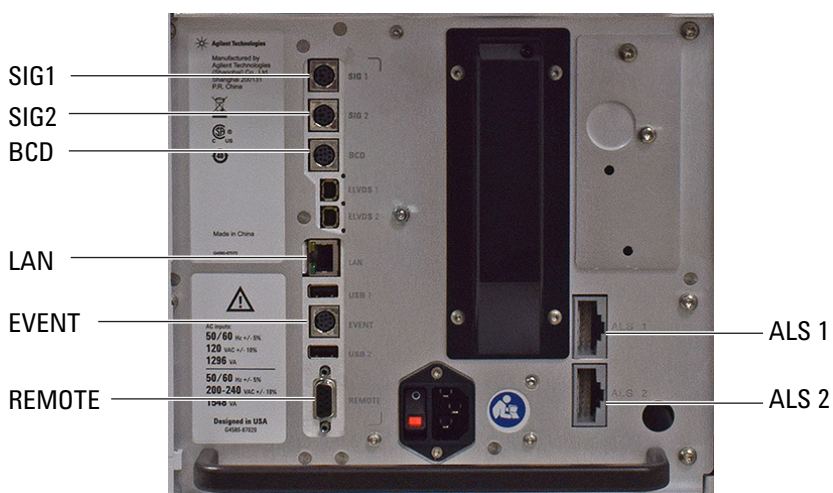
Connect the external cables.

Additional cables may be installed for control of the GC's automatic liquid sampler (ALS), connecting signal output to integrators, synchronizing the start and end of a run between various instruments, sensing conditions external to the GC, and controlling devices external to the GC.

If using Event or BCD cables, label the cables as needed to identify their intended use and appropriate connector on the GC. See [Labeling BCD and EVENT cables](#).

Back panel connectors

The figure below shows the connectors on the back panel of the GC.



See also “[Cable Diagrams](#)” on page 106.

Sampler connectors

If using an ALS, connect it to the GC using the following connectors:

ALS 1 Optional. An injector or 150-position sample tray.

ALS 2 Optional. An injector or 150-position sample tray.

The SIG (analog output) connectors

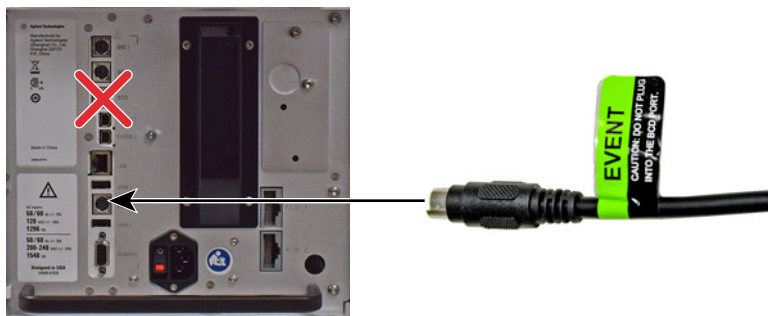
Optional. Use **SIG1** and **SIG2** for analog output signals.

REMOTE connector

Provides a port to remotely start and stop other instruments using the APG protocol. A maximum of 10 instruments can be synchronized using this connector. See “Using the Remote Start/Stop Cable” on page 100 for more detail.

EVENT connector

This connector provides two passive contact closures and two 24-volt outputs for controlling external devices.

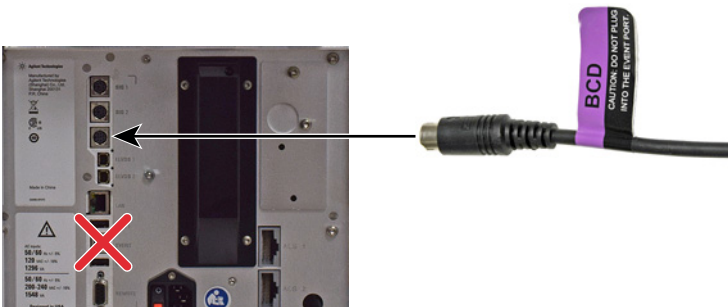


BCD input connector

This connector provides two control relays and a BCD input for a stream selection valve or a BCD generating device.

CAUTION

This connector is similar to the **EVENT** connector. Plugging a non-BCD cable into the **BCD** connector can damage the GC.



LAN connector

Standard Local Area Network (LAN) connector, for communication with data systems and other devices via TCP/IP.

Connecting cables

Use the supplied LAN cable to connect the GC to a LAN switch or hub as shown below (see “GC / MS / Agilent data system / ALS”). Other LAN configurations are possible. However Agilent typically supports only simple LAN setups. Refer to your Agilent data system documentation for details about its supported LAN configurations.

Table 7 Cabling for other instruments in a 9000 GC system

Instrument 1	Instrument 2	Type of cable	Part number
Mass Selective Detector	Headspace sampler	Splitter (“Y”) cable for remote start/stop, 1 male and 2 female connectors	G1530-61200
		Splitter (“H”) cable for APG remote, 2 male and 2 female connectors	35900-60800

Labeling BCD and EVENT cables

The **BCD** and **EVENT** connectors look similar. However, plugging an Event cable into the BCD connector can damage the GC logic board. To prevent accidental damage, the following BCD and Event cables come with labels that identify their intended use:

- G1580-60710, External valve cable
- G1580-60730, Pulsar Module Power Supply Cable
- G1580-61100, BCD Cable Assembly

For other cables, apply an Event or BCD label to the cable:

- G1580-87100, Caution label, BCD cable, purple
- G1580-87200, Caution label, Events cable, green



GC / MS / Agilent data system / ALS

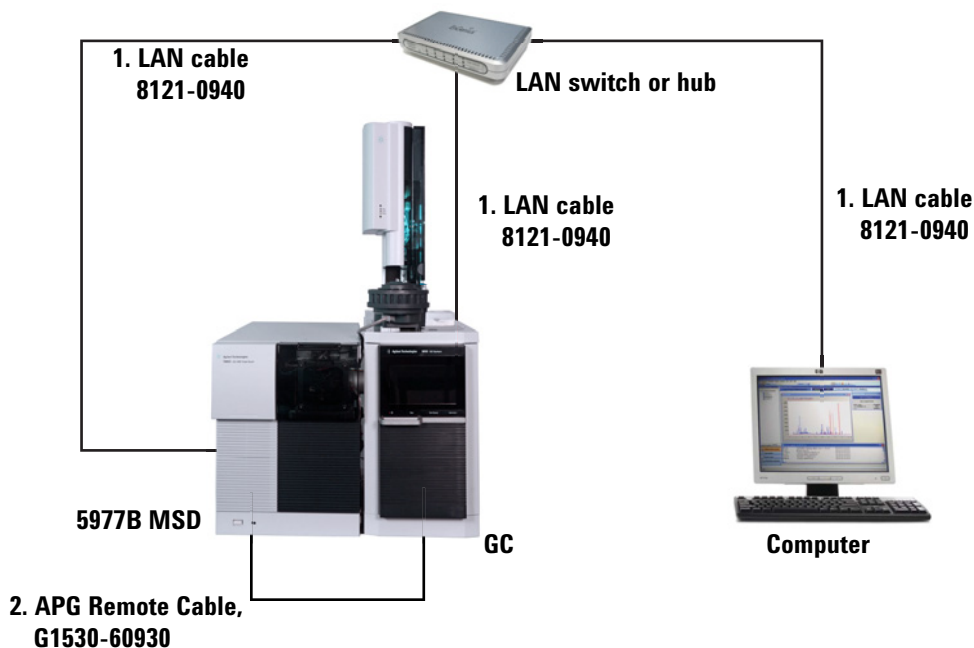


Table 8 Cables for a typical GC/MSD or GC/MS system

Number	Part number and description
1	G1530-60930, 2-m APG remote cable, 9-pin male/9-pin male
2	8121-0940, Cable, LAN, 25 foot

The communications cable used to connect a 5977B to the 9000 GC is included with the MS.

Additional cabling configurations

For additional cabling configurations, see [Appendix B](#), "Cabling Diagrams and Remote Start/Stop."

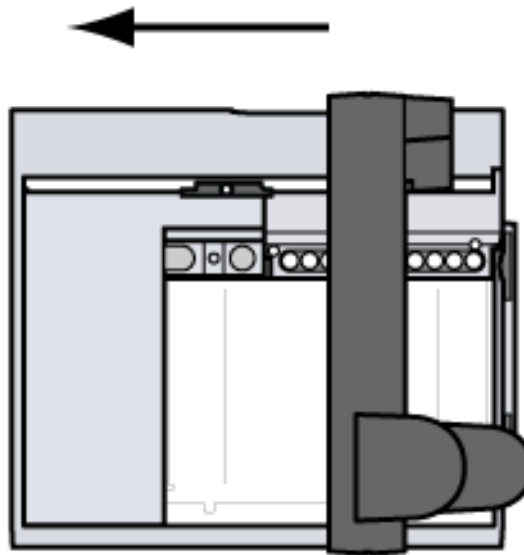
Install ALS, if available.

If installing an ALS, install it now.

Install tray bracket onto the tray (7693A only)

If a tray is not available, skip this section.

- 1 Gently park the gantry. If new, remove all of the shipping clamps from the tray. (Refer to the ALS documentation.)



1 Installing the GC

2 Place the bracket on the tray. Tighten the captive screws.

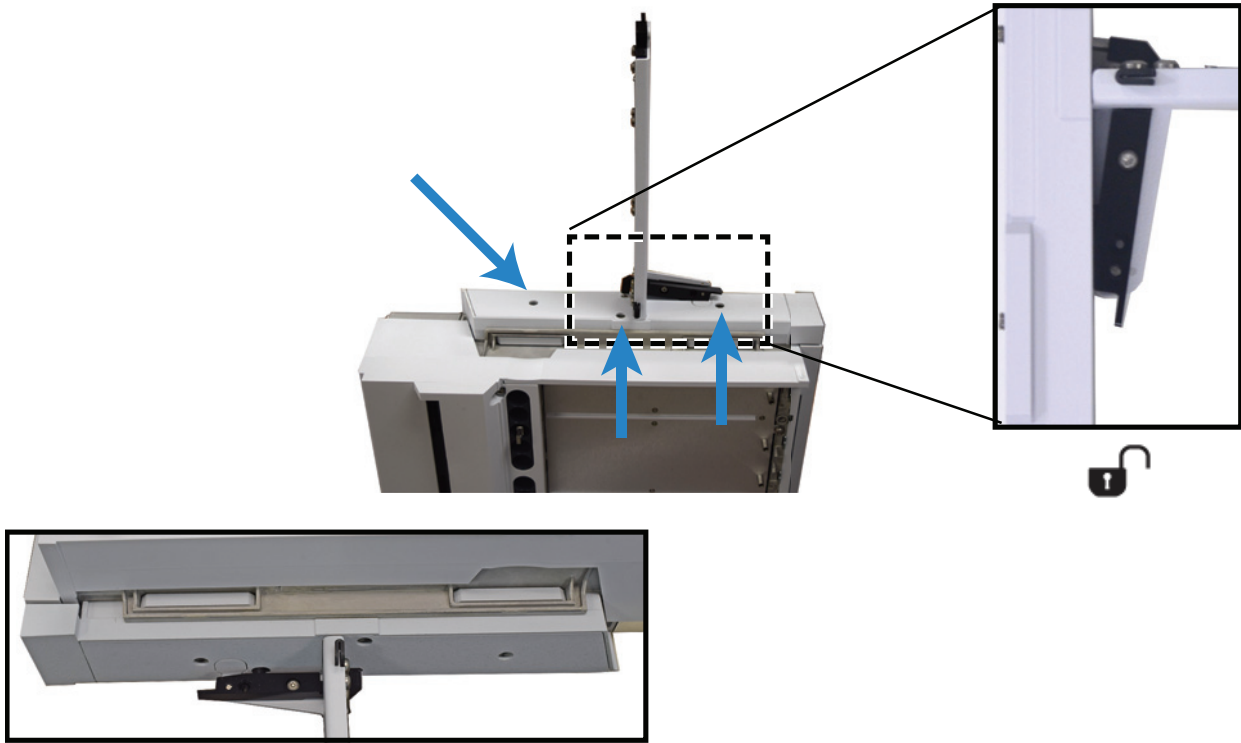


Figure 8 Assembling the tray bracket to the tray

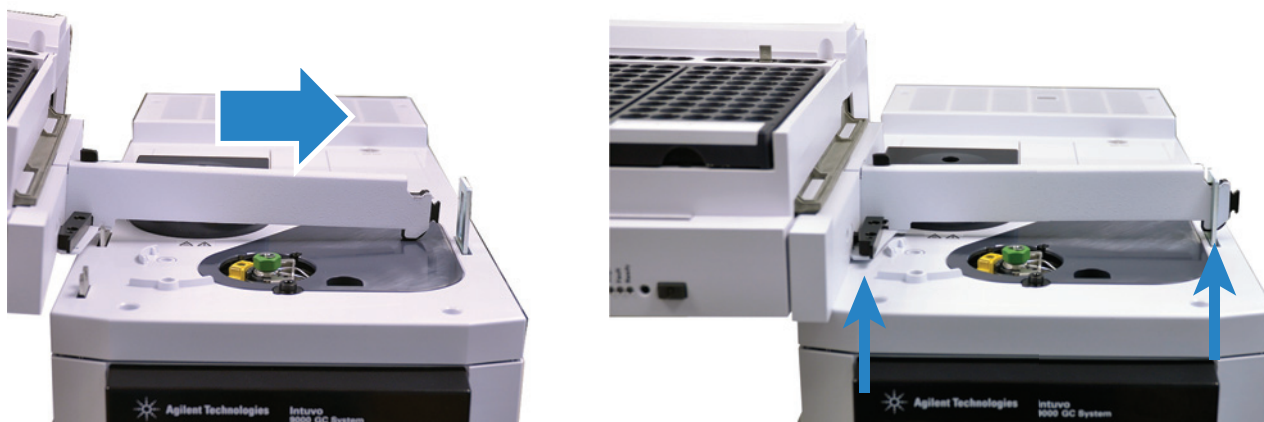


Figure 9 Bracket and tray (assembled)

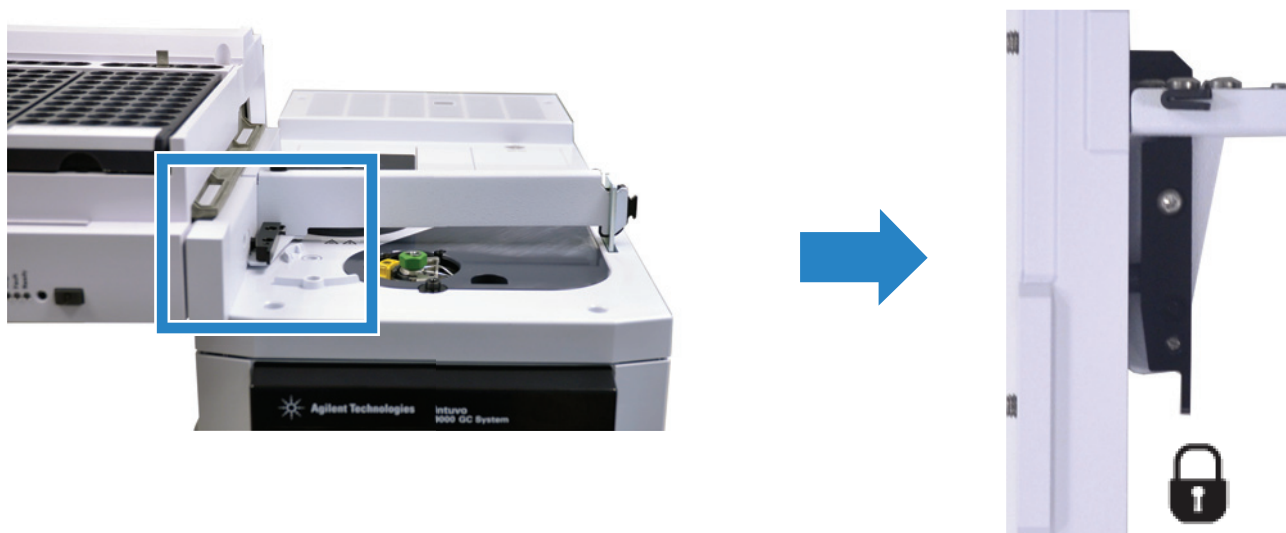
Install the tray on the GC (7693A only)

If a tray is not available, skip this section.

- 1 Place tray on the GC, inserting the tray bracket into the stop bracket.



- 2 Lock the tray in place.

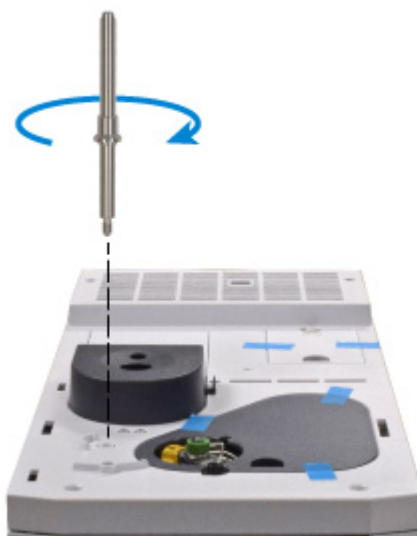


- 3 Connect the tray to the GC (the **ALS 2** connector).

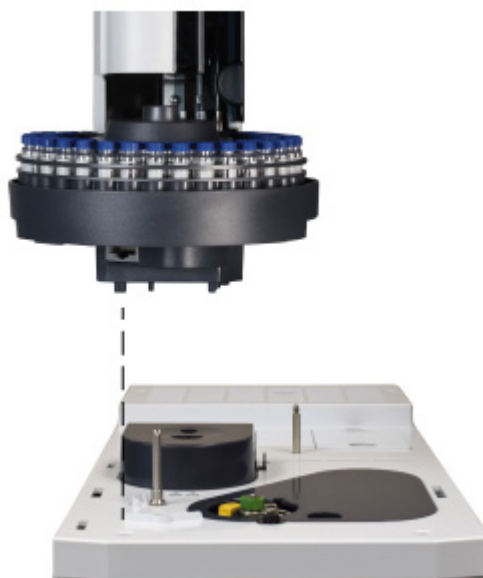
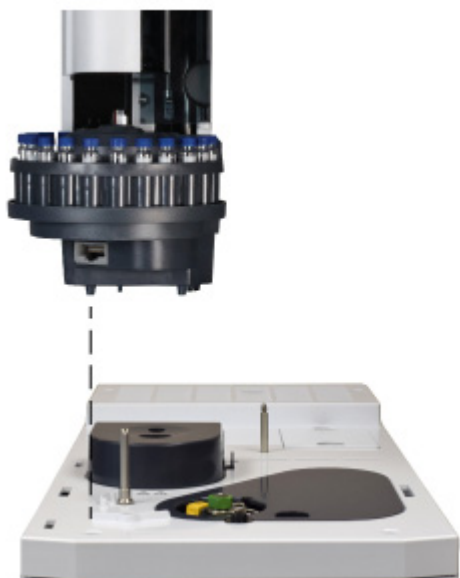
Install the injector

To install an injector:

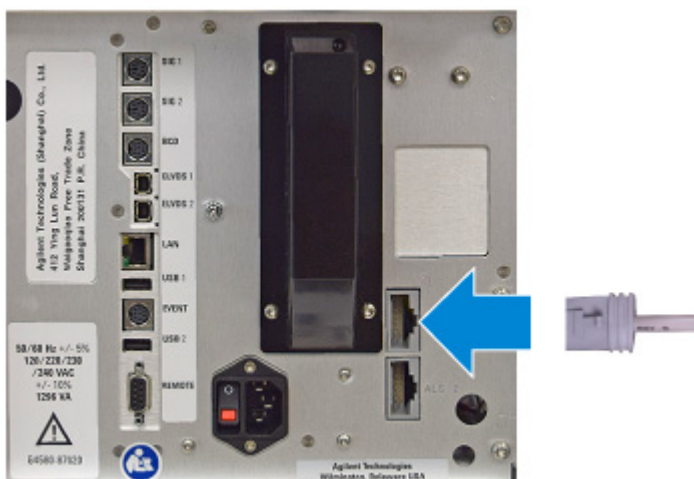
- 1 Install mounting post.



- 2 Mount the injector.

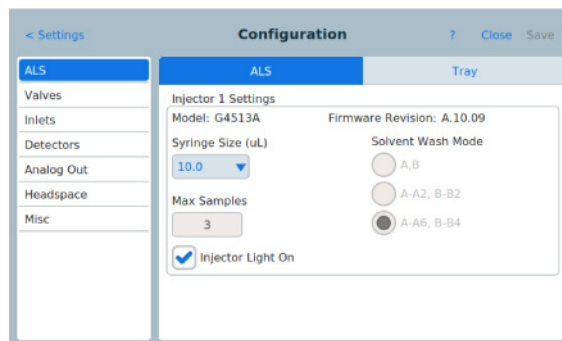


- 3 Connect the cable to the GC (ALS 1 connector).

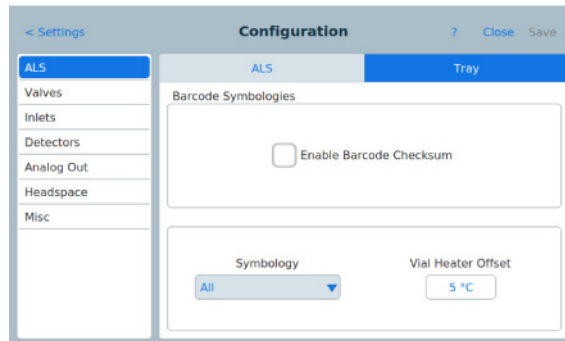


Configure the ALS

- 1 Configure the injector and tray (if installed). Select the syringe size and wash mode as applicable. (The syringe supplied by Agilent with an injector is typically 10 μ L.)

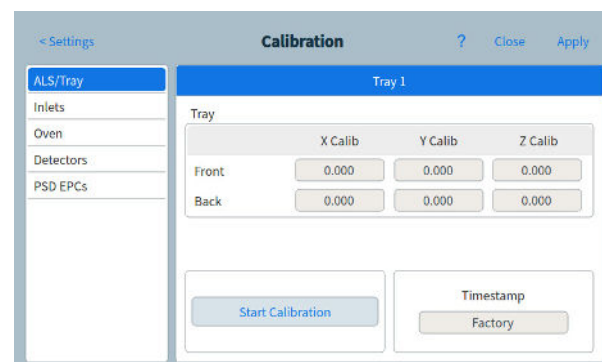
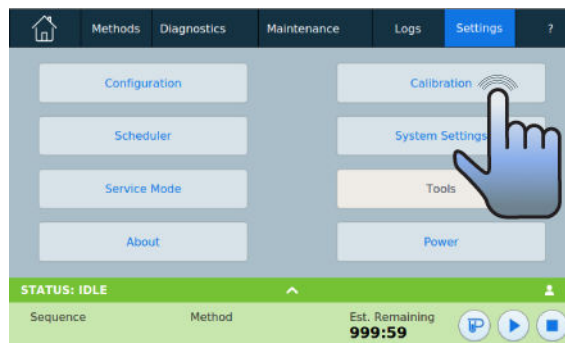


1 Installing the GC



Calibrate the tray, if installed

If installed, calibrate the tray before first use.



When calibration succeeds, the tray is ready for use.

Prepare the ALS for checkout

- 1 Prepare a 2-mL screw-top sample vial.
- 2 Prepare 4-mL waste vials and place them into the turret.
- 3 Prepare fresh solvent solutions as needed for the checkout sample for your detector type. Place the solvent vials into the injector turret. For details on the solvent needed, see the *Agilent Intuvo 9000 GC Operation Manual*.

Install the Intuvo chips and column.

The GC ships with packing materials in the inlet base, column connection, and column oven. Remove these and install the inlet chip, Guard chip, and column.

Each GC ships with a simple D1 detector chip installed. If the ordered configuration includes another detector, first verify the D1 performance, then install the detector chip for the other configuration and test. For an MS configuration with no other GC detector, you will need to replace the simple D1 chip with the MS chip before installing the column. Refer to the Intuvo 9000 GC *Maintaining Your GC* manual.

A capillary column was shipped with the GC to be used to confirm proper operation. Agilent suggests that it be used only for that purpose.

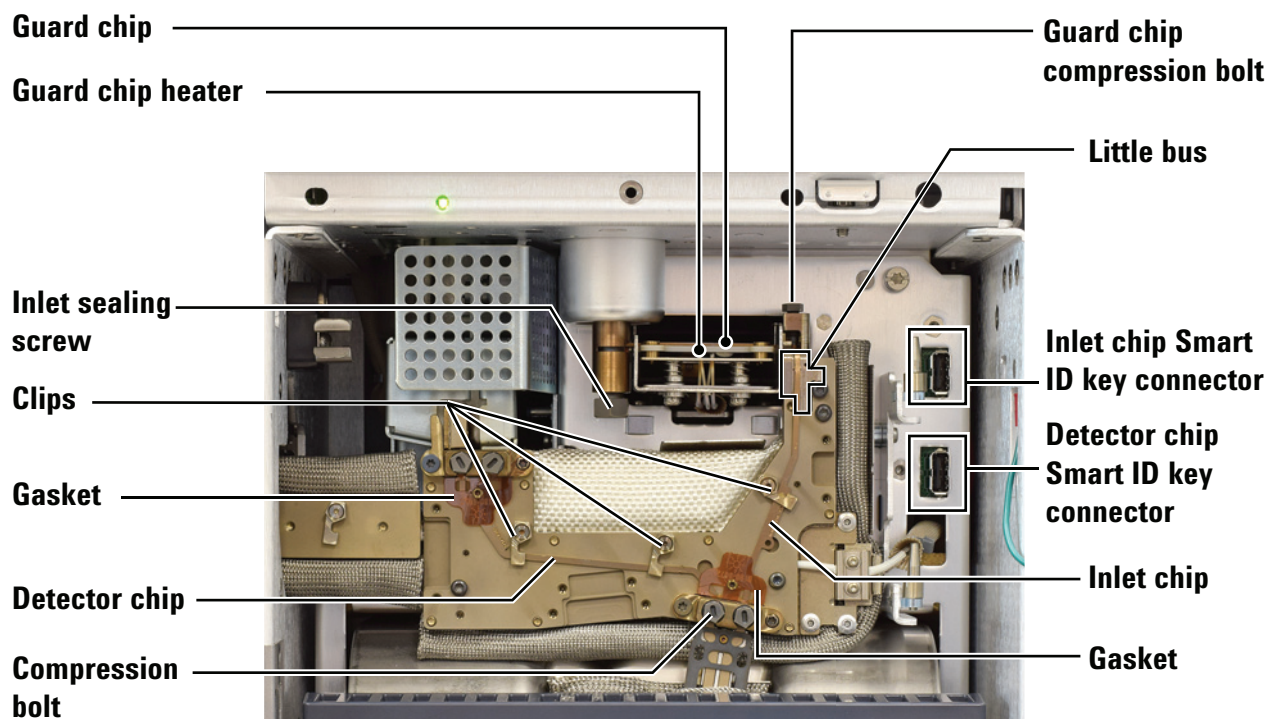


Figure 10 Intuvo GC bus components (split/splitless inlet with D1 chip shown)

Remove the packing materials

- 1 Open the GC front door.
- 2 Remove the bus door.
- 3 Open the oven door.
- 4 Remove the column plug and gasket.
 - a Remove the compression bolts using the torque driver.
 - b Remove the plug and discard.
 - c Remove and discard the gasket.

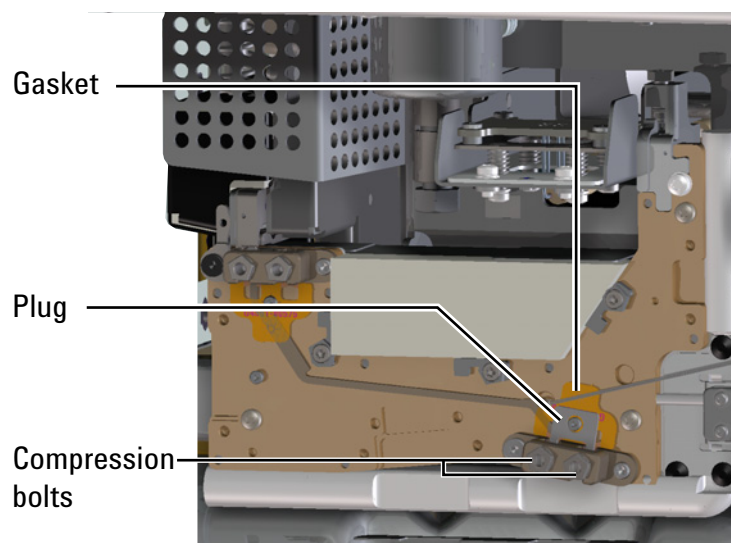


Figure 11 Remove the column plug

- 5 Remove the inlet base plug.
 - a Use a 7/16-inch open-end wrench (SS inlet) or 5/16-inch and 1/4-inch wrenches (MM inlet) to loosen the sealing screw at the inlet base. See [Figure 2](#).
 - b Gently depress the Guard chip heater assembly.
 - c Remove the plug from the inlet base and discard.

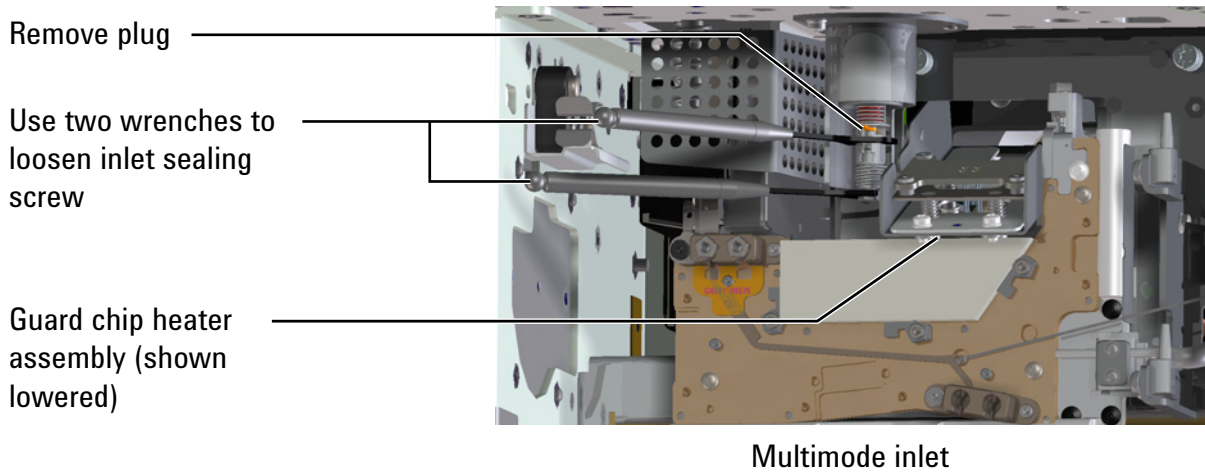
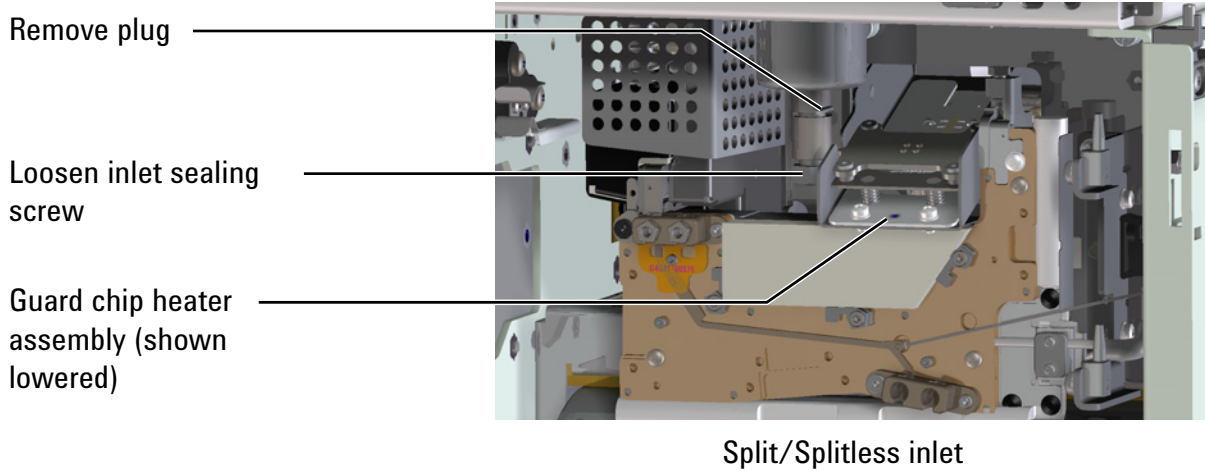


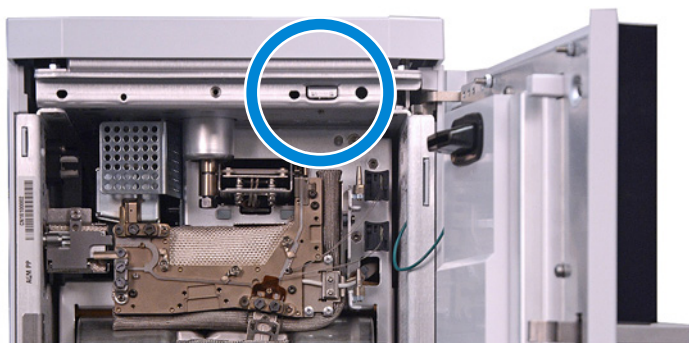
Figure 12 Remove the inlet base plug

Install the Intuvo inlet chip and Guard chip

- 1 Install the inlet chip.
 - a Remove the inlet cover.



- b Slide open the Guard chip cover to expose the Guard chip compression bolt.



- c Using the Intuvo torque driver, loosen the Guard chip compression bolt until there is a clear space between the bottom of the bolt and the little bus. (Access the Guard

chip compression bolt through the top of the GC as shown below.) See [Figure 13](#).

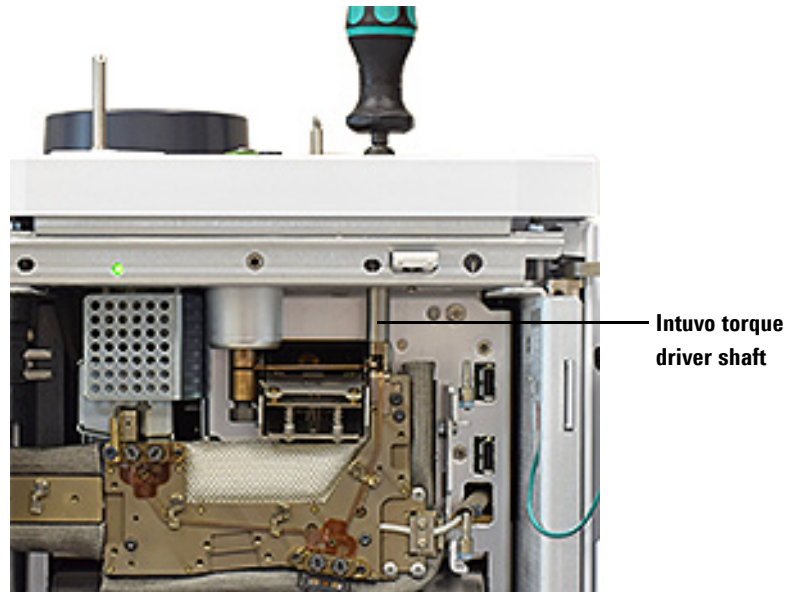


Figure 13 Loosening the Guard chip compression bolt (split/splitless inlet shown)

- d Use the torque driver to open the clips that secure the inlet chip to the bus. See [Figure 10](#).
- e Orient the new inlet chip. Slide the bottom connector of the inlet chip behind the Smart ID connector wire for the detector chip, and insert the bottom connector into the column fitting on the bus. Then, insert the top connector into the pocket in the little bus. See [Figure 10](#).

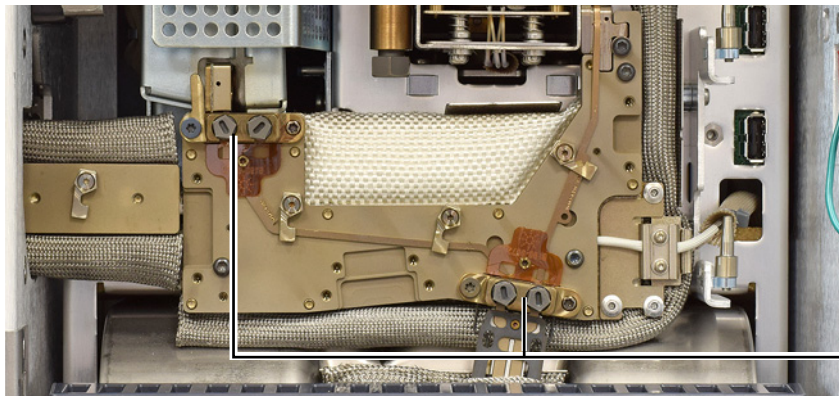
CAUTION

Make sure the connectors are fully seated in the column fitting and little bus.

- f Seat the chip's column connector into the column fitting.
- g Check your work. Both click and run connectors should be centered in their fittings, the chip's connector in the

column bus fitting should be flat against the bus, and the inlet flow chip should lay flat against the bus.

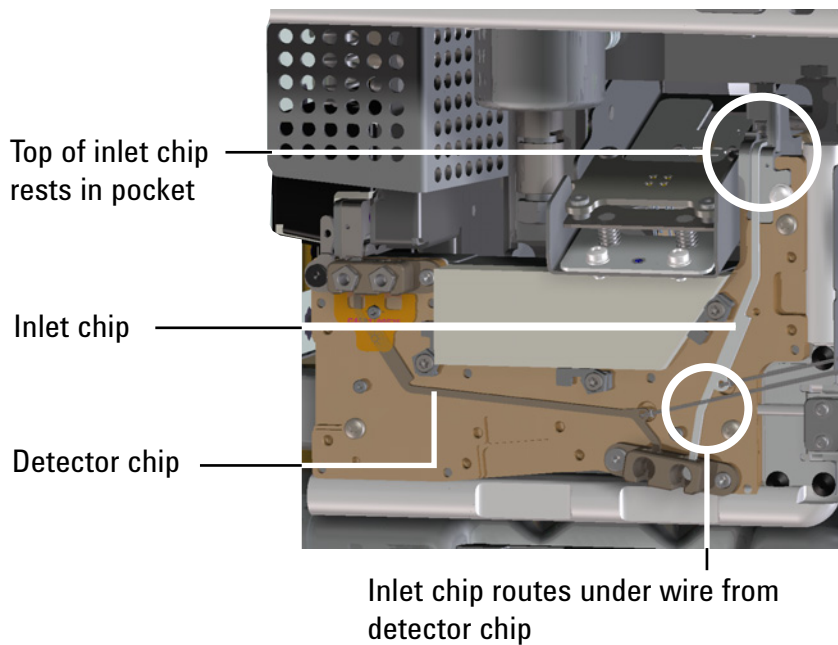
h



Click and run fittings

Figure 14 Click and run fittings

i Rotate the clips to hold the inlet chip in place.



Inlet chip routes under wire from detector chip

Figure 15 Place the inlet chip – check your work

j Insert the inlet chip Smart ID key into the lower socket to the right of the bus. See [Figure 10](#).

2 Install the Guard chip:

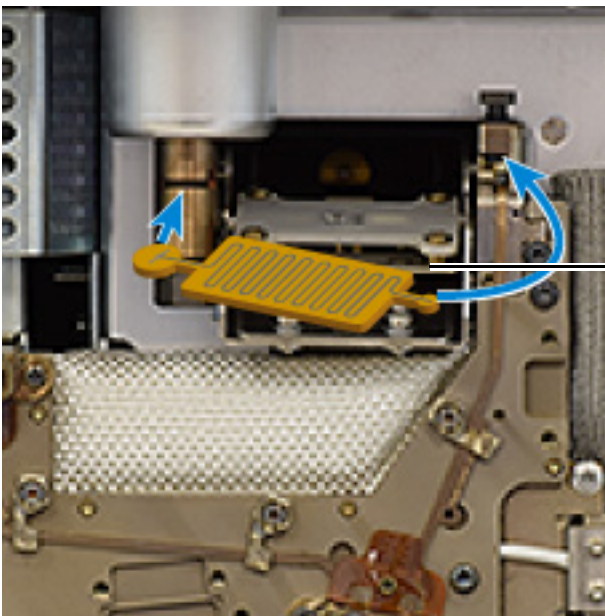
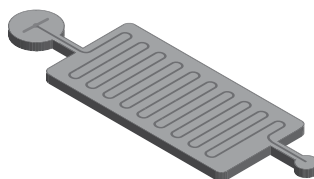


Figure 16 Guard chip orientation (split/splitless inlet shown)

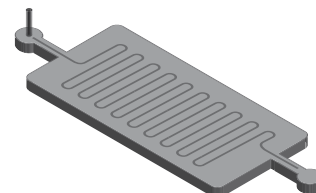
- a Orient the Guard chip as shown below.

Inlet side



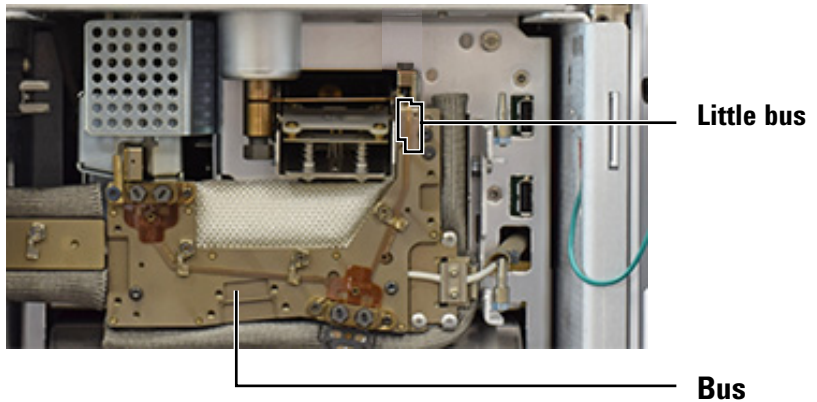
Split/Splitless Inlet

Inlet side



Multimode Inlet

- b Use your finger to gently lower the Guard chip heater.
- c Place the Guard chip left end into the inlet base. For an MMI Guard chip, avoid touching the upright tube against the sides of the opening.
- d Rotate the body of the Guard chip into the GC, lifting the Guard chip right end over the little bus and into the pocket. The little bus can move a bit if needed to help seat the Guard chip.



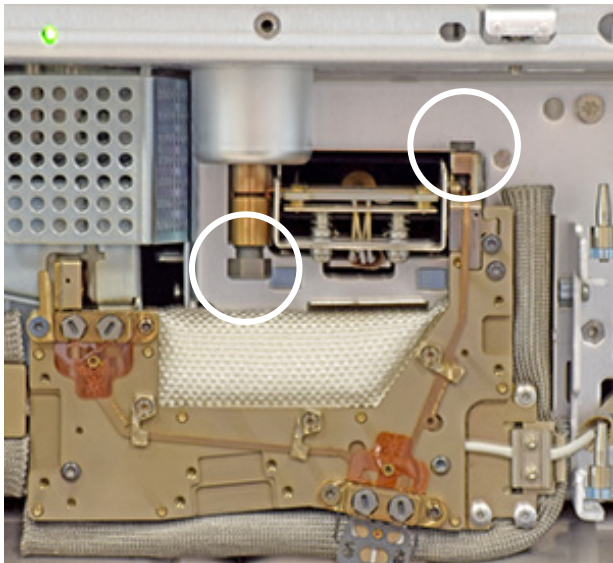
- e Check Guard chip placement. The Guard chip should be level between the inlet and little bus. You should no longer see the entire neck of the Guard chip if it is seated properly, as a portion of it will be obscured by the heater block. If not, reseal it.
- f Finger-tighten the Guard chip compression bolt until you feel slight contact on the Guard chip.

CAUTION

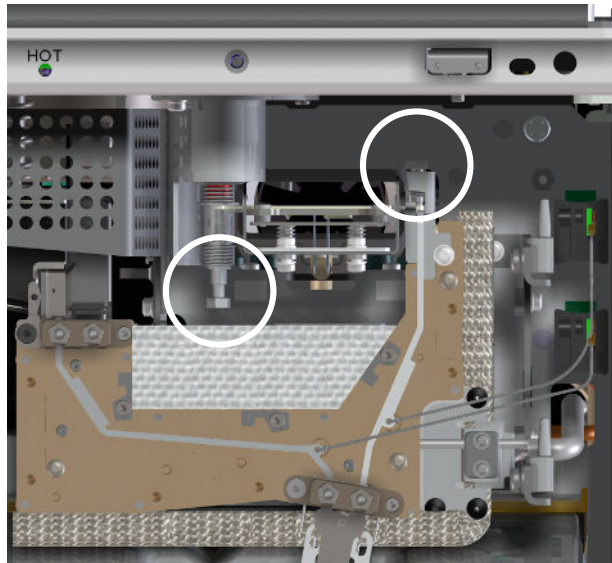
To avoid damaging the Guard chip, do not raise the Guard chip heater until after you finger-tighten the Guard chip compression bolt.

- g Gently raise the Guard chip heater.
- h Finger-tighten the inlet sealing screw.
- i Tighten the inlet sealing screw. For MMI, use two wrenches. (See the figure below.)

1 Installing the GC



Split/splitless



Multimode

- j Tighten the Guard chip compression bolt using the Intuvo torque driver until you hear one click.
- k Close the Guard chip cover.
- l Install the inlet cover.

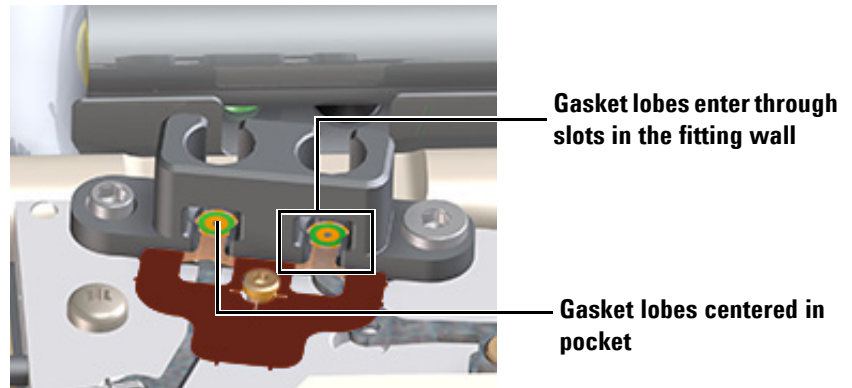
Install a new column gasket

- 1 Carefully remove the new gasket from its packaging. Inspect the gasket to be sure it is not deformed. The two round lobes are the sealing surfaces.

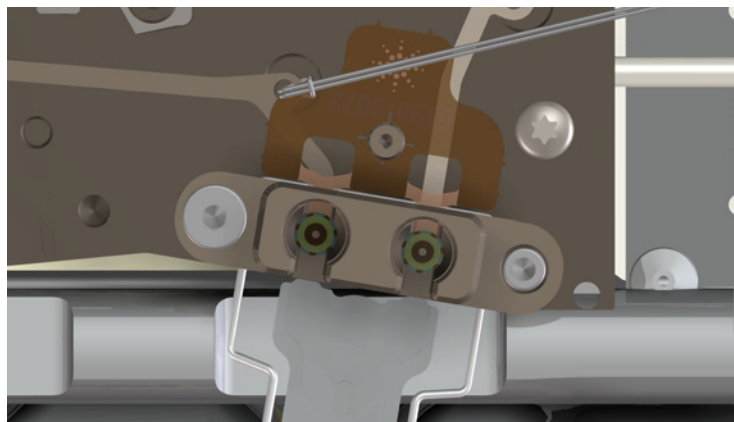
CAUTION

When handling gaskets, especially nickel gaskets, avoid any deformation. Keep the gasket sealing surfaces flat, with no creases or wrinkles. Deformation of the sealing surfaces can create leaks. Avoid contaminating the sealing surfaces.

- 2 Carefully insert the round gasket lobes into the slot of the click and run fitting, then align the lobes into the inner pockets of the click and run fitting. (Note that the gasket is double-sided.)
- 3 Locate the hole in the gasket, align it over the pin on the bus fitting, and press the gasket body flat against the bus so the pin fits through the alignment hole.

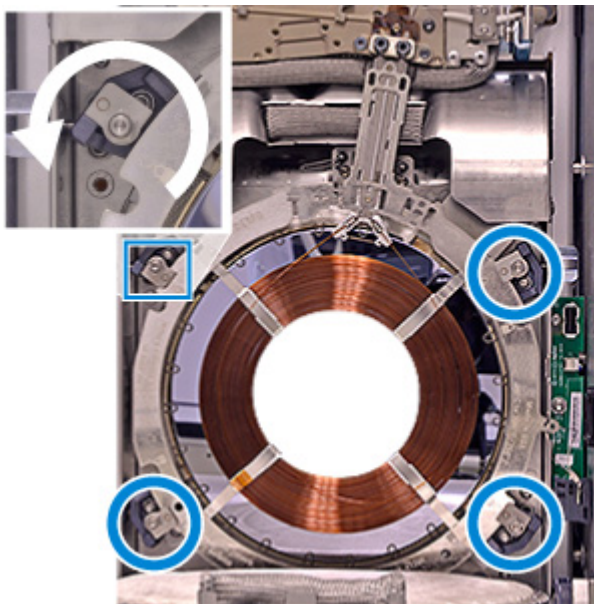


- 4 Check that the gasket's round lobes remain flat, with no wrinkles, and are centered on top of the mating flow chip sealing surfaces. See the figure below.



Install the checkout column

- 1 Use the torque driver to open the four column clamps.

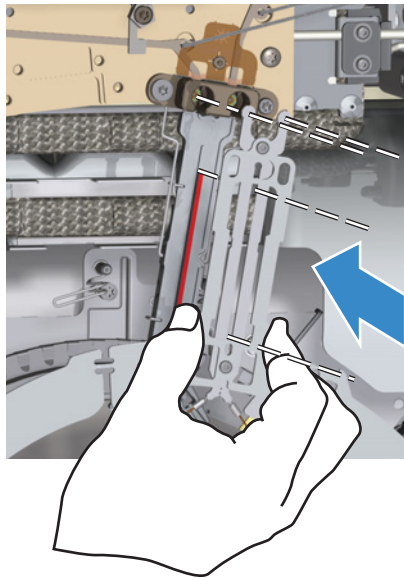


- 2 Place the column.

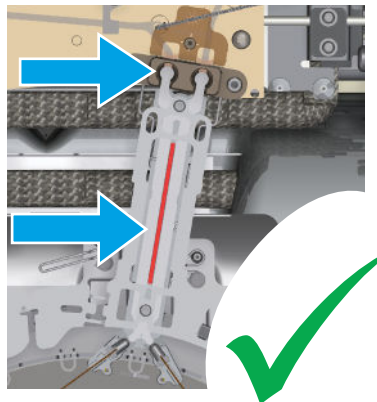
CAUTION

Hold the column assembly only by the outer ring—do not press or pull on the column itself.

- a Place the column on the bottom clamps. (Do not tighten the clamps yet.)
- b Tilt the column up so the click and run connectors mate into the right-side bus fitting. Grasp the column ring as shown in the figure and insert the column click and run connectors into the bus fitting. The column connectors should rest flat on top of both gasket lobes, so that the flow chip, gasket, and column connector lobes all align concentrically. See the figures below.

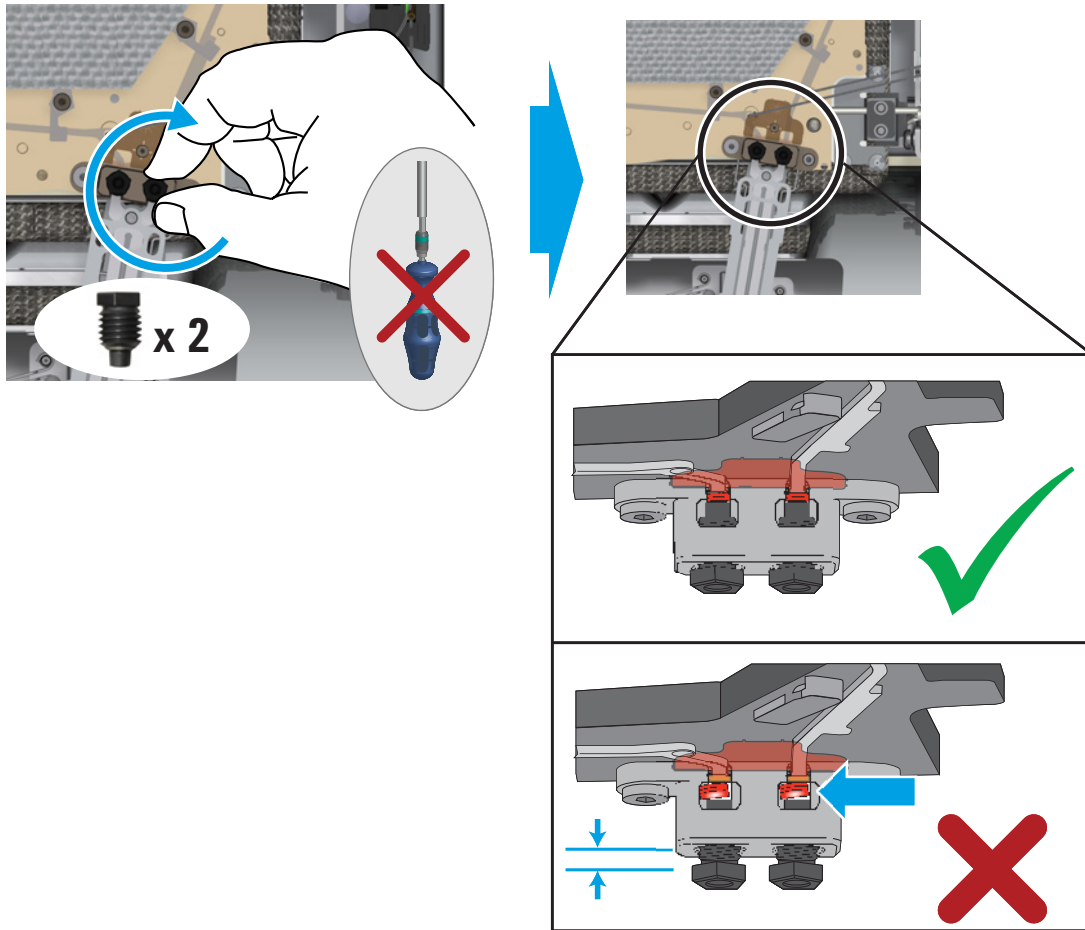


- c Check column placement. The center hub of the column connector heater should fit in the slot in the column neck as shown below.

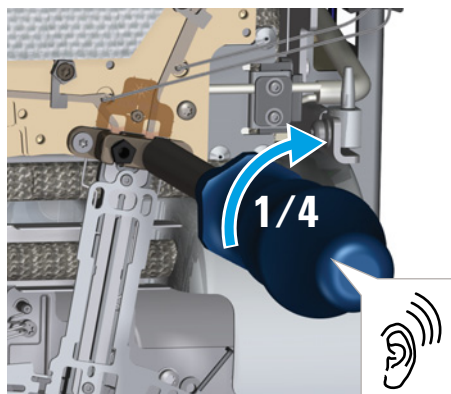


- d Install the compression bolts finger-tight.

1 Installing the GC



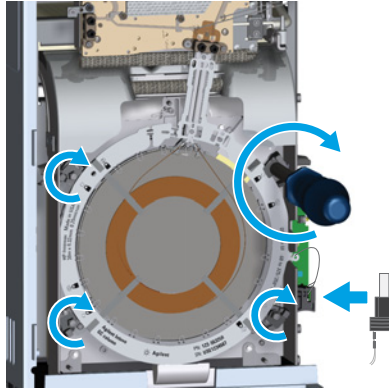
- 3 Check that the column connectors lie flat against the gasket and flow chips. If the compression bolts protrude from the bus fitting by more than about 1 thread, the column may not be properly seated. Remove the bolts and repeat [step 2](#).
- 4 Check column placement and tighten the compression bolts. Tighten the compression bolts until you hear one click (typically less than a 1/4-turn).



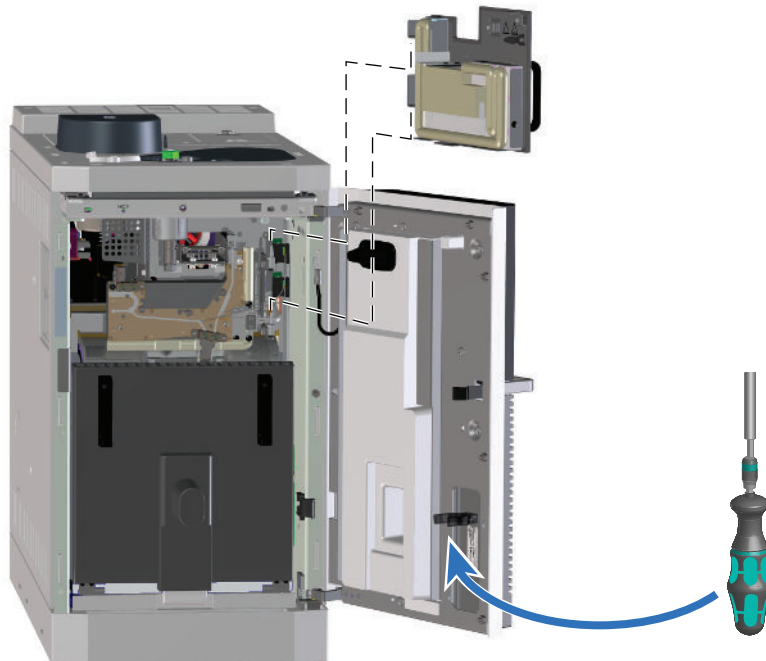
NOTE

Do not tighten the column clamps until after the column connections are properly tightened with the torque wrench.

- 5 Secure the column by using the Intuvo torque driver to close the column clamps.



- 6 Insert the column's Intuvo Smart ID Key into the lower USB connection along the right side of the oven.
 - e Close the oven door.
 - f Install the bus door.
- 7 Install the bus door. Place the torque wrench back in the front door of the instrument.



1 Installing the GC

8 Close the GC front door.

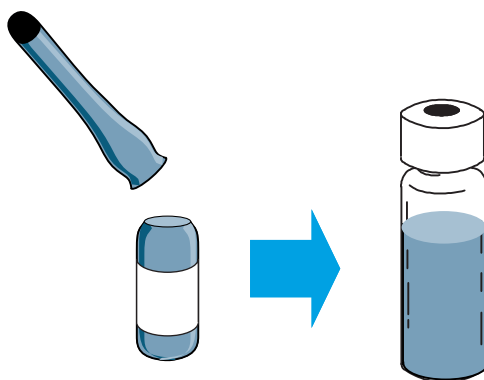
Condition the column and bake out the detector.

Before use, the column must be conditioned to remove any contaminants.

- 1 Turn on the carrier gas.
- 2 Perform a leak check. Touch **Diagnostics** and navigate to the leak check.
- 3 Refer to the checkout method for the detector. See the *Operation Manual*. Note the oven temperature, average velocity or flow, and so on.
- 4 Set the oven temperature and inlet flow conditions specified for conditioning the column. Touch **Method**, select **Active method**, then touch **Edit** to access current GC temperatures and flows.
 - Set the column temperature to 20 °C higher than the highest checkout method temperature (do not exceed the column maximum temperature). For example, for FID checkout set the column temperature to 210 °C.
 - Set the detector temperature to 20 °C higher than the checkout method temperature. For example, for FID checkout set the detector temperature to 320 °C.
 - Turn the detector gases on.
 - Light the flame, if appropriate.
- 5 Condition for the time given in the column's instructions.
- 6 Cool the oven.
- 7 Leave the carrier gas on. If using a flammable carrier gas (hydrogen), continue to vent the exhausts to a fume hood.

Transfer the checkout sample to a screw-top sample vial.

- 1 The checkout sample is contained in sealed glass vials. Wrap a piece of cloth or a paper towel around the vial to protect your fingers and snap the top off.



- 2 Use a pipette to transfer the sample to a 2-mL screw-top vial. (If using an ALS, use a vial suitable for the ALS turret or tray.)

Enter the checkout method.



Find the complete checkout methods and procedures in the *Operation Manual*.

Enter the parameters for the checkout procedure.

- If using an Agilent data system, use it to create a checkout method.
- If not using a data system, enter the setpoints using the touch screen.

Run one injection.

When the GC becomes Ready (**Not ready** light turns off), make the injection and start the run.

- For an ALS injection, press  on the GC or start the run from the data system, as appropriate.
- For a manual injection, inject the sample and press .

Evaluate Results.

Compare the chromatogram you generated with the one in the checkout procedure. There should be a close resemblance.

Prepare for the next analysis.

After evaluating the GC under the checkout conditions, installation checkout is complete. The next step is to prepare the GC for your next analysis. Be sure to cool the GC before making changes.

- Install the appropriate inlet hardware (can include septum, liner, liner-O-ring, Guard chip or jumper chip, and so on).
- Install the appropriate detector hardware (wavelength filter for FPD⁺).
- Change to any alternate gas sources as needed for the new analysis.
- Install the desired column and condition it per the manufacturer's recommendations.
- Configure the GC to match any hardware or gas type changes (liners, carrier or makeup gas types, and so on).
- Load or create the desired method.

If the GC will use a different configuration, for example, a two-column setup, a backflush-capable setup, or a second detector, install the necessary hardware now.

If installing a second column, remove the bus door air shield from the bottom of the bus door so the door will accommodate the second column. (See the *Maintaining Your GC* manual.)

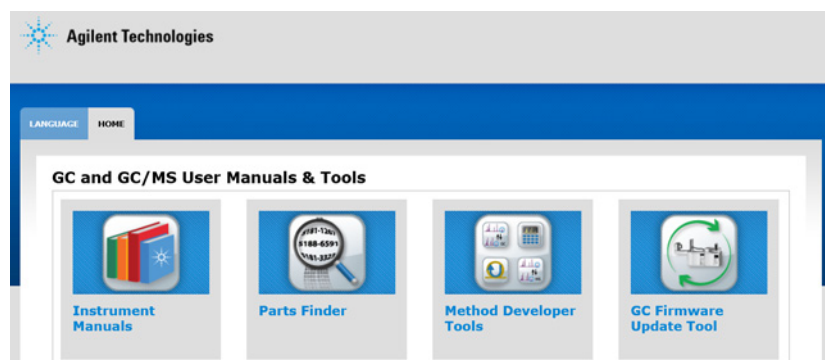
If appropriate, update firmware.

Firmware maintenance is an ongoing process. Updates are posted on the Agilent web site and may be downloaded to the GC using the GC Firmware Update Tool.

While the GC shipped with the latest firmware version available when it was manufactured, Agilent recommends that you check for any updates and install them if available.

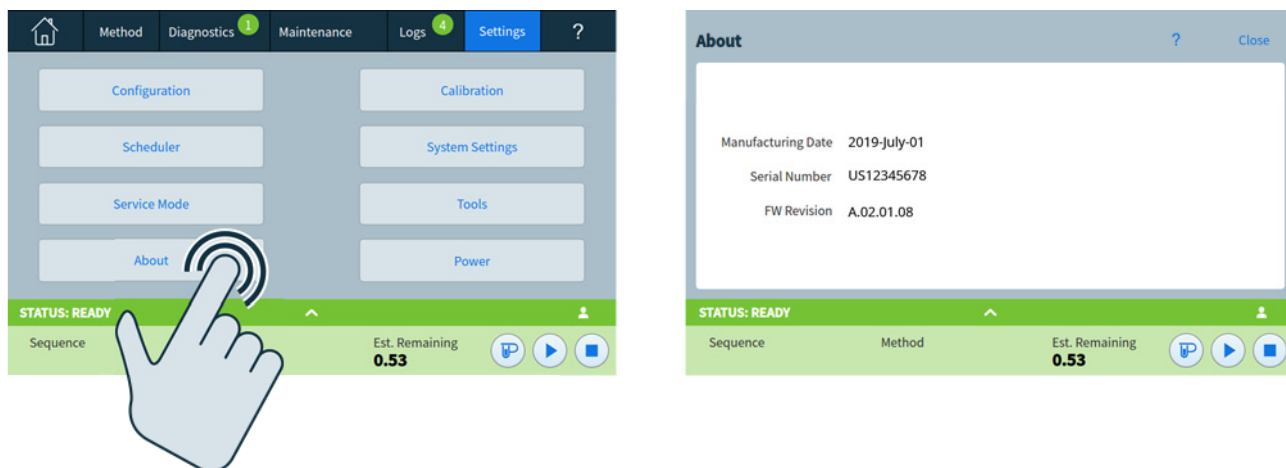
GC firmware

- 1 Install the **GC Firmware Update Tool**.
 - a Place the *Agilent GC and GC/MS User Manuals & Tools* DVD into your PC's DVD drive.
 - b Open file <D:>/index.html, where <D:> is the name of the DVD drive.

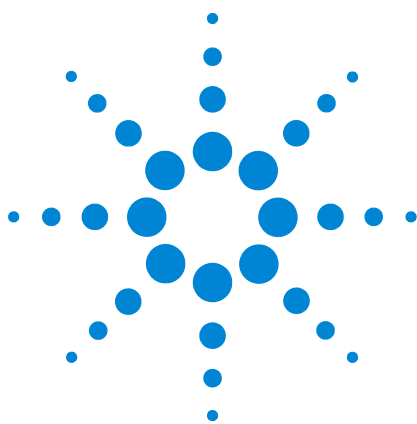


- c Click the **GC Firmware Update Tool** icon. (If your browser does not start the installer, browse to the DVD and run file <DVD drive letter>:\tools\GCFWUpdate\setup.exe.)
 - d Read the instructions, then install the utility as described.
- 2 Check the GC firmware version. Touch **Settings > About**.

1 Installing the GC



- 3 Check for any available firmware updates. Go to the Agilent web site at <http://www.chem.agilent.com>.
 - If the available firmware version is newer than the version on the GC, download it.
 - If no firmware or help updates are available, skip to the next section.
- 4 Verify that if a new firmware version is available, it is compatible with the current hardware and software. For example, verify that any data system is compatible with the new firmware. If the new firmware is not compatible or acceptable for any reason, skip to the next section.
- 5 If available, install any available firmware updates.



A Making Swagelok Connections

Making Swagelok Connections 94

Using a Swagelok Tee 97

The gas supply tubing is attached with Swagelok fittings. If you are not familiar with Swagelok connections, review the following procedures.



Making Swagelok Connections

Objective

To make a tubing connection that does not leak and that can be taken apart without damaging the fitting.

Materials needed:

- 1/8-inch (or 1/4-inch, if used) preconditioned copper tubing
- 1/8-inch (or 1/4-inch, if used) Swagelok nuts
- Front and back ferrules
- Two 7/16-inch (for 1/8-inch nuts) or 9/16-inch (for 1/4-inch nuts) wrenches
-

Procedure:

- 1 Place a Swagelok nut, back ferrule, and front ferrule to the tubing as shown in [Figure 17](#).

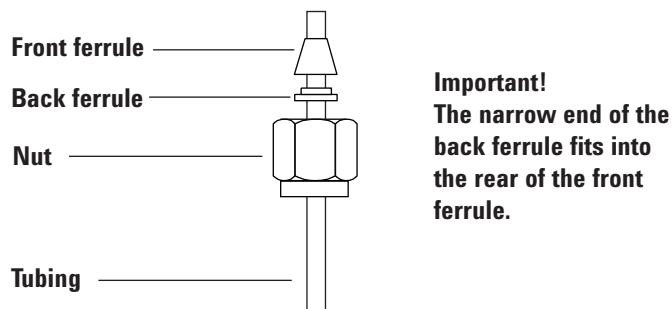


Figure 17 Swagelok nuts and ferrules

- 2 Clamp a stainless steel plug or similar fitting in a bench vise.

CAUTION

Use a separate stainless steel fitting in a vise for initial tightening of the nut. Do not use an inlet or detector fitting. Strong forces are required to properly set the ferrules, and damage to an inlet or detector fitting is very costly to repair.

- 3 Push the tubing into the stainless steel plug (see Figure 18).

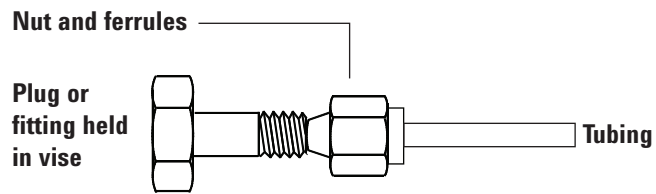


Figure 18 Assembling the fitting

- 4 Make sure that the front ferrule is touching the plug. Slide the Swagelok nut over the ferrule and thread it onto the plug.
- 5 Push the tube fully into the plug, then withdraw it approximately 1 to 2 mm (see Figure 19).

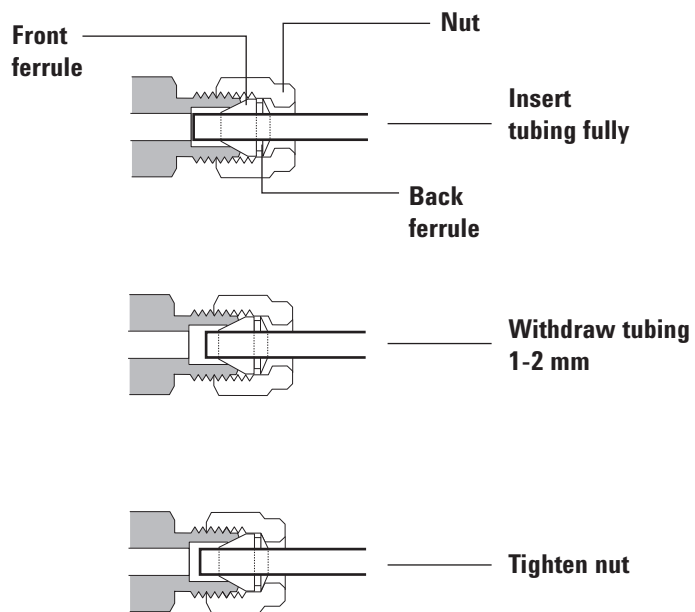


Figure 19 Insert the tubing

- 6 Finger-tighten the nut.

- 7 Mark the nut with a pencil line (see Figure 20).

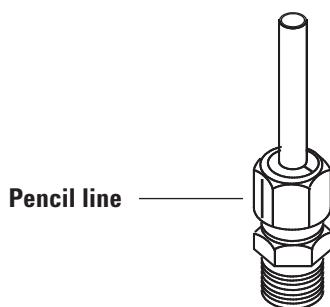


Figure 20 Marking the fitting

- 8 For 1/8-inch Swagelok fittings, use a pair of wrenches to tighten the fitting 3/4 of a turn (see Figure 21).

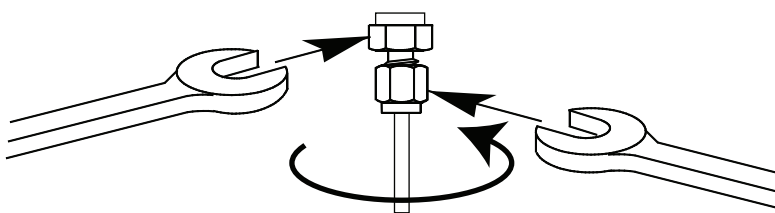


Figure 21 Final tightening

- 9 Remove the plug from the fitting. To connect the tubing, with nut and ferrules, to another fitting, finger-tighten the nut, then use a wrench to tighten it 3/4 (1/8-inch fittings) of a turn.
- 10 Both correctly- and incorrectly-swaged connections are shown in Figure 22. Note that the end of the tubing in a correctly-swaged fitting is not crushed and does not interfere with the action of the ferrules.

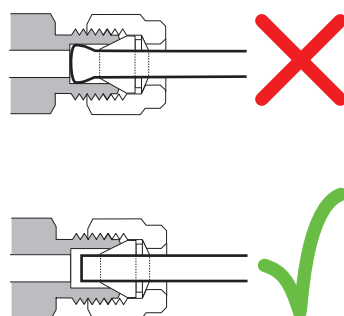


Figure 22 Completed fitting

Using a Swagelok Tee

To supply gas from a single source to more than one input, use a Swagelok Tee.

NOTE

Do not combine valve actuator air with flame ionization air. The valve action will cause major upsets in the detector signal.

Materials needed:

- 1/8-inch preconditioned copper tubing
- Tubing cutter
- 1/8-inch Swagelok nuts and front and back ferrules
- 1/8-inch Swagelok Tee
- Two 7/16-inch wrenches
- 1/8-inch Swagelok cap (optional)

Procedure:

- 1 Cut the tubing where you want to install the Tee. Connect the tubing and Tee with a Swagelok fitting. See [Figure 23](#).

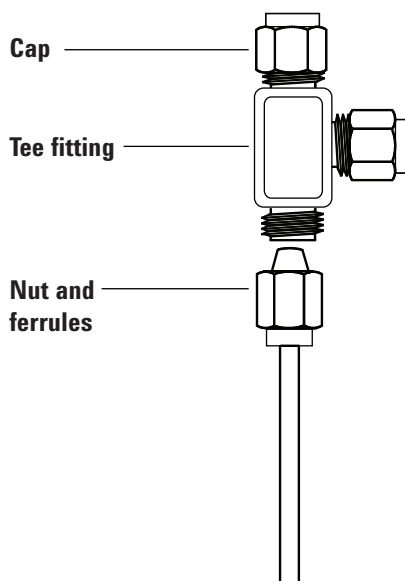
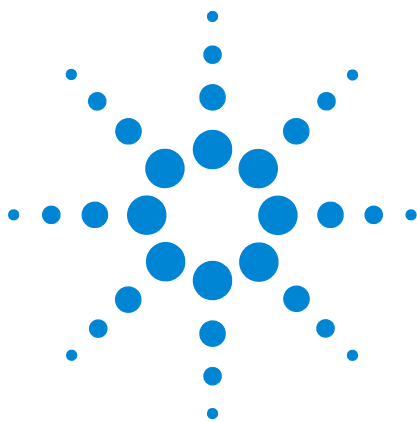


Figure 23 Swagelok tee

A Making Swagelok Connections

- 2** Measure the distance from the Tee to the instrument fittings. Attach copper tubing to the open Tee ends with Swagelok fittings.



B **Cabling Diagrams and Remote Start/Stop**

Using the Remote Start/Stop Cable	100
Multi-instrument Cabling Examples	103
Cable Diagrams	106

This section lists cabling requirements and connection diagrams that apply to less common or specialized GC installations.



Using the Remote Start/Stop Cable

Remote start/stop is used to synchronize two or more instruments. For example, you might connect an integrator and the GC so that the [**Start**]/[**Stop**] buttons on either instrument control both of them. You can synchronize a maximum of ten instruments using Remote cables.

Connecting Agilent products

If connecting two Agilent products with Remote cables, the sending and receiving circuits will be compatible—just plug in both ends of the cable.

Connecting non-Agilent products

If connecting to a non-Agilent product, the following paragraphs contain information you will need to ensure compatibility.

APG Remote signal electrical specifications

The APG signals are a modified open collector type. The signal levels are generally TTL levels (low voltage is logic zero, high voltage is logic one) but the open circuit voltage will be between 2.5 and 3.7 V. The typical voltage is 3 V. A voltage over 2.2 V will be interpreted as a high logic state while a voltage below 0.4 V will be interpreted as a low logic state. These levels provide some margin over the specifications of the devices used.

The pull-up resistance, connected to the open-circuit voltage, is in the range of about 1 kOhms to 1.5 kOhms. For a logic-low state, for a single device on the bus, the minimum current you must be able to sink is 3.3 mA. Since devices are connected in parallel, when you have multiple devices this minimum current must be multiplied by the number of devices attached on the bus. The maximum voltage for a low-input state is 0.4 V.

The bus is passively pulled high. Leakage current out of a port must be less than 0.2 mA to keep the voltage from being pulled lower than 2.2 V. Higher leakage current may cause the state to be interpreted as a low.

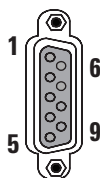
Over-voltage protection: APG Remote connections are clamped by a Zener diode to 5.6 V. Exceeding this voltage will damage the circuit (GC logic board).

APG Remote – Suggested drive circuits

A signal on the APG bus may be driven by another APG device or by one of the following circuits:

- A relay, with one side connected to ground, when closed will set a logic-low state.
- An NPN transistor, with the emitter connected to ground and the collector connected to the signal line will set a logic-low state if proper base current is supplied.
- An open-collector logic gate will perform this same function.
- A low-side drive IC will also work, but Darlington-type drivers should be avoided as they will not meet the low-side voltage requirement of less than 0.4 V

APG Remote connector



Pin	Function	Logic
1	Digital ground	
2	Prepare	LOW true
3	Start	LOW true (output)
4	Start relay	
5	Start relay	
6	Not used	
7	Ready	HIGH true (output)
8	Stop	LOW true
9	Not used	

APG Remote signal descriptions

Prepare (Low True) Request to prepare for analysis. Receiver is any module performing pre-analysis activities. For example, shorting pin 2 to ground will put the GC into **Prep Run** state. This is useful for Splitless Mode to prepare the inlet for injection or when using **Gas Saver**. This function is not needed by Agilent autosampler systems.

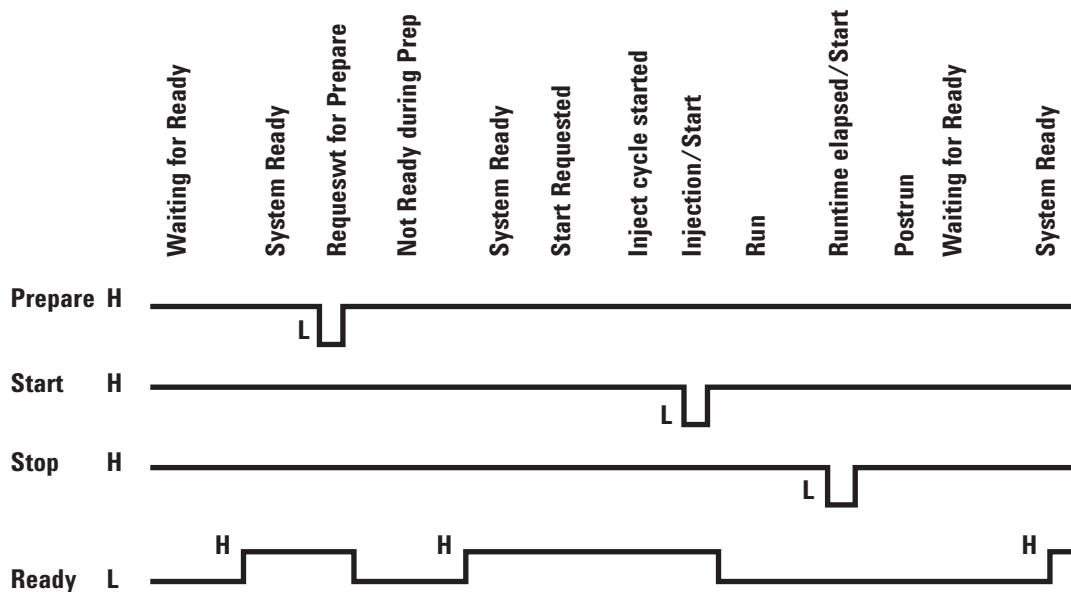
Ready (High True) If the Ready line is high (> 2.2 VDC) then the system is ready for next analysis. Receiver is any sequence controller.

Start (Low True) Request to start run/timetable. Receiver is any module performing runtime-controlled activities. The 9000 GC requires a pulse duration of at least 500 micro-seconds to sense a start from an external device.

Start Relay (Contact Closure) A 120 millisecond contact closure used as an isolated output to start another device that is not compatible or connected with APG Remote pin 3.

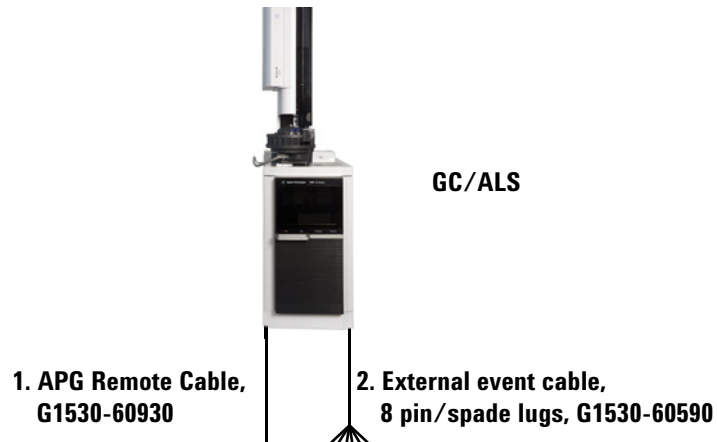
Stop (Low True) Request to reach system ready state as soon as possible (for example, stop run, abort or finish, and stop injection). Receiver is any module performing runtime-controlled activities. Normally this line is not connected, if the GC oven program is used to control the method **Stop** time.

APG Remote timing diagram



Multi-instrument Cabling Examples

GC / ALS / Non-Agilent Data System



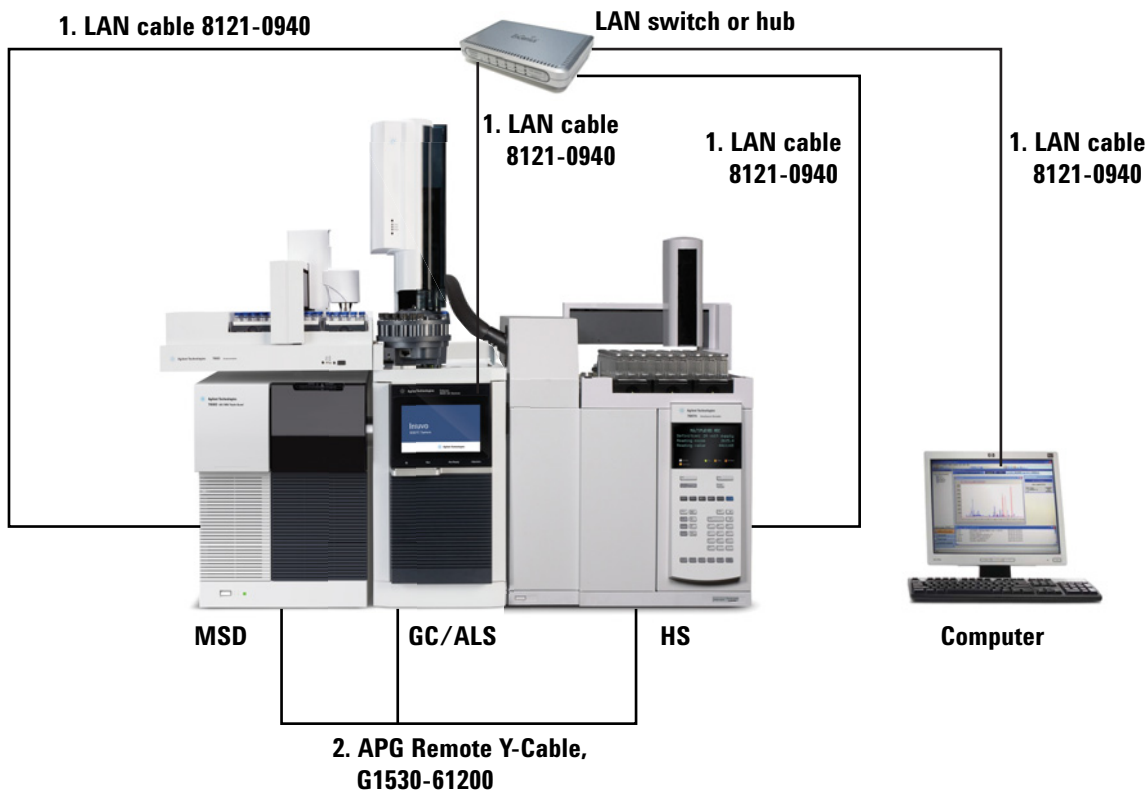
Number	Part number and description
1	G1530-60930, General use APG remote cable, 9-pin male/spade lug (0.5m)
2	G1530-60590, External event cable, 8-pin/spade lugs
	G1580-87200, Caution label, Events cable, green in color

35900-60670 APG remote cable spade lug identification

G1530-60590 External event cable spade lug identification

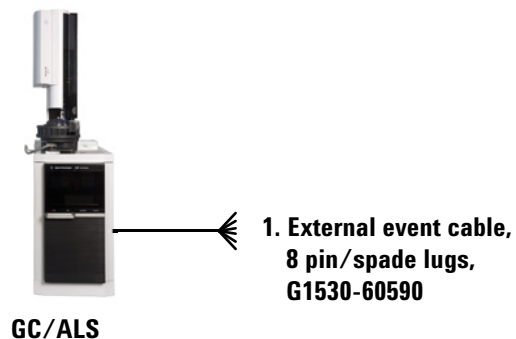
Connector 1 9 pin (male)	Signal name	Connector 2 spade lugs	Pin	Color	Signal
1	GND	Black	1	Yellow	24 V Out 1
2	Prepare	White	2	Black	24 V Out 2
3	Start	Red	3	Red	Ground
4	Shut down	Green	4	White	Ground
5	Reserved	Brown	5	Orange	Contact 1
6	Power on	Blue	6	Green	Contact 1
7	Ready	Orange	7	Brown	Contact 2
8	Stop	Yellow	8	Blue	Contact 2
9	Start Request	Violet			

Using a Y-Cable in a setup (GC/MSD/Data System/Headspace Sampler)



Number	Part number and description
1	G1530-61200, 2-m Y-cable, remote start/stop
2	8121-0940, Cable, LAN, 25 foot

GC / External Events (unspecified, non-Agilent instrument)



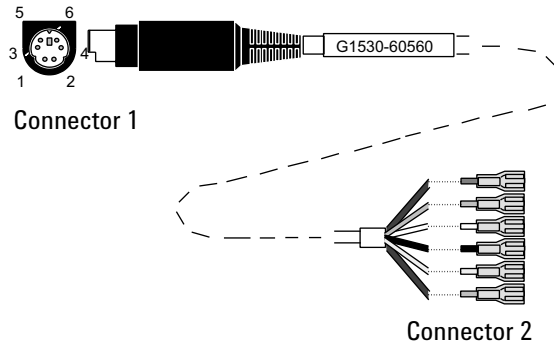
Number	Part number and description
1	G1530-60590, External events cable, 8-pin/spade lugs
	G1580-87200, Caution label, Events cable, green in color

Connector	Signal name	Maximum rating	Wire color	Corresponds to valve #
24 volt control output				
1	24 volt output 1	150 mA output	Yellow	5
2	24 volt output 2	150 mA output	Black	6
3	Ground		Red	
4	Ground		White	
Relay contact closures (normally open)				
5	Contact closure 1	48V AC/DC, 250 mA	Orange	7
6	Contact closure 1		Green	7
7	Contact closure 2	48 V AC/DC, 250 mA	Brown or violet	8
8	Contact closure 2		Blue	8

Cable Diagrams

Analog signal cable, general use, G1530-60560

Connects GC signal outputs to non-Agilent products. Also used for the Analog Input Board (AIB).



The pin assignments for the general use analog out cable are listed in [Table 9](#).

Table 9 Analog cable, general use, output connections

Connector 1	Connector 2, wire color	Signal
1	Brown or violet	Not used
2	White	0 to 1 V, 0 to 10 V (-)
3	Red	Not used
4	Black	1 V (+)
6	Blue	10 V (+)
Shell	Orange	Ground

Agilent analog signal cable, G1530-60570

This cable connects an **Analog out** port to an external data system. Both 0 to 1 volt and 0 to 10 volts are provided. Connects both GC signal outputs to Agilent 3395B/3396C integrators, and

the 35900 A/D.

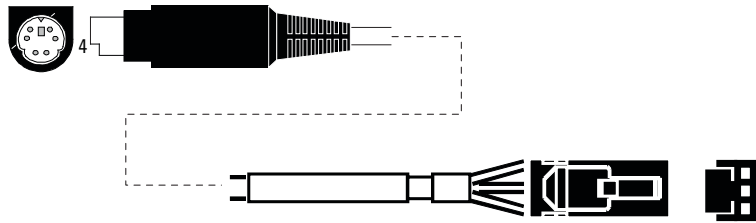
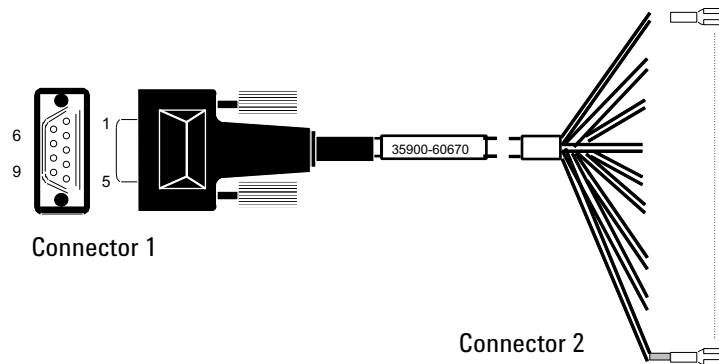


Figure 24 Analog output cable to an Agilent product

Remote start/stop cable, general use, 35900-60670



The pin assignments for the remote start/stop cable are listed in [Table 10](#).

Table 10 Remote start/stop cable connections

Connector 1, 9-pin male	Connector 2, wire color	Signal
1	Black	Digital ground
2	White	Prepare (low tone)
3	Red	Start (low tone)
4	Green	Start relay (closed during start)
5	Brown	Start relay (closed during start)
6	Blue	Open circuit
7	Orange	Ready (high true input)

Table 10 Remote start/stop cable connections (continued)

Connector 1, 9-pin male	Connector 2, wire color	Signal
8	Yellow	Stop (low tone)
9	Violet	Open circuit

Agilent APG remote start/stop cable, 03396-61010

Synchronizes the GC with an Agilent integrator. Additional cables may be used to add more instruments (up to 10 total).

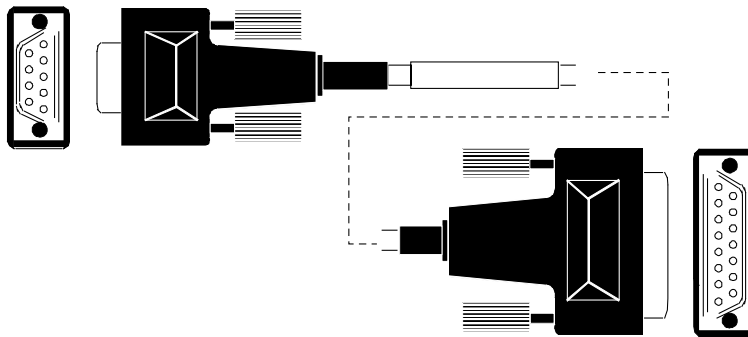


Figure 25 Remote start/stop cable, GC to Agilent integrator

Agilent APG remote start/stop cable, G1530-60930

Synchronizes the GC with another Agilent instrument. Additional cables may be used to add more instruments (up to 10 total).

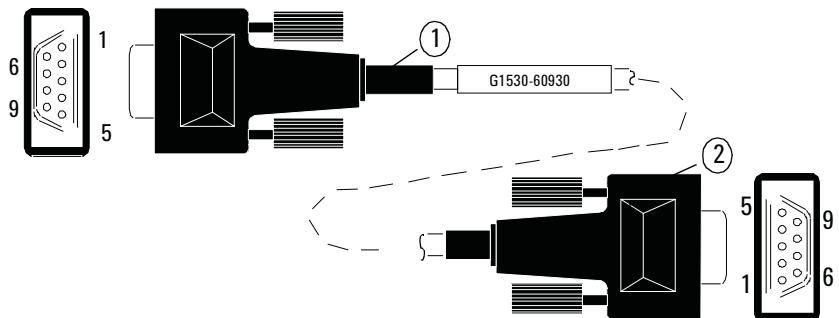


Figure 26 Remote start/stop cable, GC to Agilent instrument

Agilent remote start/stop Y-cable, G1530-61200

Synchronizes the GC with another 2 Agilent instruments.

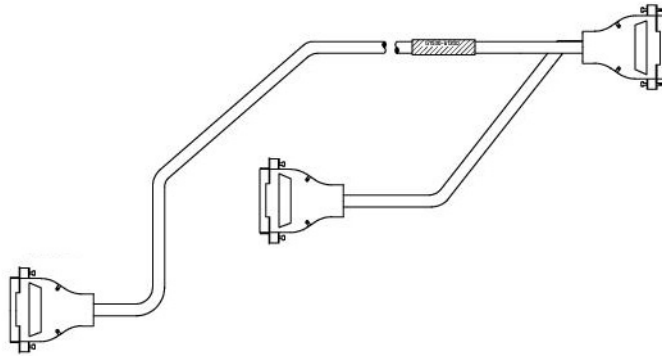


Figure 27 Remote start/stop cable, GC to Agilent instrument

BCD cable, G1530-60590

The BCD cable connector has eight passive inputs that sense total binary-coded decimal levels. The pin assignments for this connector are listed in [Table 11](#).

Table 11 BCD input connections

Pin	Function	Maximum rating
1	Relay	48 V AC/DC, 250 mA
2	Relay	48 V AC/DC, 250 mA
3	LS digit 0	
4	LS digit 1	
5	LS digit 2	
6	LS digit 3	

Table 11 BCD input connections

Pin	Function	Maximum rating
7	MS digit 0	
8	Ground	
Shield	Chassis ground	

When used for BCD input, apply label G1580-87100 to identify the cable for BCD use.

BCD cable, G1530-61100



The BCD cable connector has eight passive inputs that sense total binary-coded decimal levels. The pin assignments for this connector are listed in [Table 12](#).

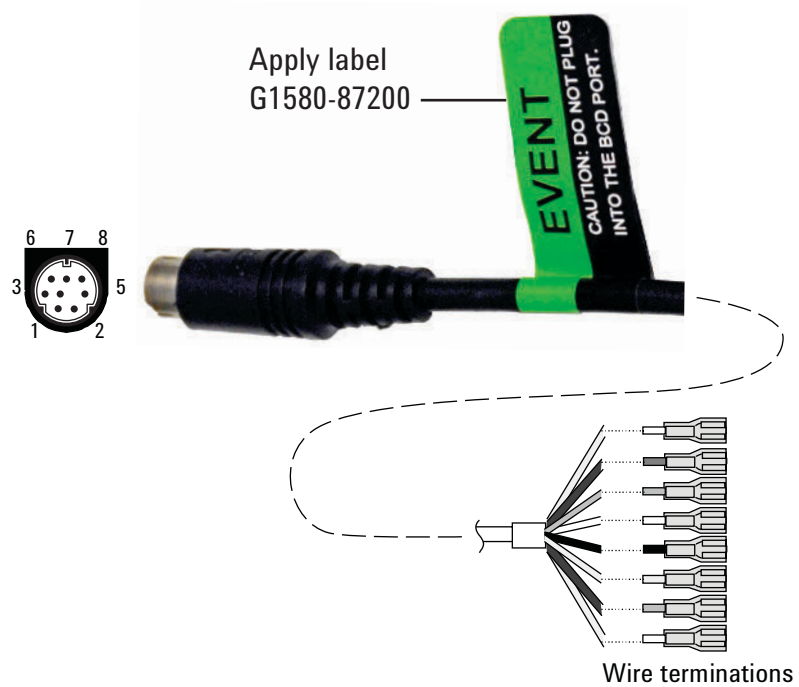
Table 12 BCD cable connections

Connector 1 Pin	Connector 2 Pin	Ribbon Cable Wire Color
	1	Brown
	2	Red
1	3	Orange
	4	Yellow

Table 12 BCD cable connections (continued)

Connector 1 Pin	Connector 2 Pin	Ribbon Cable Wire Color
	5	Green
	6	Blue
	7	Violet
	8	Gray
	9	White
2, 8	10	Black
	11	Brown
6	12	Red
	13	Orange
5	14	Yellow
	15	Green
4	16	Blue
7	17	Violet
3	18	Gray
	19	White
	20	Black
	21	Brown
	22	Red
	23	Orange
	24	Yellow
	25	Green
	26	Blue

External event cable, G1530-60590



The external event cable has two passive relay contact closures with two 24-volt control outputs. Devices connected to the passive contact closures must be connected to their own power sources.

The pin assignments for this cable are listed in [Table 13](#).

Table 13 External events cable

Connector 1 pin	Signal name	Maximum rating	Connector 2, wire color	Controlled by valve #
24 volts output				
1	24 V output 1	150 mA	Yellow	5
2	24 V output 1	150 mA	Black	6
3	Ground		Red	
4	Ground		White	
Relay contact closures (normally open)				
5	Closure 1	48 V AC/DC, 250 mA	Orange	7
6	Closure 1		Green	7

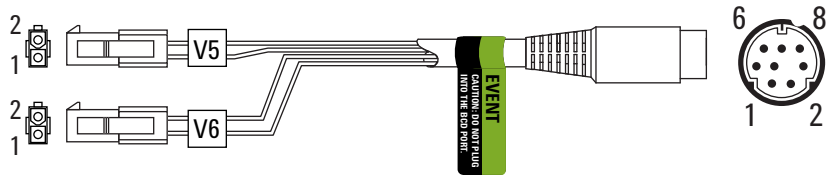
Table 13 External events cable (continued)

Connector 1 pin	Signal name	Maximum rating	Connector 2, wire color	Controlled by valve #
7	Closure 2	48 V AC/DC, 250 mA	Brown or violet	8
8	Closure 2		Blue	8

When used for external event control, apply label G1580-87200 to identify the cable for EVENT use.

External valve cable, G1580-60710

Supplies power for certain valve applications.



Connector 1 pin	Wire color	Connector and pin	Function
1	Yellow	V5 pin 1	24 V, 150 mA max.
2	Black	V6 pin 1	24 V, 150 mA max.
3	Red	V5 pin 2	Ground
4	White	V6 pin 2	Ground
5			
6			
7			
8			

