Agilent GC, GC/MS, and ALS

Site Preparation Guide

Agilent Technologies

Notices

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CAUTION

A CAUTION 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 damage to the product or loss of important data. Do not proceed beyond a CAUTION notice until the indicated conditions are fully understood and met.

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.

Contents

1
7890 Series GC Site Preparation

This section outlines the space and resource requirements for GC, GC/MS, and automatic liquid sampler (ALS) installation. For a successful and timely installation of the instrument, the site must meet these requirements before beginning installation. Necessary supplies (gases, tubing, operating supplies, consumables, and other usage-dependent items such as columns, vials, syringes, and solvents) must also be available. Note that performance verification requires the use of helium carrier gas. For MS systems using chemical ionization, methane reagent gas or methanol (for internal ionization ion traps) is also required for performance verification. Refer to the Agilent Web site at www.agilent.com for the most up-to-date listing of GC, GC/MS, and ALS supplies and consumables.

For 7697A Headspace Sampler site prep specifications, refer to the 7697A Site Prep Guide.

Customer Responsibilities

The specifications in this manual outline the necessary space, electrical outlets, gases, tubing, operating supplies, consumables, and other usage-dependent items such as columns, vials, syringes, and solvents required for the successful installation of instruments and systems.

If Agilent is delivering installation and familiarization services, users of the instrument should be present throughout these services; otherwise, they will miss important operational, maintenance, and safety information.

If Agilent is delivering installation and familiarization services, delays due to inadequate site preparation could cause loss of instrument use during the warranty period. In extreme cases, Agilent Technologies may ask to be reimbursed for the additional time required to complete the installation. Agilent Technologies provides service during the warranty period and under maintenance agreements only if the specified site requirements are met.

Installation Kits

Agilent offers several installation kits that provide parts useful during GC installation. **These kits are not supplied with the instrument.** Agilent highly recommends these kits if you did not order the pre-plumbed option 305. These kits include tools and hardware required to plumb gases to the GC.

Table 1 Installation kits

Kit	Part number	Kit contents
Recommended for FID, NPD, FPD:		
GC Supply Gas Installation Kit with Gas Purifiers	19199N	Includes Gas Clean Filter system kit CP736538 (with 1 oxygen, 1 moisture, and 2 charcoal filters), 1/8-inch brass nuts and ferrules, copper tubing, 1/8-inch brass tees, tubing cutter, 1/8-inch brass caps, universal external split vent trap with replacement cartridges, and 1/8-inch ball valve

Table 1 Installation kits (continued)

Kit	Part number	Kit contents
Recommended for TCD/ECD, MS, and MSD:		
GC Supply Gas Installation Kit	19199M	Includes 1/8-inch brass nuts and ferrules (20), copper tubing, 1/8-inch brass tees, tubing cutter, 1/8-inch brass caps, 7-mm nut driver, T-10 Torx driver, T-20 Torx driver, 4 open-end wrenches, and 1/8-inch ball valve (For TCD/ECD, also order an additional Gas Clean Filter CP17974.)
		
Gas Clean Filter kit GC-MS 1/8in.,1/pk	CP17974	Gas Clean filter kit with 1/8-inch fittings (order 2 if using separate makeup and carrier gas supplies).

You must also provide the fittings and reducers required to convert the cylinder regulator fitting (for example, 1/4-inch male NPT) to the 1/8-inch female Swagelok fitting needed to connect to the instrument. These fittings are not included with the GC. These fittings are not included with the installation kits. See “Gas Plumbing” on page 41 for part information.

Hydrogen Gas

If planning to use hydrogen as a carrier gas or for the JetClean ion source system, note that special considerations apply due to hydrogen's flammability and chromatographic properties.

- Agilent highly recommends the G3388B Leak Detector to safely check for leaks.
- Hydrogen gas requires special considerations for supply tubing. See "Gas Plumbing" on page 41 and "Supply tubing for hydrogen gas" on page 48.
- In addition to the supply pressure requirements listed in "Gas Supplies" on page 33, Agilent also recommends users of hydrogen supplies for carrier gas or the JetClean ion source system, consider the gas source and purification needs. See the additional recommendations in "Hydrogen supply requirements for carrier gas and JetClean systems" on page 35.
- When using hydrogen carrier gas with a μECD, TCD, MS, or any other detector that vents uncombusted gases, plan to vent the detector or foreline pump output to a fume hood or similar location. Uncombusted hydrogen can present a safety hazard. See "Exhaust Venting" on page 23.
- When using hydrogen carrier gas, also plan to safely vent inlet split vent flows and purge vent flows. See "Exhaust Venting" on page 23.

Dimensions and Weight

Select the laboratory bench space before the system arrives. Make sure the area is clean, clear, and level. Pay special attention to the total height requirements. Avoid bench space with overhanging shelves. See Table 2.

The instrument needs space for proper convection of heat and ventilation. Allow at least 25 cm (10 in) clearance between back of the instrument and wall to dissipate hot air and allow for routine maintenance.

Table 2 Required instrument height, width, depth, and weight

Product	Height	Width	Depth	Weight
GC				
7890 Series GCs	50 cm (19.2 in)	59 cm (23 in)	54 cm (21 in)	50 kg (112 lb)
With third detector	50 cm (19.2 in)	68 cm (27 in)	54 cm (21 in)	57 kg (125.4 lb)
GC operational oven access		Requires ≥ 30 cm (12 in) open space above GC		
MSD				
5975 Series MSD				
• Diffusion pump	41 cm (16 in)	30 cm (12 in)	54 cm (22 in)	39 kg (85 lb)
• Standard turbo pump	41 cm (16 in)	30 cm (12 in)	54 cm (22 in)	39 kg (85 lb)
• Performance turbo pump	41 cm (16 in)	30 cm (12 in)	54 cm (22 in)	41 kg (90 lb)
• Performance CI/EI turbo pump	41 cm (16 in)	30 cm (12 in)	54 cm (22 in)	46 kg (100 lb)
• Foreline pump				
Standard	21 cm (8 in)	13 cm (5 in)	31 cm (12 in)	11 kg (23.1 lb)
Oil-free	19 cm (7.5 in)	32 cm (13 in)	28 cm (11 in)	16 kg (35.2 lb)
• GC/MS operational and maintenance access		Requires 30 cm (1 ft) to its left		
5977 Series MSD				
• Diffusion pump	41 cm (16 in)	30 cm (12 in)	54 cm (22 in)	39 kg (85 lb)
• Performance turbo pump	41 cm (16 in)	30 cm (12 in)	54 cm (22 in)	41 kg (90 lb)
• Performance CI/EI turbo pump	41 cm (16 in)	30 cm (12 in)	54 cm (22 in)	46 kg (100 lb)

Table 2 Required instrument height, width, depth, and weight (continued)

Product	Height	Width	Depth	Weight
• Foreline pump				
Standard	21 cm (8 in)	13 cm (5 in)	31 cm (12 in)	11 kg (23.1 lb)
Oil-free (MVP-055)	19 cm (7.5 in)	32 cm (13 in)	28 cm (11 in)	16 kg (35.2 lb)
Oil-free (IDP3)	18 cm (7 in)	35 cm (14 in)	14 cm (6 in)	10 kg (21 lb)
• GC/MS operational and maintenance access		Requires 30 cm (1 ft) to its left		
MS				
7010 and 7000 Triple Quad MS				
• Performance turbo pump	47 cm (18.5 in)	35 cm (14 in)	86 cm (34 in)	59 kg (130 lb)
• Performance CI/EI turbo pump	47 cm (18.5 in)	35 cm (14 in)	86 cm (34 in)	63.5 kg (140 lb)
• Foreline pump	28 cm (11 in)	18 cm (7 in)	35 cm (14 in)	21.5 kg (47.3 lb)
• GC/MS operational and maintenance access		Requires 30 cm (1 ft) to its left		
7200 Q-TOF MS				
• Performance turbo pump	133 cm (52.5 in)	88 cm (34.5 in)	100 cm (39.5 in)	138 kg (305 lbs)
• Foreline pump	28 cm (11 in)	18 cm (7 in)	35 cm (14 in)	21.5 kg (47.3 lb)
• GC/Q-TOF operational and maintenance access		Requires 40 cm (16 in) on both sides, and 30 cm (12 in) in the back.		
ALS				
• GC with 7693A ALS injector		Requires 50 cm (19.5 in) above the GC		3.9 kg (8,6 lb) each
• GC with 7693A ALS tray		Requires 45 cm (17.5 in) left of the GC Requires 2 cm (1 inch) in front of GC		6.8 kg (15 lb) each
• GC with 7650A ALS injector		Requires 50 cm (19.5 in) above the GC		3.9 kg (8,6 lb) each
• GC with 7683B ALS injector		Requires 42 cm (16.5 in) above the GC		3.1 kg (7 lb) each
• GC with 7683B ALS tray		Requires 30 cm (12 in) left of the GC		3.0 kg (7 lb)

A system that includes a 7890 Series GC, a 5977, 5975, 7010 or 7000 MS, an ALS, and a computer would require about 168 cm (5.5 ft) of bench space (see Figure 1). A 7890 Series system with a GC, Ion Trap MS, ALS, and computer would require about 206 cm (6.7 ft) of bench space (or 148 cm [4.8 ft] excluding the area under the tray.) See Figure 30. Allowing for operational access and a printer, a total of 260 cm (8.5 ft) of bench space should be available for a quadrupole GC/MS system and 298 cm (9.7 ft) should be available for an Ion Trap GC/MS system. Some repairs to the GC/MS or to the GC will also require access to the back of the instrument(s).

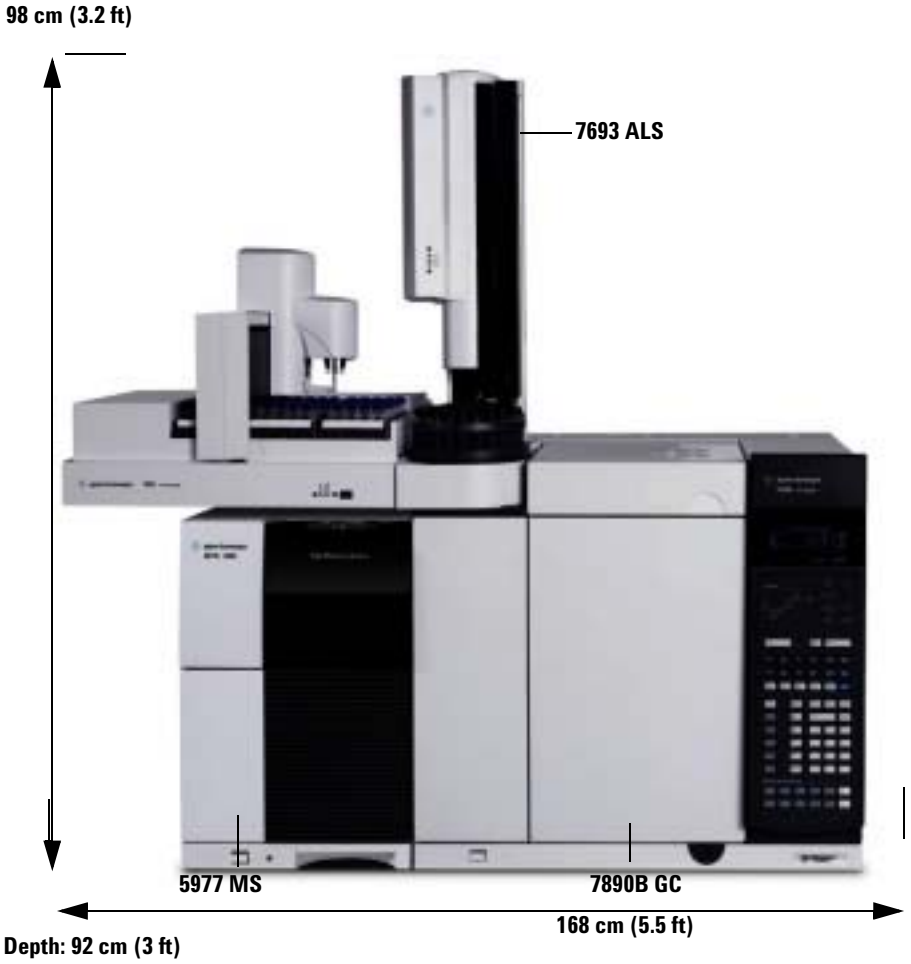


Figure 1 Front view of example installation, 7890B GC/5977 MSD system with 7693A ALS. Note that GC and ALS bench space requirements are the same, with or without an MSD.

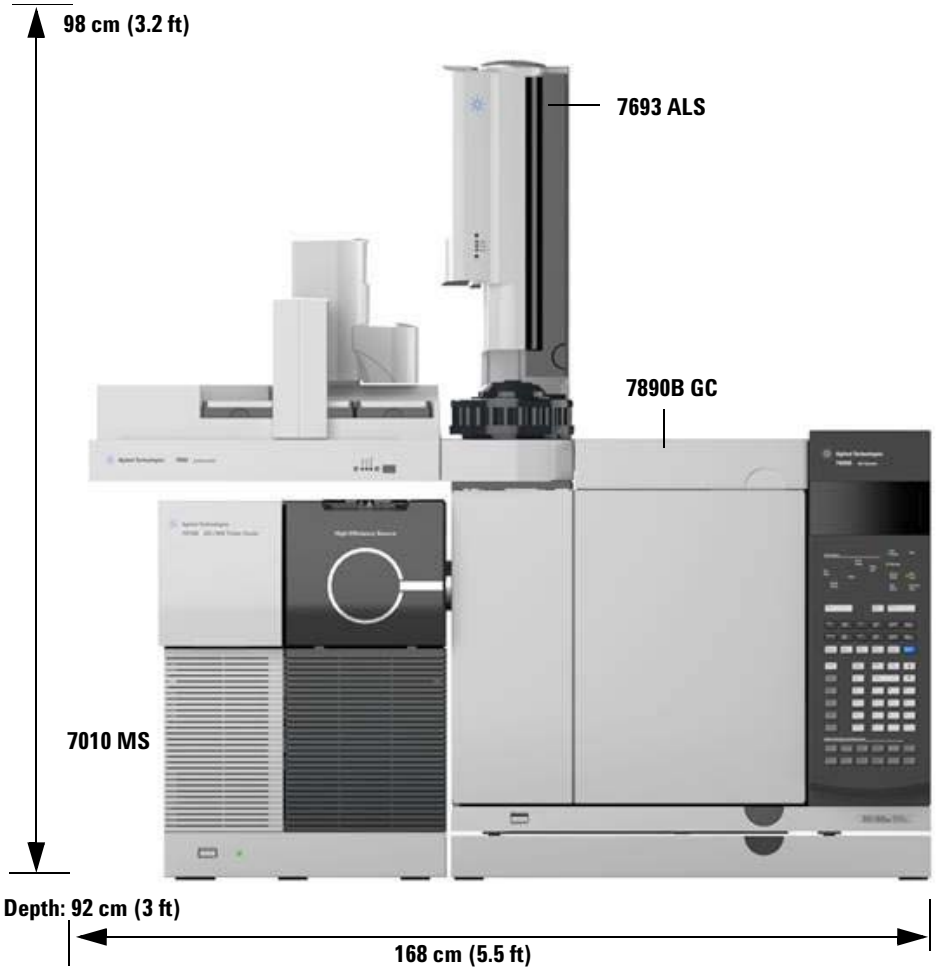


Figure 2 Front view of example installation, 7890B GC/7010 system with 7693A ALS. Note that GC and ALS bench space requirements are the same, with or without an MSD.

A 7890 Series system that includes a GC, a Q-TOF MS, an ALS, and a computer would require about 197 cm (6.5 ft) of bench space that is at least 92 cm (3 ft) deep. See Figure 3. Allowing for operational access and a printer, a total of 277 cm (9.2 ft) of bench space should be available for a 7200 Q-TOF GC/MS system. In addition, the Q-TOF requires 30 cm (1 ft) of space behind the

instrument for air circulation, the vacuum pump hose, and electrical connections; and 48 cm (1.6 ft) of space in front to allow for the RIS probe extraction tool handle when installed.

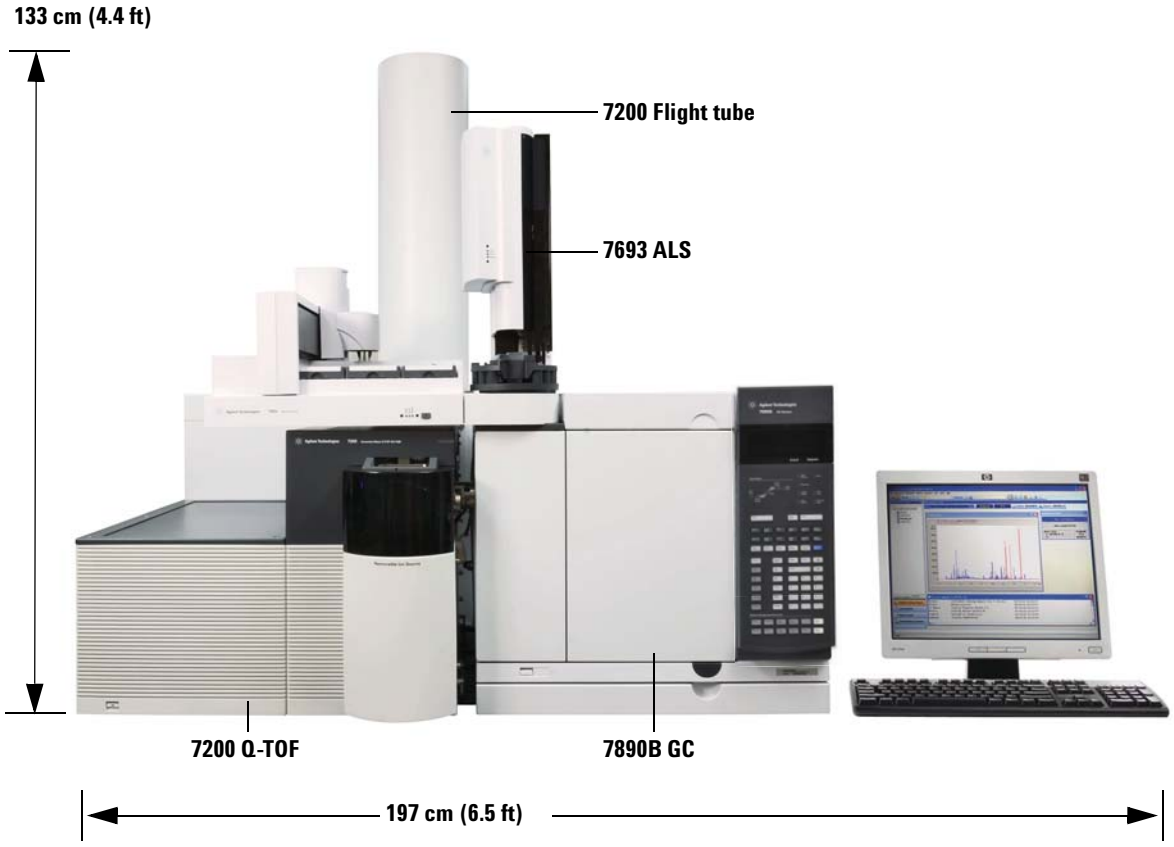


Figure 3 Front view of example installation. 7890B GC/7200 Q-TOF MS system with 7693A ALS shown.

Note that the length of the quadrupole vacuum hose is 130 cm (4 ft 3 in) from the high vacuum pump to the foreline pump, and the length of the foreline pump power cord is 2 m (6 ft 6 in).

CAUTION The supporting surface for the 7200 Q-TOF GC/MS system should be kept relatively vibration free. Do not put the rough pump on your laboratory bench with the 7200 Q-TOF GC/MS due to the vibration that the pump creates. Vibration can lead to a loss of mass accuracy and resolution.

CAUTION Make sure the 7200 Q-TOF GC/MS foreline pump is located where it is not likely to be touched by operators.

A 7890 Series GC shipping pallet for a GC is approximately 76 cm × 86 cm × 10 cm (30 × 34 × 40.5 inches). For a 7890 Series GC with a thrid detector, the pallet size is approximately 76 cm × 87 cm × 11 cm (30 × 34 × 42.5 inches).

Power Consumption

Table 3 lists site power requirements.

- The number and type of electrical outlets depend on the size and complexity of the system.
- Power consumption and requirements depend on the country to which the unit ships.
- The voltage requirements for your instrument are printed near the power cord attachment.
- The electrical outlet for the unit should have a dedicated ground.
- All instruments should be on a dedicated circuit.
- Power line conditioners should not be used with Agilent instruments.

Table 3 Power requirements

Product	Oven type	Line voltage (VAC)	Frequency (Hz)	Maximum continuous power consumption (VA)	Current rating (amps)	Power outlet current rating
7890 Series GC	Standard	Americas: 120 single phase (–10% / +10%)	48–63	2250	18.8	20 Amp Dedicated
7890 Series GC	Standard	220/230/240 single/split phase (–10% / +10%)	48–63	2250	10.2/9.8/ 9.4	10 Amp Dedicated
7890 Series GC	Fast	Japan 200 split phase (–10% / +10%)	48–63	2950	14.8	15 Amp Dedicated
7890 Series GC	Fast	220/230/240 single/split phase (–10% / +10%)[1]	48–63	2950	13.4/12.8 / 12.3	15 Amp Dedicated
MSD						
5975 Series MSD		120 (–10% / +5%)	50/60 ± 5%	1100 (400 for foreline pump only)	8	10 Amp Dedicated
5975 Series MSD		220–240 (–10% / +5%)	50/60 ± 5%	1100 (400 for foreline pump only)	8	10 Amp Dedicated

Table 3 Power requirements (continued)

Product	Oven type	Line voltage (VAC)	Frequency (Hz)	Maximum continuous power consumption (VA)	Current rating (amps)	Power outlet current rating
5975 Series MSD		200 (–10% / +5%)	50/60 ± 5%	1100 (400 for foreline pump only)	8	10 Amp Dedicated
5977 Series MSD		120 (–10% / +5%)	50/60 ± 5%	1100 (400 for foreline pump only)	8	10 Amp Dedicated
5977 Series MSD		220–240 (–10% / +5%)	50/60 ± 5%	1100 (400 for foreline pump only)	8	10 Amp Dedicated
5977 Series MSD		200 (–10% / +5%)	50/60 ± 5%	1100 (400 for foreline pump only)	8	10 Amp Dedicated
MS						
7010 or 7000 Triple Quad MS		120 (–10% / +5%)	50/60 ± 5%	1600	15	15 Amp Dedicated
7010 or 7000 Triple Quad MS		220–240 (–10% / +5%)	50/60 ± 5%	1600	15	15 Amp Dedicated
7010 or 7000 Triple Quad MS		200 (–10% / +5%)	50/60 ± 5%	1600	15	15 Amp Dedicated
7200 Q-TOF MS		200–240 (–10% / +5%)	50/60 ± 5%	1800 (1200 for foreline pump)	15	15 Amp Dedicated
All						
Data system PC (monitor, CPU, printer)		100/120/200-240 (–10% / +5%)	50/60 ± 5%	1000	15	15 Amp Dedicated

1 Option 003, 208 VAC fast oven, uses a 220 VAC unit with operating range of 198 to 242 VAC. Most labs have 4-wire service resulting in 208 VAC at the wall receptacle. It is important to measure the line voltage at the receptacle for the GC.

WARNING **Do not use extension cords with Agilent instruments. Extension cords normally are not rated to carry enough power and can be a safety hazard.**

Although your GC should arrive ready for operation in your country, compare its voltage requirements with those listed in Table 3. If the voltage option you ordered is not suitable for your installation, contact Agilent Technologies. Note that ALS instruments receive their power from the GC.

CAUTION A proper earth ground is required for GC operations. Any interruption of the grounding conductor or disconnection of the power cord could cause a shock that could result in personal injury.

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. Be sure to verify proper receptacle grounding. The GC requires an isolated ground.

Connect the GC to a dedicated circuit.

USA fast heating oven, 240 V

The 240 V fast heating oven requires 240 V/15 A power. Do not use 208 V power. Lower voltage causes slow oven ramps and prevents proper temperature control. The power cord supplied with your GC is rated for 250 V/15 A, and is a two-pole, three-wire cord with grounding (type L6-15R/L6-15P).

Canadian installation

When installing a GC in Canada, make sure your GC's power supply circuit meets the following additional requirements:

- The circuit breaker for the branch circuit, which is dedicated to the instrument, is rated for continuous operation.
- The service box branch circuit is marked as a "Dedicated Circuit."

Common instrument power cord plugs

Table 4 below shows common Agilent power cord plugs.

Table 4 Power cord terminations

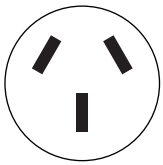
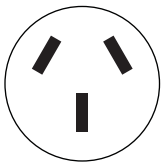
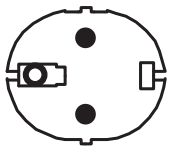
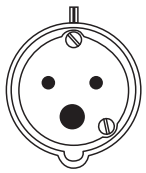
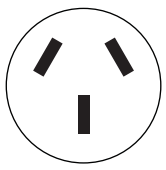
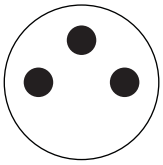
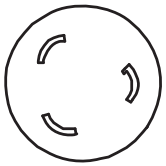
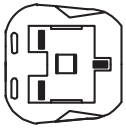
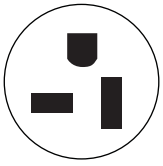
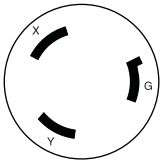
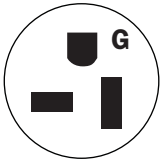
Country	Voltage	Amps	Cable length (m)	Termination type	Plug Termination
Australia	240	16	2.5	AS 3112	
China	220	15	4.5	GB 1002	
Europe, Korea	220 / 230 / 240	10	2.5	CEE/7/V11	
Denmark, Switzerland	230	16	2.5	Swiss/Denmark 1302	
India, South Africa	240	15	4.5	AS 3112	

Table 4 Power cord terminations (continued)

Country	Voltage	Amps	Cable length (m)	Termination type	Plug Termination
Israel	230	16, 16 AWG	2.5	Israeli SI32	
Japan	200	20	4.5	NEMA L6-20P	
United Kingdom, Hong Kong, Singapore, Malaysia	240	13	2.5	BS89/13	
United States	120	20, 12 AWG	4.5	NEMA 5-20P	
United States	240	15, 14 AWG	2.5	NEMA L6-15P	
Taiwan, South America		20, 12 AWG	2.5	NEMA 5-20P	

Heat Dissipation

Use Table 5 to estimate the additional BTUs of heat dissipated from this equipment. Maximums represent the heat given off when heated zones are set for maximum temperatures.

Table 5 Heat dissipation

	Oven type	
	Standard oven ramp	**Fast oven ramp (option 002 or 003)**
7890 Series GC	7681 BTU/hour maximum (8103 kJ/h)	10,071 BTU/hour maximum (10,626 kJ/h)
	Steady state, including MS interface	
5975 Series MSD	3000 BTU/hour (3165 kJ/h)	
5977 Series MSD	3000 BTU/hour (3165 kJ/h)	
7010 or 7000 Triple Quad MS	3700 BTU/hour (3904 kJ/h)	
7200 Q-TOF MS	6200 BTU/hour (6541 kJ/h)	

Exhaust Venting

During normal operation, the GC exhausts hot oven air. Depending on the installed inlet and detector types, the GC can also exhaust (or vent) uncombusted carrier gas and sample. Proper venting of these exhausts is required for operation and safety.

Hot air

Hot air (up to 450 °C) from the oven exits through a vent in the rear. Allow at least 25 cm (10 in) clearance behind the instrument, or 30 cm (12 in) behind a Q-TOF GC/MS, and 76 cm (30 in) above the Ion Trap to dissipate this air.

WARNING **Do not place temperature-sensitive items (for example, gas cylinders, chemicals, regulators, and plastic tubing) in the path of the heated exhaust. These items will be damaged and plastic tubing will melt. Be careful when working behind the instrument during cool-down cycles to avoid burns from the hot exhaust.**

For most applications, an optional oven exhaust deflector (G1530-80650, or option 306) is available and can improve oven cooling by deflecting the exhaust air up and away from the instrument. The exhaust deflector requires 14 cm (5.5 inches) behind the instrument. (For 7200 Q-TOF GC/MS, GC/QTOF exhaust deflector assembly G3850-80650 is provided.) For GCs with the exhaust deflector option installed, the exhaust is about 65 ft^3/min (1.840 m^3/min). Without the deflector, the exhaust rate is about 99 ft^3/min (2.8 m^3/min). The deflector outlet diameter is 10 cm (4 in).

Figure 4 Exhaust deflector G1530-80650

Other gases

During normal operation of the GC with many detector and inlet types, some of the carrier gas and sample vents outside the instrument through the split vent, septum purge vent, and detector exhaust. If any sample components are toxic or noxious, or if hydrogen is used as the carrier gas, these exhausts must be vented to a fume hood. Place the GC in the hood or attach a large diameter venting tube to the outlet for proper ventilation.

To further prevent contamination from noxious gases, attach a chemical trap to the vent(s).

If using a μECD, always plan to connect the μECD exhaust vent to a fume hood or vent it to the outside. See the latest revision of 10 CFR Part 20 (including Appendix B), or the applicable state regulation. For other countries, consult with the appropriate agency for equivalent requirements. Agilent recommends a vent line internal diameter of 6 mm (1/4-inch) or greater. With a line of this diameter, the length is not critical.

Vent the GC/MS system externally to the building via an ambient-pressure vent system, within 460 cm (15 ft) of both the GC split vent and GC/MS foreline pump, or vent to a fume hood.

Note that an exhaust vent system is not part of the building environmental control system, which recirculates air.

Exhaust venting must comply with all local environmental and safety codes. Contact your Environmental Health & Safety (EHS) specialist.

Exhaust vent fittings

The various inlet and detector vents terminate in the following fittings:

- TCD, μECD: The detector exhaust terminates in a 1/8-inch od tube.
- SS, MMI, PTV, VI: The split vent terminates in a 1/8-inch Swagelok female fitting.
- All inlets: The septum purge vent terminates in 1/8-inch od tubing.

Environmental Conditions

Operating the instrument within the recommended ranges optimizes instrument performance and lifetime. Performance can be affected by sources of heat and cold from heating, air conditioning systems, or drafts. See Table 6. The conditions assume a noncondensing, noncorrosive atmosphere. The instrument meets the following International Electrotechnical Commission (IEC) classifications: Equipment Class I, Laboratory Equipment, Installation Category II, and Pollution Degree 2.

Table 6 Environmental conditions for operation and storage

Product	Conditions	Operating temp range	Operating humidity range	Maximum altitude
7890 Series GC	Standard oven ramp	15 to 35 °C	5 to 95%	4,615 m
	Fast oven ramp (options 002 and 003)	15 to 35 °C	5 to 95%	4,615 m
	Storage	–40 to 70 °C	5 to 95%	
MSD				
5975 Series MSD	Operation	15 to 35 °C [1] (59 to 95 °F)	20 to 80%	4,615 m
	Storage	–20 to 70 °C (–4 to 158 °F)	0 to 95%	
5977 Series MSD	Operation	15 to 35 °C [1] (59 to 95 °F)	20 to 80%	4,615 m
	Storage	–20 to 70 °C (–4 to 158 °F)	0 to 95%	
MS				
7010 or 7000 Triple Quad MS	Operation	15 to 35 °C [2] (59 to 95 °F)	40 to 80%	5,000 m [3]
	Storage	–20 to 70 °C (–4 to 158 °F)	0 to 95%	
7200 Q-TOF MS	Operation	15 to 35 °C [2] (59 to 95 °F)	20 to 80%	2,500 m
	Storage	–20 to 70 °C (–4 to 158 °F)	0 to 95%	

1 Operation requires constant temperature (variations < 2 ^{o}C/hour)

2 Operation requires constant temperature (variations < 2 ^{o}C/hour)

3 An altitude of 3,700 meters (12,000 feet) is supported if the ambient temperature is less than 30 °C

Gas and Reagent Selection

Table 7 lists gases usable with Agilent GCs and capillary columns. When used with capillary columns, GC detectors require a separate makeup gas for optimum sensitivity. The MS and MSD use GC carrier gas.

If using any MS system, use of hydrogen as the carrier gas may require hardware modifications for best performance. Contact your Agilent service representative. Hydrogen is not supported as a carrier gas with the 7200 GC/QTOF system.

NOTE Nitrogen and Argon/Methane are generally not suitable for GC/MS carrier gas.

Table 7 Gases usable with Agilent GCs and capillary columns

Detector type	Carrier	Preferred makeup	Alternate choice	Detector, anode purge, or reference
Electron capture (ECD)	Hydrogen Helium Nitrogen Argon/Methane (5%)	Argon/Methane (5%) Argon/Methane (5%) Nitrogen Argon/Methane (5%)	Nitrogen Nitrogen Argon/Methane (5%) Nitrogen	Anode purge must be same as makeup
Flame ionization (FID)	Hydrogen Helium Nitrogen	Nitrogen Nitrogen Nitrogen	Helium Helium Helium	Hydrogen and air for detector
Flame photometric (FPD)	Hydrogen Helium Nitrogen Argon	Nitrogen Nitrogen Nitrogen Nitrogen		Hydrogen and air for detector
Nitrogen-Phosphorus (NPD)	Helium Nitrogen	Nitrogen Nitrogen	Helium[1] Helium	Hydrogen and air for detector
Thermal conductivity (TCD)	Hydrogen Helium Nitrogen	Must be same as carrier and reference	Must be same as carrier and reference	Reference must be same as carrier and makeup

1 Depending on bead type, higher makeup gas flow rates (> 5 mL/min) may introduce cooling effects or shorten bead life.

Table 8 lists gas recommendations for packed column use. In general, makeup gases are not required with packed columns.

Table 8 Gases usable with Agilent GCs and packed columns

Detector type	Carrier gas	Comments	Detector, anode purge, or reference
Electron capture (ECD)	Nitrogen	Maximum sensitivity	Nitrogen
	Argon/methane	Maximum dynamic range	Argon/Methane
Flame ionization (FID)	Nitrogen	Maximum sensitivity	Hydrogen and air for detector.
	Helium	Acceptable alternative	
Flame photometric (FPD)	Hydrogen Helium Nitrogen Argon		Hydrogen and air for detector.
Nitrogen-Phosphorus (NPD)	Helium	Optimum performance	Hydrogen and air for detector.
	Nitrogen	Acceptable alternative	
Thermal conductivity (TCD)	Helium	General use	Reference must be same as carrier and makeup.
	Hydrogen Nitrogen Argon	Maximum sensitivity[1] Hydrogen detection[2] Maximum hydrogen sensitivity[1]	

1 Slightly greater sensitivity than helium. Incompatible with some compounds.

2 For analysis of hydrogen or helium. Greatly reduces sensitivity for other compounds.

For installation checkout, Agilent requires the gas types shown in Table 9.

Table 9 Gases required for checkout

Detector	Gases required
FID	Carrier: helium Makeup: nitrogen Fuel: hydrogen Aux gas: Air
TCD	Carrier and reference: helium
NPD	Carrier: helium Makeup: nitrogen Fuel: hydrogen Aux gas: Air
uECD	Carrier: helium Anode purge and makeup: nitrogen
FPD	Carrier: helium Makeup: nitrogen Fuel: hydrogen Aux gas: Air
CI MS (external)	Reagent gas: methane

WARNING

When using hydrogen (H_2) as the carrier gas or fuel gas, be aware that hydrogen gas can flow into the GC and create an explosion hazard. Therefore, be sure that the supply is turned off until all connections are made and ensure the inlet and detector column fittings are either connected to a column or capped at all times when hydrogen gas is supplied to the instrument.

Hydrogen is flammable. Leaks, when confined in an enclosed space, may create a fire or explosion hazard. In any application using hydrogen, leak test all connections, lines, and valves before operating the instrument. Always turn off the hydrogen supply at its source before working on the instrument.

Please refer to the Hydrogen Safety Guide shipped with your instrument.

Hydrogen use is specifically prohibited with the 7200 GC/Q-TOF system.

MS and MSD systems purchased with a Self-Cleaning Ion Source also require a source of hydrogen gas in addition to helium carrier gas. This source can be shared but must meet carrier gas purity requirements.

Gas and Reagent Purity

Agilent recommends that carrier and detector gases be 99.9995% pure. See Table 10. Air needs to be zero grade or better. Agilent also recommends using high quality traps to remove hydrocarbons, water, and oxygen.

Table 10 Carrier, collision, and reagent gas purity

Carrier, collision, and reagent gas requirements	Purity	Notes
Helium (carrier and collision)	99.9995%	Hydrocarbon free
Hydrogen (carrier and self-cleaning ion source)	99.9995%	SFC grade
Nitrogen (collision)[1]	99.999%	Research or SFC grade
Nitrogen (drying gas, nebulizer pressure)[2]	99.999%	Research or SFC grade
Methane reagent gas[3]	99.999%	Research or SFC grade
Isobutane reagent gas[4]	99.99%	Instrument grade
Ammonia reagent gas[4]	99.9995%	Research or SFC grade
Carbon dioxide reagent gas[4]	99.995%	SFC grade

1 Nitrogen for the collision cell requires a separate supply from the nitrogen used for the drying gas. A separate pressure regulator is required. A high pressure bottle of nitrogen is recommended for the collision cell gas supply.

2 Purity specification is the minimum acceptable purity. Major contaminants can be water, oxygen, or air. Drying gas and nebulizer pressure gas can be supplied by a nitrogen gas generator, house nitrogen system, or liquid nitrogen dewar.

3 Required reagent gas for installation and performance verification, external CI MS only. The 5975, 5977, 7000 GC/MS, 7200 Q-TOF MS, and 240 Ion Trap operate in an external CI mode.

4 Optional reagent gases, CI mode only.

Gas Supplies

General requirements

Supply instrument gases using tanks, an internal distribution system, or gas generators. If used, tanks require two-stage pressure regulators with packless, stainless steel diaphragms. The instrument requires 1/8-inch Swagelok connections to its gas supply fittings. See Figure 32.

NOTE Plumb the gas supply tubing/regulators so that one 1/8-inch Swagelok female connector is available for each gas needed at the instrument.

Table 11 lists available Agilent two-stage tank regulators. All Agilent regulators are supplied with the 1/8-inch Swagelok female connector.

Table 11 Tank regulators

Gas type	CGA number	Max pressure	Part number
Air	346	125 psig (8.6 Bar)	5183-4641
Industrial Air	590	125 psig (8.6 Bar)	5183-4645
Hydrogen, Argon/Methane	350	125 psig (8.6 Bar)	5183-4642
Oxygen	540	125 psig (8.6 Bar)	5183-4643
Helium, Argon, Nitrogen	580	125 psig (8.6 Bar)	5183-4644

Table 12 and Table 14 list minimum and maximum delivery pressures for inlets and detectors, measured at the bulkhead fittings on the back of the instrument.

Table 12 Delivery pressures for inlets required at the GC/MS, in kPa (psig)

	Inlet type					
	Split/Splitless 150 psi	**Split/Splitless 100 psi**	**Multimode 100 psi**	**On-column**	**Purged packed**	**PTV**
Carrier (max)	1,172 (170) [1]	827 (120)	1,172 (170)	827 (120)	827 (120)	827 (120)
Carrier (min)	(20 psi) above maximum pressure used in method. (If using constant flow control in the inlet, the maximum column pressure occurs at the final oven temperature.)					

1 Japan only: 1013 (147)

Table 13 and Table 14 list minimum and maximum delivery pressures for inlets and detectors, measured at the bulkhead fittings on the back of the instrument.

Table 13 Delivery pressures for inlets required at the GC/MS, in kPa (psig)

	Inlet type		
	Split/Splitless 150 psi	**Split/Splitless 100 psi**	**Multimode 100 psi**
Carrier (max)	1,172 (170) [1]	827 (120)	1,172 (170)
Carrier (min)	(20 psi) above maximum pressure used in method. (If using constant flow control in the inlet, the maximum column pressure occurs at the final oven temperature.)		

1 Japan only: 1013 (147)

Table 14 Maximum delivery pressures for detectors, at the GC/MS, in kPa (psig)

	Detector type				
	FID	**NPD**	**TCD**	**ECD**	**FPD**
Hydrogen	240–690 (35–100)	240–690 (35–100)			310–690 (45–100)
Air	380–690 (55–100)	380–690 (55–100)			690–827 (100–120)
Makeup	380–690 (55–100)	380–690 (55–100)	380–690 (55–100)	380–690 (55–100)	380–690 (55–100)
Reference			380–690 (55–100)		

The minimum supply pressure for Auxiliary EPC and PCM modules is 138 kPa (20 psi) greater than the pressure used in your method. For example, if you need a pressure of 138 kPa (20 psi) for the method, the supply pressure must be at least 276 kPa (40 psi). Table 15 lists the maximum carrier pressure for Auxiliary EPC and PCM modules.

Table 15 Delivery pressures for Auxiliary EPC and PCM modules, in kPa (psig)

	Aux EPC	PCM 1	PCM 2 or PCM Aux
Carrier (max)	827 (120)	827 (120)	827 (120) with Forward pressure control 345 (50) with Backpressure control

Conversions: 1 psi = 6.8947 kPa = 0.068947 Bar = 0.068 ATM

Hydrogen supply requirements for carrier gas and JetClean systems

Not all systems can use hydrogen as a carrier gas. See Gas and Reagent Selection.

Hydrogen can be supplied from a generator or from a cylinder.

Agilent recommends use of a high-quality hydrogen gas generator. A high-quality generator can consistently produce purity > 99.9999%, and the generator can include built-in safety features such as limited storage, limited flow rates, and auto-shutdown. Select a hydrogen generator that provides low (good) specifications for water and oxygen content.

If using a hydrogen gas cylinder, Agilent recommends use of Gas Clean Filters to purify the gas. Consider additional safety equipment as recommended by your company safety personnel.

GC/MS Gas and Reagent Requirements

See the appropriate tables for gas and reagent gas requirements.

5975 and 5977 Series MSD

7010 and 7000 Series MS

7200 Series Q-TOF MS

5975 and 5977 Series MSD

Table 16 lists the limits on total gas flow into the 5975 Series MSD.

Table 16 5975 Series MSD total gas flow limitations

Feature	G3170A	G3171A	G3172A	G3174A
High vacuum pump	Diffusion	Standard turbo	Performance turbo	Performance turbo, EI/PCI/NCI
Optimal gas flow mL/min[1]	1.0	1.0	1.0 to 2.0	1.0 to 2.0
Maximum recommended gas flow, mL/min	1.5	2.0	4.0	4.0
Maximum gas flow, mL/min[2]	2.0	2.4	6.5	4.0
Max column id	0.25 mm (30 m)	0.32 mm (30 m)	0.53 mm (30 m)	0.53 mm (30 m)

1 Total gas flow into the MSD = column flow + reagent gas flow (if applicable) + Agilent CFT device flow (if applicable). Instruments using a JetClean ion source system may also add a small (~0.075 mL/min) hydrogen flow.

2 Expect degradation of spectral performance and sensitivity.

Table 17 lists the limits on total gas flow into the 5977 Series MSD.

Table 17 5977 Series MSD total gas flow limitations

Feature	G7037A	G7038A	G7039A	G7040A
High vacuum pump	Diffusion	Performance turbo	Performance turbo	Performance turbo
Optimal gas flow mL/min[1]	1.0	1.0 to 2.0	1.0 to 2.0	1.0 to 2.0
Maximum recommended gas flow, mL/min	1.5	4.0	4.0	4.0
Maximum gas flow, mL/min[2]	2.0	6.5	6.5	6.5
Max column id	0.25 mm (30 m)	0.53 mm (30 m)	0.53 mm (30 m)	0.53 mm (30 m)

1 Total gas flow into the MSD = column flow + reagent gas flow (if applicable) + Agilent CFT device flow (if applicable). Instruments using a JetClean ion source system may also add a small (~0.075 mL/min) hydrogen flow.

2 Expect degradation of spectral performance and sensitivity.

Table 18 lists typical flows resulting from selected carrier and reagent gas source pressures.

Table 18 5977 and 5975 Series MSD carrier and reagent gases

Carrier and reagent gas requirements	Typical pressure range	Typical flow (mL/min)
Helium (required) (column and split flow)	345 to 552 kPa (50 to 80 psi)	20 to 50
Hydrogen (optional)[1] (column and split flow)	345 to 552 kPa (50 to 80 psi)	20 to 50
Methane reagent gas (required for CI operation)	103 to 172 kPa (15 to 25 psi)	1 to 2
Isobutane reagent gas (optional)	103 to 172 kPa (15 to 25 psi)	1 to 2
Ammonia reagent gas (optional)	34 to 55 kPa (5 to 8 psi)	1 to 2
Carbon dioxide reagent gas (optional)	103 to 138 kPa (15 to 20 psi)	1 to 2

1 Hydrogen gas can be used for the carrier gas but specifications are based on helium as the carrier gas. Please observe all hydrogen gas safety cautions.

7010 and 7000 Series MS

Table 19 lists the limits on total gas flow into the Triple Quad MS.

Table 19 7010 and 7000 Triple Quad MS total gas flow limitations

Feature	
High vacuum pump	Split-flow turbo
Optimal gas flow mL/min[1]	1.0 to 2.0
Maximum recommended gas flow, mL/min	4.0
Maximum gas flow, mL/min[2]	6.5
Maximum column id	0.53 mm (30 m long)

1 Total gas flow into the MS = column flow + reagent gas flow (if applicable) + Agilent CFT/IFT device flow (if applicable). Instruments using a JetClean ion source system may also add a small (~0.075 mL/min) hydrogen flow.

2 Expect degradation of spectral performance and sensitivity.

Table 20 lists typical flows resulting from selected carrier and reagent gas source pressures.

Table 20 7010 and 7000 Triple Quad MS carrier and reagent gases

Carrier and reagent gas requirements	Typical pressure range	Typical flow (mL/min)
Helium (required) (column and split flow)	345 to 552 kPa (50 to 80 psi)	20 to 50
Hydrogen (optional)[1] (column and split flow)	345 to 552 kPa (50 to 80 psi)	20 to 50
Methane reagent gas (required for CI operation)	103 to 172 kPa (15 to 25 psi)	1 to 2
Ammonia reagent gas (optional)	34 to 55 kPa (5 to 8 psi)	1 to 2

Table 20 7010 and 7000 Triple Quad MS carrier and reagent gases (continued)

Carrier and reagent gas requirements	Typical pressure range	Typical flow (mL/min)
Isobutane reagent gas (optional)[2]	103 to 172 kPa (15 to 25 psi)	1 to 2
Carbon dioxide reagent gas (optional)[2]	103 to 138 kPa (15 to 20 psi)	1 to 2
Nitrogen for collision cell (nitrogen source is supplied to EPC module in GC.)	1.03 to 1.72 bar (104 to 172 kPa, or 15 to 25 psi)	1 to 2 (mL/min)

1 Hydrogen gas can be used for the carrier gas but specifications are based on helium as the carrier gas. Please observe all hydrogen gas safety cautions.

2 Reagent available with manual tune only.

7200 Series Q-TOF MS

Table 21 lists the limits on total gas flow into the 7200 Q-TOF GC/MS.

Table 21 7200 Q-TOF GC/MS total gas flow limitations

Feature	
High vacuum pump 1	Split-flow turbo
High vacuum pump 2	Split-flow turbo
High vacuum pump 3	Turbo
Carrier gas optimal gas flow, mL/min[1]	1.0 to 1.5
Carrier gas maximum recommended gas flow, mL/min	2.0
Carrier gas maximum gas flow, mL/min[2]	2.4
Reagent gas flow (EI/CI – CI application)	1.0 to 2.0
Collision cell gas flow rate, mL/min	1.5
Maximum column id	0.32 mm (30 m long)

1 Total gas flow into the MS = column flow + reagent gas flow (if applicable) + collision cell gas flow.

2 Expect degradation of spectral performance and sensitivity.

Table 22 lists typical flows resulting from selected carrier and reagent gas source pressures.

Table 22 7200 Q-TOF GC/MS carrier and reagent gas flows

Carrier and reagent gas requirements	Typical pressure range	Typical flow
Helium (required for carrier and IRM)	173 to 207 kPa (25 to 30 psi)	1.0 to 2.0 (mL/min)
Nitrogen for RIS transfer line actuator	6.1 to 6.8 bar (612 to 690 kPa, or (90 to 100 psi)	Up to 30 L/min
Nitrogen for collision cell (nitrogen source is supplied to EPC module in GC.)	0.7 to 2.0 bar (70 to 207 kPa, or 10 to 30 psi)	1 to 2 (mL/min)

WARNING **The use of hydrogen is specifically prohibited with the 7200 GC/Q-TOF.**

GC/MS systems with a JetClean ion source system installed use helium as the GC carrier gas and an additional supply of hydrogen gas to the MS analyzer. Table 23 shows typical supply pressures needed for operation. These values reflect the pressures supplied to the instruments, not setpoints.

Table 23 JetClean ion source system gas supply pressures

Gas supply	Pressure delivered at the GC
Helium	690 kPa (100 psi)
Hydrogen	≤ 621 kPa (90 psi)[1]

1 Any delivery pressure ≤ 621 kPa (90 psi) is acceptable as long as it is 69 kPa (10 psi) higher than the maximum hydrogen pressure needed during operation.

Gas Plumbing

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

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

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

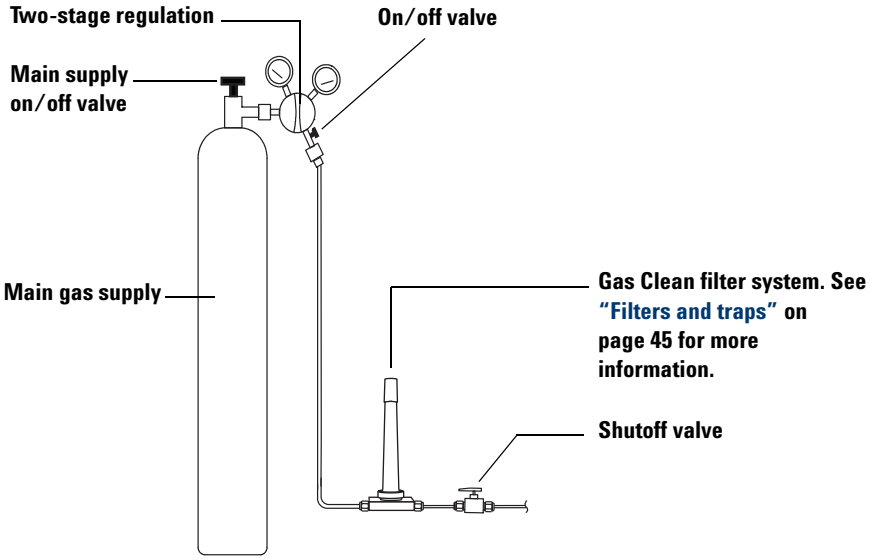


Figure 5 Recommended filters and plumbing configuration from a carrier gas cylinder

- If you have not requested option 305 (pre-plumbed tubing), you must supply pre-cleaned, 1/8-inch copper tubing and a variety of 1/8-inch Swagelok fittings to connect the GC to inlet and detector gas supplies. See the Installation Kits for recommended parts.
- Agilent strongly recommends two-stage regulators to eliminate pressure surges. High-quality, stainless-steel diaphragm-type regulators are especially recommended.
- On/off valves mounted on the outlet fitting of the two-stage regulator are not essential but are very useful. Be sure the valves have stainless-steel, packless diaphragms.
- Agilent strongly recommends installation of shut-off valves at each GC inlet supply fitting to allow the GC to be isolated for maintenance and troubleshooting. Order part number 0100-2144. (Note that some optional installation kits include one shut-off valve. See Installation Kits.)
- If you purchased automated valving, the valve actuation requires a **separate** pressurized, dry air supply at 380 kPa (55 psig). This air supply must end in a male fitting compatible with a 1/4-inch id plastic tube at the GC.
- FID, FPD, and NPD detectors require a dedicated air supply. Operation may be affected by pressure pulses in air lines shared with other devices.
- Flow- and pressure-controlling devices require at least 10 psi (138 kPa) pressure differential across them to operate properly. Set source pressures and capacities high enough to ensure this.
- Situate auxiliary pressure regulators close to the GC inlet fittings. This ensures that the supply pressure is measured at the instrument (rather than at the source); pressure at the source may be different if the gas supply lines are long or narrow.
- **Never use liquid thread sealer to connect fittings.**
- **Never use chlorinated solvents to clean tubing or fittings.**

See Installation Kits for more information.

Supply tubing for most carrier and detector gases

Use only preconditioned copper tubing (part number 5180-4196) to supply gases to the instrument. Do not use ordinary copper tubing—it contains oils and contaminants.

CAUTION Do not use methylene chloride or other halogenated solvent to clean tubing that will be used with an electron capture detector. They will cause elevated baselines and detector noise until they are completely flushed out of the system.

CAUTION Do not use plastic tubing for suppling detector and inlet gases to the GC. It is permeable to oxygen and other contaminants that can damage columns and detectors.

Plastic tubing can melt if near hot exhaust or components.

The tubing diameter depends on the distance between the supply gas and the GC and the total flow rate for the particular gas. Tubing of 1/8-in diameter is adequate when the supply line is less than 15 feet (4.6 m) long.

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

Be generous when cutting tubing for local supply lines—a coil of flexible tubing between the supply and the instrument lets you move the GC without moving the gas supply. Take this extra length into account when choosing the tubing diameter.

Supply tubing for hydrogen gas

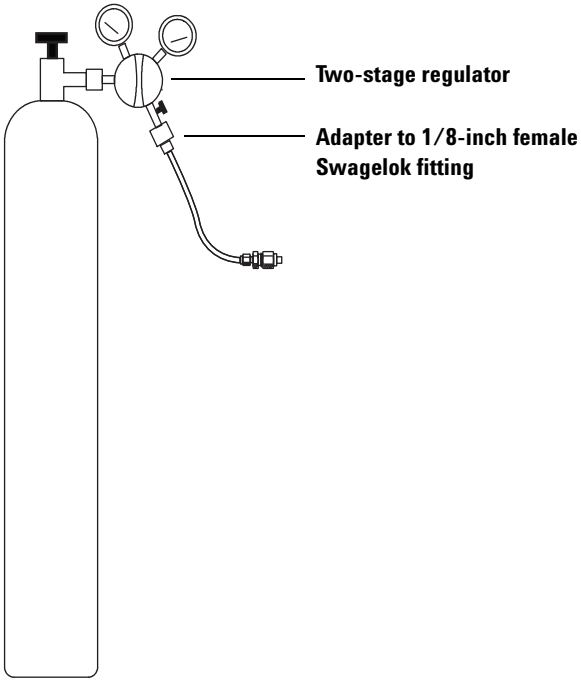
Agilent recommends using new chromatographic quality stainless steel tubing and fittings when using hydrogen.

- Do not re-use old tubing when installing or switching to hydrogen supply lines for carrier gas or the JetClean ion source system. Hydrogen gas tends to remove contaminants left on old tubing by previous gases (by helium, for example). These contaminants can appear in output as high background noise or hydrocarbon contamination for several weeks.
- Especially do not use old copper tubing, which can become brittle.

WARNING **Do not use old copper tubing with hydrogen gas. Old copper tubing can become brittle and create a safety hazard.**

Two-stage pressure regulators

To eliminate pressure surges, use a two-stage regulator with each gas tank. Stainless steel, diaphragm-type regulators are recommended.



The type of regulator you use depends on the gas type and supplier. The Agilent catalog for consumables and supplies contains information to help you identify the correct regulator, as determined by the Compressed Gas Association (CGA). Agilent Technologies offers pressure-regulator kits that contain all the materials needed to install regulators properly.

Pressure regulator-gas supply tubing connections

Use PTFE tape to seal the pipe-thread connection between the pressure regulator outlet and the fitting to which you connect the gas tubing. Instrument grade PTFE tape (part number 0460-1266), from which volatiles

have been removed, is recommended for all fittings. **Do not use pipe dope to seal the threads**; it contains volatile materials that will contaminate the tubing.

Pressure regulators typically end in fittings that must be adapted to the correct style or size. Table 24 lists parts needed to adapt a standard 1/4-inch male NPT fitting to a 1/8-inch or 1/4-inch Swagelok fitting.

Table 24 Parts for adapting NPT fittings

Description	Part number
Swagelok 1/8-inch to female 1/4-inch NPT, brass	0100-0118
Swagelok 1/4-inch to female 1/4-inch NPT, brass	0100-0119
Reducing union, 1/4-in. to 1/8-in., brass, 2/pk	5180-4131

Filters and traps

Using chromatographic-grade gases ensures that the gas in your system is pure. However, for optimum sensitivity, install high-quality filters or traps to remove traces of water or other contaminants. After installing a filter, check the gas supply lines for leaks.

Agilent recommends the Gas Clean Filter system. The Gas Clean Filter system delivers high purity gases to your analytical instruments, reducing the risk of column damage, sensitivity loss, and instrument downtime. The filters are designed for use with the GC, GC/MS, ICP-OES, ICP-MS, LC/MS, and any other analysis instrument using carrier gas. Six filters are available, including CO2, oxygen, moisture, and organics trap (charcoal).

Filter types

Each Gas Clean Filter type is designed to filter out a specific impurity that may exist in the gas supply. The following filter types are available:

- **Oxygen** - Prevents oxidation of the GC column, septum, liner, and glass wool.
- **Moisture** - Delivers fast stabilization times for increased GC productivity, and prevents hydrolization damage to the stationary phase, column, liner, glass wool, or septum in the GC.

- **Process Moisture** - Prevents oxidation of GC components and is safe to use with acetylene in process GC applications.
- **Charcoal** - Removes organic compounds and ensures correct performance of FID detectors in the GC.
- **GC/MS** - Delivers fast stabilization times for increased GC productivity, removes oxygen, moisture, and hydrocarbons from the carrier gas for MS applications, and provides ultimate GC column protection.

Table 25 on page 47 shows recommended filter connection diagrams for common instrument configurations.

Table 25 Connection diagrams for common detectors

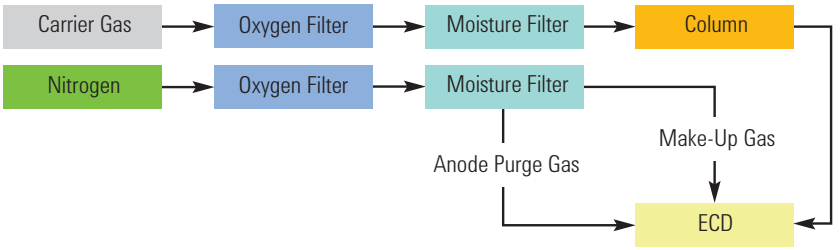
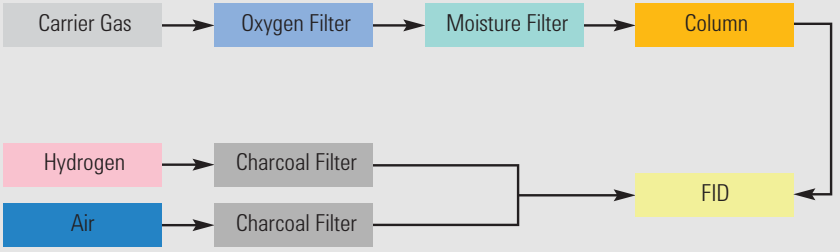
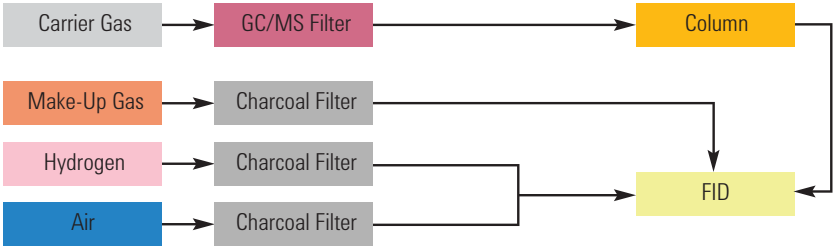
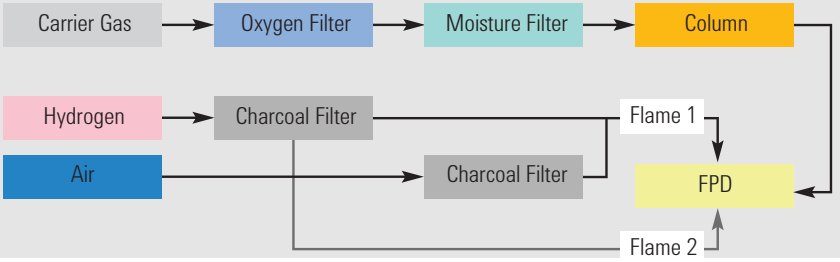
Detector	Connection Diagram
ECD Electron Capture Detector	
FID Flame Ionization Detector (Carrier Gas = Make-Up Gas)	
FID Flame Ionization Detector (Carrier Gas differs from Make-Up Gas)	
FPD Flame Photometric Detector **PFPD** Pulsed Flame Photometric Detector	

Table 25 Connection diagrams for common detectors (continued)

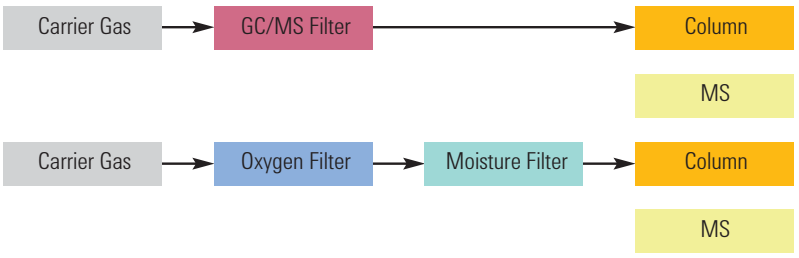
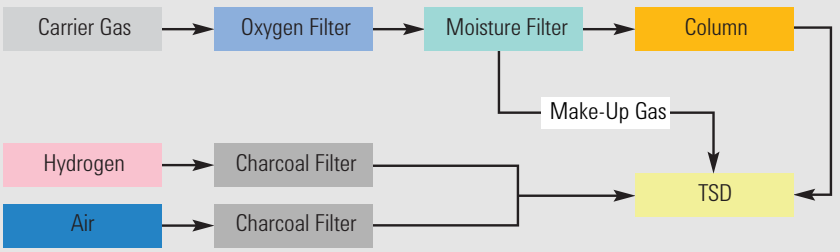
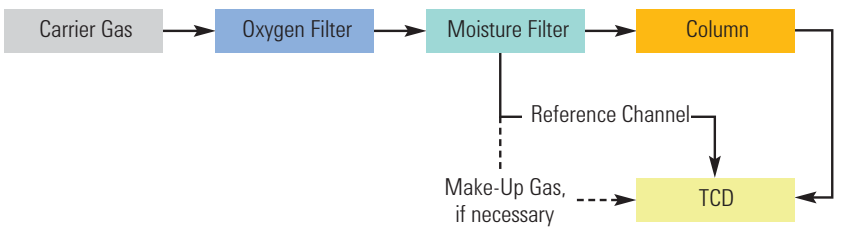
Detector	Connection Diagram
MS (ITD, MSD) Ion Trap Detector, Mass Selective Detector	
NPD, PND Nitrogen-Phosphorous Detector **TID, TSD** Thermionic Detector (Carrier Gas = Make-Up Gas)	
TCD Thermal Conductivity Detector	

Table 26 lists the most common Gas Clean Filter system kits. See the Agilent online store or contact your local Agilent sales representative for additional filters, parts, and accessories applicable to your instrument configuration.

Table 26 Recommended Gas Clean Filter kits

Description	Part number	Use
Gas Clean Filter kit (connecting unit for one filter, including one moisture filter, 1/8-inch connections, and mounting bracket for the GC)	CP17988	Carrier gas only
Gas Clean Filter kit (connecting unit for four filters, including four filters, 1/4-inch connections)	CP7995	FID, FPD, NPD
Gas Clean Filter kit (connecting unit for four filters, including four filters, 1/8-inch connections)	CP736530	FID, FPD, NPD
GC/MS Gas Clean Filter kit (includes one connecting unit and two GC/MS filters, 1/8-inch connections)	CP17976	ECD, GC/MS
GC/MS Gas Clean Filter kit (includes one connecting unit and two GC/MS filters, 1/4-inch connections)	CP17977	ECD, GC/MS
GC/MS Gas Clean Filter installation kit (includes CP17976, 1 m copper tubing, and two 1/8-inch nuts and ferrules)	CP17978	ECD, GC/MS
TCD filter kit (with oxygen and moisture filters)	CO738408	TCD

Each separate gas supply requires its own filters.

See also "Installation Kits" on page 7.

Cryogenic Cooling Requirements

Cryogenic cooling allows you to cool the oven or inlet, including cooling to setpoints below ambient temperature. A solenoid valve controls the flow of coolant to the inlet or oven. The oven can use either liquid carbon dioxide (CO_2) or liquid nitrogen (N_2) as a coolant. All inlets except the multimode inlet must use the same coolant type as the oven. The multimode inlet can use a different coolant than configured for the oven, and can also use compressed air as a coolant.

CO_2 and N_2 coolants require different hardware on the GC. (You can use air cooling on a multimode inlet, with either the CO_2 or N_2 solenoid valves and hardware.)

Oven cryogenic cooling is not compatible with the 7000 Triple Quad MS or 7200 Q-TOF MS. If your application requires GC oven cryogenic cooling, contact your Agilent sales representative.

Using carbon dioxide

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

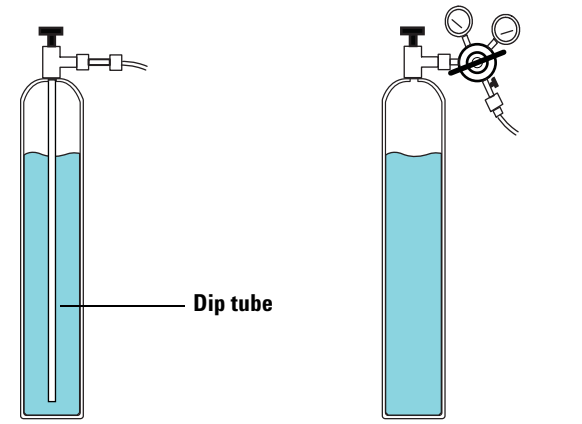
CAUTION Liquid CO_2 should not be used as a coolant for oven temperatures below –40 °C because the expanding liquid may form solid CO_2—dry ice—in the GC oven. If dry ice builds up in the oven, it can seriously damage the GC.

Liquid CO_2 is available in high-pressure tanks containing liquid. The CO_2 should be free of particulate material, oil, and other contaminants. These contaminants could clog the expansion orifice or affect the proper operation of the GC.

WARNING **Do not use copper tubing or thin-wall stainless steel tubing with liquid CO_2. Both harden at stress points and may explode.**

Additional requirements for the liquid CO_2 system include:

- The tank must have an internal dip tube or eductor tube to deliver liquid CO_2 instead of gas (see the figure below).
- Typical liquid CO_2 tank pressure will be 4830 to 6900 kPa (700 to 1,000 psi) at a temperature of 25 °C.
- Use 1/8-inch diameter heavy-wall stainless steel tubing for supply tubing. The tubing should be between 1.5 and 15 m (5 and 50 feet) long. (Agilent part number 7157-0210, 20 ft)
- Coil and fasten the ends of the tubing to prevent it from “whipping” if it breaks.
- Do not install a pressure regulator on the CO_2 tank, as vaporization and cooling would occur in the regulator instead of the oven.
- Do not use a padded tank (one to which another gas is added to increase the pressure).



Using liquid nitrogen

WARNING **Liquid nitrogen is a hazard because of the extremely low temperatures and high pressures that may occur in improperly designed supply systems.**

Liquid nitrogen can present an asphyxiant hazard if vaporizing nitrogen displaces oxygen in the air. Consult local suppliers for safety precautions and design information.

Liquid nitrogen is supplied in insulated Dewar tanks. The correct type for cooling purposes is a low-pressure Dewar equipped with a dip tube—to deliver liquid rather than gas—and a safety relief valve to prevent pressure build-up. The relief valve is set by the supplier at 138 to 172 kPa (20 to 25 psi).

WARNING **If liquid nitrogen is trapped between a closed tank valve and the cryo valve on the GC, tremendous pressure will develop and may cause an explosion. For this reason, keep the delivery valve on the tank open so that the entire system is protected by the pressure relief valve.**

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

Additional requirements for the liquid N_2 system include:

- Cryogenic cooling with Liquid N_2 requires 1/4-inch insulated copper tubing.
- If needed, set the liquid N_2 pressure to the GC at 138 to 207 kPa (20 to 30 psi). Follow the manufacturer's directions.
- Make sure the supply tubing for liquid N_2 is insulated. Foam tubing used for refrigeration and air-conditioning lines is suitable for insulation. (Foam tubing insulation is not supplied by Agilent. Contact a local supplier.) Since pressures are low, insulated copper tubing is adequate.
- Situate the liquid nitrogen tank close (within 1.5 to 3 m, or 5 to 10 feet) to the GC to ensure that liquid, not gas, is supplied to the inlet.

Using compressed air

The multimode inlet can also use compressed air cooling with the liquid N_2 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.
- The required air supply pressure depends on the installed solenoid valve type. For a multimode inlet with N_2 cooling, 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.

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 N_2 valve

Maximum Length of Cables and Hoses

The distance between system modules may be limited by some of the cabling and the vent or vacuum hoses.

- The length of the Agilent-supplied remote cable is 2 meters (6.6 feet).
- The length of the Agilent-supplied LAN cable is 10 meters (32.8 feet).
- The lengths of the power cords are 2 meters (6.6 feet).
- A quadrupole GC/MS system foreline pump can be located on the laboratory bench or on the floor. It must be close to the MS because it is connected by a hose. The hose is stiff and cannot be bent sharply. The length of the vacuum hose is 130 cm (4.24 feet) from the high vacuum pump to the foreline pump, while the length of the foreline pump power cord is 2 meters (6.6 feet).

CAUTION The supporting surface for the 7200 Q-TOF GC/MS system should be kept relatively vibration free. Do not put the rough pump on your laboratory bench with the 7200 Q-TOF GC/MS due to the vibration that the pump creates. Vibration can lead to a loss of mass accuracy and resolution.

- A Q-TOF MS system foreline pump should be located on the floor. It must be close to the MS because it is connected by a hose. The hose is stiff and cannot be bent sharply. The length of the vacuum hose is 130 cm (4.24 feet) from the high vacuum pump to the foreline pump, while the length of the foreline pump power cord is 2 meters (6.6 feet).

Site LAN Network

If you intend to connect your system to your site's LAN network, you must have an additional shielded twisted pair network cable (8121-0940).

NOTE Agilent Technologies is not responsible for connecting to or establishing communication with your site LAN network. The representative will test the system's ability to communicate on a mini-hub or LAN switch only.

NOTE The IP addresses assigned to the instrument(s) must be fixed (permanently assigned) addresses. If you intend to connect your system to your site's network, each piece of equipment must have a unique, fixed (static) IP address assigned to it.

NOTE For a Single Quad GC/MS system, Agilent recommends, sells, and supports the use of a PC with one (1) network interface card (NIC) and a network switch to isolate the GC/MS system from the site LAN. The network switch supplied with Agilent systems prevents instrument-to-PC network traffic from entering the site LAN and keeps site LAN network traffic from interfering with instrument-to-PC communications. Agilent develops and tests all Single Quad GC/MS hardware and software using the single NIC configuration and has no known network configuration issues. Alternate network configurations can be configured and managed by the end user at their own risk and expense.

NOTE For Triple Quad and Q-TOF GC/MS systems, Agilent recommends, sells, and supports the use of a PC with two (2) network interface cards (NIC) to provide both a site LAN connection and an isolated GC/MS system connection. Agilent develops and tests all Triple Quad and Q-TOF GC/MS hardware and software using the dual NIC configuration and has no known network configuration issues. Alternate network configurations can be configured and managed by the end user at their own risk and expense.

PC Requirements

If using an Agilent data system, refer to the data system documentation for PC requirements.

2
6850 Series GC Site Preparation

This section outlines the space and resource requirements for GC, GC/MS, and automatic liquid sampler (ALS) installation. For a successful and timely installation of the instrument, the site must meet these requirements before beginning installation. Necessary supplies (gases, tubing, operating supplies, consumables, and other usage-dependent items such as columns, vials, syringes, and solvents) must also be available. Note that performance verification requires the use of helium carrier gas. For MS systems using chemical ionization, methane reagent gas or methanol (for internal ionization ion traps) is also required for performance verification. Refer to the Agilent Web site at www.agilent.com/chem for the most up-to-date listing of GC, GC/MS, and ALS supplies and consumables.

For 7697A Headspace Sampler site prep specifications, refer to the 7697A Site Prep Guide.

Customer Responsibilities

The specifications in this manual outline the necessary space, electrical outlets, gases, tubing, operating supplies, consumables, and other usage-dependent items such as columns, vials, syringes, and solvents required for the successful installation of instruments and systems.

If Agilent is delivering installation and familiarization services, users of the instrument should be present throughout these services; otherwise, they will miss important operational, maintenance, and safety information.

If Agilent is delivering installation and familiarization services, delays due to inadequate site preparation could cause loss of instrument use during the warranty period. In extreme cases, Agilent Technologies may ask to be reimbursed for the additional time required to complete the installation. Agilent Technologies provides service during the warranty period and under maintenance agreements only if the specified site requirements are met.

Basic Tools and Installation Kits

The GC/MS comes with a few basic tools and consumables depending on the specific inlet and detector that you ordered. Below is a general list of what comes with the instrument.

Table 1 Basic tools

Tool or consumable	Used for
6850 Series GC	
T10 and T20 Torx wrenches	Removing tray. Removing covers to access gas control modules, traps, and pneumatic connections.
1/4-inch nut driver	FID jet replacement.
FID flow measuring insert	FID troubleshooting.
Column cutter, ceramic or diamond	Column installation.
1/8-inch Tee, Swagelok, brass	Connect gas supplies.
1/8-inch nuts & ferrules, Swagelok, brass	Connect gas supplies.
Inlet septa appropriate for type	Inlet seal.
Inlet insert or liner	Contains sample during vaporization in inlet.
GC/MS	
1.5-mm and 2.0-mm hex driver	Source maintenance.
Tool bag	Holding GC and MS tools.
Q-Tips	Cleaning source parts.
Cloths	Keeping surfaces and parts clean.
Gloves	Reducing contamination on GC and MSD parts.
Funnel	Changing oil.
Hex key, 5 mm or 8 mm	Removing oil plug.

Table 2 lists other useful tools not included with the GC.

Table 2 Useful tools not included with GC

Tool	Used for
Custom Tee, G3430-60009	Connecting the same gas to front and back EPC module.
ECD/TCD Detector plug, 5060-9055	Inlet pressure decay test
1/8-inch Ball Valve, 0100-2144	Inlet pressure decay test (one per inlet)
Digital flow meter, Flow tracker 1000	Verifying flows, checking for leaks and plugs
Electronic gas leak detector (G3388B)	Locating gas leaks; safety checks when using Hydrogen
Column cutters	Cutting columns
T-10 and T-20 Torx drivers	Removing tray; removing covers to access EPC modules, traps, and possible leaks
1/8-inch tubing cutter (wire cutter type)	Cutting gas supply tubing
Assorted wrenches: 1/4-inch, 3/8-inch, 7/16-inch, 9/16-inch	Gas supply and plumbing fittings
Electronic vial crimper	Assuring consistently air-tight vial closure, regardless of who does the crimping

Table 3 lists consumables that you may wish to order. First time GC users should consider purchasing the following supplies in order to maintain their system and prevent interruptions in the use of their system. Please refer to the latest Agilent consumables and supplies catalog and to the Agilent web site at www.agilent.com/chem for part numbers and recommended maintenance periods.

Table 3 Additional consumables

Consumable category	Consumable
Inlet supplies	Septa, o-rings, liners, adapter, and seals
Inlet preventative maintenance (PM) kits	Kits with individual parts needed to maintain an inlet
Pneumatic supplies	Gases, traps, o-rings, seals, Swagelok fittings
Column supplies	Nuts, ferrules, adapters, guard columns, retention gaps
Detector supplies	Jets, beads, liners, adapters, cleaning kits
Application supplies	Standards, columns, syringes

Agilent offers several installation kits that provide parts useful during GC installation. **These kits are not supplied with the instrument.** Agilent highly recommends these kits if you did not order the pre-plumbed option. These kits include tools and hardware required to plumb gases to the GC. See Table 4.

Table 4 Installation kits

Kit	Part number	Kit contents
Recommended for FID, NPD, FPD:		
GC Supply Gas Installation Kit with Gas Purifiers	19199N	Includes Gas Clean Filter system kit CP736538 (with 1 oxygen, 1 moisture, and 2 charcoal filters), 1/8-inch brass nuts and ferrules, copper tubing, 1/8-inch brass tees, tubing cutter, 1/8-inch brass caps, universal external split vent trap with replacement cartridges, and 1/8-inch ball valve

Table 4 Installation kits (continued)

Kit	Part number	Kit contents
Recommended for TCD/ECD, MS, and MSD:		
GC Supply Gas Installation Kit	19199M	Includes 1/8-inch brass nuts and ferrules (20), copper tubing, 1/8-inch brass tees, tubing cutter, 1/8-inch brass caps, 7-mm nut driver, T-10 Torx driver, T-20 Torx driver, 4 open-end wrenches, and 1/8-inch ball valve (For TCD/ECD , also order an additional Gas Clean Filter CP17974.)
		
Gas Clean Filter kit GC-MS 1/8in.,1/pk	CP17974	Gas Clean filter kit with 1/8-inch fittings (order 2 if using separate makeup and carrier gas supplies).

You must also provide the fittings and reducers required to convert the cylinder regulator fitting (for example, 1/4-inch male NPT) to the 1/8-inch female Swagelok fitting needed to connect to the instrument. These fittings are not included with the GC. These fittings are not included with the installation kits. See "Gas Plumbing" on page 89 for part information.

Hydrogen Carrier Gas

If planning to use hydrogen carrier gas, note that special consideration apply due to hydrogen's flammability and chromatographic properties.

- Agilent highly recommends the G3388B Leak Detector to safely check for leaks.
- Hydrogen carrier gas requires special considerations for supply tubing. See "Gas Plumbing" on page 89.
- In addition to the supply pressure requirements listed in "Gas Supplies" on page 82, Agilent also recommends users of hydrogen carrier gas consider the gas source and purification needs. See the additional recommendations in "Requirements for hydrogen as a carrier gas" on page 83.
- When using hydrogen carrier gas with a μECD, TCD, or any other detector that vents uncombusted gases, plan to vent the detector output to a fume hood or similar location. Uncombusted hydrogen can present a safety hazard. See "Exhaust Venting" on page 75.
- When using hydrogen carrier gas, also plan to safely vent inlet split vent flows and purge vent flows. See "Exhaust Venting" on page 75.

Dimensions and Weight

Select the laboratory bench space before the system arrives. Make sure the area is clean, clear, and level. Pay special attention to the total height requirements. Avoid bench space with overhanging shelves. See Table 5.

The instrument needs space for proper convection of heat and ventilation. Allow at least 25 cm (10 in) clearance between back of the instrument and wall to dissipate hot air and allow for routine maintenance.

Table 5 Required instrument height, width, depth, and weight

Product	Height	Width	Depth	Weight
GC				
6850 Series GCs	51 cm (20 in)	29 cm (12 in) 34 cm (14 in) CO_2 37 cm (15 in) 6850 ALS	57 cm (23 in)	< 23 kg (51 lb)
GC operational oven access		Requires ≥ 30 cm (12 in) open space above GC		
MSD				
5975 Series MSD				
• Diffusion pump	41 cm (16 in)	30 cm (12 in)	54 cm (22 in)	39 kg (85 lb)
• Standard turbo pump	41 cm (16 in)	30 cm (12 in)	54 cm (22 in)	39 kg (85 lb)
• Performance turbo pump	41 cm (16 in)	30 cm (12 in)	54 cm (22 in)	41 kg (90 lb)
• Performance CI/EI turbo pump	41 cm (16 in)	30 cm (12 in)	54 cm (22 in)	46 kg (100 lb)
• Foreline pump Standard	21 cm (8 in)	13 cm (5 in)	31 cm (12 in)	11 kg (23.1 lb)
• GC/MS operational and maintenance access		Requires 30 cm (1 ft) to its left		
5977 Series MSD				
• Diffusion pump	41 cm (16 in)	30 cm (12 in)	54 cm (22 in)	39 kg (85 lb)
• Performance turbo pump	41 cm (16 in)	30 cm (12 in)	54 cm (22 in)	41 kg (90 lb)
• Performance CI/EI turbo pump	41 cm (16 in)	30 cm (12 in)	54 cm (22 in)	46 kg (100 lb)

Table 5 Required instrument height, width, depth, and weight (continued)

Product	Height	Width	Depth	Weight
• Foreline pump				
Standard	21 cm (8 in)	13 cm (5 in)	31 cm (12 in)	11 kg (23.1 lb)
Oil-free (MVP-055)	19 cm (7.5 in)	32 cm (13 in)	28 cm (11 in)	16 kg (35.2 lb)
Oil-free (IDP3)	18 cm (7 in)	35 cm (14 in)	14 cm (6 in)	10 kg (21 lb)
• GC/MS operational and maintenance access		Requires 30 cm (1 ft) to its left		
MS				
7000 Triple Quad MS				
• Performance turbo pump	47 cm (18.5 in)	35 cm (14 in)	86 cm (34 in)	59 kg (130 lb)
• Performance CI/EI turbo pump	47 cm (18.5 in)	35 cm (14 in)	86 cm (34 in)	63.5 kg (140 lb)
• Foreline pump	28 cm (11 in)	18 cm (7 in)	35 cm (14 in)	21.5 kg (47.3 lb)
• GC/MS operational and maintenance access		Requires 30 cm (1 ft) to its left		
7200 Q-TOF MS				
• Performance turbo pump	133 cm (52.5 in)	88 cm (34.5 in)	100 cm (39.5 in)	138 kg (305 lbs)
• Foreline pump	28 cm (11 in)	18 cm (7 in)	35 cm (14 in)	21.5 kg (47.3 lb)
• GC/Q-TOF operational and maintenance access		Requires 40 cm (16 in) on both sides, and 30 cm (12 in) in the back.		
ALS				
• GC with 7693A ALS injector		Requires 50 cm (19.5 in) above the GC		3.9 kg (8,6 lb) each
• GC with 7693A ALS tray		Requires 45 cm (17.5 in) left of the GC Requires 2 cm (1 inch) in front of GC		6.8 kg (15 lb) each
• GC with 7683B ALS injector		Requires 42 cm (16.5 in) above the GC		3.1 kg (7 lb) each
• GC with 7683B ALS tray		Requires 30 cm (12 in) left of the GC		3.0 kg (7 lb)

A 6850 system that includes a GC, an ALS injector, and a computer would require about 138 cm (4 ft 6 in) of bench space. Allowing for operational access and a printer, a total of 229 cm (7.5 ft) of bench space should be available for a full GC/MS system. Some repairs to the MSD or to the GC will also require access to the back of the instrument(s).

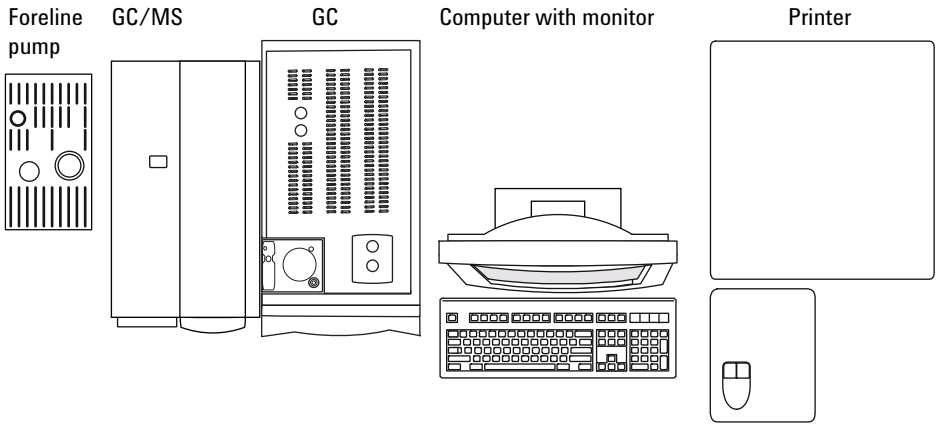


Figure 1 Top view of typical installation (6850 GC/MS system with ALS)

Note that the length of the quadrupole (and Q-TOF GC/MS) vacuum hose is 130 cm (4 ft 3 in) from the high vacuum pump to the foreline pump, and the length of the foreline pump power cord is 2 m (6 ft 6 in).

CAUTION The supporting surface for the 7200 Q-TOF GC/MS system should be kept relatively vibration free. Do not put the rough pump on your laboratory bench with the 7200 Q-TOF GC/MS due to the vibration that the pump creates. Vibration can lead to a loss of mass accuracy and resolution.

CAUTION Make sure the 7200 Q-TOF GC/MS foreline pump is located where it is not likely to be touched by operators.

Power Consumption

Table 6 lists site power requirements.

- The number and type of electrical outlets depend on the size and complexity of the system.
- Power consumption and requirements depend on the country the unit ships to.
- The voltage requirements for your instrument are printed near the power cord attachment.
- The electrical outlet for the unit should have a dedicated ground.
- All instruments should be on a dedicated circuit.

Power line conditioners should not be used with Agilent instruments.

Table 6 Power requirements

Product	Oven type	Line voltage (VAC)	Frequency (Hz)	Maximum continuous power consumption (VA)	Current rating (amps)	Power outlet current rating
6850 Series GC	Standard	Japan: 100 single phase (–10% / +10%)	48–63	1440	15	15 Amp Dedicated
6850 Series GC	Standard	Americas: 120 single phase (–10% / +10%)	48–63	1440	12	15 Amp Dedicated
6850 Series GC	Standard	230 single/split phase (–10% / +10%)	48–63	2000	9	10 Amp Dedicated
6850 Series GC	Fast	120 single phase (–10% / +10%)	48–63	2400	20	20 Amp Dedicated
6850 Series GC	Fast	220/230/240 single/split phase (–10% / +10%)	48–63	2400	11	15 Amp Dedicated
6850 Series GC	Fast	200/208 single/split phase (–10% / +10%)	48–63	2400	12	15 Amp Dedicated
MSD						
5975 Series MSD		120 (–10% / +5%)	50/60 ± 5%	1100 (400 for foreline pump only)	8	10 Amp Dedicated

Table 6 Power requirements (continued)

Product	Oven type	Line voltage (VAC)	Frequency (Hz)	Maximum continuous power consumption (VA)	Current rating (amps)	Power outlet current rating
5975 Series MSD		220–240 (–10% / +5%)	50/60 ± 5%	1100 (400 for foreline pump only)	8	10 Amp Dedicated
5975 Series MSD		200 (–10% / +5%)	50/60 ± 5%	1100 (400 for foreline pump only)	8	10 Amp Dedicated
5977 Series MSD		120 (–10% / +5%)	50/60 ± 5%	1100 (400 for foreline pump only)	8	10 Amp Dedicated
5977 Series MSD		220–240 (–10% / +5%)	50/60 ± 5%	1100 (400 for foreline pump only)	8	10 Amp Dedicated
5977 Series MSD		200 (–10% / +5%)	50/60 ± 5%	1100 (400 for foreline pump only)	8	10 Amp Dedicated
MS						
7000 Triple Quad MS		120 (–10% / +5%)	50/60 ± 5%	1600	15	15 Amp Dedicated
7000 Triple Quad MS		220–240 (–10% / +5%)	50/60 ± 5%	1600	15	15 Amp Dedicated
7000 Triple Quad MS		200 (–10% / +5%)	50/60 ± 5%	1600	15	15 Amp Dedicated
7200 Q-TOF MS		200–240 (–10% / +5%)	50/60 ± 5%	1800 (1200 for foreline pump)	15	15 Amp Dedicated
All						
Data system PC (monitor, CPU, printer)		100/120/200-240 (–10% / +5%)	50/60 ± 5%	1000	15	15 Amp Dedicated

WARNING **Do not use extension cords with Agilent instruments. Extension cords normally are not rated to carry enough power and can be a safety hazard.**

Although your GC should arrive ready for operation in your country, compare its voltage requirements with those listed in Table 6. If the voltage option you ordered is not suitable for your installation, contact Agilent Technologies. Note that ALS instruments receive their power from the GC.

CAUTION A proper earth ground is required for GC operations. Any interruption of the grounding conductor or disconnection of the power cord could cause a shock that could result in personal injury.

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. Be sure to verify proper receptacle grounding. The GC requires an isolated ground.

Connect the GC to a dedicated circuit.

Canadian installation

When installing a GC in Canada, make sure your GC's power supply circuit meets the following additional requirements:

- The circuit breaker for the branch circuit, which is dedicated to the instrument, is rated for continuous operation.
- The service box branch circuit is marked as a "Dedicated Circuit."

Common instrument power cord plugs

Table 7 below shows common Agilent power cord plugs.

Table 7 Power cord terminations

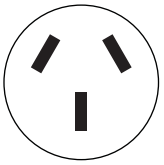
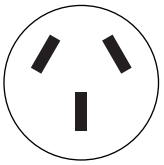
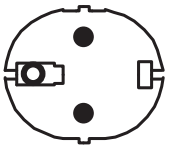
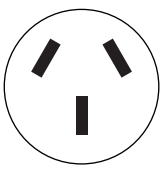
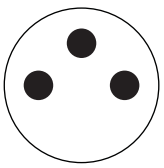
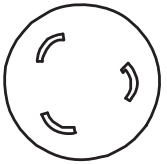
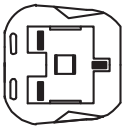
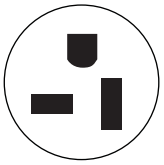
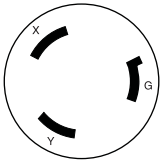
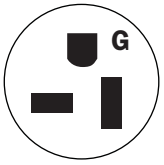
Country	Voltage	Amps	Cable length (m)	Wall termination	Plug Termination
Australia	240	16	2.5	AS 3112	
China	220	15	4.5	GB 1002	
Europe, Korea	220 / 230 / 240	10	2.5	CEE/7/V11	
Denmark, Switzerland	230	16	2.5	Swiss/Denmark 1302	
India, South Africa	240	15	4.5	AS 3112	
Israel	230	16, 16 AWG	2.5	Israeli SI32	

Table 7 Power cord terminations (continued)

Country	Voltage	Amps	Cable length (m)	Wall termination	Plug Termination
Japan	200	20	4.5	NEMA L6-20P	
United Kingdom, Hong Kong, Singapore, Malaysia	240	13	2.5	BS89/13	
United States	120	20, 12 AWG	4.5	NEMA 5-20P	
United States	240	15, 14 AWG	2.5	NEMA L6-15P	
Taiwan, South America		20, 12 AWG	2.5	NEMA 5-20P	

Heat Dissipation

Use Table 8 to estimate the additional BTUs of heat dissipated from this equipment. Maximums represent the heat given off when heated zones are set for maximum temperatures.

Table 8 Heat dissipation

	Oven type	
	Standard oven ramp	**Fast oven ramp (option 002 or 003)**
6850 Series GC	< 4800 BTU/hour maximum (< 5064 kJ/h)	< 4800 BTU/hour maximum (< 5064 kJ/h)
	Steady state, including MS interface	
5975 Series MSD	3000 BTU/hour (3165 kJ/h)	
5977 Series MSD	3000 BTU/hour (3165 kJ/h)	
7000 Triple Quad MS	3700 BTU/hour (3904 kJ/h)	
7200 Q-TOF MS	6200 BTU/hour (6541 kJ/h)	

Exhaust Venting

Hot air (up to 350 °C) from the oven exits through a vent in the rear. Allow at least 25 cm (10 in) clearance behind the instrument to dissipate this air.

WARNING **Do not place temperature-sensitive items (for example, gas cylinders, chemicals, regulators, and plastic tubing) in the path of the heated exhaust. These items will be damaged and plastic tubing will melt. Be careful when working behind the instrument during cool-down cycles to avoid burns from the hot exhaust.**

(For 7200 Q-TOF GC/MS, GC/QTOF exhaust deflector assembly G3850-80650 is provided.)An optional oven exhaust deflector (vertical (G2630-60710) or horizontal (G2628-60800)) is available and may improve oven cooling by deflecting the exhaust air away from the instrument.

During normal operation of the GC with many detectors and inlets, some of the carrier gas and sample vents outside the instrument through the split vent, septum purge vent, and detector exhaust. If any sample components are toxic or noxious, or if hydrogen is used as the carrier gas, these exhausts must be vented to a fume hood. Place the GC in the hood or attach a large diameter venting tube to the outlet for proper ventilation.

To further prevent contamination from noxious gases, attach a chemical trap to the vent(s).

Vent the GC/MS system externally to the building via an ambient-pressure vent system, within 460 cm (15 ft) of both the GC split vent and GC/MS foreline pump, or vent to a fume hood.

Note that an exhaust vent system is not part of the building environmental control system, which recirculates air.

Exhaust venting must comply with all local environmental and safety codes. Contact your Environmental Health & Safety (EHS) specialist.

Environmental Conditions

Operating the instrument within the recommended ranges optimizes instrument performance and lifetime. Performance can be affected by sources of heat and cold from heating, air conditioning systems, or drafts. See Table 9. The conditions assume a noncondensing, noncorrosive atmosphere. The instrument meets the following International Electrotechnical Commission (IEC) classifications: Equipment Class I, Laboratory Equipment, Installation Category II, and Pollution Degree 2.

Table 9 Environmental conditions for operation and storage

Product	Conditions	Operating temp range	Operating humidity range	Maximum altitude
6850 Series GC	Standard oven ramp	15 to 35 °C	5 to 95%	4,615 m
	Fast oven ramp (options 002 and 003)	15 to 35 °C	5 to 95%	4,615 m
	Storage	–5 to 40 °C	5 to 95%	
MSD				
5975 Series MSD	Operation	15 to 35 °C [1] (59 to 95 °F)	20 to 80%	4,615 m
	Storage	–20 to 70 °C (–4 to 158 °F)	0 to 95%	
5977 Series MSD	Operation	15 to 35 °C [1] (59 to 95 °F)	20 to 80%	4,615 m
	Storage	–20 to 70 °C (–4 to 158 °F)	0 to 95%	
MS				
7000 Triple Quad MS	Operation	15 to 35 °C [2] (59 to 95 °F)	40 to 80%	5,000 m [3]
	Storage	–20 to 70 °C (–4 to 158 °F)	0 to 95%	
7200 Q-TOF MS	Operation	15 to 35 °C [2] (59 to 95 °F)	20 to 80%	5,000 m [3]
	Storage	–20 to 70 °C (–4 to 158 °F)	0 to 95%	

1 Operation requires constant temperature (variations < 2 ^{o}C/hour)

2 Operation requires constant temperature (variations < 2 ^{o}C/hour)

3 An altitude of 3,700 meters (12,000 feet) is supported if the ambient temperature is less than 30 °C

Gas Selection

Table 10 lists gases usable with Agilent GCs and capillary columns. When used with capillary columns, GC detectors require a separate makeup gas for optimum sensitivity. The MS and MSD use GC carrier gas.

If using any MS system, use of hydrogen as the carrier gas may require hardware modifications for best performance. Contact your Agilent service representative. Hydrogen is not supported as a carrier gas with the 7200 GC/QTOF system.

NOTE Nitrogen and Argon/Methane are generally not suitable for GC/MS carrier gas.

Table 10 Gases usable with Agilent GCs and capillary columns

Detector type	Carrier	Preferred makeup	Alternate choice	Detector, anode purge, or reference
Electron capture (ECD)	Hydrogen Helium Nitrogen Argon/Methane (5%)	Argon/Methane (5%) Argon/Methane (5%) Nitrogen Argon/Methane (5%)	Nitrogen Nitrogen Argon/Methane (5%) Nitrogen	Anode purge must be same as makeup
Flame ionization (FID)	Hydrogen Helium Nitrogen	Nitrogen Nitrogen Nitrogen	Helium Helium Helium	Hydrogen and air for detector
Flame photometric (FPD)	Hydrogen Helium Nitrogen Argon	Nitrogen Nitrogen Nitrogen Nitrogen		Hydrogen and air for detector
Thermal conductivity (TCD)	Hydrogen Helium Nitrogen	Must be same as carrier and reference	Must be same as carrier and reference	Reference must be same as carrier and makeup

Table 11 lists gas recommendations for packed column use. In general, makeup gases are not required with packed columns.

Table 11 Gases usable with Agilent GCs and packed columns

Detector type	Carrier gas	Comments	Detector, anode purge, or reference
Electron capture (ECD)	Nitrogen	Maximum sensitivity	Nitrogen
	Argon/methane	Maximum dynamic range	Argon/Methane
Flame ionization (FID)	Nitrogen	Maximum sensitivity	Hydrogen and air for detector.
	Helium	Acceptable alternative	
Flame photometric (FPD)	Hydrogen Helium Nitrogen Argon		Hydrogen and air for detector.
Thermal conductivity (TCD)	Helium	General use	Reference must be same as carrier and makeup.
	Hydrogen	Maximum sensitivity[1]	
	Nitrogen	Hydrogen detection[2]	
	Argon	Maximum hydrogen sensitivity[1]	

1 Slightly greater sensitivity than helium. Incompatible with some compounds.

2 For analysis of hydrogen or helium. Greatly reduces sensitivity for other compounds.

For installation checkout, Agilent requires the gas types shown in Table 12.

Table 12 Gases required for checkout

Detector	Gases required
FID	Carrier: helium Makeup: nitrogen Fuel: hydrogen Aux gas: Air
TCD	Carrier and reference: helium
uECD	Carrier: helium Anode purge and makeup: nitrogen
FPD	Carrier: helium Makeup: nitrogen Fuel: hydrogen Aux gas: Air
CI MS (external)	Reagent gas: methane

WARNING

When using hydrogen (H_2) as the carrier gas or fuel gas, be aware that hydrogen gas can flow into the GC oven and create an explosion hazard. Therefore, be sure that the supply is turned off until all connections are made and ensure the inlet and detector column fittings are either connected to a column or capped at all times when hydrogen gas is supplied to the instrument.

Hydrogen is flammable. Leaks, when confined in an enclosed space, may create a fire or explosion hazard. In any application using hydrogen, leak test all connections, lines, and valves before operating the instrument. Always turn off the hydrogen supply at its source before working on the instrument.

Please refer to the Hydrogen Safety Guide shipped with your instrument.

Hydrogen use is specifically prohibited with the 7200 GC/Q-TOF system.

Gas and Reagent Purity

Agilent recommends that carrier and detector gases be 99.9995% pure. See Table 13. Air needs to be zero grade or better. Agilent also recommends using high quality traps to remove hydrocarbons, water, and oxygen.

Table 13 Carrier, collision, and reagent gas purity

Carrier, collision, and reagent gas requirements	Purity	Notes
Helium (carrier and collision)	99.9995%	Hydrocarbon free
Hydrogen (carrier)	99.9995%	SFC grade
Nitrogen (collision)[1]	99.999%	Research or SFC grade
Nitrogen (drying gas, nebulizer pressure)[2]	99.999%	Research or SFC grade
Methane reagent gas[3]	99.999%	Research or SFC grade
Isobutane reagent gas[4]	99.99%	Instrument grade
Ammonia reagent gas[4]	99.9995%	Research or SFC grade
Carbon dioxide reagent gas[4]	99.995%	SFC grade

1 Nitrogen for the collision cell requires a separate supply from the nitrogen used for the drying gas. A separate pressure regulator is required. A high pressure bottle of nitrogen is recommended for the collision cell gas supply.

2 Purity specification is the minimum acceptable purity. Major contaminants can be water, oxygen, or air. Drying gas and nebulizer pressure gas can be supplied by a nitrogen gas generator, house nitrogen system, or liquid nitrogen dewar.

3 Required reagent gas for installation and performance verification, external CI MS only. The 5975 and 5977 operate in an external CI mode.

4 Optional reagent gases, CI mode only.

Gas Supplies

Supply instrument gases using tanks, an internal distribution system, or gas generators. If used, tanks require two-stage pressure regulators with packless, stainless steel diaphragms. The instrument requires 1/8-inch Swagelok connections to its gas supply fittings.

NOTE Plumb the gas supply tubing/regulators so that one 1/8-inch Swagelok female connector is available for each gas needed at the instrument.

Table 14 lists available Agilent two-stage tank regulators. All Agilent regulators are supplied with the 1/8-inch Swagelok female connector.

Table 14 Tank regulators

Gas type	CGA number	Max pressure	Part number
Air	346	125 psig (8.6 Bar)	5183-4641
Hydrogen, Argon/Methane	350	125 psig (8.6 Bar)	5183-4642
Oxygen	540	125 psig (8.6 Bar)	5183-4643
Helium, Argon, Nitrogen	580	125 psig (8.6 Bar)	5183-4644
Air	590	125 psig (8.6 Bar)	5183-4645

Table 15 and Table 16 list minimum and maximum delivery pressures for inlets and detectors, measured at the bulkhead fittings on the back of the instrument.

Table 15 Delivery pressures for inlets required at the GC/MS, in kPa (psig)

	Inlet type				
	Split/Splitless 150 psi	Split/Splitless 100 psi	On-column	Purged packed	PTV
Carrier (max)	1,172 (170)	827 (120)	827 (120)	827 (120)	827 (120)
Carrier (min)	(20 psi) above pressure used in method				

Table 16 Delivery pressures for detectors required at the GC/MS, in kPa (psig)

	Detector type			
	FID	**TCD**	**ECD**	**FPD**
Hydrogen	240–690 (35–100)			310–690 (45–100)
Air	380–690 (55–100)			690–827 (100–120)
Makeup	380–690 (55–100)	380–690 (55–100)	380–690 (55–100)	380–690 (55–100)
Reference		380–690 (55–100)		

Conversions: 1 psi = 6.8947 kPa = 0.068947 Bar = 0.068 ATM

Requirements for hydrogen as a carrier gas

Not all systems can use hydrogen as a carrier gas. See Gas and Reagent Selection.

Hydrogen can be supplied from a generator or from a cylinder.

Agilent recommends use of a high-quality hydrogen gas generator. A high-quality generator can consistently produce purity > 99.9999%, and the generator can include built-in safety features such as limited storage, limited flow rates, and auto-shutdown. Select a hydrogen generator that provides low (good) specifications for water and oxygen content.

If using a hydrogen gas cylinder, Agilent recommends use of Gas Clean Filters to purify the gas. Consider additional safety equipment as recommended by your company safety personnel.

GC/MS Gas Requirements

See the appropriate tables for gas and reagent gas requirements.

5975 and 5977 Series MSD

7000 Series MS

7200 Series Q-TOF MS

5975 and 5977 Series MSD

Table 17 lists the limits on total gas flow into the 5975 Series MSD.

Table 17 5975 Series MSD total gas flow limitations

Feature	G3170A	G3171A	G3172A	G3174A	G3175A
High vacuum pump	Diffusion	Standard turbo	Performance turbo	Performance turbo, EI/PCI/NCI	Diffusion
Optimal gas flow mL/min[1]	1.0	1.0	1.0 to 2.0	1.0 to 2.0	1.0
Maximum recommended gas flow, mL/min	1.5	2.0	4.0	4.0	1.5
Maximum gas flow, mL/min[2]	2.0	2.4	6.5	4.0	2.0
Max column id	0.25 mm (30 m)	0.32 mm (30 m)	0.53 mm (30 m)	0.53 mm (30 m)	0.25 mm (30 m)

1 Total gas flow into the MSD = column flow + reagent gas flow (if applicable) + Agilent CFT device flow (if applicable).

2 Expect degradation of spectral performance and sensitivity.

Table 18 lists the limits on total gas flow into the 5977 Series MSD.

Table 18 5977 Series MSD total gas flow limitations

Feature	G7037A	G7038A	G7039A	G7040A
High vacuum pump	Diffusion	Performance turbo	Performance turbo	Performance turbo
Optimal gas flow mL/min[1]	1.0	1.0 to 2.0	1.0 to 2.0	1.0 to 2.0

Table 18 5977 Series MSD total gas flow limitations (continued)

Feature	G7037A	G7038A	G7039A	G7040A
Maximum recommended gas flow, mL/min	1.5	4.0	4.0	4.0
Maximum gas flow, mL/min[2]	2.0	6.5	6.5	6.5
Max column id	0.25 mm (30 m)	0.53 mm (30 m)	0.53 mm (30 m)	0.53 mm (30 m)

1 Total gas flow into the MSD = column flow + reagent gas flow (if applicable) + Agilent CFT device flow (if applicable).

2 Expect degradation of spectral performance and sensitivity.

Table 19 lists typical flows resulting from selected carrier and reagent gas source pressures.

Table 19 5977 and 5975 Series MSD carrier and reagent gases

Carrier and reagent gas requirements	Typical pressure range	Typical flow (mL/min)
Helium (required) (column and split flow)	345 to 552 kPa (50 to 80 psi)	20 to 50
Hydrogen (optional)[1] (column and split flow)	345 to 552 kPa (50 to 80 psi)	20 to 50
Methane reagent gas (required for CI operation)	103 to 172 kPa (15 to 25 psi)	1 to 2
Isobutane reagent gas (optional)	103 to 172 kPa (15 to 25 psi)	1 to 2
Ammonia reagent gas (optional)	34 to 55 kPa (5 to 8 psi)	1 to 2
Carbon dioxide reagent gas (optional)	103 to 138 kPa (15 to 20 psi)	1 to 2

1 Hydrogen gas can be used for the carrier gas but specifications are based on helium as the carrier gas. Please observe all hydrogen gas safety cautions.

7000 Series MS

Table 20 lists the limits on total gas flow into the 7000 Triple Quad MS.

Table 20 7000 Triple Quad MS total gas flow limitations

Feature	
High vacuum pump	Split-flow turbo
Optimal gas flow mL/min[1]	1.0 to 2.0
Maximum recommended gas flow, mL/min	4.0
Maximum gas flow, mL/min[2]	6.5
Maximum column id	0.53 mm (30 m long)

1 Total gas flow into the MS = column flow + reagent gas flow (if applicable) + Agilent CFT device flow (if applicable).

2 Expect degradation of spectral performance and sensitivity.

Table 21 lists typical flows resulting from selected carrier and reagent gas source pressures.

Table 21 7000 Triple Quad MS carrier and reagent gases

Carrier and reagent gas requirements	Typical pressure range	Typical flow (mL/min)
Helium (required) (column and split flow)	345 to 552 kPa (50 to 80 psi)	20 to 50
Hydrogen (optional)[1] (column and split flow)	345 to 552 kPa (50 to 80 psi)	20 to 50
Methane reagent gas (required for CI operation)	103 to 172 kPa (15 to 25 psi)	1 to 2
Ammonia reagent gas (optional)	34 to 55 kPa (5 to 8 psi)	1 to 2

Table 21 7000 Triple Quad MS carrier and reagent gases (continued)

Carrier and reagent gas requirements	Typical pressure range	Typical flow (mL/min)
Isobutane reagent gas (optional)[2]	103 to 172 kPa (15 to 25 psi)	1 to 2
Carbon dioxide reagent gas (optional)[2]	103 to 138 kPa (15 to 20 psi)	1 to 2
Nitrogen for collision cell (nitrogen source is supplied to EPC module in GC.)	1.03 to 1.72 bar (104 to 172 kPa, or 15 to 25 psi)	1 to 2 (mL/min)

1 Hydrogen gas can be used for the carrier gas but specifications are based on helium as the carrier gas. Please observe all hydrogen gas safety cautions.

2 Reagent available with manual tune only.

7200 Series Q-TOF MS

Table 22 lists the limits on total gas flow into the 7200 Q-TOF GC/MS.

Table 22 7200 Q-TOF GC/MS total gas flow limitations

Feature	
High vacuum pump 1	Split-flow turbo
High vacuum pump 2	Split-flow turbo
High vacuum pump 3	Turbo
Carrier gas optimal gas flow, mL/min[1]	1.0 to 1.5
Carrier gas maximum recommended gas flow, mL/min	2.0
Carrier gas maximum gas flow, mL/min[2]	2.4
Reagent gas flow (EI/CI – CI application)	1.0 to 2.0
Collision cell gas flow rate, mL/min	1.5
Maximum column id	0.32 mm (30 m long)

1 Total gas flow into the MS = column flow + reagent gas flow (if applicable) + collision cell gas flow.

2 Expect degradation of spectral performance and sensitivity.

Table 23 lists typical flows resulting from selected carrier and reagent gas source pressures.

Table 23 7200 Q-TOF GC/MS carrier and reagent gas flows

Carrier and reagent gas requirements	Typical pressure range	Typical flow
Helium (required for carrier and IRM)	173 to 207 kPa (25 to 30 psi)	1.0 to 2.0 (mL/min)
Nitrogen for RIS transfer line actuator	6.1 to 6.8 bar (612 to 690 kPa, or (90 to 100 psi)	Up to 30 L/min
Nitrogen for collision cell (nitrogen source is supplied to EPC module in GC.)	0.7 to 2.0 bar (70 to 207 kPa, or 10 to 30 psi)	1 to 2 (mL/min)

WARNING **The use of hydrogen is specifically prohibited with the 7200 GC/Q-TOF.**

Gas Plumbing

WARNING

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

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

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

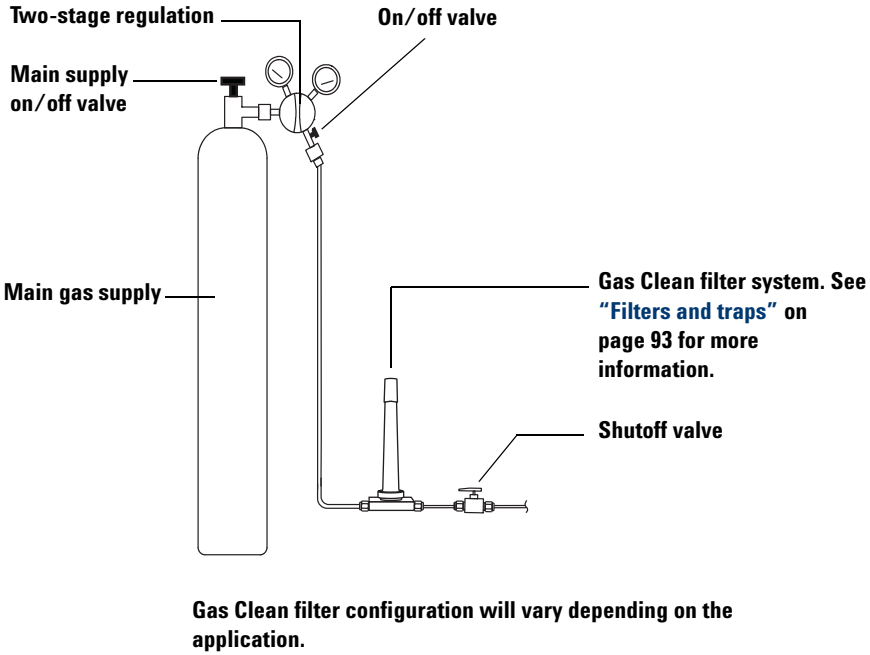


Figure 2 Recommended filters and plumbing configuration from a carrier gas cylinder

- If you have not requested option 305 (pre-plumbed tubing), you must supply pre-cleaned, 1/8-inch copper tubing and a variety of 1/8-inch Swagelok fittings to connect the GC to inlet and detector gas supplies. See the Installation Kits for recommended parts.
- Agilent strongly recommends two-stage regulators to eliminate pressure surges. High-quality, stainless-steel diaphragm-type regulators are especially recommended.
- On/off valves mounted on the outlet fitting of the two-stage regulator are not essential but are very useful. Be sure the valves have stainless-steel, packless diaphragms.
- Agilent strongly recommends installation of shut-off valves at each GC inlet supply fitting to allow the GC to be isolated for maintenance and troubleshooting. Order part number 0100-2144. (Note that some optional installation kits include one shut-off valve. See Installation Kits.)
- If you purchased automated valving, the valve actuation requires a **separate** pressurized, dry air supply at 380 kPa (55 psig). This air supply must end in a male fitting compatible with a 1/4-inch id plastic tube at the GC.
- FID and FPD detectors require a dedicated air supply. Operation may be affected by pressure pulses in air lines shared with other devices.
- Flow- and pressure-controlling devices require at least 10 psi (138 kPa) pressure differential across them to operate properly. Set source pressures and capacities high enough to ensure this.
- Situate auxiliary pressure regulators close to the GC inlet fittings. This ensures that the supply pressure is measured at the instrument (rather than at the source); pressure at the source may be different if the gas supply lines are long or narrow.
- **Never use liquid thread sealer to connect fittings.**
- **Never use chlorinated solvents to clean tubing or fittings.**

See Basic Tools and Installation Kits for more information.

Supply tubing for most carrier and detector gases

Use only preconditioned copper tubing (part number 5180-4196) to supply gases to the instrument. Do not use ordinary copper tubing—it contains oils and contaminants.

CAUTION Do not use methylene chloride or other halogenated solvent to clean tubing that will be used with an electron capture detector. They will cause elevated baselines and detector noise until they are completely flushed out of the system.

CAUTION Do not use plastic tubing for suppling detector and inlet gases to the GC. It is permeable to oxygen and other contaminants that can damage columns and detectors.

Plastic tubing can melt if near hot exhaust or components.

The tubing diameter depends on the distance between the supply gas and the GC and the total flow rate for the particular gas. Tubing of 1/8-in diameter is adequate when the supply line is less than 15 feet (4.6 m) long.

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

Be generous when cutting tubing for local supply lines—a coil of flexible tubing between the supply and the instrument lets you move the GC without moving the gas supply. Take this extra length into account when choosing the tubing diameter.

Supply tubing for hydrogen gas

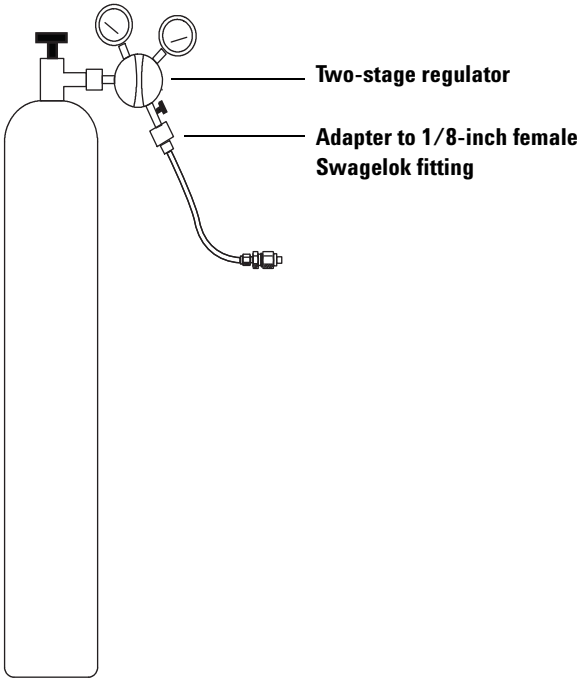
Agilent recommends using new chromatographic quality stainless steel tubing and fittings when using hydrogen.

- Do not re-use old tubing when installing or switching to hydrogen carrier gas. Hydrogen gas tends to remove contaminants left on old tubing by previous gases (by helium, for example). These contaminants can appear in output as high background noise or hydrocarbon contamination for several weeks.
- Especially do not use old copper tubing, which can become brittle.

WARNING **Do not use old copper tubing with hydrogen gas. Old copper tubing can become brittle and create a safety hazard.**

Two-stage pressure regulators

To eliminate pressure surges, use a two-stage regulator with each gas tank. Stainless steel, diaphragm-type regulators are recommended.



The type of regulator you use depends on the gas type and supplier. The Agilent catalog for consumables and supplies contains information to help you identify the correct regulator, as determined by the Compressed Gas Association (CGA). Agilent Technologies offers pressure-regulator kits that contain all the materials needed to install regulators properly.

Pressure regulator-gas supply tubing connections

Use PTFE tape to seal the pipe-thread connection between the pressure regulator outlet and the fitting to which you connect the gas tubing. Instrument grade PTFE tape (part number 0460-1266), from which volatiles

have been removed, is recommended for all fittings. **Do not use pipe dope to seal the threads**; it contains volatile materials that will contaminate the tubing.

Pressure regulators typically end in fittings that must be adapted to the correct style or size. Table 24 lists parts needed to adapt a standard 1/4-inch male NPT fitting to a 1/8-inch or 1/4-inch Swagelok fitting.

Table 24 Parts for adapting NPT fittings

Description	Part number
Swagelok 1/8-inch to female 1/4-inch NPT, brass	0100-0118
Swagelok 1/4-inch to female 1/4-inch NPT, brass	0100-0119
Reducing union, 1/4-in. to 1/8-in., brass, 2/pk	5180-4131

Filters and traps

Using chromatographic-grade gases ensures that the gas in your system is pure. However, for optimum sensitivity, install high-quality filters or traps to remove traces of water or other contaminants. After installing a filter, check the gas supply lines for leaks.

Agilent recommends the Gas Clean Filter system. The Gas Clean Filter system delivers high purity gases to your analytical instruments, reducing the risk of column damage, sensitivity loss, and instrument downtime. The filters are designed for use with the GC, GC/MS, ICP-OES, ICP-MS, LC/MS, and any other analysis instrument using carrier gas. Six filters are available, including CO2, oxygen, moisture, and organics trap (charcoal).

Filter types

Each Gas Clean Filter type is designed to filter out a specific impurity that may exist in the gas supply. The following filter types are available:

- **Oxygen** - Prevents oxidation of the GC column, septum, liner, and glass wool.
- **Moisture** - Delivers fast stabilization times for increased GC productivity, and prevents hydrolization damage to the stationary phase, column, liner, glass wool, or septum in the GC.

- **Process Moisture** - Prevents oxidation of GC components and is safe to use with acetylene in process GC applications.
- **Charcoal** - Removes organic compounds and ensures correct performance of FID detectors in the GC.
- **GC/MS** - Delivers fast stabilization times for increased GC productivity, removes oxygen, moisture, and hydrocarbons from the carrier gas for MS applications, and provides ultimate GC column protection.

Table 25 on page 95 shows recommended filter connection diagrams for common instrument configurations.

Table 25 Connection diagrams for common detectors

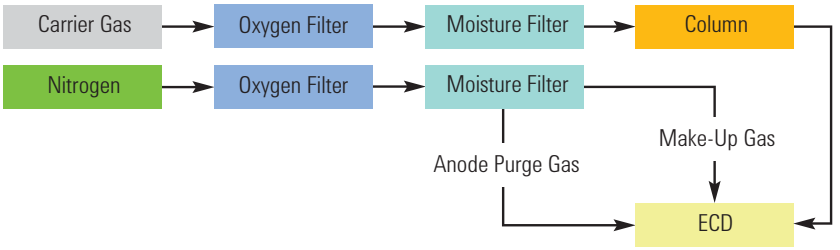
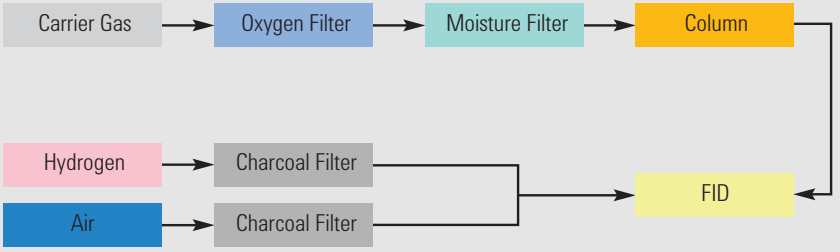
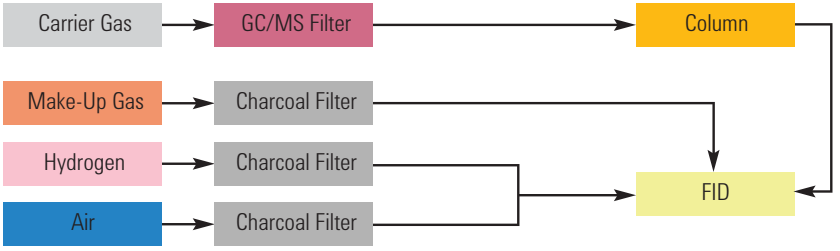
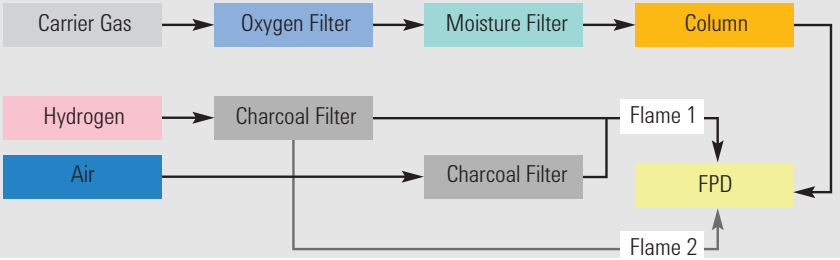
Detector	Connection Diagram
ECD Electron Capture Detector	
FID Flame Ionization Detector (Carrier Gas = Make-Up Gas)	
FID Flame Ionization Detector (Carrier Gas differs from Make-Up Gas)	
FPD Flame Photometric Detector	

Table 25 Connection diagrams for common detectors (continued)

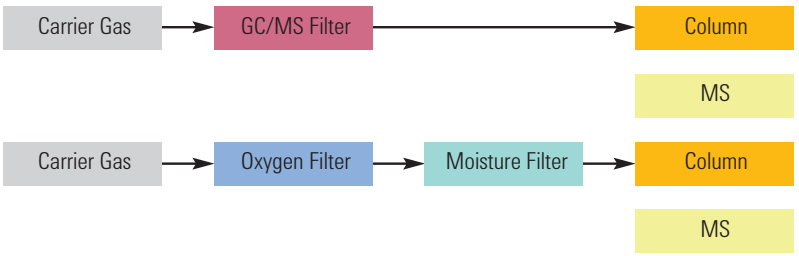
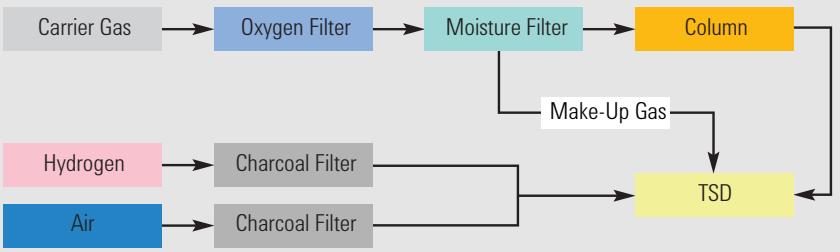
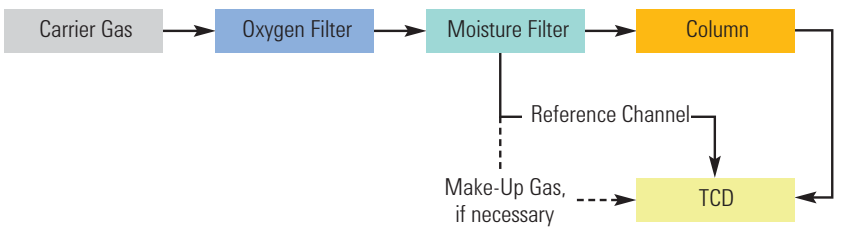
Detector	Connection Diagram
MS (MSD) Mass Selective Detector	
NPD Nitrogen-Phosphorous Detector (Carrier Gas = Make-Up Gas)	
TCD Thermal Conductivity Detector	

Table 26 lists the most common Gas Clean Filter system kits. See the Agilent online store or contact your local Agilent sales representative for additional filters, parts, and accessories applicable to your instrument configuration.

Table 26 Recommended Gas Clean Filter kits

Description	Part number	Detector
Gas Clean Filter kit (connecting unit for four filters, including four filters, 1/4-inch connections)	CP7995	FID, FPD, NPD
Gas Clean Filter kit (connecting unit for four filters, including four filters, 1/8-inch connections)	CP736530	FID, FPD, NPD
GC/MS Gas Clean Filter kit (includes one connecting unit and two GC/MS filters, 1/8-inch connections)	CP17976	ECD, GC/MS
GC/MS Gas Clean Filter kit (includes one connecting unit and two GC/MS filters, 1/4-inch connections)	CP17977	ECD, GC/MS
GC/MS Gas Clean Filter installation kit (includes CP17976, 1 m copper tubing, and two 1/8-inch nuts and ferrules)	CP17978	ECD, GC/MS
TCD filter kit (with oxygen and moisture filters)	CO738408	TCD

Each separate gas supply requires its own filters.

See also "Basic Tools and Installation Kits" on page 59.

Cryogenic Cooling Requirements

Cryogenic cooling allows you to cool the oven or inlet, including cooling to setpoints below ambient temperature. A solenoid valve controls the flow of coolant to the inlet or oven. The oven and inlet can use liquid carbon dioxide (CO_2) as a coolant.

Oven cryogenic cooling is not compatible with the 7000 Triple Quad MS or 7200 Q-TOF MS. If your application requires GC oven cryogenic cooling, contact your Agilent sales representative.

Using carbon dioxide

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

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

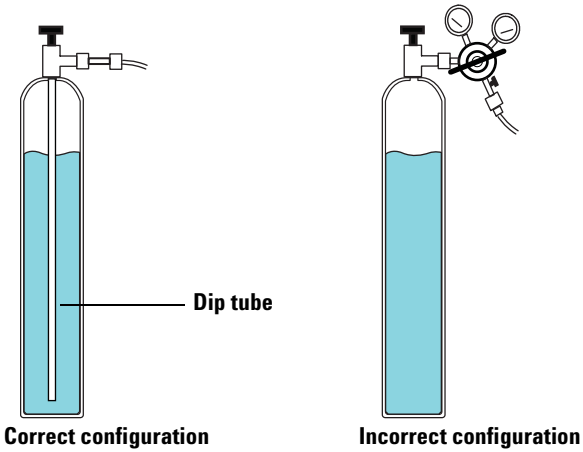
Liquid CO_2 is available in high-pressure tanks containing liquid. The CO_2 should be free of particulate material, oil, and other contaminants. These contaminants could clog the expansion orifice or affect the proper operation of the GC.

WARNING **Do not use copper tubing or thin-wall stainless steel tubing with liquid CO_2. Both harden at stress points and may explode.**

Additional requirements for the liquid CO_2 system include:

- The tank must have an internal dip tube or eductor tube to deliver liquid CO_2 instead of gas (see the figure below).

- Typical liquid CO_2 tank pressure will be 4830 to 6900 kPa (700 to 1,000 psi) at a temperature of 25 °C.
- Use 1/8-inch diameter heavy-wall stainless steel tubing for supply tubing. The tubing should be between 1.5 and 15 m (5 and 50 feet) long. (Agilent part number 7157-0210, 20 ft)
- Coil and fasten the ends of the tubing to prevent it from “whipping” if it breaks.
- Do not install a pressure regulator on the CO_2 tank, as vaporization and cooling would occur in the regulator instead of the oven.
- Do not use a padded tank (one to which another gas is added to increase the pressure).



Maximum Length of Cables

The distance between system modules may be limited by some of the cabling and the vent or vacuum hoses.

- The length of the Agilent-supplied remote cable is 2 meters (6.6 feet).
- The length of the Agilent-supplied LAN cable is 10 meters (32.8 feet).
- The lengths of the power cords are 2 meters (6.6 feet).
- A quadrupole GC/MS system foreline pump can be located on the laboratory bench or on the floor. It must be close to the MS because it is connected by a hose. The hose is stiff and cannot be bent sharply. The length of the vacuum hose is 130 cm (4.24 feet) from the high vacuum pump to the foreline pump, while the length of the foreline pump power cord is 2 meters (6.6 feet).

CAUTION The supporting surface for the 7200 Q-TOF GC/MS system should be kept relatively vibration free. Do not put the rough pump on your laboratory bench with the 7200 Q-TOF GC/MS due to the vibration that the pump creates. Vibration can lead to a loss of mass accuracy and resolution.

- A Q-TOF MS system foreline pump should be located on the floor. It must be close to the MS because it is connected by a hose. The hose is stiff and cannot be bent sharply. The length of the vacuum hose is 130 cm (4.24 feet) from the high vacuum pump to the foreline pump, while the length of the foreline pump power cord is 2 meters (6.6 feet).

Site LAN Network

If you intend to connect your system to your site's LAN network, you must have an additional shielded twisted pair network cable (8121-0940).

NOTE Agilent Technologies is not responsible for connecting to or establishing communication with your site LAN network. The representative will test the system's ability to communicate on a mini-hub or LAN switch only.

NOTE The IP addresses assigned to the instrument(s) must be fixed (permanently assigned) addresses. If you intend to connect your system to your site's network, each piece of equipment must have a unique, fixed (static) IP address assigned to it.

PC Requirements

If using an Agilent data system, refer to the data system documentation for PC requirements.

3
7820 MSD Site Preparation

This section outlines the space and resource requirements for a 7820 GC/MS installation. For a successful and timely installation of the instrument, the site must meet these requirements before beginning installation. Necessary supplies (gases, tubing, operating supplies, consumables, and other usage-dependent items such as columns, vials, syringes, and solvents) must also be available. Note that performance verification requires the use of helium carrier gas. Refer to the Agilent Web site at www.agilent.com/chem for the most up-to-date listing of GC, GC/MS, and ALS supplies and consumables.

For a general 7820A GC-only installation, refer to its documentation.

Customer Responsibilities

The specifications in this manual outline the necessary space, electrical outlets, gases, tubing, operating supplies, consumables, and other usage-dependent items such as columns, vials, syringes, and solvents required for the successful installation of instruments and systems.

If Agilent is delivering installation and familiarization services, users of the instrument should be present throughout these services; otherwise, they will miss important operational, maintenance, and safety information.

If Agilent is delivering installation and familiarization services, delays due to inadequate site preparation could cause loss of instrument use during the warranty period. In extreme cases, Agilent Technologies may ask to be reimbursed for the additional time required to complete the installation. Agilent Technologies provides service during the warranty period and under maintenance agreements only if the specified site requirements are met.

Site Preparation Good Practices

If you are not already familiar with Agilent instruments or with gas chromatography, prepare for the installation and familiarization service. Visit the Agilent web site at www. agilent.com/chem, and view the 7820 MSD information available there.

Having a basic knowledge of the instrument will enhance any familiarization services.

Agilent Technologies Installation and Familiarization Services

If you purchased installation and familiarization services from Agilent, these services include:

- Installation of the GC/MS system
- Familiarization of the GC/MS system

The basic installation and familiarization services do NOT include tasks such as:

- Network setup of instruments or computers to the site network
- Customizations
- Method or application setup, development, or testing
- Analysis of customer standards or samples
- Site preparation (such installation of gas cylinders, tubing, traps, electrical supplies, or clearing of suitable bench space)
- Familiarization or installation of non-Agilent software

To arrange for additional services, including training or application development, contact your Agilent sales representative or visit the Agilent web site at www.agilent.com/chem.

Basic Tools and Consumable Supplies

The GC comes with a few basic tools and consumables. Below is a general list of what comes with the instrument.

Table 27 Basic tools

Tool or consumable	Used for
7820A GC	
Column cutter, ceramic or diamond	Column installation.
Inlet septa appropriate for type	Inlet seal.
Inlet insert or liner	Contains sample during vaporization in inlet.
Toolkit, 19199T	Routine maintenance tasks
Tubing kit, 19199TF	Preassembled tubing for installing supply gases
G4351-60585 Ship Kit, 7820A MSD Interface/SSL Inlet	Tools and parts for installation, maintenance, and so forth.
G3170-60501 5975C MSD Ship Kit	Tools and parts for installation, maintenance, and so forth.

Table 28 lists other useful tools not included with the GC.

Table 28 Useful tools not included with GC

Tool	Used for
Custom Tee, G3430-60009	Connecting the same gas to front and back EPC module.
1/8-inch Ball Valve, 0100-2144	Inlet pressure decay test (one per inlet)
Digital flow meter, Flow tracker 1000	Verifying flows, checking for leaks and plugs
Electronic gas leak detector (G3388B)	Locating gas leaks; safety checks when using Hydrogen
Electronic vial crimper	Assuring consistently air-tight vial closure, regardless of who does the crimping

Table 29 lists consumables that you may wish to order. First time GC users should consider purchasing the following supplies in order to maintain their system and prevent interruptions in the use of their system. Please refer to the latest Agilent consumables and supplies catalog and to the Agilent web site at www.agilent.com/chem for part numbers and recommended maintenance periods.

Table 29 Additional consumables

Consumable category	Consumable
Inlet supplies	Septa, o-rings, liners, adapter, and seals
Inlet preventative maintenance (PM) kits	Kits with individual parts needed to maintain an inlet
Pneumatic supplies	Gases, traps, o-rings, seals, Swagelok fittings
Column supplies	Nuts, ferrules, adapters, guard columns, retention gaps
Application supplies	Standards, columns, syringes

Dimensions and Weight

Select the laboratory bench space before the system arrives. Make sure the area is clean, clear, and level. Pay special attention to the total height requirements. Avoid bench space with overhanging shelves. See Table 30.

The instrument needs space for proper convection of heat and ventilation. Allow at least 25 cm (10 in) clearance between back of the instrument and wall to dissipate hot air and allow for routine maintenance.

Table 30 Required instrument height, width, depth, and weight

Product	Height	Width	Depth	Weight
GC				
7820A GC	49 cm (19.5 in)	56 cm (22 in)	51 cm (20.5 in)	50 kg (110 lb)
GC operational oven access		Requires ≥ 30 cm (12 in) open space above GC		
MSD				
5975 Series MSD				
• Diffusion pump	41 cm (16 in)	30 cm (12 in)	54 cm (22 in)	39 kg (85 lb)
• Standard turbo pump	41 cm (16 in)	30 cm (12 in)	54 cm (22 in)	39 kg (85 lb)
• Performance turbo pump	41 cm (16 in)	30 cm (12 in)	54 cm (22 in)	41 kg (90 lb)
• Performance CI/EI turbo pump	41 cm (16 in)	30 cm (12 in)	54 cm (22 in)	46 kg (100 lb)
• Foreline pump Standard	21 cm (8 in)	13 cm (5 in)	31 cm (12 in)	11 kg (23.1 lb)
• GC/MS operational and maintenance access		Requires 30 cm (1 ft) to its left		
5977 Series MSD				
• Diffusion pump	41 cm (16 in)	30 cm (12 in)	54 cm (22 in)	39 kg (85 lb)
• Performance turbo pump	41 cm (16 in)	30 cm (12 in)	54 cm (22 in)	41 kg (90 lb)
• Performance CI/EI turbo pump	41 cm (16 in)	30 cm (12 in)	54 cm (22 in)	46 kg (100 lb)

Table 30 Required instrument height, width, depth, and weight (continued)

Product	Height	Width	Depth	Weight
• Foreline pump				
Standard	21 cm (8 in)	13 cm (5 in)	31 cm (12 in)	11 kg (23.1 lb)
Oil-free (MVP-055)	19 cm (7.5 in)	32 cm (13 in)	28 cm (11 in)	16 kg (35.2 lb)
Oil-free (IDP3)	18 cm (7 in)	35 cm (14 in)	14 cm (6 in)	10 kg (21 lb)
• GC/MS operational and maintenance access		Requires 30 cm (1 ft) to its left		
MS				
7010 and 7000 Triple Quad MS				
• Performance turbo pump	47 cm (18.5 in)	35 cm (14 in)	86 cm (34 in)	59 kg (130 lb)
• Performance CI/EI turbo pump	47 cm (18.5 in)	35 cm (14 in)	86 cm (34 in)	63.5 kg (140 lb)
• Foreline pump	28 cm (11 in)	18 cm (7 in)	35 cm (14 in)	21.5 kg (47.3 lb)
• GC/MS operational and maintenance access		Requires 30 cm (1 ft) to its left		
ALS				
• GC with 7693A ALS injector		Requires 50 cm (19.5 in) above the GC		3.9 kg (8,6 lb) each
• GC with 7693A ALS tray		Requires 45 cm (17.5 in) left of the GC Requires 2 cm (1 inch) in front of GC		6.8 kg (15 lb) each
• GC with 7650A ALS injector		Requires 50 cm (19.5 in) above the GC		3.9 kg (8,6 lb) each
• GC with 7683B ALS injector		Requires 42 cm (16.5 in) above the GC		3.1 kg (7 lb) each
• GC with 7683B ALS tray		Requires 30 cm (12 in) left of the GC		3.0 kg (7 lb)

A 7820 MSD system that includes a GC, ALS injector, 5977 or 5975 MSD and a computer would require about 165 cm (5 ft 5 in.) of bench space. Some repairs to the GC will also require access to the back of the instrument.

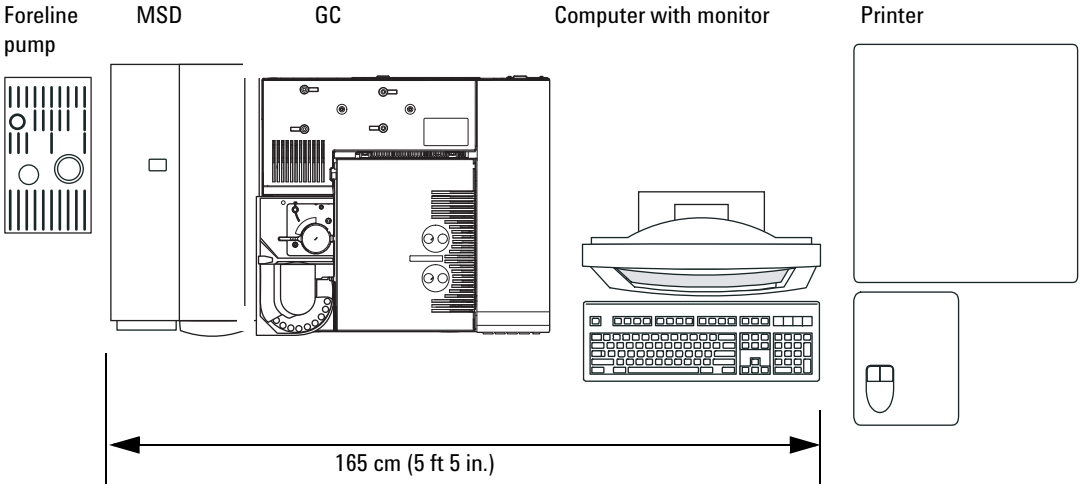


Figure 3 Top view of typical installation (7820A GC system)

Note that the length of the quadrupole vacuum hose is 130 cm (4 ft 3 in) from the high vacuum pump to the foreline pump, and the length of the foreline pump power cord is 2 m (6 ft 6 in).

Power Consumption

Table 31 lists site power requirements.

- The number and type of electrical outlets depend on the size and complexity of the system.
- Power consumption and requirements depend on the country to which the unit ships.
- The voltage requirements for your instrument are printed near the power cord attachment.
- The electrical outlet for the unit should have a dedicated ground.
- All instruments should be on a dedicated circuit.
- Power line conditioners should not be used with Agilent instruments.

Table 31 Power requirements

Product	Oven type	Line voltage (VAC)	Frequency (Hz)	Maximum continuous power consumption (VA)	Current rating (amps)	Power outlet current rating
7820A GC	Standard	100 single phase (–10% / +10%)	48–63	1500	12.5	15 Amp Dedicated
7820A GC	Standard	120 single phase (–10% / +10%)	48–63	2250	18.8	20 Amp Dedicated
7820A GC	Standard	200/220/230/240 single phase (–10% / +10%)	48–63	2250	9.6/9.3/ 9.3/9.2	10 Amp Dedicated
MSD						
5975 Series MSD		120 (–10% / +5%)	50/60 ± 5%	1100 (400 for foreline pump only)	8	10 Amp Dedicated
5975 Series MSD		220–240 (–10% / +5%)	50/60 ± 5%	1100 (400 for foreline pump only)	8	10 Amp Dedicated
5975 Series MSD		200 (–10% / +5%)	50/60 ± 5%	1100 (400 for foreline pump only)	8	10 Amp Dedicated
5977 Series MSD		120 (–10% / +5%)	50/60 ± 5%	1100 (400 for foreline pump only)	8	10 Amp Dedicated

Table 31 Power requirements (continued)

Product	Oven type	Line voltage (VAC)	Frequency (Hz)	Maximum continuous power consumption (VA)	Current rating (amps)	Power outlet current rating
5977 Series MSD		220–240 (–10% / +5%)	50/60 ± 5%	1100 (400 for foreline pump only)	8	10 Amp Dedicated
5977 Series MSD		200 (–10% / +5%)	50/60 ± 5%	1100 (400 for foreline pump only)	8	10 Amp Dedicated
MS						
7010 or 7000 Triple Quad MS		120 (–10% / +5%)	50/60 ± 5%	1600	15	15 Amp Dedicated
7010 or 7000 Triple Quad MS		220–240 (–10% / +5%)	50/60 ± 5%	1600	15	15 Amp Dedicated
7010 or 7000 Triple Quad MS		200 (–10% / +5%)	50/60 ± 5%	1600	15	15 Amp Dedicated
All						
Data system PC (monitor, CPU, printer)		100/120/200-240 (–10% / +5%)	50/60 ± 5%	1000	15	15 Amp Dedicated

WARNING **Do not use extension cords with Agilent instruments. Extension cords normally are not rated to carry enough power and can be a safety hazard.**

Although your GC should arrive ready for operation in your country, compare its voltage requirements with those listed in Table 31. If the voltage option you ordered is not suitable for your installation, contact Agilent Technologies. Note that ALS instruments receive their power from the GC.

Grounding

CAUTION A proper earth ground is required for GC operations. Any interruption of the grounding conductor or disconnection of the power cord could cause a shock that could result in personal injury.

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. Be sure to verify proper receptacle grounding.

Connect the GC to a dedicated circuit.

Canadian installation

When installing a GC in Canada, make sure your GC's power supply circuit meets the following additional requirements:

- The circuit breaker for the branch circuit, which is dedicated to the instrument, is rated for continuous operation.
- The service box branch circuit is marked as a "Dedicated Circuit."

Common instrument power cord plugs

Table 28

Heat Dissipation

Use Table 32 to estimate the additional BTUs of heat dissipated from this equipment. Maximums represent the heat given off when heated zones are set for maximum temperatures.

Table 32 Heat dissipation

	Oven type
	Standard oven ramp
7820A GC	7681 BTU/hour maximum (8103 kJ/h) 5120 BTU/hour maximum (100 V power option) (5402 kJ/h)
	Steady state, including MS interface
5975 Series MSD	3000 BTU/hour (3165 kJ/h)
5977 Series MSD	3000 BTU/hour (3165 kJ/h)
7010 or 7000 Triple Quad MS	3700 BTU/hour (3904 kJ/h)

Exhaust Venting

During normal operation, the GC exhausts hot oven air. Depending on the installed inlet and detector types, the GC can also exhaust (or vent) uncombusted carrier gas and sample. Proper venting of these exhausts is required for operation and safety.

Hot air

Hot air (up to 425 °C) from the oven exits through a vent in the rear. Allow at least 25 cm (10 in) clearance behind the instrument to dissipate this air.

WARNING **Do not place temperature-sensitive items (for example, gas cylinders, chemicals, regulators, and plastic tubing) in the path of the heated exhaust. These items will be damaged and plastic tubing will melt. Be careful when working behind the instrument during cool-down cycles to avoid burns from the hot exhaust.**

Other gases

During normal operation of the GC with many detector and inlet types, some of the carrier gas and sample vents outside the instrument through the split vent, septum purge vent, and detector exhaust. If any sample components are toxic or noxious, or if hydrogen is used as the carrier gas, these exhausts must be vented to a fume hood. Place the GC in the hood or attach a large diameter venting tube to the outlet for proper ventilation.

To further prevent contamination from noxious gases, attach a chemical trap to the vent(s).

If using a μECD, always plan to connect the μECD exhaust vent to a fume hood or vent it to the outside. See the latest revision of 10 CFR Part 20 (including Appendix B), or the applicable state regulation. For other countries, consult with the appropriate agency for equivalent requirements. Agilent recommends a vent line internal diameter of 6 mm (1/4-inch) or greater. With a line of this diameter, the length is not critical.

Vent the GC/MS system externally to the building via an ambient-pressure vent system, within 460 cm (15 ft) of both the GC split vent and GC/MS foreline pump, or vent to a fume hood.

Note that an exhaust vent system is not part of the building environmental control system, which recirculates air.

Exhaust venting must comply with all local environmental and safety codes. Contact your Environmental Health & Safety (EHS) specialist.

Exhaust vent fittings

The various inlet and detector vents terminate in the following fittings:

- TCD, μECD: The detector exhaust terminates in a 1/8-inch od tube.
- All inlets: The septum purge vent terminates in 1/8-inch od tubing.

Environmental Conditions

Operating the instrument within the recommended ranges optimizes instrument performance and lifetime. Performance can be affected by sources of heat and cold from heating, air conditioning systems, or drafts. See Table 33. The conditions assume a noncondensing, noncorrosive atmosphere. The instrument meets the following International Electrotechnical Commission (IEC) classifications: Equipment Class I, Laboratory Equipment, Installation Category II, and Pollution Degree 2.

Table 33 Environmental conditions for operation and storage

Product	Conditions	Operating temp range	Operating humidity range	Maximum altitude
7820A GC	Standard oven ramp	5 to 45 °C	5 to 90%	3,100 m
	Storage	–20 to 65 °C	0 to 90%	
MSD				
5975 Series MSD	Operation	15 to 35 °C * (59 to 95 °F)	20 to 80%	4,615 m
	Storage	–20 to 70 °C (–4 to 158 °F)	0 to 95%	
5977 Series MSD	Operation	15 to 35 °C * (59 to 95 °F)	20 to 80%	4,615 m
	Storage	–20 to 70 °C (–4 to 158 °F)	0 to 95%	
MS				
7010 or 7000 Triple Quad MS	Operation	15 to 35 °C † (59 to 95 °F)	40 to 80%	5,000 m ‡
	Storage	–20 to 70 °C (–4 to 158 °F)	0 to 95%	

* Operation requires constant temperature (variations < 2 °C/hour)

† Operation requires constant temperature (variations < 2 °C/hour)

‡ An altitude of 3,700 meters (12,000 feet) is supported if the ambient temperature is less than 30 °C

Gas and Reagent Selection

The 7820 MSD system (GC and MSD) requires helium or hydrogen carrier gas.

If using any MS system, use of hydrogen as the carrier gas may require hardware modifications for best performance. Contact your Agilent service representative.

NOTE Nitrogen and Argon/Methane are generally not suitable for GC/MS carrier gas.

WARNING **When using hydrogen (H_2) as the carrier gas or fuel gas, be aware that hydrogen gas can flow into the GC and create an explosion hazard. Therefore, be sure that the supply is turned off until all connections are made and ensure the inlet and detector column fittings are either connected to a column or capped at all times when hydrogen gas is supplied to the instrument.**

Hydrogen is flammable. Leaks, when confined in an enclosed space, may create a fire or explosion hazard. In any application using hydrogen, leak test all connections, lines, and valves before operating the instrument. Always turn off the hydrogen supply at its source before working on the instrument.

Please refer to the Hydrogen Safety Guide shipped with your instrument.

Gas and Reagent Purity

Agilent recommends that carrier and detector gases be 99.9995% pure. See Table 34. Air needs to be zero grade or better. Agilent also recommends using high quality traps to remove hydrocarbons, water, and oxygen.

Table 34 Carrier, collision, and reagent gas purity

Carrier, collision, and reagent gas requirements	Purity	Notes
Helium (carrier and collision)	99.9995%	Hydrocarbon free
Hydrogen (carrier)	99.9995%	SFC grade
Nitrogen (carrier)	99.9995%	
Nitrogen (collision)*	99.999%	Research or SFC grade
Nitrogen (drying gas, nebulizer pressure)†	99.999%	Research or SFC grade

* Nitrogen for the collision cell requires a separate supply from the nitrogen used for the drying gas. A separate pressure regulator is required. A high pressure bottle of nitrogen is recommended for the collision cell gas supply.

† Purity specification is the minimum acceptable purity. Major contaminants can be water, oxygen, or air. Drying gas and nebulizer pressure gas can be supplied by a nitrogen gas generator, house nitrogen system, or liquid nitrogen dewar.

WARNING

When using hydrogen (H_2) as the carrier gas or fuel gas, be aware that hydrogen gas can flow into the GC and create an explosion hazard. Therefore, be sure that the supply is turned off until all connections are made and ensure the inlet and detector column fittings are either connected to a column or capped at all times when hydrogen gas is supplied to the instrument.

Hydrogen is flammable. Leaks, when confined in an enclosed space, may create a fire or explosion hazard. In any application using hydrogen, leak test all connections, lines, and valves before operating the instrument. Always turn off the hydrogen supply at its source before working on the instrument.

Please refer to the Hydrogen Safety Guide shipped with your instrument.

Gas Supplies

General requirements

Supply instrument gases using tanks, an internal distribution system, or gas generators. If used, tanks require two-stage pressure regulators with packless, stainless steel diaphragms. The instrument requires 1/8-inch Swagelok connections to its gas supply fittings. See Figure 32.

NOTE Plumb the gas supply tubing/regulators so that one 1/8-inch Swagelok female connector is available for each gas needed at the instrument.

Table 35 lists available Agilent two-stage tank regulators. All Agilent regulators are supplied with the 1/8-inch Swagelok female connector.

Table 35 Tank regulators

Gas type	CGA number	Max pressure	Part number
Air	346	125 psig (8.6 Bar)	5183-4641
Industrial Air	590	125 psig (8.6 Bar)	5183-4645
Hydrogen, Argon/Methane	350	125 psig (8.6 Bar)	5183-4642
Oxygen	540	125 psig (8.6 Bar)	5183-4643
Helium, Argon, Nitrogen	580	125 psig (8.6 Bar)	5183-4644

Table 36 and Table 37 list minimum and maximum delivery pressures for inlets and detectors, measured at the bulkhead fittings on the back of the instrument.

Table 36 Delivery pressures for inlets required at the GC, in kPa (psig)

	Inlet type	
	Split/Splitless	**Purged packed**
Carrier (max)	827 (120)	827 (120)
Carrier (min)	(20 psi) above pressure used in method	

Table 37 Delivery pressures for detectors required at the GC/MS, in kPa (psig)

	Detector type				
	FID	**NPD**	**TCD**	**uECD**	**FPD**
Hydrogen	240–690 (35–100)	240–690 (35–100)			310–690 (45–100)
Air	380–690 (55–100)	380–690 (55–100)			690–827 (100–120)
Makeup	380–690 (55–100)	380–690 (55–100)	380–690 (55–100)	380–690 (55–100)	380–690 (55–100)
Reference			380–690 (55–100)		

Conversions: 1 psi = 6.8947 kPa = 0.068947 Bar = 0.068 ATM

Requirements for hydrogen as a carrier gas

Not all systems can use hydrogen as a carrier gas. See Gas and Reagent Selection.

Hydrogen can be supplied from a generator or from a cylinder.

Agilent recommends use of a high-quality hydrogen gas generator. A high-quality generator can consistently produce purity > 99.9999%, and the generator can include built-in safety features such as limited storage, limited flow rates, and auto-shutdown. Select a hydrogen generator that provides low (good) specifications for water and oxygen content.

If using a hydrogen gas cylinder, Agilent recommends use of Gas Clean Filters to purify the gas. Consider additional safety equipment as recommended by your company safety personnel.

GC/MS Gas and Reagent Requirements

See the appropriate tables for gas and reagent gas requirements.

5975 and 5977 Series MSD

7010 and 7000 Series MS

5975 and 5977 Series MSD

Table 38 lists the limits on total gas flow into the 5975 Series MSD.

Table 38 5975 Series MSD total gas flow limitations

Feature	G3175A	G3176A
High vacuum pump	Diffusion	Standard turbo
Optimal gas flow mL/min*	1.0	1.0
Maximum recommended gas flow, mL/min	1.5	2.0
Maximum gas flow, mL/min†	2.0	2.4
Max column id	0.25 mm (30 m)	0.32 mm (30 m)

* Total gas flow into the MSD = column flow + reagent gas flow (if applicable) + Agilent CFT device flow (if applicable).

† Expect degradation of spectral performance and sensitivity.

Table 39 lists the limits on total gas flow into the 5977 Series MSD.

Table 39 5977 Series MSD total gas flow limitations

Feature	G7035A	G7036A
High vacuum pump	Diffusion	Performance turbo
Optimal gas flow mL/min*	1.0	1.0 to 2.0
Maximum recommended gas flow, mL/min	1.5	4.0
Maximum gas flow, mL/min†	2.0	6.5
Max column id	0.25 mm (30 m)	0.53 mm (30 m)

* Total gas flow into the MSD = column flow + reagent gas flow (if applicable) + Agilent CFT device flow (if applicable).

† Expect degradation of spectral performance and sensitivity.

Table 40 lists typical flows resulting from selected carrier and reagent gas source pressures.

Table 40 5977 and 5975 Series MSD carrier and reagent gases

Carrier and reagent gas requirements	Typical pressure range	Typical flow (mL/min)
Helium (required) (column and split flow)	345 to 552 kPa (50 to 80 psi)	20 to 50
Hydrogen (optional)* (column and split flow)	345 to 552 kPa (50 to 80 psi)	20 to 50

* Hydrogen gas can be used for the carrier gas but specifications are based on helium as the carrier gas. Please observe all hydrogen gas safety cautions.

7010 and 7000 Series MS

Table 41 lists the limits on total gas flow into the Triple Quad MS.

Table 41 7010 and 7000 Triple Quad MS total gas flow limitations

Feature	
High vacuum pump	Split-flow turbo
Optimal gas flow mL/min*	1.0 to 2.0
Maximum recommended gas flow, mL/min	4.0
Maximum gas flow, mL/min†	6.5
Maximum column id	0.53 mm (30 m long)

* Total gas flow into the MS = column flow + reagent gas flow (if applicable) + Agilent CFT/IFT device flow (if applicable). Instruments using a JetClean ion source system may also add a small (~0.075 mL/min) hydrogen flow.

† Expect degradation of spectral performance and sensitivity.

Table 42 lists typical flows resulting from selected carrier and reagent gas source pressures.

Table 42 7010 and 7000 Triple Quad MS carrier and reagent gases

Carrier and reagent gas requirements	Typical pressure range	Typical flow (mL/min)
Helium (required) (column and split flow)	345 to 552 kPa (50 to 80 psi)	20 to 50
Hydrogen (optional)* (column and split flow)	345 to 552 kPa (50 to 80 psi)	20 to 50
Methane reagent gas (required for CI operation)	103 to 172 kPa (15 to 25 psi)	1 to 2
Ammonia reagent gas (optional)	34 to 55 kPa (5 to 8 psi)	1 to 2
Isobutane reagent gas (optional)†	103 to 172 kPa (15 to 25 psi)	1 to 2
Carbon dioxide reagent gas (optional)†	103 to 138 kPa (15 to 20 psi)	1 to 2
Nitrogen for collision cell (nitrogen source is supplied to EPC module in GC.)	1.03 to 1.72 bar (104 to 172 kPa, or 15 to 25 psi)	1 to 2 (mL/min)

* Hydrogen gas can be used for the carrier gas but specifications are based on helium as the carrier gas. Please observe all hydrogen gas safety cautions.

† Reagent available with manual tune only.

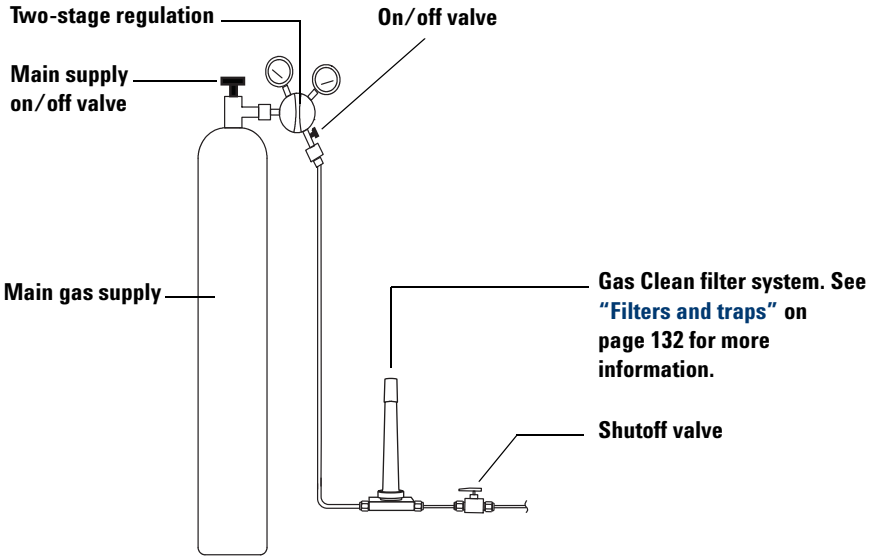
Gas Plumbing

WARNING

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

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

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



Gas Clean filter configuration will vary depending on the application.

Figure 4 Recommended filters and plumbing configuration from a carrier gas cylinder

- If you have not requested option 305 (pre-plumbed tubing), you must supply pre-cleaned, 1/8-inch copper tubing and a variety of 1/8-inch Swagelok fittings to connect the GC to inlet and detector gas supplies. See the Installation Kits for recommended parts.
- Agilent strongly recommends two-stage regulators to eliminate pressure surges. High-quality, stainless-steel diaphragm-type regulators are especially recommended.
- On/off valves mounted on the outlet fitting of the two-stage regulator are not essential but are very useful. Be sure the valves have stainless-steel, packless diaphragms.
- Agilent strongly recommends installation of shut-off valves at each GC inlet supply fitting to allow the GC to be isolated for maintenance and troubleshooting. Order part number 0100-2144. (Note that some optional installation kits include one shut-off valve. See Installation Kits.)
- If you purchased automated valving, the valve actuation requires a **separate** pressurized, dry air supply at 380 kPa (55 psig). This air supply must end in a male fitting compatible with a 1/4-inch id plastic tube at the GC.
- FID, FPD, and NPD detectors require a dedicated air supply. Operation may be affected by pressure pulses in air lines shared with other devices.
- Flow- and pressure-controlling devices require at least 10 psi (138 kPa) pressure differential across them to operate properly. Set source pressures and capacities high enough to ensure this.
- Situate auxiliary pressure regulators close to the GC inlet fittings. This ensures that the supply pressure is measured at the instrument (rather than at the source); pressure at the source may be different if the gas supply lines are long or narrow.
- **Never use liquid thread sealer to connect fittings.**
- **Never use chlorinated solvents to clean tubing or fittings.**

Supply tubing for most carrier and detector gases

Use only preconditioned copper tubing (part number 5180-4196) to supply gases to the instrument. Do not use ordinary copper tubing—it contains oils and contaminants.

CAUTION Do not use methylene chloride or other halogenated solvent to clean tubing that will be used with an electron capture detector. They will cause elevated baselines and detector noise until they are completely flushed out of the system.

CAUTION Do not use plastic tubing for suppling detector and inlet gases to the GC. It is permeable to oxygen and other contaminants that can damage columns and detectors.

Plastic tubing can melt if near hot exhaust or components.

The tubing diameter depends on the distance between the supply gas and the GC and the total flow rate for the particular gas. Tubing of 1/8-in diameter is adequate when the supply line is less than 15 feet (4.6 m) long.

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

Be generous when cutting tubing for local supply lines—a coil of flexible tubing between the supply and the instrument lets you move the GC without moving the gas supply. Take this extra length into account when choosing the tubing diameter.

Supply tubing for hydrogen gas

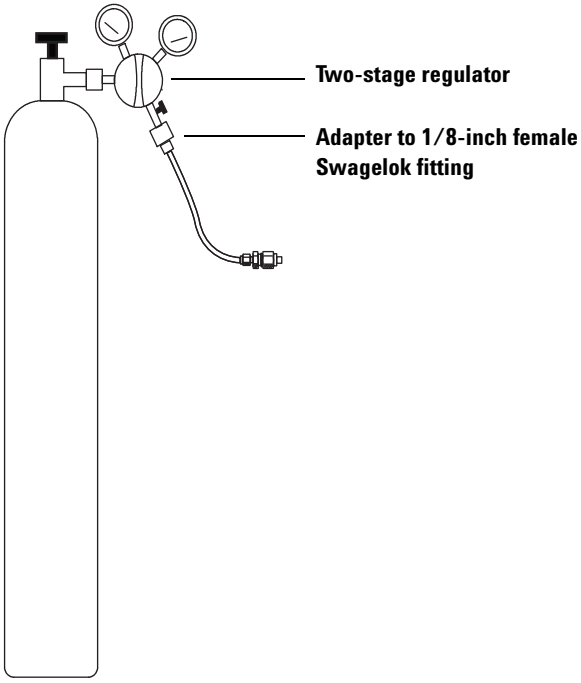
Agilent recommends using new chromatographic quality stainless steel tubing and fittings when using hydrogen.

- Do not re-use old tubing when installing or switching to hydrogen supply lines for carrier gas or the JetClean ion source system. Hydrogen gas tends to remove contaminants left on old tubing by previous gases (by helium, for example). These contaminants can appear in output as high background noise or hydrocarbon contamination for several weeks.
- Especially do not use old copper tubing, which can become brittle.

WARNING **Do not use old copper tubing with hydrogen gas. Old copper tubing can become brittle and create a safety hazard.**

Two-stage pressure regulators

To eliminate pressure surges, use a two-stage regulator with each gas tank. Stainless steel, diaphragm-type regulators are recommended.



The type of regulator you use depends on the gas type and supplier. The Agilent catalog for consumables and supplies contains information to help you identify the correct regulator, as determined by the Compressed Gas Association (CGA). Agilent Technologies offers pressure-regulator kits that contain all the materials needed to install regulators properly.

Pressure regulator-gas supply tubing connections

Use PTFE tape to seal the pipe-thread connection between the pressure regulator outlet and the fitting to which you connect the gas tubing. Instrument grade PTFE tape (part number 0460-1266), from which volatiles

have been removed, is recommended for all fittings. **Do not use pipe dope to seal the threads**; it contains volatile materials that will contaminate the tubing.

Pressure regulators typically end in fittings that must be adapted to the correct style or size. Table 43 lists parts needed to adapt a standard 1/4-inch male NPT fitting to a 1/8-inch or 1/4-inch Swagelok fitting.

Table 43 Parts for adapting NPT fittings

Description	Part number
Swagelok 1/8-inch to female 1/4-inch NPT, brass	0100-0118
Swagelok 1/4-inch to female 1/4-inch NPT, brass	0100-0119
Reducing union, 1/4-in. to 1/8-in., brass, 2/pk	5180-4131

Filters and traps

Using chromatographic-grade gases ensures that the gas in your system is pure. However, for optimum sensitivity, install high-quality filters or traps to remove traces of water or other contaminants. After installing a filter, check the gas supply lines for leaks.

Agilent recommends the Gas Clean Filter system. The Gas Clean Filter system delivers high purity gases to your analytical instruments, reducing the risk of column damage, sensitivity loss, and instrument downtime. The filters are designed for use with the GC, GC/MS, ICP-OES, ICP-MS, LC/MS, and any other analysis instrument using carrier gas. Six filters are available, including CO2, oxygen, moisture, and organics trap (charcoal).

Filter types

Each Gas Clean Filter type is designed to filter out a specific impurity that may exist in the gas supply. The following filter types are available:

- **Oxygen** - Prevents oxidation of the GC column, septum, liner, and glass wool.
- **Moisture** - Delivers fast stabilization times for increased GC productivity, and prevents hydrolization damage to the stationary phase, column, liner, glass wool, or septum in the GC.

- **Process Moisture** - Prevents oxidation of GC components and is safe to use with acetylene in process GC applications.
- **Charcoal** - Removes organic compounds and ensures correct performance of FID detectors in the GC.
- **GC/MS** - Delivers fast stabilization times for increased GC productivity, removes oxygen, moisture, and hydrocarbons from the carrier gas for MS applications, and provides ultimate GC column protection.

Table 44 on page 134 shows recommended filter connection diagrams for common instrument configurations.

Table 44 Connection diagrams for common detectors

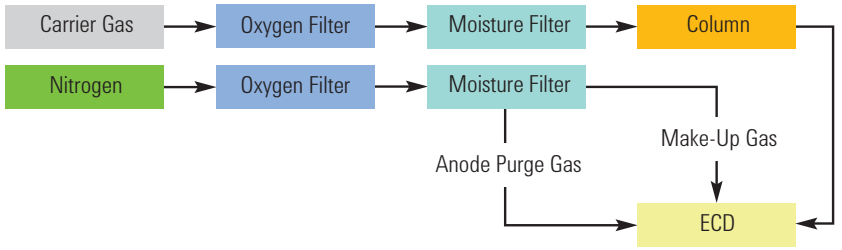
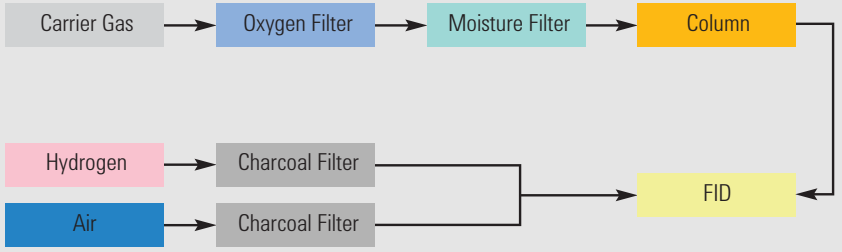
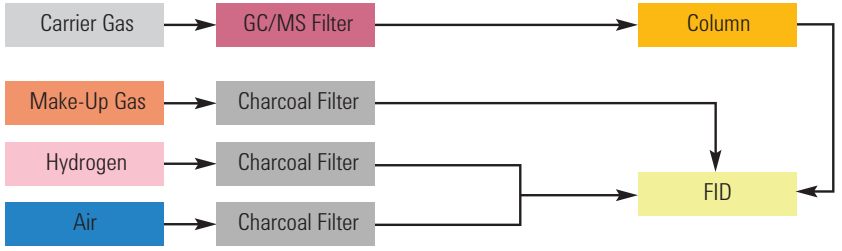
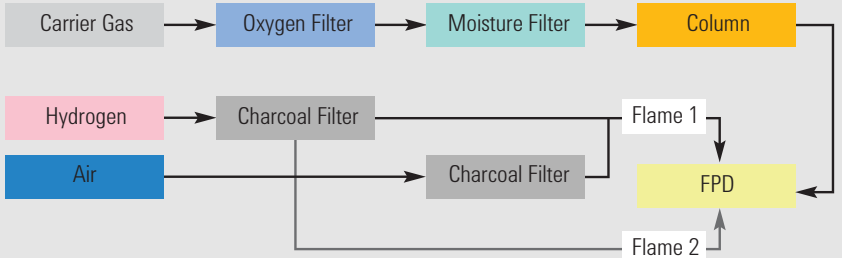
Detector	Connection Diagram
ECD Electron Capture Detector	
FID Flame Ionization Detector (Carrier Gas = Make-Up Gas)	
FID Flame Ionization Detector (Carrier Gas differs from Make-Up Gas)	
FPD Flame Photometric Detector	

Table 44 Connection diagrams for common detectors (continued)

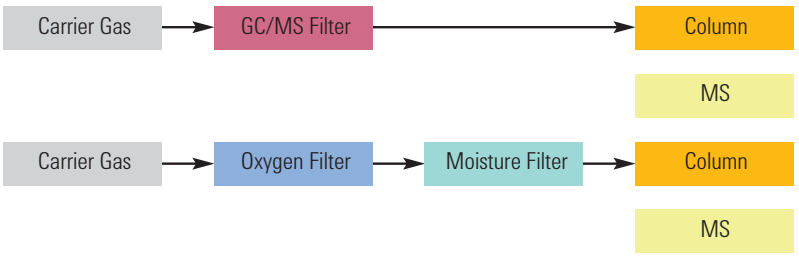
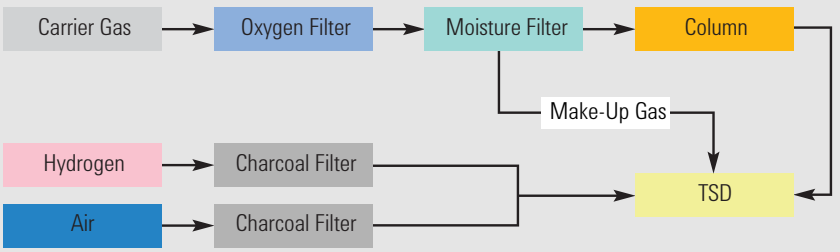
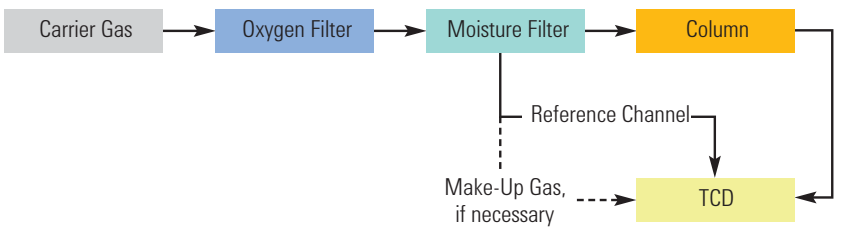
Detector	Connection Diagram
MS (MSD) Mass Selective Detector	
NPD Nitrogen-Phosphorous Detector (Carrier Gas = Make-Up Gas)	
TCD Thermal Conductivity Detector	

Table 45 lists the most common Gas Clean Filter system kits. See the Agilent online store or contact your local Agilent sales representative for additional filters, parts, and accessories applicable to your instrument configuration.

Table 45 Recommended Gas Clean Filter kits

Description	Part number	Use
Gas Clean Filter kit (connecting unit for four filters, including four filters, 1/4-inch connections)	CP7995	FID, FPD, NPD
Gas Clean Filter kit (connecting unit for four filters, including four filters, 1/8-inch connections)	CP736530	FID, FPD, NPD
GC/MS Gas Clean Filter kit (includes one connecting unit and two GC/MS filters, 1/8-inch connections)	CP17976	ECD, GC/MS
GC/MS Gas Clean Filter kit (includes one connecting unit and two GC/MS filters, 1/4-inch connections)	CP17977	ECD, GC/MS
GC/MS Gas Clean Filter installation kit (includes CP17976, 1 m copper tubing, and two 1/8-inch nuts and ferrules)	CP17978	ECD, GC/MS
TCD filter kit (with oxygen and moisture filters)	CO738408	TCD

Each separate gas supply requires its own filters.

Maximum Length of Cables

The distance between system modules may be limited by some of the cabling and the vent or vacuum hoses.

- The length of the Agilent-supplied remote cable is 2 meters (6.6 feet).
- The length of the Agilent-supplied LAN cable is 10 meters (32.8 feet).
- The lengths of the power cords are 2 meters (6.6 feet).
- A quadrupole GC/MS system foreline pump can be located on the laboratory bench or on the floor. It must be close to the MS because it is connected by a hose. The hose is stiff and cannot be bent sharply. The length of the vacuum hose is 130 cm (4.24 feet) from the high vacuum pump to the foreline pump, while the length of the foreline pump power cord is 2 meters (6.6 feet).

Site LAN Network

If you intend to connect your system to your site's LAN network, you must have an additional shielded twisted pair network cable (8121-0940).

NOTE Agilent Technologies is not responsible for connecting to or establishing communication with your site LAN network. The representative will test the system's ability to communicate on a mini-hub or LAN switch only.

NOTE The IP addresses assigned to the instrument(s) must be fixed (permanently assigned) addresses. If you intend to connect your system to your site's network, each piece of equipment must have a unique, fixed (static) IP address assigned to it.

NOTE For a Single Quad GC/MS system, Agilent recommends, sells, and supports the use of a PC with one (1) network interface card (NIC) and a network switch to isolate the GC/MS system from the site LAN. The network switch supplied with Agilent systems prevents instrument-to-PC network traffic from entering the site LAN and keeps site LAN network traffic from interfering with instrument-to-PC communications. Agilent develops and tests all Single Quad GC/MS hardware and software using the single NIC configuration and has no known network configuration issues. Alternate network configurations can be configured and managed by the end user at their own risk and expense.

PC Requirements

Any 7820 GC/MSD system requires Agilent control software. For PC requirements, refer to the Agilent data system documentation.

4
7693A and 7650 Automatic Liquid Sampler Site Preparation

This section outlines the space and resource requirements for a 7693A and 7650 automatic liquid sampler (ALS). For a successful and timely installation of the ALS, the site must meet these requirements before beginning installation. Necessary supplies (operating supplies, consumables, and other usage-dependent items such as vials, syringes, and solvents) must also be available. Refer to the Agilent Web site at www.agilent.com/chem for the most up-to-date listing of GC, GC/MS, and ALS supplies and consumables.

Refer to your GC documentation for compatibility with a specific ALS model.

Customer Responsibilities

The specifications in this manual outline the necessary space, electrical outlets, tubing, operating supplies, consumables, and other usage-dependent items such as vials, syringes, and solvents required for the successful installation of instruments and systems.

If Agilent is delivering installation and familiarization services, users of the instrument should be present throughout these services; otherwise, they will miss important operational, maintenance, and safety information.

If Agilent is delivering installation and familiarization services, delays due to inadequate site preparation could cause loss of instrument use during the warranty period. In extreme cases, Agilent Technologies may ask to be reimbursed for the additional time required to complete the installation. Agilent Technologies provides service during the warranty period and under maintenance agreements only if the specified site requirements are met.

Basic Tools and Consumable Supplies

The 7693A and 7650 ALS come with a few basic tools and consumables depending on the hardware that you ordered. Below is a general list of what comes with the instrument.

Table 46 Basic tools and consumables

Tool or consumable	Used for
T10 Torx wrench	Replacing turret. Replacing syringe carriage.
T35 Torx wrench	Removing tray.
Sample vial starter pack	
Syringe, 10 µL	

Agilent also recommends ordering other useful supplies, listed in as needed.

Table 47 Additional ALS supplies and parts

Part number	Description
Crimpers and decappers	
5062-0207	11 mm electronic crimper with 4.8 V rechargeable battery pack and charger.
5062-0210	11 mm electronic decapper with 4.8 V rechargeable battery pack and charger.
5040-4667	Ergonomic manual crimper for 11 mm caps.
5040-4668	Ergonomic manual decapper for 11 mm caps.
5040-4674	11 mm electronic crimper, manual decapper, and cap bundle. Includes 1 electronic crimper, 1 manual decapper, 100 silvertone aluminum caps with PTFE/rubber septa.
Vial racks (7693A)	
9301-0722	Rack for 12 mm, 2 mL vials, holds 50 vials per rack. 5/pk.
5182-0575	Vial storage container, holds 50 vials per container.

Dimensions and Weight

Select the laboratory bench space before the system arrives. Pay special attention to the total height requirements. Avoid bench space with overhanging shelves. See Table 48.

Table 48 Required height, width, depth, and weight

Product	Height (cm)	Width (cm)	Depth (cm)	Weight (kg)
G4513A Injector	51	16.5	16.5	3.9
G4514A Tray[1]	29	44	43	6.8
G4515A Bar Code Reader[1]	not applicable	not applicable	not applicable	0.3
G4522A Cooling Accessory	not applicable	not applicable	not applicable	2.2 (plus water weight)
7650A Injector	51	22	24	4.5
Additional space requirements				
• GC with 7693A ALS injector		Requires 50 cm (19.5 in) above the GC		
• GC with 7693A ALS tray		Requires 45 cm (17.5 in) left of the GC		
• GC with 7650 ALS injector		Requires 50 cm (19.5 in) above the GC Requires 9 cm (3.6 in) in front of the GC Requires 3 cm (1.2 in) to the left of the GC		

1 The **G4520A** Tray with a bar code reader is available with a G4514A Tray and G4515A bar code reader.

Power Consumption

The ALS components draw power from the GC. No other power source is required.

Environmental Conditions

Operating the instrument within the recommended ranges optimizes instrument performance and lifetime. The sampler system operates in the same environment as its parent GC. See:

The conditions assume a noncondensing, noncorrosive atmosphere.

Table 49 Environmental conditions for operation and storage

Product	Conditions	Operating temp range	Operating humidity range	Maximum altitude
G4513A Injector G4514A Tray[1] G4515A Bar Code Reader[1]	Operation	0 to 40 °C	5–95%	4,300 m
7650 Injector	Operation	0 to 40 °C	5–95%	4,300 m

1 The **G4520A** Tray with a bar code reader is available with a G4514A Tray and G4515A bar code reader.

Chiller Supplies

If using the optional G4522A Cooling Accessory, you will need to supply:

- A water chiller
- Tubing and 1/8-inch Swagelok fittings to connect the chilled water and return water to the chiller
- A container or drain to dispose of condensate from the tray