Agilent 990
# Micro Gas Chromatograph

# User Manual

# Notices



## Manual Part Number

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## Safety Notices

**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 Introduction



This chapter provides important information about using the Agilent 990 Micro Gas Chromatograph, Micro GC, safely. To prevent any injury to you or any damage to the instrument, it is essential that you read the information in this chapter.

# Safety Information

## Important safety warnings

There are several important safety notices that you should always keep in mind when using the Micro GC.

WARNING

**When handling or using chemicals for preparation or use within the Micro GC, all applicable local and national laboratory safety practices must be followed. This includes, but is not limited to, correct use of Personal Protective Equipment, correct use of storage vials, and correct handling of chemicals, as defined in the laboratory's internal safety analysis and standard operating procedures. Failure to adhere to laboratory safety practices could lead to injury or death.**

## Hydrogen safety

Hydrogen is a commonly used GC carrier gas. When mixed with air, hydrogen can form explosive mixtures and has other dangerous characteristics.

WARNING

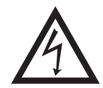
**When using hydrogen ($H_2$) as the carrier gas, be aware that hydrogen gas can create a fire or explosion hazard. Ensure that the supply is turned off until all connections are made.**

**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.**

- Hydrogen is combustible over a wide range of concentrations. At atmospheric pressure, hydrogen is combustible at concentrations from 4 % to 74.2 % by volume.
- Hydrogen has the highest burning velocity of any gas.
- Hydrogen has a very low ignition energy.
- Hydrogen that is allowed to expand rapidly from high pressure into the atmosphere can self-ignite.
- Hydrogen burns with a nonluminous flame which can be invisible under bright light.

# Safety symbols

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

| | |
|---|---|
| See accompanying instructions for more information. |  |
| Indicates a hot surface. |  |
| Indicates hazardous voltages. |  |
| Indicates earth (ground) terminal. |  |
| Indicates potential explosion hazard. |  |
| Indicates electrostatic discharge hazard. |  |
| Indicates a hazard. See the Agilent 990 GC user documentation for the item labeled. |  |
| Indicates that you must not discard this electrical/electronic product in domestic household waste |  |

# Safety and regulatory information

This instrument and its accompanying documentation comply with the CE specifications and the safety requirements for electrical equipment for measurement, control, and laboratory use (CEI/IEC 1010-1)CCSAUS and FCC-b.

This device has been tested and found to comply with the limits for a Class A digital device, pursuant to part 15 of the FCC rules. These limits are designed to provide reasonable protection against harmful interference when the equipment is operated in a commercial environment. This equipment generates, uses, and can radiate radio frequency energy and, if not installed and used in accordance with the instruction manual, may cause harmful interference to radio communications.

Operation of this equipment in a residential area is likely to cause harmful interference, in which case the user will be required to correct the interference at his own expense.

NOTE

**This instrument has been tested per applicable requirements of EMC Directive as required to carry the European Union CE Mark. As such, this equipment may be susceptible to radiation/interference levels or frequencies, which are not within the tested limits.**

# General safety precautions

To ensure safe equipment operation, follow these safety practices:

- Perform periodic leak checks on all supply lines and pneumatic plumbing.
- Do not allow gas lines to become kinked or punctured.
- Place lines away from foot traffic and extreme heat or cold.
- Store organic solvents in fireproof, vented, and clearly labeled cabinets so they are easily identified as either toxic, flammable, or both.
- Do not accumulate waste solvents. Dispose of such materials through a regulated disposal program and not through municipal sewage lines.

WARNING

**This instrument is designed for chromatographic analysis of appropriately prepared samples. It must be operated using appropriate gases or solvents and within specified maximum ranges for pressure, flows, and temperatures as described in this manual. If the equipment is used in a manner not specified by the manufacturer, the protection provided by the equipment may be impaired.**

WARNING

**It is the responsibility of the customer to inform Agilent customer support representatives if the instrument has been used for the analysis of hazardous samples, prior to any instrument service being performed or when an instrument is being returned for repair.**

- Avoid exposure to potentially dangerous voltages. Disconnect the instrument from all power sources before removing protective panels.
- When it is necessary to use a nonoriginal power cord and plug, ensure the replacement cord adheres to the color coding and polarity described in the manual and all local building safety codes.
- Replace faulty or frayed power cords immediately with the same type and rating.
- Place this instrument in a location with sufficient ventilation to remove gases and vapors.
- Ensure there is enough space around the instrument for it to cool off sufficiently.

- Before plugging the instrument in or turning the power on, always ensure that the voltage is set appropriately for your local power source.
- Do not turn on the instrument if there is a possibility of any kind of electrical damage. Instead, disconnect the power cord and contact your local Agilent sales office.
- The supplied power cord must be inserted into a power outlet with a protective ground connection. When using an extension cord, ensure that the cord is also properly grounded.
- Do not change any external or internal grounding connections, as this could endanger you or damage the instrument.
- The instrument is properly grounded when shipped. You do not need to make any changes to the electrical connections or to the instrument chassis to ensure safe operation.
- When working with this instrument, follow the regulations for Good Laboratory Practices (GLP). Wear safety glasses and appropriate clothing.
- Do not place containers with flammable liquids on this instrument. Spilling liquid over hot parts may cause fire.
- This instrument may use flammable or explosive gases, such as hydrogen gas under pressure. Before operating the instrument, know and follow prescribed operation procedures for the gases you use.
- Never try to repair or replace any component that is not described in this manual without the assistance of an Agilent service engineer. Unauthorized repairs or modifications will result in rejection of warranty claims.
- Always disconnect the AC power cord before attempting any type of maintenance.
- To prevent danger to you or damage to the instrument, use proper tools when working on the instrument.
- Do not attempt to replace any battery in this instrument, other than as specified in the manual.
- Damage can result if the instrument is stored under unfavorable conditions for prolonged periods. (For example, damage will occur if stored while subject to heat, water, or other conditions exceeding the allowable operating conditions).
- This unit has been designed and tested in accordance with recognized safety standards and is designed for use indoors.
- If the instrument is used in a manner not specified by the manufacturer, the protection provided by the instrument may be impaired.
- Substituting parts or performing any unauthorized modification to the instrument may result in a safety hazard.
- Changes or modifications not expressly approved by the responsible party for compliance could void the user's authority to operate the equipment.

# Shipping Instructions

If your Micro GC must be shipped for any reason, it is very important to always include the power supply.

# Cleaning

To clean the surface of the Micro GC:

1. Switch the Micro GC off.
2. Remove the power cable.
3. Put protection plugs on the sample inlets.
4. Put protection plugs on the column vents.
5. Use a soft brush (not hard or abrasive) to carefully brush away all dust and dirt.
6. Use a soft, clean cloth dampened with mild detergent to clean the outside of the instrument.
   - Never clean the inside of the instrument.
   - Never use alcohol or thinners to clean the instrument; these chemicals can damage the case.
   - Do not to get water on the electronic components.
   - Do not use compressed air to clean the instrument.

# Instrument Disposal

When the Micro GC or its parts have reached the end of their useful life, dispose of them in accordance with the environmental regulations that are applicable in your country.

# 2 Instrument Overview



The Agilent 990 Micro GC uses GC channels, each of which consists of a Dynamic Electronic Gas Control (DEGC) injector, column, and detector.

The Micro GC is a self-contained package with all of the normal GC components. It is a dual channel cabinet (one or two GC channels). Two cabinets can be connected to form a quad channel system (up to four GC channels). A computer with a chromatography data system (CDS) is needed to complete the system.

This chapter provides a brief overview of the Agilent 990 Micro GC.

# Principle of Operation

The Agilent 990 Micro GC can be equipped with one or two independent column channels. Each column channel is a complete, miniaturized GC with dynamic electronic gas control, micro-machined injector, narrow-bore analytical column, and micro thermal conductivity detector (μ TCD), **Figure 1**.

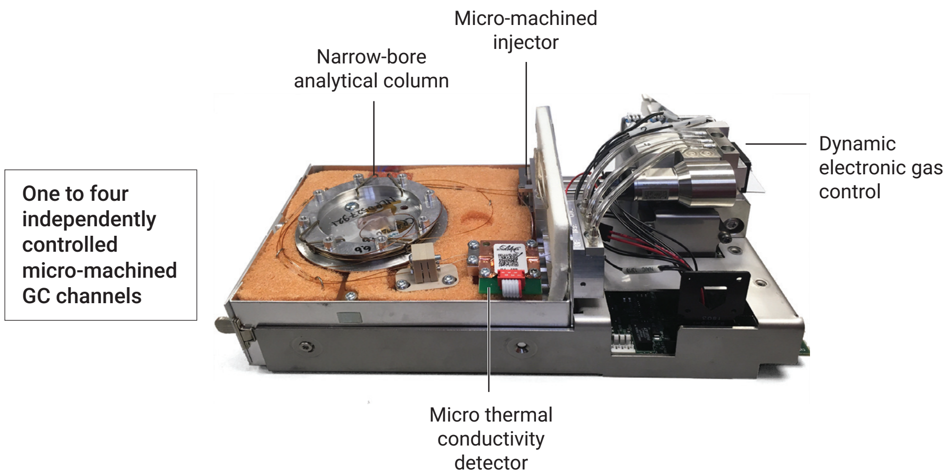



Figure 1. Agilent 990 Micro GC setup

Each Agilent 990 Micro GC cabinet has two analytical channel slots. Two cabinets can be combined to support four analytical channels simultaneously. For a three or four channel configuration, a channel extension cabinet can be connected to the Micro GC.

The Agilent 990 Micro GC analytical channels can optionally be equipped with a backflush option. The advantages include the protection of the stationary column phase against moisture and carbon dioxide. Also, the backflush option results in shorter analysis times as late elution compounds, which are not of interest, do not enter the analytical column.

# Front View

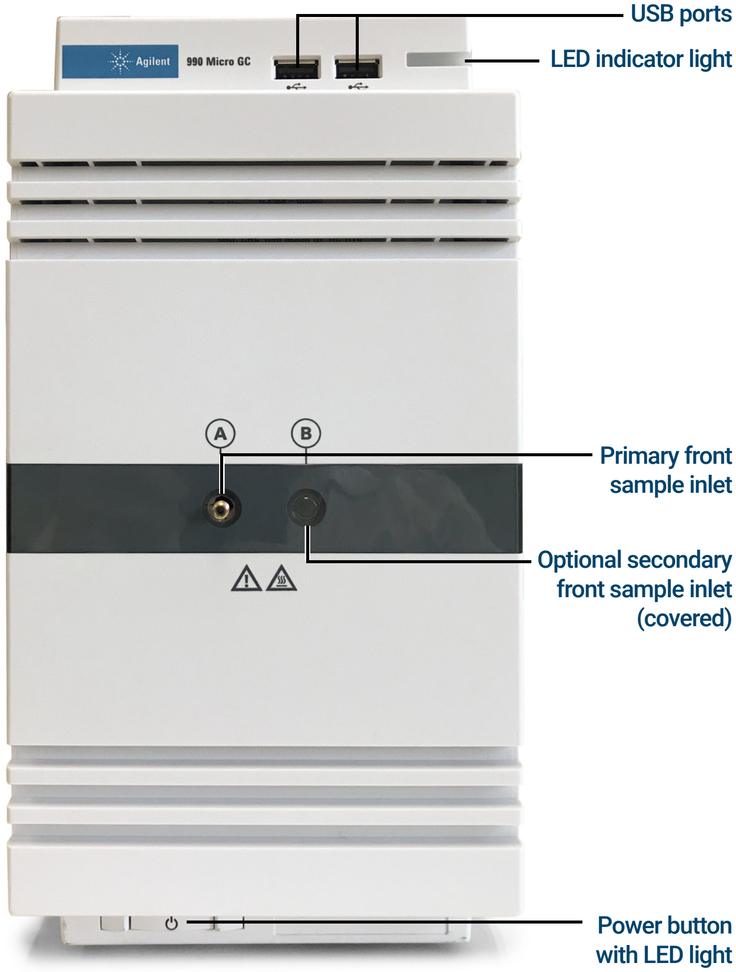



Figure 2. Front view of the Agilent 990 Micro GC

The LED indicator light has color states as described in **Table 1**.

### Table 1 LED state definitions

| LED state | Indication |
|---|---|
| Red - solid | Recoverable error. |
| Red - blinking | Critical error |
| Yellow - solid | System in **not ready** or **stabilizing** status. |
| Yellow - blinking | System in **flushing** or **column cleaning** status. |
| Green - solid | System in **ready** status:<br>All heated zone, column head pressure, and TCD statuses are within **ready** window. |
| Green - blinking | System in **run** status. |

# Front inside view

Unscrew and remove the front cover to view the channel cases and pump box.
See **Removing the Covers** on page 94.

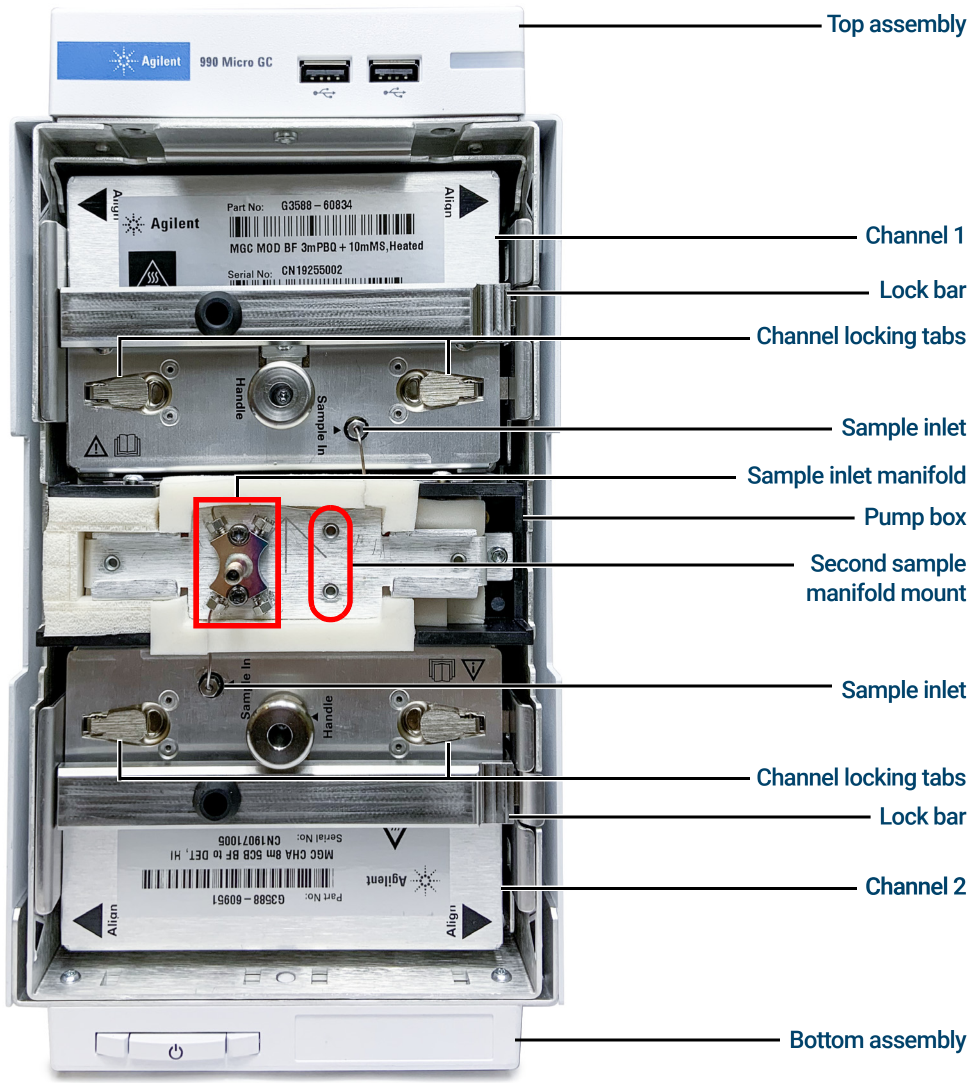



Figure 3. Front inside view of the Agilent 990 Micro GC

# Rear View

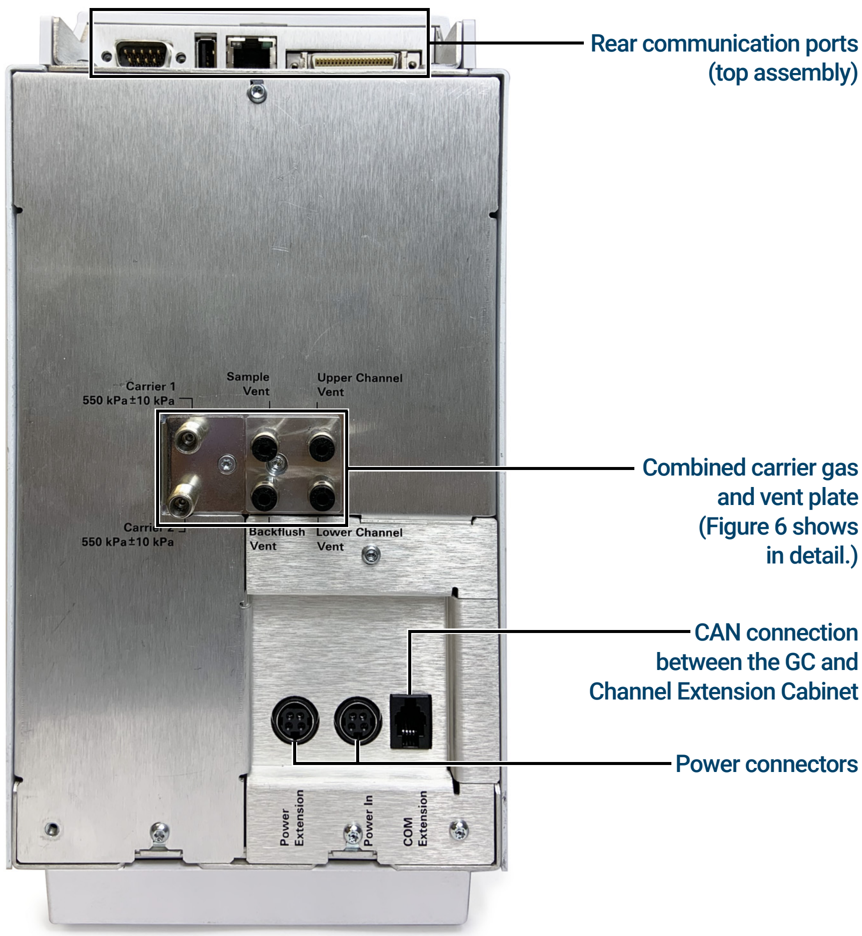



Figure 4. Rear view of the Agilent 990 Micro GC

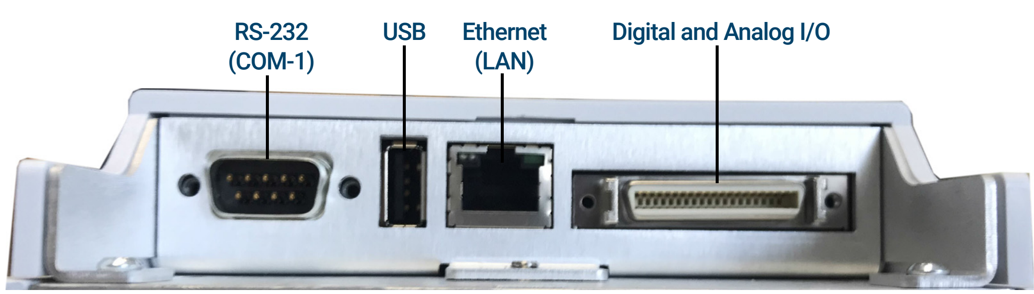



Figure 5. Rear communication ports of the Agilent 990 Micro GC top assembly

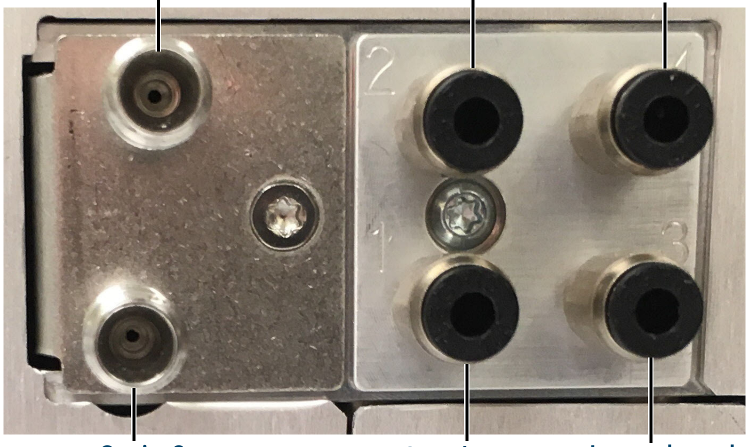



Figure 6. Combined carrier gas and vent plate

# Rear inside view

To view the interior, unscrew and remove the rear covers. See **Removing the Covers** on page 94.

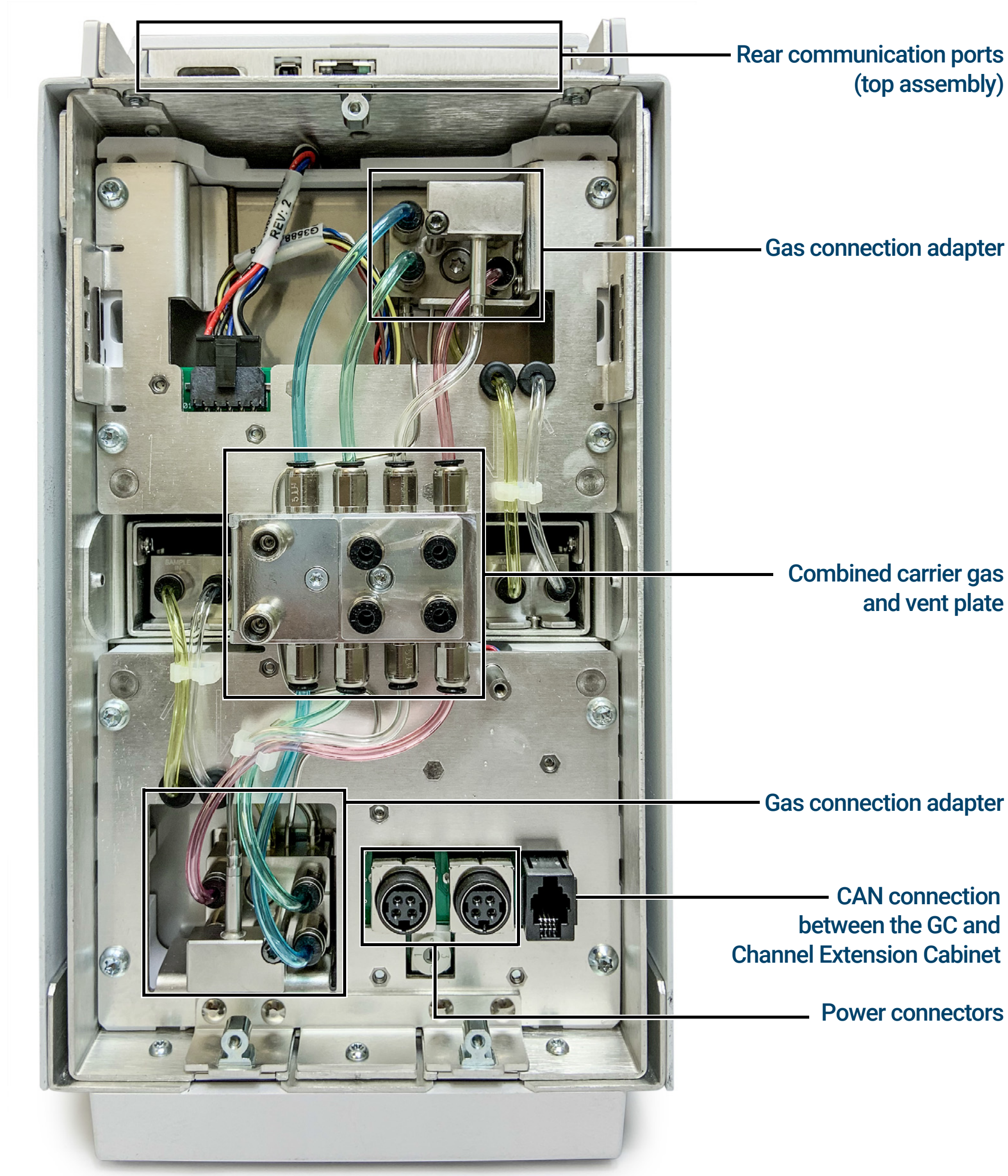



Figure 7. Rear inside view of the Agilent 990 Micro GC

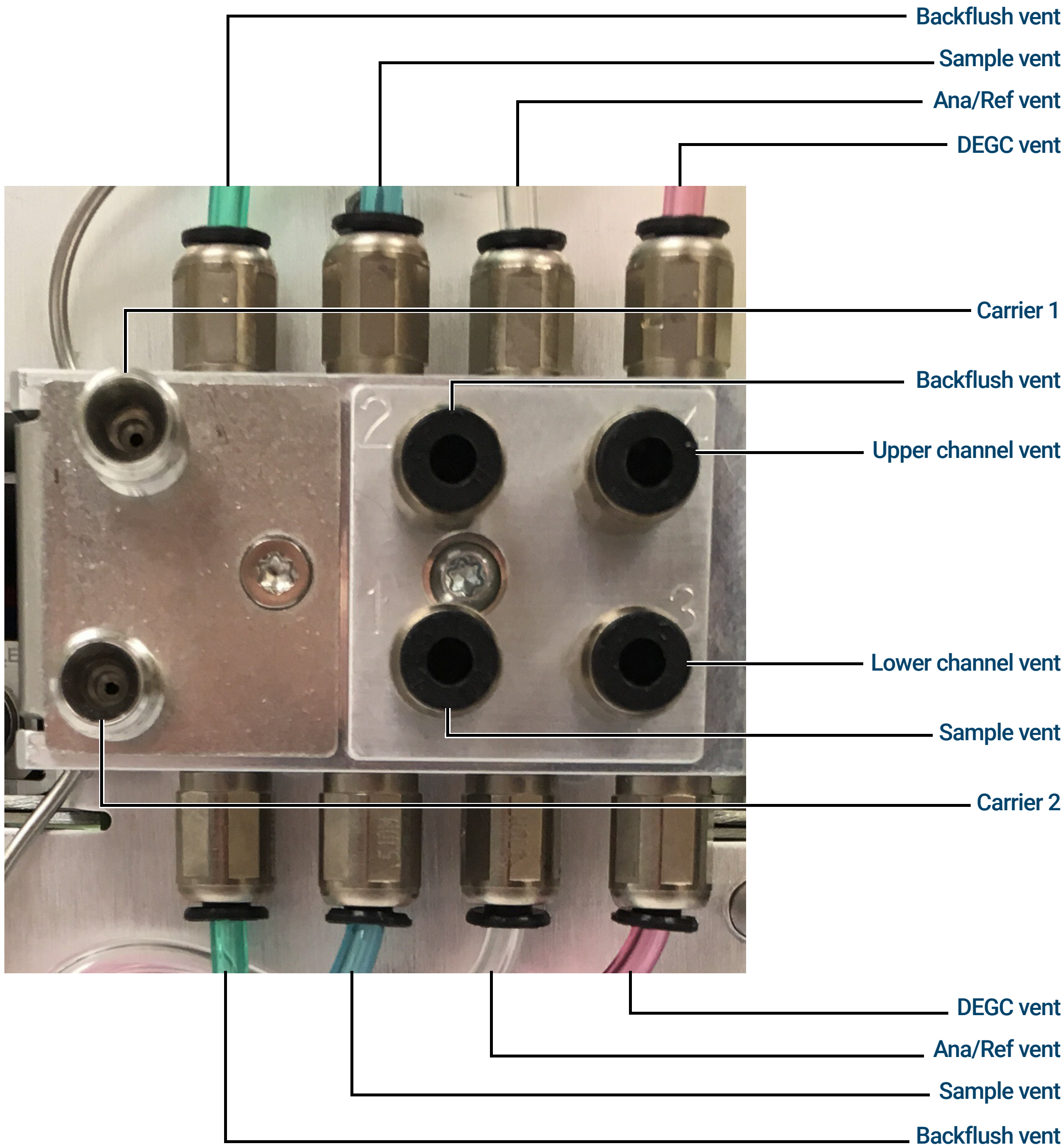



Figure 8. Combined carrier gas and vent plate, exposed view

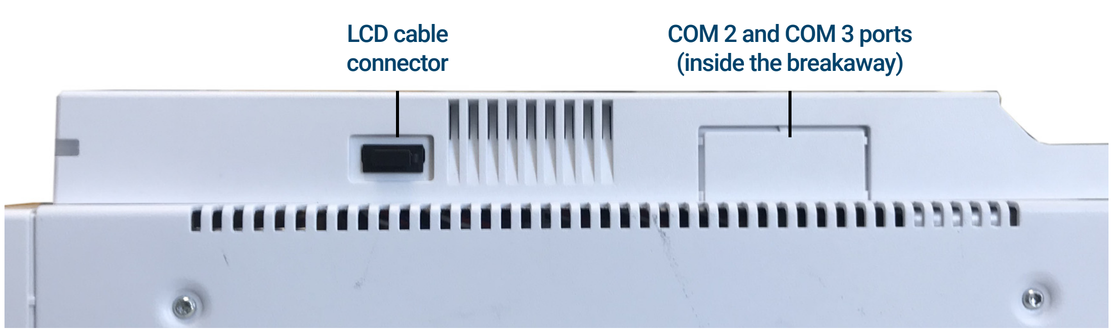



Figure 9. Top assembly LCD cable connector and port connection for COM 2 and COM 3

# Communication Ports

The Agilent 990 Micro GC licenses support communications ports as shown in **Table 2**.

**Table 2 Micro GC communication ports by license**

| Port | Connection | 990 Micro GC | 990 Micro GC (Express license) | 990 Micro GC (PRO license) |
|---|---|---|---|---|
| LAN | Ethernet | Interface with PC | Interface with PC | Interface with PC,<br>Modbus TCP |
| COM1 | RS-232 | VICI Valve | VICI Valve | VICI Valve,<br>Modbus |
| COM2 and COM3[*] | RS232<br>RS422<br>RS485 2-wire<br>RS485 4-wire | Not available | Not available | Modbus |
| Digital and Analog I/O | Y cable[†] and Extension boards | On board I/O:<br>Start in/out<br>Ready in/out<br>Relay outs<br>Extension boards[‡]:<br>Basic board<br>Digital board | On board I/O:<br>Start in/out<br>Ready in/out<br>Relay outs<br>Extension boards[‡]:<br>Basic board<br>Digital board | On board I/O:<br>Start in/out<br>Ready in/out<br>Relay outs<br>Digital ins<br>Analog ins<br>Extension boards[‡]:<br>Basic board<br>Digital board<br>Analog board |
| HDMI | HDMI | LCD touch screen[**] | LCD touch screen[**] | LCD touch screen[**] |
| USB | USB | VICI Valve[††],<br>WIFI interface[‡‡] | VICI Valve[††],<br>WIFI interface[‡‡],<br>USB storage,<br>License dongle | VICI Valve[††],<br>WIFI interface[‡‡],<br>USB storage,<br>License dongle |
| CAN | CAN | Channel Extension[***] | Channel Extension[***] | Channel Extension[***] |

* The breakaway on the side of the top assembly must be removed. See **Figure 46** on page 112.

† 'Y' cable (P/N G3588-60825) is available.

‡ Standard and 990 Micro GC (Express) supports extension board only by working with Agilent OpenLab software. 990 Micro GC (PRO) supports more advanced usage of extension boards (refer to the 990 PROstation User Manual).

** Optional accessory (P/N G3588-68862).

†† Requires USB-to-RS232 converter.

‡‡ Recommended for instrument web view

*** See **Connecting a Channel Extension Cabinet** on page 24.

# Connecting a Channel Extension Cabinet

Two cabinets can be connected for an instrument equipped with up to four GC channels. For detailed information, see the “Agilent 990 Micro GC Channel Extension Cabinet Installation Manual” (p/n G3588-90017).


Figure 10. Front view of two GC channel cabinets connected


Figure 11. Rear view of two GC channel cabinets connected

# Carrier Gas Connection

The carrier gas line is connected to the Micro GC at the back panel **Carrier 1** or **Carrier 2** port.

CAUTION

**Do not use any kind of plastic tubing since air will diffuse through the tubing, which may cause noisy baselines and decreased sensitivity. The metal tubing must be clean for GC use. Buy either flamed or chromatographically clean tubing.**

Specifications for the carrier gas:

| | |
|---|---|
| **Pressure:** | 550 kPa ±10 kPa (80 psi ±1.5 psi) |
| **Purity:** | 99.999 % minimum |
| **Dry and free of particles:** | Gas Clean filters recommended |

Gas Clean filters are recommended to remove any traces of moisture and oxygen. For low-level analysis, consider using a better grade of carrier gas.

Gas Clean filters are filled with nitrogen. If you are not using nitrogen as the carrier gas, flush filters and gas lines after installation of a new filter.

The type of analysis you want to perform dictates the type of carrier gas to use. The difference between the relative thermal conductivity of the carrier gas and the sample components should be as high as possible. See **Table 3** for several relative thermal conductivities.

**Table 3 Relative thermal conductivities**

| Gas type | Relative thermal conductivities | Gas type | Relative thermal conductivities |
|---|---|---|---|
| Hydrogen | 47.1 | Ethane | 5.8 |
| Helium | 37.6 | Propane | 4.8 |
| Methane | 8.9 | Argon | 4.6 |
| Oxygen | 6.8 | Carbon dioxide | 4.4 |
| Nitrogen | 6.6 | Butane | 4.3 |
| Carbon monoxide | 6.4 | | |

WARNING

**Your Micro GC is configured for a specific carrier gas, either He and $H_2$ or $N_2$ and Ar. Ensure that any carrier gas selection in your Agilent data system corresponds to the carrier gas physically connected to your Micro GC. Use only the carrier gas corresponding to this configuration. If you change the carrier gas type plumbed to the Micro GC, you must change the corresponding carrier gas type in the data system.**

WARNING

**Hydrogen is flammable. If you are using hydrogen as a carrier gas, pay particular attention to possible leaks at connections inside and outside of the Micro GC. Use an electronic leak tester.**

# Power

## Power source

- 90 to 264 Vac, frequency between 47 to 63 Hz.
- The room power outlet circuit must be exclusively reserved for the instrument(s).
- The network should be properly grounded.
- Installation Category (overvoltage category): II

## Power requirements

The Micro GC requires 12 Vdc, 180 W.

**CAUTION**

**Only use the power supply provided with your Micro GC.**

This Power Supply, see **Figure 12**, is tailored to meet the power needs of your Micro GC. See **Table 4** on page 28 for specifications.


Figure 12. Model GST220A12-AG2 (p/n G3588-67024)

# Disposal

Disposal of the Power Supply must be carried out in accordance with all environmental regulations applicable in your country.

# Specifications

**Table 4 Power supply specifications**

| Feature | Model: GST220A12-AG2 |
|---|---|
| Input voltage | 100 Vac to 240 Vac |
| Input frequency | 50-60Hz |
| Inrush current | 120A/230VAC |
| Output voltage | 12.0 Vdc |
| Output power | 180 W |
| Over voltage protection | 105 %-135 % rated output voltage |
| Ripple and noise | 80mV Vp-p |
| Operating temperature | -30 °C to +70 °C |
| Storage temperature | -40 °C to +85 °C |
| Humidity | 20 % to 90 % noncondensing |
| Safety standard | UL60950-1, TUV EN60950-1, BSMI CNS14336, CSA C22.2, CCCGB4943, PSE J60950-1 Approved |
| RFI/EMC standard | In compliance with CISPR22 (EN55022) Class B and FCC Part 15/CISPR 22 class B, CNS13438 class B, GB9254, EN61000-3-2, EN61000-3-3, EN61000-4-2, EN61000-4-3, EN61000-4-4, EN61000-4-5, EN61000-4-6, EN61000-4-8, EN61000-4-11 (light industry level, criteria A) |
| Dimensions | 210 × 85 × 46 mm (L×W×H) |
| Weight | 1.1 kg approximately |

# Ambient Pressure

The Micro GC automatically shuts down if the ambient pressure is greater than 120 kPa for a standard Micro GC, or is greater than 110 kPa for the Energy meter version.

# Ambient Temperature

The operating temperature for the Micro GC is 0-50 °C. The Micro GC automatically shuts down if the ambient temperature exceeds 70 °C.

# Maximum Operation Altitude

Certified up to 2,000 meters above sea level.

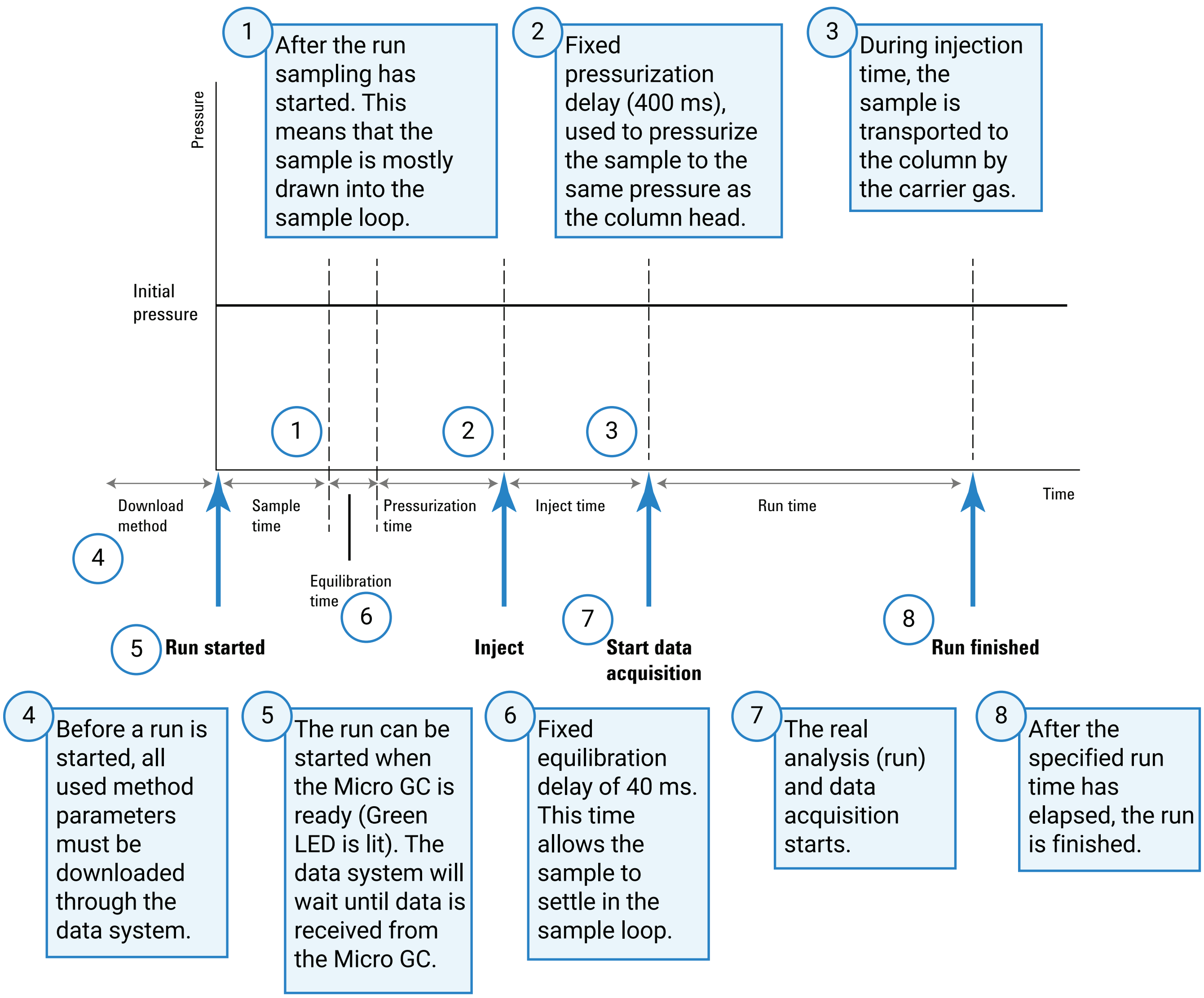
# Storage requirements

- **Humidity:** 10 % to 95 % RH (noncondensing)
- **Temperature:** –40 to +70 °C

# Micro GC Cycle with Constant Pressure

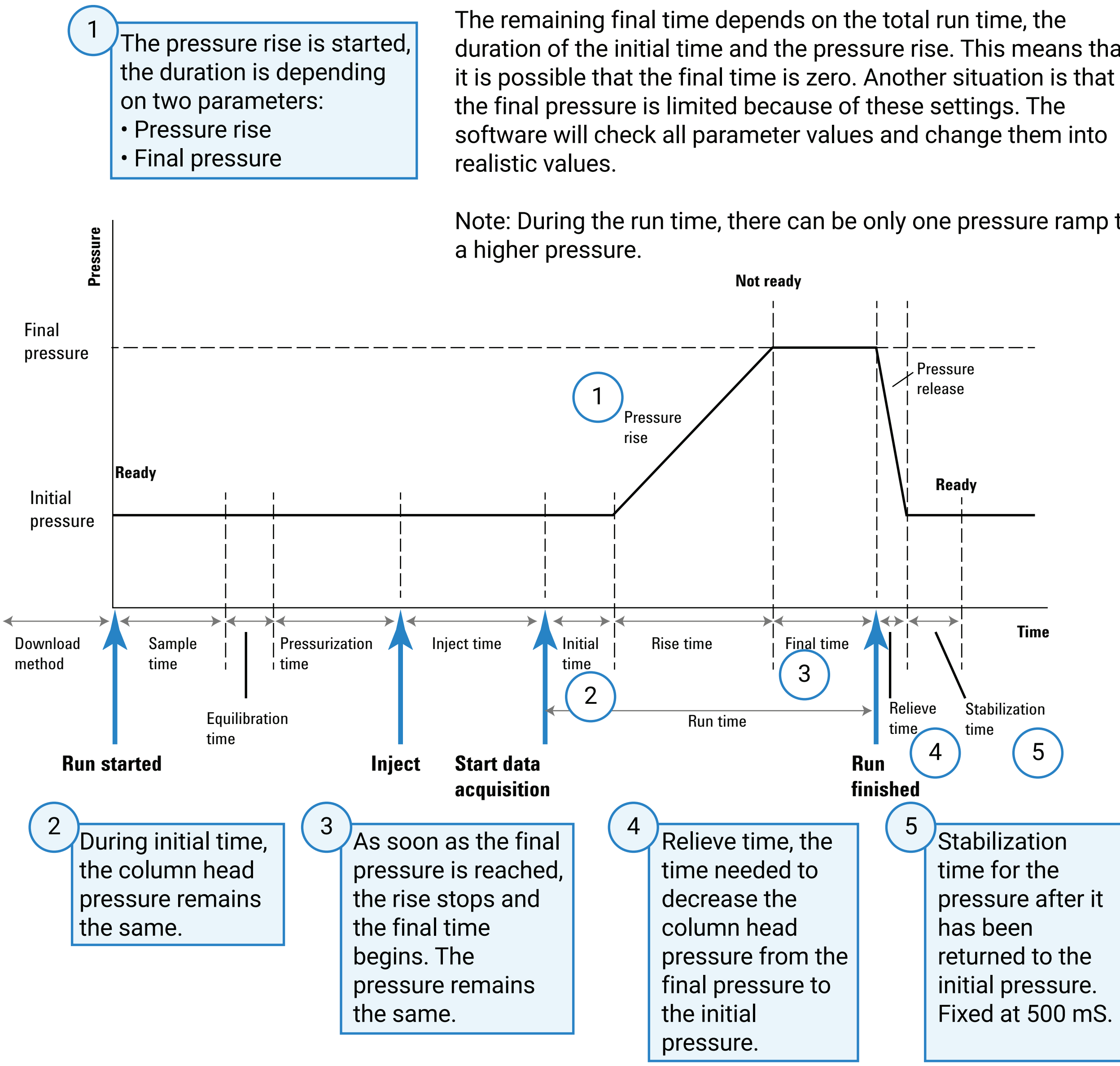
The timing diagram below provides an overview of the constant pressure cycle of the Micro GC.

This description is only for one channel. In most cases, a dual-channel system is used. When a dual-channel system is used, the sequence is the same, but the timing settings can differ. If the sample time on channel A and channel B are different, the longest time is used for both channels. Also the run time can be specified per channel; the data acquisition stops per channel as soon as the run time has elapsed. The total analysis time depends on the longest run time.



# Micro GC Cycle with Ramped Pressure

The timing diagram below provides an overview of the ramped (programmed) pressure cycle of the Micro GC. The timing before the injection is identical to the constant pressure cycle.



# 3 Installation and Use



This chapter describes how to install and use the instrument. For an initial installation, an example of a typical packing list is also included. The actual packing list and included parts depend on the options ordered.

# Pre-Installation Requirements

Prepare the installation site as described in the Site Preparation Guide (G3581-90002), including the recommended Gas Clean filters.

# Inspect the Shipping Packages

The Micro GC will arrive in one large box and one or more smaller cartons. Inspect the cartons carefully for damage or signs of rough handling. Report damage to the carrier and to your local Agilent office.

# Unpack the Micro GC

Unpack the Micro GC and accessories carefully, and transfer them to the work area using proper handling techniques. Inspect the instrument and accessories carefully for damage or signs of rough handling. Report damage to the carrier and to your local Agilent office.

WARNING **Avoid back strain or injury by following all safety precautions when lifting heavy objects.**

# Review the Packing List

**Table 5** shows a typical packing list. The actual packing list and included parts depend on the options ordered. **Figure 13** on page 35 shows the contents of the typical package shipped with the Agilent 990 Micro GC.

**Table 5 Typical Micro GC packing list**

| No.* | Part number | Item | Quantity | Units of measure |
|---|---|---|---|---|
| 1 | 2815892301 | Polyurethane, 1/16 in × 1/8 in × 25 ft, clear tubing | 1 | RL |
| 2 | CP740292 | Ethernet cross Cable yellow 2.8 mtr | 1 | EA |
| 3 | CP736879 | Capil. Ext. Filter | 1 | EA |
| 4 | CP736729 | External Sample Filter Kit | 1 | EA |
| 5 | G3588-90001 | 990 Micro GC User Information CD | 1 | EA |

* See **Figure 13**.


Figure 13. Contents of the Agilent 990 Micro GC shipping kit.

# Agilent 990 Micro GC Installation

If you are installing the Agilent 990 Micro GC for the first time, follow the steps as described below.

If you are performing a reinstallation, see **Long Storage Recovery Procedure** on page 41.

## Step 1: Connect carrier gas

### Install gas regulators and set pressures

Carrier gas cylinders should have a two-stage pressure regulator to adjust the carrier gas pressure to 550 kPa ±10 kPa (80 psi ±1.5 psi). Set cylinder regulator pressure to match the gas inlet pressure.

### Connect carrier gas to the Micro GC

The Agilent 990 Micro GC supports the use of helium, nitrogen, argon and hydrogen. The carrier gas configuration is on the rear panel. The minimum recommended purity for carrier gas is 99.999 %. Connect the carrier gas to the Micro GC **Carrier 1** fitting and **Carrier 2** fitting, if available. Turn on the gas flow. See **Carrier Gas Connection** on page 26.

## Step 2: Connect to calibration gas or checkout sample

Install the external filter unit as described in **Using the External Filter Unit** on page 47.

Connect the sample to the heated sample inlet as described in **Connecting a Sample to the 990 Micro GC** on page 49.

## Step 3: Install power supply

Connect the power connector to the Agilent 990 Micro GC, and then plug the power cord into an appropriate power source. See **Power** on page 27. Ensure that the power supply is placed within easy reach of the operator, as it functions as a power disconnect switch.

The green LED lights when all parameter set points in the system are reached. (See **Front View** on page 17.)

Your Micro GC is shipped from the factory with default settings. These events take place within the Agilent 990 Micro GC when power is activated for the first time:

1. When the Micro GC is turned on, the system begins the flush cycle procedure. The status light will flash yellow during the flush. The flush cycle is a two minute cycle in which the various valves are activated and deactivated to flush entrapped air from the manifold, valves, and tubing.
2. The default method is activated after the flush cycles finishes.
3. All heated zones are set at 30 °C.
4. The detector filaments are set to OFF.

# Step 4: Connect to computer or local network

Initial method development on the Agilent 990 Micro GC requires a connection to a computer running a Chromatography Data System. This connection uses TCP/IP over Ethernet or Wi-Fi through USB. For more details and setup procedures see **Ethernet Networks** on page 116 or **USB Wi-Fi** on page 120.

# Step 5: Install the Chromatography Data System

For instructions about installation of the chromatography data system, see the corresponding installation manual and help file.

# Step 6: Assign an IP address

The Agilent 990 Micro GC has a default static IP address assigned when first delivered. The default IP address is specified on the sticker together with the MAC address and the mainboard serial number (see **Table 6**).

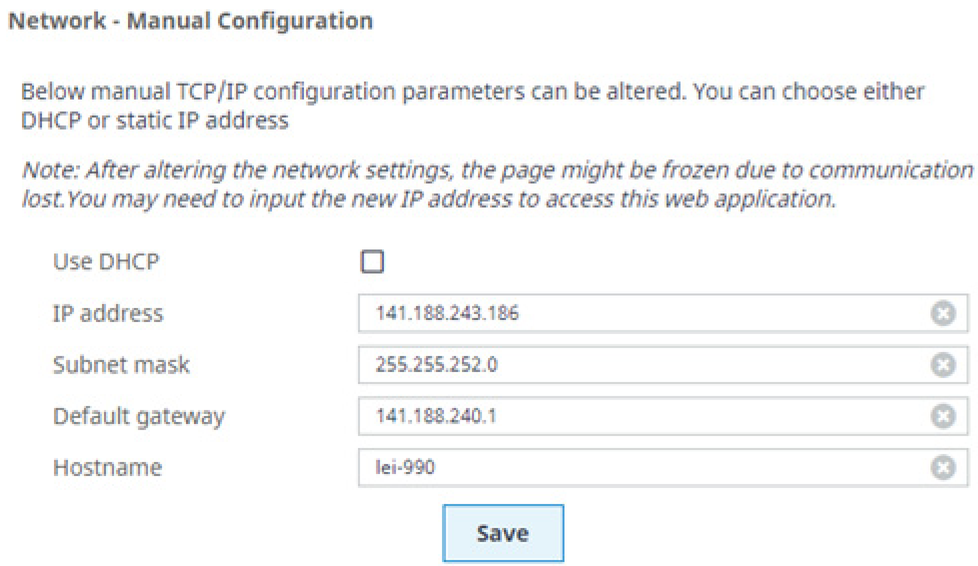
**Table 6 Factory default IP address settings**

| Setting | Factory default |
|---|---|
| IP address | 192.168.100.100 |
| Subnet mask | 255.255.255.0 |
| Host name | microgc |
| Default Gateway | N/A (not used) |

### To assign an IP address:

1. Change the IP address of your laptop or PC to an address in the same range as the current IP address as the Micro GC. For example, 192.168.100.101.
2. Start up your web browser.
3. Type the IP address of the Micro GC in the address field of the web browser to connect to the Agilent 990 Micro GC's website.
4. On the web page, click **Maintenance > Network**.
5. Click the login button on top right corner. Use the factory default login and password:
   - Login name: **service**
   - Password: **agilent**

6 Type the IP Address, Subnet mask, and Default gateway you want to assign to the Micro GC in the corresponding fields in the center of the network web page.




7 To save the IP configuration, click **Save**.

8 This IP address is now the active IP address. Because the IP address of the Agilent 990 Micro GC has changed as intended, communication with the Agilent 990 Micro GC will be lost until the new IP address is accessed.

9 Change the IP address of your laptop or PC to an address in the same range as the new IP address of the Micro GC.

10 To reestablish communication between your laptop or PC and the Agilent 990 Micro GC, type the new IP address in the web browser address bar.

NOTE

**If the IP address is unknown or forgotten, connect the laptop or PC to 192.168.10.10, the fixed IP address of the instrument, which is always accessible and cannot be changed by the users. Then another IP address can be assigned by repeating the steps above. Do not use the IP 192.168.10.10 to run the instrument directly.**

# Step 7: Complete Agilent 990 Micro GC configuration in the Chromatography Data System

1 If not already configured, complete any additional configuration for the Micro GC in the Chromatography Data System. Ensure the carrier gas types match the gas actually supplied to the Micro GC.

2 Start the Micro GC's online instrument session.

# Create the Test Method

Use a test method to perform a checkout at first startup to ensure the Agilent 990 Micro GC is functioning properly.

A test method for each standard column type has been provided in the sections listed in **Table 7**.

**CAUTION**

**If your system contains one or more Molesieve columns, ensure it is conditioned before use. See Table 15 on page 65 for parameters.**

**Table 7 Test method listings**

| Column type | Channel parameter table |
| --- | --- |
| Molsieve 5Å | **Table 15** on page 65 |
| CP-Sil 13 CB | **Table 16** on page 66 |
| CP-Sil 19 CB | **Table 17** on page 67 |
| PoraPlot 10 m | **Table 18** on page 68 |
| Hayesep A 40 cm | **Table 19** on page 69 |
| COx 1 m and AL2O3/KCl | **Table 20** on page 70 |
| MES(NGA) and CP-WAX 52 CB | **Table 22** on page 72 |

Use the data system to set up the checkout parameters for each GC channel. Apply the checkout method settings to the Micro GC, and allow the instrument to stabilize at the initial operating conditions. Monitor the instrument status using the data system's status display (refer to the data system help for details).

Each test method has been designed to determine if the instrument channel is functioning properly, and includes an example test chromatogram.

# Perform a Series of Runs

1 Create a short sequence of at least three runs using the test sample and method.
2 Run the sequence.
3 After the first run, the results for each channel should become similar to the example chromatograms.

# Shut Down Procedure

**CAUTION**

**The detector can be damaged by improper shut down. If shutting down the instrument for more than a few days, carry out the procedure below.**

1 Create a method for all channels with these settings:
   - Filaments switched OFF.
   - Column temperature set at 30 °C.
   - Injector temperature set at 30 °C.
   - Pressure set at 50 kPa.
2 Apply the method to the Micro GC.
3 Wait until the temperature of the columns and injectors are < 40 °C (to protect the column), then switch off the Micro GC.
4 Remove the carrier gas tubing and plug all the vents and carrier gas connections with 1/8-inch brass nuts or plastic caps.

Before using the instrument again, perform the “Long Storage Recovery Procedure” described below.

# Long Storage Recovery Procedure

Follow this recovery procedure if your Micro GC has been stored for a long period of time.

1 Remove the 1/8-inch brass nuts and plastic caps from all of the vents and carrier gas connections.
2 Connect the carrier gas tubing and apply pressure to the Micro GC. Refer to the Site Preparation Guide for supply pressures and other gas requirements.
3 Wait at least 10 minutes before switching ON the Micro GC.
4 Immediately check if the detector filaments are switched OFF. Switch OFF if necessary.
5 Set Injector temperature to 80 °C when conditioning the column.
6 Condition the GC column, preferably overnight. This will ensure that all the water has been removed from the column module, and no damage will occur to the TCD filaments. For more information, see **Column conditioning** on page 73.

# 4 Sample Gas Handling



The Micro GC is built for the analysis of gases and vapors only. You are advised to prepare a noncondensing gaseous standard sample for routine checkup of the instrument. Sample pressure should be between 0 and 100 kPa (0 to 15 psi), the temperature between 0 and 110 °C, and it must be filtered, preferably through a 5-mm filter. Agilent always recommends the use of the external filter kit (CP736729) between the injector and the sampling device.

For more details, see **Using the External Filter Unit** on page 47.

**CAUTION**

**Liquids in sample gases must be avoided because they will critically damage the instrument.**

# Installing Sample Inlets

Each Agilent 990 Micro GC can be outfitted with two sample inlets for up to two types of sample.

Each hexagonal sample inlet mainfold has one inlet port and four output ports.

- **Front Injection**- The external tubing for sample is connected directly from the front of the GC without going through accessories. The inlet port is at center of the manifold.

Figure 14. Sample inlet manifold

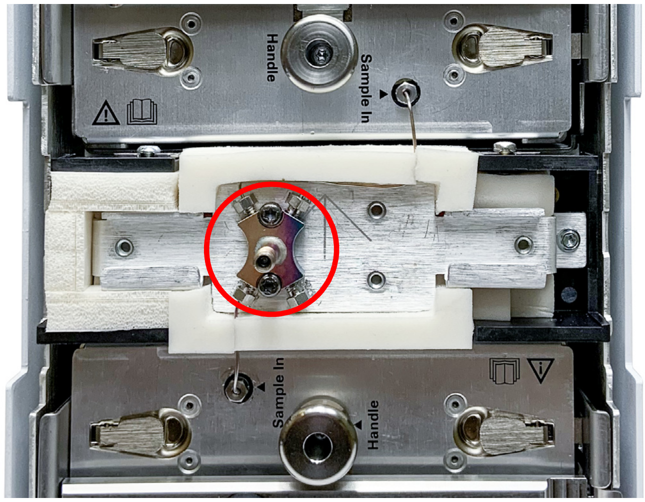
## Installing and configuring a sample inlet manifold

There are many configurations for inlet tubing. The following steps outline the process of installing the sample inlet manifold with one channel. See the section **Sample inlet configurations** on page 46 for more information.

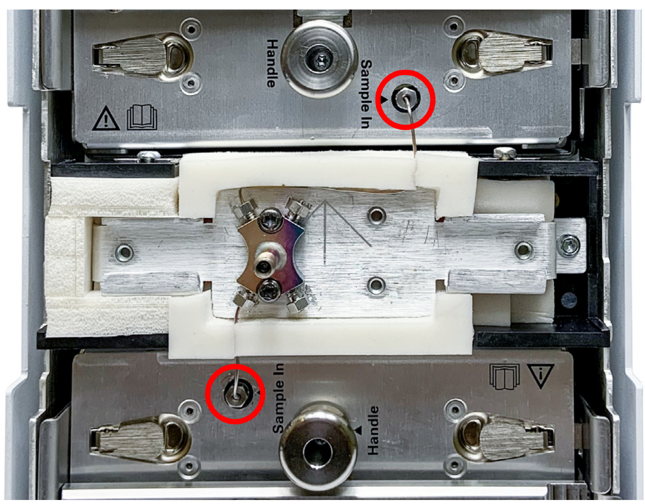
1 Unscrew and remove the Torx T-10 screw at the top of the front cover, and remove the front cover.

2 Connect sample inlet tubing to the Hexagonal Sample Inlet Manifold (p/n G3588-60662).

3 Using two Torx T-10 screws, attach the Hexagonal Sample Inlet Manifold to the front of the Pump Assembly in the position shown below.




4 Connect sample inlet tubing to the GC Channel.



# Sample inlet configurations

There are many sample inlet configurations possible with the Agilent 990 Micro GC. The following images include configurations using one and two GC units.

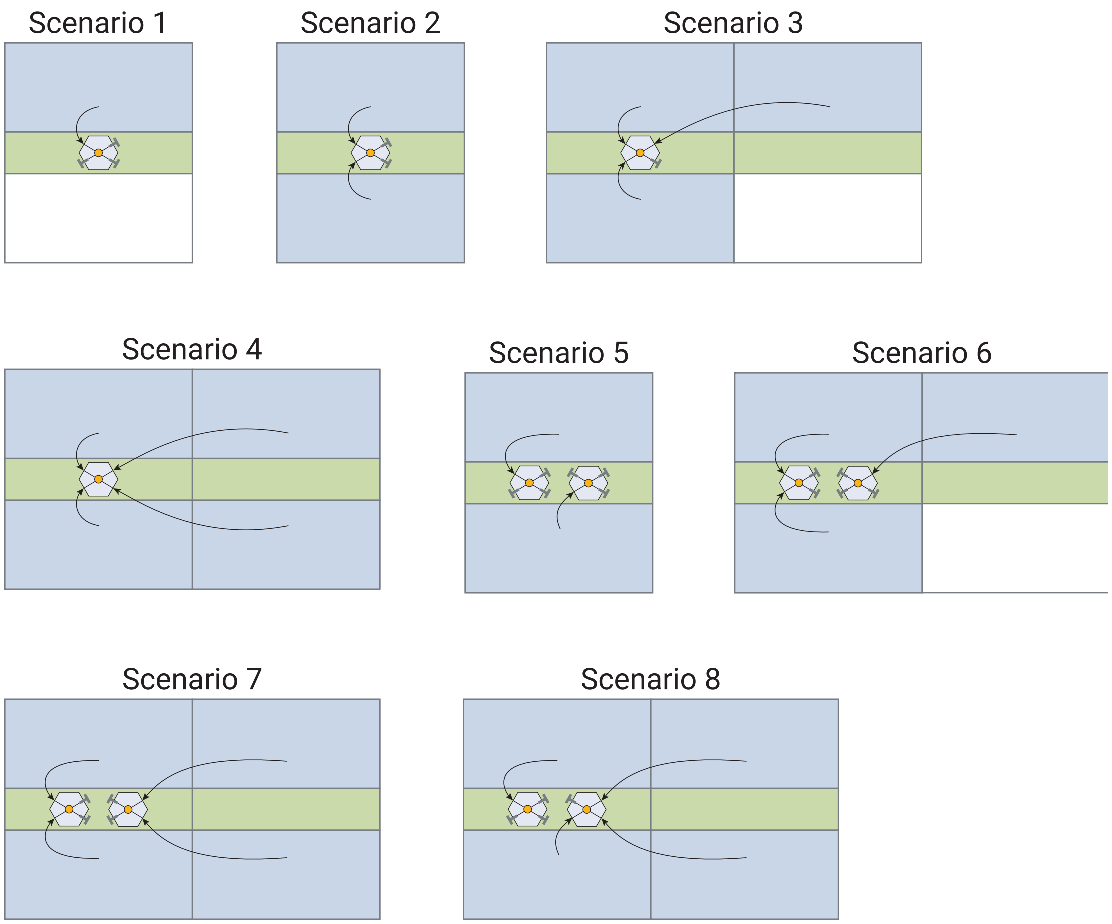



Figure 15.  Sample inlet configurations

# Using the External Filter Unit

The male part of the filter must be hand-tightened into the female part, followed by a 1/8 turn with a 7/16-inch wrench. See **Figure 16**. Orient the arrow on the female half of the filter toward the fingertight fitting.

Replace the external filter unit at regular intervals. See **Review the Packing List** on page 35 for part numbers.

For more information about the external filer, please refer to External Sample Filter Manual (p/n G3588-90018).

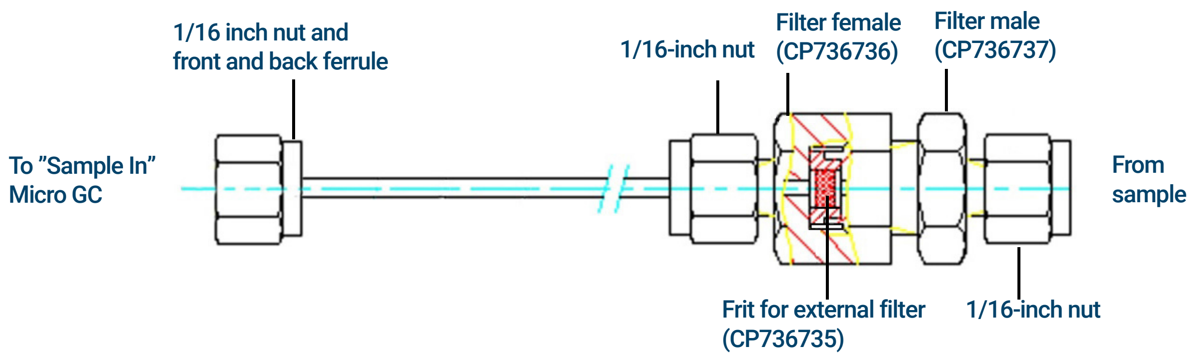



Figure 16. Heated injector connection

Whenever possible, remove moisture from samples introduced to the Micro GC.

# Heated Zones

The heated zones in the 990 Micro GC can be categorized into unit level heated zone and channel related heated zone. Unit level heat zone is for sample inlets heating, and to keep the sample line heated without cold spots between the column module and sample inlet. The heated zone prevents the sample from condensing in the sample lines when analyzing condensible samples.

Channel related heated zone includes injector, column, and channel sample line. There is no unheated injector for the 990 Micro GC. The injector heater can be disabled by the user if necessary and made to work in unheated mode.

**Table 8 Summary of 990 Micro GC heated zones**

| Heated zone | Temperature set point range (°C) | Set point resolution (°C) | Temperature stability | Actual working temperature range (°C) | Maximum power/W |
|---|---|---|---|---|---|
| Injector | 30-110 | 1 | ±1 °C | Ambient temperature + 15 | 6-7 W |
| Column | 30-180* | 1 | ±0.2 °C | Ambient temperature + 15 | 8-9 W |
| Sample line† | 30-110 | 1 | N/A | Ambient temperature + 15 | 3 W |
| Sample inlet | 30-110 | 1 | ±2 °C | Ambient temperature + 15 | 10 W |

* Maximum temperature depends on the column type.

† **Note:** The sample line temperature is not settable by the user. It is determined by the set point of the injector temperature.

# Connecting a Sample to the 990 Micro GC

The following sections describe how to connect your sample to the 990 Micro GC depending on the sample inlet configuration.

WARNING

**The metal surfaces of the sample inlet heater can be very hot. Before connecting a sample, allow the sample inlet heater to cool down to ambient temperature.**

## Front inlet

Connect the tubing for sample to the sample inlet at the front of the Micro GC using 1/16-inch Swagelok nuts.

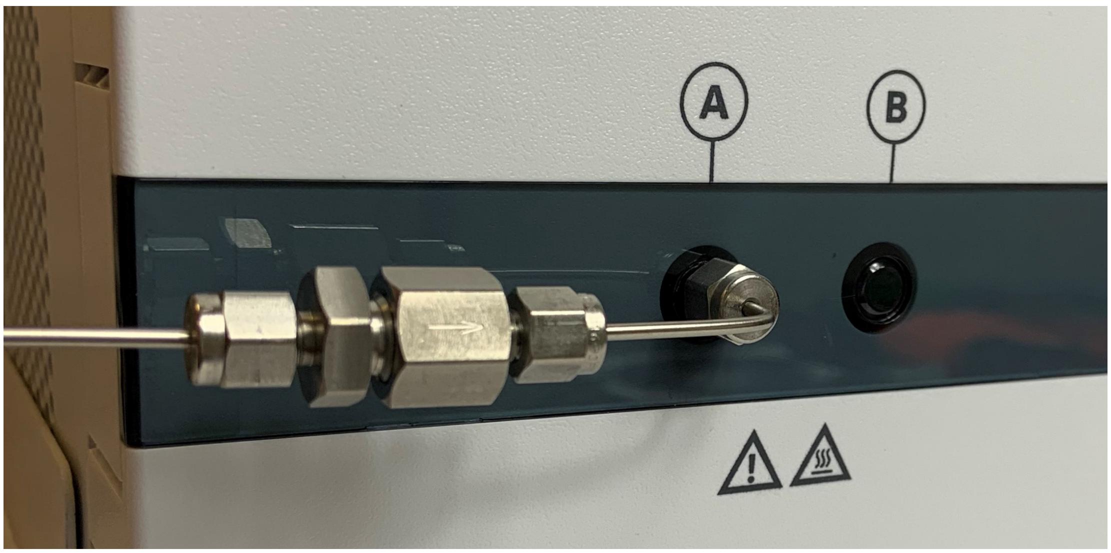



Figure 17. Front Sample Inlet

## Connecting sample inlet accessories

### Connecting the micro-gasifier

Install the micro-gasifier, and connect the micro-gasifier sample line to the internal sample inlet using a 1/16-inch Swagelok fitting. Please refer to the Micro GC Micro Gasifier User Manual (p/n G3535-90000).

### Connect the Genie Filter to the Micro GC

Please refer to the Genie Filter Installation Guide (p/n G3588-90019).

CAUTION

**Ensure separated liquids are properly drained through the bypass tubing outside of the Micro GC. To operate properly, the bypass must remain free of blockage.**

# 990 Micro GC Optional Pressure Regulators

Agilent offers two optional sample inlet pressure regulator assemblies for the 990 Micro GC. These assemblies are provided fully assembled, and require field installation on the rear of the GC.

G3588-68863 provides a pressure regulator, Genie filter (for sample drying) and needle valve, along with the required mounting bracket and hardware required for installation.

G3588-68864 provides a pressure regulator and needle valve, along with the required mounting bracket and hardware required for installation.

Installation instructions for both assemblies are provided below.

## G3588-68863

The Agilent pressure regulator assembly (G3588-68863) provides a pressure regulator, Genie filter (for sample drying) and needle valve, along with the required mounting bracket and hardware required for installation.

**Figure 18** shows the components and connection points for the Agilent pressure regulator assembly (G3588-68863).

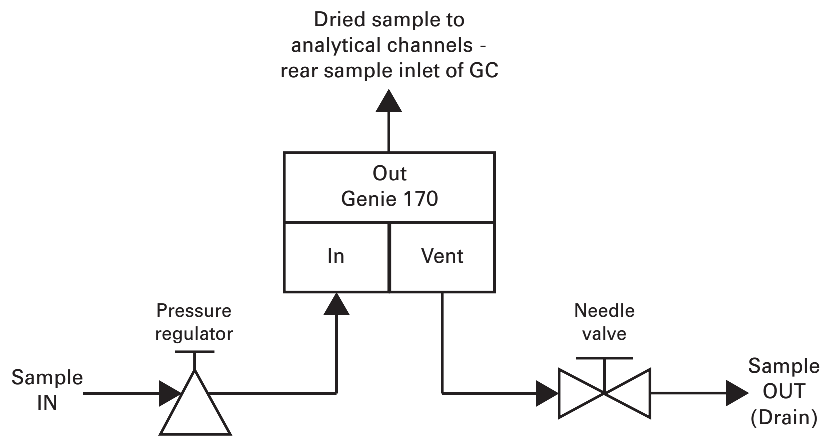



Figure 18. Agilent pressure regulator assembly (G3588-68863) functional block diagram

The pressure regulator has been tested to the fixed specifications shown in **Table 9**.

### Table 9 Pressure regulator specifications

| Attribute | Specification |
|---|---|
| Input | 25 bar (2.5 Mpa) |
| Output | 0.7 bar (10.1 psi or 70 kPa) |
| Flow | 20 mL/min |

The sample flows through the pressure regulator and into the Genie filter. Dried sample is then applied to the rear sample inlet of the GC.

NOTE

**The typical working pressure of the Genie filter is > 0.5 bar. Sample will not flow through the filter if this working pressure is not maintained.**

Vented sample flows through a needle valve for draining.

### G3588-68863 Installation

The G3588-68863 pressure regulator assembly is supplied fully assembled and ready to install on the GC. To install the assembly, do the following:

1 Shut down the GC, then allow the column and injector to cool.
   See **Shut Down Procedure** on page 41.

**WARNING** **The metal surfaces of the channel and sample inlet can be very hot. Before connecting a tubing for sample, allow the GC components to cool to ambient temperature.**

2 At the front of the GC, disconnect any existing tubing for sample from the sample inlet.

3 Attach two Torx T-20 screws to the left side of the GC. Leave them loose enough that there is room to install the bracket between the screw heads and the GC.

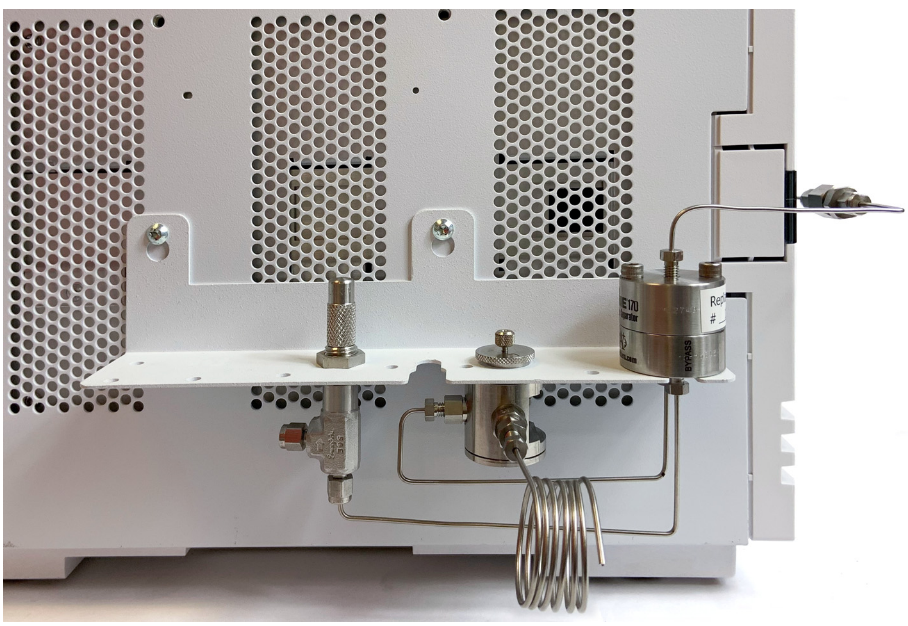
4 Slide the bracket onto the GC.

5 Tighten the two Torx T-20 screws to secure the bracket to the GC.

6 Position the G3588-68863 pressure regulator assembly at the side of the GC, and secure using the lower mounting bolt.

7 Use a 5/16 inch wrench to screw the sample line nuts to the Genie filter outlet.

8 Connect the 1/16 tubing to the sample inlet manifold by the 1/16 inch Swagelok fitting.



WARNING

**The pressure regulator has a maximum inlet pressure of 3,000 psi. Applying higher pressures may result in serious personal injury and equipment damage.**

9 Connect the Sample IN port on the pressure regulator to the sample input line.

10 Start the GC (see **Long Storage Recovery Procedure** on page 41).

11 Leak test the system to ensure that all connections are leak free.

# G3588-68864

G3588-68864 provides a pressure regulator and needle valve, along with the required mounting bracket and hardware required for installation.

The block diagram below shows the components and connection points for the G3588-68864 pressure regulator assembly.

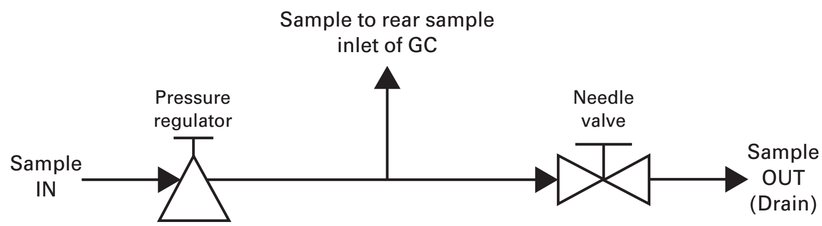



Figure 19. G3588-68864 pressure regulator assembly functional block diagram

The pressure regulator has been tested to the fixed specifications shown in **Table 10**.

**Table 10 Pressure regulator specifications**

| Attribute | Specification |
| --- | --- |
| Input | 25 bar (2.5 Mpa) |
| Output | 0.7 bar (10.1 psi or 70 kPa) |
| Flow | 20 mL/min |

The sample flows through the pressure regulator and into the rear sample inlet of the GC.

A needle valve provides for venting the sample for draining.

### G3588-68864 Installation

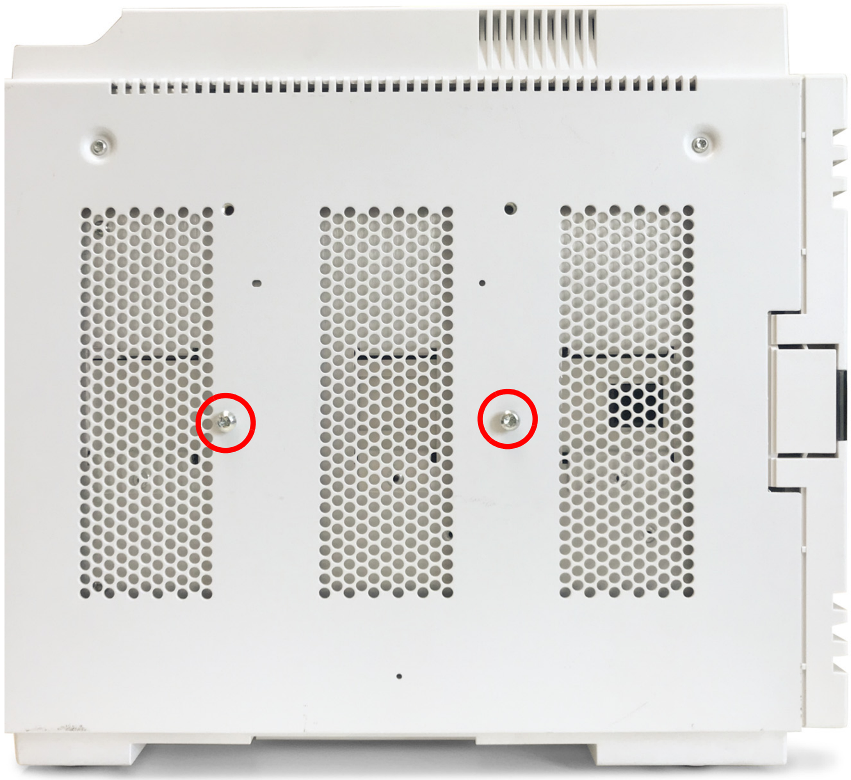
The G3588-68864 pressure regulator assembly is supplied fully assembled and ready to install on the GC. To install the assembly, do the following:

1 Shut down the GC and allow the column and injector to cool.
See **Shut Down Procedure** on page 41.

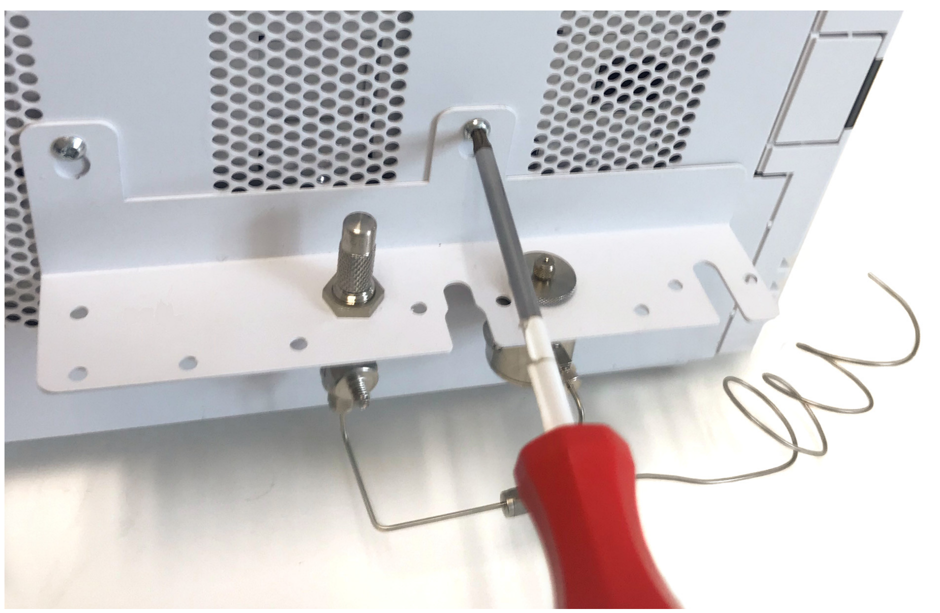
**WARNING** **The metal surfaces of the channel and sample inlet can be very hot. Before connecting a tubing for sample, allow the GC components to cool to ambient temperature.**

2 At the front of the GC, disconnect any existing tubing for sample from the sample inlet.

3 Attach two Torx T-20 screws to the left side of the GC. Leave them loose enough that there is room to install the bracket between the screw heads and the GC.



4 Slide the bracket onto the GC.



5 Use a 5/16 inch wrench to connect the 1/16 inch tubing to the sample inlet manifold by the 1/16 inch Swagelock fitting.

6 Connect the 1/16 tubing to the sample inlet manifold by the 1/16 inch Swagelok fitting.

**WARNING**

**The pressure regulator has a maximum inlet pressure of 3,000 psi. Applying higher pressures may result in serious personal injury and equipment damage.**

7 Connect the Sample IN port on the pressure regulator to the sample input line.

8 Start the GC (see **Long Storage Recovery Procedure** on page 41).

9 Leak test the system to ensure that all connections are leak free.

# Manual Injection

Manual injection is possible with the sample inlet that can accommodate 1/16-inch tubing.

## Manual injection guidelines

- Use sample pump mode, and set sampling time of 10 to 20 seconds in the method. This clearly marks when injector loop is flushed (sound of the pump). Then gently push the syringe during that period.
- Flush the sample path 6 to 10 times. Bulkhead union, additional tubing, pressure relieve valve, and ball valve adds dead volume to the system, estimated at 500 to 1,000 µL.
- Total sample volume is dependent on the internal volume of the Micro GC and the number of times flushed and the sampling time in the method.

## Injection procedure

1 Do not use continuous flow mode.
2 Minimum sample volume should be > 10 mL.
3 Insert or connect syringe and start the run.
4 Gently inject when pump starts to aspirate.

When performing manual injection with a luer lock valve, use a10 mL gas tight syringe (p/n 5190-1543: syringe 10 mL, PTPE, luer lock valve).

There may be unique syringe requirements when performing Septum nut injection.

NOTE

**The manual syringe injection would lead to increase the repeatability (RSD%) compared to automated pump or continuous flow mode.**

Figure 20. Septum nut injection port (p/n G3588-68865) installed

Figure 21. Luer lock injection port (p/n G3588-68866) installed

# Manual injection flow diagram

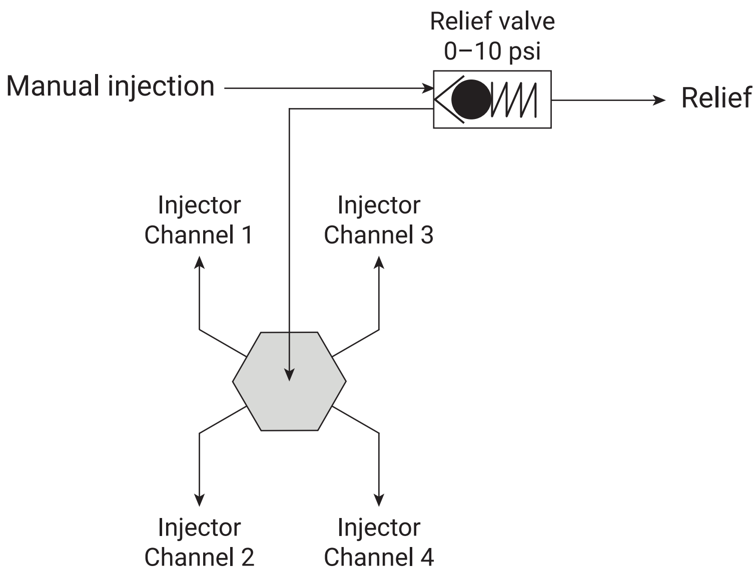



Figure 22. Manual injection flow diagram for the 990 Micro GC

To replace the septum, see **Septum Replacement for Manual Injection** on page 103.

# Manual injection kits

**Table 11 Manual injection kits**

| Option | Part Number | Description |
|---|---|---|
| Opt# 555 | G3588-68865 | Septum nut injection port |
| Opt# 556 | G3588-68866 | Luer lock injection port |

Table 12 G3588-68865 Septum nut injection port shipping kit

| #* | Part Number | Description | Quantity | Unit |
|---|---|---|---|---|
| 1 | G3588-60865 | Manual injection with Septum | 1 | EA |
| 2 | CP742990 | Support ZF2SI | 1 | EA |
| 3 | CP742984 | Septum Low bleed | 1 | EA |
| 4 | 2815892301 | POLYURETHANE,1/16inx1/8inx25ft,CLEARTUB. | 1 | RL |
| 5 | CP86757 | SCR-SKT Button-HD T-20 M4X.7 8 SST Zn | 2 | EA |
| 6 | CP742983 | Septum injection port Assy | 1 | EA |
| 7 | 0100-0053 | Stainless Nut 1/16 in | 1 | EA |
| 8 | CP4625 | Vesper Ferrule 1/16 x 0.8mm 10pk | 2 | EA |
| 9 | CP179463 | GLASSSL.ID 1.0 RED | 27 | CM |

* See **Figure 23**.

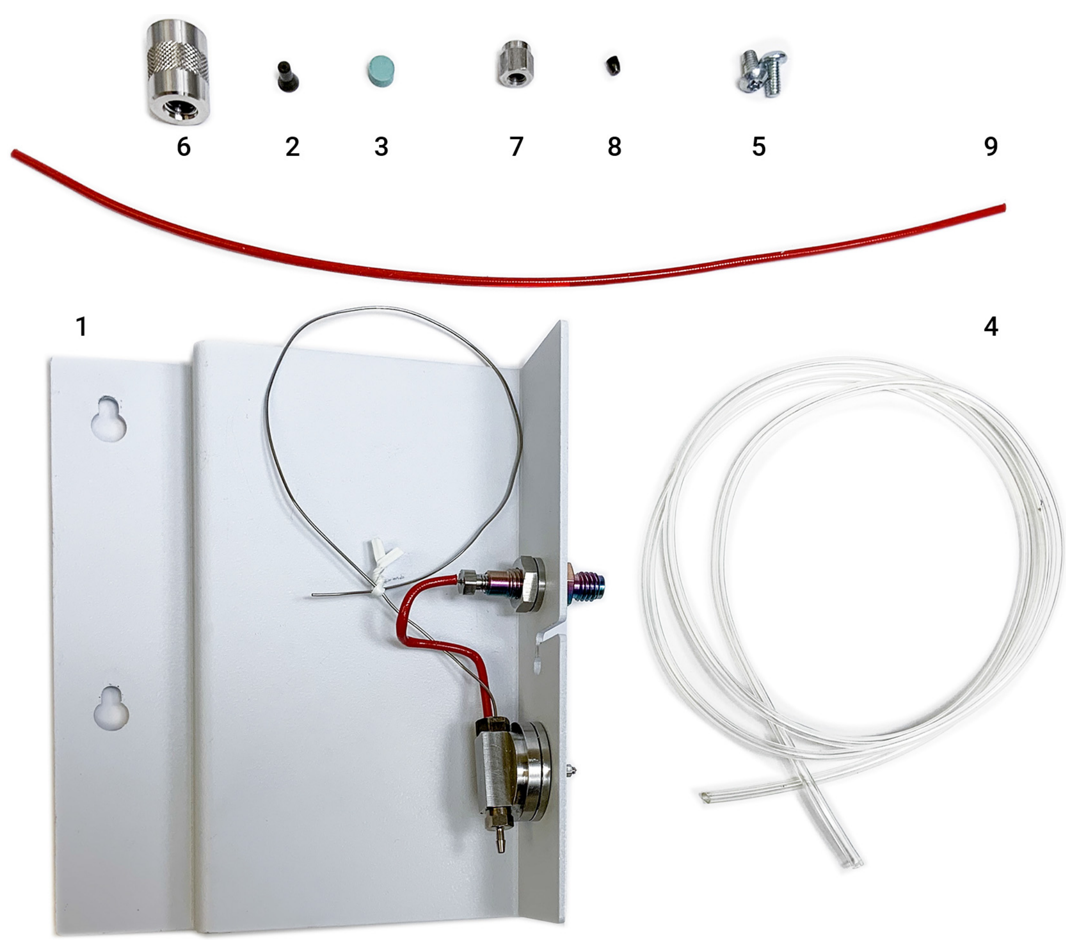



Figure 23. Septum nut injection port (p/n G3588-68865)

Table 13 G3588-68866 Luer lock injection port shipping kit

| #* | Part Number | Description | Quantity | Unit |
|---|---|---|---|---|
| 1 | G3588-60866 | Manual injection with Luer Lock | 1 | EA |
| 2 | CP86757 | SCR-SKT Button-HD T-20 M4X.7 8 SST Zn | 2 | EA |
| 3 | CP4625 | Vespel Ferrule 1/16 x 0.8mm 10pk | 2 | EA |
| 4 | CP914757 | Fitting, ext Luer lock,10-32 thrd,1/pk | 1 | EA |
| 5 | VLZLA1 | Female luer adapter to 1/16 ftgs | 1 | EA |
| 6 | 2815892301 | POLYURETHANE,1/16inx1/8inx25ft,CLEARTUB. | 1 | RL |
| 7 | 0100-0053 | Stainless Nut 1/16 in | 1 | EA |
| 8 | CP179463 | GLASSSL.ID 1.0 RED | 27 | CM |

* See **Figure 24**.

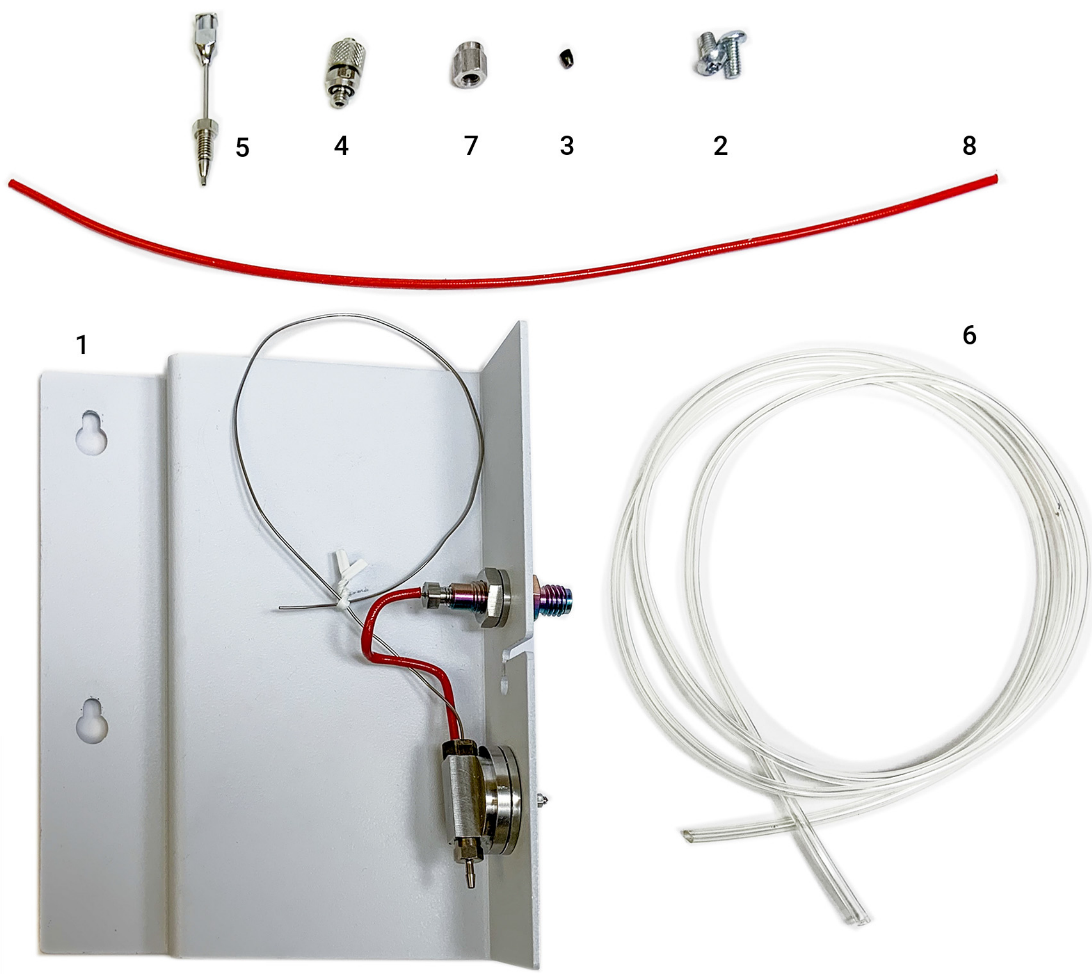



Figure 24. Luer lock injection port (p/n G3588-68866)

# 5 Micro GC Channels



The instrument is a dual channel cabinet (one or two GC channels). Two cabinets can be connected to form a quad channel system (up to four GC channels). A GC channel contains a gas regulator, an injector, a column, and a TCD detector. See **Figure 25** on page 62.

This chapter provides a brief discussion on the major components in the Micro GC and the backflush option.

# Carrier Gas

The Micro GC is configured for use with either He and $H_2$ or $N_2$ and Ar.

Agilent recommends you use gases with a minimum purity of 99.999 %. Since the injection valve is operated pneumatically, there is a limit of 550 kPa ±10 kPa (80 psi ±1.5 psi) to the main gas supply.

**CAUTION**

**Your Micro GC is configured either for carrier gas He and $H_2$ or $N_2$ and Ar. Use the carrier gas type for which your instrument is configured, otherwise the detector filaments can be damaged.**

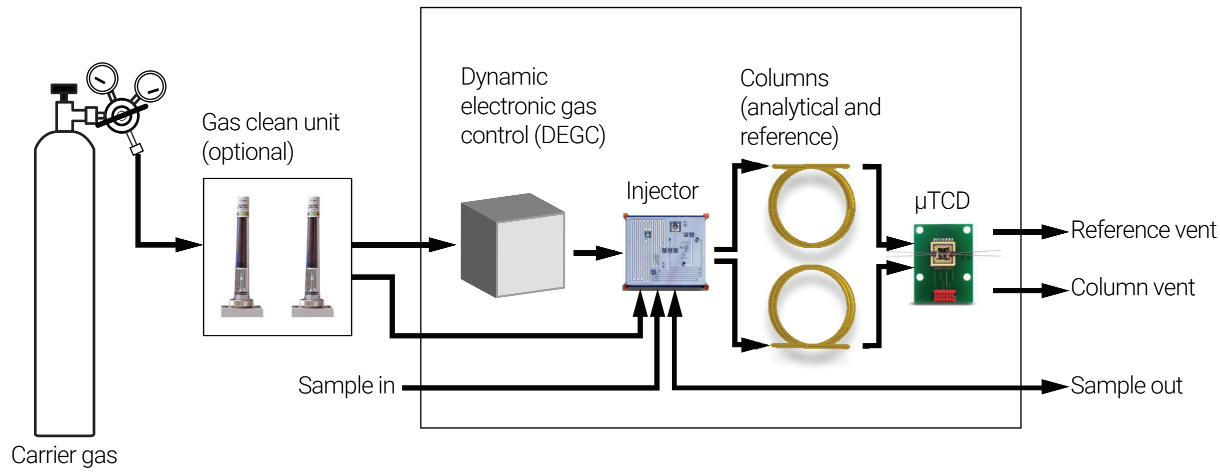



Figure 25. Gas flow diagram

# Dynamic Electronic Gas Control (DEGC)

The Micro GCs have built-in regulators that can be adjusted to get a constant or programmed pressure control, which, once constant or programmed pressure control is obtained, results in a constant or programmed flow through the injector, column, and detector. The pressure range is from 50 to 350 kPa (7 to 50 psi). This pressure sets a continuous flow of carrier gas of about 0.2 to 4.0 mL/min, depending on column length and type.

A typical pressure rise is 200 kPa/min, which will give a significant pressure increase during the run without excessive baseline disturbance. In most cases, baseline subtraction may improve the quality of chromatograms that suffer from baseline drift.

# Inert Sample Path

The 990 Micro GC is equipped with an Ultimetal-treated sample path. This deactivation method ensures the integrity of the sample and helps to achieve the best detection limits possible.

The deactivation is applied to tubing running from the sample inlet to the injector.

# Injector

The injector has a built-in 10-µL sample loop that is filled with the gaseous sample. The pressure of the sample should be between 0 and 100 kPa (0 to 15 psi) and the sample temperature within 0 to 110 °C.

When the chromatographic data system sends a START command, the vacuum pump draws the gas sample through the loop. Then, after the pump stops, the injector injects the gas sample from the sample loop into the gas stream. A typical injection time is 40 ms. This equals an average injection volume of 1 µL. A practical minimum value is 40 ms. A value of 0 to 10 ms might result in an injection that is not repeatable.

# Column

Altering the GC channels requires a trained Agilent service engineer.

Other columns are available by contacting Agilent Technologies.

**Table 14** shows several standard columns and their selected applications.

**Table 14 Agilent Micro GC columns and applications**

| Column/Phase type | Target components |
|---|---|
| Molsieve 5Å | Permanent gases ($N_2/O_2$ separation), methane, CO, NO, and so forth. 20 m required for $O_2$-Ar baseline separation), He, Ne, $H_2$. Natural gas and biogas analysis. Optional Retention Time Stability (RTS) configuration. |
| Hayesep A | Hydrocarbons C1–C3, $N_2$, $CO_2$, air, volatile solvents, natural gas analysis. |
| CP-Sil 5 CB | Hydrocarbons C3–C10, aromatics, organic solvents, natural gas analysis. |
| CP-Sil 19 CB | Hydrocarbons C4–C10, high boiling solvents, BTX. |
| CP-WAX 52 CB | Polar volatile solvents, BTX. |
| PLOT Al2O3/KCl | Light hydrocarbons C1–C5 saturated and unsaturated. Refinery gas analysis. |
| PoraPLOT U | Hydrocarbons C1–C6, halocarbons/freons, anesthetics, $H_2S$, $CO_2$, $SO_2$, volatile solvents, $N_2O$. Separation of ethane, ethylene, and acetylene. |
| PoraPLOT Q | Hydrocarbons C1–C6, halocarbons/freons, anesthetics, $H_2S$, $CO_2$, $SO_2$, volatile solvents, $N_2O$. Separation of propylene and propane, coelution of ethylene and acetylene. |
| CP-COX | CO, $CO_2$, $H_2$, Air (coelution of $N_2$ and $O_2$ ), $CH_4$. |
| CP-Sil 19CB for THT | THT and C3–C6+ in Natural Gas Matrix. |
| CP-Sil 13CB for TBM | TBM and C3–C6+ in Natural Gas Matrix. |
| MES NGA | Unique column specially tested for MES in natural gas (1 ppm). |
| Volamine | $NH_3$ (40ppm ~ 20%) |

CAUTION

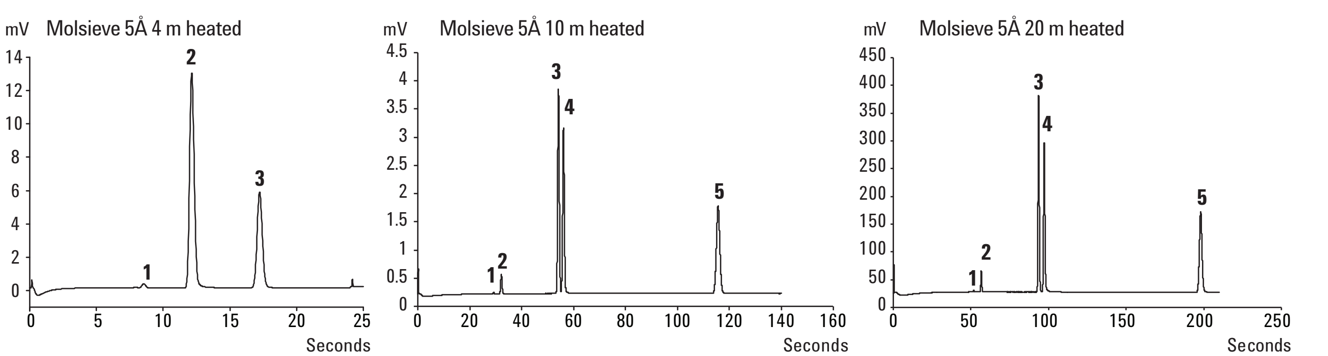
**All columns except the HayeSep A (160 °C) and MES (110 °C) columns can be used up to 180 °C. Exceeding this temperature will cause the column to lose efficiency instantly and the column module will need replacement. All channels have a built-in protection that prevents a setpoint above the maximum temperature.**

# Molsieve 5Å columns

The Molsieve 5Å column is designed to separate: hydrogen, carbon monoxide, methane, nitrogen, oxygen, and some noble gases. Higher molecular weight components have much higher retention times on this column.

### Table 15 Molsieve 5Å instrument parameters

| Parameter | 4 m Heated | 10 m Heated | 20 m Heated |
|---|---|---|---|
| Column temperature | 110 °C | 40 °C | 40 °C |
| Injector temperature | 110 °C | 50 °C | 50 °C |
| Column pressure | 100 kPa (15 psi) | 150 kPa (21 psi) | 200 kPa (28 psi) |
| Sample time | 30 s | 30 s | 30 s |
| Injection time | 40 ms | 40 ms | 40 ms |
| Run time | 25 s | 140 s | 210 s |
| Detector sensitivity | Auto | Auto | Auto |
| Peak 1 | Hydrogen 1.0 % | Neon 18 ppm | Neon 18 ppm |
| Peak 2 | Argon/Oxygen 0.4 % | Hydrogen 1.0 % | Hydrogen 1.0 % |
| Peak 3 | Nitrogen 0.2 % | Argon 0.2 % | Argon 0.2 % |
| Peak 4 | ________ | Oxygen 0.2 % | Oxygen 0.2 % |
| Peak 5 | ________ | Nitrogen 0.2 % | Nitrogen 0.2 % |

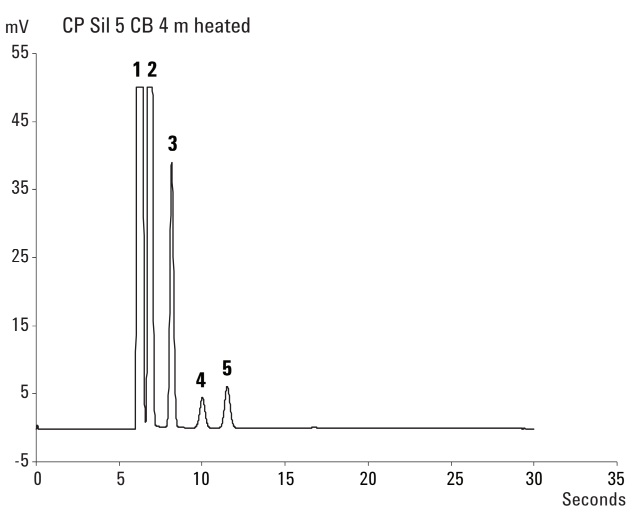


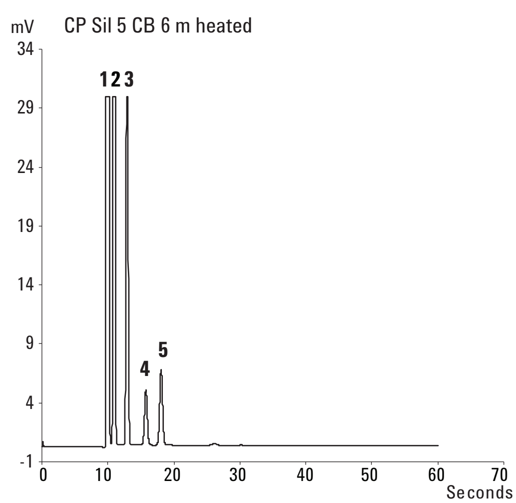
# CP-Sil 5 CB columns

The natural gas components, mostly hydrocarbons, separate in the same order on the non-polar and medium-polar CP-Sil CB columns. Nitrogen, methane, carbon dioxide, and ethane are not separated on these columns. They produce a composite peak. For separation of these components, consider a PoraPLOT U or HayeSep A column.

### Table 16 CP-Sil 5 CB instrument parameters

| Parameters | 4 m Heated | 6 m Heated |
|---|---|---|
| Column temperature | 50 °C | 50 °C |
| Injector temperature | 110 °C | 110 °C |
| Column pressure | 150 kPa (21 psi) | 150 kPa (21 psi) |
| Sample time | 30 s | 30 s |
| Injection time | 40 ms | 40 ms |
| Run time | 30 s | 30 s |
| Detector sensitivity | Auto | Auto |
| Peak 1 | Composite balance | Composite balance |
| Peak 2 | Ethane 8.1 % | Ethane 8.1 % |
| Peak 3 | Propane 1.0 % | Propane 1.0 % |
| Peak 4 | *i*-Butane 0.14 % | *i*-Butane 0.14 % |
| Peak 5 | *n*-Butane 0.2 % | *n*-Butane 0.2 % |

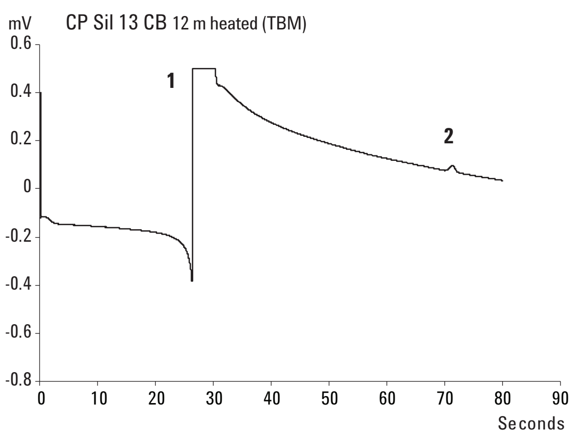


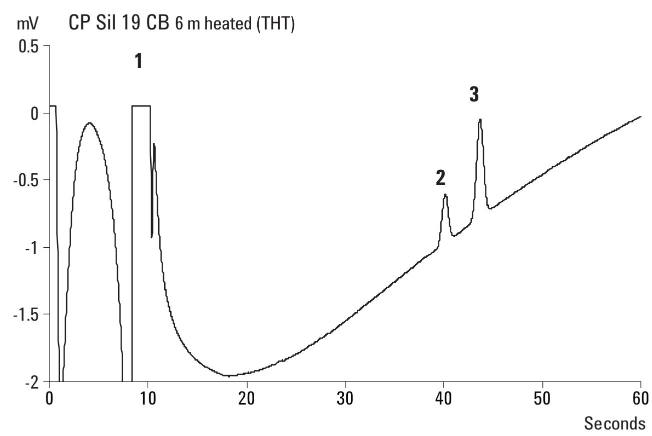



# CP-Sil 13 CB and CP-Sil 19 CB columns

### Table 17 CP-Sil CB instrument parameters

| Parameter | CP-Sil 13 CB 12 m Heated (TBM) | CP-Sil 19 CB 6 m Heated (THT) |
|---|---|---|
| Column temperature | 40 °C | 85 °C |
| Injector temperature | 50 °C | 85 °C |
| Column pressure | 250 kPa (38 psi) | 200 kPa (25 psi) |
| Sample time | 30 s | 30 s |
| Injection time | 255 ms | 255 ms |
| Run time | 80 s | 35 s |
| Detector sensitivity | Auto | Auto |
| Peak 1 | Methane balance | Helium balance |
| Peak 2 | TBM 6.5 ppm | THT 4.6 ppm |
| Peak 3 | ______ | *n*-Nonane 4.5 ppm |

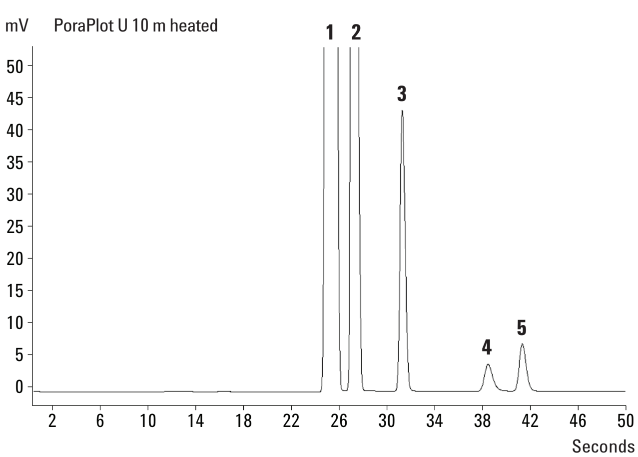


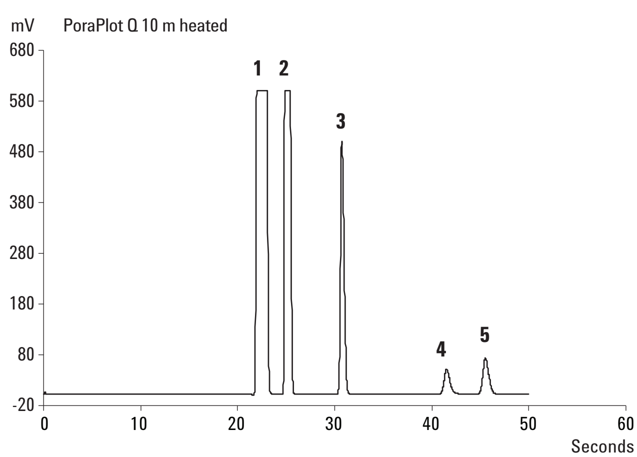



# PoraPlot 10 m column

### Table 18 PoraPlot 10 m instrument parameters

| Parameter | PoraPlot U 10 m Heated | PoraPlot Q 10 m Heated |
|---|---|---|
| Column temperature | 150 °C | 150 °C |
| Injector temperature | 110 °C | 110 °C |
| Column pressure | 150 kPa (21 psi) | 150 kPa (21 psi) |
| Sample time | 30 s | 30 s |
| Injection time | 40 ms | 40 ms |
| Run time | 100 s | 50 s |
| Detector sensitivity | Auto | Auto |
| Peak 1 | Composite balance | Composite balance |
| Peak 2 | Ethane 8.1 % | Ethane 8.1 % |
| Peak 3 | Propane 1.0 % | Propane 1.0 % |
| Peak 4 | *i*-Butane 0.14 % | *i*-Butane 0.14 % |
| Peak 5 | *n*-Butane 0.2 % | *n*-Butane 0.2 % |



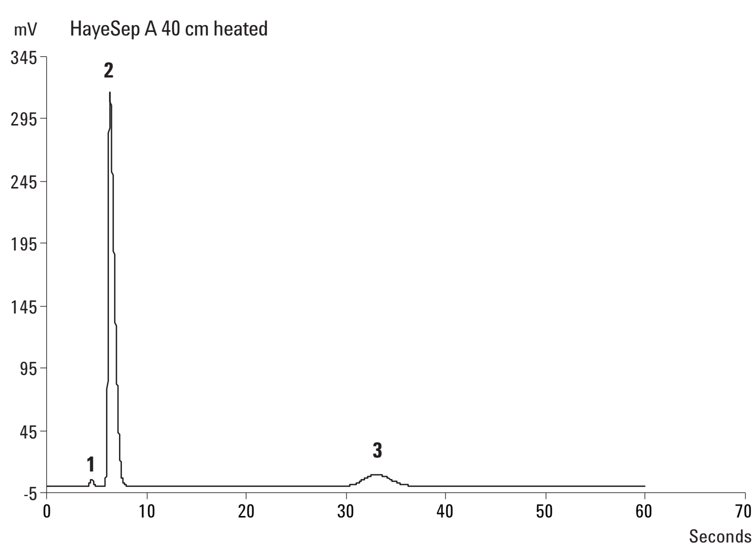
# HayeSep A 40 cm heated column

The HayeSep A column separates oxygen, methane, carbon dioxide, ethane, acetylene, ethylene, and selected sulfur gases. Nitrogen coelutes with oxygen. Components with a higher molecular weight than propane have long retention times on this column.

WARNING **Maximum allowable column temperature is 160 °C.**

### Table 19 HayeSep instrument parameters

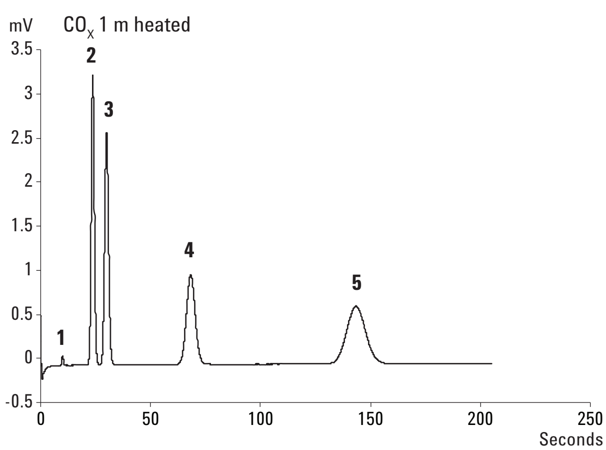
| Parameter | HayeSep A 40 cm Heated |
| --- | --- |
| Column temperature | 50 °C |
| Injector temperature | 110 °C |
| Column pressure | 150 kPa (21 psi) |
| Sample time | 30 s |
| Injection time | 40 ms |
| Run time | 60 s |
| Detector sensitivity | Auto |
| Peak 1 | Nitrogen 0.77 % |
| Peak 2 | Methane balance |
| Peak 3 | Ethane 8.1 % |

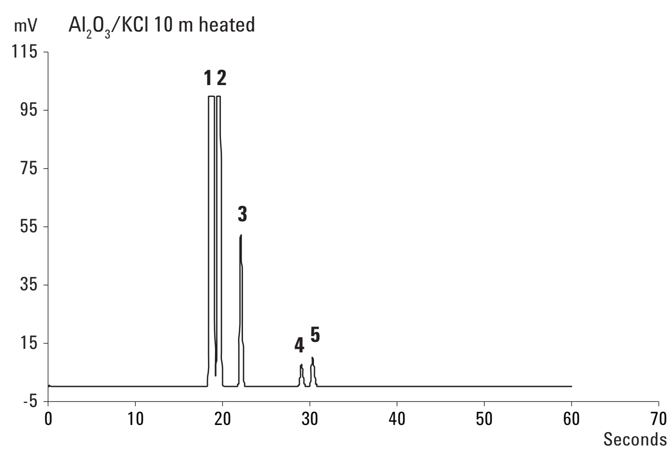


# $CO_X$ and $Al_2O_3$/KCl columns

**Table 20 $CO_X$ and $Al_2O_3$/KCl instrument parameters**

| Parameter | $CO_X$ 1 m Heated | $Al_2O_3$/KCl 10 m Heated |
|---|---|---|
| Column temperature | 80 °C | 100 °C |
| Injector temperature | 110 °C | 110 °C |
| Column pressure | 200 kPa (28 psi) | 150 kPa (21 psi) |
| Sample time | 30 s | 30 s |
| Injection time | 40 ms | 40 ms |
| Run time | 204 s | 60 s |
| Detector sensitivity | Auto | Auto |
| Peak 1 | Hydrogen 1.0 % | Composite balance |
| Peak 2 | Nitrogen 1.0 % | Ethane 8.1 % |
| Peak 3 | CO 1.0 % | Propane 1.0 % |
| Peak 4 | Methane 1.0 % | *i*-Butane 0.14 % |
| Peak 5 | $CO_2$ 1.0 % | *n*-Butane 0.2 % |
| | Helium balance | |

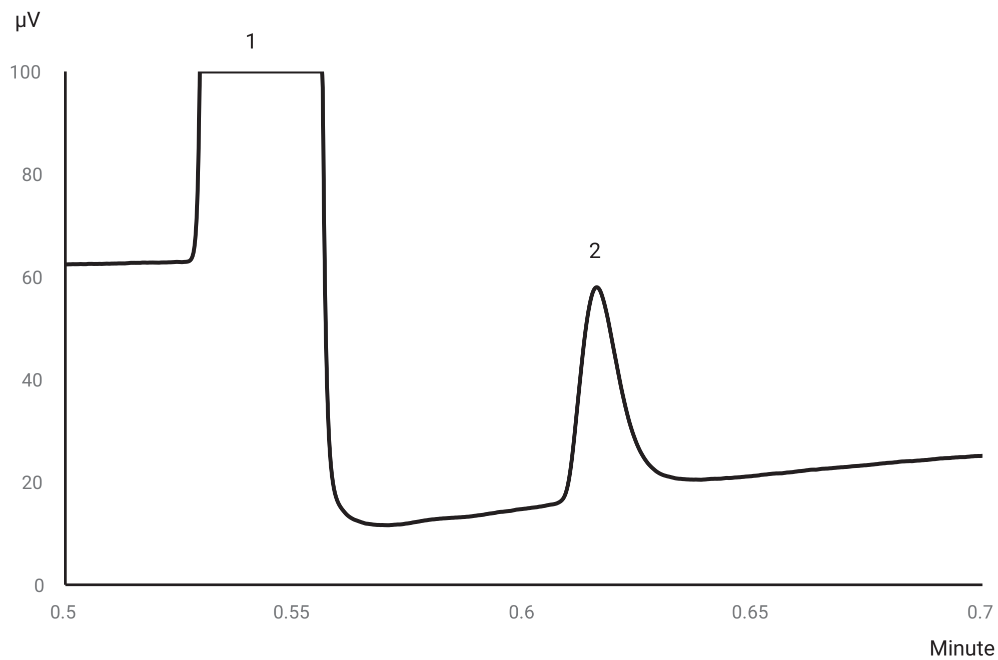


# Volamine Column

### Table 21 CP-Volamine instrument parameters

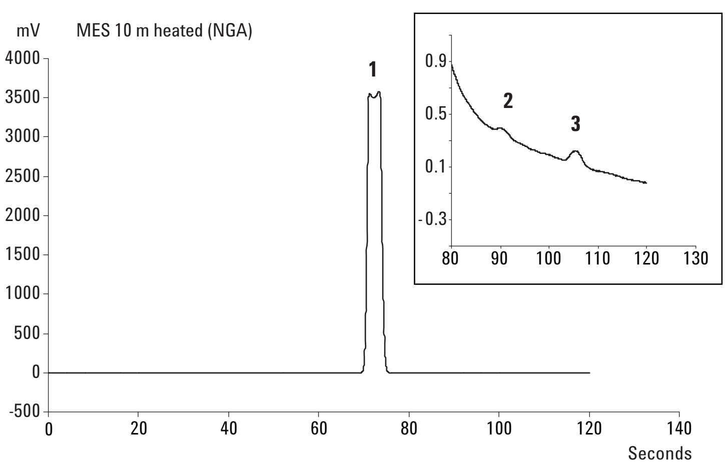
| Parameter | CP-Volamine 15m Heated |
|---|---|
| Column temperature | 50 °C |
| Injector temperature | 50 °C |
| Column pressure | 150 kPa (21 psi) |
| Sample time | 30 s |
| Injection time | 40 ms |
| Run time | 60 s |
| Detector sensitivity | Auto |
| Peak 1 | Nitrogen Balance |
| Peak 2 | Ammonia 100 ppm |

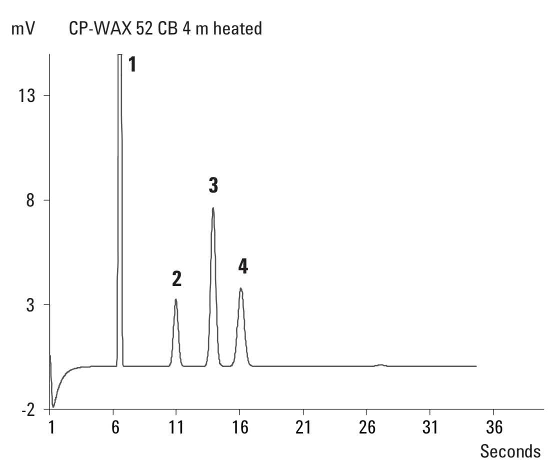


# MES (NGA) and CP-WAX 52 CB columns

### Table 22 MES (NGA) and CP-WAX 52 CB instrument parameters

| Parameter | MES 10 M Heated (NGA) | CP-WAX 52 CB 4 M Heated |
|---|---|---|
| Column temperature | 90 °C | 60 °C |
| Injector temperature | 110 °C | 110 °C |
| Column pressure | 70 kPa (10 psi) | 150 kPa (21 psi) |
| Sample time | 30 s | 30 s |
| Injection time | 500 ms | 40 ms |
| Run time | 120 s | 35 s |
| Detector sensitivity | Auto | Auto |
| Peak 1 | Nitrogen Balance | Nitrogen 0.75 % |
| Peak 2 | *n*-Decane 11.2 ppm | Acetone 750 ppm |
| Peak 3 | MES 14. 2 ppm | Methanol 0.15 % |
| Peak 4 | ______ | Ethanol 0.30 % |
| | | Helium Balance |



# Column conditioning

Follow this procedure to make sure that any water inside the analytical column is removed before the TCD is switched on.

Column conditioning is specifically recommended if the 990 Micro GC has been inactive for a long period of time.

**CAUTION**

**The detector filaments may be damaged by improper conditioning. To avoid damaging the detector filaments, follow this procedure.**

### Column conditioning procedure

1. Switch off the TCD filaments in the method.
2. Set the column temperature of the module to the maximum temperature (110 °C, 160 °C, or 180 °C depending on the column limit). Leave the filaments off.
3. Set injector temperature to 80 °C.
4. Download this method to the Micro GC.
5. Keep the downloaded method to condition the column, preferably overnight.

This will ensure that all the water has been removed from the column, and no damage will occur to the TCD filaments.

### Nitrogen and oxygen merging in Molsieve columns

On a properly activated Molsieve column, nitrogen and oxygen will be well separated. However, over time these two peaks begin to merge. This is caused by water and carbon dioxide present in the sample or carrier gas, adsorbing to the stationary phase.

To restore the column efficiency, condition the column, for approximately one hour as described above. After reconditioning, you can test the column performance by injecting plain air. If you have a proper separation between nitrogen and oxygen, the column separation power has been restored. The longer the reconditioning period, the better the column performance.

# Replacing Channel Column, Injector Die, and TCD

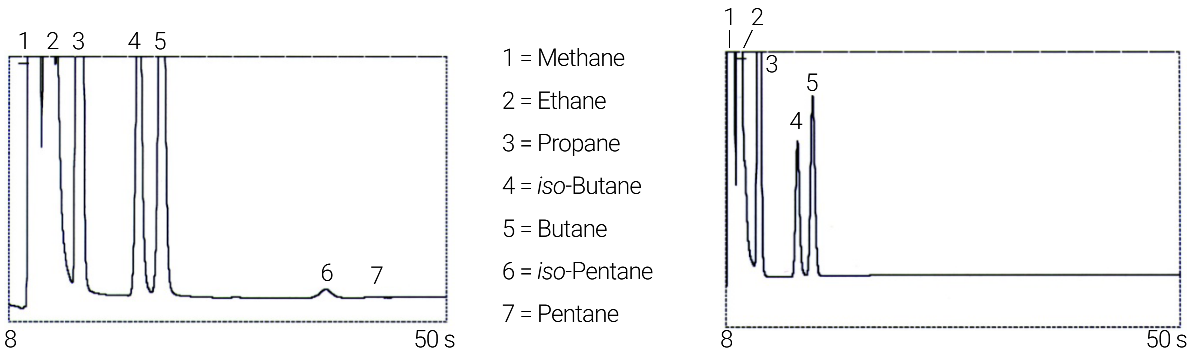
The channel column, injector die and micro-TCD can be replaced by service engineers and OEM partners.

See the Agilent 990 Micro GC Service Manual (p/n G3588-90020) for detailed information.

# Backflush Option

Backflush to vent is an advanced technique used to prevent later-eluting compounds from reaching the analytical column and detector. The main reason for applying this technique is to keep the analytical column clean, and reduce analysis time.

The Micro GC is optionally available with GC modules that incorporate backflush capabilities.




Natural gas analysis, straight

Natural gas analysis, with backflush at eight seconds

Figure 26. Natural gas analysis

A backflush system always consists of a precolumn and an analytical column. The two columns are coupled at a *pressure point*, which makes it possible to invert the carrier gas flow direction through the precolumn at a preset time, called the *backflush time*. See **Figure 28** on page 76.

The injector, two columns, and detector are in series.

The sample is injected onto the precolumn where a preseparation takes place; injection takes place in normal mode. See **Figure 27**.

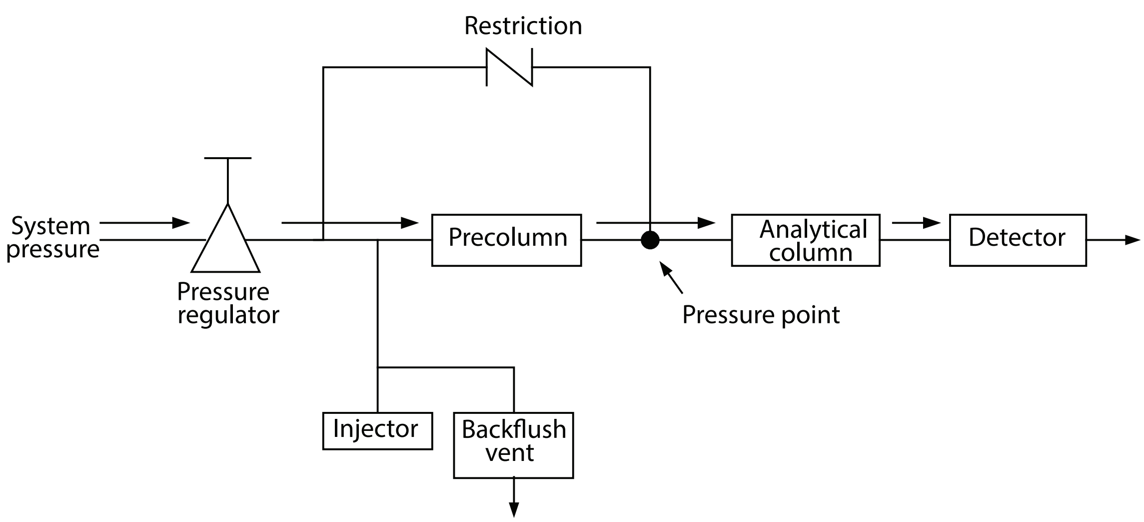



Figure 27. Backflush system normal flows

When all compounds to be quantified are transferred to the analytical column, the backflush valve switches (at the backflush time). On the precolumn, the flow inverts and all compounds left on the precolumn now backflush to the vent. On the analytical column the separation continues because there the flow is not inverted. See **Figure 28**.

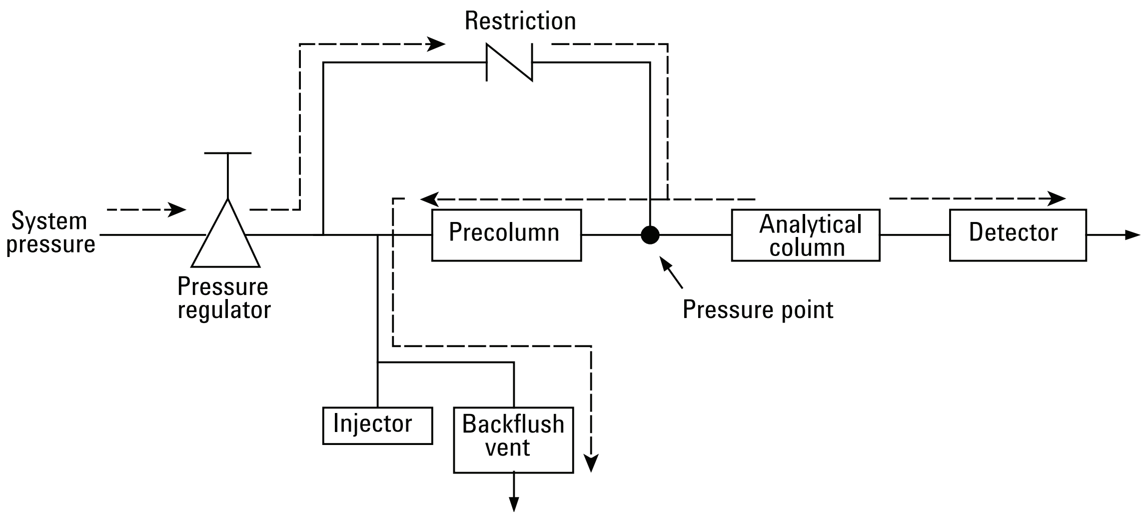



Figure 28. Backflush flows

The standby mode is the backflush configuration (if the instrument is equipped with the optional backflush valve).

Backflushing saves the time required to elute high boiling components that are not of interest, and ensures that the precolumn will be in good condition for the next run.

# Tuning the backflush time (except on a HayeSep A channel)

Tuning the backflush time is necessary for each new channel. This chapter describes how to tune the backflush time on all channels except HayeSep A.

## Tuning procedure for the backflush time

1. Set the backflush time to 0 seconds, and analyze the checkout sample or a proper sample for the specific channel. The goal is to identify the components in the calibration standard.
2. Change the backflush time to 10 seconds and perform a run. The following can be observed:
   - When the backflush time is set too early, the peaks of interest are partially or totally backflushed.
   - If the backflush time is set too late, the unwanted components are not backflushed and show up in the chromatogram.
3. Perform runs with different backflush times until there is no significant difference in the peak of interest. To fine tune the backflush time, set smaller steps (for example 0.10 seconds) until you find the optimal backflush time.

Figure 29 shows a simple example of tuning the backflush time for the CP-Molsieve 5A channel.

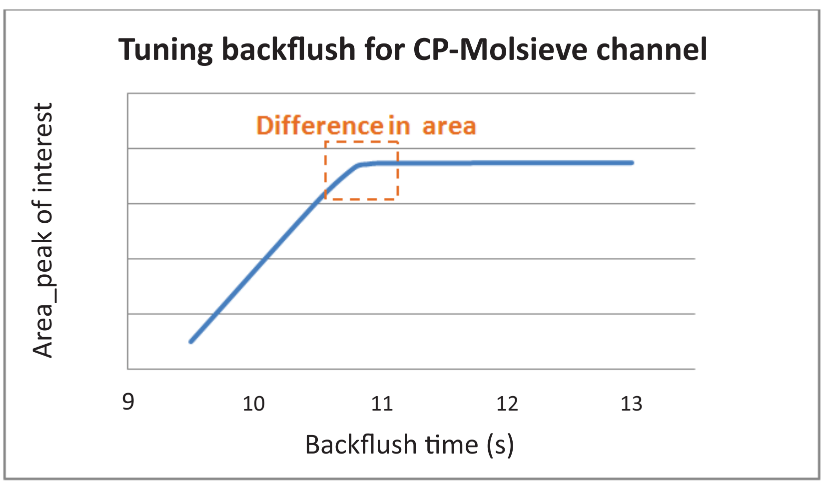



Figure 29. Effect of the backflush time on the peak of interest

# Tuning the backflush time on a HayeSep A channel

For each new HayeSep A channel with a backflush option, it is necessary to tune the backflush time properly. The tuning procedure of the HayeSep A channel is different than the tuning procedure of other channels.

The goal for tuning the backflush time for the HayeSep A channel is to get all peaks of interest, components up to propane, on the HayeSep A column while all unwanted peaks that elute after propane are backflushed.

## Tuning procedure for HayeSep A channel

1. Set the backflush time of the HayeSep A channel to 0 seconds.
2. Set an appropriate run time for the first analysis (for example 300 seconds or longer).
3. Analyze the NGA Gas Calibration standard, and identify all components in the calibration standard.
4. When all peaks of interest are identified, select a proper backflush time after propane peak.

**Figure 30** shows an example of the tuning procedure of HayeSep A channel. In this example, the propane peak elutes around 90 seconds, proper backflush time for the HayeSep A here is around 120 seconds.

Consider that the total run time must be sufficient to backflush all unwanted components from the column. The ideal total run time is approximately twice the backflush time or higher. So in this example, a total run time of 240 seconds is sufficient to backflush all unwanted components from the HayeSep A channel.

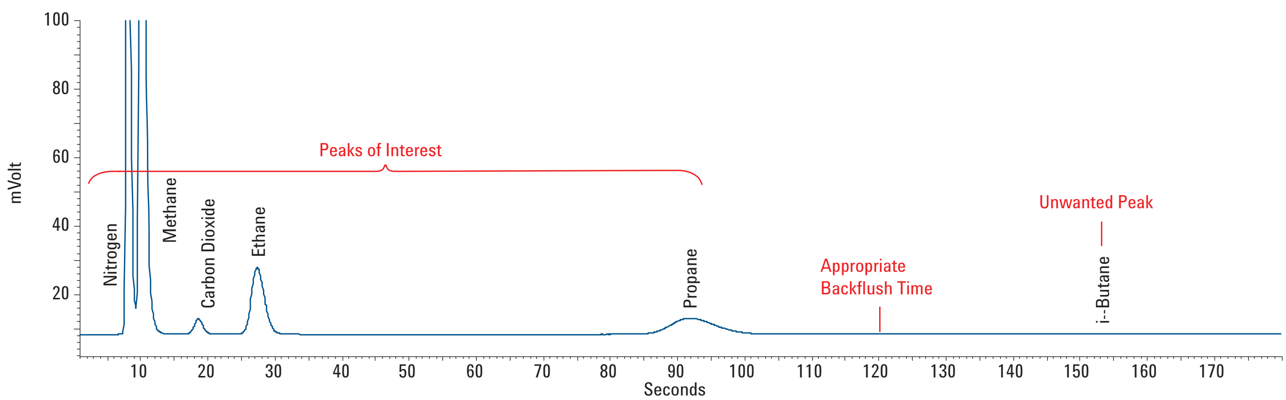



Figure 30. Selecting backflush time for a HayeSep A channel

## To disable backflush

To disable backflushing, set the backflush time to 0. This puts the system in normal mode during the entire run.

# Backflush to Detector

Backflush to detector is an advanced technique to elute high boiling point compounds as a group through the reference column, and show as one peak on the chromatogram just before the low boiling point compounds. The benefit of this technique is that the analysis time is reduced. In some cases, the analysis could even be done on just one channel.

The Agilent 990 Micro GC offers two types of backflush to detector channels. A CP-Sil 5 CB for natural gas analysis and Al2O3 for refinery gas analysis. The backflush to detector channel is factory tuned to group the C6+ components.

## CP-Sil 5 CB Backflush to detector

The CP-Sil 5 CB backflush to detector micro GC channel is configured with an 8 m CP-Sil 5 CB analytical column and a 0.5 m CP-Sil 5 CB precolumn. It elutes C6+ in natural gas as one peak through the reference column, and shortens analysis time to 90 seconds. It is compliant with GPA2172 for calorific value calculation.

## Al2O3 Backflush to detector

The Al2O3 back flush to detector micro GC channel is configured with a 10 m Al2O3/KCl analytical column and a 1 m CP-Sil 5 CB precolumn. It elutes C6+ in refinery gas as one peak through the reference column, and shortens analysis time to 210 seconds.

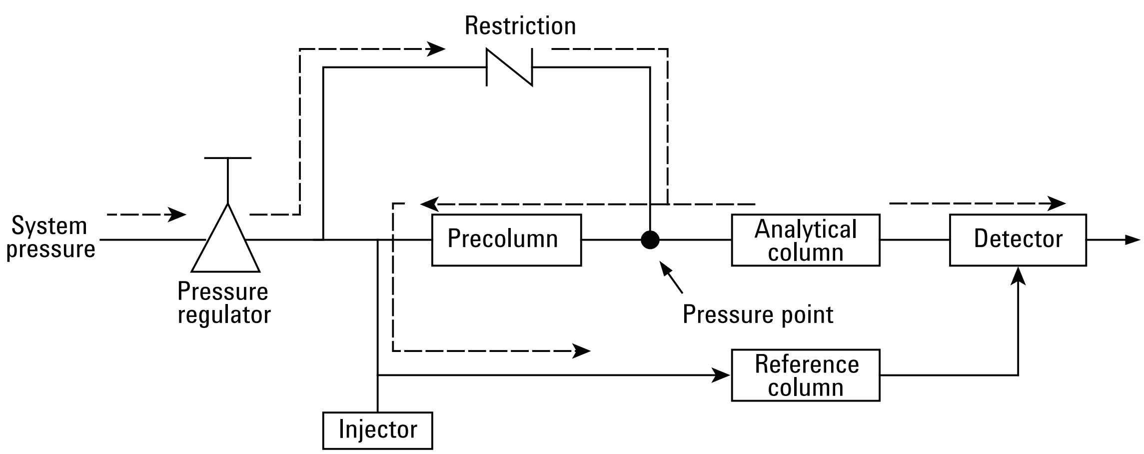



Figure 31. Backflush to detector flow

# Tuning the backflush time

To set the proper backflush time for each new backflush to detector channel, follow either the **"8 m 5CB BF2D procedure"** or the **"10 m Al2O3/KCl BF2D procedure"** on page 81.

## 8 m 5CB BF2D procedure

**Table 23 8 m 5CB BF2D settings**

| Parameter | Settings |
|---|---|
| Column pressure | 150 kPa |
| Injection temperature | 110 °C |
| Column temperature | 72 °C |
| Injection time | 40 ms |
| Run time | 90 s |
| Sample gas | NGA gas |

1. Set backflush (BF) time to 0 seconds. Start a run to obtain the peaks of all eluted components. Record the retention time (RT) of *n*-pentane and 2,2-dimethylbutane.
2. Set run time to a value which is 10 seconds longer than the RT of 2,2-dimethylbutane. Set BF time to 5 seconds. Start a run again.
3. Increase BF time by 0.5 seconds steps, and start a run. Observe the peak height of 2,2-dimethylbutane. Continue increasing BF time until the 2,2-dimethylbutane peak is observed (peak height > 3 µV).
4. Finely tune the BF time, find the data point when the 2,2-dimethylbutane peak is observed. Decrease BF time by 0.1 seconds steps, and start a run until the peak disappears (peak height < 3 µV). Set BF time for this channel to that value minus 0.2 seconds. A typical "clean cut" time range of 8m 5CB BF2D channel is approximately 0.3-0.5 seconds. (See **Figure 32**.)

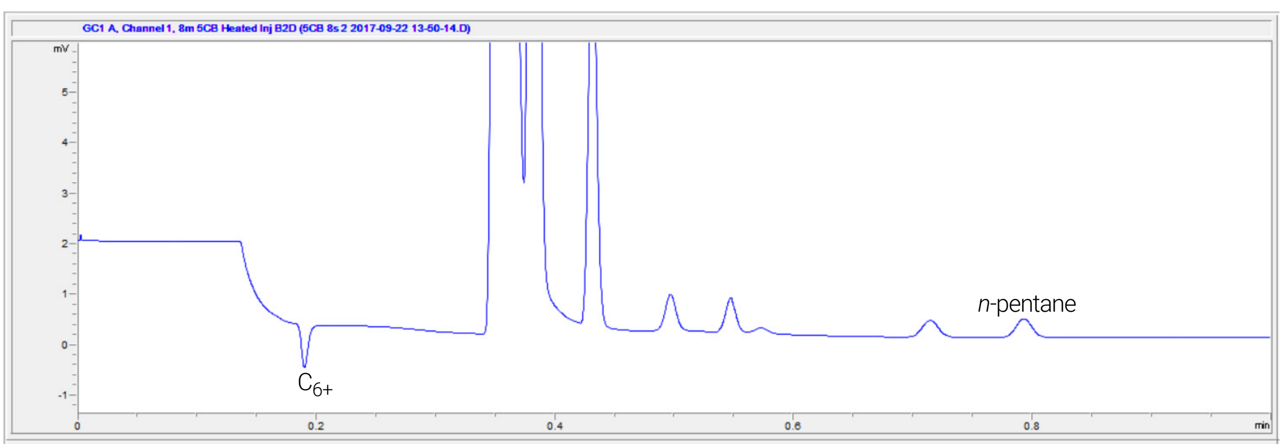



Figure 32. 8m 5CB Column for natural gas analysis

### 10 m Al2O3/KCl BF2D procedure

**Table 24 10 m Al2O3/KCl BF2D settings**

| Parameters | Settings |
|---|---|
| Column pressure | 300 kPa |
| Injection temperature | 100 °C |
| Column temperature | 90 °C |
| Injection time | 40 ms |
| Run time | 600 s |
| Sample gas | RGA gas |

1. Set backflush (BF) time to 0 seconds. Run method to obtain the peaks of all eluted components. Record the retention time (RT) of *cis*-2-pentene and *n*-hexane.
2. Set run time to a value which is 10 seconds longer than the RT of *n*-hexane. Set BF time to 5 seconds. Start a run.
3. Increase BF time by 0.5 seconds steps, and start a run. Observe the peak height of *n*-hexane. Continue increasing BF time until the *n*-hexane peak is observed (peak height > 3 µV).
4. Finely tune the BF time, find the data point when the *n*-hexane peak is observed. Decrease BF time by 0.1 seconds steps, and start a run until the peak disappears (peak height < 3 µV). Set BF time for this channel to that value minus 0.4 seconds. A typical "clean cut" time range of 10m Al2O3 BF2D channel is approximately 1-2 seconds. (See **Figure 33**.)

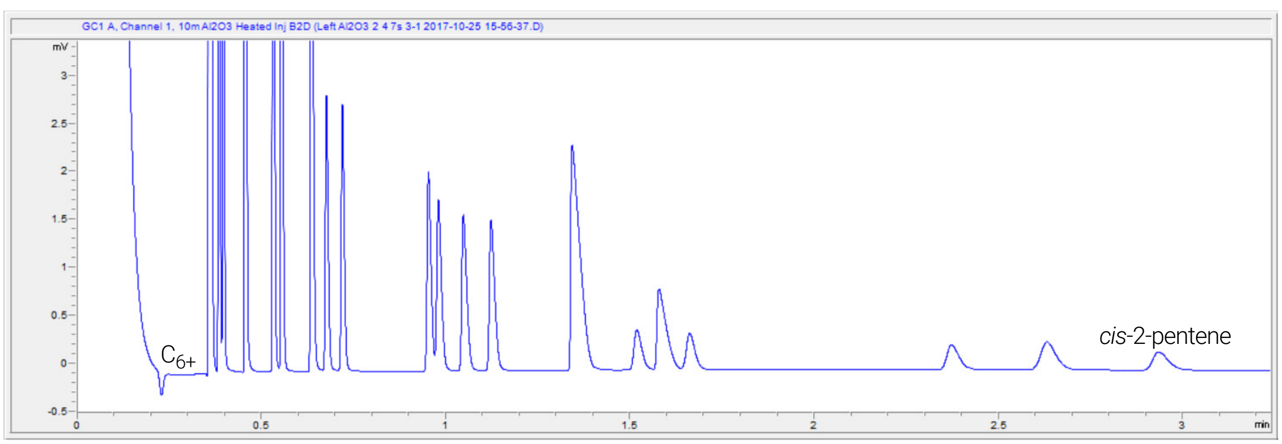



Figure 33. 10m Al2O3 Column for refinery gas analysis

# To disable backflush

To disable backflushing, set the **Backflush Time** to **0**. This puts the system in normal mode during the entire run.

# Set invert signal time

Invert signal time enables the backflush to detector channel to plot the signal from a negative peak to a positive peak in the selected time interval. See **Figure 34** for the OpenLAB CDS configuration and **Figure 35** for the PROstation SW configuration.

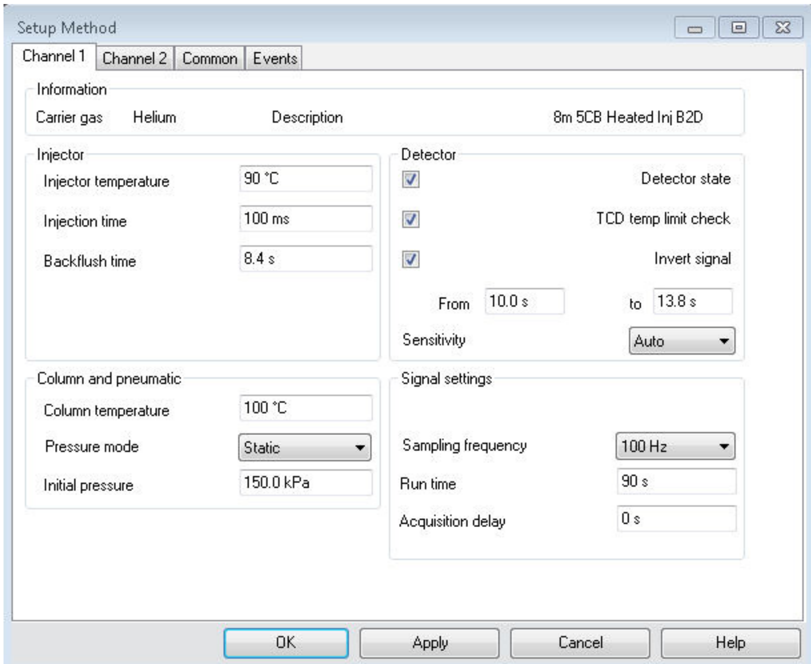



Figure 34. Method configuration in OpenLAB CDS

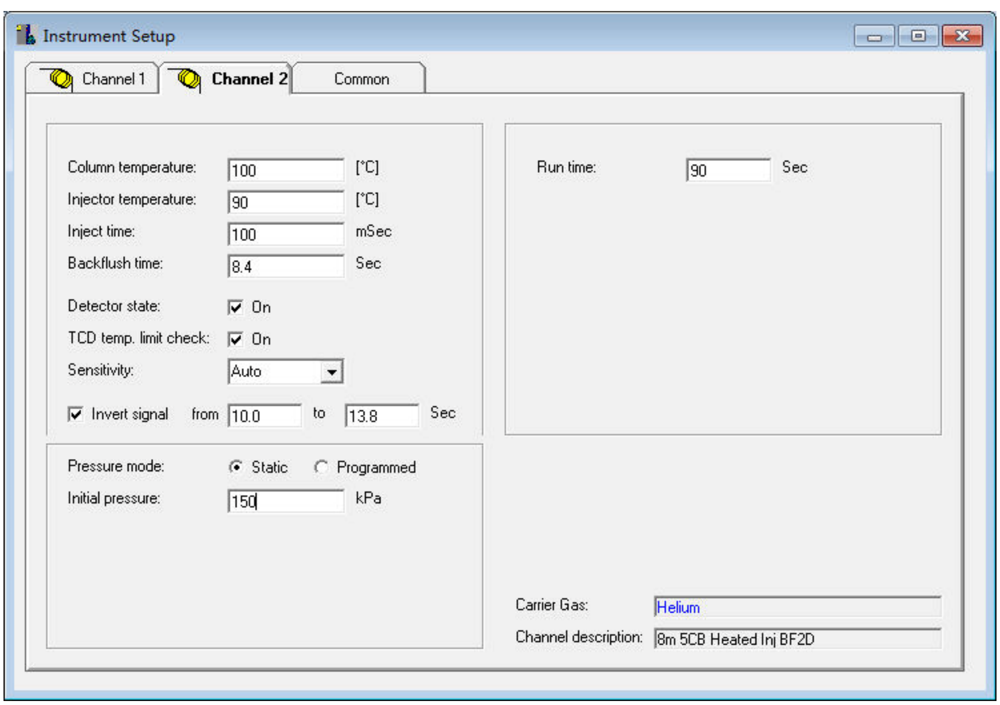



Figure 35. Method configuration in PROstation SW

# Checkout information

### Table 25 8 m 5CB BF2D and 10 m Al2O3/KCl BF2D instrument method parameters

| Method settings | 8 m 5CB Heated BF2D | 10 m Al2O3/KCl Heated BF2D |
|---|---|---|
| Carrier gas | Helium | Helium |
| Column temperature (°C) | 72 | 90 |
| Injector temperature (°C) | 110 | 100 |
| Column pressure (kPa) | 150 | 300 |
| Sample inlet temperature (°C) | 110 | 100 |
| Sample time (s) | 30 | 30 |
| Injection time (ms) | 40 | 40 |
| Run time (s) | 90 | 600 |
| Detector sensitivity | Auto | Auto |

### Table 26 8 m 5CB BF2D and 10 m Al2O3/KCl BF2D peak identification

| Peak identification | 8 m 5CB Heated BF2D | 10 m Al2O3/KCl Heated BF2D |
|---|---|---|
| Peak 1 | Composite balance | Propane 1.99 % |
| Peak 2 | Ethane 4.06 % | Propylene 0.980 % |
| Peak 3 | Propane 0.520 % | Acetylene 1.06 % |
| Peak 4 | *i*-Butane 0.0502 % | Propadiene 1.01 % |
| Peak 5 | *n*-Butane 0.0495 % | *i*-Butane 0.295 % |
| Peak 6 | Neopentane 0.0101 % | *n*-Butane 0.295 % |
| Peak 7 | *i*-Pentane 0.0306 % | *trans*-2-Butylene 0.303 % |
| Peak 8 | *n*-Pentane 0.0306 % | *i*-Butylene 0.295 % |
| Peak 9 | $C_{6+}$ | *i*-Butylene 0.307 % |
| Peak 10 | | *cis*-2-Butylene 0.306 % |
| Peak 11 | | Methyl acetylene 1.01 % |
| Peak 12 | | *i*-Pentane 0.104 % |
| Peak 13 | | 1,3-Butadiene 0.311 % |
| Peak 14 | | *n*-Pentane 0.097 % |
| Peak 15 | | *trans*-2-Pentene 0.098 % |
| Peak 16 | | 2-Methyl-2-butene 0.046 % |
| Peak 17 | | *i*-Pentene 0.097 % |
| Peak 18 | | *cis*-2-Pentene 0.094 % |
| Peak 19 | | $C_{6+}$ |

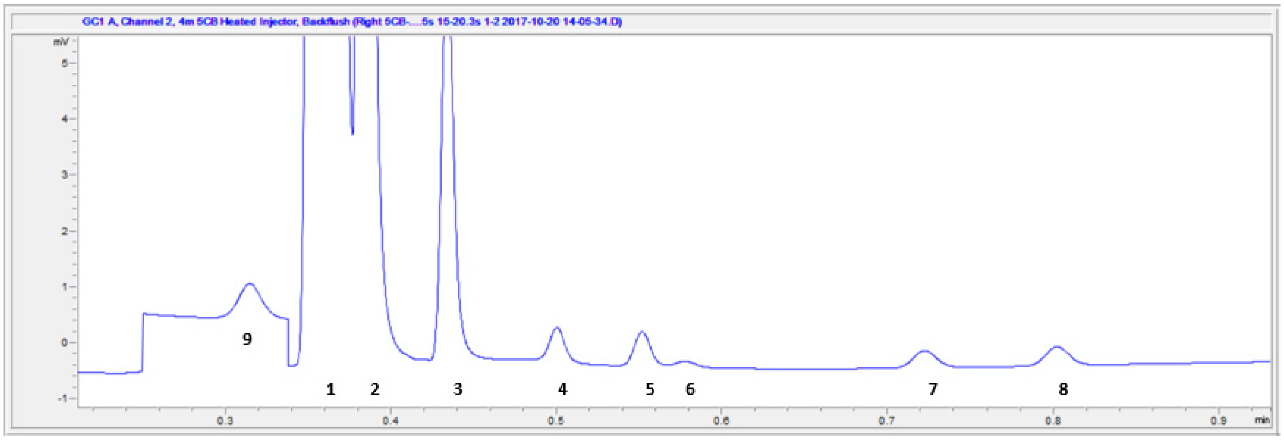



Figure 36. 8m 5CB BF2D for natural gas analysis

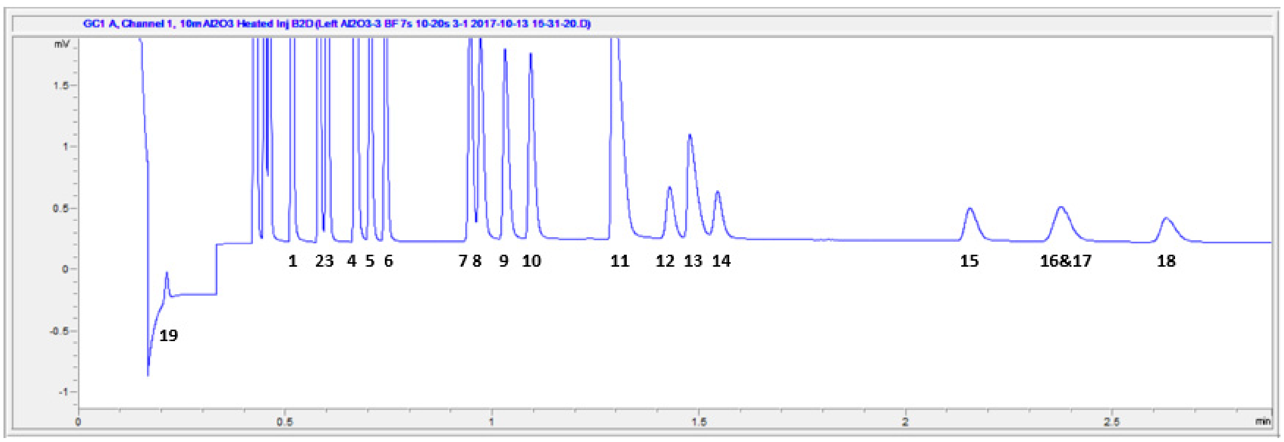



Figure 37. 10m Al2O3/KCl BF2D for refinery gas analysis

## C6+ Calorific value calculation

For calorific value calculation and application setup, please refer to the “calorific power” section from the 990-PRO Micro GC Manual or designated energy meter software.

# TCD Detector

Each GC channel is equipped with a thermal conductivity detector (TCD). This detector responds to the difference in thermal conductivity between a reference cell (carrier gas only) and a measurement cell (carrier gas containing sample components). The construction of a TCD is such that the changing thermal conductivity of the carrier gas stream, due to components present, is compared to the thermal conductivity of a constant reference gas stream.

# 6 Channel Exchange and Installation



The Agilent 990 Micro GC is designed for fast and easy installation and connection of analytical channels. This chapter describes how to install and remove GC channels.

**WARNING** **Before removing the Micro GC covers, allow all heated zones to cool down. Turn off the power, then disconnect the power cord at the source.**

**WARNING** **Remove any tubing connected to the sample-in and carrier gas inlet connectors.**

# Replacement Procedure for Micro GC Channel

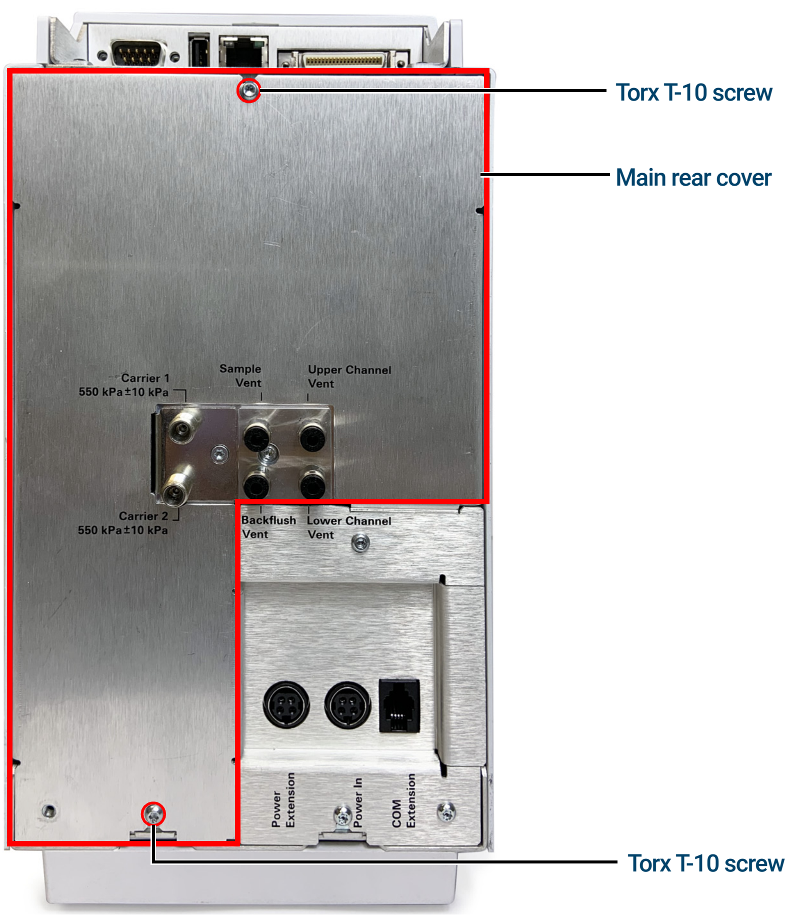
## Tools required

The following tools are required to perform the replacement procedure described in this section. Allow approximately 5 to 10 minutes to complete this process. Refer to p/n 19199H for the installation tool kit.

- 3/16 inch open-end wrench
- Torx T-10
- Torx T-20

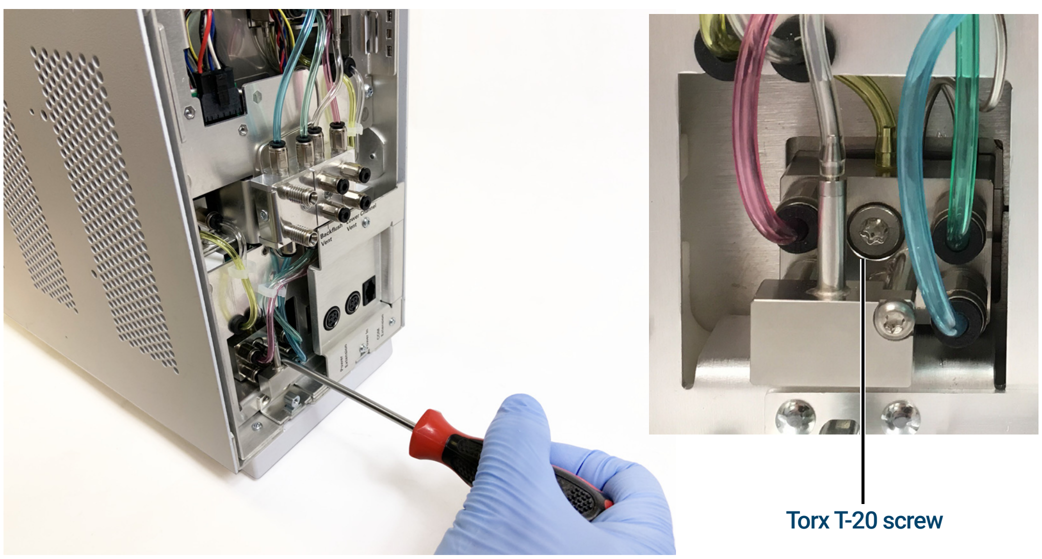
## Channel removal procedure

1 Remove power cord.
2 Remove sample-in and carrier gas connections.
3 Remove the main rear cover by removing the two Torx T-10 screws.

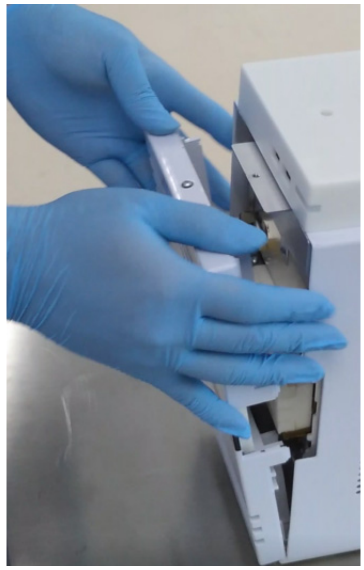


4 Carefully lift and remove main rear cover.

5 Loosen (do not remove) the Torx T-20 screw attaching the Gas Connection Adapter to the channel you are removing.

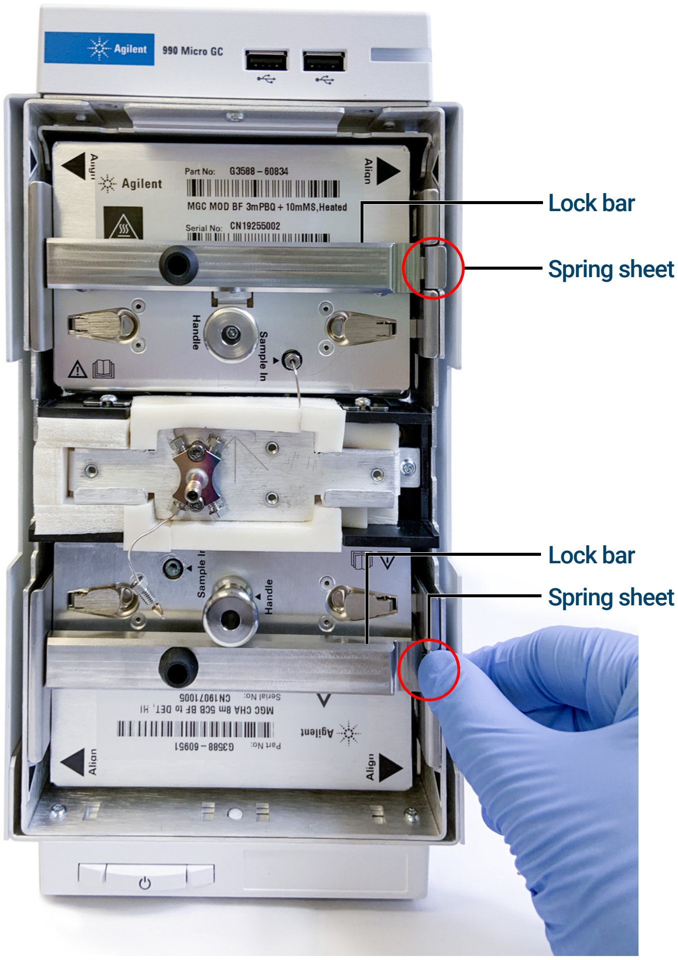


6 At the front of the device, unscrew and remove the front cover.



7 Use a 3/16 inch open-end wrench to remove the sample line tubing from the channels.

8 Press the spring sheet to remove the lock bar.




9 Lift both channel locking tabs to unlock the channel from the cabinet.

10 Pull the handle to slide the channel out of the cabinet.

# Channel installation procedure

1 Push both tabs down.


2 Carefully slide the channel into the cabinet, until it clicks into place.

3 Insert the lock bar into the square hole on the left side, then press the lock bar on the right until a click is heard.

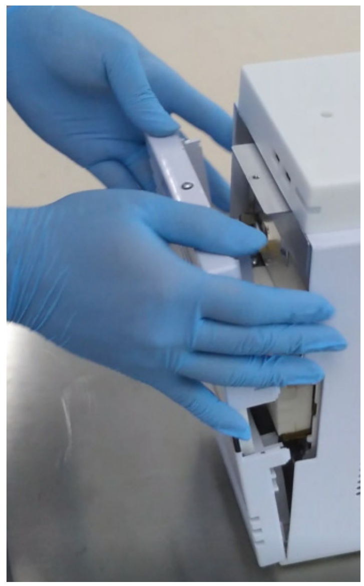

4 The remaining steps are the reverse of the **Channel removal procedure** on page 86.

# 7 Replacement Procedures

# Removing the Covers

## Removing the front cover

1 Unscrew the Torx T-10 screw at the top of the front cover, and gently pull forward from the top edge to remove the cover.



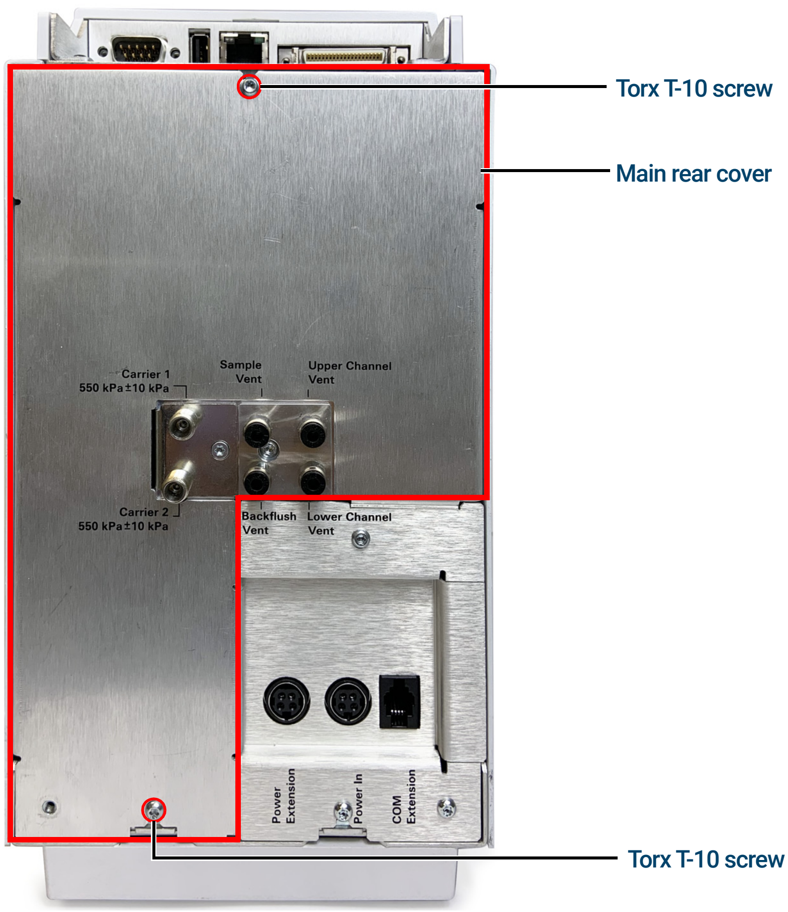
2 Installation is the reverse of removal.

# Removing the rear covers

1 Remove power cord.

2 Remove sample-in and carrier gas connections.

3 Remove the rear covers by removing the four Torx T-10 screws, two for each cover.



4 Carefully lift and remove main and secondary rear covers.

5 Installation is the reverse of removal.

# Sample Line Replacement

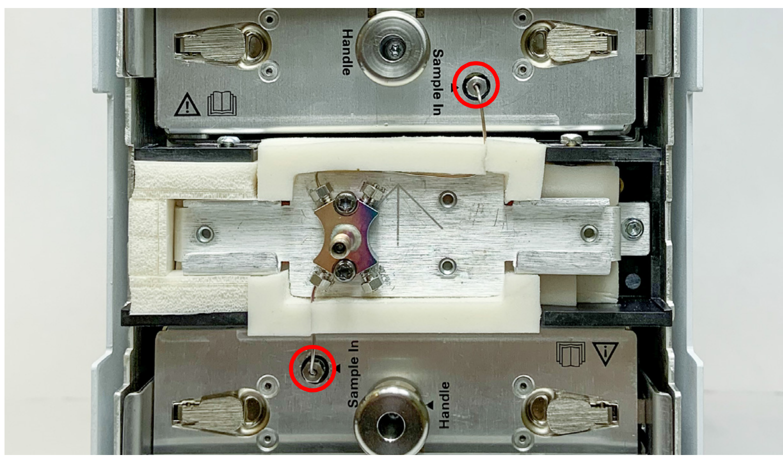
## Tools required

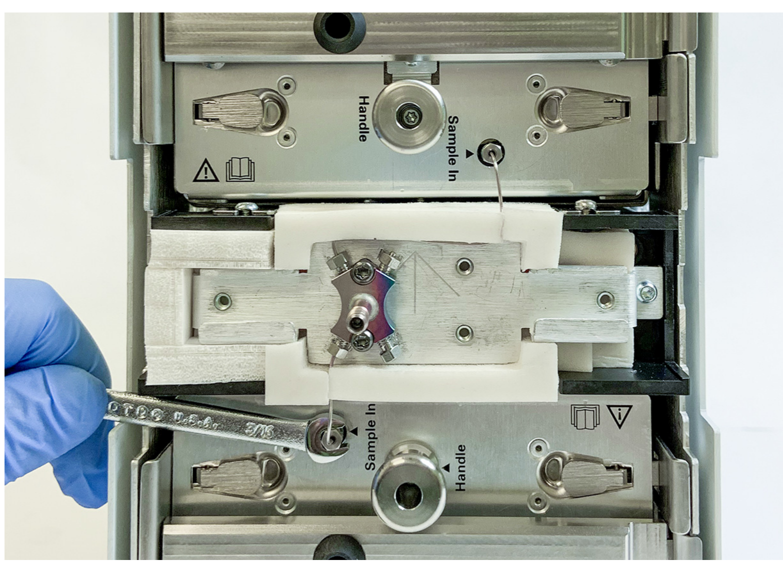
The following tools are required to perform the replacement procedure described following section. Allow approximately 5 to 10 minutes to complete this process.

- 3/16 inch open-end wrench
- Torx T-10 screwdriver

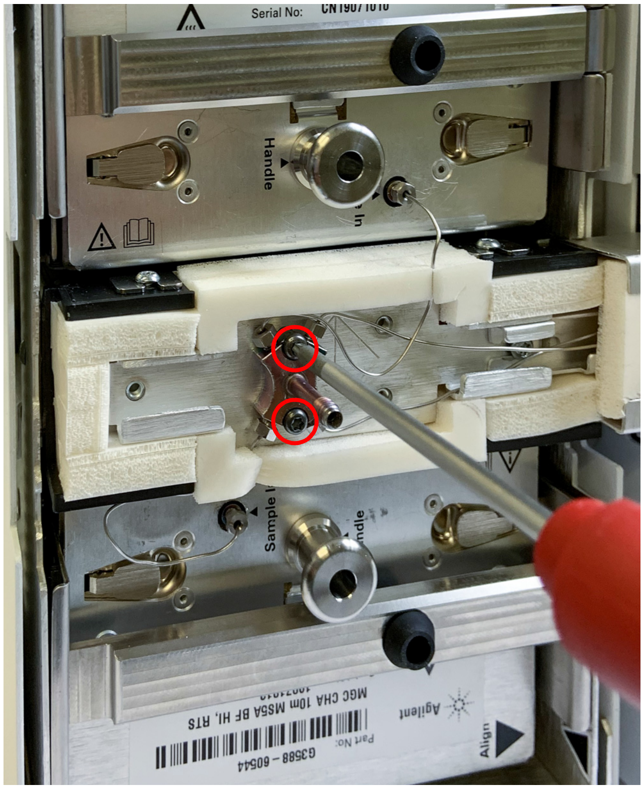
## Replacement procedure for Micro GC sample line

1. Shut down the GC, and allow time for it to cool to ambient room temperature.
2. Disconnect the GC power plug from the mains outlet.
3. Disconnect any sample gas feed lines attached to the inlet port.
4. Remove the front cover as described in **Removing the front cover** on page 94.
5. Use a 3/16 inch wrench to unscrew the sample line nut from the front of the channels.



6 Remove the two Torx T-10 screws from the inlet manifold.




7 Use a 3/16 inch wrench to unscrew the sample line nuts from the inlet manifold.

8. Use a 3/16 inch wrench to screw the new sample line nut to the inlet manifold.
9. Install the inlet manifold using two Torx T-10 screws.
10. Use a 3/16 inch wrench to screw the new sample line nut to the front of the channel.
11. Tuck the sample line into the GC cabinet so that the line does not interfere with replacement of the front cover.
12. Replace the front cover.

# RTS Filter Replacement

## Tools required

The following tools are required to perform the replacement procedure described following section. Allow approximately 5 to 10 minutes to complete this process.

- 3/16 open-end wrench
- Torx T-10
- Torx T-20

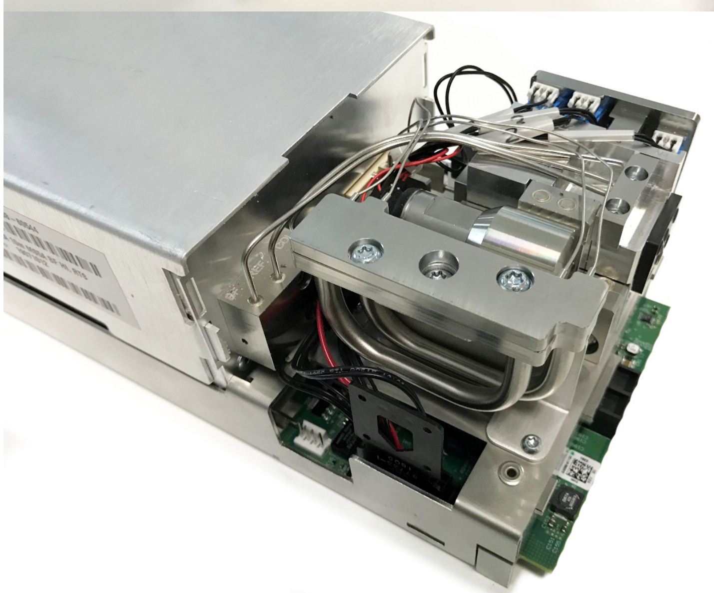
## Replacement procedure for Micro GC RTS filter

1 Shut down the GC, and allow it to cool to ambient room temperature.

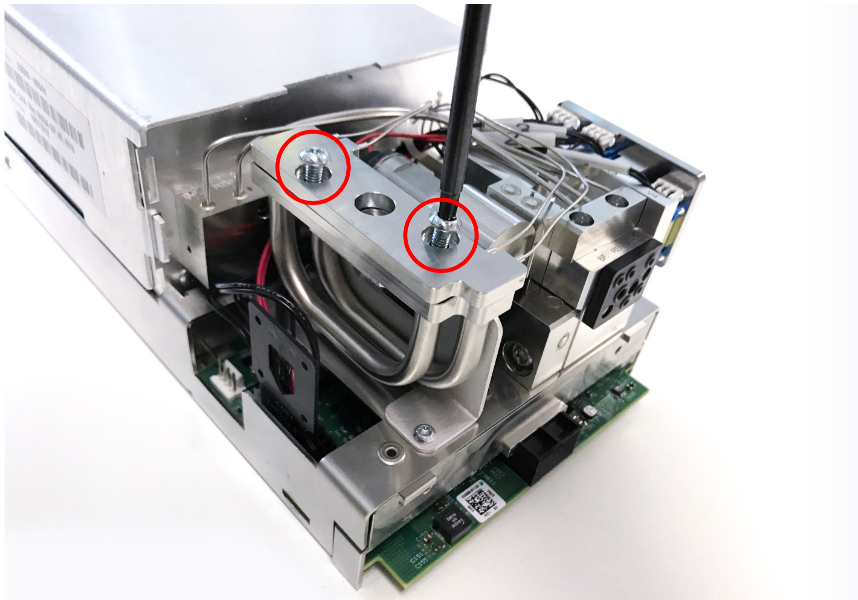
2 Remove the main back cover of the GC as described in **Removing the rear covers** on page 95.

3 Remove the channel using the procedure in **Channel Exchange and Installation** on page 85.

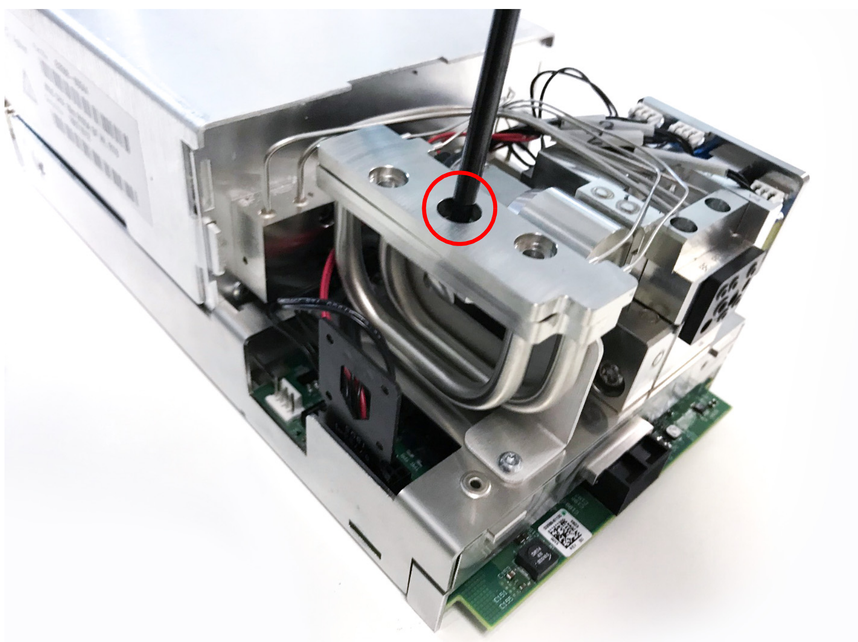
4 Unscrew the two Torx T-10 screws and remove the DEGC cover.



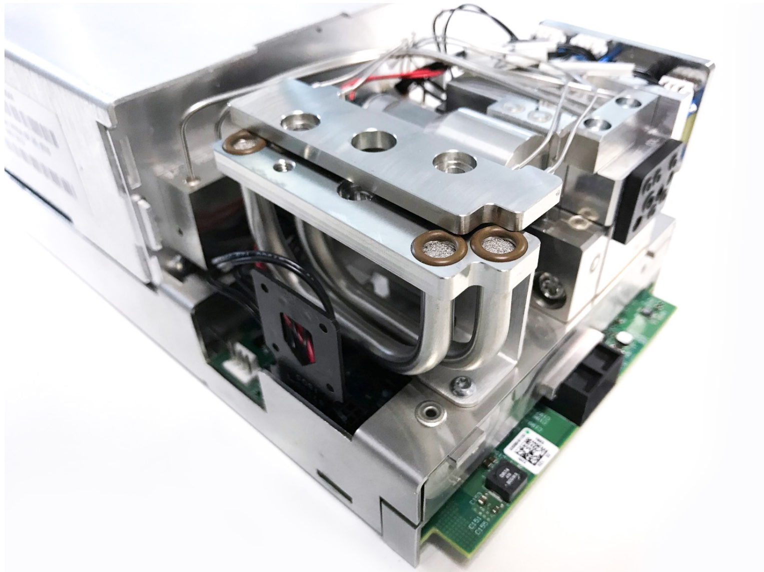
5 Remove the two Torx T-20 screws.

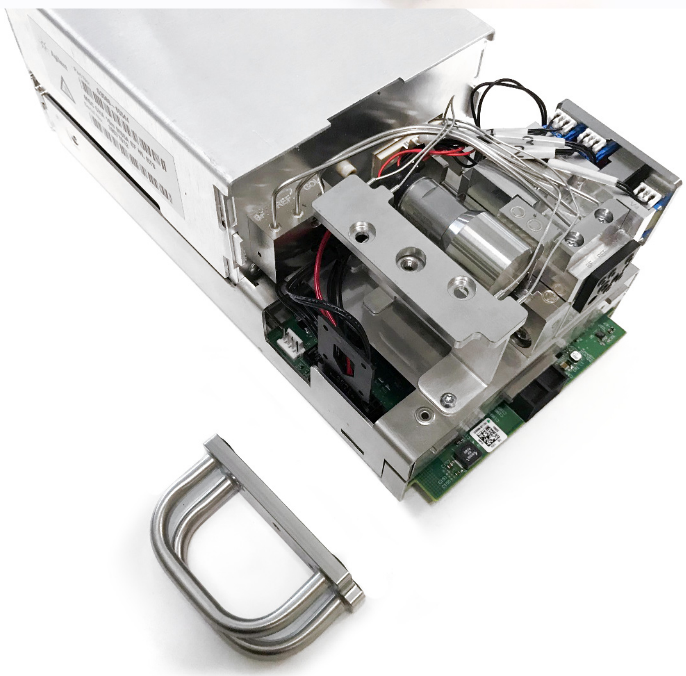


6 Remove the Torx T-20 screw in the center.



7 Carefully remove the RTS filter.





8 Installing is the reverse of removing.

# Septum Replacement for Manual Injection

## Septum injection port

Figure 38. Manual injection septum replacement

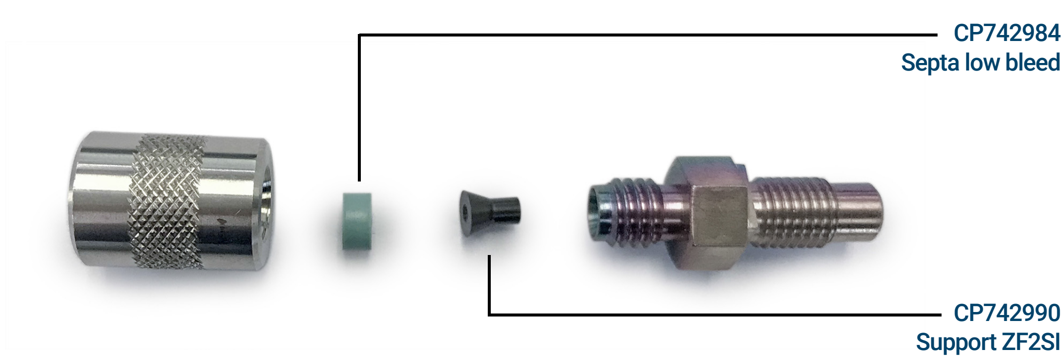



Figure 39. Disassembled septum injection port

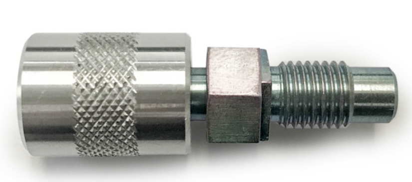


Figure 40. Septum injector assembly (CP742985)

# Genie Filter Membrane Replacement

## Tools required

The following tools are required to perform the replacement procedure described following section. Allow approximately 5 to 10 minutes to complete this process.

- Gloves
- Torx T-20 screwdriver
- Tweezers

## Replacement procedure for Genie Filter membrane

1 Remove all tubing.


2 Remove the two screws with a T-20 screwdriver.


NOTE

**Wear gloves to prevent contamination of the filter.**

3 Separate the two parts. Considerable force may be required to separate the two parts of the filter.


4 Use tweezers to remove the attached white membrane.


5 Place a new membrane at the center of the part, and replace the top.

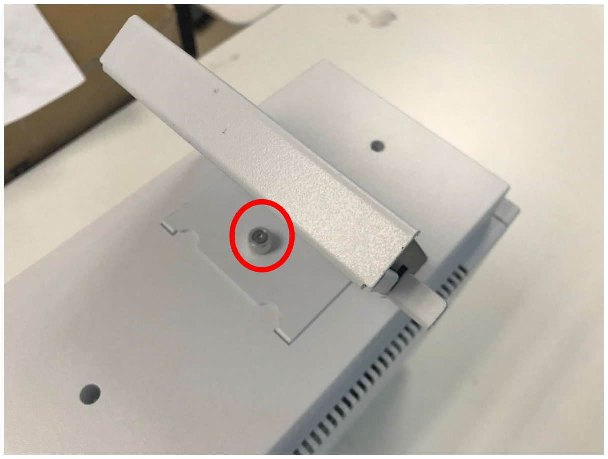
6 Replace the two screws, and tighten with a T-20 screwdriver.

# Connecting the External LCD

The Agilent 990 Micro GC comes with an optional LCD (p/n G3588-68862). The display is a 4.7 inch touch screen. The LCD is fixed at the top of main unit and controlled by the mainboard. The local LCD can show system status, system information, and test results to users. It also displays errors, reminder messages, and guidance for system maintenance and diagnostics.

To mount the LCD on the Micro GC:

1 Attach the LCD mounting bracket using the captive thumb screw.



2 Connect the LCD assembly to the side of the top assembly using the HDMI communication cord.

## LCD touch screen

The LCD touch screen is connected to the GC through an HDMI cable. It is used for displaying instrument information with limited control capability.

NOTE

**For the touchscreen to function, it must be connected before powering on the GC.**

### Overview

You can see how many channels are installed, the instrument status, column actual temperature, injector actual temperature and actual pressure, as well as other information.

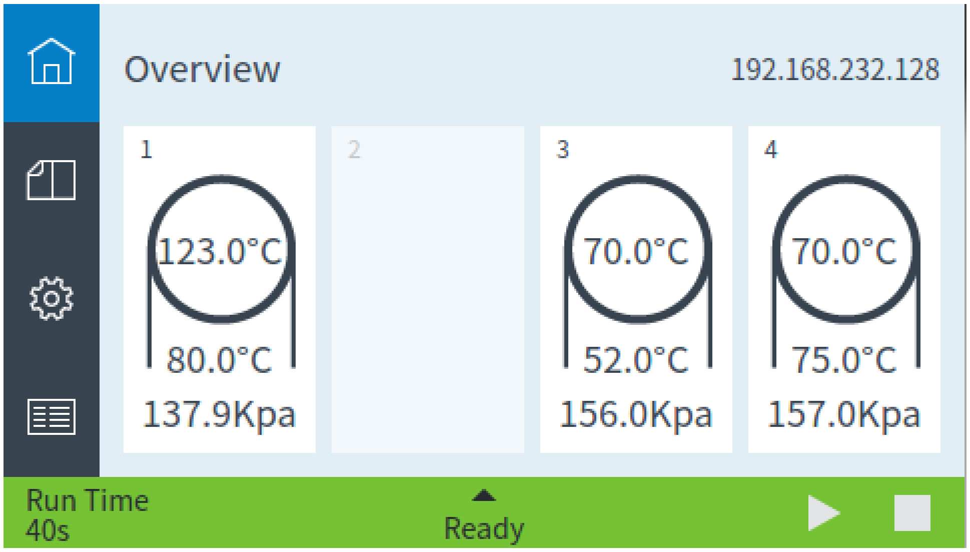



Figure 41. Overview

### Method and Status

This page displays instrument status and setpoints.

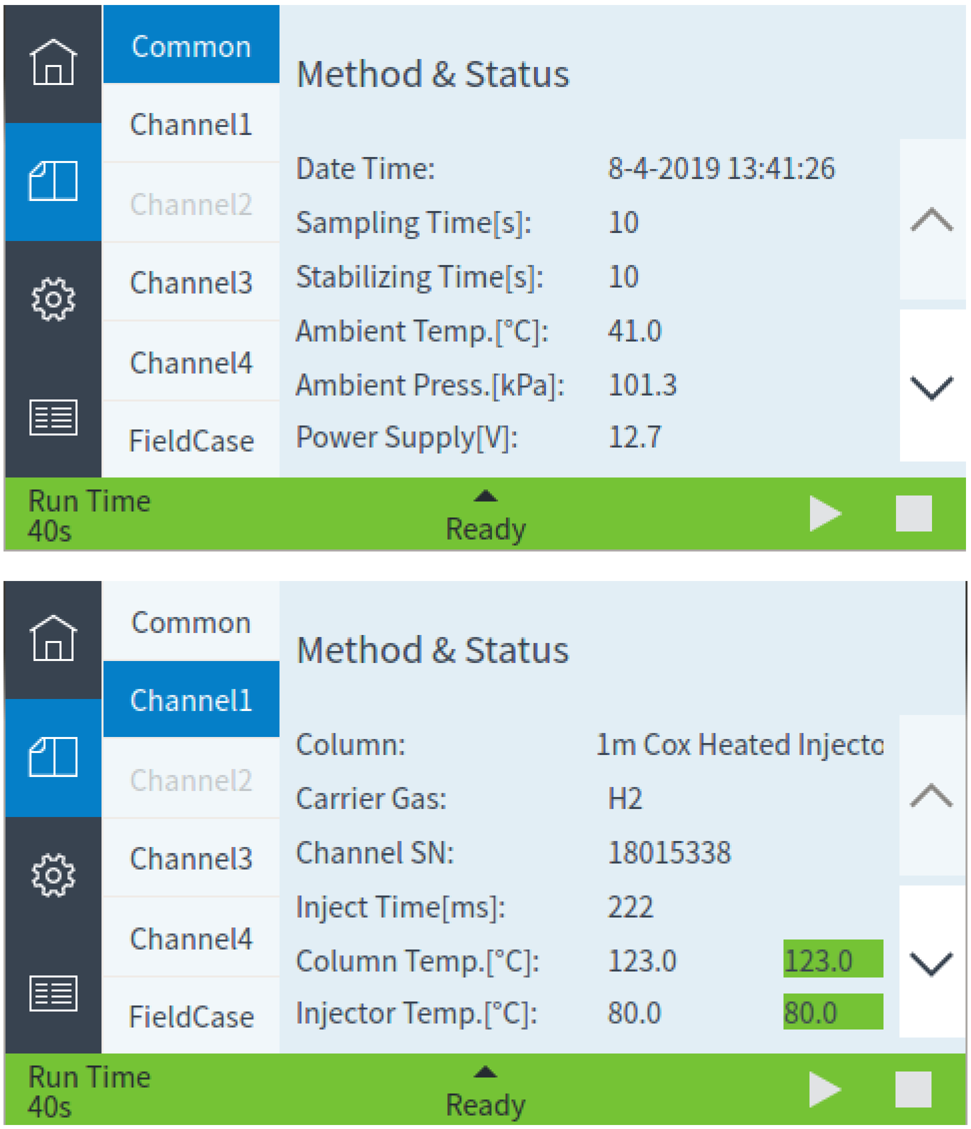



Figure 42. Method & Status

NOTE

**Method editing is not supported by LCD UI. The only exception is the 990 Mobile Micro GC, which allows the user to switch the gas source through this LCD UI.**

### Configuration

This is for display information of network, license and firmware version. It also supports rebooting the Micro GC and changing the language of LCD UI.

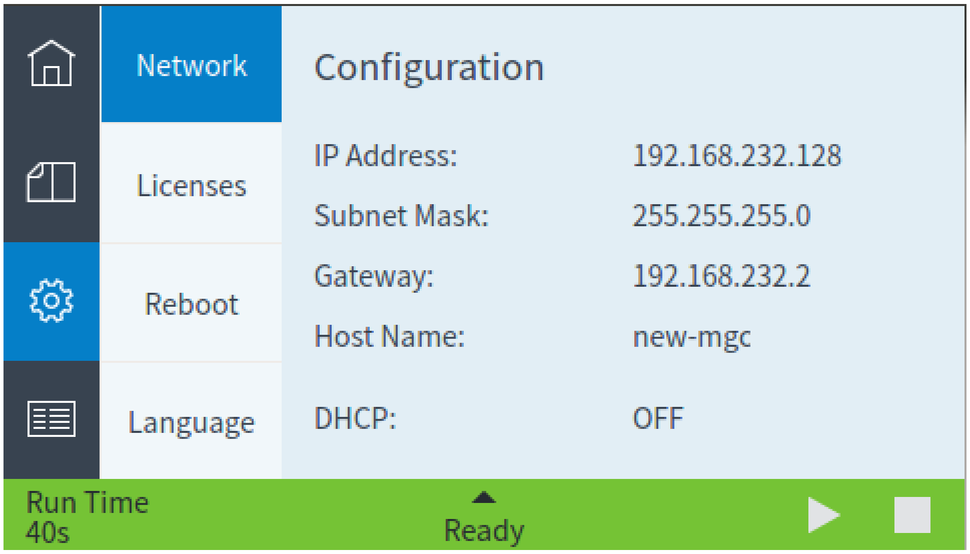



Figure 43. Configuration

### Customized Display

This is a customizable page for displaying instrument information, including:

- Actual operating conditions
- Instrument and run status
- Calculated values
- Instrument errors

This feature needs a PRO license. See PROstation for 990 Micro GC User Manual (p/n G3588-90012)

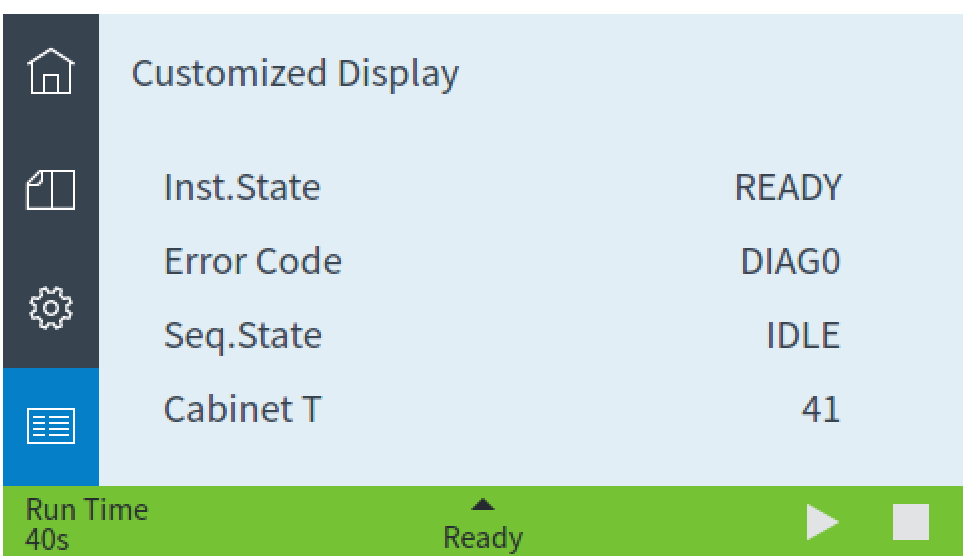



Figure 44. Customized Display

8

# Communications



This chapter describes the input and output ports of the Micro GC for interfacing with external devices. Also included is an overview of the constant pressure cycle and the ramped (programmed) pressure cycle of the Micro GC.

# Access the Connection Ports

The external device connection ports on the 990 Micro GC are located in the top assembly. The connectors at the rear of the top assembly, from left to right, are RS-232 (COM-1), USB, Ethernet (LAN), and multiconnector (for digital and analog I/O). See **Figure 45**. For details of COM 1, see **Table 27** and **Figure 48** on page 113.

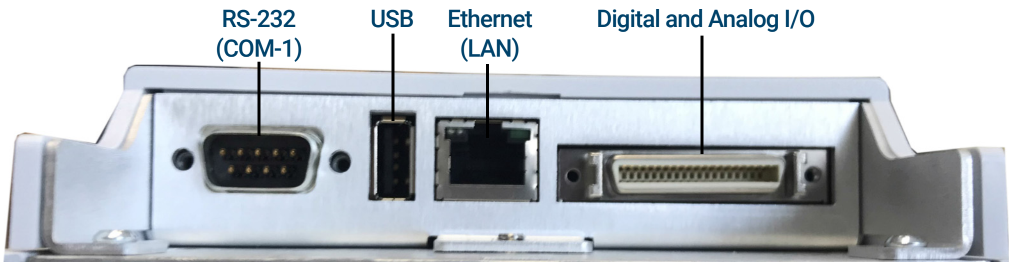



Figure 45. Top assembly rear connection ports

The side of the top assembly features the LCD cable connector and a breakaway which conceals the COM 2 and COM 3 connection ports. See **Figure 46**. For details of COM 2 and COM 3, see **Table 28** and **Figure 49** on page 114.

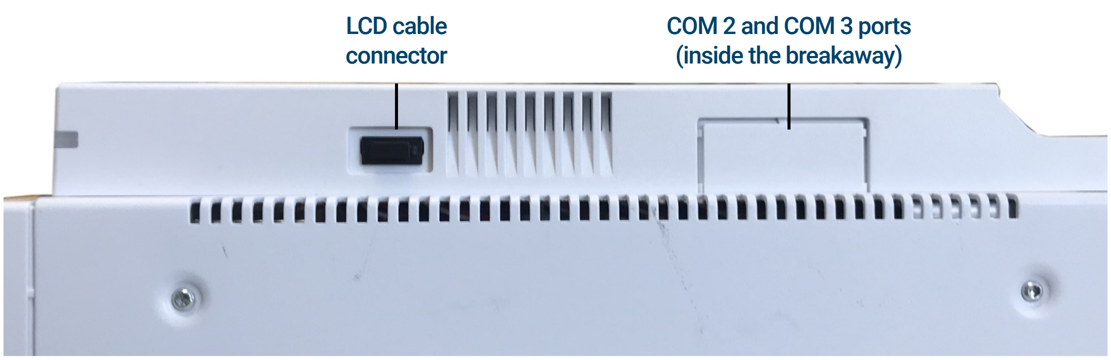



Figure 46. Top assembly LCD cable connector and port connection for COM 2 and COM 3

The front of the top assembly features two USB connectors. See **Figure 47**.

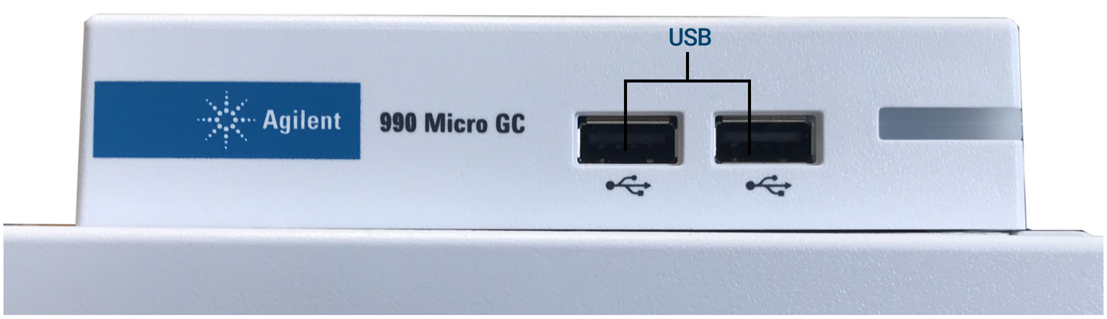



Figure 47. Top assembly front USB ports

### Table 27 COM 1 PINs

| | PIN | Comment | |
|---|---|---|---|
| COM 1 | 1 | NC | no connection |
| | 2 | RXD | received data |
| | 3 | TXD | transmit data |
| | 4 | NC | no connection |
| | 5 | GND | signal ground |
| | 6 | NC | no connection |
| | 7 | RTS | request to send |
| | 8 | CTS | clear to send |
| | 9 | NC | no connection |

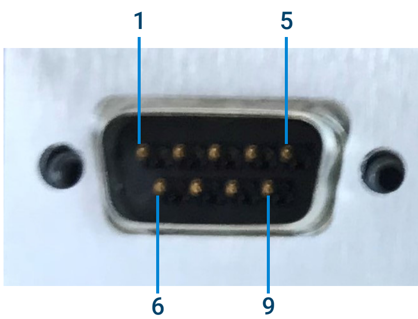



Figure 48. COM 1 detail

Table 28 COM 2 and COM 3 PINs

| Com port | PIN No. | RS 232 | RS 422/485 | RS485 2-wire |
|---|---|---|---|---|
| COM2 | 1 | GND | GND | GND |
| | 2 | RTS | TX- | Data- |
| | 3 | TXD | TX+ | Data+ |
| | 4 | RXD | RX+ | not used |
| | 5 | CTS | RX- | not used |
| COM3 | 6 | GND | GND | GND |
| | 7 | RTS | TX- | Data- |
| | 8 | TXD | TX+ | Data+ |
| | 9 | RXD | RX+ | not used |
| | 10 | CTS | RX- | not used |


Figure 49. COM 2 and COM 3 detail

# 990 Chromatography Data Systems

The 990 Micro GC requires an Agilent chromatography data system (CDS) for control, peak identification, integration, data analysis, reporting, and so forth. The CDS requires a LAN (Ethernet) connection or Wi-Fi. Multiple Micro GCs can be controlled using an Agilent data system such as OpenLAB EZChrom, OpenLAB ChemStation, or OpenLAB 2.x. The maximum number of Micro GCs controlled is limited by your software license. For detailed information on setting method parameters, see the help files in the data system. For information on connections between Micro GCs and external devices, see **External I/O** on page 123.

# Ethernet Networks

About the internet protocol:

- Developed to allow cooperating computers to share resources across a network.
- TCP and IP are the two best-known protocols in the Internet Protocol Suite.
- Other protocols/services are FTP, Remote Login (Telnet), Mail, and SMTP.

The Agilent data systems require an Ethernet network for data communications with the Micro GC. This network can be a local area network (LAN) or wide area network (WAN).

General requirements:

- Micro GC with main board installed (100 Mbps connection)
  - Cat 6, Cat5e, or Cat 5 UTP/STP cabling.
  - The network should comply with Standard Ethernet (IEEE 802.3).
  - The network must be 100BASE-T, 10/100BASE-TX, or 10/100/100BASE compatible hubs or switches.
- TCP/IP should be used on the network.

The Micro GC ships with an Ethernet crossover cable (RJ-45 connector, 2.8 meter) for direct connection between the Micro GC and a PC with a chromatography data system (CDS).

## IP Addresses

- An IP address uniquely identifies a computer or device on the network or internet.
- IP addresses are made up of four 8-bit numbers, and each of these numbers is separated by a decimal point.
- Each of the 8-bit numbers can represent a decimal value of 0-255.
- Each part of an IP address can only be in that range (for example, 198.12.253.98).

A network can be public (addressable from the internet) or private (not addressable from the internet). A private network can also be isolated, that is, physically not connected to the internet or other networks. In many cases, you can set up an isolated LAN for instruments. For example, an isolated, private LAN may consist of a workstation computer, four Micro GCs, a printer, a LAN switch, and cabling. Isolated LANs must use IP addresses in the "private" ranges shown in **Table 29**.

**Table 29 Private (isolated) LAN IP address ranges**

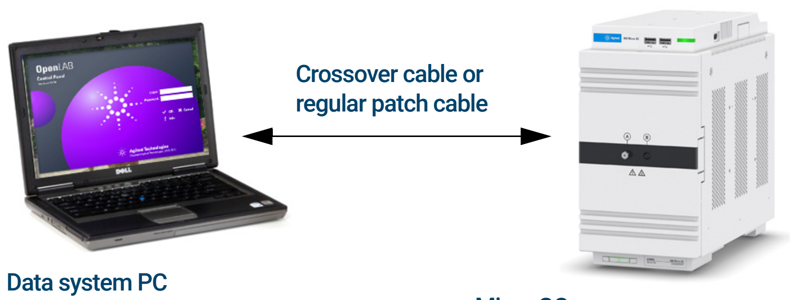
| Starting IP | Ending IP | Subnet mask | Type |
|---|---|---|---|
| 0.0.0.0 | 255.255.255.255 | N/A | Public |
| 10.0.0.0 | 10.255.255.255 | 255.0.0.0 | Private |
| 172.16.0.0 | 172.31.255.255 | 255.255.0.0 | Private |
| 192.168.0.0 | 192.168.255.255 | 255.255.0.0 | Private |

# Example network configurations

## Peer-to-peer

A peer-to-peer network (See **Figure 50**) is required to assign or change the IP address of a Micro GC. It can also be used when no network is required or available. The cable(s) used for peer-to-peer connections depend on the installed main board.

- For a Micro GC with main board installed, either a crossover cable (CP740292) or a regular (noncrossed) patch cable can be used.




**Data system PC**
Any IP address allowed

**Micro GC**
with mainboard

Single 990 connected to a local workstation. IP address in the same subnet range as the computer subnet range.

Figure 50. Peer-to-peer (single instrument)

Peer-to-peer communication requires IP addresses in the same subnet range for the computer and the Micro GC.

After assigning or changing the IP address of a Micro GC, you can remove the connection cable and connect the computer and Micro GC to a local network using normal cabling. See **Rear View** on page 19.

## Local Area Network (LAN)

An example of a LAN configuration is shown in **Figure 51**.

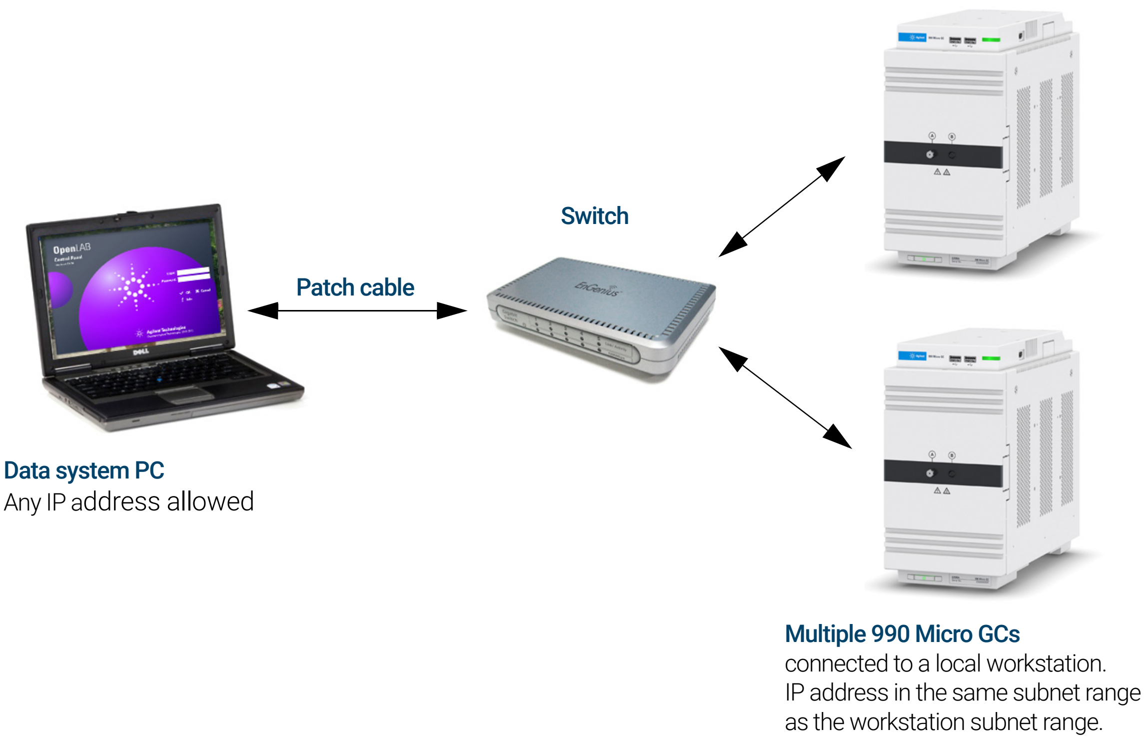



Figure 51. Local network (multiple instruments)

OpenLAB CDS maximum connections are limited by the computer speed, license, and network performance.

### Global network (WAN)

An example of a Global network is shown in **Figure 52**.

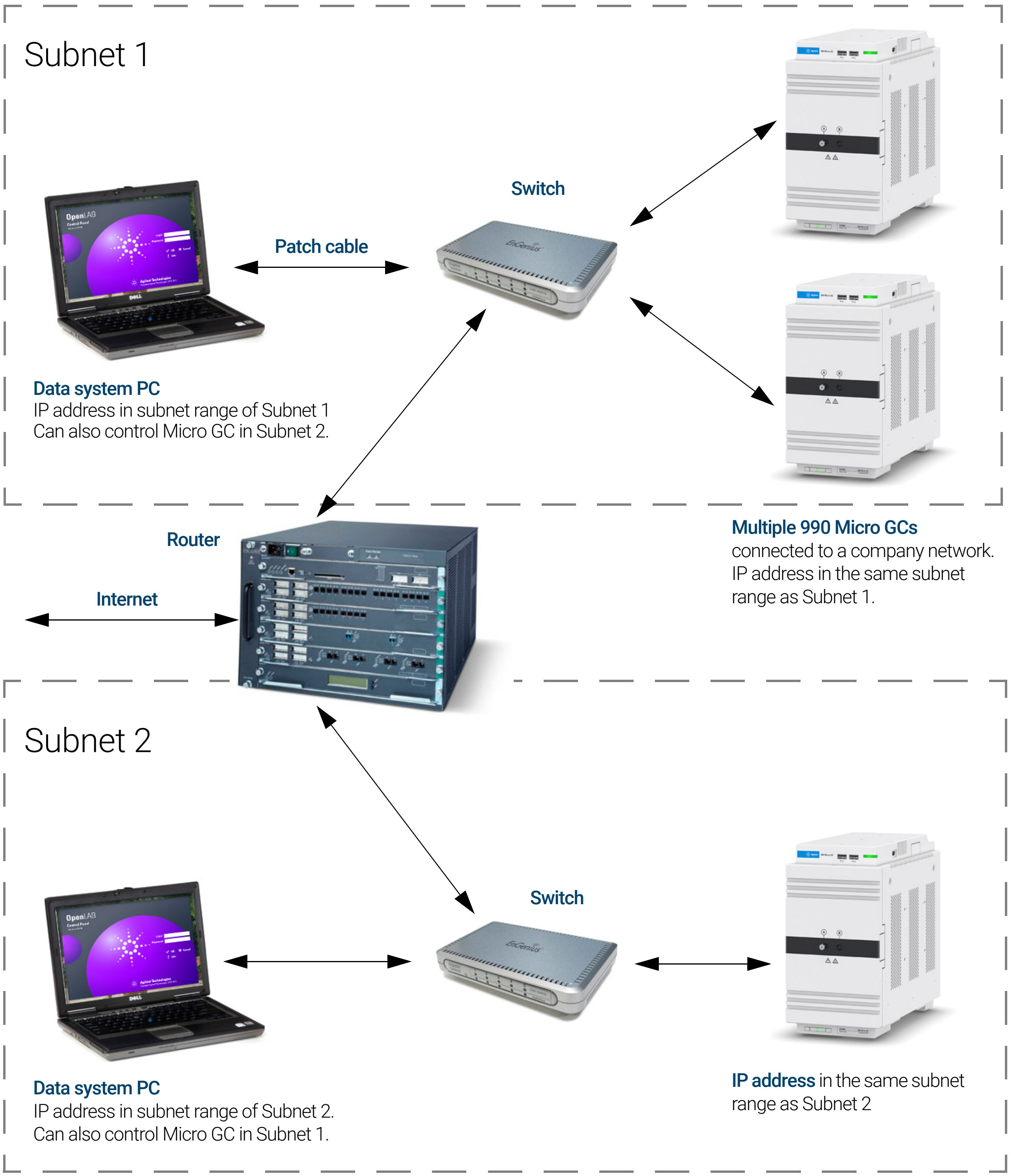



Figure 52. Global network with multiple instruments

# USB Wi-Fi

The 990 Micro GC with main board includes a USB port. USB Wi-Fi has the following functions:

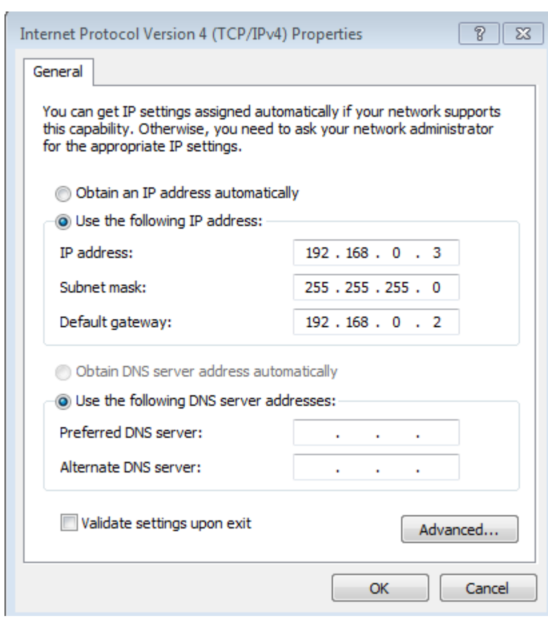
- Supports 1 USB Network Interface Card (NIC)
- Supports NIC running in AP mode (ad-hoc mode)
- Supports configuration through GC web page.
- Supports hotpluging

**Table 30 USB Wifi part numbers**

| Part number | Country |
|---|---|
| G3581-60060 | USB wifi for China |
| 0960-3303 | USB wifi for other countries |

Preparation: One USB Network Interface Card (NIC) (Requires Realteck RTL8188 family chipset.)

1. Insert the USB NIC into USB port of 990 Micro GC or through a USB hub.
2. On your PC desktop, open the wireless connection panel. Find the instrument WIFI hotspot. Note the name **'AP-990'** is the default SSID name of USB NIC attached to micro GC. You are able to change this name through the GC web page later.
3. Connect to the hotspot. You will be prompted to input the WPA passphrase. The default passphrase is **12345678**. You are able to change it through the GC web page later.
4. The wireless IP address of Micro GC is fixed to **192.168.0.2** (Submask 255.255.255.0). Then please make sure the wireless settings of your PC is in the same network range. You are free to set your local PC wireless IP from 192.168.0.3 to 192.168.0.255.




5. Now you are able to access to GC's webpage through IP address 192.168.0.2.
6. For more available configurations of the WIFI function, please refer to **Maintenance** > **Network WIFI (optional)** in the web interface.

# Frequently Asked Questions (FAQ)

**Q**: Can I connect the Micro GC to my site network?

**A**: Yes, if the network is standard Ethernet and uses TCP/IP with UTP cabling.

**Q**: I'm using a DHCP server; can I use this to assign an IP address to the Micro GC?

**A**: If you have a Micro GC with main board installed, yes.

**Q**: How do I assign an IP address to the Micro GC?

**A**: See **Step 6: Assign an IP address** on page 37.

**Q**: Are the network settings saved if the Micro GC is restarted, or after loss of power?

**A**: Yes, the network settings of the Micro GC are stored in flash memory, and will not be erased at loss of power.

**Q**: Can I control my Micro GC from anywhere in the world through the Internet?

**A**: Yes, if your network is designed for this, and has internet access or remote access facilities (the ports 4900, 4901 and 4902 must be open).

**Q**: How Can I connect to my Micro GC if the IP address is forgotten or unknown?

**A**: See the **Note** on **page 38** to assign another IP.

## Glossary of network terms

**Crossover cable** A cable used to connect two, and only two, Ethernet devices directly without the use of a hub or switch.

**Domain** One of several settings within the TCP/IP configuration that identifies paths used to communicate with Ethernet devices. The Domain is an IP address.

**Ethernet address (MAC address)** This is a unique identifier that every Ethernet communication device has assigned to it. Typically, the Ethernet address cannot be changed and is the permanent way of identifying a particular hardware device. The Ethernet address consists of 6 pairs of hexadecimal digits.

**Gateway** This is one of several settings within the TCP/IP configuration that identifies paths used to connect with Ethernet devices on a different subnet. The Gateway is assigned an IP Address.

**Host name** The host name is an alternate way of identifying a device that is friendlier to people. Frequently the host name and the IP address may be used interchangeable.

**IP address** This is a unique number for each Ethernet device within the set of connected devices. Two PCs may have identical IP addresses so long as they are not interconnected to each other through the Internet. The IP Address consists of a series of four sets of decimal numbers (between 1 and 255) that provide routing information used by the TCP/IP protocol to establish a reliable connection. Without the IP Address, communications would be bogged down trying to establish connections to Ethernet addresses at unknown locations.

**Patch cable** A cable that is used to connect Ethernet devices to hubs, switches, or your company network.

**Protocol** A set of rules that govern how computers send and receive information.

**RJ45 connector** A telephone jack style connector used for a Universal Twisted Pair (UTP) hardware connection for 10/100Base-T Ethernet connections. RJ45-style connectors are used by the Micro GC.

**TCP/IP** An international standard protocol used by the Internet. We use this protocol for communication to the Micro GC. You may find several network protocols, such as IPX/SPX and NetBEUI, installed on your computer.

# External I/O

Connections between Micro GCs and external devices are made with the appropriate cable to the External I/O port. The external I/O port can handle six analog inputs (input 0 to 10 Volt).

The user interface receives analog information and translates it into actions to be taken by the local user interface, events, or data to be shown or stored in the remote user interface. In OpenLAB EZChrom and OpenLAB ChemStation only status is visible.

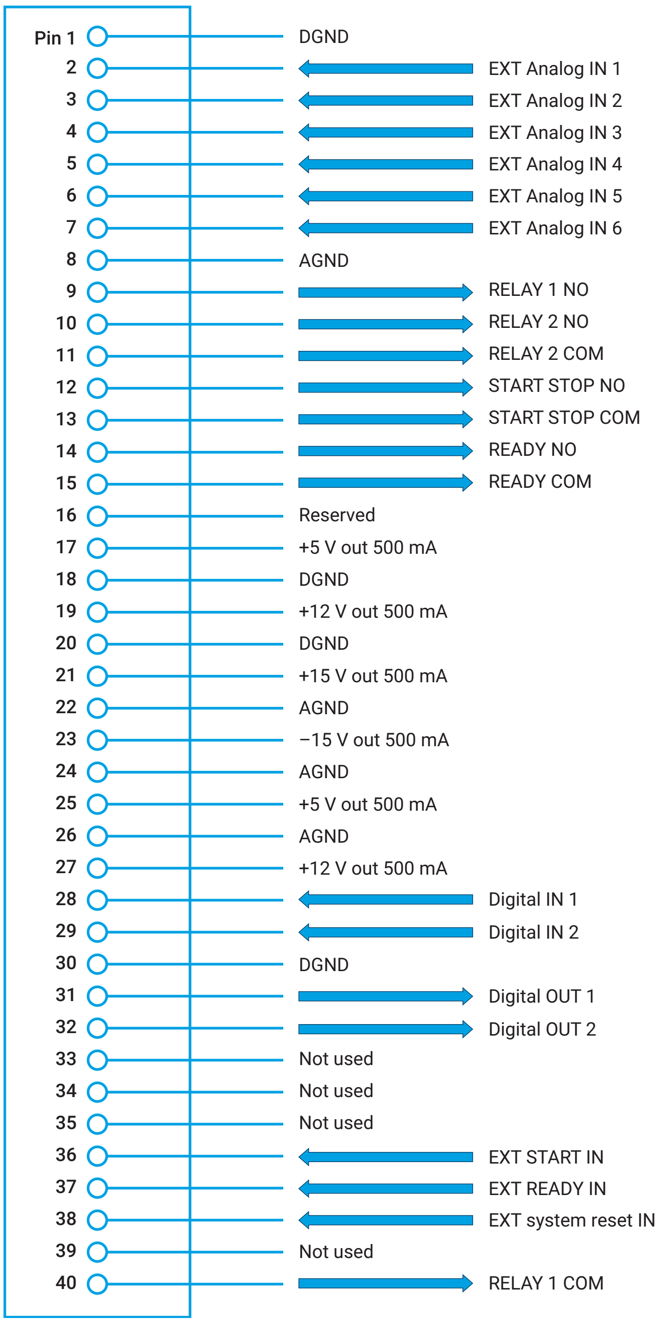



Figure 53. External connections

The 40 pin External I/O can be adapted to separated 25 pin Digital I/O (see **Figure 54**) and 15 pin Analog I/O (see **Figure 55**), with an extension Y Cable (p/n G3588-60825) shown in **Figure 56** on page 125. Note the I/O definition of adapted ports are compatible with those of the 990 Micro GC.

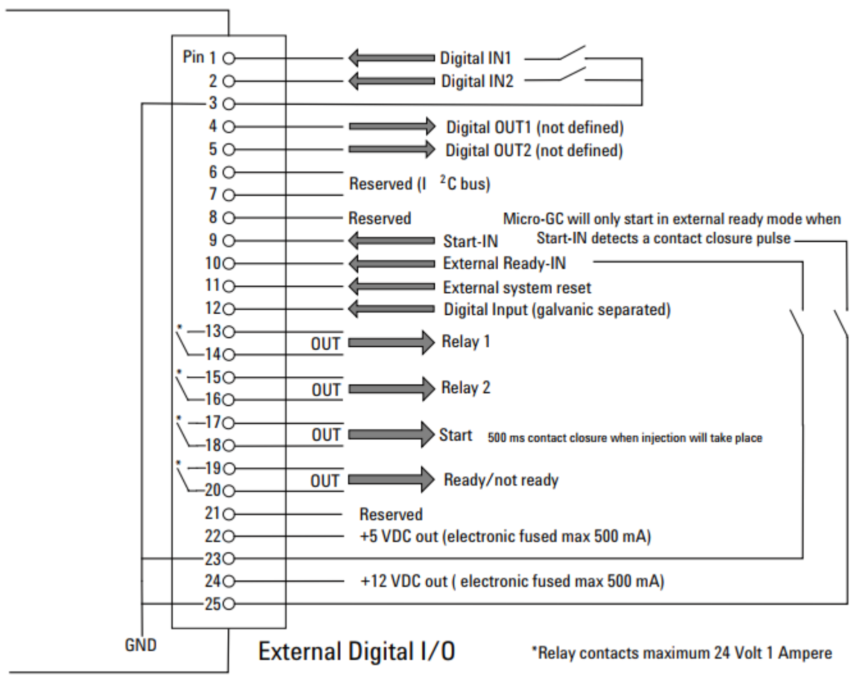



Figure 54. External digital I/O

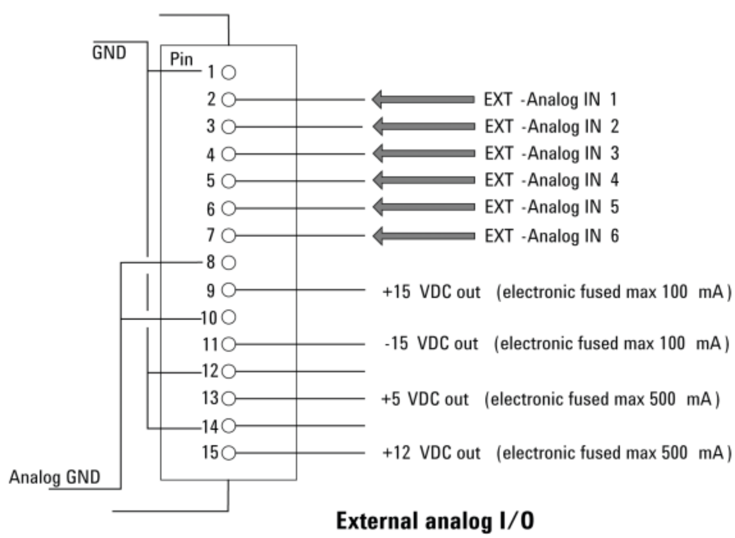



Figure 55. External analog I/O

Figure 56. Extension Y Cable (p/n G3588-60825)

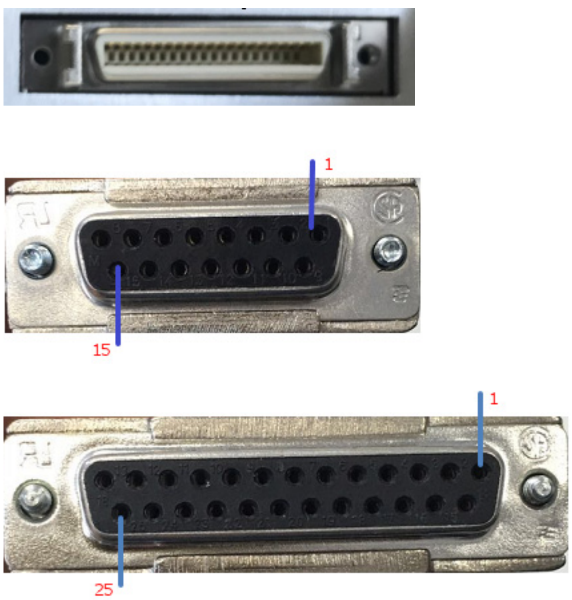



Figure 57. Analog and digital I/O for Extension Y Cable (p/n G3588-60825)

# 9 Errors

# Error Handling

During operation, a series of events and error messages are generated indicating the start or finishing of certain actions and procedures as well as smaller and fatal errors somewhere in the instrument. This section describes how the Micro GC reacts to these events or messages.

The following error classes as well as the subsequent actions are available:

**Class 0 *Internal info*:** These are events indicating a certain procedure has started or finished. In no way do they influence the proper functioning of the instrument.

**Class 1 *Advisory warning*; the instrument continues:** These are the less critical advisory warnings not requiring immediate action by the user. The ongoing run may be minimally affected by it and thus need not be stopped. Class 1 error messages indicate certain malfunctions of the instrument. Some errors of this type keep the instrument from becoming ready.

**Class 2 *Recoverable errors for logging*; instrument shutdown, red LED ON:** These are recoverable errors for which the user needs immediate warning (a popup or warning may appear in the data system and the red LED lights). The run in progress is stopped since its results will definitely be wrong. Corrective action by the user or instrument service may be required. This kind of error can be cleared without power cycle.

**Class 3 *Critical errors for logging*; instrument shutdown, red LED ON:** These are critical errors for which the user needs immediate warning. The red LED lights. An instrument shutdown occurs. Corrective action by the user or service is required. This kind of error can only be cleared with a power cycle.

**Class 4 *Fatal errors for logging*; instrument shutdown, red LED ON, Auto Reboot:** These are fatal errors for which the user needs immediate warning. The red LED lights. An instrument shutdown and auto reboot occur.

All errors, regardless of class, are available to the data system under instrument status (for troubleshooting). All Class 1 and higher errors are also logged in the instrument's flash memory.

All errors are identified by numbers built from the error class and a number. Events are not numbered.

# Error List

The GC error code is reported as CLNNN in which:

**C** = error class (severity)

**L** = location

**NNN** = error number or event number.

The Error class can be one of the following values:

- 0=diagnostic info.
- 1=advisory warning.
- 2=recoverable error.
- 3=critical error.
- 4=fatal error.

There are five locations:

- 0=mainboard.
- 1=channel 1.
- 2=channel 2.
- 3=channel 3.
- 4=channel 4.

**Table 31 Error list**

| Error code | Class | Error messages |
| --- | --- | --- |
| 0 | INFO | |
| 1 | INFO | Init passed |
| 2 | RECOVERABLE | Init error |
| 3 | CRITICAL | Pressure too low, chan = <n> |
| 4 | CRITICAL | Pressure too high, chan = <n> |
| 5 | RECOVERABLE | Pressure cannot reach its setpoint, chan = <n> |
| 6 | INFO | Pressure restored, chan = <n> |
| 7 | RECOVERABLE | Sample line temperature fault, chan = <n> |
| 8 | CRITICAL | Sample line heater sensor fault, chan = <n> |
| 9 | CRITICAL | Sample line heater is open, chan = <n> |
| 10 | CRITICAL | Sample line heater is short, chan = <n> |
| 11 | WARNING | Sample line heating too slow, chan = <n> |
| 12 | INFO | Sample line temperature is restored, chan = <n> |
| 13 | RECOVERABLE | Injector temperature fault, chan = <n> |
| 14 | CRITICAL | Injector heater sensor fault, chan = <n> |
| 15 | CRITICAL | Injector heater is open, chan = <n> |
| 16 | CRITICAL | Injector heater is short, chan = <n> |
| 17 | RECOVERABLE | Injector heating too slow, chan = <n> |

Table 31 Error list (continued)

| Error code | Class | Error messages |
|---|---|---|
| 18 | INFO | Injector temperature is restored, chan = <n> |
| 19 | RECOVERABLE | Column temperature fault, chan = <n> |
| 20 | CRITICAL | Column heater sensor fault, chan = <n> |
| 21 | CRITICAL | Column heater is open, chan = <n> |
| 22 | CRITICAL | Column heater is short, chan = <n> |
| 23 | RECOVERABLE | Column heating too slow, chan = <n> |
| 24 | INFO | Column temperature is restored, chan = <n> |
| 25 | RECOVERABLE | Aux zone temperature fault, chan = <n> |
| 26 | CRITICAL | Aux zone heater sensor fault, chan = <n> |
| 27 | CRITICAL | Aux zone heater is open, chan = <n> |
| 28 | CRITICAL | Aux zone heater is short, chan = <n> |
| 29 | WARNING | Aux zone heating too slow, chan = <n> |
| 30 | INFO | Aux zone temperature is restored, chan = <n> |
| 31 | RECOVERABLE | Inlet <n> temperature fault |
| 32 | CRITICAL | Inlet <n> sensor fault |
| 33 | CRITICAL | Inlet <n> is open |
| 34 | CRITICAL | Inlet <n> is short |
| 35 | RECOVERABLE | Inlet <n> heating too slow |
| 36 | INFO | Inlet <n> temperature is restored |
| 37 | RECOVERABLE | Spare heater 1 temperature fault |
| 38 | CRITICAL | Spare heater 1 sensor fault |
| 39 | CRITICAL | Spare heater 1 is open |
| 40 | CRITICAL | Spare heater 1 is short |
| 41 | RECOVERABLE | Spare heater 1 heating too slow |
| 42 | INFO | Spare heater 1 temperature is restored |
| 43 | RECOVERABLE | Spare heater 2 temperature fault |
| 44 | CRITICAL | Spare heater 2 sensor fault |
| 45 | CRITICAL | Spare heater 2 is open |
| 46 | CRITICAL | Spare heater 2 is short |
| 47 | RECOVERABLE | Spare heater 2 heating too slow |
| 48 | INFO | Spare heater 2 temperature is restored |
| 49 | INFO | Self-testing cycle start |
| 50 | INFO | Self-testing cycle end |
| 51 | RECOVERABLE | License lost due to key detached |
| 52 | INFO | License restored |
| 53 | INFO | Wait for preconditions of flush cycle |
| 54 | INFO | Start one flush cycle |

### Table 31 Error list (continued)

| Error code | Class | Error messages |
|---|---|---|
| 55 | INFO | One cycle of flush passed |
| 56 | WARN | Flush cycles aborted |
| 57 | INFO | Start column clean |
| 58 | INFO | Column clean passed |
| 59 | WARN | Column clean aborted |
| 60 | INFO | Temperature equilibrating after column cleaning |
| 61 | INFO | Temperature equilibrating passed |
| 62 | INFO | TCD calib, chan = <n> |
| 63 | INFO | TCD calib success, chan = <n> |
| 64 | RECOVERABLE | TCD calib failed, chan = <n> |
| 65 | WARN | Detector ADC error, chan = <n> |
| 66 | INFO | Detector enabled, chan = <n> |
| 67 | INFO | Detector disabled, chan = <n> |
| 68 | WARN | TCD temperature limit activated, chan = <n> |
| 69 | WARN | TCD temperature limit deactivated, chan = <n> |
| 70 | WARN | Channel unit changed, chan = <n> |
| 71 | CRITICAL | ADC mux offset Is out of range, chan = <n> |
| 72 | INFO | ADC mux offset is ok, chan = <n> |
| 73 | WARN | Stream select failed |
| 74 | INFO | Stream select ok |
| 75 | RECOVERABLE | Ambient temperature too high |
| 76 | INFO | Ambient temperature error cleared |
| 77 | RECOVERABLE | Ambient pressure too high |
| 78 | INFO | Ambient pressure error cleared |
| 79 | WARN | Battery 1 lower power |
| 80 | INFO | Battery 1 power restored |
| 81 | WARN | Battery 2 lower power |
| 82 | INFO | Battery 2 power restored |
| 83 | RECOVERABLE | Low power supply |
| 84 | INFO | Main power supply restored |
| 85 | CRITICAL | Internal power failure, chan = <n> |
| 86 | INFO | Internal power failure restored. chan = s<n> |
| 87 | INFO | Loading mainboard EDS |
| 88 | INFO | Loading channel controller <n> EDS |
| 89 | INFO | Loading analytical module <n> EDS |
| 90 | WARN | Mainboard EDS logging error |
| 91 | WARN | CCB EDS logging error, chan = <n> |

Table 31 Error list (continued)

| Error code | Class | Error messages |
|---|---|---|
| 92 | WARN | AMI EDS logging error, chan = <n> |
| 93 | CRITICAL | Channel controller EDS validation failed, chan = <n> |
| 94 | CRITICAL | Analytical module EDS validation failed, chan = <n> |
| 95 | CRITICAL | Mainboard EDS validation failed |
| 96 | WARN | CCB EDS option checksum incorrect, chan = <n> |
| 97 | WARN | CCB EDS logbook checksum incorrect, chan = <n> |
| 98 | WARN | CCB EDS protected checksum incorrect, chan = <n> |
| 99 | WARN | CCB EDS option2 checksum incorrect, chan = <n> |
| 100 | WARN | AMI EDS option checksum incorrect, chan = <n> |
| 101 | WARN | AMI EDS logbook checksum incorrect, chan = <n> |
| 102 | WARN | AMI EDS protected checksum incorrect, chan = <n> |
| 103 | WARN | AMI EDS option2 checksum incorrect, chan = <n> |
| 104 | WARN | Mainboard EDS option checksum incorrect |
| 105 | WARN | Mainboard EDS logbook checksum incorrect |
| 106 | WARN | Mainboard EDS protected checksum incorrect |
| 107 | WARN | CCB EDS option struct version invalid, chan = <n> |
| 108 | WARN | CCB EDS protected struct version invalid, chan = <n> |
| 109 | WARN | CCB EDS option2 struct version invalid, chan = <n> |
| 110 | WARN | AMI EDS option struct version invalid, chan = <n> |
| 111 | WARN | AMI EDS protected struct version invalid, chan = <n> |
| 112 | WARN | AMI EDS option2 struct version invalid, chan = <n> |
| 113 | WARN | Mainboard EDS option struct version invalid |
| 114 | WARN | Mainboard EDS protected struct version invalid |
| 115 | INFO | Run starts |
| 116 | WARN | Not ready to start run in 2 mins |
| 117 | INFO | Sample injection |
| 118 | INFO | Run is completed |
| 119 | WARN | Run is aborted |
| 120 | INFO | Anyapp report generated! Run #<n> |
| 121 | WARN | Anyapp report store failed |
| 122 | INFO | Automation starts |
| 123 | WARN | Automation is aborted |
| 124 | INFO | Sequence started |
| 125 | INFO | Sequence quit |
| 126 | INFO | Calibration block started |
| 127 | INFO | Calibration block quit |
| 128 | INFO | Verification block started |

Table 31 Error list (continued)

| Error code | Class | Error messages |
|---|---|---|
| 129 | INFO | Verification block quit |
| 130 | INFO | Recalculate |
| 131 | INFO | Clear all calibration curves |
| 132 | WARN | FTP storage failure |
| 133 | WARN | USB storage failure |
| 134 | INFO | Channel board <n> is detected |
| 135 | INFO | Pump board <n> is detected |
| 136 | INFO | Field case is detected |
| 137 | CRITICAL | IOC communication error |
| 138 | FATAL | IOC fatal error |
| 139 | CRITICAL | Mainboard CAN bus ID is not correct |
| 140 | FATAL | IOC GPIO init failed |
| 141 | FATAL | IOC CAN bus init failed |
| 142 | CRITICAL | IOC CAN bus id conflict detected |
| 143 | FATAL | IOC ISR error |
| 144 | CRITICAL | IOC I2C bus init error |
| 145 | WARN | TCD autozero health check failure, chan = <n> |
| 146 | WARN | TCD autozero health check warning, chan = <n> |
| 147 | INFO | TCD autozero warning cleared, chan = <n> |
| 148 | FATAL | IOC communication lost |
| 149 | FATAL | Internal watchdog error |
| 150 | FATAL | OOA timer not available |
| 151 | FATAL | OOA event loop stuck |
| 152 | CRITICAL | Internal fatal software error |
| 153 | CRITICAL | Field case initialization failure |
| 154 | INFO | reserved |
| 155 | CRITICAL | Field case gas cylinder <n> low pressure |
| 156 | INFO | Field case gas cylinder <n> pressure restored |
| 157 | INFO | Field case valve <n> switches to use gas cylinder |
| 158 | INFO | Field case valve <n> switches to use external gas |
| 159 | WARN | Field case battery <n> over temperature |
| 160 | WARN | Field case battery <n> over current |
| 161 | WARN | Field case battery <n> over voltage |
| 162 | WARN | Field case battery <n> cell short |
| 163 | WARN | Field case battery <n> cell open |
| 164 | WARN | Field case battery <n> NTC open |
| 165 | WARN | Field case battery <n> gauge communication failure |

Table 31 Error list (continued)

| Error code | Class | Error messages |
|---|---|---|
| 166 | WARN | Field case battery fan open |
| 167 | WARN | Field case mainboard fan open |
| 168 | WARN | Field case switch valve <n> open |
| 169 | WARN | Field case pump <n> not detected |
| 170 | WARN | Pump <n> open |
| 171 | WARN | Pump valve <n> open |
| 172 | WARN | Pump board fan <n> open |
| 173 | RECOVERABLE | Channel <n> is lost |
| 174 | WARN | Pump board <n> is lost |
| 175 | WARN | Field case is lost |
| 176 | INFO | Start leak detection process |
| 177 | WARN | Channel <n> is found leak |
| 178 | INFO | Leak detection process finish |
| 179 | WARN | Leak detection process aborted |
| 180 | INFO | Extension board <n> detected |
| 181 | CRITICAL | $H_2$ pressure too low, chan = <n> |
| 182 | CRITICAL | $H_2$ pressure too high, chan = <n> |
| 183 | CRITICAL | $H_2$ pressure cannot reach its setpoint, chan = <n> |
| 184 | CRITICAL | Gasifier purge valve short |
| 185 | WARN | Gasifier purge valve open |
| 186 | CRITICAL | Gasifier transferline sensor short |
| 187 | CRITICAL | Gasifier vaporizer sensor short |
| 188 | WARN | Gasifier transferline sensor open |
| 189 | WARN | Gasifier vaporizer sensor open |
| 190 | WARN | Gasifier transferline heater open |
| 191 | WARN | Gasifier vaporizer heater open |
| 192 | CRITICAL | Gasifier transferline heater short |
| 193 | CRITICAL | Gasifier vaporizer heater short |
| 194 | WARN | Gasifier transferline heating too slow |
| 195 | WARN | Gasifier vaporizer heating too slow |
| 196 | WARN | Gasifier communication lost |
| 197 | INFO | Gasifier is detected |
| 198 | WARN | Field case battery <n> cannot start charging due to over temperature |
| 199 | WARN | Field case battery <n> stops charging due to over temperature |

# 10 Micro GC Biogas Analyzers



Biogas is a type of biofuel produced by the biological breakdown of organic material in an anaerobic environment. The anaerobic digestion or fermentation process of biodegradable materials such as manure, sewage, municipal waste, green waste, plant material, or crops produces biogas. Biogas is composed of methane, carbon monoxide, hydrogen, carbon dioxide, nitrogen, hydrogen sulfide, and oxygen. When methane, hydrogen, and carbon monoxide are combusted or oxidized with oxygen, energy is produced that can be used as fuel.

The Agilent 990 Micro GC Biogas Analyzer is a factory-tuned analyzer specific for biogas analysis.

Two types of Biogas Analyzers are available: Agilent 990 Micro GC Biogas Analyzer and the Agilent 990 Micro GC Biogas Analyzer Extended. The choice of configuration depends on the type of biogas sample.

## Biogas Analyzer

The Agilent 990 Micro GC Biogas Analyzer is used to analyze pure biogas including analysis of permanent gases, hydrogen sulfide and hydrocarbons up to *n*-propane. This is a basic cabinet equipped with a CP-Molsieve 5A channel and a CP-PoraPLOT U channel with dual carrier gas option.

## Biogas Analyzer Extended

The Agilent 990 Micro GC Biogas, Analyzer Extended, is used to analyze biogas mixed with other hydrocarbon streams. The analysis consists of permanent gases, hydrogen sulfide and hydrocarbons up to *n*-heptane. The Biogas Analyzer Extended is a basic cabinet and a channel extension cabinet equipped with three channels: a CP-Molsieve 5A, a CP-PoraPLOT U channel and a CP-Sil 5 CB channel with dual carrier gas option.

Before starting up the Analyzer make sure that correct carrier gases are connected for all channels. Argon carrier gas is required for the CP-Molsieve channel and Helium for all other channels. The required pressure for all carrier gases is 550 kPa ±10 kPa (80 psi ±1.5 psi).

# Checkout Information

The Biogas Analyzer is factory tuned including appropriate settings for backflush times for the CP-Molsieve 5A and CP-PoraPLOT U channel. Final checkout of the Agilent 990 Micro GC Biogas Analyzers is performed with a Universal Gas Calibration standard. This contains helium, neon, hydrogen, oxygen, nitrogen, methane, ethane, ethylene, carbon dioxide, carbon monoxide, acetylene, *n*-propane, methyl acetylene and *n*-butane. Not all components of this Calibration Standard are specified for the Biogas Analyzers. This calibration standard is used as a reference for the performance of the Biogas Analyzer. For more details regarding the Universal Gas Calibration Standard, see **Certificate of the Universal Gas Calibration Standard**.

The Universal Gas Calibration Standard is shipped with the Analyzer and will be used by the Agilent Customer Engineer at installation. The factory tuned method, final chromatogram (Test Report) and this Biogas Analyzer user manual are supplied with the Biogas Analyzer on the analyzer CD.

Use the Universal Gas Calibration Standard to perform reference checks on the Biogas Analyzer. Load the method from the Analyzer CD if Openlab CDS EZChrom Edition is used or create a method using the settings from the method PDF file on the Analyzer CD. For a quick start, see **The Biogas Analyzer Method**. Connect and inject the Calibration Standard.

The Universal Gas Calibration Standard does not contain hydrogen sulfide, neo-pentane, *n*-pentane or *i*-pentane. For these components, reference chromatograms are included in this manual.

# CP-Molsieve channel

The CP-Molsieve 5A channel of the Biogas Analyzer analyzes permanent gases such as helium, neon, hydrogen, oxygen, nitrogen, methane and carbon monoxide.

**Figure 58** is a chromatogram of the Universal gas Calibration Standard analyzed on the CP-Molsieve 5A channel.

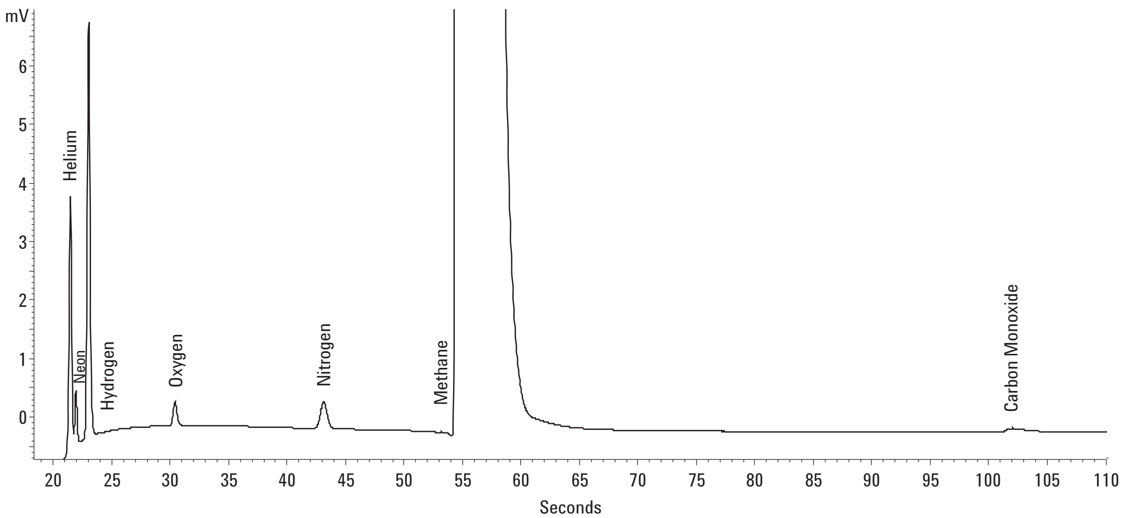



Figure 58. The Universal Gas Calibration Standard analyzed on the CP-Molsieve channel

# CP-PoraPLOT U channel

The CP-PoraPLOT U channel of the Biogas Analyzer is used to analyze carbon dioxide, ethane, hydrogen sulfide and *n*-propane. This channel and the sample inlet are Ultimetal deactivated which results in improved performance for hydrogen sulfide analysis.

The chromatogram obtained from the Universal Gas Calibration Standard with the CP-PoraPLOT U is shown in **Figure 59**.

If a sample contains hydrogen sulfide, the chromatogram resembles **Figure 60**.

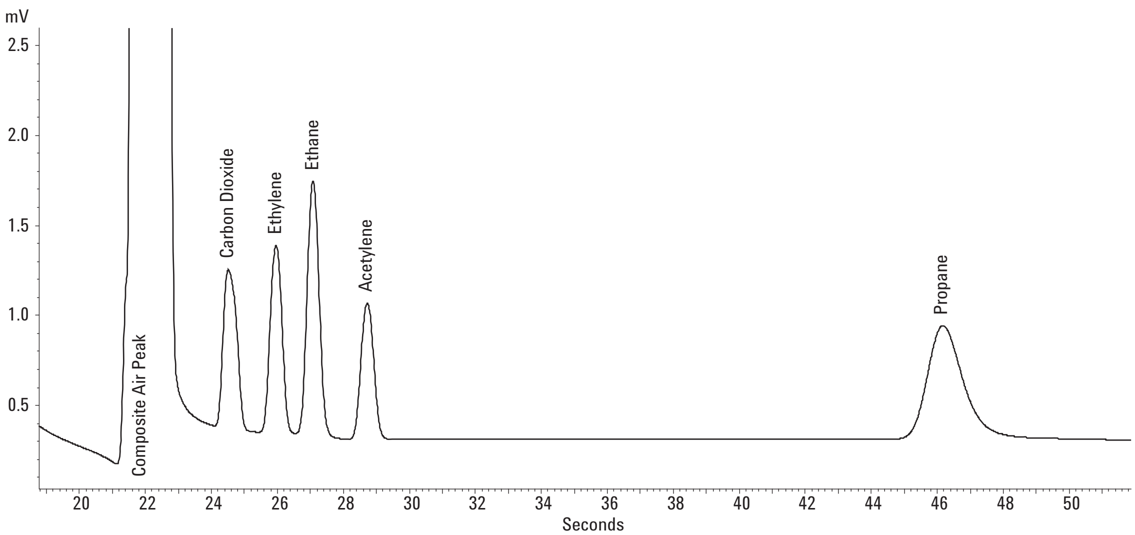



Figure 59. The Universal Gas Calibration Standard analyzed on the CP-PoraPLOT U channel

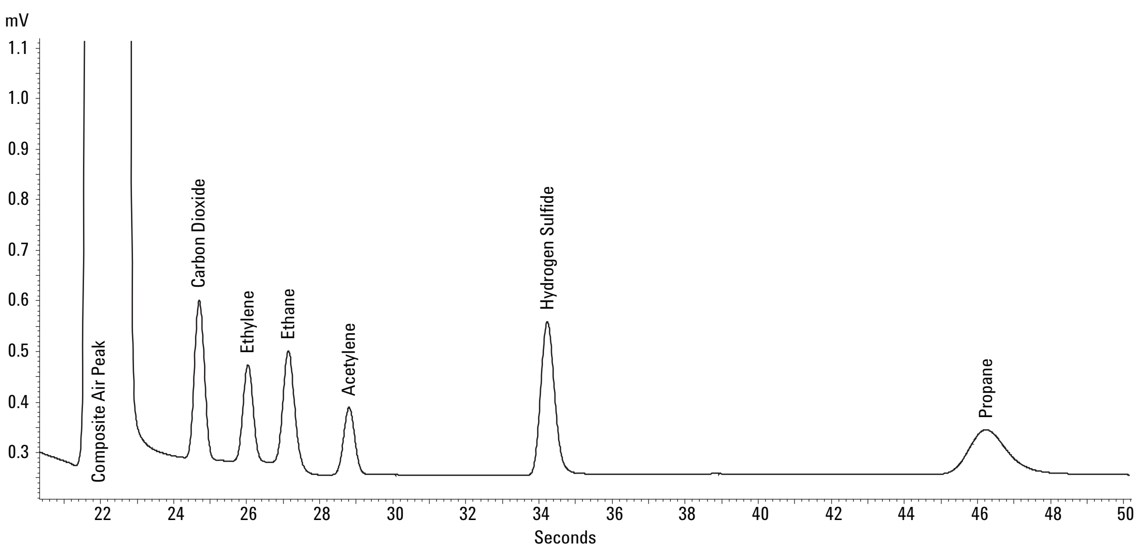



Figure 60. A mixture with hydrogen sulfide analyzed on the CP-PoraPLOT U channel

# CP Sil 5 CB channel

The CP-Sil 5 CB channel of the Biogas Analyzer Extended is used to analyze the hydrocarbon up to *n*-heptane. Hydrocarbons that are specified for this analyzer are *i*-butane, *n*-butane, *neo*-pentane, *n*-pentane, *iso*-pentane, *n*-hexane, and *n*-heptane. The Universal Gas Calibration Standard does not contain all these hydrocarbons. A reference chromatogram is included in this manual for the missing components.

Analyzing the Universal Gas Calibration Standard with the CP-Sil 5 CB results in the chromatogram shown in **Figure 61**.

If a hydrocarbon mixture up to *n*-hexane is used, the chromatogram resembles **Figure 62**.

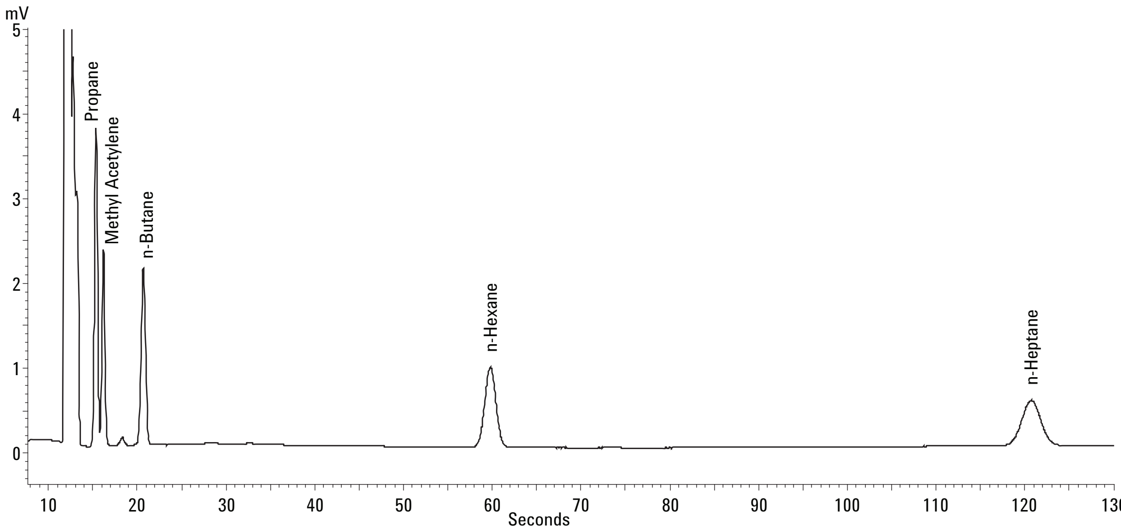



Figure 61. The Calibration Standard analyzed on CP-Sil 5 CB channel

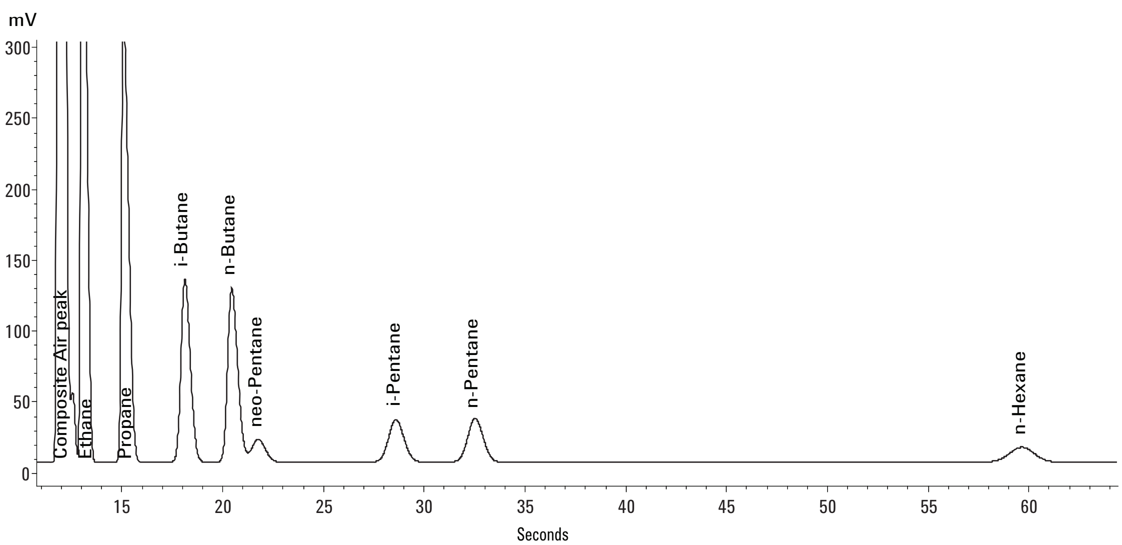



Figure 62. A hydrocarbon mixture up to *n*-Hexane analyzed on the CP-Sil 5 CB channel

For tuning the backflush time, please refer to **"Tuning the backflush time on a HayeSep A channel"** on page 78.

# Certificate of the Universal Gas Calibration Standard

Part No: 5184-3541 Part No. Kit: 5184-3546

Agilent Technologies
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## Certificate of Analysis

### Universal Gas Calibration Standard

**Agilent Part No:** 5183-4800, 5184-3541 **Sample Lot No:** 021510U

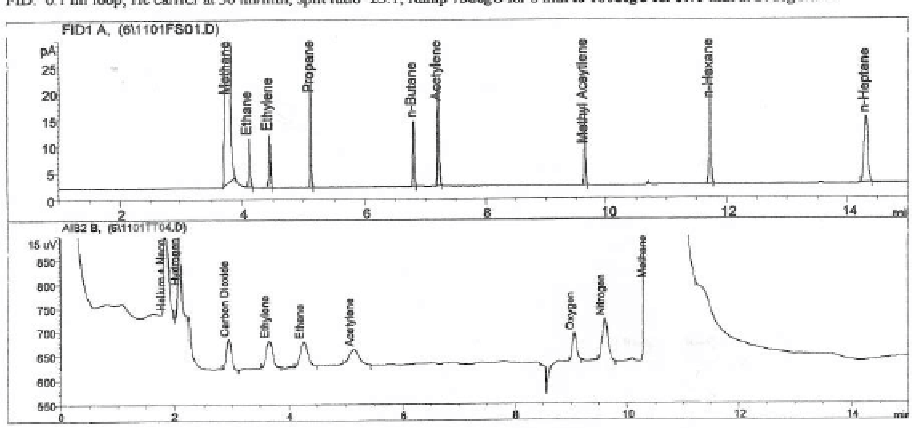
**Concentrations (±mole%):**

| | | | |
|---|---|---|---|
| Helium | 0.1000% (±5%) | n-Hexane | 0.0500% (±5%) |
| Neon | 0.0496% (±5%) | n-Heptane | 0.0500% (±5%) |
| Hydrogen | 0.0988% (±5%) | Water content ($H_2O$) | <5 ppm |
| Oxygen | 0.0500% (±5%) | Other impurities (HC's) | <1 ppm |
| Nitrogen | 0.1000% (±5%) | | |
| Methane | Balance | | |
| Ethane | 0.0497% (±5%) | | |
| Ethylene | 0.0497% (±5%) | | |
| Carbon Dioxide | 0.0500% (±5%) | | |
| Carbon Monoxide | 0.0995% (±5%) | | |
| Acetylene | 0.0494% (±5%) | | |
| Propane | 0.0501% (±5%) | | |
| Methyl Acetylene | 0.0501% (±5%) | | |
| n-Butane | 0.0501% (±5%) | | |

**Traceability:**
This standard was produced gravimetrically following Specialty Gas Work Instruction #15. Balances used are calibrated per POIS 2.140, traceable to NIST. Concentrations were verified on an Agilent model 6890 gas chromatograph, using a Wasson valve switch, Variable Pressure Control and multiple packed/capillary columns.

**Standards Used:**
Praxair UGS Primary Standard, serial # CC309710

**Analytical GC Chromatogram:**
Analytical columns: Agilent MS-5A PLOT, U-PLOT
TCD: 1.0 ml loop; He carrier at 35 ml/min; oven temp = 90degC
FID: 0.1 ml loop; He carrier at 30 ml/min; split ratio=25:1; Ramp 75degC for 6 min to 180degC for 3.75 min at 20degC/min




Date of Release: 15 February, 2010
Expiration Date: 15 February, 2012

Analyst: John Goddard
Senior Chemist

# The Biogas Analyzer Method

**Table 32 The Biogas Analyzer method**

| Method settings | CP-Molsieve 5A | CP-PoraPLOT U | CP-Sil 5 CB |
|---|---|---|---|
| Carrier gas | Argon | Helium | Helium |
| Injector temperature (°C) | 110 | 110 | 110 |
| Injection time (ms) | 40 | 40 | 40 |
| Backflush time (s) | 11 | 14 | - |
| Column temperature (°C) | 80 | 80 | 60 |
| Pressure (kPa) | 200 | 150 | 150 |
| Sample inlet temperature (°C) | 110 | 110 | 110 |
| Invert signal | Yes | No | No |

For more details of the method see the PDF method file available on the analyzer CD.

The backflush time must be tuned for each new CP-Molsieve and CP-PoraPLOT channel.

# 11 Micro GC Natural Gas Analyzer

# Agilent 990 Micro GC - Natural Gas Analyzers

## Introduction

Natural gas is a fossil fuel. Millions of years ago, the remains of plants, animals, and micro-organisms were buried underneath layers of soil and sediment. Due to the weight of the soil and sediment, the pressure and temperature increased. This resulted in the slow transformation of the organisms into natural gas and oil.

The composition of natural gas varies widely. Natural gas is a combustible mixture of hydrocarbon gases that mainly consists of methane, smaller amounts of light hydrocarbons such as ethane, propane, *n*-butane, *n*-pentane, hexanes plus, and other gases such as nitrogen, carbon dioxide, oxygen, hydrogen, and hydrogen sulfide. Natural gas can also contain traces of argon, helium, neon, and xenon. Natural gas in its pure form is colorless and odorless.

Natural Gas Analyzers have been designed to analyze the different compositions of natural gas.

## Types of Agilent 990 Micro GC - Natural Gas Analyzers

The following four types of Natural Gas Analyzers can be used to analyze natural gas:

- The Agilent 990 Micro GC - Natural Gas Analyzer A
- The Agilent 990 Micro GC - Natural Gas Analyzer A Extended
- The Agilent 990 Micro GC - Natural Gas Analyzer B
- The Agilent 990 Micro GC - Natural Gas Analyzer B Extended

## Agilent 990 Micro GC - Natural Gas Analyzer A and the Extended Version

### Natural Gas Analyzer A

The Agilent 990 Micro GC - Natural Gas Analyzer A is used to analyze natural gas samples containing methane, carbon dioxide, and hydrocarbons up to *n*-nonane.

The Agilent 990 Micro GC - Natural Gas Analyzer A is a basic cabinet micro GC equipped with two channels:

- HayeSep A channel (straight)
- 6 meter CP-Sil 5 CB channel

### Natural Gas Analyzer A Extended

The Agilent 990 Micro GC - Natural Gas Analyzer A Extended is used to analyze methane, carbon dioxide, and hydrocarbons up to *n*-dodecane.

The Agilent 990 Micro GC - Natural Gas A Extended is a basic cabinet and a channel extension cabinet micro GC equipped with three channels:

- HayeSep A channel with a backflush option
- 4 meter CP-Sil 5 CB channel with a backflush option
- 8 meter CP-Sil 5 CB channel

# Agilent 990 Micro GC - Natural Gas Analyzer B and the Extended Version

## Natural Gas Analyzer B

The Agilent 990 Micro GC - Natural Gas Analyzer B is used to analyze methane, carbon dioxide, hydrogen sulfide, and light hydrocarbons up to *n*-nonane in natural gas.

The Agilent 990 Micro GC - Natural Gas Analyzer B is a basic cabinet micro GC equipped with two channels:

- PoraPLOT U channel with a backflush option
- 6 meter CP-Sil 5 CB channel

## Natural Gas Analyzer B Extended

The Agilent990 Micro GC - Natural Gas Analyzer B Extended is used to analyze hydrogen, nitrogen, oxygen, methane, carbon dioxide, carbon monoxide, hydrogen sulfide, and hydrocarbons up to *n*-nonane.

The Agilent 990 Micro GC - Natural Gas Analyzer B Extended is a basic cabinet and a channel extension cabinet micro GC equipped with three channels:

- PoraPLOT U channel with a backflush option
- 6 meter CP-Sil 5 CB channel
- CP-Molsieve 5A channel with a backflush option

The Natural Gas Analyzer B Extended version is equipped with a dual carrier gas option for the CP-Molsieve 5A channel. It is made flexible for analysis of hydrogen and helium on the

CP-Molsieve 5A channel if required. For the analysis of helium on the CP-Molsieve 5A channel, the carrier gas must be argon. All analyzers are factory tuned on helium as a carrier gas.

Before starting up the Agilent 990 Micro GC - Natural Gas Analyzer, ensure that correct carrier gases are connected for all channels. For all types of analyzers, the required carrier gas is helium. However, to analyze helium on the CP-Molsieve 5A, the carrier gas must be argon. The required pressure for carrier gas is 550 kPa ±10 kPa (80 psi ±1.5 psi).

# Checkout Information

## Introduction

The Agilent 990 Micro GC - Natural Gas Analyzers are factory tuned on carrier gas helium including appropriate settings for back flush times for the following channels:

- HayeSep A
- 4 meter CP-Sil 5 CB
- CP-Molsieve 5A
- PoraPLOT U

The final checkout of the Agilent 990 Micro GC - Natural Gas Analyzer is performed with a NGA Gas Calibration standard and a Universal Gas Calibration standard.

- The NGA Gas Calibration standard contains nitrogen, methane, ethane, carbon dioxide, propane, *iso*-butane, *n*-butane, *iso*-pentane, *n*-pentane, and *n*-hexane. This natural gas standard does not contain all components specified for each type of Natural Gas Analyzer. Therefore, a second checkout sample, the Universal Gas Calibration standard is analyzed on the Natural Gas Analyzer.
- The Universal Gas Calibration standard contains helium, neon, hydrogen, oxygen, nitrogen, methane, ethane, ethylene, carbon dioxide, carbon monoxide, acetylene, propane, methyl acetylene, *n*-butane, *n*-hexane, and *n*-heptane. Not all components in the Universal Gas Calibration standard are specified for the Natural Gas Analyzer.

More detailed information about the NGA Gas Calibration standard and the Universal Gas Calibration standard can be found in **Certificate of the NGA Gas Calibration Standard** on page 160 and **Certificate of the Universal Gas Calibration Standard** on page 161.

The components specified for each channel are described in **Agilent 990 Micro GC - Natural Gas Analyzer A and the Extended Version** on page 144 and **Agilent 990 Micro GC - Natural Gas Analyzer B and the Extended Version** on page 145.

The NGA Gas Calibration standard and the Universal Gas Calibration standard are shipped with the analyzer and used by the Agilent Customer Engineer at installation. The factory tuned method, final chromatogram (Test Report), and the Natural Gas Analyzer User Manual are supplied on the Analyzer CD.

**To perform reference checks** on the analyzer, use the NGA Gas Calibration standard or the Universal Gas Calibration standard. If OpenLAB CDS EZChrom is used, load the method from the analyzer CD or create a method using the settings from the method pdf-file available on the analyzer CD. For a quick start, see the method settings for Natural Gas Analyzers listed in **Typical Method Settings for Natural Gas Analyzers** on page 162. Connect and inject the NGA Gas Calibration standard.

**To analyze helium** on the CP-Molsieve 5A channel, use the Universal Gas Calibration standard for the checkout. Ensure that the carrier gas argon is supplied and configured before starting the analysis. For more information on how to configure the carrier gas for the analyzer see **Carrier Gas Type Configuration** on page 164. Method settings for this analysis can be found in **Method for CP-Molsieve 5A Channel with Carrier Gas Argon** on page 168.

The NGA Gas Calibration standard and the Universal Gas Calibration standard do not contain hydrogen sulfide. A reference chromatogram of hydrogen sulfide is included in this manual.

# Natural Gas Analyzer A and the A Extended Version

### HayeSep A straight

The HayeSep A channel of the Natural Gas Analyzer A is specified for the analysis of methane, carbon dioxide, ethane, and propane.

Analysis of the NGA Gas Calibration standard results in the chromatogram shown in **Figure 63**.

Analysis of the Universal Gas Calibration standard results in a chromatogram similar to **Figure 64**.

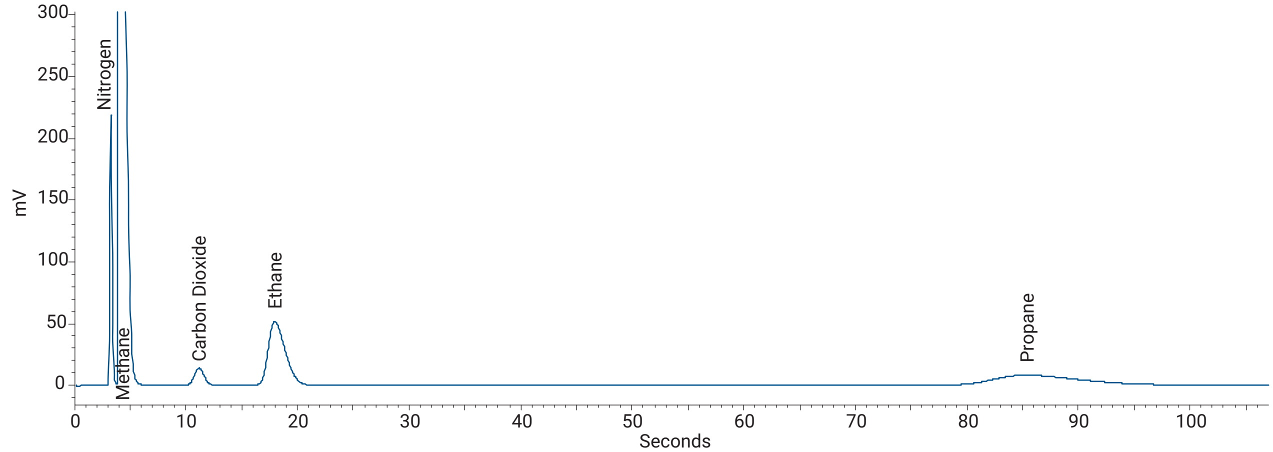



Figure 63. NGA Gas Calibration standard analyzed with the HayeSep A channel on Analyzer A

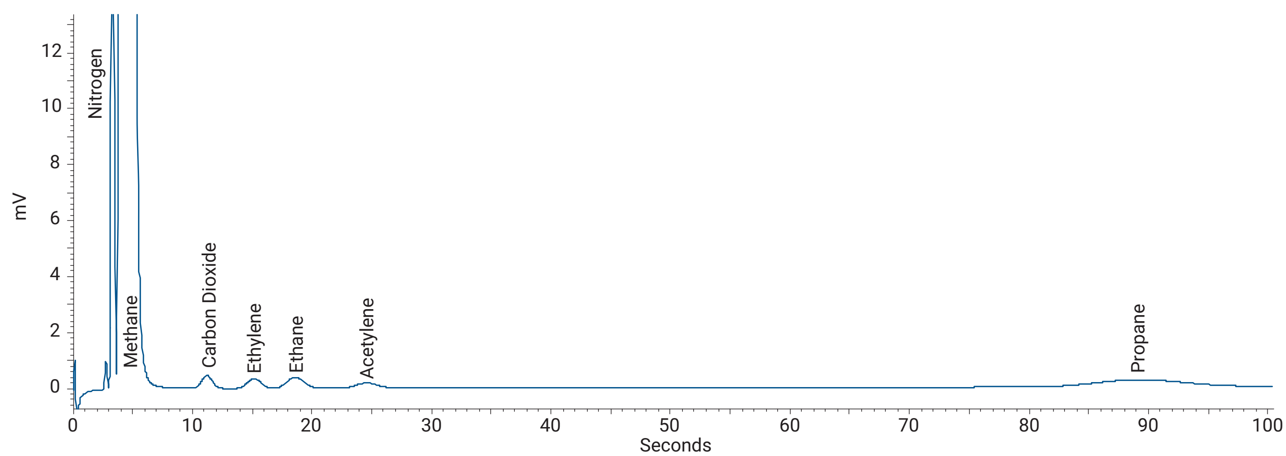



Figure 64. Universal Gas Calibration standard analyzed with the HayeSep A channel on Analyzer A

### 6 meter CP-Sil 5 CB

The 6 meter CP-Sil 5 CB channel of the Natural Gas Analyzer A is specified for the analysis of light hydrocarbons from propane up to *n*-nonane.

Analysis of the NGA Gas Calibration standard results in a chromatogram similar to **Figure 65**.

Analysis of a sample containing neo-pentane results in a chromatogram similar to **Figure 66**.

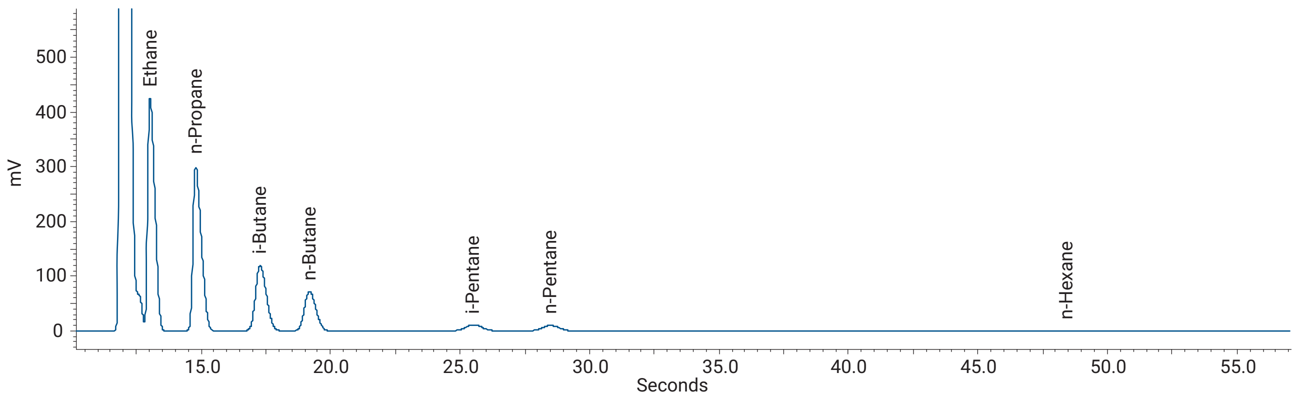



Figure 65. NGA Gas Calibration standard analyzed with the 6 meter CP-Sil 5 CB channel on Analyzer A

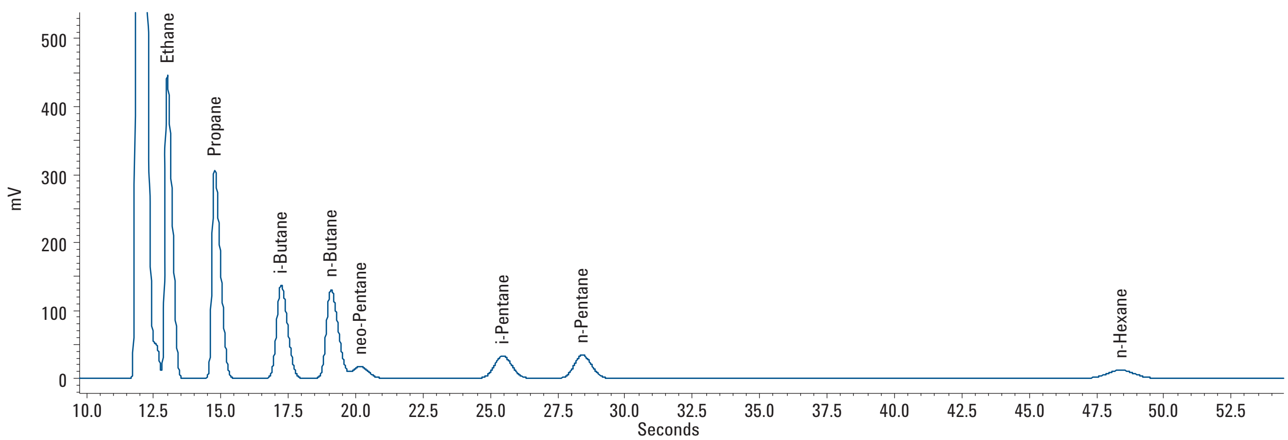



Figure 66. Sample containing neo-pentane analyzed with the 6 meter CP-Sil 5 CB channel on Analyzer A

Analysis of the Universal Gas Calibration standard results in a chromatogram similar to **Figure 67**.

Analysis of a sample containing heavier hydrocarbons up to *n*-nonane results in a chromatogram similar to **Figure 68**.

If a sample contains hydrocarbons up to *n*-nonane ensure that the total run time is increased sufficiently to detect all hydrocarbons on this channel.

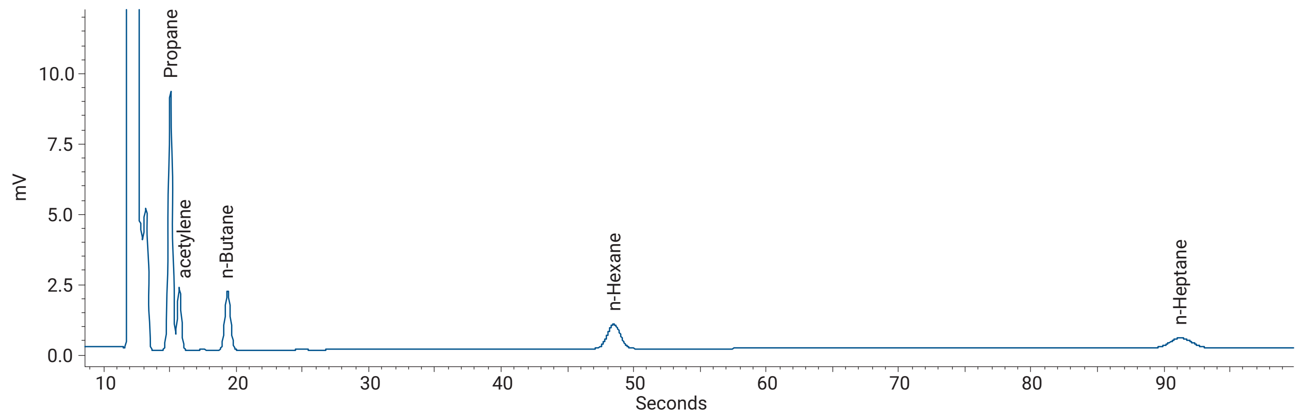



Figure 67. Universal Gas Calibration standard analyzed with the 6 meter CP-Sil 5 CB channel on Analyzer A

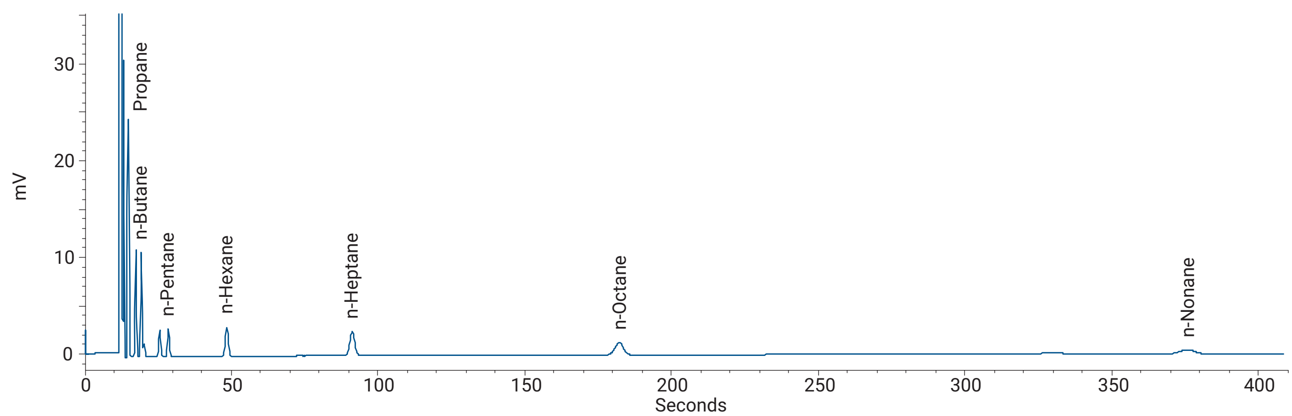



Figure 68. Sample containing hydrocarbons up to *n*-nonane analyzed with the 6 meter CP-Sil 5 CB channel on Analyzer A

## HayeSep A backflush

The HayeSep A channel, with backflush option, of the Natural Gas Analyzer A Extended is specified for the analysis of methane, carbon dioxide, ethane, and propane.

Analysis of the NGA Gas Calibration standard results in the chromatogram shown in **Figure 69**.

Analysis of the Universal Gas Calibration standard results in a chromatogram similar to **Figure 70**.

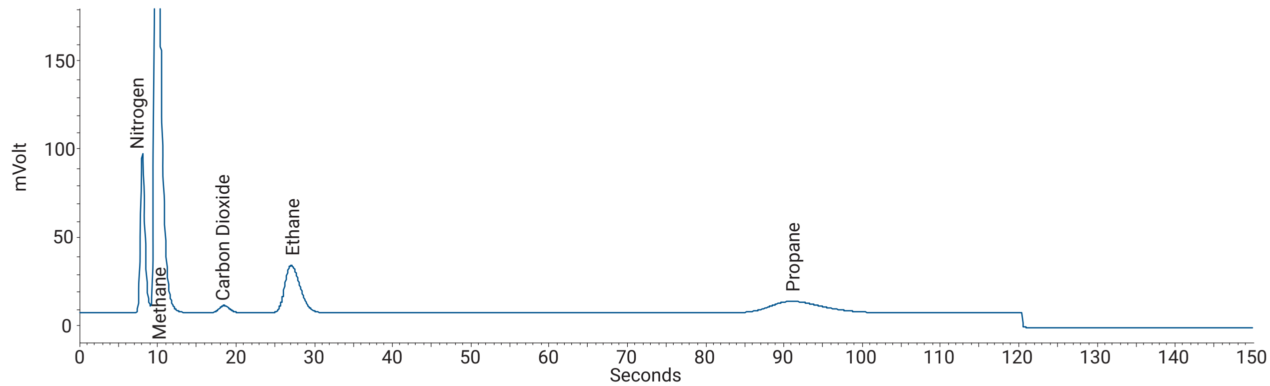



Figure 69. NGA Gas Calibration standard analyzed with the HayeSep A channel on Analyzer A Extended

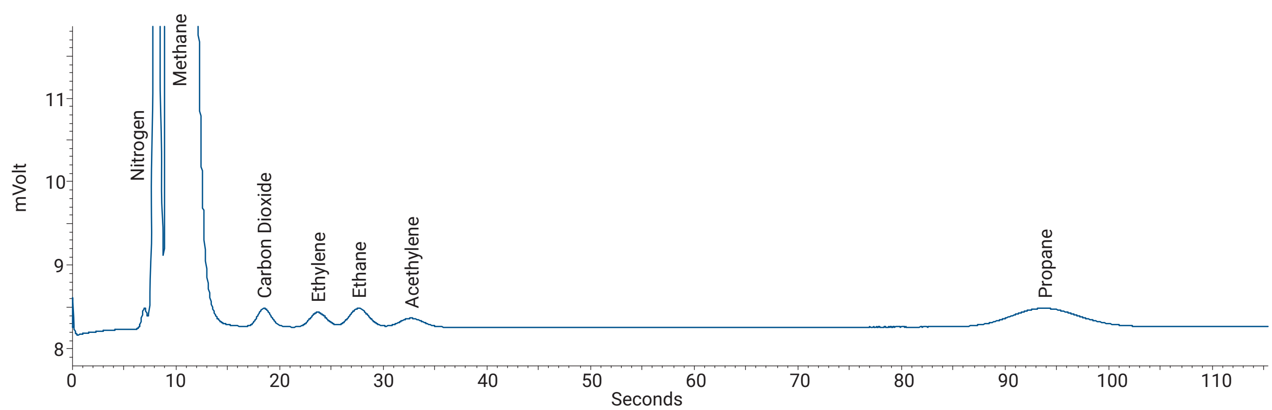



Figure 70. Universal Gas Calibration standard analyzed with the HayeSep A channel on Analyzer A Extended

### 4 meter CP-Sil 5 CB

The 4 meter CP-Sil 5 CB channel of the Natural Gas Analyzer A Extended is specified for the analysis of light hydrocarbons propane, *n*-butane, *iso*-butane, *iso*-pentane, and *n*-pentane.

Analysis of the NGA Gas Calibration standard results in the chromatogram shown in **Figure 71**.

Analysis of a sample containing neo-pentane results in a chromatogram similar to **Figure 72**.

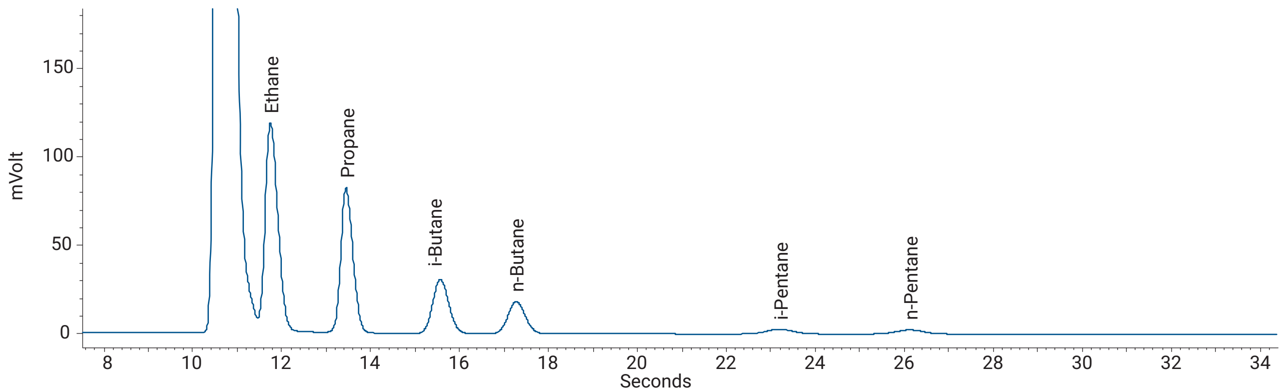



Figure 71. NGA Gas Calibration standard analyzed with the 4 meter CP-Sil 5 CB channel on Analyzer A Extended

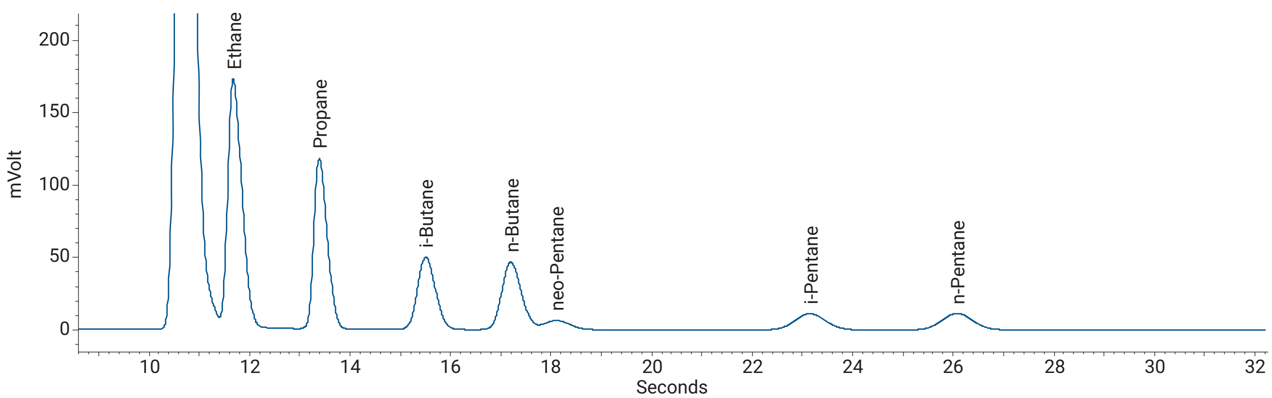



Figure 72. Sample containing neo-pentane analyzed with the 4 meter CP-Sil 5 CB channel on Analyzer A Extended

Analysis of the Universal Gas Calibration standard results in the chromatogram shown in **Figure 73**.

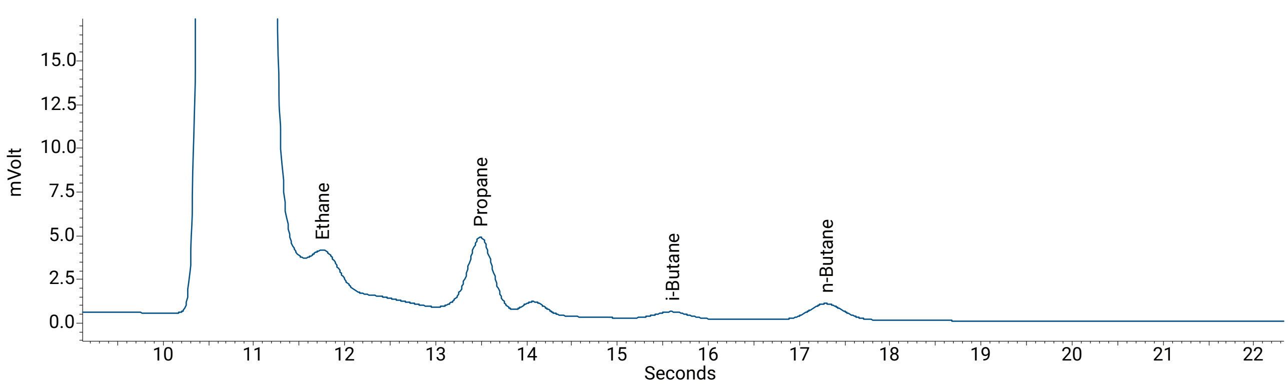



Figure 73. Universal Gas Calibration standard analyzed with the 4 meter CP-Sil 5 CB channel on Analyzer A Extended

### 8 meter CP-Sil 5 CB

The 8 meter CP-Sil 5 CB channel of the Natural Gas Analyzer A Extended is used for the analysis of hydrocarbons from *n*-hexane up to *n*-dodecane.

The NGA Gas Calibration standard and the Universal Gas Calibration standard do not contain heavy hydrocarbons up to *n*-dodecane. Reference chromatograms of the NGA Gas Calibration standard and the Universal Gas Calibration standard are included in this manual. For heavy hydrocarbons up to *n*-dodecane an additional sample is analyzed for identification.

Analysis of the NGA Gas Calibration standard results in the chromatogram shown in **Figure 74**.

Reference check of the Universal Gas Calibration standard results in a chromatogram similar to **Figure 75**.

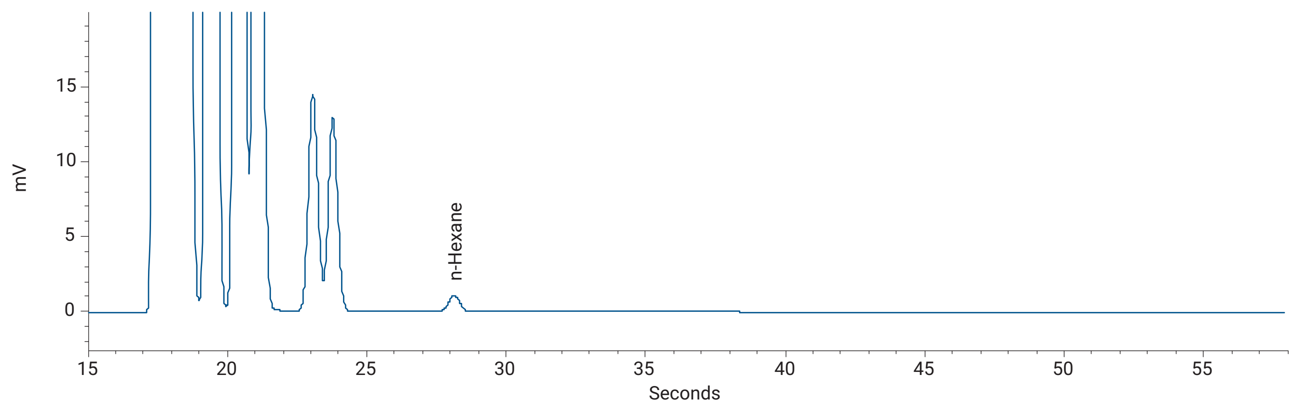



Figure 74. NGA Gas Calibration standard analyzed with the 8 meter CP-Sil 5 CB channel on Analyzer A Extended

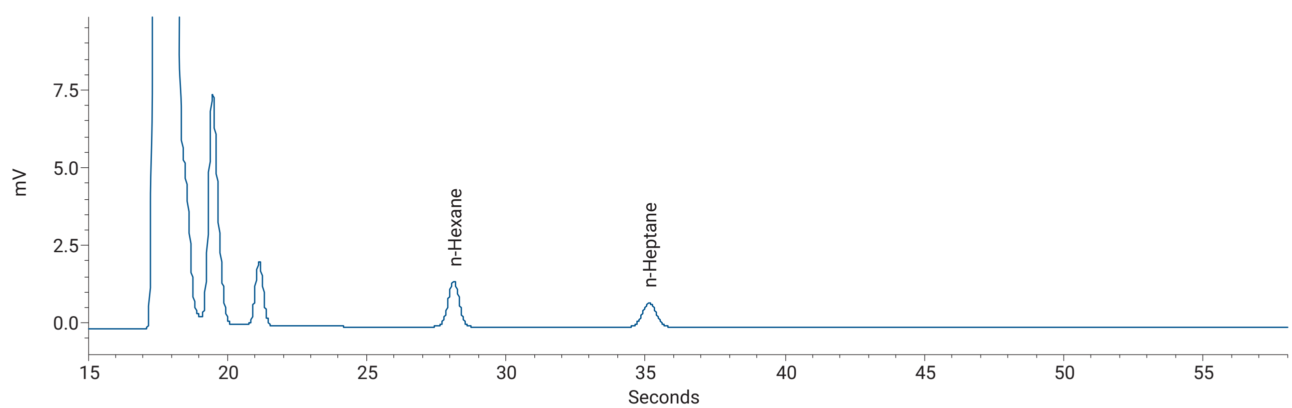



Figure 75. Universal Gas Calibration standard analyzed with the 8 meter CP-Sil 5 CB channel on Analyzer A Extended

Analysis of a sample containing heavier hydrocarbons up to *n*-decane results in the chromatogram shown in **Figure 76**.

Analysis of a sample that contains heavier hydrocarbons up to *n*-dodecane results in a chromatogram similar to **Figure 77**.

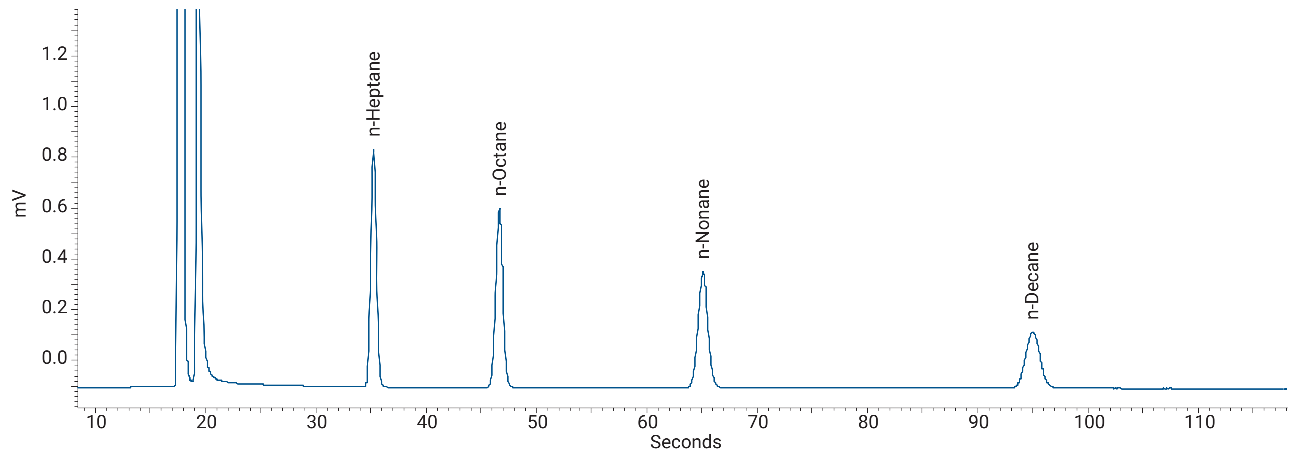



Figure 76. Hydrocarbon gas mix containing *n*-heptane to *n*-decane analyzed with the 8 meter CP-Sil 5 CB channel on Analyzer A Extended

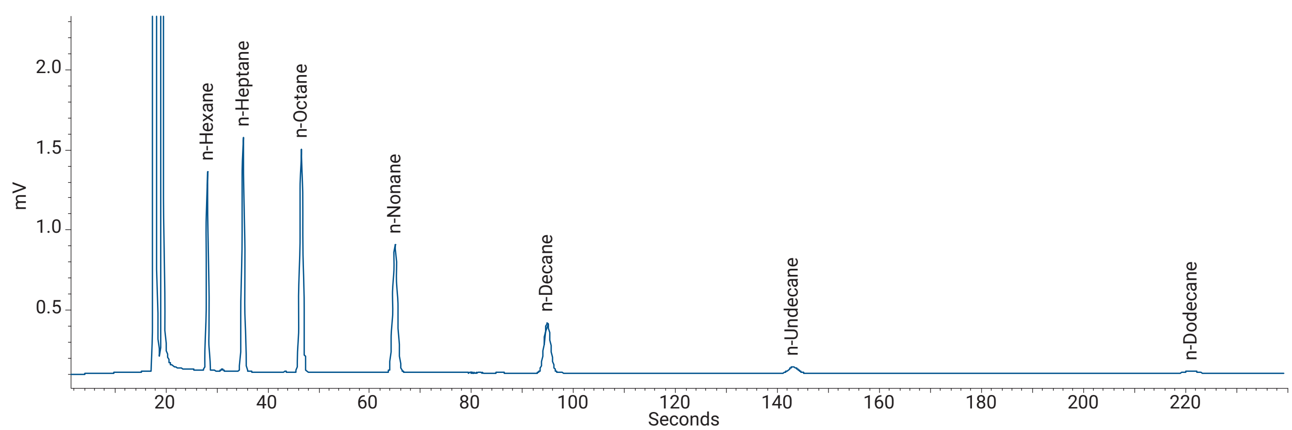



Figure 77. Hydrocarbon gas mix containing *n*-hexane to *n*-dodecane analyzed with the 8 meter CP-Sil 5 CB channel on Analyzer A Extended

# Natural Gas Analyzer B and B Extended Version

## PoraPLOT U

The PoraPLOT U channel of the Agilent 990 Micro GC - Natural Gas Analyzer B and Extended version is specified for the analysis of methane, carbon dioxide, ethane, hydrogen sulfide, and propane in natural gas samples. The total sample path of this channel is deactivated (Ultimetal), which results in better performance and peak shape for hydrogen sulfide.

Analysis of the NGA Gas Calibration standard results in a chromatogram similar to **Figure 78**.

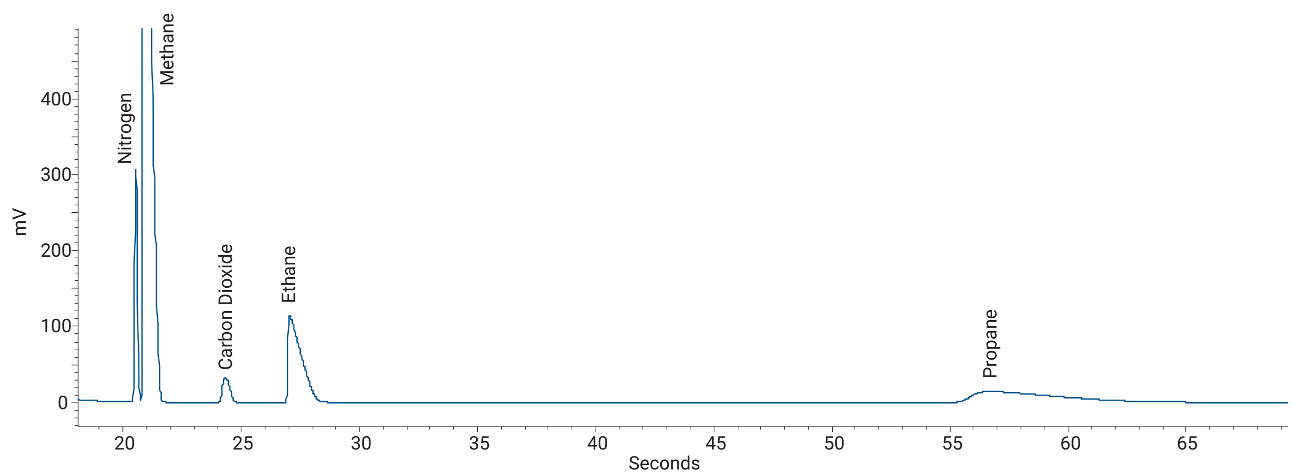



Figure 78. NGA Gas Calibration standard analyzed with the PoraPLOT U channel on Analyzer B

Analysis of the Universal Gas Calibration standard results in a chromatogram similar to **Figure 79**.

Analysis of a sample containing hydrogen sulfide results in a chromatogram similar to **Figure 80**.

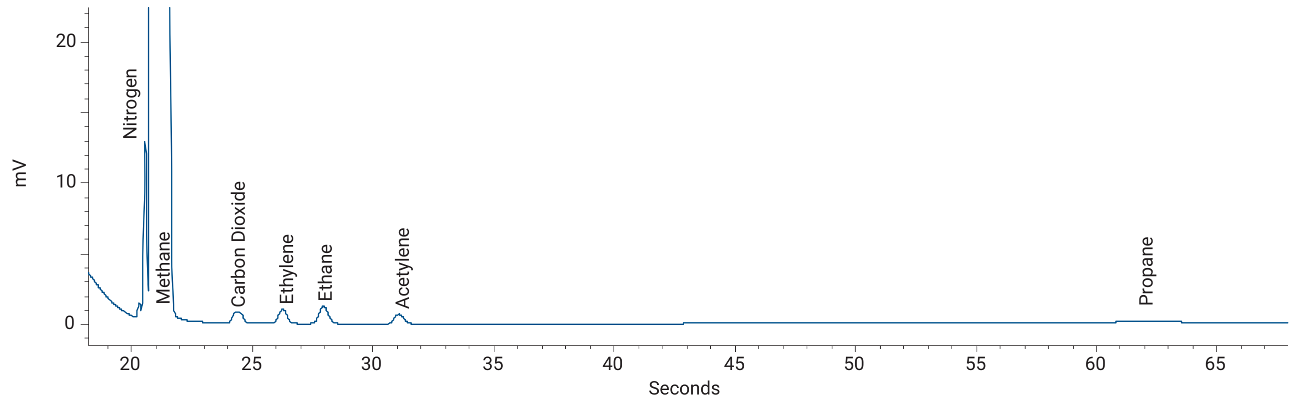



Figure 79. Universal Gas Calibration standard analyzed with the PoraPLOT U channel on Analyzer B

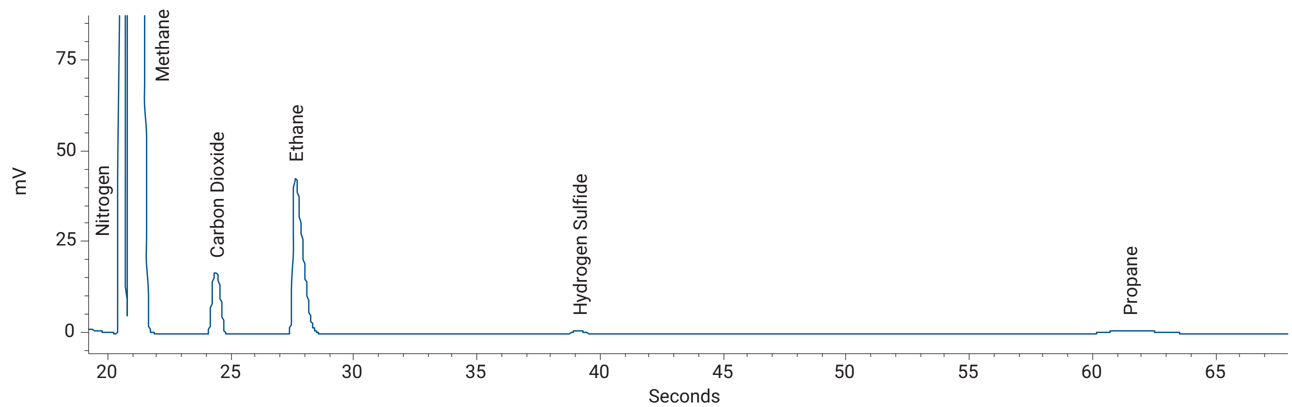



Figure 80. Sample containing hydrogen sulfide analyzed with the PoraPLOT U channel on Analyzer B

### 6 meter CP Sil 5 CB

The 6 meter CP-Sil 5 CB channel of the Natural Gas Analyzer B and the B Extended is specified for the analysis of hydrocarbons from propane to *n*-nonane.

Analysis of the NGA Gas Calibration standard results in the chromatogram shown in **Figure 81**.

Analysis of the Universal Gas Calibration standard results in a chromatogram similar to **Figure 82**.

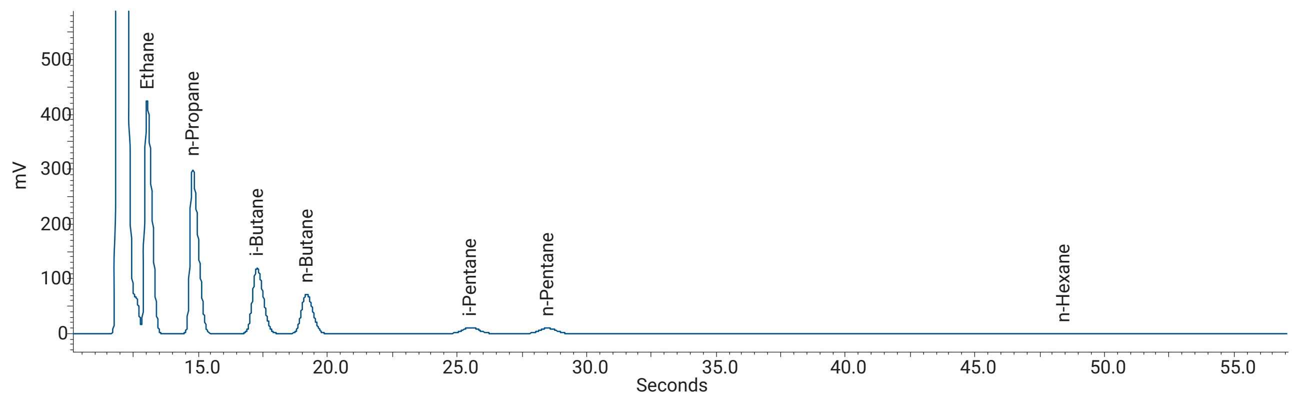



Figure 81. NGA Gas Calibration standard analyzed with the 6 meter CP-Sil 5 CB channel on Analyzer B

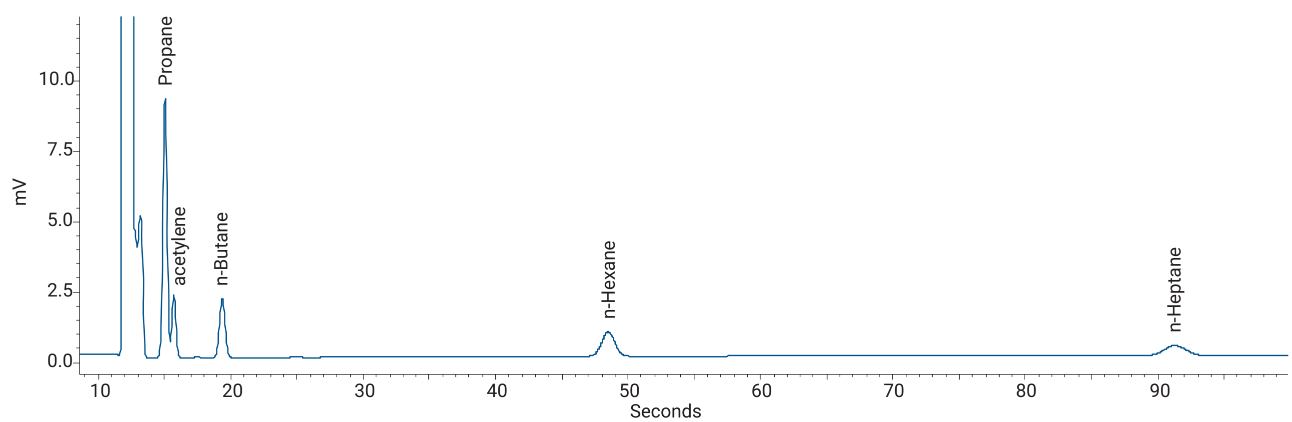



Figure 82. Universal Gas Calibration standard analyzed with the 6 meter CP-Sil 5 CB channel on Analyzer B

Analysis of a sample containing neo-pentane results in a chromatogram similar to **Figure 83**.

Analysis of a sample containing hydrocarbons up to *n*-nonane results in a chromatogram similar to **Figure 84**.

For samples that contain hydrocarbons up to *n*-nonane, increase the total run time to detect all hydrocarbons on this channel.

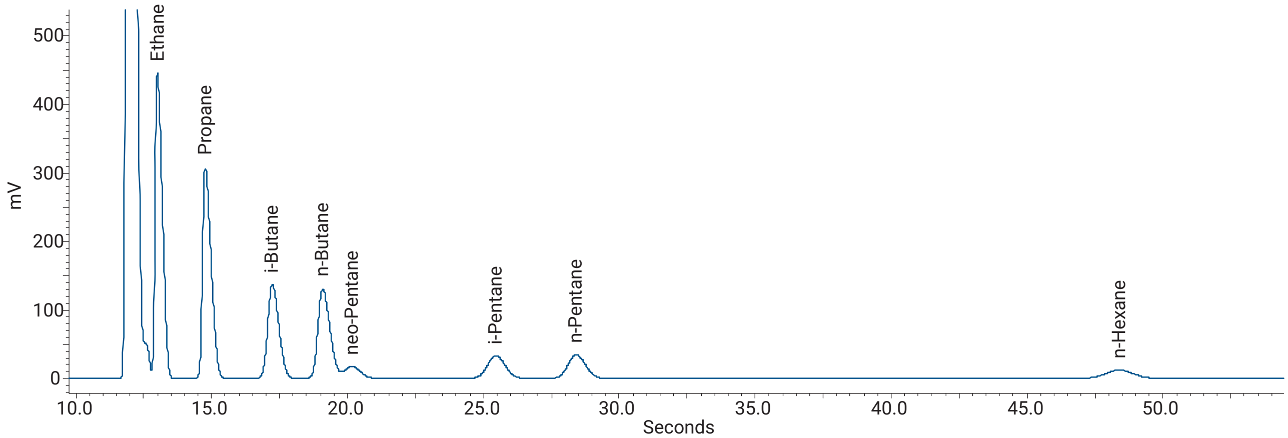



Figure 83. Sample containing *neo*-pentane analyzed with the 6 meter CP-Sil 5 CB channel on Analyzer B

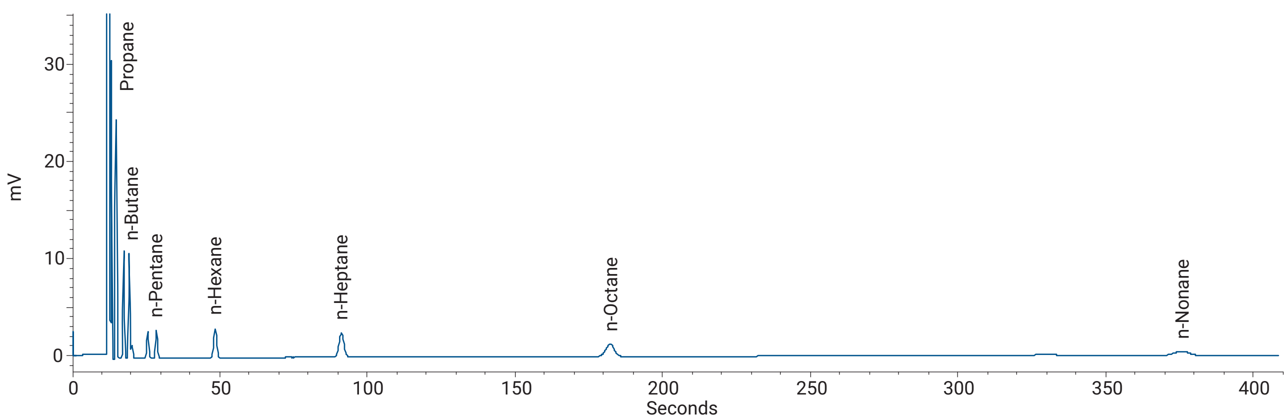



Figure 84. Sample containing hydrocarbons up to *n*-nonane analyzed with the 6 meter CP-Sil 5 CB channel on Analyzer B

### CP-Molsieve 5A

The CP-Molsieve 5A channel of the Natural Gas Analyzer B Extended is used for the analysis of permanent gases such as hydrogen, oxygen, nitrogen, methane, and carbon monoxide.

Analysis of the NGA Gas Calibration standard results in a chromatogram similar to **Figure 85**.

Analysis of the Universal Gas Calibration results in the chromatogram shown in **Figure 86**.

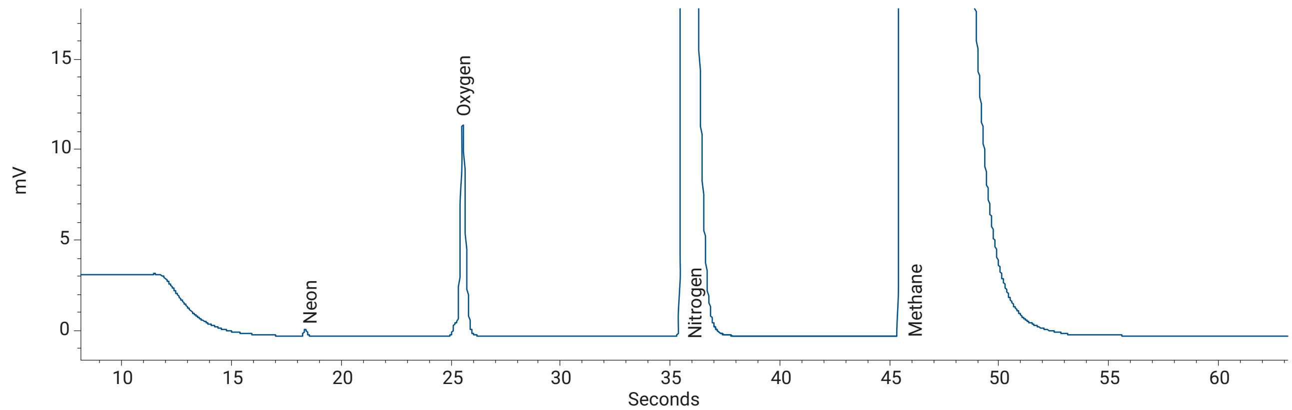



Figure 85. NGA Gas Calibration standard analyzed with the CP-Molsieve 5A channel on Analyzer B Extended

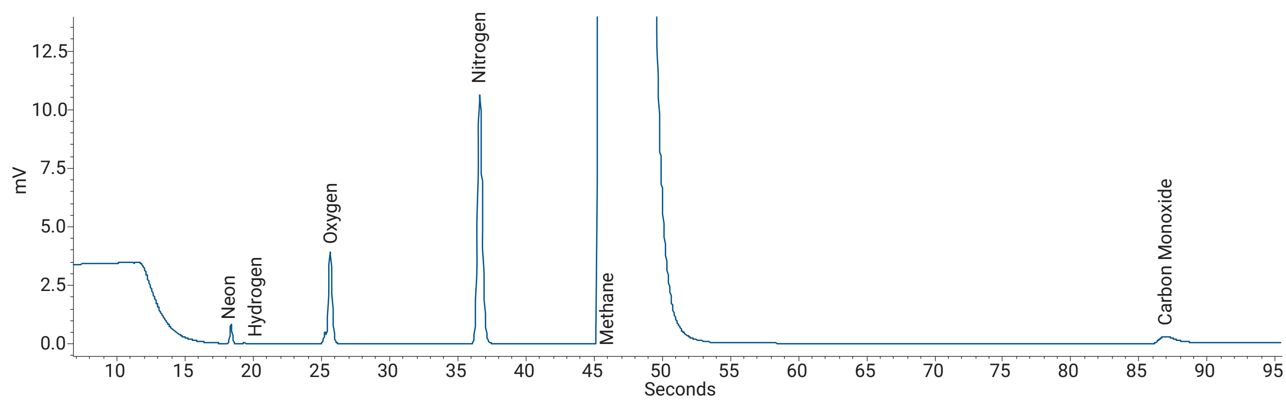



Figure 86. Universal Gas Calibration standard analyzed with the CP-Molsieve 5A channel on Analyzer B Extended

CAUTION

**The CP-Molsieve 5A channel is factory tuned on carrier gas helium. If analysis of helium or hydrogen is required on the CP-Molsieve 5A channel, the carrier gas must be changed and configured for argon.**

Analysis of the Universal Gas Calibration standard results in a chromatogram similar to **Figure 87**.

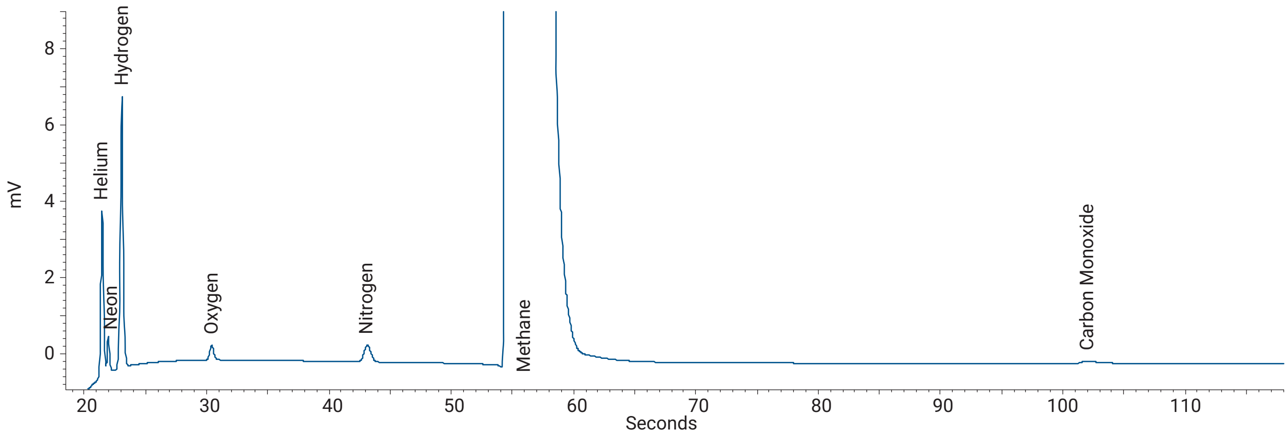



Figure 87. Universal Gas Calibration standard analyzed with the CP-Molsieve 5A channel on Analyzer B Extended

For tuning the backflush time, please refer to **Tuning the backflush time on a HayeSep A channel** on page 78.

# Certificate of the NGA Gas Calibration Standard

Part number: 5184-3544

Agilent Technologies
Innovating the HP Way

PRAXAIR

## Certificate of Analysis

### NGA Gas Calibration Standard

**Agilent Part No:** 5184-3536, 5184-3542 **Sample Lot No:** 031111N

**Concentrations (±mole%):**

| | |
|---|---|
| Nitrogen | 5.16% (±5%) |
| Methane | Balance |
| Ethane | 8.98% (±5%) |
| Carbon Dioxide | 1.49 (±5%) |
| Propane | 6.04% (±5%) |
| Isobutane | 3.04% (±5%) |
| n-Butane | 2.00% (±5%) |
| Isopentane | 0.500% (±5%) |
| n-Pentane | 0.500% (±5%) |
| n-Hexane | 0.100% (±5%) |
| Water content | <5 ppm |
| Other impurities | <1 ppm |
| BTU value | 1257 |

**Traceability:**

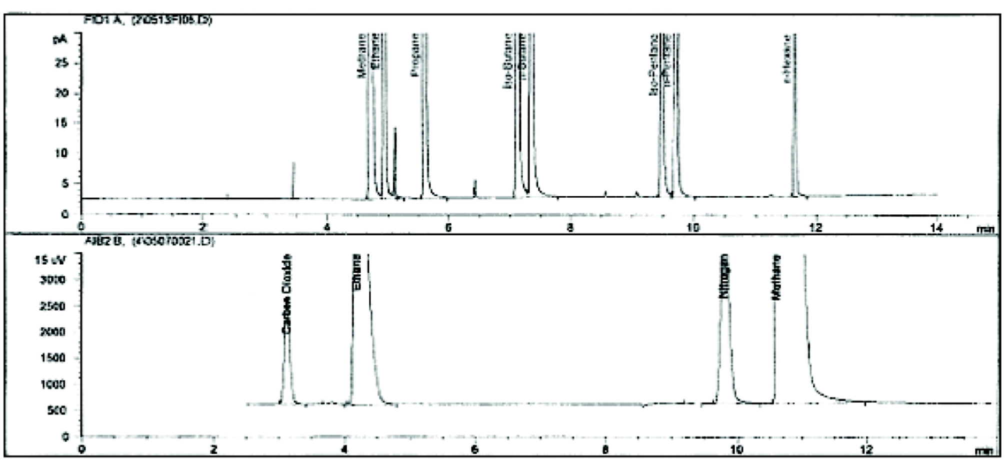
This standard was produced gravimetrically following Specialty Gas Work Instruction #15. Balances used are calibrated per POIS 2.140, traceable to NIST. Concentrations were verified on an Agilent model 6890 gas chromatograph, using a Wasson valve switch, Variable Pressure Control and multiple packed/capillary columns

**Standards Used:**

Praxair NGA Primary Standard Source Gas, serial #155624D

**Analytical GC Chromatograms:**

Analytical columns: Agilent MS-5A PLOT, U-PLOT
TCD: 1.0 ml loop; He carrier at 35 ml/min; oven temp = 90degC
FID: 0.1 ml loop; He carrier at 30 ml/min; split ratio=25:1; Ramp 75degC for 6 min to 180degC for 3.75 min at 20degC/min




Date of Release: 11 March, 2011
Expiration Date: 11 March, 2013

Analyst: John J. Goddard
Senior Chemist

# Certificate of the Universal Gas Calibration Standard

Part number 5184-3546

Agilent Technologies
Innovating the HP Way

PRAXAIR

## Certificate of Analysis

### Universal Gas Calibration Standard

**Agilent Part No:** 5183-4800, 5184-3541 **Sample Lot No:** 021510U

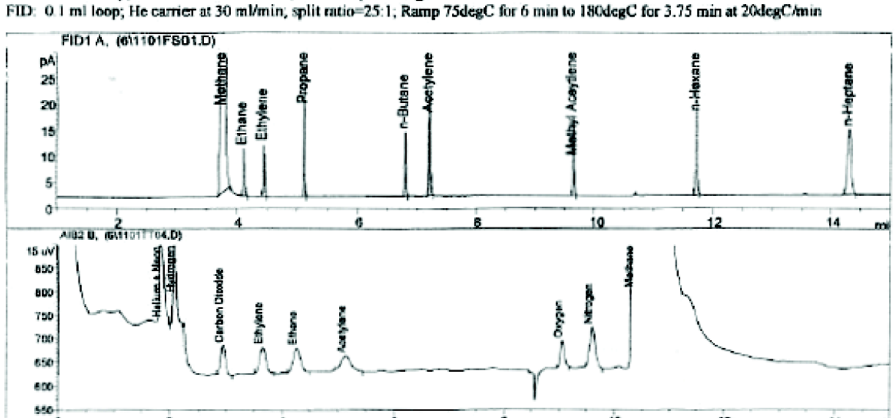
**Concentrations (±mole%):**

| | | | |
|---|---|---|---|
| Helium | 0.1000% (±5%) | n-Hexane | 0.0500% (±5%) |
| Neon | 0.0496% (±5%) | n-Heptane | 0.0500% (±5%) |
| Hydrogen | 0.0988% (±5%) | Water content ($H_2O$) | <5 ppm |
| Oxygen | 0.0500% (±5%) | Other impurities (HC's) | <1 ppm |
| Nitrogen | 0.1000% (±5%) | | |
| Methane | Balance | | |
| Ethane | 0.0497% (±5%) | | |
| Ethylene | 0.0497% (±5%) | | |
| Carbon Dioxide | 0.0500% (±5%) | | |
| Carbon Monoxide | 0.0995% (±5%) | | |
| Acetylene | 0.0494% (±5%) | | |
| Propane | 0.0501% (±5%) | | |
| Methyl Acetylene | 0.0501% (±5%) | | |
| n-Butane | 0.0501% (±5%) | | |

**Traceability:**
This standard was produced gravimetrically following Specialty Gas Work Instruction #15. Balances used are calibrated per POIS 2.140, traceable to NIST. Concentrations were verified on an Agilent model 6890 gas chromatograph, using a Wasson valve switch, Variable Pressure Control and multiple packed/capillary columns.

**Standards Used:**
Praxair UGS Primary Standard, serial # CC309710

**Analytical GC Chromatogram:**
Analytical columns: Agilent MS-5A PLOT, U-PLOT
TCD: 1.0 ml loop; He carrier at 35 ml/min; oven temp = 90degC
FID: 0.1 ml loop; He carrier at 30 ml/min; split ratio=25:1; Ramp 75degC for 6 min to 180degC for 3.75 min at 20degC/min




Date of Release: 15 February, 2010
Expiration Date: 15 February, 2012

Analyst: John Goddard
Senior Chemist

# Typical Method Settings for Natural Gas Analyzers

Typical method settings for the Natural Gas Analyzers are given in Tables **33** - **36**.

### Table 33 Method for Agilent 990 Micro GC - Natural Gas Analyzer A

| Method settings* | HayeSep A | CP-Sil 5 CB_6m |
|---|---|---|
| Carrier gas | Helium | Helium |
| Injector temperature (°C) | 110 | 110 |
| Injection time (ms) | 40 | 40 |
| Column temperature (°C) | 60 | 70 |
| Pressure (kPa) | 260 | 150 |
| Sample inlet temperature (°C) | 110 | 110 |

* For more details of the method, see the pdf-method file available on the Natural Gas Analyzer CD.

### Table 34 Method for Agilent 990 Micro GC - Natural Gas Analyzer A Extended

| Method settings* | HayeSep A | CP-Sil 5 CB_4m | CP-Sil 5 CB_8m |
|---|---|---|---|
| Carrier gas | Helium | Helium | Helium |
| Injector temperature (°C) | 110 | 110 | 110 |
| Injection time (ms) | 20 | 40 | 40 |
| Backflush time (s)† | 120 | 12 | - |
| Column temperature (°C) | 90 | 60 | 150 |
| Pressure (kPa) | 340 | 150 | 200 |
| Sample inlet temperature (°C) | 110 | 110 | 110 |

* For more details of the method, see the pdf-method file available on the Natural Gas Analyzer CD.

† The backflush time must be tuned for each new CP-Molsieve 5A, PoraPLOT U, 4 meter CP-Sil 5 CB, and HayeSep A channel.

### Table 35 Method for Agilent 990 Micro GC - Natural Gas Analyzer B

| Method settings* | PoraPLOT U | CP-Sil 5 CB_6m |
|---|---|---|
| Carrier gas | Helium | Helium |
| Injector temperature (°C) | 110 | 110 |
| Injection time (ms) | 40 | 40 |
| Backflush time (s)† | 17 | - |
| Column temperature (°C) | 60 | 70 |
| Pressure (kPa) | 175 | 150 |
| Sample inlet temperature (°C) | 110 | 110 |

* For more details of the method, see the pdf-method file available on the Natural Gas Analyzer CD.

† The backflush time must be tuned for each new CP-Molsieve 5A, PoraPLOT U, 4 meter CP-Sil 5 CB, and HayeSep A channel.

### Table 36 Method for Agilent 990 Micro GC - Natural Gas Analyzer B Extended

| Method settings* | CP-Molsieve 5A | PoraPLOT U | CP-Sil 5 CB_6m |
|---|---|---|---|
| Carrier gas | Helium | Helium | Helium |
| Injector temperature (°C) | 110 | 110 | 110 |
| Injection time (ms) | 40 | 40 | 40 |
| Backflush time (s)† | 11 | 17 | - |
| Column temperature (°C) | 80 | 60 | 70 |
| Pressure (kPa) | 200 | 175 | 150 |
| Sample inlet temperature (°C) | 110 | 110 | 110 |

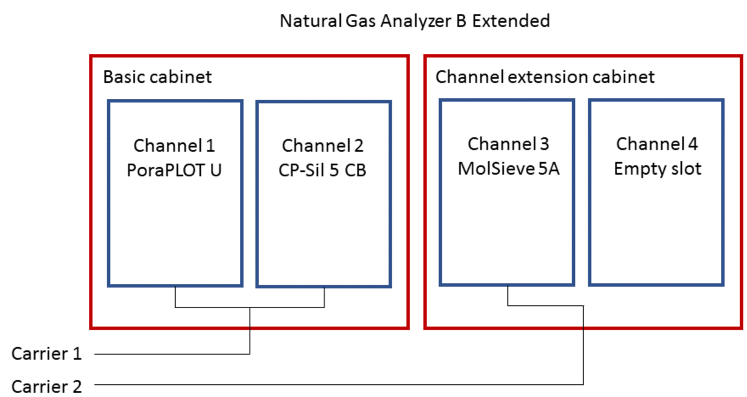
* For more details of the method, see the pdf-method file available on the Natural Gas Analyzer CD.

† The backflush time must be tuned for each new CP-Molsieve 5A, PoraPLOT U, 4 meter CP-Sil 5 CB, and HayeSep A channel.

# Carrier Gas Type Configuration

The Agilent 990 Micro GC - Natural Gas Analyzers are factory tuned using the carrier gas helium. When analysis of helium is required, the carrier gas must be changed to argon.

Instruments with the dual carrier option are typically configured as shown below.

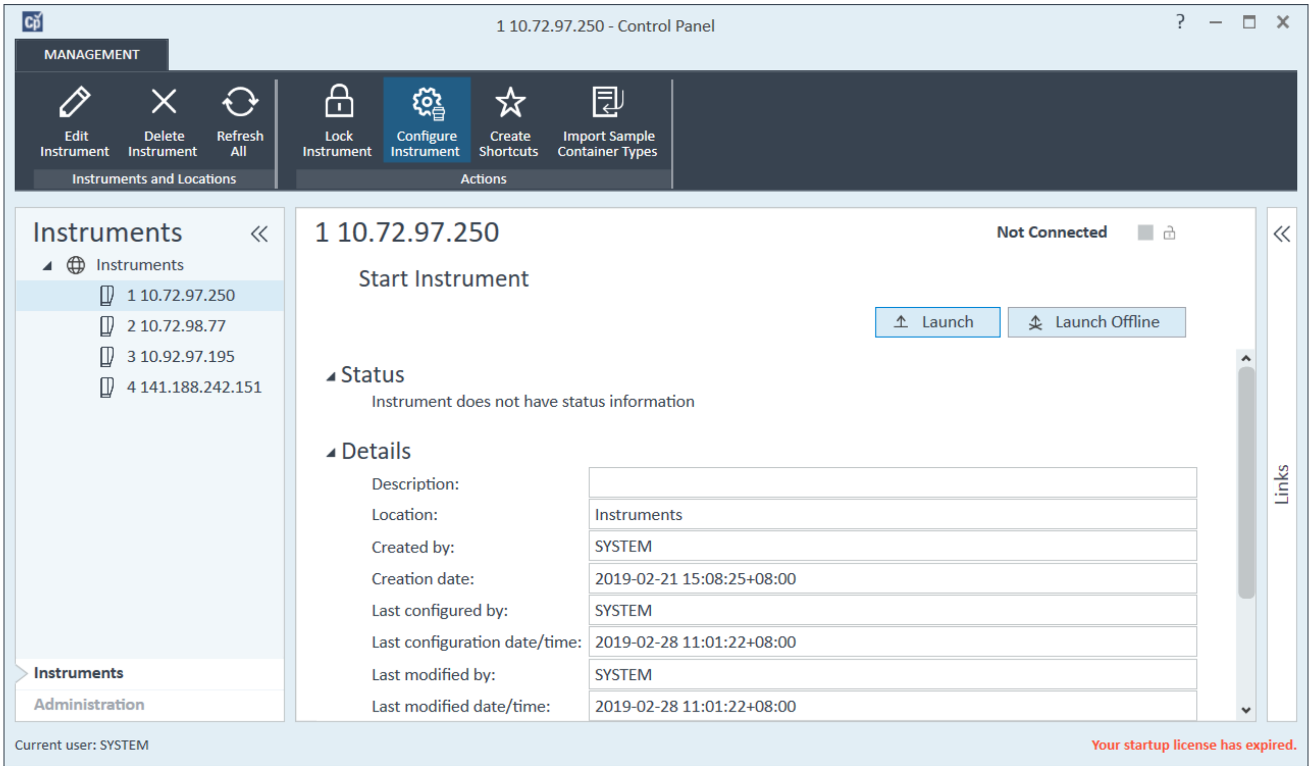


# Procedure to change the carrier gas type

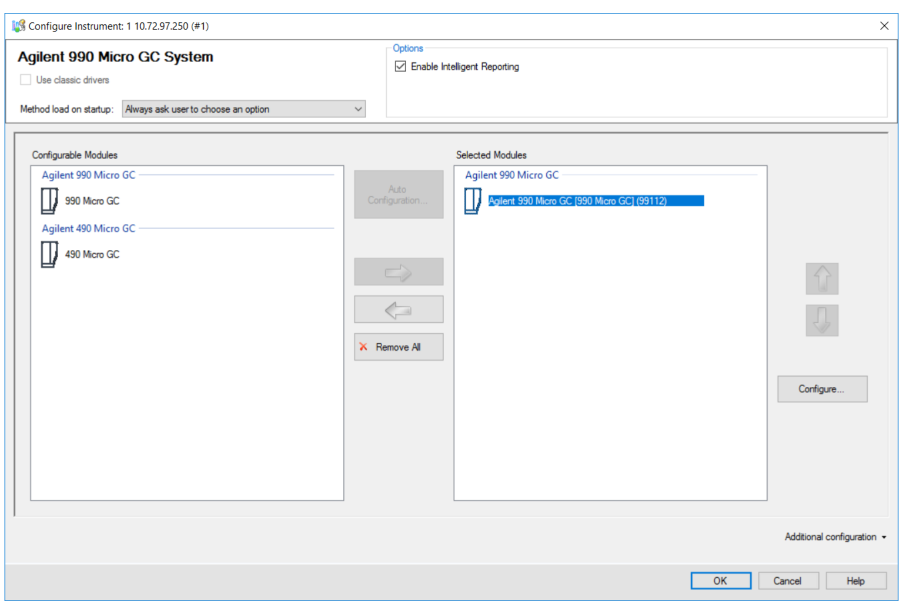
If you are using Agilent OpenLAB CDS edition, use the following procedure to change the carrier gas type.

1 In the Agilent OpenLAB Control Panel Navigation pane, select the instrument.

2 In the Actions toolbar, select **Configure Instrument**.

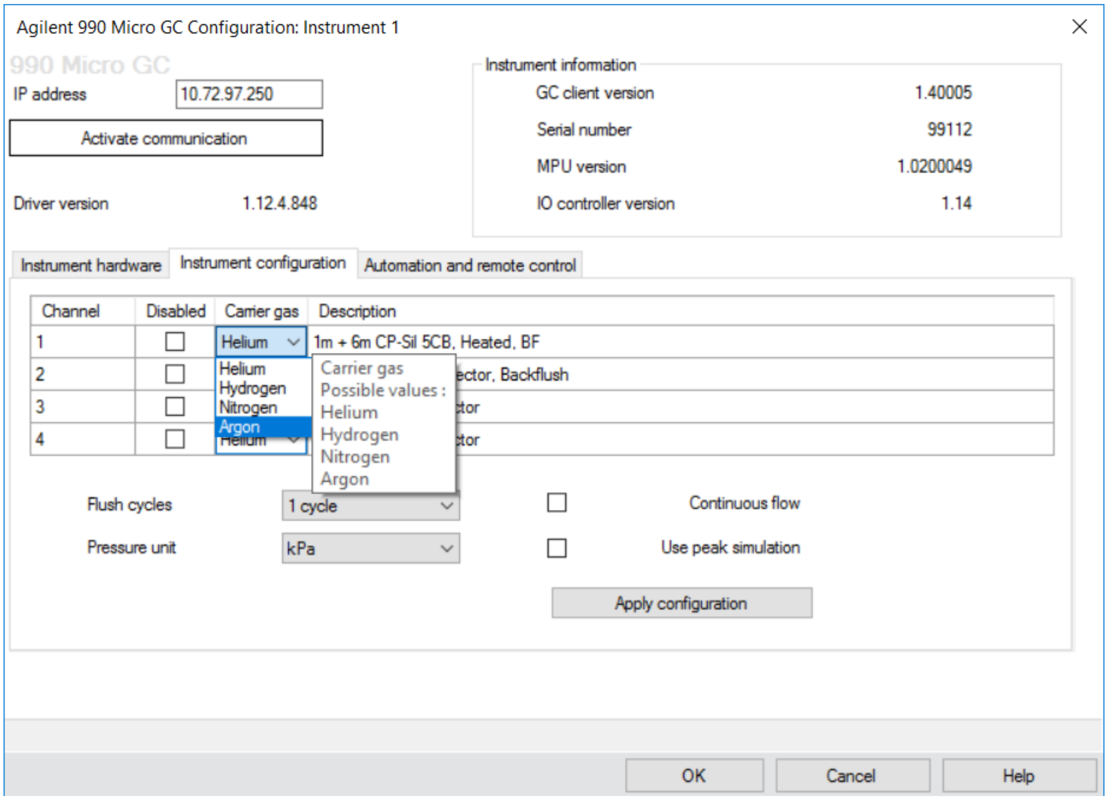



3 Double-click **Agilent 990 Micro GC**.

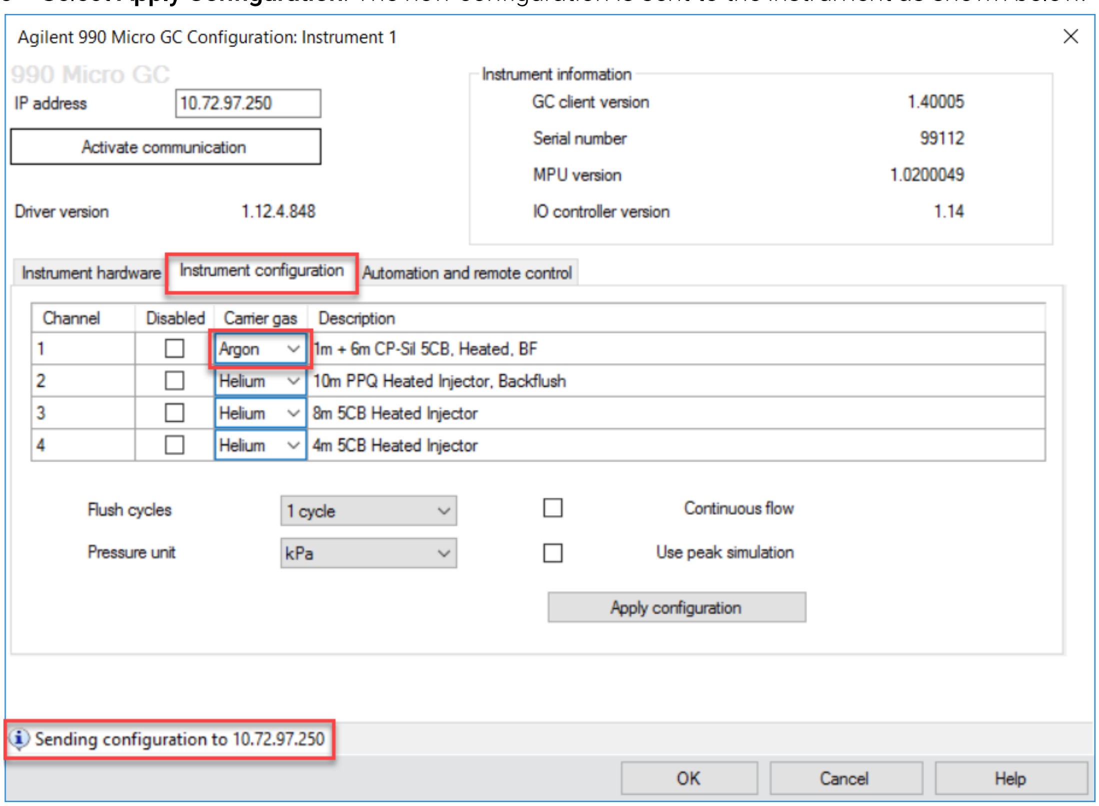


4 In the Configuration dialog box, select the Instrument configuration tab.

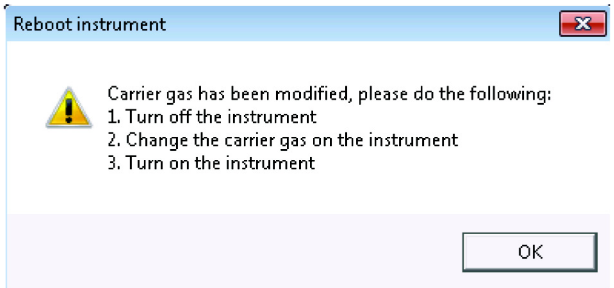
5 In the Carrier gas list, select **Argon**.




6 Select **Apply Configuration**. The new configuration is sent to the instrument as shown below.



7 When the configuration is complete, in the **Reboot Instrument** dialog box select **OK**.




8 Turn off the instrument.

9 Change the carrier gas on the instrument.

10 Restart the Agilent 990 Micro GC - Natural Gas Analyzer.

The Agilent 990 Micro GC is now configured for carrier gas Argon.

# Method for CP-Molsieve 5A Channel with Carrier Gas Argon

Typical method setting for analysis of helium and hydrogen on the CP-Molsieve 5A channel.

**Table 37 Method setting for analysis of helium with Natural Gas Analyzer B Extended**

| Method settings | CP-Molsieve 5A |
|---|---|
| Carrier gas | Argon |
| Injector temperature (°C) | 110 |
| Injection time (ms) | 40 |
| Backflush time (s)* | 11 |
| Column temperature (°C) | 80 |
| Pressure (kPa) | 200 |
| Sample inlet temperature (°C) | 110 |
| Invert signal | Yes |

* The backflush time must be tuned for each new CP-Molsieve 5A channel.

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