



# **Agilent 7890 Series Gas Chromatograph**

## **Troubleshooting**



**Agilent Technologies**

# Notices

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### WARNING

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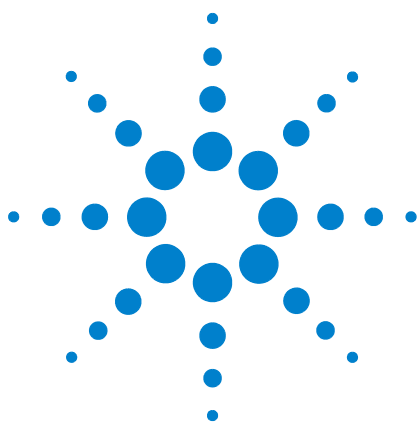
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# 1

## Concepts and General Tasks

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## Concepts

This manual provides lists of symptoms and corresponding tasks to perform should you experience errors associated with GC hardware or chromatographic output, GC Not Ready messages, and other common issues.

Each section describes a problem and provides a bulleted list of possible causes for you to troubleshoot. These lists are not intended for use in the development of new methods. Proceed with troubleshooting under the assumption that method(s) are working properly.

This manual also includes common troubleshooting tasks as well as information needed prior to calling Agilent for service.

While this manual describes troubleshooting for 7890 Series GCs in general, when describing GC keyboard usage and firmware features, this manual assumes a 7890B GC using firmware B.02.01. Features that are specific to one GC model only (7890A or 7890B) are noted.

### How to troubleshoot using this manual

Use the following steps as a general approach to troubleshooting:

- 1 Observe the symptoms of the problem.
- 2 Look up the symptoms in this manual using the Table of Contents or the **Search** tool. Review the list of possible causes of the symptom.
- 3 Check each possible cause or perform a test that narrows the list of possible causes until the symptom is resolved.

### The [Status] key

Be sure to also use the **[Status]** and **[Info]** keys on the GC keypad while using this troubleshooting information. These keys will display additional useful information related to the status of the GC and its components.

## Error conditions

If a problem occurs, a status message appears. If the message indicates broken hardware, more information may be available. Press the applicable component key (for example, **[Front Det]**, **[Oven]**, or **[Front Inlet]**).

## **7890B/5977 GC/MSD Systems**

When used with a 5977 MSD, the 7890B GC and MSD closely interact with each other. In addition to simply sending start run commands and general status information (ready or not ready), the instruments change their settings based on each other's status. For example:

- A GC shutdown may cause the MSD to shut down or otherwise protect itself.
- Venting the MSD causes changes in the GC to support the venting process.
- An MSD shutdown may cause the GC to change its settings to protect itself and the MSD.
- A loss of communications between the instruments may causes changes in one or both instruments.
- The GC sleep/wake cycle triggers the MSD sleep/wake cycle (if available).

Because of this interaction, always check the displays on both instruments and in the data system to learn the complete system status. In general, the GC display will present many MSD status and other information messages.

## Configurable Items to Always Keep Current

Certain configurable items in the GC must always be kept current. Failure to do so will lead to reduced sensitivity, chromatographic errors, and possible safety concerns.

If equipped with the optional G3494A or G3494B Barcode Reader accessory (7890B only), you can directly scan parts data (column, liner and ALS syringe information) into the GC without having to type it into the GC at the keypad.

### Inlet and detector configuration

Be sure to configure the GC and all related components to reflect an inlet or detector change. Below are some examples of components to keep current after making changes to the inlet or detector:

**Liners:** The appropriateness of liner type varies depending on the GC inlet mode, for example split mode versus splitless mode, and the analysis.

**FPD filters:** The FPD filters require different gas flows to function properly. Configure the flow according to the FPD filter installed (phosphorus versus sulfur).

**FID and NPD jets:** Use the jet appropriate for the type of column installed (capillary column versus packed column).

**NPD bead type:** Always configure the NPD bead type. An incorrect type can lead to poor performance or premature bead failure.

### Column configuration

Reconfigure the GC every time a column is trimmed or changed. Also verify that the data system reflects the correct column type, length, id, and film thickness. The GC relies on this information to calculate flows. Not updating the GC after altering a column causes incorrect flows, changed or incorrect split ratios, retention time changes, and peak shifts.

## Automatic Liquid Sampler configuration

Keep the Automatic Liquid Sampler (ALS) configuration up-to-date to ensure proper operation. ALS items to keep current include injector position, installed syringe size, and solvent and waste bottle usage.

## Gas configuration

### WARNING

**Always configure the GC appropriately when working with hydrogen. Hydrogen leaks quickly and poses a safety concern if too much of it is released into the air or into the GC oven.**

---

Reconfigure the GC every time the gas type is changed. If the GC is configured to a gas other than what is actually being plumbed, incorrect flow rates will result.

To confirm the gas configuration:

- 1 Press **[Config]**.
- 2 Scroll to the appropriate detector or column item on the display and press **[Enter]** to see the type of gas configured.

## To View the Run Log, Maintenance Log, and Event Log

The GC maintains internal event logs, each of which holds up to 250 entries. Use these logs to troubleshoot problems, especially when a message no longer appears on the display.

To access the logs, press [**Logs**] to toggle to the desired log. The display will indicate the number of entries the log contains. Scroll through the list.

### Run Log

For each run, the run log records deviations from the planned method. This log is overwritten at the start of each run. The run log information can be used for Good Laboratory Practice (GLP) standards and can be uploaded to an Agilent data system. When the Run Log contains entries, the **Run Log** LED lights.

### Maintenance Log

The maintenance log contains an entry for each time an Early Maintenance Feedback limit is reached, reset, or changed. The log records details such as the counter item, the counter value, the new counter value, and whether or not the counter was reset (indicating a part replacement). When the maintenance log is full, the GC overwrites entries, beginning with the oldest.

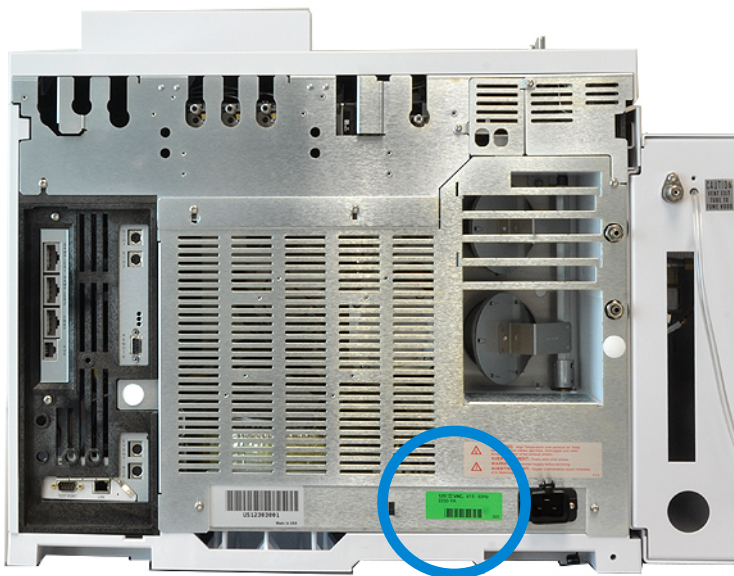
### Event Log

The event log records events such as shutdowns, warnings, faults, and GC state changes (start run, stop run, and so forth) that occur during GC operation. When the event log is full, the GC overwrites entries, beginning with the oldest.

## Information to Obtain Before Calling Agilent for Service

Gather the following information before contacting Agilent for service:

- Symptoms
- Problem description
- Hardware installed and parameters/configuration when the error occurred (sample, supply gas type, gas flow rates, detectors/inlets installed, and so forth)
- Any messages that appear on the GC display
- Results of any troubleshooting tests you have run
- Instrument details. Obtain the following information:
  - GC serial number, which can be found on a sticker located beneath the keypad on the bottom right corner of the GC.
  - GC firmware revision (press **[Status]**, then **[Clear]**)
  - GC power configuration (located on a label on the back panel of the GC to the left of the GC power cable)



- Oven configuration (fast- or slow-heating)
- Press the **[Status]** key to display previous **Error**, **Not Ready**, and **Shutdown** messages.

To obtain service/support contact numbers, see the Agilent Web site at [www.agilent.com/chem](http://www.agilent.com/chem).



## 2 ALS and Detector Symptoms

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## Plunger Errors

If the ALS reports a front or back plunger error, check the following possible causes:

- The syringe plunger is sticking or is not securely connected to the plunger carrier.
- The plunger solenoid is binding.
- The plunger carrier encoder is inoperable.
- The autoinjector plunger carrier mechanism will not move.
- The plunger does not move freely due to sample residue or wear. Install a new syringe, making sure to prime the syringe with solvent before installing.

### Procedure

- 1 Remove the syringe and check it for plunger stickiness or binding. Replace the syringe if necessary ([7693A](#), [7650A](#), [7683](#)).
- 2 Check the viscosity of the sample against the viscosity parameter. Reset the viscosity parameter if necessary.
- 3 Restart the sequence.
- 4 If the error occurs again, obtain Agilent service.

## Vial Mishandled by ALS (7693A)

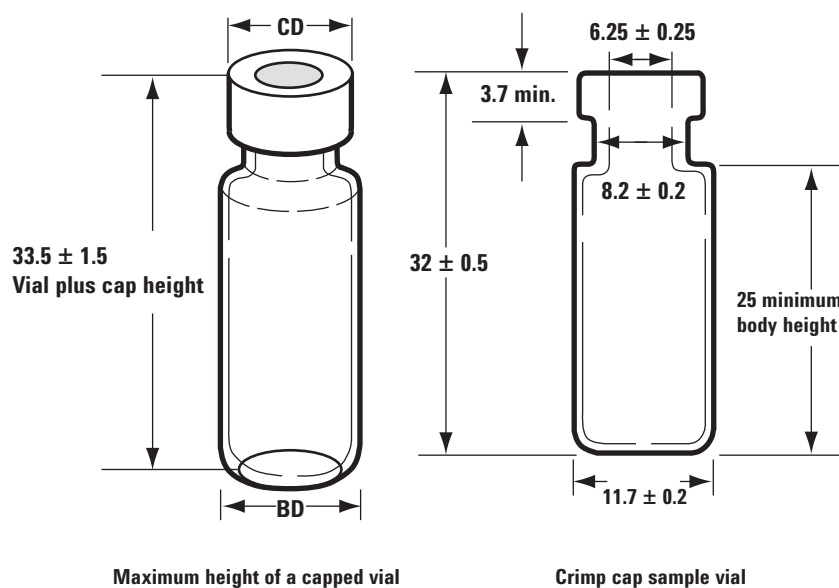
Refer to your [sampler operating documentation](#) for additional information.

When you find a mishandled sample vial, do the following:

- Check for folds or wrinkles in the crimp cap, especially near the neck of the sample vial.
- Use Agilent-recommended sample vials.

The figure below shows the critical dimensions for sample vials and microvial inserts to be used with the 7693A ALS system. These dimensions do not make up a complete set of specifications.

**Body Diameter (BD) =  $11.7 \pm 0.2$**   
**Cap Diameter (CD) =  $BD \times 1.03$  maximum**  
**All dimensions in millimeters**

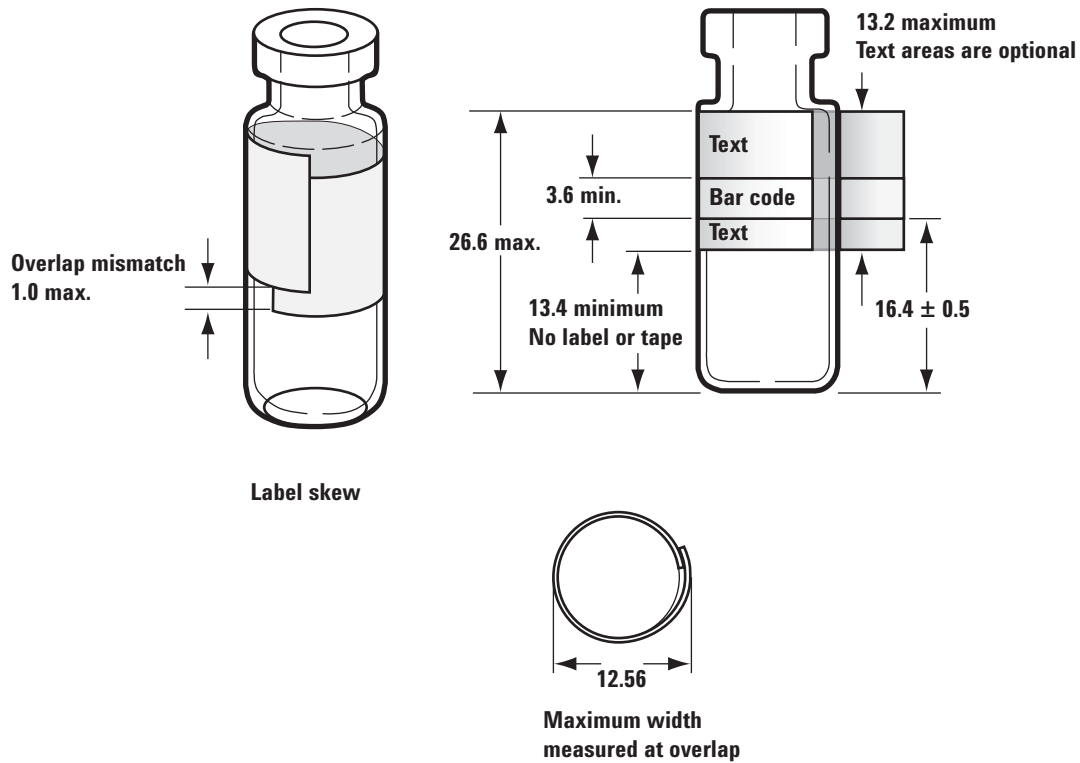


- Verify the transfer turret is installed if using a G4514A tray.
- Check sample labels (if applicable).
  - Check that they are the correct size.
  - Verify that the labels do not interfere with the gripper.

Vials are available with a write-on spot for easy marking. If you choose to make and apply your own labels, Agilent Technologies recommends the positioning and maximum label thickness shown in the figure below.

## 2 ALS and Detector Symptoms

All dimensions in millimeters



- Check that the tray vial racks are clean and snapped into the tray base.
- [Calibrate](#) the system.

## Alignment Light on 7693A/7650A Injector Tower is On

If the Align Mode light is on, first verify that the turret is properly installed. Then, perform the alignment procedure as described in the [7693A Automatic Liquid Sampler Installation, Operation and Maintenance](#) manual or the [7650A Automatic Liquid Sampler Installation, Operation and Maintenance](#) manual.

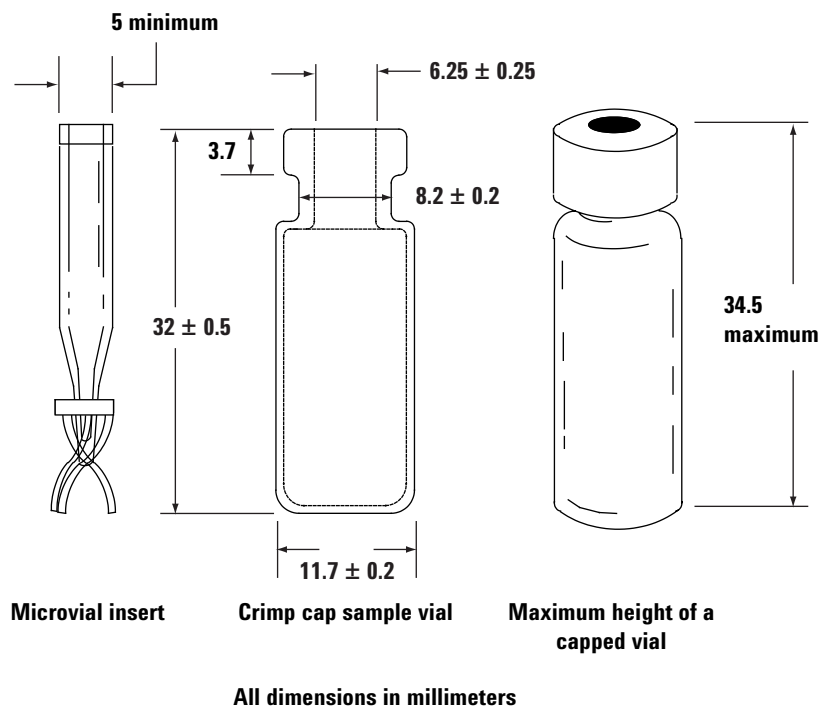
## Vial Mishandled by ALS (7683)

Refer to your [sampler operating documentation](#) for additional information.

When you find a mishandled sample vial, do the following:

- Check for folds or wrinkles in the crimp cap, especially near the neck of the sample vial.
- Use Agilent-recommended sample vials.
  - The distance from the vial bottom to the top of the neck should be approximately 28.4 mm.
  - The bottle neck diameter should be  $8.2 \pm 0.2$  mm. The sampler injector and the tray use clear or amber glass sample vials with crimp caps, or Target® DP™ screw-cap vials. Use amber glass vials for light-sensitive samples. Refer to your Agilent catalog for consumables and supplies for acceptable vial types. Incompatible sample vials cause tray and turret errors.

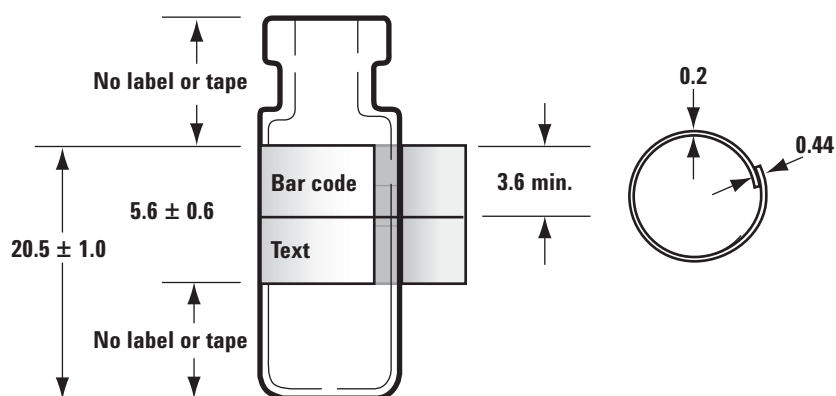
The figure below shows the critical dimensions for sample vials and microvial inserts to be used with the sampler. These dimensions do not make up a complete set of specifications.



- Verify the transfer turret is installed if using a tray and G2913A injector.
- Check sample labels (if applicable).
  - Check that they are the correct size.
  - Verify that the labels do not interfere with the gripper.

Vials are available with a write-on spot for easy marking. If you choose to make and apply your own labels, Agilent Technologies recommends the positioning and maximum label thickness shown in the figure below.

All dimensions in millimeters



- Check that the tray vial racks are clean and snapped into the tray base.
- If the tray cannot deliver or retrieve vials from a bar code reader:
  - 1 Press **[Config]**.
  - 2 Scroll to and select **Sample tray**.
  - 3 Scroll to **Grip offset** and press **[Mode/Type]**.
  - 4 Scroll to the desired adjustment (**Up**, **Default**, or **Down**) and press **[Enter]**.
- If the sample vial touches the side of the turret hole as the vial is raised or lowered, adjust the turret rotation.

For 7683B, adjust the gripper height as follows:

- 1 Press **[Config]**.
- 2 Scroll to and select **Sample tray**.
- 3 Scroll to **Front injector offset** and press **[Mode/Type]**.
- 4 Scroll to the desired adjustment (**Clock**, **Counterclock**, or **Default**) and press **[Enter]**.

## Alignment Light on 7683B Injector Tower is On

Refer to the [7683B Automatic Liquid Sampler Installation, Operation and Maintenance](#) manual for additional information.

When the Align Mode light is on, the injector will not operate until the following procedure is performed:

- 1 When the injector is not operating, open the injector tower door.
- 2 Slide the syringe carriage up until it stops.
- 3 Remove the syringe.
- 4 Carefully remove the needle support assembly from the injector.
- 5 Use a pen to press the recessed alignment button located above the indicator lights, then close the door.
- 6 The injector will then go through the following steps:
  - a The turret rotates to verify that the needle support assembly was removed, then rotates to determine what type of turret is installed.
  - b The syringe carriage moves all the way down, then moves back up again and clears the turret.
  - c The syringe carriage steps down until it touches the turret. This sets its position relative to the turret.
  - d The plunger moves to calibrate six stops. Observe each of the six steps to verify the plunger loop is functioning properly. If it is missing stops, send the injector to Agilent for repair.
- 7 When the alignment is complete, the Ready light turns on and the sampler returns to the ready state. Install the needle support assembly and syringe.

## Syringe Needle Bends During Injection into Inlet

**WARNING**

When troubleshooting the injector, keep your hands away from the syringe needle. The needle is sharp and may contain hazardous chemicals.

---

Refer to your ALS documentation for additional information:

[7683B Automatic Liquid Sampler Installation, Operation and Maintenance](#)

[7693A Automatic Liquid Sampler Installation, Operation and Maintenance](#)

[7650A Automatic Liquid Sampler Installation, Operation and Maintenance](#)

- Check that the GC septum nut is not too tight.
- Check that the syringe is installed correctly into the syringe carriage.
- Check that the needle support and guide are clean. Remove any residue or septum deposits. Install a new needle support assembly (7683) or needle support foot (7693A or 7650A) if necessary.
- If using the cool on-column inlet, check that the correct insert for the syringe is installed. See [To Check the Needle-to-Column Size on the COC Inlet](#) for more information.
- Check that you are using the proper syringe. The combined length of the syringe barrel and needle should be approximately 126.5 mm.
- Check that the sample vial dimensions meet specification. See [“Vial Mishandled by ALS \(7693A\)”](#) or [“Vial Mishandled by ALS \(7683\)”](#).
- Check that the crimp cap is properly installed. Refer to your sampler documentation.

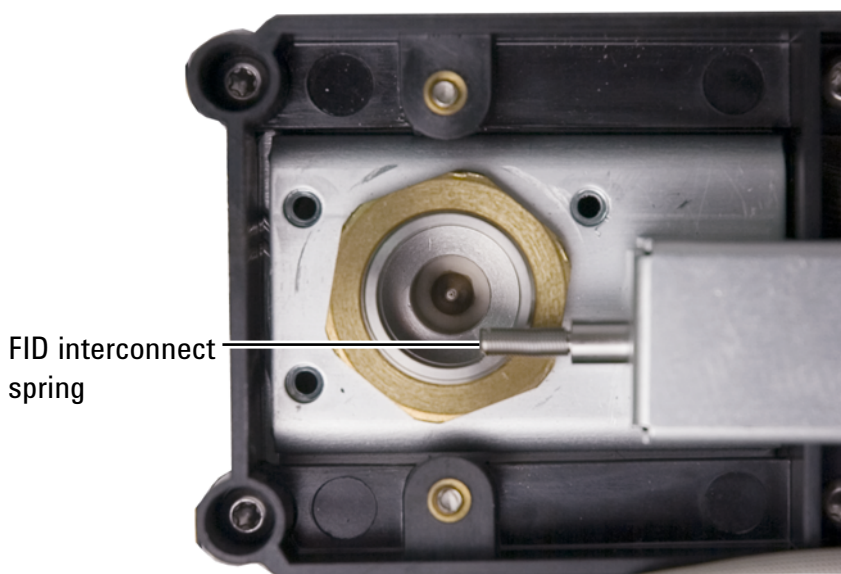
## FID Fails Leakage Current Test

### Possible causes

A failed leakage current test usually indicates misassembly, contamination, or a damaged part.

### Procedure

- 1 If you have just performed maintenance on the FID, first verify that the detector was reassembled properly before troubleshooting detector problems.
- 2 [Replace](#) the PTFE (FID) for contamination.
- 3 Make sure that the interconnect spring is not damaged, bent, or dirty. The interconnect spring should be touching the bottom of the collector. If the interconnect spring is damaged, bent, or dirty, call Agilent for service.

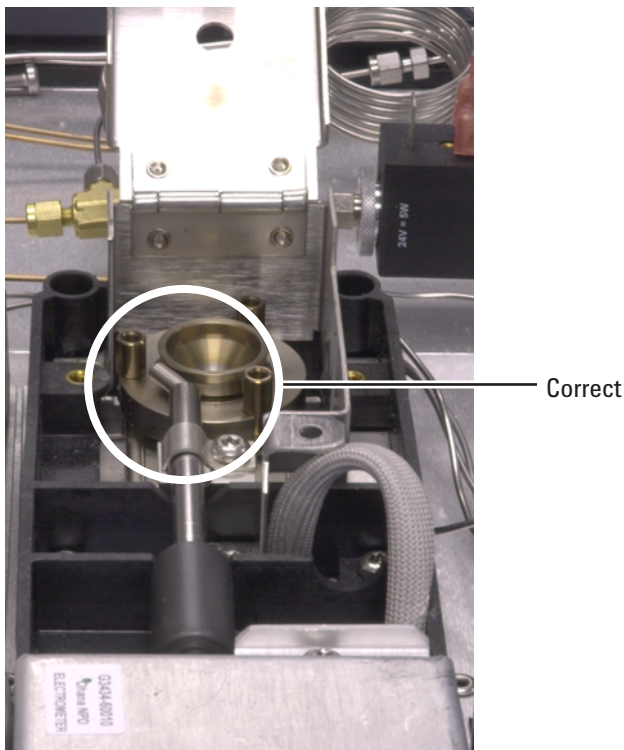


## NPD Fails Leakage Current Test

A failed leakage current test usually indicates misassembly, contamination, or a damaged part.

If you have just performed maintenance on the NPD, first verify that the detector was reassembled properly before troubleshooting detector problems.

- 1 Replace the [ceramic insulators](#). Retest.
- 2 Set the bead voltage to 0.0 V. Turn off the adjust offset. View the output (leakage current).
- 3 Remove the bead and store in a safe place.
- 4 Remove the three screws that secure the lid in place, then remove the lid.
- 5 Examine the interconnect spring. Make sure that the interconnect spring is not damaged, bent, or dirty. The interconnect spring should be touching the bottom of the collector. If the interconnect spring is damaged, bent, or dirty, call Agilent for service.



- 6 If the interconnect spring is not damaged or dirty, and the detector output signal is still high, contact Agilent for service.

## FID Fails Baseline Test

If you have just performed maintenance on the FID, first verify that the detector was reassembled properly before troubleshooting detector problems.

If the FID fails the baseline test:

- Ensure the [purity and quality](#) of the gas.
- Replace dirty/expended chemical traps.
- [Bakeout](#) the detector.

## To Resolve Low Sensitivity with an FID

See [“To Resolve Low Sensitivity with an FID”](#).

## FID Does Not Ignite

- Verify that the Lit Offset is  $\leq 2.0$  pA.
- Ensure that the FID temperature is high enough for ignition ( $>150$  °C). Agilent recommends  $>300$  °C.
- Check that the FID ignitor glows during ignition sequence. (See [To Verify FID Ignitor Function During Ignition Sequence](#).)
- Check that the air and hydrogen pressures meet Agilent's recommendations (hydrogen  $> 35$  psi [210 kPa] and air  $> 55$  psi [380 kPa]). See the [Agilent GC, GC/MS, and ALS Site Preparation Guide](#).
- Try increasing the supply pressures to the FID flow module. This makes the flame easier to light without changing the setpoints.
- Increase hydrogen flow and decrease or turn off makeup gas flow until ignition occurs, then reduce them toward the method values. Experiment for the best values.

Increasing hydrogen flow and decreasing makeup flow will help the FID ignite more easily. If it will light under these modified conditions, the cause could be a partially clogged jet, a weak ignitor, or a leak at the column fitting.

- Check for a plugged or partially plugged jet. (See [To Check for a Plugged FID Jet](#).)
- Measure the FID flow rates. Actual flow rates should be within  $\pm 10\%$  of the setpoint. (See [FID starting conditions](#).) The hydrogen:air ratio greatly impacts ignition. Nonoptimal flow settings can prevent flame ignition. (See [To Measure a Detector Flow](#).)
- There could be a large leak in the system if the flame still will not light. Large leaks result in measured flow rates being different from actual flow rates, causing nonideal ignition conditions. Thoroughly leak check the whole system, especially the column fitting at the FID. (See [Checking for Leaks](#).)
- Check the column flow rate. (See [To Measure a Column Flow](#).) Hydrogen flow should be greater than the sum of the column flow and makeup flow.
- If the analysis permits, substitute nitrogen for helium as makeup.

## FID Ignitor Does Not Glow During Ignition Sequence

**WARNING**

Keep body parts at a safe distance from the FID chimney while performing this task. If using hydrogen, the FID flame will not be visible.

- 1 Remove the detector top cover.
- 2 Turn the FID flame **On**.
- 3 Observe the ignitor plug through the FID chimney. The small hole should glow during ignition sequence.



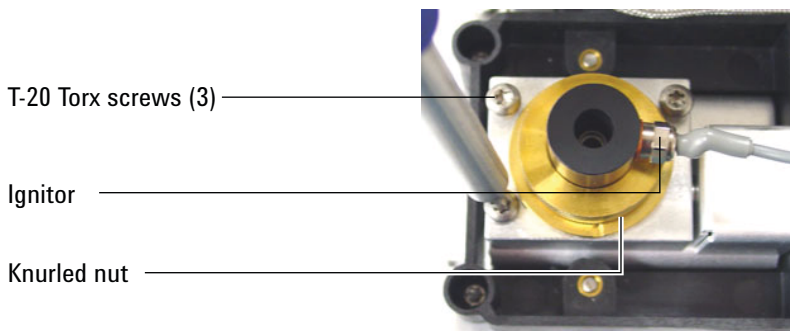
If the test fails, check for the following possible causes:

- The ignitor may be bad; replace the ignitor. (See [To Perform Maintenance on the FID Collector Assembly](#).)
- Detector temperature is set to  $< 150\text{ }^{\circ}\text{C}$ . Agilent recommends operating the FID at  $> 300\text{ }^{\circ}\text{C}$ .
- The ignitor is not making a good connection to the ground:
  - The ignitor must be tightly screwed into the FID castle assembly.
  - The three T-20 Torx screws that hold the collector assembly in place must be tight.

## 2 ALS and Detector Symptoms

- The brass knurled nut that holds the FID castle assembly in place must be tight.

Perform FID maintenance if these parts are corroded or oxidized.



## Corrosion in FID Collector and Ignitor Glow Plug

Agilent recommends inspecting the collector and ignitor glow plug for corrosion while performing maintenance on the FID.

The FID combustion process results in condensation. This condensation, combined with chlorinated solvents or samples, causes corrosion and sensitivity loss.

To avoid corrosion, keep the detector temperature above 300 °C.

## FPD Does Not Ignite

- Check that the FPD temperature is high enough for ignition (> 150 °C).
- Check FPD flow rates and that they match the type of filter installed in the FPD. The hydrogen:air ratio greatly impacts ignition. Nonoptimal flow settings can prevent flame ignition.

**Table 1** FPD<sup>+</sup> recommended flows

|                                             | Sulfur mode flows,<br>mL/min | Phosphorus mode<br>flows, mL/min |
|---------------------------------------------|------------------------------|----------------------------------|
| Carrier (hydrogen, helium, nitrogen, argon) |                              |                                  |
| Packed columns                              | 10 to 60                     | 10 to 60                         |
| Capillary columns                           | 1 to 5                       | 1 to 5                           |
| Detector gases                              |                              |                                  |
| Hydrogen                                    | 60                           | 60                               |
| Air                                         | 60                           | 60                               |
| Carrier + makeup                            | 60                           | 60                               |

**Table 2** FPD recommended flows

|                                             | Sulfur mode flows,<br>mL/min | Phosphorus mode<br>flows, mL/min |
|---------------------------------------------|------------------------------|----------------------------------|
| Carrier (hydrogen, helium, nitrogen, argon) |                              |                                  |
| Packed columns                              | 10 to 60                     | 10 to 60                         |
| Capillary columns                           | 1 to 5                       | 1 to 5                           |
| Detector gases                              |                              |                                  |
| Hydrogen                                    | 50                           | 75                               |
| Air                                         | 60                           | 100                              |
| Carrier + makeup                            | 60                           | 60                               |

- Measure the actual detector flows. (See [To Measure a Detector Flow.](#))
- The column may be [installed too high](#) into the detector.
- Check that the FPD ignitor operates. (See [To Verify That the FPD Flame Is Lit.](#))

- During the ignition sequence, display the air flow rate. The air flow rate should go to 200 mL/min (7890A) or 400 mL/min (7890B) while trying to ignite to flame. If not, there is insufficient air supply pressure.
- Check the column and makeup flow rates.
- Ensure that condensation in the vent tube is not dripping back into the detector. The flexible plastic vent tube must run from the detector into a container, without sagging, in order to properly drain water condensate. Keep the open tube end out of the water in the container.
- Check the **Lit offset** value. The typical **Lit offset** value is 2.0. If it is zero, autoignition is turned off. If it is too large, the software will not recognize that the flame is lit and will shut the detector down.
- If the flame still will not light, there could be a large leak in the system. This results in measured flow rates being different from actual flow rates, causing non-ideal ignition conditions. Thoroughly leak check the whole system. (See [Checking for Leaks](#).)
- Try increasing the supply pressures to the FPD flow module. This makes the flame easier to light without changing the setpoints.
- Under some operating conditions, the flame will light more easily with the vent tube removed. After lighting the flame, reinstall the vent tube.
- The sulfur mode can be particularly hard to light (FPD only, not FPD<sup>+</sup>). Try changing to the phosphorus mode flows, lighting the flame, and gradually alter the flows to the sulfur values.
- Check cable connections to coupling, coupling connection to glow plug, tight glow plug.

## NPD Adjust Offset Process Fails

- Inspect the jet to see if it is clogged. (See [To Check for a Plugged NPD Jet.](#))
- Measure the actual detector flows. (See [To Measure a Detector Flow.](#)) If the hydrogen or makeup flows are zero or much lower than the displayed flow, suspect a plugged jet.
- Check the condition of the bead. [Replace](#) if necessary.
- Verify that the flow settings are correct. See [Flows, temperatures, and bead information.](#)
- If the process still fails, there could be a large leak in the system. This causes measured flow rates to be different from actual flow rates. Thoroughly leak check the whole system, especially the detector column fitting. (See [Checking for Leaks.](#))
- Set the equilibration time to 0.0.

## NPD Bead Will Not Ignite

- Set the equilibration time to 0.0.
- Verify that the flow settings are correct and appropriate. See [Flows, temperatures, and bead information](#).
- If the process still fails, there could be a large leak in the system. This causes measured flow rates to be different from actual flow rates. Thoroughly leak check the whole system, especially the detector column/adaptor fitting. (See [Checking for Leaks](#).)
- Check for fault messages. Press [**Service Mode**], then go to **Diagnostics > Front detector** or **Back detector > Detector signal**. You can also read the bead voltage.
- Check the condition of the bead. [Replace](#) if necessary.
- Inspect the jet to see if it is clogged. (See [To Check for a Plugged NPD Jet](#).)
- Measure the actual detector flows. (See [To Measure a Detector Flow](#).) If the hydrogen or makeup flows are zero or much lower than the displayed flow, suspect a plugged jet.

## FPD<sup>+</sup> Temperature Will Not Become Ready

If the FPD<sup>+</sup> emission block temperature will not become ready:

- Check the oven temperature. If the oven temperature is high (over 325 °C) for a long time, set the emission block temperature to its highest value (165 °C).
- Check the transfer line temperature. If the transfer line is set to a very high temperature (near 400 °C), set the emission block temperature to at least 150 °C.

## Blinking Not Ready Light: Detector Hardware Fault/TCD Filament Voltage

If the TCD filament is open, the Not Ready LED blinks and the GC will not become Ready.

- 1 Press [**Status**]. If the display reads **Front detector hardware fault** or (**Back** or **Aux detector hardware fault**), the problem may be the TCD filament.
- 2 Press [**Front Det**] (or [**Back Det**] or [**Aux Det #**]).
- 3 If the display reads **Fault: TCD Filament Voltage**, scroll to the **Filament** setpoint.

If the setpoint is flashing **Off**, the problem is an open TCD filament.

- 4 Power cycle the GC.
- 5 Press [**Front Det**] (or [**Back Det**] or [**Aux Det #**]).
- 6 Scroll to the **Filament** and press [**Off/No**] to disable the TCD filament. Contact Agilent for service.

To continue to use the GC without the TCD:

- 1 Turn off all TCD parameters. Save the method.
- 2 Reconfigure the GC to use another detector. Move the column and set other parameters as needed.

## Shutdown (Defective) Device

By default, the GC monitors the status of all configured devices (inlets, detectors, valve box heaters, valves, oven heater, EPC modules, and so forth) and becomes ready when all of them reach setpoint. If the GC senses a problem in one of these devices, the GC will either never become ready, or may go into a shutdown state to protect itself or prevent a safety hazard. However, there may be a time when you do not wish to have the readiness state of a device prevent a run from starting. An important example is when an inlet or detector heater is defective. Normally, this fault prevents the GC from becoming ready and starting a run. However, you can set the GC to ignore this problem so that you can use the other inlet or detector until the device is repaired.

Not all devices can be ignored. You can ignore the readiness state of inlets, detectors, the oven, or an EPC module. The readiness state of other devices and components can never be ignored, for example, injection devices such as a switching valve or automatic liquid sampler.

To ignore the status of a device:

- 1 Turn off the device's heater and gas flows as applicable. (Make sure that it cannot create a safety hazard.)
- 2 Press **[Config]**, then select the element.
- 3 Scroll to **Ignore Ready** and press **[On/Yes]** to set it to **True**.

You can now use the GC until the device is repaired.

### CAUTION

Do not ignore the readiness state of a device that is being used unless you do not care if it reaches setpoint.

Be sure to return a broken device to **Ignore Ready = False** after it is repaired. Otherwise, its state (temperature, flow, pressure, and so forth) will continue to be ignored, even if using this device in the analysis.

---

To consider a device's readiness, set **Ignore Ready** to **False**.



## 3 Chromatographic Symptoms

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## Retention Times Not Repeatable

- Replace the septum.
- Check for leaks in the inlet, liner (as applicable), and column connection. (See [“Checking for Leaks”](#).)
  - [To Perform an Inlet Leak Check](#)
  - [To Check for Leaks in a Split/Splitless Inlet](#)
  - [To Perform a PP Pressure Decay Leak Test](#)
  - [To Check for Leaks in a Multimode Inlet](#)
  - [To Perform a COC Pressure Decay Leak Test](#)
  - [To Perform a PTV Pressure Decay Test](#)
  - [To Perform a VI Pressure Decay Test](#)
- Check for sufficient carrier gas supply pressure. The pressure delivered to the GC must be at least 40 kPa (10 psi) greater than the maximum inlet pressure required at final oven temperature.
- Run replicates of known standards to verify the problem.
- Verify that you are using the correct liner type for the sample being injected. (See [Selecting the correct inlet liner](#).)
- Consider if this is the first run. (Has the GC stabilized?)
- If using an FID or NPD and retention times increase (drift), check the jet for contamination or replace the jet.
  - [To Replace an FID Jet](#)
  - [To Check for a Plugged FID Jet](#)
  - [To Maintain the NPD Collector, Ceramic Insulators, and Jet](#)
  - [To Check for a Plugged NPD Jet](#)

## Peak Areas Not Repeatable

Check the ALS syringe operation. (See the Troubleshooting section of the sampler user manual: [7693A](#), [7650A](#), [7683B](#).)

- [Replace](#) the syringe.
- Check for leaks in the inlet, liner (as applicable), and column connection. (See [“Checking for Leaks”](#).)
- Check sample level in vials.
- Run replicates of known standards to verify the problem.
- Consider if this is the first run. (Has the GC stabilized?)

For a multimode or split/splitless inlet in split mode, also check for:

- An abnormal split vent restriction. See:
  - [To Run the Inlet Trap Check](#)
  - [To Perform a SS Split Vent Restriction Test](#).
- To troubleshoot small leaks in a multimode or split/splitless inlet, see [To Check for Leaks in a Split/Splitless Inlet](#) or [To Check for Leaks in a Multimode Inlet](#).

## Contamination or Carryover

If your output has contamination or unexpected peaks, do the following:

### Isolate the source

- 1 Perform a solvent blank run using a new, pure source of solvent. If the contamination disappears, the problem may be either in the sample or solvent-related.
- 2 Perform a blank run (remove the syringe from the injector and start a run). If the contamination disappears, the problem is in the syringe.
- 3 Remove the column from the detector and cap the detector fitting. Perform another blank run. If the contamination disappears, the problem is in the inlet or column. If the contamination remains, the problem is in the detector.

### Check possible causes—all inlet and detector combinations

#### Inlet, sampler, sample, gas supply

- Check the septum type and installation. The vial septum may be dissolving in the sample. Be sure the vial septum is resistant enough to the solvent you are using. Also ensure the vial septum is flat. If the vial septum is not flat, the needle tends to core the septum and drop pieces into the sample, causing contamination and ghost peaks.
- Perform complete inlet [maintenance](#): Replace all consumable parts and bake out the inlet.
- Check for sample carryover from previous runs. Make several no-injection blank runs and see if the ghost peaks go away or get smaller.
- Check the septum purge flow. If it is too low, the septum may have collected contamination or condensate may be clogged in the purge line. For SS, MMI, PTV, and PP inlets: Set the purge flow to at least 3 mL/min to keep the septum clean. For COC inlets, set the septum purge flow to at least 15 mL/min. Measure the flow. See [“To Measure a Column Flow”](#).
- Check all gas trap indicators and dates.

- Verify the gas [purity](#). Perform replicate runs, several with a short interval between them, then several with a large interval. If the contamination peaks are larger for the runs made with the longer interval, suspect contaminated gas: the contamination has more time to deposit onto the column and liner.
- Check for supply tubing and fitting contamination.
- If you suspect that there is contamination in the inlet, perform the bakeout procedure ([SS](#), [MMI](#), [PP](#), [COC](#), [PTV](#), [VI](#)).
- Verify the operation of the inlets. Clean the inlet and replace the contaminated inlet parts.
  - [To Clean the Split/Splitless Inlet](#)
  - [To Clean the Purged Packed Inlet](#)
  - [To Clean the Cool On-Column Inlet](#)
  - [To Clean the Septumless Head on the PTV Inlet](#)
  - [To Clean the Multimode Inlet](#)
  - [To Clean the Septum Seat in the Septum Head Assembly of the PTV Inlet](#)
  - [To Clean the VI](#)
- Check the solvent level in the ALS wash bottles.
- Replace the ALS syringe if necessary ([7693A](#), [7683](#)).
- Check the sample injection volume. Verify that the ALS is injecting enough sample into the inlet. Use the Solvent Vapor Volume Calculator to determine how much of the sample should be injected.
- Ghost peaks are sometimes caused by contaminated sample vials. Try new or clean vials to see if ghost peaks disappear.
- Some samples change with heat or ultraviolet light. Check the sample stability.

### Column, method

- Perform column maintenance: [Bake out](#) contaminants, [remove](#) the contaminated length of column near the inlet, and [reverse and bake out](#) the column as needed.
- If you suspect that there is contamination in the column, perform the [bakeout](#) procedure.

- Verify that the oven program temperature and time are sufficient for the samples being injected. Ghost peaks that are broader than adjacent sample peaks could be from a previous run.
- Inspect the column for contamination. High molecular weight samples that contain residues may cause the syringe, the inlet liner, or the first few inches of column to become contaminated.
- Install an Agilent column backflush system.

#### **Detector, detector gas supply**

- Check all gas trap indicators and dates.
- Verify the gas [purity](#). Perform replicate runs, several with a short interval between them, then several with a large interval. If the contamination peaks are larger for the runs made with the longer interval, suspect contaminated gas: the contamination has more time to deposit onto the column and liner.
- Check for supply tubing and fitting contamination.
- If you suspect that there is contamination in the detector, perform the bakeout procedure ([FID](#), [TCD](#), [uECD](#)).
- Verify the operation of the detectors. Replace the contaminated detector parts.
  - [To Maintain the NPD Collector, Ceramic Insulators, and Jet](#)
  - [Maintaining the FID](#)

## Larger Peaks Than Expected

- Check each configured column's dimensions against the actual column dimensions. (See [“Configurable Items to Always Keep Current”](#).) Refer to [To configure a single column](#) or [To configure multiple columns](#) in the Advanced User Guide for procedures on configuring columns.
- Check the autosampler injection volume. In the normal injection mode, the sampler uses fast injection to deliver a representative amount of the sample. Fast injection minimizes needle fractionation. Chromatograms from manual injection or slower auto injection devices show higher levels of low molecular weight materials versus higher molecular weight materials because the volatiles boil out of the needle faster than the higher weight materials.
- Check the vial caps. Loose vial caps can cause selective loss of lighter materials from a sample. The cap should not rotate easily if installed properly.
- Check configured syringe size. Some syringe sizes are specified at half-capacity. If the maximum syringe volume is marked at half-height on the barrel, not at the top of the barrel, enter **twice** the labeled volume when configuring the syringe size.

## Peaks Not Displayed/No Peaks

- If using an autosampler:
  - Ensure that there is sample in the vial.
  - Verify that the ALS plunger carriage is secured to the syringe plunger.
  - Check that the syringe is installed correctly and draws sample.
  - Verify that the turret/tray is loaded correctly and injections are not from out-of-sequence vials.
  - Watch to see that the sample is pulled into the syringe.
- Verify the detector in use is assigned to a signal.
- Check the column for proper installation.
- Ensure that the column is not plugged. (See [“To Measure a Column Flow”](#).) Perform column [maintenance](#).
- Check for leaks. (See [“Checking for Leaks”](#).)
- Check the flow settings, then measure the actual detector flows. (See [“To Measure a Detector Flow”](#).)
- Some samples change with heat or ultraviolet light. Check sample stability.
- Check the sample level in the vial.
- If the sample is viscous, try the following:
  - Increase the viscosity delay time.
  - Dilute the sample in an appropriate low-viscosity solvent.
  - Turn the tower fan off.
  - For 7683B ALS, use the tray quadrants to warm the sample. For 7693A ALS, use the vial heater (accessory G4514A Bar Code Reader/Mixer/Heater) to warm the sample vial.

If the problem is with the detector, see [Table 3](#).

**Table 3** Detector troubleshooting

| Detector | Solution                                                                                                                                                                                                           |
|----------|--------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| FID, FPD | <ul style="list-style-type: none"><li>• Verify that the electrometer is turned on.</li><li>• Verify that the flame is still lit.</li></ul>                                                                         |
| TCD      | <ul style="list-style-type: none"><li>• Verify that the filament is turned on.</li><li>• Ensure that the reference gas is not set to zero. (The filament will not turn on with zero reference gas flow.)</li></ul> |

## **Baseline Rise During Oven Temperature Program**

- Inspect the column for bleed.
- Check for leaks/oxygen in carrier gas supply. Oxygen can damage bonded phase capillary columns.
- Check gas supply oxygen trap indicator or date.
- Make solvent blank runs to evaluate baseline without sample.
- Make “no injection” blank runs (remove the syringe from the injector and start a run) to evaluate baseline without solvent.
- Check for contamination. (See [Contamination or Carryover](#).)
- Consider the effect of column film thickness on bleed. Try using a column with a thinner film.
- Check for leaks at the column fittings. (See [“Checking for Leaks”](#).)
- Prepare and use a column compensation profile.

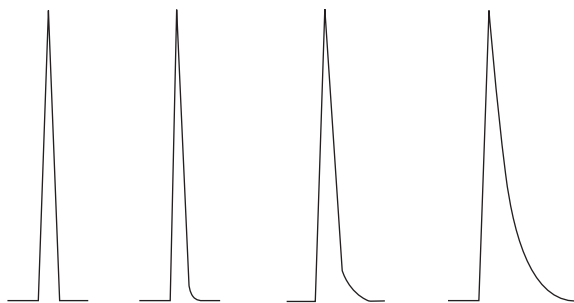
## Poor Peak Resolution

- Set column flow to optimum linear velocity.
- Install and use deactivated consumable parts in the inlet (for example, a liner).
- Perform column maintenance: [Bake out](#) contaminants, [remove](#) the contaminated length of column near the inlet, and [reverse and bake out](#) the column as needed.
- Check column [installation](#) at both ends.
- Select a higher resolution column.

## Peak Tailing

The figure below shows an example of tailing peaks. When troubleshooting tailing peaks, consider:

- Which peaks are tailing?
- Are the tailing peaks active compounds, all compounds, or are there trends (such as early eluters or late eluters)?



- Check the column for severe contamination.
  - If using a capillary column, [remove](#) 1/ 2 to 1 meter from the front of the column.
  - For bonded and cross-linked phases, solvent rinse the column.
  - Check for inlet contamination. Tailing will sometimes increase with compound retention. Clean the inlet and replace contaminated inlet parts. ([See the 7890 Series Maintenance manual.](#))
- Consider the column stationary phase (active column). This only affects active compounds. An active column usually produces tailing that increases with retention time.
  - [Cut off](#) 1 meter from the front of the column.
  - Replace the column.
- Verify that the column was cut and installed properly.
  - Re-cut and [reinstall the column](#) into the inlet and replace the ferrules. Make a clean, square cut using a reliable tool.
  - Confirm the installation is leak free. If there is a leak at the column fitting, you will see more tailing for early eluting peaks. ([See “Checking for Leaks”.](#))
- Consider the type of adapter, liner, and inlet seal being used. One or all of these may be contaminated or active.

- Use a new, deactivated liner. This only affects active compounds.
- Clean or replace the inlet seal.
- Check adapters (if installed) and liner for solid particles. If solid particles are visible, clean or replace.
- For capillary splitless injection, consider compatibility between the solvent and column.
  - Use a different solvent. This will help in instances where there is more tailing for the early eluting peaks or those closest to the solvent front.
  - Use a 3 to 5 meter retention gap.
- Verify that the injection technique is adequate. This is usually related to erratic plunger depression or having sample in the syringe needle.
- Verify the inlet temperature.
  - If the temperature is too high, tailing is generally worse for early eluters. Decrease inlet temperature by 50 °C.
  - If the temperature is too low, tailing usually increases with retention. Increase inlet temperature by 50 °C.
- Check for dead volume in the system. Check for correct column [installation](#) at both ends.
  - If peak tailing decreases with retention time, reduce dead volume in transfer line connections, fused silica unions, and so forth.
  - A column installed too high into a detector or inlet can create dead volume areas.
- Inspect any transfer lines for cold spots. Cold spots cause tailing that usually increases with retention time.

## NPD Peak Tailing

For NPD, do the following:

- Verify that you are using the correct bead for the sample being run. If you are analyzing phosphorus, install a black bead. White beads can cause peak tailing when phosphorus is being analyzed.
- Verify that the correct [jet](#) is installed. Use an extended jet.
- [Replace](#) the ceramic insulators.

## Peak Boiling Point or Molecular Weight Discrimination Poor

If you have trouble with peak boiling point or molecular weight discrimination (inlet discrimination), do the following:

- Check the inlet for contamination. Clean and change the liner if necessary. Replace all inlet consumable parts. See the [Maintenance manual](#).
- Adjust the inlet temperature.
- Run standards against a known method to determine expected performance.

### For any inlet operating in split mode with any detector

- Check liner type. Use a liner optimized for split analysis—one that contains glass wool or other surface area packing to allow complete sample vaporization.
- Increase the inlet temperature and verify that the insulation cup is installed and contains insulation.
- Check column cut and installation into the inlet. See the topic for the [SS](#), [MMI](#), [PTV](#), and [VI](#).

### For any inlet operating in splitless mode with any detector

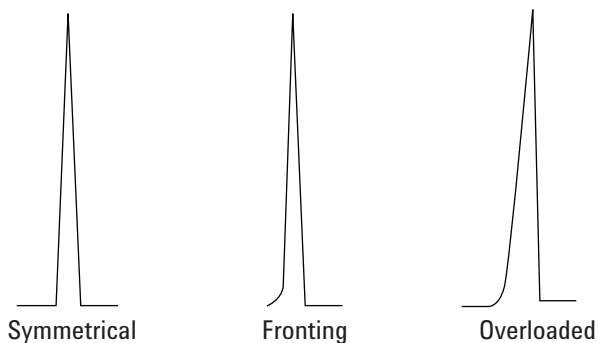
- Check the inlet for leaks. (See [“Checking for Leaks”](#).)
- Check liner type. Use a liner optimized for splitless analysis (deactivated, large volume).
- Verify that the oven starting temperature is less than the solvent boiling point.
- Check column cut and installation into the inlet. See the topic for the [SS](#), [MMI](#), [PTV](#), and [VI](#).
- Check that the solvent vapor volume does not exceed the liner capacity.
- Check for appropriate purge delay time. (Liner volume/column flow)

## Sample Decomposition in Inlet/Missing Peaks

- Lower the inlet temperature.
- Check for air or water in the carrier gas; verify gas purity and functionality of traps.
- Verify that the liner is appropriate for the sample being run.
- Perform complete inlet [maintenance](#): Replace all consumable parts and bake out the inlet.
- Install a deactivated liner (if liner is used).
- Check for leaks at the septum, liner, and column fittings. (See [“Checking for Leaks”](#).)
- Install an Agilent Direct Connect liner.
- Use a pulsed pressure method for quicker sample transfer to column.
- Bake out the inlet. See the following:
  - [To Bakeout Contaminants from the Split/Splitless Inlet](#)
  - [To Bakeout Contaminants from the Multimode Inlet](#)
  - [To Bakeout Contaminants from the Purged Packed Inlet](#)
  - [To Bakeout Contaminants from the COC Inlet](#)
  - [To Bakeout Contaminants from the PTV Inlet](#)
  - [To Bakeout Contaminants from the VI Inlet](#)
- Clean the inlet. See the following:
  - [To Clean the Split/Splitless Inlet](#)
  - [To Clean the Multimode Inlet](#)
  - [To Clean the Purged Packed Inlet](#)
  - [To Clean the COC Inlet](#)
  - [To Clean the Septumless Head on the PTV Inlet](#)
  - [To Clean the Septum Seat in the Septum Head Assembly of the PTV Inlet](#)
  - [To Clean the VI](#)

## Peak Fronting

The figure below shows examples of the three types of peaks: symmetric, fronting, and overloaded.



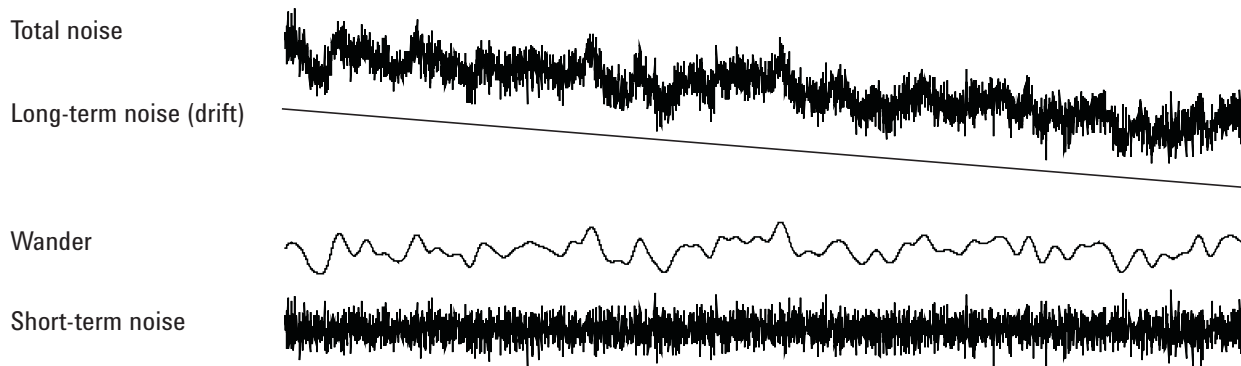
If peak fronting or overloading occurs, try the following:

- Verify that the injection volume is appropriate. Column overload is the most common cause for fronting peaks.
  - Decrease injection volume, dilute the sample, and/or increase the split ratio.
  - Change the column type or film thickness.
- Ensure that the column is [installed](#) properly. If not, reinstall the column in the inlet.
- Verify that the appropriate injection technique is being used. This is usually related to erratic plunger depression or having sample in the syringe needle.
- If using capillary splitless injection, consider the compound solubility in the injection solvent.
  - Change the solvent.
  - Use a retention gap.
- Check purity of sample solvent. For solvents with large differences in polarity or boiling points, a mixed sample solvent can cause peak fronting. Change the sample solvent.

## Noisy Detector, Including Wander, Drift, and Baseline Spikes

Noise should be measured under “normal” operating conditions, with a column connected and carrier gas on. FID electrometer noise or drift (flame off), for instance, will not provide much indication of how the detector will perform in practice because major sources of noise are not included in this measurement. Noise typically has a high frequency component (electronic in origin) and lower frequency components that are referred to as wander and drift.

Wander is random in direction but at a lower frequency than the short-term electronic noise. Long-term noise (drift) is a monotonic change in signal over a period that is long compared to the wander and electronic noise (see below). Terms like “short” and “long” are relative to the width of the chromatographic peaks. In general, one should measure noise over a period of time that is about 10 times the peak width at half height (or 10 times the area/height ratio for a Gaussian peak). Measuring for longer times can over-estimate noise; shorter times may underestimate noise.



### Noisy baseline

A noisy baseline or high detector output can indicate leaks, contamination, or electrical problems. Some noise is inevitable with any detector, although high attenuations can mask it. Since noise limits useful detector sensitivity, it should be minimized.

- For all detectors, check for leaks at the column fittings. (See [“Checking for Leaks”](#).)
- For the FID, see [To Isolate the Cause of FID Noise](#).
- For the TCD, verify data collection at  $\leq 5$  Hz.

If noise appears suddenly on a previously clean baseline, do the following:

- Consider recent changes made to the system.
- Bakeout the inlet. See the following:
  - [To Bakeout Contaminants from the Split/Splitless Inlet](#)
  - [To Bakeout Contaminants from the MMI Inlet](#)
  - [To Bakeout Contaminants from the Purged Packed Inlet](#)
  - [To Bakeout Contaminants from the COC Inlet](#)
  - [To Bakeout Contaminants from the PTV Inlet](#)
  - [To Bakeout Contaminants from the VI Inlet](#)

Bakeout can reduce septum bleed and other contaminants. New septa may contribute noise from bleed of low molecular weight material. If noise decreases when inlet temperature is lowered, this is a likely cause. Use only high quality septa and store them where they cannot become contaminated.

- Verify the [purity](#) of carrier and detector gases. If a tank was replaced recently and the old one is still available and still has some gas in it, try the older tank to see if noise decreases.

If the new gas is so badly contaminated that it saturates traps, changing to the old one may show little improvement until the traps are replaced or regenerated. This problem is most common with nitrogen carrier gas. Deal with a reliable gas supplier.

- For the TCD, check for ambient air pressure fluctuations at the GC. Air currents from a fan or air conditioner blowing across the GC may interfere with gas exiting the detector. This is a possible, though not very likely cause of noise since detectors are well protected. Switching off the air current source or shielding the detector exit identifies this problem. Install the TCD outlet restrictor (G1532-60070).
- Loose connections in the detector or its signal path generate noise.
- Verify proper reassembly after recent maintenance.
- Inspect the detector for contamination.

If noise increases gradually to an unacceptable level, check the following possible causes:

- Bakeout the detector ([FID](#), [TCD](#), [uECD](#)).

- Inspect the detector for contamination. Replace parts as needed. ([See the 7890 Series Maintenance manual.](#))
- Inspect the column and inlet for contamination.
- Inspect the FID or NPD jet for contamination.
  - [To Check for a Plugged FID Jet](#)
  - [To Replace an FID Jet](#)
  - [To Check for a Plugged NPD Jet](#)
  - [To Maintain the NPD Collector, Ceramic Insulators, and Jet](#)
- Verify that the FPD photomultiplier tube (PMT) is properly installed. If it is not, light leaks and ultimately noise will result.

FIDs are susceptible to gradual buildup of deposits in the detector. In extreme cases, spiking occurs along with increased noise level.

Carbon (black) deposits may form from solvents that burn poorly (primarily chlorinated materials and aromatics). Avoid such solvents if possible. If you must use them, be prepared to clean the detector regularly.

Silicon dioxide (white) is formed when bleed from a silicone column is burned in the flame. To minimize this, use low column loadings, select phases with high temperature limits, condition columns thoroughly before use, and use the lowest possible oven temperature for the analysis.

To remove either type of deposit, disassemble the detector and scrub with a small brush. A solvent (almost anything will do) helps flush away the particles. Agilent recommends [replacing](#) dirty collector and insulator parts.

Other factors that can contribute to noise:

- Column installed too high into detector.
- Oven temperature exceeds column maximum recommended temperatures.

## Baseline wander and drift

Baseline wander or drift can occur when a flow or temperature setting is changed. If the system has not stabilized at the new conditions before it starts a run, some baseline changes are to be expected. The following cases assume that sufficient stabilization time has elapsed since the last change in operating conditions.

If experiencing baseline wander, check for leaks, especially at the septum and at the column. (See [“Checking for Leaks”](#).) If the leak is at the detector end of the column, retention times are stable from run to run but sensitivity is reduced. If it is at the inlet end, sensitivity is reduced and retention times are increased.

Also consider whether the oven temperature program is sufficient.

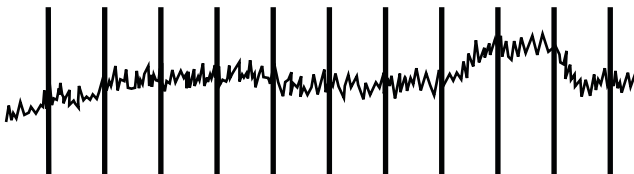
Baseline drift is most often seen during temperature programming. To correct baseline drift, do the following:

- Verify that column compensation is used and the profile is current. (To compensate for bleed.)
- Verify that the column is conditioned.
- Check column bleed while at operating temperature.
- Check the signal mode assigned to the column in the data system.
- Check the column compensation profile. It may be too little (upscale drift) or too much (downscale drift).

This cause of drift is minimized by thorough column conditioning. Operating at a lower temperature reduces the drift but prolongs the analysis. Use of a chromatographically equivalent column with a higher temperature limit is also possible.

## Baseline spiking

There are two types of spiking on the baseline output: cyclic and random. Spiking will not normally be noticed on the display; it will be noticed only on a plot or online trace.

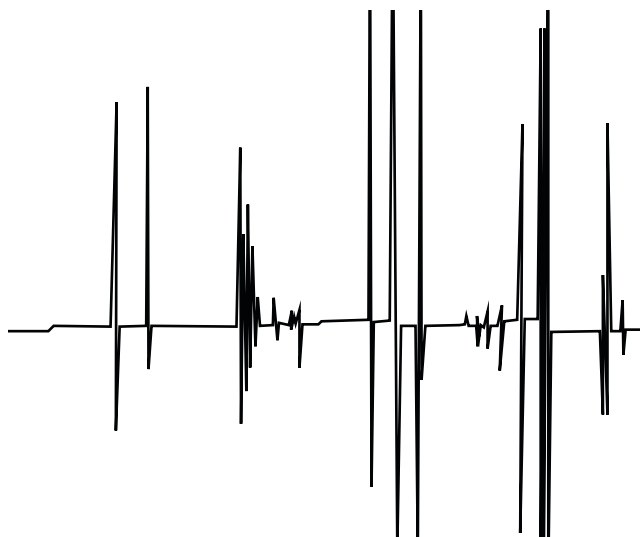


**Figure 1** Cyclic spiking

Cyclic spiking can be caused by the following:

- An electric motor
- Building heating/cooling system

- Other electronic interferences in the lab



**Figure 2** Random spiking

Spikes are isolated baseline disturbances, usually appearing as sudden (and large) upscale movements. If accompanied by noise, resolve the noise problem first since spiking may disappear at the same time.

- Check for a contaminated detector. In an extremely dirty FID, particles of carbon or silicon dioxide may break away and fall into the detection zone.
- For a packed column, check that the packed column exit is properly sealed with glass wool. This will cause packing particles to be blown into the detector. A defective or missing glass wool plug at the exit of a packed column will do this. This may happen with any detector but the flame detector is particularly susceptible because of the narrow bore of the jet.
- Check packed column installation. The bottom of the jet or the end of a transfer tube extends into the end of the column. If it touches a glass wool plug, spikes are produced.
- Check for the correct jet. See the following:
  - [Selecting an FID jet](#)
  - [To replace an FID jet](#)
  - [Selecting an NPD jet](#)
  - [To Maintain the NPD Collector, Ceramic Insulators, and Jet](#)

- Check that the detector temperature is not too low. See the following:
  - [Recommended starting conditions for new FID methods](#)
  - [Selecting reference and makeup flows for the TCD](#)
  - [Recommended starting conditions for new uECD methods](#)

## Microcell Electron Capture Detector (uECD) Noise and Sensitivity

### CAUTION

Detector disassembly and/or cleaning procedures other than thermal should be performed only by personnel trained and licensed appropriately to handle radioactive materials. Trace amounts of radioactive  $^{63}\text{Ni}$  may be removed during these other procedures, causing possible hazardous exposure to radiation.

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### WARNING

**To prevent possible hazardous contamination of the area with radioactive material, the detector exhaust vent must always be connected to a fume hood, or otherwise vented in compliance with local regulations.**

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Performance problems associated with the ECD include (but are not limited to) loss of sensitivity (real, or perceived), high signal background, noisy baseline, and chromatographic peaks or humps that are not characteristic of the samples being injected.

If the problems are not accompanied by an increase in the signal output, as read from the front keypad of the GC, then suspect the detector only after the other parts of the chromatographic system have been checked.

Before starting extensive troubleshooting, consider first the nature of the problem:

- 1 If recent changes were made in the system, such as changing carrier or detector gases, performing inlet or column maintenance, or changing the column, investigate the possibilities that contamination or leaks were introduced.
- 2 If the problem has been chronic and is now acute enough to interfere with analysis, suspect contamination, column degradation, or ultimately a bad ECD cell.

#### See also:

[“Display signal evaluation”](#)

[“Sensitivity”](#)

## Display signal evaluation

The first consideration is the signal value when the GC is in the idle state. The “idle” signal level is a function of the type and quality of the carrier and detector gases, as well as the flows and application. It may be different for different situations but as a general rule, the following values apply (Table 4). Figure 3 shows typical uECD life cycle stages.

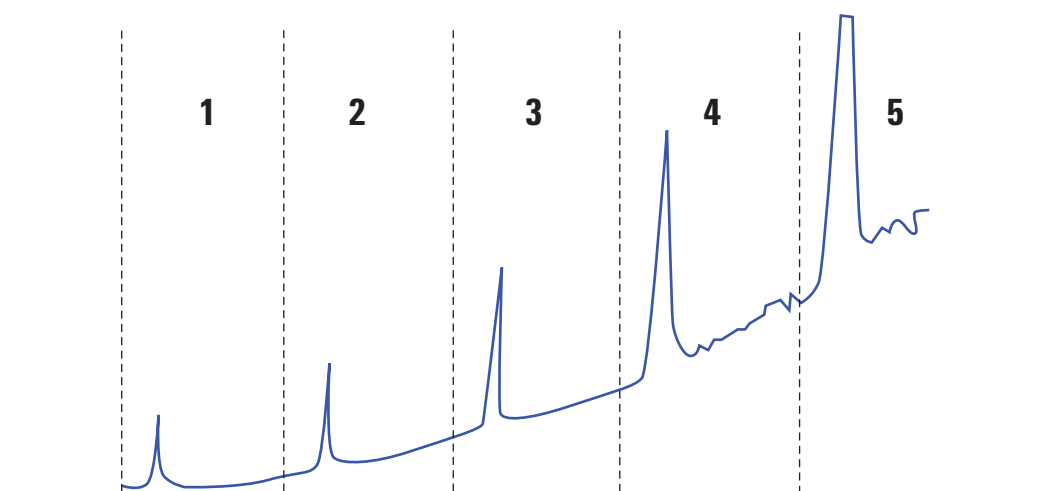
**Table 4** uECD signal evaluation

| ECD signal   | Comments                                                                                                                                                     |
|--------------|--------------------------------------------------------------------------------------------------------------------------------------------------------------|
| <200         | uECD is “healthy”.                                                                                                                                           |
| 200 to 400   | Slightly elevated, no cause for concern at this point. Signal still in “good” range.                                                                         |
| 400 to 1000  | System showing signs of contamination from gases, column, or samples. If the signal increases in response to increased oven temperature, suspect the column. |
| 1000 to 2000 | Suspect more severe contamination, follow the troubleshooting guidelines.                                                                                    |
| >2000        | If the following procedures do not work, suspect the uECD cell.                                                                                              |

### NOTE

It may take 24 hours for the uECD baseline to completely stabilize, especially if you are starting with a cold system and want to assure high-sensitivity operation. For the most accurate results, run the detector at normal operating conditions for as long as possible (at least 2 hours and up to 24 hours) before running the frequency test.

If you will be injecting into an unused inlet, you must use low-bleed septa. Make sure to condition new septa before use in an inlet for several hours with 1 to 5 mL/min carrier flow.

**Typical ECD Life Cycle Stages:****Stage 1: New cell**

Background = 100 Hz. Cell meets Agilent signal-to-noise (S/N) standard.

**Stage 2: 6 months – 1 year**

Background = 180 Hz. Increased response.

**Stage 3: 1–2 years**

Background = 350 Hz. More response, increasing noise, lower S/N.

**Stage 4: 2–4 years**

Background > 500 Hz. Noisy baseline, negative peaks. Thermal cleaning required.

**Stage 5: 4–10 years**

Background > 1000 Hz. Huge response. Very noisy, cell contaminated. Requires cell exchange.

**Figure 3** Typical ECD life cycle

## Sensitivity

If the ECD is in the “good” signal range and sensitivity is the issue, the problems quite likely may be in the inlet or column. Consider the following issues:

- 1 If using an inlet with split and splitless modes, verify that the mode has not changed and that the split valve is functioning. This can be done by verifying that there is a corresponding change in the response by making split and then splitless injection, all other method parameters remaining the same. If using split mode, verify the split flow using a flow meter.
- 2 Check all flow rates. See [“Measuring FID, TCD, uECD, and FPD flows”](#).

- 3 Confirm that complete inlet maintenance has been performed. This includes trimming and re-installing the column.
- 4 Verify that the injecting device is working properly. If the method uses a sampling valve, make a direct syringe injection of concentration similar to that introduced by the valve. Rule out a problem with the valve.
- 5 Inspect the mixing liner in the makeup gas adapter. A small piece of graphite or sample contamination will reduce sensitivity. See [To Replace the uECD Fused Silica Indented Mixing Liner and Install the Makeup Gas Adapter](#).

#### Contamination (high baseline)

If the ECD has a baseline higher than expected for its age, check the following:

- Rule out all other possible causes. See “[Sensitivity](#)” above. Also check carrier and detector gas supplies, supply gas traps, and the column.
- Inspect the mixing liner in the makeup gas adapter. A small piece of graphite can contaminate results. See [To Replace the uECD Fused Silica Indented Mixing Liner and Install the Makeup Gas Adapter](#).
- If the detector baseline is > 500 Hz, regardless of detector age, [bakeout](#) the detector. Let it run for 1–2 days.

## Low Peak Area or Height (Low Sensitivity)

- If using an inlet in split mode, check the split ratio.
- Check for leaks. (See “[Checking for Leaks](#)”.) To troubleshoot small leaks in a multimode or split/splitless inlet, see [To Check for Leaks in a Split/Splitless Inlet](#) or [To Check for Leaks in a Multimode Inlet](#).
- Check the inlet for contamination. (See “[Contamination or Carryover](#)”.)
- Check each column and verify that it was cut and installed properly at each end.
- Verify that the column type is correct.
- Perform column maintenance: [Bake out](#) contaminants, [remove](#) the contaminated length of column near the inlet, and [reverse and bake out](#) the column as needed.
- Verify that the liner type is appropriate for the sample.
- Verify that the detector flow settings are correct.

Measure the actual detector flows. If an actual flow does not match the GC display, check for contamination and restrictions, for example a plugged jet. See the following:

- [To Measure a Detector Flow](#)
- [To Check for a Plugged FID Jet](#)
- [To Check for a Plugged NPD Jet](#)
- Check the supply gas [purity](#).
- Check all trap indicators and dates.
- Verify that the method parameters are correct.
- Some samples change with heat or ultraviolet light. Check sample stability.
- Check configured syringe size. Some syringe sizes are specified at half-capacity. If the maximum syringe volume is marked at half-height on the barrel, not at the top of the barrel, enter **twice** the labeled volume when configuring the syringe size.
- If the drop in peak area or height happened gradually due to baseline rise, rather than a sudden change, check for detector contamination. Bakeout the detector ([FID](#), [TCD](#), [uECD](#)).

If using an FID:

- Verify that the correct [jet](#) is installed.

- Check for a dirty jet.
- Check for contaminated detector parts.
  - [To Perform Maintenance on the FID Collector Assembly](#)
  - [To Check for a Plugged FID Jet](#)

If using a uECD:

- Replace the fused silica indented mixing liner.
- Replace and reinstall column.
- [Clean](#) the makeup gas adapter.

If using an NPD:

- Check the detector for contamination.
- Replace ceramic insulators.
- Replace the bead.

If using an FPD:

- Verify correct column [installation](#).
- Check that the correct filter is installed and is clean.
- Check the flow rates.
- Check the makeup gas type.

## To Resolve Low Sensitivity with an FID

In normal use, the FID can develop deposits on the collector, insulators, jet, and so forth. To reduce contamination buildup, Agilent recommends using the detector at 300 °C or higher. However, even with normal use deposits develop in the jet (usually white silica from column bleed or black, carbonaceous soot). These deposits reduce sensitivity and cause chromatographic noise and spikes. Jets require periodic cleaning or replacement. The following procedure checks for causes of low sensitivity by frequency of occurrence.

For sensitivity loss associated with noise, wander, or drift, also see [“Noisy Detector, Including Wander, Drift, and Baseline Spikes”](#).

- 1 Check detector flow settings. See [Recommended starting conditions for new FID methods](#).

The general rule is 1:1 flow ratio of hydrogen to (column + makeup gas).

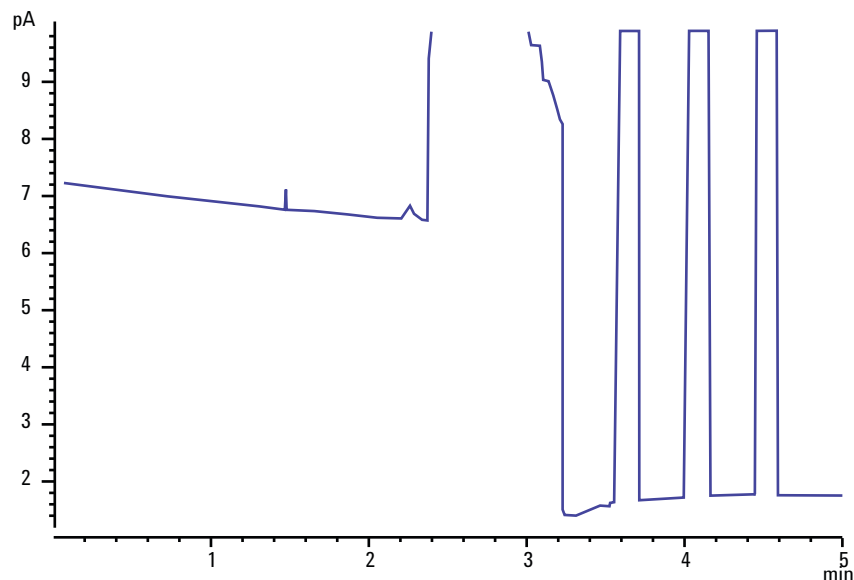
- 2 Measure the actual detector flow rates. See [“To Measure a Detector Flow”](#). If the actual hydrogen, makeup, and

capillary column flows are lower than the display, the jet is becoming plugged. See [“To Check for a Plugged FID Jet”](#). Replace the jet.

- 3 Check that column is properly installed. Reinstall it. See [To Install a Capillary Column in the FID](#). Make sure the column is installed all the way to the tip and withdrawn 1–2 mm (column id > 100 µm).
- 4 Check inlet parameters that control venting, such as split ratio and splitless purge delay time. Make sure the sample is not being inadvertently vented.
- 5 Perform inlet maintenance (replace all consumable parts) and pressure test the inlet when completed. See the [maintenance manual](#) and [“Checking for Leaks”](#).
- 6 Perform complete FID maintenance. Disassemble the FID and clean or replace all parts. Refer to the following:
  - [To Perform Maintenance on the FID Collector Assembly](#)

## FID Flame Goes Out During a Run and Attempts to Reignite

The following is an example chromatogram showing a flameout from a large solvent peak.



After a flameout, the GC will try to ignite the flame three times. The GC tries to reignite whenever the detector output falls below the **Lit offset** setpoint, regardless of whether or not the flame was extinguished. (In a very clean system, the baseline output may be less than 2 pA.)

If the FID flame goes out during a run, do the following:

- See if an aromatic solvent peak or water extinguished the flame.
- Check for a plugged jet.
- Verify that the gas flow settings are correct. Verify that **Lit offset** is set appropriately.

If the FID flame attempts to reignite but is already lit, do the following:

- Verify that the FID **Lit offset** setting is appropriate for the run (typically < 2.0 pA).
- Check to see if an aromatic peak or water extinguished the flame.
- Check for a partially plugged jet. Measure actual hydrogen, air, and makeup flows at the detector. (See [“To Measure a Detector Flow”](#).) Replace the [jet](#) as needed.

- Check that column is properly installed. Reinstall it. See [To Install a Capillary Column in the FID](#). Make sure the column is installed all the way to the tip and withdrawn 1–2 mm (column id > 100 µm).
- Check for leaks at the detector column fitting. (See [“Checking for Leaks”](#).)

## FID Baseline Output Above 20 pA

- Verify the purity of the carrier and detector gas supply. See the [Agilent GC, GC/MS, and ALS Site Preparation Guide](#).
- Inspect the column for column bleed. Lower the oven temperature to ambient. If the detector output drops significantly, suspect a contaminated or bleeding column or contaminated carrier gas. Confirm column bleed by turning off column flow (with oven cool) and checking the detector output.
- Check the gas supply trap indicators/dates and ensure that the traps are not expended.
- Verify that the detector was reassembled properly after recent maintenance.
- Inspect the detector for contamination. [Bake out](#) the detector.
- Check that the FID leakage current is < 2.0 pA. (See [“To Measure FID Leakage Current”](#).)

## FID Baseline Output at Maximum (~8 Million)

If the FID output seems to be stuck at a very high value (up to 8 million counts), check for a shorted collector.

- 1 Check if the interconnect spring has been bent. **Remove** the collector assembly and visually inspect the spring.
- 2 **Disassemble** the collector assembly and visually check for rust buildup on any parts. Replace parts as needed. To avoid this problem, operate the detector at >300 °C.
- 3 Check for carbonization in the detector due to injection or aromatic or chlorinated solvents. To avoid this problem, operate the detector at >300 °C. **Reassemble** and install the collector and operate the detector using higher air and hydrogen flows (air must be 450 mL/min, hydrogen at 35 mL/min). .

## FPD Flame Goes Out During a Run and Attempts to Reignite

If the flame goes out during a run, do the following:

- Check the GC system for leaks, especially at the detector column fitting. (See [“Checking for Leaks”](#).)
- FPD<sup>+</sup>: Verify the transfer line temperature is set  $\geq 200$  °C.
- FPD: Verify the detector temperature is set  $\geq 200$  °C.
- Ensure that condensation in the vent tube is not dripping back into the detector. The flexible plastic vent tube must run from the detector into a container, without sagging, in order to properly drain water condensate. Keep the open tube end out of the water in the container.

If the FPD flame goes out and then reignites, do the following:

- Verify that the **Lit offset** setting is lower than the normal baseline.
- Check for leaks. (See [“Checking for Leaks”](#).)
- Check the flow settings, then measure the actual detector flows. (See [“To Measure a Detector Flow”](#).)
- Certain environmental conditions, such as:
  - Strong electromagnetic fields
  - Large ambient temperature swings
  - Large atmospheric pressure swings

can cause an artificially low signal in the GC, incorrectly indicating that the flame has gone out. As a result, the run aborts and the GC tries to relight an already-lit flame.

You can verify that the flame is lit by holding a cold, shiny surface (such as a mirror or a wrench) over the exit tube. Condensation on the surface indicates that the flame is lit.

Reset the **Lit offset** to 2.0.

## FPD Quenching/Repeatability

Hydrocarbon quenching occurs when a high concentration of carbon dioxide from a hydrocarbon peak is in the flame at the same time as the sulfur species. Part of the light emitted by the sulfur species is absorbed by some CO<sub>2</sub> species.

Self-quenching occurs at high concentrations of the heteroatom species. Some other ground state (inactivated) species reabsorbs the emitted photon, preventing it from reaching the PMT.

To resolve hydrocarbon quenching:

- The column should provide good separation of the compounds, those that contain sulfur or phosphorus as well as those that do not but may absorb light.
- Optimize the chromatographic separation such that hydrocarbon peaks are resolved from sulfur or phosphorus peaks.
  - 1 Run the analysis first on a FID in order to see all the peaks (the FPD ignores hydrocarbons).
  - 2 Run the analysis on the FPD.
  - 3 Modify the method so that the peak of interest is separate from the rest of the peaks.

## FPD Output Too High or Too Low

- Verify that the correct filter is being used. Do not use a phosphorus filter with sulfur-optimized flows or a sulfur filter with phosphorus-optimized flows.
- Check the position of the column as installed in the detector.
- Check the gas [purity](#).
- Verify that the flows are optimized for the filter being used. Monitor the FPD output. The table below provides examples of detector output when the filter installed in the detector and the gas flows in use do not match.

| Gas flows optimized for | Outputs            |                        |
|-------------------------|--------------------|------------------------|
|                         | With sulfur filter | With phosphorus filter |
| Sulfur                  | 30 to 50           | 10 to 12 (low)         |
| Phosphorus              | 240 to 250 (high)  | 30 to 50               |

Besides having a mismatch between the filter installed and a particular set of gas flows, check the FPD signal output with the flame lit:

- If the output is 0.5 to 3.0, check that the flame is ON.
- If the output is 0, check if the electrometer is turned OFF or the signal cable is disconnected.
- If the output < 30, the flame may be in the wrong position. Check detector flows, column flow, and column position. See the following:
  - [To Measure a Column Flow](#)
  - [To Measure a Detector Flow](#)

## FPD Low Peak Areas

- Check the flow settings, then measure the actual detector flows. (See [“To Measure a Detector Flow”](#).)
- Perform complete inlet [maintenance](#): Replace all consumable parts and bake out the inlet.
- Perform column maintenance: [Bake out](#) contaminants, [remove](#) the contaminated length of column near the inlet, and [reverse and bake out](#) the column as needed.
- Verify that the column is installed properly.
- Consider the filter type (sulfur or phosphorus).
- Check the system for leaks. (See [“Checking for Leaks”](#).)
- Verify that the method settings are appropriate.
- Check the flow rates.
- Check the makeup gas type.

## **FPD Large Peak Width at Half-Height**

If the FPD produces peaks that are abnormally wide at half the peak height, do the following:

- Check the actual injection volume; reduce if necessary.
- Verify that the liner is not reacting with the sample.

## FPD Baseline Output High, > 20 pA

- Check the supply gas [purity](#).
- Check all trap indicators and dates.
- Check the detector for contamination.
- Check for light leaks at the photomultiplier tube (PMT); tighten the PMT if it is loose.
- Perform complete inlet [maintenance](#): Replace all consumable parts and bake out the inlet.
- Perform column maintenance: [Bake out](#) contaminants as needed.

## **NPD Solvent Quenching**

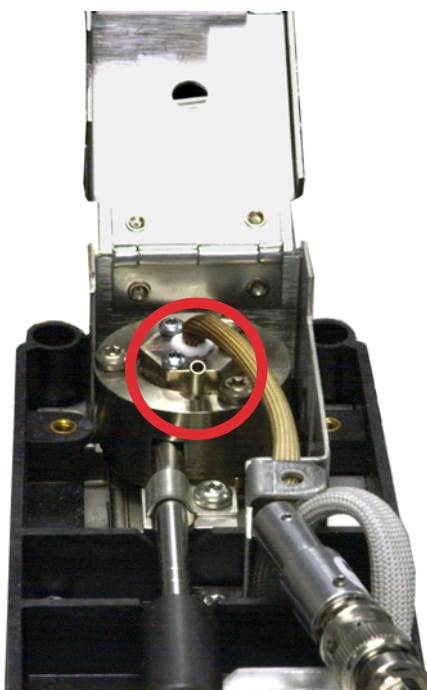
If the baseline does not recover after a solvent peak, try the following:

- Turn hydrogen off/on around the solvent peak.
- Use nitrogen as the makeup gas.
- Set the total column flow and makeup gas to less than 10 mL/min.
- Increase the air flow by 10 mL/min.
- Increase the detector temperature to 325 °C.
- Implement an Agilent Dean's switch solvent vent solution.

## NPD Response Low

- Perform complete inlet [maintenance](#): Replace all consumable parts and bake out the inlet.
- Perform column maintenance: [Bake out](#) contaminants as needed. [Verify](#) correct column installation.
- A large concentration of solvent has extinguished the hydrogen/air plasma. Increase the bead voltage. Run the makeup gas at a flow rate of 5 mL/min.
- Verify that there is hydrogen coming from the external supply. Check that flow and pressure are turned on at the keyboard. The hydrogen flow rate should be between 1.0 and 5.5 mL/min. Measure the actual gas flow at the detector. (See [“To Measure a Detector Flow”](#).)
- Check for a partially plugged jet. See [To Check for a Plugged FID Jet](#).
- If the upper ceramic insulator is contaminated, a high offset (2 to 15 pA or more) will occur when the bead is off. This directly affects sensitivity. [Replace](#) the ceramic insulator.

- Verify that the bead is activated. Look through the vent hole on the detector lid to see if the bead is glowing orange. If the bead is not glowing, check the detector background signal. Reduce the bead voltage to zero to establish a reference level, and then look for a sudden sharp increase in output as the bead voltage increases, which indicates that ignition occurred. If 4 V are being supplied to the bead but it is not igniting, the bead is probably burned out. Replace the bead.



- [Replace](#) the insulators/collector.
- Check for liquid phase contamination (polar phases).

**NPD Baseline Output > 8 million**

- The collector is shorted to the detector housing.  
Disassemble the collector and insulators and reinstall.

## NPD Adjust Offset Process Not Functioning Properly

- Inspect the jet to see if it is clogged. (See [To Check for a Plugged NPD Jet.](#))
- Measure the actual detector flows. (See [To Measure a Detector Flow.](#)) If the hydrogen or makeup flows are zero or much lower than the displayed flow, suspect a plugged jet.
- Check the condition of the bead. [Replace](#) if necessary.
- Verify that the flow settings are correct. See [Flows, temperatures, and bead information.](#)
- If the process still fails, there could be a large leak in the system. This causes measured flow rates to be different from actual flow rates. Thoroughly leak check the whole system, especially the detector column fitting. (See [Checking for Leaks.](#))
- Set the equilibration time to 0.0.

## NPD Low Selectivity

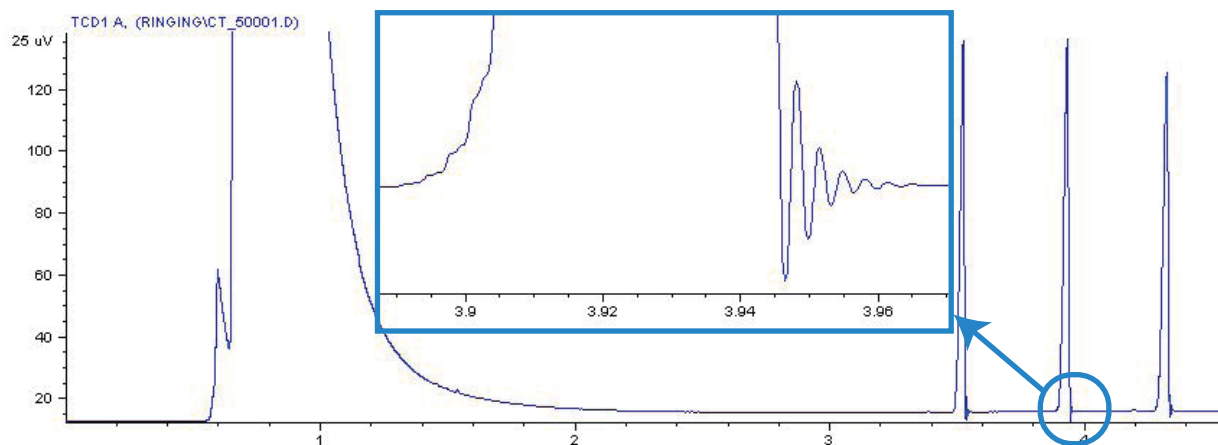
(High hydrocarbon response relative to nitrogen or phosphorus.)

- Verify that the hydrogen flow is correct (< 3 mL/min).
- Inspect the bead; it may be defective or expended.
- Verify correct bead voltage.
- [Replace](#) the collector and insulators.

## **Negative Peaks Seen with TCD**

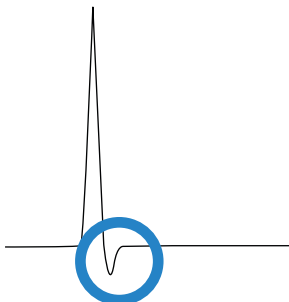
- Verify that the correct gas type is being used.
- Check for a leak in the system, especially at the detector column fitting. (See [“Checking for Leaks”](#).)
- Consider thermal conductivity of analytes relative to carrier.
- Check the flow settings, then measure the actual detector flows. (See [“To Measure a Detector Flow”](#).)

## TCD Baseline Has Dampened Sinusoidal Noise Trailing Peaks (Ringing Baseline)

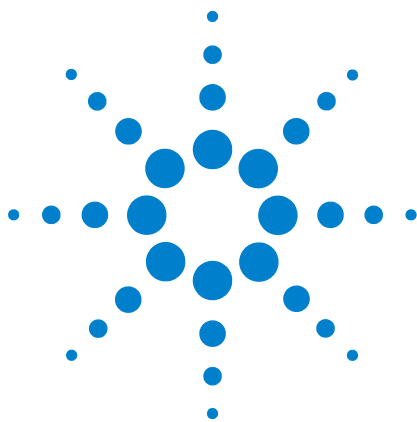


Wrong data rate is selected in the data system. For TCD, the data rate should be  $\leq 5$  Hz.

## TCD Peaks Have Negative Dip on Tail



- Check for leaks at the detector column adapter fitting. (See “[Checking for Leaks](#)”.)
- Upgrade the detector to a passivated filament.



## 4 GC Not Ready Symptoms

- GC Never Becomes Ready [90](#)
- Flow Never Becomes Ready [91](#)
- Oven Temperature Never Cools Down/Cools Very Slowly [92](#)
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This section includes faults and symptoms that will occur when the GC is on but cannot perform analyses. This is indicated by a “Not Ready” warning, by fault messages, or by other symptoms.



## GC Never Becomes Ready

Normally the GC becomes ready after flows and temperatures reach setpoint. If the GC does not become ready after a long period of time:

- Press [**Status**] or a component key (for example, [**Front inlet**]) to see which setpoints or conditions are not ready.
- Check for a sampler problem.
- Check for a data system problem.
- If performing manual injections in splitless or gas-saver mode, you may need to press [**Prep Run**] to prepare the inlet for the injection. Do this, for example:
  - To toggle the inlet purge valve before a splitless injection
  - To prepare for a pulsed injection
  - To turn off gas saver.

For more information on [**Prep Run**], see the [Agilent 7890 GC Advanced User Guide](#).

## Flow Never Becomes Ready

If the gas flow never becomes ready, check for the following:

- Check the supply gas for [sufficient delivery pressure](#).
- Check the restrictors installed in the Aux EPC module. See [Restrictors](#) in the Advanced User Guide.
- Check the configured gas type. The configured gas type must match the actual gas plumbed to the GC.
- Check for leaks in the gas delivery plumbing and the GC. (See “[Checking for Leaks](#)”.)

## Oven Temperature Never Cools Down/Cools Very Slowly

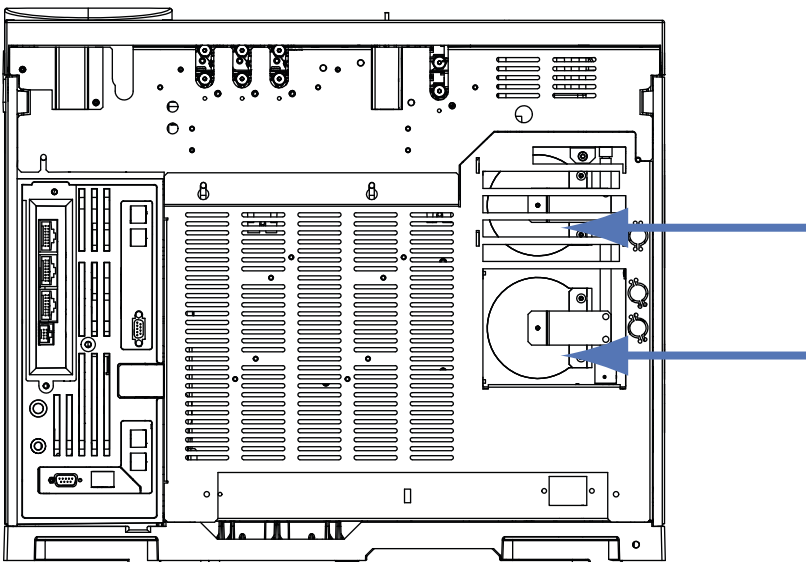
If the oven does not cool down or cools down very slowly:

**WARNING**

**The exhaust coming from the back of the GC is very hot. Keep hands and face away from the exhaust vent.**

- Check oven flapper operation.
  - 1 Decrease oven temperature by at least 20 degrees.
  - 2 Verify that the oven flaps in the back of the GC are **open**. Listen to verify that the fan is operating. The figure below illustrates the location of the two oven flaps.

If the flaps are not operating smoothly, contact Agilent for service.



If using cryo cooling:

- Check for sufficient cryo coolant.
- Check if operating limits have been exceeded.

## Oven Never Heats Up

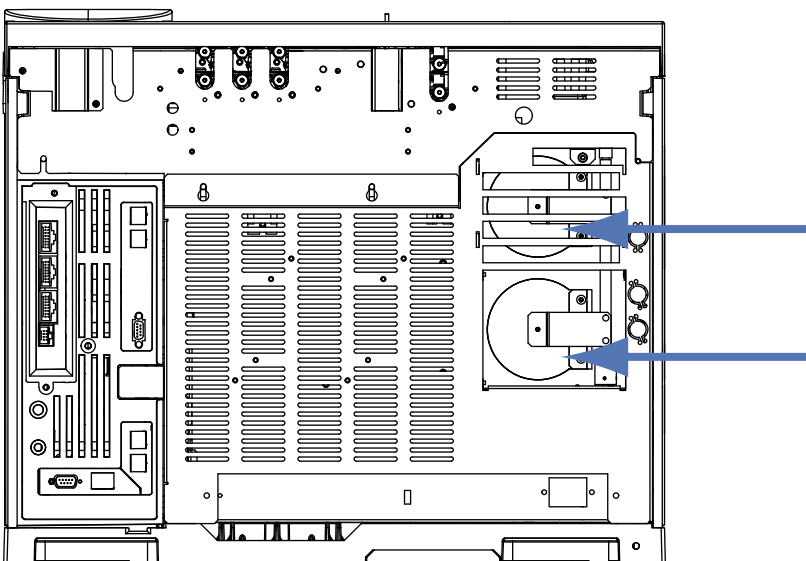
- Press **[Status]** to check for errors to report to Agilent.

### WARNING

The exhaust coming from the back of the GC is very hot. Keep hands and face away from the exhaust vent.

- Power cycle the GC.
- Check oven flapper operation.
  - 1 Increase oven temperature by at least 20 degrees.
  - 2 Verify that the oven flaps in the back of the GC are **closed**. The figure below illustrates the location of the two oven flaps.

If the flap is stuck open or if the flaps are closed and the oven still does not heat, contact Agilent.



## Temperature Never Becomes Ready

To be considered ready, a temperature must be at setpoint  $\pm 1$  °C for 30 s. If a temperature never becomes ready, do the following:

- Check for a missing insulation cup on an inlet or detector.
- Check for a very large temperature difference between the oven and inlet or detector.
- Check for missing insulation around the inlet or detector.
- If using an inlet cryo cooling (COC, PTV, or MMI):
  - Check cryo coolant level.
  - Check if operating limits have been exceeded. If, for example, you are operating the GC in a hot room at a high oven temperature and a very low inlet temperature, an inlet may not reach its desired temperature.

## Cannot Set a Flow or Pressure

If you cannot set a flow or pressure using the split/splitless, MMI, PTV, VI, or cool on-column inlets, do the following:

- Check the column mode.
- Check that a capillary column is configured to the correct inlet.
- Check the configured column dimensions.
- Check that the flow is turned on.

If you cannot set a flow or pressure using the purged packed inlet, do the following:

- Check the column mode.
- Check that the flow is turned on.
- Check the inlet mode. When using inlet flow control, you can set only flow control modes for columns. When using inlet pressure control, you can set the column for both flow and pressure modes.

## A Gas Does Not Reach Setpoint Pressure or Flow

If an inlet does not reach its pressure setpoint, it will shut down in an amount of time determined by the type of inlet. Do the following:

- Check for sufficient gas supply delivery pressure. The pressure at the supply should be at least 10 psi greater than the desired setpoint.
- Check for leaks. (See [“Checking for Leaks”](#).) A large leak may be present somewhere in the system. Use an electronic leak detector to find leaks, then correct them. Do not forget to check the column—a broken column is a very large leak.
- To troubleshoot a multimode or split/splitless inlet, see [“To Check for Leaks in a Multimode Inlet”](#) or [“To Check for Leaks in a Split/Splitless Inlet”](#).
- If using gas saver, be sure that the gas saver flow rate is high enough to maintain the highest column-head pressure used during a run.
- Check for an incorrectly installed column.
- Check for a defective inlet or detector pressure sensor.

If you are using a split/splitless inlet, MMI inlet, PTV inlet, or volatiles interface:

- Check the split ratio. Increase the amount of split flow.

## A Gas Exceeds Pressure Setpoint or Flow

If a gas exceeds its pressure or flow setpoint, do the following:

If using a split/splitless inlet, MMI inlet, PTV inlet, or volatiles interface:

- Decrease the split ratio.
- Replace the split vent filter. See the procedure for the [SS](#), [MMI](#), [PTV](#), or [VI](#).
- Check the split vent trap line for contamination or an abnormal restriction. Run the split vent restriction test in Agilent Instrument Utilities, if available, or from the GC front panel. See:
  - [To Check or Monitor Split Vent Line Backpressure](#)
  - [To Run the Inlet Trap Check](#)
  - [To Check a Split Vent Line for Contamination](#)
- Verify that the correct liner is selected (if liner is used). See [Selecting the correct MMI inlet liner](#) or [Selecting the correct SS inlet liner](#).
- Verify the method pressure settings for the SS inlet are above the minimum viable settings available on the GC. See [Table 4](#).
- Check the gold seal for contamination (for split/splitless inlet). See [To Replace the Gold Seal on the Split/Splitless Inlet](#).
- For a split/splitless inlet, if using a liner that causes a restriction, install a [high flow gold seal](#).

If using an FID or NPD:

- Check for a plugged jet. See [“To Check for a Plugged FID Jet”](#) or [“To Check for a Plugged NPD Jet”](#).

Valves:

- Check for a misaligned rotor. [Align the rotor](#).

## The Inlet Pressure or Flow Fluctuates

A fluctuation in inlet pressure causes variations in the flow rate and retention times during a run. Do the following:

- Check if the gas purifier or gas generator is operating at or near capacity.
- Check the supply gas for [sufficient delivery pressure](#).
- Verify that the supply pressure regulator is functioning properly. Systems with long supply tubing lengths may require a step-down regulator near the GC. Also, use an additional regulator to smooth out fluctuations caused by gas generators.
- Check for leaks. (See “[Checking for Leaks](#)”.) A large leak may be present somewhere in the system. Use an electronic leak detector to find leaks, then correct them. Do not forget to check the column—a broken column is a very large leak.
- Check for large restrictions in the inlet liner or split vent trap.
- Verify that the correct liner is installed. Some liners have large pressure drops caused by design or tight packaging.
- Check for extreme changes in room temperature during runs. Correct laboratory temperature problem or move the instrument to a more suitable location.
- Check for a restriction in headspace, purge and trap, and any other external sampling devices.
- Verify Auto Flow Zero feature is On. See [AutoFlowZero](#).

## Cannot Maintain a Pressure as Low as the Setpoint on a Split Inlet

If the GC cannot maintain a pressure as low as the setpoint, check for the following:

- Consider using a liner designed for split analysis.
- Method pressure parameter (or resultant pressure from a flow setting) is too low for the carrier gas type. See [Split/Splitless inlet split mode minimum operating pressures](#) or [Multimode inlet split mode minimum operating pressures](#) and the table below.

**Table 5** Approximate minimum viable inlet pressures for inlet in split mode, in psi (split/splitless, multimode)

|                                          | Split vent flow (mL/min) |         |         |         |
|------------------------------------------|--------------------------|---------|---------|---------|
|                                          | 50–100                   | 100–200 | 200–400 | 400–600 |
| <b>Helium and hydrogen carrier gases</b> |                          |         |         |         |
| Split liners - 5183-4647, 19251-60540    | 2.5                      | 3.5     | 4.5     | 6.0     |
| Splitless liners - 5062-3587, 5181-8818  | 4.0                      | 5.5     | 8.0     | 11.0    |
| <b>Nitrogen carrier gas</b>              |                          |         |         |         |
| Split liners - 19251-60540, 5183-4647    | 3.0                      | 4.0     | —       | —       |
| Splitless liners - 5062-3587, 5181-8818  | 4.0                      | 6.0     | —       | —       |

- Check for a plugged liner.
- Check for contamination or restriction in the split vent line. See:
  - [To Perform a SS Split Vent Restriction Test.](#)
  - [To Check or Monitor Split Vent Line Backpressure](#)
  - [To Run the Inlet Trap Check](#)
  - [To Check a Split Vent Line for Contamination](#)
- For the split/splitless inlet, replace gold seal..See [To Replace the Gold Seal on the Split/Splitless Inlet.](#)

## The Measured Column Flow Does Not Equal the Displayed Flow

If the actual column flow does not match the calculated flow displayed on the GC within 10%, do the following:

- Verify that the measured flows are corrected to 25 °C and 1 atmosphere.
- Verify that the correct column dimensions are configured accurately, including the actual (trimmed) column length.
- A short (<15 m) 0.58 to 0.75 mm id WCOT column is being used with a split/splitless capillary inlet. The total flow controller is set for a high flow rate, which creates some pressure in the inlet and causes column flow even with a setpoint pressure of zero. (In these situations, an actual pressure may be shown on the display, even with a zero setpoint.) With short, 530 to 750 mm columns, keep the total flow rate as low as possible (for example, 20 to 30 mL/min). Install a longer column with higher resistance (for example, 15 to 30 m).
- The split vent line or trap may be partly plugged, creating an actual inlet pressure higher than the setpoint pressure. Check for a restriction in the split vent line. See [To Run the Inlet Trap Check](#).
- If using a Mass Selective Detector, verify the column outlet for the transfer line is set to **MSD**.
- Make sure that the auto flow zero is turned on. As applicable, zero the flow and pressure sensor for the flow module. If this does not solve the problem, replace the flow module.

## FID Does Not Ignite

- Verify that the Lit Offset is  $\leq 2.0$  pA.
- Ensure that the FID temperature is high enough for ignition ( $>150$  °C). Agilent recommends  $>300$  °C.
- Check that the FID ignitor glows during ignition sequence. (See [To Verify FID Ignitor Function During Ignition Sequence](#).)
- Check that the air and hydrogen pressures meet Agilent's recommendations (hydrogen  $> 35$  psi [210 kPa] and air  $> 55$  psi [380 kPa]). See the [Agilent GC, GC/MS, and ALS Site Preparation Guide](#).
- Try increasing the supply pressures to the FID flow module. This makes the flame easier to light without changing the setpoints.
- Increase hydrogen flow and decrease or turn off makeup gas flow until ignition occurs, then reduce them toward the method values. Experiment for the best values.

Increasing hydrogen flow and decreasing makeup flow will help the FID ignite more easily. If it will light under these modified conditions, the cause could be a partially clogged jet, a weak ignitor, or a leak at the column fitting.

- Check for a plugged or partially plugged jet. (See [To Check for a Plugged FID Jet](#).)
- Measure the FID flow rates. Actual flow rates should be within  $\pm 10\%$  of the setpoint. (See [FID starting conditions](#).) The hydrogen:air ratio greatly impacts ignition. Nonoptimal flow settings can prevent flame ignition. (See [To Measure a Detector Flow](#).)
- There could be a large leak in the system if the flame still will not light. Large leaks result in measured flow rates being different from actual flow rates, causing nonideal ignition conditions. Thoroughly leak check the whole system, especially the column fitting at the FID. (See [Checking for Leaks](#).)
- Check the column flow rate. (See [To Measure a Column Flow](#).) Hydrogen flow should be greater than the sum of the column flow and makeup flow.
- If the analysis permits, substitute nitrogen for helium as makeup.

## FID Ignitor Does Not Glow During Injection Sequence

**WARNING**

Keep body parts at a safe distance from the FID chimney while performing this task. If using hydrogen, the FID flame will not be visible.

---

- 1 Remove the detector top cover.
- 2 Turn the FID flame **On**.
- 3 Observe the ignitor plug through the FID chimney. The small hole should glow during ignition sequence.

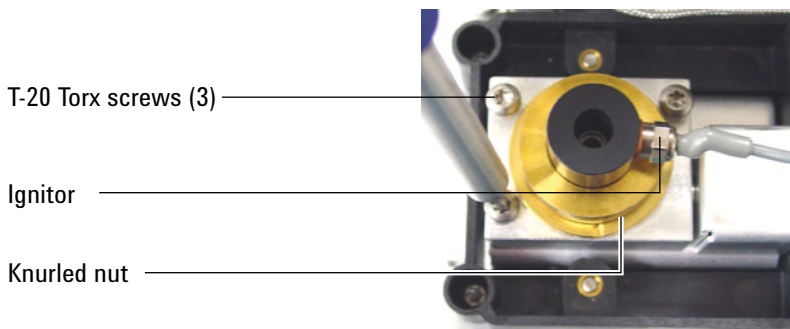


If the test fails, check for the following possible causes:

- The ignitor may be bad; replace the ignitor. (See [To Perform Maintenance on the FID Collector Assembly](#).)
- Detector temperature is set to  $< 150\text{ }^{\circ}\text{C}$ . Agilent recommends operating the FID at  $> 300\text{ }^{\circ}\text{C}$ .
- The ignitor is not making a good connection to the ground:
  - The ignitor must be tightly screwed into the FID castle assembly.
  - The three T-20 Torx screws that hold the collector assembly in place must be tight.

- The brass knurled nut that holds the FID castle assembly in place must be tight.

Perform FID maintenance if these parts are corroded or oxidized.



## FID or NPD Measured Hydrogen and Makeup Gas Flows Much Less Than Setpoint

- Check for a clogged or partially clogged jet. A clogged jet creates backpressure. Since the flow module uses pressure control, the increased backpressure simulates proper flow. The actual flow rate will drop but the GC remains functional. See:

[“To Check for a Plugged FID Jet”](#)

[“To Check for a Plugged NPD Jet”](#)

- Check for a column fitting leak at the detector base.
- Replace the [FID](#) or [NPD](#) jet.

## NPD Adjust Offset Process Fails

- Inspect the jet to see if it is clogged. (See [To Check for a Plugged NPD Jet.](#))
- Measure the actual detector flows. (See [To Measure a Detector Flow.](#)) If the hydrogen or makeup flows are zero or much lower than the displayed flow, suspect a plugged jet.
- Check the condition of the bead. [Replace](#) if necessary.
- Verify that the flow settings are correct. See [Flows, temperatures, and bead information.](#)
- If the process still fails, there could be a large leak in the system. This causes measured flow rates to be different from actual flow rates. Thoroughly leak check the whole system, especially the detector column fitting. (See [Checking for Leaks.](#))
- Set the equilibration time to 0.0.

## FPD Does Not Ignite

- Check that the FPD temperature is high enough for ignition ( $> 150\text{ }^{\circ}\text{C}$ ).
- Check FPD flow rates and that they match the type of filter installed in the FPD. The hydrogen:air ratio greatly impacts ignition. Nonoptimal flow settings can prevent flame ignition.

**Table 6** FPD<sup>+</sup> recommended flows

|                                             | Sulfur mode flows,<br>mL/min | Phosphorus mode<br>flows, mL/min |
|---------------------------------------------|------------------------------|----------------------------------|
| Carrier (hydrogen, helium, nitrogen, argon) |                              |                                  |
| Packed columns                              | 10 to 60                     | 10 to 60                         |
| Capillary columns                           | 1 to 5                       | 1 to 5                           |
| Detector gases                              |                              |                                  |
| Hydrogen                                    | 60                           | 60                               |
| Air                                         | 60                           | 60                               |
| Carrier + makeup                            | 60                           | 60                               |

**Table 7** FPD recommended flows

|                                             | Sulfur mode flows,<br>mL/min | Phosphorus mode<br>flows, mL/min |
|---------------------------------------------|------------------------------|----------------------------------|
| Carrier (hydrogen, helium, nitrogen, argon) |                              |                                  |
| Packed columns                              | 10 to 60                     | 10 to 60                         |
| Capillary columns                           | 1 to 5                       | 1 to 5                           |
| Detector gases                              |                              |                                  |
| Hydrogen                                    | 50                           | 75                               |
| Air                                         | 60                           | 100                              |
| Carrier + makeup                            | 60                           | 60                               |

- Measure the actual detector flows. (See [To Measure a Detector Flow.](#))
- The column may be [installed too high](#) into the detector.
- Check that the FPD ignitor operates. (See [To Verify That the FPD Flame Is Lit.](#))

- During the ignition sequence, display the air flow rate. The air flow rate should go to 200 mL/min (7890A) or 400 mL/min (7890B) while trying to ignite to flame. If not, there is insufficient air supply pressure.
- Check the column and makeup flow rates.
- Ensure that condensation in the vent tube is not dripping back into the detector. The flexible plastic vent tube must run from the detector into a container, without sagging, in order to properly drain water condensate. Keep the open tube end out of the water in the container.
- Check the **Lit offset** value. The typical **Lit offset** value is 2.0. If it is zero, autoignition is turned off. If it is too large, the software will not recognize that the flame is lit and will shut the detector down.
- If the flame still will not light, there could be a large leak in the system. This results in measured flow rates being different from actual flow rates, causing non-ideal ignition conditions. Thoroughly leak check the whole system. (See [Checking for Leaks](#).)
- Try increasing the supply pressures to the FPD flow module. This makes the flame easier to light without changing the setpoints.
- Under some operating conditions, the flame will light more easily with the vent tube removed. After lighting the flame, reinstall the vent tube.
- The sulfur mode can be particularly hard to light (FPD only, not FPD<sup>+</sup>). Try changing to the phosphorus mode flows, lighting the flame, and gradually alter the flows to the sulfur values.
- Check cable connections to coupling, coupling connection to glow plug, tight glow plug.

## Valve Not Ready

Troubleshooting depends on the type of valve.

### External valves

External valves are valves connected to the GC through the external events or BCD connectors on the back panel

This Not Ready state means that the +24 V supply to the pneumatics valves is actually less than +16.5 V. All valves are disabled to prevent improper operation.

When full voltage is restored, the GC becomes ready.

This Not Ready state could indicate a hardware problem in the external valve or in the GC analog and power board.

### Gas sampling valves

The GC is normally not ready whenever the inject time or load time has not elapsed. It becomes ready when the specified load or inject time has passed.

### Multiposition valve

A multiposition valve can cause the GC to be in a not ready state for one of the following reasons:

- The multiposition valve is not at the setpoint position. The GC remains not ready until the valve reaches the setpoint.
- The BCD cable is missing or not plugged into the receptacle. If the cable is missing, the valve will never become ready.
- The BCD setpoint is incorrect for the valve BCD output polarity. The valve will most likely shutdown with Illegal Position or Not Switching shutdown errors.
- If the valve is plugged or the sample is viscous, the switching time may be too short for the valve to switch. Increase the switching time.

## Blinking Not Ready Light: Detector Hardware Fault/TCD Filament Voltage

If the TCD filament is open, the Not Ready LED blinks and the GC will not become Ready.

- 1 Press [**Status**]. If the display reads **Front detector hardware fault** or (**Back** or **Aux detector hardware fault**), the problem may be the TCD filament.
- 2 Press [**Front Det**] (or [**Back Det**] or [**Aux Det #**]).
- 3 If the display reads **Fault: TCD Filament Voltage**, scroll to the **Filament** setpoint.

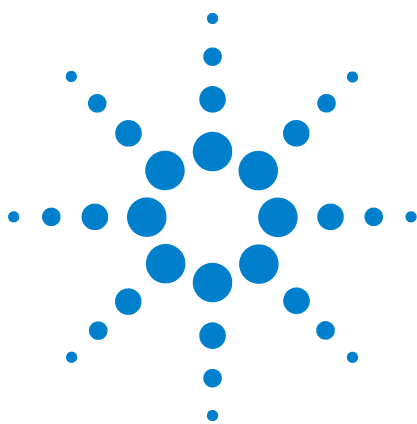
If the setpoint is flashing **Off**, the problem is an open TCD filament.

- 4 Power cycle the GC.
- 5 Press [**Front Det**] (or [**Back Det**] or [**Aux Det #**]).
- 6 Scroll to the **Filament** and press [**Off/No**] to disable the TCD filament. Contact Agilent for service.

To continue to use the GC without the TCD:

- 1 Turn off all TCD parameters. Save the method.
- 2 Reconfigure the GC to use another detector. Move the column and set other parameters as needed.





## 5 Shutdown Symptoms

|                    |     |
|--------------------|-----|
| Column Shutdowns   | 112 |
| Hydrogen Shutdowns | 114 |
| 7890B MSD Shutdown | 116 |
| Thermal Shutdowns  | 118 |



## Column Shutdowns

The GC monitors inlet and auxiliary gas streams. If a carrier gas (which can include an auxiliary flow module or pneumatics control module) is unable to reach its flow or pressure setpoint, the GC assumes that a leak exists. It will warn you with a beep after 25 seconds, and it will continue to beep in intervals. After about 5 minutes, the GC will shut down components to create a safe state. The GC:

- Displays **Front inlet pressure shutdown**.
- Turns off to avoid column damage.
- Opens oven flaps in the back of the oven halfway.
- Flashes oven temperature setpoint **Off**.
- Turns off all flows for the column. When viewed, their parameters flash **Off**. For example, the septum purge and column flows for a split/splitless inlet would turn off.
- Turns off all other heaters. When viewed, their temperature parameters flash **Off**.
- Attempts to turn on a shut-down zone fail with an error message.
- Turns off the TCD filament.
- Turns off the FID or FPD ignitor, and the air and fuel gas flows.
- Turns off the NPD bead, and air and fuel gas flows.
- 7890B: Communicates with 5977 MSD, if present, so the MSD can react to the shutdown event.

To recover from this state.

- 1 Fix the cause of the shutdown. Verify the carrier gas supply. The GC requires a delivered gas pressure of 70 kPa (10 psi) higher than the highest pressure used in the run. See the [Agilent GC, GC/MS, and ALS Site Preparation Guide](#).
  - Check for a broken column near the inlet.
  - Check for leaks.
  - Replace the inlet septum.
  - Replace the inlet O-ring.
  - Check the supply pressure.
- 2 Press the key for the device that initiated the shutdown. Scroll to the pneumatic parameter that is flashing **Off**, then press [**On**] or [**Off**].

For example, if the front inlet ran out of carrier gas, press [**Front Inlet**], scroll to the pressure or flow parameter, then press [**On**].

- After a column shutdown, you can turn on a detector gas flow even if the keyboard is locked by a data system.

## Hydrogen Shutdowns

Hydrogen gas may be used as a carrier or as fuel for some detectors. When mixed with air, hydrogen can form explosive mixtures.

The GC monitors inlet and auxiliary gas streams. If a stream is unable to reach its flow or pressure setpoint and if that stream is configured to use hydrogen, the GC assumes that a leak exists. It will warn you with a beep after 25 seconds, and it will continue to beep in intervals. After about 5 minutes, the GC will shut down components to create a safe state. The GC:

- Displays **Hydrogen Safety Shutdown**.
- Closes the carrier supply valve to the inlet and closes and turns off both pressure and flow controls. When viewed, these parameters will flash **Off**.
- Opens the split vent valves in the split/splitless and PTV inlets.
- Turns off the oven heater and fan and opens the oven flaps.
- Turns off all heaters (including any devices connected to the auxiliary heater controls, such as valve box heaters and transfer line heaters). When viewed, these parameters will flash **Off**.
- Turns off the TCD filament.
- Turns off the FID or FPD ignitor, and the air and fuel gas flows.
- Turns off the NPD bead, and air and fuel gas flows.
- Sounds an alarm.
- 7890B: Communicates with 5977 MSD, if present, so the MSD can react to the shutdown event.

**WARNING**

The GC cannot detect leaks in the detector gas streams. For this reason, it is vital that the column fittings of the FID, NPD, and any other detectors that use hydrogen always be connected to a column or have a cap or plug installed and that hydrogen streams be configured so that the GC is aware of them.

---

To recover from a hydrogen shutdown state:

- 1 Fix the cause of the shutdown:
  - Replace the inlet septum. See the [Maintenance](#) manual.
  - Replace the inlet O-ring. See the [Maintenance](#) manual.
  - Check for broken column.
  - Check the supply pressure. Make sure the gas supply meets the pressure recommendations listed in the [Agilent GC, GC/MS, and ALS Site Preparation Guide](#).
  - Check the system for leaks. See [Leak Check Tips](#).
- 2 Power cycle the GC.
- 3 After the GC powers back on, press the key for the device that initiated the shutdown. Scroll to the pneumatic parameter that is flashing **Off**, then press [**On**] or [**Off**]. For example, if the front inlet ran out of carrier gas, press [**Front Inlet**], scroll to the pressure or flow parameter, then press [**On**].
  - After a column shutdown, you can turn on a detector gas flow even if the keyboard is locked by a data system.

## 7890B MSD Shutdown

If the 7890B receives a shutdown event from, or loses communications with, a connected 5977 MSD, the GC reacts with changes such as:

- Turning off the column oven.
- Setting low pressures/flows for the MSD flow path.
- Turning off hydrogen carrier gas flow, if used.
- Aborting a current run.
- Turning off the MS transfer line heater.
- Blocking all setpoint changes.

The exact changes depend on the event that triggered the shutdown. For example, the GC may react differently to a communications loss than to a failure in the MSD high vacuum pump.

When troubleshooting an MSD Shutdown:

- 1 Check all GC, MSD and data system events and logs. The GC will enter MS Shutdown if:
  - The GC cannot maintain carrier flow into the MS.
  - The MS reports a shutdown or fault.
  - The GC and MS lose communications with each other.
- 2 Check the current communications status.
  - a Press [**Aux Det #**].
  - b The **MS2GC** setting should read **Connected**. If not, check the entered GC and MSD IP addresses in the GC, the MSD, and the PC. All GC and MSD IP addresses must match in all three places.
  - c Check the GC and MS LAN connections. Is the LAN switch or hub operating?

### Clearing an MS Shutdown

Unlike other shutdowns, you cannot clear this state by turning off a setpoint (because setpoint changes are blocked). Instead, clear this state by disabling GC to MS communications.

- 1 Press [**Aux Det #**].
- 2 Scroll to **MS2GC**.
- 3 Press **Off/No**.

If the GC started the shutdown, you can now troubleshoot the problem and resolve the GC fault.

### **After resolving an MS Shutdown**

After resolving the GC or MS problem, always restore GC to MS communications.

- 1** Press [**Aux Det #**].
- 2** Scroll to **MS2GC**.
- 3** Press **On/Yes**.

## Thermal Shutdowns

A thermal fault means that the oven or another heated zone is not within its allowable temperature range (lower than minimum temperature or higher than maximum temperature). Several things could cause this error:

- A problem with the electrical supply to the instrument.
- A malfunction of the zone control electronics.
- A shorted temperature sensor.
- A shorted heater.

To recover from this state:

- 1 Fix the cause of the shutdown:
  - Check for missing insulation.
- 2 Most thermal shutdowns can be cleared by shutting off the thermal zone.



## 6 GC Power On and Communication Symptoms

GC Does Not Turn On [120](#)

PC Cannot Communicate with GC [121](#)

GC Cannot Communicate with 5977 MSD [122](#)

GC Does Not Recover After Firmware Update [123](#)

GC Turns On, Then Stops During Startup (During Self-Test) [124](#)



## **GC Does Not Turn On**

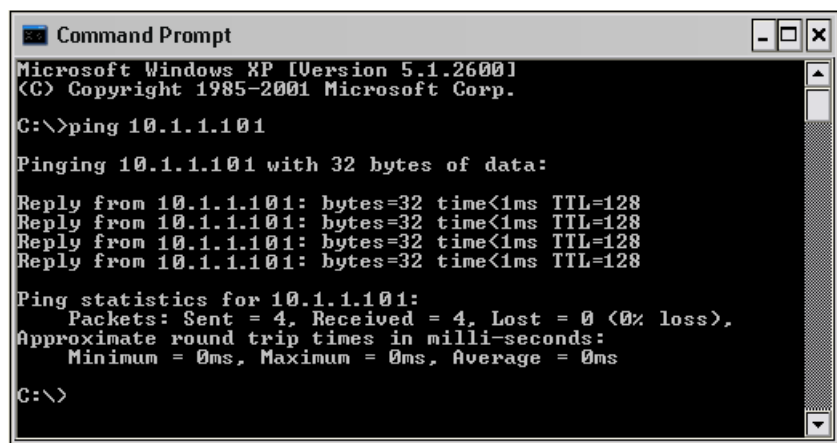
If the GC does not turn on:

- Check the power cord.
- Check the building's power.
- If the problem is at the GC, turn off the GC power. Wait 30 seconds, then turn the on the GC power.

## PC Cannot Communicate with GC

- Run a **ping** test

The MS-DOS **ping** command verifies communications across a TCP/IP connection. To use it, open the command prompt window. Type **ping** followed by an IP address. For example, if the IP address is 10.1.1.101, enter **ping 10.1.1.101**. If LAN communications are working properly, you will see a successful reply. For example:



```

Microsoft Windows XP [Version 5.1.2600]
(C) Copyright 1985-2001 Microsoft Corp.

C:\>ping 10.1.1.101

Pinging 10.1.1.101 with 32 bytes of data:

Reply from 10.1.1.101: bytes=32 time<1ms TTL=128
Reply from 10.1.1.101: bytes=32 time<1ms TTL=128
Reply from 10.1.1.101: bytes=32 time<1ms TTL=128
Reply from 10.1.1.101: bytes=32 time<1ms TTL=128

Ping statistics for 10.1.1.101:
    Packets: Sent = 4, Received = 4, Lost = 0 (0% loss),
    Approximate round trip times in milli-seconds:
        Minimum = 0ms, Maximum = 0ms, Average = 0ms

C:\>
  
```

If the ping test is successful, check the software configuration.

If the problem is that a data system cannot connect to the GC, check if another PC is controlling the GC. At the GC keypad, press **[Options]**, scroll to and select **Communication**, then scroll the display down. If a computer is connected to the GC, its network name will appear below the **Enable DHCP** line.

If the ping test is unsuccessful, do the following:

- Check the LAN cabling.
- Verify the IP address, subnet mask, and gateway addresses.
- Make sure all network devices (hubs, switches, and so forth) are turned on, properly connected, and working.
- Check for a defective LAN card in the PC.
- If using a direct PC to GC setup, make sure you are using a crossover cable. If using a setup with a hub or switch (that is, connecting to a building or site LAN), make sure you are NOT using a crossover cable.

## GC Cannot Communicate with 5977 MSD

- 1 First, check that GC to MS communications are enabled.
  - a Press [**Aux Det #**].
  - b Scroll to **MS2GC**.

If the entry reads **Off**, press [**On/Yes**].

If the entry reads **Connecting** but does not connect, continue troubleshooting.

- 2 Check that the GC IP address is correctly entered and correct as needed. Go to **Options > Communications**.
- 3 Check that the MS IP address is correctly entered into the GC. Under **Options > Communications**, scroll to **Mass Spec.** to see the current MS IP address. Compare it against the IP address shown on the MS display.
- 4 Use the MS keypad to check the MS and GC IP addresses entered into the MS. They must exactly match those entered into the GC.
- 5 If the addresses are correct in both the GC and the MS, **ping** the GC and MS from a computer on the same local LAN. (See “[PC Cannot Communicate with GC](#)” for more information about the PC **ping** command.)
- 6 If using an Agilent data system, check the GC and MS IP addresses entered into the data system software. Again, these must exactly match the values entered into each instrument.

## GC Does Not Recover After Firmware Update

If the GC starts but does not display the “Power on successful” message, look for any error messages. Record any messages. Then resolve the problem as follows:

- 1 Try power cycling the GC.
- 2 If the GC still does not recover, turn off the GC.
- 3 While pressing the [**Stop**] and [**0**] keys, turn on the GC. Continue to hold the keys until the GC reboots. You should see a display similar to the following:

MMON Version X.XX

IP = 10. 1. 1.101

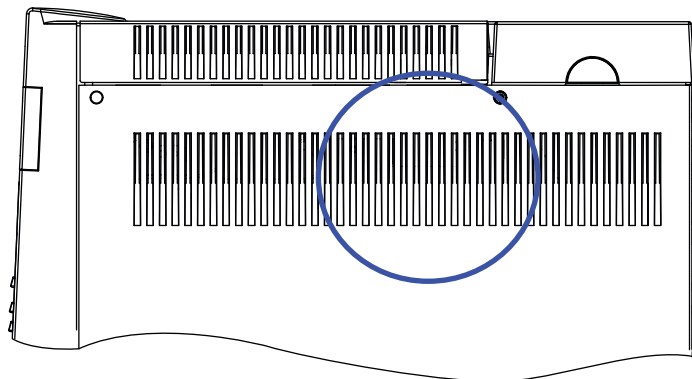
If this display appears, you can now communicate to the GC. Reload the firmware.

- 4 If the GC does not boot up and show a display similar to the one above, or if the update fails again, contact Agilent for service.

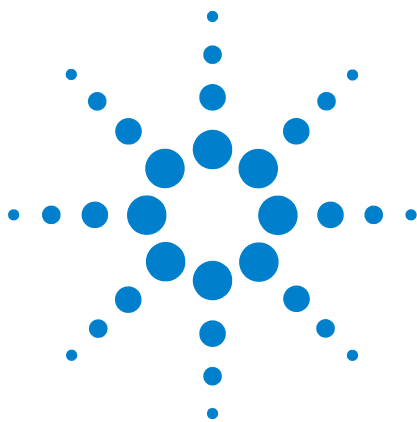
## GC Turns On, Then Stops During Startup (During Self-Test)

If the GC turns on but the normal display does not appear:

- 1 Turn the GC power switch **Off**. Wait one minute, then turn the GC power **On**.
- 2 If the GC does not return to normal, record any messages that appear on the display. Observe the GC back panel, and look for LED indicator lights (green, yellow, or red) above the REMOTE connector and whether they are flashing or constant. (For older GCs, look through the slots in the GC right side panel where shown below.) Contact Agilent for service, and provide the display information to the Agilent support personnel. (See also [“Information to Obtain Before Calling Agilent for Service”](#).)



Older GC: LEDs visible through side panel.



## 7 Checking for Leaks

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## Leak Check Tips

When checking for leaks, consider the system in two parts: external leak points and GC leak points.

- **External leak points** include the gas cylinder (or gas purifier), regulator and its fittings, supply shutoff valves, and connections to the GC supply fittings.
- **GC leak points** include inlets, detectors, column connections, valve connections, and connections between flow modules and inlets/detectors.

**WARNING**

**Hydrogen (H<sub>2</sub>) is flammable and is an explosion hazard when mixed with air in an enclosed space (for example, a flow meter). Purge flowmeters with inert gas as needed. Always measure gases individually. Always turn off detectors to prevent flame/bead autoignition.**

---

**WARNING**

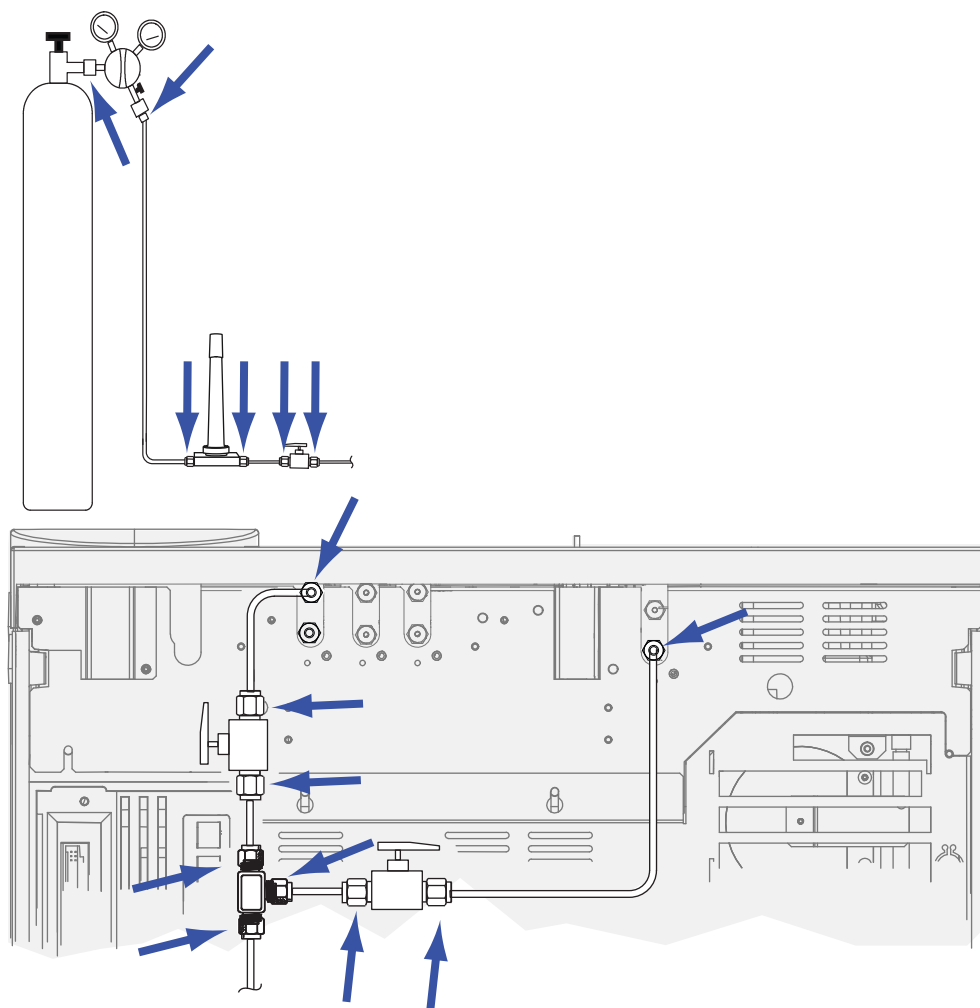
**Hazardous sample gases may be present.**

---

- 1 Gather the following:
  - Electronic leak detector capable of detecting the gas type
  - 7/16-in, 9/16-in, and 1/4-in wrenches for tightening Swagelok and column fittings
- 2 Check any potential leak points associated with any maintenance recently performed.
- 3 Check GC fittings and connections that undergo thermal cycling, since thermal cycling tends to loosen some fitting types. Use the electronic leak detector to determine if a fitting is leaking.
  - Start by checking any newly made connections first.
  - Remember to check connections in the gas supply lines after changing traps or supply cylinders.

## To Check for External Leaks

Check for leaks at these connections:



- Gas supply bulkhead fittings
- Gas cylinder fitting
- Regulator fittings
- Traps
- Shut-off valves
- T-fittings

Perform a pressure drop test.

- 1 Turn off the GC.
- 2 Set the regulator pressure to 415 kPa (60 psi).

## **7**    **Checking for Leaks**

- 3** Fully turn the regulator pressure adjustment knob counterclockwise to shut the valve.
- 4** Wait 10 min. If there is a pressure loss greater than 7 kPa (1 psi), there is a leak in the external connections.

## To Check for GC Leaks

Check for leaks at these connections:

- Inlet septum, septum head, liner, split vent trap, split vent trap line, and purge vent fittings
- Column connections to inlets, detectors, valves, splitters, and unions
- Fittings from the flow modules to the inlets, detectors, and valves
- Column adapters
- Agilent capillary flow fittings

First, use the GC's built-in leak test to check for leaks at the inlet column fitting, septum, liner, split vent trap line, and so forth. See [“To Perform an Inlet Leak Check”](#). Correct any leaks found using this test. If the GC still shows symptoms of a leak, check the other possible leak points.

If using Agilent Instrument Utilities, you can also use it to remotely run an inlet leak check (for selected inlet types).

If the inlet passes the inlet leak check but you still suspect a leak in the inlet, you can use the Instrument Utilities software to perform a pressure decay test for most inlets. (You can also perform a manual pressure decay test on any inlet.) Any inlet that passes the inlet pressure decay test can be considered leak free.

- [To Perform a SS Pressure Decay Leak Test](#)
- [To Perform a MMI Pressure Decay Test](#)
- [To Perform a PP Pressure Decay Leak Test](#)
- [To Perform a COC Pressure Decay Leak Test](#)
- [To Perform a PTV Pressure Decay Test](#)
- [To Perform a VI Pressure Decay Test](#)

Use an electronic leak detector to check column connections and tubing connections. See also:

- [To Check for Leaks in a Split/Splitless Inlet](#)
- [To Check for Leaks in a Multimode Inlet](#)
- [Leaks in Capillary Flow Fittings](#)

## **Leaks in Capillary Flow Fittings**

For capillary flow fittings, a leak usually indicates that the fitting has been overtightened. Unless the fitting is obviously loose, do not tighten it further. Instead, remove the connection, trim the column end, and install it again. (See [To Attach a Capillary Column Using SilTite Metal Fittings](#).)

Also inspect the plate and connection for a broken column tip.

## To Perform an Inlet Leak Check

The GC provides a real-time, built-in leak check for all inlets. This check is most useful for finding inlet leaks during and after inlet maintenance. While not as thorough or sensitive as a complete inlet pressure test, it is normally performed with the column installed and configured, and provides a quick assurance that the inlet is reasonably leak-free. Agilent recommends running the check before and during inlet maintenance, so that as you tighten any fittings you can watch the inlet stop leaking. The test is appropriate for all applications, although some may require more robust leak testing.

The inlet leak check finds leaks at the:

- Inlet column fitting
- Gold seal (as applicable)
- Split vent trap housing (as applicable)
- Septum nut and septum (as applicable)
- Insert weldment nut/septum head assembly (as applicable)

To run the test:

- 1 At the GC keypad, press [**Service Mode**], scroll to **Front inlet leak check** or **Back inlet leak check**, then press [**Enter**].
- 2 The display will be similar to [Figure 4](#):

```

      FRONT INLET LEAK CHECK
TotalFlow   1.74   Col   1.34<
Test Inlet           (ON to Start)
Test pressure           10.0 psi
Warning if check flow   OFF
Fault if check flow     OFF
      Last test results
      Tue Oct 20 16:07 2009
Test flow OK:           4.8
Reset the test results? (yes)

```

**Figure 4** Example front inlet leak check display. Example assumes a test has been previously run. (Scroll the display to see all lines.)

- 3 Verify that the **Test pressure** is acceptable. Typically, the default pressure of 10 psi works well. If desired, enter a different inlet pressure.
  - For repeatable results, use the same value for the same hardware.
  - Enter a higher test pressure if using a column that produces high backpressure.
- 4 Scroll to **Test Inlet** and press [On/Yes].
- 5 After a moment, the test stabilizes.
  - The **TotalFlow** reading shows the total flow of carrier gas through the inlet. The **Col** reading shows the flow through the column.
  - The approximate leak rate is **TotalFlow – Col**, in mL/min.
  - Consider the inlet leak free if the **Col** reading *approximately equals* the **TotalFlow** reading.
- 6 While monitoring the readings, tighten fittings, replace the septum, change the liner O-ring, and so forth as needed. If the repair stops the leak, you will see the **Col** reading decrease to be *approximately* equal to the **TotalFlow** reading.

#### NOTE

If you ran the test on a leak-free inlet before performing maintenance, the leak test result after maintenance should be about the same as it was before maintenance.

- 7 If the test still fails:
  - [Replace](#) the septum
  - [Reinstall the column into the inlet](#)
  - [Replace the liner and liner O-ring](#)
  - Open the split vent trap and check the O-ring seating. [Replace](#) the split vent trap if needed.

If the test passes, but you still suspect an inlet leak, perform a pressure decay leak test. See:

- [To Perform a SS Pressure Decay Leak Test](#)
- [To Perform a MMI Pressure Decay Test](#)
- [To Perform a PP Pressure Decay Leak Test](#)
- [To Perform a PTV Pressure Decay Test](#)
- [To Perform a VI Pressure Decay Test](#)

## To set warning limits for a leak check

The GC provides two alerts related to the inlet leak check:

- **Warning if pressure check:** If the measured pressure exceeds the limit, turn on the Service Due indicator.
- **Fault if pressure check:** If the measured pressure exceeds the limit, make the GC Not Ready.

You can determine reasonable inlet leak check results, then set the GC to either go Not Ready or set the Service Due indicator if the leak check fails. To set one or both limits:

- 1 When the inlet is considered leak-free, run the inlet leak check. (Assume the inlet is leak-free if the **TotalFlow** and **Col** readings are very close and you are satisfied with the GC's chromatographic results.)
- 2 Note the **TotalFlow** result.
- 3 Scroll to **Warning if pressure check** or **Fault if pressure check**.
- 4 Enter a limit using the keypad, then press **[Enter]**.
  - Select a flow rate that is higher than the acceptable TotalFlow reading. Ideally, enter a value that corresponds to known chromatographic problems.
  - The warning and fault limits can be different, for example, a warning at a lower limit, and a fault at a higher one.
- 5 If desired, repeat for **Fault if pressure check**.
- 6 The test is now set up.
- 7 Periodically rerun the test. When the test fails, fix any leaks.

To clear a Not Ready condition or to turn off the Service Due indicator:

- 1 Press **[Service Mode]**, scroll to **Front inlet leak check** or **Back inlet leak check**, then press **[Enter]**.
- 2 Scroll to **Reset the test results?** and press **[On/Yes]**.

## To disable a warning limit for the inlet leak check

- 1 Press **[Service Mode]**, scroll to **Front inlet leak check** or **Back inlet leak check**, then press **[Enter]**.
- 2 Scroll to the warning limit, then press **[Off/No]**.

## To Check for Leaks in a Split/Splitless Inlet

This procedure describes how to check for and fix leaks in the split/splitless inlet. Follow the procedures below based on the inlet's symptoms.

### Cannot Reach Pressure Setpoint

If the split/splitless EPC inlet does not reach its pressure setpoint, the GC will be "Not Ready." Pressing [**Status**] indicates the front (or back) inlet pressure is not ready. The GC will shut down in approximately 5.5 minutes if the inlet cannot pressurize and control.

If you have recently performed maintenance, first check for leaks on any fittings/parts you handled.

- 1 Verify sufficient gas supply pressure delivered to the GC (see the [GC, GC/MS, and ALS Site Preparation Guide](#)), and verify no leaks in the gas supply (see [To Check for External Leaks](#)). The inlet requires 70 kPa (10 psi) above the highest pressure used in the method.
  - 120 psi maximum for 0–100 psi inlet
  - 170 psi maximum for 0–150 psi inlet
- 2 Check the total flow setting. Total flow must be high enough to maintain inlet pressure throughout the run. Wide bore columns require higher flow rates. Typically 50 mL/min is sufficient. To increase total flow:
  - Increase split ratio if in split mode
  - Increase the purge flow for splitless mode
- 3 Put your thumb (or a septum) over the split vent exhaust. If the inlet pressure begins to rise to the setpoint, call Agilent for service. If the pressure remains low, continue with the next step.
- 4 Perform the inlet run leak check. See ["To Perform an Inlet Leak Check"](#). The total flow provides an indication of the magnitude of the leak. Monitor the total flow while checking/tightening fittings:
  - Septum nut
  - Column
  - Split vent trap/O-rings
  - Liner/O-rings
  - Gold seal

- Split vent line connection to the inlet body
- Flow block fittings on the flow manifold

Alternately, use an electronic leak detector to check these fittings/connections.

If these checks do not resolve the problem, contact Agilent for service.

## Low Sensitivity or Poor Repeatability

A small leak in the split/splitless EPC inlet can cause low sensitivity or poor repeatability. Check for and isolate a small leak as described below.

If you have recently performed maintenance, first check for leaks on any fittings/parts you handled.

- 1 Perform the inlet pressure decay test. See [“To Perform a SS Pressure Decay Leak Test”](#). If the test passes, consider the inlet leak-free and check other possible causes for the low sensitivity or poor repeatability.
- 2 If the pressure decay test fails, perform the inlet leak check. See [“To Perform an Inlet Leak Check”](#). Monitor the total flow while checking/tightening fittings:
  - Septum nut
  - Column
  - Split vent trap
  - Liner/O-ring
  - Gold seal
  - Split vent line connection to the inlet body
  - Flow block fittings on the flow manifold
- 3 If the inlet (prep run) leak check did not resolve the problem, the leak may be too small to detect using that test. Use an electronic leak detector to check the fittings/connections.

If these checks do not resolve the problem, contact Agilent for service.

## To Perform a SS Pressure Decay Leak Test

Use the Agilent Instrument Utilities Split/Splitless Inlet Pressure Decay Test to determine if the inlet is leaking. Open the software, select the GC, and run the test for the inlet. See [To Perform an Inlet Leak Check](#) and [To Perform a SS Split Vent Restriction Test](#).

If the Instrument Utilities software is not available, see the procedure below.

If the test fails:

- See [“To Check for Leaks in a Split/Splitless Inlet”](#).
- Check the plugged column fitting and septum purge cap.

### To perform a SS inlet pressure decay test at the GC keyboard

The pressure decay test checks for leaks from the inlet flow module up to the column fitting.

After performing maintenance, first check for leaks in externally accessible areas. See [“To Check for External Leaks”](#).

If a leak is known to exist, check the externally accessible inlet fittings first, especially any connection that has seen recent maintenance, such as the septum nut, column adapter, column connection, and so forth.

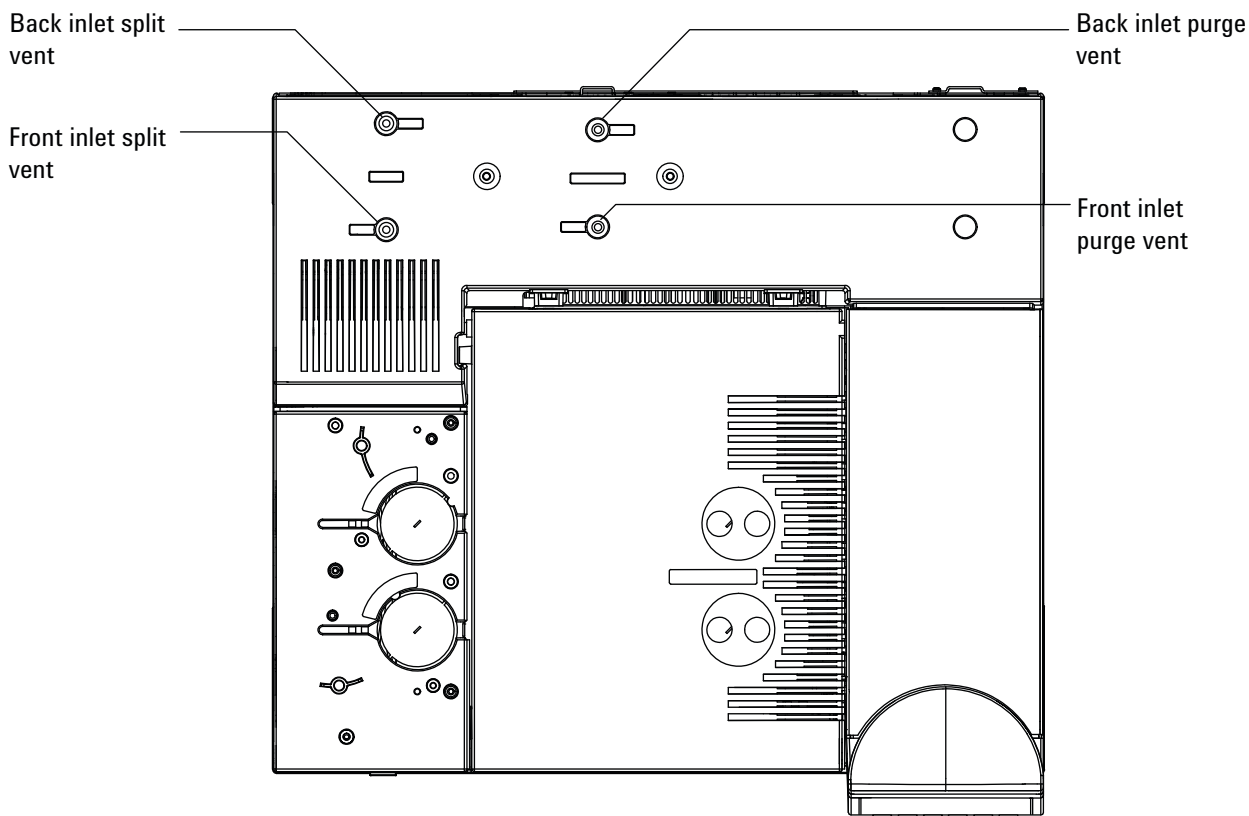
The pressure decay leak test described below requires removing the column and capping the inlet column fitting. This test can/cannot find the following types of leaks:

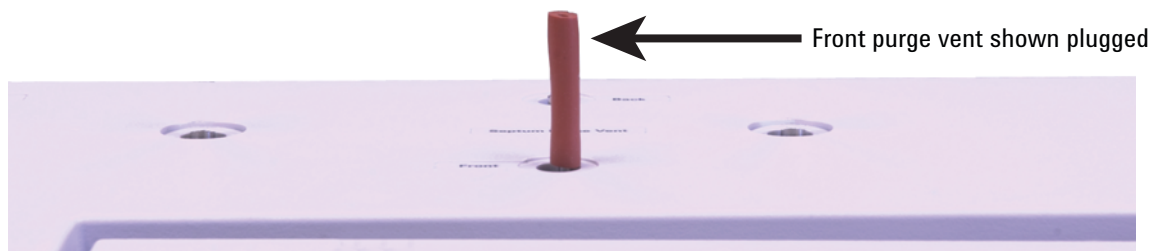
| The test can find leaks at the:                                          | The test cannot find leaks at the:                               |
|--------------------------------------------------------------------------|------------------------------------------------------------------|
| septum                                                                   | column fitting                                                   |
| septum nut                                                               | gas supply bulkhead fittings to the flow module                  |
| liner O-ring seal                                                        | tubing and connections in a transfer line connected to the inlet |
| gold seal/washer and reducing nut                                        | internal leaks in an EPC module (septum purge valve)             |
| inlet body                                                               |                                                                  |
| flow manifold split vent valve                                           |                                                                  |
| flow manifold septum purge valve                                         |                                                                  |
| split vent tubing and trap                                               |                                                                  |
| septum purge tubing                                                      |                                                                  |
| seals within the tubing between the inlet flow module and the inlet body |                                                                  |

- 1 Gather the following (see [Consumables and parts for the split/splitless inlet](#)):
  - No-hole ferrule
  - 1/4-inch wrench
  - Heat-resistant gloves (if the inlet is hot)
  - Column nut
  - New septum
  - O-ring
  - ECD/TCD Detector plug (part no. 5060-9055)
- 2 Load the [inlet maintenance method](#) and wait for the GC to become ready.
- 3 Remove the column, if installed.
- 4 Plug the column fitting with a column nut and a no-hole ferrule.
- 5 Remove the old septum and replace it with a new one. See [To change the septum on the split/splitless inlet](#).
- 6 Inspect the O-ring and replace it if it is hard and brittle or cracked. See [To change the liner and O-ring on the split/splitless inlet](#).
- 7 Set the inlet to **Split Mode**.

## 7 Checking for Leaks

- 8 Configure the column as **Inlet: Unspecified**.
- 9 Set the inlet temperature to 70 °C.
- 10 Set the **Total flow** to 60 mL/min.
- 11 Enter a pressure setpoint of 25 psi (172 kPa). Make sure that the pressure supplied to the GC is at least 10 psi (70 kPa) higher than the inlet pressure.
- 12 If pressure cannot be achieved, there is either a large leak or the supply pressure is too low.
- 13 Set the **Septum purge** flow to 3.0 mL/min.
- 14 Allow the inlet temperature to stabilize. Temperature changes can invalidate the test.
- 15 Cap the septum purge fitting with the ECD/TCD detector plug.





- 16 From the keypad, press [**Service Mode**]. Select **Diagnostics > Front or Back Inlet > Pneumatics Control > Septum Purge control**.
- 17 Scroll to the **Constant duty cycle** and enter **50**. Wait 10 seconds.
- 18 Press [**Front Inlet**] or [**Back Inlet**]. Scroll to **Pressure** and press **Off/No**.
- 19 Quickly turn off the carrier gas supply at its source.
- 20 Monitor the pressure for 10 minutes. Use the timer by pressing [**Time**] and [**Enter**].

**For GCs with no device installed in the carrier flow path:**

A pressure drop of less than 0.5 psig (0.05 psi/min or less; 3.4 kPa or 0.34 kPa/min) is acceptable.

If the pressure drops much faster than the acceptable rate, see [“To Correct Leaks in the Split Splitless Inlet”](#). Retest.

**For a GC with a 7697A Headspace Sampler:**

A pressure drop of less than 1.7 psig (0.17 psi/min or less; 11.7 kPa or 1.17 kPa/min) is acceptable. If the 7697A passes all its leak tests (restriction, pressure decay, and cross port), and if the GC inlet pressure decay test passes without the 7697A installed, check the 7697A carrier flow path. See the Headspace Sampler documentation.

**For a GC with a G1888 Headspace Sampler:**

A pressure drop of less than 2 psig in 5 minutes (0.4 psi/min or less; 13.8 kPa or 2.76 kPa/min) is acceptable when using a 1 cc sample loop.

**For all GCs:**

Note that liner size impacts pressure drop. An inlet with a smaller volume liner does not tolerate as large a leak rate as an inlet with a larger volume liner.

- 21 After the inlet passes the test, restore the GC to operating condition.
- Remove any caps/plugs.
  - Reinstall the column.
  - Restore the correct column configuration.
  - Load the operating method.

## To Correct Leaks in the Split Splitless Inlet

If the inlet fails a pressure decay test, check the following:

- Check the caps/plugs used in the test—make sure each is correctly installed and tight.
- If you performed the leak test after performing maintenance, check for proper installation of the part(s) handled during the maintenance.
- Check the tightness of the septum nut. See [To change the septum on the split/Splitless inlet](#).
- Check the septum. Replace if old or damaged.
- Check the insert assembly installation.
- Check the liner and liner O-ring. See [To change the liner and O-ring on the split/splitless inlet](#).
- If you changed the gold seal, verify correct installation. See [To replace the gold seal on the split/splitless inlet](#).
- Make sure the inlet temperature remained constant during the test.

If these items do not resolve the problem, contact Agilent for service.

## To Check for Leaks in a Multimode Inlet

This procedure describes how to check for and fix leaks in the Multimode inlet. Follow the procedures below based on the inlet's symptoms.

### Cannot Reach Pressure Setpoint

If the Multimode EPC inlet does not reach its pressure setpoint, the GC will be "Not Ready." Pressing [**Status**] indicates the front (or back) inlet pressure is not ready. The GC will shut down in approximately 5.5 minutes if the inlet cannot pressurize and control.

If you have recently performed maintenance, first check for leaks on any fittings/parts you handled.

- 1 Verify sufficient gas supply pressure delivered to the GC (see the [GC, GC/MS, and ALS Site Preparation Guide](#)), and verify no leaks in the gas supply (see [To Check for External Leaks](#)). The inlet requires 70 kPa (10 psi) above the highest pressure used in the method.
  - 120 psi maximum for 0–100 psi inlet
  - 170 psi maximum for 0–150 psi inlet
- 2 Check the total flow setting. Total flow must be high enough to maintain inlet pressure throughout the run. Wide bore columns require higher flow rates. Typically 50 mL/min is sufficient. To increase total flow:
  - Increase split ratio if in split mode
  - Increase the purge flow for splitless mode
- 3 Put your thumb (or a septum) over the split vent exhaust. If the inlet pressure begins to rise to the setpoint, call Agilent for service. If the pressure remains low, continue with the next step.
- 4 Perform the inlet leak check. See ["To Perform an Inlet Leak Check"](#). The total flow provides an indication of the magnitude of the leak. Monitor the total flow while checking/tightening fittings:
  - Septum nut
  - Column
  - Split vent trap/O-rings
  - Liner/O-rings
  - Split vent line connection to the inlet body

- Flow block fittings on the flow manifold

Alternately, use an electronic leak detector to check these fittings/connections.

If these checks do not resolve the problem, contact Agilent for service.

## Low Sensitivity or Poor Repeatability

A small leak in the Multimode EPC inlet can cause low sensitivity or poor repeatability. Check for and isolate a small leak as described below.

If you have recently performed maintenance, first check for leaks on any fittings/parts you handled.

- 1 Perform the inlet pressure decay test. If the test passes, consider the inlet leak-free and check other possible causes for the low sensitivity or poor repeatability.
- 2 If the pressure decay test fails, set the inlet to split mode. Set a column flow of 3 mL/min, a septum purge flow of 3 mL/min, and a purge flow of 50 mL/min. Press **[Prep Run]**. Monitor the inlet total flow. If the total flow is much greater than 6 mL/min, check/tighten the following fittings:
  - Septum nut
  - Column
  - Split vent trap
  - Liner/O-ring
  - Split vent line connection to the inlet body
  - Flow block fittings on the flow manifold

If the problem continues, the leak may be small.

- 3 Use an electronic leak detector to check the fittings/connections.

If these checks do not resolve the problem, contact Agilent for service.

## To Perform a MMI Pressure Decay Test

Use the Agilent Instrument Utilities Multimode Inlet Pressure Decay Test to determine if the inlet is leaking. Open the software, select the GC, and run the test for the inlet.

If the Instrument Utilities software is not available, see the procedure below.

If the test fails:

- Check the plugged column fitting and septum purge cap.
- Check the septum head. Tighten if needed.
- Replace the septum if necessary.
- Inspect and re-install the liner if it is leaking.
- Tighten the split vent trap if needed, or install a new cartridge and O-rings.
- Tighten the split vent line connection to the inlet.

## To Perform a Multimode Inlet Pressure Decay Test

The pressure decay test checks for leaks from the inlet flow module up to the column fitting.

After performing maintenance, first check for leaks in externally accessible areas. See [“To Check for External Leaks”](#).

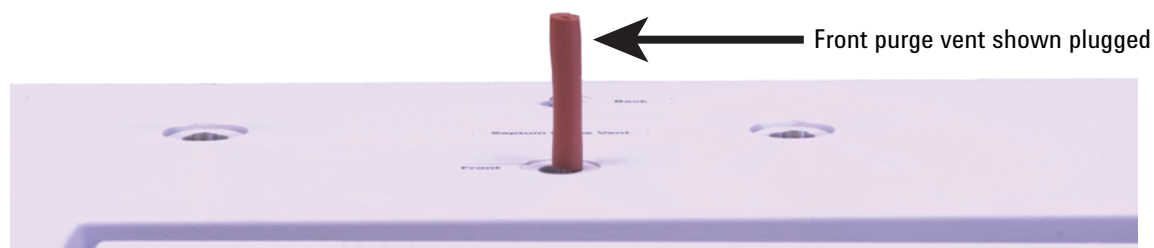
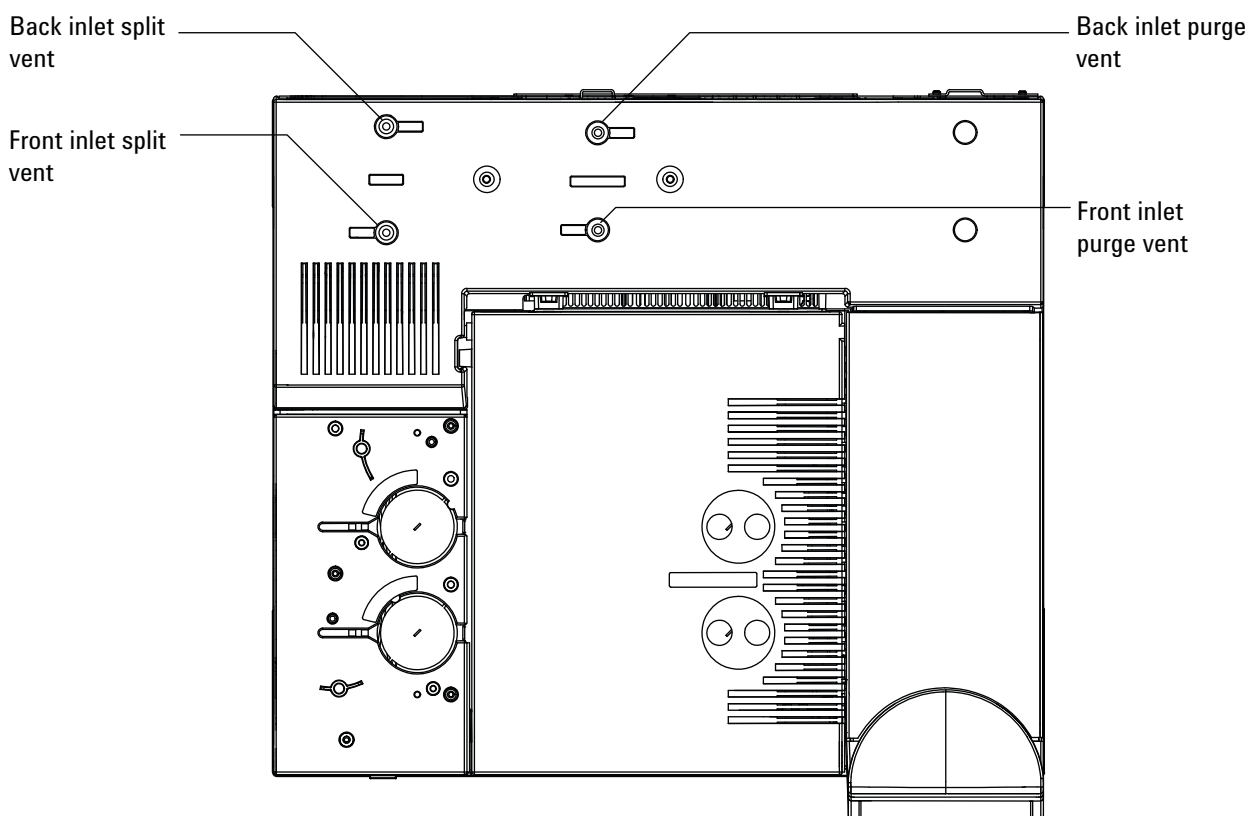
If a leak is known to exist, check the externally accessible inlet fittings first, especially any connection that has seen recent maintenance, such as the septum nut, column adapter, column connection, and so forth.

The pressure decay leak test described below requires removing the column and capping the inlet column fitting. This test can/cannot find the following types of leaks:

| The test can find leaks at the:                                          | The test cannot find leaks at the:                               |
|--------------------------------------------------------------------------|------------------------------------------------------------------|
| septum                                                                   | column fitting                                                   |
| septum nut                                                               | gas supply bulkhead fittings to the flow module                  |
| liner O-ring seal                                                        | tubing and connections in a transfer line connected to the inlet |
| inlet body                                                               |                                                                  |
| flow manifold split vent valve                                           |                                                                  |
| flow manifold septum purge valve                                         |                                                                  |
| split vent tubing and trap                                               |                                                                  |
| septum purge tubing                                                      |                                                                  |
| seals within the tubing between the inlet flow module and the inlet body |                                                                  |

- 1 Gather the following (see [Consumables and parts for the Multimode inlet](#)):
  - No-hole ferrule
  - 1/4-inch wrench
  - Heat-resistant gloves (if the inlet is hot)
  - Column nut
  - New septum
  - O-ring
  - ECD/TCD Detector plug (part no. 5060-9055)
- 2 Load the [inlet maintenance method](#) and wait for the GC to become ready.
- 3 Remove the column, if installed.
- 4 Plug the column fitting with a column nut and a no-hole ferrule.
- 5 Remove the old septum and replace it with a new one. See [To change the septum on the multimode inlet](#).
- 6 Inspect the O-ring and replace it if it is hard and brittle or cracked. See [To change the liner and O-ring on the Multimode inlet](#).
- 7 Set the inlet to **Split Mode**.
- 8 Configure the column as **Inlet: Unspecified**.
- 9 Set the inlet temperature to 70 °C.

- 10 Set the **Total flow** to 60 mL/min.
- 11 Enter a pressure setpoint of 25 psi (172 kPa). Make sure that the pressure supplied to the GC is at least 10 psi (70 kPa) higher than the inlet pressure.
- 12 If pressure cannot be achieved, there is either a large leak or the supply pressure is too low.
- 13 Set the **Septum purge** flow to 3.0 mL/min.
- 14 Allow the inlet temperature to stabilize. Temperature changes can invalidate the test.
- 15 Cap the septum purge fitting with the ECD/TCD detector plug.



- 16 From the keypad, press [**Service Mode**]. Select **Diagnostics** > **Front or Back Inlet** > **Pneumatics Control** > **Septum Purge control**.
- 17 Scroll to the **Constant duty cycle** and enter **50**. Wait 10 seconds.
- 18 Press [**Front or Back Inlet**]. Scroll to **Pressure** and press **Off/No**.
- 19 Quickly turn off the carrier gas supply at its source.
- 20 Monitor the pressure for 10 minutes. Use the timer by pressing [**Time**] and [**Enter**].

A pressure drop of less than 0.5 psig (0.05 psi/min or less; 3.4 kPa or 0.34 kPa/min) is acceptable.

If the pressure drops much faster than the acceptable rate, see [“To Correct Leaks in the Multimode Inlet”](#). Retest.

Note that liner size impacts pressure drop. An inlet with a smaller volume liner does not tolerate as large a leak rate as an inlet with a larger volume liner.

- 21 After the inlet passes the test, restore the GC to operating condition.
  - Remove any caps/plugs.
  - Reinstall the column.
  - Restore the correct column configuration.
  - Load the operating method.

## **To Correct Leaks in the Multimode Inlet**

If the inlet fails a pressure decay test, check the following:

- Check the caps/plugs used in the test—make sure each is correctly installed and tight.
- If you performed the leak test after performing maintenance, check for proper installation of the part(s) handled during the maintenance.
- Check the tightness of the septum nut. See [To change the septum on the Multimode inlet](#).
- Check the septum. Replace if old or damaged.
- Check the insert assembly installation.
- Check the liner and liner O-ring. See [To change the liner and O-ring on the Multimode inlet](#).
- Make sure the inlet temperature remained constant during the test.

If these items do not resolve the problem, contact Agilent for service.

## To Perform a PP Pressure Decay Leak Test

Use the Agilent Instrument Utilities Purged/Packed Inlet Pressure Decay Test to determine if the inlet is leaking. Open the software, select the GC, and run the test for the inlet.

If the Instrument Utilities software is not available, see the procedure below.

If the test fails:

- Tighten the septum nut/Merlin cap.
- [Replace](#) the septum or Merlin Microseal.
- Tighten the top insert weldment. [Replace](#) the liner.
- [Replace](#) the O-ring and tighten the column adapter connection. [Re-install](#) if needed.
- Check the plugged column fitting and the septum purge cap.

## To Perform a PP Inlet Pressure Decay Test

The pressure decay test checks for leaks from the inlet flow module up to the column fitting.

After performing maintenance, first check for leaks in externally accessible areas. See [“To Check for External Leaks”](#).

If a leak is known to exist, check the externally accessible inlet fittings first, especially any connection that has seen recent maintenance, such as the septum nut, column adapter, column connection, and so forth.

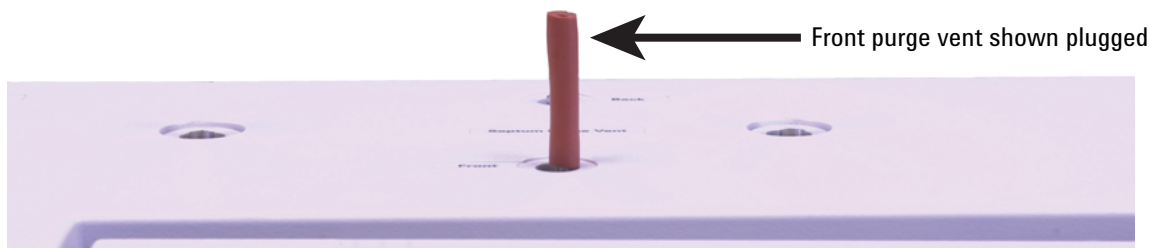
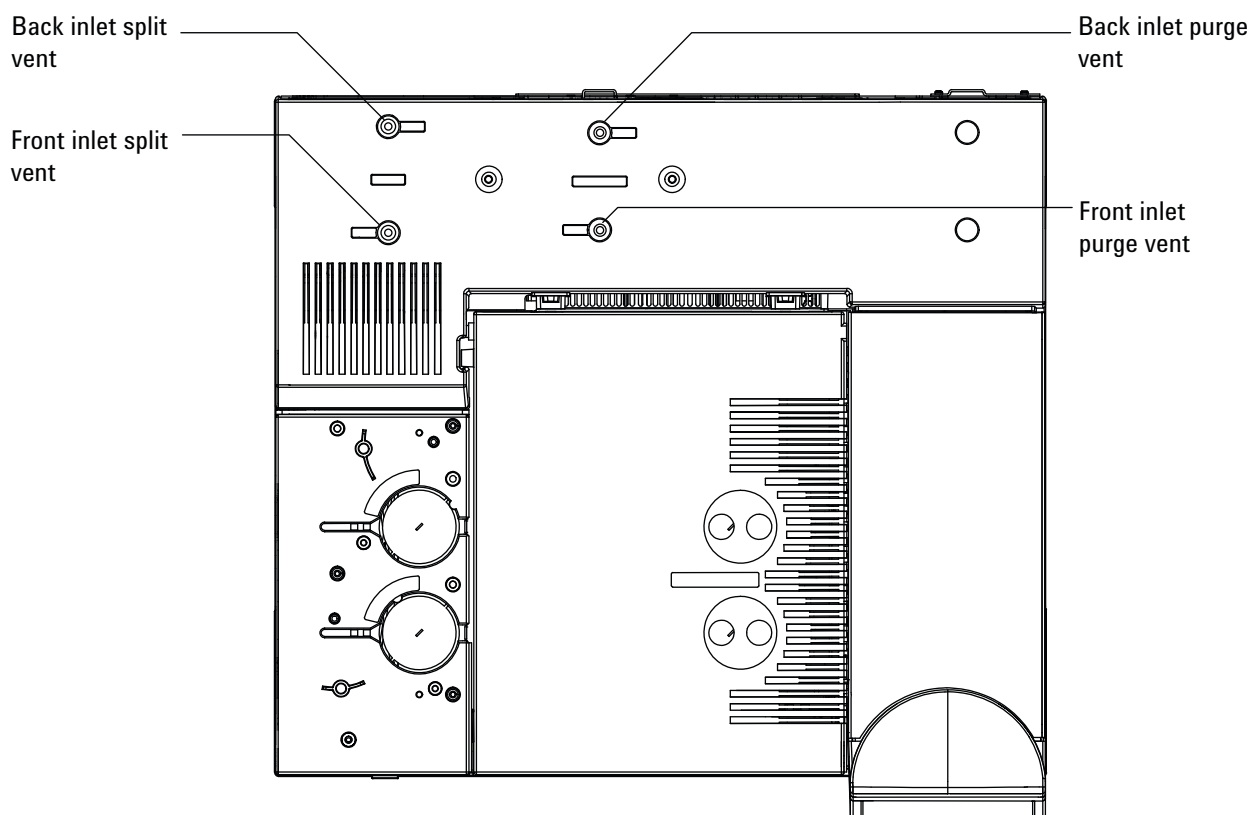
The pressure decay leak test described below requires removing the column and capping the inlet column fitting. This test can/cannot find the following types of leaks:

| The test can find leaks at the: | The test cannot find leaks at the:              |
|---------------------------------|-------------------------------------------------|
| septum                          | column fitting                                  |
| septum nut                      | gas supply bulkhead fittings to the flow module |
| glass insert O-ring seal        |                                                 |
| adapter and ferrule             |                                                 |
| inlet body                      |                                                 |

| The test can find leaks at the:                                          | The test cannot find leaks at the: |
|--------------------------------------------------------------------------|------------------------------------|
| top insert weldment                                                      |                                    |
| seals within the tubing between the inlet flow module and the inlet body |                                    |

- 1 Gather the following (see [Consumables and parts for the purged packed inlet](#)):
  - No-hole ferrule
  - 1/4-inch wrench
  - 7/16-inch wrench
  - Heat-resistant gloves (if the inlet is hot)
  - 9/16-inch wrench
  - 1/8- and 1/4-inch Swagelok caps
  - ECD/TCD Detector plug (part no. 5060-9055)
- 2 Load the [inlet maintenance method](#) and wait for the GC to become ready.
- 3 Set the total flow to 40 mL/min and purge the inlet for about 1 minute.
- 4 Remove the column, if installed.
- 5 Plug the column fitting.
  - If the capillary column adapter is installed, use a column nut and a no-hole ferrule
  - If a 1/8-inch packed column adapter is installed, use a 1/8-inch Swagelok cap (5180-4121).
  - If a 1/4-inch packed column adapter is installed, use a 1/4-inch Swagelok cap (5180-4120)
- 6 Remove the old septum and replace it with a new one. See [To change the septum on the purged packed inlet](#).
- 7 Inspect the O-ring and replace it if it is hard and brittle or cracked. See [To change the O-ring on the purged packed inlet](#).
- 8 If unsure of the quality of the adapter ferrule, replace it. See [To change the glass insert on a PP inlet](#).
- 9 Configure, but do not install, a capillary column to put the inlet in pressure control mode.
- 10 Set the inlet temperature to 100 °C.

- 11 Enter a pressure setpoint of 25 psi (172 kPa). Make sure that the pressure supplied to the GC is at least 10 psi (70 kPa) higher than the inlet pressure.
- 12 If pressure cannot be achieved, there is either a large leak or the supply pressure is too low.
- 13 Set the **Septum purge** flow to 3.0 mL/min.
- 14 Allow the inlet temperature to stabilize. Temperature changes can invalidate the test.
- 15 Cap the septum purge fitting with the ECD/TCD detector plug.



- 16 From the keypad, press [**Service Mode**]. Select **Diagnostics > Front or Back Inlet > Pneumatics Control > Septum Purge control**.
- 17 Scroll to the **Constant duty cycle** and enter **50**. Wait 10 seconds.
- 18 Press [**Front or Back Inlet**]. Scroll to **Pressure** and press **Off/No**.
- 19 Quickly turn off the carrier gas supply at its source.
- 20 Monitor the pressure for 10 minutes. Use the timer by pressing [**Time**] and [**Enter**].

A pressure drop of less than 0.7 psig (0.07 psi/min or less; 4.8 kPa or 0.48 kPa/min) is acceptable.

If the pressure drops much faster than the acceptable rate, see [“To Correct Leaks in the Packed Column Inlet”](#). Retest.

- 21 After the inlet passes the test, restore the GC to operating condition.
- 22 Remove any caps/plugs.
  - Reinstall the column.
  - Restore the correct column configuration.
  - Load the operating method.

## To Correct Leaks in the Packed Column Inlet

If the inlet fails a pressure decay test, check the following:

- Check the caps/plugs used in the test—make sure each is correctly installed and tight.
- If you performed the leak test after performing maintenance, check for proper installation of the part(s) handled during the maintenance.
- Check the tightness of the septum nut. See [To change the septum on the purged packed inlet](#).
- Check the septum. Replace if old or damaged.
- Check that the top insert weldment is installed tightly.
- Replace the O-ring. See [To change the O-ring on the purged packed inlet](#). Also check the glass insert. See [To change the glass insert on a PP inlet](#).
- Replace the ferrule seal on the adapter.
- Make sure the inlet temperature remained constant during the test.

If these items do not resolve the problem, contact Agilent for service.

## To Perform a COC Pressure Decay Leak Test

Use the Agilent Instrument Utilities Cool On-Column Inlet Pressure Decay Test to determine if the inlet is leaking. Open the software, select the GC, and run the test for the inlet.

If the Instrument Utilities software is not available, see the procedure below.

If the test fails:

- Check the plugged column fitting and the septum purge cap.
- Tighten the septum nut.
- [Replace](#) the septum if necessary.

## To Perform a COC Pressure Decay Test

The pressure decay test checks for leaks from the inlet flow module up to the column fitting.

After performing maintenance, first check for leaks in externally accessible areas. See [“To Check for External Leaks”](#).

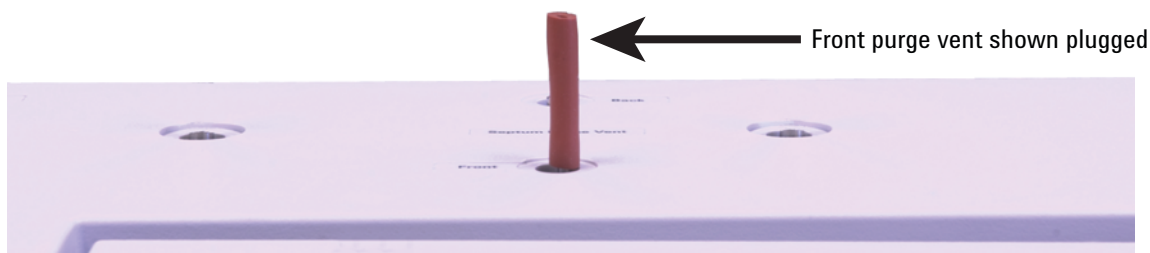
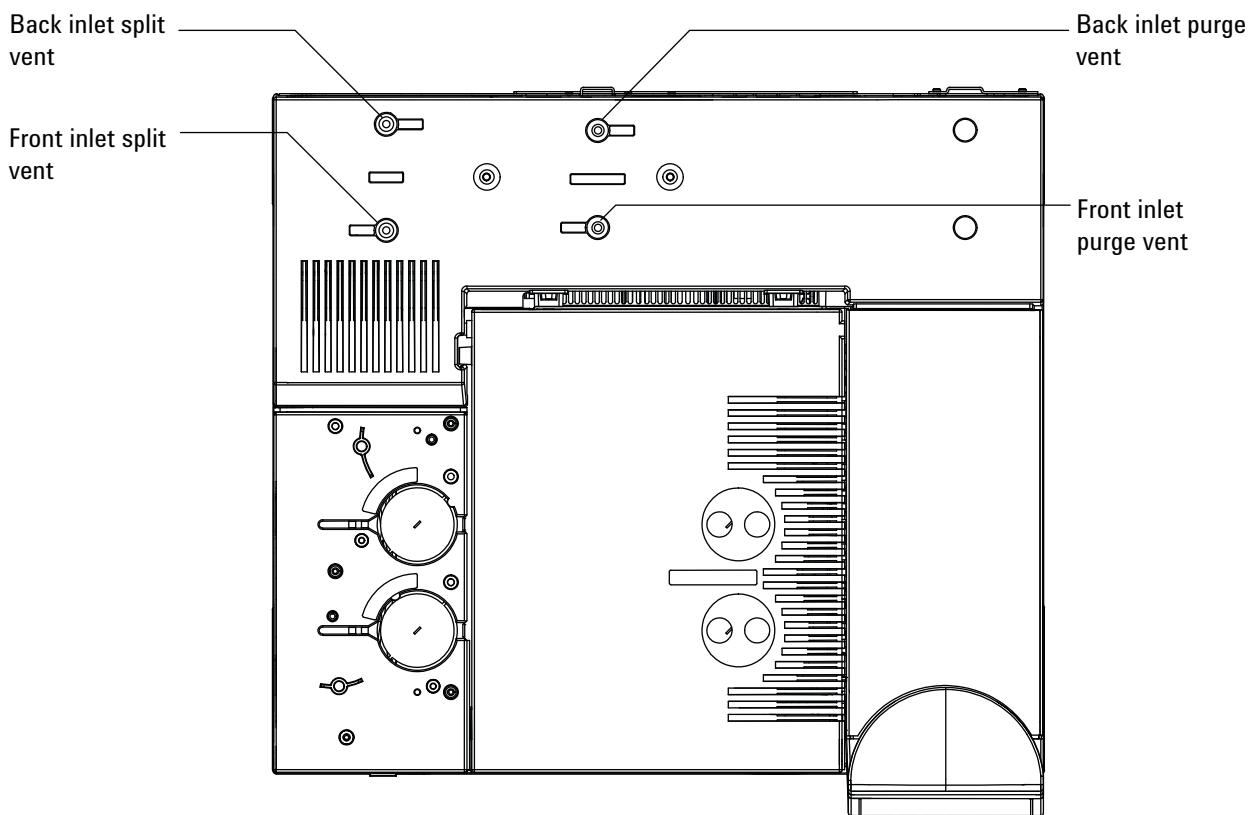
If a leak is known to exist, check the externally accessible inlet fittings first, especially any connection that has seen recent maintenance, such as the septum nut, column adapter, column connection, and so forth. See [“To Check for External Leaks”](#).

The pressure decay leak test described below requires removing the column and capping the inlet column fitting. This test can/cannot find the following types of leaks:

| The test can find leaks at the:                                          | The test cannot find leaks at the:              |
|--------------------------------------------------------------------------|-------------------------------------------------|
| septum                                                                   | column fitting                                  |
| septum nut or cooling tower                                              | gas supply bulkhead fittings to the flow module |
| seals within the tubing between the inlet flow module and the inlet body |                                                 |
| inlet body                                                               |                                                 |

- 1 Gather the following (see [Consumables and parts for the COC inlet](#)):
  - No-hole ferrule
  - 1/4-inch wrench
  - Heat-resistant gloves (if the inlet is hot)
  - Column nut
  - New septum
  - ECD/TCD Detector plug (part no. 5060-9055)
- 2 Load the [inlet maintenance method](#) and wait for the GC to become ready.
- 3 Remove the column, if installed.
- 4 Plug the column fitting with a column nut and no-hole ferrule.
- 5 Remove the old septum and replace it with a new one. See [To change a septum on the COC inlet](#).
- 6 Enter a pressure setpoint of 25 psi (172 kPa). Make sure that the pressure supplied to the GC is at least 10 psi (70 kPa) higher than the inlet pressure.
- 7 Wait 5 minutes for the pressure to equilibrate. If pressure cannot be achieved, there is either a large leak or the supply pressure is too low.
- 8 Set the **Septum purge** flow to 3.0 mL/min.
- 9 Allow the inlet temperature to stabilize. Temperature changes can invalidate the test.
- 10 Cap the septum purge fitting with the ECD/TCD detector plug.

## 7 Checking for Leaks



- 11 From the keypad, press [**Service Mode**]. Select **Diagnostics > Front or Back Inlet > Pneumatics Control > Septum Purge control**.
- 12 Scroll to the **Constant duty cycle** and enter **50**. Wait 10 seconds.
- 13 Press [**Front or Back Inlet**]. Scroll to **Pressure** and press **Off/No**.
- 14 Quickly turn off the carrier gas supply at its source.
- 15 Monitor the pressure for 10 minutes. Use the timer by pressing [**Time**] and [**Enter**].

A pressure drop of less than 1.0 psig (0.1 psi/min or less; 6.9 kPa or 0.69 kPa/min) is acceptable.

If the pressure drops much faster than the acceptable rate, see [“To Correct Leaks in the Cool On-Column Inlet”](#). Retest.

- 16** After the inlet passes the test, restore the GC to operating condition.
- Remove any caps/plugs.
  - Reinstall the column.
  - Restore the correct column configuration.
  - Load the operating method.

## **To Correct Leaks in the Cool On-Column Inlet**

If the inlet fails a pressure decay test, check the following:

- Check the caps/plugs used in the test—make sure each is correctly installed and tight.
- If you performed the leak test after performing maintenance, check for proper installation of the part(s) handled during the maintenance.
- Check the tightness of the septum nut or cooling tower assembly. See [To change a septum nut or cooling tower and septum on a COC inlet](#).
- Check the septum. Replace if old or damaged.
- Make sure the inlet temperature remained constant during the test.

If these items do not resolve the problem, contact Agilent for service.

## To Perform a PTV Pressure Decay Test

See the procedure below.

If the test fails:

- Check the plugged column fitting and septum purge cap.
- Check the septum head. Tighten if needed.
- [Replace](#) the septum if necessary.
- If using a septumless head, tighten. [Rebuild](#) as needed.
- Inspect and [re-install](#) the liner if it is leaking.
- [Replace](#) the inlet adapter if it is leaking.
- Tighten the split vent trap if needed, or [install](#) a new cartridge and O-rings.
- Tighten the split vent line connection to the inlet.

## To Perform a PTV Pressure Decay Test

The pressure decay test checks for leaks from the inlet flow module up to the column fitting.

After performing maintenance, first check for leaks in externally accessible areas. See [“To Check for External Leaks”](#).

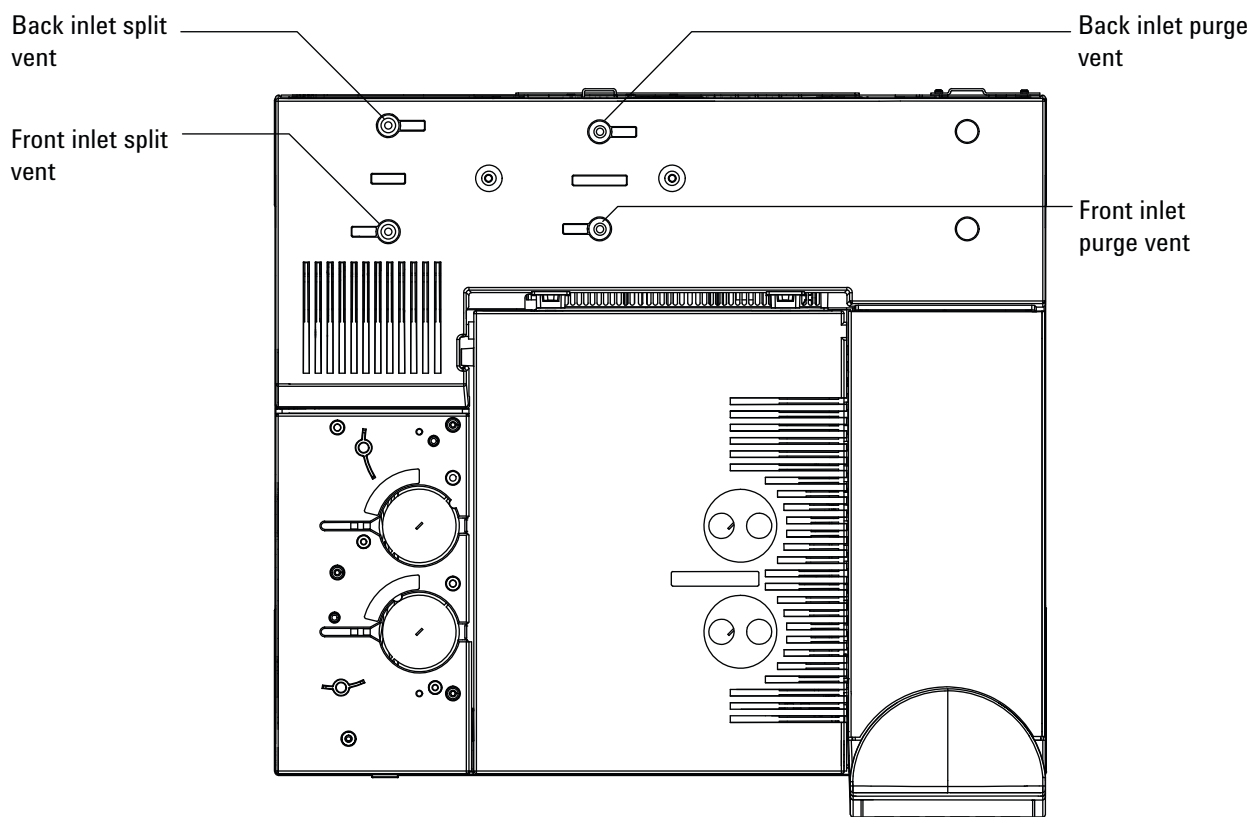
If a leak is known to exist, check the externally accessible inlet fittings first, especially any connection that has seen recent maintenance, such as the septum nut, column adapter, column connection, and so forth.

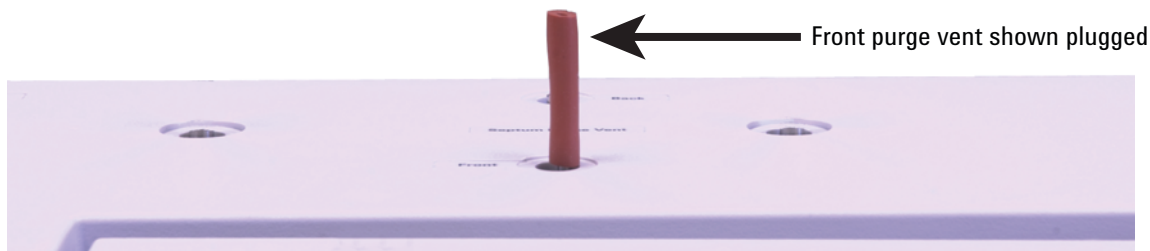
The pressure decay leak test described below requires removing the column and capping the inlet column fitting. This test can/cannot find the following types of leaks:

| The test can find leaks at the:                                          | The test cannot find leaks at the:                               |
|--------------------------------------------------------------------------|------------------------------------------------------------------|
| septum                                                                   | column fitting                                                   |
| septum nut                                                               | gas supply bulkhead fittings to the flow module                  |
| liner O-ring seal                                                        | tubing and connections in a transfer line connected to the inlet |
| gold seal/washer and reducing nut                                        |                                                                  |
| inlet body                                                               |                                                                  |
| flow manifold split vent valve                                           |                                                                  |
| flow manifold septum purge valve                                         |                                                                  |
| split vent tubing and trap                                               |                                                                  |
| septum purge tubing                                                      |                                                                  |
| seals within the tubing between the inlet flow module and the inlet body |                                                                  |

- 1 Gather the following (see [Consumables and parts for the PTV inlet](#)):
  - No-hole ferrule
  - 1/4-inch wrench
  - Heat-resistant gloves (if the inlet is hot)
  - Column nut
  - New septum
  - New Graphpak 3D ferrule and liner
  - ECD/TCD Detector plug (part no. 5060-9055)
- 2 Load the [inlet maintenance method](#) and wait for the GC to become ready.
- 3 Remove the column, if installed.
- 4 Plug the column fitting with a column nut and a no-hole ferrule.
- 5 If using the septum head, and the quality of the septum (or Microseal) and GRAPHACK-3D ferrule on the glass liner are unknown, replace them now. See [To change the septum on the PTV inlet](#) and [To change the liner on the PTV inlet](#).
- 6 Set the inlet to **Split Mode**.
- 7 Configure the column as 0 length.

- 8 Set the inlet temperature to 100 °C.
- 9 Set the **Total flow** to 60 mL/min.
- 10 Enter a pressure setpoint of 25 psi (172 kPa). Make sure that the pressure supplied to the GC is at least 10 psi (70 kPa) higher than the inlet pressure.
- 11 If pressure cannot be achieved, there is either a large leak or the supply pressure is too low.
- 12 Set the **Septum purge** flow to 3.0 mL/min.
- 13 Allow the inlet temperature to stabilize. Temperature changes can invalidate the test.
- 14 Cap the septum purge fitting with the ECD/TCD detector plug.





15 From the keypad, press [**Service Mode**]. Select **Diagnostics** > **Front or Back Inlet** > **Pneumatics Control** > **Septum Purge control**.

16 Scroll to the **Constant duty cycle** and enter **50**. Wait 10 seconds.

17 Press [**Front or Back Inlet**]. Scroll to **Pressure** and press **Off/No**.

18 Quickly turn off the carrier gas supply at its source.

19 Monitor the pressure for 10 minutes. Use the timer by pressing [**Time**] and [**Enter**].

A pressure drop of less than 0.5 psig (0.05 psi/min or less; 3.4 kPa or 0.34 kPa/min) is acceptable.

If the pressure drops much faster than the acceptable rate, see [“To Correct Leaks in the PTV Inlet”](#). Retest.

Note that liner size impacts pressure drop. An inlet with a smaller volume liner does not tolerate as large a leak rate as an inlet with a larger volume liner.

20 After the inlet passes the test, restore the GC to operating condition.

- Remove any caps/plugs.
- Reinstall the column.
- Restore the correct column configuration.
- Load the operating method.

## To Correct Leaks in the PTV Inlet

If the inlet fails a pressure decay test, check the following:

- Check the caps/plugs used in the test—make sure each is correctly installed and tight.
- If you performed the leak test after performing maintenance, check for proper installation of the part(s) handled during the maintenance.
- If using a septum head, check the tightness of the septum nut. See [To change the septum on the PTV inlet](#).
- If using a septum head, check the septum. Replace if old or damaged.
- Check that the septumless- or septum- head assembly is installed tightly.
- Replace the liner and Graphpak 3D ferrule. See [To change the liner on the PTV inlet](#).
- Check the Graphpak adapter seal against the inlet body. Replace the silver seal and reinstall the adapter if needed. See [To replace the inlet adapter for the PTV inlet](#).
- If using the septumless head, check for leaks around the guide cap. Replace the PTFE ferrule in the guide cap. See [To replace the PTFE ferrule on a PTV inlet](#).
- Check for leaks at the split vent trap. Tighten as necessary. Replace the split vent trap filter and O-rings. See [To replace the filter in the PTV inlet split vent line](#).
- Make sure the inlet temperature remained constant during the test.

If these items not resolve the problem, contact Agilent for service.

## To Perform a VI Pressure Decay Test

See the procedure below.

If the test fails:

- Check the plugged column fitting and septum purge cap.
- Tighten the pneumatic connections to the volatiles interface. Install new seals as needed.
- Tighten the split vent trap if needed, or [install](#) a new cartridge and O-rings.

## To Perform a VI Pressure Decay Test

The pressure decay test checks for leaks from the inlet flow module up to the column fitting.

Initially test the VI with a sampling system installed. If the system fails the leak test, then isolate the VI from the sampler as described in [“To Prepare the VI for a Closed System Leak Check”](#) on page 168.

After performing maintenance, first check for leaks in externally accessible areas. See [“To Check for External Leaks”](#).

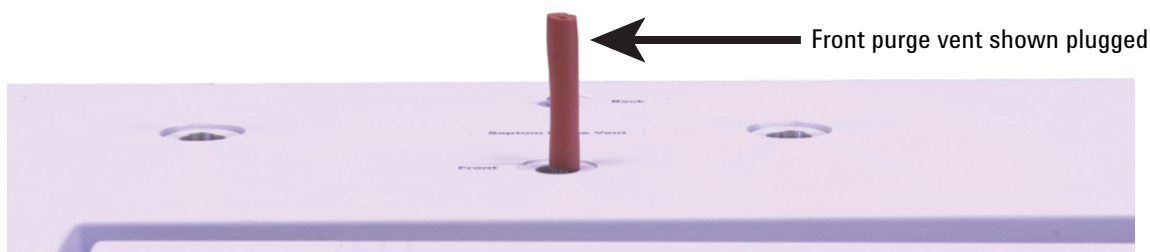
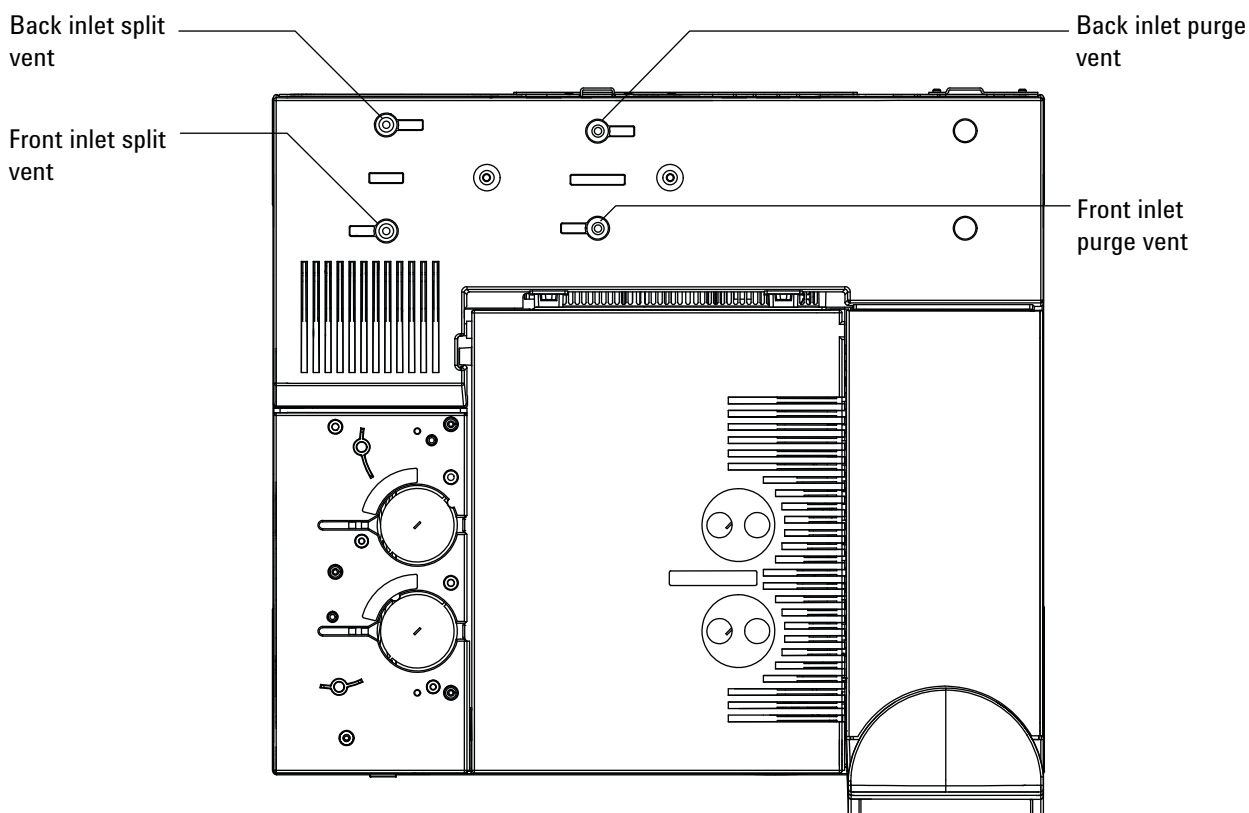
If a leak is known to exist, check the externally accessible inlet fittings first, especially any connection that has seen recent maintenance, such as the column connection, split vent line, and so forth.

The pressure decay leak test described below requires removing the column and capping the inlet column fitting. This test can/cannot find the following types of leaks:

| The test can find leaks at the:                   | The test cannot find leaks at the:                               |
|---------------------------------------------------|------------------------------------------------------------------|
| sampler connection                                | column fitting                                                   |
| pressure sensing line connection to the interface | gas supply bulkhead fittings to the flow module                  |
| split vent line connection to the interface       | tubing and connections in a transfer line connected to the inlet |
| the connected sampler's entire sample flow path   |                                                                  |
| flow manifold split vent valve                    |                                                                  |
| flow manifold septum purge valve                  |                                                                  |
| split vent tubing and trap                        |                                                                  |

- 1 Gather the following (see [Consumables and parts for the VI](#)):
  - No-hole ferrule
  - 1/4-inch wrench
  - Heat-resistant gloves (if the inlet is hot)
  - Long column nut
  - ECD/TCD Detector plug (part no. 5060-9055)
- 2 Load the [inlet maintenance method](#) and wait for the GC to become ready.
- 3 Remove the column, if installed.
- 4 Plug the column fitting with a column nut and a no-hole ferrule.
- 5 Set the inlet to **Split Mode**.
- 6 Configure the column as 0 length.
- 7 Set the inlet temperature to 100 °C.
- 8 Set the **Total flow** to 60 mL/min.
- 9 Enter a pressure setpoint of 25 psi (172 kPa). Make sure that the pressure supplied to the GC is at least 10 psi (70 kPa) higher than the inlet pressure.
- 10 If pressure cannot be achieved, there is either a large leak or the supply pressure is too low.
- 11 Set the **Septum purge** flow to 3.0 mL/min.
- 12 Allow the inlet temperature to stabilize. Temperature changes can invalidate the test.

- 13 Cap the septum purge fitting with the ECD/TCD detector plug.



- 14 From the keypad, press [**Service Mode**]. Select **Diagnostics** > **Front or Back Inlet** > **Pneumatics Control** > **Septum Purge control**.
- 15 Scroll to the **Constant duty cycle** and enter **50**. Wait 10 seconds.
- 16 Press [**Front or Back Inlet**]. Scroll to **Pressure** and press **Off/No**.
- 17 Quickly turn off the carrier gas supply at its source.
- 18 Monitor the pressure for 10–15 minutes. Use the timer by pressing [**Time**] and [**Enter**].

The pressure should drop approximately 1 psi (6.9 kPa) during the first 1 to 2 minutes. After an initial pressure drop of about 1 psi, the pressure should not drop more than 0.03 psi/min (0.21 kPa/min).

If the pressure drop is 0.03 psi/min or less, you can consider the interface-gas sampler system leak-free.

If the pressure drops faster than the acceptable rate, you must check the interface and sampler systems separately to determine the source of the leak. See [“To Prepare the VI for a Closed System Leak Check”](#) to create a closed flow system, then return to this section and complete steps 10 to 16.

If you find a leak in the interface, refer to [“To Correct Leaks in the Volatiles Interface”](#).

If the interface is leak-free, pressure check the sampling device. See the operating manual for your sampler for instructions.

- 19 After the VI passes the test, restore the GC to operating condition.
  - Remove any caps/plugs.
  - If needed, reconnect the sampling device.
  - Reinstall the column.
  - Restore the correct column configuration.
  - Load the operating method.

## To Prepare the VI for a Closed System Leak Check

To leak check the interface independently of the gas sampling device, you must disconnect the sampler from the interface to isolate the interface flow system from the sampler.

**WARNING**

**Be careful! The oven and/or inlet may be hot enough to cause burns. If either is hot, wear heat-resistant gloves to protect your hands.**

---

- 1 Gather the following:
  - 1/16-inch nut for transfer line
  - Ferrule for transfer line
  - Heat-resistant gloves (if the inlet is hot)
- 2 Disconnect the transfer line from the interface.
- 3 Disconnect the carrier line from the sampler.
- 4 Prepare the end of the carrier line using a 1/16-inch male nut and ferrule.
- 5 Connect the carrier line to the interface where you removed the transfer line and tighten the nut finger tight. Tighten an additional 1/4 to 1/2 turn with the 1/4-inch wrench.
- 6 Return to [“To Perform a VI Pressure Decay Test”](#) and repeat steps 9 to 16.

## To Correct Leaks in the Volatiles Interface

If the inlet fails a pressure decay test, check the following:

- The caps and plugs used in the test—make sure each is correctly installed and tight.
- If you performed the leak test after performing maintenance, check for proper installation of the part(s) handled during the maintenance.
- The split vent and pressure sensing connections at the interface.
- The sampler connection to the interface.
- The sampler.

If these items do not resolve the problem, contact Agilent for service.

## **7    Checking for Leaks**



## 8 Troubleshooting Tasks

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- To Measure a Split Vent or Septum Purge Flow [176](#)
- To Measure a Detector Flow [178](#)
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- To Adjust the FPD Lit Offset [201](#)
- When to Change Gas Purifiers [202](#)
- To Check a Split Vent Line for Contamination [203](#)
- To Ignore a Device's Readiness State [205](#)
- To Use the Stopwatch [206](#)



## To Measure a Column Flow

### Measuring FID, TCD, uECD, and FPD column flow

The following procedure can be used to measure column flow with an FID, TCD, uECD, and FPD.

**WARNING**

Hydrogen (H<sub>2</sub>) is flammable and is an explosion hazard when mixed with air in an enclosed space (for example, a flow meter). Purge flowmeters with inert gas as needed. Always measure gases individually. Always turn off detectors to prevent flame/bead autoignition.

---

**WARNING**

Be careful! The detector may be hot enough to cause burns. If the detector is hot, wear heat-resistant gloves to protect your hands.

---

- 1 Gather the following:
  - Appropriate flowmeter adapter tube (can be found in the GC ship kit)
  - Electronic flowmeter calibrated for the gas and flow rates of concern
- 2 Turn off the detector.
- 3 Turn off the detector flows.
- 4 Connect the appropriate adapter to the detector exhaust.

**NOTE**

Flowmeter tube diameters vary by model; modify the adapter to the flowmeter tubing as needed.

---

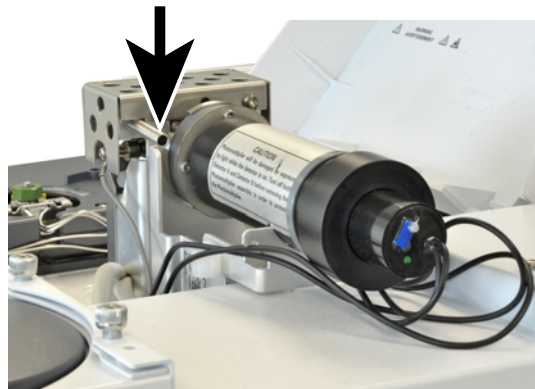
A 1/8-in rubber adapter tube attaches directly to a uECD or TCD exhaust vent.



A separate adapter (19301-60660) is supplied for the FID. Insert the adapter into the detector exhaust vent as far as possible. You will feel resistance as the adapter O-ring is forced into the detector exhaust vent. Twist and push the adapter during insertion to ensure a good seal.



For the FPD, remove the plastic tubing from the FPD exhaust and connect the flowmeter directly to the FPD vent tube. If necessary, use a 1/4-inch tube adapter between the detector exhaust and the flowmeter tubing.



- 5 Connect the flowmeter to the flowmeter adapter to measure flow rates.

## Measuring NPD column flow

- 1 Gather the following:
  - NPD flowmeter adapter tool (G1534-60640)



- Flow-measuring insert (19301-60660)
  - Electronic flowmeter calibrated for the gas and flow rates of concern
- 2 Set the bead voltage to 0.0 V.
  - 3 Cool the NPD to 100 °C.

### **WARNING**

**Be careful! The detector may be hot enough to cause burns. If the detector is hot, wear heat-resistant gloves to protect your hands.**

- 4 Remove the bead and store it carefully until reinstallation.
- 5 Insert the NPD flowmeter adapter tool into the NPD collector.
- 6 Attach the flow-measuring insert to the NPD flowmeter adapter tool.



- 7 Place the flowmeter tubing over the flow-measuring insert to begin measuring flows.

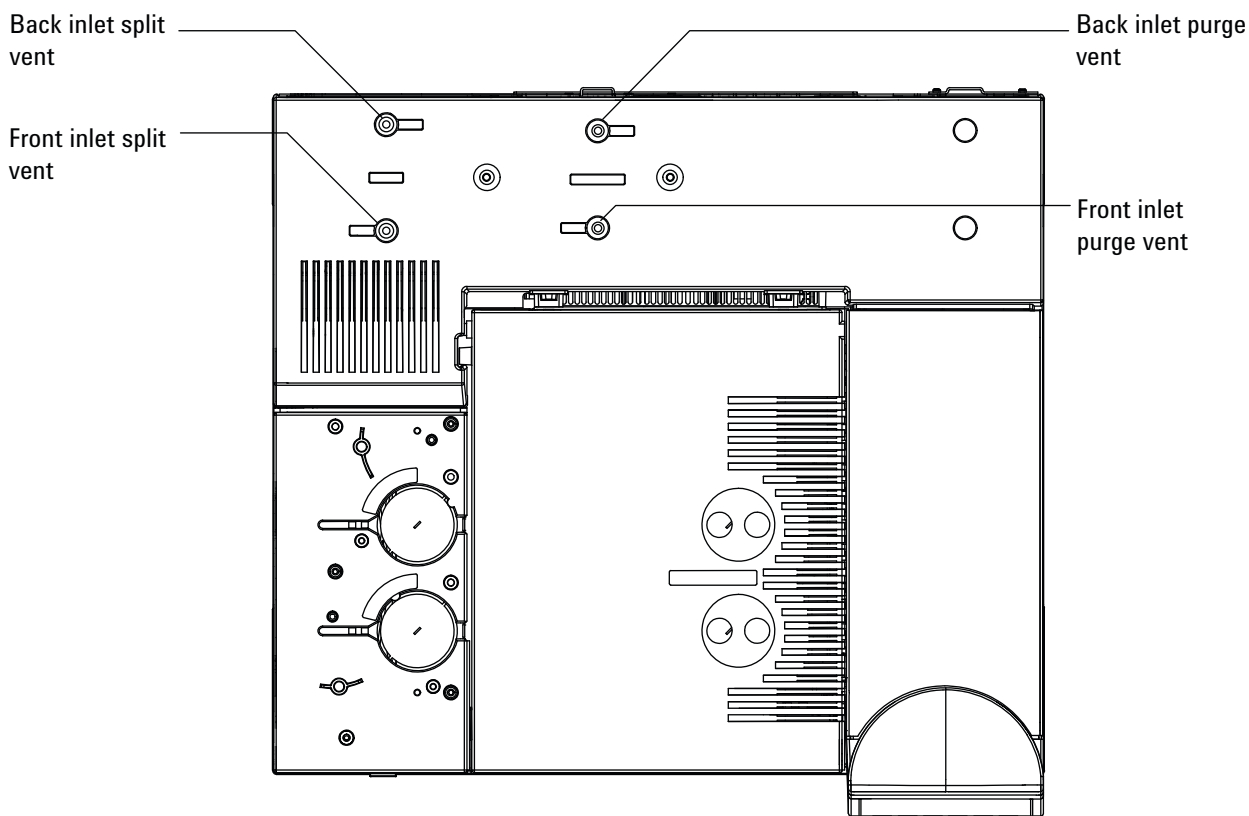
## To Measure a Split Vent or Septum Purge Flow

Note that the GC reports flows calibrated to 25 °C and 1 atmosphere. Correct flowmeter results accordingly.

**WARNING**

**Hydrogen (H<sub>2</sub>) is flammable and is an explosion hazard when mixed with air in an enclosed space (for example, a flow meter). Purge flowmeters with inert gas as needed. Always measure gases individually. Always turn off detectors to prevent flame/bead autoignition.**

Septum purge and split vent flows exit through the pneumatic module at the top rear of the GC. See the figure below.



To measure split vent or septum purge flows, attach the flowmeter to the appropriate tube. Remove the GC pneumatics cover to access the back inlet exhausts.

- The split vent has a 1/8-in Swagelok threaded fitting. Create and use a 1/8-in tube adapter (as shown below) to convert the 1/8-in threaded fitting into a 1/8-in tube. This prevents the rubber flowmeter tubing from leaking around the threads, which will result in leakage and thus an incorrect flow reading.



- The septum purge is a 1/8-in tube. Use the red rubber adapter shown to measure flows.

## To Measure a Detector Flow

Detectors, especially detectors with flame, require precise flow measurements to function properly. Incorrect flows are caused by:

- Restrictions in the supply line, which will cause a **Not Ready** message on the GC display (all detectors)
- A leaking column or column adapter fitting (all detectors)
- A plugged jet (FID, NPD).
- A leak in the burner chamber, window seal, or ignitor seal (FPD)
- A pressure sensor that needs to be zeroed. (See [To Zero the EPC Module Pressure Sensor.](#))
- An EPC valve that is not operating correctly.

To isolate the problem, compare the flow of **one channel of gas** against the actual flow rate.

### Measuring FID, TCD, uECD, and FPD flows

#### WARNING

Hydrogen (H<sub>2</sub>) is flammable and is an explosion hazard when mixed with air in an enclosed space (for example, a flow meter). Purge flowmeters with inert gas as needed. Always measure gases individually. Always turn off detectors to prevent flame/bead autoignition.

#### 1 Gather the following:

- Appropriate flowmeter adapter tube (can be found in the GC ship kit)
- Electronic flowmeter calibrated for the gas and flow rates of concern

#### CAUTION

To avoid damaging the column, cool the oven before turning off the column flow.

- 2 Set the oven temperature to ambient (35 °C).
- 3 Turn off the column flow and pressure.
- 4 Shut off all detector gases.

- 5 Turn off (where applicable): the FID flame, FPD flame, and TCD filament.
- 6 Cool the detector.
- 7 Connect the appropriate adapter to the detector exhaust.

**NOTE**

Flowmeter tube diameters vary by model; modify the adapter to the flowmeter tubing as needed.

---

A rubber adapter tube attaches directly to a uECD, or TCD exhaust vent.



A separate adapter (19301-60660) is supplied for the FID. Insert the adapter into the detector exhaust vent as far as possible. You will feel resistance as the adapter O-ring is forced into the detector exhaust vent. Twist and push the adapter during insertion to ensure a good seal.



## 8 Troubleshooting Tasks

For the FPD, remove the plastic tubing from the FPD exhaust and connect the flowmeter directly to the FPD vent tube. If necessary, use a 1/4-inch tube adapter between the detector exhaust and the flowmeter tubing.



- 8 Connect the flowmeter to the flowmeter adapter.
- 9 Measure the actual flow rate of each gas one at a time.

### Measuring NPD flows

- 1 Gather the following:
  - NPD flowmeter adapter tool (G1534-60640)



- Flow-measuring insert (19301-60660)
  - Electronic flowmeter calibrated for the gas and flow rates of concern
- 2 Set the bead voltage to 0.0 V.
  - 3 Cool the NPD to 100 °C.

**WARNING**

**Be careful! The detector may be hot enough to cause burns. If the detector is hot, wear heat-resistant gloves to protect your hands.**

- 4 [Remove the bead](#) and store it carefully until reinstallation.
- 5 Insert the NPD flowmeter adapter tool into the NPD collector.
- 6 Attach the flow-measuring insert to the NPD flowmeter adapter tool.



- 7 Place the flowmeter tubing over the flow-measuring insert to begin measuring flows.

## To Perform the GC Self-Test

- 1 Turn the GC off.
- 2 Wait 1 min, then turn the GC back on. If the main GC status screen appears, the GC has passed the self-test.

Agilent 7890B GC  
B.xx.xx [xxx]

Power on successful

## To Check or Monitor Split Vent Line Backpressure

Agilent provides a built-in test that measures backpressure in the split vent trap and line for the split/splitless, multimode, PTV, and VI inlets. The test measures the pressure developed in the split vent flow path at a given, user-selected flow rate. This flow rate can be your method **Split flow** setpoint, or the default 400 mL/min used by Agilent to compare “typical” values.

By running the test on a clean system, you can establish a baseline for expected backpressure in the split vent line. Then, you can re-run the test periodically to determine whether or not the trap needs to be replaced before it impacts your chromatography.

The pressure measured by the test depends on:

- The liner installed
- The flow rate used

Therefore, the actual measured value will vary between different setups and from GC to GC.

The test checks for:

- Liner restriction
- Contamination on the gold seal (split/splitless inlet only)
- Restrictions in the split vent line, such as condensed sample contamination in the split vent line and trap

The test can also provide a measure of suitability for the installed hardware. Run the test using your method's setpoints and hardware. If the measured test pressure is close to the desired column head pressure, this means that even a minor amount of restriction in the split vent line can cause the GC to become not ready. You may wish to install a different liner or adjust the method. (For splitless liners, first try reinstalling the liner. Splitless liners create more backpressure than split liners, and so minor variations in orientation can make a difference at low head pressures.)

## To set a warning limit for the inlet trap check

To use the inlet trap check to monitor the split vent trap:

- 1 If the existing split vent trap has been used for many sample injections, replace it. Make sure that the GC is clean:
  - Replace inlet hardware if needed.
  - Check that the split vent line is free from contamination or restrictions.
- 2 Run the inlet trap check. See [“To Run the Inlet Trap Check”](#).
- 3 Note the pressure. This reading is the backpressure you can expect from a clean system with the installed liner.
- 4 Determine a practical split vent backpressure limit.

Use the GC normally. Periodically rerun the inlet trap check. You will need to change the split vent trap when either:

- You see chromatographic issues related to a restriction in the split vent, typically poor split mode area repeatability, or
- The reported test pressure approaches or exceeds the method column head pressure setpoint.

Run the inlet trap check and note the pressure. Change the split vent trap.

- 5 Set a warning limit and behavior, if desired.

Now that you know when the trap needs to be changed, you can set one or two limits in the test. Use these limits to set the service due indicator, or to force the GC to go Not ready. The two limits are:

- **Warning if pressure check:** If the measured pressure exceeds the limit, turn on the service due indicator.
- **Fault if pressure check:** If the measured pressure exceeds the limit, make the GC Not Ready.

To set a warning limit:

- a Press **[Service Mode]**, scroll to **Front inlet trap check** or to **Back inlet trap check**, then press **[Enter]**.
- b Scroll to the desired limit.
- c Enter a limit using the keypad, then press **[Enter]**.

(To disable a warning, select it then press **[Off/No]**.)

The test is now set up.

- 6 Periodically rerun the test. When the test fails, replace the split vent trap.

To clear a Not Ready condition or to turn off the Service Due indicator:

- 1 Press [**Service Mode**], scroll to **Front inlet trap check** or to **Back inlet trap check**, then press [**Enter**].
- 2 Scroll to **Reset the test results?** and press [**On/Yes**].

### To disable a warning limit for the inlet trap check

- 1 Press [**Service Mode**], scroll to **Front inlet trap check** or **Back inlet trap check**, then press [**Enter**].
- 2 Scroll to the warning, then press [**Off/No**].

## To Run the Inlet Trap Check

From the GC keypad:

- 1 Press **[Service Mode]**, scroll to **Front inlet trap check** or **Back inlet trap check**, then press **[Enter]**. The display will be similar to [Figure 5](#):

```

      FRONT INLET TRAP CHECK
Inlet Pressure      5.471 psi<
Test Inlet          (ON to Start)
Test flow rate      400mL/min
Warning if pressure check OFF
Fault if pressure check  OFF
      Last test results
      Tue Oct 20 16:07 2009
Test pressure OK:      4.8
Reset the test results? (yes)

```

**Figure 5** Example front inlet trap check display. Example assumes a test has been previously run. Scroll to see all lines of the display.

- 2 Scroll to **Test flow rate** and enter a flow rate. A typical flow rate for this test is 400 mL/min, but you may find other values more appropriate for your setup.
- 3 Scroll to **Test Inlet** and press **[On/Yes]** to start the test.
- 4 Wait while the pressure stabilizes. When stable, the **Test Inlet** line of the display changes to **Test pressure OK x.xx**, where x.xx is the current pressure.

If the inlet cannot achieve the test setpoint, check for a leak (at the inlet, split vent trap, or split vent line) or low supply gas pressure.

- 5 Note the resulting **Inlet Pressure**. If the measured pressure exceeds any limits you have set up, the GC will respond accordingly. See [“To Check or Monitor Split Vent Line Backpressure”](#).

Typical pressures for a clean split flow path are:

- 1–2 psi (7–14 kPa) at 400 mL/min for a split liner
- 3–10 psi (21–69 kPa) at 400 mL/min for a splitless liner

If the pressure for a splitless liner seems abnormally high for a clean system, try reinstalling the liner.

If pressure on a clean system is within these ranges, but is near the operating pressure for the method, consider a change in hardware or the method. See also [Cannot Maintain a Pressure as Low as the Setpoint on a Split Inlet](#).

- 6 Press **[Off/No]** to stop the test.

### NOTE

The most recent test results display at the bottom of the display. Scroll down to see them.

---

To clear a Not Ready condition or Service Due indicator, scroll to **Reset the test results?** and press **[On/Yes]**.

## To Perform a SS Split Vent Restriction Test

Use the Agilent Instrument Utilities Split Vent Restriction Test to determine if there is an abnormal restriction in the split vent flow path. Open the software, select the GC, and run the test for the inlet. (Alternately, see [“To Run the Inlet Trap Check”](#).)

If the test fails:

- Consider whether the setup exceeds the [minimum viable pressures](#) obtainable by the GC. See also [Table 4](#).
- Consider the liner used. Agilent [recommends](#) a low pressure-drop liner for split analyses, part number 5183-4647.
- [Replace](#) the split vent trap filter.
- Inspect and [replace](#) the gold seal. If not using the low pressure drop liner, consider installing a high-flow gold seal, 5182-9652.
- Check for contamination in the split vent line. See [“To Check a Split Vent Line for Contamination”](#).

If the problem remains, contact Agilent for service.

## To Adjust the FID Lit Offset

To adjust the FID **Lit offset**:

- 1 Press [**Config**].
- 2 Scroll to **Front detector** or **Back detector** (wherever the detector is installed) and press [**Enter**].
- 3 Scroll to **Lit offset**. With the **Lit offset** line highlighted, enter the new parameter for the detector and press [**Enter**].
- 4 Lit offset should be < 2.0 pA or lower than the normal FID output when lit.

## To Verify That the FID Flame Is Lit

To verify that the FID flame is lit, hold a mirror or other reflective surface over the collector exhaust. Steady condensation indicates that the flame is lit.

Typically the FID output will be between 5.0 and 20.0 pA when lit and < 2.0 pA when not lit.

If the flame does not light, do the following:

- Verify that the detector temperature is above 150 °C. Agilent recommends operating the FID  $\geq 300$  °C.
- Verify correct detector flows.
- Inspect the jet for contamination.
- Verify that the jet is installed correctly.
- Check the column connections for leaks.

## To Verify FID Ignitor Function During Ignition Sequence

**WARNING**

Keep body parts at a safe distance from the FID chimney while performing this task. If using hydrogen, the FID flame will not be visible.

---

- 1 Remove the detector top cover.
- 2 Turn the FID flame **On**.
- 3 Observe the ignitor plug through the FID chimney. The small hole should glow during ignition sequence.

## To Measure FID Leakage Current

- 1 Load the analytical method.
  - Make sure flows are acceptable for ignition.
  - Heat the detector to operating temperature or to 300 °C.
- 2 Turn off the FID flame.
- 3 Press **[Front Det]** or **[Back Det]**, then scroll to **Output**.
- 4 Verify that the output is stable and < 1.0 pA.

If the output is unstable or > 1.0 pA, turn off the GC and check for proper assembly of the upper FID parts and for contamination. If the contamination is confined to the detector, [bakeout the FID](#).

- 5 Turn on the flame.

## To Measure FID Baseline Output

- 1 With the column installed, load your checkout method.
- 2 Set the oven temperature to 35 °C.
- 3 Press **[Front Det]** or **[Back Det]**, then scroll to **Output**.
- 4 When the flame is lit and the GC is ready, verify that the output is stable and < 20 pA (this may take some time).
- 5 If the output is not stable or > 20 pA, the system or gas may be contaminated. If this contamination is isolated to the detector, bakeout the FID.

## To Isolate the Cause of FID Noise

FID noise is the result of mechanical, electrical and chemical factors. FID noise can be a subjective parameter. Often FID baseline noise is perceived based on history of a given detector or comparison with another detector in the lab. For proper diagnosis of noise it is important to evaluate the detector noise under documented conditions against a known standard. Find more detailed information about noise in [Noisy Detector, Including Wander, Drift, and Baseline Spikes](#).

Before troubleshooting the detector, perform a noise test using your Agilent data system. If the detector fails the noise test, then troubleshoot the cause as described below.

To isolate the cause of FID noise:

- 1 If the noise test fails, remove the column and re-evaluate detector noise with the FID capped and re-ignited, using only H<sub>2</sub>/air and makeup detector gases. If it passes, suspect contaminated column/carrier gas.
- 2 If the noise failed with no column installed, repeat the noise test with only H<sub>2</sub> and air - set makeup flow to "Off". If it passes, suspect contaminated makeup gas.
- 3 If the noise test still fails, see [To Measure FID Leakage Current](#). If the leakage test fails, replace or clean the collector and PTFE insulators, the interconnect with spring, and/or the entire FID electrometer assembly. If the leakage test fails, replace or clean the [collector and PTFE insulators](#), the [interconnect](#) with spring, and/or the entire FID [electrometer](#) assembly.
- 4 If the leakage current test is OK, suspect a contaminated jet or contaminated H<sub>2</sub> or Air detector gas supplies (gases, tubing, traps), especially if the background of the detector when lit is >20 pA.

## To Measure NPD Leakage Current

- 1 Load the analytical method.
- 2 Set the **NPD Adjust Offset** to **Off** and the **Bead Voltage** to **0.00 V**.
  - Leave the NPD at operating temperature.
  - Leave flows on or off.
- 3 Press **[Front Det]** or **[Back Det]**, then scroll to **Output**.
- 4 Verify that the output (leakage current) is stable and < 1.0 pA.
- 5 The output should slowly drop toward 0.0 pA, and should stabilize in the tenths of a picoamp. Current > 2.0pA indicates a problem.

If the current is > 2.0pA, do the following:

- Inspect the [jet](#) for contamination.
- Check the column or column adapter fitting for leaks.
- Ensure that the metal sealing ring is not crushed or misaligned. See [To Maintain the NPD Collector, Ceramic Insulators, and Jet](#)

## To Check for a Plugged FID Jet

The most common cause of FID ignition problems is a plugged or partially plugged jet. If the jet is not completely plugged and the flame still ignites, a secondary symptom will be lengthening peak retention times. Jet plugging is most common with thick-film/high bleed or packed columns and high temperature applications. It is best to operate the column oven within the temperature limits of the column and also to operate the FID at least 20 °C hotter than the maximum oven temperature in the GC method. If the FID jet is becoming plugged, actual H<sub>2</sub>, Makeup and Capillary carrier flows will be lower than the values indicated by the GC.

To check for a plugged FID jet:

- 1 Leave the column installed in the FID. If already removed, cap off the detector column fitting in the oven. (Leaving the column installed will determine if the column is installed too high in the jet, plugging the orifice.)
- 2 Set the makeup flow to “Off”. Confirm a reading on the GC display of 0.0 mL/min for actual makeup flow. If not 0.0 – follow the procedure [To Zero the EPC Module Pressure Sensor](#).
- 3 Set the hydrogen flow to 75 mL/minute (increase the H<sub>2</sub> supply pressure as needed to achieve this flow rate setting.)
- 4 Monitor the makeup flow “Actual” reading

If the makeup flow is indicating a value in excess of 1.0 mL/min, this indicates that the jet is plugged or partially plugged; pressure is backing up from the H<sub>2</sub> channel into the makeup channel of the EPC system, resulting in a false flow indication on the makeup channel.

Alternately, remove the jet from the housing and hold it up to a light source. Check the holes in the jet for contamination. If plugged, [replace](#) the jet.

## **To Check for a Plugged NPD Jet**

The detector EPC module controls flow by maintaining a calibrated gas pressure against a fixed restriction. A plugged jet will cause inaccurate flow readings.

To check for a plugged NPD jet, measure the actual hydrogen and makeup flows. (See [Measuring NPD flows](#).) If the flows are lower than the displayed values, [replace](#) the jet.

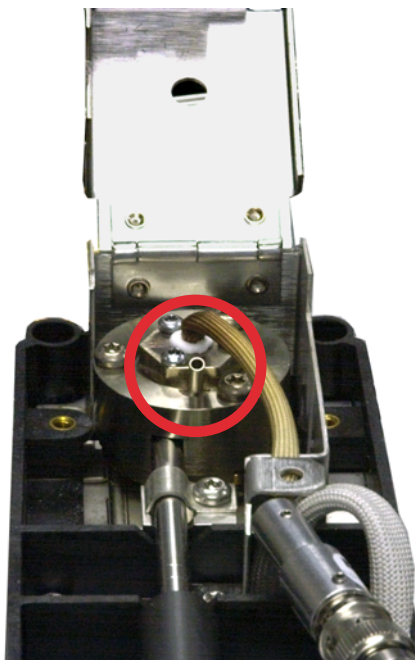
## To Verify That the NPD Bead Is Ignited

**WARNING**

Hot exhaust! Detector exhaust is hot and can cause burns.

---

To verify that the bead is ignited, look through the vent hole on the detector lid to see if the bead is glowing orange.



The NPD output is selected by the operator as part of the adjust offset process and generally is between 5.0 and 50.0 pA.

## **To Verify That the FPD Flame Is Lit**

To verify that the FPD flame is lit:

- 1** Remove the rubber drip tube from the detector vent.
- 2** Hold a mirror or shiny surface near the aluminum exhaust tube. Steady condensation means that the flame is lit.

## To Adjust the FPD Lit Offset

To adjust the FPD **Lit offset**:

- 1 Press **[Config]**.
- 2 Scroll to **Front detector** or **Back detector** (wherever the detector is installed) and press **[Enter]**.
- 3 Scroll to **Lit offset**. With the **Lit offset** line highlighted, enter the new parameter for the FPD (typical value is 2.0 pA), and press **[Enter]**.

## When to Change Gas Purifiers

Agilent highly recommends using purifying traps in the gas lines to prevent impurities from entering and contaminating the GC system or damaging the column. Some traps are single-purpose for the removal of oxygen, moisture, or hydrocarbons, while combination traps remove all those contaminants.

The best way to know when it is time to change a trap is to use an indicating trap, which should be placed after a high capacity trap. Agilent recommends using glass indicating traps such as the Gas Clean Filter system, whose clear tubes display a distinct color change in response to contamination. This color change tells the analyst it is time to change traps.

If no indicating traps are used, it is best to follow the manufacturer's recommendation for replacement frequency. Typically, the manufacturer will state how many gas cylinders can be purified with a given trap. If desired, it is possible to estimate when to replace the trap by performing a rough calculation. For example: you have a standard "K" size cylinder with He at 99.995% purity that contains 7,800 L of He. Assuming a worst case scenario in which the remaining 0.005% is all oxygen, you should have 39 mL, or about 56 mg of O<sub>2</sub> in the tank. Agilent's OT3 oxygen trap, for example, has a capacity of 600 mg O<sub>2</sub>. Therefore, you need to replace the OT3 trap every 10 cylinders. This is just a rough estimate, and it is prudent to change traps too early rather than too late.

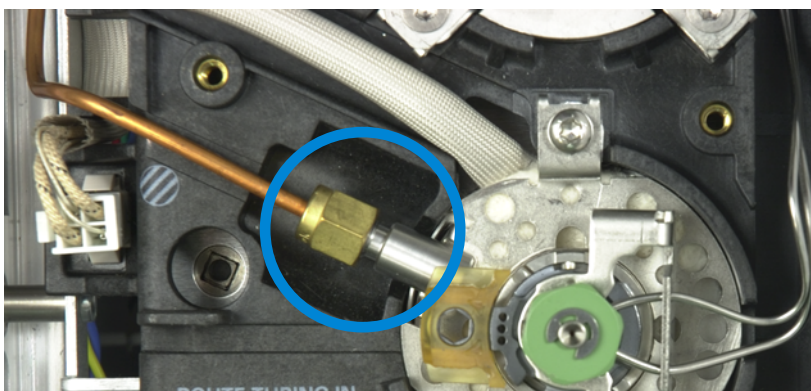
## To Check a Split Vent Line for Contamination

This procedure applies to the multimode and split/splitless inlets.

**WARNING**

**Be careful! The oven, inlet, and/or detector may be hot enough to cause burns. If the oven, inlet, or detector is hot, wear heat-resistant gloves to protect your hands.**

- 1 Gather the following:
  - 7/16-inch wrench
  - Wrench, hex for changing septum
  - Heat-resistant gloves if the inlet is hot
  - Cleaning brushes
- 2 Load the [inlet maintenance method](#) and wait for the GC to become ready.
- 3 Loosen the 1/8-inch Swagelok nut that seals the copper split vent line to the injection port.



- 4 Inspect the 1/8-inch copper split line for condensed sample. Flush or replace the copper split vent line.
- 5 Remove the septum head.
- 6 Check the split tube fitting in the shell weldment for blockage. Clean the split tube with a brush and suitable solvent.
- 7 Reassemble the split/splitless inlet and run the split vent restriction test to test for restrictions in the split vent flow path. If the inlet still fails, suspect flow module contamination or defects.

- 8 Check for leaks. Run the pressure decay test. See [“To Perform a SS Pressure Decay Leak Test”](#) or [“To Perform a MMI Pressure Decay Leak Test”](#).

## To Ignore a Device's Readiness State

By default, the GC monitors the status of all configured devices (inlets, detectors, valve box heaters, valves, oven heater, EPC modules, and so forth) and becomes ready when all of them reach setpoint. If the GC senses a problem in one of these devices, the GC will either never become ready, or may go into a shutdown state to protect itself or prevent a safety hazard. However, there may be a time when you do not wish to have the readiness state of a device prevent a run from starting. An important example is when an inlet or detector heater is defective. Normally, this fault prevents the GC from becoming ready and starting a run. However, you can set the GC to ignore this problem so that you can use the other inlet or detector until the device is repaired.

Not all devices can be ignored. You can ignore the readiness state of inlets, detectors, the oven, or an EPC module. The readiness state of other devices and components can never be ignored, for example, injection devices such as a switching valve or automatic liquid sampler.

To ignore the status of a device:

- 1 Turn off the device's heater and gas flows as applicable. (Make sure that it cannot create a safety hazard.)
- 2 Press **[Config]**, then select the element.
- 3 Scroll to **Ignore Ready** and press **[On/Yes]** to set it to **True**.

You can now use the GC until the device is repaired.

### CAUTION

Do not ignore the readiness state of a device that is being used unless you do not care if it reaches setpoint.

Be sure to return a broken device to **Ignore Ready = False** after it is repaired. Otherwise, its state (temperature, flow, pressure, and so forth) will continue to be ignored, even if using this device in the analysis.

---

To consider a device's readiness, set **Ignore Ready** to **False**.

## To Use the Stopwatch

In the stopwatch mode, both the time (to 0.1 second) and reciprocal time (to 0.01 min<sup>-1</sup>) are displayed. Use the stopwatch when measuring flows with a bubble flowmeter.

- 1 Press [**Time**] and scroll to the time = line.
- 2 Press [**Enter**] to start the stopwatch.
- 3 Press [**Enter**] again to stop.
- 4 Press [**Clear**] to set to zero.

You can access other functions while the stopwatch is running. Press [**Time**] again to view the stopwatch display.