Agilent

Agilent 8860 Gas Chromatograph

Maintaining Your Gas Chromatograph (GC)

Notices

Manual Part Number

G2790-90015

Edition

Seventh edition, August, 2024
Sixth edition, March 2023
Fifth edition, September 2021
Fourth edition November 2020
Third edition, November 2019
Second edition, July 2019
First edition, January 2019

Printed in USA

Agilent Technologies (Shanghai) Co., Ltd.
412 Ying Lun Road
Waigaoqiao Free Trade Zone
Shanghai 200131 P.R. China

Warranty

The material contained in this document is provided "as is," and is subject to being changed, without notice, in future editions. Further, to the maximum extent permitted by applicable law, Agilent disclaims all warranties, either express or implied, with regard to this manual and any information contained herein, including but not limited to the implied warranties of merchantability and fitness for a particular purpose. Agilent shall not be liable for errors or for incidental or consequential damages in connection with the furnishing, use, or performance of this document or of any information contained herein. Should Agilent and the user have a separate written agreement with warranty terms covering the material in this document that conflict with these terms, the warranty terms in the separate agreement shall control.

Technology Licenses

The hardware and/or software described in this document are furnished under a license and may be used or copied only in accordance with the terms of such license.

Restricted Rights Legend

U.S. Government Restricted Rights. Software and technical data rights granted to the federal government include only those rights customarily provided to end user customers. Agilent provides this customary commercial license in Software and technical data pursuant to FAR 12.211 (Technical Data) and 12.212 (Computer Software) and, for the Department of Defense, DFARS 252.227-7015 (Technical Data -Commercial Items) and DFARS 227.7202-3 (Rights in Commercial Computer Software or Computer Software Documentation).

Safety Notices

CAUTION

A CAUTION notice denotes a hazard. It calls attention to an operating procedure, practice, or the like that, if not correctly performed or adhered to, could result in damage to the product or loss of important data. Do not proceed beyond a CAUTION notice until the indicated conditions are fully understood and met.

WARNING

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

Contents

1 About Maintaining the GC

This section provides an overview of the maintenance procedures included in this document. It also lists the tools needed for routine maintenance and the information needed to safely perform the various maintenance task.

Overview of Maintenance

This manual details the routine tasks needed to maintain the Agilent 8860 Gas Chromatograph (GC). The procedures assume a basic knowledge of tool use and of GC operation. Readers are, for example, expected to know how to:

- Safely turn devices on and off
- Load methods
- Change component temperatures, flows, and pressures
- Make typical pneumatic connections using Swagelok and other standard fittings
- Reset GC service counters
- Use the browser interface

Where to find a procedure

Included in this manual are chapters on maintaining the following GC components:

- Capillary Columns
- Split/Splitless Inlet (SSL)
- Purged Packed Inlet (PPI)
- Packed Column Inlet (PCI)
- Cool On-Column Inlet (COC)
- Flame Ionization Detector (FID)
- Thermal Conductivity Detector (TCD)
- Electron Capture Detector (ECD)
- Nitrogen-Phosphorus Detector (NPD)
- Flame Photometric Detector Plus (FPD+)
- Auxiliary Electronic Pressure Control Module (Aux EPC)
- Pneumatics Control Module (PCM)
- Valves

Each chapter includes:

- A list of the most commonly used consumables and parts for the component
- An exploded parts view of the component
- Detailed procedures for routine maintenance tasks associated with the component

Tools and Materials Required for Maintenance

Table 1 lists the tools needed for most GC maintenance procedures. The specific tools required to perform a maintenance procedure are listed in step 1 of each procedure.

Table 1 Tools and materials for GC maintenance

Common tools	Part number
Wrench, angled, septum nut	19251-00100
Wrench, open-end, 1/4-inch and 5/16-inch	8710-0510*
Wrench, open-end, 9/16-inch and 7/16-inch	8710-0803
Wrench, capillary inlet	G3452-20512*
Flathead screwdriver	
Column cutter, wafer, 4/pk	5181-8836*
Driver, nut, 1/4-inch	8710-1561*
T-20 Torx key or screwdriver	8710-1807
T-10 Torx key or screwdriver	8710-2140
3-mm hex key wrench	8710-2411
Electronic flow meter(s) or bubble meter(s) capable of calibrated measurements at 1, 10, and 100 mL/min flow ranges	
Electronic leak detector	
Magnifying loupe, 20X	430-1020
Metric ruler	
Bench vise (for setting Swagelok fittings)	
Razor or sharp knife	
Tweezers, or thin needle-nose pliers	8710-0007 8710-0004
Needle-nose pliers	
ESD wrist strap (for installing new components)	9300-1408
Gloves, heat-resistant (for handling hot parts)	
Wooden cotton swab (for removing FID filters)	
Tools and materials for cleaning procedures	
Cleaning brushes—The FID cleaning kit contains appropriate brushes for cleaning detectors and inlets	9301-0985
Cleaning brushes—For cleaning split/splitless inlet split vent fitting, FID and collectors	8710-1346
Jet cleaning wire (.010-inch)	
Clean, lint-free cloth (to protect contamination-sensitive detector parts)	
Small ultrasonic cleaning bath with aqueous detergent (for cleaning detector and inlet parts)	

Table 1 Tools and materials for GC maintenance

Common tools	Part number
Gloves, clean, lint-free, nylon (for handling contamination-sensitive parts)	large: 8650-0030 small: 8650-0029
Steel wool, 0- or 00-grade (for cleaning an inlet's septum seating surfaces)	

* Included with the GC ship kits

Preparing for Maintenance

Before routine maintenance procedures, the GC must be made ready. This process can include:

- Setting low temperatures to avoid burns and other injuries
- Setting reduced flows to avoid safety hazards and to prevent damage to the instrument
- Turning off the GC and disconnecting the GC from power
- Venting a mass selective detector (MSD)
- Making other settings to prevent damage to the instrument (electronics, columns, and so forth) or to connected instruments (MSD)

To put the GC in a general standby state suitable for most maintenance, open the browser interface. From the browser interface, go to **Maintenance > Instrument > Perform Maintenance > Maintenance Mode > Start Maintenance**. Follow the prompts. To exit maintenance mode and restore the previous GC settings, click **Finished.**

If you turned off the GC or changed other settings, return to the **Maintenance Mode** screen as needed. Note that the **Maintenance Mode** ends when the GC is turned off.

For automated maintenance procedures available through the GC, the GC will make the instrument safe to work on and walk you through the steps required to replace the part selected.

WARNING

If you choose to perform maintenance without using the GC's built-in features, first cool all heated zones in the instrument, including auxiliary heaters or other heated devices you might contact during maintenance. Then turn off the GC and unplug the power cord.

Automated Maintenance Procedures

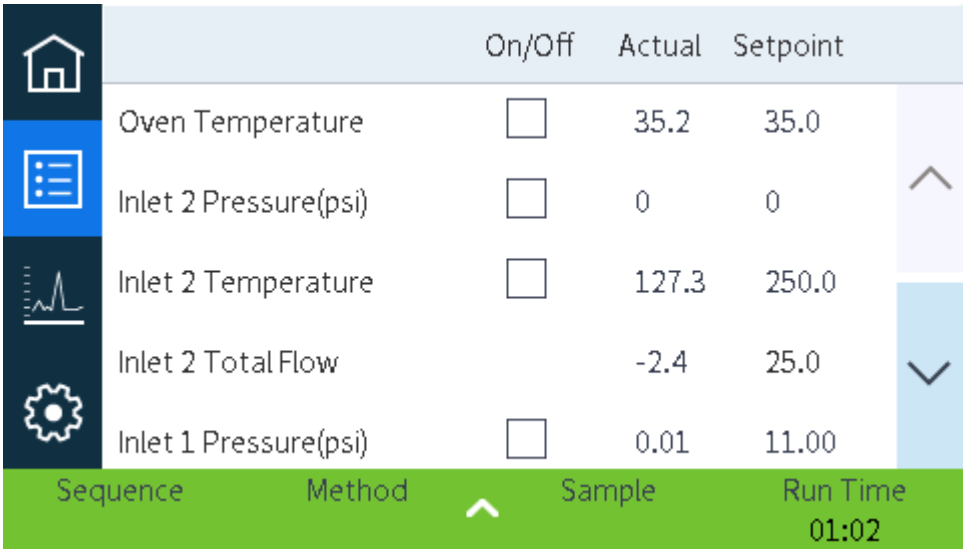
The GC provides many automated procedures that walk you through routine maintenance tasks and which automatically include steps such as cool downs, leak tests, EMF resets, and even blank runs to confirm baseline performance. Access and run these procedures from both the touchscreen and the browser interface. Navigate to **Maintenance**, select the device (inlet, detector, and so forth), and then choose **Perform Maintenance** to see the list of available automated procedures. Select the desired test from the available listing and select Start **Maintenance** to begin. These procedures require an idle GC, and will not run if the GC is not idle.

Note that Agilent data systems can prevent automated confirmation runs in maintenance procedures. For example, a data system can prevent the GC from performing a blank diagnostic run after replacing certain parts. If you have a GC operating with a data system, and later use the data system to disable local run features, you may notice that certain maintenance procedures will no longer perform the blank run (or another diagnostic run). This behavior is normal. If you wish to perform a confirmation blank run after the maintenance is complete, you can do so manually using the data system. Tests such as leak checks and pressure checks will run during maintenance, since these do not start a run.

Viewing Status Data

The GC can display signal and other data that can be very useful during maintenance. For example:

- Instrument status: Readiness state, running state.
- Instrument status details: Not ready modules, error modules, warnings.
- Module status details: **Actual**/**Setpoint** pairs for each module, quick **On**/**Off** for certain modules, firmware version and instrument IP address.



Finding a Replacement Part Number

Agilent now provides the Parts Finder tool to help you locate replacement and consumable part numbers. If using an Agilent data system, Parts Finder will be installed. If you want to install the tool on another computer, Parts Finder is included on the Agilent *GC and GC/MS User Manuals & Tools* DVD.

To find a consumable or replacement part using Parts Finder, navigate to the part graphically, based on the part's location in the GC.

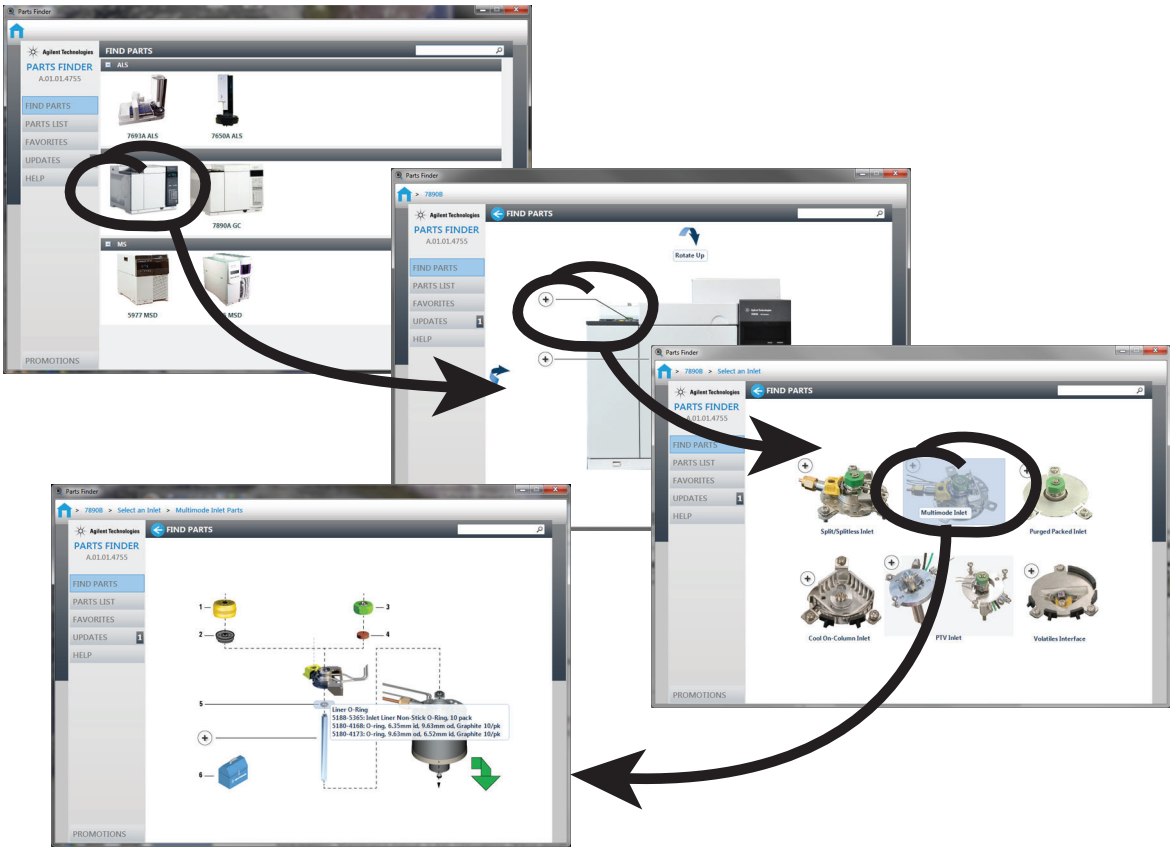


Figure 1. Quickly navigate to replacement parts by clicking on images of GC components

Part numbers are also included in this manual.

2 Removing Covers

This section describes how to remove covers as needed for routine maintenance.

Only the covers listed in this chapter should be removed. Removing other GC covers can compromise the safety features of the GC, leading to personal injury or damage to the instrument.

To Remove the Detector Top Cover

This cover protects the detectors, valve box, and valve assembly. To remove the detector top cover:

1 Turn off the GC and unplug the power cord.

2 Remove the detector cover by raising the cover up, then firmly lift up on the right side of the cover to free it from the GC. Set the cover aside.

3 When finished with the maintenance procedure, place the detector cover vertically on the GC and insert the left side first, then gently snap in the right side onto the GC.

WARNING

Be careful! With the power switch on, potentially dangerous voltages also exist:

- **All electronics boards in the instrument.**
- **The internal wires and cables connected to these boards.**
- **The wires for the oven heater.**

The covers shield these parts as the parts may be hot enough to cause burns. Never remove a cover unless the instrument is unplugged.

CAUTION

Do not force the cover, either when installing it or closing it. This could break the plastic parts.

Figure 2. 8860 GC covers

To Remove the Pneumatics Cover

The pneumatics cover protects the flow manifolds in the back top of the GC.

1 Disconnect any vent tubing connected to the split and septum purge vents.

2 Press the buttons located on each side of the pneumatics cover and lift up to remove it from the GC.

To Remove the Electronics Cover

You may need to raise the electronics cover to perform NPD maintenance. The steps required depend on whether or not an FPD+ is installed.

WARNING

Be careful! With the power switch on, potentially dangerous voltages also exist:

- **All electronics boards in the instrument.**
- **The internal wires and cables connected to these boards.**
- **The wires for the oven heater.**

The covers shield these parts as the parts may be hot enough to cause burns. Never remove a cover unless the instrument is unplugged.

CAUTION

Raising the electronics cover exposes the GC electronics.

Without FPD+ installed:

1 Turn off the GC and unplug the power cord.

2 Raise or remove the detector top cover.

3 Loosen the captive screws on the right side cover, slide the cover backwards, then remove.

4 Loosen the captive screw located on the left side of the electronics cover.

5 Reach under the back of the electronics cover to release the clip holding it in place, then raise the electronics cover and remove.

With FPD+ installed:

1 Turn off the GC and unplug the power cord.

2 Raise or remove the detector top cover.

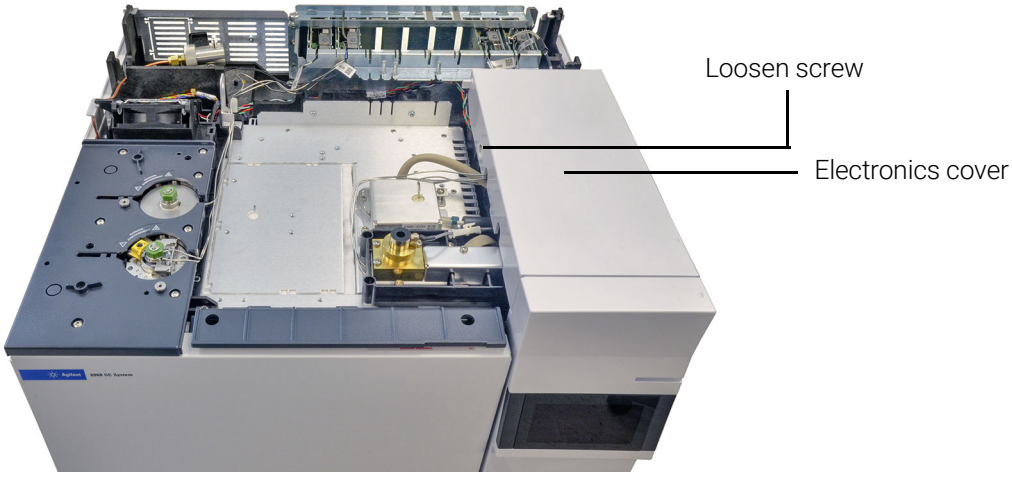


Figure 3. 8860 GC electronics cover

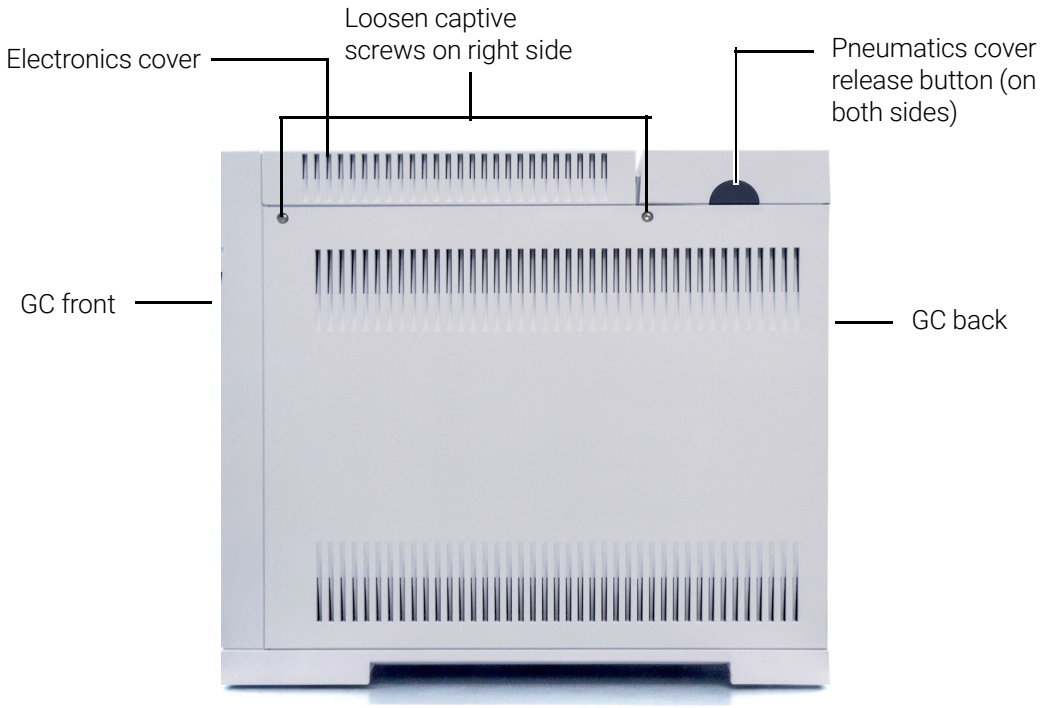


Figure 4. Loosen captive screws located on the right side of the GC

3 Loosen the two captive screws on the right side cover, slide the cover backwards, then remove.

4 Loosen the captive screw located on the left side of the electronics cover.

5 Reach under the back of the electronics cover to release the clip holding it in place, then raise the electronics cover and remove.

6 Loosen the two thumbscrews in the tray below the PMT, and remove the two screws in the back of the tray.

7 Remove the tray from the electronics cover.

3 Maintaining the GC

Consumables and Parts for General GC Maintenance

Table 2 lists consumable parts for the hydrogen sensor module accessory and for general GC maintenance.

Table 2 Consumables and parts for general GC maintenance

Description	Part number
Hydrogen sensor parts	
Calibration gas cylinder, 2 percent hydrogen gas in 17 L compressed air	5190-6890
Cylinder stand with locking screw	1400-3583
Pressure regulator, with gage	G3440-80153
Fittings and hardware	
Fittings kit, 1/8-inch brass, 20/pk	5080-8750
Plug, 1/8-inch brass 6/pk	5180-4124
Tee, 1/8-inch brass 2/pk	5180-4160
Union, 1/8-inch brass 2/pk	5180-4127
Cross, union 1/8-inch brass	0100-0161
GC Supply Gas Installation Kit with Gas Purifiers	19199N
Installation kit for GCs without gas purifiers	19199M
PTFE tape	0460-1266
Copper tubing, 1/8-inch 12 ft.	5021-7107
Copper tubing, 1/8-inch od, 50 ft	5180-4196
Gas regulators	
Regulator, 2-stage, brass body, stainless steel diaphragms, 125 psi max, CGA350, hydrogen, argon/methane, with 1/8-inch fitting. For 1/4-inch tubing purchase a 1/4-inch adapter.	5183-4642
Regulator, 2-stage, brass body, stainless steel diaphragms, 125 psi max, CGA346, air, with 1/8-inch fitting. For 1/4-inch tubing purchase a 1/4-inch adapter.	5183-4641
Regulator, 2-stage, brass body, stainless steel diaphragms, 125 psi max, CGA590, industrial air, with 1/8-inch fitting. For 1/4-inch tubing purchase a 1/4-inch adapter.	5183-4645
Regulator, 2-stage, brass body, stainless steel diaphragms, 125 psi max, CGA580, helium, argon, nitrogen, 1/8-inch fitting. For 1/4-inch tubing purchase a 1/4-inch adapter.	5183-4644
Regulator, 2-stage, brass body, stainless steel diaphragms, 125 psi max, CGA540, oxygen, 1/8-inch fitting. For 1/4-inch tubing purchase a 1/4-inch adapter.	5183-4643
Gas Clean Filters	
Gas Clean connecting unit, 1-position), 1/4-inch	CP7980
Gas Clean connecting unit, 1-position), 1/8-inch	CP7988
Gas Clean connecting unit, 2-position), 1/4-inch	CP738406

Table 2 Consumables and parts for general GC maintenance (continued)

Description	Part number
Gas Clean connecting unit, 2-position), 1/8-inch	CP738407
Gas Clean Smart Sensor for 8890 (replacement sensor)	CP179885
Gas Clean kit (connecting unit for one filter, one carrier gas filter, 1/8-inch connections, mounting bracket, and Smart Sensor) for new GC	
Connect unit, Gas Clean, 4 filter, 1/4-inch, 1/pk	CP7989
Gas Clean connecting unit, 4-position), 1/8-inch fittings	CP736520
Gas Clean high-flow connecting unit, 2-position), with 1/4-inch fittings, for high-flow applications such as ICP-MS or ICP-OES	CP17984
High flow connecting unit 1/8-inch	CP17985
Gas Clean filter GC-MS, 1/pk	CP17973
Gas Clean filter oxygen, 1/pk	CP17970
Gas Clean filter moisture, 1/pk	CP17971
Gas Clean filter charcoal, 1/pk	CP17972
Gas Clean filter kit for TCD	CP738408
Gas Clean Filter kit (connecting unit for one filter, including one carrier gas filter, 1/8-inch connections, a smart sensor, and mounting bracket for the GC) for carrier gas only	CP179880
Gas Clean Filter kit (connecting unit for four filters, including four filters, 1/4-inch connections) for FID, FPD, NPD	CP7995
Gas Clean Filter kit (connecting unit for four filters, including four filters, 1/8-inch connections) for FID, FPD, NPD	CP736530
GC/MS Gas Clean Filter kit (includes one connecting unit and two GC/MS filters, 1/8-inch connections) for ECD, GC/MS	CP17976
GC/MS Gas Clean Filter kit (includes one connecting unit and two GC/MS filters, 1/4-inch connections) for ECD, GC/MS	CP17977
GC/MS Gas Clean Filter installation kit (includes CP17976, 1 m copper tubing, and two 1/8-inch nuts and ferrules) for ECD, GC/MS	CP17978
TCD filter kit (with oxygen and moisture filters) for TCD	CO738408
Flush head, Gas Clean connecting unit, used to purge gas lines after installing connecting unit	CP7987
Gas Clean wall-mounting bracket for 1-position) connecting unit only	CP7981

For additional general and filters, refer to the Agilent web site and Parts Finder software. For additional information about choosing the correct gas line filters, see the *GC, GC/MS, and ALS Site Preparation Guide* and visit the Agilent web site.

Parts Identification

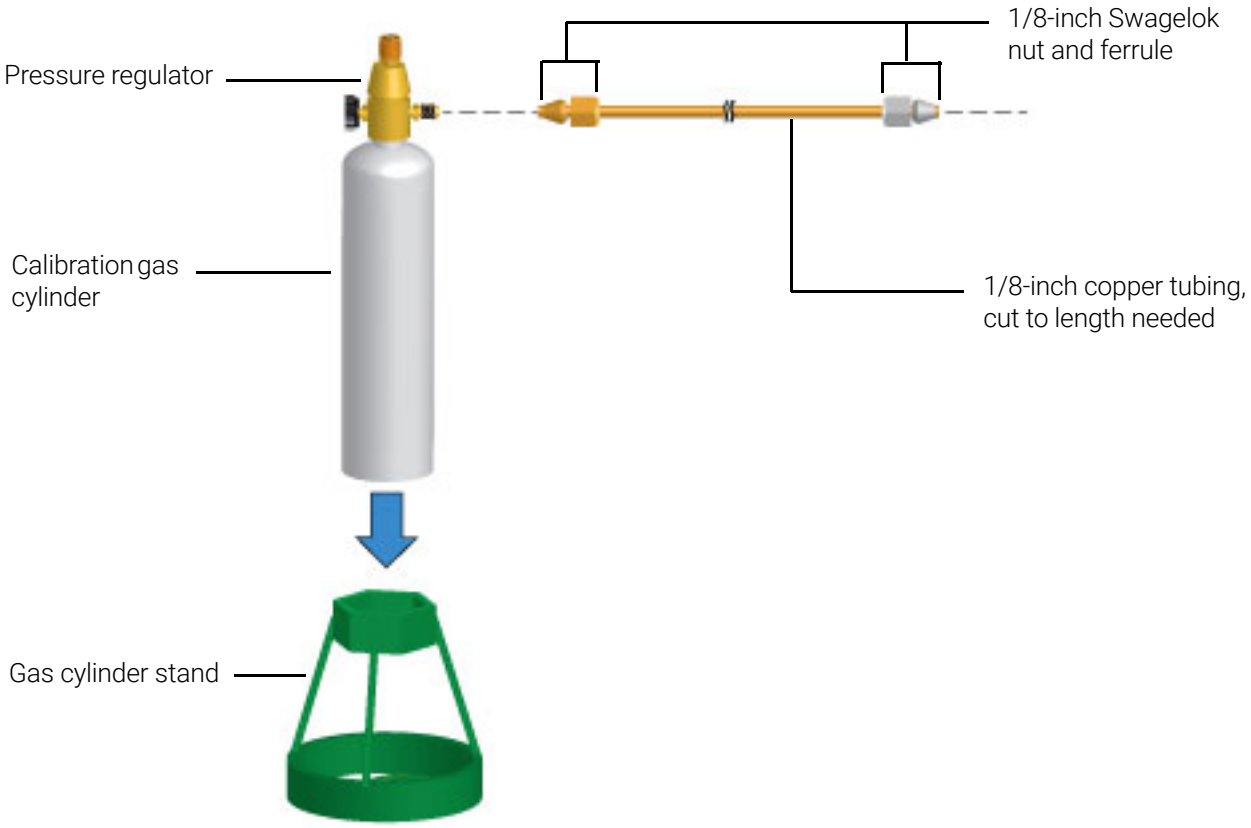


Figure 5. Hydrogen sensor calibration gas cylinder parts identification

To Install the Hydrogen Sensor Calibration Gas Cylinder

WARNING

Connect only the Agilent calibration gas to the hydrogen sensor fitting. The calibration gas is 2% hydrogen in air and is not potentially explosive. Gases with higher concentrations of hydrogen can create a dangerous condition in the oven or damage the hydrogen sensor.

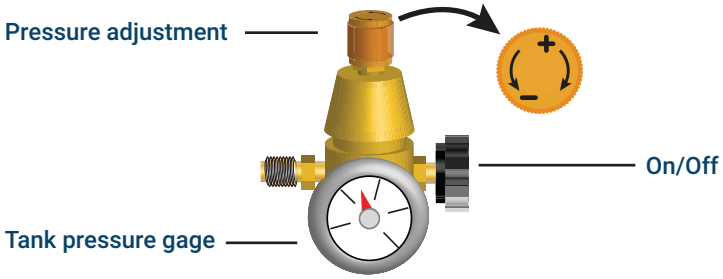
WARNING

Be careful! The oven and/or detector may be hot enough to cause burns. While hydrogen sensor calibration can be performed at any temperature, cool the oven and detector to safe handling temperatures, < 40 °C, before continuing.

This procedure describes how to replace an existing hydrogen calibration gas cylinder. If not replacing an existing cylinder, skip to **step 4**.

1 Make sure the old cylinder is empty.

2 Turn the pressure regulator completely off and set the output pressure as low as possible (full CCW).



3 Remove the pressure regulator from the old cylinder.

4 Install the pressure regulator onto the new cylinder.

5 Install the new cylinder into the stand.

6 Turn on the pressure in the new cylinder.

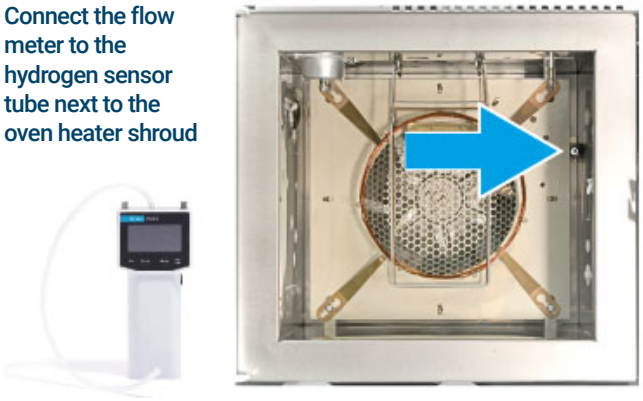
7 Check for leaks in the external fittings between the gas cylinder and the GC using a leak detection fluid. Correct any leaks. Be careful not to let any fluid contact GC electronics. Use leak detection fluid only on connections outside of the GC.

8 Initiate calibration. Using the browser interface, select **Settings** > **Calibration** > **H2 Sensor** > **Start Calibration**.

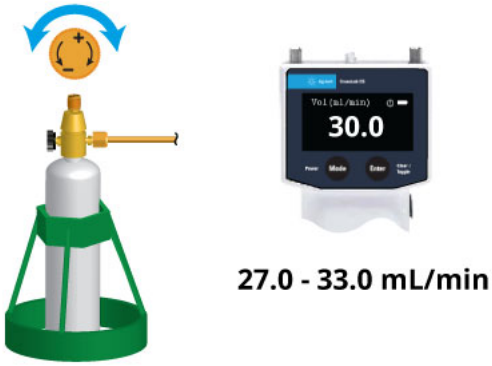
9 When prompted to set the calibration flow, select **Set Flow** to confirm.

10 Allow the oven to cool to the set point before continuing with the calibration. Actual oven temperature will display. Select **Continue** when the temperature setpoint has been met.

11 Open the GC oven door and connect a flowmeter tube to the sensor tube in the oven. At the browser interface, select **Turn On**. The hydrogen sensor module will begin to send calibration gas across the sensor.



12 While continuing to measure the flow rate from the tube, adjust the pressure regulator on the calibration gas cylinder until the flow rate is approximately 30 mL/min (+/- 3 mL). Remove the flowmeter and tubing and close the oven door.



13 Allow the calibration cycle to complete. (approximately 5 minutes total time)

14 Turn off the calibration gas. You may disconnect the gas from the GC if desired.

If calibration fails

If a calibration fails, from the browser, go to **Settings** then choose **Service Mode** > **H2 Sensor** > **Calibration**. The first line will indicate that the hydrogen sensor calibration failed. Check the following:

- Check the calibration gas. Is it the correct type? Is the tank empty or low?
- Check for leaks in the calibration gas supply.
- Check for restrictions in the supply tubing.
- Check if the calibration gas is flowing at the expected rate of 30 mL/min. Adjust the pressure as needed.

The GC records hydrogen sensor calibration events in its Maintenance log.

4 Maintaining Capillary Columns

Consumables and Parts for Columns

See the Agilent catalog for consumables and supplies for a more complete listing, or visit the Agilent Web site for the latest information (**www.agilent.com**).

Table 3 Nuts, ferrules, and hardware for capillary columns

Column id (mm)	Description	Typical use	Part number/quantity
.530	Ferrule, Vespel/graphite, 0.8-mm id	0.45-mm and 0.53-mm capillary columns	5062-3512 (10/pk)
	Ferrule, graphite, 1.0-mm id	0.53-mm capillary columns	5080-8773 (10/pk)
	Ferrule, graphite, 0.8-mm id	0.53-mm capillary columns	500-2118 (10/pk)
	Column nut, finger-tight (for 0.53-mm columns)	Connect column to inlet or detector	5020-8293
.320	Ferrule, Vespel/graphite, 0.5-mm id	0.32-mm capillary columns	5062-3514 (10/pk)
	Ferrule, graphite, 0.5-mm id	0.1-mm, 0.2-mm, 0.25-mm, and 0.32-mm capillary columns	5080-8853 (10/pk)
	Column nut, finger-tight (for .100- to .320-mm columns)	Connect column to inlet or detector	5020-8292
.250	Ferrule, Vespel/graphite, 0.4-mm id	0.1-mm, 0.2-mm, and 0.25-mm capillary columns	5181-3323 (10/pk)
	Ferrule, graphite, 0.5-mm id	0.1-mm, 0.2-mm, 0.25-mm, and 0.32-mm capillary columns	5080-8853 (10/pk)
	Column nut, finger-tight (for .100- to .320-mm columns)	Connect column to inlet or detector	5020-8292
.100 and .200	Ferrule, Vespel/graphite, 0.37-mm id	0.1-mm and 0.2-mm capillary columns	5062-3516 (10/pk)
	Ferrule, Vespel/graphite, 0.4-mm id	0.1-mm, 0.2-mm, and 0.25-mm capillary columns	5181-3323 (10/pk)
	Ferrule, graphite, 0.5-mm id	0.1-mm, 0.2-mm, 0.25-mm, and 0.32-mm capillary columns	5080-8853 (10/pk)
	Ferrule, graphite, 0.4-mm id		500-2114 (10/pk)
	Column nut, finger-tight (for .100- to .320-mm columns)	Connect column to inlet or detector	5020-8292
All	Ferrule, no-hole	Testing	5181-3308 (10/pk)
	Capillary column blanking nut	Testing–use with any ferrule	5020-8294
	Column nut, universal	Connect column to inlet or detector	5181-8830 (2/pk)
	Column nut, collared, self-tightening	Connect column to inlet or detector	G3440-81011
	Collar for self-tightening nut	Connect column to inlet or detector	G3440-81012
	Column nut, collared, self-tightening MSD	Connect column to inlet or detector	G3440-81013
	Column cutter, ceramic wafer	Cutting capillary columns	5181-8836 (4/pk)
	Pencil, diamond tipped	Cutting capillary columns	420-1000
	Ferrule tool kit	Ferrule installation	440-1000

Table 4 Capillary column hangers

Description	Part Number
Column hanger	1460-1914
Capillary column clip kit, for 7-inch column basket	G1530-61580

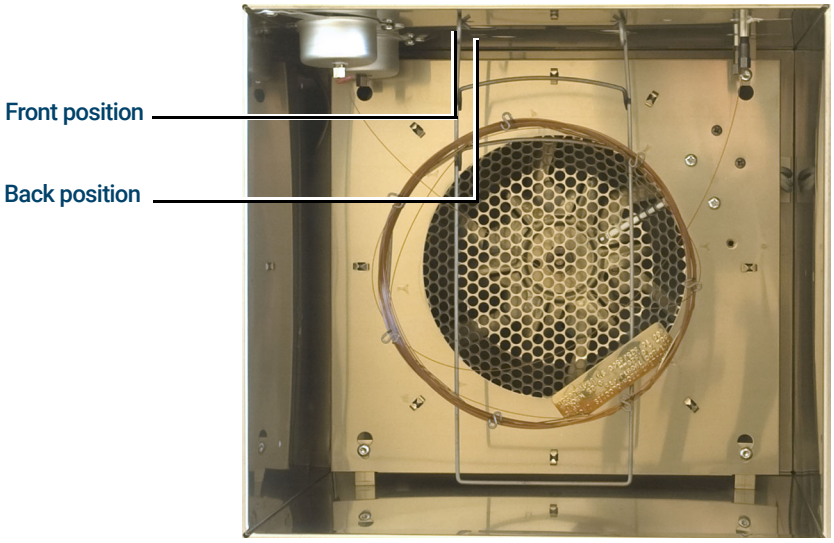
To Install a Capillary Column Hanger

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

WARNING **Wear safety glasses to protect your eyes from flying particles while handling, cutting, or installing glass or fused silica capillary columns. Use care in handling these columns to prevent puncture wounds.**

1 Place GC in maintenance mode: **Maintenance > Instrument > Perform Maintenance > Maintenance Mode > Start Maintenance.** Wait for the GC to become ready.

2 Select either the front or back hanger position. (Hanger is shown in back position.)



3 Insert the ends of the hanger into the slots in the selected position.

To Install Capillary Column Clips

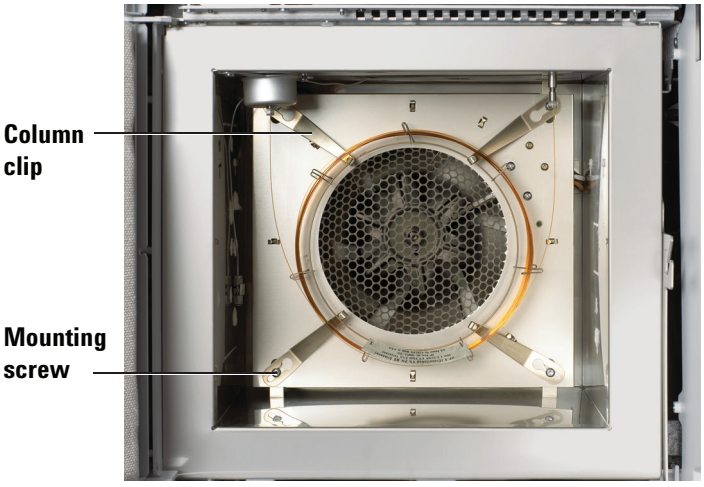
WARNING **Be careful! The oven may be hot enough to cause burns. If the oven is hot, wear heat-resistant gloves to protect your hands.**

WARNING **Wear safety glasses to protect your eyes from flying particles while handling, cutting, or installing glass or fused silica capillary columns. Use care in handling these columns to prevent puncture wounds.**

1 Gather the following:
   - Capillary column clip kit, see **"Consumables and Parts for Columns"** on page 30.
   - T-20 Torx screwdriver

2 Place GC in maintenance mode: **Maintenance > Instrument > Perform Maintenance > Maintenance Mode > Start Maintenance.** Wait for the GC to become ready.

3 Loosen the four corner mounting screws, but do not remove.



4 Slip each corner screw through the large hole on the clip.

5 Slide the clip so that the screw is positioned in the slot.

6 Tighten the screws enough to hold the clips in place. Once the column is installed, fully tighten the four corner screws to secure the clips and column to the oven wall.

To Condition a Capillary Column

This conditioning procedure provides generic instructions. Always follow the column manufacturer's recommendations.

1 Gather the following:
   - One 7/16-inch, and 1/4-inch wrenches
   - No-hole ferrule. See **"Consumables and Parts for Columns"** on page 30.
   - Column nut

WARNING **Do not use hydrogen as the carrier for conditioning! It could vent into the oven and present an explosion hazard.**

WARNING **Be careful! The oven and all internal GC components may be hot enough to cause burns. If the oven is hot, wear heat-resistant gloves to protect your hands.**

WARNING **Wear safety glasses to protect your eyes from flying particles while handling, cutting, or installing glass or fused silica capillary columns. Use care in handling these columns to prevent puncture wounds.**

2 Manually set the inlet and oven temperature to < 40 °C, and wait for the inlet, oven, and all other parts you might come into contact with inside the oven to cool before continuing.

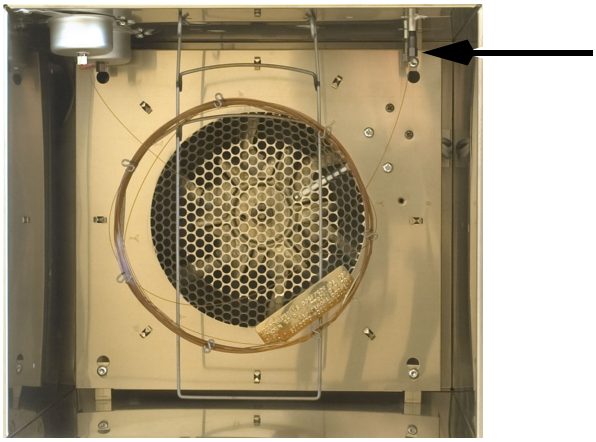
3 Install the column into the inlet using new ferrules. If the column is already installed, skip this step. An installed column can be conditioned while connected to a detector.

NOTE **Perform the column installation procedure manually. Do not use the automated column installation wizard.**

- **"To Install a Capillary Column with the Split/Splitless Inlet"**
- **"To Install a Capillary Column with the Purged Packed Inlet"**

- "To Install a Capillary Column with the Cool On-Column Inlet"

4 Cap any open column fittings, for example, the detector column fitting.



5 Turn off all detectors.

6 Set a minimum velocity of 30 cm/s, or as recommended by the column manufacturer.

7 Set the oven to 120 °C.

8 Let gas flow through the column for 15 to 30 minutes to remove air.

9 Program the oven from 120 °C to the maximum temperature limit for the column. Increase the temperature at a rate of 10 to 15 °C/min. Hold at the maximum temperature for 30 minutes.

10 Manually set the oven temperature to < 40 °C, and wait for the oven, column and all other parts you might come into contact with inside the oven to cool before continuing.

WARNING

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

WARNING

Wear safety glasses to protect your eyes from flying particles while handling, cutting, or installing glass or fused silica capillary columns. Use care in handling these columns to prevent puncture wounds.

11 If not already installed, attach the column to the detector. For details, select your specific detector.

NOTE

Perform the installation procedure manually. Do not use the automated installation wizard.

- To Install a Capillary Column in the FID
- To Install a Capillary Column in the NPD
- To Install a Capillary Column in the TCD
- To Install a Capillary Column in the ECD
- To Install a Capillary Column to the FPD+

12 Restore the analytical method.
   - For FIDor any FPD+, immediately turn off the flame.
   - For NPD, immediately turn off the bead.

13 After the GC becomes ready, wait 10 minutes, then ignite the detector flame or bead.

To Cut a Loop from a Column

1 Gather the following:
   - New ferrule(s) for the column inlet connection
   - Column cutter

2 Place GC in maintenance mode: **Maintenance > Instrument > Perform Maintenance > Maintenance Mode > Start Maintenance** and wait for the GC to become ready.

WARNING

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

WARNING

Wear safety glasses to protect your eyes from flying particles while handling, cutting, or installing glass or fused silica capillary columns. Use care in handling these columns to prevent puncture wounds.

3 Loosen the inlet column nut and remove the column from the inlet.

4 Uncoil one loop of column from the column hanger.

5 Cut the unwanted loop from the column.

6 Install the column into the inlet using the new ferrules.

NOTE

Perform the installation procedure manually. Do not use the automated column installation wizard.

   - **"To Install a Capillary Column with the Split/Splitless Inlet"**
   - **"To Install a Capillary Column with the Purged Packed Inlet"**
   - **"To Install a Capillary Column with the Cool On-Column Inlet"**

7 Exit maintenance mode. Select **Maintenance > Instrument > Perform Maintenance > Maintenance Mode > Finished**.

To Reverse a Column and Bakeout Contaminants

1 Gather the following:
   - 1/4-inch wrench
   - Column cutter

2 Place GC in maintenance mode: **Maintenance > Instrument > Perform Maintenance > Maintenance Mode > Start Maintenance** and wait for the GC to become ready.

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

WARNING **Wear safety glasses to protect your eyes from flying particles while handling, cutting, or installing glass or fused silica capillary columns. Use care in handling these columns to prevent puncture wounds.**

3 Disconnect the column from the inlet and detector.

4 If necessary, cut a loop from the column. See **"To Cut a Loop from a Column"** on page 37. Do not attach the column to the inlet.

5 Remove the column from the hanger and reverse its position (inlet and detector ends) and place the column back on the hanger.

6 Attach the column to the inlet.

NOTE **Perform the installation procedure manually. Do not use the automated column installation wizard.**

- **"To Install a Capillary Column with the Split/Splitless Inlet"**
- **"To Install a Capillary Column with the Purged Packed Inlet"**
- **"To Install a Capillary Column with the Cool On-Column Inlet"**

7 Attach your column to the detector.

NOTE **Perform the installation procedure manually. Do not use the automated column installation wizard.**

- **To Install a Capillary Column in the FID**
- **To Install a Capillary Column in the NPD**
- **To Install a Capillary Column in the TCD**
- **To Install a Capillary Column in the ECD**
- **To Install a Capillary Column to the FPD+**

8 Exit maintenance mode. Select **Maintenance > Instrument > Perform Maintenance > Maintenance Mode > Finished.**

9 Set the column flow to the normal operating value, or set the capillary column gas velocity to 30 cm/s.

   For Split/Splitless inlets, select split mode and set the split vent flow to 200 mL/min.

10 Purge the column with carrier flow for at least 10 minutes before heating the oven.

11 Set the inlet temperature to 300 °C or 25 °C above the normal operating temperature.

12 Set the column oven 25 °C above the GC method final oven temperature to bake contaminants out of the inlet, mostly through the split vent. Do not exceed the column manufacturer's maximum temperature limit.

13 Bakeout for 30 minutes.

5 Maintaining the Split/Splitless Inlet

Consumables and Parts for the Split/Splitless Inlet

See the Agilent catalog for consumables and supplies for a more complete listing, or visit the Agilent Web site for the latest information (**www.agilent.com**).

Table 5 Split, splitless, direct, and direct connect inlet liners

Mode	Description	Deactivated	Part number
Split	Low-pressure drop, glass wool, single taper, 870 µL	Yes	5183-4647
Split	Glass wool, 990 µL	No	19251-60540
Split	MS Certified, single taper, glass wool	Yes	5188-6576
Split—Manual only	Empty pin and cup, 800 µL	No	18740-80190
Split—Manual only	Packed pin and cup, 800 µL	No	18740-60840
Split or splitless	Ultra Inert, low pressure drop, glass wool	Yes	5190-2295
Splitless	Single taper, glass wool, 900 µL	Yes	5062-3587
Splitless	Single taper, no glass wool, 900 µL	Yes	5181-3316
Splitless	Dual taper, no glass wool, 800 µL	Yes	5181-3315
Splitless	MS Certified, single taper, glass wool	Yes	5188-6568
Splitless	Ultra Inert, low-frit liner, 4-mm (1/pk)	Yes	5190-5112
Splitless	Ultra Inert, low-frit liner, 4-mm (5/pk)	Yes	5190-5112-005
Splitless—Direct inject	2-mm id, quartz, 250 µL	No	18740-80220
Splitless—Direct inject	2-mm id, 250 µL	Yes	5181-8818
Direct inject —Headspace or purge and trap	1.5-mm id, 140 µL	No	18740-80200
Direct column connect	Single taper, splitless 4-mm id	Yes	G1544-80730
Direct column connect	Dual taper, splitless 4-mm id	Yes	G1544-80700
Universal	Ultra Inert, mid-frit liner, 4-mm (1/pk)	Yes	5190-5105
Universal	Ultra Inert, mid-frit liner, 4-mm (5/pk)	Yes	5190-5105-005

Table 6 Nuts, ferrules, and hardware for capillary columns

Column id (mm)	Description	Typical use	Part number/quantity
.530	Ferrule, Vespel/graphite, 0.8-mm id	0.45-mm and 0.53-mm capillary columns	5062-3512 (10/pk)
	Ferrule, graphite, 1.0-mm id	0.53-mm capillary columns	5080-8773 (10/pk)
	Ferrule, graphite, 0.8-mm id	0.53-mm capillary columns	500-2118 (10/pk)
	Column nut, finger-tight (for 0.53-mm columns)	Connect column to inlet or detector	5020-8293

Table 6 Nuts, ferrules, and hardware for capillary columns (continued)

Column id (mm)	Description	Typical use	Part number/quantity
.320	Ferrule, Vespel/graphite, 0.5-mm id	0.32-mm capillary columns	5062-3514 (10/pk)
	Ferrule, graphite, 0.5-mm id	0.1-mm, 0.2-mm, 0.25-mm, and 0.32-mm capillary columns	5080-8853 (10/pk)
	Column nut, finger-tight (for .100- to .320-mm columns)	Connect column to inlet or detector	5020-8292
.250	Ferrule, Vespel/graphite, 0.4-mm id	0.1-mm, 0.2-mm, and 0.25-mm capillary columns	5181-3323 (10/pk)
	Ferrule, graphite, 0.5-mm id	0.1-mm, 0.2-mm, 0.25-mm, and 0.32-mm capillary columns	5080-8853 (10/pk)
	Column nut, finger-tight (for .100- to .320-mm columns)	Connect column to inlet or detector	5020-8292
.100 and .200	Ferrule, Vespel/graphite, 0.37-mm id	0.1-mm and 0.2-mm capillary columns	5062-3516 (10/pk)
	Ferrule, Vespel/graphite, 0.4-mm id	0.1-mm, 0.2-mm, and 0.25-mm capillary columns	5181-3323 (10/pk)
	Ferrule, graphite, 0.5-mm id	0.1-mm, 0.2-mm, 0.25-mm, and 0.32-mm capillary columns	5080-8853 (10/pk)
	Ferrule, graphite, 0.4-mm id		500-2114 (10/pk)
	Column nut, finger-tight (for .100- to .320-mm columns)	Connect column to inlet or detector	5020-8292
All	Ferrule, no-hole	Testing	5181-3308 (10/pk)
	Capillary column blanking nut	Testing–use with any ferrule	5020-8294
	Column nut, universal	Connect column to inlet or detector	5181-8830 (2/pk)
	Column nut, collared, self-tightening	Connect column to inlet or detector	G3440-81011
	Collar for self-tightening nut	Connect column to inlet or detector	G3440-81012
	Column nut, collared, self-tightening MSD	Connect column to inlet or detector	G3440-81013
	Column cutter, ceramic wafer	Cutting capillary columns	5181-8836 (4/pk)
	Pencil, diamond tipped	Cutting capillary columns	420-1000
	Ferrule tool kit	Ferrule installation	440-1000

Table 7 Other consumables and parts for the split/splitless inlet

Description/quantity	Part number
Septum retainer nut for headspace	18740-60830
Septum retainer nut	18740-60835
11-mm septum, high-temperature, low-bleed, 50/pk	5183-4757
11-mm septum, prepierced, long life, 50/pk	5183-4761
Nonstick fluorocarbon liner O-ring (for temperatures up to 350 °C), 10/pk	5188-5365

Table 7 Other consumables and parts for the split/splitless inlet (continued)

Description/quantity	Part number
Graphite O-ring for split liner (for temperatures above 350 °C), 10/pk	5180-4168
Graphite O-ring for splitless liner (for temperatures above 350 °C), 10/pk	5180-4173
Split vent trap PM kit, single cartridge	5188-6495
Retaining nut	G1544-20590
Gold-plated seal (standard application)	5188-5367
Gold-plated seal with cross (high split flows) (includes SS washer)	5182-9652
Stainless steel washer (0.375-inch od), 12/pk	5061-5869
Reducing nut	18740-20800
Column nut, blanking plug	5020-8294
Capillary inlet preventative maintenance kit, split	5188-6496
Capillary inlet preventative maintenance kit, splitless	5188-6497

Exploded Parts View of the Split/Splitless Inlet

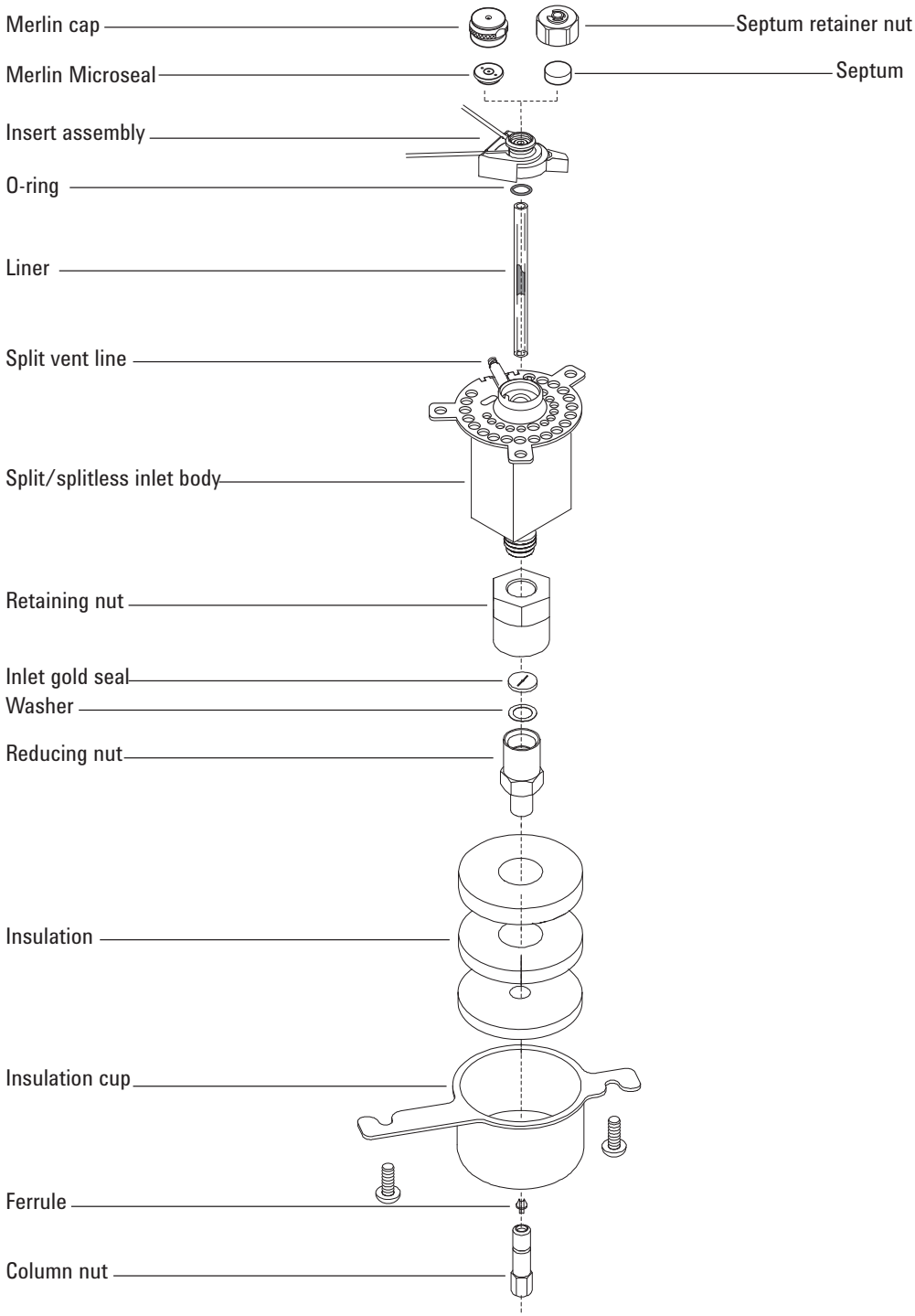


Figure 6. Split/splitless inlet exploded parts

To Install a Capillary Column with the Split/Splitless Inlet

WARNING

Do not use hydrogen as the carrier for conditioning! It could vent into the oven and present an explosion hazard.

1 Gather the following, see **"Consumables and Parts for the Split/Splitless Inlet"** on page 42:
   - Column
   - Ferrule(s)
   - Column nut
   - Septum
   - Column cutter
   - Isopropanol
   - Lab tissue
   - Metric ruler
   - Two 1/4-inch open-end wrenches
   - Lint-free gloves

2 Launch the GC maintenance wizard: **Maintenance > Column > Perform Maintenance > Install Column > Start Maintenance.** Wait for the GC to become ready.
The wizard will guide you through the maintenance steps described below.

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.

WARNING

Wear safety glasses to protect your eyes from flying particles while handling, cutting, or installing glass or fused silica capillary columns. Use care in handling these columns to prevent puncture wounds.

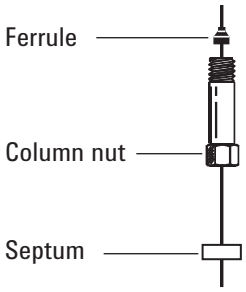
3 Verify that the correct glass liner is installed. See **"Consumables and Parts for the Split/Splitless Inlet"** on page 42.

4 Place the column on the hanger with the ends pointing up and the label to the front.

CAUTION

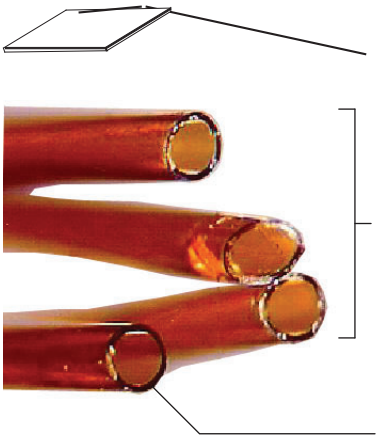
Wear clean, lint-free gloves to prevent contamination of parts with dirt and skin oils.

5 Place a septum, capillary column nut, and ferrule on the column.



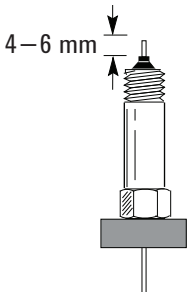
6 Score the column using a glass scribing tool. The score must be square to ensure a clean break.

7 Break off the column end by supporting it against the column cutter opposite the scribe. Inspect the end with a magnifying loupe to make certain there are no burrs or jagged edges.

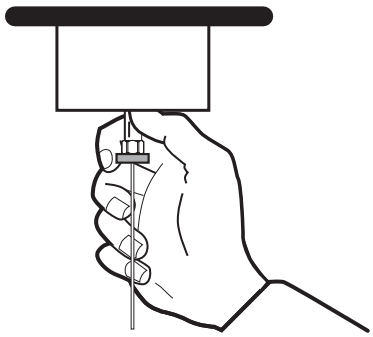


8 Wipe the column walls with a tissue dampened with isopropanol to remove fingerprints and dust.

9 Position the column so it extends 4 to 6 mm above the end of the ferrule. Slide the septum up the column to hold the column nut at this position.



10 Thread the column nut into the inlet but do not tighten.



11 Adjust the column position so that the septum contacts the bottom of the column nut. Finger-tighten the column nut until it begins to grip the column.

12 Tighten the column nut an additional 1/4 to 1/2 turn with a wrench so that the column cannot be pulled from the fitting with gentle pressure.

13 Configure the new column.

14 Condition the column per the manufacturer's recommendation. See **To Condition a Capillary Column**.

15 Install the column into the detector.

- **To Install a Capillary Column in the FID**
- **To Install a Capillary Column in the NPD**
- **To Install a Capillary Column in the TCD**
- **To Install a Capillary Column in the ECD**
- **To Install a Capillary Column to the FPD+**

16 The GC maintenance wizard will perform checks at the appropriate times, including **Leak & Restriction** tests, and will automatically reset the maintenance counters.

17 Select **Finished**, then select **OK** to exit the GC maintenance wizard**.**

18 After the column is installed at both inlet and detector, establish a flow of carrier gas and purge as recommended by the column manufacturer.

19 Restore the analytical method.

- For FID or FPD+, immediately turn off the flame.
- For NPD, immediately turn off the bead.

20 After the GC becomes ready, wait 10 minutes then ignite the detector flame or bead.

WARNING

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

21 Allow the oven, inlet, and detector to equilibrate at operating temperature, then retighten the fittings.

To Change the Septum on the Split/Splitless Inlet

1 Gather the following:
   - Replacement septum, see **"Consumables and Parts for the Split/Splitless Inlet"** on page 42.
   - Wrench, hex for changing septum
   - 0- or 00-grade steel wool (optional)
   - Tweezers
   - Wrench, capillary inlet (optional)

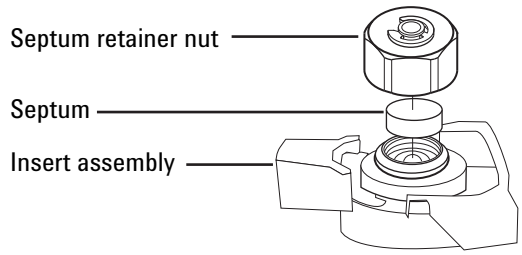
2 Launch the GC maintenance wizard: **Maintenance > Inlets,** select the inlet, then select **Perform Maintenance > Replace Septum > Start Maintenance.** The wizard will walk through the steps needed to replace the septum (those same steps are repeated below).

WARNING

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

3 Remove the septum retainer nut or Merlin cap.

4 Use tweezers to remove the septum or Merlin Microseal from the insert assembly. Do not gouge or scratch the interior of the insert assembly.

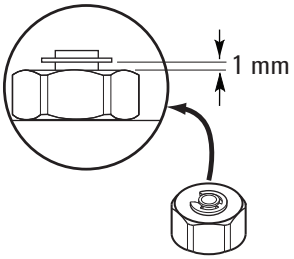


5 Firmly press the new septum or Merlin Microseal into the fitting. The metal parts side of the Merlin Microseal should face down (toward the oven).

6 Install the septum retainer nut or Merlin cap and finger-tighten. Tighten the septum retainer nut until the C-ring is about 1 mm above the nut.

CAUTION

Overtightening the septum nut can cause contamination.



7 Select **Maintenance** > **Inlets** > **Septum injections**, then touch **Reset Counter**.

8 Perform an inlet **Leak & Restriction** test and reset the maintenance counters.

9 Select **Finished**, then select **OK** to exit the GC maintenance wizard.

10 Restore the analytical method.

To Clean the Septum Seat in the Insert Assembly of the Split/Splitless Inlet

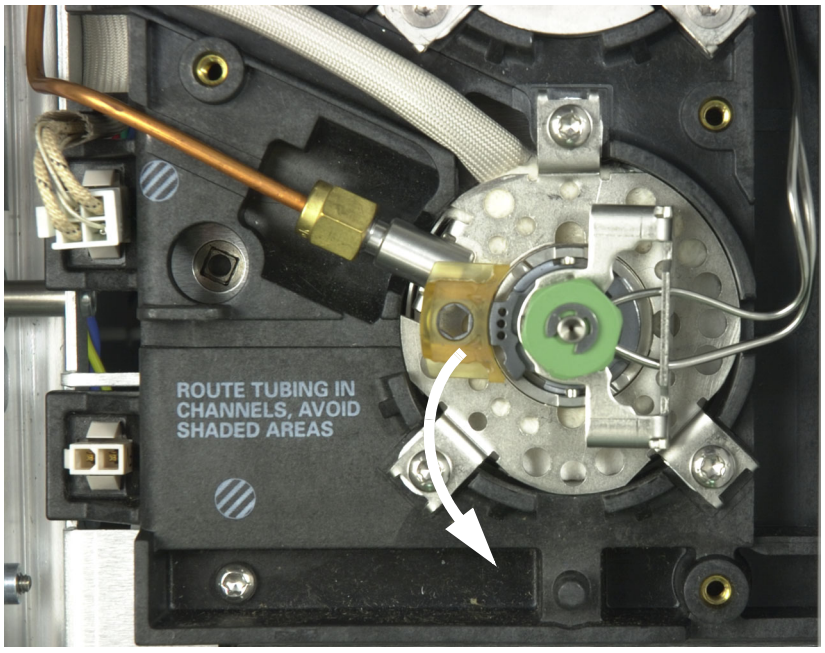
1 Gather the following:
   - Replacement septum, see **"Consumables and Parts for the Split/Splitless Inlet"** on page 42.
   - Wrench, hex for changing septum
   - 0- or 00-grade steel wool (optional)
   - Tweezers
   - Compressed, filtered, dry air or nitrogen
   - Wrench, capillary inlet (optional)

2 Manually set the inlet and oven temperature to < 40 °C, and wait for the inlet, oven, and other parts you might come into contact with inside the oven, to cool before continuing. Alternately, place the GC in maintenance mode: **Maintenance > Instrument > Perform Maintenance > Maintenance Mode > Start Maintenance.**

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.

3 Slide the locking tab forward (counterclockwise). Lift the insert assembly straight up and away from the inlet to avoid chipping or breaking the liner.



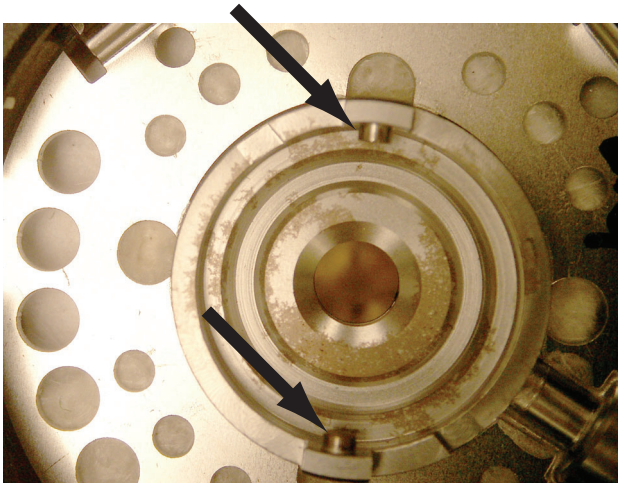
4 Remove the septum retainer nut or Merlin cap.

5 Use tweezers to remove the septum or Merlin Microseal from the retainer nut. See **"To Change the Septum on the Split/Splitless Inlet"** on page 50.

6 Scrub the residue from the retainer nut and septum holder with a small piece of rolled-up steel wool and tweezers. Do not do this over the inlet.

7 Use compressed air or nitrogen to blow away the pieces of steel wool and septum.

8 Line up the tab on the bottom of the insert assembly with the slot on the inlet body and push down to connect. Slide the locking tab to the left.



9 Firmly press the new septum or Merlin Microseal into the fitting. See **"To Change the Septum on the Split/Splitless Inlet"** on page 50.

10 Replace the septum retainer nut or Merlin cap and finger-tighten. See **"To Change the Septum on the Split/Splitless Inlet"** on page 50.

11 Exit maintenance mode. Select **Maintenance > Instrument > Perform Maintenance > Maintenance Mode > Finished.**

12 Select **Maintenance** > **Inlet** > **Septum injections**, then select **Reset**.

13 Perform a **Leak & Restriction** test.

14 Restore the analytical method.

To Change the Liner and O-Ring on the Split/Splitless Inlet

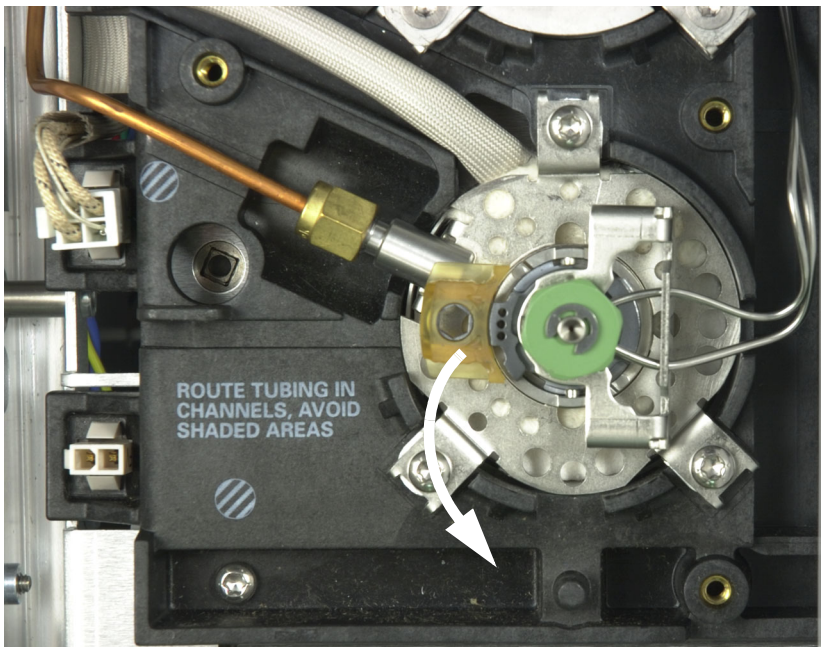
1 Gather the following:
   - Replacement O-ring, see **"Consumables and Parts for the Split/Splitless Inlet"** on page 42.
   - Replacement liner
   - Tweezers
   - Wrench, hex for changing septum (optional)
   - Wrench, capillary inlet (optional)
   - Lint-free gloves

2 Launch the GC maintenance wizard: **Maintenance > Inlets,** select the inlet, then select **Perform Maintenance > Replace Liner > Start Maintenance.** The wizard will walk through the steps needed to replace the liner and O-ring (those same steps are repeated below).

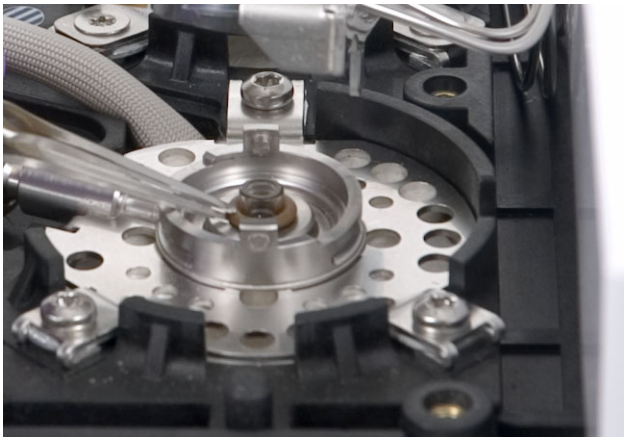
WARNING

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.

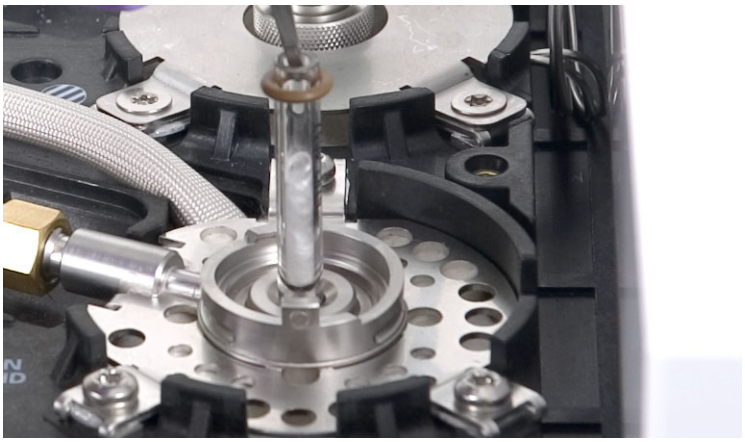
3 Slide the locking tab forward (counterclockwise). Lift the insert assembly straight up and away from the inlet to avoid chipping or breaking the liner.



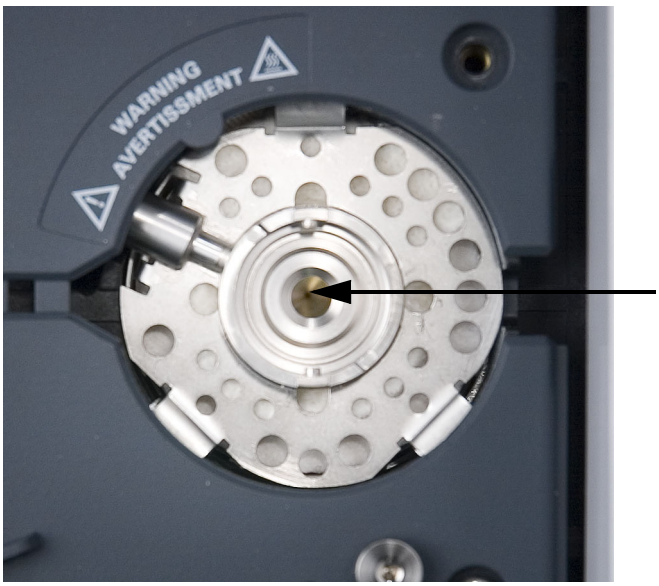
4 Loosen the O-ring from the sealing surface with tweezers.



5 Grasp the liner with tweezers and pull it out.



6 Inspect the surface of the gold seal for graphite or rubber septum contamination. If required, replace the gold seal. See**"To Replace the Gold Seal on the Split/Splitless Inlet"** on page 57.



7 Clean the inlet if there is visible or suspected contamination. See **"To Clean the Split/Splitless Inlet"** on page 61.

8 Clean O-ring residue from sealing surface.

CAUTION

Wear clean, lint-free gloves to prevent contamination of parts with dirt and skin oils.

9 Slide a new O-ring onto the replacement liner.

10 Return the liner to the inlet, pushing it all the way in until the liner contacts the gold seal.

11 Line up the tab on the bottom of the insert assembly with the slot on the inlet body and push down to connect. Slide the locking tab to the back.

12 Turn on the inlet. Allow the inlet and column to purge with carrier gas for 15 minutes before heating the inlet or the column oven.

13 Bakeout contaminants. See **"To Bakeout Contaminants from the Split/Splitless Inlet"** on page 63.

14 Configure the new column.

15 The GC maintenance wizard will perform checks at the appropriate times, including **Leak & Restriction** tests, and will automatically reset the maintenance counters.

16 Select **Finished**, then select **OK** to exit the GC installation wizard.

17 Restore the analytical method.

To Replace the Gold Seal on the Split/Splitless Inlet

1 Gather the following:
   - Replacement gold seal, see **"Consumables and Parts for the Split/Splitless Inlet"** on page 42.
   - Replacement washer
   - 1/4-inch wrench (for column)
   - 1/2-inch wrench
   - Lint-free gloves

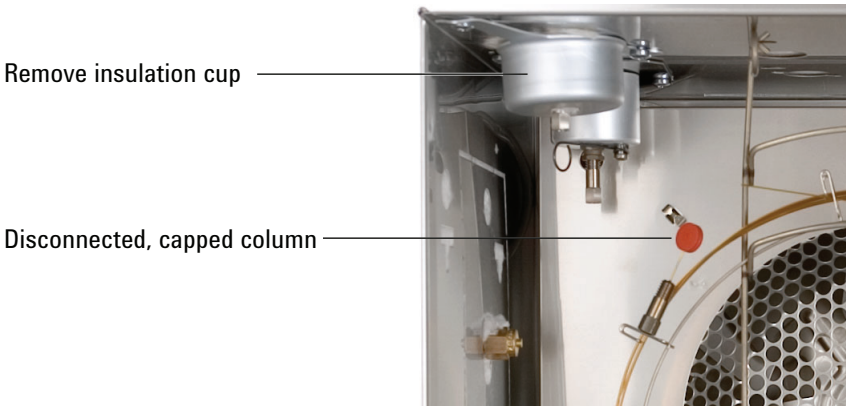
2 Launch the GC maintenance wizard: **Maintenance > Inlets,** select the inlet, then select **Perform Maintenance > Replace Gold Seal (bottom) > Start Maintenance.** The wizard will walk through the steps needed to replace the liner and O-ring (those same steps are repeated below). Wait for the GC to become ready.

WARNING

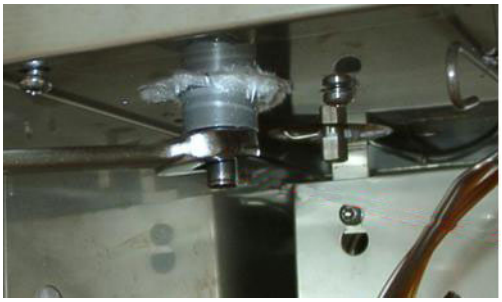
Be careful! The oven and/or inlet may be hot enough to cause burns. If either is hot, wear heat-resistant gloves to protect your hands.

3 Remove the inlet liner.

4 Remove the column from the inlet. Cap the open end of the column to prevent contamination. Remove the insulation cup around the base of the inlet.



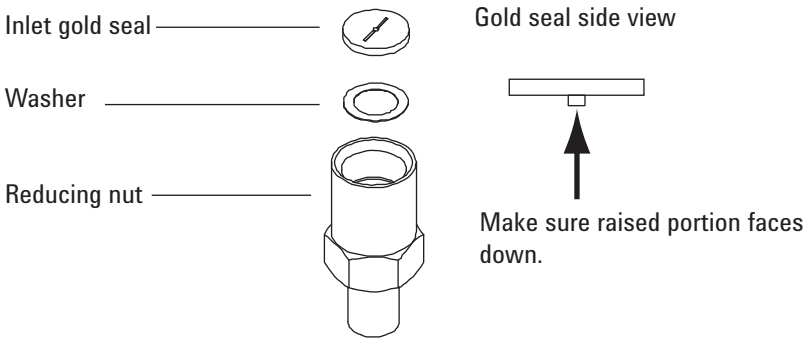
5 Loosen and remove the reducing nut. Remove the washer and seal inside the reducing nut.



CAUTION

Wear clean, lint-free gloves to prevent contamination of parts with dirt and skin oils.

6 Put on gloves to protect the new gold seal and washer from contamination. Put a new washer in the reducing nut and place the new gold seal on top of it (raised portion facing down).



7 Replace the reducing nut and tighten securely with a wrench.

8 Replace the inlet liner.

9 Install the column and the insulation cup.

10 Bakeout contaminants. See **"To Bakeout Contaminants from the Split/Splitless Inlet"** on page 63.

11 Perform an inlet **Leak & Restriction** test and reset the maintenance counters.

12 Select **Finished**, then select **OK** to exit the GC installation wizard.

13 Restore the analytical method.

To Replace the Filter in the Split Vent Trap for the Split/Splitless Inlet

1 Gather the following:
   - New split vent filter cartridge. See **"Consumables and Parts for the Split/Splitless Inlet"** on page 42.

2 Launch the GC maintenance wizard: **Maintenance > Inlets,** select the inlet, then select **Perform Maintenance > Replace Split Vent Trap > Start Maintenance.** The wizard will walk through the steps needed to replace the filter (those same steps are repeated below).

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.

WARNING

The split vent trap may contain residual amounts of any samples or other chemicals you have injected into the GC. Follow your company's safety procedures for handling these types of substances while replacing the trap filter cartridge.

3 Remove the pneumatics cover (top, back of GC). See **"To Remove the Pneumatics Cover"** on page 19.

4 Completely loosen the knurled nut that secures the split vent trap in place as shown in **Figure 7**.

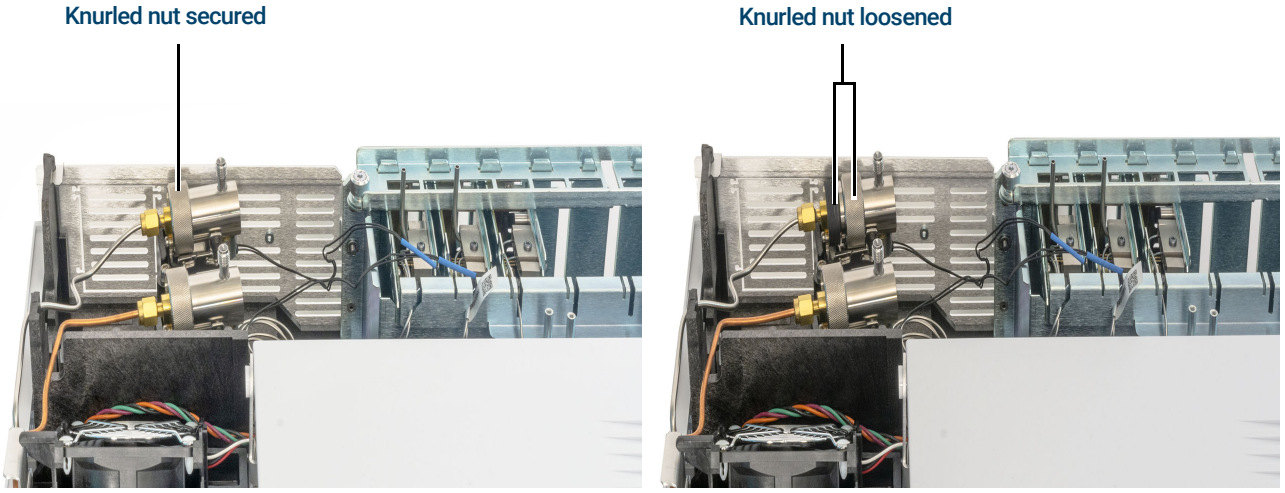


Figure 7. Loosen the knurled nut

5 Slide the trap assembly back from the guided mounting bracket and tilt up to expose the filter as shown in **Figure 8**.

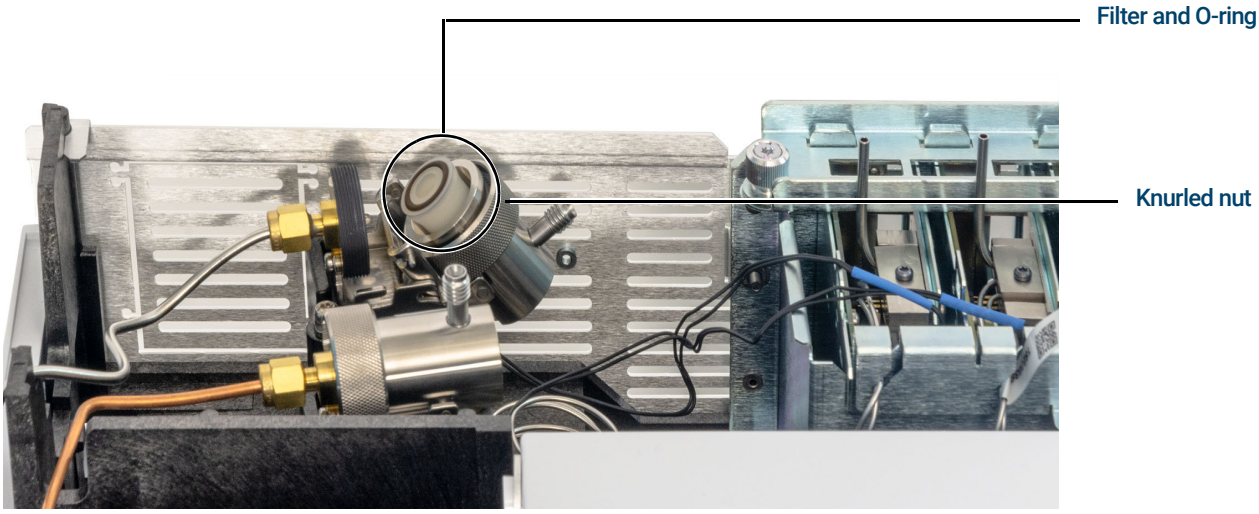


Figure 8. Slide trap assembly to expose the filter

6 Remove the old filter cartridge and two O-rings.

7 Verify the new O-rings are seated properly on the new filter cartridge.

8 Install the new filter cartridge then reassemble the trap using your fingers to fully tighten the knurled nut. The nut should thread easily.

If the knurled nut does not thread easily, loosen, reassemble the 2 parts of the trap, and thread again. Do not force it.

9 The GC maintenance wizard will perform checks at the appropriate times, including **Leak & Restriction** tests, and will automatically reset the maintenance counters.

10 Select **Finished**, then select **OK** to exit the GC maintenance wizard.

11 Install the pneumatics cover.

To Clean the Split/Splitless Inlet

1 Gather the following:
   - Replacement septum, see **"Consumables and Parts for the Split/Splitless Inlet"** on page 42.
   - Replacement liner
   - Replacement O-ring
   - Replacement gold seal
   - Replacement washer
   - Solvent that will clean the type of deposits in your inlet
   - Compressed, filtered, dry air or nitrogen
   - Beaker
   - Cleaning brushes—The FID cleaning kit (part number 9301-0985) contains appropriate brushes
   - Lint-free gloves
2 Manually set the inlet and oven temperature to < 40 °C, and wait for the inlet, oven, and other parts you might come into contact with inside the oven, to cool before continuing. Alternately, place the GC in maintenance mode: **Maintenance > Instrument > Perform Maintenance > Maintenance Mode > Start Maintenance.**

WARNING

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

3 Remove the inlet liner, O-ring, and septum. See **"To Change the Liner and O-Ring on the Split/Splitless Inlet"** on page 54.
4 Disconnect the column from the inlet.
5 Remove the reducing nut, gold seal, and washer. See **"To Replace the Gold Seal on the Split/Splitless Inlet"** on page 57.
6 Place a beaker in the oven under the inlet to catch the solvent.

CAUTION

Wear clean, lint-free gloves to prevent contamination of parts with dirt and skin oils.

7 Soak a cleaning brush in the solvent and scrub the inside of the insert assembly. Repeat 10 times.
8 Rinse the inlet with the solvent.
9 Blow the inside of the inlet dry with compressed air or nitrogen.
10 Install the gold seal, washer, and reducing nut.
11 Install the liner, O-ring, and septum.
12 Install the column. See **"To Install a Capillary Column with the Split/Splitless Inlet"** on page 46.

13 Exit maintenance mode. Select **Maintenance > Instrument > Perform Maintenance > Maintenance Mode > Finished.**

14 Bakeout contaminants. See **"To Bakeout Contaminants from the Split/Splitless Inlet"** on page 63.

15 Perform an inlet **Leak & Restriction** test.

16 On the GC, select **Maintenance** > **Inlets**, then reset the counters for the parts you changed.

17 Restore the analytical method.

To Bakeout Contaminants from the Split/Splitless Inlet

1. Put the inlet into split mode.
2. Set the column flow to the normal operating value, or set the capillary column gas velocity to 30 cm/s.
3. Set the inlet split vent flow to 200 mL/min.
4. Purge the column with carrier flow for at least 10 minutes before heating the oven.
5. If the column is attached to the detector, set the detector 25 °C above normal operating temperature.

WARNING

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

6. If the column is not attached to the detector, cap the detector fitting.
7. Set the inlet temperature to 300 °C or 25 °C above the normal operating temperature to bakeout contaminants from the inlet, mostly through the split vent.
8. Set the column oven 25 °C above the GC method final oven temperature to bake contaminants from the column. Do not exceed the column manufacturer's maximum temperature limit.
9. Bakeout for 30 minutes or until the detector baseline is free of contamination peaks.

6 Maintaining the Purged Packed Inlet

Consumables and Parts for the Purged Packed Inlet

See the Agilent catalog for consumables and supplies for a more complete listing, or visit the Agilent Web site for the latest information (**www.agilent.com**).

Table 8 Purged packed inlet parts

Description	Part number/quantity
Preventative maintenance kit	5188-6498
Purged packed glass liners and column adapters	
Glass liner	5080-8732 (25/pack) or 5181-3382 deactivated (5/pack)
0.53-mm column adapter	19244-80540
1/8-inch column adapter	19243-80530
1/4-inch column adapter	19243-80540
Recommended septa and O-rings for the purged packed inlet	
11-mm solid septum, low-bleed, red	5181-1263 (50/pk)
11-mm septum with partial through-hole, low-bleed, red	5181-3383 (50/pk)
11-mm septum, low-bleed, gray	5080-8896 (50/pk)
Merlin Microseal septum (30 psi)	5181-8815
11-mm high-temperature silicone septum (350 °C and higher)	5182-0739 (50/pk)
Viton O-ring (Top insert weldment)	5080-8898 (12/pk)
Packed column adapters for detectors	
Pre-swaged 1/8-inch packed column adapter	G3450-60191
Pre-swaged inert 1/8-inch packed column adapter	G3450-60192
Pre-swaged 1/4-inch packed column adapter	G3450-60193
Pre-swaged inert 1/4-inch packed column adapter	G3450-60194

Table 9 Nuts and ferrules for packed columns

Description	Typical use	Part number/quantity
1/8-inch id Swagelok stainless steel nut, front ferrule, back ferrule	1/8-inch column	5080-8751 (20 each/pk)
1/8-inch id Swagelok brass nut, front ferrule, back ferrule	1/8-inch column	5080-8750 (20 each/pk)
1/8-inch id Vespel/ graphite ferrule	1/8-inch column	0100-1332 (10/pk)
1/8-inch id brass tubing nut	1/8-inch column	5180-4103 (10/pk)

Table 9 Nuts and ferrules for packed columns (continued)

Description	Typical use	Part number/quantity
1/4-inch id Swagelok stainless steel nut, front ferrule, back ferrule	1/4-inch column	5080-8753 (20 each/pk)
1/4-inch id Swagelok brass nut, front ferrule, back ferrule	1/4-inch column	5080-8752 (20 each/pk)
1/4-inch id Vespel/ graphite ferrule	Inlet/detector liner/adapters 1/4-inch column	5080-8774 (10/pk)
1/4-inch id brass tubing nut	1/4-inch column	5180-4105 (10/pk)

Table 10 Nuts, ferrules, and hardware for capillary columns

Column id (mm)	Description	Typical use	Part number/quantity
.530	Ferrule, Vespel/graphite, 0.8-mm id	0.45-mm and 0.53-mm capillary columns	5062-3512 (10/pk)
	Ferrule, graphite, 1.0-mm id	0.53-mm capillary columns	5080-8773 (10/pk)
	Ferrule, graphite, 0.8-mm id	0.53-mm capillary columns	500-2118 (10/pk)
	Column nut, finger-tight (for 0.53-mm columns)	Connect column to inlet or detector	5020-8293
.320	Ferrule, Vespel/graphite, 0.5-mm id	0.32-mm capillary columns	5062-3514 (10/pk)
	Ferrule, graphite, 0.5-mm id	0.1-mm, 0.2-mm, 0.25-mm, and 0.32-mm capillary columns	5080-8853 (10/pk)
	Column nut, finger-tight (for .100 to 320-mm columns)	Connect column to inlet or detector	5020-8292
.250	Ferrule, Vespel/graphite, 0.4-mm id	0.1-mm, 0.2-mm, and 0.25-mm capillary columns	5181-3323 (10/pk)
	Ferrule, graphite, 0.5-mm id	0.1-mm, 0.2-mm, 0.25-mm, and 0.32-mm capillary columns	5080-8853 (10/pk)
	Column nut, finger-tight (for .100 to 320-mm columns)	Connect column to inlet or detector	5020-8292
.100 and .200	Ferrule, Vespel/graphite, 0.37-mm id	0.1-mm and 0.2-mm capillary columns	5062-3516 (10/pk)
	Ferrule, Vespel/graphite, 0.4-mm id	0.1-mm, 0.2-mm, and 0.25-mm capillary columns	5181-3323 (10/pk)
	Ferrule, graphite, 0.5-mm id	0.1-mm, 0.2-mm, 0.25-mm, and 0.32-mm capillary columns	5080-8853 (10/pk)
	Ferrule, graphite, 0.4-mm id		500-2114 (10/pk)
	Column nut, finger-tight (for .100- to .320-mm columns)	Connect column to inlet or detector	5020-8292
All	Ferrule, no-hole	Testing	5181-3308 (10/pk)
	Capillary column blanking nut	Testing–use with any ferrule	5020-8294
	Column nut, universal	Connect column to inlet or detector	5181-8830 (2/pk)
	Column nut, collared, self-tightening	Connect column to inlet or detector	G3440-81011

Table 10 Nuts, ferrules, and hardware for capillary columns (continued)

Column id (mm)	Description	Typical use	Part number/quantity
	Collar for self-tightening nut	Connect column to inlet or detector	G3440-81012
	Column nut, collared, self-tightening MSD	Connect column to inlet or detector	G3440-81013
	Column cutter, ceramic wafer	Cutting capillary columns	5181-8836 (4/pk)
	Pencil, diamond tipped	Cutting capillary columns	420-1000
	Ferrule tool kit	Ferrule installation	440-1000

Exploded Parts View of the Purged Packed Inlet

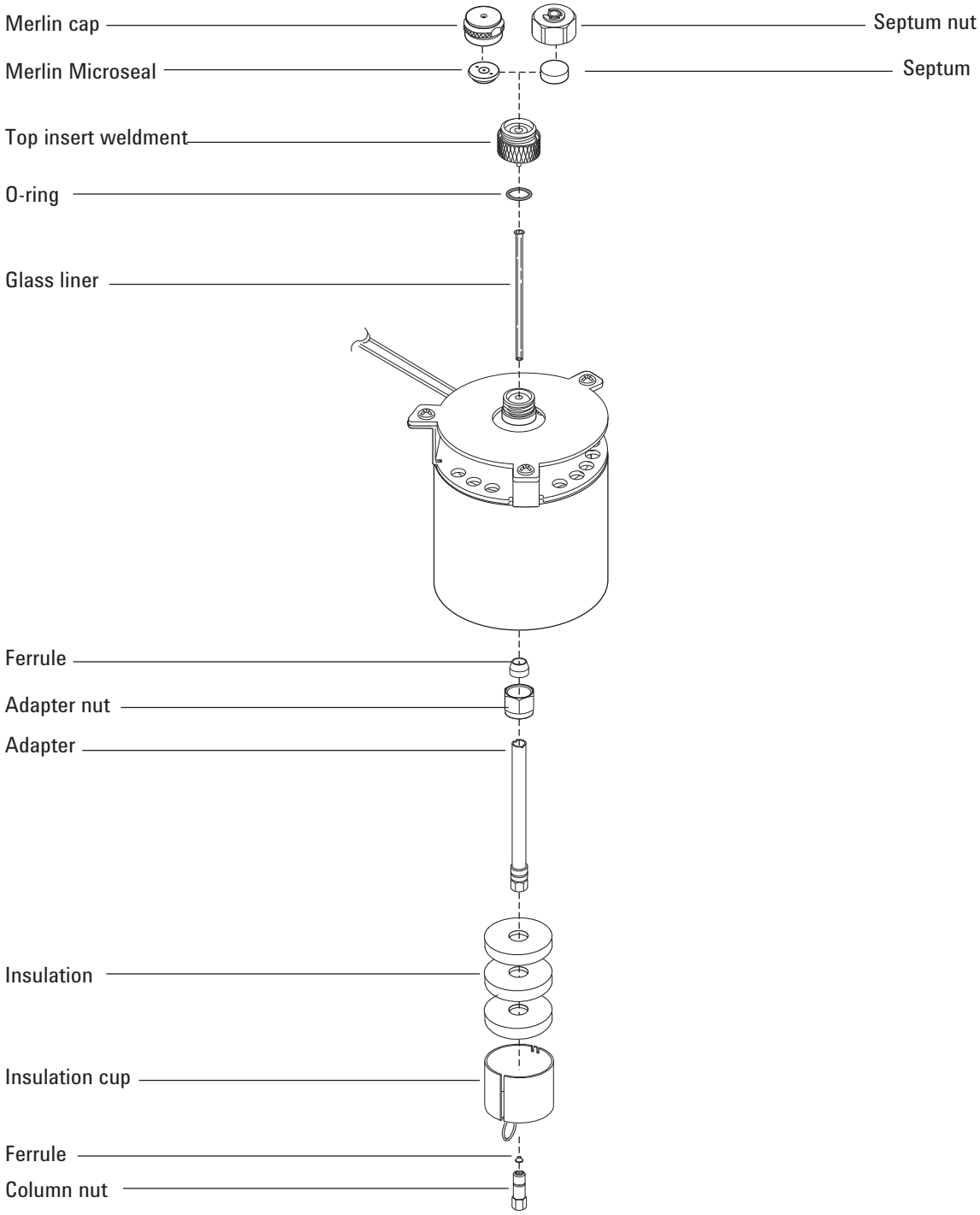


Figure 9. Purged packed inlet exploded parts

To Install a Capillary Column with the Purged Packed Inlet

1 Gather the following:
- Column
- Ferrule, see **"Consumables and Parts for the Purged Packed Inlet"** on page 66.
- Column nut
- Glass liner
- Viton O-ring
- 0.53-mm column adapter
- Septum
- Two 1/4-inch wrenches
- Metric ruler
- Lint-free gloves

2 Launch the GC maintenance wizard: **Maintenance > Column > Perform Maintenance > Install Column > Start Maintenance.** Wait for the GC to become ready.
The wizard will guide you through the maintenance steps described below.

WARNING

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

WARNING

Wear safety glasses to protect your eyes from flying particles while handling, cutting, or installing glass or fused silica capillary columns. Use care in handling these columns to prevent puncture wounds.

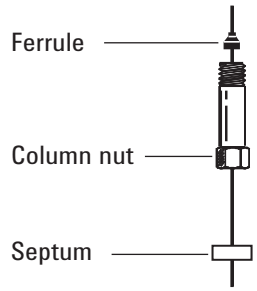
3 Install a 0.53-mm column adapter. See **"To Install an Adapter on the Purged Packed Inlet"** on page 78.

CAUTION

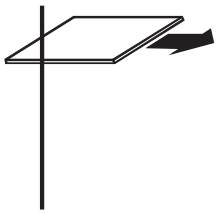
Wear clean, lint-free gloves to prevent contamination of parts with dirt and skin oils.

4 Install a new Viton O-ring. See **"To Change the O-Ring on the Purged Packed Inlet"** on page 79.

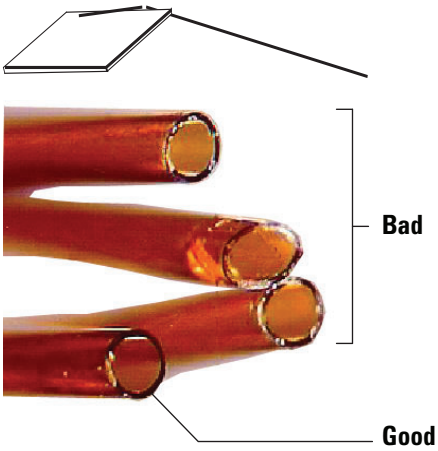
5 Place a septum, capillary column nut, and ferrule on the column.



6 Score the column using a glass scribing tool. The score must be square to ensure a clean break.

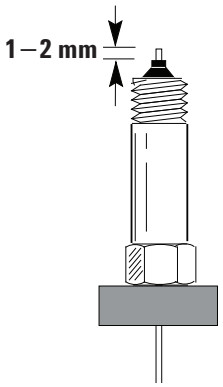


7 Break off the column end by supporting it against the column cutter opposite the scribe. Inspect the end with a magnifying loupe to make certain there are no burrs or jagged edges.

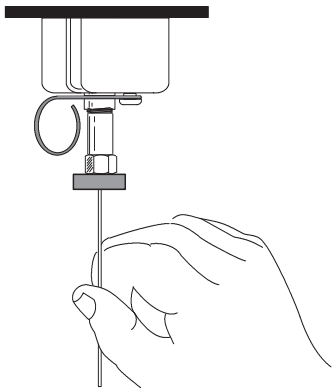


8 Wipe the column walls with a tissue dampened with isopropanol to remove fingerprints and dust.

9 Position the column so it extends 1 to 2 mm above the end of the ferrule. Slide the septum up the column to hold the column nut at this fixed position.



10 Thread the column nut into the inlet adapter but do not tighten.



11 Adjust the column position so that the septum is even with the bottom of the column nut. Finger-tighten the column nut until it begins to grip the column.

12 Tighten the column nut an additional 1/4 to 1/2 turn with a wrench so that the column cannot be pulled from the fitting with gentle pressure.

13 Configure the new column.

14 Condition the column per the manufacturer's recommendation. See **"To Condition a Capillary Column"**.

15 Install the column into the detector.

NOTE

Perform the column installation procedure manually. Do not use the automated column installation wizard.

- **To Install a Capillary Column in the FID**
- **To Install a Capillary Column in the NPD**
- **To Install a Capillary Column in the TCD**
- **To Install a Capillary Column in the ECD**
- **To Install a Capillary Column to the FPD+**

16 The GC maintenance wizard will perform checks at the appropriate times, including **Leak & Restriction** tests, and will automatically reset the maintenance counters.

17 Select **Finished**, then select **OK** to exit the GC maintenance wizard.

18 After the column is installed at both inlet and detector, establish a flow of carrier gas and purge as recommended by the column manufacturer.

19 Restore the analytical method.

- For FPD+, immediately turn off the flame.
- For NPD, immediately turn off the bead.

20 After the GC becomes ready, wait 10 minutes then ignite the detector flame or adjust offset on the NPD bead.

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.

21 Allow the oven, inlet, and detector to equilibrate at operating temperature, then retighten the fittings.

To Change the Septum on the Purged Packed Inlet

1 Gather the following:
   - Replacement septum, see **"Consumables and Parts for the Purged Packed Inlet"** on page 66.
   - Septum nut wrench
   - 0- or 00-grade steel wool (optional)
   - Tweezers

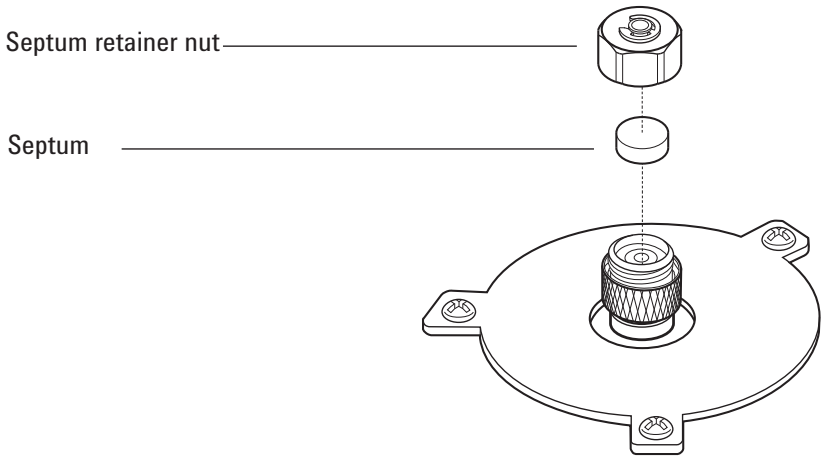
2 Launch the GC maintenance wizard: **Maintenance > Inlets,** select the inlet, then select **Perform Maintenance > Replace Septum > Start Maintenance.** Wait for the GC to become ready. The wizard will guide you through the maintenance steps described below.

WARNING

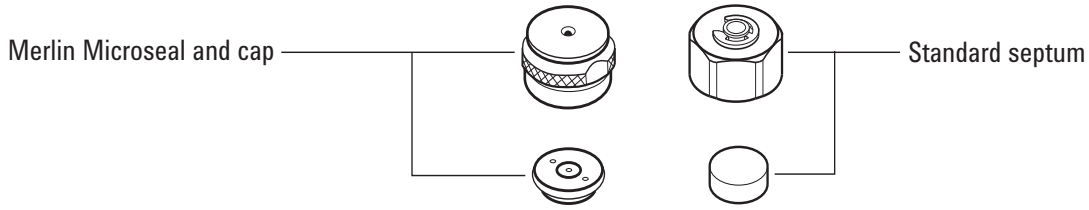
Be careful! The oven and/or inlet may be hot enough to cause burns. If the inlet is hot, wear heat-resistant gloves to protect your hands.

3 Remove the septum retainer nut or Merlin cap.

4 Use tweezers to remove the septum or Merlin Microseal from the retainer nut. Do not gouge or scratch the interior of the septum head.



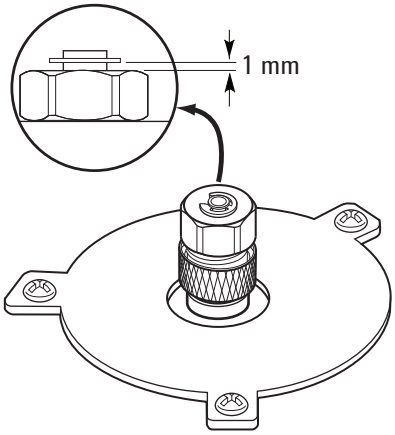
5 Firmly press the new septum or Merlin Microseal into the fitting. The metal parts side of the Merlin Microseal should face down (toward the oven).



6 Replace the septum retainer nut or Merlin cap and finger-tighten. Tighten the septum retainer nut until the C-ring is about 1 mm above the nut.

CAUTION

Overtightening the septum nut can cause contamination.



7 The GC maintenance wizard will perform checks at the appropriate times, including **Leak & Restriction** tests, and will automatically reset the maintenance counters.

8 Select **Finished**, then select **OK** to exit the GC maintenance wizard.

9 Restore the analytical method.

To Clean the Septum Seat in the Purged Packed Inlet

1 Gather the following:
   - Replacement septum, see **"Consumables and Parts for the Purged Packed Inlet"** on page 66.
   - Septum nut wrench
   - 0- or 00-grade steel wool (optional)
   - Tweezers
   - Compressed, filtered, dry air or nitrogen
   - Ultrasonic cleaning bath
   - Lint-free gloves
2 Manually set the inlet and oven temperature to < 40 °C, and wait for the inlet, oven, and other parts you might come into contact with inside the oven, to cool before continuing. Alternately, place the GC in maintenance mode: **Maintenance > Instrument > Perform Maintenance > Maintenance Mode > Start Maintenance.**

WARNING

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

3 Remove the septum retainer nut or Merlin cap.
4 Loosen the top insert assembly and remove.

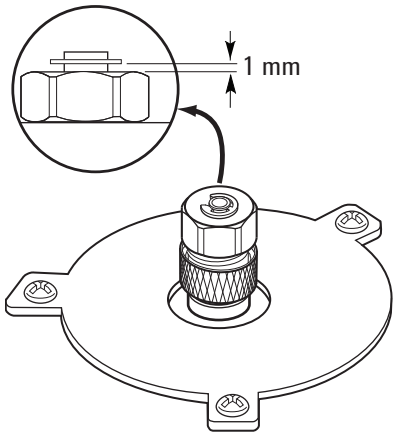
CAUTION

Wear clean, lint-free gloves to prevent contamination of parts with dirt and skin oils.

5 Use tweezers to remove the septum or Merlin Microseal from the top insert assembly. Do not gouge or scratch the interior of the septum head.
6 Scrub the residue from the top insert assembly and septum nut with a small piece of rolled-up steel wool and tweezers. Ultrasonically clean the retainer nut and top insert assembly.
7 Use compressed air or nitrogen to blow away the pieces of steel wool and septum.
8 Wearing gloves, inspect the O-ring and replace, if necessary. See **"To Change the O-Ring on the Purged Packed Inlet"** on page 79.
9 Install the top insert assembly and hand-tighten firmly.
10 Firmly press the new septum or Merlin Microseal into the fitting.
11 Install the septum retainer nut or Merlin cap and finger-tighten. Tighten the septum retainer nut until the C-ring is about 1 mm above the nut.

CAUTION

Overtightening the septum nut can cause contamination.



12 Perform an inlet **Leak & Restriction** test and reset the maintenance counters.

13 Exit maintenance mode. Select **Maintenance > Instrument > Perform Maintenance > Maintenance Mode > Finished.**

14 Select **Maintenance** > **Inlets** > **Septum injections**, then select **Reset Counter**.

15 Restore the analytical method.

To Install an Adapter on the Purged Packed Inlet

1 Gather the following:
   - Brass tubing nut, see **"Consumables and Parts for the Purged Packed Inlet"** on page 66.
   - Adapter (0.53 mm, 1/8-inch packed, or 1/4-inch packed)
   - 7/16-inch and 9/16-inch wrench
   - Vespel/graphite ferrule
   - Methanol
   - Lint-free gloves

2 Place GC in maintenance mode: **Maintenance > Instrument > Perform Maintenance > Maintenance Mode > Start Maintenance.** Wait for the GC to become ready.

WARNING

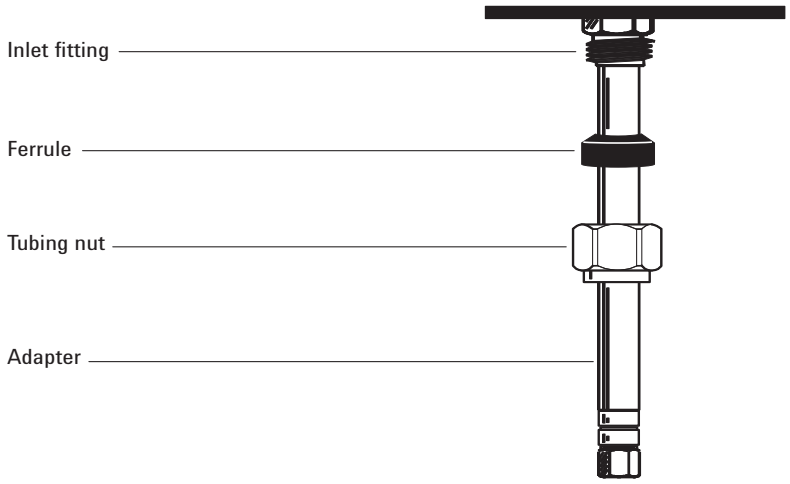
Be careful! The oven and/or inlet may be hot enough to cause burns. If the inlet is hot, wear heat-resistant gloves to protect your hands.

CAUTION

Wear clean, lint-free gloves to prevent contamination of parts with dirt and skin oils.

3 Clean the end of the adapter with a lint-free cloth and methanol to remove contamination such as fingerprints.

4 Place the tubing nut and Vespel/graphite ferrule on the adapter.



5 Insert the adapter straight into the inlet base as far as possible.

6 Hold the adapter in this position and finger-tighten the nut.

7 Tighten an additional 1/4 turn with a wrench.

8 Exit maintenance mode. Select **Maintenance > Instrument > Perform Maintenance > Maintenance Mode > Finished.**

To Change the O-Ring on the Purged Packed Inlet

1 Gather the following:
   - Replacement O-ring, see **"Consumables and Parts for the Purged Packed Inlet"** on page 66.
   - Septum nut wrench
   - Tweezers
   - Lint-free gloves

2 Launch the GC maintenance wizard: **Maintenance > Inlets,** select the inlet, then select **Perform Maintenance > Replace O-Ring > Start Maintenance.** Wait for the GC to become ready. The wizard will guide you through the maintenance steps described below.

WARNING

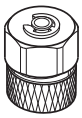
Be careful! The oven and/or inlet may be hot enough to cause burns. If the inlet is hot, wear heat-resistant gloves to protect your hands.

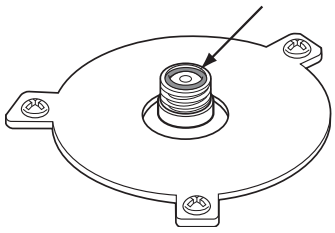
3 Loosen the top insert assembly to remove the top portion of the inlet.

CAUTION

Wear clean, lint-free gloves to prevent contamination of parts with dirt and skin oils.

4 Use tweezers to remove the old O-ring.





5 Insert a new O-ring.

6 Install and tighten the top insert assembly.

7 The GC maintenance wizard will perform checks at the appropriate times, including **Leak & Restriction** tests, and will automatically reset the maintenance counters.

8 Select **Finished**, then select **OK** to exit the GC maintenance wizard.

9 Restore the analytical method.

To Change the Glass Liner on the Purged Packed Inlet

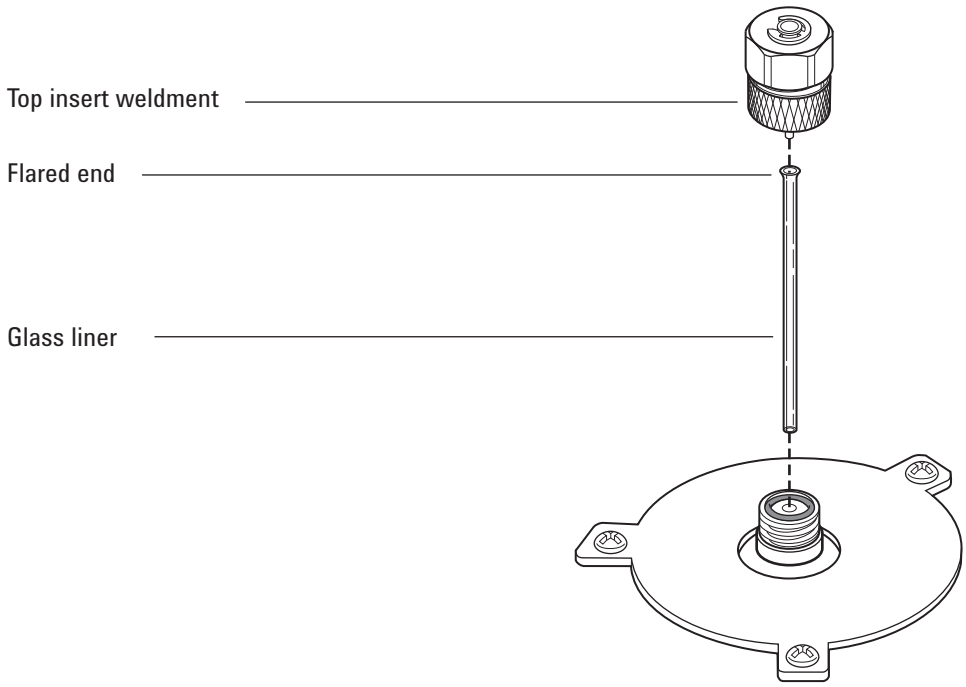
1 Gather the following:
   - Replacement glass liner, see **"Consumables and Parts for the Purged Packed Inlet"** on page 66.
   - 9/16-inch wrench
   - Lint-free gloves

2 Launch the GC maintenance wizard: **Maintenance > Inlets,** select the inlet, then select **Perform Maintenance > Replace Liner > Start Maintenance.** Wait for the GC to become ready. The wizard will guide you through the maintenance steps described below.

WARNING

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

3 Loosen the top insert assembly to remove the top portion of the inlet.



4 Use a thin wire or wood splint to carefully lift and remove the old glass liner.

CAUTION

Wear clean, lint-free gloves to prevent contamination of parts with dirt and skin oils.

5 Wearing gloves, inspect the O-ring and replace, if necessary. See **"To Change the O-Ring on the Purged Packed Inlet"** on page 79.

6 Wearing gloves, grasp the flared end (top) of the replacement glass liner with tweezers and install it in the inlet. If the glass liner does not seat properly because a capillary column is installed, remove the column, install the glass liner, and replace the column. See **"To Install a Capillary Column with the Purged Packed Inlet"** on page 70.

7 Install the top insert assembly and hand-tighten firmly.

8 Configure the new liner.

9 The GC maintenance wizard will perform checks at the appropriate times, including **Leak & Restriction** tests, and will automatically reset the maintenance counters.

10 Select **Finished**, then select **OK** to exit the GC maintenance wizard**.**

11 Restore the analytical method.

To Clean the Purged Packed Inlet

1 Gather the following:
   - Replacement O-ring, see **"Consumables and Parts for the Purged Packed Inlet"** on page 66.
   - Replacement glass liner
   - Replacement septum
   - Solvent that will clean the type of deposits in your inlet
   - Compressed, filtered, dry air or nitrogen
   - Beaker
   - Cleaning brushes—The FID cleaning kit (part number 9301-0985) contains appropriate brushes
   - Lint-free gloves

2 Manually set the inlet and oven temperature to < 40 °C, and wait for the inlet, oven, and other parts you might come into contact with inside the oven, to cool before continuing. Alternately, place the GC in maintenance mode: **Maintenance > Instrument > Perform Maintenance > Maintenance Mode > Start Maintenance.**

WARNING

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

3 Remove the column.

4 Remove the septum nut and septum.

5 Remove the top insert assembly.

6 Remove the glass liner and O-ring.

7 If used, remove the adapter.

8 Ultrasonically clean the septum nut, top insert assembly, and adapter (if used) in a suitable solvent.

9 Place a beaker in the oven under the inlet to catch the solvent.

CAUTION

Wear clean, lint-free gloves to prevent contamination of parts with dirt and skin oils.

10 Soak a cleaning brush with the solvent and vigorously scrub the interior walls of the inlet.

11 Blow the inside of the inlet dry with compressed air or nitrogen.

12 Install the adapter, if used. See **"To Install an Adapter on the Purged Packed Inlet"** on page 78.

13 Install the glass liner and O-ring. See **"To Change the Glass Liner on the Purged Packed Inlet"** on page 80.

14 Install the top insert assembly and finger-tighten.

NOTE

Perform the installation procedures manually. Do not use the automated installation wizards.

15 Install the septum and septum nut. See **"To Change the Septum on the Purged Packed Inlet"** on page 74.

16 Attach the column. See **"To Install a Capillary Column with the Purged Packed Inlet"** on page 70.

17 Restore the analytical method.

To Bakeout Contaminants from the Purged Packed Inlet

1. Set the column flow to the normal operating value, or set the capillary column gas velocity to 30 cm/s.
2. Purge the column with carrier flow for at least 10 minutes before heating the oven.
3. If the column is attached to the detector, set the detector 25 °C above normal operating temperature.

   If the column is not attached to the detector, cap the detector fitting.

WARNING

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

4. Set the inlet temperature to 300 °C or 25 °C above the normal operating temperature.
5. Set the column oven 25 °C above the GC method final oven temperature to bake contaminants out of the inlet. Do not exceed the column manufacturer's maximum temperature limit.
6. Bakeout for 30 minutes or until the detector baseline is free of contamination peaks.

To Install a Packed Metal Column

1 Gather the following:
   - 7/16-inch, 9/16-inch, and 1/2-inch wrenches
   - Lint-free gloves

2 Launch the GC maintenance wizard: **Maintenance > Column > Perform Maintenance > Install Column > Start Maintenance.** Wait for the GC to become ready.
The wizard will guide you through the maintenance steps described below.

3 Prepare the packed metal column. See **"To Install Ferrules on a Packed Metal Column"** on page 93.

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.

4 Install the 1/8-inch or 1/4-inch packed column inlet adapter, if necessary. See **"To Install an Adapter on the Purged Packed Inlet"** on page 78.

CAUTION

Wear clean, lint-free gloves to prevent contamination of parts with dirt and skin oils.

5 Attach the column to the inlet adapter.

6 Finger-tighten the nut.

7 Tighten the nut an additional 1/4 turn with a wrench (for a 1/8-inch column) or an additional 3/4 turn (for a 1/4-inch column).

   Use two wrenches, one on the column nut and the other on the adapter, to prevent the adapter from rotating.

8 The GC maintenance wizard will perform checks at the appropriate times, including **Leak & Restriction** tests, and will automatically reset the maintenance counters.

   Select **Finished**, then select **OK** to exit the GC maintenance wizard.

9 Select **Method > Configuration > Columns**, then select the Packed column. Select **Column Type > Packed**, then choose your **Inlet** and **Outlet Connection** to identify the inlet and detector to which the column is attached. Double-click the column to manually set your column temperatures. Configure the new packed column (make sure either column length or diameter is zero).

WARNING

Do not use hydrogen as the carrier for conditioning! It could vent into the oven and present an explosion hazard.

10 Condition the column, if necessary. See **"To Condition a Packed Column"** on page 92.

11 Place GC in maintenance mode: **Maintenance > Instrument > Perform Maintenance > Maintenance Mode > Start Maintenance.** Wait for the GC to become ready.

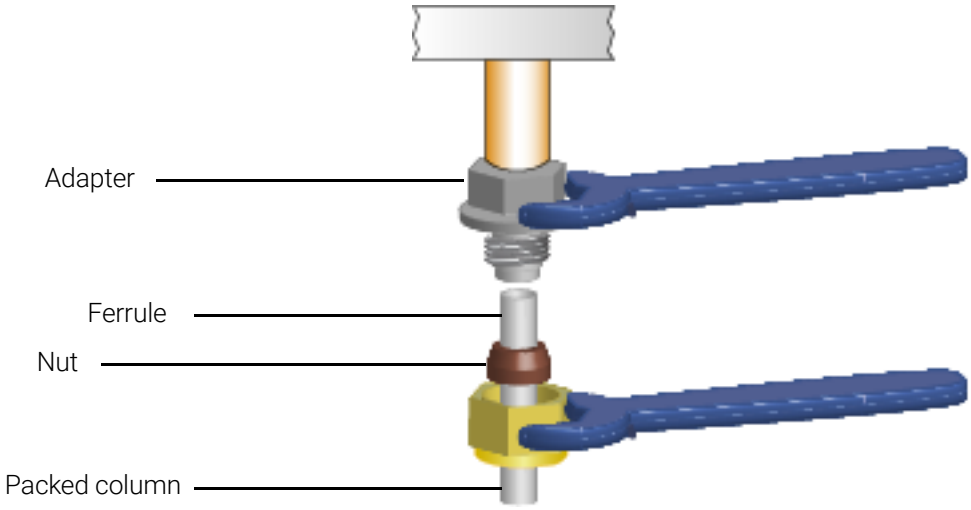
WARNING

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.

12 If required, install a packed column adapter onto the detector column fitting. See **"To Install a Packed Column Adapter onto a Detector"** on page 88.

13 Place a nut and ferrule onto the packed column.

14 Attach the column to the detector or detector adapter. Finger-tighten the nut.



15 Using two wrenches, one on the adapter and one on the column nut, tighten the column nut an additional 1/4 turn (for a 1/8-inch column) or an additional 3/4 turn (for a 1/4-inch column).

16 Exit maintenance mode. Select **Maintenance > Instrument > Perform Maintenance > Maintenance Mode > Finished.**

17 Establish a flow of carrier gas and purge as recommended by the packing manufacturer. Generally:

- 20 to 30 mL/min for 2-mm id glass or 1/8-inch od metal columns
- 50 to 60 mL/min for 4-mm id glass or 1/4-inch od metal columns

18 Heat the oven to 200 °C, cool it to a safe handling temperature, then re-tighten the column connection. (Re-tighten until snug, only about 15 degrees rotation.) Repeat two more times. This process will set the Vespel/graphite ferrule to help prevent leaks.

19 Restore the analytical method.

- For FPD+, immediately turn off the flame.
- For NPD, immediately turn off the bead.

20 After the GC becomes ready, wait 10 minutes then ignite the detector flame or adjust offset on the NPD bead.

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.

21 Allow the oven, inlet, and detector to equilibrate at operating temperature, then retighten the fittings.

22 Perform the inlet **Leak & Restriction** test and reset the maintenance counters.

To Install a Packed Column Adapter onto a Detector

This procedure applies to the FID, FPD+, NPD, and TCD.

1 Gather the following:
   - Packed column adapter, see **"Consumables and Parts for the Purged Packed Inlet"** on page 66.
   - Ferrule, Vespel/graphite, 0.8-mm id
   - 7/16-inch wrench (for the packed column adapter and 1/8-inch packed column nuts)
   - 9/16-inch wrench (for 1/4-inch packed column nuts)
   - 1/8-inch nut and ferrule for a 1/8-inch packed column, or a 1/4-inch nut and ferrule for a 1/4-inch packed column
   - Lint-free gloves

2 Place GC in maintenance mode: **Maintenance > Instrument > Perform Maintenance > Maintenance Mode > Start Maintenance.** Wait for the GC to become ready.

WARNING

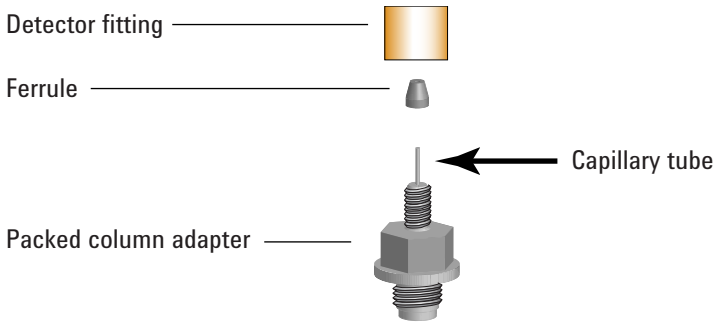
Be careful! The oven and/or detector may be hot enough to cause burns. If the detector is hot, wear gloves to protect your hands.

CAUTION

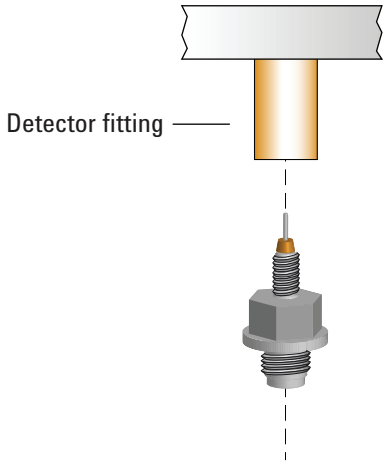
Wear clean, lint-free gloves to prevent contamination of parts with dirt and skin oils.

Handle the adapter carefully and install the packed column before installing the adapter into the detector base. The thin-walled capillary tube that carries the sample into the detector can be damaged by rough handling.

3 Place a ferrule onto the packed column adapter.



4 Carefully install the adapter assembly into the detector fitting. Align the adapter so the it enters the detector fitting as vertically as possible. Avoid stressing the adapter capillary tube. Finger-tighten the adapter into the detector base, then tighten an additional 1/8 turn using a wrench.



5 Exit maintenance mode. Select **Maintenance > Instrument > Perform Maintenance > Maintenance Mode > Finished.**

After installation, heat the oven to 200 °C, cool it to a safe handling temperature, then re-tighten the column connection. (Re-tighten until snug, only about 15 degrees rotation.) Repeat two more times. This process will set the Vespel/graphite ferrule to help prevent leaks.

To Install a Packed Glass Column

1 Gather the following:
- 9/16-inch wrench
- Two 1/4-inch brass nuts, see **"Consumables and Parts for the Purged Packed Inlet"** on page 66.
- Two 1/4-inch Vespel/graphite ferrules
- Lint-free gloves

2 Launch the GC maintenance wizard: **Maintenance > Column > Perform Maintenance > Install Column > Start Maintenance.** Wait for the GC to become ready.
The wizard will walk through the steps needed to replace the septum (those same steps are repeated below).

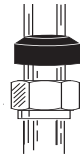
WARNING

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.

CAUTION

Wear clean, lint-free gloves to prevent contamination of parts with dirt and skin oils.

3 Assemble a brass nut and Vespel/graphite ferrule on each end of the column.



Glass columns must be simultaneously inserted into the inlet and detector and installed parallel to the oven door. When conditioning the column, do not attach the column to the detector.

4 If conditioning the column, insert the column into the purged packed inlet until it bottoms. Withdraw the column 1 to 2 mm. Finger-tighten the inlet column nut. See **"To Condition a Packed Column"** on page 92.

CAUTION

Overtightening the column nut or forcing it to bottom in either the inlet or detector may shatter the column.

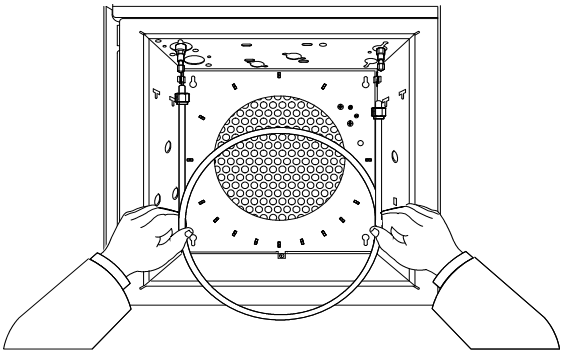
5 Tighten the inlet column nut 1/4 turn with a wrench.

WARNING

Do not use hydrogen as the carrier for conditioning! It could vent into the oven and present an explosion hazard.

6 After conditioning, remove the column from the inlet.

7 Simultaneously insert the column into the inlet and detector fittings but do not force it. It may be necessary to start the long end of the column in the inlet at an angle to clear the oven floor.



8 Withdraw the column 1 to 2 mm from both the inlet and detector. Finger-tighten both column nuts.

CAUTION

Overtightening the column nut or forcing it to bottom in either the inlet or detector may shatter the column.

9 Tighten both column nuts 1/4 turn with a wrench.

10 The GC maintenance wizard will perform checks at the appropriate times, including **Leak & Restriction** tests, and will automatically reset the maintenance counters.

11 Select **Finished**, then select **OK** to exit the GC maintenance wizard.

12 Configure the new packed column (make sure either column length or diameter is zero).

13 Establish a flow of carrier gas and purge as recommended by the packing manufacturer. Generally:

- 20 to 30 mL/min for 2-mm id glass or 1/8-inch od metal columns
- 50 to 60 mL/min for 4-mm id glass or 1/4-inch od metal columns

14 Restore the analytical method.

- For FPD+, immediately turn off the flame.
- For NPD, immediately turn off the bead.

15 After the GC becomes ready, wait 10 minutes then ignite the detector flame or adjust offset on the NPD bead.

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.

16 Allow the oven, inlet, and detector to equilibrate at operating temperature, then retighten the fittings.

17 Perform the inlet **Leak & Restriction** test and reset the maintenance counters.

To Condition a Packed Column

1 Gather the following:
- Capillary adapter
- Column nut and no-hole ferrule or blanking nut
- Two 7/16-inch wrenches
- 1/4-inch open-end wrench
- Lint-free gloves

WARNING **Do not use hydrogen as the carrier for conditioning! It could vent into the oven and present an explosion hazard.**

2 Place GC in maintenance mode: **Maintenance > Instrument > Perform Maintenance > Maintenance Mode > Start Maintenance.** Wait for the GC to become ready.

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.**

CAUTION **Wear clean, lint-free gloves to prevent contamination of parts with dirt and skin oils.**

3 Install the proper liner in the inlet and attach the column. See **"To Install a Packed Metal Column"** on page 85.

4 If present, remove the packed column adapter from the detector base. (If it is installed to the column, it can be conditioned with the column.)

5 Cap the detector fitting with the no-hole ferrule and column nut, or with a blanking nut.

6 Enter a column flow as recommended by the packing manufacturer or an appropriate flow as follows:
- 20 to 30 mL/min for 2-mm id glass or 1/8-inch od metal columns
- 50 to 60 mL/min for 4-mm id glass or 1/4-inch od metal columns

7 Raise the oven temperature slowly to the conditioning temperature for the column. The conditioning temperature is never higher than the maximum temperature limit for the column; 30 °C less than the maximum is usually sufficient.

8 Continue conditioning overnight at the final temperature. Cool the oven to room temperature with carrier flow on.

9 Attach the column to the detector and maintain established flow. See **"To Install a Packed Metal Column"** on page 85.

10 Perform the inlet **Leak & Restriction** test and reset the maintenance counters.

11 Exit maintenance mode. Select **Maintenance > Instrument > Perform Maintenance > Maintenance Mode > Finished.**

To Install Ferrules on a Packed Metal Column

1 Gather the following:
   - Wrenches
   - Stainless steel male Swagelok fitting, 1/4- or 1/8-inch od
   - Brass Swagelok nut and ferrule set, see **"Consumables and Parts for the Purged Packed Inlet"** on page 66.
   - Lint-free gloves

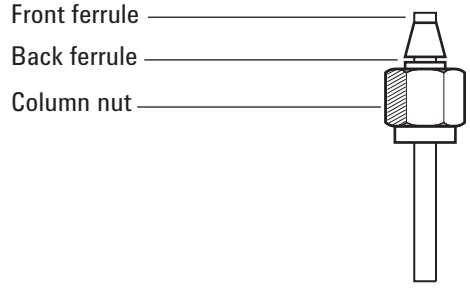
2 Verify that the column end is cut square and is free of burns and deformation.

3 Secure the fitting in a bench vise.

CAUTION

Wear clean, lint-free gloves to prevent contamination of parts with dirt and skin oils.

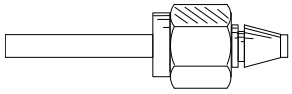
4 Assemble a Swagelok nut and ferrules onto the column.



5 Fully insert the column into the vise-held fitting, then withdraw 1–2 mm. Finger-tighten the nut.

6 Tighten the nut an additional 3/4 turn with a wrench (for a 1/8-inch column) or an additional 1-1/4 turn (for a 1/4-inch column).

7 Unscrew the column nut from the vise-held fitting and remove the column. Ferrules should now be set in place on the column with the column end correctly positioned.



7 Maintaining the Packed Column Inlet

Consumables and Parts for the Packed Column Inlet

See the Agilent catalog for consumables and supplies for a more complete listing, or visit the Agilent Web site for the latest information (**www.agilent.com**).

Table 11 Packed column inlet parts

Description	Part number/quantity
Preventative maintenance kit	5188-6498
Packed column glass liners and column adapters	
Glass liner	5080-8732 (25/pack) or 5181-3382 deactivated (5/pack)
1/8-inch column adapter	19243-80530
1/4-inch column adapter	19243-80540
Recommended septa and O-rings for the packed column inlet	
11-mm solid septum, low-bleed, red	5181-1263 (50/pk)
11-mm septum with partial through-hole, low-bleed, red	5181-3383 (50/pk)
11-mm septum, low-bleed, gray	5080-8896 (50/pk)
Merlin Microseal septum (30 psi)	5181-8815
11-mm high-temperature silicone septum (350 °C and higher)	5182-0739 (50/pk)
Viton O-ring (Top insert weldment)	5080-8898 (12/pk)
Packed column adapters for detectors	
Pre-swaged 1/8-inch packed column adapter	G3450-60191
Pre-swaged inert 1/8-inch packed column adapter	G3450-60192
Pre-swaged 1/4-inch packed column adapter	G3450-60193
Pre-swaged inert 1/4-inch packed column adapter	G3450-60194

Table 12 Nuts and ferrules for packed columns

Description	Typical use	Part number/quantity
1/8-inch id Swagelok stainless steel nut, front ferrule, back ferrule	1/8-inch column	5080-8751 (20 each/pk)
1/8-inch id Swagelok brass nut, front ferrule, back ferrule	1/8-inch column	5080-8750 (20 each/pk)
1/8-inch id Vespel/ graphite ferrule	1/8-inch column	0100-1332 (10/pk)
1/8-inch id brass tubing nut	1/8-inch column	5180-4103 (10/pk)

Table 12 Nuts and ferrules for packed columns (continued)

Description	Typical use	Part number/quantity
1/4-inch id Swagelok stainless steel nut, front ferrule, back ferrule	1/4-inch column	5080-8753 (20 each/pk)
1/4-inch id Swagelok brass nut, front ferrule, back ferrule	1/4-inch column	5080-8752 (20 each/pk)
1/4-inch id Vespel/ graphite ferrule	Inlet/detector liner/adapters 1/4-inch column	5080-8774 (10/pk)
1/4-inch id brass tubing nut	1/4-inch column	5180-4105 (10/pk)

Exploded Parts View of the Packed Column Inlet

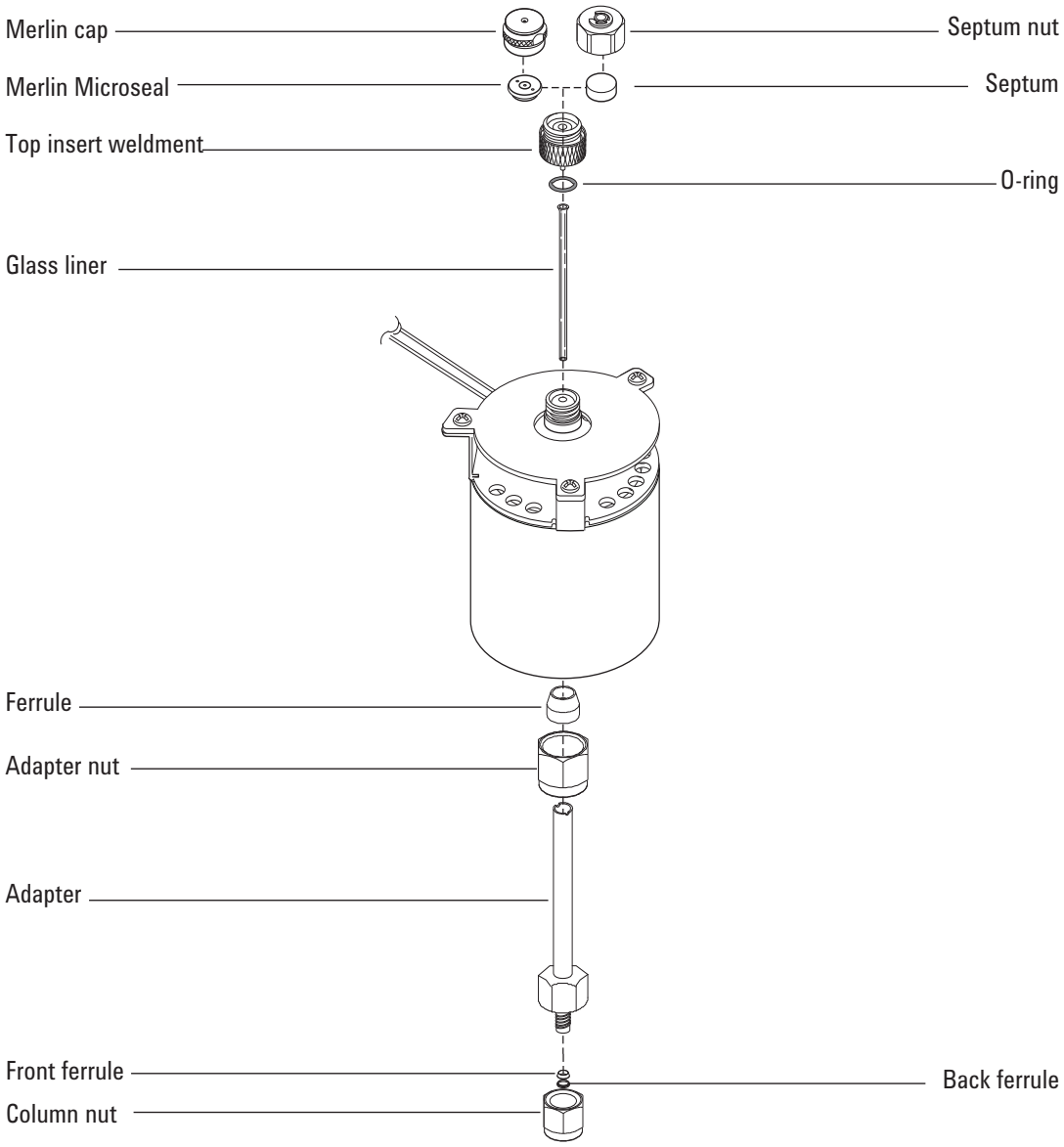


Figure 10. Packed column inlet exploded parts

To Change the Septum on the Packed Column Inlet

1 Gather the following:
   - Replacement septum. See **"Consumables and Parts for the Packed Column Inlet"** on page 96.
   - Septum nut wrench
   - 0- or 00-grade steel wool (optional)
   - Tweezers

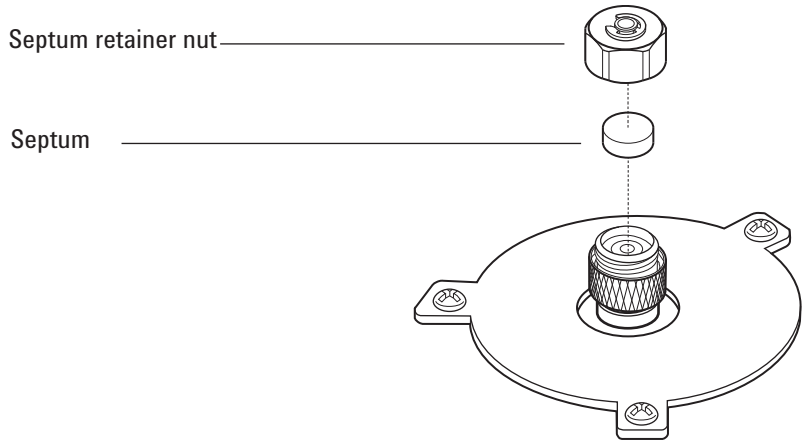
2 Launch the GC maintenance wizard: **Maintenance > Inlets,** select the inlet, then select **Perform Maintenance > Replace Septum > Start Maintenance.** The wizard will walk through the steps needed to replace the septum (those same steps are repeated below).

WARNING

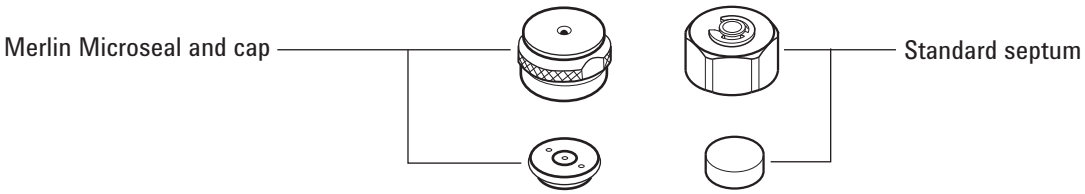
Be careful! The oven and/or inlet may be hot enough to cause burns. If the inlet is hot, wear heat-resistant gloves to protect your hands.

3 Remove the septum retainer nut or Merlin cap.

4 Use tweezers to remove the septum or Merlin Microseal from the retainer nut. Do not gouge or scratch the interior of the septum head.



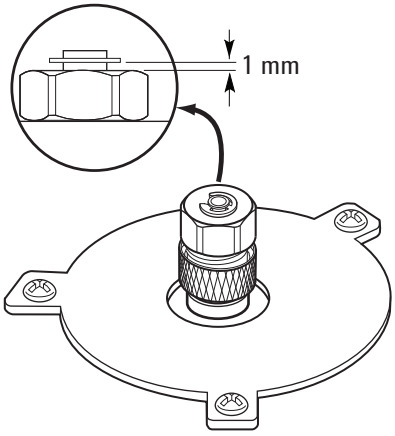
5 Firmly press the new septum or Merlin Microseal into the fitting. The metal parts side of the Merlin Microseal should face down (toward the oven).



6 Replace the septum retainer nut or Merlin cap and finger-tighten. Tighten the septum retainer nut until the C-ring is about 1 mm above the nut.

CAUTION

Overtightening the septum nut can cause contamination.



7 Reset the septum counter.

8 The GC maintenance wizard will perform checks at the appropriate times, including **Leak & Restriction** tests, and will automatically reset the maintenance counters.

9 Select **Finished**, then select **OK** to exit the GC maintenance wizard.

10 Restore the analytical method.

To Clean the Septum Seat in the Packed Column Inlet

1 Gather the following:
   - Replacement septum. See **"Consumables and Parts for the Packed Column Inlet"** on page 96.
   - Septum nut wrench
   - 0- or 00-grade steel wool (optional)
   - Tweezers
   - Compressed, filtered, dry air or nitrogen
   - Ultrasonic cleaning bath
   - Lint-free gloves
2 Manually set the inlet and oven temperature to < 40 °C, and wait for the inlet, oven, and other parts you might come into contact with inside the oven, to cool before continuing. Alternately, place the GC in maintenance mode: **Maintenance > Instrument > Perform Maintenance > Maintenance Mode > Start Maintenance.**

WARNING

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

3 Remove the septum retainer nut or Merlin cap.
4 Loosen the top insert weldment and remove.

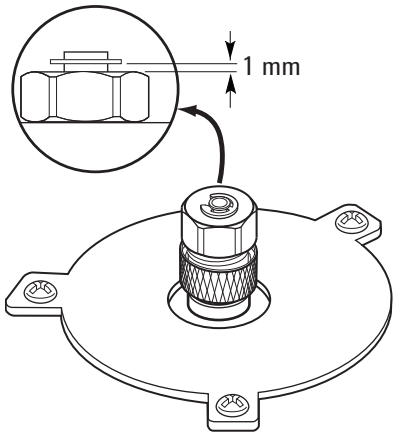
CAUTION

Wear clean, lint-free gloves to prevent contamination of parts with dirt and skin oils.

5 Use tweezers to remove the septum or Merlin Microseal from the top insert weldment. Do not gouge or scratch the interior of the septum head.
6 Scrub the residue from the top insert weldment and septum nut with a small piece of rolled-up steel wool and tweezers. Ultrasonically clean the retainer nut and top insert weldment.
7 Use compressed air or nitrogen to blow away the pieces of steel wool and septum.
8 Wearing gloves, inspect the O-ring and replace, if necessary. See **"To Change the O-Ring on the Packed Column Inlet"** on page 104.
9 Install the top insert weldment and hand-tighten firmly.
10 Firmly press the new septum or Merlin Microseal into the fitting.
11 Install the septum retainer nut or Merlin cap and finger-tighten. Tighten the septum retainer nut until the C-ring is about 1 mm above the nut.

CAUTION

Overtightening the septum nut can cause contamination.



12 Exit maintenance mode. Select **Maintenance > Instrument > Perform Maintenance > Maintenance Mode > Finished.**

13 Perform an inlet **Leak & Restriction** test and reset the maintenance counters.

14 Restore the analytical method.

To Install an Adapter on the Packed Column Inlet

1 Gather the following:
- Brass tubing nut. See **"Consumables and Parts for the Packed Column Inlet"** on page 96.
- Adapter (1/8-inch packed or 1/4-inch packed)
- 7/16-inch and 9/16-inch wrench
- Vespel/graphite ferrule
- Methanol
- Lint-free gloves

2 Place GC in maintenance mode: **Maintenance > Instrument > Perform Maintenance > Maintenance Mode > Start Maintenance.** Wait for the GC to become ready.

WARNING

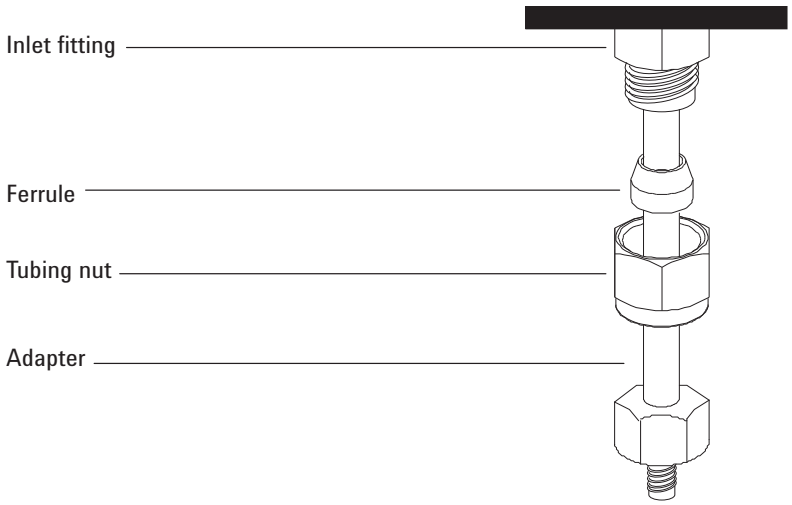
Be careful! The oven and/or inlet may be hot enough to cause burns. If the inlet is hot, wear heat-resistant gloves to protect your hands.

CAUTION

Wear clean, lint-free gloves to prevent contamination of parts with dirt and skin oils.

3 Clean the end of the adapter with a lint-free cloth and methanol to remove contamination such as fingerprints.

4 Place the tubing nut and Vespel/graphite ferrule on the adapter.



5 Insert the adapter straight into the inlet base as far as possible.

6 Hold the adapter in this position and finger-tighten the nut.

7 Tighten an additional 1/4 turn with a wrench.

8 Exit maintenance mode. Select **Maintenance > Instrument > Perform Maintenance > Maintenance Mode > Finished.**

To Change the O-Ring on the Packed Column Inlet

1 Gather the following:
- Replacement O-ring. See **"Consumables and Parts for the Packed Column Inlet"** on page 96.
- Septum nut wrench
- Tweezers
- Lint-free gloves

2 Launch the GC maintenance wizard: **Maintenance > Inlets,** select the inlet, then select **Perform Maintenance > Replace O-Ring > Start Maintenance.** Wait for the GC to become ready. The wizard will walk through the steps needed to replace the O-ring (those same steps are repeated below).

WARNING

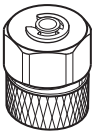
Be careful! The oven and/or inlet may be hot enough to cause burns. If the inlet is hot, wear heat-resistant gloves to protect your hands.

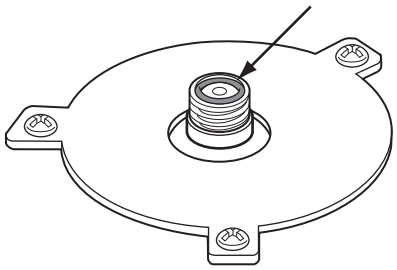
3 Loosen the top insert weldment to remove the top portion of the inlet.

CAUTION

Wear clean, lint-free gloves to prevent contamination of parts with dirt and skin oils.

4 Use tweezers to remove the old O-ring.





5 Insert a new O-ring.

6 Install and tighten the top insert weldment.

7 The GC maintenance wizard will perform checks at the appropriate times, including **Leak & Restriction** tests, and will automatically reset the maintenance counters.

8 Select **Finished**, then select **OK** to exit the GC maintenance wizard.

9 Restore the analytical method.

To Change the Glass Liner on the Packed Column Inlet

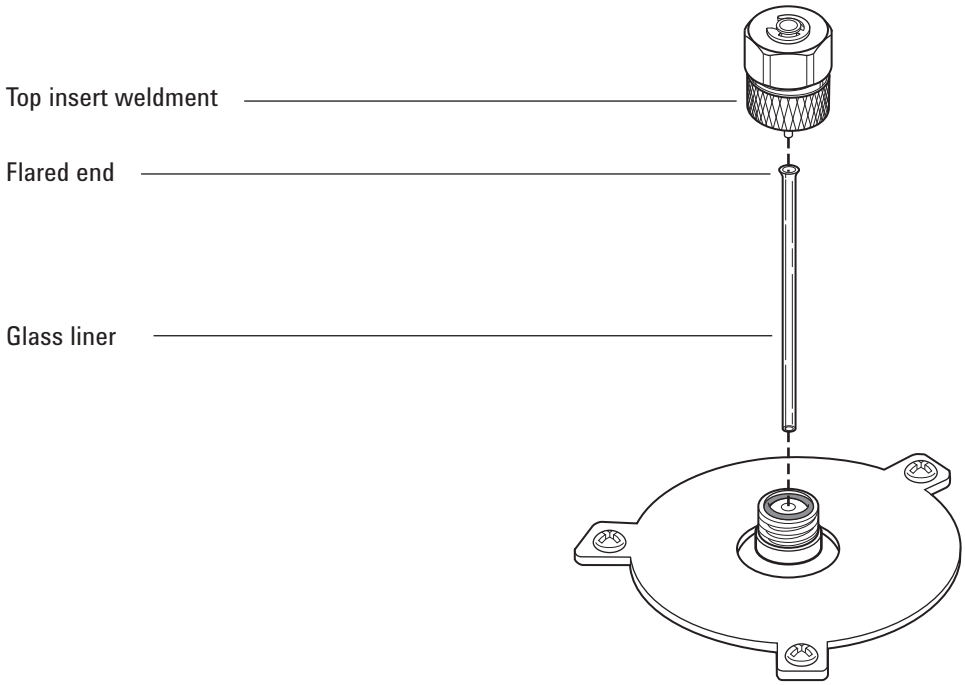
1 Gather the following:
- Replacement glass liner. See **"Consumables and Parts for the Packed Column Inlet"** on page 96.
- 9/16-inch wrench
- Lint-free gloves

2 Place GC in maintenance mode: **Maintenance > Instrument > Perform Maintenance > Maintenance Mode > Start Maintenance.** Wait for the GC to become ready.

WARNING

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

3 Loosen the top insert weldment to remove the top portion of the inlet.



4 Use a thin wire or wood splint to carefully lift and remove the old glass liner.

CAUTION

Wear clean, lint-free gloves to prevent contamination of parts with dirt and skin oils.

5 Wearing gloves, inspect the O-ring and replace, if necessary. See **"To Change the O-Ring on the Packed Column Inlet"** on page 104.

6 Wearing gloves, grasp the flared end (top) of the replacement glass liner with tweezers and install it in the inlet.

7 Install the top insert weldment and hand-tighten firmly.

8 Exit maintenance mode. Select **Maintenance > Instrument > Perform Maintenance > Maintenance Mode > Finished.**

9 Reset the EMF counter.

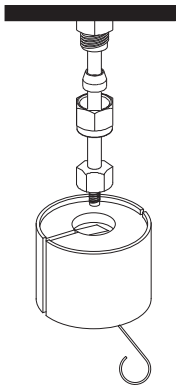
10 Perform an inlet **Leak & Restriction** test and reset the maintenance counters.

11 Restore the analytical method.

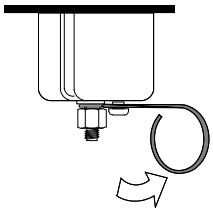
To Install an Insulation Cup on the Packed Column Inlet

1 Gather the following:
   - No-hole ferrule
   - Column nut

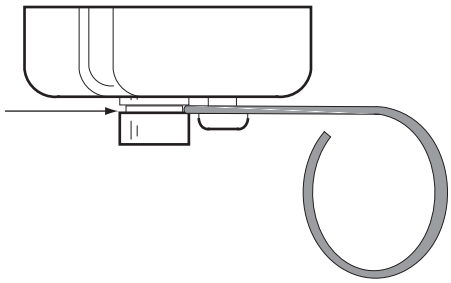
2 Install a plug (for example, a column nut with no-hole ferrule).



3 Push the cup spring to the right. Slide the cup over the inlet fitting so that the insulation at the top of the cup is flush against the oven roof.



4 Place the spring into the groove in the inlet liner. Remove the column nut and no-hole ferrule.



To Clean the Packed Column Inlet

1 Gather the following:
   - Replacement O-ring. See **"Consumables and Parts for the Packed Column Inlet"** on page 96.
   - Replacement glass liner
   - Replacement septum
   - Solvent that will clean the type of deposits in your inlet
   - Compressed, filtered, dry air or nitrogen
   - Beaker
   - Cleaning brushes—The FID cleaning kit (part number 9301-0985) contains appropriate brushes
   - Lint-free gloves

2 Manually set the inlet and oven temperature to < 40 °C, and wait for the inlet, oven, and other parts you might come into contact with inside the oven, to cool before continuing. Alternately, place the GC in maintenance mode: **Maintenance > Instrument > Perform Maintenance > Maintenance Mode > Start Maintenance.**

WARNING

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

3 Remove the column.

4 Remove the septum nut and septum.

5 Remove the top insert weldment.

6 Remove the glass liner and O-ring.

7 If used, remove the adapter.

8 Ultrasonically clean the septum nut, top insert weldment, and adapter (if used) in a suitable solvent.

9 Place a beaker in the oven under the inlet to catch the solvent.

CAUTION

Wear clean, lint-free gloves to prevent contamination of parts with dirt and skin oils.

10 Soak a cleaning brush with the solvent and vigorously scrub the interior walls of the inlet.

11 Blow the inside of the inlet dry with compressed air or nitrogen.

12 Install the adapter, if used. See **"To Install an Adapter on the Packed Column Inlet"** on page 103.

13 Install the glass liner and O-ring. See **"To Change the Glass Liner on the Packed Column Inlet"** on page 105.

14 Install the top insert weldment and finger-tighten.

15 Install the septum and septum nut. See **"To Change the Septum on the Packed Column Inlet"** on page 99.

16 Attach the column.

17 Exit maintenance mode. Select **Maintenance > Instrument > Perform Maintenance > Maintenance Mode > Finished.**

18 Reset the septum and glass liner counters.

19 Perform an inlet **Leak & Restriction** test and reset the maintenance counters.

20 Restore the analytical method.

To Bakeout Contaminants from the Packed Column Inlet

1 Set the column flow to the normal operating value.

2 Purge the column with carrier flow for at least 10 minutes before heating the oven.

3 If the column is attached to the detector, set the detector 25 °C above normal operating temperature.

   If the column is not attached to the detector, cap the detector fitting.

WARNING

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

4 Set the inlet temperature to 300 °C or 25 °C above the normal operating temperature.

5 Set the column oven 25 °C above the GC method final oven temperature to bake contaminants out of the inlet. Do not exceed the column manufacturer's maximum temperature limit.

6 Bakeout for 30 minutes or until the detector baseline is free of contamination peaks.

To Install a Packed Metal Column

1 Gather the following:
   - 7/16-inch, 9/16-inch, and 1/2-inch wrenches
   - Lint-free gloves
2 Place GC in maintenance mode: **Maintenance > Instrument > Perform Maintenance > Maintenance Mode > Start Maintenance.** Wait for the GC to become ready.
3 Prepare the packed metal column. See **"To Install Ferrules on a Packed Metal Column"** on page 118.

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.

4 Install the 1/8-inch or 1/4-inch packed column inlet adapter, if necessary. See **"To Install an Adapter on the Packed Column Inlet"** on page 103.

CAUTION

Wear clean, lint-free gloves to prevent contamination of parts with dirt and skin oils.

5 Attach the column to the inlet adapter. Finger-tighten the nut.
6 Tighten the nut an additional 1/4 turn with a wrench (for a 1/8-inch column) or an additional 3/4 turn (for a 1/4-inch column).

   Use two wrenches, one on the column nut and the other on the adapter, to prevent the adapter from rotating.
7 Configure the new packed column (make sure either column length or diameter is zero).
8 Exit maintenance mode. Select **Maintenance > Instrument > Perform Maintenance > Maintenance Mode > Finished.**

WARNING

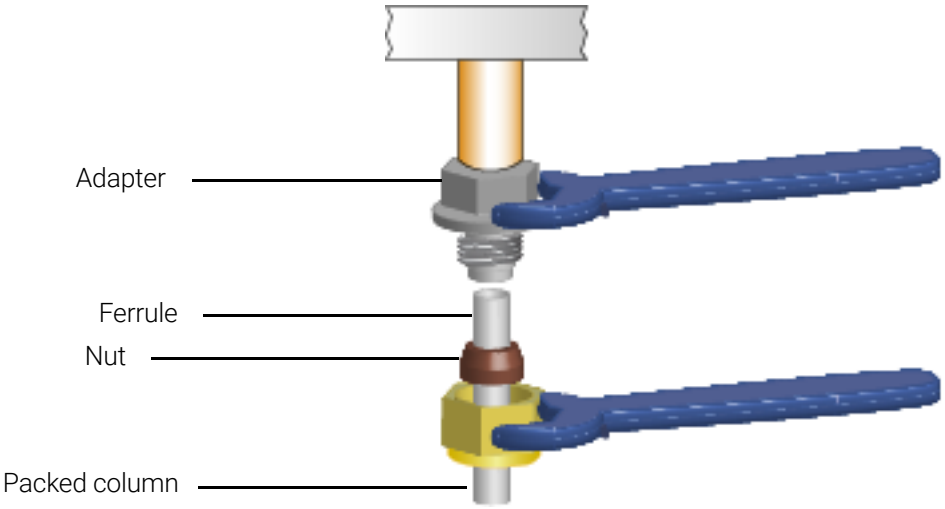
Do not use hydrogen as the carrier for conditioning! It could vent into the oven and present an explosion hazard.

9 Condition the column, if necessary. See **"To Condition a Packed Column"** on page 117.
10 Place GC in maintenance mode: **Maintenance > Instrument > Perform Maintenance > Maintenance Mode > Start Maintenance.** Wait for the GC to become ready.

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.

11 If required, install a packed column adapter onto the detector column fitting. See **"To Install a Packed Column Adapter on a Detector Fitting"** on page 113.
12 Place a nut and ferrule onto the packed column.
13 Attach the column to the detector or detector adapter. Finger-tighten the nut.



14 Using two wrenches, one on the adapter and one on the column nut, tighten the column nut an additional 1/4 turn (for a 1/8-inch column) or an additional 3/4 turn (for a 1/4-inch column).

15 Exit maintenance mode. Select **Maintenance > Instrument > Perform Maintenance > Maintenance Mode > Finished.**

16 Establish a flow of carrier gas and purge as recommended by the packing manufacturer. Generally:

- 20 to 30 mL/min for 2-mm id glass or 1/8-inch od metal columns
- 50 to 60 mL/min for 4-mm id glass or 1/4-inch od metal columns

17 Heat the oven to 200 °C, cool it to a safe handling temperature, then re-tighten the column connection. (Re-tighten until snug, only about 15 degrees rotation.) Repeat two more times. This process will set the Vespel/graphite ferrule to help prevent leaks.

18 Restore the analytical method.

- For FPD+, immediately turn off the flame.
- For NPD, immediately turn off the bead.

19 After the GC becomes ready, wait 10 minutes then ignite the detector flame or adjust offset on the NPD bead.

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.

20 Allow the oven, inlet, and detector to equilibrate at operating temperature, then retighten the fittings.

21 Perform the inlet **Leak & Restriction** test.

22 Reset the maintenance counters.

To Install a Packed Column Adapter on a Detector Fitting

This procedure applies to the FID, FPD+, NPD, and TCD.

1 Gather the following:
- Packed column adapter, see **"Consumables and Parts for the Packed Column Inlet"** on page 96.
- Ferrule, Vespel/graphite, 0.8-mm id
- 7/16-inch wrench (for the packed column adapter and 1/8-inch packed column nuts)
- 9/16-inch wrench (for 1/4-inch packed column nuts)
- 1/8-inch nut and ferrule for a 1/8-inch packed column, or a 1/4-inch nut and ferrule for a 1/4-inch packed column
- Lint-free gloves

2 Place GC in maintenance mode: **Maintenance > Instrument > Perform Maintenance > Maintenance Mode > Start Maintenance.** Wait for the GC to become ready.

WARNING

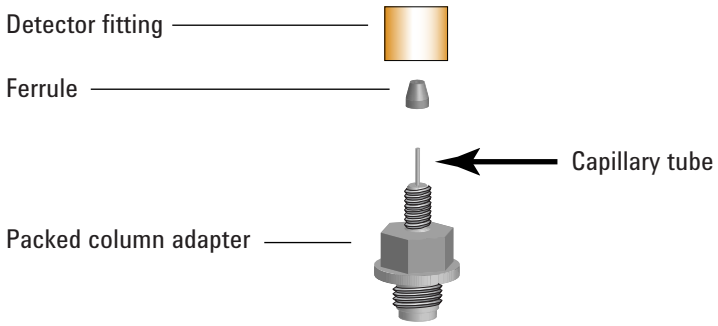
Be careful! The oven and/or detector may be hot enough to cause burns. If the detector is hot, wear gloves to protect your hands.

CAUTION

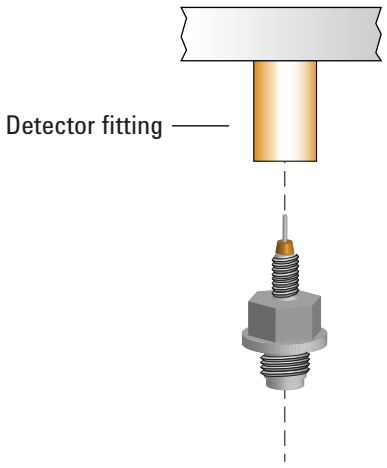
Wear clean, lint-free gloves to prevent contamination of parts with dirt and skin oils.

Handle the adapter carefully and install the packed column before installing the adapter into the detector base. The thin-walled capillary tube that carries the sample into the detector can be damaged by rough handling.

3 Place a ferrule onto the packed column adapter.



4 Carefully install the adapter assembly into the detector fitting. Align the adapter so the it enters the detector fitting as vertically as possible. Avoid stressing the adapter capillary tube. Finger-tighten the adapter into the detector base, then tighten an additional 1/8 turn using a wrench.



5 Exit maintenance mode. Select **Maintenance > Instrument > Perform Maintenance > Maintenance Mode > Finished.**

After installation, heat the oven to 200 °C, cool it to a safe handling temperature, then re-tighten the column connection. (Re-tighten until snug, only about 15 degrees rotation.) Repeat two more times. This process will set the Vespel/graphite ferrule to help prevent leaks.

To Install a Packed Glass Column

1 Gather the following:
   - 9/16-inch wrench
   - Two 1/4-inch brass nuts. See **"Consumables and Parts for the Packed Column Inlet"** on page 96.
   - Two 1/4-inch Vespel/graphite ferrules
   - Lint-free gloves

2 Launch the GC maintenance wizard: **Maintenance > Column > Perform Maintenance > Install Column > Start Maintenance.** Wait for the GC to become ready.
The wizard will walk through the steps needed to replace the septum (those same steps are repeated below).

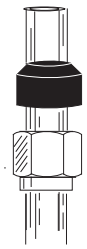
WARNING

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.

CAUTION

Wear clean, lint-free gloves to prevent contamination of parts with dirt and skin oils.

3 Assemble a brass nut and Vespel/graphite ferrule on each end of the column.



Glass columns must be simultaneously inserted into the inlet and detector and installed parallel to the oven door. When conditioning the column, do not attach the column to the detector.

4 If conditioning the column, insert the column into the packed column inlet until it bottoms. Withdraw the column 1 to 2 mm. Finger-tighten the inlet column nut. See **"To Condition a Packed Column"** on page 117.

CAUTION

Overtightening the column nut or forcing it to bottom in either the inlet or detector may shatter the column.

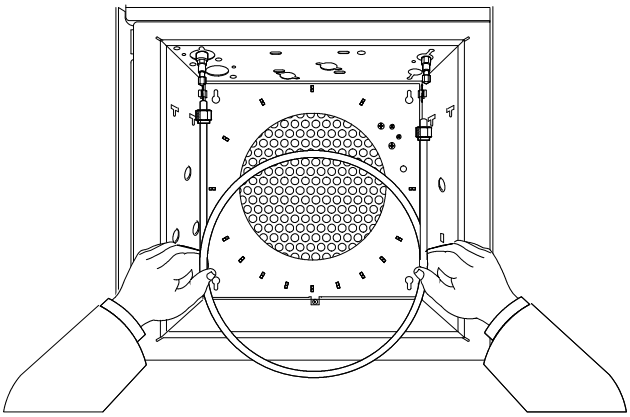
5 Tighten the inlet column nut 1/4 turn with a wrench.

WARNING

Do not use hydrogen as the carrier for conditioning! It could vent into the oven and present an explosion hazard.

6 After conditioning, remove the column from the inlet.

7 Simultaneously insert the column into the inlet and detector fittings but do not force it. It may be necessary to start the long end of the column in the inlet at an angle to clear the oven floor.



8 Withdraw the column 1 to 2 mm from both the inlet and detector. Finger-tighten both column nuts.

CAUTION

Overtightening the column nut or forcing it to bottom in either the inlet or detector may shatter the column.

9 Tighten both column nuts 1/4 turn with a wrench.

10 Configure the new packed column (make sure either column length or diameter is zero).

11 Establish a flow of carrier gas and purge as recommended by the packing manufacturer. Generally:

- 20 to 30 mL/min for 2-mm id glass or 1/8-inch od metal columns
- 50 to 60 mL/min for 4-mm id glass or 1/4-inch od metal columns

12 After the GC becomes ready, wait 10 minutes then ignite the detector flame.

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.

13 Allow the oven, inlet, and detector to equilibrate at operating temperature, then retighten the fittings.

14 The GC maintenance wizard will perform checks at the appropriate times, including **Leak & Restriction** tests, and will automatically reset the maintenance counters.

15 Select **Finished**, then select **OK** to exit the GC maintenance wizard**.**

16 Restore the analytical method.

To Condition a Packed Column

1 Gather the following:
- Capillary adapter, column nut, and no-hole ferrule (for FID), or 1/8-inch Swagelok cap (for TCD)
- Two 7/16-inch wrenches
- 1/4-inch open-end wrench
- Lint-free gloves

WARNING **Do not use hydrogen as the carrier for conditioning! It could vent into the oven and present an explosion hazard.**

2 Place GC in maintenance mode: **Maintenance > Instrument > Perform Maintenance > Maintenance Mode > Start Maintenance.** Wait for the GC to become ready.

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.**

CAUTION **Wear clean, lint-free gloves to prevent contamination of parts with dirt and skin oils.**

3 Install the proper liner in the inlet and attach the column. See **"To Install a Packed Metal Column"** on page 111.

4 Cap the detector(s) fittings with the capillary adapter, no-hole ferrule and column nut (FID) or 1/8-inch cap (TCD).

5 Enter a column flow as recommended by the packing manufacturer or an appropriate flow as follows:
- 20 to 30 mL/min for 2-mm id glass or 1/8-inch od metal columns
- 50 to 60 mL/min for 4-mm id glass or 1/4-inch od metal columns

6 Raise the oven temperature slowly to the conditioning temperature for the column. The conditioning temperature is never higher than the maximum temperature limit for the column; 30 °C less than the maximum is usually sufficient.

7 Continue conditioning overnight at the final temperature. Cool the oven to room temperature with carrier flow on.

8 Attach the column to the detector and maintain established flow. See **"To Install a Packed Metal Column"** on page 111.

9 Exit maintenance mode. Select **Maintenance > Instrument > Perform Maintenance > Maintenance Mode > Finished.**

To Install Ferrules on a Packed Metal Column

1 Gather the following:
   - Wrenches
   - Stainless steel male Swagelok fitting, 1/4- or 1/8-inch od
   - Brass Swagelok nut and ferrule set. See **"Consumables and Parts for the Packed Column Inlet"** on page 96.
   - Lint-free gloves

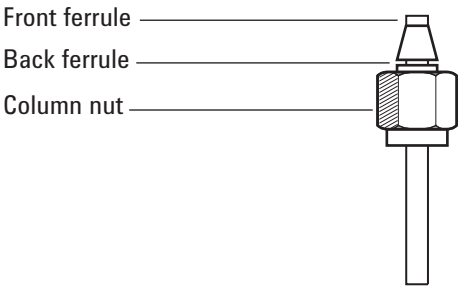
2 Verify that the column end is cut square and is free of burns and deformation.

3 Secure the fitting in a bench vise.

CAUTION

Wear clean, lint-free gloves to prevent contamination of parts with dirt and skin oils.

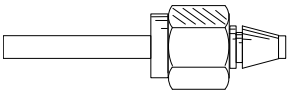
4 Assemble a Swagelok nut and ferrules onto the column.



5 Fully insert the column into the vise-held fitting, then withdraw 1–2 mm. Finger-tighten the nut.

6 Tighten the nut an additional 3/4 turn with a wrench (for a 1/8-inch column) or an additional 1-1/4 turn (for a 1/4-inch column).

7 Unscrew the column nut from the vise-held fitting and remove the column. Ferrules should now be set in place on the column with the column end correctly positioned.



8 Maintaining the COC Inlet

Consumables and Parts for the Cool On-Column Inlet

See the Agilent catalog for consumables and supplies for a more complete listing, or visit the Agilent Web site for the latest information (**www.agilent.com**).

Table 13 Recommended parts for injections onto 0.53-mm fused silica columns

Column type	Part number
Insert, fused silica, 0.53 mm id	19245-20580 (no rings)
Septum nut, 530 µm	G1545-80530
Syringe barrel, removable needle, 5 µL	5182-0836
Needle, 530 µm (3/pk)	5182-0832
Plunger button, 10/pk, for manual injections using syringe barrel 5182-0836	5181-8866
On-column insert spring	19245-60760

Table 14 Recommended parts for injections onto 0.53-mm aluminum-clad columns

Column type	Part number
Insert, aluminum-clad, 0.53 mm id	19245-20780 (4 rings)
Septum nut, 530 µm	G1545-80530
Syringe barrel, removable needle, 5 µL	5182-0836
Needle, 530 µm (3/pk)	5182-0832
Plunger button, 10/pk, for manual injections using syringe barrel 5182-0836	5181-8866
On-column insert spring	19245-60760

Table 15 Recommended parts for injections onto 0.32-mm fused silica columns

Column type	Part number
Insert, fused silica, 0.32 mm id	19245-20525 (5 rings)
Septum nut, 250/320 µm	19245-80521
Syringe barrel, removable needle, 5 µL	5182-0836
Needle, 320 µm (3/pk)	5182-0831
Plunger button, 10/pk, for manual injections using syringe barrel 5182-0836	5181-8866
On-column insert spring	19245-60760

Table 16 Recommended parts for injections onto 0.25-mm fused silica columns

Column type	Part number
Insert, 0.25 mm id	19245-20515 (6 rings)
Septum nut, 250/320 µm	19245-80521
Syringe barrel, removable needle, 5 µL	5182-0836
Needle, 250 µm (3/pk)	5182-0833
Plunger button, 10/pk, for manual injections using syringe barrel 5182-0836	5181-8866
On-column insert spring	19245-60760

Table 17 Recommended parts for injections onto 0.2-mm fused silica columns

Description	Part number/quantity
Insert, fused silica, 0.20 mm id	19245-20510
Cooling tower assembly	19320-80625
Syringe barrel, for fused silica needle, 10 µL	9301-0658
Replacement needles, fused silica, 0.18 mm	19091-63000 (6/pk)
Replacement PTFE ferrule for fused silica syringe	0100-1389
Removable stainless steel needle syringe, 10 µL	5182-9633
Replacement stainless steel needles, 0.23 mm	5182-9645 (3/pk)
On-column insert spring	19245-60760

Table 18 Recommended septa for the COC inlet

Description	Part number/quantity
For 0.53-mm and 0.25/0.32-mm septum nuts	
5-mm solid septum for manual and automatic injection	5181-1261
5-mm long-life septum	5183-4762 (50/pk)
5-mm advanced green septum	5183-4760 (50/pk)
5-mm, high-temperature, low-bleed septum	5183-4758 (50/pk)
5-mm through-hole septum for automatic injection	5181-1260 (25/pk)
For the duckbill septum	
Duckbill septum for manual injection only (must use cooling tower with duckbill)	19245-40050 (10/pk)

Table 19 Nuts, ferrules, and hardware for capillary columns

Column id (mm)	Description	Typical use	Part number/quantity
.530	Ferrule, Vespel/graphite, 0.8-mm id	0.45-mm and 0.53-mm capillary columns	5062-3512 (10/pk)
	Ferrule, graphite, 1.0-mm id	0.53-mm capillary columns	5080-8773 (10/pk)
	Ferrule, graphite, 0.8-mm id	0.53-mm capillary columns	500-2118 (10/pk)
	Column nut, finger-tight (for 0.53-mm columns)	Connect column to inlet or detector	5020-8293
.320	Ferrule, Vespel/graphite, 0.5-mm id	0.32-mm capillary columns	5062-3514 (10/pk)
	Ferrule, graphite, 0.5-mm id	0.1-mm, 0.2-mm, 0.25-mm, and 0.32-mm capillary columns	5080-8853 (10/pk)
	Column nut, finger-tight (for .100- to .320-mm columns)	Connect column to inlet or detector	5020-8292
.250	Ferrule, Vespel/graphite, 0.4-mm id	0.1-mm, 0.2-mm, and 0.25-mm capillary columns	5181-3323 (10/pk)
	Ferrule, graphite, 0.5-mm id	0.1-mm, 0.2-mm, 0.25-mm, and 0.32-mm capillary columns	5080-8853 (10/pk)
	Column nut, finger-tight (for .100- to .320-mm columns)	Connect column to inlet or detector	5020-8292
.100 and 200	Ferrule, Vespel/graphite, 0.37-mm id	0.1-mm and 0.2-mm capillary columns	5062-3516 (10/pk)
	Ferrule, Vespel/graphite, 0.4-mm id	0.1-mm, 0.2-mm, and 0.25-mm capillary columns	5181-3323 (10/pk)
	Ferrule, graphite, 0.5-mm id	0.1-mm, 0.2-mm, 0.25-mm, and 0.32-mm capillary columns	5080-8853 (10/pk)
	Ferrule, graphite, 0.4-mm id		500-2114 (10/pk)
	Column nut, finger-tight (for .100- to .320-mm columns)	Connect column to inlet or detector	5020-8292
All	Ferrule, no-hole	Testing	5181-3308 (10/pk)
	Capillary column blanking nut	Testing–use with any ferrule	5020-8294
	Column nut, universal	Connect column to inlet or detector	5181-8830 (2/pk)
	Column nut, collared, self-tightening	Connect column to inlet or detector	G3440-81011
	Collar for self-tightening nut	Connect column to inlet or detector	G3440-81012
	Column nut, collared, self-tightening MSD	Connect column to inlet or detector	G3440-81013
	Column cutter, ceramic wafer	Cutting capillary columns	5181-8836 (4/pk)
	Pencil, diamond tipped	Cutting capillary columns	420-1000
	Ferrule tool kit	Ferrule installation	440-1000

Exploded Parts View of the Cool On-Column Inlet

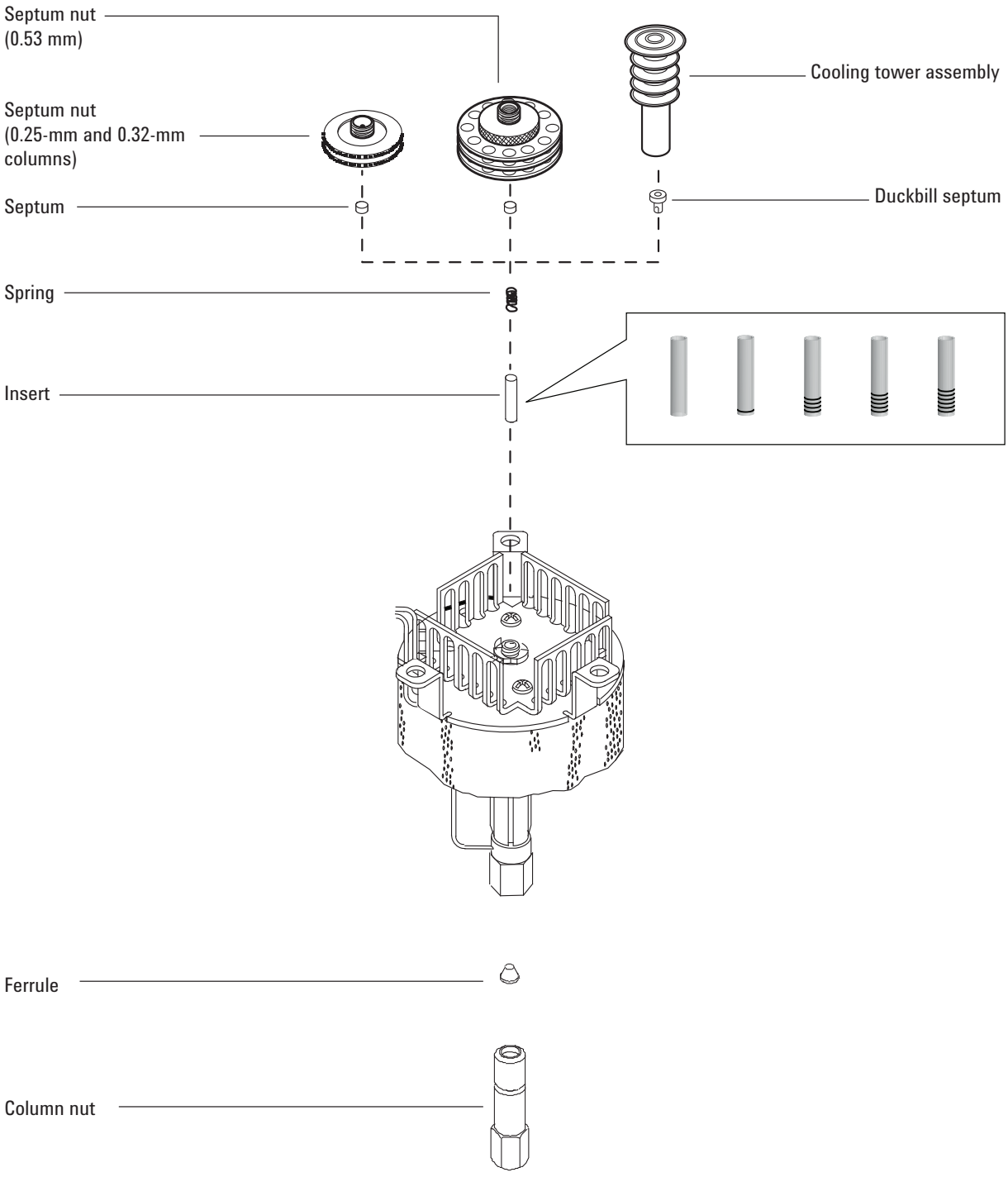


Figure 11. Cool on-column inlet exploded parts

To Install a Capillary Column with the Cool On-Column Inlet

1 Gather the following:
- Column nut and ferrule, see **"Consumables and Parts for the Cool On-Column Inlet"** on page 120.
- Column cutter
- 1/4-inch and 5/16-inch wrenches
- Lint-free gloves

2 Launch the GC maintenance wizard: **Maintenance > Column > Perform Maintenance > Install Column > Start Maintenance.** Wait for the GC to become ready.
The wizard will guide you through the maintenance steps described below.

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.

WARNING

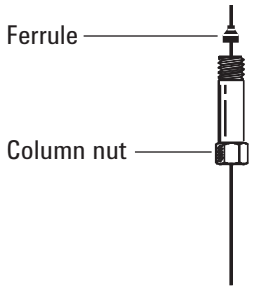
Wear safety glasses to protect your eyes from flying particles while handling, cutting, or installing glass or fused silica capillary columns. Use care in handling these columns to prevent puncture wounds.

CAUTION

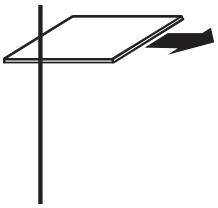
Wear clean, lint-free gloves to prevent contamination of parts with dirt and skin oils.

3 Before installing the column, be sure the correct insert is installed for the needle and column. See **"To Install an Insert on the COC Inlet"** on page 130.

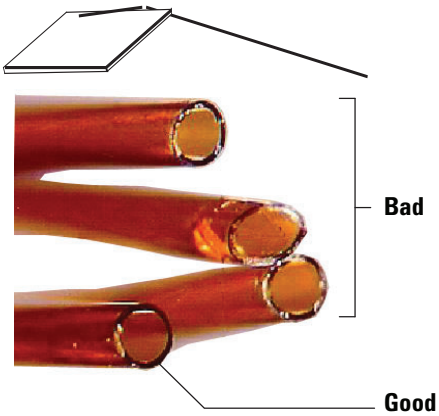
4 Place a capillary column nut and ferrule on the column.



5 Score the column using a glass scribing tool. The score must be square to ensure a clean break.



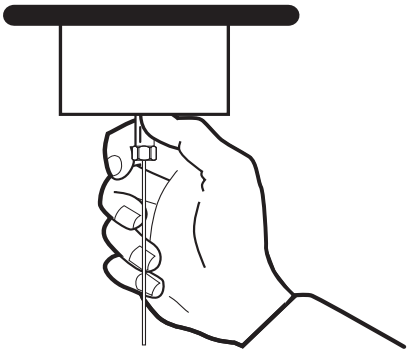
6 Break off the column end by supporting it against the column cutter opposite the scribe. Inspect the end with a magnifying loupe to make certain there are no burrs or jagged edges.



7 Wipe the column walls with a tissue dampened with isopropanol to remove fingerprints and dust.

8 Gently insert the column into the inlet until it bottoms. You should feel spring tension as you push up on the column. (Do not withdraw the column.)

9 Insert the column nut into the inlet fitting and finger-tighten.



WARNING

To avoid bending the inlet, always use two wrenches. Use a 5/16-inch wrench to support the inlet while tightening the column nut with a 1/4-inch wrench.

10 Tighten the column nut an additional 1/4 turn with a wrench or until the column does not move.

11 If using an automatic injection system with a 0.25-mm or 0.32-mm column, verify that the column installation by manually pushing the syringe into the inlet.

12 Configure the new column.

13 Condition the column per the manufacturer's recommendation. See **To Condition a Capillary Column**.

14 Install the column into the detector.

NOTE

Execute the column installation procedure manually. Do not use the automated column installation wizard.

- **To Install a Capillary Column in the FID**
- **To Install a Capillary Column in the NPD**
- **To Install a Capillary Column in the TCD**
- **To Install a Capillary Column in the ECD**
- **To Install a Capillary Column to the FPD+**

15 The GC maintenance wizard will perform checks at the appropriate times, including **Leak & Restriction** tests, and will automatically reset the maintenance counters.

16 Select **Finished**, then select **OK** to exit the GC maintenance wizard**.**

17 After the column is installed at both inlet and detector, establish a flow of carrier gas and purge as recommended by the column manufacturer.

18 Restore the analytical method.

- For FPD+, immediately turn off the flame.
- For NPD, immediately turn off the bead

19 After the GC becomes ready, wait 10 minutes then ignite the detector flame or adjust offset on the NPD bead.

WARNING

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

20 Allow the oven, inlet, and detector to equilibrate at operating temperature, then retighten the fittings.

To Check the Needle-to-Column Size on the COC Inlet

1 Gather the following:
   - Insert, see **"Consumables and Parts for the Cool On-Column Inlet"** on page 120.
   - Syringe needle

2 Place GC in maintenance mode: **Maintenance > Instrument > Perform Maintenance > Maintenance Mode > Start Maintenance.** Wait for the GC to become ready.

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.

WARNING

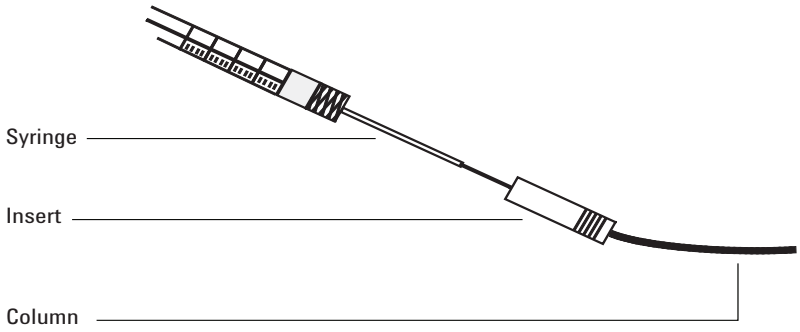
Wear safety glasses to protect your eyes from flying particles while handling, cutting, or installing glass or fused silica capillary columns. Use care in handling these columns to prevent puncture wounds.

3 Check that the needle is the correct size for the desired column id. If needed, replaced the needle with one of the correct size. See **"Consumables and Parts for the Cool On-Column Inlet"** on page 120, and **"To Replace a Needle in a Syringe"** on page 135 or **"To Replace the Fused Silica Needle in a Syringe for the COC Inlet"** on page 136.

4 Identify the correct insert for the column size. See **"Consumables and Parts for the Cool On-Column Inlet"** on page 120. Use the insert that is the same size as the syringe needle to verify that the column you plan to use is the correct size.

5 Make a clean cut on the end of the column. See **"To Install a Capillary Column with the Cool On-Column Inlet"** on page 124.

6 Insert the column into one end of the insert.



7 Insert the syringe needle through the other end of the insert and into the column. The needle should visibly enter the column without any obstruction. If the needle cannot pass easily into the column, reverse the insert to try the needle and column in the other end.

8 Exit maintenance mode. Select **Maintenance > Instrument > Perform Maintenance > Maintenance Mode > Finished.**

To Change a Septum on the COC Inlet

1 Gather the following:
- Replacement septum, see **"Consumables and Parts for the Cool On-Column Inlet"** on page 120.
- Tweezers
- A thin wire (0.2-inch diameter) for removing septum from inlet
- Lint-free gloves

2 Launch the GC maintenance wizard: **Maintenance > Inlets,** select the inlet, then select **Perform Maintenance > Replace Septum > Start Maintenance.** The wizard will guide you through the maintenance steps described below.

WARNING

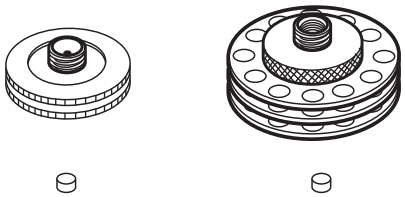
Be careful! The oven and/or inlet may be hot enough to cause burns. If either is hot, wear heat-resistant gloves to protect your hands.

CAUTION

Wear clean, lint-free gloves to prevent contamination of parts with dirt and skin oils.

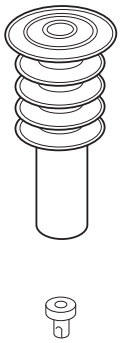
3 Replace the septum.
- If you are using a septum nut, grasp the knurling and unscrew. Remove the old septum with tweezers.
- Use tweezers to install a new septum. Push the septum into the septum nut until properly seated. Firmly tighten the nut.

For 250/320-µm automated injections	For 530-µm automated injections



- If you are using a cooling tower, grasp the three rings and unscrew. The spring and duckbill septum may pop out of the inlet when you remove the cooling tower. Be careful not to lose them. If they do not pop out, use a thin wire to remove them from the inlet. Insert the replacement duckbill septum into the spring and place in the inlet. Reattach the cooling tower assembly, then finger-tighten.

For manual 200-µm injections with fused silica needle



4 Before making an injection, check the alignment of the entire assembly using the proper size syringe.

5 The GC maintenance wizard will perform checks at the appropriate times, including **Leak & Restriction** tests, and will automatically reset the maintenance counters.

6 Select **Finished**, then select **OK** to exit the GC maintenance wizard**.**

7 Restore the analytical method.

To Install an Insert on the COC Inlet

1 Gather the following:
   - Lint-free gloves
   - Replacement insert, see **"Consumables and Parts for the Cool On-Column Inlet"** on page 120.

2 Place GC in maintenance mode: **Maintenance > Instrument > Perform Maintenance > Maintenance Mode > Start Maintenance.** Wait for the GC to become ready.

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.

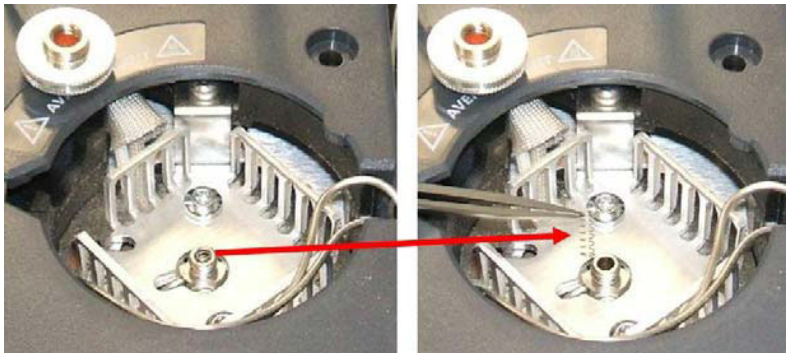
CAUTION

Wear clean, lint-free gloves to prevent contamination of parts with dirt and skin oils.

3 Remove the column from the inlet.

4 Locate the septum nut or cooling tower assembly at the top of the inlet and remove it. If the septum remains in the septum nut, do not remove it unless you want to change it. If necessary, replace the existing septum or duckbill with a new one. See **"To Change a Septum on the COC Inlet"** on page 128.

5 Remove the spring from the inlet with an extraction wire (or tweezers) and set it aside. Be careful not to lose or damage it because you will use the spring to keep the new insert in position.



6 Remove the existing insert from the inlet by gently pushing it out from below with a wire or piece of column. Store the insert for possible later use.

7 Check that the insert is the correct size for both the needle and column. See **"To Check the Needle-to-Column Size on the COC Inlet"** on page 127.

8 Lower the new insert straight into the inlet from the top. The insert can be installed either end up.

9 Install the spring on top of the insert.

10 Install the septum and septum nut or duckbill septum and cooling tower assembly and finger-tighten.

NOTE

Execute the column installation procedure manually. Do not use the automated column installation wizard.

11 Install the column. See **"To Install a Capillary Column with the Cool On-Column Inlet"** on page 124.

12 Exit maintenance mode. Select **Maintenance > Instrument > Perform Maintenance > Maintenance Mode > Finished.**

To Clean the COC Inlet

1 Gather the following:
- 1/4-inch and 5/16-inch wrenches
- Cleansing bath
- Aqueous detergent
- Distilled water
- Methanol
- Compressed, filtered, dry air or nitrogen
- Lint-free gloves

2 Manually set the inlet and oven temperature to < 40 °C, and wait for the inlet, oven, and other parts you might come into contact with inside the oven, to cool before continuing. Alternately, place the GC in maintenance mode: **Maintenance > Instrument > Perform Maintenance > Maintenance Mode > Start Maintenance.**

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.**

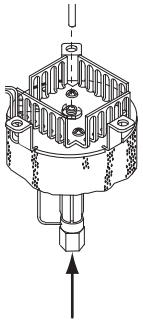
WARNING **Wear safety glasses to protect your eyes from flying particles while handling, cutting, or installing glass or fused silica capillary columns. Use care in handling these columns to prevent puncture wounds.**

CAUTION **Wear clean, lint-free gloves to prevent contamination of parts with dirt and skin oils.**

3 Remove the column.

4 Remove the septum nut or cooling tower and then remove the septum.

5 Remove the existing insert from the inlet by gently pushing it out from below with a wire or piece of column. Store the insert for possible later use.



6 Fill an ultrasonic cleansing bath with aqueous detergent and place the spring and insert into it. Sonicate for 1 minute.

7 Drain the aqueous detergent and fill the bath with distilled water. Sonicate for 1 minute.

8 Remove the spring and insert from the bath and rinse thoroughly with water and methanol.

9 Dry the spring and insert with compressed air or nitrogen.

10 Install the insert. See **"To Install an Insert on the COC Inlet"** on page 130.

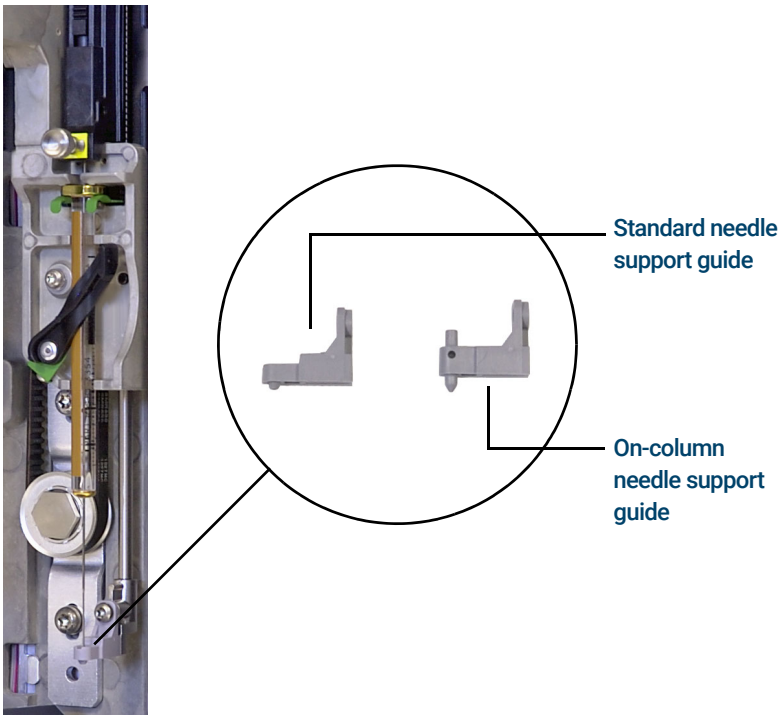
11 Install the column. See **"To Install a Capillary Column with the Cool On-Column Inlet"** on page 124.

12 Exit maintenance mode. Select **Maintenance > Instrument > Perform Maintenance > Maintenance Mode > Finished.**

To Replace the 7693A Injector Needle Support Guide

Before using a 7693A ALS to make injections onto the COC inlet, install the on-column needle support guide.

Refer to the 7693A ALS documentation for complete details.



1. Open the injector door.
2. Remove the syringe.
3. Slide the syringe carriage up to the top position.
4. Completely remove the T-10 Torx screw from the support foot. Be careful to not let the screw fall into the turret assembly.
5. Slide off the support foot.
6. Slide on the new support foot.
7. Replace the T-10 Torx screw and tighten.
8. Install the appropriate syringe.
9. Close the injector door.
10. Align the injector.

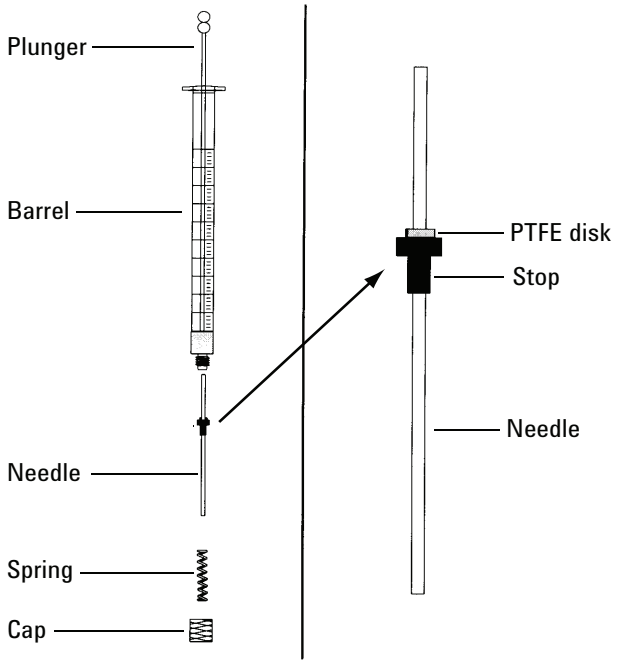
To Replace a Needle in a Syringe

1 Gather the following, see **Table 16**, "Recommended parts for injections onto 0.25-mm fused silica columns," on page 121:

- Syringe barrel
- Needle, 250-µm or 320-µm

2 Unscrew the syringe barrel cap and remove the spring.

3 Make sure that the needle has the PTFE disk as shown below. If the syringe barrel does not have the PTFE disk, use the instructions in the syringe box to wrap the needle.



4 Check the new needle for a small wire inserted for shipment. Remove the wire if present.

5 Slide the spring and the cap over the needle.

6 Insert the needle into the syringe barrel.

7 Screw the cap back on the syringe barrel.

To Replace the Fused Silica Needle in a Syringe for the COC Inlet

NOTE

The fused silica needle and syringe are only used with the cooling tower and duckbill septum for manual, on-column injections onto 200-µm columns.

1 Gather the following:
   - New fused silica syringe needle, see **"Consumables and Parts for the Cool On-Column Inlet"** on page 120.
   - Solvent

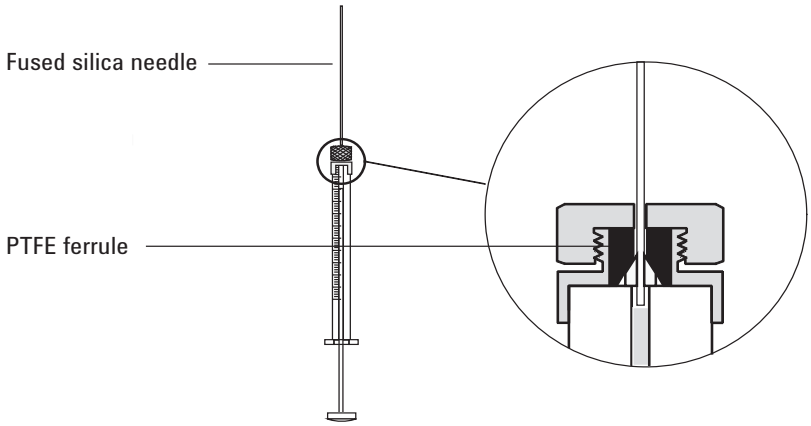
WARNING

Wear safety glasses to protect your eyes from flying particles while handling, cutting, or installing glass or fused silica capillary columns. Use care in handling these columns to prevent puncture wounds.

2 Loosen the retaining nut and remove the old needle.

3 Hold the syringe vertically and insert the new fused silica needle so it is visible inside the syringe barrel. If the needle cannot be inserted into the syringe barrel, the PTFE ferrule may be blocked. You may need to replace the ferrule.

4 Push the plunger down until it bottoms. The needle will be flush with the plunger end.



5 Finger-tighten the retaining nut. Pull the needle gently to be sure the PTFE ferrule has formed a tight seal with the needle. Tighten the retaining nut further, if necessary.

6 Loosen the retaining nut just enough so the needle is again free.

7 Depress the syringe plunger slowly until it pushes the needle to the end of the barrel, then finger-tighten the retaining nut.

8 Use a solvent to rinse the syringe and check for leaks or blocks. Leaks may be fixed by further tightening the retaining nut. Blocks or serious leaks require repeating this procedure.

To Bakeout Contaminants from the COC Inlet

1. Set the column flow to the normal operating value, or set the capillary column gas velocity to 30 cm/s.
2. Purge the column with carrier flow for at least 10 minutes before heating the oven.
3. Set the inlet mode to **Oven Track**.
4. If the column is attached to the detector, set the detector 25 °C above normal operating temperature.

   If the column is not attached to the detector, cap the detector fitting.

WARNING

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

5. Set the column oven 25 °C above the GC method final oven temperature to bake contaminants out of the inlet. Do not exceed the column manufacturer's maximum temperature limit.
6. Bakeout for 30 minutes or until the detector baseline is free of contamination peaks.

9 Maintaining the FID

Consumables and Parts for the FID

See the Agilent catalog for consumables and supplies for a more complete listing, or visit the Agilent Web site for the latest information (**www.agilent.com**).

Table 20 Nuts, ferrules, and hardware for capillary columns

Column id (mm)	Description	Typical use	Part number/quantity
.530	Ferrule, Vespel/graphite, 0.8-mm id	0.45-mm and 0.53-mm capillary columns	5062-3512 (10/pk)
	Ferrule, graphite, 1.0-mm id	0.53-mm capillary columns	5080-8773 (10/pk)
	Ferrule, graphite, 0.8-mm id	0.53-mm capillary columns	500-2118 (10/pk)
	Column nut, finger-tight (for 0.53-mm columns)	Connect column to inlet or detector	5020-8293
.320	Ferrule, Vespel/graphite, 0.5-mm id	0.32-mm capillary columns	5062-3514 (10/pk)
	Ferrule, graphite, 0.5-mm id	0.1-mm, 0.2-mm, 0.25-mm, and 0.32-mm capillary columns	5080-8853 (10/pk)
	Column nut, finger-tight (for .100- to .320-mm columns)	Connect column to inlet or detector	5020-8292
.250	Ferrule, Vespel/graphite, 0.4-mm id	0.1-mm, 0.2-mm, and 0.25-mm capillary columns	5181-3323 (10/pk)
	Ferrule, graphite, 0.5-mm id	0.1-mm, 0.2-mm, 0.25-mm, and 0.32-mm capillary columns	5080-8853 (10/pk)
	Column nut, finger-tight (for .100- to .320-mm columns)	Connect column to inlet or detector	5020-8292
.100 and .200	Ferrule, Vespel/graphite, 0.37-mm id	0.1-mm and 0.2-mm capillary columns	5062-3516 (10/pk)
	Ferrule, Vespel/graphite, 0.4-mm id	0.1-mm, 0.2-mm, and 0.25-mm capillary columns	5181-3323 (10/pk)
	Ferrule, graphite, 0.5-mm id	0.1-mm, 0.2-mm, 0.25-mm, and 0.32-mm capillary columns	5080-8853 (10/pk)
	Ferrule, graphite, 0.4-mm id		500-2114 (10/pk)
	Column nut, finger-tight (for .100- to .320-mm columns)	Connect column to inlet or detector	5020-8292
All	Ferrule, no-hole	Testing	5181-3308 (10/pk)
	Capillary column blanking nut	Testing–use with any ferrule	5020-8294
	Column nut, universal	Connect column to inlet or detector	5181-8830 (2/pk)
	Column nut, collared, self-tightening	Connect column to inlet or detector	G3440-81011
	Collar for self-tightening nut	Connect column to inlet or detector	G3440-81012
	Column nut, collared, self-tightening MSD	Connect column to inlet or detector	G3440-81013
	Column cutter, ceramic wafer	Cutting capillary columns	5181-8836 (4/pk)
	Pencil, diamond tipped	Cutting capillary columns	420-1000
	Ferrule tool kit	Ferrule installation	440-1000

Table 21 FID parts and subassemblies

Description	Part number/quantity
Screw, M4 × 25 mm, Torx, T20	0515-2712 (3/pk)
PTFE chimney (optional)	19231-21050
Collector assembly	G4591-60691
Pre-swaged 1/8-inch packed column adapter	G3450-60191
Pre-swaged inert 1/8-inch packed column adapter	G3450-60192
Pre-swaged 1/4-inch packed column adapter	G3450-60193
Pre-swaged Inert 1/4-inch packed column adapter	G3450-60194
Jet, FID, 0.011-inch id	G4591-20320
Jet,FID, universal fit, 0.011 inch id	5200-0176
Jet,FID, universal fit, 0.018 inch id	5200-0177
Jet,FID, universal fit, 0.030 inch id	5200-0178

Table 22 FID collector assembly parts

Description	Part number/quantity
Screw, M4 × 25 mm, Torx, T20	0515-2712 (3/pk)
Collector assembly	G4591-60691
Collector nut	19231-20940
Spring washer	3050-1246
Ignitor castle	19231-20910
Ignitor castle, Hastelloy	19231-21060
Upper/lower collector insulator	G1531-20700
Collector body	G1531-20690
Collector body, Hastelloy	G1531-21090
Spanner nut, base	19231-20990
Collector mount	G4591-20690
Collector housing	19231-21010
Gasket	5180-4165 (12/pk)
Ignitor (glow plug) assembly with O-ring	19231-60680

Exploded Parts Views of the Flame Ionization Detector

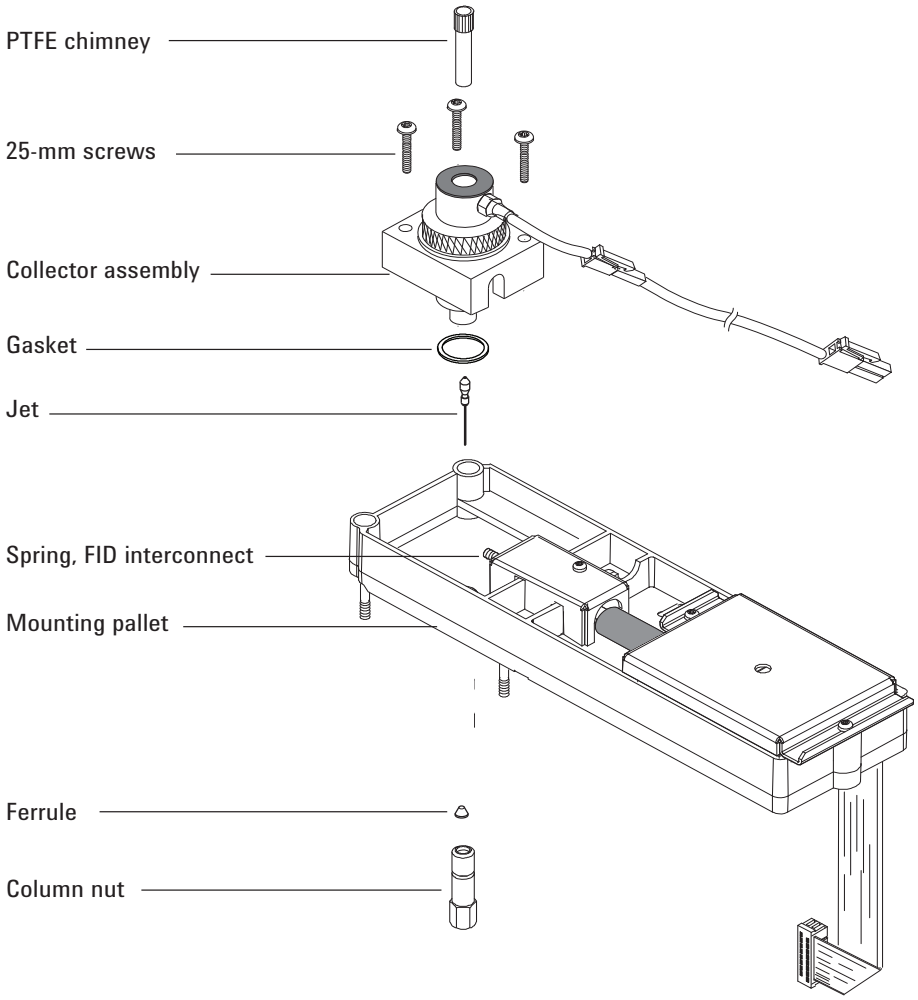


Figure 12. Flame ionization detector (FID) assembly exploded parts

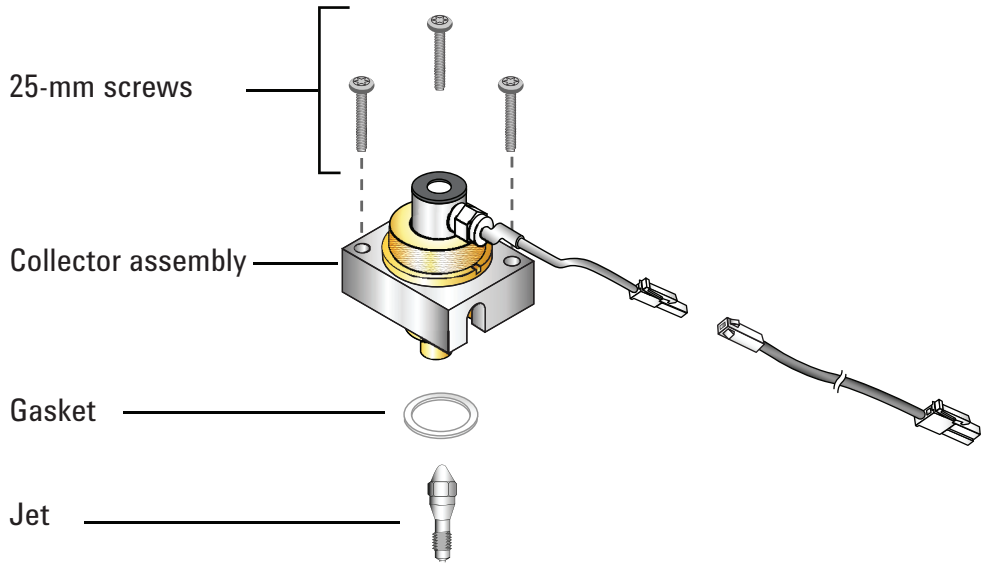


Figure 13. FID exploded parts view

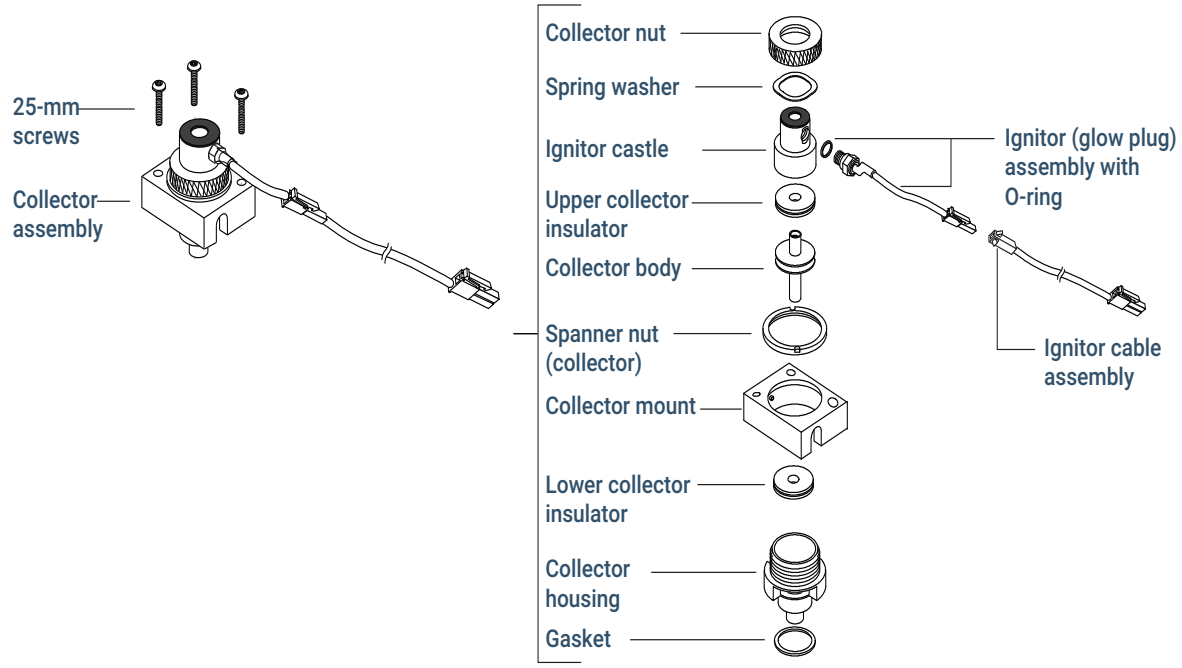


Figure 14. FID collector assembly exploded parts view

To Install a Capillary Column in the FID

1 Gather the following materials, see **"Consumables and Parts for the FID"** on page 140:

- Column
- Ferrule(s)
- Column nut
- Column cutter
- 1/4-inch open-end wrench
- Septum
- Isopropanol
- Lab tissue
- Lint-free gloves

2 Launch the GC maintenance wizard: **Maintenance > Column > Perform Maintenance > Install Column > Start Maintenance.** Wait for the GC to become ready.
The wizard will guide you through the maintenance steps described below.

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.

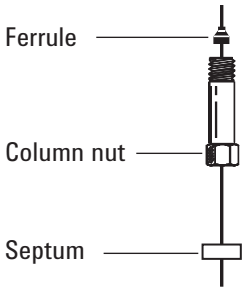
WARNING

Wear safety glasses to protect your eyes from flying particles while handling, cutting, or installing glass or fused silica capillary columns. Use care in handling these columns to prevent puncture wounds.

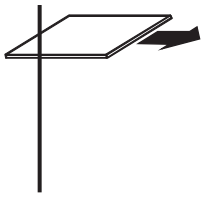
CAUTION

Wear clean, lint-free gloves to prevent contamination of parts with dirt and skin oils.

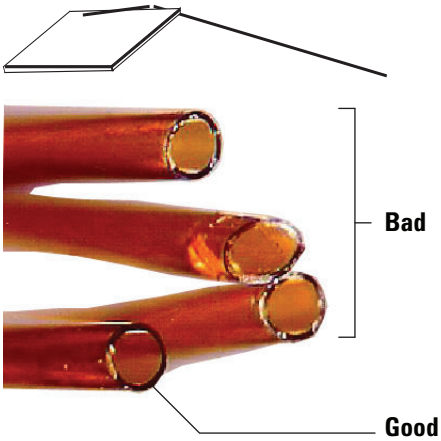
3 Place a septum (if the column id is ≤0.1 mm), capillary column nut, and ferrule on the column.



4 Score the column using a glass scribing tool. The score must be square to ensure a clean break.



5 Break off the column end by supporting it against the column cutter opposite the scribe. Inspect the end with a magnifying loupe to make certain there are no burrs or jagged edges.



6 Wipe the column walls with a tissue dampened with isopropanol to remove fingerprints and dust.

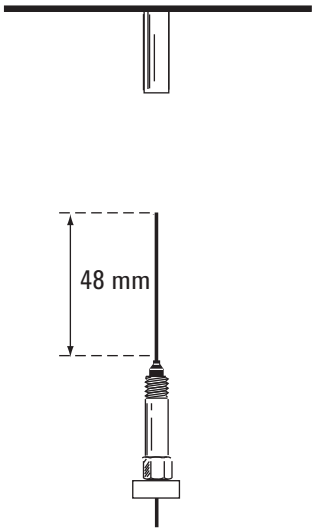
7 Install the capillary column.

If the column id is greater than 0.1 mm:

a Gently insert the column into the detector until it bottoms; do not attempt to force it further.

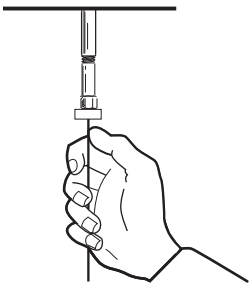
b Finger-tighten the column nut, then withdraw the column about 2 mm. Tighten the nut an additional 1/4 turn with a wrench.

If the column id is 0.1 mm or less position the column so it extends above the ferrule by 48 mm. Slide the septum up to hold the column nut and ferrule at this fixed position.



c Insert the column into the detector. Slide the nut and ferrule up the column to the detector base. Finger-tighten the column nut until it grips the column.

d Adjust the column (*not* the septum) position so that the septum is even with the bottom of the column nut. Tighten the nut an additional 1/4 turn with a wrench.



8 The GC maintenance wizard will perform checks at the appropriate times, including **Leak & Restriction** tests, and will automatically reset the maintenance counters.

9 Select **Finished**, then select **OK** to exit the GC maintenance wizard**.**

To Replace an FID Jet

1 Gather the following:
- Replacement jet
- T-20 Torx screwdriver
- 1/4-inch nut driver
- Tweezers
- Compressed, filtered, dry air or nitrogen
- Solvent that will clean the type of deposits in your detector
- Clean cloth
- Cotton swab
- Lint-free gloves

2 Launch the GC maintenance wizard: **Maintenance > Detectors,** select the detector, then select **Perform Maintenance > Replace FID Jet > Start Maintenance.** The wizard will guide you through the maintenance steps described below.

WARNING

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

WARNING

Wear safety glasses to protect your eyes from flying particles while handling, cutting, or installing glass or fused silica capillary columns. Use care in handling these columns to prevent puncture wounds.

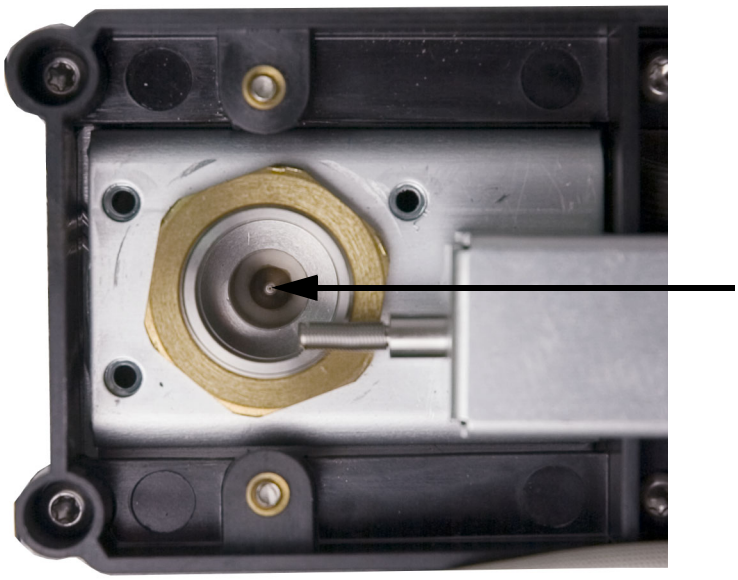
3 If installed, remove the capillary column from the detector.

CAUTION

Wear clean, lint-free gloves to prevent contamination of parts with dirt and skin oils.

4 Remove the FID castle assembly and place it on a clean cloth.

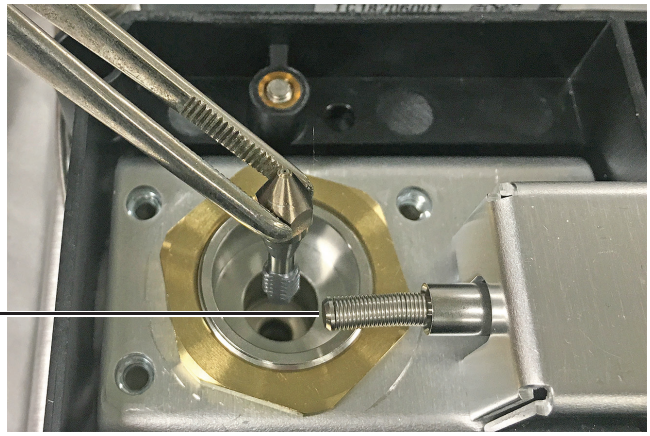
5 Locate the jet inside the housing.



CAUTION

Handle the clean or new jet only with tweezers, or wear gloves.

6 Loosen the jet, then lift it out of the housing with tweezers.



Interconnector spring

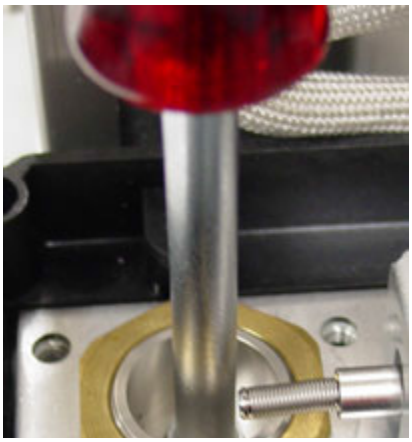
7 Clean the detector base cavity using solvent, a swab, and compressed air or nitrogen.

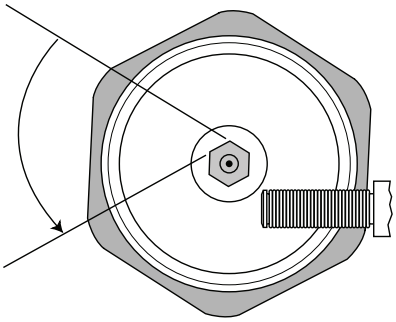
8 Use tweezers to lower the new jet into the housing.

CAUTION

Do not overtighten the jet! Overtightening may permanently deform and damage the jet, the detector base, or both. The torque specification is 10 inch-pounds.

9 Carefully screw the jet into the housing. Tighten 1/6-turn past finger-tight (1/6-turn is one "flat" on a typical screwdriver handle, or the jet head).





10 Install the castle assembly.

11 The GC maintenance wizard will perform checks at the appropriate times, including **Leak & Restriction** tests, and will automatically reset the maintenance counters.

12 Select **Finished**, then select **OK** to exit the GC maintenance wizard**.**

13 Attach the capillary column to the detector.

- **a** Install the column in the detector. See **"To Install a Capillary Column in the FID"** on page 144.
- **b** After the column is installed at both inlet and detector, establish a flow of carrier gas and purge as recommended by the column manufacturer.
- **c** Check the FID leakage current. See **"To Check the FID Leakage Current"** on page 158.
- **d** Bakeout the detector. See **"To Bakeout the FID"** on page 161.
- **e** Restore the analytical method.

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.

- **f** Allow the oven, inlet, and detector to equilibrate at operating temperature, then retighten the fittings.

14 Check the FID baseline. See **"To Check the FID Baseline"** on page 159.

To Perform Maintenance on the FID Collector Assembly

NOTE

Perform only the steps and gather only the parts that apply to the desired maintenance task(s).

1 Gather the following:
- Replacement ignitor assembly, see **"Consumables and Parts for the FID"** on page 140.
- Replacement ignitor castle
- Two collector insulators
- Collector
- Spring washer
- Gasket
- T-20 Torx screwdriver
- 1/4-inch nut driver
- Tweezers
- 5/16-inch wrench
- Lint-free gloves
- Clean cloth

CAUTION

To avoid contaminating the FID, wear clean, lint-free gloves when handling the collector assembly.

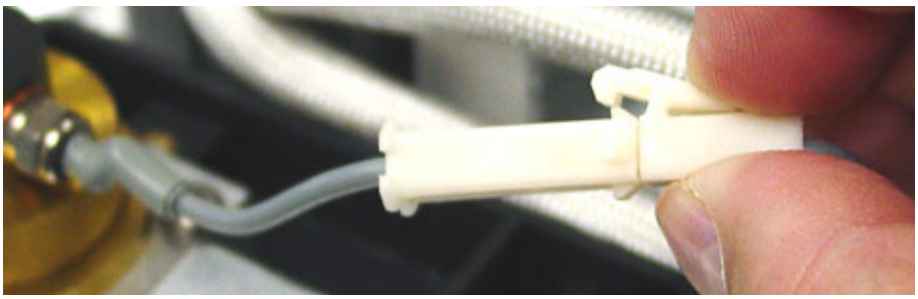
2 Launch the GC maintenance wizard: **Maintenance > Detectors,** select the detector, then select **Perform Maintenance > Maintain FID Collector > Start Maintenance.** The wizard will guide you through the maintenance steps described below.

WARNING

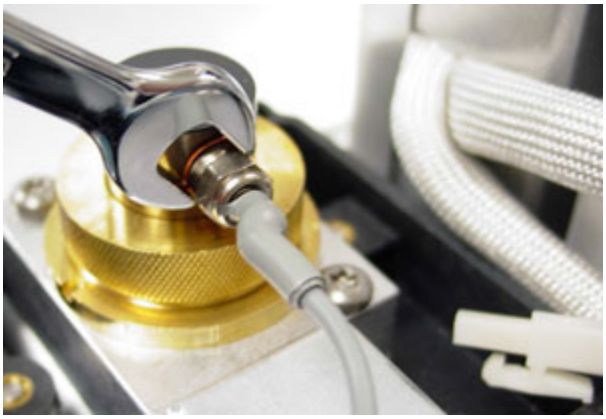
Be careful! The oven and/or detector may be hot enough to cause burns. If the detector is hot, wear gloves to protect your hands.

3 Remove the FID ignitor. If you are not replacing the ignitor, skip to **step 5**.

a Disconnect the ignitor cable assembly.



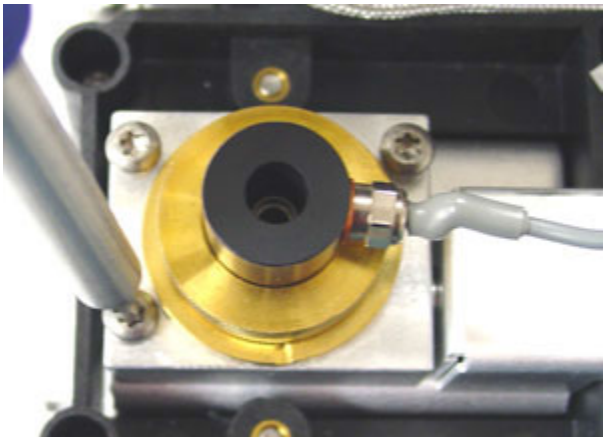
b Loosen the ignitor with a wrench.



c Turn the nut counterclockwise by hand. Remove the ignitor and copper washer.

4 If replacing only the FID ignitor assembly with copper washer, skip to **step 16** for assembly.

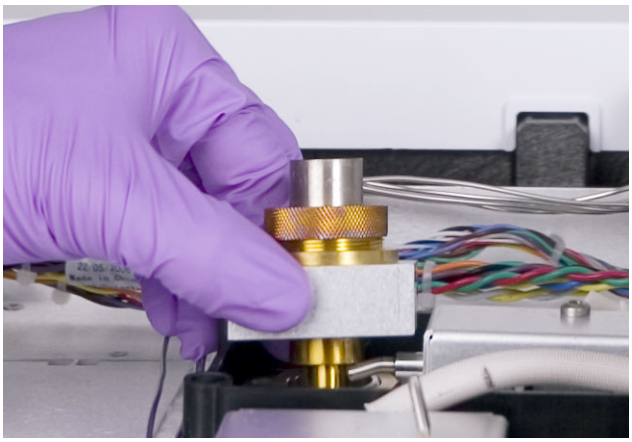
5 Remove the three screws that secure the collector assembly to the FID mounting pallet.



CAUTION

This step exposes the interconnect spring. Be careful not to touch or disfigure the spring while working on the FID. Any dirt or bending will reduce the sensitivity of your detector.

6 Remove the collector assembly. Place it on a clean cloth for additional disassembly.



7 Remove the gasket from the bottom of the assembly, if necessary.

8 Remove the FID ignitor castle.

a Loosen the collector nut.

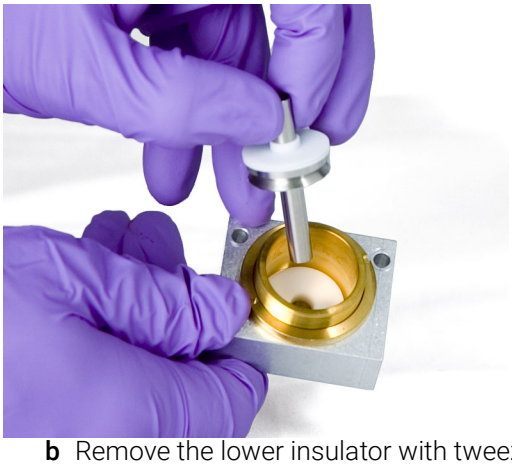
b Remove the collector nut and the spring washer.

c Lift the castle out of the collector housing. When removing the castle, some of the collector parts may be attached. Set these on a clean cloth to protect from scratches or dirt.

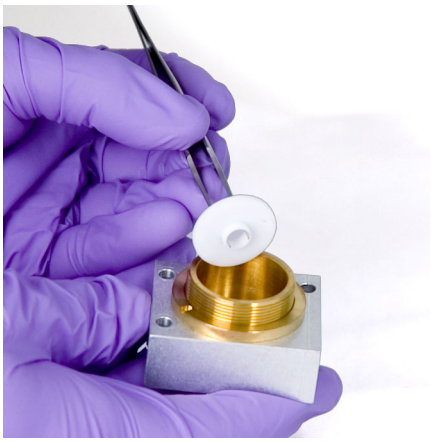
9 If only replacing the FID castle, skip to **step 15** for reassembly.

10 Remove the collector and insulators.

a If needed, remove the collector and upper insulator from the FID housing. The lower insulator may come out with the collector, but often remains in the FID housing. Place the parts on a clean cloth.



b Remove the lower insulator with tweezers and place the parts on a clean cloth.

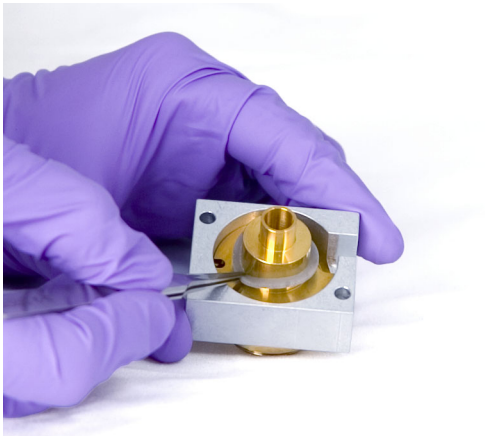


11 Remove the collector housing from the mount, if necessary.

12 Use tweezers to remove the gasket from the bottom of the housing.

The collector assembly is now completely disassembled. Reassemble as follows:

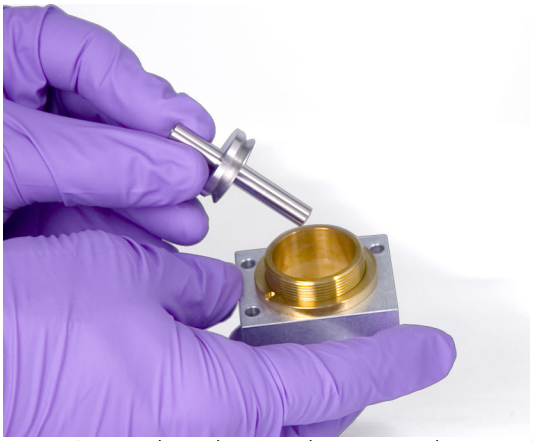
13 Use tweezers to install a new gasket onto the housing, being sure that it lays flat on the brass surface.



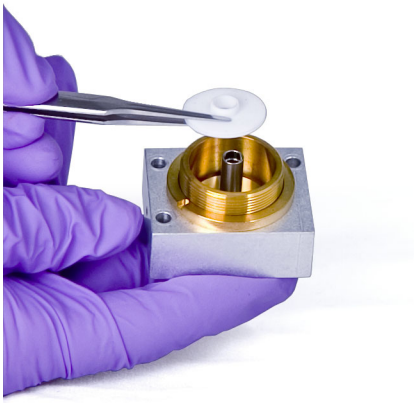
14 Install the collector insulators.

a Insert one of the insulators into the base of the housing. Seat the insulator with the flat surface facing out of the housing.

b Insert the long end of collector into the housing and lower insulator.



c Insert the other insulator onto the top of the collector, with the flat surface facing towards the housing.



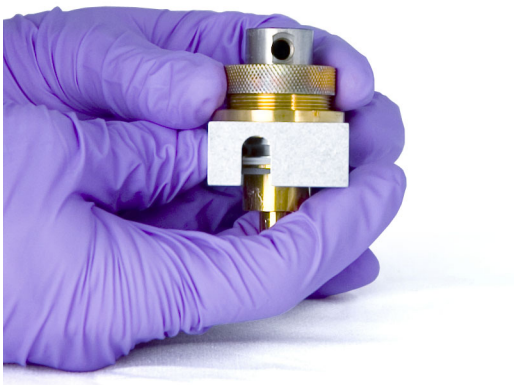
15 Install the FID ignitor castle.

a Orient the castle so that the threaded hole for the ignitor faces toward the electronics.

b Insert the FID castle into the collector housing.

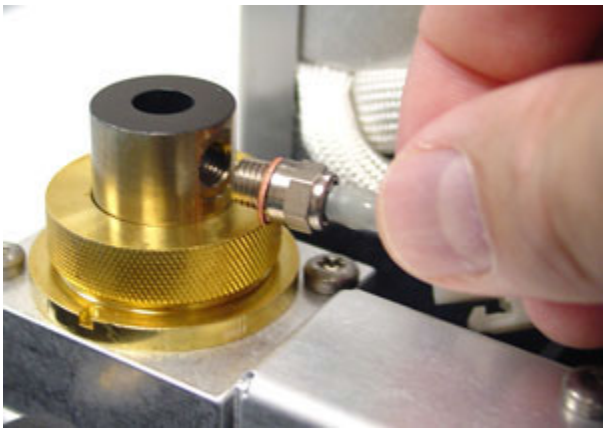
c Install the spring washer over the castle.

d Install the collector nut over the castle and tighten firmly. The seal should be airtight. Maintain the orientation of the ignitor hole with the base as shown below.

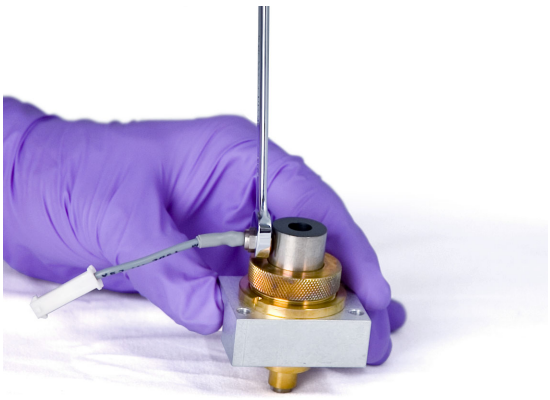


16 Install the FID ignitor.

a Insert the ignitor and copper seal into the threaded hole of the castle. Keep the mating threads clean.

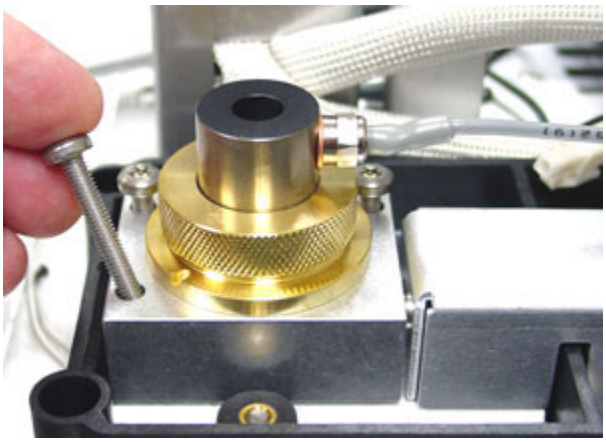


b Tighten the ignitor with a wrench. Ignition requires a good electrical contact that is free of any dirt.



17 Lower the collector assembly into the housing.

18 Insert the three screws and tighten (to 18-inch-pounds).



19 Connect the ignitor extension cable.

20 Verify assembly:

a Check the FID leakage current. See **"To Check the FID Leakage Current"** on page 158.

b Bakeout the detector. See **"To Bakeout the FID"** on page 161.

c Check the FID baseline. See **"To Check the FID Baseline"** on page 159.

21 The GC maintenance wizard will perform checks at the appropriate times, including **Leak & Restriction** tests, and will automatically reset the maintenance counters.

22 Select **Finished**, then select **OK** to exit the GC maintenance wizard**.**

To Check the FID Leakage Current

1. Load the analytical method.
   - Make sure flows are acceptable for ignition.
   - Heat the detector to operating temperature or 300 °C.
2. Perform a Leakage Current Test: **Diagnostics > Diagnostics Tests >** select **Leakage Current Test** for the detector**.** Read the **Test Details** screen then press **Start Test**.
3. Turn off the FID flame.
4. Show the detector output signal in **Status**. Go to **Home > Status listing > +Add**. Select the detector's output from the drop-down list, then touch **Add**.
5. 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 contamination. If this contamination is confined to the detector, bakeout the FID. See **"To Bakeout the FID"** on page 161.
6. Turn on the flame.

To Check the FID Baseline

1. With the column installed, load your checkout method.
2. Set the oven temperature to 35 °C.
3. Show the detector output signal in **Status**. Go to **Home > Status listing > +Add**. Select the detector's output from the drop-down list, then touch **Add**.
4. When the flame is lit and the GC is ready, verify that the output is stable and < 20 pA.

   If the output is not stable or > 20 pA, the system or gas may be contaminated. If this contamination is isolated to the detector, then bakeout the FID. See **"To Bakeout the FID"** on page 161.

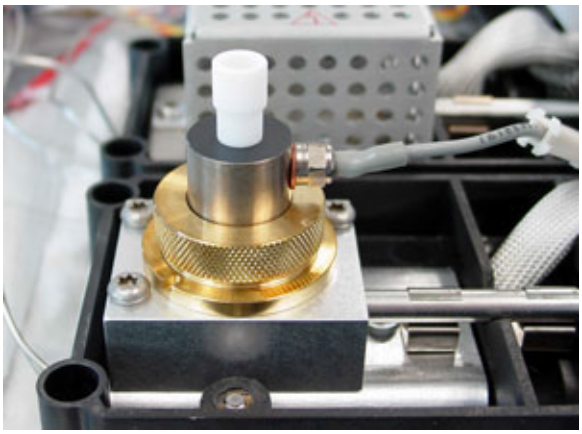
To Install the Optional FID PTFE Chimney Insert

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 Light the FID flame.

2 Insert the PTFE chimney into the FID castle.



NOTE

When installed, the PTFE chimney insert prevents ignition.

To Bakeout the FID

1 Bakeout the FID with the column installed or uninstalled. If uninstalled, gather the following, see **"Consumables and Parts for the FID"** on page 140:

- Capillary adapter (adaptable FID only)
- Column nut
- No-hole ferrule

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.

2 If the column is uninstalled:

a Cool the GC oven and detector

b Plug the detector connection with the capillary adapter, column nut, and no-hole ferrule

WARNING

If using hydrogen as a carrier gas, turn off the hydrogen supply and cap the end of the column to prevent an oven explosion.

3 Maintain inert carrier gas flow through the column, or remove the column from the GC.

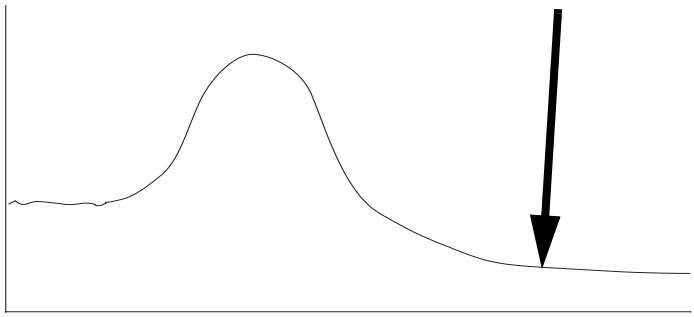
4 Set the detector temperature at 350 to 375 °C.

5 Set normal operating flows.

6 Light the FID flame.

7 Set the oven temperature to 250 °C or 25 °C above the normal maximum operating temperature. Do not exceed the column's temperature limit.

8 Hold at temperature for 30 minutes or until the baseline settles at a lower value. The baseline will typically rise, then fall to a final value lower than the initial baseline.



9 Restore the analytical method and allow the FID to equilibrate.

10 Check the FID output value. It should be lower than the first reading. If it is not, contact your Agilent service representative.

Without a column installed, a clean system baseline should be < 20 pA.

11 If the column is not installed in the FID, install it. See **"To Install a Capillary Column in the FID"** on page 144.

10 Maintaining the TCD

Consumables and Parts for the Thermal Conductivity Detector

See the Agilent catalog for consumables and supplies for a more complete listing, or visit the Agilent Web site for the latest information (**www.agilent.com**).

Standard TCD column hardware

Table 23 Nuts, ferrules, and hardware for capillary columns

Column id (mm)	Description	Typical use	Part number/quantity
.530	Ferrule, Vespel/graphite, 0.8-mm id	0.45-mm and 0.53-mm capillary columns	5062-3512 (10/pk)
	Ferrule, graphite, 1.0-mm id	0.53-mm capillary columns	5080-8773 (10/pk)
	Ferrule, graphite, 0.8-mm id	0.53-mm capillary columns	500-2118 (10/pk)
	Column nut, finger-tight (for 0.53-mm columns)	Connect column to inlet or detector	5020-8293
.320	Ferrule, Vespel/graphite, 0.5-mm id	0.32-mm capillary columns	5062-3514 (10/pk)
	Ferrule, graphite, 0.5-mm id	0.1-mm, 0.2-mm, 0.25-mm, and 0.32-mm capillary columns	5080-8853 (10/pk)
	Column nut, finger-tight (for .100- to .320-mm columns)	Connect column to inlet or detector	5020-8292
.250	Ferrule, Vespel/graphite, 0.4-mm id	0.1-mm, 0.2-mm, and 0.25-mm capillary columns	5181-3323 (10/pk)
	Ferrule, graphite, 0.5-mm id	0.1-mm, 0.2-mm, 0.25-mm, and 0.32-mm capillary columns	5080-8853 (10/pk)
	Column nut, finger-tight (for .100- to .320-mm columns)	Connect column to inlet or detector	5020-8292
.100 and .200	Ferrule, Vespel/graphite, 0.37-mm id	0.1-mm and 0.2-mm capillary columns	5062-3516 (10/pk)
	Ferrule, Vespel/graphite, 0.4-mm id	0.1-mm, 0.2-mm, and 0.25-mm capillary columns	5181-3323 (10/pk)
	Ferrule, graphite, 0.5-mm id	0.1-mm, 0.2-mm, 0.25-mm, and 0.32-mm capillary columns	5080-8853 (10/pk)
	Ferrule, graphite, 0.4-mm id		500-2114 (10/pk)
	Column nut, finger-tight (for .100- to .320-mm columns)	Connect column to inlet or detector	5020-8292
All	Ferrule, no-hole	Testing	5181-3308 (10/pk)
	Capillary column blanking nut	Testing–use with any ferrule	5020-8294
	Column nut, universal	Connect column to inlet or detector	5181-8830 (2/pk)
	Column nut, collared, self-tightening	Connect column to inlet or detector	G3440-81011
	Collar for self-tightening nut	Connect column to inlet or detector	G3440-81012

Table 23 Nuts, ferrules, and hardware for capillary columns (continued)

Column id (mm)	Description	Typical use	Part number/quantity
	Column nut, collared, self-tightening MSD	Connect column to inlet or detector	G3440-81013
	Column cutter, ceramic wafer	Cutting capillary columns	5181-8836 (4/pk)
	Pencil, diamond tipped	Cutting capillary columns	420-1000
	Ferrule tool kit	Ferrule installation	440-1000

Table 24 Packed column adapters

Description	Part number/quantity
Pre-swaged 1/8-inch packed column adapter	G3450-60191
Pre-swaged inert 1/8-inch packed column adapter	G3450-60192
Pre-swaged 1/4-inch packed column adapter	G3450-60193
Pre-swaged Inert 1/4-inch packed column adapter	G3450-60194

To Install a Capillary Column in the TCD

1 Gather the following materials, see **"Consumables and Parts for the Thermal Conductivity Detector"** on page 164:

- Column
- Ferrule(s)
- Column nut
- Column cutter
- 1/4-inch open-end wrench
- Septum
- Isopropanol
- Lab tissue
- Lint-free gloves

2 Launch the GC maintenance wizard: **Maintenance > Column > Perform Maintenance > Install Column > Start Maintenance.** Wait for the GC to become ready.
The wizard will guide you through the maintenance steps described below.

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.

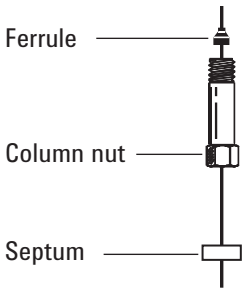
WARNING

Wear safety glasses to protect your eyes from flying particles while handling, cutting, or installing glass or fused silica capillary columns. Use care in handling these columns to prevent puncture wounds.

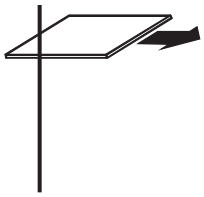
CAUTION

Wear clean, lint-free gloves to prevent contamination of parts with dirt and skin oils.

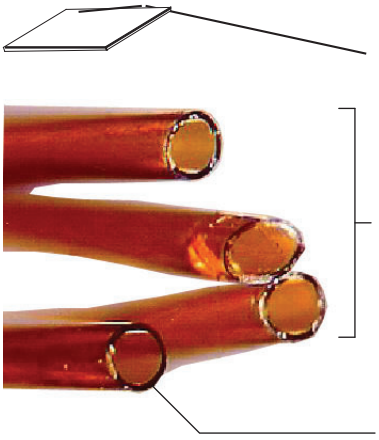
3 Place a septum (if the column id is ≤0.1 mm), capillary column nut, and ferrule on the column.



4 Score the column using a glass scribing tool. The score must be square to ensure a clean break.



5 Break off the column end by supporting it against the column cutter opposite the scribe. Inspect the end with a magnifying loupe to make certain there are no burrs or jagged edges.



6 Wipe the column walls with a tissue dampened with isopropanol to remove fingerprints and dust.

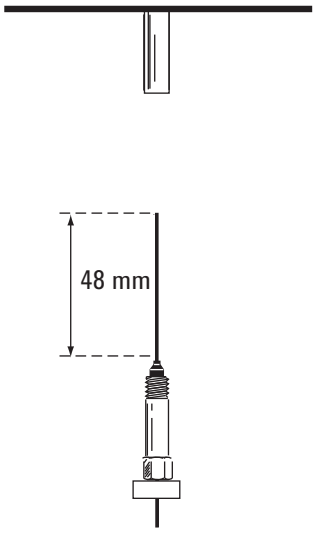
7 Install the capillary column.

If the column id is greater than 0.1 mm:

a Gently insert the column into the detector until it bottoms; do not attempt to force it further.

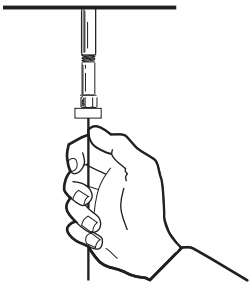
b Finger-tighten the column nut, then withdraw the column about 2 mm. Tighten the nut an additional 1/4 turn with a wrench.

If the column id is 0.1 mm or less position the column so it extends above the ferrule by 48 mm (capillary optimized fitting). Slide the septum up to hold the column nut and ferrule at this fixed position.



c Insert the column into the detector. Slide the nut and ferrule up the column to the detector base. Finger-tighten the column nut until it grips the column.

d Adjust the column (*not* the septum) position so that the septum is even with the bottom of the column nut. Tighten the nut an additional 1/4 turn with a wrench.



8 The GC maintenance wizard will perform checks at the appropriate times, including **Leak & Restriction** tests, and will automatically reset the maintenance counters.

9 Select **Finished**, then select **OK** to exit the GC maintenance wizard**.**

To Bakeout Contaminants from the TCD

The bakeout can be performed with the column installed or the detector capped.

CAUTION

If the column is not installed, you must turn off the TCD filament and cap the detector column fitting to prevent irreparable damage to the filament caused by oxygen entering the detector.

1 If the column is not installed, cap the detector.

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.

2 Turn off the TCD filament.

3 If the column is attached to the inlet, maintain inert carrier gas flow through the column.

WARNING

If using hydrogen as a carrier gas, turn off the hydrogen supply and cap the end of the column to prevent an oven explosion.

4 Set the reference gas flow rate between 20 and 30 mL/min.

5 Set the detector temperature to 375 °C.

6 Hold at 375 °C for several hours.

7 If the column is uninstalled, install it. See **"To Install a Capillary Column in the TCD"** on page 166.

8 Load the analytical method.

WARNING

Be careful! The oven or detector fittings may be hot enough to cause burns.

9 Allow the oven, inlet, and detector to equilibrate at operating temperature, then re-tighten the fittings.

11 Maintaining the ECD

This section describes the routine maintenance tasks for the Electron Capture Detector (ECD). For important regulatory and safety information for this detector, refer to the general information booklet and CD provided with the detector.

Important Safety Information About the ECD

The ECD contains a cell plated with ^{63}Ni, a radioactive isotope. The beta particles released at the energy level in the detector have little penetrating power—the surface layer of the skin or a few sheets of paper will stop most of them—but they may be hazardous if the isotope is ingested or inhaled. For this reason, handle the cell with care. Cap the detector inlet and outlet fittings when the detector is not in use. Never introduce corrosive chemicals into the detector. Vent detector exhaust outside the laboratory environment.

Refer to the safety documentation provided with the detector for important details about safety, maintenance, and compliance with local government regulation.

WARNING

Materials that may react with the ^{63}Ni source, either to form volatile products or to cause physical degradation of the plated film, must be avoided. These materials include oxidizing compounds, acids, wet halogens, wet nitric acid, ammonium hydroxide, hydrogen sulfide, PCBs, and carbon monoxide. This list is not exhaustive but indicates the kinds of compounds that may cause damage to ^{63}Ni detectors.

WARNING

In the extremely unlikely event that both the oven and the detector-heated zone should go into thermal runaway (maximum, uncontrolled heating in excess of 400 °C) at the same time and the detector remains exposed to this condition for more than 12 hours, take the following steps:

- **After turning off the main power and allowing the instrument to cool, cap the detector inlet and exhaust vent openings. Wear disposable plastic gloves and observe normal laboratory safety precautions.**
- **Return the cell for disposal, following directions included with the License Verification Form (part number 19233-90750).**
- **Include a letter stating the condition of abuse.**

It is unlikely, even in this very unusual situation, that radioactive material will escape the cell. However, permanent damage to the ^{63}Ni plating within the cell is possible; therefore, the cell must be returned for exchange.

WARNING

Do not use solvents to clean the ECD.

WARNING

You may not open the ECD cell unless authorized to do so by your local nuclear regulatory agency. Do not disturb the four socket-head bolts. These hold the cell halves together. United States customers removing or disturbing them is a violation of the terms of the exemption and could create a safety hazard.

When handling ECDs:

- Never eat, drink, or smoke.
- Always wear safety glasses when working with or near open ECDs.
- Wear protective clothing such as laboratory jackets, safety glasses, and gloves, and follow good laboratory practices. Wash hands thoroughly with a mild nonabrasive cleaner after handling ECDs.

- Cap the inlet and outlet fittings when the ECD is not in use.
- Connect the ECD exhaust vent to a fume hood or vent it to the outside. See the latest revision of 10 CFR Part 20 (including Appendix B), or the applicable state regulation. For other countries, consult with the appropriate agency for equivalent requirements.

  Agilent Technologies recommends a vent line internal diameter of 6 mm (1/4-inch) or greater. With a line of this diameter, the length is not critical.

Consumables and Parts for the ECD

See the Agilent catalog for consumables and supplies for a more complete listing, or visit the Agilent Web site for the latest information (**www.agilent.com**).

Table 25 ECD consumables and parts

Description	Part number/quantity
Fused silica indented mixing liner	G2397-20540
Makeup gas adapter	G3433-63000
ECD wipe test kit	18713-60050
Insulation	19234-60715 (1/pk)
Nut, 1/4-inch Swagelok adapter	5180-4105 (10/pk)
Ferrule, graphitized Vespel, 1/4-inch	5080-8774 (10/pk)
Capillary column blanking nut	5020-8294
1/4-inch Detector adapter, for 1/8-inch packed columns	19301-80530

Table 26 Nuts, ferrules, and hardware for capillary columns

Column id (mm)	Description	Typical use	Part number/quantity
.530	Ferrule, Vespel/graphite, 0.8-mm id	0.45-mm and 0.53-mm capillary columns	5062-3512 (10/pk)
	Ferrule, graphite, 1.0-mm id	0.53-mm capillary columns	5080-8773 (10/pk)
	Ferrule, graphite, 0.8-mm id	0.53-mm capillary columns	500-2118 (10/pk)
	Column nut, finger-tight (for 0.53-mm columns)	Connect column to inlet or detector	5020-8293
.320	Ferrule, Vespel/graphite, 0.5-mm id	0.32-mm capillary columns	5062-3514 (10/pk)
	Ferrule, graphite, 0.5-mm id	0.1-mm, 0.2-mm, 0.25-mm, and 0.32-mm capillary columns	5080-8853 (10/pk)
	Column nut, finger-tight (for .100- to .320-mm columns)	Connect column to inlet or detector	5020-8292
.250	Ferrule, Vespel/graphite, 0.4-mm id	0.1-mm, 0.2-mm, and 0.25-mm capillary columns	5181-3323 (10/pk)
	Ferrule, graphite, 0.5-mm id	0.1-mm, 0.2-mm, 0.25-mm, and 0.32-mm capillary columns	5080-8853 (10/pk)
	Column nut, finger-tight (for .100- to .320-mm columns)	Connect column to inlet or detector	5020-8292
.100 and .200	Ferrule, Vespel/graphite, 0.37-mm id	0.1-mm and 0.2-mm capillary columns	5062-3516 (10/pk)
	Ferrule, Vespel/graphite, 0.4-mm id	0.1-mm, 0.2-mm, and 0.25-mm capillary columns	5181-3323 (10/pk)
	Ferrule, graphite, 0.5-mm id	0.1-mm, 0.2-mm, 0.25-mm, and 0.32-mm capillary columns	5080-8853 (10/pk)

Table 26 Nuts, ferrules, and hardware for capillary columns (continued)

Column id (mm)	Description	Typical use	Part number/quantity
	Ferrule, graphite, 0.4-mm id		500-2114 (10/pk)
	Column nut, finger-tight (for .100- to .320-mm columns)	Connect column to inlet or detector	5020-8292
All	Ferrule, no-hole	Testing	5181-3308 (10/pk)
	Capillary column blanking nut	Testing–use with any ferrule	5020-8294
	Column nut, universal	Connect column to inlet or detector	5181-8830 (2/pk)
	Column nut, collared, self-tightening	Connect column to inlet or detector	G3440-81011
	Collar for self-tightening nut	Connect column to inlet or detector	G3440-81012
	Column nut, collared, self-tightening MSD	Connect column to inlet or detector	G3440-81013
	Column cutter, ceramic wafer	Cutting capillary columns	5181-8836 (4/pk)
	Pencil, diamond tipped	Cutting capillary columns	420-1000
	Ferrule tool kit	Ferrule installation	440-1000

Exploded Parts View of the Electron Capture Detector

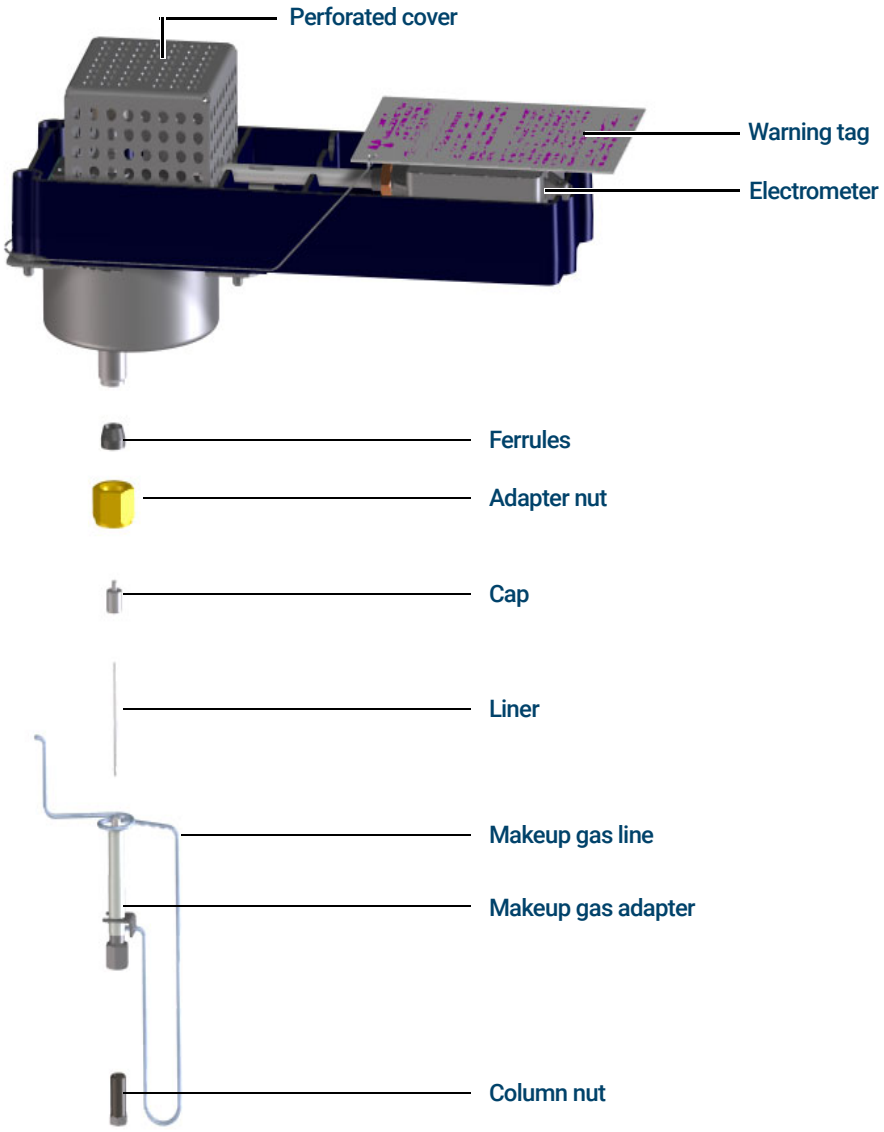


Figure 15. Electron Capture Detector (ECD) exploded parts

To Replace the ECD Fused Silica Indented Mixing Liner and Install the Makeup Gas Adapter

1 Gather the following:
- Fused silica indented mixing liner, see **"Consumables and Parts for the ECD"** on page 174.
- 1/4-inch Swagelok nut
- 1/4-inch Vespel/graphite ferrule
- 9/16-inch wrench
- Methanol
- Lint-free gloves

2 Place GC in maintenance mode: **Maintenance > Instrument > Perform Maintenance > Maintenance Mode > Start Maintenance.** Wait for the GC to become ready to continue (all zones cooled to safe handling temperatures).

WARNING

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

WARNING

Wear safety glasses to protect your eyes from flying particles while handling, cutting, or installing glass or fused silica capillary columns. Use care in handling these columns to prevent puncture wounds.

3 Remove the column from the makeup gas adapter.

CAUTION

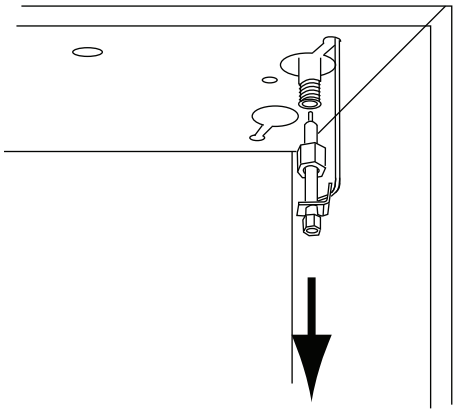
To prevent damage avoid flexing/bending the tubing on the makeup gas adapter.

4 Remove the makeup gas adapter.

a Loosen the adapter nut with a wrench and slide out the makeup gas adapter from the ECD. Remove the ferrule.

The makeup gas adapter will remain attached to the supply tubing and hang suspended in the oven.

b Adjust the adapter's position so that maintenance can be performed on the adapter easily and without obstruction.



5 Unscrew and remove the adapter cap.

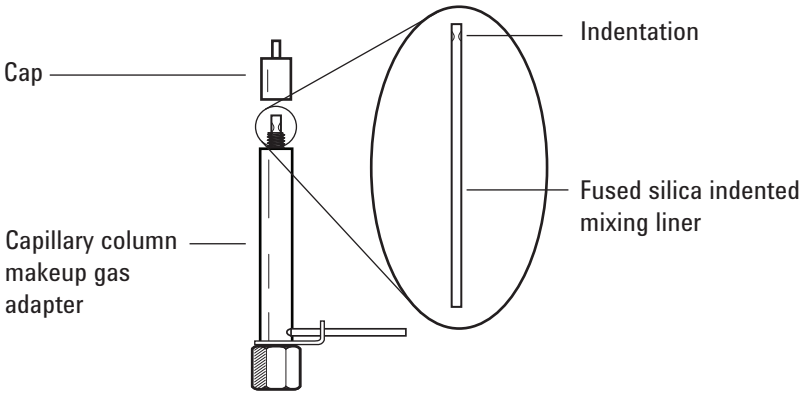
CAUTION

Wear clean, lint-free gloves to prevent contamination of parts with dirt and skin oils.

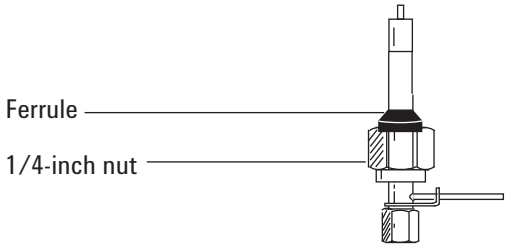
6 Remove the fused silica indented mixing liner and inspect. Replace it if it is broken or contaminated with sample or graphite.

7 Ultrasonically clean the adapter cap in methanol. Clean the outer surfaces of the makeup gas adapter with methanol.

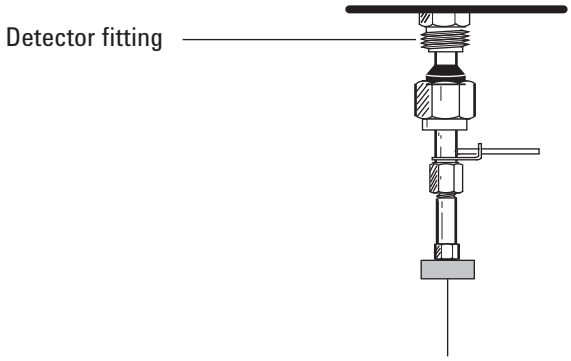
8 Install the fused silica indented mixing liner into the makeup gas adapter, then install the cap. The indentation on the fused silica indented mixing liner must be at the cap end of the adapter.



9 Place a new 1/4-inch Swagelok nut and ferrule onto the makeup gas adapter.

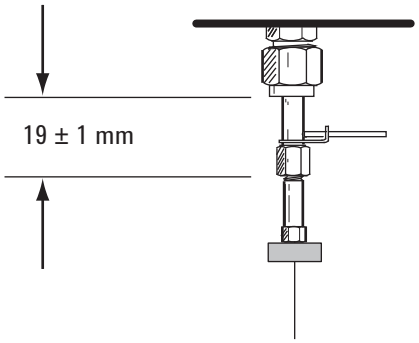


10 Slowly install the adapter straight into the detector fitting. Jiggle the adapter, if necessary, to make sure it is seated all the way into the detector fitting. Be careful not to break the column end.



11 Tighten the nut finger-tight and then use a 9/16-inch wrench to tighten until snug.

If the adapter is properly installed, the distance between the 1/4-inch nut and the bottom of the adapter will be 19 ± 1 mm. If the distance is 22 to 23 mm, install the adapter into the detector fitting.



12 Attach the column. See **"To Install a Capillary Column in the ECD"** on page 180.

13 Perform an inlet **Leak & Restriction** test and reset the maintenance counters.

14 Exit maintenance mode. Select **Maintenance > Instrument > Perform Maintenance > Maintenance Mode > Finished.**

To Install a Capillary Column in the ECD

1 Gather the following:
- Ferrule, see **"Consumables and Parts for the ECD"** on page 174.
- Column nut
- Septum
- Column
- 1/4-inch, 5/16-inch, and 9/16-inch wrenches
- Column cutter
- Lint-free gloves

2 Launch the GC maintenance wizard: **Maintenance > Column > Perform Maintenance > Install Column > Start Maintenance.** Wait for the GC to become ready.
The wizard will guide you through the maintenance steps described below.

WARNING

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

WARNING

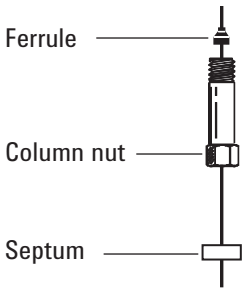
Wear safety glasses to protect your eyes from flying particles while handling, cutting, or installing glass or fused silica capillary columns. Use care in handling these columns to prevent puncture wounds.

3 Load the **inlet maintenance method** and wait for the GC to become ready.

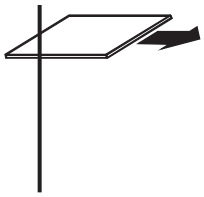
CAUTION

Wear clean, lint-free gloves to prevent contamination of parts with dirt and skin oils.

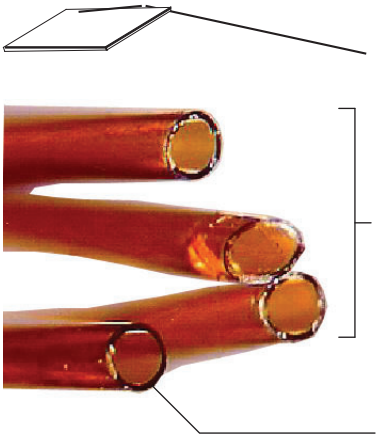
4 Place a septum (if the column id is ≤0.2 mm), capillary column nut, and ferrule on the column.



5 Score the column using a glass scribing tool. The score must be square to ensure a clean break.



6 Break off the column end by supporting it against the column cutter opposite the scribe. Inspect the end with a magnifying loupe to make certain there are no burrs or jagged edges.

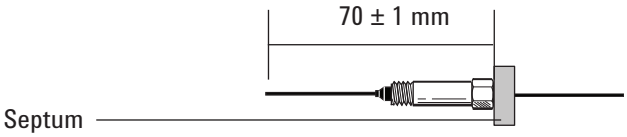


7 Wipe the column walls with a tissue dampened with isopropanol to remove fingerprints and dust.

8 Install the column.

If the column id is 200 um or more, push the column into the adapter until it stops at the indentation. Pull it back 1 to 2 mm and tighten the column nut with one 5/16-inch wrench on the adapter and another 1/4-inch wrench on the column nut.

If the id is less the 200 um, mark the column with a septum 70 ± 1 mm from the end. Insert column and nut into the adapter with the septum at the rear of the column nut, and tighten the column nut with one 5/16-inch wrench on the adapter and another 1/4-inch wrench on the column nut.



9 After heating the detector, retighten the 9/16-inch makeup adapter nut and 1/4-inch column nut.

10 The GC maintenance wizard will perform checks at the appropriate times, including **Leak & Restriction** tests, and will automatically reset the maintenance counters.

11 Select **Finished**, then select **OK** to exit the GC maintenance wizard**.**

To Bakeout the ECD

WARNING

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}Ni may be removed during other procedures, causing possible hazardous exposure to b- and x-radiation.

CAUTION

To prevent possible hazardous contamination of the area with radioactive material, the detector exhaust vent always must be connected to a fume hood or otherwise vented in compliance with the latest revision of 10 CFR Part 20, or with state regulations with which the Nuclear Regulatory Commission has entered into an agreement (USA only). For other countries, consult with the appropriate agency for equivalent requirements.

1 Gather the following:
   - Column nut and no-hole ferrule, see **"Consumables and Parts for the ECD"** on page 174.
   - Blanking nut with any column ferrule

2 With the detector oven at normal operating temperatures, show the detector output signal in **Status**. Note the value of the Output for later comparison.
   a Go to **Home > Status listing > +Add**.
   b Select **Signal Value** for the ECD from the drop-down list.
   c Touch **Add**.

WARNING

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

WARNING

Wear safety glasses to protect your eyes from flying particles while handling, cutting, or installing glass or fused silica capillary columns. Use care in handling these columns to prevent puncture wounds.

3 If the column maximum temperature is < 250 °C, remove the column from the detector.

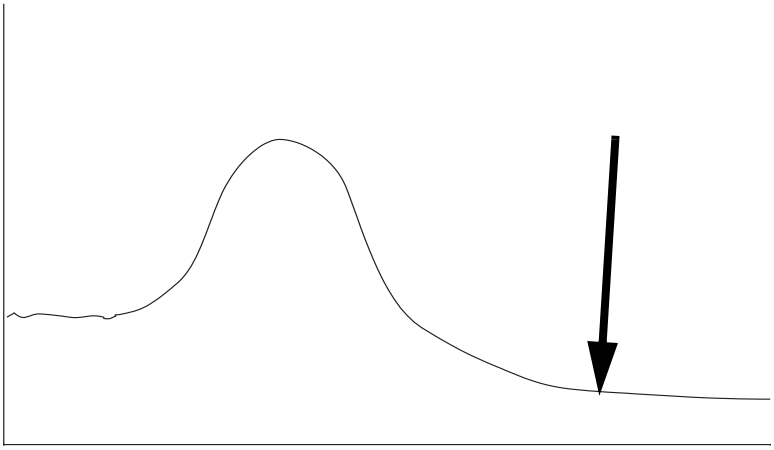
4 If the column is uninstalled, plug the detector connection with the column nut and no-hole ferrule.

   Maintain inert carrier gas flow through the column, or remove the column from the GC.

5 Set the ECD temperature to 350 to 375 °C, the makeup gas flow to 60 mL/min, and the oven temperature to 250 °C. If the column is uninstalled, leave the oven off to protect the column.

6 If the column is installed in the ECD, set the oven temperature to 250 °C. If the column is uninstalled, leave the oven off to protect the column.

7 Allow thermal cleaning to continue for several hours and then cool the system to normal operating temperatures. The figure below shows detector output during a typical cleaning cycle.



8 Check the ECD output value on the control table. It should be lower than the first reading. If it is not, contact your Agilent service representative.

9 Reinstall the column.

10 Restore the analytical method.

12 Maintaining the NPD

Consumables and Parts for the NPD

See the Agilent catalog for consumables and supplies for a more complete listing, or visit the Agilent Web site for the latest information (**www.agilent.com**).

Table 27 NPD parts

Description	Part number/quantity
Collector	G1534-20530
Screw, M3 × 0.5 × 8 mm	0515-0655
NPD Blos bead assembly	G3434-60806
Screw, M4 × 10 mm	0515-2495
J-clamp	1400-0015
NPD ceramic insulator kit • Metal C-rings, top and bottom • Ceramic insulators, upper and lower	5182-9722
NPD chemical sample kit solution of 0.65 ppm azobenzene, 1000 ppm octadecane, 1 ppm malathion in isooctane, 3 ampoules	18789-60060
NPD lid standoff	G1534-20590
NPD raised jet weldment	G4594-81000
NPD Jet, universal fit, 0.011 id	5200-0179
Nut, 1/8-inch, brass, for packed column adapters	5180-4103 (10/pk)
Ferrule, Vespel/graphite, 1/8-inch, for packed column adapters	0100-1332 (10/pk)
Nut, 1/4-inch, brass, for packed column adapters	5180-4105 (10/pk)
Ferrule, Vespel, 1/4-inch, for packed column adapters	5080-8774 (10/pk)
Pre-swaged 1/8-inch packed column adapter	G3450-60191
Pre-swaged inert 1/8-inch packed column adapter	G3450-60192
Pre-swaged 1/4-inch packed column adapter	G3450-60193
Pre-swaged inert 1/4-inch packed column adapter	G3450-60194

Table 28 Nuts, ferrules, and hardware for capillary columns

Column id (mm)	Description	Typical use	Part number/quantity
.530	Ferrule, Vespel/graphite, 0.8-mm id	0.45-mm and 0.53-mm capillary columns	5062-3512 (10/pk)
	Ferrule, graphite, 1.0-mm id	0.53-mm capillary columns	5080-8773 (10/pk)
	Ferrule, graphite, 0.8-mm id	0.53-mm capillary columns	500-2118 (10/pk)
	Column nut, finger-tight (for 0.53-mm columns)	Connect column to inlet or detector	5020-8293

Table 28 Nuts, ferrules, and hardware for capillary columns (continued)

Column id (mm)	Description	Typical use	Part number/quantity
.320	Ferrule, Vespel/graphite, 0.5-mm id	0.32-mm capillary columns	5062-3514 (10/pk)
	Ferrule, graphite, 0.5-mm id	0.1-mm, 0.2-mm, 0.25-mm, and 0.32-mm capillary columns	5080-8853 (10/pk)
	Column nut, finger-tight (for .100- to .320-mm columns)	Connect column to inlet or detector	5020-8292
.250	Ferrule, Vespel/graphite, 0.4-mm id	0.1-mm, 0.2-mm, and 0.25-mm capillary columns	5181-3323 (10/pk)
	Ferrule, graphite, 0.5-mm id	0.1-mm, 0.2-mm, 0.25-mm, and 0.32-mm capillary columns	5080-8853 (10/pk)
	Column nut, finger-tight (for .100- to .320-mm columns)	Connect column to inlet or detector	5020-8292
.100 and .200	Ferrule, Vespel/graphite, 0.37-mm id	0.1-mm and 0.2-mm capillary columns	5062-3516 (10/pk)
	Ferrule, Vespel/graphite, 0.4-mm id	0.1-mm, 0.2-mm, and 0.25-mm capillary columns	5181-3323 (10/pk)
	Ferrule, graphite, 0.5-mm id	0.1-mm, 0.2-mm, 0.25-mm, and 0.32-mm capillary columns	5080-8853 (10/pk)
	Ferrule, graphite, 0.4-mm id		500-2114 (10/pk)
	Column nut, finger-tight (for .100- to .320-mm columns)	Connect column to inlet or detector	5020-8292
All	Ferrule, no-hole	Testing	5181-3308 (10/pk)
	Capillary column blanking nut	Testing–use with any ferrule	5020-8294
	Column nut, universal	Connect column to inlet or detector	5181-8830 (2/pk)
	Column nut, collared, self-tightening	Connect column to inlet or detector	G3440-81011
	Collar for self-tightening nut	Connect column to inlet or detector	G3440-81012
	Column nut, collared, self-tightening MSD	Connect column to inlet or detector	G3440-81013
	Column cutter, ceramic wafer	Cutting capillary columns	5181-8836 (4/pk)
	Pencil, diamond tipped	Cutting capillary columns	420-1000
	Ferrule tool kit	Ferrule installation	440-1000

Exploded Parts View of the Nitrogen-Phosphorus Detector

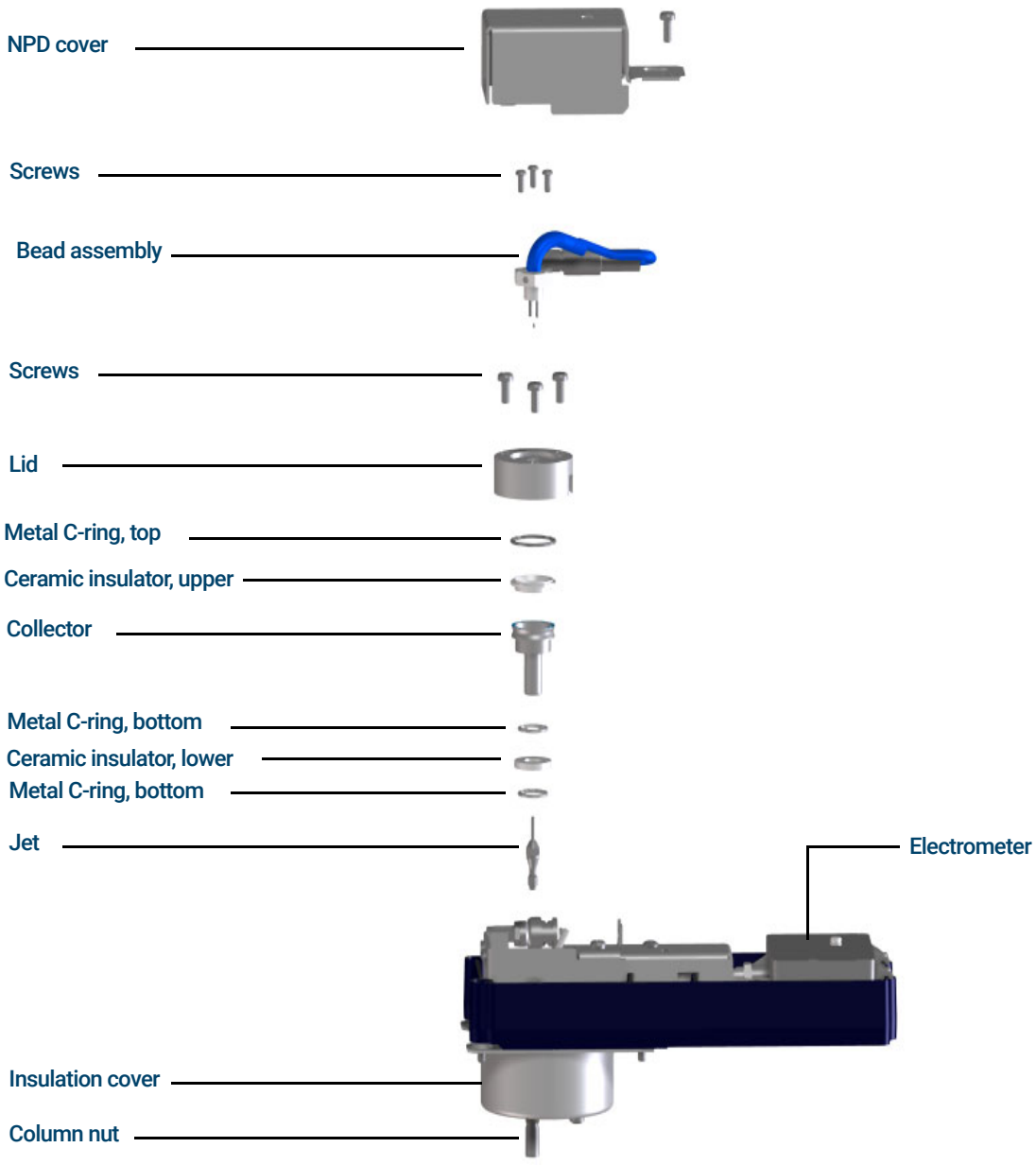


Figure 16. Nitrogen-Phosphorus Detector (NPD) exploded parts

To Install a Capillary Column in the NPD

1 Gather the following materials:
- Column
- Ferrule(s), see **"Consumables and Parts for the NPD"** on page 186.
- Column nut
- Column cutter
- 1/4-inch open-end wrench
- Septum
- Isopropanol
- Lab tissue
- Lint-free gloves

2 Place GC in maintenance mode: **Maintenance > Instrument > Perform Maintenance > Maintenance Mode > Start Maintenance.** Wait for the GC to become ready.

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.

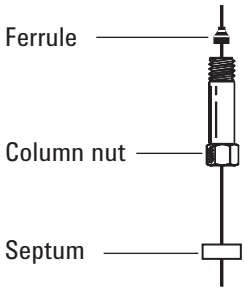
WARNING

Wear safety glasses to protect your eyes from flying particles while handling, cutting, or installing glass or fused silica capillary columns. Use care in handling these columns to prevent puncture wounds.

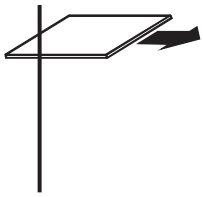
CAUTION

Wear clean, lint-free gloves to prevent contamination of parts with dirt and skin oils.

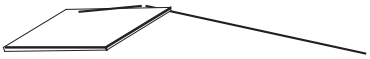
3 Place a septum (if the column id is ≤0.1 mm), capillary column nut, and ferrule on the column.

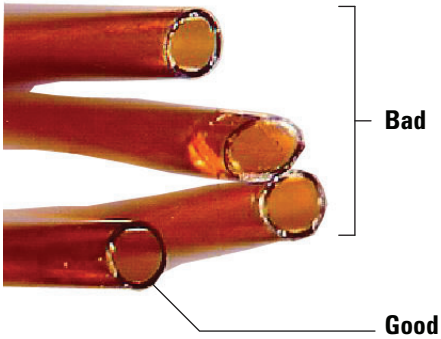


4 Score the column using a glass scribing tool. The score must be square to ensure a clean break.



5 Break off the column end by supporting it against the column cutter opposite the scribe. Inspect the end with a magnifying loupe to make certain there are no burrs or jagged edges.





6 Wipe the column walls with a tissue dampened with isopropanol to remove fingerprints and dust.

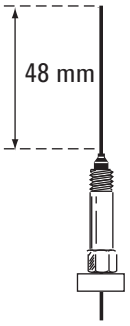
7 Install the capillary column.

If the column id is greater than 0.1 mm:

a Gently insert the column into the detector until it bottoms; do not attempt to force it further.

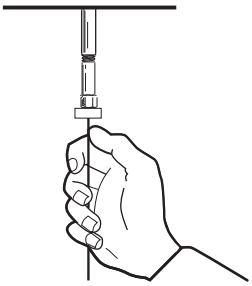
b Finger-tighten the column nut, then withdraw the column about 2 mm. Tighten the nut an additional 1/4 turn with a wrench.

If the column id is 0.1 mm or less position the column so it extends above the ferrule by 48 mm (capillary optimized fitting). Slide the septum up to hold the column nut and ferrule at this fixed position.



c Insert the column into the detector. Slide the nut and ferrule up the column to the detector base. Finger-tighten the column nut until it grips the column.

d Adjust the column (*not* the septum) position so that the septum is even with the bottom of the column nut. Tighten the nut an additional 1/4 turn with a wrench.



8 Exit maintenance mode. Select **Maintenance > Instrument > Perform Maintenance > Maintenance Mode > Finished.**

To Replace the NPD Bead Assembly

1 Gather the following:
   - Replacement NPD bead assembly, see **"Consumables and Parts for the NPD"** on page 186.
   - Lint-free gloves
   - T-10 Torx screwdriver

2 Place GC in maintenance mode: **Maintenance > Instrument > Perform Maintenance > Maintenance Mode > Start Maintenance.** Wait for the GC to become ready to continue (all zones cooled to safe handling temperatures).

CAUTION

The bead is delicate. Be careful not to break or crack the bead. When performing maintenance on the NPD, avoid touching the bead with your fingers, and prevent it from coming in contact with other surfaces.

3 Turn off the NPD bead.

   Agilent data system users: After turning off the bead, save the data system method and shut down the instrument session. (Note that in some data system versions, you may need to use the GC touchscreen or browser interface for these settings. To do this, the keypad must be unlocked and you must close the GC parameters screen of the data system. Upload the revised setting, then save the method and shut down the instrument session.)

4 Remove the GC detector top cover. See **"To Remove the Detector Top Cover"** on page 18.

WARNING

Hazardous voltages are present when the electronics top cover is open.

5 Remove the electronics cover. See **"To Remove the Electronics Cover"** on page 20.

6 Put on lint-free gloves before touching any of the detector parts.

WARNING

Be careful! The oven or detector fittings may be hot enough to cause burns.

CAUTION

Wear clean, lint-free gloves to prevent contamination of parts with dirt and skin oils.

7 Remove the screw from the NPD cover then lift up and set aside. See **Figure 17**.

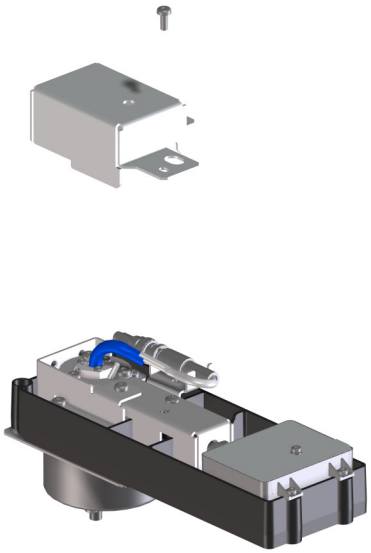
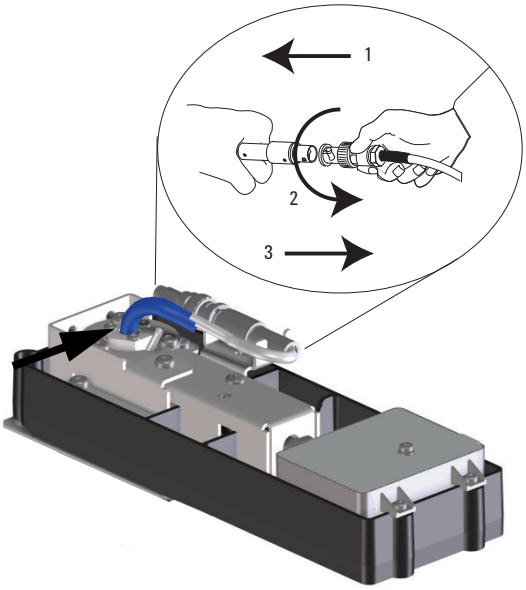
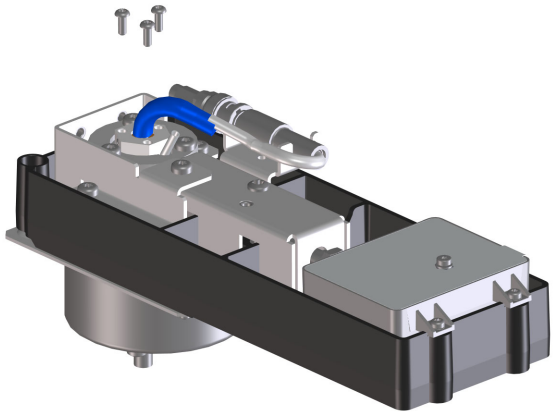


Figure 17. Remove NPD cover

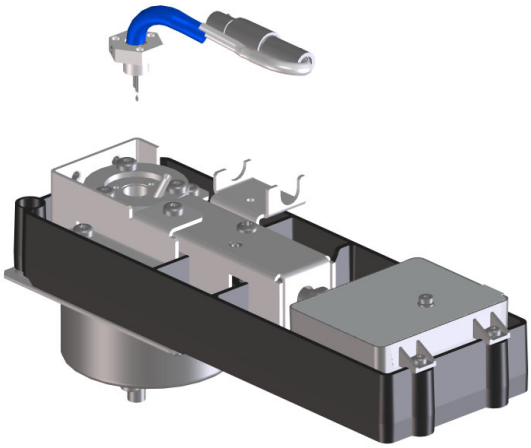
8 Twist the ring to disconnect the bead assembly cable. Push and twist the lock so that the button slides up in the groove, then pull the cable ends apart.



9 Remove the 3 T-10 Torx screws from the bead assembly.



10 Gently lift up and remove the old bead assembly. Avoid bumping the bead on the sides of the collector.



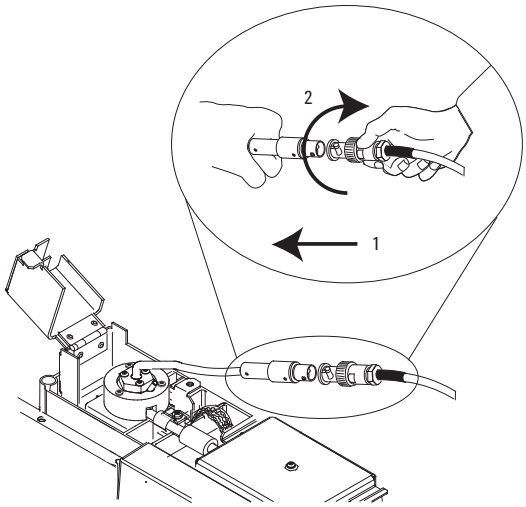
11 Remove the protective cap covering the new bead.

12 Mount the new bead assembly on the NPD lid. Be careful not to bump the bead on the sides of the lid or collector.

13 Replace the screws. Finger-tighten the first screw; tighten the remaining screws normally and then completely tighten the first screw. Do not overtighten the screws.

14 Carefully bend the bead assembly so it will mate with the bead power cable.

15 Reconnect the bead assembly cable to the NPD cable and twist the ring to lock the connection.



16 Close the NPD cover, install the GC detector top cover, and install the electronics top cover. All covers must be closed to get a stable NPD baseline.

17 Exit maintenance mode. Select **Maintenance > Instrument > Perform Maintenance > Maintenance Mode > Finished.**

18 Restore normal NPD operating gas flows.

19 With all gases on, heat the detector to 150 °C and hold for about 15 minutes, then increase the temperature to 250 °C and hold for 15 minutes.

20 Increase the temperature to operating value (310 to 320 °C recommended). Allow 15 minutes for equilibration.

21 Check the NPD leakage current. See **"To Check the NPD Leakage Current"** on page 201. If > 2.0 pA, verify bead installation or see the *Troubleshooting* manual.

22 If using an Agilent data system, connect to the instrument.

23 Restore the analytical method. Confirm the detector hydrogen, air, makeup gas flow rates.

24 Start the **Adjust offset** process. Enter the desired offset in the **Target offset** field.An offset of 25 to 30 pA is sufficient for most applications. The bead life may be shortened at a higher offset.

25 Reset the bead counter.

To Maintain the NPD Collector, Ceramic Insulators, and Jet

When replacing the jet, always install a new collector, ceramic insulators, and metal C-rings.

When replacing the collector, Agilent recommends replacing the ceramic insulators and metal C-rings.

WARNING

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

1 Gather the following:
   - NPD ceramic insulator kit, see **"Consumables and Parts for the NPD"** on page 186.
   - Collector
   - Cap for the bead
   - T-10 and T-20 Torx screwdrivers
   - Tweezers
   - Cotton swab
   - Solvent
   - Methanol
   - Jet
   - Lint-free gloves
   - Compressed, filtered dry air or nitrogen

CAUTION

The bead is delicate. Be careful not to break or crack the bead. When performing maintenance on the NPD, avoid touching the bead with your fingers, and prevent it from coming in contact with other surfaces.

2 Turn off the bead and disable **Adjust Offset**.

3 Check and note the NPD leakage current for reference. See **"To Check the NPD Leakage Current"** on page 201.

4 Launch the GC maintenance wizard: **Maintenance > Detector> Perform Maintenance > Replace NPD Ceramics> Start Maintenance**. Wait for the GC to become ready. The wizard will guide you through the maintenance steps described below.

Be careful! The oven or detector fittings may be hot enough to cause burns.

WARNING

5 Remove the bead. See **"To Replace the NPD Bead Assembly"** on page 192.

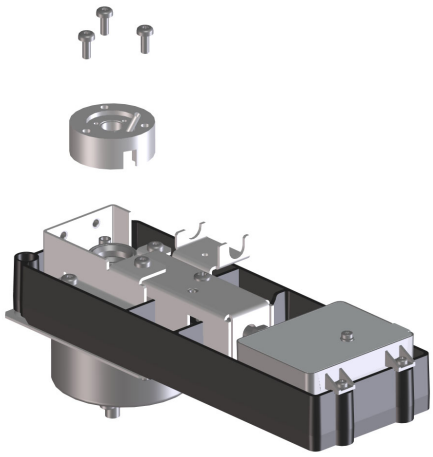
This step exposes the interconnect spring. Be careful not to touch or disfigure the spring while working on the FID. Any dirt or bending will reduce the sensitivity of your detector.

CAUTION

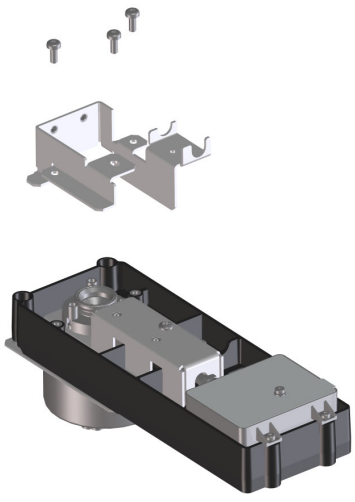
Wear clean, lint-free gloves to prevent contamination of parts with dirt and skin oils.

CAUTION

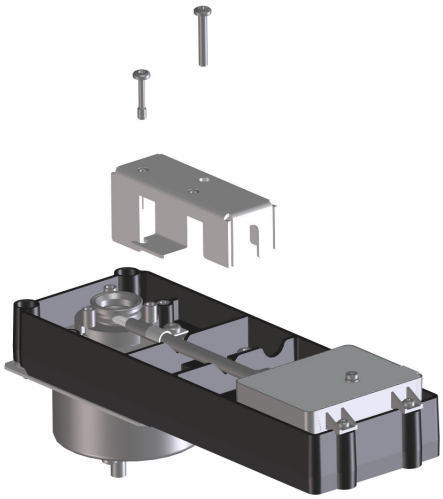
6 Remove the screws that secure the lid, then lift up the lid and set aside. The top metal C-ring and upper ceramic insulator may be attached to the lid.



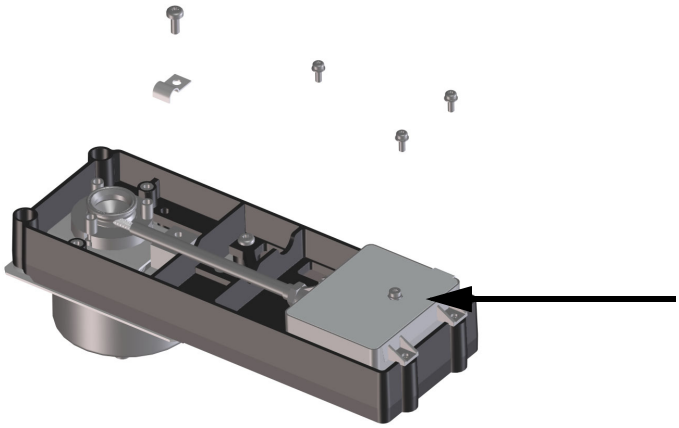
7 Remove the screws that secure the cover base, then lift up the cover base and set aside.



8 Remove the screws that secure the interconnect cover, then lift up the cover and set aside.



9 Remove the screws that secure the electrometer, then lift up and set aside.



10 Pull the electrometer away from the detector to free the interconnect. Turn the electrometer to the right to obtain working space. Be careful not to touch or bend the spring. Be careful not to lose the EMI suppressor.

11 Remove the large metal C-ring and the upper ceramic insulator if they were not attached to the lid.

12 Remove the collector. If the detector is operated at high temperatures, the collector parts may stick inside the detector. Gently push and wiggle them to break the seal.

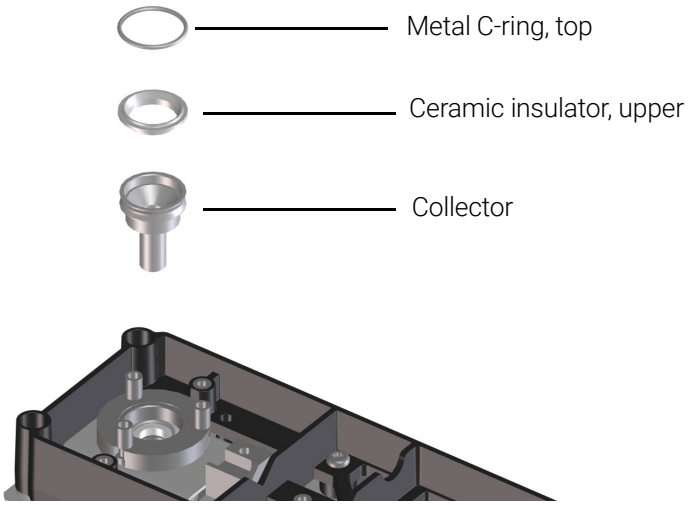


Figure 18. NPD collector, upper insulator, and metal C-ring

13 Use tweezers to remove the lower ceramic insulator and the two small metal C-rings located above and below the collector. If these parts are stuck together, do not separate them. If they are not stuck, remember which metal ring was on top of the insulator and which was below it. The pieces must be reassembled in the same orientation.

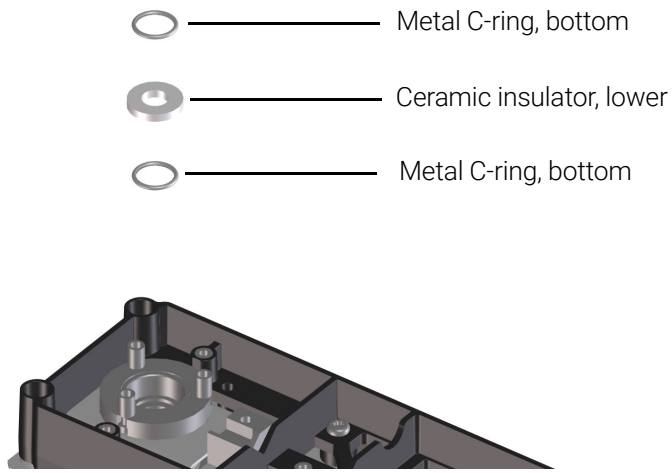
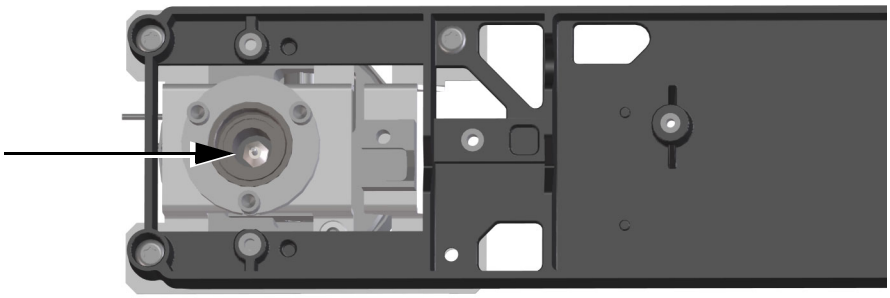


Figure 19. NPD lower ceramic insulator and metal C-ring

14 If not replacing the jet, skip to **step 21**.

15 Remove the column from the detector.

16 Loosen the jet with a nut driver.



17 Pull the jet straight out of the detector. Use tweezers, if necessary.

CAUTION

The adaptable NPD jet is longer than the capillary optimized NPD extended jet and should never be installed in a capillary optimized detector.

18 Place the jet in the detector body.

19 Using a nut driver, tighten the jet 1/6 turn past finger-tight. *Do not overtighten*.

20 Attach the column to the detector.

21 Use a cotton swab wetted with solvent to clean the residue from the inside of the collector and around the jet. If the collector appears very dirty, replace it with a new one.

22 Install the bottom metal C-ring, the lower ceramic insulator, and the top metal C-ring. See **Figure 19**.

23 Install the collector.

24 Install the upper ceramic insulator and top metal C-ring above the collector. See **Figure 18**.

25 Install the lid, making sure that the NPD lid standoffs are in their slots. Hold the lid flat while each of the screws is tightened until they touch the lid. Tighten each screw evenly, 1/2 turn at a time, until tight. Do not overtighten.

26 Slide the electrometer interconnect into the slot on the lid and lower the electrometer into the mounting tray. Be careful not to touch or bend the spring.

27 Install the J-clamp and screws to secure the electrometer to the pallet.

28 The GC maintenance wizard will perform checks at the appropriate times, including **Leak & Restriction** tests, and will automatically reset the maintenance counters.

29 Select **Finished**, then select **OK** to exit the GC maintenance wizard.

30 Install the bead assembly and restore normal operating conditions. See **"To Replace the NPD Bead Assembly"** on page 192. Do not reset the bead counter unless replaced.

After installing new collector parts, the NPD leakage current should be lower. See **"To Check the NPD Leakage Current"** on page 201. If the leakage current is abnormal, check for proper reassembly of the detector (especially where the electrometer interconnect contacts the collector assembly) and for leaks.

To Check the NPD Leakage Current

1. Load the analytical method.
2. Turn **Off** the **Bead**.
   - Leave the NPD at operating temperature
   - Leave flows on or off
3. Show the detector output signal in **Status**.
4. Verify that the output (leakage current) is stable and < 2.0 pA.

   The output should slowly drop towards 0.0 pA, and should stabilize in the *tenths* of a picoamp. Current > 2.0 pA indicates a problem.

To Bakeout the NPD

WARNING

If using hydrogen as a carrier gas, turn off the hydrogen supply and cap the end of the column to prevent an oven explosion.

1 Bakeout the NPD with the column installed or uninstalled. If uninstalled, gather the following, see **"Consumables and Parts for the NPD"** on page 186:
   - Column nut
   - No-hole ferrule

2 Place GC in maintenance mode: **Maintenance > Instrument > Perform Maintenance > Maintenance Mode > Start Maintenance.** Wait for the GC to become ready to continue (all zones cooled to safe handling temperatures).

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.

3 Turn off the bead.

4 If the column is uninstalled, plug the detector connection with the column nut, and no-hole ferrule.

   Maintain inert carrier gas flow through the column, or remove the column from the GC.

5 Set normal operating flows.

6 Set the detector temperature at 25 °C above the typical method set-point temperature.

7 Set the oven temperature to 250 °C or 25 °C above the normal maximum operating temperature. Do not exceed the column's temperature limit.

8 Hold at temperature for 15 to 30 minutes.

9 If the column is not installed in the NPD, install it. See **"To Install a Capillary Column in the NPD"** on page 189.

10 Restore the analytical method and allow the NPD to equilibrate at operating temperatures and flows for 10 to 30 minutes.

11 Check the NPD leakage current. See **"To Check the NPD Leakage Current"** on page 201.

12 Start the NPD bead Auto Adjust process.

13 Exit maintenance mode. Select **Maintenance > Instrument > Perform Maintenance > Maintenance Mode > Finished.**

Allow 1 to 2 hours for a new Blos bead to equilibrate.

13 Maintaining the FPD+

Consumables and Parts for the FPD+

See the Agilent catalog for consumables and supplies for a more complete listing, or visit the Agilent Web site for the latest information (**www.agilent.com**).

Table 29 FPD supplies

Description	Part number/quantity
Sulfur filter	1000-1437
Sulfur filter spacer	19256-20910
Phosphorus filter	19256-80010
Exit tube assembly	G3435-60330
O-ring for exit tube assembly	0905-1014
Ignitor	19256-60750
Screw, M3 × 6 mm, T-10	0515-0680
Collet	19256-20690
Column measuring tool	G3435-81380
Spring to secure photomultiplier tube	1460-1160
Nut, 1/8-inch, brass, for packed column adapters	5180-4103 (10/pk)
Ferrule, Vespel/graphite, 1/8-inch, for packed column adapters	0100-1332 (10/pk)
Nut, 1/4-inch, brass, for packed column adapters	5180-4105 (10/pk)
Ferrule, Vespel, 1/4-inch, for packed column adapters	5080-8774 (10/pk)
Pre-swaged 1/8-inch packed column adapter	G3450-60191
Pre-swaged inert 1/8-inch packed column adapter	G3450-60192
Pre-swaged 1/4-inch packed column adapter	G3450-60193
Pre-swaged inert 1/4-inch packed column adapter	G3450-60194
Preventive maintenance kit, single FPD+	G3435-67000

Table 30 Nuts, ferrules, and hardware for capillary columns

Column id (mm)	Description	Typical use	Part number/quantity
.530	Ferrule, Vespel/graphite, 0.8-mm id	0.45-mm and 0.53-mm capillary columns	5062-3512 (10/pk)
	Ferrule, graphite, 1.0-mm id	0.53-mm capillary columns	5080-8773 (10/pk)
	Ferrule, graphite, 0.8-mm id	0.53-mm capillary columns	500-2118 (10/pk)
	Column nut, finger-tight (for 0.53-mm columns)	Connect column to inlet or detector	5020-8293

Table 30 Nuts, ferrules, and hardware for capillary columns (continued)

Column id (mm)	Description	Typical use	Part number/quantity
.320	Ferrule, Vespel/graphite, 0.5-mm id	0.32-mm capillary columns	5062-3514 (10/pk)
	Ferrule, graphite, 0.5-mm id	0.1-mm, 0.2-mm, 0.25-mm, and 0.32-mm capillary columns	5080-8853 (10/pk)
	Column nut, finger-tight (for .100- to .320-mm columns)	Connect column to inlet or detector	5020-8292
.250	Ferrule, Vespel/graphite, 0.4-mm id	0.1-mm, 0.2-mm, and 0.25-mm capillary columns	5181-3323 (10/pk)
	Ferrule, graphite, 0.5-mm id	0.1-mm, 0.2-mm, 0.25-mm, and 0.32-mm capillary columns	5080-8853 (10/pk)
	Column nut, finger-tight (for .100- to .320-mm columns)	Connect column to inlet or detector	5020-8292
.100 and .200	Ferrule, Vespel/graphite, 0.37-mm id	0.1-mm and 0.2-mm capillary columns	5062-3516 (10/pk)
	Ferrule, Vespel/graphite, 0.4-mm id	0.1-mm, 0.2-mm, and 0.25-mm capillary columns	5181-3323 (10/pk)
	Ferrule, graphite, 0.5-mm id	0.1-mm, 0.2-mm, 0.25-mm, and 0.32-mm capillary columns	5080-8853 (10/pk)
	Ferrule, graphite, 0.4-mm id		500-2114 (10/pk)
	Column nut, finger-tight (for .100- to .320-mm columns)	Connect column to inlet or detector	5020-8292
All	Ferrule, no-hole	Testing	5181-3308 (10/pk)
	Capillary column blanking nut	Testing–use with any ferrule	5020-8294
	Column nut, universal	Connect column to inlet or detector	5181-8830 (2/pk)
	Column nut, collared, self-tightening	Connect column to inlet or detector	G3440-81011
	Collar for self-tightening nut	Connect column to inlet or detector	G3440-81012
	Column nut, collared, self-tightening MSD	Connect column to inlet or detector	G3440-81013
	Column cutter, ceramic wafer	Cutting capillary columns	5181-8836 (4/pk)
	Pencil, diamond tipped	Cutting capillary columns	420-1000
	Ferrule tool kit	Ferrule installation	440-1000

Exploded Parts View of the Flame Photometric Detector Plus

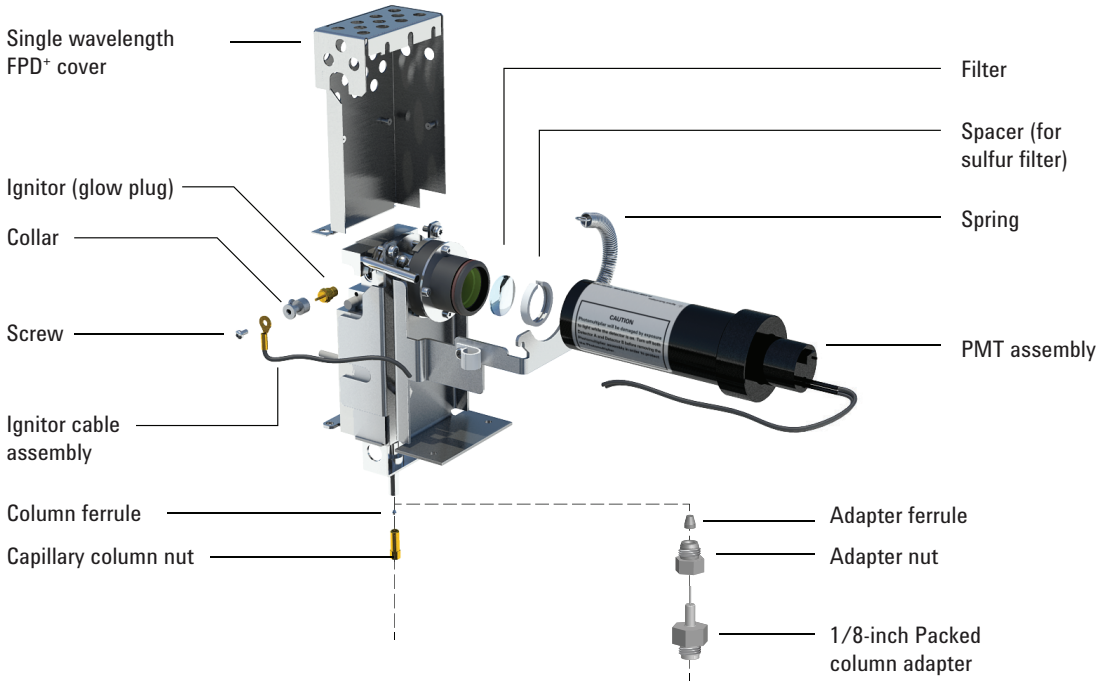


Figure 20. Flame Photometric Detector Plus (FPD+) single wavelength exploded parts

To Install a Capillary Column to the FPD+

1 Gather the following:
- Column measuring tool, see **"Consumables and Parts for the FPD+"** on page 204.
- Column cutter
- 1/4-inch and 7/16-inch wrenches
- Column nut
- Ferrule
- Capillary column
- Lint-free gloves

2 Launch the GC maintenance wizard: **Maintenance > Column > Perform Maintenance > Install Column > Start Maintenance.** Wait for the GC to become ready.
The wizard will guide you through the maintenance steps described below.

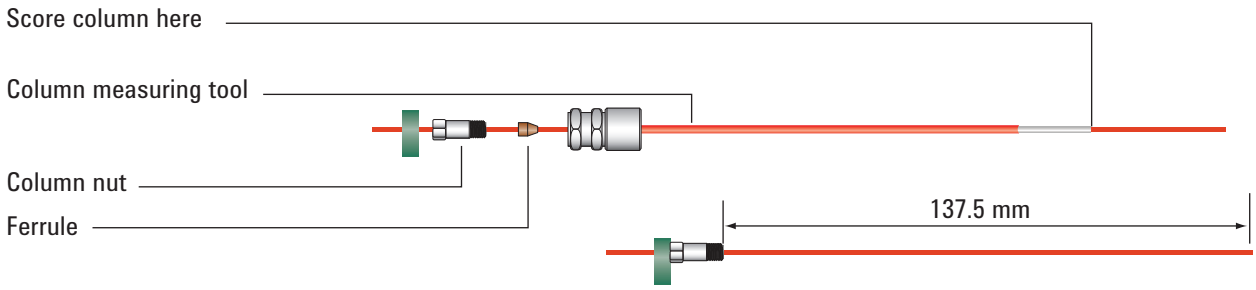
WARNING **Be careful! The oven and/or detector may be hot enough to cause burns. If the detector is hot, wear gloves to protect your hands.**

WARNING **Wear safety glasses to protect your eyes from flying particles while handling, cutting, or installing glass or fused silica capillary columns. Use care in handling these columns to prevent puncture wounds.**

CAUTION **Wear clean, lint-free gloves to prevent contamination of parts with dirt and skin oils.**

3 Assemble a septum, column nut, and ferrule on the end of the column.

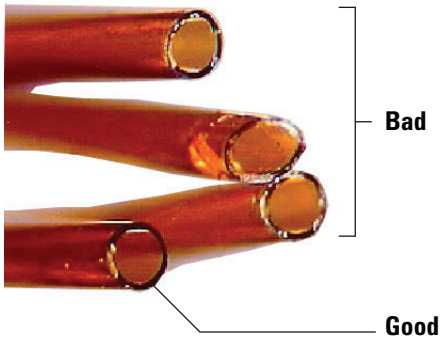
4 Insert the end of the column through the column measuring tool so that the end protrudes beyond the tool.



5 Tighten the column nut until it grips the column. Tighten the nut an additional 1/8 to 1/4 turn with a pair of wrenches. Snug the septum against the base of the column nut.

6 Use a wafer cutter at 45 ° to score the column.

7 Snap off the column end. The column may protrude about 1 mm beyond the end of the tool. Inspect the end with a magnifying loupe to make certain that there are no burrs or jagged edges.



8 Remove the column, nut, and swaged ferrule from the tool.

9 Wipe the column walls with a tissue dampened with isopropanol to remove fingerprints and dust.

10 Carefully thread the swaged column up into the detector fitting. Finger-tighten the column nut, then use a wrench to tighten an additional 1/8 turn.

11 The GC maintenance wizard will perform checks at the appropriate times, including **Leak & Restriction** tests, and will automatically reset the maintenance counters.

12 Select **Finished**, then select **OK** to exit the GC maintenance wizard**.**

To Change the FPD+ Wavelength Filter

CAUTION

Do not touch the filter with your bare hands. For optimum performance and to avoid scratches, use lint-free gloves for assembling and inserting the filter into the assembly.

1 Gather the following:
   - Sulfur filter with filter spacer, see **"Consumables and Parts for the FPD+"** on page 204.
   - Phosphorus filter
   - Cotton swab
   - Lens tissue
   - Lint-free gloves

2 Verify that the PMT voltage is off.
   a Navigate to **Methods > Active Method > Edit > Detectors**, scroll to **Detector Specifics**, then select the **Photomultiplier High Voltage**.
   b If the voltage is enabled, turn it off and apply the updated method.

3 Launch the GC maintenance wizard: **Maintenance > Detector > Perform Maintenance > Replace FPD Filter> Start Maintenance.** Wait for the GC to become ready.
The wizard will guide you through the maintenance steps described below.

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.

CAUTION

The photomultiplier tube (PMT) is extremely sensitive to light. Always turn off the electrometer (which turns off the high voltage to the PMT) before removing the PMT housing or opening the emissions chamber. Failing to do this can destroy the PMT.

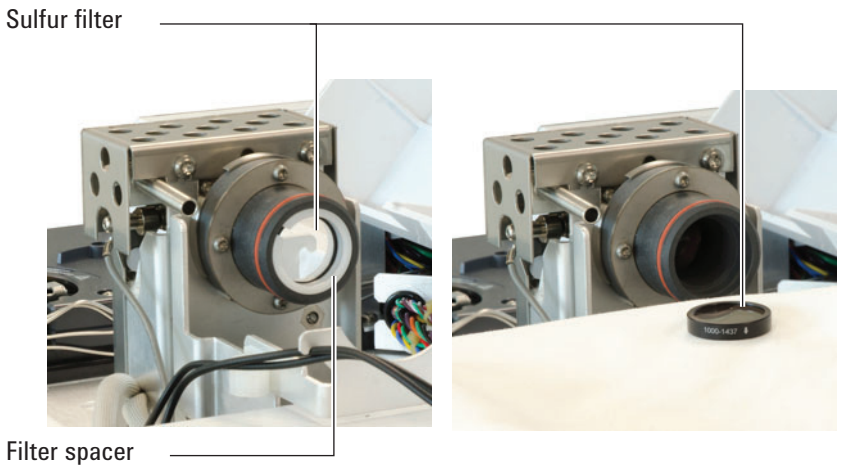
Even with the electrometer off, protect the PMT from room light. Cap the housing after it is removed, place it end down to exclude light, or reduce the room light level before exposing the PMT. A brief exposure (always with the electrometer turned off) will not damage it, but prolonged exposure will cause a gradual loss of sensitivity.

4 Disconnect the retaining spring that holds the PMT assembly to the bracket. With a rotating motion, pull the assembly away from the filter housing.

5 To prevent light from damaging the PMT, cap the end or place it face down.

6 Place a clean cloth under the filter housing to catch the filter.

- For phosphorus filter, use the sharpened wooden tip of a toothpick or cotton swab to dislodge the filter from the housing.
- For sulfur filter (shown below), use the wooden tip of the cotton swab to remove the filter spacer. Then dislodge the filter from the housing.



CAUTION

Do not use cleaning fluids. Cleaning fluids will damage lens coatings.

7 Clean the new filter with lens tissue.

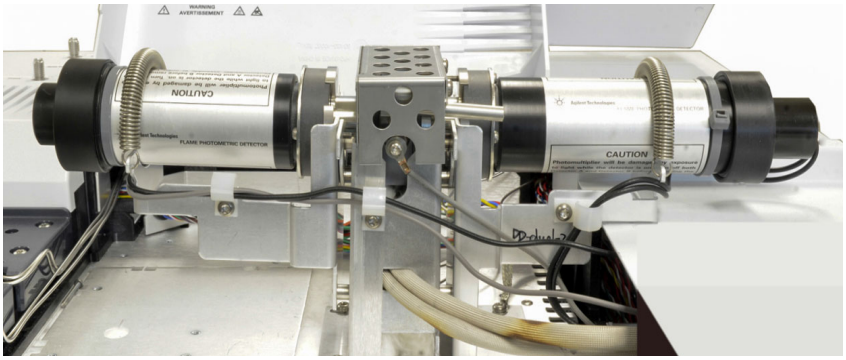
CAUTION

Filters are designed for the light of the flame to pass through in a specific direction. The triangle (on the edge of the phosphorus filter) and the arrow (on the edge of the sulfur filter) should face *away* from the flame and *toward* the PMT.

8 Install the filter in the filter housing. Install the sulfur filter spacer, if necessary.

9 Replace the PMT assembly and secure with the spring.

10 Route the PMT wires through the clips as shown. Avoid placing the wires very near heated areas (such as the emission block or oven top).



11 The GC maintenance wizard will perform checks at the appropriate times, including **Leak & Restriction** tests, and will automatically reset the maintenance counters.

12 Select **Finished**, then select **OK** to exit the GC maintenance wizard**.**

13 Restore the analytical method.

To Remove the FPD+ Cover

1 Gather the following:
   - T-20 Torx screwdriver
2 Turn off the flame, then turn off the GC.

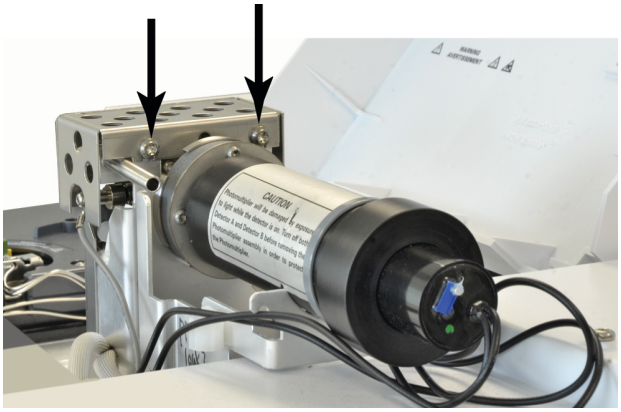
CAUTION

When turning off the GC, first turn off the flame to prevent condensation from dripping into the jet and column.

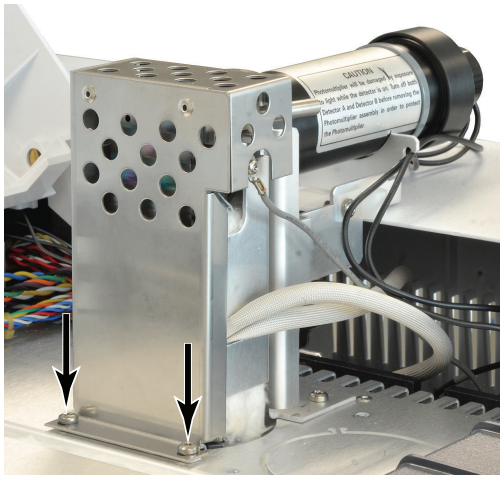
WARNING

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

3 Open the FPD detector top cover.
4 **Loosen the screws securing the FPD cover to the top of the detector.**



5 For a single wavelength FPD, remove the two screws at the bottom left of the cover.



6 Lift the cover off the detector.

To Replace the FPD+ Ignitor

1 Gather the following:
- Ignitor replacement kit, see **"Consumables and Parts for the FPD+"** on page 204.
- Torx screwdrivers, T-20 and T-10
- 5/16-inch nut driver (or wrench)

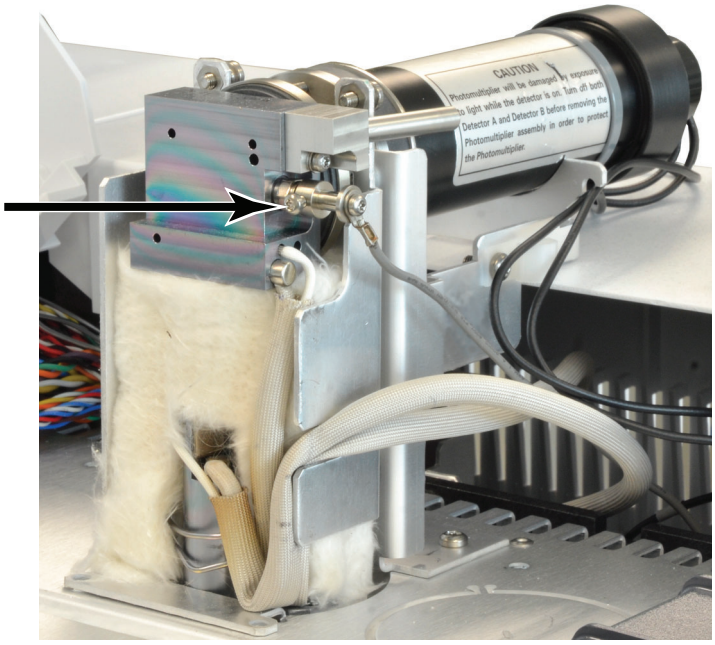
2 Launch the GC maintenance wizard: **Maintenance > Detector > Perform Maintenance > Replace FPD Ignitor> Start Maintenance.** Wait for the GC to become ready.
The wizard will guide you through the maintenance steps described below.

WARNING

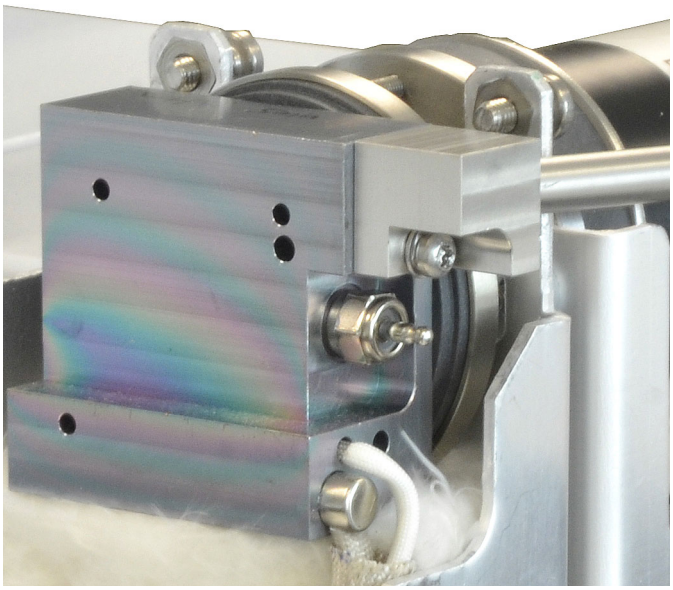
Be careful! The detector may be hot enough to cause burns. If the detector is hot, wear heat-resistant gloves to protect your hands.

3 Remove the FPD cover. See **"To Remove the FPD+ Cover"** on page 212.

4 Loosen the collet screw holding the cable assembly to the ignitor. Remove the collet and cable assembly.

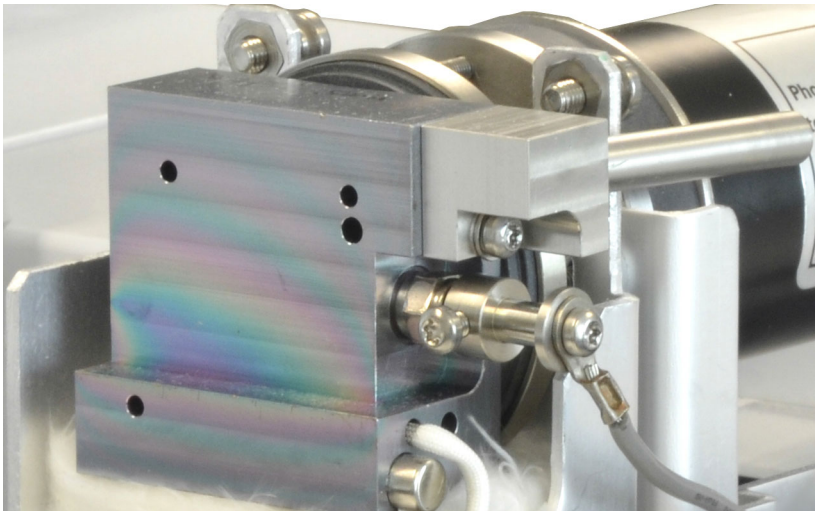


5 Use a nut driver to loosen and remove the glow plug.
- If using a 5/16-inch wrench, you may need to remove the exit tube assembly using a T-10 Torx driver



6 Install the new ignitor assembly and tighten with the nut driver. Do not overtighten. (If the ignitor comes with a copper washer, discard the copper washer.)

7 Replace the ignitor collet and cable assembly and tighten the screw. Align the collet set screw as shown. Do not let the collet screw touch metal parts, such as the emission block or PMT bracket (dual wavelength detector).



8 Replace the FPD cover. See **"To Install the FPD+ Cover"** on page 215.

9 The GC maintenance wizard will perform checks at the appropriate times, including **Leak & Restriction** tests, and will automatically reset the maintenance counters.

10 Select **Finished**, then select **OK** to exit the GC maintenance wizard**.**

11 Restore the analytical method.

12 Wait 20 min. for the detector to heat up, then ignite the flame.

To Install the FPD+ Cover

1 Gather the following:
   - T-20 Torx screwdriver
2 Install the cover.

   Single-wavelength detector:
   a Start the two screws on the right side of the cover.
   b Start and tighten the screws at the base on the left side.
   c Tighten the screws on the right side.

   Dual-wavelength detector: Install the cover (two screws).
3 Close the FPD detector top cover.

Cleaning the FPD+ Brazement

CAUTION

The brazement uses an inert coating layer. Abrasives may scratch this layer. Hard scrubbing can scratch this layer. Solutions or soaps with a pH > 8 can also damage this layer. Do not steam clean.

The FPD+ brazement, which consists of the transfer line and emission block assemblies, uses an inert coating layer to provide better performance. Normally, manually cleaning the brazement is not required. However, if it becomes necessary to clean the brazement to remove contamination, note that exposing the inert coating to abrasives or certain solvents will degrade the coating. If cleaning is needed, follow the recommendations below for best results:

- Rinse with a solvent appropriate to dissolve the expected contaminants. Avoid abrasive or highly basic solutions (see the caution above). Recommended solvents: dichloromethane, acetone, or methanol.
- Mildly sonicate if needed, but excessive sonication can damage the coating layer.
- Gently remove solids using a soft, nylon bristle brush. Do not scrub hard. Recommended brush: Use the MMI inlet cleaning brush from the MMI cleaning kit (G3510-80820). (Do **NOT** used the MMI inlet abrasive cleaning swab, G3510-80829.)

14 Maintaining EPC Modules

This chapter describes the maintenance procedures for Auxiliary EPC (Aux) and Pneumatics Control Module (PCM). Pneumatic Switching Devices (PSD) do not have any required routine maintenance.

Consumables and Parts for the Aux EPC

See the Agilent catalog for consumables and supplies for a more complete listing, or visit the Agilent Web site for the latest information (**www.agilent.com**).

Table 31 Aux EPC consumables

Description	Part number
O-rings, package of 6	5181-3344
Blue dot frit, high flow resistance	G3430-80063
Red dot frit, medium flow resistance	G3430-80062
Brown dot frit, low flow resistance	G3430-80061
No frit (brass tube), zero flow resistance	G3430-20011

Table 32 Auxiliary channel frits

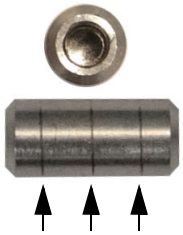
Frit marking		Flow resistance	Flow characteristic	Often used with
Three rings Blue		High	3.33 ± 0.3 SCCM @ 15 PSIG	NPD Hydrogen
Two rings Red		Medium	30 ± 1.5 SCCM H2 @ 15 PSIG	FID Hydrogen
One ring Brown		Low	400 ± 30 SCCM AIR @ 40 PSIG	FID Air, QuickSwap, Purged splitters, Deans Switch

Table 32 Auxiliary channel frits (continued)

Frit marking		Flow resistance	Flow characteristic	Often used with
None (brass tube)		Zero	No restriction	Headspace vial pressurization, purged splitter and Deans Switch when using backflush

Installing or Replacing Frits in the Aux EPC

To install or replace a frit in the Aux EPC block:

1 Gather the following:
- T-10 Torx screwdriver
- Appropriate O-ring and frit
- Tweezers

WARNING

When hydrogen is used, dangerously high flows are possible if insufficient flow resistance is provided downstream of the supply tube. Always use either the High (Blue dot) or Medium (Red dot) frit with hydrogen.

2 Turn off the gas supply to the channel.

3 To select the appropriate auxiliary channel frit. See **Table 32**.

4 Identify which frit needs to be changed. Trace the tubing as needed to confirm. Markings on top of the partner fitting identify positioning of the flow channels.

5 Remove the screw to the partner fitting.

6 Lift the partner fitting away from the Aux EPC module. This exposes the frits and O-rings.

7 Gently remove the frit and O-ring using the tweezers. Be careful to avoid scratching the metal surfaces.

8 Place a new O-ring onto the end of the new frit, and insert the frit into the EPC module.

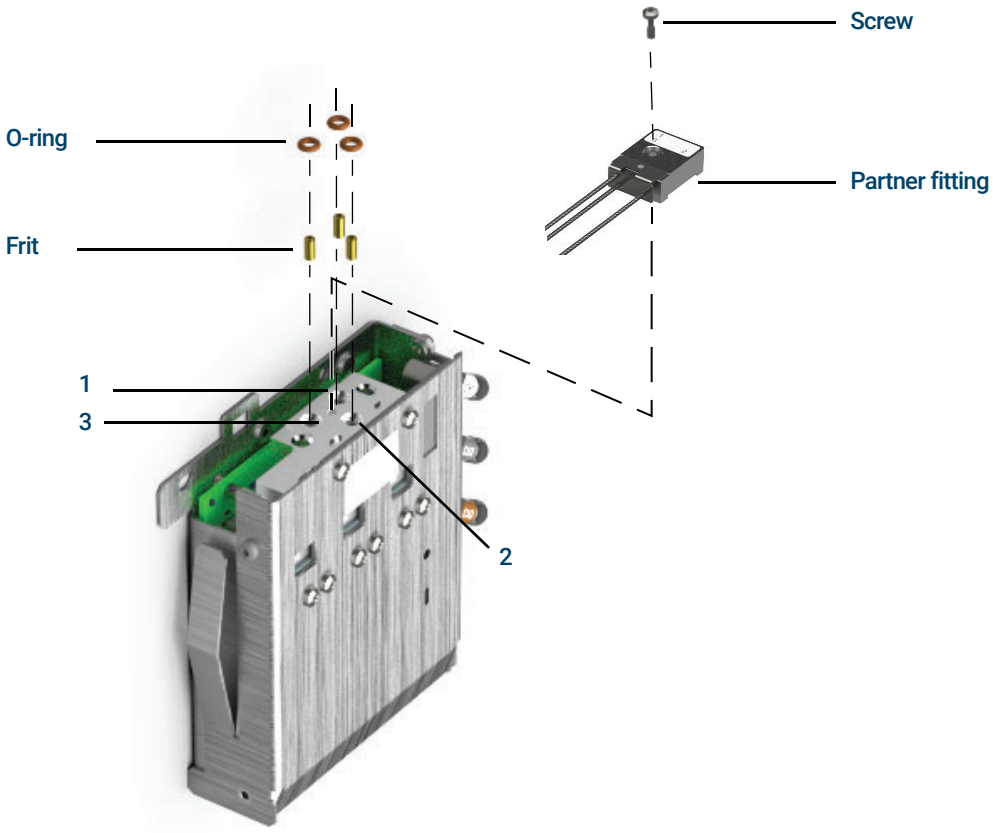


Figure 21. Replace an Aux EPC frit

9 Place the partner fitting onto the Aux EPC module, and secure in place using the screw.

10 Restore gas flows and check for leaks at the fitting.

After installing or replacing a frit, be sure to update the Aux EPC module PIDs used with your module. If needed, update the Aux EPC module PIDs using the GC Firmware Update Tool available on **www.agilent.com**. To download the GC Firmware Update Tool, open a web browser, navigate to www.agilent.com, then in the search box type in “GC Firmware Update” to search for the tool.

Consumables and Parts for the PCM

See the Agilent catalog for consumables and supplies for a more complete listing, or visit the Agilent Web site for the latest information (**www.agilent.com**).

Table 33 PCM consumables

Description	Part number
O-rings, package of 12	5180-4181
Proportional valve, Carrier	G3430-67013
Proportional valve, AUX	G3430-67016

Calibrating the PCM Interface

The interface's flow module contains a pressure sensor that must be zeroed after it is installed on the GC. Calibration ensures an accurate interface pressure display.

Do not connect the carrier gas to the flow module until you have zeroed the interface's pressure sensor.

Complete the following steps:

1. If the gas supply is connected to the GC, turn off the supply at the source, then disconnect the supply line from the PCM inlet fitting.
2. Turn on the GC and wait 15 minutes to allow it to reach thermal equilibrium.
3. When the GC has reached thermal equilibrium, press **Options**, scroll to Calibration and press **Enter**.
4. Scroll to the module to be zeroed and press **Enter.**
5. Scroll to a zero line and press **Info**. The GC will remind you of the conditions necessary for zeroing that specific sensor.

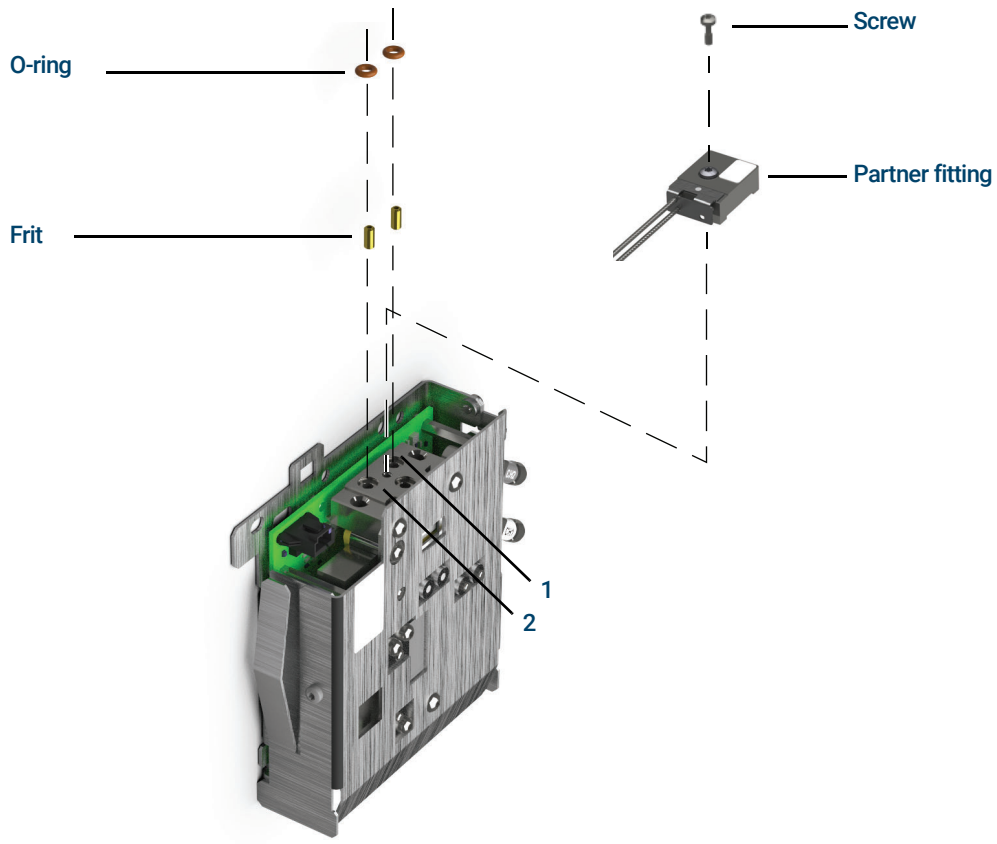
   Flow sensors. Verify that the gas is connected and flowing (turned on).
6. Press **On/Yes** to zero or **Clear** to cancel.
7. Turn off the GC.
8. Plumb the carrier gas to the flow module.
9. Turn on the GC.

If you were calibrating the flow sensor after replacing the PCM, check for leaks.

Installing or Replacing Frits in the PCM

To install or replace a frit:

1. Gather the following:
   - O-rings, package of 12, p/n 5180-4181
   - Frit
   - Tweezers
2. Turn off the gas supply to the channel.
3. Select the appropriate frit. Markings on top of the EPC module identify positioning of the flow channels.
4. Remove the screw holding the partner fitting onto the EPC module.
5. Remove the frit and O-ring using the tweezers. Be careful to avoid scratching the metal surfaces.
6. Remove the other O-ring as well. Replace it with a new O-ring.



7. Place a new O-ring on the new frit and press it down into the block.
8. Place the partner fitting on the module and tighten the screw firmly.

9 Restore the gas supply.

WARNING

When hydrogen is used, dangerously high flows are possible if insufficient flow resistance is provided downstream of the supply tube. Always use either the High (Blue dot) or Medium (Red dot) frit with hydrogen.

After installing or replacing a frit, be sure to update the PIDs used with your PCM. If needed, update the module PIDs using the GC Firmware Update Tool available on **www.agilent.com**. To download the GC Firmware Update Tool, open a web browser, navigate to www.agilent.com, then in the search box type in “GC Firmware Update” to search for the tool.

15 Maintaining a Valve

Consumables and Parts for Valves

See the Agilent catalog for consumables and supplies for a more complete listing, or visit the Agilent Web site for the latest information (**www.agilent.com**).

Table 34 Valve supplies

Description	Part number
Valves, gas sampling	
6-port, 300 psi	0101-0584 **
6-port, 400 psi, 225 °C maximum temperature	5062-9508
Rotor, 6-port valve 225 °C	5181-7459
6-port, 300 °C maximum temperature	0101-0460
6-port Hastelloy, 400 psi, 225 °C maximum temperature	5062-9509
10-port, 400 psi, 225 °C maximum temperature	5062-9510
Rotor, 10 port valve 225 °C	5181-7460
10-port Nitronic 60, 300 psi, 350 °C maximum temperature	0101-0585
10-port Hastelloy, 400 psi, 225 °C maximum temperature	5062-9511
Valves, gas sampling * (for all GCs ordered after August, 2024)	
6 port valve, 225 °C, Nitronic 60	G3450-83000
Rotor for 6-port valve p/n G3450-83000, 225 °C	G3450-83002
10-port valve, 225 °C, Nitronic 60	G3450-83001
Rotor for 10-port valve p/n G3450-83001, 225 °C	G3450-83003
Gas sampling valve sample loops	
0.25-cc	0101-0303
0.50-cc	0101-0282
1.00-cc	0101-0299
2.00-cc	0101-0300
2.0-mL nickel loop, 1/16-inch	0101-0955
5.00-cc	0101-0301
10.00-cc	0101-0302
Ferrule, 1/16-inch stainless steel (10/pk)	5181-1291
Nut, 1/16-inch (10/pk)	5181-1292

* Caution: Consideration of the compatibility of valves and rotors. Rotors must match with the valves. For 6 port valves, G3450-83002 must match with G3450-83000. For 10 port valve, G3450-83003 must match with G3450-83001.

Be sure to order the replacement valve or rotor that matches the valve installed in the GC. See **Figure 22** and **Figure 23** to verify the installed valve type.

Exploded Parts View of GC Rotary Valves

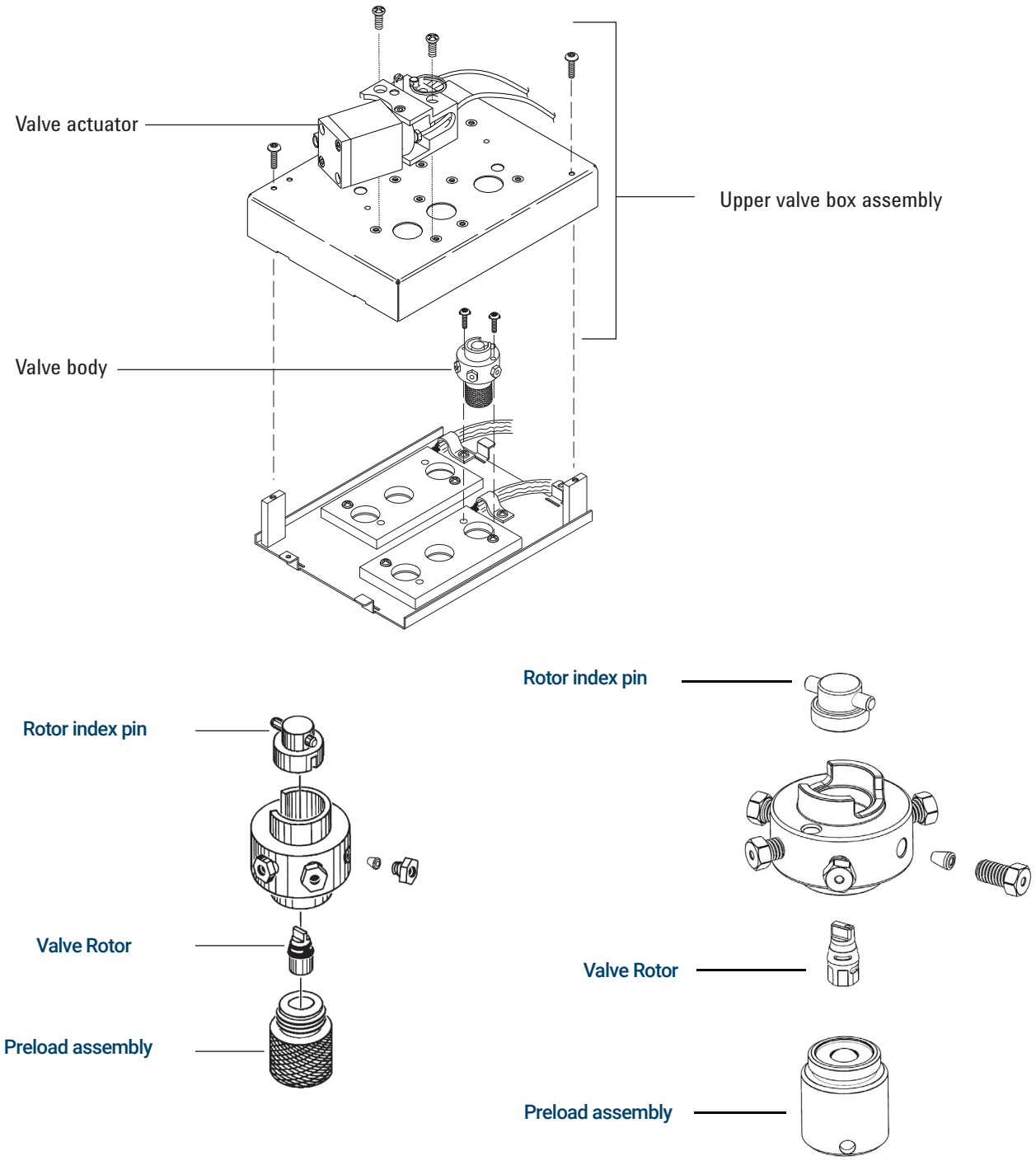
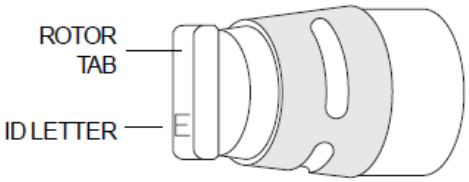


Figure 22. GC rotary valve exploded parts

Number of ports	ID letter toward
3	Port 2
4	Port 3
6	Port 4
8	Port 5
10	Port 6
Internal sample	The side of the valve with the four ports



5181-7459

G3450-83002

Figure 23. Valve rotor alignment

To Replace a Gas Sampling Valve Loop

1 Gather the following:
   - Replacement sample loop, see **"Consumables and Parts for Valves"** on page 228.
   - 1/4-inch wrench
   - Vacuum cleaner

2 Place GC in maintenance mode: **Maintenance > Instrument > Perform Maintenance > Maintenance Mode > Start Maintenance.** Wait for the GC to become ready.

3 Turn off the detector.

WARNING

The oven, inlet, detector, and valve box may be very hot.

Sample and/or harmful gases may be present. Refer to your company's standard operating procedures for purging the chemicals from the sample line.

4 Set all valve box valves to **Off**.

5 Leave on the GC and valve actuator air.

6 Turn off the carrier gas and sample line flows and relieve any back pressure to the valve.

WARNING

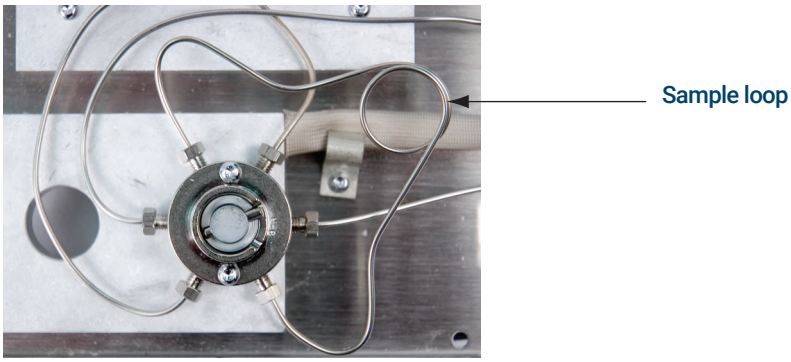
The valve box insulation is made of refractory ceramic fibers (RCFs). To avoid inhaling RCF particles, we recommend these safety procedures:

- **Ventilate your work area**
- **Wear long sleeves, gloves, safety glasses, and a disposable dust/mist respirator**
- **Dispose of insulation in a sealed plastic bag**
- **Vacuum any residual particles and discard**
- **Wash your hands with mild soap and cold water after handling RCFs.**

7 Remove the upper valve box. See **"To Remove the Upper Valve Box"** on page 237.

8 Vacuum any loose particulate insulation.

9 When the valve is cool, loosen the sample loop's two 1/4-inch fittings on the valve head and remove the loop.



10 Install the new sample loop.

11 Repressurize the sample loop and check for leaks.

12 Install the upper valve box. See **"To Install the Upper Valve Box"** on page 238.

13 Exit maintenance mode: Select **Maintenance > Instrument > Perform Maintenance > Maintenance Mode > Finished.**

14 Restore the analytical method.

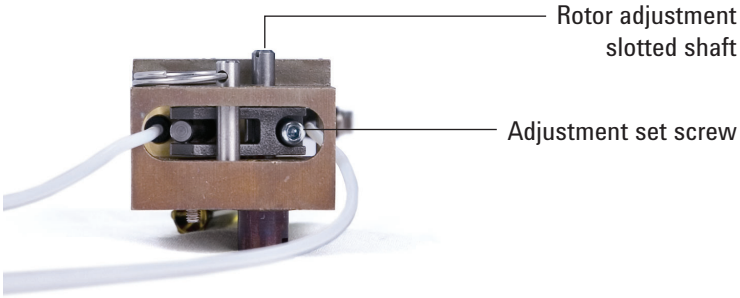
To Align a Rotary Valve Rotor

1 Gather the following:
   - Flathead screwdriver
   - 3-mm hex key wrench
   - T-20 Torx screwdriver
2 Set the oven and valve box heated zones to a safe handling temperature (25 °C).
3 Set all valves to **Off**.

WARNING

The oven, inlet, detector, and valve box may be very hot. If they are hot, wear heat-resistant gloves to protect your hands.

4 Loosen the adjustment set screw.



5 Locate the rotor adjustment shaft on top of the actuator. Using a flathead screwdriver, rotate the valve rotor counterclockwise until it stops, then back it off a small amount to set one end of the rotor's motion (< 1 mm).
6 Tighten the adjustment set screw.
7 Turn the valve **On**, turn **Off** to check for smooth operation.
8 Restore the analytical method.

To Replace a Rotary Valve in the Valve Box

WARNING

Do not install a liquid sampling valve (LSV) in the valve box if you plan to heat the box above 75 °C. Heating an LSV over 75 °C can cause a leak and subsequent explosion. LSVs should be mounted in the side location to avoid potential explosions.

1 Gather the following:
   - Replacement valve, see **"Consumables and Parts for Valves"** on page 228.
   - T-10 Torx screwdriver
   - 1/4-inch wrench
   - Needle-nosed pliers
   - Vacuum

2 Place GC in maintenance mode: **Maintenance > Instrument > Perform Maintenance > Maintenance Mode > Start Maintenance.** Wait for the GC to become ready.

WARNING

The oven, inlet, detector, and valve box may be very hot.

Sample and/or harmful gases may be present. Refer to your company's standard operating procedures for purging the chemicals from the sample line.

3 Set all valves to **Off**.

4 Leave on the GC and valve actuator air.

5 Turn off the carrier gas and sample line flows and relieve any back pressure to the valve.

WARNING

The valve box insulation is made of refractory ceramic fibers (RCFs). To avoid inhaling RCF particles, we recommend these safety procedures:

- **Ventilate your work area**
- **Wear long sleeves, gloves, safety glasses, and a disposable dust/mist respirator**
- **Dispose of insulation in a sealed plastic bag**
- **Vacuum any residual particles and discard**
- **Wash your hands with mild soap and cold water after handling RCFs.**

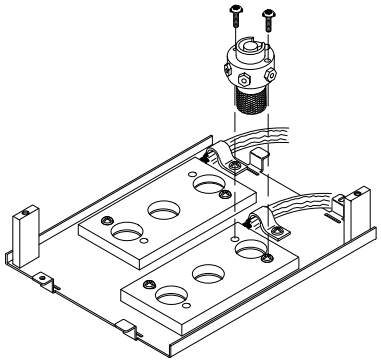
6 Remove the upper valve box. See **"To Remove the Upper Valve Box"** on page 237. Vacuum any RCF insulation particulates from the valve box area.

7 Note the tubing connections to the existing valve and label if desired.

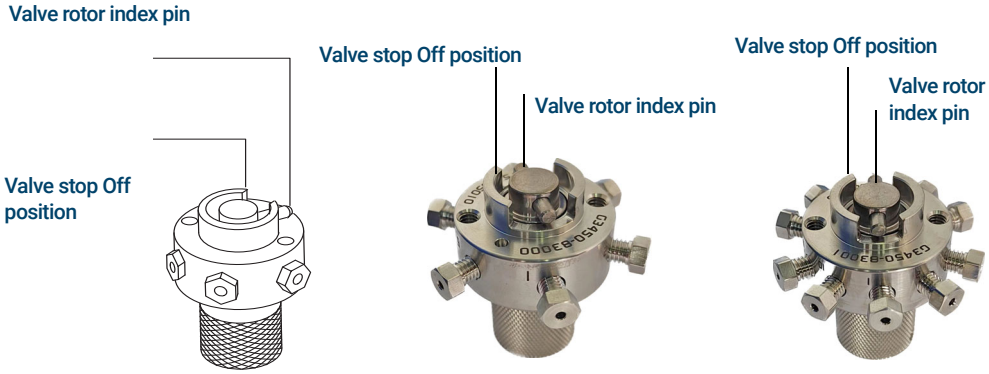
8 Disconnect the existing valve fittings.

9 Remove the two T-10 Torx screws attaching the valve to the valve box, then remove the valve from the valve box.

10 Place the new valve in the valve box. The gap in the index ring on top of a 6-port valve points toward the back of the GC if installed correctly. This is the **On** position. Install and tighten the two screws with a screwdriver.



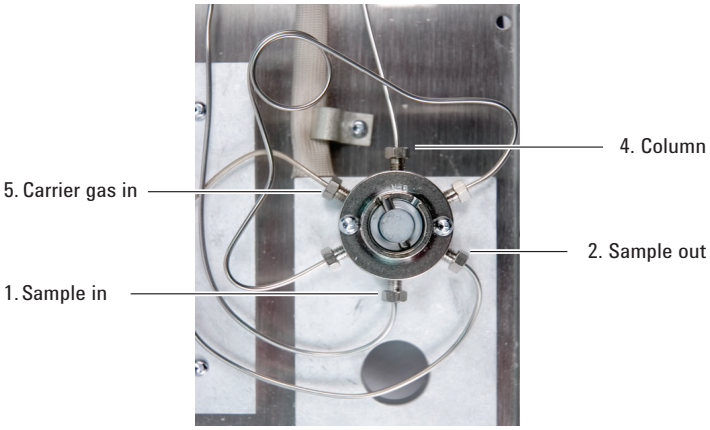
11 Use needle-nosed pliers to move the valve rotor index pin of the valve counterclockwise until the pin touches the valve stop **Off** position.



12 Plumb the new valve using the existing fittings.

WARNING

Hazardous sample gases may be present.



13 Turn on the carrier and sample gases, then check for leaks at the valve fittings.

- Using the needle-nosed pliers to toggle the valve, check both the **On** and **Off** positions.

- When leak free, set the valve to **Off**. See **step 11**.

14 Install the upper valve box assembly. See **"To Install the Upper Valve Box"** on page 238.

15 Perform an inlet **Leak & Restriction** test and reset the maintenance counters.

16 Exit maintenance mode. Select **Maintenance > Instrument > Perform Maintenance > Maintenance Mode > Finished.**

17 Restore the analytical method.

To Remove the Upper Valve Box

1 Gather a T-20 Torx screwdriver.

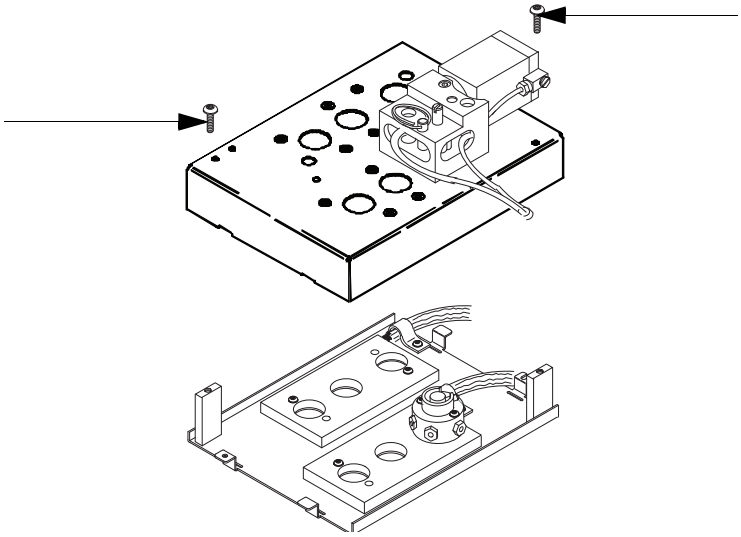
2 Set the valve box to a safe handling temperature (25 °C), or prepare for maintenance: **Maintenance > Instrument > Perform Maintenance > Maintenance Mode > Start Maintenance.** Wait for the GC to become ready.

WARNING

The oven, inlet, detector, and valve box may be very hot. If they are hot, wear heat-resistant gloves to protect your hands.

3 Lift and remove the detector cover.

4 Remove the mounting screws from the upper valve box.



5 Lift up and set aside.

6 Exit maintenance mode. Select **Maintenance > Instrument > Perform Maintenance > Maintenance Mode > Finished.**

WARNING

The valve box insulation is made of refractory ceramic fibers (RCFs). To avoid inhaling RCF particles, we recommend these safety procedures:

- **Ventilate your work area**
- **Wear long sleeves, gloves, safety glasses, and a disposable dust/mist respirator**
- **Dispose of insulation in a sealed plastic bag**
- **Vacuum any residual particles and discard**
- **Wash your hands with mild soap and cold water after handling RCFs.**

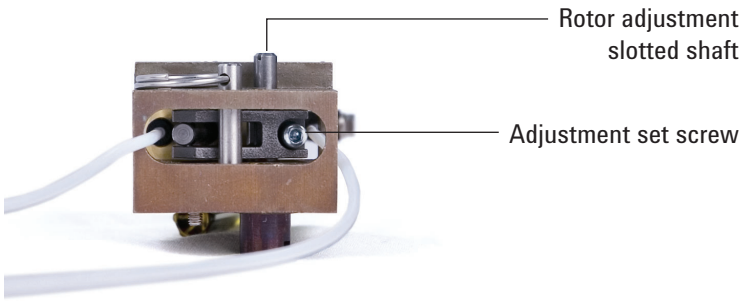
To Install the Upper Valve Box

1 Gather the following:
   - T-20 Torx screwdriver
   - 3-mm hex key wrench
   - Flathead screwdriver

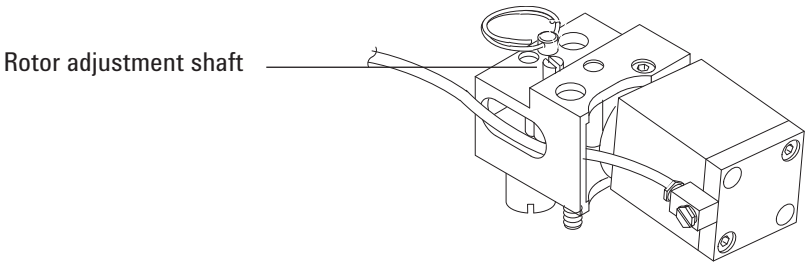
2 Verify that all valve rotors are in the full counterclockwise position (valve **Off**).

3 For each actuator that mates with a newly installed valve:

   a Loosen the adjustment set screw.



   b Locate the rotor adjustment shaft on top of the actuator. Use a screwdriver to rotate the valve rotor counterclockwise until it stops.



4 Locate the two half-moon cutouts at the bottom back of the upper valve box. Place the upper valve box on top of the lower valve assembly, routing the heater/sensor wires through the cutouts. Secure with two T-20 mounting screws.

5 Push each coupling/shaft assembly downward with a flathead screwdriver until the slot on the coupling engages the rotor index pin.

   If the coupling and valve do not engage, check that both are fully counterclockwise and try again. If necessary, turn the shaft slightly to engage the coupling.

6 For each newly installed valve:

   a Using a flathead screwdriver, turn the rotor adjustment shaft counterclockwise until it stops, then back it off a small amount (< 1 mm) to set one end of the rotor's motion.

   b Tighten the adjustment set screw.

7 Install the detector cover.

8 Restore normal operating condition.

A Swagelok Connections

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

Making Swagelok Connections

Objective

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

Materials needed:

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

1 Place a Swagelok nut, back ferrule, and front ferrule to the tubing as shown in **Figure 24**.

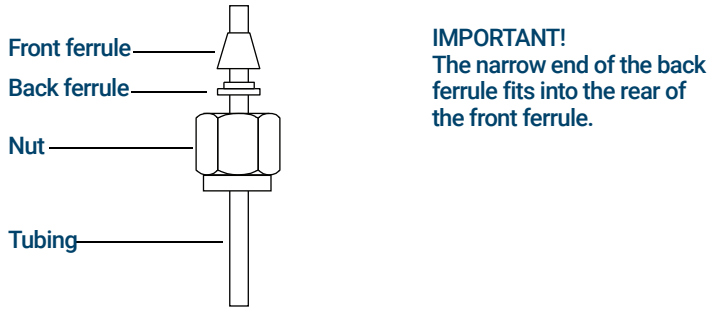


Figure 24. Swagelok nuts and ferrules

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

CAUTION

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

3 Push the tubing into the stainless steel plug. See **Figure 25**.

4 Make sure that the front ferrule is touching the plug. Slide the Swagelok nut over the ferrule and thread it onto the plug.

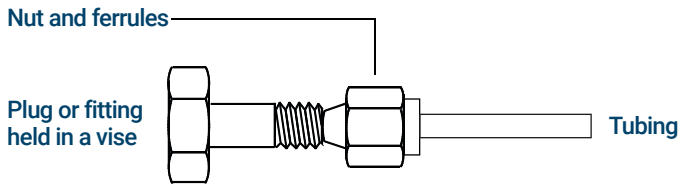


Figure 25. Assemble the fitting

5 Push the tube fully into the plug, then withdraw it approximately 1 to 2 mm as shown in **Figure 26**.

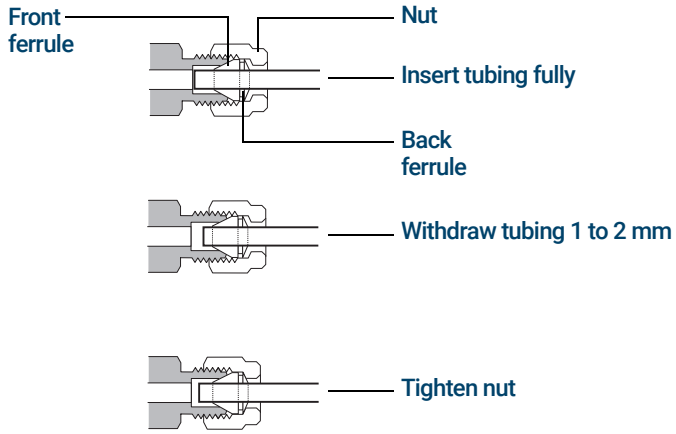


Figure 26. Insert the tubing

6 Finger-tighten the nut.

7 Mark the nut with a pencil line. See **Figure 27**.

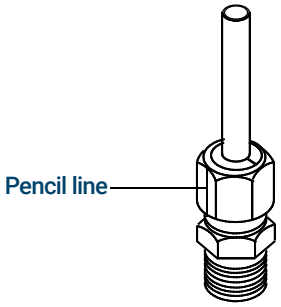


Figure 27. Mark the fitting

8 For 1/8-inch Swagelok fittings, use a pair of 7/16-inch wrenches to tighten the fitting 3/4 of a turn. See **Figure 28**.

For 1/4-inch fittings, use a pair of 9/16-inch wrenches to tighten them 1-1/4 turn, as shown in **Figure 28**.

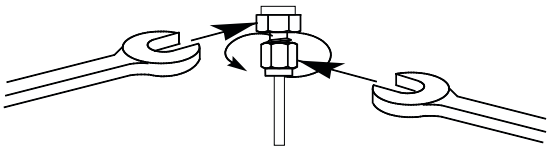


Figure 28. Final tightening

9 Remove the plug from the fitting. To connect the tubing, with nut and ferrules, to another fitting, finger-tighten the nut, then use a wrench to tighten it 3/4 (1/8-inch fittings) or 1-1/4 (1/4-inch fittings) of a turn.

10 Both correctly- and incorrectly-swaged connections are shown in **Figure 29**. Note that the end of the tubing in a correctly-swaged fitting is not crushed and does not interfere with the action of the ferrules.

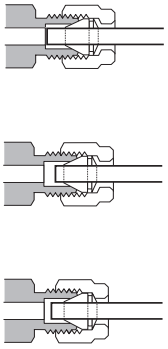


Figure 29. Completed fitting

Using a Swagelok Tee

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

NOTE

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

Materials needed:

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

1 Cut the tubing where you want to install the Tee. Connect the tubing and Tee with a Swagelok fitting. See **Figure 30**.

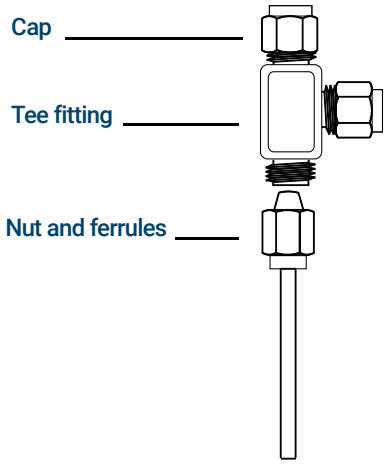


Figure 30. Swagelok tee

2 Measure the distance from the Tee to the GC inlets. Attach copper tubing to the open Tee ends with Swagelok fittings.

www.agilent.com

Seventh edition, August 2024