Thermo Scientific

Instant Connect Helium Saver Injector Module

for TRACE 1300/1310 Gas Chromatographs

User Guide

PN 31709737 Revision B January 2016

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Release history:

First Edition, released May 2014 - *"Original Instructions"*
Second Edition, released January 2016

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Instant Connect Helium Saver Injector Module

This guide provides technical information and installation instructions for the Thermo Scientific Instant Connect Helium Saver Injector Module.

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Introduction

The Instant Connect Helium Saver Injector Module is an innovative split/splitless (SSL) inlet system capable of dramatically reducing consumption of increasingly expensive and difficult-to-procure helium gas. In addition, the detrimental effects of continual out gassing and deposition of matrix residuals onto the head of the column are reduced. This may prolong column lifetime, reduce the frequency of column trimmings, and improve analytical performance.

Figure 1. The Instant Connect Helium Saver Injector Module

The module and injector components are shown in Figure 2 and Figure 3.

Figure 2. The Instant Connect Helium Saver Injector Module Components

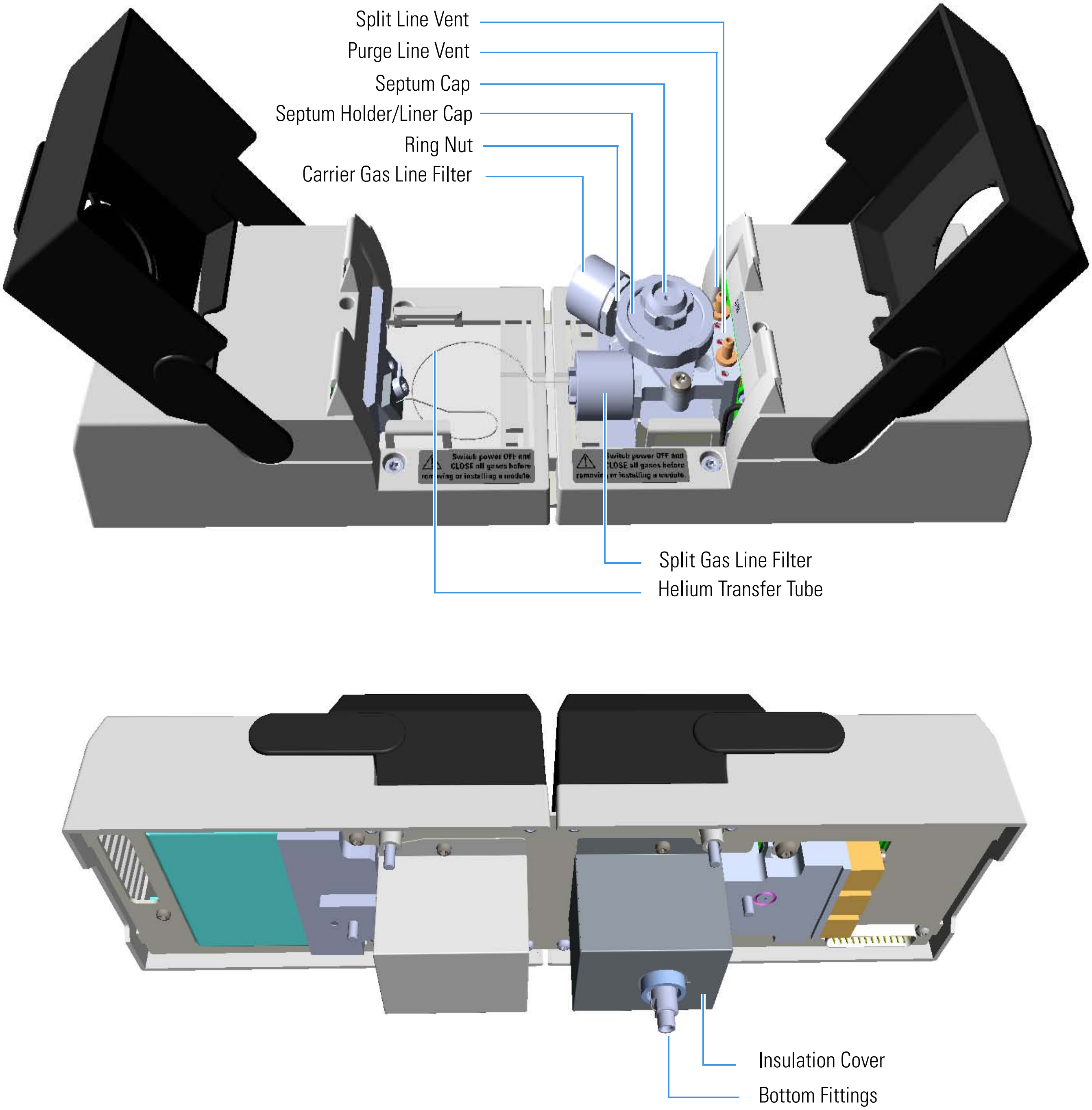
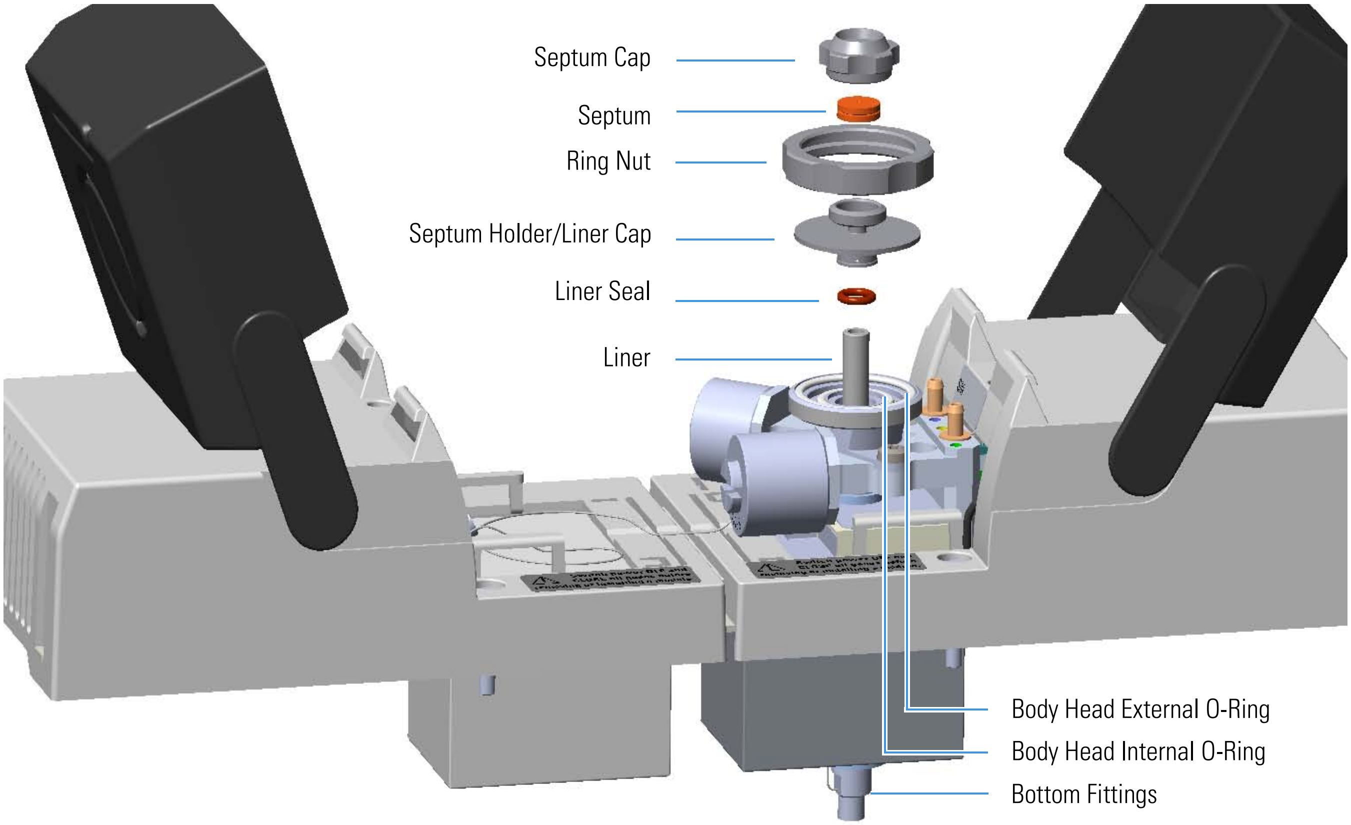


Figure 3. The Instant Connect Helium Saver Injector Module: Injector Components

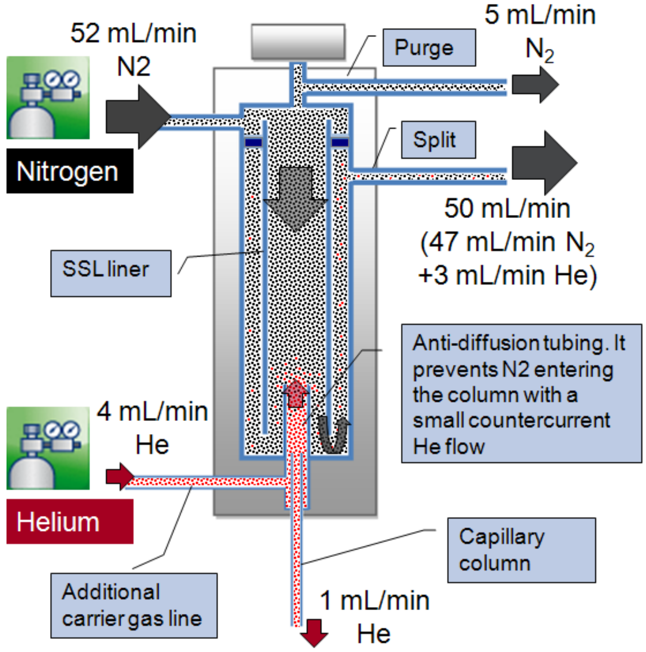


Principle of Operation

In a conventional split/splitless injector, the amount of carrier gas used for analytical separation is typically on the order of 1 milliliter per minute (mL/min), while the split flow plus the septum purge flow may be as high as 50 times this amount. The novel module essentially eliminates large helium consumption by decoupling the gas used for the analysis from the gas used for maintaining split and purge flows. The split and purge flows are accomplished using nitrogen, while the carrier gas remains helium. This allows for all the advantages of helium operation with mass spectrometers (inertness, sensitivity, and safety) while at the same time conserving helium, a limited natural resource. Using a laboratory nitrogen gas generator with the module also allows for reducing the frequency of high-pressure cylinder changes from months to years.

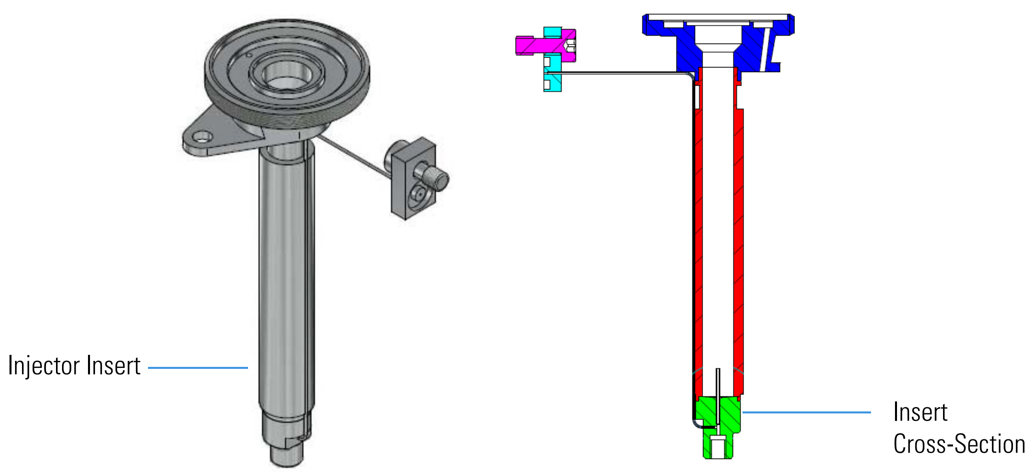
Figure 4 on page 4 illustrates the injector module in the default mode of operation.

Figure 4. The Instant Connect Helium Saver Injector Module in Default Mode



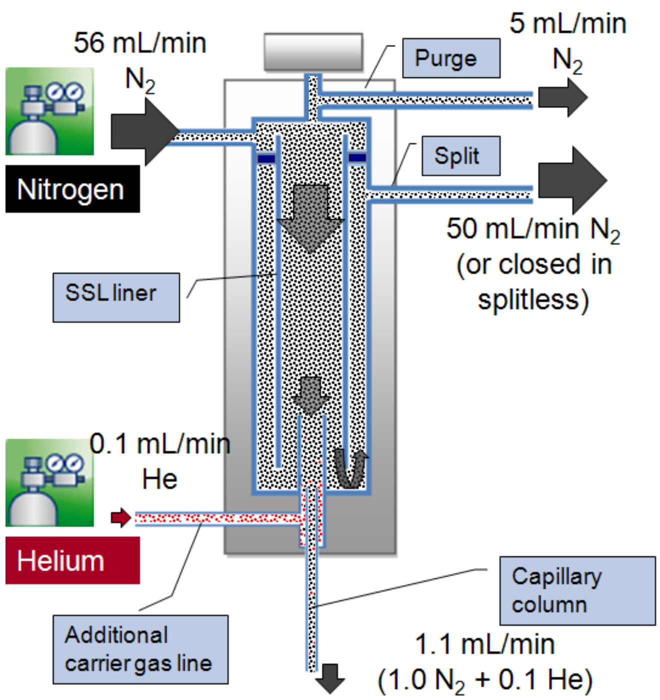
Nitrogen gas enters near the top of the inlet in the same manner as a conventional SSL and pressurizes the inlet. The nitrogen flow is caused to flow down the bore of a glass liner, then around the outer diameter and out a split vent located near the top of the injector. A small-bore stainless-steel tube runs along the side of the injector body in order to preheat a small helium flow. The small helium flow is selectable between two levels, typically 4 mL/min or 0.1 mL/min based on the setting of a valve contained in a compartment to the left of the inlet housing that uses fixed capillary restrictors and a set head pressure. The helium flow is delivered into the base of the heated injector body at a junction near the tip of the analytical column, but before a short segment of tubing that acts as a back diffusion barrier. The insert details are illustrated in Figure 5 on page 4.

Figure 5. Instant Connect Helium Saver Injector Module Insert



The inlet is pressurized with nitrogen, but when the helium delivery is set to 4 mL/min (the default condition), the column consumes 1 mL/min of helium (if that is the desired flow rate), while the 3 mL/min excess is diverted upward, contributing to the bulk nitrogen gas purge in the confines of the injector body. The 3 mL/min of upward helium flow is sufficient to prevent significant back diffusion of nitrogen into the carrier gas stream. In the default condition, matrix residuals residing in the injection port liner are precluded from entering the analytical column. During an injection sequence, (illustrated in Figure 6 on page 5) the helium flow is switched to 0.1 mL/min, which acts as a residual purge to keep the gas delivery line free from injected solvents and contamination.

Figure 6. The Instant Connect Helium Saver Injector Module in Injection Mode



During this time, nitrogen acts to sweep the injected analytes onto the column for the duration of the splitless time when in splitless mode, or for a few seconds (the helium delay time) when in split mode. The short (12 mm) back diffusion barrier offers very low flow restriction and residence time for analytes, resulting in identical retention times and peak shapes. The low residence time of analytes in the back diffusion barrier as well as a proprietary inert coating also ensures no activity toward fragile or surface active analytes.

Gas Requirements

Nitrogen 99.999% with a gas regulator output capable of up to 150 psig (1030 kPa; 10.3 bar).

The nitrogen supply should be attached to a high capacity oxygen trap designed for carrier gas purification. Reactive ambient temperature traps such as Restek™ #20601 are suitable.

This trap has the capacity to purify more than five 200 ft^3 cylinders to 15 pbb when the incoming gas purity is 99.999%.

Helium 99.999% with a gas regulator output capable of up to 150 psig.

Helium purity is critically important, particularly with respect to oxygen, nitrogen, and water vapor. Conventional chemical traps at low helium flow rates add contamination rather than remove it, particularly regarding nitrogen and argon. It is highly recommended that you use a heated zirconium-based gettering trap specifically designed for helium purification. These gettering traps efficiently remove nitrogen, which is difficult to remove with conventional chemical traps. Thermo Scientific part number 1R120577-0001 contains all the materials necessary for treatment of nitrogen and helium supplies.

The helium should be delivered using the stainless steel tubing provided with the purification kit, with the tubing connections leading directly from the gettering trap to the GC make-up gas connection. The gettering trap should be located immediately adjacent to the GC.
The standard outfit kit contains a 1 m length of 1/16 in. stainless steel tubing which can be used along with a customer supplied gettering trap if desired. Remote cylinder placement is acceptable provided the heated gettering trap is located adjacent to the GC using small bore tubing. Internal surface area should be minimized in order to reduce water vapor intensity in the air/water spectrum of a GC/MS.

Consumables

The consumables required for this injector are the septum, the glass liner, and the o-rings.

Septum

You should always use good quality septa, such as the BTO septum supplied with the TRACE 1300/TRACE 1310. Such septa resist deformation, have longer life expectancy, and have a low bleed level, even at high temperatures.
SSL injector is compatible with the **Merlin Microseal™ High Pressure Valve** instead of the standard septum.

Liner

The sample injection mode used determines the choice of liner to install into the injector body. An appropriate liner must ensure complete sample vaporization and contain the entire volume of the vaporized sample without reacting with it.
Thermo Scientific Chromatography Data Systems include the **Vapor Volume Calculator** that rapidly calculates the expansion volume of several factors (solvent, injected liquid volume, temperature, and inlet pressure) to help you determine if a liner dimension is suitable for a method.

Split Liners

Select an appropriate liner from Table 1.

Table 1. Split Liners

No	Liner	Description
1		Deactivated liner 4-mm ID; Glass Wool; 900 µL theoretical volume.
2		Deactivated empty liner; 4-mm ID.
3		Mini Lam Deactivated empty liner; 4-mm ID.

Splitless Liners

Select an appropriate liner from Table 2.

Table 2. Splitless Liners

No	Liner	Description
1		Deactivated Single Tapered Glass Wool; 900 µL theoretical volume.
2		Deactivated Single Tapered empty liner.

HS/SPME Liners

Select an appropriate liner from Table 3.

Table 3. HS/SPME Liners

No	Liner	Description
1		Deactivated empty liner; 1.2-mm ID.

O-rings

The internal (carrier line) and external (purge line) o-rings of the body head must be replaced if there are leaks. To replace the o-rings, please refer to *TRACE 1300/TRACE 1310 Hardware Manual*.

Using Instant Connect Helium Saver Injector Module Parameters

This menu includes the operating parameters for the Instant Connect Helium Saver Injector Module. Editable parameters vary with the operating mode: split, splitless, surged splitless, and the flow mode: constant flow, constant pressure, programmed flow, programmed pressure. You can also perform backflush applications.

The following sections list and describe the parameters controlling the front/back SSL injector. They are:

Carrier Gas Parameters

Set the carrier gas control parameters. Visualized parameters change according to the **Flow Mode** set.

Pressure — Defines the actual and setpoint pressure of the carrier gas. The range is On/Off; 5–1000 kPa (0.725-145 psi; 0.05-10 bar). This line is not editable when the Constant Flow or Programmed Flow mode is selected.

Column Flow — Defines the carrier gas flow rate through the column. The range is On/Off; 0.01–100 mL/min. Select **On** to display the actual and setpoint values. Select **Off** or **0** to turn off all inlet flows. This line is not editable when the Constant Pressure or Programmed Pressure mode is selected.

Flow Mode — Defines the carrier gas control mode to use. Each mode activates or deactivates the dedicated parameters.

- **Constant Flow** — The column flow is kept constant throughout the analysis. The pressure at the column head will change with the column temperature to maintain a consistent flow.
- **Constant Pressure** — The pressure at the column head is kept constant throughout the analysis. During a temperature program, the column flow decreases due to the increase of the carrier gas viscosity.

- **Programmed Flow** — The column flow rate can be programmed to change during the analytical run for up to three flow ramps.

  The parameters are:

  – **Initial Flow** — Defines the beginning flow rate.

  – **Initial Time** — Defines how long the Initial Flow is maintained.

  – **Ramp 1** — The ramp rate in mL/min^2 to reach the final flow rate. Select **On** to enable the ramp and display the setpoint value.

  – **Final Flow** — The final flow rate the carrier gas will reach at the end of the ramp rate.

  – **Final Time** — Defines how long the corresponding Final flow must be maintained.

  – **Ramp 2-3** — To program additional ramps, select **On** and enter the ramp rates in mL/min^2. The Final Flow and Final Time menu items for the ramp are displayed. The ranges and functions of these menu items are identical to the Final Flow and Final Time menu items for Ramp 1.

- **Programmed Pressure** —The inlet pressure can be programmed to change during the analytical run up to three pressure ramps.

  The parameters are:

  – **Initial Pressure** — Defines the initial pressure.

  – **Initial Time** — Defines how long the Initial Pressure is maintained.

  – **Ramp 1** — Defines the ramp pressure in kPa/min to reach the Final Pressure. Select **On** to enable the ramp and display the setpoint value.

  – **Final Pressure** — Defines the final pressure the carrier gas will reach at the end of the ramp rate.

  – **Final Time** — Defines how long the corresponding final pressure must be maintained.

  – **Ramp 2-3** — To program additional ramps, select **On** and enter the ramp rates in kPa/min. The Final Pressure and Final Time menu items for the ramp are displayed. The ranges and functions of these menu items are identical to the Final Pressure and Final Time menu items for Ramp 1.

Linear Velocity — The calculated velocity of the carrier gas through the column, expressed in cm/s. It is not editable.

Void Time — The elution time of an un-retained peak, expressed in seconds. It is not editable.

Gas Saver — This function reduces carrier gas consumption.
The range is On/Off; 5–500 mL/min. Select **On** to turn on the gas saver flow and display the setpoint values. Select **Off** to turn off the gas saver flow. The flow is retained in memory.

Gas Saver Time — Defines the time in the run when the gas saver function starts to operate. Usually it starts after the injection to conserve gas. Set a value from 0.00 to 999.99 min. This line does not appear if Gas saver flow is Off.

Vacuum Comp. — Use this parameter only when the TRACE 1300/TRACE 1310 GC is coupled with a mass spectrometer detector to compensate for vacuum column outlet. The range is On/Off.

Injection Mode

Choose which injection mode to use with the SSL injector. Each mode activates or deactivates the dedicated parameters.

Split — The carrier flow is split in the injection port with the bulk going out the split vent. The split vent remains open all the time.

Splitless — Closes the split vent during injection to drive the entire sample into the column. Splitless times of about 1 minute are typical.

Surged Splitless — Same as **Splitless** but can also program a surge during an injection. Surge starts at Prep Run and continues until the surge duration time is finished. Surge is further defined in next group of controls.

Inlet Parameters

The SSL injection parameters are described below:

Temperature — Defines the setpoint for the injector's temperature. Depending on the injection mode you select, set a temperature high enough to vaporize the sample and the solvent. Enter a value for the inlet temperature in the range of 0-400 °C.

Split Flow — Enter a value in the range of 5-1250 mL/min. The **Split Ratio** is adjusted automatically. In addition, this value is governed by the initial column flow rate entered on the associated carrier gas control. If the flow rate is changed, the Split Flow value is adjusted so that the Split Ratio is maintained. However, if the Split Flow value then falls outside its limits, a warning is generated.

Split Ratio — Enabled when the injection mode is set to **Split**. It is also associated to the Flow Mode set to either Constant Flow or Programmed Flow. Specify the ratio of split flow to column flow. Calculate the split ratio: Split Ratio = (split flow) / (column flow). Enter a value in the range of 1-12500. The Split Flow entry is adjusted automatically.

Splitless Time — Enabled when the injection mode is set to either **Splitless** or **Surged Splitless**. Specify the length of time the split valve remains closed after a splitless injection. Enter a value in the range of 0.00-999.99 min. The timer begins at the start of the run. The split vent reopens when the splitless time ends.

Purge Parameters

Purge parameters are available when the injection mode is set to either **Splitless** or **Surged Splitless**.

Constant Septum Purge — Controls the septum purge for the injector. The choose are **On Off**. Select **On** to activate the function to continuously flush the septum with a purge flow.

> **Note** The purge flow, in the range of 0.5-50 mL/min, must be set in the Configuration Page of the injector module.

Stop Purge For — Enabled if the Constant Septum Purge parameter is set to **On**. You can then enter a time from 0.00 to 999.99 min at which the septum purge ceases.

Surge Parameters

Surge parameters are enabled when the injection mode is set to **Surged Splitless**.

Surge Pressure — Defines the pressure applied during the splitless time to produce a surge of flow in the injector to speed the transfer of the sample. Enter a value in the range of 5-1000 kPa (0.725-145 psi; 0.05-10 bar).

Surge Duration — Defines the time that the surge pressure is maintained. Enter a value in the range of 0.00-999.99 min. Typically, set to coincide with the **Splitless time**.

Setting Gas Parameters

Before starting, check that the carrier gas type is correct for the analysis.

❖ To set gas parameters

1. Program the carrier gas flow.
   a. Select **Flow Mode**.
   b. Choose the mode you want from Constant flow, Constant Pressure, Programmed Flow or Programmed Pressure.
   c. Enter the initial **Flow**, or **Pressure.**
      i. If you select the Constant Flow mode, enter the desired **Column Flow** value. The necessary pressure is calculated and adjusted to maintain the constant flow.
      ii. If you select Constant Pressure mode, enter the desired **Pressure** value.
   d. Enter a **Programmed Flow/Programmed Pressure**.

   > **Note** When you select Programmed Flow or Programmed Pressure mode, the menu for the carrier contains parameters for up to three program ramps.

i. Select **Progr Flow/Pressure**, scroll to Initial Flow/Press and enter the desired value. Press Enter.

ii. Scroll to Initial Time and enter a value. This parameter ends the initial part of the program.

e. Program the **Ramps**.

i. Scroll to Ramp 1 and enter the value.

ii. Scroll to Final Flow 1/Pressure 1 and enter the final value for the ramp.

iii. Scroll to Final Time 1 and enter the final time for Ramp 1. This operation ends the first ramp setting.

iv. If you do not want a second ramp, leave Ramp 2 set to **Off**. To enter a second ramp, scroll to Ramp 2 and enter the value.

v. Scroll to Final Flow 2 /Pressure 2 and enter the final value for the ramp.

vi. Scroll to Final Time 2 and enter the final time for Ramp 2. This operation ends the second ramp setting.

vii. If you do not want a third ramp, leave Ramp 3 set to **Off**. To enter a third ramp, scroll to Ramp 3 and enter the value.

viii. Scroll to Final Flow 3/Pressure 3 and enter the final value for the ramp.

ix. Scroll to Final Time 3 and enter the final time for Ramp 3. This operation ends the third ramp setting.

2. If the TRACE 1300/TRACE 1310 GC is working with a mass spectrometer detector, set **Vacuum Compensation** to **On** to compensate for vacuum column outlet.

Setting Parameters for the Split Mode

Before starting, verify that the correct liner is installed into the injector body and the system is free of leaks.

❖ To set a Split injection

1. Program the carrier gas flow.
2. From the mode list, choose **Split**.
3. Set the injector **Temperature**.
4. If carrier **Flow** mode (Programmed or Constant) is selected, specify the **Split Flow** or **Split Ratio**.

   a. If you want a specific **Split Flow**, enter that value. **Split Ratio** will be calculated.

   b. If you want a specific **Split Ratio**, enter that value. **Split Flow** will be calculated.

5. If desired, turn on **Gas Saver** and set **Gas Saver Time** after the injection time.

Setting Parameters for the Splitless Mode

Before starting, verify that the correct liner is installed into the injector body and the system is free of leaks.

❖ To set a Splitless injection

1. Program the carrier gas flow.
2. From the mode list, choose **Splitless**.
3. Set the injector **Temperature**.
4. Enter the **Splitless Time**.
5. If desired turn on **Constant Septum Purge** and enter into **Stop Purge For** how many minutes elapse before restarting the purge.
6. If desired, turn on **Gas Saver** and set **Gas Saver Time** after the injection time.

Setting Parameters for the Surged Splitless Mode

Before starting, verify that the correct liner is installed into the injector body and the system is free of leaks.

❖ To set a Surged Splitless injection

1. Program the carrier gas flow.
2. From the Mode list, choose **Surged Splitless**.
3. Set the injector **Temperature**.
4. Enter the **Splitless Time**.
5. If desired turn on **Constant Septum Purge** and enter into **Stop Purge For** how many minutes elapse before restarting the purge.
6. Set the values for **Surge Pressure** and **Surge Duration**.
7. If desired, turn on **Gas Saver** and set **Gas Saver Time** after the injection time.

Installation

The Instant Connect Helium Saver Injector Module is designed as a “double wide” module that fits into the space provided by one detector module and one injector module on the upper deck of a Thermo Scientific TRACE 1300/1310 series GC. The module may be placed in either the Front or Back position on the upper deck. If it is placed in the Front location, it will be necessary to plumb the helium supply to the Front Make Up gas connection on the back panel of the GC. If the module is located in the Back position of the deck it will necessary to plumb the helium to the Back Make Up gas connection on the back panel of the

GC. It is necessary to plumb the nitrogen gas to the corresponding Front or Back Carrier gas connections. Although nitrogen will not be the actual carrier gas for the analytical separation, it will be the carrier gas during the injection, and it is necessary to plumb the nitrogen to the carrier gas input.

For optimal results, use a high capacity oxygen trap on the nitrogen supply, and a heated zirconium alloy gettering trap on the helium supply. These traps can be purchased together as Thermo Scientific part number 1R120577-0001. Alternatively, customers may opt to provide their own helium purification. Due to the low flow rate of helium employed, conventional chemical traps (non-heated traps) may actually contaminate the gas supply. Heated zirconium-based traps specifically designed for helium are ideal. These traps can also remove nitrogen, which is difficult to eliminate from conventional traps.

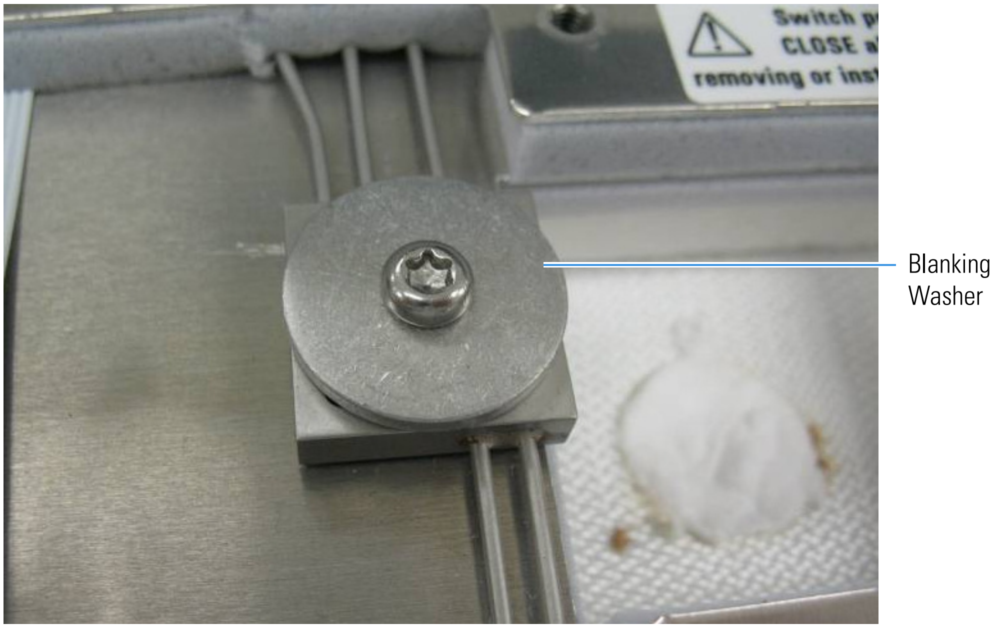
❖ To install the Instant Connect Helium Saver Injector Module

1. Cool the GC and MS heated zones and then shut off all carrier and detector gases on the local GC user interface as well as at the source cylinder.

Figure 7. Removing the Dummy Modules

2. Remove the detector and injector “dummy modules” from the locations where the module will be installed by loosening the two captive T20 screws on each module. See Figure 7 on page 14.

Figure 8. Removing the Blanking Washers



3. Remove the blanking washers from the detector and injector pneumatic network. See Figure 8 on page 15.

Figure 9. Confirming Presence of O-rings

4. Ensure there is an o-ring present in the o-ring seat of each position on the pneumatic network block. See Figure 9 on page 15.

Figure 10. Plumbing the Helium Cylinder

5. Plumb a cylinder of high purity helium 99.999+% to the appropriate make-up gas connection on the back of the GC using the adapter provided. See Figure 10 on page 16. The Thermo Scientific gas purification kit part number 1R120577-0001 contains a heated gettering trap which can be used directly with this fitting.

   Alternatively, a customer supplied gettering trap can be used along with the provided 1/16 in. stainless steel tubing. Set the regulator pressure such that helium purges the make-up line of the pneumatic network for 15 min at a flow of 20–100 mL/min. The flow can be measured directly from the detector block at the left most port as shown in Figure 9 on page 15. This will purge the gas line as well as eliminate air from the gettering material of an in-line heated helium purifier. Do this before applying power to the purifier. Ensure the hose leading to the flowmeter is clean and dust free before holding it against the o-ring seat.

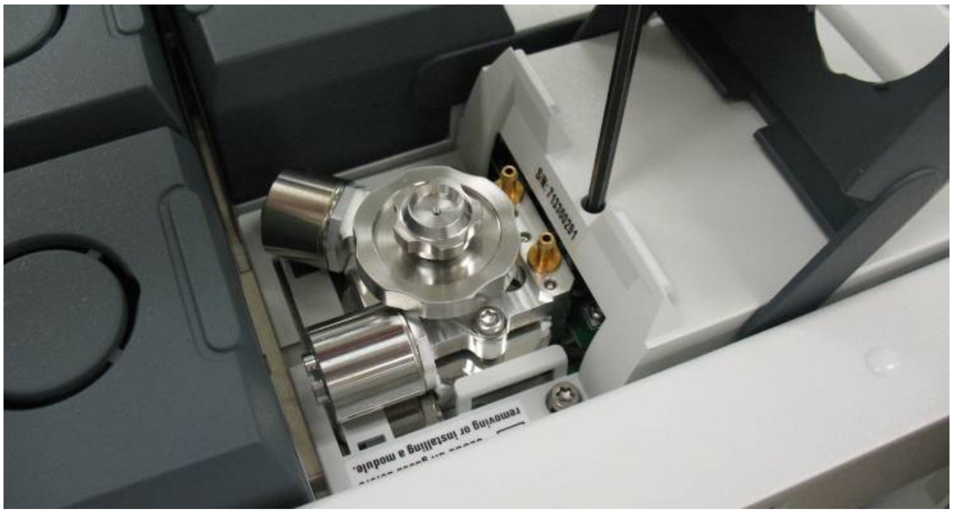
Figure 11. Positioning the Instant Connect Helium Saver Injector Module

6. Carefully insert the Instant Connect Helium Saver Injector Module into position on the GC top deck after first inserting the ceramic insulator shown in Figure 11 on page 16. Also, be sure to remove the column nut from the injector if it has not already been removed. This prevents damage to the ceramic insulator when the module is inserted. It may be helpful to insert the left side of the module just prior to the right side in order to

clear the space properly. The module fits snugly into position but should not require undue force to clear the sheet metal opening.

7. Secure the T20 screws near the center line of the module leading to the injector and detector pneumatic network prior to tightening the captive screws which hold the module. See Figure 12 on page 17. It will be necessary to push down on the right side of the module near the back edge to ensure engagement of the 25 pin D-sub electrical connector. Wiggle the module as necessary to engage the pins and then secure the screws.

Figure 12. Securing the Instant Connect Helium Saver Injector Module in Place



8. At this point, the regulator that delivers the helium can be set to the appropriate pressure: typically 110 psig will suffice for 0.25 mm i.d. columns of 30 m length. Dial the pressure up slowly while tapping the pressure gauge in order to set the appropriate pressure. Table 4 serves as a guide for setting the correct helium regulator pressure.

Table 4. Determining Correct Helium Regulator Pressure for Column Type (Sheet 1 of 2)

Column Length	Column i.d.	Desired Flow *	Required helium regulator pressure psig (kPa; bar) **
5 m/10 m	0.10 mm	0.4 mL/min	110 psig (760 kPa; 7.6 bar)
		0.5 mL/min	120 psig (830 kPa; 8.3 bar)
		0.6 mL/min	130 psig (900 kPa; 9 bar)
10 m/20 m	0.18 mm	0.8 mL/min	100 psig (690 kPa; 6.9 bar)
		1.0 mL/min	110 psig (760 kPa; 7.6 bar)
		1.2 mL/min	120 psig (830 kPa; 8.3 bar)
		1.5 mL/min	130 psig (900 kPa; 9 bar)
		2.0 mL/min	140 psig (970 kPa; 9.7 bar)
15 m	0.25 mm	1.0 mL/min	100 psig (690 kPa; 6.9 bar)
		1.2 mL/min	110 psig (760 kPa; 7.6 bar)
		1.7 mL/min	120 psig (830 kPa; 8.3 bar)

Table 4. Determining Correct Helium Regulator Pressure for Column Type (Sheet 2 of 2)

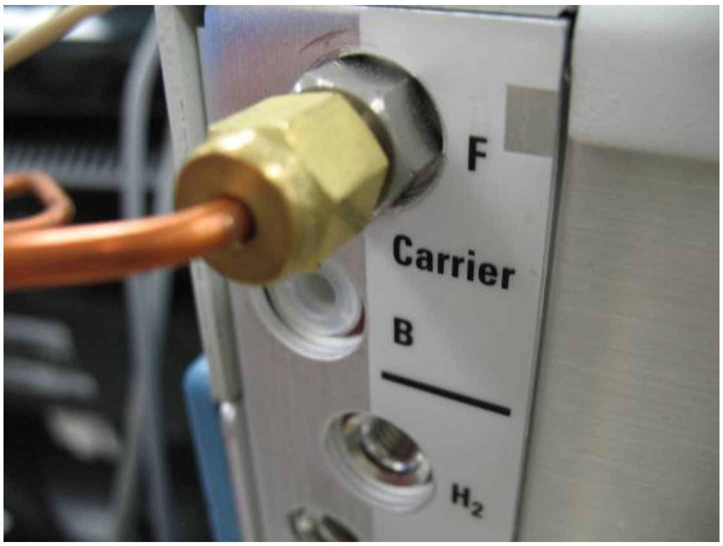
Column Length	Column i.d.	Desired Flow *	Required helium regulator pressure psig (kPa; bar) **
		2.2 mL/min	130 psig (900 kPa; 9 bar)
		2.7 mL/min	140 psig (970 kPa; 9.7 bar)
30 m	0.25 mm	1.0 mL/min	100 psig (690 kPa; 6.9 bar)
		1.2 mL/min	110 psig (760 kPa; 7.6 bar)
		1.7 mL/min	120 psig (830 kPa; 8.3 bar)
		2.2 mL/min	130 psig (900 kPa; 9 bar)
		2.7 mL/min	140 psig (970 kPa; 9.7 bar)
		3.2 mL/min	150 psig (1030 kPa; 10.3 bar)
60 m	0.25 mm	1.0 mL/min	120 psig (830 kPa; 8.3 bar)
		1.2 mL/min	130 psig (900 kPa; 9 bar)
		1.7 mL/min	140 psig (970 kPa; 9.7 bar)
		2.2 mL/min	150 psig (1030 kPa; 10.3 bar)
100 m	0.25 mm	1.0 mL/min	130 psig (900 kPa; 9 bar)
		1.2 mL/min	140 psig (970 kPa; 9.7 bar)
		1.7 mL/min	150 psig (1030 kPa; 10.3 bar)
30 m	0.32 mm	1.5 mL/min	100 psig (690 kPa; 6.9 bar)
		2.0 mL/min	110 psig (760 kPa; 7.6 bar)
		2.5 mL/min	120 psig (830 kPa; 8.3 bar)
		3.0 mL/min	130 psig (900 kPa; 9 bar)
		3.5 mL/min	140 psig (970 kPa; 9.7 bar)
60 m	0.32 mm	1.5 mL/min	110 psig (760 kPa; 7.6 bar)
		2.0 mL/min	120 psig (830 kPa; 8.3 bar)
		2.5 mL/min	130 psig (900 kPa; 9 bar)
		3.0 mL/min	140 psig (970 kPa; 9.7 bar)
		3.5 mL/min	150 psig (1030 kPa; 10.3 bar)
100 m	0.32 mm	1.5 mL/min	130 psig (900 kPa; 9 bar)
		2.0 mL/min	140 psig (970 kPa; 9.7 bar)
		2.5 mL/min	150 psig (1030 kPa; 10.3 bar)

* For flow rates not specifically listed, round up in pressure to the next highest value. For example, if 1.5 mL/min is desired using a 0.25 mm ID column of 15 m length, use a helium regulator pressure of 110 psig (760 kPa; 7.6 bar).

** Minimum pressure required to avoid nitrogen back diffusion into the helium carrier gas. Higher pressure will result in a slightly higher (than minimum) consumption of helium, but will not result in adverse analytical performance.

9. Plumb a nitrogen supply to the appropriate Carrier input at the back of the GC as shown in Figure 13 on page 19. The Thermo Scientific gas purification kit contains a high capacity oxygen trap that should be placed in the nitrogen line. Be sure to purge the regulator and gas line before attaching the oxygen filter. Keep nitrogen flowing through the trap while attaching the filter to the back of the GC in order to prevent oxygen from entering the trap. Adjust the pressure regulator to supply a pressure sufficient for the analytical method in use. In general, 75 psig is more than sufficient for most applications. Very small bore capillaries may require higher pressures.

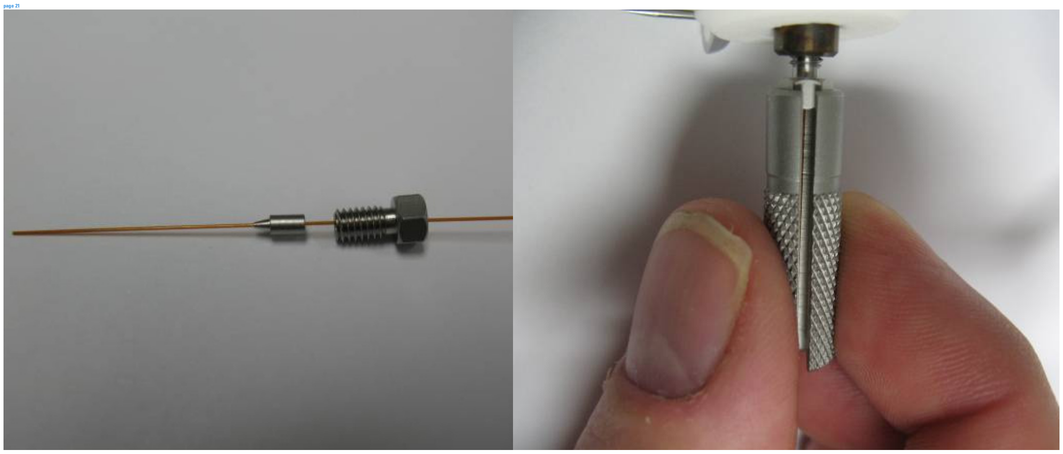
Figure 13. Plumbing the Nitrogen Supply to the GC



Column Installation

The Instant Connect Helium Saver Injector Module is designed to be used with Silflow™ metallic ferrules. This allows for very accurate trimming of the column following compression of the ferrule onto the column. It is important that only 5 mm of column protrudes past the tip of the ferrule for proper operation. The inlet has been designed to work optimally with 0.25 mm i.d. columns, although larger (up to 0.32 mm i.d.) or narrower i.d.'s can be used successfully. Insert the column through the SilFlow™ nut and ferrule as shown in Figure 14 on page 20. Allow a few centimeters of column to extend past the tip of the ferrule and insert it into the base of the inlet. It will be necessary to gently poke around in order to find the small bore cone that serves as a column guide and ferrule seat. Use the knurled tool to tighten the nut by finger force only, until the ferrule grabs the column, and the column no longer slides in the bore of the ferrule.

Figure 14. Installing the Column Nut and Ferrule

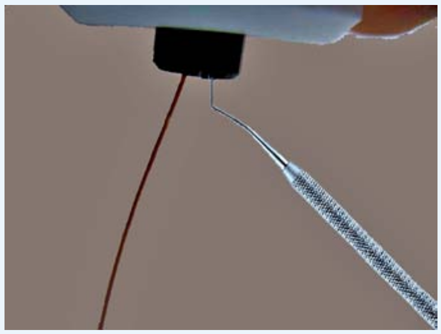


The column connection should appear as shown in Figure 15 on page 20. The column should be fully captured by the ferrule without the ability to slide it up or down. At this point, remove the nut and ferrule assembly and confirm the column will not slide in the ferrule (See first **Tip** on page 21). Trim the column such that only 5 mm extends past the tip of the ferrule. Carefully reinstall the column and again tighten the ferrule. The column is now installed in the injector.

Figure 15. Installing the Column in the Injector

Tip An indispensable tool for removal of the column from the inlet is a scaler. When the SilFlow ferrule engages the inlet on tightening, it is slightly deformed at the tip in order for the sealing to occur. This causes the ferrule to become “stuck,” which is a normal occurrence.

The ferrule can easily be removed by inserting the pointed tip of the scaler gently along the side of the ferrule and pressing vertically to cause the ferrule to be displaced to the side. Gently pulling on the column at the same time will dislodge the ferrule.



Note The standard outfit kit for the Instant Connect Helium Saver Injector Module is equipped with SilFlow ferrules having internal diameters of 0.50, 0.40 and 0.35 mm.

If you are using a 0.32 mm id column, use the 0.50 mm i.d. ferrules supplied.

If you are using a 0.25 mm id column or smaller, use the 0.35 mm id ferrule if the column will pass through it.

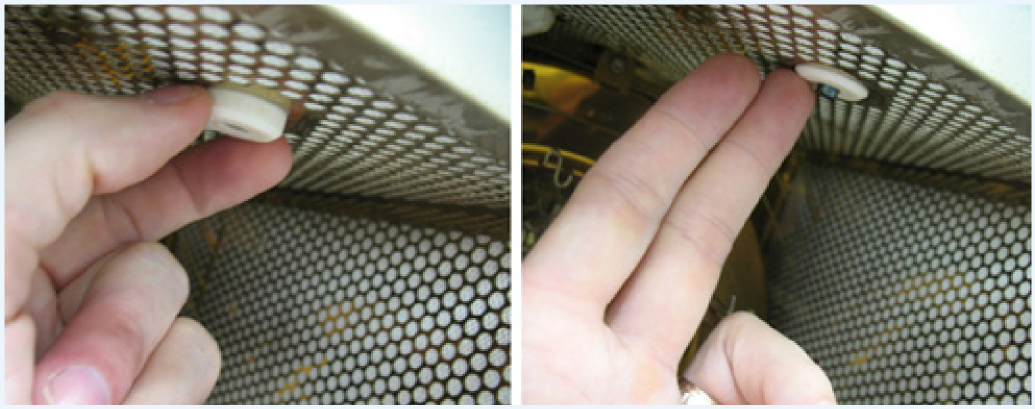
This will allow easy finger tightening of the ferrule using the hand tool without undue torque. In other words, use the smallest ferrule that will fit your columns.

The ideal situation is when the column passes through the hole with slight pressure.

The replacement Thermo Scientific part numbers are as follows:

- 0.50 mm ferrule **10ea**. 29063467 (for 0.32 columns)
- 0.40 mm ferrule **10ea.** 29063466 (for 0.25 columns and smaller on the high end of the o.d. tolerance)
- 0.35 mm ferrule **10ea**. 29063465 (for 0.25 columns and smaller on the low end of the o.d. tolerance)

Tip When installing the column, nut and ferrule, lift up slightly on the ceramic insulator surrounding the base of the injector insert as shown in figure. This will expose the end of the insert and make it easier to locate the column in the central hole. After the final trimming and installation of the column, make sure to pull the insulator back to its lowest position.



Checking for Leaks

A hand held helium leak detector may be used to check for helium leaks around the inlet and column connection. With the helium conservation enabled, approximately 4 mL/min of helium will enter the injection port. For maximum sensitivity of the leak detector, set the split flow to **Off** during leak check. This results only in column and septum purge flows.
The composition of the gas mixture in the inlet will be mostly helium and allow good sensitivity. For bulk nitrogen leak detection, the GC column exit can be plugged, and the automated pressure drop leak detection of the GC used for determining the pressure drop. The helium delivery block should be parked in the rear "blocked" position of Figure 23 on page 34 if leak checking is done based on pressure drop. The block must be replaced in the front position to resume operation.

Operation

❖ **To operate the Instant Connect Helium Saver Injector Module**

1. Turn on the GC power and establish nitrogen flow to the inlet by setting a carrier gas flow, split flow, and septum purge flow as for a standard SSL injector.

2. Ensure the inlet has been configured with the conservation enabled. This will establish approximately 4 mL/min of helium flow to the back diffusion preventer of the inlet when the helium pressure is 110 psig at the regulator.

3. Interface the terminal end of the GC column to the mass spectrometer and pump the system down. Do not enable the thermal zones at this point.

4. After several minutes, check the air/water spectrum if the system appears relatively leak free (the system has good ion gauge pressure). There likely will be some residual nitrogen and water vapor in the gas lines which may take overnight to subside.

5. If the air/water spectrum otherwise looks good, heat the ion source, transfer line and injector to their respective operational temperatures.

6. Tune the mass spectrometer according to standard procedure. The autotune should appear normal and report a passing leak check.

7. The Instant Connect Helium Saver Injector Module operates identically to the standard SSL with respect to setting column flows, pressures, temperatures, and other features. It is best to leave the "Enable Conservation" field of the inlet configuration defaulted to **Yes**. This will ensure that nitrogen is delivered to the GC column only during the splitless time for splitless injections.

8. It is also necessary to configure the Oven "**Ready Delay**" for 1 minute. This will allow the GC column to completely fill with nitrogen before an injection is made, as well as serve to allow the residual purge to stabilize at a low value.

Split Mode Injections

If the injection is a Split mode injection, some of the sample will enter the column and the remainder will exit the split vent in accordance with the split ratio. The split is accomplished using nitrogen, but it is necessary to switch to helium following the injection. If the switch to helium is done at the same time as the injection, the sample will be largely lost, being occluded from entering the column by the back flow of helium. A few seconds are needed for the sample transfer to the column, particularly for heavy molecular weight components. This delay is called the "Helium delay" in the inlet configuration menu, and a value of 0.10 minutes should be sufficient time for sample transfer even for heavy components.

Maximizing Helium Lifetime

It is possible to extend the lifetime of a cylinder of helium beyond three years of continuous use to more than ten by putting the inlet in a standby condition when the GC is not in use. This is done by configuring the "Enable conservation" field to read **No**. This puts the helium delivery valve in the residual purge mode, which allows nitrogen to enter the column continuously. It is suggested that this mode of operation only be attempted after complete familiarization of the inlet and its operation.

Also note that water vapor will accumulate in the gas lines when the GC is in standby condition. For this reason, operation should not commence until a few hours after reconfiguring the "Enable conservation" field to **Yes**. Do not attempt to tune the MS when "Enable conservation" is set to **No**. For most situations, it is best to leave "Enable conservation" set to **Yes**. This eliminates any waiting for water vapor to subside and still results in good cylinder lifetime.

Maintaining an Instant Connect Helium Saver Injector Module

This section provides instructions for maintaining an Instant Connect Helium Saver Injector Module.

The module and injector components are shown in Figure 16 and Figure 17.

Figure 16. Instant Connect Helium Saver Injector Module Components

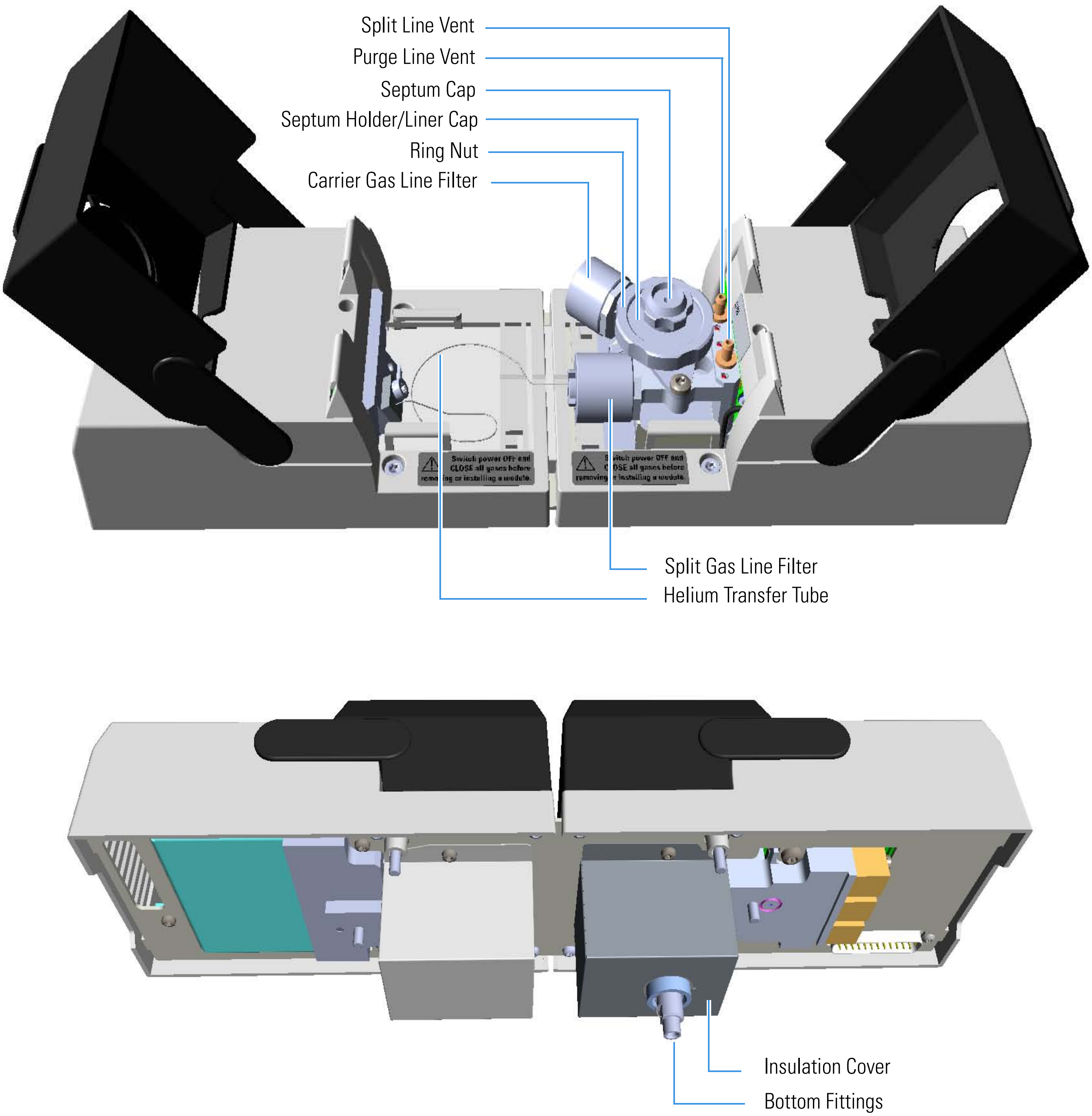
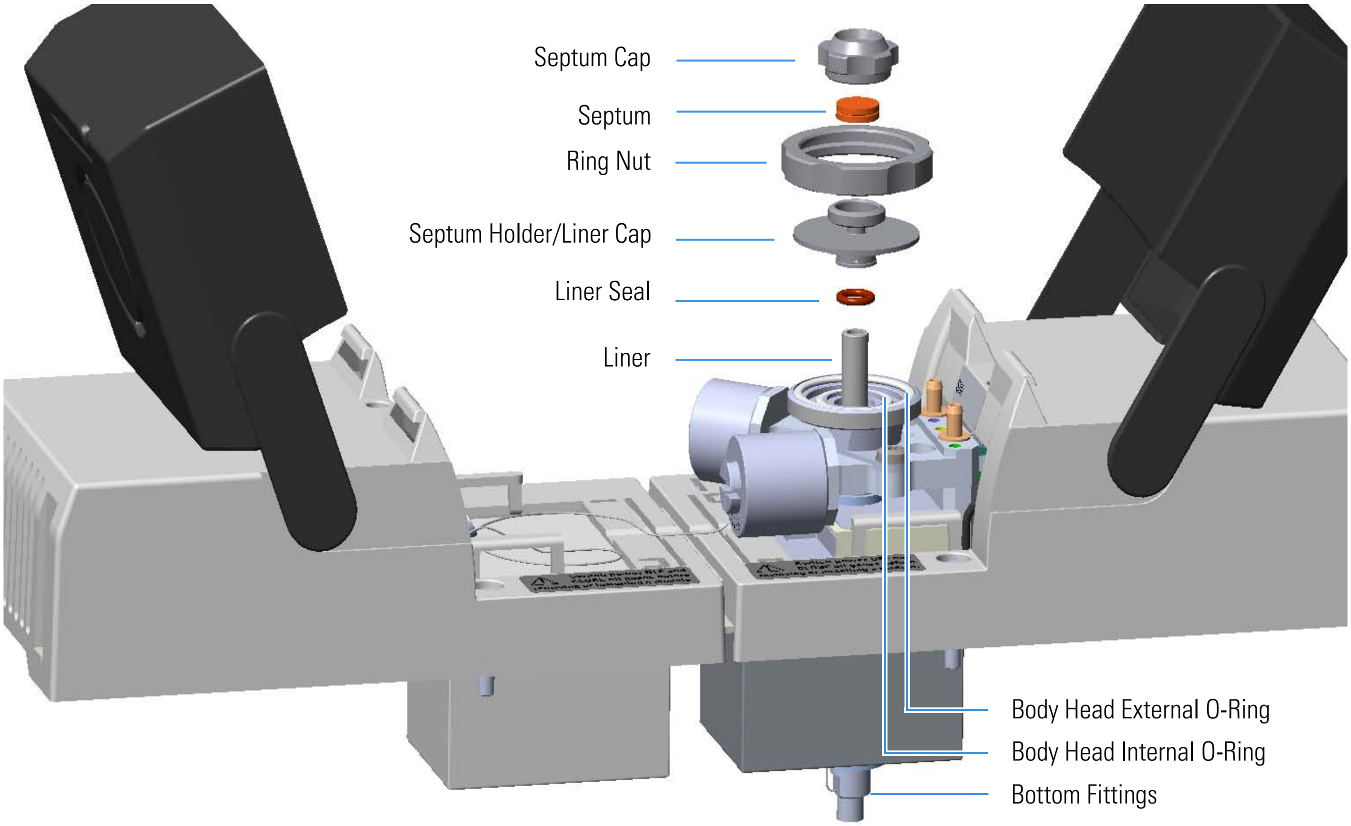


Figure 17. Instant Connect Helium Saver Injector Module: Injector Components



Maintaining the Instant Connect Helium Saver Injector Module is largely the same as a conventional SSL inlet. One advantage of the Instant Connect Helium Saver Injector Module is that routine septum and liner changes can be accomplished without cooling the MS transfer line or ion source. This is particularly desirable since cooling down and re-establishing stable MS temperatures takes much longer than cooling down and re-establishing the inlet temperature.

The Instant Connect Helium Saver Injector Module periodic maintenance includes:

- **Replacing the septum**

  The septum needs to be changed intermittently to prevent leakage. Replace the septum at least after every 200 injections, or every time a problem related to septum damage, or wear occurs.

  See "Replacing the Septum" on page 27.

- **Cleaning or replacing the liner**

  Injection port liner needs to be replaced or cleaned as it becomes dirty.

  See"Cleaning or Replacing the Glass Liner" on page 28.

> **Tip** It is good practice to replace the septum every time you replace the glass liner.

- **Replacing the active carbon filters on the carrier gas line and split line**

  The active carbon filters must be replaced depending on the volume of solvent injected in the time.

  See "Replacing the Carrier and Split Lines Filters" on page 30.

- **Replacing the body head o-rings**

  The internal (carrier line) and external (purge line) o-rings of the body head must be replaced when there are leaks present.

  See "Replacing the Body Head O-Rings" on page 31

- **Cleaning the Injector Body**

  Over time, contamination of the module will occur due to the deposition of cored septum particles or other material not captured by the glass wool of the injection port liner. In this case, the injector insert should be removed and cleaned according to the following procedure.

  See "Cleaning the Instant Connect Helium Saver Injector Module Injector Body" on page 32

Before maintaining the injector, read the following warning:

WARNING The injector fittings could be hot. Carry out all the operation at low temperature to avoid burns. Therefore, before beginning the sequence, the injector must be cooled to room temperature.

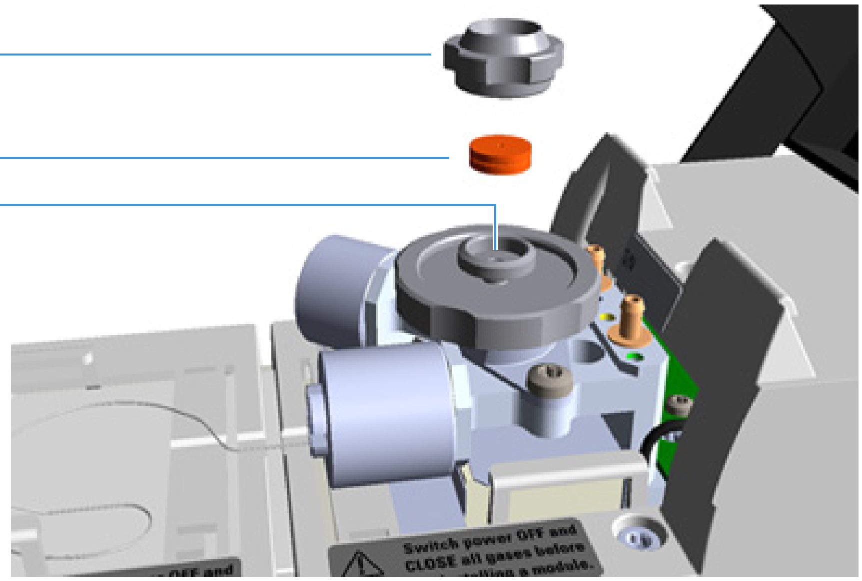
CAUTION When handling organic solvents, you must take precautions to avoid health hazards.

Materials needed to maintain an Instant Connect Helium Saver Injector Module
Septum
Tweezers
Glass liner
Liner seal (O-ring)
Ultrasonic cleaner
Mixture 1:1 methanol/acetone
Carrier gas line and/or split gas line active carbon filters
Body head internal o-ring
Body head external o-ring
1/8-inch wrench

Replacing the Septum

❖ To replace the septum

Figure 18. Instant Connect Helium Saver Injector Module: Septum Replacement



Note Care should be taken when performing this procedure in order to keep from damaging analytical columns.

1. Put the GC in standby condition.
2. Cool the oven and injector to room temperature.

   Note By pressing the **Maintenance** button, the GC cool down is automatically carried out.

3. Ensure the **Enable conservation** field in the configuration page of the inlet reads **Yes**.
4. Check that there is at least 20 mL/min split flow exiting the split line, then turn the column flow to **Off** in the GC user interface and allow the inlet to depressurize.
5. Put the autosampler away if present.
6. Open the module flap cover.
7. Replace the septum.

   a. Unscrew and remove the septum cap.

   b. Using tweezers, remove the septum from the septum holder.

   c. Avoid touching the septum with your fingers. Insert a new septum into the septum holder using tweezers.

   d. Screw and tighten the septum cap to finger-tight.

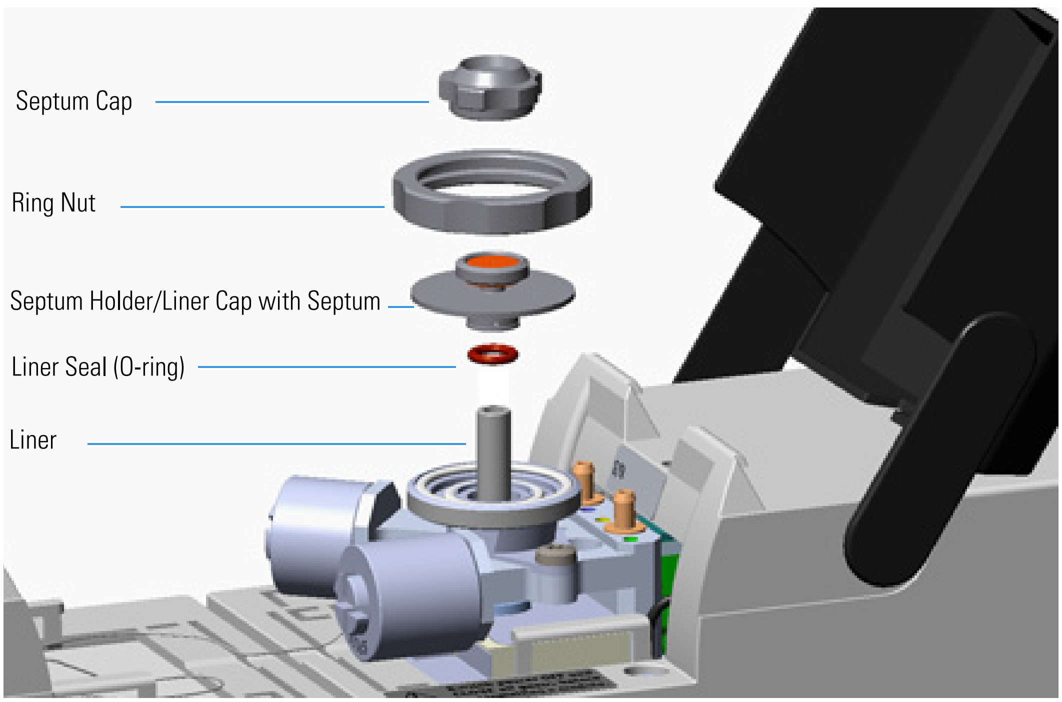
CAUTION Do not overtighten the septum cap because you might damage the septum and affect instrument performance.

8. Close the module flap cover.
9. If present, move the autosampler towards the module to restore the original alignment.
10. Wait two or three minutes for helium to purge the inlet.
11. Turn the inlet flow back on and enable the inlet heater.
12. Set the normal injector, detector, and GC working conditions.

Cleaning or Replacing the Glass Liner

❖ To clean or replace the glass liner

Figure 19. Instant Connect Helium Saver Injector Module: Glass Liner Replacement



Note Care should be taken when performing the procedure in order to keep from damaging analytical columns.

1. Put the GC in standby condition.
2. Cool the oven and injector to room temperature.

Note By pressing the **Maintenance** button, the GC cool down is automatically carried out.

3. Ensure the **Enable conservation** field in the configuration page of the inlet reads **Yes**.
4. Check that there is at least 20 mL/min split flow exiting the split line, then turn the column flow to **Off** in the GC user interface and allow the inlet to depressurize.
5. Remove the autosampler if present.
6. Open the module flap cover.
7. Remove the top parts of the injector.
   a. Unscrew the septum cap of the injector.
   b. Unscrew the ring nut.
   c. Remove the septum holder/liner cap with septum from the injector body head.
8. Remove the liner.
   a. Using tweezers, remove the liner with the liner seal (o-ring) from the injector.
9. Replace or clean the liner.
   - If you are going to clean the dirty liner, go to step 10.
   - If you are going to use a new liner, go directly to step 11.
10. Clean the liner.
   a. Put the liner into an ultrasonic cleaner filled with a methanol/acetone mixture (1:1).
   b. Sonicate the liner for about half an hour.
   c. Using tweezers, remove the liner from the bath and dry it with compressed clean air.
11. Install the liner
   a. Holding the new (or cleaned) liner with tweezers place a new liner seal over the liner.
   b. Insert the liner into the injector, and push it gently towards the bottom of the injector.
12. Reinstall the top parts of the injector.
   a. Place the septum holder/liner cap with the septum on the body head of the injector, and fix it by screwing the ring nut.
   b. Screw and tighten the septum cap to finger-tight.

CAUTION Do not overtighten the septum cap because you might damage the septum and affect instrument performance.

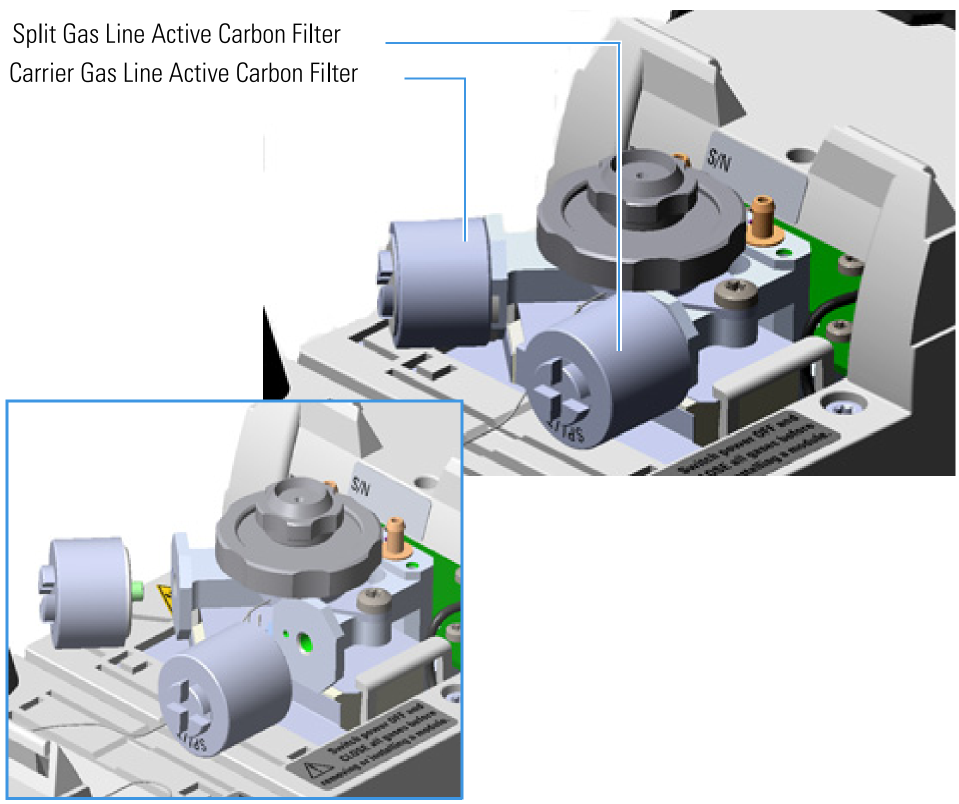
13. Close the module flap cover.
14. If present, move the autosampler towards the module to restore the original alignment.
15. Wait two or three minutes for helium to purge the inlet.
16. Turn the inlet flow back on and enable the inlet heater.
17. Set the normal injector, detector, and GC working conditions.

Replacing the Carrier and Split Lines Filters

IMPORTANT The dimensions of the filters are different. The filter on the split gas line is bigger than the filter on the carrier gas line. Do not invert their position when you replace them. It is not necessary to replace the filters together.

❖ To replace the active carbon filters on carrier gas line and split line

Figure 20. Instant Connect Helium Saver Injector Module: Active Filters Replacement



1. Put the GC in standby condition, then cool the oven and injector to room temperature.

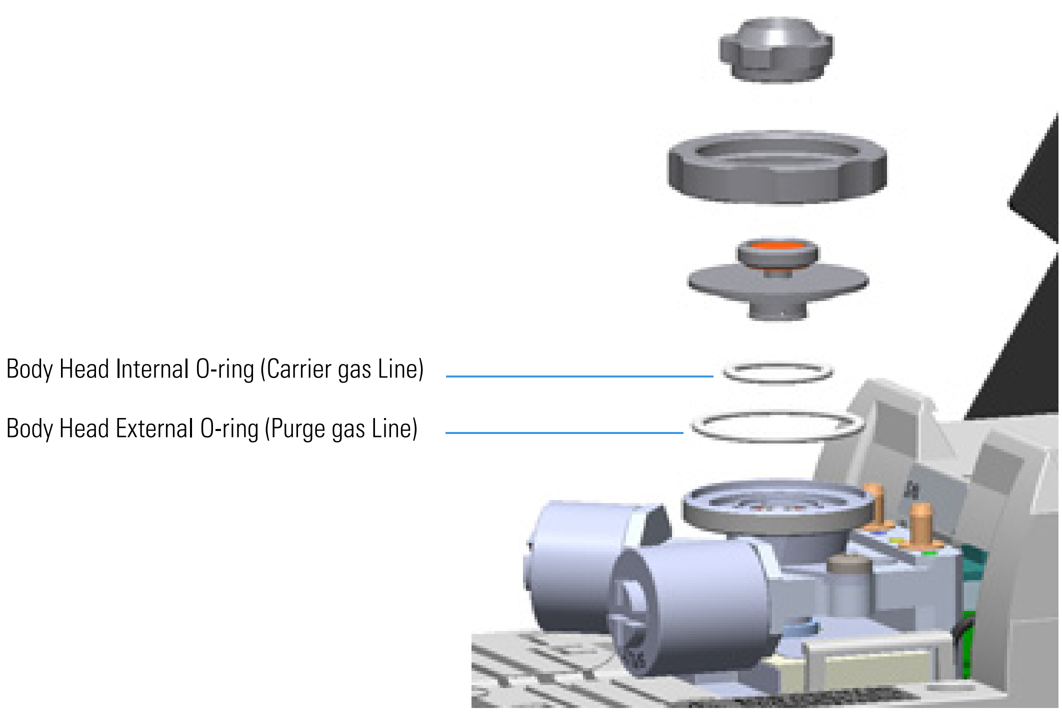
Note By pressing the **Maintenance** button, the GC cool down is automatically carried out.

2. Ensure the **Enable conservation** field in the configuration page of the inlet reads **Yes**.
3. Check that there is at least 20 mL/min split flow exiting the split line, then turn the column flow to **Off** in the GC user interface and allow the inlet to depressurize.
4. Remove the autosampler if present.
5. Open the module flap cover.
6. Replace the filter.
   a. Remove the filter to replace from its seat by turning it counter-clockwise.
   b. Install the new filter, with o-rings, in its seat by turning it clockwise.
7. Close the module flap cover.
8. If present, move the autosampler towards the module to restore the original alignment.
9. Wait two or three minutes for helium to purge the inlet.
10. Turn the inlet flow back on and enable the inlet heater.
11. Set the normal injector, detector, and GC working conditions.

Replacing the Body Head O-Rings

❖ **To replace the body head o-rings**

Figure 21. Instant Connect Helium Saver Injector Module: Body Head O-Rings Replacement



1. Put the GC in standby condition.
2. Cool the oven and injector to room temperature

> **Note** By pressing the **Maintenance** button, the GC cool down is automatically carried out.

3. Ensure the **Enable conservation** field in the configuration page of the inlet reads **Yes**.
4. Check that there is at least 20 mL/min split flow exiting the split line, then turn the column flow to **Off** in the GC user interface and allow the inlet to depressurize.
5. Remove the autosampler if present.
6. Open the module flap cover.
7. Remove the top parts of the injector.
   a. Unscrew the septum cap of the injector.
   b. Unscrew the ring nut.
   c. Remove the septum holder/liner cap with septum from the injector body head.
8. Replace the head body o-rings.
   a. Use tweezers to remove the body head internal and external o-rings, and replace them with new o-rings.
9. Reinstall the top parts of the injector.
   a. Place the septum holder/liner cap with the septum on the body head of the injector and fix it by screwing the ring nut.
   b. Screw and tighten the injector cap to fingertight.

> **CAUTION** Do not overtighten the septum cap because you might damage the septum and affect instrument performance.+

10. Close the module flap cover.
11. If present, move the autosampler towards the module to restore the original alignment.
12. Wait two or three minutes for helium to purge the inlet.
13. Turn the inlet flow back on and enable the inlet heater.
14. Set the normal injector, detector, and GC working conditions.

Cleaning the Instant Connect Helium Saver Injector Module Injector Body

Over time, contamination of the Instant Connect Helium Saver Injector Module will occur due to the deposition of cored septum particles or other material not captured by the glass wool of the injection port liner. In this case, the injector insert should be removed and cleaned according to the following procedure.

❖ To clean the Instant Connect Helium Saver Injector Module injector body

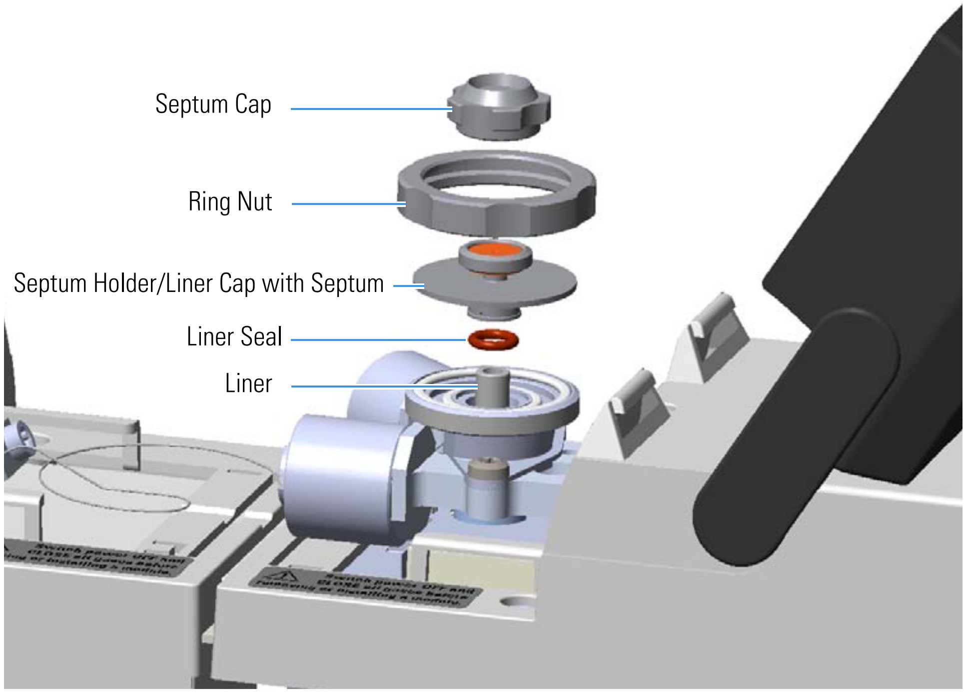
Materials needed
Ultrasonic cleaning bath
Methanol/acetone mixture 1:1
GC-grade methanol
Methylene chloride
Hexane
T20 Torxhead screwdriver
Forceps or tweezers

1. Put the GC in standby condition.
2. Cool the GC oven, injector, transfer line, and ion source.

   Note By pressing the **Maintenance** button, the GC cool down is automatically carried out.

3. Vent the mass spectrometer and set the inlet flow rate (nitrogen) to **Off**. Keep the helium enabled and pressurized as usual.
4. Remove the autosampler if present.
5. Open the module flap covers.
6. Remove the top parts of the injector. See Figure 22.
   a. Unscrew the septum cap of the injector.
   b. Unscrew the ring nut.
   c. Remove the septum holder/liner cap with septum from the injector body head.
7. Remove the liner. See Figure 22.
   a. Use tweezers to remove the liner with the liner seal from the injector.
8. Remove the analytical column.
   a. Unscrew the capillary column retaining nut, then remove the analytical column with its ferrule from the bottom of the injector.

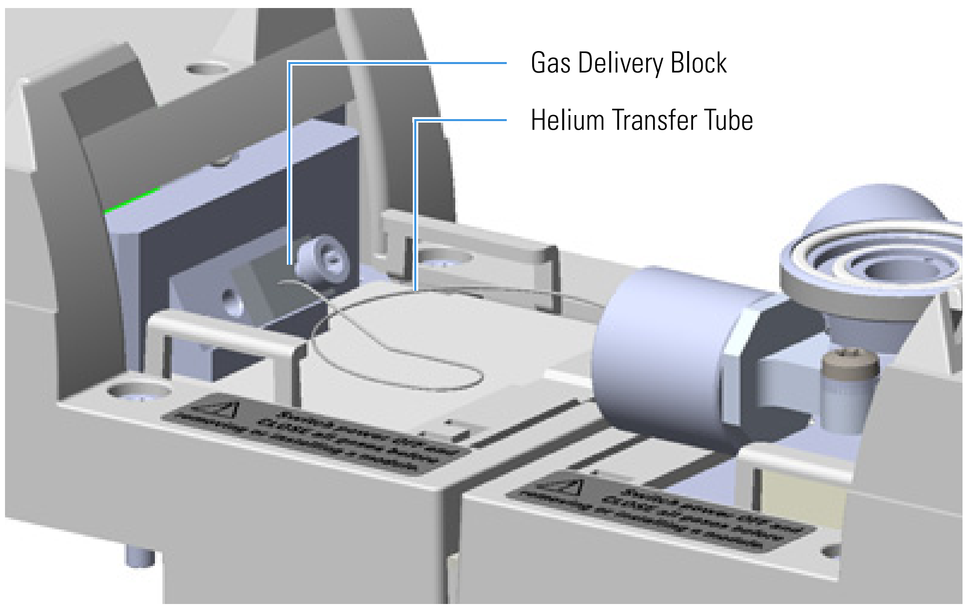
Figure 22. Instant Connect Helium Saver Injector Module: Cleaning the Injector Body (1)



9. Disconnect the helium transfer tube See Figure 23.

   a. Loosen the captive screw of the helium transfer tube and remove the tube from the gas delivery block.

Figure 23. Instant Connect Helium Saver Injector Module: Cleaning the Injector Body (2)



10. Remove the body head o-rings. See Figure 24.

    a. Using tweezers, remove both the internal and external body head o-rings.

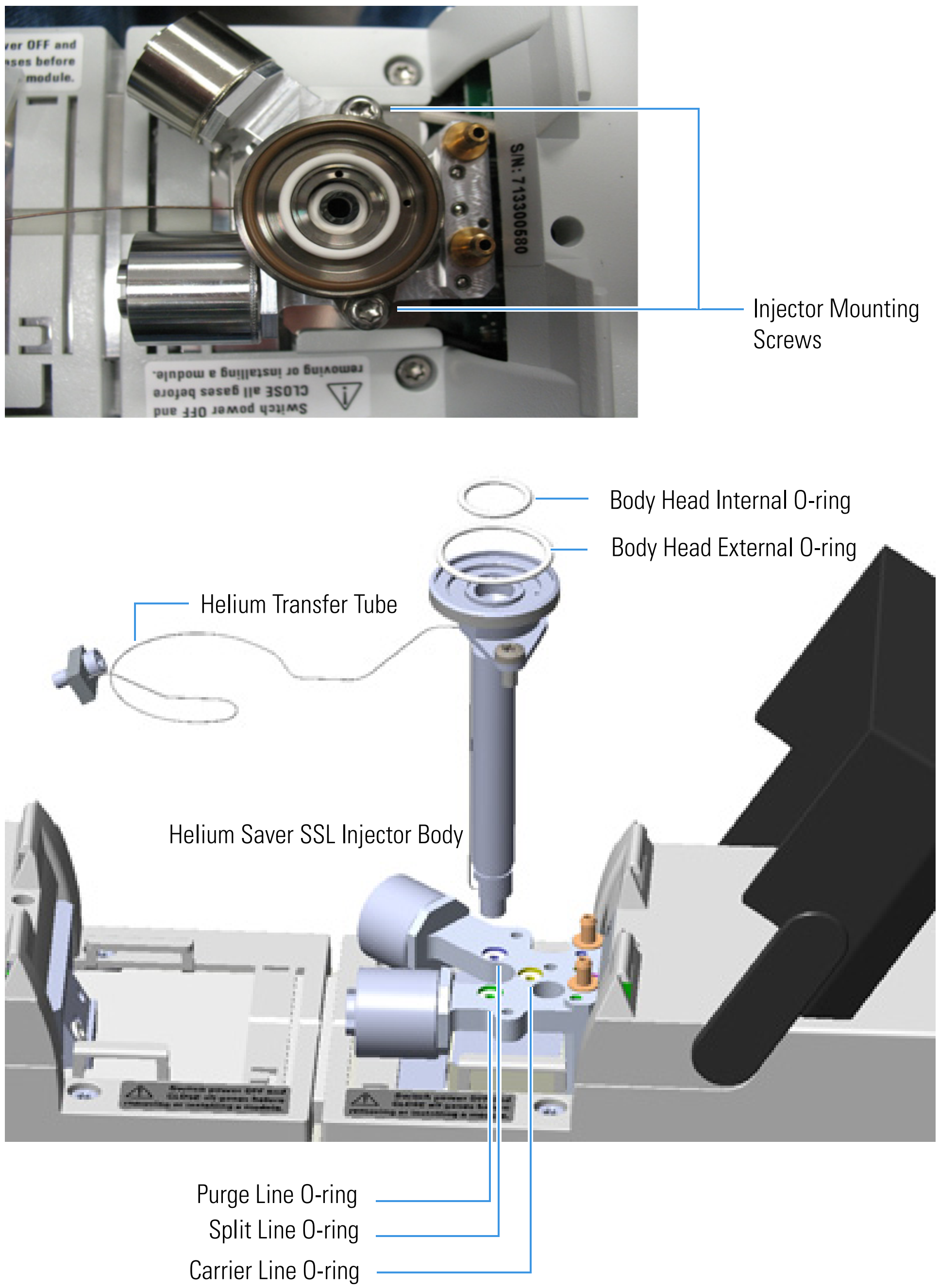
b. Place and keep all the removed components on a clean surface.

11. Remove the injector body. See Figure 24.

a. Using a T20 Torxhead screwdriver, undo the two injector body fixing screws, and extract the injector body from its housing.

Note Do not remove the carrier, split and purge lines o-rings.

Figure 24. Instant Connect Helium Saver Injector Module: Cleaning the Injector Body (3)



12. Clean the injector body.
    a. Ultrasonically clean the injector insert using a warm 1% Liquinox solution.
    b. Thoroughly rinse the insert then ultrasonically clean in chromatographic grade methanol or acetone followed by solvents of lower polarity such as methylene chloride and hexane. Limit ultrasonication to 5 min in each solvent.
    c. Blow dry the insert using high purity gas (do not use compressed house air as it contains residual oils from the compressor) then assemble in the reverse order of removal.

> **Note** Do not use abrasives, cleaning wires, or brushes on the inlet insert as these will damage the passivation treatment layers. Be especially careful not to bend the short segment of tubing at the base of the insert interior. Nothing should be inserted into the bore of the insert other than glass liners.

13. Reinstall the injector body.
    a. Reinstall and fix the injector body into its housing by screwing the two fixing screws.
    b. Using tweezers, replace both the internal and external body head o-rings.
14. Reconnect the additional helium carrier gas line mating block.
15. Reinstall the liner.
    a. Using tweezers, place the liner seal over the liner, insert the liner into the injector, and push it gently towards the bottom of the injector.
16. Reinstall the analytical column. See “Column Installation” on page 19.
17. Reinstall the top parts of the injector.
    a. Place the septum holder/liner cap with the septum on the body head of the injector. Fix them by screwing the ring nut.
    b. Screw and tighten the injector cap to finger tight.

> **CAUTION** Do not overtighten the septum cap because you might damage the septum and affect instrument performance.

18. Close the module flap covers.
19. If present, move the autosampler towards the module to restore the original alignment.
20. Wait two or three minutes for helium to purge the inlet.
21. Turn the inlet flow back on and enable the inlet heater.
22. Set the normal injector, detector, and GC working conditions.

Optimizing Helium Conservation

The helium flow delivered to the back diffusion preventer (tubing) on the base of the SSL is of two different flow rates as mentioned in "Principle of Operation" on page 3. The default flow is approximately 4 mL/min for all times except during injection, when it is reduced to approximately 0.1 mL/min. Since the flow is delivered by setting a pressure upstream of a capillary restrictor designed into the module, the actual flow rates depend on the inlet pressure as well as the input helium pressure. For a 30 m column of 0.25 mm i.d. and 1.2 mL/min column flow rate, the helium pressure should be set to approximately 110 psig. This will ensure that nitrogen is occluded from entering the column even at the highest column temperature where the inlet pressure will also be at its highest point. It is important to note that the actual helium flow is not critical to the operation of the inlet since the inlet pressure is set by the nitrogen flow. An excess of helium will simply be diverted upward into the inlet where it contributes to the bulk purge flow. Since the purpose of the inlet is conserving helium, the reduction of helium to a minimum can be accomplished in the following manner.

1. Ensure helium conservation is enabled in the inlet configuration page and that a minute or two has elapsed for any remaining nitrogen to exit the column. Start with 100 psig helium pressure. Nitrogen will give a higher response than helium for both ion gauge equipped systems and systems having only a convection gauge. These gauges can be used to evaluate if nitrogen or helium is exiting the column and can also be used as guides for method development.

2. At the initial oven temperature of the GC method, ensure an adequate air/water spectrum. The air/water spectrum should exhibit a nitrogen peak (*m/z* 28) no larger than twice the intensity of water vapor (*m/z* 18). If the nitrogen peak is larger than this, stop scanning the air/water spectrum and increase the regulator pressure to 110 psig. Wait a minute for the system to stabilize and again check the air/water spectrum. Repeat these steps until nitrogen does not dominate the spectrum. An autotune should indicate a leak free condition. Do not leave the instrument continually scanning air/water when nitrogen dwarfs the spectrum. This could result in decreased electron multiplier lifetime.

3. After getting a good air/water spectrum as in step 2, stop scanning air/water and increase the oven temperature to the final temperature used in the method. Allow a minute for stabilization to occur then check the air/water spectrum again. Ensure the nitrogen peak is of similar intensity to that in step 2.

4. If the nitrogen peak dwarfs the intensity of water vapor (*m/z* 18) and oxygen (*m/z* 32), stop scanning and increase the helium pressure at the regulator to 10 psig above the present setting and wait for one minute for the system to stabilize.

5. Check the air/water spectrum to be sure the nitrogen is reduced to an acceptable level. Increase the regulator pressure in 10 psig increments if necessary until the nitrogen is reduced.

6. Cool the GC oven to the initial oven temperature. Keep the regulator pressure set to that obtained in step 5. This will ensure nitrogen is only a minor contaminant at all points the GC run regardless of the inlet pressure (which increases with oven temperature) for constant flow mode conditions.

Notes on Air/Water Spectra

The mass spectrometer should pass the leak check diagnostic routine in Auto Tune which evaluates the amount of oxygen present. In general, the intensity of water vapor (*m/z* 18) should be less than ten times the intensity of oxygen (*m/z* 32) with a passing leak check in Auto tune. The amount of water vapor present will depend on how long the system has been in operation, and whether the helium flow has been put into standby condition either overnight or over the course of a weekend. The nitrogen peak (*m/z* 28) should be greater than two times the indicated abundance of oxygen but should not dwarf the abundance of water vapor.