

Troubleshooting Tips & Tricks for your GC Analyzer & CFT Application

7890A/7890B GC Overview



Definitions

Carrier Gas

- Pressurized gas used to transport the sample through the system.

Detector Support Gases

- Gases needed by specific detectors to operate, i.e. hydrogen and air.

Sample Introduction

- Method of “placing” the sample into the carrier gas stream.

Inlet

- Device that controls the carrier gas flow and sample introduction onto the column.

Column

- Device that separation of the components in the sample.

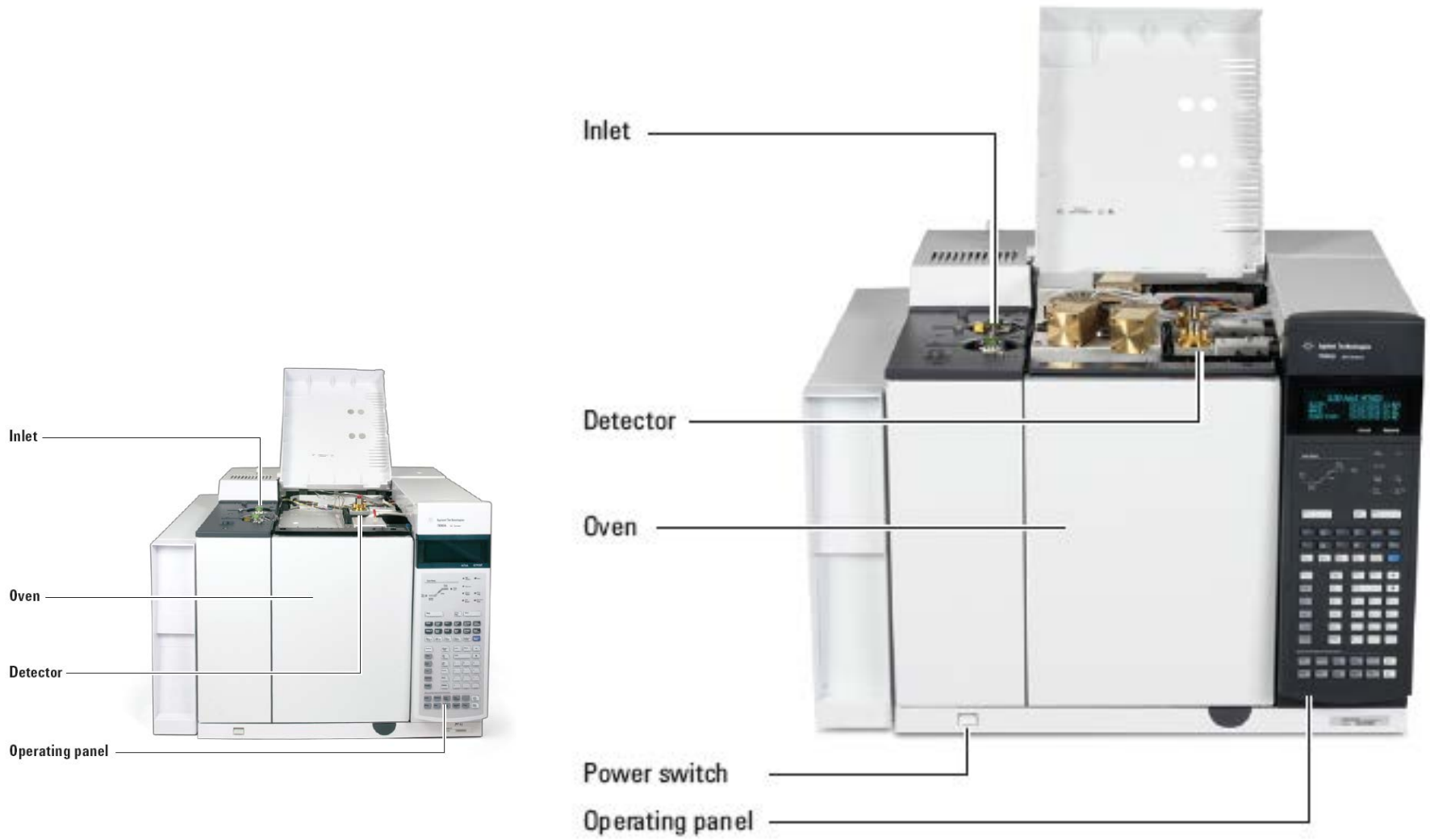
Detector

- Device that responds to sample components as they elute from the column.

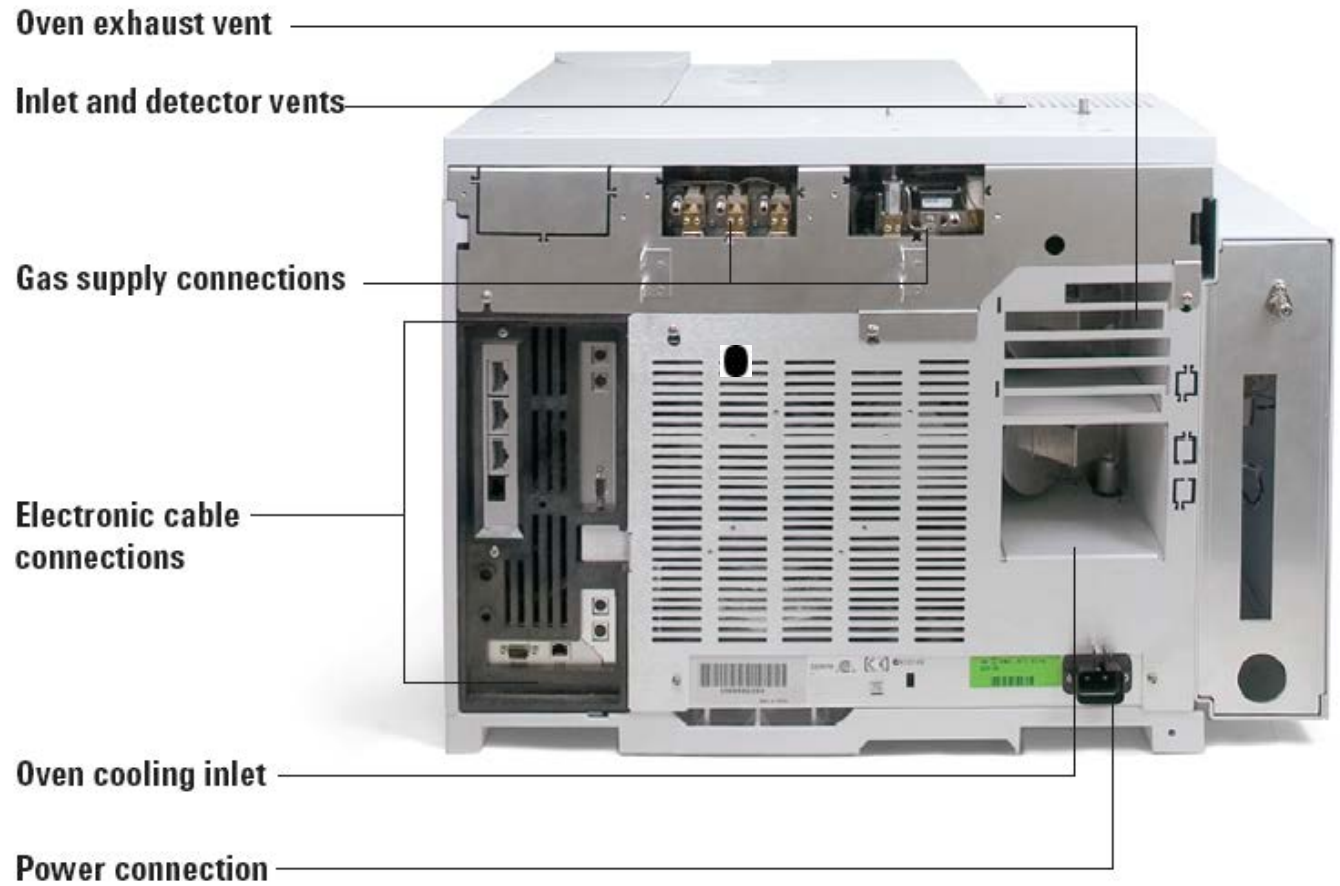
Data Acquisition

- Collection, conversion, and storage of detector signal used for integration and generation of chromatogram and reports.

Agilent 7890B & 7890 Front View



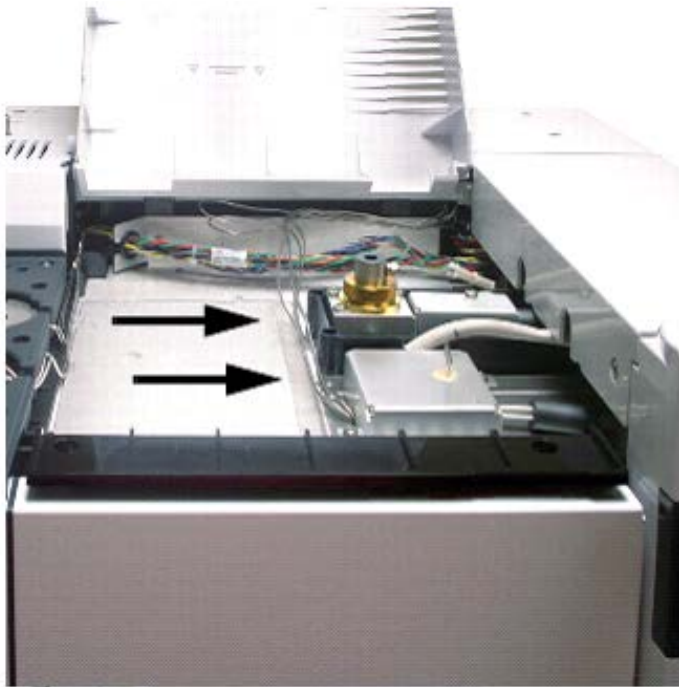
Agilent 7890A & 7890B Rear View



Agilent 7890 Top View

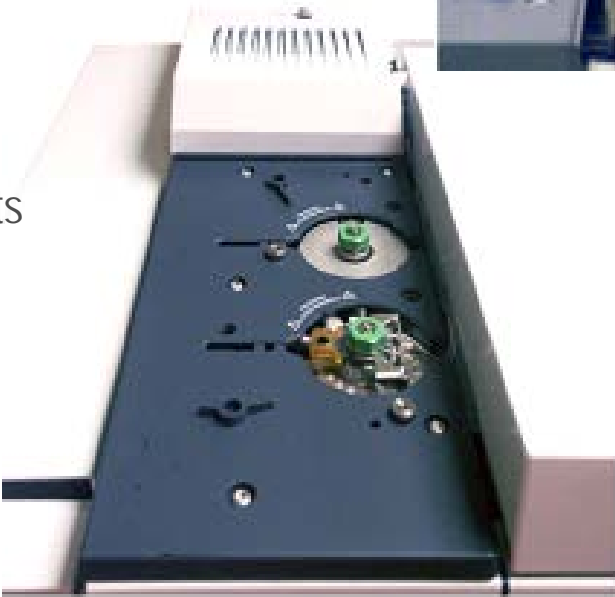


Valve Box, Actuators and Valves



Detectors

Inlets



Gas Supply Characteristics

Gases must be chosen with consideration of the type of detector used:

Inert.

Dry.

Pure.

99.9995% pure.

Using Compressed Gases Safely

Obtain safety information from your company's safety department or from your local gas supplier.

Carrier Gas Plumbing

**Stainless Steel Diaphragm
Tank Regulator.**

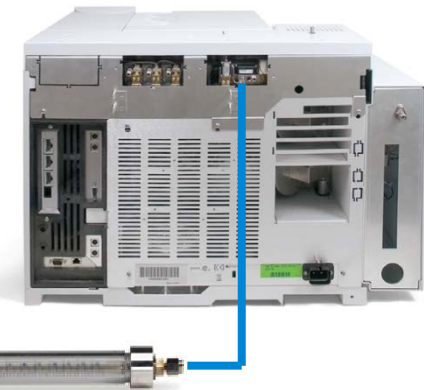
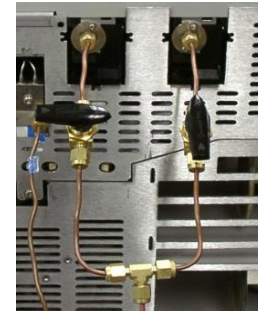
**1/8" Swagelok -
NPT Adapter.**

**1/8" Copper Tubing
P/N 5180-4196.**

**Moisture Trap
P/N 5060-9084.**

**Hydrocarbon
Trap
P/N 5060-9096.**

**Indicating O2 Trap
P/N IOT-2-HP.**



Gas System Maintenance

Filters/Traps

- Re-condition or replace at manufacture's recommended interval.
- Default replacement interval is every 3 cylinders.

Leaks

- Every 4 to 6 months check all external tubing and fittings for leaks.
- Electronic leak detector recommended for internal and external leak detection.

Liquid leak detection (soap solution) is NOT recommended.



Troubleshooting Process

- 1. Know operation fundamentals.**
- 2. Gather information about problem.**
- 3. Verify symptoms.**
- 4. Verify operational parameters.**
- 5. Isolate the problem.**
- 6. Fix the problem.**
- 7. Verify fix.**
- 8. Document fix.**
- 9. Create PM task?**

Isolate the Problem

Inspect parts/assemblies.

Review common recurring fixes:

- Instrument Log book.
- ChemStation Logbook
- Instrument Utilities Logs if configured

Check site/environmental conditions.

7890 Keypad

GC & GC/MS User Manuals and Tools

Theorize a solution.

Isolate problem to assembly/functional area:

- Flow.
- Chemical.
- Electrical.
- Mechanical.
- Operational.

Reprinted with permission from Troubleshooting the Troubleshooting Course, ©. 1982
Published by The Center for Effective Performance, 4250 Perimeter Park South, Suite 311,
Atlanta, GA 30341. 1-800-558-4237.

Fix the Problem

Only try one “fix” at a time.

Try quick fixes and easy solutions first.

Perform related maintenance tasks:

- Make sure to reset EMF resource counters on GC.
- Instrument Utilities Software

Reprinted with permission from Troubleshooting the Troubleshooting Course, ©. 1982
Published by The Center for Effective Performance, 4250 Perimeter Park South, Suite
311, Atlanta, GA 30341. 1-800-558-4237.

Verify the Fix

Verify that system performance is restored:

- ChemStation method.
- 7890 Keypad method
- Instrument Utilities

Verify that parts replaced are bad.

Restore system to operational configuration.

Reprinted with permission from Troubleshooting the Troubleshooting Course, ©. 1982
Published by The Center for Effective Performance, 4250 Perimeter Park South, Suite 311,
Atlanta, GA 30341. 1-800-558-4237.

Document the Fix

Review troubleshooting and fix actions.

Update instrument logbook.

Update Instrument Utilities Software.

Reprinted with permission from Troubleshooting the Troubleshooting Course, ©. 1982
Published by The Center for Effective Performance, 4250 Perimeter Park South, Suite 311,
Atlanta, GA 30341. 1-800-558-4237.

Make a Preventive Maintenance Task

Has the problem occurred before?

Did consumables repair problem?

Should the repair action be made part of scheduled preventive maintenance?

Instrument Utilities Software:

- For scheduled maintenance.

Service Mode:

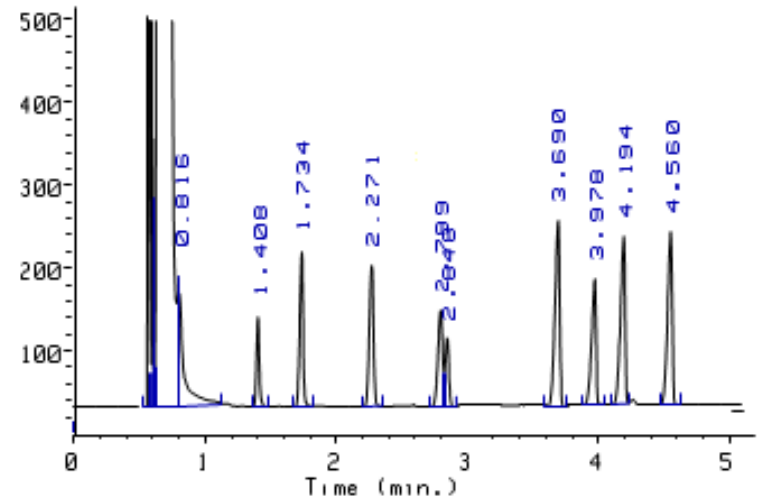
- EMF Resource counters.

Reprinted with permission from Troubleshooting the Troubleshooting Course, ©. 1982
Published by The Center for Effective Performance, 4250 Perimeter Park South, Suite
311, Atlanta, GA 30341. 1-800-558-4237.

Chromatographic Troubleshooting

Use Chromatogram to:

- Evaluate system performance:
 - Detector response.
 - Baseline.
 - Peak resolution.
 - Retention times.
- Evaluate maintenance/repair steps.
- Verify “fix” actions.



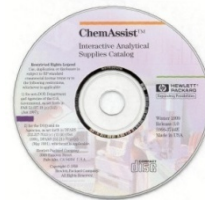
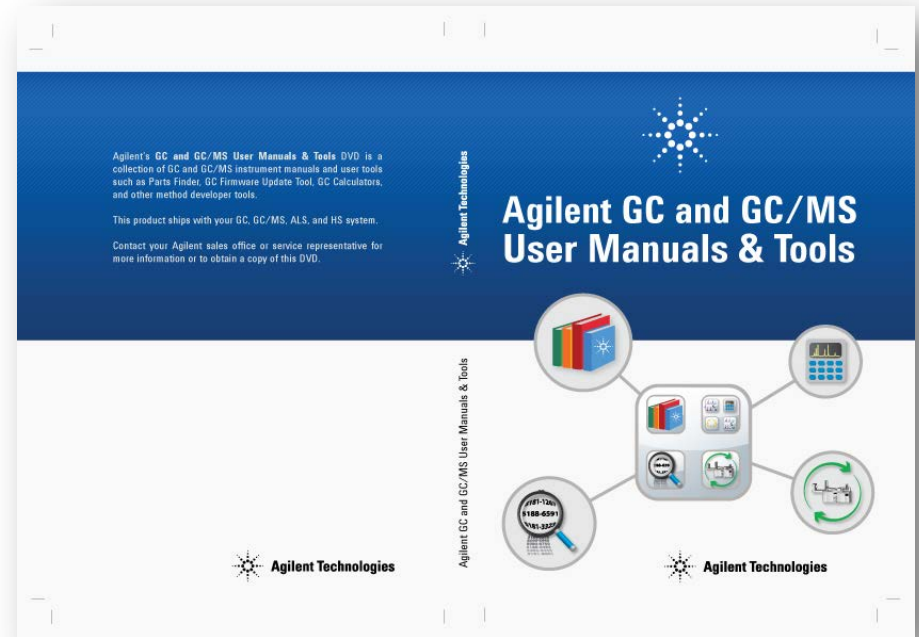


Troubleshooting Tips & Tricks for your GC Analyzer & CFT Application

Diagnostics

Reference Documentation

- GC and GC/MS User Manuals & Tools DVD
 - Documentation
 - Videos
 - Calculator
 - Parts finder
 - Firmware update
 - Instrument utilities
- www.chem.agilent.com



Chromatographic Troubleshooting Tools

- Reference points
 - Chromatogram and report of “standard”
 - Copy of method parameters
- Known good standard samples
 - TCD Checkout PN: 18710-60170
 - FID Checkout PN: 5188-5372
 - ECD Checkout PN: 18713-60040
 - FPD Checkout PN: 5188-5953
 - NPD Checkout PN: 18789-60060
- New syringe
- Spare column
- Spare consumables and frequently replaced parts
 - Ferrules
 - Septa
 - Inlet liners
 - O-rings

Agilent website: www.chem.agilent.com



Common Tools

- Torx drivers (T10 and T20)
- Open-end wrenches (1/4", 1/2", 3/8", 5/8", 5/16", 7/16", 9/16")
- 1/4" hex nut driver
- 7 mm hex nut driver
- Tweezers
- Flashlight
- Volt-ohm meter
- Needle-nose pliers
- Spare fuses (check the instrument manual)

Instrument Tools and Supplies

- Electrostatic discharge (ESD) protective wrist strap
- FID cleaning kit (PN 9301-0985)
- FID flow meter adapter (PN 19231-60660)
- Column cutter
- Electronic leak detector
- Electronic flow meter or soap film bubble meter
- Solvents for cleaning parts
- Light weight cotton gloves

Error Messages and Logbooks

Keypad and Display

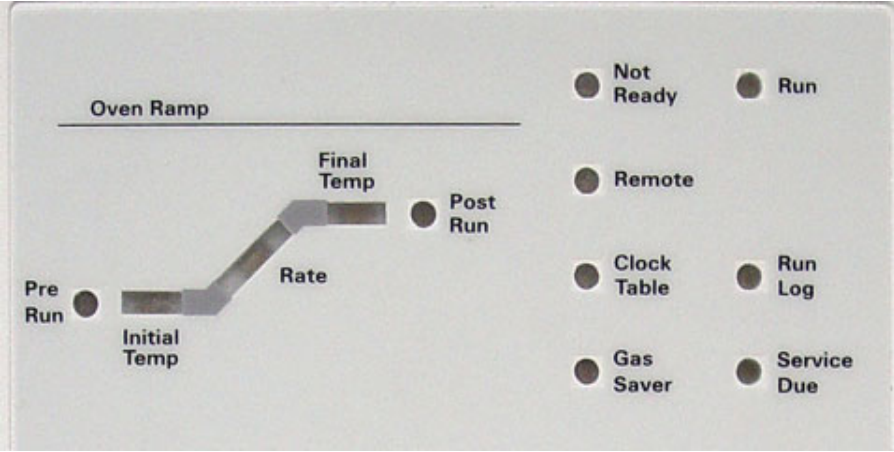
GC & GC/MS User Manuals and Tools

- Instrument Utilities

Open Lab ChemStation



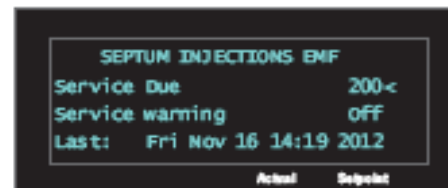
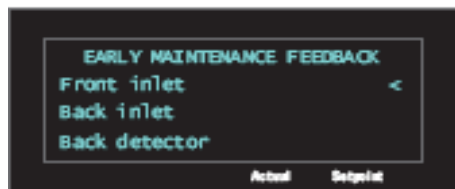
Agilent 7890 Keypad



7890B Features – Early Maintenance Feedback

EMF (Counters)

- Injection based
- Time based
- Track usage
- Replace parts before degradation impacts chromatographic results.
- Two Warning Thresholds
 - Service Due
 - Service indicator lights
 - Maintenance log created
 - Service Warning
 - Reminder that the component needs



7890B Features – Resource Conservation

Resource Conservation, the system provides an instrument schedule to conserve resources such as electricity and gases.

- Sleep Method
 - Sets low flows and temperatures
- Wake Method
 - Sets new flows and conditions, typically to restore operating conditions
- Condition Method
 - Sets flows and temperatures high enough to clean out contamination

```
INST SCHEDULE
Go to sleep now.
Edit the Instrument Schedule?<
Edit clock table?
Actual  Setpoint
```

```
INST SCHEDULE ( 1 of 2)
Monday: 17:30<
Go to Sleep.
Actual  Setpoint
```

```
INST SCHEDULE ( 2 of 2)
Tuesday: 07:30<
wake with WAKE file.
Actual  Setpoint
```


GC and GC/MS User Manuals & Tools

- Parts Finder
 - Interactive software
 - Locate replacements parts for your Agilent instrument
 - Add parts to Parts List and print
 - Order parts
- Firmware Update
 - Easily update firmware to your instrument
- Instrument Utilities
 - Monitor instruments
 - View all the instruments' information
 - Tests and diagnostics
 - Status of instruments on the network



Parts Finder

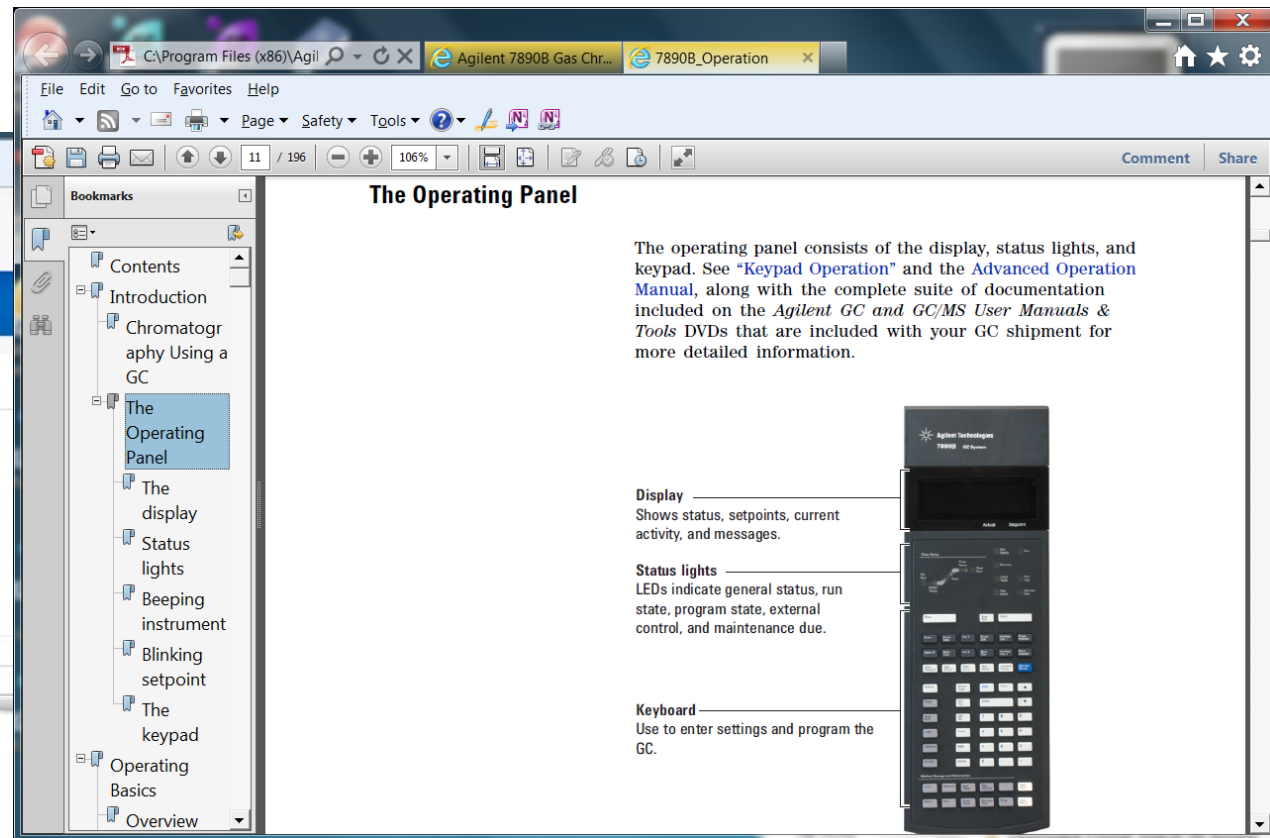
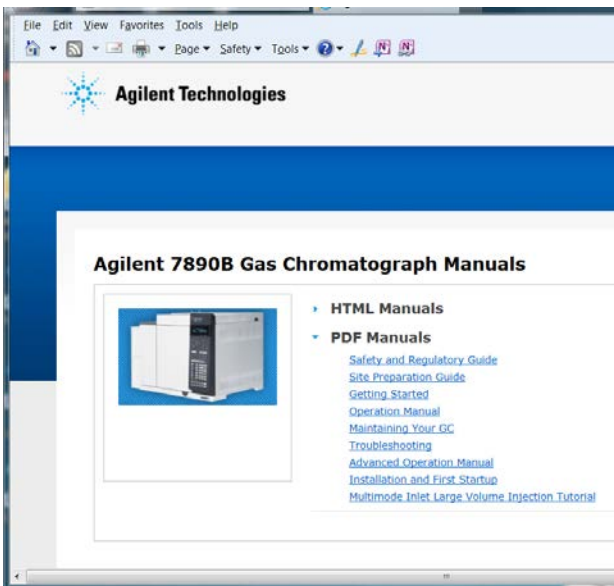
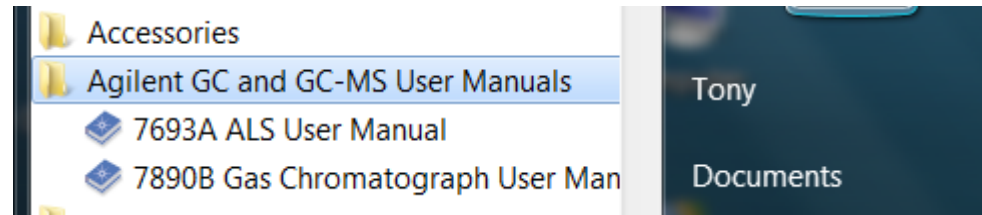


GC Firmware Update Tool



Instrument Utilities Software

User Manuals



Parts Finder

Easily find parts through search

Selective to specific instrument

- 7693A, 7650A, 7890A, 7890B, 5975 MSD, 5977 MSD

Search by component area

Interactive image

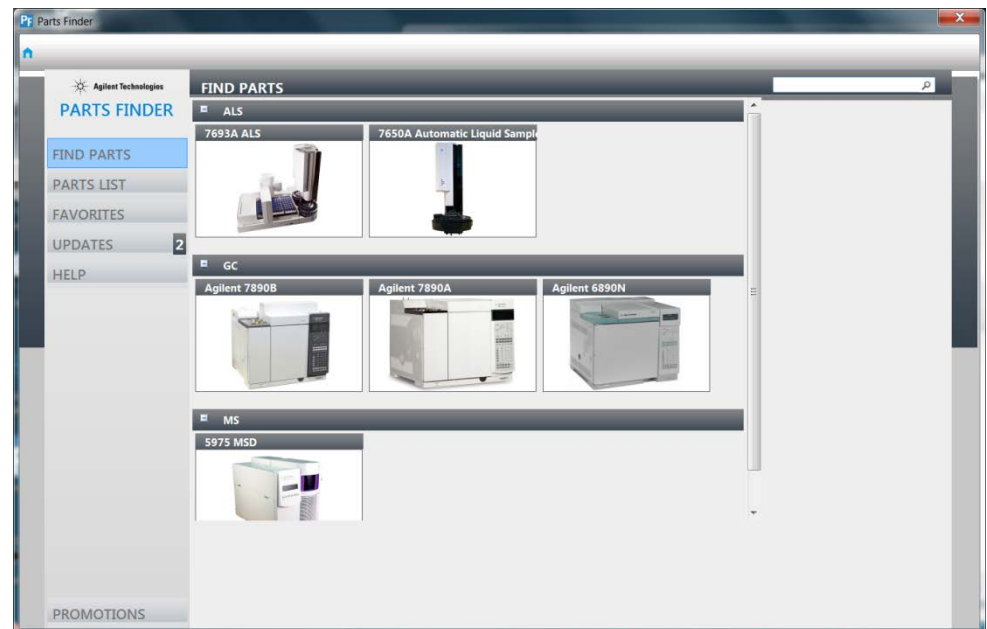
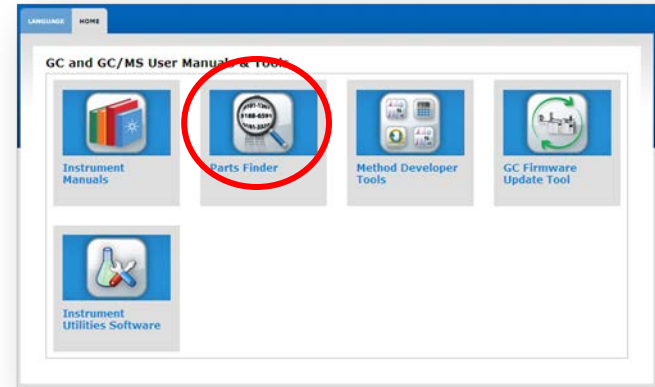
Interactive

Can access Agilent Store to place an order

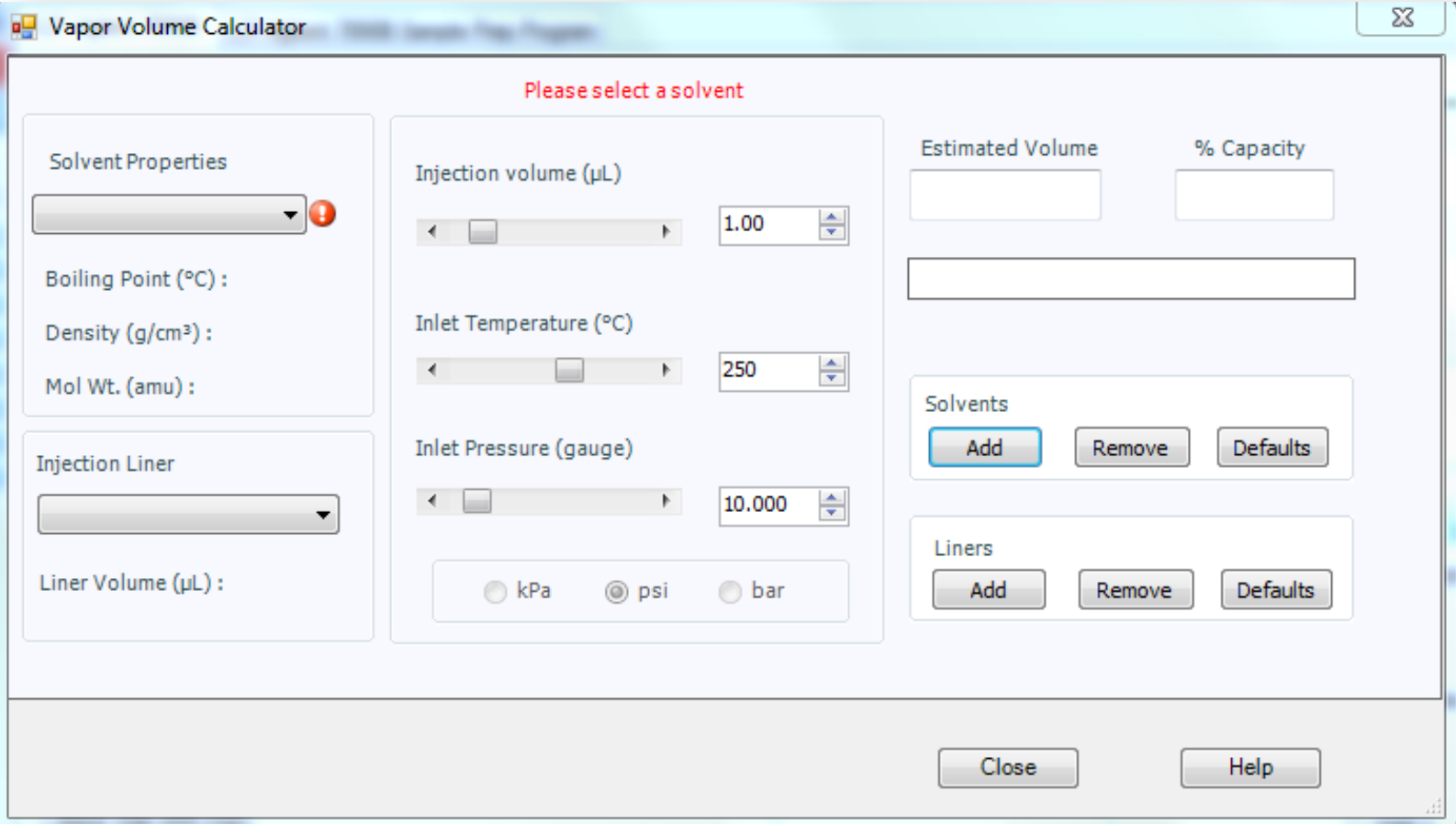
Can add to parts list

Can add parts to favorite folder

Component breakdown by areas



Method Developer Tools – The Vapor Volume Calculator from OpenLAB C01.05



Method Developer Tools – The GC Method Translator from OpenLAB C01.05

Agilent Technologies Method Translator

Speed gain
 1.7872
 Translate
 Best Efficiency

Original Method Parameters

Gas: He

Leng: 30 m

Inner Diamete: 320 µm

Film Thicknes: 0.25 µm

Phase: 320

Inlet Pressure (psi): 7.4311

Outlet Flow (mL/min): 1.5958

Average Velocity (cm/sec): 27

Outlet Pressure (psi): 14.696

Holdup (min): 1.8519

Outlet Velocity (cm/s): 34.178

Pressure Units: PSI

Original Column Capacity: 2.48

Calculated Method Parameters

Gas: H2

Leng: 30 m

Inner Diamete: 320 µm

Film Thicknes: 0.25 µm

Phase: 320

Inlet Pressure (psi): 6

Outlet Flow (mL/min): 2.7304

Average Velocity (cm/sec): 48.255

Outlet Pressure (psi): 14.696

Holdup (min): 1.0362

Outlet Velocity (cm/s): 58.48

Translated Column Capacity: 2.48

The column capacity of the translated method is 60% of the original column capacity. You may need to adjust your injection volume.

#	Ramp Rate (°C/min)	Final Temp (°C)	Final Time (min)
Init		35	0

#	Ramp Rate (°C/min)	Final Temp (°C)	Final Time (min)
Init		35	0

Total Run Time

Instrument Utilities – Configure

Agilent Instrument Utilities - Configuration

Configure

- Users
- Access Rights
- Instruments
- Alerts
- Licenses
- Network
- Software

Agilent Instrument Utilities

- Lab Logbook

Help

- Configuring instruments
- Available Instruments
- My Instruments

Tasks

- To start monitoring an instrument
- To stop monitoring an instrument
- To add an instrument to monitor
- To remove an instrument
- To edit instrument attributes

Useful Links

Configure Instruments

My Instruments Available Instruments

Model	Serial	Name	Address	Active
Agilent 7890	CN10729099	Unnamed Agilent 7890 [CN10729099]	192.168.254.29	

[Print List](#) [Remove from My Instruments](#)

Current Selection

Name: Unnamed Agilent 7890 [CN10729099] NetworkAddress: 192.168.254.29 Do not track network address changes

Description: Agilent 7890 [CN10729099] originally found at 192.168.254.29

Contact: Training Automatically restart monitoring

[Start Monitoring](#) [Save Changes](#)

Your installation is currently licensed for 1 monitored instrument(s)

Instrument Utilities – Tests

Agilent Instrument Utilities

Current User: Training-PC\Training [Administrator]
Current Instrument: Unnamed Agilent 7890 [CN10729099]

Version B.1.08.13009.0328

Tests

Module View

- Inlet: Purged Pack
Position: Front
- Inlet: Split/Splitless**
Position: Back
- Detector: FID
Position: Front

Tests

Test:

- Back Split Splitless Inlet 7890 Vent Restriction Test
- Back Split Splitless Inlet 7890 Leak Check**
- Back Split Splitless Inlet 7890 Pressure Decay Test

Name: Back Split Splitless Inlet 7890 Leak Check

Approx. Time: 5 min

Description:

Agilent Instrument Utilities

Diagnostic Results

Stop Test
Print Results

Help

- S/S inlet prep run leak check
- About Test Automation

Tasks

- To troubleshoot a test failure

To Improve Test Results

- Leak Check Tips
- To Check for GC Leaks
- To Check for External Leaks
- S/S inlet pressure decay test
- To Install a Capillary Column
- To Change the Septum
- To Change the Liner and O-Ring

General

Test Name: Back Split Splitless Inlet 7890 Leak Check
Description: Use the Split/Splitless Leak Check to quickly test for leaks in the inlet after performing maintenance or if a gross leak is suspected. It provides a fast result and requires no disassembly. It is not as definitive as the pressure decay test.

Approx. Time: 5 min
Status: **Running**

Test Procedure

- Inspect the GC configuration
- Establishing control of the selected GC
- Downloading Leak Check method to selected GC
- Entering Prep Run state
- System will attempt to establish pneumatic conditions
- Restoring original method and disconnecting from GC

Category	Source	Time	Message
	Back Split Splitless Inlet 7890 Leak Check	1/17/2013 12:14:07 PM	Back Split Splitless Inlet 7890 Leak Check started on Unnamed Agilent 7890 [CN10729099] by Training-PC\Training
	Back Split Splitless Inlet 7890 Leak Check	1/17/2013 12:14:07 PM	Inspect the instrument configuration to ensure it meets the selected test requirements.
	Back Split Splitless Inlet 7890 Leak Check	1/17/2013 12:14:09 PM	Establishing control of Unnamed Agilent 7890 [CN10729099]

Inlet Prep Run Leak Check

Use the prep run leak check to look for leaks while tightening fittings and as a before/after test when performing maintenance.

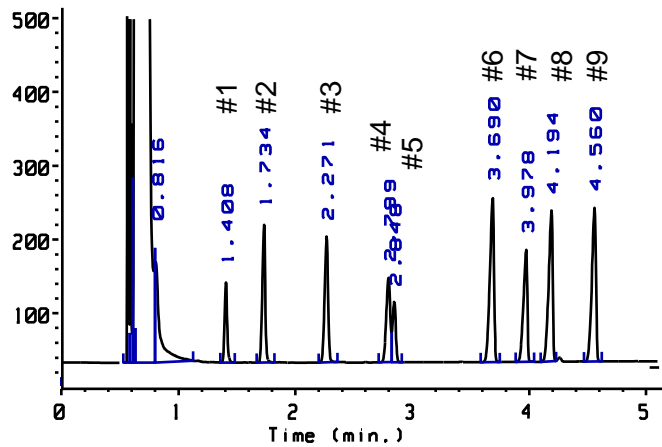
Preparation

You must close any open data system session for this instrument before starting the test.

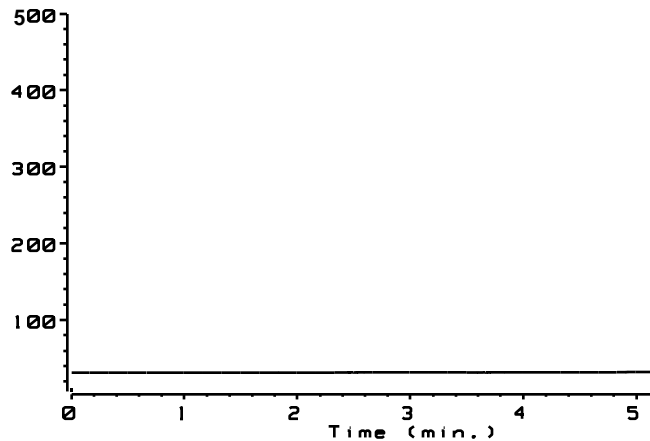
Run Test Now

Problem Chromatogram

Typical Chromatogram



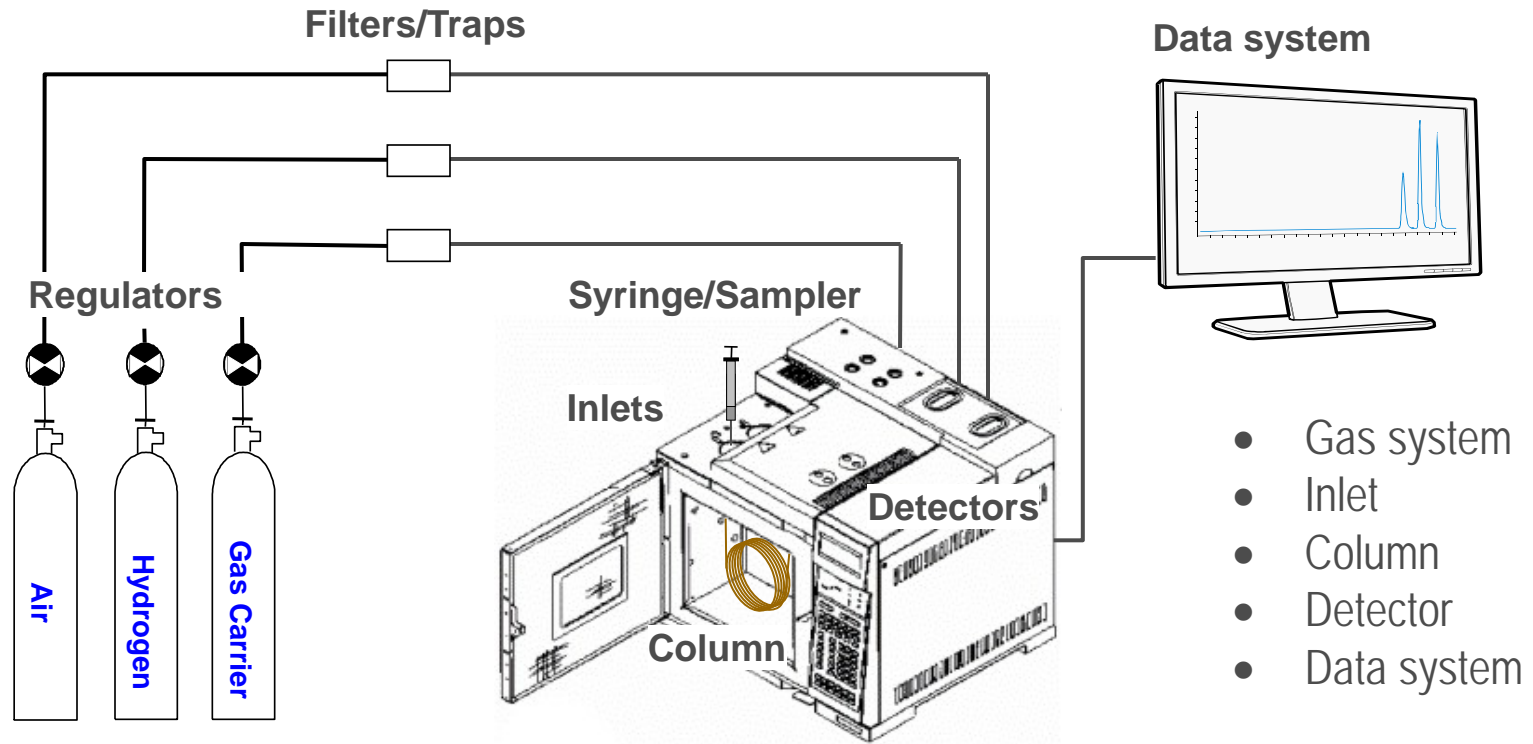
Problem Chromatogram



Peak No.	Peak Width	Area	Type
#1	0.023	1639	BB
#2	0.027	3291	BB
#3	0.032	3522	BB
#4	0.037	2750	BV
#5	0.03	1590	VB
#6	0.037	5473	BB
#7	0.034	3465	BB
#8	0.037	4932	BV
#9	0.036	5020	BB



Isolate the Problem to a Functional Area



Know the purpose and function of the major component areas.

Functional Areas

Flow

- improper supply pressures
- leaks

Chemical

- contaminated or “aged” samples/standards
- contaminated supply gases/traps
- contaminated inlet, column, detector

Electrical

- cable connections

Mechanical

- auto sampler syringe condition or installation
- vial fill level and sampling depth settings

Operational

- incorrect method loaded
- method parameters modified but not saved

Solve the Problem

Fix the problem.

Verify the fix.

Document fix.

Add to PM schedule if consumable solve problem.

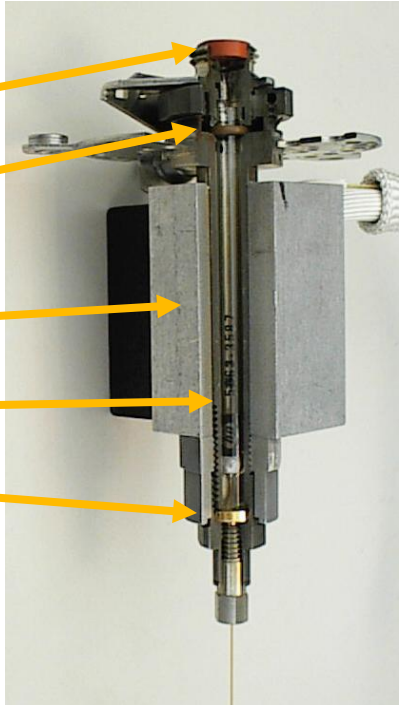
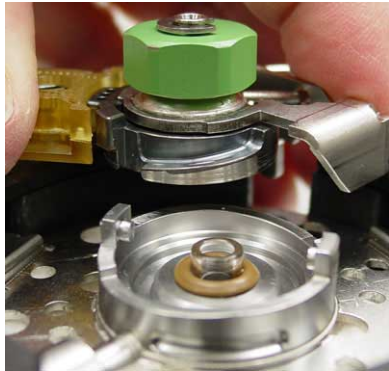
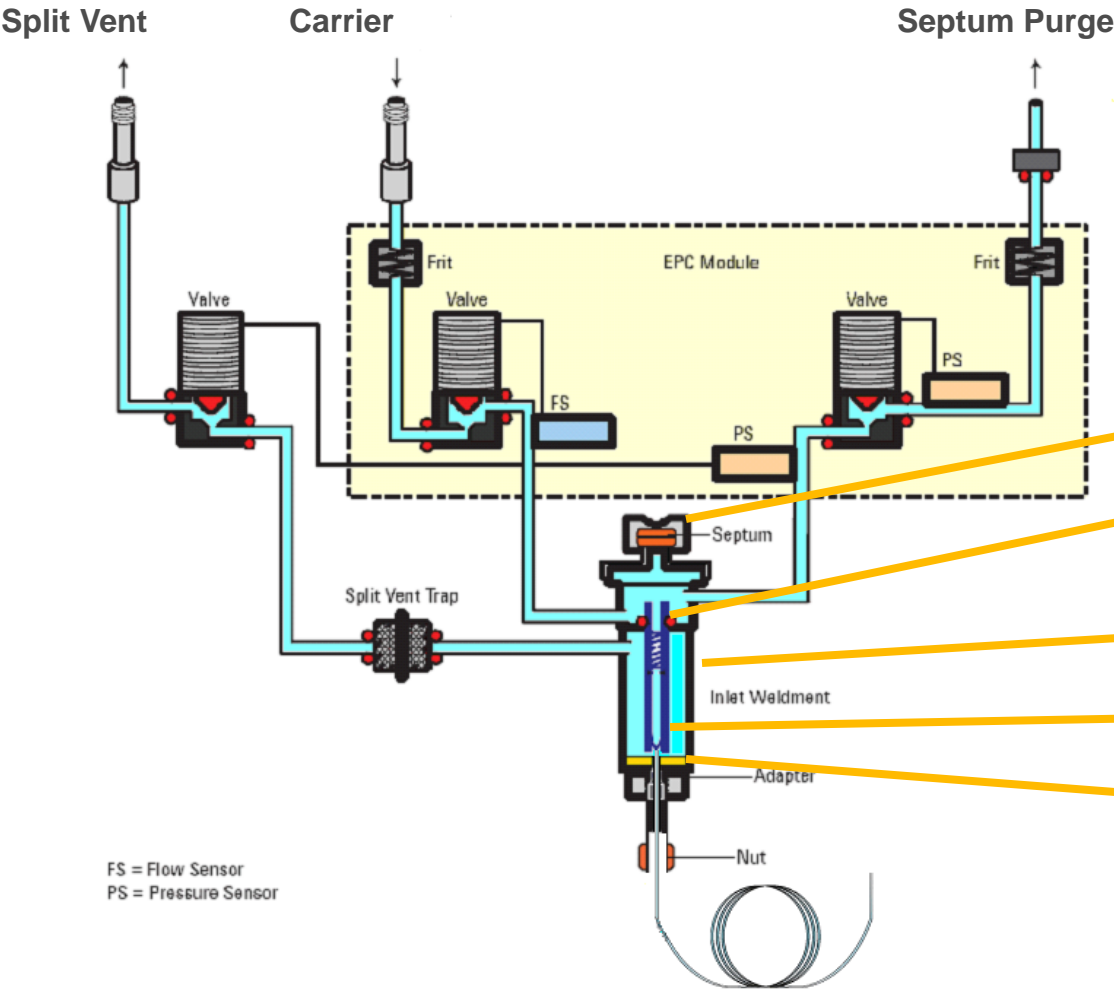
Do not forget

- **Reset counters or EMF**
 - Open Lab ChemStation
 - 7890B or 7890A Keypad
 - Instrument Utilities
- **Schedule maintenance.**

SSI Injection Modes

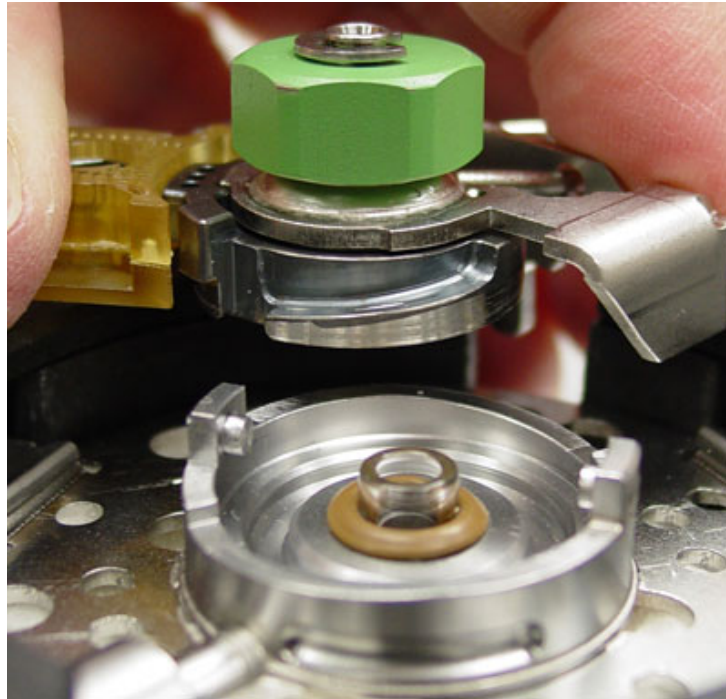
Injection Mode	Purpose
Split	Major component analysis.
Pulsed-split	Allows larger injection volume without liner overload and faster transfer to column.
Splitless	Trace component analysis.
Pulsed-splitless	Larger injection volume without liner overload and faster transfer to column.

Agilent 7890 Split/Splitless Inlet

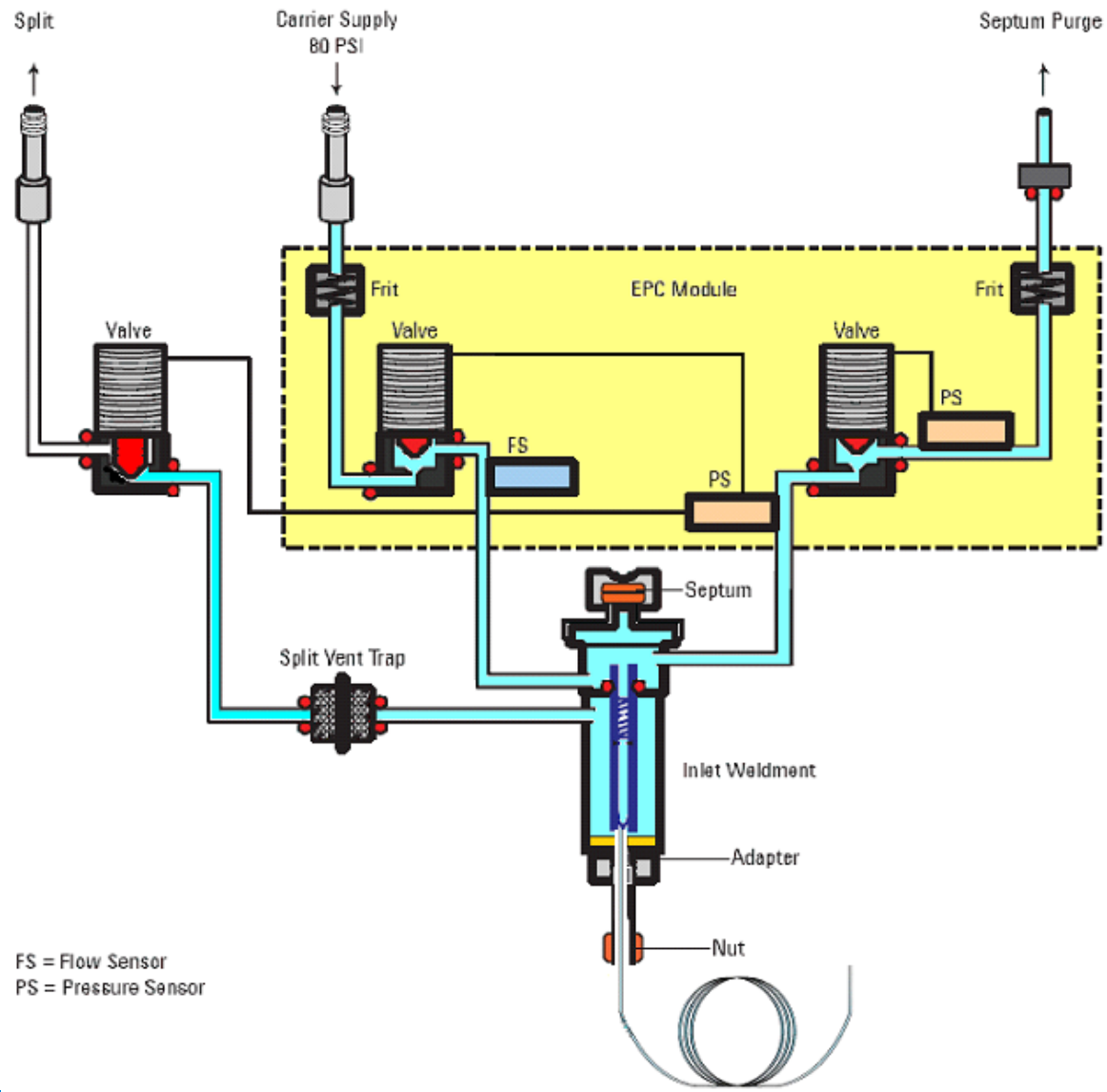


SSI Splitless Mode

- Trace analysis
- Nearly all of the analytes and solvent enter the column.

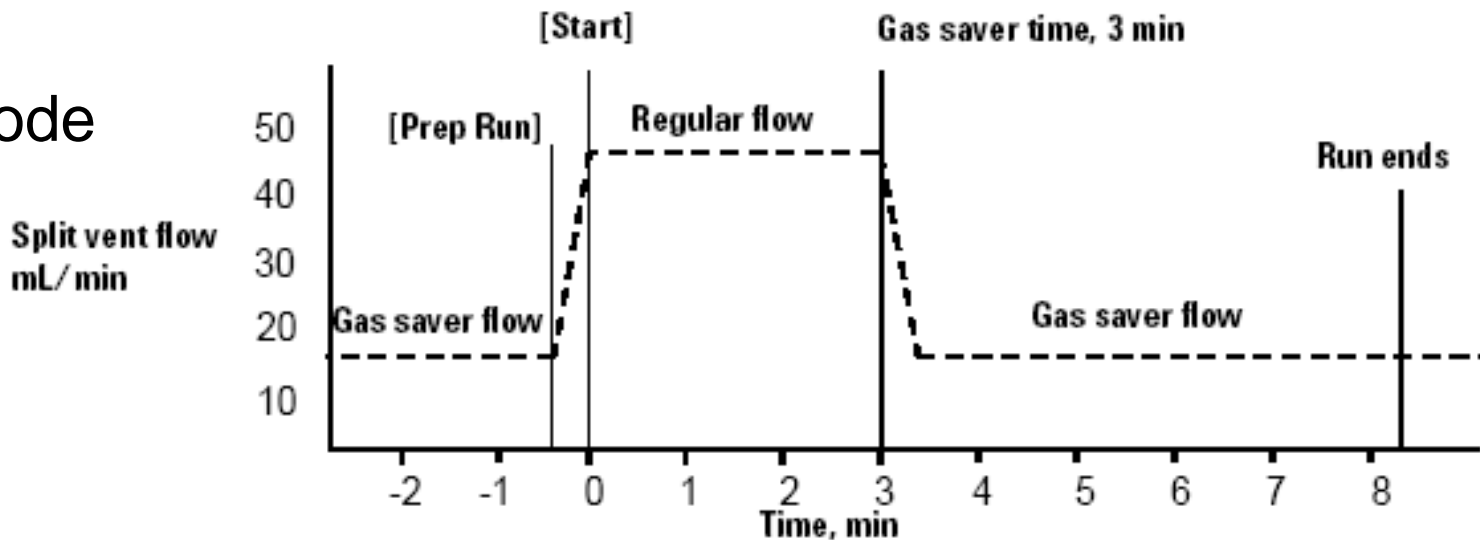


SSI Splitless Mode Flow Diagram

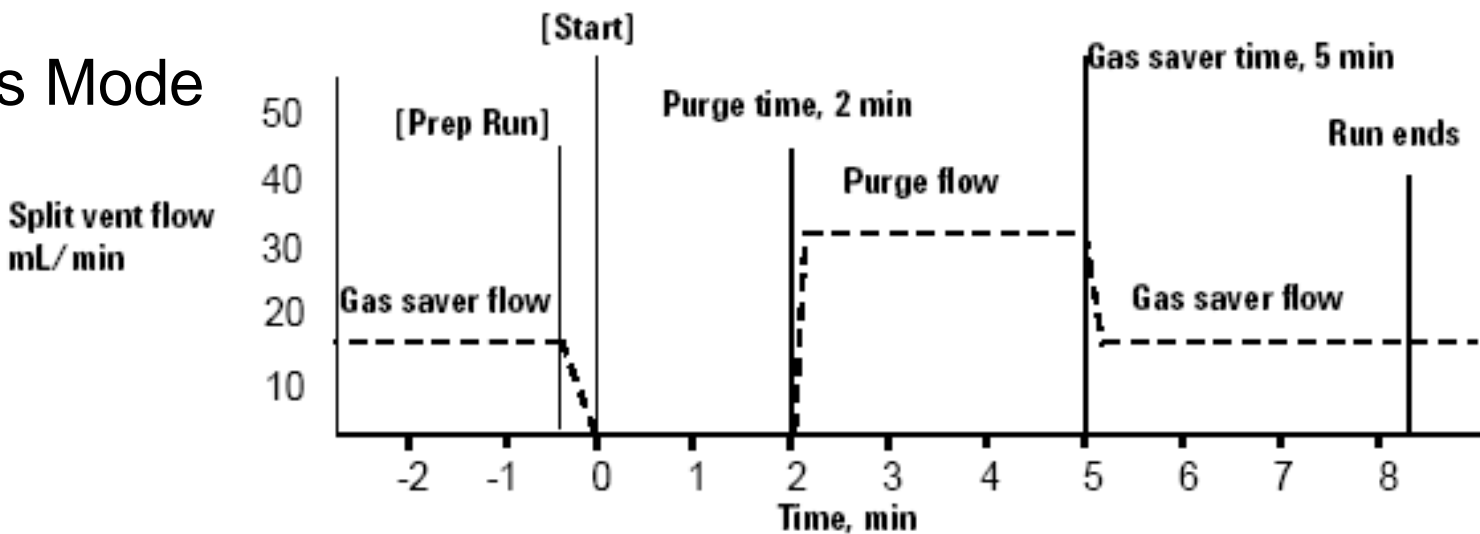


Gas Saver

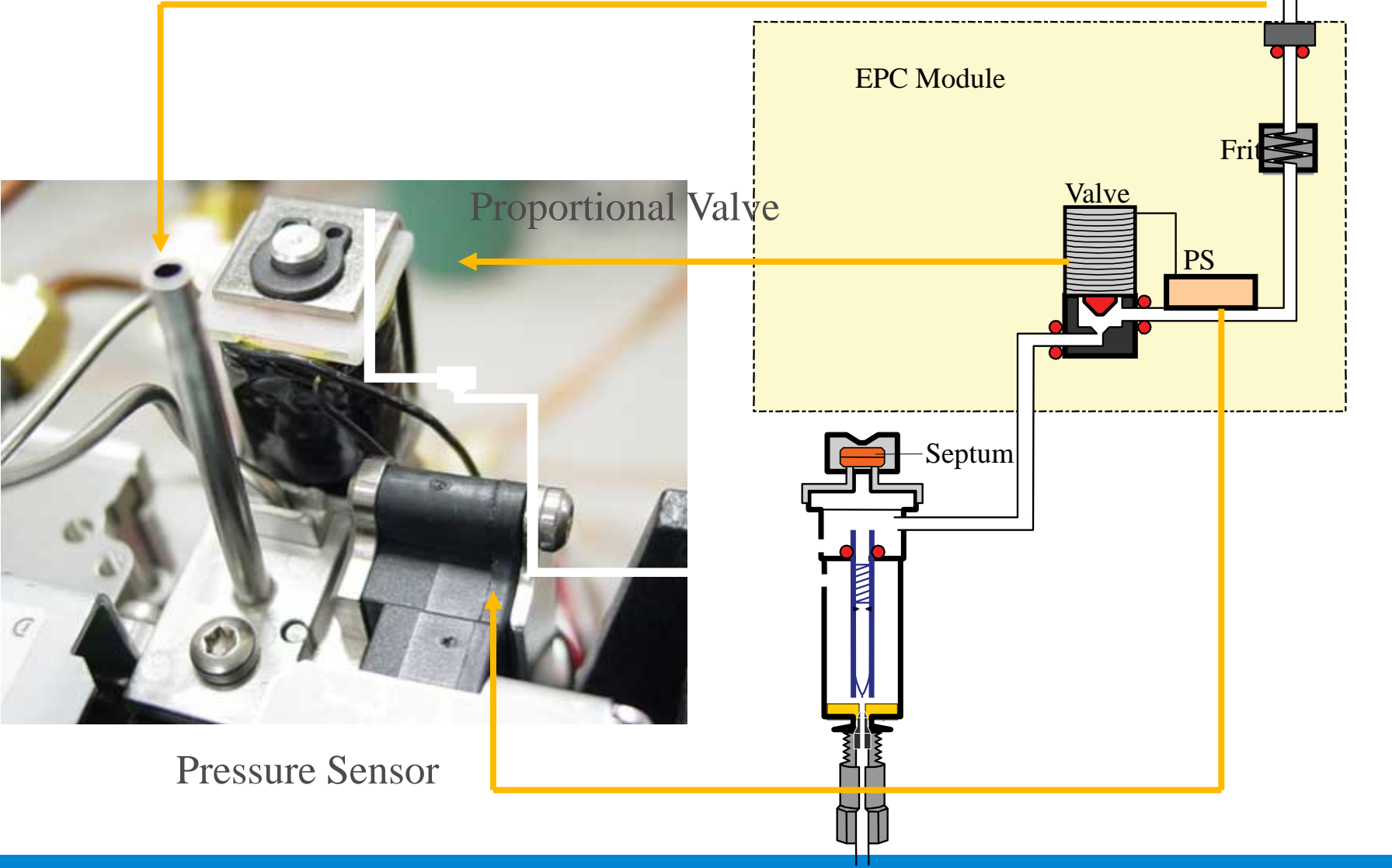
Split Mode



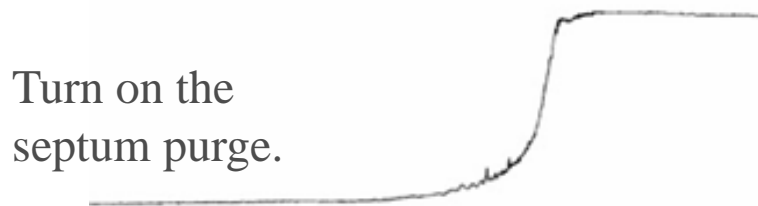
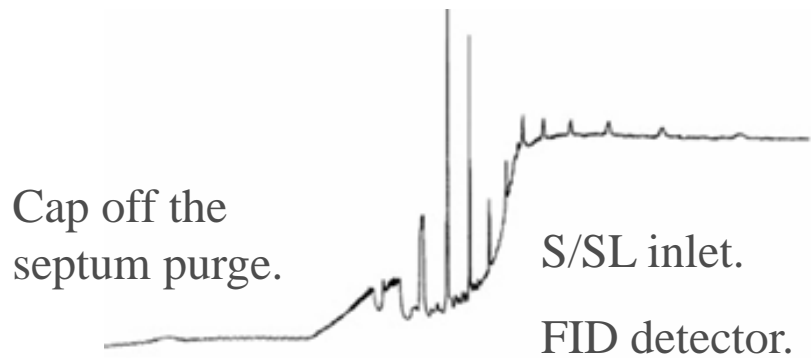
Splitless Mode



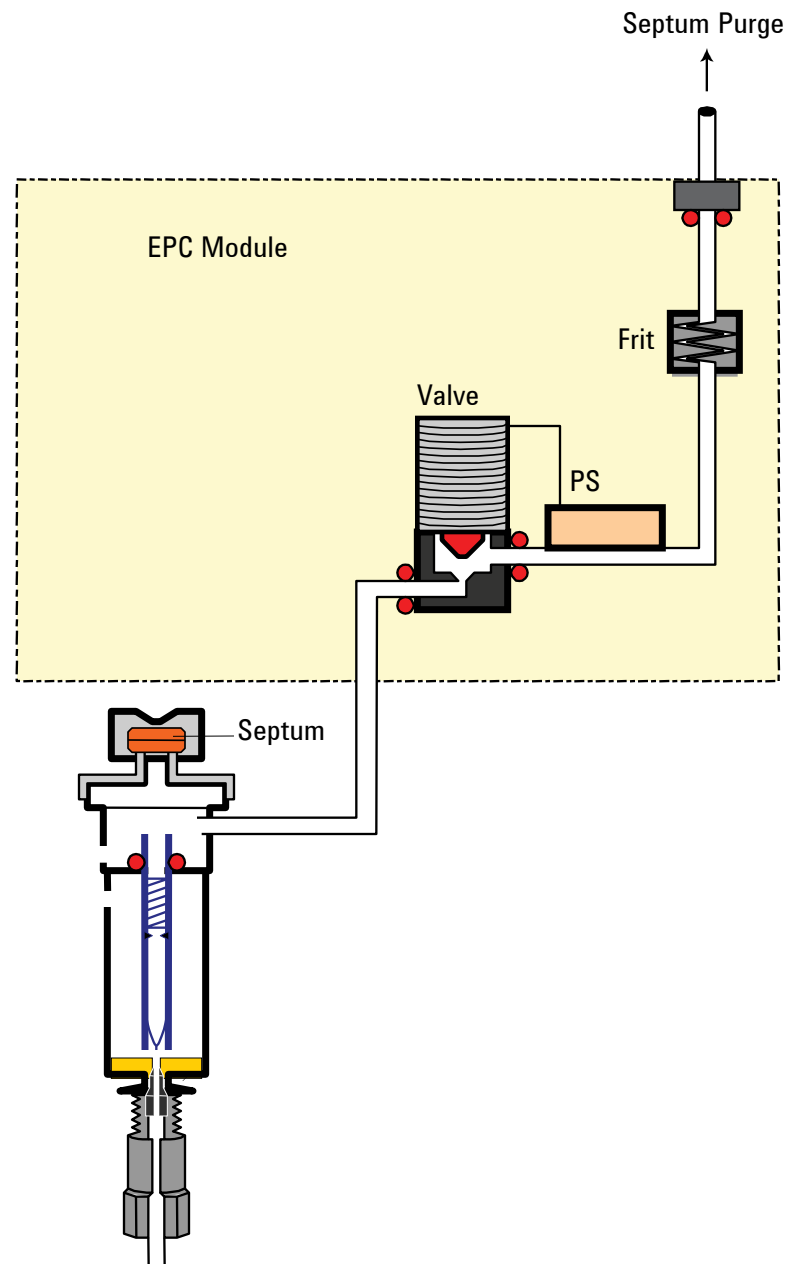
Variable Septum Purge



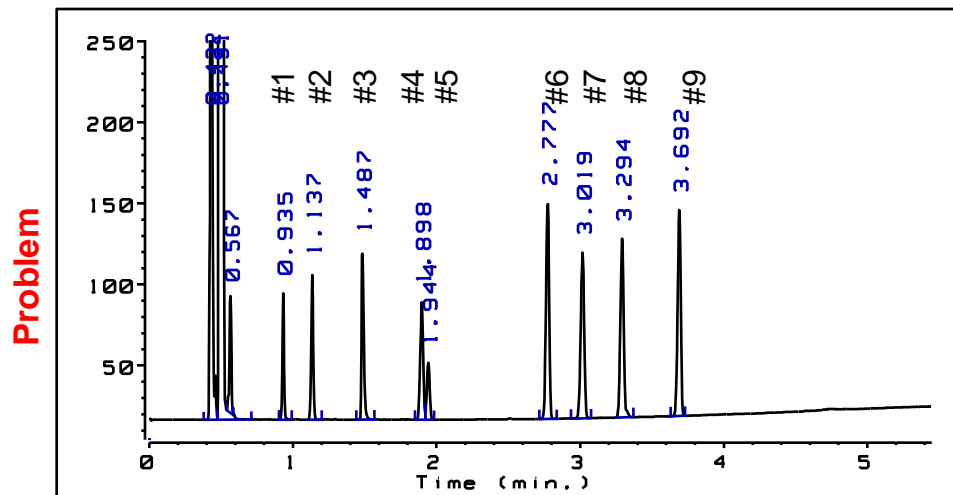
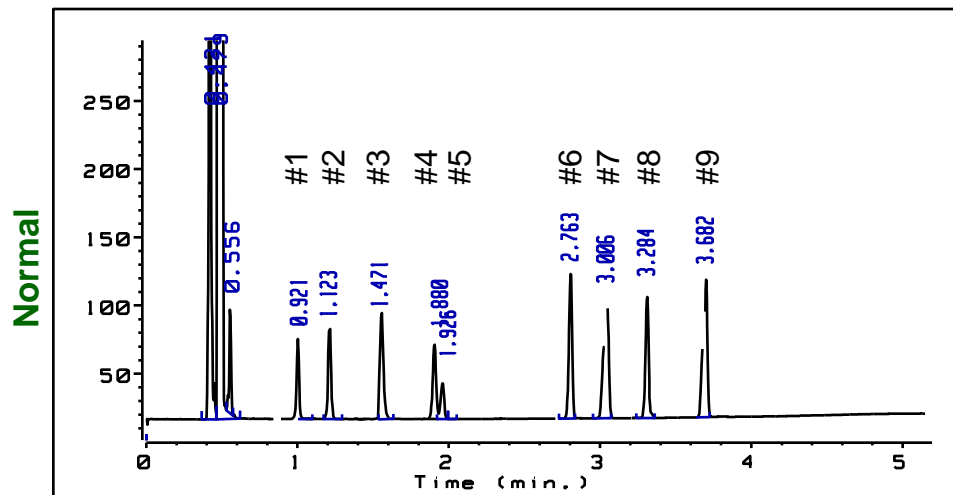
Effects of Septum Purging



Septum purge prevents septa volatiles from getting into the column.
Used in four inlets: SSL, PP, COC,
and PTV.



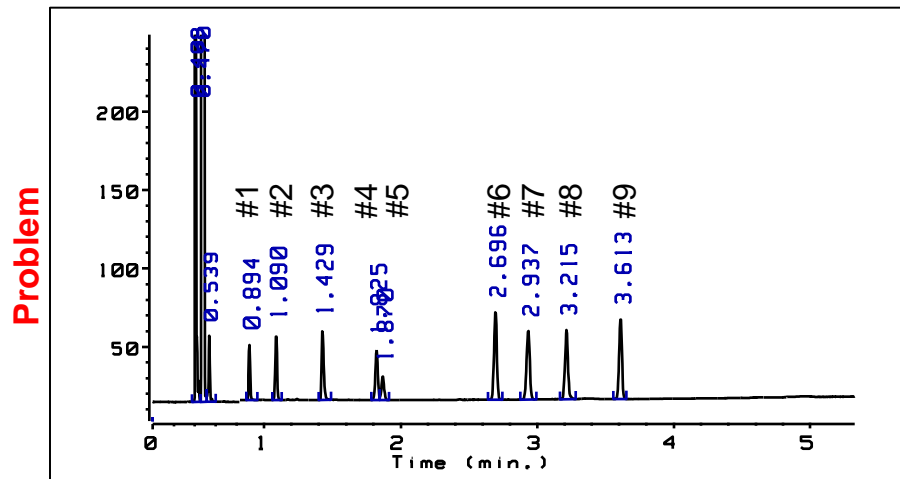
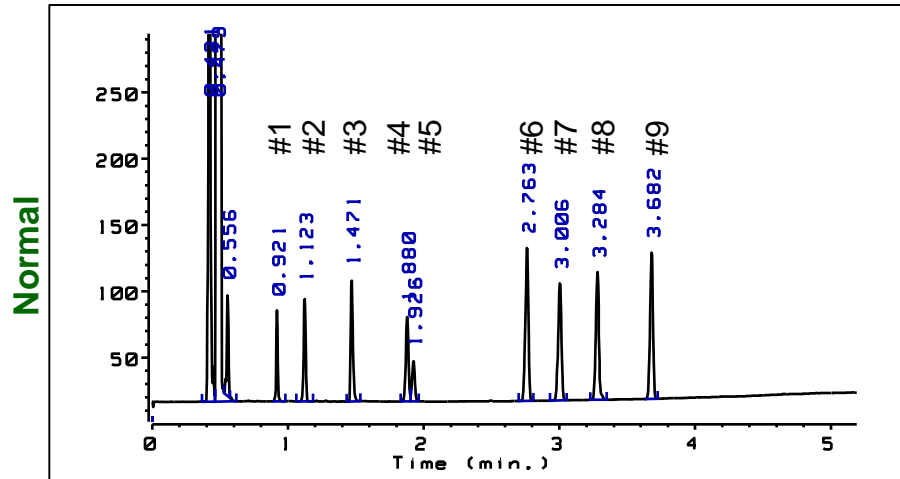
SSI Problem #1



Peak No.	Before Peak Width	After Peak Width	Before Area	After Area	Type
#1	0.024	0.025	780	1099	BB
#2	0.024	0.026	1310	1630	BB
#3	0.018	0.035	1820	2140	BB
#4	0.022	0.022	1390	1899	BV
#5	0.022	0.022	705	889	VB
#6	0.025	0.024	2890	3680	BB
#7	0.027	0.027	2420	3088	BB
#8	0.025	0.025	2430	3092	BB
#9	0.024	0.024	2615	3256	BB

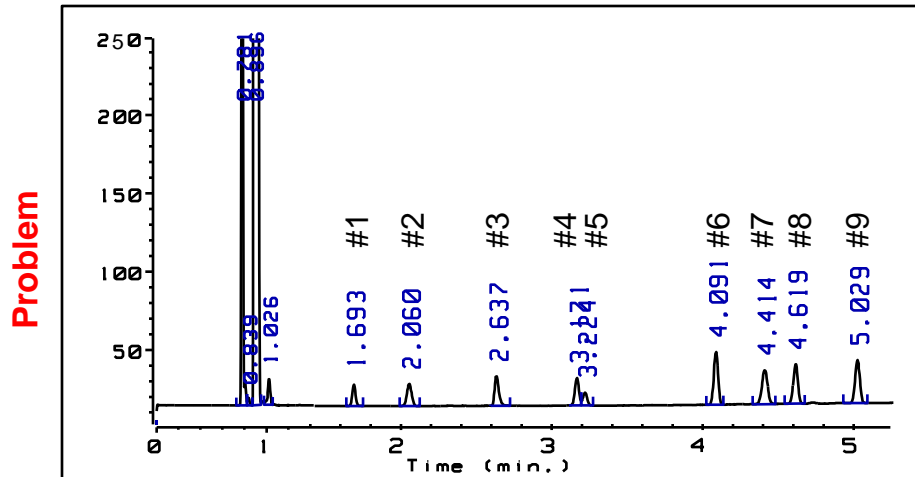
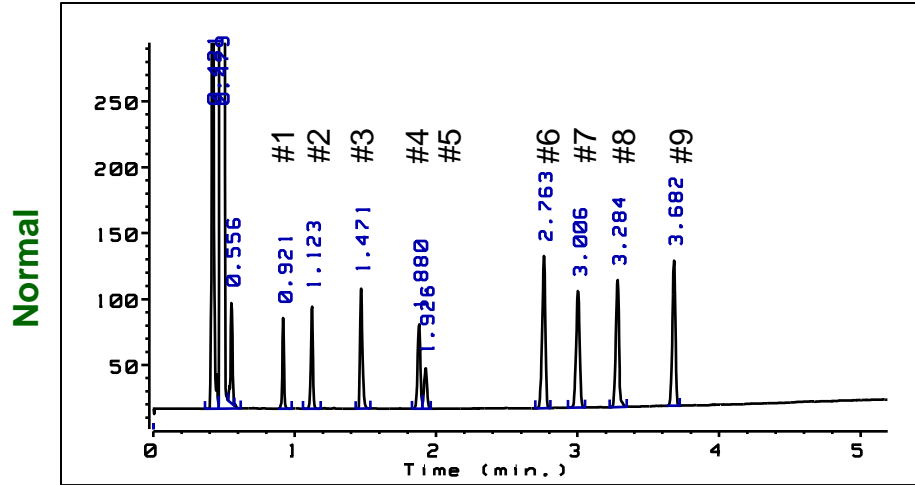
- Manual split injection
- Narrow-bore capillary column
- FID.

SSI Problem #2 – Which Flow Was Adjusted?



Peak No.	Before Peak Width	After Peak Width	Before Area	After Area	Type
#1	0.024	0.023	530	242	BB
#2	0.024	0.023	804	371	BB
#3	0.018	0.017	1068	453	BB
#4	0.022	0.021	909	400	BV
#5	0.022	0.021	435	195	VB
#6	0.025	0.023	1826	790	BB
#7	0.027	0.026	1535	698	BB
#8	0.025	0.024	1538	657	BB
#9	0.024	0.023	1687	713	BB

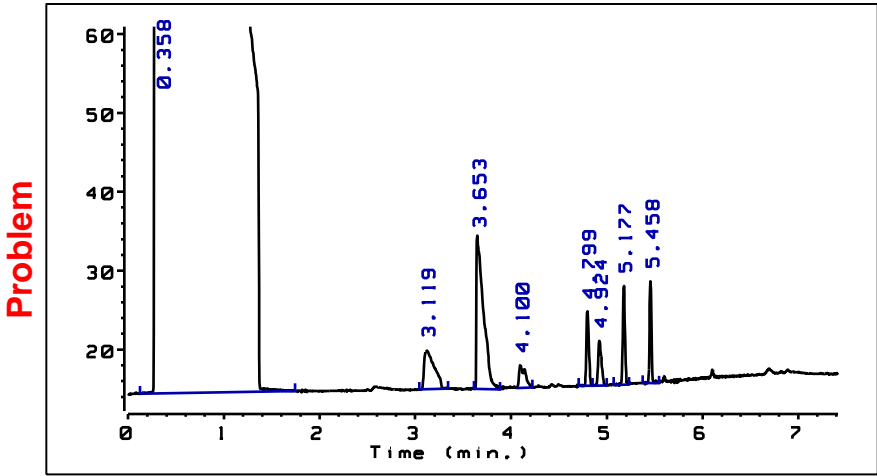
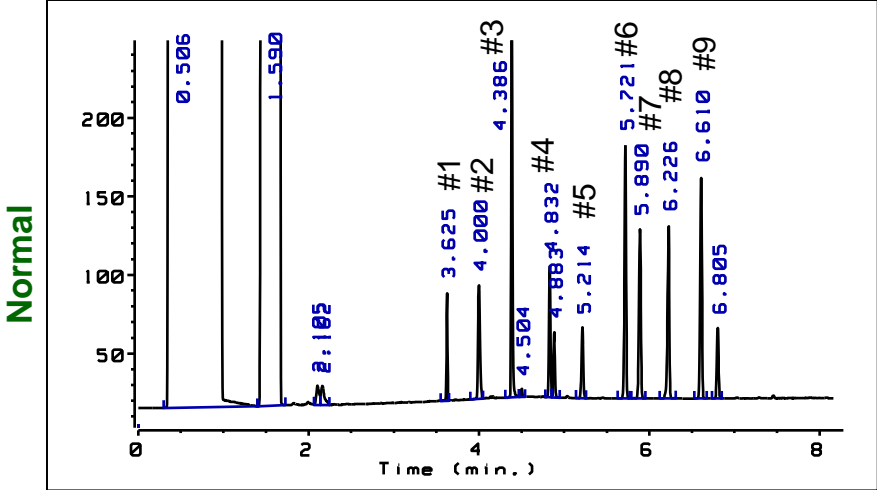
SSI Problem #3 – Which Flow Was Adjusted?



Peak No.	Before Peak Width	After Peak Width	Before Area	After Area	Type
#1	0.024		530		BB
#2	0.024		804		BB
#3	0.018	0.031	1068	332	BB
#4	0.022	0.028	909	238	BV
#5	0.022		435		VB
#6	0.025	0.031	1826	585	BB
#7	0.027	0.040	1535	505	BB
#8	0.025	0.033	1538	465	BB
#9	0.024	0.034	1687	531	BB



SSI Problem #4



Peak No.	Peak Width	Area	Type
#1	0.021	551	BV
#2	0.026	1214	BB
#3	0.018	2521	BV
#4	0.020	1037	BV
#5	0.019	511	VB
#6	0.022	2253	BB
#7	0.025	1737	BB
#8	0.024	1703	BB
#9	0.023	2104	BB

SSI Septa and Merlin Microseal



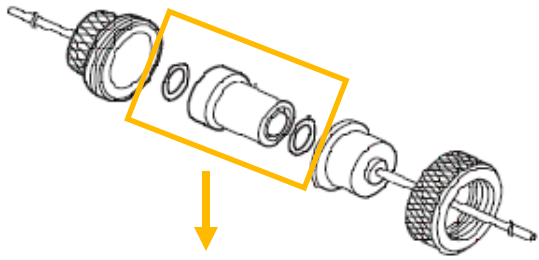
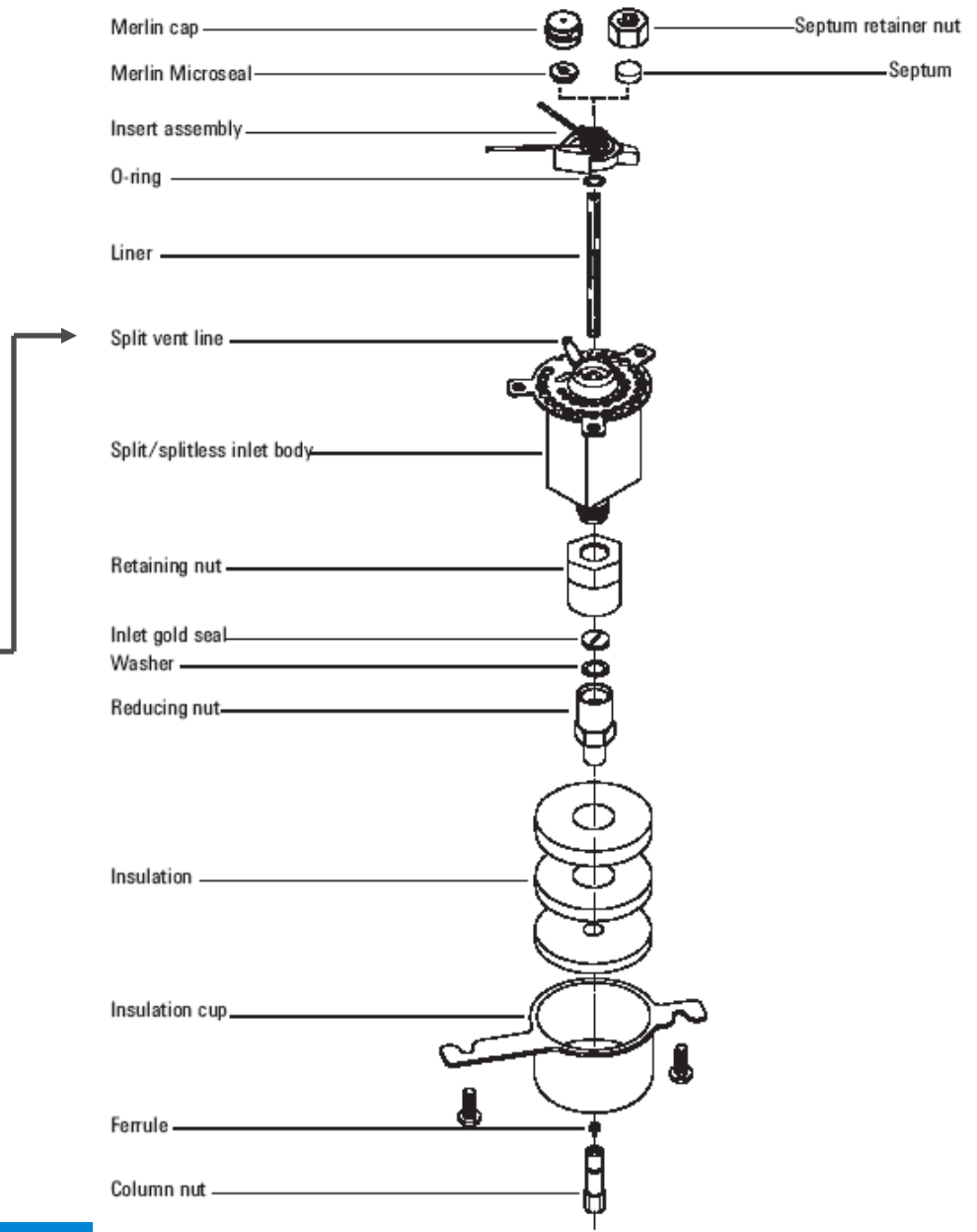
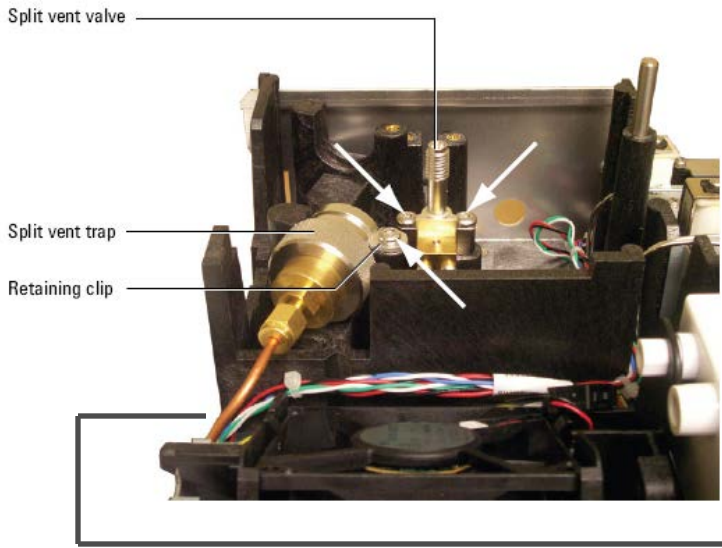
- High Temp Analysis.
- Low Bleed.
- Lower Coring.
- Packaged in glass to maintain purity.
- 11-mm diameter.



- Longer life alternative.
- Duckbill design.
- Inlet pressures: 3-100 psi.
- Inlet temperatures: 100-300°C.

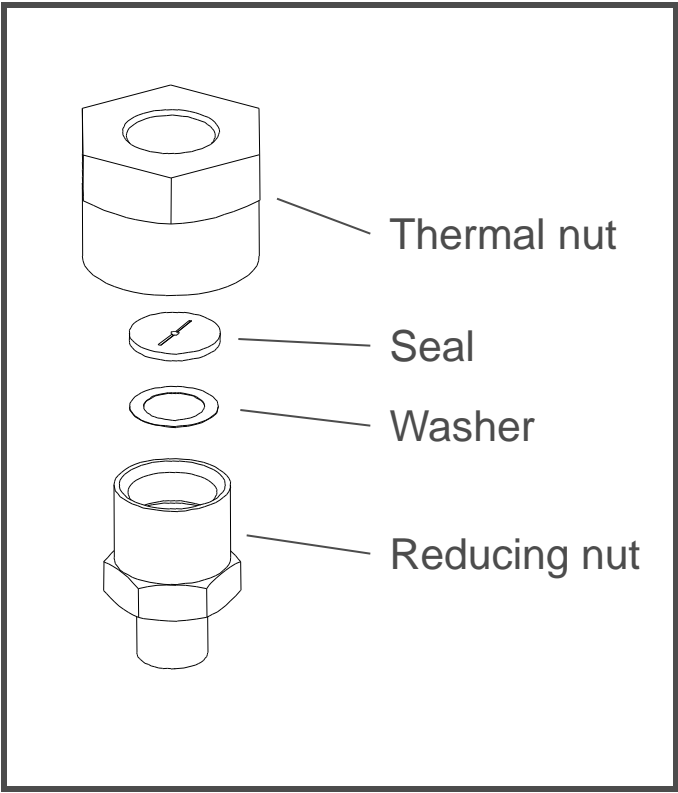
Merlin microseal requires 23 gauge syringe needle tapered tip.

SSI Assembly

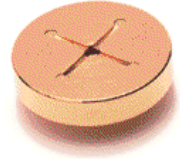


**Replacement Filter
Cartridge Kit
P/N G1544-80530**

SSI Seals



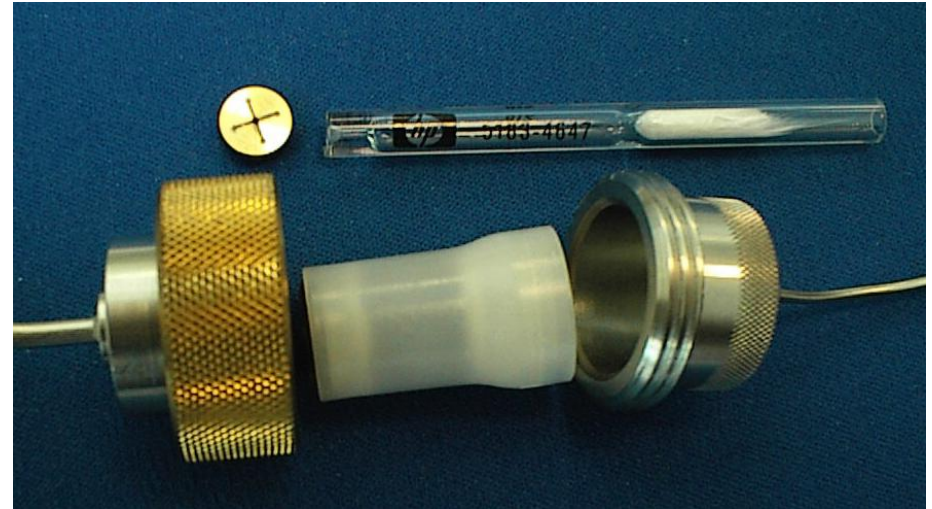
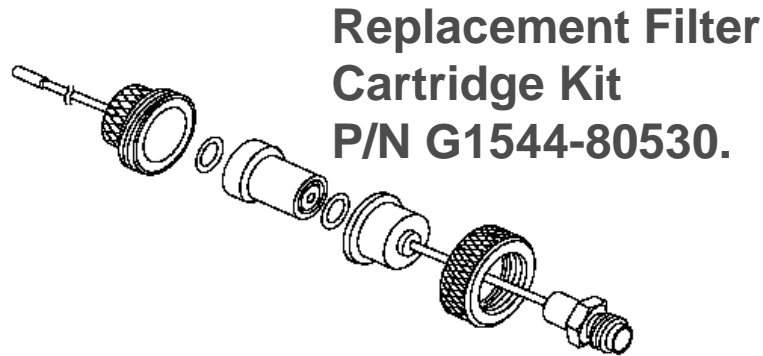
Gold seal (original)



Gold seal (cross)

18740-20885	Gold-plated seal
5182-9652	Gold-plated (cross) seal
18740-20880	Stainless steel seal
5061 - 5869	Washer

Agilent 7890 – Split/Splitless Capillary Inlet



GLASS POSITIONING BEAD







Deactivated Split Liner
P/N 5183-4647













High Split Flow Gold Seal.
P/N 5182-9652 - Use with liners that introduce restriction.

Split Liner

Liner	Description	Volume	Mode	Deactivated	Part Number
	Low Pressure Drop – Positioning Bead	870 µL	Split – Fast Injection	Yes	5183-4647
	4mm ID, Glass Wool	990 µL	Split – Fast Injection	No	19251-60540
	Empty Pin & Cup	800 µL	Split – Manual Only	No	18740-80190
	Packed Pin & Cup	800 µL	Split – Manual Only	No	18740-60840

Splitless Liner

Liner	Description	Volume	Mode	Deactivated	Part Number
	Single Taper Glass Wool	900 uL	Splitless	Yes	5062-3587
	Single Taper	900 uL	Splitless	Yes	5181-3316
	Dual Taper	800 uL	Splitless	Yes	5181-3315
	2 mm Quartz	250 uL	Splitless	No	18740-80220
	2 mm Quartz	250 uL	Splitless	Yes	5181-8818
	1.5 mm	140 uL	Direct Inject, Purge & Trap, Headspace	No	18740-80200
	Single Taper Glass Wool	900 uL	Splitless	Yes	5062-3587
	Single Taper	900 uL	Splitless	Yes	5181-3316
	4 mm Single Taper	Direct column connect		Yes	G1544-80700
	4 mm Dual Taper	Direct column connect		Yes	G1544-80730

SSI Liner Volume versus Sample Volume

Solvent	Density	Mol. Wt.	Exp. Ratio
Isooctane	0.69	114	138:1
Hexane	0.66	86	174:1
Pentane	0.62	72	198:1
Ethyl acetate	0.90	88	233:1
Chloroform	1.48	119	284:1
Methylene Chloride	1.33	85	356:1
Methanol	0.79	32	563:1
Water	1.00	18	1261:1

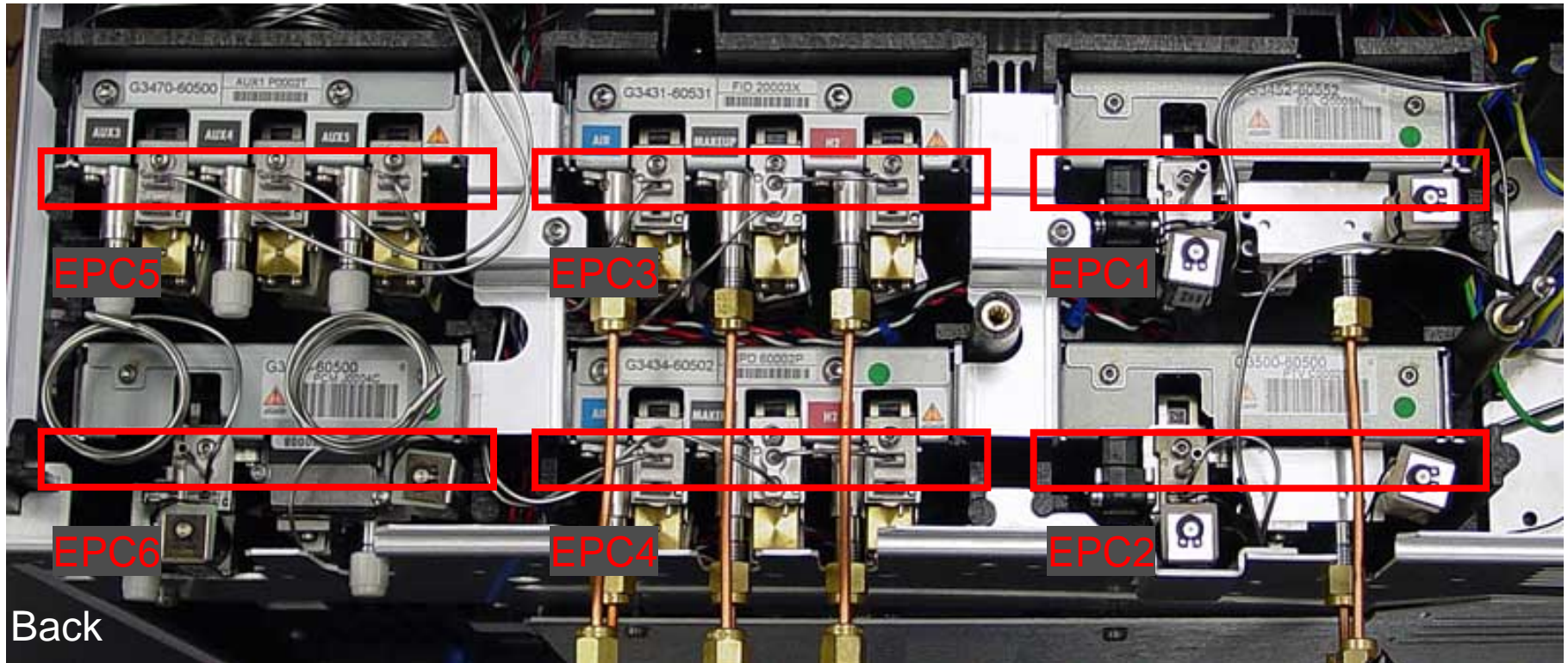
Injection temperature = 250° C.
Column head pressure = 13 psi (90 kPa).

EPC Modules

Auxiliary

Front Detector

Front Inlet



PCM

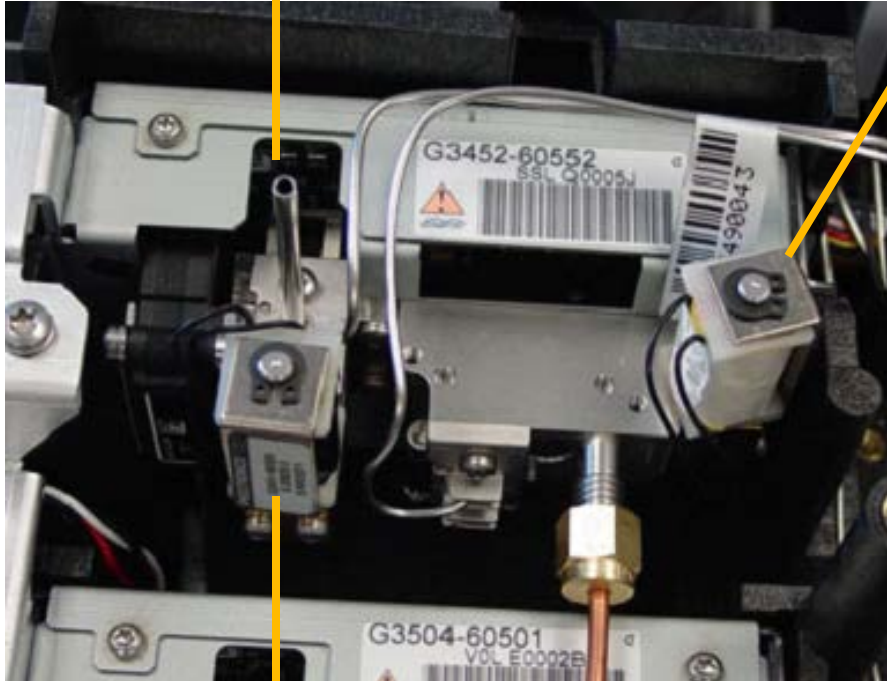
Back Detector

Back Inlet

SSI EPC Module

Septum Purge Vent

Carrier Control Valve



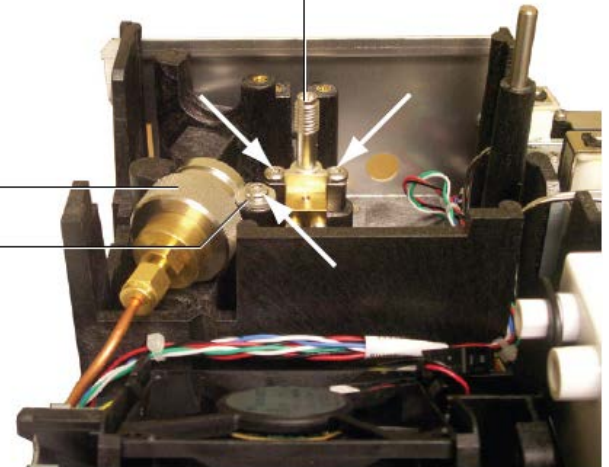
Carrier Gas Inlet

Septum Purge Valve

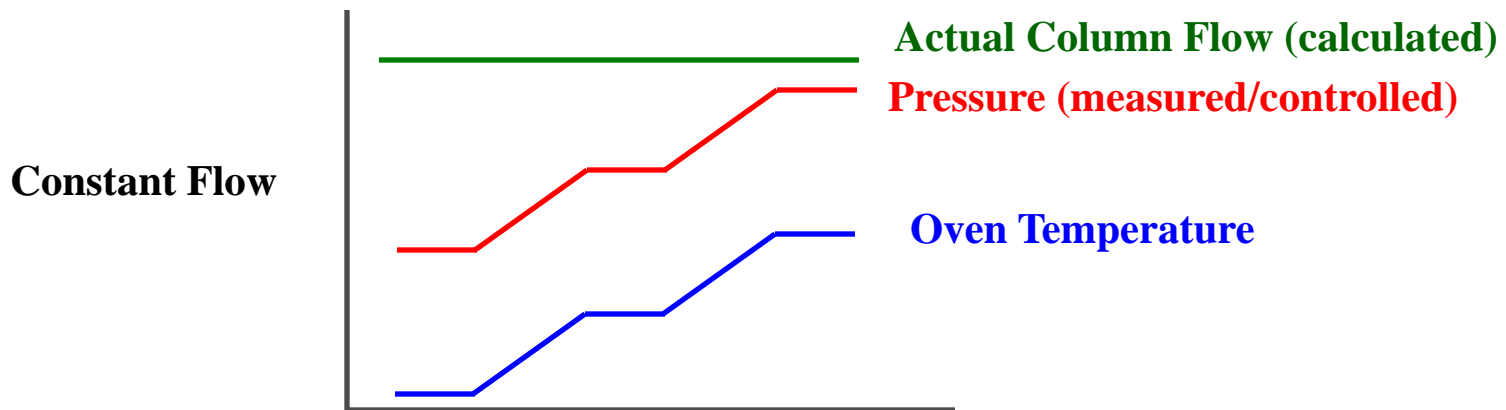
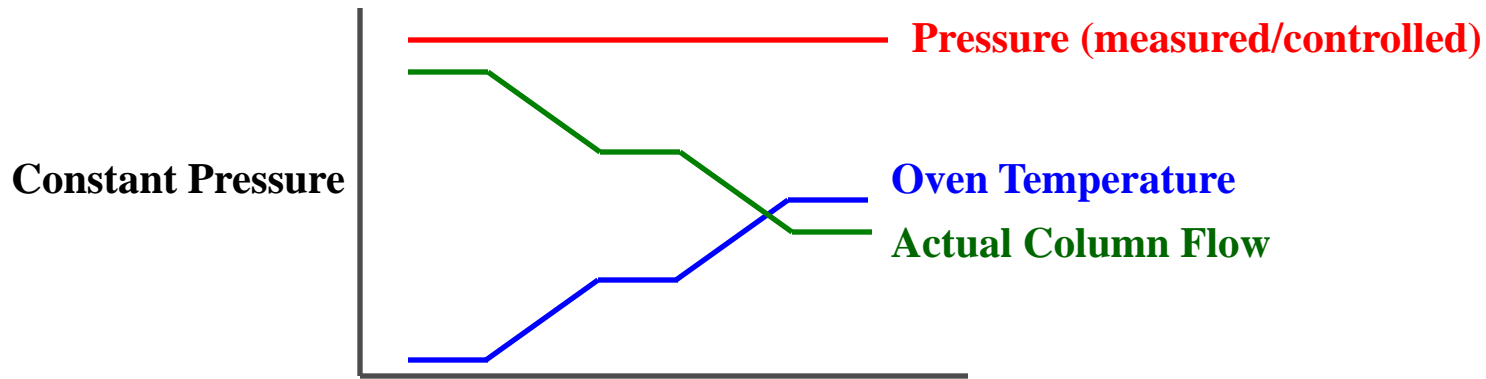
Split vent valve

Split vent trap

Retaining clip



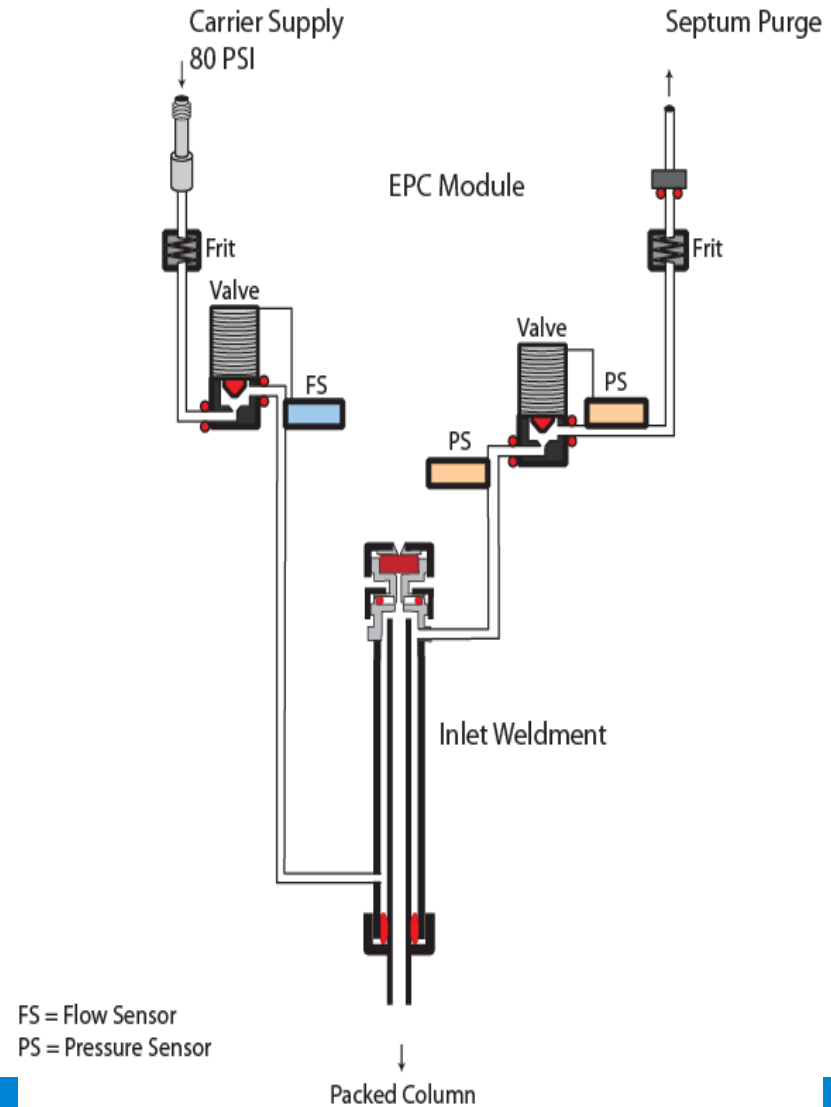
EPC Module Constant Pressure versus Constant Flow



PPI Flow-Controlled Flow Diagram

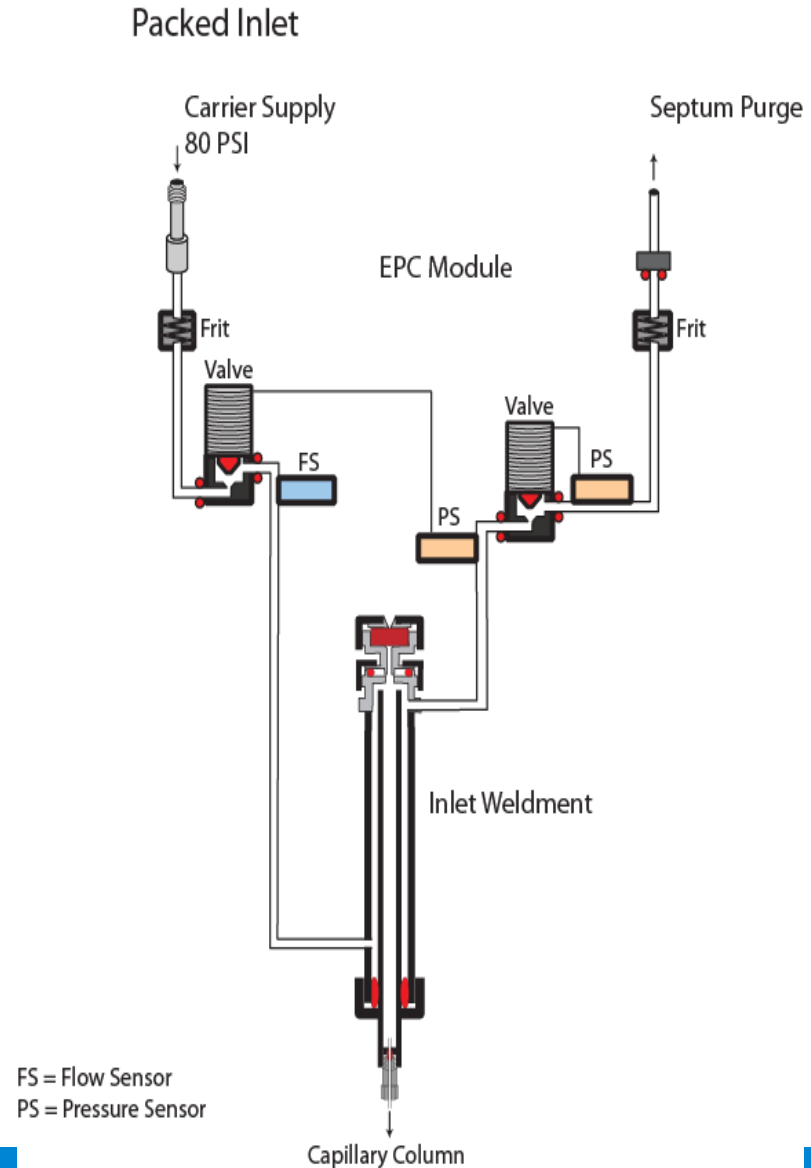
Packed Inlet

Flow-controlled mode recommended for packed columns.

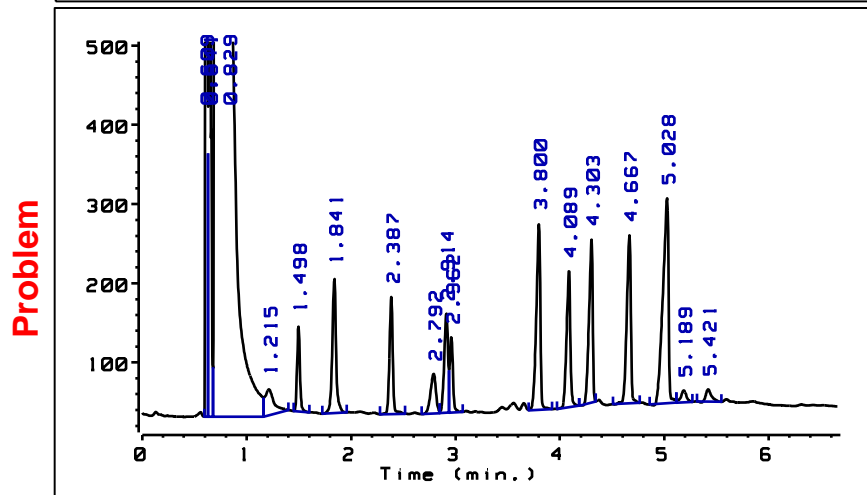
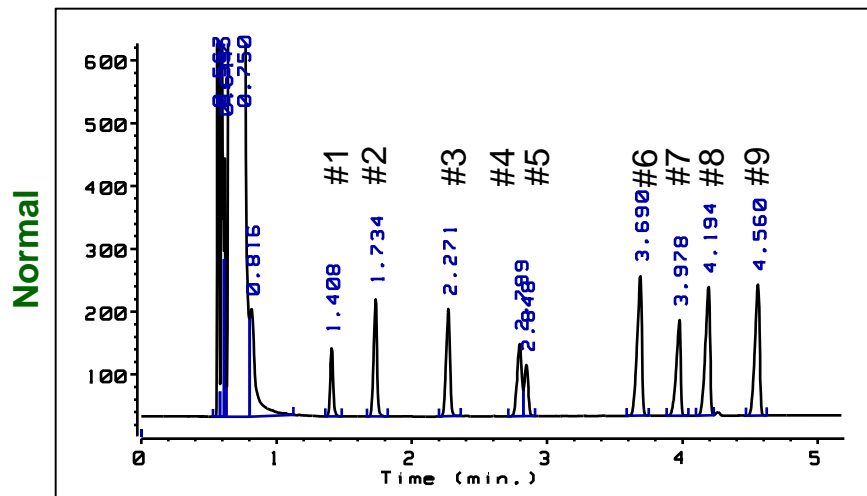


PPI Pressure-Controlled Flow Diagram

Pressure-controlled mode recommended for capillary columns.

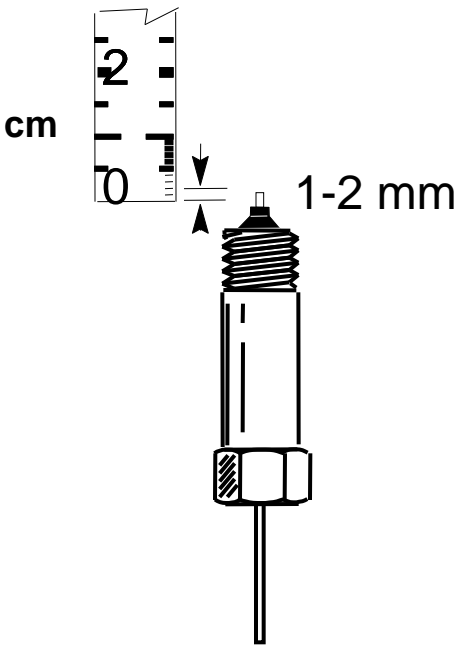
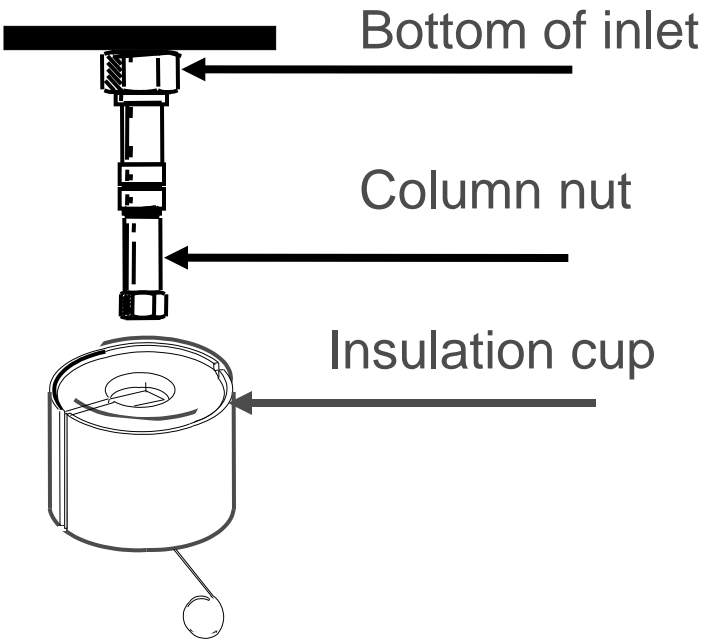


PPI Problem #1



Peak No.	Before Peak Width	After Peak Width	Before Area	After Area	Type
#1	0.023	0.029	1639	2009	BB
#2	0.027	0.039	3291	4394	BB
#3	0.032	0.035	3522	3363	BB
#4	0.037	0.040	2750	3252	BV
#5	0.03	0.033	1590	2141	VB
#6	0.037	0.039	5473	6168	BB
#7	0.034	0.040	3465	4516	BB
#8	0.037	0.039	4932	5568	BV
#9	0.036	0.044	5020	6049	BB

PPI Column Installation



Typical Injection Port Problems

- Discrimination
 - Needle
 - Inlet
- Sample decomposition
- Incorrect temperature
- Contamination
- Blockage
- Leaks
- Flashback

Detecting Leaks

- EPC “chirp” alarm and shutdown
- Electronic leak detector
- Pressure test
- Chromatographic changes
 - Retention times
 - Area counts
- Methanol

~~Soap-film leak detection fluids~~



Routine Injection Port Maintenance

- Change septum.
- Clean or replace syringe.
- Perform pressure decay or leak test and repair any leaks.
- Clean or replace liners/inserts.
- Replace O-rings.
- Clean or replace seal and washer (SSI).

Questions?

