Lost and Found: Troubleshooting Missing Peaks in GC Analysis

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Agilent
Trusted Answers

“Everything Was Just Fine... and Then This Happened!”

“How do I troubleshoot?”

Track your actions/keep a logbook of events:

- Changed column, liner, septum, or syringe
- Injected samples, or used another method
- Carried out maintenance, cut column, or inlet flush

It's Peak Season for Great Peak Shaps DE.2051937593

Logic
=
Something changed
(slowly or suddenly)
=
Something is different

Logical Troubleshooting

Troubleshooting starts with isolating the problem.

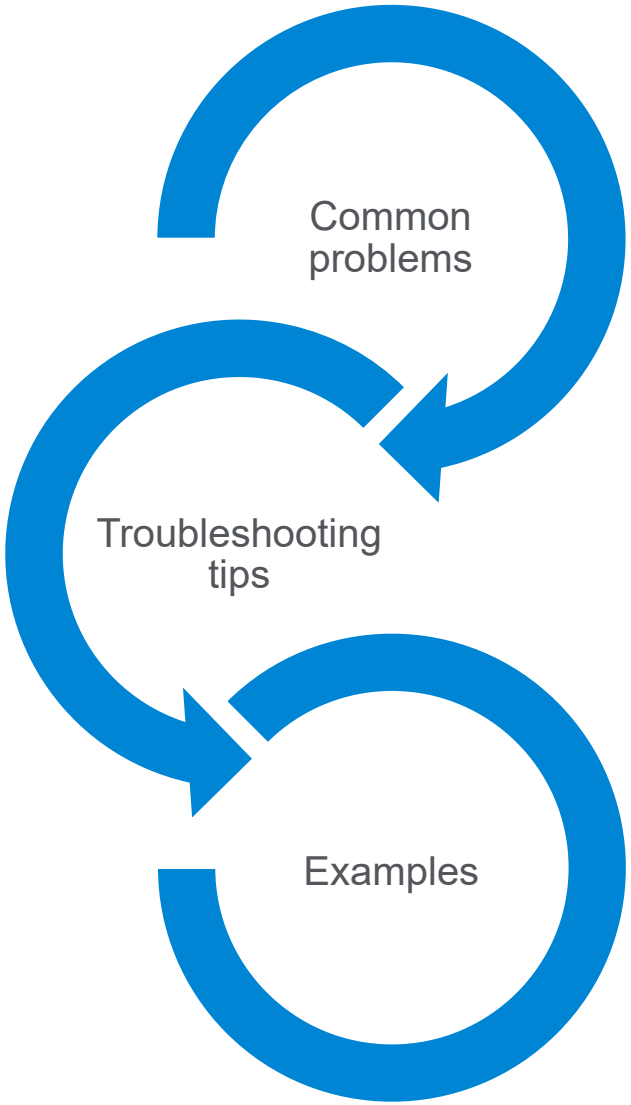
- There are five basic areas from where problems can arise:
  - -Injector
  - -Flow
  - -Column
  - -Detector
  - -Electronics

  Or…

  - A combination of these

Knowing what can and cannot cause the symptom is key, and most importantly **DON'T PANIC!**

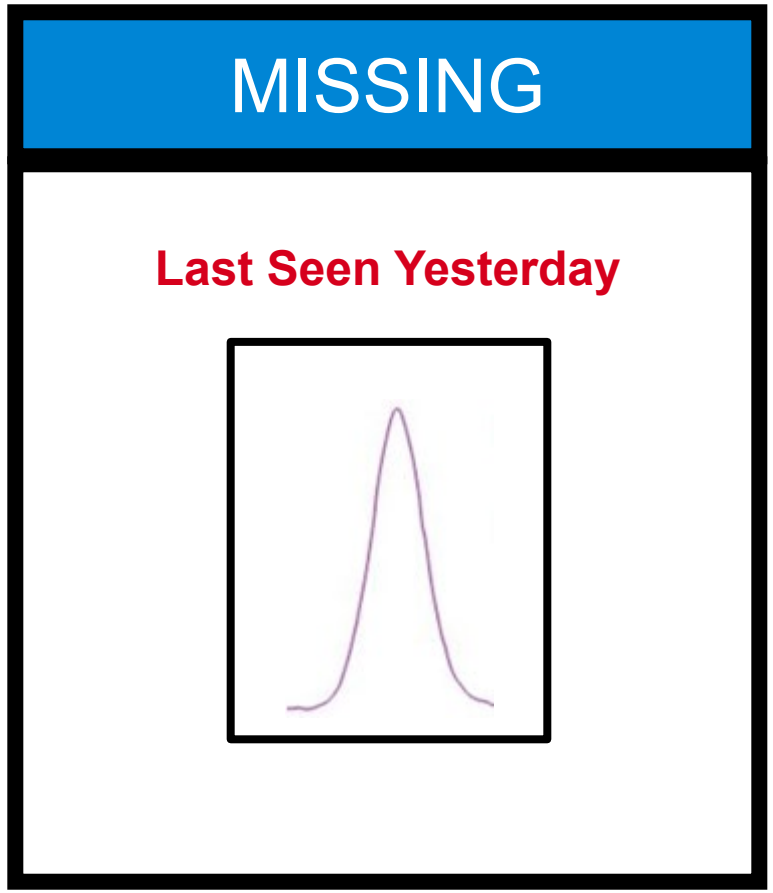
Agenda



Common Peak Shape Issues

- **Peak tailing** – flow path or activity
- **Bonus peaks** – in sample or back flash (carry-over)
- **Split peaks** – injector problems, mixed solvent
- **No peaks** – wasn't introduced, wasn't detected
- **Response changes** – activity, injector discrimination, detector problem
- **Peak fronting** – overload or solubility mismatch, injector problems
- **Shifting retention** – leaks, column aging, contamination, or damage
- **Loss of resolution** – separation decreasing, peak broadening
- **Baseline disturbances** – column bleed, contamination, electronics
- **Noisy or spiking baseline** – electronics or contaminated detector
- **Quantitation problems** – activity, injector, or detector problems
- **Other**

No Peaks



Detector (not on, or not operational)

Injector (not working)

Plugged syringe/plunger not moving

- Wrong injector (or detector)
- Huge leak (older systems)
- No carrier gas flow

Not the column unless…

- Broken column or no column

New Agilent Universal Fit GC Detector Jets

- Easier column installation and jet replacement, reducing the risk of column damage
- Lubricant-free threads, reducing the risk of contamination
- Made from strong material, reducing the risk of deforming
- Universal – fits in both capillary column and packed column (adaptable) FID detectors

Previous Jets				New Universal Fit Jets			
Previous Jet PN	**Jet Orifice ID (inch/mm)**	**Jet Length (inch/mm)**	**Fit of Detector Fitting Type**	**New Jet PN (use for re-order)**	**Jet Orifice ID (inch/ mm)**	**Jet Length (inch / mm)**	**Fit of Detector Fitting Type**
19244-80560	***0.011 / 0.29***	***2.4 / 62***	***FID, Adaptable***	**5200-0176**	**0.011 / 0.29**	**1.2 / 31**	**FID, Capillary & Adaptable**
G1531-80560	***0.011 / 0.29***	***1.7 / 43***	***FID, Capillary***				
18710-20119	***0.018 / 0.47***	***2.5 / 64***	***FID, Adaptable***	**5200-0177**	**0.018 / 0.47**	**1.2 / 31**	**FID, Capillary & Adaptable**
19244-80620	***0.018 / 0.47***	***2.4 / 62***	***FID, Adaptable***				
G1531-80620	***0.018 / 0.47***	***1.7 / 43***	***FID, Capillary***				
18789-80070	***0.030 / 0.76***	***2.5 / 64***	***FID, Adaptable***	**5200-0178**	**0.030 / 0.76**	**1.2 / 31**	**FID, Capillary & Adaptable**
G1534-80580	***0.011 / 0.29***	***2.0 / 52***	***NPD, Capillary***	**5200-0179**	**0.011 / 0.29**	**1.6 / 40**	**NPD, Capillary & Adaptable**
G1534-80590	***0.011 / 0.29***	***2.8 / 71***	***NPD, Adaptable***				

MS Tune Report Interpretation

Symmetrical smooth peak shapes

Consistent mass peak widths

Low water and air

Correct mass assignments

Acceptable column flow rate

Reasonable EM voltage

Proper absolute abundance

Typical relative abundance

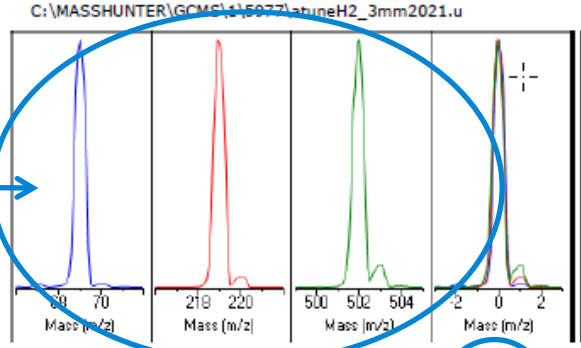
Proper isotope ratios

Gain Factor

Autotune - 5977

Tune timestamp: 1/28/2021 7:05 AM (UTC-05:00) — Obi-Wan Kenobi

C:\MASSHUNTER\GCMS\1\5977\atuneH2_3mm2021.u — US1934M023

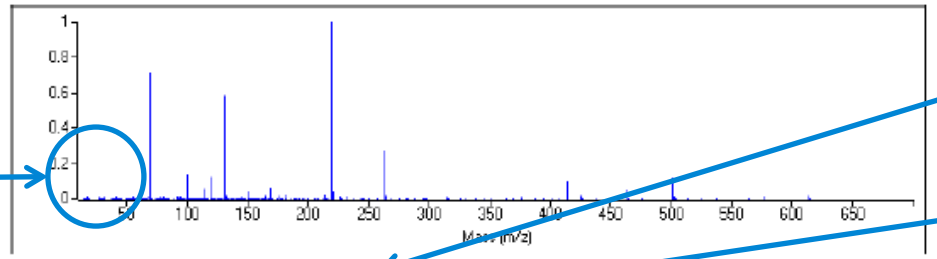


Ion Polarity	Pos	PFTBA	Open
Emission	34.6	Mass Gain	17
Electron Energy	70.0	Mass Offset	-25
Filament	1	Amu Gain	2415
Repeller	30.91	Amu Offset	135.69
Ion Focus	79.5	Width219	-0.033
Entrance Lens	20.2	DC Polarity	Pos
Ent Lens Offset	13.23	HED Enable	On
Ion Body	0.00	EM Volts	989.4
Post Extractor 1	0	Extractor Lens	0.00
Post Extractor 2	0	Scan Speed	3
JetClean Flow Actual/[Setpoint]	0.00 [0.00]	Averages	3

Actual m/z	Abund	Rel Abund	Pw50
69.00	343,938	100.0%	0.60
218.90	467,811	136.0%	0.62
502.00	57,672	16.8%	0.62

Temperatures and Pressures			
MS Source	230	Turbo Speed	100.0
MS Quad	150	Hi Vac	N/C

Low	High	Step	Speed	Threshold	Peaks	Base	Abundance	Total Ion
10.00	701.00	0.10	3	100	263	219.00	459,136	1,825,819



Target m/z	Actual m/z	Abund	Rel Abund	Iso m/z	Iso Abund	Iso Ratio
69.00	69.00	328,448	100.0%	70.00	4,839	1.5%
219.00	219.00	459,136	139.8%	220.00	19,640	4.3%
502.00	502.00	55,424	16.9%	503.00	4,669	8.4%

Air/Water Check: H20 ~1.3% N2 ~1.4% O2 ~0.2% CO2 ~0.5% N2/H20 ~108.0%

Column(1) Flow: 1.20 Column(2): 0.00 ml/min Interface Temp: 250

Ramp Criteria:

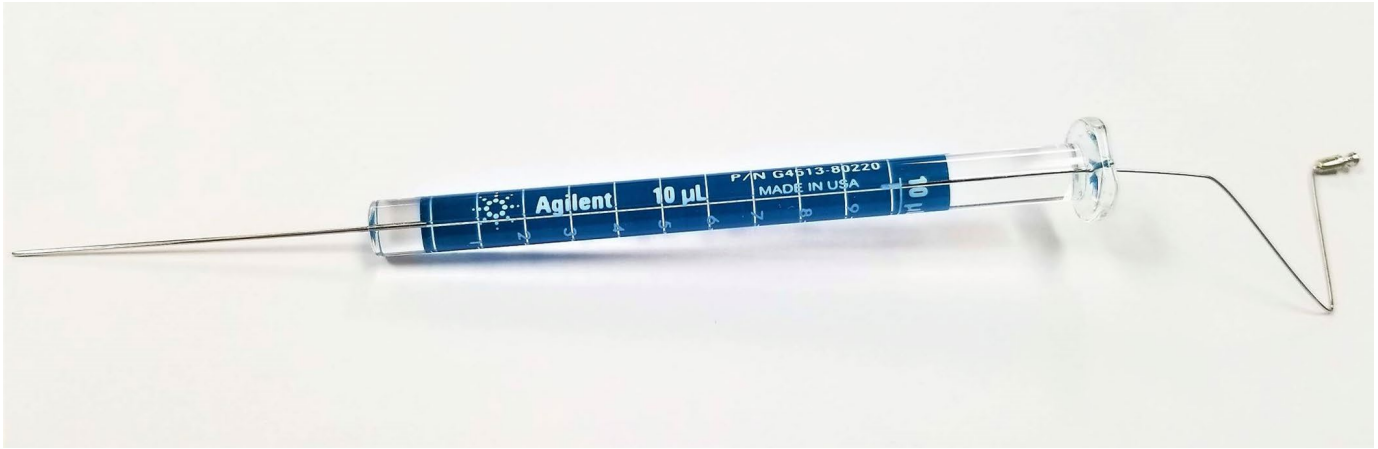
Ion Focus maximum 90 volts using ion 502; Electron Multiplier Gain 100464.862

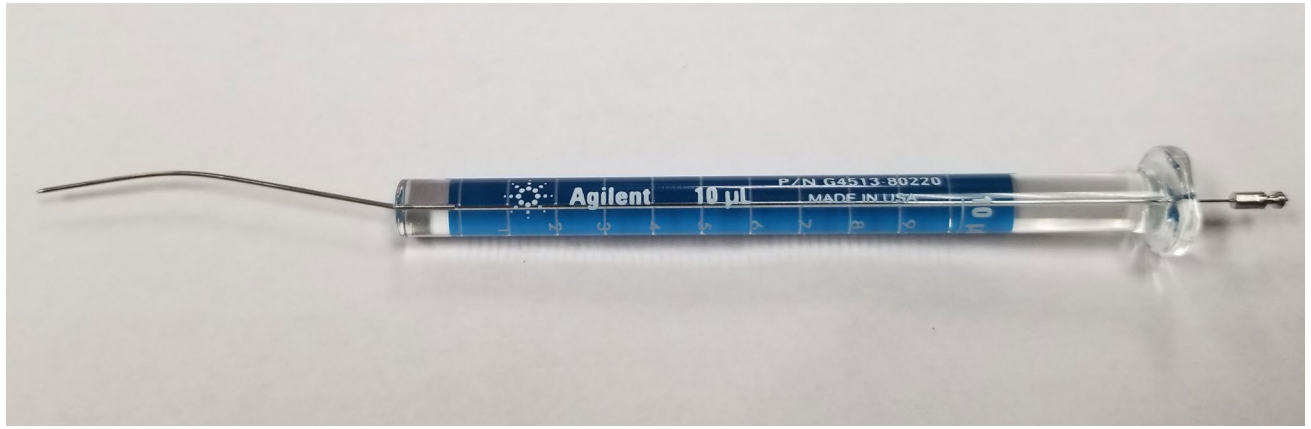
Repeller maximum 35 volts using ion 219; Gain Factor 1.0046

Mass Gain Values(Scan Speed): 23(3) 34(2) 41(1) 66(0) 118(FS1) 126(FS2)

TARGET MASS:	50	69	131	219	414	502	1050
Amu Offset	135.7	135.7	135.7	135.7	135.7	135.7	135.7
Entrance Lens Offset	13.2	13.2	13.2	13.2	13.2	13.2	13.2

Autosampler Issues





Troubleshooting

Problem: Bent Plunger or stuck syringe

Possible causes:

- Particles such as dust, salts, metal, leftover sample, or glass can fill the narrow gap between the plunger shaft and the inside wall of the barrel.
- Overtightened septum nut compresses septa, causing excessive resistance during injection

Suggested actions:

- Switch to a syringe with PTFE-tipped plunger
- Avoid using 5 µL syringes where possible
- If plunger movement feels “gritty”, carefully remove plunger from barrel, flush with solvent, and wipe dry with lint-free cloth. Carefully reinsert plunger into barrel. Finally, submerge needle tip into container of solvent and cycle plunger to pull solvent into and out of the barrel.
- Never cycle the plunger in a dry syringe
- Do not “mix-and-match” plungers and barrels
- Immediately clean syringes after use
- Loosen septum nut

Troubleshooting

Problem: Bent needle

Possible causes:

- Improper needle alignment
- Narrow gauge needles (26 g) bend more easily than larger gauge (23 g) needles
- Needles tend to bend when inserted into sample vial, not the inlet. This can be caused by septa that are too “rough”.
- Needles bent during installation into the autosampler are more likely to bend when pushed through the sample vial cap septum.
- On-column inlets – wrong needle gauge
  - Use correct needle support

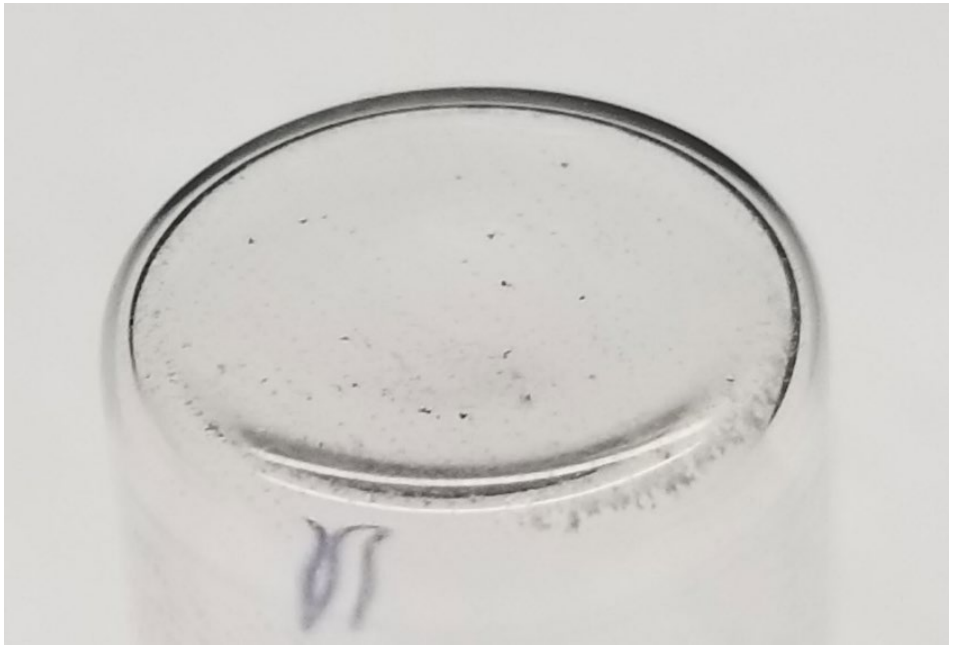
Suggested actions:

- Use syringes with 23 to 26 gauge tapered needles
- Re-align autosampler
- Check septum nut is not overtight

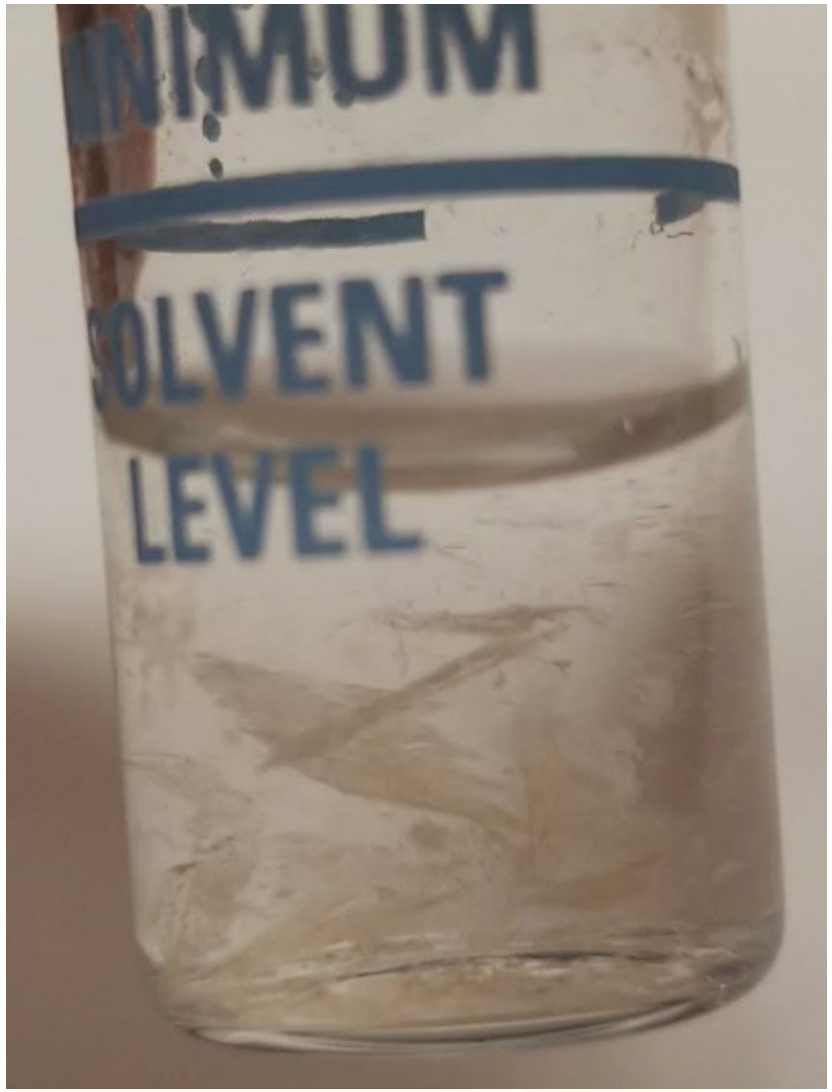
Washes and Pumps: Solvents

Frequently clean or replace wash vials

- Traces of previous samples will accumulate over time
- Do not refill or “top-off” the vial, instead empty, rinse, and replace solvent
- Use a cotton swab to remove particulates from the glass surface



Contaminated wash vial bottom



Contaminated wash solvent

Washes and Pumps: Solvents

Choose a wash solvent or a series of solvents that make sense for the analysis

- Is the analyte soluble in the solvent?
- Wash solvent = sample solvent when possible
- If wash solvent ≠ sample solvent, are they miscible?
- If using a binary wash system, make sure solvents are miscible and rinse with the sample solvent last just before the sample
- Do not use acidic or alkaline solvents with syringes
- What other solvents are used/analytes determined in methods on the same GC?

Use both A and B wash vials
Second wash vial will be cleaner than first
Second wash vial should never be water (rust)

Avoid viscous solvents and solvents with high vapor expansion volumes. Use the vapor volume calculator to make sure it will not overload the inlet liner.

Agilent CrossLab CS (Cartridge System)

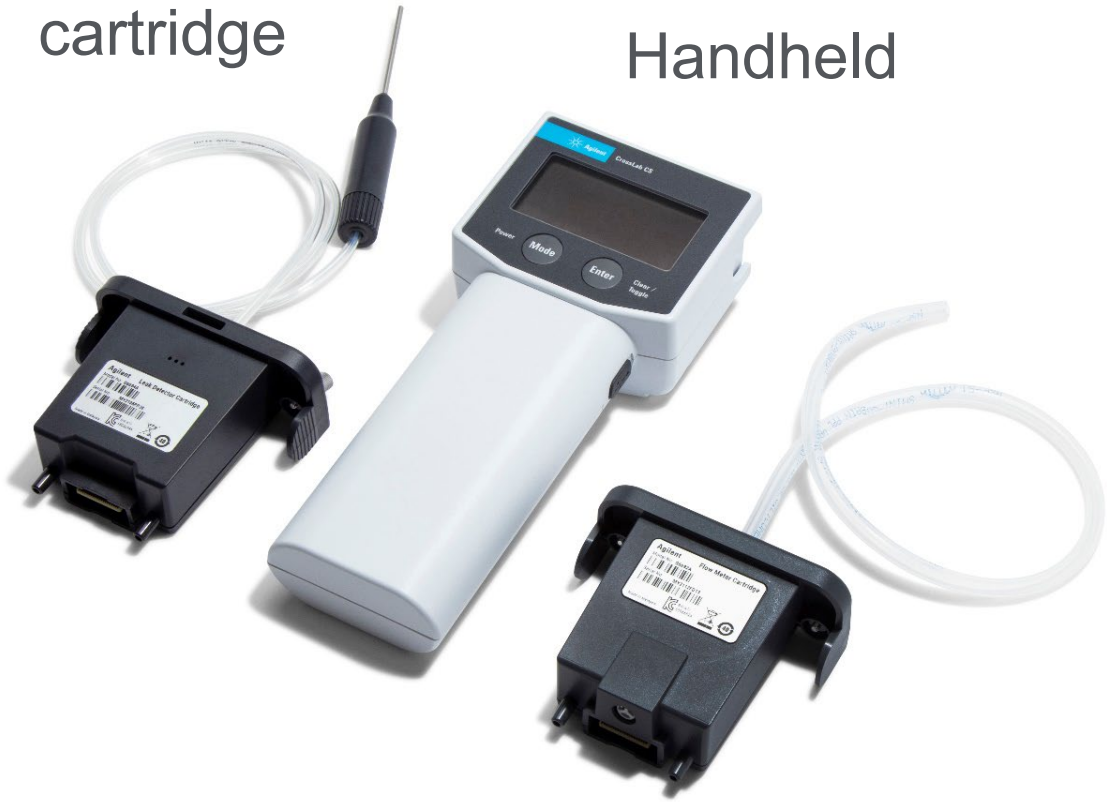
No Peaks from Leaks

Features:

- Exchangeable cartridge with ADM Flow Meter
- Automatic Notification of Probe Filter Replacement
- Ergonomic and robust design
- Universal 3AA or USB power
- USB connects to web interface for added functionality and firmware updates
- Easy to view OLED Screen
- Kickstand

Leak detector cartridge

Handheld



ADM Flowmeter cartridge

The Cost of Leaks

- Cost of gases
- Contamination from exposure
- Reduced consumable lifetime
- Reduced productivity from downtime
- Detector noise and elevated baselines
- Time in troubleshooting

It is critical that every customer checks for leaks. They should have the best tool for the job! Check valves, fittings, and traps for leaks after every maintenance, and after thermal cycling as these can loosen some types of fittings.

Assets Available for Launch

- **Agilent.com CrossLab CS Leak Detector**

www.agilent.com/chem/gas-leak-detector

- **Agilent.com – ADM Flow Meter**

Agilent CrossLab CS Cartridge System | Agilent

- **Installation manual**

Agilent CrossLab CS Electronic Leak Detector manual
Part number: G6693-90000

The installation manual is available on Agilent.com.

- **Innovation minute video**

The video is available on Agilent.com.

- **Technical overview**

Agilent CrossLab Cartridge System (CS) Electronic Leak Detector
Publication number: 5994-4262EN

The technical overview is available on Agilent.com

- **Brochure**

GC Troubleshooting in the Palm of Your Hand
Publication number: 5994-3607EN

The brochure is available on Agilent.com

- **Flyer**

Is a Leak Causing Your Inaccurate Results?
Publication number: 5994-4202EN

The flyer is available on Agilent.com

Ordering Guide

1 year warranty

- G6693A – CrossLab CS Electronic Leak Detector
- G6694A – Electronic Leak Detector Cartridge
- G6699A - CrossLab CS Bundle: ADM Flow Meter and Electronic Leak Detector
  - The bundle will include 1 handheld, 2 cartridges, and a **free** carrying case.

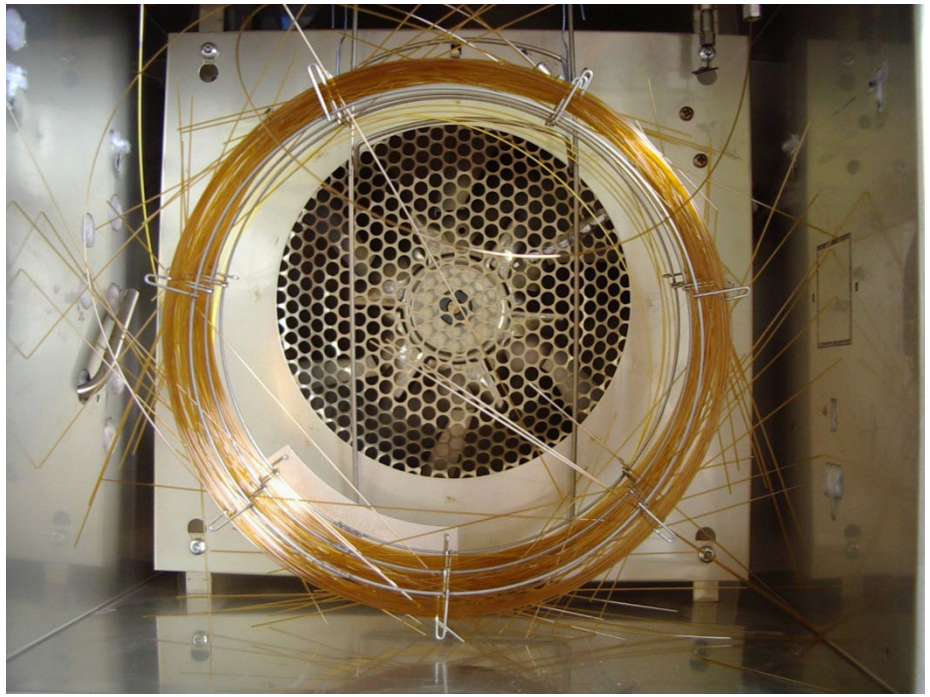
- G6694-60005 – Replacement Probe Filter
- G6691-40500– Carrying Case

Existing products:

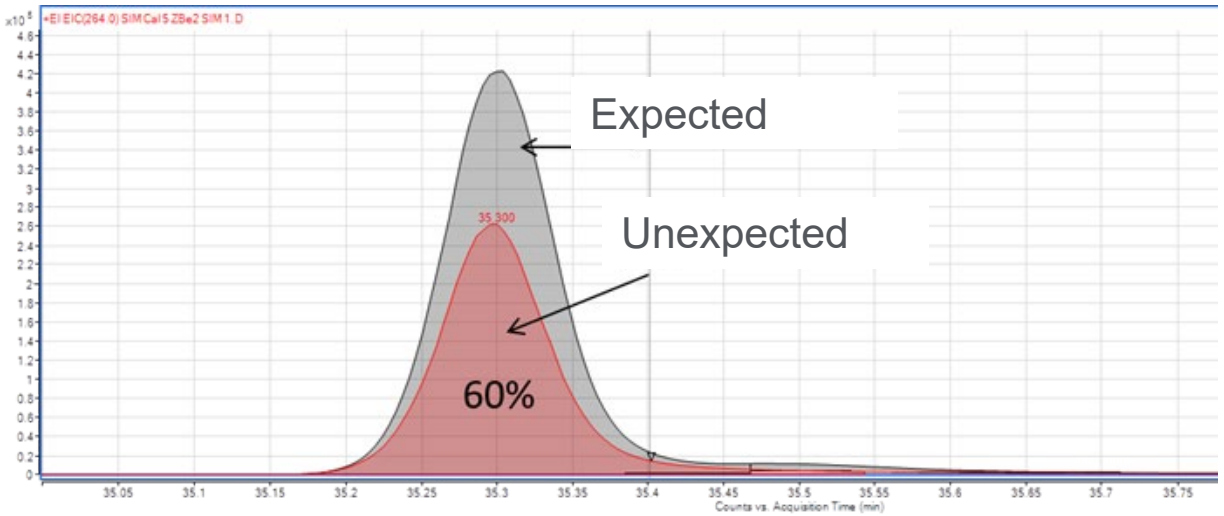
- G6691A – CrossLab CS ADM Flow Meter
- G6692A – ADM Flow Meter Cartridge*
  - Note that the ADM Flow Meter cartridge is ordered annually for calibration.
    The Electronic Leak Detector does not need to be recalibrated!

Physical Damage to the Polyimide Coating

- The smaller the tubing diameter, the more flexible it is
- Avoid scratches and abrasions
- Immediate breakage does not always occur upon physical damage



Peak Response
All change in size



Injector

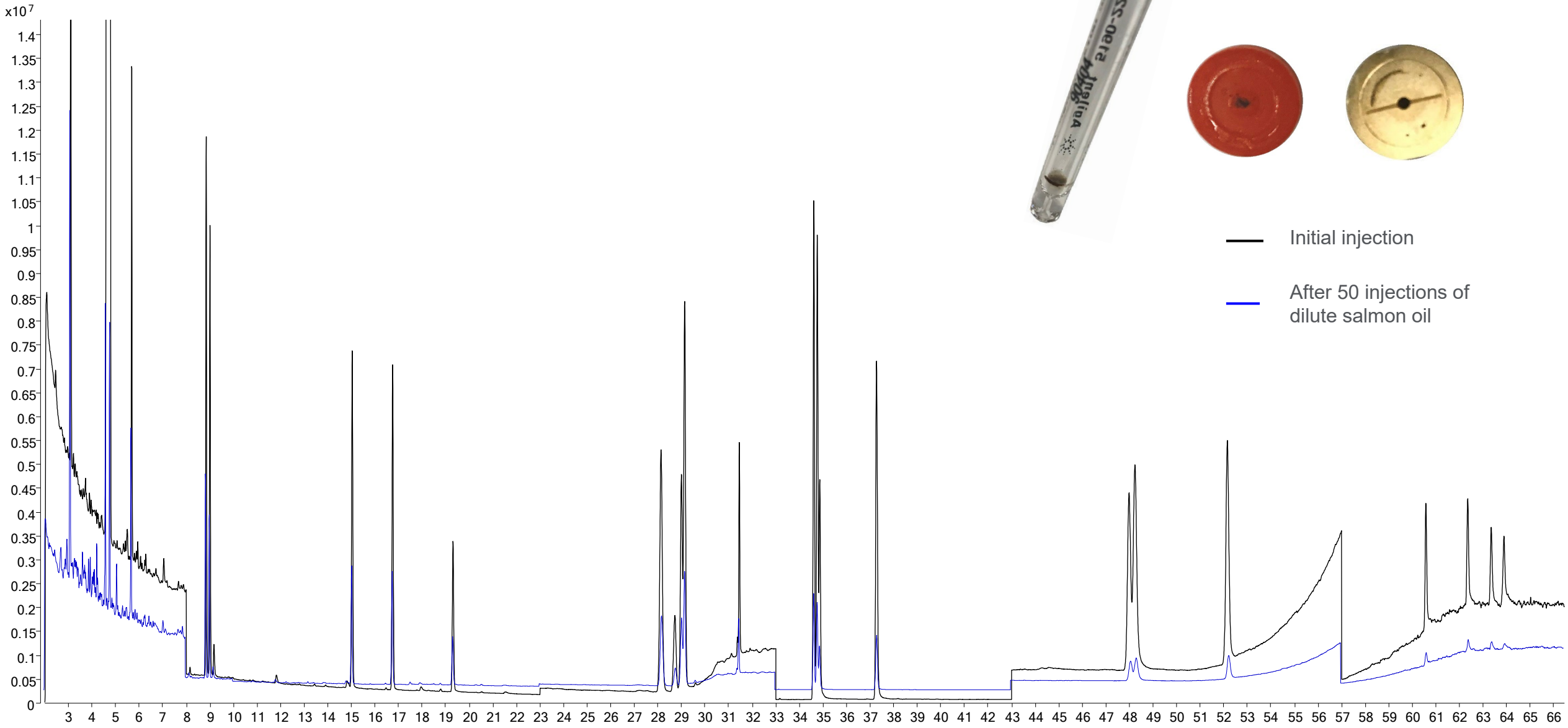
- Leaky syringe
- Split ratio set incorrectly
- Wrong purge activation time
- Septum purge flow too high
- Injector temperature too low*

Detector (response problem)

- Settings or flows changed
- Electronics failing

***Tip:** Ask yourself, is it all of them or some of them? If all, then injector or detector?

50 ng/mL Before 50 Injections of Salmon Oil



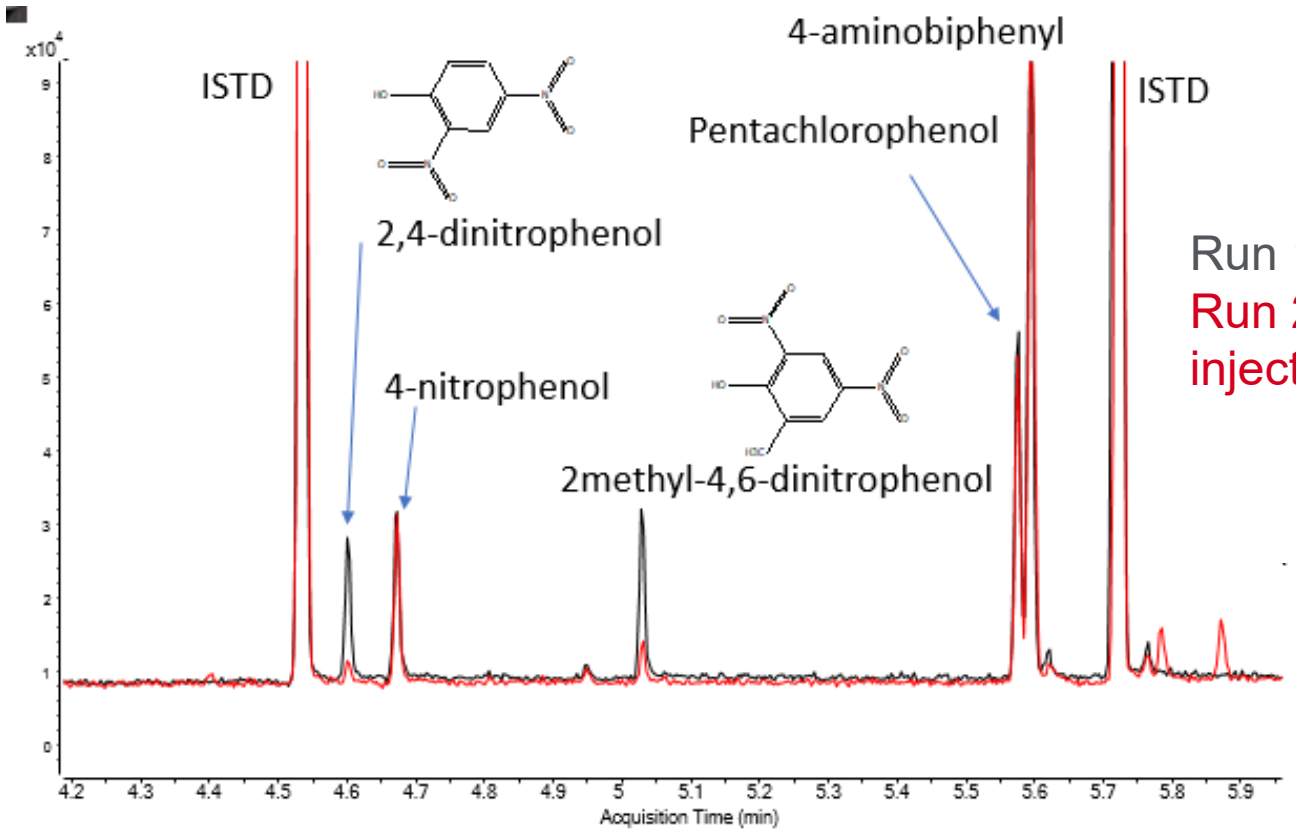
Initial injection

After 50 injections of dilute salmon oil

Agilent

Peak Response

Some change in size



Run 1

Run 26 (after 25 matrix injections

Injector or column is active/contaminated

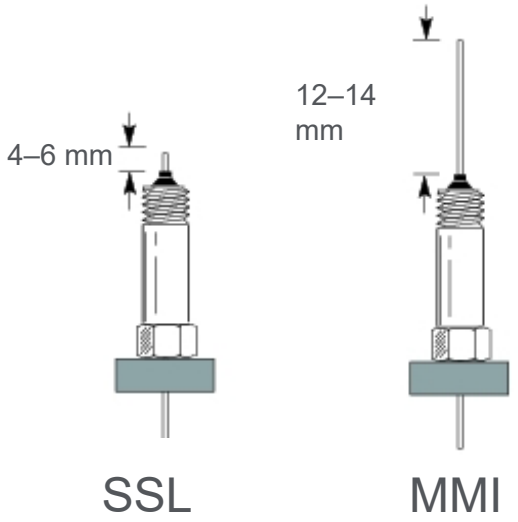
- Irreversible adsorption of active compounds (-OH, -NH, -SH)

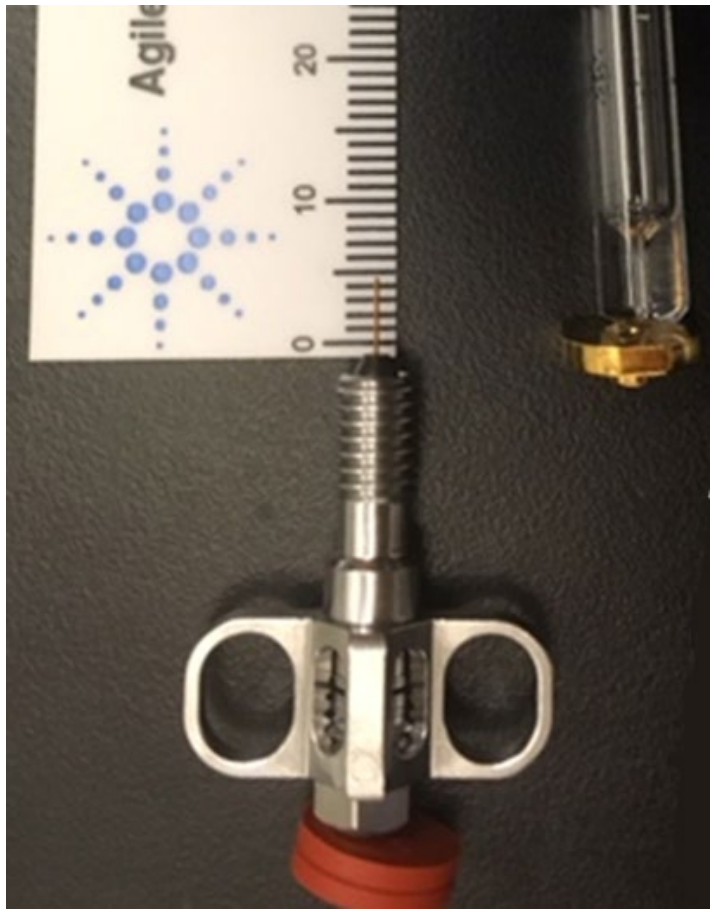
Decomposition of sample

- Temperature change – discrimination
- Evaporation from sample

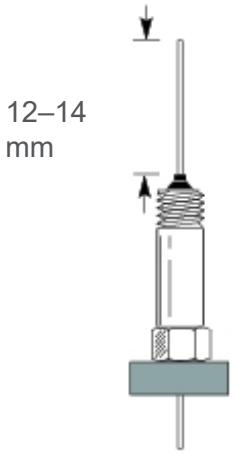
Why Does the Length Above the Ferrule Matter?

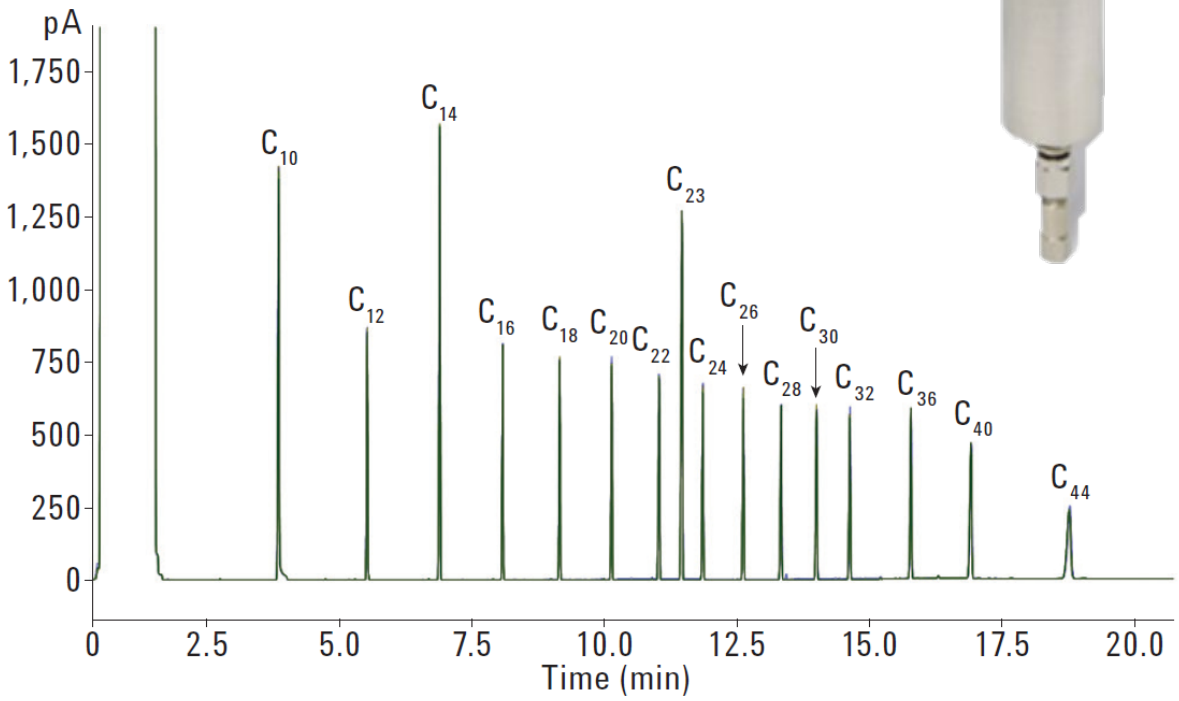
The tip of the column enters the bottom of the liner but does not pass the taper





What Happens if the Column Sits Too Low?





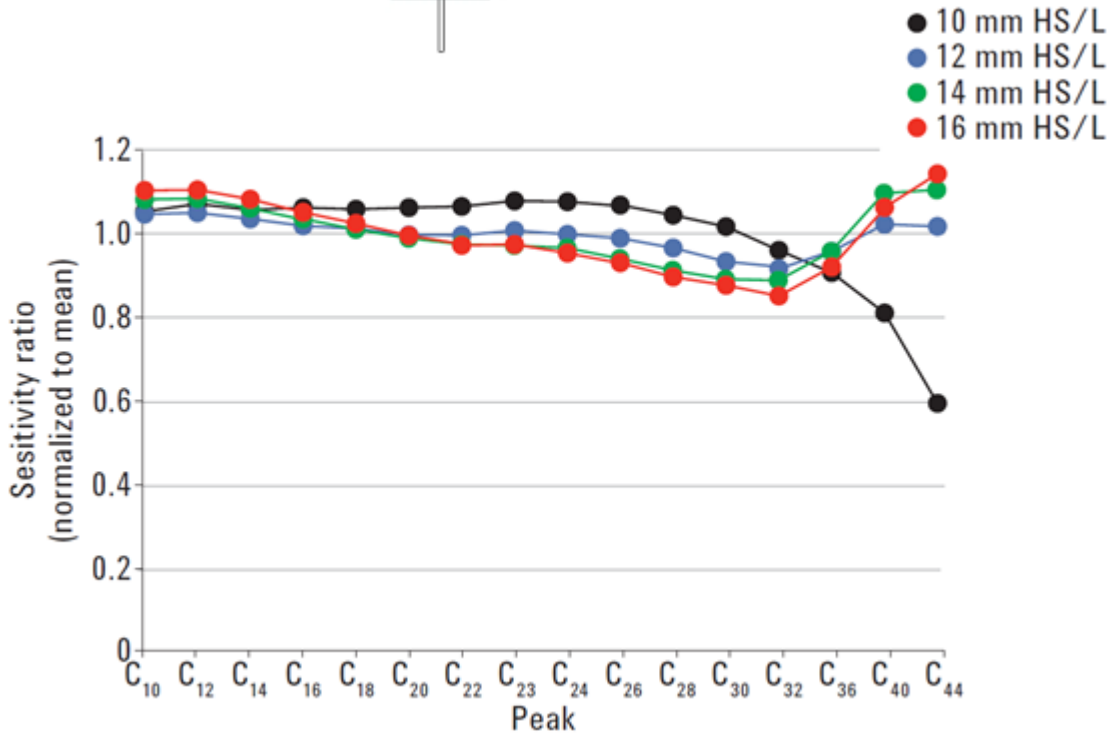
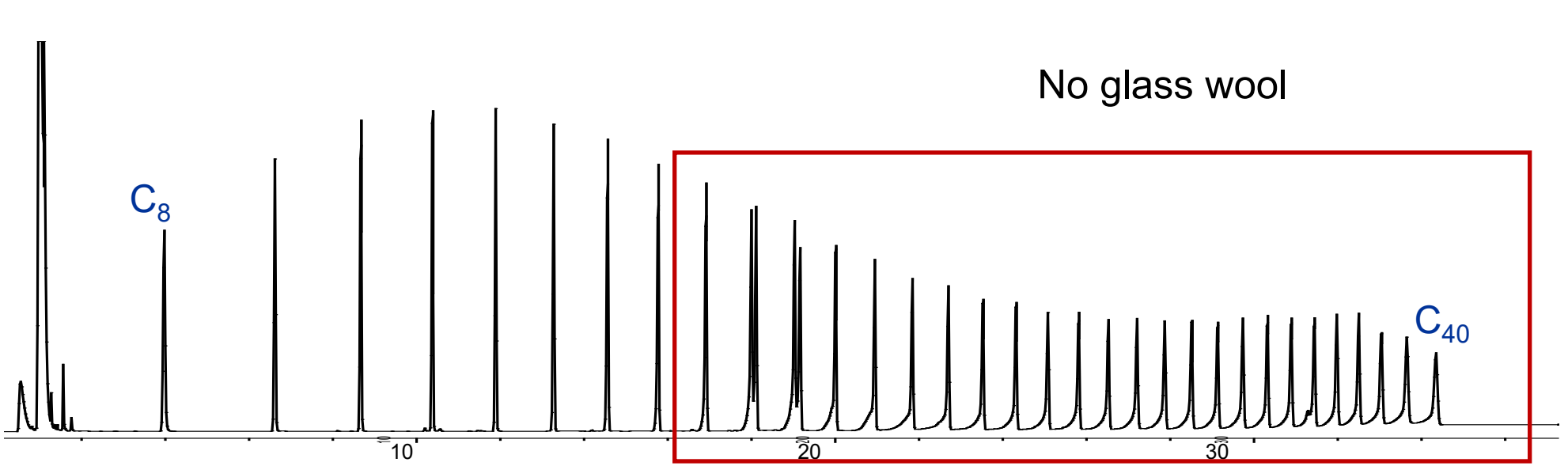
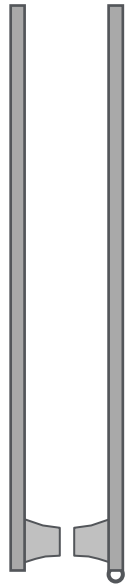


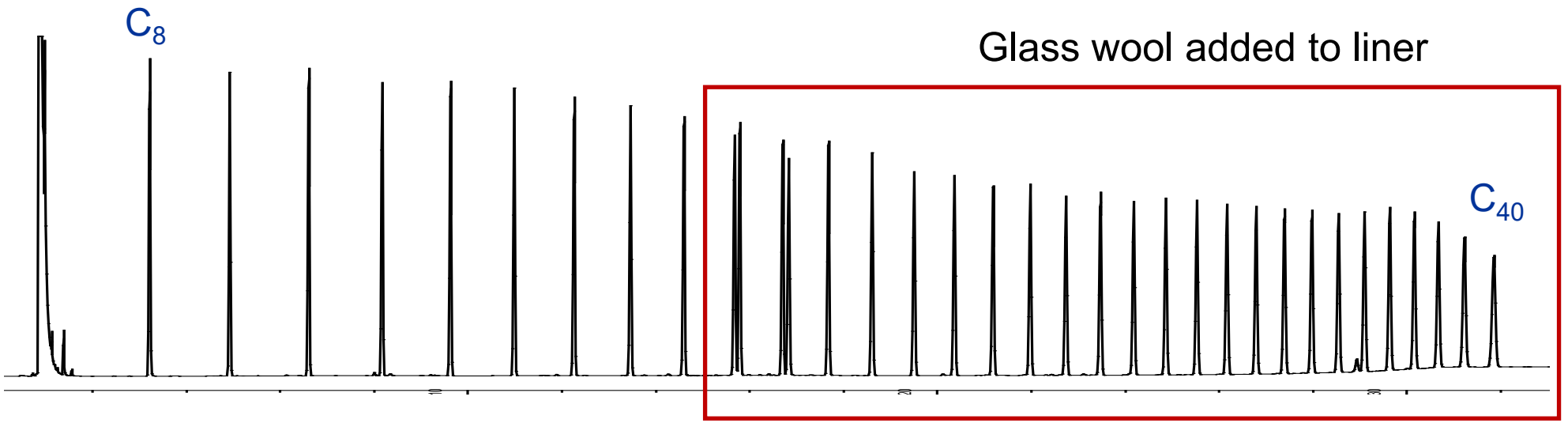
Figure 4. Overlay of four replicate chromatograms of the $C_{10–44}$ mixture in hot splitless mode at 14 mm install length.

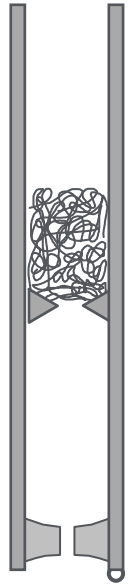
Agilent Publication 5991-7619EN

What Does Mass Discrimination Look Like?

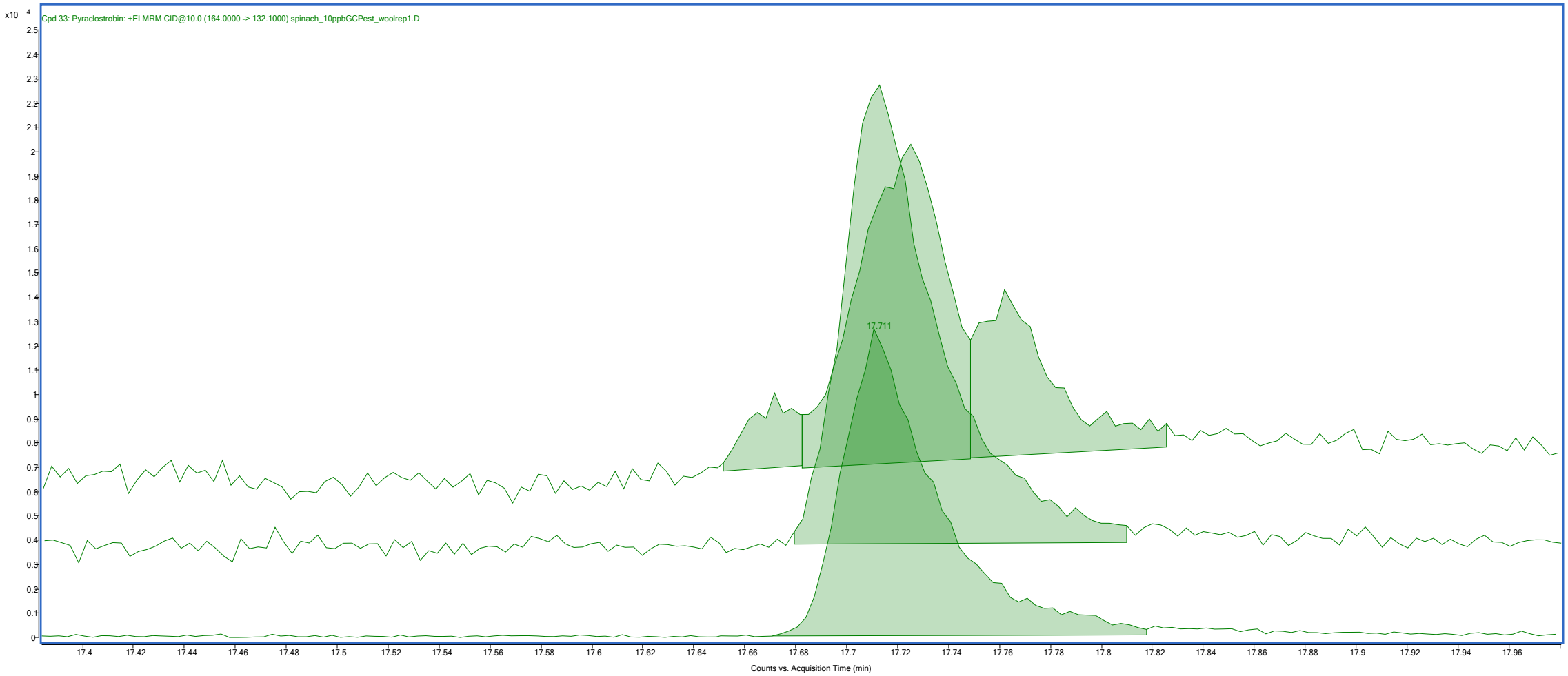




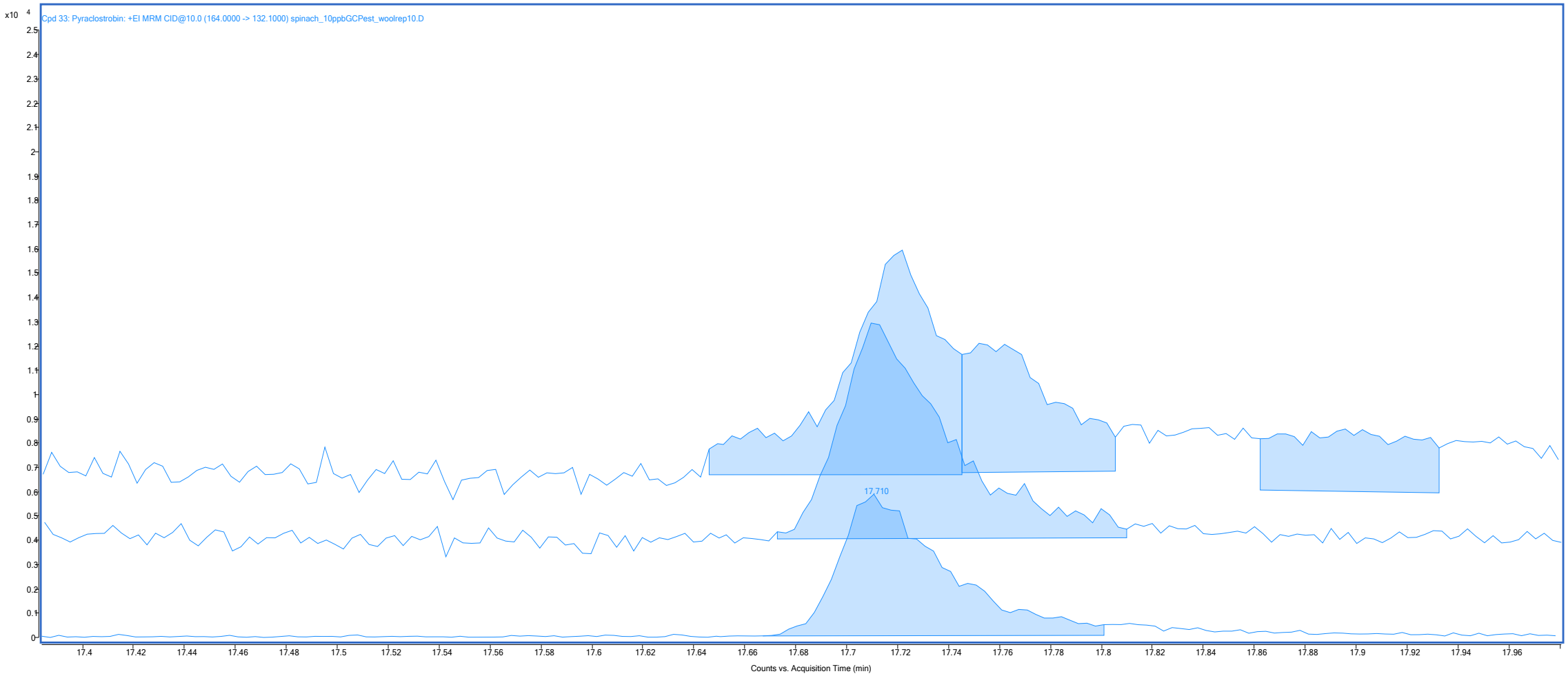




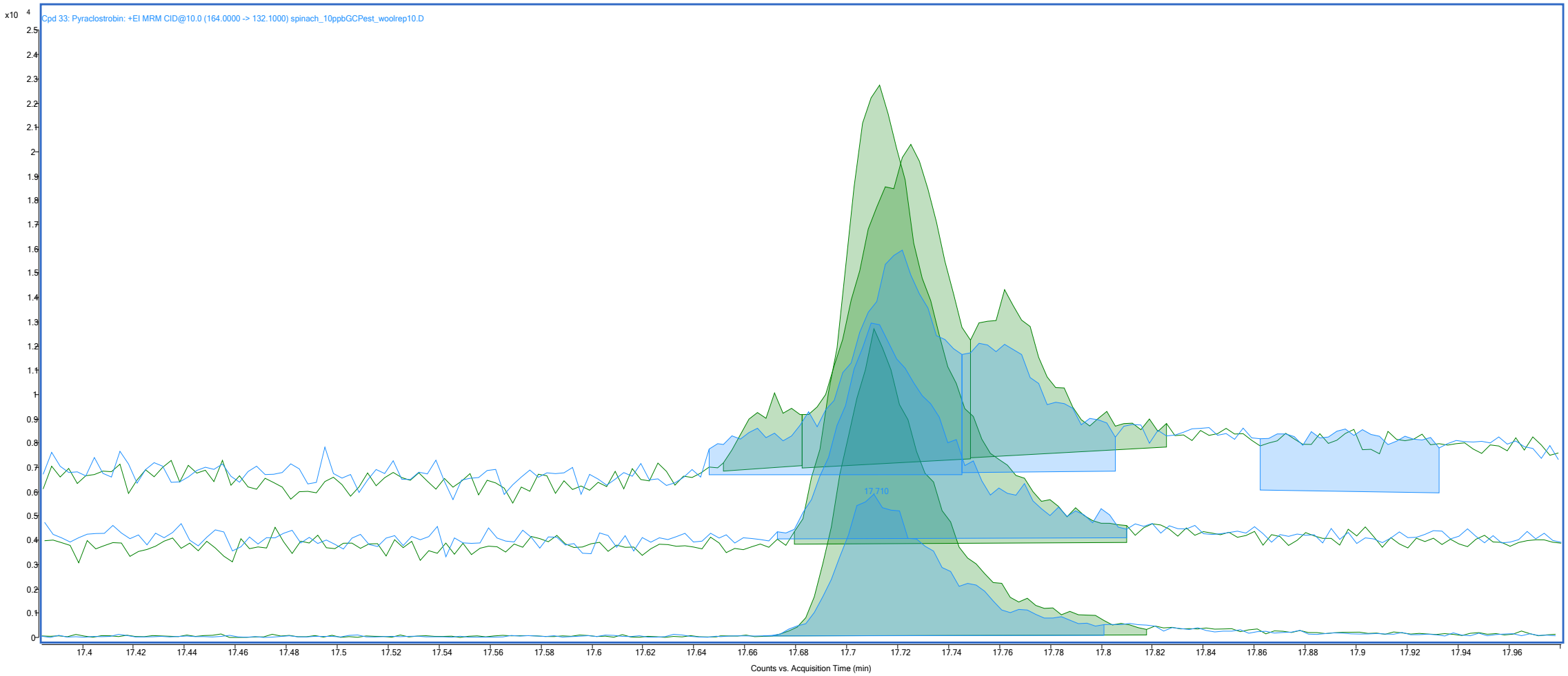
Change in Response: Pyraclostrobin in Spinach on Run 1



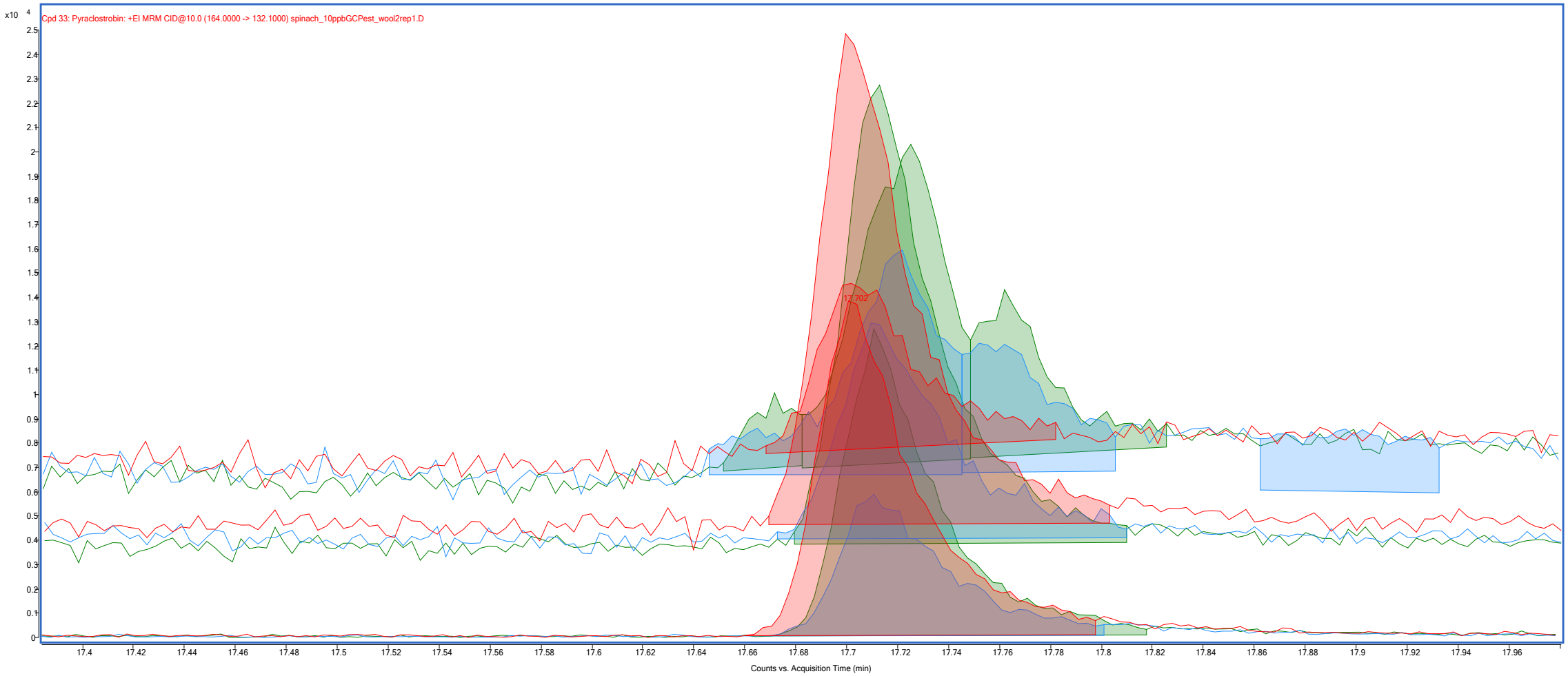
Change in Response: Pyraclostrobin in Spinach on Run 65



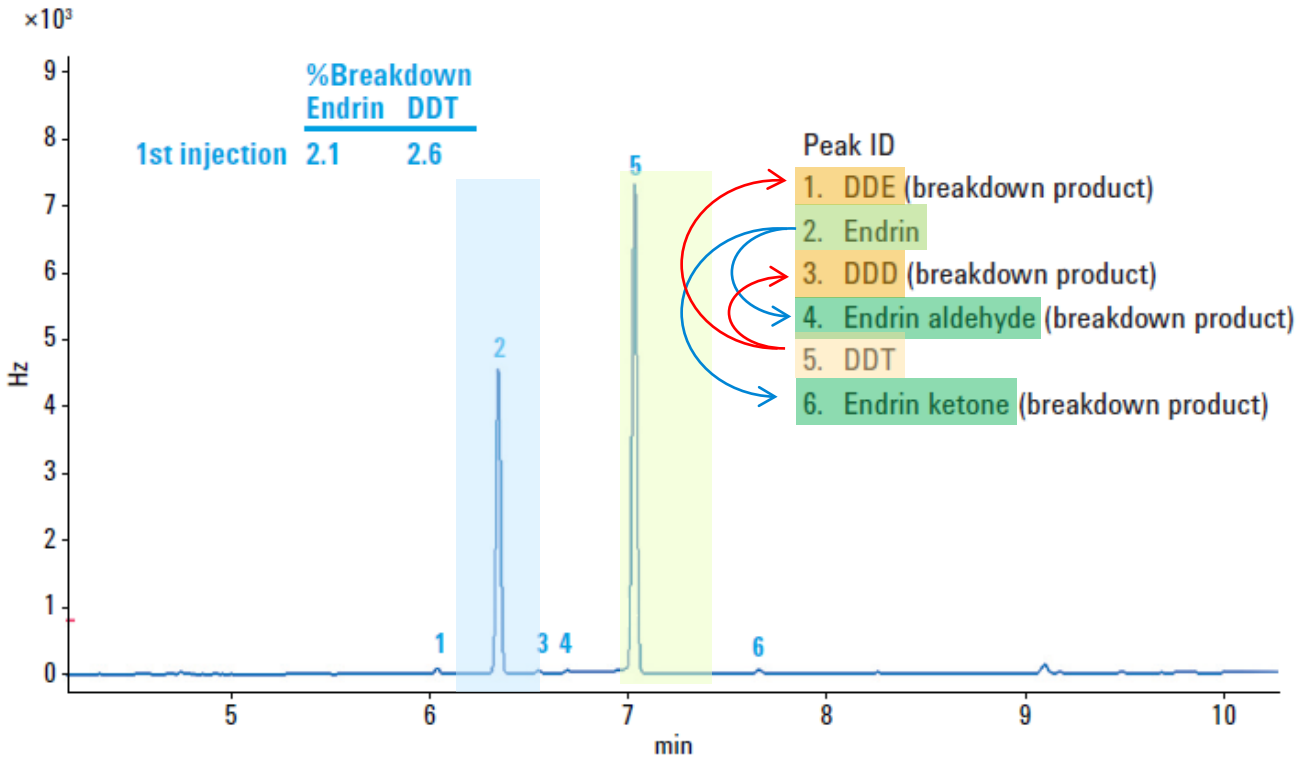
Change in Response: Pyraclostrobin in Spinach on Run 1 vs Run 65



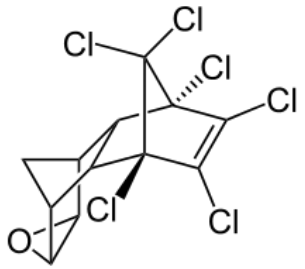
Change in Response: Pyraclostrobin in Spinach with New Liner



Environmental Pesticides Probes: Endrin/DDT Breakdown



Endrin

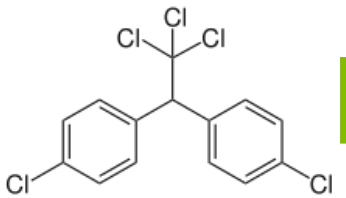


Exposure to heat or surface contaminants

Endrin aldehyde
Endrin ketone

$$\%\ \text{Endrin breakdown} = \frac{(\text{Peak area}_{EA} + \text{Peak area}_{EK})}{(\text{Peak area}_{EA} + \text{Peak area}_{EK} + \text{Peak area}_{\text{Endrin}})} \times 100$$

DDT



Exposure to metal surfaces or contaminants

DDE
DDD

$$\%\ \text{DDT breakdown} = \frac{(\text{Peak area}_{DDE} + \text{Peak area}_{DDD})}{(\text{Peak area}_{DDE} + \text{Peak area}_{DDD} + \text{Peak area}_{DDT})} \times 100$$

Pesticides Can Be Very Difficult Compounds (Detection in Food Matrices)

Varied reactions to different types of matrices

- Enhanced response
- Decrease response
- Interference for transition and matrix

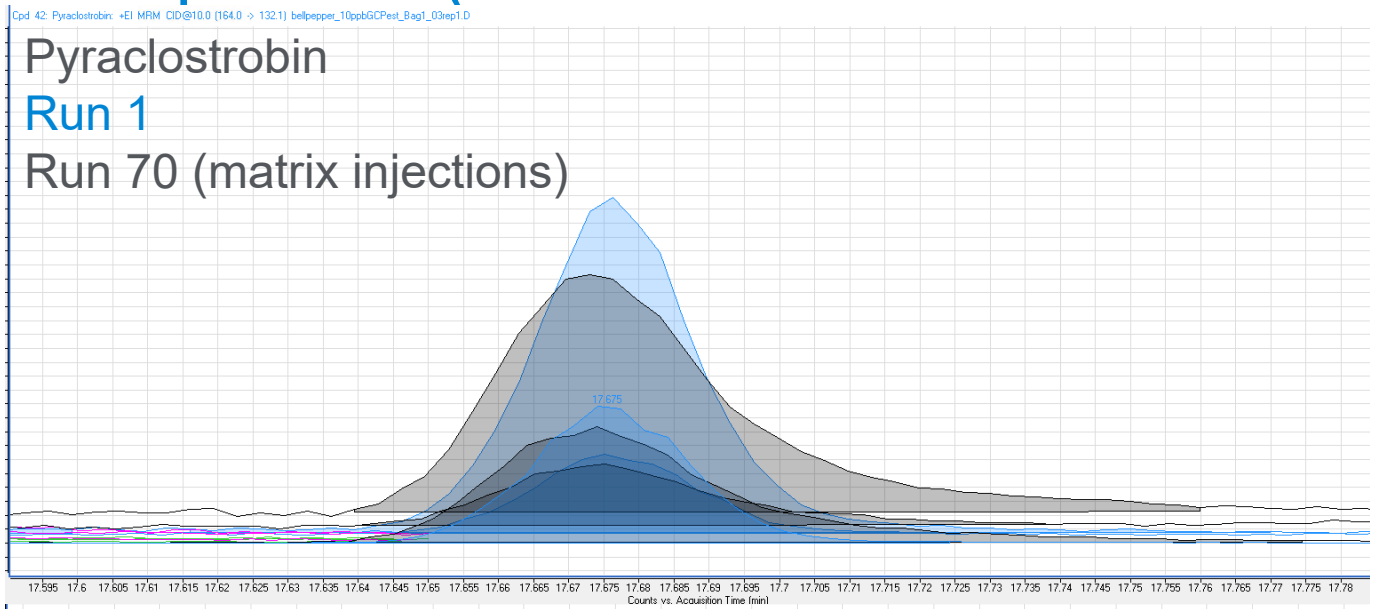
Which pesticides are sensitive to inertness (or lack of)?

The answer is **most.**

Examples include…

- Omethoate
- Deltamethrin
- Methacrifos
- Pyraclostrobin
- Folpet
- Atrazine

The list can continue for a long time!



How Do We Mitigate Pesticide Breakdown, Loss of Response?

Most compounds may lose some response with repeated matrix injections

Use:

Matrix matched calibration curves and quant methods

- Does not fix breakdown, but user better knows what to expect for target analytes

Use a deactivated liner with barrier

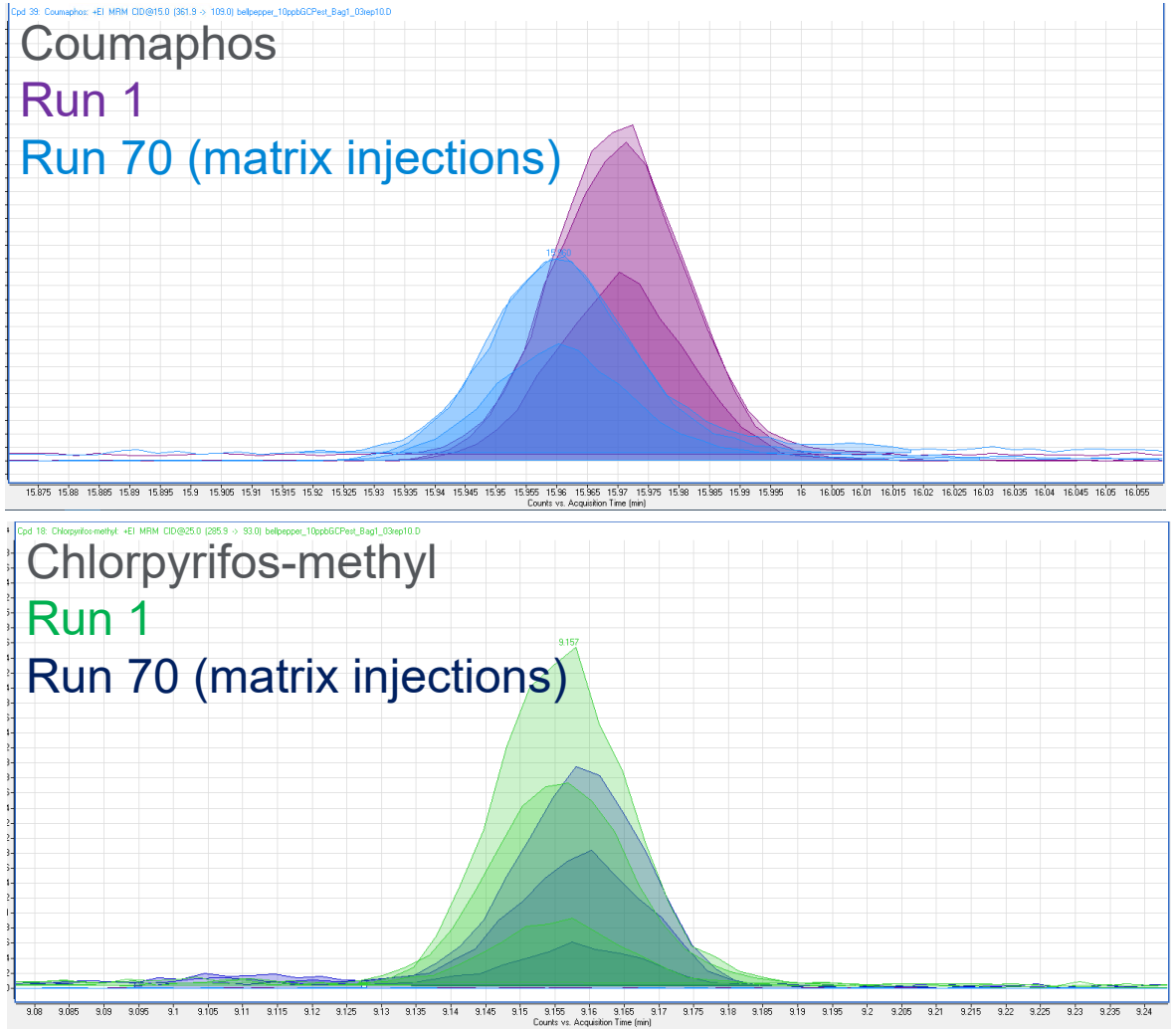
- Ultra Inert frit or glass wool liners

Preemptive maintenance

- Have a standard QC check and criteria for inlet maintenance

Use (mid column) backflush

- Prevent matrix from migrating as far onto column **and** allows you to trim or swap first column without venting MSD



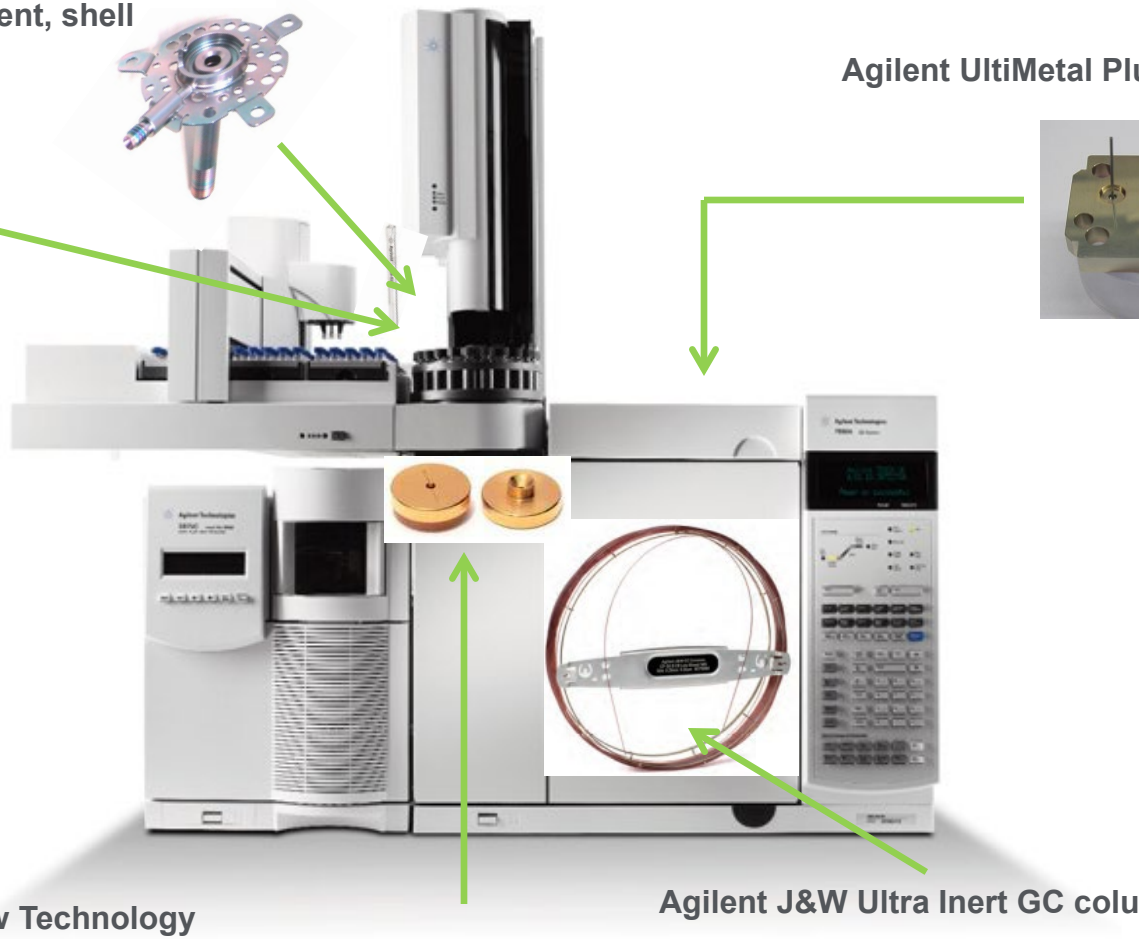
Agilent Inert Flow Solution

Agilent UltiMetal Plus inlet weldment, shell and transfer lines

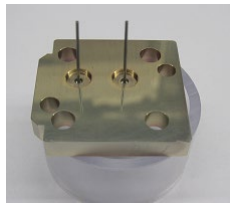
Agilent Ultra Inert inlet liner

Agilent UltiMetal Plus ferrules

Agilent UltiMetal Capillary Flow Technology Devices, Ultimate union



Agilent UltiMetal Plus– TCD, FPD, NPD/FID jets

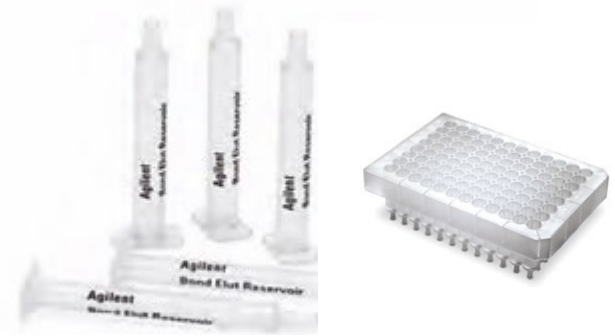


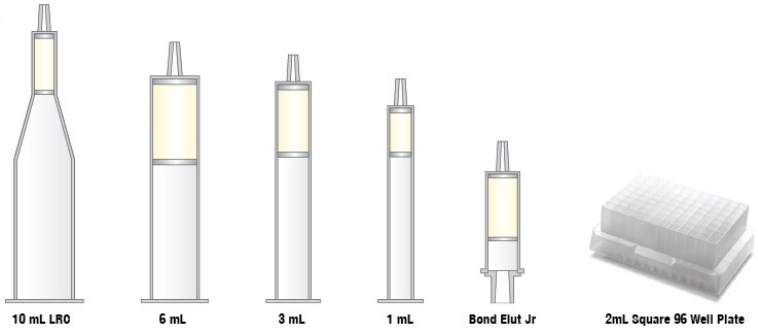
Agilent Ultra Inert gold seal

Agilent J&W Ultra Inert GC column

5990-8532EN brochure

Offline Options for Sample Matrix Removal





Bond Elut Solid Phase Extraction cartridges and plates

Captiva syringe filters

QuEChERS

Filter vials

Captiva EMR-Lipid filtration cartridges and plates

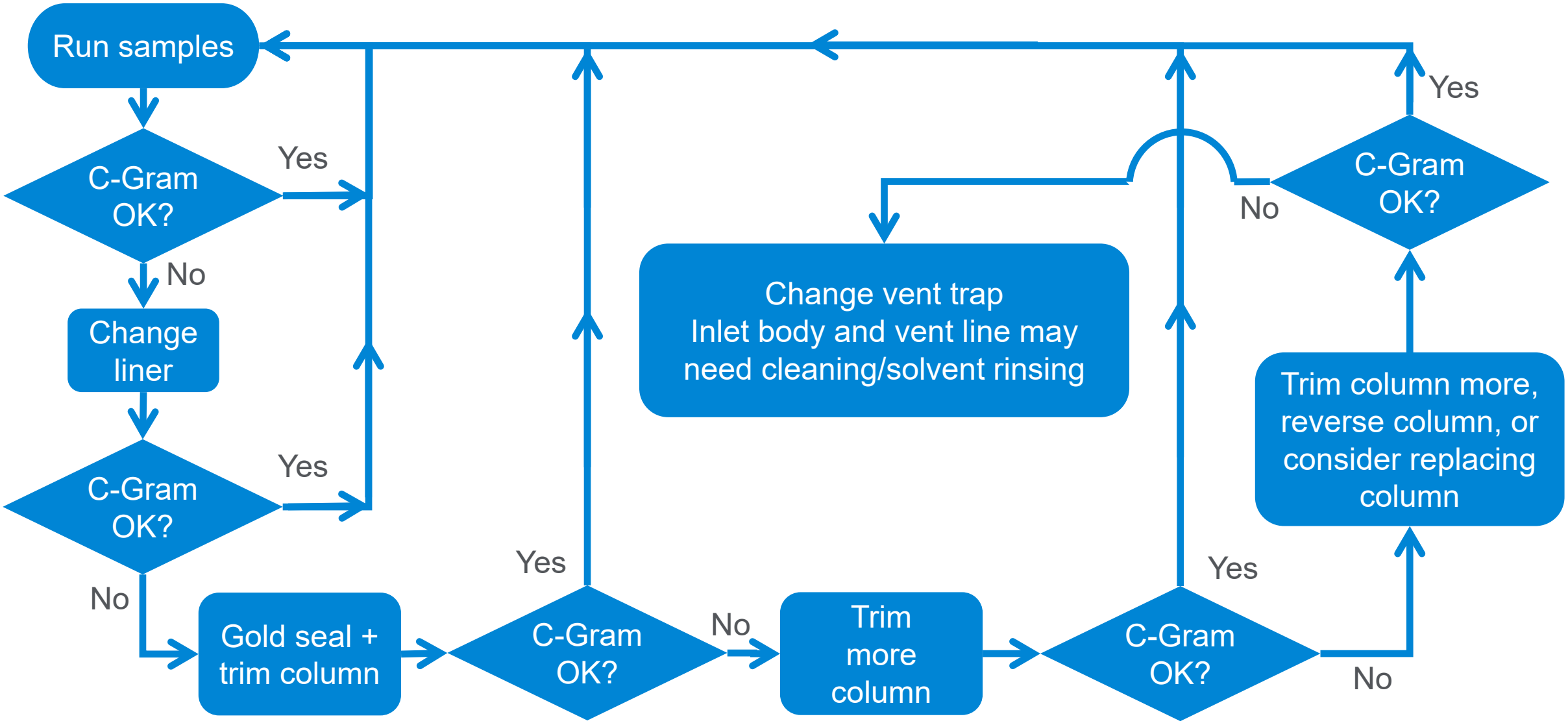
Synthetic Chem Elut S

When Do I Change Specific Parts?

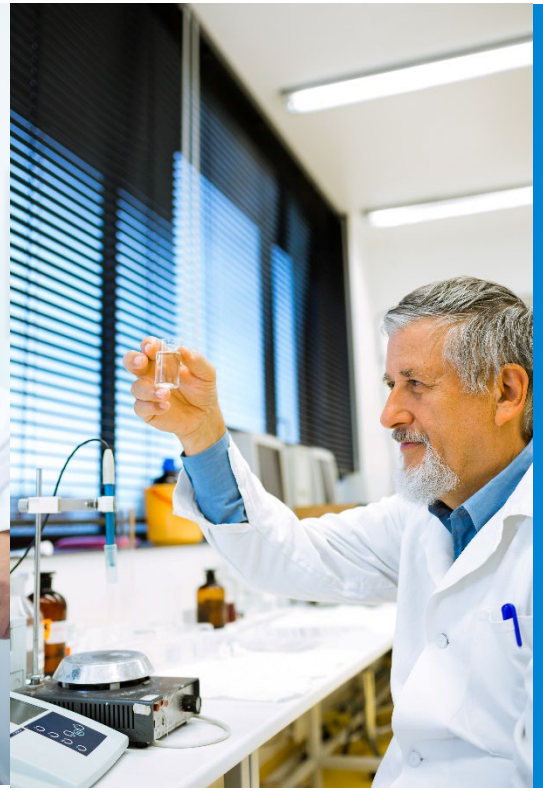
Item	Typical Schedule	Comments
Septum Nut	3-6 months	Septum nut can get warn and shed metal particle into the liner. Replace to minimize activity in the inlet/liner.
Syringe	Every 3 months	Check movement of plunger and replace if it does not move freely and cannot be cleaned.
Gold Seal	Monthly	At a minimum replace when trimming the front end of the column
Split Vent Trap	6 months-1 year	Often forgotten. Can also cause retention instability.
Liner	Weekly	The liner takes the brunt of the sample load/residues. Replace often to help prevent unwanted down time.
Trim/Replace column	Weekly-Monthly	When experiencing chromatographic problems trim ½ to 1 meter of the front end of the column. Replace liner, septum and gold seal.
Inlet Setpa	100-200 injections	Depends a bit on septum type and manual/auto injections.

Schedule is an approximation of average usage requirements. Actual frequency is application and sample specific. Use your chromatography as a guide to developing a normal maintenance schedule.

Inlet Maintenance Flowchart



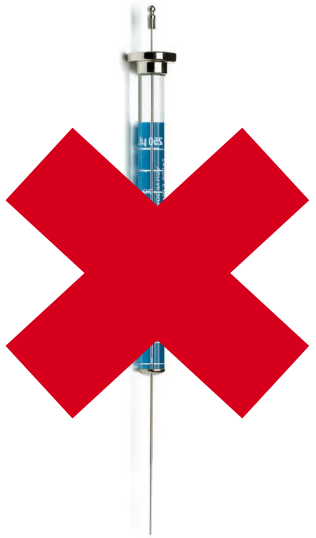
Troubleshooting Techniques



Troubleshooting Tools

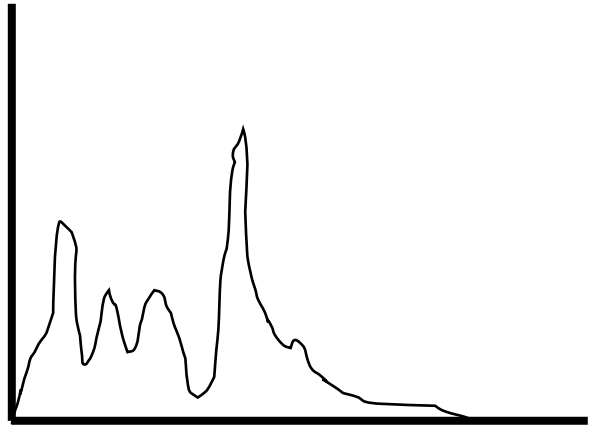
Bleed profile (noninjection): *baseline problems*
Inject a nonretained peak: *peak shape problems*
Test mix: *all problems*
Isolate the components: *all problems*

Perform a Noninjection “Blank”



Remove syringe from autosampler

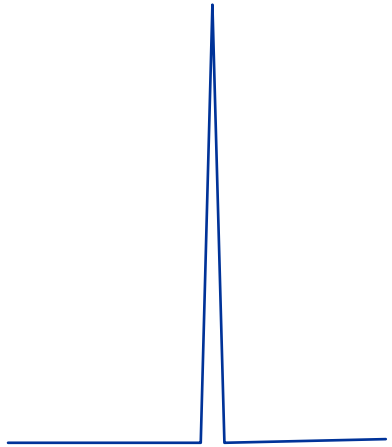
Run your program



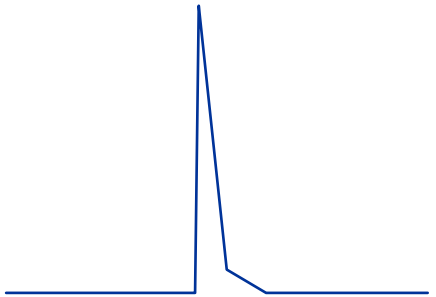
If you see peaks, it is likely that there is inlet contamination

Inject a Nonretained Compound to Check Flow Path

Used to check flow path



Good installation



Improper installation or injector leak

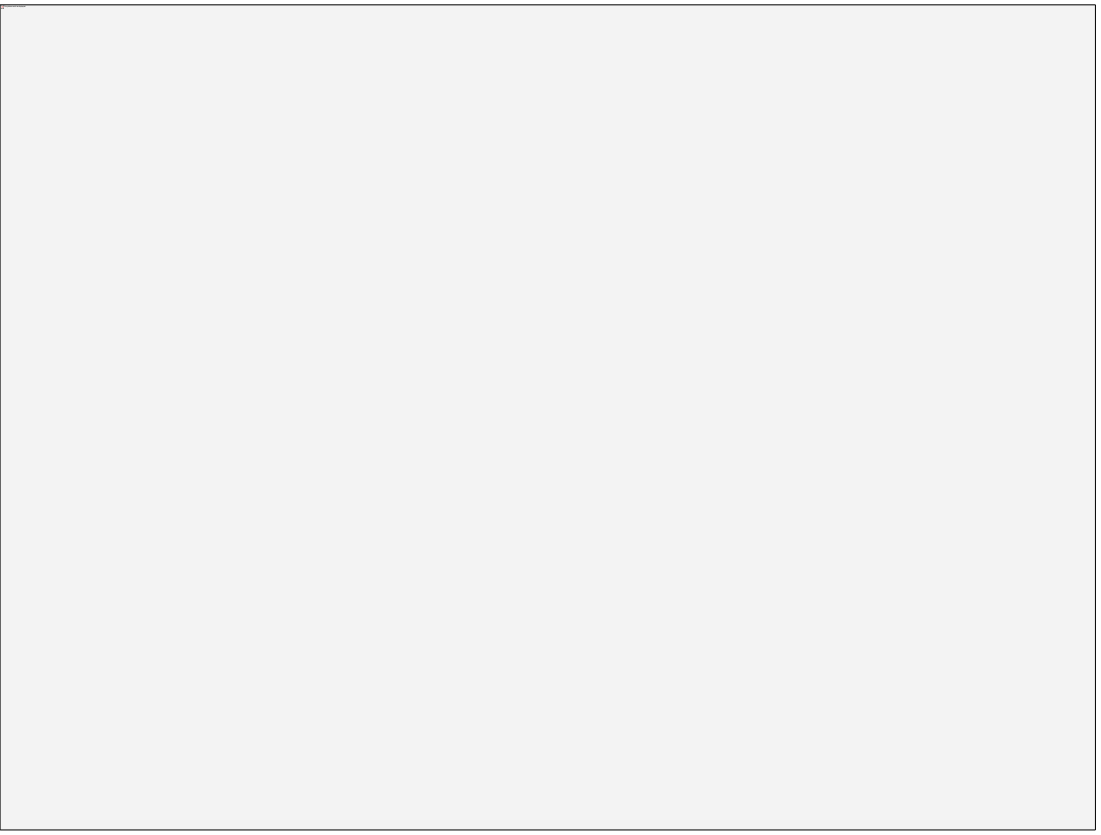
Potential explanations:

- Injector or septum leak
- Too low of a split ratio
- Liner problem (broken, leaking, or misplaced)
- Column position in injector and detector

Test Mix – Make Your Own!

A test mix is used to determine how “good” the column is, or whether a problem is related to the chemical properties of the analytes.

It is simplest to use your own standard.



Compound	Purpose
Hydrocarbons	Efficiency Retention
Alcohols	Activity
FAMEs, PAHs	Retention
Acids	Acidic character Activity
Bases	Basic character Activity

Test Conditions	
Inlet:	Split (250 °C)
Detector:	FID(320 °C)
Flow:	37.3 cm/sec (1.8 mL/min)
Carrier gas:	Hydrogen
Holdup compound:	Methane (0.671 min)
Temperature program:	Isothermal (110 °C)

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- Sample preparation materials, columns, supplies, instrumentation, and reference materials are all from a single source.

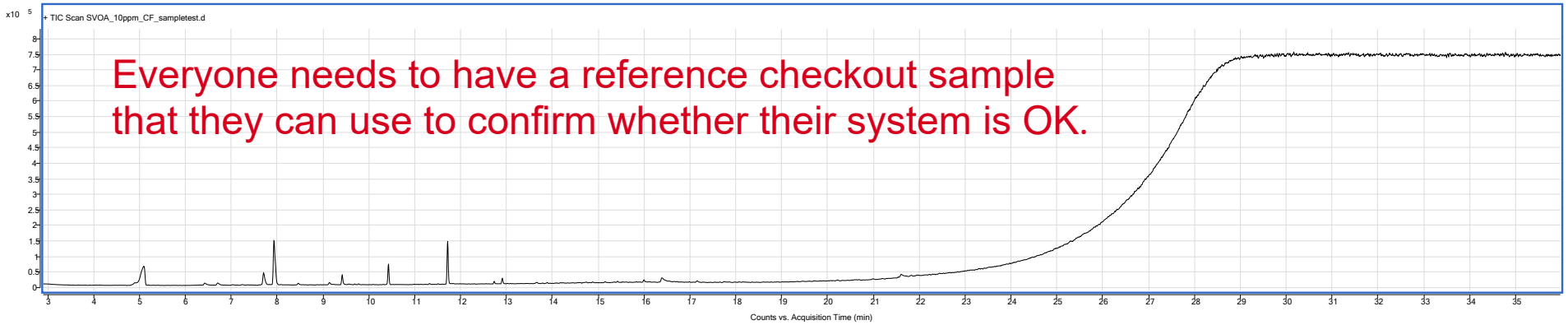
Not Getting the Response You Expect?

- If you are seeing a reduction in response or see no peaks, try injecting a much higher concentration
- Inject something simple as well

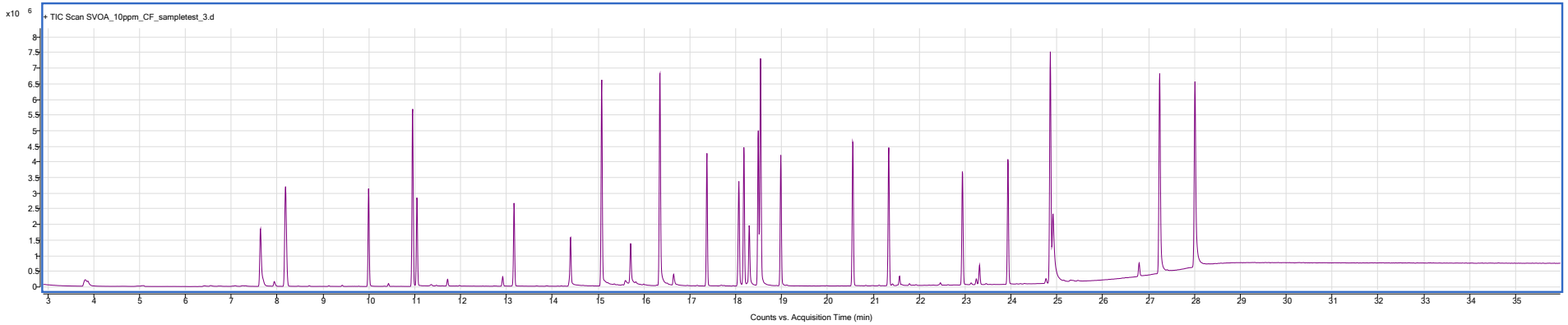
Troubleshooting Example

Problem: No Peaks with Semivolatiles Checkout Mixture

What my TIC looked like:



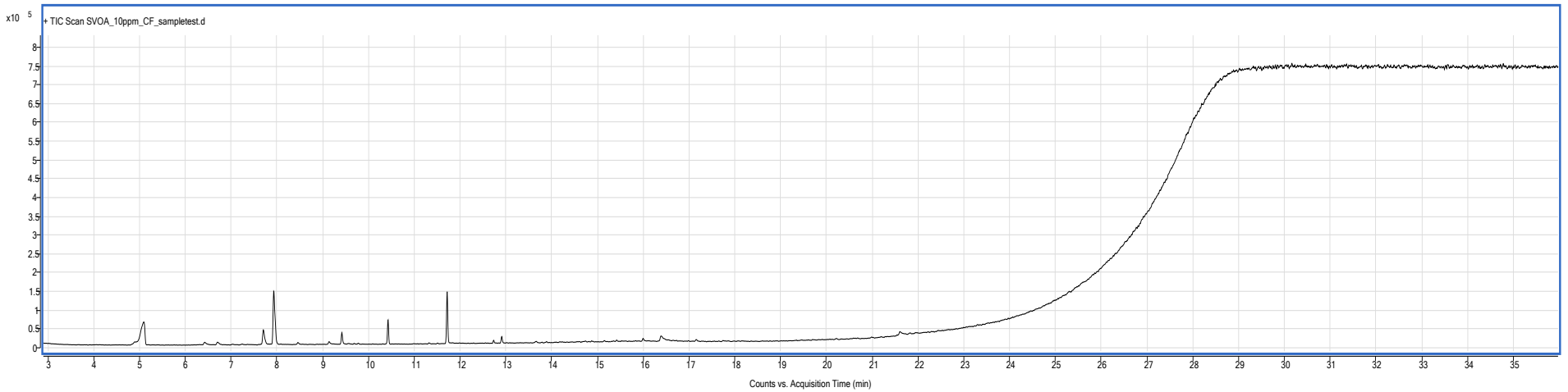
What my TIC should look like:



Problem: No Peaks with Semivolatiles Checkout Mixture

What could cause this?

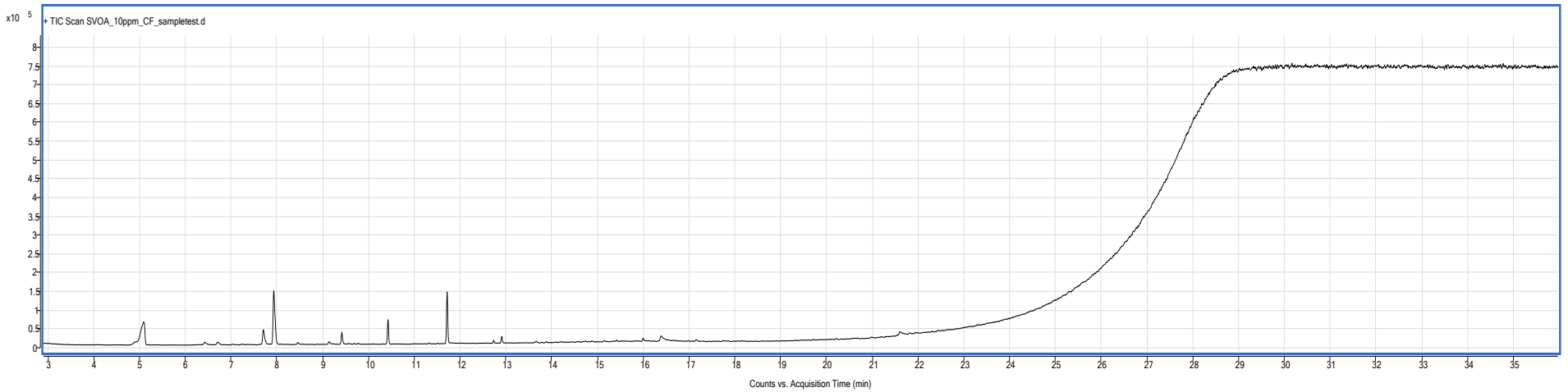
- The wrong vial was injected
- The sample has degraded
- The inlet is leaking
- The column is damaged



Problem: No Peaks with Semivolatiles Checkout Mixture

What could cause this?

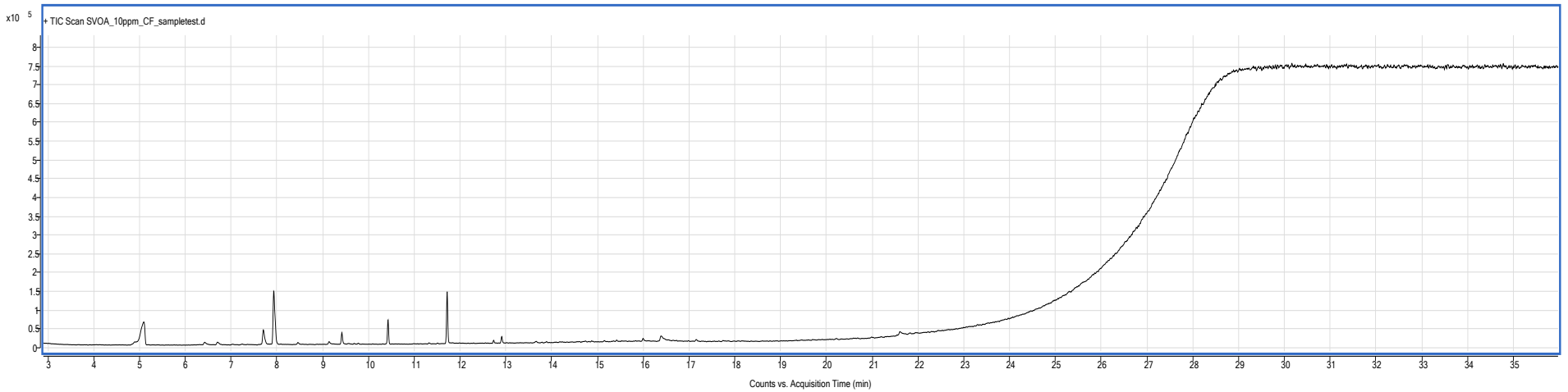
- The wrong vial was injected: **Sequence and vial checked, no problem found**
- The sample has degraded
- The inlet is leaking
- The column is damaged



Problem: No Peaks with Semivolatiles Checkout Mixture

What could cause this?

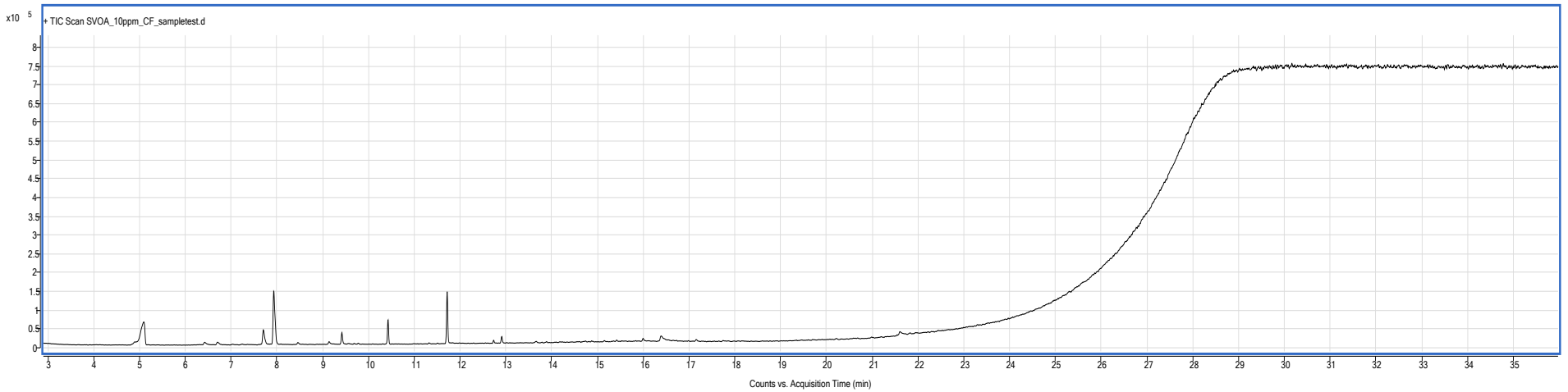
- The wrong vial was injected: **Sequence and vial checked, no problem found**
- The sample has degraded: **A new vial of standard was used, no difference observed**
- The inlet is leaking
- The column is damaged



Problem: No Peaks with Semivolatiles Checkout Mixture.

What could cause this?

- The wrong vial was injected: **Sequence and vial checked, no problem found**
- The sample has degraded: **A new vial of standard was used, no difference observed**
- The inlet is leaking: **A tune was performed. O_2, N_2, and H_2O levels were normal**
- The column is damaged



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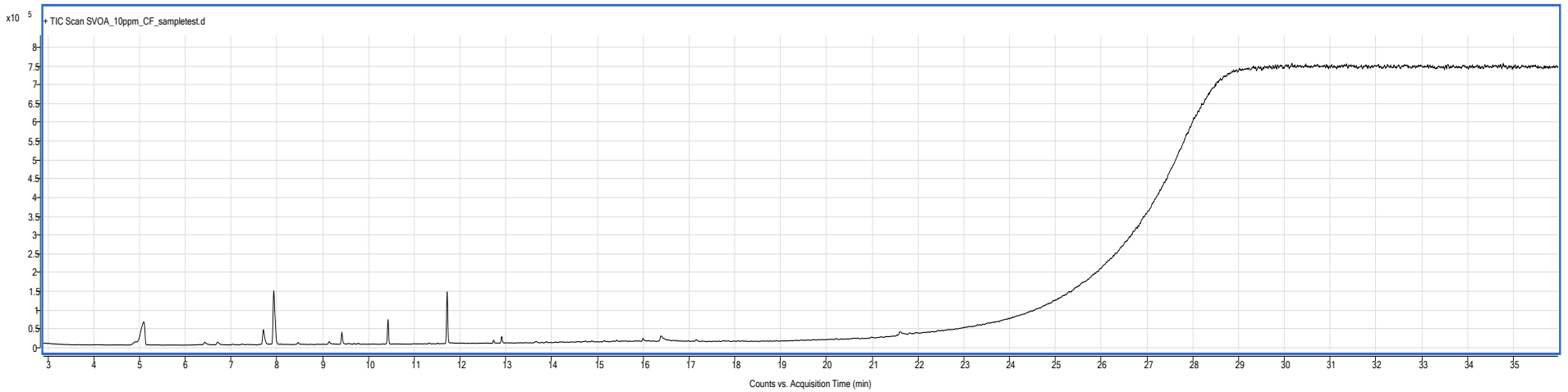
What could cause this?

- The wrong vial was injected: **Sequence and vial checked, no problem found**
- The sample has degraded: **A new vial of standard was used, no difference observed**
- The inlet is leaking: **A tune was performed. O_2, N_2, and H_2O levels were normal**
- The column is damaged: **“Well, I guess I need to replace my column”**



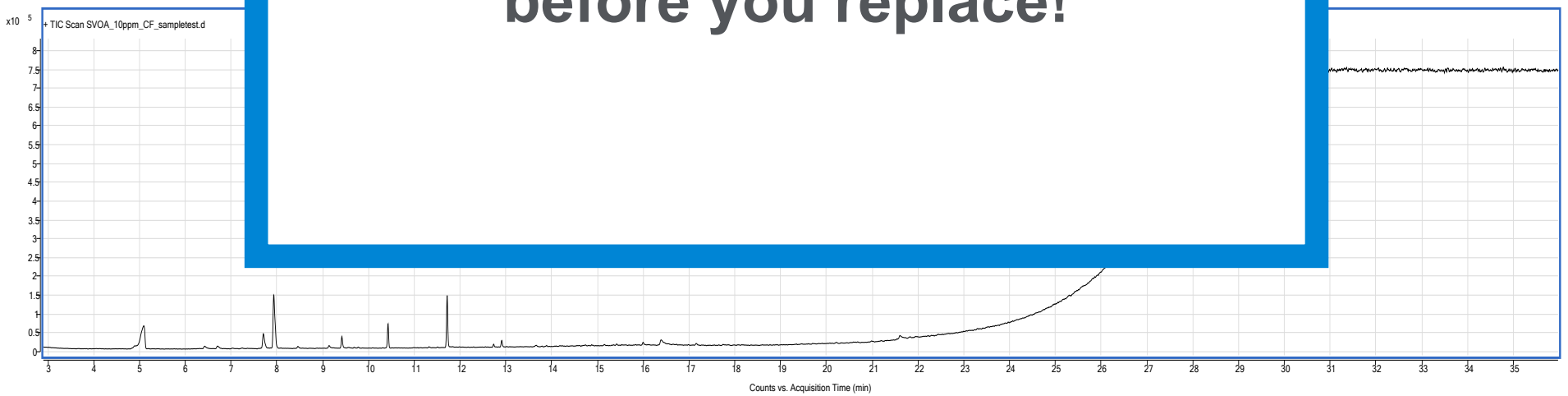
Problem: No Peaks with Semivolatiles Checkout Mixture

What could cause this?

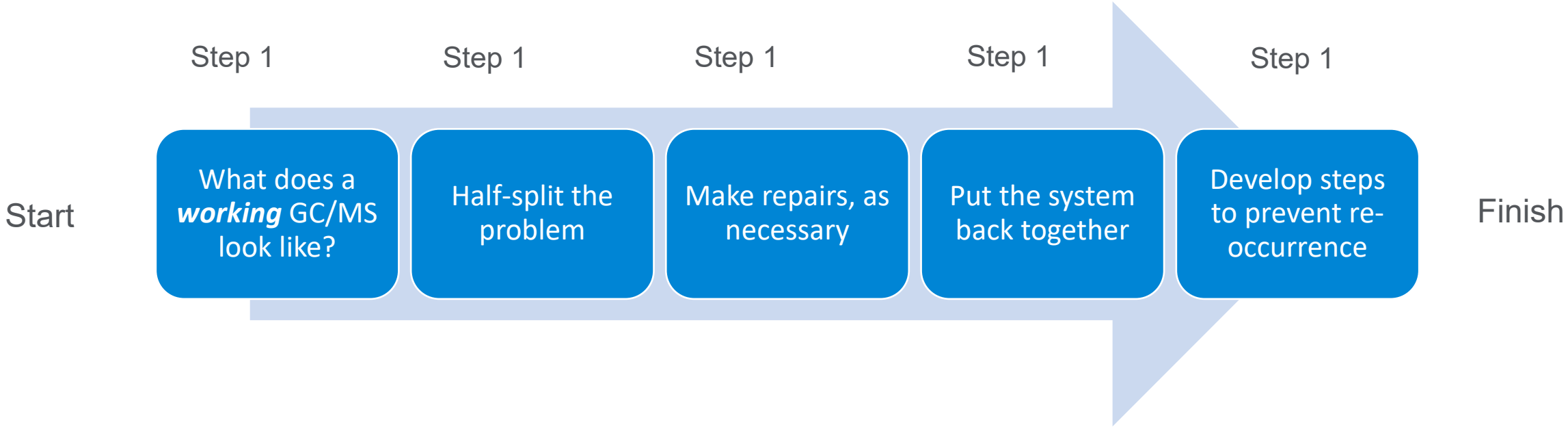
- The wrong vial was injected: **Sequence and vial checked, no problem found**
- The sample has degraded: **A new vial of standard was used, no difference observed**
- The inlet is leak **normal**
- The column is d

WAIT

Test (a few more things) before you replace!



Follow a Logical Troubleshooting Procedure!



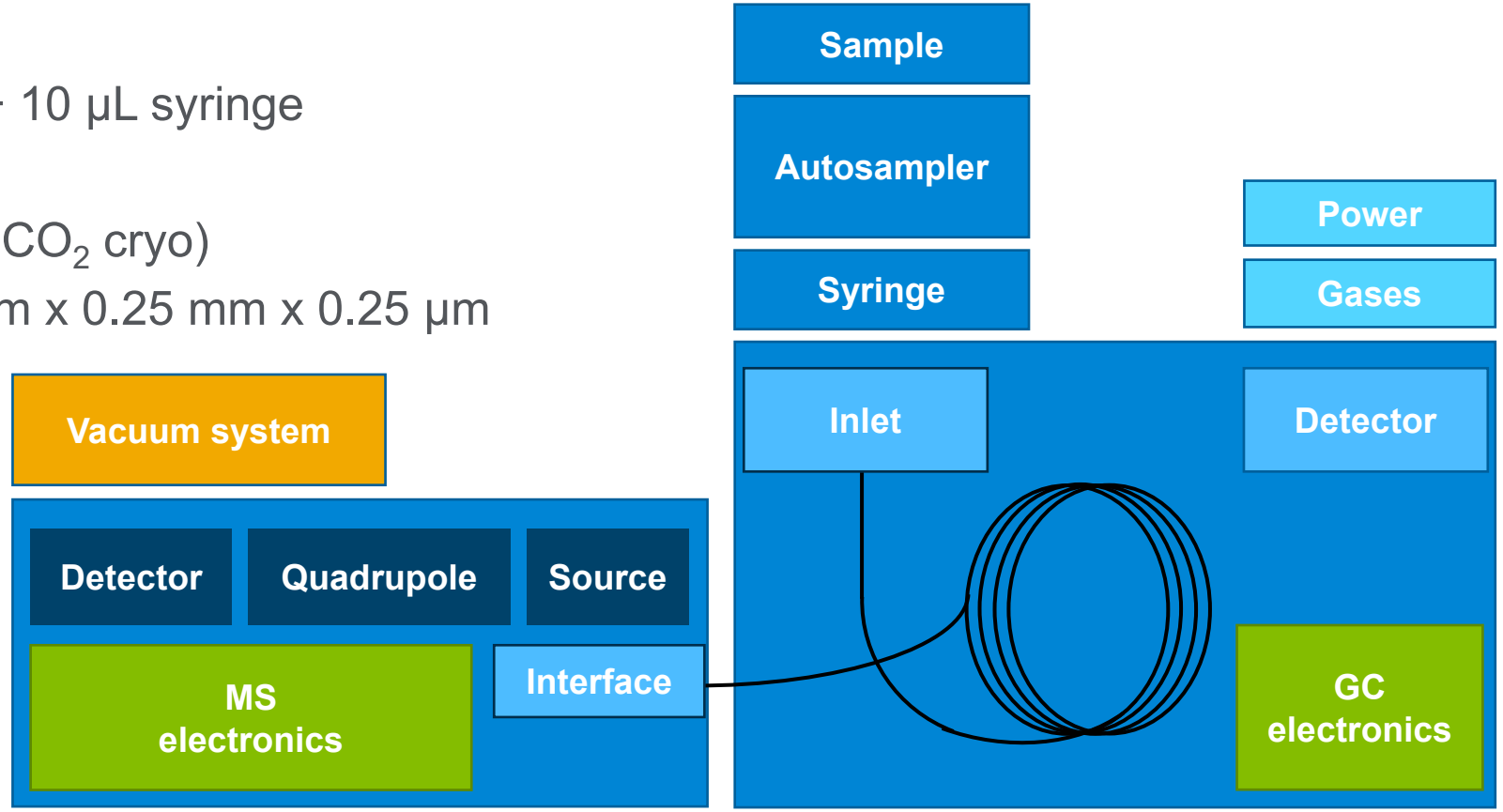
Troubleshooting Step 1: What is the “Working System”?

What does a ***working*** GC/MS look like? → Half-split the problem → Make repairs, as necessary → Put the system back together → Develop steps to prevent re-occurrence

What are the components of the GC/MS system?

Follow the sample flow-path

- Agilent 7693A autosampler + 10 µL syringe
- Agilent 7890B GC
- Agilent multimode inlet (with CO_2 cryo)
- Agilent J&W HP-5ms UI, 30 m x 0.25 mm x 0.25 µm
- Agilent 5977A series extractor GC/MSD



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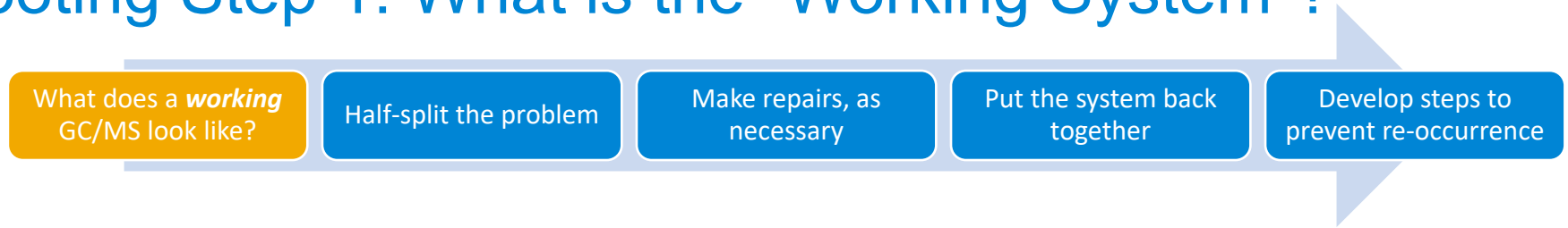
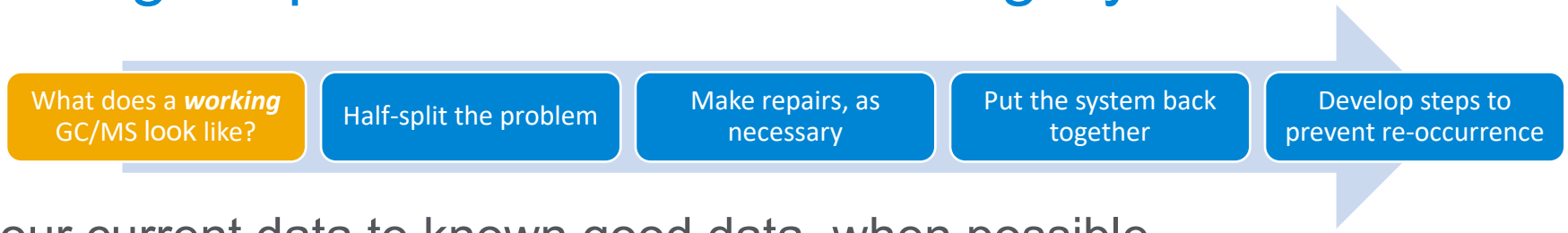


Compare your current data to known good data, when possible.
Use overlay to zero-in on differences.

- How does your background compare to normal?
- Does the problem occur for every run, every analyte, every method?
  Only affects certain samples/analytes/Instruments?
- Are the peaks smaller or larger than normal?
- Is the peak shape gaussian, or are the peaks splitting, tailing, or saturated?

Troubleshooting Step 1: What is the “Working System”?

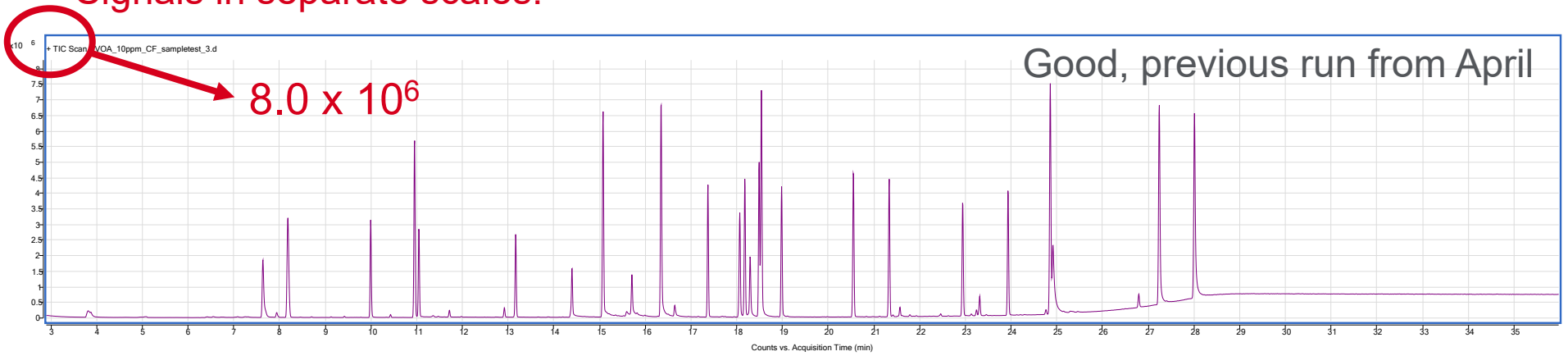


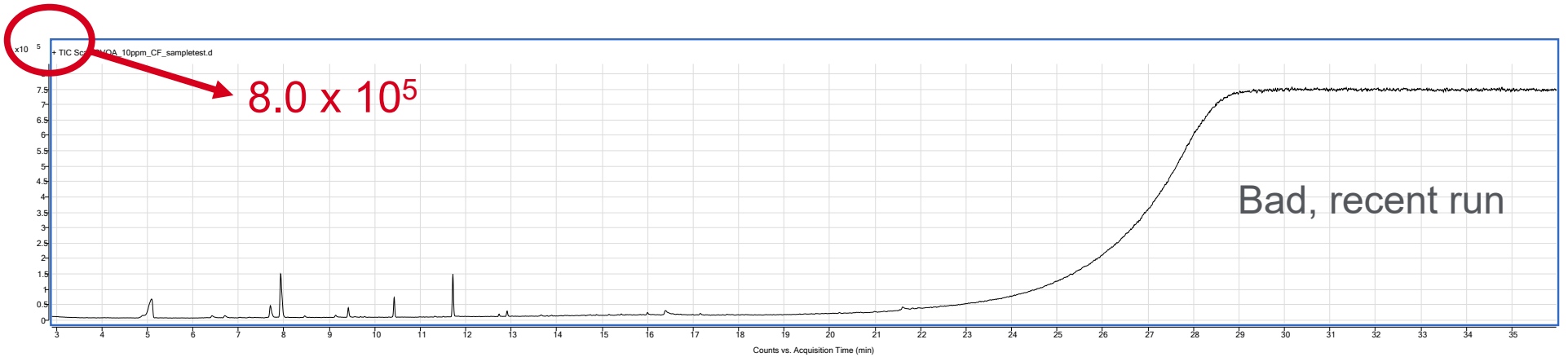
Compare your current data to known good data, when possible.

- How does your background compare to normal?
  Background looked **much** bigger than peaks in the good TIC
- Does the problem occur for every run, every analyte, every method?
  Only affects certain samples/analytes?
  Occurring on all checkout sample runs attempted
- Are the peaks smaller or larger than normal?
  Definitely smaller
- Is the peak shape gaussian, or are the peaks splitting, tailing, or saturated?
  Let’s find out

Troubleshooting Step 1: What is the “Working System”?

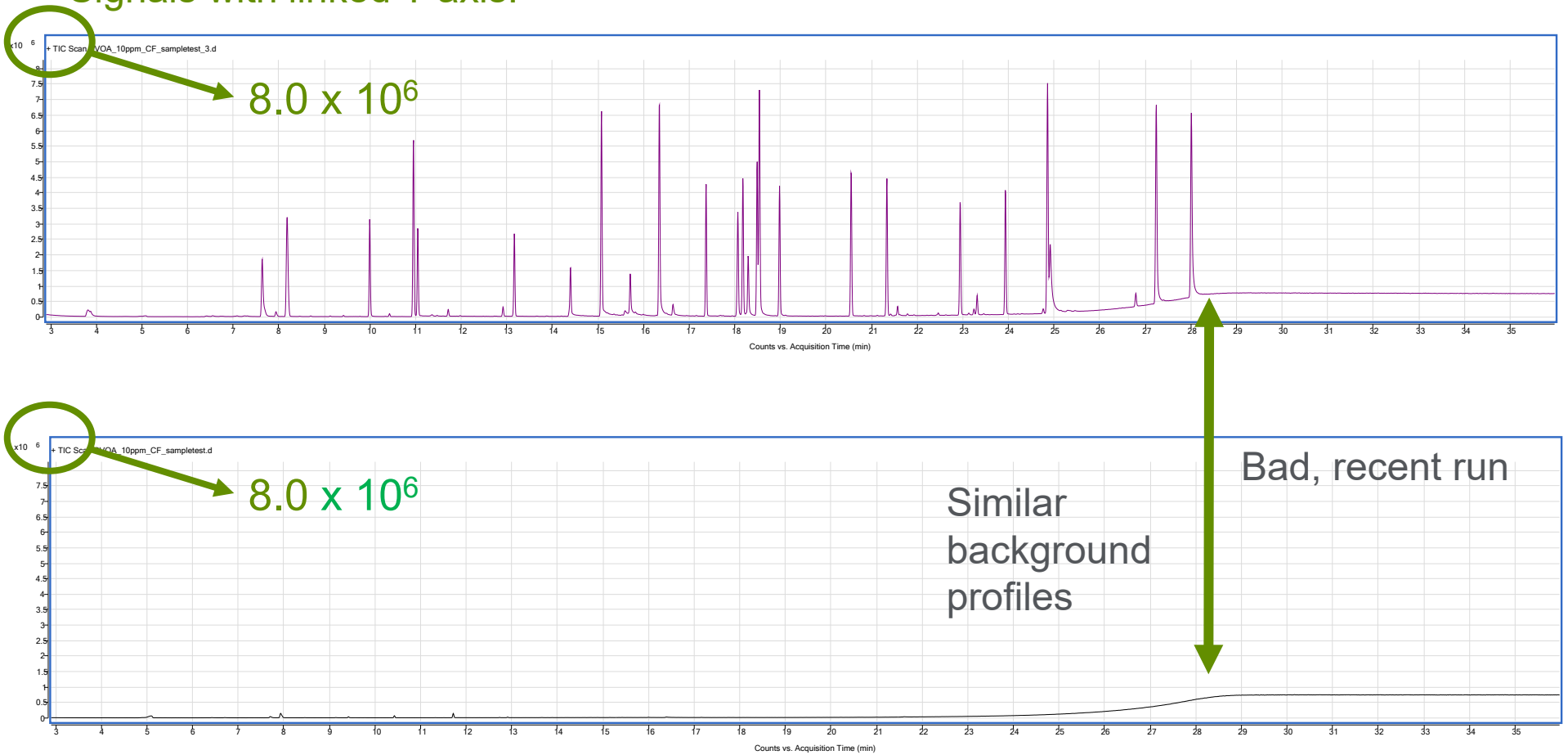
Compare your current data to known good data.
Now, the data is much clearer, and the background is not significantly higher.
Signals in separate scales:





Troubleshooting Step 1: What is the “Working System”?

Compare your current data to known good data.
Now, the data is much clearer, and the background is not significantly higher.
Signals with linked Y axis:



Troubleshooting Step 2: Break Apart (Half-Split) the Problem

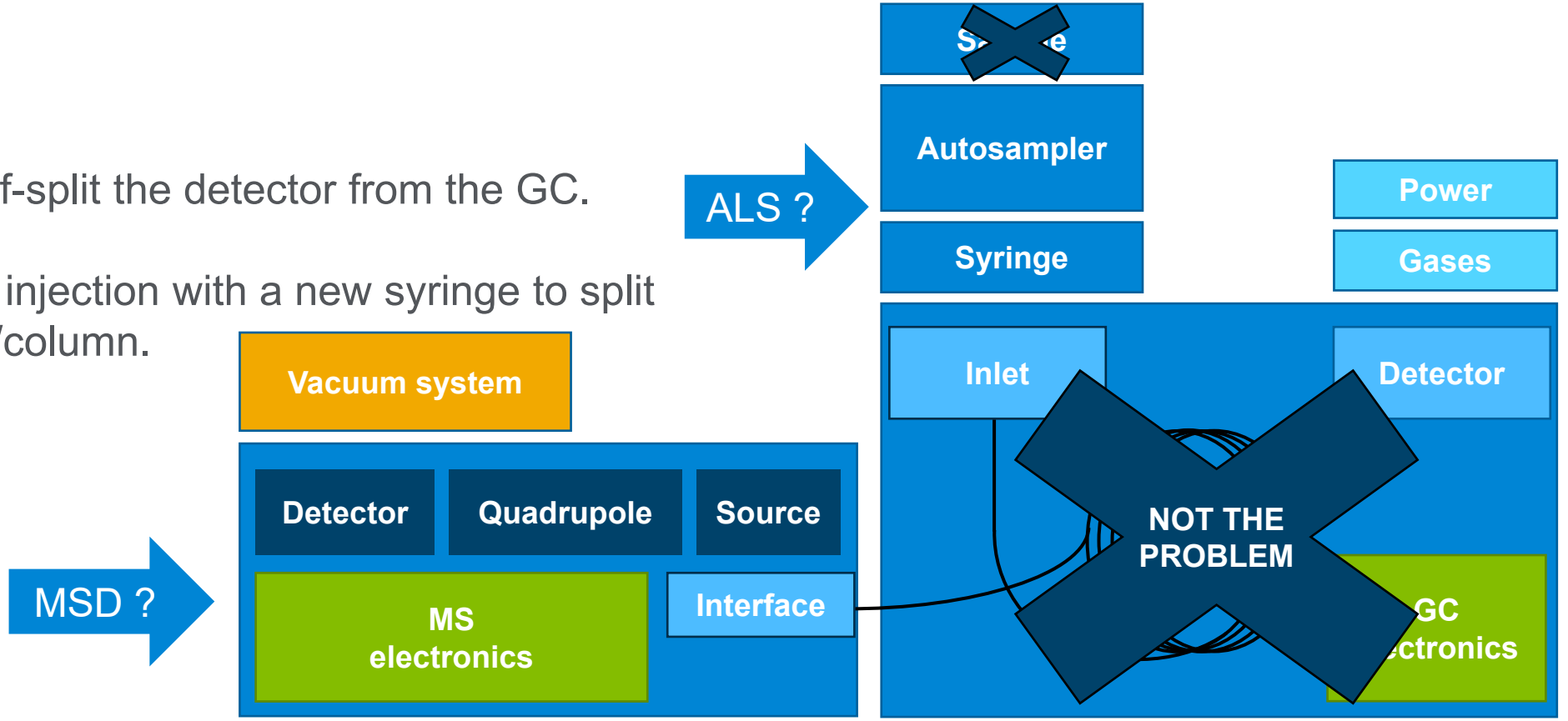
What does a ***working*** GC/MS look like? → **Half-split the problem** → Make repairs, as necessary → Put the system back together → Develop steps to prevent re-occurrence

Think of a set of tests that will break the system into smaller pieces.

1. Try a new sample.

2. Tune the MS to half-split the detector from the GC.

3. Perform a manual injection with a new syringe to split autosampler and inlet/column.



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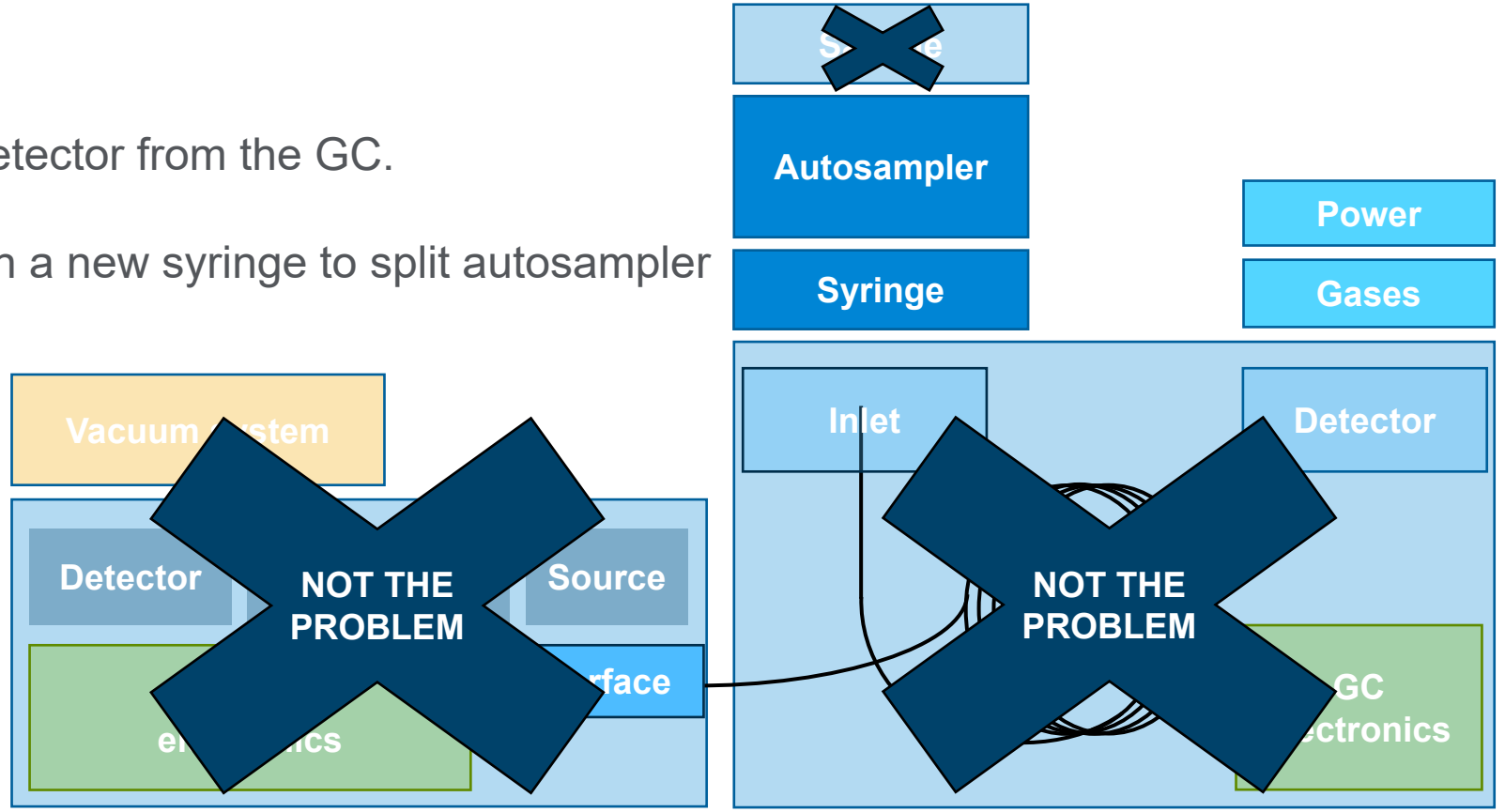

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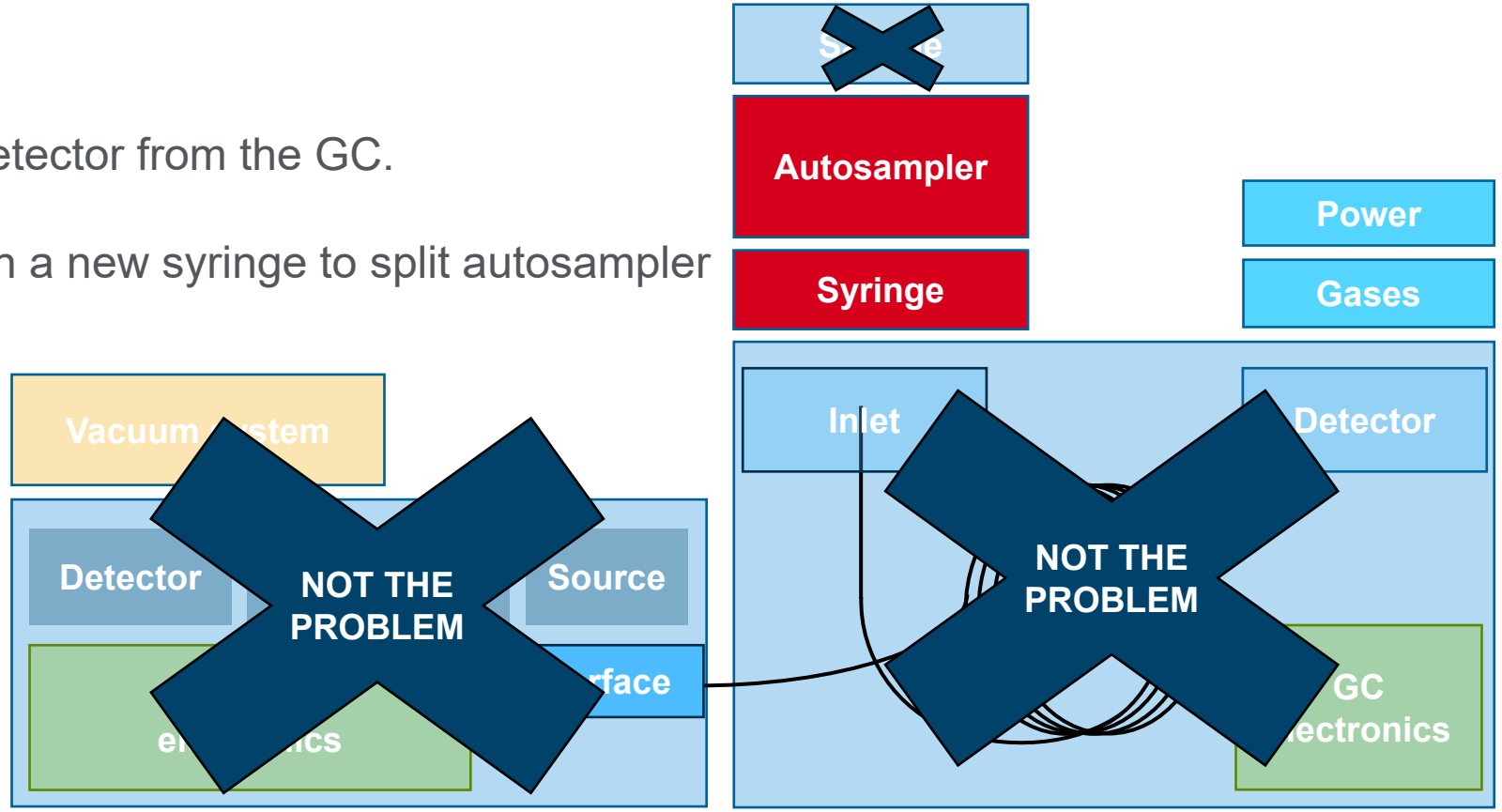


Troubleshooting Step 2: Narrow Focus of the Problem

What does a ***working*** GC/MS look like? | Half-split the problem | Make repairs, as necessary | Put the system back together | Develop steps to prevent re-occurrence

Let's focus on the autosampler and syringe:

Autosampler

Syringe

While sample was new, what is the solvent? Dichloromethane

What kind of syringe? Agilent 10 µL syringe, 23-26s/42/cone (G4513-80204)

Does the autosampler work? Autosampler turns and moves plunger up and down

Does the syringe pull up liquid? No, it doesn't

We may have found the problem!

Troubleshooting Step 3: Make the Repair

What does a ***working*** GC/MS look like? | Half-split the problem | **Make repairs, as necessary** | Put the system back together | Develop steps to prevent re-occurrence

Replace the syringe with a 10 µL PTFE tipped plunger syringe (G4513-80203) – a much easier repair than venting and changing the column.

PTFE tipped syringes are more chemically resistant and offer a reduced chance of carry over and longer syringe lifetime.

Proper syringe maintenance must still be performed. Clean and refill syringe wash vials frequently.

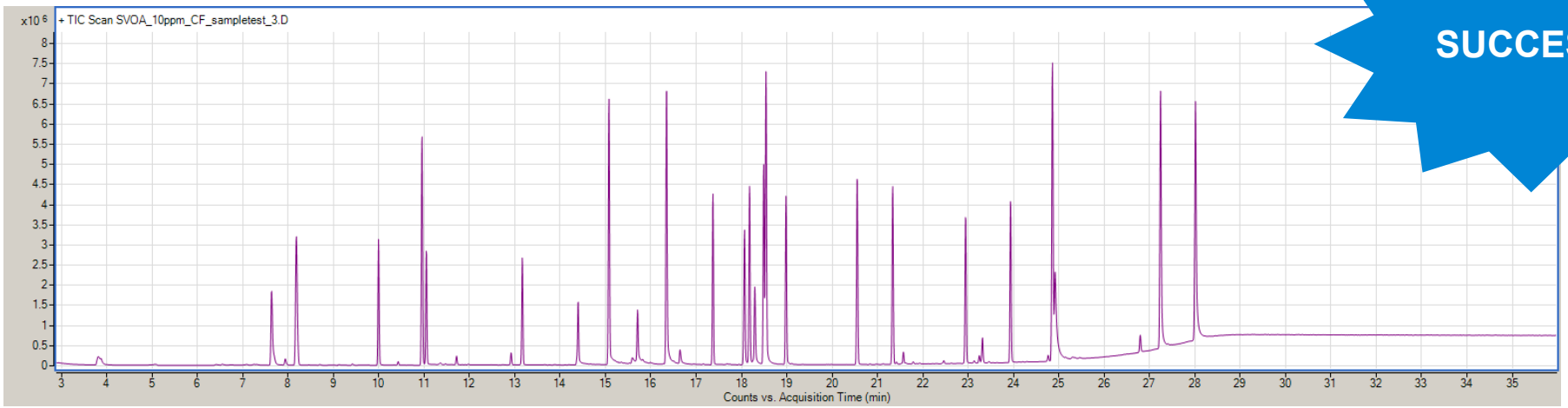
Beware highly concentrated samples and samples with particulates (organic material, salts, etc.)

Syringe

Troubleshooting Step 4: Put the System Back Together

What does a ***working*** GC/MS look like? | Half-split the problem | Make repairs, as necessary | Put the system back together | Develop steps to prevent re-occurrence

What happened with a new syringe?



SUCCESS!

Have a Good Troubleshooting Story? Let Us Know!

Please call or email us today to share a troubleshooting success story or if you need help troubleshooting!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Troubleshooting Tips

1. Isolate the problem

   (blank run, inject unretained compound, jumper tube test)

2. Change only one variable at a time

3. Compare before/after chromatograms

   (Peak shape, response, retention, baseline rise, background, look for trends, etc.)

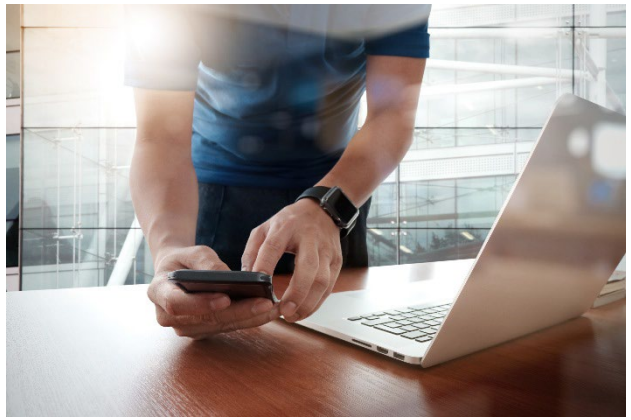
4. Utilize technical support

Remember

Complete system = carrier gas + injector + column + detector + data system

- Multiple causes and effects
- Do not change too many variables at once

Contact Agilent Chemistries and Supplies Technical Support



1-800-227-9770 Option 3, Option 3:

Option 1 for GC and GC/MS columns and supplies

Option 2 for LC and LC/MS columns and supplies

Option 3 for sample preparation, filtration, and QuEChERS

Option 4 for spectroscopy supplies

Option 5 for chemical standards

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lc-column-support@agilent.com

spp-support@agilent.com

spectro-supplies-support@agilent.com

chem-standards-support@agilent.com