

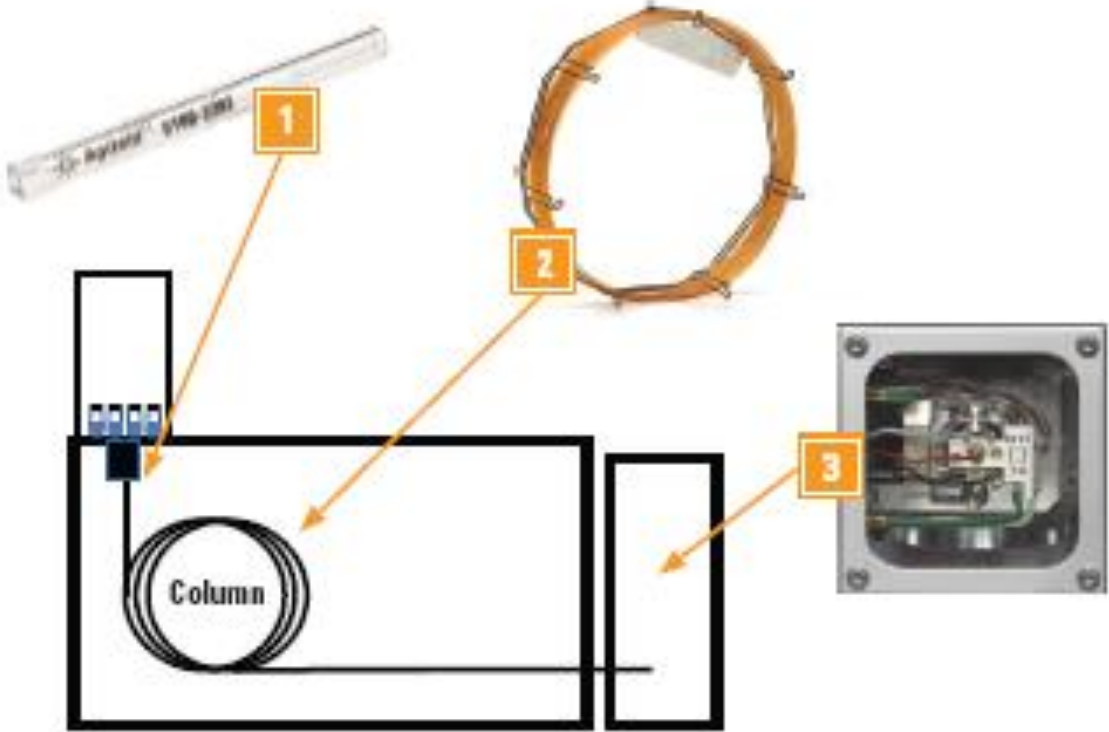
# Lower Detection Limits and Quantitate with Confidence with Breakthrough Ultra Inert Technology

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September 22, 2011

# Goals of the Presentation

1. Understand what it means to be *INERT*, and why it is important to have an inert flow path
2. Talk about the pieces of the flow path
  - Liner
  - Column
3. Inert MS Source
4. ??????

# Snapshot of Flowpath



# What is meant by inert?

According to Wikipedia....

To be in a state of doing little or nothing!

As it Pertains to Chromatography....

*Not Chemically Reactive*

# What Does GC System Inertness Look Like?

**Easier question: What does poor inertness look like?**

Symptoms of poor GC system inertness:

- \* Tailing peaks
- \* Reduced peak response
- \* No peak response
- \* Extra peaks!
- \* Poor linearity of a peak – usually at low concentrations
- \* Unstable detector baseline

# GC System Inertness

## What do we mean?

Problems with poor inertness usually limited to —“active” solutes.

**Tailing or breakdown of “benign” solutes is symptomatic of a more generalized system problem, usually related to gross contamination.**

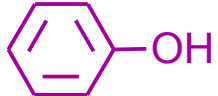


# GC System Inertness

## What do we mean?

Problems with poor inertness usually limited to **“active”** solutes.

For example:

Alcohols & Diols (-OH), Phenols () ,  
Amines (-NH<sub>3</sub>), Acids (COOH), Thiols &  
Sulfur in general like to tail.

Thermally labile and structurally **“strained”** solutes will breakdown or rearrange, e.g., DDT, Endrin, Carbamates, Nitroglycerines.



# Possible Inertness Problem Areas

## Inlet

- liner, liner packing, gold seal, stainless steel

## Consumables

- septa, syringe, vial, caps, inserts, solvents

## Column

## GC Detector

- source geometry, material, column interface, acquisition rates

## Temperatures

- inlet, transfer line, source, quads, oven

**Other method factors** i.e. samples and standards preparation



# What is the Surface Area Contribution to Overall Flowpath Inertness?

## GC Flowpath Surface Areas

	L (cm)	d (cm)	$\pi$	Surface Area (cm <sup>2</sup> )
Liner	7.85	0.4	3.142	9.86
Gold Seal		0.8	3.142	0.5
Column	3000	0.025	3.142	235.6

# Let's Start at the Inlet



# Liner Problems

Many chromatographic problems are blamed on the column.

Often, an active liner is the culprit.

## Symptoms include:

- Poor peak shape

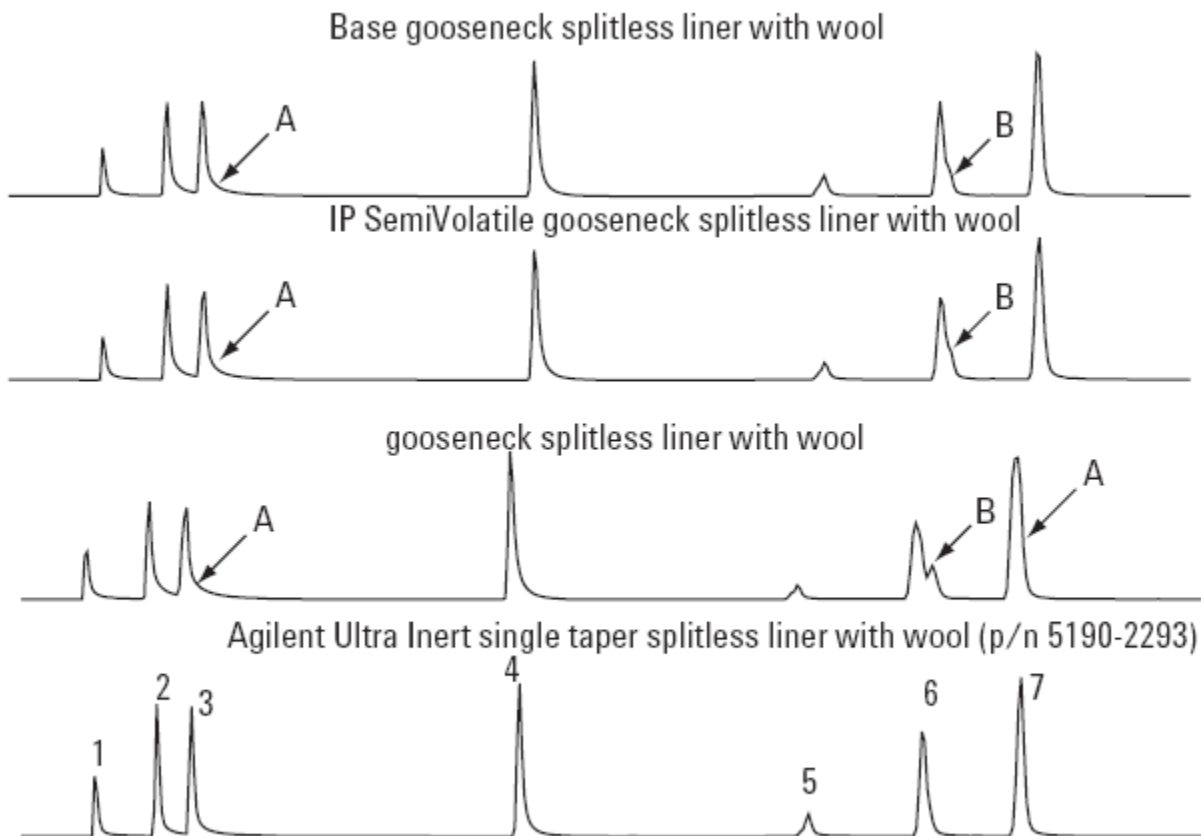
- Irregular baselines

- Poor resolution

- Poor response

- Extra Peaks

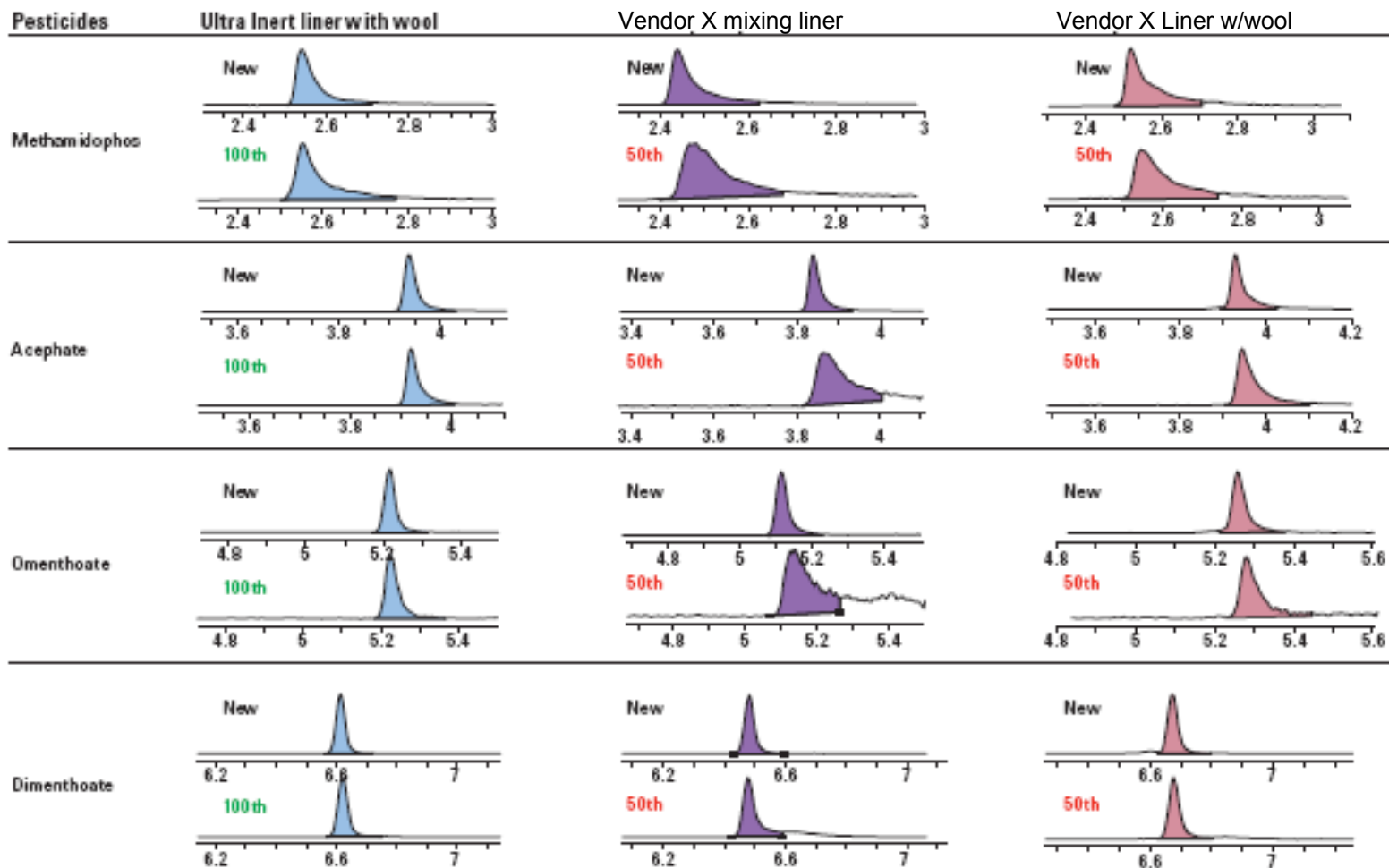
# Degradation in the Liner



1. Amphetamine
2. Phentermine
3. Methamphetamine
4. Nicotine
5. MDA
6. DMA
7. MDEA

Pub: 5990-7596EN

# Pesticides



# Liner Deactivation

1. Surface Preparation Treatment
2. Drying of the liner
3. Coating
4. Drying

# LINER DEACTIVATION

Prior to deactivation, surface must be cleaned with an acid leach step:

- Place liner in clean test tube
- Cover liner with 1N HCl or HNO<sub>3</sub> solution
- Soak for at least 8 hours (overnight is preferred)
- If acid solution is highly discolored, replace with clean solution and continue to soak until no color change is noted
- Do not soak liners for longer than 24 hours
- Rinse with deionized water followed by methanol
- Dry the liner at 100-150°C. *Do not exceed 150°C.*

# LINER DEACTIVATION

## Solution Silylation Procedure

Place liner in screw cap test tube

Cover liner with 10% TMCS or DMCS in toluene

Tightly seal with PTFE-lined cap

Allow to stand for at least 8 hours

Remove from solution and thoroughly rinse with toluene, then methanol

Dry the liner at 75-100°C

NOTE: Several liners can be done in one test tube, but rotate the tube several times to ensure that all surfaces are exposed to the solution.



# Ultra Inert GC Inlet Liners – ultimate deactivation performance

- Response levels / Inertness : 2,4-Dinitrophenol recovery
  - peak shape and signal to noise at trace levels (0.5 ppm)
- Robustness : Endrin / DDT Breakdown
  - < 20% breakdown of Endrin after a sequence of 100 injections -- not just the first injection
- Reliability / Linearity: Response factors of active compounds
  - over low level calibration range – 2 ng to 80 ng on column

# Reliability / Quality Assurance : Ultra Inert Liner *Certificate of Performance*

Lot to Lot Liner Reproducibility assured:

Each Ultra Inert deactivation lot is *Certified* to ensure consistent and efficient coverage using both acidic and basic probes at trace (2 ng) levels on column

*Certificate of Performance* with every liner is printed on a label ready to peel and stick into your laboratory notebook for easier compliance.

**Traceability:** Deactivation lot number and glass lot numbers are on the Certificate  
Part Number is permanently identified on the liner for fast and easy re-ordering

## *Certificate of Performance*

5190-2293 Ultra Inert Liner

Splitless, Sngl taper, Glass Wool

Liner Body Lot: 0023A

Deactivation Lot: B11002

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Tested for: 2ng 4-Aminopyridine  
2ng 2,4-Dinitrophenol

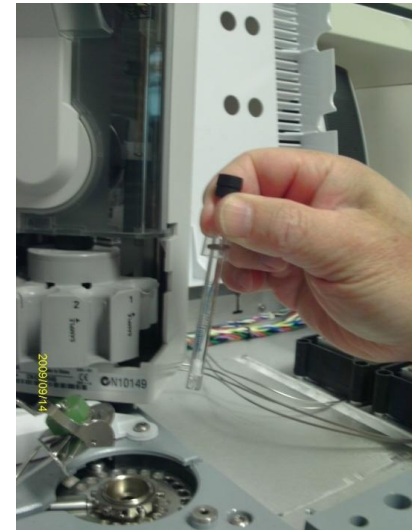
# More Benefits of Ultra Inert Deactivated Liners

## Unequaled Reproducibility

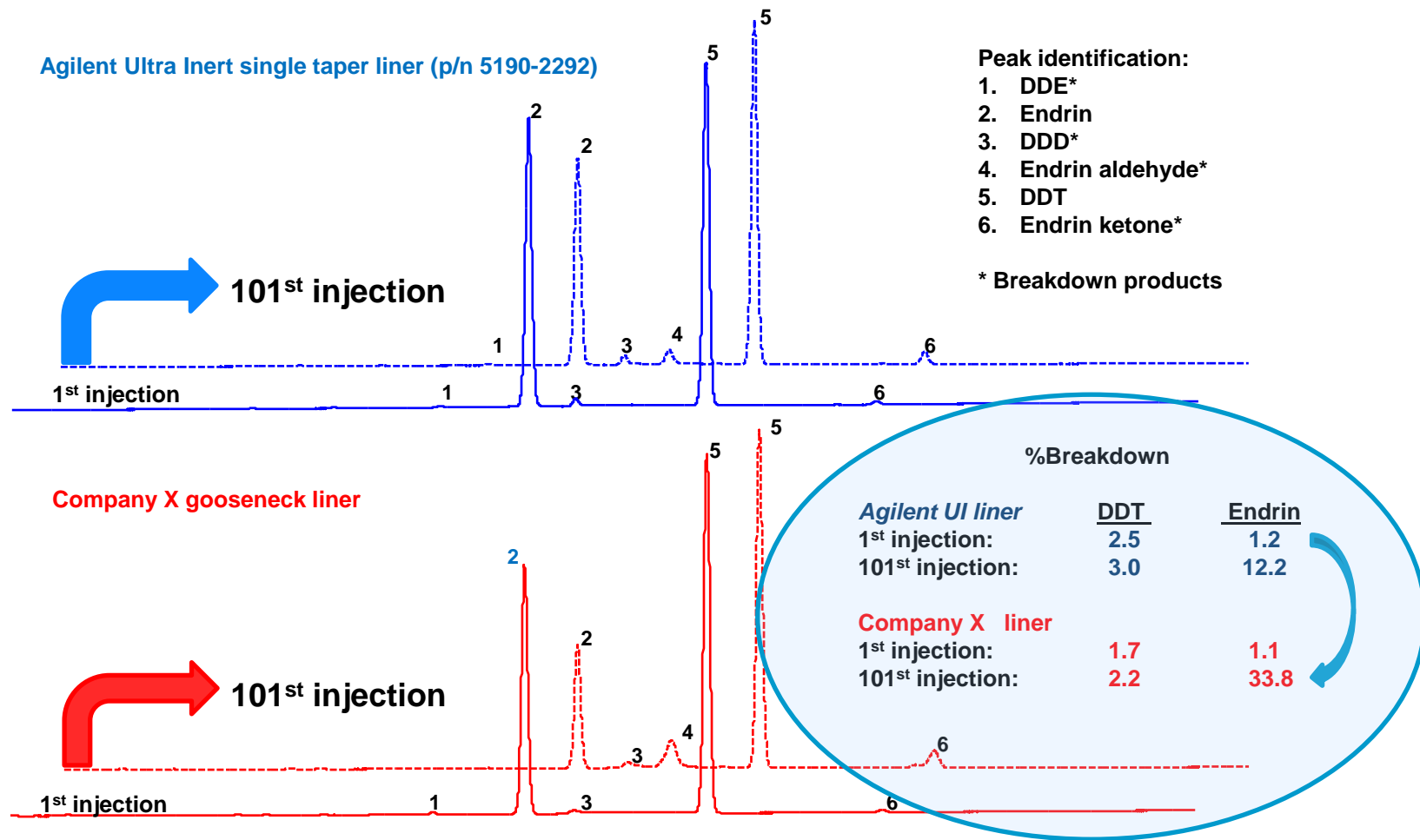
- Lot testing ensures reproducible coverage of deactivation
  - QC test with probes selected to reveal activity
  - QC method tailored to test liner -- not column or system -- inertness
- Lab notebook friendly **Certificate of Performance** on a **sticker** shipped with each liner

## Ease of Use with exclusive Touchless™ packaging...

- Plasma treated Non-Stick **O-ring** is **preinstalled** on the liner
- Packaging is Pharmaceutical grade PTEG tubing approved by GCMS extraction testing for cleanliness
- Install new liner with O-ring without touching – or risk contaminating – the new, clean Ultra Inert liner



# Robustness: Endrin Decomposition Test

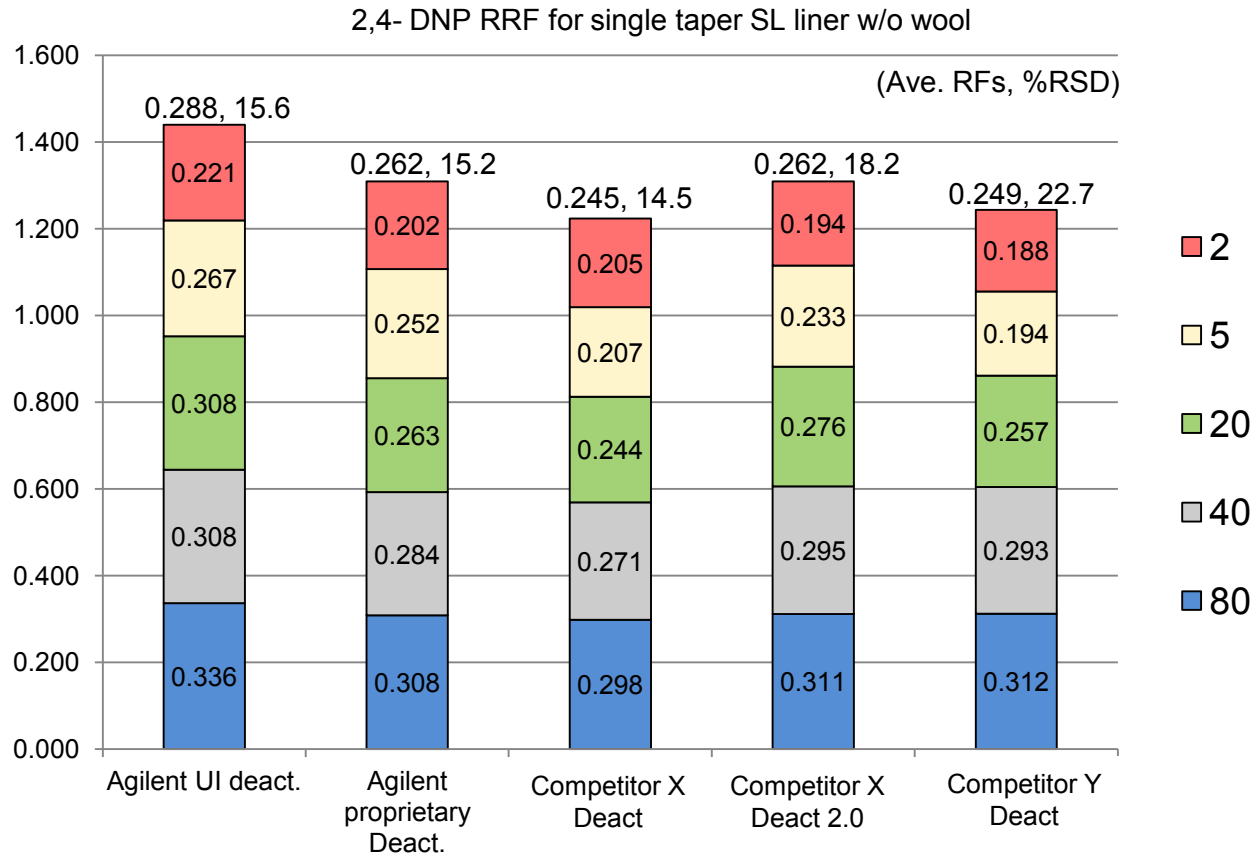


Pass/Fail criteria : < 20% degradation

Agilent **Ultra Inert** deactivation **passes** Endrin/DDT decomposition test after 100 injections

# Semi Volatile critical component : 2, 4 DNP

## Comparison of splitless single taper liners without wool



Response Factors (FID) over calibration range (2-80 ng on column)

# Glass Wool, or No Glass Wool?

Provides a lot of additional surface area to help with sample mixing and volatilization

Helps trap non-volatile residues which minimizes the amount that gets into the column

**Provides a lot of additional surface area**

# Semivolatile Activity Comparison

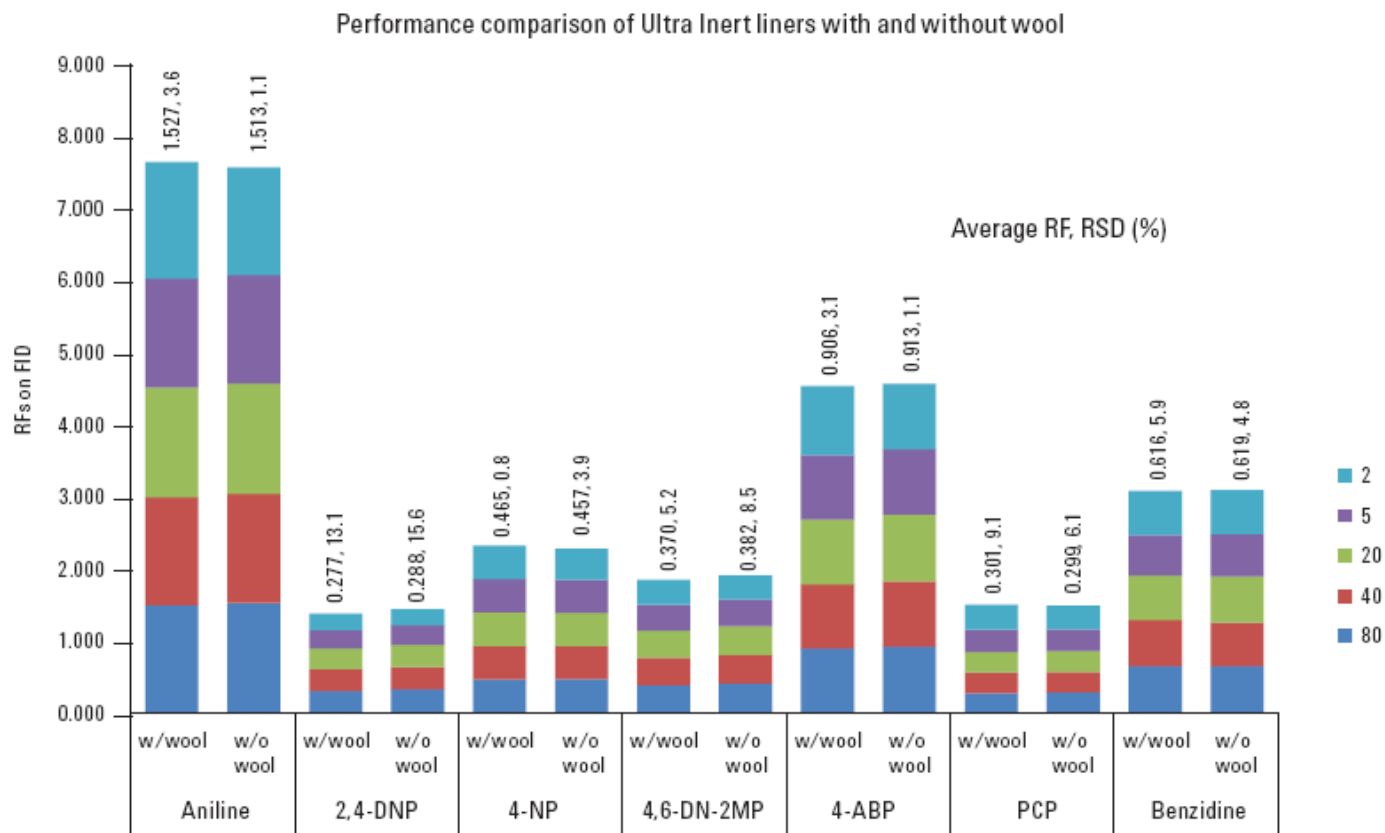
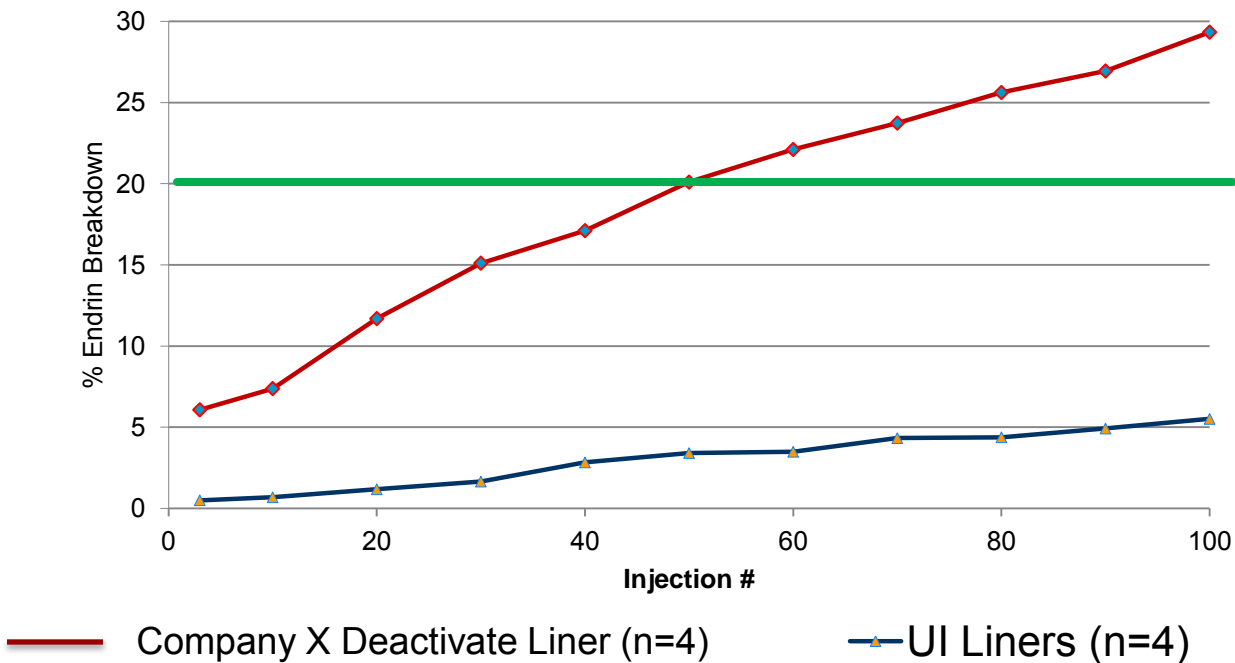


Figure 6. Performance comparison of Agilent Ultra Inert deactivated liner with wool (p/n 5190-2293) and Ultra Inert deactivated liner without wool (p/n 5190-2292).

PUB: 5990-7381EN

# Robustness: Endrin Breakdown on Liners with Wool

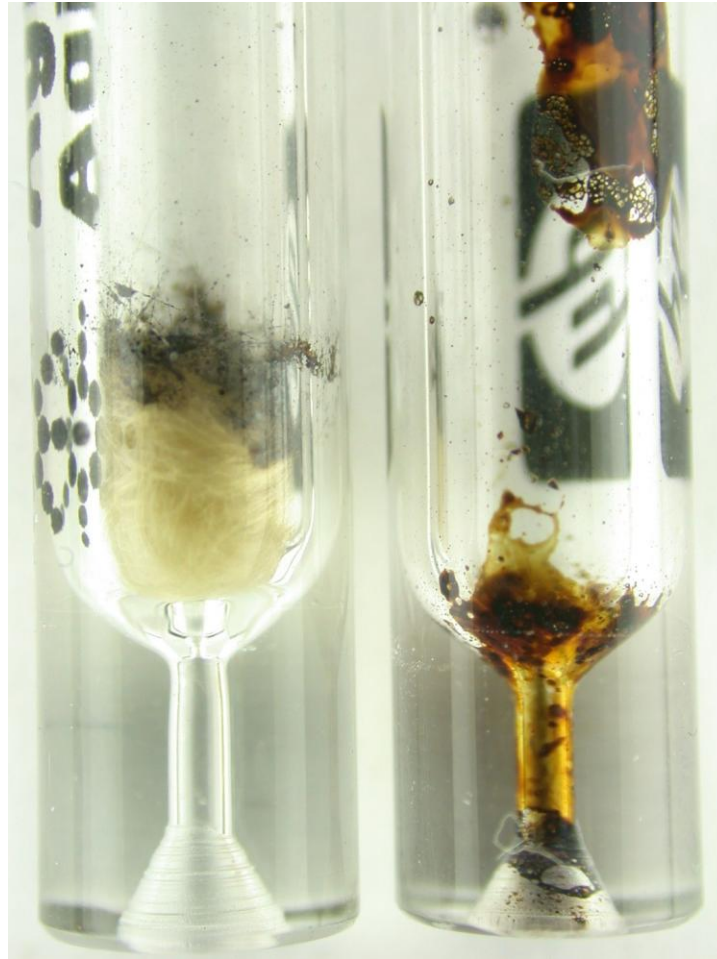
Endrin: 100 ppb  
Liner type: Splitless single taper liners **with wool**  
Detector: ECD



Exceptional inertness maintained through a sequence of 100 injections



Just Because you can't see it, doesn't mean it's not there.....



# Ultra Inert Liners Available for non-Agilent GC's

## Agilent CrossLab

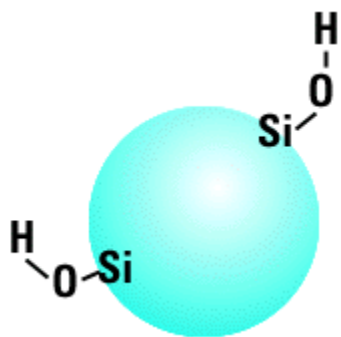
### We currently support:

- Bruker, Varian\*
- CTC
- PerkinElmer
- Shimadzu
- Thermo Scientific
- And more coming soon

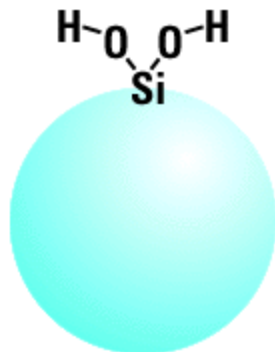


# Where does column activity come from?

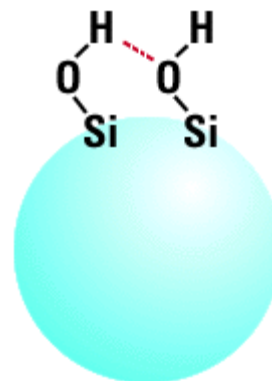
Isolated



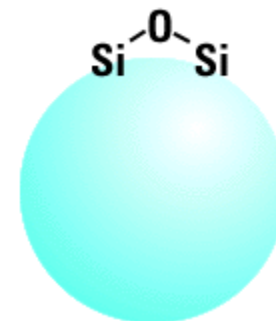
Geminal



Vicinal



Siloxane



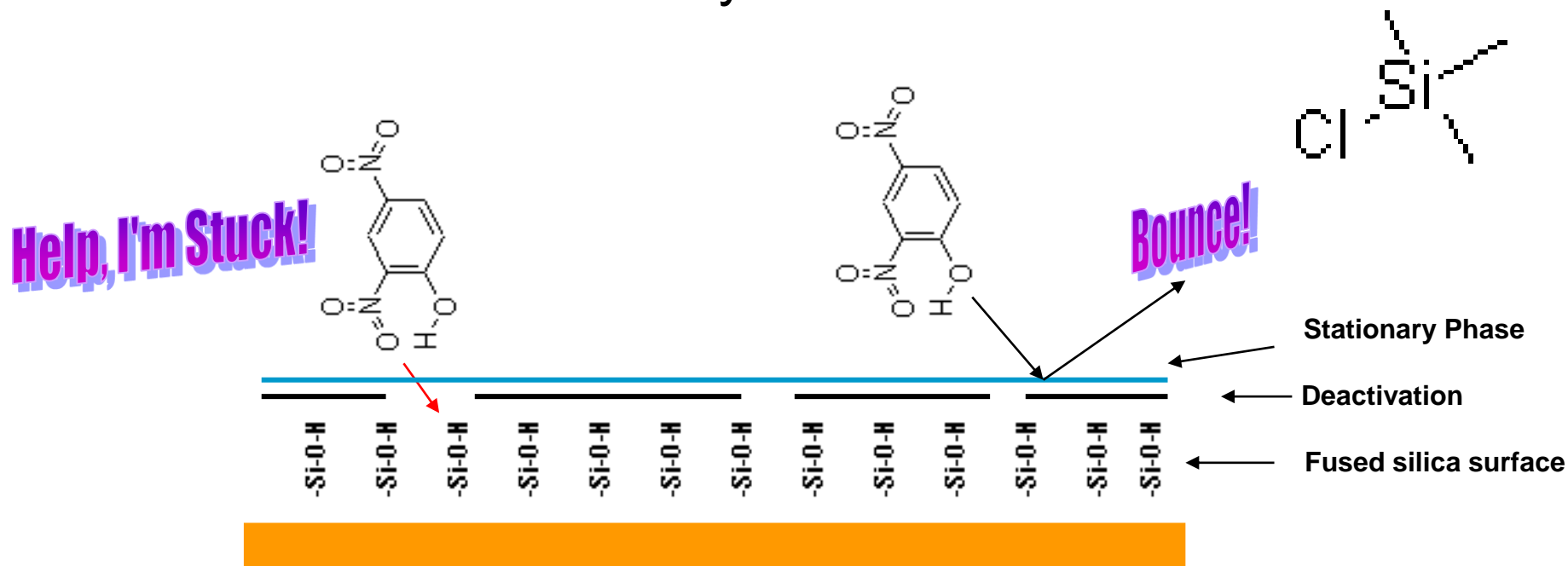
Sterically difficult to cap all of them—estimates 40-65% capped with traditional deactivation.

Non-traditional sources such as trace impurities in starting materials and manufacturing lines.

# Traditional Deactivations

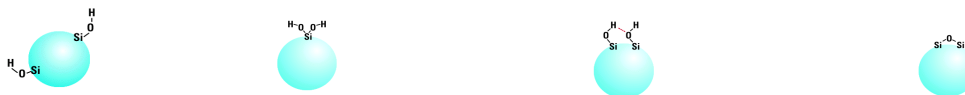
Dichlorodimethylsilane, various silazanes, etc... —end caps”

Traditional deactivation has gaps in surface coverage due to bulky TMS type moieties, and tight fused silica lattice, and is somewhat inert and chemically resistant.

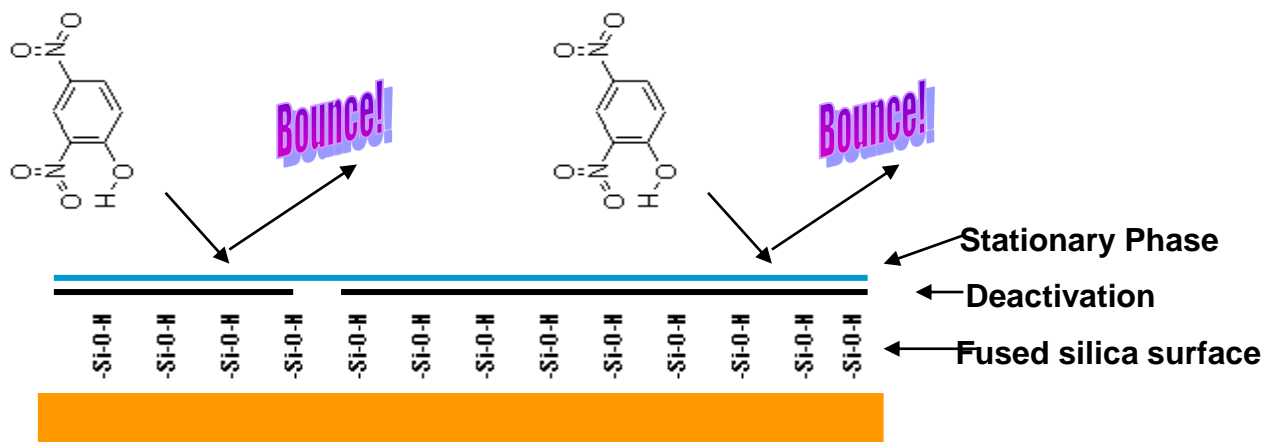


# DB-5ms and HP-5ms Engineered Deactivations

## Polymeric Deactivation Technology



—“Binds” at multiple points with many silanols



—“Blocks” sterically hindered active silanols, fewer silanols

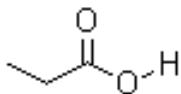
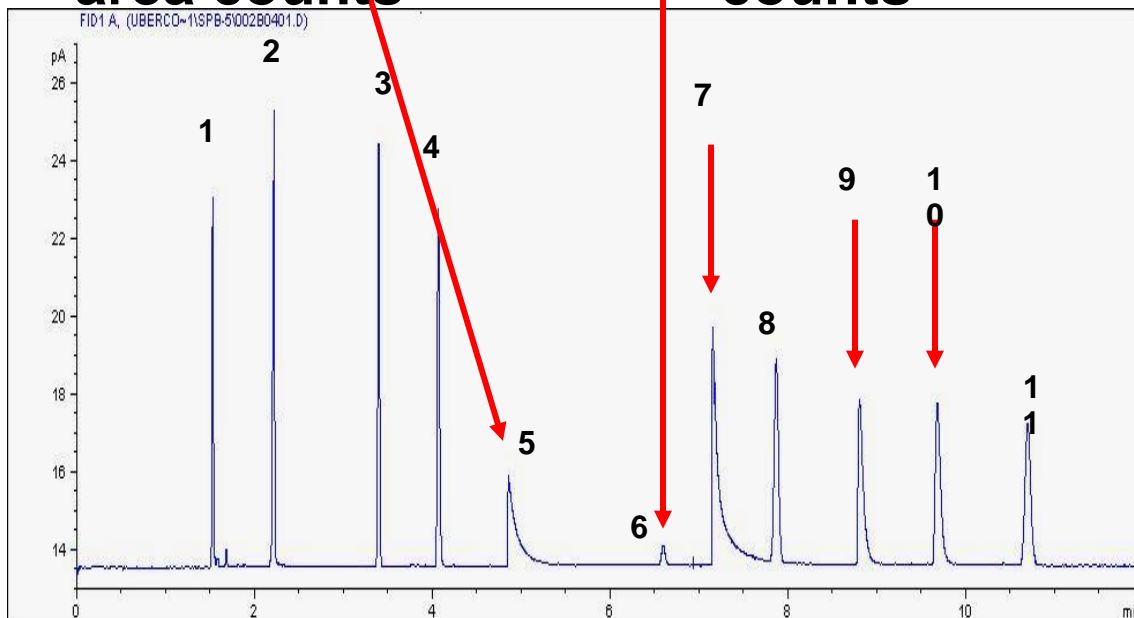
# What does Column Activity look like?

Tailing, and loss of response.

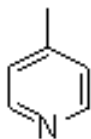
**Loss of peak height, but same area counts**

**Loss of peak height and area counts**

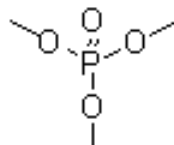
	Probe	0.5 ul inj, 1:50 split, (ng)
1	Methane	?
2	Propionic Acid	7.0
3	Octane	2.4
4	Nitrobutane	4.9
5	4-Picoline	2.7
6	Trimethyl Phosphate	12.7
7	1,2-Pentandiol	5.4
8	Propylbenzene	2.2
9	1-Hetpanol	3.3
10	3-Octanone	3.0
11	Decane	2.2



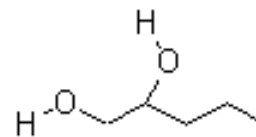
2



5



6



7

# What are the specific benefits of High Inertness?

Greater sensitivity for traditional trace active analytes

meet RRF requirements with greater ease

more runs before maintenance

Greater reliability for ultra-trace non-traditionally active analytes (<100 ppb PAHs, Chlorinated dioxins, etc...)

# Who benefits from 'Ultra' Inert Columns?

Anyone doing trace analysis of active analytes

Environmental semivolatile analysts

Pesticide residue analysts

Forensic/Drugs of abuse analysts

Anyone in Industry, Government, or Academia interested in **ultra-trace amounts of even modestly active analytes**

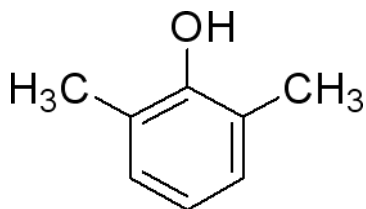




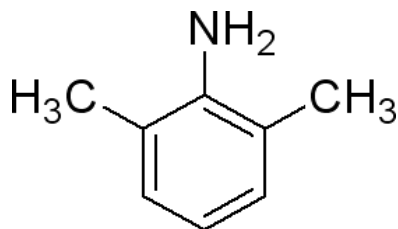
# Test Probes and Column Activity QC Testing

- Test probes are vital to ensure the quality and reproducibility of GC columns
  - Properly deactivated
  - Contain the correct amount of stationary phase
  - consistent batch-to-batch relative retention time
- Test probes can either highlight or mask the deficiencies of a column, normally include:
  - An organic acid (peak tailing or lost response of acid indicates the column is basic)
  - A base (peak tailing or lost response of base indicates the column is acidic)
  - An alcohol (gives indication of any oxygen damage or exposed silanols)
  - Non-active probes (e.g. alkanes)
- Good test probes allows the probative portion of the test module to penetrate and fully interact with the columns stationary phase and surface.
  - Low molecular weight
  - Low boiling points
  - No steric shielding of active group

# Weak Probes vs. Strong Probes



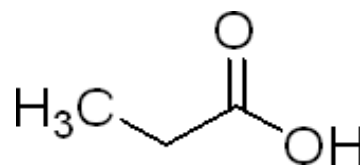
2,6-Dimethylphenol



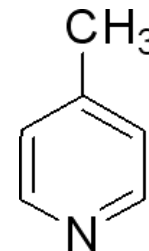
2,6-Dimethylaniline

## Weak Probes

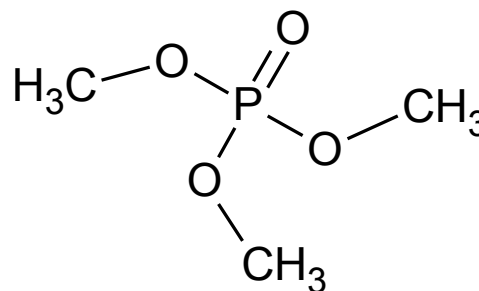
Acidic and basic portion of the molecules are shielded by the methyl groups of the 2,6-dimethyl substituted phenyl ring



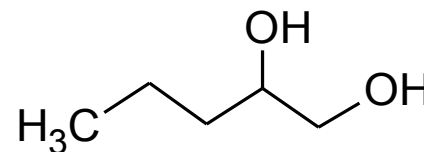
1-Propionic acid



4-Picoline



Trimethyl phosphate



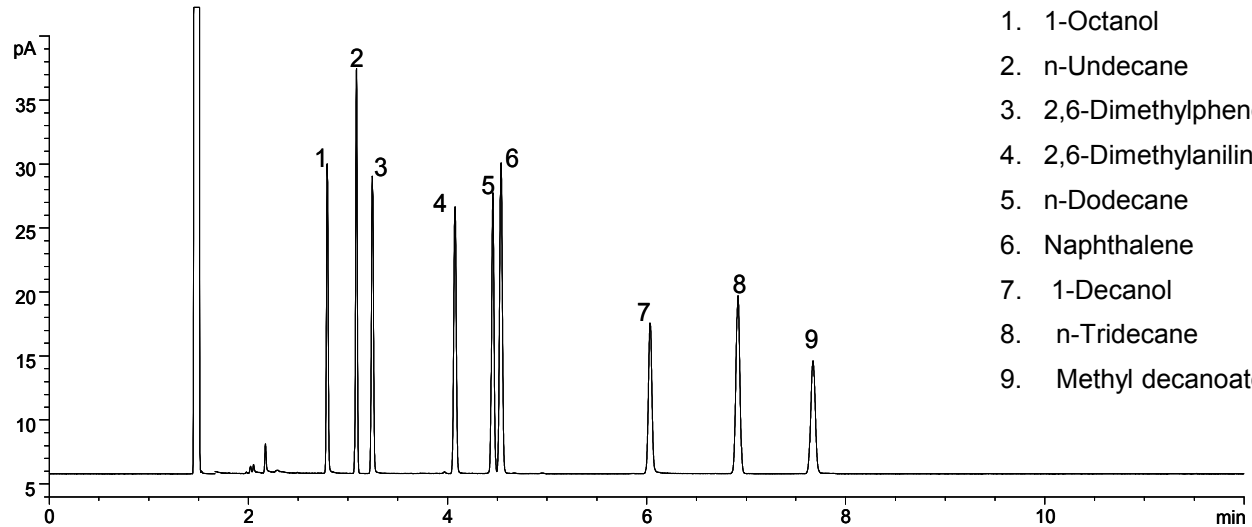
1,2-Pentandiol

## Stronger Probes

Active end of each compound is available to interact with any active sites on the columns

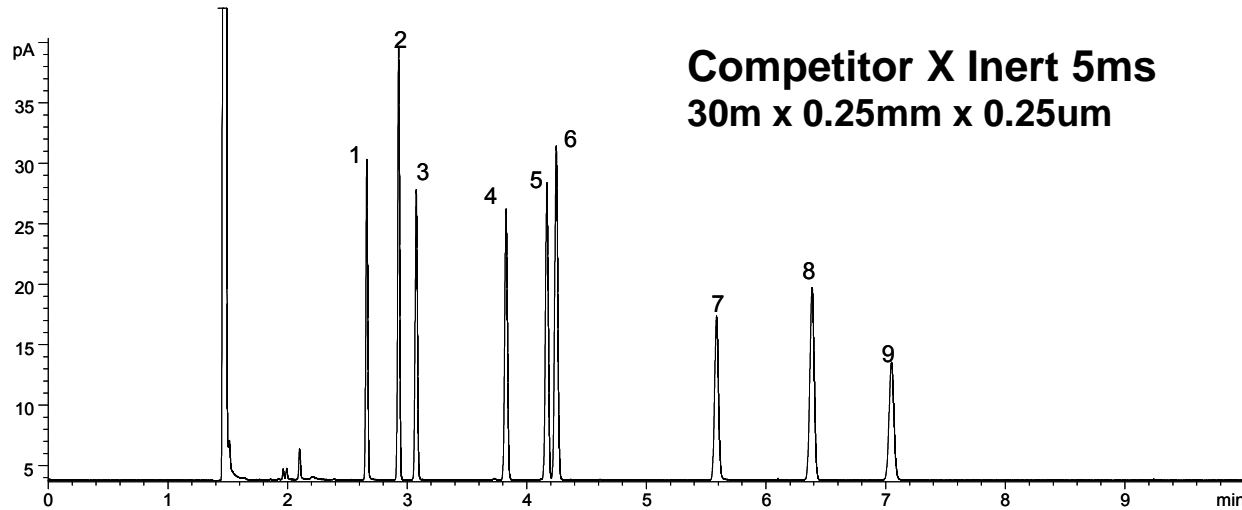
# Grob-Type Mix - QC Testing of the 80s

**Agilent J&W DB-5ms  
Ultra Inert  
30m x 0.25mm x 0.25um  
(P/N 122-5532UI)**



1. 1-Octanol
2. n-Undecane
3. 2,6-Dimethylphenol
4. 2,6-Dimethylaniline
5. n-Dodecane
6. Naphthalene
7. 1-Decanol
8. n-Tridecane
9. Methyl decanoate

- Less demanding test mix
- Less probative probes for column activity
- Elevated oven temperature at 120°C allows the molecules to sweep past active sites and mask solute/column interactions.



**Competitor X Inert 5ms  
30m x 0.25mm x 0.25um**

Sampler: Agilent 7683B, 5 µL syringe (Agilent part # 5181-1273), 1.5 µL split injection, 4 ng each component

Carrier: Hydrogen constant pressure 37 cm/s

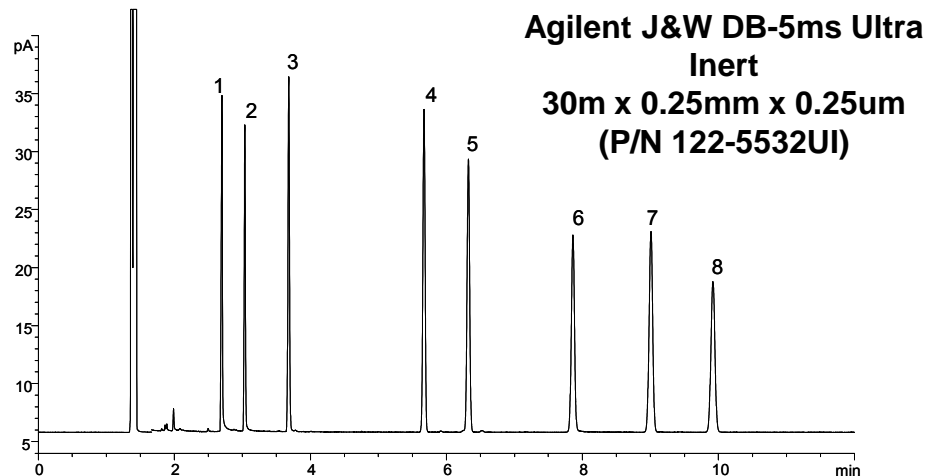
Inlet: Split/splitless; 250 °C, 1.4 ml/min. column flow, split flow 100 ml/min.

Liner: Deactivated single taper w glass wool (Agilent part # 5183-4647)

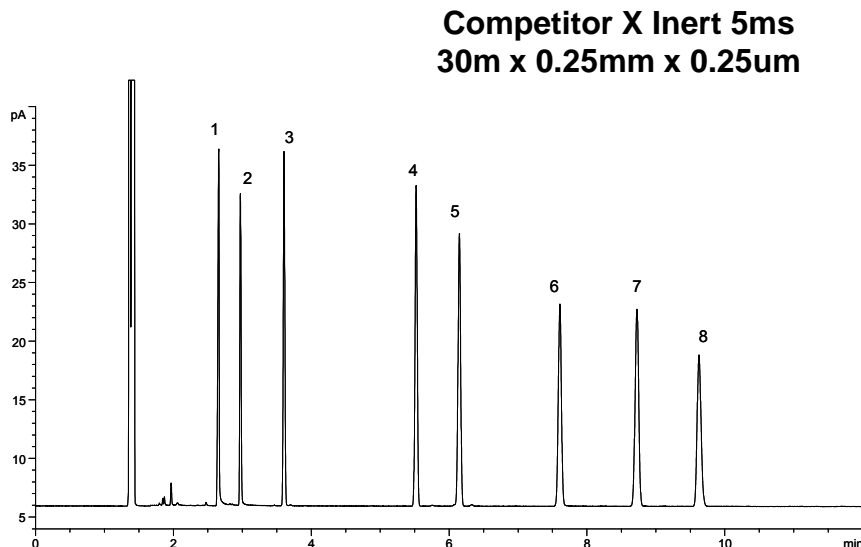
Oven: 120 °C isothermal

Detection: FID at 325 °C, 450 ml/min. air, 40 ml/min. hydrogen, 45 ml/min. nitrogen makeup

# DB-5ms Test Mix – QC Testing of the 90s



1. 2-Ethylhexanic acid
2. 1,6-Hexanediol
3. 4-Chlorophenol
4. Tridecane
5. 1-Methylnaphthalene
6. 1-Undecanol
7. Tetradecane
8. Dichlorohexylamine



Carrier: Hydrogen constant pressure 38 cm/s  
Inlet: 25°C Split flow 75 mL/min  
Liner: Deactivated single taper w/wool (5183-4647)  
Oven: 125°C Isothermal  
Detector: FID, 320°C. 450 mL/min Air, 40 mL/min H<sub>2</sub>, 45 mL/min N<sub>2</sub> Makeup

# Ultra Inert Test Mix – QC Testing for Today's Demanding Applications

Probe	(ng on column)	Column functional test
1. 1-Propionic acid	1.0	Basicity
2. 1-Octene	0.5	Polarity
3. n-Octane	0.5	Hydrocarbon marker
4. 4-Picoline	1.0	Acidity
5. n-Nonane	1.0	Hydrocarbon marker
6. Trimethyl phosphate	1.0	Acidity
7. 1,2-Pentanediol	1.0	Silanol
8. n-Propylbenzene	1.0	Hydrocarbon marker
9. 1-Heptanol	1.0	Silanol
10. 3-Octanone	1.0	Polarity
11. n-Decane	1.0	Hydrocarbon marker

- Carefully selected very demanding test probes for in-depth evaluation of column inertness
- Test temperature 65° C (isothermal), well below that normally used in conventional tests

**Sampler:** Agilent 7683B, 0.5 µL syringe (Agilent part # 5188-5246), 0.02 µL split injection

**Carrier:** Hydrogen constant pressure, 38 cm/s

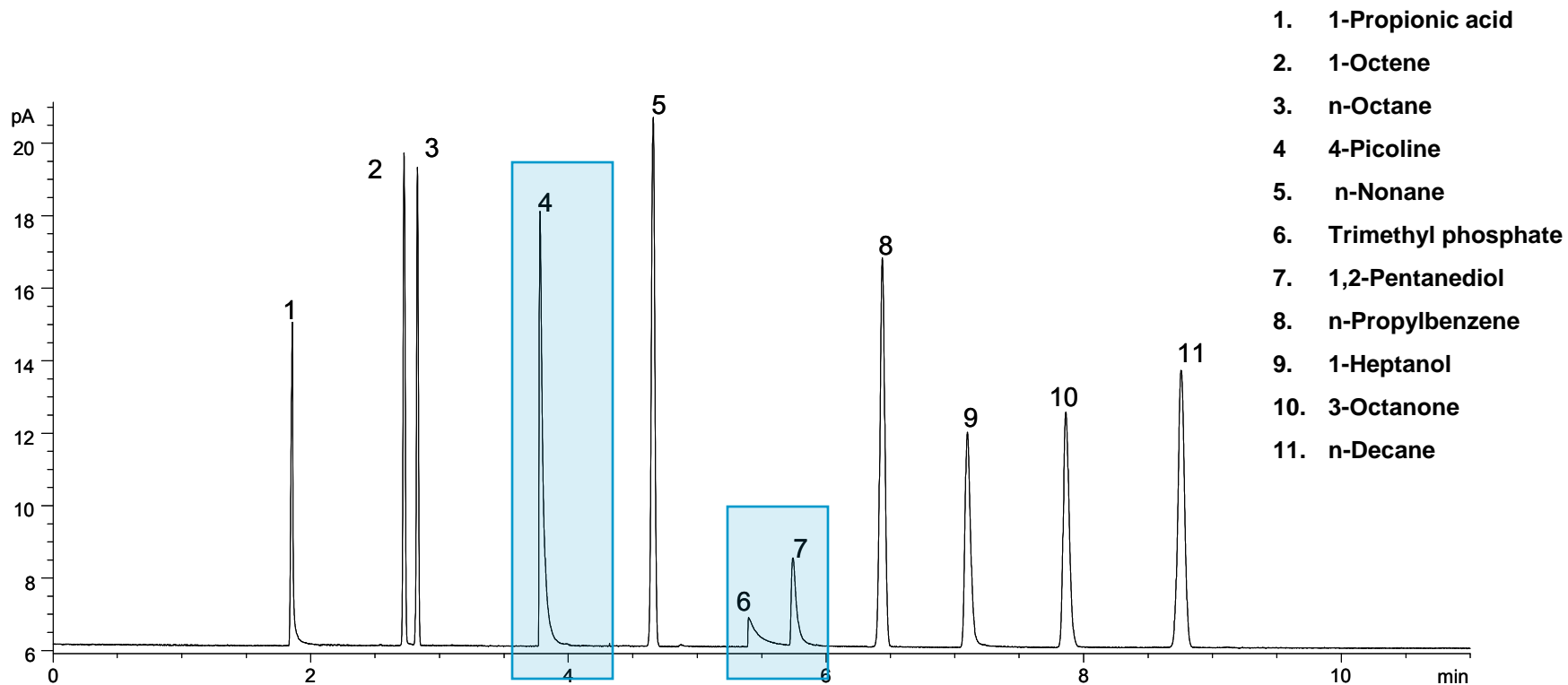
**Inlet:** Split/splitless; 250 °C, 1.4 ml/min. column flow, split flow 900 ml/min., gas saver flow 75 ml/min. on at 2.0 min.

**Liner:** Deactivated single taper w glass wool (Agilent part # 5183-4647)

**Oven:** 65 °C isothermal

**Detection:** FID at 325 °C, 450 ml/min. air, 40 ml/min. hydrogen, 45 ml/min., nitrogen makeup

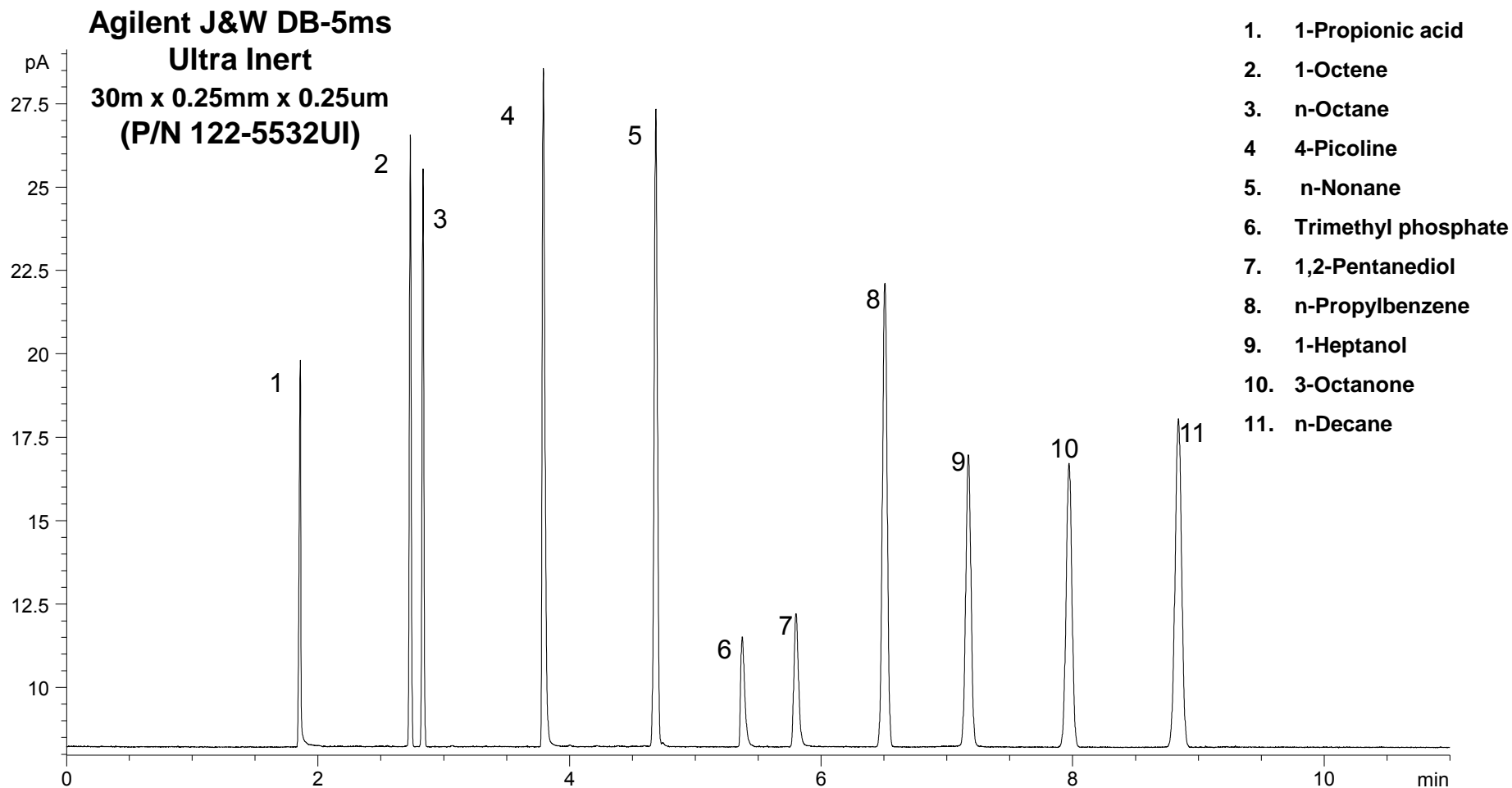
# Ultra Inert Test Mix on Competitor X Inert 5ms



**All highlighted peaks have poor peak shape – poor column deactivation**

- The Competitor X column showed very poor performance when tested against the Über One test mix.
- Less demanding test probes masked the column activity for this column.
- The same column performed well with Grob-type test mix and DB-5ms test mix

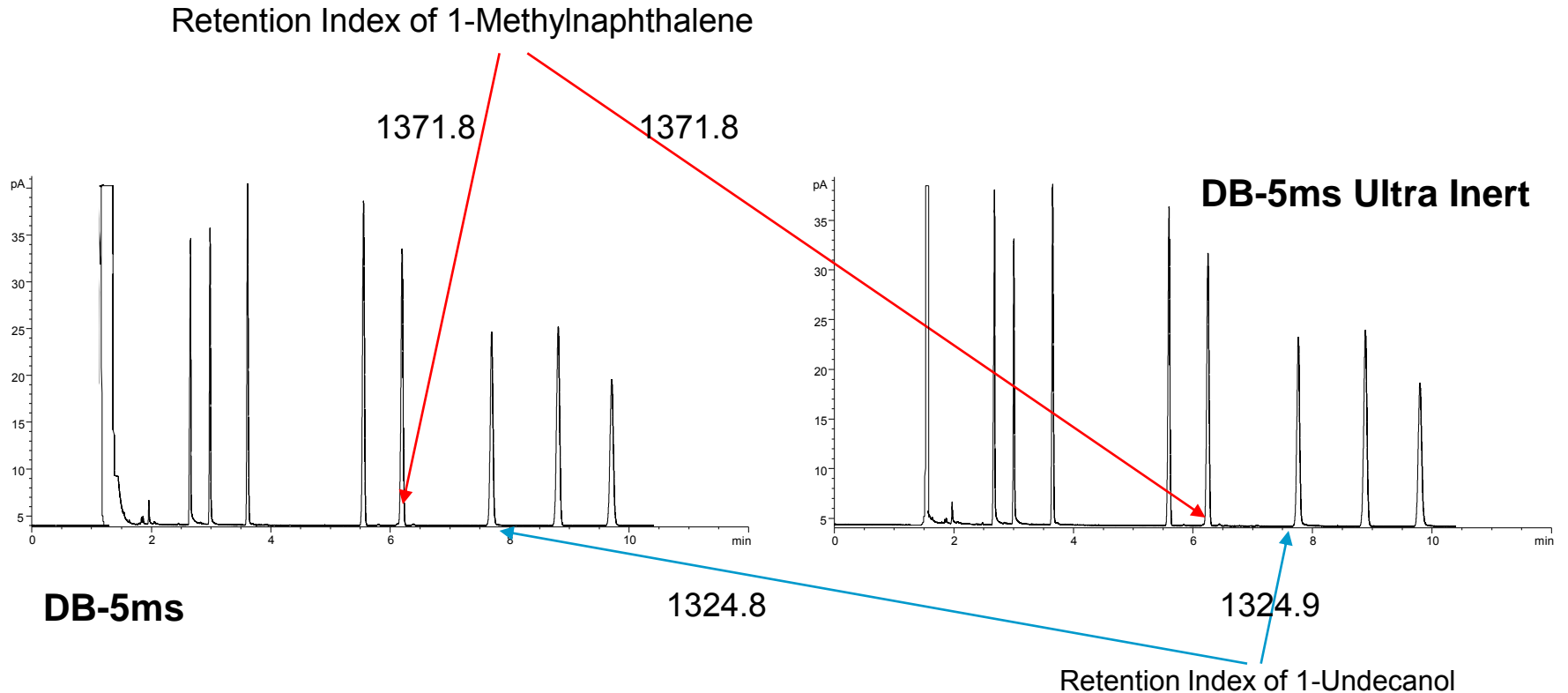
# Ultra Inert Test Mix on Agilent J&W DB-5ms Ultra Inert



- Nice Peak Shapes for challenging active compounds
- Increased peak heights for accurate integration and detection of trace samples
- Routine analysis of demanding analytes now feasible

# Same Selectivity – No Method Re-Development

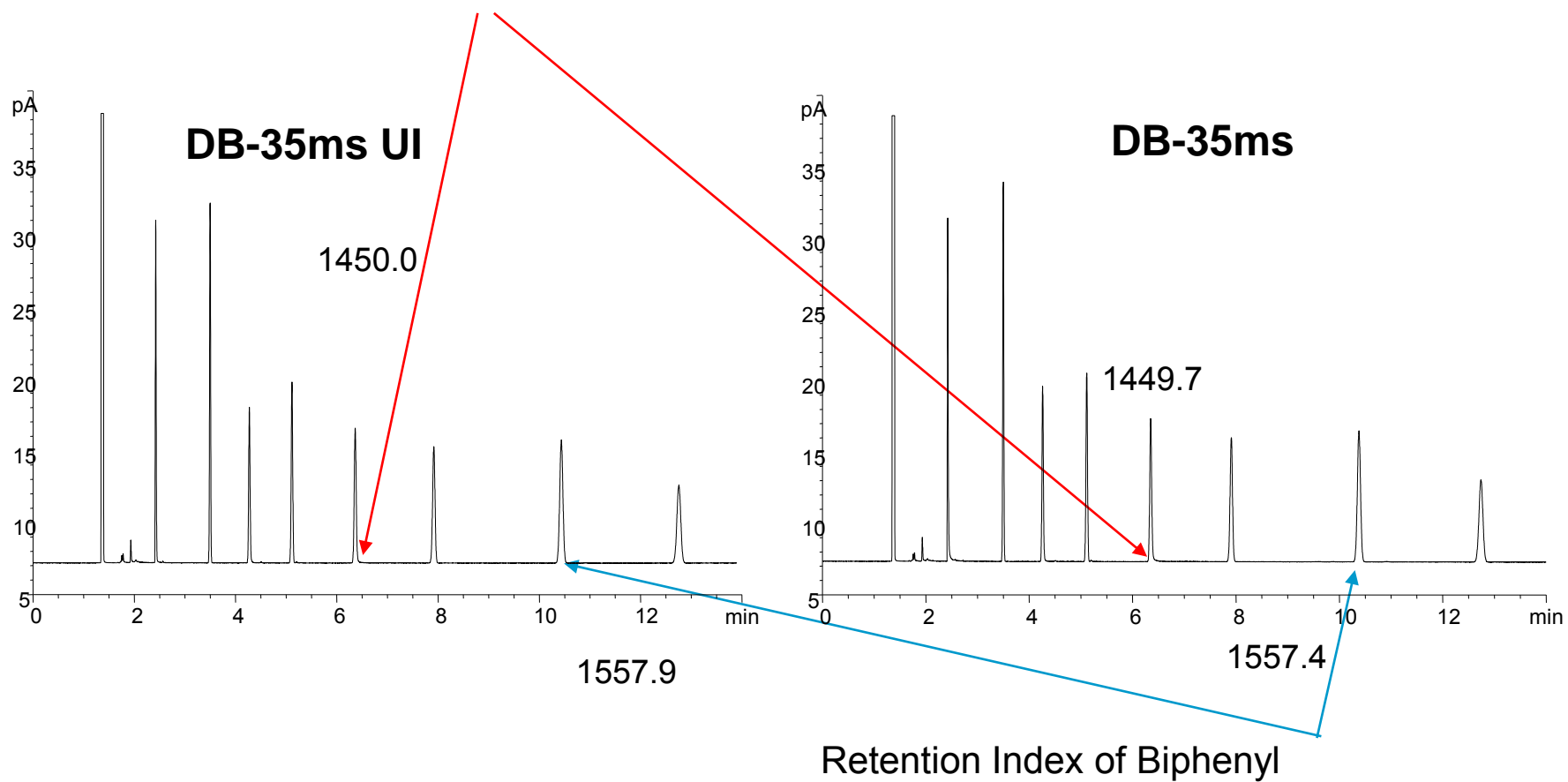
- DB-5ms Ultra Inert columns have the same selectivity as their DB-5ms counterparts
- HP-5ms Ultra Inert columns have the same selectivity as their HP-5ms counterparts





# DB-35ms Ultra Inert Exhibits the Same Selectivity as DB-35ms

Retention Index of 1 Undecanol



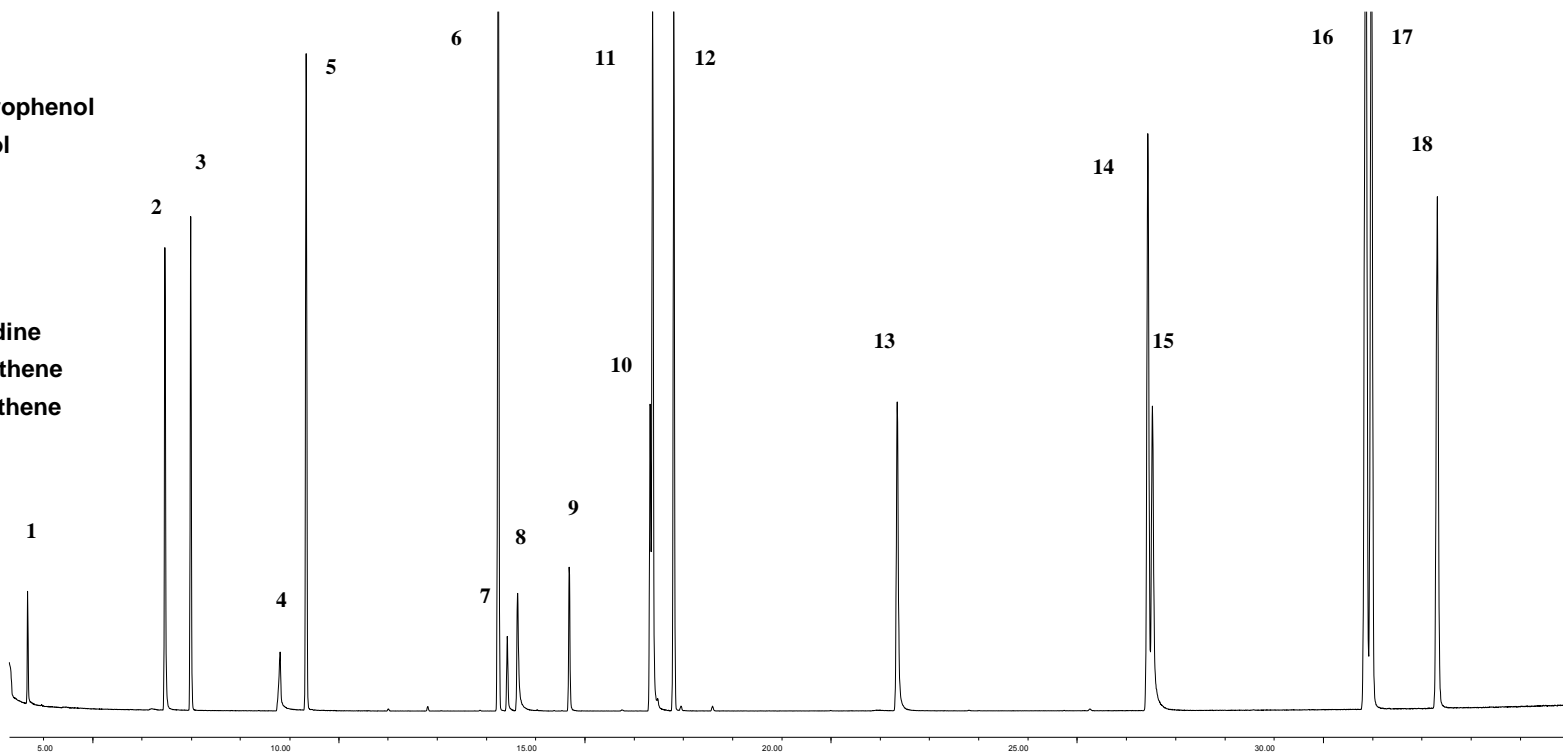
# Application Examples

- Semi Volatile Analysis
- Brominated Fire Retardants
- Drugs of abuse
- Pesticides in Orange Oil
- PAHs
- PBDEs

# Semi Volatile Analysis

GC : Agilent 6890N/5975B MSD  
Sampler : Agilent 7683B, 5.0  $\mu$ L syringe (Agilent part # 5188-5246), 1.0  $\mu$ L splitless injection, 5 ng on column  
Carrier: Helium constant flow 30 cm/s  
Inlet: Split/splitless; 260% C, 53.7 ml/min. total flow, purge flow 50 ml/min. on at 0.5 min., gas saver off  
Inlet Liner: Deactivated single taper w glass wool (Agilent part # 5183-4647)  
Column: DB-5ms Ultra Inert 30m x 0.25mm x 0.25 $\mu$ m (Agilent part # 122-5532UI)  
Oven: 40% C (1 min) to 100% C (15% C/min), 10% C to 210% C (1 min), 5% C/min. to 310% C (8 min)  
Detection: MSD source at 300% C, quadrupole at 180% C, transfer line at 290% C, scan range 50-550 AMU

1. N-nitrosodimethylamine
2. Aniline
3. 1,4 dichlorobenzene-D4
4. Benzoic acid
5. Naphthalene- D8
6. Acenaphthene-D10
7. 2,4-dinitrophenol
8. 4-nitrophenol
9. 2-methyl-4,6-dinitrophenol
10. pentachlorophenol
11. 4-aminobiphenyl
12. Penanthrene-D10
13. Benzidine
14. Chrysene-D12
15. 3,3'-dichlorobenzidine
16. Benzo [b] fluoroanthene
17. Benzo [k] fluoroanthene
18. Perylene-D12

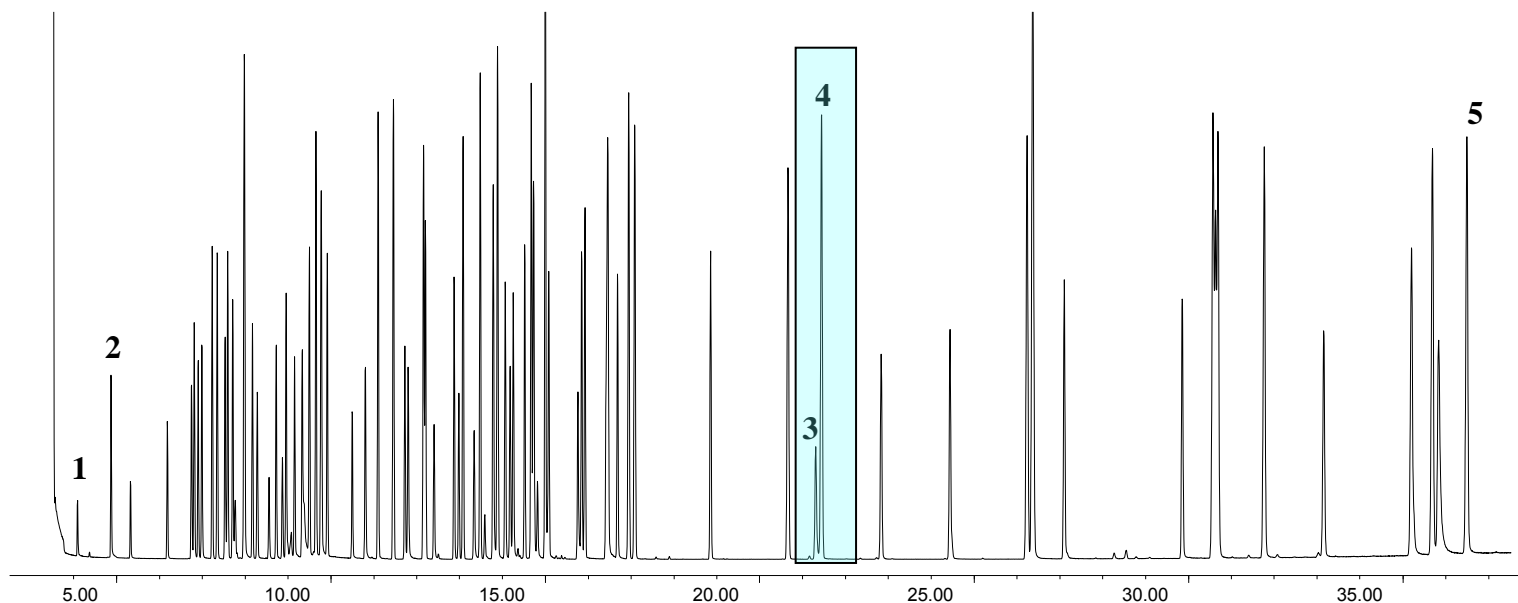


# “Large Mix” 5 ng on Column AccuStandard 8270 Mixes 1,2,3,4a,4b,5 &6 (93 Compounds) Select compound highlighted

1. n-Nitrosodimethylamine
2. 2-methyl pyridine
3. Benzidene
4. Flouranthene
5. Benzo (g,h,i) perylene

## GC/MSD Conditions

Column: DB-5ms Ultra Inert 30 m x 0.25 mm x 0.25 µm part # 122-5532UI  
Carrier: He 30 cm/sec constant flow  
Oven: 40% C (1min) to 100 % C (15 % C/min), 10 % C /min to 210% C (1min), 5 % C/min to 310% C (8 min)  
Inlet: splitless 260 % C purge flow 50 % ml/min at 0.5 min, gas saver 80 ml/min on at 1 minute  
MSD: transfer line 290 % C, source 300 % C, quad 180 % C

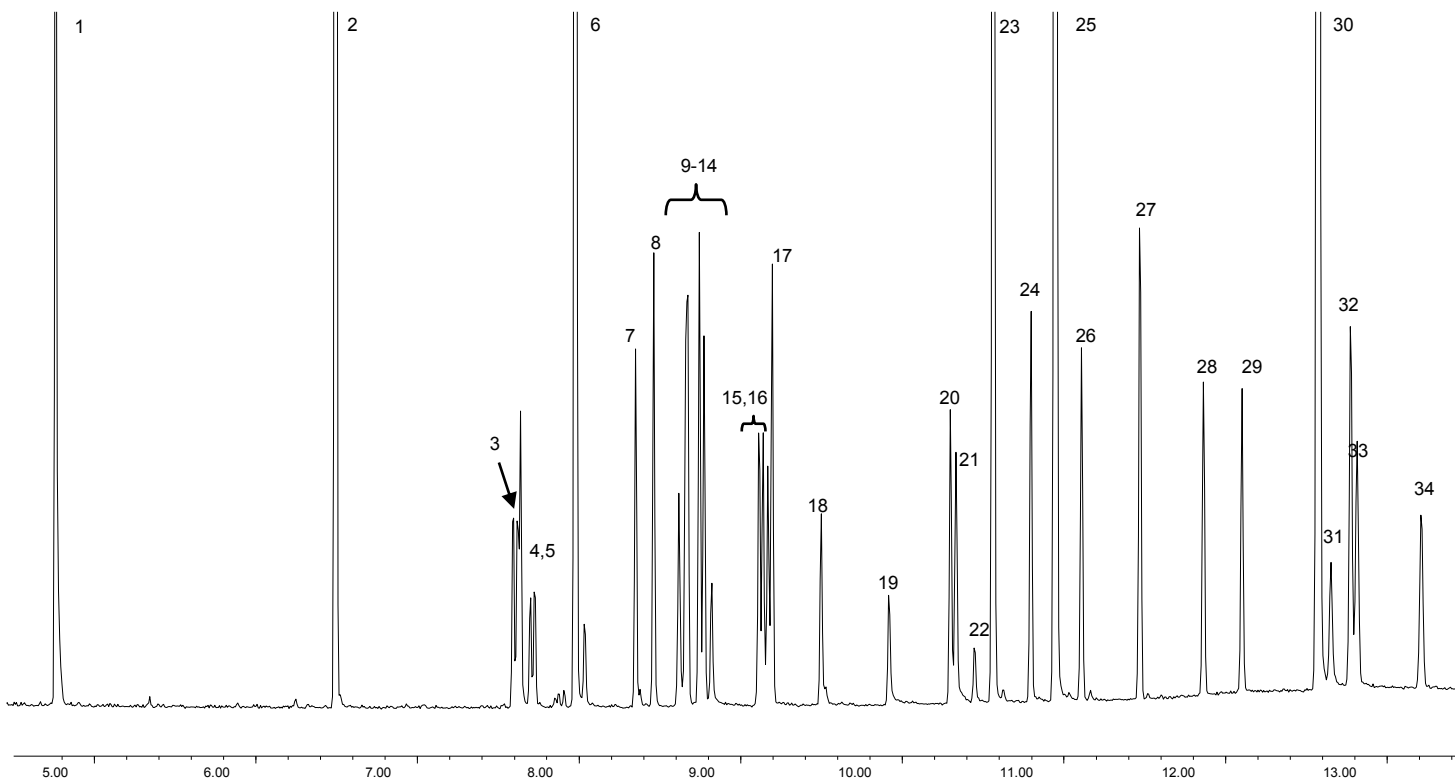


# Pesticides and Fire Retardants (US EPA 527)

- 1,2-Dimethyl-2-nitrobenzene
- Acenaphthalene-D10
- Dimethoate
- Atrazine
- Propazine
- Anthracene-D10
- Vinclozoline
- Prometryne
- Bromacil
- Malathion
- Thiazopyr
- Dursban
- Benthiocarb
- Parathion
- Terbus sulfone
- Bioallethrin
- Oxychlorane
- Fenamiphos
- Nitrophen
- Norflurazone
- Kepone
- Hexazinone
- Triphenyl phosphate
- Bifenthrin
- Chrysene-D12
- BDE-47
- Mirex
- BDE-100
- BDE-99
- Perylene-D12
- Fenvalerate
- Esfenvalerate
- Hexabromobiphenyl
- BDE-153

## GC/MSD Conditions

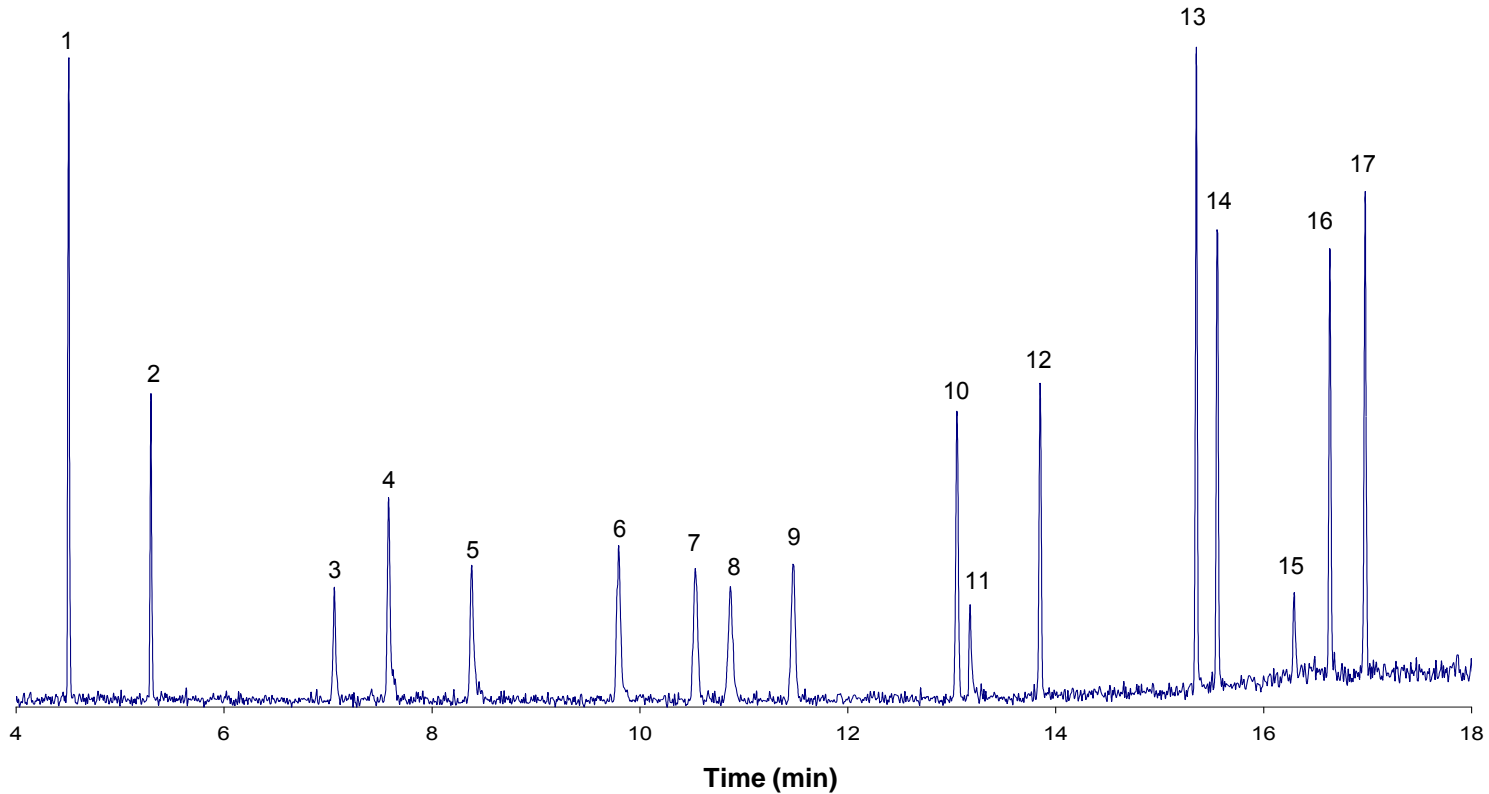
Sample: Pesticide/PBDE standards 1 ng with 5ng IS/SS on column  
Column: DB-5MS Ultra Inert 30m x 0.25mm x 0.25um (Agilent part # 122-5532UI)  
Carrier: Helium 52cm/sec, constant flow  
Oven: 60°C (1min) to 210°C (25°/min), 20°C/min to 310°C (3 min)  
Injection: Splitless, 250°C, purge flow 50ml/min at 1min, gas saver 80ml/min on at 3 min  
MSD: Transfer Line 290°C, Source 300°C, Quad 180°C



# Drugs of Abuse

Column: DB-5ms Ultra Inert 30 m x 0.25 mm x 0.25  $\mu$ m (Agilent part # 122-5532UI)  
Carrier: Helium 43.8 cm/sec constant flow  
Oven: 120% C (2min) 20 % C/min to 180 % C (6 min hold), 18 % C /min to 270% C (2min),  
25 % C/min to 325% C (2 min)  
Inlet: split 30:1, ~ 1 ng on column 250 %C, single taper liner (Agilent # 5181-3316)  
MSD: transfer line 300 % C, source 280 % C, quad 200 % C, full scan m/z 50-450

1. Nicotine
2. Phenmetrazine
3. Ibuprofen
4. Butabarbital
5. Amobarbital
6. Secobarbital
7. Caffeine
8. Benzphetamine
9. Hexobarbital
10. Tropacocaine
11. Phenbarbital
12. Procaine
13. L-cocaine
14. Chlorcytzone
15. Codine
16. Diazepam
17. Oxymorphone



# Bezodiazepines

Column: DB-5ms Ultra Inert  
122-5532UI  
30m x 0.25 mm x 0.25 µm

Carrier: Hydrogen, 53 cm/sec, constant flow

Flow Program (mL/min): 1.6 for 11 min  
1.6 to 2.4 at 60 mL/min<sup>2</sup> hold 2 min

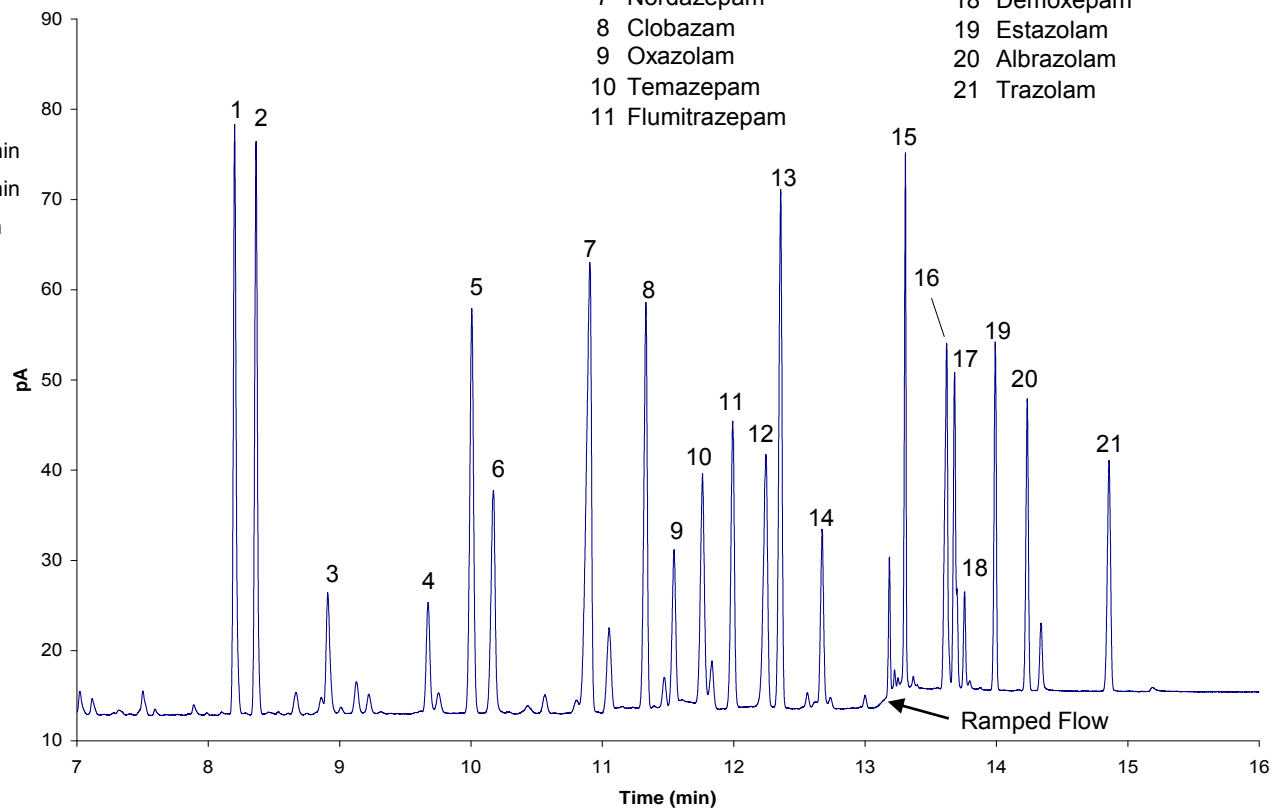
Oven: 2.4 to 5.0 at 50 mL/min<sup>2</sup> hold 9 min  
170 °C for 3.2 min

Injection: 170-250 °C at 24.7 °C/min, hold 5.3 min  
250-280 °C at 18.6 °C/min, hold 4.0 min  
280-325 °C at 50.0 °C/min, hold 4 min  
Pulsed Splitless, 280 °C

Detector: 20 psi pulse pressure for 0.38 min  
50 mL/min purge at 0.40 min  
Direct Connect liner G1544-80730  
FID, 350 °C

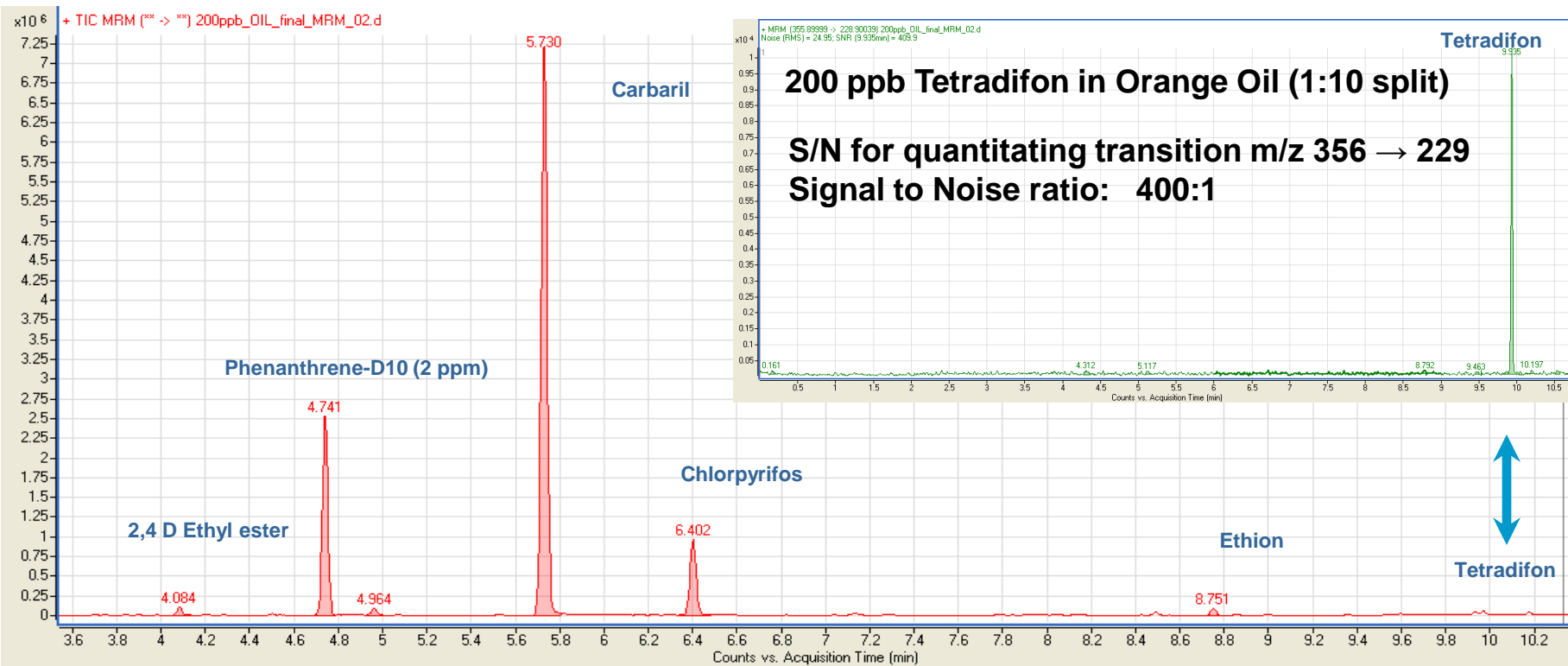
Sample: 5-10 ng on column

- |                      |                     |
|----------------------|---------------------|
| 1 Medazepam          | 12 Bromozepam       |
| 2 Halazepam          | 13 Prazam           |
| 3 Oxazepam           | 14 Lormetazepam     |
| 4 Lorazepam          | 15 Nitrazepam       |
| 5 Diazepam           | 16 Chlordiazepoxide |
| 6 Desalkyl Aurazepam | 17 Clonazepam       |
| 7 Nordazepam         | 18 Demoxepam        |
| 8 Clobazam           | 19 Estazolam        |
| 9 Oxazolam           | 20 Albrazolam       |
| 10 Temazepam         | 21 Trazolam         |
| 11 Flumitrazepam     |                     |



# Pesticides in Orange Oil

Analysis was carried out on the Agilent 7890A/5975 GC/MS or 7890A/7000 GC/MS/MS equipped with either a 7683 or 7683B Series ALS, split/splitless injection port and triple-axis detector. An Agilent J&W DB-5ms Ultra Inert 15 m x 0.25 mm x 0.25 um column (Agilent part # 122-5512UI) was used. The initial GC oven temperature was 70° C, which was held for 0.67 minutes. The oven was then ramped by 75° C/minute to 150° C, held for 0 minutes and ramped by 9° C/minute to 200° C and held for 0 minutes before ramping by 24° C/minute to 280° C and holding for 3 minutes. A six-minute post-run at 320° C was used. Pressure was held constant at 10 psi throughout the run and a split ratio of 10:1 for a 1uL injection. An open ended 4 mm helical liner was used (Agilent #5188-5396). The inlet temperature was 250° C and transfer line was set to 280° C. In the case of both detectors the source temperature was set to 300° C and the analyzer to 180° C.

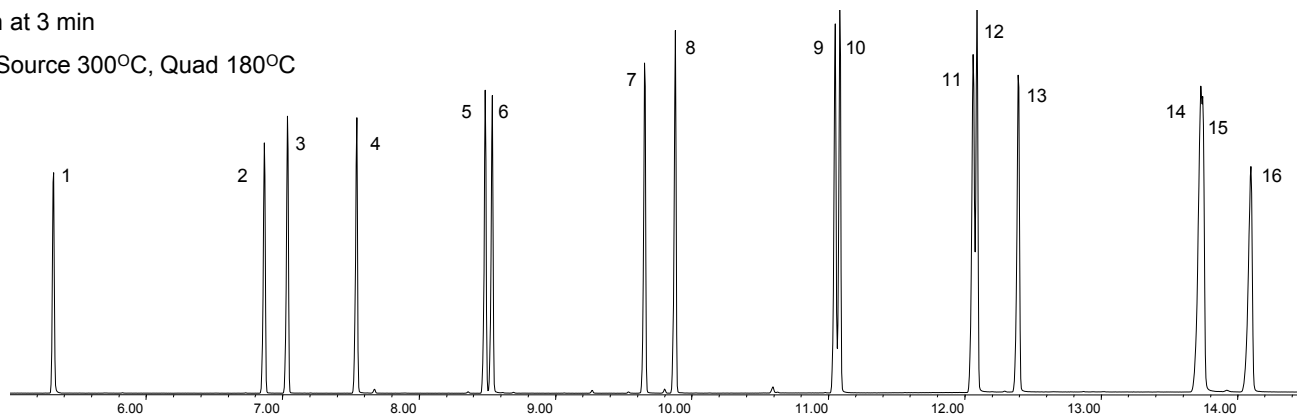




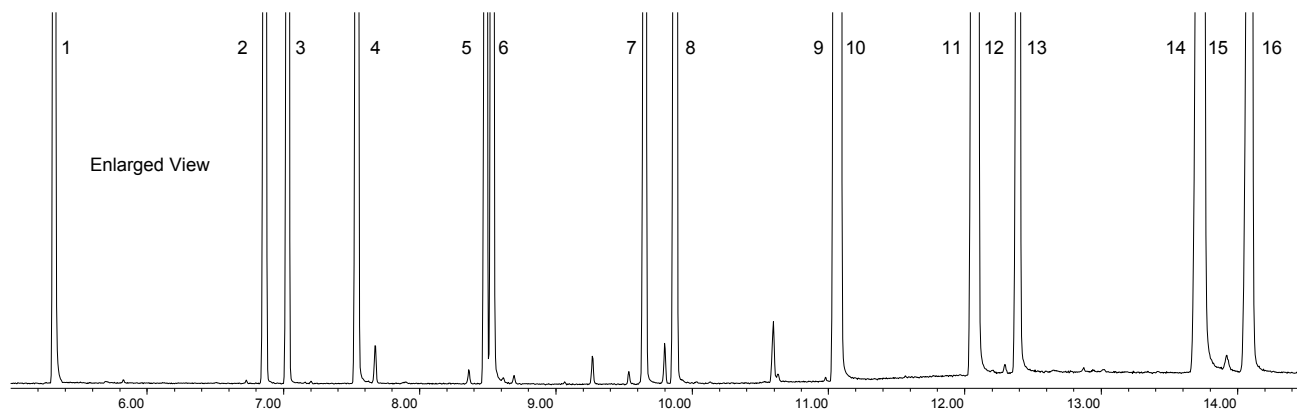
# PAH Analysis

## GC/MSD Conditions

Sample: 10ug/ml PAH Standard  
Column: DB-5ms Ultra Inert 30m x 0.25mm x 0.25um (Agilent part # 122-5532UI)  
Carrier: Helium 45cm/sec, constant flow  
Oven: 55°C (1min) to 320°C (25°/min), hold 3 min  
Injection: Pulsed splitless, 300°C, 40psi until 0.2 min, purge flow 30ml/min at 0.75 min  
Gas saver 80ml/min on at 3 min  
MSD: Transfer Line 280°C, Source 300°C, Quad 180°C



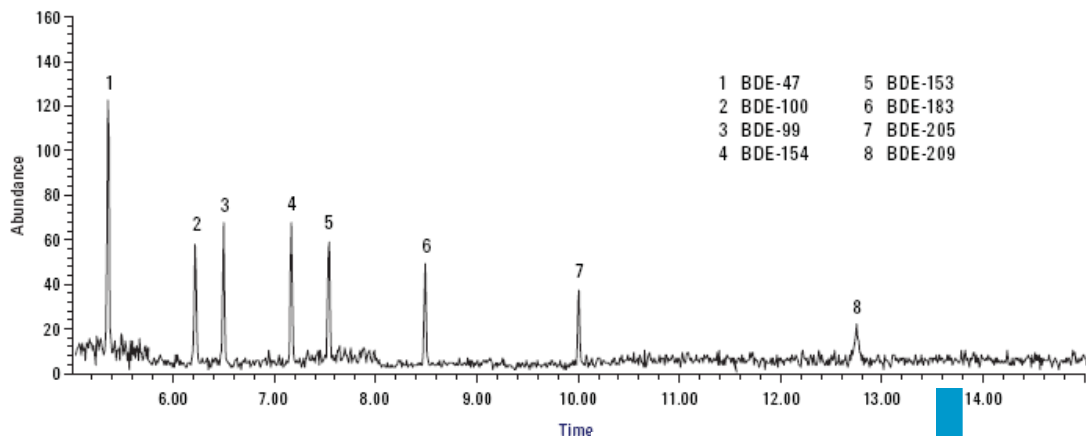
1. Naphthalene
2. Acenaphthylene
3. Acenaphthene
4. Fluorene
5. Phenanthrene
6. Anthracene
7. Fluoranthene
8. Pyrene
9. Benz[a]anthracene
10. Chrysene
11. Benz[b]fluoranthene
12. Benz[k]fluoranthene
13. Benz[a]pyrene
14. Indeno[1,2,3-cd]pyrene
15. Dibenzo[a,h]anthracene
16. Benzo[g,h,i]perylene



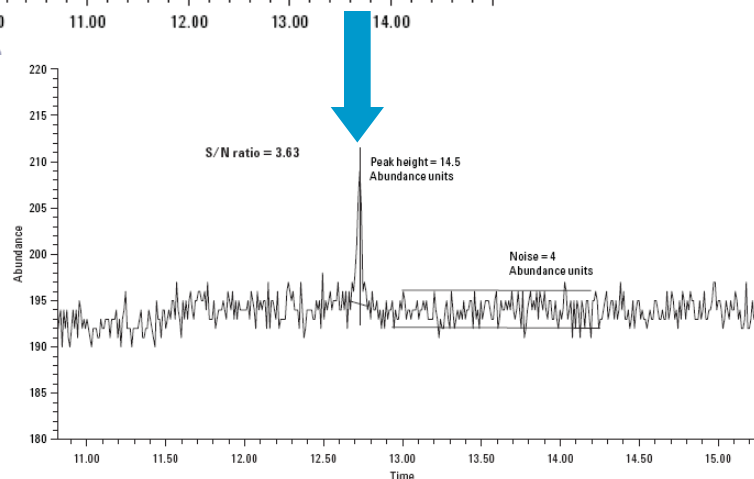
# PBDE Analysis

## GC/MS conditions

Column: DB-5ms Ultra Inert 15 m × 0.25 mm × 0.25 μm (Agilent part # 122-5512UI)  
Carrier: Carrier Helium 72 cm/s, constant flow  
Oven: 150 to 325 °C (17 °C/min), hold 5 min  
Injection: Pulsed splitless; 325 °C, 20 psi until 1.5 min, purge flow 50 mL/min at 2.0 min  
MSD: Source at 300 °C, Quadrupole at 150 °C, transfer line at 300 °C, scan range 200–1000 amu



Total ion chromatogram (SIM mode) of a **0.005-ng** (BDEs -47, -100, -99, -154, -153, -183, and -205) and **0.025-ng** (BDE-209) on-column loading



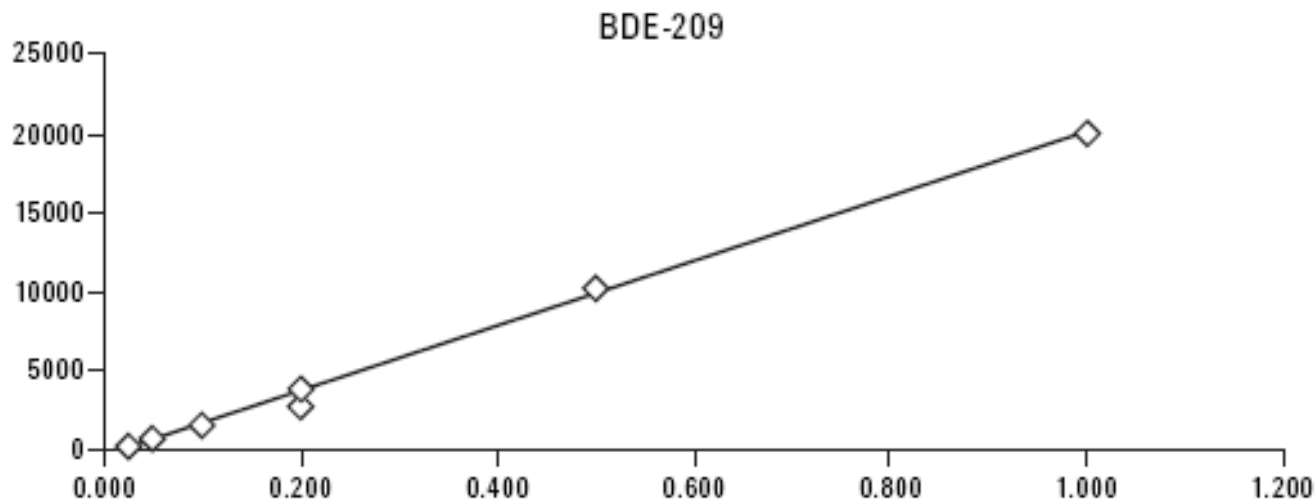
Enlarged section of BDE-209 with excellent sensitivity for trace level analysis

# PBDE Analysis

## GC/MS conditions

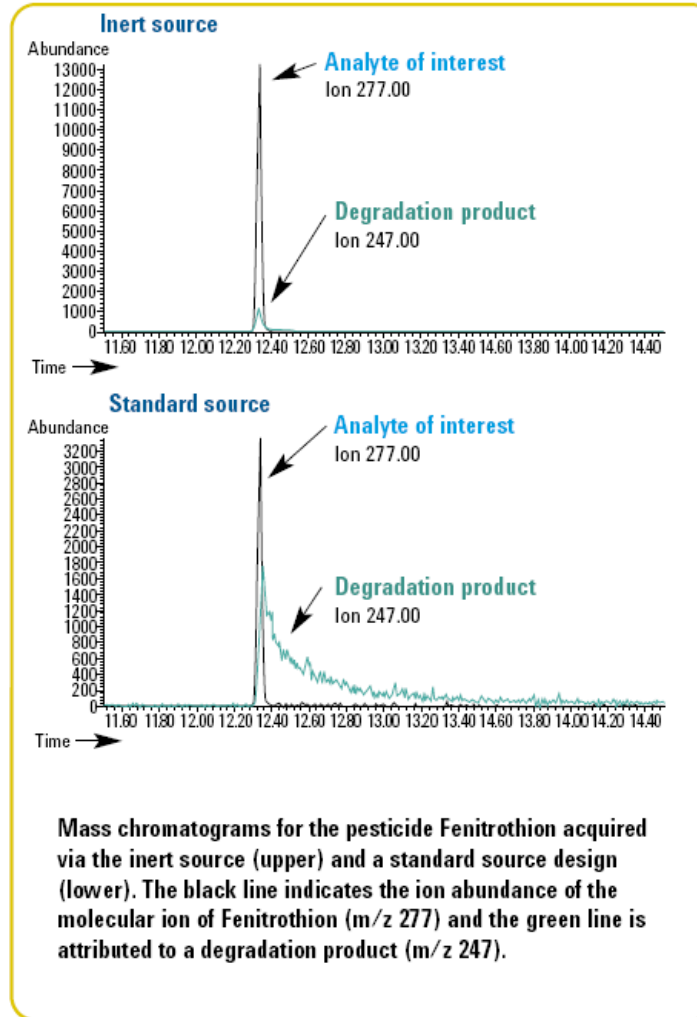
Column: DB-5ms Ultra Inert 15 m × 0.25 mm × 0.25 μm (Agilent part # 122-5512UI)  
Carrier: Carrier Helium 72 cm/s, constant flow  
Oven: 150 to 325 °C (17 °C/min), hold 5 min  
Injection: Pulsed splitless; 325 °C, 20 psi until 1.5 min, purge flow 50 mL/min at 2.0 min  
MSD: Source at 300 °C, Quadrupole at 150 °C, transfer line at 300 °C, scan range 200–1000 amu

BDR	R <sup>2</sup>
47	0.999
100	0.999
99	0.999
154	0.999
153	1.000
183	0.999
205	0.999
209	0.997

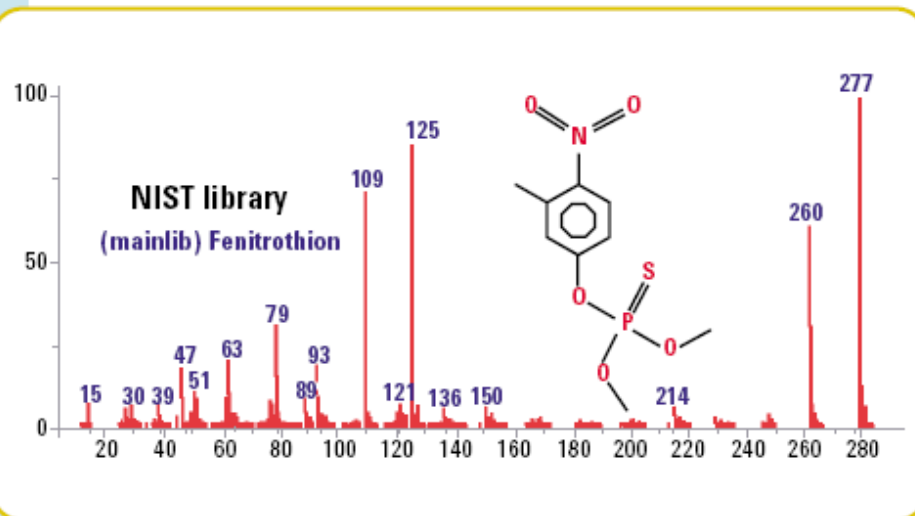
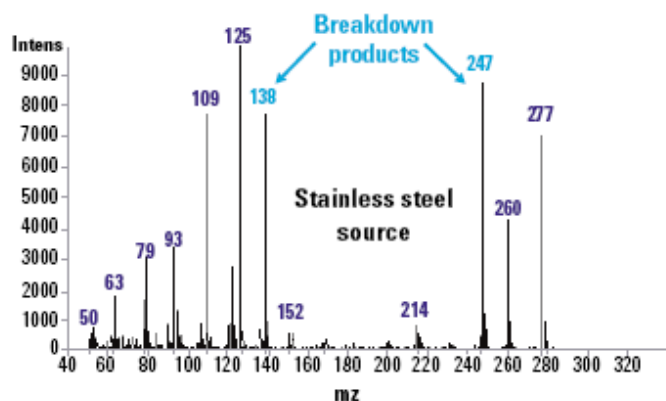
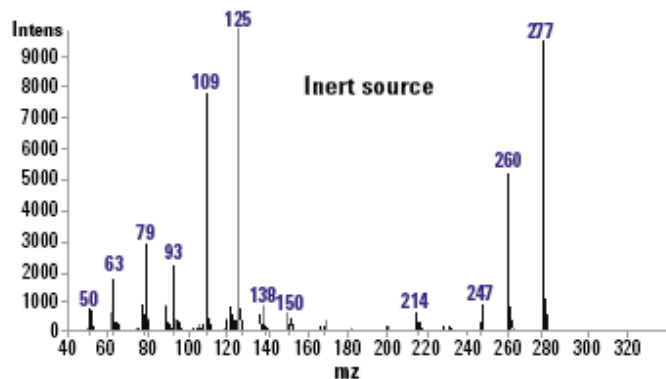


Linearity is excellent across the range studied (0.5 ng/mL to 1,000 ng/mL, except for BDE-209 at 2.5 to 1,000 ng/mL range), giving R<sup>2</sup> values of 0.997 or greater in all cases and demonstrating highly inert surface of the column.

# Inert MSD Source



# Inert MSD Source



Improved spectral integrity. New inert source eliminates surface activity reactions, resulting in more reliable library matches.

# Don't Forget About....

- Sample Discrimination
- Sample Stability
- Carrier Gas
- Sample Prep
- Sample Vials

# Conclusions.....

Inert flow path gives better peak shapes for active compounds allowing for lower detection limits

Agilent Ultra Inert liners are packed with Touchless packaging

\*\*Available for non-Agilent Systems

Both the Agilent UI Liners and Columns go through rigorous testing to ensure performance as well as column to column, or liner to liner reproducibility.

**For more information, please visit this website:**

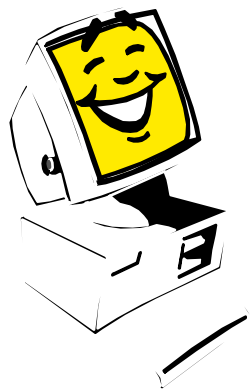
<http://www.chem.agilent.com/en-US/Products/columns-supplies/gc-gc-mscolumns/Pages/ultrainterhome.aspx>

# Agilent/J&W Technical Support

800-227-9770 (phone: US & Canada)\*

**\* Select option 3..3..1**

**866-422-5571 (fax)**



email: [gc-column-support@agilent.com](mailto:gc-column-support@agilent.com)

[www.agilent.com/chem](http://www.agilent.com/chem)

