HP-PLOT U

- Bonded divinylbenzene/ethylene glycol dimethacrylate
- More polar than HP-PLOT Q
- Excellent column for C_1-C_7 hydrocarbons, CO_2, methane, air/CO, water, oxygenates, amines, solvents, alcohols, ketones, and aldehydes
- Improved resolution in less time than conventional packed columns

Similar Phases: RTU PLOT

HP-PLOT U

ID (mm)	Length (m)	Film (µm)	Temp Limits (°C)	7 in Cage	5 in Cage	PLOT PT	7890/6890 LTM II Module
0.32	30	10.00	-60 to 190	19091P-UO4	19091P-UO4E		19091P-UO4LTM
0.53	15	20.00	-60 to 190	19095P-UO3			
	30	20.00	-60 to 190	19095P-UO4	19095P-UO4E	19095P-UO4PT	19095P-UO4LTM

HP-PLOT Al_2O_3 KCl

- Least "polar" alumina phase
- Aluminum oxide deactivated with KCl
- Standard column choice for light hydrocarbon analysis – C_1-C_8 hydrocarbon isomers
- Low retention of olefins relative to comparable paraffin
- Excellent for quantitation of dienes, especially propadiene and butadiene from ethylene and propylene streams
- Recommended phase for many ASTM methods
- Preferred KCl deactivated alumina

Similar Phases: Rt-Alumina PLOT, Alumina PLOT, Al_2O_3/KCl, AB-PLOT Al_2O_3 KCl, AT-Alumina

HP-PLOT Al_2O_3 KCl

ID (mm)	Length (m)	Film (µm)	Temp Limits (°C)	7 in Cage	5 in Cage	PLOT PT	7890/6890 LTM II Module
0.25	30	5.00	-60 to 200	19091P-K33			19091P-K33LTM
0.32	50	8.00	-60 to 200	19091P-K15	19091P-K15E	19091P-K15PT	
0.53	30	15.00	-60 to 200	19095P-K23		19095P-K23PT	19095P-K23LTM
	50	15.00	-60 to 200	19095P-K25	19095P-K25E	19095P-K25PT	

GS-Alumina KCl

- Least "polar" alumina phase
- Aluminum oxide deactivated with KCl
- Good choice for light hydrocarbon analysis
- Good resolution of propadiene and butadiene from ethylene and propylene streams

Similar Phases: Al_2O_3/KCl, Al_2O_3/Na_2SO_4, Rt-Alumina PLOT, Alumina PLOT, AB-PLOT Al_2O_3 KCl, AT-Alumina

GS-Alumina KCl

ID (mm)	Length (m)	Temp Limits (°C)	7 in Cage	5 in Cage	PLOT PT
0.53	30	-60 to 200	115-3332		
	50	-60 to 200	115-3352	115-3352E	115-3352PT

CP-Al_2O_3/KCl and CP-Al_2O_3/Na_2SO_4

- Aluminum oxide PLOT columns offer high selectivity for separating ppm levels of C_1-C_5 hydrocarbons in process streams
- High capacity thick films
- No need for sub-ambient cooling
- Choice of two selectivities covers a broad range of applications
- Available in fused silica and UltiMetal

Note: The KCl deactivation salt results in a relatively apolar Al_2O_3 surface while the Na_2SO_4 deactivation provides a polar surface. Unsaturated compounds such as ethylene and acetylene (ethyne) are retained longer.

Selectivity Through KCl or Na_2SO_4 Deactivation

Note: Aluminum oxide PLOT columns are deactivated using KCl or NA_2SO_4 treatments which provide a reproducible and stable deactivation up to 200 °C. The KCl salt deactivation results in a relatively apolar Al_2O_3 surface, while the NA_2SO_4 deactivation provides a polar surface. Unsaturated compounds such as ethylene and acetylene (ethyne) are retained longer.

Similar Phases: Al_2O_3/KCl, Rt-Alumina PLOT, Alumina PLOT, RT-Alumina BOND/KCl, Alumina chloride PLOT, AB-PLOT Al_2O_3 KCl

CP-Al_2O_3/KCl

ID (mm)	Length (m)	Film (µm)	Temp Limits (°C)	7 in Cage	5 in Cage	PLOT PT
0.25	25	4.00	-100 to 200/200	CP7576		
	50	4.00	-100 to 200/200	CP7577		
0.32	10	5.00	-100 to 200/200	CP7511		
	25	5.00	-100 to 200/200	CP7519		
	50	5.00	-100 to 200/200	CP7515	CP7515I5	CP7515PT
0.53	25	10.00	-100 to 200/200	CP7517		CP7517PT
	50	10.00	-100 to 200/200	CP7518		CP7518PT

CP-Al_2O_3/KCl UltiMetal

ID (mm)	Length (m)	Film (µm)	Temp Limits (°C)	7 in Cage
0.53	50	10.00	-100 to 200/200	CP6918

Similar Phases: Al_2O_3/Na_2SO_4, Rt-Alumina PLOT, Alumina PLOT, Rt-Alumina BOND/Na_2SO_4, MXT-AluminaBOND/Na_2SO_4, Alumina sulfate PLOT

CP-Al_2O_3/Na_2SO_4

ID (mm)	Length (m)	Film (µm)	Temp Limits (°C)	7 in Cage	5 in Cage	PLOT PT
0.25	25	4.00	-100 to 200/200	CP7586		
	50	4.00	-100 to 200/200	CP7587		
0.32	50	5.00	-100 to 200/200	CP7565	CP7565I5	CP7565PT
0.53	25	10.00	-100 to 200/200	CP7567		
	50	10.00	-100 to 200/200	CP7568		CP7568PT

CP-Al_2O_3/Na_2SO_4 UltiMetal

ID (mm)	Length (m)	Film (µm)	Temp Limits (°C)	7 in Cage
0.53	50	10.00	-100 to 200/200	CP6968

HP-PLOT Al_2O_3 S

- Middle range of "polarity" for alumina phases
- Aluminum oxide deactivated with sodium sulfate
- Excellent general use column for light hydrocarbon analysis – C_1-C_8 hydrocarbon isomers
- Best for resolving acetylene from butane and propylene from isobutane

Similar Phases: Al_2O_3/Na_2SO_4, Rt-Alumina PLOT, Alumina PLOT, Rt-Alumina BOND/Na_2SO_4, MXT-AluminaBOND/Na_2SO_4, Alumina sulfate PLOT, AT-Alumina

HP-PLOT Al_2O_3 S

ID (mm)	Length (m)	Film (µm)	Temp Limits (°C)	7 in Cage	5 in Cage	PLOT PT	7890/6890 LTM II Module
0.25	30	5.00	-60 to 200	19091P-S33			
0.32	25	8.00	-60 to 200	19091P-S12		19091P-S12PT	19091P-S12LTM
	50	8.00	-60 to 200	19091P-S15	19091P-S15E	19091P-S15PT	
0.53	15	15.00	-60 to 200	19095P-S21			
	30	15.00	-60 to 200	19095P-S23		19095P-S23PT	
	50	15.00	-60 to 200	19095P-S25	19095P-S25E	19095P-S25PT	

GS-Alumina

- Most "polar" alumina phase
- Aluminum oxide with proprietary deactivation
- Excellent general use column for light hydrocarbon analysis – C_1-C_8 hydrocarbon isomers
- Separates C_1-C_4 saturated and unsaturated hydrocarbons
- Best for resolving cyclopropane from propylene
- Faster, more efficient, and provides more sensitivity than packed equivalents
- Minimal conditioning time required
- Preferred substitution for sodium sulfate deactivated Alumina because of its regenerative nature

Note: Alumina columns have a tendency to adsorb water and CO_2 which, over time, results in changes in retention time. We use an advanced, proprietary deactivation process which allows for rapid regeneration. Fully water saturated GS-Alumina columns regenerate in 7 hours or less at 200 °C.

Similar Phases: Al_2O_3/KCl, Al_2O_3/Na_2SO_4, Rt-Alumina PLOT, Alumina PLOT, AB-PLOT Al_2O_3 KCl, AT-Alumina

GS-Alumina

ID (mm)	Length (m)	Temp Limits (°C)	7 in Cage	PLOT PT
0.53	30	-60 to 200	115-3532	115-3532PT
	50	-60 to 200	115-3552	115-3552PT

HP-PLOT Al_2O_3 M

- Most "polar" alumina phase (similar to GS-Alumina)
- Aluminum oxide deactivated with proprietary deactivation
- Good general use column for light hydrocarbon analysis – C_1-C_8 hydrocarbon isomers
- Good for resolving acetylene from butane and propylene from isobutane

Similar Phases: AB-PLOT Al_2O_3 M, BGB-PLOT Al_2O_3 M, AT-Alumina

HP-PLOT Al_2O_3 M

ID (mm)	Length (m)	Film (µm)	Temp Limits (°C)	7 in Cage	5 in Cage	PLOT PT
0.32	50	8.00	-60 to 200	19091P-M15	19091P-M15E	
0.53	30	15.00	-60 to 200	19095P-M23		
	50	15.00	-60 to 200	19095P-M25		19095P-M25PT

GS-GasPro

- Unique bonded silica PLOT column technology
- Excellent choice for light hydrocarbons and sulfur gases
- Retention stability not affected by water
- Separates CO and CO_2 on a single column
- Ideal PLOT column for GC/MS – no particles

Similar Phases: CP-Silica PLOT

GS-GasPro

ID (mm)	Length (m)	Temp Limits (°C)	7 in Cage
0.32	5	-80 to 260/300	113-4302
	15	-80 to 260/300	113-4312
	30	-80 to 260/300	113-4332
	60	-80 to 260/300	113-4362

CP-SilicaPLOT

- No influence of water on retention times
- Elution of CO_2 and sulfur gases at ppm levels
- Separates cyclopropane from propylene
- Ideal for a wide range of applications such as COS in ethylene, freons, hydrocarbons, propylene and sulfur compounds
- High selectivity for C_1-C_4 isomers in the presence of water
- No negative influence on retention or peak shape when water is present in the sample
- Inert surface preparation results in no decomposition pentadienes or freons

Similar Phases: GS-GasPro

CP-SilicaPLOT

ID (mm)	Length (m)	Film (µm)	Temp Limits (°C)	7 in Cage	5 in Cage
0.25	30	3.00	-80 to 225/225	CP8564	
0.32	15	4.00	-80 to 225/225	CP8566	
	30	4.00	-80 to 225/225	CP8567	
	60	4.00	-80 to 225/225	CP8568	
0.53	30	6.00	-80 to 225/225	CP8570	CP8570I5
	60	6.00	-80 to 225/225	CP8571	

CarboBOND and CarboPLOT P7

- Single column solution for ASTM D2505 for higher productivity
- Stable and robust for high repeatability of results
- Available in bonded and PLOT versions for improved versatility and enhanced productivity

CarboBOND

CarboBOND

ID (mm)	Length (m)	Film (µm)	Temp Limits (°C)	7 in Cage
0.53	25	5.00	-100 to 200/300	CP7371
		10.00	-100 to 200/300	CP7374
	50	5.00	-100 to 200/300	CP7372
		10.00	-100 to 200/300	CP7375

CarboPLOT P7

CarboPLOT P7

ID (mm)	Length (m)	Film (µm)	Temp Limits (°C)	7 in Cage
0.53	10	25.00	-200 to 115/115	CP7513
	25	25.00	-200 to 115/115	CP7514

GS-CarbonPLOT

- High stability, bonded carbon layer stationary phase
- Unique selectivity for inorganic and organic gases
- Extended temperature limit of 360 °C
- Ideal for GC/MS – no particle generation
- Retention stability not affected by water

Similar Phases: Carbopack, CLOT, Carboxen-1006 PLOT

GS-CarbonPLOT

ID (mm)	Length (m)	Film (µm)	Temp Limits (°C)	7 in Cage	7890/6890 LTM II Module
0.32	15	1.50	0 to 360	113-3112	
	30	1.50	0 to 360	113-3132	
		3.00	0 to 360	113-3133	113-3133LTM
	60	1.50	0 to 360	113-3162	
0.53	15	3.00	0 to 360	115-3113	
	30	3.00	0 to 360	115-3133	115-3133LTM

HP-PLOT Molesieve

- A PLOT column for the analysis of permanent gases
- O_2, N_2, CO and CH_4 resolve in less than 5 min
- Durable molecular sieve 5Å coating minimizes baseline spiking and damage to multiport valves
- Select a thick film for Ar/O_2 separation without cryogenic cooling
- Select thin film HP-PLOT Molesieve columns for routine air monitoring applications
- Replaces GS-Molesieve

Note: Molecular sieve columns will absorb water, which, over time results in changes in retention time. We use an advanced, proprietary deactivation process which allows for rapid regeneration. Fully saturated HP-PLOT Molesieve columns regenerate in 7 hours or less at 200 °C.

Similar Phases: Rt-Msieve 5A, MXT-Msieve 5A

HP-PLOT Molesieve

ID (mm)	Length (m)	Film (µm)	Temp Limits (°C)	7 in Cage	5 in Cage	7890/6890 LTM II Module
0.32	15	25.00	-60 to 300	19091P-MS7		19091P-MS7LTM
	30	12.00	-60 to 300	19091P-MS4	19091P-MS4E	
		25.00	-60 to 300	19091P-MS8		19091P-MS8LTM
0.53	15	25.00	-60 to 300	19095P-MS5		
		50.00	-60 to 300	19095P-MS9		
	30	25.00	-60 to 300	19095P-MS6	19095P-MS6E	
		50.00	-60 to 300	19095P-MS0	19095P-MS0E	19095P-MS0LTM

CP-Molsieve 5Å

- Separate argon and oxygen at ambient temperature to reduce costs
- High efficiency for increased productivity
- Symmetrical peaks for accurate results

Similar Phases: Rt-Msieve 5A, MXT-Msieve 5A, Mol Sieve 5A PLOT

CP-Molsieve 5Å

ID (mm)	Length (m)	Film (µm)	Temp Limits (°C)	7 in Cage	5 in Cage	PLOT PT*
0.25	25	30.00	-200 to 350/350	CP7533		
0.32	10	30.00	-200 to 350/350	CP7535	CP7535I5	
	25	30.00	-200 to 350/350	CP7536		CP7536PT
	30	10.00	-200 to 350/350	CP7534	CP7534I5	CP7534PT
	50	30.00	-200 to 350/350	CP7540	CP7540I5	
0.53	10	50.00	-200 to 350/350	CP7537		
	15	15.00	-200 to 350/350	CP7543		
	25	50.00	-200 to 350/350	CP7538	CP7538I5	CP7538PT
	30	15.00	-200 to 350/350	CP7544		
	50	50.00	-200 to 350/350	CP7539		CP7539PT

* CP-Molsieve 5Å PT columns have a lower operating temperature of 300 ºC

CP-Molsieve 5Å UltiMetal

ID (mm)	Length (m)	Film (µm)	Temp Limits (°C)	7 in Cage	5 in Cage
0.53	10	50.00	-200 to 350/350	CP6937	
	25	50.00	-200 to 350/350	CP6938	CP6938I5

Particle Traps for use with PLOT Columns

Though highly stabilized, it is impossible to guarantee that no particles will dislodge from the column wall. When used in valve-switching applications, the use of a particle trap can prevent scarring of the column switching valve rotors and changes in flow restriction.

Agilent highly recommends using PLOT PT columns with integrated particle traps but for those analysts who prefer to install individual particle traps, a variety of fused silica and UltiMetal fused silica particle traps are available.

Particle Traps for use with PLOT Columns

ID (mm)	Length (m)	Part No.
0.32	2.5	5181-3351
0.53	2.5	5181-3352

Particle Traps for PoraPLOT Columns

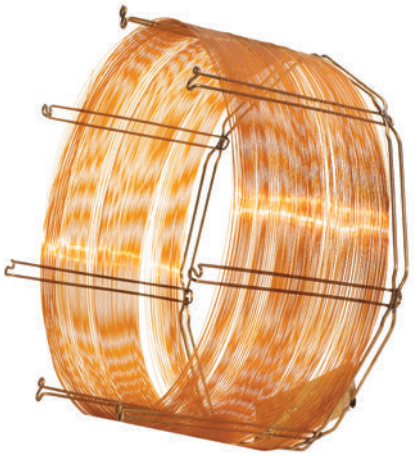
ID (mm)	Length (m)	Material	Part No.
0.32	2.5	Fused Silica	CP4016
0.53	2.5	Fused Silica	CP4017
0.53	2.5	UltiMetal	CP4018*

*Includes CP-UltiMetal connector

Particle Trap Connectors for PoraPLOT Columns

ID (mm)	Material	Unit	Part No.
0.25/0.32	Fused Silica	10/pk	CP4788
0.53	Fused Silica	10/pk	CP4789
0.25	UltiMetal	5/pk	CP4795
0.53	UltiMetal	5/pk	CP4796

Columns with Non-Bonded Stationary Phases



Whenever possible, Agilent recommends the use of bonded and cross-linked polymers. Bonded polymers are more rugged, will have longer lifetimes and can be solvent rinsed. However, Agilent recognizes that some methods have been developed on non-bonded phases and therefore maintains these columns to support established methods.

HP-101

- 100% Dimethylpolysiloxane

Because HP-101 columns are not bonded or cross-linked, we do not recommend solvent rinsing.

HP-101

ID (mm)	Length (m)	Film (µm)	Temp Limits (°C)	7 in Cage	5 in Cage
0.20	25	0.20	-60 to 280	19091Y-102	
0.32	25	0.30	-60 to 280	19091Y-012	19091Y-012E
	50	0.30	-60 to 280	19091Y-015	

HP-17

- 50% Phenyl and 50% methyl siloxane

Because HP-17 columns are not bonded or cross-linked, we do not recommend solvent rinsing.

HP-17

ID (mm)	Length (m)	Film (µm)	Temp Limits (°C)	7 in Cage
0.53	10	2.00	25 to 260/280	19095L-121

CAM

- Base deactivated polyethylene glycol
- Specifically designed for amine analysis
- Excellent peak shape for primary amines
- Replaces HP-Basicwax

Because CAM columns are not bonded or cross-linked, we do not recommend solvent rinsing.

CAM

ID (mm)	Length (m)	Film (µm)	Temp Limits (°C)	7 in Cage	7890/6890 LTM II Module
0.25	15	0.25	60 to 220/240	112-2112	
	30	0.25	60 to 220/240	112-2132	
		0.50	60 to 220/240	112-2133	112-2133LTM
	60	0.25	60 to 220/240	112-2162	
0.32	30	0.25	60 to 220/240	113-2132	113-2132LTM
		0.50	60 to 220/240	113-2133	
0.53	30	1.00	60 to 200/220	115-2132	115-2132LTM

DX-1 and DX-4

- DX-1: 90% Dimethylpolysiloxane 10% polyethylene glycol
- DX-4: 15% Dimethylpolysiloxane 85% polyethylene glycol

Because DX series GC columns are not bonded and cross-linked, we do not recommend solvent rinsing.

DX-1

ID (mm)	Length (m)	Film (µm)	Temp Limits (°C)	7 in Cage
0.32	30	1.00	50 to 250/270	123-6133

DX-4

ID (mm)	Length (m)	Film (µm)	Temp Limits (°C)	7 in Cage
0.25	30	0.25	50 to 250/270	122-6432
	60	0.25	50 to 250/270	122-6462
0.32	15	0.25	50 to 250/270	123-6412
	30	0.25	50 to 250/270	123-6432

SE-30 and SE-54

- SE-30: 100% Dimethylpolysiloxane
- SE-54: (5%-Phenyl)(1%-vinyl)-methylpolysiloxane

Because SE series GC columns are not bonded or cross-linked, we do not recommend solvent rinsing.

SE-30

ID (mm)	Length (m)	Film (µm)	Temp Limits (°C)	7 in Cage
0.32	30	0.25	0 to 325/350	113-3032

SE-54

ID (mm)	Length (m)	Film (µm)	Temp Limits (°C)	7 in Cage
0.25	30	0.25	0 to 325/350	112-5432
	60	0.25	0 to 325/350	112-5462
0.32	30	0.25	0 to 325/350	113-5432

Guard Columns

- DuraGuard and EZ-Guard columns with "built-in" guard columns, no press-fit connectors
- Minimize front-end contamination and increase column lifetime
- Aid in focusing sample onto the front of the column for better peak shape
- Minimize MSD contamination originating from the column (when used as transfer line to the MS detector)

Guard columns (or retention gaps) are often added to the front of the analytical column to protect against contamination, or to act as a band-focusing device for liquid samples introduced by on-column and splitless injection techniques.

When resolution or response in a chromatogram diminishes, remove a coil from the guard column so that peak shapes will improve. By removing a coil, the column length is shortened and peaks will elute somewhat faster. For best results, check the integration time windows of your data system.

TIPS & TOOLS

Column contamination from sample matrix components is the number one cause of column failure. Use Agilent DuraGuard GC columns with built-in guard if you do not want to use column connectors.

DuraGuard

DuraGuard

Phase	ID (mm)	Length (m)	Film (µm)	Guard Length (m)	Part No.
DB-1	0.25	30	0.25	10	122-1032G
DB-XLB	0.25	30	0.25	10	122-1232G
DB-5ms	0.25	30	0.25	10	122-5532G
			0.50	10	122-5536G
			1.00	10	122-5533G
		60	0.25	10	122-5562G
	0.53	30	0.50	10	125-5537G
DB-5.625	*0.25*	*30*	*0.25*	*5*	*122-5631G5*
DB-1701	0.53	30	1.00	10	125-0732G
DB-624	0.53	30	3.00	5	125-1334G5

Agilent J&W High Efficiency GC columns are displayed using italicized descriptions and part numbers

A special tab clearly distinguishes the EZ-Guard guard column section from the analytical column

EZ-Guard

EZ-Guard

Phase	ID (mm)	Length (m)	Film (µm)	Guard Length (m)	Part No.
VF-1ms	0.20	12	0.33	5	CP9023
	0.25	30	0.25	5	CP9010
			0.25	10	CP9011
VF-5ms	0.25	15	0.25	5	CP9021
		30	0.25	5	CP9012
			0.25	10	CP9013
			0.50	5	CP9014
			0.50	10	CP9015
		60	0.25	5	CP9016
VF-Xms	0.25	30	0.10	10	CP9022
			0.25	10	CP9019
VF-17ms	0.25	30	0.25	5	CP9024
			0.25	10	CP9025
VF-1701ms	0.25	30	0.25	5	CP9176
			0.25	10	CP9177
VF-35ms	0.25	30	0.25	5	CP9026
			0.25	10	CP9027

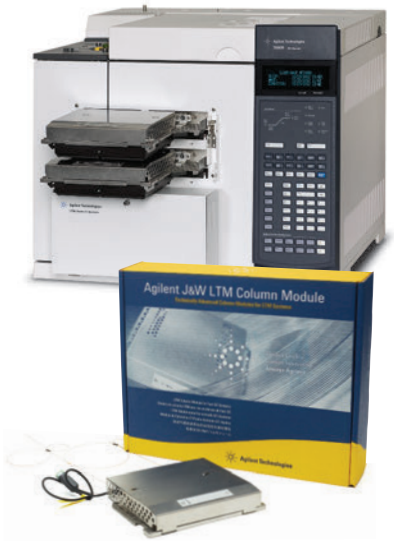
LTM Column Modules

Shorten analytical cycle times and boost your high speed gas chromatography capabilities

Agilent J&W LTM column modules combine a high quality fused silica capillary column with heating and temperature sensing components for a low thermal mass column assembly. The LTM column module contains a patented design which heats and cools the column very efficiently for significantly shorter analytical cycle times compared to conventional air-bath GC oven techniques, while simultaneously using less power.

Agilent offers LTM technology for our popular 7890 and 6890 Series GC systems, and the 5975T GC/MS.

For more information, visit **www.agilent.com/chem/LTMcol**



LTM II standard format with 5 in column toroid

Agilent J&W LTM II Low Thermal Mass Column Modules for 7890A/B Series GC Systems

Available in a wide variety of Wall Coated Open Tubular (WCOT) and select Porous Layer Open Tubular (PLOT) column configurations.

- The capacity to run up to four column modules simultaneously – with four different temperature programs – to maximize your productivity
- Rapid temperature programming rates for higher analysis speeds
- Faster cooling times – as low as one minute or less – to decrease idling and downtime
- Excellent retention time repeatability and performance – comparable to conventional GC

All LTM II column modules are packaged with:

- Two 1 m guard columns (one each for the inlet and detector) fused silica the same id as the analytical column
- Flexible Metal ferrules that fit the dimensions of the analytical and guard columns

TIPS & TOOLS

For information on Agilent UltiMetal Plus Flexible Metal ferrules, **turn to page 43.**

TIPS & TOOLS

When replacing LTM columns, be sure to turn off the instrument power to avoid damage to the column heater and temperature sensing circuitry.

LTM Solution for Ultra Sensitive THCA Application

Specially configured LTM II columns for high sensitivity THCA triple quadrupole GC/MS application, per application note 5990-7535EN.

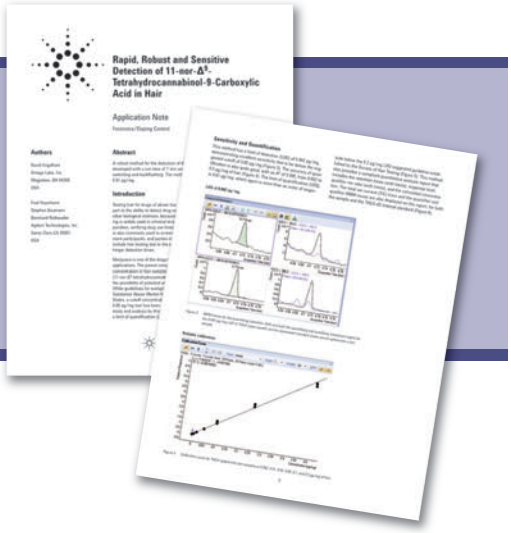
- Accurate and robust method for detection of THCA metabolite in hair
- Fast analysis run time
- High sensitivity 0.01 pg/mg LOQ

LTM II Columns

Phase	Description	ID (mm)	Length (m)	Film (µm)	Part No.
DB-17ms	5 m DuraGuard and long legs	0.25	15	0.25	G3900-65001
DB-1ms	With long column legs	0.25	15	0.25	G3903-65002
DB-1	Transfer line	0.15	1	1.20	G3903-61004

TIPS & TOOLS

For more information on THCA detection, view this Application Note on-line: *Rapid, Robust and Sensitive Detection of 11-nor-Δ9-Tetrahydrocannabinol-9-Carboxylic Acid in Hair* (publication # 5990-7535EN), **www.agilent.com/chem/library**



LTM Solution for Fast Simulated Distillation, ASTM D7798-13 and ASTM D2887

Simulated distillation is the preferred method for characterizing boiling point distributions of petroleum fractions because it requires less labor than physical distillation. Simulated distillation determines quantitative mass yield (% off) based on the boiling points for the components in feedstocks and finished petroleum-based materials. Using these results, producers can make informed decisions about process optimization and efficiency. A standard simulated distillation run takes about 20 to 30 min. However, with LTM technology, this time can be reduced to 2.5 min, greatly increasing the analyst's productivity.

ASTM recently released a new method, ASTM D7798-13, for fast simulated distillation, and so Agilent developed the Fast Simulated Distillation Analyzer (G3445B#658) to address this new method. Note that this method is similar to ASTM D2887. The new method does not address high temperature simulated distillation or extended simulated distillation. For ASTM D7798-13, Agilent uses the standard 0.25 µm film column configuration (calibration mix C_5-C_{44}). For fast LTM analysis of ASTM D2887, with Agilent analyzer G3445B#653, the 0.5 µm film column is used (calibration mix C_5-C_{40}).

LTM II Columns

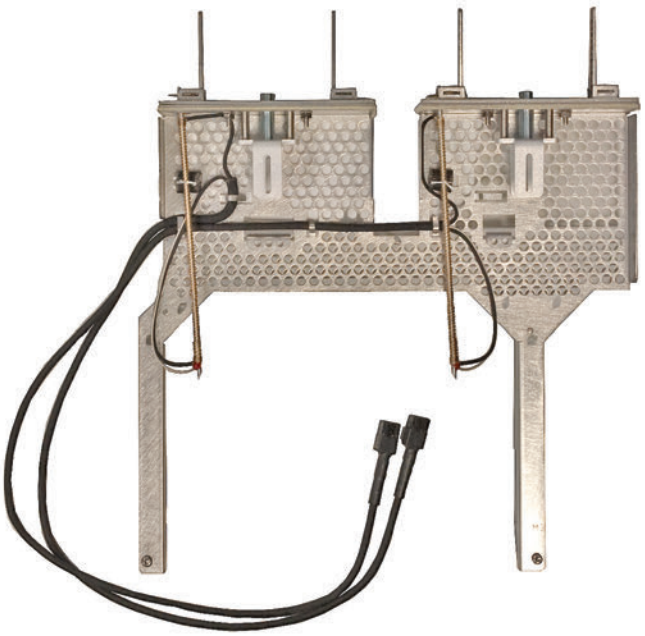
Phase	Description	ID (mm)	Length (m)	Film (µm)	Part No.
DB-Sim-Dist	LTM II	0.25	4	0.25	G3900-65004
DB-Sim-Dist	LTM II	0.25	4	0.50	G3900-65003

LTM II Transfer Line Module

The LTM II transfer line module provides the interface between the standard LTM II 5 in column module and the GC oven. The transfer line module has two heated tubes (transfer lines) through which the column leads pass from the LTM column module into the oven. These transfer lines are temperature programmable to prevent cold spots in the sample path between the GC oven and the LTM column assembly. Each LTM column module attaches to a transfer line module, and the resulting module assembly inserts into slots in the LTM oven door.

LTM II Transfer Line Module

Description	Part No.
LTM II transfer line module, 5 in	G3900-64016



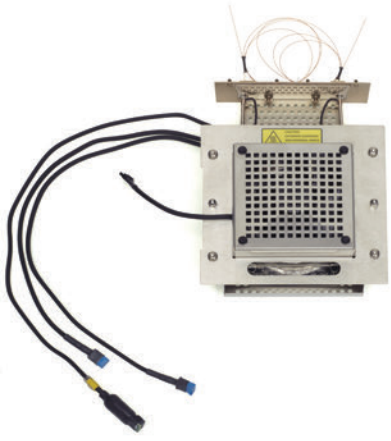
Agilent J&W LTM Column Modules for Transportable 5975T GC/MSD Systems

This LTM column technology is designed specifically for Agilent 5975T GC/MS systems. These modules include an integrated 3 in LTM capillary column toroid assembly with heated transfer lines, cooling fan assembly and sheet metal enclosure. Replacement column toroid assemblies are also available. Benefits of the LTM column modules include:

- Faster heating and cooling times – as low as one minute or less – for more rapid analytical cycle times
- Excellent retention time repeatability and performance comparable to conventional GC
- Less power consumption for longer in-field operation
- Integrated module design to facilitate easy column module change in the field

5975T LTM GC/MSD

Replacement column toroid for LTM 5975T column modules



5975T complete column module

TIPS & TOOLS

Although LTM technology allows very fast temperature programming and fast cycle times, operating under maximum conditions will shorten the lifetime of the LTM column heating circuitry especially for extended 24 hour continuous operation. If you have flexibility in your GC method and/or setup, there are three simple things you can do to improve your LTM Column Module life:

1. Lowering the maximum temperature
2. Lowering the ramp rate during heating
3. Use shorter column lengths. With less thermal mass, heater circuitry generally lasts longer.

Custom LTM Column Ordering

Custom LTM columns are ordered using p/n 100-2000LTM

- Long legs 30 cm column ends (total column length includes the 30 cm column ends)
- **Note:** Long legs are standard for 5975T LTM columns
- Non-standard columns – custom column length, 3 in small format and other special request LTM columns

Note: When requesting quote for custom LTM columns, please specify the following:

- Instrument model, e.g. 7890 or 5975T
- LTM column format: 5 in standard or 3 in small format
- For 5975T, please indicate whether it is for a complete column module or replacement column toroid

Contact your local Agilent office or Authorized Agilent Distributor to receive a quote for your custom column needs. You can find order forms in the back of Agilent's Essential Chromatography Catalog.

Customers in the United States, Canada, and Puerto Rico can request a custom column quote online at **www.agilent.com/chem/CustomColumn**

Custom LTM II standard format (5 in) with long legs

Agilent J&W LTM II Low Thermal Mass Column Modules for 7890A/B Series GC Systems

Phase	ID (mm)	Length (m)	Film (µm)	Part No.
CAM	0.25	30	0.25	112-2133LTM
	0.32	30	0.25	113-2132LTM
	0.53	30	1.00	115-2132LTM
Carbowax 20M	0.25	30	0.25	112-2032LTM
Cyclodex-B	0.25	30	0.25	112-2532LTM
CycloSil-B	0.25	30	0.25	112-6632LTM
	0.32	30	0.25	113-6632LTM
DB-1	0.10	5	0.12	127-100ALTM
		10	0.40	127-1013LTM
		20	0.40	127-1023LTM
	0.15	10	1.20	12A-1015LTM
	0.18	10	0.18	121-1012LTM
			0.20	121-101ALTM
			0.40	121-1013LTM
		20	0.18	121-1022LTM
			0.40	121-1023LTM
	0.20	12	0.33	128-1012LTM
		25	0.33	128-1022LTM
	0.25	15	0.25	122-1012LTM
		25	0.25	122-1022LTM
		30	0.25	122-1032LTM
			0.50	122-103ELTM
			1.00	122-1033LTM
	0.32	5	0.33	123-100ALTM
		15	0.10	123-1011LTM
			0.25	123-1012LTM
			5.00	123-1015LTM
		30	0.25	123-1032LTM
			0.50	123-103ELTM
			1.00	123-1033LTM
			1.50	123-103BLTM
			5.00	123-1035LTM

(Continued)

Agilent J&W LTM II Low Thermal Mass Column Modules for 7890A/B Series GC Systems

Phase	ID (mm)	Length (m)	Film (µm)	Part No.
DB-1	0.53	5	5.00	125-1005LTM
		10	2.65	125-10HBLTM
		15	0.15	125-1011LTM
			1.50	125-1012LTM
			5.00	125-1015LTM
		25	5.00	125-1025LTM
		30	0.25	125-103KLTM
			1.00	125-103JLTM
			1.50	125-1032LTM
			3.00	125-1034LTM
			5.00	125-1035LTM
DB-1301	0.53	30	1.50	125-1333LTM
DB-17	0.10	10	0.10	127-1712LTM
	0.18	20	0.18	121-1722LTM
	0.25	30	0.25	122-1732LTM
	0.32	30	0.25	123-1732LTM
	0.53	15	1.00	125-1712LTM
		15	1.50	125-1713LTM
		30	1.00	125-1732LTM
DB-1701	0.18	20	0.18	121-0722LTM
	0.25	15	1.00	122-0713LTM
		30	0.25	122-0732LTM
		30	1.00	122-0733LTM
	0.32	15	0.25	123-0712LTM
	0.53	15	1.00	125-0712LTM
DB-1701P	0.25	30	0.25	122-7732LTM
DB-17ht	0.25	5	0.15	122-1801LTM
		30	0.15	122-1831LTM
DB-17ms	0.18	20	0.18	121-4722LTM
	0.25	15	0.15	122-4711LTM
		15	0.25	122-4712LTM
		30	0.25	122-4732LTM
	0.32	30	0.25	123-4732LTM

(Continued)

Agilent J&W LTM II Low Thermal Mass Column Modules for 7890A/B Series GC Systems

Phase	ID (mm)	Length (m)	Film (µm)	Part No.
DB-1ht	0.25	30	0.10	122-1131LTM
	0.32	5	0.25	123-1102LTM
		15	0.10	123-1111LTM
DB-1ms	0.10	10	0.10	127-0112LTM
		20	0.40	127-0123LTM
	0.18	20	0.18	121-0122LTM
	0.20	25	0.33	128-0122LTM
	0.25	15	0.25	122-0112LTM
		30	0.25	122-0132LTM
DB-200	0.25	30	0.25	122-2032LTM
			0.50	122-2033LTM
DB-210	0.53	30	1.00	125-0232LTM
DB-225	0.25	15	0.25	122-2212LTM
		30	0.25	122-2232LTM
DB-225ms	0.25	15	0.25	122-2912LTM
		30	0.25	122-2932LTM
DB-23	0.25	30	0.25	122-2332LTM
DB-2887	0.53	10	3.00	125-2814LTM
DB-35	0.32	30	0.50	123-1933LTM
	0.53	30	1.00	125-1932LTM
DB-35ms	0.25	30	0.25	122-3832LTM
DB-5	0.10	10	0.10	127-5012LTM
			0.17	127-501ELTM
			0.40	127-5013LTM
	0.15	10	1.20	12A-5015LTM
	0.18	10	0.18	121-5012LTM
			0.40	121-5013LTM
		20	0.18	121-5022LTM
			0.40	121-5023LTM
	0.20	25	0.33	128-5022LTM

(Continued)

Agilent J&W LTM II Low Thermal Mass Column Modules for 7890A/B Series GC Systems

Phase	ID (mm)	Length (m)	Film (µm)	Part No.
DB-5	0.25	10	0.25	122-5002LTM
		15	0.25	122-5012LTM
		30	0.25	122-5032LTM
			0.50	122-503ELTM
			1.00	122-5033LTM
	0.32	5	1.00	123-5003LTM
		10	0.50	123-500ELTM
		15	0.10	123-5011LTM
			0.25	123-5012LTM
			1.00	123-5013LTM
		25	0.25	123-5022LTM
		30	0.25	123-5032LTM
			0.50	123-503ELTM
			1.50	123-503BLTM
	0.53	15	1.50	125-5012LTM
		30	1.50	125-5032LTM
			5.00	125-5035LTM
DB-5ht	0.25	15	0.10	122-5711LTM
		30	0.10	122-5731LTM
	0.32	10	0.10	123-5701LTM
DB-5ms	0.18	20	0.18	121-5522LTM
			0.36	121-5523LTM
	0.20	25	0.33	128-5522LTM
	0.25	15	0.10	122-5511LTM
			0.25	122-5512LTM
		25	0.25	122-5522LTM
		30	0.25	122-5532LTM
			1.00	122-5533LTM
	0.32	15	0.25	123-5512LTM
			1.00	123-5513LTM
		30	0.50	123-5536LTM
			1.00	123-5533LTM
	0.53	30	1.50	125-5532LTM
			1.00	125-553JLTM

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Agilent J&W LTM II Low Thermal Mass Column Modules for 7890A/B Series GC Systems

Phase	ID (mm)	Length (m)	Film (µm)	Part No.
DB-5ms Ultra Inert	0.18	20	0.18	121-5522UILTM
			0.36	121-5523UILTM
	0.25	15	0.25	122-5512UILTM
		25	0.25	122-5522UILTM
		30	0.25	122-5532UILTM
			0.50	122-5536UILTM
			1.00	122-5533UILTM
DB-608	0.32	30	0.50	123-1730LTM
DB-624	0.18	20	1.00	121-1324LTM
	0.20	10	1.12	128-1314LTM
		25	1.12	128-1324LTM
	0.25	30	1.40	122-1334LTM
	0.32	30	1.80	123-1334LTM
	0.45	30	2.55	124-1334LTM
	0.53	30	3.00	125-1334LTM
DB-ALC1	0.32	30	1.80	123-9134LTM
DB-FFAP	0.10	10	0.10	127-3212LTM
		15	0.10	127-32H2LTM
	0.25	30	0.25	122-3232LTM
	0.32	30	0.25	123-3232LTM
			0.50	123-3233LTM
			1.00	123-3234LTM
	0.53	15	0.50	125-3217LTM
DB-VRX	0.18	20	1.00	121-1524LTM
	0.25	30	1.40	122-1534LTM

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Agilent J&W LTM II Low Thermal Mass Column Modules for 7890A/B Series GC Systems

Phase	ID (mm)	Length (m)	Film (µm)	Part No.
DB-WAX	0.10	10	0.10	127-7012LTM
			0.20	127-7013LTM
		20	0.10	127-7022LTM
			0.20	127-7023LTM
	0.18	10	0.18	121-7012LTM
			0.30	121-7013LTM
		20	0.18	121-7022LTM
			0.30	121-7023LTM
	0.20	30	0.20	128-7032LTM
	0.25	15	0.25	122-7012LTM
			0.50	122-7013LTM
		30	0.25	122-7032LTM
			0.50	122-7033LTM
	0.32	15	0.25	123-7012LTM
			0.50	123-7013LTM
		30	0.25	123-7032LTM
			0.50	123-7033LTM
	0.53	30	0.25	125-7031LTM
			1.00	125-7032LTM
DB-WAXetr	0.25	30	0.25	122-7332LTM
	0.32	30	1.00	123-7334LTM
	0.53	30	1.50	125-7333LTM
DB-XLB	0.25	15	0.10	122-1211LTM
		30	0.25	122-1232LTM
GS-CarbonPLOT	0.32	30	3.00	113-3133LTM
	0.53	30	3.00	115-3133LTM
GS-Q	0.32	30	0.00	113-3432LTM

(Continued)

Agilent J&W LTM II Low Thermal Mass Column Modules for 7890A/B Series GC Systems

Phase	ID (mm)	Length (m)	Film (µm)	Part No.
HP-1	0.20	25	0.11	19091Z-002LTM
			0.50	19091Z-202LTM
	0.32	25	0.17	19091Z-012LTM
		30	0.10	19091Z-313LTM
			4.00	19091Z-613LTM
			5.00	19091Z-713LTM
	0.53	10	0.88	19095Z-021LTM
			2.65	19095Z-121LTM
		30	0.88	19095Z-023LTM
			2.65	19095Z-123LTM
			5.00	19095Z-623LTM
HP-1ms	0.18	20	0.18	19091S-677LTM
	0.25	30	0.10	19091S-833LTM
			0.25	19091S-933LTM
			0.50	19091S-633LTM
			1.00	19091S-733LTM
	0.32	30	1.00	19091S-713LTM
HP-20M	0.32	25	0.30	19091W-012LTM
HP-35	0.25	15	0.25	19091G-131LTM
HP-5	0.18	20	0.18	19091J-577LTM
	0.25	5	0.10	19091J-330LTM
		30	0.25	19091J-433LTM
		30	1.00	19091J-233LTM
	0.32	15	0.25	19091J-411LTM
		30	0.25	19091J-413LTM
			0.50	19091J-113LTM
	0.53	10	2.65	19095J-121LTM
HP-50+	0.25	5	0.15	19091L-330LTM
		15	0.25	19091L-431LTM
		30	0.25	19091L-433LTM
	0.53	15	1.00	19095L-021LTM

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TIPS & TOOLS

For more information about LTM II Column Modules, visit **www.agilent.com/chem/ltmcol_ii**

Agilent J&W LTM II Low Thermal Mass Column Modules for 7890A/B Series GC Systems

Phase	ID (mm)	Length (m)	Film (µm)	Part No.
HP-5ms	0.18	20	0.18	19091S-577LTM
	0.20	12	0.33	19091S-101LTM
		25	0.33	19091S-102LTM
	0.25	15	0.10	19091S-331LTM
			0.25	19091S-431LTM
		30	0.25	19091S-433LTM
	0.32	10	0.50	19091S-111LTM
		30	0.25	19091S-413LTM
HP-5ms Ultra Inert	0.18	20	0.18	19091S-577UILTM
	0.25	15	0.25	19091S-431UILTM
		30	0.25	19091S-433UILTM
			0.50	19091S-133UILTM
			1.00	19091S-233UILTM
	0.32	30	0.25	19091S-413UILTM
			1.00	19091S-213UILTM
HP-88	0.25	30	0.20	112-8837LTM
HP-Fast Residual Solvent	0.53	30	1.00	19095V-420LTM
HP-FFAP	0.20	25	0.33	19091F-102LTM
	0.25	30	0.25	19091F-433LTM
	0.32	25	0.50	19091F-112LTM
	0.53	10	1.00	19095F-121LTM
		30	1.00	19095F-123LTM
HP-INNOWax	0.18	20	0.18	19091N-577LTM
	0.20	25	0.20	19091N-102LTM
	0.25	5	0.15	19091N-030LTM
		30	0.25	19091N-133LTM
	0.32	30	0.15	19091N-013LTM
	0.53	30	1.00	19095N-123LTM

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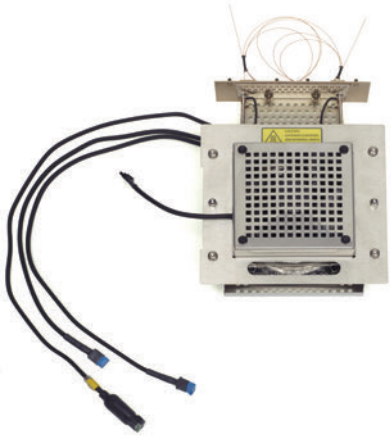
Agilent J&W LTM II Low Thermal Mass Column Modules for 7890A/B Series GC Systems

Phase	ID (mm)	Length (m)	Film (µm)	Part No.
HP-PLOT Al_2O_3 KCl	0.25	30	5.00	19091P-K33LTM
	0.53	30	15.00	19095P-K23LTM
HP-PLOT Al_2O_3 S	0.32	25	8.00	19091P-S12LTM
HP-PLOT Molesieve	0.32	15	25.00	19091P-MS7LTM
		30	25.00	19091P-MS8LTM
	0.53	30	50.00	19095P-MS0LTM
HP-PLOT Q	0.32	15	20.00	19091P-QO3LTM
		30	20.00	19091P-QO4LTM
	0.53	15	40.00	19095P-QO3LTM
		30	40.00	19095P-QO4LTM
HP-PLOT U	0.32	30	10.00	19091P-UO4LTM
	0.53	30	20.00	19095P-UO4LTM
Ultra 2	0.20	12	0.33	19091B-101LTM
		25	0.33	19091B-102LTM
	0.32	25	0.52	19091B-112LTM

Replacement column toroid
for LTM 5975T column modules



LTM 5975T column module

Agilent J&W LTM Column Modules for Transportable 5975T GC/MSD Systems

Phase	ID (mm)	Length (m)	Film (µm)	Toroid Assembly	Column Module
DB-5ms Ultra Inert	0.18	20	0.18	221-5522UILTM	G3900-63014
	0.25	15	0.25	222-5512UILTM	G3900-63031
		30	0.25	222-5532UILTM	G3900-63005
HP-5ms Ultra Inert	0.18	20	0.18	29091S-577UILTM	G3900-63039
	0.25	15	0.25	29091S-431UILTM	G3900-63038
		30	0.25	29091S-433UILTM	G3900-63001
DB-1	0.25	30	0.25	222-1032LTM	G3900-63002
DB-1ms	0.18	20	0.18	221-0122LTM	G3900-63009
	0.25	15	0.25	222-0112LTM	G3900-63016
		30	0.25	222-0132LTM	G3900-63017
DB-1ht	0.25	15	0.10	222-1111LTM	G3900-63018
		30	0.10	222-1131LTM	G3900-63019
HP-1ms	0.18	20	0.18	29091S-677LTM	G3900-63040
	0.25	30	0.10	29091S-833LTM	G3900-63041
		15	0.25	29091S-931LTM	G3900-63042
DB-5ms	0.18	20	0.18	221-5522LTM	G3900-63013
	0.25	15	0.25	222-5512LTM	G3900-63030
		30	0.25	222-5532LTM	G3900-63004
DB-5ht	0.25	30	0.10	222-5731LTM	G3900-63033
		15	0.10	222-5711LTM	G3900-63032

(Continued)

Agilent J&W LTM Column Modules for Transportable 5975T GC/MSD Systems

Phase	ID (mm)	Length (m)	Film (µm)	Toroid Assembly	Column Module
HP-5ms	0.25	30	0.25	29091S-433LTM	G3900-63007
DB-35ms	0.18	20	0.18	221-3822LTM	G3900-63011
	0.25	15	0.25	222-3812LTM	G3900-63026
		30	0.25	222-3832LTM	G3900-63027
DB-17ms	0.18	20	0.18	221-4722LTM	G3900-63012
	0.25	15	0.25	222-4712LTM	G3900-63028
		30	0.25	222-4732LTM	G3900-63029
DB-225ms	0.25	15	0.25	222-2912LTM	G3900-63022
		30	0.25	222-2932LTM	G3900-63023
DB-1701	0.25	30	0.25	222-0732LTM	G3900-63003
DB-WAX	0.25	15	0.50	222-7013LTM	G3900-63034
		30	0.50	222-7033LTM	G3900-63035
HP-INNOWax	0.18	20	0.18	29091N-577LTM	G3900-63036
	0.25	30	0.25	29091N-133LTM	G3900-63008
DB-FFAP	0.25	15	0.25	222-3212LTM	G3900-63024
		30	0.25	222-3232LTM	G3900-63025
DB-608	0.18	20	0.18	221-6822LTM	G3900-63015
DB-VRX	0.18	20	1.00	221-1524LTM	G3900-63006
	0.25	30	1.40	222-1534LTM	G3900-63021
DB-624	0.18	20	1.00	221-1324LTM	G3900-63010
	0.25	30	1.40	222-1334LTM	G3900-63020
HP-VOC	0.20	30	1.12	29091R-303LTM	G3900-63037

TIPS & TOOLS

For more information about LTM Column Modules for 5975T, visit **www.agilent.com/chem/5975t_ltm_col**

Fused Silica Tubing

Deactivated Tubing

Deactivated tubing can be used as retention gaps, guard columns, or transfer lines. Our standard deactivation process is a phenyl methyl deactivation – the preferred choice for most applications due to its inertness and robustness.

Deactivated Fused Silica

ID (mm)	OD (mm)	Length (m)	Part No.
0.05	0.36	1	160-2655-1
		5	160-2655-5
		10	160-2655-10
0.10	0.19	1	160-1010-1
		5	160-1010-5
		10	160-1010-10
	0.36	1	160-2635-1
		5	160-2635-5
		5	19091-60620E
		10	160-2635-10
0.15	0.36	1	160-2625-1
		5	160-2625-5
		10	160-2625-10
0.18	0.34	1	160-2615-1
		5	160-2615-5
		10	160-2615-10
0.20	0.36	1	160-2205-1
		5	160-2205-5
		10	160-2205-10

(Continued)

Deactivated Fused Silica

ID (mm)	OD (mm)	Length (m)	Part No.
0.25	0.36	1	160-2255-1
		5	160-2255-5
		10	160-2255-10
		30	160-2255-30
0.32	0.43	1	160-2325-1
		5	160-2325-5
		10	160-2325-10
		30	160-2325-30
0.45	0.67	1	160-2455-1
		5	160-2455-5
		10	160-2455-10
0.53	0.67	1	160-2535-1
		5	160-2535-5
		10	160-2535-10
		30	160-2535-30
0.53	0.70	5	CP8003*

* 7 in cage

Deactivated Fused Silica High Temperature (400 °C)

ID (mm)	OD (mm)	Length (m)	Part No.
0.05	0.36	5	160-2815-5
0.10	0.36	5	160-2825-5
0.25	0.35	5	160-2845-5
		10	160-2845-10
0.32	0.43	5	160-2855-5
		10	160-2855-10
0.53	0.67	5	160-2865-5
		10	160-2865-10

Retention Gaps

ID (mm)	OD (mm)	Length (m)	Connector	Unit	Part No.
0.25	0.36	2.5	Universal	5/pk	CP8007
0.32	0.45	2.5	Universal	5/pk	CP8008
		2.5	0.32/0.25	5/pk	CP8129
		2.5	0.32/0.32	5/pk	CP8128
0.53	0.70	2.5	Universal	5/pk	CP8009
		2.5	0.53/0.25	5/pk	CP8135
		2.5	0.53/0.32	5/pk	CP8134
		4.0	Universal	3/pk	CP8015

Retention Gaps Apolar Deactivated

ID (mm)	OD (mm)	Length (m)	Unit	Part No.
0.25	0.36	10	6/pk	CP8016

Retention Gaps Medium Polar Deactivated

ID (mm)	OD (mm)	Length (m)	Connector	Unit	Part No.
0.25	0.36	2.5	Universal	5/pk	CP8017
0.32	0.45	2.5	Universal	5/pk	CP8018
0.53	0.70	2.5	Universal	5/pk	CP8019

Retention Gaps Polar Deactivated

ID (mm)	OD (mm)	Length (m)	Connector	Unit	Part No.
0.25	0.36	2.5	Universal	5/pk	CP8087
0.32	0.45	2.5	Universal	5/pk	CP8088
0.53	0.70	2.5	Universal	5/pk	CP8089

Retention Gaps in Three Polarities

A package of 3 apolar, 1 medium polar and 1 polar deactivated

ID (mm)	OD (mm)	Length (m)	Connector	Unit	Part No.
0.25	0.36	2.5	Universal	5/pk	CP8070
0.32	0.45	2.5	Universal	5/pk	CP8080
0.53	0.70	2.5	Universal	5/pk	CP8090

Restriction for Rapid-MS

ID (mm)	OD (mm)	Length (m)	Unit	Part No.
0.1	0.39	0.6	5/pk	CP8121

Guard Column MSD

ID (mm)	OD (mm)	Length (m)	Unit	Part No.
0.53	0.70	5	1/pk	CP8186
			6/pk	CP68186

Large Volume Guard

ID (mm)	OD (mm)	Length (m)	Unit	Part No.
0.53	0.70	10	1/pk	CP8187
			6/pk	CP68187
0.53	0.70	12	1/pk	CP108194

Undeactivated Fused Silica

Undeactivated tubing or bare fused silica is commonly used for capillary electrophoresis. It can also be used for transfer lines and other applications where inertness is not critical.

Undeactivated Fused Silica

ID (mm)	OD (mm)	Length (m)	Part No.
0.02	0.36	5	160-2660-5
0.05	0.36	5	160-2650-5
		10	160-2650-10
0.075	0.36	5	160-2644-5
		10	160-2644-10
0.10	0.36	5	160-2634-5
		10	160-2634-10
0.18	0.34	5	160-2610-5
		10	160-2610-10
0.20	0.36	5	160-2200-5
		10	160-2200-10
0.25	0.36	5	160-2250-5
		10	160-2250-10
0.32	0.43	5	160-2320-5
		10	160-2320-10
		50	19091-21050
0.53	0.67	5	160-2530-5
		10	160-2530-10

Stainless Steel Tubing

UltiMetal Plus Stainless Steel Capillary Tubing

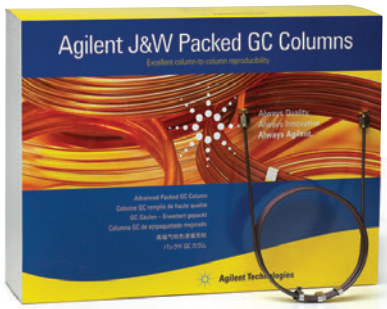
UltiMetal Plus stainless steel capillary tubing can be used as retention gaps, guard columns, or transfer lines.

UltiMetal Plus Stainless Steel Capillary Tubing

Description	ID (mm)	OD (mm)	Length (m)	Part No.
UltiMetal Plus transfer line	0.25	1.59	2	CP6571
UltiMetal Plus transfer line	0.25	1.59	10	CP6572
UltiMetal Plus transfer line	0.75	1.59	2	CP6573
UltiMetal Plus transfer line	0.75	1.59	10	CP6574
UltiMetal Plus guard column	0.25	0.5	2	CP6575
UltiMetal Plus guard column	0.53	0.8	2	CP6576
UltiMetal Plus guard column	0.53	0.8	5	CP6577
UltiMetal Plus guard column	0.53	0.8	10	CP6578
UltiMetal Plus capillary tubing	0.25	0.5	50	CP6579
UltiMetal Plus capillary tubing	0.32	0.5	50	CP6580
UltiMetal Plus capillary tubing	0.53	0.8	50	CP6581

ProSteel Deactivated

ID (mm)	OD (mm)	Length (m)	Part No.
0.53	0.67	5	160-4535-5



Agilent J&W Packed GC Columns

Agilent J&W Packed GC Columns are designed and manufactured to offer excellent and reproducible performance for all sample types associated with packed column separations, most important in the hydrocarbon processing industry.

The highly efficient and rigorous packing technology used in Agilent J&W Packed GC Columns assures column-to-column reproducibility and ultimate efficiency, while the UltiMetal treated stainless steel tubing allows for improved inertness and peak shape performance.

You can choose from a wide range of tubing materials – including stainless steel, UltiMetal, nickel, glass, copper and PTFE – plus hundreds of stationary phases, packings, and supports. All Agilent J&W Packed GC Columns can bend to fit Agilent and non-Agilent instruments with no impact on performance.

And, you can create your custom configurations
by visiting **www.agilent.com/chem/packedcolumnsordering**

Carbosieve S-II

Length	OD (in)	ID (mm)	Mesh	UltiMetal	Stainless Steel
20 in (0.51 m)	1/8	2	80/100	G3591-81105	G3591-80105

15% Carbowax 1540

Length	OD (in)	ID (mm)	Support	Mesh	UltiMetal	Stainless Steel	Nickel
15 ft (4.57 m)	1/8	2	Chromosorb WHP	60/80	G3591-81095	G3591-80095	G3591-82095

5% Carbowax 20M (G16, G$1)

Length	OD (in)	ID (mm)	Support	Mesh	UltiMetal	Stainless Steel	Nickel
7.22 ft (2.2 m)	1/8	2	Chromosorb WHP	100/120	G3591-81084	G3591-80084	G3591-82084

10% Carbowax 20M (G16, G$1)

Length	OD (in)	ID (mm)	Support	Mesh	Stainless Steel
6.56 ft (2 m)	1/8	2	Chromosorb WHP	80/100	G3591-70016

10% Carbowax 20M (G16, G$1) + 2% KOH

Length	OD (in)	ID (mm)	Support	Mesh	Stainless Steel
5.91 ft (1.8 m)	1/8	2	Chromosorb WHP	80/100	G3591-70012

20% Carbowax 20M (G16, G$1)

Length	OD (in)	ID (mm)	Support	Mesh	UltiMetal	Stainless Steel	Nickel
9.84 ft (3 m)	1/8	2	Chromosorb WHP	100/120	G3591-81099	G3591-80099	G3591-82099

7% Carbowax M + 3% Polyphenolether 6 ring + 2% KOH

Length	OD (in)	ID (mm)	Support	Mesh	UltiMetal	Nickel
4 ft (1.22 m)	1/8	2	Chromosorb WAW	80/100	G3591-81050	G3591-82050

Carboxen-1000

Length	OD (in)	ID (mm)	Mesh	UltiMetal	Stainless Steel
10 ft (3.05 m)	1/8	2	60/80	G3591-81055	G3591-80055

Chromosorb 101

Length	OD (in)	ID (mm)	Mesh	UltiMetal	Stainless Steel
6 ft (1.83 m)	1/8	2	80/100	G3591-81021	G3591-80021

Chromosorb 102

Length	OD (in)	ID (mm)	Mesh	UltiMetal	Stainless Steel	Nickel
2 ft (0.61 m)	1/8	2	80/100	G3591-81139	G3591-80139	G3591-82139

25% DC-200 (500 cSt)

Length	OD (in)	ID (mm)	Support	Mesh	UltiMetal	Stainless Steel	Nickel
15 ft (4.57 m)	1/8	2	Chromosorb PAW	80/100	G3591-81001	G3591-80001	G3591-82001

30% DC-200 (500 cSt)

Length	OD (in)	ID (mm)	Support	Mesh	UltiMetal	Stainless Steel	Nickel
20 ft (6.1 m)	1/8	2	Chromosorb PAW	100/120	G3591-81140	G3591-80140	G3591-82140
30 ft (9.14 m)	1/8	2	Chromosorb PAW	80/100	G3591-81082	G3591-80082	G3591-82082
30 ft (9.14 m)	1/8	2	Chromosorb PAW	60/80	CP2058*		

*Preconditioned and pretested

35% DC-200 (500 cSt)

Length	OD (in)	ID (mm)	Support	Mesh	UltiMetal	Stainless Steel	Nickel
3 ft (0.91 m)	1/8	2	Chromosorb PAW	80/100	G3591-81039	G3591-80039	G3591-82039
5 ft (1.52 m)	1/8	2	Chromosorb PAW	80/100	G3591-81027	G3591-80027	
10 ft (3.05 m)	1/8	2	Chromosorb PAW	80/100	G3591-81030	G3591-80030	
30 ft (9.14 m)	1/8	2	Chromosorb PAW	80/100	G3591-81032	G3591-80032	G3591-82032

15% Hallcomid M-18

Length	OD (in)	ID (mm)	Support	Mesh	UltiMetal	Stainless Steel	Nickel
9.84 ft (3 m)	1/8	2	Chromosorb WHP	100/120	G3591-81067	G3591-80067	G3591-82067

30% DC 200/500

Length	OD (in)	ID (mm)	Support	Mesh	UltiMetal	Stainless Steel
2 ft (0.61 m)	1/8	2	Chromosorb PAW	60/80	G3591-81160	G3591-80160
30 ft (9.14 m)	1/8	2	Chromosorb PAW	60/80	G3591-81161	G3591-80161

HayeSep A

Length	OD (in)	ID (mm)	Mesh	UltiMetal
1.31 ft (0.4 m)	1/8	2.1	80/100	G3591-81211**
2 ft (0.61 m)	1/16	1	80/100	G3591-81212*
5 ft (1.52 m)	1/8	2.1	80/100	G3591-81210*
5.58 ft (1.7 m)	1/16	1	80/100	G3591-81213*

*Specially coiled for Large Valve Oven, 41 mm mandrel

**Specially coiled for Large Valve Oven, 25 mm mandrel

HayeSep D

Length	OD (in)	ID (mm)	Mesh	Stainless Steel
6.56 ft (2 m)	1/8	2	80/100	G3591-80158

HayeSep DB

Length	OD (in)	ID (mm)	Mesh	UltiMetal	Stainless Steel	Nickel
30 ft (9.14 m)	1/8	2	100/120	G3591-81088	G3591-80088	G3591-82088

HayeSep N

Length	OD (in)	ID (mm)	Mesh	UltiMetal	Stainless Steel	Nickel
1.64 ft (0.5 m)	1/8	2	80/100	G3591-81156	G3591-80156	
1.64 ft (0.5 m)	1/16	1	80/100	CP1307*		
6 ft (1.83 m)	1/8	2	80/100	G3591-81037	G3591-80037	G3591-82037
6 ft (1.83 m)	1/8	2	80/100	CP2068*		
7 ft (2.13 m)	1/8	2	60/80	G3591-81060	G3591-80060	
8 ft (2.44 m)	1/8	2	80/100	G3591-81011	G3591-80011	G3591-82011
20 ft (6.1 m)	1/8	2	80/100	G3591-81045	G3591-80045	

*Preconditioned and pretested

HayeSep N + HayeSep R 1:1

Length	OD (in)	ID (mm)	Mesh	UltiMetal	Stainless Steel
8 ft (2.44 m)	1/8	2	45/60	G3591-81091	G3591-80091

HayeSep P

Length	OD (in)	ID (mm)	Mesh	UltiMetal
6 ft (1.83 m)	1/8	2	80/100	CP2062

HayeSep Q

Length	OD (in)	ID (mm)	Mesh	UltiMetal	Stainless Steel	Nickel
0.82 ft (0.25 m)	1/16	1	80/100	CP1308*		
1.64 ft (0.5 m)	1/8	2	80/100	G3591-81023	G3591-80023	G3591-82023
1.64 ft (0.5 m)	1/8	2	80/100	CP81073*		
3 ft (0.91 m)	1/8	2	80/100	G3591-81020	G3591-80020	G3591-82020
3.28 ft (1 m)	1/8	2	80/100	G3591-81146	G3591-70007	
3.28 ft (1 m)	1/8	2	80/100	CP81069*		
3.9 ft (1.2 m)	1/8	2	80/100			G3591-82159
4 ft (1.22 m)	1/8	2	80/100	G3591-81019	G3591-80019	
4.92 ft (1.5 m)	1/16	1	80/100	CP1305*		
5.91 ft (1.8 m)	1/8	2	80/100		G3591-70011	
6 ft (1.83 m)	1/8	2	80/100	G3591-81004	G3591-80004	G3591-82004
6.56 ft (2 m)	1/8	2	80/100		G3591-70005	
8 ft (2.44 m)	1/8	2	80/100	G3591-81047	G3591-80047	
9 ft (2.74 m)	1/8	2	80/100	G3591-81033	G3591-80033	G3591-82033
9.84 ft (3 m)	1/8	2	80/100		G3591-70006	
10 ft (3.05 m)	1/8	2	80/100	G3591-81002	G3591-80002	G3591-82002
12 ft (3.66 m)	1/8	2	80/100	G3591-81121	G3591-80121	G3591-82121

*Preconditioned and pretested

HayeSep R

Length	OD (in)	ID (mm)	Mesh	UltiMetal	Stainless Steel	Nickel
3.28 ft (1 m)	1/8	2	80/100	CP86678*		
6 ft (1.83 m)	1/8	2	80/100	G3591-81102	G3591-80124	G3591-82102
8.53 ft (2.6 m)	1/8	2	80/100	CP86677*		
12 ft (3.66 m)	1/8	2	80/100	G3591-81100	G3591-80100	
12 ft (3.66 m)	1/8	2	80/100	CP2055*		

*Preconditioned and pretested

HayeSep T

Length	OD (in)	ID (mm)	Mesh	UltiMetal	PTFE
1.64 ft (0.5 m)	1/8	2	80/100	G3591-81143	
1.64 ft (0.5 m)	1/8	2.4	60/80		G3591-74001

MolSieve 5Å

Length	OD (in)	ID (mm)	Mesh	UltiMetal	Stainless Steel	Nickel
1 ft (0.30 m)	1/8	2	60/80	G3591-81077	G3591-80077	
1.64 ft (0.5 m)	1/8	2	60/80	G3591-81147		
1.97 ft (0.6 m)	1/4	4	80/100		G3591-70004	
3 ft (0.91 m)	1/8	2	60/80	G3591-81103	G3591-80103	
3 ft (0.91 m)	1/8	2	80/100	G3591-81074	G3591-80074	
3 ft (0.91 m)	1/8	2	100/120	G3591-81075	G3591-80075	
3.28 ft (1 m)	1/8	2	80/100		G3591-70008	
3.28 ft (1 m)	1/8	2	60/80	CP81025*		
3.28 ft (1 m)	1/8	2	60/80	G3591-81149		
4 ft (1.22 m)	1/8	2	45/60	G3591-81090	G3591-80090	
4 ft (1.22 m)	1/8	2	60/80	G3591-81104	G3591-80104	G3591-82104
4.92 ft (1.5 m)	1/16	1	80/100	CP1306*		
5 ft (1.52 m)	1/8	2	80/100	CP2046		
6 ft (1.83 m)	1/8	2	45/60	CP2065		
6 ft (1.83 m)	1/8	2	60/80	G3591-81017	G3591-80017	G3591-82017
6.56 ft (2 m)	1/8	2	45/60		G3591-70013	
6.56 ft (2 m)	1/8	2	60/80		G3591-70002	
6.56 ft (2 m)	1/8	2	80/100		G3591-70003	
7 ft (2.13 m)	1/8	2	45/60	G3591-81062	G3591-80062	
7 ft (2.13 m)	1/8	2.1	60/80	G3591-81209**		
8 ft (2.44 m)	1/8	2	60/80	G3591-81022	G3591-80022	G3591-82022
9 ft (2.74 m)	1/8	2	60/80	G3591-81046	G3591-80046	
9 ft (2.74 m)	1/8	2	80/100	G3591-81064	G3591-80064	G3591-82064
10 ft (3.05 m)	1/8	2	80/100	CP2045		
13.1 ft (4 m)	1/8	2	80/100	CP1483*		
15 ft (4.57 m)	1/8	2	45/60	G3591-81061	G3591-80061	
20 ft (6.1 m)	1/8	2	45/60		G3591-80107	
20 ft (6.1 m)	1/8	2	60/80	G3591-81056	G3591-80056	
25 ft (7.62 m)	1/8	2	60/80	G3591-81065	G3591-80065	

*Preconditioned and pretested

**Specially coiled for Large Valve Oven, 41 mm mandrel

MolSieve 13X

Length	OD (in)	ID (mm)	Mesh	UltiMetal	Stainless Steel	Nickel
2 ft (0.61 m)	1/8	2	45/60	G3591-81031	G3591-80031	
3 ft (0.91 m)	1/8	2	45/60	G3591-81028	G3591-80028	
3 ft (0.91 m)	1/8	2	45/60	CP2059*		
3.94 ft (1.2 m)	1/16	1	80/100	CP1309*		
4 ft (1.22 m)	1/8	2	45/60	G3591-81012	G3591-80012	G3591-82012
4.9 ft (1.5 m)	1/8	2	80/100	G3591-81085	G3591-80085	
4.92 ft (1.5 m)	1/8	2	80/100	CP81071*		
6 ft (1.83 m)	1/8	2	60/80	G3591-81035	G3591-80035	G3591-82035
6.56 ft (2 m)	1/16	1	80/100	G3591-81214*		
9 ft (2.74 m)	1/8	2	45/60	G3591-81054	G3591-80054	
9.84 ft (3 m)	1/8	2	45/60		G3591-70017	
9.84 ft (3 m)	1/8	2	80/100		G3591-70015	
10 ft (3.05 m)	1/8	2	45/60	G3591-81003	G3591-80003	G3591-82003
10 ft (3.05 m)	1/16	1	60/80	G3591-81097	G3591-80097	
10 ft (3.05 m)	1/8	2	60/80	G3591-81101	G3591-80101	G3591-82101
10 ft (3.05 m)	1/8	2	80/100	G3591-81043	G3591-80043	G3591-82043
12 ft (3.66 m)	1/8	2	60/80	G3591-81058	G3591-80058	
15 ft (4.57 m)	1/8	2	45/60	G3591-81098	G3591-80098	

*Preconditioned and pretested

**Specially coiled for Large Valve Oven, 41 mm mandrel

1.5% OV-101

Length	OD (in)	ID (mm)	Support	Mesh	UltiMetal	Stainless Steel
2 ft (0.61 m)	1/8	2	Chromosorb GHP	100/120	G3591-81162	G3591-80162

10% OV-101

Length	OD (in)	ID (mm)	Support	Mesh	UltiMetal	Stainless Steel	Nickel
2.6 ft (0.79 m)	1/8	2	Chromosorb WHP	60/80	G3591-81048	G3591-80048	G3591-82048
5 ft (1.52 m)	1/8	2	Chromosorb PAW	80/100	G3591-81093	G3591-80093	G3591-82093

20% OV-101

Length	OD (in)	ID (mm)	Support	Mesh	UltiMetal	Stainless Steel	Nickel
4 ft (1.22 m)	1/8	2	Chromosorb WHP	80/100	G3591-81025	G3591-80025	G3591-82025

10% PEG-20M

Length	OD (in)	ID (mm)	Support	Mesh	UltiMetal	Stainless Steel	Nickel
6.56 ft (2 m)	1/8	2	Chromosorb W	80/100	G3591-81119	G3591-80119	G3591-82119

20% PEG-20M

Length	OD (in)	ID (mm)	Support	Mesh	UltiMetal	Stainless Steel	Nickel
6.56 ft (2 m)	1/8	2	Chromosorb W	80/100	G3591-81122	G3591-80122	G3591-82122
13.1 ft (4 m)	1/8	2	Chromosorb W	80/100	G3591-81123	G3591-80123	G3591-82123

Porapak N

Length	OD (in)	ID (mm)	Mesh	UltiMetal	Stainless Steel	Nickel
3 ft (0.91 m)	1/8	2	80/100	G3591-81072	G3591-80072	G3591-82072
3.9 ft (1.2 m)	1/8	2	60/80	G3591-81087	G3591-80087	G3591-82087
6 ft (1.83 m)	1/8	2	80/100	G3591-81036	G3591-80036	G3591-82036
8.2 ft (2.5 m)	1/8	2	50/80	G3591-81086	G3591-80086	
9 ft (2.74 m)	1/8	2	80/100	G3591-81044	G3591-80044	G3591-82044
12 ft (3.66 m)	1/8	2	60/80	G3591-81059	G3591-80059	

Porapak N + Porapak R 1:1

Length	OD (in)	ID (mm)	Mesh	Stainless Steel
12 ft (3.66 m)	1/8	2	50/80	G3591-80110

Porapak Q

Length	OD (in)	ID (mm)	Mesh	UltiMetal	Stainless Steel	Nickel
3 ft (0.91 m)	1/8	2	80/100	G3591-81135	G3591-80135	G3591-82135
3.28 ft (1 m)	1/8	2	80/100		G3591-70014	
5.91 ft (1.8 m)	1/8	2	80/100		G3591-70010	
6 ft (1.83 m)	1/8	2	60/80	G3591-81136	G3591-80136	G3591-82136
6 ft (1.83 m)	1/8	2	80/100	G3591-81013	G3591-80013	G3591-82013
6.56 ft (2 m)	1/8	2	80/100		G3591-70001	
8 ft (2.44 m)	1/8	2	60/80	G3591-81137	G3591-80137	G3591-82137
8.2 ft (2.5 m)	1/8	2	80/100	G3591-81083	G3591-80083	
9 ft (2.74 m)	1/8	2	80/100	G3591-81016	G3591-80016	G3591-82016
9.84 ft (3 m)	1/8	2	80/100		G3591-70009	
13 ft (3.96 m)	1/8	2	80/100	G3591-81053	G3591-80053	G3591-82053
15 ft (4.57 m)	1/8	2	80/100	G3591-81066	G3591-80066	
25 ft (7.62 m)	1/8	2	100/120	G3591-81052	G3591-80052	
30 ft (9.14 m)	1/16	1	80/100	G3591-81096	G3591-80096	

Porapak QS

Length	OD (in)	ID (mm)	Mesh	UltiMetal	Stainless Steel	Nickel
4.92 ft (1.5 m)	1/8	2	50/80		G3591-70018	
6.56 ft (2 m)	1/8	2	80/100	G3591-81157	G3591-80157	
8 ft (2.44 m)	1/8	2	80/100	G3591-81051	G3591-80051	G3591-82051

Porapak R

Length	OD (in)	ID (mm)	Mesh	UltiMetal	Stainless Steel	Nickel
6 ft (1.83 m)	1/8	2	60/80	G3591-81106	G3591-80106	G3591-82106

Porapak T

Length	OD (in)	ID (mm)	Mesh	UltiMetal	Stainless Steel
1.5 ft (0.46 m)	1/8	2	80/100	G3591-81138	G3591-80138
6.56 ft (2 m)	1/8	2	80/100	G3591-81120	G3591-80120

10% SE-30

Length	OD (in)	ID (mm)	Support	Mesh	UltiMetal
2.5 ft (0.76 m)	1/8	2	Chromosorb W	80/100	CP2073

20% Sebaconitrile

Length	OD (in)	ID (mm)	Support	Mesh	UltiMetal	Stainless Steel	Nickel
2 ft (0.61 m)	1/8	2	Chromosorb PAW	80/100	G3591-81029	G3591-80029	G3591-82029
19.7 ft (6 m)	1/8	2	Chromosorb PAW	80/100	G3591-81071	G3591-80071	
30 ft (9.14 m)	1/8	2	Chromosorb PAW	60/80	G3591-81176	G3591-80176	G3591-82176
30 ft (9.14 m)	1/8	2	Chromosorb PAW	80/100	G3591-81026	G3591-80026	G3591-82026

20% Sebaconitrile/2% H_3PO_4

Length	OD (in)	ID (mm)	Support	Mesh	UltiMetal	Stainless Steel	Nickel
2 ft (0.61 m)	1/8	2	Chromosorb PAW	80/100	G3591-81015	G3591-80015	G3591-82015
30 ft (9.14 m)	1/8	2	Chromosorb PAW	80/100	G3591-81014	G3591-80014	G3591-82014

Silica Gel

Length	OD (in)	ID (mm)	Mesh	UltiMetal	Stainless Steel
2 ft (0.61 m)	1/8	2	60/80	G3591-81141	G3591-80141
4 ft (1.22 m)	1/8	2	60/80	G3591-81142	G3591-80142
6 ft (1.83 m)	1/8	2	60/80		G3591-80108
10 ft (3.05 m)	1/8	2	60/80	CP2050	

0.1% SP-1000

Length	OD (in)	ID (mm)	Support	Mesh	UltiMetal	Stainless Steel	Nickel
7 ft (2.13 m)	1/8	2	Carbopak C	80/100	G3591-81063	G3591-80063	G3591-82063

15% SP-2100

Length	OD (in)	ID (mm)	Support	Mesh	Stainless Steel
1.64 ft (0.5 m)	1/16	1	Chromosorb PAW	80/100	G3591-80170
7.22 ft (2.2 m)	1/16	1	Chromosorb PAW	80/100	G3591-80171

25% SP-2100

Length	OD (in)	ID (mm)	Support	Mesh	UltiMetal	Stainless Steel
1.64 ft (0.5 m)	1/16	1	Chromosorb PAW	80/100	G3591-81007	G3591-80007
5.7 ft (1.75 m)	1/16	1	Chromosorb PAW	80/100	G3591-81008	G3591-80008
15 ft (4.57 m)	1/8	2	Chromosorb PAW	80/100	G3591-81068	G3591-80068

20% TCEP

Length	OD (in)	ID (mm)	Support	Mesh	UltiMetal	Stainless Steel	Nickel
1.84 ft (0.56 m)	1/16	0.75	Chromosorb PAW	80/100	G3591-81215*		
1.84 ft (0.56 m)	1/16	1	Chromosorb PAW	80/100	G3591-81006	G3591-80006	
5 ft (1.52 m)	1/8	2	Chromosorb PAW	80/100	G3591-81094	G3591-80094	
15 ft (4.57 m)	1/8	2	Chromosorb PAW	80/100	G3591-81049	G3591-80049	G3591-82049

* Specially coiled for Large Valve Oven, 41 mm mandrel

10% UC W982

Length	OD (in)	ID (mm)	Support	Mesh	UltiMetal	Stainless Steel	Nickel
1.5 ft (0.46 m)	1/8	2	Chromosorb PAW	80/100	G3591-81034	G3591-80034	
2 ft (0.61 m)	1/8	2	Chromosorb PAW	80/100	G3591-81040	G3591-80040	G3591-82040

12% UC W982

Length	OD (in)	ID (mm)	Support	Mesh	UltiMetal	Stainless Steel	Nickel
2 ft (0.61 m)	1/8	2	Chromosorb PAW	80/100	G3591-81000	G3591-80000	G3591-82000

TIPS & TOOLS

To learn more about Agilent J&W Packed GC Columns please visit **www.agilent.com/chem/packedcolumns**

Custom GC Column Ordering

Even though we offer over a thousand readily available columns, Agilent recognizes that sometimes you need something a little out of the ordinary. That's why we developed our Custom Column Shop. If you can't find what you're looking for in our standard order guides, we will design, build, and test capillary GC columns to meet your needs.

- We can create columns with non-standard lengths or unusual film thickness.
- We can connect columns together in series or as dual columns.
- We recognize that sometimes customers have specific column performance requirements for their applications that might not be met with standard test mixes. As a result, we can also custom-test your columns with your desired test mixture and test conditions to meet specific performance requirements.
- We can create DuraGuard or EZ-Guard columns with an integrated guard column (retention gap). Most phases can be manufactured with a built-in guard column, which means you get the advantages of a guard column without the union. Available in DB, CP and VF phases.

Custom columns are ordered using the p/ns below. Be sure to provide the details of your desired custom service or column including phase, length, id, and film thickness.

- 100-2000 Custom Capillary DB & HP columns
- 100-6000 Custom Capillary CP & VF columns
- 100-9000 UltiMetal treated tubing and parts
- 100-2000 LTM – Custom Low Thermal Mass column configurations
- 100-5000 Custom packed columns or bulk phases/supports

Contact your local Agilent office or Authorized Agilent Distributor to receive a quote for your custom column needs. You can find order forms in the back of Agilent's Essential Chromatography Catalog.

Customers in the United States, Canada, and Puerto Rico can request a custom column quote online at **www.agilent.com/chem/CustomColumn**

Agilent J&W GC Column Test Standards

Compare your column's performance to the test chromatogram shipped with your Agilent J&W column. The column test standard contains components that test the column for resolution characteristics, efficiency, and inertness. The test mixes are supplied at a concentration of 250 ng/µL in 2 mL vials. Match the phase and column diameter in the chart below to find the test mix for your column.

Agilent J&W GC Column Test Standards

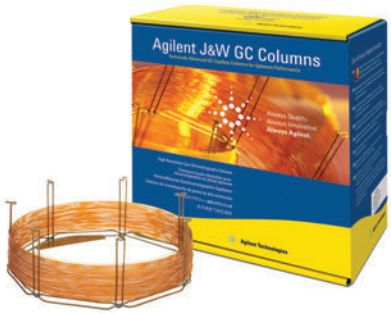
Column Description	Microbore (0.05 & 0.10 mm ID) Part No.	Capillary (0.18 & 0.32 mm ID) Part No.	Megabore (0.45 & 0.53 mm ID) Part No.
OV-351		200-0032	
DB-1ht		200-0010	
DB-1	200-0010	200-0310	200-0110
DB-5	200-0010	200-0310	200-0110
DB-5ht		200-0010	
DB-5ms		200-0185	200-0185
DB-624		200-0113	200-0113
DB-2887			200-0110
DB-WAX	200-0070	200-0370	200-0070
DB-WAXetr		200-0370	200-0070
SE-30		200-0010	
SE-52		200-0010	
SE-54		200-0010	200-0010
HP-1		5080-8858	8500-6812
HP-5		5080-8858	8500-6812
HP-FFAP	8500-6813	8500-6813	8500-6813
GS-OxyPLOT			5188-5379

Test Standards for Agilent J&W CP and VF Columns

Test Mix 31 Hazardous, 1/pk	Part No.
VF-1ms	CP0031
VF-5ms	CP0031
VF-17ms	CP0031
VF-35ms	CP0031
VF-Xms	CP0031
VF-1301ms	CP0031
VF-200ms	CP0031
VF Rapid-MS	CP0031
CP-Sil 5 CB	CP0031
CP-Sil 8 CB	CP0031
CP-Sil 24 CB	CP0031
CP-1301	CP0031

TIPS & TOOLS

Ensure highest quality gas while keeping gas lines clean and leak-free with Agilent's high-capacity gas filter. Learn more at **www.agilent.com/chem/gasclean**



Column Installation and Troubleshooting

Quick reference guides and tips to ensure peak performance

Agilent J&W GC columns are backed by decades of chromatography experience, so you can count on superior quality and dependability. And you can help ensure maximum performance, efficiency, and column life by implementing the most current installation and troubleshooting procedures.

In this section, you'll discover tips, techniques, and easy reference guides that will help you:

- Confidently install any capillary column
- Condition and test new columns
- Alleviate and avoid column performance degradation due to thermal damage, oxygen damage, and other factors
- Pinpoint and fix the most common column problems

So you'll expand your hours of continuous operation, decrease downtime, and get the reproducible results that your lab demands.

Capillary Column Installation Quick Reference Guide

For more detailed installation information, refer to the GC Column Installation Guide which is provided with your column, or visit **www.agilent.com/chem/columninstall**

Precolumn Installation Check List

1. Replace oxygen, moisture, and hydrocarbon traps as needed.
2. Clean the injection port, replace critical injection port seals, replace injection port liners, and change septa as needed.
3. Check detector seals, and replace as necessary. Clean or replace detector jets as necessary.
4. Carefully inspect the column for damage or breakage.
5. Check your GC manufacturer's gas pressure requirements and verify gas cylinder delivery pressures to ensure that an adequate supply of carrier, makeup, and fuel gases are available. Minimum recommended carrier gas purity percentages are: helium 99.995% and hydrogen 99.995%, with H_20 <1 ppm and O_2 <0.5 ppm.
6. Gather the necessary installation tools: You will need a column cutter, column nuts, column nut wrench, ferrules, a magnifying loupe, and typewriter correction fluid.

Installing the Column

1. Uncoil approximately 0.5 m of tubing (1 coil ~ 0.5 m) from the column basket at both ends of the column for injector and detector installation. Avoid using sharp bends in the tubing.
2. Mount the column in the oven. Use a handling bracket if available.
3. Install the column nut and graphite/polyimide or graphite ferrule at each column end; pull the nut and ferrule down the tubing approximately 15 cm (**Table 6**).
4. Score (scratch) the column. Use a light touch to score the column about 4 to 5 cm from each end.

(Continued)

Table 6:

Ferrule Sizes

Column ID (mm)	Ferrule ID (mm)
0.10	0.4
0.18	0.4
0.20	0.4
0.25	0.4
0.32	0.5
0.45	0.8
0.53	0.8

5. Make a clean break. Grasp the column between the thumb and forefinger as close to the score point as possible. Gently pull and bend the column. The column should part easily. If the column does not break easily, do not force it. Score the column again in a different place (farther from the end than before) and try again for a clean break.
6. Use a magnifying loupe to inspect the cut. Make sure the cut is square across the tubing with no polyimide or "glass" fragments at the end of the tube.
7. Install the column in the inlet. Check the GC manufacturer's instrument manual for the correct insertion distance in the injection port type being used. Slide the column nut and ferrule to the proper distance and then mark the correct distance on the column with typewriter correction fluid just behind the column nut. Allow the fluid to dry. Insert the column into the injector. Finger tighten the column nut until it starts to grab the column, and then tighten the nut an additional 1/4 to 1/2 turn, so that the column cannot be pulled from the fitting when gentle pressure is applied. Verify that the correct column insertion distance has been maintained by looking at the typewriter correction fluid mark.
8. Turn on the carrier gas and establish the proper flow rate. Set head pressure, split flow, and septum purge flow to appropriate levels. See **Table 7** for nominal head pressures. If fusing a split/splitless inlet, check that the purge (split) valve is "on" (open).
9. Confirm carrier gas flow through the column. Immerse the end of the column in a vial of solvent and check for bubbles.
10. Install the column into the detector. Check the instrument manufacturer's manual for the proper insertion distance.
11. Check for leaks. **This is very important**. Do not heat the column without thoroughly checking for leaks.
12. Establish proper injector and detector temperatures.
13. Establish proper makeup and detector gas flows. Ignite or turn "on" the detector.
14. Purge the column for a minimum of 10 min at ambient temperature. Add the appropriate additional purge time following inlet or trap maintenance.
15. Inject non-retained substance to check for proper injector installation. Examples: butane or methane (FID), headspace vapors from acetonitrile (NPD), headspace vapors from methylene chloride (ECD), air (TCD), argon (mass spectrometer). Proper installation is indicated by a symmetrical non-retained peak. If tailing is observed, reinstall the column into the inlet.

Conditioning and Testing the Column

1. Set oven temperature 20 °C above the maximum temperature of the analysis or at the maximum temperature of the column (whichever is lower) for 2 hours. If after 10 min at the upper temperature the background does not begin to fall, immediately cool the column and check for leaks.
2. If you are using polyimide or graphite/polyimide ferrules, recheck column nut tightness after the conditioning process.
3. Confirm final proper average linear velocity by injecting a non-retained substance again.

Table 7:

Approximate Head Pressures (psig)							
	Column ID (mm)						
Column Length (m)	**0.1**	**0.18**	**0.2**	**0.25**	**0.32**	**0.45**	**0.53**
10	35-45	5-13					
12			10-15				
15				8-12	5-13		1-2
20	75-100	10-20					
25			20-30				
30				15-25	10-20	3-5	2-4
40		35-50					
50			30-60		15-25		
60				30-45	20-30	6-10	4-8
75						8-14	5-13
105				60-80			10-15

Causes of Column Performance Degradation

Column Breakage

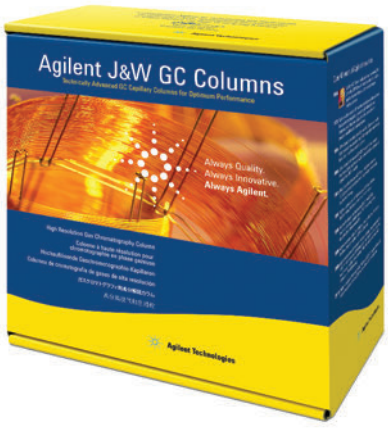
Fused silica columns break wherever there is a weak point in the polyimide coating. The polyimide coating protects the fragile but flexible fused silica tubing. The continuous heating and cooling of the oven, vibrations caused by the oven fan, and being wound on a circular cage all place stress on the tubing. Eventually breakage occurs at a weak point. Weak spots are created where the polyimide coating is scratched or abraded. This usually occurs when a sharp point or edge is dragged over the tubing. Column hangers and tags, metal edges in the GC oven, column cutters, and miscellaneous items on the lab bench are just some of the common sources of sharp edges or points.

It is rare for a column to spontaneously break. Column manufacturing practices tend to expose any weak tubing and eliminate it from use in finished columns. Larger diameter columns are more prone to breakage. This means that greater care and prevention against breakage must be taken with 0.45-0.53 mm id tubing than with 0.18-0.32 mm id tubing.

A broken column is not always fatal. If a broken column was maintained at a high temperature either continuously or with multiple temperature program runs, damage to the column is very likely. The back half of the broken column has been exposed to oxygen at elevated temperatures which rapidly damages the stationary phase. The front half is fine since carrier gas flowed through this length of column. If a broken column has not been heated or only exposed to high temperatures or oxygen for a very short time, the back half has probably not suffered any significant damage.

A union can be installed to repair a broken column. Any suitable union will work to rejoin the column. Problems with dead volume (peak tailing) may occur with improperly installed unions.

Thermal Damage



Exceeding a column's upper temperature limit results in accelerated degradation of the stationary phase and tubing surface. This results in the premature onset of excessive column bleed, peak tailing for active compounds and/or loss of efficiency (resolution). Fortunately, thermal damage is a slower process, thus prolonged times above the temperature limit are required before significant damage occurs. Thermal damage is greatly accelerated in the presence of oxygen. Overheating a column with a leak or high oxygen levels in the carrier gas results in rapid and permanent column damage.

Setting the GC's maximum oven temperature at or only a few degrees above the column's temperature limit is the best method to prevent thermal damage. This prevents the accidental overheating of the column. If a column is thermally damaged, it may still be functional. Remove the column from the detector. Heat the column for 8-16 hours at its isothermal temperature limit. Remove 10-15 cm from the detector end of the column. Reinstall the column and condition as usual. The column usually does not return to its original performance; however, it is often still functional. The life of the column will be reduced after thermal damage.

Oxygen Damage

Oxygen is an enemy to most capillary GC columns. While no column damage occurs at or near ambient temperatures, severe damage occurs as the column temperature increases. In general, the temperature and oxygen concentration at which significant damage occurs is lower for polar stationary phases. It is constant exposure to oxygen that is the problem. Momentary exposure such as an injection of air or a very short duration septum nut removal is not a problem.

A leak in the carrier gas flow path (e.g., gas lines, fittings, injector) is the most common source of oxygen exposure. As the column is heated, very rapid degradation of the stationary phase occurs. This results in the premature onset of excessive column bleed, peak tailing for active compounds and/or loss of efficiency (resolution). These are the same symptoms as for thermal damage. Unfortunately, by the time oxygen damage is discovered, significant column damage has already occurred. In less severe cases, the column may still be functional but at a reduced performance level. In more severe cases, the column is irreversibly damaged.

Maintaining an oxygen and leak-free system is the best prevention against oxygen damage. Good GC system maintenance includes periodic leak checks of the gas lines and regulators, regular septa changes, using high quality carrier gases, installing and changing oxygen traps, and changing gas cylinders before they are completely empty.

Chemical Damage

There are relatively few compounds that damage stationary phases. Introducing nonvolatile compounds (e.g., salts) in a column often degrades performance, but damage to the stationary phase does not occur. These residues can often be removed and performance returned by solvent rinsing the column.

Inorganic or mineral bases and acids are the primary compounds to avoid introducing into a column. The acids include hydrochloric (HCl), sulfuric (H_2SO_4), nitric (HNO_3), phosphoric (H_3PO_4), and chromic (CrO_3). The bases include potassium hydroxide (KOH), sodium hydroxide (NaOH), and ammonium hydroxide (NH_4OH). Most of these acids and bases are not very volatile and accumulate at the front of the column. If allowed to remain, the acids or bases damage the stationary phase. This results in the premature onset of excessive column bleed, peak tailing for active compounds and/or loss of efficiency (resolution). The symptoms are very similar to thermal and oxygen damage. Hydrochloric acid and ammonium hydroxide are the least harmful of the group. Both tend to follow any water that is present in the sample. If the water is not or only poorly retained by the column, the residence time of the HCl and NH_4OH in the column is short. This tends to eliminate or minimize any damage by these compounds. Thus, if HCl or NH_4OH are present in a sample, using conditions or a column with no water retention will render these compounds relatively harmless to the column.

The only organic compounds that have been reported to damage stationary phases are perfluoroacids. Examples include trifluoroacetic, pentafluoropropanoic, and heptafluorobutyric acid. They need to be present at high levels (e.g., 1% or higher). Most of the problems are experienced with splitless or megabore direct injections where large volumes of the sample are deposited at the front of the column.

Since chemical damage is usually limited to the front of the column, trimming or cutting 0.5-1 m from the front of the column often eliminates any chromatographic problems. In more severe cases, five or more meters may need to be removed. The use of a guard column or retention gap will minimize the amount of column damage; however, frequent trimming of the guard column may be necessary. The acid or base often damages the surface of the deactivated fused silica tubing which leads to peak shape problems for active compounds.

Column Contamination

Column contamination is one of the most common problems encountered in capillary GC. Unfortunately, it mimics a very wide variety of problems and is often misdiagnosed as another problem. A contaminated column is usually not damaged, but it may be rendered useless.

There are two basic types of contaminants: nonvolatile and semivolatile. Nonvolatile contaminants or residues do not elute and accumulate in the column. The column becomes coated with these residues which interfere with the proper partitioning of solutes in and out of the stationary phase. Also, the residues may interact with active solutes resulting in peak adsorption problems (evident as peak tailing or loss of peak size). Active solutes are those containing a hydroxyl (-OH) or amine (-NH) group, and some thiols (-SH) and aldehydes. Semivolatile contaminants or residues accumulate in the column, but eventually elute. Hours to days may elapse before they completely leave the column. Like nonvolatile residues, they may cause peak shape and size problems, and, in addition, are usually responsible for many baseline problems (instability, wander, drift, ghost peaks, etc.).

Contaminants originate from a number of sources, with injected samples being the most common. Extracted samples are among the worst types. Biological fluids and tissues, soils, waste and ground water, and similar types of matrixes contain high amounts of semivolatile and nonvolatile materials. Even with careful and thorough extraction procedures, small amounts of these materials are present in the injected sample. Several to hundreds of injections may be necessary before the accumulated residues cause problems. Injection techniques such as on-column, splitless, and megabore direct place a large amount of sample into the column, thus column contamination is more common with these injection techniques.

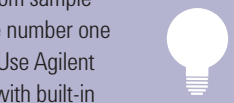
Occasionally, contaminants originate from materials in gas lines and traps, ferrule and septa particles, or anything coming in contact with the sample (vials, solvents, syringes, pipettes, etc.). These types of contaminants are probably responsible when a contamination problem suddenly develops and similar samples in previous months or years did not cause any problems.

Minimizing the amount of semivolatile and nonvolatile sample residues is the best method to reduce contamination problems. Unfortunately, the presence and identity of potential contaminants are often unknown. Rigorous and thorough sample cleanup is the best protection against contamination problems. The use of a guard column or retention gap often reduces the severity or delays the onset of column contamination induced problems. If a column becomes contaminated, it is best to solvent rinse the column to remove the contaminants.

Maintaining a contaminated column at high temperatures for long periods of time (often called baking-out a column) is not recommended. Baking-out a column may convert some of the contaminating residues into insoluble materials that cannot be solvent rinsed from the column. If this occurs, the column cannot be salvaged in most cases. Sometimes the column can be cut in half and the back half may still be useable. Baking-out a column should be limited to 1-2 hours at the isothermal temperature limit of the column.

TIPS & TOOLS

Column contamination from sample matrix components is the number one cause of column failure. Use Agilent DuraGuard GC columns with built-in guard if you do not want to use column connectors.



Column rinse kit, 430-3000

Solvent Rinsing Columns

Solvent rinsing columns involves removing the column from the GC and passing milliliters of solvent through the column. Any residues soluble in the rinse solvents are washed from the column. Injecting large volumes of solvent while the column is still installed is not rinsing and doing so will not remove any contaminants from the column. **A capillary GC column must have a bonded and cross-linked stationary phase before it can be solvent rinsed.** Solvent rinsing a non-bonded stationary phase results in severe damage to the column.

A column rinse kit is used to force solvent through the column (see picture). The rinse kit is attached to a pressurized gas source (N_2 or He), and the column is inserted into the rinse kit. Solvent is added to the vial, and the vial is pressurized using the gas source. The pressure forces solvent to flow through the column. Residues dissolve into the solvent and are backflushed out of the column with the solvent. The solvent is then purged from the column, and the column is properly conditioned.

Before rinsing a column, cut about 0.5 meter from the front (i.e., injector end) of the column. Insert the detector end of the column into the rinse kit. Multiple solvents are normally used to rinse columns. Each successive solvent must be miscible with the previous one. High boiling point solvents should be avoided especially as the last solvent. The sample matrix solvent(s) is often a good choice.

Methanol, methylene chloride and hexane are recommended and work very well for the majority of cases. Acetone can be substituted for methylene chloride to avoid using halogenated solvents; however, methylene chloride is one of the best rinsing solvents. If aqueous based samples (e.g., biological fluids and tissues) were injected, use water before the methanol. Some residues originating from aqueous based samples are only soluble in water and not organic solvents. Water and alcohols (e.g., methanol, ethanol, isopropanol) should be used to rinse bonded polyethylene glycol based stationary phases (e.g., DB-WAX, DB-WAXetr, DB-FFAP, HP-INNOWax) **only as a last resort**.

Table 8 lists the suggested solvent volumes for different diameter columns. Using larger solvent volumes is not harmful, but rarely better and merely wasteful. After adding the first solvent, pressurize the rinse kit, but stay below 20 psi. Use the highest pressure that keeps the solvent flow rate below 1 mL/min. Except for most 0.53 mm id columns, the rinse kit pressure will reach 20 psi before the flow rate reaches 1 mL/min. Longer rinse times are required when using heavy or viscous solvents, and for longer or smaller diameter columns. When all or most of the first solvent has entered the column, add the next solvent. The previous solvent does not have to vacate the column before the next solvent is started through the column.

After the last solvent has left the column, allow the pressurizing gas to flow through the column for 5-10 min. Install the column in the injector and turn on the carrier gas. Allow the carrier gas to flow through the column for 5-10 min. Attach the column to the detector (or leave it unattached if preferred). Using a temperature program starting at 40-50 °C, heat the column at 2-3 °/min until the upper temperature limit is reached. Maintain this temperature for 1-4 hours until the column is fully conditioned.

Table 8:

Solvent Volumes for Rinsing Columns

Column ID (mm)	Solvent Volume (mL)
0.18-0.2	3-4
0.25	4-5
0.32	6-7
0.45	7-8
0.53	10-12

Using larger volumes will not damage the column

Column Storage

Capillary columns should be stored in their original box when removed from the GC. Place a GC septa over the ends to prevent debris from entering the tubing. Upon reinstallation of the column, the column ends need to be trimmed by 2-4 cm to ensure that a small piece of septa is not lodged in the column.

If a column is left in a heated GC, there should always be carrier gas flow. The carrier gas flow can be turned off only if the oven, injector, detector and transfer lines are turned off (i.e., not heated). Without carrier gas flow, damage to the heated portion of the column occurs.

Evaluating the Problem

The first step in any troubleshooting effort is to step back and evaluate the situation. Rushing to solve the problem often results in a critical piece of important information being overlooked or neglected. In addition to the problem, look for any other changes or differences in the chromatogram. Many problems are accompanied by other symptoms. Retention time shifts, altered baseline noise or drift, or peak shape changes are only a few of the other clues that often point to or narrow the list of possible causes. Finally, make note of any changes or differences involving the sample. Solvents, vials, pipettes, storage conditions, sample age, extraction, preparation techniques, or any other factor influencing the sample environment can be responsible.

Checking the Obvious

A surprising number of problems involve fairly simple and often overlooked components of the GC system or analysis. Many of these items are transparent in the daily operation of the GC and are often taken for granted ("set it and forget it"). The areas and items to check include:

- Gases: pressures, carrier gas average linear velocity, and flow rates (detector, split vent, septum purge)
- Temperatures: column, injector, detector, and transfer lines
- System parameters: purge activation times, detector attenuation and range, mass ranges, etc.
- Gas lines and traps: cleanliness, leaks, and expiration
- Injector consumables: septa, liners, O-rings, and ferrules
- Sample integrity: concentration, degradation, solvent, and storage
- Syringes: handling technique, leaks, needle sharpness, and cleanliness
- Data system: settings and connections

The Most Common Problems

Ghost Peaks or Carryover

System contamination is responsible for most ghost peaks or carryover problems. If the extra ghost peaks are similar in width to the sample peaks (with similar retention times), the contaminants were likely introduced into the column at the same time as the sample. The extra compounds may be present in the injector (i.e., contamination) or in the sample itself. Impurities in solvents, vials, caps and syringes are only some of the possible sources. Injecting sample and solvent blanks may help to find possible sources of the contaminants. If the ghost peaks are much broader than the sample peaks, the contaminants were most likely already in the column when the injection was made. These compounds were still in the column when a previous GC run was terminated. They elute during a later run and are often very broad. Sometimes numerous ghost peaks from multiple injections overlap and elute as a hump or blob. This often takes on the appearance of baseline drift or wander.

Increasing the final temperature or time in the temperature program is one method to minimize or eliminate a ghost peak problem. Alternatively, a short bake out after each run or series of runs may remove the highly retained compounds from the column before they cause a problem.

Condensation Test

Use this test whenever injector or carrier gas contamination problems are suspected (e.g., ghost peaks or erratic baseline).

1. Leave the GC at 40-50 °C for 8 or more hours.
2. Run a blank analysis (i.e., start the GC, but with no injection) using the normal temperature conditions and instrument settings.
3. Collect the chromatogram for this blank run.
4. Immediately repeat the blank run as soon as the first one is completed. Do not allow more than 5 min to elapse before starting the second blank run.
5. Collect the chromatogram for the second blank run and compare it to the first chromatogram.
6. If the second chromatogram contains a substantially larger amount of peaks and baseline instability, the incoming carrier gas line or the carrier gas is contaminated.
7. If the second chromatogram contains few peaks or very little baseline drift, the carrier gas and incoming carrier gas lines are relatively clean.

Troubleshooting Guides

Excessive Baseline Noise

Possible Cause	Solution	Comments
Injector contamination	Clean the injector; replace liner, gold seal	Try a condensation test; gas lines may also need cleaning
Column contamination	Bake out the column	Limit the bake out to 1-2 hours
	Solvent rinse the column	Only for bonded and cross-linked phases
		Check for inlet contamination
Detector contamination	Clean the detector	Usually the noise increases over time and not suddenly
Contaminated or low quality gases	Use better grade gases; also check for expired gas traps or leaks	Usually occurs after changing a gas cylinder
Column inserted too far into the detector	Reinstall the column	Consult GC manual for proper insertion distance
Incorrect detector gas flow rates	Adjust the flow rates to the recommended values	Consult GC manual for proper flow rates
Leak when using an MS, ECD, or TCD	Find and eliminate the leak	Usually at the column fittings or injector
Old detector filament, lamp or electron multiplier	Replace appropriate part	
Septum degradation	Replace septum	For high temperature applications use an appropriate septum

Baseline Instability or Disturbances

Possible Cause	Solution	Comments
Injector contamination	Clean the injector	Try a condensation test; gas lines may also need cleaning
Column contamination	Bake out the column	Limit a bake out to 1-2 hours
Unequilibrated detector	Allow the detector to stabilize	Some detectors may require up to 24 hours to fully stabilize
Incompletely conditioned column	Fully condition the column	More critical for trace level analyses
Change in carrier gas flow rate during the temperature program	Normal in many cases	MS, TCD and ECD respond to changes in carrier gas flow rate

Tailing Peaks

Possible Cause	Solution	Comments
Column contamination	Trim the column	Remove 0.5-1 m from the front of the column
	Solvent rinse the column	Only for bonded and cross-linked phases
		Check for inlet contamination
Column activity	Irreversible; replace the column	Only affects active compounds
Solvent-phase polarity mismatch	Change sample solvent to a single solvent	More tailing for the early eluting peaks or those closest to the solvent front
	Use a retention gap	3-5 m retention gap is sufficient
Solvent effect violation for splitless or on-column injections	Decrease the initial column temperature	Peak tailing decreases with retention
Too low of a split ratio	Increase the split ratio	Flow from split vent should be 20 mL/min or higher
Poor column installation	Reinstall the column	More tailing for early eluting peaks
Some active compounds always tail	None	Most common for amines and carboxylic acids

Split Peaks

Possible Cause	Solution	Comments
Injection technique	Change technique	Usually related to erratic plunger depression or having sample in the syringe needle; Use an auto injector
Mixed sample solvent	Change sample solvent to a single solvent	Worse for solvents with large differences in polarity or boiling points
Poor column installation	Reinstall the column	Usually a large error in the insertion distance
Sample degradation in the injector	Reduce the injector temperature	Peak broadening or tailing may occur if the temperature is too low
	Change to an on-column injection	Requires an on-column injector
Poor sample focusing	Use a retention gap	For splitless and on-column injection

Retention Time Shift

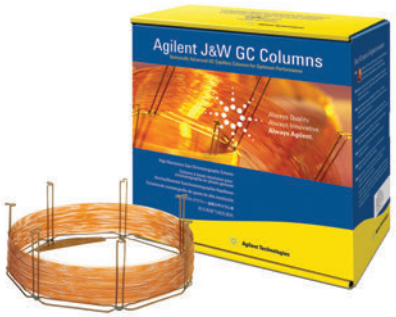
Possible Cause	Solution	Comments
Change in carrier gas velocity	Check the carrier gas velocity	All peaks will shift in the same direction by approximately the same amount
Change in column temperature	Check the column temperature	Not all peaks will shift by the same amount
Change in column dimension	Verify column identity	
Large change in compound concentration	Try a different sample concentration	May also affect adjacent peaks; Sample overloading is corrected with an increase in split ratio or sample dilution
Leak in the injector	Leak check the injector	A change in peak size usually occurs
Blockage in a gas line	Clean or replace the plugged line	More common for the split line; also check flow controllers and solenoids
Septum leak	Replace septum	Check for needle barb
Sample solvent incompatibility	Change sample solvent to a single solvent Use a retention gap	For splitless injection

Change in Peak Size

Possible Cause	Solution	Comments
Change in detector response	Check gas flows, temperatures and settings	All peaks may not be equally affected
	Check background level or noise	May be caused by system contamination and not the detector
Change in the split ratio	Check split ratio	All peaks may not be equally affected
Change in the purge activation time	Check the purge activation line	For splitless injection
Change in injection volume	Check the injection technique	Injection volumes are not linear
Change in sample concentration	Check and verify sample concentration	Changes may also be caused by degradation, evaporation, or variances in sample temperature or pH
Leak in the syringe	Use a different syringe	Sample leaks past the plunger or around the needle; Leaks are not often readily visible
Column contamination	Trim the column	Remove 0.5-1 m from the front of the column
	Solvent rinse the column	Only for bonded and cross-linked phases
Column activity	Irreversible	Only affects active compounds
Coelution	Change column temperature or stationary phase	Decrease column temperature and check for the appearance of a peak shoulder or tail
Change in injector discrimination	Maintain the same injector parameters	Most severe for split injections
Sample flashback	Inject less, use a larger liner, reduce the inlet temperature	Less solvent and higher flow rates are most helpful
Decomposition from inlet contamination	Clean the injector; replace liner, gold seal	Only use deactivated liners and glass wool in the inlet

Loss of Resolution

Possible Cause	Solution	Comments
Decrease in separation		
Different column temperature	Check the column temperature	Differences in other peaks will be visible
Different column dimensions or phase	Verify column identity	Differences in other peaks will be visible
Coelution with another peak	Change column temperature	Decrease column temperature and check for the appearance of a peak shoulder or tail
Increase in peak width		
Change in carrier gas velocity	Check the carrier gas velocity	A change in the retention time also occurs
Column contamination	Trim the column	Remove 0.5-1 m from the front of the column
	Solvent rinse the column	Only for bonded and cross-linked phases
Change in the injector	Check the injector settings	Typical areas: split ratio, liner, temperature, injection volume
Change in sample concentration	Try a different sample concentration	Peak widths increase at higher concentrations
Improper solvent effect, lack of focusing	Lower oven temperature, better solvent, sample phase polarity match, use a retention gap	For splitless injection



GC and GC/MS Applications

Industry-specific applications from your partner in chromatography

With over 40 years of chromatography expertise, Agilent is a great resource for all types of applications. In fact, we're developing new ones every day.

Simply turn to the pages listed below for the most current applications based on your area of specialization.

Environmental – you'll learn how to perform critical analyses – such as measuring the levels of atmospheric halocarbons and identifying organochlorine pesticides in soil – while meeting your increasing demands for speed and accuracy. **Turn to page 501.**

Food, Flavors, and Fragrances – we'll discuss how to ensure quality, safety, and regulatory compliance for fragrances, perfumes, and essential oils. Applications focus on chiral compounds, menthol, and FAMEs. **Turn to page 554.**

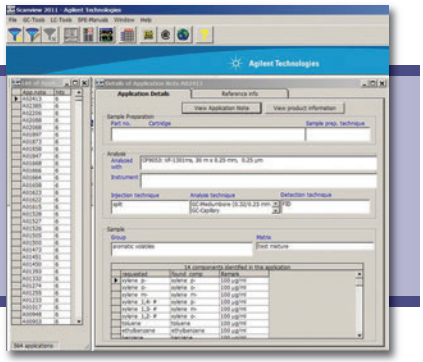
Energy and Fuels – here you'll find applications – such as the analysis of sulfur compounds in propylene – that you can use right away to meet regulatory requirements, improve efficiency, and maintain good environmental stewardship. **Turn to page 576.**

Industrial Chemical – we'll help you maintain product quality – and production efficiency – by sharing the latest applications for alcohols, halogenated hydrocarbons, aromatic solvents, phenols, and inorganic gases. **Turn to page 602.**

Forensic Toxicology and Pharma – we'll bring you fully up-to-date on the newest screening methods for controlled substances such as amphetamines, narcotics, and alcohol. We'll also review the latest techniques for monitoring residual solvents. **Turn to page 635.**

TIPS & TOOLS

Search the ScanView database to find almost 2000 GC applications and standard methods of all types, old and new. Get your free copy of ScanView at **www.agilent.com/chem/scanview**



Environmental Applications, Hydrocarbons

Unleaded Gasoline

Column: **DB-VRX**
124-1534
30 m x 0.45 mm, 2.55 µm

Carrier: Helium at 109 cm/s (10.4 mL/min), measured at 40 °C

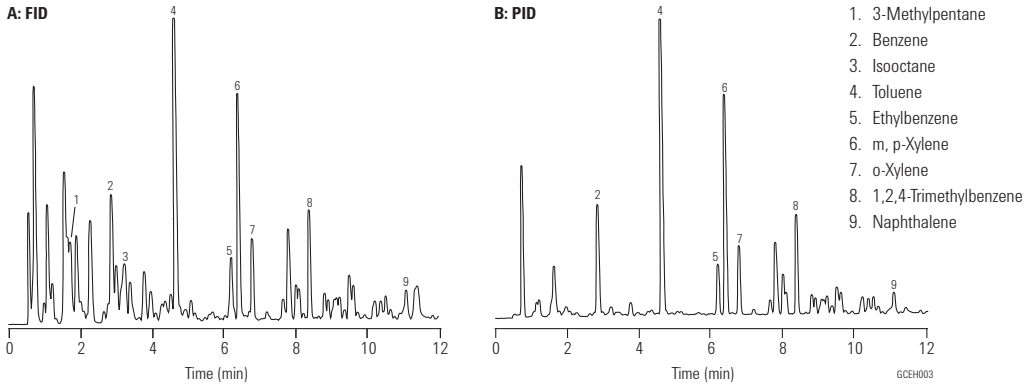
Oven: 40 °C for 2 min,
40-200 °C at 12 °C/min,
200 °C for 5 min

Sampler: Purge and Trap (O.I.A. 4560)
Trap: BTEX (Supelco) at 50 °C during purge
Desorb: 270 °C for 1 min

Injection: LVI (Low Volume Injector)

Detector: A: FID, 250 °C
B: PID (O.I.A. 4430), 200 °C

Sample: 115 ppb gasoline in 5 mL water



1. 3-Methylpentane
2. Benzene
3. Isooctane
4. Toluene
5. Ethylbenzene
6. m, p-Xylene
7. o-Xylene
8. 1,2,4-Trimethylbenzene
9. Naphthalene

Determination of Chlorophenols in Water and Soil

Column: **VF-5ms**
CP8961
60 m x 0.32 mm, 0.25 µm

Oven: 60 °C, 30 °C/min to 300 °C

Carrier: He 80 kPa, 0.8 bar, 5.7 psi

Injection: Splitless, initial time: 1 min; Splitflow: 50 mL/min
250 °C
2 µL

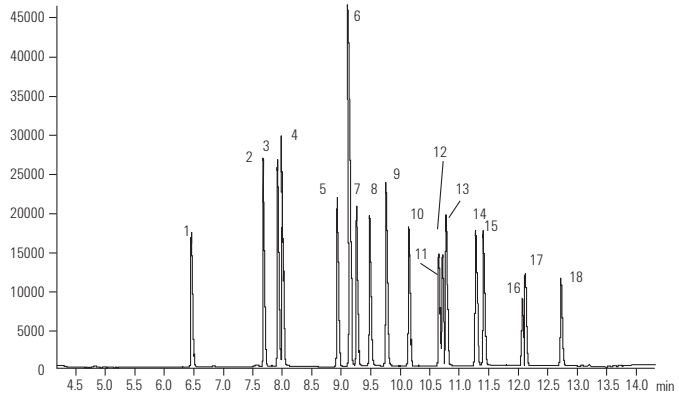
Detector: MS
280 °C

Sample: Isohexane

Sample Conc: Standard, 1 µg/mL, derivatization with acetic acid anhydride

Dr. Weßling, Laboratorien GmbH

1. Phenol
2. 2-Chlorophenol
3. 3-Chlorophenol
4. 4-Chlorophenol
5. 2,6-Dichlorophenol
6. 2,4+2,5-Dichlorophenol
7. 3,5-Dichlorophenol
8. 2,3-Dichlorophenol
9. 3,4-Dichlorophenol
10. 2,4,6-Trichlorophenol
11. 2,3,6-Trichlorophenol
12. 2,3,5-Trichlorophenol
13. 2,4,5-Trichlorophenol
14. 2,3,4-Trichlorophenol
15. 3,4,5-Trichlorophenol
16. 2,3,5,6-Tetrachlorophenol
17. 2,3,4,6-Tetrachlorophenol
18. 2,3,4,5-Tetrachlorophenol



PBDEs by ECD

Column: **DB-XLB**
15 m x 0.18 mm, 0.07 µm
Agilent Technologies custom column

Carrier: Hydrogen at 72 cm/s at 100 °C (4.0 mL/min), constant flow mode

Oven: 100 °C for 0.5 min
100 °C to 300 °C at 30 °C/min
300 °C for 5 min

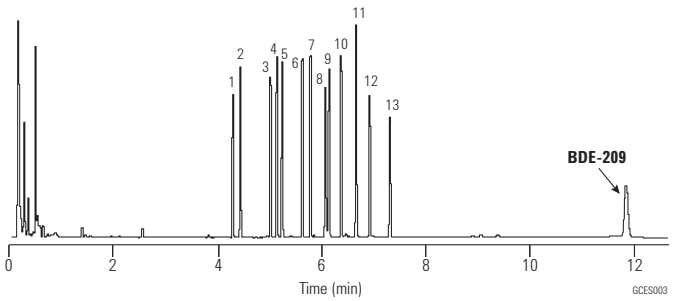
Injection: Split, 250 °C
Split ratio 20:1

Detector: ECD, 300 °C
Peak, Congener (2.5 mg/mL)

Sample: 1 µL

Special thanks to AccuStandard, Inc. of New Haven, CT, for PBDE standards.

1. 2,2',4-TriBDE (BDE-17)
2. 2,4,4'-TriBDE (BDE-28)
3. 2,3',4',6-Tetra-BDE (BDE-71)
4. 2,2',4,4'-Tetra-BDE (BDE-47)
5. 2,3',4,4'-TetraBDE (BDE-66)
6. 2,2',4,4',6-PentaBDE (BDE-100)
7. 2,2',4,4',5-PentaBDE (BDE-99)
8. 2,2',3,4,4'-PentaBDE (BDE-85)
9. 2,2',4,4',5,6'-HexaBDE (BDE-154)
10. 2,2',4,4',5,5'-HexaBDE (BDE-153)
11. 2,2',3,4,4',5'-HexaBDE (BDE-138)
12. 2,2',3,4,4',5',6-HeptaBDE (BDE-183)
13. 2,3,3',4,4',5,6-HeptaBDE (BDE-190)
14. DecaBDE (BDE-209) (12.5 mg/mL)



Diesel Fuel

Column: **DB-5ms**
125-5532
30 m x 0.53 mm, 1.50 µm

Carrier: Helium at 48.5 cm/s, measured at 60 °C

Oven: 60 °C for 2 min
60-300 °C at 12 °C/min
300 °C for 10 min

Injection: Direct, 280 °C

Detector: FID, 250 °C
Nitrogen makeup gas at 30 mL/min

Sample: 1 µL injection in hexane
A: Standard, 50 ng/component
B: Sample, 0.6 mg/mL

Suggested Supplies

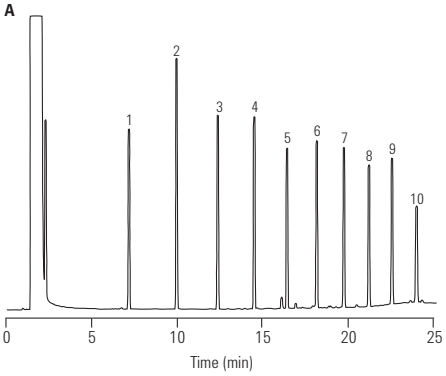
Septum: 11 mm Advanced Green septa, 5183-4759

Liner: Direct connect, single taper, deactivated, 4 mm id, G1544-80730

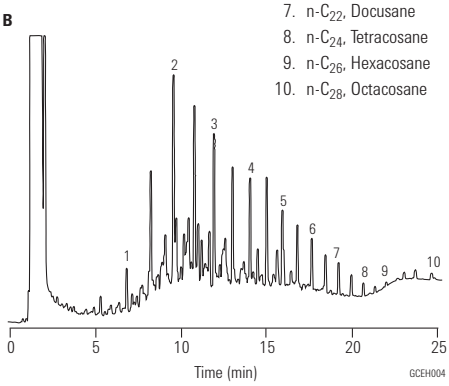
Syringe: 10 µL tapered, FN 23-26s/42/HP, 5181-1267

1. n-C_{10}, Decane
2. n-C_{12}, Dodecane
3. n-C_{14}, Tetradecane
4. n-C_{16}, Hexadecane
5. n-C_{18}, Octadecane
6. n-C_{20}, Eicosane
7. n-C_{22}, Docusane
8. n-C_{24}, Tetracosane
9. n-C_{26}, Hexacosane
10. n-C_{28}, Octacosane

Diesel fuel standard
50 ng/component



Diesel fuel
0.6 mg/mL



Analysis of Polycyclic Aromatic Hydrocarbons

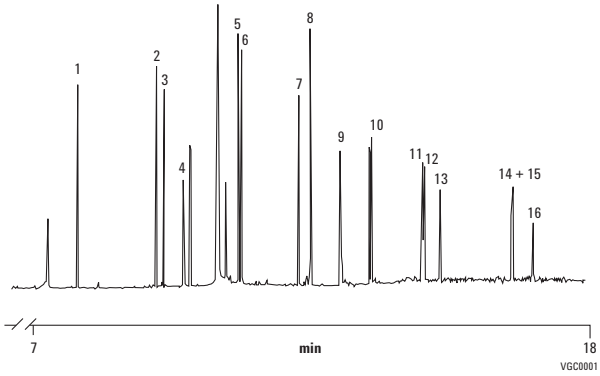
Column: **VF-Xms**
CP8805
30 m x 0.25 mm, 0.10 µm

Sample: 1 µL ca. 3 ng per component on-column

Carrier: Helium, 60 kPa

Injection: Split, T=275 °C

Detector: Agilent Ion Trap MS



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

Dioxins and Dibenzofurans

Column: **CP-Sil 88**
CP6173
50 m x 0.25 mm, 0.20 µm

Sample: 1.0 µL Toluene

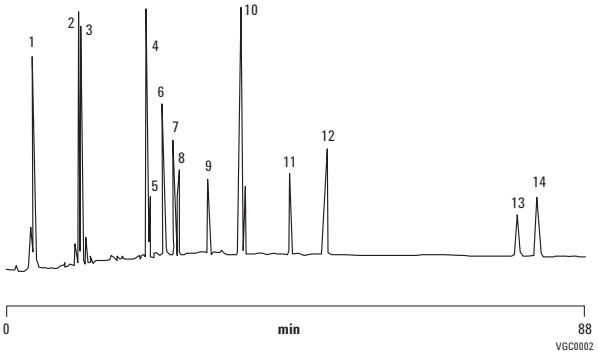
Sample Conc: 100-400 pg/µL

Carrier: Helium, 170 kPa (1.7 bar, 24 psi)

Oven: 100 °C to 180 °C to 230 °C, 3 °C/min

Injection: Splitless

Detector: MSD



1. 2,3,7-8-TCDD
2. 2,3,7,8-TCDF
3. 1,2,3,7,8-PeCDF
4. 1,2,3,4,7,8-HxCDF
5. 1,2,3,6,7,8-HxCDF
6. 2,3,4,7,8-PeCDF
7. 1,2,3,4,7,8-HxCDD + 1,2,3,7,8-PeCDD
8. 1,2,3,6,7,8-HxCDD
9. 1,2,3,7,8,9-HxCDD
10. 1,2,3,4,6,7,8-HxCDF
11. 2,3,4,6,7,8-HpCDD
12. 1,2,3,4,6,7,8-HpCDD
13. 1,2,3,4,6,7,8,9-OCDF
14. 1,2,3,4,6,7,8,9-OCDD

78 Semi-volatile Components on an Agilent J&W DB-UI 8270D

Column: **DB-UI 8270D**
122-9732
30 m x 0.25 mm, 0.25 µm

Instrument: Agilent 7890 Series GC

Carrier: Helium, 1.2 mL/min constant flow,
septum, purge 3 mL/min,
purge time on 0.7 min 50 mL/min, gas saver off

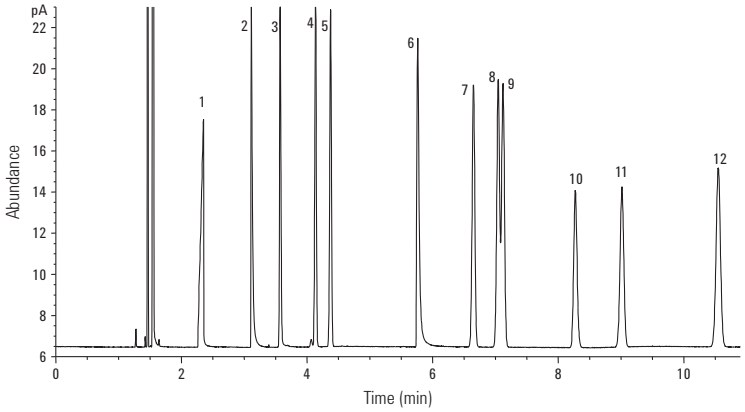
Oven: 30 °C (1.0 min), 15 °C/min to 100 °C,
20 °C/min to 240 °C (0.5 min),
15 °C to 325 °C (6.7 min)

Inlet: MMI in nonpulsed splitless mode, 1 µL at 275 °C

Inlet liner: Dual taper direct connect liner

Sampler: Agilent 7693, 10.0 µL syringe (p/n G4513-80216)

Detector: MSD: 325 °C Transfer line,
280 °C source,
150 °C quad, 35-500 amu range



Example total ion chromatogram of a 78 component semi-volatile standard injection with a 10 ng on-column loading for each component.

Polybrominated Diphenyl Ethers (PBDEs)

Column: **DB-5ms Ultra Inert**
122-5512UI
15 m x 0.25 mm, 0.25 µm

Instrument: Agilent 6890N/5973B MSD

Sampler: Agilent 7683B, 5.0 µL syringe (p/n 5188-5246), 1.0 µL splitless injection, 5 ng each component on-column

Carrier: Helium 72 cm/s, constant flow

Inlet: Pulsed splitless; 325 °C, 20 psi until 1.5 min, purge flow 50 mL/min at 2.0 min

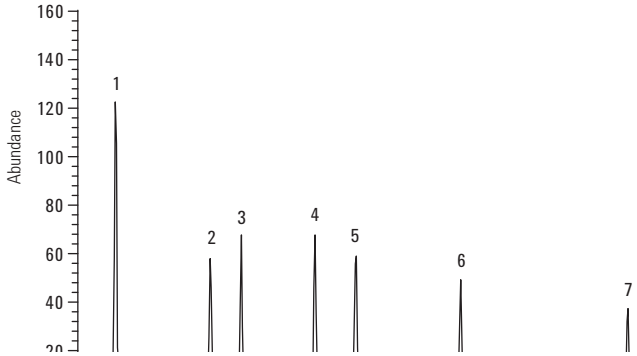
Oven: 150 to 325 °C (17 °C/min), hold 5 min

Detector: MSD source at 300 °C, quadrupole at 150 °C, transfer line at 300 °C, scan range 200-1000 amu

Suggested Supplies

Liner: Direct connect, dual taper, deactivated, 4 mm id, G1544-80700

Syringe: Autosampler syringe, 0.5 µL, 23 g, cone, 5188-5246



15+1 EU Priority PAHs

Resolution of Critical Pairs on an Agilent J&W DB-EUPAH Column

Column: **DB-EUPAH**
121-9627
20 m x 0.18 mm, 0.14 µm

Instrument: Agilent 6890N/5975B MSD

Sampler: Agilent 7683B, 5.0 µL syringe, 0.5 µL splitless injection, injection speed 75 µL/min

Carrier: Helium, ramped flow 1.0 mL/min (0.2 min), 5 mL/min^2 to 1.7 mL/min

Inlet: 325 °C splitless, purge flow 60 mL/min at 0.8 min

Oven: 45 °C (0.8 min) to 200 °C (45 °C/min), 2.5 °C/min to 225 °C, 3 °C/min to 266 °C, 5 °C/min to 300 °C, 10 °C/min to 320 °C (4.5 min)

Detector: MSD source at 300 °C, quadrupole at 180 °C, transfer line at 330 °C, scan range 50-550 amu

All 15+1 EU regulated priority PAHs are well resolved with the DB-EUPAH column. Challenging benzo[b,k,j]fluoranthene isomers are baseline resolved, allowing for accurate quantitation of each isomer. In addition, baseline resolution is achieved for critical pairs benz[a]anthracene and cyclopenta[c,d]pyrene, cyclopenta[c,d]pyrene and chrysene, and indeno[1,2,3-cd]pyrene and dibenz[a,h]anthracene. This application demonstrates that the DB-EUPAH column can provide excellent sensitivity and selectivity for the analysis of EU regulated PAHs.

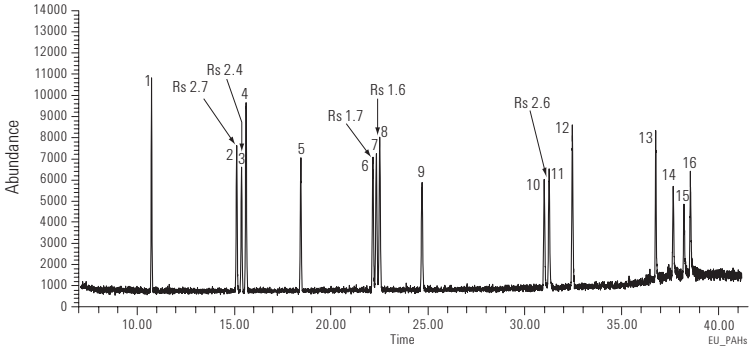
Suggested Supplies

Septum: 11 mm Advanced Green septa, 5183-4759

Liner: Direct connect, dual taper, deactivated, 4 mm id, G1544-80700

Syringe: 5 µL tapered, FN 23-26s/42/HP, 5181-1273

1. Benzo[c]fluorene
2. Benz[a]anthracene
3. Cyclopenta[c,d]pyrene
4. Chrysene
5. 5-Methylchrysene
6. Benzo[b]fluoranthene
7. Benzo[k]fluoranthene
8. Benzo[j]fluoranthene
9. Benz[a]pyrene
10. Indeno[1,2,3-cd]pyrene
11. Dibenz[a,h]anthracene
12. Benzo[g,h,i]perylene
13. Dibenzo[a,l]pyrene
14. Dibenzo[a,e]pyrene
15. Dibenzo[a,i]pyrene
16. Dibenzo[a,h]pyrene



Environmental Applications, Pesticides and Herbicides

Fast CLP Pesticides

Column: **DB-CLP1**
123-8232
30 m x 0.32 mm, 0.25 µm

Column: **DB-CLP2**
123-8336
30 m x 0.32 mm, 0.50 µm

Instrument: Agilent 7890 GC with dual µECD

Carrier: Helium, constant flow 3.5 mL/min

Oven: 150 °C (hold 0.2 min), 45 °C/min to 250 °C,
18 °C/min to 300 °C, 30 °C/min to 330 °C, hold 2.5 min

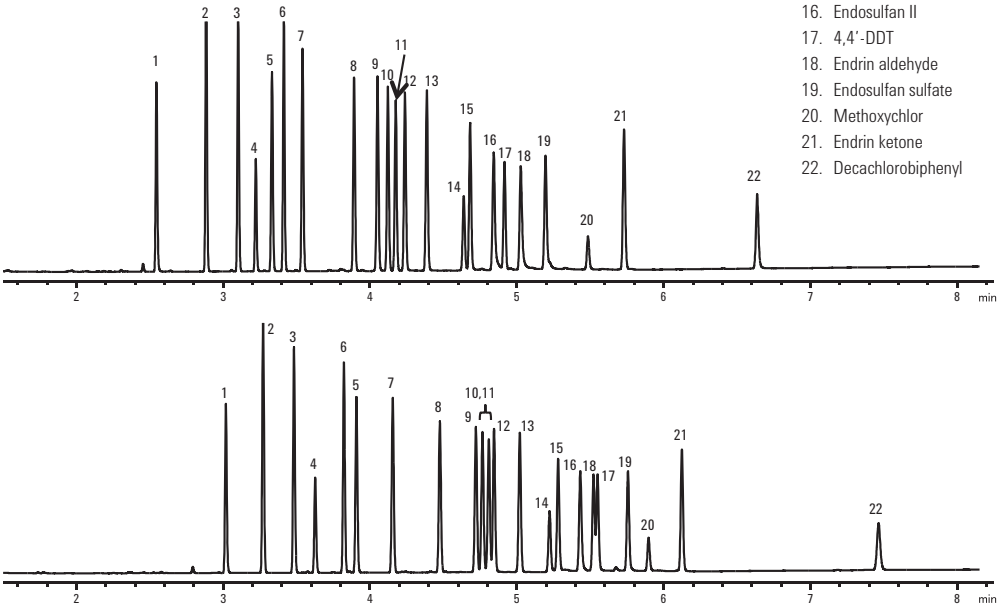
Sampler: Agilent 7693

Injection: 1 µL splitless

Detector: µECD at 340 °C

Sample: 50 ng/mL CLP Pesticides

1. Tetrachloro-m-xylene
2. α-BHC
3. γ-BHC
4. β-BHC
5. Heptachlor
6. δ-BHC
7. Aldrin
8. Heptachlor epoxide
9. γ-Chlordane
10. α-Chlordane
11. Endosulfan I
12. 4,4′-DDE
13. Dieldrin
14. Endrin
15. 4,4′-DDD
16. Endosulfan II
17. 4,4′-DDT
18. Endrin aldehyde
19. Endosulfan sulfate
20. Methoxychlor
21. Endrin ketone
22. Decachlorobiphenyl



EPA Method 504.1 – 1,2 dibromoethane (EDB), 1,2-dibromo-3-chloropropane (DBCP), and 1,2,3-trichloropropane (123TCP)

Column: **DB-CLP1**
123-8232
30 m x 0.32 mm, 0.25 µm

Column: **DB-CLP2**
123-8336
30 m x 0.32 mm, 0.50 µm

Carrier: Helium, constant flow, 3.75 mL/min

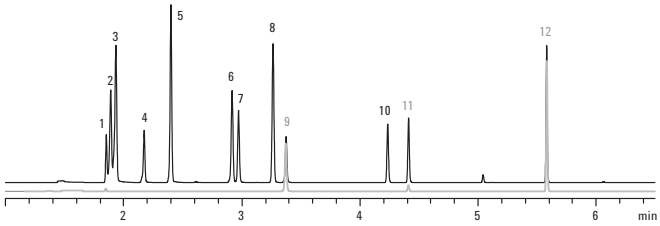
Oven: 50 °C, hold 1.5 min, 20 °C/min to 95 °C, 40 °C/min to 175 °C, hold 1.25 min

Injection: 2 µL, splitless, 200 °C

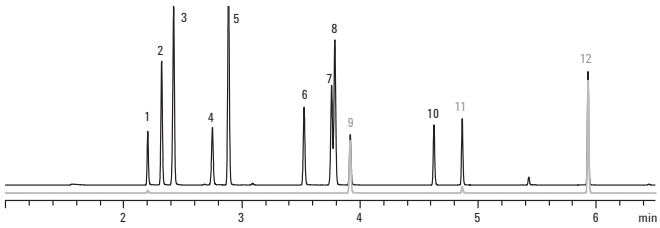
Detector: µECD, 300 °C

Sample: 100 ng/mL EPA 504.1 analytes, 100 ng/mL chlorinated solvents + trihalomethanes

1. Chloroform
2. 1,1,1-Trichloroethane
3. Carbon tetrachloride
4. Trichloroethane
5. Bromodichloromethane
6. Tetrachloroethane
7. 1,1,2-Trichloroethane
8. Dibromochloromethane
9. 1,2-Dibromoethane (EDB)
10. Bromoform
11. 1,2,3-Trichloropropane (123TCP)
12. 1,2-Dibromo-3-chloropropane (DBCP)



100 ng/mL chlorinated solvents + THMs
100 ng/mL EPA 504.1 analytes



100 ng/mL chlorinated solvents + THMs
100 ng/mL EPA 504.1 analytes

Agilent J&W DB-CLP1/DB-CLP2 columns analyze 1,2-dibromoethane (EDB), 1,2-dibromo-3-chloropropane (DBCP), and 1,2,3-trichloropropane (123TCP) according to EPA Method 504.1 with cooler analysis temperatures allowing a faster GC cycle time.

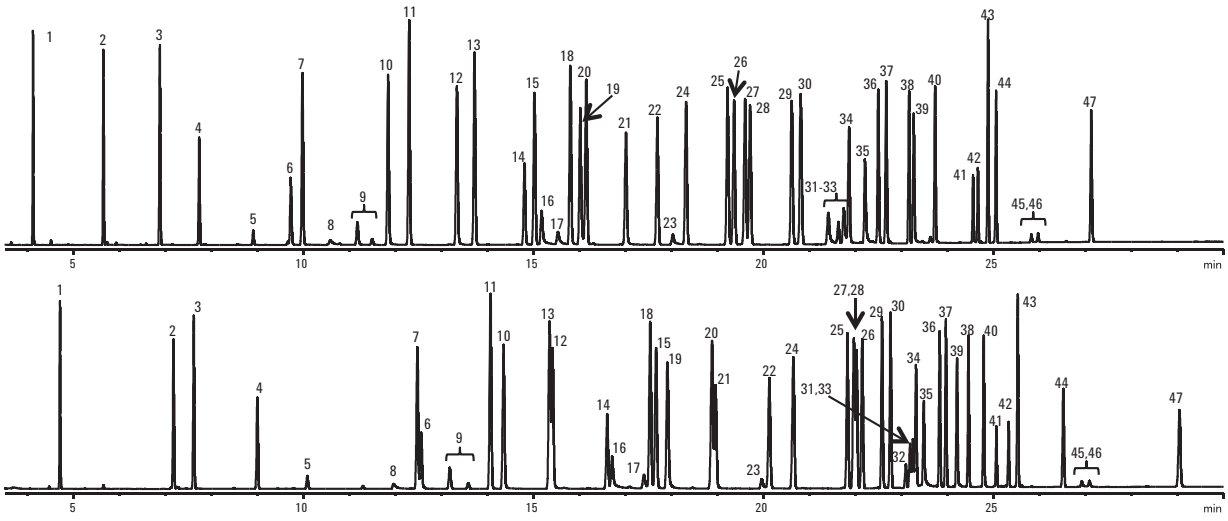
Organochlorine Pesticides, EPA Method 8081B

Column: **DB-CLP1**
123-8232
30 m x 0.32 mm, 0.25 µm

Column: **DB-CLP2**
123-8336
30 m x 0.32 mm, 0.25 µm

Instrument:	Agilent 7890 GC with dual µECD
Carrier:	Helium at 43.5 cm/s (constant flow)
Oven:	80 °C (hold 0.5 min) to 150 °C at 20 °C/min, 5 °C/min to 235 °C, 15 °C/min to 300 °C, hold 5 min
Sampler:	Agilent 7693
Injection:	2 µL, splitless
Detector:	µECD at 325 °C
Sample:	50 ng/mL 8081B analytes

1. 1,2-Dibromo-3-chloropropane
2. Hexachlorocyclopentadiene
3. 1-Bromo-2-nitrobenzene
4. Etridiazole
5. Chloroneb
6. Trifluralin
7. TCMX
8. Propachlor
9. Di-allate isomers (250 ng/mL)
10. Hexachlorobenzene
11. α-BHC
12. Pentachloronitrobenzene
13. γ-BHC
14. β-BHC
15. Heptachlor
16. Dichlone
17. Alachlor
18. δ-BHC
19. Chlorothalonil
20. Aldrin
21. DCPA
22. Isodrin
23. Kelthane
24. Heptachlor epoxide
25. γ-Chlordane
26. trans-Nonachlor
27. α-Chlordane
28. Endosulfan I
29. 4,4'-DDE
30. Dieldrin
31. Chlorobenzilate (250 ng/mL)
32. Perthane (250 ng/mL)
33. Chloropropylate (250 ng/mL)
34. Endrin
35. Nitrofen
36. 4,4'-DDD
37. Endosulfan II
38. 4,4'-DDT
39. Endrin aldehyde
40. Endosulfan sulfate
41. Captafol
42. Methoxychlor
43. Endrin ketone
44. Mirex
45. cis-Permethrin
46. trans-Permethrin
47. Decachlorobiphenyl



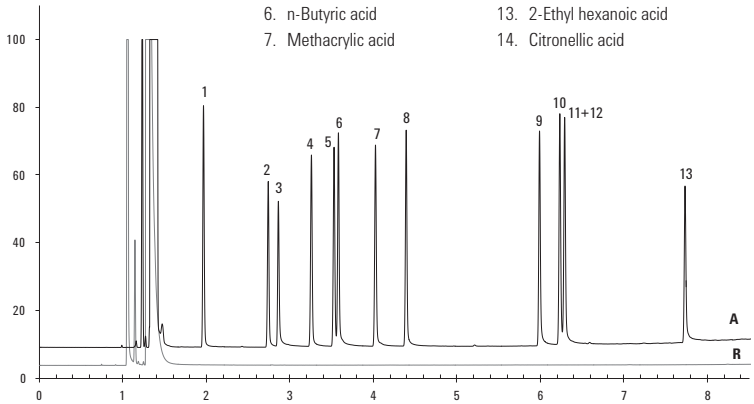
DB-624UI Organic Acid Performance

Column: **DB-624 Ultra Inert**
123-1334UI
30 m x 0.32 mm, 1.80 µm

Column:	Non-Agilent 624, 30 m x 0.32 mm, 1.8 µm
Carrier:	Hydrogen, 4 mL/min constant flow
Oven:	70 °C (1 min), then 20 °C/min to 260 °C
Inlet:	250 °C, 1 µL, split 1:200
Inlet liner:	4 mm, glass wool
Detector:	FID at 260 °C

Organic acid mix C_1-C_{10} (6 to 17 ng) on a DB-624UI column (A) and a traditional non-Agilent 624 column (R) after conditioning at 260 °C for 1 h.

1. Formic acid (<DL)
2. Acetic acid
3. Propionic acid
4. Acrylic acid
5. Isobutyric acid
6. n-Butyric acid
7. Methacrylic acid
8. Isopentanoic acid
9. n-Pentanoic acid
10. n-Heptanoic acid
11. Levulinic acid
12. 2-Propyl pentanoic acid
13. 2-Ethyl hexanoic acid
14. Citronellic acid



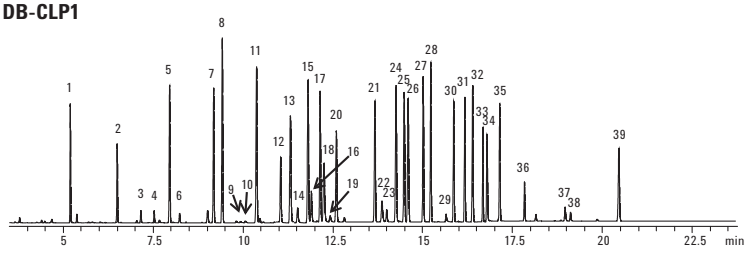
EPA Method 551 – Chlorinated Solvents, Trihalomethanes (THMs), and Disinfection Byproducts (DBPs)

Column: **DB-CLP1**
123-8232
30 m x 0.32 mm, 0.25 µm

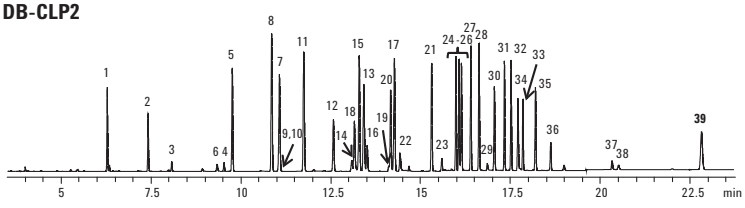
Column: **DB-CLP2**
123-8336
30 m x 0.32 mm, 0.50 µm

Carrier:	Helium, constant flow, 45 cm/s
Oven:	35 °C, hold 5.75 min, 20 °C/min to 95 °C, 40 °C/min to 200 °C, hold 1.25 min
Injection:	2 µL splitless, 200 °C
Detector:	µECD, 300 °C

DB-CLP1



DB-CLP2



1. Chloroform
2. 1,1,1-Trichloroethane
3. Carbon tetrachloride
4. Trichloroacetonitrile
5. Trichloroethane
6. Chloral hydrate
7. Bromodichloromethane
8. 1,1-Dichloro-2-propanone
9. Dichloroacetonitrile
10. Chloropicrin
11. Tetrachloroethane
12. 1,1,2-Trichloroethane
13. Dibromochloromethane
14. 1,2-Dibromoethane
15. 1,1,1-Trichloro-2-propanone
16. Bromochloroacetonitrile
17. Bromoform
18. 1,2,3-Trichloropropane
19. Dibromoacetonitrile
20. 1,2-Dibromo-3-chloropropane

Analysis of Semivolatiles

Column A: **DB-5.625**
122-5632
30 m x 0.25 mm, 0.50 µm

Column B: **DB-5.625**
121-5622
20 m x 0.18 mm, 0.36 µm

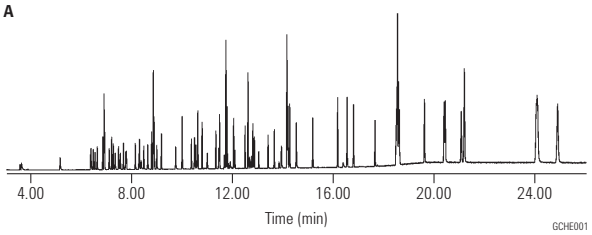
Carrier: He constant flow mode, 1.1 mL/min

Oven: 40 °C (1 min), 25 °C/min to 320 °C
4.80 min hold

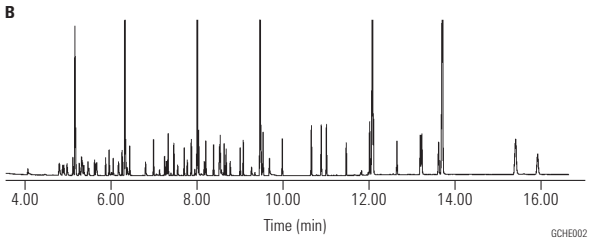
Injection: Splitless 0.5 µL injected at 300 °C,
QuickSwap pressure 5.0 psi during acquisition,
80.0 psi during backflush with inlet set to
1.0 psi during backflush

Detector: Agilent 5975C Performance Turbo MSD
equipped with 6 mm large-aperture drawout lens,
p/n G2589-20045

Translating 0.25 mm id column method to 0.18 mm id format results in 32% reduction in analysis time. Resolution of 77 peaks of interest is also maintained for the faster 0.18 mm id separation.



US EPA Method 8270, 5 ng/mL System Performance Check Compounds
Chromatogram using a DB-5.625, 30 m x 0.25 mm, 0.5 µm



US EPA Method 8270, 5 ng/mL System Performance Check Compounds
Chromatogram using a DB-5.625, 20 m x 0.18 mm, 0.36 µm

TIPS & TOOLS

Learn more about the Agilent 7890B GC System at **www.agilent.com/chem/7890BGC**

Pesticides, EPA 508.1

Column: **DB-35ms**
123-3832
30 m x 0.32 mm, 0.25 µm

Column: **DB-XLB**
123-1236
30 m x 0.32 mm, 0.50 µm

Carrier: Helium at 45 cm/s (EPC in constant flow mode)

Oven: 75 °C for 0.5 min
75-300 °C at 10 °C/min
300 °C for 2 min

Injection: Splitless, 250 °C
30 s purge activation time

Detector: µECD, 350 °C
Nitrogen makeup gas
(column + makeup flow = 30 mL/min constant flow)

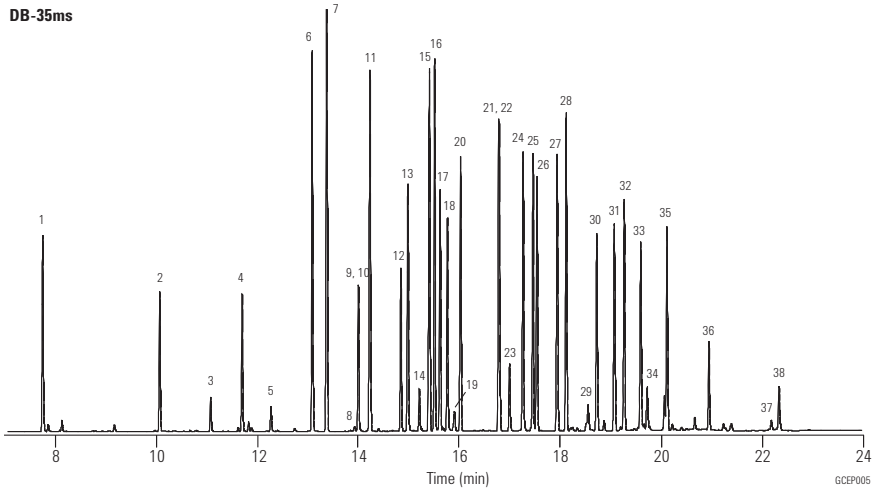
Sample: 50 pg per component

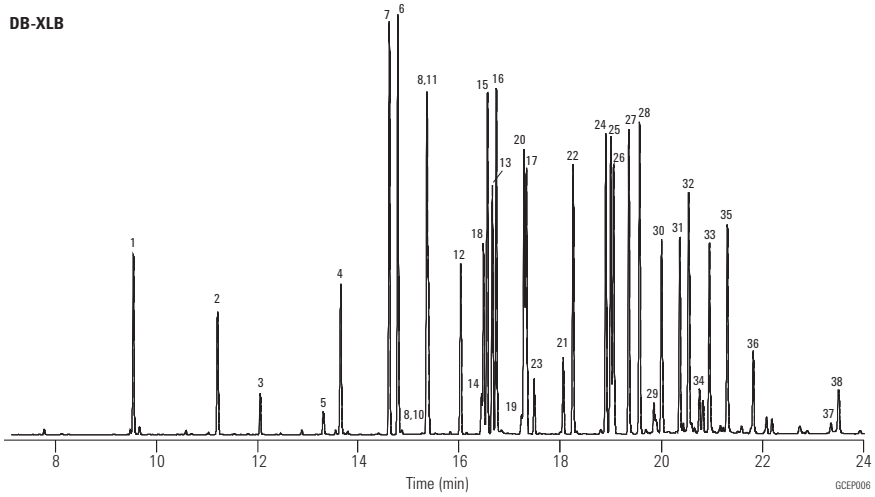
Suggested Supplies

Septum: 11 mm Advanced Green septa, 5183-4759

Liner: Direct connect, single taper, deactivated, 4 mm id, G1544-80730

Syringe: 10 µL tapered, FN 23-26s/42/HP, 5181-1267





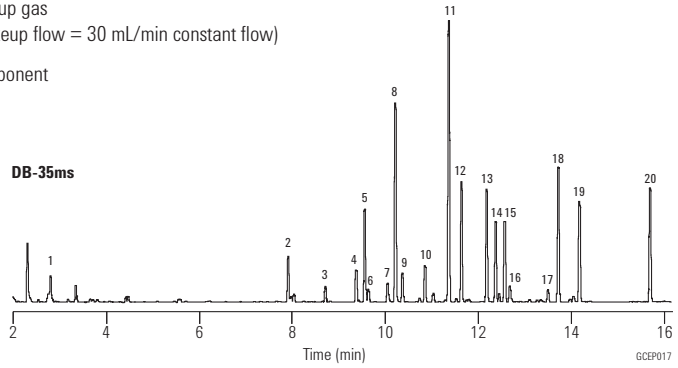
1. Hexachlorocyclopentadiene
2. Etridiazole
3. Chloroneb
4. Trifluralin
5. Propachlor
6. Hexachlorobezene
7. α-BHC
8. Atrazine
9. Pentachloronitrobenzene
10. Simazine
11. γ-BHC
12. β-BHC
13. Heptachlor
14. Alachlor
15. δ-BHC
16. Chlorothalonil
17. Aldrin
18. Metribuzin
19. Metolachlor
20. DCPA
21. 4,4'-Dibromobiphenyl
22. Heptachlor epoxide
23. Cyanazine
24. γ-Chlordane
25. α-Chlordane
26. Endosulfan I
27. 4,4'-DDE
28. Dieldrin
29. Chlorobenzilate
30. Endrin
31. 4,4'-DDD
32. Endosulfan II
33. 4,4'-DDT
34. Endrin aldehyde
35. Endosulfan sulfate
36. Methoxychlor
37. cis-Permethrin
38. trans-Permethrin

Phenoxy Acid Herbicides – Methyl Derivatives, EPA 8151A

Column:	**DB-35ms** **123-3832** **30 m x 0.32 mm, 0.25 µm**
Carrier:	Helium at 45 cm/s (EPC in constant flow mode)
Oven:	50 °C for 0.5 min 50-100 °C at 25 °C/min 100-320 °C at 12 °C/min 320 °C for 2 min
Injection:	Splitless, 250 °C 30 s purge activation time
Detector:	µECD, 350 °C Nitrogen makeup gas (column + makeup flow = 30 mL/min constant flow)
Sample:	50 pg per component

Suggested Supplies

Septum:	11 mm Advanced Green septa, 5183-4759
Liner:	Splitless, single taper, deactivated, 4 mm id, 5181-3316
Syringe:	10 µL tapered, FN 23-26s/42/HP, 5181-1267



1. Dalapon
2. 3,5-Dichlorobenzoic acid
3. 4-Nitrophenol
4. Methyl-2,4-dichlorophenylacetate (SS)
5. Dicamba
6. MCPP
7. MCPA
8. 4,4'-Dibromooctafluorobiphenyl (IS)
9. Dichloroprop
10. 2,4-D
11. Pentachlorophenol
12. 2,4,5-T,P
13. 2,4,5-T
14. Chloramben
15. Dinoseb
16. 2,4-DB
17. Bentazone
18. DCPA
19. Picloram
20. Acifluorofen

Direct Comparison for Rapid CLP (Contract Laboratory Program) Pesticide Analysis

Column: **DB-17ms**
121-4722
20 m x 0.18 mm, 0.18 µm

Column: **DB-XLB**
121-1222
20 m x 0.18 mm, 0.18 µm

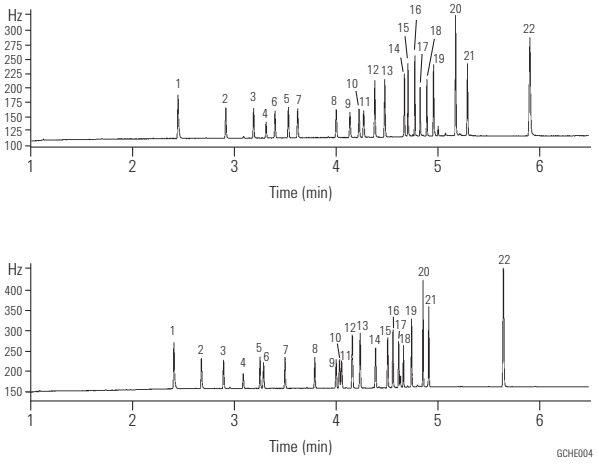
Carrier: Hydrogen (69 cm/s at 120 °C, ramped at 99 mL/min to 106 cm/s at 4.4 min)

Oven: 120 °C (0.32 min); 120 °C/min to 160 °C; 30 °C/min to 258 °C (0.18 min); 38.81 °C/min to 300 °C (1.5 min)

Injection: Split/splitless, 220 °C, pulsed splitless (35 psi for 0.5 min, purge flow of 40 mL/min on at 1 min, gas saver flow 20 mL/min on 3 min)

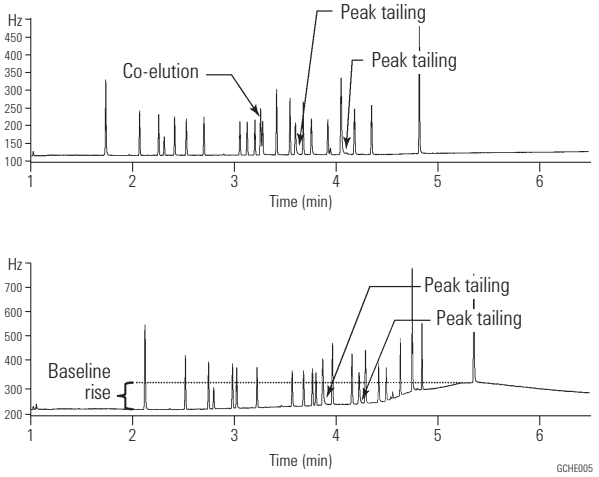
Detector: µECD 320 °C; nitrogen makeup; constant column + makeup flow 60 mL/min

DB-17ms primary column
DB-XLB confirmatory column



1. Tetrachloro-m-xylene
2. α-BHC
3. γ-BHC
4. β-BHC
5. δ-BHC
6. Heptachlor
7. Aldrin
8. Heptachlor epoxide
9. γ-Chlordane
10. α-Chlordane
11. Endosulfan I
12. 4,4' DDE
13. Dieldrin
14. Endrin
15. 4,4' DDD
16. Endosulfan II
17. 4,4' DDT
18. Endrin aldehyde
19. Endosulfan sulfate
20. Methoxychlor
21. Endrin ketone
22. Decachlorobiphenyl

Vendor R primary column, 20 m x 0.18 mm, 0.18 µm
Vendor R confirmatory column, 20 m x 0.18 mm, 0.14 µm



The DB-17ms primary column and DB-XLB confirmatory column sufficiently resolved all the peaks of interest in less than six minutes with sharp, symmetrical peaks and minimal baseline drift. In contrast, vendor R's primary analysis column resolved only 20 of 22 peaks with visible peak tailing. Vendor R's confirmatory column resolved all 22 peaks of interest but with peak tailing and an unacceptable level of temperature dependent baseline drift.

Aroclors 1016-1268 (without 1221)

Column: **DB-XLB**
121-1232
30 m x 0.18 mm, 0.18 µm

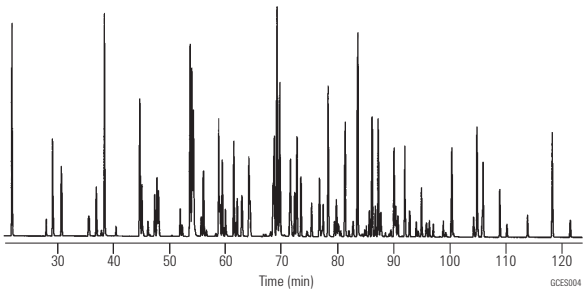
Carrier: Helium at 37 cm/s, measured at 150 °C

Oven: 100 °C for 1 min
100-265 °C at 1.2 °C/min

Injection: Hot on-column, 250 °C

Detector: MSD, 340 °C transfer line, SIM

Sample: 1 µL in isooctane, 12.5 ppm



Suggested Supplies

Septum: 11 mm Advanced Green septa, 5183-4759

Liner: Direct connect, single taper, deactivated, 4 mm id, G1544-80730

Syringe: 10 µL tapered, FN 23-26s/42/HP, 5181-1267

CLP Pesticides

Column: **DB-35ms**
123-3832
30 m x 0.32 mm, 0.25 µm

Column: **DB-XLB**
123-1236
30 m x 0.32 mm, 0.50 µm

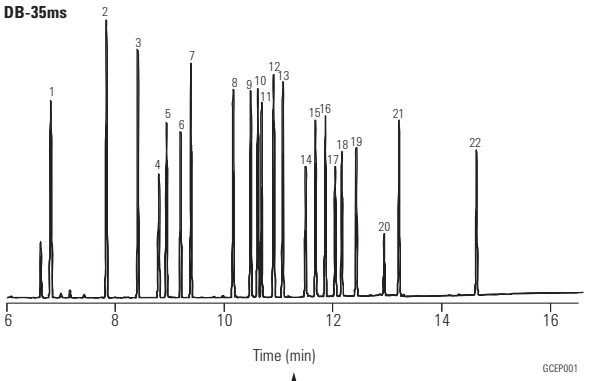
Carrier: Helium at 45 cm/s
(EPC in constant flow mode)

Oven: 110 °C for 0.5 min
110-320 °C at 15 °C/min
320 °C for 2 min

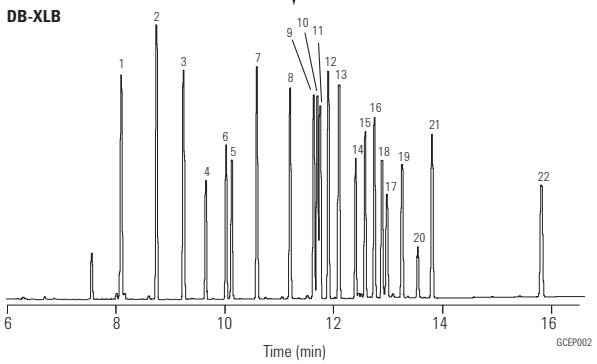
Injection: Splitless, 250 °C
30 s purge activation time

Detector: µECD, 350 °C
Nitrogen makeup gas
(column + makeup flow =
30 mL/min constant flow)

Sample: 50 pg per component



Complete resolution and confirmation of 22 CLP Pesticides in under 16 minutes!



1. Tetrachloro m-xylene (SS)
2. α-BHC
3. γ-BHC
4. β-BHC
5. Heptachlor
6. δ-BHC
7. Aldrin
8. Heptachlor epoxide
9. γ-Chlordane
10. α-Chlordane
11. Endosulfan I
12. 4,4'-DDE
13. Dieldrin
14. Endrin
15. 4,4'-DDD
16. Endosulfan II
17. 4,4'-DDT
18. Endrin aldehyde
19. Endosulfan sulfate
20. Methoxychlor
21. Endrin ketone
22. Decachlorobiphenyl (SS)

SS - Surrogate Standard

Suggested Supplies

Septum: 11 mm Advanced Green septa, 5183-4759

Liner: Splitless, single taper, deactivated, 4 mm id, 5181-3316

Syringe: 10 µL tapered, FN 23-26s/42/HP, 5181-1267

High Speed VOC, EPA Method 8260

Column: **DB-VRX**
121-1524
20 m x 0.18 mm, 1.00 µm

Carrier: Helium at 55 cm/s (1.5 mL/min)

Oven:
45 °C for 3.0 min
45-190 °C at 36 °C/min
190-225 °C at 20 °C/min
225 °C for 0.5 min

Sampler: Purge and trap (Tekmar 3100)
Purge: 11 min
Trap: VoCarb 3000
Preheat: 245 °C
Desorb: 250 °C for 1 min
Bake: 260 °C for 10 min
Line & valve: 100 °C

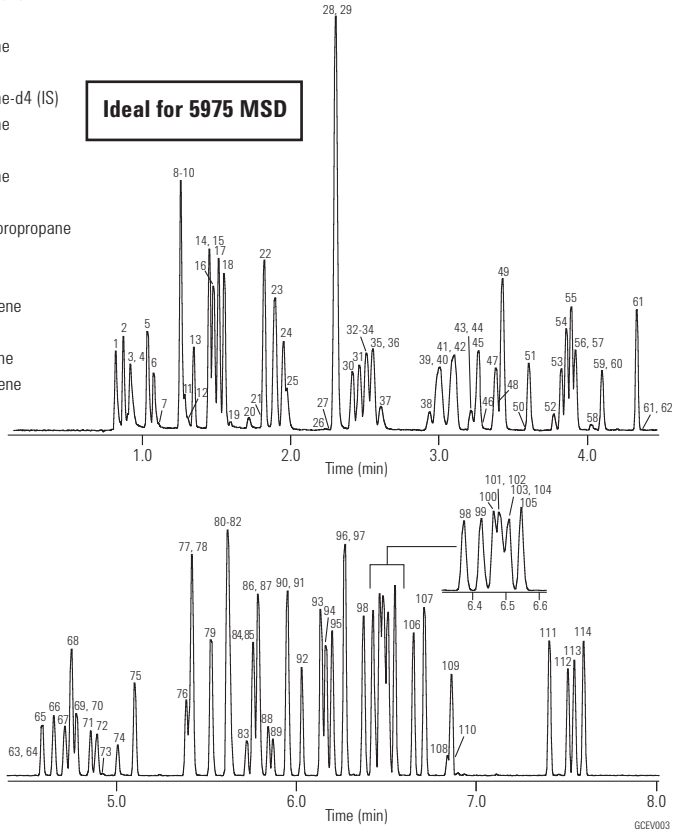
Injection: Split, 150 °C
Split ratio 60:1

Detector: Agilent 5975 MSD
Scan range: 35-260 amu
Scan rate: 3.25 scans/s
Quad temp: 150 °C
Source temp: 200 °C
Transfer line temp: 200 °C

Sample: 5 mL
- Halogentated and aromatic analytes at 40 ppb
- Internal standards at 20 ppb
- Polar analytes (i.e., ethers, alcohols and ketones at 100-800 ppb)

1. Dichlorodifluoromethane
2. Chloromethane
3. Hydroxypropionitrile
4. Vinyl chloride
5. Bromomethane
6. Chloroethane
7. Ethanol
8. Acetonitrile
9. Acrolein
10. Trichlorofluoromethane
11. Isopropyl alcohol
12. Acetone
13. Ethyl ether
14. 1,1-Dichloroethene
15. tert-Butyl alcohol
16. Acrylonitrile
17. Methylene chloride
18. Allyl chloride
19. Allyl alcohol
20. 1-Propanol
21. Propargyl alcohol
22. trans-1,2-Dichloroethene
23. MTBE
24. 1,1-Dichloroethane
25. Propionitrile
26. 2-Butanone
27. Diisopropyl ether
28. cis-1,2-Dichloroethene
29. Methacrylonitrile
30. Bromochloromethane
31. Chloroform
32. 2,2-Dichloropropane
33. Ethyl acetate
34. Ethyl-tert-butyl ether
35. Methyl acrylate
36. Dibromofluoromethane (IS)
37. Isobutanol
38. Dichloroethane-d4 (IS)
39. Pentafluorobenzene
40. 1,2-Dichloroethane
41. 1,1,1-Trichloroethane
42. 1-Chlorobutane
43. Crotonaldehyde
44. 2-Chloroethanol
45. 1,1-Dichloropropene
46. 1-Butanol
47. Carbon tetrachloride
48. Chloroacetonitrile
49. Benzene
50. tert-Amylmethyl ether
51. Fluorobenzene (IS)
52. 2-Pentanone
53. Dibromomethane
54. 1,2-Dichloropropane
55. Trichloroethene
56. Bromodichloromethane
57. 2-Nitropropane
58. 1,4-Dioxane
59. Epichlorohydrin
60. Methyl methacrylate
61. cis-1,3-Dichloropropene
62. Propiolactone
63. Bromoacetone
64. Pyridine
65. trans-1,3-Dichloropropene
66. 1,1,2-Trichloroethane
67. Toluene-d8 (IS)
68. Toluene
69. 1,3-Dichloropropane
70. Paraldehyde
71. Ethyl methacrylate
72. Dibromochloromethane
73. 3-Chloropropionitrile
74. 1,2-Dibromoethane
75. Tetrachloroethene
76. 1,1,1,2-Tetrachloroethane
77. 1-Chlorohexane
78. Chlorobenzene
79. Ethylbenzene
80. Bromoform
81. m-Xylene
82. p-Xylene
83. trans-Dichlorobutene
84. 1,3-Dichloro-2-propanol
85. Styrene
86. 1,1,2,2-Tetrachloroethane
87. o-Xylene
88. 1,2,3-Trichloropropane
89. cis-Dichlorobutene
90. 4-Bromofluorobenzene (IS)
91. Isopropylbenzene
92. Bromobenzene
93. Propylbenzene
94. 2-Chlorotoluene
95. 4-Chlorotoluene
96. 1,3,5-Trimethylbenzene
97. Pentachloroethane
98. tert-Butylbenzene
99. 1,2,4-Trimethylbenzene
100. sec-Butylbenzene
101. 1,3-Dichlorobenzene
102. Benzyl chloride
103. 1,4-Dichlorobenzene-d4 (IS)
104. 1,4-Dichlorobenzene
105. Isopropyltoluene
106. 1,2-Dichlorobenzene
107. Butylbenzene
108. 1,2-Dibromo-3-chloropropane
109. Hexachloroethane
110. Nitrobenzene
111. 1,2,4-Trichlorobenzene
112. Naphthalene
113. Hexachlorobutadiene
114. 1,2,3-Trichlorobenzene

Ideal for 5975 MSD



Suggested Supplies

Septum: 11 mm Advanced Green septa, 5183-4759

Liner: Direct, 1.5 mm id, 18740-80200

Seal: Gold plated seal, 18740-20885

PBDEs

Column: **DB-XLB**
122-1231
30 m x 0.25 mm, 0.10 µm

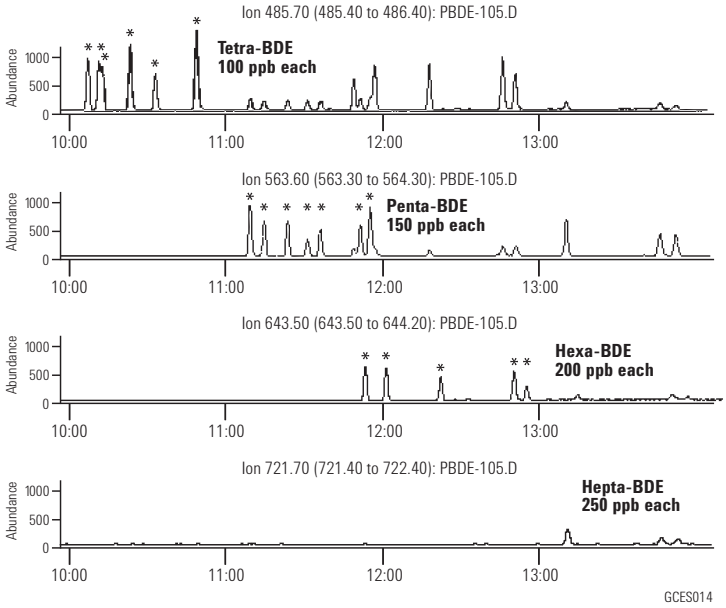
Carrier: Helium at 38 cm/s at 100 °C (1.2 mL/min), constant flow mode

Oven: 100 °C for 1 min; 100 °C to 340 °C at 20 °C/min, 340 °C for 12 min

Injection: Cool on-column, oven-track mode

Detector: Agilent 5973 MSD, 325 °C transfer line, EI SIM (ions monitored: 231.8, 248.0, 327.9, 398.6, 400.5, 405.8, 845.7, 563.6, 643.5, 721.4, 799.3)

Sample: 0.5 µL



For a complete Application Note, visit **www.agilent.com/chem**, select "Literature" from the Library and type 5989-0094EN into the "Keyword" field.

EPA Volatiles by GC/MS (Split Injector)

Column: **DB-VRX**
122-1564
60 m x 0.25 mm, 1.40 µm

Carrier: Helium at 30 cm/s, measured at 45 °C

Oven:
45 °C for 10 min
45-190 °C at 12 °C/min
190 °C for 2 min
190-225 °C at 6 °C/min
225 °C for 1 min

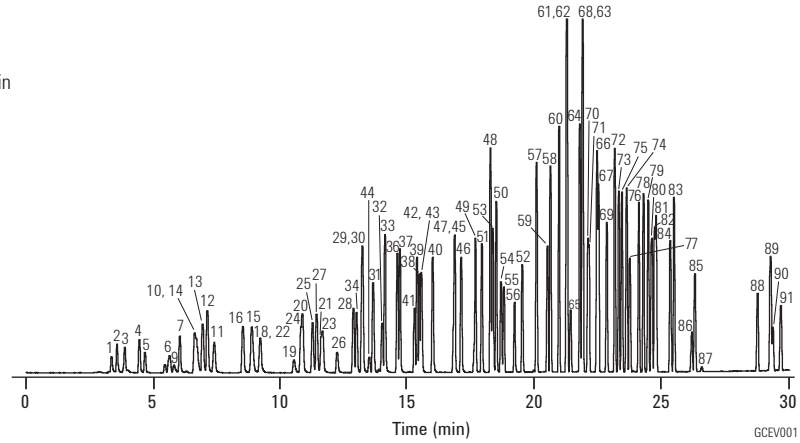
Sampler: Purge and trap (O.I.A. 4560)
Purge: Helium for 11 min at 40 mL/min
Trap: Tenax/Silica Gel/Carbosieve
Preheat: 175 °C
Desorb: 220 °C for 0.6 min

Injection: Split, 110 °C
Split flow 30 mL/min

Detector: MSD, 235 °C transfer line
Full scan 35-260 amu (m/z 44 subtracted)

Suggested Supplies

Septum: 11 mm Advanced Green septa, 5183-4759
Liner: Direct, 1.5 mm id, 18740-80200
Seal: Gold plated seal kit, 5188-5367



1. Dichlorodifluoromethane
2. Chloromethane
3. Vinyl chloride
4. Bromomethane
5. Chloroethane
6. Trichlorofluoromethane
7. Diethyl ether
8. 1,1-Dichloroethene
9. Acetone
10. Iodomethane
11. Carbon disulfide
12. Allyl chloride
13. Methylene chloride
14. Acrylonitrile
15. Methyl-tert-butyl ether
16. trans-1,2-Dichloroethene
17. Hexane
18. 1,1-Dichloroethane
19. 2-Butanone
20. cis-1,2-Dichloroethene
21. 2,2-Dichloropropane
22. Propionitrile
23. Methyl acrylate
24. Methacrylonitrile
25. Bromochloromethane
26. Tetrahydrofuran
27. Chloroform
28. Pentafluorobenzene (IS)
29. 1,1,1-Trichloroethane
30. 1-Chlorobutane
31. 1,1-Dichloropropene
32. Carbon tetrachloride
33. Benzene
34. 1,2-Dichloroethane
35. 2,2-Dimethylhexane
36. Fluorobenzene (IS)
37. 1,4-Difluorobenzene (IS)
38. Trichloroethene
39. 1,2-Dichloropropane
40. Methyl methacrylate
41. Dibromomethane
42. Bromodichloromethane
43. 2-Nitropropane
44. Chloroacetonitrile
45. cis-1,3-Dichloropropene
46. 4-Methyl-2-pentanone
47. 1,1-Dichloro-2-propanone
48. Toluene
49. trans-1,3-Dichloropropene
50. Ethyl methacrylate
51. 1,1,2-Trichloroethane
52. Tetrachloroethene
53. 1,3-Dichloropropane
54. 2-Hexanone
55. Dibromochloromethane
56. 1,2-Dibromoethane
57. 1-Chloro-3-fluorobenzene (IS)
58. Chlorobenzene
59. 1,1,1,2-Tetrachloroethane
60. Ethylbenzene
61. m-Xylene
62. p-Xylene
63. o-Xylene
64. Styrene
65. Bromoform
66. Isopropylbenzene
67. 4-Bromofluorobenzene (SS)
68. 1,1,2,2-Tetrachloroethane
69. Bromobenzene
70. 1,2,3-Trichloropropane
71. trans-1,4-Dichloro-2-butene
72. n-Propylbenzene
73. 2-Chlorotoluene
74. 1,3,5-Trimethylbenzene
75. 4-Chlorotoluene
76. tert-Butylbenzene
77. Pentachloroethane
78. 1,2,4-Trimethylbenzene
79. sec-Butylbenzene
80. 1,3-Dichlorobenzene
81. p-Isopropyltoluene
82. 1,4-Dichlorobenzene
83. n-Butylbenzene
84. 1,2-Dichlorobenzene
85. Hexachloroethane
86. 1,2-Dibromo-3-chloropropane
87. Nitrobenzene
88. 1,2,4-Trichlorobenzene
89. Hexachlorobutadiene
90. Naphthalene
91. 1,2,3-Trichlorobenzene

EPA Method 525.2

Column: **DB-5ms**
122-5532
30 m x 0.25 mm, 0.25 µm

Carrier: Helium at 32 cm/s, measured at 45 °C, constant flow mode

Oven:
45 °C for 1 min
45-130 °C at 30 °C/min
130 °C for 3 min
130-180 °C at 12 °C/min
180-240 °C at 7 °C/min
240-325 °C at 12 °C/min
325 °C for 5 min

Injection:
Splitless, 300 °C
1.0 min purge activation time
Focus liner

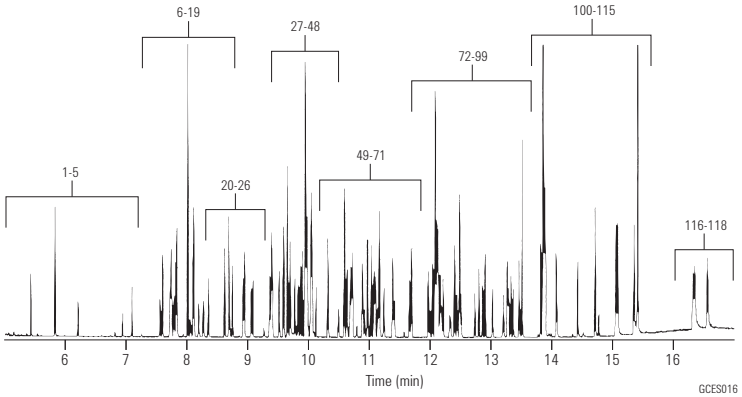
Detector:
MSD, 325 °C transfer line
Full scan m/z 45-450

Sample:
Composite mixture of AccuStandard Method 525.2 standards (M-525.2-SV-ASL, M-525.2-FS-ASL, M-525.2-CP-ASL, M-525.2-NP1-ASL, M-525.2-NP2-ASL): target compounds at 2 ng/µL, IS/SS at 5 ng/µL

Suggested Supplies

Septum: 11 mm Advanced Green septa, 5183-4759
Liner: Direct connect, single taper, deactivated, 4 mm id, G1544-80730
Syringe: 10 µL tapered, FN 23-26s/42/HP, 5181-1267

Compound	RT	m/z
1. Isophorone	5.85	82
2. 1,3-Dimethyl-2-nitrobenzene (SS)	6.65	134
3. Dichlorvos	7.41	109
4. Hexachlorocyclopentadiene	8.87	237
5. EPTC	9.17	128
6. Mevinphos	10.09	127
7. Butylate	10.18	57/146
8. Vernolate	10.42	128
9. Dimethyl phthalate	10.45	163
10. Terrazole (etridiazole)	10.47	211/183
11. 2,6-Dinitrotoluene	10.56	165
12. Tillam (pebulate)	10.61	128
13. Acenaphthylene	10.65	152
14. Acenaphthene-d10 (IS)	11	164
15. Chloroneb	11.17	191
16. 2-Chlorobiphenyl	11.19	188
17. Tebuthiuron	11.37	156
18. 2,4-Dinitrotoluene	11.51	165
19. Molinate	11.68	126
20. Diethyl phthalate	12.21	149
21. Fluorene	12.35	166
22. Propachlor	12.46	120
23. Ethoprop	12.82	158
24. Cycloate	12.86	83/154
25. Chlorpropham	13.08	127
26. Trifluralin	13.14	306
27. α-BHC	13.69	181
28. 2,3-Dichlorobiphenyl	13.74	222/152
29. Hexachlorobenzene	13.77	284
30. Gesatamine (atraton)	13.99	196/169
31. Prometon	14.14	225/168
32. Atrazine	14.26	200/215
33. Simazine	14.27	201/186
34. β-BHC	14.28	181
35. Pentachlorophenol	14.35	266
36. Propazine	14.35	214/172
37. γ-BHC	14.52	181
38. Terbufos	14.62	57
39. Pronamide	14.69	173
40. Diazinon	14.76	137/179
41. Phenanthrene-d10 (IS)	14.85	188
42. Chlorothalonil	14.89	266
43. Phenanthrene	14.92	178
44. Terbacil	15.02	161
45. Methyl paraoxon	15.04	109
46. Disulfoton	15.05	88
47. Anthracene	15.06	178
48. δ-BHC	15.20	181
49. 2,4,5-Trichlorobiphenyl	15.59	256
50. Metribuzin	15.95	198
51. Alachlor	16.14	160
52. Simetryn	16.23	213
53. Ametryn	16.33	227/170
54. Heptachlor	16.36	100
55. Prometryn	16.40	241/184
56. Prebane (terbutryn)	16.72	226/185
57. Bromacil	16.79	205
58. Di-n-butyl phthalate	16.90	149
59. 2,2',4,4'-Tetrachlorobiphenyl	17.02	292
60. Metolachlor	17.11	162
61. Dursban (chlorpyrifos)	17.15	197/97
62. Cyanazine	17.23	225/68
63. Dacthal (DCPA methyl ester)	17.27	301
64. Aldrin	17.29	66
65. Triadimefon	17.43	57
66. Diphenamid	17.73	72/167
67. MGK-264 (isomer A)	17.78	164/66
68. MGK-264 (isomer B)	18.11	164
69. Heptachlor epoxide	18.28	81
70. 2,2',3',4,6-Pentachlorobiphenyl	18.34	326
71. Merphos	18.36	209/153
72. γ-Chlordane	18.88	373
73. Tetrachlorvinphos (stirifos)	18.95	109
74. Butachlor	19.03	176/160
75. Pyrene-d10 (SS)	19.13	212
76. Pyrene	19.18	202
77. α-Chlordane	19.21	375/373
78. Endosulfan I	19.22	195
79. trans-Nonachlor	19.28	409
80. Fenamiphos	19.33	303/154
81. Napropamide	19.39	72
82. Tricyclazole	19.61	189
83. p,p'-DDE	19.76	246
84. DEF	19.84	57/169
85. 2,2',4,4',5,6'-Hexachlorobiphenyl	19.90	360
86. Dieldrin	19.92	79
87. Carboxin	19.97	143
88. Endrin	20.43	67/81
89. Chlorobenzilate	20.56	139
90. Endosulfan II	20.68	195
91. p,p'-DDD	20.77	235/165
92. Endrin aldehyde	21.01	67
93. Norflurazon	21.36	145
94. Benzyl butyl phthalate	21.49	149
95. Endosulfan sulfate	21.53	272
96. p,p'-DDT	21.61	235/165
97. Hexazinone	21.68	171
98. Bis(2-ethylhexyl) adipate	21.87	129
99. Triphenylphosphate (SS)	21.98	326/325
100. Endrin ketone (breakdown product)	22.52	67/317
101. 2,2',3,3',4,4',6-Heptachlorobiphenyl	22.59	394/396
102. Benz[a]anthracene	22.66	228
103. Chrysene-d12 (IS)	22.68	240
104. 2,2',3,3',4,5',6,6'-Octachlorobiphenyl	22.70	430/428
105. Methoxychlor	22.73	227
106. Chrysene	22.74	228
107. Bis(2-ethylhexyl) phthalate	23.10	149
108. Fenarimol	23.80	139
109. cis-Permethrin	24.38	183
110. trans-Permethrin	24.50	183
111. Benzo[b]fluoranthene	25.06	252
112. Benzo[k]fluoranthene	25.12	252
113. Fluridone	25.66	328
114. Benzo[a]pyrene	25.67	252
115. Perylene-d12 (SS)	25.78	264
116. Indeno[1,2,3-c,d]pyrene	27.63	276
117. Dibenz[a,h]anthracene	27.69	278
118. Benzo[g,h,i]perylene	28.11	276



Pesticides and Fire Retardants (US EPA 527)

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

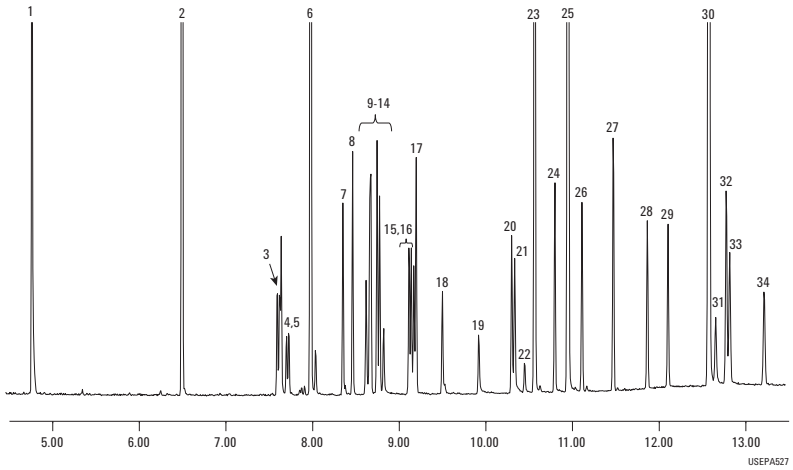
Carrier: Helium, 52 cm/s, constant flow

Oven: 60 °C (1 min) to 210 °C (25 °C/min), 20 °C/min to 310 °C (3 min)

Injection: Splitless, 250 °C, purge flow 50 mL/min at 1 min,
gas saver 80 mL/min on at 3 min

Detector: Transfer line 290 °C, source 300 °C, quad 180 °C

Sample: Pesticide/PBDE standards, 1 ng with 5 ng IS/SS on-column



1. 1,2-Dimethyl-2-nitrobenzene
2. Acenaphthalene-D10
3. Dimethoate
4. Atrazine
5. Propazine
6. Anthracene-D10
7. Vinclozoline
8. Prometryn
9. Bromacil
10. Malathion
11. Thiazopyr
12. Dursban
13. Benthiocarb
14. Parathion
15. Terbufos sulfone
16. Bioallethrin
17. Oxychlordane
18. Fenamiphos
19. Nitrophen
20. Norflurazon
21. Kepone
22. Hexazinone
23. Triphenyl phosphate
24. Bifenthrin
25. Chrysene-D12
26. BDE-47
27. Mirex
28. BDE-100
29. BDE-99
30. Perylene-D12
31. Fenvalerate
32. Esfenvalerate
33. Hexabromobiphenyl
34. BDE-153

EPA Method 508.1 – Chlorinated Pesticides and Herbicides

Column: **DB-CLP1**
123-8232
30 m x 0.32 mm, 0.25 µm

Column: **DB-CLP2**
123-8336
30 m x 0.32 mm, 0.50 µm

Carrier: Helium, constant flow, 35 cm/s

Oven: 80 °C, hold 0.5 min, 26 °C/min to 175 °C, 6.5°C/min to 235 °C, 15 °C/min to 300 °C, hold 6 min

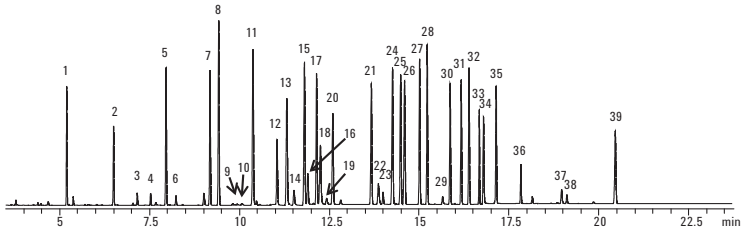
Injection: 2 µL, splitless, 250 °C

Detector: µCED, 340 °C

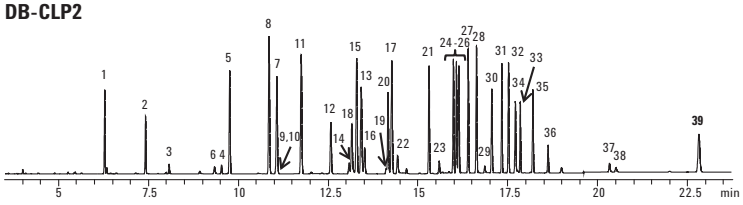
Sample: 100 ng/mL EPA 508.1 analytes, 100 ng/mL pesticide surrogate mix

1. Hexchlorocyclopentadiene
2. Etridiazole
3. Chloroneb
4. Trifluralin
5. Tetrachloro-m-xylene (surrogate standard)
6. Propachlor
7. Hexachlorobenzene
8. α-BHC
9. Atrazine
10. Simazine
11. γ-BHC
12. ß-BHC
13. Heptachlor
14. Alachlor
15. δ-BHC
16. Chlorothalonil
17. Aldrin
18. Metribuzin
19. Metolachlor
20. DCPA
21. Heptachlor epoxide
22. Cyanazine
23. Butachlor
24. γ-Chlordane
25. α-Chlordane
26. Endosulfan I
27. 4,4'-DDE
28. Dieldrin
29. Chlorobenzilate
30. Endrin
31. 4,4'-DDD
32. Endosulfan II
33. 4,4'-DDT
34. Endrin aldehyde
35. Endosulfan sulfate
36. Methoxychlor
37. cis-Permethrin
38. trans-Permethrin
39. Decachlorobiphenyl (surrogate standard)

DB-CLP1



DB-CLP2



The DB-CLP1 column separates all chlorinated pesticide and herbicide analytes acording to EPA Method 505.

Chlorinated Pesticides, EPA Method 508

Column: **HP-5ms**
19091S-433
30 m x 0.25 mm, 0.25 µm

Carrier: Helium, 24 psi, 45 cm/s (80 °C) constant flow

Oven: 80 °C for 1 min
80-180 °C at 30 °C/min
180-205 °C at 3 °C/min
205 °C for 4 min
205-290 °C at 2 °C/min
290 °C for 2 min

Injection: Splitless
1 min purge delay

Detector: ECD, 320 °C
Nitrogen makeup gas at 60 mL/min
Anode purge 3 mL/min

Sample: 1 µL

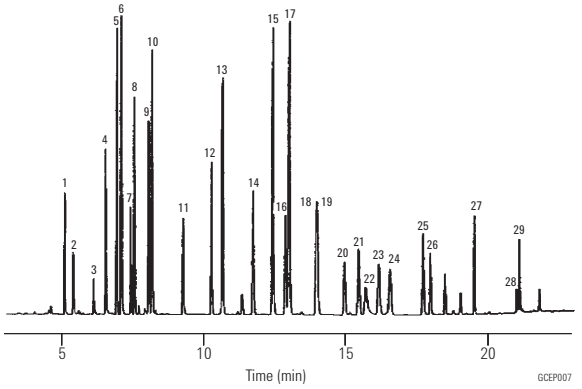
Suggested Supplies

Septum: 11 mm Advanced Green septa, 5183-4759

Liner: Direct connect, single taper, deactivated, 4 mm id, G1544-80730

Syringe: 10 µL tapered, FN 23-26s/42/HP, 5181-1267

1. Etridiazole
2. Chloroneb
3. Propachlor
4. Trifluralin
5. α-BHC
6. Hexachlorobezene
7. β-BHC
8. δ-BHC
9. γ-BHC
10. Chlorothalonil
11. Heptachlor
12. Aldrin
13. DCPA
14. Heptachlor epoxide
15. γ-Chlordane
16. Endosulfan I
17. α-Chlordane
18. Dieldrin
19. 4,4'-DDE
20. Endrin
21. Endosulfan II
22. Chlorobenzilate
23. 4,4'-DDD
24. Endrin aldehyde
25. Endosulfan sulfate
26. 4,4'-DDT
27. Methoxychlor
28. cis-Permethrin
29. trans-Permethrin



Organochlorine Pesticides

Column: **DB-5**
125-5037
30 m x 0.53 mm, 0.50 µm

Carrier: Helium at 30 cm/s (4.0 mL/min)

Oven: 150-275 °C at 4 °C/min
275 °C for 30 min

Injection: Splitless, 250 °C

Detector: ECD, 300 °C
Nitrogen makeup gas at 30 mL/min

Sample: 0.7 µL of 100 pg/µL standard in isooctane

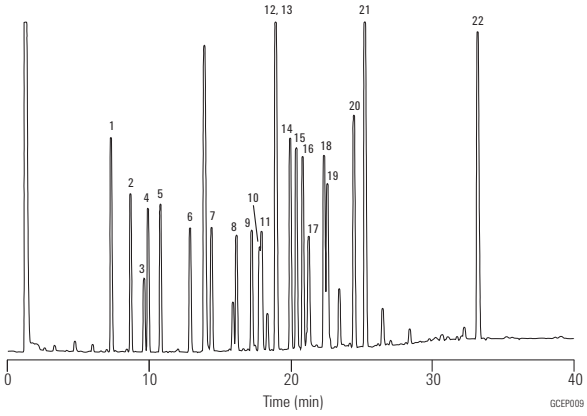
Suggested Supplies

Liner: Splitless, single taper, deactivated, 4 mm id, 5181-3316

Septum: 11 mm Advanced Green septa, 5183-4759

Syringe: 10 µL tapered, FN 23-26s/42/HP, 5181-1267

1. 2,4,5,6-Tetrachloro-m-xylene (IS)
2. α-BHC
3. β-BHC
4. γ-BHC
5. δ-BHC
6. Heptachlor
7. Aldrin
8. Heptachlor epoxide
9. γ-Chlordane
10. Endosulfan I
11. α-Chlordane
12. Dieldrin
13. p,p'-DDE
14. Endrin
15. Endosulfan II
16. p,p'-DDD
17. Endrin aldehyde
18. Endosulfan sulfate
19. p,p'-DDT
20. Endrin ketone
21. Methoxychlor
22. Decachlorobiphenyl (IS)



Organochlorine Pesticides III

Column: **DB-1701**
125-0737
30 m x 0.53 mm, 0.50 µm

Carrier: Helium at 30 cm/s (4.0 mL/min)

Oven: 150-275 °C at 4 °C/min
275 °C for 30 min

Injection: Splitless, 250 °C

Detector: ECD, 300 °C
Nitrogen makeup gas at 30 mL/min

Sample: 0.7 µL of 100 pg/µL standard in isooctane

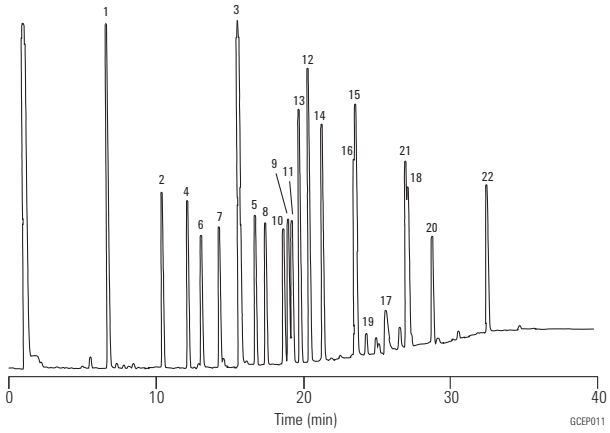
Suggested Supplies

Septum: 11 mm Advanced Green septa, 5183-4759

Liner: Splitless, single taper, deactivated, 4 mm id, 5181-3316

Syringe: 10 µL tapered, FN 23-26s/42/HP, 5181-1267

1. 2,4,5,6-Tetrachloro-m-xylene (IS)
2. α-BHC
3. β-BHC
4. γ-BHC
5. δ-BHC
6. Heptachlor
7. Aldrin
8. Heptachlor epoxide
9. γ-Chlordane
10. Endosulfan I
11. α-Chlordane
12. Dieldrin
13. p,p'-DDE
14. Endrin
15. Endosulfan II
16. p,p'-DDD
17. Endrin aldehyde
18. Endosulfan sulfate
19. p,p'-DDT
20. Endrin ketone
21. Methoxychlor
22. Decachlorobiphenyl (IS)



Organochlorine Pesticides IV

Column: **DB-35**
125-1937
30 m x 0.53 mm, 0.50 µm

Carrier: Helium at 30 cm/s (4.0 mL/min)

Oven: 150-275 °C at 4 °C/min
275 °C for 30 min

Injection: Splitless, 250 °C

Detector: ECD, 300 °C
Nitrogen makeup gas at 30 mL/min

Sample: 0.7 µL of 100 pg/µL standard in isooctane

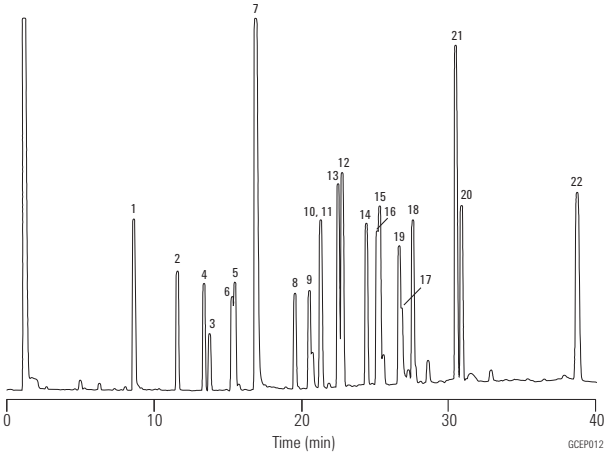
Suggested Supplies

Septum: 11 mm Advanced Green septa, 5183-4759

Liner: Splitless, single taper, deactivated, 4 mm id, 5181-3316

Syringe: 10 µL tapered, FN 23-26s/42/HP, 5181-1267

1. 2,4,5,6-Tetrachloro-m-xylene (IS)
2. α-BHC
3. β-BHC
4. γ-BHC
5. δ-BHC
6. Heptachlor
7. Aldrin
8. Heptachlor epoxide
9. γ-Chlordane
10. Endosulfan I
11. α-Chlordane
12. Dieldrin
13. p,p'-DDE
14. Endrin
15. Endosulfan II
16. p,p'-DDD
17. Endrin aldehyde
18. Endosulfan sulfate
19. p,p'-DDT
20. Endrin ketone
21. Methoxychlor
22. Decachlorobiphenyl (IS)



Organochlorine Pesticides, DB-5/DB-1701P

Column: **DB-5**
123-5032
30 m x 0.32 mm, 0.25 µm

Column: **DB-1701P**
123-7732
30 m x 0.32 mm, 0.25 µm

Column: **Guard Column**
160-2535-10
30 m x 0.32 mm, 0.25 µm

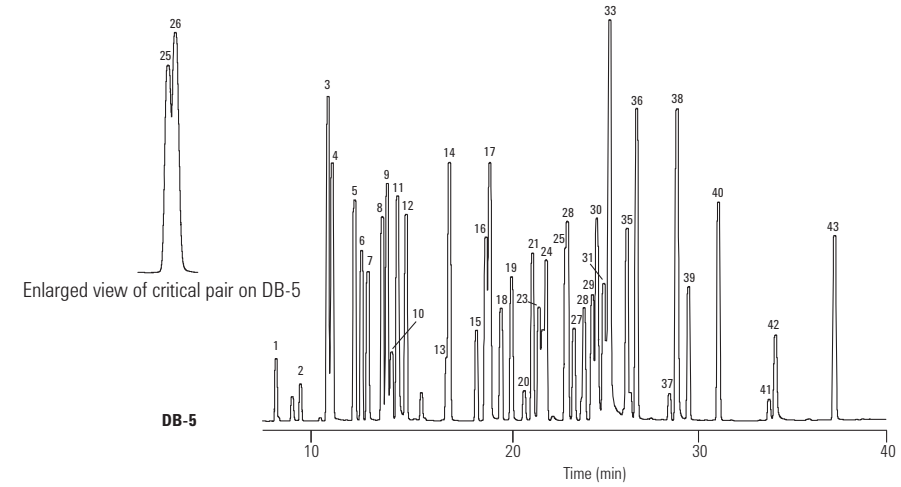
Carrier: Helium at 29.2 cm/s, measured at 150 °C

Oven: 60 °C for 0.5 min
60-140 °C at 20 °C/min
140-280 °C at 11 °C/min
280 °C for 23 min

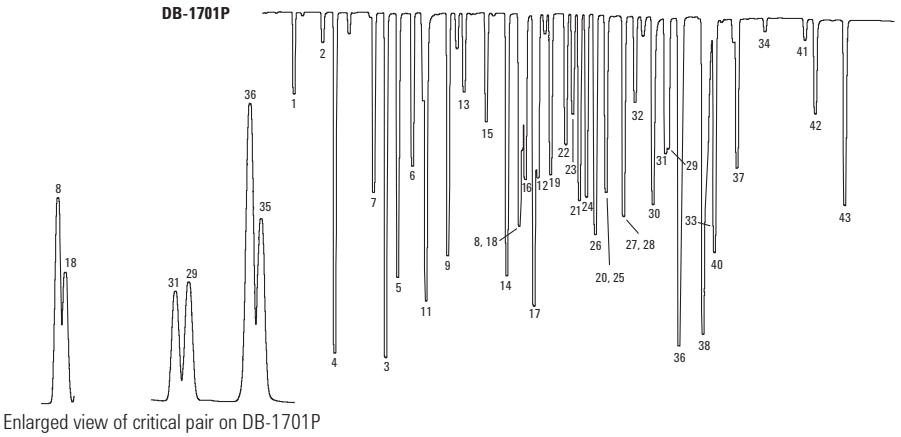
Injection: Splitless, 200 °C

Detector: ECD, 325 °C
Nitrogen makeup gas at 30 mL/min

Sample: 2.0 µL, 20-200 pg/µL



Enlarged view of critical pair on DB-5



Enlarged view of critical pair on DB-1701P

1. Etridiazole
2. Chloroneb
3. Propachlor
4. Tetrachloro-m-xylene (IS)
5. Trifluralin
6. α-BHC
7. Hexachlorobenzene
8. β-BHC
9. γ-BHC
10. Pentachloronitrobenzene
11. p,p'-Dichlorobiphenyl
12. δ-BHC
13. Heptachlor
14. Alachlor
15. Aldrin
16. Chlorpyrifos
17. DCPA
18. Isodrin
19. Heptachlor epoxide
20. Captan
21. γ-Chlordane
22. o,p'-DDE
23. Endosulfan I
24. α-Chlordane
25. Dieldrin
26. p,p'-DDE
27. o,p'-DDD
28. Endrin
29. Endosulfan II
30. Chlorobenzilate
31. p,p'-DDD
32. o,p'-DDT
33. Endrin aldehyde
34. Endrin ketone
35. Carbophenothion
36. p,p'-DDT
37. Endosulfan sulfate
38. Hexabromobenzene (HBB)
39. Methoxychlor
40. Mirex
41. cis-Permethrin
42. trans-Permethrin
43. Decachlorobiphenyl (IS)

Organochlorine Pesticides

Column: **VF-17ms**
CP8982
30 m x 0.25 mm, 0.25 µm

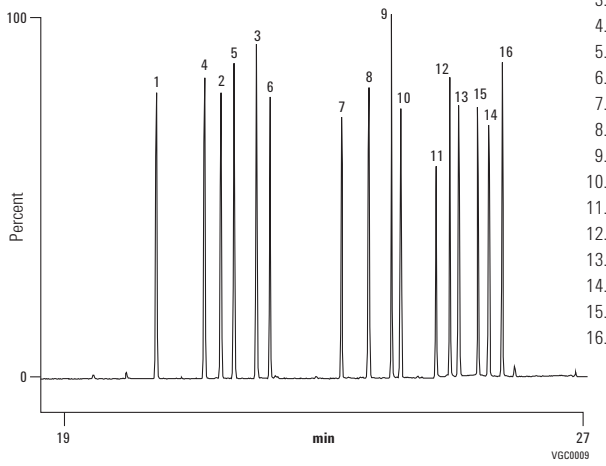
Sample: 1.0 µL

Sample Conc: 200 µg/mL

Carrier: Helium, 70 kPa

Injection: Splitter, 1:100

Detector: MS, Ion Trap, TIC



1. α-BHC
2. β-BHC
3. δ-BHC
4. γ-BHC (lindane)
5. Heptachlor
6. Aldrin
7. Heptachlor epoxide
8. Endosulfan I
9. 4,4'-DDE
10. Dieldrin
11. Endrin
12. 4,4'-DDD
13. Endosulfan II
14. Endrin aldehyde
15. 4,4'-DDT
16. Endosulfan sulfate

Nitrogen/Phosphorus Containing Pesticides, EPA Method 507

Column: **HP-5ms**
19091S-433
30 m x 0.25 mm, 0.25 µm

Carrier: Helium, 30 cm/s (13.6 psi) pressure program

Oven: 80-178 °C at 30 °C/min
178 °C for 4 min
178-205 °C at 2 °C/min
205-310 °C at 30 °C/min
310 °C for 4 min

Injection: Splitless, 260 °C
1 min purge delay

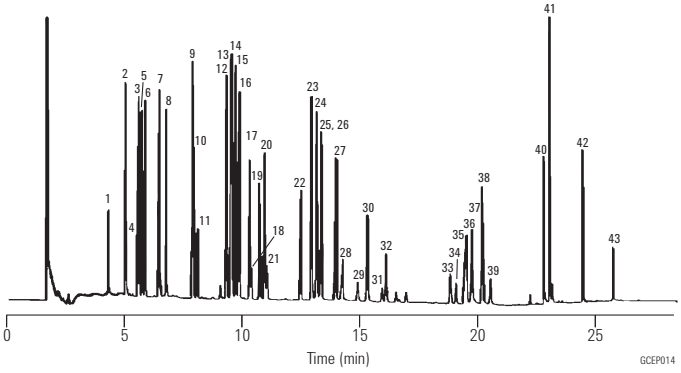
Detector: NPD, 290 °C
Helium makeup gas at 30 mL/min

Suggested Supplies

Septum: 11 mm Advanced Green septa, 5183-4759

Liner: Direct connect, single taper, deactivated, 4 mm id, G1544-80730

Syringe: 10 µL tapered, FN 23-26s/42/HP, 5181-1267



1. Dichlorvos
2. EPTC
3. Butylate
4. Mevinphos
5. Vernolate
6. Pebulate
7. Tebuthiuron
8. Molinate
9. Ethoprop
10. Cycloate
11. Chlorpropham
12. Atraton
13. Simazine
14. Prometon
15. Atrazine
16. Propazine
17. Terbufos
18. Pronamide
19. Diazinon
20. Disulfoton
21. Terbacil
22. Metribuzin
23. Simetryn
24. Alachlor
25. Ametryn
26. Prometryn
27. Terbutryn
28. Bromacil
29. Metolachlor
30. Triadimefon
31. MGK-264
32. Diphenamid
33. Stirifos
34. Butachlor
35. Fenamiphos
36. Napropamide
37. Tricyclazole
38. Merphos
39. Carboxin
40. Norflurazon
41. Hexazinone
42. Fenarimol
43. Fluridone

Herbicides I

Column: **DB-XLB**
122-1232
30 m x 0.25 mm, 0.25 µm

Carrier: Helium at 32 cm/s, measured at 50 °C

Oven: 50 °C for 1 min
50-180 °C at 10 °C/min
180-230 °C at 5 °C/min
230-320 °C at 10 °C/min
320 °C for 2 min

Injection: Splitless, 250 °C
30 s purge activation time

Detector: MSD, 300 °C transfer line
Full scan 50-400

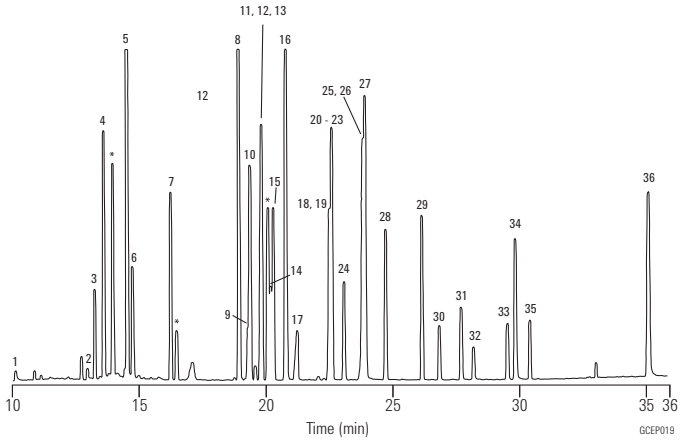
Sample: 2 µL x 10-50 ng/µL solution
in acetone

Suggested Supplies

Septum: 11 mm Advanced Green septa, 5183-4759

Liner: Splitless, single taper, deactivated, 4 mm id, 5181-3316

Syringe: 10 µL tapered, FN 23-26s/42/HP, 5181-1267



1. Monuron
2. Diuron
3. EPTC
4. Dichlobenil
5. Vernolate
6. Pebulate
7. Molinate
8. Sulfallate
9. Atraton
10. Prometon
11. Atrazine
12. Propazine
13. Simazine
14. Terbuthylazine
15. Pronamide
16. Secbumeton
17. Terbacil
18. Alachlor
19. Propanil
20. Ametryn
21. Prometryn
22. Simetryn
23. Metribuzin
24. Terbutryn
25. Metolachlor
26. Bromacil
27. Dacthal
28. Diphenamid
29. Butachlor
30. Napropamide
31. Carboxin
32. Tricyclazole
33. Norflurazon
34. Hexazinone
35. Difolatan
36. Fluridone

* Impurity

Herbicides II

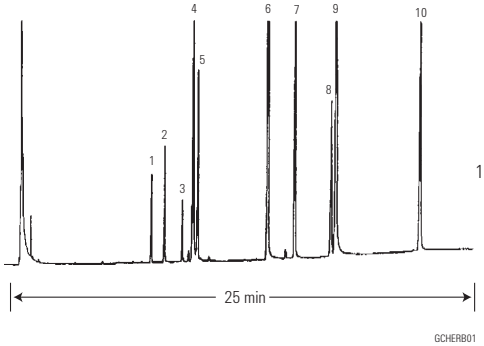
Column: **DB-210**
122-0232
30 m x 0.25 mm, 0.25 µm

Carrier: Helium at 35 cm/s

Oven: 140-215 °C at 3 °C/min

Injection: Split 1:50, 1 µL

Detector: ECD, 300 °C
Nitrogen makeup gas at 30 mL/min



1. Phorate
2. Ethoprop
3. Terbufos
4. Atrazine
5. Fonofos
6. Propachlor
7. Chlorpyrifos
8. Alachlor
9. Metolachlor
10. Cyanazine

C_1 and C_2 Halocarbons (Freons)

Column: **GS-GasPro**
113-4362
60 m x 0.32 mm

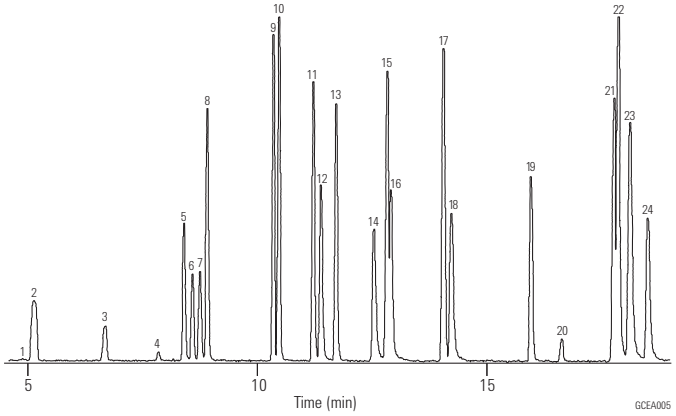
Carrier: Helium at 35 cm/s, constant velocity

Oven: 40 °C for 2 min,
40-120 °C at 10 °C/min
120 °C for 3 min
120-200 °C at 10 °C/min

Injection: Splitless, 250 °C
0.20 min purge activation time

Detector: MSD, 280 °C,
Full scan 45-180 amu

Sample: 1.0 µL of 100 ppm mixture
of AccuStandard M-REF &
M-REF-X in methanol



Suggested Supplies

Septum: 11 mm Advanced Green septa, 5183-4759

Liner: Splitless, single taper, deactivated, 4 mm id, 5181-3316

Seal: Gold plated seal, 18740-20885

Syringe: 10 µL tapered, FN 23-26s/42/HP, 5181-1267

		Freon #
1.	Chlorotrifluoromethane*	13
2.	Trifluoromethane	23
3.	Bromotrifluoromethane	13B1
4.	Chloropentafluoroethane	115
5.	Pentafluoroethane	125
6.	1,1,1-Trifluoroethane	143a
7.	Dichlorodifluoromethane	12
8.	Chlorodifluoromethane	22
9.	1,1,1,2-Tetrafluoroethane	134a
10.	Chloromethane	40
11.	1,1,2,2-Tetrafluoroethane	134
12.	Bromochlorodifluoromethane	12B1
13.	1,1-Difluoroethane	152a
14.	1,2-Dichloro-1,1,2,2-tetrafluoroethane	114
15.	2-Chloro-1,1,1,2-tetrafluoroethane	124
16.	1-Chloro-1,1-difluoroethane	142b
17.	Dichlorofluoromethane	21
18.	Trichlorofluoromethane	11
19.	Chloroethane	160
20.	Dichloromethane	30
21.	1,1-Dichloro-1-fluoroethane	141b
22.	2,2-Dichloro-1,1,1-trifluoroethane	123
23.	1,1,2-Trichloro-1,2,2-trifluoroethane	113
24.	1,2-Dibromo-1,1,2,2-tetrafluoroethane	114B2

*Peak not shown

Nitrogen Containing Herbicides (EPA Method 507)

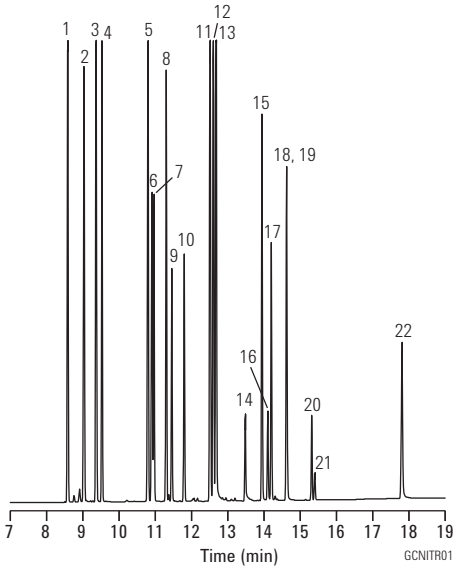
Column: **DB-35**
125-1937
30 m x 0.53 mm, 0.50 µm

Carrier: Helium at 38 cm/s (5 mL/min),
measured at 150 °C

Oven: 60 °C for 1 min
60-290 °C at 15 °C/min
290 °C for 5 min

Injection: Megabore direct, 290 °C, 1 µL of 3 ng/µL standard

Detector: NPD, 290 °C



1. Eptam
2. Sutan
3. Vernam
4. Tillam
5. Ordram
6. Treflan
7. Balan
8. Ro-Neet
9. Propachlor
10. Tolban
11. Propazine
12. Atrazine
13. Simazine
14. Terbacil
15. Sencor
16. Dual
17. Paarlan
18. Prowl
19. Bromacil
20. Oxadiazon
21. GOAL
22. Hexazinone

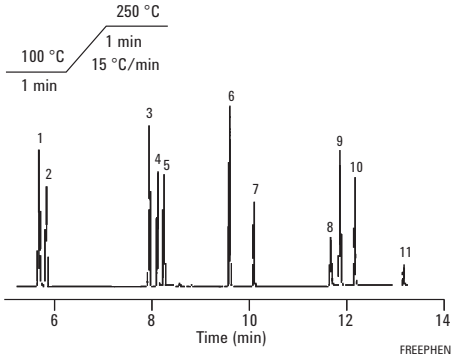
Free Phenols

Column: **HP-50+**
19091L-433
30 m x 0.25 mm, 0.25 µm

Carrier: Hydrogen, constant flow 45 cm/s

Injection: Split, 100:1

Detector: FID, 300 °C



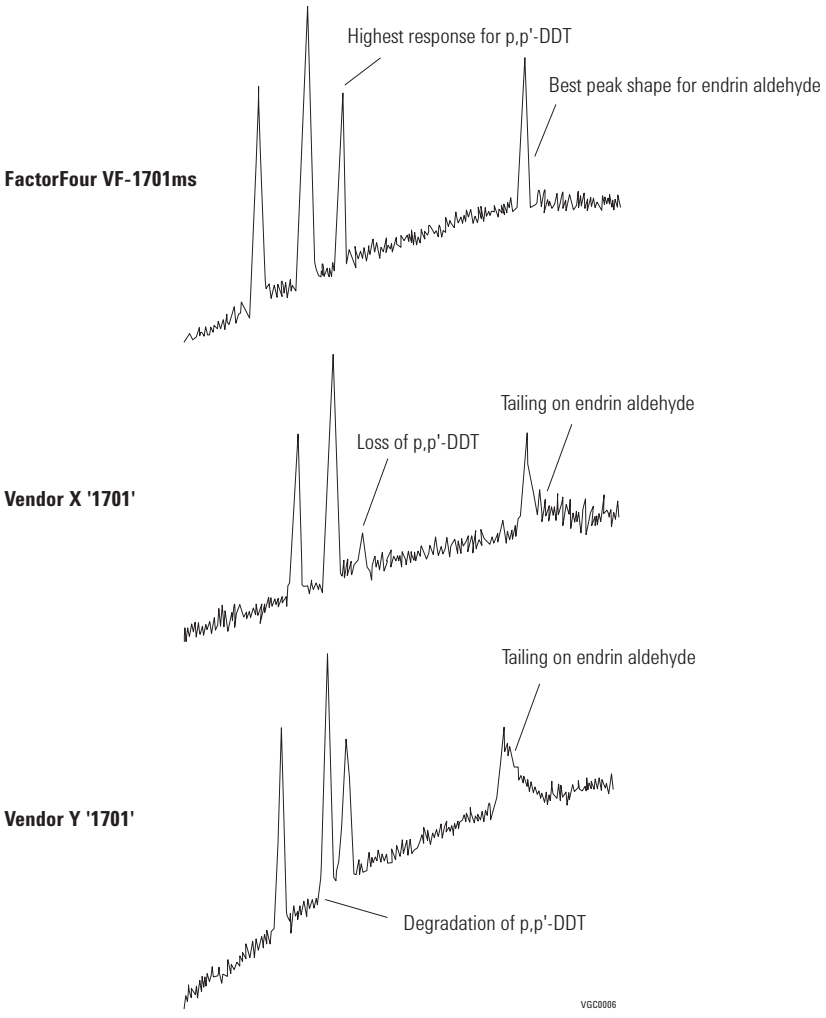
1. Phenol
2. 2-Chlorophenol
3. 2,4-Dimethylphenol
4. 2-Nitrophenol
5. 2,4-Dichlorophenol
6. 4-Chloro-3-methylphenol
7. 2,4,6-Trichlorophenol
8. 2,4-Dinitrophenol
9. 4-Nitrophenol
10. 2-Methyl-4,6-dinitrophenol
11. Pentachlorophenol

EPA 625 Halogenated Pesticides on "1701" Type Phases

Column: **VF-1701 Pesticides**
CP9070
30 m x 0.25 mm, 0.25 µm

Oven: 150 °C, 5 °C/min to 275 °C

Injection: Split: T=275 °C
ECD: T=275 °C, 2 pg



Organochlorine Pesticides to EPA 625 via GC/MS

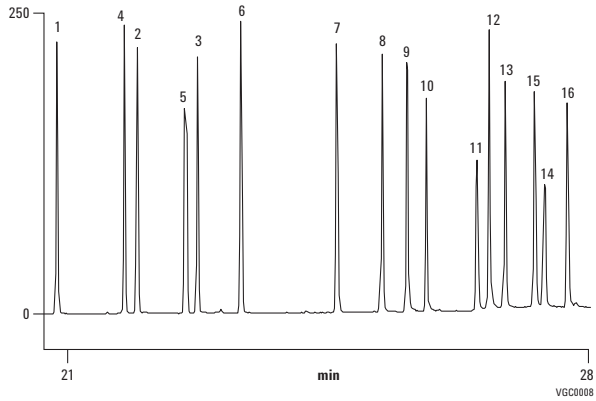
Column: **VF-35ms**
CP8877
30 m x 0.25 mm, 0.25 µm

Carrier: Helium, approx. 1.0 mL/min, 60 kPa

Oven: 45 °C + 10 °C/min to 325 °C

Injection: Split/splitless, in split mode, 1:100

Detector: Ion Trap MS



1. α-BHC
2. β-BHC
3. δ-BHC
4. γ-BHC (lindane)
5. Heptachlor
6. Aldrin
7. Heptachlor epoxide
8. Endosulfan I
9. 4,4'-DDE
10. Dieldrin
11. Endrin
12. 4,4'-DDD
13. Endosulfan II
14. Endrin aldehyde
15. 4,4'-DDT
16. Endosulfan sulfate

Organochlorine Pesticides I EPA Method 8081A

Column: **DB-35ms**
122-3832
30 m x 0.25 mm, 0.25 µm

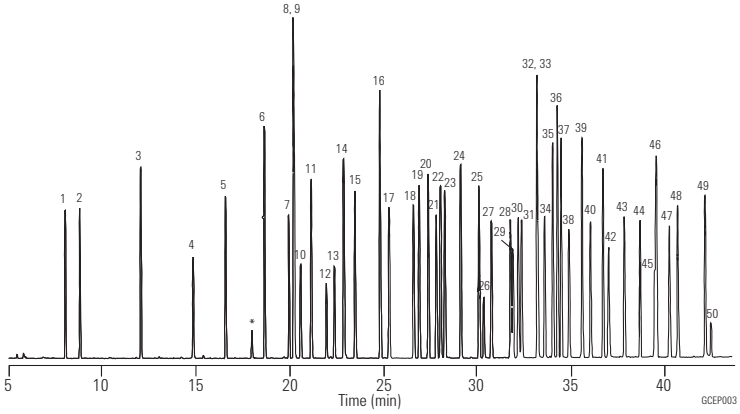
Carrier: Helium at 35 cm/s, measured at 50 °C

Oven: 50 °C for 1 min
50-100 °C at 25 °C/min
100-300 °C at 5 °C/min
300 °C for 5 min

Injection: Splitless, 250 °C
30 s purge activation time

Detector: MSD, 300 °C transfer line
Full scan at m/z 50-500

Sample: 1 µL of 35 µg/mL composite 8081A standards, AccuStandard Inc.



Standards used were a composite of individual solutions supplied courtesy of AccuStandard Inc., 25 Science Park, New Haven, CT 06511, 800-442-5290.

1. 1,2-Dibromo-3-chloropropane
2. 4-Chloro-3-nitrobenzotrifluoride (SS)
3. Hexachloropentadiene
4. 1-Bromo-2-nitrobenzene (IS)
5. Terrazole
6. Chloroneb
7. Trifluralin
8. 2-Bromobiphenyl (SS)
9. Tetrachloro m-xylene (SS)
10. α, α-Dibromo-m-xylene
11. Propachlor
12. Di-allate A
13. Di-allate B
14. Hexachlorobenzene
15. α-BHC
16. Pentachloronitrobenzene (IS)
17. γ-BHC
18. β-BHC
19. Heptachlor
20. Alachlor
21. δ-BHC
22. Chlorothalonil
23. Aldrin
24. Dacthal
25. Isodrin
26. Kelthane
27. Heptachlor epoxide
28. γ-Chlordane
29. trans-Nonachlor
30. α-Chlordane
31. Endosulfan I
32. Captan
33. p,p'-DDE
34. Dieldrin
35. Chlorobenzilate
36. Perthane
37. Chloropropylate
38. Endrin
39. p,p'-DDD
40. Endosulfan II
41. p,p'-DDT
42. Endrin aldehyde
43. Endosulfan sulfate
44. Dibutyl chlorendate (SS)
45. Captafol
46. Methoxychlor
47. Endrin ketone
48. Mirex
49. cis-Permethrin
50. trans-Permethrin

* Breakdown Products
SS - Surrogate Standard
IS - Internal Standard

Suggested Supplies

Septum: 11 mm Advanced Green septa, 5183-4759

Liner: Splitless, single taper, deactivated, 4 mm id, 5181-3316

Syringe: 10 µL tapered, FN 23-26s/42/HP, 5181-1267

Organochlorine Pesticides II EPA Method 8081A

Column: **DB-5ms**
122-5532
30 m x 0.25 mm, 0.25 µm

Carrier: Helium at 35 cm/s, measured at 50 °C

Oven: 50 °C for 1 min
50-100 °C at 25 °C/min
100-300 °C at 5 °C/min
300 °C for 5 min

Injection: Splitless, 250 °C
30 s purge activation time

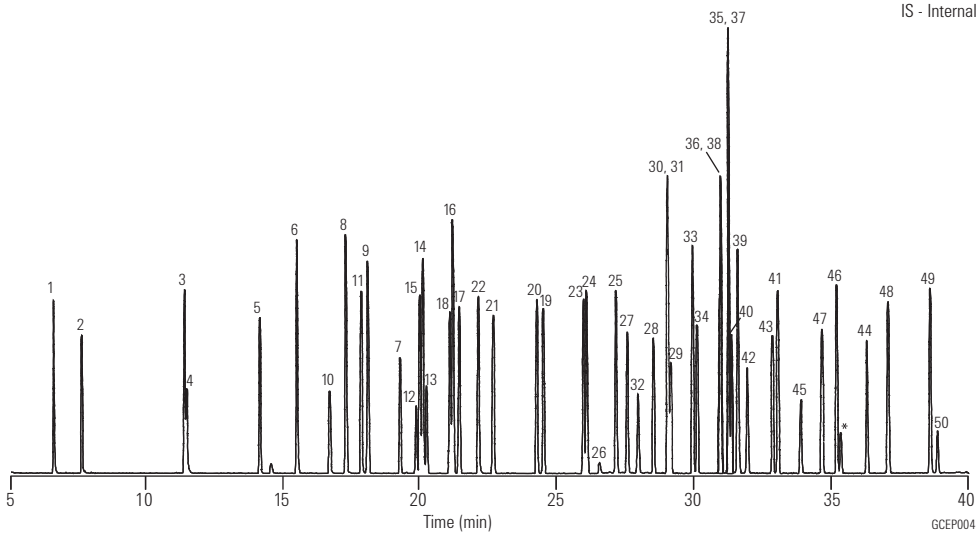
Detector: MSD, 300 °C transfer line
Full scan at m/z 50-500

Sample: 1 µL of 35 µg/mL composite 8081A standards, AccuStandard Inc.

Standards used were a composite of individual solutions supplied courtesy of AccuStandard Inc., 25 Science Park, New Haven, CT 06511, 800-442-5290.

1. 1,2-Dibromo-3-chloropropane
2. 4-Chloro-3-nitrobenzotrifluoride (SS)
3. Hexachloropentadiene
4. 1-Bromo-2-nitrobenzene (IS)
5. Terrazole
6. Chloroneb
7. Trifluralin
8. 2-Bromobiphenyl (SS)
9. Tetrachloro m-xylene (SS)
10. α, α-Dibromo-m-xylene
11. Propachlor
12. Di-allate A
13. Di-allate B
14. Hexachlorobenzene
15. α-BHC
16. Pentachloronitrobenzene (IS)
17. γ-BHC
18. β-BHC
19. Heptachlor
20. Alachlor
21. δ-BHC
22. Chlorothalonil
23. Aldrin
24. Dacthal
25. Isodrin
26. Kelthane
27. Heptachlor epoxide
28. γ-Chlordane
29. trans-Nonachlor
30. α-Chlordane
31. Endosulfan I
32. Captan
33. p,p'-DDE
34. Dieldrin
35. Chlorobenzilate
36. Perthane
37. Chloropropylate
38. Endrin
39. p,p'-DDD
40. Endosulfan II
41. p,p'-DDT
42. Endrin aldehyde
43. Endosulfan sulfate
44. Dibutyl chlorendate (SS)
45. Captafol
46. Methoxychlor
47. Endrin ketone
48. Mirex
49. cis-Permethrin
50. trans-Permethrin

* Breakdown Products
SS - Surrogate Standard
IS - Internal Standard

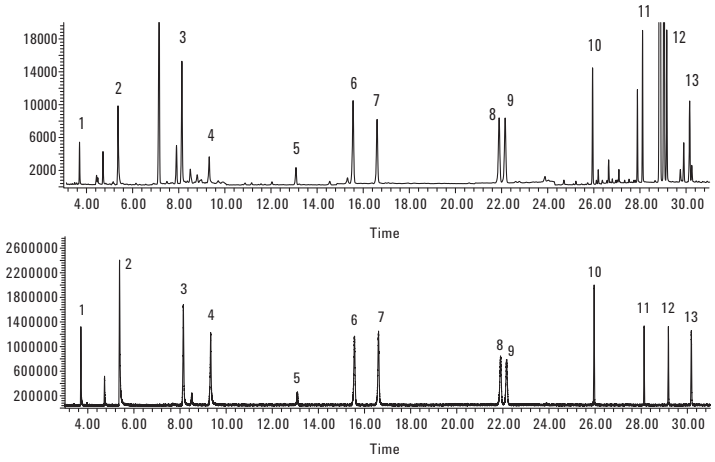


Organophosphorus Pesticides in Apple Matrix

Column: **DB-35ms Ultra Inert**
121-3822UI
20 m x 0.18 mm, 0.18 µm

Instrument:	Agilent 7890 GC/Agilent 5975C Series GC/MSD
Sampler:	Agilent 7683B automatic liquid sampler, 5.0 µL syringe (p/n 5181-1273)
CFT Device:	Purged 2-way splitter (p/n G3180B) Split Ratio MSD:FPD = 3:1
MSD Restrictor:	1.2 m x 0.15 mm id deactivated fused silica tubing
FPD Restrictor:	1.4 m x 0.15 mm id deactivated fused silica tubing
PCM 1:	3.8 psi constant pressure
Inlet:	1 µL splitless; 250 °C, purge flow 60 mL/min at 0.25 min, gas saver on at 2 min 20 mL/min
Carrier:	Helium, constant pressure 43.5 psi at 95 °C
Oven:	95 °C (1.3 min), 15 °C/min to 125 °C, 5 °C/min to 165 °C, 2.5 °C/min to 195 °C, 20 °C/min to 280 °C (3.75 min)
Postrun Backflush:	5 min at 280 °C, PCM 1 pressure 70 psi during backflush, 2 psi inlet pressure during backflush
Detector:	310 °C transfer line, 310 °C source, 150 °C quad

1. Oxydemeton-methyl
2. Methamidophos
3. Mevinphos
4. Acephate
5. Naled
6. Diazinon
7. Dimethoate
8. Chlorpyrifos
9. Malathion
10. Methidathion
11. TPP (surrogate std)
12. Phosmet



MSD (SIM): 600 ng/mL

FPD (P): 200 ng/mL

GC/MS-SIM and FPD chromatograms of a matrix matched organophosphorus pesticides standard analyzed on an Agilent J&W DB-35ms UI column. The effluent spilt ratio is MSD:FPD = 3:1.

Environmental Applications, Semivolatiles

Agilent's Ultra Inert Test Probe Mixture

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

Carrier: Hydrogen, constant pressure, 38 cm/s

Oven: 65 °C isothermal

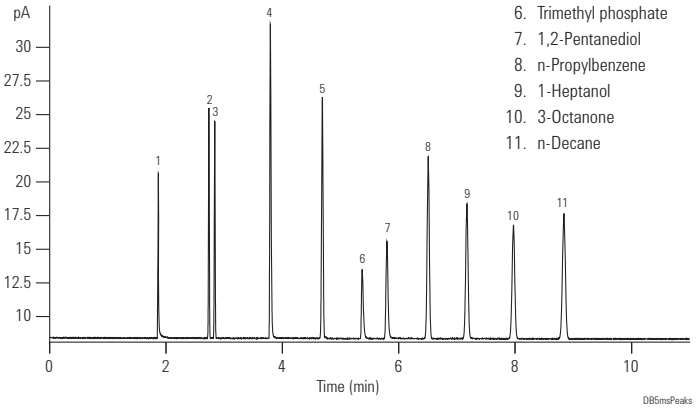
Sampler: Agilent 7683B, 0.5 µL syringe
(p/n 5188-5246), 0.02 µL split injection

Injection: Split/splitless, 250 °C, 1.4 mL/min; split column flow 900 mL/min; gas saver flow 75 mL/min at 2.0 min

Detector: FID at 325 °C; 450 mL/min air, 40 mL/min hydrogen, 45 mL/min nitrogen makeup

A properly deactivated DB-5ms Ultra Inert column delivers symmetrical peak shapes, along with increased peak heights, which allow for accurate integration and detection of trace analytes.

1. 1-Propionic acid
2. 1-Octene
3. n-Octane
4. 4-Picoline
5. n-Nonane
6. Trimethyl phosphate
7. 1,2-Pentanediol
8. n-Propylbenzene
9. 1-Heptanol
10. 3-Octanone
11. n-Decane



Trace Level Polycyclic Aromatic Hydrocarbon (PAH) Analyses

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

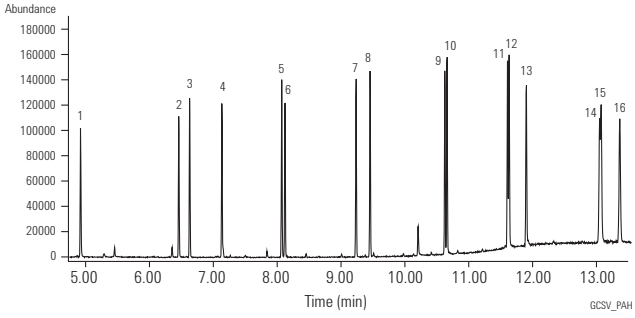
Carrier: Helium constant flow 30 cm/s

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)

Injection: Split/splitless, 260 °C, 53.7 mL/min total flow, purge flow 50 mL/min on at 0.5 min, gas saver flow 80 mL/min on at 3.0 min

Detector: MSD source at 300 °C
Quadrupole at 180 °C
Transfer line at 290 °C
Scan range 50-550 amu

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



Tetrachlorodibenzo-p-furans

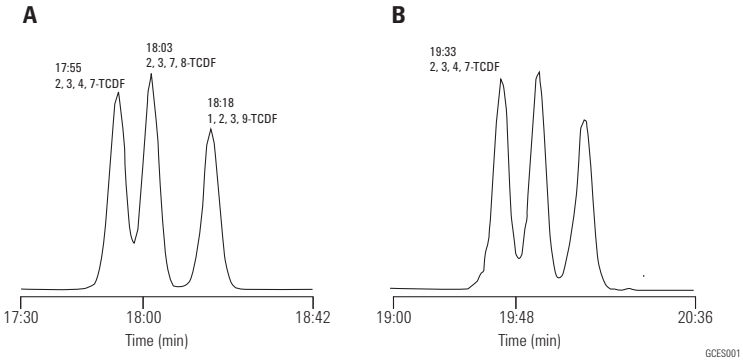
Column A: **DB-225**
122-2232
30 m x 0.25 mm, 0.25 µm

Column B: **DB-225ms**
122-2932
30 m x 0.25 mm, 0.25 µm

Carrier: Helium at 12 mL/min

Oven: 160-250 °C at 7 °C/min
250 °C until compounds elute

Injection: Splitless, 240 °C



Note the separation between 2,3,7,8-TCDF and 2,3,4,7-TCDF on DB-225 is also easily achievable (and actually a little better) on Agilent J&W DB-225ms.

Congeners in DIN Method PCBs

Column: **DB-XLB**
122-1236
30 m x 0.25 mm, 0.50 µm

Carrier: Helium at 34.2 cm/s, measured at 150 °C

Oven: 100 °C for 1 min
100-320 °C at 5.6 °C/min

Injection: Hot on-column, 250 °C
Split flow 100 mL/min

Detector: MSD, 300 °C transfer line
SIM of 221.9, 255.9,
291.9, 325.8, 359.8,
395.8, 429.7, 463.7

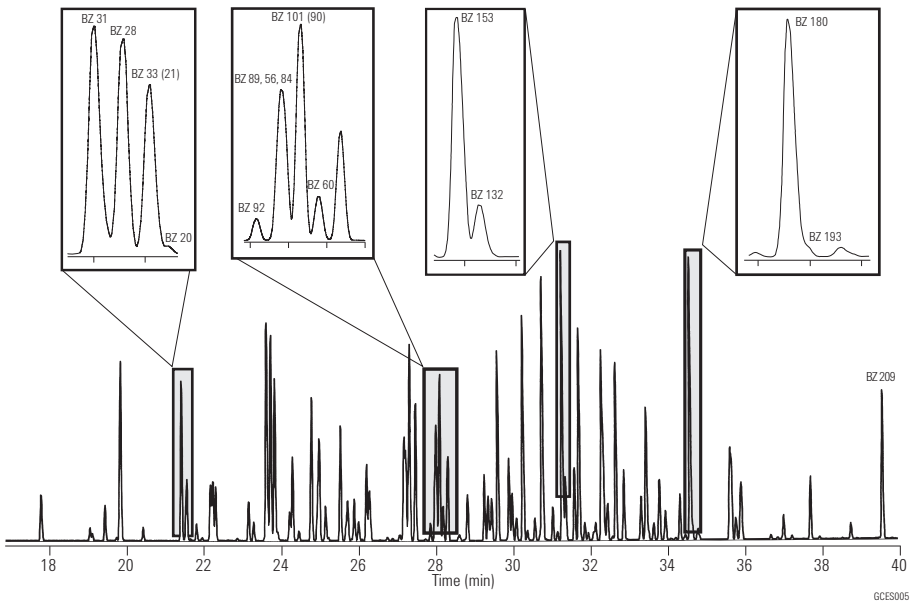
Sample: 2 µL dilute Aroclor mixture

Suggested Supplies

Septum: 11 mm Advanced Green septa, 5183-4759

Liner: Direct connect, single taper, deactivated, 4 mm id, G1544-80730

Syringe: 10 µL tapered, FN 23-26s/42/HP, 5181-1267



Extended Temperature Program Resolving Congeners 52 and 138

Column: **DB-XLB**
122-1236
30 m x 0.25 mm, 0.50 µm

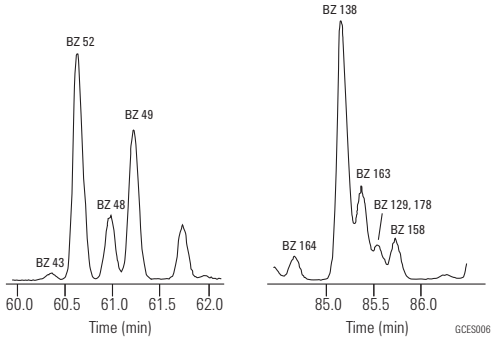
Carrier: Helium at 34.2 cm/s, measured at 150 °C

Oven: 100 °C for 1 min
100-275 °C at 1.6 °C/min

Injection: Hot on-column, 250 °C
Split flow 100 mL/min

Detector: MSD, 300 °C transfer line
SIM of 221.9, 255.9, 291.9, 325.8, 359.8, 395.8, 429.7, 463.7

Sample: 2 µL dilute Aroclor mixture



PCBs by EPA Method 8082

Column: **DB-35ms**
123-3832
30 m x 0.32 mm, 0.25 µm

Column: **DB-XLB**
123-1236
30 m x 0.32 mm, 0.50 µm

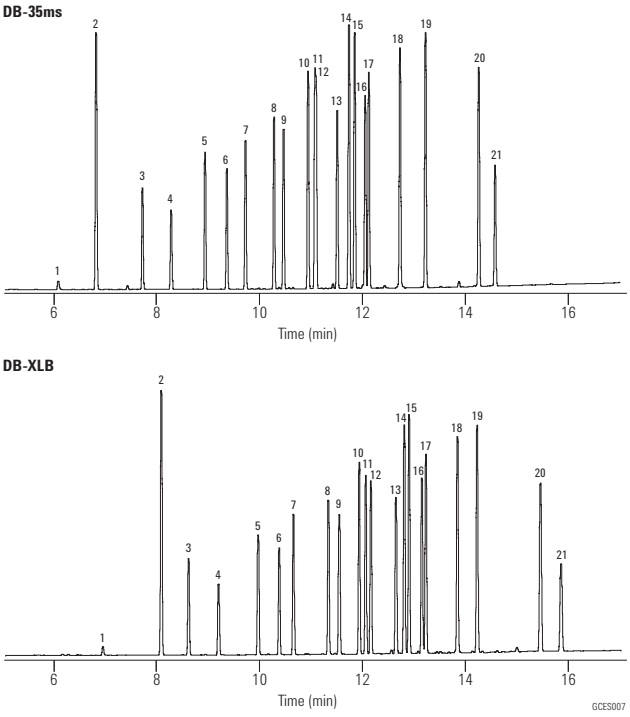
Carrier: Helium at 45 cm/s
(EPC in constant flow mode)

Oven: 110 °C for 0.5 min
110-320 °C at 15 °C/min
320 °C for 5 min

Injection: Splitless, 250 °C
30 s purge activation time

Detector: µECD, 350 °C
Nitrogen makeup gas
(column + makeup flow = 30 mL/min constant flow)

Sample: 50 pg per component



1. IUPAC 1
2. Tetrachloro-m-xylene (IS/SS)
3. IUPAC 5
4. IUPAC 18
5. IUPAC 31
6. IUPAC 52
7. IUPAC 44
8. IUPAC 66
9. IUPAC 101
10. IUPAC 87
11. IUPAC 110
12. IUPAC 151
13. IUPAC 153
14. IUPAC 141
15. IUPAC 137
16. IUPAC 187
17. IUPAC 183
18. IUPAC 180
19. IUPAC 170
20. IUPAC 206
21. Decachlorobiphenyl (IS/SS)

IS/SS - Internal Standard/ Surrogate Standard

Suggested Supplies

Septum: 11 mm Advanced Green septa, 5183-4759

Liner: Splitless, single taper, deactivated, 4 mm id, 5181-3316

Syringe: 10 µL tapered, FN 23-26s/42/HP, 5181-1267

Automated Cleanup of PCB extracts from Waste Oil Using 7696A Sample Prep Workbench

Column: **DB-5ms**
122-5532
30 m x 0.25 mm, 0.25 µm

Instrument: Agilent 7000 Triple Quadrupole GC/MS system

Carrier: Helium, 1 mL/min constant flow
During backflush: 2 mL/min

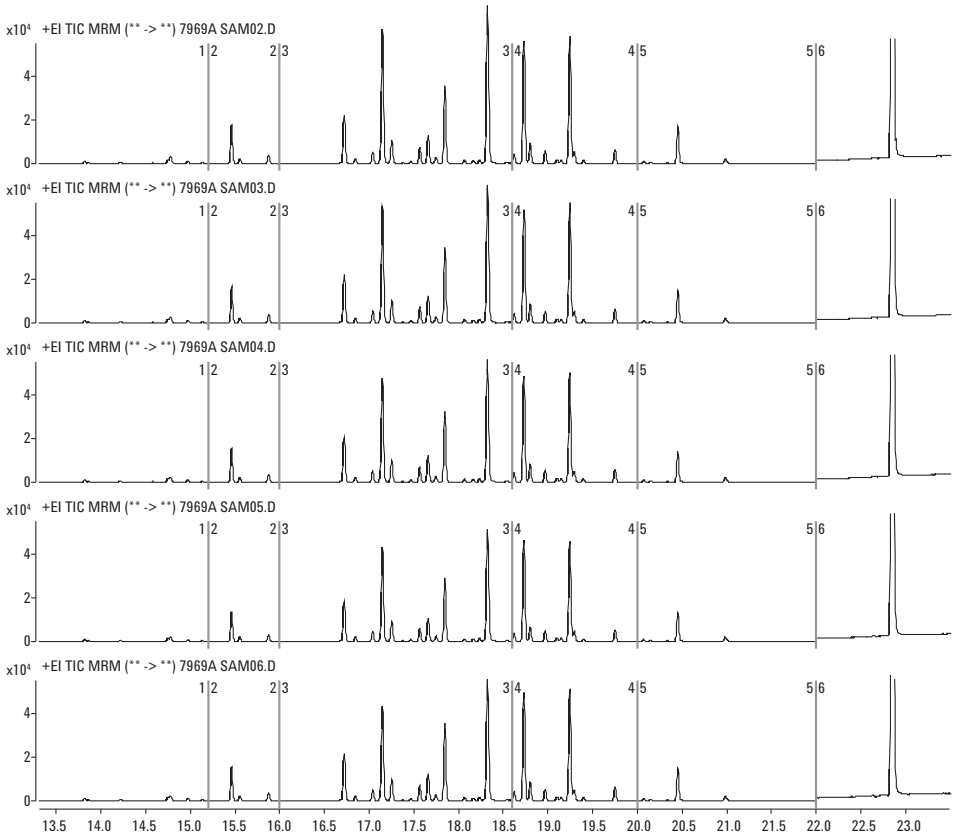
Oven: 80 °C (1 min), 10 °C/min to 305 °C, 7.5 min hold

Injection: 1 µL, pulsed splitless
QuickSwap: 28 kPa constant pressure
Backflush: Start at 23.5 min

Detector: MRM mode
CE 25 V, dwell time 100 ms per transition

Trichloro-biphenyls:	256.0 > 186.0; 258.0 > 186.0
Tetrachloro-biphenyls:	293.8 > 222.0; 291.8 > 222.0
Pentachloro-biphenyls:	325.8 > 256.0; 327.8 > 256.0
Hexachloro-biphenyls:	359.9 > 289.9; 361.9 > 289.9
Heptachloro-biphenyls:	393.8 > 323.8; 395.8 > 323.8
Octachloronapthalene (IS):	404.0 > 404.0 (CE OV)

Sample: Reference sample BCR-449, five aliquots



Counts vs. Acquisition Time (min)

Pyrethrins

Column: **DB-1**
123-1032
30 m x 0.32 mm, 0.25 µm

Carrier: Helium at 39 cm/s, measured at 150 °C

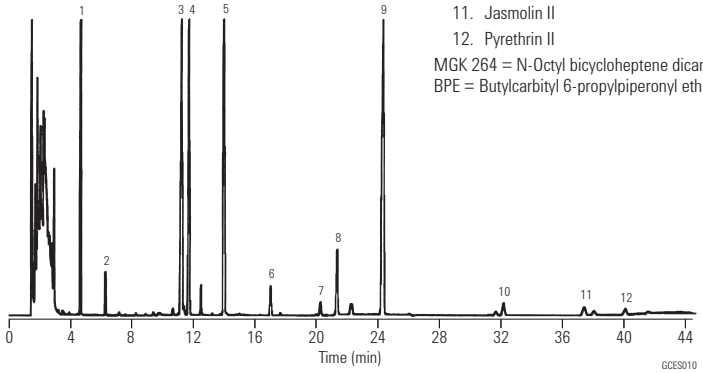
Oven: 180 °C for 11 min
180-200 °C at 10 °C/min
200 °C for 8 min
200-210 °C at 10 °C/min
210 °C for 18 min
210-245 °C at 30 °C/min
245 °C for 4 min

Injection: Split, 250 °C
Split ratio 1:20

Detector: FID, 300 °C
Helium makeup gas at 30 mL/min

Sample: 1 µL

Chromatogram courtesy of Khan Nguyen and Richard Moorman of Sandoz Agro Inc.



1. Heptadecane
2. Octadecane
3. Endo-MGK 264
4. Exo-MGK 264
5. Methoprene
6. Cinerin I
7. Jasmolin I
8. Pyrethrin I
9. BPE (PB)
10. Cinerin II
11. Jasmolin II
12. Pyrethrin II

MGK 264 = N-Octyl bicycloheptene dicarboximide
BPE = Butylcarbityl 6-propylpiperonyl ether

Organotin Compounds I

Column: **HP-1**
19091Z-012
25 m x 0.32 mm, 0.17 µm

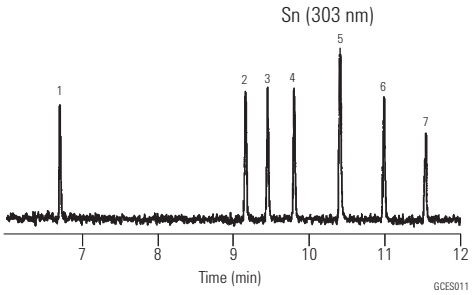
Carrier: Helium, 100 kPa

Oven: 50 °C for 1 min
50-260 °C at 15 °C/min

Injection: Splitless

Detector: AED, 330 °C

Sample: 1 µL



1. Dimethylpentyltin
2. Tetrabutyltin
3. Methyltripentyltin
4. Tributylpentyltin
5. Dibutylpentyltin
6. Butlypentyltin
7. Tetrapentyltin

Suggested Supplies

Septum: 11 mm Advanced Green septa, 5183-4759

Liner: Direct connect, single taper, deactivated, 4 mm id, G1544-80730

Syringe: 10 µL tapered, FN 23-26s/42/HP, 5181-1267

Organotin Compounds II

Column: **HP-5**
19091J-002
25 m x 0.20 mm, 0.11 µm

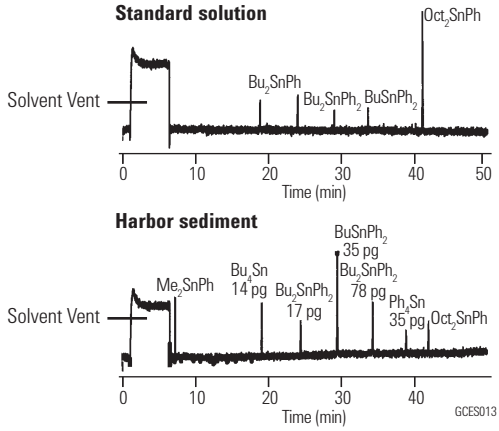
Carrier: Helium, 0.75 mL/min constant flow

Oven: 60-360 °C at 5 °C/min

Injection: Splitless, 300 °C

Detector: AED, 300 °C
Hg selective at 254 mm

Sample: 1 µL



Suggested Supplies

Septum: 11 mm Advanced Green septa, 5183-4759

Liner: Direct connect, single taper, deactivated, 4 mm id, G1544-80730

Syringe: 10 µL tapered, FN 23-26s/42/HP, 5181-1267

Semivolatile Compounds, US EPA Method 8270

Column: **HP-5ms**
19091S-133
30 m x 0.25 mm, 0.50 µm

Carrier:	Ramped flow 1.2 mL/min for 0.0 min Ramp at 99 mL/min to 2.0 mL/min 2.0 mL/min for 0.35 min Ramp at 10 mL/min to 1.2 mL/min	Injection:	Splitless, 250 °C 30 mL/min purge flow at 0.35 min
Oven:	40 °C for 1.0 min 40-100 °C at 15 °C/min 100-240 °C at 20 °C/min 240-310 °C at 10 °C/min	Detector:	5973 MSD, 310 °C transfer line Scan range 35-500 amu, 3.25 scans/s
		Sample:	1 µL of 50 ng standard

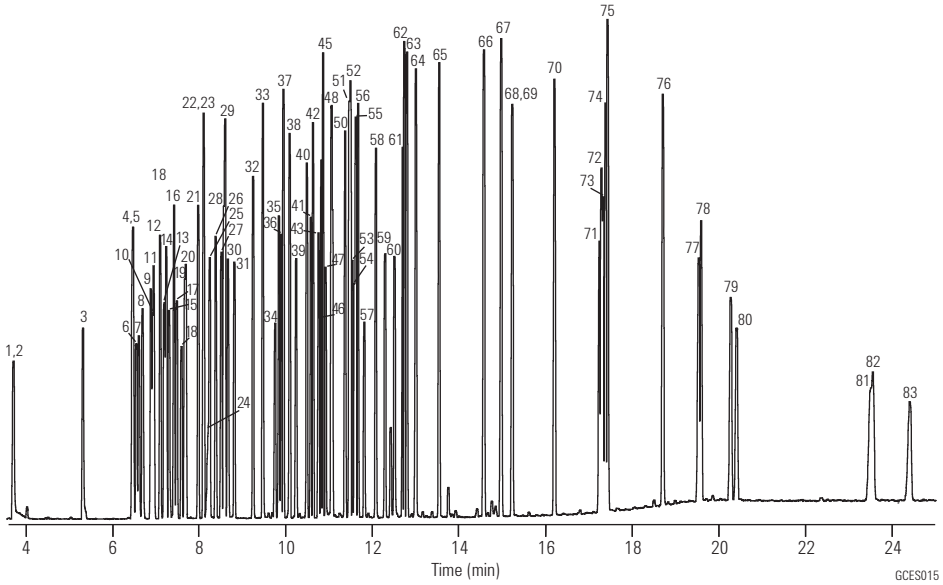
Suggested Supplies

Septum: 11 mm Advanced Green septa, 5183-4759

Liner: Splitless, single taper, deactivated, 4 mm id, 5181-3316

Syringe: 10 µL tapered, FN 23-26s/42/HP, 5181-1267

1. n-Nitrosodimethylamine
2. Pyridine
3. 2-Fluorophenol
4. Phenol-d5
5. Phenol
6. Aniline
7. Bis(2-chloroethyl) ether
8. 2-Chlorophenol
9. 1,3-Dichlorobenzene
10. 1,4-Dichlorobenzene-d4
11. 1,4-Dichlorobenzene
12. Benzyl alcohol
13. 1,2-Dichlorobenzene
14. 2-Methylphenol
15. Bis(2-chloroisopropyl) ether
16. 4-Methylphenol
17. n-Nitroso-di-n-propylamine
18. Hexachloroethane
19. Nitrobenzene-d5
20. Nitrobenzene
21. Isophorone
22. 2-Nitrophenol
23. 2,4-Dimethylphenol
24. Benzoic acid
25. Bis(2-chloroethoxy) methane
26. 2,4-Dichlorophenol
27. 1,2,4-Trichlorobenzene
28. Naphthalene-d8
29. Naphthalene
30. 4-Chloroaniline
31. Hexachlorobutadiene
32. 4-Chloro-3-methylphenol
33. 2-Methylnaphthalene
34. Hexachlorocyclopentadiene
35. 2,4,6-Trichlorophenol
36. 2,4,5-Trichlorophenol
37. 2-Fluorobiphenyl
38. 2-Chloronaphthalene
39. 2-Nitroaniline
40. Dimethyl phthalate
41. 2,6-Dinitrotoluene
42. Acenaphthylene
43. 3-Nitroaniline
44. Acenaphthene-d10
45. Acenaphthene
46. 2,4-Dinitrophenol
47. 4-Nitrophenol
48. Dibenzofuran
49. 2,4-Dinitrotoluene
50. Diethyl phthalate
51. 4-Chlorophenyl-phenyl ether
52. Fluorene
53. 4-Nitroaniline
54. 4,6-Dinitro-2-methylphenol
55. n-Nitrosodiphenylamine
56. Azobenzene
57. 2,4,6-Tribromophenol
58. 4-Bromophenyl-phenylether
59. Hexachlorobenzene
60. Pentachlorophenol
61. Phenanthrene-d10
62. Phenanthrene
63. Anthracene
64. Carbazole
65. Di-n-butyl phthalate
66. Fluoranthene
67. Pyrene
68. Terphenyl-d14
69. Benzidine
70. Butylbenzylphthalate
71. 3,3'-Dichlorobenzidine
72. Benzo[a]anthracene
73. Chrysene-d12
74. Chrysene
75. Bis(2-ethylhexyl) phthalate
76. Di-n-octylphthalate
77. Benzo[b]fluoranthene
78. Benzo[k]fluoranthene
79. Benzo[a]pyrene
80. Perylene-d12
81. Indeno[1,2,3-cd]pyrene
82. Dibenz[a,h]anthracene
83. Benzo[g,h,i]perylene



A variety of HP-5ms and DB-5ms columns can be used for 8270 and similar semivolatiles applications. The column shown above was chosen to maximize inertness and robustness to residues with a thicker 0.5 µm film, but the price paid is a slightly longer run time.
An HP-5ms, 30 m x 0.25 mm id, 0.25 µm, p/n 19091S-433 would give shorter run times, with slightly less inertness and robustness.
A DB-5ms, 30 m x 0.25 mm id, 0.25 µm, p/n 122-5532, would give slightly less inertness, but offer better resolution of PAHs such as benzo[b]fluoranthene and benzo[k]fluoranthene.
A DB-5ms, 20 m x 0.18 mm x 0.18 µm, p/n 121-5522, can offer significantly reduced run times with a modest loss of inertness.

US EPA Method 8061 (Phthalate Esters)

Column: **DB-5ms**
121-5522
20 m x 0.18 mm, 0.18 µm

Carrier: Helium at 49 cm/s, measured at 80 °C
constant flow program

Oven: 80 °C for 0.5 min
80-160 °C at 30 °C/min
160-320 °C at 15 °C/min

Injection: Splitless, 300 °C
30 s purge activation time

Detector: MSD, 325 °C transfer line
Full scan m/z 50-400

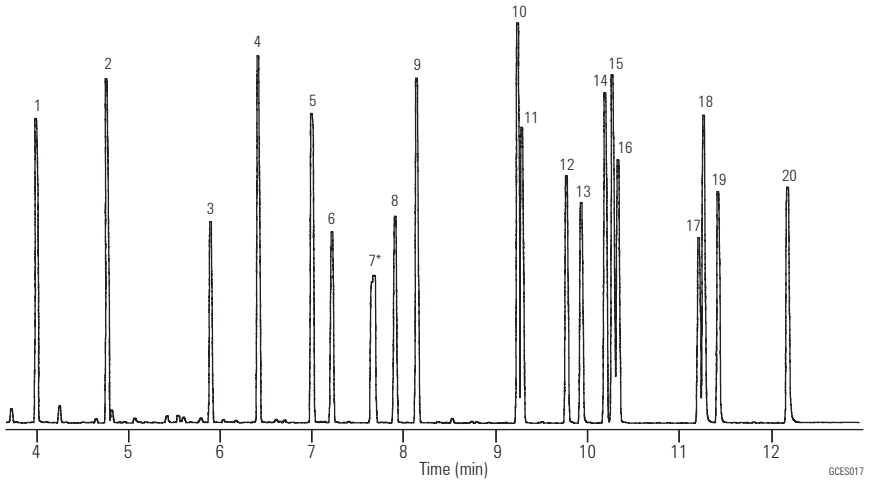
Sample: 1 µL of 20 ng/µL
Method 8061 mixture (AccuStandard) in hexane

Suggested Supplies

Septum: 11 mm Advanced Green septa, 5183-4759

Liner: Splitless, single taper, deactivated, 4 mm id, 5181-3316

Syringe: 10 µL tapered, FN 23-26s/42/HP, 5181-1267



1. Dimethyl phthalate
2. Diethyl phthalate
3. Benzyl benzoate (IS)
4. Diisobutyl phthalate
5. Di-n-butyl phthalate
6. Bis(4-methoxyethyl) phthalate
7. Bis(4-methyl-2-pentyl) phthalate *
8. Bis(2-ethoxyethyl) phthalate
9. Diamyl phthalate
10. Dihexyl phthalate
11. Butyl benzyl phthalate
12. Hexyl 2-ethylhexyl phthalate
13. Bis(2-n-butoxyethyl) phthalate
14. Dicyclohexyl phthalate
15. Bis(2-ethylhexyl) phthalate
16. Diphenyl phthalate (SS)
17. Diphenyl isophthalate (SS)
18. Di-n-octyl phthalate
19. Dibenzyl phthalate (SS)
20. Dinonyl phthalate

* Two isomers
IS - Internal Standard
SS - Surrogate Standard

PAHs

Column: **DB-17ms**
122-4732
30 m x 0.25 mm, 0.25 µm

Carrier: Helium at: 34.1 cm/s, measured at 150 °C

Oven: 95 °C for 0.5 min
95-340 °C at 5 °C/min
340 °C for 5 min

Injection: Split, 300 °C
Split ratio 1:40

Detector: MSD, 340 °C transfer line
Scan 80-330 amu

Sample: 2 µL, PAH standard

Suggested Supplies

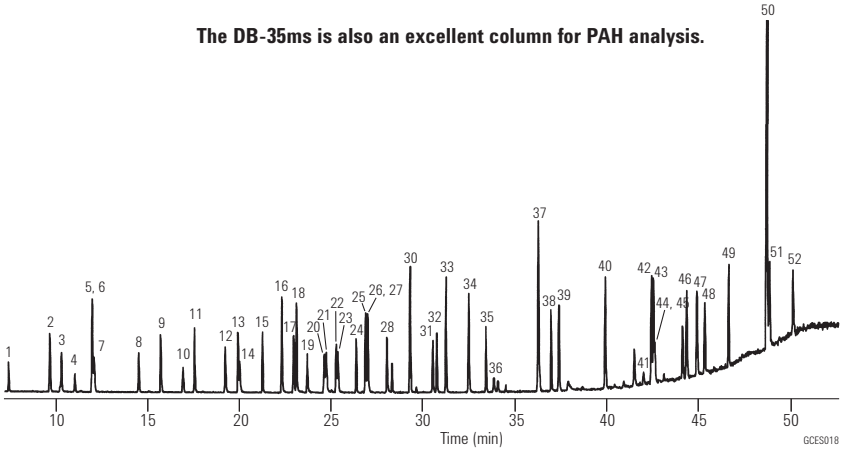
Septum: 11 mm Advanced Green septa, 5183-4759

Liner: Direct connect, single taper, deactivated, 4 mm id, G1544-80730

Syringe: 10 µL tapered, FN 23-26s/42/HP, 5181-1267

		Ions			Ions
1.	Naphthalene	128	27.	3,6-Dimethylphenanthrene	206, 191
2.	2-Methylnaphthalene	142, 141	28.	1,3-Dinitronaphthalene	126, 218
3.	1-Methylnaphthalene	142, 141	29.	1,5-Dinitronaphthalene	218, 114
4.	Azulene	128	30.	Fluoranthene	202
5.	Acenaphthene	154	31.	2,2'-Dinitrobiphenyl	198, 139
6.	Biphenyl	154	32.	Pyrene	202
7.	2,6-Dimethylnaphthalene	156, 155	33.	2-Methylfluoranthene	216, 215
8.	Acenaphthalene	152	34.	2,3-Benzofluorene	216, 215
9.	Dibenzofuran	168, 139	35.	Dodecahydrotriphenylene	240, 198
10.	Dibenzo-p-dioxin	184	36.	1-Amino-4-nitronaphthalene	188, 115
11.	Fluorene	166, 165	37.	9-Phenylanthracene	254, 253
12.	1-Nitronaphthalene	127, 173	38.	1,2-Benzanthracene	228
13.	9,10-Dihydroanthracene	179, 180	39.	Chrysene	240
14.	2-Nitronaphthalene	127, 173	40.	Benz[a]anthracene-7,12-dione	258, 202
15.	2-Nitrobiphenyl	152, 115	41.	2,7-Dinitrofluorene	256, 163
16.	Dibenzothiophene	184	42.	Benzo[b]fluoroanthene	252
17.	Phenanthrene	178	43.	Benzo[k]fluoranthene	252
18.	Anthracene	178	44.	7,12-Dimethylbenz[a]anthracene	256, 241
19.	3-Nitrobiphenyl	199, 152	45.	Benzo[e]pyrene	252
20.	4-Nitrobiphenyl	199, 152	46.	Benzo[a]pyrene	252
21.	5,6-Benzoquinoline	179	47.	Perylene	252
22.	Carbazole	167	48.	3-Methylcholanthrene	268
23.	2-Methylanthracene	192, 191	49.	9,10-Diphenylanthracene	330
24.	1,2,3,4-Tetrahydrofluoranthene	178, 206	50.	1,2,3,4-Dibenzanthracene	278
25.	2-Phenylnaphthalene	204	51.	1,2,5,6-Dibenzanthracene	278
26.	9-Methylanthracene	192, 191	52.	Benzo[g,h,i]perylene	276

The DB-35ms is also an excellent column for PAH analysis.



Phenols

Column: **DB-5ms**
122-5532
30 m x 0.25 mm, 0.25 µm

Column: **DB-XLB**
122-1232
30 m x 0.25 mm, 0.25 µm

Carrier: He at 1.2 mL/min constant flow

Oven: 40 °C for 2 min
40-100 °C at 40 °C/ min
100 °C for 0.50 min
100-140 °C at 2 °C/min
140-340 °C at 30 °C/min

Injection: Pulsed splitless, 200 °C
Pulse pressure & time: 25 psi for 1 min
Purge flow & time: 50 mL/min for 0.25 min
Gas saver flow & time: 20 mL/min for 3 min

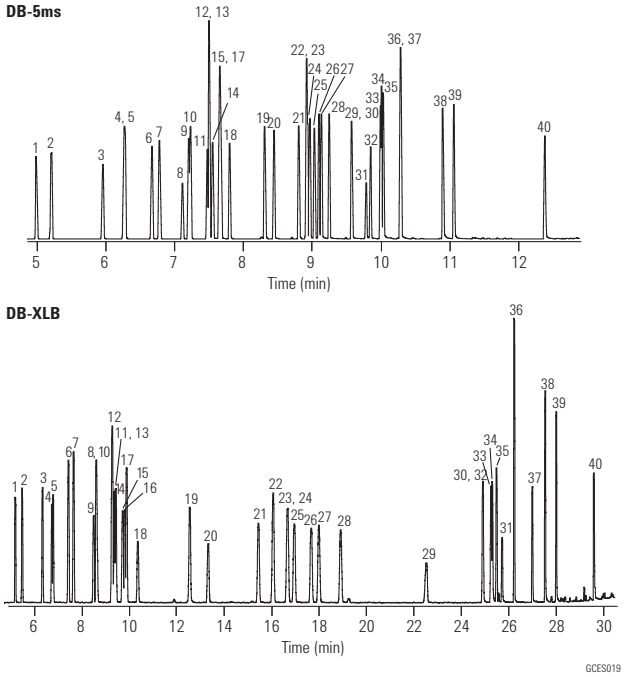
Detector: MSD, 320 °C transfer line
Quadrupole at 150 °C
Source at 230 °C

Suggested Supplies

Septum: 11 mm Advanced Green septa, 5183-4759

Liner: Direct connect, single taper, deactivated, 4 mm id, G1544-80730

Syringe: 10 µL tapered, FN 23-26s/42/HP, 5181-1267

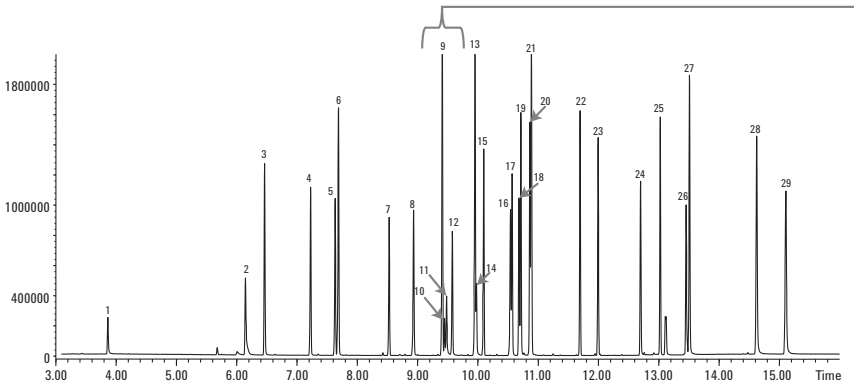


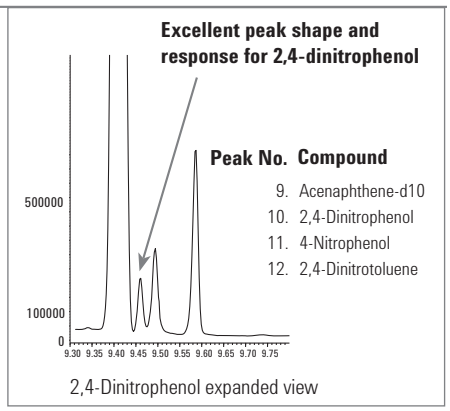
1. Phenol
2. 2-Chlorophenol
3. 2-Methylphenol
4. 4-Methylphenol
5. 3-Methylphenol
6. 2-Chloro-5-methylphenol
7. 2,6-Dimethylphenol
8. 2-Nitrophenol
9. 2,4-Dimethylphenol
10. 2,5-Dimethylphenol
11. 2,4-Dichlorophenol
12. 2,3-Dimethylphenol
13. 2,5-Dichlorophenol
14. 2,3-Dichlorophenol
15. 2-Chlorophenol
16. 4-Chlorophenol
17. 3,4-Dimethylphenol
18. 2,6-Dichlorophenol
19. 4-Chloro-2-methylphenol
20. 4-Chloro-3-methylphenol
21. 2,3,5-Trichlorophenol
22. 2,4-Dibromophenol
23. 2,4,6-Trichlorophenol
24. 2,4,5-Trichlorophenol
25. 2,3,4-Trichlorophenol
26. 3,5-Dichlorophenol
27. 2,3,6-Trichlorophenol
28. 3,4,-Dichlorophenol
29. 3-Nitrophenol
30. 2,5-Dinitrophenol
31. 2,4-Dinitrophenol
32. 4-Nitrophenol
33. 2,3,5,6-Tetrachlorophenol
34. 2,3,4,5-Tetrachlorophenol
35. 2,3,4,6-Tetrachlorophenol
36. 3,4,5-Trichlorophenol
37. 2-Methyl-4,6-dinitrophenol
38. Pentachlorophenol
39. Dinoseb
40. 2-Cyclohexyl-4,6-dinitrophenol

10 ng/µL Semivolatile Checkout Standard on a 20 m x 0.18 mm, 0.36 µm Agilent J&W DB-UI 8270D Capillary GC Column using an Ultra Inert Liner with Wool

Column:	**DB-UI 8270D 121-9723 20 m x 0.18 mm, 0.36 µm**
Inlet:	S/SL 1 µL pulsed splitless, 300 °C 44 psi pulse to 1.4 min, purge flow 50 mL/min at 1.42 min, gas saver off
Inlet liner:	Agilent Ultra Inert single taper with wool (p/n 5190-2293)
Oven:	40 °C (2.5 min), 25 °C/min to 320 °C (4.8 min)
Carrier:	Helium, constant flow 1.58 mL/min set at 40 °C
MSD:	325 °C transfer line, 300 °C source, 150 °C quad, 30-550 amu range
GC/MSD:	Agilent 7890 Series GC/5975C Series GC/MSD
Aux EPC:	2 psi with 5 mL/min bleed during run
Sampler:	Agilent 7683B, 5.0 µL syringe (p/n G4513-80206)
Backflush:	Post run 3.5 min at 75 psi Aux EPC, 2 psi inlet pressure

1. N-Nitrosodimethylamine
2. Aniline
3. 1,4-Dichlorobenzene-d4
4. Isophorone
5. 1,3-Dimethyl-2-nitrobenzene
6. Naphthalene
7. Hexachlorocyclopentadiene
8. Mevinphos
9. Acenaphthene-d10
10. 2,4-Dinitrophenol
11. 4-Nitrophenol
12. 2,4-Dinitrotoluene
13. Fluorene
14. 4,6,-Dinitro-2-methyl phenol
15. Trifluralin
16. Simazine
17. Atrazine
18. Pentachlorophenol
19. Terbufos
20. Chlorothalonil
21. Phenanthrene-d10
22. Aldrin
23. Heptachlor epoxide
24. Endrin
25. 4,4'-DDT
26. 3,3'-Dichlorobenzidine
27. Chrysene d-12
28. Benzo[b]fluoranthene
29. Perylene-d12

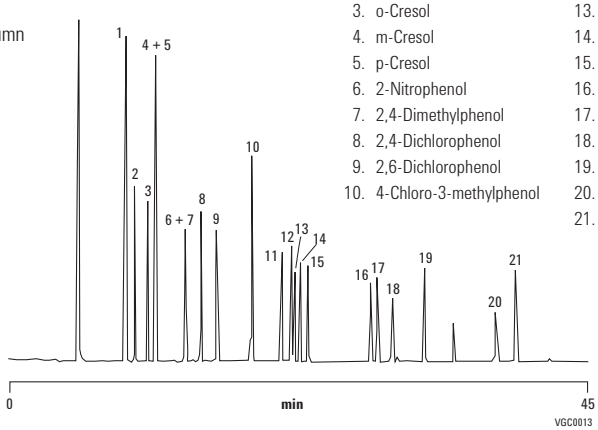




High Resolution Phenol Analysis by GC/MS

Column:	**VF-5ms CP8944 30 m x 0.25 mm, 0.25 µm**
Sample Conc:	Approx. 5-10 ng per component on-column
Carrier:	Helium, 70 kPa
Injection:	Split, 1:200, T=275 °C
Detector:	Agilent Ion Trap MS

1. Phenol
2. 2-Chlorophenol
3. o-Cresol
4. m-Cresol
5. p-Cresol
6. 2-Nitrophenol
7. 2,4-Dimethylphenol
8. 2,4-Dichlorophenol
9. 2,6-Dichlorophenol
10. 4-Chloro-3-methylphenol
11. 2,3,5-Trichlorophenol
12. 2,4,6-Trichlorophenol
13. 2,4,5-Trichlorophenol
14. 2,3,4-Trichlorophenol
15. 2,3,6-Trichlorophenol
16. 4-Nitrophenol
17. 2,4-Dinitrophenol
18. 2,3,5,6 Tetrachlorophenol
19. 2-Methyl-4,6-dinitrophenol
20. Pentachlorophenol
21. 2-sec-Butyl-4,6-dinitrophenol (dionseb)



Phenols According to EPA Method 8040

Column: **CP-Sil 8 CB**
CP7454
50 m x 0.32 mm, 0.25 µm

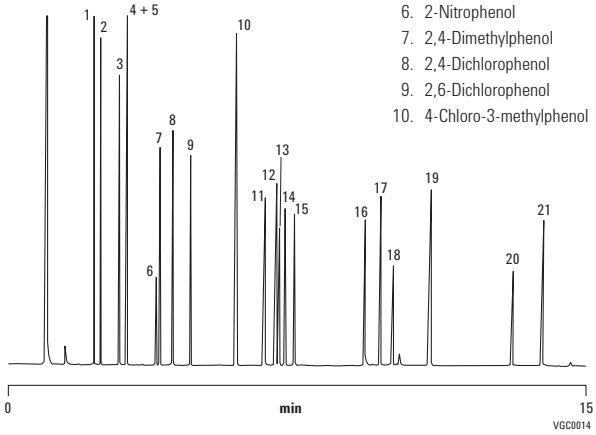
Sample Conc: 1 ppm

Oven: 80 °C to 200 °C, 8 °C/min

Carrier: H_2, 150 kPa (1.5 bar, 21 psi)

Injection: Split, 100 mL/min

Detector: FID



1. Phenol
2. 2-Chlorophenol
3. o-Cresol
4. m-Cresol
5. p-Cresol
6. 2-Nitrophenol
7. 2,4-Dimethylphenol
8. 2,4-Dichlorophenol
9. 2,6-Dichlorophenol
10. 4-Chloro-3-methylphenol
11. 2,3,5-Trichlorophenol
12. 2,4,6-Trichlorophenol
13. 2,4,5-Trichlorophenol
14. 2,3,4-Trichlorophenol
15. 2,3,6-Trichlorophenol
16. 4-Nitrophenol
17. 2,4-Dinitrophenol
18. 2,3,5,6-Tetrachlorophenol
19. 2-Methyl-4,6-dinitrophenol
20. Pentachlorophenol
21. 2-sec-Butyl-4,6-dinitrophenol (dionseb)

EPA Method 552.2

Column: **DB-35ms**
123-3832
30 m x 0.32 mm, 0.25 µm

Column: **DB-XLB**
123-1236
30 m x 0.32 mm, 0.50 µm

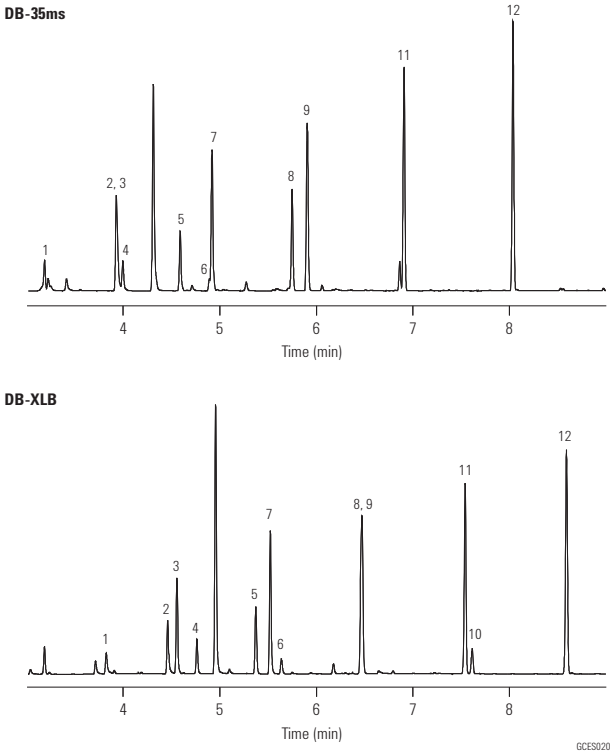
Carrier: Helium at 45 cm/s
(EPC in constant flow mode)

Oven: 40 °C for 0.5 min
40-200 °C at 15 °C/min
200 °C for 2 min

Injection: Splitless, 250 °C
30 s purge activation time

Detector: µECD, 350 °C
Nitrogen makeup gas
(column + makeup flow =
30 mL/min constant flow)

Sample: 50 pg per component



1. Chloroacetic acid
2. Bromoacetic acid
3. Dichloroacetic acid
4. Dalapon
5. Trichloroacetic acid
6. 1,2,3-Trichloropropane (IS)
7. Bromochloroacetic acid
8. Bromodichloroacetic acid
9. Dibromoacetic acid
10. 2,3-Dibromopropionic acid (SS)
11. Chlorodibromoacetic acid
12. Tribromoacetic acid

IS - Internal Standard
SS - Surrogate Standard

Suggested Supplies

Septum: 11 mm Advanced Green septa, 5183-4759

Liner: Direct connect, dual taper, deactivated, 4 mm id, G1544-80700

Syringe: 10 µL tapered, FN 23-26s/42/HP, 5181-1267

Environmental Applications, Volatiles

Extended Analyte List for EPA Method 8021 (ELCD)

Column: **DB-624**
124-1374
75 m x 0.45 mm, 2.55 µm

Column: **DB-VRX**
124-1574
75 m x 0.45 mm, 2.55 µm

Carrier: Helium at 9 mL/min, measured at 35 °C

Oven:
35 °C for 12 min
35-60 °C at 5 °C/min
60 °C for 1 min
60-200 °C at 17 °C/min
200 °C for 5 min

Sampler: Purge and Trap (O.I.A. 4560)
Trap: VoCarb 3000
Preheat: 175 °C
Desorb: 260 °C for 1 min

Injection: J&W LVI (Low Volume Injector), 150 °C

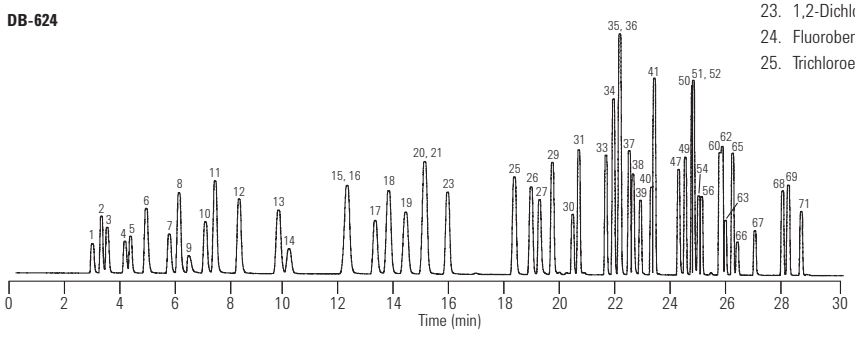
Detector: A: PID (O.I.A. 4430), 200 °C Helium makeup gas at 20 mL/min
B: ELCD (O.I.A. 4420), with NiCat reaction tube in the halogen mode, 950 °C reactor temperature

Sample: 20 ppb per component in 5 mL water

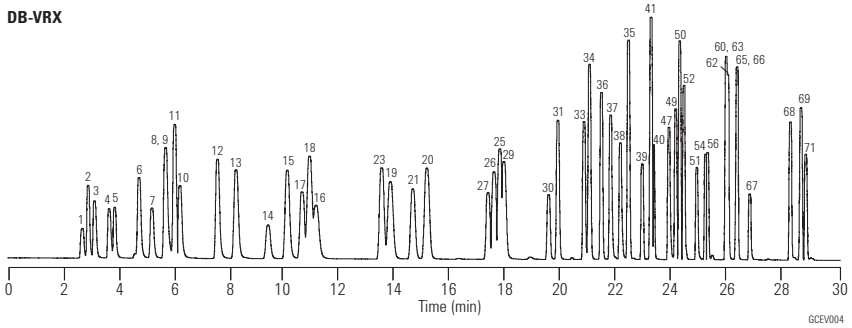
Suggested Supplies

Liner: Direct, 1.5 mm id, 18740-80200
Seal: Gold plated seal, 18740-20885
Septum: 11 mm Advanced Green septa, 5183-4759

DB-624



DB-VRX



GCEV004

1. Dichlorodifluoromethane
2. Chloromethane
3. Vinyl chloride
4. Bromomethane
5. Chloroethane
6. Trichlorofluoromethane
7. 2-Chloropropane (IS)
8. 1,1-Dichloroethene
9. Iodomethane
10. Allyl chloride
11. Methylene chloride
12. trans-1,2-Dichloroethene
13. 1,1-Dichloroethane
14. Chloroprene
15. cis-1,2-Dichloroethene
16. 2,2-Dichloropropane
17. Bromochloromethane
18. Chloroform
19. 1,1,1-Trichloroethane
20. Carbon tetrachloride
21. 1,1-Dichloropropene
22. Benzene
23. 1,2-Dichloroethane
24. Fluorobenzene (IS)
25. Trichloroethene
26. 1,2-Dichloropropane
27. Dibromomethane
28. Trifluorotoluene (IS)
29. Bromodichloromethane
30. 2-Chloroethyl vinyl ether
31. cis-1,3-Dichloropropene
32. Toluene
33. trans-1,3-Dichloropropene
34. 1,1,2-Trichloroethane
35. Tetrachloroethene
36. 1,3-Dichloropropane
37. Dibromochloromethane
38. 1,2-Dibromoethane
39. 1-Chloro-3-fluorobenzene (IS)
40. Chlorobenzene
41. 1,1,1,2-Tetrachloroethane
42. Ethylbenzene
43. m-Xlyene
44. p-Xylene
45. Styrene
46. o-Xylene
47. Bromoform
48. Isopropylbenzene
49. cis-1,4-Dichlorobutene
50. 1,1,2,2-Tetrachloroethane
51. Bromobenzene
52. 1,2,3-Trichloropropane
53. n-Propylbenzene
54. 2-Chlorotoluene
55. 1,3,5-Trimethylbenzene
56. 4-Chlorotoluene
57. tert-Butylbenzene
58. 1,2,4-Trimethylbenzene
59. sec-Butylbenzene
60. 1,3-Dichlorobenzene
61. p-Isopropyltoluene
62. 1,4-Dichlorobenzene
63. Benzyl chloride
64. n-Butylbenzene
65. 1,2-Dichlorobenzene
66. Bis(2-chloroisopropyl) ether
67. 1,2-Dibromo-3-chloropropane
68. 1,2,4-Trichlorobenzene
69. Hexachlorobutadiene
70. Naphthalene
71. 1,2,3-Trichlorobenzene

Fast VOC Analysis

Column: **DB-624**
121-1324
20 m x 0.18 mm, 1.00 µm

Carrier: Helium at 37 cm/s, (constant flow mode)

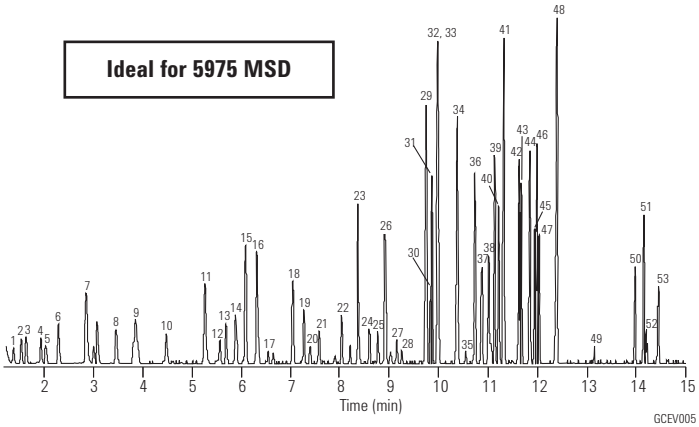
Oven: 35 °C for 4 min
35-200 °C at 15 °C/min
200 °C for 0.1 min
60-200 °C at 17 °C/min

Sampler: Purge and trap (Tekmar LSC 3000)
Purge: Helium for 11 min at 50 mL/min
Preheat: 250 °C
Desorb: 260 °C for 2 min
Line & valve: 100 °C

Detector: MSD, 250 °C transfer line
Full scan 35-260 amu
3.25 scans per s

Sample: 10 ppb per component in 25 mL water

Ideal for 5975 MSD



Suggested Supplies

Septum: 11 mm Advanced Green septa, 5183-4759
Liner: Direct, 1.5 mm id, 18740-80200
Seal: Gold plated seal, 18740-20885

1. Dichlorofluoromethane
2. Chloromethane
3. Vinyl chloride
4. Bromomethane
5. Chloroethane
6. Trichlorofluoromethane
7. 1,1-Dichloroethene
8. Methylene chloride
9. trans-1,2-Dichloroethene
10. 1,1-Dichloroethane
11. 2,2-Dichloropropane
12. Bromochloromethane
13. Chloroform
14. 1,1,1-Trichloroethane
15. Carbon tetrachloride
16. Benzene
17. Fluorobenzene
18. Trichloroethene
19. 1,2-Dichloropropane
20. Dibromomethane
21. Bromodichloromethane
22. cis-1,3-Dichloropropene
23. Toluene
24. trans-1,3-Dichloropropene
25. 1,1,2-Trichloroethane
26. Tetrachloroethene
27. Dibromochloromethane
28. 1,2-Dibromomethane
29. Chlorobenzene
30. 1,1,1,2-Tetrachloroethane
31. Ethylbenzene
32. m-Xylene
33. p-Xylene
34. o-Xylene
35. Bromoform
36. Isopropylbenzene
37. Bromofluorobenzene
38. Bromobenzene
39. n-Propylbenzene
40. 2-Chlorotoluene
41. 1,3,5-Trimethylbenzene
42. tert-Butylbenzene
43. 1,2,4-Trimethylbenzene
44. sec-Butylbenzene
45. 1,3-Dichlorobenzene
46. 4-Isopropyltoluene
47. 1,4-Dichlorobenzene
48. 1,2-Dichlorobenzene
49. 1,2-Dibromo-3-chloropropane
50. 1,2,4-Trichlorobenzene
51. Hexachlorobutadiene
52. Naphthalene
53. 1,2,3-Trichlorobenzene

Analysis of Volatile Organic Compounds in Environmental Waters Using the Agilent 7697A Headspace and 7890B/5977A GC/MS

Column: **VF-624ms**
CP9103
60 m x 0.25 mm, 1.40 µm

Instrument: Agilent 7697A Headspace and 7890B/5977A GC/MS

Carrier: Helium, 11 mL/min, 160 °C

Oven: 32 °C for 2 min, then 10 °C/min to 220 °C for 5 min

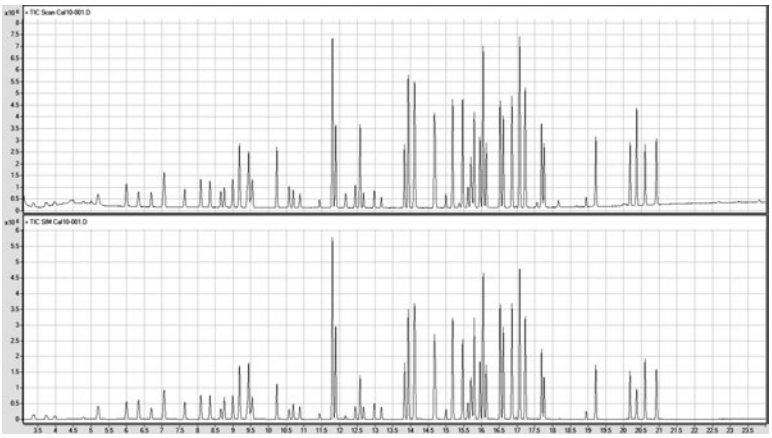
Injection: Split, 4:1, 160 °C for 5 min, purge 100 mL/min for 1 min

Detector: 5977A MSD, simultaneous Scan/SIM mode

Sample: Standard VOC mix

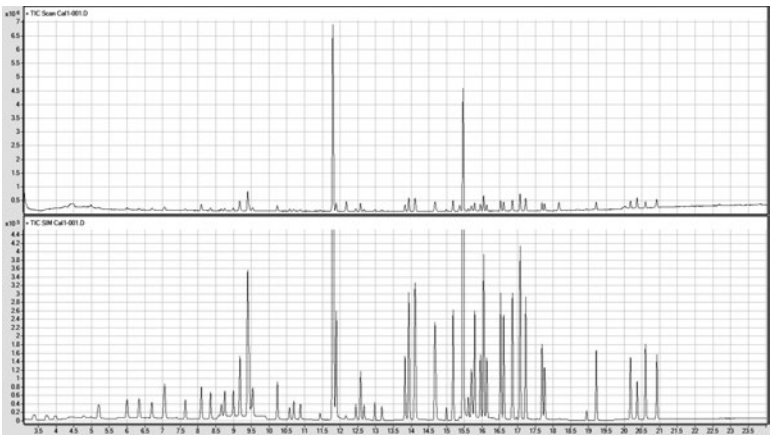
Sample Conc: 10 µg/L

		RT, min	CAS Number
1.	Dichlorodifluoromethane	3.387	75-71-8
2.	Chloromethane	3.734	74-87-3
3.	Vinyl chloride	3.980	75-01-4
4.	Bromomethane	4.390	74-83-9
5.	Chloroethane	4.788	75-00-3
6.	Trichlorofluoromethane	5.202	75-69-4
7.	1,1-Dichloroethene	5.998	75-34-4
8.	Carbon disulfide	6.338	75-15-0
9.	Dichloromethane	6.701	75-09-2
10.	Methyl tert-butyl ether	7.046	1634-04-4
11.	trans-1,2-Dichloroethene	7.069	156-60-5
12.	1,1-Dichloroethane	7.644	75-34-3
13.	Ethyl tert-butyl ether	8.091	637-92-3
14.	cis-1,2-Dichloroethene	8.353	156-59-2
15.	2,2-Dichloropropane	8.370	594-20-7
16.	Bromochloromethane	8.656	74-97-5
17.	Chloroform	8.756	67-66-3
18.	1,1,1-Trichloroethane	8.995	71-55-6
19.	1,1-Dichloro-1-propene	9.177	563-58-6
20.	Carbon tetrachloride	9.189	56-23-5
21.	Benzene	9.440	71-43-2
22.	1,2-Dichloroethane	9.497	107-06-2
23.	tert-Amyl methyl ether	9.540	994-05-8
24.	Trichloroethene	10.232	79-01-6
25.	1,2-Dichloropropane	10.576	78-87-5
26.	Dibromomethane	10.699	74-95-3
27.	Bromodichloromethane	10.884	75-27-4
28.	cis-1,3-Dichloropropene	11.437	10061-01-5
29.	Toluene	11.890	108-88-3
30.	trans-1,3-Dichloropropene	12.165	10061-02-6
31.	1,1,2-Trichloroethane	12.443	79-00-5
32.	Tetrachloroethene	12.580	127-18-4
33.	1,3-Dichloropropane	12.673	142-28-9
34.	Dibromochloromethane	12.981	124-48-1
35.	1,2-Dibromoethane	13.175	106-93-4
36.	Chlorobenzene	13.830	108-90-7
37.	1,1,1,2-Tetrachloroethane	13.939	630-20-6
38.	Ethylbenzene	13.934	100-41-4
39.	m and p-Xylene	14.115	108-38-3 & 106-42-3
40.	o-Xylene	14.669	95-47-6
41.	Styrene	14.699	100-42-5
42.	Bromoform	14.994	75-25-2
43.	Isopropylbenzene	15.183	98-82-8
44.	1,1,2,2-Tetrachloroethane	15.612	79-34-5
45.	Bromobenzene	15.697	108-86-1
46.	1,2,3-Trichloropropane	15.731	96-18-4
47.	n-Propylbenzene	15.793	103-65-1
48.	2-Chlorotoluene	15.952	95-49-8
49.	3-Chlorotoluene	16.042	108-41-8
50.	1,3,5-Trimethylbenzene	16.048	108-67-8
51.	4-Chlorotoluene	16.133	106-43-4
52.	tert-Butylbenzene	16.526	98-06-6
53.	1,2,4-Trimethylbenzene	16.608	95-63-6
54.	sec-Butylbenzene	16.856	135-98-8
55.	1,3-Dichlorobenzene	17.071	541-73-1
56.	4-Isopropyltoluene	17.077	99-87-6
57.	1,4-Dichlorobenzene	17.220	106-46-7
58.	1,2,3-Trimethylbenzene	17.231	526-73-8
59.	n-Butylbenzene	17.689	104-51-8
60.	1,2-Dichlorobenzene	17.761	95-50-1
61.	1,2-Dibromo-3-chloropropane	18.949	96-12-8
62.	1,3,5-Trichlorobenzene	19.215	108-70-3
63.	1,2,4-Trichlorobenzene	20.179	120-82-1
64.	Hexachlorobutadiene	20.370	87-68-3
65.	Naphthalene	20.604	91-20-3
66.	1,2,3-Trichlorobenzene	20.922	87-61-6



Counts vs. Acquisition Time (min)

10 µg/L VOC Standard Scan and SIM Traces



Counts vs. Acquisition Time (min)

1 µg/L VOC Standard Scan and SIM Traces

EPA Method 551

Column: **DB-1**
122-1033
30 m x 0.25 mm, 1.00 µm

Carrier: Helium at 24.8 cm/s, measured at 150 °C

Oven: 35 °C for 9 min
35-40 °C at 10 °C/min
40 °C for 3 min
40-150 °C at 6 °C/min
150 °C for 1 min

Injection: Splitless, 200 °C
15 s purge activation time

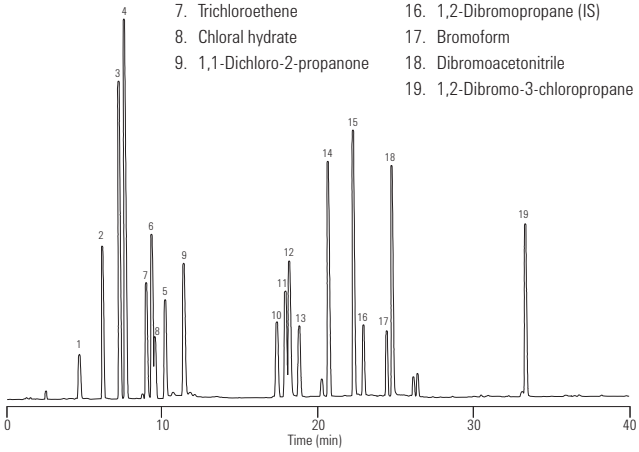
Detector: ECD, 300 °C

Sample: 1 µL of 50 pg/µL, AccuStandard

Suggested Supplies

Septum: 11 mm Advanced Green septa, 5183-4759
Liner: Splitless, single taper, deactivated, 4 mm id, 5181-3316
Seal: Gold plated seal, 18740-20885
Syringe: 10 µL tapered, FN 23-26s/42/HP, 5181-1267

1. Chloroform
2. 1,1,1-Trichloroethane
3. Carbon tetrachloride
4. Trichloroacetonitrile
5. Dichloroacetonitrile
6. Bromodichloromethane
7. Trichloroethene
8. Chloral hydrate
9. 1,1-Dichloro-2-propanone
10. Chloropicrin
11. Dibromochloromethane
12. Bromochloroacetonitrile
13. 1,2-Dibromoethane
14. Tetrachloroethene
15. 1,1,1-Trichloropropanone
16. 1,2-Dibromopropane (IS)
17. Bromoform
18. Dibromoacetonitrile
19. 1,2-Dibromo-3-chloropropane



European Red List Volatiles

Column: **DB-5.625**
122-5632
30 m x 0.25 mm, 0.50 µm

Column: **DB-624**
122-1334
30 m x 0.25 mm, 1.40 µm

Carrier: Helium at 35 cm/s, measured at 40 °C

Oven: 40 °C for 2 min
40-140 °C at 12 °C/min

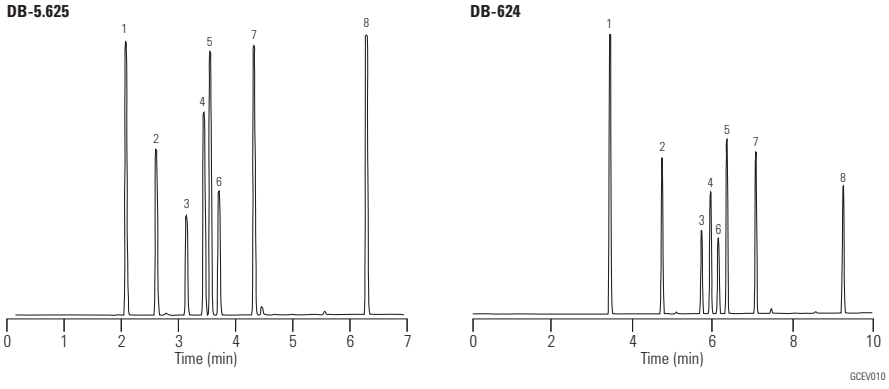
Injection: Split, 250 °C
Split ratio 1:50

Detector: FID, 300 °C
Nitrogen makeup gas at 30 mL/min

Sample: 1 µL of headspace of neat mixture

Suggested Supplies

Septum: 11 mm Advanced Green septa, 5183-4759
Liner: Direct, 1.5 mm id, 18740-80200
Seal: Gold plated seal, 18740-20885



1. 1,1-Dichloroethylene
2. 1,1-Dichloroethane
3. Chloroform
4. 1,1,1-Trichloroethane
5. 1,2-Dichloroethane
6. Carbon tetrachloride
7. Trichloroethylene
8. Tetrachloroethylene

EPA Volatiles by GC/MS (Split Injector)

Column: **DB-VRX**
122-1564
60 m x 0.25 mm, 1.40 µm

Carrier: Helium at 30 cm/s, measured at 45 °C

Oven:
45 °C for 10 min
45-190 °C at 12 °C/min
190 °C for 2 min
190-225 °C at 6 °C/min
225 °C for 1 min

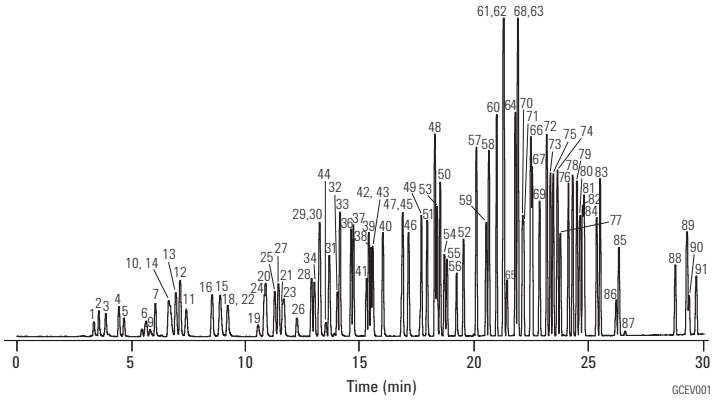
Sampler: Purge and trap (O.I.A. 4560)
Purge: Helium for 11 min at 40 mL/min
Trap: Tenax/Silica Gel/Carbosieve
Preheat: 175 °C
Desorb: 220 °C for 0.6 min

Injection:
Split, 110 °C
Split flow 30 mL/min

Detector:
MSD, 235 °C transfer line
Full scan 35-260 amu (m/z 44 subtracted)

Suggested Supplies

Septum: 11 mm Advanced Green septa, 5183-4759
Liner: Direct, 1.5 mm id, 18740-80200
Seal: Gold plated seal kit, 5188-5367



Column: **DB-624**
122-1364
60 m x 0.25 mm, 1.40 µm

Carrier: Helium at 31 cm/s, measured at 40 °C

Oven:
45 °C for 3 min
45-90 °C at 8 °C/min
90 °C for 4 min
90-200 °C at 6 °C/min
200 °C for 5 min

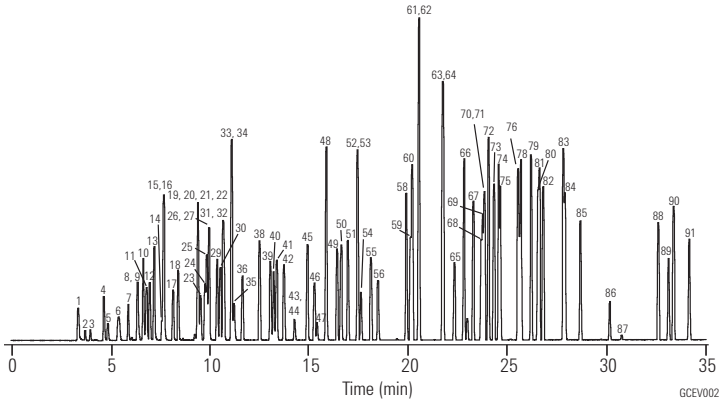
Sampler: Purge and trap (O.I.A. 4560)
Purge: Helium for 11 min at 40 mL/min
Trap: Tenax/Silica Gel/Carbosieve
Preheat: 175 °C
Desorb: 220 °C for 0.6 min

Injection:
Split, 110 °C
Split flow 30 mL/min

Detector:
MSD, 235 °C transfer line
Full scan 35-260 amu (m/z 44 subtracted)

Suggested Supplies

Septum: 11 mm Advanced Green septa, 5183-4759
Liner: Direct, 1.5 mm id, 18740-80200
Seal: Gold plated seal kit, 5188-5367



1. Dichlorodifluoromethane
2. Chloromethane
3. Vinyl chloride
4. Bromomethane
5. Chloroethane
6. Trichlorofluoromethane
7. Diethyl ether
8. 1,1-Dichloroethene
9. Acetone
10. Iodomethane
11. Carbon disulfide
12. Allyl chloride
13. Methylene chloride
14. Acrylonitrile
15. Methyl-tert-butyl ether
16. trans-1,2-Dichloroethene
17. Hexane
18. 1,1-Dichloroethane
19. 2-Butanone
20. cis-1,2-Dichloroethene
21. 2,2-Dichloropropane
22. Propionitrile
23. Methyl acrylate
24. Methacrylonitrile
25. Bromochloromethane
26. Tetrahydrofuran
27. Chloroform
28. Pentafluorobenzene (IS)
29. 1,1,1-Trichloroethane
30. 1-Chlorobutane
31. 1,1-Dichloropropene
32. Carbon tetrachloride
33. Benzene
34. 1,2-Dichloroethane
35. 2,2-Dimethylhexane
36. Fluorobenzene (IS)
37. 1,4-Difluorobenzene (IS)
38. Trichloroethene
39. 1,2-Dichloropropane
40. Methyl methacrylate
41. Dibromomethane
42. Bromodichloromethane
43. 2-Nitropropane
44. Chloroacetonitrile
45. cis-1,3-Dichloropropene
46. 4-Methyl-2-pentanone
47. 1,1-Dichloro-2-propanone
48. Toluene
49. trans-1,3-Dichloropropene
50. Ethyl methacrylate
51. 1,1,2-Trichloroethane
52. Tetrachloroethene
53. 1,3-Dichloropropane
54. 2-Hexanone
55. Dibromochloromethane
56. 1,2-Dibromoethane
57. 1-Chloro-3-fluorobenzene (IS)
58. Chlorobenzene
59. 1,1,1,2-Tetrachloroethane
60. Ethylbenzene
61. m-Xylene
62. p-Xylene
63. o-Xylene
64. Styrene
65. Bromoform
66. Isopropylbenzene
67. 4-Bromofluorobenzene (SS)
68. 1,1,2,2-Tetrachloroethane
69. Bromobenzene
70. 1,2,3-Trichloropropane
71. trans-1,4-Dichloro-2-butene
72. n-Propylbenzene
73. 2-Chlorotoluene
74. 1,3,5-Trimethylbenzene
75. 4-Chlorotoluene
76. tert-Butylbenzene
77. Pentachloroethane
78. 1,2,4-Trimethylbenzene
79. sec-Butylbenzene
80. 1,3-Dichlorobenzene
81. p-Isopropyltoluene
82. 1,4-Dichlorobenzene
83. n-Butylbenzene
84. 1,2-Dichlorobenzene
85. Hexachloroethane
86. 1,2-Dibromo-3-chloropropane
87. Nitrobenzene
88. 1,2,4-Trichlorobenzene
89. Hexachlorobutadiene
90. Naphthalene
91. 1,2,3-Trichlorobenzene

IS - Internal Standard
SS - Surrogate Standard

Note: Some compounds not present in both chromatograms

Environmental Applications, Air Analysis

EPA Air Analysis
Compendium Method TO-14 Standard

Column: **DB-1**
123-1063
60 m x 0.32 mm, 1.00 µm

Carrier: Helium at 25 cm/s measured off of CO_2 at 35 °C
constant flow mode

Oven: 35 °C for 5 min
35-120 °C at 5 °C/min
120-220 °C at 30 °C/min
220 °C for 5 min

Injection: Entech 7100 cryogenic sample preconcentrator

Detector: MSD
Full scan of m/z 40-250

Sample: 400 mL of a 10 ppbV TO-14 standard
and 100 mL of a 20 ppbv IS/SS standard

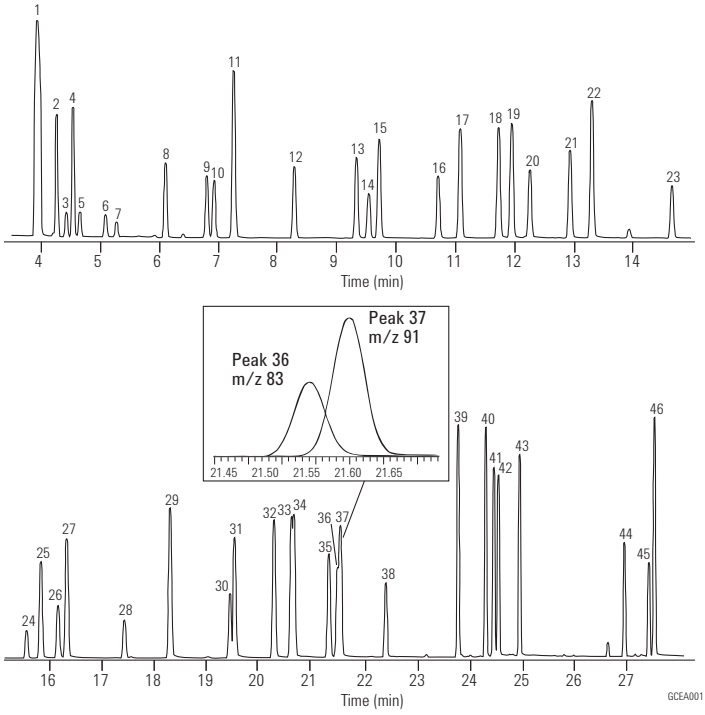
Suggested Supplies

Septum: 11 mm Advanced Green septa, 5183-4759

Liner: Direct, 1.5 mm id, 18740-80200

Seal: Gold plated seal, 18740-20885

1. CO_2
2. Freon 12 (dichlorodifluoromethane)
3. Chloromethane
4. Freon 114 (1,2-dichloro-1,1,2,2-tetrafluoroethane)
5. Vinyl chloride
6. Bromomethane
7. Chloroethane
8. Freon 11 (trichlorofluoromethane)
9. 1,1-Dichloroethene
10. Methylene chloride
11. Freon 113 (1,1,2-trichloro-1,2,2-trifluoroethane)
12. 1,1-Dichloroethane
13. cis-1,2-Dichloroethene
14. Bromochloromethane (IS)
15. Chloroform
16. 1,2-Dichloroethane
17. 1,1,1-Trichloroethane
18. Benzene
19. Carbon tetrachloride
20. 1,4-Difluorobenzene (IS)
21. 1,2-Dichloropropane
22. Trichloroethene
23. cis-1,3-Dichloropropene
24. trans-1,3-Dichloropropene
25. 1,1,2-Trichloroethane
26. Toluene-d8 (SS)
27. Toluene
28. 1,2-Dibromoethane
29. Tetrachloroethene
30. Chlorobenzene-d5 (SS)
31. Chlorobenzene
32. Ethylbenzene
33. m-Xylene
34. p-Xylene
35. Styrene
36. 1,1,2,2-Tetrachloroethane
37. o-Xylene
38. 4-Bromofluorobenzene (SS)
39. 1,3,5-Trimethylbenzene
40. 1,2,4-Trimethylbenzene
41. 1,3-Dichlorobenzene
42. 1,2-Dichlorobenzene
43. 1,4-Dichlorobenzene
44. 1,2,4-Trichlorobenzene
45. 1,2-Dibromobenzene (IS)
46. Hexachloro-1,3-butadiene



Agilent wishes to thank Entech Instruments for providing this chromatogram.

Formaldehyde, 50 ppb

Column: **DB-5ms**
123-5563
60 m x 0.32 mm, 1.00 µm

Carrier: Helium, 1.5 mL/min

Oven: 35 °C for 5 min
35-85 °C at 10 °C/min

Sampler: Entech 7100 cryogenic sample preconcentrator

Detector: GC/MS 6890/5973N
Scan 29-180 amu 0-6 min
33-280 amu 6-30 min
Electron impact 70 eV

Sample: 100 cc 50 ppb Formaldehyde/20 ppb others

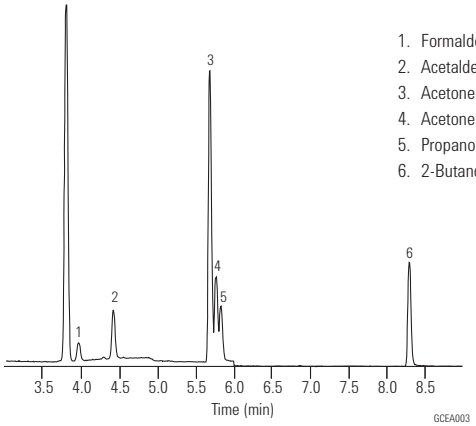
Agilent wishes to thank Entech Instruments for providing this chromatogram.

Suggested Supplies

Septum: 11 mm Advanced Green septa, 5183-4759

Liner: Direct, 1.5 mm id, 18740-80200

Seal: Gold plated seal, 18740-20885



1. Formaldehyde
2. Acetaldehyde
3. Acetone-d6
4. Acetone
5. Propanol
6. 2-Butanone

Sulfur in Air

Column: **DB-5ms**
123-5563
60 m x 0.32 mm, 1.00 µm

Carrier: Helium, 1.5 mL/min

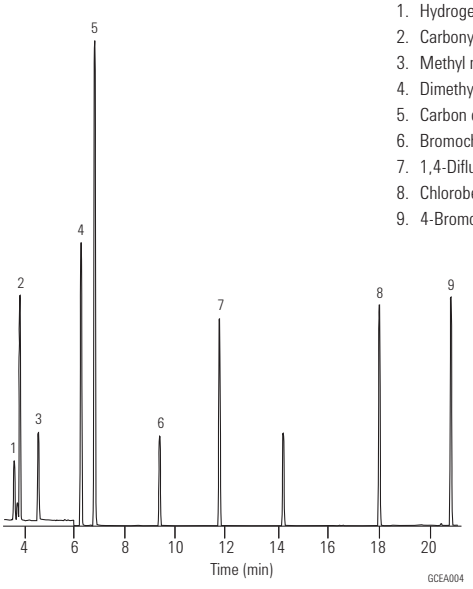
Oven: 35 °C for 5 min
35-140 °C at 6 °C/min
140-220 °C at 15 °C/min
220 °C for 3 min

Sampler: Entech 7100 cryogenic sample preconcentrator

Detector: GC/MS 6890/5973N
Scan 29-180 amu 0-6 min
33-280 amu 6-30 min
Electron impact 70 eV

Sample: 400 cc 10 ppb sulfurs

Agilent wishes to thank Entech Instruments for providing this chromatogram.



1. Hydrogen sulfide
2. Carbonyl sulfide
3. Methyl mercaptan
4. Dimethyl sulfide
5. Carbon disulfide
6. Bromochloromethane
7. 1,4-Difluorobenzene
8. Chlorobenzene-d5
9. 4-Bromofluorobenzene

N_2O I

Column: **HP-PLOT Q**
19095P-Q04
30 m x 0.53 mm, 40.00 µm

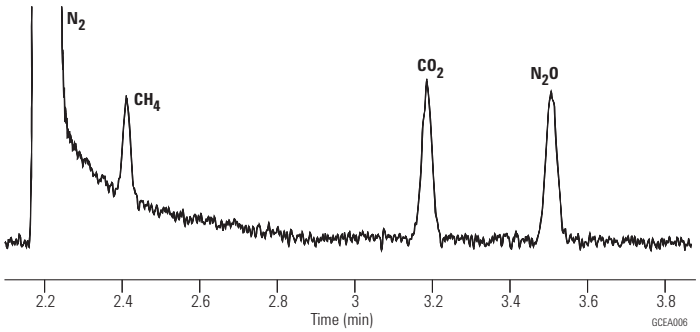
Carrier: Helium, 5 psi (approximately 8 mL/min)

Oven: 35 °C isothermal

Injection: 250 µL, injected
Split ratio 1:3

Detector: TCD, 200 °C

Sample: Approximately 200 ppmv methane
200 ppmv CO_2
250 ppmv N_2O (nitrogen balance gas)



N_2O II

Column: **HP-PLOT Molesieve**
19095P-MS6
30 m x 0.53 mm, 25.00 µm

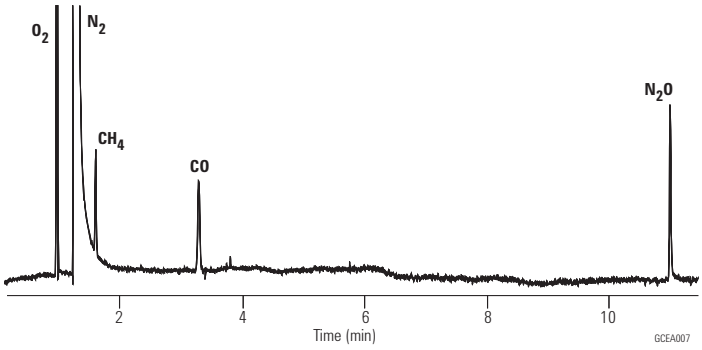
Carrier: Helium, 6 psi (approximately 10 mL/min)

Oven: 50 °C (5 min), 25 °C/min to 200 °C and hold

Injection: 250 µL injected
Split ratio 1:4

Detector: TCD, 250 °C
Column compensation on

Sample: Approximately 200 ppmv methane
200 ppmv CO_2
250 ppmv N_2O (nitrogen balance gas)



N_2O III

Column: **GS-CarbonPLOT**
113-3133
30 m x 0.32 mm, 3.00 µm

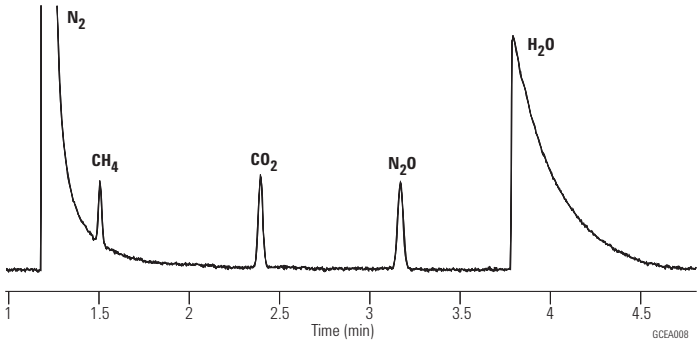
Carrier: Helium, 12 psi (approximately 3 mL/min)

Oven: 35 °C isothermal

Injection: 250 µL injected
Split ratio 1:4

Detector: TCD, 200 °C

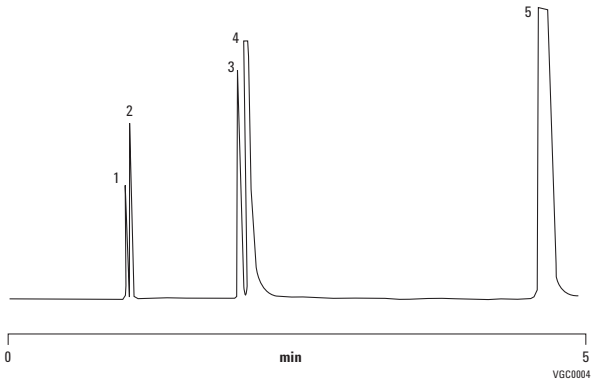
Sample: Approximately 200 ppmv methane
200 ppmv CO_2
250 ppmv N_2O (nitrogen balance gas)



Permanent Gases on a Thick Film Molsieve Column

Column: **CP-Molsieve 5Å**
CP7538
25 m x 0.53 mm, 50.00 µm

Sample: 10 µL
Sample Conc: % range
Carrier: H_2
Oven: 30 °C
Injection: Split, 100 mL/min
Detector: TCD

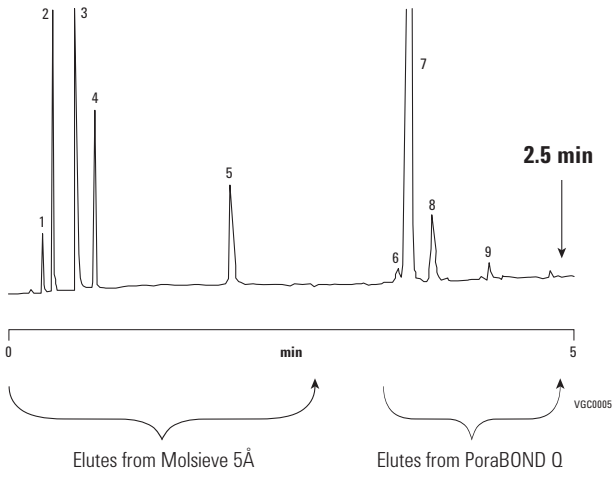


1. Helium
2. Neon
3. Argon
4. Oxygen
5. Nitrogen

Fast Analysis of Permanent Gases and CO_2 using Tandem PLOT Columns

Column: **Select for Permanent Gases/CO_2**
CP7429

Sample: 10 µL
Sample Conc: % level
Carrier: H_2, 60 kPa
Oven: 45 °C
Injection: Split, 50 mL/min
Detector: µ-TCD



1. He (from ms-5Å)
2. O_2 (from ms-5Å)
3. N_2 (from ms-5Å)
4. Methane (from ms-5Å)
5. CO (from ms-5Å)
6. He (from PBQ)
7. $N_2 + O_2 + CO$ (from PBQ)
8. Methane (from PBQ)
9. CO_2 (from PBQ)

EPA Air Analysis Method TO-15 (1 ppbv standard)

Column: **DB-5ms**
123-5563
60 m x 0.32 mm, 1.00 µm

Carrier: Helium, 1.5 mL/min

Oven: 35 °C for 5 min
35-140 °C at 6 °C/min
140-220 °C at 15 °C/min
220 °C for 3 min

Sampler: Entech 7100 cryogenic sample preconcentrator

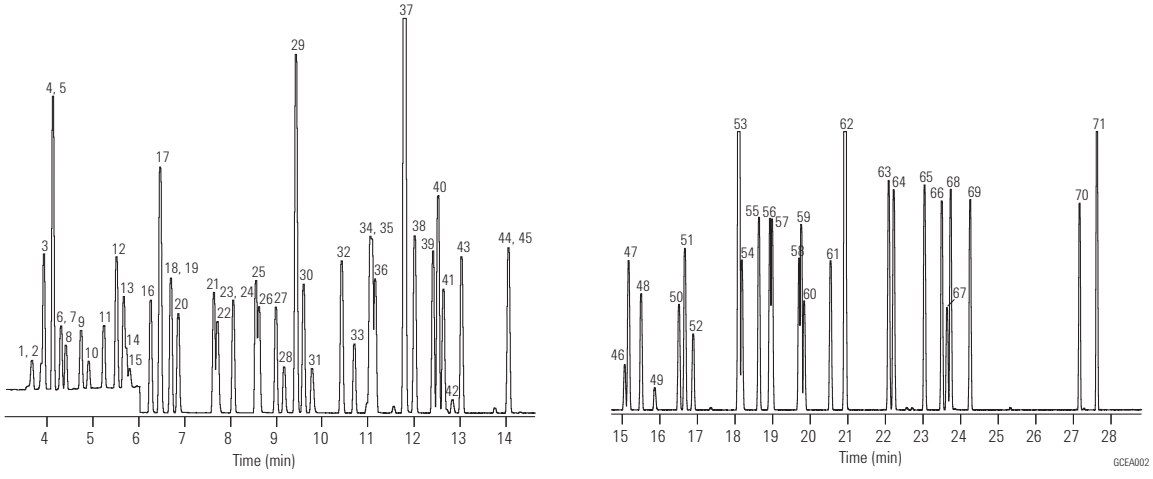
Detector: GC/MS 6890/5973N
Scan 29-180 amu 0-6 min
33-280 amu 6-30 min
Electron impact 70 eV

Sample: 400 mL sample load
All compounds at 10 ppbv except formaldehyde (50 ppbv), acetaldehyde (20 ppbv), propanol (20 ppbv), acetone (30 ppbv), 2-butanone (30 ppbv)

Suggested Supplies

Septum: 11 mm Advanced Green septa, 5183-4759
Liner: Direct, 1.5 mm id, 18740-80200
Seal: Gold plated seal, 18740-20885

		Quantitation Ion			Quantitation Ion			Quantitation Ion
1.	Formaldehyde	30	26.	n-Hexane	57	51.	Tetrachloroethene	166
2.	Propene	41	27.	cis-1,2-Dichloroethene	96	52.	1,2-Dibromoethane	107
3.	Dichlorodifluoromethane	85	28.	Ethyl acetate	43	53.	Chlorobenzene-d5 (IS)	117
4.	Chloromethane	50	29.	Bromochloromethane (IS)	128	54.	Chlorobenzene	112
5.	Dichlorotetrafluoroethane	85	30.	Chloroform	83	55.	Ethylbenzene	91
6.	Acetaldehyde	29	31.	Tetrahydrofuran	42	56.	m-Xylene	91
7.	Vinyl chloride	62	32.	1,1,1-Trichloroethane	97	57.	p-Xylene	91
8.	1,3-Butadiene	39	33.	1,2-Dichloroethane	62	58.	Styrene	104
9.	Bromomethane	94	34.	Benzene	78	59.	o-Xylene	91
10.	Chloroethane	64	35.	Carbon tetrachloride	117	60.	Bromoform	173
11.	Bromoethene	106	36.	Cyclohexane	56	61.	1,1,2,2-Tetrachloroethane	83
12.	Trichlorofluoromethane	101	37.	1,4-Difluorobenzene (IS)	114	62.	4-Bromofluorobenzene	95
13.	Acetone	58	38.	2,2,4-Trimethylpentane (isooctane)	57	63.	4-Ethyltoluene	105
14.	Propanal	29	39.	n-Heptane	41	64.	1,3,5-Trimethylbenzene	105
15.	Isopropyl alcohol	45	40.	Trichloroethene	130	65.	1,2,4-Trimethylbenzene	105
16.	1,1-Dichloroethene	61	41.	1,2-Dichloropropane	63	66.	1,3-Dichlorobenzene	146
17.	1,1,2-Trichloro-1,2-2-trifluoroethane	101	42.	1,4-Dioxane	88	67.	Benzyl chloride	91
18.	Methylene chloride	49	43.	Bromodichloromethane	83	68.	1,4-Dichlorobenzene	146
19.	3-Chloro-1-propene (allyl chloride)	76	44.	4-Methyl-2-pentanone (MIBK)	43	69.	1,2-Dichlorobenzene	146
20.	Carbon disulfide	76	45.	cis-1,3-Dichloropropene	75	70.	1,2,4-Trichlorobenzene	180
21.	trans-1,2-Dichloroethene	96	46.	trans-1,3-Dichloropropene	75	71.	Hexachlorobutadiene	225
22.	tert-Butyl methyl ether (MTBE)	73	47.	Toluene	91			
23.	1,1-Dichloroethane	63	48.	1,1,2-Trichloroethane	97			
24.	Vinyl acetate	43	49.	2-Hexanone	43			
25.	2-Butanone (MEK)	72	50.	Dibromochloromethane	129			



Agilent wishes to thank Entech Instruments for providing this chromatogram.

Food, Flavor, and Fragrance Applications

DB-624UI 1 µL/L Fermented Beverage Standard Mix

Column: **DB-624 Ultra Inert**
123-1334UI
30 m x 0.32 mm, 1.80 µm

Carrier: Helium, 2.3 mL/min, constant flow set at 35 °C

Oven: 35 °C for 5 min
10 °C/min to 100 °C for 1.5 min
15 °C/min to 220 °C for 3.0 min
25 °C/min to 250 °C for 2.8 min

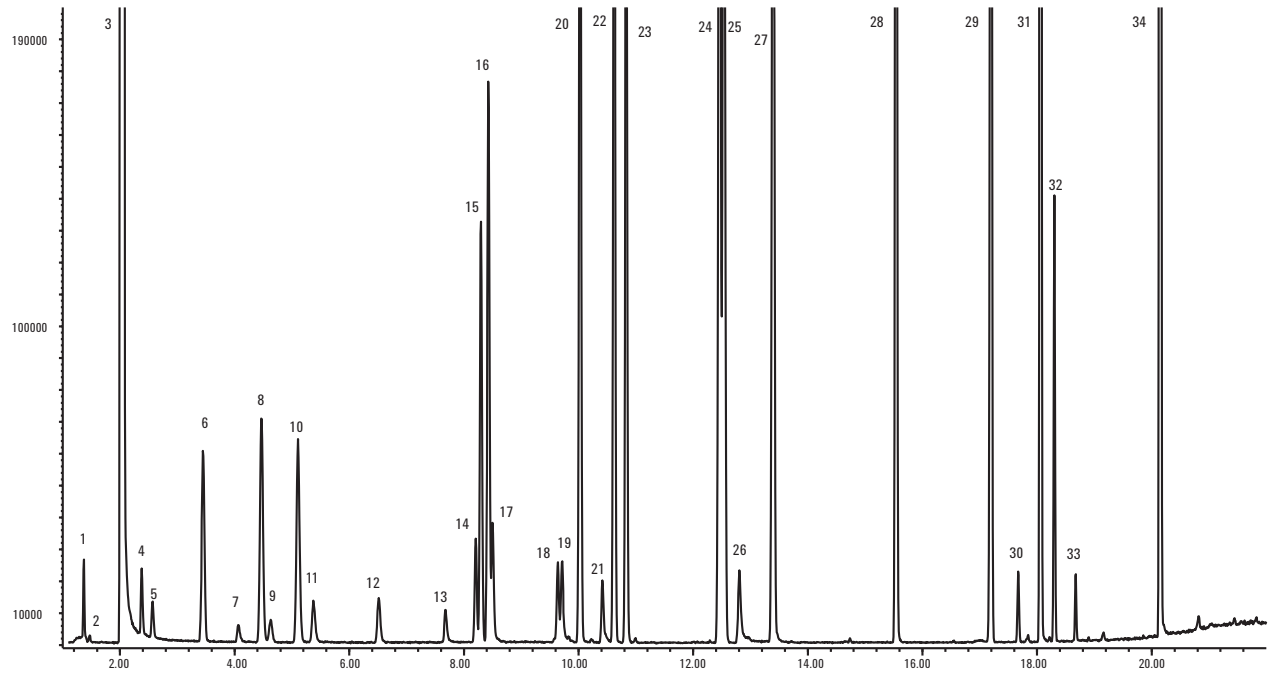
Inlet: Split/splitless, 220 °C, 1 µL, split 20:1

MSD Restrictor: Scan mode 30-400 amu, source temp 230 °C, quad temp 150 °C, transfer line temp 260 °C

Instrument: Agilent 7890/5975C equipped with MMI and FID

Sampler: Agilent 7697A headspace with 111 position tray, 1 mL sample loop

1. Acetyl aldehyde
2. Methanol
3. Ethanol
4. Acetone
5. Isopropanol
6. Isobutyl aldehyde
7. 1-Propanol
8. Butyl aldehyde
9. 2,3 Butanedione (VDK)
10. Ethyl acetate
11. 2-Butanol
12. Isobutyl alcohol
13. 1-Butanol
14. 2,3 Pentanedione (VDK)
15. Ethyl propanoate
16. Propyl acetate
17. 3-Pentanol
18. Isoamyl alcohol
19. Active amyl alcohol
20. Isobutyl acetate
21. 1-Pentanol
22. Ethyl butanoate
23. Hexanal
24. Isoamyl acetate
25. Active amyl acetate
26. 1-Hexanol
27. Heptanal
28. Octanal
29. 1,3,5-Trioxane impurity
30. 1,3,5-Trioxane impurity
31. Ethyl caprylate
32. 1-Phenyl ethyl acetate
33. Benzaldehyde, 3 methoxy
34. Ethyl caprate



Spearmint Oil

Column A: **DB-1**
122-1032
30 m x 0.25 mm, 0.25 µm

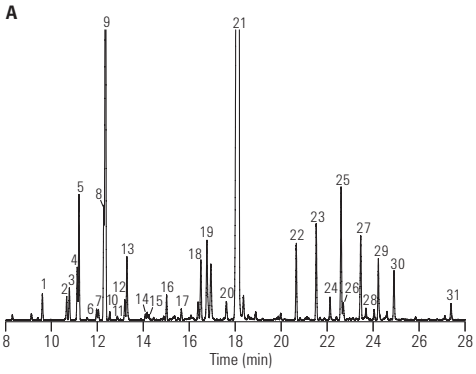
Column B: **DB-1**
121-1022
20 m x 0.18 mm, 0.18 µm

Carrier: A: Helium 25 cm/s measured at 40 °C
B: Hydrogen 47 cm/s measured at 40 °C

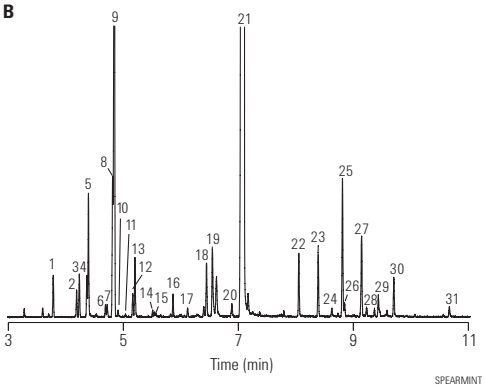
Oven: A: 40 °C hold 1 min, 5 °C/min to 290 °C
B: 40 °C hold 0.38 min, 13 °C/min to 290 °C hold 13.09 min

Injection: 250 °C, Split 40:1, 1 µL injection

Original method with a DB-1, 30 m x 0.25 mm, 0.25 µm column and helium carrier



Faster method with a high efficiency DB-1, 20 m x 0.18 mm, 0.18 µm column and hydrogen carrier



1. α-Pinene
2. Sabinene
3. β-Pinene
4. 3-Octanol
5. Myrcene
6. α-Terpinene
7. ρ-Cymene
8. 1,8-Cineol
9. Limonene
10. cis-Ocimene
11. trans-Ocimene
12. γ-Terpinene
13. trans-Sabinene hydrate
14. Terpinolene
15. Linalool
16. 3-Octyl acetate
17. Isomenthone
18. Terpinen-4-ol
19. Dihydro carvone
20. trans-Carveol
21. l-Carvone
22. trans-Dihydro carveol acetate
23. cis-Carvyl acetate
24. cis-Jasmone
25. β-Bourbonene
26. α-Bourbonene
27. β-Caryophyllene
28. α-Copaene
29. trans-β-Farnesene
30. Germacrene-d
31. Viridiflorol

Using hydrogen as a carrier gas in conjunction with the high efficiency column resulted in an overall speed gain of 61% compared to the original method. In addition, the resolution was well maintained throughout the method translation process.

Lavender Oil Characterization

Column: **DB-1ms Ultra Inert**
122-0132UI
30 m x 0.25 mm, 0.25 µm

Instrument: Agilent 7890A/5975B MSD and a 6890N FID equipped

Sampler: Agilent 7683B, 5.0 µL syringe (p/n 5188-5246), 1.0 µL injection

Carrier: Helium 40 cm/s, constant flow MSD system, 35 cm/s FID system

Inlet: 200:1 split

Oven: 62 °C 12.5 min hold, 3 °C/min to 92 °C, then 5 °C/min to 165 °C, then 100 °C/min to 310 °C, 2.5 min hold

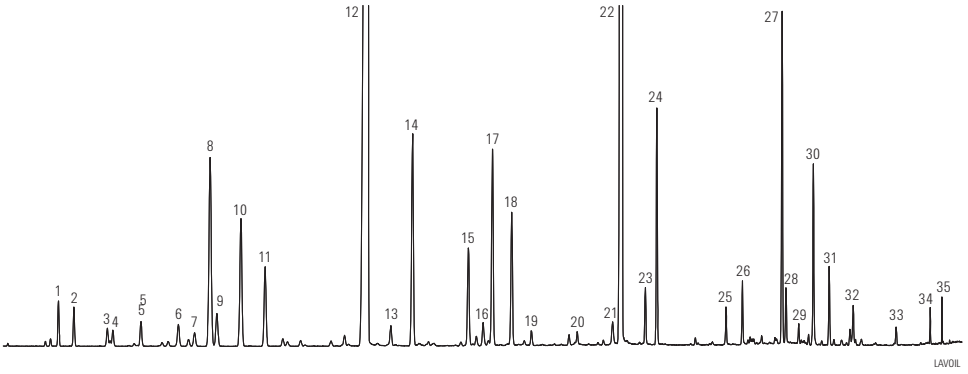
Detector: MSD source at 300 °C, quadrupole at 180 °C, transfer line at 280 °C, scan range 45-450 amu

Suggested Supplies

Septum: 11 mm Advanced Green septa, 5183-4759

Liner: Single taper, MS certified liner with restriction to hold glass wool, 5188-6576

Syringe: 5 µL tapered, FN 23-26s/42/HP, 5181-1273



1. α-Pinene
2. Camphene
3. 1-Octen-3-ol
4. 3-Octanone
5. β-Myrcene
6. 3-Carene
7. o-Cymene
8. Eucalyptol
9. D-Limonene
10. β-trans-Ocimene
11. β-cis-Ocimene
12. β-Linalool
13. Octen-1-ol acetate
14. Camphor
15. Borneol
16. Lavandulol
17. Terpinen-4-ol
18. α-Terpineol
19. Hexyl butyrate
20. Cumic aldehyde
21. cis-Geraniol
22. Linalool acetate
23. Borneol acetate
24. Lavandulyl acetate
25. Nerol acetate
26. Geranyl Acetate
27. Caryophyllene
28. α-Santolene
29. α-Bergamotene
30. β-Farnesene
31. Germacrene D
32. γ-Cadinene
33. Caryophyllene oxide
34. tau-Cardinol
35. α -Bisabolol

GC/MS total ion chromatogram of lavender oil sample on an Agilent J&W DB-1ms Ultra Inert 30 m x 0.25 mm, 0.25 µm capillary GC column (p/n 122-0132UI). The well-resolved, sharp peaks observed on the column ensure reliable analysis and fingerprinting of lavender oils.

Essential Oils

Column: **DB-WAX**
121-7022
20 m x 0.18 mm, 0.18 µm

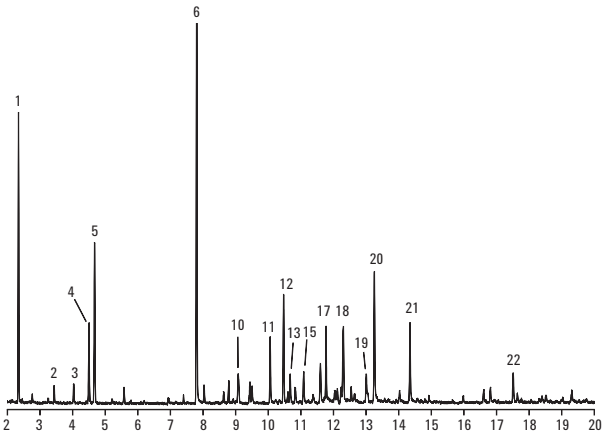
Carrier: Hydrogen at 44.3 cm/s
Measured at 45 °C

Oven: 45 °C hold 0.77 min
7.79 °C/min to 250 °C

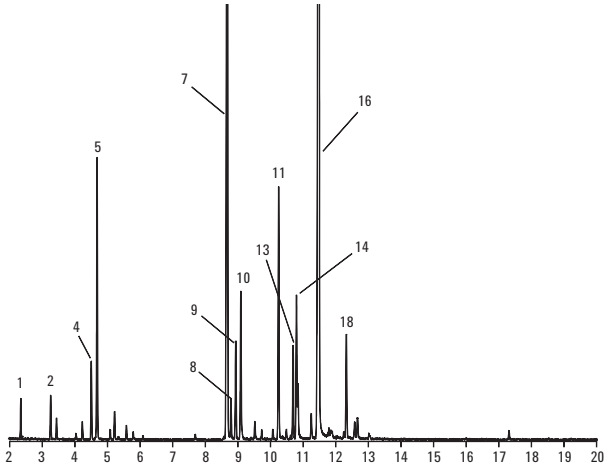
Injection: Split 1:30, 250 °C
1 µL of 1:35 oil in acetone

Detector: MSD full scan at m/z 40-500
250 °C transfer line

Wild chamomile



Peppermint



1. α-Pinene
2. β-Pinene
3. β-Myrcene
4. D-Limonene
5. Eucalyptol
6. 2,4-Hexadienal
7. Menthone
8. γ-Terpinene
9. Menthofuran
10. Iso-menthone
11. Δ-Carane
12. Bornyl acetate
13. β-Caryophyllene
14. Isomenthol
15. Citronellyl formate
16. Menthol
17. t-β-Farnesene
18. γ-Cadinene
19. δ-Cadinene
20. Citronellol
21. Nerol
22. β-Maaliene

Fragrance Reference Standard

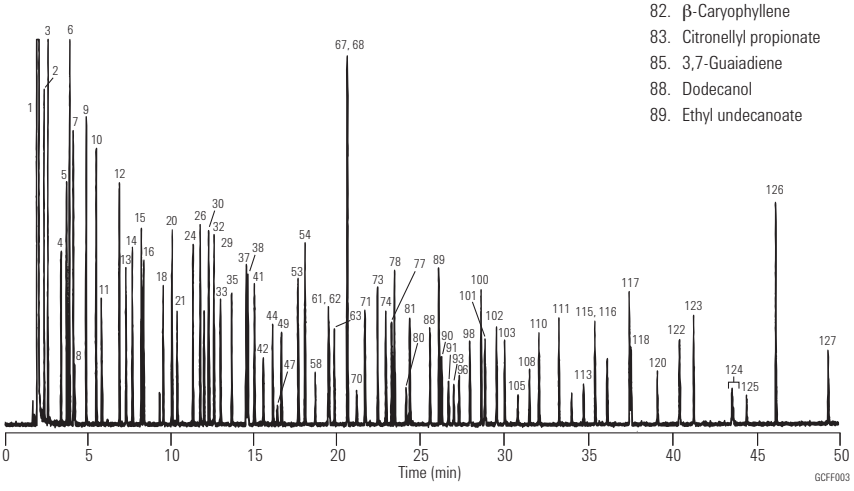
Column:	**DB-1** **122-1032** **30 m x 0.25 mm, 0.25 µm**
Carrier:	Helium at 25 cm/s, measured at 150 °C
Oven:	40 °C for 1 min 40-290 °C at 5 °C/min
Injection:	Split, 250 °C Split ratio 1:50
Detector:	MSD, 300 °C transfer line
Sample:	1 µL of a 1:20 dilution of neat sample in acetone

Suggested Supplies

Septum:	11 mm Advanced Green septa, 5183-4759
Liner:	Split, single taper, low pressure drop, glass wool, 5183-4647
Seal:	Gold plated seal, 18740-20885
Syringe:	5 µL tapered, FN 23-26s/42/HP, 5181-1273

Many thanks to Carl Frey, Manager of Analytical Services, Dragoco, and Kevin Myung, Director of Flavor and Perfumery Research, Bush Boake Allen, Inc. for contributing to this work.

1. Acetone
2. 2,3-Butanedione (diacetyl)
3. Ethyl acetate
4. 2,3-Pentanedione (acetyl propionyl)
5. Ethyl propionate
6. Methyl butyrate
7. 3-Methylbutyl alcohol
8. 2-Methylbutyl alcohol
9. Isobutyl acetate
10. Ethyl butyrate
11. Furfural
12. Ethyl isovalerate
13. Hexanol
14. Allyl butyrate
15. Ethyl pentanoate
16. Hexylene glycol
17. α-Thujone
18. Benzaldehyde
19. α-Pinene
20. Camphene
21. 3,5,5-Trimethylhexanol
22. Sabinene
23. β-Pinene
24. Ethyl hexanoate
25. Myrcene
26. Hexyl acetate
cis-Linalool oxide
Methyl benzoate
trans-Linalool oxide
28. Methyl-cresol
29. Benzyl alcohol
30. para-Cymene
31. 1,8-Cineol
32. Limonene
33. 2,6-Dimethylhept-5-enal
34. γ-Terpinene
35. Octanol
37. Ethyl heptanoate
38. Linalool
39. Benzene ethanol
41. Rose oxide, cis-rose
42. Rose oxide, trans-rose
43. Camphor
44. Citronellal
45. Benzyl acetate
46. Menthone
47. Isoborneol
48. Isomenthone
49. Borneol
51. Terpinen-4-ol
52. α-Terpineol
53. Ethyl octanoate
54. Octyl acetate
56. Fenchyl acetate
57. Citronellol
58. Neral
59. Carvone
Phenylethyl acetate
60. Geraniol
61. Linalyl acetate
62. Geranial
63. Hydroxycitronellal
64. Citronellyl formate
66. Bornyl acetate
67. Vertenex (isomer 1)
68. Ethyl nonanoate
69. Geranyl formate
70. Vertenex (isomer 2)
71. γ-Nonalactone
72. Citronellyl acetate
73. Neryl acetate
74. Geranyl acetate
76. Diphenyl oxide
78. Ethyl decanoate
79. α-Copaene
80. Florazone (isomer 1)
81. Florazone (isomer 2)
82. β-Caryophyllene
83. Citronellyl propionate
85. 3,7-Guaiadiene
88. Dodecanol
89. Ethyl undecanoate
90. Eugenyl acetate
91. Frambinone (raspberry ketone)
93. Isoamyl salicylate
94. δ-Cadinene
95. cis-Nerolidol
96. Rosatol (rosetone)
Geranyl butyrate
97. trans-Nerolidol
98. n-Amyl salicylate
99. Phenyl ethyl tiglate
100. Ethyl dodecanoate
101. Benzophenone
102. Dibenzyl ether
103. γ-Dodecalactone
104. Citronellyl tiglate
105. Evernyl
106. Geranyl tiglate
107. Geranyl-2-methyl valerate
108. Celestolide
109. Heptadec-1-ene
110. Benzyl benzoate
111. Ethyl tetradecanoate
112. Benzyl salicylate
113. Tonalid
114. Nonadec-1-ene
115. Isopropylmyristate
116. Ethyl pentadecanoate
Nonadecane
117. Ethyl hexadecanoate
118. Musk T (ethylene brassylate)
119. Eicosane
120. Cinnamyl phenyl acetate
121. Heneicosane
122. Phenyl ethyl cinnamate
123. Ethyl octadecanoate
124. Hercolyn D (tetrahydro & dihydro methyl abietate)
125. Cinnamyl cinnamate
126. Cetearyl octanoate
127. Cetearyl decanoate



Fragrance Reference Standard

Column: **DB-WAX**
122-7032
30 m x 0.25 mm, 0.25 µm

Carrier: Helium at 25 cm/s,
measured at 150 °C

Oven: 45 °C for 2 min
45-250 °C at 3 °C/min
250 °C for 34 min

Injection: Split, 250 °C
Split ratio 1:50

Detector: MSD, 250 °C transfer line

Sample: 1 µL of a 1:20 dilution of neat sample in acetone

Suggested Supplies

Septum: 11 mm Advanced Green septa, 5183-4759

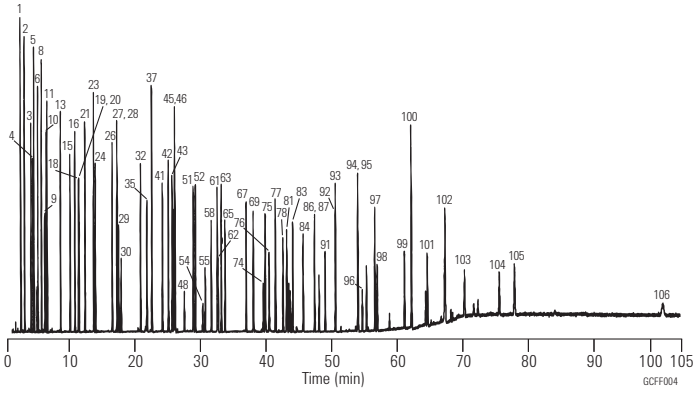
Liner: Split, single taper, low pressure drop, glass wool, 5183-4647

Seal: Gold plated seal, 18740-20885

Syringe: 5 µL tapered, FN 23-26s/42/HP, 5181-1273

Many thanks to Carl Frey, Manager of Analytical Services, Dragoco, and Kevin Myung, Director of Flavor and Perfumery Research, Bush Boake Allen, Inc. for contributing to this work.

1. Acetone
2. Ethyl acetate
3. Ethyl propionate
4. 2,3-Butanedione (diacetyl)
5. Methyl butyrate
6. Isobutyl acetate
7. α-Pinene
8. Ethyl butyrate
9. 2,3-Pentanedione (acetyl propionyl)
10. Camphene
11. Ethyl isovalerate
12. β-Pinene
13. Ethyl pentanoate
14. Myrcene
15. Allyl butyrate
16. Limonene
17. 1,8-Cineol
18. 3,5,5-Trimethylhexanol
19. 3-Methylbutyl alcohol
20. 2-Methylbutyl alcohol
21. Ethyl hexanoate
22. γ-Terpinene
23. p-Cymene
24. Hexyl acetate
25. Terpinolene
26. Ethyl heptanoate
27. 2,6-Dimethylhept-5-enal (melonal)
28. Rose oxide, cis-rose
29. Hexanol
30. Rose oxide, trans-rose
31. Methyl-para-cresol
32. Ethyl octanoate
33. cis-Linalool oxide
34. Menthone
35. Furfural
36. trans-Linalool oxide
37. Octyl acetate
38. Isomenthone
39. α-Copaene
40. Camphor
41. Benzaldehyde
42. Ethyl nonanoate
43. Linalool
44. Linalyl acetate
45. Vertenex (isomer 1)
46. Octanol
47. β-Caryophyllene
48. Vertenex (isomer 2)
49. Terpinen-4-ol
50. Methyl benzoate
51. Hexylene glycol
52. Ethyl decanoate
53. Citronellyl acetate
54. Isoborneol
55. Neral
56. α-Terpineol
57. Geranyl formate
58. Borneol
59. β-Bisabolene
60. Benzyl acetate
61. Neryl acetate
62. Geranial
63. Ethyl undecanoate
64. δ-Cadinene
65. Geranyl acetate
66. Citronellol
67. Ethyl dodecanoate
68. Geraniol
69. Benzyl alcohol
70. Geranyl butyrate
71. Nonadecane
72. Benzene ethanol
73. Nonadec-1-ene
74. Florazone (isomer 1)
75. Florazone (isomer 2)
76. Hydroxycitronellal
77. Dodecanol
78. Diphenyl oxide
79. Citronellyl tiglate
80. Eugenyl methyl ether
81. γ-Nonalactone
83. Ethyl tetradecanoate
84. n-Amyl salicylate
85. Geranyl tiglate
86. Ethyl pentadecanoate
87. Isopropylmyristate
90. Phenyl ethyl tiglate
91. Rosatol (rosetone)
92. Eugenyl acetate
93. Ethyl hexadecanoate
94. γ-Dodecalactone
95. Dibenzyl ether
96. Tonalid
97. Ethyl octadecanoate
98. Benzophenone
99. Benzyl benzoate
100. Cetearyl octanoate
101. Musk T (ethylene brassylate)
102. Cetearyl decanoate
103. Frambinone (raspberry ketone)
104. Cinnamyl phenyl acetate
105. Phenyl ethyl cinnamate
106. Cinnamyl cinnamate



Perfume

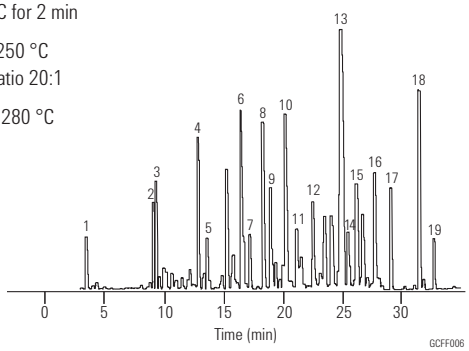
Column: **HP-INNOWax**
19091N-133
30 m x 0.25 mm, 0.25 µm

Carrier: Helium, 30 cm/s
0.9 mL/min constant flow

Oven: 80 °C for 1 min
80-250 °C at 5 °C/min
250 °C for 2 min

Injection: Split, 250 °C
Split ratio 20:1

Detector: MSD, 280 °C



Suggested Supplies

Septum: 11 mm Advanced Green septa, 5183-4759
Liner: Split, single taper, low pressure drop, glass wool, 5183-4647
Seal: Gold plated seal, 18740-20885
Syringe: 5 µL tapered, FN 23-26s/42/HP, 5181-1273

1. Limonene
2. Linalool
3. Linalyl acetate
4. Benzyl acetate
5. Citronellol
6. Benzene ethanol
7. α-Methyl ionone
8. Carvacrol and geraniol
9. Isoamyl salicylate
10. n-Amyl salicylate
11. Commamyl acetate
12. Acetyl cedrene
13. Diethyl phthalate
14. Tonalid
15. Coumarin
16. Musk xylene
17. Benzyl benzoate
18. Benzyl salicylate
19. Musk ketone

Chiral Compounds in Essential Oils and Fragrances

Column: **HP-Chiral 20β**
19091G-B233
30 m x 0.25 mm, 0.25 µm

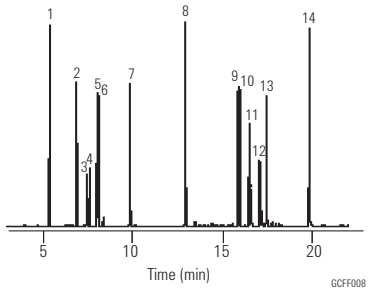
Carrier: Hydrogen, 39 cm/s,
constant pressure

Oven: 65 °C for 1 min
65-170 °C at 5 °C/min

Injection: Split, 250 °C
Split ratio 30:1

Detector: FID, 300 °C

Sample: 1 µL
0.25 ng/µL each
analyte in Hexane



1. 1,2-Dimethylbenzene
2. Myrcene
3. (-)-Camphene
4. (+)-Camphene
5. (+)-β-Pinene
6. 1S-(-)-β-Pinene
7. Cineole
8. (R)-(+)-Citronellal
9. 1S,2R,5S-(+)-Menthol
10. 1R,2S,5R-(-)-Menthol
11. α-Terpineol
12. (+/-)-Isoborneol
13. (+)-Borneol
14. trans-Cinnamaldehyde

Menthol

Column: **Cyclodex-B**
112-2532
30 m x 0.25 mm, 0.25 µm

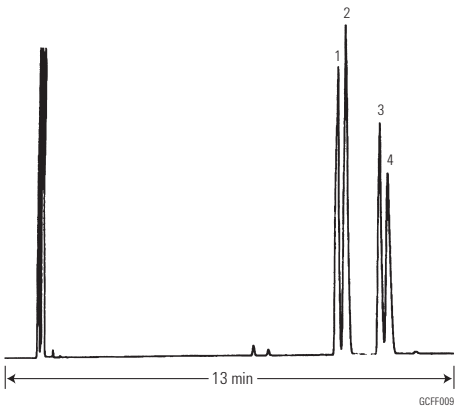
Carrier: Hydrogen, 55 cm/s

Oven: 105 °C isothermal

Injection: Split, 250 °C
Split ratio 1:100

Detector: FID, 300 °C
Nitrogen makeup gas at 30 mL/min

Sample: 1 µL of 1 µg/µL each chloroform



1. (+)-Neomenthol
2. (-)- Neomenthol
3. (+)-Menthol
4. (-)-Menthol

FAMEs

Column: **DB-23**
122-2362
60 m x 0.25 mm, 0.25 µm

Carrier: Hydrogen at 43 cm/s,
constant pressure mode

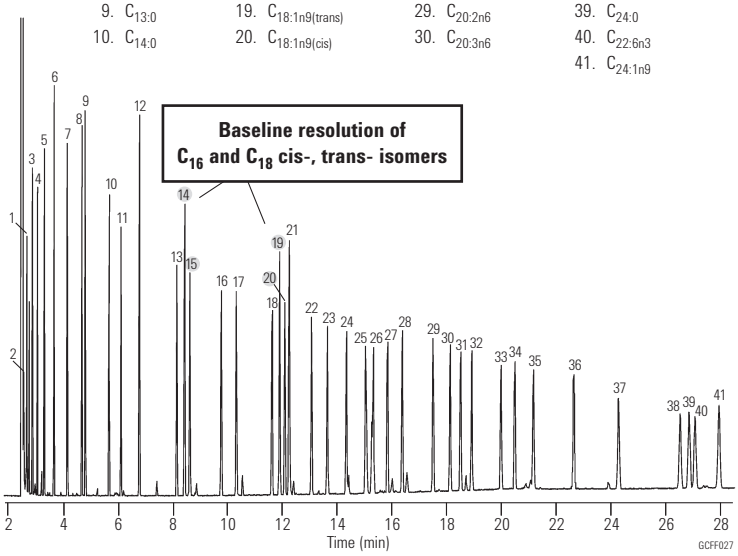
Oven: 130 °C for 1.0 min
130-170 °C at 6.5 °C/min
170-215 °C at 2.75 °C/min
215 °C for 12 min
215-230 °C at 40 °C/min
230 °C for 3 min

Injection: Split, 270 °C
Split ratio 50:1

Detector: FID, 280 °C

Chromatogram provided courtesy of Steve Watkins and Jeremy Ching, FAME Analytics, http://www.fameanalytics.com

1. $C_{6:0}$
2. $C_{7:0}$
3. $C_{8:0}$
4. $C_{9:0}$
5. $C_{10:0}$
6. $C_{11:0}$
7. $C_{12:0}$
8. BHT
9. $C_{13:0}$
10. $C_{14:0}$
11. $C_{14:1n5}$
12. $C_{15:0}$
13. $C_{16:0}$
14. $C_{16:1n7(trans)}$
15. $C_{16:1n7(cis)}$
16. $C_{17:0}$
17. $C_{17:1}$
18. $C_{18:0}$
19. $C_{18:1n9(trans)}$
20. $C_{18:1n9(cis)}$
21. $C_{18:1n7}$
22. $C_{18:2n6}$
23. $C_{18:3n6}$
24. $C_{18:3n3}$
25. $C_{18:2(d9,11)}$
26. $C_{18:2(d10,12)}$
27. $C_{20:0}$
28. $C_{20:1n9}$
29. $C_{20:2n6}$
30. $C_{20:3n6}$
31. $C_{20:4n6}$
32. $C_{20:3n3}$
33. $C_{20:5n3}$
34. $C_{22:0}$
35. $C_{22:1n9}$
36. $C_{22:2n6}$
37. $C_{22:4n6}$
38. $C_{22:5n3}$
39. $C_{24:0}$
40. $C_{22:6n3}$
41. $C_{24:1n9}$



Suggested Supplies

Septum: 11 mm Advanced Green septa, 5183-4759

Liner: Split, single taper, low pressure drop, glass wool, 5183-4647

Seal: Gold plated seal, 18740-20885

Syringe: 5 µL tapered, FN 23-26s/42/HP, 5181-1273

Analysis of Fragrance and Allergens

Column: **VF-WAXms**
CP9205
30 m x 0.25 mm, 0.25 µm

Oven: 100 °C to 250 °C with 10 °C/min

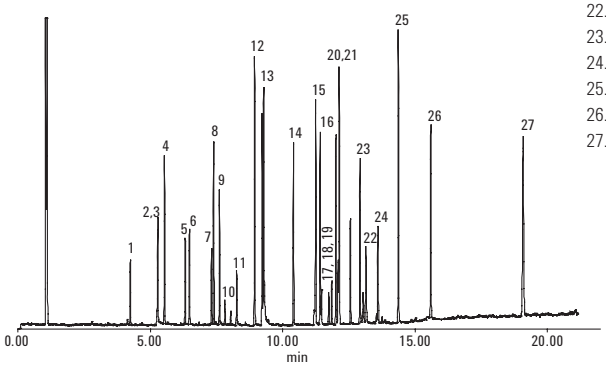
Carrier: Helium, 1.0 mL/min

Injection: Split 1:30, T=250 °C

Detector: GC/MS Ion Trap
Trap: 200 °C
Manifold: 60 °C

Sample: 0.1 µL, Fragrances mixture (500 ppm)

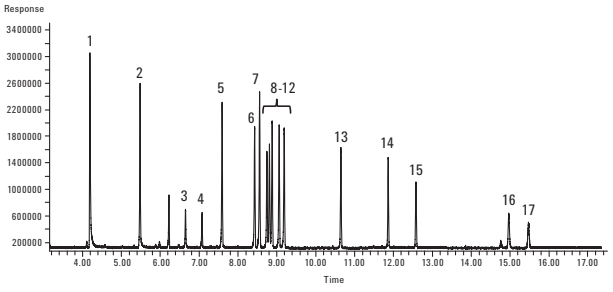
1. Linalool
2. Methyl heptine carbonate
3. Phenyl acetaldehyde
4. Methyl chavicol
5. Methyl octine carbonate
6. Citronellol
7. Geraniol
8. Methyl gamma ionone
9. Benzyl alcohol
10. Cinnamaldehyde
11. Hydroxy citronellal
12. Methyl eugenol
13. Lilial
14. Eugenol
15. Amyl cinnamyl aldehyde
16. Anisic alcohol
17. Cinnamyl alcohol
18. Farnesol isomer I + II
19. Farnesol isomer III
20. iso-Eugenol
21. Hexyl cinnamic aldehyde
22. Lyral (4,4-isomer)
23. Coumarin
24. Amyl cinnamic alcohol
25. Benzyl benzoate
26. Benzyl salicylate
27. Benzyl cinnamate



Organophosphorus Pesticide Residues in Olive Oil Extract

Column:	**DB-35ms Ultra Inert** **122-3832UI** **30 m x 0.25 mm, 0.25 µm**
Instrument:	Agilent 7890/5975C
Sampler:	Agilent 7683B, 5.0 µL syringe (p/n 5181-1273)
CFT Device:	Purged 2-way splitter (p/n G3180B) Split ratio MSD:FPD = 1:1
MSD Restrictor:	1.43 m x 0.18 mm id deactivated fused silica tubing
FPD Restrictor:	0.53 m x 0.18 mm id deactivated fused silica tubing
Aux EPC:	3.8 psi constant pressure
Inlet:	2 µL splitless; 250 °C, purge flow 60 mL/min at 0.25 min, gas saver on at 2 min 20 mL/min
Carrier:	Helium, constant pressure 28.85 psi at 95 °C
Oven:	95 °C (0.5 min), 25 °C/min to 210 °C, 10 °C/min to 250 °C (0.5 min), 20 °C to 290 °C (4.5 min)
Postrun Backflush:	7.5 min at 290 °C, Aux EPC pressure 54 psi during backflush, 2 psi inlet pressure during backflush
Detector:	MSD: 300 °C transfer line, 300 °C source, 150 °C quad FPD: 230 °C, hydrogen 75 mL/min, air 100 mL/min, carrier + makeup (N_2) 60 mL/min

1. Methamidophos
2. Acephate
3. Omethoate
4. Diazinon
5. Dimethoate
6. Pirimiphos-methyl
7. Parathion-methyl
8. Malathion
9. Chlorpyrifos
10. Fenitrothion
11. Parathion
12. Fenthion
13. Methidathion
14. Carbophenothion
15. Triphenyl-phosphate (surrogate std)
16. Azinphos-methyl
17. Azinphos-ethyl



GC/FPD chromatogram of a 100 ng/mL matrix-matched organophosphorus pesticide standard with analyte protectant analyzed on an Agilent J&W DB-35ms UI GC column.

TIPS & TOOLS

View the latest GC column focused applications, products and educational resources at **www.agilent.com/chem/myGCcolumns**

Fragrance Allergens

Column: **HP-5ms**
19091S-433
30 m x 0.25 mm, 0.25 µm

Carrier: Helium, 1.2 mL/min,
constant pressure of 70 kPa

Oven: 50 °C in 1 min, 8 °C/min to 250 °C,
250-300 °C at 35 °C/min
300 °C hold, 5 min
5973N MSD in scan (40-350 amu)
Solvent delay, 3.0 min

Injection: Split, 250 °C
Split ratio 1:50

Sample: 1 µL, 50 ppm standard

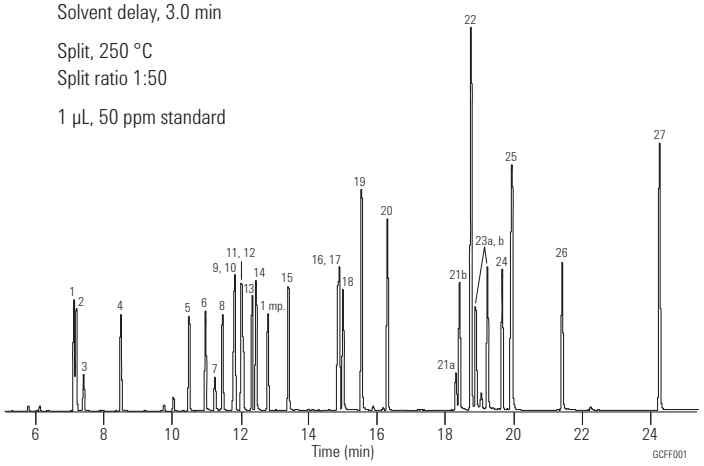
Suggested Supplies

Septum: 11 mm Advanced Green septa, 5183-4759

Liner: Split, single taper, low pressure drop, glass wool, 5183-4647

Seal: Gold plated seal, 18740-20885

Syringe: 5 µL tapered, FN 23-26s/42/HP, 5181-1273



1. Limonene
2. Benzyl alcohol
3. Phenyl acetaldehyde
4. Linalool
5. Methyl heptine carbonate
6. Citronellol
7. Neral
8. Geraniol
9. Citral (geranial)
10. Cinnamaldehyde
11. Anisyl alcohol
12. Hydroxy citronellal
13. Methyl octine carbonate
14. Cinnamic alcohol
15. Eugenol
16. Coumarin
17. Cinnamyl acetate
18. Isoeugenol
19. Alpha isomethyl ionone
20. Lilial (BMHCA)
21a. Lyral 1
21b. Lyral 2
22. Amyl cinnamyl alcohol
23a. Farnesol 1
23b. Farnesol 1
24. Hexyl cinnamaldehyde
25. Benzyl benzoate
26. Benzyl salicylate
27. Benzyl cinnamate

Flavor Mixture

Column: **Ultra 2**
19091B-112
25 m x 0.32 mm, 0.52 µm

Carrier: Helium, 90 kPa, 2.2 mL/min constant flow

Oven: 80 °C for 1 min
80-210 °C at 8 °C/min
210 °C for 2 min

Injection: Split, 250 °C
Split ratio 20:1

Detector: IRD, 280 °C
Wide Band MCT, 550 to 4000 cm^{-1}

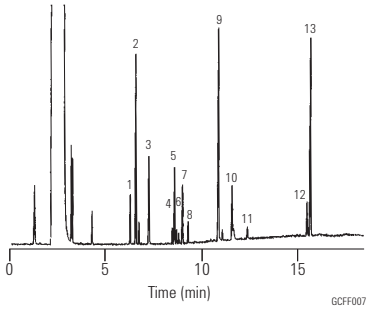
Suggested Supplies

Septum: 11 mm Advanced Green septa, 5183-4759

Liner: General purpose split/splitless liner, taper, glass wool, 5183-4711

Seal: Gold plated seal, 18740-20885

Syringe: 10 µL tapered, FN 23-26s/42/HP, 5181-1267



1. Fenchone
2. Thujone
3. Benzaldehyde
4. trans-Carveol
5. Farnesol
6. cis-Carveol
7. trans-Geraniol
8. Citral
9. Eugenol
10. Vanillin
11. trans-Isoeugenol
12. trans-Citronellyl tiglate
13. cis-Citronellyl tiglate

Lemon Oil

Column: **DB-5**
127-5022
20 m x 0.10 mm, 0.10 µm

Carrier: Hydrogen at 60 cm/s, measured at 40 °C

Oven: 40 °C for 3 min
40-185 °C at 30 °C/min
185 °C for 3 min

Injection: Split, 275 °C
Split ratio 1:275

Detector: Nitrogen makeup gas at 30 mL/min

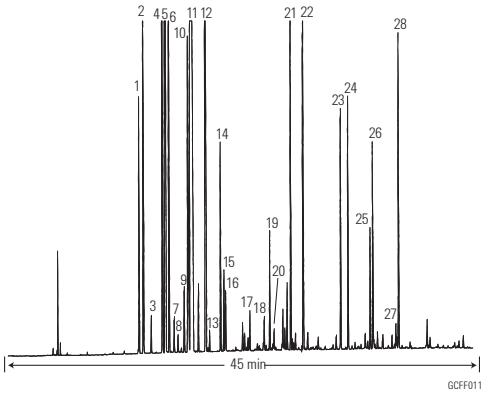
Suggested Supplies

Septum: 11 mm Advanced Green septa, 5183-4759

Liner: Split, single taper, low pressure drop, glass wool, 5183-4647

Seal: Gold plated seal, 18740-20885

Syringe: 5 µL tapered, FN 23-26s/42/HP, 5181-1273



1. α-Thujone
2. β-Thujone
3. Camphene
4. Sabinene
5. β-Pinene
6. Myrcene
7. Octanal
8. α-Phellandrene
9. α-Terpinene
10. r-Cymene
11. δ-Limonene
12. γ-Terpinene
13. Octanol
14. Terpinolene
15. Linalool
16. Nonanal
17. Citronellal
18. Terpinen-4-ol
19. α-Terpineol
20. Decanal
21. Neral
22. Geranial
23. Neryl acetate
24. Geranyl acetate
25. β-Caryophyllene
26. trans-α-Bergamotene
27. α-Humulene
28. β-Bisabolene

Cold-pressed Orange Oil

Column: **DB-5**
127-5022
20 m x 0.10 mm, 0.10 µm

Carrier: Hydrogen at 60 cm/s, measured at 70 °C

Oven: 70 °C for 1 min
70-250 °C at 30 °C/min
250-310 °C at 20 °C/min
310 °C for 2 min

Injection: Split, 275 °C
Split ratio 1:275

Detector: FID, 350 °C
Nitrogen makeup gas at 30 mL/min

Chromatogram courtesy of Tastemaker

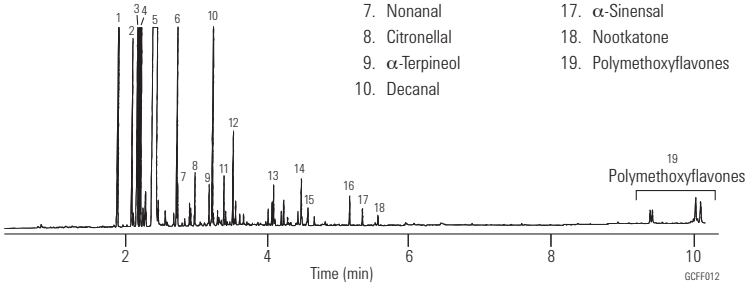
Suggested Supplies

Septum: 11 mm Advanced Green septa, 5183-4759

Liner: Split, single taper, low pressure drop, glass wool, 5183-4647

Seal: Gold plated seal, 18740-20885

Syringe: 5 µL tapered, FN 23-26s/42/HP, 5181-1273



1. α-Pinene
2. Sabinene
3. Myrcene
4. Octanal
5. Limonene
6. Linalool
7. Nonanal
8. Citronellal
9. α-Terpineol
10. Decanal
11. Neral
12. Geranial
13. Dodecenal
14. Valencene
15. Cadinene
16. β-Sinensal
17. α-Sinensal
18. Nootkatone
19. Polymethoxyflavones

Peppermint Oil

Column: **DB-WAX**
122-7062
60 m x 0.25 mm, 0.25 µm

Carrier: Helium at 25 cm/s (0.73 mL/min)

Oven: 75 °C for 8 min
75-200 °C at 4 °C/min
200 °C for 5 min

Injection: Split, 270 °C
Split ratio 1:150

Detector: FID, 270 °C
Nitrogen makeup gas at 30 mL/min

Sample: 1 µL neat

Thanks to William Faas of A.M. Todd Company for providing the sample and assisting with peak identification.

Suggested Supplies

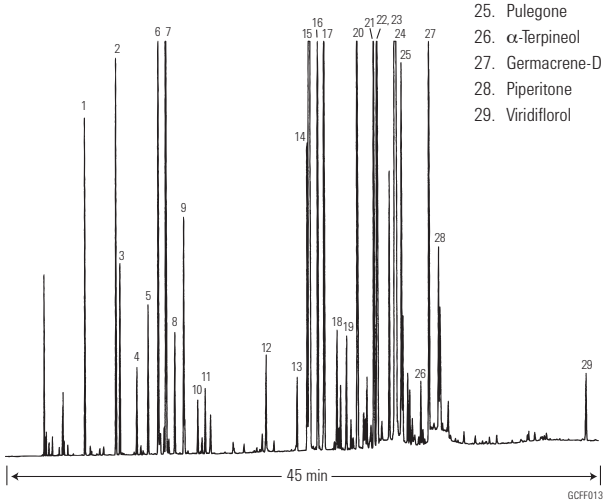
Septum: 11 mm Advanced Green septa, 5183-4759

Liner: Split, single taper, low pressure drop, glass wool, 5183-4647

Seal: Gold plated seal, 18740-20885

Syringe: 5 µL tapered, FN 23-26s/42/HP, 5181-1273

1. α-Pinene
2. β-Pinene
3. Sabinene
4. Myrcene
5. α-Terpinene
6. (+/-)-Limonene
7. 1,8-Cineol
8. cis-Ocimene
9. Terpinene
10. r-Cymene
11. γ-Terpinolene
12. 3-Octanol
13. 1-Octen-3-ol
14. trans-Sabinene hydrate
15. (+/-)-Methone
16. Methofuran
17. d-Isomethone
18. β-Bourbonene
19. Linalool
20. Menthyl acetate
21. Neomenthol
22. Terpinen-4-ol
23. β-Caryophyllene
24. (+/-)-Menthol
25. Pulegone
26. α-Terpineol
27. Germacrene-D
28. Piperitone
29. Viridiflorol



Spearmint Oil (Western)

Column: **DB-WAX**
122-7062
60 m x 0.25 mm, 0.25 µm

Carrier: Helium at 25 cm/s (0.73 mL/min)

Oven: 75 °C for 8 min
75-200 °C at 4 °C/min
200 °C for 5 min

Injection: Split, 270 °C
Split ratio 1:150

Detector: FID, 270 °C
Nitrogen makeup gas at 30 mL/min

Sample: 1 µL neat

Thanks to William Faas of A.M. Todd Company for providing the sample and assisting with peak identification.

Suggested Supplies

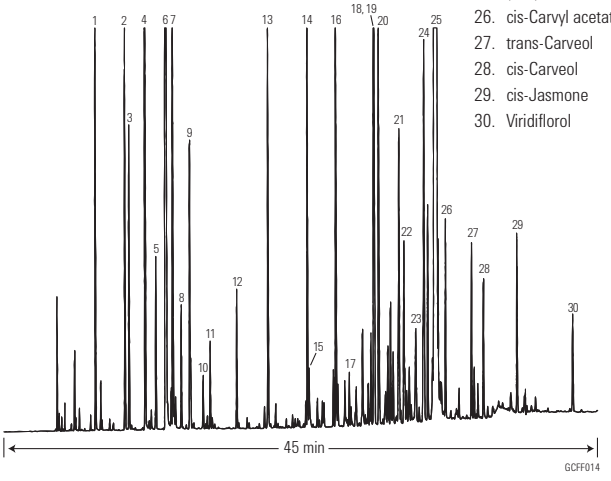
Septum: 11 mm Advanced Green septa, 5183-4759

Liner: Split, single taper, low pressure drop, glass wool, 5183-4647

Seal: Gold plated seal, 18740-20885

Syringe: 5 µL tapered, FN 23-26s/42/HP, 5181-1273

1. α-Pinene
2. β-Pinene
3. Sabinene
4. Myrcene
5. α-Terpinene
6. (+/-)-Limonene
7. 1,8-Cineol
8. cis-Ocimene
9. γ-Terpinene
10. r-Cymene
11. Terpinolene
12. 3-Octylacetate
13. 3-Octanol
14. trans-Sabinene hydrate
15. (+/-)-Methone
16. β-Bourbonene
17. Linalool
18. Terpinen-4-ol
19. β-Caryophyllene
20. Dihydro carvone
21. trans-Dihydro carvyl
22. trans-β-Farnesene
23. α-Terpineol
24. Germacrene-D
25. (+/-)-Carvone
26. cis-Carvyl acetate
27. trans-Carveol
28. cis-Carveol
29. cis-Jasmone
30. Viridiflorol



Ylang Ylang Oil

Column: **DB-XLB**
122-1232
30 m x 0.25 mm, 0.25 µm

Carrier: Helium at 34 cm/s, measured at 50 °C

Oven: 50 °C for 1 min
50-250 °C at 3.5 °C/min

Injection: Split, 250 °C
Split ratio 1:125

Detector: MSD, 310 °C transfer line
full scan at m/z 35-550

Sample: 1 µL of 10% oil in methylene chloride

Suggested Supplies

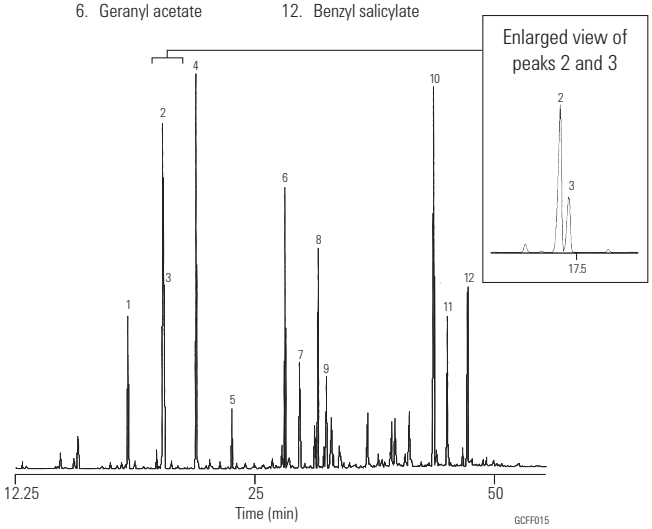
Septum: 11 mm Advanced Green septa, 5183-4759

Liner: Split, single taper, low pressure drop, glass wool, 5183-4647

Seal: Gold plated seal, 18740-20885

Syringe: 5 µL tapered, FN 23-26s/42/HP, 5181-1273

1. r-Methylansiole
2. Linalool
3. Methylbenzoate
4. Benzylacetate
5. Geraniol
6. Geranyl acetate
7. β-Caryophyllene
8. Cinnamyl acetate
9. Germacrene-D
10. Benzyl benzoate
11. Farnesol acetate
12. Benzyl salicylate

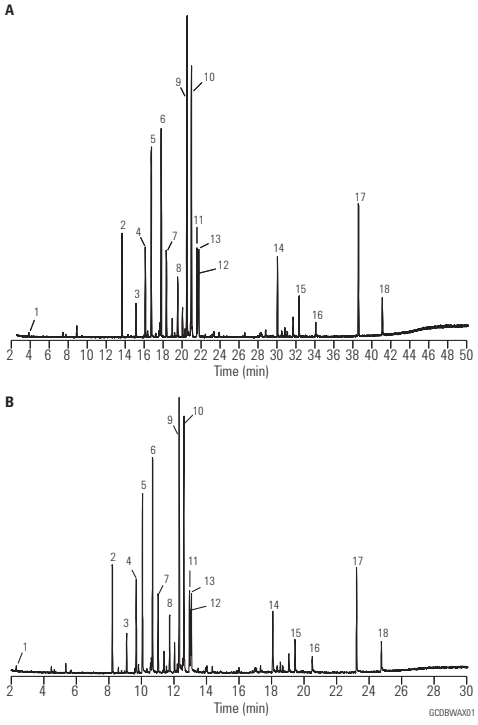


Ylang Ylang Oil

Column: **DB-WAX**
121-7022
20 m x 0.18 mm, 0.18 µm

Carrier: A: Helium 26.3 cm/s measured at 45 °C
B: Hydrogen 44.3 cm/s measured at 45 °C

Oven: A: 45 °C hold 1.28 min
4.68 °C/min to 250 °C hold 21.81 min
B: 45 °C hold 0.77 min
7.79 °C/min to 250 °C hold 13.09 min



1. α-Pinene
2. Methyl-ρ-cresol
3. α-Copaene
4. α-Gurjunene
5. Linalool
6. β-Caryophyllene
7. Methyl benzoate
8. α-Caryophyllene
9. Germacrene-d
10. Benzyl acetate
11. Farnescene
12. δ-Cadinene
13. Geranial acetate
14. trans-Cinnamyl acetate
15. β-Bisbolene
16. Farnesyl acetate
17. Benzyl benzoate
18. Benzyl salicylate

Rosemary Oil

Column: **CycloSil-B**
112-6632
30 m x 0.25 mm, 0.25 µm

Carrier: Hydrogen at 40 cm/s, measured at 60 °C

Oven: 55 °C for 1 min
50-180 °C at 5 °C/min

Injection: Split, 250 °C
Split ratio 50:1

Detector: FID, 340 °C

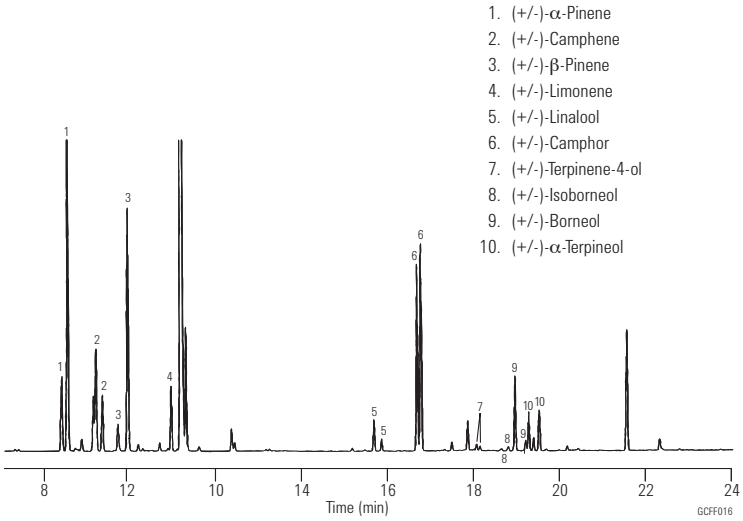
Suggested Supplies

Septum: 11 mm Advanced Green septa, 5183-4759

Liner: Split, single taper, low pressure drop, glass wool, 5183-4647

Seal: Gold plated seal, 18740-20885

Syringe: 5 µL tapered, FN 23-26s/42/HP, 5181-1273



Citrus Flavored Carbonated Beverage (Soda)

Column: **CycloSil-B**
112-6632
30 m x 0.25 mm, 0.25 µm

Carrier: Helium at 37 cm/s,
measured at 40 °C

Oven: 40-190 °C at 2 °C/min

Sampler: Headspace
No stir, NaCl 1g/10 mL sample
Adsorption: 27 °C for 68 min
Desorption: 250 °C for 15 min

Injection: Split, 1:5
Polyacrylate fiber, 85 µm

Detector: MSD, 280 °C transfer line

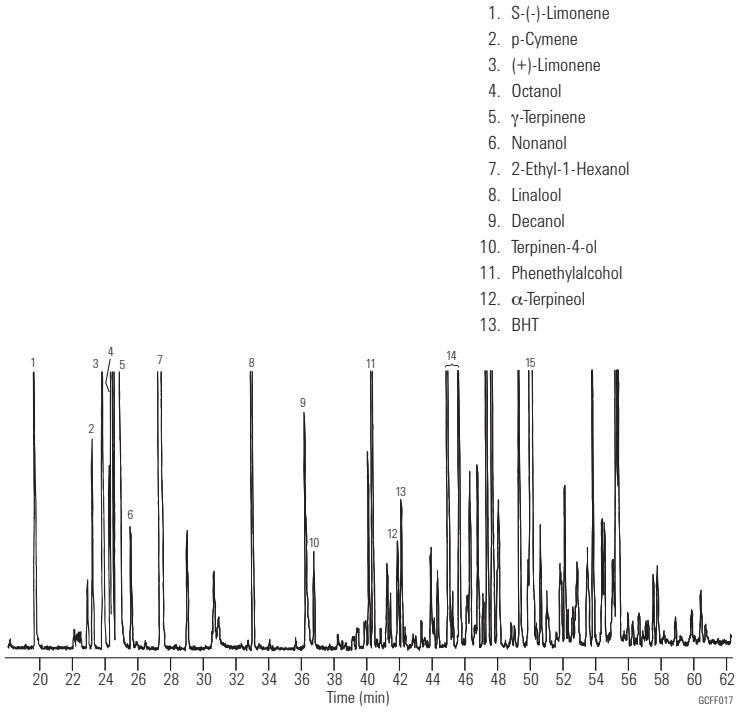
Suggested Supplies

Septum: 11 mm Advanced Green septa, 5183-4759

Liner: Split, single taper, low pressure drop, glass wool, 5183-4647

Seal: Gold plated seal, 18740-20885

Syringe: 5 µL tapered, FN 23-26s/42/HP, 5181-1273



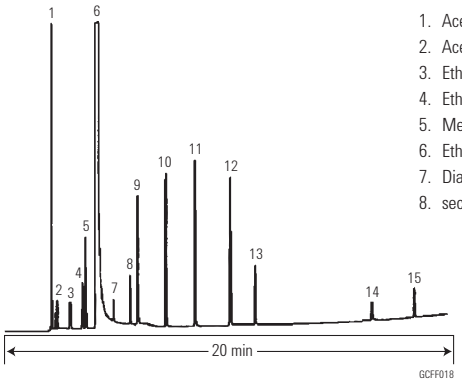
Alcohol Beverage Standard

Column: **HP-FFAP**
19091F-105
50 m x 0.20 mm, 0.33 µm

Carrier: Hydrogen

Oven: 60 °C for 4 min
60-200 °C at 6 °C/min
200 °C for 2 min

Detector: FID



1. Acetaldehyde
2. Acetone
3. Ethyl formate
4. Ethyl acetate
5. Methanol
6. Ethanol
7. Diacetyl
8. sec-Butanol
9. n-Propanol
10. Isobutanol
11. n-Butanol
12. Isoamyl alcohol
13. n-Amyl alcohol
14. Acetic acid
15. Propionic acid

Bourbon

Column: **HP-INNOWax**
19091N-133
30 m x 0.25 mm, 0.25 µm

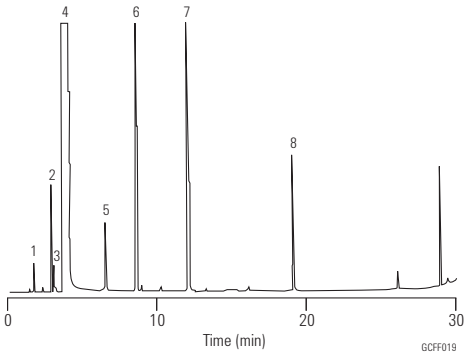
Carrier: Helium, 33 cm/s, 15.5 psi (35 °C)
1.5 mL/min constant flow

Oven: 35 °C for 5 min
35-150 °C at 5 °C/min
150-250 °C at 20 °C/min
250 °C for 2 min

Injection: Split, 220 °C
Split ratio 25:1

Detector: FID, 280 °C

Sample: 1 µL



1. Acetaldehyde
2. Ethyl acetate
3. Methanol
4. Ethanol
5. Acetic acid
6. n-Propanol
7. Isobutanol
8. 2-Methyl-1-butanol or 3-methyl-1-butanol

Alditol Acetates

Column: **DB-225**
122-2231
30 m x 0.25 mm, 0.15 µm

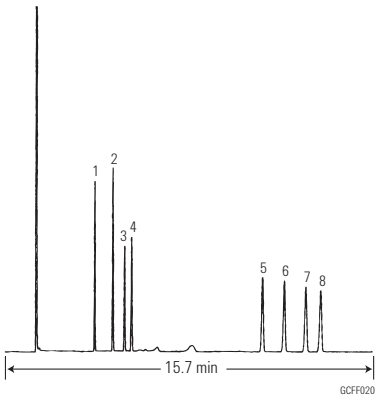
Carrier: Hydrogen at 36.5 cm/s

Oven: 220 °C isothermal

Injection: Split, 225 °C
Split ratio 1:50

Detector: FID, 250 °C
Nitrogen makeup gas at 30 mL/min

Sample: 1 µL



1. Rhamnitol
2. Fucitol
3. Ribitol
4. Arabinitol
5. Mannitol
6. Galactitol
7. Glucitol
8. Inositol

Strawberry Syrup

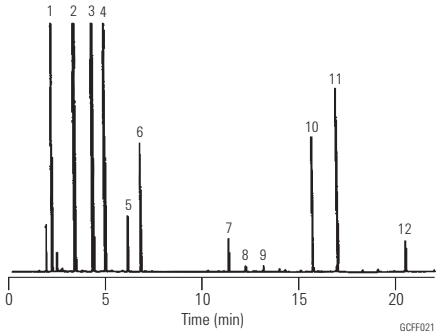
Column: **HP-INNOWax**
19091N-213
30 m x 0.32 mm, 0.50 µm

Carrier: Helium, 40 cm/s, 11.7 psi (60 °C)
2.5 mL/min constant flow

Oven: 60 °C for 1 min
60-250 °C at 10 °C/min
250 °C for 2 min

Injection: Split, 220 °C
Split ratio 60:1

Detector: FID, 275 °C



1. Ethyl acetate
2. Ethyl butyrate
3. Isoamyl acetate
4. Amyl acetate
5. Isoamyl butyrate
6. Amyl butyrate
7. Ethyl benzoate
8. Citronellol
9. Geraniol
10. Ethyl-3-phenyl oxiran carboxylate
11. Strawberry aldehyde
12. Benzyl benzoate

Separation of TMS-derivatized Sugars using VF-1ms

Column: **VF-1ms**
CP8912
30 m x 0.25 mm, 0.25 µm

Sample: 5 µL, splitless 1 µL

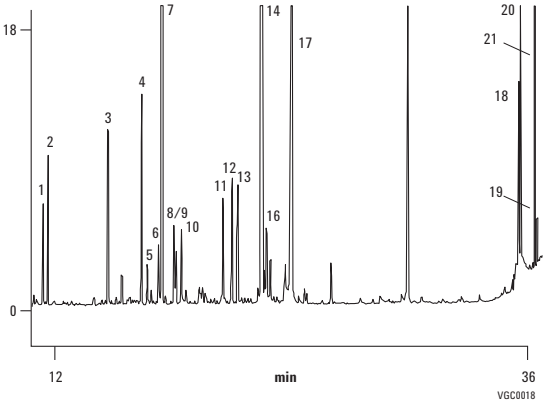
Sample Conc: 40 ppb

Carrier: He, 1.0 mL/min

Oven: 105 °C to 240 °C,
4 °C/min to 300 °C,
20 °C/min

Injection: Split; 1:15

Detector: MS



1. Threitol
2. Erythritol
3. Rhamnose 1
4. Rhamnose 2
5. Xylose 1
6. Arabitol
7. Ribitol
8. 3-0-Methylglucose 1
9. Xylose 2
10. Rhamnitol
11. 3-0-Methylglucose 2
12. Glucuronic acid-1,5-lactone
13. Ribose 2
14. Manitol
15. Sorbitol (not identified)
16. Galactitol
17. Glucuronic acid
18. Lactulose
19. Lactose
20. Sucrose
21. Threhalose

Organic Acids

Column: **DB-FFAP**
122-3232
30 m x 0.25 mm, 0.25 µm

Carrier: Helium at 40 cm/s, measured at 100 °C

Oven: 100 °C for 5 min
100-250 °C at 10 °C/min
250 °C for 12 min

Injection: Split, 250 °C
Split ratio 1:50

Detector: FID, 300 °C
Nitrogen makeup gas at 30 mL/min

Suggested Supplies

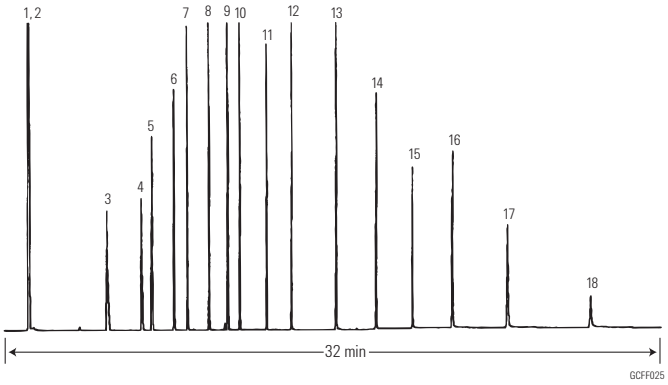
Septum: 11 mm Advanced Green septa, 5183-4759

Liner: Split, single taper, low pressure drop, glass wool, 5183-4647

Seal: Gold plated seal, 18740-20885

Syringe: 5 µL tapered, FN 23-26s/42/HP, 5181-1273

1. Acetone
2. Formic acid
3. Acetic acid
4. Propionic acid
5. Isobutyric acid
6. Butyric acid
7. Isovaleric acid
8. Valeric acid (pentanoic acid)
9. Isocaproic acid
10. Caproic acid (hexanoic acid)
11. Heptanoic acid
12. Octanoic acid
13. Decanoic acid
14. Dodecanoic acid
15. Tetradecanoic acid
16. Hexadecanoic acid
17. Octadecanoic acid
18. Arachidic acid (eicosanoic acid)



Acids

Column: **VF-WAXms**
CP9205
30 m x 0.25 mm, 0.25 µm

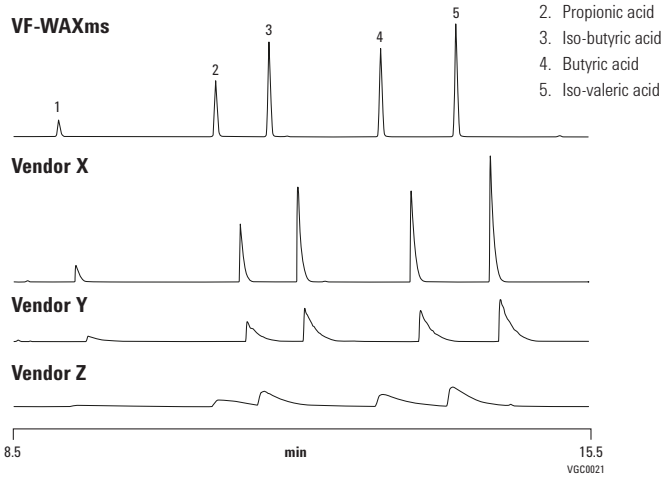
Sample: Acid sample, 0.1% (Cyclohexane), 1.0 µL

Carrier: Hydrogen, 75 kPa

Oven: 60 °C to 200 °C, 5 °C/min

Injection: 250 °C, split 100 mL/min

1. Acetic acid
2. Propionic acid
3. Iso-butyric acid
4. Butyric acid
5. Iso-valeric acid



Bacterial Fatty Acid Methyl Esters

Column: **DB-5**
122-5032
30 m x 0.25 mm, 0.25 µm

Carrier: Hydrogen at 42 cm/s

Oven: 150 °C for 4 min
150-250 °C at 4 °C/min

Injection: Split ratio 1:100

Detector: FID
Nitrogen makeup gas at 30 mL/min

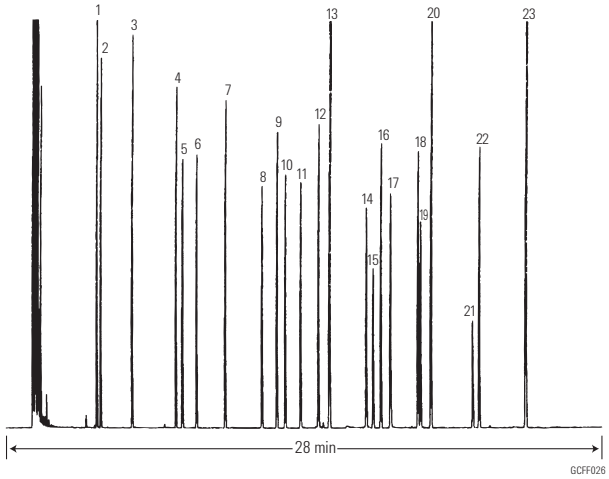
Suggested Supplies

Septum: 11 mm Advanced Green septa, 5183-4759

Liner: Split, single taper, low pressure drop, glass wool, 5183-4647

Seal: Gold plated seal, 18740-20885

Syringe: 5 µL tapered, FN 23-26s/42/HP, 5181-1273



1. $C_{11:0}$ Methyl undecanoate
2. 2-OH $C_{10:0}$ Methyl 2-hydroxydecanoate
3. $C_{12:0}$ Methyl laurate
4. $C_{13:0}$ Methyl tridecanoate
5. 2-OH $C_{12:0}$ Methyl 2-hydroxydodecanoate
6. 3-OH $C_{12:0}$ Methyl 3-hydroxydodecanoate
7. $C_{14:0}$ Methyl myristate
8. 12-Me $C_{14:0}$ Methyl 12-methyltetradecanoate
9. $C_{15:0}$ Methyl pentadecanoate
10. 2-OH $C_{14:0}$ Methyl 2-hydroxytetradecanoate
11. 3-OH $C_{14:0}$ Methyl 3-hydroxytetradecanoate
12. $C_{16:1}$ Methyl palmitoleate
13. $C_{16:0}$ Methyl palmitate
14. 14-Me $C_{16:0}$ Methyl 14-methylhexadecanoate
15. 9,10-diMe $C_{16:0}$ Methyl cis-9,10-methyl hexadecanoate
16. $C_{17:0}$ Methyl heptadecanoate
17. 2-OH $C_{16:0}$ Methyl 2-hydroxyhexadecanoate
18. $C_{18:1}$ Methyl oleate
19. $C_{18:1}$ Methyl elaidate
20. $C_{18:0}$ Methyl stearate
21. 9,10-diMe $C_{18:0}$ Methyl cis-9,10-methylene octadecanoate
22. $C_{19:0}$ Methyl nonadecanoate
23. $C_{20:0}$ Methyl arachidate

Separation of cis-trans FAME Isomers

Column: **Select FAME**
CP7421
200 m x 0.25 mm

Sample: 0.5 µL

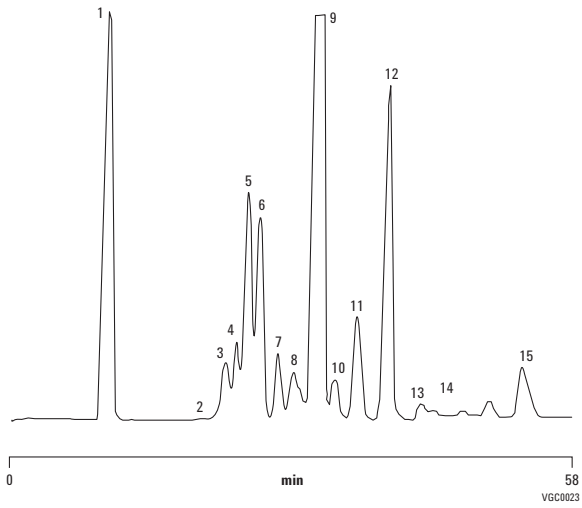
Sample Conc: 5 ng approx. per component on the column

Carrier: Helium, 520 kPa

Oven: 185 °C

Injection: Split, 1:20

Detector: FID



1. C18:0
2. C18:1 7 trans
3. C18:1 8 trans
4. C18:1 9 trans
5. C18:1 10 trans
6. C18:1 11 trans
7. C18:1 12 trans
8. C18:1 13 trans + ?
9. C18:1 9 cis
10. C18:1 10 cis
11. C18:1 11 cis
12. C18:1 12 cis
13. C18:1 13 cis
14. C18:1 14 cis
15. C18:1 15 cis

69 Component FAME Mix

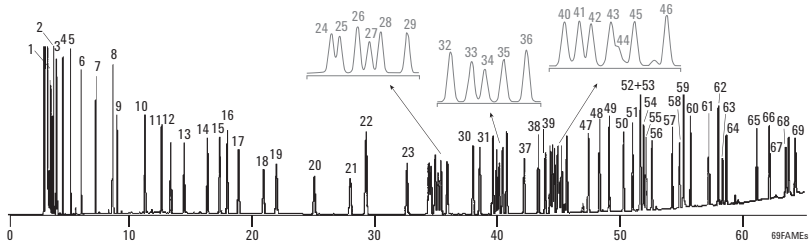
Column: **HP-88**
112-8867
60 m x 0.25 mm, 0.20 µm

Carrier: He at 1.4 mL/min constant flow

Oven: 125 °C
125 °C to 145 °C at 8 °C/min
145 °C for 26 min
145 °C to 220 °C at 2 °C/min
220 °C for 1 min

Injection: Split, 250 °C
Split ratio 50:1
1 µL of 70 ppm each in $CHCl_3$

Detector: FID, 260 °C



1. nC6:0
2. nC7:0
3. nC8:0
4. nC9:0
5. nC10:0
6. nC11:0
7. nC12:0
8. C12:1 (11c)
9. nC13:0
10. nC14:0
11. C14:1 (9t)
12. C14:1 (9c)
13. nC15:0
14. C15:1 (10t)
15. C15:1 (10c)
16. C15:1 (14c)
17. nC16:0
18. C16:1 (9t)
19. C16:1 (9c)
20. nC17:0
21. C17:1 (10t)
22. C17:1 (10c)
23. nC18:0
24. C18:1 (6t)
25. C18:1 (9t)
26. C18:1 (11t)
27. nC18:1 (6c)
28. C18:1 (9c)
29. C18:1 (11c)
30. nC18:2 (9t,12t)
31. C19:1 (10t)
32. nC19:0
33. C19:1 (7t)
34. C18:2 (9c,12c)
35. C19:1 (7c)
36. C19:1 (10c)
37. C18:3 g(6c,9c,12c)
38. nC20:0
39. C18:3 (9c,12c,15c)
40. C20:1 (5c)
41. C19:2 (10c,13c)
42. C20:1 (11t)
43. C18:2 CONJ
44. C20:1 (8c)
45. C20:1 (11c)
46. C18:2 (10t,12c)
47. nC21:0
48. C20:2 (11c,14c)
49. C21:1 (12c)
50. C20:3 (8c,11c,14c)
51. nC22:0
52. C22:1 (13t)
53. C20:4 (5c,8c,11c,14c)
54. C20:3 (11c,14c,17c)
55. C21:2 (12c,15c)
56. C22:1 (13c)
57. nC23:0
58. C20:5 (EPA)
59. C22:2 (13c,16c)
60. C23:1 (14c)
61. nC24:0
62. C22:3 (13c,16c,19c)
63. C22:4 (7c,10c,13c,16c)
64. C24:1 (15c)
65. C22:5 (DPA)
66. C22:6 (DHA)
67. C18:1-12 Hydroxy (9t)
68. C18:0 12 Hydroxy
69. C18:1-12 Hydroxy (9c)

FAME Standard

Column: **DB-WAX**
127-7012
10 m x 0.10 mm, 0.10 µm

Carrier: Hydrogen at 77 cm/s,
measured at 40 °C

Oven: 40 °C for 0.5 min
40-195 °C at 25 °C/min
195-205 °C at 3 °C/min
205-230 °C at 8° C/min
230° C for 1 min

Injection: Split, 250 °C
Split ratio 1:30

Detector: FID, 250 °C

Suggested Supplies

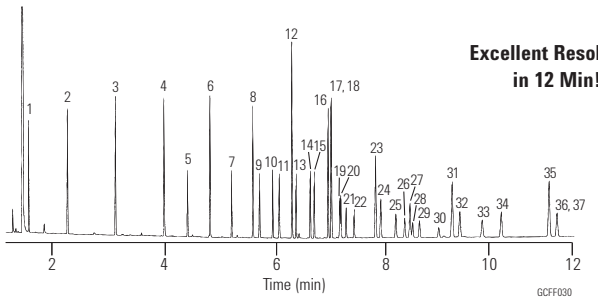
Septum: 11 mm Advanced Green septa, 5183-4759

Liner: Split, single taper, low pressure drop, glass wool, 5183-4647

Seal: Gold plated seal, 18740-20885

Syringe: 5 µL tapered, FN 23-26s/42/HP, 5181-1273

1. Butyric acid methyl ester ($C_{4:0}$)
2. Caproic acid methyl ester ($C_{6:0}$)
3. Caprylic acid methyl ester ($C_{8:0}$)
4. Capric acid methyl ester ($C_{10:0}$)
5. Undecanoic acid methyl ester ($C_{11:0}$)
6. Lauric acid methyl ester ($C_{12:0}$)
7. Tridecanoic acid methyl ester ($C_{13:0}$)
8. Myristic acid methyl ester ($C_{14:0}$)
9. Myristoleic acid methyl ester ($C_{14:1}$)
10. Pentadecanoic acid methyl ester ($C_{15:0}$)
11. cis-10-Pentadecenoic acid methyl ester ($C_{15:1}$)
12. Palmitic acid methyl ester ($C_{16:0}$)
13. Palmitoleic acid methyl ester ($C_{16:1}$)
14. Heptadecanoic acid methyl ester ($C_{17:0}$)
15. cis-10-Heptadecenoic acid methyl ester ($C_{17:1}$)
16. Stearic acid methyl ester ($C_{18:0}$)
17. Oleic acid methyl ester ($C_{18:1n9c}$)
18. Elaidic acid methyl ester ($C_{18:1n9t}$)
19. Linoleic acid methyl ester ($C_{18:2n6c}$)
20. Linolelaidic acid methyl ester ($C_{18:2n6t}$)
21. γ-Linolenic acid methyl ester ($C_{18:3n6}$)
22. Linolenic acid methyl ester ($C_{18:3n3}$)
23. Arachidic acid methyl ester ($C_{20:0}$)
24. cis-11-Eicosenoic acid methyl ester ($C_{20:1}$)
25. cis-11,14-Eicosadienoic acid methyl ester ($C_{20:2}$)
26. cis-8,11,14-Eicosatrienoic acid methyl ester ($C_{20:3n6}$)
27. Heneicosanoic acid methyl ester ($C_{21:0}$)
28. cis-11,14,17-Eicosatrienoic acid methyl ester ($C_{20:3n3}$)
29. Arachidonic acid methyl ester ($C_{20:4n6}$)
30. cis-5,8,11,14,17-Eicosapentaenoic acid methyl ester ($C_{20:5n3}$)
31. Behenic acid methyl ester ($C_{22:0}$)
32. Erucic acid methyl ester ($C_{22:1n9}$)
33. cis-13,16-Docosadienoic acid methyl ester ($C_{22:2}$)
34. Tricosanoic acid methyl ester ($C_{23:0}$)
35. Lignoceric acid methyl ester ($C_{24:0}$)
36. cis-4,7,10,13,16,19-Docosahexaenoic acid methyl ester ($C_{22:6n3}$)
37. Nervonic acid methyl ester ($C_{24:1}$)



FAME Standard

Column: **DB-225**
127-2222
20 m x 0.10 mm, 0.10 µm

Carrier: Hydrogen at 59.3 cm/s, measured at 35 °C

Oven: 35 °C for 0.5 min
35-195 °C at 25 °C/min
195-205 °C at 3 °C/min
205-230 °C at 8 °C/min
230 °C for 1 min

Injection: Split, 250 °C
Split ratio 1:30

Detector: FID, 250 °C

Suggested Supplies

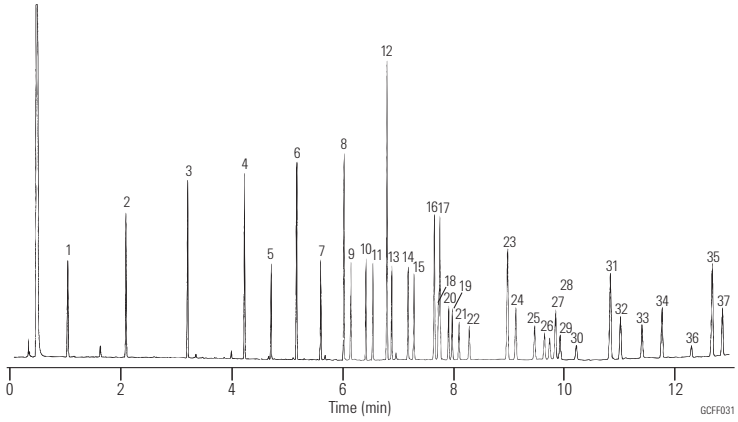
Septum: 11 mm Advanced Green septa, 5183-4759

Liner: Split, single taper, low pressure drop, glass wool, 5183-4647

Seal: Gold plated seal, 18740-20885

Syringe: 5 µL tapered, FN 23-26s/42/HP, 5181-1273

1. Butyric acid methyl ester (C4:0)
2. Caproic acid methyl ester (C6:0)
3. Caprylic acid methyl ester (C8:0)
4. Capric acid methyl ester (C10:0)
5. Undecanoic acid methyl ester (C11:0)
6. Lauric acid methyl ester (C12:0)
7. Tridecanoic acid methyl ester (C13:0)
8. Myristic acid methyl ester (C14:0)
9. Myristoleic acid methyl ester (C14:1)
10. Pentadecanoic acid methyl ester (C15:0)
11. cis-10-Pentadecenoic acid methyl ester (C15:1)
12. Palmitic acid methyl ester (C16:0)
13. Palmitoleic acid methyl ester (C16:1)
14. Heptadecanoic acid methyl ester (C17:0)
15. cis-10-Heptadecenoic acid methyl ester (C17:1)
16. Stearic acid methyl ester (C18:0)
17. Oleic acid methyl ester (C18:1n9c)
18. Elaidic acid methyl ester (C18:1n9t)
19. Linoleic acid methyl ester (C18:2n6c)
20. Linolelaidic acid methyl ester (C18:2n6t)
21. γ-Linolenic acid methyl ester (C18:3n6)
22. Linolenic acid methyl ester (C18:3n3)
23. Arachidic acid methyl ester (C20:0)
24. cis-11-Eicosenoic acid methyl ester (C20:1)
25. cis-11,14-Eicosadienoic acid methyl ester (C20:2)
26. cis-8,11,14-Eicosatrienoic acid methyl ester (C20:3n6)
27. Heneicosanoic acid methyl ester (C21:0)
28. cis-11,14,17-Eicosatrienoic acid methyl ester (C20:3n3)
29. Arachidonic acid methyl ester (C20:4n6)
30. cis-5,8,11,14,17-Eicosapentaenoic acid methyl ester (C20:5n3)
31. Behenic acid methyl ester (C22:0)
32. Erucic acid methyl ester (C22:1n9)
33. cis-13,16-Docosadienoic acid methyl ester (C22:2)
34. Tricosanoic acid methyl ester (C23:0)
35. Lignoceric acid methyl ester (C24:0)
36. cis-4,7,10,13,16,19-Docosahexaenoic acid methyl ester (C22:6n3)
37. Nervonic acid methyl ester (C24:1)



Canola Oil Margarine Partially Hydrogenated FAMEs AOCS Method 1c-89

Column: **DB-23**
122-2362
60 m x 0.25 mm, 0.25 µm

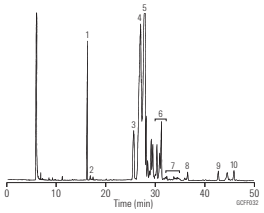
Carrier: Helium at 15 cm/s (0.44 mL/min), measured at 150 °C

Oven: 150-200 °C at 1.3 °C/min
200 °C for 10 min

Injection: Split, 210 °C
Split 1:100

Detector: FID, 210 °C

Sample: 1 µL



Suggested Supplies

Septum: 11 mm Advanced Green septa, 5183-4759

Liner: Split, single taper, low pressure drop, glass wool, 5183-4647

Seal: Gold plated seal, 18740-20885

Syringe: 5 µL tapered, FN 23-26s/42/HP, 5181-1273

1. C16:0 Methyl palmitate
2. C16:1 Methyl palmitoleate
3. C18:0 Methyl stearate
4. C18:1 trans-Methyl elaidate and multiple isomers
5. C18:1 cis-Methyl oleate and multiple isomers
6. C18:2 trans-Multiple isomers
7. C18:2 cis-Multiple isomers
8. C18:3 Methyl linolenate
9. C20:0 Methyl arachidate
10. C20:1 Methyl 11-eicosanoate

Butter Triglycerides I

Column: **DB-5ht**
123-5731
30 m x 0.32 mm, 0.10 µm

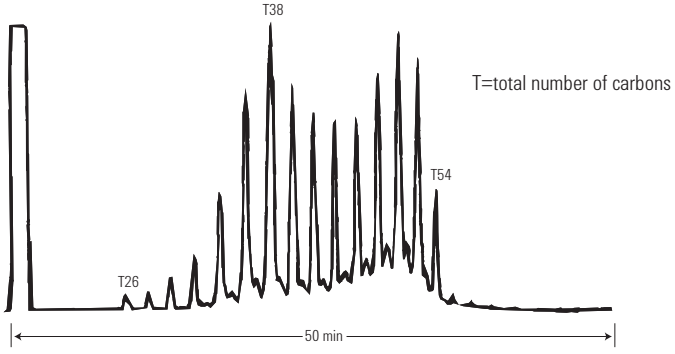
Carrier: Hydrogen at 55 cm/s, measured at 250 °C

Oven: 35-250 °C at 70 °C/min
250-400 °C at 5 °C/min
400 °C for 20 min

Injection: Cool on-column

Detector: FID, 400 °C
Nitrogen makeup gas at 30 mL/min
Baseline corrected

Sample: 1 µL of 9 µg/µL in toluene
(approximately 1% w/w solution)



Butter Triglycerides II

Column: **DB-17ht**
123-1831
30 m x 0.32 mm, 0.15 µm

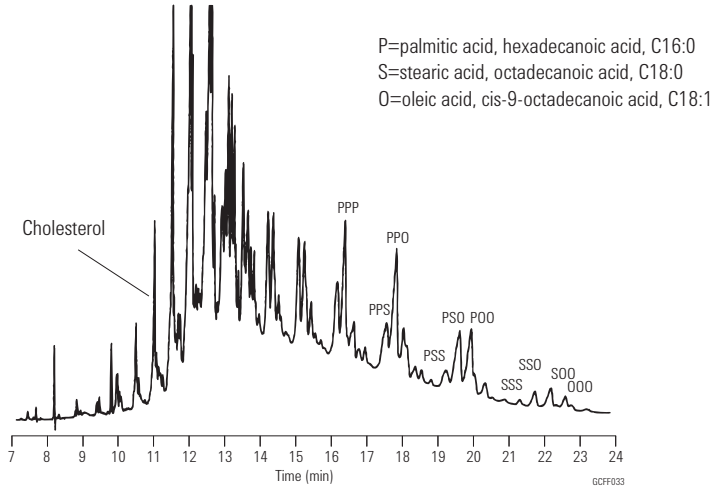
Carrier: Hydrogen at 40 cm/s

Oven: 250-365 °C at 5 °C/min
365 °C for 1 min

Injection: Cool on-column

Detector: FID, 400 °C
Nitrogen makeup gas at 30 mL/min
Baseline corrected

Sample: 1 µL of 9 µg/µL in toluene
(approximately 1% w/w solution)



Fast Screening of FAME Isomers in Butter

Column: **VF-23ms**
CP8822
30 m x 0.25 mm, 0.25 µm

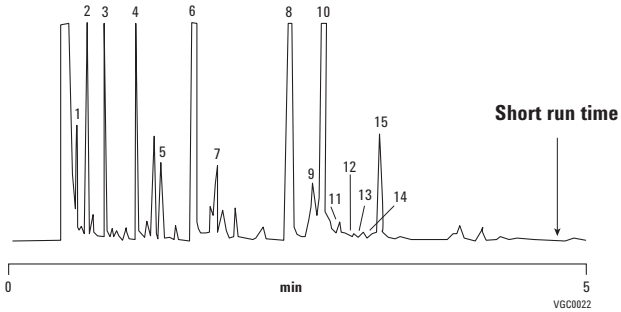
Sample: 0.5 µL ca. 5 ng per component on column

Carrier: Hydrogen, 70 kPa

Oven: 185 °C

Injection: Split, 1:100
T=275 °C

Detector: FID



1. C8:0
2. C10:0
3. C12:0
4. C14:0
5. C14:1
6. C14:1
7. C16:1 9-cis
8. C16:1 9-cis
9. C18:1 trans
10. C18:1 9-cis
11. C18:1 13-cis
12. C18:2 9-trans, 12-trans
13. C18:2 9-cis, 12-trans
14. C18:2 9-trans,12-cis
15. C18:2 9-cis, 12-cis

Pesticides in Sunflower Oil

Column: **VF-5ms**
CP8960
60 m x 0.25 mm, 0.25 µm

Sample: 5 µL, splitless

Sample Conc: 40 ppb

Carrier: He, 1.2 mL/min, constant flow

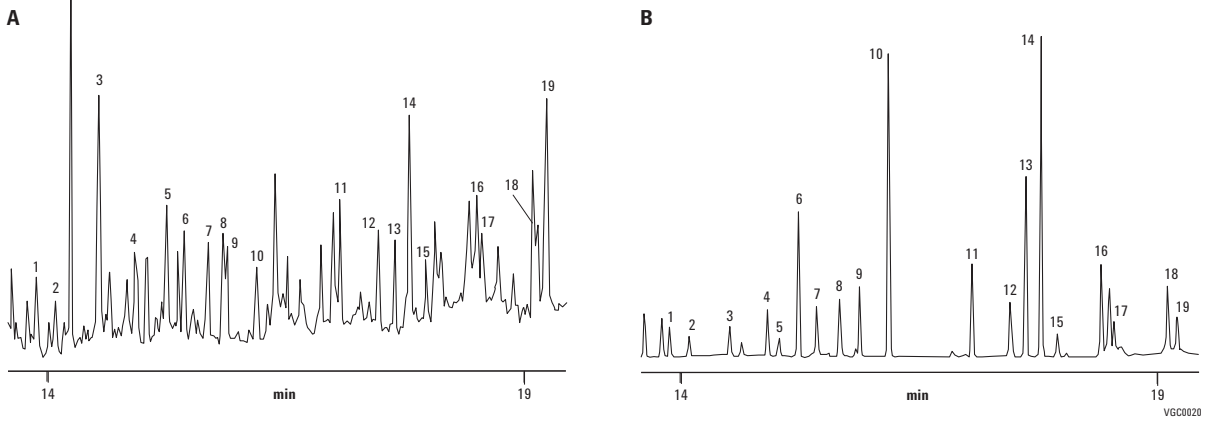
Oven: 70 °C (3.0 min), 25 °C to 190 °C/min (0.0 min) to 10 °C/min to 320 °C (10 min)

Injection: 1079 with carbofrit liner

Detector: A: Ion Trap in MS/MS, full scan
B: MS/MS

1. β-HCH
2. γ-HCH
3. δ-HCH
4. + Vinclozolin
5. Pyrimiphos methyl
6. + Malathion
7. Chloropyrifos
8. Ethyl parathion
9. Pyrimiphos ethyl
10. Bromofos
11. o,p'-DDE
12. α-Endosulfan
13. p,p'-DDE
14. o,p'-DDD
15. Dieldrin
16. p,p'-DDD
17. b Endosulfan
18. p,p'-DDT
19. Endosulfan sulfate

1. β-HCH
2. γ-HCH
3. δ-HCH
4. + Vinclozolin
5. Methyl parathion
6. Pyrimiphos methyl
7. + +Fenitrothion
8. Chloropyrifos
9. Pyrimiphos ethyl
10. Promofos
11. o,p'-DDE
12. α-Endosulfan
13. p,p'-DDE
14. o,p'-DDD
15. Dieldrin
16. p,p'-DDD
17. b Endosulfan
18. p,p'-DDT
19. Endosulfan sulfate



Energy and Fuels Applications

Fast Analysis of Aromatic Solvent

Column: **HP-INNOWax**
19091N-216
60 m x 0.32 mm, 0.50 µm

Carrier: Helium at 20 psi constant pressure mode

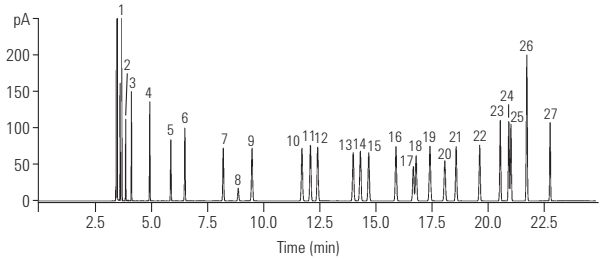
Oven: 75 °C (10 min); 3 °C/min to 100 °C (0 min)
10 °C/min to 145 °C (0 min)

Injection: Split/splitless at 250 °C
100:1 split ratio

Detector: FID at 250 °C

Sample: 1.0 µL

Unified aromatic solvent method



Column: **HP-INNOWax**
19091N-577
20 m x 0.18 mm, 0.18 µm

Carrier: Helium at 33 psi constant pressure mode

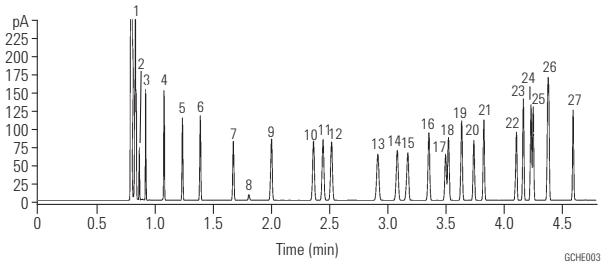
Oven: 70 °C (3 min); 45 °C/min to 145 °C (1 min)

Injection: Split/splitless at 250 °C
100:1 to 600:1 split ratio

Detector: FID at 250 °C

Sample: 0.2 to 1.0 µL

Optimized unified aromatic solvent method



1. Heptane
2. Cyclohexane
3. Octane
4. Nonane
5. Benzene
6. Decane
7. Toluene
8. 1,4-Dioxane
9. Undecane
10. Ethylbenzene
11. p-Xylene
12. m-Xylene
13. Cumene
14. Dodecane
15. o-Xylene
16. Propylbenzene
17. p-Ethyltoluene
18. m-Ethyltoluene
19. t-Butylbenzene
20. s-Butylbenzene
21. Styrene
22. Tridecane
23. 1,3-Diethylbenzene
24. 1,2-Diethylbenzene
25. n-Butylbenzene
26. a-Methylstyrene
27. Phenylacetylene

This application showcases the practicality using high efficiency GC columns in daily aromatic solvent analysis. The result: a four-fold reduction in run time (compared to a 0.32 mm id column) with no compromise in resolution.