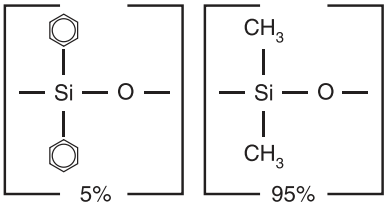
Brominated Flame Retardants Analysis

Rtx®-1614 Structure

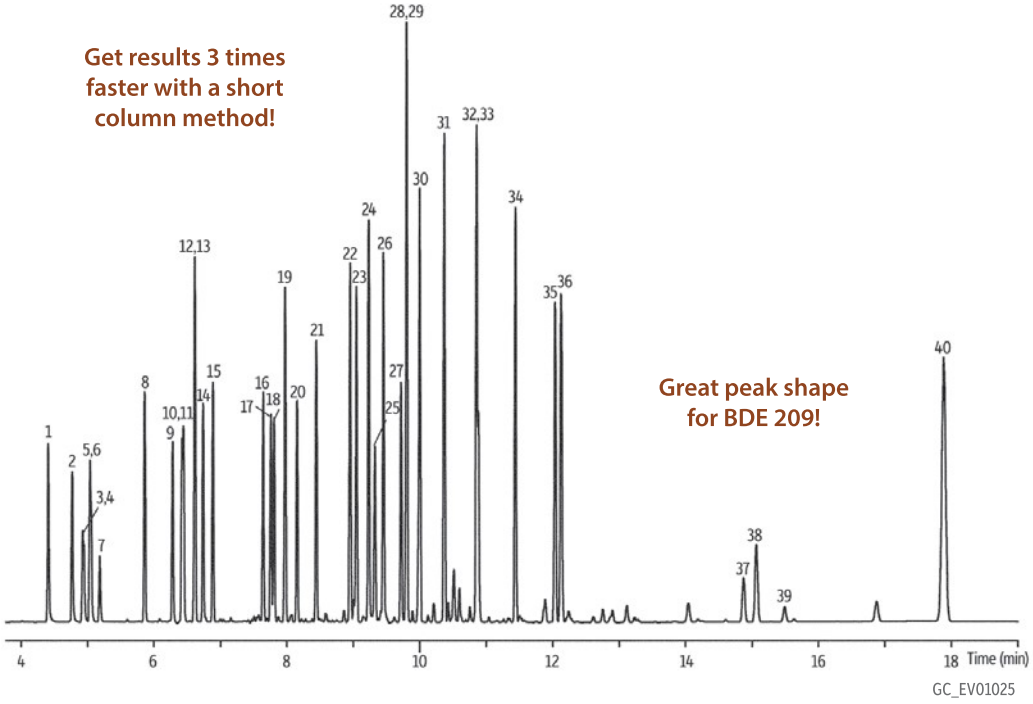


Rtx®-1614 Columns (fused silica)
(5% diphenyl, 95% dimethyl polysiloxane)

- Optimized for PBDE analysis by EPA Method 1614.
- Short column option resolves BDE-209 3 times faster, with less thermal breakdown.
- Unique deactivation gives higher BDE-209 response than competitor columns, for greater analytical sensitivity.
- Exceeds EPA Method 1614 resolution criteria for BDE-49 and BDE-71.
- Stable to 360 °C.

ID	df	temp. limits	15-Meter cat.#	30-Meter cat.#
0.25 mm	0.10 µm	-60 to 330/360 °C	10296	10295

Brominated Flame Retardants on Rtx®-1614



Peaks
1. BDE-10
2. BDE-7
3. BDE-8
4. BDE-11
5. BDE-12
6. BDE-13
7. BDE-15
8. BDE-30
9. BDE-32
10. BDE-17
11. BDE-25
12. BDE-28
13. BDE-33
14. BDE-35
15. BDE-37
16. BDE-75
17. BDE-49
18. BDE-71
19. BDE-47
20. BDE-66
21. BDE-77
22. BDE-100
23. BDE-119
24. BDE-99
25. BDE-116
26. BDE-118
27. BDE-85
28. BDE-155
29. BDE-126
30. BDE-154
31. BDE-153
32. BDE-138
33. BDE-166
34. BDE-183
35. BDE-181
36. BDE-190
37. BDE-208
38. BDE-207
39. BDE-206
40. BDE-209

Column Rtx®-1614, 15 m, 0.25 mm ID, 0.10 µm (cat.# 10296)
Sample 100 - 300 ppb PBDE PAR solution (#EO-5113, Cambridge Isotope Laboratories Inc.)
500 ppb decabromodiphenyl ether (#BDE-209, Wellington Laboratories)
Injection
Inj. Vol.: 1 µL splitless (hold 1 min)
Liner: 4 mm cyclo double taper (cat.# 20896)
Inj. Temp.: 340 °C
Oven
Oven Temp.: 120 °C (hold 1 min) to 275 °C at 15 °C/min to 300 °C at 5 °C/min (hold 5 min)
Carrier Gas
Linear Velocity: 60 cm/sec @ 120 °C
Detector µ-ECD @ 345 °C

Dioxin & Furan Analysis

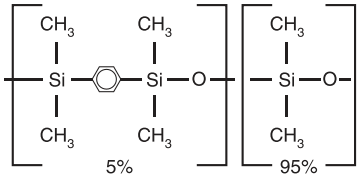
Rxi®-5Sil MS Columns (fused silica)
(low-polarity phase; Crossbond® 1,4-bis(dimethylsiloxy)phenylene dimethyl polysiloxane)

- Engineered to be a low-bleed GC-MS column.
- Excellent inertness for active compounds.
- Ideal for use in dual column confirmation of dioxin and furan.
- Temperature range: -60 °C to 350 °C.

The Rxi®-5Sil MS stationary phase incorporates phenyl groups in the polymer backbone. This improves thermal stability, reduces bleed, and makes the phase less prone to oxidation. Rxi®-5Sil MS columns are ideal for GC-MS applications requiring high sensitivity, including use in ion trap systems.

ID	df	temp. limits	30-Meter cat.#	60-Meter cat.#
0.18 mm	0.10 µm	-60 to 320/350 °C		43607
0.25 mm	0.25 µm	-60 to 320/350 °C	13623	

Rxi®-5Sil MS Structure

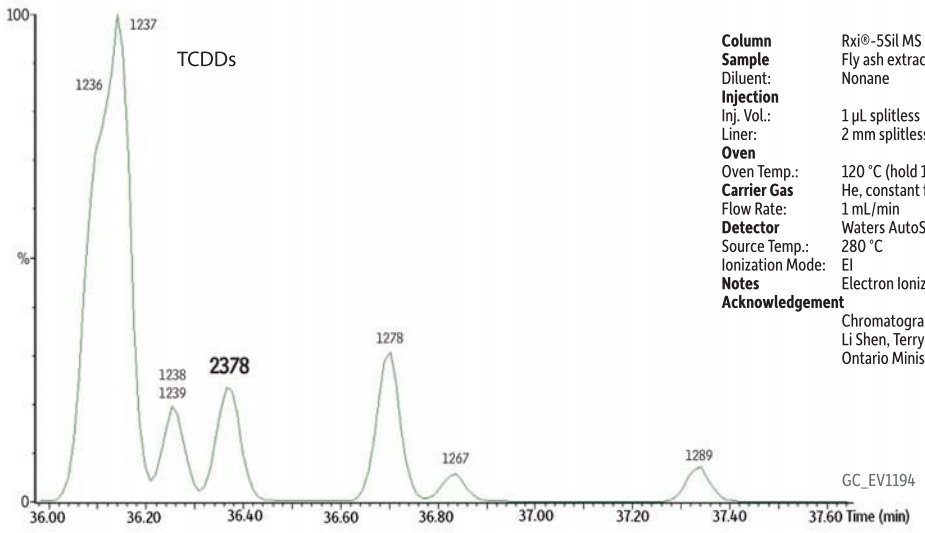


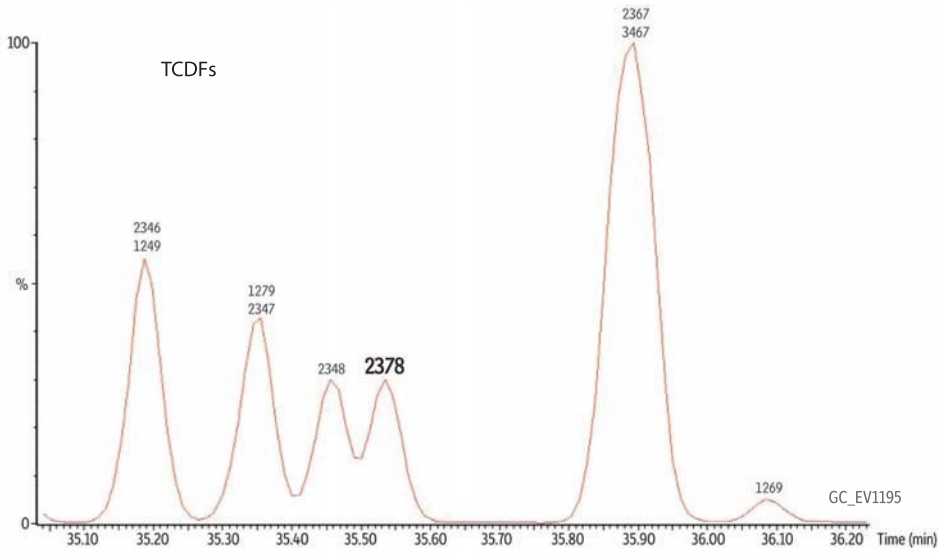
Similar to: (5%-phenyl)-methylpolysiloxane

similar phases

DB-5ms, DB-5msUI, VF-5ms, ZB-5ms, ZB-SemiVolatiles, Rtx-5Sil MS

Dioxins (TCDDs) and Furans (TCDFs) in Fly Ash on an Rxi®-5Sil MS column





Column	Rxi®-5Sil MS , 60 m, 0.18 mm ID, 0.10 µm (cat.#43607)
Sample	Fly ash extract
Diluent:	Nonane
Injection	
Inj. Vol.:	1 µL splitless
Liner:	2 mm splitless liner (cat.# 20712)
Oven	
Oven Temp.:	120 °C (hold 1 min) to 160 °C at 10 °C/min to 300°C at 2.5°C/min
Carrier Gas	He, constant flow
Flow Rate:	1 mL/min
Detector	Waters AutoSpec Ultima Mass Spectrometer
Source Temp.:	280 °C
Ionization Mode:	EI
Notes	Electron Ionization at 40eV
Acknowledgement	Chromatogram courtesy of Karen MacPherson, Li Shen, Terry Kolic, and Eric Reiner at the Ontario Ministry of the Environment

Restek innovation!

Excellent for dioxins or furans.

"Using the Rtx®-Dioxin2 column allowed us to combine EPA 1613 TCDD-only and TCDF confirmation analyses onto one column and one instrument. This resulted in multiple benefits—we shortened run times, reduced instrument downtime and column changes, and increased instrument capacity for our full list samples."

Owen Cosby
Supervisor, HRMS Services
Maxxam Analytics

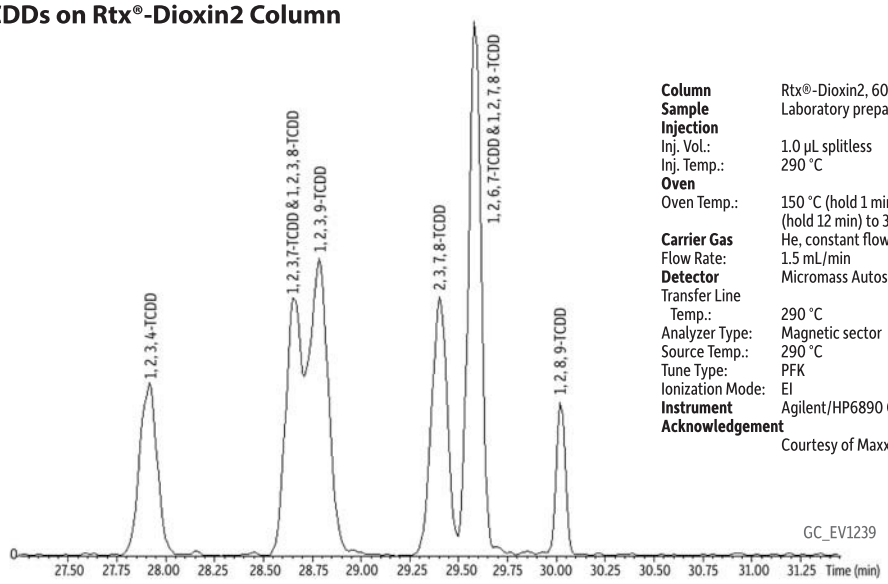
Dioxin & Furan Analysis

Rtx®-Dioxin2 Columns (fused silica)
(proprietary Crossbond® phase)

- Isomer specificity for 2,3,7,8-TCDD and 2,3,7,8-TCDF achieved with one GC column.
- Thermally stable to 340 °C for longer lifetime.
- Unique selectivity for toxic dioxin and furan congeners allows use as a confirmation GC column.

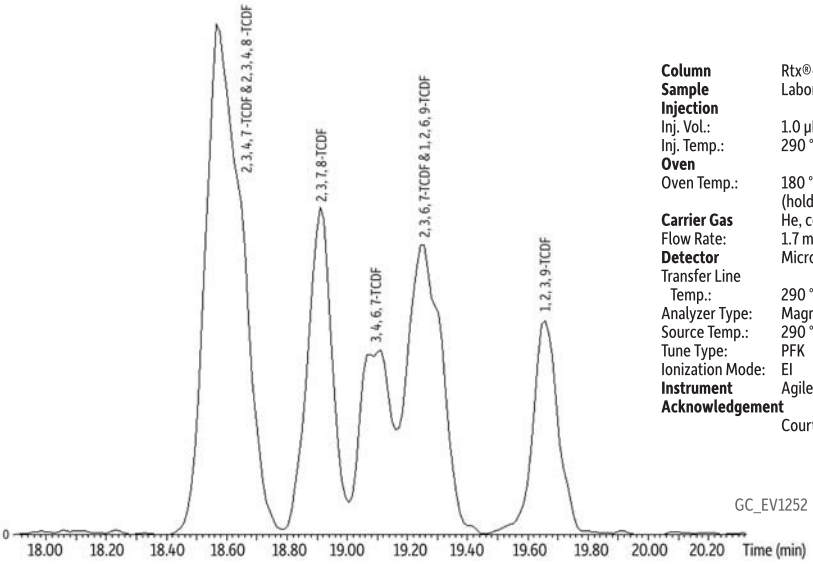
ID	df	temp. limits	40-Meter cat.#	60-Meter cat.#
0.18 mm	0.18 µm	20 to 320/340 °C	10759	
0.25 mm	0.25 µm	20 to 320/340 °C		10758

TCDDs on Rtx®-Dioxin2 Column



Column Rtx®-Dioxin2, 60 m, 0.25 mm ID, 0.25 µm (cat.# 10758)
Sample Laboratory prepared test mix
Injection
Inj. Vol.: 1.0 µL splitless
Inj. Temp.: 290 °C
Oven
Oven Temp.: 150 °C (hold 1 min) to 210 °C at 30 °C/min (hold 1 min) to 250 °C at 3 °C/min (hold 12 min) to 330 °C at 70 °C/min (hold 6 min)
Carrier Gas
Flow Rate: 1.5 mL/min
Detector Micromass Autospec Ultima
Transfer Line Temp.: 290 °C
Analyzer Type: Magnetic sector
Source Temp.: 290 °C
Tune Type: PFK
Ionization Mode: EI
Instrument Agilent/HP6890 GC
Acknowledgement
Courtesy of Maxxam Analytics (Ontario, Canada).

TCDFs on Rtx®-Dioxin2 Column



Column Rtx®-Dioxin2, 60 m, 0.25 mm ID, 0.25 µm (cat.# 10758)
Sample Laboratory prepared test mix
Injection
Inj. Vol.: 1.0 µL splitless
Inj. Temp.: 290 °C
Oven
Oven Temp.: 180 °C (hold 1 min) to 235 °C at 45 °C/min (hold 1 min) to 250 °C at 3 °C/min (hold 15 min) to 300 °C at 50 °C/min (hold 1 min)
Carrier Gas
Flow Rate: 1.7 mL/min
Detector Micromass Autospec Ultima
Transfer Line Temp.: 290 °C
Analyzer Type: Magnetic sector
Source Temp.: 290 °C
Tune Type: PFK
Ionization Mode: EI
Instrument Agilent/HP6890 GC
Acknowledgement
Courtesy of Maxxam Analytics (Ontario, Canada).

Mineral Oils/Extractable Petroleum Hydrocarbon Analysis

Rtx®-Mineral Oil Columns (fused silica)

- Application specific columns meet DIN EN ISO 9377-2:2000 requirements.
- Optimized column dimensions for fast mineral oil screening.
- Surface linked phase guarantees long lifetime, robustness, and stability to 400 °C.

The Rtx®-Mineral Oil stationary phase and column dimensions were optimized for the fast screening of mineral oils in extracts from solids and water samples according to DIN EN ISO 9377-2:2000. The 0.10 µm column is the gold standard for the method, whereas the 0.15 µm column provides more complete separation of C10 from the solvent peak when large injection volumes are used. Compared with common industry solutions, the unique surface bonding of the Rtx®-Mineral Oil column ensures long column lifetime, even at higher temperatures. These unique columns can be used at temperatures ranging from 380 °C (isothermal) to 400 °C (programmable), and each column is tested individually for bleed to ensure exceptional performance at these extreme conditions.

ID	df	temp. limits	15-Meter cat.#
0.32 mm	0.10 µm	-60 to 380/400 °C	18079
	0.15 µm	-60 to 380/400 °C	18074
	0.30 µm	-60 to 380/400 °C	18075

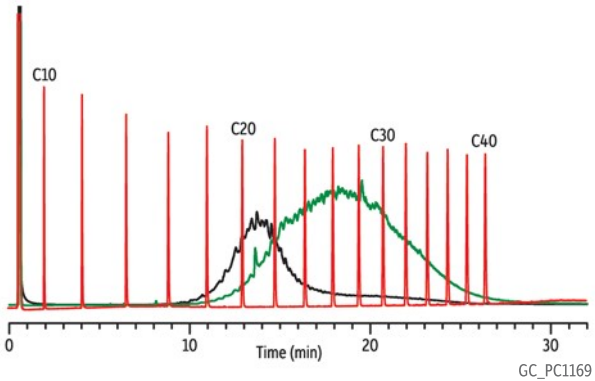
similar phases

Select Mineral Oil

Fused Silica Capillary & PLOT Column Ferrule Guide

GC Column ID	Ferrule ID
0.15 mm	0.4
0.18 mm	0.4
0.25 mm	0.4
0.32 mm	0.5
0.53 mm	0.8

Mineral Oil and Motor Oil on Rtx®-Mineral Oil



GC_PC1169

Column	Rtx®-Mineral Oil, 15 m, 0.32 mm ID, 0.15 µm (cat.# 18074) using IP deactivated guard column 2 m, 0.53 mm ID (cat.# 10047)
Sample	Custom mineral oil/motor oil mix
Diluent:	Hexane
Conc.:	500 µg/mL
Injection	
Inj. Vol.:	0.5 µL cold on-column
Temp. Program:	53 °C to 300 °C at 10 °C/min (hold 20 min)
Oven	
Oven Temp.:	50 °C to 300 °C at 10 °C/min (hold 20 min)
Carrier Gas	H_2, constant flow
Linear Velocity:	40 cm/sec @ 50 °C
Dead Time:	0.625 min @ 50 °C
Detector	FID @ 330 °C
Make-up Gas Flow Rate:	30 mL/min
Make-up Gas Type:	N_2
Data Rate:	20 Hz
Instrument	Agilent/HP6890 GC
Notes	Black trace = mineral oil Green trace = motor oil Red trace = C10-C40 standard

Restek's state-of-the-art facility and rigorous product testing programs ensure you get the quality you need for accurate, reliable results.

Restek innovation!

See **pages 193–202.**

PCB Congeners Analysis

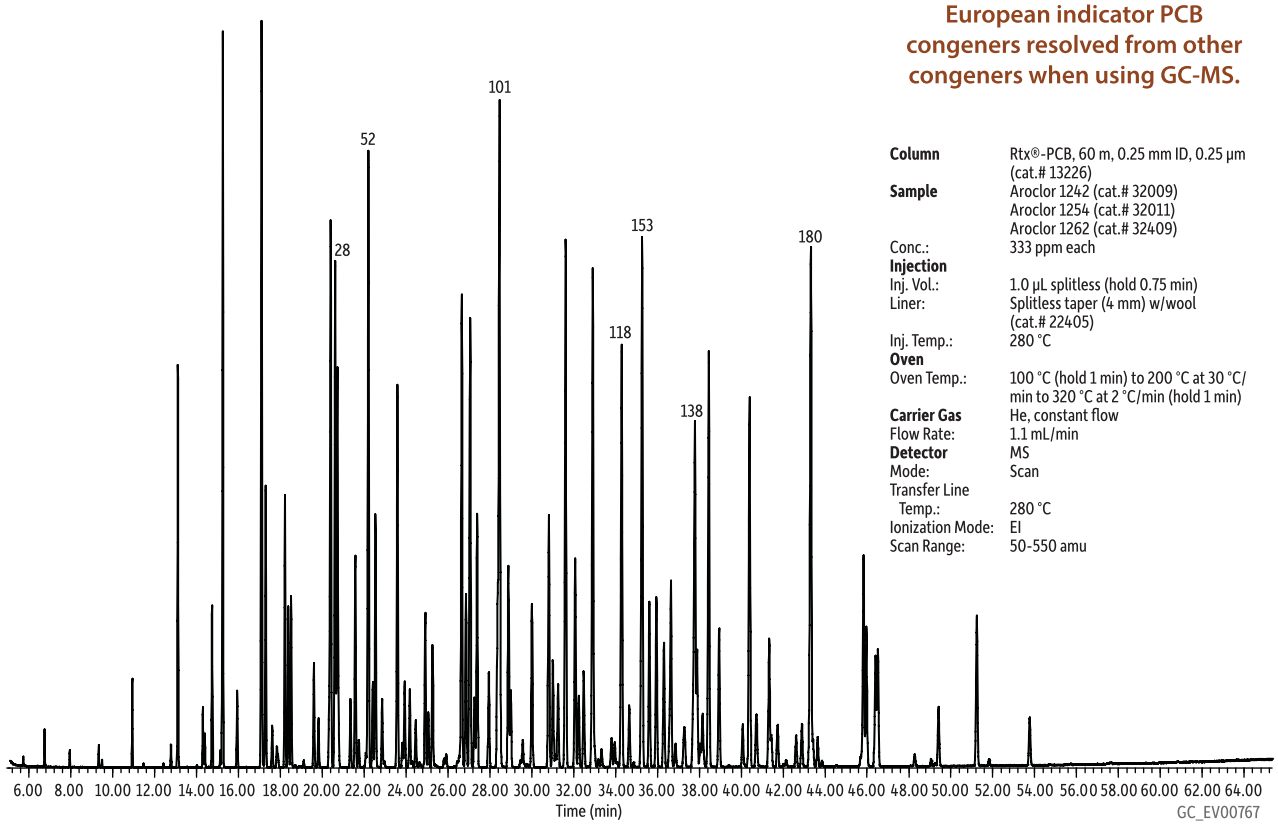
Rtx®-PCB Columns (fused silica)
(proprietary Crossbond® phase)

- Unique polymer for PCBs analysis by GC-ECD or GC-MS.
- Good results for other semivolatiles.
- Low polarity; inert to active compounds.
- Stable to 340 °C.

ID	df	temp. limits*	20-Meter cat.#	30-Meter cat.#	40-Meter cat.#	60-Meter cat.#
0.18 mm	0.18 µm	30 °C to 320 °C	41302		41303	41304
0.25 mm	0.25 µm	30 °C to 320/340 °C		13223		13226
0.32 mm	0.50 µm	30 °C to 320/340 °C		13239		

*Maximum temperatures listed are for shorter length columns. Longer columns may have a different maximum temperature.

Aroclor PCBs on Rtx®-PCB



Peaks identified with PCB congener numbers.

European indicator PCB congeners resolved from other congeners when using GC-MS.

Column	Rtx®-PCB, 60 m, 0.25 mm ID, 0.25 µm (cat.# 13226)
Sample	Aroclor 1242 (cat.# 32009) Aroclor 1254 (cat.# 32011) Aroclor 1262 (cat.# 32409)
Conc.:	333 ppm each
Injection	
Inj. Vol.:	1.0 µL splitless (hold 0.75 min)
Liner:	Splitless taper (4 mm) w/wool (cat.# 22405)
Inj. Temp.:	280 °C
Oven	
Oven Temp.:	100 °C (hold 1 min) to 200 °C at 30 °C/min to 320 °C at 2 °C/min (hold 1 min)
Carrier Gas	He, constant flow
Flow Rate:	1.1 mL/min
Detector	MS
Mode:	Scan
Transfer Line Temp.:	280 °C
Ionization Mode:	EI
Scan Range:	50-550 amu

PCB Congeners Analysis

Rxi®-XLB Columns (fused silica)
(low-polarity proprietary phase)

- General-purpose columns exhibiting extremely low bleed. Ideal for many GC-MS applications, including pesticides, PCB congeners (e.g., Aroclor mixes), PAHs.
- Unique selectivity.
- Temperature range: 30 °C to 360 °C.

similar phases

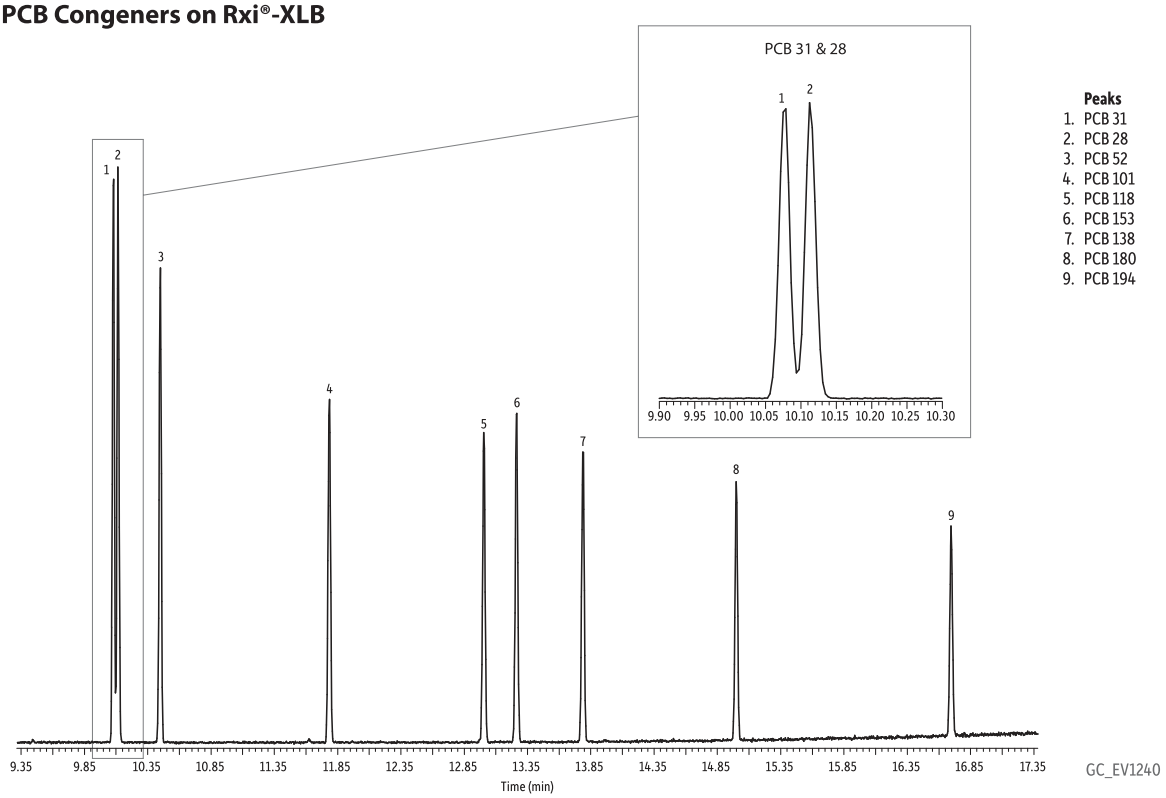
DB-XLB, VF-Xms, MR1, ZB-XLB

ID	df	temp. limits*	15-Meter cat.#	30-Meter cat.#	60-Meter cat.#
0.25 mm	0.10 µm	30 to 340/360 °C	13705	13708	
	0.25 µm	30 to 340/360 °C	13720	13723	13726
	0.50 µm	30 to 340/360 °C		13738	
	1.00 µm	30 to 340/360 °C		13753	
0.32 mm	0.25 µm	30 to 340/360 °C		13724	13727
	0.50 µm	30 to 340/360 °C		13739	
	1.00 µm	30 to 340/360 °C		13754	
0.53 mm	0.50 µm	30 to 320/360 °C		13740	

ID	df	temp. limits	20-Meter cat.#
0.18 mm	0.18 µm	30 to 340/360 °C	43702

*Maximum temperatures listed are for shorter length columns. Longer columns may have a different maximum temperature.

EU PCB Congeners on Rxi®-XLB



Peaks
1. PCB 31
2. PCB 28
3. PCB 52
4. PCB 101
5. PCB 118
6. PCB 153
7. PCB 138
8. PCB 180
9. PCB 194

Column	Rxi®-XLB, 30 m, 0.25 mm ID, 0.25 µm (cat.# 13723)
Sample	PCB congener standard #2 (cat.# 32294)
	PCB 31 (cat.# custom)
Diluent:	Dichloromethane
Conc.:	3.5 ppm
Injection	
Inj. Vol.:	0.5 µL splitless (hold 1.75 min)
Liner:	2.0 mm ID straight inlet liner w/wool (cat.# 21718)
Inj. Temp.:	300 °C
Purge Flow:	50 mL/min
Oven	
Oven Temp.:	40 °C (hold 2 min) to 240 °C at 30 °C/min (hold 2 min) to 340 °C at 10 °C/min (hold 5 min)

Carrier Gas	He, constant flow
Flow Rate:	1 mL/min
Detector	MS
Mode:	Scan
Transfer Line Temp.:	300 °C
Analyzer Type:	Quadrupole
Source Temp.:	280 °C
Electron Energy:	70 eV
Ionization Mode:	EI
Scan Range:	45-550 amu
Scan Rate:	5 scans/sec
Instrument	PE Clarus 500 GC & Clarus 500 MS

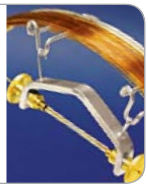
Restek innovation!

CarboPrep®
SPE Cartridges
See **page 398**.

also available

Column connectors

See **pages 227–233** for a wide selection.



free literature

Analyze Chlorinated Pesticides, PCBs and Chlorinated Herbicides

Download your free copy from
www.restek.com

lit. cat.#
EVBR1013D-UNV

Pesticides Analysis (Chlorinated)

Rtx®-CLPesticides/Rtx®-CLPesticides2

- Application-specific columns for organochlorine pesticides and herbicides.
- Low bleed—ideal for high sensitivity GC-ECD or GC-MS analyses.
- Baseline separations in less than 10 minutes.
- Stable to 340 °C.
- Analyze EPA Method 8081B, 8082A, 8151A, 504.1, 515, 508.1, and 552.2 compounds without time-consuming column changes.

Rtx®-CLPesticides Columns (fused silica)
(proprietary Crossbond® phases)

ID	df	temp. limits	15-Meter cat.#	20-Meter cat.#	30-Meter cat.#	60-Meter cat.#
0.18 mm	0.18 µm	-60 to 320/340 °C		42102		
0.25 mm	0.25 µm	-60 to 320/340 °C	11120		11123	11126
0.32 mm	0.32 µm	-60 to 320/340 °C			11141	
	0.50 µm	-60 to 320/340 °C	11136		11139	
0.53 mm	0.50 µm	-60 to 300/320 °C			11140	

Rtx®-CLPesticides2 Columns (fused silica)
(proprietary Crossbond® phases)

ID	df	temp. limits	10-Meter cat.#	15-Meter cat.#	20-Meter cat.#	30-Meter cat.#	60-Meter cat.#
0.18 mm	0.14 µm	-60 to 320/330 °C	42301		42302		
0.25 mm	0.20 µm	-60 to 320/340 °C				11323	11326
0.32 mm	0.25 µm	-60 to 320/340 °C		11321		11324	
	0.50 µm	-60 to 320/340 °C				11325	
0.53 mm	0.42 µm	-60 to 300/320 °C		11337		11340	

NOTE: Analyzing dirty or derivatized samples can contaminate your column. Restek does not recommend analyzing trace-level pesticide samples following derivatized samples (e.g., Methods 8151A and 552.2) without first performing inlet maintenance. Standard steps include trimming the guard column and changing the inlet liner, O-ring, seal, and septum.

kit

Rtx®-CLPesticides Column Kit (0.25 mm ID)
(Note: Columns are not preconnected in this kit.)

Description	qty.	cat.#
Rtx-CLPesticides Kit (0.25 mm ID)	kit	11199
Includes (each product also available separately)		
30m, 0.25mm ID, 0.25µm Rtx-CLPesticides Column Column	ea.	11123
30m, 0.25mm ID, 0.20µm Rtx-CLPesticides2 Column Column	ea.	11323
Universal Angled "Y" Press-Tight Connector, Deactivated	ea.	20403-261
5 m, 0.25 mm ID Siltek Guard Column	ea.	10026

Save money with our kits. Each includes recommended guard and analytical column combinations.

kit

Rtx®-CLPesticides Column Kit (0.32 mm ID)
(Note: Columns are not preconnected in this kit.)

Description	qty.	cat.#
Rtx-CLPesticides Kit (0.32 mm ID)	kit	11196
Includes (each product also available separately)		
30m, 0.32mm ID, 0.32µm Rtx-CLPesticides Column Column	ea.	11141
30m, 0.32mm ID, 0.25µm Rtx-CLPesticides2 Column Column	ea.	11324
Universal Angled "Y" Press-Tight Connector, Deactivated	ea.	20403-261
5 m, 0.32 mm ID Siltek Guard Column	ea.	10027

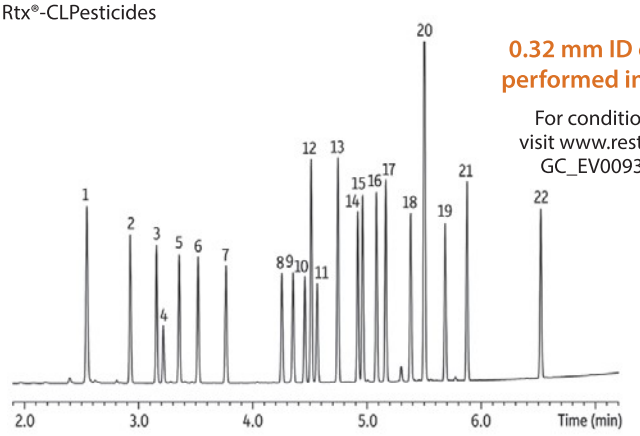
kit

Rtx®-CLPesticides Column Kit (0.53 mm ID)
(Note: Columns are not preconnected in this kit.)

Description	qty.	cat.#
Rtx-CLPesticides Kit (0.53 mm ID)	kit	11197
Includes (each product also available separately)		
30m, 0.53mm ID, 0.50µm Rtx-CLPesticides Column Column	ea.	11140
30m, 0.53mm ID, 0.42µm Rtx-CLPesticides2 Column Column	ea.	11340
Universal Angled "Y" Press-Tight Connector, Deactivated	ea.	20403-261
5m, 0.53mm ID IP Deactivated Guard Column	ea.	10045

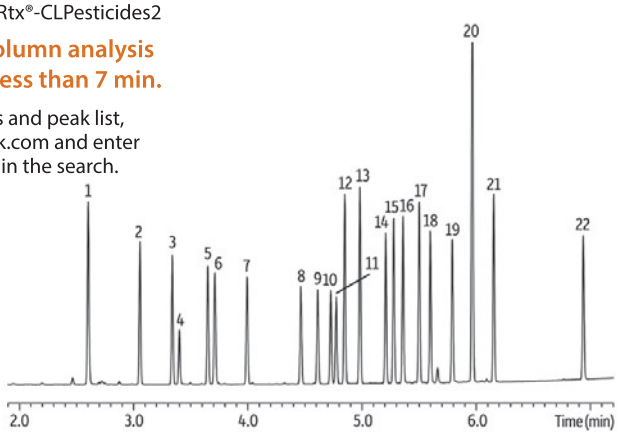
Organochlorine Pesticide Mix AB #2 on Rtx®-CLPesticides and Rtx®-CLPesticides2 (0.32 mm ID column set)

Rtx®-CLPesticides



GC_EV00933

Rtx®-CLPesticides2



GC_EV00933A

0.32 mm ID column analysis performed in less than 7 min.

For conditions and peak list, visit www.restek.com and enter GC_EV00933 in the search.

Method Compound List	Column Pair	Analysis Time (min)	Coelutions	Restek Advantage
8081B (Organochlorine pesticides)	Rtx-CLPesticides / Rtx-CLPesticides2	7 / 7	0 / 0	• Increase sample throughput with 7 min analyses and baseline resolution.
	Competitor A set	7 / 8	0 / 1	
	Competitor B set	10 / 9	0 / 0	
8081B (extended) (Organochlorine pesticides)	Rtx-CLPesticides / Rtx-CLPesticides2	24 / 23	1 / 2	• Best balance of speed and selectivity. • All compounds are resolved on at least one column.
	Competitor A set	27 / 29	0 / 3	
	Competitor B set	NDP / 16	NDP / 3	
8082A (Polychlorinated biphenyls [PCBs], Aroclors)	Rtx-CLPesticides / Rtx-CLPesticides2	7 / 7	n/a	• Fast PCB analysis times.
	Competitor A set	6 / 7	n/a	
	Competitor B set	24 / 21	n/a	
8151A (Chlorinated herbicides)	Rtx-CLPesticides / Rtx-CLPesticides2	13 / 13	1 / 0	• More elution order changes improve confidence in confirmational results.
	Competitor A set	13 / 13	0 / 0	
	Competitor B set	16 / 15	1 / 1	
504.1 (EDB, DBCP, TCP)	Rtx-CLPesticides / Rtx-CLPesticides2	6 / 6	0 / 0	• Reliably separate analytes from trihalomethane interferences.
	Competitor A set	6 / 6	0 / 0	
	Competitor B set	NDP	NDP	
505 (Organohalide pesticides)	Rtx-CLPesticides / Rtx-CLPesticides2	18 / 18.5	1 / 1	• All compounds resolved on at least one column.
	Competitor A set	14 / 14	0 / 1	
	Competitor B set	35 / 36	1 /2	
508.1 (Chlorinated pesticides, herbicides, organohalides)	Rtx-CLPesticides / Rtx-CLPesticides2	23.5 / 24	2 / 2	• Good balance of speed and resolution.
	Competitor A set	21 / 23	0 / 3	
	Competitor B set	18 / 17	2 / 4	
552.2 (Haloacetic acids, dalapon)	Rtx-CLPesticides / Rtx-CLPesticides2	12 / 12	0 / 0	• No coelutions—get accurate results for compounds that coelute on other columns.
	Competitor A set	8 / 9	1 / 1	
	Competitor B set	NDP/10	NDP/1	

Comparison based on published competitor data. All columns tested were 0.32 mm ID. NDP = no data published.

How much time do column changes cost you?

Switch to Rtx®-CLPesticides columns and analyze pesticides, herbicides, PCBs and more on a single column set.

did you know?

Analyzing dirty or derivatized samples can contaminate your column. Restek does not recommend analyzing trace-level pesticide samples following derivatized samples (e.g., Methods 8151A and 552.2) without first performing inlet maintenance. Standard steps include trimming the guard column and changing the inlet liner, O-ring, seal, and septum.

For more information go to

www.restek.com/**CLP7**

Pesticides Analysis (Organophosphorus)

FAST
efficient analysis of OPPs in EPA Method 8141

Rtx®-OPPesticides/Rtx®-OPPesticides2

- Application-specific columns for organophosphorus pesticides; best column combination for U.S. EPA Method 8141.
- Low bleed—ideal for GC-FPD, GC-NPD, or GC-MS analyses.
- Stable to 330 °C.

Using sophisticated computer modeling software, we created two stationary phases for separating the 53 organophosphorus pesticides (OPP) listed in EPA Method 8141. Separation is improved and analysis time is significantly reduced, compared to other columns. The extended upper temperature limit of these phases (330 °C) allows analysts to bake out high molecular weight contamination typically associated with pesticide samples. The low-bleed columns are a perfect match for sensitive detection systems.

Restek innovation!
- Better separations
- Faster analyses

Rtx®-OPPesticides Columns (fused silica)

(proprietary Crossbond® phases)

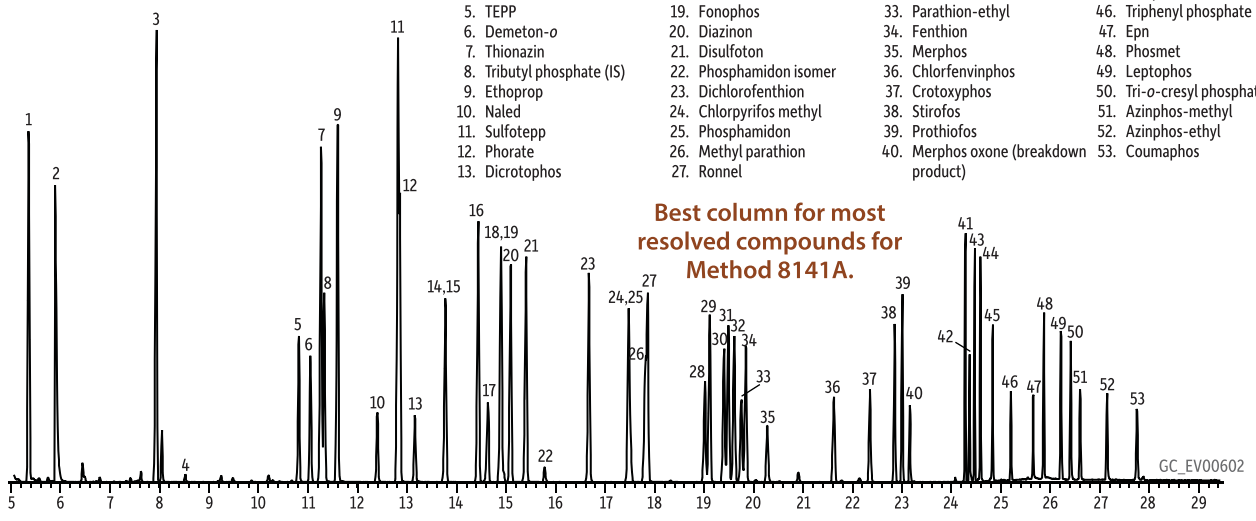
ID	df	temp. limits	30-Meter cat.#
0.25 mm	0.25 µm	-20 to 310/330 °C	11223
0.32 mm	0.50 µm	-20 to 310/330 °C	11239
0.53 mm	0.83 µm	-20 to 310/330 °C	11240

Rtx®-OPPesticides2 Columns (fused silica)

(proprietary Crossbond® phases)

ID	df	temp. limits	20-Meter cat.#	30-Meter cat.#
0.18 mm	0.20 µm	-20 to 310/330 °C	11244	
0.25 mm	0.25 µm	-20 to 310/330 °C		11243
0.32 mm	0.32 µm	-20 to 310/330 °C		11241
0.53 mm	0.50 µm	-20 to 300/330 °C		11242

Organophosphorus Pesticides U.S. EPA Method 8141A on Rtx®-OPPesticides2



Peaks
1. Dichlorvos
2. Hexamethylphosphoramide
3. Mevinphos
4. Trichlorfon
5. TEPP
6. Demeton-*o*
7. Thionazin
8. Tributyl phosphate (IS)
9. Ethoprop
10. Naled
11. Sulfotepp
12. Phorate
13. Dicrotophos
14. Demeton-S
15. Monocrotophos
16. Terbufos
17. Dimethoate
18. Dioxathion
19. Fonophos
20. Diazinon
21. Disulfoton
22. Phosphamidon isomer
23. Dichlorofenthion
24. Chlorpyrifos methyl
25. Phosphamidon
26. Methyl parathion
27. Ronnel
28. Fenitrothion
29. Aspon
30. Malathion
31. Chlorpyrifos
32. Trichloronate
33. Parathion-ethyl
34. Fenthion
35. Merphos
36. Chlorfenvinphos
37. Crotoxyphos
38. Stirofos
39. Prothiofos
40. Merphos oxone (breakdown product)
41. Ethion
42. Fensulfothion
43. Sulprofos
44. Carbophenothion
45. Famphur
46. Triphenyl phosphate (SS)
47. Epn
48. Phosmet
49. Leptophos
50. Tri-*o*-cresyl phosphate
51. Azinphos-methyl
52. Azinphos-ethyl
53. Coumaphos

Column	Rtx®-OPPesticides2, 30 m, 0.25 mm ID, 0.25 µm (cat.# 11243)
Sample	Triphenylphosphate (cat.# 32281)
	Tributylphosphate (cat.# 32280)
	8140/8141 OP pesticide calibration mix A (cat.# 32277)
	8141 OP pesticide calibration mix B (cat.# 32278)
Conc.:	100 ppm (100 ng on-column)
Injection	
Inj. Vol.:	1.0 µL splitless (hold 0.4 min)
Liner:	Double taper splitless (4 mm) (cat.# 20785)
Inj. Temp.:	250 °C
Oven	
Oven Temp.:	80 °C (hold 0.5 min) to 140 °C at 20 °C/min to 210 °C at 4 °C/min (hold 1 min) to 280 °C at 30 °C/min (hold 5 min)
Carrier Gas	He, constant flow
Flow Rate:	1.0 mL/min
Detector	MS
Mode:	Scan
Transfer Line Temp.:	280 °C
Analyzer Type:	Quadrupole
Ionization Mode:	EI
Scan Range:	35-400 amu
Notes	U.S. EPA Method 8141A custom standard mix. Additional mixes not shown. Contact Restek for more information.

Polycyclic Aromatic Hydrocarbons (PAHs) Analysis

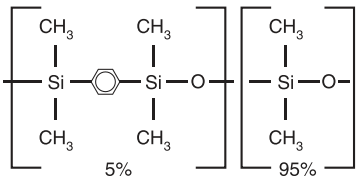
Rxi®-5Sil MS Columns (fused silica)
(low-polarity phase; Crossbond® 1,4-bis(dimethylsiloxy)phenylene dimethyl polysiloxane)

- Engineered to be a low-bleed GC-MS column.
- Excellent inertness for active compounds.
- General-purpose columns—ideal for GC-MS analysis of semivolatiles, polycyclic aromatic compounds, chlorinated hydrocarbons, phthalates, phenols, amines, organochlorine pesticides, organophosphorus pesticides, drugs, solvent impurities, and hydrocarbons.
- Temperature range: -60 °C to 350 °C.

ID	df	temp. limits	15-Meter cat.#	30-Meter cat.#	60-Meter cat.#
0.25 mm	0.10 µm	-60 to 320/350 °C	13605	13608	
	0.25 µm	-60 to 320/350 °C	13620	13623	13626
	0.50 µm	-60 to 320/350 °C	13635	13638	
	1.00 µm	-60 to 320/350 °C	13650	13653	13697
0.32 mm	0.25 µm	-60 to 320/350 °C	13621	13624	
	0.50 µm	-60 to 320/350 °C		13639	
	1.00 µm	-60 to 320/350 °C		13654	
0.53 mm	1.50 µm	-60 to 320/330 °C		13670	

ID	df	temp. limits	10-Meter cat.#	20-Meter cat.#	40-Meter cat.#	60-Meter cat.#
0.15 mm	0.15 µm	-60 to 320/350 °C	43815	43816		
	2.0 µm	-60 to 320/350 °C		43817		
0.18 mm	0.10 µm	-60 to 320/350 °C				43607
	0.18 µm	-60 to 320/350 °C		43602	43605	
	0.36 µm	-60 to 320/350 °C		43604		

Rxi®-5Sil MS Structure

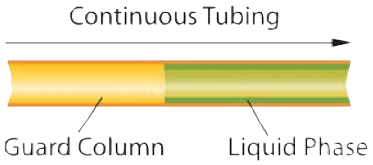


Similar to: (5%-phenyl)-methylpolysiloxane

similar phases

DB-5ms, DB-5msUI, VF-5ms, ZB-5ms, ZB-SemiVolatiles, Rtx-5Sil MS

Integra-Guard® Built-In Guard Column

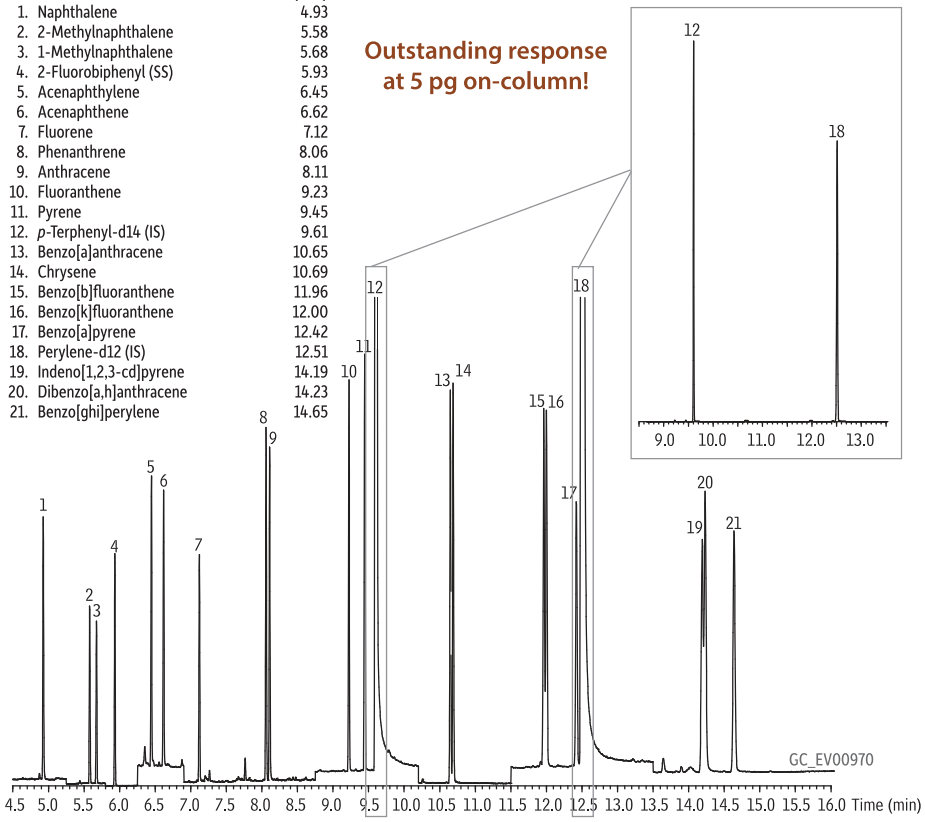


Get the protection without the connection!
See **page 23** for Rxi®-5Sil MS columns with built-in Integra-Guard® guard columns.

Polycyclic Aromatic Hydrocarbons on Rxi®-5Sil MS

Peaks		t_R (min)
1.	Naphthalene	4.93
2.	2-Methylnaphthalene	5.58
3.	1-Methylnaphthalene	5.68
4.	2-Fluorobiphenyl (SS)	5.93
5.	Acenaphthylene	6.45
6.	Acenaphthene	6.62
7.	Fluorene	7.12
8.	Phenanthrene	8.06
9.	Anthracene	8.11
10.	Fluoranthene	9.23
11.	Pyrene	9.45
12.	*p*-Terphenyl-d14 (IS)	9.61
13.	Benzo[a]anthracene	10.65
14.	Chrysene	10.69
15.	Benzo[b]fluoranthene	11.96
16.	Benzo[k]fluoranthene	12.00
17.	Benzo[a]pyrene	12.42
18.	Perylene-d12 (IS)	12.51
19.	Indeno[1,2,3-cd]pyrene	14.19
20.	Dibenzo[a,h]anthracene	14.23
21.	Benzo[ghi]perylene	14.65

Outstanding response at 5 pg on-column!



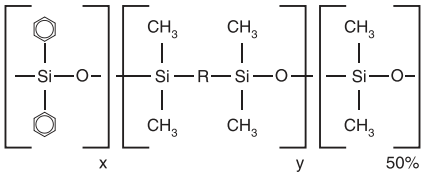
Column Rxi®-5Sil MS, 30 m, 0.25 mm ID, 0.25 µm (cat.# 13623)
Sample PAH mix, 1 µL of 0.005 µg/mL (IS 2 µg/mL)
SV Calibration mix #5 / 610 PAH Mix (cat.# 31011)
1-Methylnaphthalene (cat.# 31283)
2-Methylnaphthalene (cat.# 31285)
2-Fluorobiphenyl (cat.# 31091)
Conc.: 5 pg on-column
Injection
Inj. Vol.: 1.0 µL pulsed splitless (hold 0.15 min)
Liner: Drilled Uniliner® (hole near top) w/wool (cat.# 21055-200.5)
Inj. Temp.: 300 °C
Pulse Pressure: 20 psi (137.9 kPa)
Pulse Time: 0.2 min
Purge Flow: 60 mL/min
Oven
Oven Temp.: 50 °C (hold 0.5 min) to 290 °C at 25 °C/min to 320 °C at 5 °C/min
Carrier Gas He, constant flow
Flow Rate: 1.4 mL/min
Detector MS
Mode: SIM
SIM Program:

Start Time Group (min)	Ion(s)	Dwell (ms)
1	128 m/z	100
2	142 m/z	100
3	172 m/z	100
4	152 m/z	100
5	166 m/z	100
6	178 m/z	100
7	202,244 m/z	100
8	228 m/z	100
9	252,264 m/z	100
10	276,278 m/z	100

Transfer Line Temp.: 290 °C
Ionization Mode: EI

Polycyclic Aromatic Hydrocarbons (PAHs) Analysis

Rxi®-17Sil MS Structure



Similar to: (50%-phenyl)-methylpolysiloxane

similar phases

DB-17ms, VF-17ms

Rxi®-17Sil MS Columns (fused silica)
(midpolarity Crossbond® phase)

- 340/360 °C upper temperature limits.
- Excellent inertness and selectivity for active environmental compounds, such as PAHs.
- Equivalent to USP phase G3.
- Low bleed for use with sensitive detectors, such as MS.

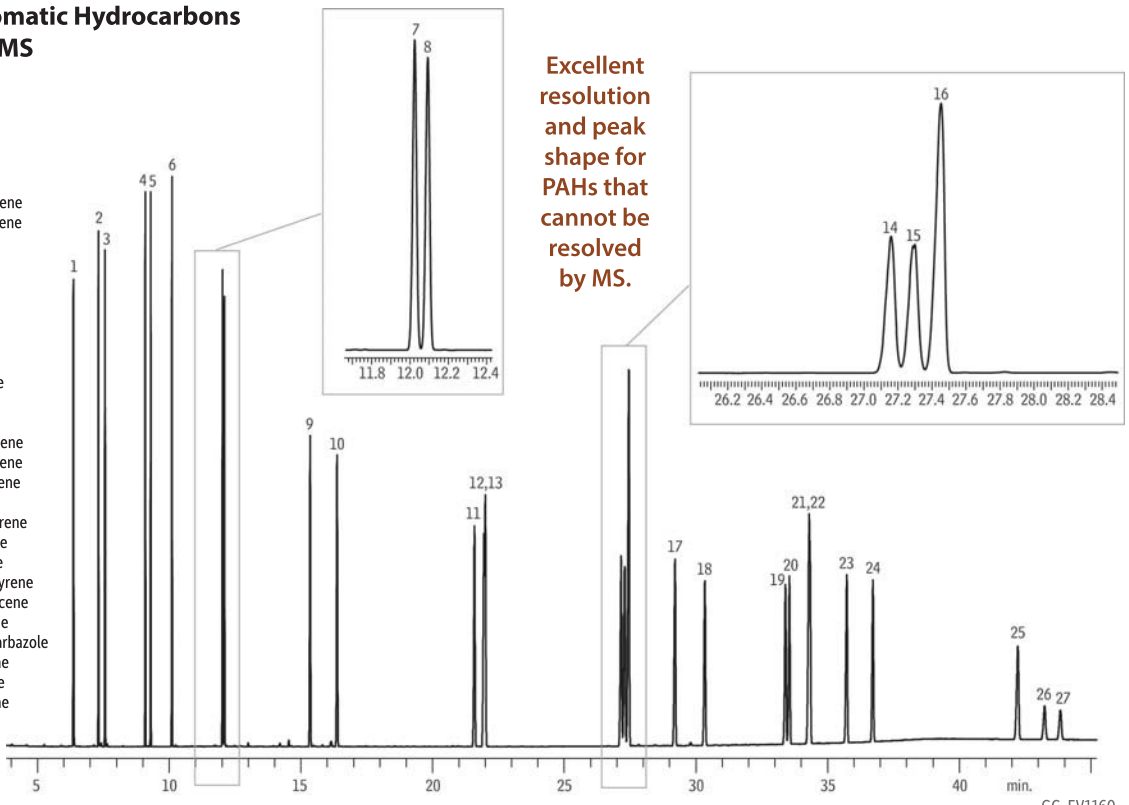
ID	df	temp. limits*	15-Meter cat.#	30-Meter cat.#	60-Meter cat.#
0.25 mm	0.25 µm	40 to 340/360 °C	14120	14123	14126
0.32 mm	0.25 µm	40 to 340/360 °C	14121	14124	

ID	df	temp. limits	10-Meter cat.#	20-Meter cat.#
0.15 mm	0.15 µm	40 to 340/360 °C	43820	43821
0.18 mm	0.18 µm	40 to 340/360 °C		14102
	0.36 µm	40 to 340/360 °C		14111

*Maximum temperatures listed are for shorter length columns. Longer columns may have a different maximum temperature.

Polycyclic Aromatic Hydrocarbons on Rxi®-17Sil MS

Peaks
1. Naphthalene
2. 2-Methylnaphthalene
3. 1-Methylnaphthalene
4. Acenaphthylene
5. Acenaphthene
6. Fluorene
7. Phenanthrene
8. Anthracene
9. Fluoranthene
10. Pyrene
11. Benz[a]anthracene
12. Chrysene
13. Triphenylene
14. Benzo[b]fluoranthene
15. Benzo[k]fluoranthene
16. Benzo[j]fluoranthene
17. Benzo[a]pyrene
18. 3-Methylcholanthrene
19. Dibenz[a,h]acridine
20. Dibenz[a,j]acridine
21. Indeno[1,2,3-cd]pyrene
22. Dibenz[a,h]anthracene
23. Benzo[ghi]perylene
24. 7H-Dibenzo[c,g]carbazole
25. Dibenzo[a,e]pyrene
26. Dibenzo[a,i]pyrene
27. Dibenzo[a,h]pyrene



GC_EV1160

Column	Rxi®-17Sil MS, 30 m, 0.25 mm ID, 0.25 µm (cat.# 14123)
Sample	PAH supplement mix for method 8100 (cat.# 31857) EPA Method 8310 PAH mixture (cat.# 31841) Triphenylene (custom)
Diluent:	Dichloromethane
Conc.:	10 ppm
Injection	
Inj. Vol.:	0.5 µL splitless (hold 1.75 min)
Liner:	Auto SYS XL PSS split/splitless w/wool (cat.# 21718)
Inj. Temp.:	320 °C
Purge Flow:	75 mL/min
Oven	
Oven Temp.:	65 °C (hold 0.5 min) to 220 °C at 15 °C/min to 330 °C at 4 °C/min (hold 15 min)
Carrier Gas	He, constant flow
Flow Rate:	2.0 mL/min
Detector	FID @ 320 °C
Instrument	PE Clarus 600 GC
Acknowledgement	Instrument provided by PerkinElmer

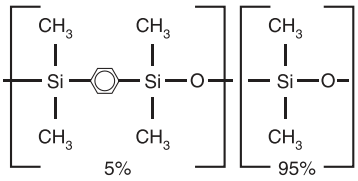
Semivolatiles Analysis

Rxi®-5Sil MS Columns (fused silica)
(low-polarity phase; Crossbond® 1,4-bis(dimethylsiloxy)phenylene dimethyl polysiloxane)

- Engineered to be a low-bleed GC-MS column.
- Excellent inertness for active compounds.
- General-purpose columns—ideal for GC-MS analysis of semivolatiles, polycyclic aromatic compounds, chlorinated hydrocarbons, phthalates, phenols, amines, organochlorine pesticides, organophosphorus pesticides, drugs, solvent impurities, and hydrocarbons.
- Temperature range: -60 °C to 350 °C.

The Rxi®-5Sil MS stationary phase incorporates phenyl groups in the polymer backbone. This improves thermal stability, reduces bleed, and makes the phase less prone to oxidation. Rxi®-5Sil MS columns are ideal for GC-MS applications requiring high sensitivity, including use in ion trap systems.

Rxi®-5Sil MS Structure



Similar to: (5%-phenyl)-methylpolysiloxane

similar phases

DB-5ms, DB-5msUI, VF-5ms, ZB-5ms, ZB-SemiVolatiles, Rtx-5Sil MS

ID	df	temp. limits	15-Meter cat.#	30-Meter cat.#	60-Meter cat.#
0.25 mm	0.10 µm	-60 to 320/350 °C	13605	13608	
	0.25 µm	-60 to 320/350 °C	13620	13623	13626
	0.50 µm	-60 to 320/350 °C	13635	13638	
	1.00 µm	-60 to 320/350 °C	13650	13653	13697
0.32 mm	0.25 µm	-60 to 320/350 °C	13621	13624	
	0.50 µm	-60 to 320/350 °C		13639	
	1.00 µm	-60 to 320/350 °C		13654	
0.53 mm	1.50 µm	-60 to 320/330 °C		13670	

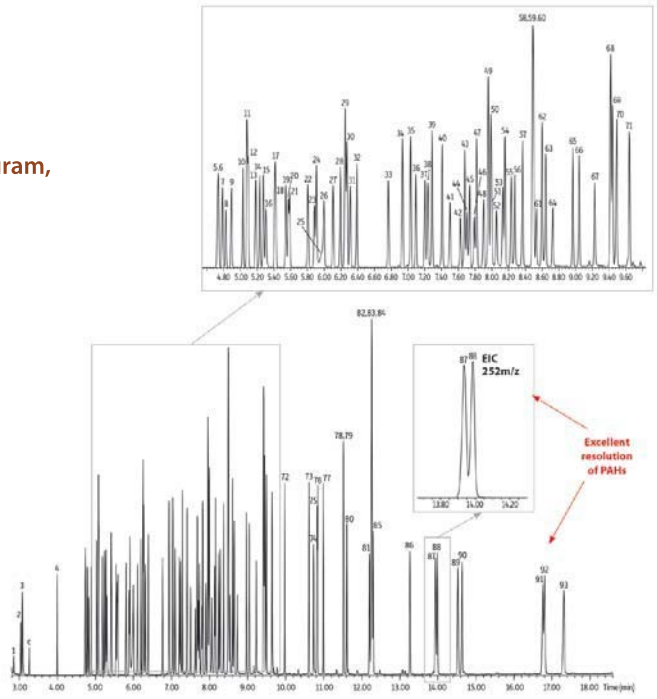
ID	df	temp. limits	10-Meter cat.#	20-Meter cat.#	40-Meter cat.#	60-Meter cat.#
0.15 mm	0.15 µm	-60 to 320/350 °C	43815	43816		
	2.0 µm	-60 to 320/350 °C		43817		
0.18 mm	0.10 µm	-60 to 320/350 °C				43607
	0.18 µm	-60 to 320/350 °C		43602	43605	
	0.36 µm	-60 to 320/350 °C		43604		

ordering note

Get the protection without the connection!
For Rxi®-5Sil MS columns with built-in Integra-Guard® guard columns, see **page 23**.

Semivolatiles by EPA Method 8270 on Rxi®-5Sil MS (30 m, 0.25 mm ID, 0.25 µm) w/Drilled Uniliner® Inlet Liner

For complete chromatogram, see page 33.



GC_EV00943

free literature

Whole Air Canister Sampling and Preconcentration GC-MS Analysis
for pptv Levels of Trimethylsilanol in Semiconductor Cleanroom Air

lit. cat.#
EVAN1788-UNV

Analysis of Trace Oxygenates in Petroleum-Contaminated Wastewater, Using Purge-and-Trap GC-MS (U.S. EPA Methods 5030B & 8260)

lit. cat.#
EVAN1449-UNV

Download your free copies from
www.restek.com

Volatile Organics Analysis

Rtx®-VMS Columns (fused silica)
(proprietary Crossbond® phase)

- Application-specific columns for analyzing volatile organic pollutants by GC-MS including Methods TO-15, TMS, and EPA 8260.
- Complete separation of U.S. EPA Method 8260 compounds in less than 10 minutes.
- Stable to 260 °C.
- No known equivalent phases.

Rtx®-VMS columns offer lower bleed, better selectivity, and overall faster analysis for separating volatile organic compounds, such as those listed in U.S. EPA Method 8260B. The Rtx®-VMS stationary phase is a highly stable polymer that provides outstanding analysis of volatile compounds, in combination with sensitive ion traps and Agilent 5973 mass spectrometers. 0.18 and 0.25 mm ID columns allow sample splitting at the injection port, eliminating the added expense and maintenance of a jet separator. A 0.45 mm or 0.53 mm ID column can be directly connected to the purge-and-trap transfer line in a system equipped with a jet separator.

ID	df	temp. limits	30-Meter cat.#	price	60-Meter cat.#	75-Meter cat.#
0.25 mm	1.40 µm	-40 to 240/260 °C	19915		19916	
0.32 mm	1.80 µm	-40 to 240/260 °C	19919		19920	
0.45 mm	2.55 µm	-40 to 240/260 °C	19908		19909	
0.53 mm	3.00 µm	-40 to 240/260 °C	19985		19988	19974

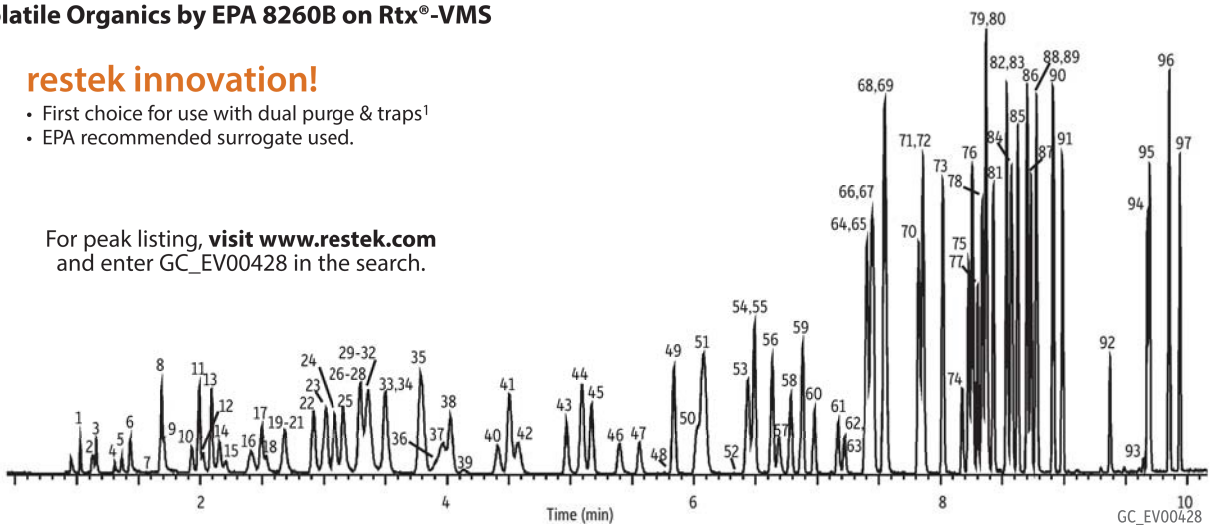
ID	df	temp. limits	20-Meter cat.#	price	40-Meter cat.#
0.18 mm	1.00 µm	-40 to 240/260 °C	49914		49915

Volatile Organics by EPA 8260B on Rtx®-VMS

restek innovation!

- First choice for use with dual purge & traps[1]
- EPA recommended surrogate used.

For peak listing, **visit www.restek.com** and enter GC_EV00428 in the search.



Column	Rtx®-VMS, 20 m, 0.18 mm ID, 1.00 µm (cat.# 49914)
Sample	
Diluent:	Water
Conc.:	10 ppb in 5 mL RO water (unless noted); ketones 2.5X
Injection	Purge and trap split (split ratio 40:1)
Liner:	1 mm split (cat.# 20973)
Inj. Temp.:	220 °C
Purge and Trap	
Instrument:	Tekmar LCS 3100
Trap Type:	Vocarb® 3000
Purge:	11 min @ ambient, flow 40 mL/min
Dry Purge:	1 min, flow 40 mL/min
Desorb Preheat Temp.:	245 °C
Desorb:	2 min @ 250 °C, flow 40 mL/min
Bake:	8 min @ 260 °C
Interface Connection:	Injection port
Transfer Line Tubing:	Silcosteel® treated 0.53 mm ID tubing (cat.# 20595)
Transfer Line Temp.:	120 °C

Oven	
Oven Temp.:	50 °C (hold 4 min) to 100 °C at 18 °C/min (hold 0 min) to 230 °C at 40 °C/min (hold 3 min)
Carrier Gas	He, constant flow
Flow Rate:	1.0 mL/min
Detector	MS
Mode:	Scan
Transfer Line Temp.:	280 °C
Analyzer Type:	Quadrupole
Tune Type:	BFB
Ionization Mode:	EI
Scan Range:	35-300 amu
Instrument	HP6890 GC & 5973 MSD
Notes	For proper flows, adjust retention time of dichlorodifluoromethane to a retention time of 1.03 min @ 50 °C

[1]A.L. Hilling and G. Smith, Environmental Testing & Analysis, 10(3), 15-19, 2001.

Volatile Organics Analysis

Rtx®-VRX Columns (fused silica)
(proprietary Crossbond® phase)

- Application-specific columns for volatile organic pollutants.
- Excellent for U.S. EPA Method 8021 compounds.
- Stable to 260 °C.

The Rtx®-VRX stationary phase and optimized column dimensions provide low bleed, excellent resolution, and fast analysis times for volatile compounds.

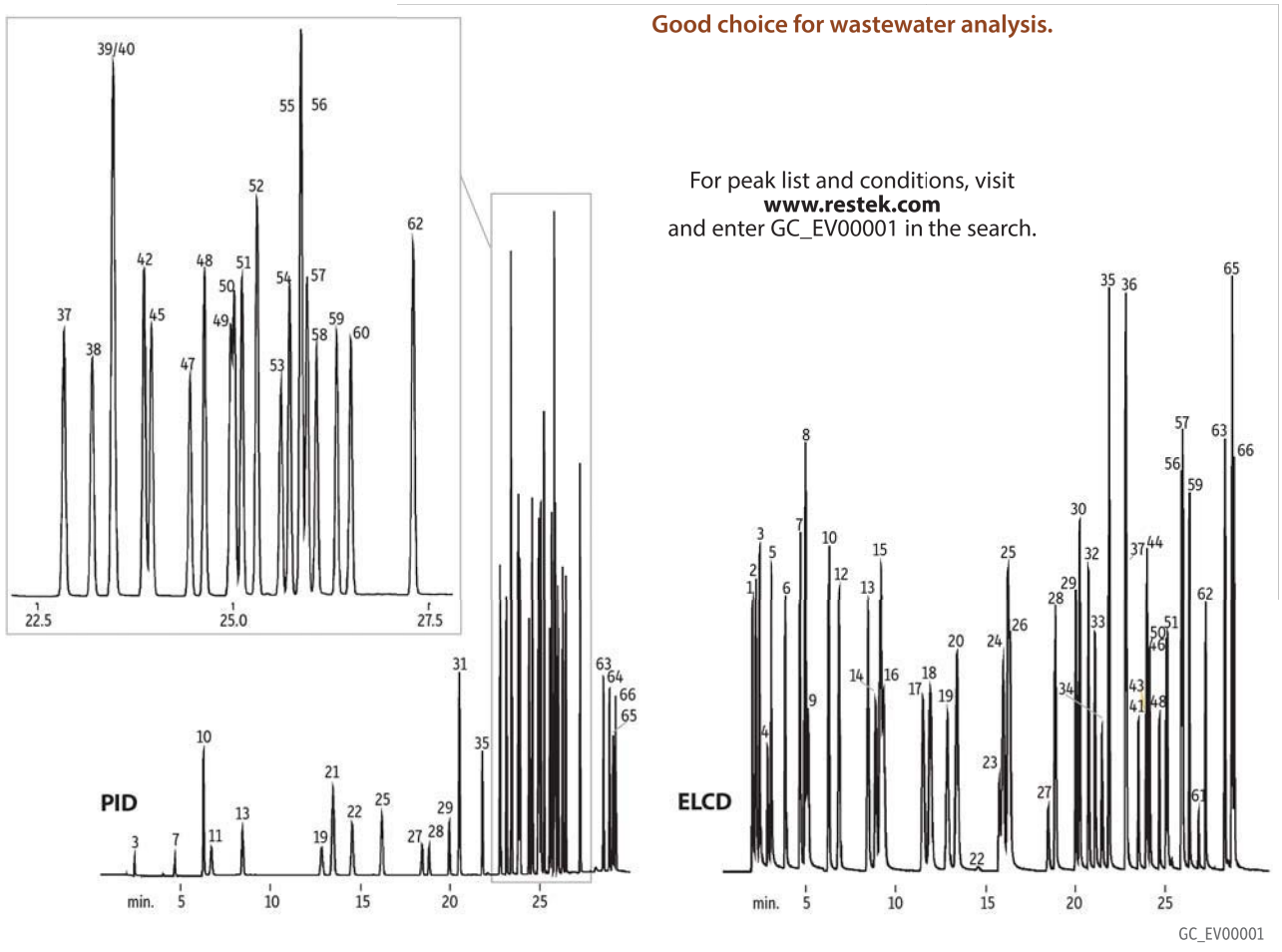
similar phases

DB-VRX

ID	df	temp. limits	30-Meter cat.#	60-Meter cat.#	75-Meter cat.#
0.25 mm	1.40 µm	-40 to 240/260 °C	19315	19316	
0.32 mm	1.80 µm	-40 to 240/260 °C	19319	19320	
0.45 mm	2.55 µm	-40 to 240/260 °C	19308		19309
0.53 mm	3.00 µm	-40 to 240/260 °C	19385	19388	

ID	df	temp. limits	20-Meter cat.#	40-Meter cat.#
0.18 mm	1.00 µm	-40 to 240/260 °C	49314	49315

Volatile Organics by EPA 8021 on Rtx®-VRX



Volatile Organics Analysis

similar phases
DB-502.2

also available


Metal MXT® Columns

Rugged, flexible, Siltek®-treated stainless steel tubing; inertness comparable to fused silica tubing.

MXT®-502.2 columns .....page 111
MXT®-Volatiles .....page 111

Rtx®-502.2 Columns (fused silica)
(proprietary Crossbond® diphenyl/dimethyl polysiloxane phase)

- Application-specific columns with unique selectivity for volatile organic pollutants. The Rtx®-502.2 column is cited in U.S. EPA Method 502.2 and in many gasoline range organics (GRO) methods for monitoring underground storage tanks.
- Excellent separation of trihalomethanes; ideal polarity for light hydrocarbons and aromatics.
- Stable to 270 °C.

An Rtx®-502.2 column will enable you to quantify all compounds listed in U.S. EPA methods 502.2 or 524.2, whether you use a mass spectrometer or a PID in tandem with an ELCD. The diphenyl/dimethyl polysiloxane based Rtx®-502.2 stationary phase provides low bleed and thermal stability to 270 °C. A 105-meter column can separate the light gases specified in EPA methods without subambient cooling. Narrow bore columns can interface directly in GC/MS systems.

ID	df	temp. limits*	30-Meter cat.#	60-Meter cat.#	75-Meter cat.#	105-Meter cat.#
0.25 mm	1.40 µm	-20 to 250/270 °C	10915	10916		
0.32 mm	1.80 µm	-20 to 250/270 °C	10919	10920		10921
0.45 mm	2.55 µm	-20 to 250/270 °C			10986	
0.53 mm	3.00 µm	-20 to 250/270 °C	10908	10909		10910

ID	df	temp. limits	20-Meter cat.#	40-Meter cat.#
0.18 mm	1.00 µm	-20 to 250/270 °C	40914	40915

*Maximum temperatures listed are for shorter length columns. Longer columns may have a different maximum temperature.

similar phases
VOCOL

Rtx®-Volatiles Columns (fused silica)
(proprietary Crossbond® diphenyl/dimethyl polysiloxane phase)

- Application-specific columns for volatile organic pollutants.
- Stable to 280 °C.

Rtx®-Volatiles columns were the first columns designed specifically for analyses of the 34 volatile organic pollutants listed in U.S. EPA methods 601, 602, and 624. With these columns, you can quantify all compounds listed in these methods, whether you use a mass spectrometer or a PID in tandem with an ELCD. The diphenyl/dimethyl polysiloxane based Rtx®-Volatiles stationary phase provides low bleed and thermal stability to 280 °C. Narrow bore columns can interface directly in GC/MS systems.

ID	df	temp. limits*	30-Meter cat.#	60-Meter cat.#	105-Meter cat.#
0.25 mm	1.00 µm	-20 to 270/280 °C	10900	10903	
0.32 mm	1.50 µm	-20 to 270/280 °C	10901	10904	
0.53 mm	2.00 µm	-20 to 270/280 °C	10902	10905	10906

*Maximum temperatures listed are for shorter length columns. Longer columns may have a different maximum temperature.

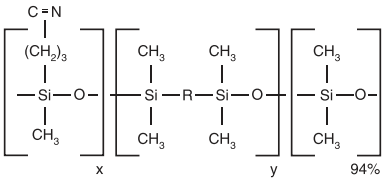
Volatile Organics Analysis

Rxi®-624Sil MS Columns (fused silica)
(midpolarity Crossbond® phase)

- Low-bleed, high-thermal stability column—maximum temperatures up to 320 °C.
- Inert—excellent peak shape for a wide range of compounds.
- Selective—G43 phase highly selective for volatile organics and residual solvents, great choice for USP<467>.
- Manufactured for column-to-column reproducibility—well-suited for validated methods.

ID	df	temp. limits	20-Meter cat.#	30-Meter cat.#	60-Meter cat.#	75-Meter cat.#	105-Meter cat.#
0.18 mm	1.00 µm	-20 to 300/320 °C	13865				
0.25 mm	1.40 µm	-20 to 300/320 °C		13868	13869		
0.32 mm	1.80 µm	-20 to 300/320 °C		13870	13872		
0.53 mm	3.00 µm	-20 to 280/300 °C		13871	13873	13874	13875

Rxi®-624Sil MS (G43) Structure

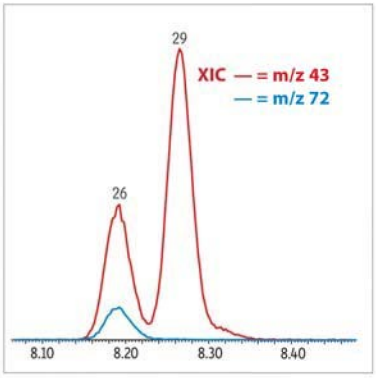


Similar to: (6%-cyanopropylphenyl)-methylpolysiloxane

similar phases

DB-624, VF-624ms, CP-Select 624 CB

Volatiles by EPA Method 8260 on Rxi®-624Sil MS (30 m, 0.25 mm ID, 1.40 µm)



Resolution of critical pairs, low bleed, and high inertness make this a great column for volatiles!

For peak list, visit **www.restek.com** and enter GC_EV1169 in the search.

Column	Rxi®-624Sil MS, 30 m, 0.25 mm ID, 1.40 µm (cat.# 13868)
Sample	8260A surrogate mix (cat.# 30240) 8260A internal standard mix (cat.# 30241) 8260B MegaMix® calibration mix (cat.# 30633) VOA calibration mix #1 (ketones) (cat.# 30006) 8260B acetate mix (Revised) (cat.# 30489) California oxygenates mix (cat.# 30465) 502.2 calibration mix #1 (gases) (cat.# 30042)
Conc.:	25 ppb in RO water
Injection	Purge and trap split (split ratio 30:1)
Inj. Temp.:	225 °C
Purge and Trap	
Instrument:	OI Analytical 4660
Trap Type:	10 Trap
Purge:	11 min @ 20 °C
Desorb Preheat Temp.:	180 °C
Desorb:	0.5 min @ 190 °C
Bake:	5 min @ 210 °C
Interface Connection:	Injection port
Oven	
Oven Temp.:	35 °C (hold 5 min) to 60 °C at 11 °C/min to 220 °C at 20 °C/min (hold 2 min)
Carrier Gas	He, constant flow
Flow Rate:	1.0 mL/min
Detector	MS
Mode:	Scan
Transfer Line Temp.:	230 °C
Analyzer Type:	Quadrupole
Source Temp.:	230 °C
Quad Temp.:	150 °C
Electron Energy:	70 eV
Solvent Delay Time:	1.5 min
Tune Type:	BFB
Ionization Mode:	EI
Scan Range:	36-260 amu
Instrument	Agilent 7890A GC & 5975C MSD
Notes	
Other Purge-and-Trap Conditions:	Sample Inlet: 40 °C Sample: 40 °C Water Management: Purge 110 °C, Desorb 0 °C, Bake, 240 °C
Acknowledgement	Eclipse 4660 purge-and-trap courtesy of O.I. Analytical, College Station, TX.