

Application-Specific Columns

Clinical, Forensic, & Toxicology	65
Environmental	66–81
Foods, Flavors, & Fragrances	82–89
Petroleum & Petrochemical	90–93
Pharmaceutical.....	94–97
Specially Deactivated	984–103



Unique Column Chemistries for Application-Specific and Specially Deactivated Columns

Designed to help solve chromatographic challenges, these stationary phases are optimized for the best separations, accurate quantification, and shorter analysis times.

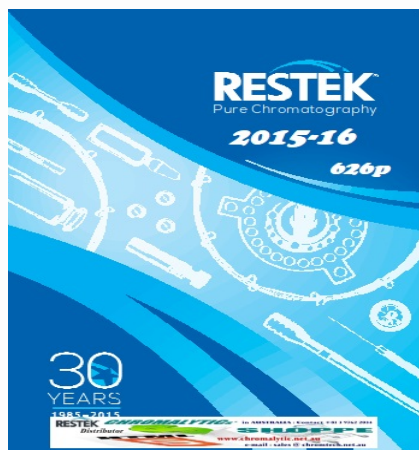
Application-Specific Columns

- Clinical, Forensic, & Toxicology
- Environmental
- Foods, Flavors, & Fragrances
- Petroleum and Petrochemical
- Pharmaceutical

Specially Deactivated Columns

Designed for specific classes of compounds.

- Acidic compound analysis
- Basic compound analysis
- Chiral analysis



Blood Alcohol Analysis

Rtx®-BAC Plus 1/Rtx®-BAC Plus 2 Columns

- Optimized column selectivities guarantee resolution of ethanol, internal standards, and frequently encountered interferences.
- Robust and reproducible column chemistry ensures longer column lifetime and consistent results.
- Stable to 260 °C.

These application-specific columns for blood alcohol analysis baseline separate all critical compounds—including ethanol, methanol, acetone, *tert*-butanol, acetaldehyde, isopropanol, and *n*-propanol—in less than 2 minutes. Every Rtx®-BAC Plus 1 and Rtx®-BAC Plus 2 column is qualified with a test mix containing these important BAC target compounds to ensure reproducibility.

These columns baseline separate all blood alcohol compounds in blood, breath, or urine, in less than 2 minutes, under isothermal conditions. Isothermal analysis increases productivity by eliminating the need for oven cycling. Confirmation is easily achieved with this tandem set because there are two elution order changes between the columns.

Rtx®-BAC Plus 1 Columns (fused silica)

ID	df	temp. limits	30-Meter cat.#
0.32 mm	1.80 µm	-20 to 240/260 °C	18004
0.53 mm	3.00 µm	-20 to 240/260 °C	18005

Rtx®-BAC Plus 2 Columns (fused silica)

ID	df	temp. limits	30-Meter cat.#
0.32 mm	0.6 µm	-20 to 240/260 °C	18006
0.53 mm	1.0 µm	-20 to 240/260 °C	18007

similar phases

DB-ALC1, ZB-BAC1
DB-ALC2, ZB-BAC2

free literature

Rtx®-BAC Plus 1 and
Rtx®-BAC Plus 2 Columns
Advanced Technology for Fast,
Reliable Measurement
of Alcohol in Blood

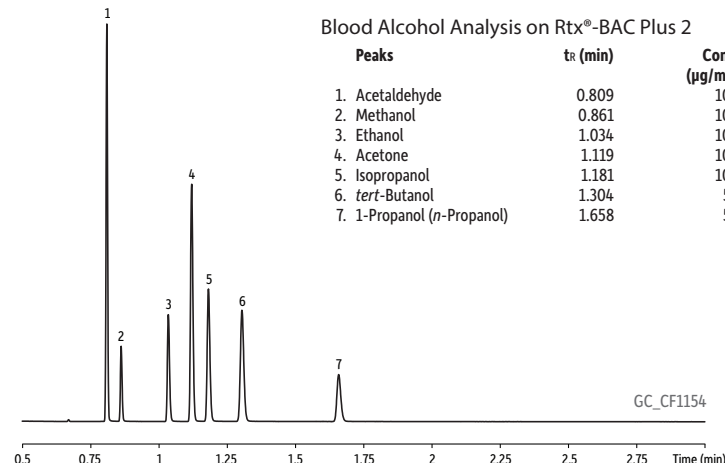
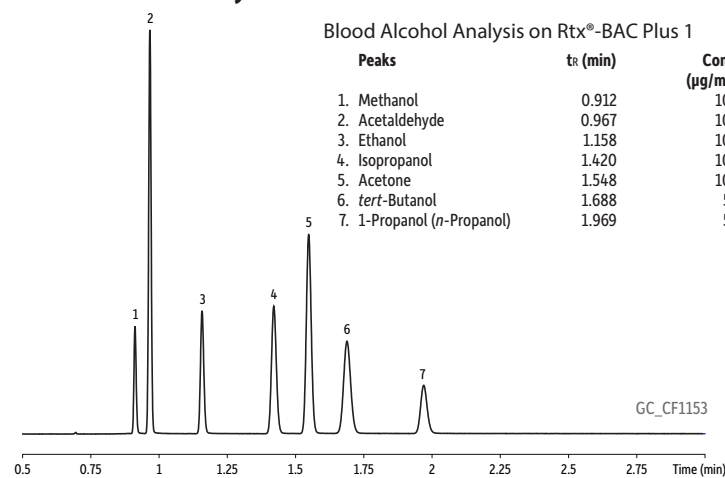
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lit. cat.#
CFBR1538-UNV



Blood Alcohol Analysis on Rtx®-BAC Plus 1 and Rtx®-BAC Plus 2



Column Rtx®-BAC Plus 1, 30 m, 0.32 mm ID, 1.8 µm (cat.# 18004)
Sample BAC resolution control standard n-P (cat.# 36010)
BAC resolution control standard t-B (cat.# 36011)

Diluent: Water
Conc.: 50 µL of each standard were diluted in 900 µL water in a 20 mL headspace vial.

Injection
Liner: Headspace-loop split (split ratio 50:1)
1 mm ID straight inlet liner (cat.# 20972)

Headspace-Loop
Inj. Port Temp.: 200 °C
Instrument: Tekmar HT3
Inj. Time: 3 min
Transfer Line
Temp.: 125 °C
Valve Oven Temp.: 125 °C

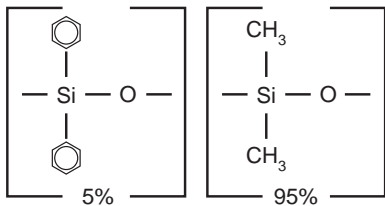
Standby flow
rate: 50 mL/min
Sample Temp.: 60 °C

Sample Equil.
Time: 5 min
Vial Pressure: 30 psi
Pressurize Time: 1 min
Loop Pressure: 20 psi
Loop Fill Time: 1 min

Oven
Oven Temp.: 40 °C (hold 3 min)
Carrier Gas He, constant flow
Linear Velocity: 80 cm/sec @ 40 °C

Detector
Make-up Gas Flow Rate: 30 mL/min
Make-up Gas Type: N₂
Instrument Agilent/HP6890 GC
Notes Headspace concentrator courtesy of Teledyne Tekmar, Mason, OH.

Brominated Flame Retardants Analysis

Rtx[®]-1614 StructureRtx[®]-1614 Columns (fused silica)

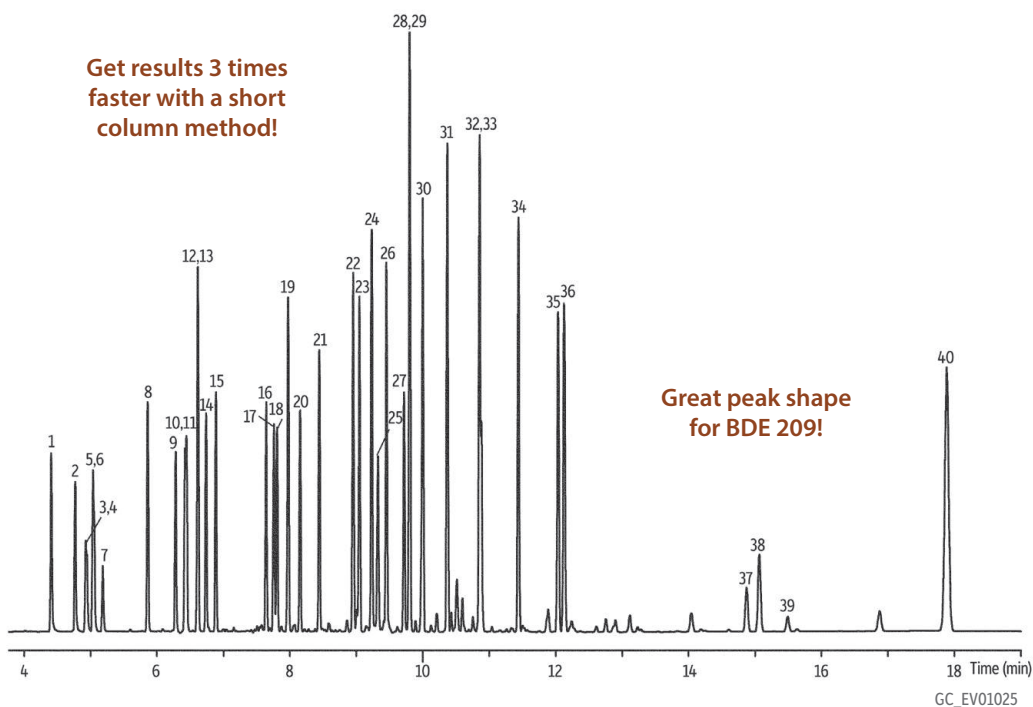
(5% diphenyl, 95% dimethyl polysiloxane)

- 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

Get results 3 times
faster with a short
column method!



GC_EV01025

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
 He, constant linear velocity

Linear Velocity: 60 cm/sec @ 120 °C

Detector µ-ECD @ 345 °C

Dioxin & Furan Analysis

Rxi®-5Sil MS Columns (fused silica)

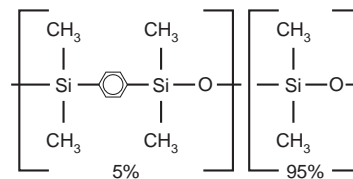
(low-polarity phase; Crossbond® 1,4-bis(dimethylsiloxy)phenylene dimethyl polysiloxane)

- 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 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

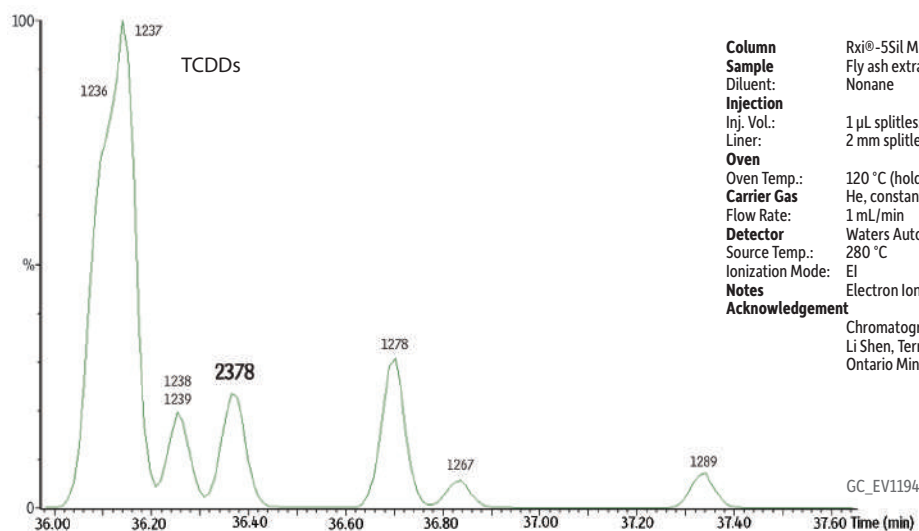


Similar to: (5%-phenyl)-methylpolysiloxane

similar phases

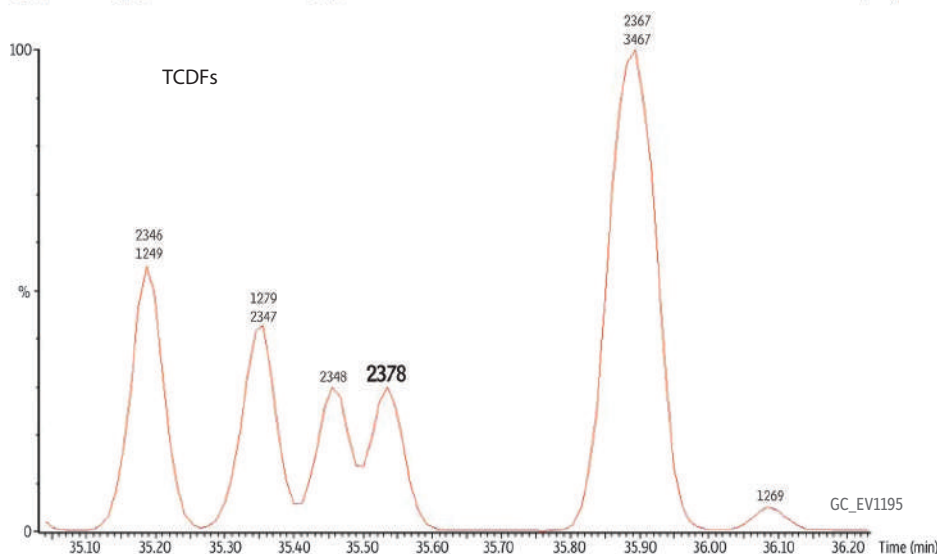
DB-5ms, DB-5msUI, VF-5ms, ZB-5ms, ZB-SemiVolatiles, Rtx-5Sil MS

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

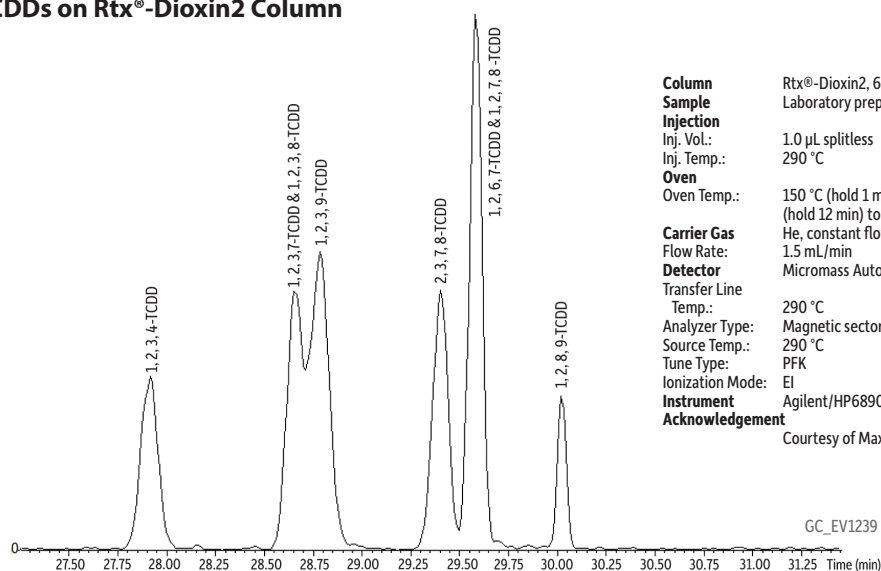
Rtx®-Dioxin2 Columns (fused silica)

(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

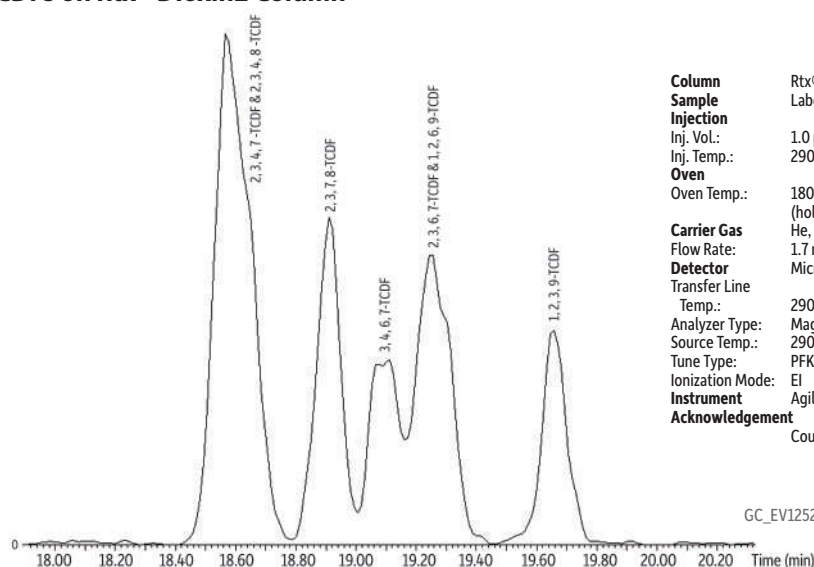
TCDDs on Rtx®-Dioxin2 Column



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: He, constant flow
 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).

GC_EV1239

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: He, constant flow
 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).

GC_EV1252

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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

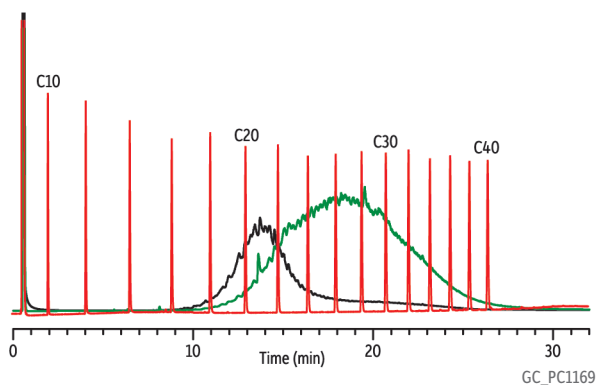
similar phases

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 H₂, 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: N₂

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.

PCB Congeners Analysis

Restek innovation!

Rtx®-PCB Columns (fused silica)

(proprietary Crossbond® phase)

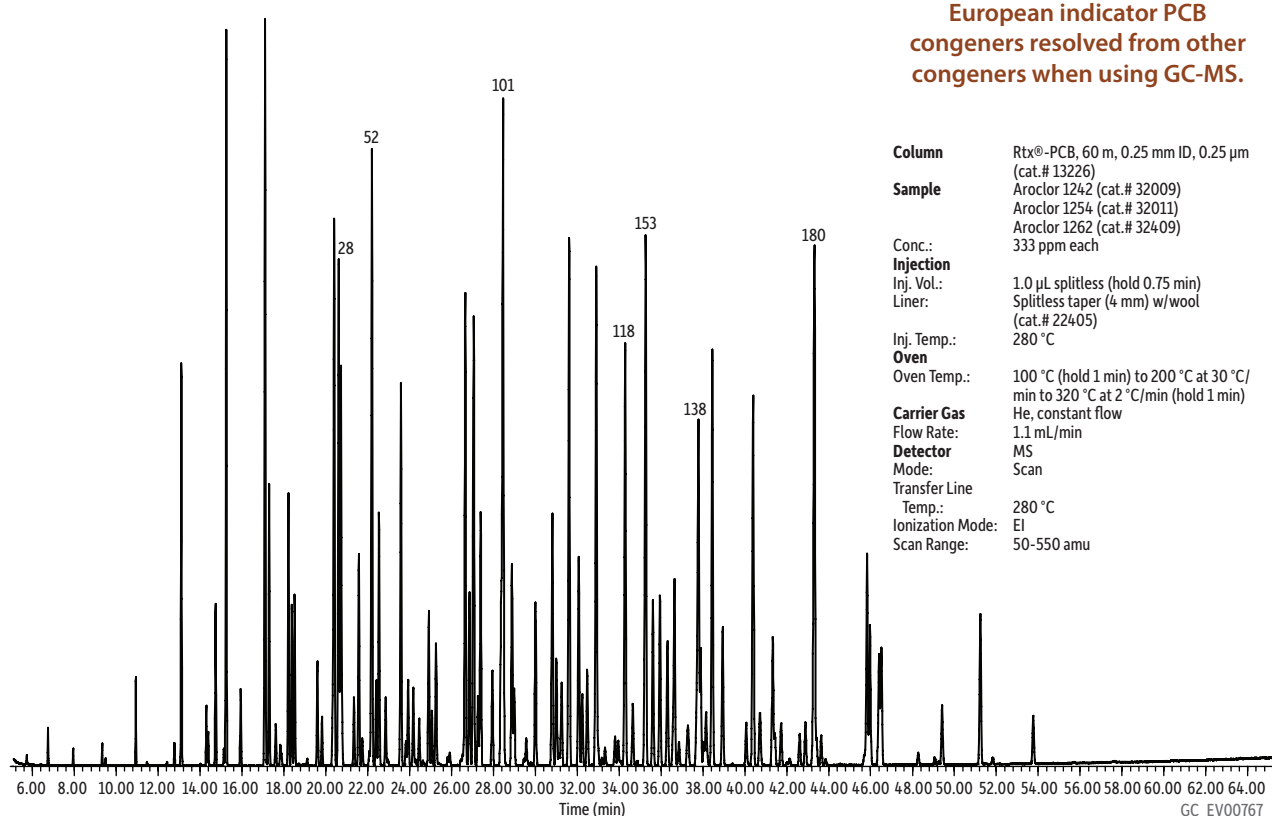
- Unique polymer for PCBs analysis by GC-ECD or GC-MS.
- Good results for other semivolatiles.
- Low polarity; inert to active compounds.
- Stable to 340 °C.



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



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

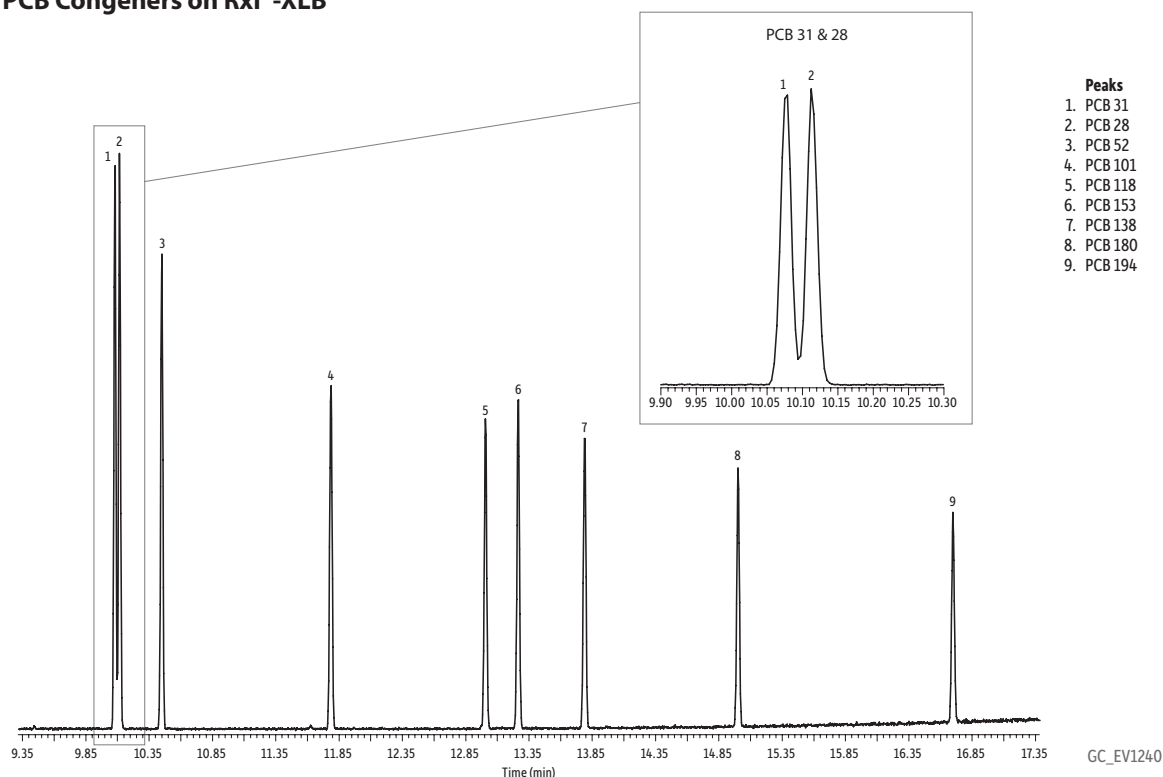
DB-XLB, VF-Xms, MR1, ZB-XLB

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	
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



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

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PCBs and Chlorinated
Herbicides

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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

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 ID Deactivated Guard Column	ea.	10025

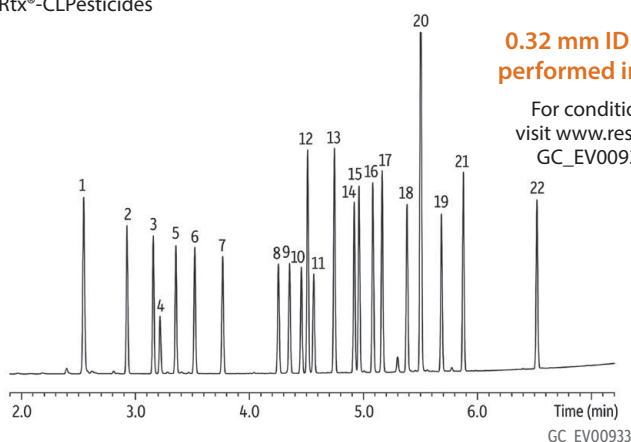
Save money with our
kits. Each includes
recommended guard
and analytical column
combinations.

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

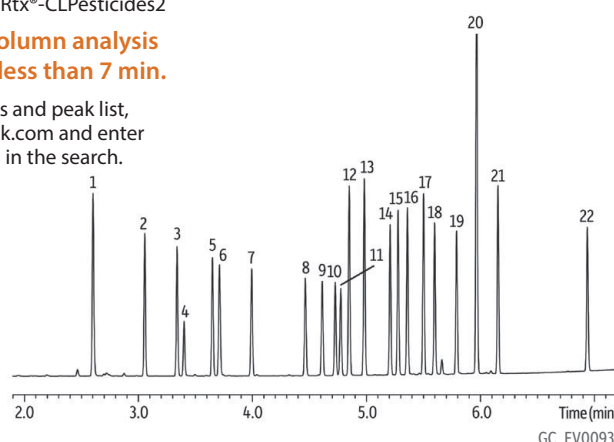
Rtx®-CLPesticides

Rtx®-CLPesticides2

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.

GC_EV00933



GC_EV00933A

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	

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

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

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FASTefficient analysis
of OPPs in EPA
Method 8141**Restek innovation!**

- Better separations
- Faster analyses

Pesticides Analysis (Organophosphorus)**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.

Rtx®-OPPesticides Columns (fused silica)

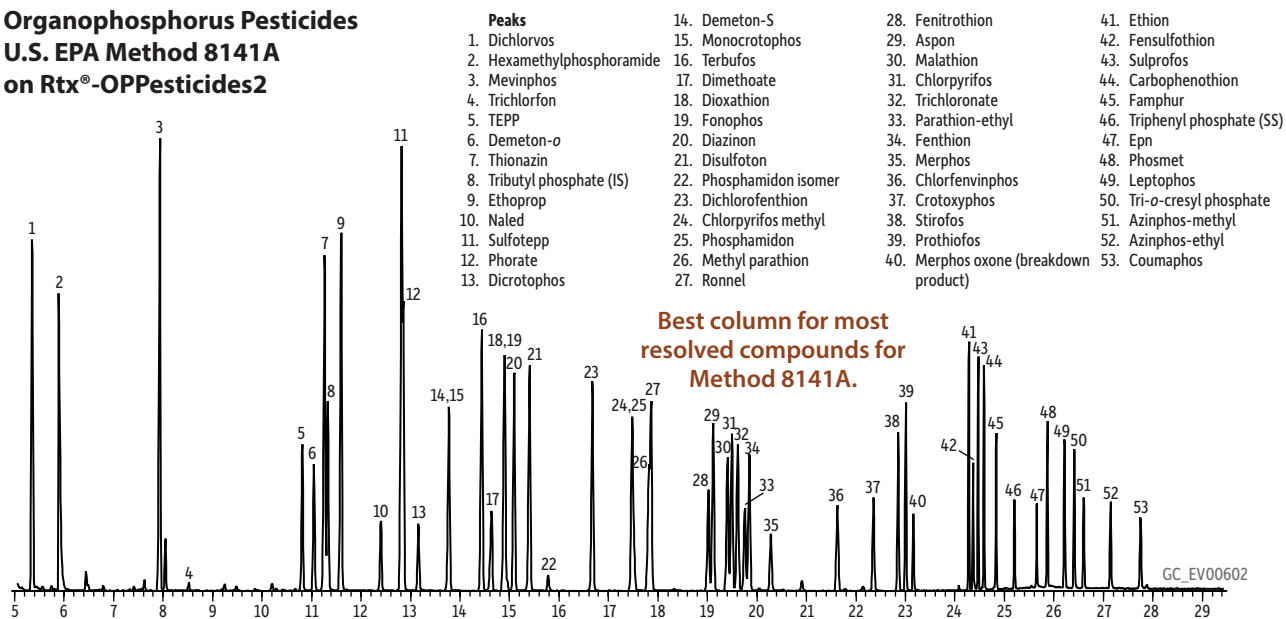
(proprietary Crossbond® phases)

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**


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 1.0 µL splitless (hold 0.4 min)
Inj. Vol.: Double taper splitless (4 mm) (cat.# 20785)
Inj. Temp.: 250 °C
Oven 80 °C (hold 0.5 min) to 140 °C at 20 °C/min to 210 °C at 4 °C/min
Oven Temp.: (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.

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Polycyclic Aromatic Hydrocarbons (PAHs) Analysis

Rxi®-5Sil MS Columns (fused silica)

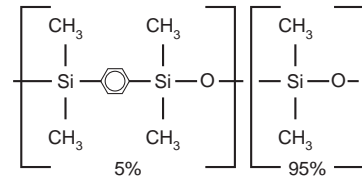
(low-polarity phase; Crossbond® 1,4-bis(dimethylsiloxy)phenylene dimethyl polysiloxane)

- 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

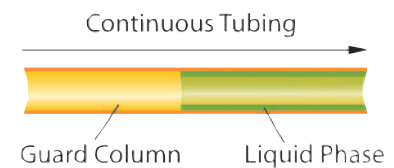


Similar to: (5%-phenyl)-methylpolysiloxane

similar phases

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

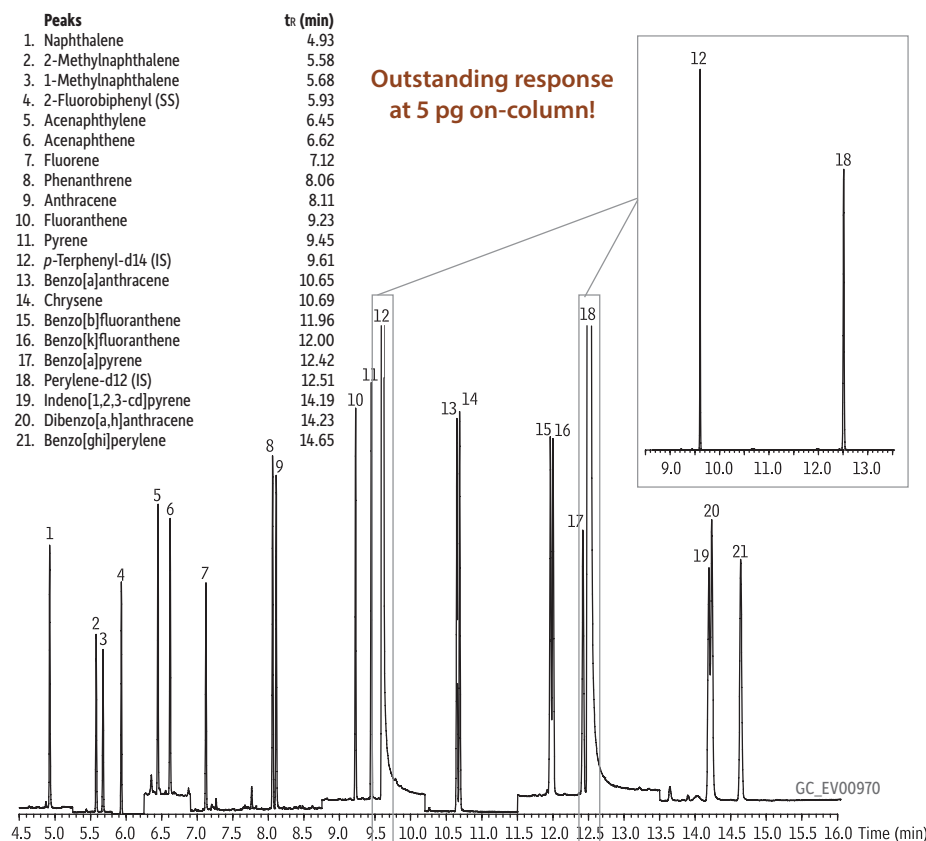
Integra-Guard® Built-In Guard Column



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



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 (15.2 µg/mL) SV Calibration mix #5 / 610 PAH Mix (cat.# 31011) 1-Methylnaphthalene (cat.# 31283) 2-Methylnaphthalene (cat.# 31285) 2-Fluorobiphenyl (cat.# 31091) 5 pg on-column	
Conc.:		
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 Flow:	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		
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

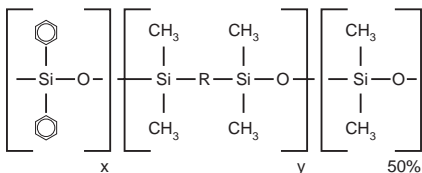
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Polycyclic Aromatic Hydrocarbons (PAHs) Analysis

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	

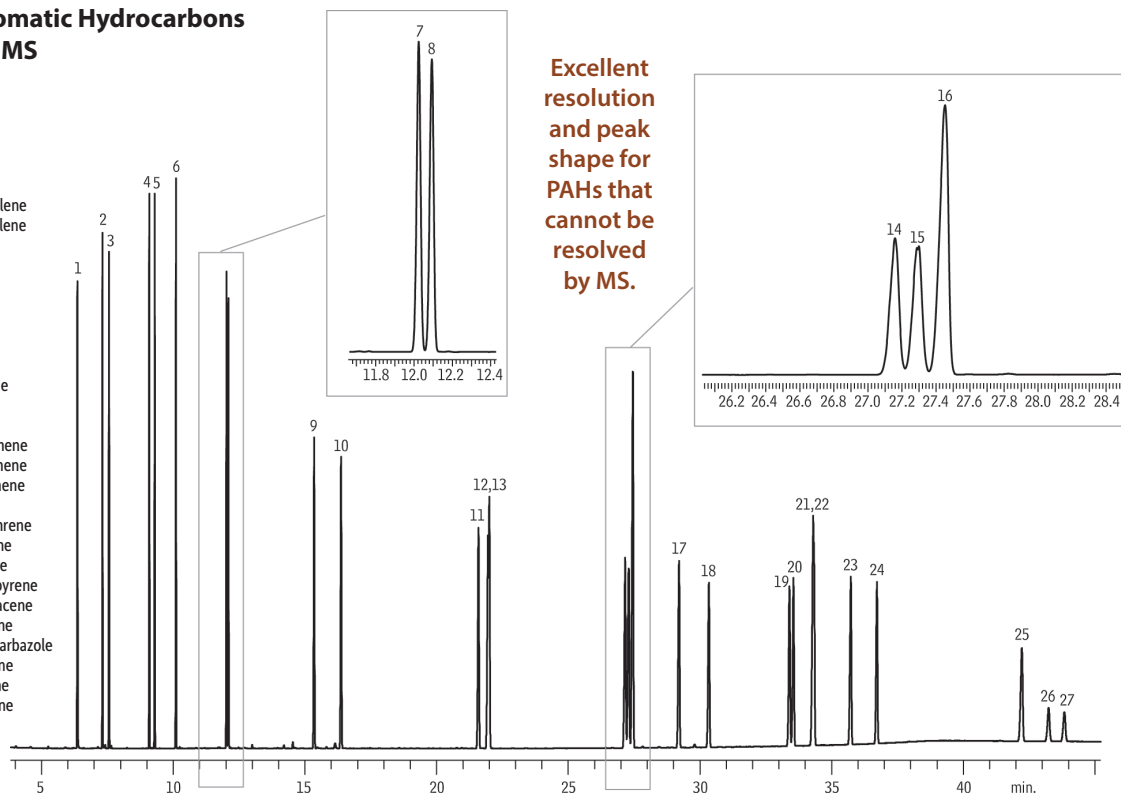
ID	df	temp. limits	10-Meter cat.#	20-Meter cat.#
0.15 mm	0.15 µm	40 to 340/360 °C	43820	43821
0.18 mm	0.18 µm	40 to 340/360 °C		14102
	0.36 µm	40 to 340/360 °C		14111

*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



Excellent resolution and peak shape for PAHs that cannot be resolved by MS.

Column Sample

Rxi®-17Sil MS, 30 m, 0.25 mm ID, 0.25 µm (cat.# 14123)
PAH supplement mix for method 8100 (cat.# 31857)
EPA Method 8310 PAH mixture (cat.# 31841)

Diluent:

Triphenylene (custom)
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

GC_EV1160

Semivolatiles Analysis

Rxi®-5Sil MS Columns (fused silica)

(low-polarity phase; Crossbond® 1,4-bis(dimethylsiloxy)phenylene dimethyl polysiloxane)

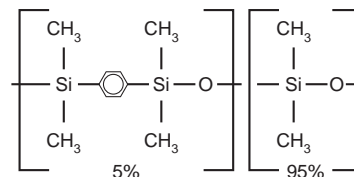
- Engineered to be a low-bleed GC-MS column.
- Excellent inertness for active compounds.
- General-purpose columns—ideal for GC-MS analysis of semivolatiles, polycyclic aromatic compounds, chlorinated hydrocarbons, phthalates, phenols, amines, organochlorine pesticides, organophosphorus pesticides, drugs, 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.

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

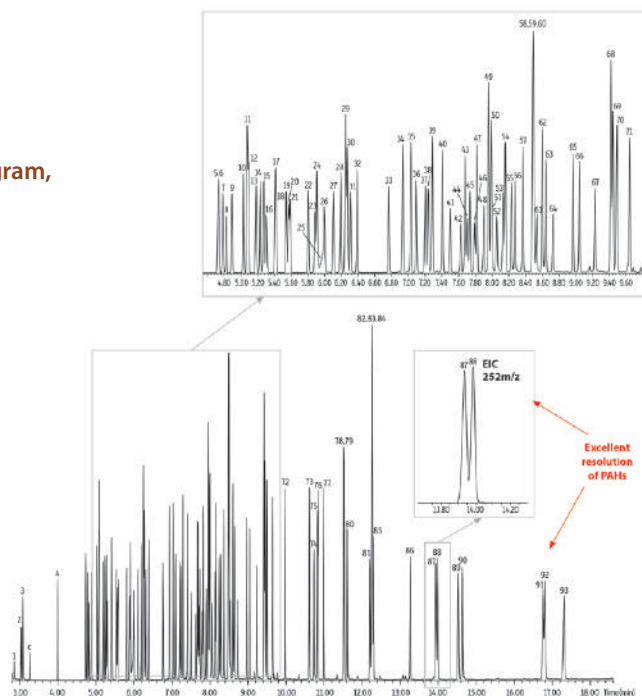
ordering note

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

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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



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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.#	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

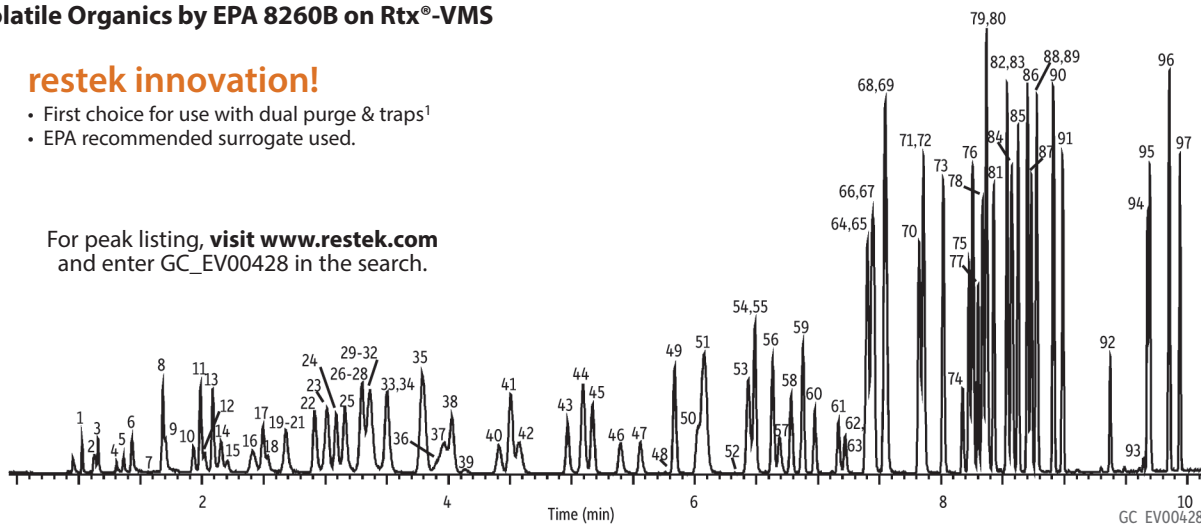
ID	df	temp. limits	20-Meter cat.#	40-Meter cat.#
0.18 mm	1.00 µm	-40 to 240/260 °C	49914	49915

Volatile Organics by EPA 8260B on Rtx®-VMS

restek innovation!

- First choice for use with dual purge & traps¹
- 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)
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

¹A.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.

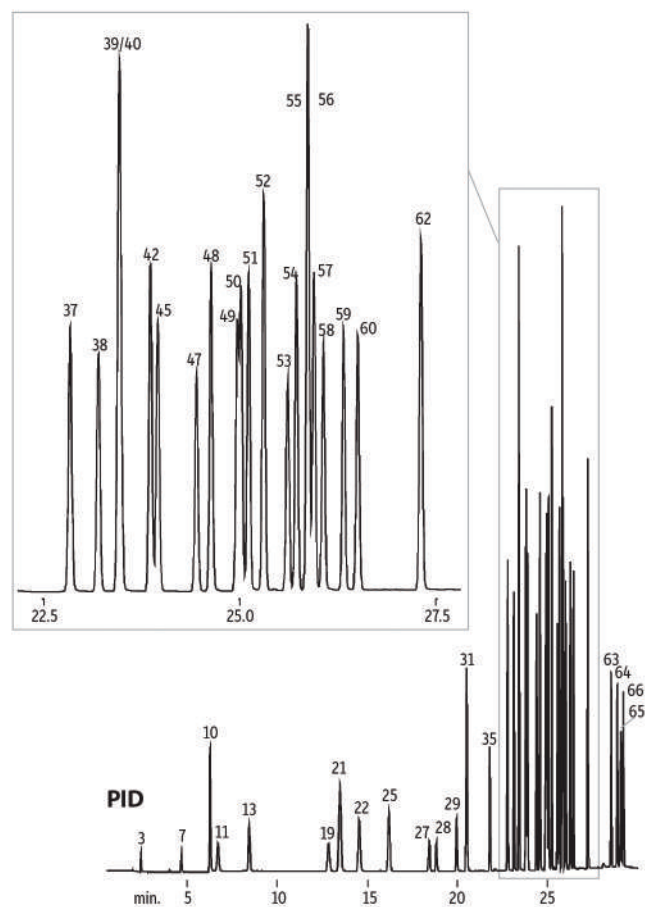
ID	df	temp. limits	30-Meter cat.#	60-Meter cat.#	75-Meter cat.#
0.25 mm	1.40 µm	-40 to 240/260 °C	19315	19316	
0.32 mm	1.80 µm	-40 to 240/260 °C	19319	19320	
0.45 mm	2.55 µm	-40 to 240/260 °C	19308		19309
0.53 mm	3.00 µm	-40 to 240/260 °C	19385	19388	

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

similar phases

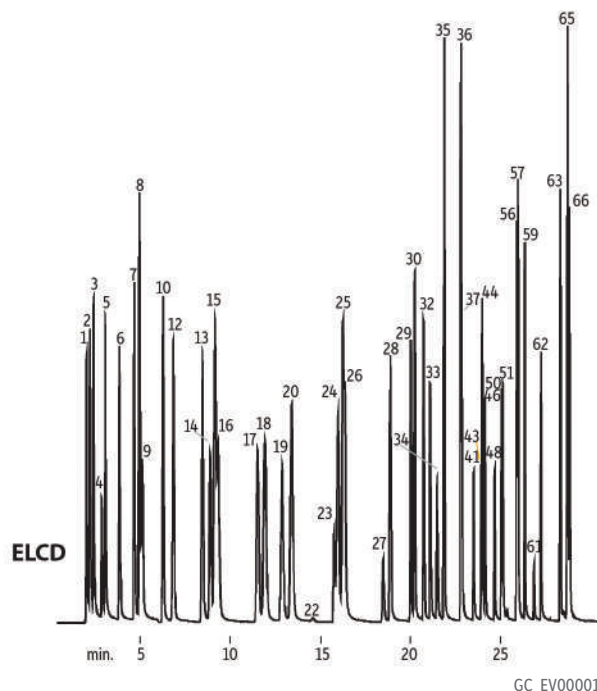
DB-VRX

Volatile Organics by EPA 8021 on Rtx®-VRX



Good choice for wastewater analysis.

For peak list and conditions, visit www.restek.com and enter GC_EV00001 in the search.



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 columnspage 111

MXT®-Volatilespage 111



Volatile Organics Analysis

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.

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.



True Blue Performance





See pages 193–202 or visit www.restek.com/sky

Volatile Organics Analysis

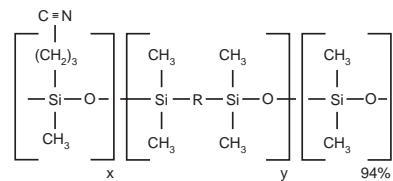
Rxi®-624Sil MS Columns (fused silica)

(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

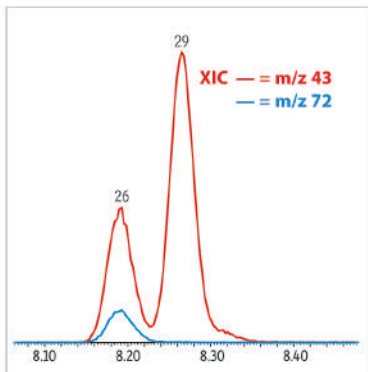


Similar to: (6%-cyanopropylphenyl)-methylpolysiloxane

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 Sample

Rxi®-624Sil MS, 30 m, 0.25 mm ID, 1.40 µm (cat.# 13868)
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.:

Injection

Inj. Temp.:

Purge and Trap

Instrument:

Trap Type:

Purge:

Desorb Preheat Temp.:

Desorb:

Bake:

Interface Connection:

Oven

Oven Temp.:

Carrier Gas

Flow Rate:

Detector

Mode:

Transfer Line Temp.:

Analyzer Type:

Source Temp.:

Quad Temp.:

Electron Energy:

Solvent Delay Time:

Tune Type:

Ionization Mode:

Scan Range:

Instrument

Notes

Other Purge-and-Trap Conditions:

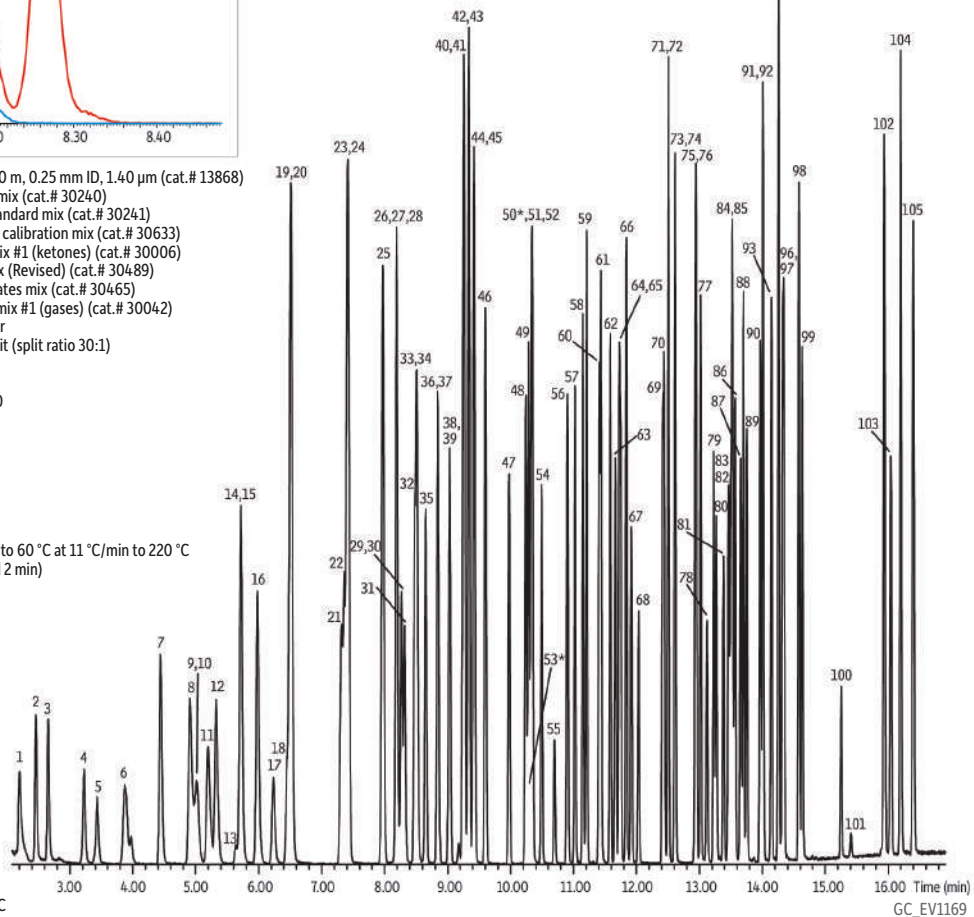
Sample Inlet: 40 °C

Sample: 40 °C

Water Management: Purge 110 °C, Desorb 0 °C, Bake, 240 °C

Eclipse 4660 purge-and-trap courtesy of O.I. Analytical, College Station, TX.

Acknowledgement



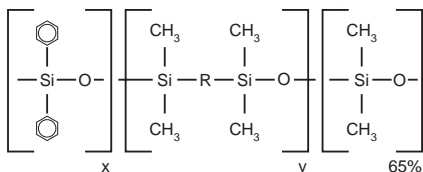
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Cannabis Potency Analysis

Rxi®-35Sil MS Structure



similar phases

DB-35ms, DB-35msUI, VF-35ms, MR2

Rxi®-35Sil MS Columns (fused silica)

(midpolarity Crossbond® phase)

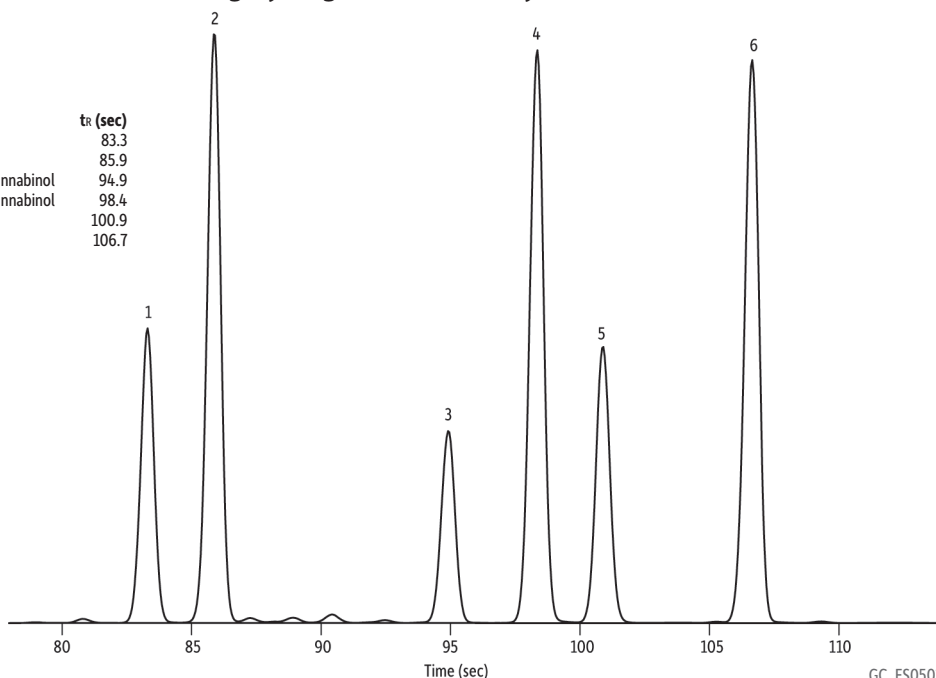
- Special selectivity and excellent inertness for substituted polar compounds, such as drugs, pesticides, herbicides, PCBs, phenols, etc.
- Provides superior separation for cannabinoids.
- Very low-bleed phase for GC-MS analysis.
- Extended temperature range: 50 °C to 340/360 °C.

The higher aromatic content of the Rxi®-35Sil MS column allows for superior separation of cannabinoids over traditional 5-type columns. Baseline separation can be achieved for a comprehensive list of cannabinoids by using a cost-effective 15 m column and readily available hydrogen carrier gas. The arylene content of the Rxi®-35Sil MS stationary phase ensures long column lifetime at the high elution temperatures required for cannabinoids analysis.

ID	df	temp. limits	15-Meter cat.#	30-Meter cat.#
0.25 mm	0.25 µm	50 to 340/360 °C	13820	13823

Cannabinoids on Rxi®-35Sil MS Using Hydrogen Carrier Gas by GC-FID

Peaks	tr (sec)
1. Cannabichromene	83.3
2. Cannabidiol	85.9
3. Delta-8-Tetrahydrocannabinol	94.9
4. Delta-9-Tetrahydrocannabinol	98.4
5. Cannabigerol	100.9
6. Cannabinol	106.7



GC_FS0501

Column Rxi®-35Sil MS, 15 m, 0.25 mm ID, 0.25 µm (cat.# 13820)
Sample Cannabinoids standard (cat.# 34014)
 Cannabichromene (cat.# 34092)
 delta-8-Tetrahydrocannabinol (THC) (cat.# 34090)
 Cannabigerol (cat.# 34091)

Injection
 Inj. Vol.: 1 µL split (split ratio 50:1)
 Liner: Sky® 4 mm Precision® liner w/wool (cat.# 23305.5)
 Inj. Temp.: 250 °C
 Split Vent Flow Rate: 125 mL/min
Oven
 Oven Temp.: 225 °C (hold 0.1 min) to 330 °C at 35 °C/min (hold 0.9 min)
Carrier Gas
 H₂, constant flow
 Flow Rate: 2.5 mL/min
Detector
 FID @ 350 °C
 Constant Column +
 Constant Make-up: 50 mL/min
 Make-up Gas Type: N₂
 Hydrogen flow: 40 mL/min
 Air flow: 450 mL/min
 Data Rate: 20 Hz
Instrument Agilent/HP6890 GC



FAME Analysis (*cis*/

Rt®-2560 Column (fused silica)

(highly polar phase; biscyanopropyl polysiloxane—not bonded)

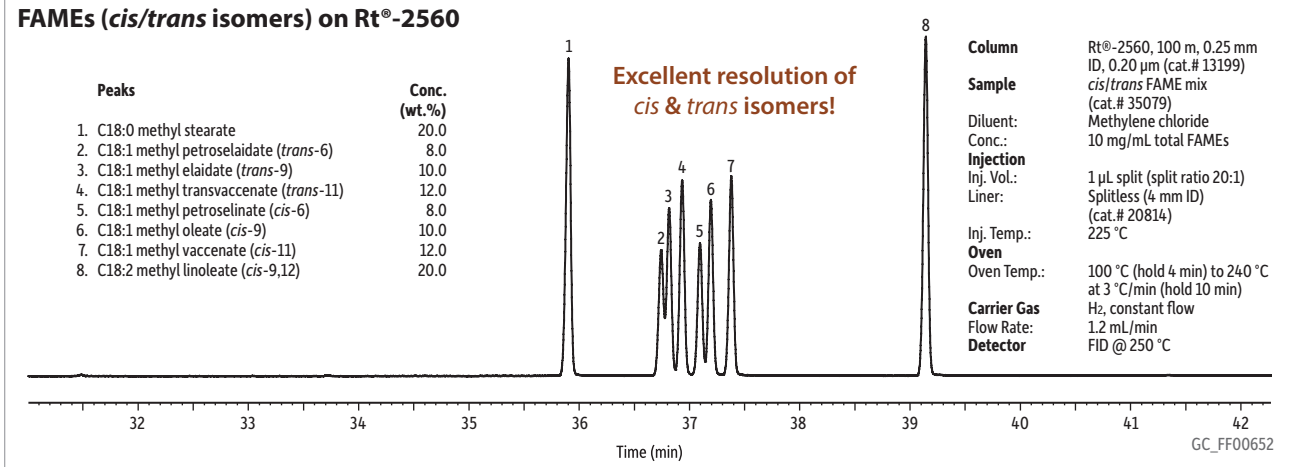
- Application-specific column for *cis/trans* FAMES.
- Stable to 250 °C.

Because the Rt®-2560 stationary phase is not bonded, it should not be solvent rinsed.

similar phases

HP-88, CP-Sil 88, SPB-2560

ID	df	temp. limits	100-Meter cat.#
0.25 mm	0.20 µm	20 to 250 °C	13199



FAME Analysis (Polyunsaturated)

FAMEWAX Columns (USP G16) (fused silica)

(polar phase; Crossbond® polyethylene glycol)

- Application-specific columns for FAMES, specially tested with a FAME mixture.
- Temperature range: 20 °C to 250 °C.

The elution order of polyunsaturated FAMES on FAMEWAX columns is comparable to that on other Carbowax® columns, but baseline resolution is achieved in significantly less time.

ID	df	temp. limits	30-Meter cat.#
0.25 mm	0.25 µm	20 to 240/250 °C	12497
0.32 mm	0.25 µm	20 to 240/250 °C	12498
0.53 mm	0.50 µm	20 to 250 °C	12499

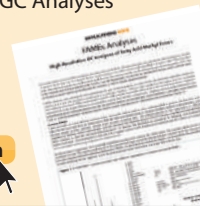
FAMES Analyses

High-Resolution GC Analyses of Fatty Acid Methyl Esters

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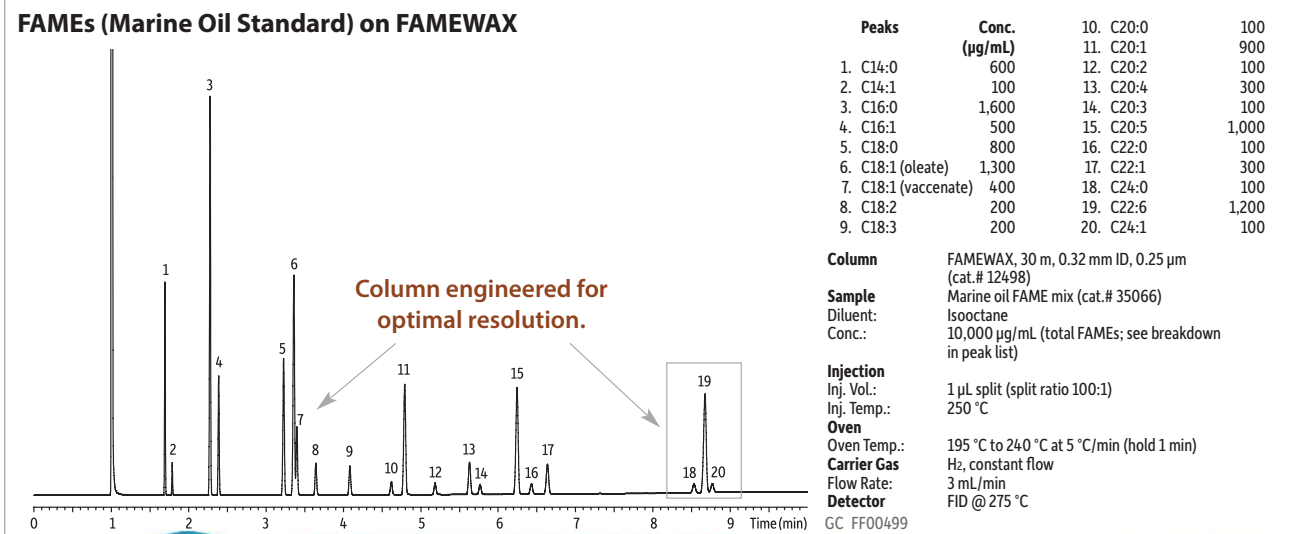
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lit. cat.# 59584B



similar phases

Select FAME, Omegawax



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PAHs in Food Analysis

“The Rxi®-PAH column enabled us to separate important PAH derivative isomers, which we were experiencing trouble with for months. This column is excellent for PAH, NPAH, and OPAH separation and I would recommend anyone working in this field to try it out. Thank you Restek!”

Mohammed Salim Alam
Research Fellow
University of Birmingham, UK

Rxi®-PAH GC Column
Resolve Important Isobaric Polycyclic Aromatic Hydrocarbons for Food Safety and Environmental Methods

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lit. cat.#
GNTS1718-UNV

**Rxi®-PAH Columns** (fused silica)

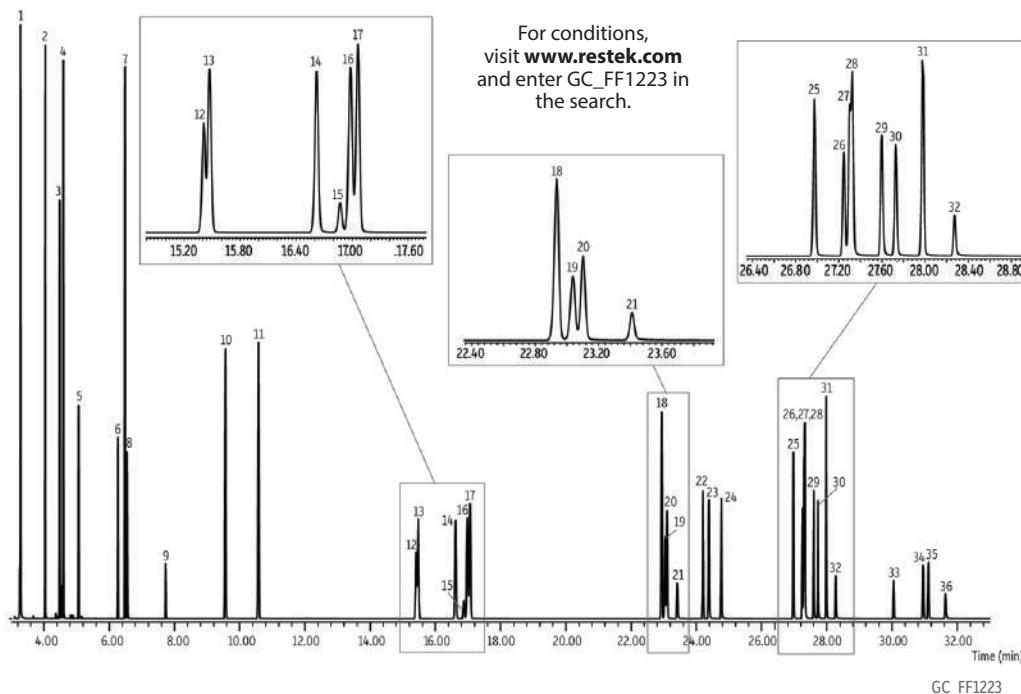
(midpolarity proprietary phase)

- Ideal for EFSA PAH4 analysis—separates all priority compounds: benz[a]anthracene, chrysene, benzo[b]fluoranthene, and benzo[a]pyrene.
- Best resolution of chrysene from interfering PAHs, triphenylene, and cyclopenta[cd]pyrene.
- Complete separation of benzo [b], [k], [j], and [a] fluoranthenes.
- 360 °C thermal stability allows analysis of low volatility dibenzo pyrenes.

The Rxi®-PAH GC columns were designed by Restek with a higher phenyl-content stationary phase that provides unique selectivity to separate important polycyclic aromatic hydrocarbons (PAH) for food safety that cannot be distinguished by mass spectrometry. Even difficult priority compounds, such as the European Food Safety Authority (EFSA) PAH4, are easily separated and accurately quantified—results that cannot be achieved on typical GC columns. Arylene modification and surface bonding of the stationary phase increase thermal stability and ruggedness so relatively nonvolatile, higher molecular weight PAHs can be analyzed routinely without interference from column bleed. Excellent column efficiency means that the column can be trimmed for maintenance purposes many times without losing critical PAH separations, including those that are part of environmental methods, as well as food safety testing. The selectivity and efficiency of the Rxi®-PAH column make it ideal for EFSA PAH4 analysis; chrysene/triphenylene separation and resolution of all benzofluoranthenes are easily achieved.

ID	df	temp. limits	30-Meter cat.#	40-Meter cat.#	60-Meter cat.#
0.18 mm	0.07 µm	to 360 °C		49316	
0.25 mm	0.10 µm	to 360 °C	49318		49317

NIST SRM 2260a PAH Mix on Rxi®-PAH



Peaks

1. Naphthalene
2. Biphenyl
3. Acenaphthylene
4. Acenaphthene
5. Fluorene
6. Dibenzothiophene
7. Phenanthrene
8. Anthracene
9. 4H-Cyclopenta[def]phenanthrene
10. Fluoranthene
11. Pyrene
12. Benzo[ghi]fluoranthene
13. Benzo[c]phenanthrene
14. Benz[a]anthracene
15. Cyclopenta[cd]pyrene
16. Triphenylene
17. Chrysene
18. Benzo[b]fluoranthene
19. Benzo[k]fluoranthene
20. Benzo[j]fluoranthene
21. Benzo[a]fluoranthene
22. Benzo[e]pyrene
23. Benzo[a]pyrene
24. Perylene
25. Dibenz[a,j]anthracene
26. Dibenz[a,c]anthracene
27. Indeno[1,2,3-cd]pyrene
28. Dibenz[a,h]anthracene
29. Benzo[b]chrysene
30. Picene
31. Benzo[ghi]perylene
32. Anthanthrene
33. Dibenzo[b,k]fluoranthene
34. Dibenzo[a,e]pyrene
35. Coronene
36. Dibenzo[a,h]pyrene

For conditions, visit www.restek.com and enter GC_FF1223 in the search.

GC_FF1223

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Pesticide Analysis in Cannabis

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.

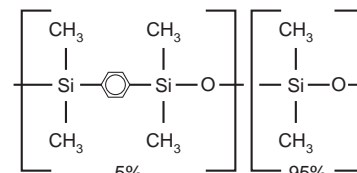
ID	df	temp. limits	30-Meter cat.#
0.25 mm	0.25 µm	-60 to 320/350 °C	13623
	0.50 µm	-60 to 320/350 °C	13638

Rxi®-5Sil MS with Integra-Guard®

- Extend column lifetime.
- Eliminate leaks with a built-in retention gap.
- Inertness verified by isothermal testing.

Description	qty.	cat.#
30 m, 0.25 mm ID, 0.25 µm Rxi-5Sil MS w/5 m Integra-Guard Column	ea.	13623-124
30 m, 0.25 mm ID, 0.50 µm Rxi-5Sil MS w/5 m Integra-Guard Column	ea.	13638-124

Rxi®-5Sil MS Structure



Similar to: (5%-phenyl)-methylpolysiloxane

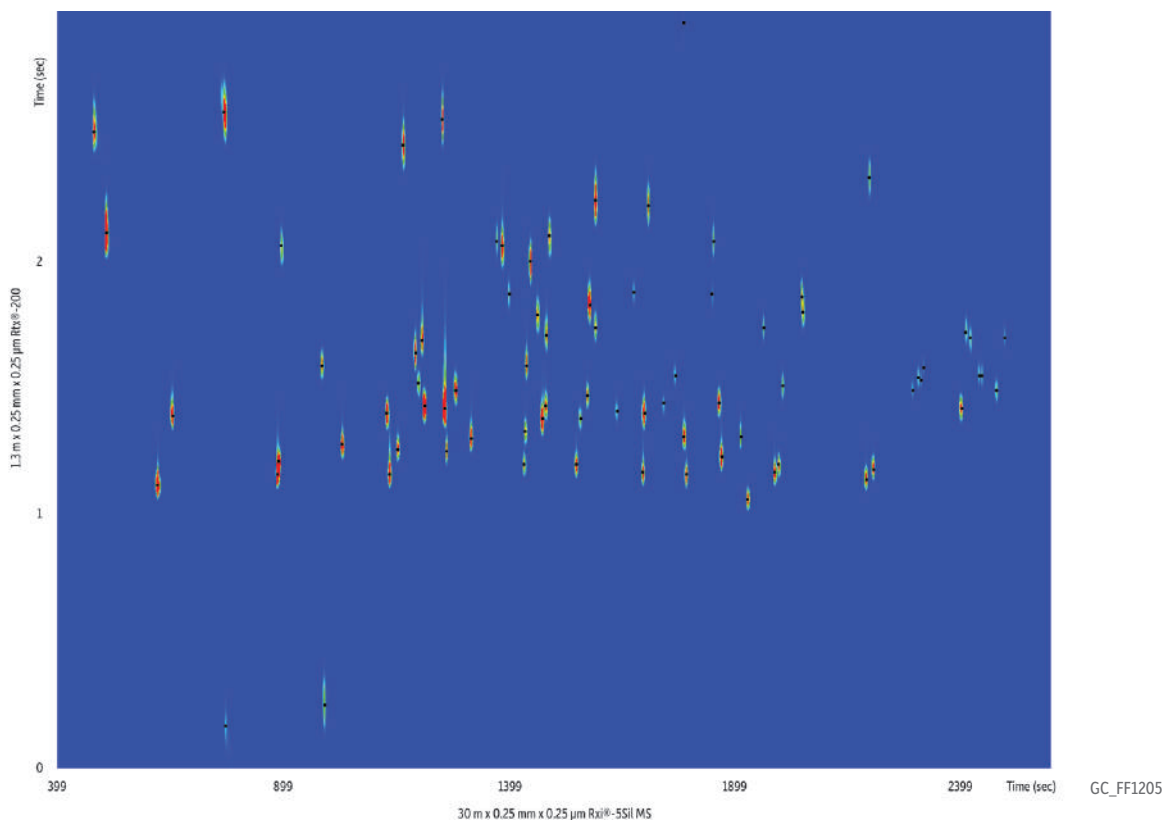
similar phases

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

Growing Analytical Solutions for Medical Cannabis Labs

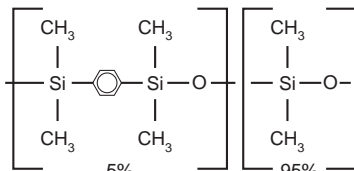
www.restek.com/cannabis

Marijuana Pesticides by GCxGC on Rxi®-5Sil MS and Rtx®-200



Column: Rxi®-5Sil MS 30 m, 0.25 mm ID, 0.25 µm (cat.# 13623); Rtx®-200 1.3 m, 0.25 mm ID, 0.25 µm (cat.# 15020); **Sample:** Diluent: Toluene; **Injection:** Inj. Vol.: 1 µL splitless (hold 1 min); Liner: Sky® 4 mm single taper w/wool (cat.# 23303.1); Inj. Temp.: 250 °C; Purge Flow: 40 mL/min; **Oven:** Oven Temp.: Rxi®-5Sil MS: 80 °C (hold 1 min) to 310 °C at 5 °C/min; Rtx®-200: 85 °C (hold 1 min) to 315 °C at 5 °C/min; **Carrier Gas:** He, corrected constant flow (2 mL/min); **Modulation:** Modulator Temp. Offset: 20 °C; Second Dimension Separation Time: 3 sec; Hot Pulse Time: 0.9 sec; Cool Time between Stages: 0.6 sec; **Detector:** TOFMS; Transfer Line Temp.: 290 °C; Analyzer Type: TOF; Source Temp.: 225 °C; Electron Energy: 70 eV; Mass Defect: -20 mu/100 u; Solvent Delay Time: 5 min; Tune Type: PFTBA; Ionization Mode: EI; Acquisition Range: 45-550 amu; Spectral Acquisition Rate: 100 spectra/sec; **Instrument:** LECO Pegasus 4D GCxGC-TOFMS; **Notes:** Rtx®-200 (cat.# 15020) is a 15 m column. A 1.3 m section was used as the second dimension column.

For a peak list visit www.restek.com and enter chromatogram GC_FF1205 in the search function

Rxi®-5Sil MS Structure

Similar to: (5%-phenyl)-methylpolysiloxane

similar phases

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

also available

Comprehensive 203-compound GC multiresidue pesticide kit



See page 568.

Pesticide Residues in Food 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.

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		

Chlorinated Pesticide Residues in Olive Oil on Rxi®-5Sil MS

Column Rxi®-5Sil MS 30 m, 0.25 mm ID, 0.25 µm (cat.# 13623)
Sample Olive oil spiked with organochlorine pesticide mix AB # 3 (cat.# 32415)
 Conc.: 10 µg/mL

Injection
 Inj. Vol.: 1 µL splitless (hold 0.5 min)
 Liner: Single taper w/wool (cat.# 22286-200.1)
 Inj. Temp.: 225 °C

Oven
 Oven Temp.: 130 °C (hold 0.5 min) to 330 °C at 5 °C/min

Carrier Gas He, constant flow

Flow Rate: 1 mL/min

Detector MS

Mode: SIM

Transfer Line

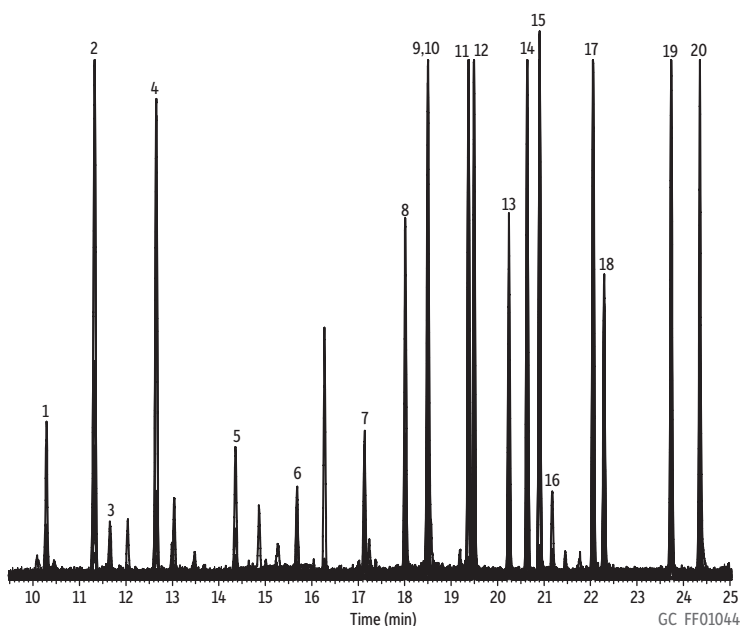
Temp.: 320 °C

Ionization Mode: EI

Notes**Extraction and dSPE Cleanup for Pesticide Residues in Olive Oil**

Test sample: A 1.5 mL sample of commercially obtained virgin olive oil was spiked with a standard organochlorine pesticide mix. The spiked sample was processed as follows.

1. Dilute with 1.5 mL hexane.
2. Add 6 mL of acetonitrile (ACN).
3. Mix for 30 minutes on a shaker.
4. Allow layers to separate (approximately 20 minutes), then collect the top (ACN) layer.
5. Repeat the liquid-liquid extraction (steps 2-4) and combine both ACN extract layers.
6. Place 1 mL of the combined ACN extract in a 1.5 mL tube containing 150 mg magnesium sulfate and 50 mg PSA.
7. Shake the tube for 2 minutes.
8. Centrifuge at 3,000 U/min for approximately 5 minutes.
9. Remove the top layer and inject directly into the gas chromatograph system.



For peak list, visit www.restek.com and enter GC_FF01044 in the search

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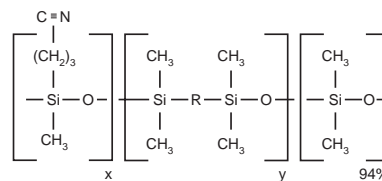
Residual Solvent Analysis for Cannabis Concentrates

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.

Rxi®-624Sil MS (G43) Structure



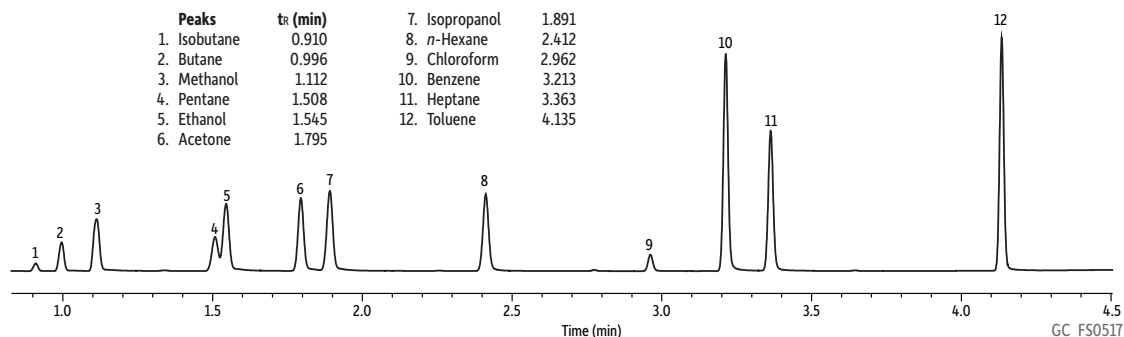
Similar to: (6%-cyanopropylphenyl)-methylpolysiloxane

similar phases

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

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

Residual Solvents in Cannabis Concentrates on Rxi®-624Sil MS by Headspace–Full Evaporation Technique (HS-FET)



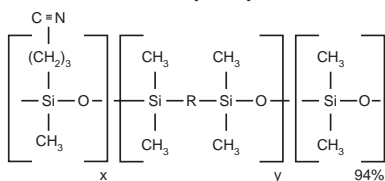
Column Rxi®-624Sil MS, 30 m, 0.25 mm ID, 1.40 µm (cat.# 13868)
Sample Residual solvent mix
Diluent: Dimethyl sulfoxide (DMSO)
Conc.: 500 ppm (For the HS-FET technique, 10 µL of a 1,000 µg/mL standard was placed into a 20 mL headspace vial to represent a 500 ppm sample concentration, assuming a 20 mg sample.)
Injection
Liner: headspace-loop split (split ratio 10:1)
Headspace-Loop
Instrument: Tekmar HT3
Inj. Time: 1.0 min
Transfer Line Temp.: 160 °C
Valve Oven Temp.: 160 °C
Needle Temp.: 140 °C
Sample Temp.: 140 °C
Platen temp
equil. time: 1.0 min
Sample Equil. Time: 30.0 min
Vial Pressure: 20 psi
Pressurize Time: 5.0 min
Loop Pressure: 15 psi
Loop Fill Time: 2.0 min

Oven
Oven Temp.: 35 °C (hold 1.5 min) to 300 °C at 30 °C/min (hold 2.0 min)
Carrier Gas He, constant flow
Linear Velocity: 80 cm/sec
Detector FID @ 250 °C
Make-up Gas
Flow Rate: 45 mL/min
Make-up Gas Type: N₂
Hydrogen flow: 40 mL/min
Air flow: 450 mL/min
Data Rate: 20 Hz
Instrument Agilent/HP6890 GC
Notes The butane used for standard preparation was a mixture of butane and isobutane in an unknown ratio. The concentrations of butane and isobutane should be considered approximate, but do not exceed 500 ppm for either component.

ChromaBLOGraphy
Check out the Restek blog for the most current topics in chromatography.
blog.restek.com

Terpenes Analysis for Cannabis and Hops

Rxi®-624Sil MS (G43) Structure



Similar to: (6%-cyanopropylphenyl)-methylpolysiloxane 94%

similar phases

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

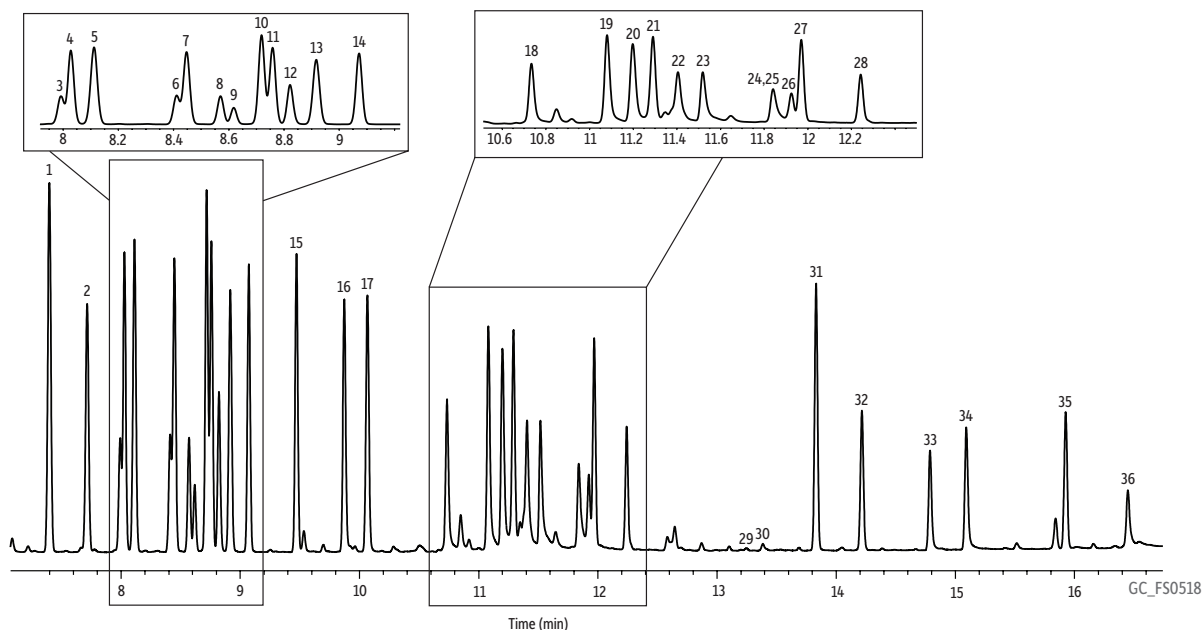
Rxi®-624Sil MS Columns (fused silica)

(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

Medical Cannabis Terpenes on Rxi®-624Sil MS by FET-HS-GC



Peaks	tr (min)	10. Limonene	8.71	20. Borneol	11.19	30. Citral 4	13.43
1. α-Pinene	7.39	11. p-Cymene	8.75	21. α-Terpineol	11.29	31. β-caryophyllene	13.83
2. Camphene	7.71	12. β-Ocimene	8.82	22. Dihydrocarveol	11.40	32. α-Humulene	14.21
3. β-Myrcene	7.98	13. Eucalyptol	8.91	23. Citronellol	11.51	33. Nerolidol 1	14.78
4. Sabinene	8.02	14. γ-Terpinene	9.06	24. Geraniol	11.82	34. Nerolidol 2	15.08
5. β-Pinene	8.11	15. Terpinolene	9.47	25. 2-Piperidinone	11.88	35. Caryophyllene oxide	15.92
6. α-Phellandrene	8.4	16. Linalool	9.87	26. Citral 1	11.92	36. α-Bisabolol	16.43
7. δ-3-Carene	8.44	17. Fenchone	10.06	27. Pulegone	11.97		
8. α-Terpinene	8.57	18. Isopulegol	10.73	28. Citral 2	12.24		
9. Ocimene	8.61	19. dl-Menthol	11.08	29. Citral 3	13.19		

Column Rxi® -624Sil MS, 30 m, 0.25 mm ID, 1.40 µm (cat.# 13868)
Sample Terpenes mix
Diluent: Isopropyl alcohol
Conc.: 200 ng/µL (0.02% wt/vol). The sample was prepared by placing 10 µL into the headspace vial.
Injection headspace-loop split (split ratio 10:1)
Liner: Sky® 1.0 mm ID straight inlet liner (cat.# 23333.1)
Headspace-Loop
Inj. Port Temp.: 250 °C
Instrument: Tekmar HT-3
Inj. Time: 1.0 min
Transfer Line Temp.: 160 °C
Valve Oven Temp.: 160 °C
Needle Temp.: 140 °C
Sample Temp.: 140 °C
Sample Equil. Time: 30.0 min

Vial Pressure: 20 psi
Loop Pressure: 15 psi
Oven
Oven Temp.: 60 °C (hold 0.10 min) to 300 °C at 12.50 °C/min (hold 3.0 min)
Carrier Gas He, constant flow
Linear Velocity: 33 cm/sec
Detector FID @ 320 °C
Make-up Gas
Flow Rate: 45 mL/min
Make-up Gas Type: N₂
Hydrogen flow: 40 mL/min
Air flow: 450 mL/min
Data Rate: 20 Hz
Instrument Agilent/HP6890 GC

Triglycerides in Foods Analysis

Rtx®-65TG Columns (fused silica)

(high-polarity phase; Crossbond® diphenyl dimethyl polysiloxane)

- Application-specific columns, specially tested for triglycerides.
- Stable to 370 °C.

The Rtx®-65TG phase resolves triglycerides by degree of unsaturation as well as by carbon number. Because of the chemistry required to achieve 370 °C thermal stability, an Rtx®-65TG column should not be used for the analyses of polar compounds.

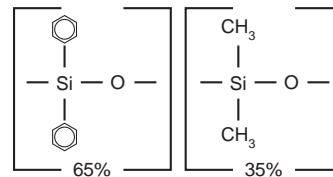
ID	df	temp. limits	15-Meter cat.#	30-Meter cat.#
0.25 mm	0.10 µm	40 to 370 °C	17005	17008
0.32 mm	0.10 µm	40 to 370 °C	17006	17009
0.53 mm	0.10 µm	40 to 370 °C	17007	17010

please note

Triglycerides are often injected via on-column injection. Use 0.53 mm retention gaps and appropriate connectors.

- Vu2 Union® connectors (see page 229.)
- MXT®-Union connector kits for fused silica (see page 231.)

Rtx®-65TG Structure

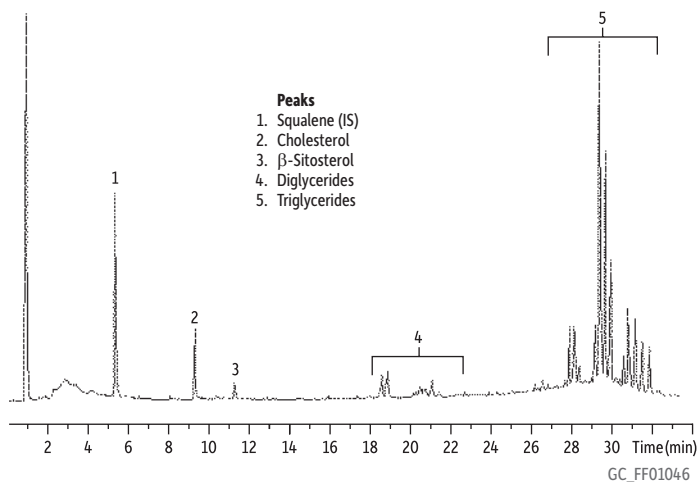


Similar to: (65%-phenyl)-methylpolysiloxane

crossbond® technology

Reduces bleed, prolongs column lifetime, and allows rejuvenation through solvent rinsing.

Egg Pasta Sterols & Glycerides on Rtx®-65TG



Column Rtx®-65TG, 30 m, 0.25 mm ID, 0.10 µm (cat.# 17008)
Sample Fat extract from egg pasta in diethyl ether solution with 3,000 ppm squalene (IS)
Conc.: 50 µg/mL
Injection
 Inj. Vol.: 0.5 µL pvt split (split ratio 80:1)
 Inlet Temp. Program: 70 °C (hold 12 min) to 370 °C at 99 °C/min (hold 5 min)
Oven
 Oven Temp.: 220 °C (hold 2 min) to 360 °C at 5 °C/min (hold 5 min)
Carrier Gas H₂, constant flow
Flow Rate: 1.5 mL/min
Detector FID @ 370 °C

Acknowledgement
 Daniele Naviglio, Fabiana Pizzolongo; Dipartimento di Scienza degli Alimenti – Università degli Studi di Napoli “Federico II” – Via Università, 100 - 80055 Portici (NA) – Italia



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Aromatics & Oxygenates in Gasoline Analysis

Rt®-TCEP Columns (fused silica)

(highly polar phase; 1,2,3-tris[2-cyanoethoxy]propane—not bonded)

- General-purpose columns, ideal for aromatics and oxygenates in gasoline.
- Temperature range: 0 °C to 135 °C.

Most gasolines contain aliphatic hydrocarbons up to *n*-dodecane (C12). To improve identification of the aromatics and oxygenates, it is desirable to elute benzene after C11 and toluene after C12. The extremely polar Rt®-TCEP stationary phase provides a retention index for benzene greater than 1,100 and permits the separation of alcohols and aromatics from the aliphatic constituents in gasoline.

Rt®-TCEP columns have the same high polarity as TCEP packed columns (precolumns in ASTM Method D4815 for the analysis of petroleum oxygenates), with the efficiency of a capillary column. The result is a column that can separate a wide variety of compounds with an elution pattern unattainable using other high polarity siloxanes.

The Rt®-TCEP column incorporates a nonbonded stationary phase coated on a surface specialized for enhanced polymer stability and extended column lifetime. Solvent rinsing should be avoided. Conditioning is necessary only if the column is to be used at temperatures near the maximum operating temperature.

ID	df	temp. limits	30-Meter cat.#	60-Meter cat.#
0.25 mm	0.40 µm	0 to 135 °C	10998	10999

similar phases

SPB-TCEP, CP-TCEP

free literature

Analyzing Oxygenates in Gasoline Using TCEP and RtX®-1/MXT®-1 Columns

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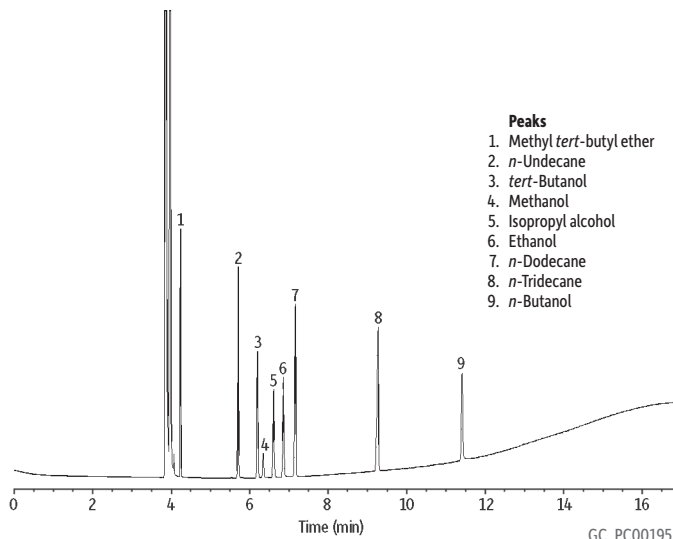
lit. cat.# 59587A



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Get six columns for the price of five.
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Petroleum Oxygenates on Rt®-TCEP



Column Rt®-TCEP, 60 m, 0.25 mm ID, 0.40 µm (cat.# 10999)
 Sample Conc.: 500 ppm
 Injection Inj. Vol.: 1.0 µL split
 Inj. Temp.: 200 °C
 Split Vent Flow Rate: 46 mL/min
 Oven Oven Temp.: 60 °C (hold 5 min) to 100 °C at 5 °C/min (hold 10 min)
 Carrier Gas He, constant pressure
 Linear Velocity: 30 cm/sec @ 80 °C
 Detector FID @ 200 °C
 Notes FID sensitivity: 6.4 x 10⁻¹¹ AFS

GC_PC00195

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Biodiesel Fuels Analysis

Rtx®-Biodiesel TG Columns (fused silica)

- Linearity for all reference compounds exceeds method requirements.
- Columns with retention gaps feature Alumaseal® connectors to prevent leaks and extend column life.
- Low column bleed at high temperatures.
- For glycerin and glycerides analysis, according to ASTM D6584 and EN 14105 methods.
- Stable to 350 °C.

Description	temp. limits	cat.#
10 m, 0.32 mm ID, 0.10 µm	to 330/380 °C	10292
10 m, 0.32 mm ID, 0.10 µm with 2 m x 0.53 mm ID Retention Gap	to 330/380 °C	10291
15 m, 0.32 mm ID, 0.10 µm	to 330/380 °C	10294
15 m, 0.32 mm ID, 0.10 µm with 2 m x 0.53 mm ID Retention Gap	to 330/380 °C	10293

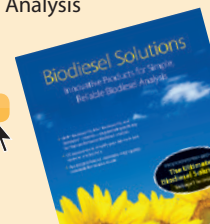
free literature

Biodiesel Solutions
Innovative Products for Simple,
Reliable Biodiesel Analysis

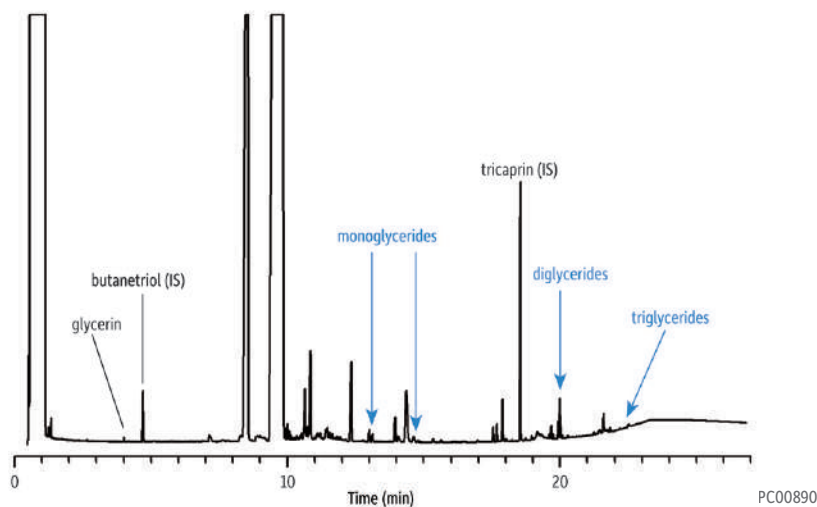
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PCFL1409-UNV



Glycerin in Biodiesel on Rtx®-Biodiesel TG



Column Rtx®-Biodiesel TG, 10 m, 0.32 mm ID, 0.10 µm using Hydroguard® tubing 2 m, 0.53 mm ID, with Alumaseal® connector (cat.# 10291)

Sample Injection
Inj. Vol.: 1.0 µL cold on-column
Temp. Program: oven track

Oven
Oven Temp.: 50 °C (hold 1 min) to 180 °C at 15 °C/min (hold 7 min) to 230 °C at 30 °C/min to 380 °C at 30 °C/min (hold 5 min)

Carrier Gas H₂, constant flow

Flow Rate: 4 mL/min

Detector FID @ 380 °C

did you know?

Using hydrogen instead of helium can cut analysis time in half! Visit www.restek.com to learn more.

similar phases

HP-PONA, DB-Petro, CP-Sil PONA C8, Petrocol DH

Method Recommended

Method	Column	cat. #	Dimensions
D6729	Rtx-DHA-100	10148	100 m x 0.25 mm, 0.50 µm
D6730	Rtx-DHA-100 & Rtx-5 DHA Tuning Column	10148 & 10165	100 m x 0.25 mm, 0.50 µm w/ precolumn
D6733	Rtx-DHA-50	10147	50 m x 0.20 mm, 0.50 µm
D5501	Rtx-DHA-150	10149	150 m x 0.25 mm, 1.0 µm

free literature

Detailed Hydrocarbon Analysis
Featuring Rtx®-DHA Columns

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PCFL1007B-UNV



Detailed Hydrocarbon Analysis (DHA)

Rtx®-DHA Columns (fused silica)

(Crossbond® 100% dimethyl polysiloxane—optimized for hydrocarbon analysis)

- Columns meet or exceed all ASTM D6730-01 and CAN/CGSB 3.0 No. 14.3-99 method guidelines; test report for method D6730 supplied with each column.
- Excellent responses and peak symmetry for polar oxygenates.
- Stable to 340 °C.

Gasolines are complex mixtures of hundreds of compounds. Information about concentrations of the individual components is important for evaluating raw materials and for controlling refinery processes. ASTM D6730-01 outlines a high-resolution GC method for detailed hydrocarbon analysis (DHA) of gasolines. Rtx®-DHA columns are ideal for DHA methods and easily meet or exceed both ASTM D6730-01 and Canadian General Standards Board CAN/CGSB 3.0 No. 14.3-99 requirements. Every Rtx®-DHA column is tested for retention, efficiency, stationary phase selectivity, and bleed—guaranteeing reproducible column-to-column performance.

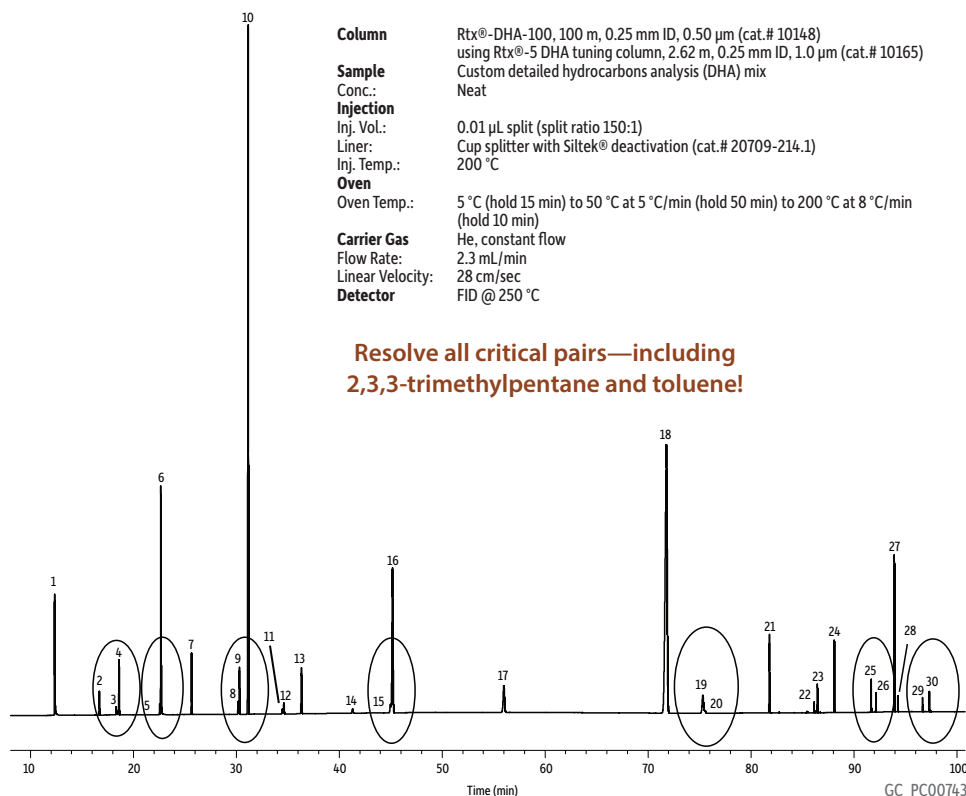
ID	df	temp. limits	50-Meter cat.#	100-Meter cat.#	150-Meter cat.#
0.20 mm	0.50 µm	-60 to 300/340 °C	10147		
0.25 mm	0.50 µm	-60 to 300/340 °C		10148	
	1.00 µm	-60 to 280/340 °C			10149

Rtx®-5 DHA Tuning Column (fused silica)

(Crossbond® 5% diphenyl/95% dimethyl polysiloxane—optimized for hydrocarbon analysis)

ID	df	temp. limits	5-Meter cat.#
0.25 mm	1.00 µm	-60 to 325/350 °C	10165

Detailed Hydrocarbons Analysis on Rtx®-DHA-100



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Simulated Distillation Analysis (C5-C44)

Rtx®-2887 Column (fused silica)

(nonpolar phase; Crossbond® 100% dimethyl polysiloxane—for simulated distillation)

- Application-specific column for simulated distillation.
- Stable to 360 °C.

The Rtx®-2887 column's stationary phase, column dimensions, and film thickness have been optimized to exceed the resolution and skewing factor requirements specified in ASTM Method D2887. Each column is individually tested to guarantee a stable baseline with low bleed and reproducible retention times. The Crossbond® methyl silicone stationary phase has increased stability compared to packed columns, ensuring stable baselines and shorter conditioning times.

ID	df	temp. limits	10-Meter cat.#
0.53 mm	2.65 µm	-60 to 360 °C	10199

similar phases

DB-2887, Petrocol 2887, Petrocol EX2887

also available

MXT®-1HT SimDist
and more simulated
distillation products

See **pages 113–115.**



free literature

Rtx®-2887/MXT®-2887

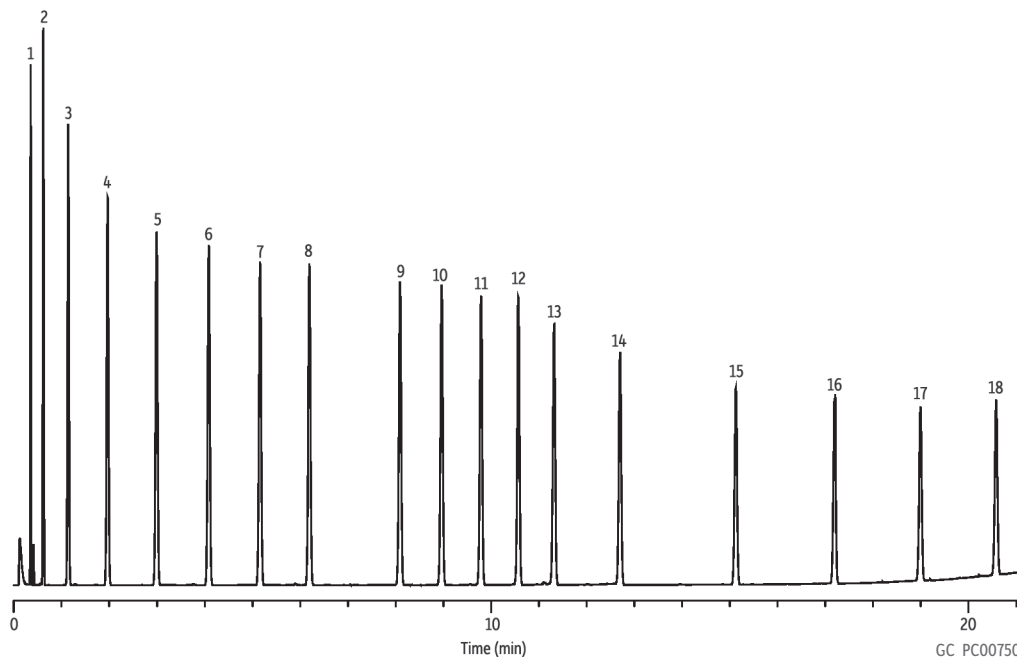
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Distillation of Petroleum Fractions

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lit. cat.# 59567B



Simulated Distillation (C5-C44) on Rtx®-2887



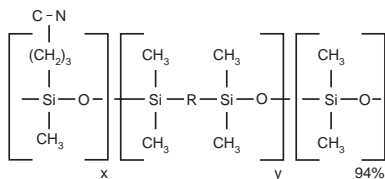
- Peaks**
1. C5
 2. C6
 3. C7
 4. C8
 5. C9
 6. C10
 7. C11
 8. C12
 9. C14
 10. C16
 11. C18
 12. C20
 13. C24
 14. C28
 15. C32
 16. C36
 17. C40
 18. C44

Column Rtx®-2887, 10 m, 0.53 mm ID, 2.65 µm (cat.# 10199)
Sample C5 to C44 hydrocarbon standard
Diluent: Carbon disulfide
Conc.: 0.01-0.1 wt. %
Injection
Inj. Vol.: 1 µL direct
Inj. Temp.: 360 °C
Oven
Oven Temp.: 35 °C to 360 °C at 15 °C/min (hold 5 min)
Carrier Gas He, constant flow
Flow Rate: 15 mL/min
Linear Velocity: 112 cm/sec
Detector FID @ 360 °C

Organic Volatile Impurities (OVI) Analysis

G43 phase

Rxi®-624Sil MS Structure



Similar to: (6%-cyanopropylphenyl)-methylpolysiloxane

Rxi®-624Sil MS Columns (fused silica)

(midpolarity Crossbond® phase)

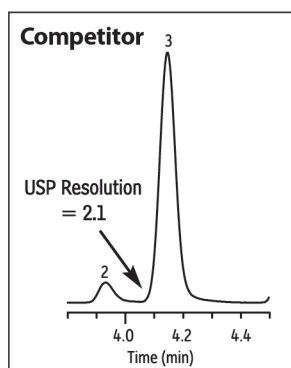
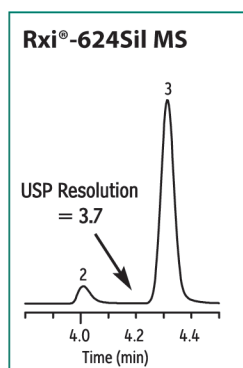
- Low-bleed, high-thermal stability column—maximum temperatures up to 320 °C.
- Inert—excellent peak shape for a wide range of compounds.
- Selective—G43 phase highly selective for volatile organics and residual solvents, great choice for USP<467>.
- Manufactured for column-to-column reproducibility—well-suited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

similar phases

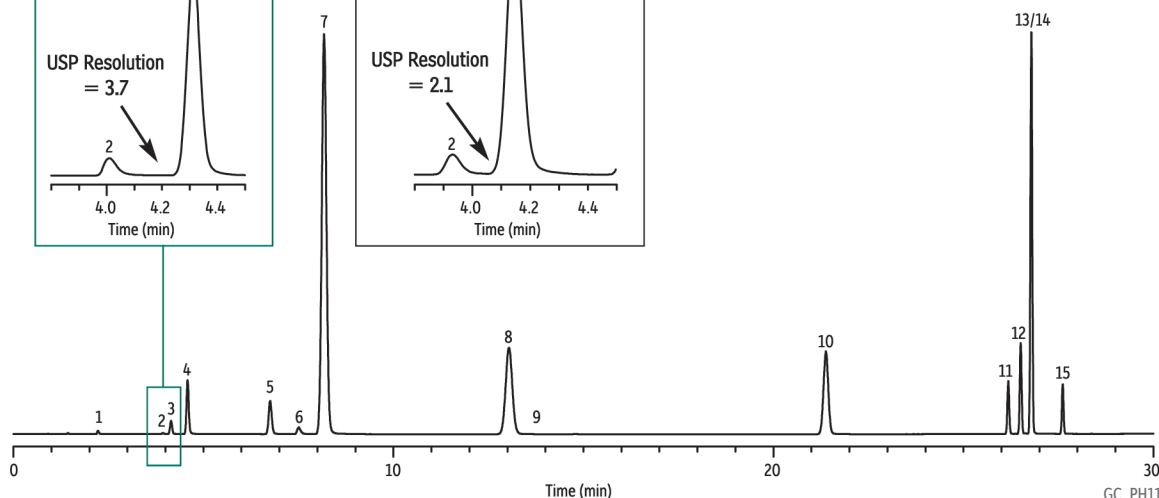
DB-624, VF-624ms, CP-Select 624 CB

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

Competitor Comparison: Class 2 - Mix A Residual Solvents for USP <467> Water-Soluble Articles



Improve system suitability pass rates with greater resolution on Rxi®-624Sil MS columns.



GC_PH1161

Column Rxi®-624Sil MS, 30 m, 0.32 mm ID, 1.80 µm (cat.# 13870)
Sample Residual solvents class 2 - mix A (cat.# 36271)
Diluent: Water
Injection Headspace-loop split (split ratio 5:1)
Liner: 1 mm split (cat.# 20972)
Headspace-Loop
Inj. Port Temp.: 140 °C
Instrument: Tekmar HT3
Inj. Time: 1 min
Transfer Line Temp.: 110 °C
Valve Oven Temp.: 110 °C
Sample Temp.: 80 °C
Sample Equil. Time: 60 min
Vial Pressure: 10 psi
Pressurize Time: 0.5 min
Pressure
Equilibration Time: 0.05 min
Loop Pressure: 5 psi
Loop Fill Time: 0.1 min
Oven
Oven Temp.: 40 °C (hold 20 min) to 240 °C at 10 °C/min (hold 20 min)
Carrier Gas He, constant flow
Linear Velocity: 35 cm/sec
Dead Time: 1.45 min @ 40 °C
Detector FID @ 250 °C
Data Rate: 5 Hz
Instrument Agilent/HP6890 GC
Acknowledgement Teledyne Tekmar

Peaks	TR (min)	Conc. (µg/mL)
1. Methanol	2.281	25.00
2. Acetonitrile	4.009	3.42
3. Dichloromethane	4.313	5.00
4. <i>trans</i> -1,2-Dichloroethene	4.798	7.83
5. <i>cis</i> -1,2-Dichloroethene	7.028	7.83
6. Tetrahydrofuran	7.706	5.75
7. Cyclohexane	8.708	32.33
8. Methylcyclohexane	14.099	9.83
9. 1,4-Dioxane	15.054	3.17
10. Toluene	22.018	7.42
11. Chlorobenzene	26.570	3.00
12. Ethylbenzene	26.837	3.07
13. <i>m</i> -Xylene	27.147	10.85
14. <i>p</i> -Xylene	27.147	2.53
15. <i>o</i> -Xylene	27.927	1.63

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Organic Volatile Impurities (OVI) Analysis

Stabilwax® Columns (fused silica)

(polar phase; Crossbond® polyethylene glycol)

- Most stable polyethylene glycol (PEG) column available.
- Rugged enough to withstand repeated water injections.
- Lowest-bleed PEG column on the market; long column lifetimes.
- Temperature range: 40 °C to 260 °C.
- Equivalent to USP G14, G15, G16, G20, and G39 phases.

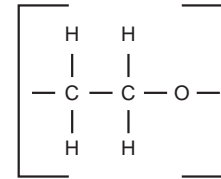
Restek's polar-deactivated surface tightly binds the Carbowax® polymer and increases thermal stability, relative to competitive columns. Because of the increased stability produced by the bonding process, Stabilwax® columns exhibit long column lifetimes, even when programming repeatedly up to 260 °C. The bonding mechanism of the column also produces polar compound retention times that do not shift, as is often observed on other wax-type columns. In addition, this bonding mechanism produces a column that can be rejuvenated by solvent washing.

ID	df	temp. limits	15-Meter cat.#	30-Meter cat.#	60-Meter cat.#
0.25 mm	0.10 µm	40 to 250/260 °C	10605	10608	10611
	0.25 µm	40 to 250/260 °C	10620	10623	10626
	0.50 µm	40 to 250/260 °C	10635	10638	10641
0.32 mm	0.25 µm	40 to 250/260 °C	10621	10624	10627
	0.50 µm	40 to 250/260 °C	10636	10639	10642
	1.00 µm	40 to 240/250 °C	10651	10654	10657
0.53 mm	0.25 µm	40 to 250/260 °C	10622	10625	10628
	0.50 µm	40 to 250/260 °C	10637	10640	10643
	1.00 µm	40 to 240/250 °C	10652	10655	10658
	1.50 µm	40 to 230/240 °C	10666	10669	10672
	2.00 µm	40 to 220/230 °C	10667	10670	

ID	df	temp. limits	10-Meter cat.#	20-Meter cat.#
0.15 mm	0.15 µm	40 to 250/260 °C	43830	43831
0.18 mm	0.18 µm	40 to 250 °C		40602

G16 phase

Stabilwax® Structure



similar phases

HP-INNOWax, CP-Wax 52 CB, VF-WAX MS, ZB-WAXplus

ordering note

Get the protection without the connection!

For Stabilwax® columns with built-in Integra-Guard® guard columns, see page 23.

free literature

Custom Residual Solvent Mixes

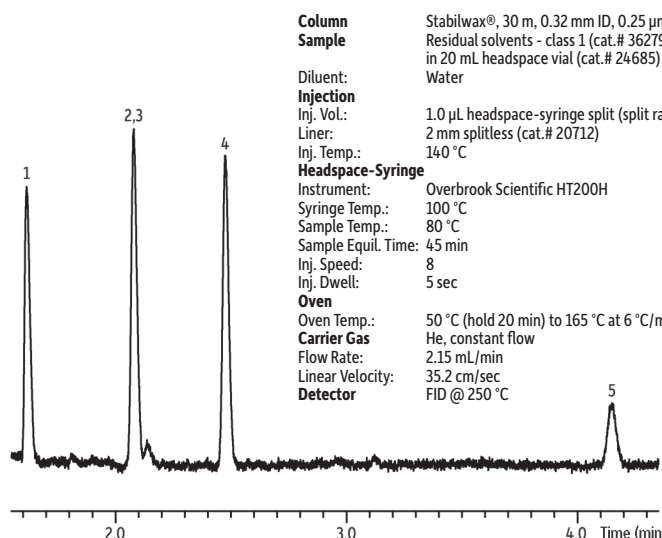
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lit. cat.#
PHTS1212



Residual Solvents (Class 1) on Stabilwax® (G16)



Column Stabilwax®, 30 m, 0.32 mm ID, 0.25 µm (cat.# 10624)
Sample Residual solvents - class 1 (cat.# 36279)
 in 20 mL headspace vial (cat.# 24685)
Diluent: Water
Injection
 Inj. Vol.: 1.0 µL headspace-syringe split (split ratio 5:1)
 Liner: 2 mm splitless (cat.# 20712)
 Inj. Temp.: 140 °C
Headspace-Syringe
 Instrument: Overbrook Scientific HT200H
 Syringe Temp.: 100 °C
 Sample Temp.: 80 °C
 Sample Equil. Time: 45 min
 Inj. Speed: 8
 Inj. Dwell: 5 sec
Oven
 Oven Temp.: 50 °C (hold 20 min) to 165 °C at 6 °C/min (hold 20 min)
Carrier Gas
 He, constant flow
 Flow Rate: 2.15 mL/min
 Linear Velocity: 35.2 cm/sec
Detector
 FID @ 250 °C

Peaks

- 1,1-Dichloroethene
- 1,1,1-Trichloroethane
- Carbon tetrachloride
- Benzene
- 1,2-Dichloroethane

System suitability
criteria met

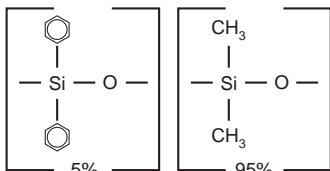
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G27 phase

Rtx[®]-5 Structure

Similar to: (5%-phenyl)-methylpolysiloxane

similar phases

HP-5, DB-5, CP-Sil 8 CB, ZB-5

NOTE: DB-5MS is a silarylene-based polymer, similar to Rxi-5Sil MS.

USP

Pharmaceutical
Standards

See pages 595–596.



Organic Volatile Impurities (OVI) Analysis

Rtx[®]-5 (G27) Columns (fused silica)(low-polarity phase; Crossbond[®] diphenyl dimethyl polysiloxane)

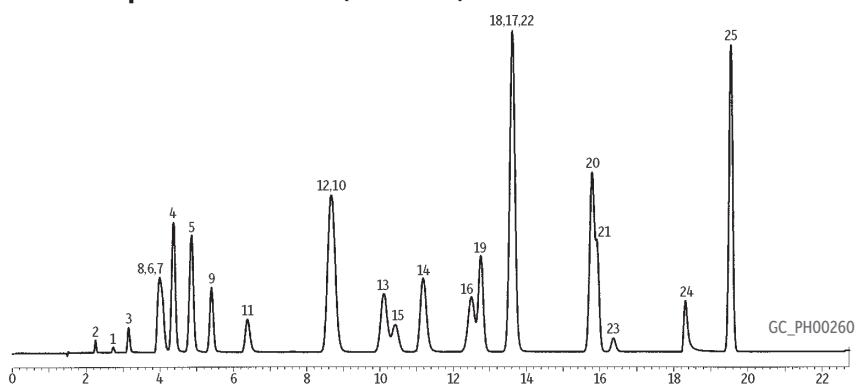
- General-purpose columns for drugs, solvent impurities, pesticides, hydrocarbons, PCB congeners (e.g., Aroclor mixes), essential oils, semivolatiles.
- Temperature range: -60 °C to 350 °C.
- Equivalent to USP G27 and G36 phases.

The diphenyl dimethyl polysiloxane stationary phase is the most popular GC stationary phase and is used in a wide variety of applications. All residual catalysts and low molecular weight fragments are removed from the Rtx[®]-5 polymer, providing a tight mono-modal distribution and extremely low bleed.

ID	df	temp. limits*	15-Meter cat.#	30-Meter cat.#	60-Meter cat.#	105-Meter cat.#
0.25 mm	0.10 µm	-60 to 330/350 °C	10205	10208	10211	
	0.25 µm	-60 to 330/350 °C	10220	10223	10226	10229
	0.50 µm	-60 to 330/350 °C	10235	10238	10241	10244
	1.00 µm	-60 to 325/340 °C	10250	10253	10256	10259
0.32 mm	0.10 µm	-60 to 330/350 °C	10206	10209		
	0.25 µm	-60 to 330/350 °C	10221	10224	10227	
	0.50 µm	-60 to 330/350 °C	10236	10239	10242	
	1.00 µm	-60 to 325/340 °C	10251	10254	10257	10260
	1.50 µm	-60 to 310/330 °C	10266	10269	10272	10275
	3.00 µm	-60 to 280/300 °C	10281	10284	10287	10290
0.53 mm	0.10 µm	-60 to 320/340 °C	10207	10210		
	0.25 µm	-60 to 320/340 °C	10222	10225	10228	
	0.50 µm	-60 to 320/330 °C	10237	10240	10243	
	1.00 µm	-60 to 320/330 °C	10252	10255	10258	
	1.50 µm	-60 to 310/330 °C	10267	10270	10273	
	3.00 µm	-60 to 270/290 °C	10282	10285	10288	
	5.00 µm	-60 to 270/290 °C	10277	10279	10283	

ID	df	temp. limits	10-Meter cat.#	20-Meter cat.#	40-Meter cat.#
0.18 mm	0.20 µm	-60 to 325/340 °C	40201	40202	40203
	0.40 µm	-60 to 315/330 °C	40210	40211	40212

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

Organic Volatile Impurities on Rtx[®]-5 (Rtx[®]-G27)

Peaks

1. Ethylene oxide
2. Methanol
3. Ethanol
4. Diethyl ether
5. 1,1-Dichloroethane
6. Acetone
7. Isopropanol
8. Acetonitrile
9. Methylene chloride
10. *n*-Hexane
11. *n*-Propanol
12. Methyl ethyl ketone
13. Ethyl acetate
14. Tetrahydrofuran
15. Chloroform
16. 1,1,1-Trichloroethane
17. Carbon tetrachloride
18. Benzene
19. 1,2-Dichloroethane
20. Heptane
21. Trichloroethylene
22. *n*-Butanol
23. 1,4-Dioxane
24. Pyridine
25. Toluene

Column Rtx[®]-5 w/5m Integra-Guard[®] Column (Rtx[®]-G27), 30 m, 0.53 mm ID, 5.00 µm (cat.# 10279-126)
Sample Headspace injection of common solvents for pharmaceutical processing. Prepared to equal about 500 ppm in the bulk pharmaceutical. Samples shaken and heated at 90 °C for 15 minutes, 1 mL headspace injection.

Injection
 Inj. Vol.: 1,000 µL headspace-syringe split (split ratio 2:1)
 Inj. Temp.: 220 °C

Oven
 Oven Temp.: 35 °C (hold 10 min) to 100 °C at 5 °C/min to 240 °C at 25 °C/min (hold 5 min)

Carrier Gas
 He, constant pressure
 Linear Velocity: 35 cm/sec @ 35 °C

Detector
 FID @ 240 °C

Notes
 FID sensitivity: 1.05 x 10⁻¹¹ AFS

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Organic Volatile Impurities (OVI) Analysis

Rtx®-G27 Column (fused silica with 5-meter Integra-Guard® guard column)

(Crossbond® diphenyl dimethyl polysiloxane)

- Application-specific columns for residual solvents in pharmaceutical products.
- Analytical column with Integra-Guard® guard column eliminates connecting problems and leaks.
- Rtx®-G27 stable to 290 °C.

Some methods require the use of a guard column. Our Integra-Guard® integrated guard column system makes it easy to comply.

ID	df	temp. limits	30-Meter with 5-Meter, 0.53mm ID Integra-Guard Guard Column cat.#
0.53 mm	5.00 µm	-60 to 270/290 °C	10279-126

Rtx®-G43 Column (fused silica with 5-meter Integra-Guard® guard column)

(Crossbond® cyanopropylmethyl phenylmethyl polysiloxane)

- Application-specific columns for residual solvents in pharmaceutical products. Meet all requirements of USP <467>.
- Analytical column with Integra-Guard® guard column eliminates connecting problems and leaks.
- Rtx®-G43 stable to 240 °C.

Some USP <467> methods require the use of a guard column. Our Integra-Guard® integrated guard column system makes it easy to comply.

ID	df	temp. limits	30-Meter with 5-Meter, 0.53mm ID Integra-Guard Guard Column cat.#
0.53 mm	3.00 µm	-20 to 240 °C	16085-126

free literature

A Technical Guide for
Static Headspace
Analysis
Using GC



lit. cat.#
59895B

Custom Residual
Solvents
Mixes

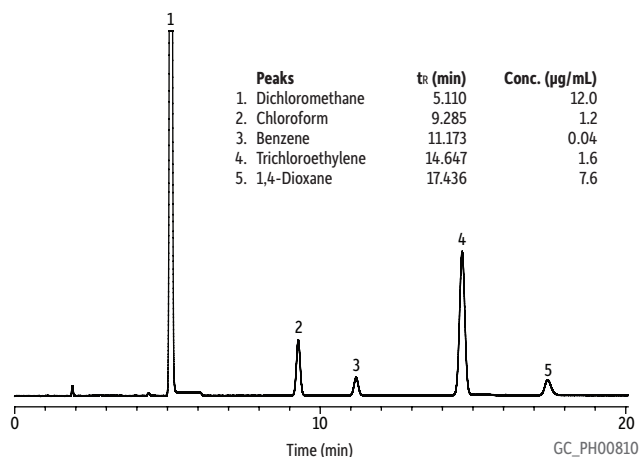


lit. cat.#
PHTS1212

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USP <467> Residual Solvents on Rtx®-1301 (G43) by Static Headspace



Column

Rtx®-1301 w/5 m Integra-Guard®, 30 m, 0.53 mm ID, 3.00 µm
(cat.# 16085-126)

Sample

USP <467> calibration mixture #5 (cat.# 36007)

Diluent:

DMSO

Conc.:

To each 22 mL headspace vial 5mL water, ~1.0 g of sodium sulfate and 100 µL of stock standard were added.
headspace-loop split (split ratio 2:1)

Injection Headspace-Loop

Inj. Port Temp.: 180 °C
Instrument: Teledyne Tekmar HT3
Inj. Time: 1.0 min
Transfer Line Temp.: 150 °C
Valve Oven Temp.: 150 °C
Standby flow rate: 10 mL/min
Sample Temp.: 80 °C
Platen temp equil. time: 2.0 min
Sample Equil. Time: 15.0 min
Mixer time: 2.0 min
Mixing level: 5
Mixer stabilize time: 0.5 min
Vial Pressure: 15 psi
Pressurize Time: 2.0 min
Pressure Equilibration Time: 0.5 min
Loop Pressure: 5 psi
Loop Fill Time: 2.0 min
Loop fill equil. time: 0.5 min

Oven

Oven Temp.: 40 °C (hold 20 min) to 240 °C at 25 °C/min (hold 10 min)

Carrier Gas

He, constant flow

Flow Rate:

5 mL/min

Detector

FID @ 250 °C

Make-up Gas Flow Rate:

45 mL/min

Notes

FID conditions:
hydrogen flow: 40 mL/min
air flow: 450 mL/min

Acidic Compounds Analysis

Stabilwax®-DA Columns (fused silica)

(polar phase; Crossbond® acid-deactivated Carbowax® polyethylene glycol—for acidic compounds)

- Application-specific columns for free (underivatized) acids, some inorganic acids.
- Resistant to oxidative damage.
- Temperature range: 40 °C to 260 °C.
- Equivalent to USP G25, G35 phases.

Stabilwax®-DA bonded polyethylene glycol has an acidic functionality incorporated into the polymer structure. This permits analysis of acidic compounds without derivatization, significantly reduces adsorption of acids, and increases sample capacity for volatile free acids. Stabilwax®-DA columns last longer and give better peak shapes for high molecular weight acids.

Some inorganic acids also chromatograph well on a Stabilwax®-DA column; the limitation is the volatility of the acidic compound.

similar phases

HP-FFAP, DB-FFAP, CP-WAX 58 FFAP CB, NUKOL, ZB-FFAP

crossbond® technology

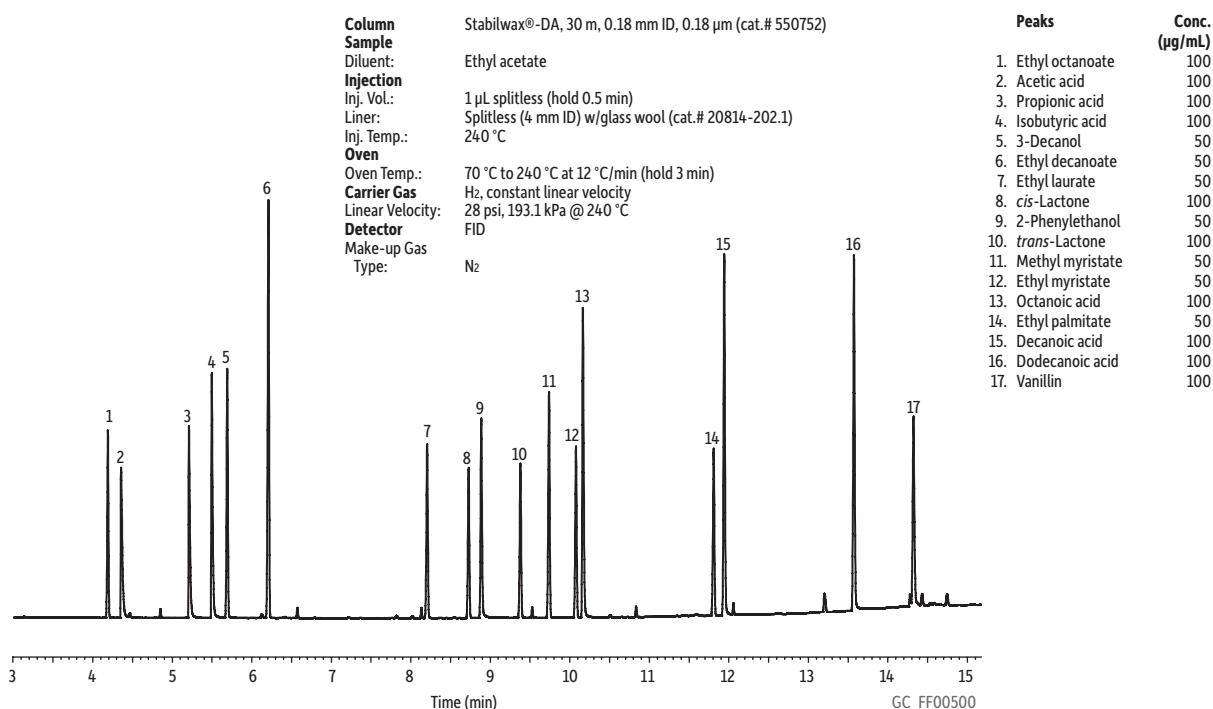
Reduces bleed, prolongs column lifetime, and allows rejuvenation through solvent rinsing.

please note

Stabilwax®-DA columns should not be rinsed with water.

ID	df	temp. limits	15-Meter cat.#	30-Meter cat.#	60-Meter cat.#
0.25 mm	0.10 µm	40 to 250/260 °C	11005	11008	
	0.25 µm	40 to 250/260 °C	11020	11023	11026
	0.50 µm	40 to 250/260 °C	11035	11038	11041
0.32 mm	0.10 µm	40 to 250/260 °C		11009	
	0.25 µm	40 to 250/260 °C	11021	11024	11027
	0.50 µm	40 to 250/260 °C	11036	11039	11042
	1.00 µm	40 to 240/250 °C	11051	11054	11057
0.53 mm	0.10 µm	40 to 250/260 °C	11007		
	0.25 µm	40 to 250/260 °C	11022	11025	
	0.50 µm	40 to 250/260 °C	11037	11040	
	1.00 µm	40 to 240/250 °C	11052	11055	11058
	1.50 µm	40 to 230/240 °C	11062	11065	11068

Underivatized Alcoholic Beverage Acids and Methyl Esters on Stabilwax®-DA



Basic Compounds Analysis

Rtx®-Volatile Amine Columns (fused silica)

- Unique selectivity for baseline resolution of all volatile amines.
- Excellent inertness assures accuracy and sensitivity for volatile amines, including free ammonia.
- Highly robust phase withstands repeated water injections, resulting in longer column lifetime.
- High temperature stability (290 °C) ensures elution of amines up to C16 and allows contaminants to be removed by “baking out” the column.

The Rtx®-Volatile Amine column was designed specifically for analyzing volatile amines in difficult matrices, such as water. The unique base deactivation creates an exceptionally inert surface for these sensitive compounds, resulting in highly symmetrical peaks, which allow low detection limits. The stable bonded phase yields a column that is not only retentive and highly selective for these compounds but is also very robust and able to withstand repeated water injections. Comparisons made by customers performing routine volatile amine applications have shown the Rtx®-Volatile Amine column outperforms other amine-specific columns, especially for peak shape and lifetime. Each Rtx®-Volatile Amine column is held to stringent quality specifications and tested with a specially designed test mix that includes basic compounds to ensure exceptional inertness, reliability, and reproducibility. These qualities assure consistent performance and make the Rtx®-Volatile Amine column the best choice for volatile amines analysis.

similar phases

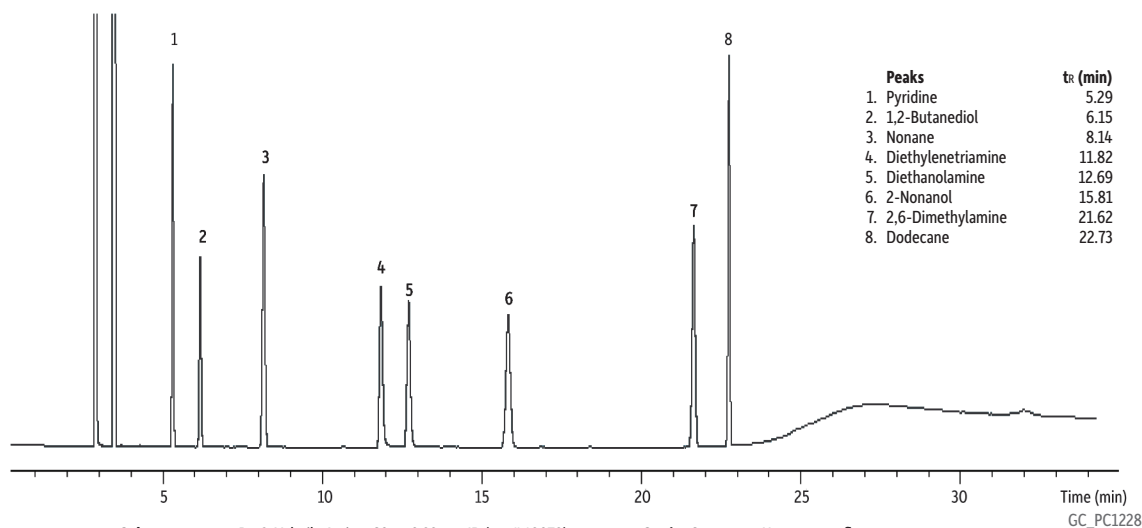
CP-Volamine

please note

We recommend using base-deactivated fused silica guard columns (**page 22**) and base-deactivated liners (**page 203**) with Rtx®-Volatile Amine columns.

ID	temp. limits	15-Meter cat.#	30-Meter cat.#	60-Meter cat.#
0.32 mm	-60 to 270/290 °C	18076	18077	18078

Volatile Amine Test Mix on Rtx®-Volatile Amine (60 m x 0.32 mm ID)



Column Rtx®-Volatile Amine, 60 m, 0.32 mm ID (cat.# 18078)
Sample Volatile amine column test mix (cat.# 35008)
Diluent: Methanol:dichloromethane (50:50)
Conc.: 900-1,800 µg/mL snap and shoot
Injection
Inj. Vol.: 1 µL split (split ratio 17.8:1)
Liner: Sky® 4 mm single taper w/wool (cat.# 23303.1)
Inj. Temp.: 250 °C
Split Vent
Flow Rate: 60 mL/min
Oven
Oven Temp.: 160 °C (hold 21 min) to 290 °C at 40 °C/min (hold 10 min)

Carrier Gas He, constant flow
Flow Rate: 3.4 mL/min
Detector FID @ 300 °C
Make-up Gas
Flow Rate: 30 mL/min
Make-up Gas Type: Nz
Data Rate: 50 Hz
Instrument Agilent/HP6890 GC

GC_PC1228

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similar phases

Optima-5Amine

Basic Compounds Analysis

Rtx®-5 Amine Columns (fused silica)

(low-polarity phase; Crossbond® 5% diphenyl/95% dimethyl polysiloxane)

- Application-specific columns for amines and other basic compounds, including alkylamines, diamines, triamines, ethanolamines, and nitrogen-containing heterocyclics.
- Stable to 315 °C.

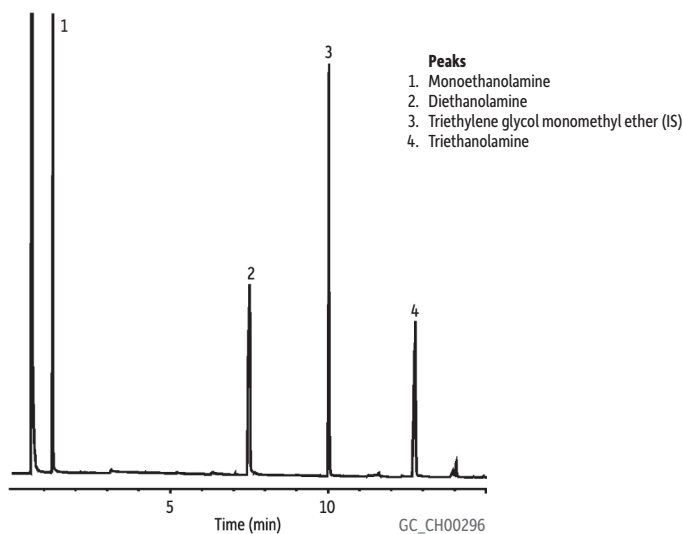
Active basic compounds that otherwise require derivatization, or an alternative analytical technique, can be analyzed on an Rtx®-5 Amine column. The tubing surface is chemically altered to reduce tailing of basic compounds, eliminating the need for column priming. An Rtx®-5 Amine column is ideal for analyzing a wide variety of basic compounds, but breakthrough technology also allows the analysis of neutral compounds, adsorptive compounds with oxygen groups susceptible to hydrogen bonding, or even weakly acidic compounds such as phenols. Every Rtx®-5 Amine column is tested to ensure that it exceeds the requirements for analyzing ppm levels of amines, without priming, and to ensure low bleed at maximum operating temperature.

ID	df	temp. limits	15-Meter cat.#	30-Meter cat.#
0.25 mm	0.25 µm	-60 to 315 °C	12320	12323
	0.50 µm	-60 to 300/315 °C	12335	12338
	1.00 µm	-60 to 300/315 °C	12350	12353
0.32 mm	1.00 µm	-60 to 300/315 °C	12351	12354
	1.50 µm	-60 to 290/305 °C	12366	12369
0.53 mm	1.00 µm	-60 to 290/305 °C	12352	12355
	3.00 µm	-60 to 280/295 °C	12382	12385

please note

We recommend using base-deactivated fused silica guard columns (page 22) and base-deactivated liners (page 203) with Rtx®-5 Amine columns.

Ethanolamines on Rtx®-5 Amine



Column Rtx®-5 Amine, 15 m, 0.25 mm ID, 0.50 µm (cat.# 12335)
Sample Ethanolamine mix
Diluent: Methanol
Conc.: 34 ng on column
Injection
Inj. Vol.: 1.0 µL split (split ratio 58:1)
Inj. Temp.: 280 °C
Oven
Oven Temp.: 50 °C (hold 2 min) to 180 °C at 10 °C/min (hold 2 min)
Carrier Gas H₂, constant pressure
Linear Velocity: 43 cm/sec @ 50 °C
Detector FID @ 300 °C
Notes FID sensitivity: 6.4 x 10⁻¹¹ AFS

Basic Compounds Analysis

Rtx®-35 Amine Columns (fused silica)

(midpolarity phase; Crossbond® 35% diphenyl/65% dimethyl polysiloxane)

- Application-specific columns for amines and other basic compounds, including alkylamines, diamines, triamines, ethanolamines, and nitrogen-containing heterocyclics.
- Stable to 220 °C.

Active basic compounds that otherwise require derivatization, or an alternative analytical technique, can be analyzed on an Rtx®-35 Amine column. The tubing surface is chemically altered to reduce tailing of basic compounds, eliminating the need for column priming. An Rtx®-35 Amine column is ideal for analyzing a wide variety of basic compounds, but breakthrough technology also allows the analysis of neutral compounds and adsorptive compounds with oxygen groups susceptible to hydrogen bonding. Every Rtx®-35 Amine column is tested to ensure that it meets the requirements for analyzing ppm levels of amines, without priming, and to ensure low bleed at maximum operating temperature.

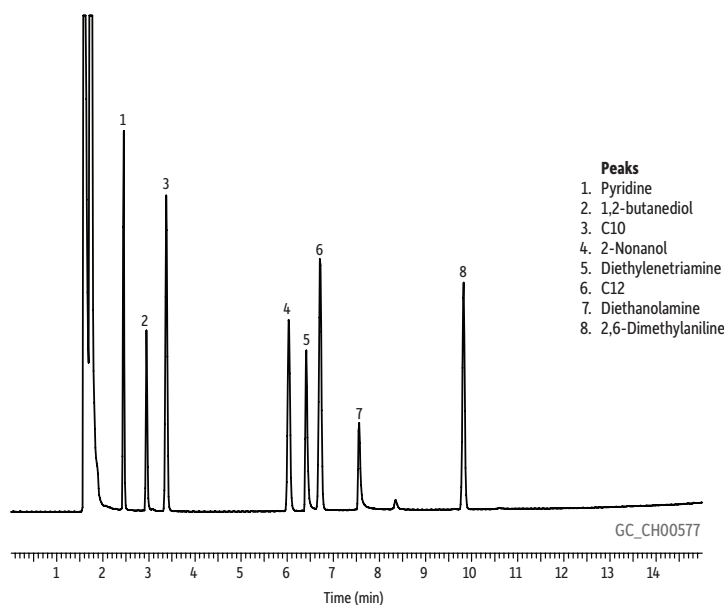
ID	df	temp. limits	15-Meter cat.#	30-Meter cat.#
0.25 mm	0.50 µm	0 to 220 °C	11335	11338
	1.00 µm	0 to 220 °C	11350	11353
0.32 mm	1.00 µm	0 to 220 °C	11351	11354
	1.50 µm	0 to 220 °C	11366	11369
0.53 mm	1.00 µm	0 to 220 °C	11352	11355
	3.00 µm	0 to 220 °C		11385

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please note

We recommend using base-deactivated fused silica guard columns (page 22) and base-deactivated liners (page 203) with Rtx®-35 Amine columns.

Amine Test Mix Rtx®-35 Amine



Column Rtx®-35 Amine, 30 m, 0.53 mm ID, 1.00 µm (cat.# 11355)
Sample Amine column test mix (cat.# 35002)
Diluent: Methanol/methylene chloride
Conc.: 450-900 ppm
Injection
Inj. Vol.: 1.0 µL split (split ratio 10:1)
Liner: Splitless taper (4 mm), base deactivated (cat.# 20798-210.1)
Inj. Temp.: 250 °C
Oven
Oven Temp.: 110 °C (hold 4 min) to 200 °C at 8 °C/min (hold 5 min)
Carrier Gas He, constant pressure
Linear Velocity: 30 cm/sec
Detector FID @ 300 °C



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CAM, CP-WAX 51 for Amines,
Carbowax® Amine

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Basic Compounds Analysis

Stabilwax®-DB Columns (fused silica)

(polar phase; Crossbond® base-deactivated Carbowax® polyethylene glycol—for amines and basic compounds)

- Application-specific columns for underivatized amines and other basic compounds, including alkylamines, diamines, triamines, nitrogen-containing heterocyclics. No need for column priming.
- Temperature range: 40 °C to 220 °C.

Stabilwax®-DB columns reduce adsorption and improve responses for many basic compounds, without analyte derivatization or column priming. For different selectivity of basic compounds, or higher oven temperatures, use an Rtx®-5 Amine column.

Stabilwax®-DB is a bonded stationary phase, but avoid rinsing these columns with water or alcohols.

ID	df	temp. limits	15-Meter cat.#	30-Meter cat.#	60-Meter cat.#
0.25 mm	0.25 µm	40 to 210/220 °C	10820	10823	
	0.50 µm	40 to 210/220 °C		10838	
0.32 mm	0.25 µm	40 to 210/220 °C	10821	10824	
	0.50 µm	40 to 210/220 °C		10839	
	1.00 µm	40 to 210/220 °C	10851	10854	10857
0.53 mm	0.50 µm	40 to 210/220 °C		10840	
	1.00 µm	40 to 210/220 °C	10852	10855	10858
	1.50 µm	40 to 210/220 °C		10869	

Volatile Organic Compounds by U.S. EPA Method 1671 on Stabilwax®-DB

Peaks	tr (min)	Conc. (µg/mL)
1. Dimethylamine	1.71	200
2. Methylamine	1.76	200
3. Diethylamine	2.46	200
4. Triethylamine	2.64	200
5. Tetrahydrofuran (IS)	4.88	100
6. Methanol	7.12	40
7. Ethanol	8.01	40
8. Acetonitrile	9.82	200
9. n-Propanol	11.03	200
10. Methyl Cellosolve®	15.56	200
11. Formamide	18.68	500
12. Dimethyl sulfoxide	23.75	100
13. Ethylene glycol*		500

*Included in sample, but does not elute due to base deactivation in the DB phase.

Columns Stabilwax®-DB 30 m, 0.32 mm ID, 1.00 µm (cat.# 10854) and Stabilwax® 30 m, 0.32 mm ID, 1.00 µm (cat.# 10654) using IP deactivated guard column 5 m, 0.53 mm ID (cat.# 10045) with SeCure® "Y" connector kit (cat.# 20278)

Sample 1671 Volatile organics mix

Diluent: Deionized water

Injection Inj. Vol.: 1.0 µL split (split ratio 12:1)

Liner: Gooseneck splitless (4 mm) (cat.# 20798)

Inj. Temp.: 200 °C

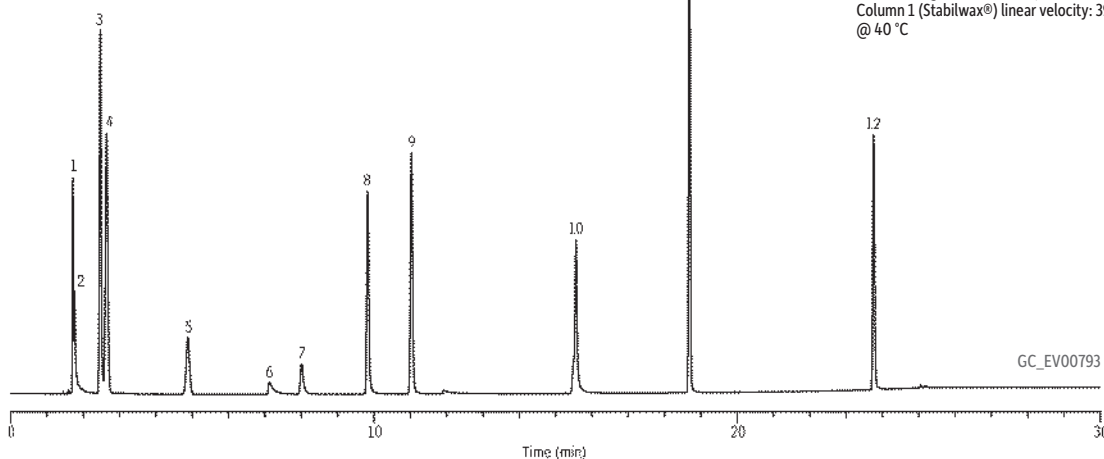
Oven Oven Temp.: 40 °C (hold 5 min) to 180 °C at 7 °C/min (hold 5 min)

Carrier Gas He, constant pressure

Linear Velocity: 39.68 cm/sec @ 40 °C

Detector FID @ 250 °C

Notes "Y" Press-Tight® Connector (cat.# 20405) also used Column 1 (Stabilwax®) linear velocity: 39.25 cm/sec @ 40 °C



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Chiral Analysis

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By adding β or γ cyclodextrin to our bonded Rtx[®]-1701 stationary phase, we greatly enhance overall utility and column lifetime for our chiral columns, compared to columns that have pure cyclodextrin stationary phases. Separations of more than one hundred chiral compounds have been achieved using our unique DEX columns, and our columns continue to demonstrate stability after hundreds of temperature program cycles.

Rt[®]- γ DEXsa Columns (fused silica)

(2,3-di-acetoxy-6-O-*tert*-butyl dimethylsilyl gamma cyclodextrin added into 14% cyanopropylphenyl/86% dimethyl polysiloxane)

Uses: Larger organic molecules. Also useful for flavor compounds in fruit juices.

ID	df	temp. limits	30-Meter cat.#
0.25 mm	0.25 μ m	40 to 230 °C	13113
0.32 mm	0.25 μ m	40 to 230 °C	13112

Rt[®]- β DEXm Columns (fused silica)

(permethylated beta cyclodextrin added into 14% cyanopropylphenyl/86% dimethyl polysiloxane)

Uses: General-purpose chiral phase with many published applications.

ID	df	temp. limits	30-Meter cat.#
0.25 mm	0.25 μ m	40 to 230 °C	13100
0.32 mm	0.25 μ m	40 to 230 °C	13101

Rt[®]- β DEXsm Columns (fused silica)

(2,3-di-O-methyl-6-O-*tert*-butyl dimethylsilyl beta cyclodextrin added into 14% cyanopropylphenyl/86% dimethyl polysiloxane)

Uses: Excellent column for most chiral compounds in essential oils.

ID	df	temp. limits	30-Meter cat.#
0.25 mm	0.25 μ m	40 to 230 °C	13105
0.32 mm	0.25 μ m	40 to 230 °C	13104

Rt[®]- β DEXse Columns (fused silica)

(2,3-di-O-ethyl-6-O-*tert*-butyl dimethylsilyl beta cyclodextrin added into 14% cyanopropylphenyl/86% dimethyl polysiloxane)

Uses: Similar in performance to Rt- β DEXsm but provides better resolution for limonene, linalool, linalyl acetate, ethyl-2-methylbutyrate, 2,3-butane diol, and styrene oxides.

ID	df	temp. limits	30-Meter cat.#
0.25 mm	0.25 μ m	40 to 230 °C	13107
0.32 mm	0.25 μ m	40 to 230 °C	13106

Rt[®]- β DEXsp Columns (fused silica)

(2,3-di-O-propyl-6-O-*tert*-butyl dimethylsilyl beta cyclodextrin added into 14% cyanopropylphenyl/86% dimethyl polysiloxane)

Uses: Often useful in dual-column configurations, with the Rt- β DEXsm column, for complex enantiomeric separations.

ID	df	temp. limits	30-Meter cat.#
0.25 mm	0.25 μ m	40 to 230 °C	13111
0.32 mm	0.25 μ m	40 to 230 °C	13110

Rt[®]- β DEXsa Columns (fused silica)

(2,3-di-acetoxy-6-O-*tert*-butyl dimethylsilyl beta cyclodextrin added into 14% cyanopropylphenyl/86% dimethyl polysiloxane)

Uses: Unique selectivity for esters, lactones, and other fruit flavor components.

ID	df	temp. limits	30-Meter cat.#
0.25 mm	0.25 μ m	40 to 230 °C	13109
0.32 mm	0.25 μ m	40 to 230 °C	13108

Rt[®]- β DEXcst Columns (fused silica)

(Proprietary cyclodextrin material added into 14% cyanopropylphenyl/86% dimethyl polysiloxane)

Uses: Proprietary stationary phase, developed specifically for the fragrance industry. Also used for pharmaceutical applications.

ID	df	temp. limits	30-Meter cat.#
0.25 mm	0.25 μ m	40 to 230 °C	13103
0.32 mm	0.25 μ m	40 to 230 °C	13102

free literature

Grape Flavor Analysis,
Using an Rt[®]- γ DEXsa
GC Column

lit. cat.#
59553



GC Analysis of Chiral Flavor
Compounds in Apple Juices,
Using Rt[®]- β DEXsm and
Rt[®]- β DEXse
Columns

lit. cat.#
59546



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tech tip

Lower elution temperatures significantly improve chiral selectivity.

This can be achieved the following ways:

- Faster linear velocities (80 cm/sec) with hydrogen carrier gas.
- Slower temperature ramp rates (1–2 °C/min).
- Appropriate minimum operating temperature (40 or 60 °C).
- On-column concentrations of 50 ng or less.