

GC Applications



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GC Applications by Column Phase

GC Applications by Column Phase (Alphabetical Order) - see pages 734-735 for our Applications by Compound Class Index

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Searching for a chromatogram?
www.restek.com

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Choosing a Volatiles GC Column for PID/ELCD*

Restek Phase	Coelutions by Peak Numbers (Coelutions by PID/ELCD are indicated in BOLD)	Close Pairs by PID/ELCD	Suggested Confirmation Column	Poor Choice for Confirmation Column	Thick Phase Stable Temp. (°C)	Recommended High Temp. for VOA Work (°C)	Advantages	Page # for Chromatogram ²
Rtx-VGC	28/29¹, 53/54	7/8, 32/33	Rtx-502.2, Rtx-VRX, Rtx-1	Rtx-VMS, Rtx-DXL	260	230	fast runtime	565
Rtx-502.2	14/15, 33/34, 39/40	4/5, 44/45, 56/57, 52/55, 64/65	Rtx-VGC, Rtx-VRX, Rtx-1	Rtx-Volatiles, Vocol, Rtx-35, Rtx-20	270	240	low bleed	567
Rtx-Volatiles	14/15, 21/22, 38/40, 44/45, 53/55	56/57, 68/69	Rtx-VGC, Rtx-1, Rtx-624	Rtx-502.2, Vocol, Rtx-20, Rtx-35	270	240	low bleed	no
Rtx-624	7/8, 10/11, 52/53, 31/34, 53/55, 59/60	32/33, 44/45, 51/54	Rtx-VGC, Rtx-502.2	Rtx-1701	280	240		no
Rtx-VRX	11/13, 39/43, 46/50, 40/44	8/9, 15/17, 24/27, 58/60	Rtx-VGC, Rtx-502.2	Rtx-1	260	230		566
Rtx-1	9/12, 15/17, 25/26, 24/27, 33/36, 38/40, 40/44, 45/50, 56/57	7/12, 49/55	Rtx-502	Rtx-VRX	320	260		no
Rtx-1701	9/10, 18/19, 16/20, 50/53, 51/55, 54/56	5/6, 29/30, 32/33	Rtx-502.2	Rtx-624	270	240		no
Rtx-200	2/3, 5/6, 11/12, 14/16, 22/24, 28/35, 32/33/37, 43/44, 50/55/56, 57/58	13/17, 36/37	Rtx-VGC		320	240	<i>m/p</i> xylene separation	no
Rtx-35	4/5, 16/19, 18/20, 21/22, 34/31, 39/38/41/42/40, 46/51/49, 53/54, 48/52/55, 61/62, 66/67	2/3,	Rtx-VGC, Rtx-624	Rtx-502.2, Rtx-Volatiles, Rtx-20	270	240		no
Rtx-50	4/5/6, 8/7/12, 25/28, 32/33, 37/41/42, 38/40, 45/47, 46/54/52, 56/55/48, 57/58	2/3, 20/18, 31/32, 39/41/42	Rtx-VGC, Rtx-624	Rtx-35	280	240		no
Rtx-DXL (custom)	4/5, 9/10, 25/27, 38/39, 47/50, 49/46/48, 52/54, 53/55	27/28, 32/36/31, 65/67	Rtx-502.2	Rtx-VGC	220	200		no

¹ Can be resolved under different conditions. See application showing method 601/602 with the Rtx®-VGC column on www.restek.com/chromatograms (search: chromatogram number GC_EV00420).

² pages listed include GC/MS analyses.

Volatile Analytes:

1. dichlorodifluoromethane
2. chloromethane
3. vinyl chloride
4. bromomethane
5. chloroethane
6. trichlorofluoromethane
7. 1,1-dichloroethene
8. Freon ®113
9. methylene chloride
10. *trans*-1,2-dichloroethene
11. methyl *tert*-butyl ether
12. *tert*-butyl alcohol
13. 1,1-dichloroethane
14. *cis*-1,2-dichloroethene
15. 2,2-dichloropropane
16. bromochloromethane
17. chloroform
18. carbon tetrachloride
19. 1,1,1-trichloroethane
20. 1,1-dichloropropene
21. benzene
22. 1,2-dichloroethane
23. fluorobenzene
24. trichloroethene
25. dibromomethane
26. 1,2-dichloropropane
27. bromodichloromethane
28. 2-chloroethyl vinyl ether
29. *cis*-1,3-dichloropropene
30. toluene
31. tetrachloroethene
32. *trans*-1,3-dichloropropene
33. 2-bromo-1-chloropropane
34. 1,1,2-trichloroethane
35. dibromochloromethane
36. 1,3-dichloropropane
37. 1,2-dibromoethane
38. chlorobenzene
39. ethyl benzene
40. 1,1,1,2-tetrachloroethane
41. *m*-xylene
42. *p*-xylene
43. 1-chloro-2-fluorobenzene
44. *o*-xylene
45. styrene
46. bromoform
47. isopropyl benzene
48. bromobenzene
49. *n*-propylbenzene
50. 1,4-dichlorobutane
51. 1,1,2,2-tetrachloroethane
52. 2-chlorotoluene
53. 1,3,5-trimethylbenzene
54. 1,2,3-trichloropropane
55. 4-chlorotoluene
56. *tert*-butylbenzene
57. 1,2,4-trimethylbenzene
58. *sec*-butylbenzene
59. *p*-isopropyl toluene
60. 1,3-dichlorobenzene
61. 1,4-dichlorobenzene
62. *n*-butylbenzene
63. 1,2-dichlorobenzene
64. 4-bromo-1-chlorobenzene
65. 1,2-bromo-3-chloropropane
66. hexachlorobutadiene
67. 1,2,4-trichlorobenzene
68. naphthalene
69. 1,2,3-trichlorobenzene

Conditions for Rtx®-VGC, Rtx®-502.2, Rtx®-Volatiles, Rtx®-VRX and Rtx®-1: optimum conditions on 75m, 0.45mm ID, 2.55μm columns.

Conditions for all other columns: 60m, 0.53mm ID, 3.0μm column, flow 10mL/min., temp. program: 35°C (hold 9 min.) to 220°C @ 11°C/min. (hold 10 min.)

Analytes identified using Agilent 5971a mass selective detector with splitless injection or using Finnigan PID/ELCD

Please see chromatograms on pages 565–574 for more details, or call technical service at 800-356-1688 (ext. 4), or your Restek representative.

for **more** info

*For GC/MS analyses, see
Rtx®-VMS applications on pages
568–571.

Compounds listed in US EPA Methods 502.2, 8021, 8010, 8020, 601 & 602, plus commonly added compounds.

m/p xylene coelute on all phases listed above except Rtx®-200 in 60m, 0.25mm ID, 1.0μm under optimized conditions. See 8260 application, using the Rtx®-200 column, www.restek.com/chromatograms (search: chromatogram number GC_EV00429).

Volatiles

Volatile Organic Compounds Retention Time Index

Data collected using a 60m, 0.25mm ID, 1.4 μ m Rtx®-VMS column; Oven: 40°C (hold 6 min.) to 230°C @ 14°C/min. (hold 11 min.); Carrier gas: helium; Regulation: constant pressure; Flow rate: 1mL/min.; Linear velocity: 21cm/sec.; Dead time: 4.90 min.

Component	Rtx®-VMS Ret. Time	Component	Rtx®-VMS Ret. Time	Component	Rtx®-VMS Ret. Time
dichlorodifluoromethane	5.52	benzene-d6	14.72	bromoform	20.30
chloromethane	6.26	pentafluorobenzene	14.75	isopropylbenzene	20.51
vinyl chloride	6.54	1,2-dichloroethane-d4	14.79	1,2-butanediol	20.82
water	6.70	1,2-dichloroethane	14.90	valeric acid	20.89
bromomethane	7.61	tert-amyl-methyl ether	15.00	1,4-dichlorobutane	20.90
methanol	7.93	isobutyl alcohol	15.06	bromobenzene	20.91
2-methylbutane	7.96	fluorobenzene	15.16	4-bromo-1-fluorobenzene	20.95
chloroethane	8.00	isopropyl acetate	15.34	cis-1,4-dichloro-2-butene	20.97
trichlorofluoromethane	8.41	formic acid	15.37	n-decane	21.04
n-pentane	8.61	trichlorethene	15.39	n-propylbenzene	21.07
diethylether	9.59	1,4-difluorobenzene	15.58	1,1,2,2-tetrachloroethane	21.10
1,1-dichloroethene	9.64	n-butanol	15.60	1,3,5-trimethylbenzene	21.30
carbon disulfide	9.65	methyl cyclohexane	15.78	1-ethyl-4-methylbenzene	21.33
Freon® 113	9.70	acetic acid	15.93	1-ethyl-3-methylbenzene	21.34
ethanol	9.74	dibromomethane	16.05	1,2,3-trichloropropane	21.39
iodomethane	9.99	1,2-dichloropropane	16.17	trans-1,4-dichloro-2-butene	21.40
3-chlorotrifluoropropane	10.45	bromodichloromethane	16.23	2-chlorotoluene	21.40
chloro-methyl-methylether	10.54	methyl methacrylate	16.28	4-chlorotoluene	21.61
acrolein	10.57	α,α,α -trifluorotoluene	16.45	cyclohexane	21.78
2-methylpentane	10.59	1,4-dioxane	16.49	tert-butylbenzene	21.81
allyl chloride	10.72	n-propyl acetate	16.70	1-ethyl-2-methylbenzene	21.82
methylene chloride	10.98	2-chloroethyl-vinyl-ether	16.92	1,2,4-trimethylbenzene	21.88
3-methylpentane	11.09	2-chloroethanol	16.93	pentachloroethane	21.92
acetone	11.24	cis-1,3-dichloropropene	17.04	1,3-dichloro-2-propanol	22.05
trans-1,2-dichloroethene	11.24	1-bromo-2-chloroethane	17.05	sec-butylbenzene	22.06
methyl tert-butyl ether	11.42	n-octane	17.17	isocapric acid	22.09
2-propanol	11.52	toluene-d8	17.28	p-isopropyltoluene	22.22
tert-butyl alcohol	11.56	toluene	17.36	1,3-dichlorobenzene	22.53
methyl acetate	11.63	propionic acid	17.61	caproic acid	22.55
hexane	11.64	chloroacetonitrile	17.64	1,4-dichlorobenzene	22.64
acetonitrile	12.22	4-methyl-2-pentanone	17.76	n-butylbenzene	22.88
chloroprene	12.30	2-bromo-1-chloropropane	17.81	malononitrile	22.89
1,1-dichloroethane	12.42	2-nitropropane	17.83	benzyl chloride	23.23
acrylonitrile	12.60	pyridine	17.86	1,2-dichlorobenzene-d4	23.36
diisopropyl ether	12.62	1,1-dichloropropanone	17.88	1,2-dichlorobenzene	23.38
2,4-dimethylpentane	12.68	trans-1,3-dichloropropene	17.88	hexachloroethane	23.63
vinyl acetate	13.02	tetrachloroethene	17.89	1-octanol	23.70
ethyl-tert-butyl ether	13.08	ethyl methacrylate	17.92	bis-(2-chloro-isopropyl) ether	24.06
1-propanol	13.18	1,1,2-trichloroethane	18.11	4-bromo-1-chlorobenzene	24.09
cis-1,2-dichloroethene	13.32	dibromochloromethane	18.40	benzyl alcohol	24.23
allyl alcohol	13.35	1,3-dichloropropane	18.49	heptanoic acid	24.29
2,2-dichloropropane	13.48	isobutyric acid	18.55	n-dodecane	24.54
bromochloromethane	13.62	1,2-dibromoethane	18.78	3-bromochlorobenzene	24.61
chloroform	13.75	n-butyl acetate	18.80	1,2-dibromo-3-chloropropane	24.78
cyclohexane	13.84	2-hexanone	18.82	2-bromochlorobenzene	25.54
methyl acrylate	13.87	butyric acid	19.17	hexachlorobutadiene	25.99
carbon tetrachloride	13.94	1-chloro-3-fluorobenzene	19.17	nitrobenzene	26.02
tetrahydrofuran	14.03	ethylbenzene	19.36	1,2,4-trichlorobenzene	26.19
1,1,1-trichloroethane	14.06	chlorobenzene	19.39	benzyl acetate	26.29
ethyl acetate	14.13	1-chloro-4-fluorobenzene	19.39	n-tridecane	26.51
2-butanone	14.18	ethylbenzene-d10	19.40	naphthalene	27.01
dibromofluoromethane	14.18	1-chlorohexane	19.41	1,2,3-trichlorobenzene	27.46
1,1-dichloropropene	14.20	1,1,1,2-tetrachloroethane	19.44	n-tetradecane	28.83
propargyl alcohol	14.35	m-xylene	19.53	2-methylnaphthalene	30.36
1-chlorobutane	14.51	p-xylene	19.54	1-methylnaphthalene	30.96
2,2,4-trimethylpentane	14.53	chlorobenzene-d5	19.55	n-pentadecane	31.65
propionitrile	14.59	1-chloro-2-fluorobenzene	19.67	2-chloronaphthalene	33.36
benzene	14.60	o-xylene	20.13		
n-heptane (C7)	14.62	stryrene	20.17		
methacrylonitrile	14.64	isovaleric acid	20.18		

for more info

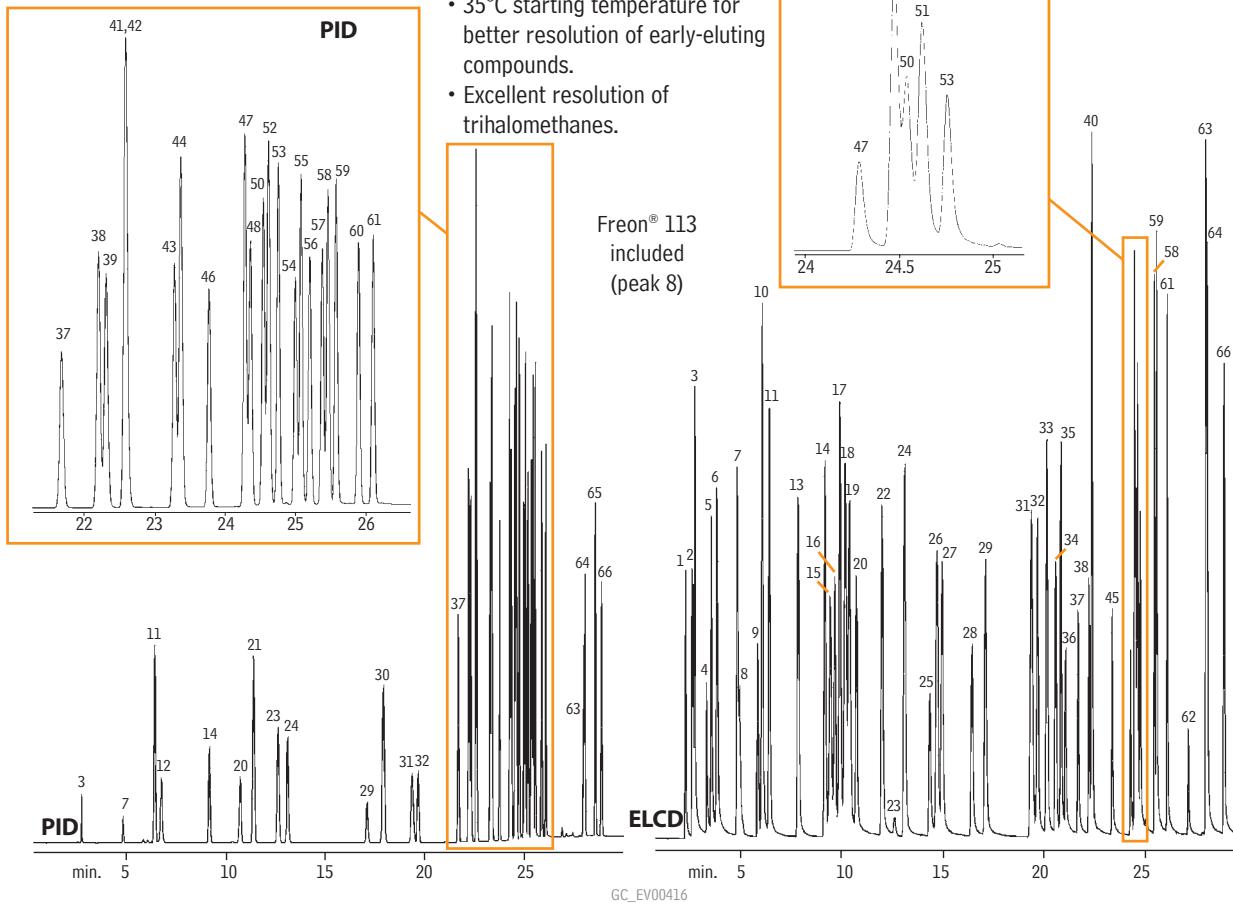
See pages 568-571 for Rtx®-VMS applications.

Volatile Organics
US EPA Method 502/8021
Rtx®-VGC

Primary column, dual-column analysis. Polymer specially designed for volatiles analysis by PID/ELCD. Confirmation analysis shown on page 566.

Rtx®-VGC

75m, 0.45mm ID, 2.55 μ m (cat.# 19409)



Primary column:
Rtx®-VGC, 75m, 0.45mm ID, 2.55 μ m (cat. # 19409)
Confirmation column:
Rtx®-VRX, 75m, 0.45mm ID, 2.55 μ m (cat. # 19309)
Conc.:
20ppb in 5mL of RO water.
Concentrator:
Tekmar LSC-3000 Purge and Trap
Trap:
Vocarb 3000
Purge:
11 min. @ 40mL/min.
Dry purge:
1 min. @ 40mL/min. (MCS by-passed with Silcosteel® tubing, cat. # 21035)
Desorb preheat:
245°C
Desorb:
250°C for 2 min.
Bake:
260°C for 8 min.
Interface:
direct
Transfer line:
0.32mm ID Siltek® tubing

1. dichlorodifluoromethane
2. chloromethane
3. vinyl chloride
4. bromomethane
5. chloroethane
6. trichlorofluoromethane
7. 1,1-dichloroethene
8. Freon® 113
9. allyl chloride
10. methylene chloride
11. *trans*-1,2-dichloroethene
12. methyl *tert*-butyl ether
13. 1,1-dichloroethane
14. *cis*-1,2-dichloroethene
15. 2,2-dichloropropane
16. bromochloromethane
17. chloroform
18. carbon tetrachloride
19. 1,1,1-trichloroethane
20. 1,1-dichloropropene
21. benzene
22. 1,2-dichloroethane
23. fluorobenzene (SS)
24. trichloroethene
25. dibromomethane
26. 1,2-dichloropropane
27. bromodichloromethane
28. 1-bromo-2-chloroethane (SS)

GC:
Oven temp.: Finnigan 9001
35°C (hold 4 min.) to 75°C @ 3°C/min. (hold 2 min.)
to 175°C @ 21°C/min. to 205°C @ 35°C/min. (hold 5 min.)
Carrier gas: helium 11mL/min., constant pressure
Adjust dichlorodifluoromethane to a retention time of 2.28 min.
@ 35°C on the Rtx®-VGC column.
Detectors: μGold Tandem PID/HALL® 2000
PID: makeup 7mL/min., purge 7mL/min., set @ 0.35mV,
base temp. 200°C.
ELCD HALL® 2000: RxnGas 25mL/min., RxnTemp. 940°C,
propanol flow 470 μ L/min.

29. *cis*-1,3-dichloropropene
30. toluene
31. tetrachloroethene
32. *trans*-1,3-dichloropropene
33. 1,1,2-trichloroethane
34. dibromochloromethane
35. 1,3-dichloropropane
36. 1,2-dibromoethane
37. 1-chloro-3-fluorobenzene (SS)
38. chlorobenzene
39. ethylbenzene
40. 1,1,2-tetrachloroethane
41. *m*-xylene
42. *p*-xylene
43. *o*-xylene
44. styrene
45. bromoform
46. isopropylbenzene
47. bromobenzene
48. *n*-propylbenzene
49. 1,1,2,2-tetrachloroethane
50. 2-chlorotoluene
51. 1,2,3-trichloropropane
52. 1,3,5-trimethylbenzene
53. 4-chlorotoluene
54. *tert*-butylbenzene
55. 1,2,4-trimethylbenzene
56. *sec*-butylbenzene
57. *p*-isopropyltoluene
58. 1,3-dichlorobenzene
59. 1,4-dichlorobenzene
60. *n*-butylbenzene
61. 1,2-dichlorobenzene
62. 1,2-dibromo-3-chloropropane
63. hexachlorobutadiene
64. 1,2,4-trichlorobenzene
65. naphthalene
66. 1,2,3-trichlorobenzene

Acknowledgement: Finnigan 9001 GC, μGold Tandem Photoionization/HALL® 2000 Electrolytic Conductivity Detector provided courtesy of Thermo Scientific GC & GC/MS Division, 2215 Grand Avenue Pkwy, Austin, Texas 78728

Volatiles

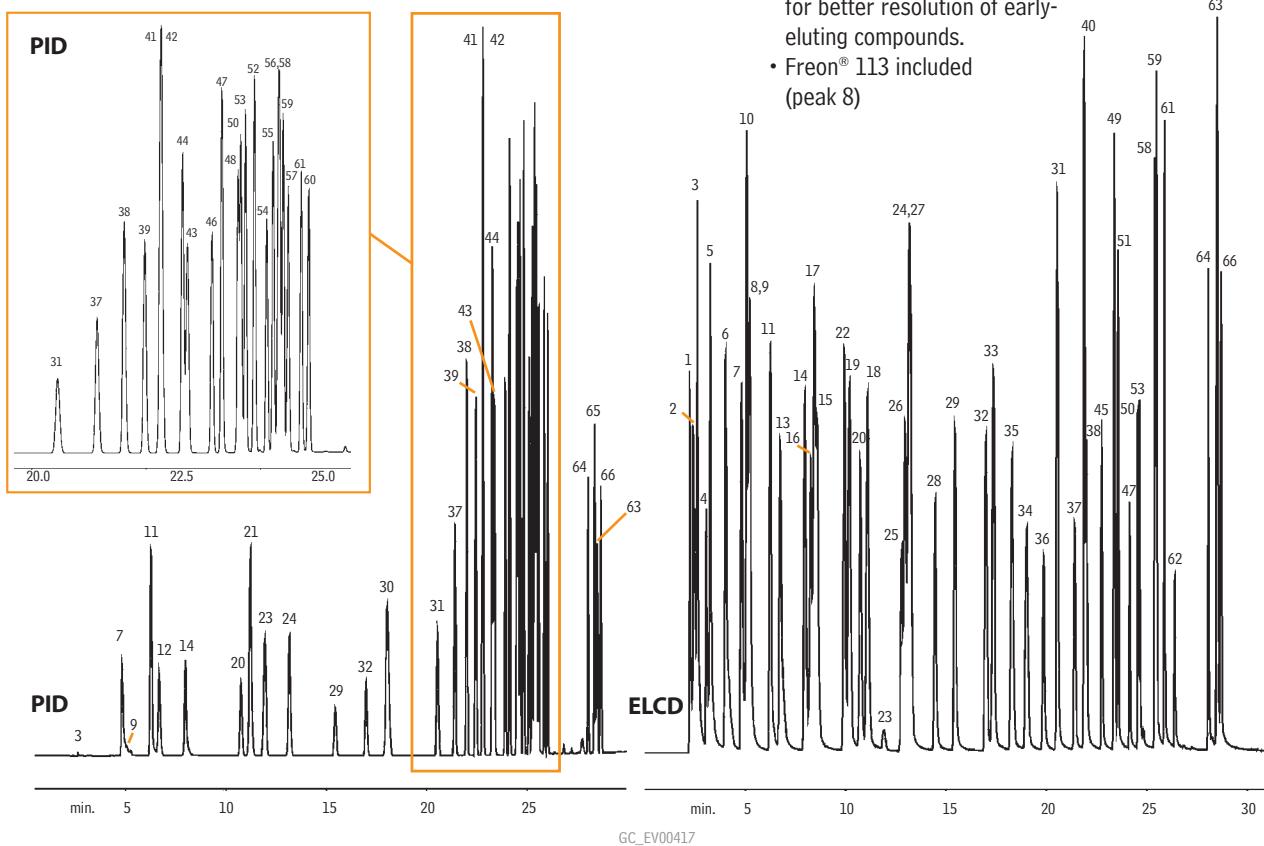
Volatile Organics US EPA Method 8021

Rtx®-VRX

Excellent confirmation column to Rtx®-VGC. Primary analysis shown on page 565.

Rtx®-VRX

75m, 0.45mm ID, 2.55μm (cat.# 19309)



Primary column: Rtx®-VGC, 75m, 0.45mm ID, 2.55μm (cat.# 19409)
Confirmation column: Rtx®-VRX, 75m, 0.45mm ID, 2.55μm (cat.# 19309)
Conc.: 20ppb in 5mL of RO water.
Concentrator: Tekmar LSC-3000 Purge and Trap
Trap: Vocabarb 3000
Purge: 11 min. @ 40mL/min.
Dry purge: 1 min. @ 40mL/min. (MCS by-passed with Silcosteel® tubing, cat.# 21035)
Desorb preheat: 245°C
Desorb: 250°C for 2 min.
Bake: 260°C for 8 min.
Interface: direct
Transfer line: 0.32mm ID Siltek® tubing

GC: Finnigan 9001
Oven temp.: 35°C (hold 4 min.) to 75°C @ 3°C/min. (hold 2 min.) to 175°C @ 21°C/min. to 205°C @ 35°C/min. (hold 5 min.)
Carrier: helium 11mL/min., constant pressure
Adjust dichlorodifluoromethane to a retention time of 2.28 min. @ 35°C on the Rtx®-VGC column.
Detectors: μGold Tandem PID/HALL® 2000
PID: makeup 7mL/min., purge 7mL/min., set @ 0.35mV, base temp. 200°C.
ELCD HALL® 2000: RxnGas 25mL/min., RxnTemp. 940°C, propanol flow 470μL/min.

- | | | | |
|-------------------------------------|---------------------------------|-----------------------------------|---------------------------------|
| 1. dichlorodifluoromethane | 18. carbon tetrachloride | 35. 1,3-dichloropropane | 52. 1,3,5-trimethylbenzene |
| 2. chloromethane | 19. 1,1,1-trichloroethane | 36. 1,2-dibromoethane | 53. 4-chlorotoluene |
| 3. vinyl chloride | 20. 1,1-dichloropropene | 37. 1-chloro-3-fluorobenzene (SS) | 54. tert-butylbenzene |
| 4. bromomethane | 21. benzene | 38. chlorobenzene | 55. 1,2,4-trimethylbenzene |
| 5. chloroethane | 22. 1,2-dichloroethane | 39. ethylbenzene | 56. sec-butylbenzene |
| 6. trichlorofluoromethane | 23. fluorobenzene (SS) | 40. 1,1,1,2-tetrachloroethane | 57. p-isopropyltoluene |
| 7. 1,1-dichloroethene | 24. trichloroethene | 41. m-xylene | 58. 1,3-dichlorobenzene |
| 8. Freon® 113 | 25. dibromomethane | 42. p-xylene | 59. 1,4-dichlorobenzene |
| 9. allyl chloride | 26. 1,2-dichloropropane | 43. o-xylene | 60. n-butylbenzene |
| 10. methylene chloride | 27. bromodichloromethane | 44. styrene | 61. 1,2-dichlorobenzene |
| 11. trans-1,2-dichloroethene | 28. 1-bromo-2-chloroethane (SS) | 45. bromoform | 62. 1,2-dibromo-3-chloropropane |
| 12. methyl <i>tert</i> -butyl ether | 29. cis-1,3-dichloropropene | 46. isopropylbenzene | 63. hexachlorobutadiene |
| 13. 1,1-dichloroethane | 30. toluene | 47. bromobenzene | 64. 1,2,4-trichlorobenzene |
| 14. cis-1,2-dichloroethene | 31. tetrachloroethene | 48. n-propylbenzene | 65. naphthalene |
| 15. 2,2-dichloropropane | 32. trans-1,3-dichloropropene | 49. 1,1,2,2-tetrachloroethane | 66. 1,2,3-trichlorobenzene |
| 16. bromochloromethane | 33. 1,1,2-trichloroethane | 50. 2-chlorotoluene | |
| 17. chloroform | 34. dibromochloromethane | 51. 1,2,3-trichloropropane | |

Acknowledgement: Finnigan 9001 GC, μGold Tandem Photoionization/HALL® 2000 Electrolytic Conductivity Detector provided courtesy of Thermo Scientific GC & GC/MS Division, 2215 Grand Avenue Pkwy, Austin, Texas 78728

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- 35°C starting temperature for better resolution of early-eluting compounds.
- Freon® 113 included (peak 8)

Volatile Organics US EPA Method 502.2 Rtx®-502.2

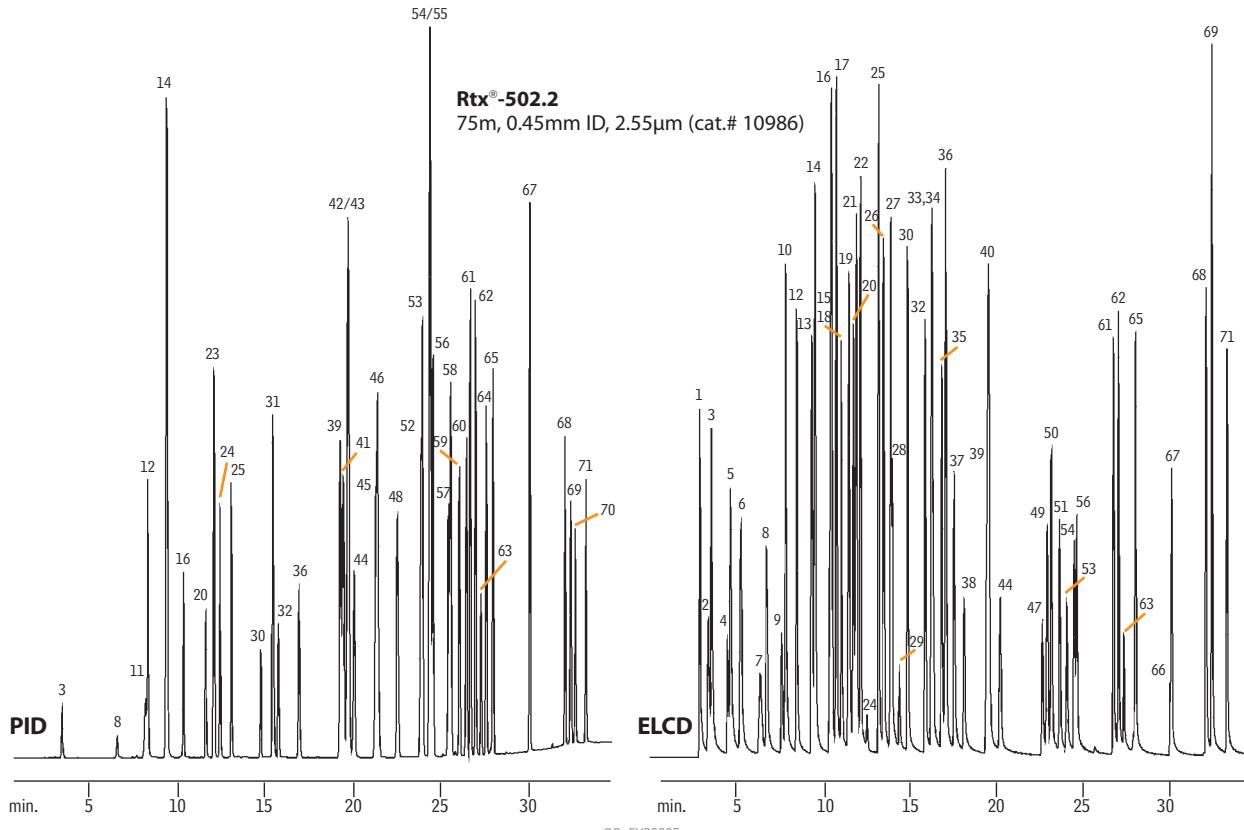
for more info

A confirmation analysis can be found on
www.restek.com/chromatograms

Search: chromatogram number
GC EV00006

For EPA Method 601/602 chromatograms
www.restek.com/chromatograms

Search: chromatogram numbers
GC_EV00540 & GC_EV00420



- | | |
|---------------------------------------|-----------------------------------|
| 1. dichlorodifluoromethane | 37. dibromochloromethane |
| 2. chloromethane | 38. 1,2-dibromoethane |
| 3. vinyl chloride | 39. chlorobenzene |
| 4. bromomethane | 40. 1,1,1,2-tetrachloroethane |
| 5. chloroethane | 41. ethyl benzene |
| 6. trichlorofluoromethane | 42. <i>m</i> -xylene |
| 7. Freon® 113 | 43. <i>p</i> -xylene |
| 8. 1,1-dichloroethene | 44. 1-chloro-2-fluorobenzene (IS) |
| 9. allyl chloride | 45. <i>o</i> -xylene |
| 10. methylene chloride | 46. styrene |
| 11. methyl <i>tert</i> -butyl ether | 47. bromoform |
| 12. <i>trans</i> -1,2-dichloroethene | 48. isopropyl benzene |
| 13. 1,1-dichloroethane | 49. 1,4-dichlorobutane (SS) |
| 14. chloropropene (40ppb) | 50. 1,1,2,2-tetrachloroethane |
| 15. 2,2-dichloropropane | 51. 1,1,2,3-trichloropropane |
| 16. <i>cis</i> -1,2-dichloroethene | 52. <i>n</i> -propylbenzene |
| 17. chloroform | 53. bromobenzene |
| 18. bromochloromethane | 54. 2-chlorotoluene |
| 19. 1,1,1-trichloroethane | 55. 1,3,5-trimethylbenzene |
| 20. 1,1-dichloropropene | 56. 4-chlorotoluene |
| 21. carbon tetrachloride | 57. <i>tert</i> -butylbenzene |
| 22. 1,2-dichloroethane | 58. 1,2,4-trimethylbenzene |
| 23. benzene | 59. <i>sec</i> -butylbenzene |
| 24. fluorobenzene (SS) | 60. <i>p</i> -isopropyltoluene |
| 25. trichloroethene | 61. 1,3-dichlorobenzene |
| 26. 1,2-dichloropropane | 62. 1,4-dichlorobenzene |
| 27. bromodichloromethane | 63. benzyl chloride |
| 28. dibromomethane | 64. <i>n</i> -butylbenzene |
| 29. 2-chloroethyl vinyl ether | 65. 1,2-dichlorobenzene |
| 30. <i>cis</i> -1,3-dichloropropene | 66. 1,2-bromo-3-chloropropane |
| 31. toluene | 67. 4-bromo-1-chlorobenzene (SS) |
| 32. <i>trans</i> -1,3-dichloropropene | 68. 1,2,4-trichlorobenzene |
| 33. 1,1,2-trichloroethane | 69. hexachlorobutadiene |
| 34. 2-bromo-1-chloropropane (IS) | 70. naphthalene |
| 35. 1,3-dichloropropane | 71. 1,2,3-trichlorobenzene |
| 36. tetrachloroethene | |

Column
Conc
Tri.

Rtx®-502.2, 75m, 0.45mm ID, 2.55 μ m (cat. # 10986).
 20ppb in 5mL of RO water (unless otherwise noted, peak 14).
 a combination of the following reference materials was used:
 502.2 Cal2000 MegaMix® (cat. # 30431)
 502.2 Calibration Mix #1A (cat. # 30439)
 502.2 Internal Standard Mix #2 (cat. # 30041)
 1-chloro-2-fluorobenzene (cat. # 30040)
 4-bromochlorobenzene (cat. # 30230)
 2-chloretoyl vinyl ether (cat. # 30265)
 1,4-dichlorobutane (cat. # 30227)
 MTBE (cat. # 30402)
 and custom mixtures of Freon® 113, allyl chloride,
 chloroprene, and benzyl choride.

Concentrator:
Trap:
Purge:
Dry purge:
Desorb preheat:
Desorb:
Bake:

Tekmar LSC-3000 Purge and Trap
Vocarb 3000
11 min. @ 40mL/min.
1 min. @ 40mL/min. (MCS off)
245°C
250°C for 2 min.
260°C for 8 min.

Bake.
GC:
Carrier gas:
Oven temp.:

Detectors:

Finnigan 9001
 helium, 9mL/min. constant pressure
 35°C (hold 6 min.) to 115°C @ 11°C/min. (hold 7 min.) to 130°C @ 7°C/min. (no hold), to 220°C @ 9.2°C/min. (hold 4 min.)
 μ Gold Tandem PID/HALL® 2000
 PID: makeup 7mL/min., purge 7mL/min. set @ 0.35mV, base temp. 200°C
 HALL® 2000: Rxn gas 25mL/min., Rxn temp. 940°C
 propane flow 470mL/min.

PID: makeup 7mL/min., purge 7mL/min. set @ 0.35mV, base temp. 200°C
 HALL® 2000: Rxn gas 25mL/min., Rxn temp. 940°C
 propane flow 470 mL/min.

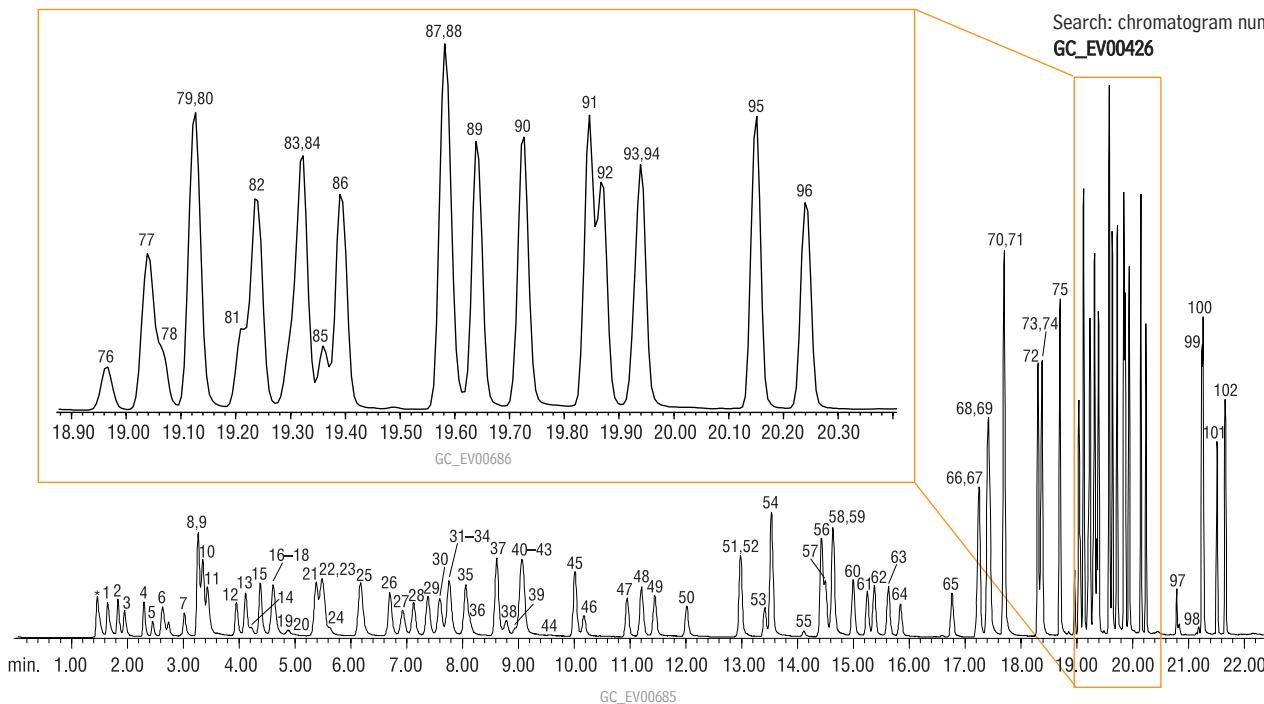
Acknowledgement: Finnigan 9001 GC, μ Gold Tandem Photoionization/HALL® 2000 Electrolytic Conductivity Detector provided courtesy of Thermo Scientific GC & GC/MS Division, 2215 Grand Avenue Pkwy, Austin, Texas 78728

Volatiles

Volatile Organics

US EPA Method 8260 (80ppb Standard)

Rtx®-VMS



Column: Rtx®-VMS, 30m, 0.25mm ID, 1.4 μ m (cat.# 19915)
Sample: Calibration, internal standard, surrogate standard mixes (cat.# 30475B, 30465, 30006, 30240, 30074)

Purge and trap conditions:
O.I. Analytical 4560 with 4551A Autosampler

Trap: #10 (Tenax/silica gel/carbon molecular sieve)

Purge time: 11 min.

Purge flow rate: 38mL/min.

Desorb flow rate: 32mL/min.

Desorb time: 1.0 min.

Bake time: 10 min.

Sample size: 10mL

Water management: 110°C purge, 0°C desorb, 240°C bake

Split ratio: 1:25

Temperatures:

Sample: 40°C

Trap: 20°C purge, 190°C desorb, 210°C bake

6-Port valve: 110°C
Transfer line: 110°C
Sparge mount: 45°C
Desorb preheat: 150°C
Valve manifold: 50°C
Other conditions: pre-purge, pre-heat, dry purge OFF

Chromatography:

Inj. temp.: 250°C
Carrier gas: helium, constant flow
Flow rate: 1.3 mL/min.
Dead time: 1.47 min. @ 35°C
Oven temp.: 35°C (hold 7 min.) to 90°C @ 4°C/min.(no hold) to 220°C @ 45°C/min. (hold 1 min.)
Det.: Agilent 5971A GC/MS
Transfer line temp.: 280°C
Scan range: 35-260amu
Tune: PFTBA/BFB

- *carbon dioxide
- 1. dichlorodifluoromethane
- 2. chloromethane
- 3. vinyl chloride
- 4. bromomethane
- 5. chloroethane
- 6. trichlorofluoromethane
- 7. diethyl ether
- 8. 1,1-dichloroethene
- 9. carbon disulfide
- 10. Freon® 113
- 11. iodomethane
- 12. allyl chloride
- 13. methylene chloride
- 14. acetone
- 15. trans-1,2-dichloroethene
- 16. methyl-d3-tert-butyl-ether
- 17. methyl acetate
- 18. methyl-tert-butyl-ether
- 19. tert-butyl alcohol
- 20. acetonitrile
- 21. diisopropyl ether
- 22. chloroprene
- 23. 1,1-dichloroethane
- 24. acrylonitrile
- 25. ethyl-tert-butyl ether
- 26. cis-1,2-dichloroethene
- 27. 2,2-dichloropropane
- 28. bromochloromethane
- 29. chloroform
- 30. carbon tetrachloride
- 31. tetrahydrofuran
- 32. methyl acrylate
- 33. 1,1,1-trichloroethane
- 34. dibromoform
- 35. 1,1-dichloropropene
- 36. 2-butanone
- 37. benzene
- 38. propionitrile
- 39. methacrylonitrile
- 40. 1,2-dichloroethane-d4
- 41. pentafluorobenzene
- 42. tert-amyl-methyl ether
- 43. 1,2-dichloroethane
- 44. isobutyl alcohol
- 45. trichloroethene
- 46. 1,4-difluorobenzene
- 47. dibromomethane
- 48. 1,2-dichloropropane
- 49. bromodichloromethane
- 50. methyl methacrylate
- 51. cis-1,3-dichloropropene

- 52. 2-chloroethyl vinyl ether
- 53. toluene-d8
- 54. toluene
- 55. 2-nitropropane
- 56. tetrachloroethene
- 57. 2-bromo-1-chloropropane
- 58. 4-methyl-2-pentanone
- 59. trans-1,3-dichloropropene
- 60. 1,1,2-trichloroethane
- 61. ethyl methacrylate
- 62. dibromochloromethane
- 63. 1,3-dichloropropane
- 64. 1,2-dibromoethane
- 65. 2-hexanone
- 66. chlorobenzene-d5
- 67. chlorobenzene
- 68. ethylbenzene
- 69. 1,1,2-tetrachloroethane
- 70. m-xylene
- 71. p-xylene
- 72. o-xylene
- 73. bromoform
- 74. styrene
- 75. isopropylbenzene
- 76. 4-bromo-1-fluorobenzene (SS)
- 77. bromobenzene
- 78. cis-1,4-dichloro-2-butene
- 79. 1,4-dichlorobutane
- 80. n-propylbenzene
- 81. 1,1,2,2-tetrachloroethane
- 82. 2-chlorotoluene
- 83. 1,2,3-trichloropropane
- 84. 1,3,5-trimethylbenzene
- 85. trans-1,4-dichloro-2-butene
- 86. 4-chlorotoluene
- 87. tert-butylbenzene
- 88. pentachloroethane
- 89. 1,2,4-trimethylbenzene
- 90. sec-butylbenzene
- 91. p-isopropyltoluene
- 92. 1,3-dichlorobenzene
- 93. 1,4-dichlorobenzene-d4
- 94. 1,4-dichlorobenzene
- 95. n-butylbenzene
- 96. 1,2-dichlorobenzene
- 97. 1,2-dibromo-3-chloropropane
- 98. nitrobenzene
- 99. hexachlorobutadiene
- 100. 1,2,4-trichlorobenzene
- 101. naphthalene
- 102. 1,2,3-trichlorobenzene

Acknowledgments: Purge & trap courtesy of O.I. Analytical.

for more info

EPA Method 8240 chromatograms
www.restek.com/chromatograms

Search: chromatogram number
GC_EV00426

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Good choice for alcohols & oxygenates!

free literature

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

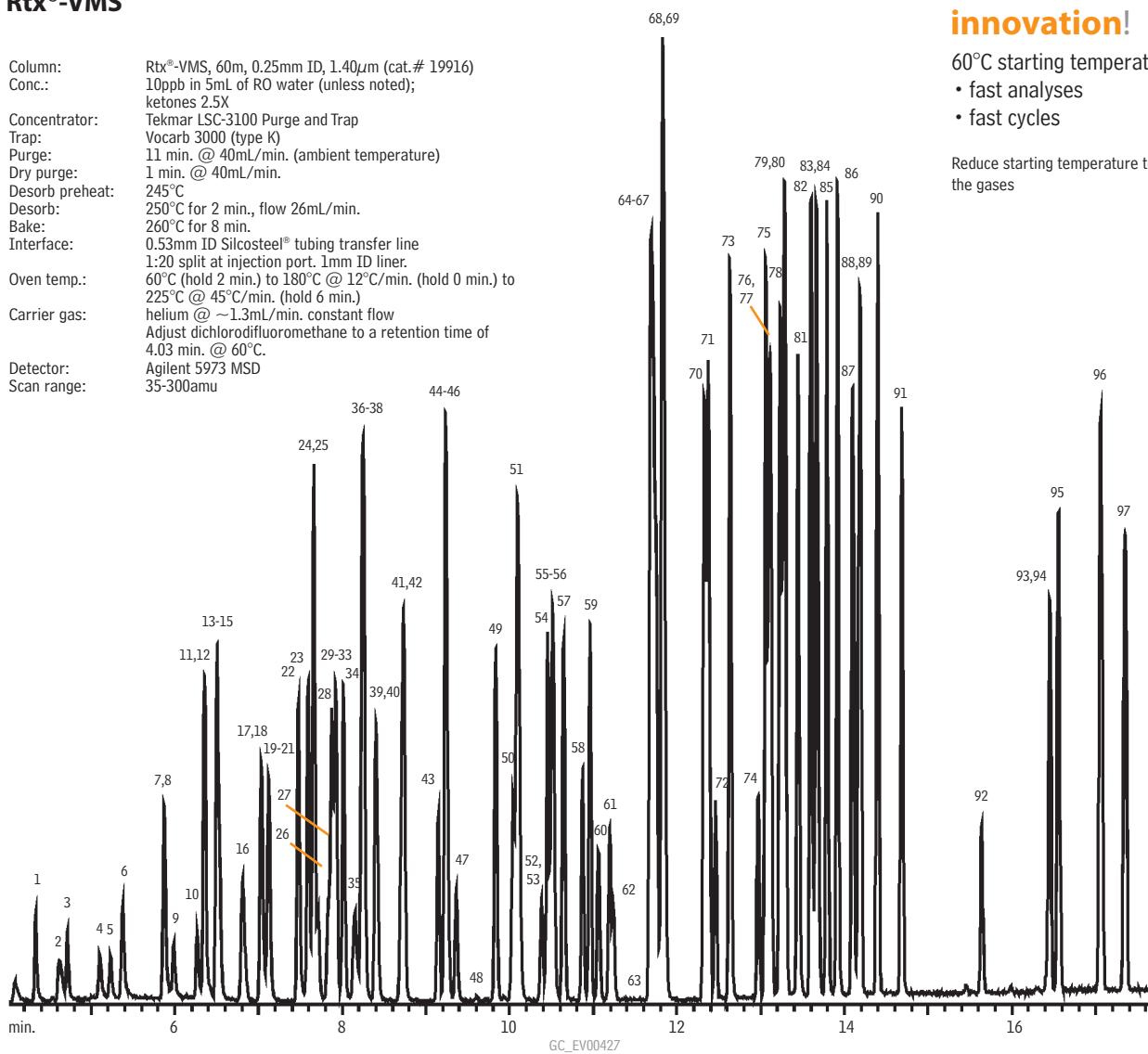
This 8-page note describes a practical, effective approach to monitoring oxygenates in wastewater. We evaluated the Rtx®-VMS stationary phase for oxygenates recovery, adjusted purge and trap conditions to increase responses for oxygenates, and optimized GC conditions to eliminate coelutions of ion-sharing analytes. The result is a sensitive, accurate analysis for gasoline oxygenates in wastewater, in the presence of much higher total gasoline content.

Download your free copy from www.restek.com.

Applications Note
lit. cat.# 59856

Volatile Organics
US EPA Method 8260B
Rtx®-VMS

Column: Rtx®-VMS, 60m, 0.25mm ID, 1.40 μ m (cat.# 19916)
Conc.: 10ppb in 5mL of RO water (unless noted);
ketones 2.5X
Concentrator: Tekmar LSC-3100 Purge and Trap
Trap: Vocabar 3000 (type K)
Purge: 11 min. @ 40mL/min. (ambient temperature)
Dry purge: 1 min. @ 40mL/min.
Desorb preheat: 245°C
Desorb: 250°C for 2 min., flow 26mL/min.
Bake: 260°C for 8 min.
Interface: 0.53mm ID Silcosteel® tubing transfer line
1:20 split at injection port. 1mm ID liner.
Oven temp.: 60°C (hold 2 min.) to 180°C @ 12°C/min. (hold 0 min.) to
225°C @ 45°C/min. (hold 6 min.)
Carrier gas: helium @ ~1.3mL/min. constant flow
Adjust dichlorodifluoromethane to a retention time of
4.03 min. @ 60°C.
Detector: Agilent 5973 MSD
Scan range: 35-300amu



- | | | | |
|---|-------------------------------------|---------------------------------------|---------------------------------|
| 1. dichlorodifluoromethane | 26. ethyl acetate | 51. toluene | 76. 1,1,2,2-tetrachloroethane |
| 2. chloromethane | 27. methyl acrylate | 52. 4-methyl-2-pentanone | 77. bromobenzene |
| 3. vinyl chloride | 28. propargyl alcohol (500ppb) | 53. pyridine (250ppb) | 78. 1,3,5-trimethylbenzene |
| 4. bromomethane | 29. dibromodifluoromethane (SMC) | 54. <i>trans</i> -1,3-dichloropropene | 79. 2-chlorotoluene |
| 5. chloroethane | 30. tetrahydrofuran | 55. ethyl methacrylate | 80. 1,2,3-trichloropropane |
| 6. trichlorodifluoromethane | 31. carbon tetrachloride | 56. tetrachloroethene | 81. 4-chlorotoluene |
| 7. ethanol (2500ppb) | 32. 2-butanone | 57. 1,1,2-trichloroethane | 82. <i>tert</i> -butylbenzene |
| 8. 1,1-dichloroethene | 33. 1,1,1-trichloroethane | 58. dibromochloromethane | 83. 1,2,4-trimethylbenzene |
| 9. carbon disulfide (40ppb) | 34. 1,1-dichloropropene | 59. 1,3-dichloropropane | 84. pentachloroethane |
| 10. allyl chloride | 35. pentafluorobenzene (IS) | 60. <i>n</i> -butyl acetate | 85. <i>sec</i> -butylbenzene |
| 11. methylene chloride | 36. <i>tert</i> -amyl methyl ether | 61. 1,2-dibromoethane | 86. <i>p</i> -isopropyltoluene |
| 12. acetone | 37. benzene | 62. 2-hexanone | 87. 1,3-dichlorobenzene |
| 13. <i>trans</i> -1,2-dichloroethene | 38. isobutyl alcohol (500ppb) | 63. 2-picoline (250ppb) | 88. 1,4-dichlorobenzene-d4 (IS) |
| 14. <i>tert</i> -butyl alcohol (100ppb) | 39. 1,2-dichloroethane | 64. ethylbenzene | 89. 1,4-dichlorobenzene |
| 15. methyl <i>tert</i> -butyl ether | 40. isopropyl acetate | 65. chlorobenzene-D5 (IS) | 90. <i>n</i> -butylbenzene |
| 16. diisopropyl ether | 41. 1,4-difluorobenzene (SMC) | 66. chlorobenzene | 91. 1,2-dichlorobenzene |
| 17. 1,1-dichloroethane | 42. trichloroethene | 67. 1,1,1,2-tetrachloroethane | 92. 1,2-dibromo-3-chloropropane |
| 18. acrylonitrile | 43. dibromomethane | 68. <i>m</i> -xylene | 93. nitrobenzene (250ppb) |
| 19. vinyl acetate* | 44. bromodichloromethane | 69. <i>p</i> -xylene | 94. hexachlorobutadiene |
| 20. allyl alcohol (250ppb) | 45. 1,2-dichloropropane | 70. <i>o</i> -xylene | 95. 1,2,4-trichlorobenzene |
| 21. ethyl- <i>tert</i> -butyl ether* | 46. methyl methacrylate | 71. styrene | 96. naphthalene |
| 22. <i>cis</i> -1,2-dichloroethene | 47. <i>n</i> -propyl acetate | 72. bromoform | 97. 1,2,3-trichlorobenzene |
| 23. 2,2-dichloropropane | 48. 2-chloroethanol (2500ppb) | 73. isopropylbenzene | |
| 24. bromochloromethane | 49. <i>cis</i> -1,3-dichloropropene | 74. 4-bromo-1-fluorobenzene (SMC) | |
| 25. chloroform | 50. toluene-d8 (SMC) | 75. <i>n</i> -propylbenzene | |

*Peaks 19 & 21 share an ion (43).

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60°C starting temperature

- fast analyses
- fast cycles

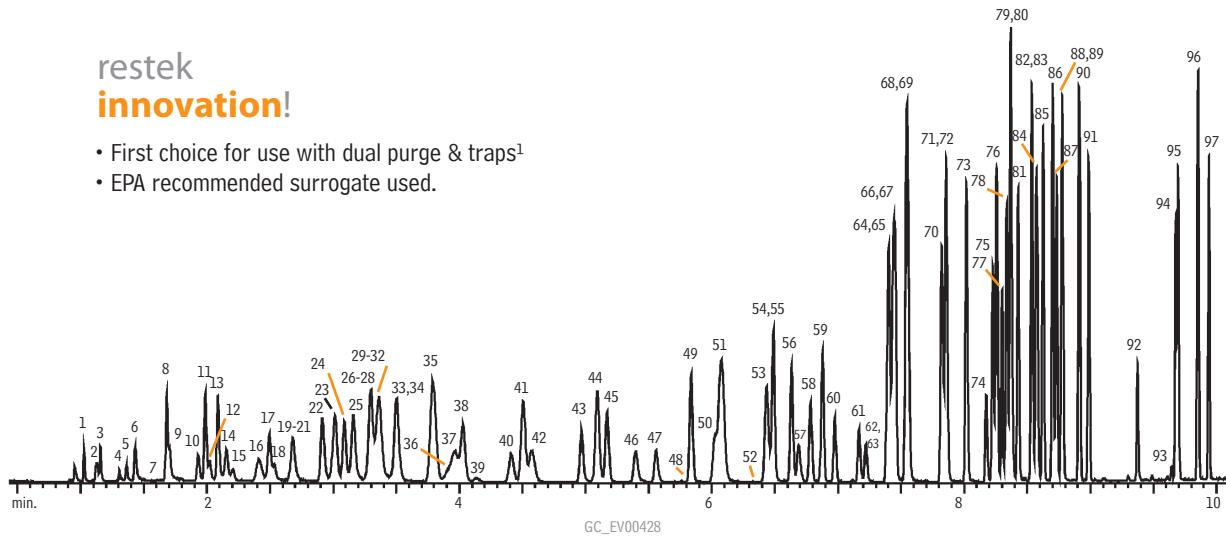
Reduce starting temperature to best focus
the gases

Volatiles

Volatile Organics US EPA Method 8260B Rtx[®]-VMS

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- First choice for use with dual purge & traps¹
- EPA recommended surrogate used.

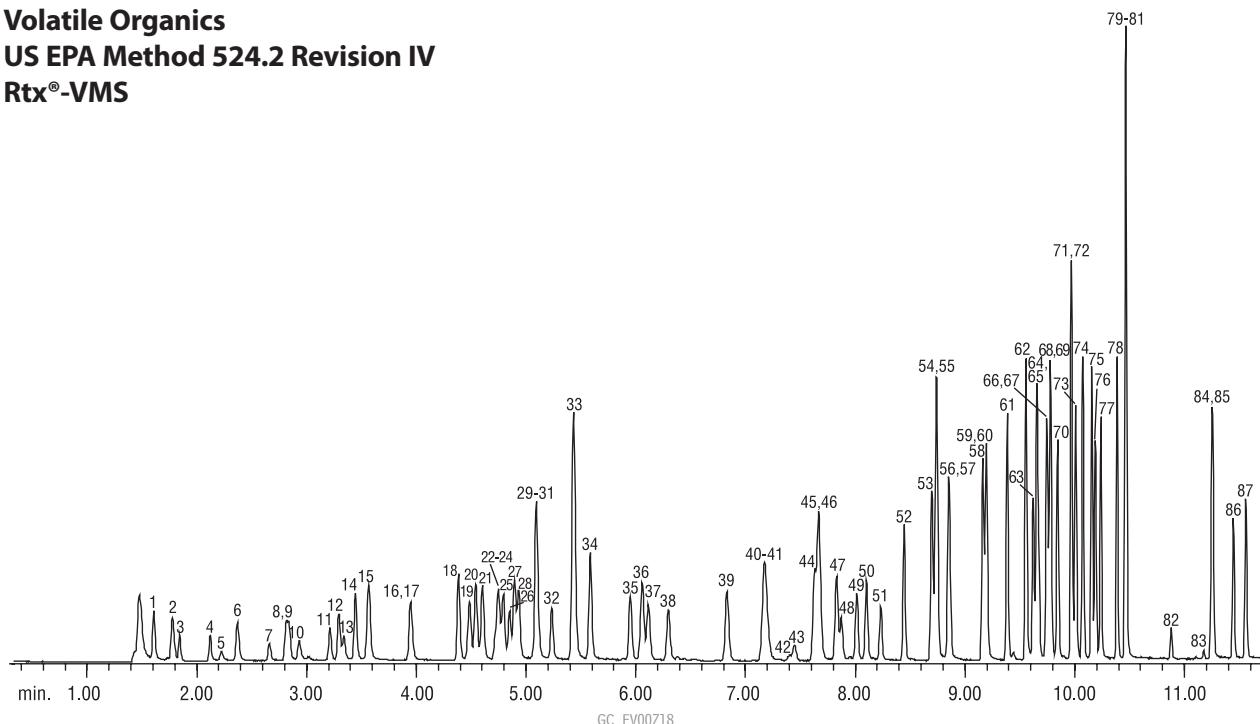


Column: Rtx[®]-VMS, 20m, 0.18mm ID, 1.00 μ m (cat.# 49914)
Conc.: 10ppb in 5mL of RO water unless otherwise noted; ketones at 2.5X
Concentrator:
Trap: Tekmar LSC-3100 Purge and Trap
Purge: 11 min. @ 40mL/min. (ambient temperature)
Dry purge: 1 min. @ 40mL/min.
Desorb preheat: 245°C
Desorb: 250°C for 2 min., flow 40mL/min.
Bake: 260°C for 8 min.
Interface: 0.53mm ID Silcosteel[®] tubing transfer line 1:40 split at injection port. 1mm ID liner.
Oven temp.: 50°C (hold 4 min.) to 100°C @ 18°C/min. (hold 0 min.) to 230°C @ 40°C/min. (hold 3 min.)
Carrier gas: helium @ ~1.0mL/min. constant flow
Detector: Adjust dichlorodifluoromethane to a retention time of 1.03 min. @ 50°C.
Scan range: Agilent 5973 MSD
35-300amu

1. dichlorodifluoromethane	26. ethyl acetate	51. toluene	76. <i>n</i> -propylbenzene
2. chloromethane	27. carbon tetrachloride	52. pyridine (250ppb)	77. 1,1,2,2-tetrachloroethane
3. vinyl chloride	28. methyl acrylate	53. tetrachloroethene	78. 2-chlorotoluene
4. bromomethane	29. propargyl alcohol (500ppb)	54. 4-methyl-2-pentanone	79. 1,3,5-trimethylbenzene
5. chloroethane	30. dibromofluoromethane (SMC)	55. <i>trans</i> -1,3-dichloropropene	80. 1,2,3-trichloropropane
6. trichlorofluoromethane	31. tetrahydrofuran	56. 1,1,2-trichloroethane	81. 4-chlorotoluene
7. ethanol (2500ppb)	32. 1,1,1-trichloroethane	57. ethyl methacrylate	82. <i>tert</i> -butylbenzene
8. 1,1-dichloroethene	33. 2-butanone	58. dibromochloromethane	83. pentachloroethane
9. carbon disulfide (40ppb)	34. 1,1-dichloropropene	59. 1,3-dichloropropane	84. 1,2,4-trimethylbenzene
10. allyl chloride	35. benzene	60. 1,2-dibromoethane	85. <i>sec</i> -butylbenzene
11. methylene chloride	36. pentafluorobenzene (IS)	61. <i>n</i> -butyl acetate	86. <i>p</i> -isopropyltoluene
12. acetone	37. <i>tert</i> -amyl-methyl ether	62. 2-hexanone	87. 1,3-dichlorobenzene
13. trans-1,2-dichloroethene	38. 1,2-dichloroethane	63. 2-picoline (250ppb)	88. 1,4-dichlorobenzene-d4 (IS)
14. methyl <i>tert</i> -butyl ether	39. isobutyl alcohol (500ppb)	64. chlorobenzene-D5 (IS)	89. 1,4-dichlorobenzene
15. <i>tert</i> -butyl alcohol (100ppb)	40. isopropyl acetate	65. chlorobenzene	90. <i>n</i> -butylbenzene
16. diisopropyl ether	41. trichloroethene	66. ethylbenzene	91. 1,2-dichlorobenzene
17. 1,1-dichloroethane	42. 1,4-difluorobenzene (SMC)	67. 1,1,2-tetrachloroethane	92. 1,2-dibromo-3-chloropropane
18. acrylonitrile	43. dibromomethane	68. <i>m</i> -xylene	93. nitrobenzene (250ppb)
19. vinyl acetate	44. 1,2-dichloropropane	69. <i>p</i> -xylene	94. hexachlorobutadiene
20. allyl alcohol (250ppb)	45. bromodichloromethane	70. o-xylene	95. 1,2,4-trichlorobenzene
21. ethyl- <i>tert</i> -butyl ether	46. methyl methacrylate	71. styrene	96. naphthalene
22. <i>cis</i> -1,2-dichloroethene	47. <i>n</i> -propyl acetate	72. bromoform	97. 1,2,3-trichlorobenzene
23. 2,2-dichloropropane	48. 2-chloroethanol (2500ppb)	73. isopropylbenzene	
24. bromochloromethane	49. <i>cis</i> -1,3-dichloropropene	74. 4-bromo-1-fluorobenzene (SMC)	
25. chloroform	50. toluene-d8 (SMC)	75. bromobenzene	

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

Volatile Organics
US EPA Method 524.2 Revision IV
Rtx®-VMS

**Purge and Trap Conditions:**

Concentrator: Tekmar LSC-3100 purge and trap
 Trap: Vocarb 3000 (type K)
 Purge: 11 min. @ 40mL/min. @ ambient temperature.
 Dry purge: 1 min. @ 40mL/min. (MCS bypassed using Silcosteel® tubing)
 Desorb preheat: 245°C
 Desorb: 250°C for 2 min., flow 33mL/min.
 Bake: 260°C for 8 min.
 Interface: Silcosteel® transfer line
 1:30 split at injection port. 1mm ID split inlet liner
 (cat.# 20972)

Column:
 Sample:

Rtx®-VMS, 30m, 0.25mm ID, 1.4 μ m (cat.# 19915)
 502.2 Calibration Mix #1 (cat.# 30042)
 Drinking Water VOA MegaMix®, 524.2 Rev 4 (cat.# 30601)
 524 Internal Standard/Surrogate Mix (cat.# 30201)
 Ketone Mix, EPA Method 524.2 Rev 4.1 (cat.# 30602)
 Compounds at 20 ppb each in 5mL RO water
 (ketones at 50ppb; internal standards at 40ppb)
 250°C
 helium, constant flow
 1.1mL/min.
 1.48 min. @ 40°C
 40°C (hold 2 min.) to 85°C @ 14°C/min. (hold 2 min.) to
 220°C @ 30°C/min. (hold 4 min.).
 Agilent 5971A GC/MS
 280°C
 35-300amu
 PFTBA/BFB
 EI

1. dichlorodifluoromethane	19. 2,2-dichloropropane	37. bromodichloromethane	55. 1,1,1,2-tetrachloroethane	73. 1,2,4-trimethylbenzene
2. chloromethane	20. bromochloromethane	38. methyl methacrylate	56. <i>m</i> -xylene	74. sec-butylbenzene
3. vinyl chloride	21. chloroform	39. <i>cis</i> -1,3-dichloropropene	57. <i>p</i> -xylene	75. <i>p</i> -isopropyltoluene
4. bromomethane	22. methyl acrylate	40. toluene	58. <i>o</i> -xylene	76. 1,3-dichlorobenzene
5. chloroethane	23. carbon tetrachloride	41. chloroacetonitrile	59. styrene	77. 1,4-dichlorobenzene
6. trichlorofluoromethane	24. tetrahydrofuran	42. 2-nitropropane	60. bromoform	78. <i>n</i> -butylbenzene
7. diethyl ether	25. 1,1,1-trichloroethane	43. 1,1-dichloropropanone	61. isopropylbenzene	79. hexachloroethane
8. 1,1-dichloroethene	26. 2-butanone	44. 4-methyl-2-pentanone	62. 4-bromofluorobenzene	80. 1,2-dichlorobenzene-d4
9. carbon disulfide	27. 1,1-dichloropropene	45. tetrachloroethene	63. bromobenzene	81. 1,2-dichlorobenzene
10. iodomethane	28. 1-chlorobutane	46. <i>trans</i> -1,3-dichloropropene	64. <i>n</i> -propylbenzene	82. 1,2-dibromo-3-chloropropane
11. allyl chloride	29. propionitrile	47. 1,1,2-trichloroethane	65. 1,1,2,2-tetrachloroethane	83. nitrobenzene
12. methylene chloride	30. methacrylonitrile	48. ethyl methacrylate	66. 2-chlorotoluene	84. hexachlorobutadiene
13. acetone	31. benzene	49. dibromochloromethane	67. 1,2,3-trichloropropane	85. 1,2,4-trichlorobenzene
14. <i>trans</i> -1,2-dichloroethene	32. 1,2-dichloroethane	50. 1,3-dichloropropane	68. 1,3,5-trimethylbenzene	86. naphthalene
15. methyl <i>tert</i> -butyl ether	33. fluorobenzene	51. 1,2-dibromoethane	69. <i>trans</i> -1,4-dichloro-2-butene	87. 1,2,3-trichlorobenzene
16. 1,1-dichloroethane	34. trichloroethene	52. 2-hexanone	70. 4-chlorotoluene	
17. acrylonitrile	35. dibromomethane	53. chlorobenzene	71. <i>tert</i> -butylbenzene	
18. <i>cis</i> -1,2-dichloroethene	36. 1,2-dichloropropane	54. ethylbenzene	72. pentachloroethane	

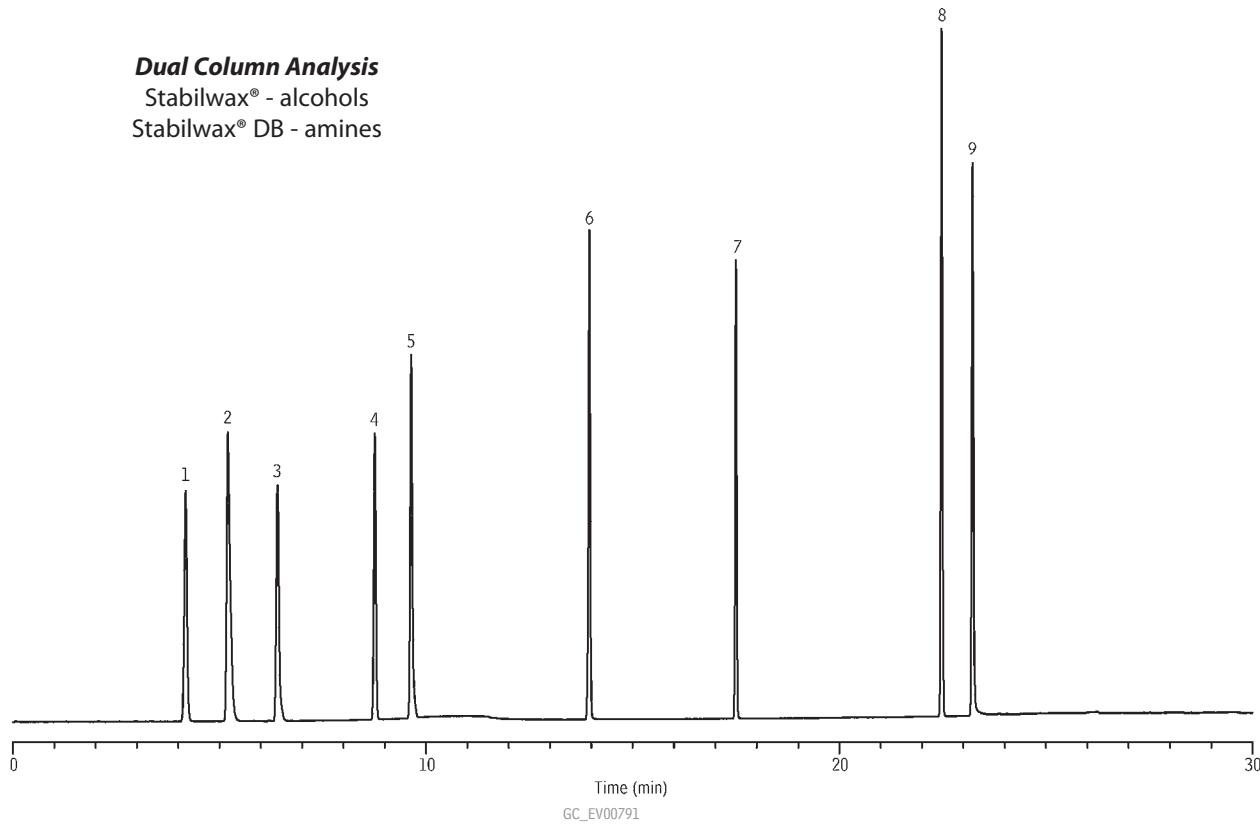
*Peaks 42 & 43 share an ion (43).

Volatiles

**Volatile Organic
US EPA Method 1671
Stabilwax®**

Dual Column Analysis

Stabilwax® - alcohols
Stabilwax® DB - amines



Peak	Retention Time (min.)
1. tetrahydrofuran (IS)	4.17
2. methanol	5.20
3. ethanol	6.40
4. acetonitrile	8.75
5. n-propanol	9.64
6. methyl Cellosolve®	13.95
7. formamide	17.50
8. dimethyl sulfoxide	22.47
9. ethylene glycol	23.22

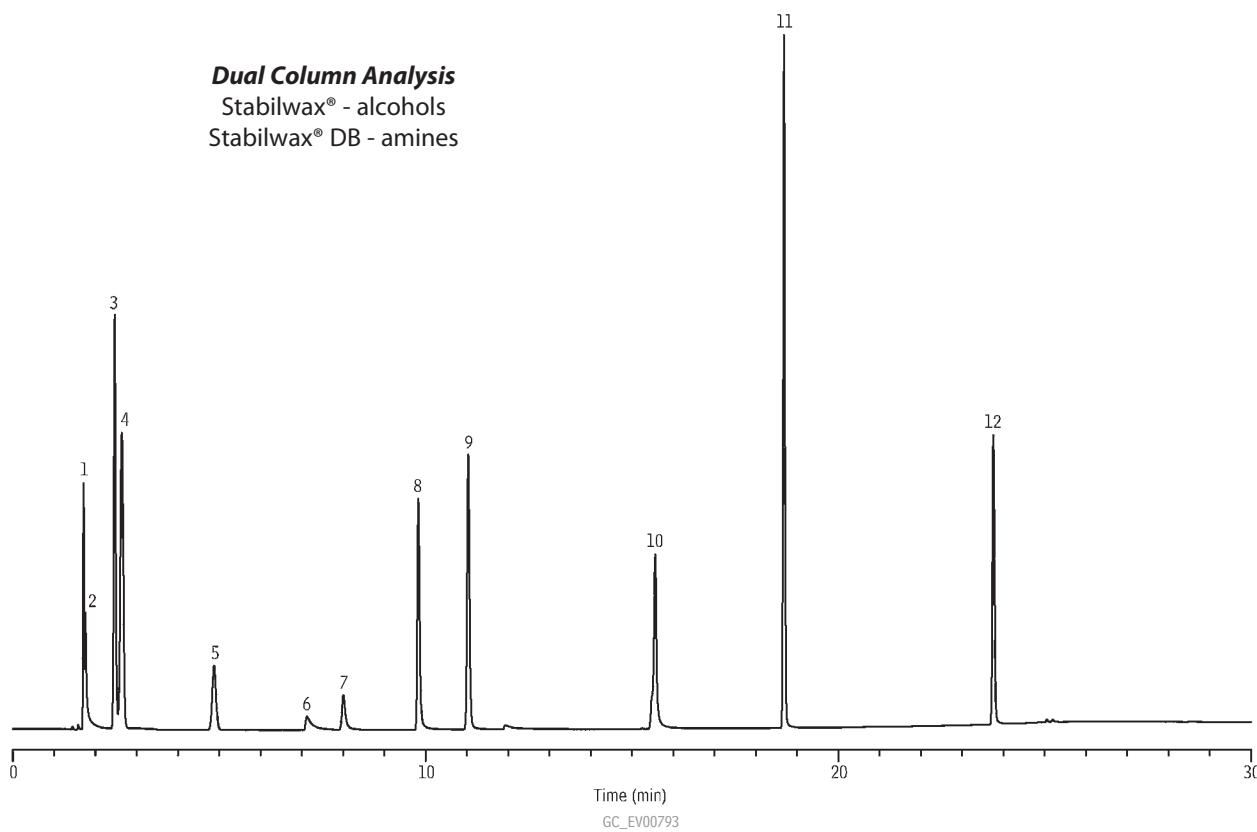
Columns: shown: Stabilwax®, 30m, 0.32mm ID, 1.0 μ m (cat.# 10654)
(Column 2: Stabilwax® DB, 30m, 0.32mm ID, 1.0 μ m (cat.# 10854))
Flow from injector split to two columns using 0.53mm ID intermediate-polarity deactivated guard column (cat.# 10045), SeCure™ "Y" Connector (cat.# 20278), and "Y" Press-Tight® Connector (cat.# 20405)
Sample: 100 μ g/mL 1671 volatile organics mix in deionized water
Inj.: 1.0 μ L, split (split ratio 12:1), 4mm gooseneck splitless inlet liner (cat.# 20798)
Inj. temp.: 200°C
Carrier gas: helium, constant pressure
Linear velocity: 2.48mL/min. / 39.25cm/sec. @ 40°C
(Column 2: 2.51mL/min. / 39.68cm/sec. @ 40°C)
Oven temp.: 40°C (5 min.) to 180°C @ 7°C/min., hold 5 min.
Det.: FID @ 250°C

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Volatile Organic Compounds
US EPA Method 1671
Stabilwax® DB

Dual Column Analysis

Stabilwax® - alcohols
 Stabilwax® DB - amines



Peak	Retention Time (min.)	Concentration ($\mu\text{g/mL}$)
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. <i>n</i> -propanol	11.03	200
10. methyl Cellosolve®	15.56	200
11. formamide	18.68	500
12. dimethyl sulfoxide	23.75	100
ethylene glycol	no elution*	500

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

Columns: shown: Stabilwax® DB, 30m, 0.32mm ID, 1.0 μm (cat.# 10854)
 (Column 1 - not shown: Stabilwax®, 30m, 0.32mm ID, 1.0 μm (cat.# 10654))

Flow from injector split to two columns using 0.53mm ID intermediate-polarity deactivated guard column (cat.# 10045), SeCure™ "Y" Connector (cat.# 20278), and "Y" Press-Tight® Connector (cat.# 20405)

Sample: 1671 volatile organic mix in deionized water, concentrations indicated on figure.

Inj.: 1.0 μL , split (split ratio 12:1), 4mm gooseneck splitless inlet liner (cat.# 20798)

Inj. temp.: 200°C

Carrier gas: helium, constant pressure

Linear velocity: 2.51mL/min. / 39.68cm/sec. @ 40°C

(Column 1: 2.48mL/min. / 39.25cm/sec. @ 40°C)

Oven temp.: 40°C (5 min.) to 180°C @ 7°C/min., hold 5 min.

Det.: FID @ 250°C

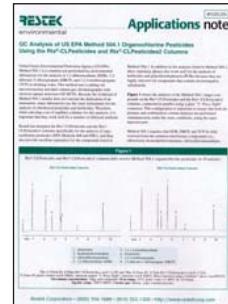
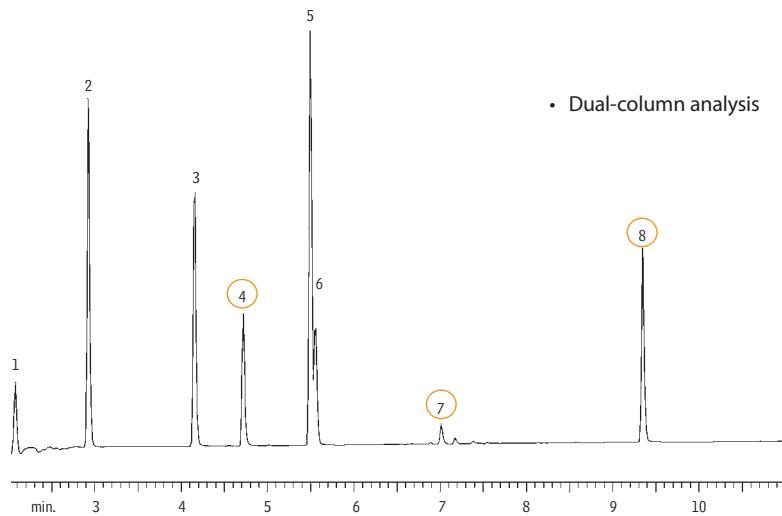
Volatiles

EDB/DBCP

US EPA Method 504.1

Rtx®-CLPesticides & Rtx®-CLPesticides2

Rtx®-CLPesticides



free literature

GC Analysis of US EPA Method 504.1 Organochlorine Pesticides, Using the Rtx®-CLPesticides and Rtx®-CLPesticides2 Columns

A versatile column pair for analyzing organochlorine pesticides, herbicides, or PCBs

Analysts following Method 504.1 in monitoring 1,2-dibromoethane (EDB), 1,2-dibromo-3-chloropropane (DBCP), and 1,2,3-trichloropropane (TCP) in drinking water will value Rtx®-CLPesticides and Rtx®-CLPesticides2 columns because this same primary column/confirmation column pair can be used to perform numerous related analyses: organochlorine pesticides (e.g., by EPA Method 608 or 8081), herbicides, or polychlorinated biphenyls (PCBs). Details in this 2-page note show EDB, DBCP, and TCP are fully resolved from common interference compounds, per requirements of Method 504.1.

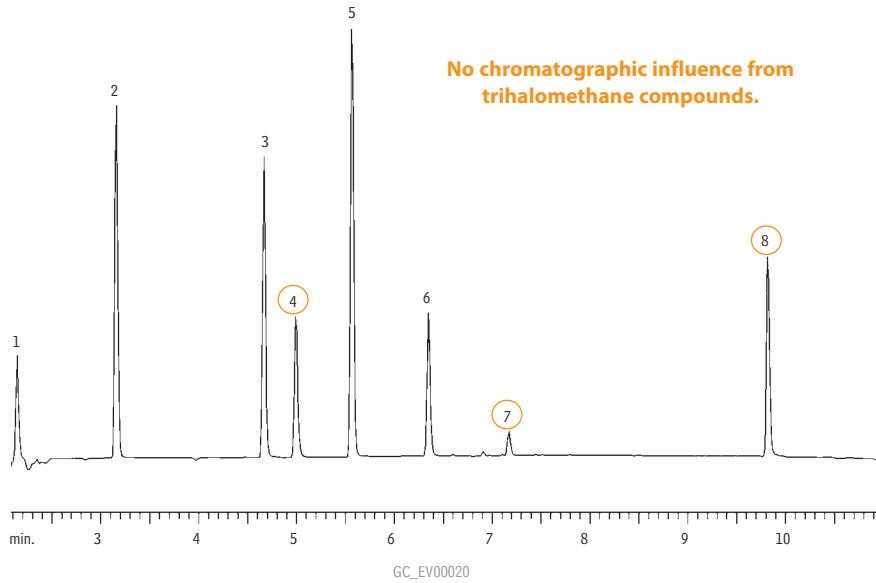
Applications Note
lit. cat.# 59539

Rtx®-CLPesticides and Rtx®-CLPesticides2 columns also are ideal for:

- *Triazine herbicides (lit. cat.# 59101)*
- *PCBs (lit. cat.# 59120)*
- *Haloacetic acids (lit. cat.# 59175)*
- *Polynuclear aromatic hydrocarbons (lit. cat.# 59196A)*

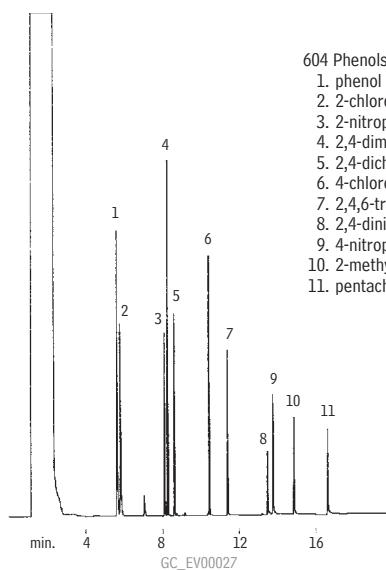
Download your free copy of the literature listed here from www.restek.com.

Rtx®-CLPesticides2



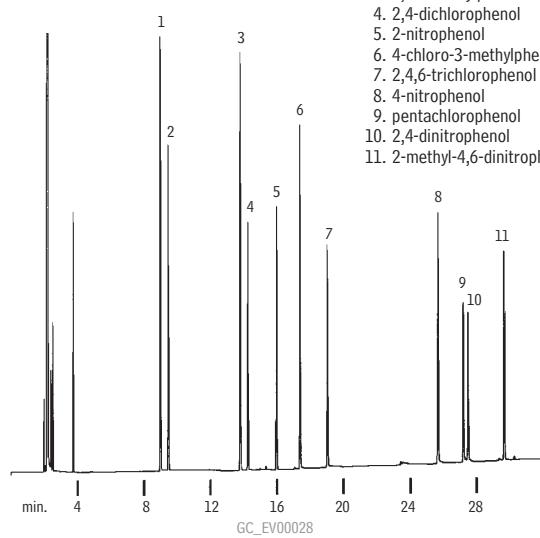
1. chloroform
2. bromodichloromethane
3. chlorodibromomethane
4. 1,2-dibromoethane (EDB)
5. 1,1,2-tetrachloroethane
6. bromoform
7. 1,2,3-trichloropropane
8. 1,2-dibromo-3-chloropropane (DBCP)

Columns: Rtx®-CLPesticides, 30m, 0.32mm ID, 0.50µm (cat.# 11139), Rtx®-CLPesticides2, 30m, 0.32mm ID, 0.25µm (cat.# 11324), 0.32mm ID guard column (cat.# 10044), universal angled "Y" Press-Tight® connector (cat.# 20403)
Inj. On-column conc.: 10µg each compound.
Oven temp.: 35°C (hold 2 min.) to 300°C @ 12°C/min.
Inj./det. temp.: 200°C/300°C
Carrier gas: helium, 12psi constant pressure

Phenols**US EPA Method 604****MXT®-5**

- 604 Phenols Mix (cat.# 31029)
 1. phenol
 2. 2-chlorophenol
 3. 2-nitrophenol
 4. 2,4-dimethylphenol
 5. 2,4-dichlorophenol
 6. 4-chloro-3-methylphenol
 7. 2,4,6-trichlorophenol
 8. 2,4-dinitrophenol
 9. 4-nitrophenol
 10. 2-methyl-4,6-dinitrophenol
 11. pentachlorophenol

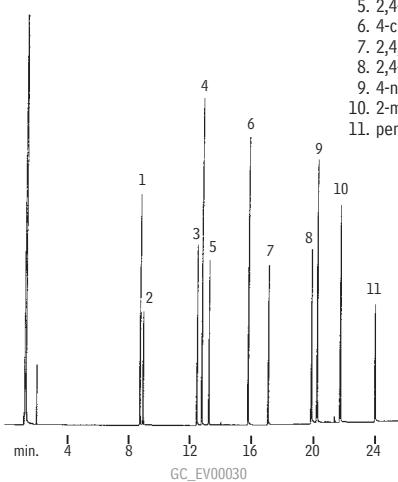
Column: MXT®-5, 30m, 0.28mm ID, 0.25 μ m (cat.# 70224)
 Inj.: 1.0 μ L splitless injection of phenols
 Conc.: 25ng/ μ L per component
 Oven temp.: 40°C to 250°C @ 10°C/min.
 Inj./det. temp.: 280°C/300°C
 Carrier gas: hydrogen
 Linear velocity: 50cm/sec. set @ 40°C
 FID sensitivity: 2.56 x 10⁻¹⁰ AFS

Phenols**US EPA Method 604****Rtx®-200**

Column: Rtx®-200, 30m, 0.32mm ID, 0.25 μ m (cat.# 15024)
 Inj.: 1.0 μ L split injection of a 200ng standard
 Oven temp.: 50°C (hold 4 min.) to 250°C @ 6°C/min.
 Inj./det. temp.: 250°C
 Carrier gas: helium
 Linear velocity: 20cm/sec.
 FID sensitivity: 4 x 10⁻¹¹ AFS
 Split ratio: 40:1

Phenols**US EPA Method 604****Rtx®-5**

- 604 Phenols Mix (cat.# 31029)
 1. phenol
 2. 2-chlorophenol
 3. 2-nitrophenol
 4. 2,4-dimethylphenol
 5. 2,4-dichlorophenol
 6. 4-chloro-3-methylphenol
 7. 2,4,6-trichlorophenol
 8. 2,4-dinitrophenol
 9. 4-nitrophenol
 10. 2-methyl-4,6-dinitrophenol
 11. pentachlorophenol



Column: Rtx®-5, 30m, 0.25mm ID, 0.25 μ m (cat.# 10223)
 Inj.: 1.0 μ L split injection of phenols.
 Conc.: 3-5ng/ μ L per component.
 Oven temp.: 50°C (hold 4 min.) to 250°C @ 8°C/min.
 Inj./det. temp.: 250°C
 Carrier gas: hydrogen
 Linear velocity: 40cm/sec. set @ 110°C
 FID sensitivity: 8 x 10⁻¹¹ AFS
 Split ratio: 40:1

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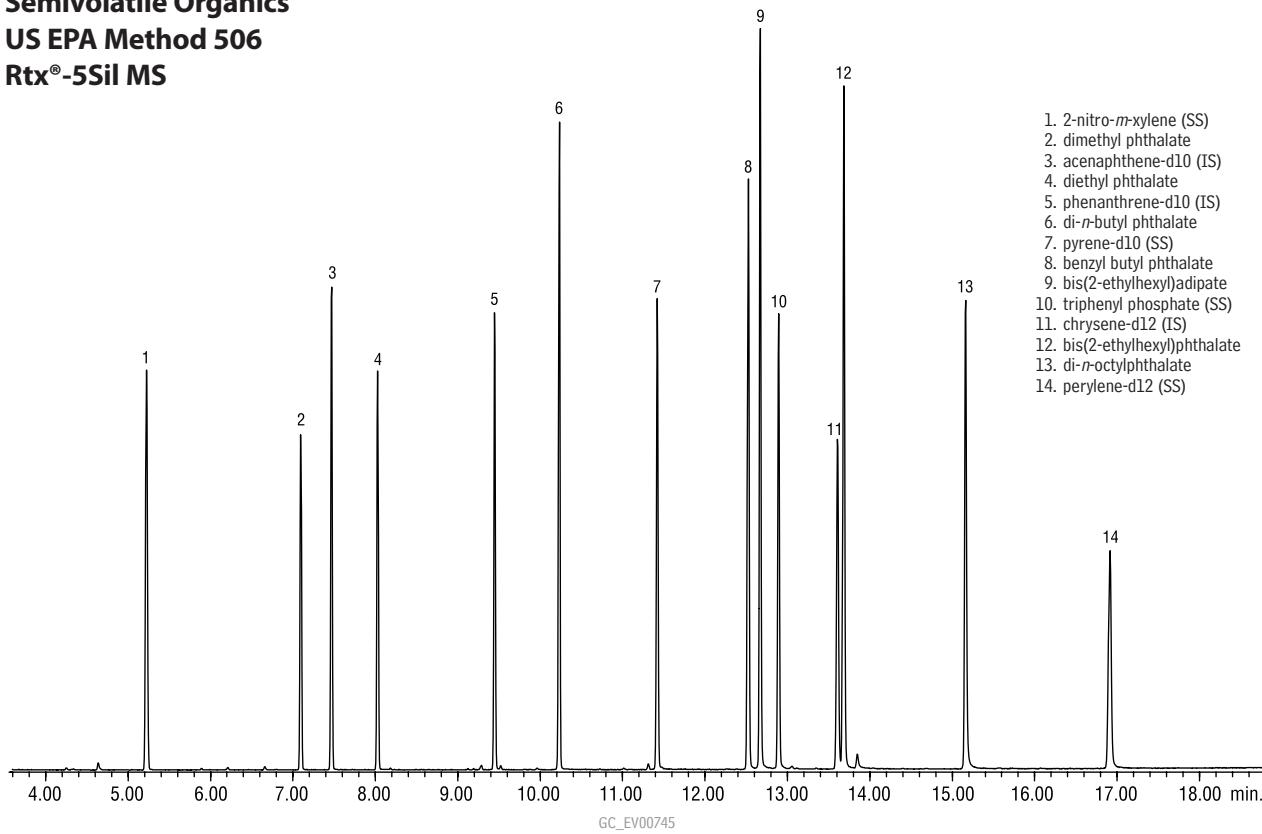


Semivolatiles

Semivolatile Organics

US EPA Method 506

Rtx®-5Sil MS



Column: Rtx®-5Sil MS, 30m, 0.25mm ID, 0.25µm (cat.# 12723)
 Sample: 506 Calibration Mix, 1000µg/mL each analyte (cat.# 31845)
 Method 525.2 Internal Standard Mix (cat.# 31825)
 Method 525.2 Surrogate Standard Mix (cat.# 31826)
 Inj.: 1.0µL, 20ppm each analyte (10ng on column)
 4mm splitless single gooseneck inlet liner (cat.# 20799)
 splitless hold time 0.40 min., 0.45 min. pressure pulse @ 50psi
 GC: Agilent 6890
 Inj. temp.: 270°C
 Carrier gas: helium, constant flow
 Flow rate: 1.0mL/min.
 Oven temp.: 80°C (hold 0.5 min.) to 260°C @ 18°C/min. (hold 1 min.)
 Det.: Agilent 5973 GC/MS
 Transfer line temp.: 280°C
 Scan range: 35–550amu
 Solvent delay: 3 min.
 Tune: DFTPP

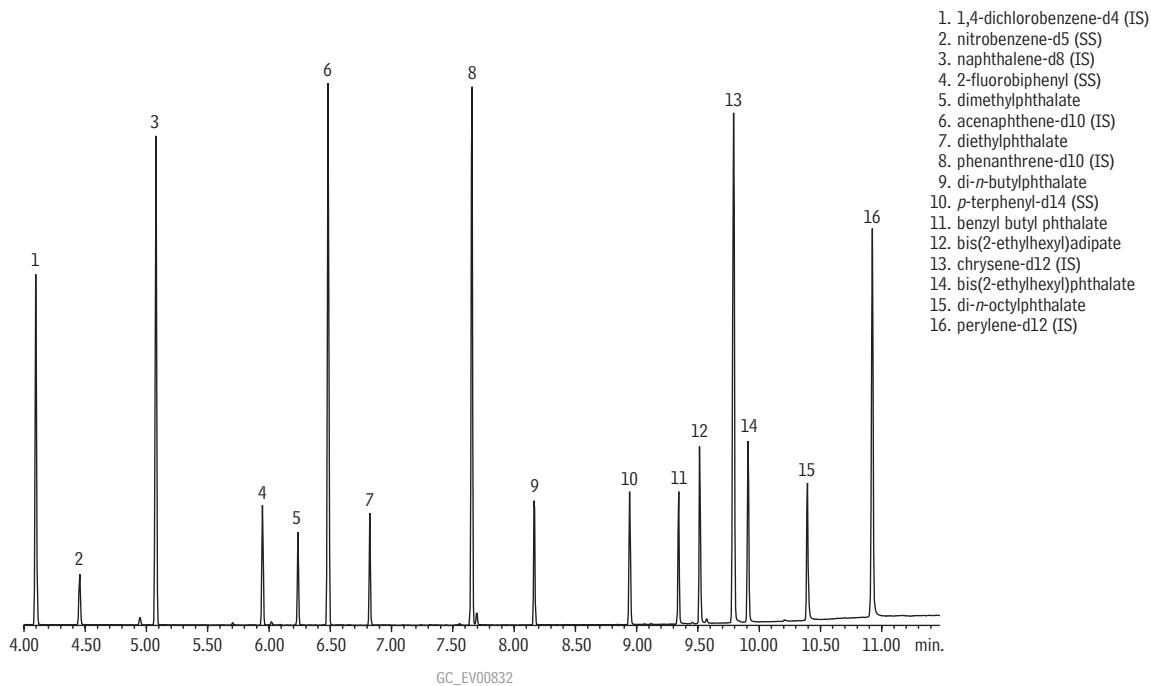
a plus 1 story

"Any time I have any type of chromatography question, I know that I can call Restek Technical Service for assistance. Every time I have spoken to them, they have been extremely helpful, and friendly!"

Carisa A. Kelley, Oxygen Research

Phthalate & Adipate Esters
US EPA Method 506
Rxi®-1ms

Rxi® Technology!



Column: Rxi®-1ms, 30m, 0.25mm ID, 0.25 μ m (cat.# 13323)
 Sample: US EPA Method 506 mix:
 506 Calibration Mix (cat.# 31845),
 SV Internal Standard Mix (cat.# 31206), B/N Surrogate Mix (4/89 SOW)
 (cat.# 31024)
 Inj.: 1.0 μ L, 5 μ g/mL each analyte
 (internal standards 25 μ g/mL), split (10:1)
 4mm Drilled Uniliner® inlet liner (hole on bottom) (cat.# 20771)
 Instrument: Agilent 6890
 Inj. temp.: 250°C
 Carrier gas: helium, constant flow
 Flow rate: 1.2mL/min.
 Oven temp.: 50°C (hold 1 min.) to 330°C @ 30°C/min. (hold 2 min.)
 Det.: Agilent 5973 MSD
 Transfer line temp.: 280°C
 Scan range: 35-550amu
 Solvent delay: 3.75 min.
 Tune: DFTPP
 Ionization: EI

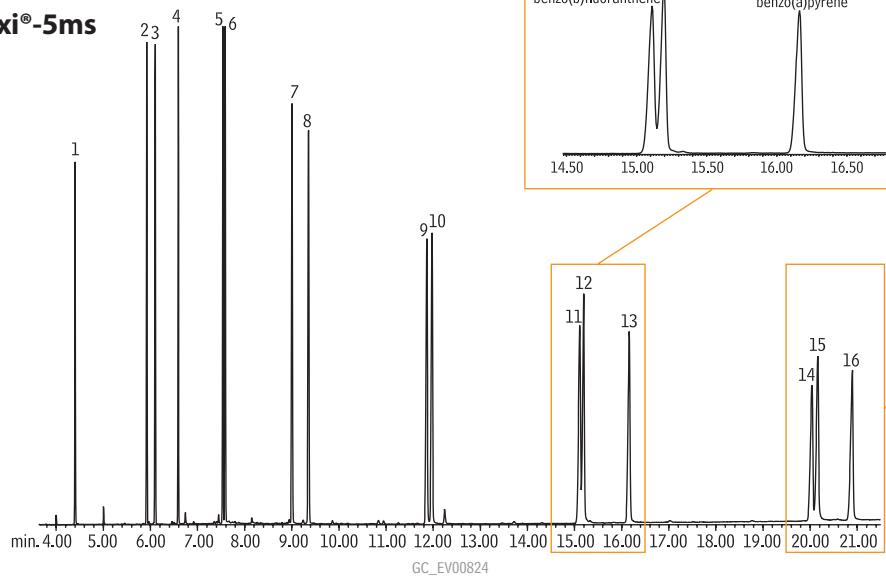
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Semivolatiles

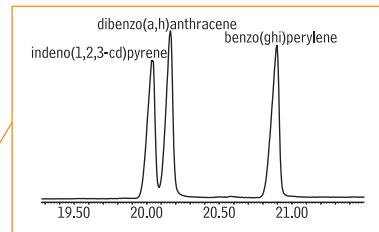
Polycyclic Aromatic Hydrocarbons

US EPA Method 610

Rxi®-5ms



Rxi® Technology!



Column: Rxi®-5ms, 30m, 0.25mm ID, 0.25 μ m (cat.# 13423)
Sample: SV Calibration Mix #5/610 PAH Mix (cat.# 31011)
Inj.: 1.0 μ L, 10ppm each analyte (10ng on column), splitless (hold 0.1 min.)
Instrument: Agilent 6890
Inj. temp.: 275°C
Carrier gas: helium, constant flow

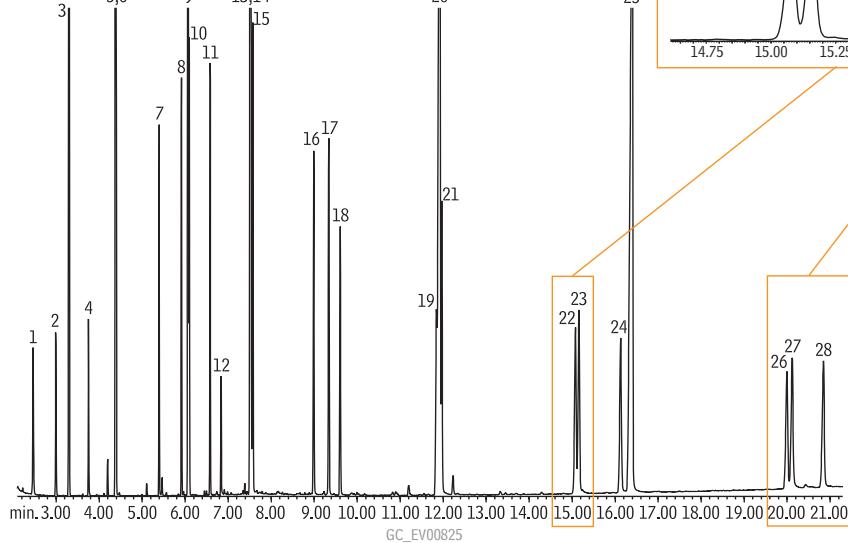
Flow rate: 1.2mL/min.
Oven temp.: 75°C (hold 0.5 min.) to 245°C @ 25°C/min., to 330°C @ 4°C/min. (hold 1 min.)
Det.: Agilent 5973 GC/MS
Transfer line temp.: 280°C
Scan range: 35-550amu
Solvent delay: 2 min.
Tune: DFTPP
Ionization: EI

1. naphthalene
2. acenaphthylene
3. acenaphthene
4. fluorene
5. phenanthrene
6. anthracene
7. fluoranthene
8. pyrene
9. benzo(a)anthracene
10. chrysene
11. benzo(b)fluoranthene
12. benzo(k)fluoranthene
13. benzo(a)pyrene
14. indeno(1,2,3-cd)pyrene
15. dibenzo(a,h)anthracene
16. benzo(ghi)perylene

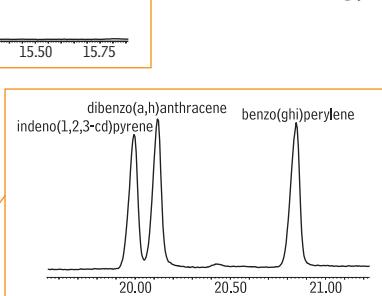
Polycyclic Aromatic Hydrocarbons

US EPA Method 610 (with Internal Standards & Surrogates)

Rxi®-5ms



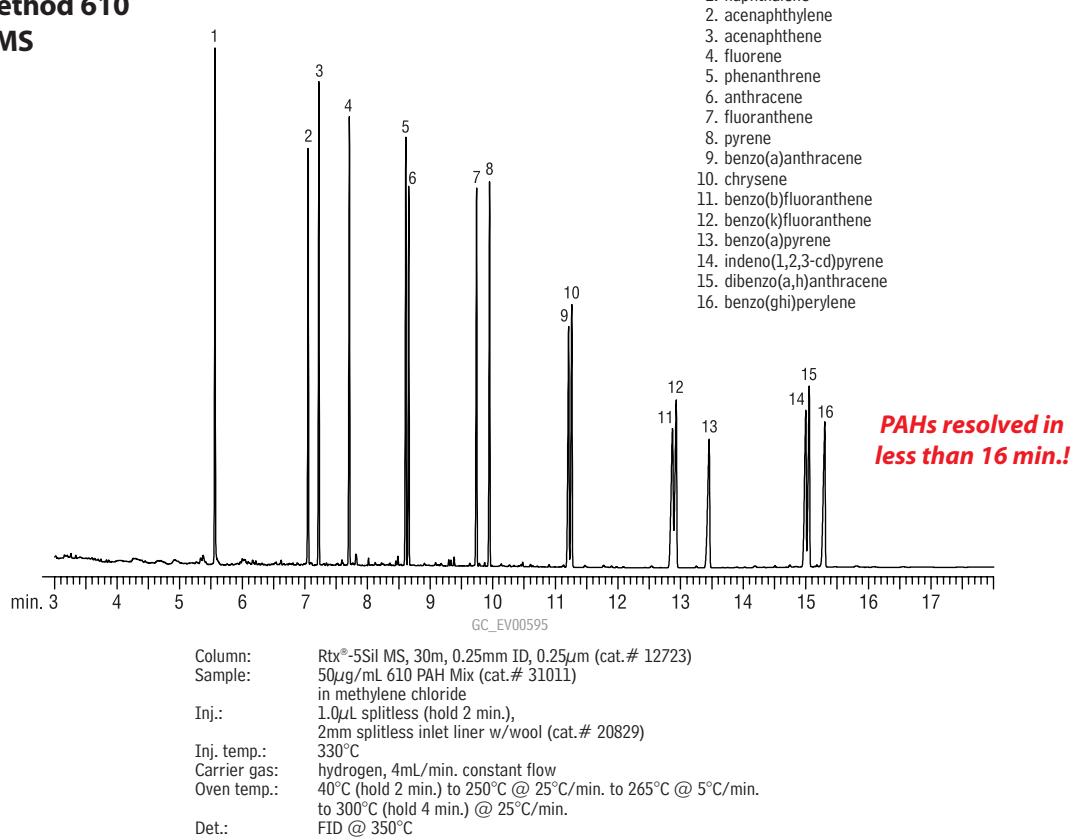
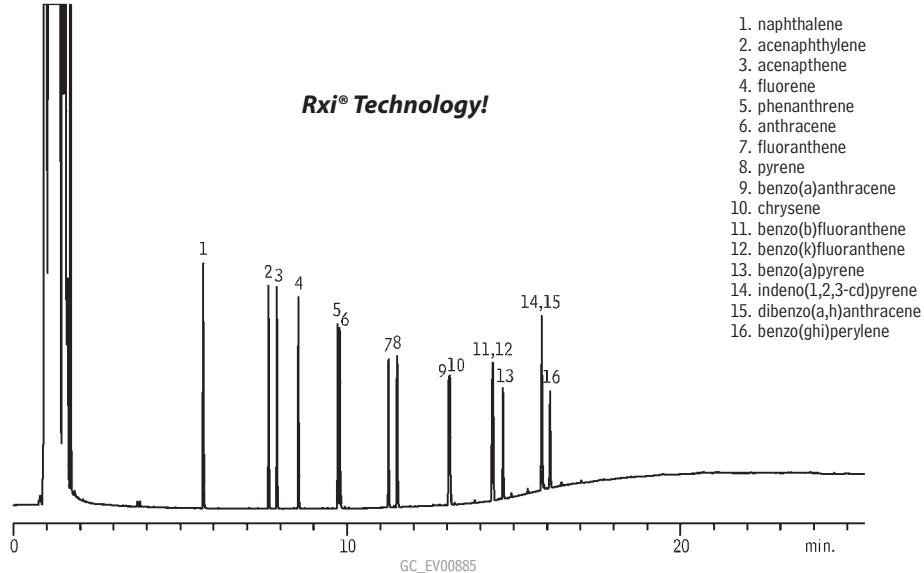
Rxi® Technology!



Column: Rxi®-5ms, 30m, 0.25mm ID, 0.25 μ m (cat.# 13423)
Sample: SV Calibration Mix #5/610 PAH Mix (cat.# 31011), Acid Surrogate Mix (4/89 SOW) (cat.# 31025), B/N Surrogate Mix (4/89 SOW) (cat.# 31024), SV Internal Standard Mix (cat.# 31206)
Inj.: 1.0 μ L, 10ppm each analyte (10ng on column; 40ng each internal standard), splitless (hold 0.1 min.)
Instrument: Agilent 6890

Inj. temp.: 275°C
Carrier gas: helium, constant flow
Flow rate: 1.2mL/min.
Oven temp.: 75°C (hold 0.5 min.) to 245°C @ 25°C/min., to 330°C @ 4°C/min. (hold 1 min.)
Det.: Agilent 5973 GC/MS
Transfer line temp.: 280°C
Scan range: 35-550amu
Solvent delay: 2 min.
Tune: DFTPP
Ionization: EI

1. 2-fluorophenol
2. phenol-d6
3. 1,4-dichlorobenzene-d4
4. nitrobenzene-d5
5. naphthalene-d8
6. naphthalene
7. 2-fluorobiphenyl
8. acenaphthylene
9. acenaphthene-d10
10. acenaphthene
11. fluorene
12. 2,4,6-tribromophenol
13. phenanthrene-d10
14. phenanthrene
15. anthracene
16. fluoranthene
17. pyrene
18. ρ -terphenyl-d14
19. benzo(a)anthracene
20. chrysene-d12
21. chrysene
22. benzo(b)fluoranthene
23. benzo(k)fluoranthene
24. benzo(a)pyrene
25. perylene-d12
26. indeno(1,2,3-cd)pyrene
27. dibenzo(a,h)anthracene
28. benzo(ghi)perylene

Polycyclic Aromatic Hydrocarbons**US EPA Method 610****Rtx®-5Sil MS****Polycyclic Aromatic Hydrocarbons****US EPA Method 610****Rxi®-1ms****new!**

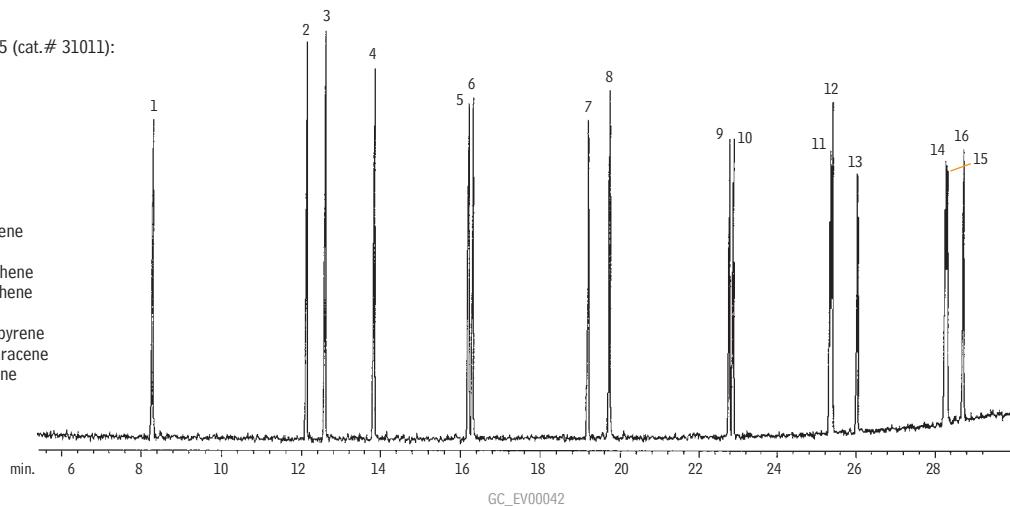
Column: Rxi®-1ms, 20m, 0.18mm ID, 0.18µm (cat.# 13302)
Sample: SV Calibration Mix #5/610 PAH Mix (cat.# 31011),
2000µg/mL each component in methylene chloride
Inj.: 0.5µL, split, split ratio 20:1, 3.5mm Precision™ inlet liner (cat.# 21021)
Instrument: Shimadzu GC-2010
Inj. temp.: 275°C
Carrier gas: hydrogen, constant pressure
Linear velocity: 55cm/sec. @ 40°C
Oven temp.: 40°C (hold 1 min.) to 330°C @ 20°C/min. (hold 10 min.)
Det.: FID @ 350°C

Semivolatiles

Polycyclic Aromatic Hydrocarbons US EPA Method 8100 MXT®-5

Reference Standards
SV Calibration Mix #5 (cat.# 31011):

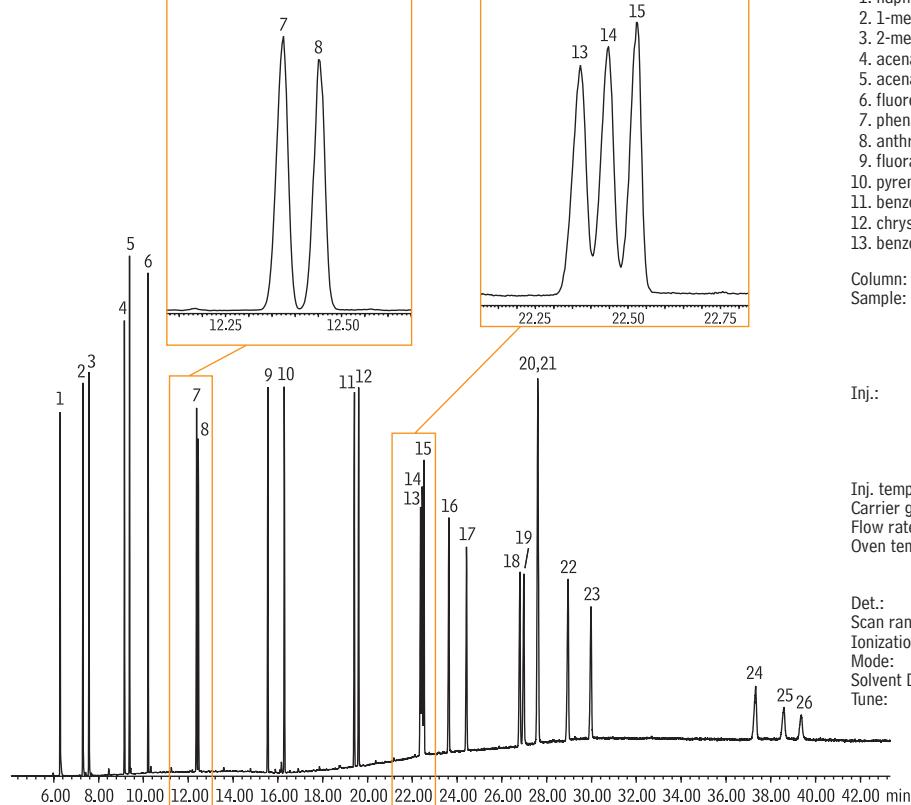
1. naphthalene
2. acenaphthylene
3. acenaphthene
4. fluorene
5. phenanthrene
6. anthracene
7. fluoranthene
8. pyrene
9. benzo(a)anthracene
10. chrysene
11. benzo(b)fluoranthene
12. benzo(k)fluoranthene
13. benzo(a)pyrene
14. indeno(1,2,3-cd)pyrene
15. dibenzo(a,h)anthracene
16. benzo(ghi)perylene



Column: MXT®-5, 30m, 0.28mm ID, 0.25μm (cat.# 70224)
Inj.: 1.0μL splitless injection of PAHs
Conc.: 20ng/μL
Oven temp.: 40°C to 325°C @ 10°C/min. (hold 10 min.)
Inj./det. temp.: 280°C/325°C
Detector: MS
Carrier gas: helium
Linear velocity: 50cm/sec. set @ 325°C
Splitless hold time: 1 min.

Polycyclic Aromatic Hydrocarbons Rtx®-50

new!

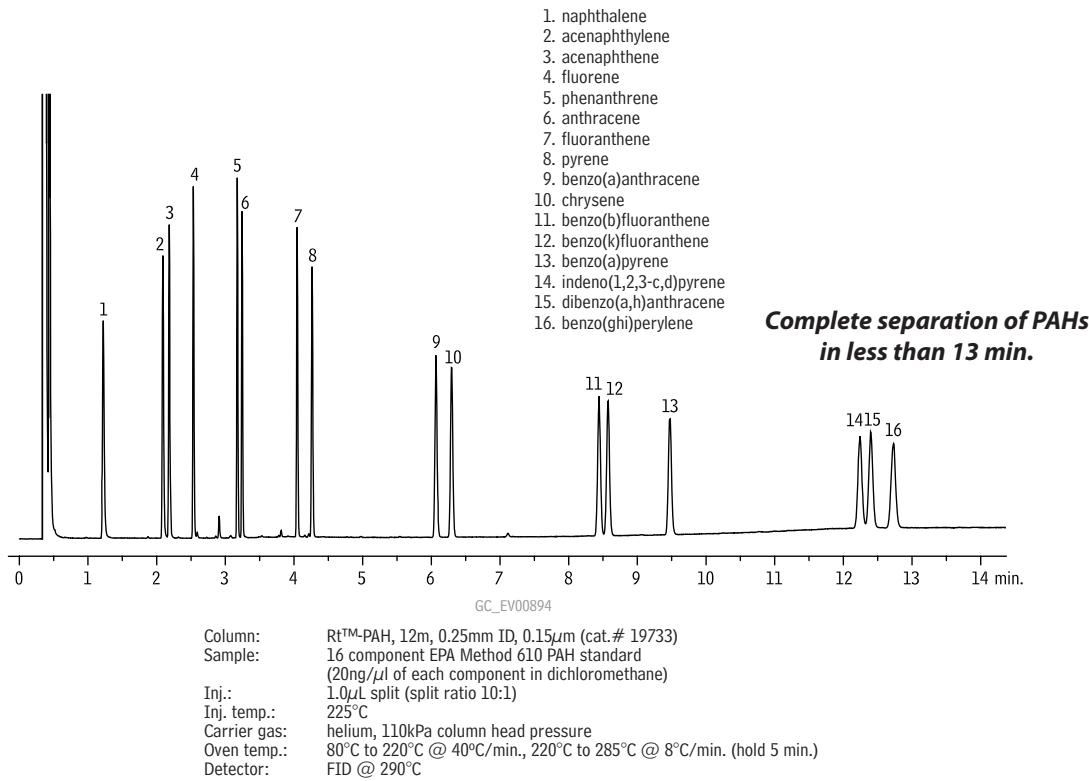


1. naphthalene
2. 1-methylnaphthalene
3. 2-methylnaphthalene
4. acenaphthylene
5. acenaphthene
6. fluorene
7. phenanthrene
8. anthracene
9. fluoranthene
10. pyrene
11. benzo(a)anthracene
12. chrysene
13. benzo(b)fluoranthene
14. benzo(k)fluoranthene
15. benzo(j)fluoranthene
16. benzo(a)pyrene
17. 3-methylcholanthrene
18. dibenzo(a,h)acridine
19. dibenzo(a,j)acridine
20. indeno(1,2,3-cd)pyrene
21. dibenzo(a,h)anthracene
22. benzo(ghi)perylene
23. 7H-dibenzo(c,g)carbazole
24. dibenzo(a,e)pyrene
25. dibenzo(a,i)pyrene
26. dibenzo(a,h)pyrene

Column: Rtx®-50, 30m, 0.25mm ID, 0.25μm (cat.# 10523)
Sample: PAH Mix, 20μg/mL each compound
SV Calibration Mix #5/610 PAH Mix (cat.# 31011)
PAH Supplement Mix for Method 8100 (cat.# 31857)
1-methylnaphthalene (cat.# 31283)
2-methylnaphthalene (cat.# 31285)
Inj.: 1.0μL (20ng on-column concentration), pulsed splitless; pulse 20psi @ 0.3 min., 40mL/min. @ 0.2 min., 4mm Drilled Uniliner® (hole near top) inlet liner (cat.# 21055)
Inj. temp.: 300°C
Carrier gas: helium, constant flow
Flow rate: 1.2mL/min.
Oven temp.: 90°C (hold 2.0 min.) to 215°C @ 25°C/min. to 220°C @ 2.5°C/min. to 300°C @ 10°C/min. to 320°C @ 2.5°C/min. (hold 15 min.)
Det.: MS
Scan range: 50-550amu
Ionization: EI
Mode: scan
Solvent Delay: 4.0 min.
Tune: DFTPP

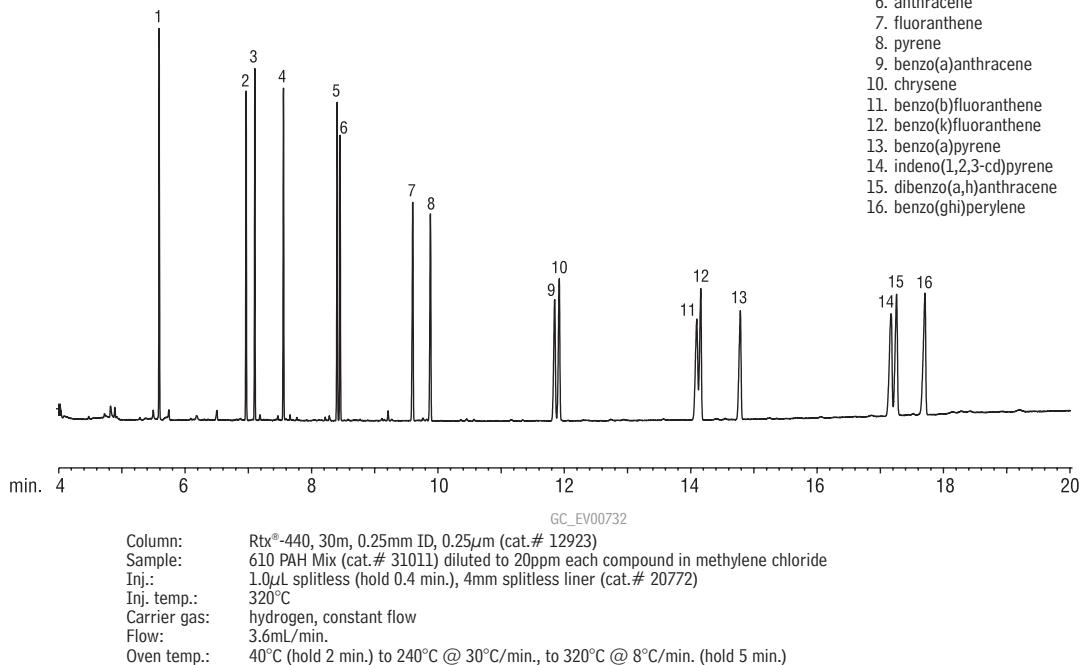
Polycyclic Aromatic Hydrocarbons RtTM-PAH

new!



Chromatogram courtesy of J&K Scientific.

Polycyclic Aromatic Hydrocarbons US EPA Method 610 Rtx[®]-440



1. naphthalene
2. acenaphthylene
3. acenaphthene
4. fluorene
5. phenanthrene
6. anthracene
7. fluoranthene
8. pyrene
9. benzo(a)anthracene
10. chrysene
11. benzo(b)fluoranthene
12. benzo(k)fluoranthene
13. benzo(a)pyrene
14. indeno(1,2,3-c,d)pyrene
15. dibenz(a,h)anthracene
16. benzo(ghi)perylene

Semivolatiles

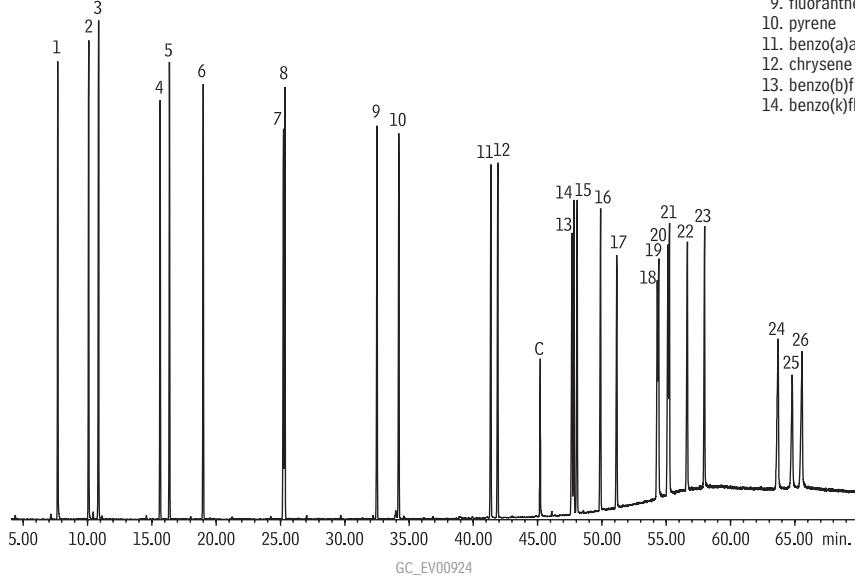
Polycyclic Aromatic Hydrocarbons

Rxi®-17

new!

- maximum resolution
- benzo(j)fluoranthene resolved

Rxi® Technology!



Peak List	Ret. Time (min.)		
1. naphthalene	7.70	15. benzo(j)fluoranthene	48.07
2. 1-methylnaphthalene	10.08	16. benzo(a)pyrene	49.89
3. 2-methylnaphthalene	10.85	17. 3-methylcholanthrene	51.15
4. acenaphthylene	15.64	18. dibenz(a,h)acridine	54.30
5. acenaphthene	16.36	19. dibenz(a,i)acridine	54.41
6. fluorene	19.00	20. indeno(1,2,3-cd)pyrene	55.13
7. phenanthrene	25.24	21. dibenz(a,h)anthracene	55.24
8. anthracene	25.36	22. benzo(ghi)perylene	56.64
9. fluoranthene	32.50	23. 7H-dibenzo(c,g)carbazole	57.98
10. pyrene	34.21	24. dibenz(a,e)pyrene	63.69
11. benzo(a)anthracene	41.37	25. dibenz(a,i)pyrene	64.79
12. chrysene	41.91	26. dibenz(a,h)pyrene	65.56
13. benzo(b)fluoranthene	47.67		
14. benzo(k)fluoranthene	47.82	c = contaminant	

Column: Rxi®-17, 30m, 0.25mm ID, 0.25µm (cat.# 13523)
 Sample: PAH mix, 50µg/mL each component:
 EPA Method 610 Mix (cat.# 31011)
 PAH Supplement Mix (cat.# 31857)
 1-methylnaphthalene (cat.# 31283)
 2-methylnaphthalene (cat.# 31285)

Instrument: Agilent 6890
 Inj.: 1.0µL pulsed splitless injection (50ng each component on column), 4mm Drilled Uniliner® inlet liner with hole near top (cat.# 21055); pulse: 20psi @ 0.3 min., 40mL/min. @ 0.2 min.

Inj. temp.: 300°C
 Carrier gas: helium, constant flow
 Flow rate: 1.2mL/min.
 Oven temp.: 100°C (hold 0.5 min.) to 320°C @ 4°C/min. (hold 20 min.)

Det.: Agilent 5973 GC/MS
 Scan range: 50-550amu
 Solvent delay: 4.0 min.
 Tune: DFTPP
 Ionization: EI

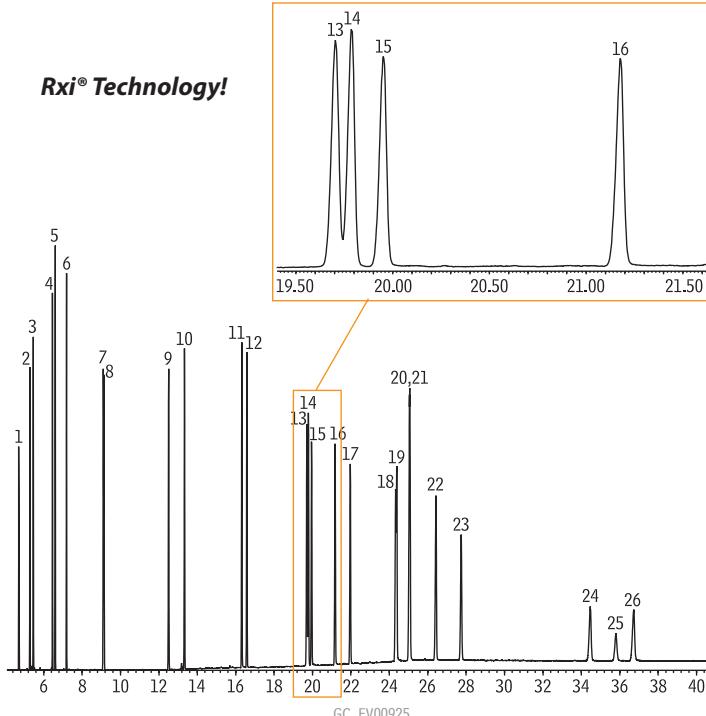
Polycyclic Aromatic Hydrocarbons

Rxi®-17

new!

- benzo(j)fluoranthene resolved

Rxi® Technology!



Peak List	Ret. Time (min.)	Ret. Time (min.)	
1. naphthalene	4.70	14. benzo(k)fluoranthene	19.78
2. 1-methylnaphthalene	5.28	15. benzo(j)fluoranthene	19.95
3. 2-methylnaphthalene	5.46	16. benzo(a)pyrene	21.17
4. acenaphthylene	6.45	17. 3-methylcholanthrene	21.97
5. acenaphthene	6.60	18. dibenz(a,h)acridine	24.33
6. fluorene	7.18	19. dibenz(a,i)acridine	24.39
7. phenanthrene	9.10	20. indeno(1,2,3-cd)pyrene	25.04
8. anthracene	9.14	21. dibenz(a,h)anthracene	25.07
9. fluoranthene	12.50	22. benzo(ghi)perylene	26.43
10. pyrene	13.33	23. 7H-dibenzo(c,g)carbazole	27.75
11. benzo(a)anthracene	16.32	24. dibenz(a,e)pyrene	34.46
12. chrysene	16.58	25. dibenz(a,i)pyrene	35.80
13. benzo(b)fluoranthene	19.70	26. dibenz(a,h)pyrene	36.73

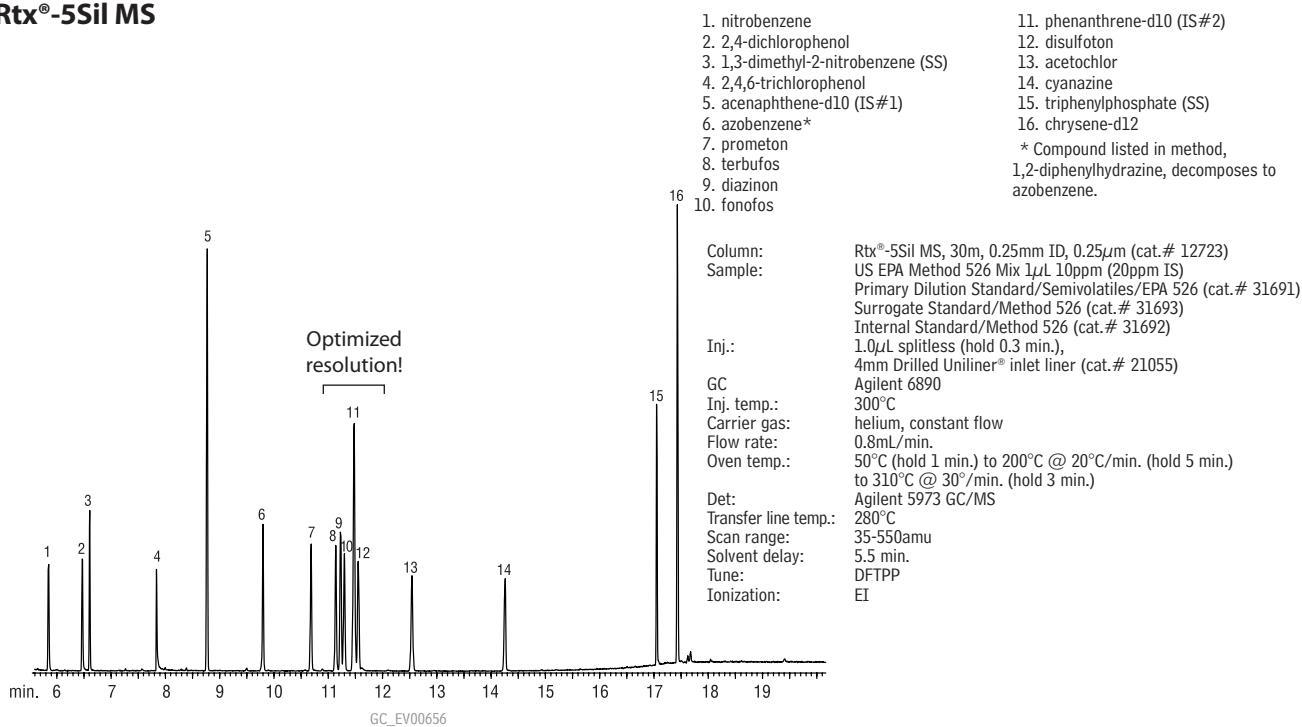
Column: Rxi®-17, 30m, 0.25mm ID, 0.25µm (cat.# 13523)
 Sample: PAH mix, 20µg/mL each component:
 EPA Method 610 Mix (cat.# 31011)
 PAH Supplement Mix (cat.# 31857)
 1-methylnaphthalene (cat.# 31283)
 2-methylnaphthalene (cat.# 31285)

Instrument: 1.0µL pulsed splitless injection (20ng each component on column), 4mm Drilled Uniliner® inlet liner with hole near top (cat.# 21055); pulse: 20psi @ 0.3 min., 40mL/min. @ 0.2 min.

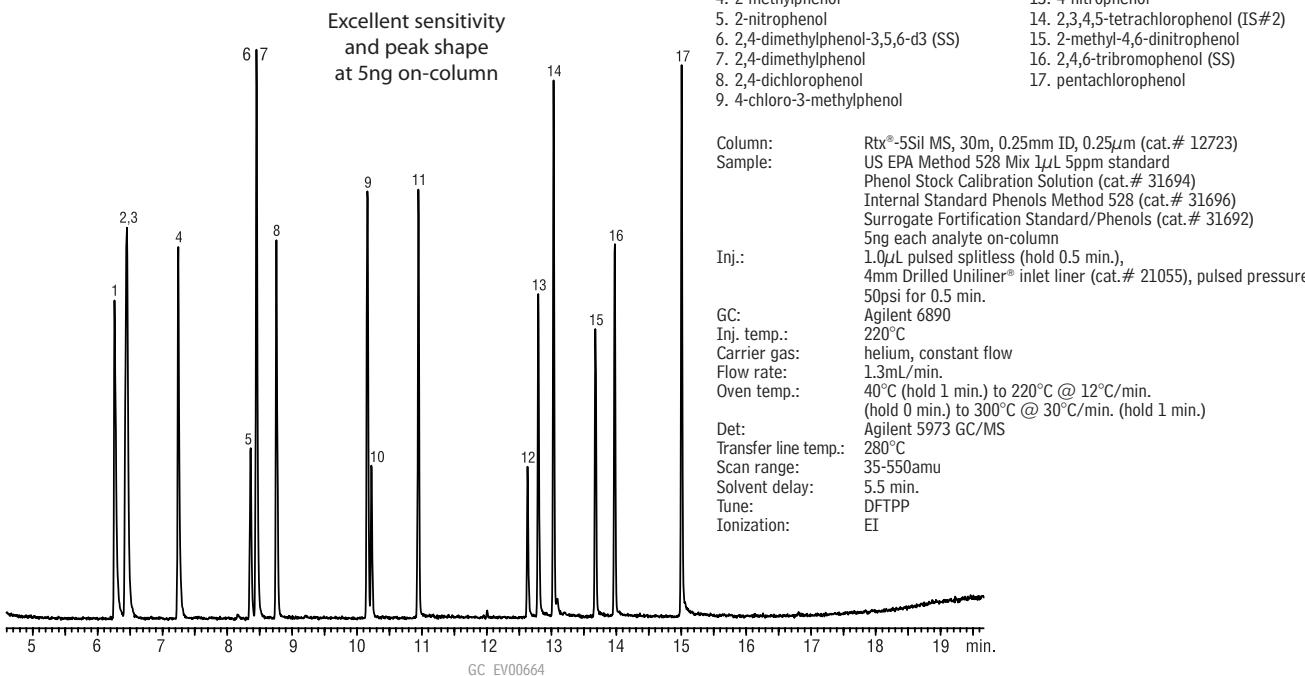
Inj. temp.: 300°C
 Carrier gas: helium, constant flow
 Flow rate: 1.2mL/min.
 Oven temp.: 90°C (hold 1.0 min.) to 215°C @ 25°C/min. (hold 0.5 min.) to 235°C @ 4°C/min., to 280°C @ 15°C/min., to 320°C @ 4°C/min. (hold 20 min.)

Det.: Agilent 5973 GC/MS
 Scan range: 50-550amu
 Solvent delay: 4.0 min.
 Tune: DFTPP
 Ionization: EI

Semivolatile Organics
US EPA Method 526 (Screening)
Rtx®-5Sil MS



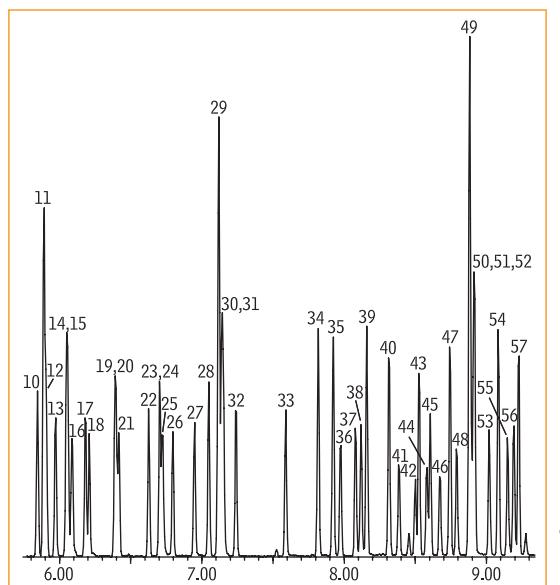
Phenols
US EPA Method 528
Rtx®-5Sil MS



Semivolatiles

Semivolatile Organics US EPA Method 8270 RxI®-5Sil MS

new!



Column: RxI®-5Sil MS, 30m, 0.25mm ID, 0.5 μ m (cat.# 13638)
 Sample: US EPA Method 8270D Mix, 1 μ L of 10 μ g/mL (IS 40 μ g/mL)
 8270 MegaMix® (cat.# 31850)
 Benzoic Acid (cat.# 31879)

8270 Benzidines Mix (cat.# 31852)
 Acid Surrogate Mix (4/89 SOW) (cat.# 31025)
 Revised B/N Surrogate Mix (cat.# 31887)
 1,4-Dioxane (cat.# 31853)

SV Internal Standard Mix (cat.# 31206)
 1.0 μ L (10ng on-column concentration),

4mm Drilled Uniliner® (hole near bottom) inlet liner (cat.# 20756),
 pulsed splitless: pulse 30psi @ 0.3 min., 40mL/min. @ 0.25 min.

Inj. temp.: 250°C

Carrier gas: helium, constant flow

Flow rate: 1.2mL/min.

Oven temp.: 40°C (hold 1.0 min.) to 280°C @ 25°C/min. to 320°C @ 5°C/min. (hold 3.5 min.)

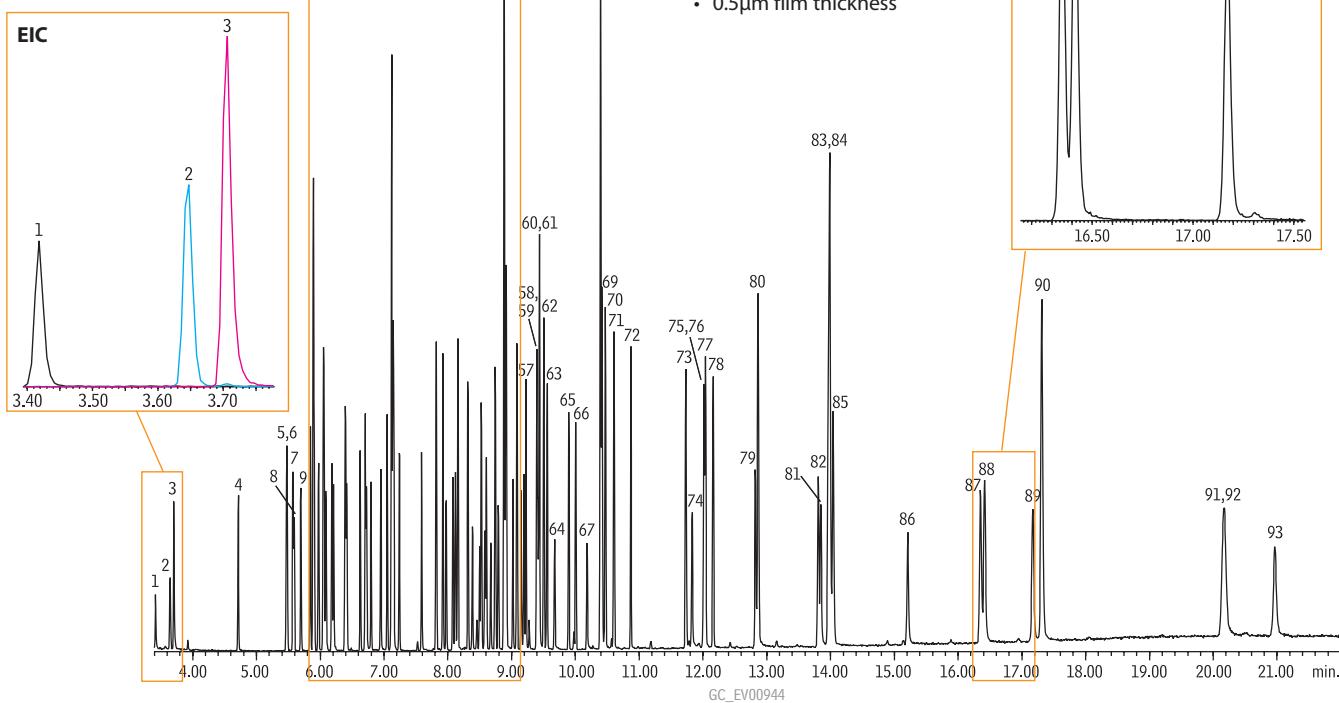
Det.: MS

Transfer line temp.: 280°C

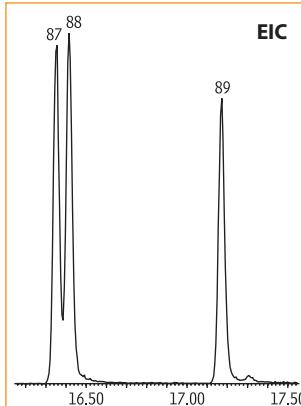
Scan range: 35-550amu

Ionization: EI

Mode: scan



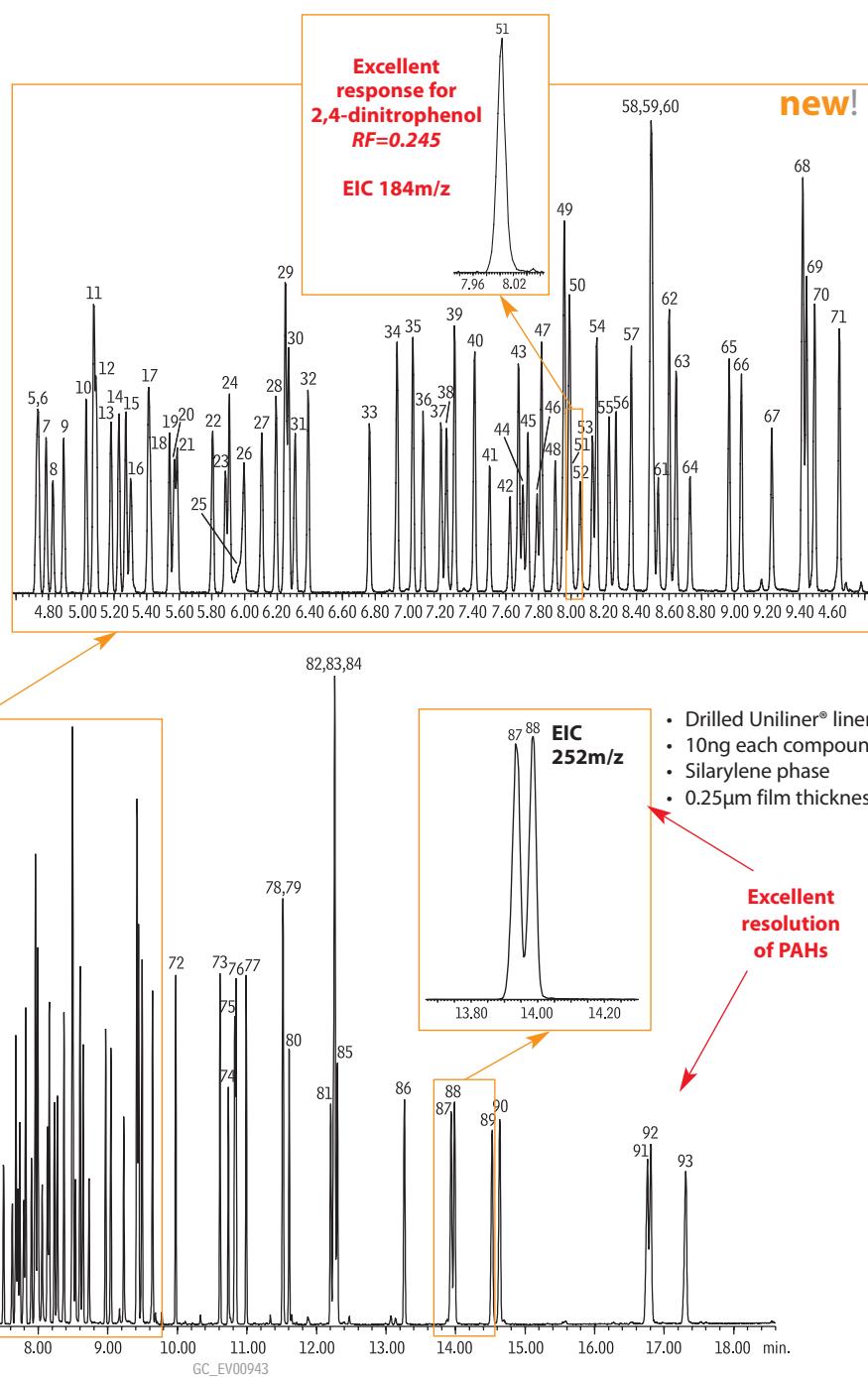
- Drilled Uniliner® liner
- 10ng each compound
- Silarylene phase
- 0.5 μ m film thickness



1. 1,4-dioxane	18. <i>n</i> -nitroso-di- <i>n</i> -propylamine	35. 1-methylnaphthalene	52. 4-nitrophenol	67. pentachlorophenol	84. chrysene-d12 (IS)
2. <i>n</i> -nitrosodimethylamine	19. hexachloroethane	36. hexachlorocyclopentadiene	53. 2,4-dinitrotoluene	68. phenanthrene-d10 (IS)	85. chrysene
3. pyridine	20. nitrobenzene-d5 (SS)	37. 2,4,6-trichlorophenol	54. dibenzofuran	69. phenanthrene	86. di- <i>n</i> -octyl phthalate
4. 2-fluorophenol (SS)	21. nitrobenzene	38. 2,4,5-trichlorophenol	55. 2,3,5,6-tetrachlorophenol	70. anthracene	87. benzo(b)furanthene
5. phenol-d6 (SS)	22. isophorone	39. 2-fluorobiphenyl (SS)	56. 2,3,4,6-tetrachlorophenol	71. carbazole	88. benzo(k)furanthene
6. phenol	23. 2,4-dimethylphenol	40. 2-chloronaphthalene	57. diethyl phthalate	72. di- <i>n</i> -butyl phthalate	89. benzo(a,p)pyrene
7. aniline	24. benzoic acid	41. 2-nitroaniline	58. 4-chlorophenyl phenyl ether	73. fluoranthene	90. perylene-d12 (IS)
8. bis(2-chloroethyl) ether	25. 2-nitrophenol	42. 1,4-dinitrobenzene	59. 4-nitroaniline	74. benzidine	91. dibenz(a,h)anthracene
9. 2-chlorophenol	26. bis(2-chloroethoxy)methane	43. dimethyl phthalate	60. fluorene	75. pyrene-d10 (SS)	92. indeno(1,2,3-cd)pyrene
10. 1,3-dichlorobenzene	27. 2,4-dichlorophenol	44. 1,3-dinitrobenzene	61. 4,6-dinitro-2-methylphenol	76. 3,3'-dimethylbenzidine	93. benzo(ghi)perylene
11. 1,4-dichlorobenzene-d4 (IS)	28. 1,2,4-trichlorobenzene	45. 2,6-dinitrotoluene	62. <i>n</i> -nitrosodiphenylamine	77. pyrene	
12. 1,4-dichlorobenzene	29. naphthalene-d8 (IS)	46. 1,2-dinitrobenzene	63. 1,2-diphenylhydrazine	78. <i>p</i> -terphenyl-d14 (SS)	
13. benzyl alcohol	30. naphthalene	47. acenaphthylene	64. 3-nitroaniline	79. butyl benzyl phthalate	
14. 2-methylphenol	31. 4-chloroaniline	48. 3-nitroaniline	(as azobenzene)	80. bis(2-ethylhexyl) adipate	
15. 1,2-dichlorobenzene	32. hexachlorobutadiene	49. acenaphthene-d10 (IS)	64. 2,4,6-tribromophenol (SS)	81. bis(2-ethylhexyl) phthalate	
16. bis(2-chloroisopropyl) ether	33. 4-chloro-3-methylphenol	50. 2,4-dinitrophenol	65. 4-bromophenyl phenyl ether	82. 3,3'-dichlorobenzidine	
17. 4-methylphenol/3-methylphenol	34. 2-methylnaphthalene	51. acenaphthene	66. hexachlorobenzene	83. benzo(a)anthracene	

Semivolatile Organics**US EPA Method 8270****Rxi®-5Sil MS**

Column: Rxi®-5Sil MS, 30m, 0.25mm ID, 0.25 μ m (cat.# 13623)
 Sample: US EPA Method 8270D Mix, 1 μ L of 10 μ g/mL (IS 40 μ g/mL)
 8270 MegaMix® (cat.# 31850)
 Benzoic Acid (cat.# 31879)
 8270 Benzidines Mix (cat.# 31852)
 Acid Surrogate Mix (4/89 SOW) (cat.# 31025)
 Revised B/N Surrogate Mix (cat.# 31887)
 1,4-Dioxane (cat.# 31853)
 SV Internal Standard Mix (cat.# 31206)
 Inj.: 1.0 μ L (10ng on-column concentration), 4mm Drilled Uniliner® (hole near bottom) inlet liner (cat.# 20756), pulsed splitless: pulse 25psi @ 0.2 min., 60mL/min. @ 0.15 min.
 Inj. temp.: 250°C
 Carrier gas: helium, constant flow 1.2mL/min.
 Flow rate: 40°C (hold 1.0 min.) to 280°C @ 25°C/min. to 320°C @ 5°C/min. (hold 1 min.)
 Det.: MS
 Transfer line temp: 280°C
 Scan range: 35-550amu
 Ionization: EI
 Mode: scan

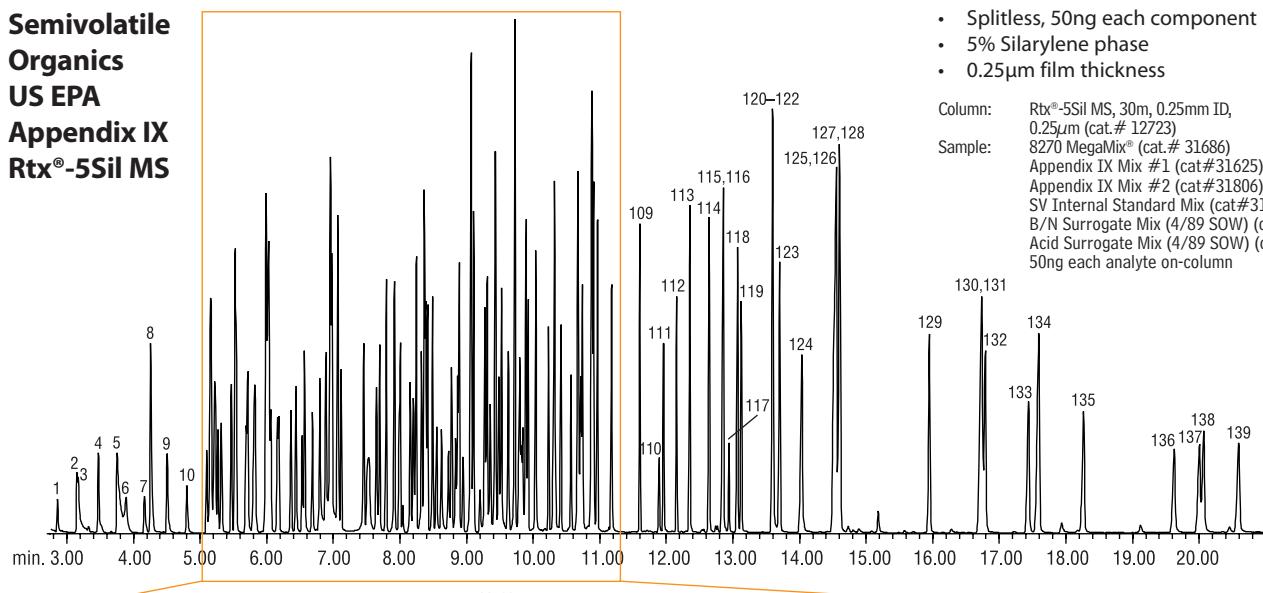


1. 1,4-dioxane	17. 4-methylphenol-3-methylphenol	34. 2-methylnaphthalene	51. 2,4-dinitrophenol	66. hexachlorobenzene	83. bis(2-ethylhexyl) phthalate
2. <i>n</i> -nitrosodimethylamine	18. <i>n</i> -nitroso-di- <i>n</i> -propylamine	35. 1-methylnaphthalene	52. 4-nitrophenol	67. pentachlorophenol	84. chrysene-d12 (IS)
3. pyridine	19. hexachloroethane	36. hexachlorocyclopentadiene	53. 2,4-dinitrotoluene	68. phenanthrene-d10 (IS)	85. chrysene
c. toluene	20. nitrobenzene-d5 (SS)	37. 2,4,6-trichlorophenol	54. dibenzofuran	69. phenanthrene	86. di- <i>n</i> -octyl phthalate
4. 2-fluorophenol (SS)	21. nitrobenzene	38. 2,4,5-trichlorophenol	55. 2,3,5,6-tetrachlorophenol	70. anthracene	87. benzo(b)fluoranthene
5. phenol-d6 (SS)	22. isophorone	39. 2-fluorobiphenyl (SS)	56. 2,3,4,6-tetrachlorophenol	71. carbazole	88. benzo(k)fluoranthene
6. phenol	23. 2-nitrophenol	40. 2-chloronaphthalene	57. diethyl phthalate	72. di- <i>n</i> -butyl phthalate	89. benzo(a)pyrene
7. aniline	24. 2,4-dimethylphenol	41. 2-nitroaniline	59. fluorene	73. fluoranthene	90. perylene-d12 (IS)
8. bis(2-chloroethyl) ether	25. benzoic acid	42. 1,4-dinitrobenzene	74. benzidine	74. benzidine	91. dibenzo(a,h)anthracene
9. 2-chlorophenol	26. bis(2-chloroethoxy)methane	43. dimethyl phthalate	60. 4-nitroaniline	75. pyrene-d10 (SS)	92. indeno(1,2,3-cd)pyrene
10. 1,3-dichlorobenzene	27. 2,4-dichlorophenol	44. 1,3-dinitrobenzene	61. 4,6-dinitro-2-methylphenol	76. pyrene	93. benzo(g)h)perylene
11. 1,4-dichlorobenzene	28. 1,2,4-trichlorobenzene	45. 2,6-dinitrotoluene	62. <i>n</i> -nitrosodiphenylamine	77. <i>p</i> -terphenyl-d14 (SS)	
12. 1,4-dichlorobenzene	29. naphthalene-d8 (IS)	46. 1,2-dinitrobenzene	(diphenylamine)	78. 3,3'-dimethylbenzidine	
13. benzyl alcohol	30. naphthalene	47. acenaphthylene	63. 1,2-diphenylhydrazine (as azobenzene)	79. butyl benzyl phthalate	
14. 1,2-dichlorobenzene	31. 4-chloroaniline	48. 3-nitroaniline	64. 2,4,6-tribromophenol (SS)	80. bis(2-ethylhexyl) adipate	
15. 2-methylphenol	32. hexachlorobutadiene	49. acenaphthene-d10 (IS)	65. 4-bromophenyl phenyl ether	81. 3,3'-dichlorobenzidine	
16. bis(2-chloroisopropyl) ether	33. 4-chloro-3-methylphenol	50. acenaphthene	82. benzo(a)anthracene		

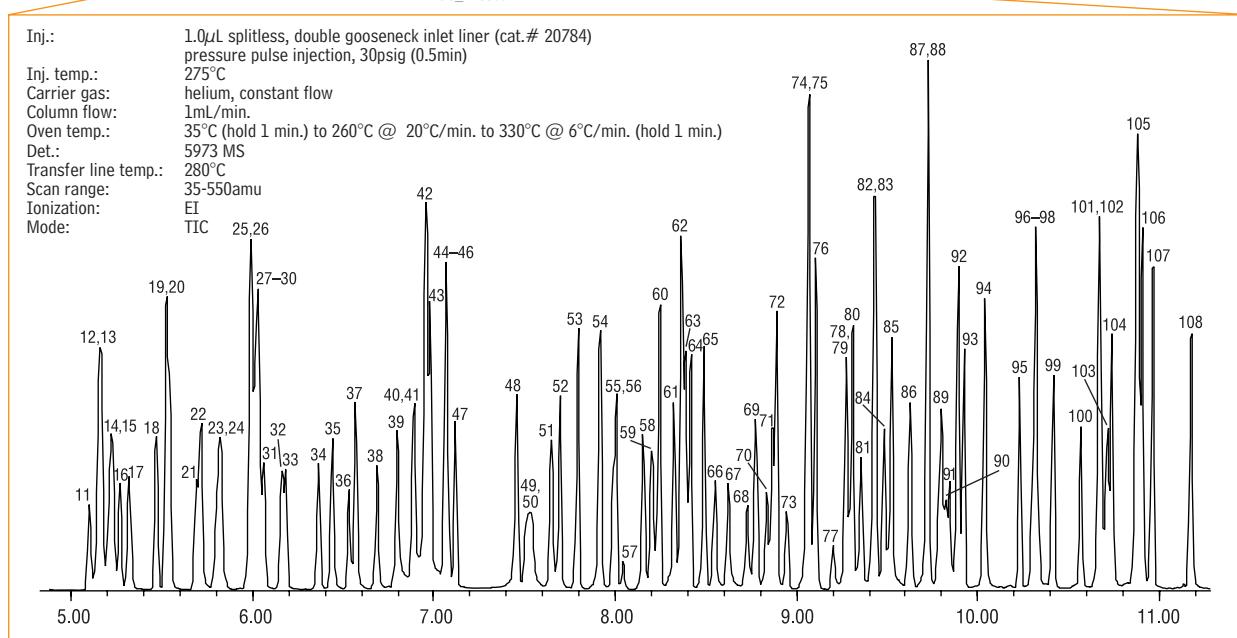
c = contaminant

Semivolatiles

**Semivolatile
Organics
US EPA
Appendix IX
Rtx®-5Sil MS**



- Splitless, 50ng each component
 - 5% Silarylene phase
 - 0.25µm film thickness
- Column: Rtx®-5Sil MS, 30m, 0.25mm ID, 0.25µm (cat.# 12723)
- Sample: 8270 MegaMix® (cat.# 31686)
Appendix IX Mix #1 (cat.#31625)
Appendix IX Mix #2 (cat.#31806)
SV Internal Standard Mix (cat.#31206)
B/N Surrogate Mix (4/89 SOW) (cat.#31062)
Acid Surrogate Mix (4/89 SOW) (cat.#31063)
50ng each analyte on-column

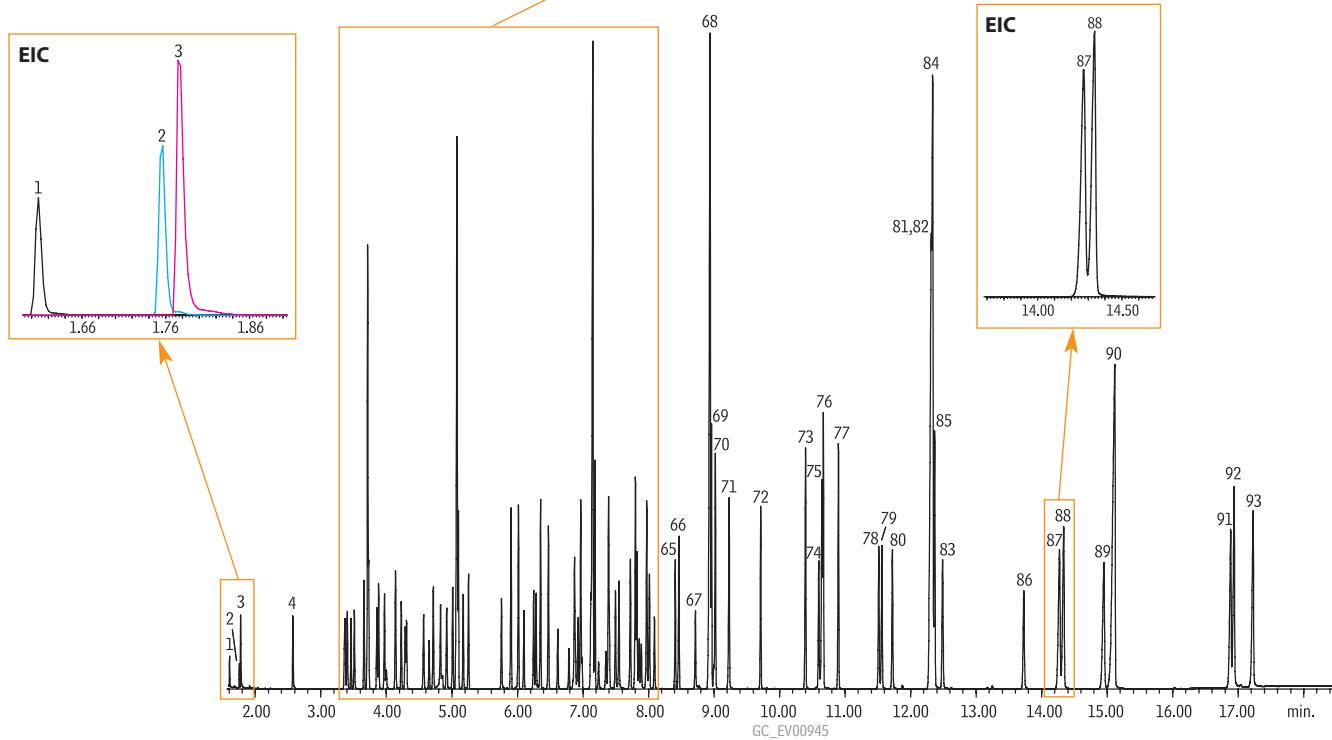
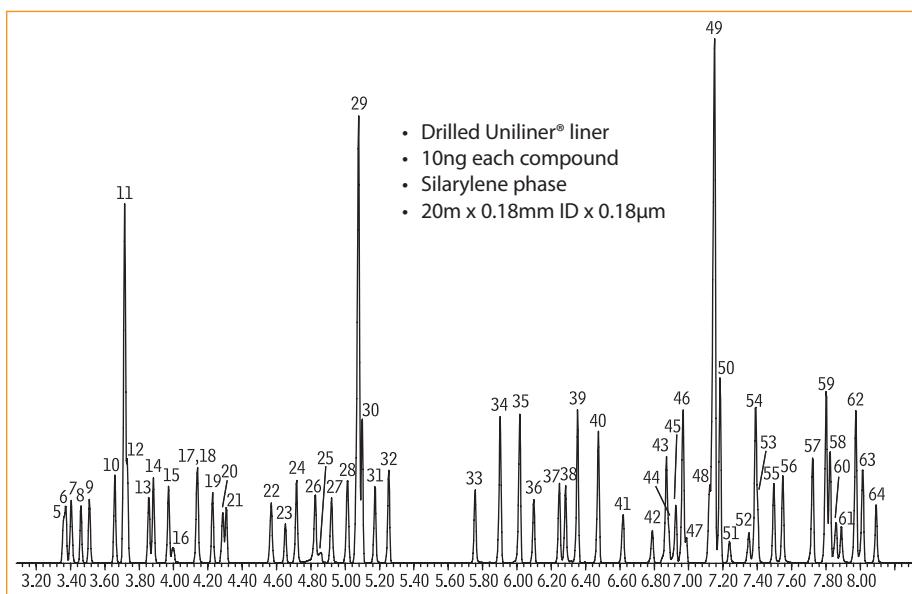


1. 1,4-dioxane	24. bis(2-chloroisopropyl)ether	47. hexachlorobutadiene	71. 2,6-dinitrotoluene	95. diallate	119. dichlorobenzilate
2. pyridine	25. acetophenone	48. N-nitroso- <i>n</i> -butylamine	72. acenaphthylene	96. 1,3,5-trinitrobenzene	120. 3,3-dimethylbenzidine
3. N-nitrosodimethylamine	26a. 4-methylphenol	49. 1,4-phenylenediamine	73. 1,2-dinitrobenzene	97. phenacetin	121. benzyl butyl phthalate
4. ethyl methacrylate	26b. 3-methylphenol	50. caprolactam	74. 3-nitroaniline	98. 4-bromophenyl phenyl ether	122. Kepone
5. 2-picoline	27. N-nitroso- <i>d</i> - <i>n</i> -propylamine	51. 4-chloro-3-methylphenol	75. acenaphthene-d10 (IS)	99. hexachlorobenzene	123. bis(2-ethylhexyl)adipate
6. N-nitrosomethylethylamine	28. nitrosopyrrolidine	52. isosafrole	76. acenaphthene	100. atrazine	124. 2-acetylaminofluorene
7. methyl methanesulfonate	29. <i>o</i> -toluidine	53. 2-methylnaphthalene	77. 2,4-dinitrophenol	101. 4-methobiphenyl	125. benz(a)anthracene
8. 2-fluorophenol	30. 4-nitrosomorpholine	54. 1-methylnaphthalene	78. pentachlorobenzene	102. pentachlorophenol	126. chrysene-d12 (IS)
9. N-nitrosodiethylamine	31. hexachloroethane	55. hexachlorocyclopentadiene	79. 4-nitrophenol	103. pentachloronitrobenzene	127. chrysene
10. ethyl methanesulfonate	32. nitrobenzene-d5 (SS)	56. 1,2,4,5-tetrachlorobenzene	80. dibenzofuran	104. propyzamide	128. bis(2-ethylhexyl)phthalate
11. benzaldehyde	33. nitrobenzene	57. isosafrole	81. 2,4-dinitrotoluene	105. phenanthrene-d10 (IS)	129. di- <i>n</i> -octyl phthalate
12. phenol-d6 (SS)	34. N-nitrosopiperidine	58. 2,4,6-trichlorophenol	82. 1-naphthalamine	106. phenanthrene	130. benzo(b)fluoranthene
13. phenol	35. isophorone	59. 2,4,5-trichlorophenol	83. 2,3,4,6-tetrachlorophenol	107. anthracene	131. 7,12-dimethyl-
14. aniline	36. 2-nitrophenol	60. 2-fluorobiphenyl (SS)	84. 2,3,5,6-tetrachlorophenol	108. carbazole	benzo(a)anthracene
15. pentachloroethane	37. 2,4-dimethylphenol	61. safrole	85. 2-naphthylamine	109. di- <i>n</i> -butylphthalate	132. benzo(k)fluoranthene
16. bis(2-chloroethyl)ether	38. bis(2-chloroethoxy)methane	62. biphenyl	86. diethyl phthalate	110. 4-nitroquinoline-1-oxide	133. benzo(a)pyrene
17. 2-chlorophenol	39. 2,4-dichlorophenol	63. 2-chloronaphthalene	87. fluorene	111. methapyrilene	134. perylene-d12 (IS)
18. 1,3-dichlorobenzene	40. 1,2,4-trichlorobenzene	64. 1-chloronaphthalene	88. 4-chlorophenyl phenyl ether	112. isodrin	135. 3-methylcholanthrene
19. 1,4-dichlorobenzene-d4 (IS)	41. α , ω -dimethylphenylamine	65. diphenyl ether	89. 2-methyl-5-nitroaniline	113. fluoranthene	136. dibenzo(a,j)acridine
20. 1,4-dichlorobenzene	42. naphthalene-d8 (IS)	66. 2-nitroaniline	90. 4-nitroaniline	114. pyrene	137. indeno(1,2,3-cd)pyrene
21. benzyl alcohol	43. naphthalene	67. 1,4-naphthoquinone	91. 4,6-dinitro-2-methylphenol	115. Aramite (isomer)	138. dibenzo(a,h)anthracene
22. 1,2-dichlorobenzene	44. 2,6-dichlorophenol	68. 1,4-dinitrobenzene	92. diphenylamine	116. <i>p</i> -terphenyl-d14 (SS)	139. benzo(ghi)perylene
23. 2-methylphenol	45. 4-chloroaniline	69. dimethylphthalate	93. azobenzene	117. Aramite (isomer)	
	46. hexachloropropene	70. 1,3-dinitrobenzene	94. 2,4,6-tribromophenol (SS)	118. dimethylaminoazobenzene	

new!

Semivolatile Organics**US EPA Method 8270****Rxi®-5Sil MS**

Column: Rxi®-5Sil MS, 20m, 0.18mm ID, 0.18 μ m (cat.# 43602)
 Sample: US EPA Method 8270D Mix, 1 μ L of 10 μ g/mL (IS 40 μ g/mL) 8270 MegaMix® (cat.# 31850)
 Benzoic Acid (cat.# 31879)
 8270 Benzidines Mix (cat.# 31852)
 Acid Surrogate Mix (4/89 SOW) (cat.# 31025)
 Revised B/N Surrogate Mix (cat.# 31887)
 1,4-Dioxane (cat.# 31853)
 SV Internal Standard Mix (cat.# 31206)
 Inj.: 1.0 μ L (10ng on-column concentration), 4mm Drilled Uniliner® (hole near bottom) inlet liner (cat.# 20756), pulsed splitless: pulse 20psi @ 0.2 min., 60mL/min. @ 0.15 min.
 Inj. temp.: 250°C
 Carrier gas: helium, constant flow 1.0mL/min.
 Flow rate: 50°C (hold 0.5 min.) to 260°C @ 20°C/min. to 280°C @ 5°C/min. to 330°C @ 20°C/min. (hold 1.0 min.)
 Oven temp.: Det.: MS
 Transfer line temp: 280°C
 Scan range: 35-550amu
 Ionization: EI scan

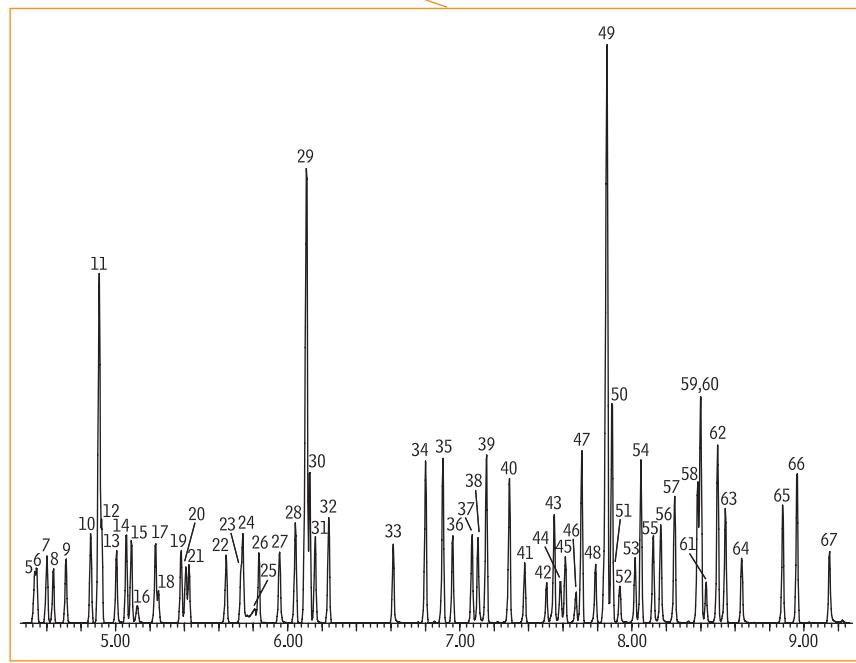
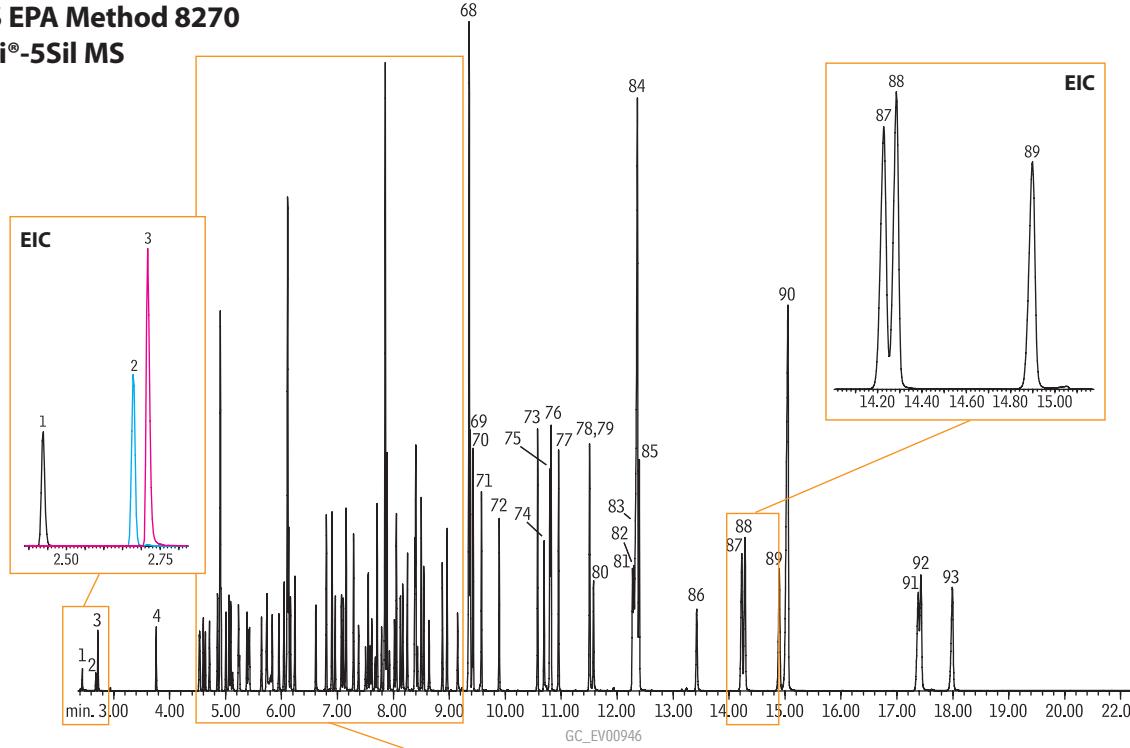


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|-----------------------------------|--------------------------------|-------------------------------|---------------------------------|-------------------------------|---------------------------------|
| 1. 1,4-dioxane | 18. n-nitroso-di-n-propylamine | 35. 1-methylnaphthalene | 52. 4-nitrophenol | 67. pentachlorophenol | 84. chrysene |
| 2. n-nitrosodimethylamine | 19. hexachloroethane | 36. hexachlorocyclopentadiene | 53. dibenzofuran | 68. phenanthrene-d10 (IS) | 85. bis(2-ethylhexyl) phthalate |
| 3. pyridine | 20. nitrobenzene-d5 (SS) | 37. 2,4,6-trichlorophenol | 54. 2,4-dinitrotoluene | 69. phenanthrene | 86. di-n-octyl phthalate |
| 4. 2-fluorophenol (SS) | 21. nitrobenzene | 38. 2,4,5-trichlorophenol | 55. 2,3,5,6-tetrachlorophenol | 70. anthracene | 87. benzo(b)fluoranthene |
| 5. phenol-d6 (SS) | 22. isophorone | 39. 2-fluorobiphenyl (SS) | 56. 2,3,4,6-tetrachlorophenol | 71. carbazole | 88. benzo(k)fluoranthene |
| 6. phenol | 23. 2-nitrophenol | 40. 2-chloronaphthalene | 57. diethyl phthalate | 72. di-n-butyl phthalate | 89. benzo(a)pyrene |
| 7. aniline | 24. 2,4-dimethylphenol | 41. 2-nitroaniline | 58. fluorene | 73. fluoranthene | 90. perylene-d12 (IS) |
| 8. bis(2-chloroethyl) ether | 25. bis(2-chloroethoxy)methane | 42. 1,4-dinitrobenzene | 59. 4-chlorophenyl phenyl ether | 74. benzidine | 91. dibenz(a,h)anthracene |
| 9. 2-chlorophenol | 26. benzoic acid | 43. dimethyl phthalate | 60. 4-nitroaniline | 75. pyrene-d10 (SS) | 92. indeno(1,2,3-cd)perylene |
| 10. 1,3-dichlorobenzene | 27. 2,4-dichlorophenol | 44. 1,3-dinitrobenzene | 61. 4,6-dinitro-2-methylphenol | 76. pyrene | 93. benzo(ghi)perylene |
| 11. 1,4-dichlorobenzene-d4 (IS) | 28. 1,2,4-trichlorobenzene | 45. 2,6-dinitrotoluene | 62. n-nitrosodiphenylamine | 77. p-terphenyl-d14 (SS) | |
| 12. 1,4-dichlorobenzene | 29. naphthalene-d8 (IS) | 46. 1,2-dinitrobenzene | 63. 1,2-diphenylhydrazine | 78. 3,3'-dimethylbenzidine | |
| 13. benzyl alcohol | 30. naphthalene | 47. acenaphthylene | 64. 2,4,6-tribromophenol (SS) | 79. butyl benzyl phthalate | |
| 14. 1,2-dichlorobenzene | 31. 4-chloroaniline | 48. 3-nitroaniline | 65. 4-bromophenyl phenyl ether | 80. bis(2-ethylhexyl) adipate | |
| 15. 2-methylphenol | 32. hexachlorobutadiene | 49. acenaphthene-d10 (IS) | 66. hexachlorobenzene | 81. benzo(a)anthracene | |
| 16. bis(2-chloroisopropyl) ether | 33. 4-chloro-3-methylphenol | 50. acenaphthene | 83. chrysene-d12 (IS) | 82. 3,3'-dichlorobenzidine | |
| 17. 4-methylphenol/3-methylphenol | 34. 2-methylnaphthalene | 51. 2,4-dinitrophenol | | 84. chrysene | |

Semivolatiles

Semivolatile Organics US EPA Method 8270 Rxi®-5Sil MS

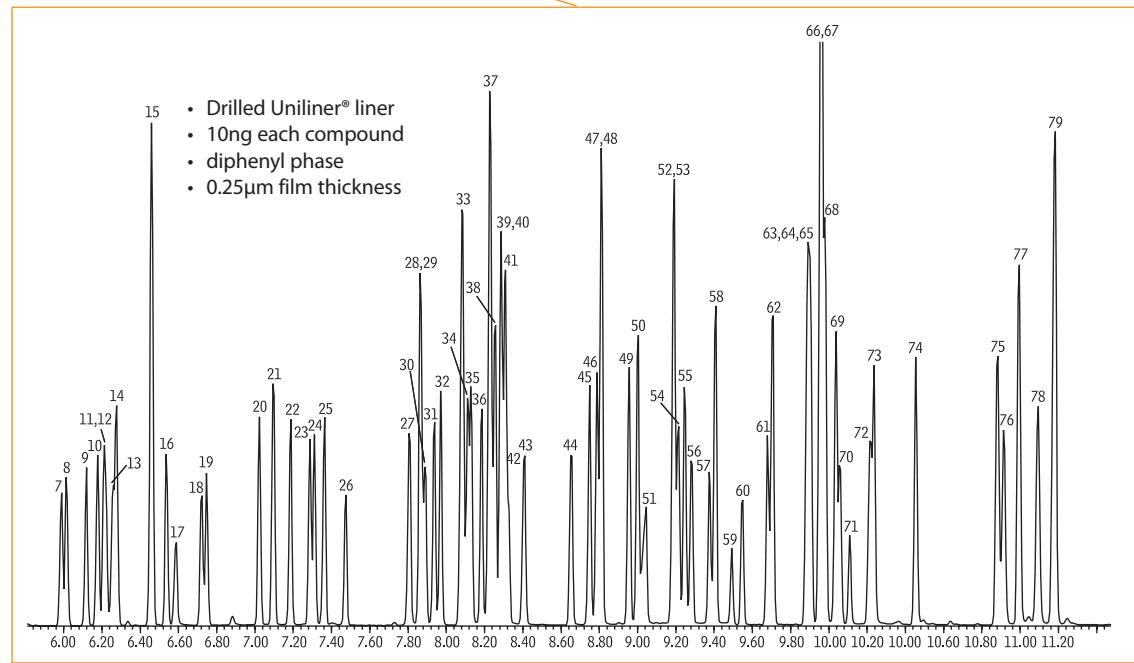
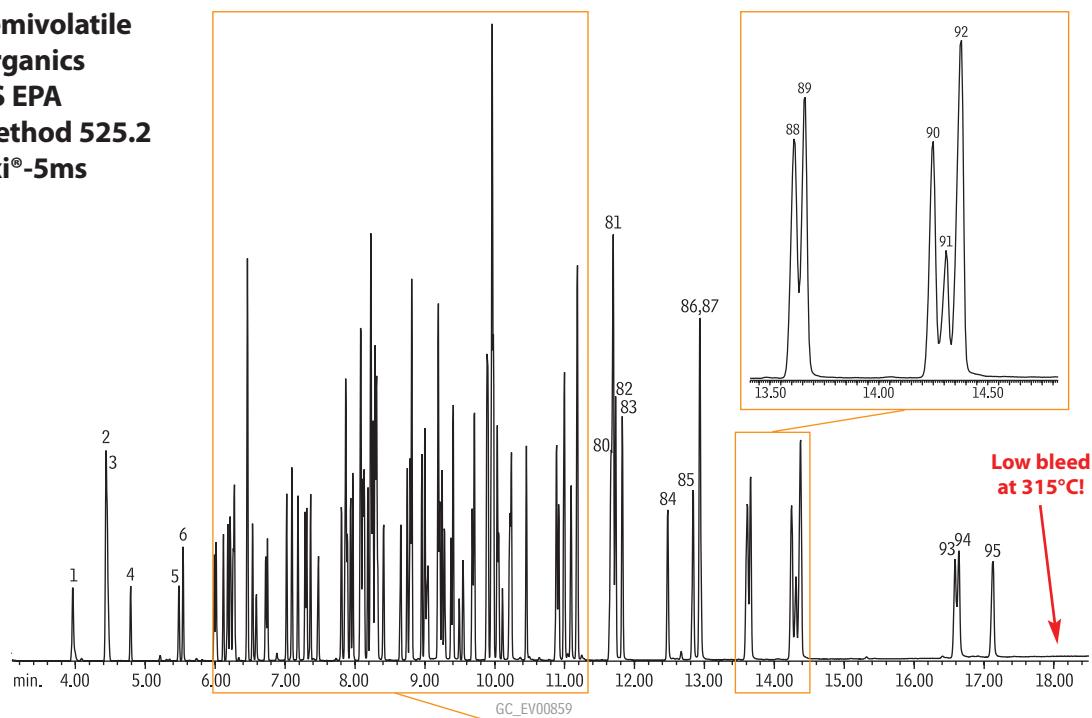
new!



Column: Rxi®-5Sil MS, 20m, 0.18mm ID, 0.36 μ m (cat.# 43604)
 Sample: US EPA Method 8270D Mix, 1 μ L of 10 μ g/mL (IS 40 μ g/mL)
 8270 MegaMix® (cat.# 31850)
 Benzoic Acid (cat.# 31879)
 8270 Benzidines Mix (cat.# 31852)
 Acid Surrogate Mix (4/89 SOW) (cat.# 31025)
 Revised B/N Surrogate Mix (cat.# 31887)
 1,4-Dioxane (cat.# 31853)
 SV Internal Standard Mix (cat.# 31206)
 1.0 μ L (10ng on-column concentration), 4mm Drilled Uniliner® (hole near bottom) inlet liner (cat.# 20756), pulsed splitless: pulse 20psi @ 0.2 min., 60mL/min. @ 0.15 min.
 Inj. temp.: 250°C
 Carrier gas: helium, constant flow
 Flow rate: 1.2mL/min.
 Oven temp.: 40°C (hold 1.0 min.) to 280°C @ 25°C/min. to 330°C @ 5°C/min.
 Det.: MS
 Transfer line temp.: 280°C
 Scan range: 35-550amu
 Ionization: EI
 Mode: scan

1. 1,4-dioxane	18. <i>n</i> -nitroso-di- <i>n</i> -propylamine	35. 1-methylnaphthalene	52. 4-nitrophenol	67. pentachlorophenol	84. chrysene-d12 (IS)
2. <i>n</i> -nitrosodimethylamine	19. hexachloroethane	36. hexachlorocyclopentadiene	53. 2,4-dinitrotoluene	68. phenanthrene-d10 (IS)	85. chrysene
3. pyridine	20. nitrobenzene-d5 (SS)	37. 2,4,6-trichlorophenol	54. dibenzofuran	69. phenanthrene	86. di- <i>n</i> -octyl phthalate
4. 2-fluorophenol (SS)	21. nitrobenzene	38. 2,4,5-trichlorophenol	55. 2,3,5,6-tetrachlorophenol	70. anthracene	87. benzo(b)fluoranthene
5. phenol-d6 (SS)	22. isophorone	39. 2-fluorobiphenyl (SS)	56. 2,3,4,6-tetrachlorophenol	71. carbazole	88. benzo(k)fluoranthene
6. phenol	23. 2-nitrophenol	40. 2-chloronaphthalene	57. diethyl phthalate	72. di- <i>n</i> -butyl phthalate	89. benzo(a)pyrene
7. aniline	24. 2,4-dimethylphenol	41. 2-nitroaniline	58. fluorene	73. fluoranthene	90. perylene-d12 (IS)
8. bis(2-chloroethyl) ether	25. benzoic acid	42. 1,4-dinitrobenzene	59. 4-chlorophenyl phenyl ether	74. benzidine	91. dibenz(a,h)anthracene
9. 2-chlorophenol	26. bis(2-chloroethoxy)methane	43. dimethyl phthalate	60. 4-nitroaniline	75. pyrene-d10 (SS)	92. indeno(1,2,3-cd)pyrene
10. 1,3-dichlorobenzene	27. 2,4-dichlorophenol	44. 1,3-dinitrobenzene	61. 4,6-dinitro-2-methylphenol	76. pyrene	93. benzo(ghi)perylene
11. 1,4-dichlorobenzene-d4 (IS)	28. 1,2,4-trichlorobenzene	45. 2,6-dinitrotoluene	62. <i>n</i> -nitrosodiphenylamine (diphenylamine)	77. <i>p</i> -terphenyl-d14 (SS)	
12. 1,4-dichlorobenzene	29. naphthalene-d8 (IS)	46. 1,2-dinitrobenzene	63. 1,2-diphenylhydrazine (as azobenzene)	78. butyl benzyl phthalate	
13. benzyl alcohol	30. naphthalene	47. acenaphthylene	64. 2,4,6-tri bromophenol (SS)	79. 3,3-dimethylbenzidine	
14. 2-methylphenol	31. 4-chloroaniline	48. 3-nitroaniline	65. 4-bromophenyl phenyl ether	80. bis(2-ethylhexyl) adipate	
15. 1,2-dichlorobenzene	32. hexachlorobutadiene	49. acenaphthene-d10 (IS)	66. hexachlorobenzene	81. 3,3'-dichlorobenzidine	
16. bis(2-chloroisopropyl) ether	33. 4-chloro-3-methylphenol	50. acenaphthene		82. bis(2-ethylhexyl) phthalate	
17. 4-methylphenol-3-methylphenol	34. 2-methylnaphthalene	51. 2,4-dinitrophenol		83. benzo(a)anthracene	

**Semivolatile
Organics
US EPA
Method 525.2
Rxi®-5ms**



Column: Rxi®-5ms, 30m, 0.25mm ID, 0.25µm (cat.# 13423)
 Sample: US EPA Method 525.2 mix, 10µg/ml each analyte,
 25µg/ml each internal standard and surrogate:
 Method 525.2 Semivolatile Mix (cat.# 31899), Organonitrogen Pesticide Mix #1 (cat.# 33012),
 Organonitrogen Pesticide Mix #2 (cat.# 33011), Organophosphate Pesticide Mix #1 (cat.# 33013),
 Nitrogen/Phosphorous Pesticide Mix #2 (cat.# 32423), Method 525.2 Internal Standard Mix (cat.# 31825),
 Method 525.2 Surrogate Standard Mix (cat.# 31826)

Instrument: Agilent 6890
 Inj.: 1.0µL, pulsed splitless injection: 50psi (0.3 min.), 80mL/min. (0.15 min.), gas saver 15mL/min. (1 min.),
 4mm Drilled Uniliner® inlet liner, hole near bottom (cat.# 20771)

Inj. temp.: 250°C
 Carrier gas: helium, constant flow
 Flow rate: 1.2mL/min.
 Oven temp.: 90°C (1 min.) to 270°C @ 20°C/min., to 315°C @ 6°C/min.
 Det.: Agilent 5973 MSD
 Interface line temp.: 280°C
 Scan range: 35-550amu
 Solvent delay: 3.00 min.
 Tune: DFTPP
 Ionization: EI

1. isophorone
2. 2-nitro-m-xylene (SS)
3. naphthalene
4. dichlorvos (DDVP)
5. hexachlorocyclopentadiene
6. EPTC
7. mevinphos
8. butylate
9. vornolate
10. dimethyl phthalate
11. pebulate
12. etridiazole (Terrazole®)
13. 2,6-dinitrotoluene
14. acenaphthylene
15. acenaphthene-d10 (IS)
16. chlorneb
17. tebuturon
18. 2,4-dinitrotoluene
19. molinate
20. diethyl phthalate
21. fluorene
22. propachlor
23. ethoprop (ethoprophos)
24. cyclotane
25. chlorpropham
26. trifluralin
27. atraton
28. hexachlorobenzene
29. prometon
30. simazine
31. atrazine
32. propazine
33. pentachlorophenol
34. terbufos
35. pronamide (propyzamide)
36. diazinon
37. phenanthrene-d10 (IS)
38. phenanthrene
39. disulfoton
40. methyl paraoxon
41. anthracene
42. terbacil
43. chlorothalonil
44. metribuzin
45. simetryn
46. ametryn
47. alachlor
48. prometryn
49. terbutryn
50. di-n-butyl phthalate
51. bromacil
52. cyanazine (Bladex)
53. metolochlor
54. chlorpyrifos (Dursban®)
55. triadimenol
56. Dacthal® (DCPA)
57. MGK-264 (isomer A)
58. diphenamid
59. MGK-264 (isomer B)
60. merphos
61. heptachlor epoxide
62. fluoranthene
63. stirofos
64. disulfoton sulfone
65. butachlor
66. pyrene-d10 (SS)
67. fenamiphos
68. pyrene
69. napropamide (Devrinol®)
70. trans-nonachlor
71. merphos oxide
72. tricyclazole (Beam)
73. carboxin
74. chlorbenzilate
75. benzyl butyl phthalate
76. norflurazon
77. bis(2-ethylhexyl) adipate
78. hexazinone (Velpar®)
79. triphenylphosphate (SS)
80. benzo(a)anthracene
81. chrysene-d12 (IS)
82. chrysene
83. bis(2-ethylhexyl) phthalate
84. fenarimol
85. cis-permethrin
86. trans-permethrin
87. di-n-octyl phthalate
88. benzo(b)fluoranthene
89. benzo(k)fluoranthene
90. benzo(a)pyrene
91. fluridone (Sonar®)
92. perylene-d12 (SS)
93. indeno(1,2,3-cd)pyrene
94. dibenzo(a,h)anthracene
95. benzo(g,h)perylene

Semivolatiles

Semivolatile Organics

US EPA Method 8270D by GC/MS

Rtx®-XLB

Column: Rtx®-XLB, 20m, 0.18mm ID, 0.18 μ m (cat.# 42802)

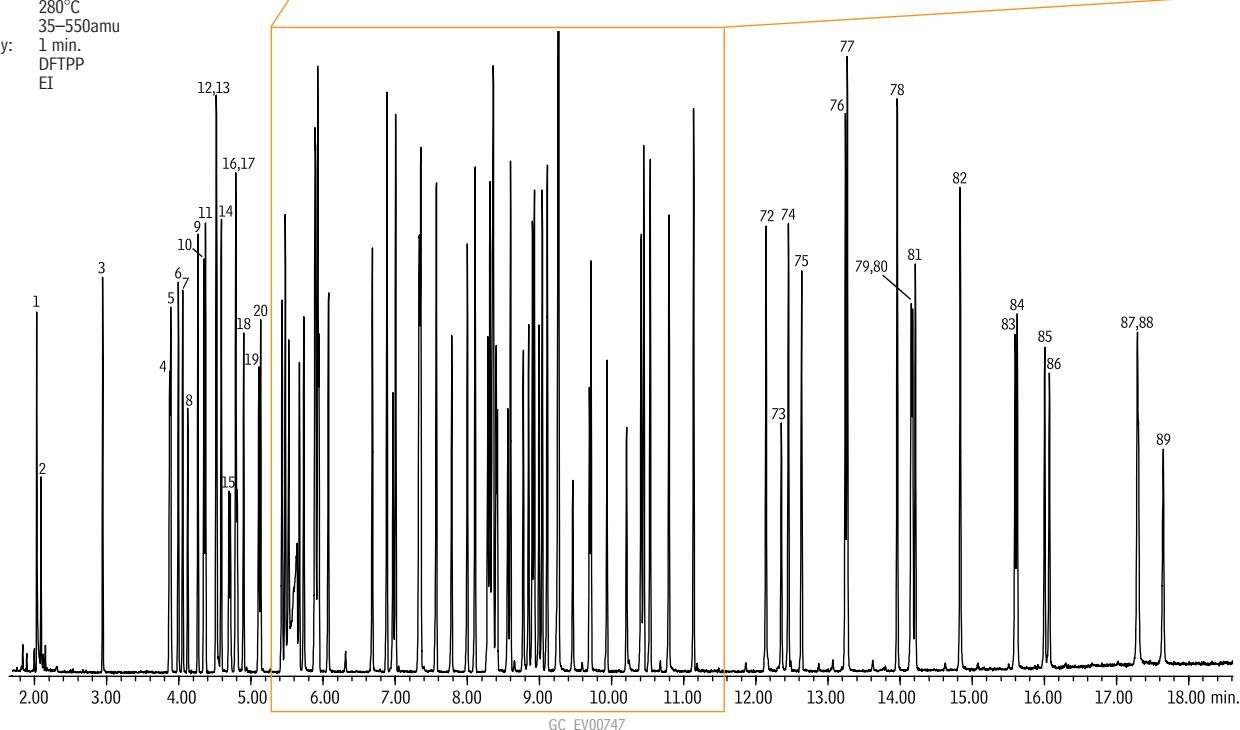
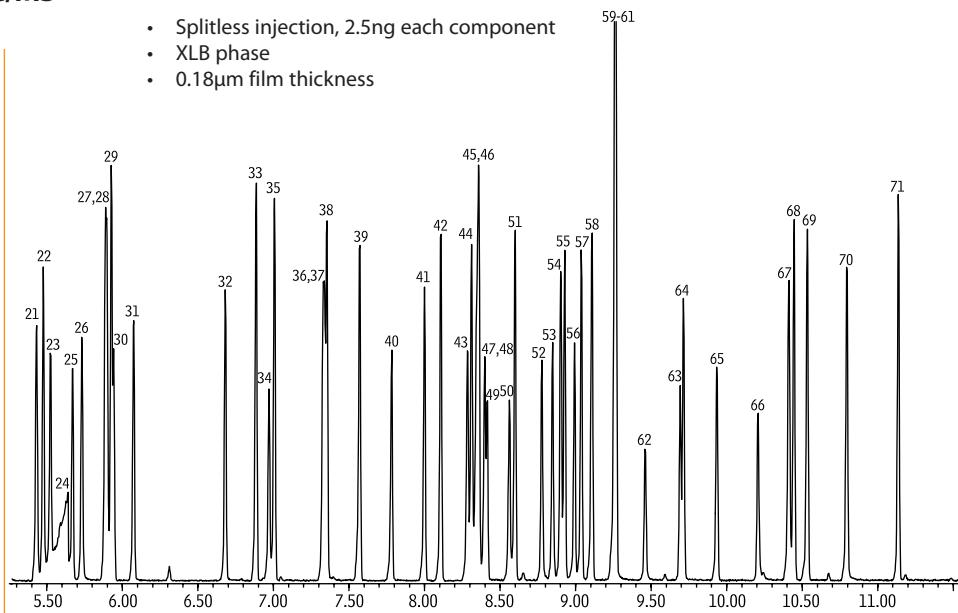
Sample: US EPA Method 8270D mix: 8270 MegaMix® (cat.# 31850), benzoic acid (cat.# 31415), benzidine (cat.# 31441), 2,4-dinitrophenol (cat.# 31291), Acid Surrogate Mix (4/89 SOW) (cat.# 31063), B/N Surrogate Mix (4/89 SOW) (cat.# 31062)

Inj.: 0.5 μ L, 5ppm each analyte (2.5ng on column) (2.5ppm/1.25ng on column for 3-methylphenol and 4-methylphenol)
2mm splitless cyclo double gooseneck inlet liner (cat.# 20907); splitless hold time 0.15 min.; pressure pulse: 0.20 min. @ 30psi

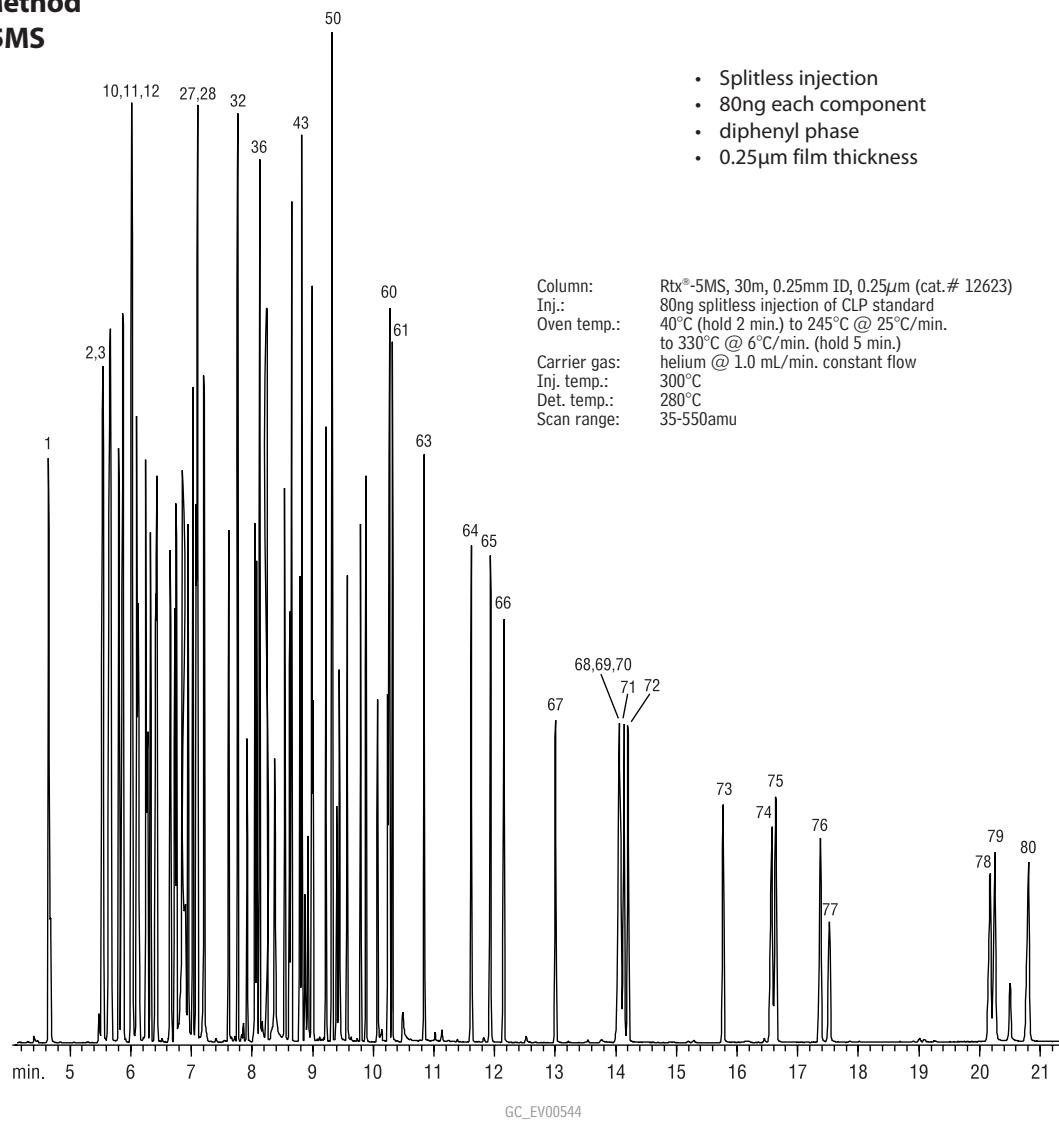
GC: Agilent 6890
Inj. temp.: 270°C
Carrier gas: helium
Flow rate: 1.2mL/min., constant flow
Oven temp.: 40°C (hold 0.5 min.) to 90°C @ 14°C/min. (no hold) to 330°C @ 22°C/min. (hold 1 min.)

Det.: Agilent 5973 GC/MS
Transfer line temp.: 280°C
Scan range: 35–550amu
Solvent delay: 1 min.
Tune: DFTPP
Ionization: EI

- Splitless injection, 2.5ng each component
- XLB phase
- 0.18 μ m film thickness



1. pyridine	19. nitrobenzene-d5	38. 2-fluorobiphenyl	57. 4-chlorophenyl phenyl ether	76. benzyl butyl phthalate
2. N-nitrosodimethylamine	20. nitrobenzene	39. 2-chloronaphthalene	58. fluorene	77. bis(2-ethylhexyl)adipate
3. 2-fluorophenol	21. isophorone	40. 2-nitroaniline	59. diphenylamine	78. bis(2-ethylhexyl)phthalate
4. phenol-d6	22. 2,4-dimethylphenol	41. dimethylphthalate	60. 4-nitroaniline	79. benzo(a)anthracene
5. phenol	23. 2-nitrophenol	42. acenaphthylene	61. azobenzene	80. chrysene-d12
6. aniline	24. benzoic acid	43. 2,6-dinitrotoluene	62. 2,4,6-tribromophenol	81. chrysene
7. 2-chlorophenol	25. bis(2-chloroethoxy)methane	44. acenaphthene-d10	63. 4,6-dinitro-2-methylphenol	82. di-n-octyl phthalate
8. bis(2-chloroethyl)ether	26. 2,4-dichlorophenol	45. 1,4-dinitrobenzene	64. 4-bromophenyl phenyl ether	83. benzo(b)fluoranthene
9. 1,3-dichlorobenzene	27. 1,2,4-trichlorobenzene	46. acenaphthene	65. hexachlorobenzene	84. benzo(k)fluoranthene
10. 1,4-dichlorobenzene-d4	28. naphthalene-d8	47. 1,3-dinitrobenzene	66. pentachlorophenol	85. benzo(a)pyrene
11. 1,4-dichlorobenzene	29. naphthalene	48. 3-nitroaniline	67. phenanthrene-d10	86. perylene-d12
12. 1,2-dichlorobenzene	30. hexachlorobutadiene	49. 1,2-dinitrobenzene	68. phenanthrene	87. indeno(1,2,3-cd)pyrene
13. benzyl alcohol	31. 4-chloroaniline	50. 4-nitrophenol	69. anthracene	88. dibenzo(a,h)anthracene
14. 2-methylphenol	32. 4-chloro-3-methylphenol	51. dibenzofuran	70. carbazole	89. benzo(ghi)perylene
15. bis(2-chloroisopropyl)ether	33. 2-methylnaphthalene	52. 2,3,4,6-tetrachlorophenol	71. di-n-butylphthalate	
16. hexachloroethane	34. hexachlorocyclopentadiene	53. 2,3,5,6-tetrachlorophenol	72. fluoranthene	
17a. 4-methylphenol	35. 1-methylnaphthalene	54. 2,4-dinitrophenol	73. benzidine	
17b. 3-methylphenol	36. 2,4,6-trichlorophenol	55. diethyl phthalate	74. pyrene	
18. N-nitroso-di-n-propylamine	37. 2,4,5-trichlorophenol	56. 2,4-dinitrotoluene	75. <i>p</i> -terphenyl-d14	

Semivolatile Organics**CLP Method****Rtx®-5MS**

	RT		RT		RT
1. 2-fluorophenol (SS)	4.65	28. naphthalene	7.10	56. 4-bromophenyl phenyl ether	9.80
2. phenol-d6 (SS)	5.53	29. 4-chloroaniline	7.20	57. hexachlorobenzene	9.88
3. phenol	5.55	30. hexachlorobutadiene	7.21	58. pentachlorophenol	10.07
4. bis(2-chloroethyl)ether	5.64	31. 4-chloro-3-methylphenol	7.62	59. phenanthrene-d10 (IS)	10.24
5. 2-chlorophenol-d4 (SS)	5.66	32. 2-methylnaphthalene	7.77	60. phenanthrene	10.27
6. 2-chlorophenol	5.67	33. hexachlorocyclopentadiene	7.92	61. anthracene	10.32
7. 1,3-dichlorobenzene	5.81	34. 2,4,6-trichlorophenol	8.05	62. carbazole	10.49
8. 1,4-dichlorobenzene-d4 (IS)	5.86	35. 2,4,5-trichlorophenol	8.08	63. di-n-butylphthalate	10.84
9. 1,4-dichlorobenzene	5.87	36. 2-fluorobiphenyl (SS)	8.13	64. fluoranthene	11.62
10. 1,2-dichlorobenzene-d4 (IS)	6.01	37. 2-chloronaphthalene	8.25	65. pyrene	11.94
11. benzyl alcohol	6.01	38. 2-nitroaniline	8.38	66. p-terphenyl-d14 (SS)	12.16
12. 1,2-dichlorobenzene	6.03	39. dimethylphthalate	8.54	67. benzyl butyl phthalate	13.01
13. 2-methylphenol	6.10	40. 2,6-dinitrotoluene	8.62	68. benzo(a)anthracene	14.05
14. bis(2-chloroisopropyl)ether	6.13	41. acenaphthylene	8.66	69. 3,3'-dichlorobenzidine	14.06
15. 4-methylphenol/3-methylphenol	6.25	42. acenaphthene-d10 (IS)	8.79	70. chrysene-d12 (IS)	14.08
16. N-nitroso-di-n-propylamine	6.28	43. acenaphthene	8.83	71. chrysene	14.14
17. hexachloroethane	6.33	44. 3-nitroaniline	8.88	72. bis(2-ethylhexyl)phthalate	14.2
18. nitrobenzene-d5 (SS)	6.41	45. 2,4-dinitrophenol	8.88	73. di-n-octyl phthalate	15.77
19. nitrobenzene	6.43	46. 4-nitrophenol	8.92	74. benzo(b)fluoranthene	16.57
20. isophorone	6.66	47. dibenzofuran	8.99	75. benzo(k)fluoranthene	16.64
21. 2-nitrophenol	6.73	48. 2,4-dinitrotoluene	9.01	76. benzo(a)pyrene	17.38
22. 2,4-dimethylphenol	6.75	49. diethyl phthalate	9.22	77. perylene-d12 (IS)	17.52
23. bis(2-chloroethoxy)methane	6.85	50. 4-chlorophenyl phenyl ether	9.32	78. indeno(1,2,3-cd)pyrene	20.18
24. benzoic acid	6.91	51. fluorene	9.33	79. dibenz(a,h)anthracene	20.26
25. 2,4-dichlorophenol	6.95	52. 4-nitroaniline	9.39	80. benzo(ghi)perylene	20.81
26. 1,2,4-trichlorobenzene	7.03	53. 2-methyl-4,6-dinitrophenol	9.40		
27. naphthalene-d8 (IS)	7.08	54. diphenylamine	9.44		
		55. 2,4,6-tribromophenol (SS)	9.57		

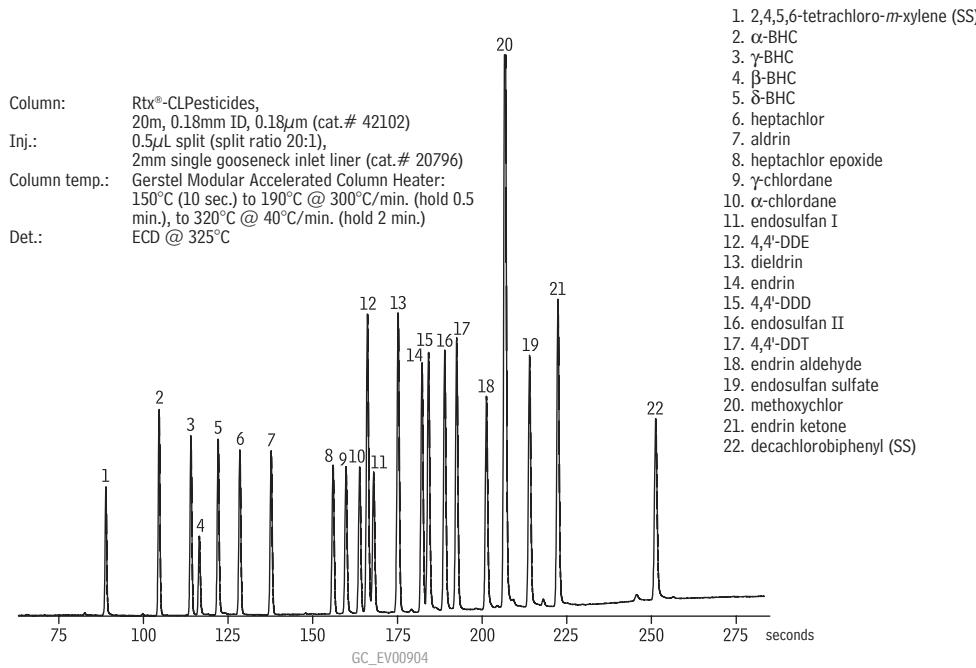
Pesticides

Organochlorine Pesticides

US EPA Method 8081

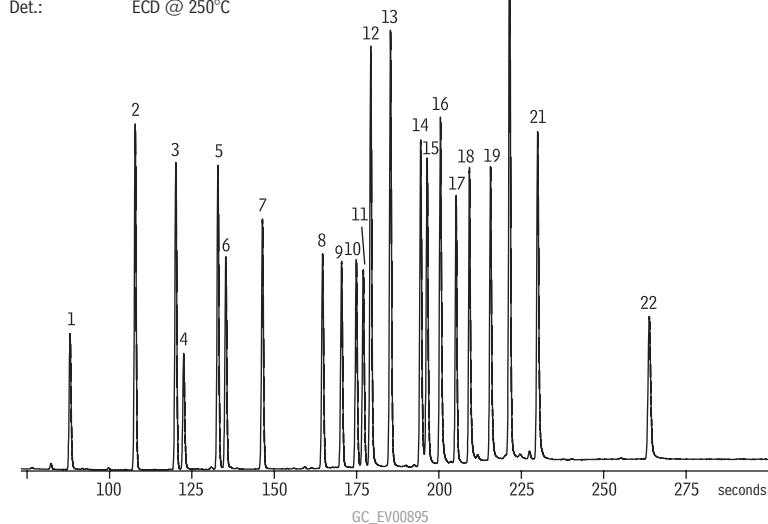
Rtx®-CLPesticides & Rtx®-CLPesticides2

new!



Column: Rtx®-CLPesticides2,
20m, 0.18mm ID, 0.14 μ m (cat.# 42302)
Inj.: 1.0 μ L split (split ratio 20:1), 4mm Siltex®
gooseneck splitless inlet liner (cat.# 20798-214.1)
Column temp.: Gerstel Modular Accelerated Column Heater;
Gerstel module temp.: 140°C to 220°C (hold 1 min.)
@ 120°C/min., to 305°C @ 50°C/min., to 330°C @
300°C/min. (hold 2 min.)
Det.: ECD @ 250°C

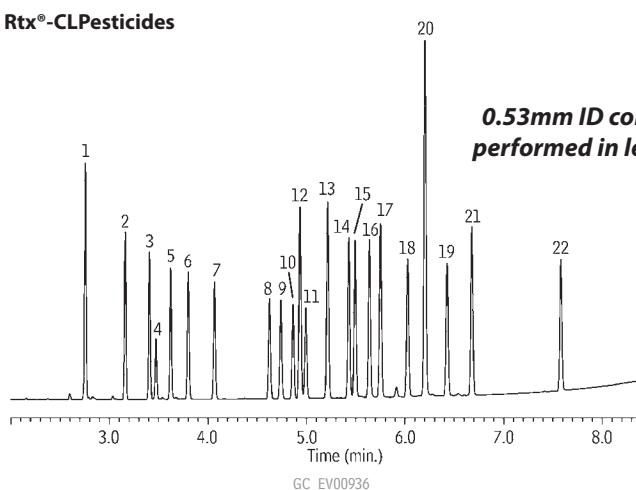
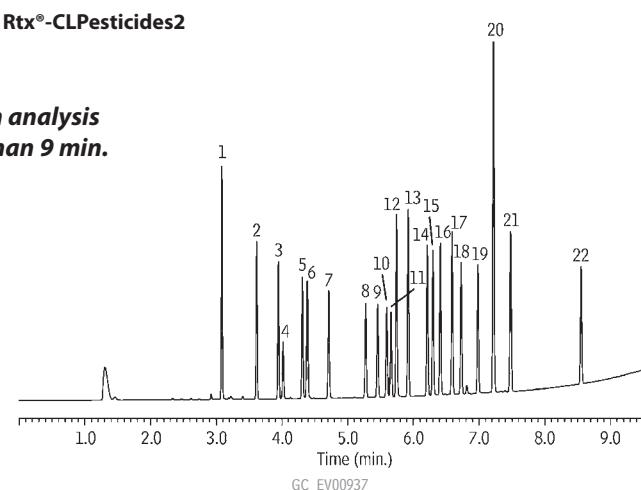
**Fast ramp rates
achieved using
Gerstel MACH!**



Sample: Organochlorine Pesticide Mix AB #2 (8-80 μ g/mL each component
in hexane/toluene 1:1, cat.# 32292),
Pesticide Surrogate Mix (200 μ g/ml each component in acetone, cat.# 32000)
Inj.: 0.5 μ L split (split ratio 20:1), 2mm single gooseneck inlet liner (cat.# 20796)
Inj. temp.: 250°C
Carrier gas: helium, constant flow
Flow rate: 1.5mL/min.
Oven temp.: 275°C

new!

Organochlorine Pesticide Mix AB #2 Rtx®-CLPesticides and Rtx®-CLPesticides2

Rtx®-CLPesticides**Rtx®-CLPesticides2**

**0.53mm ID column analysis
performed in less than 9 min.**

Columns: Rtx®-CLPesticides, 30m, 0.53mm ID, 0.50 μ m (cat.# 11140) and Rtx®-CLPesticides2, 30m, 0.53mm ID, 0.42 μ m (cat.# 11340) with 5m x 0.53mm ID Rxi® deactivated guard tubing (cat.# 10054), connected using Siltek® Treated Universal "Y" Press-Tight® connector (cat.# 20486)

Sample: Organochlorine Pesticide Mix AB #2, 8-80 μ g/mL each component in hexane/toluene (cat.# 32292), Pesticide Surrogate Mix, 200 μ g/mL each component in acetone (cat.# 32000)

Inj.: 1.0 μ L splitless (hold 0.3 min.), 4mm single gooseneck inlet liner (cat.# 20799)

Inj. temp.: 250°C

Carrier gas: helium, constant flow

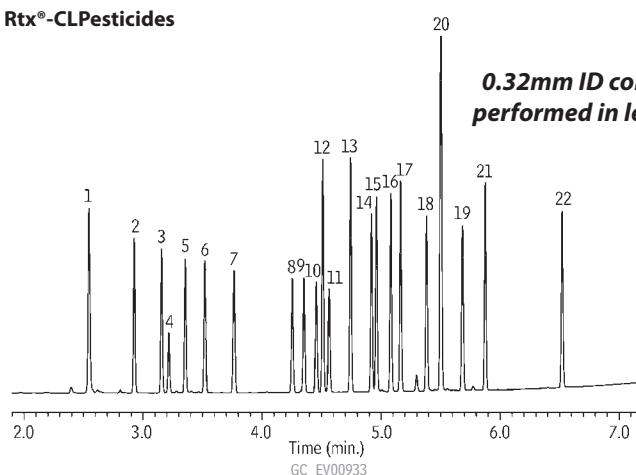
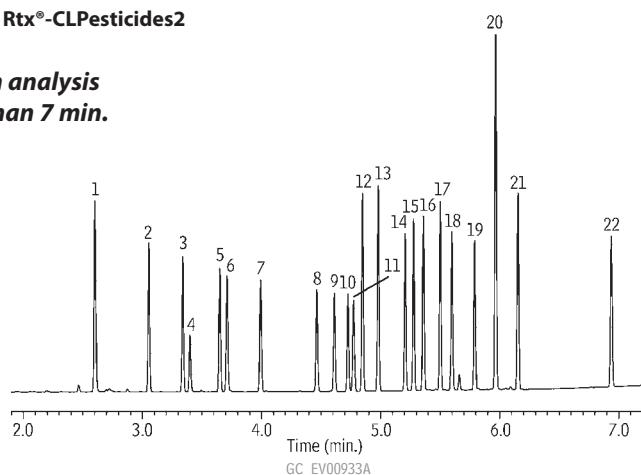
Linear velocity: 45cm/sec. @ 120°C

Oven temp.: 120°C to 200°C @ 45°C/min. to 230°C @ 12.5°C/min. to 325°C (hold 2 min.) @ 30°C/min.

Det.: ECD @ 330°C

- | | |
|---|-----------------------------|
| 1. 2,4,5,6-tetrachloro- <i>m</i> -xylene (SS) | 12. 4,4'-DDE |
| 2. α -BHC | 13. dieldrin |
| 3. γ -BHC | 14. endrin |
| 4. β -BHC | 15. 4,4'-DDD |
| 5. δ -BHC | 16. endosulfan II |
| 6. heptachlor | 17. 4,4'-DDT |
| 7. aldrin | 18. endrin aldehyde |
| 8. heptachlor epoxide (isomer B) | 19. endosulfan sulfate |
| 9. γ -chlordane | 20. methoxychlor |
| 10. α -chlordane | 21. endrin ketone |
| 11. endosulfan I | 22. decachlorobiphenyl (SS) |

Organochlorine Pesticide Mix AB #2 Rtx®-CLPesticides and Rtx®-CLPesticides2

Rtx®-CLPesticides**Rtx®-CLPesticides2**

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

Columns: Rtx®-CLPesticides, 30m, 0.32mm ID, 0.32 μ m (cat.# 11141) and Rtx®-CLPesticides2, 30m, 0.32mm ID, 0.25 μ m (cat.# 11324) with 5m x 0.32mm ID Rxi® deactivated guard tubing (cat.# 10039), connected using Deactivated Universal "Y" Press-Tight® connector (cat.# 20405-261)

Sample: Organochlorine Pesticide Mix AB #2, 8-80 μ g/mL each component in hexane/toluene (cat.# 32292), Pesticide Surrogate Mix, 200 μ g/mL each component in acetone (cat.# 32000)

Inj.: 1.0 μ L splitless (hold 0.3 min.), 4mm single gooseneck inlet liner (cat.# 20799)

Inj. temp.: 250°C

Carrier gas: helium, constant flow

Linear velocity: 60cm/sec. @ 120°C

Oven temp.: 120°C to 200°C @ 45°C/min. to 230°C @ 15°C/min. to 330°C (hold 2 min.) @ 30°C/min.

Det.: ECD @ 330°C

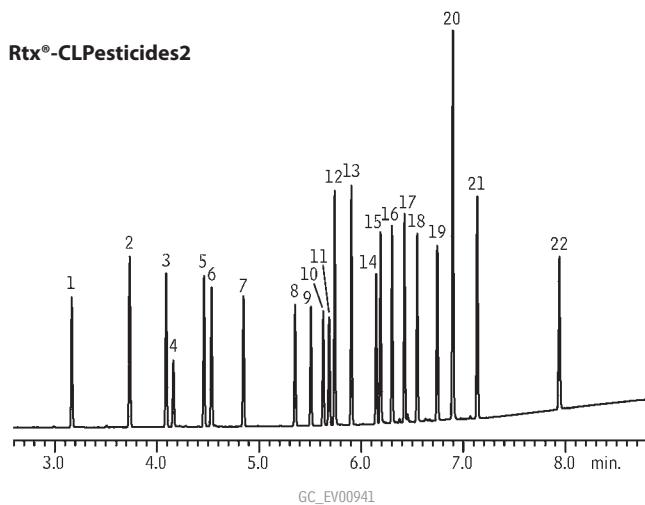
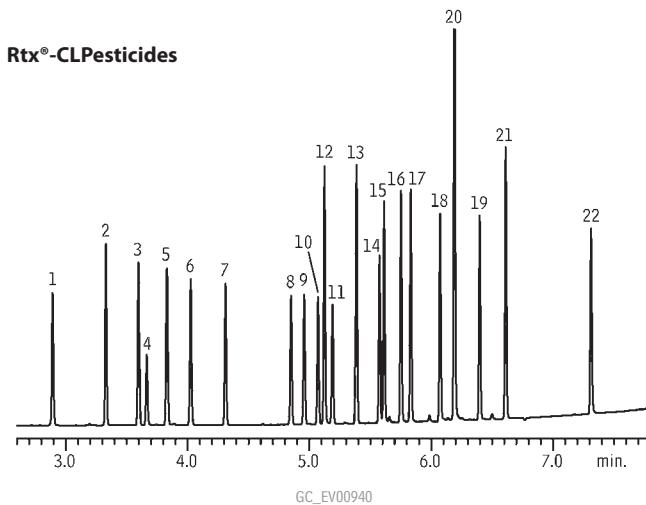
- | | |
|---|-----------------------------|
| 1. 2,4,5,6-tetrachloro- <i>m</i> -xylene (SS) | 12. 4,4'-DDE |
| 2. α -BHC | 13. dieldrin |
| 3. γ -BHC | 14. endrin |
| 4. β -BHC | 15. 4,4'-DDD |
| 5. δ -BHC | 16. endosulfan II |
| 6. heptachlor | 17. 4,4'-DDT |
| 7. aldrin | 18. endrin aldehyde |
| 8. heptachlor epoxide (isomer B) | 19. endosulfan sulfate |
| 9. γ -chlordane | 20. methoxychlor |
| 10. α -chlordane | 21. endrin ketone |
| 11. endosulfan I | 22. decachlorobiphenyl (SS) |

Pesticides

Organochlorine Pesticide Mix AB #2

new!

Rtx®-CLPesticides and Rtx®-CLPesticides2 (0.25mm ID column set)



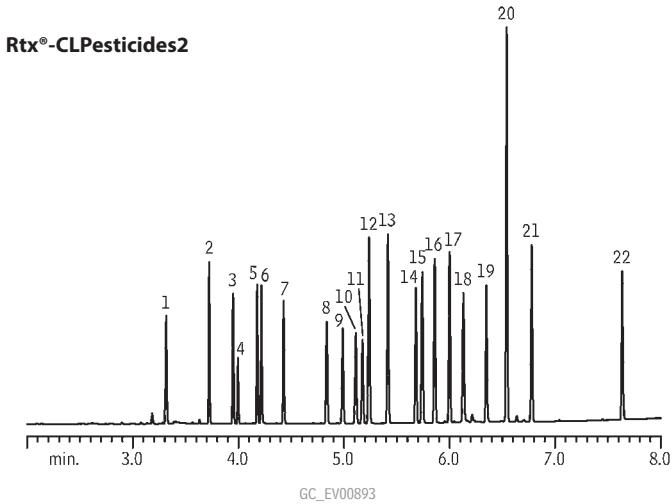
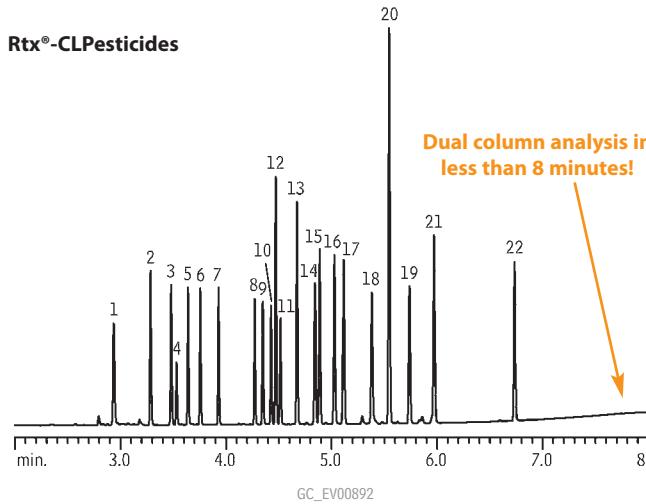
Columns: Rtx®-CLPesticides, 30m, 0.25mm ID, 0.25 μ m (cat.# 11123) and Rtx®-CLPesticides2, 30m, 0.25mm ID, 0.20 μ m (cat.# 11323) with 5m x 0.25mm ID RxI® deactivated guard tubing (cat.# 10029), connected using Siltel®-treated Universal "Y" Press-Tight® Connector (cat.# 20486). Sample: Organochlorine Pesticide Mix AB #2, 8-80 μ g/mL each component in hexane/toluene (cat.# 32292), Pesticide Surrogate Mix, 200 μ g/mL each component in acetone (cat.# 32000). Inj.: 0.5 μ L splitless (hold 0.5 min.), 2mm Cyclo Double Gooseneck inlet liner (cat.# 20908). Inj. temp.: 250°C. Carrier gas: helium, constant flow. Linear velocity: 41cm/sec. @ 125°C. Oven temp.: 125°C to 200°C @ 45°C/min. to 230°C @ 12.5°C/min. to 330°C (hold 2 min.) @ 30°C/min. Det.: ECD @ 330°C.

- | | |
|---|-----------------------------|
| 1. 2,4,5,6-tetrachloro- <i>m</i> -xylene (SS) | 12. 4,4'-DDE |
| 2. α -BHC | 13. dieldrin |
| 3. γ -BHC | 14. endrin |
| 4. β -BHC | 15. 4,4'-DDD |
| 5. δ -BHC | 16. endosulfan II |
| 6. heptachlor | 17. 4,4'-DDT |
| 7. aldrin | 18. endrin aldehyde |
| 8. heptachlor epoxide (isomer B) | 19. endosulfan sulfate |
| 9. γ -chlordane | 20. methoxychlor |
| 10. α -chlordane | 21. endrin ketone |
| 11. endosulfan I | 22. decachlorobiphenyl (SS) |

Organochlorine Pesticides

new!

Rtx®-CLPesticides and Rtx®-CLPesticides2 (0.18mm ID column set)



Columns: Rtx®-CLPesticides, 20m, 0.18mm ID, 0.18 μ m (cat.# 42102) and Rtx®-CLPesticides2, 20m, 0.18mm ID, 0.14 μ m (cat.# 42302) with 5m x 0.53mm ID intermediate-polarity deactivated guard tubing (cat.# 10045), connected using SeCet™ "Y" Connector Kit (cat.# 20276) with Universal "Y" Press-Tight® Connector (cat.# 20486). Sample: Organochlorine Pesticide Mix AB #2 (cat.# 32292), 8-80 μ g/mL each component in hexane/toluene, Pesticide Surrogate Mix (cat.# 32000), 200 μ g/mL each component in acetone. Inj.: 0.5 μ L splitless (hold 0.75 min.), 2mm single gooseneck inlet liner (cat.# 20796). Inj. temp.: 250°C. Carrier gas: helium, constant flow. Linear velocity: 20cm/sec. @ 140°C. Oven temp.: 140°C (hold 1 min.) to 250°C @ 35°C/min. (hold 1 min.) to 330°C @ 35°C/min. (hold 3 min.). Det.: ECD @ 350°C.

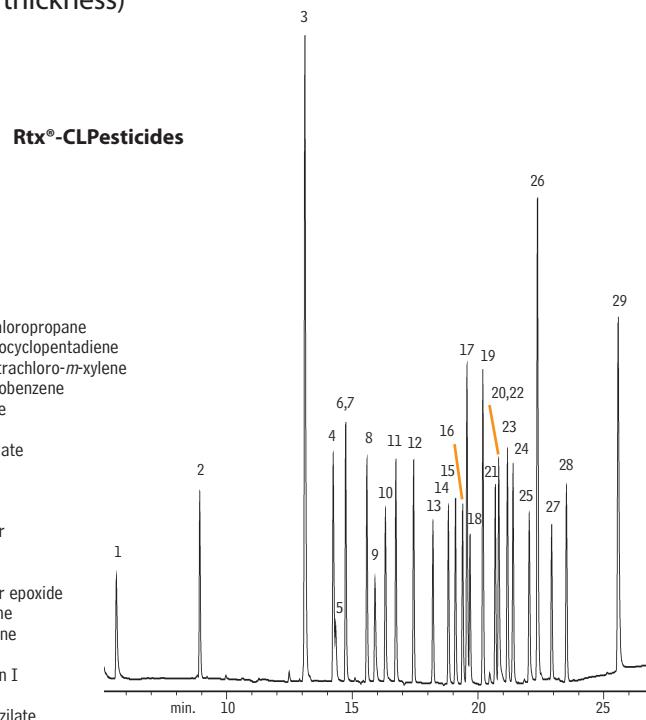
- | | |
|---|-----------------------------|
| 1. 2,4,5,6-tetrachloro- <i>m</i> -xylene (SS) | 12. 4,4'-DDE |
| 2. α -BHC | 13. dieldrin |
| 3. γ -BHC | 14. endrin |
| 4. β -BHC | 15. 4,4'-DDD |
| 5. δ -BHC | 16. endosulfan II |
| 6. heptachlor | 17. 4,4'-DDT |
| 7. aldrin | 18. endrin aldehyde |
| 8. heptachlor epoxide | 19. endosulfan sulfate |
| 9. γ -chlordane | 20. methoxychlor |
| 10. α -chlordane | 21. endrin ketone |
| 11. endosulfan I | 22. decachlorobiphenyl (SS) |

Organochlorine Pesticides

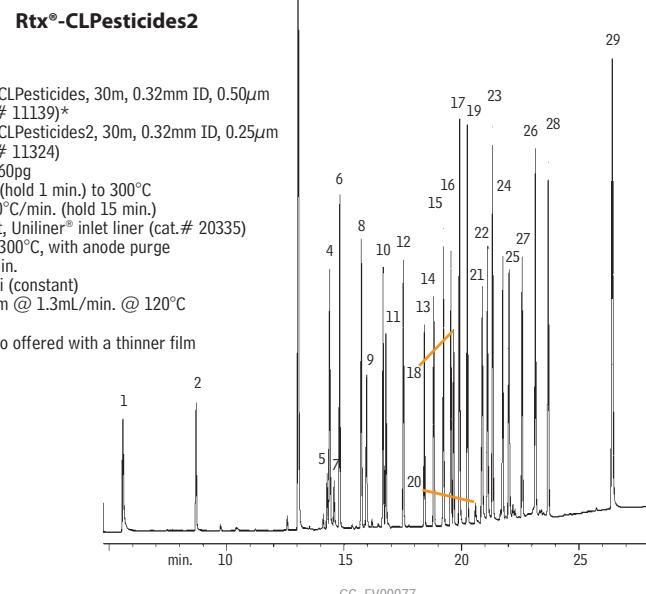
US EPA Method 8081A

Rtx®-CLPesticides & Rtx®-CLPesticides2

(standard film thickness)



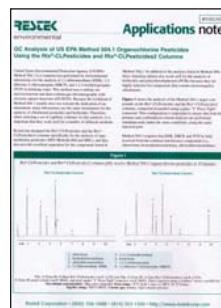
1. dibromochloropropane
2. hexachlorocyclopentadiene
3. 2,4,5,6-tetrachloro-*m*-xylene
4. hexachlorobenzene
5. *cis*-diallate
6. α -BHC
7. *trans*-diallate
8. γ -BHC
9. β -BHC
10. δ -BHC
11. heptachlor
12. aldrin
13. isodrin
14. heptachlor epoxide
15. γ -chlordane
16. α -chlordane
17. 4,4'-DDE
18. endosulfan I
19. dieldrin
20. chlorobenzilate
21. endrin
22. 4,4'-DDD
23. endosulfan II
24. 4,4'-DDT
25. endrin aldehyde
26. methoxychlor
27. endosulfan sulfate
28. endrin ketone
29. decachlorobiphenyl



Columns: Rtx®-CLPesticides, 30m, 0.32mm ID, 0.50 μ m (cat.# 11139)*
Rtx®-CLPesticides2, 30m, 0.32mm ID, 0.25 μ m (cat.# 11324)
On-column conc.: 16–160pg
Oven temp.: 80°C (hold 1 min.) to 300°C
@ 10°C/min. (hold 15 min.)
Inj.: direct, Uniliner® inlet liner (cat.# 20335)
Det.: ECD, 300°C, with anode purge
Dead time: 1.9 min.
Head pressure: 8.7psi (constant)
Flow rate: helium @ 1.3mL/min. @ 120°C

*Rtx®-CLPesticides is also offered with a thinner film thickness (cat.# 11141).

free literature



GC Analysis of US EPA Method 504.1 Organochlorine Pesticides, Using the Rtx®-CLPesticides and Rtx®-CLPesticides2 Columns

A versatile column pair for analyzing organochlorine pesticides, herbicides, or PCBs

Analysts following Method 504.1 in monitoring 1,2-dibromoethane (EDB), 1,2-dibromo-3-chloropropane (DBCP), and 1,2,3-trichloropropane (TCP) in drinking water will value Rtx®-CLPesticides and Rtx®-CLPesticides2 columns because this same primary column/confirmation column pair can be used to perform numerous related analyses: organochlorine pesticides (e.g., by EPA Method 608 or 8081), herbicides, or polychlorinated biphenyls (PCBs). Details in this 2-page note show EDB, DBCP, and TCP are fully resolved from common interference compounds, per requirements of Method 504.1.

Applications Note

lit. cat.# 59539

Rtx®-CLPesticides and Rtx®-CLPesticides2 columns also are ideal for:

- *Triazine herbicides* (lit. cat.# 59101)
- *PCBs* (lit. cat.# 59120)
- *Haloacetic acids* (lit. cat.# 59175)
- *Polynuclear aromatic hydrocarbons* (lit. cat.# 59196A)

Download your free copy of the literature listed here from www.restek.com.

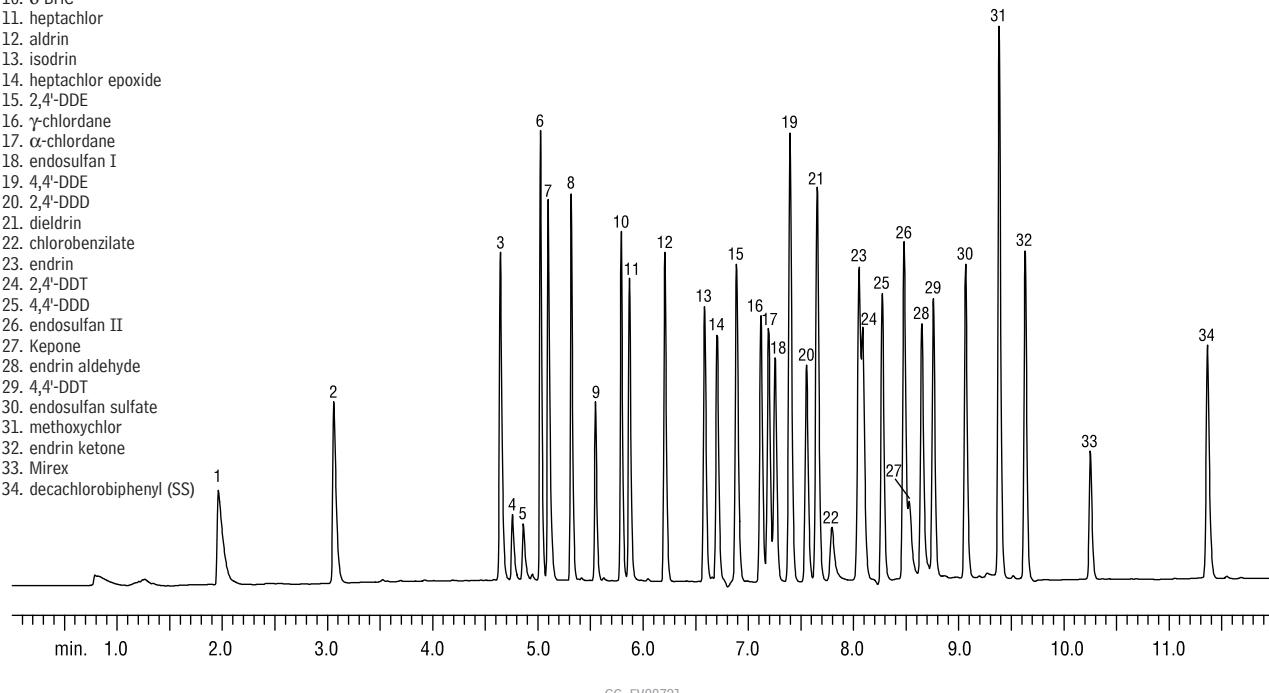
Pesticides

Organochlorine Pesticides

US EPA Method 8081A

Rtx®-XLB

1. 1,2-dibromo-3-chloropropane
2. hexachlorocyclopentadiene
3. 2,4,5,6-tetrachloro-*m*-xylene (SS)
4. *cis*-diallate
5. *trans*-diallate
6. α -BHC
7. hexachlorobenzene
8. γ -BHC
9. β -BHC
10. δ -BHC
11. heptachlor
12. aldrin
13. isodrin
14. heptachlor epoxide
15. 2,4'-DDE
16. γ -chlordane
17. α -chlordane
18. endosulfan I
19. 4,4'-DDE
20. 2,4'-DDD
21. dieldrin
22. chlorobenzilate
23. endrin
24. 2,4'-DDT
25. 4,4'-DDD
26. endosulfan II
27. Kepone
28. endrin aldehyde
29. 4,4'-DDT
30. endosulfan sulfate
31. methoxychlor
32. endrin ketone
33. Mirex
34. decachlorobiphenyl (SS)

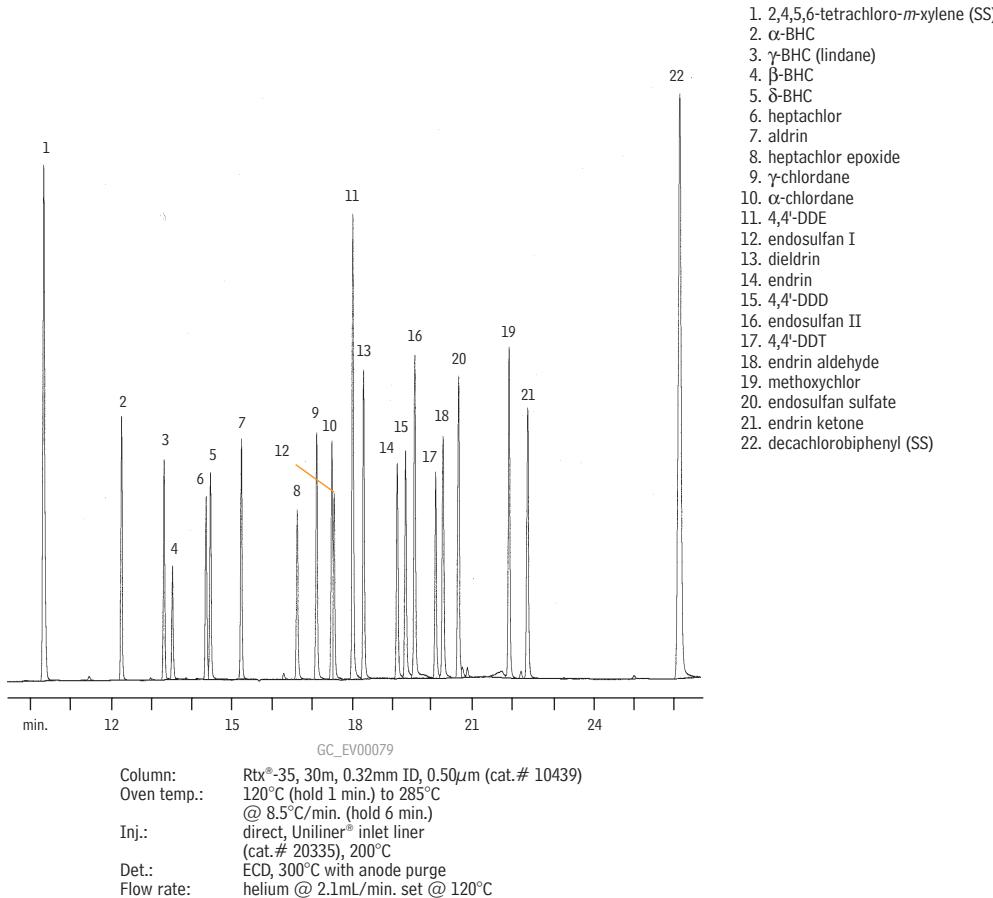


Column: Rtx®-XLB, 30m, 0.32mm ID, 0.5 μ m (cat.# 12839)
 Sample: 8081A pesticides, 80-160ppb in hexane
 8081A Pesticides/Surrogates
 8080 Organochlorine Pesticide Mix AB #2 (20 components) (cat.# 32292)
 8081a Organochlorine Pesticide Mix C #2 (7 components) (cat.# 32295)
 2,4'-DDT (cat.# 32200)
 2,4'-DDD (cat.# 32098)
 2,4'-DDE (cat.# 32099)
 Kepone (custom)
 Mirex (custom)
 2,4,5,6-tetrachloro-*m*-xylene (ss, 20ppb) (cat.# 32027)
 decachlorobiphenyl (ss, 40ppb) (cat.# 32029)
 Inj.: 1.0 μ L splitless (hold 0.75 min.), 4mm Drilled Uniliner® inlet liner (cat.# 21055)
 Inj. temp.: 220°C
 Carrier gas: hydrogen, constant pressure
 Linear velocity: 60cm/sec. @ 120°C
 Oven temp.: 120°C (hold 0.5 min.) to 260°C @ 29°C/min. (hold 2.5 min.), to 330°C @ 28°C/min. (hold 3 min.)
 Det.: ECD @ 320°C

Searching for a chromatogram?

www.restek.com

Organochlorine Pesticides
US EPA Method 8081
Rtx®-35



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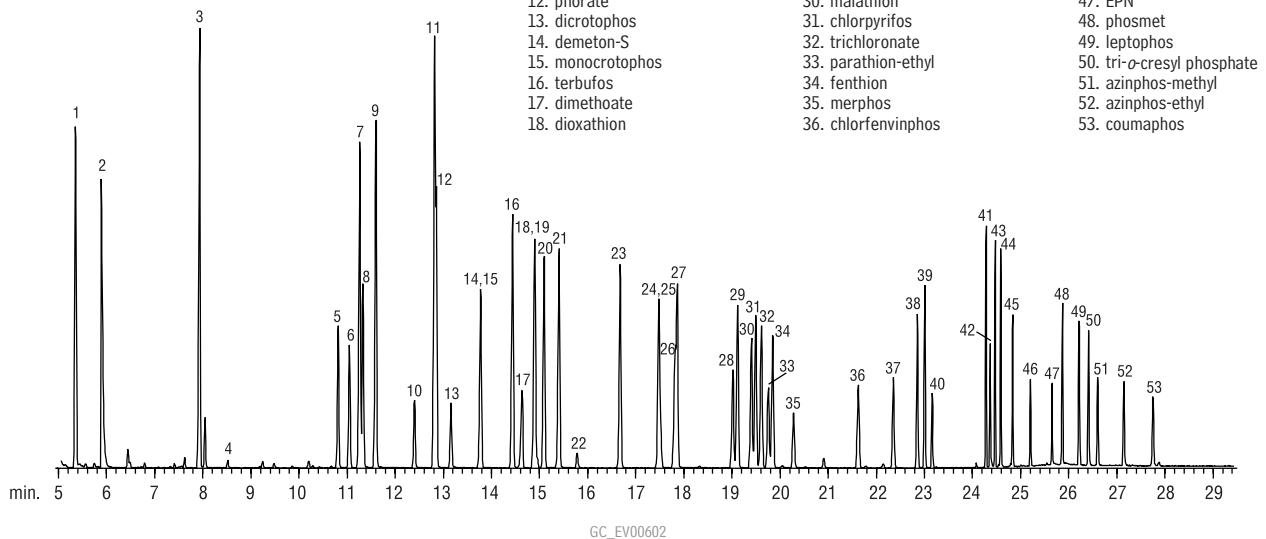
Pesticides

Organophosphorus Pesticides

US EPA Method 8141A

Rtx®-OPPesticides2

Excellent resolution of 53 organophosphorus pesticides!



Column: Rtx®-OPPesticides2, 30m, 0.25mm ID, 0.25 μ m (cat.# 11243)
 Sample: US EPA Method 8141A Custom Standard Mix 1 μ L 100ppm (100ng on column)
 Triphenylphosphate Standard (cat.# 32281)
 Tributylphosphate Standard (cat.# 32280)
 8140/8141 OP Pesticides Calibration Mix A (cat.# 32277)
 8141 OP Pesticides Calibration Mix B (cat.# 32278)

Inj.: Custom Mixes: Call Restek for Information
 1.0 μ L splitless (hold 0.4 min.), 4mm double
 gooseneck inlet liner (cat.# 20785)

Inj. temp.: 250°C
 Carrier gas: helium, constant flow
 Flow rate: 1.0mL/min.
 Oven temp.: 80°C (hold 0.5 min.) to 140°C @ 20°C/min.
 to 210°C @ 4°C/min. (hold 1 min.) to 280°C @ 30°C (hold 5 min.)
 Det: MS
 Transfer line temp.: 280°C
 Scan range: 35-400amu
 Ionization: EI

for **more** info

GC Columns for Pesticide Analyses

Choose from 9 capillary GC phases for pesticide analyses and more than 50 combinations of column ID and phase film thickness. For descriptions of special purpose columns, see pages 22-23. To locate a column type in this catalog, see pages 14-15.

Partners in Pesticide Analysis



Please visit www.restek.com/pesticides for information about the ChemService product line.

Organophosphorus Pesticides**US EPA Method 8141A****Rtx®-OPPesticides & Rtx®-OPPesticides2**

- Dual-column injector

GC: splitless, purge on 1.0 min. constant pressure
Oven temp.: 80°C (hold 0.5 min.) to 280°C
(@ 12°C/min. (hold 10 min.))

Injector: 200°C
Inlet liner: 4mm Siltek® single gooseneck inlet liner

Detector: FPD @ 250°C

Dead time: 1.03 min. @ 80°C

Injection: 1µL US EPA Method 8141A Custom Standard Mixes (100mg/mL)

Triphenylphosphate Standard (cat.# 32281)

Tributylphosphate Standard

(cat.# 32280)

8140/8141 OP Pesticides Calibration

Mix A (cat.# 32277)

8141 OP Pesticides Calibration Mix B

(cat.# 32278)

1. dichlorvos
2. hexamethylphosphoramide

3. mevinphos

4. trichlorfon

5. TEPP

6. demeton-O

7. tributyl phosphate (SS)

8. thionazin

9. ethoprop

10. naled

11. sulfotep

12. phorate

13. dicrotophos

14. monocrotophos

15. demeton-S

16. terbufos

17. dimethoate

18. diazinon

19. dioxathion

20. fonophos

21. disulfoton

22. phosphamidon isomer
(breakdown product)

23. dichlorofenthion

24. phosphamidon

25. chlorpyrifos methyl

26. parathion-methyl

27. ronnel

28. aspon

29. fenitrothion

30. malathion

31. chlorpyrifos

32. trichloronate

33. parathion-ethyl

34. fenthion

35. merphos

36. chlorgenvinphos

37. crot oxyphos

38. stirofos

39. tokuthion

40. merphos oxone
(breakdown product)

41. ethion

42. fensulfothion

43. bolstar

44. carbophenothion

45. famphur

46. triphenyl phosphate (SS)

47. EPN

48. phosmet

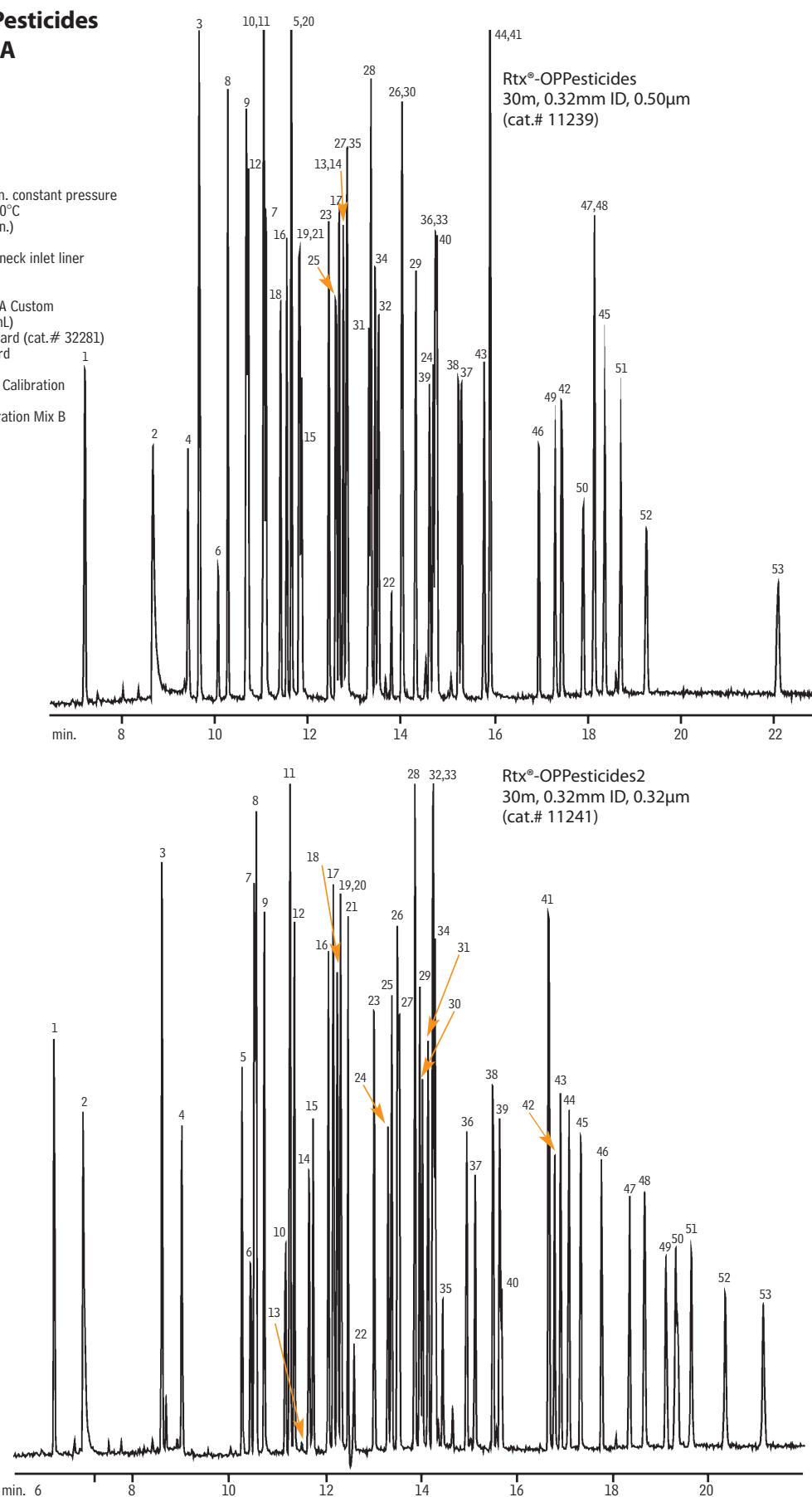
49. leptophos

50. tri-o-cresyl phosphate

51. azinphos-methyl

52. azinphos-ethyl

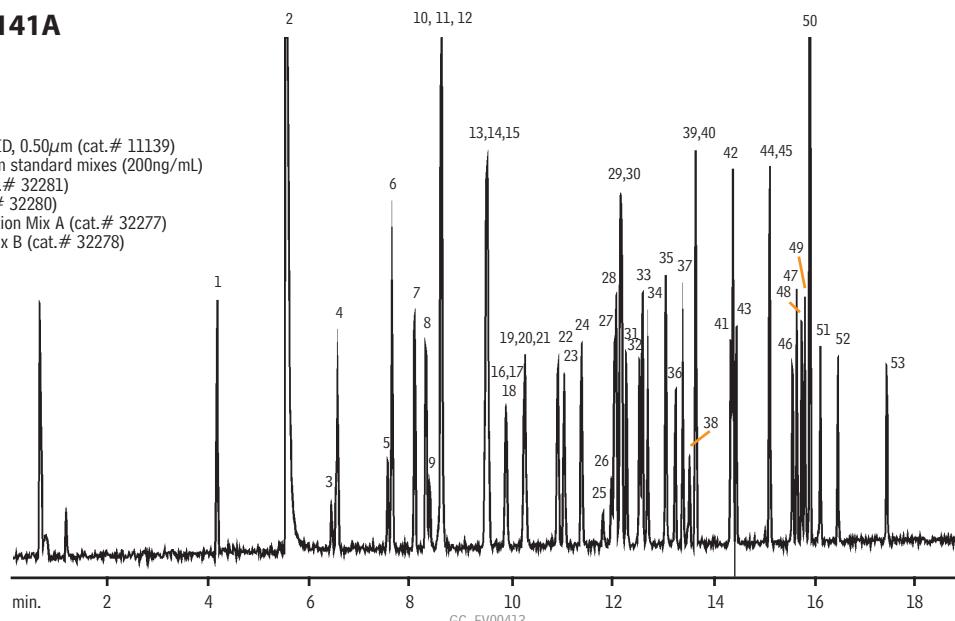
53. coumaphos



Organophosphorus Pesticides**US EPA Method 8140/8141/8141A****Rtx®-CLPesticides**

Column: Rtx®-CLPesticides, 30m, 0.32mm ID, 0.50 μ m (cat.# 11139)
 Sample: 1 μ L US EPA Method 8141A custom standard mixes (200ng/mL)
 Triphenylphosphate Standard (cat.# 32281)
 Tributylphosphate Standard (cat.# 32280)
 8140/8141 OP Pesticides Calibration Mix A (cat.# 32277)
 8141 OP Pesticides Calibration Mix B (cat.# 32278)

splitless hold time: 1 min.
 Oven temp.: 100°C to 180°C @ 10°C/min.
 (hold 2 min.), to 300°C @ 18°C/min. (hold 3 min.)
 Inj./det. temp.: 250°C/280°C FPD

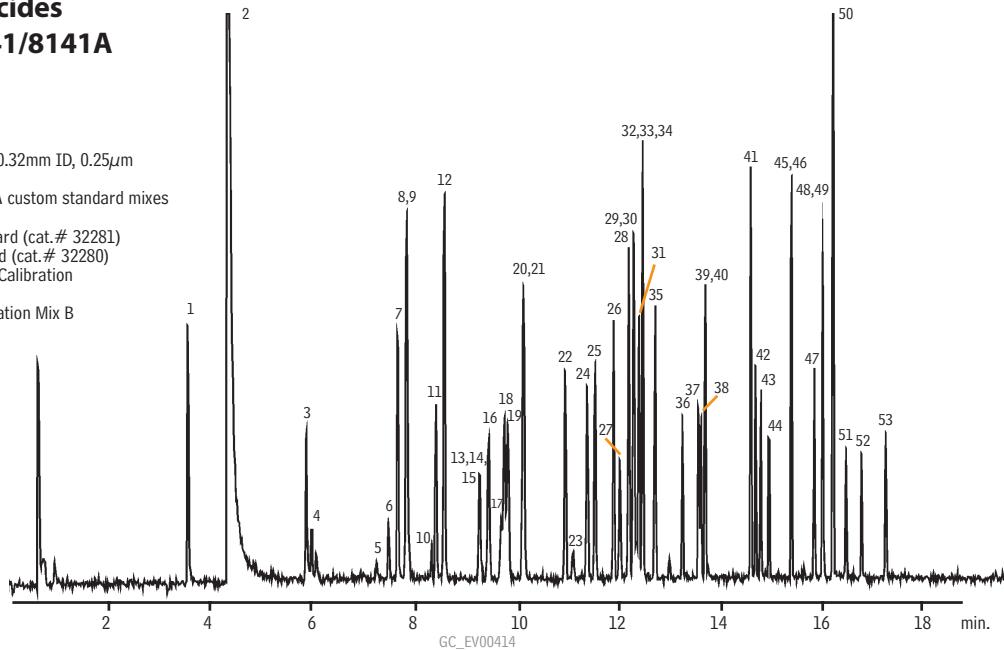


- | | | | | |
|-----------------------------|----------------------|-------------------------|---------------------|------------------------------|
| 1. dichlorvos | 12. sulfotep | 23. chloryrifos methyl | 34. phosphamidon | 45. triphenyl phosphate (SS) |
| 2. hexamethylphosphoramide | 13. demeton-S | 24. ronnel | 35. parathion-ethyl | 46. leptophos |
| 3. trichlorfon | 14. terbufos | 25. phosphamidon isomer | 36. chlorfenvinphos | 47. ethion |
| 4. mevinphos | 15. fonophos | 26. merphos | 37. tokuthion | 48. phosmet |
| 5. demeton-O | 16. dicrotophos | 27. chloryrifos | 38. merphos oxone | 49. EPN |
| 6. thionazin | 17. diazinon | 28. fenthion | 39. crotoxyphos | 50. tri-o-cresyl phosphate |
| 7. ethoprop | 18. disulfoton | 29. aspon | 40. stirofos | 51. azinphos-methyl |
| 8. phorate | 19. dioxathion | 30. parathion-methyl | 41. bolstar | 52. azinphos-ethyl |
| 9. naled | 20. monocrotophos | 31. trichloronate | 42. famphur | 53. coumaphos |
| 10. tributyl phosphate (SS) | 21. dimethoate | 32. malathion | 43. carbophenothion | |
| 11. TEPP | 22. dichlorofenthion | 33. fenitrothion | 44. fensulfothion | |

Organophosphorus Pesticides**US EPA Method 8140/8141/8141A****Rtx®-CLPesticides2**

Column: Rtx®-CLPesticides2, 30m, 0.32mm ID, 0.25 μ m
 (cat.# 11324)
 Sample: 1 μ L US EPA Method 8141A custom standard mixes
 (200ng/mL)
 Triphenylphosphate Standard (cat.# 32281)
 Tributylphosphate Standard (cat.# 32280)
 8140/8141 OP Pesticides Calibration
 Mix A (cat.# 32277)
 8141 OP Pesticides Calibration Mix B
 (cat.# 32278)

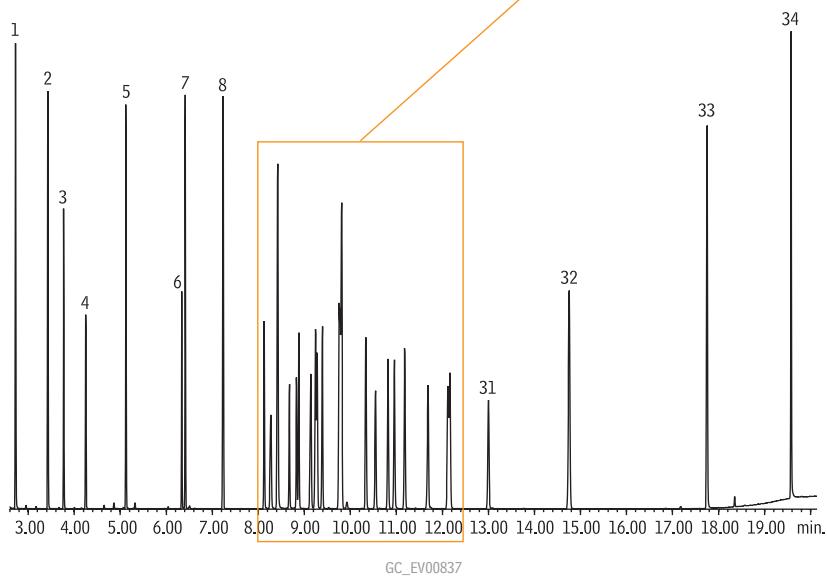
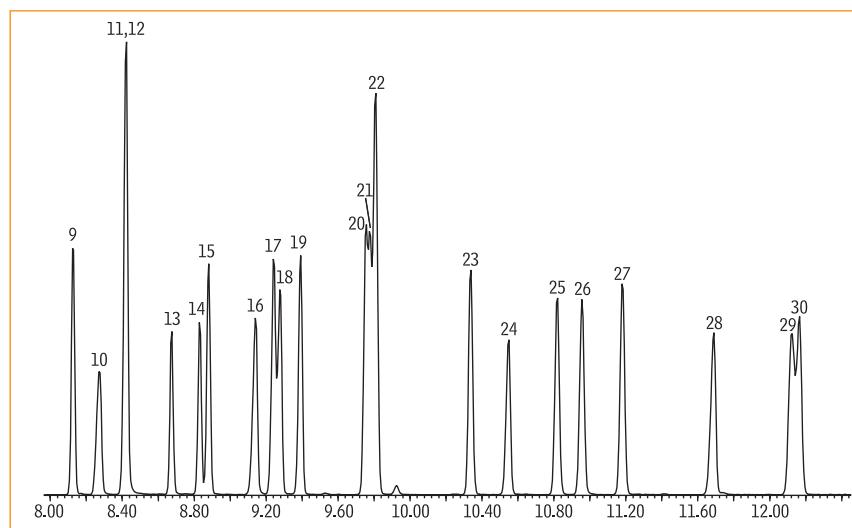
splitless hold time: 1 min.
 Oven temp.: 100°C to 180°C @ 10°C/min.,
 to 300°C @ 18°C/min.
 (hold 3 min.)
 Inj./det. temp.: 250°C/280°C FPD



- | | | | | |
|----------------------------|----------------------|-------------------------|---------------------|------------------------------|
| 1. dichlorvos | 12. sulfotep | 23. phosphamidon isomer | 34. malathion | 45. triphenyl phosphate (SS) |
| 2. hexamethylphosphoramide | 13. demeton-S | 24. chloryrifos methyl | 35. parathion-ethyl | 46. ethion |
| 3. mevinphos | 14. dicrotophos | 25. ronnel | 36. chlorfenvinphos | 47. EPN |
| 4. trichlorfon | 15. dioxathion | 26. parathion-methyl | 37. crotoxyphos | 48. phosmet |
| 5. demeton-O | 16. terbufos | 27. phosphamidon | 38. tokuthion | 49. leptophos |
| 6. thionazin | 17. moncrotophos | 28. aspon | 39. merphos oxone | 50. tri-o-cresyl phosphate |
| 7. tributyl phosphate (SS) | 18. fonophos | 29. chloryrifos | 40. stirofos | 51. azinphos-methyl |
| 8. ethoprop | 19. diazinon | 30. trichloronate | 41. famphur | 52. azinphos-ethyl |
| 9. TEPP | 20. disulfoton | 31. merphos | 42. bolstar | 53. coumaphos |
| 10. naled | 21. dimethoate | 32. fenitrothion | 43. carbophenothion | |
| 11. phorate | 22. dichlorofenthion | 33. fenthion | 44. fensulfothion | |

Pesticides**Minnesota Ag List 1****Rxi®-1ms****Rxi® Technology!**

1. 2-fluorophenol (SS)
2. phenol-d6 (SS)
3. 1,4-dichlorobenzene-d4 (IS)
4. nitrobenzene-d5 (SS)
5. naphthalene-d8 (IS)
6. EPTC
7. 2-fluorobiphenyl (SS)
8. acenaphthene-d10 (IS)
9. propachlor
10. desisopropyl atrazine
11. desethyl atrazine
12. 2,4,6-tribromophenol (SS)
13. ethalfluralin
14. trifluralin
15. phorate
16. simazine
17. prometon
18. atrazine
19. propazine
20. terbufos
21. fonofos
22. phenanthrene-d10 (IS)
23. triallate
24. metribuzin
25. dimethenamid
26. acetochlor
27. alachlor
28. cyanazine
29. metolachlor
30. chlorpyrifos
31. pendimethalin
32. *p*-terphenyl-d14 (SS)
33. chrysene-d12 (IS)
34. perylene-d12 (IS)



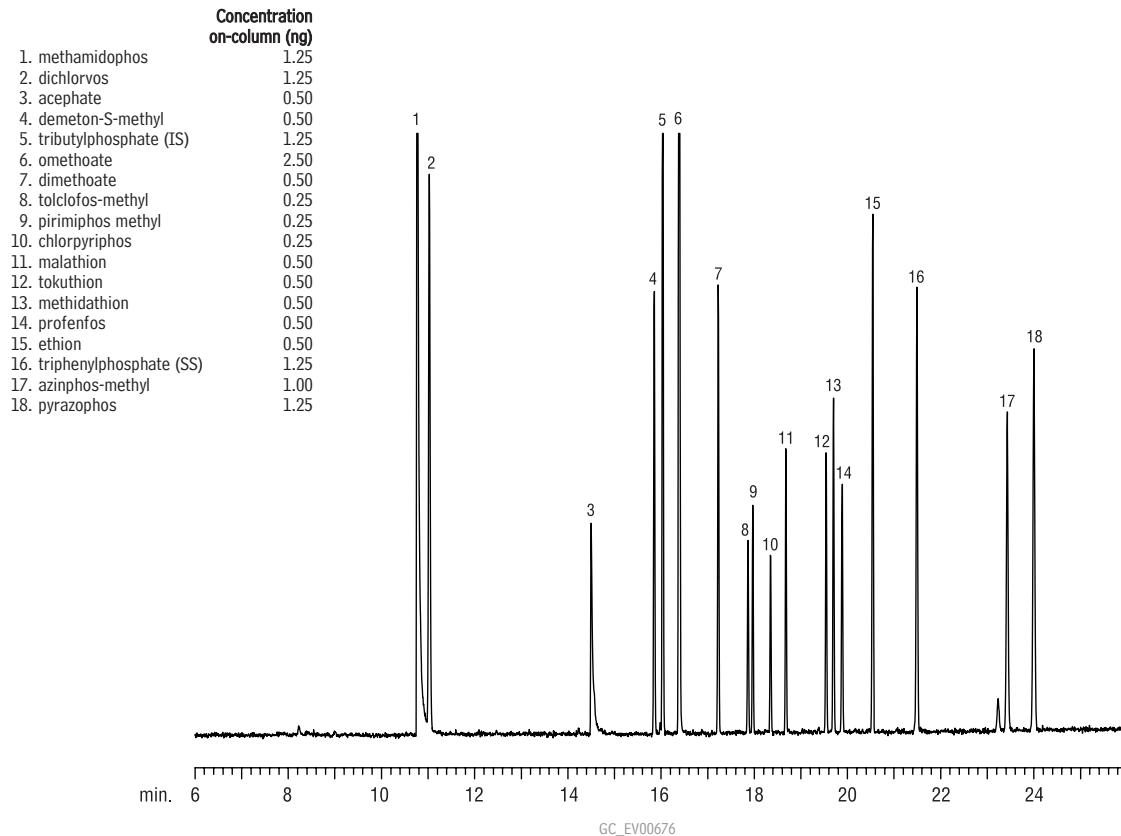
GC_EV00837

Column: Rxi®-1ms, 30m, 0.25mm ID, 0.25 μ m (cat.# 13323)
 Sample: Minnesota Ag List 1 Pesticides Mix A (cat.# 32406),
 Minnesota Ag List 1 Pesticides Mix B (cat.# 32407),
 SV Internal Standard Mix (cat.# 31206),
 B/N Surrogate Mix (4/89 SOW) (cat.# 31024),
 Acid Surrogate Mix (4/89 SOW) (cat.# 31025)
 Inj.: 1.0 μ L, 10 μ g/mL each analyte (internal standards 25 μ g/mL), split (10:1)
 4mm Drilled Uniliner® inlet liner (hole near bottom) (cat.# 20771)
 Instrument: Agilent 6890
 Inj. temp.: 250°C
 Carrier gas: helium, constant flow
 Flow rate: 1.2mL/min.
 Oven temp.: 70°C (hold 1 min.) to 180°C @ 20°C/min., to 230°C @ 5°C/min., to 325°C @ 40°C/min. (hold 3.5 min.)
 Det.: Agilent 5973 MSD
 Transfer line temp.: 280°C
 Scan range: 35-550amu
 Solvent delay: 2.50 min.
 Tune: DFTPP
 Ionization: EI

Pesticides

Organophosphorus Pesticides (European)

Rtx®-CLPesticides

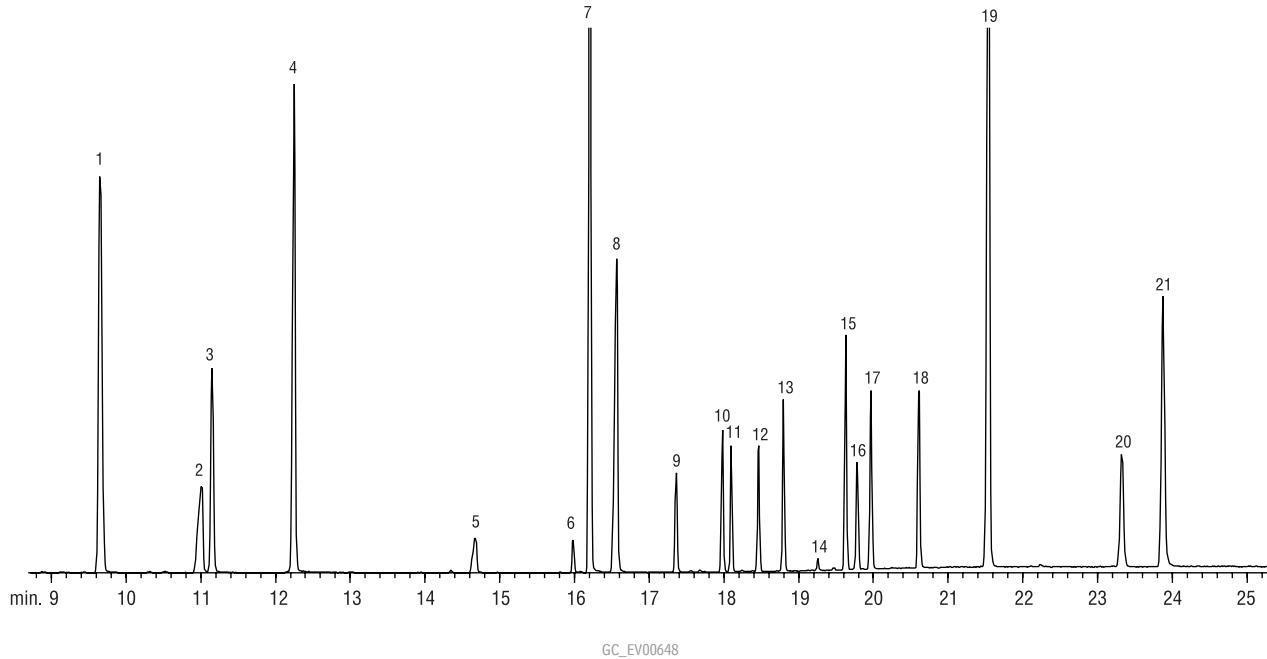


Column: Rtx®-CLPesticides, 30m, 0.32mm ID, 0.50 μ m (cat.# 11139)
 Sample: European OPP Mix (cat.# 32418)
 100–1000 μ g/mL in acetone
 Inj.: 0.5 μ L direct, open-top Siltek® Drilled Uniliner®
 inlet liner (cat.# 21055-214.5)
 Inj. temp.: 250°C
 Carrier gas: helium, constant pressure
 Linear velocity: 35cm/sec. @ 80°C
 Oven temp.: 80°C (hold 1 min.) to 150°C @ 7°C/min.
 to 280°C @ 15°C/min. (hold 10 min.)
 Det.: FPD @ 280°C



Organophosphorus Pesticides (European)

Rtx®-CLPesticides



Column: Rtx®-CLPesticides, 30m, 0.25mm ID, 0.25 μ m (cat.# 11123)
 Sample: Custom European Mix (call for details)
 1-bromo-2-nitrobenzene (cat.# 32279)
 4-chloro-3-nitrobenzotrifluoride (cat.# 32282)
 tributylphosphate (cat.# 32280)
 triphenylphosphate (cat.# 32281)
 Inj.: 1.0 μ L splitless (hold 0.4 min.)
 4mm double gooseneck inlet liner (cat.# 20785)
 Inj. temp.: 250°C
 Carrier gas: helium, constant flow, 6psi head pressure
 Flow rate: 0.75mL/min.
 Linear velocity: 28cm/sec.*
 Dead time: 1.82 min. @ 80°C
 Oven temp.: 80°C (hold 1.0 min.) to 150°C @ 7°C/min. (no hold)
 to 280°C @ 15°C/min. (hold 7 min.)
 Det.: Agilent 5971A GC/MS
 Transfer line temp.: 280°C
 Scan range: 35–400amu
 Solvent Delay: 5 min.
 Tune: PFTBA
 Ionization: EI

*This mix was prepared for FPD analyses. Peaks will be equivalent height with FPD detection if linear velocity is set at 28cm/sec. (0.32mm ID column).

Compound	Conc. on-column (ng)
1. 4-chloro-3-nitro-trifluoride	100
2. methamidophos	50
3. dichlorvos	50
4. 1-bromo-2-nitrobenzene	100
5. acephate	20
6. demeton-S-methyl	20
7. TBP (IS)	100
8. omethoate	100
9. dimethoate	20
10. tolclofos-methyl	10
11. pirimiphos methyl	10
12. chloryrifos	10
13. malathion	20
14. quinalphos	10
15. tokuthion (prothiofos)	20
16. methidathion	20
17. profenfos	20
18. ethion	20
19. TPP (SS)	100
20. azinphos-methyl	40
21. pyrazophos	50

a plus 1 story

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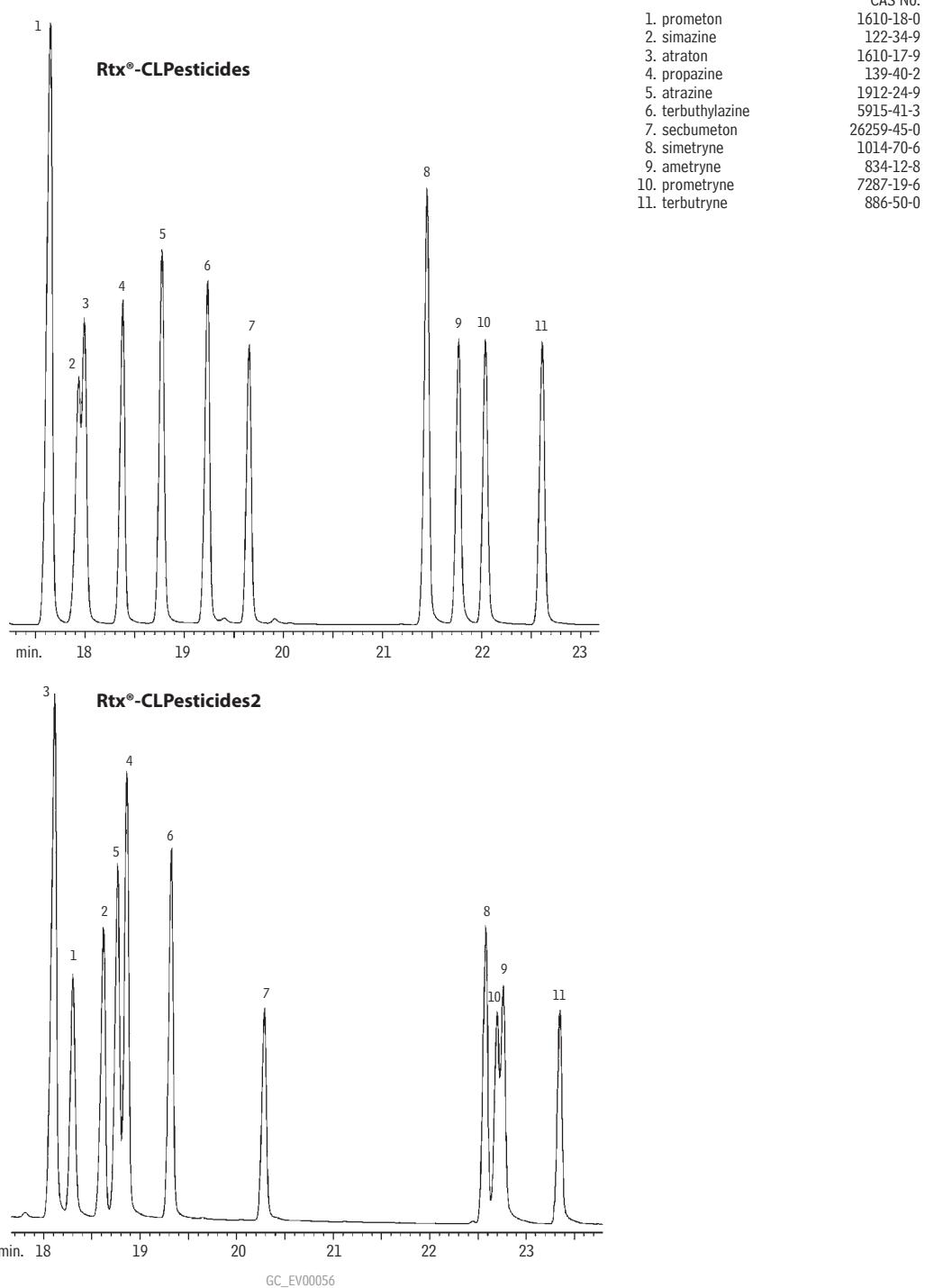
John T. Brunette, Chemist, Bausch & Lomb

Pesticides/Herbicides

Nitrogen/Phosphorus Pesticides & Herbicides

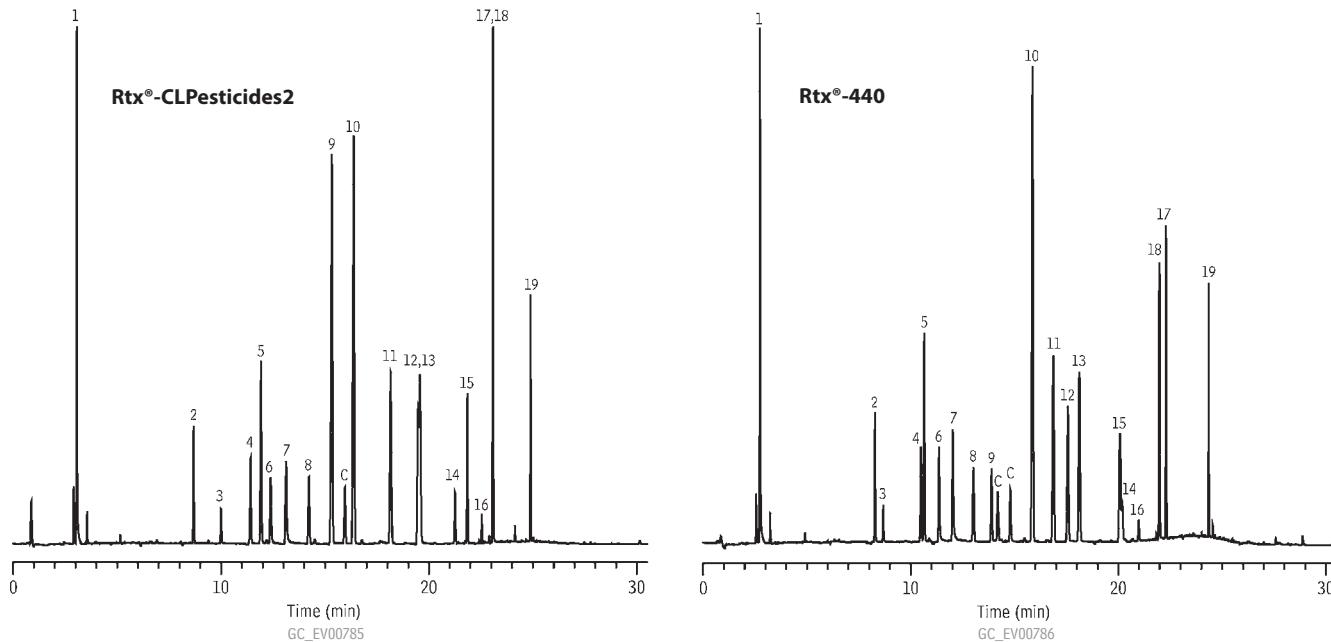
US EPA Method 619

Rtx®-CLPesticides & Rtx®-CLPesticides2 (dual column analysis)



Columns: Rtx®-CLPesticides, 30m, 0.32mm ID, 0.50 μ m (cat.# 11139) and Rtx®-CLPesticides2, 30m, 0.32mm ID, 0.25 μ m (cat.# 11324)
Inj.: with a 5m, 0.32mm ID guard column (cat.# 10044) and a "V" Press-Tight® connector (cat.# 20403)
Conc.: Direct injection using a Uniliner® inlet liner (cat.# 21303) and adaptor for an Agilent 5890 (cat.# 20964)
Oven temp.: On-column, 50 μ g each compound
Inj./det. temp.: 100°C (hold 0 min.) to 250°C @ 4°C/min. (hold 5 min.)
Carrier gas: 250°C/275°C
GC: hydrogen, 9.65psi constant pressure
Agilent 6890 with purged packed injection port

Organochlorine Pesticides
US EPA Method 8151A
Rtx®-CLPesticides2 & Rtx®-440



Columns: Rtx®-CLPesticides2, 30m, 0.25mm ID, 0.50 μ m (cat.# 11325)
 Rtx®-440, 30m, 0.25mm ID, 0.50 μ m (cat.# 12939)

Sample: derivatized (methyl ester) herbicide mixes in hexane:
 Herbicide Mix #1 (cat.# 32055) 200 μ g/mL each component
 Herbicide Mix #2 (cat.# 32057) 2000 μ g/mL each component
 Herbicide Mix #3 (cat.# 32059) 20,000 μ g/mL each component
 Herbicide Mix #4 (cat.# 32062) 200 μ g/mL each component
 Herbicide Surrogate (cat.# 32050) 200 μ g/mL 2,4-dichlorophenyl acetic acid methyl ester (DCAA methyl ester)
 all diluted 1000x in hexane

Inj.: 1.0 μ L splitless (hold 0.75 min.), 2mm Siltek® treated single gooseneck inlet liner (cat.# 20961)
 Inj. temp.: 275°C
 Carrier gas: hydrogen, constant pressure
 Linear velocity: 71cm/sec. @ 110°C
 Oven temp.: 50°C (hold 1 min.) to 140°C @ 20°C/min. to 185°C @ 3°C/min. to 310°C @ 25°C/min. (hold 5 min.)
 Det.: ECD @ 330°C
 Instrument.: Shimadzu GC-2010 with ECD and FID

- 1. dalapon
- 2. 3,5 dichlorobenzoic acid methyl ester
- 3. 4-nitroanisole
- 4. DCAA methyl ester(SS)
- 5. dicamba methyl ester
- 6. MCPP methyl ester
- 7. MCPA methyl ester
- 8. dichlorprop methyl ester
- 9. 2,4-D methyl ester
- 10. pentachloroanisole
- 11. 2,4,5-TP methyl ester
- 12. chloramben methyl ester
- 13. 2,4,5-T methyl ester
- 14. 2,4-DB methyl ester
- 15. dinoseb methyl ester
- 16. bentazon methyl deriv.
- 17. DCPA methyl ester
- 18. picloram methyl ester
- 19. acifluorfen methyl ester
- C=sample contaminant

Herbicides

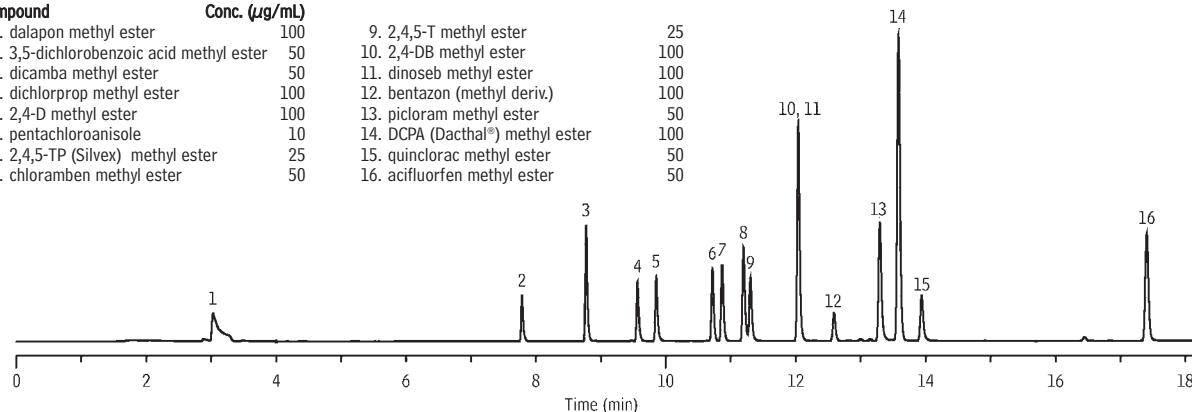
Chlorophenoxyacid Herbicides (methyl esters)

US EPA Method 515 by GC/ECD

Rtx®-440

Compound	Conc. ($\mu\text{g/mL}$)
1. dalapon methyl ester	100
2. 3,5-dichlorobenzoic acid methyl ester	50
3. dicamba methyl ester	50
4. dichlorprop methyl ester	100
5. 2,4-D methyl ester	100
6. pentachloroanisole	10
7. 2,4,5-TP (Silvex) methyl ester	25
8. chloramben methyl ester	50

9. 2,4,5-T methyl ester	25
10. 2,4-DB methyl ester	100
11. dinoseb methyl ester	100
12. bentazon (methyl deriv.)	100
13. picloram methyl ester	50
14. DCPA (Dacthal®) methyl ester	100
15. quinclorac methyl ester	50
16. acifluorfen methyl ester	50



GC_EV00756

Column: Rtx®-440, 30m, 0.32mm ID, 0.25 μm (cat.# 12924)
 Sample: 10-100 $\mu\text{g/mL}$ each methyl ester in MTBE (cat.# 32444)
 Inj.: 1.0 μL splitless (hold 0.45 min.), 4mm Siltek® double gooseneck splitless inlet liner (cat.# 20784-214.1)
 Inj. temp.: 225°C
 Carrier gas: helium, constant pressure
 Inlet pressure: 10.5psi set @ 70°C
 Oven temp.: 70°C (hold 1 min.) to 210°C @ 20°C/min. (hold 1 min.) to 300°C @ 5°C/min.
 Det.: ECD @ 320°C

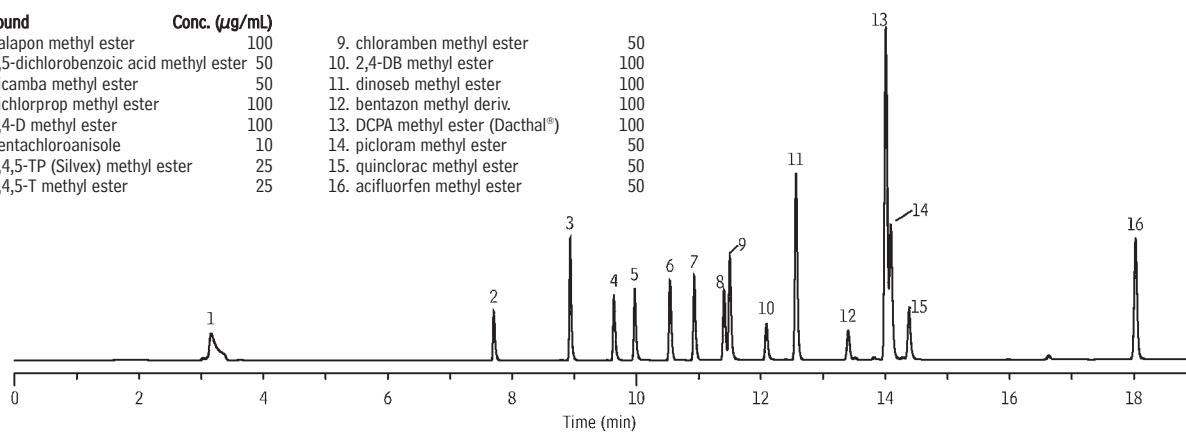
Chlorophenoxyacid Herbicides (methyl esters)

US EPA Method 515 by GC/ECD

Rtx®-CLPesticides2

Compound	Conc. ($\mu\text{g/mL}$)
1. dalapon methyl ester	100
2. 3,5-dichlorobenzoic acid methyl ester	50
3. dicamba methyl ester	50
4. dichlorprop methyl ester	100
5. 2,4-D methyl ester	100
6. pentachloroanisole	10
7. 2,4,5-TP (Silvex) methyl ester	25
8. 2,4,5-T methyl ester	25

9. chloramben methyl ester	50
10. 2,4-DB methyl ester	100
11. dinoseb methyl ester	100
12. bentazon methyl deriv.	100
13. DCPA methyl ester (Dacthal®)	100
14. picloram methyl ester	50
15. quinclorac methyl ester	50
16. acifluorfen methyl ester	50



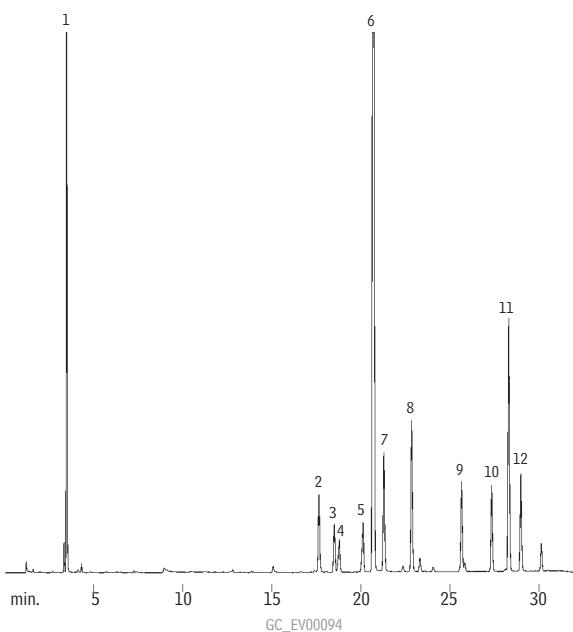
GC_EV00755

Column: Rtx®-CLPesticides2, 30m, 0.32mm ID, 0.25 μm (cat.# 11324)
 Sample: 10-100 $\mu\text{g/mL}$ each methyl ester in MTBE (cat.# 32444)
 Inj.: 1.0 μL splitless (hold 0.45 min.), 4mm Siltek® double gooseneck splitless inlet liner (cat.# 20784-214.1)
 Inj. temp.: 225°C
 Carrier gas: helium, constant pressure
 Inlet pressure: 10.5psi set @ 70°C
 Oven temp.: 70°C (hold 1 min.) to 210°C @ 20°C/min. (hold 1 min.) to 300°C @ 5°C/min.
 Det.: ECD @ 320°C

Chlorophenoxyacid Herbicides**US EPA Method 615****Rtx®-35**

**Analysis optimized
using Pro ezGC™
software!**

1. dalapon
2. DCAA (SS)
3. dicamba
4. MCPP
5. MCPA
6. DBOB (IS)
7. dichlorprop
8. 2,4-D
9. 2,4,5-TP
10. 2,4,5-T
11. dinoseb
12. 2,4-DB

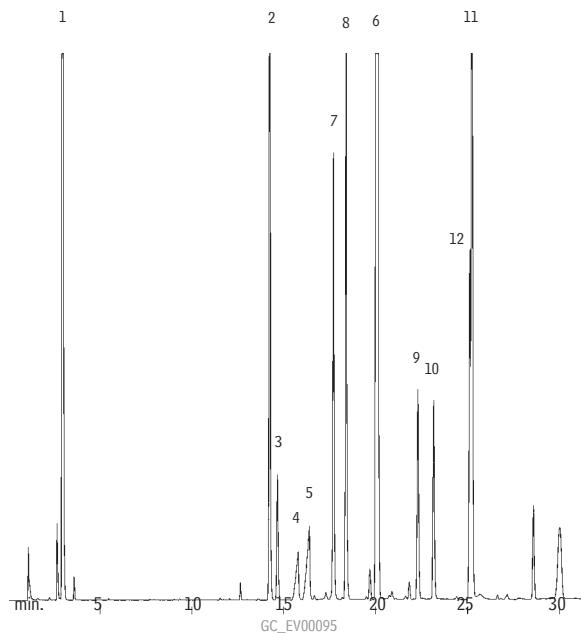


Column: Rtx®-35, 30m, 0.53mm ID, 0.50 μ m (cat.# 10440)
 Sample: 0.5 μ L direct injection of chlorophenoxy herbicides,
 on-column concentration 10–10,000 μ g/mL
 Oven temp.: 60°C to 150°C @ 8°C/min. (hold 5 min.),
 to 210°C @ 4°C/min.
 Inj./det. temp.: 250°C/275°C
 Carrier gas: helium
 Linear velocity: 35cm/sec. set @ 60°C
 Det.: ECD w/anode purge

**Chlorophenoxyacid Herbicides****US EPA Method 615****Rtx®-5**

**Analysis optimized
using Pro ezGC™
software!**

1. dalapon
2. DCAA (SS)
3. dicamba
4. MCPP
5. MCPA
6. DBOB (IS)
7. dichlorprop
8. 2,4-D
9. 2,4,5-TP
10. 2,4,5-T
11. dinoseb
12. 2,4-DB



Column: Rtx®-5, 30m, 0.53mm ID, 0.50 μ m (cat.# 10240)
 Sample: 0.5 μ L direct injection of chlorophenoxy herbicides,
 on-column concentration 10–10,000 μ g/mL
 Oven temp.: 60°C to 150°C @ 8°C/min. (hold 5 min.),
 to 210°C @ 4°C/min.
 Inj./det. temp.: 250°C/275°C
 Carrier gas: helium
 Linear velocity: 35cm/sec. set @ 60°C
 Det.: ECD w/anode purge

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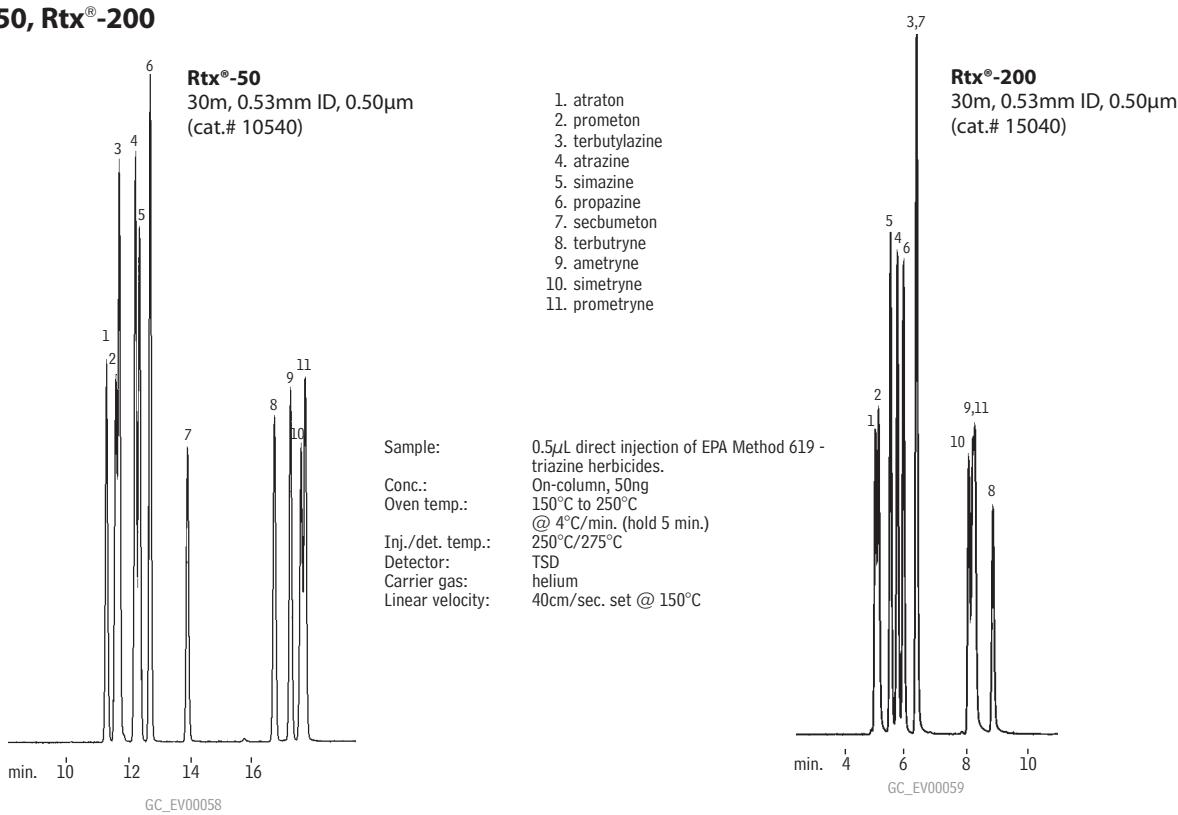
Visit www.restek.com for details.

Herbicides

Triazine Herbicides

US EPA Method 619

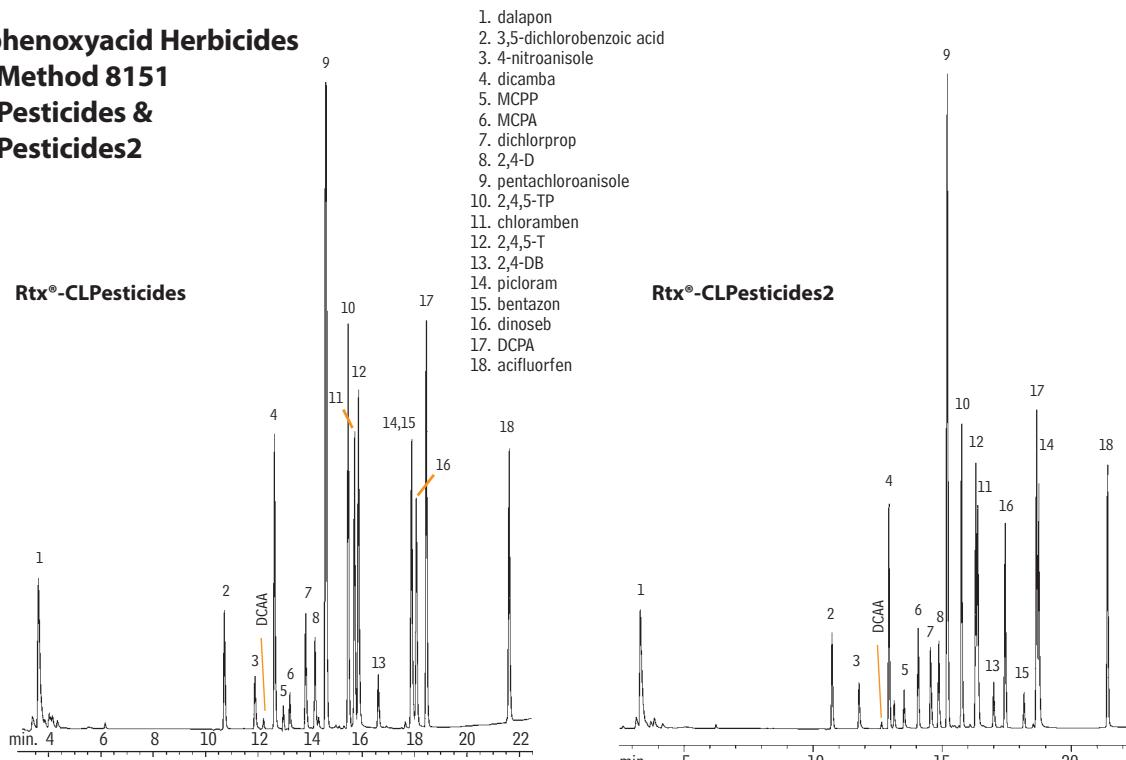
Rtx®-50, Rtx®-200



Chlorophenoxyacid Herbicides

US EPA Method 8151

Rtx®-CLPesticides & Rtx®-CLPesticides2



Columns:

Rtx®-CLPesticides, 30m, 0.32mm ID, 0.50µm (cat.# 11139)
and Rtx®-CLPesticides2, 30m, 0.32mm ID, 0.25µm (cat.# 11324)

Inj.:

1.0µL direct injection of derivatized chlorophenoxy herbicides, Uniliner® inlet liner (cat.# 20335)

Conc.:

on-column, 200–20,000pg/mL

Open temp.:

80°C (hold 1 min.) to 300°C @ 10°C/min. (hold 10 min.)
200°C/300°C

Inj./det. temp.:

ECD w/anode purge

Carrier gas:

helium

Inlet pressure:

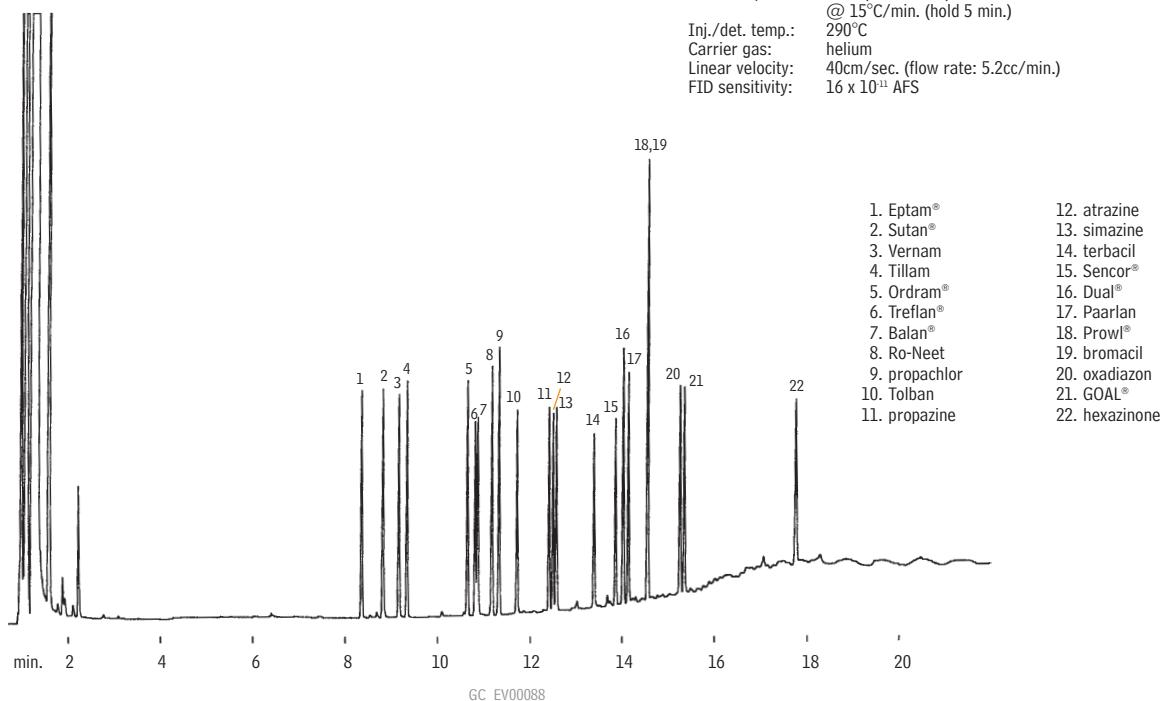
12.5psi set @ 80°C

Det.:

ECD w/anode purge

Nitrogen-Containing Herbicides

Rtx®-35

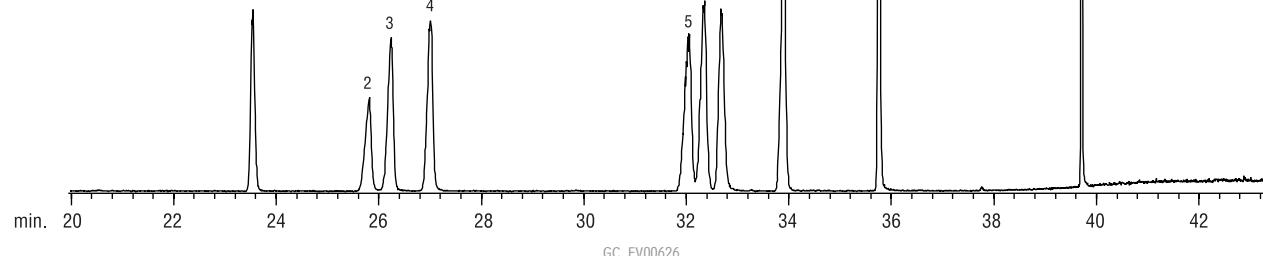


Triazine Herbicides (French) & Degradation Products

Rtx®-OPPesticides2

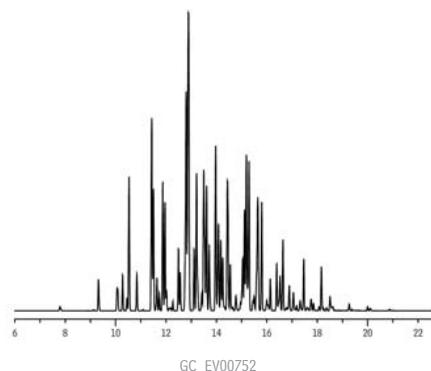
Peak List:	CAS#
1. trifluralin	1582-09-8
2. desisopropylatrazine	1007-28-9
3. desethyl-atrazine	6190-65-4
4. desethyl-terbutylazine	—
5. simazine	122-34-9
6. atrazine	1912-24-9
7. terbumeton	33693-04-8
8. terbutylazine	5915-41-3
9. secbumeton	26259-45-0
10. cyanazine	21725-46-2

Column: Rtx®-OPPesticides2, 30m, 0.25mm ID, 0.25 μ m (cat.# 11243)
 Sample: custom standard, 100ng/ μ L each component
 Inj.: 1.0 μ L splitless (hold 0.5 min.), 4mm single gooseneck inlet liner (cat.# 20904)
 Inj. temp.: 300°C
 Carrier gas: helium, constant pressure
 Flow rate: 1.0mL/min. @ 80°C (27.22cm/sec.)
 Oven temp.: 80°C (hold 1 min.) to 140°C @ 25°C/min. (hold 5 min.) to 165°C @ 1°C/min. to 300°C @ 15°C (hold 1 min.)
 Det: Agilent 5971A GC/MS
 Transfer line temp.: 280°C
 Scan range: 35-360amu
 Ionization: EI



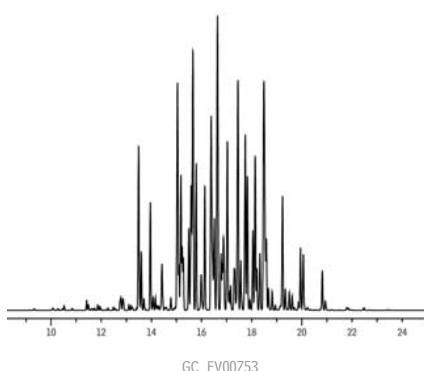
PCB Mixtures

Aroclor 1242 PCBs Rtx®-PCB



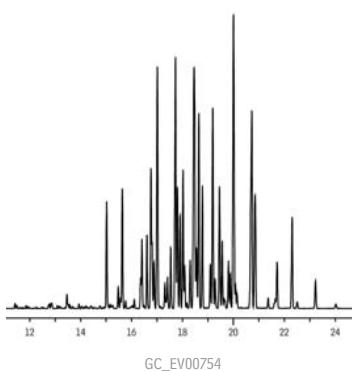
Sample: 200ng/mL Aroclor 1242 (cat.# 32009)

Aroclor 1254 PCBs Rtx®-PCB



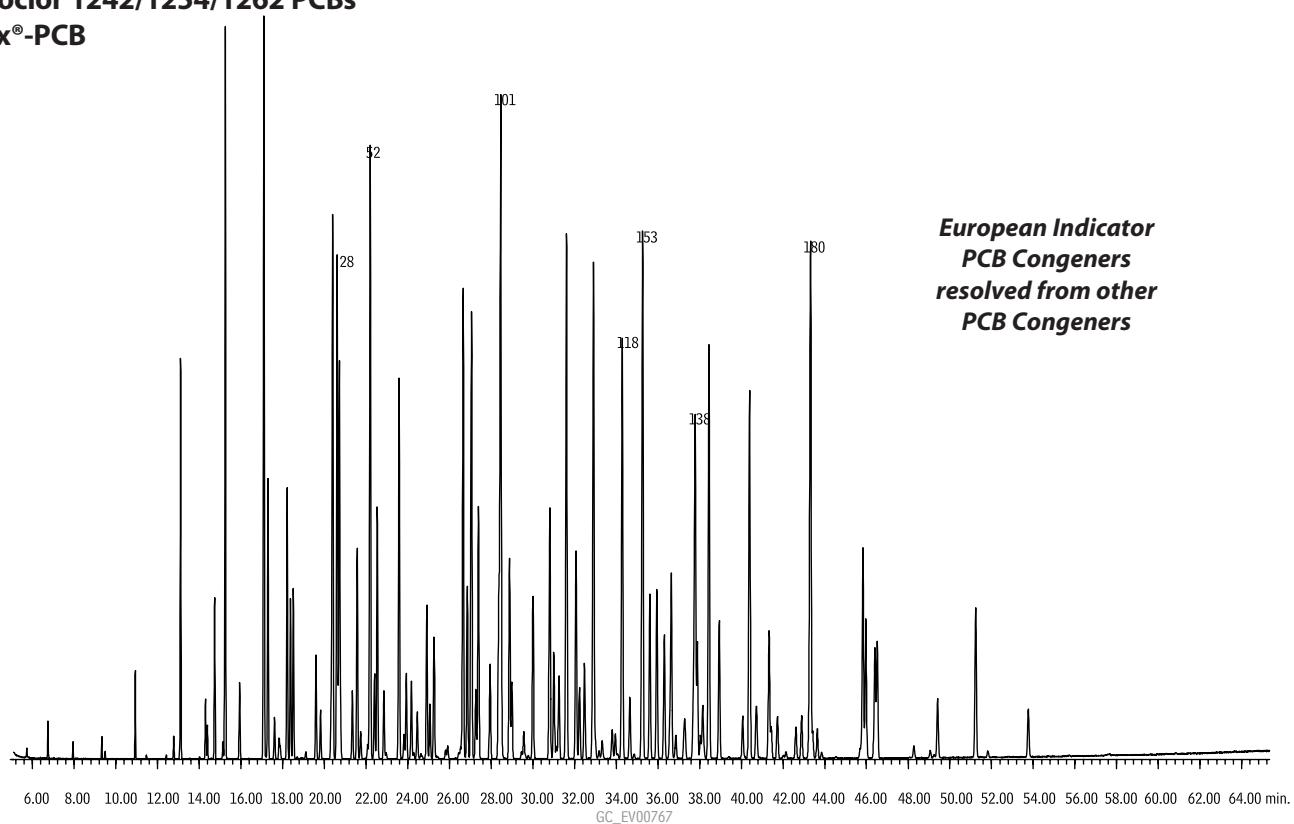
Sample: 200ng/mL Aroclor 1254 (cat.# 32011)
Column: Rtx®-PCB, 30m, 0.25mm ID, 0.25 μ m (cat.# 13223)
Inj.: 1.0 μ L splitless (hold 0.75 min.), 3.5mm ID single gooseneck inlet liner (cat.# 20962)
Inj. temp.: 250°C
Carrier gas: hydrogen, constant pressure
Linear velocity: 71cm/sec. @ 110°C
Oven temp.: 100°C (hold 1.0 min.) to 300°C @ 10°C/min.
(hold 4 min.)
Det.: ECD @ 310°C

Aroclor 1260 PCBs Rtx®-PCB



Sample: 200ng/mL Aroclor 1260 (cat.# 32012)

Aroclor 1242/1254/1262 PCBs Rtx®-PCB



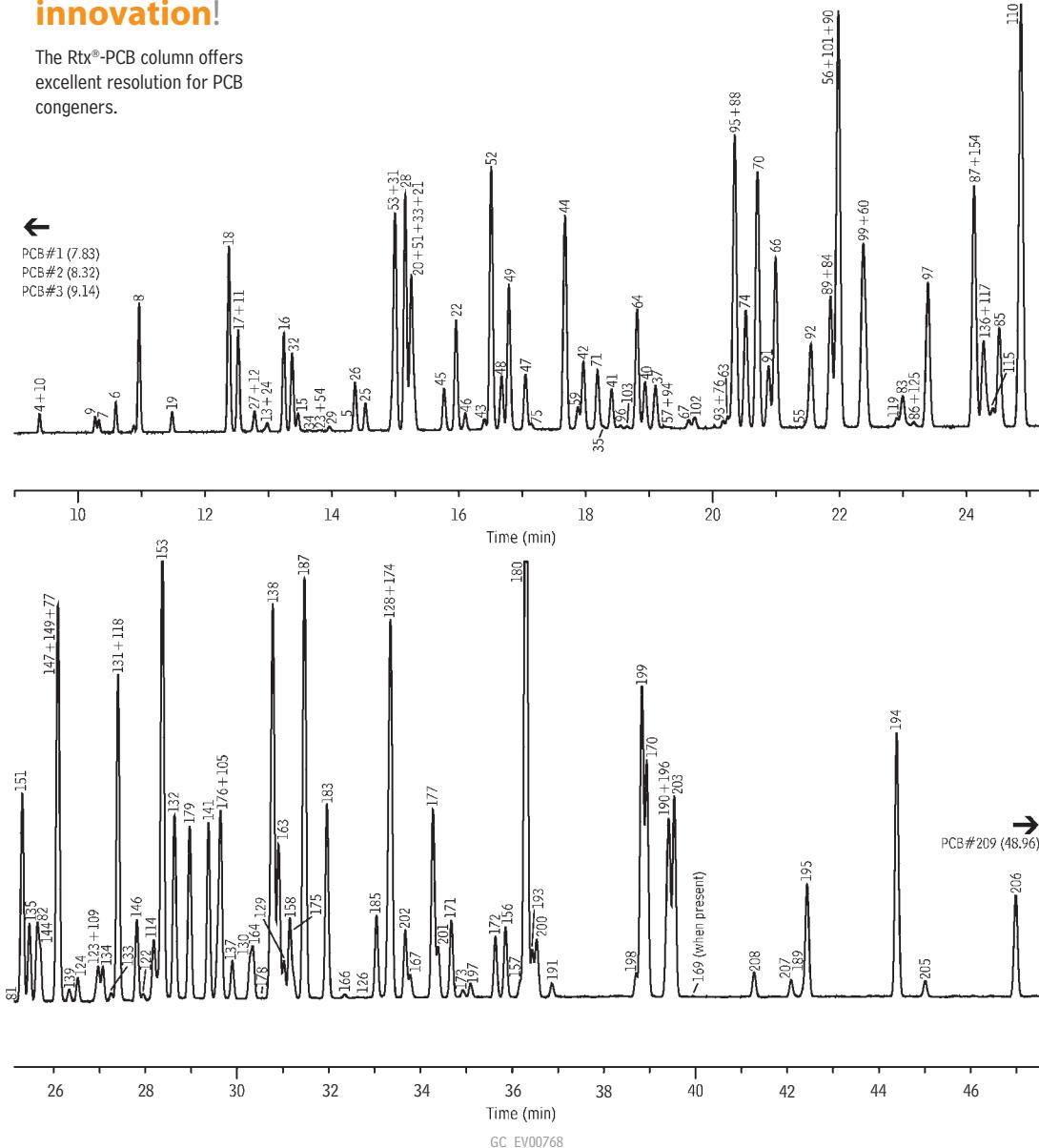
Column: Rtx®-PCB, 60m, 0.25mm ID, 0.25 μ m (cat.# 13226)
Sample: Aroclor 1242 (cat.# 32009), 1254 (cat.# 32011), 1262 (cat.# 32409), 333ppm each
Inj.: 1.0 μ L splitless (hold 0.75 min.), 4mm single gooseneck inlet liner w/wool (cat.# 22405)
Inj. temp.: 280°C
Carrier gas: helium, constant flow
Flow rate: 1.1mL/min.
Oven temp.: 100°C (hold 1 min.) to 200°C @ 30°C/min., to 320°C @ 2°C/min. (hold 1 min.)
Det.: MS
Transfer line temp.: 280°C
Scan range: 50 to 550amu
Ionization: EI
Mode: scan

Aroclor 1242/1254/1262 PCBs

Rtx®-PCB

restek
innovation!

The Rtx®-PCB column offers excellent resolution for PCB congeners.

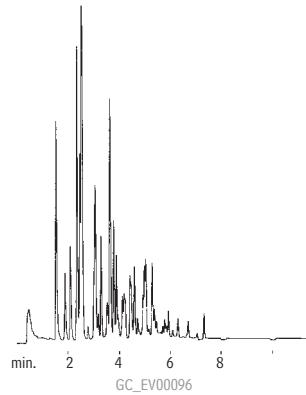


Column: Rtx®-PCB, 40m, 0.18mm ID, 0.18 μ m (cat.# 41303)
 Sample: 300ng/mL Aroclor 1242/1254/1262 in hexane: Aroclor 1242 (cat.# 32009),
 Aroclor 1254 (cat.# 32011), Aroclor 1262 (cat.# 32409)
 Inj.: 1.0 μ L splitless (hold 0.75 min.), 4mm single gooseneck inlet liner (cat.# 20983)
 Inj. temp.: 230°C
 Carrier gas: hydrogen, constant pressure
 Linear velocity: 40cm/sec. @ 100°C
 Oven temp.: 100°C (hold 1 min.) to 200°C @ 30°C/min., to 320°C @ 2°C/min. (hold 1 min.)
 Det.: ECD @ 330°C

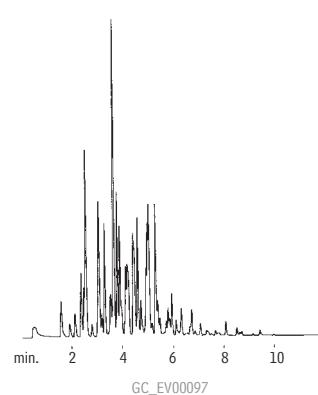
PCB Mixtures

Aroclor PCBs (Quick Screening) Rtx®-5

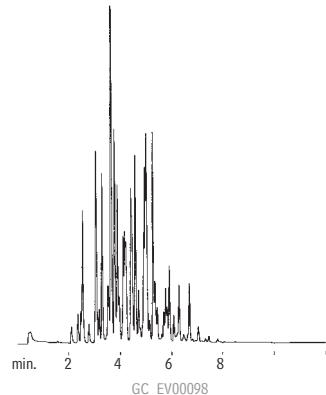
Aroclor 1221 Mix (cat.# 32007)



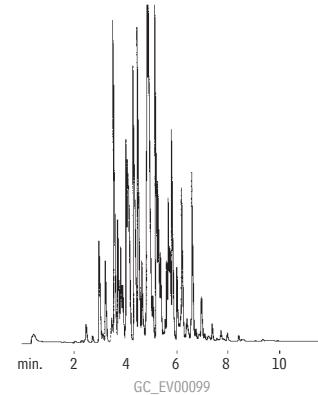
Aroclor 1232 Mix (cat.# 32008)



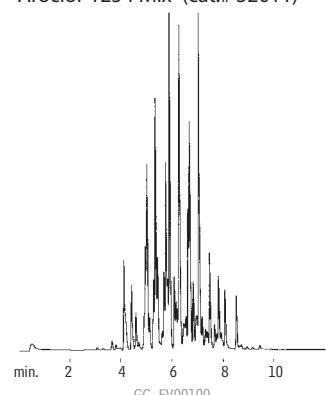
Aroclor 1242 Mix (cat.# 32009)



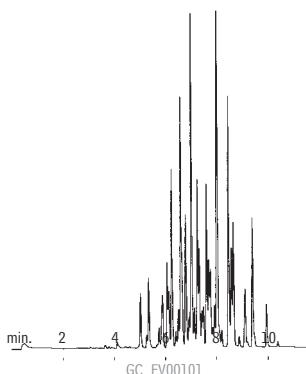
Aroclor 1248 Mix (cat.# 32010)



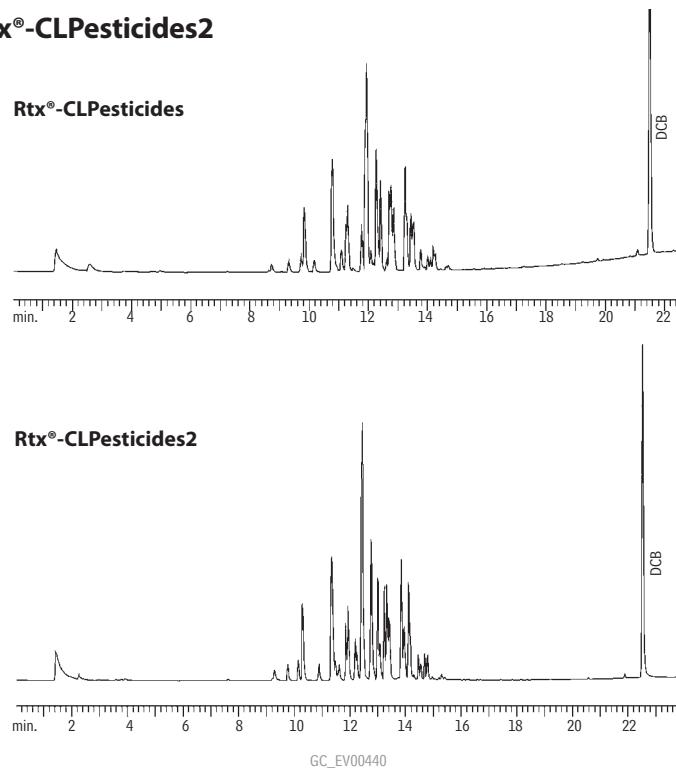
Aroclor 1254 Mix (cat.# 32011)



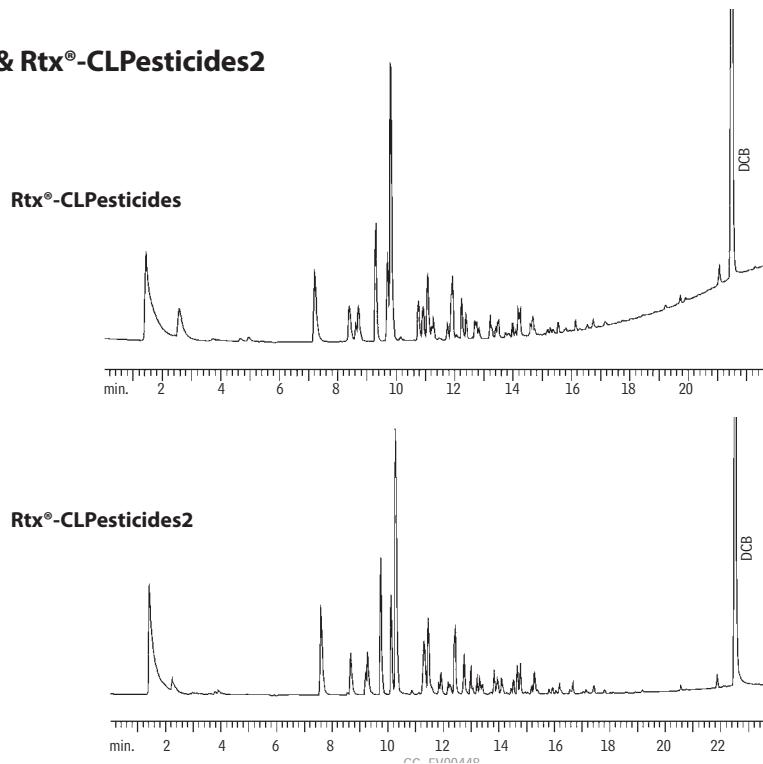
Aroclor 1260 Mix (cat.# 32012)



Column: Rtx®-5, 15m, 0.53mm ID, 0.50 μ m (cat.# 10237)
 Inj.: 1.0 μ L direct injection
 Conc.: 50ppm
 Oven temp.: 150°C to 300°C @ 12°C/min. (hold 5 min.)
 Inj./det. temp.: 250°C/310°C
 Carrier gas: helium
 Linear velocity: 30cm/sec. set @ 150°C
 ECD sensitivity: 16kHz full scale

Aroclor 1016 PCBs**Rtx®-CLPesticides & Rtx®-CLPesticides2**

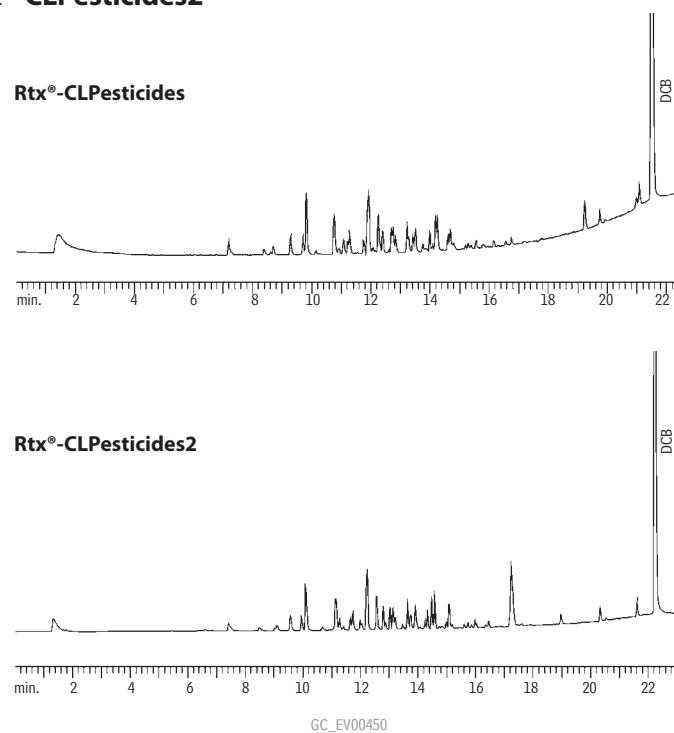
Columns: Rtx®-CLPesticides, 30m, 0.32mm ID, 0.50 μ m (cat.# 11139)
 Rtx®-CLPesticides2, 30m, 0.32mm ID, 0.25 μ m (cat.# 11324)
 Inj.: 0.5 μ L direct injection, 160pg on-column concentration
 Oven temp.: 120°C (hold 1 min.) to 300°C @ 9°C/min. (hold 10 min.)
 Inj. temp.: 210°C
 Det.: ECD with anode purge, 310°C
 Carrier gas: helium

Aroclor 1221 PCBs**Rtx®-CLPesticides & Rtx®-CLPesticides2**

PCB Mixtures

Aroclor 1232 PCBs

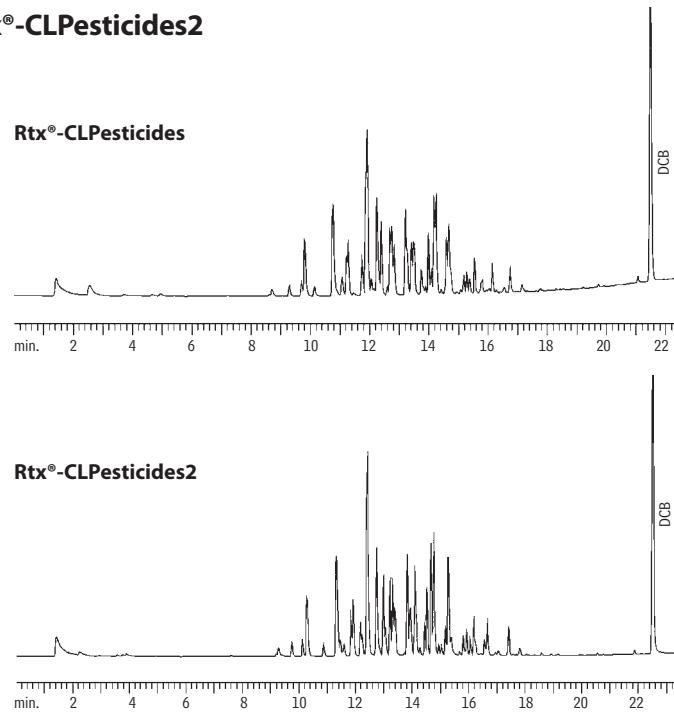
Rtx®-CLPesticides & Rtx®-CLPesticides2

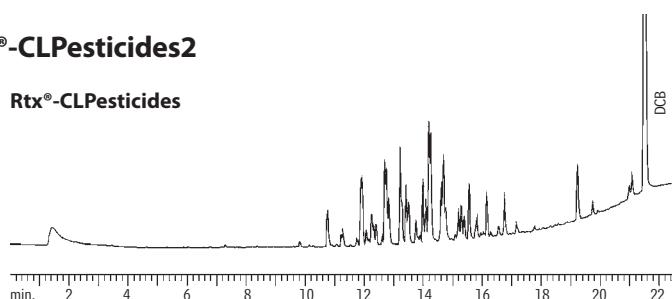
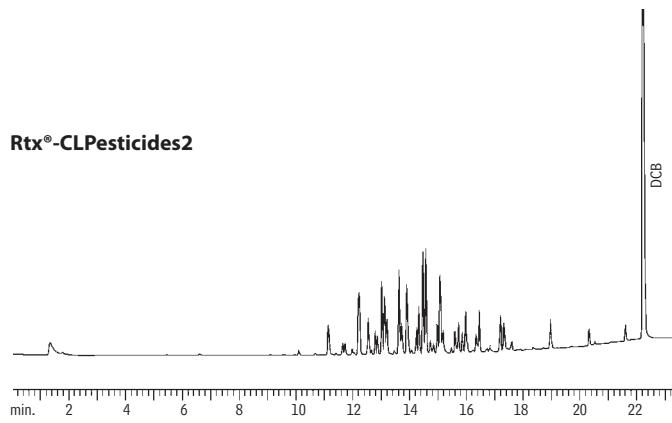


Columns: Rtx®-CLPesticides, 30m, 0.32mm ID, 0.50 μ m (cat.# 11139)
 Rtx®-CLPesticides2, 30m, 0.32mm ID, 0.25 μ m (cat.# 11324)
 Inj.: 0.5 μ L direct injection, 160pg on-column concentration.
 Oven temp.: 120°C (hold 1 min.) to 300°C @ 9°C/min. (hold 10 min.)
 Inj. temp.: 210°C
 Det.: ECD with anode purge, 310°C
 Carrier gas: helium

Aroclor 1242 PCBs

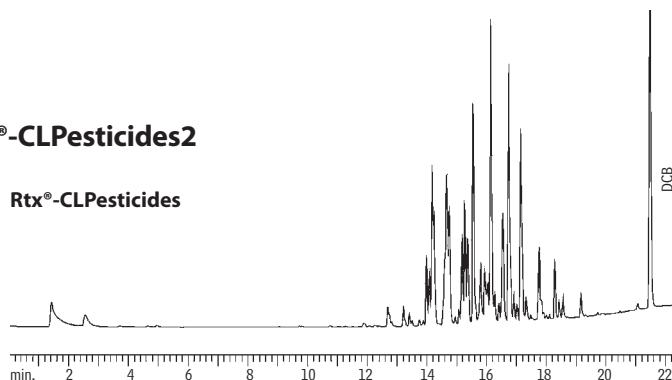
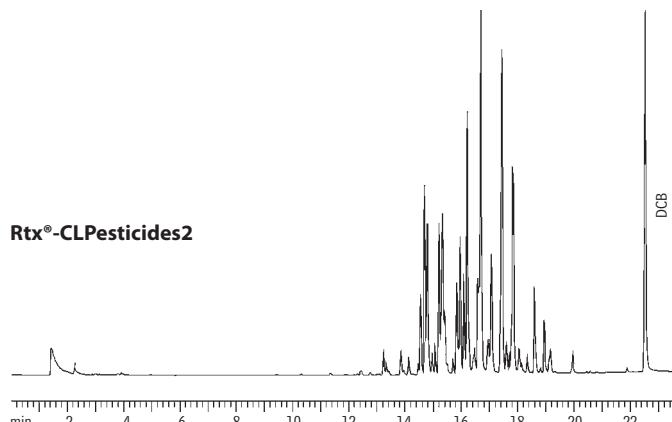
Rtx®-CLPesticides & Rtx®-CLPesticides2



Aroclor 1248 PCBs**Rtx®-CLPesticides & Rtx®-CLPesticides2****Rtx®-CLPesticides****Rtx®-CLPesticides2**

GC_EV00453

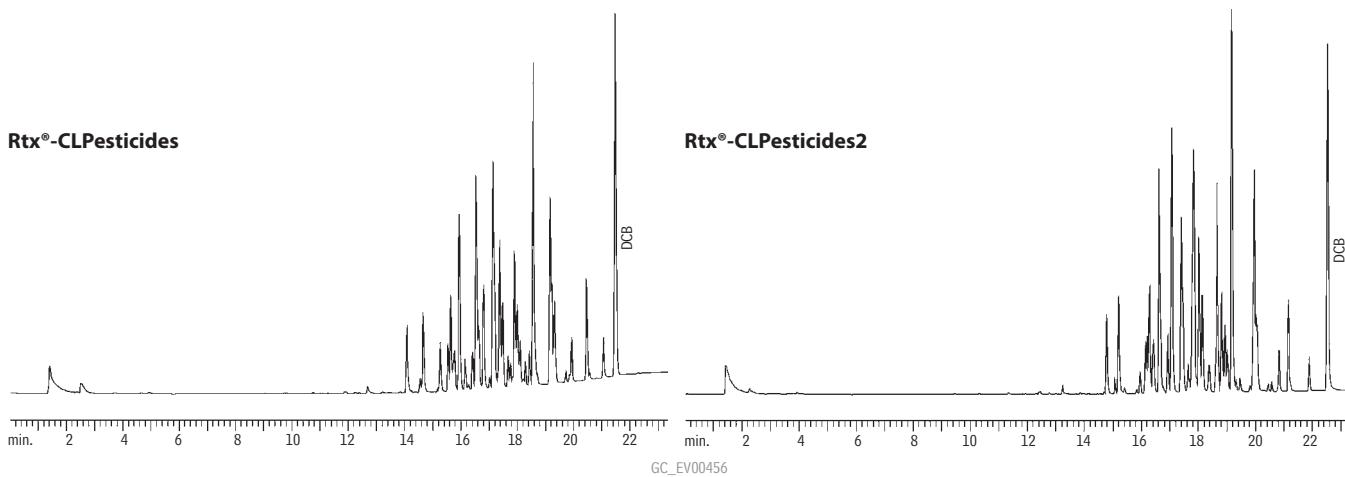
Columns: Rtx®-CLPesticides, 30m, 0.32mm ID, 0.50 μ m (cat.# 11139)
 Rtx®-CLPesticides2, 0.32mm ID, 0.25 μ m (cat.# 11324)
 Inj.: 0.5 μ L direct injection, 160pg on-column concentration
 Oven temp.: 120°C (hold 1 min.) to 300°C @ 9°C/min. (hold 10 min.)
 Inj. temp.: 210°C
 Det.: ECD with anode purge, 310°C
 Carrier gas: helium

Aroclor 1254 PCBs**Rtx®-CLPesticides & Rtx®-CLPesticides2****Rtx®-CLPesticides****Rtx®-CLPesticides2**

PCB Mixtures

Aroclor 1260 PCBs

Rtx®-CLPesticides & Rtx®-CLPesticides2



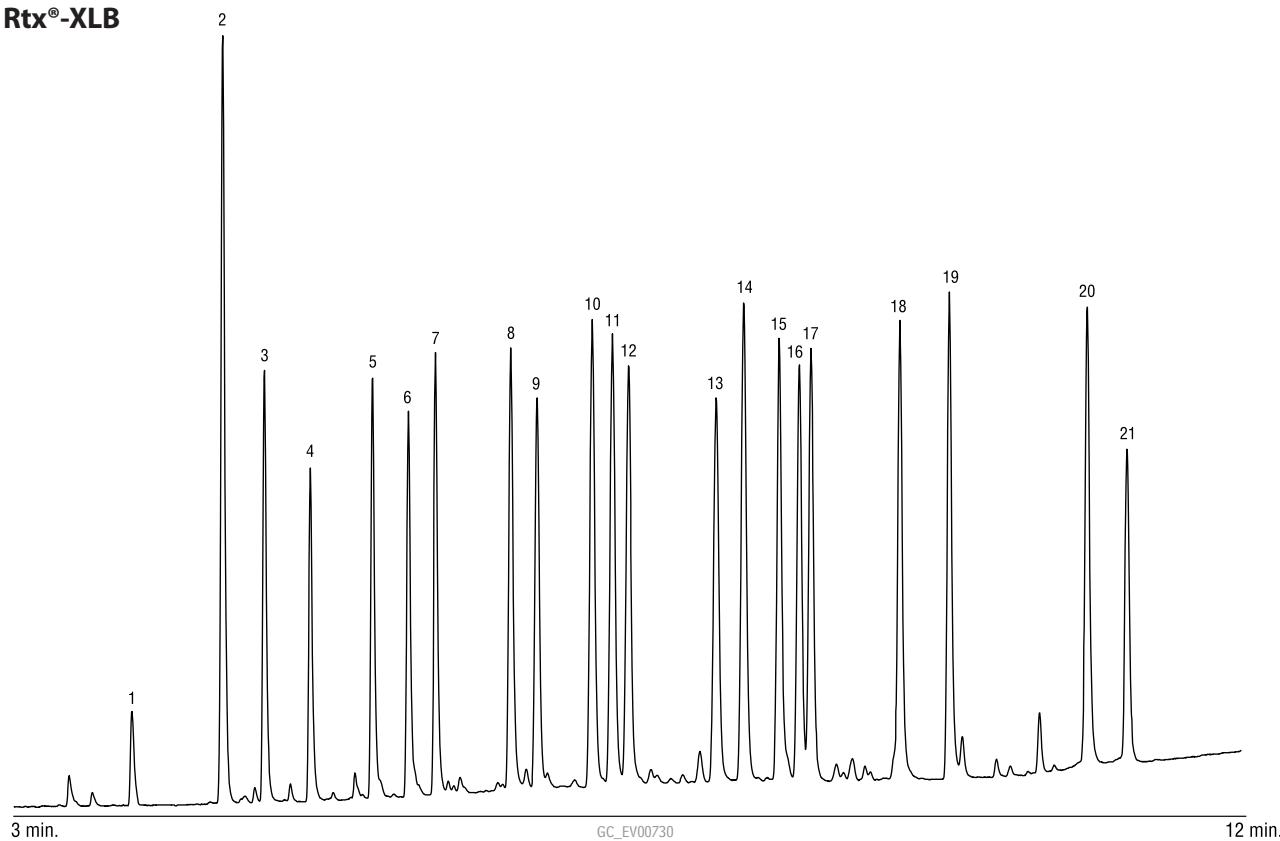
Columns: Rtx®-CLPesticides, 30m, 0.32mm ID, 0.50 μ m (cat.# 11139)
 Rtx®-CLPesticides2, 0.32mm ID, 0.25 μ m (cat.# 11324)
 Inj.: 0.5 μ L direct injection, 160pg on-column concentration
 Oven temp.: 120°C (hold 1 min.) to 300°C @ 9°C/min. (hold 10 min.)
 Inj. temp.: 210°C
 Det.: ECD with anode purge, 310°C
 Carrier gas: helium

it's a fact

Restek On-The-Road training seminars are full-day courses presented in an engaging multimedia format. They are equally valuable to beginning chromatographers, those who have moderate experience and want a better understanding of the subject matter, and those interested in the "best practices" and latest technologies. **No sales pitch is presented**, just the facts on how to make your chromatography results better. The bulk of each course is lecture, but numerous demonstrations and problem-solving exercises facilitate and reinforce the understanding of important principles. See page 11 or visit www.restek.com for more information.

PCB Congeners

Rtx®-XLB



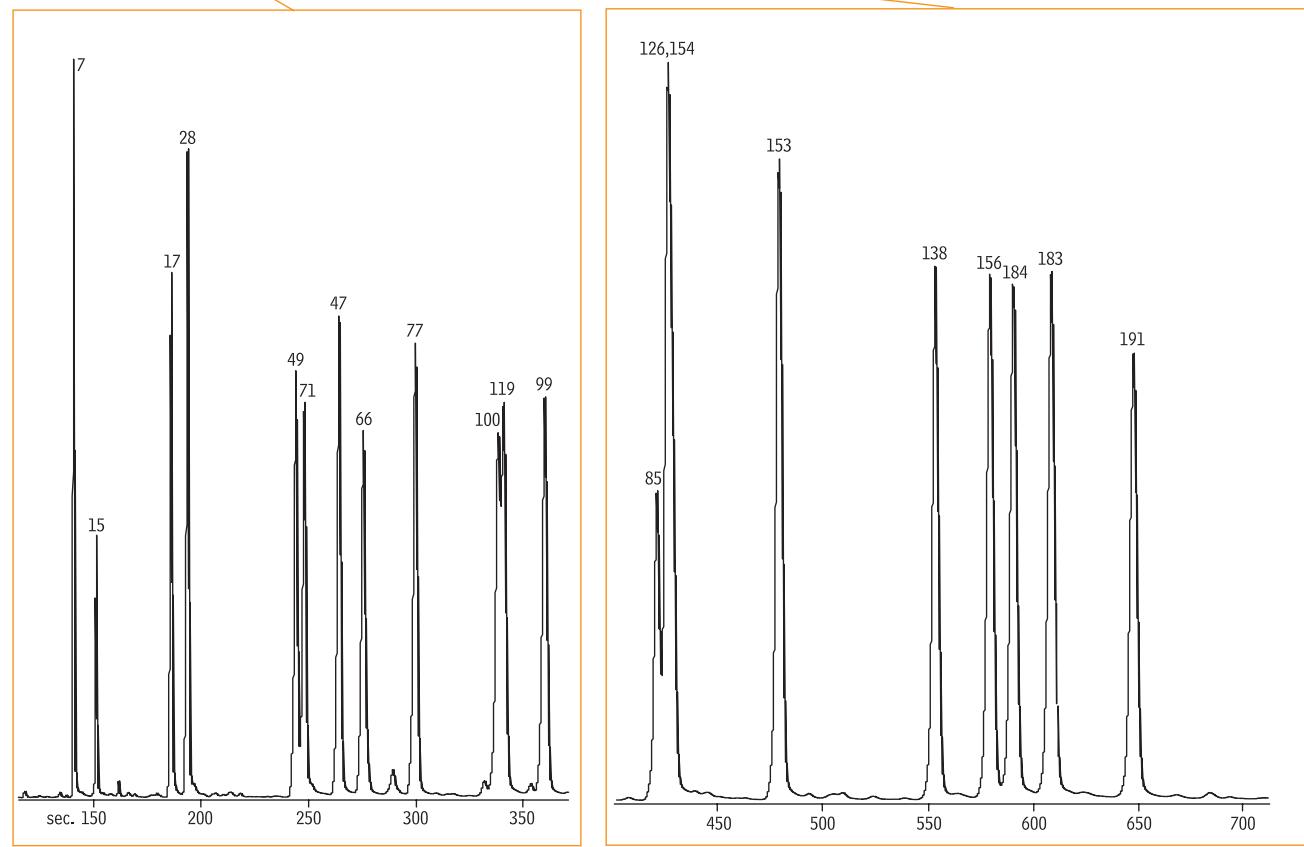
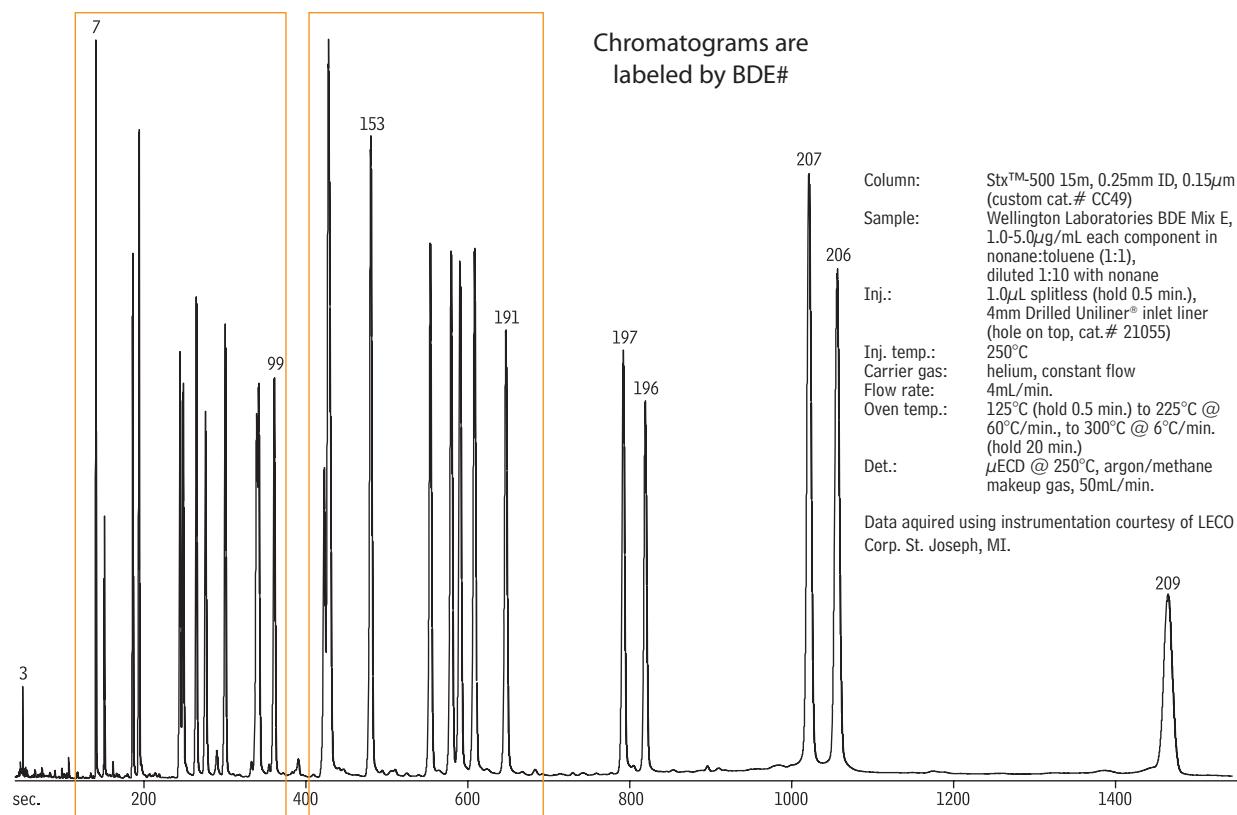
Column: Rtx®-XLB, 30m, 0.32mm ID, 0.50 μ m (cat.# 12839)
 Sample: 200ppb each PCB congener in hexane (cat.# 32416), 200ppb
 2,4,5,6-tetrachloro-*m*-xylene (SS) (cat.# 32027), 100ppb
 decachlorobiphenyl (IS) (cat.# 32289)
 Inj.: 1.0 μ L splitless (hold 0.75 min.), 4mm Drilled Uniliner® inlet liner (cat.# 21055)
 Inj. temp.: 220°C
 Carrier gas: hydrogen, constant pressure
 Linear velocity: 66cm/sec. @ 120°C
 Oven temp.: 120°C (hold 0.5 min.) to 260°C @ 29°C/min. (hold 2.5 min.), to 330°C @
 28°C/min. (hold 5 min.)
 Det.: ECD @ 320°C

Compound	RT (min.)
1. 2-chlorobiphenyl	3.86
2. 2,4,5,6-tetrachloro- <i>m</i> -xylene (SS)	4.53
3. 2,3-dichlorobiphenyl	4.83
4. 2,2',5-trichlorobiphenyl	5.17
5. 2,4',5-trichlorobiphenyl	5.63
6. 2,2',5,5'-tetrachlorobiphenyl	5.89
7. 2,2',3,5'-tetrachlorobiphenyl	6.09
8. 2,3,4,4'-tetrachlorobiphenyl	6.64
9. 2,2',4,5,5'-pentachlorobiphenyl	6.84
10. 2,2',3,4,5'-pentachlorobiphenyl	7.24
11. 2,3,3',4',6-pentachlorobiphenyl	7.39
12. 2,2',3,5,5',6-hexachlorobiphenyl	7.51
13. 2,2',4,4',5,5'-hexachlorobiphenyl	8.15
14. 2,2',3,4,5,5'-hexachlorobiphenyl	8.35
15. 2,2',3,4,4',5'-hexachlorobiphenyl	8.61
16. 2,2',3,4',5,5'-heptachlorobiphenyl	8.76
17. 2,2',3,4,4',5'-heptachlorobiphenyl	8.84
18. 2,2',3,4,4',5,5'-heptachlorobiphenyl	9.50
19. 2,2',3,3',4,4',5-heptachlorobiphenyl	9.86
20. 2,2',3,3',4,4',5,5',6-nonachlorobiphenyl	10.87
21. decachlorobiphenyl (SS)	11.17

Polybrominated Diphenyl Ethers (PBDEs)

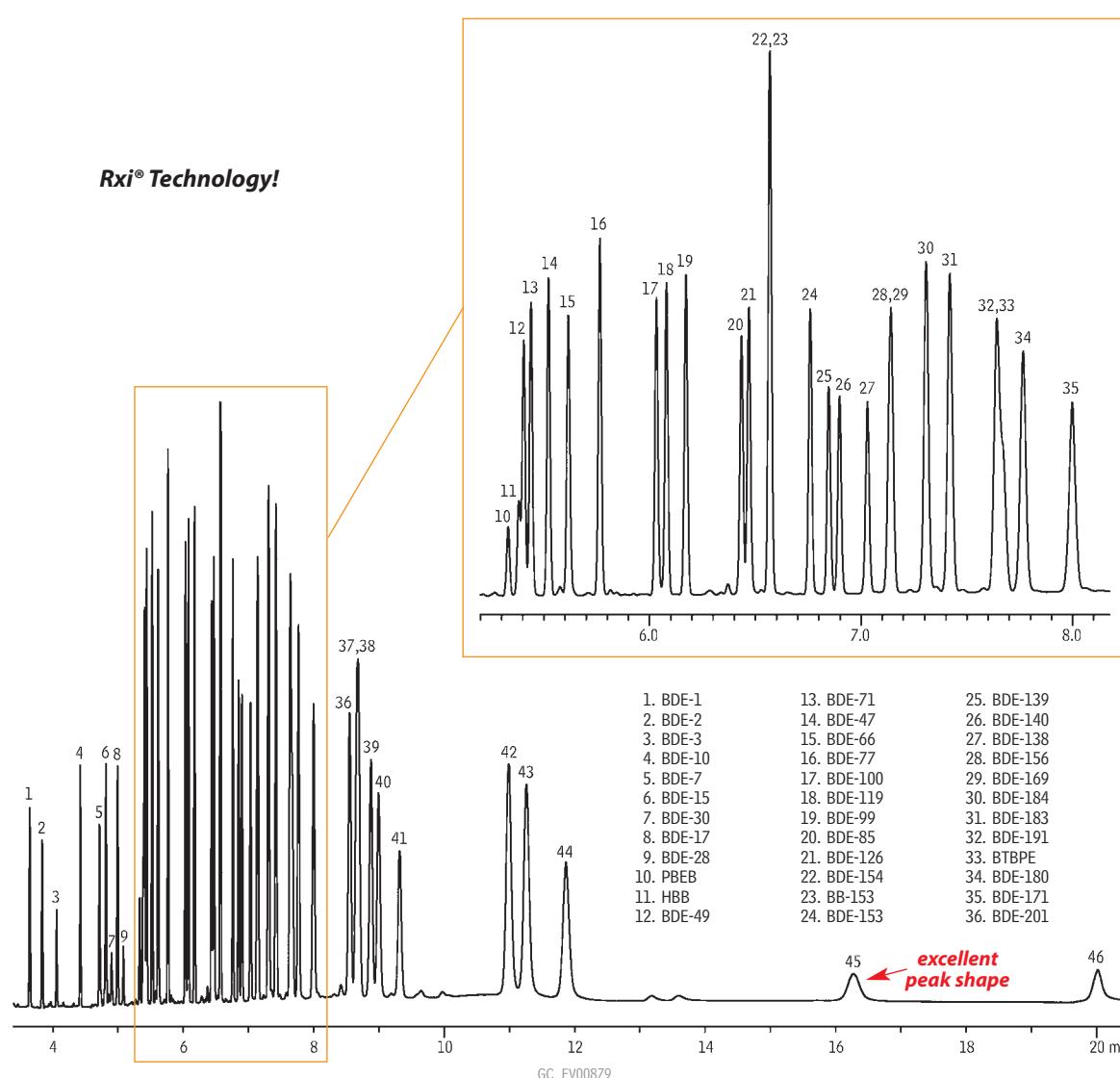
Polybrominated Diphenyl Ethers (PBDEs)

Stx™-500



Brominated Flame Retardants**new!**

BFR-PAR Mix
Rxi®-5ms

Rxi® Technology!

Column: Rxi®-5ms, 15m, 0.25mm ID, 0.25µm (cat.# 13420)
 Sample: Wellington BFR-PAR Mix (Wellington Laboratories Inc., Guelph, Ontario, Canada; Wellington cat.# BFR-PAR)
 Inj.: 1.0µL splitless (hold 1 min.), 4mm Siltek® goose-neck inlet liner (cat.# 20798-214.1)
 Inj. temp.: 220°C
 Carrier gas: helium, constant flow
 Linear velocity: 40cm/sec. @ 100°C
 Oven temp.: 100°C (hold 1 min.) to 295°C @ 25°C/min. (hold 7 min.)
 Det.: ECD @ 300°C

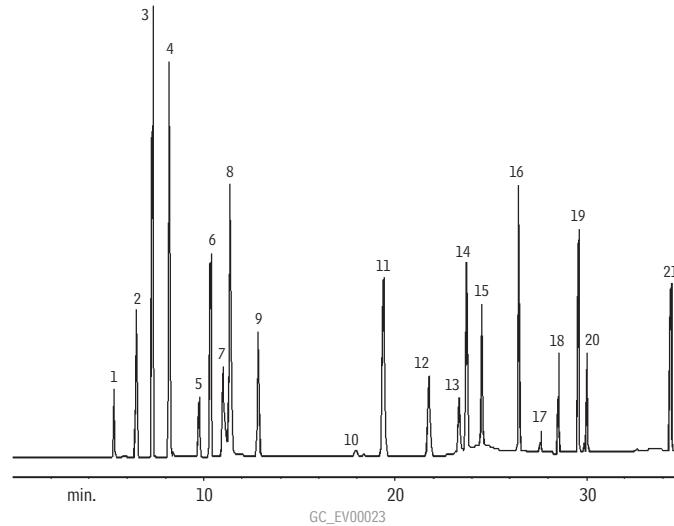
Searching for a chromatogram?
www.restek.com

Chlorinated Disinfection Byproducts

Chlorinated Disinfection Byproducts

US EPA Method 551.1

Rtx®-5



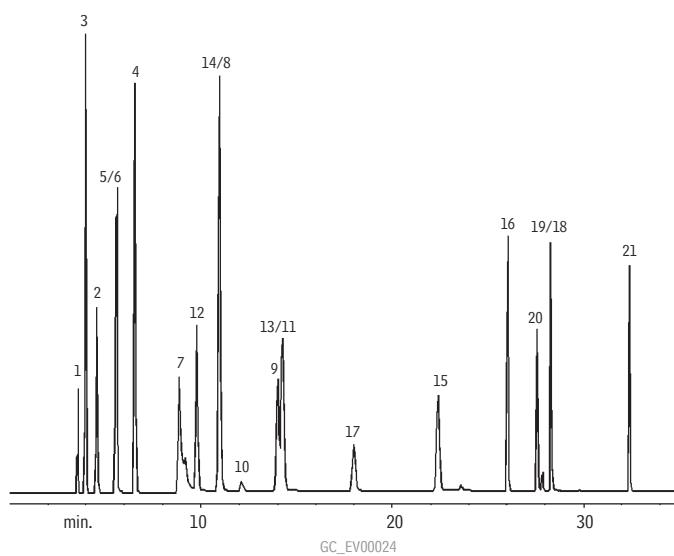
Column: Rtx®-5, 30m, 0.25mm ID, 1.0 μ m (cat.# 10253)
 Inj.: 1.0 μ L split injection, 1ng on-column concentration.
 Oven temp.: 35°C (hold 22 min.) to 200°C @ 10°C/min.
 Inj./det. temp.: 200°C/290°C
 Carrier gas: helium
 Linear velocity: 30cm/sec. @ 50°C
 ECD sensitivity: 20kHz full scale
 Split ratio: 10:1

- 1. chloroform
- 2. 1,1,1-trichloroethane
- 3. carbon tetrachloride
- 4. trichloroacetonitrile
- 5. trichloroethylene
- 6. bromodichloromethane
- 7. chloral hydrate
- 8. dichloroacetonitrile
- 9. 1,1-dichloro-2-propanone
- 10. 1,1,2-trichloroethane
- 11. chloropicrin
- 12. dibromochloromethane
- 13. 1,2-dibromoethane (EDB)
- 14. tetrachloroethylene
- 15. bromochloroacetonitrile
- 16. 1,1,1-trichloro-2-propanone
- 17. bromoform
- 18. dibromoacetonitrile
- 19. 1,2,3-trichloropropane
- 20. 4-bromofluorobenzene (IS)
- 21. 1,2-dibromo-3-chloropropane (DBCP)

Chlorinated Disinfection Byproducts

US EPA Method 551.1

Rtx®-200



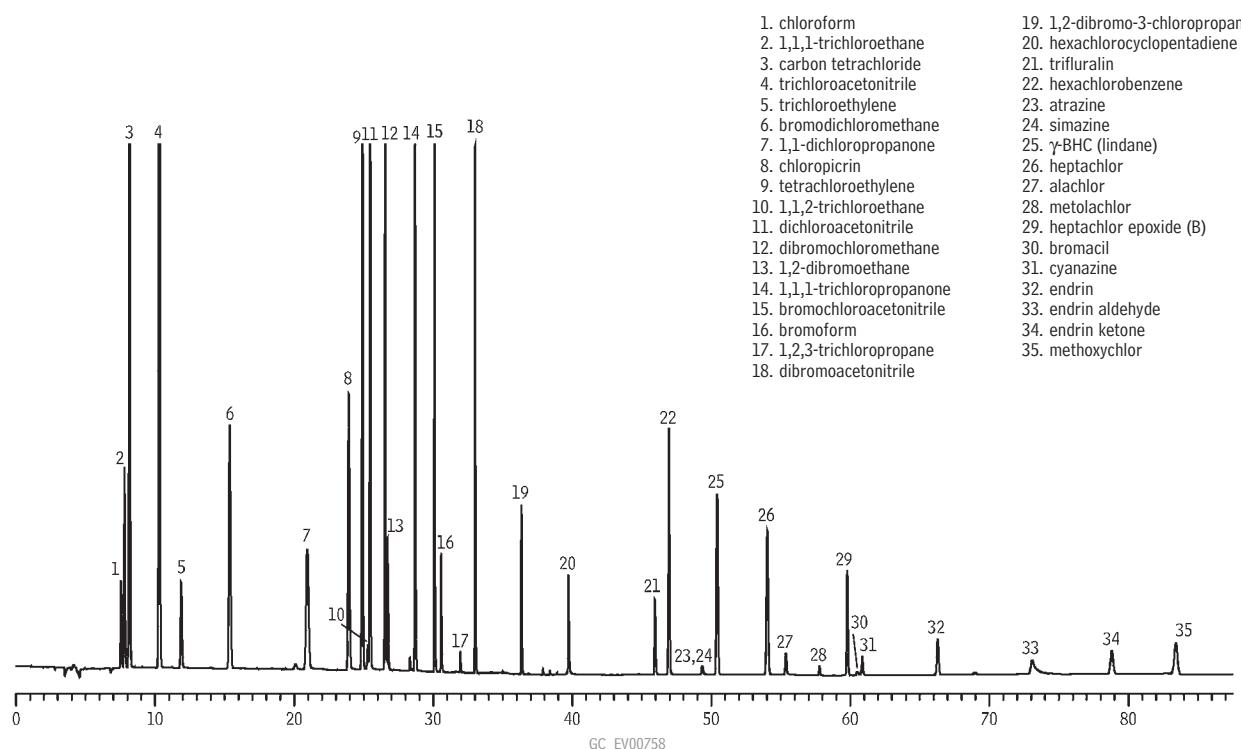
Column: Rtx®-200, 30m, 0.25mm ID, 1.0 μ m (cat.# 15053)
 Inj.: 1.0 μ L split injection, 1ng on-column concentration.
 Oven temp.: 35°C (hold 22 min.) to 200°C @ 10°C/min.
 Inj./det. temp.: 200°C/290°C
 Carrier gas: helium
 Linear velocity: 30cm/sec. @ 50°C
 ECD sensitivity: 20kHz full scale
 Split ratio: 10:1

Chlorinated Disinfection Byproducts

Chlorinated Disinfection Byproducts, Chlorinated Solvents, and Halogenated Pesticides

US EPA Method 551.1

Rtx®-1301



Column: Rtx®-1301, 30m, 0.25mm ID, 1.0 μ m (cat.# 16053)
 Sample: 5 - 10 μ g/mL each analyte (Method 551.1 Pesticide/Herbicide Mix (cat.# 32438) and Disinfection Byproducts & Chlorinated Solvents Mix (cat.# 30615))
 Inj.: 1.0 μ L splitless (hold 0.5 min.), 4mm split injection liner w/wool (cat.# 20781)
 Inj. temp.: 200°C
 Carrier gas: helium, constant pressure
 Linear velocity: 30cm/sec. @ 35°C
 Oven temp.: 35°C (hold 22 min.) to 145°C @ 10°C/min. (hold 2 min.)
 to 225° @ 20°C/min. (hold 15 min.) to 260° @ 10°C/min. (hold 30 min.)
 Det.: ECD @ 290°C



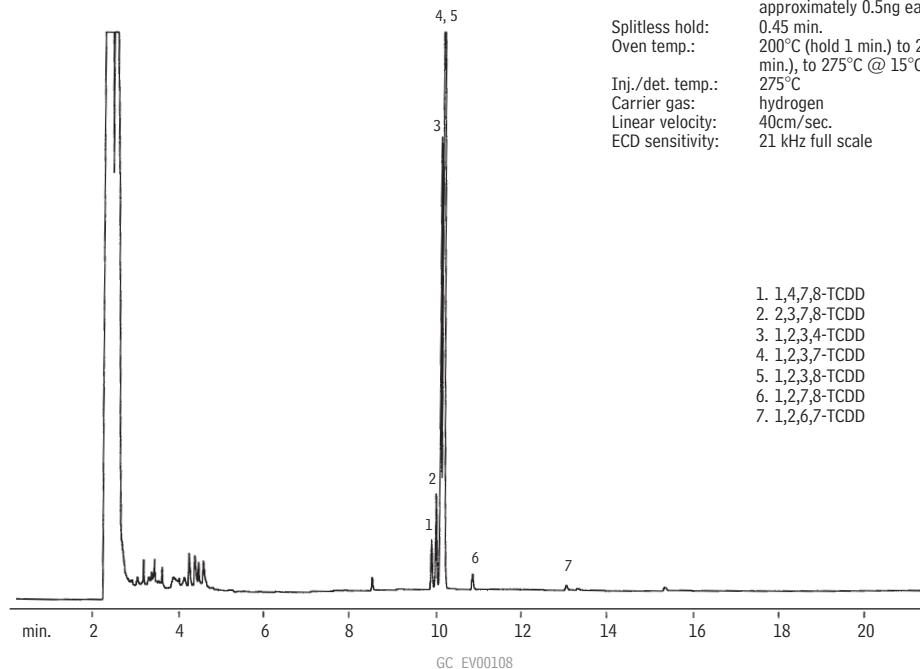
Catch the Buzz!

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Dioxins

TCDD Isomers

RtTM-2330



Column: RtTM-2330, 60m, 0.25mm ID, 0.20 μ m (cat.# 10726)
 Sample: 2.0 μ L splitless injection of TCDD isomers,
 approximately 0.5ng each isomer.
 Splitless hold:
 Oven temp.: 0.45 min.
 200°C (hold 1 min.) to 250°C @ 8°C/min. (hold 15
 min.), to 275°C @ 15°C/min. (hold 5 min.)
 Inj./det. temp.: 275°C
 Carrier gas: hydrogen
 Linear velocity: 40cm/sec.
 ECD sensitivity: 21 kHz full scale

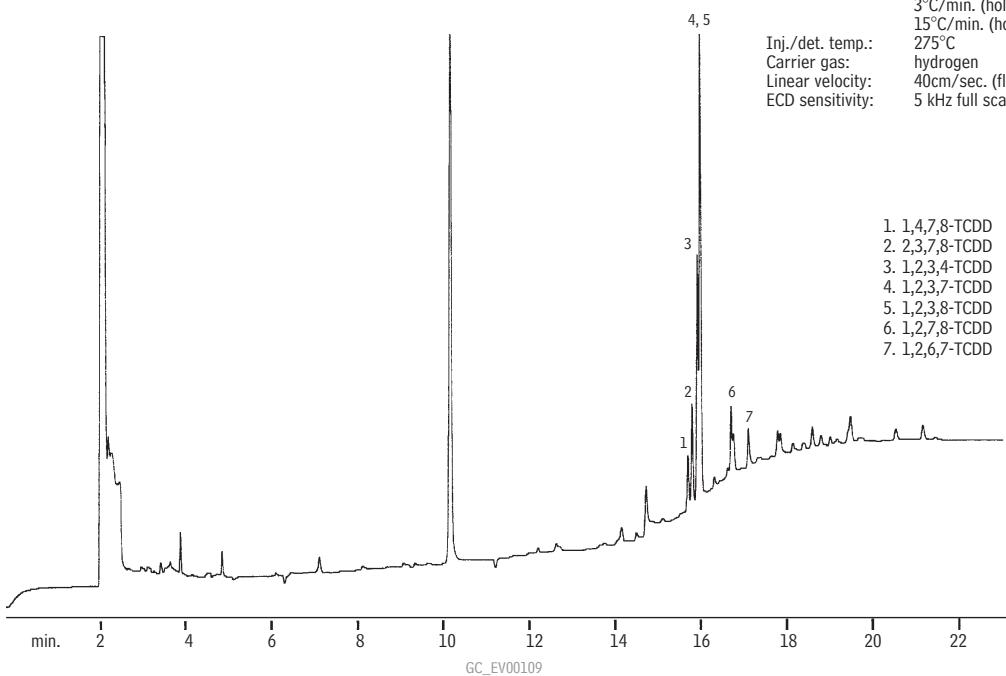
1. 1,4,7,8-TCDD
2. 2,3,7,8-TCDD
3. 1,2,3,4-TCDD
4. 1,2,3,7-TCDD
5. 1,2,3,8-TCDD
6. 1,2,7,8-TCDD
7. 1,2,6,7-TCDD

also available

For Rtx®-Dioxin2 columns,
 designed specifically for
 dioxin/furan analysis, see
 page 84.

TCDD Isomers

RtTM-2330

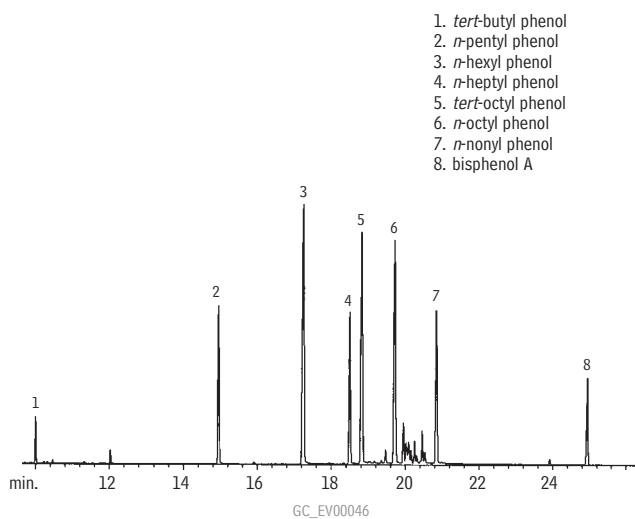


Column: RtTM-2330, 60m, 0.32mm ID, 0.20 μ m (cat.# 10727)
 Sample: 1.5 μ L cold on-column injection of TCDD isomers,
 approximately 0.5ng each isomer.
 Oven temp.: 200°C (hold 1 min.) to 240°C @
 3°C/min. (hold 6 min.), to 275°C @
 15°C/min. (hold 30 min.)
 Inj./det. temp.: 275°C
 Carrier gas: hydrogen
 Linear velocity: 40cm/sec. (flow rate: 3.2cc/min.)
 ECD sensitivity: 5 kHz full scale

1. 1,4,7,8-TCDD
2. 2,3,7,8-TCDD
3. 1,2,3,4-TCDD
4. 1,2,3,7-TCDD
5. 1,2,3,8-TCDD
6. 1,2,7,8-TCDD
7. 1,2,6,7-TCDD

Endocrine Disruptors

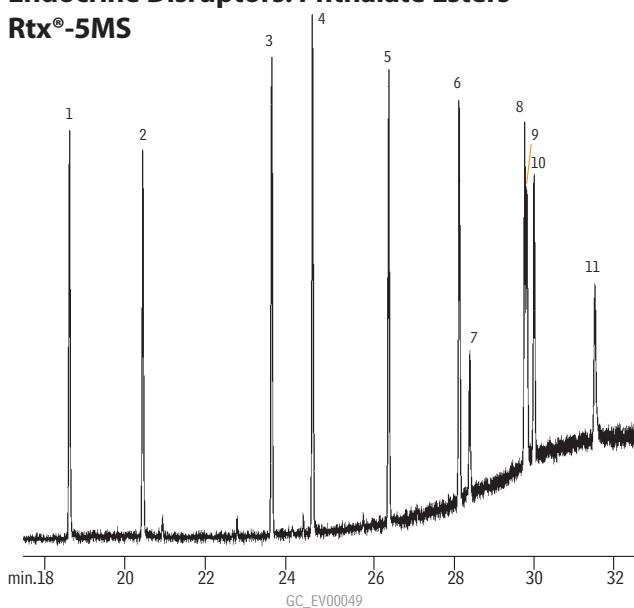
Endocrine Disruptors: Alkyl Phenols Rtx®-5MS



1. *tert*-butyl phenol
2. *n*-pentyl phenol
3. *n*-hexyl phenol
4. *n*-heptyl phenol
5. *tert*-octyl phenol
6. *n*-octyl phenol
7. *n*-nonyl phenol
8. bisphenol A

Column: Rtx®-5MS, 30m, 0.25mm ID, 0.25 μ m (cat. # 12623)
 Conc.: 5–10ng on-column
 Inj.: splitless, purge on @ 1 min.
 Oven temp.: 35°C (hold 1 min.) to 300°C @ 10°C/min. (hold 15 min.)
 Inj./det. temp.: 275°C/310°C
 Carrier gas: helium

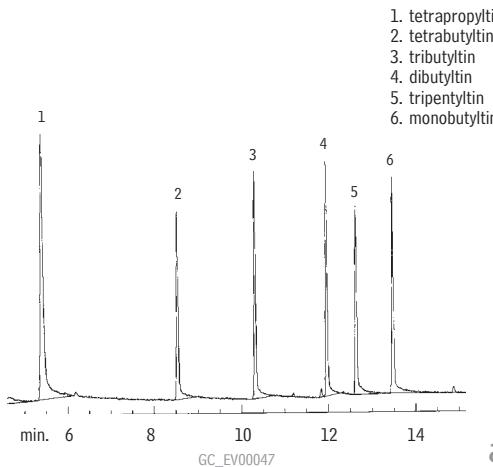
Endocrine Disruptors: Phthalate Esters Rtx®-5MS



1. dimethyl phthalate
2. diethyl phthalate
3. isobutyl phthalate
4. dibutyl phthalate
5. dipentyl phthalate
6. dihexyl phthalate
7. benzylethyl phthalate
8. diheptyl phthalate
9. 2-ethylhexyl phthalate
10. cyclohexyl phthalate
11. dioctyl phthalate

Column: Rtx®-5MS, 30m, 0.25mm ID, 0.50 μ m (cat. #12638)
 Conc.: 100pg on-column injection MS-SIM.
 Oven temp.: 35°C (hold 1 min.) to 285°C @ 10°C/min.
 Pressure: 7.5psi constant pressure

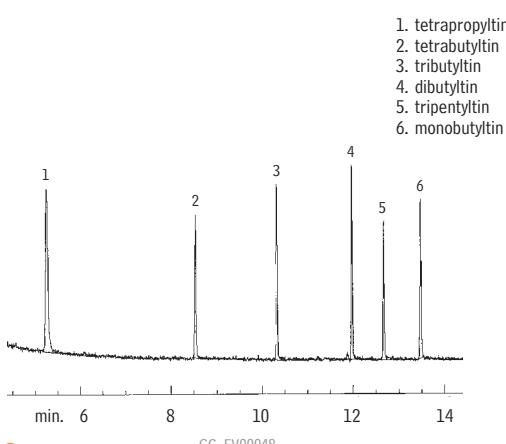
Endocrine Disruptors: Butyl Tins (hexyl derivatives) Rtx®-5



1. tetrapropyltin
2. tetrabutyltin
3. tributyltin
4. dibutyltin
5. tripentyltin
6. monobutyltin

Column: Rtx®-5, 30m, 0.32mm ID, 0.50 μ m (cat. # 10239)
 Conc.: 500pg on-column direct injection
 Oven temp.: 100°C (hold 1 min.) to 285°C
 @ 10°C/min.
 Inj./det. temp.: 250°C
 Carrier gas: helium
 Linear velocity: 45cm/sec.
 Detector: FPD with 610nm filter

Endocrine Disruptors: Butyl Tins (hexyl derivatives) Rtx®-35



1. tetrapropyltin
2. tetrabutyltin
3. tributyltin
4. dibutyltin
5. tripentyltin
6. monobutyltin

also available

Butyl tin reference materials—see page 482.

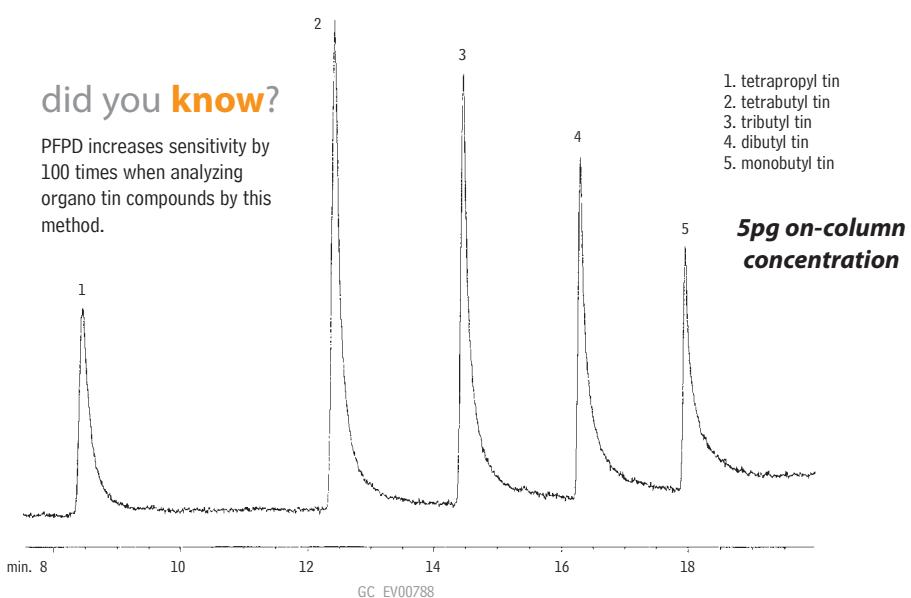
Column: Rtx®-35, 30m, 0.32mm ID, 0.50 μ m (cat. # 10439)
 Conc.: 500pg on-column direct injection
 Oven temp.: 100°C (hold 1 min.) to 285°C
 @ 10°C/min.
 Inj./det. temp.: 250°C
 Carrier gas: helium
 Linear velocity: 45cm/sec.
 Detector: FPD with 610nm filter

Organo Tins; Explosives

Organo Tins Rtx®-35

did you know?

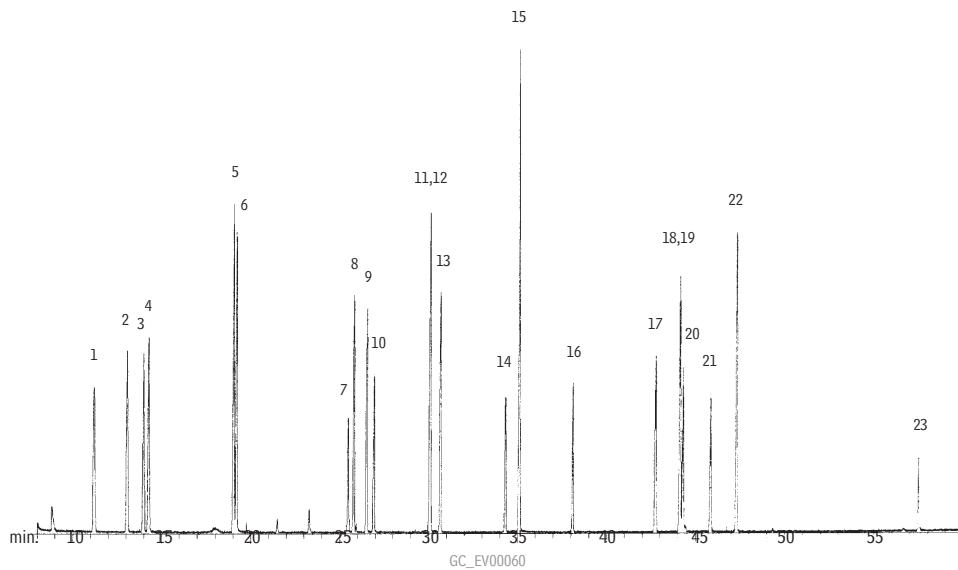
FPD increases sensitivity by 100 times when analyzing organo tin compounds by this method.



Column: Rtx®-35, 30m, 0.32mm ID, 1.0 μ m (cat.# 10454)
 Inj.: direct injection using a Uniliner® inlet liner (cat.# 20335)
 Conc.: 5pg on-column
 Head pressure: 15psi, constant
 Oven temp.: 100°C (hold 1 min.) to 285°C @ 10°C/min. (hold 10 min.)
 Detector: PFPD* Model 5380 courtesy of O.I. Analytical Corp., College Station, TX

*Peak tailing is a function of this detector.

Explosives Rtx®-200



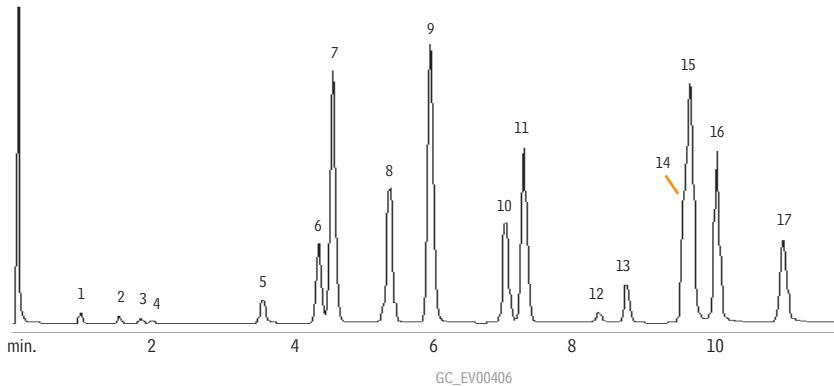
Column: Rtx®-200, 30m, 0.25mm ID, 0.25 μ m (cat.# 15023)
 Inj.: 1.0 μ L splitless injection
 Conc.: 20ng/ μ L
 Oven temp.: 80°C (hold 2 min.) to 260°C @ 3°C/min. (hold 2 min.)
 Inj. temp.: 280°C
 Det.: MS, 300°C
 Carrier gas: helium
 Linear velocity: 20cm/sec. set @ 80°C
 Splitless hold time: 0.6 min.

- 1. 2-nitrotoluene
- 2. 3-nitrotoluene
- 3. 4-nitrotoluene
- 4. 2,3-diaminotoluene
- 5. 2,6-diaminotoluene
- 6. 2,4-diaminotoluene
- 7. 1,4-dinitrobenzene
- 8. 2,6-dinitrotoluene
- 9. 2-amino-6-nitrotoluene
- 10. 1,3-dinitrobenzene
- 11. 2,4-dinitrotoluene
- 12. 2-amino-4-nitrotoluene
- 13. 2,3-dinitrotoluene
- 14. 3,4-dinitrotoluene
- 15. 3-nitrobiphenyl
- 16. 2,4,6-trinitrotoluene
- 17. 2,4,5-trinitrotoluene
- 18. 4-amino-2,6-dinitrotoluene
- 19. 2,3,4-trinitrotoluene
- 20. 1,3-dinitronaphthalene
- 21. 2,6-diamino-4-nitrotoluene
- 22. 2-amino-4,6-dinitrotoluene
- 23. 2,2-dinitrobiphenyl

Explosives**US EPA Method 8095****Rtx®-TNT & Rtx®-TNT2****Rtx®-TNT**

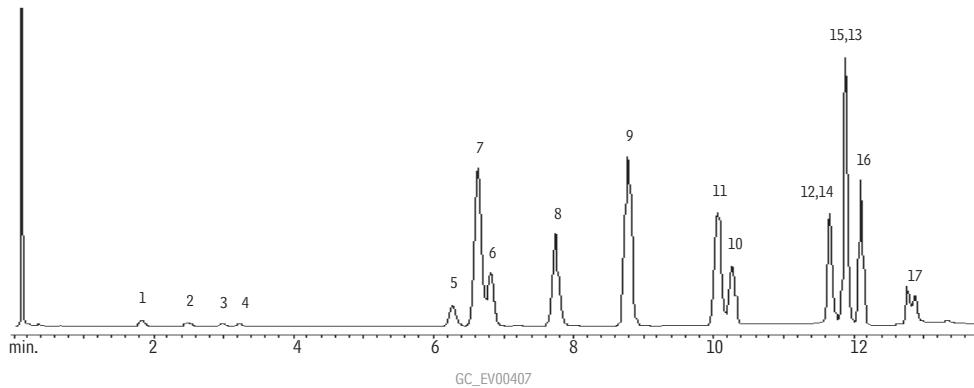
restek
innovation!

Improved resolution of
nitroaromatic compounds such
as those listed in US EPA
Method 8095



Column: Rtx®-TNT, 6m, 0.53mm ID, 1.50 μ m (cat.# 12998)
 Inj.: Direct injection using a 1mm Siltek® Uniliner® inlet liner (cat.# 21052-214.1)
 On-column conc.: est. 200-1000pg/compound. 8095 Calibration Mix A (cat.# 31607),
 8095 Calibration Mix B (cat.# 31608), and 3,4-dinitrotoluene (cat.# 31452)
 Oven temp.: 80°C (hold 1 min.) to 180°C @ 10°C/min. to 300°C @
 30°C/min. (hold 3 min.)
 Inj. temp.: 250°C
 Det.: ECD @ 330°C with anode purge
 Dead time: 4.4 sec.
 Head pressure: helium @ 3psi (20.7 KPa)
 Flow rate: helium @ 17mL/min. @ 80°C

1. nitrobenzene
2. 2-nitrotoluene
3. 3-nitrotoluene
4. 4-nitrotoluene
5. nitroglycerine
6. 1,3-dinitrobenzene
7. 2,6-dinitrotoluene
8. 2,4-dinitrotoluene
9. 3,4-dinitrotoluene (IS)
10. 1,3,5-trinitrobenzene
11. trinitrotoluene
12. PETN
13. RDX
14. 4-amino-2,6-dinitrotoluene
15. 3,5-dinitroaniline
16. 2-amino-4,6-dinitrotoluene
17. tetryl

Rtx®-TNT2

Column: Rtx®-TNT2, 6m, 0.53mm ID, 1.50 μ m (cat.# 12999)
 Inj.: Direct injection using a 1mm Siltek® Uniliner® (cat.# 21052-214.1)
 On-column conc.: est. 200-1000pg/compound. 8095 Calibration Mix A (cat.# 31607),
 8095 Calibration Mix B (cat.# 31608), and 3,4-dinitrotoluene (cat.# 31452)
 Oven temp.: 80°C (hold 1 min.) to 180°C @ 10°C/min. to 300°C @
 30°C/min. (hold 3 min.)
 Inj. temp.: 250°C
 Det.: ECD @ 330°C with anode purge
 Dead time: 4.4 sec.
 Head pressure: helium @ 3psi (20.7 KPa)
 Flow rate: helium @ 17mL/min. @ 80°C

Gasoline Range Organics (GRO)

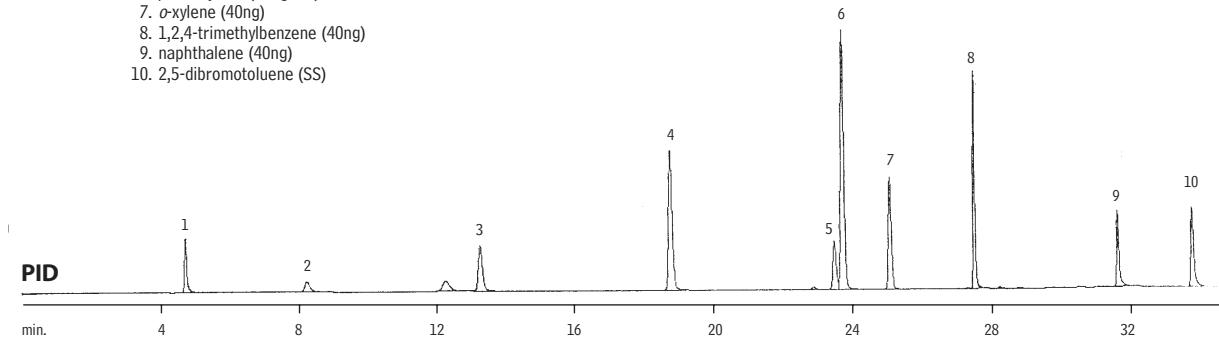
Volatile Petroleum Hydrocarbons (VPH)

Massachusetts Department of Environmental Protection

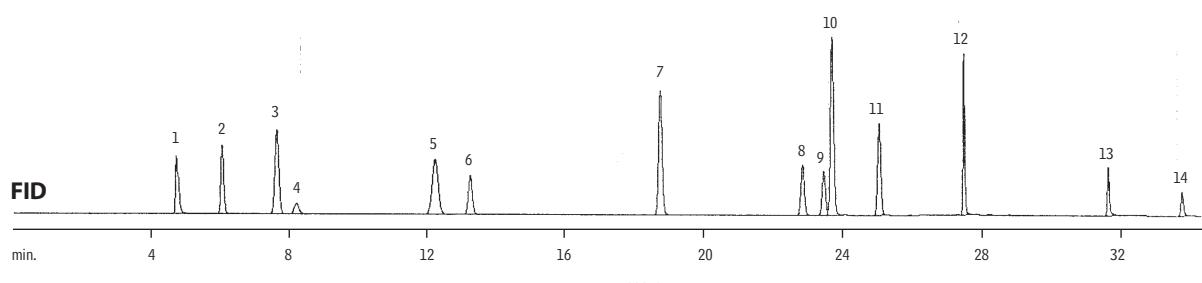
Rtx®-502.2

For VPH analysis on an Rtx®-502.2 column, use PID for aromatic compounds and FID for aliphatic compounds.

1. methanol
2. methyl *tert*-butyl ether (60ng)
3. benzene (20ng)
4. toluene
5. ethylbenzene (20ng)
6. *p*+*m*-xylene (40ng ea.)
7. *o*-xylene (40ng)
8. 1,2,4-trimethylbenzene (40ng)
9. naphthalene (40ng)
10. 2,5-dibromotoluene (SS)



1. methanol
2. *n*-pentane (40ng)
3. 2-methylpentane (60ng)
4. methyl *tert*-butyl ether (60ng)
5. 2,2,4-trimethylpentane (60ng)
6. benzene (20ng)
7. toluene (60ng)
8. *n*-nonane (40ng)
9. ethylbenzene (20ng)
10. *p*+*m*-xylene (40ng ea.)
11. *o*-xylene (40ng)
12. 1,2,4-trimethylbenzene (40ng)
13. naphthalene (40ng)
14. 2,5-dibromotoluene (SS)



Column: Rtx®-502.2, 105m, 0.53mm ID, 3.0 μ m (cat.# 10910)
 Conc.: on-column at levels listed
 Oven temp: 45°C to 90°C @ 3°C/min., to 140° @ 5°C/min., to 230° @ 45°C/min. (hold 8 min.)
 Carrier gas: helium @ 15mL/min. Tekmar Model LSC 2000
 Trap: BTEX
 Purge: helium @ 40mL/min. for 11 min.
 Dry purge: 2 min.
 Desorb preheat: 245°C
 Desorb: 2 min. @ 250°C
 Bake: 6 min. @ 260°C

Chromatograms courtesy of Severn Trent Laboratories, Burlington, VT.

free literature

Optimizing Massachusetts Volatile Petroleum Hydrocarbon GC Analysis

Massachusetts VPH affords more reliable quantification of volatile petroleum hydrocarbons, relative to older "analytical window" methods, and has been adopted by other states and in Canada. This 2-page note offers valuable tips for selecting a trap and a capillary GC column compatible with the methodology. Reference mixes specifically designed for MA VPH are described.

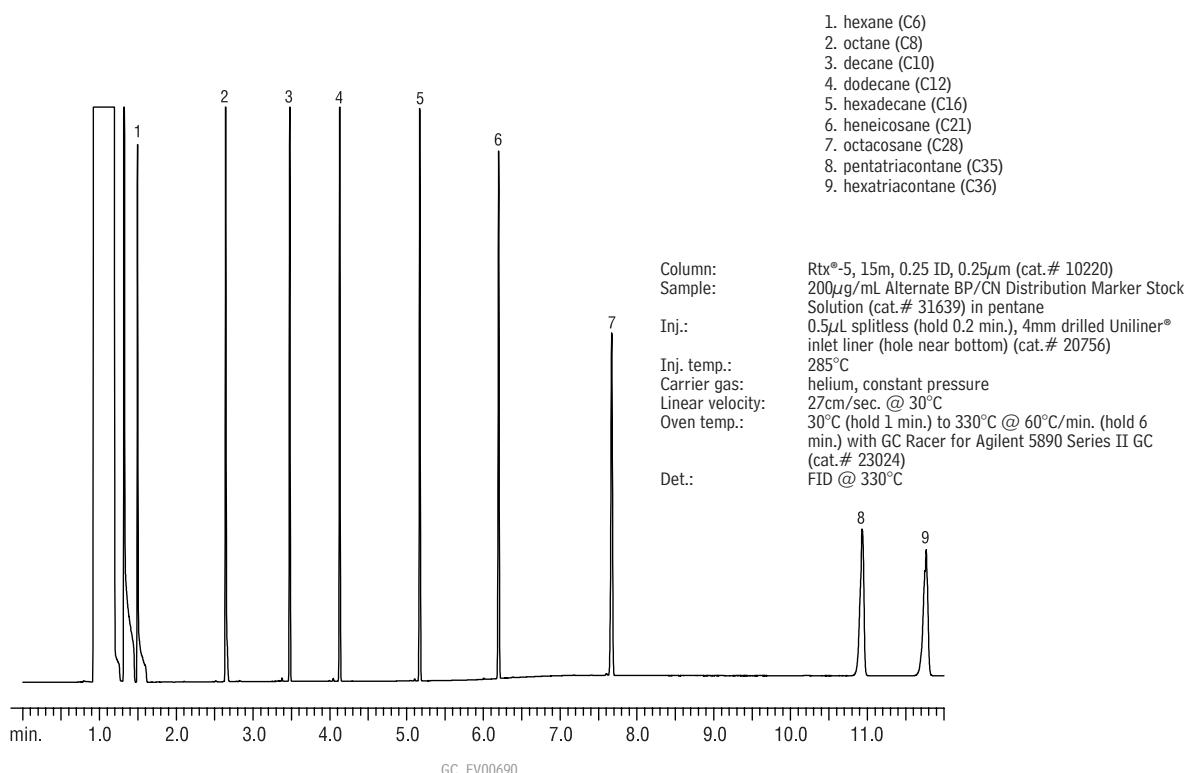
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Applications Note
lit. cat.# 59150



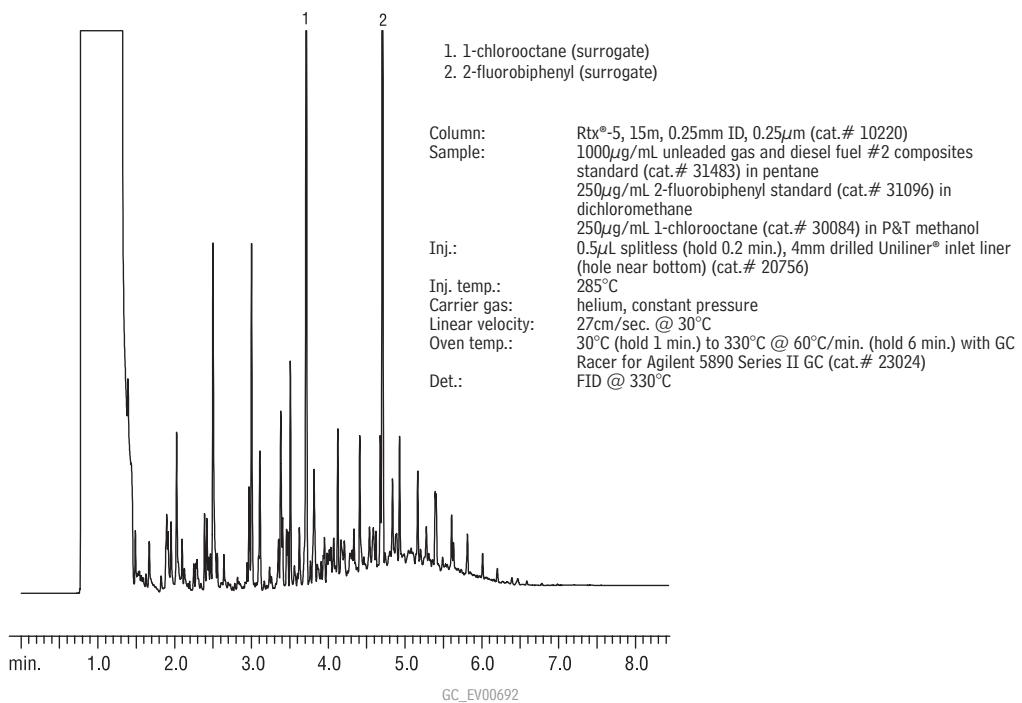
Texas UST: Alternate Boiling Point/Carbon Number Distribution Marker

Rtx®-5



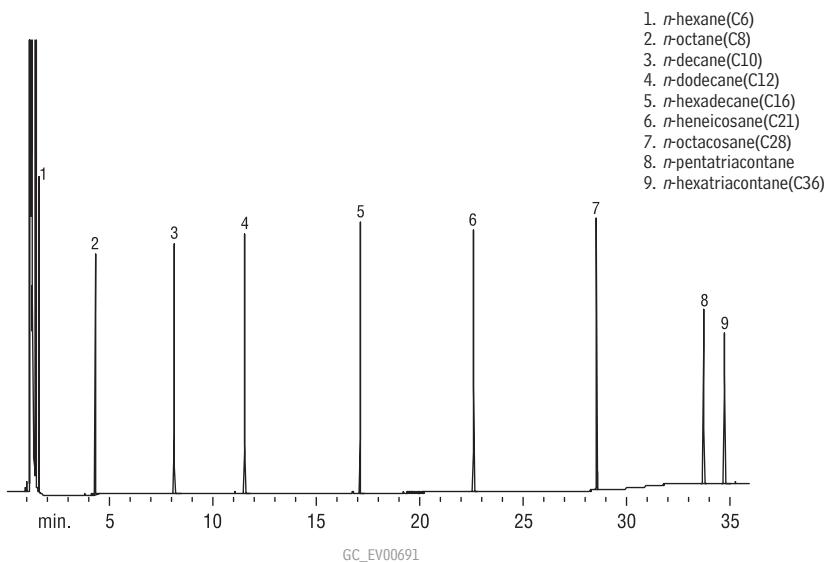
Texas UST: diesel/gas composites

Rtx®-5



Gasoline Range Organics (GRO)

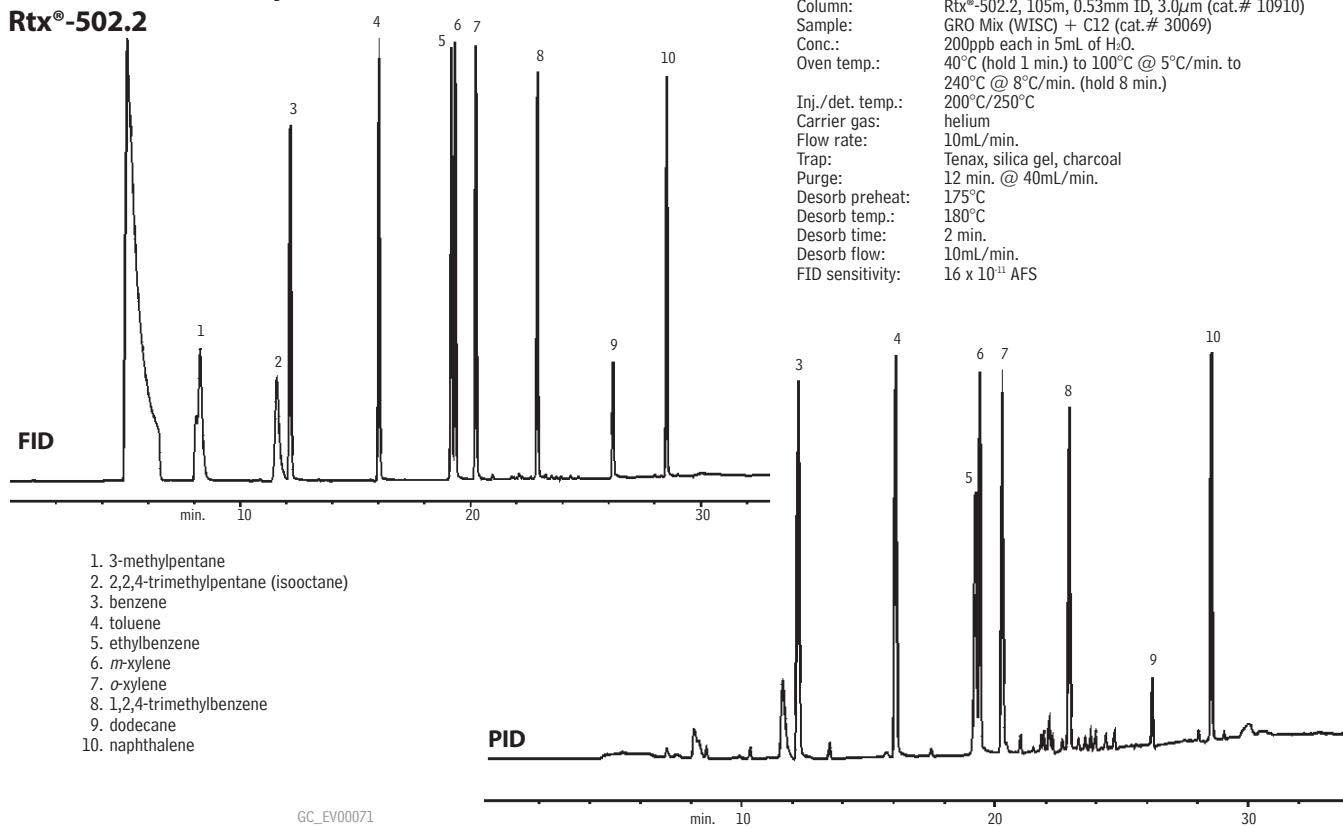
Texas UST: Alternate Boiling Point/Carbon Number Distribution Marker Rtx®-5



Column: Rtx®-5, 30m, 0.25mm ID, 0.50 μ m (cat.# 10238)
 Sample: 1 μ L Alternate Boiling Point/Carbon Number Distribution Marker Stock Solution (cat.# 31639), 200 μ g/mL each component in pentane
 Carrier gas: hydrogen @ 40cm/sec.
 Oven temp.: 40°C (hold 2 min.) to 330°C @ 10°C/min. (hold 5 min.)
 Inj. temp.: 250°C
 Det. temp.: 330°C
 Det.: FID

Wisconsin GRO Mix, plus C12

Rtx®-502.2

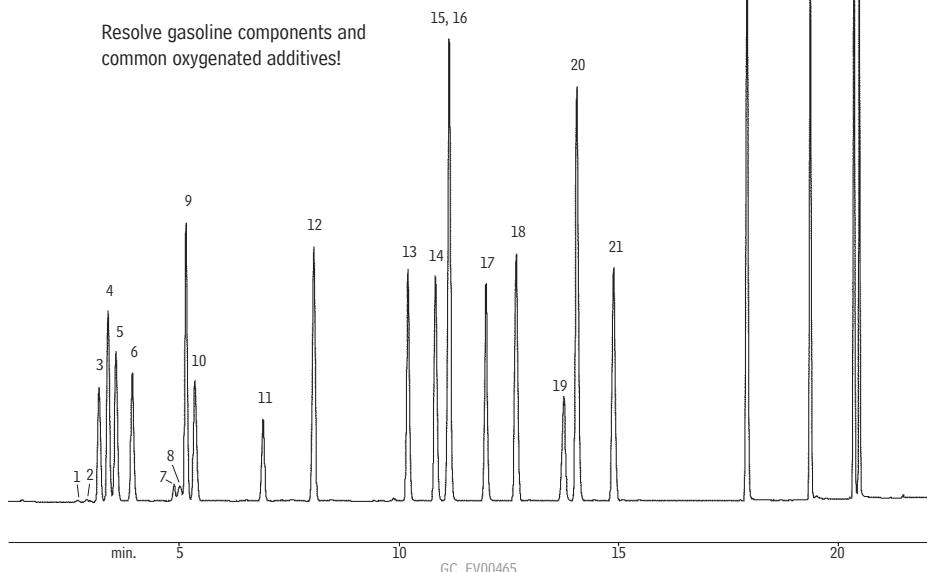


Gasoline Range Organics (GRO)

Oxygenates Rtx®-VGC

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Resolve gasoline components and common oxygenated additives!

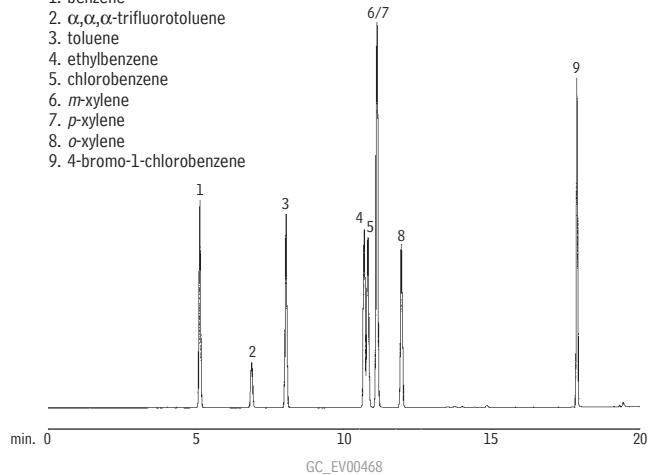


1. 2-methylpentane
2. 3-methylpentane
3. methyl *tert*-butyl ether
4. *tert*-butanol
5. diisopropyl ether
6. ethyl-*tert*-butyl ether
7. isooctane
8. *n*-heptane
9. benzene
10. *tert*-amyl-methyl ether
11. α,α,α -trifluorotoluene
12. toluene
13. 1-chloro-3-fluorobenzene
14. ethylbenzene
15. *m*-xylene
16. *p*-xylene
17. *o*-xylene
18. isopropylbenzene
19. ethylmethylbenzene
20. 1,3,5-trimethylbenzene
21. 1,2,4-trimethylbenzene
22. 4-bromochlorobenzene
23. naphthalene
24. 2-methylnaphthalene
25. 1-methylnaphthalene

see conditions below

BTEX Rtx®-VGC

1. benzene
2. α,α,α -trifluorotoluene
3. toluene
4. ethylbenzene
5. chlorobenzene
6. *m*-xylene
7. *p*-xylene
8. *o*-xylene
9. 4-bromo-1-chlorobenzene

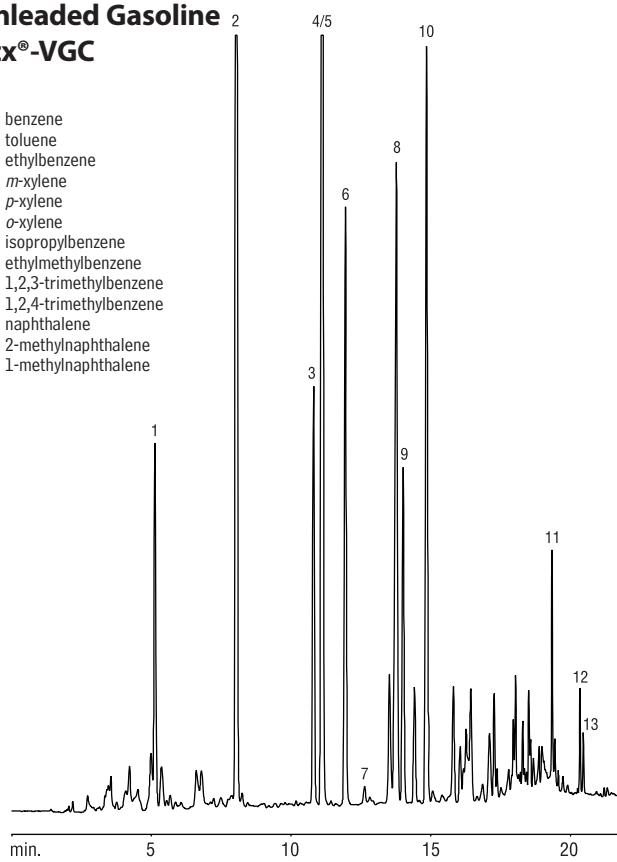


Conditions for all chromatograms on this page:

Column: Rtx®-VGC, 30m, 0.45mm, 2.55 μ m (cat.# 19408)
 Sample: each component 100ppb in 5mL of RO water, except *tert*-butanol 5000ppb; 2/1-methylnaphthalene 150ppb; ethylmethylbenzene 50ppb
 Concentrator: Tekmar LSC-3100 Purge and Trap
 Trap: Vocarb 3000
 Purge: 11 min. @ 40mL/min. @ 35°C
 Dry purge: 1 min. (MCS bypassed)
 GC: Finnigan 9001
 Oven temp.: 40°C (hold 2 min.) to 130°C @ 6°C/min. (hold 0 min.) to 230°
 Carrier gas: helium @ ~8mL/min.
 Detector: Finnigan PID, make up 7mL/min., purge 7mL/min., set @ 0.35mV, base temperature 200°C.

Unleaded Gasoline Rtx®-VGC

1. benzene
2. toluene
3. ethylbenzene
4. *m*-xylene
5. *p*-xylene
6. *o*-xylene
7. isopropylbenzene
8. ethylmethylbenzene
9. 1,2,3-trimethylbenzene
10. 1,2,4-trimethylbenzene
11. naphthalene
12. 2-methylnaphthalene
13. 1-methylnaphthalene

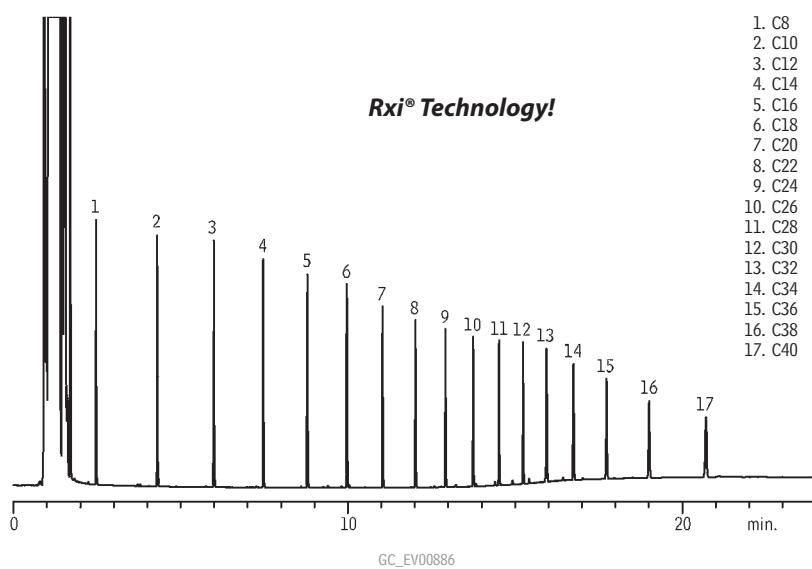


Gasoline Range Organics (GRO)

Petroleum Hydrocarbons (TPH)

Rxi®-1ms

new!



Column: Rxi®-1ms, 20m, 0.18mm ID, 0.18 μ m (cat.# 13302)
 Sample: Florida TRPH Standard (cat.# 31266), 500 μ g/mL each component in hexane
 Inj.: 0.5 μ L, split, split ratio 20:1, 3.5mm Precision™ inlet liner (cat.# 21021)
 Instrument: Shimadzu GC-2010*
 Inj. temp.: 275°C
 Carrier gas: hydrogen, constant pressure
 Linear velocity: 55cm/sec. @ 40°C
 Oven temp.: 40°C (hold 1 min.) to 330°C @ 20°C/min. (hold 10 min.)
 Det.: FID @ 350°C

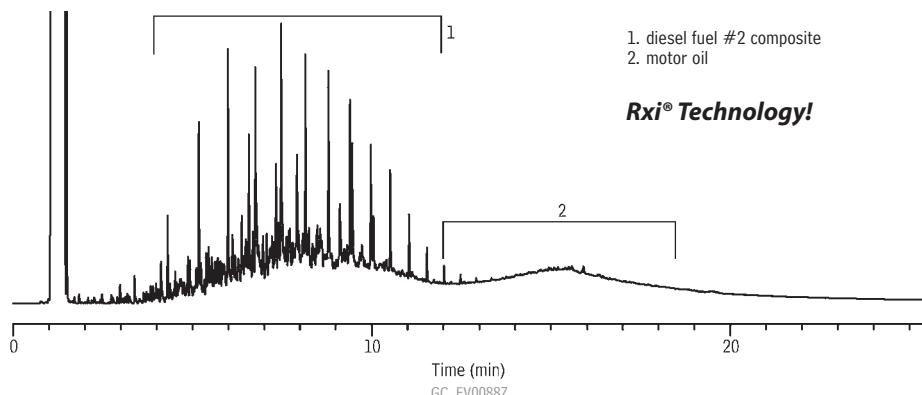
*GC courtesy of Shimadzu Scientific.

Lubrication Range Organics

Diesel Fuel #2/Motor Oil

Rxi®-1ms

new!

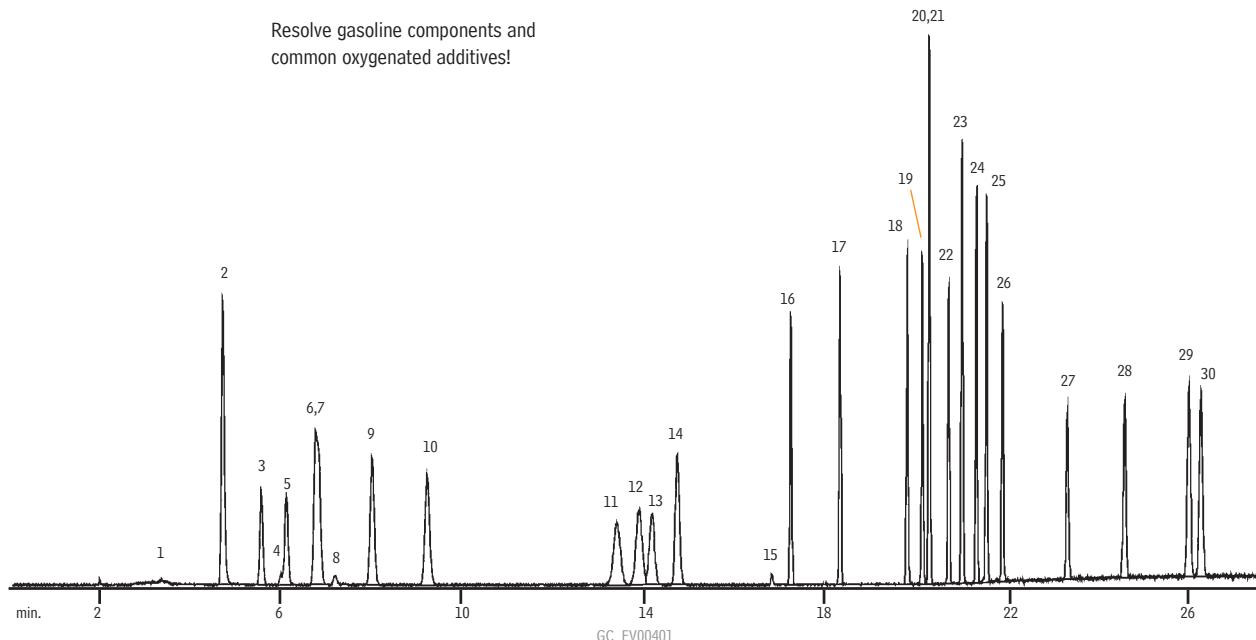


Column: Rxi®-1ms, 20m, 0.18mm ID, 0.18 μ m (cat.# 13302)
 Sample: Diesel #2/Motor Oil (cat.# 31682) 5000 μ g/mL each component in hexane
 Inj.: 0.5 μ L, split, split ratio 20:1, 3.5mm Precision™ inlet liner (cat.# 21021)
 Instrument: Shimadzu GC-2010
 Inj. temp.: 275°C
 Carrier gas: hydrogen, constant pressure
 Linear velocity: 55cm/sec. @ 40°C
 Oven temp.: 40°C (hold 1 min.) to 330°C @ 20°C/min. (hold 10 min.)
 Det.: FID @ 350°C

Oxygenates Rtx®-VGC

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Resolve gasoline components and
common oxygenated additives!



Column: Rtx®-VGC 30m, 0.25mm, 1.40 μ m (cat.# 19415)
 Inj.: 10:1 split at injection port; 1mm ID liner
 Conc.: Compounds at 100ppb in 5mL of RO water (unless otherwise noted)
 Oven program: 35°C (hold 14 min.) to 220°C @ 24°C/min. (hold 6 min.)
 Carrier gas: helium @ ~1mL/min. constant flow
 Concentrator: Tekmar LSC-3100 Purge and Trap
 Trap: Vocarb 3000
 Purge: 11 min. @ 40mL/min. @ ambient temperature
 Dry purge: 1 min. @ 40mL/min. (MCS bypassed using Silcosteel® tubing)
 Desorb preheat: 245°C
 Desorb: 250°C for 2 min., Flow 10mL/min.
 Bake: 260°C for 8 min.
 Interface: transfer line 0.32mm ID Siltek® fused silica
 Detector: Agilent 5973 MS
 Scan range: 25-300amu

1. methanol (100,000ppb)
2. ethanol (10,000ppb)
3. 2-methylpentane
4. 2-propanol (500ppb)
5. 3-methylpentane
6. hexane
7. methyl *tert*-butyl ether
8. *tert*-butanol (500ppb)
9. diisopropyl ether
10. ethyl-*tert*-butyl ether
11. isooctane
12. benzene
13. *n*-heptane
14. *tert*-amyl methyl ether
15. 1-butanol (500ppb)
16. α,α,α -trifluorotoluene
17. toluene
18. 1-chloro-3-fluorobenzene
19. ethylbenzene
20. *m*-xylene
21. *p*-xylene
22. α -xylene
23. isopropylbenzene
24. decane
25. 1,3,5-trimethylbenzene
26. 1,2,4-trimethylbenzene
27. 4-bromochlorobenzene
28. naphthalene
29. 2-methylnaphthalene (150ppb)
30. 1-methylnaphthalene (150ppb)

free literature

Resolving Oxygenates from Gasoline Additives, Using an Rtx®-VGC GC Column

Avoid coelution of compounds that share quantification ions

Successful analysis of oxygenates in environmental samples depend on the ability of the analytical column to resolve the oxygenates from early-eluting alkanes, alkenes, and alkynes. Nonpolar columns are used for this application, but they are incompatible with polar compounds, and thus can give broad peaks and reduced sample capacity for the alcohols. The unique polarity of Rtx®-VGC columns makes them ideal for oxygenates analysis. Example chromatograms with both PID and MS detection are shown in this 4-page note; purge and trap conditions also are discussed.

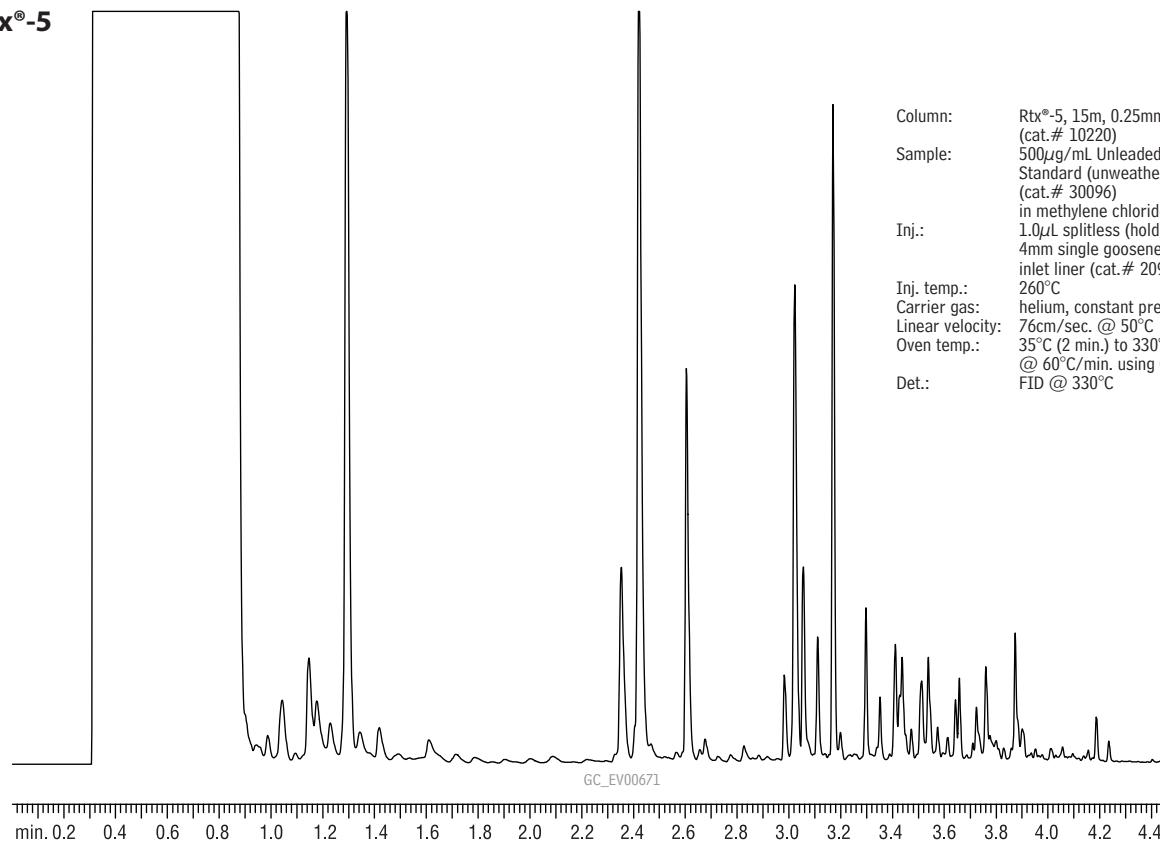
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Applications Note
lit. cat.# 59345

Gasoline Range Organics (GRO)

Unleaded Gasoline

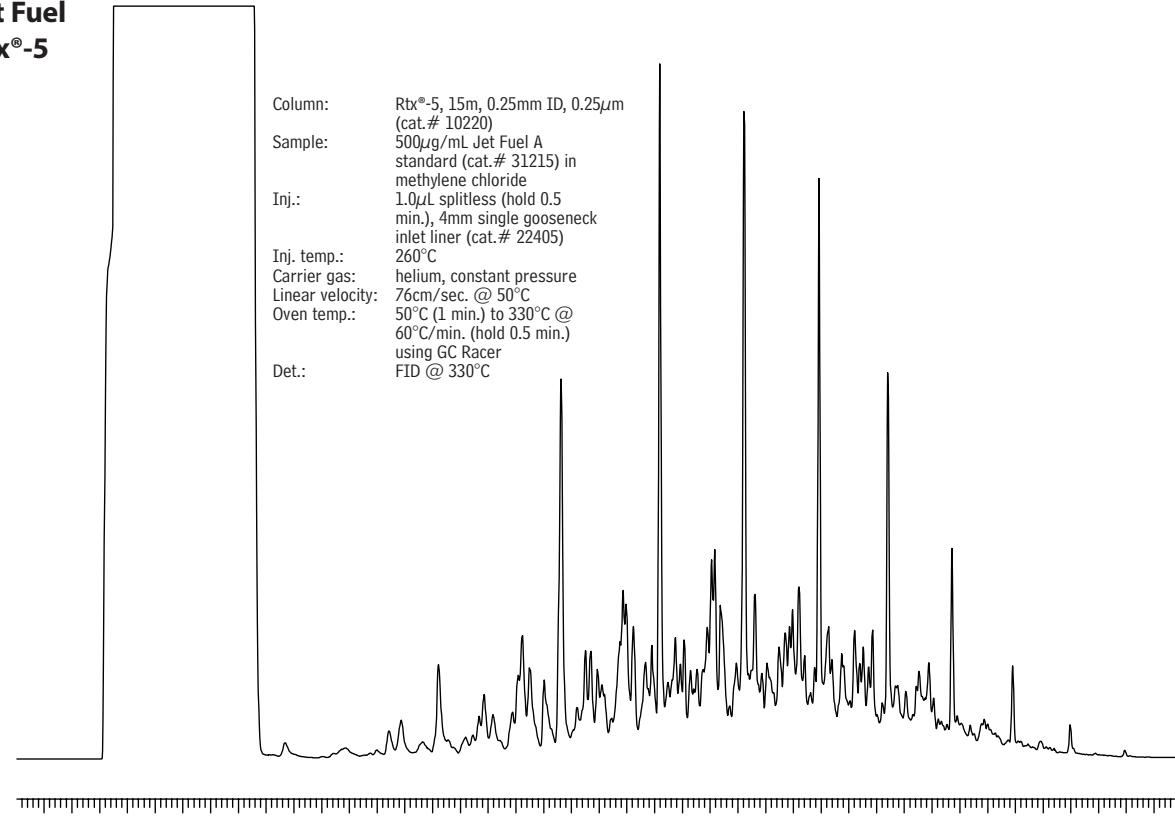
Rtx®-5



Column: Rtx®-5, 15m, 0.25mm ID, 0.25 μ m (cat.# 10220)
 Sample: 500 μ g/mL Unleaded Gasoline Standard (unweathered) (cat.# 30096)
 Inj.: 1.0 μ L splitless (hold 0.5 min.), 4mm single gooseneck inlet liner (cat.# 20904)
 Inj. temp.: 260°C
 Carrier gas: helium, constant pressure
 Linear velocity: 76cm/sec. @ 50°C
 Oven temp.: 35°C (2 min.) to 330°C @ 60°C/min. using GC Racer
 Det.: FID @ 330°C

Jet Fuel

Rtx®-5



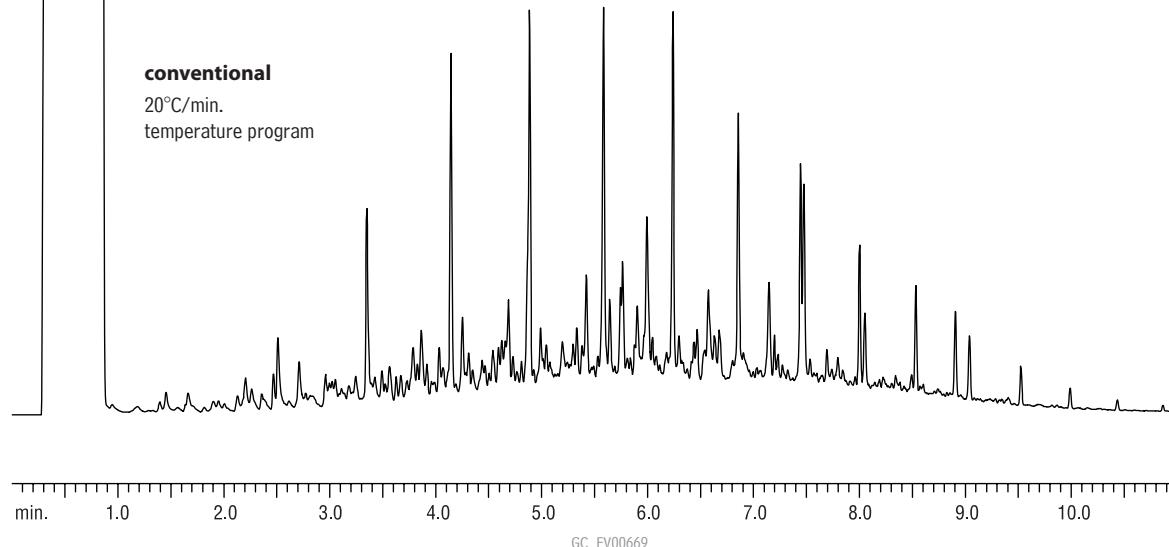
Column: Rtx®-5, 15m, 0.25mm ID, 0.25 μ m (cat.# 10220)
 Sample: 500 μ g/mL Jet Fuel A standard (cat.# 31215) in methylene chloride
 Inj.: 1.0 μ L splitless (hold 0.5 min.), 4mm single gooseneck inlet liner (cat.# 22405)
 Inj. temp.: 260°C
 Carrier gas: helium, constant pressure
 Linear velocity: 76cm/sec. @ 50°C
 Oven temp.: 50°C (1 min.) to 330°C @ 60°C/min. (hold 0.5 min.) using GC Racer
 Det.: FID @ 330°C

Diesel Range Organics (DRO)

Diesel Fuel Rtx[®]-5

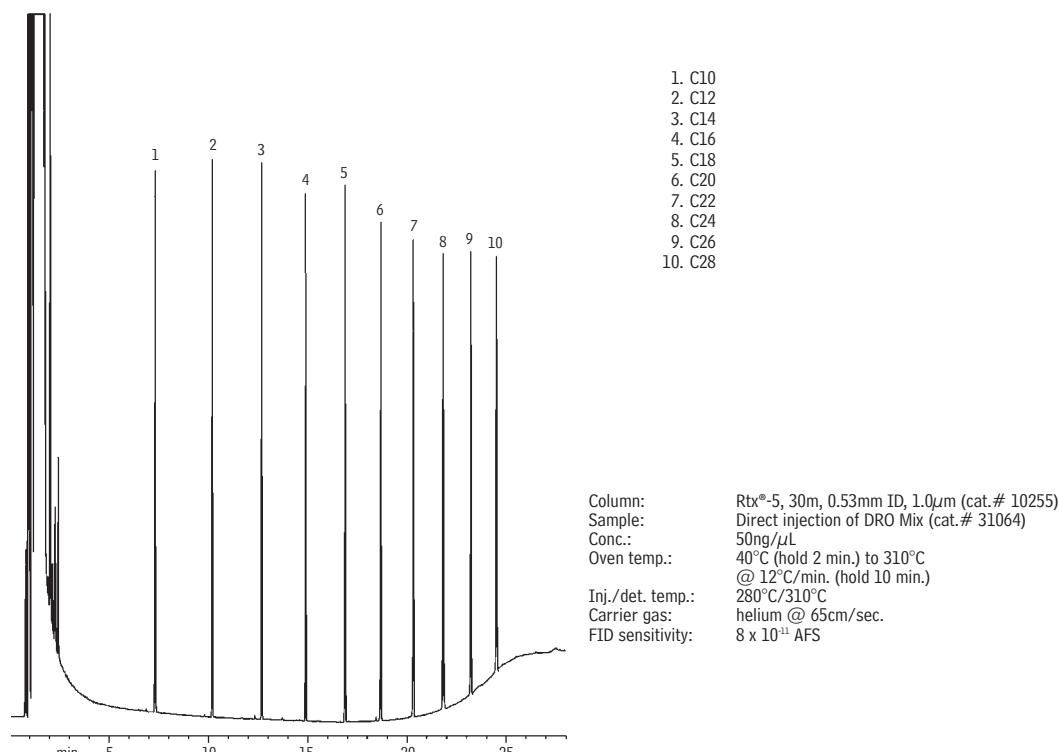
For Biodiesel chromatograms,
see pages 678–681.

Column: Rtx[®]-5, 15m, 0.25mm ID, 0.25 μ m (cat.# 10220)
 Sample: 500 μ g/ml Diesel Fuel Composite standard (cat.# 31093) in methylene chloride
 Inj.: 1.0 μ L splitless (hold 0.5 min.), 4mm single gooseneck inlet liner (cat.# 20904)
 Inj. temp.: 260°C
 Carrier gas: helium, constant pressure
 Linear velocity: 76cm/sec. @ 50°C
 Oven temp.: 50°C (1 min.) to 330°C @ 20°C/min.
 Det.: FID @ 330°C



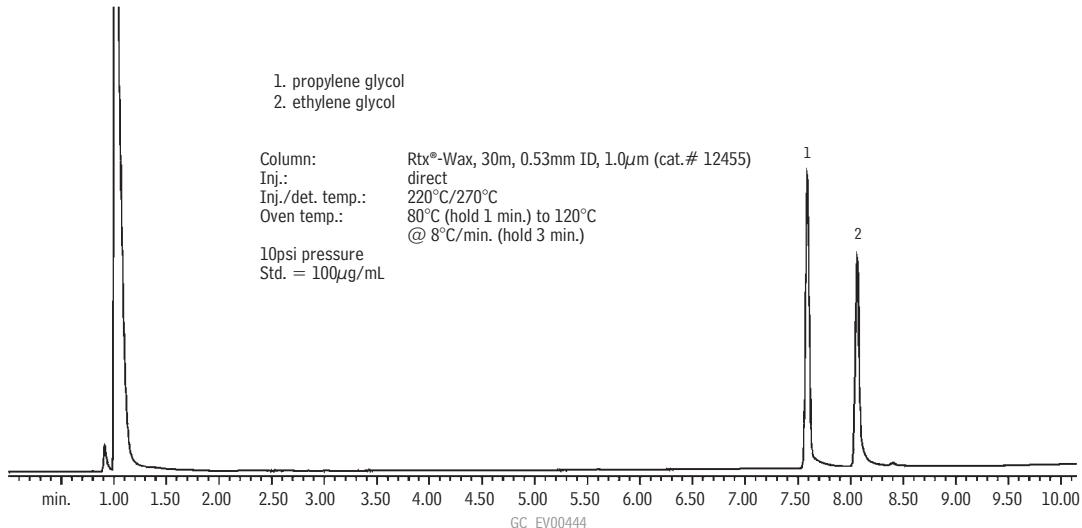
DRO Mix Rtx[®]-5

- 1. C10
- 2. C12
- 3. C14
- 4. C16
- 5. C18
- 6. C20
- 7. C22
- 8. C24
- 9. C26
- 10. C28



Glycols

Glycols Rtx®-Wax



free literature

Techniques to Optimizing GC Analysis of Ethylene Glycol in Water

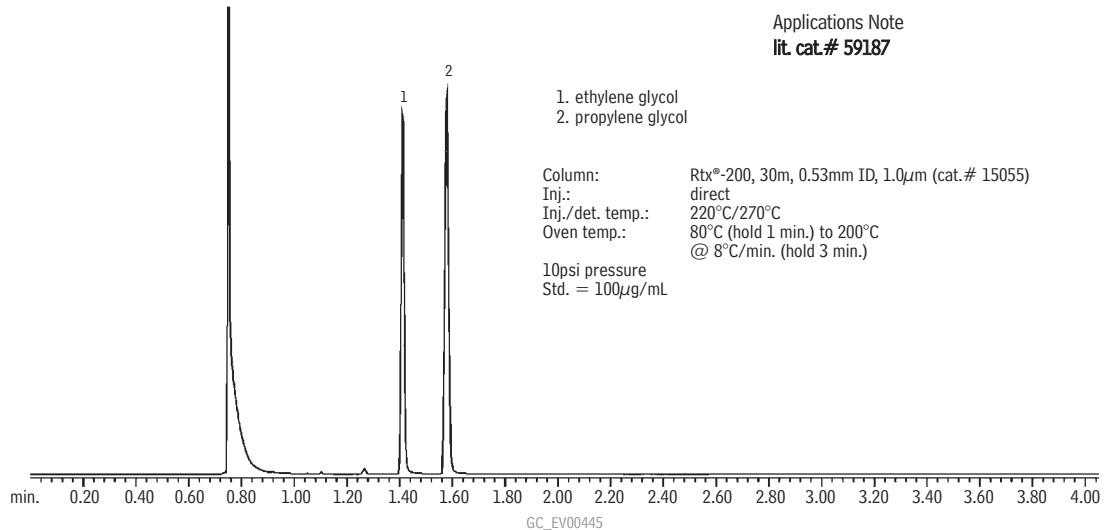
Avoid the problems that aqueous samples can create

Direct injections of water-based samples, such as samples containing ethylene glycol, can cause problems for chromatographers. This 4-page note alerts analysts to the potential for poor peak shape, sample carryover, and FID flameout, and describes approaches to follow to avoid these problems. With care, detection limits of 1-10ppm ethylene glycol can be attained.

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Applications Note
lit. cat.# 59187

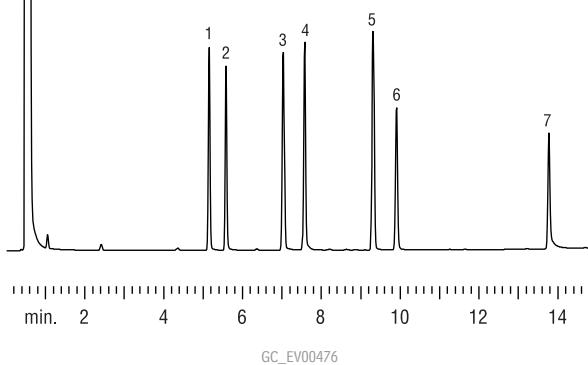
Glycols Rtx®-200



Glycols Stabilwax®

1. 1,2-propylene glycol
2. ethylene glycol
3. 1,3-butylene glycol
4. 1,3-propylene glycol
5. 1,4-butylene glycol
6. diethylene glycol
7. glycerol

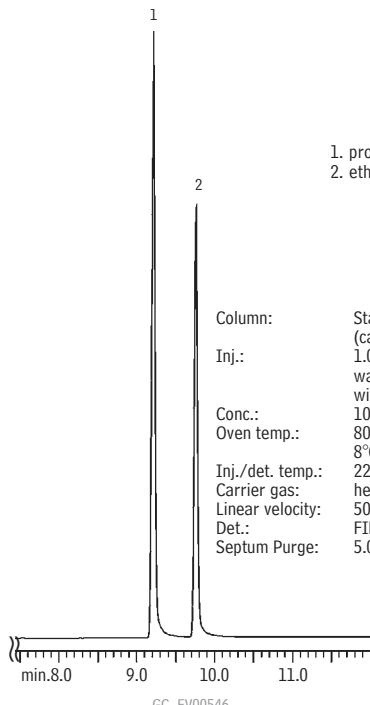
Column: Stabilwax®, 30m, 0.53mmID, 1.0 μ m (cat.# 10655)
 Inj.: 1.0 μ L direct injection, open-top Uniliner® inlet liner without wool (cat.# 20843-205)
 Conc.: 150ppm
 Solvent: water/methanol (50:50)
 Oven temp.: 80°C to 200°C @ 8°C/min. (hold 10 min.)
 Septa purge: 5.0cc/min.
 Carrier gas: helium
 Linear velocity: 50cm/sec.
 Column flow rate: 6.9mL/min.
 Det.: FID @ 270°C
 Make up gas flow: 45cc/min.



Glycols Stabilwax®

1. propylene glycol
2. ethylene glycol

Column: Stabilwax®, 30m, 0.53mm ID, 1.0 μ m (cat.# 10655)
 Inj.: 1.0 μ L of direct injection of glycols in water. Open-top Uniliner® inlet liner without wool (cat.# 20843-205)
 Conc.: 100ppm
 Oven temp.: 80°C (hold 1 min.) to 200°C @ 8°C/min. (hold 5 min.)
 Inj./det. temp.: 225°C/250°C
 Carrier gas: helium
 Linear velocity: 50cm/sec.
 Det.: FID
 Septum Purge: 5.0cc/min.



Glycols Rtx®-BAC1 & Rtx®-BAC2

Rtx®-BAC1

1. ethylene glycol
2. propylene glycol

Columns: Rtx®-BAC1, 30m, 0.32mm ID, 1.8 μ m (cat.# 18003)
 Rtx®-BAC2, 30m, 0.32mm ID, 1.2 μ m (cat.# 18002)
 Inj.: 0.5 μ L split injection
 Conc.: 1%
 Solvent: methanol
 Oven temp.: 100°C to 240°C @ 5°C/min. (hold 5 min.)
 Inj. temp.: 240°C
 Inj. mode: 100:1 split
 Inlet liner: 4mm single gooseneck (cat.# 20798)
 Septa purge: 5.0cc/min.
 Carrier gas: helium, constant pressure
 Pressure: 12psi
 Linear velocity: 37cm/sec.
 Column flow rate: 2.1mL/min.
 Det.: FID @ 240°C
 Make-up gas flow: 40cc/min.

min. 0 5

Rtx®-BAC2

- 1
- 2

min. 0 5

HROMalytic Chromatography Products '08

Australian Distributors

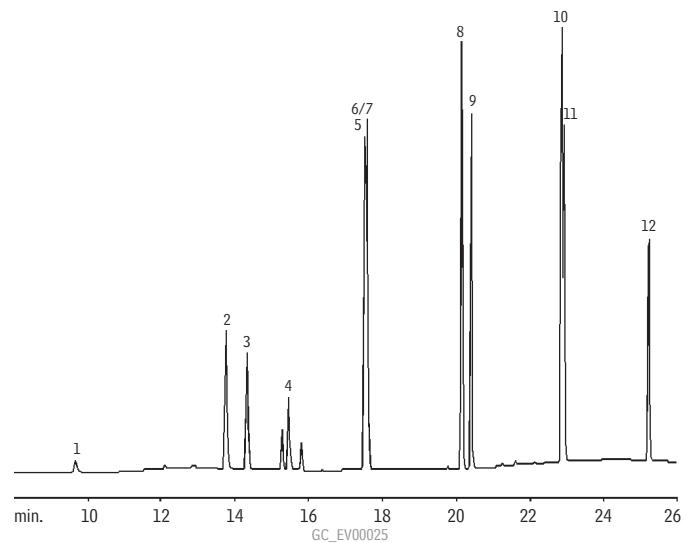
ECH nology

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RESTEK

Haloacetic Acids

**Haloacetic Acids
US EPA Method 552.2
Rtx®-5**

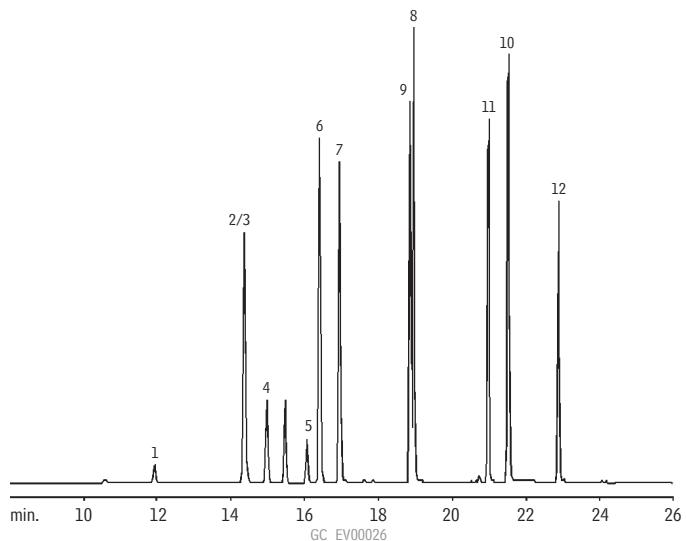


Column: Rtx®-5, 30m, 0.25mm ID, 1.0 μ m (cat. # 10253)
Inj.: 1.0 μ L split injection. 1ng on-column concentration.
Oven temp.: 50°C (hold 10 min.) to 225°C @ 8°C/min.
Inj./det. temp.: 200°C/290°C
Carrier gas: helium
Linear velocity: 30cm/sec. @ 50°C
ECD sensitivity: 20kHz full scale
Split ratio: 10:1

1. monochloroacetic acid (MCAA)
2. monobromoacetic acid (MBAA)
3. dichloroacetic acid (DCAA)
4. dalapon
5. 1,2,3-trichloropropane (I.S.)
6. bromochloroacetic acid (BCAA)
7. trichloroacetic acid (TCAA)
8. dibromoacetic acid (DBAA)
9. bromodichloroacetic acid (BDCAA)
10. 2,3-dibromopropionic acid (Sur.)
11. chlorodibromoacetic acid (CDBAA)
12. tribromoacetic acid (TBAA)

(All compounds derivatized)

**Haloacetic Acids
US EPA Method 552.2
Rtx®-200**



Column: Rtx®-200, 30m, 0.25mm ID, 1.0 μ m (cat. # 15053)
Inj.: 1.0 μ L split injection. 1ng on-column concentration.
Oven temp.: 50°C (hold 10 min.) to 225°C @ 8°C/min.
Inj./det. temp.: 200°C/290°C
Carrier gas: helium
Linear velocity: 30cm/sec. @ 50°C
ECD sensitivity: 20kHz full scale
Split ratio: 10:1

Haloacetic Acids**US EPA Method 552.2****Rtx®-CLPesticides & Rtx®-CLPesticides2****Rtx®-CLPesticides**

30m, 0.32mm ID, 0.50µm (cat.# 11139)

		RT
1. monochloroacetic acid	MCAA	4.41
2. monobromoacetic acid	MBAA	5.75
3. dichloroacetic acid	DCAA	5.92
4. dalapon	DL	6.35
5. 1,2,3-trichloropropane	IS	6.97
6. trichloroacetic acid	TCAA	7.20
7. bromochloroacetic acid	BCAA	7.31
8. dibromoacetic acid	DBAA	8.43
9. bromodichloroacetic acid	BDCAA	8.52
10. chlorodibromoacetic acid	CDBAA	9.68
11. 2,3-dibromopropionic acid	SURR	9.82
12. tribromoacetic acid	TBAA	10.73

C = contaminant in solvent

(Compounds derivatized to esters)

restek
innovation!

- Restek recommended for Method 552.2.
- Best resolution!

**Rtx®-CLPesticides2**

30m, 0.32mm ID, 0.25µm (cat.# 11324)

		RT
1. monochloroacetic acid	MCAA	3.70
2. monobromoacetic acid	MBAA	5.43
3. dichloroacetic acid	DCAA	5.50
4. dalapon	DL	5.78
6. trichloroacetic acid	TCAA	6.83
5. 1,2,3-trichloropropane	IS	6.98
7. bromochloroacetic acid	BCAA	7.17
9. bromodichloroacetic acid	BDCAA	8.43
8. dibromoacetic acid	DBAA	8.49
10. chlorodibromoacetic acid	CDBAA	9.80
11. 2,3-dibromopropionic acid	SURR	9.86
12. tribromoacetic acid	TBAA	11.04

C = contaminant in solvent

(Compounds derivatized to esters)

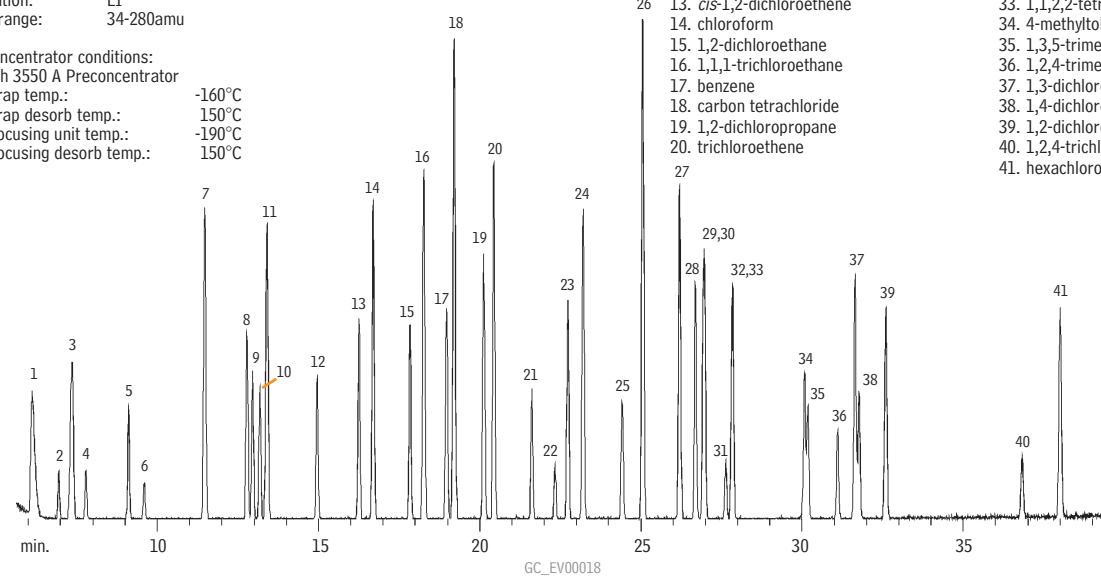


Sample: 2µL splitless injection of custom haloacetic acid methyl derivatives in MTBE (20-200µg/mL)
 Oven temp.: 40°C (hold 4 min.) to 200°C @ 14°C/min.
 Inj. temp.: 200°C
 Carrier gas: helium
 Linear velocity: 46cm/sec.
 ECD temp.: 300°C

Air**US EPA TO-14 Compounds****Rtx®-1**

Column: Rtx®-1, 60m, 0.32mm ID, 3.0 μ m (cat.# 10187)
 Sample: 5mL of 2ppmv TO-14 standard.
 Oven temp.: 30°C (hold 4 min.) to 250°C @ 7°C/min. (hold 15 min.).
 Detector: MS
 Det. temp.: 250°C
 Carrier gas: helium
 Linear velocity: 21cm/sec. set @ 30°C
 Ionization: EI
 Scan range: 34-280amu

Preconcentrator conditions:
 Nutech 3550 A Preconcentrator
 Cryotrap temp.: -160°C
 Cryotrap desorb temp.: 150°C
 Cryofocusing unit temp.: -190°C
 Cryofocusing desorb temp.: 150°C

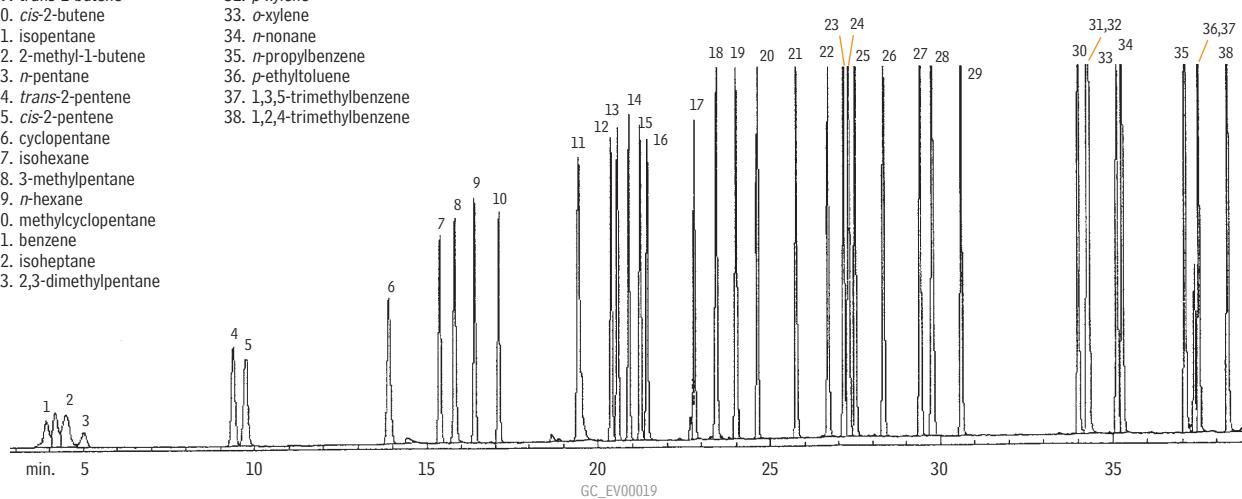


1. dichlorodifluoromethane
2. chloromethane
3. 1,2-dichlorotetrafluoroethane
4. vinyl chloride
5. bromomethane
6. chloroethane
7. trichlorofluoromethane
8. 1,1-dichloroethene
9. methylene chloride
10. 3-chloropropene
11. 1,1,2-trichloro-1,2,2-trifluoroethane
12. 1,1-dichloroethane
13. cis-1,2-dichloroethene
14. chloroform
15. 1,2-dichloroethane
16. 1,1,1-trichloroethane
17. benzene
18. carbon tetrachloride
19. 1,2-dichloropropane
20. trichloroethylene
21. cis-1,3-dichloropropene
22. trans-1,3-dichloropropene
23. 1,1,2-trichloroethane
24. toluene
25. 1,2-dibromoethane
26. tetrachloroethene
27. chlorobenzene
28. ethylbenzene
29. m-xylene
30. p-xylene
31. styrene
32. o-xylene
33. 1,1,2,2-tetrachloroethane
34. 4-methyltoluene
35. 1,3,5-trimethylbenzene
36. 1,2,4-trimethylbenzene
37. 1,3-dichlorobenzene
38. 1,4-dichlorobenzene
39. 1,2-dichlorobenzene
40. 1,2,4-trichlorobenzene
41. hexachlorobutadiene

Ozone Precursors**Rtx®-1**

- | | |
|--------------------------|----------------------------|
| 1. ethylene | 24. 3-methylhexane |
| 2. acetylene | 25. 2,2,4-trimethylpentane |
| 3. ethane | 26. n-heptane |
| 4. propylene | 27. methylcyclohexane |
| 5. propane | 28. 2,2,3-trimethylpentane |
| 6. isobutane | 29. toluene |
| 7. 1-butene | 30. ethylbenzene |
| 8. n-butane | 31. m-xylene |
| 9. trans-2-butene | 32. p-xylene |
| 10. cis-2-butene | 33. o-xylene |
| 11. isopentane | 34. n-nonane |
| 12. 2-methyl-1-butene | 35. n-propylbenzene |
| 13. n-pentane | 36. p-ethyltoluene |
| 14. trans-2-pentene | 37. 1,3,5-trimethylbenzene |
| 15. cis-2-pentene | 38. 1,2,4-trimethylbenzene |
| 16. cyclopentane | |
| 17. isohexane | |
| 18. 3-methylpentane | |
| 19. n-hexane | |
| 20. methyliccyclopentane | |
| 21. benzene | |
| 22. isoheptane | |
| 23. 2,3-dimethylpentane | |

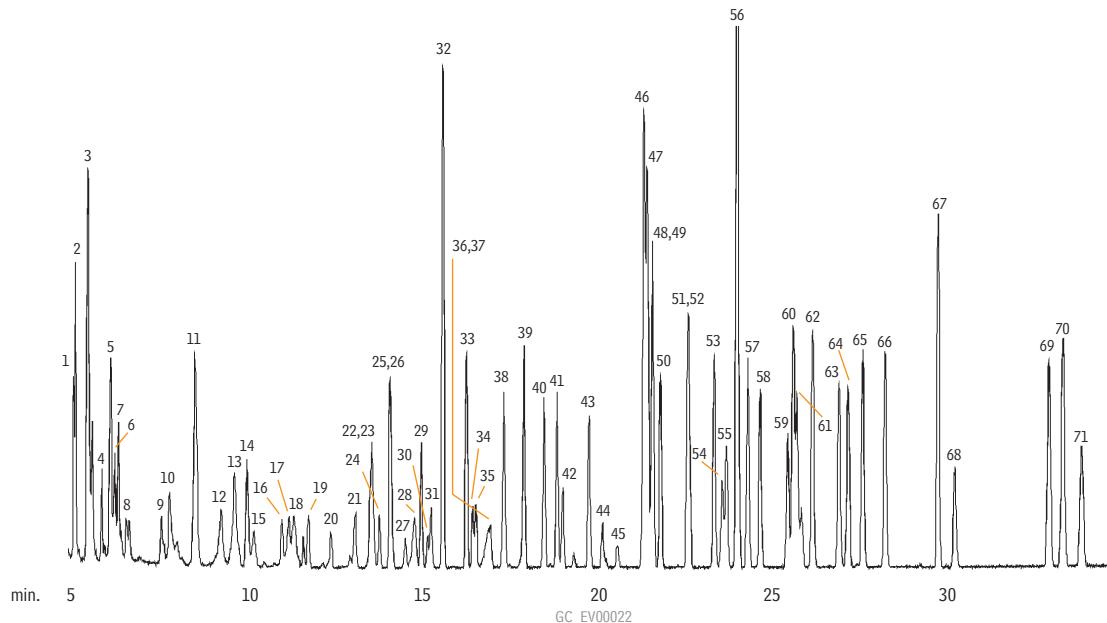
Column: Rtx®-1, 60m, 0.32mm ID, 3.0 μ m (cat.# 10187)
 Sample: 0.5L of C2-C9 gas standard cryogenically concentrated;
 15nL/component described onto column.
 Oven temp.: -60°C (hold 5 min.) to 100°C @ 8°C/min., to
 150°C @ 6°C/min., then to 240°C @ 8°C/min.
 Carrier gas: helium
 Linear velocity: 30cm/sec. (flow rate: 1.8cc/min.)
 FID sensitivity: 64×10^{-12} AFS



Permission to publish this chromatogram granted by Radian Corporation.

Air Toxins

Rtx®-502.2



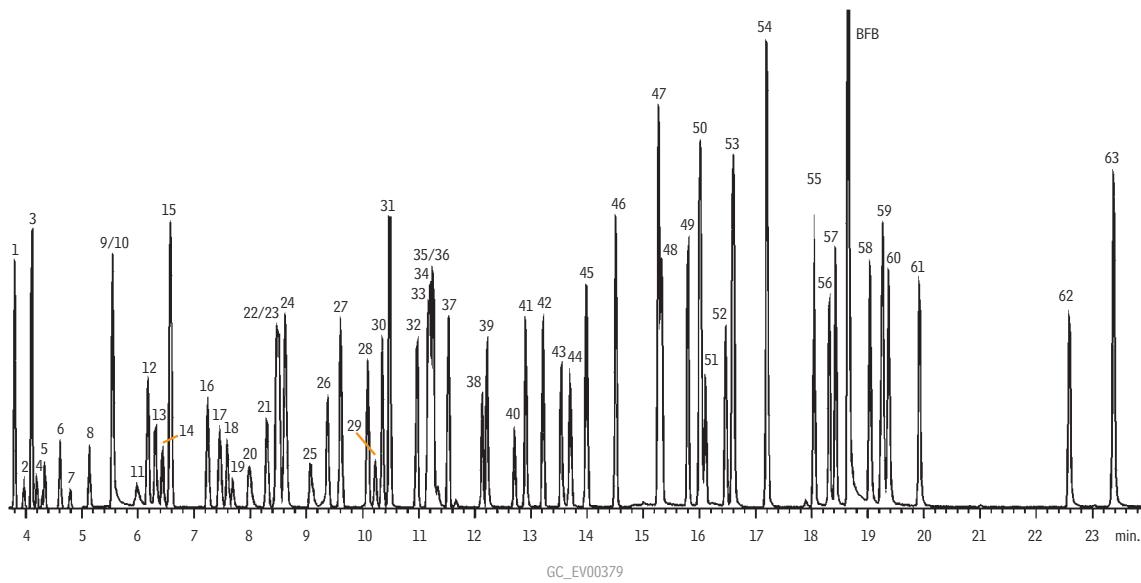
- | | | | |
|------------------------------|--------------------------------------|---------------------------|-------------------------------|
| 1. chlorodifluoromethane | 19. <i>trans</i> -1,2-dichloroethene | 37. bromodichloromethane | 55. 1,1,1,2-tetrachloroethane |
| 2. dichlorodifluoromethane | 20. 1,1-dichloroethane | 38. 4-methyl-2-pentanone | 56. 4-bromofluoromethane |
| 3. dichlorotetrafluoroethane | 21. methyl ethyl ketone | 39. octane | 57. <i>n</i> -propylbenzene |
| 4. chloromethane | 22. <i>cis</i> -1,2-dichloroethene | 40. toluene | 58. 1,3,5-trimethylbenzene |
| 5. butane | 23. methacrylonitrile | 41. 2-hexanone | 59. α -methylstyrene |
| 6. vinyl chloride | 24. chloroform | 42. 1,1,2-trichloroethane | 60. <i>tert</i> -butylbenzene |
| 7. 1,3-butadiene | 25. bromochloromethane | 43. tetrachloroethene | 61. 1,2,4-trimethylbenzene |
| 8. acetaldehyde | 26. tetrahydrofuran | 44. dibromochloromethane | 62. <i>sec</i> -butylbenzene |
| 9. bromomethane | 27. 1,1,1-trichloroethane | 45. 1,2-dibromoethane | 63. 1,3-dichlorobenzene |
| 10. chloroethane | 28. <i>n</i> -butanol | 46. chlorobenzene-d5 | 64. 1,4-dichlorobenzene |
| 11. trichlorofluoromethane | 29. heptane | 47. chlorobenzene | 65. butylbenzene |
| 12. isopropanol | 30. 1,2-dichloroethane | 48. <i>m</i> -xylene | 66. 1,2-dichlorobenzene |
| 13. acetone | 31. benzene | 49. <i>p</i> -xylene | 67. dodecane |
| 14. 1,1-dichloroethene | 32. 1,4-difluorobenzene | 50. 2-heptanone | 68. dibromochloropropane |
| 15. acetonitrile | 33. trichloroethene | 51. styrene | 69. 1,2,4-trichlorobenzene |
| 16. dichloromethane | 34. ethyl methacrylate | 52. α -xylene | 70. hexachlorobutadiene |
| 17. acrylonitrile | 35. 1,2-dichloropropene | 53. isopropylbenzene | |
| 18. 1-propanol | 36. 1,4-dioxane | 54. bromoform | 71. naphthalene |

Column: Rtx®-502.2, 60m, 0.32mm ID, 1.8 μ m (cat.# 10920)
 Sample: 500mL of 10ppbv standard concentrated on an AEROCAN® 6000 using a glass bead trap at 165°C then desorbed at 200°C for 4 min. @ 1mL/min., cryofocused @ -175°C then desorbed @ 150°C
 Oven temp.: 35°C (hold 6 min.) to 120°C @ 15°C/min., then to 200°C @ 5°C/min., then to 220°C @ 25°C/min. (hold 10 min.)
 Det. & det. temp.: Agilent-5971A GC/MS, 280°C
 Carrier gas: helium @ 1mL/min.
 Linear velocity: 20cm/sec.
 Scan range: 28-260amu
 Solvent delay: 4 min.

Permission to publish this chromatogram granted by Tekmar Company.

US EPA TO-14/TO-15 Compounds

Rtx®-1



Column: Rtx®-1, 60m, 0.32mm ID, 1.0 μ m (cat.# 10157)
 Sample: 200ml of 10ppbv TO-15 standard, injected into TO-Can™ canister and
 humidified to 70% RH.
 Concentrator: Nutech 3550 Preconcentrator
 200ml of sample concentrated at -160°C, thermally desorbed at
 150°C, and cryofocused at -185°C
 Oven temp.: 30°C (hold 4 min.) to 175°C @ 9°C/min. to 220°C @ 40°C/min.
 Carrier gas: helium @ 1.2mL/min.
 Det.: Agilent 5971 MS
 Scan range: 35-265amu

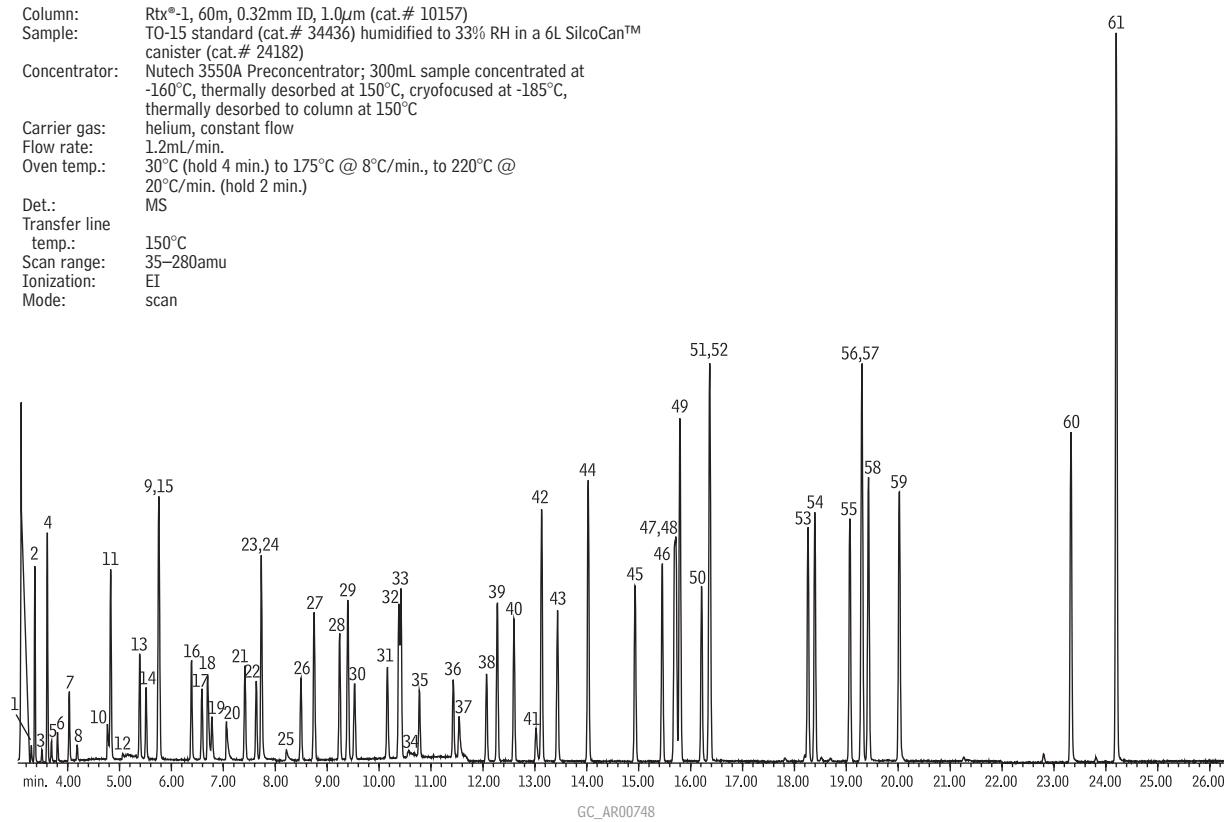
- | | | |
|--------------------------------------|---------------------------------------|-------------------------------|
| 1. dichlorofluoromethane | 23. <i>n</i> -hexane | 45. 1,2-dibromoethane |
| 2. chloromethane | 24. chloroform | 46. tetrachloroethene |
| 3. dichlorotetrafluoroethane | 25. tetrahydrofuran | 47. chlorobenzene-d5 (IS) |
| 4. vinyl chloride | 26. 1,2-dichloroethane | 48. chlorobenzene |
| 5. 1,3-butadiene | 27. 1,1,1-trichloroethane | 49. ethylbenzene |
| 6. bromomethane | 28. benzene | 50a. <i>m</i> -xylene |
| 7. chloroethane | 29. carbon tetrachloride | 50b. <i>p</i> -xylene |
| 8. bromoethene | 30. cyclohexane | 51. bromoform |
| 9. acetone | 31. 1,4-difluorobenzene (IS) | 52. styrene |
| 10. trichlorofluoromethane | 32. 1,2-dichloropropane | 53. 1,1,2,2-tetrachloroethane |
| 11. isopropyl alcohol | 33. bromodichloromethane | 54. <i>o</i> -xylene |
| 12. 1,1-dichloroethene | 34. trichloroethene | 55. 2-chlorotoluene |
| 13. methylene chloride | 35. 1,4-dioxane | 56. 4-ethyltoluene |
| 14. 3-chloropropene | 36. 2,2,4-trimethylpentane | 57. 1,3,5-trimethylbenzene |
| 15. carbon disulfide | 37. <i>n</i> -heptane | 58. 1,2,4-trimethylbenzene |
| 16. Freon® TF | 38. <i>cis</i> -1,3-dichloropropene | 59. 1,3-dichlorobenzene |
| 17. <i>trans</i> -1,2-dichloroethene | 39. methyl isobutyl ketone | 60. 1,4-dichlorobenzene |
| 18. 1,1-dichloroethane | 40. <i>trans</i> -1,3-dichloropropene | 61. 1,2-dichlorobenzene |
| 19. methyl <i>tert</i> -butyl ether | 41. 1,1,2-trichloroethane | 62. 1,2,4-trichlorobenzene |
| 20. methyl ethyl ketone | 42. toluene | 63. hexachlorobutadiene |
| 21. <i>cis</i> -1,2-dichloroethene | 43. methyl butyl ketone | |
| 22. bromochloromethane (IS) | 44. dibromochloromethane | |

Chromatogram courtesy of Gina Maio, Severn Trent Laboratories, Inc., Burlington, VT.

US EPA TO-15 Compounds

Rtx®-1

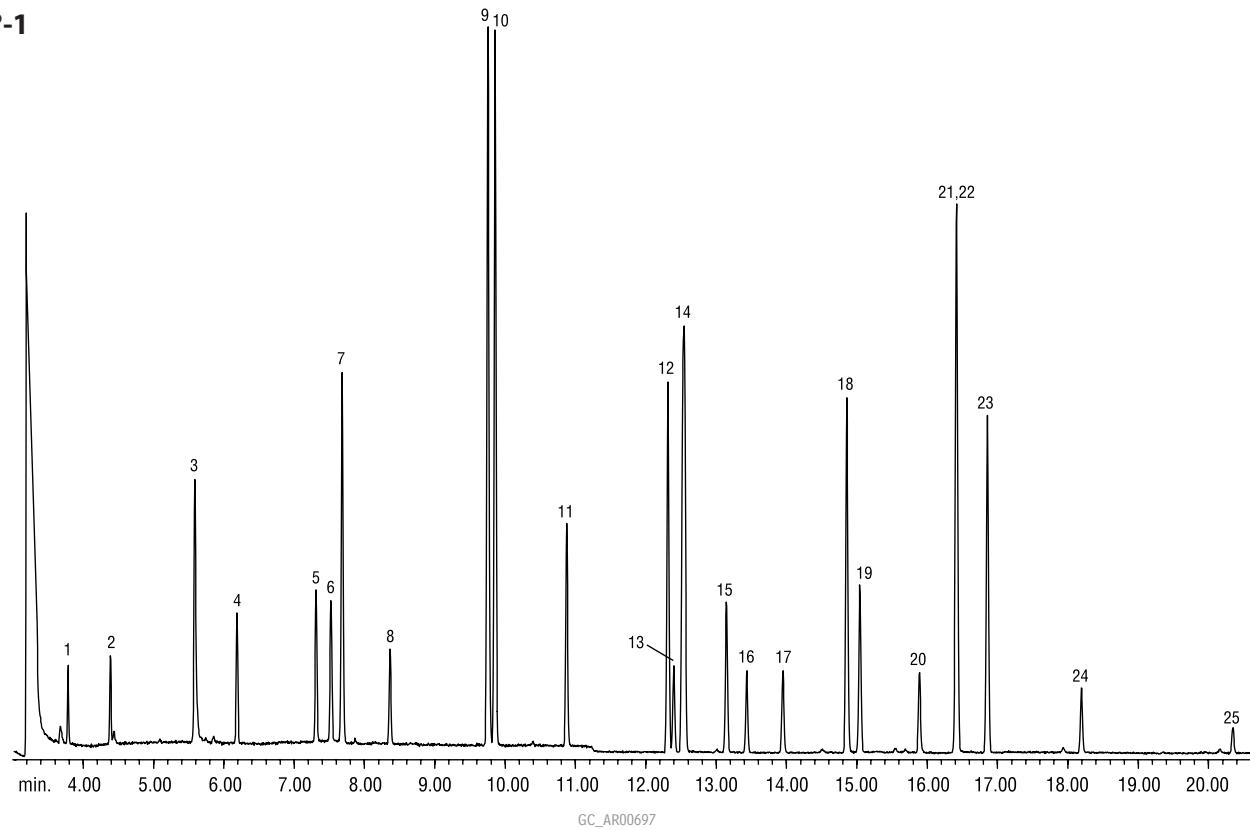
Column: Rtx®-1, 60m, 0.32mm ID, 1.0 μ m (cat. # 10157)
 Sample: TO-15 standard (cat.# 34436) humidified to 33% RH in a 6L SilcoCan™ canister (cat.# 24182)
 Concentrator: Nutech 3550A Preconcentrator; 300mL sample concentrated at -160°C, thermally desorbed at 150°C, cryofocused at -185°C, thermally desorbed to column at 150°C
 Carrier gas: helium, constant flow
 Flow rate: 1.2mL/min.
 Oven temp.: 30°C (hold 4 min.) to 175°C @ 8°C/min., to 220°C @ 20°C/min. (hold 2 min.)
 Det.: MS
 Transfer line temp.: 150°C
 Scan range: 35–280amu
 Ionization: EI
 Mode: scan



- | | | |
|--|---------------------------------------|-------------------------------|
| 1. propylene | 22. hexane | 43. 1,2-dibromoethane |
| 2. Freon®-12 (dichlorodifluoromethane) | 23. chloroform | 44. tetrachloroethylene |
| 3. chloromethane | 24. ethyl acetate | 45. chlorobenzene |
| 4. Freon®-114 (dichlorotetrafluoroethane) | 25. tetrahydrofuran | 46. ethylbenzene |
| 5. vinyl chloride | 26. 1,2-dichloroethane | 47. <i>p</i> -xylene |
| 6. 1,3-butadiene | 27. 1,1,1-trichloroethane | 48. <i>m</i> -xylene |
| 7. bromomethane | 28. benzene | 49. bromoform |
| 8. chloroethane | 29. carbon tetrachloride | 50. styrene |
| 9. carbon disulfide | 30. cyclohexane | 51. <i>o</i> -xylene |
| 10. acetone | 31. 1,2-dichloropropane | 52. 1,1,2,2-tetrachloroethane |
| 11. Freon®-11 (trichlorofluoromethane) | 32. trichloroethylene | 53. 4-ethyltoluene |
| 12. isopropyl alcohol | 33. bromodichloromethane | 54. 1,3,5-trimethylbenzene |
| 13. 1,1-dichloroethene | 34. 1,4-dioxane | 55. 1,2,4-trimethylbenzene |
| 14. methylene chloride | 35. heptane | 56. 1,3-dichlorobenzene |
| 15. Freon®-113 (1,1,2-trichloro-1,2,2-trifluoroethane) | 36. <i>cis</i> -1,3-dichloropropene | 57. benzyl chloride |
| 16. <i>trans</i> -1,2-dichloroethene | 37. methyl isobutyl ketone | 58. 1,4-dichlorobenzene |
| 17. 1,1-dichloroethane | 38. <i>trans</i> -1,3-dichloropropene | 59. 1,2-dichlorobenzene |
| 18. methyl <i>tert</i> -butyl ether | 39. 1,1,2-trichloroethane | 60. 1,2,4-trichlorobenzene |
| 19. vinyl acetate | 40. toluene | |
| 20. methyl ethyl ketone | 41. methyl butyl ketone | |
| 21. <i>cis</i> -1,2-dichloroethene | 42. dibromochloromethane | 61. hexachloro-1,3-butadiene |

Searching for a chromatogram?

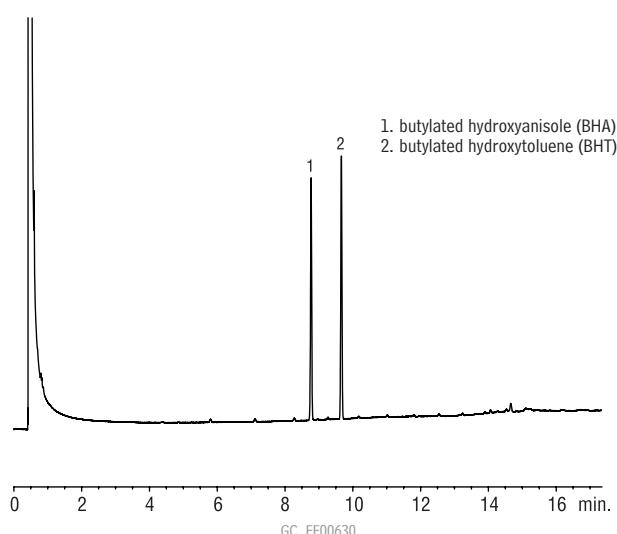
www.restek.com

Air**Massachusetts APH Mix****Rtx®-1**

Column: Rtx®-1, 60m, 0.32mm ID, 1.0 μ m (cat.# 10157)
 Sample: Massachusetts APH Mix, (cat.# 34446)
 Concentrator: Nutech 3550A Air Preconcentrator, 100mL of a 40ppbv standard concentrated at -160°C, thermally desorbed at 150°C and cryofocused at -185°C
 Carrier gas: helium
 Flow rate: 1mL/min.
 Oven temp.: 35°C (hold 1 min.) to 220°C @ 8°C/min.
 Det: MS, Agilent 5971
 Transfer line temp.: 250°C
 Scan range: 35-280amu
 Ionization: EI
 Mode: scan

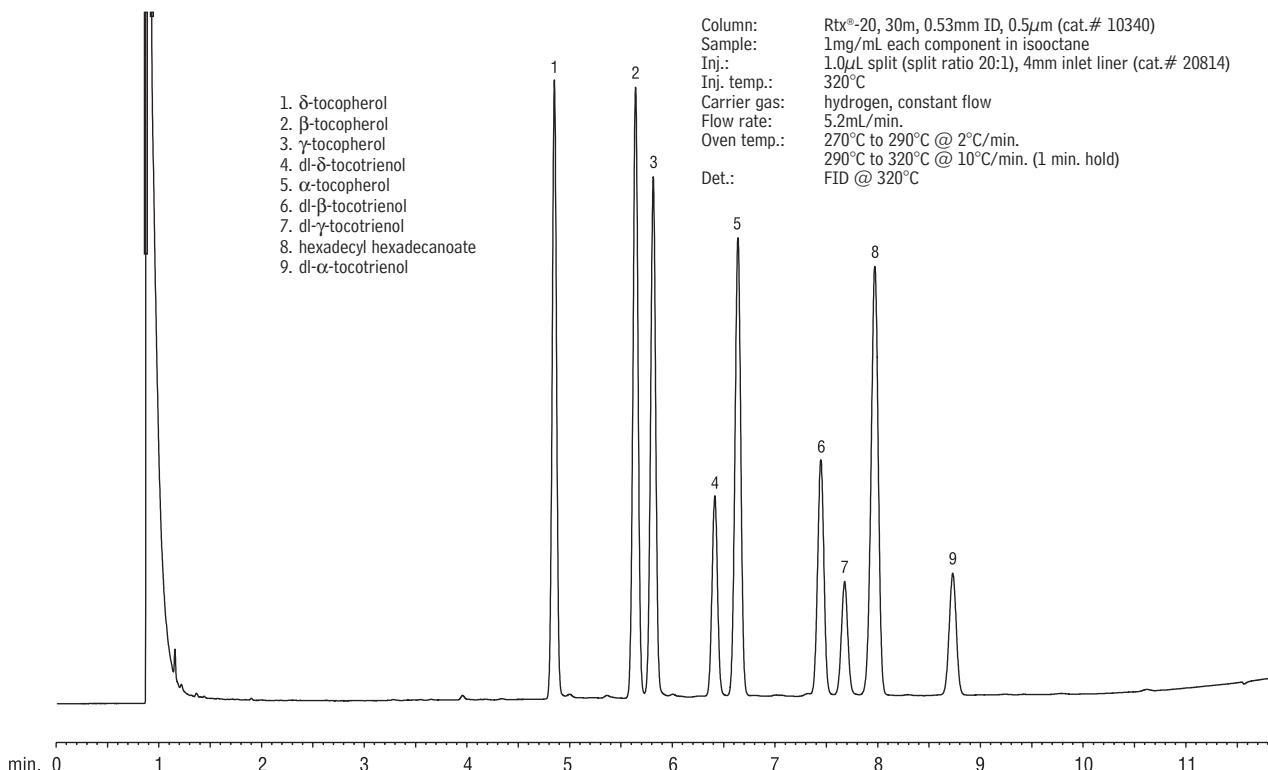
1. 1,3-butadiene
 2. isopentane
 3. methyl *tert*-butyl ether
 4. hexane
 5. benzene
 6. cyclohexane
 7. 2,3-dimethylpentane
 8. heptane
 9. toluene-D8
 10. toluene
 11. octane
 12. ethylbenzene
 13. 2,3-dimethylheptane
 14. 1,3-butadiene
 14a. *m*-xylene
 14b. *p*-xylene
 15. *o*-xylene
 16. nonane
 17. isopropylbenzene
 18. 1-methyl-3-ethylbenzene
 19. 1,3,5-trimethylbenzene
 20. decane
 21. 1,2,3-trimethylbenzene
 22. *p*-isopropyltoluene
 23. butylcyclohexane
 24. undecane
 25. dodecane



BHA and BHT**Rtx®-50**

Column: Rtx®-50, 30m, 0.53mm ID, 0.50 μ m (cat.# 10540)
 Sample: 50ppm each in methanol
 Inj.: 1.0 μ L direct, gooseneck splitless inlet liner, 4mm (cat.# 20798)
 Inj. temp.: 280°C
 Carrier gas: helium, constant pressure
 Linear velocity: 60cm/sec. @ 50°C
 Oven temp.: 50°C to 240°C @ 15°C/min. (hold 3 min.)
 Det.: FID @ 280°C

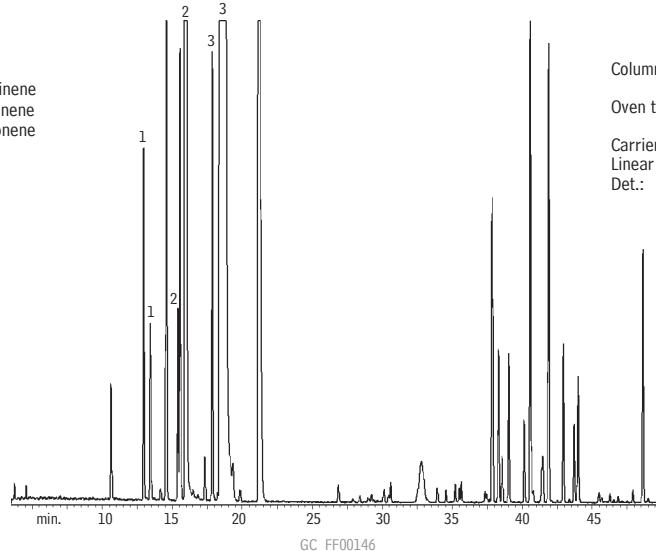
Searching for a chromatogram?
www.restek.com

Tocopherols and Tocotrienols**Rtx®-20**

Chiral Separations

Lemon Oil Rt™- β DEXsm

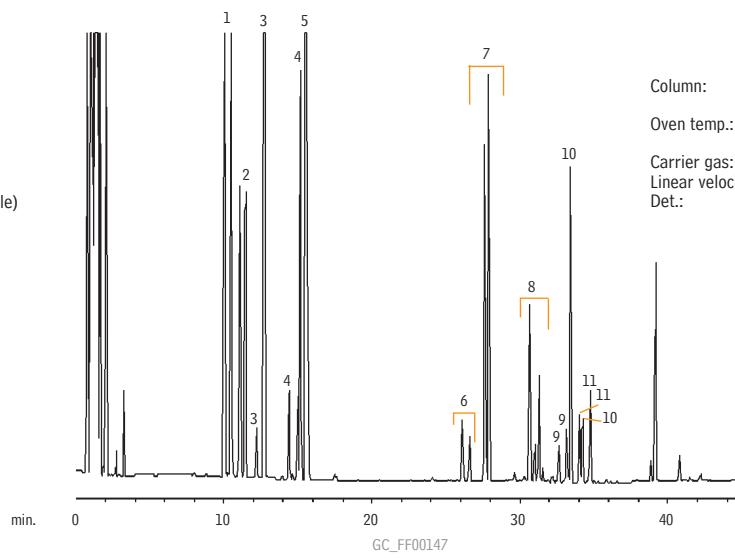
1. (-/+) α -pinene
2. (+/-) β -pinene
3. (-/+)limonene



Column: Rt™- β DEXsm, 30m, 0.32mm ID, 0.25 μ m (cat.# 13104)
Oven temp.: 40°C (hold 1 min.) to 200°C @ 2°C/min. (hold 3 min.)
Carrier gas: hydrogen
Linear velocity: 80cm/sec.
Det.: FID @ 220°C

Rosemary Oil Rt™- β DEXsm

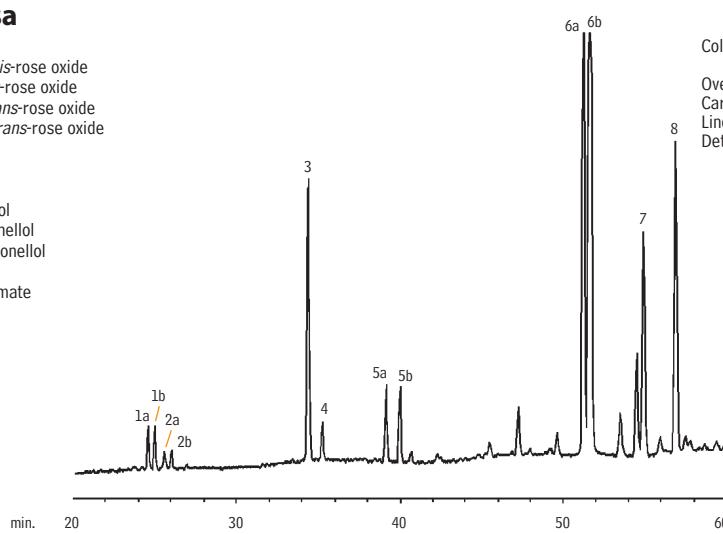
1. (-/+) α -pinene
2. (+-)camphene
3. (+/-) β -pinene
4. (-/+)limonene
5. eucalyptol (1,8-cineole)
6. (-/+)linalool
7. (+-)camphor
8. (-/+)terpinen-4-ol
9. (+/-)isoborneol
10. (+/-)borneol
11. (+/-) α -terpineol



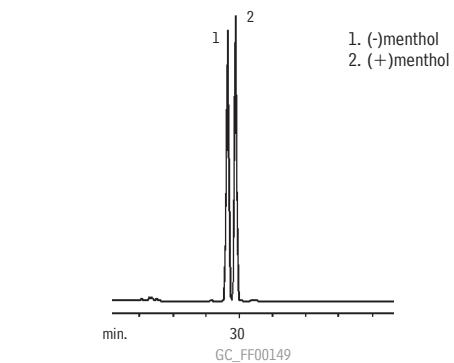
Column: Rt™- β DEXsm, 30m, 0.32mm ID, 0.25 μ m (cat.# 13104)
Oven temp.: 40°C (hold 1 min.) to 200°C @ 2°C/min. (hold 3 min.)
Carrier gas: hydrogen
Linear velocity: 80cm/sec.
Det.: FID @ 220°C

Geranium Oil (Commercial) Rt™- β DEXsa

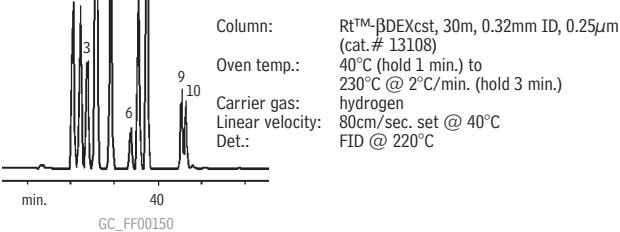
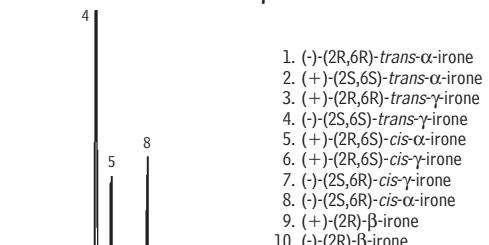
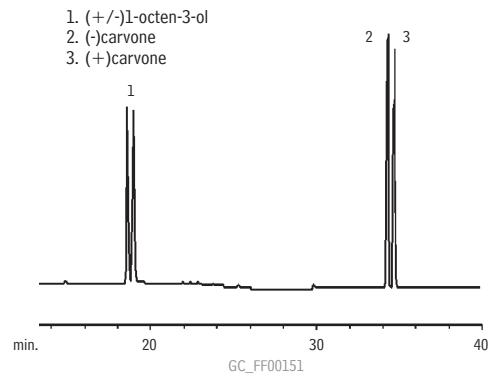
- 1a. (+)-(2R,4S)-*cis*-rose oxide
1b. (-)(2S,4R)-*cis*-rose oxide
2a. (-)(2R,4R)-*trans*-rose oxide
2b. (+)(2S,4S)-*trans*-rose oxide
3. isomenthone
4. menthone
5a. (-)(R)-linalool
5b. (+)(S)-linalool
6a. (-)(S)- β -citronellol
6b. (+)(R)- β -citronellol
7. geraniol
8. citronellyl formate



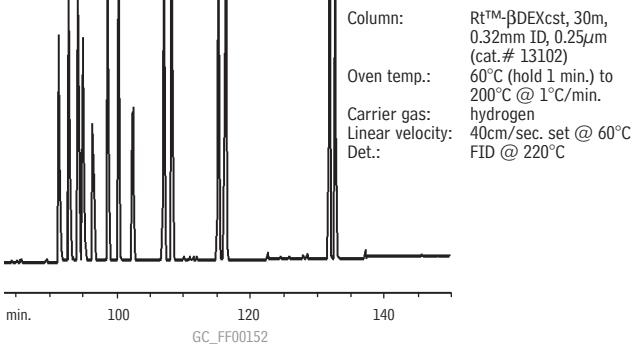
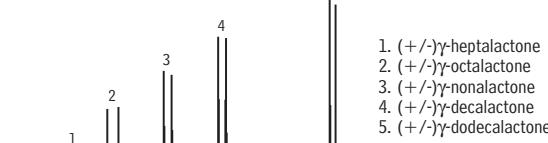
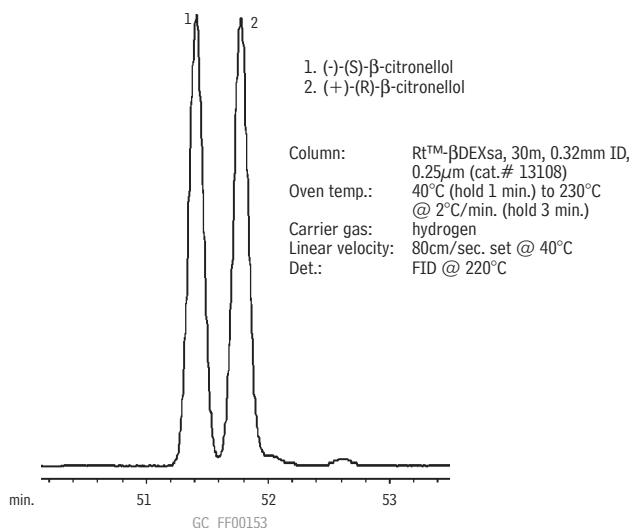
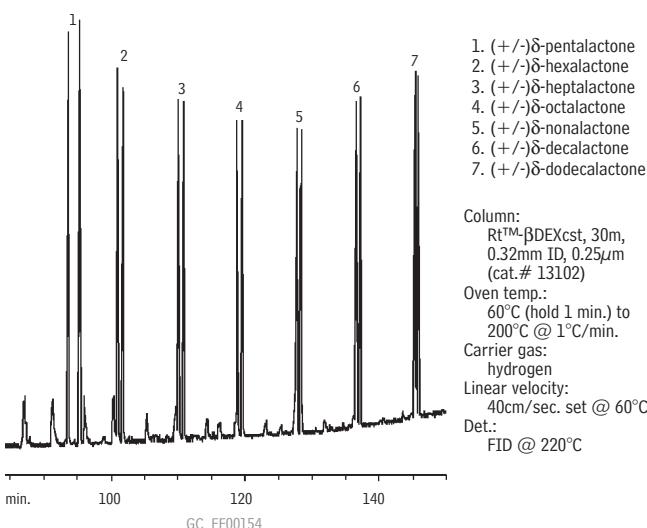
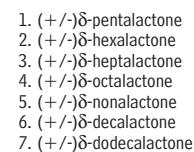
Column: Rt™- β DEXsa, 30m, 0.25mm ID, 0.25 μ m (cat.# 13109)
Oven temp.: 60°C to 110°C @ 1°C/min. (hold 30 min.)
Carrier gas: hydrogen
Linear velocity: 40cm/sec. set @ 60°C
Det.: FID @ 220°C

Menthol - Rt™- β DEXsp

Column: Rt™- β DEXsp, 30m, 0.32mm ID, 0.25 μ m (cat.# 13110)
Oven temp.: 60°C (hold 1 min.) to 200°C @ 2°C/min.
Carrier gas: hydrogen
Linear velocity: 80cm/sec. set @ 40°C
Det.: FID @ 220°C

Irone Isomers - Rt™- β DEXcst**1-octen-3-ol and carvone - Rt™- β DEXsa**

Column: Rt™- β DEXsa, 30m, 0.32mm ID, 0.25 μ m (cat.# 13108)
Oven temp.: 40°C (hold 1 min.) to 230°C @ 2°C/min. (hold 3 min.)
Carrier gas: hydrogen
Linear velocity: 80cm/sec. set @ 40°C
Det.: FID @ 220°C

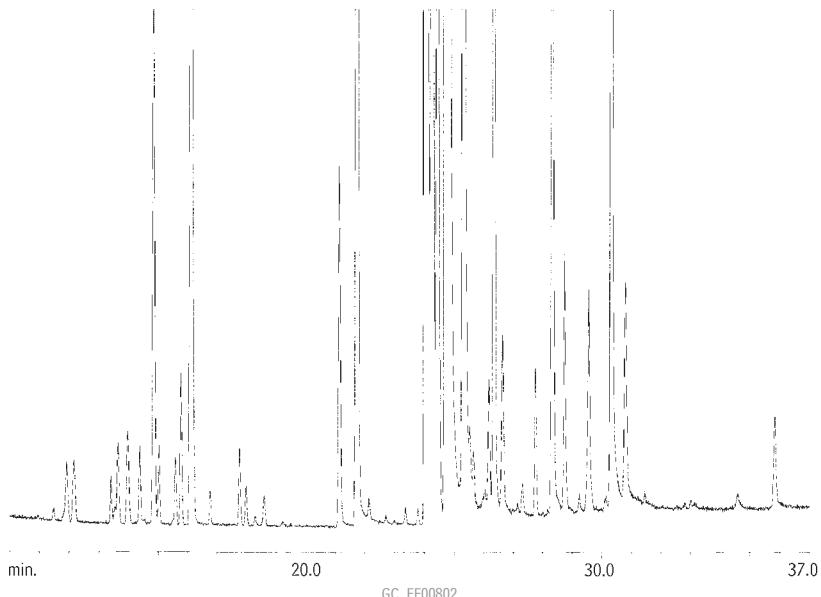
 γ -lactones - Rt™- β DEXcst **β -citronellol - Rt™- β DEXsa** **δ -lactones - Rt™- β DEXcst**

Chiral Separations

Commercial Peppermint Oil

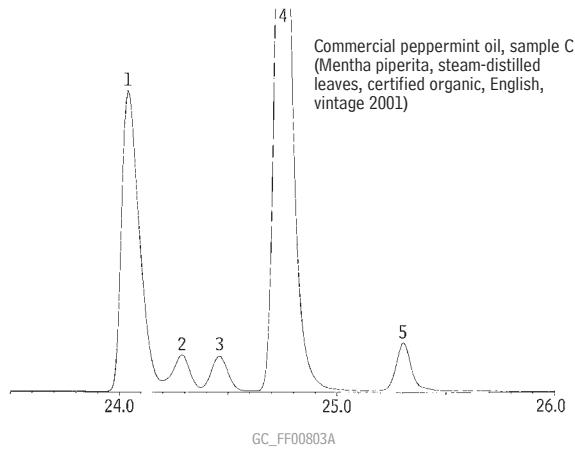
RtTM- γ DEXsm

Commercial peppermint oil, sample B



Column: RtTM- γ DEXsm, 30m, 0.25mm ID, 0.25 μ m (cat.# 13113)
 Inj.: 1.0 μ L neat, split (split ratio 1:150)
 Inj. temp.: 230°C
 Carrier gas: helium, constant pressure
 Flow rate: 35cm/sec. at 100°C
 Oven temp.: 40°C to 120°C @ 5°C/min. to 135°C @ 3°C/min. to 200°C @ 5°C/min.
 MS
 Det: Transfer line temp.: 200°C
 Scan range: 40-300amu
 Ionization: EI
 Mode: scan

1. menthone
2. menthol
3. menthone
4. menthol
5. methyl acetate



free literature

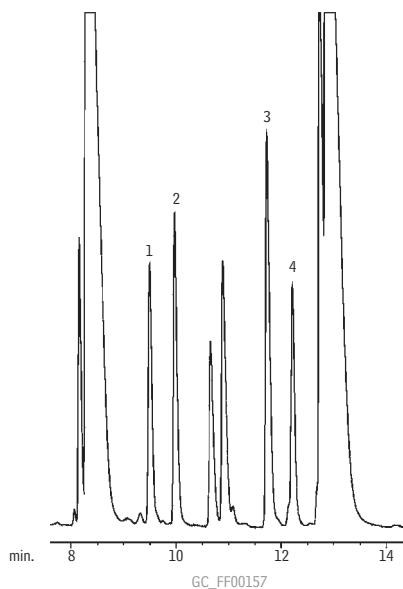
Request **A Guide to the Analysis of Chiral Compounds by GC** for more information about chiral separations.

Many example chromatograms in our 24-page chiral analysis guide will help you find the best chiral column, or columns, for your application.

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Technical Guide
 lit. cat.# **59889**

Apple Juice with Standards RtTM- β DEXse

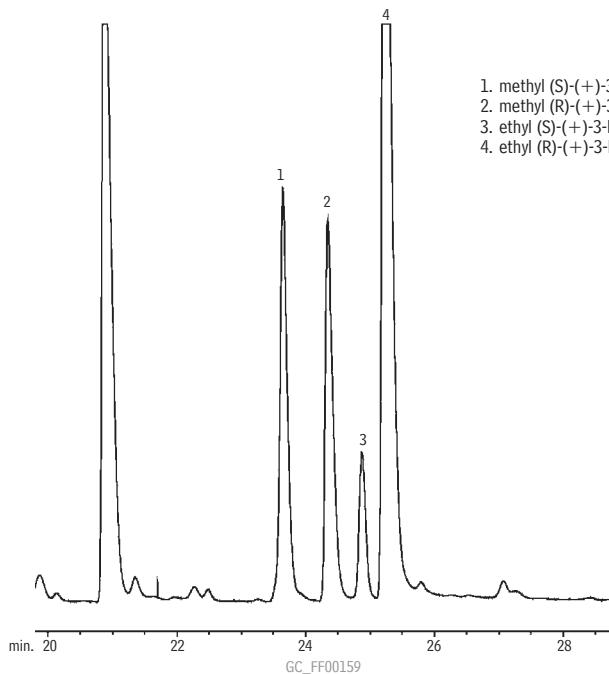


- 1. (R)-ethyl 2-methylbutyrate
- 2. (S)-ethyl 2-methylbutyrate
- 3. (R)-2-methylbutyrate
- 4. (S)-2-methylbutyrate



Column: RtTM- β DEXse, 30m, 0.32mm ID, 0.25 μ m (cat.# 13106)
 Inj.: 1.0 μ L split injection
 On-column conc. ~50ng
 (standards):
 Oven temp.: 40°C (hold 1 min.) to 220°C @ 2°C/min.
 Inj./det. temp.: 220°C
 Carrier gas: hydrogen
 Linear velocity: 80cm/sec.

Grape Juice Extract RtTM- γ DEXsa

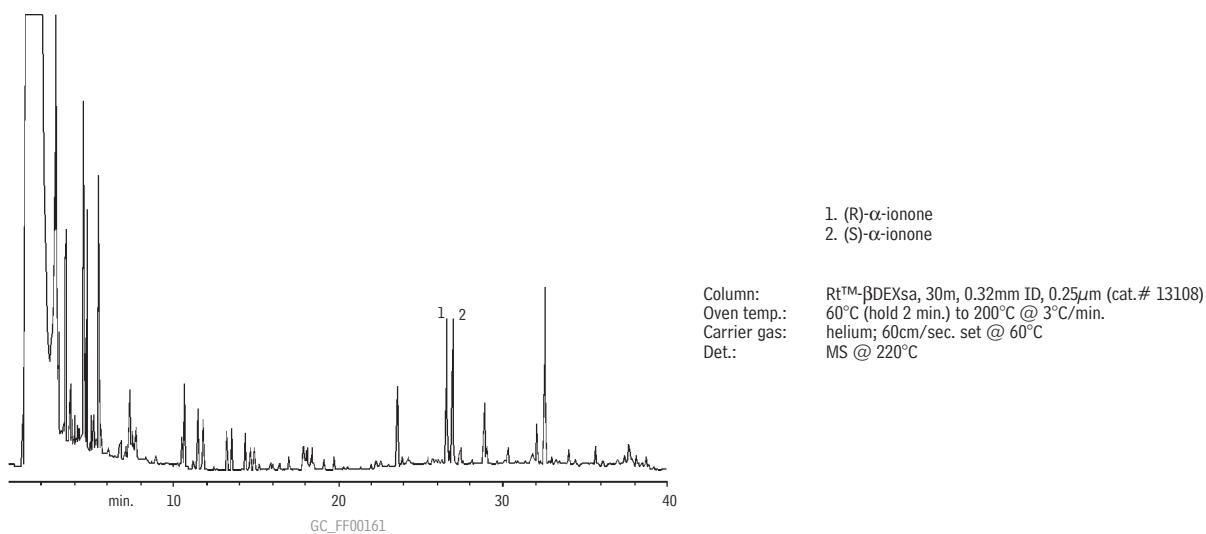


- 1. methyl (S)-(+)-3-hydroxybutyrate
- 2. methyl (R)-(+)-3-hydroxybutyrate
- 3. ethyl (S)-(+)-3-hydroxybutyrate
- 4. ethyl (R)-(+)-3-hydroxybutyrate

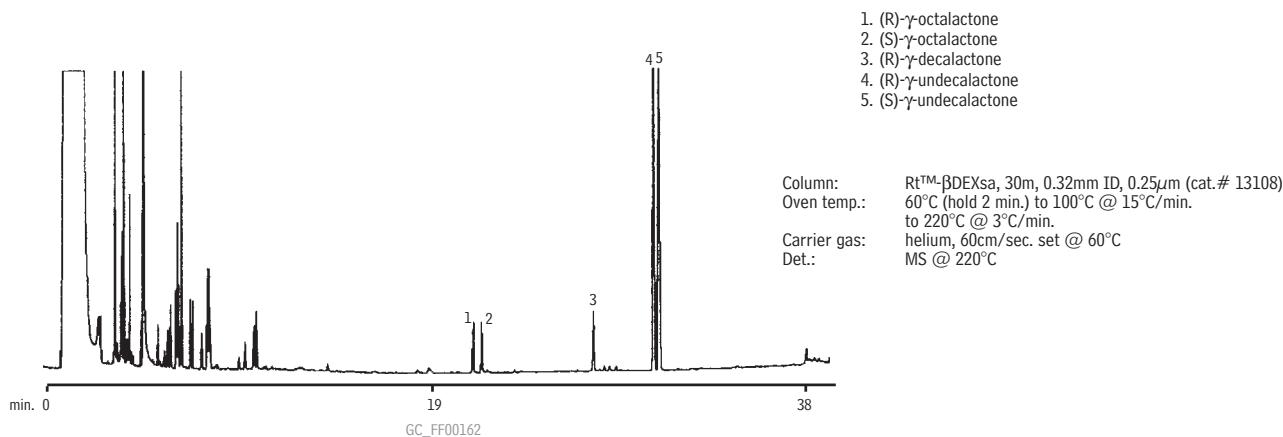
Column: RtTM- γ DEXsa, 30m, 0.32mm ID, 0.25 μ m (cat.# 13112)
 Inj.: 1.0 μ L split injection
 On-column conc.: ~150ng/enantiomer
 Oven temp.: 40°C (hold 1 min.) to 200°C @ 2°C/min.
 Inj./det. temp.: 220°C/230°C
 Carrier gas: hydrogen
 Linear velocity: 80cm/sec. set @ 40°C
 Split ratio: 25:1

Chiral Separations

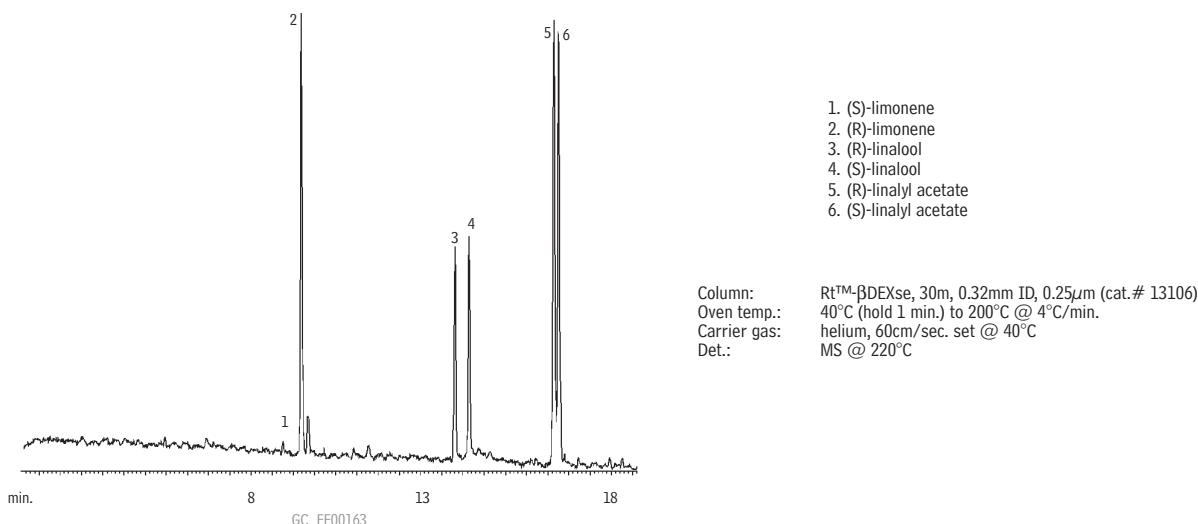
Raspberry Flavor - RtTM- β DEXsa



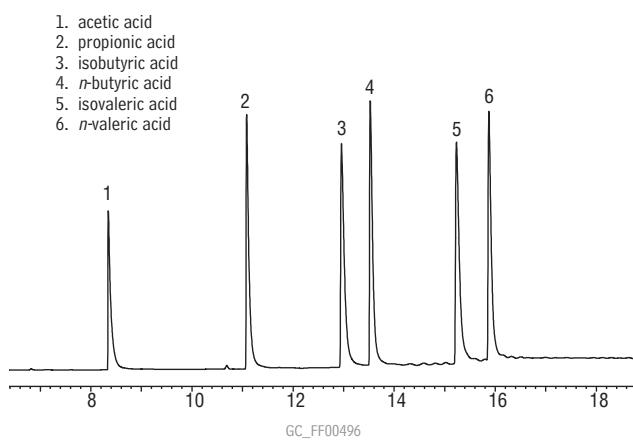
Peach/Vanilla Flavor - RtTM- β DEXsa



Bergamot Flavor - RtTM- β DEXse

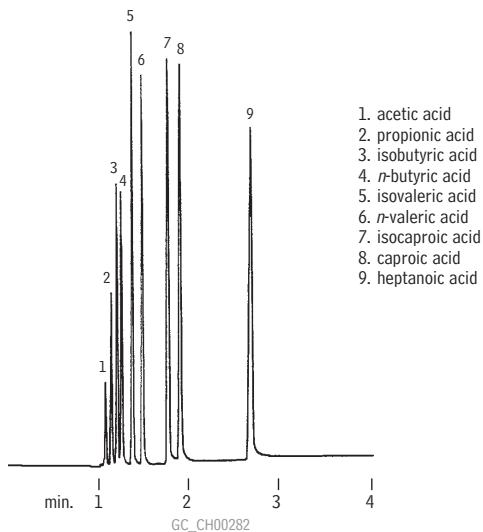


Fatty Acids (Free) RtTM-QPLOT



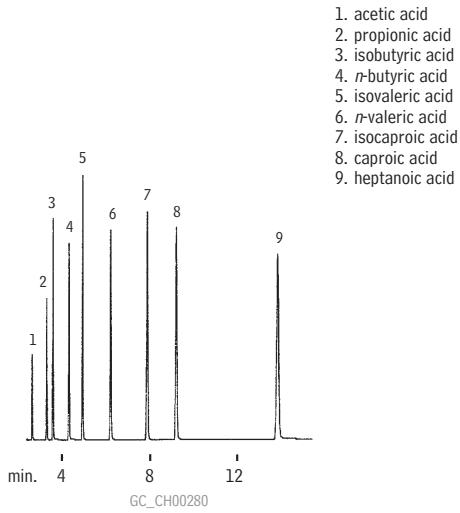
Column: RtTM-QPLOT, 30m, 0.32mm ID, 10 μ m (cat.# 19718)
 Sample: fatty acids mix
 Conc.: 5% of each compound in water
 Sample size: 0.5 μ L
 Inlet liner: 3mm split w/glass wool (cat.# 20936-202.1)
 Oven temp.: 75°C to 240°C @ 10°C/min. (hold 15 min.)
 Injector: split @ 240°C
 Carrier gas: hydrogen (constant pressure mode)
 Head pressure: 12.0psi
 Column flow rate: 1.1cc/min. @ 100°C
 Split ratio: 100:1
 Detector: FID @ 240°C
 Make-up gas flow: 40cc/min.

Fatty Acids (Free) Rtx®-200



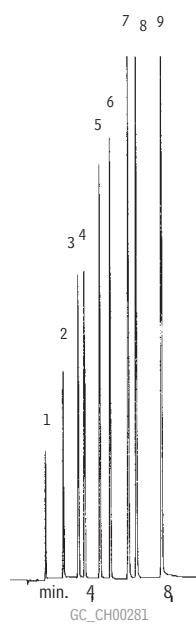
Column: Rtx®-200, 30m, 0.25mm ID, 0.25 μ m (cat.# 15023)
 Sample: 0.8 μ L split injection of a free fatty acid standard
 Conc.: approximately 10 to 20ng/ μ L.
 Oven temp.: 90°C
 Inj./det. temp.: 250°C
 Carrier gas: hydrogen
 Linear velocity: 40cm/sec. (flow rate: 1.4cc/min.)
 FID sensitivity: 4 x 10¹¹ AFS
 Split vent: 40cc/min.

Fatty Acids (Free) Stabilwax®-DA



Column: Stabilwax®-DA, 30m, 0.25mm ID, 0.25 μ m (cat.# 11023)
 Sample: 1.0 μ L split injection of a free acid standard
 Conc.: approximately 10 to 20ng/ μ L
 Oven temp.: 145°C
 Inj./det. temp.: 250°C
 Carrier gas: hydrogen
 Linear velocity: 40cm/sec.
 FID sensitivity: 2 x 10¹¹ AFS
 Split ratio: 50:1

Fatty Acids (Free) Rtx®-1

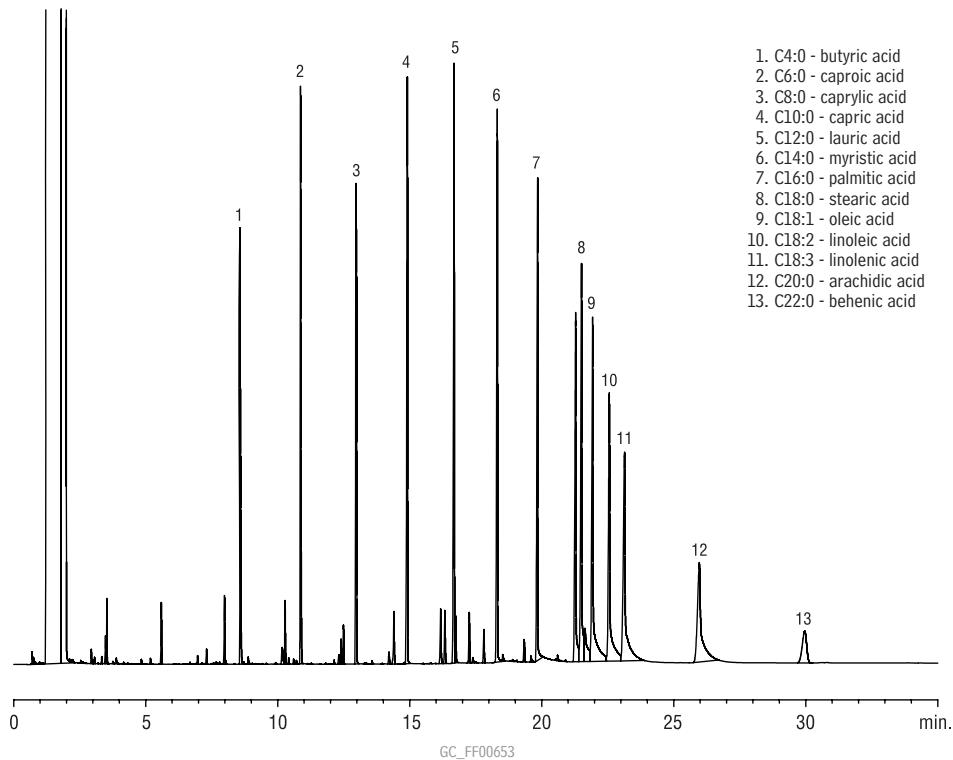


1. acetic acid
 2. propionic acid
 3. isobutyric acid
 4. n-butyric acid
 5. isovaleric acid
 6. n-valeric acid
 7. isocaprylic acid
 8. caproic acid
 9. heptanoic acid

Column: Rtx®-1, 30m, 0.53mm ID, 5.0 μ m (cat.# 10179)
 Sample: 0.2 μ L injection of a 10–20ng/ μ L free fatty acid standard in water.
 Inj.: Direct injection using a Uniliner® inlet liner
 Oven temp.: 60°C to 180°C @ 15°C/min.
 Inj./det. temp.: 250°C
 Carrier gas: hydrogen
 Linear velocity: 50cm/sec. (flow rate: 6cc/min.)
 FID sensitivity: 4 x 10¹¹ AFS

Fatty Acids

**Fatty Acids (Free)
Stabilwax®-DA**



Column: Stabilwax®-DA, 30m, 0.32mm ID, 0.25 μ m (cat.# 11024)
 Sample: 1.0 μ L free fatty acid mix
 Solvent: methanol
 Conc.: 100ppm in methanol
 Inj.: splitless/250°C
 Splitless hold time: 0.25min.
 Carrier gas: hydrogen (constant flow)
 Flow rate: 6.0mL/min.
 Split flow: 75mL/min.
 Det.: FID @ 250°C
 Inlet liner: laminar cup splitter
 Oven temp.: 40°C to 250°C @ 10°C/min. (hold 15 min.)

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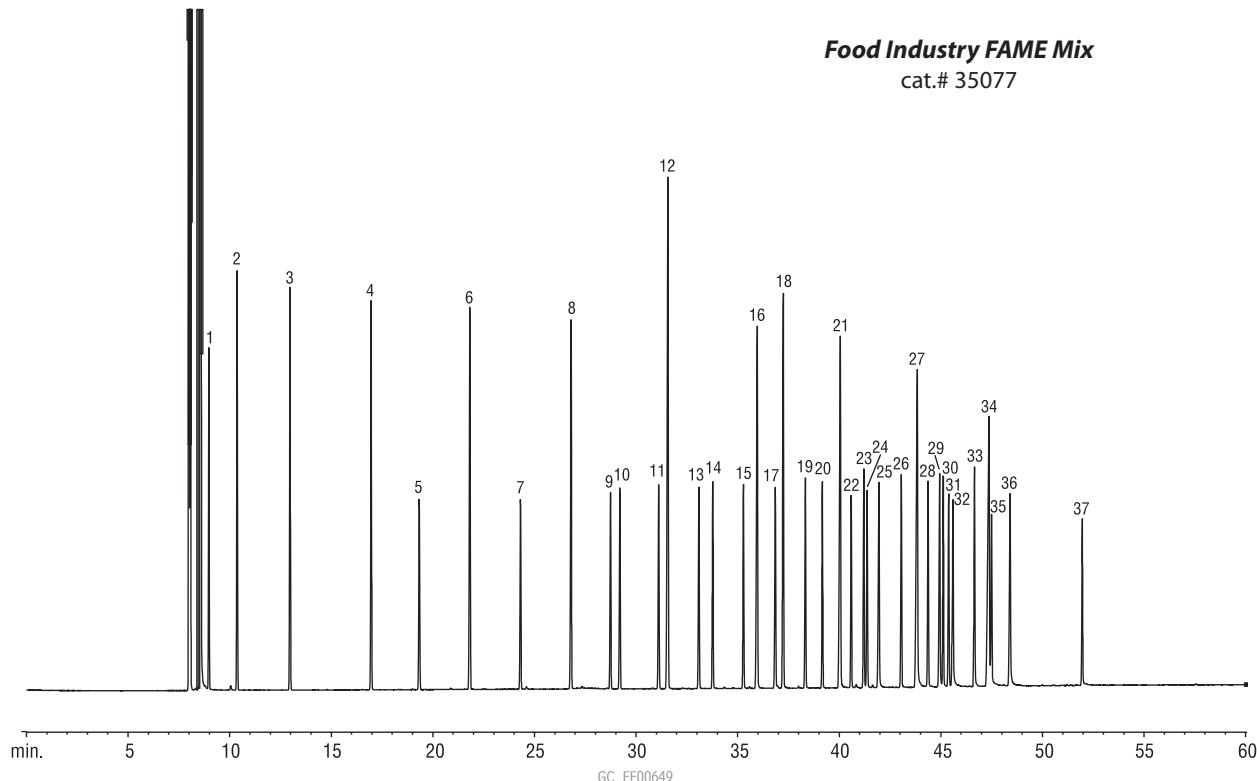
www.restek.com/FFF

FAMEs (AOAC 996.06 Standard)

RtTM-2560

Food Industry FAME Mix

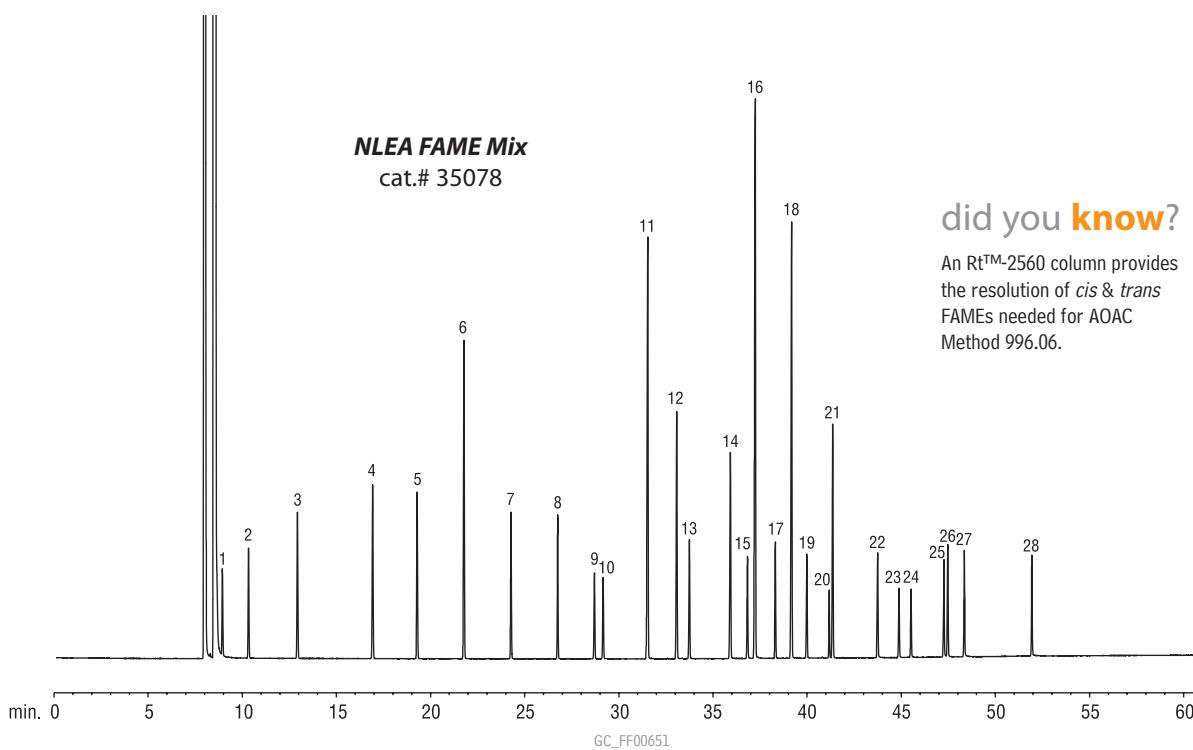
cat.# 35077



Compound	% in Mix
1. C4:0 methyl butyrate	4.0
2. C6:0 methyl hexanoate	4.0
3. C8:0 methyl octanoate	4.0
4. C10:0 methyl decanoate	4.0
5. C11:0 methyl undecanoate	2.0
6. C12:0 methyl laurate	4.0
7. C13:0 methyl tridecanoate	2.0
8. C14:0 methyl myristate	4.0
9. C14:1 methyl myristoleate (<i>cis</i> -9)	2.0
10. C15:0 methyl pentadecanoate	2.0
11. C15:1 methyl pentadecenoate (<i>cis</i> -10)	2.0
12. C16:0 methyl palmitate	6.0
13. C16:1 methyl palmitoleate (<i>cis</i> -9)	2.0
14. C17:0 methyl heptadecanoate	2.0
15. C17:1 methyl heptadecenoate (<i>cis</i> -10)	2.0
16. C18:0 methyl stearate	4.0
17. C18:1 methyl elaidate (<i>trans</i> -9)	2.0
18. C18:1 methyl oleate (<i>cis</i> -9)	4.0
19. C18:2 methyl linoleaidate (<i>trans</i> -9,12)	2.0
20. C18:2 methyl linoleate (<i>cis</i> -9,12)	2.0
21. C20:0 methyl arachidate	4.0
22. C18:3 methyl γ -linolenate (<i>cis</i> -6,9,12)	2.0
23. C20:1 methyl eicosenoate (<i>cis</i> -11)	2.0
24. C18:3 methyl linolenate (<i>cis</i> -9,12,15)	2.0
25. C21:0 methyl heneicosanoate	2.0
26. C20:2 methyl eicosadienoate (<i>cis</i> -11,14)	2.0
27. C22:0 methyl behenate	4.0
28. C20:3 methyl eicosatrienoate (<i>cis</i> -8,11,14)	2.0
29. C22:1 methyl erucate (<i>cis</i> -13)	2.0
30. C20:3 methyl eicosatrienoate (<i>cis</i> -11,14,17)	2.0
31. C20:4 methyl arachidonate (<i>cis</i> -5,8,11,14)	2.0
32. C23:0 methyl tricosanoate	2.0
33. C22:2 methyl docosadienoate (<i>cis</i> -13,16)	2.0
34. C24:0 methyl lignocerate	4.0
35. C20:5 methyl eicosapentaenoate (<i>cis</i> -5,8,11,14,17)	2.0
36. C24:1 methyl nervonate (<i>cis</i> -15)	2.0
37. C22:6 methyl docosahexaenoate (<i>cis</i> -4,7,10,13,16,19)	2.0

Column: RtTM-2560, 100m, 0.25mm ID, 0.2 μ m (cat.# 13199)
 Sample: Food Industry FAME Mix (cat.# 35077),
 30mg/mL total FAMEs in methylene chloride
 Inj.: 2.0 μ L split (split ratio 200:1), 4mm inlet liner (cat.# 20814)
 Inj. temp.: 225°C
 Carrier gas: hydrogen, constant flow
 Flow rate: 1.2mL/min.
 Oven temp.: 100°C (4 min. hold) to 240°C @ 3°C/min. (10 min. hold)
 Det.: FID @ 250°C

Searching for a chromatogram?
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FAMEs**FAMEs (NLEA Mix)****Rt™-2560****did you know?**

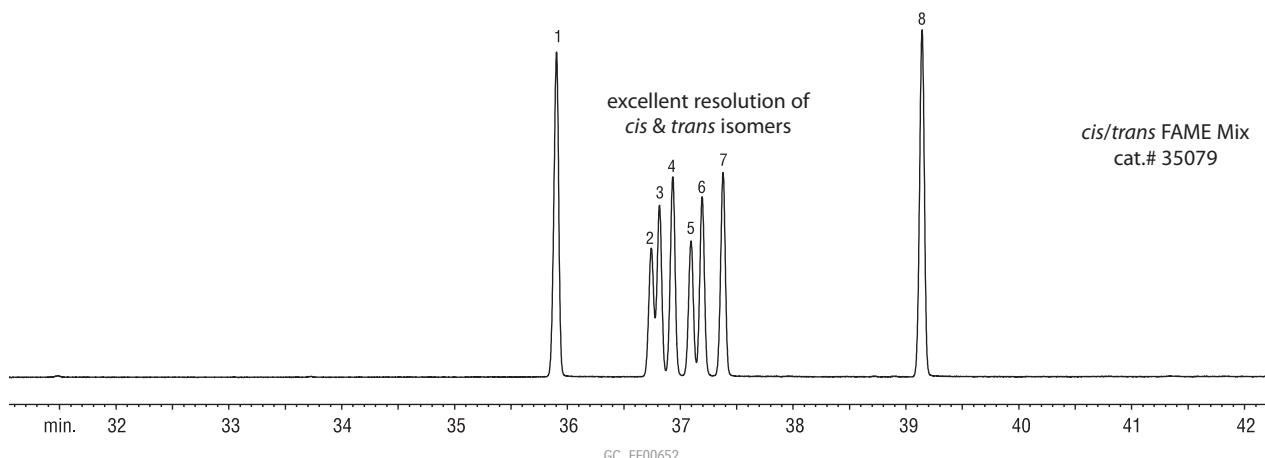
An Rt™-2560 column provides the resolution of *cis* & *trans* FAMEs needed for AOAC Method 996.06.

Column: Rt™-2560, 100m, 0.25mm ID, 0.20 μ m (cat.# 13199)
 Sample: NLEA FAME Mix (cat.# 35078), 30mg/mL
 total FAMEs in methylene chloride
 Inj.: 1.0 μ L split (split ratio 100:1),
 4mm inlet liner (cat.# 20814)
 Inj. temp.: 225°C
 Carrier gas: hydrogen, constant flow
 Flow rate: 1.2mL/min.
 Oven temp.: 100°C (4 min. hold) to 240°C @ 3°C/min. (10 min. hold)
 Det.: FID @ 250°C

1. C4:0 methyl butyrate
2. C6:0 methyl hexanoate
3. C8:0 methyl octanoate
4. C10:0 methyl decanoate
5. C11:0 methyl undecanoate
6. C12:0 methyl laurate
7. C13:0 methyl tridecanoate
8. C14:0 methyl myristate
9. C14:1 methyl myristoleate (*cis*-9)
10. C15:0 methyl pentadecanoate

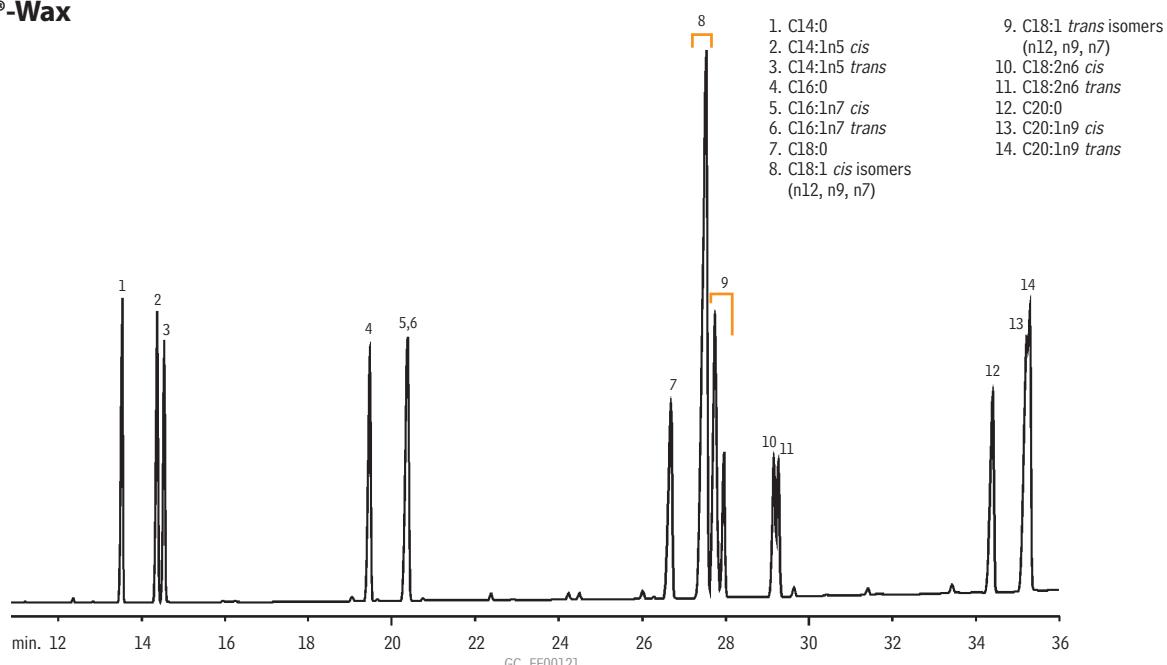
11. C16:0 methyl palmitate
12. C16:1 methyl palmitoleate (*cis*-9)
13. C17:0 methyl heptadecanoate
14. C18:0 methyl stearate
15. C18:1 methyl elaidate (*trans*-9)
16. C18:1 methyl oleate (*cis*-9)
17. C18:2 methyl linoelaidate (*trans*-9,12)
18. C18:2 methyl linoleate (*cis*-9,12)
19. C20:0 methyl arachidate
20. C20:1 methyl eicosenoate (*cis*-11)

21. C18:3 methyl linolenate (*cis*-9,12,15)
22. C22:0 methyl behenate
23. C22:1 methyl erucate (*cis*-13)
24. C23:0 methyl tricosanoate
25. C24:0 methyl lignocerate
26. C20:5 methyl eicosapentaenoate (*cis*-5,8,11,14,17)
27. C24:1 methyl nervonate (*cis*-15)
28. C22:6 methyl docosahexaenoate (*cis*-4,7,10,13,16,19)

FAMEs (*cis/trans* isomers)**RtTM-2560**

Column: RtTM-2560, 100m, 0.25mm ID, 0.2 μ m (cat.# 13199)
 Sample: *cis/trans* FAME Mix (cat.# 35079), 10mg/mL total FAMEs in methylene chloride
 Inj.: 1.0 μ L split (split ratio 20:1), 4mm inlet liner (cat.# 20814)
 Inj. temp.: 225°C
 Carrier gas: hydrogen, constant flow
 Flow rate: 1.2mL/min.
 Oven temp.: 100°C (4 min. hold) to 240°C @ 3°C/min. (10 min. hold)
 Det.: FID @ 250°C

Compound	% in Mix
1. C18:0 methyl stearate	20.0
2. C18:1 methyl petroselaidate (<i>trans</i> -6)	8.0
3. C18:1 methyl elaidate (<i>trans</i> -9)	10.0
4. C18:1 methyl transvaccenate (<i>trans</i> -11)	12.0
5. C18:1 methyl petroselinate (<i>cis</i> -6)	8.0
6. C18:1 methyl oleate (<i>cis</i> -9)	10.0
7. C18:1 methyl vaccenate (<i>cis</i> -11)	12.0
8. C18:2 methyl linoleate (<i>cis</i> -9,12)	20.0

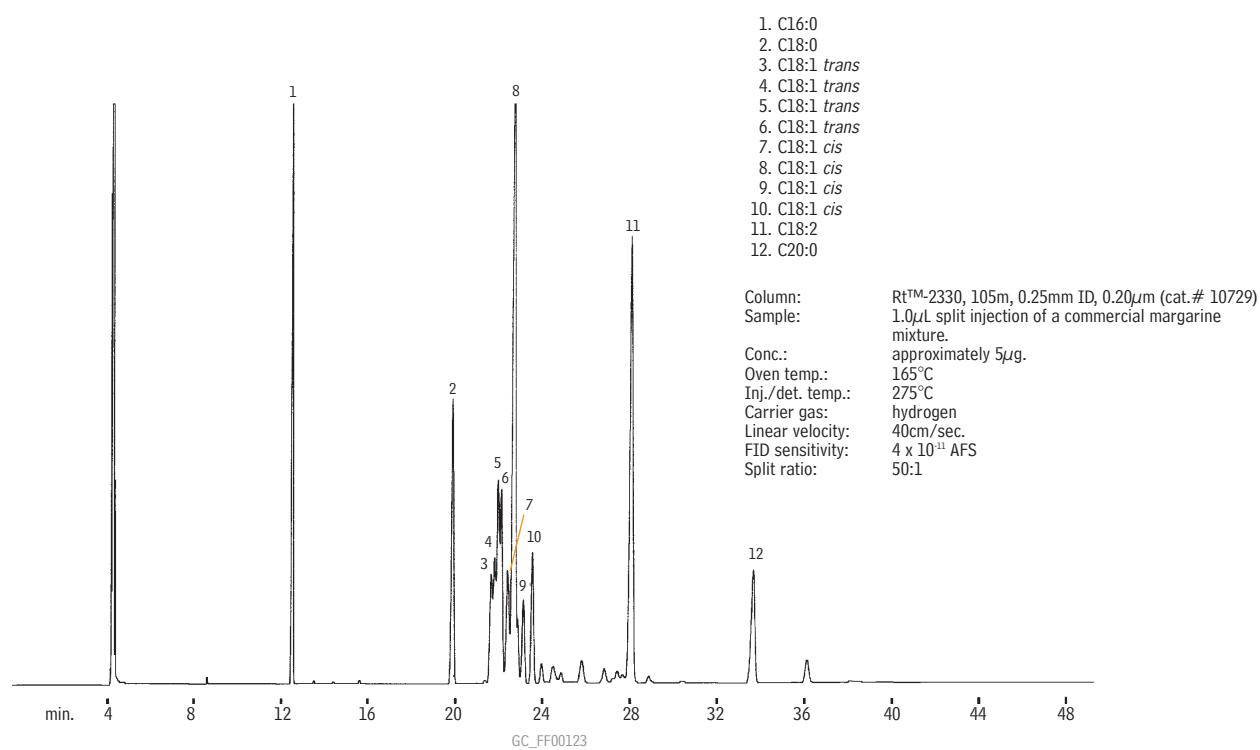
FAMEs (*cis/trans* isomers)**Rtx®-Wax**

Column: Rtx®-Wax, 60m, 0.25mm ID, 0.25 μ m (cat.#12426)
 On-column conc.: 40–75ng.
 Oven temp.: 165°C to 250°C @ 2°C/min.
 Inj./det. temp.: 220°C/250°C
 Carrier gas: helium
 Linear velocity: 20cm/sec. set @ 165°C
 Split ratio: 50:1

FAMEs

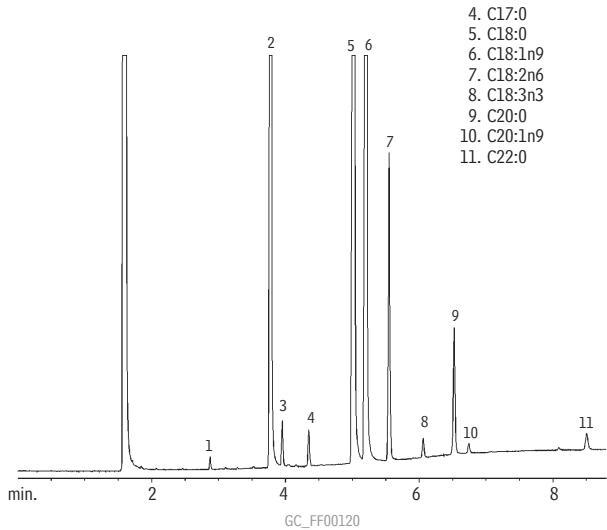
FAMEs (Commercial Margarine)

Rt™-2330



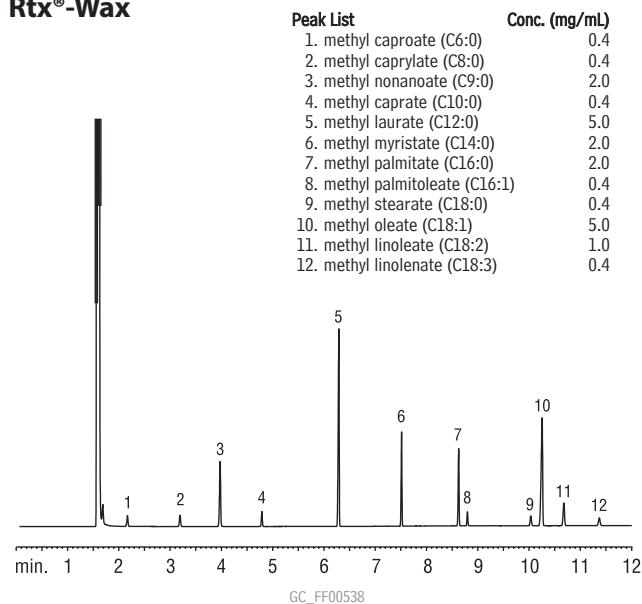
FAMEs (Cocoa Butter)

Stabilwax®



FAMEs (Saw Palmetto)

Rtx®-Wax



Column: Rtx®-Wax, 30m, 0.25mm, 0.25 μ m (cat.# 12423)
 Sample: 1 μ L split injection of saw palmetto standard
 Conc.: see peak list

Oven temp.: 120°C (hold 3 min.) to 220°C

Inj./det. temp.: at 20°C/min. (hold 12 min.)

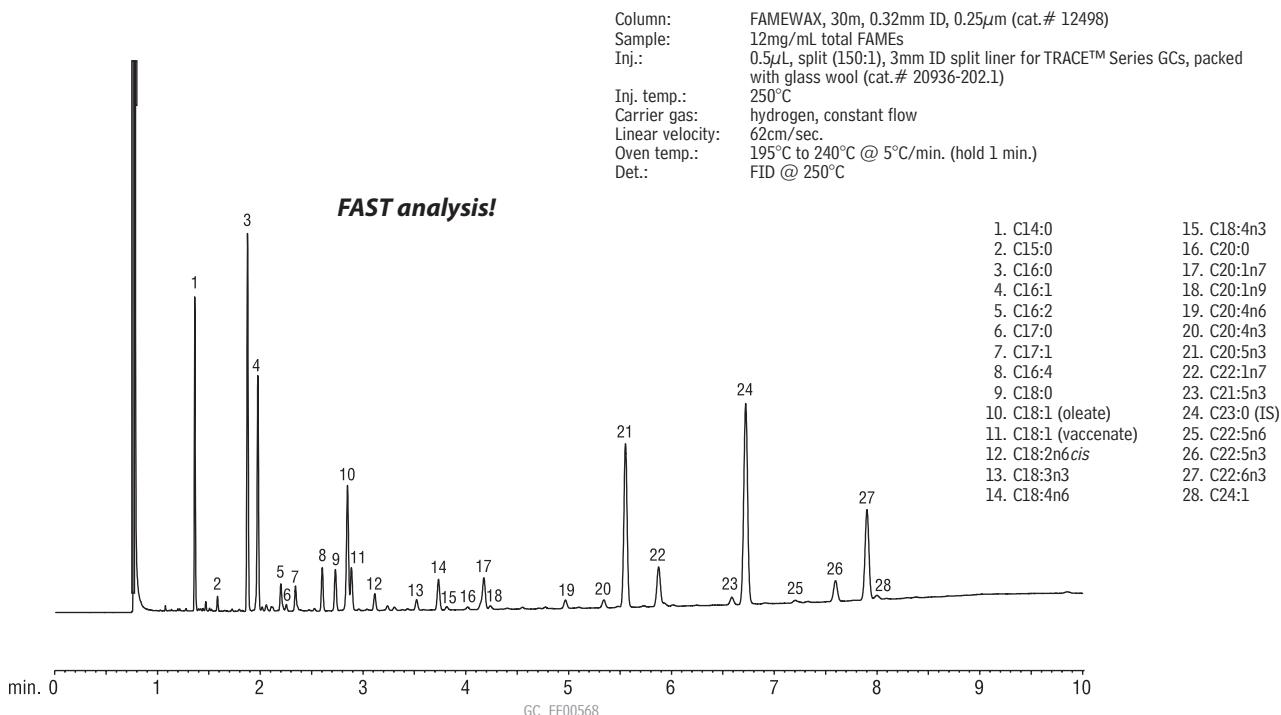
Carrier gas: 250°C/300°C

Linear velocity: helium

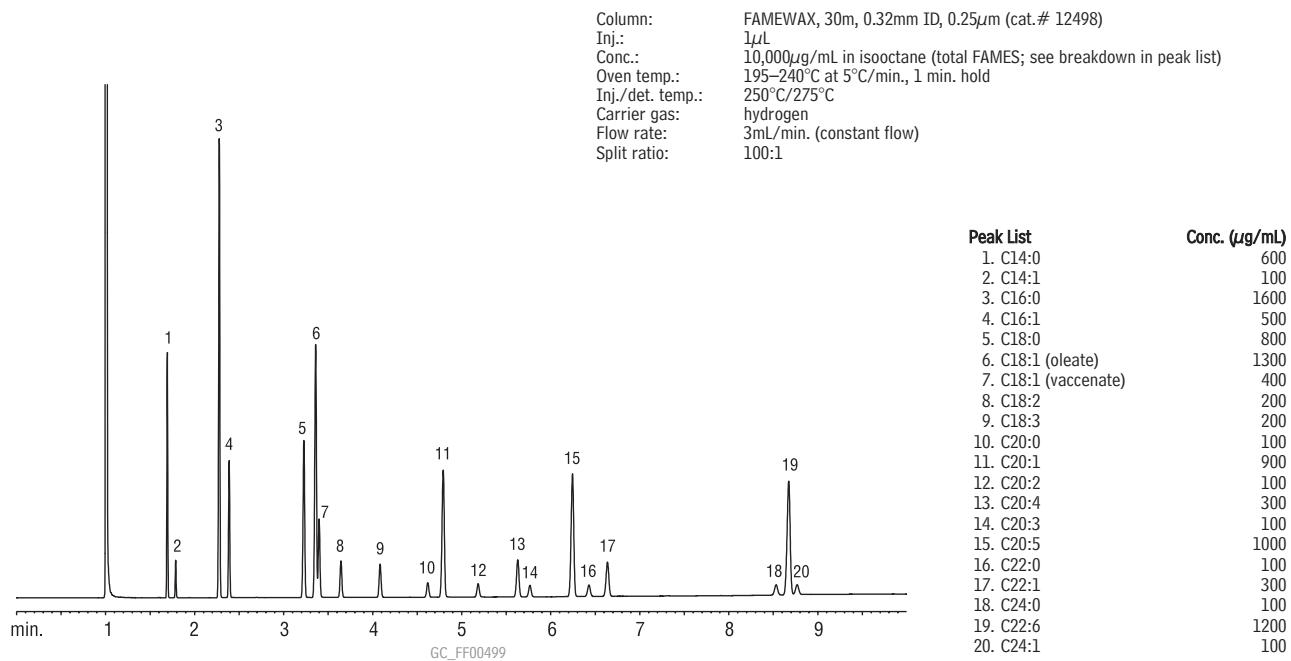
Split ratio: 1mL/min. (34 cm/sec.)

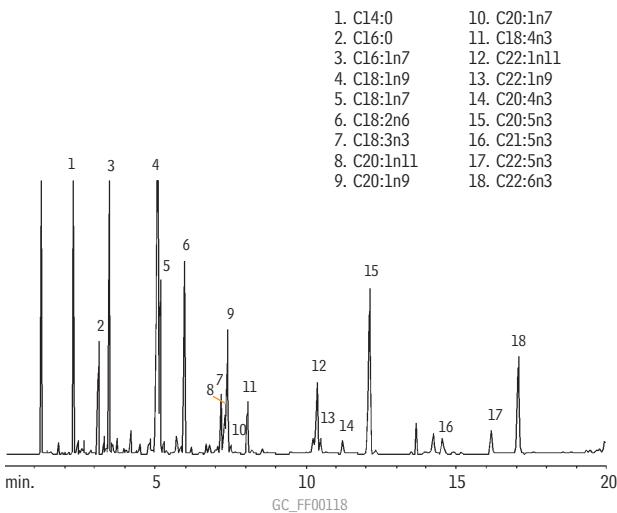
Split ratio: 100:1

FAMEs (Marine Oil Standard) FAMEWAX

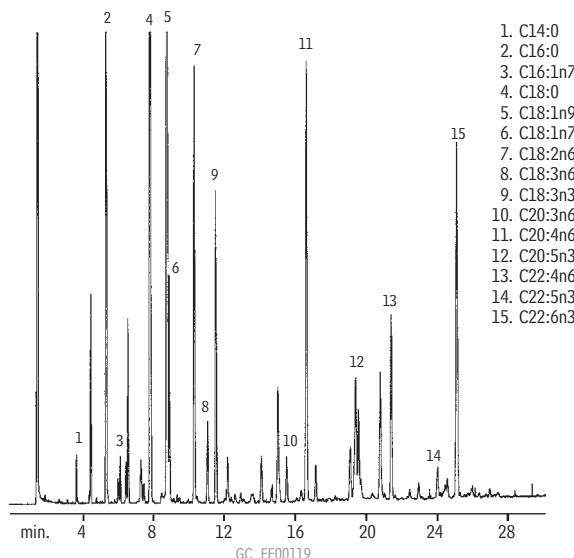


FAMEs (Marine Oil Standard) FAMEWAX

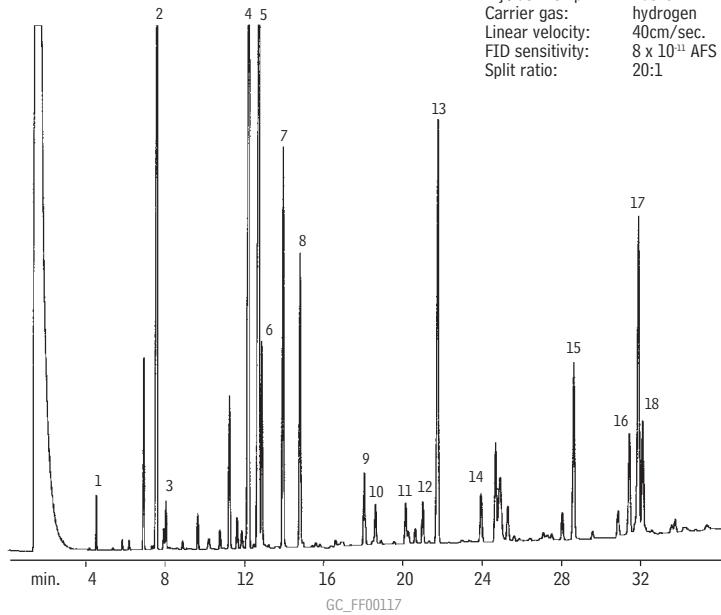


FAMEs**FAMEs (PUFA, marine source)****RtTM-2330**

Column: RtTM-2330, 30m, 0.25mm ID, 0.20 μ m (cat. # 10723)
 Sample: 0.5 μ L split injection of a PUFA mix
 Oven temp.: 160°C to 225°C @ 2°C/min.
 Inj./det. temp.: 225°C/250°C
 Carrier gas: hydrogen
 Linear velocity: 45cm/sec. set @ 160°C
 FID sensitivity: 8 x 10¹¹ AFS
 Split ratio: 35:1

FAMEs (PUFA, animal source)**RtTM-2330**

Column: RtTM-2330, 30m, 0.32mm ID, 0.20 μ m (cat. # 10724)
 Sample: 0.1 μ L split injection of PUFA 2 mix
 Oven temp.: 160°C to 250°C @ 2°C/min. (hold 10 min.)
 260°C
 Carrier gas: hydrogen
 Linear velocity: 40cm/sec.
 FID sensitivity: 8 x 10¹¹ AFS
 Split ratio: 20:1

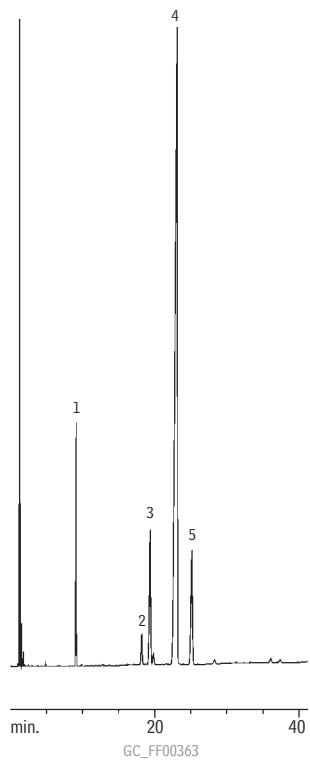
FAMEs (PUFA, animal source)**MXT[®]-WAX**

Column: MXT[®]-WAX, 30m, 0.28mm ID, 0.25 μ m (cat. # 70624)
 Sample: 0.1 μ L split injection of PUFA 2 mix
 Oven temp.: 160°C to 250°C @ 2°C/min. (hold 10 min.)
 260°C
 Carrier gas: hydrogen
 Linear velocity: 40cm/sec.
 FID sensitivity: 8 x 10¹¹ AFS
 Split ratio: 20:1

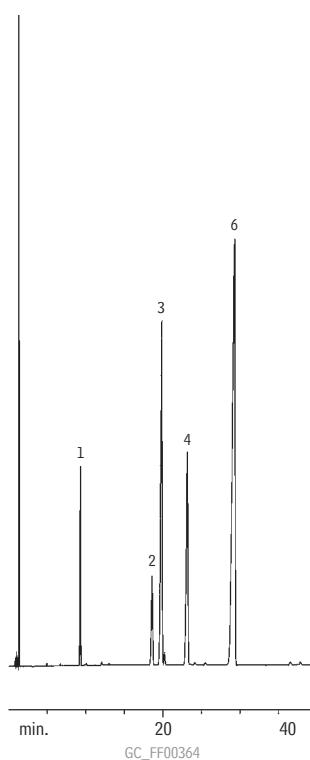
- 1. C14:0
- 2. C16:0
- 3. C16:1n7
- 4. C18:0
- 5. C18:1n9
- 6. C18:1n7
- 7. C18:2n6
- 8. C18:3n3
- 9. C18:4n3
- 10. C20:1n9
- 11. C20:2n6
- 12. C20:3n6
- 13. C20:4n6
- 14. C20:5n3
- 15. C22:4n6
- 16. C22:5n3
- 17. C22:6n3
- 18. C24:1n9

**FAMEs (Evening Primrose Oil)
FAMEWAX**

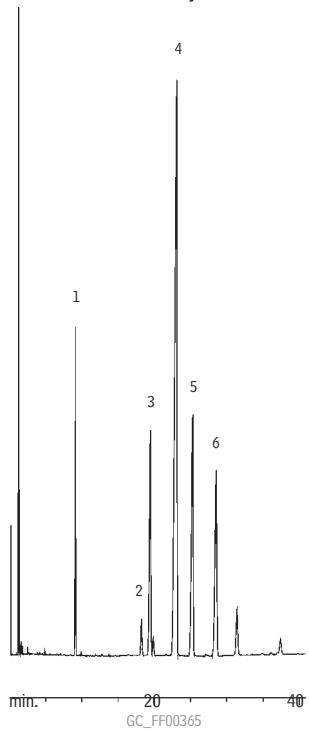
1. C16:0
2. C18:0
3. C18:1n9
4. C18:2n6
5. C18:3n6


**FAMEs (Flax Seed Oil)
FAMEWAX**

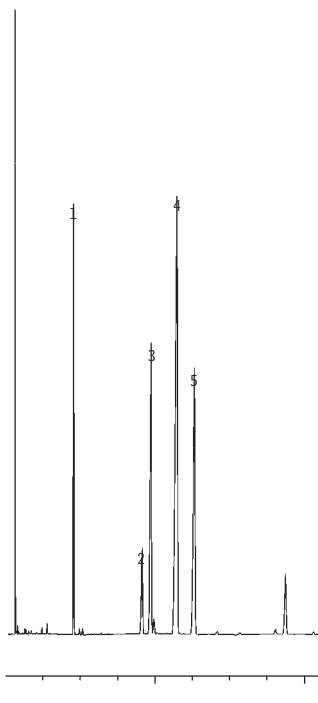
1. C16:0
2. C18:0
3. C18:1n9
4. C18:2n6
5. C18:3n6
6. C18:3n3


**FAMEs (Black Currant Seed Oil)
FAMEWAX**

1. C16:0
2. C18:0
3. C18:1n9
4. C18:2n6
5. C18:3n6
6. C18:3n3


**FAMEs (Borage Seed Oil)
FAMEWAX**

1. C16:0
2. C18:0
3. C18:1n9
4. C18:2n6
5. C18:3n6



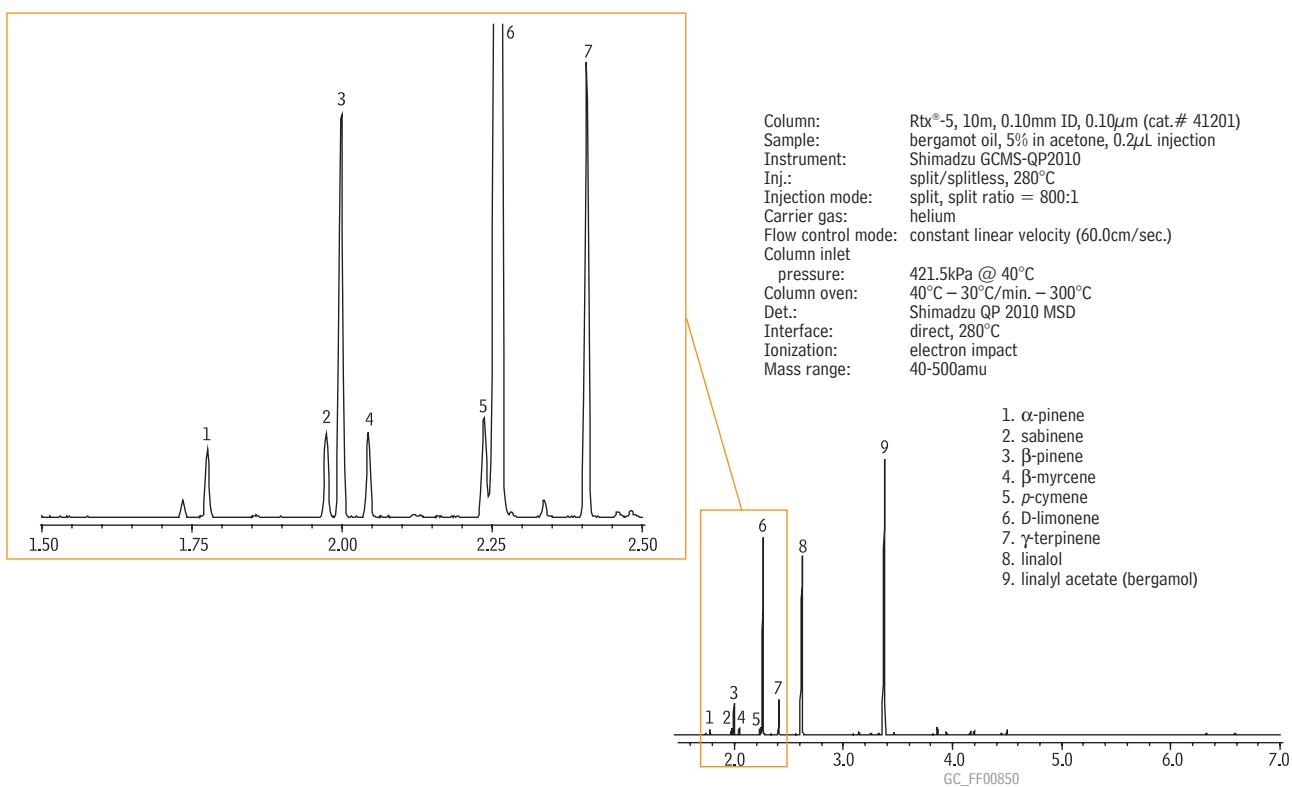
Column and conditions for all four oils analyses:
 Column: FAMEWAX, 30m, 0.25mm ID, 0.25 μ m (cat.# 12497)
 Oven temp.: 165°C (hold 30 min.) to 220°C @ 1.5°C/min. (hold 15 min.)
 Inj. temp.: 225°C
 Det. temp.: 230°C
 Carrier gas: helium @ 40cm/sec.

Essential Oils

Bergamot Oil

Fast GC/MS

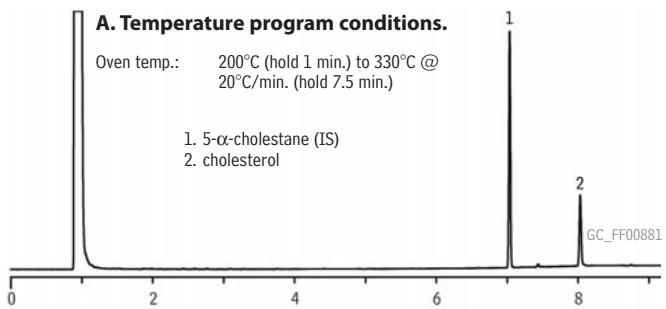
Rtx®-5



Underivatized Cholesterol

Rxi®-5ms

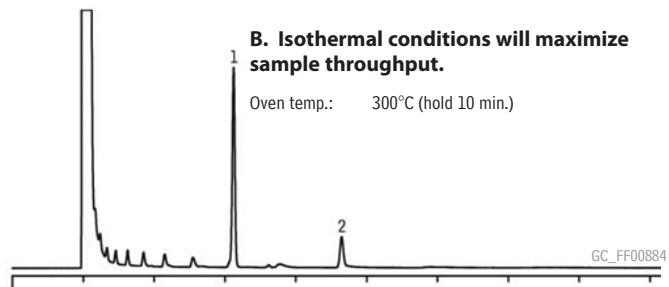
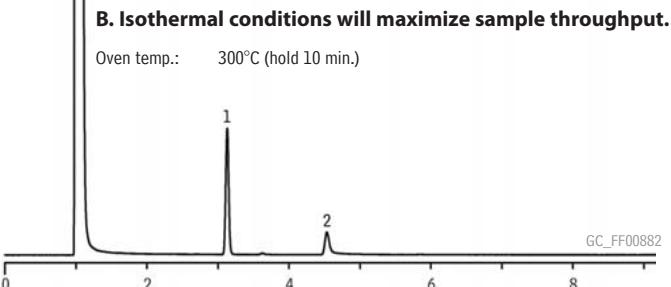
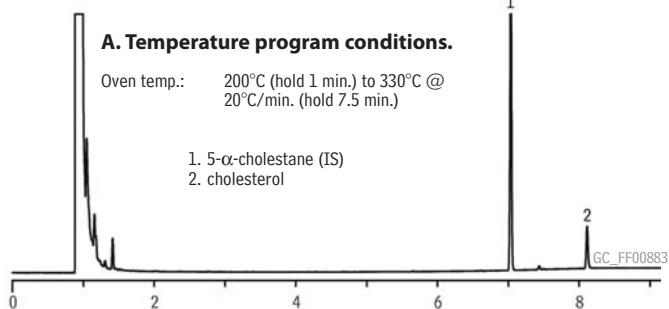
new!



Derivatized Cholesterol

Rxi®-5ms

new!

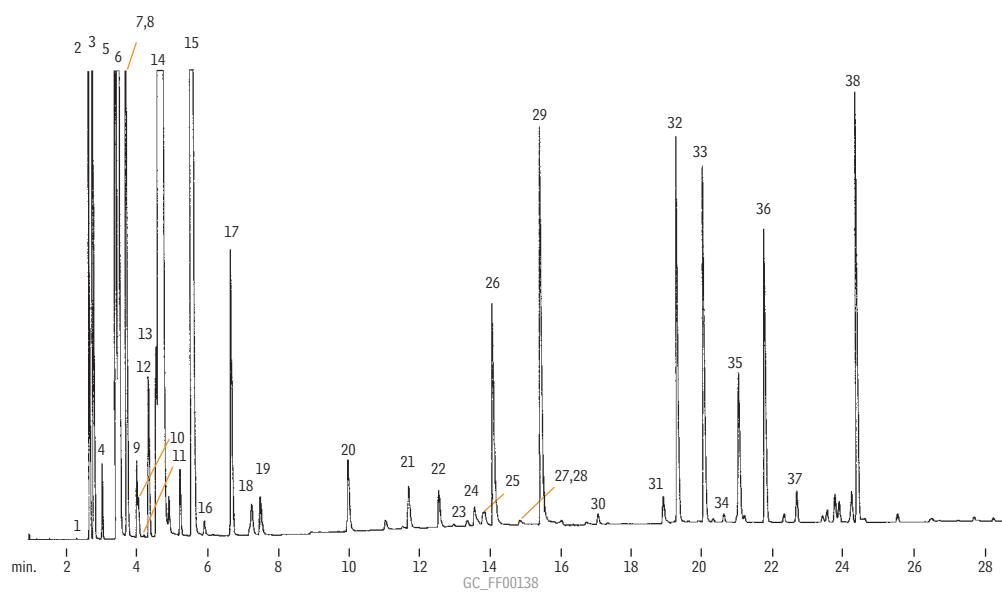


Column: Rxi®-5ms, 15m, 0.25mm ID, 0.25 μ m (cat.# 13420)
Sample: 1000 μ g/mL cholesterol in DMF, 1000 μ g/mL 5- α -cholestane in hexane; 25ng cholesterol, 150ng 5- α -cholestane on column
Inj.: 1.0 μ L, split (20:1), single gooseneck inlet liner w/wool (cat.# 22405)
Inj. temp.: 250°C
Carrier gas: helium, constant pressure (9.7psi @ 200°C)
Linear velocity: 24cm/sec.
Oven temp.: see above
Det.: FID @ 340°C

Column: Rxi®-5ms, 15m, 0.25mm ID, 0.25 μ m (cat.# 13420)
Sample: 1000 μ g/mL cholesterol in hexane, 1000 μ g/mL 5- α -cholestane in hexane; 50ng derivatized cholesterol, 150ng 5- α -cholestane on column
Inj.: 1.0 μ L, split (20:1), single gooseneck inlet liner w/wool (cat.# 22405)
Inj. temp.: 250°C
Carrier gas: helium, constant pressure (9.7psi @ 200°C)
Linear velocity: 24cm/sec.
Oven temp.: see above
Det.: FID @ 340°C

Lemon Oil

Rtx®-5

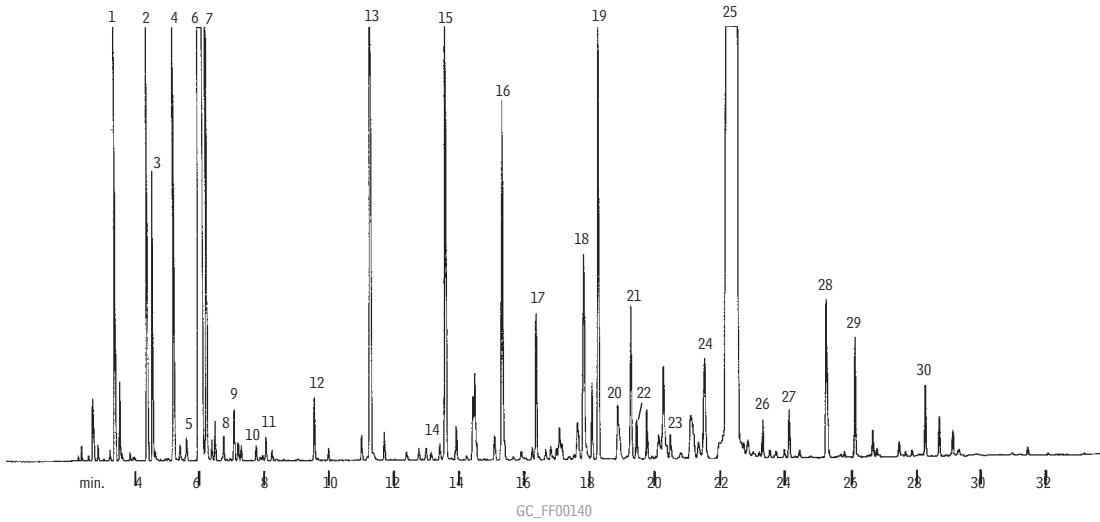


Column: Rtx®-5, 30m, 0.32mm ID, 0.25µm (cat.# 10224)
 Sample: Wet needle split injection of a neat lemon oil
 Oven temp.: 75°C (hold 8 min.) to 250°C @ 4°C/min.
 Inj./det. temp.: 250°C
 Carrier gas: hydrogen
 Linear velocity: 40cm/sec. (flow rate: 3.2cc/min.)
 FID sensitivity: 2×10^{11} AFS
 Split ratio: 100:1

1. heptanol
2. α -thujene
3. α -pinene
4. camphene
5. sabinene
6. β -pinene
7. 6-methyl-5-hepten-2-one
8. myrcene
9. octanal
10. α -phellandrene
11. 3-carene
12. α -terpinene
13. ρ -cymene
14. limonene
15. γ -terpinene
16. octanol
17. terpinolene
18. linalool
19. nonanal
20. citronellal
21. terpinene-4-ol
22. α -terpineol
23. decanol
24. octyl acetate
25. nerol
26. neral
27. carvone
28. geraniol
29. geranial
30. nonyl acetate
31. citronellyl acetate
32. neryl acetate
33. geranyl acetate
34. dodecanal
35. β -caryophyllene
36. *trans*- α -bergamotene
37. α -humulene
38. β -bisabolene

Spearmint Oil (Native)

Stabilwax®

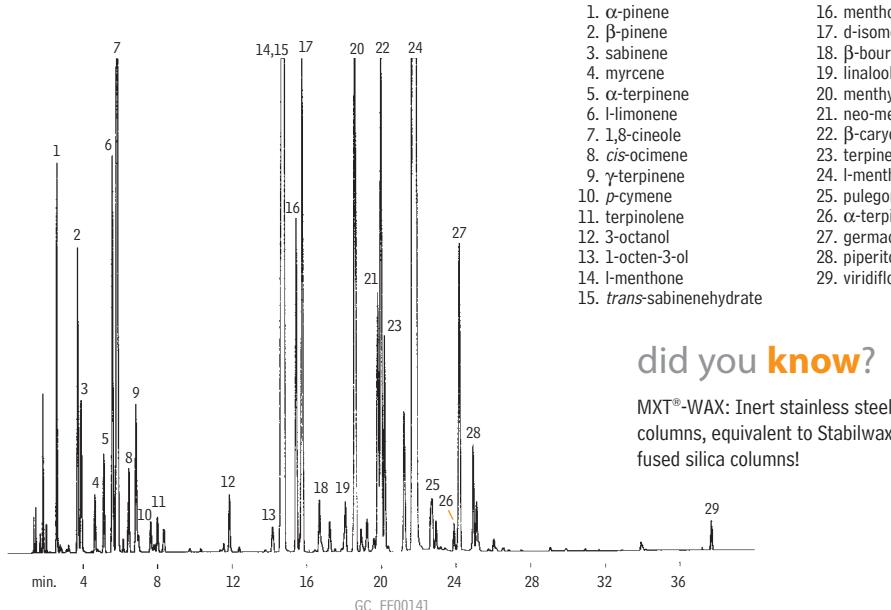


Column: Stabilwax®, 60m, 0.25mm ID, 0.25µm (cat.# 10626)
 Sample: 0.2µL split injection of a neat spearmint oil
 Oven temp.: 75°C (hold 4 min.) to 200°C @ 4°C/min. (hold 10 min.)
 Inj./det. temp.: 250°C
 Carrier gas: hydrogen
 Linear velocity: 40cm/sec. set @ 160°C
 FID sensitivity: 4×10^{11} AFS
 Split ratio: 100:1

- | | | |
|------------------------|-----------------------------------|---|
| 1. α -pinene | 11. terpinolene | 21. <i>trans</i> -dihydrocarvyl acetate |
| 2. β -pinene | 12. 3-octyl acetate | 22. β -farnesene |
| 3. sabinene | 13. 3-octanol | 23. α -terpineol |
| 4. myrcene | 14. l-menthone | 24. germacrene- Δ |
| 5. α -terpinene | 15. <i>trans</i> -sabinenehydrate | 25. carvone |
| 6. l-limonene | 16. β -bourbonene | 26. <i>cis</i> -carvyl acetate |
| 7. 1,8-cineole | 17. linalool | 27. <i>trans</i> -carveol |
| 8. <i>cis</i> -ocimene | 18. terpinene-4-ol | 28. <i>cis</i> -carveol |
| 9. γ -terpinene | 19. β -caryophyllene | 29. <i>cis</i> -jasmon |
| 10. ρ -cymene | 20. dihydrocarvone | 30. viridiflorol |

Essential Oils

Peppermint Oil MXT®-WAX

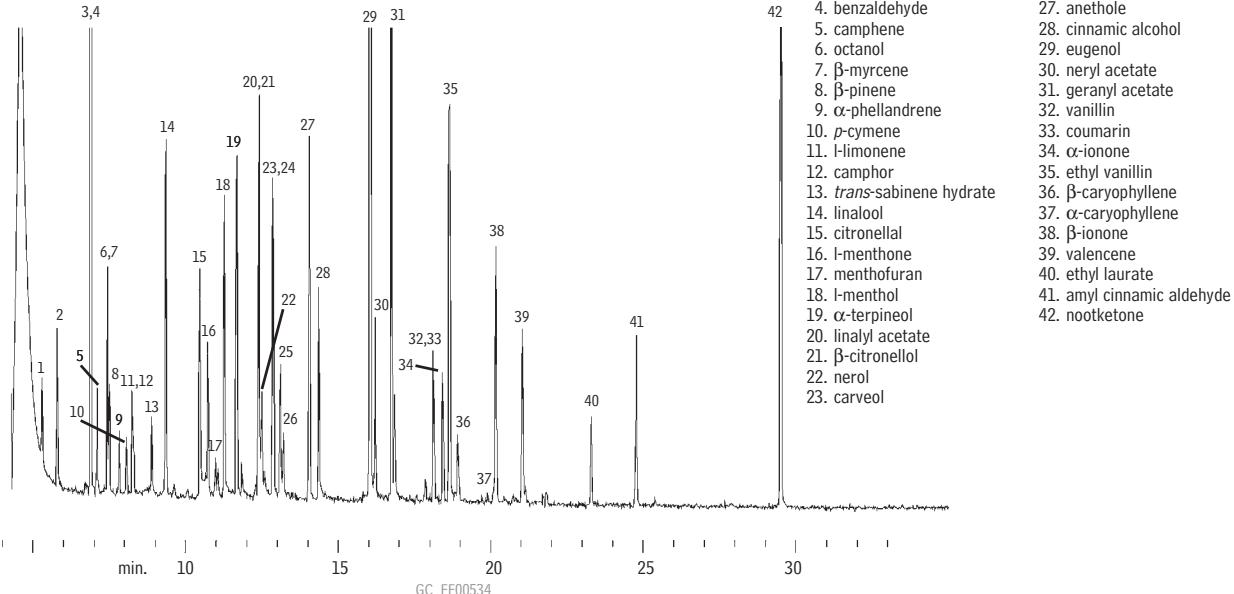


did you know?

MXT®-WAX: Inert stainless steel columns, equivalent to Stabilwax® fused silica columns!

Column: MXT®-WAX, 30m, 0.28mm ID, 0.50 μ m (cat.# 70639)
 Sample: 1.0 μ L split injection of peppermint oil
 Oven temp.: 75°C (hold 4 min.) to 240°C @ 4°C/min.
 Inj./det. temp.: 250°C
 Carrier gas: hydrogen
 Linear velocity: 40cm/sec. set @ 75°C
 FID sensitivity: 16 x 10¹¹ AFS
 Split ratio: 50:1

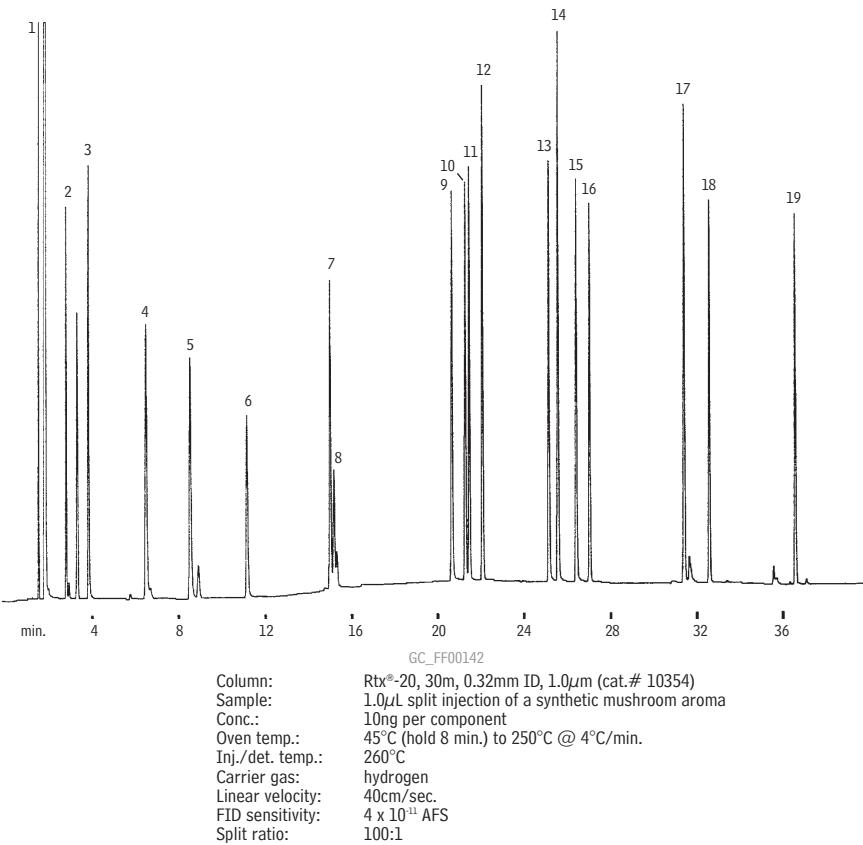
Synthetic Essential Oil Mixture Rtx®-1



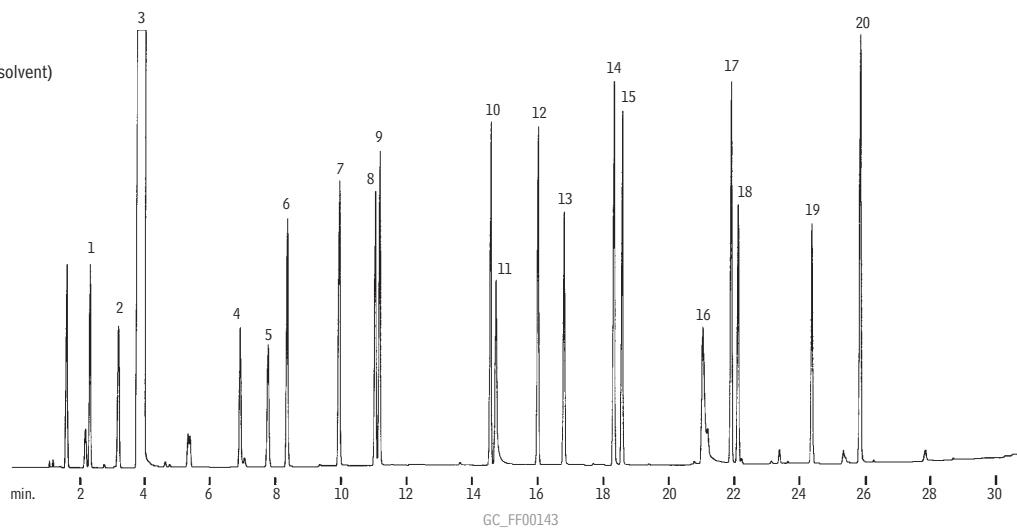
Column: Rtx®-1, 60m, 0.25mm ID, 0.25 μ m (cat.# 10126)
 Sample: 1.0 μ L split injection of 42 flavor components
 Oven temp.: 100°C to 260°C @ 4°C/min. (hold 1 min.)
 Inj./det. temp.: 250°C/280°C
 Det. type: MSD
 Carrier gas: helium
 Linear velocity: 30cm/sec. set @ 50°C
 FID sensitivity: 2 x 10¹¹ AFS
 Split vent: 100cc/min.

Mushroom Aroma (Synthetic)**Rtx®-20**

1. acetone
2. ethyl acetate
3. 1-butanol
4. 3-methyl-1-butanol
5. 1-pentanol
6. hexanal
7. furfural
8. amyl acetate
9. 1-octen-3-ol
10. 3-octanol
11. 3-octanone
12. benzaldehyde
13. octyl alcohol
14. benzyl alcohol
15. phenylacetaldehyde
16. nonanal
17. α -terpineol
18. 2,4-nonadienal
19. 2,4-decadienal

**Mushroom Aroma (Synthetic)****Stabilwax®**

1. acetone
2. ethyl acetate
3. methylene chloride (solvent)
4. hexanal
5. amyl acetate
6. 1-butanol
7. 3-methyl-1-butanol
8. 1-pentanol
9. 3-octanone
10. 3-octanol
11. nonanal
12. 1-octen-3-ol
13. furfural
14. benzaldehyde
15. octyl alcohol
16. phenylacetaldehyde
17. α -terpineol
18. 2,4-nonadienal
19. 2,4-decadienal
20. benzyl alcohol

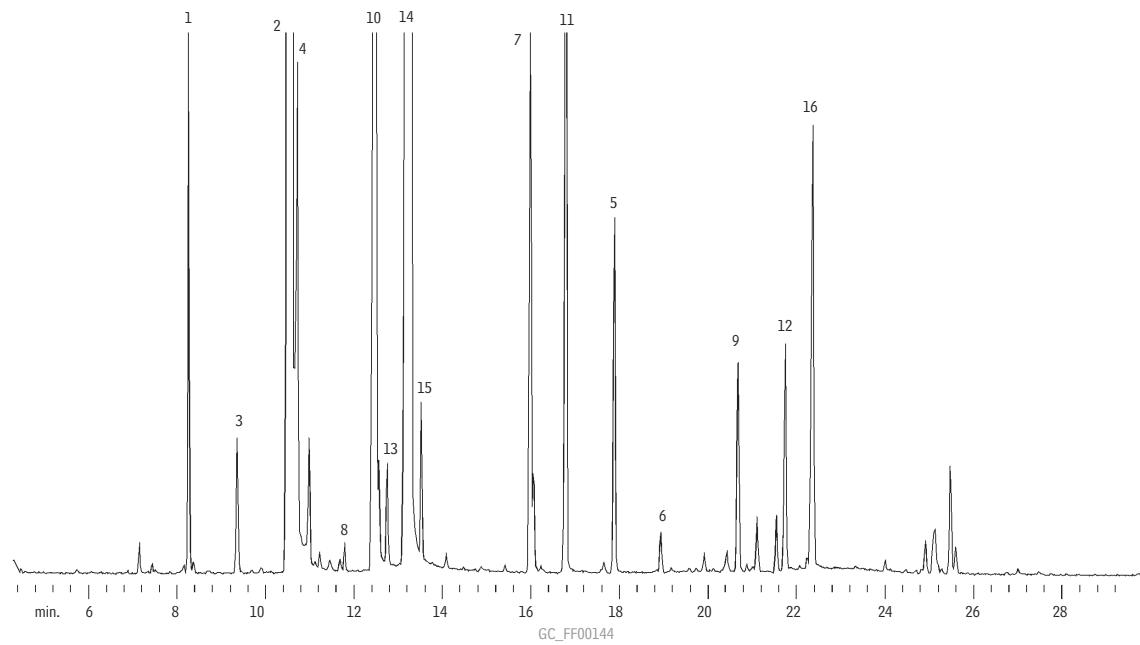


Column: Stabilwax®, 30m, 0.32mm ID, 1.0 μ m (cat.# 10654)
 Sample: 1.0 μ L split injection of a synthetic mushroom aroma
 Conc.: 10ng per component
 Oven temp.: 40°C to 220°C @ 6°C/min.
 Inj./det. temp.: 260°C
 Carrier gas: hydrogen
 Linear velocity: 40cm/sec.
 FID sensitivity: 4 x 10⁻¹¹ AFS
 Split ratio: 100:1

Essential Oils

Citronella Java Oil

Rtx®-1

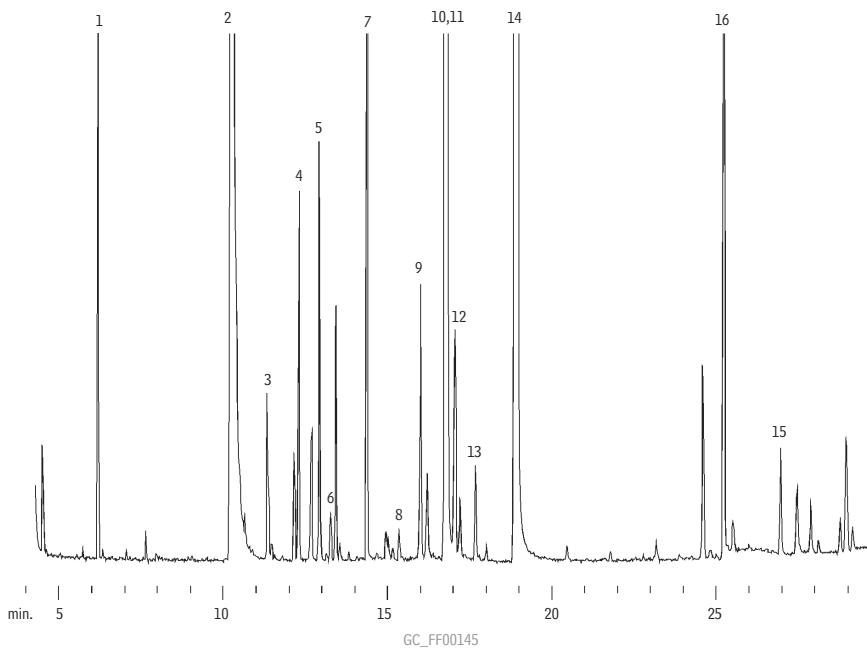


Column: Rtx®-1, 60m, 0.25mm ID, 0.25 μ m (cat.# 10126)
 Sample: 1.0 μ L split injection of citronella Java oil
 Oven temp.: 100°C to 260°C @ 4°C/min. (hold 1 min.)
 Inj./det. temp.: 250°C/280°C
 Det. type: MSD
 Carrier gas: helium
 Linear velocity: 30cm/sec. set @ 50°C
 Split vent: 100cc/min.

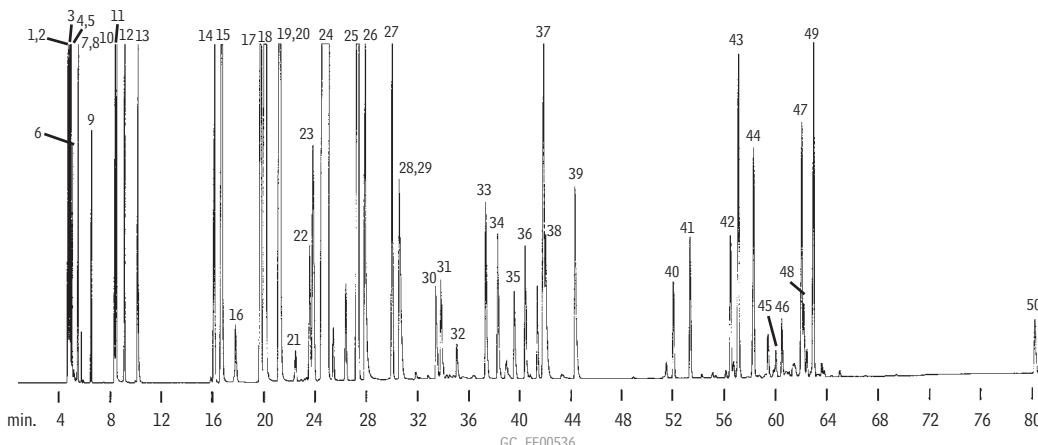
- 1. limonene
- 2. citronellal
- 3. linalool
- 4. borneol
- 5. γ -elemene
- 6. β -caryophyllene
- 7. neryl acetate
- 8. α -terpineol
- 9. germancrene- Δ
- 10. β -citronellol
- 11. geranyl acetate
- 12. δ -cadinene
- 13. nerol
- 14. geraniol
- 15. eugenol
- 16. α -bergamotene

Citronella Java Oil

Stabilwax®

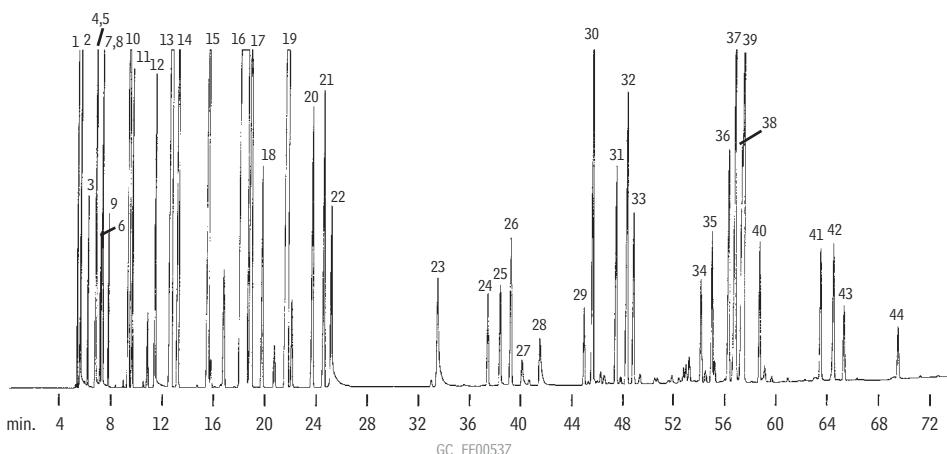


Column: Stabilwax®, 60m, 0.25mm ID, 0.25 μ m (cat.# 10626)
 Sample: 1.0 μ L split injection of citronella Java oil
 Oven temp.: 100°C to 260°C @ 4°C/min. (hold 1 min.)
 Inj./det. temp.: 250°C/280°C
 Det. type: MSD
 Carrier gas: helium
 Linear velocity: 30cm/sec. set @ 50°C
 Split vent: 100cc/min.

Flavor Volatiles**Rtx®-1**

1. methanol	11. ethylbutyrate	21. α -phellandrene	31. <i>trans</i> -limonene monoxide	41. geranyl acetate
2. acetaldehyde	12. furfural	22. α -terpinene	32. citronellal	42. α -ionone
3. ethanol	13. <i>trans</i> -2-hexenal	23. ρ -cymene	33. terpineole-4-ol	43. β -caryophyllene
4. acetone	14. α -thujene	24. δ -limonene	34. α -terpineol	44. <i>trans</i> - α -bergamotene
5. isopropyl alcohol	15. α -pinene	25. γ -terpinene	35. decanal	45. BHA
6. methylene chloride	16. camphene	26. octanol	36. d & l carveol	46. β -ionone
7. hexane	17. sabinene	27. terpinolene	37. nerol	47. valencene
8. ethyl acetate	18. β -pinene	28. nonanal	38. carvone	48. γ -elemene
9. ethyl propionate	19. octanal	29. linalool	39. geranial	49. β -bisabolene
10. <i>n</i> -hexanal	20. myrcene	30. <i>cis</i> -limonene monoxide	40. neryl acetate	50. nootketone

Column: Rtx®-1, 60m, 0.53mm ID, 0.50 μ m (cat.# 10143)
 Sample: 0.8 μ L split injection of a flavor volatiles test mix
 Oven temp.: 70° (hold 15 min.) to 190°C @ 2°C/min. (hold 5 min.)
 Inj./det. temp.: 220°C/260°C
 Carrier gas: helium
 Linear velocity: 20cm/sec. set @ 70°C
 FID sensitivity: 64 x 10¹¹ AFS
 Split ratio: 20:1

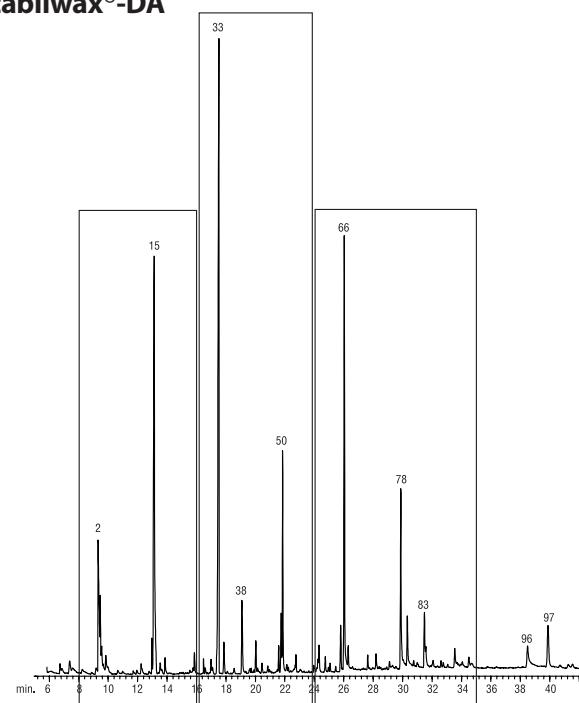
Flavor Volatiles**Stabilwax®**

1. hexane	10. α -pinene	19. γ -terpinene	28. decanal	37. valencene
2. acetaldehyde	11. ethylbutyrate	20. ρ -cymene	29. linalool	38. geranial
3. acetone	12. <i>n</i> -hexanal	21. terpinolene	30. octanol	39. carvone
4. methanol	13. β -pinene	22. octanal	31. <i>trans</i> - α -bergamotene	40. geranyl acetate
5. ethyl acetate	14. sabinene	23. nonanal	32. β -caryophyllene	41. d/l carveol
6. isopropyl alcohol	15. myrcene	24. <i>cis</i> -limonene monoxide	33. terpineole-4-ol	42. α -ionone
7. ethanol	16. δ -limonene	25. <i>trans</i> -limonene	34. nerol	43. d/l carveol
8. methylene chloride	17. 1,8-cineole	26. furfural	35. α -terpineol	44. β -ionone
9. ethyl propionate	18. <i>trans</i> -2-hexenal	27. citronellal	36. neryl acetate	

Column: Stabilwax®, 60m, 0.53mm ID, 0.50 μ m (cat.# 10643)
 Sample: 0.8 μ L split injection of a flavor volatiles test mix
 Oven temp.: 70°C (hold 15 min.) to 190°C @ 2°C/min. (hold 5 min.)
 Inj./det. temp.: 220°C/260°C
 Carrier gas: helium
 Linear velocity: 20cm/sec. set @ 70°C
 FID sensitivity: 64 x 10¹¹ AFS
 Split ratio: 20:1

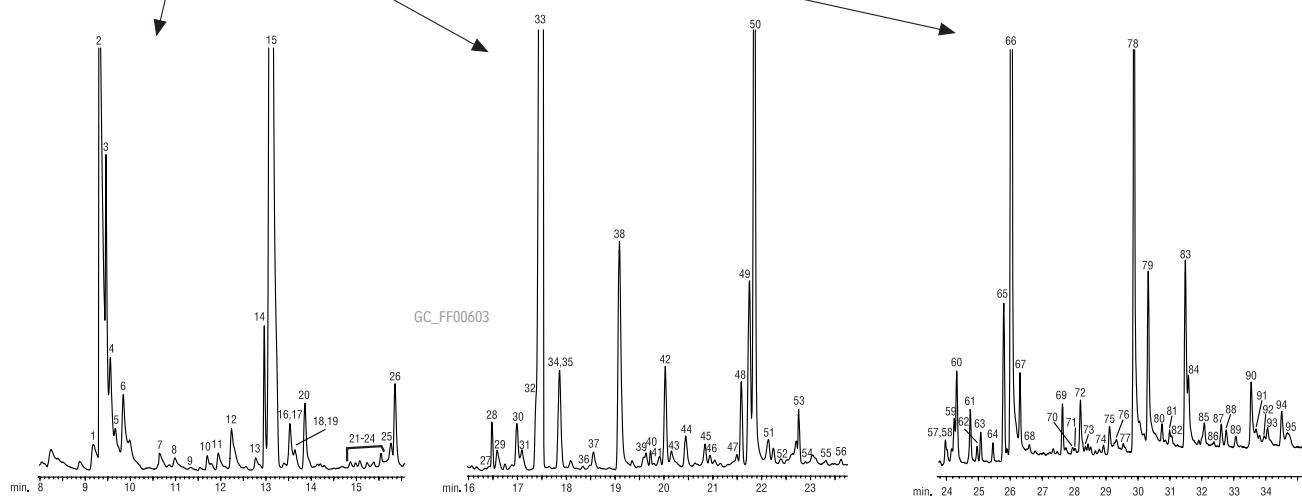
Flavors

Malt Whiskey Stabilwax®-DA



Column: Stabilwax®-DA, 30m, 0.18mm ID, 0.18 μ m (cat.# 550752)
 Inj.: 10 μ L large volume injection (splitless), at 10 μ L/min.
 Std. conc.: neat
 Gerstel CIS Injector: 35°C (hold 2 min.), to 300°C @ 10°C/sec. (hold 5 min.)
 Helium vent flow: 600mL/min. with 1.8 min. vent end time
 Carrier gas: helium
 Linear velocity: 45cm/sec.
 Oven temp.: 60°C (hold 2 min.) to 100°C @ 20°C/min., to 240°C @ 5°C/min. (hold 10 min.)
 Det.: MSD
 Transfer line temp.: 240°C
 Quadrupole temp.: 150°C
 MS source temp.: 230°C
 Scan range: 30–400amu
 Ionization: 70eV
 Mode: EI

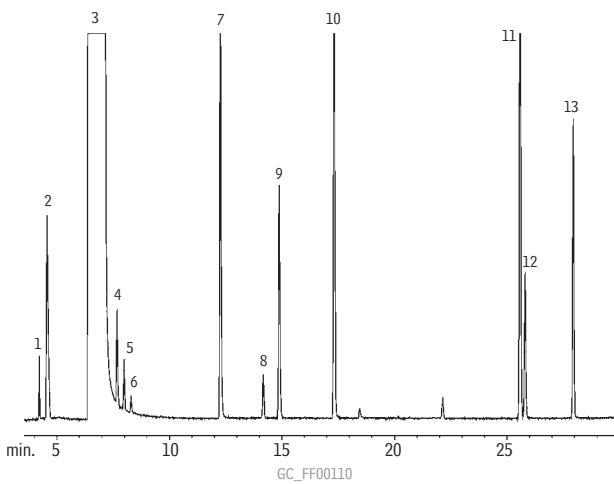
Chromatogram courtesy of Kevin MacNamara, Ph.D., Irish Distilleries, Ltd.



- | | | | | |
|--|-------------------------------------|--|---------------------------------------|--|
| 1. ethyl octanoate | 23. ethyl undecanoate | 44. unknown | 66. decanoic acid | 87. ethyl vanillate |
| 2. acetic acid | 24. isobutyl decanoate | 45. phenol | 67. ethyl 9-hexadecanoate | 88. acetovanillone |
| 3. siloxane | 25. 2(5H)-furanone | 46. methyl tetradecanoate | 68. triacosan | 89. vanillin methyl ketone |
| 4. 1-hydroxy-2,3-butadiene | 26. unknown | 47. nerolidol | 69. unknown | 90. tetradecanoic acid |
| 5. 1-hydroxy-2-propanone acetate | 27. di(ethylene glycol) butyl ether | 48. diethyl malate | 70. phthalide | 91. ethyl homovanillate |
| 6. furfural | 28. siloxane | 49. ethyl tetradecanoate | 71. diethyl phthalate | 92. propiovanillone |
| 7. formic acid | 29. methyl dodecanoate | 50. octanoic acid | 72. hexadecanol | 93. fatty acid ester |
| 8. propionic acid | 30. 2-phenylethyl acetate | 51. unknown | 73. 4-hydroxyccinnamic acid (decomp.) | 94. (similar to 4-allyl-2,6-dimethoxyphenol) |
| 9. isobutyric acid | 31. methyl cyclopentenolone | 52. p-cresol | 74. methyl stearate | 95. unknown |
| 10. dimethyl sulfoxide | 32. hexanoic acid | 53. siloxane | 75. benzoic acid | 96. hexadecanoic acid |
| 11. 5-methyl furfural | 33. ethyl dodecanoate | 54. diethyl octanedioate | 76. methyl 8-octadecenoate | 97. syringaldehyde |
| 12. methyl decanoate + unknown | 34. isoamyl decanoate | 55. monomethyl succinate (possible) | 77. ethyl stearate | |
| 13. butyric acid | 35. guaiacol | 56. 3,5-dimethyl-2,4(5H)furanidine | 78. dodecanoic acid | |
| 14. siloxane | 36. dodecyl acetate (possible) | 57. nonanoic acid | 79. hydroxymethylfurfural | |
| 15. ethyl decanoate | 37. whiskey lactone (L) | 58. diethyl 2-hydroxyglutarate | 80. ethyl linoleate | |
| 16. furfuryl alcohol | 38. 2-phenylethanol | 59. unknown | 81. 4-allyl-2,6-dimethoxyphenol | |
| 17. isoamyl octanoate | 39. heptanoic acid | 60. tetradecanol | 82. diisobutyl phthalate | |
| 18. isovaleric acid | 40. siloxane | 61. 4-vinylguaiacol | 83. vanillin | |
| 19. 2-methylbutyric acid | 41. dimethoxybenzene or 4-methyl- | 62. diethyl nonanedioate | 84. sinapic acid (decomp.) | |
| 20. diethyl succinate | guaiacol | 63. methyl hexadecanoate | 85. 2-phenylethyl decanoate | |
| 21. 3-methyl-2(5H)-furanone (possible) | 42. whiskey lactone (2) | 64. ethyl γ -lactone 2-hydroxyglutarate | 86. 2 unknowns | |
| 22. valeric acid | 43. dodecanol | 65. ethyl hexadecanoate | 87. 4-propenyl-2,6-dimethoxyphenol | |

Rum Rtx®-1301

1. acetaldehyde
2. methanol
3. ethanol
4. acetone
5. ethyl formate
6. isopropanol
7. *n*-propanol
8. ethyl acetate
9. sec-butanol
10. isobutanol
11. isoamyl alcohol
12. active amyl alcohol
13. *n*-amyl alcohol

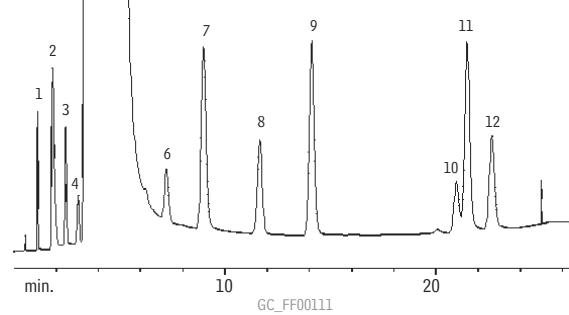


Column: Rtx®-1301, 60m, 0.25mm ID, 1.4 μ m (cat.# 16016)
 Inj.: 1.0 μ L split injection using a Cyclosplitter® inlet liner (cat.# 20706)
 Conc.: neat
 Oven temp.: 35°C (hold 5 min.) to 100°C @ 1°C/min.
 Inj./det. temp.: 150°C/200°C
 Carrier gas: hydrogen @ 40cm/sec.
 Split ratio: 100:1

Rum CarboBlack B

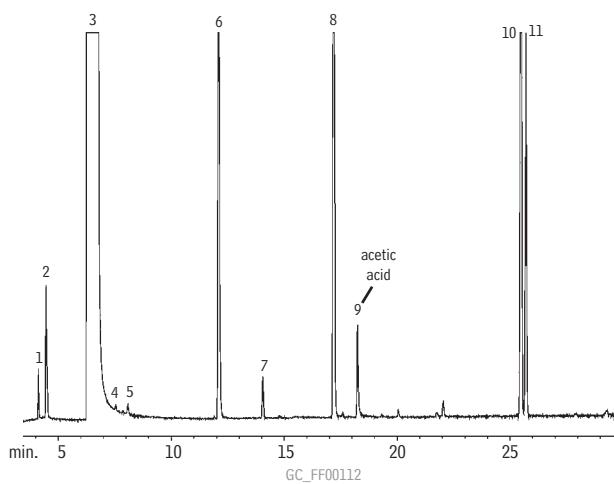
Column: 5% Carbowax® 20M 80/120 CarboBlack B, 2m, $\frac{1}{8}$ " OD, 2mm ID SilcoSmooth™ tubing (cat.# 80105)
 Inj.: 0.5 μ L on-column injection, neat
 Oven temp.: 65°C (hold 5 min.) to 150°C @ 4°C/min.
 Inj./det. temp.: 200°C/250°C
 Det.: FID
 Carrier gas: nitrogen
 Column flow rate: 20mL/min.
 FID sensitivity: 1.28 x 10⁻¹⁰ AFS

1. acetaldehyde
2. methanol
3. acetone
4. ethyl formate
5. ethanol
6. ethyl acetate
7. *n*-propanol
8. sec-butanol
9. isobutanol
10. active amyl alcohol
11. isoamyl alcohol
12. *n*-amyl alcohol



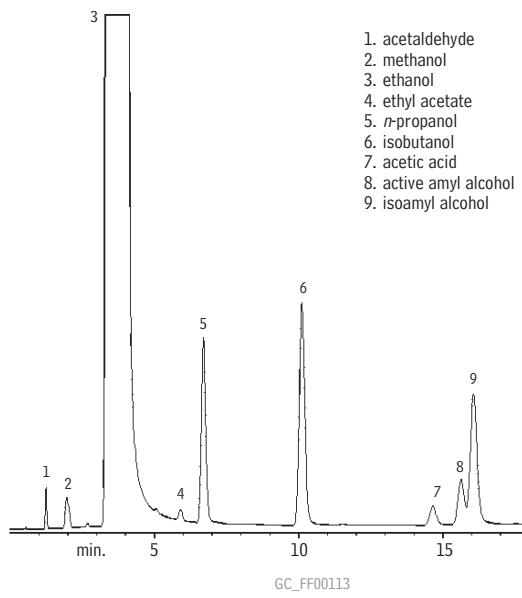
Scotch Rtx®-1301

1. acetaldehyde
2. methanol
3. ethanol
4. acetone
5. isopropanol
6. *n*-propanol
7. ethyl acetate
8. isobutanol
9. acetic acid
10. isoamyl alcohol
11. active amyl alcohol



Column: Rtx®-1301, 60m, 0.25mm ID, 1.4 μ m (cat.# 16016)
 Inj.: 1.0 μ L split injection using a Cyclosplitter® inlet liner (cat.# 20706)
 Conc.: neat
 Oven temp.: 35°C (hold 5 min.) to 100°C @ 1°C/min.
 Inj./det. temp.: 150°C/200°C
 Carrier gas: hydrogen @ 40cm/sec.
 Split ratio: 100:1

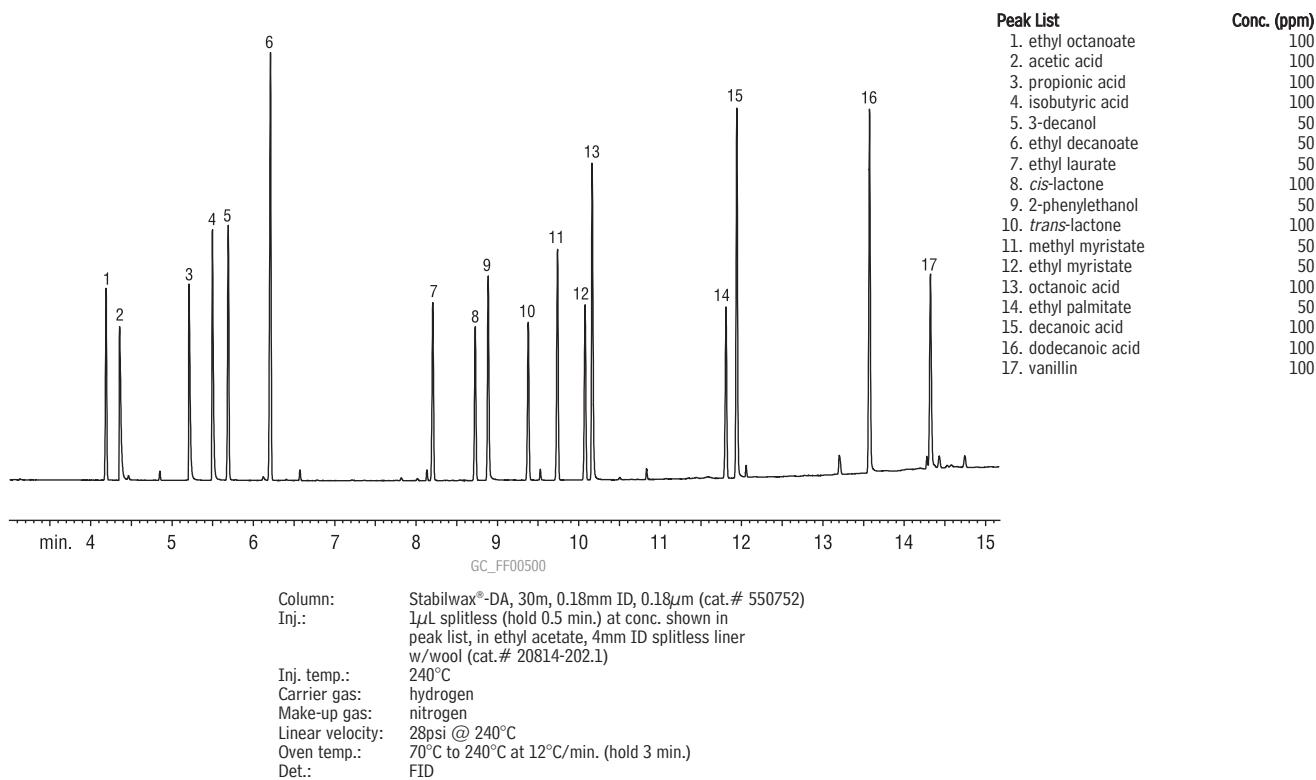
Scotch CarboBlack B



Column: 5% Carbowax® 20M 80/120 CarboBlack B, 2m, $\frac{1}{8}$ " OD, 2mm ID SilcoSmooth™ tubing (cat.# 80105)
 Inj.: 0.5 μ L on-column injection, neat
 Oven temp.: 70°C to 150°C @ 4°C/min.
 Inj./det. temp.: 200°C/250°C
 Det.: FID
 Carrier gas: nitrogen
 Column flow rate: 20mL/min.
 FID sensitivity: 1.28 x 10⁻¹⁰ AFS

Flavors

Alcoholic Beverage Standard: Acids and Esters Stabilwax®-DA



free literature

Analyzing Alcoholic Beverages by Gas Chromatography

Selectivity, sensitivity, and minimal sample preparation make GC a powerful tool for monitoring alcoholic beverage composition

Volatile component profiles of alcoholic beverages reveal a wide range of compounds: acids, alcohols, aldehydes, and others. This 16-page guide describes packed column GC and capillary GC approaches to monitoring these complex mixtures of analytes. A separate section is devoted to detailed information about quantifying trace sulfur compounds in beer.

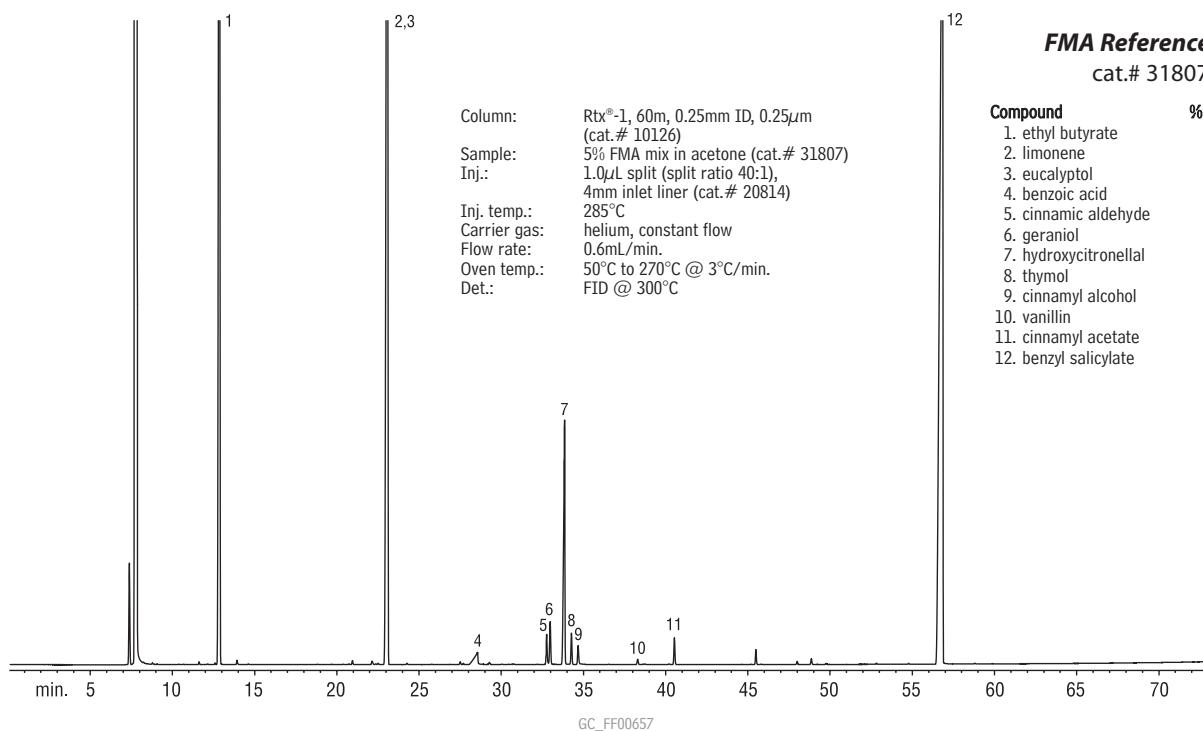
Technical Guide
lit. cat.# 59462

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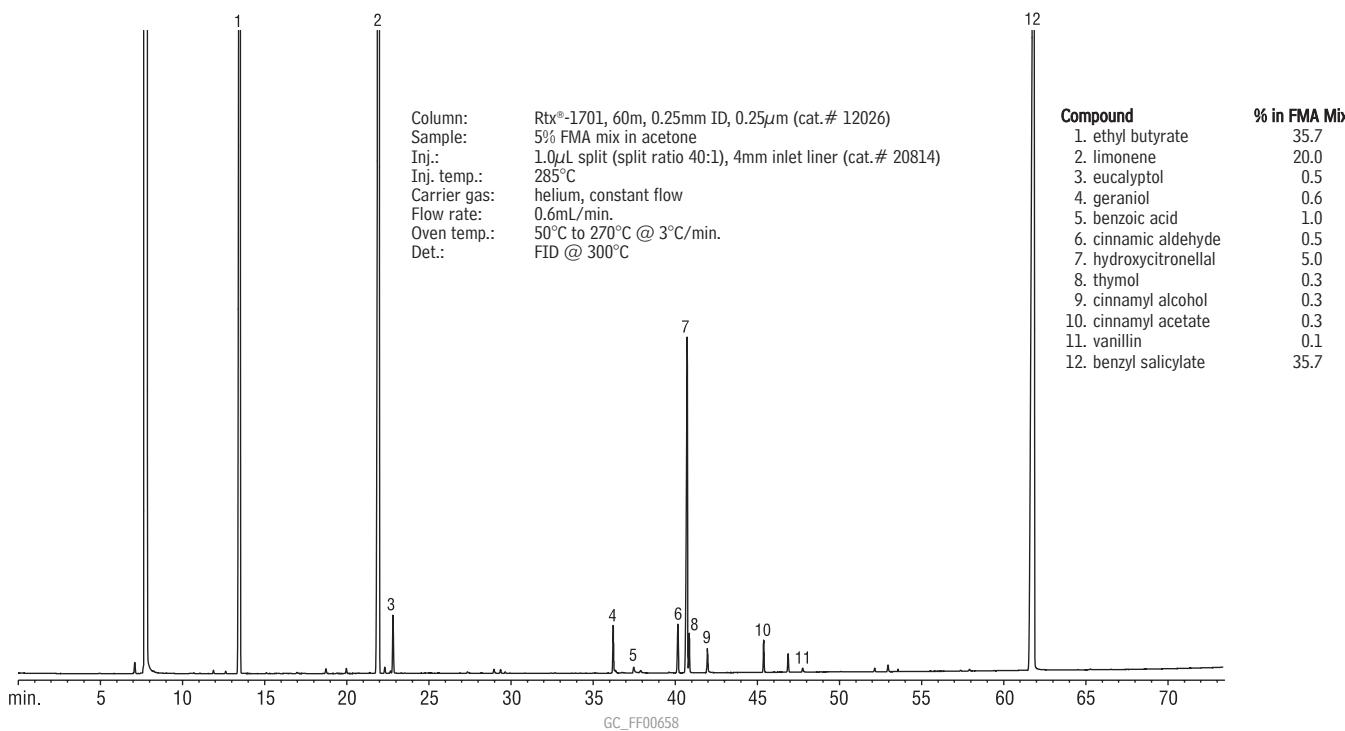
5% Fragrance Materials Association Mix

Rtx®-1



5% Fragrance Materials Association Mix

Rtx®-1701

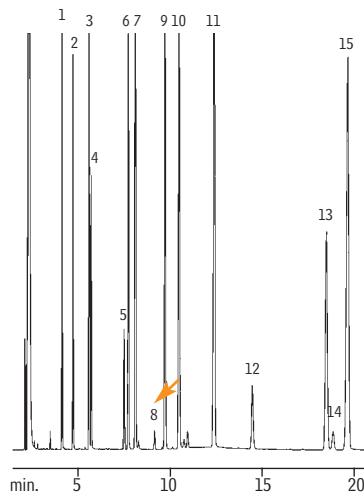


Flavors & Fragrances; Food Contaminants

Flavor & Fragrance Compounds

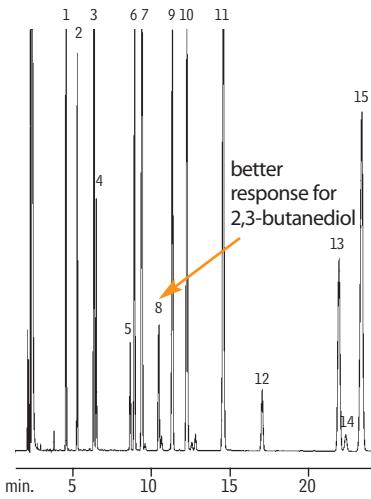
Rt™-CW20M F&F

Carbowax®



Rt™-CW20M F&F

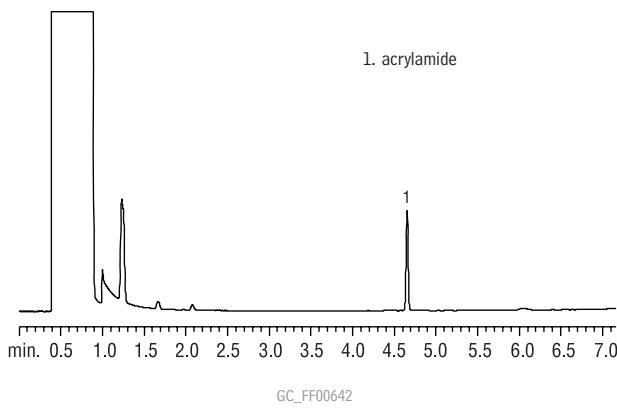
1. methyl heptanoate
2. hexanol
3. methyl octanoate
4. nonanal
5. menthone
6. citronellal
7. methyl nonanoate
8. 2,3-butanediol
9. linalool
10. linalyl acetate
11. methyl decanoate
12. menthol
13. α -terpineol
14. γ -terpineol
15. methyl undecanoate



Columns:
Inj.:
Carrier gas:
Inj./det. temp.:
Oven temp.:

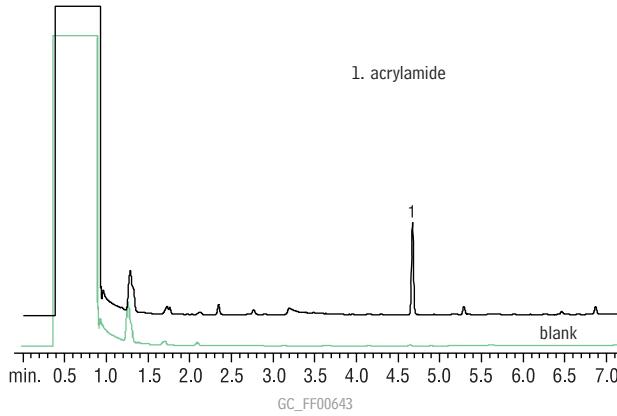
traditional Carbowax® 20M or Rt™-CW20M F&F, 50m, 0.32mm ID, 0.33 μ m, (cat.# 12539)
On-column injection of 5ng to 150ng each compound in methylene chloride, split 10:1
hydrogen, 40cm/sec.
220°C
110°C

Acrylamide (Reference Standard) Stabilwax®



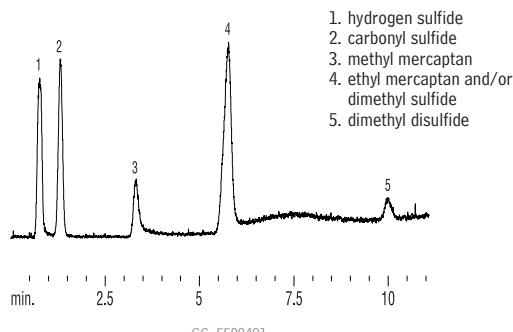
Column: Stabilwax®, 15m, 0.53mm ID, 0.50 μ m (cat.# 10637)
Sample: 25 μ g/mL acrylamide standard in water
Inj.: 1.0 μ L, 0.5 min hold
Liner: 2mm splitless with wool (cat.# 20830)
Inj. temp.: 260°C
Carrier gas: helium, constant pressure
Linear velocity: 62cm/sec. @ 100°C
Oven temp.: 100°C (hold 0.5 min.) to 200°C @ 15°C/min.
Det.: FID @ 260°C

Acrylamide (Potato Chip Extract) Stabilwax®



Column: Stabilwax®, 15m, 0.53mm ID, 0.50 μ m (cat.# 10637)
Sample: 1g of potato chips spiked with 100 μ g acrylamide
Inj.: 1.0 μ L, 0.5 min. hold
Liner: 2mm splitless with wool (cat.# 20830)
Inj. temp.: 260°C
Carrier gas: helium, constant pressure
Linear velocity: 62cm/sec. @ 100°C
Oven temp.: 100°C (hold 0.5 min.) to 200°C @ 15°C/min.
Det.: FID @ 260°C

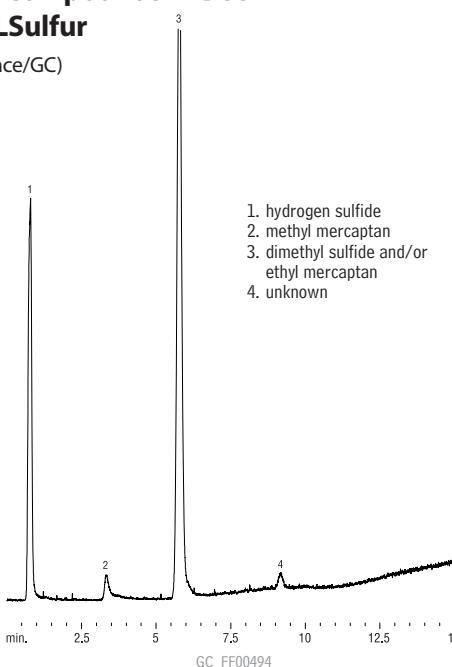
Sulfur Compounds in Beverage Grade CO₂ RtTM-XLSulfur



Column: RtTM-XLSulfur, 100/120 mesh, 1m, 0.75mm ID Sulfinert® tubing (cat.# 19806)
Conc.: sulfur standard @ 20ppb each in CO₂
Inj.: 1cc sample loop, 6-port Valco® valve
Carrier gas: helium
Flow rate: 10mL/min. @ ambient temp.
Oven temp.: 60°C to 260°C @ 15°C/min. (hold 5 min.)
Det. sensitivity: SCD, attn. x 1
Det. temp.: 800°C

Sulfur Compounds in Beer RtTM-XLSulfur

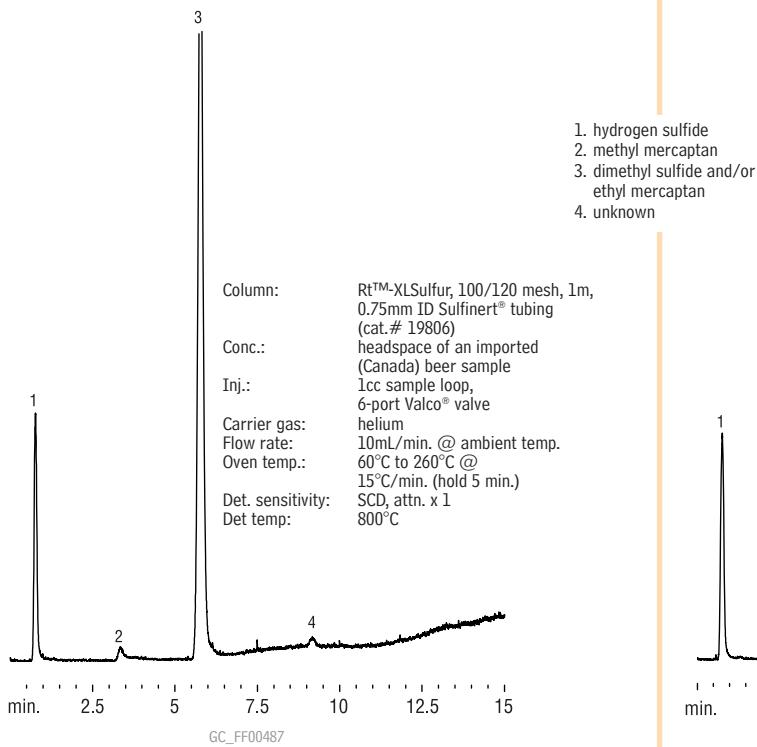
(Headspace/GC)



Column: RtTM-XLSulfur, 100/120 mesh, 1m, 0.75mm ID Sulfinert® tubing (cat.# 19806)
Conc.: headspace of a domestic (US) beer sample
Inj.: 1cc sample loop, 6-port Valco® valve
Carrier gas: helium
Flow rate: 10mL/min. @ ambient temp.
Oven temp.: 60°C to 260°C @ 15°C/min. (hold 5 min.)
Det. sensitivity: SCD, attn. x 1
Det. temp.: 800°C

Sulfur Compounds in Beer RtTM-XLSulfur

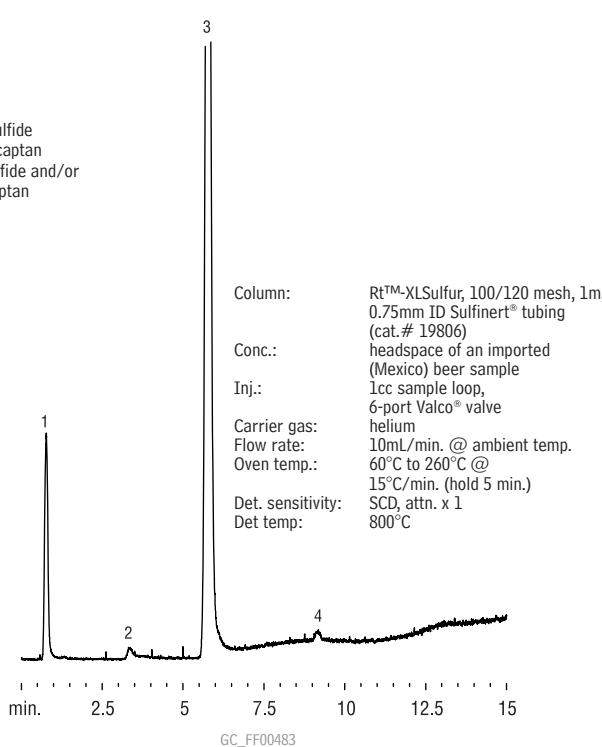
(Headspace/GC)



Column: RtTM-XLSulfur, 100/120 mesh, 1m, 0.75mm ID Sulfinert® tubing (cat.# 19806)
Conc.: headspace of an imported (Canada) beer sample
Inj.: 1cc sample loop, 6-port Valco® valve
Carrier gas: helium
Flow rate: 10mL/min. @ ambient temp.
Oven temp.: 60°C to 260°C @ 15°C/min. (hold 5 min.)
Det. sensitivity: SCD, attn. x 1
Det temp.: 800°C

Sulfur Compounds in Beer RtTM-XLSulfur

(Headspace/GC)

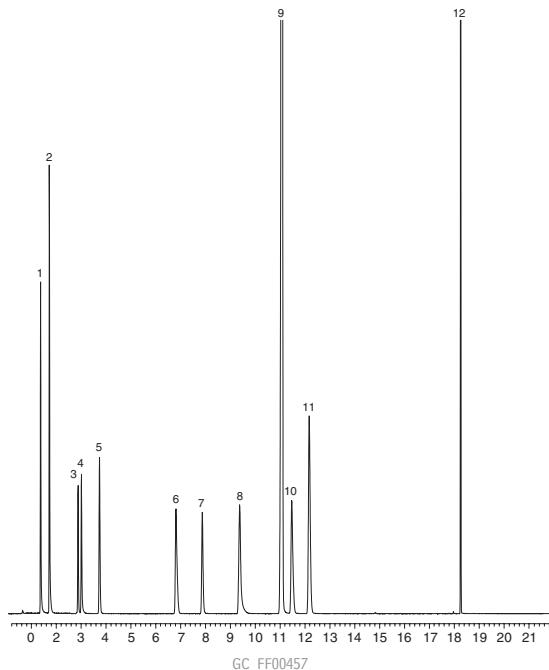


Column: RtTM-XLSulfur, 100/120 mesh, 1m, 0.75mm ID Sulfinert® tubing (cat.# 19806)
Conc.: headspace of an imported (Mexico) beer sample
Inj.: 1cc sample loop, 6-port Valco® valve
Carrier gas: helium
Flow rate: 10mL/min. @ ambient temp.
Oven temp.: 60°C to 260°C @ 15°C/min. (hold 5 min.)
Det. sensitivity: SCD, attn. x 1
Det temp.: 800°C

Food Contaminants

Food Packaging Volatiles

Rtx®-5MS



Volatiles Standard

1. isopropanol
2. methylene chloride
3. 2-methyl-1-propanol
4. tetrahydrofuran
5. benzene
6. toluene
7. hexanal
8. furfural
9. 4-heptanone (IS)
10. butyl ether
11. styrene
12. dodecane

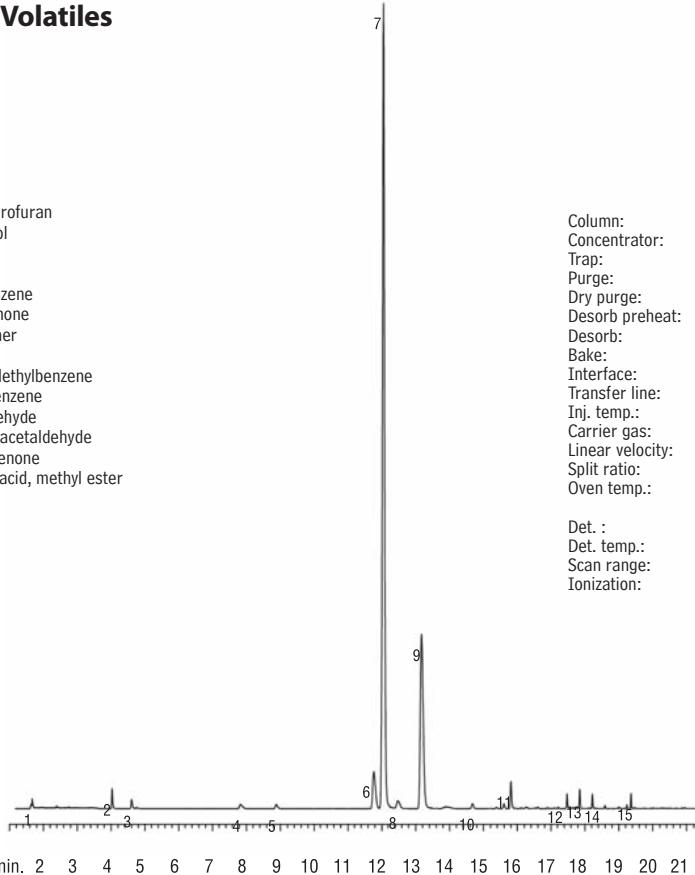
Column: Rtx®-5MS, 30m, 0.25mm ID, 1 μ m (cat.# 12653)
 Concentrator: Tekmar LSC-3100 purge & trap
 Trap: Vocarb 3000, type K
 Purge: 10 min. @ 40mL/min. @ 60°C
 Dry purge: 3 min. @ 40mL/min.
 Desorb preheat: 220°C
 Desorb: 245°C, 2 min., 40mL/min.
 Bake: 230°C, 6 min.
 Interface: 1:20 split at injection port with 1mm ID liner
 Transfer line: 0.53mm ID Silcosteel® MXT® tubing (cat.# 20591)
 Oven temp.: 50°C to 92°C @ 3°C/min., to 220°C @ 20°C/min., hold 1 min.
 Inj. temp.: 250°C
 Carrier gas: helium
 Linear velocity: 36cm/sec. (1mL/min.)
 Split ratio: 20:1
 Det.: MSD
 Det. temp.: 280°C
 Scan range: 35–260amu
 Ionization: EI @ 70 eV

Food Packaging Volatiles

Rtx®-5MS

1. tetrahydrofuran
2. 1-butanol
3. toluene
4. hexanal
5. ethylbenzene
6. 4-heptanone
7. butyl ether
8. styrene
9. 1-methylethylbenzene
10. propylbenzene
11. benzaldehyde
12. benzeneacetaldehyde
13. acetophenone
14. benzoic acid, methyl ester
15. decanal

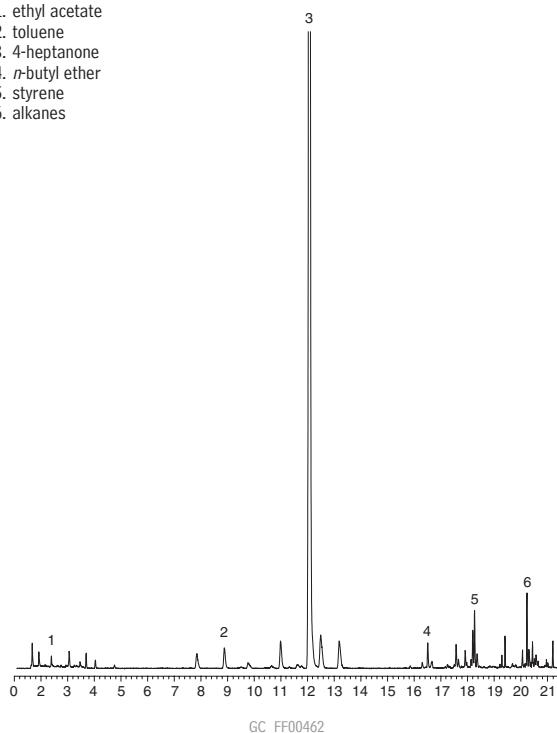
Column: Rtx®-5MS, 30m, 0.25mm ID, 1 μ m (cat.# 12653)
 Concentrator: Tekmar LSC-3100 purge & trap
 Trap: Vocarb 3000, type K
 Purge: 10 min. @ 40mL/min. @ 60°C
 Dry purge: 3 min. @ 40mL/min.
 Desorb preheat: 220°C
 Desorb: 245°C, 2 min., 40mL/min.
 Bake: 230°C, 6 min.
 Interface: 1:20 split at injection with 1mm ID liner
 Transfer line: 0.53mm ID Silcosteel® MXT® tubing (cat. # 20591)
 Inj. temp.: 250°C
 Carrier gas: helium
 Linear velocity: 36cm/sec. (1mL/min.)
 Split ratio: 20:1
 Oven temp.: 50°C to 92°C @ 3°C/min., to 220°C @ 20°C/min., hold for 1 min.
 Det. : MSD (Agilent 5973)
 Det. temp.: 280°C
 Scan range: 35–260amu
 Ionization: EI @ 70eV



Food Packaging Volatiles by Purge & Trap GC/MS**Rtx®-5MS**

(Purge & Trap GC/MS)

1. ethyl acetate
2. toluene
3. 4-heptanone
4. *n*-butyl ether
5. styrene
6. alkanes



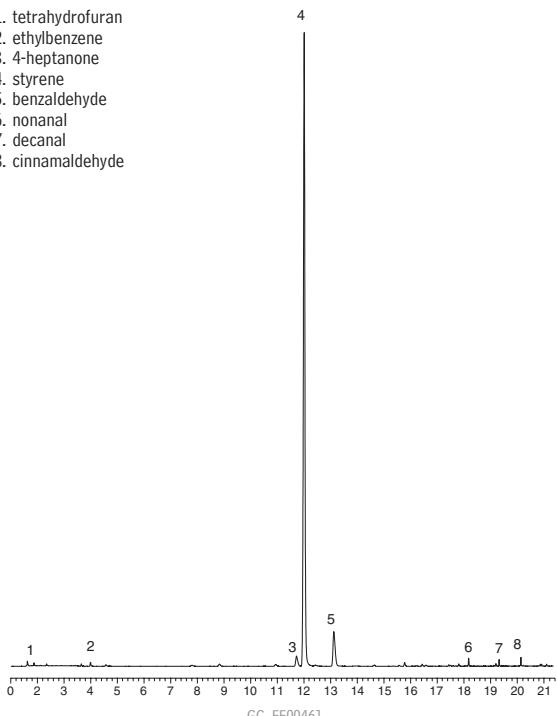
Column: Rtx®-5MS, 30m, 0.25mm ID, 1 μ m (cat.# 12653)
 GC: Agilent 6890
 Oven temp.: 50°C to 92°C @ 3°C/min., to 220°C @ 20°C/min. (hold 1 min.)
 Injector temp.: 250°C
 Carrier gas: helium
 Linear velocity: 36cm/sec. (1mL/min.)
 Det. sensitivity: NA
 Split ratio: 20:1
 Det.: MSD (Agilent 5973)
 Det. temp.: 280°C
 Scan range: 35-260amu
 Ionization: EI @ 70eV
 Mode:

Sample Conditions:
 Sample: Overwrap, inner bowl
 Concentrator: Tekmar LSC-3100 purge & trap
 Trap: Vocarb 3000, type K
 Purge: 10 min. @ 40mL/min., at 60°C
 Dry purge: 3 min. @ 40mL/min.
 Desorb preheat: 220°C
 Desorb: 245°C, 2 min., 40mL/min.
 Bake: 230°C, 6 min.
 Interface: 1:20 split at injection port with 1mm ID inlet liner
 Transfer line: 0.53mm ID Silcosteel® MXT® tubing (cat.# 20591)

Food Packaging Volatiles by Purge & Trap GC/MS**Rtx®-5MS**

(Purge & Trap GC/MS)

1. tetrahydrofuran
2. ethylbenzene
3. 4-heptanone
4. styrene
5. benzaldehyde
6. nonanal
7. decanal
8. cinnamaldehyde



Column: Rtx®-5MS, 30m, 0.25mm ID, 1 μ m (cat.# 12653)
 GC: Agilent 6890
 Oven temp.: 50°C to 92°C @ 3°C/min., to 220°C @ 20°C/min. (hold 1 min.)
 Inj. temp.: 250°C
 Carrier gas: helium
 Linear velocity: 36cm/sec. (1mL/min.)
 Det. sensitivity: NA
 Split ratio: 20:1
 Det.: MSD (Agilent 5973)
 Det. temp.: 280°C
 Scan range: 35-260amu
 Ionization: EI @ 70eV
 Mode:

Sample Conditions:
 Sample: Overwrap, lid of bowl
 Concentrator: Tekmar LSC-3100 purge & trap
 Trap: Vocarb 3000, type K
 Purge: 10 min. @ 40mL/min., at 60°C
 Dry purge: 3 min. @ 40mL/min.
 Desorb preheat: 220°C
 Desorb: 245°C, 2 min., 40mL/min.
 Bake: 230°C, 6 min.
 Interface: 1:20 split at injection port with 1mm ID inlet liner
 Transfer line: 0.53mm ID Silcosteel® MXT® tubing (cat.# 20591)

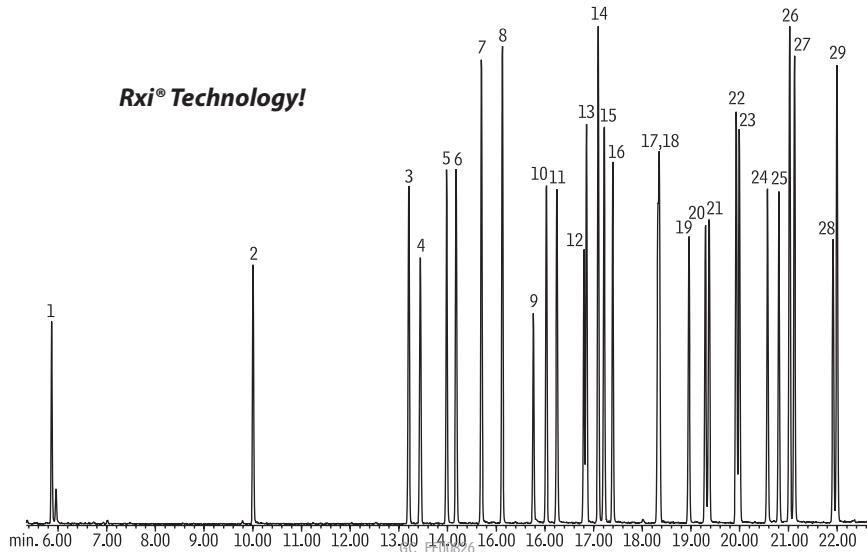
Food Contaminants

Organochlorine and Organophosphorus Pesticides

FAPAS® Proficiency Testing

Rxi®-5ms

Rxi® Technology!



1. dichlorvos
2. methacrifos
3. α -BHC
4. hexachlorobenzene
5. δ -BHC (lindane)
6. β -BHC
7. diazinon
8. etrimphos
9. phosphamidon
10. chlorpyrifos-methyl
11. heptachlor
12. fenitrothion
13. pirimiphos methyl
14. malathion
15. aldrin
16. chlorpyrifos
17. heptachlor epoxide
18. oxychlordane
19. *trans*-chlordane
20. endosulfan I
21. *cis*-chlordane
22. 2,4'-DDT
23. dieleadrin
24. endrin
25. endosulfan II
26. 4,4'-DDE
27. 4,4'-DDD
28. endosulfan sulfate
29. 4,4'-DDT

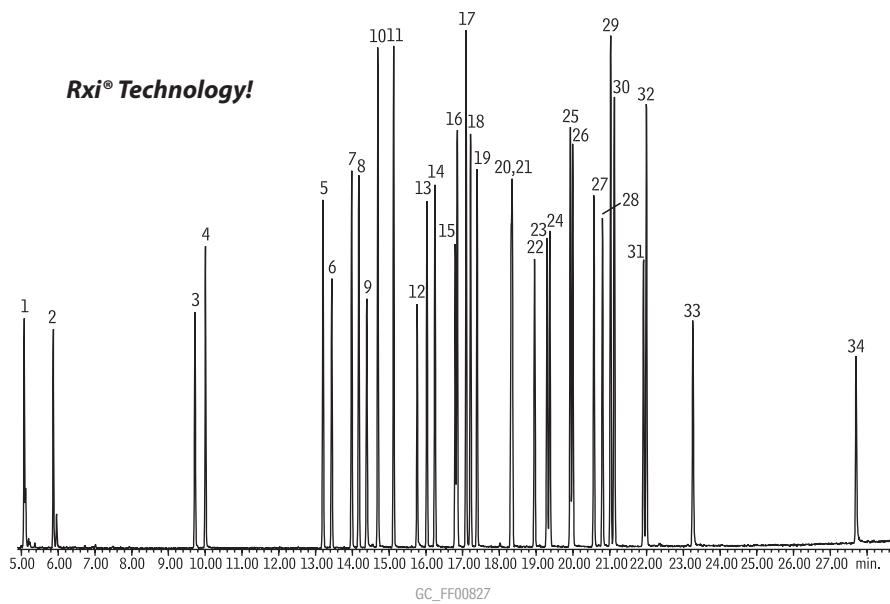
Column: Rxi®-5ms, 30m, 0.25mm ID, 0.25 μ m (cat.# 13423)
 Sample: FAPAS® Series 5 OC Pesticide Mix 1 (cat.# 32412), FAPAS® Series 9 OP Pesticide Mix 1 (cat.# 32413)
 Inj.: 1.0 μ L, 10ppm each analyte, split (10:1) 4mm Drilled Uniliner® inlet liner (hole near bottom) (cat.# 20771)
 Instrument: Agilent 6890
 Inj. temp.: 290°C
 Carrier gas: helium, constant flow
 Flow rate: 1.2mL/min.
 Oven temp.: 100°C (hold 0.5 min.) to 300°C @ 7°C/min. (hold 1 min.)
 Det.: Agilent 5973 GC/MS
 Transfer line temp.: 280°C
 Scan range: 35-550amu
 Solvent delay: 4 min.
 Tune: DFTPP
 Ionization: EI

Organochlorine and Organophosphorus Pesticides

FAPAS® Proficiency Testing

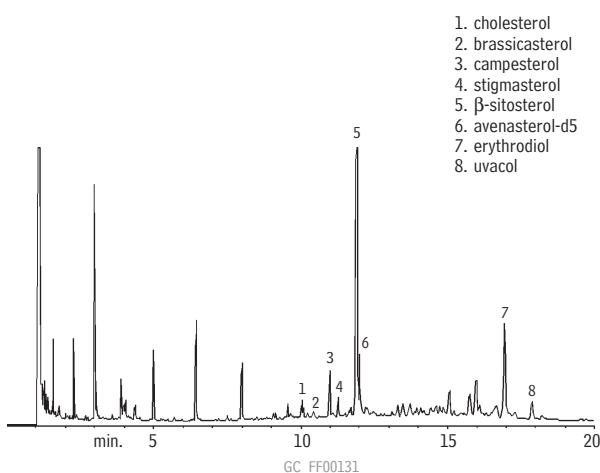
Rxi®-5ms

Rxi® Technology!



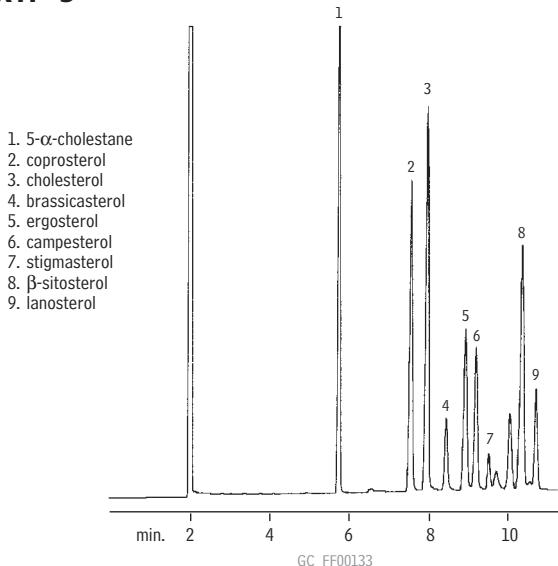
1. naphthalene-d8
2. dichlorvos
3. acenaphthene-d10
4. methacrifos
5. α -BHC
6. hexachlorobenzene
7. δ -BHC (lindane)
8. β -BHC
9. phenanthrene-d10
10. diazinon
11. etrimphos
12. phosphamidon
13. chlorpyrifos-methyl
14. heptachlor
15. fenitrothion
16. pirimiphos methyl
17. malathion
18. aldrin
19. chlorpyrifos
20. heptachlor epoxide
21. oxychlordane
22. *trans*-chlordane
23. endosulfan I
24. *cis*-chlordane
25. 2,4'-DDT
26. dieleadrin
27. endrin
28. endosulfan II
29. 4,4'-DDE
30. 4,4'-DDD
31. endosulfan sulfate
32. 4,4'-DDT
33. chrysene-d12
34. perylene-d12

Column: Rxi®-5ms, 30m, 0.25mm ID, 0.25 μ m (cat.# 13423)
 Sample: FAPAS® Series 5 OC Pesticide Mix 1 (cat.# 32412), FAPAS® Series 9 OP Pesticide Mix 1 (cat.# 32413), SV Internal Standard Mix (cat.# 31206)
 Inj.: 1.0 μ L, 10ppm each analyte, split (10:1) 4mm Drilled Uniliner® inlet liner (hole near bottom) (cat.# 20771)
 Instrument: Agilent 6890
 Inj. temp.: 290°C
 Carrier gas: helium, constant flow
 Flow rate: 1.2mL/min.
 Oven temp.: 100°C (hold 0.5 min.) to 300°C @ 7°C/min. (hold 1 min.)
 Det.: Agilent 5973 GC/MS
 Transfer line temp.: 280°C
 Scan range: 35-550amu
 Solvent delay: 4 min.
 Tune: DFTPP
 Ionization: EI

Sterols (Olive Oil)**XTI®-5**

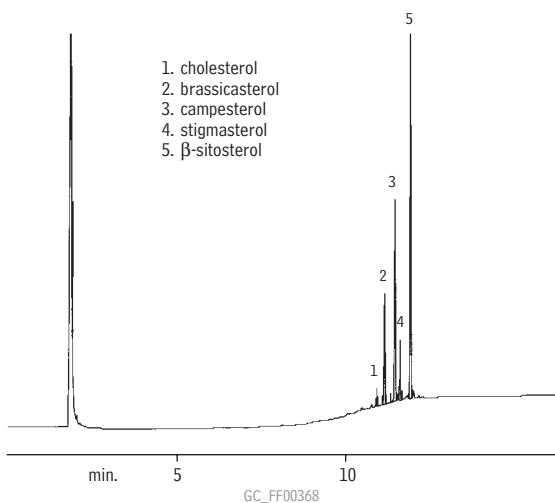
1. cholesterol
2. brassicasterol
3. campesterol
4. stigmasterol
5. β -sitosterol
6. avenasterol-d5
7. erythrodiol
8. uvacol

Column: XTI®-5, 30m, 0.25mm ID, 0.25 μ m (cat.# 12223)
 Sample: 0.5 μ L splitless injection of a sterol fraction from olive pomace oil
 Conc.: 10–2500ng
 Oven temp.: 227°C to 305°C @ 8°C/min. (hold 10 min.)
 Inj./det. temp.: 300°C
 Carrier gas: helium
 Linear velocity: 35cm/sec. set @ 227°C (1.3mL/min.)
 FID sensitivity: 8×10^{11} AFS
 Splitless hold time: 1.00 min.

Sterols**XTI®-5**

1. 5- α -cholestane
2. coprosterol
3. cholesterol
4. brassicasterol
5. ergosterol
6. campesterol
7. stigmasterol
8. β -sitosterol
9. lanosterol

Column: XTI®-5, 30m, 0.25mm ID, 0.50 μ m (cat.# 12238)
 Inj.: 1.0 μ L split injection
 On-column conc.: 250ng
 Oven temp.: 330°C
 Inj./det. temp.: 300°C
 Carrier gas: helium
 Linear velocity: 30cm/sec. set @ 40°C
 FID sensitivity: 8×10^{11} AFS
 Split ratio: 100:1

Phytosterols (Saw Palmetto)**Rtx®-5**

1. cholesterol
2. brassicasterol
3. campesterol
4. stigmasterol
5. β -sitosterol

Column: Rtx®-5, 60m, 0.25mm ID, 0.25 μ m (cat.# 10226)
 Inj.: 1 μ L splitless injection*
 Oven temp.: 200°C (hold 1 min.) to 340°C @ 15°C/min. (hold 10 min.)
 Inj./FID temp.: 345°C/355°C

*Split injection may be used, but results can have greater variability. A split flow of 112mL/min. is suggested.

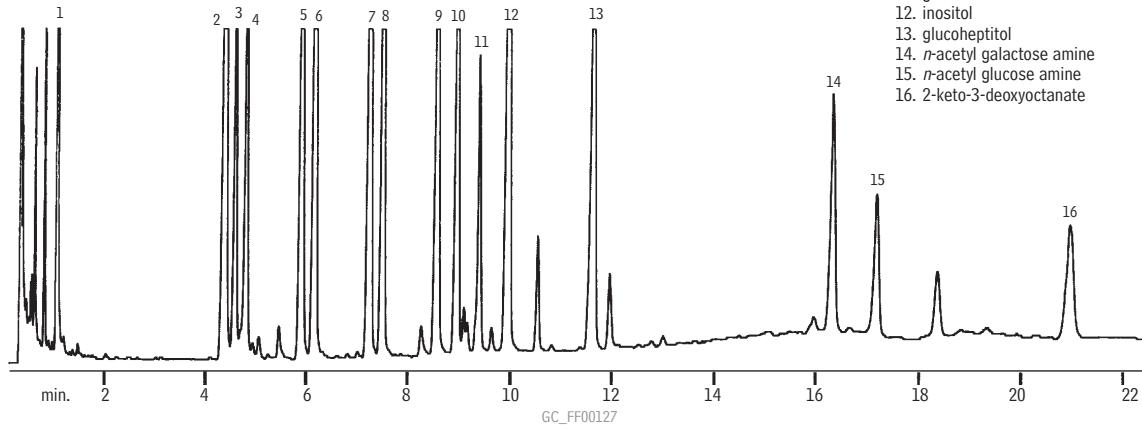
Chromatogram provided by the Institute for Nutraceutical Advancement (INA)

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Sugars

Sugars (Alditol Acetates)

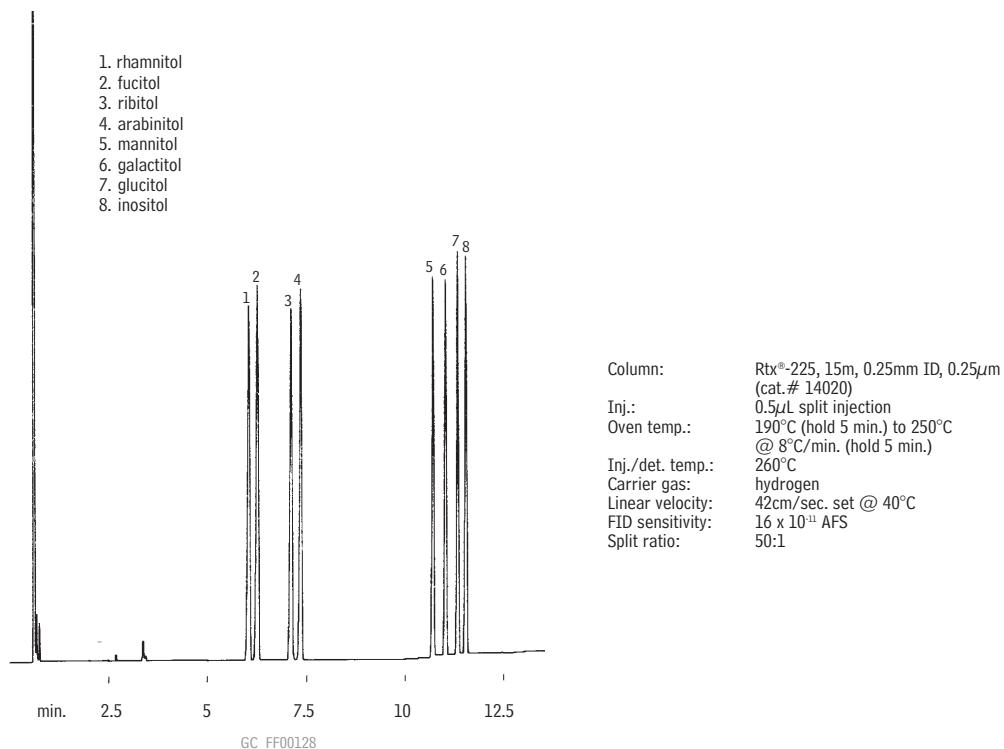
RtTM-2330



1. glyceraldehyde
2. deoxyribitol
3. rhamnitol
4. fucitol
5. ribitol
6. arabinitol
7. xylitol
8. deoxyglucitol
9. mannitol
10. galactitol
11. glucitol
12. inositol
13. glucoheptitol
14. *n*-acetyl galactose amine
15. *n*-acetyl glucose amine
16. 2-keto-3-deoxyoctanate

Column: RtTM-2330, 15m, 0.32mm ID, 0.20 μ m (cat.# 10721)
 Inj.: 0.6 μ L split injection
 Oven temp.: 175°C (hold 2 min.) to 240°C @ 8°C/min. (hold 1 min.) to 265°C @ 8°C/min. (hold 12 min.)
 Inj./det. temp.: 275°C
 Carrier gas: helium
 Linear velocity: 80cm/sec. (flow rate: 10cc/min.)
 FID sensitivity: 2 x 10¹¹ AFS
 Split ratio: 20:1



Sugars (Alditol Acetates)**Rtx®-225****free literature****Foods, Flavors, and Fragrances Catalog!**

Includes important analysis tips, and chromatograms for analysis of fats and oils, carbohydrates, vitamins, amino acids, organic acids, preservatives, flavors and fragrances, essential oils, and chiral separations. Retention time indices and complete product listings for all relevant GC and HPLC products also are included.
lit. cat.# 59260A

Also available—Monitoring Volatile Compounds in Food Contact Packaging, Using Purge and Trap GC/MS and an Rbx®-5MS Capillary Column

Applications Note
lit. cat.# 59348

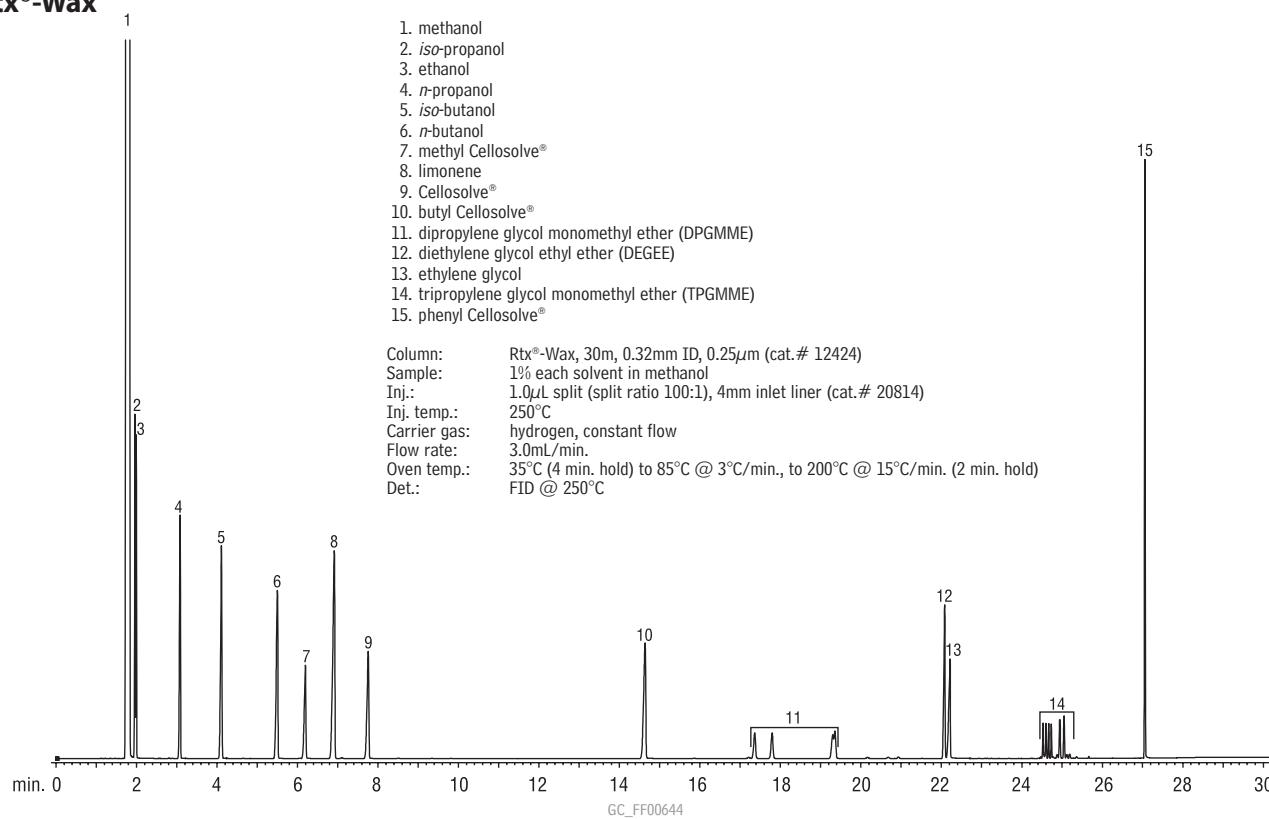
Searching for free technical literature?

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Cleaning Solvents

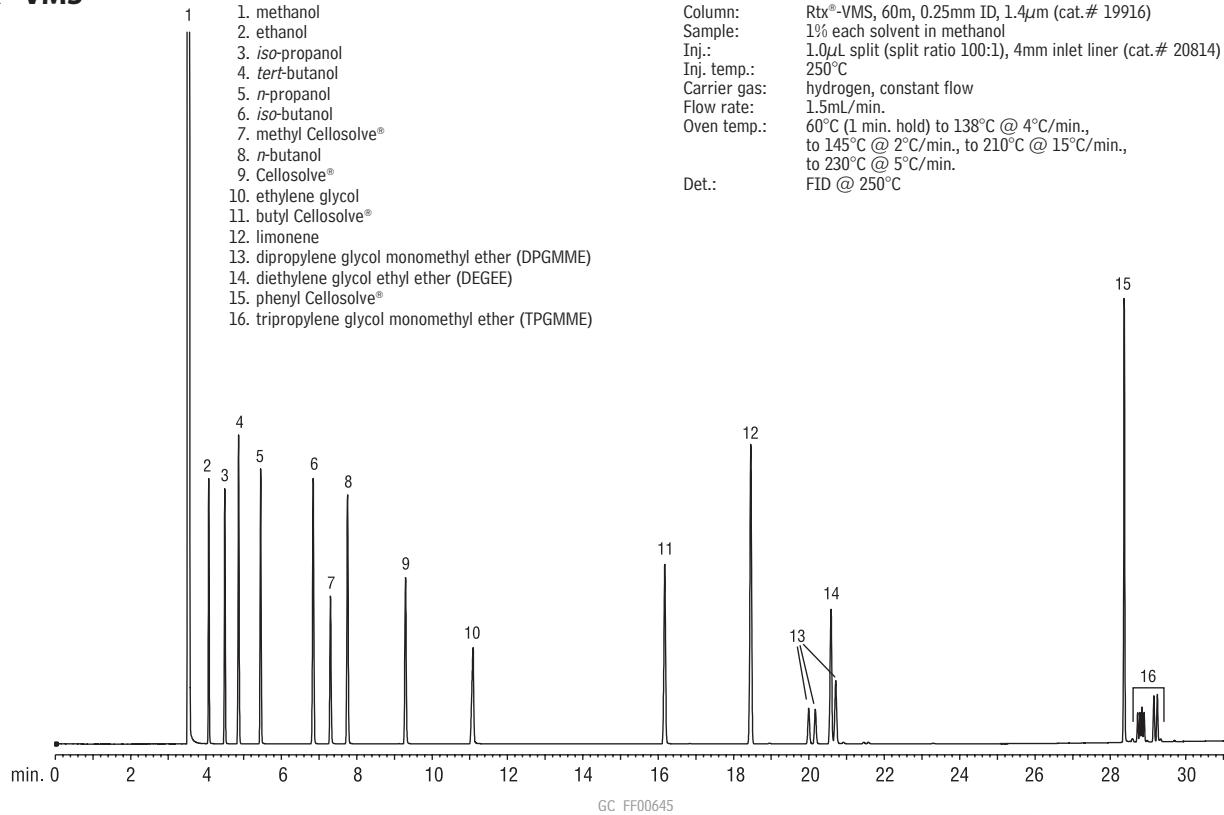
Cleaning Solvents

Rtx®-Wax



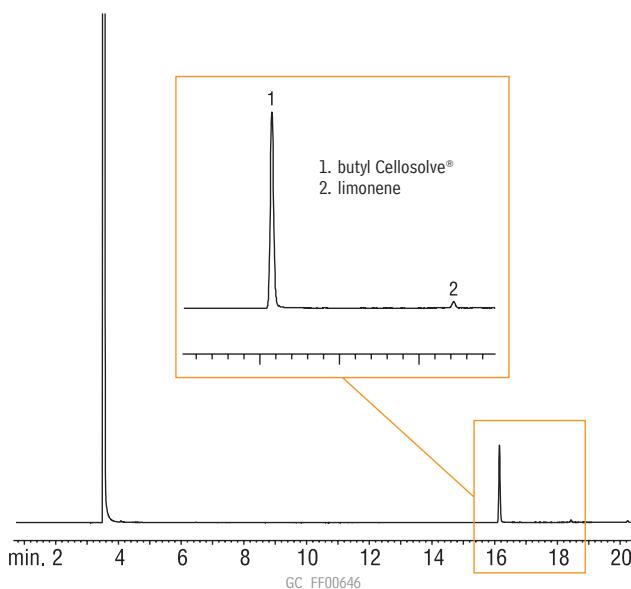
Cleaning Solvents

Rtx®-VMS



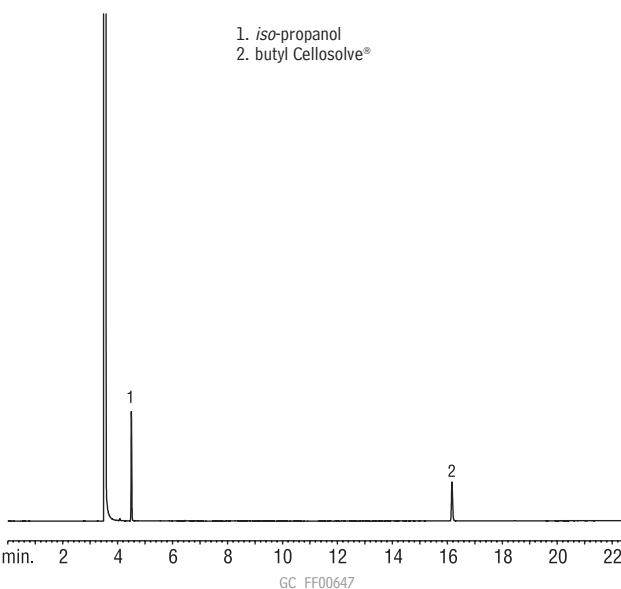
Cleaning Solvents; Fragrances

Cleaning Solvents (All-Purpose Cleaner) Rtx®-VMS



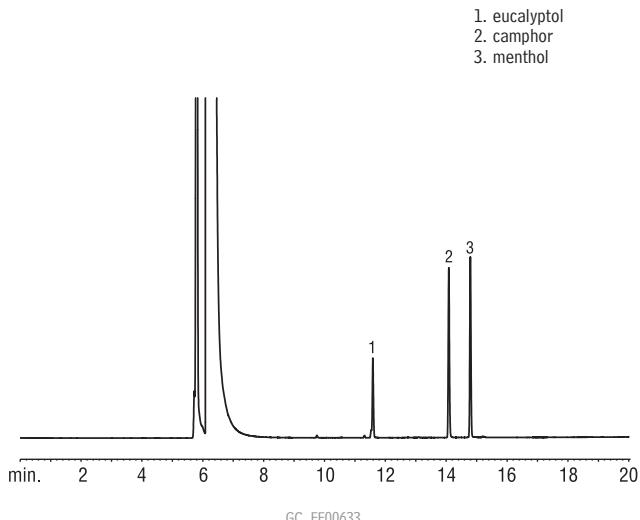
Column: Rtx®-VMS, 60m, 0.25mm ID, 1.4 μ m (cat.# 19916)
 Sample: approx. 5% cleaner in methanol
 Inj.: 1.0 μ L split (split ratio 100:1), 4mm inlet liner (cat.# 20814)
 Inj. temp.: 250°C
 Carrier gas: hydrogen, constant flow
 Flow rate: 1.5mL/min.
 Oven temp.: 60°C (1 min. hold) to 138°C @ 4°C/min. to 145°C @ 2°C/min. to 210°C @ 15°C/min. to 230°C @ 5°C/min.
 Det.: FID @ 250°C

Cleaning Solvents (Glass Cleaner) Rtx®-VMS



Column: Rtx®-VMS, 60m, 0.25mm ID, 1.4 μ m (cat.# 19916)
 Sample: approx. 5% cleaner in methanol
 Inj.: 1.0 μ L split (split ratio 100:1), 4mm inlet liner (cat.# 20814)
 Inj. temp.: 250°C
 Carrier gas: hydrogen, constant flow
 Flow rate: 1.5mL/min.
 Oven temp.: 60°C (1 min. hold) to 138°C @ 4°C/min. to 145°C @ 2°C/min. to 210°C @ 15°C/min. to 230°C @ 5°C/min.
 Det.: FID @ 250°C

Personal Care Product Fragrances Rtx®-1

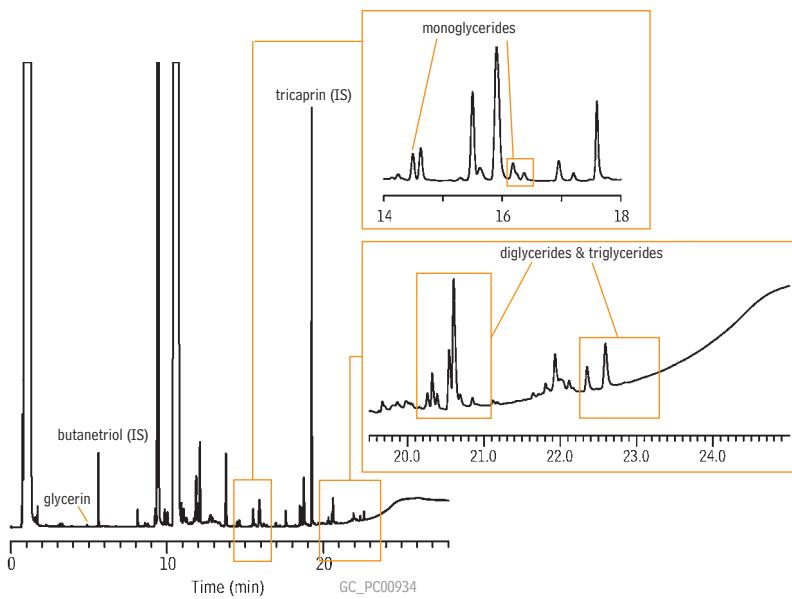


Column: Rtx®-1, 60m, 0.25mm ID, 0.25 μ m (cat.# 10126)
 Sample: 130ppm eucalyptus oil, 250ppm camphor,
 260ppm menthol in methanol
 Inj.: 1.0 μ L split (split ratio 20:1), 4mm inlet liner (cat.# 20814)
 Inj. temp.: 275°C
 Carrier gas: helium, constant flow
 Flow rate: 0.6mL/min.
 Oven temp.: 80°C to 180°C @ 5°C/min.
 Det.: FID @ 300°C

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**Derivatized B100 and Internal Standards
MXT®-Biodiesel TG with 2m Integra Gap™**

new!



Column: MXT®-Biodiesel TG, 14m, 0.53mm ID, 0.16 μ m with built-in 2m Integra-Gap™ (total column length 16m) (cat.# 70289)
 Sample: B100 + IS Butanetriol & Tricaprin derivatized with MSTFA as per ASTM D-6584
 Inj.: 1.0 μ L cool on-column
 Inj. temp.: oven track
 Carrier gas: hydrogen, constant flow
 Flow rate: 4mL/min.
 Oven temp.: 50°C (hold 1 min.) to 180°C @ 15°C/min., to 230°C @ 7°C/min., to 430°C @ 30°C/min. (hold 5 min.)
 Det.: FID @ 430°C

Get More!

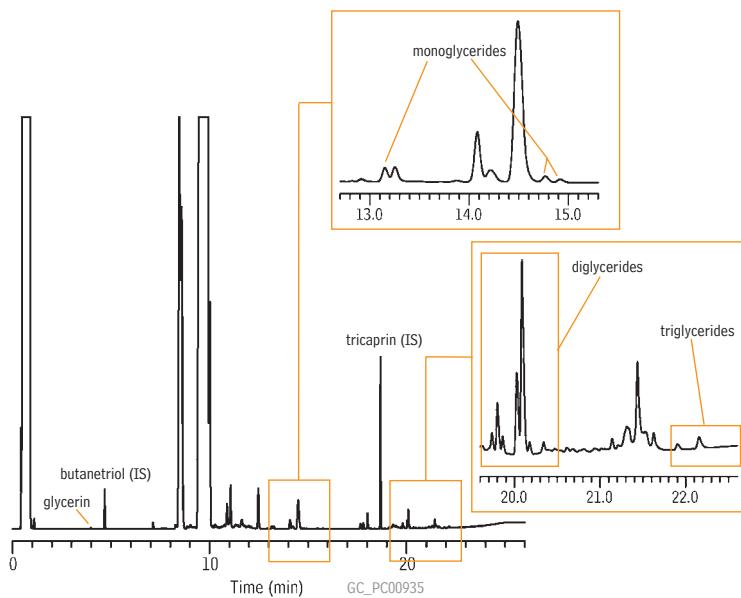
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new!

Derivatized B100 and Internal Standards
MXT®-Biodiesel TG with 2m x 0.53mm ID Retention Gap

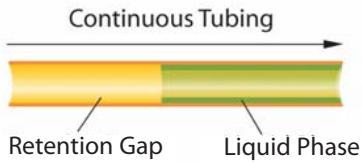


Column: MXT®-Biodiesel TG, 10m, 0.32mm ID, 0.1 μ m
 with 2m x 0.53mm retention gap (cat.# 70290)
 Sample: B100 + IS Butanetriol & Tricaprín derivatized with MSTFA as per ASTM D-6584
 Inj.: 1.0 μ L cool on-column
 Inj. temp.: oven track
 Carrier gas: hydrogen, constant flow
 Flow rate: 4mL/min.
 Oven temp.: 50°C (hold 1 min.) to 180°C @ 15°C/min., to 230°C @ 7°C/min., to 430°C @ 30°C/min. (hold 5 min.)
 Det.: FID @ 430°C

new!

Integra-Gap™ technology.

- built-in retention gap
- eliminates connector



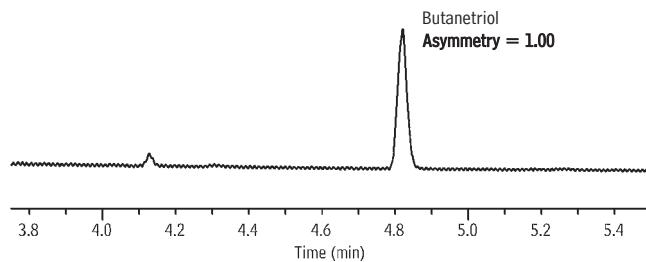
Fuels

Biodiesel Oil (B100)

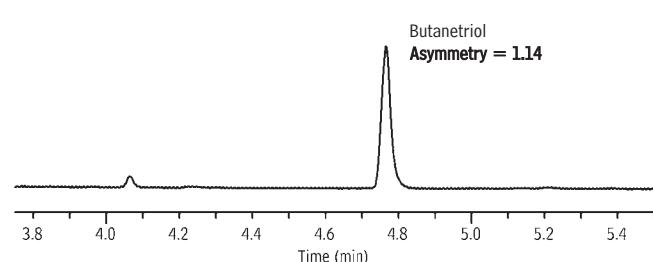
Rtx®-Biodiesel TG

new!

A. Rtx®-Biodiesel TG
with Alumaseal™ Connector and
2 meters of 0.53mm ID Hydroguard™ tubing



B. Rtx®-Biodiesel TG
with Universal Press-Tight® Connector and
2 meters of 0.53mm ID Hydroguard™ tubing



GC_PC00905

Columns: A. Rtx®-Biodiesel TG, 10m, 0.32mm ID, 0.10 μ m connected to 2m x 0.53mm Hydroguard™ tubing using Alumaseal™ connector
B. Rtx®-Biodiesel TG, 10m, 0.32mm ID, 0.10 μ m connected to 2m x 0.53mm Hydroguard™ tubing using Universal Press-Tight™ connector

Sample: Biodiesel (B100) with butanetriol at 12.5ppm (12.5ng on-column)

Inj.: 1 μ L, cool on-column injection

Inj. temp.: oven track mode

Carrier gas: hydrogen, constant flow 4cc/min.

Linear velocity: 79cm/sec.

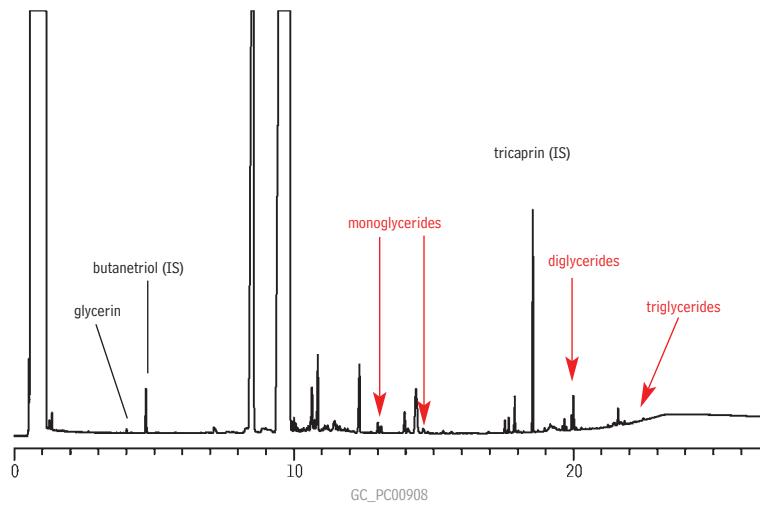
Oven temp.: 50°C (hold 1 min.) to 180°C @ 15°C/min. to 230°C @ 7°C/min. to 380°C @ 30°C/min. (hold 5 min.)

Det.: FID @ 380°C

Biodiesel Oil (B100) and Internal Standards

Rtx®-Biodiesel TG

new!



Column: Rtx®-Biodiesel TG, 10m, 0.32mm ID, 0.10 μ m connected to 2m x 0.53mm Hydroguard™ tubing using Alumaseal™ connector (cat.# 10291)

Sample: biodiesel oil (B100) plus monoolein, diolein, triolein, glycerin, butanetriol, tricaprin

Inj.: 1 μ L, cool on-column

Inj. temp.: oven track

Carrier gas: hydrogen, constant flow

Flow rate: 4mL/min.

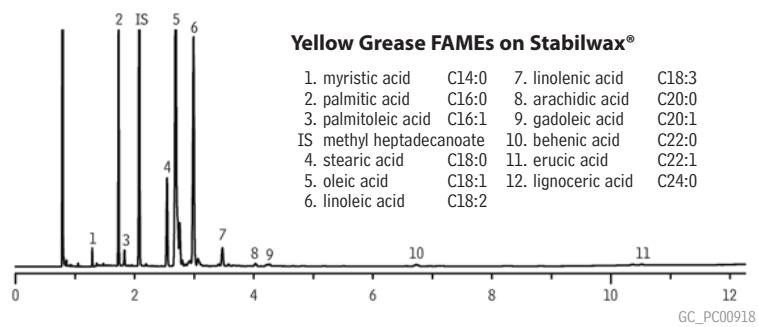
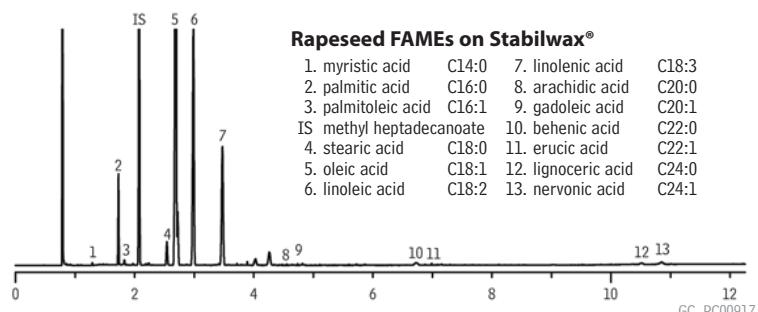
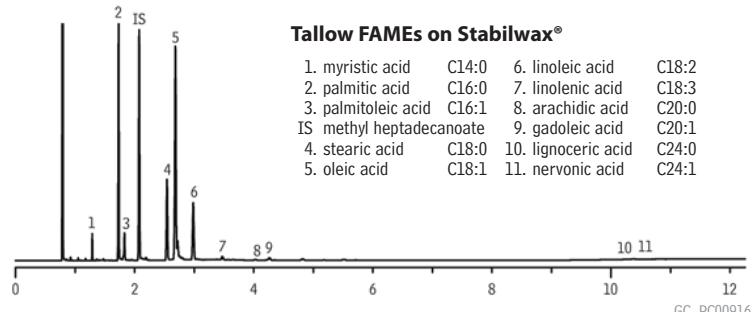
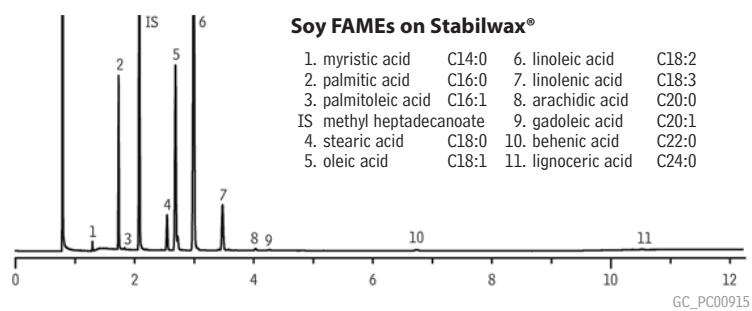
Oven temp.: 50°C (hold 1 min.) to 180°C @ 15°C/min. to 230°C @ 7°C/min. to 380°C @ 30°C/min. (hold 5 min.)

Det.: FID @ 380°C

new!

FAMEs in Biodiesel Oils

Stabilwax®

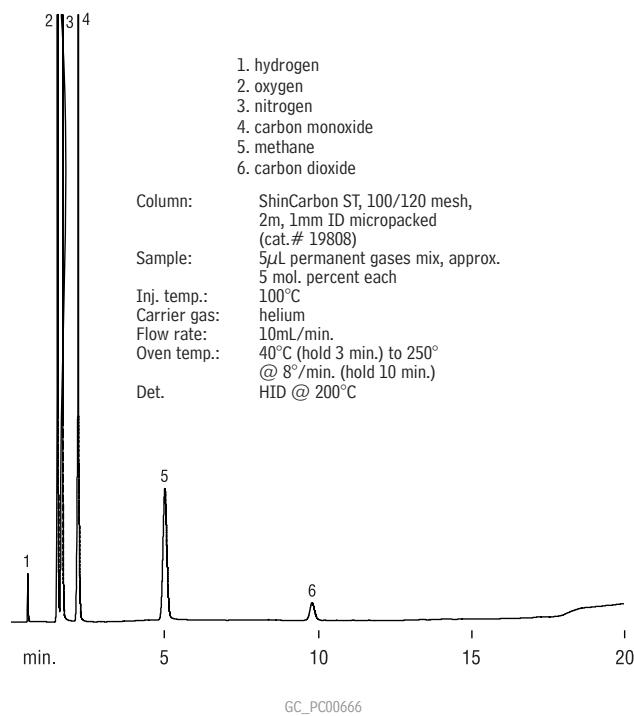


Column: Stabilwax®, 30m, 0.32mm ID, 0.25 μ m (cat.# 10624)
 Sample: various sources of biodiesel (B100), prepared according to European Method EN 14103
 Inj.: 1.0 μ L split (split ratio 100:1), Cycl splitter® inlet liner (cat.# 20706)
 Inj. temp.: 250°C
 Carrier gas: hydrogen, constant flow, 3mL/min.
 Linear velocity: 60cm/sec.
 Oven temp.: 210°C (hold 5 min.) to 230°C @ 20°C/min. (hold 5 min.)
 Det.: FID @ 250°C

Permanent Gases

ShinCarbon ST

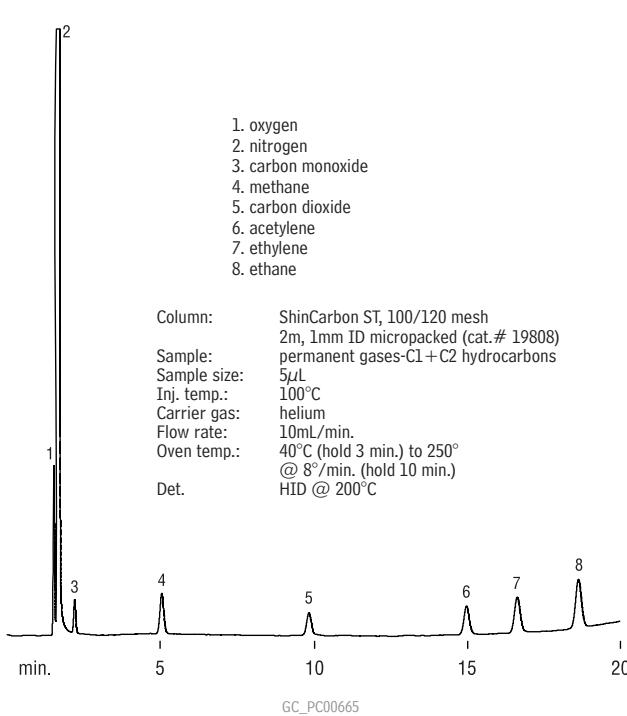
(micropacked)



Permanent Gases, C1+C2 hydrocarbons

ShinCarbon ST

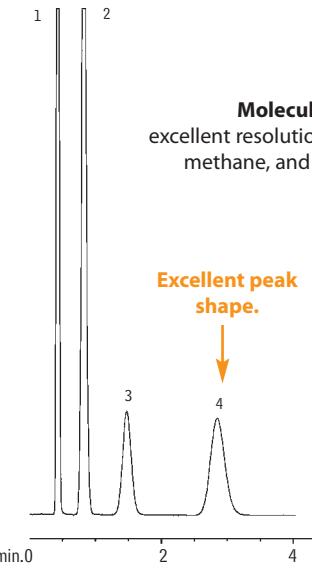
(micropacked)



Permanent Gases

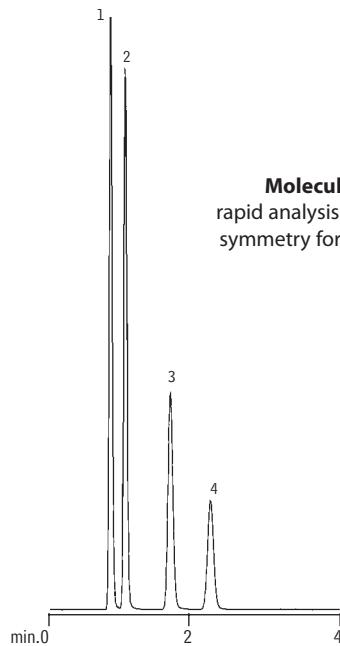
Molecular Sieve 5A and Molecular Sieve 13X

(packed)



- 1. oxygen
- 2. nitrogen
- 3. methane
- 4. carbon monoxide

10 μ L helium, 5–10% each component
Oven temp.: 50°C
Inj./det. temp.: 150°C/200°C
Carrier gas: hydrogen
Flow: 30mL/min., helium
Det.: TCD

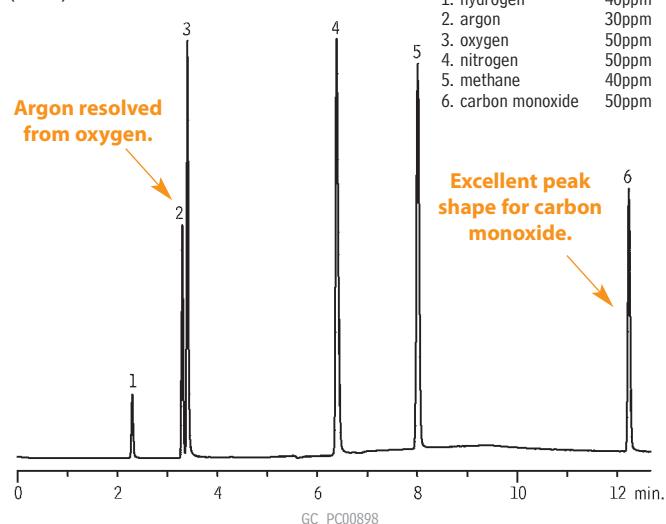


Molecular Sieve 5A 80/100 mesh
1m x 1/8" x 2mm ID SilcoSmooth™ tubing (cat.# 80440-800)

Molecular Sieve 13X 80/100 mesh
2m x 1/8" x 2mm (ID) SilcoSmooth™ tubing (cat.# 80439-800)

Permanent Gases**Rt™-Msieve 5A**

(PLOT)

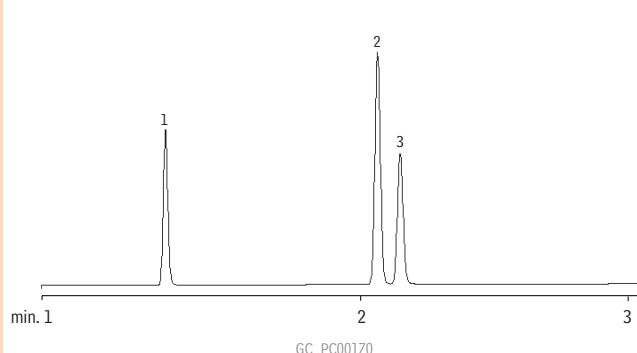


Column: Rt™-Msieve 5A, 30m, 0.53mm ID, 50 μ m (cat.# 19723)
 Sample: permanent gases (ppm)
 Inj.: 5 μ L sample loop, 6-port Valco valve, valve temp.: ambient
 Inj. temp.: 200°C
 Carrier gas: helium, constant flow
 Linear velocity: 5mL/min.
 Oven temp.: 27°C (hold 5 min.) to 100°C @ 10°C/min. (hold 5 min.)
 Det.: Valco helium ionization detector @ 150°C

new!**Permanent Gases****Rt™-MSieve 5A**

(PLOT)

1. hydrogen, 29.1 ppm
2. argon, 53.4 ppm
3. oxygen, 31.3 ppm

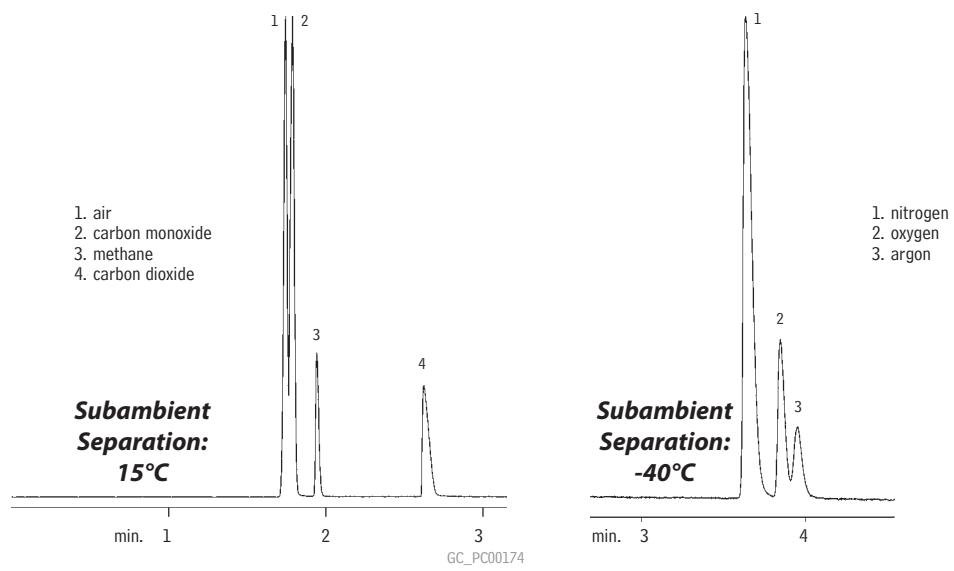


Column: Rt™-Msieve 5A, 30m, 0.53mm ID, 50 μ m (cat.# 19723)
 Sample: 0.5mL (sample loop injection)
 Column temp.: 27°C
 Carrier gas: helium
 Linear velocity: 34cm/sec.
 Det.: Valco HID

Chromatogram courtesy of Larry McElmurry, Mobile Analytical Labs.

Permanent Gases**Rt™-QPLOT**

(PLOT)



Rt™-QPLOT, 30m, 0.32mm ID (cat.# 19718)

Sample conc.: 2-5 mol%
 Det.: TCD
 Inj./det. temp.: 100°C/150°C
 Carrier gas: hydrogen
 Linear velocity: 34cm/sec.
 Split flow: 40:1

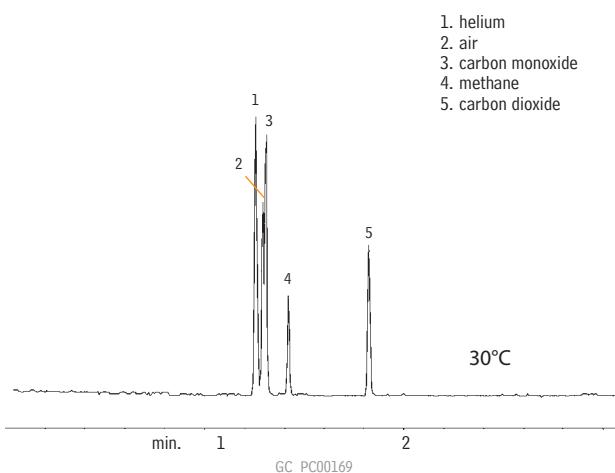
Sample conc.: 2-5 mol%
 Det.: TCD
 Inj./det. temp.: 100°C/150°C
 Carrier gas: hydrogen
 Linear velocity: 20cm/sec.
 Split flow: 40:1

Permanent Gases; Chlorofluorocarbon Gases; Hydrocarbon Gases

Permanent Gases

RtTM-QPLOT

(PLOT)



Column: RtTM-QPLOT, 30m, 0.32mm ID (cat.# 19718)
Sample: 30 μ L split injection (40:1), 2-5 mol%
Column temp.: 30°C
Inj. temp.: 30°C
Det.: HP μ TCD
Det. temp.: 200°C
Carrier gas: hydrogen
Linear velocity: 38cm/sec.
Split flow: 40:1

Chlorofluorocarbon Gases

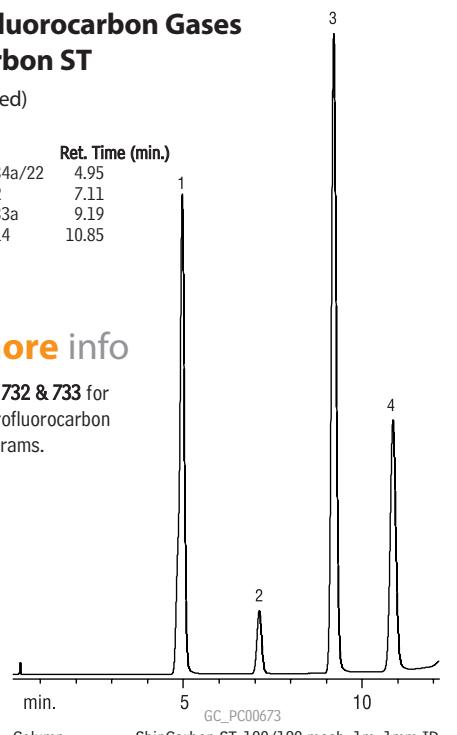
ShinCarbon ST

(micropacked)

Peak	Ret. Time (min.)
1. Freon® 134a/22	4.95
2. Freon® 12	7.11
3. Freon® 133a	9.19
4. Freon® 114	10.85

for more info

see pages 732 & 733 for
more chlorofluorocarbon
chromatograms.

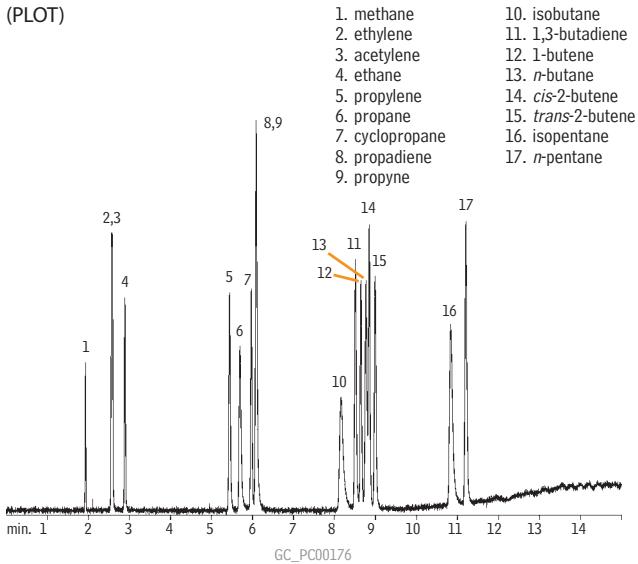


Column: ShinCarbon ST, 100/120 mesh, 1m, 1mm ID Silcosteel® micropacked column (cat.# 19809)
Sample: fluorocarbon blend, 5 μ L ~1-3% each
Inj. temp.: 200°C
Det.: FID @ 250°C
Carrier gas: helium
Linear velocity: 10mL/min.
Oven temp.: 125°C to 320°C @ 16°C/min.

Hydrocarbon Gases

RtTM-QPLOT

(PLOT)

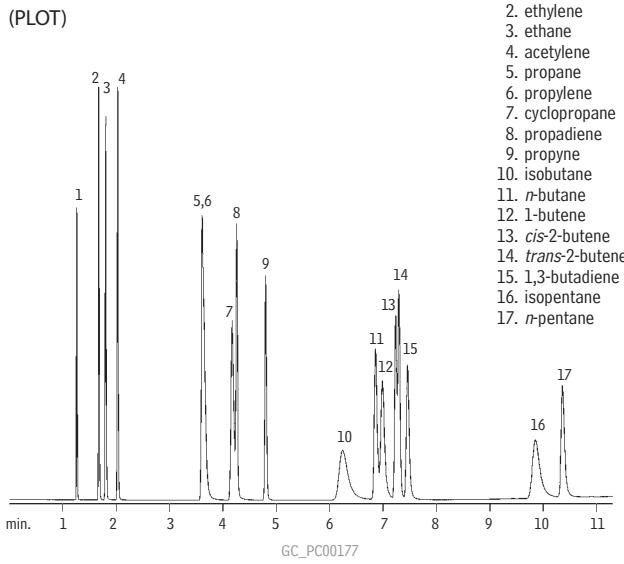


Column: RtTM-QPLOT, 30m, 0.32mm ID (cat.# 19718)
Inj.: 300 μ L split injection (40:1), 1000ppm
Oven temp.: 50°C (2 min.) to 220°C @ 15°C/min.
Inj./det. temp.: 250°C
Carrier gas: helium
Linear velocity: 42cm/sec. set @ 80°C (5.6mL/min.)
Split flow: 40mL/min.
FID sensitivity: 1.28 x 10⁻¹⁰ AFS

Hydrocarbon Gases

RtTM-UPLOT

(PLOT)

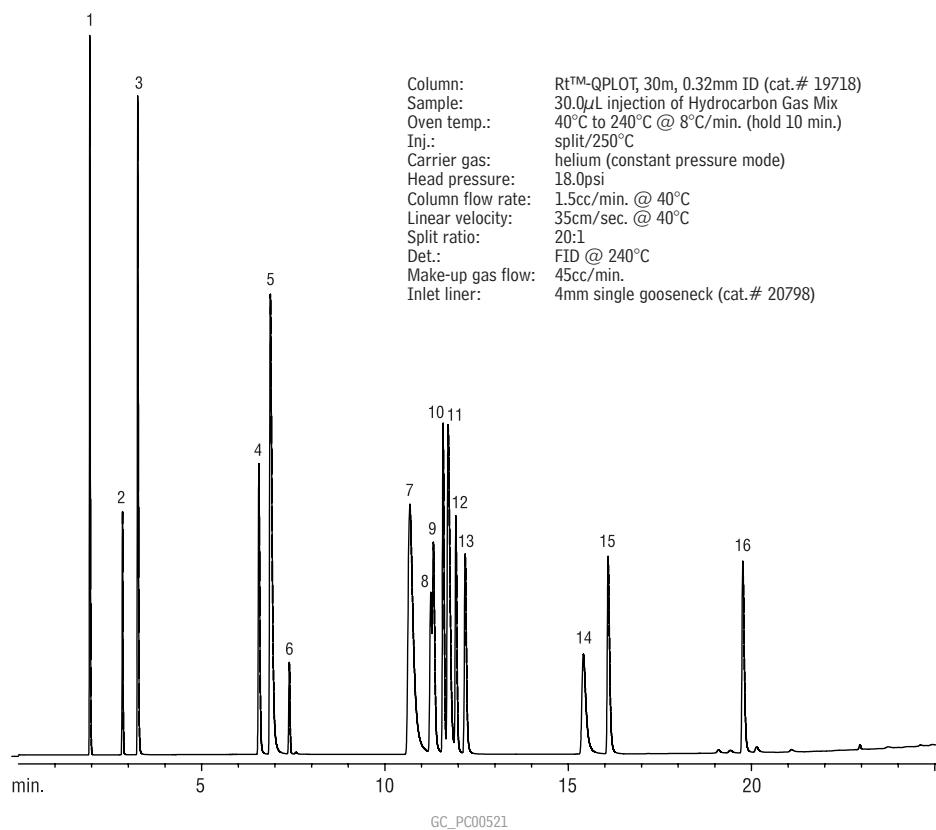


Column: RtTM-UPLOT, 30m, 0.32mm ID (cat.# 19724)
Inj.: 300 μ L split injection (40:1), 1000ppm
Oven temp.: 50°C to 190°C @ 10°C/min.
Inj./det. temp.: 250°C
Carrier gas: helium
Linear velocity: 42cm/sec. set @ 80°C (5.6mL/min.)
Split flow: 40mL/min.
FID sensitivity: 1.28 x 10⁻¹⁰ AFS

Hydrocarbon Gases**RtTM-QPLOT**

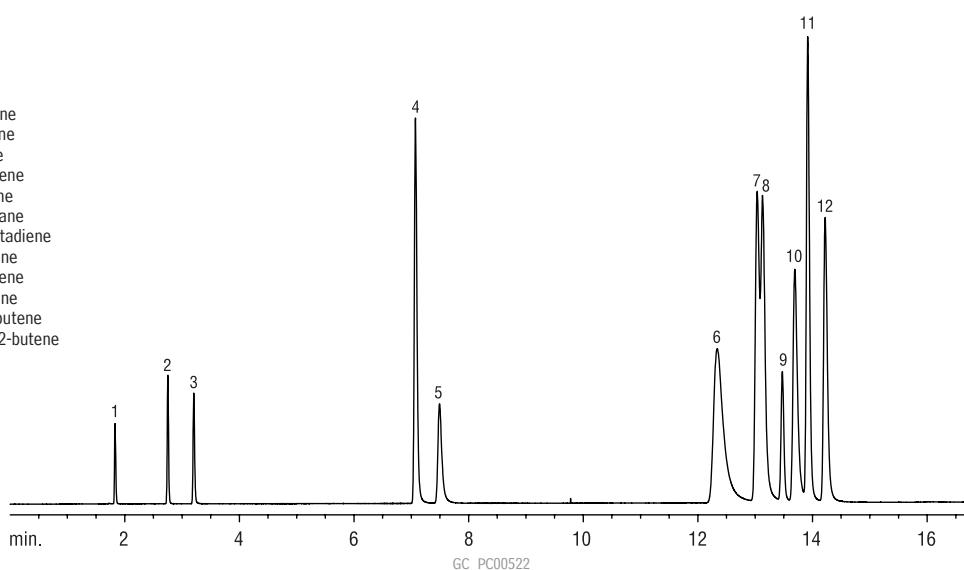
(PLOT)

1. methane
2. ethene
3. ethane
4. propene
5. propane
6. propadiene
7. isobutane
8. 1,3-butadiene
9. 1-butene
10. isobutene
11. n-butane
12. cis-2-butene
13. trans-2-butene
14. isopentane
15. n-pentane
16. n-hexane

**Hydrocarbon Gases****RtTM-QPLOT**

(PLOT)

1. methane
2. ethylene
3. ethane
4. propylene
5. propane
6. isobutane
7. 1,3-butadiene
8. 1-butene
9. isobutene
10. n-butane
11. cis-2-butene
12. trans-2-butene



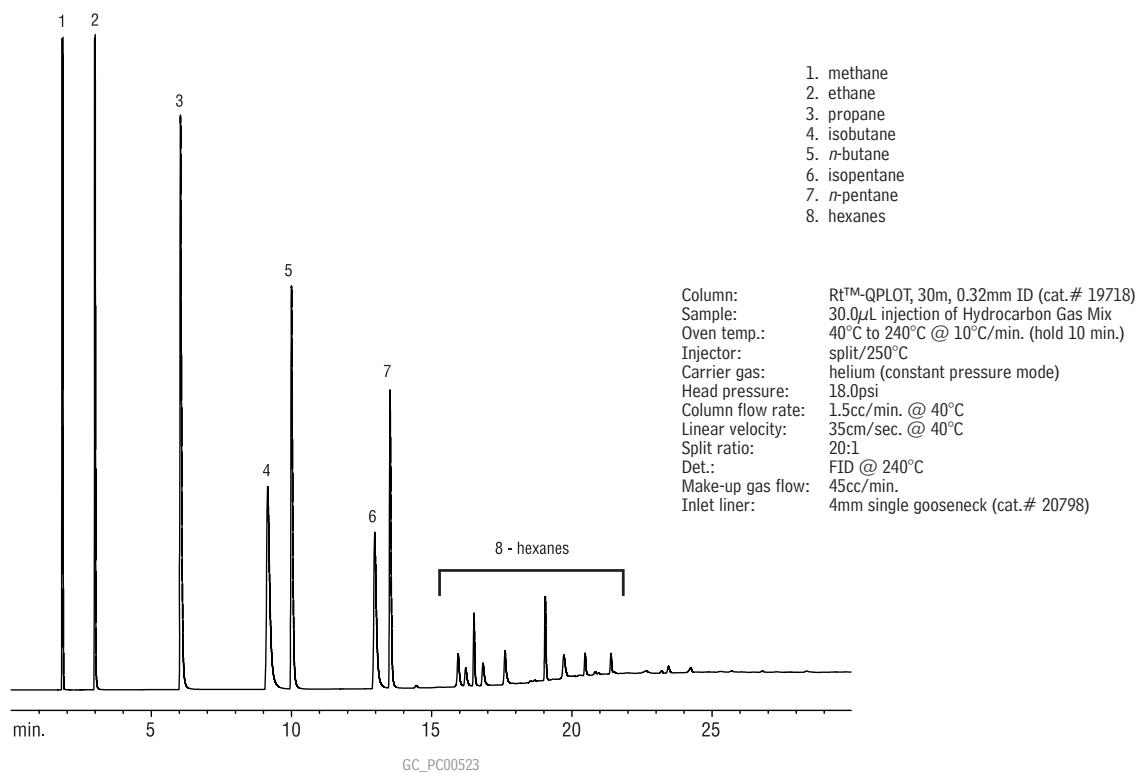
Column: RtTM-QPLOT, 30m, 0.32mm ID (cat.# 19718)
 Sample: 30.0 μ L injection of Hydrocarbon Gas Mix
 Oven temp.: 35°C to 240°C @ 10°C/min. (hold 10 min.)
 Injector: split/250°C
 Carrier gas: helium (constant pressure mode)
 Head pressure: 18.0psi
 Column flow rate: 1.5cc/min. @ 40°C
 Linear velocity: 35cm/sec. @ 40°C
 Split ratio: 20:1
 Det.: FID @ 240°C
 Make-up gas flow: 45cc/min.
 Inlet liner: 4mm single gooseneck (cat.# 20798)

Hydrocarbon Gases

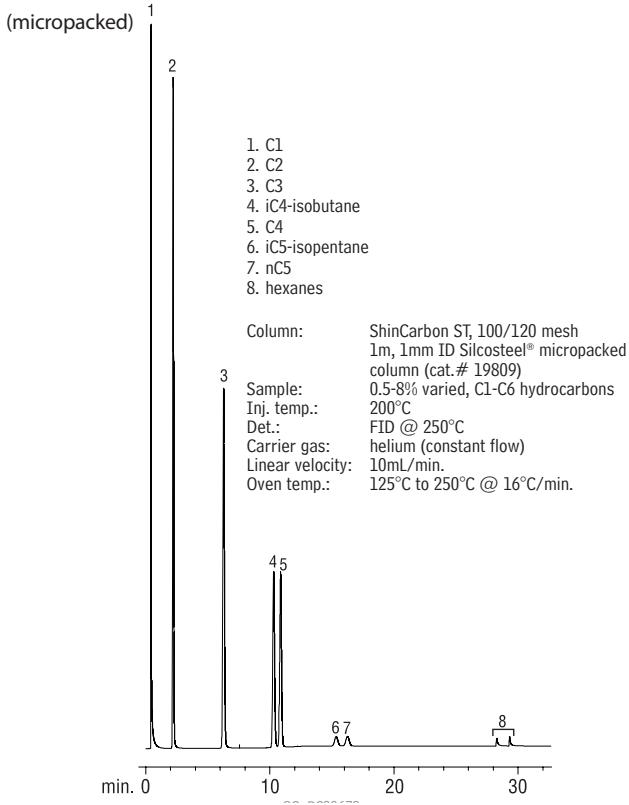
Hydrocarbon Gases

Rt™-QPLOT

(PLOT)



Natural Gas ShinCarbon ST



free literature

ShinCarbon ST Micropacked GC Columns: Above-Ambient Analyses of Permanent Gases and Light Hydrocarbons

A ShinCarbon ST micropacked column will separate hydrogen, oxygen, nitrogen, carbon dioxide, carbon monoxide, and methane in 10 minutes, without cryogenic cooling—a separation that has been impossible for a single GC or GSC column without subambient temperature. The 2-page note also shows separations of light hydrocarbon/permanent gas mixtures, natural gas components, sulfur dioxide, and fluorocarbons—all obtained using a 1-meter or 2-meter micropacked column and above-ambient initial temperatures.

Download your free copy from www.restek.com.

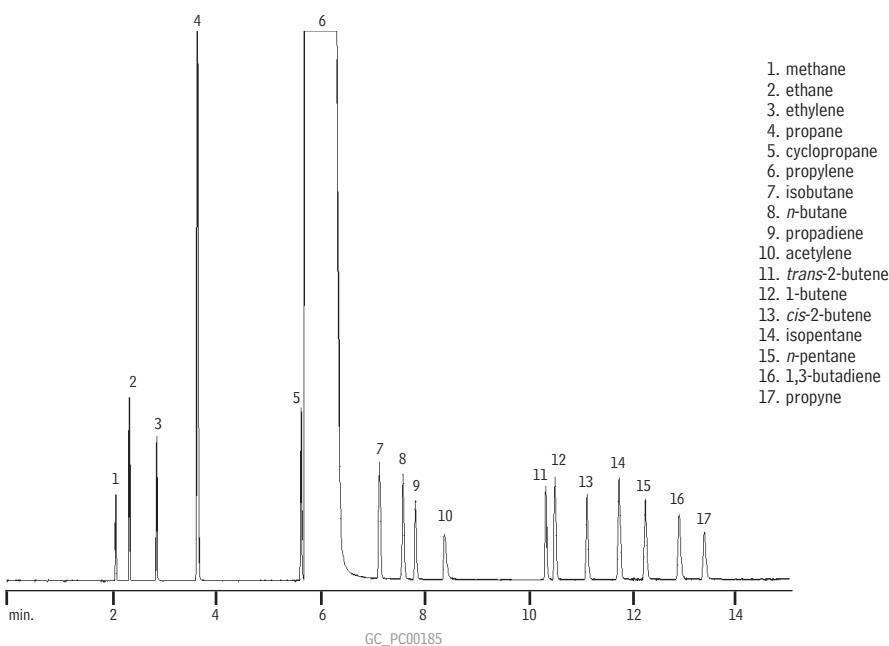
Applications Note
lit. cat.# 59519A

Hydrocarbon Gases; Hydrocarbons

Propylene Purity

RtTM-Alumina

(PLOT)

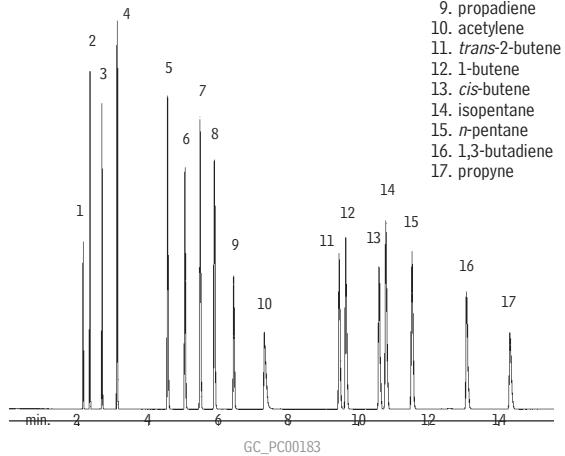


- 1. methane
- 2. ethane
- 3. ethylene
- 4. propane
- 5. cyclopropane
- 6. propylene
- 7. isobutane
- 8. n-butane
- 9. propadiene
- 10. acetylene
- 11. trans-2-butene
- 12. 1-butene
- 13. cis-2-butene
- 14. isopentane
- 15. n-pentane
- 16. 1,3-butadiene
- 17. propyne

Refinery Gas

Rt-Alumina™

(PLOT)

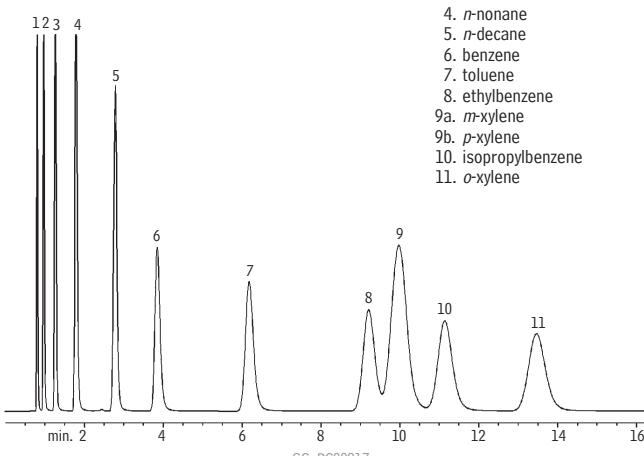


- 1. methane
- 2. ethane
- 3. ethylene
- 4. propane
- 5. cyclopropane
- 6. propylene
- 7. isobutane
- 8. n-butane
- 9. propadiene
- 10. acetylene
- 11. trans-2-butene
- 12. 1-butene
- 13. cis-butene
- 14. isopentane
- 15. n-pentane
- 16. 1,3-butadiene
- 17. propyne

Aromatics, Aliphatics

10% TCEP 100/120 Chromosorb® PAW

(packed)



- 1. n-hexane
- 2. n-heptane
- 3. n-octane
- 4. n-nonane
- 5. n-decane
- 6. benzene
- 7. toluene
- 8. ethylbenzene
- 9a. m-xylene
- 9b. p-xylene
- 10. isopropylbenzene
- 11. o-xylene

Column: RtTM-Alumina, 50m, 0.53mm ID (cat.# 19701)
 Inj.: 100µL hydrocarbon mix split injection, 1000ppm
 (gas-tight syringe)
 Oven temp.: 40°C to 120°C @ 5°C/min. (hold 5 min.)
 Inj./det. temp.: 200°C
 Carrier gas: helium
 Linear velocity: 37.5cm/sec. set @ 80°C (5.0mL/min.)
 Split flow: 60mL/min.
 FID sensitivity: 1.28 x 10⁻¹⁰ AFS

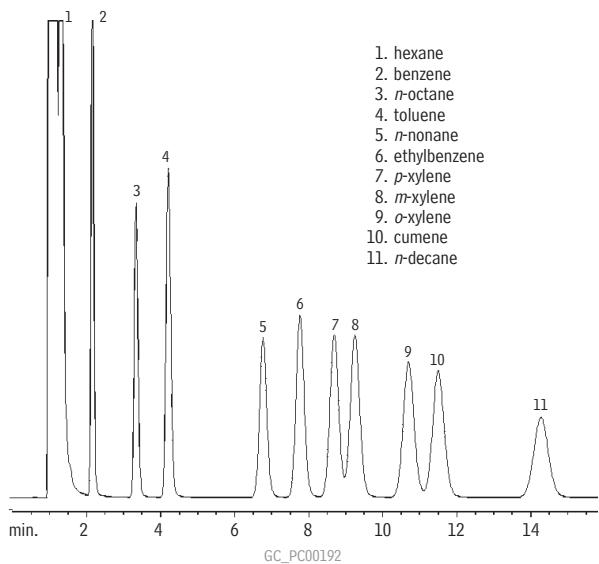
Column: 10% TCEP on 100/120 Chromosorb® PAW,
 2.5m, 1/8" OD, 2mm ID SilcoSmooth™
 tubing (cat.# 80126)
 Sample size: 0.1mL neat
 Oven temp.: 80°C
 Inj./det. temp.: 200°C/250°C
 Carrier gas: nitrogen
 Flow rate: 20mL/min.
 FID sensitivity: 128 x 10⁻¹⁰ AFS

Hydrocarbons

Aromatics (Xylene Isomers plus Cumene)

5% RtTM-1200/1.75% Bentone[®] 34

(packed)

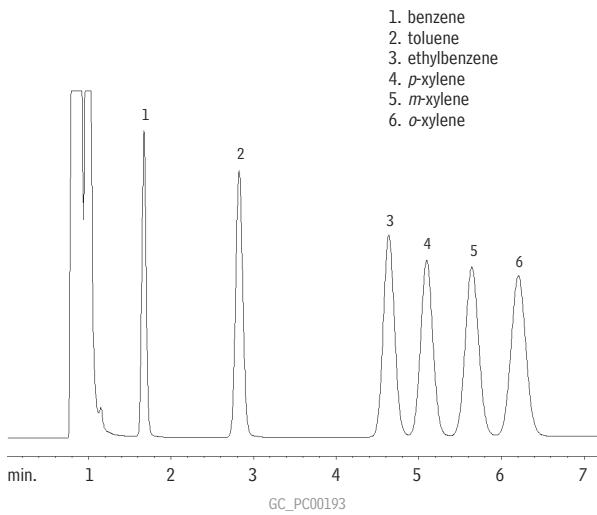


Column: 5% RtTM-1200/1.75% Bentone[®] 34 on 100/120 SilcoportTM, 1.8m, $\frac{1}{4}$ " OD, 2mm ID SilcoSmoothTM tubing (cat.# 80125)
Sample size: 0.1 μ L
Conc.: 0.5 μ g/ μ L in hexane
Oven temp.: 75°C
Inj./det. temp.: 200°C
Carrier gas: nitrogen
Flow rate: 20mL/min.
FID sensitivity: 32×10^{-11} AFS

Aromatics (Xylene Isomers /BTEX)

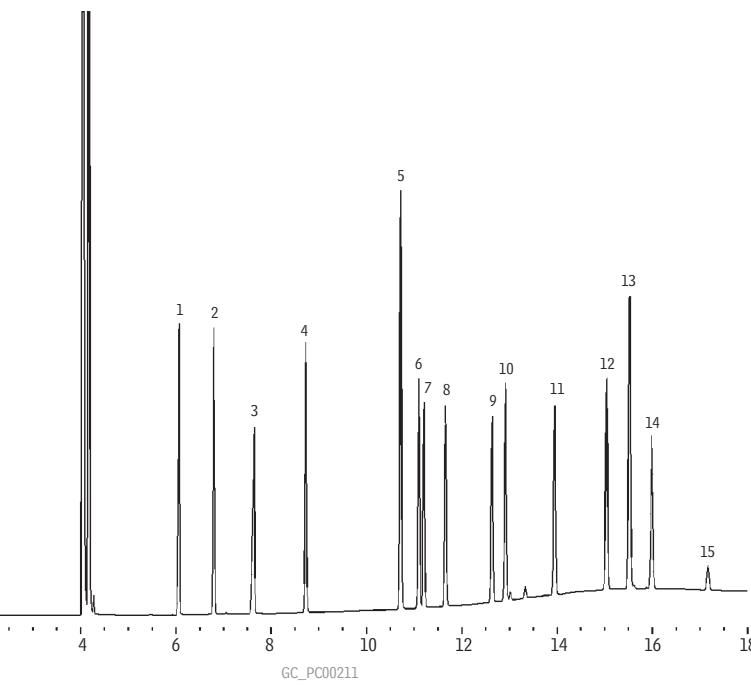
5% RtTM-1200/5% Bentone[®] 34

(packed)

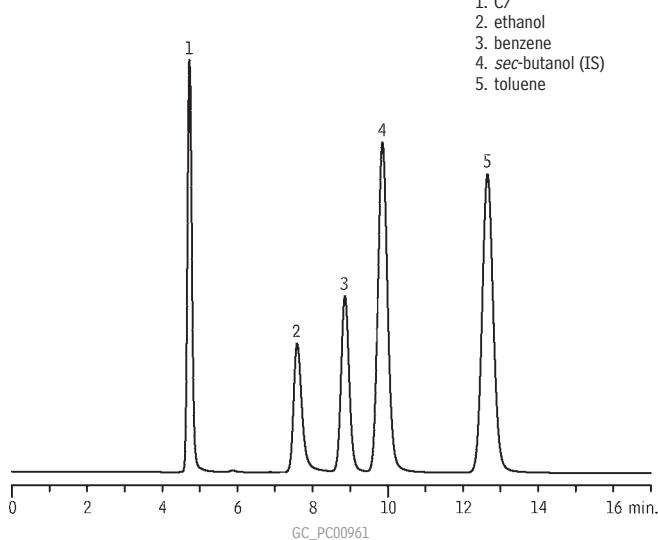


Column: 5% RtTM-1200/5% Bentone[®] 34 100/120 SilcoportTM, 2m, $\frac{1}{8}$ " OD, 2mm ID SilcoSmoothTM tubing (cat.# 80129)
Sample size: 0.1 μ L
Conc.: 0.5 μ g/ μ L in hexane
Oven temp.: 100°C
Inj./det. temp.: 200°C
Carrier gas: nitrogen
Flow rate: 20mL/min.
FID sensitivity: 32×10^{-11} AFS

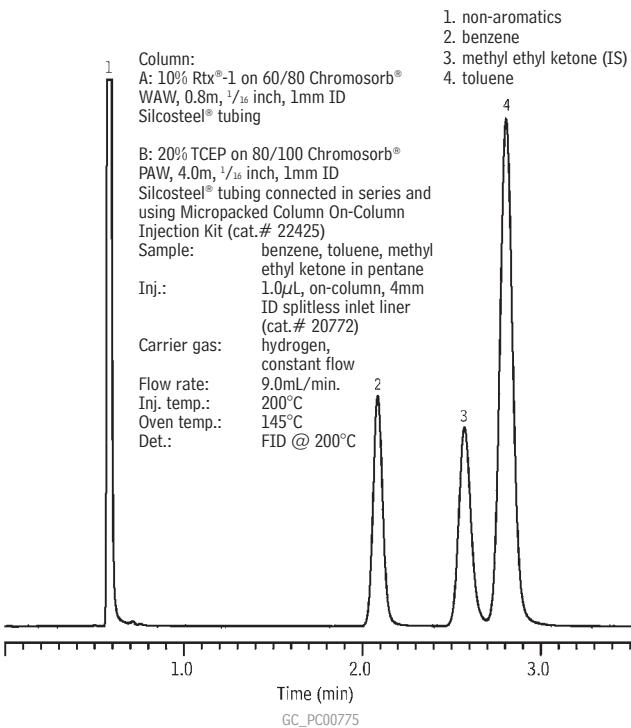
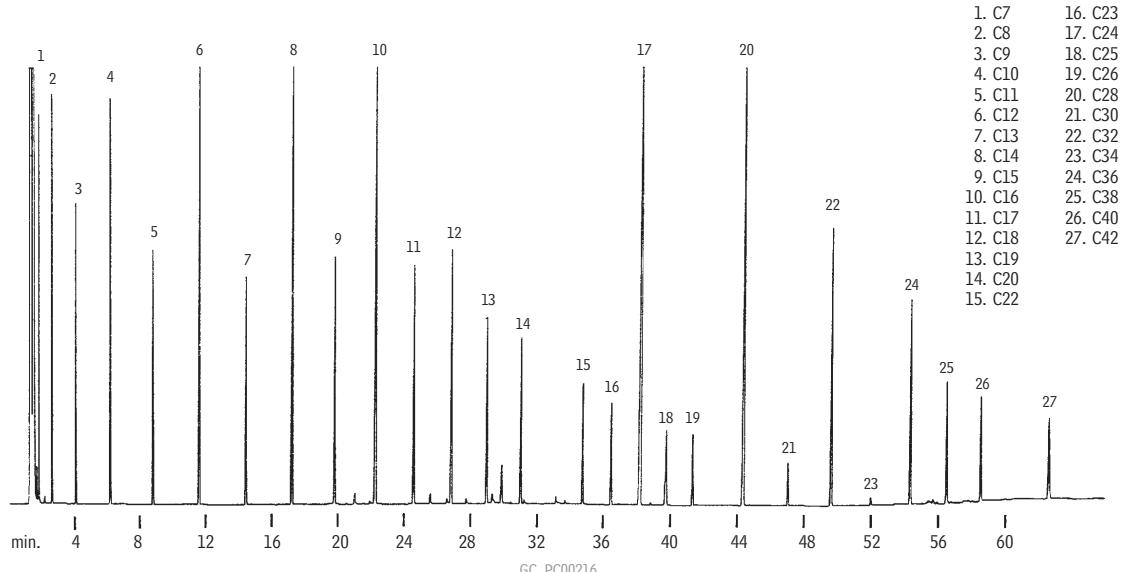
Aromatics RtTM-TCEP



Column: RtTM-TCEP, 60m, 0.25mm ID, 0.40 μ m (cat.# 10999)
Inj.: 1.0 μ L split injection, components @ 500ppm (ethylbenzene @ 1000ppm)
Oven temp.: 60°C (hold 5 min.) to 100°C @ 5°C/min. (hold 10 min.)
Inj./det. temp.: 200°C
Carrier gas: helium
Linear velocity: 30cm/sec. set @ 80°C
FID sensitivity: 6.4×10^{-11} AFS
Split flow: 46mL/min.

**Spark Ignition Fuel Aromatics
D3606 Column Set**


Column: D3606 Column Set
column 1: 6' x 1/4" OD (1.8m x 2mm ID), nonpolar Rtx®-1 polymer
column 2: 16' x 1/4" OD (4.9m x 2mm ID), proprietary packing
Sample: 0.05µg/µL; C7 (26%), ethanol (10%), benzene(10%), sec-butanol (26%),
toluene (26%)
Inj.: 0.05µL, direct injection
Inj. temp.: 200°C
Carrier gas: helium, constant flow
Flow rate: 20mL/min.
Oven temp.: 135°C, isothermal
Det.: FID @ 250°C

new!
**Motor Oil & Aviation Gas
ASTM Method D3606-99
10% Rtx®-1 & 20% TCEP
(micropacked)**

**Hydrocarbons, C7-C42
Rtx®-1**


min. 1 4 8 12 16 20 24 28 32 36 40 44 48 52 56 60

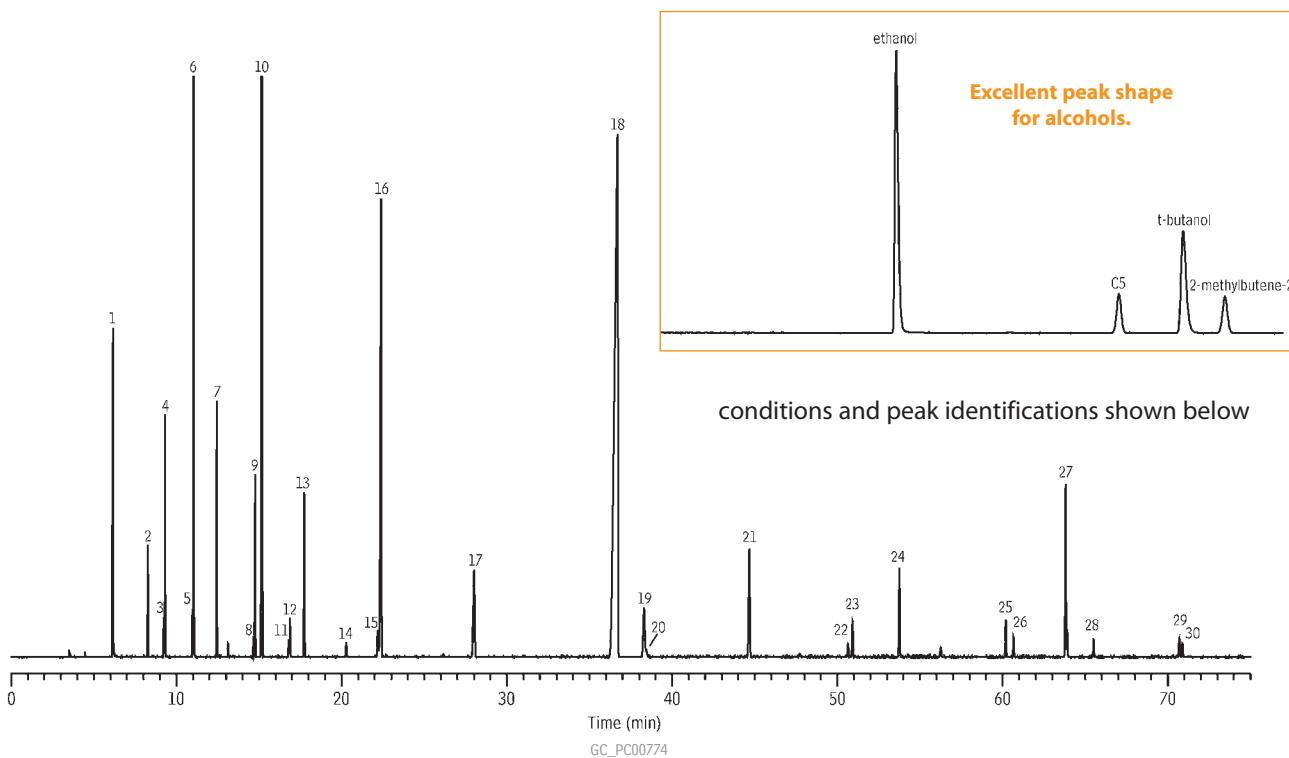
GC_PC00216

Column: Rtx®-1, 30m, 0.53mm ID, 0.25µm (cat.# 10125)
Sample: 0.2µL injection of a synthetic hydrocarbon mix,
~ 0.1mg/ml. per component
Inj.: Direct injection using a Uniliner® inlet liner
Oven temp.: 40°C to 340°C @ 5°C/min.
Inj./det. temp.: 340°C
Carrier gas: hydrogen
Linear velocity: 40cm/sec. set @ 40°C
FID sensitivity: 64 x 10⁻¹¹ AFS

Hydrocarbons

Fast Detailed Hydrocarbons Analysis (DHA)

Rtx®-1PONA/Rtx®-5PONA



Detailed Hydrocarbons Analysis (DHA) Rtx®-1PONA/Rtx®-5PONA

Column: Rtx®-1PONA, 100m, 0.25mm ID, 0.5 μ m (cat. # 10195) plus Rtx®-5PONA tuning column, 2.62m, 0.25mm ID, 1.0 μ m, connected via Press-Tight® connector (cat. # 20446)

Sample: custom detailed hydrocarbons analysis (DHA) mix, neat

Inj.: 0.01 μ L, split (split ratio 150:1), 4mm cup inlet liner (cat. # 20709)

Inj. temp.: 200°C

Carrier gas: helium, constant flow

Linear velocity: 28cm/sec. (2.3mL/min.)

Oven temp.: 35°C

Det.: FID @ 250°C

C5 efficiency: 613,596 total theoretical plates

k' (C5): 0.489

tert-butanol skewness: 1.25

Resolution (tert-butanol/2-methylbutene-2): 5.60

1. ethanol
2. C5
3. tert-butanol
4. 2-methylbutene-2

Column: Rtx®-1PONA 100m, 0.25mm ID, 0.5 μ m (cat. # 10195) plus Rtx®-5PONA tuning column (cat. # 10196), connected via angled Press-Tight® connector (cat. # 20446)

DHA/oxygenates setup blend

Inj.: 0.01 μ L, split (split ratio 150:1), 4mm ID cup inlet liner (cat. # 20709)

A: front slice of DHA/oxygenates setup blend

B: DHA/oxygenates setup blend

Carrier gas: hydrogen, constant flow (3.62cc/min.)

Linear velocity: 55cm/sec.

Inj. temp.: 250°C

Oven temp.: A: 35°C

B: 5°C (hold 8.32 min.) (elute C5) to 48°C @ 22°C/min. (hold 26.32 min.) (elute ethylbenzene) to 141°C @ 3.20°C/min. (no hold) (elute C12) to 300°C @ 1°C/min.

Det.: FID @ 300°C

A: Front end of DHA/oxygenates setup blend

C5 efficiency: 586,825 plates

C5 k': 0.476

tert-butanol skew: 2.10

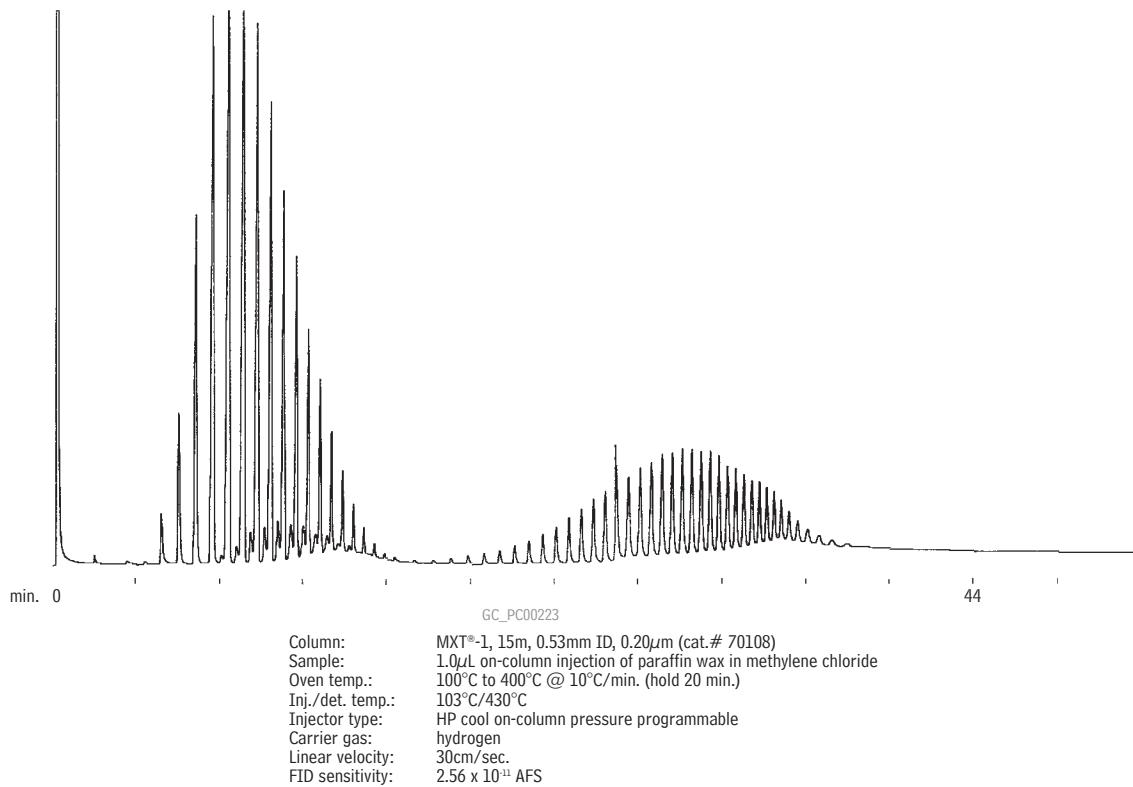
Resolution tert-butanol/2-methylbutene-2: 5.39

B: DHA/oxygenates setup blend

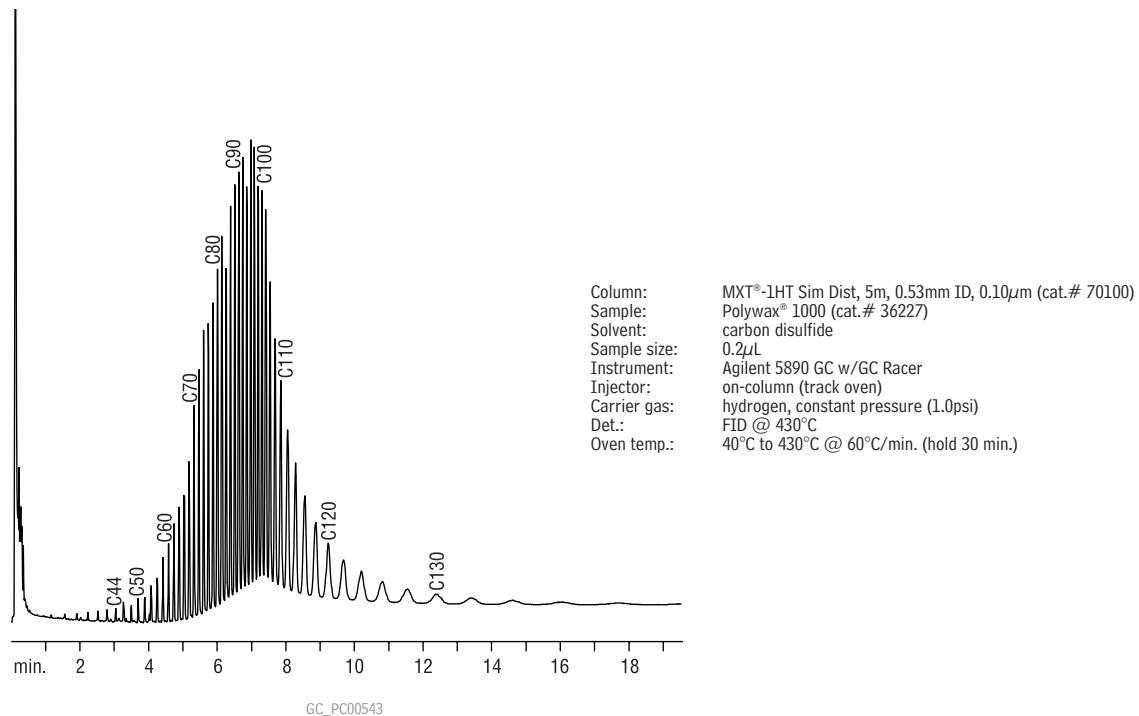
1. ethanol
2. C5
3. tert-butanol
4. 2-methylbutene-2
5. 2,3-dimethylbutane
6. methyl tert-butyl ether (MTBE)
7. C6
8. 1-methylcyclopentene
9. benzene
10. cyclohexane
11. 3-ethylpentane
12. 1,2-dimethylcyclopentane
13. C7
14. 2,2,3-trimethylpentane
15. 2,3,3-trimethylpentane
16. toluene
17. C8
18. ethylbenzene
19. p-xylene
20. 2,3-dimethylheptane
21. C9
22. 5-methylnonane
23. 1,2-methylethylbenzene
24. C10
25. C11
26. 1,2,3,5-tetramethylbenzene
27. naphthalene
28. C12
29. 1-methylnaphthalene
30. C13

Chromatogram courtesy of Neil Johansen, Inc., Aztec, New Mexico, in association with Envantage Analytical Software, Inc., Cleveland, Ohio.

**Hydrocarbons (High Temperature Petroleum Wax)
MXT®-1**

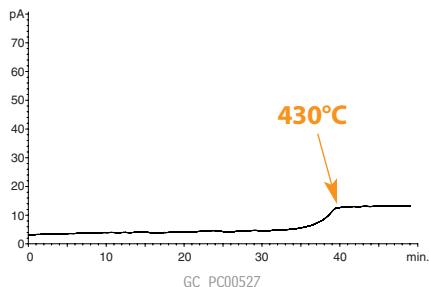


**Hydrocarbons (C44-C130)
MXT®-1HT Sim Dist**



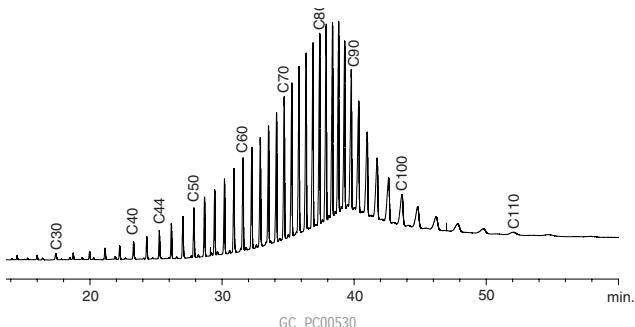
Hydrocarbons

Bleed Profile MXT®-1HT Sim Dist



Column: MXT®-1HT Sim Dist, 5m, 0.53mm ID, 0.10 μ m (cat.# 70100)
 Oven temp.: 40°C to 430°C @ 10°C/min. (hold 30 min.)
 Injector: on-column (track oven)
 Carrier gas: helium (constant pressure)
 Head pressure: 1.0psi
 Linear velocity: 60cm/sec.
 Flow rate: 7.8mL/min.
 Det.: FID @ 430°C
 Make-up gas flow: 40cc/min.

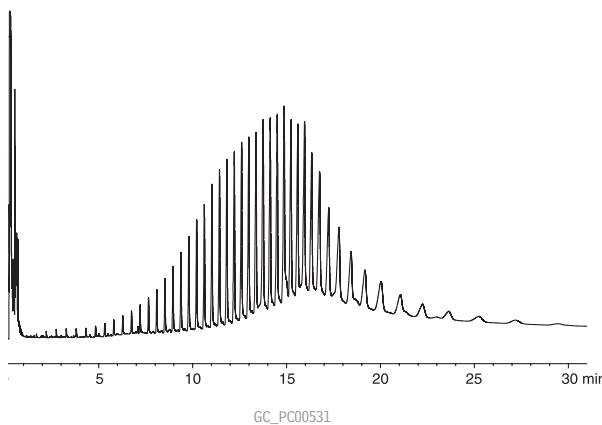
Hydrocarbons (C30-C110) MXT®-1HT Sim Dist



Column: MXT®-1HT Sim Dist, 5m, 0.53mm ID, 0.10 μ m (cat.# 70100)
 Sample: 0.2 μ L Polywax® 1000 standard (cat.# 36227)
 Solvent: carbon disulfide
 Oven temp.: 40°C to 430°C @ 10°C/min. (hold 30 min.)
 Injector: on-column (track oven)
 Carrier gas: helium (constant pressure)
 Head pressure: 1.0psi
 Linear velocity: 60cm/sec.
 Flow rate: 7.8mL/min.
 Det.: FID @ 430°C
 Make-up gas flow: 40cc/min.

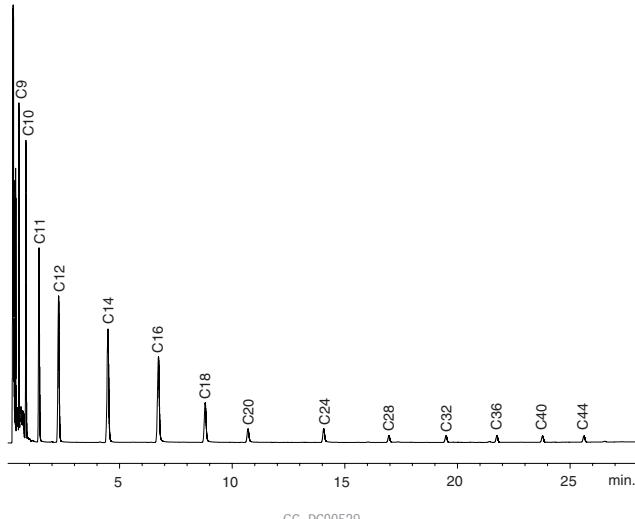
Hydrocarbons (C44-C100) MXT®-1HT Sim Dist

(fast GC)



Column: MXT®-1HT Sim Dist, 5m, 0.53mm ID, 0.10 μ m (cat.# 70100)
 Sample: 0.2 μ L injection of Polywax® 1000
 Solvent: carbon disulfide
 Oven temp.: 40°C to 430°C @ 60°C/min. (hold 25 min.)
 Injector: on-column (track oven)
 Carrier gas: helium (constant pressure)
 Head pressure: 1.0psi
 Linear velocity: 60cm/sec.
 Flow rate: 7.8mL/min.
 Det.: FID @ 430°C
 Make up gas flow: 40cc/min.

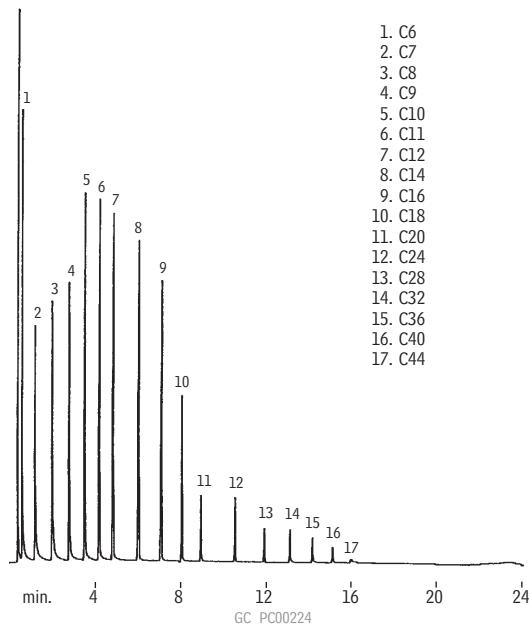
Hydrocarbons (C10-C44) MXT®-1HT Sim Dist



Column: MXT®-1HT Sim Dist, 5m, 0.53mm ID, 0.10 μ m (cat.# 70100)
 Sample: 0.2 μ L hydrocarbon standard (cat.# 31222)
 Solvent: carbon disulfide
 Oven temp.: 40°C to 430°C @ 10°C/min. (hold 30 min.)
 Injector: on-column (track oven)
 Carrier gas: helium (constant pressure)
 Head pressure: 1.0psi
 Linear velocity: 60cm/sec.
 Flow rate: 7.8mL/min.
 Det.: FID @ 430°C
 Make-up gas flow: 40cc/min.

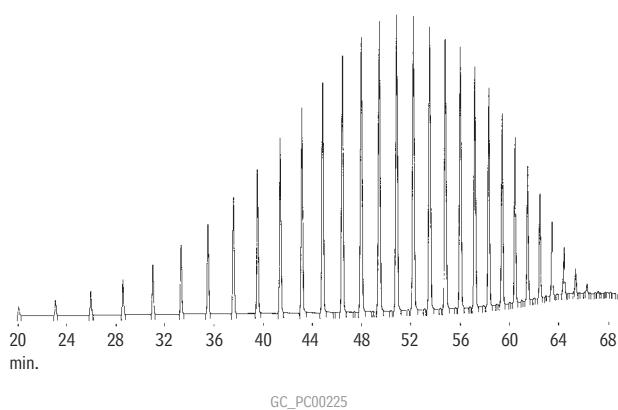
Hydrocarbons (Simulated Distillation)

Simulated Distillation (Standard Calibration) MXT®-1 Sim Dist



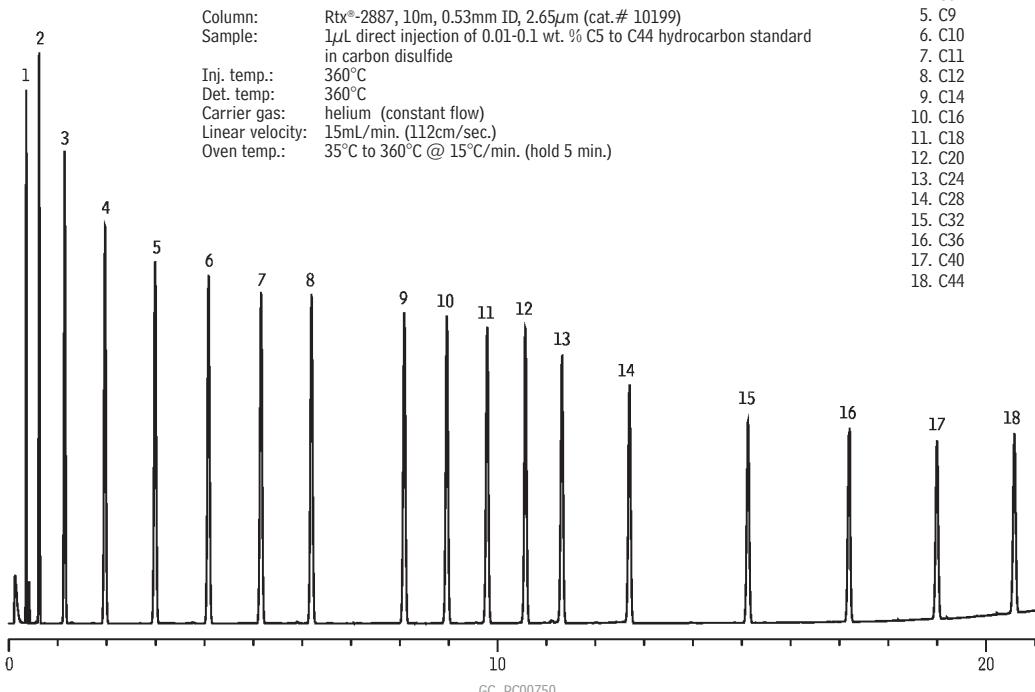
Column: MXT®-1 Sim Dist, 6m, 0.53mm ID, 0.15 μ m (cat.# 70101)
 Sample: Wet needle on-column injection of ASTM D2887 standard
 Oven temp.: -12°C to 430°C @ 20°C/min.
 Inj./det. temp.: -17°C to 433°C/430°C
 Carrier gas: hydrogen
 Linear velocity: 40cm/sec.
 FID sensitivity: 128 x 10⁻¹¹ AFS

Simulated Distillation (High-Temperature) MXT®-500 Sim Dist



Column: MXT®-500 Sim Dist, 6m, 0.53mm ID, 0.15 μ m (cat.# 70104)
 Sample: cold on-column injection of Polywax® 655 in CS₂
 Oven temp.: 40°C to 430°C @ 6°C/min.
 Carrier gas: helium
 Linear velocity: 40cm/sec.
 FID sensitivity: 2 x 10⁻¹¹ AFS

Simulated Distillation Rtx®-2887



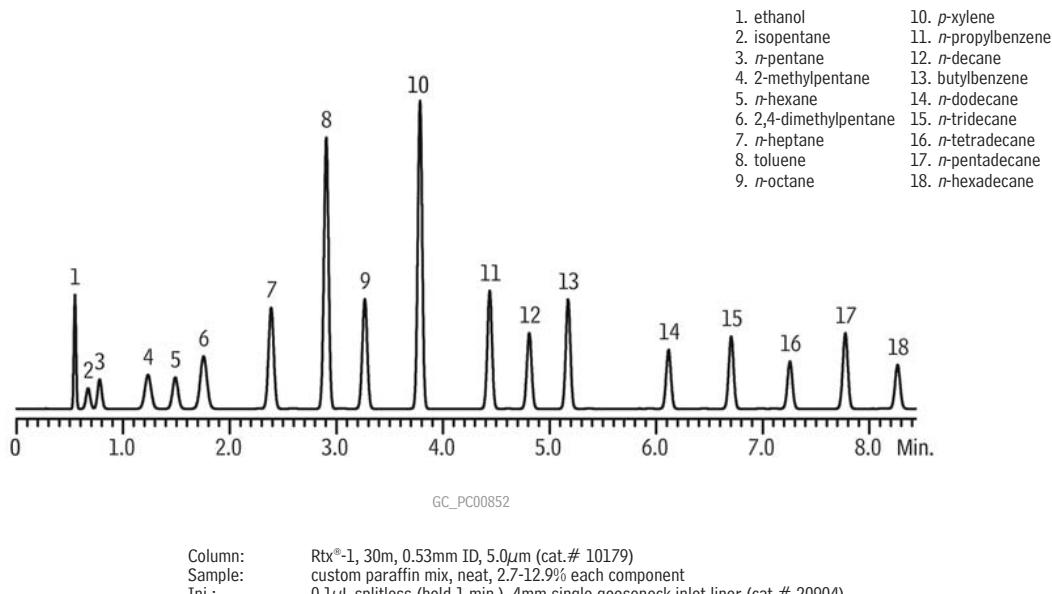
Column: Rtx®-2887, 10m, 0.53mm ID, 2.65 μ m (cat.# 10199)
 Sample: 1 μ L direct injection of 0.01-0.1 wt. % C5 to C44 hydrocarbon standard in carbon disulfide
 Inj. temp.: 360°C
 Det. temp.: 360°C
 Carrier gas: helium (constant flow)
 Linear velocity: 15mL/min. (112cm/sec.)
 Oven temp.: 35°C to 360°C @ 15°C/min. (hold 5 min.)

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

Hydrocarbons (Simulated Distillation)

Simulated Distillation

Rtx®-1 (Hydrogen Carrier Gas)

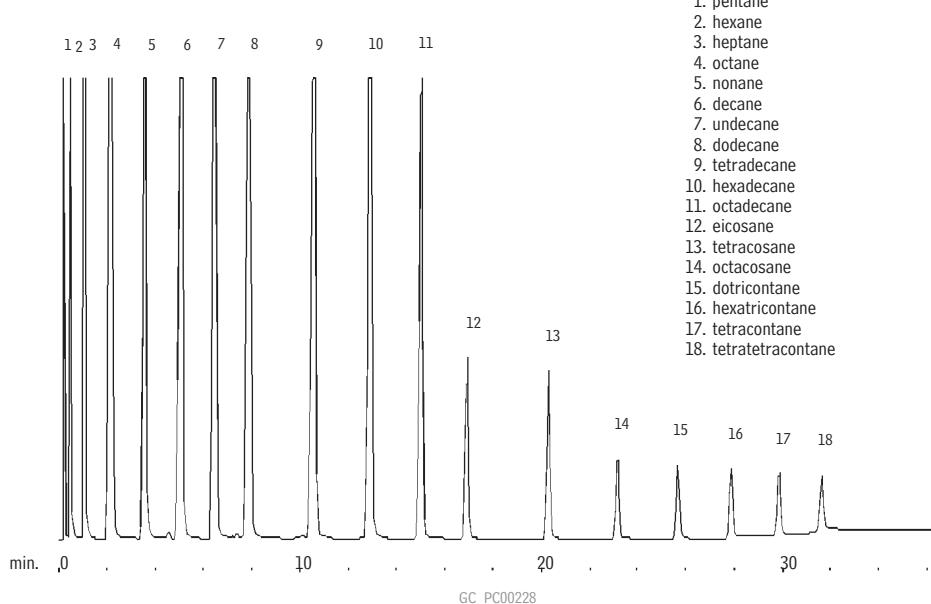


Column: Rtx®-1, 30m, 0.53mm ID, 5.0 μ m (cat.# 10179)
 Sample: custom paraffin mix, neat, 2.7-12.9% each component
 Inj.: 0.1 μ L splitless (hold 1 min.), 4mm single gooseneck inlet liner (cat.# 20904)
 Inj. temp.: 250°C
 Carrier gas: hydrogen, constant flow (Parker ChromGas® hydrogen generator)
 Linear velocity: 184cm/sec. @ 40°C
 Oven temp.: 40°C (1 min.) to 265°C @ 25°C/min. (hold 4 min.)
 Det.: FID @ 280°C

Simulated Distillation (ASTM D-2887)

Rtx®-1 SimDist 2887

(packed)



Column: Rtx®-1 SimDist 2887, SilcoSmooth™ stainless steel, 25", 1/8", 2mm ID (cat.# 80000)
 Inj.: 1.0 μ L direct injection, 1-12% (w/w) each component
 Oven temp.: 35°C to 350°C @ 10°C/min. (hold 5 min.)
 Inj./det. temp.: 350°C
 Carrier gas: helium @ 25mL/min.
 FID sensitivity: 256 x 10⁻¹¹ AFS

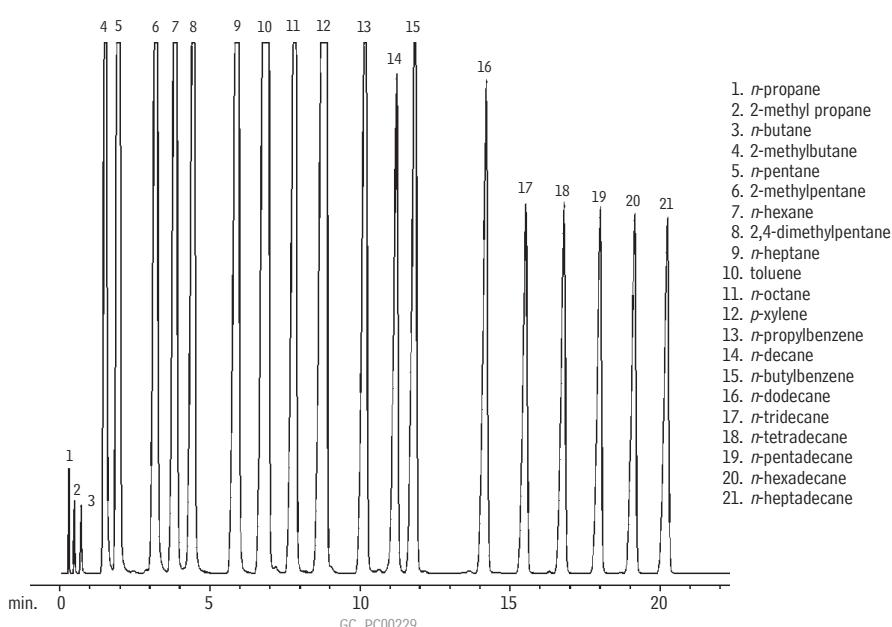
cat.# 31674 (1% each listed analyte in CS₂) and cat.# 31675 (5% each, neat)
 meet requirements of ASTM D2887-01.

Hydrocarbons (Simulated Distillation)

Simulated Distillation (ASTM D-3710 Calibration)

Rtx®-1 SimDist 2887

(packed)

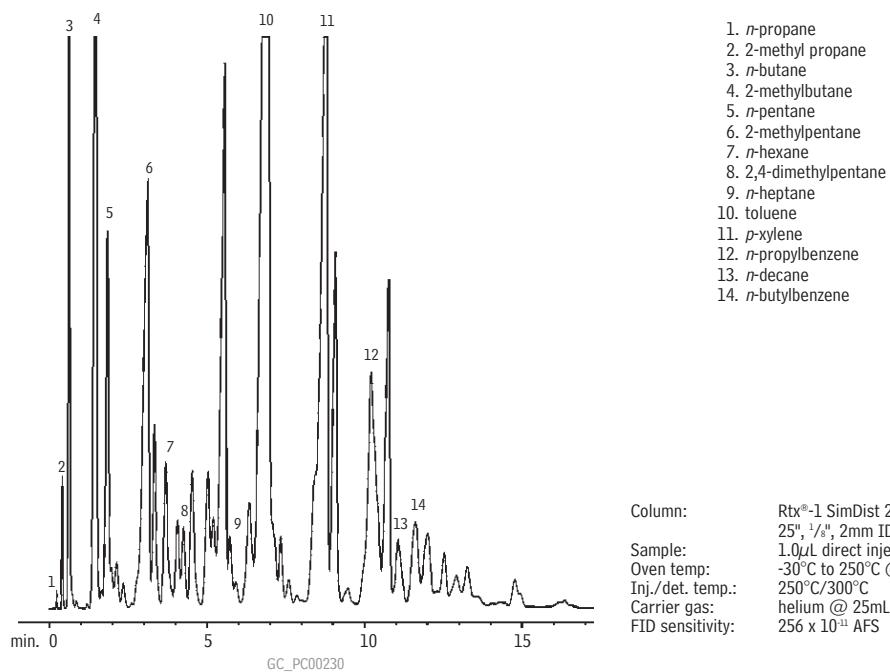


Column: Rtx®-1 SimDist 2887, SilcoSmooth™ stainless steel, 25", $\frac{1}{8}$ ", 2mm ID (cat.# 80000)
 Sample: D-3710 Calibration Mix, C3, C4, C16, & C17 added
 Oven temp: -30°C to 250°C @ 10°C/min.
 Inj./det. temp.: 250°C/300°C
 Carrier gas: helium @ 25mL/min.
 FID sensitivity: 256×10^{11} AFS

Simulated Distillation (ASTM D-3710, Gasoline)

Rtx®-1 SimDist 2887

(packed)

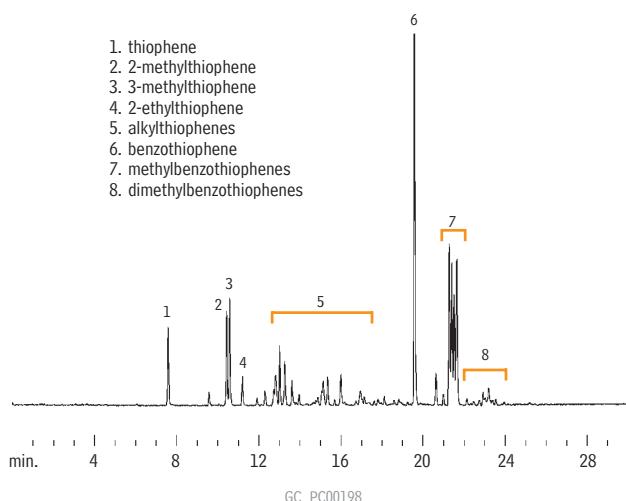


Column: Rtx®-1 SimDist 2887, SilcoSmooth™ stainless steel, 25", $\frac{1}{8}$ ", 2mm ID (cat.# 80000)
 Sample: 1.0 μ L direct injection of unleaded gasoline (ASTM D-2887)
 Oven temp: -30°C to 250°C @ 10°C/min.
 Inj./det. temp.: 250°C/300°C
 Carrier gas: helium @ 25mL/min.
 FID sensitivity: 256×10^{11} AFS

Sulfur Compounds

Sulfur in Gasoline

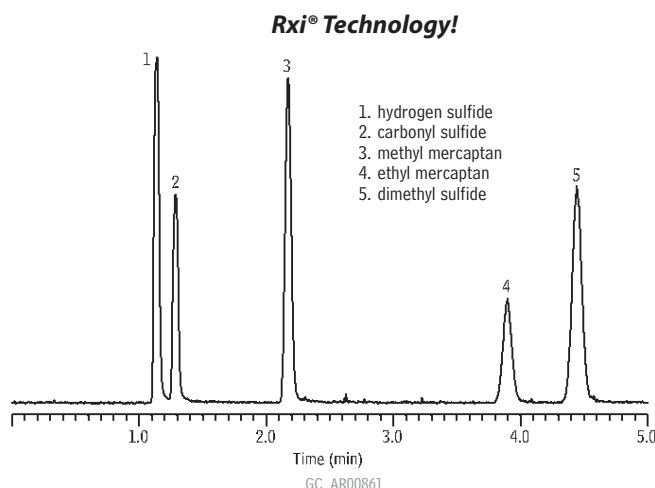
Rtx®-1



Column: Rtx®-1, 30m, 0.32mm ID, 4.0 μ m (cat.# 10198)
 Sample: 1.0 μ L split injection of gasoline containing 300ppm total sulfur
 Oven temp.: 40°C (hold 3 min.) to 275°C @ 10°C/min. (hold 5 min.)
 Inj./det. temp.: 275°C
 Det.: SCD
 Carrier gas: helium
 Linear velocity: 70cm/sec. (flow rate: 2.5mL/min.)
 Split ratio: 10:1

Sulfur Compounds

Rxi®-1ms



Column: Rxi®-1ms, 30m, 0.32mm ID, 4.00 μ m (cat.# 13396)
 Sample: hydrogen sulfide, carbonyl sulfide, methyl mercaptan, ethyl mercaptan, dimethyl sulfide, 100 ppbv each in helium

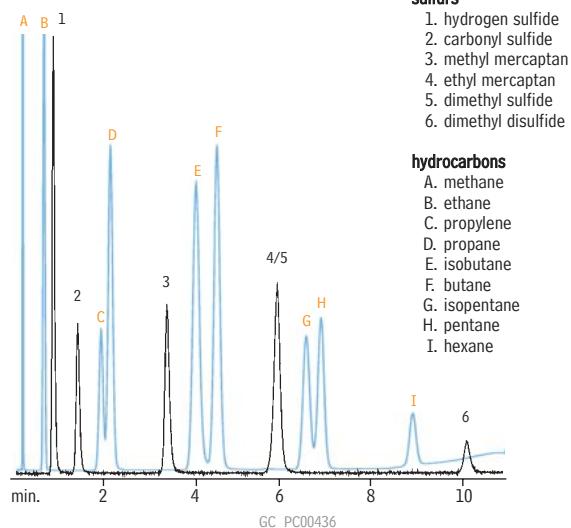
Inj.: 1mL splitless, direct
 Sample loop temp.: 30°C
 Carrier gas: helium, constant pressure
 Linear velocity: 48cm/sec. @ 30°C
 Oven temp.: 30°C
 Det.: sulfur chemiluminescence detector
 Det. temp.: 800°C

Sample storage & transfer:
 SilcoCan™ air monitoring canister with Siltek® treated 1/4" valve (cat.# 24182-650);
 Sulfinert® treated gas sample loop, 1cc (cat.# 22848); Sulfinert® treated gas sample loop, 10cc (custom order)

Sulfur Compounds

Rt™-XLSulfur

(micropacked)



Column: Rt™-XLSulfur micropacked column, 1m, 0.75mm ID (cat.# 19806)
 Conc.: 50ppb each
 Oven temp.: 60°C to 230°C @ 15°C/min.
 Carrier gas: helium
 Flow rate: 9mL/min.
 Det.: SCD/FID

Sulfur standards courtesy of DCG Partnership 1 Ltd., Pearland, TX.

Get More!

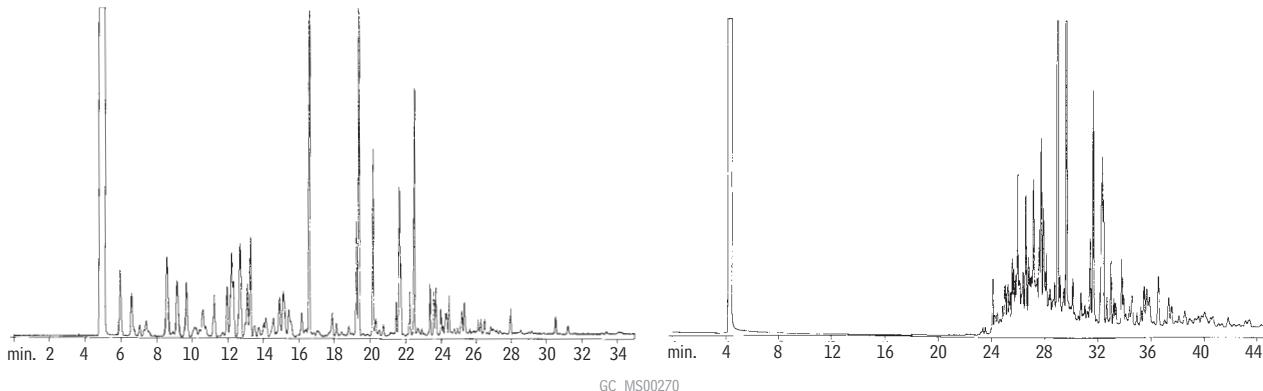
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Unleaded Gasoline Rtx®-1

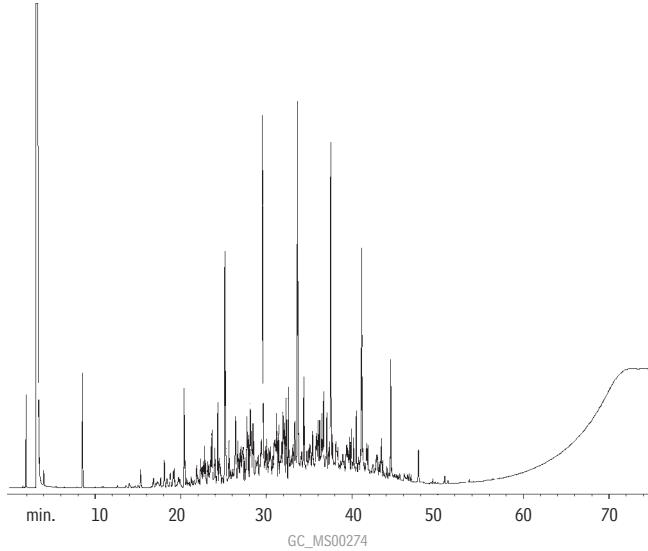
Unweathered



99% Weathered

Column: Rtx®-1, 30m, 0.53mm ID, 1.50 μ m (cat.# 10170)
 Oven temp.: 40°C (hold 3 min.) to 75°C @ 15°C/min. to 275°C @ 20°C/min. (hold 5 min.)
 Inj./det. temp.: 250°C/285°C
 Carrier gas: hydrogen
 Linear velocity: 50cm/sec. set @ 40°C
 FID sensitivity: 4.10 x 10⁹ AFS
 Split ratio: 30:1

Kerosene Rtx®-1

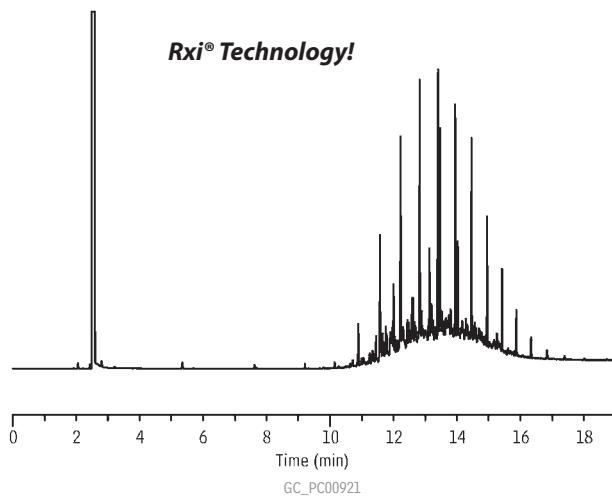


Column: Rtx®-1, 30m, 0.32mm ID, 1.5 μ m (cat.# 10169)
 Sample: 1.0 μ L split injection of a kerosene standard (cat.# 31094)
 Conc.: 5000 μ g/mL
 Oven temp.: 40°C (hold 5 min.) to 300°C @ 4°C/min. (hold 5 min.)
 Inj./det. temp.: 275°C/300°C
 Carrier gas: helium
 Linear velocity: 30cm/sec. set @ 40°C
 Split ratio: 30:1

Arson Accelerants

50% Weathered Diesel Fuel #2
Rxi®-1ms

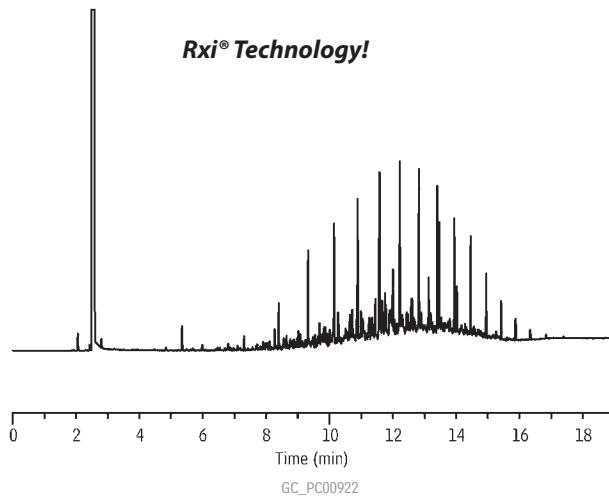
new!



Column: Rxi®-1ms, 30m, 0.25mm ID, 0.50 μ m (cat.# 13338)
 Sample: 5000 μ g/mL diesel fuel #2, 50% weathered (cat.# 31235) in methylene chloride
 Inj.: 1.0 μ L split (split ratio 20:1), 4mm single gooseneck w/wool inlet liner (cat.# 22405)
 Inj. temp.: 250°C
 Carrier gas: helium, constant flow
 Linear velocity: 28cm/sec. @ 50°C
 Oven temp.: 50°C (hold 2 min.) to 75°C @ 10°C/min., 300°C @ 20°C/min. (hold 5 min.)
 Det.: FID @ 300°C

Unweathered Diesel Fuel #2
Rxi®-1ms

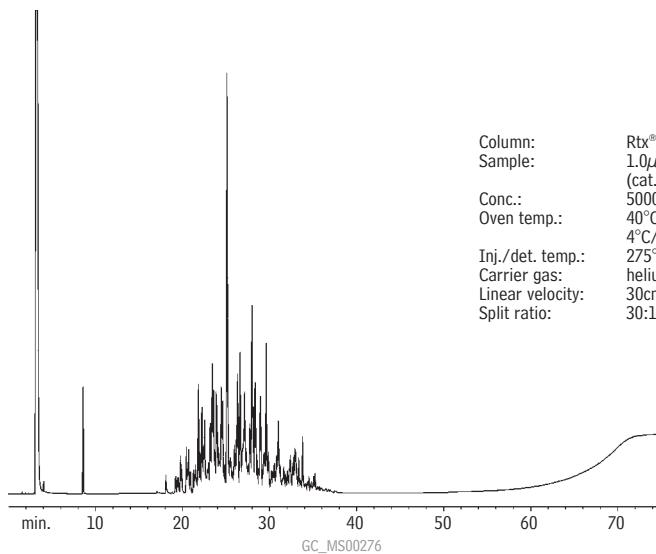
new!



Column: Rxi®-1ms, 30m, 0.25mm ID, 0.50 μ m (cat.# 13338)
 Sample: 5000 μ g/mL diesel fuel #2, unweathered (cat.# 31233) in methylene chloride
 Inj.: 1.0 μ L split (split ratio 20:1), 4mm single gooseneck w/wool inlet liner (cat.# 22405)
 Inj. temp.: 250°C
 Carrier gas: helium, constant flow
 Linear velocity: 28cm/sec. @ 50°C
 Oven temp.: 50°C (hold 2 min.) to 75°C @ 10°C/min., 300°C @ 20°C/min. (hold 5 min.)
 Det.: FID @ 300°C

Mineral Spirits

Rtx®-1

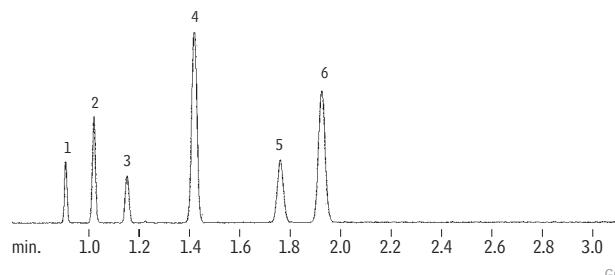


Column: Rtx®-1, 30m, 0.32mm ID, 1.5 μ m (cat.# 10169)
 Sample: 1.0 μ L split injection of a mineral spirits standard (cat.# 31225)
 Conc.: 5000 μ g/mL
 Oven temp.: 40°C (hold 5 min.) to 300°C @ 4°C/min. (hold 5 min.)
 Inj./det. temp.: 275°C/300°C
 Carrier gas: helium
 Linear velocity: 30cm/sec. set @ 40°C
 Split ratio: 30:1

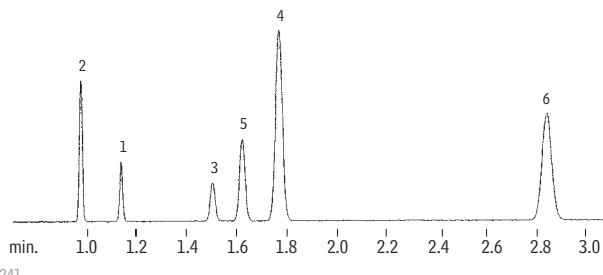
Blood Alcohol**Rtx®-BAC1 & Rtx®-BAC2 (0.32mm ID Columns)**

(headspace analysis)

	Conc. w/v
1. methanol	0.1%
2. acetaldehyde	0.2%
3. ethanol	0.2%
4. isopropanol	0.1%
5. acetone	0.01%
6. n-propanol	0.1%



Rtx®-BAC1, 30m, 0.32mm ID, 1.8µm (cat.# 18003)



Rtx®-BAC2, 30m, 0.32mm ID, 1.2µm (cat.# 18002)

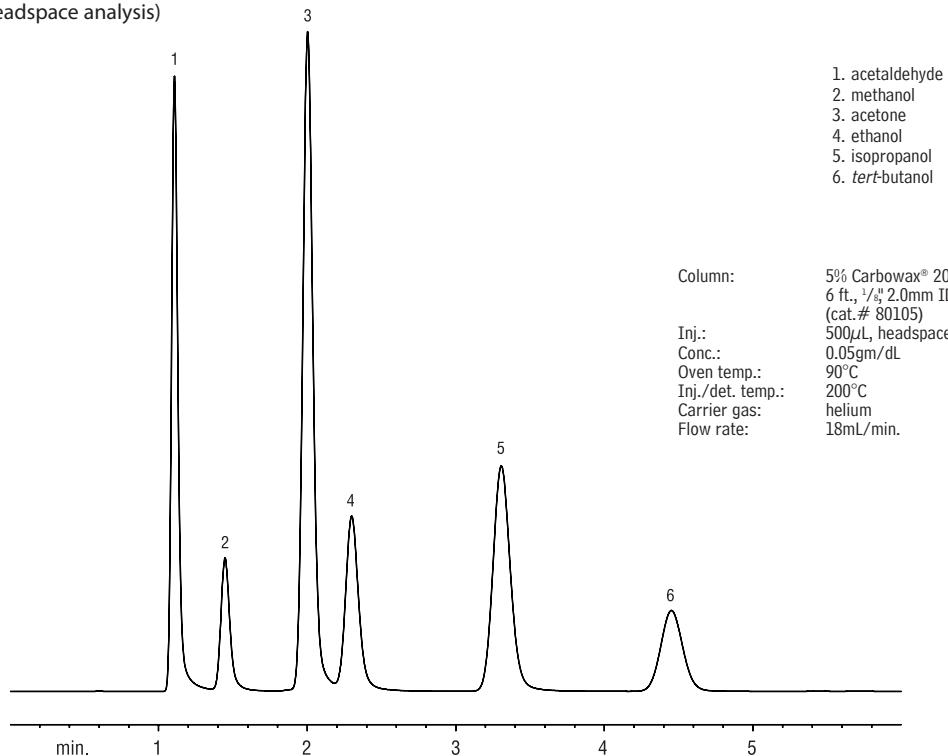
Dual-column analysis using a two-hole ferrule.

Sample: 1.0mL headspace sample of a blood alcohol mix
on a PerkinElmer HS 40 headspace autosampler
Oven temp.: 40°C
Inj. temp.: 200°C
Carrier gas: helium
Sample equilibration: 70°C, 15 min.
Vial pressure: 30psi
Vial pressurization time: 0.15 min.

Vial sampling time: 0.01 min.
Transfer line: 0.32mm ID Hydroguard™ fused silica tubing
Transfer line temp.: 200°C
Injection port sleeve: 2mm ID
Split flow: 20mL/min.

Blood Alcohol**5% Carbowax® 20M on CarboBlack B**

(packed; headspace analysis)



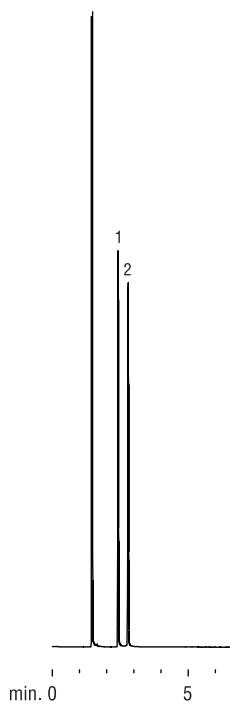
Column: 5% Carbowax® 20M on 80/120 CarboBlack B,
6 ft., 1/8" 2.0mm ID SilcoSmooth™ tubing
(cat.# 80105)
Inj.: 500µL, headspace
Conc.: 0.05gm/dL
Oven temp.: 90°C
Inj./det. temp.: 200°C
Carrier gas: helium
Flow rate: 18mL/min.

Glycols; GHB/GBL

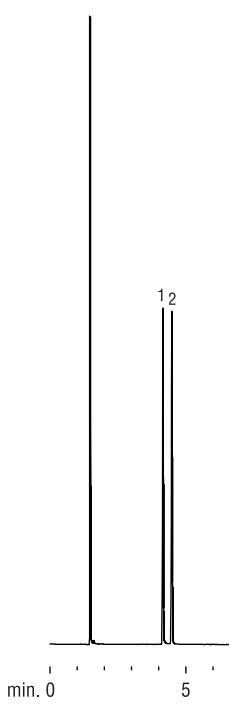
Glycols

Rtx®-BAC1 & Rtx®-BAC2

Rtx®-BAC1



Rtx®-BAC2



1. ethylene glycol
2. propylene glycol

Columns: Rtx®-BAC1, 30m, 0.32mm ID, 1.8 μ m (cat.# 18003)
Rtx®-BAC2, 30m, 0.32mm ID, 1.2 μ m (cat.# 18002)
Inj.: 0.5 μ L split injection
Conc.: 1%
Solvent: methanol
Oven temp.: 100°C to 240°C @ 5°C/min. (hold 5 min.)
Inj. temp.: 240°C
Inj. mode: 100:1 split
Inlet liner: 4mm single gooseneck (cat.# 20798)
Septa purge: 5.0cc/min.
Carrier gas: helium, constant pressure
Pressure: 12psi
Linear velocity: 37cm/sec.
Column flow rate: 2.1mL/min.
Det.: FID @ 240°C
Make-up gas flow: 40cc/min.

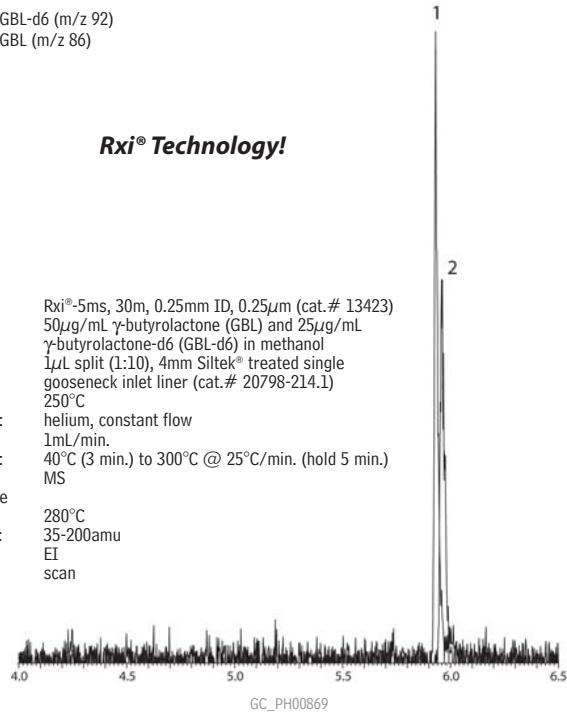
GC_EV00474

γ -butyrolactone and γ -butyrolactone-d6 **new!** **Rxi®-5ms**

1. GBL-d6 (m/z 92)
2. GBL (m/z 86)

Rxi® Technology!

Column: Rxi®-5ms, 30m, 0.25mm ID, 0.25 μ m (cat.# 13423)
Sample: 50 μ g/mL γ -butyrolactone (GBL) and 25 μ g/mL γ -butyrolactone-d6 (GBL-d6) in methanol
Inj.: 1 μ L split (1:10), 4mm Siltek® treated single gooseneck inlet liner (cat.# 20798-214.1)
Inj. temp.: 250°C
Carrier gas: helium, constant flow
Flow rate: 1mL/min.
Oven temp.: 40°C (3 min.) to 300°C @ 25°C/min. (hold 5 min.)
Det: MS
Transfer line temp.: 280°C
Scan range: 35-200amu
Ionization: EI
Mode: scan



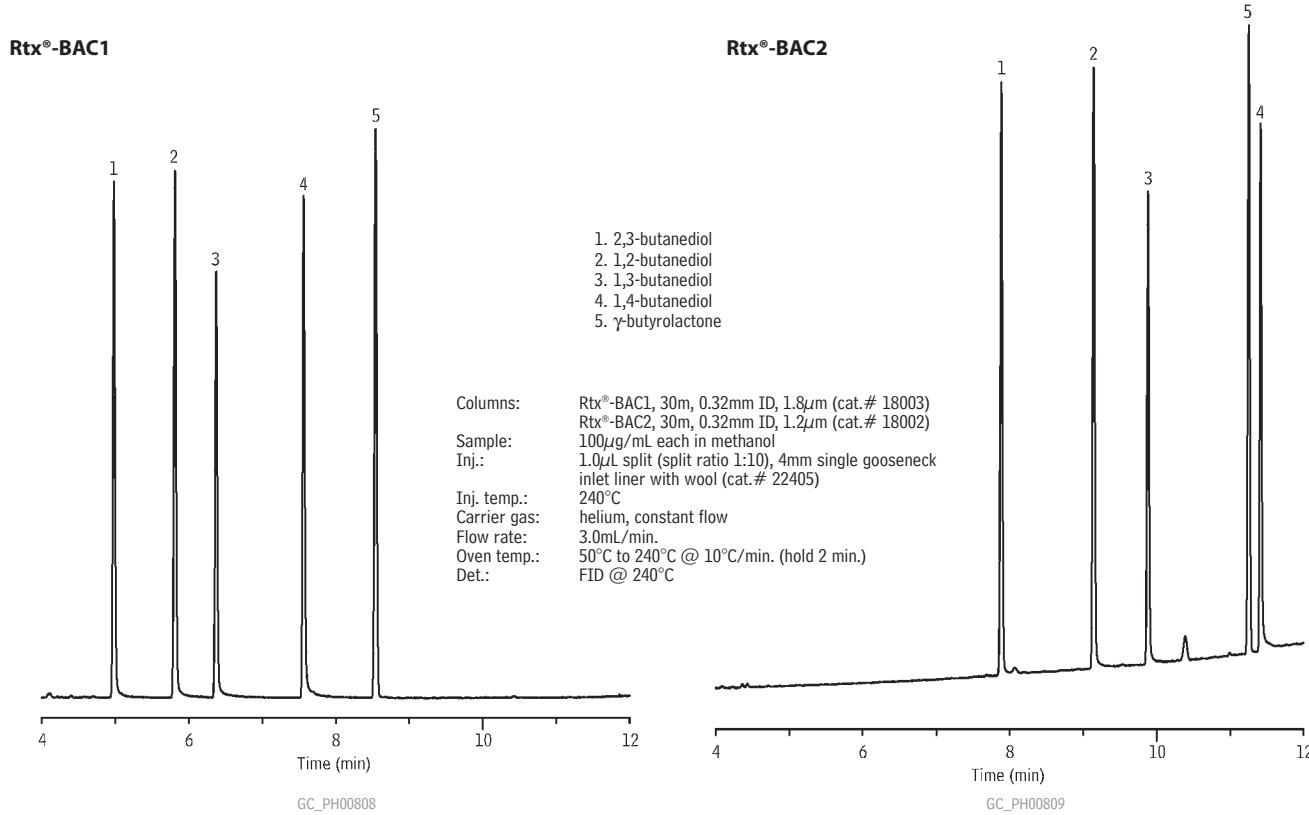
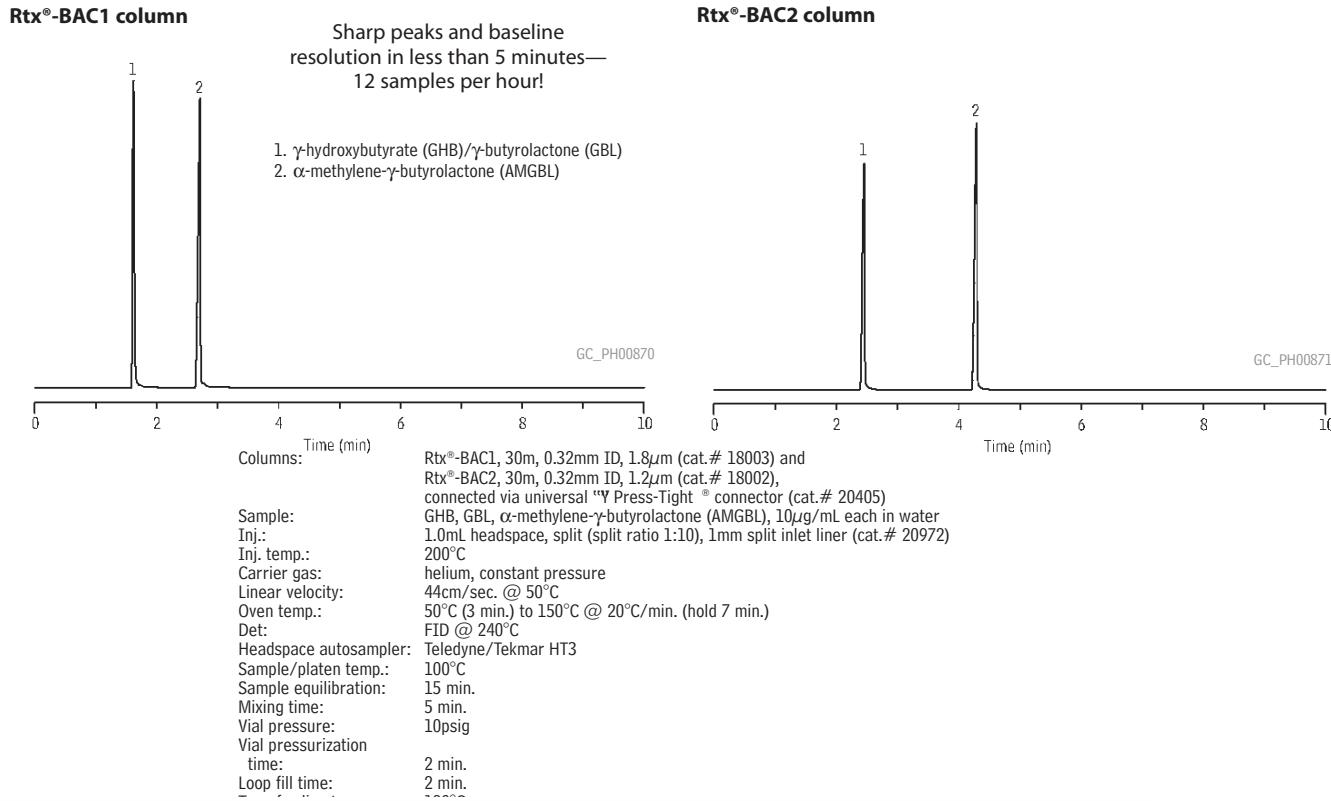
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Hydroxybutyrate (GHB)"

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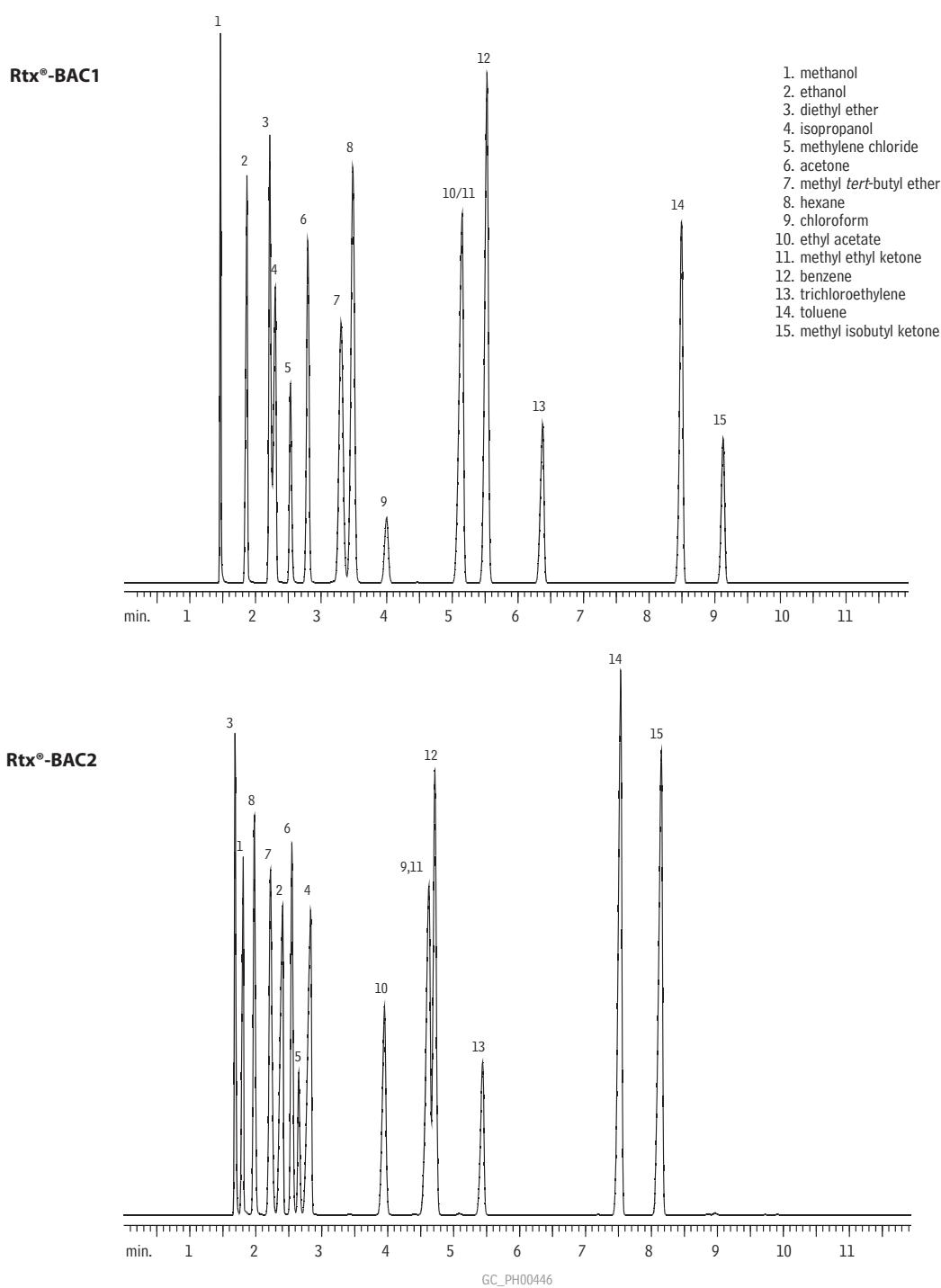


γ -butyrolactone & 1,4-butanediol **γ -hydroxybutyrate (GHB) and γ -butyrolactone (GBL)****Rtx®-BAC1 and Rtx®-BAC2 (dual column analysis)**

Abused Inhalants

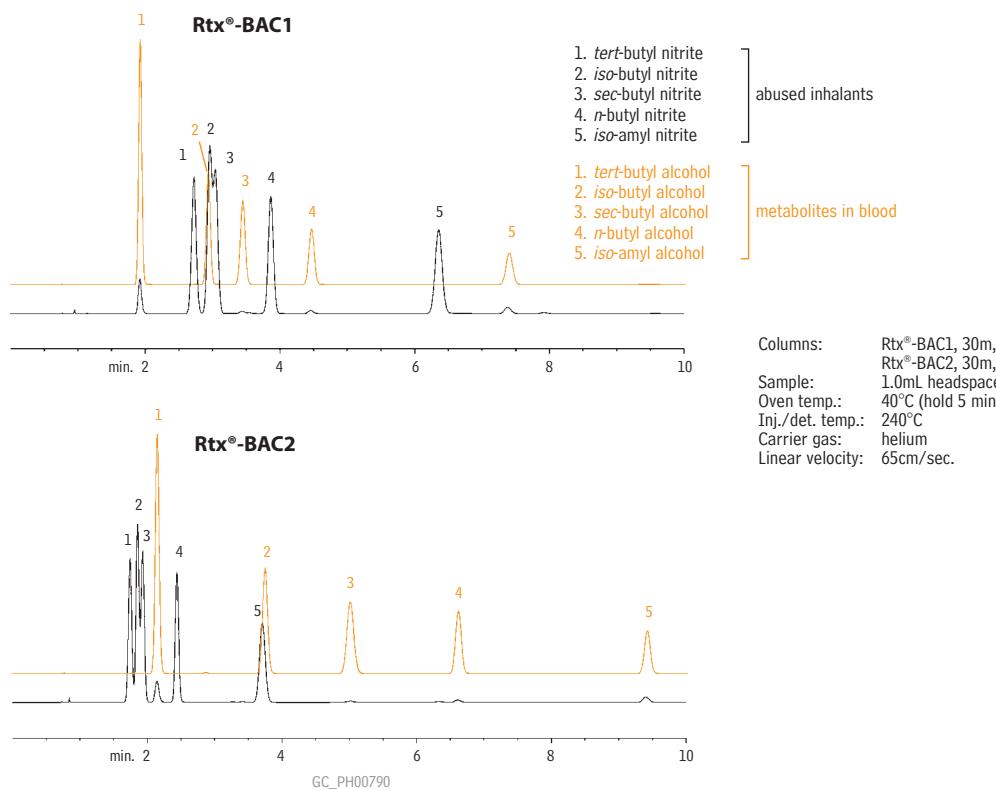
Abused Inhalants

Rtx®-BAC1 & Rtx®-BAC2



Columns: Rtx®-BAC1, 30m, 0.32mm ID, 1.80 μ m (cat.# 18003)
 Rtx®-BAC2, 30m, 0.32mm ID, 1.20 μ m (cat.# 18002)
 Oven temp.: 40°C (hold 4 min.) to 120°C @ 10°C/min.
 Carrier gas: helium
 Linear velocity: 50cm/sec.
 Det.: FID
 Sample: 250 μ L headspace
 Transfer line temp.: 125°C
 Sample loop temp.: 125°C
 Vial temp.: 70°C

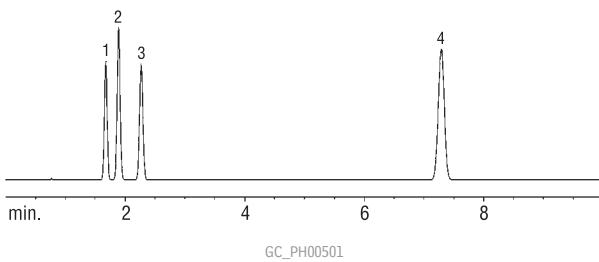
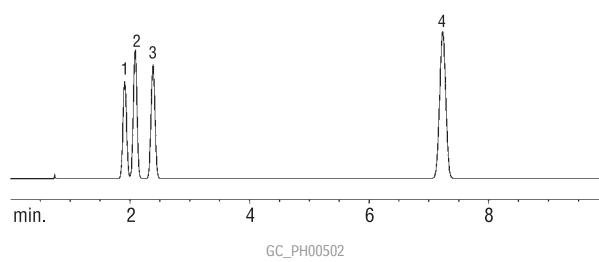
Acknowledgement: Analyses performed using a Tekmar 7000 Headspace Autosampler on loan courtesy of Tekmar-Dohrmann.

Alkyl Nitrites**Rtx®-BAC1 & Rtx®-BAC2**

Columns: Rtx®-BAC1, 30m, 0.53mm ID, 3.0 μ m (cat.# 18001)
Rtx®-BAC2, 30m, 0.53mm ID, 2.0 μ m (cat.# 18000)
Sample: 1.0mL headspace sample
Oven temp.: 40°C (hold 5 min.) to 240°C @ 5°C/min.
Inj./det. temp.: 240°C
Carrier gas: helium
Linear velocity: 65cm/sec.

Anesthetics**Rtx®-BAC1 & Rtx®-BAC2**

(headspace analysis)

Rtx®-BAC1, 30m, 0.53mm ID, 3.0 μ m (cat.# 18001)**Rtx®-BAC2, 30m, 0.53mm ID, 2.0 μ m (cat.# 18000)**

Sample: 1.0mL headspace sample
Oven temp.: 40°C (hold 5 min.) to 240°C @ 5°C/min.
Inj./det. temp.: 240°C
Carrier gas: helium
Linear velocity: 65cm/sec.

1. isoflurane
2. enflurane
3. halothane
4. methoxyflurane

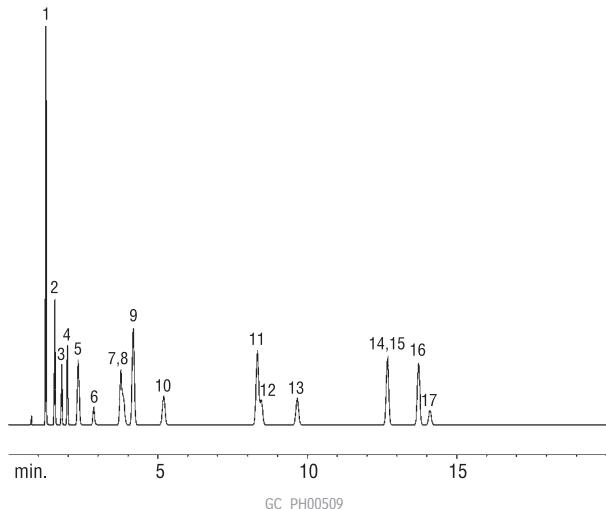
Solvents; Cocaine

Solvents

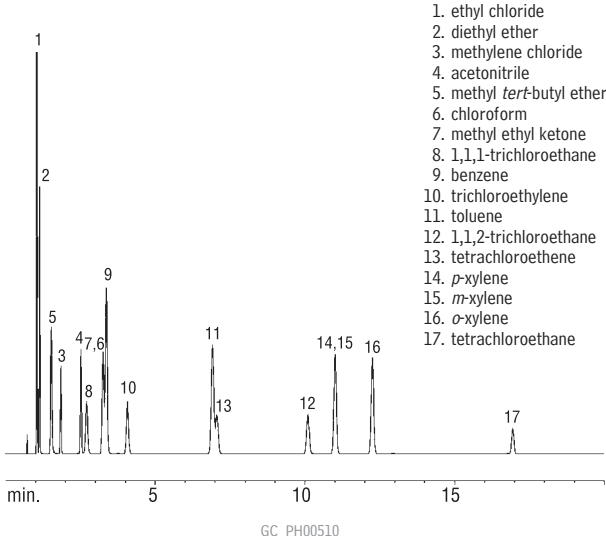
Rtx®-BAC1 & Rtx®-BAC2

(headspace analysis)

Rtx®-BAC1, 30m, 0.53mm ID, 3.0µm (cat.# 18001)



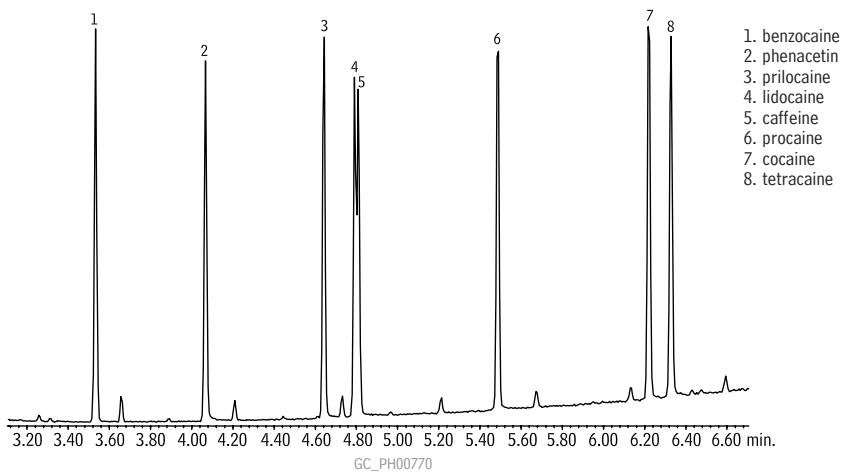
Rtx®-BAC2, 30m, 0.53mm ID, 2.0µm (cat.# 18000)



Sample: 1.0mL headspace sample
Oven temp.: 40°C (hold 5 min.) to 240°C @ 5°C/min.
Inj./det. temp.: 240°C
Carrier gas: helium
Linear velocity: 65cm/sec.

Cocaine & Cocaine Adulterants

Rtx®-440

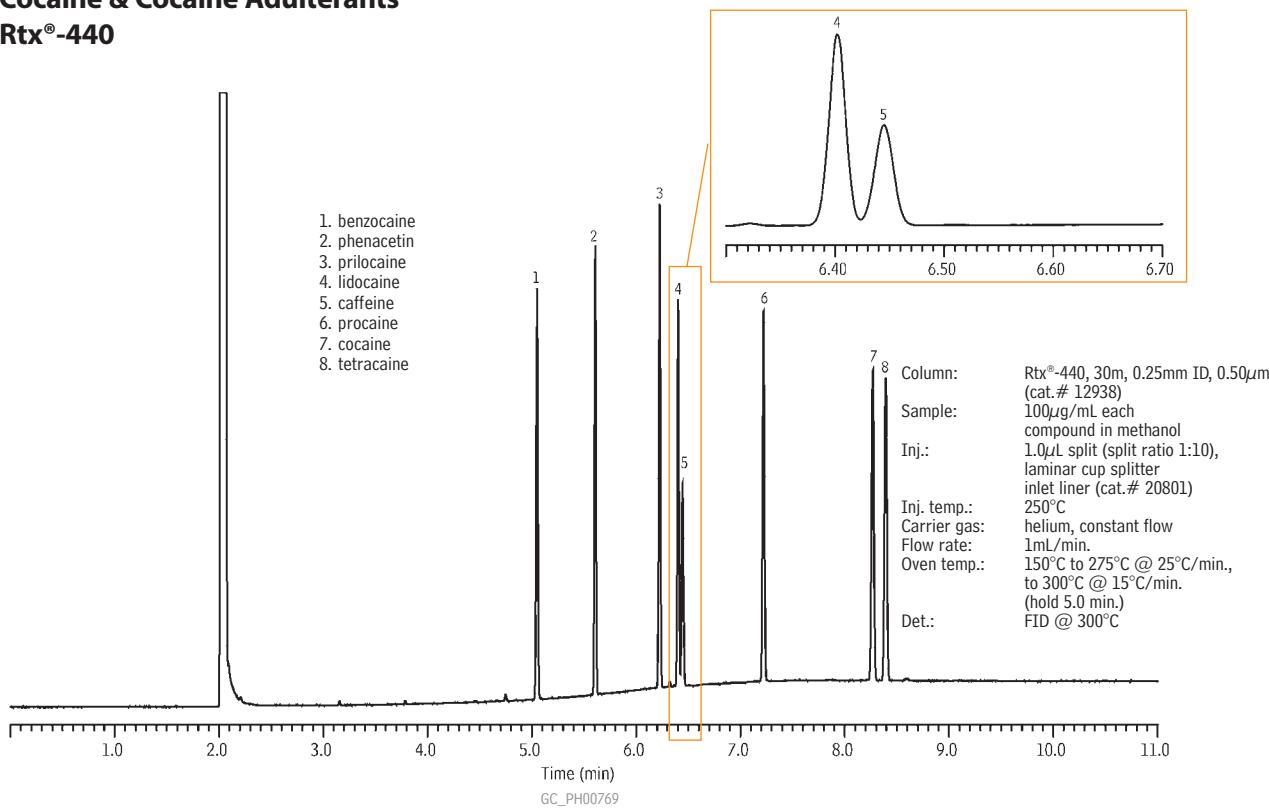


Column: Rtx®-440, 30m, 0.25mm ID, 0.50µm (cat.# 12938)
Sample: 100µg/mL each compound in methanol
Inj.: 1.0µL split (split ratio 1:10), laminar cup splitter inlet liner (cat.# 20801)
Inj. temp.: 250°C
Carrier gas: helium, constant flow
Flow rate: 1mL/min.
Oven temp.: 150°C to 275°C @ 25°C/min., to 300°C @ 15°C/min. (hold 5.0 min.)
Det.: MS
Transfer line temp.: 180°C
Scan range: 35-550amu
Ionization: EI
Mode: scan

1. benzocaine
2. phenacetin
3. prilocaine
4. lidocaine
5. caffeine
6. procaine
7. cocaine
8. tetracaine

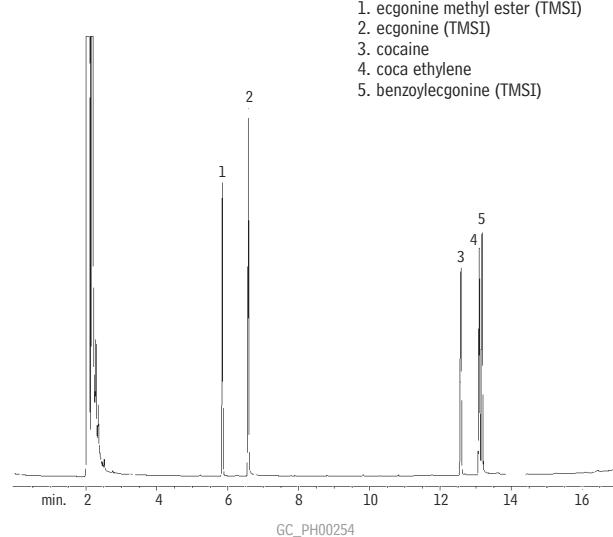
Cocaine & Cocaine Adulterants

Rtx®-440



Cocaine & Metabolites (TMS Derivatives)

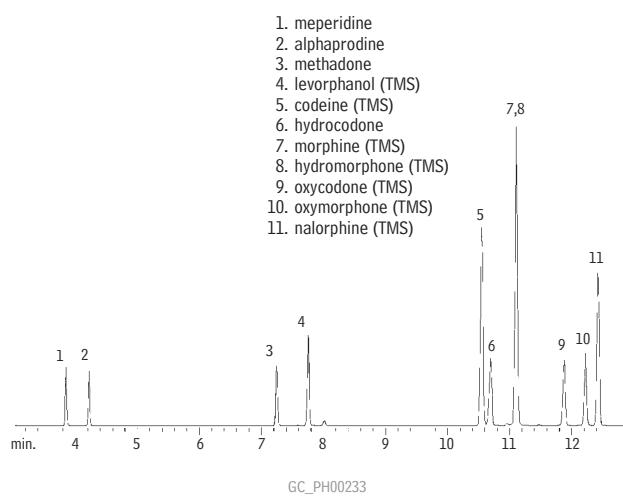
Rtx®-5



Column: Rtx®-5, 30m, 0.25mm ID, 0.25 μ m (cat.# 10223)
Sample: 1.0 μ L split injection of cocaine and cocaine metabolites
Oven temp.: 150°C to 320°C @ 10°C/min.
Inj./det. temp.: 250°C/300°C
Carrier gas: helium
Linear velocity: 30cm/sec. set @ 50°C
FID sensitivity: 2.56 x 10¹⁰ AFS
Split ratio: 30:1

Opiates (TMS Derivatives)

Rtx®-5

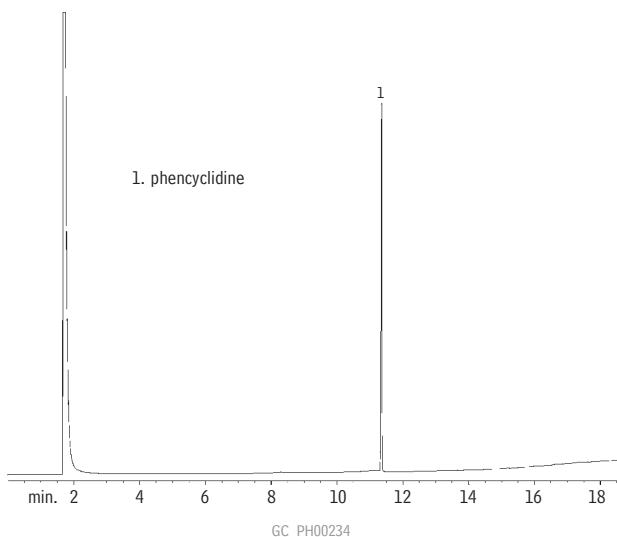


Column: Rtx®-5, 30m, 0.25mm ID, 0.25 μ m (cat.# 10223)
Sample: 2.0 μ L split injection of opiates
Conc: 2000ng/ μ L
Oven temp.: 200°C to 325°C @ 7°C/min.
Inj./det. temp.: 250°C/300°C
Det. type: MS
Ionization: EI
Carrier gas: helium
Mode: full scan
Linear velocity: 30cm/sec. set @ 200°C
Split ratio: 50:1

PCP; Cannabinoids

Phencyclidine (PCP)

Rtx®-5

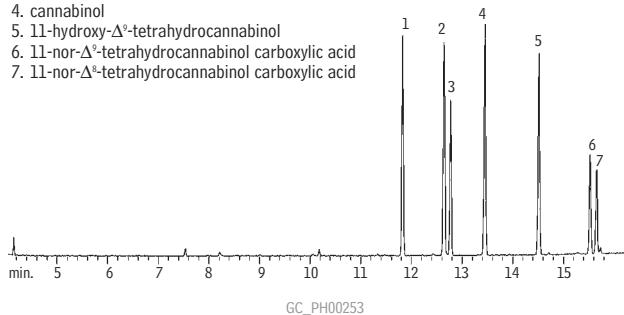


Column: Rtx®-5, 30m, 0.25mm ID, 0.25 μ m (cat.# 10223)
Sample: 1.0 μ L split injection of phencyclidine
Conc.: 1000ng/ μ L
Oven temp.: 50°C (hold 1 min.) to 250°C @ 25°C/min.,
then to 325°C @ 10°C/min. (hold 2 min.)
Inj./det. temp.: 250°C/325°C
Carrier gas: helium
Linear velocity: 30cm/sec. set @ 50°C
FID sensitivity: 2.56 x 10⁻¹⁰ AFS
Split ratio: 30:1

Cannabinoids (TMS Derivatives)

Rtx®-5

1. cannabidiol
2. Δ^8 -tetrahydrocannabinol
3. Δ^9 -tetrahydrocannabinol
4. cannabinol
5. 11-hydroxy- Δ^9 -tetrahydrocannabinol
6. 11-nor- Δ^9 -tetrahydrocannabinol carboxylic acid
7. 11-nor- Δ^8 -tetrahydrocannabinol carboxylic acid

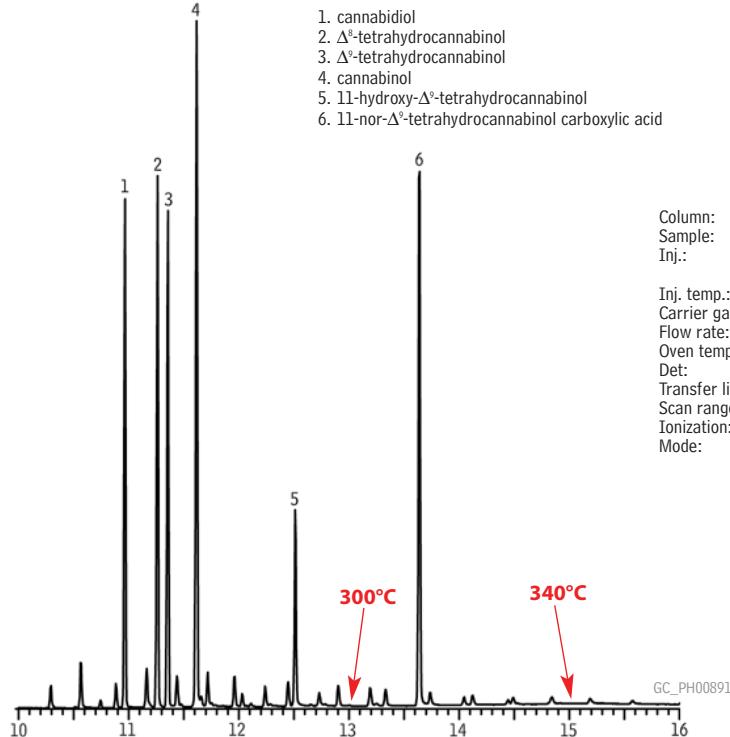


Column: Rtx®-5, 15m, 0.25mm ID, 0.25 μ m (cat.# 10220)
Sample: 1.0 μ L splitless injection of cannabinoids
Conc.: 100 μ g/mL
Oven temp.: 50°C (hold 0.5 min.) to 225°C @ 30°C/min.,
to 325°C @ 10°C/min.
Inj. temp.: 225°C
Interface temp.: 320°C
Det.: MSD
Ionization: EI
Carrier gas: helium
Scan range: 40-500amu
Linear velocity: 40cm/sec. set @ 50°C
Splitless hold time: 0.75 min.

Cannabinoids Rxi®-5ms

new!

1. cannabidiol
2. Δ^8 -tetrahydrocannabinol
3. Δ^9 -tetrahydrocannabinol
4. cannabinol
5. 11-hydroxy- Δ^9 -tetrahydrocannabinol
6. 11-nor- Δ^9 -tetrahydrocannabinol carboxylic acid



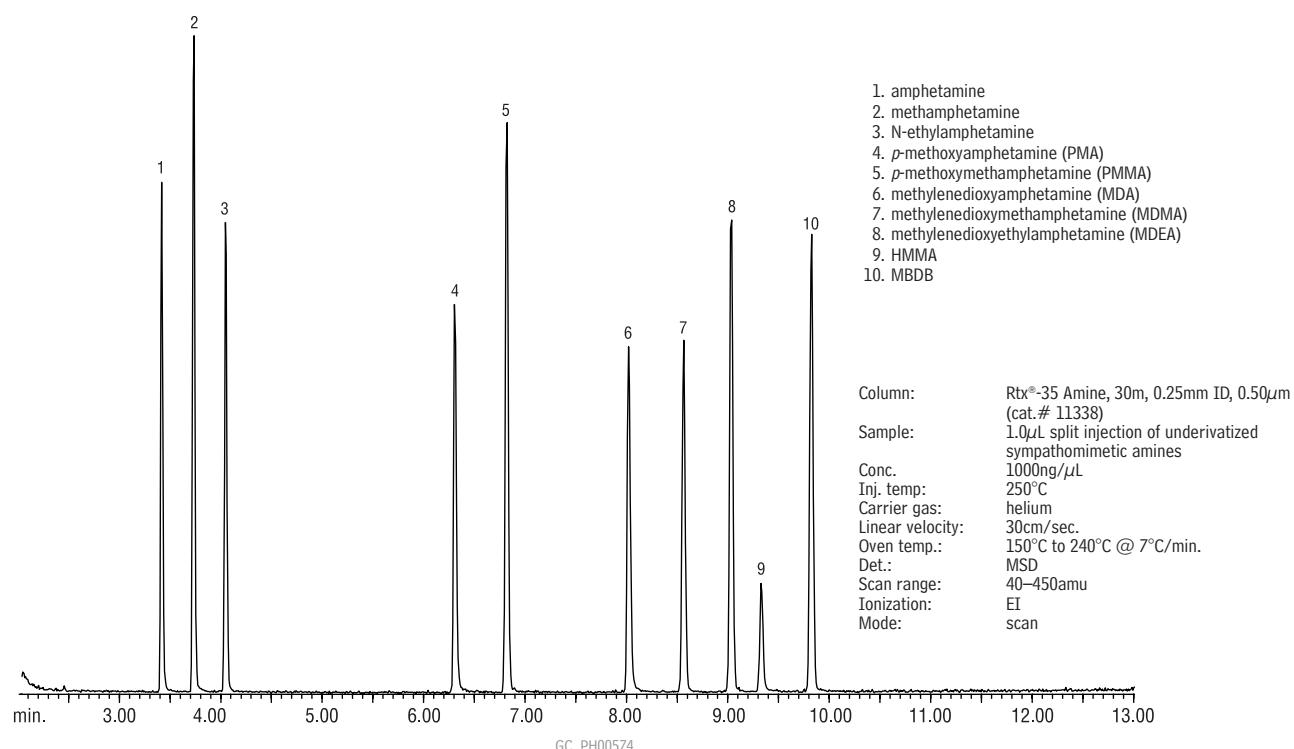
Rxi® Technology!

Column: Rxi®-5ms, 12m, 0.20mm ID, 0.33 μ m (cat.# 13497)
Sample: 1000 μ g/mL each component in methanol
Inj.: 1.0 μ L, split, split ratio 25:1, 4mm ID base-deactivated
single gooseneck inlet liner w/wool (cat.# 20798-211.1)
Inj. temp.: 250°C
Carrier gas: helium, constant flow
Flow rate: 1mL/min.
Oven temp.: 40°C to 340°C @ 20°C/min. (hold 5 min.)
Det: MS
Transfer line temp.: 280°C
Scan range: 100-550amu
Ionization: EI
Mode: scan

Sympathomimetic Amines

Sympathomimetic Amines (Basic Drugs) (Underivatized)

Rtx®-35 Amine



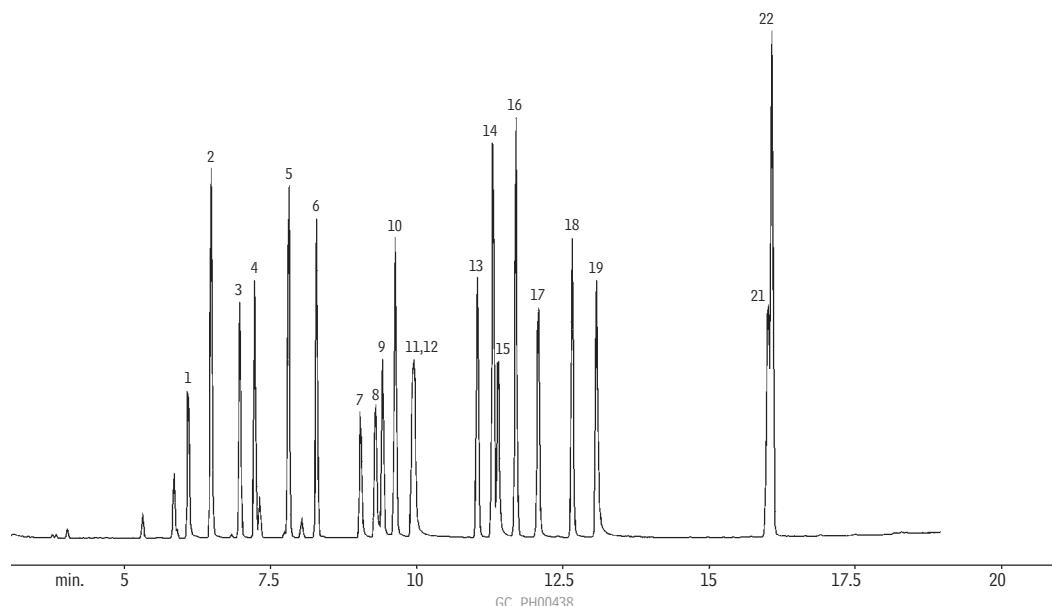
it's a fact

Restek On-The-Road training seminars are full-day courses presented in an engaging multimedia format. They are equally valuable to beginning chromatographers, those who have moderate experience and want a better understanding of the subject matter, and those interested in the "best practices" and latest technologies. **No sales pitch is presented**, just the facts on how to make your chromatography results better. The bulk of each course is lecture, but numerous demonstrations and problem-solving exercises facilitate and reinforce the understanding of important principles. See page 11 for more information.

Sympathomimetic Amines

Sympathomimetic Amines (Basic Drugs) (Underivatized)

Rtx®-5 Amine



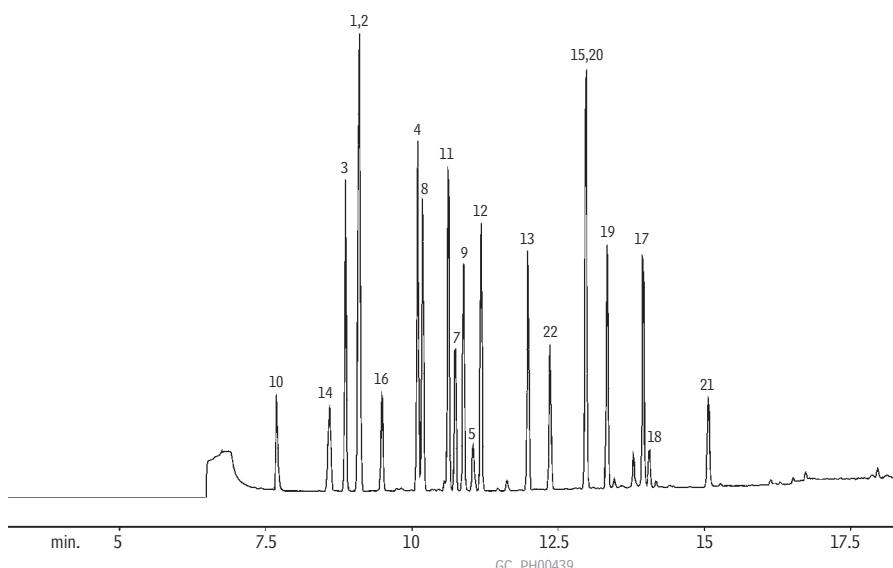
Column: Rtx®-5 Amine, 30m, 0.25mm ID, 0.50 μ m (cat.# 12338)
 Instrument: Varian 3400 GC coupled with Varian Saturn 2000 MS detector
 Inj.: 1 μ L, split, split vent flow rate 45mL/min.
 Inj. temp.: 250°C
 Carrier gas: helium
 Det.: Mass spectroscopy data collected using a scan range of 40 amu through 600 amu.
 Oven temp.: 100°C to 310°C @ 10°C/min.

Ionization performed in the EI Auto mode.

1. phenylethylamine
2. amphetamine
3. phentermine
4. methamphetamine
5. fenfluramine
6. mephentermine
7. cathinone
8. phenylpropanolamine
9. methcathinone
10. nicotine
11. ephedrine
12. pseudoephedrine
13. phenmetrazine
14. phendimetrazine
15. methylenedioxymethamphetamine
16. diethylpropion
17. methylenedioxymethamphetamine
18. methylenedioxymethamphetamine
19. 4-methyl-2,5-dimethoxyamphetamine
20. phenylephrine
21. caffeine
22. benzphetamine

Sympathomimetic Amines (Basic Drugs) (Underivatized)

Rtx®-200



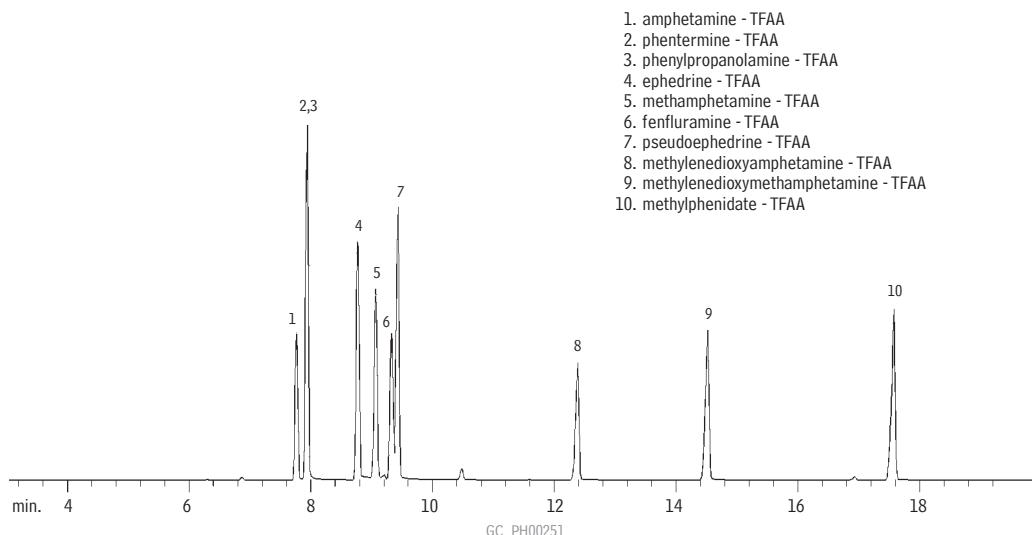
Column: Rtx®-200, 30m, 0.25mm ID, 0.50 μ m (cat.# 15038)
 Instrument: Varian 3400 GC coupled with Varian Saturn 2000 MS detector
 Inj.: 1 μ L, split, split vent flow rate 45mL/min.
 Inj. temp.: 250°C
 Carrier gas: helium
 Det.: Mass spectroscopy data collected using a scan range of 40 amu through 600 amu.
 Oven temp.: 100°C to 310°C @ 10°C/min.

Ionization performed in the EI Auto mode.

Sympathomimetic Amines

Sympathomimetic Amines (Basic Drugs) (TFAA Derivatives)

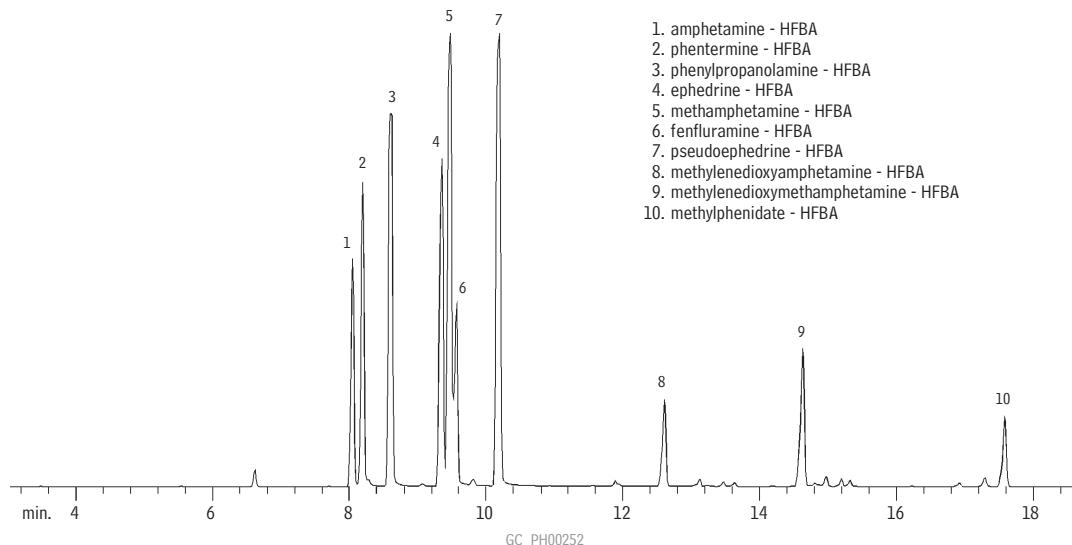
Rtx®-5



Column: Rtx®-5, 30m, 0.25mm ID, 0.25 μ m (cat.# 10223)
 Sample: 1.0 μ L splitless injection of derivatized sympathomimetic amines
 Conc.: approximately 2.5ng/ μ L
 Oven temp.: 40°C (hold 1 min.) to 150°C @ 30°C/min.,
 to 300°C @ 5°C/min.
 Inj. temp.: 225°C
 Interface temp.: 275°C
 Det.: MSD
 Ionization: EI
 Carrier gas: helium
 Linear velocity: 20cm/sec. set @ 100°C
 Splitless hold time: 1 min.

Sympathomimetic Amines (Basic Drugs) (HFBA Derivatives)

Rtx®-5

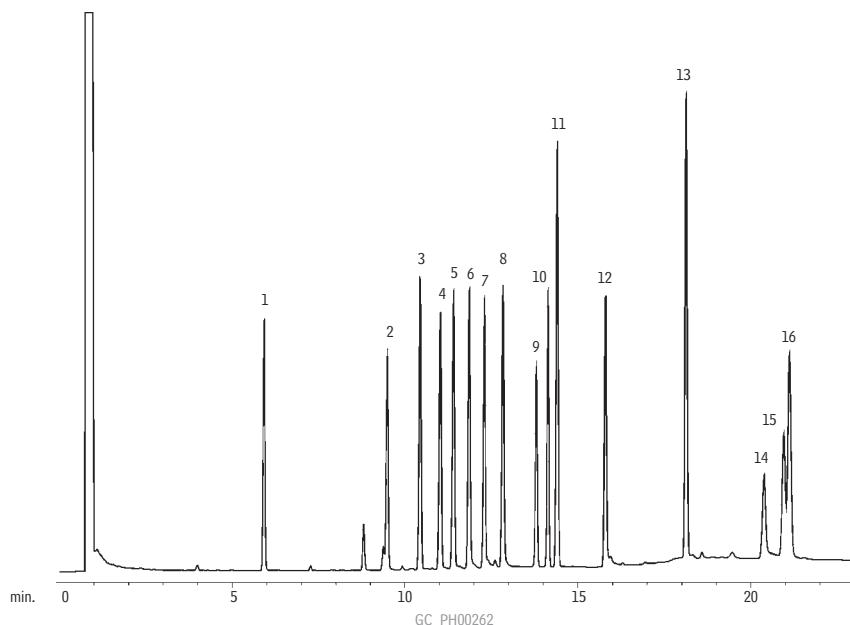


Column: Rtx®-5, 30m, 0.25mm ID, 0.25 μ m (cat.# 10223)
 Sample: 1.0 μ L splitless injection of sympathomimetic amines
 Conc.: approximately 2.5ng/ μ L
 Oven temp.: 40°C (hold 1 min.) to 150°C @ 30°C/min.,
 to 300°C @ 5°C/min.
 Inj. temp.: 225°C
 Interface temp.: 275°C
 Det.: MSD
 Ionization: EI
 Carrier gas: helium
 Linear velocity: 20cm/sec. set @ 100°C
 Splitless hold time: 1 min.

Barbiturates

Barbiturates (Acidic/Neutral Drugs) (Underivatized)

Rtx®-35

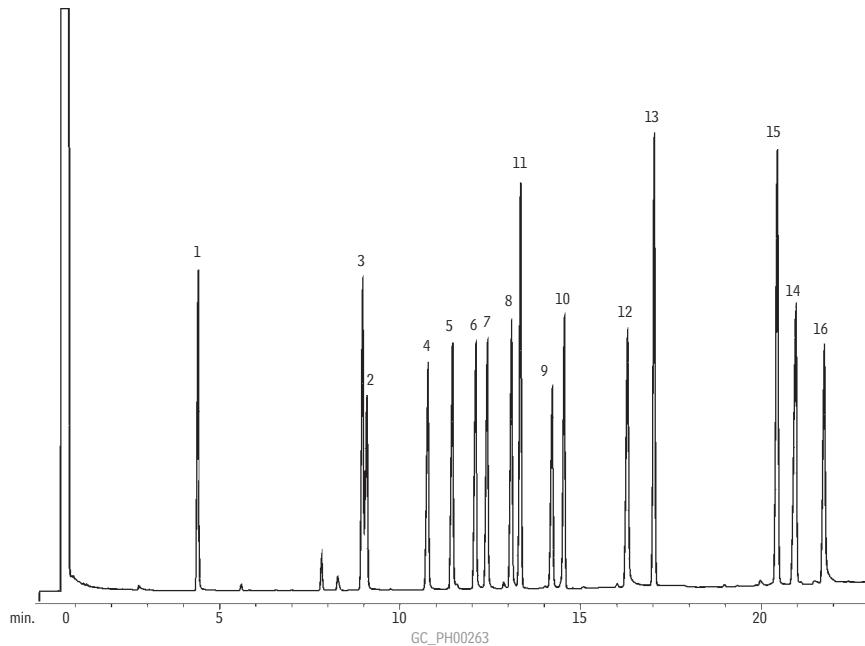


Column: Rtx®-35, 30m, 0.53mm ID, 1.0 μ m (cat.# 10455)
 Sample: 1.0 μ L splitless injection of acidic/neutral drugs
 Conc.: 50 μ g/mL
 Oven temp.: 100°C to 280°C @ 10°C/min. (hold 5 min.)
 Inj./det. temp.: 250°C
 Carrier gas: helium
 Linear velocity: 40cm/sec. set @ 100°C
 FID sensitivity: 5.12 x 10⁻¹⁰ AFS
 Splitless hold time: 0.5 min.

1. ethosuximide
2. barbital
3. methyprylon
4. aprobarbital
5. butalbital
6. amobarbital
7. pentobarbital
8. secobarbital
9. meprobamate
10. carisoprodal
11. glutethimide
12. phenobarbital
13. methaqualone
14. primidone
15. carbamazepine
16. diphenylhydantoin

Barbiturates (Acidic/Neutral Drugs) (Underivatized)

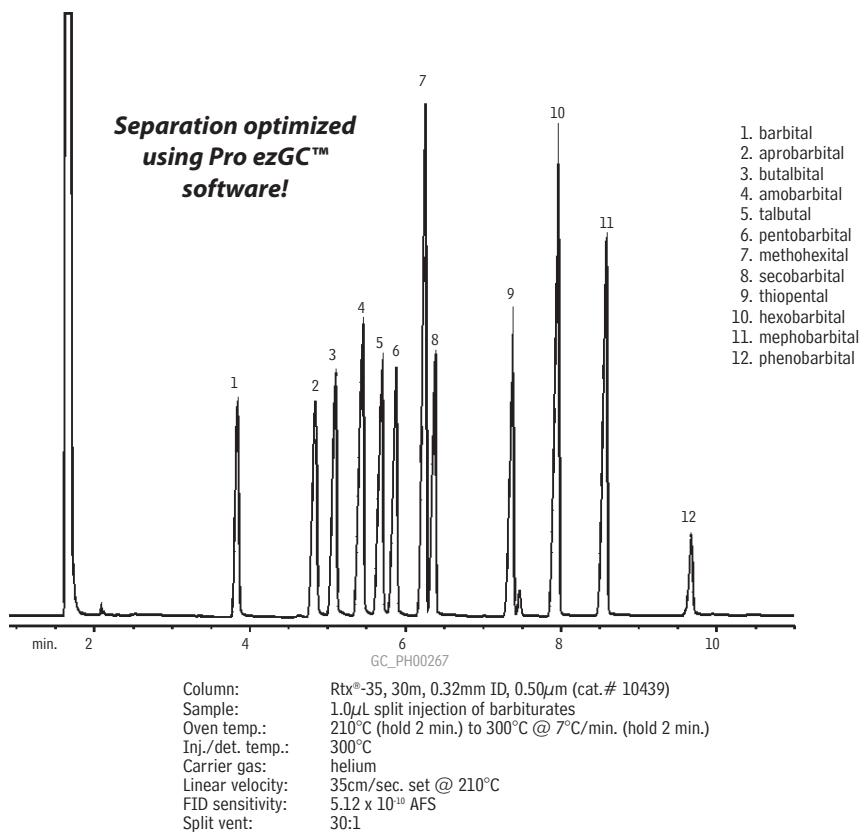
Rtx®-1701



Column: Rtx®-1701, 15m, 0.53mm ID, 0.50 μ m (cat.# 12037)
 Sample: 1.0 μ L splitless injection of acidic/neutral drugs
 Conc.: 50 μ g/mL concentration
 Oven temp.: 100°C to 280°C @ 7°C/min.
 Inj./det. temp.: 250°C/275°C
 Carrier gas: helium
 Linear velocity: 40cm/sec. set @ 100°C
 FID sensitivity: 5.12 x 10⁻¹⁰ AFS
 Splitless hold time: 0.5 min.

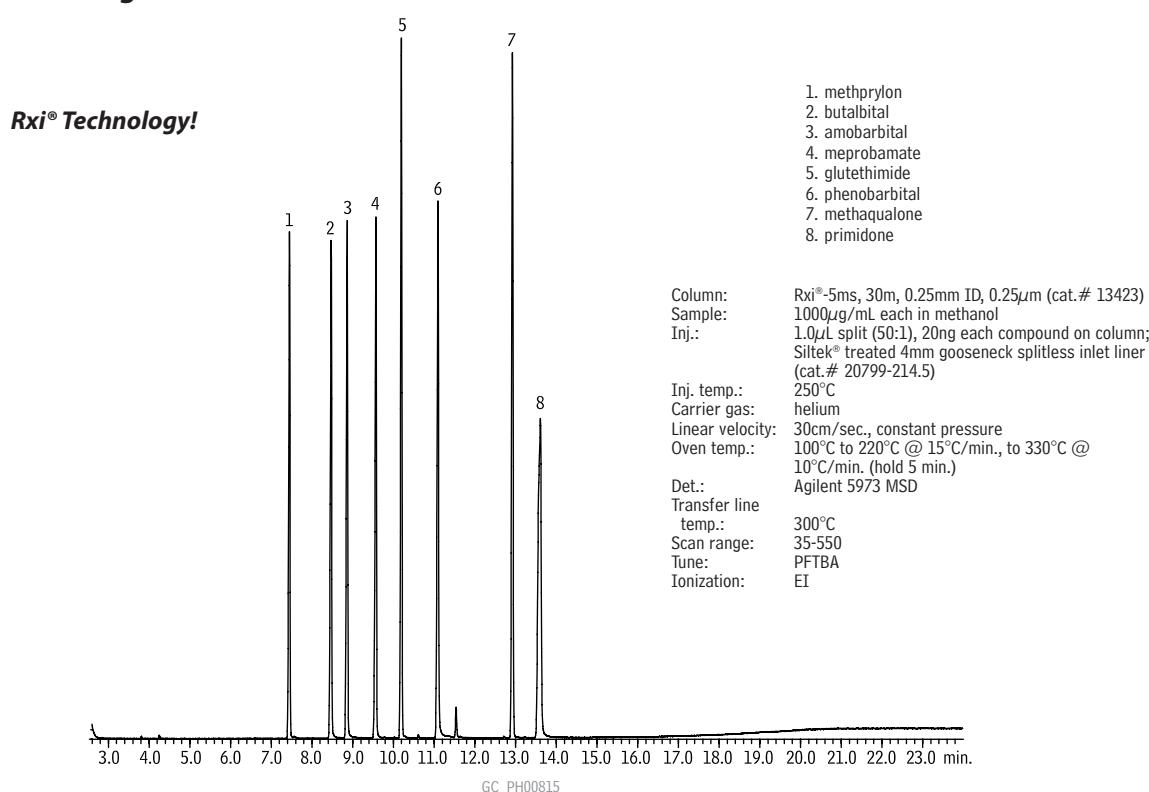
Barbiturates (Acidic/Neutral Drugs) (Underivatized)

Rtx®-35



Acidic/Neutral Drugs

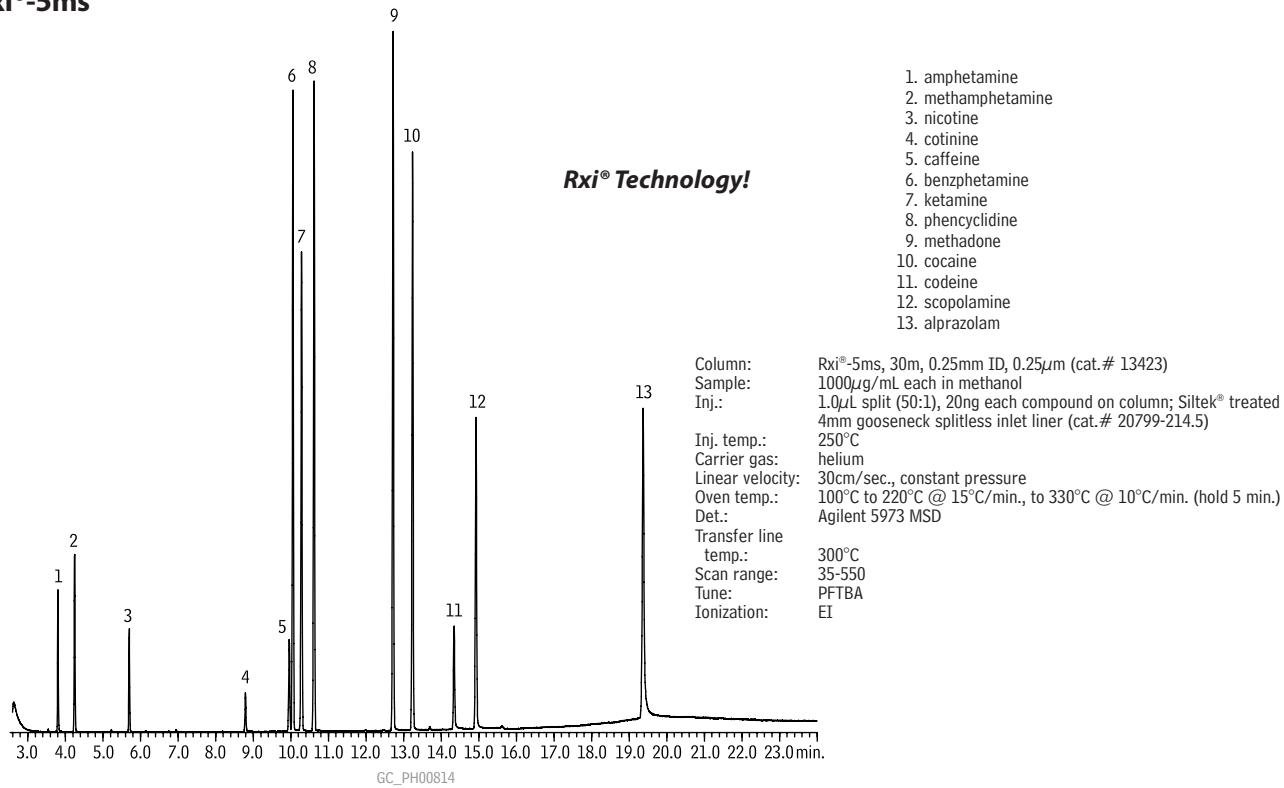
Rxi®-5ms



Basic Drugs

Basic Drugs (Underivatized)

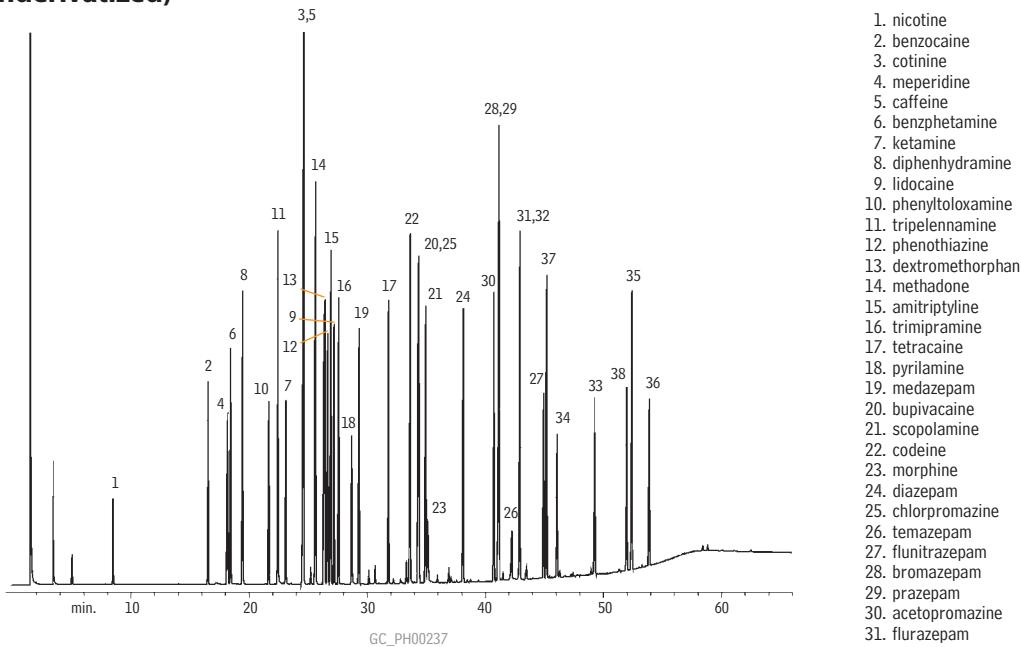
Rxi®-5ms



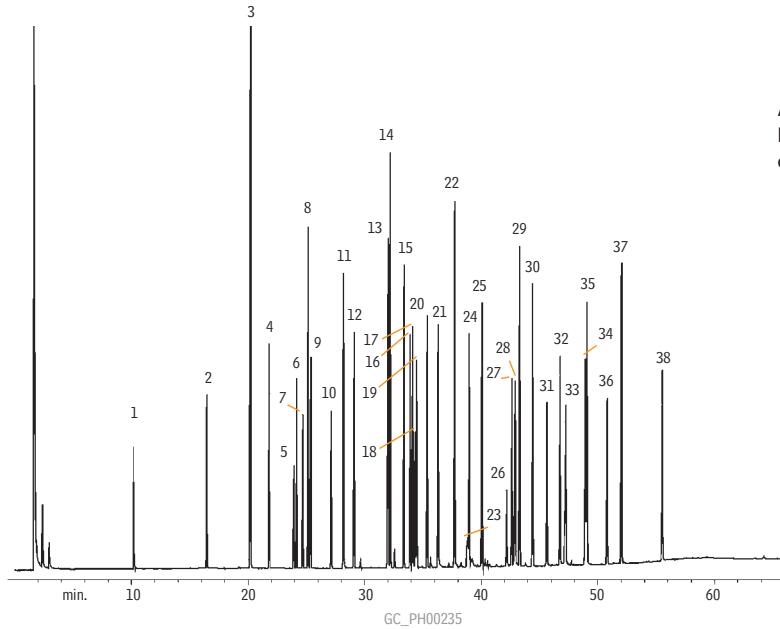
Basic Drugs (Underivatized)

Rtx®-200

Analysis on
Rtx®-5 and Rtx®-35
columns: page 713.

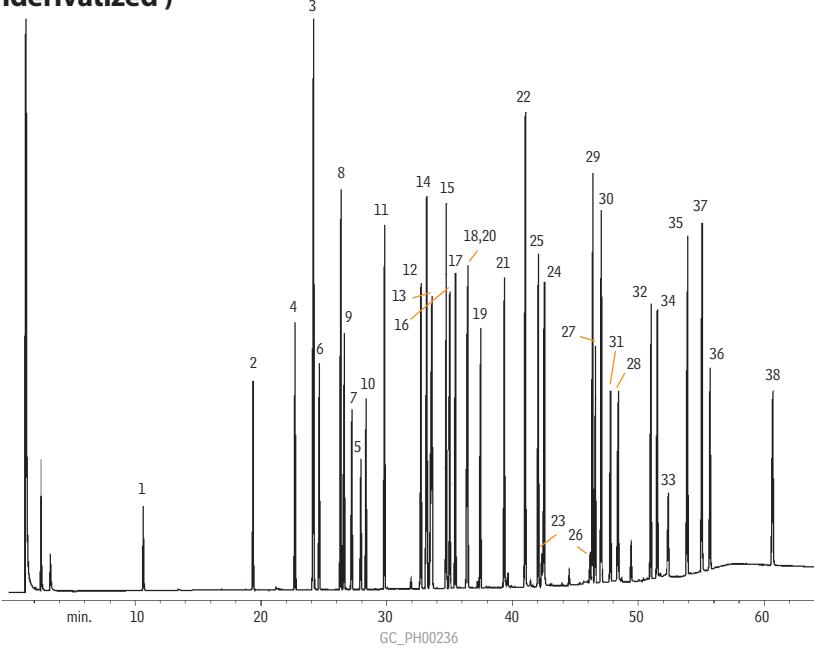


Column: Rtx®-200, 30m, 0.25mm ID, 0.25 μ m (cat.# 15023)
 Sample: 1.0 μ L split injection of a basic drug sample (1mg/mL)
 Conc.: 1000ng/ μ L
 Oven temp.: 100°C to 325°C @ 4°C/min. (hold 10 min.)
 Inj./det. temp.: 250°C/320°C
 Carrier gas: helium
 Linear velocity: 30cm/sec. set @ 100°C
 FID sensitivity: 1.28 x 10⁻¹⁰ AFS
 Split ratio: 50:1

Basic Drugs (Underivatized)**Rtx®-5**

Column: Rtx®-5, 30m, 0.25mm ID, 0.25 μ m (cat.# 10223)
 Sample: 1.0 μ L split injection of a basic drug sample
 Conc.: 1000ng/ μ L
 Oven temp.: 100°C to 325°C @ 4°C/min. (hold 10 min.)
 Inj./det. temp.: 250°C/320°C
 Carrier gas: helium
 Linear velocity: 30cm/sec. set @ 100°C
 FID sensitivity: 1.28 x 10⁻¹⁰ AFS
 Split ratio: 50:1

1. nicotine
2. benzocaine
3. cotinine
4. meperidine
5. caffeine
6. benzphetamine
7. ketamine
8. diphenhydramine
9. lidocaine
10. phenyltoloxamine
11. tripeptenamine
12. phenothiazine
13. dextromethorphan
14. methadone
15. amitriptyline
16. trimipramine
17. tetracaine
18. pyrilamine
19. medazepam
20. bupivacaine
21. scopolamine
22. codeine
23. morphine
24. diazepam
25. chlorpromazine
26. temazepam
27. flunitrazepam
28. bromazepam
29. prazepam
30. acetopromazine
31. flurazepam
32. papaverine
33. clonazepam
34. haloperidol
35. alprazolam
36. triazolam
37. thioridazine
38. trazodone

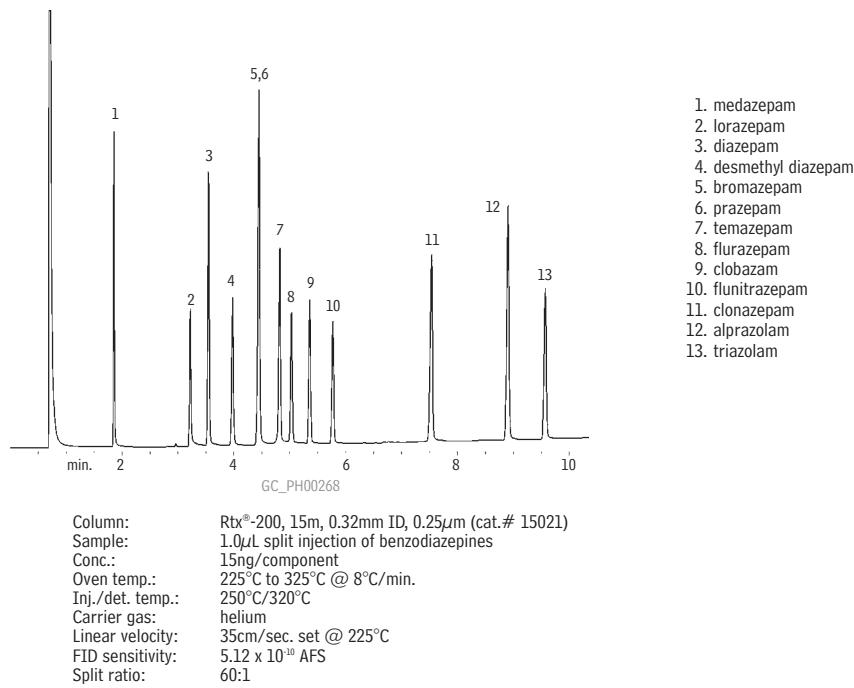
Basic Drugs (Underivatized)**Rtx®-35**

Rtx®-35, 30m, 0.25mm ID, 0.25 μ m (cat.# 10423)
 Sample: 1.0 μ L split injection of a basic drug sample
 Conc.: 1000ng/ μ L
 Oven temp.: 100°C to 325°C @ 4°C/min.
 (hold 10 min.)
 Inj./det. temp.: 250°C/320°C
 Carrier gas: helium
 Linear velocity: 30cm/sec. set @ 100°C
 FID sensitivity: 1.28 x 10⁻¹⁰ AFS
 Split ratio: 50:1

Benzodiazepines; Phenothiazines

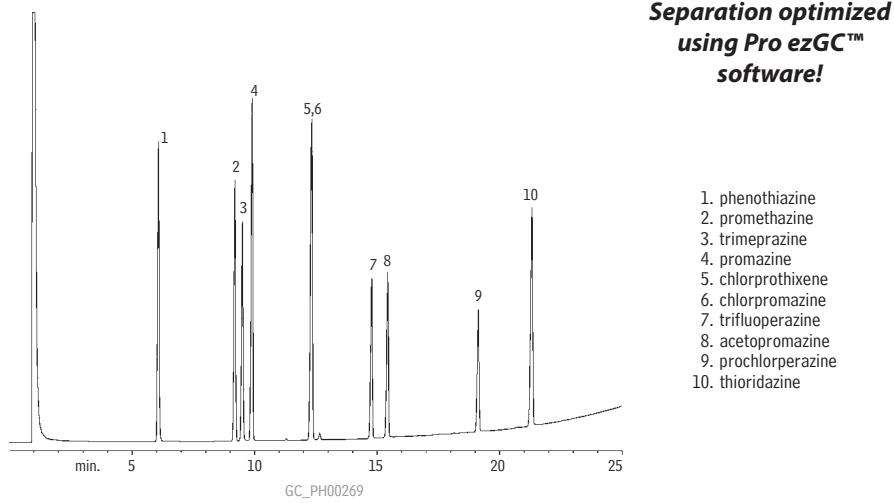
Benzodiazepines (Basic Drugs) (Underivatized)

Rtx®-200



Phenothiazines (Basic Drugs) (Underivatized)

Rtx®-5



Column: Rtx®-5, 15m, 0.32mm ID, 0.50 μ m (cat.# 10236)
 Sample: 1.0 μ L split injection of phenothiazines
 Conc.: 2000ng/ μ L
 Oven temp.: 200°C to 325°C @ 5°C/min.
 Inj./det. temp.: 250°C/315°C
 Carrier gas: helium
 Linear velocity: 25cm/sec. set @ 200°C
 FID sensitivity: 2.56 x 10⁻¹⁰ AFS
 Split ratio: 30:1



did you know?

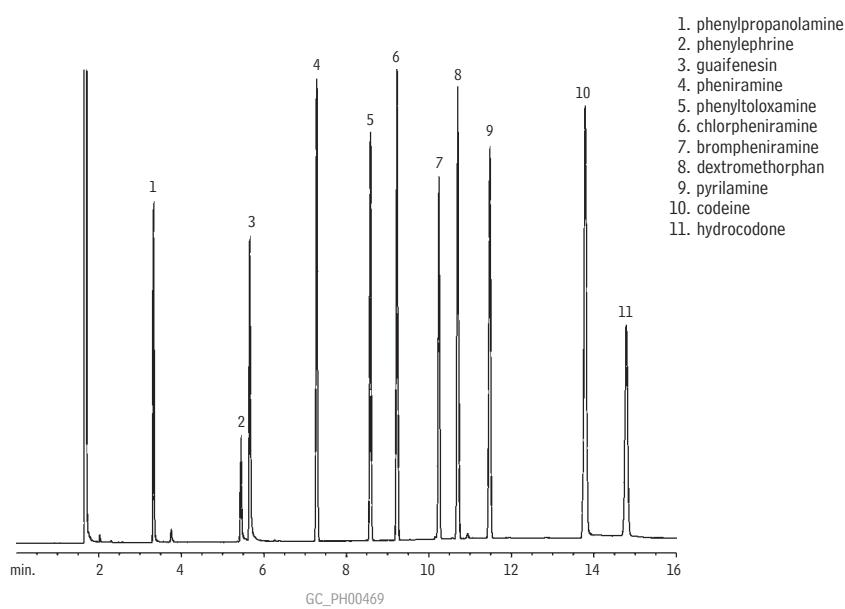
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Cold Medications (Basic Drugs) (Underivatized)

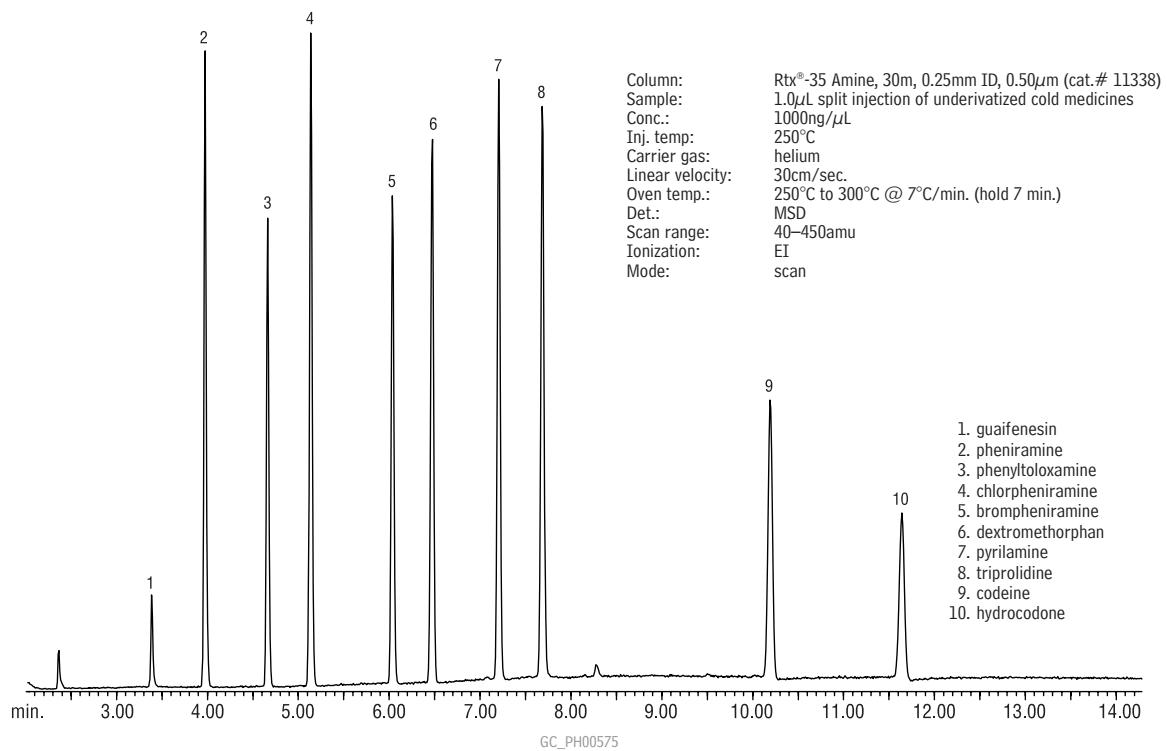
Rtx®-5 Amine



Column: Rtx®-5 Amine, 30m, 0.53mm ID, 1.0 μ m (cat.# 12355)
 Oven temp.: 175°C to 280°C @ 10°/min. (hold 5.5 min.)
 Inj./det. temp.: 250°C/280°C
 Carrier gas: helium
 Linear velocity: 40cm/sec.
 Sample size: 1 μ L
 Split vent flow: 88mL/min.
 Split ratio: 20:1

Cold Medications (Basic Drugs) (Underivatized)

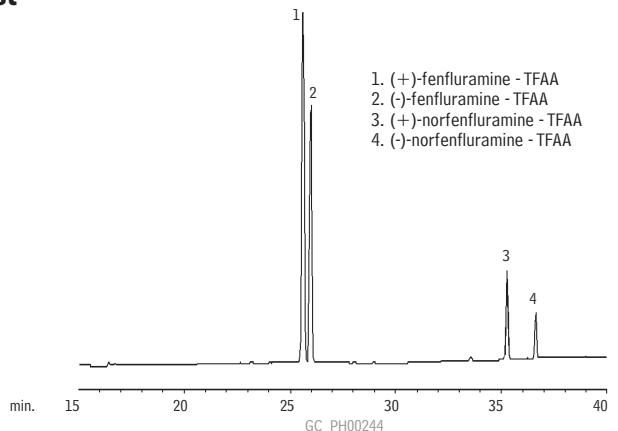
Rtx®-35 Amine



Chiral Analyses

Fenfluramine (TFAA Derivative)

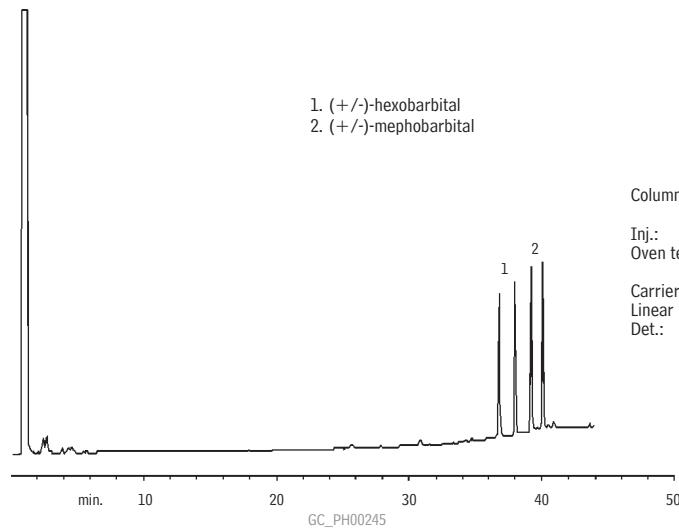
RtTM- β DEXcst



Column: RtTM- β DEXcst, 30m, 0.32mm ID, 0.25 μ m (cat.# 13102)
Inj.: On-column, 25ng/enantiomer
Oven temp.: 90°C (hold 1 min.) to 200°C @ 2°C/min. (hold 3 min.)
Carrier gas: hydrogen
Linear velocity: 80cm/sec. set @ 60°C
Det.: FID @ 220°C

Barbiturates (Underivatized)

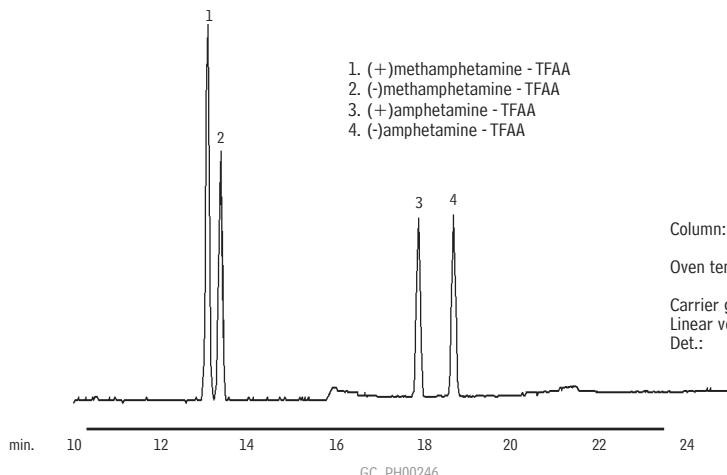
RtTM- β DEXcst



Column: RtTM- β DEXcst, 30m, 0.32mm ID, 0.25 μ m (cat.# 13102)
Inj.: On-column, 25ng/enantiomer
Oven temp.: 60°C (hold 1 min.) to 220°C @ 3°C/min.
Carrier gas: hydrogen
Linear velocity: 80cm/sec. set @ 60°C
Det.: FID @ 220°C

Amphetamine and Methamphetamine (TFAA Derivatives)

RtTM- β DEXcst

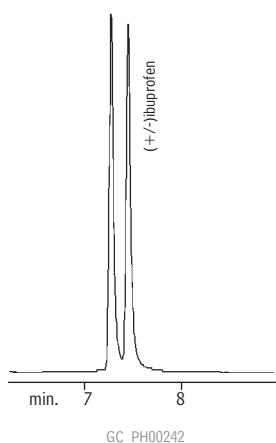


Column: RtTM- β DEXcst, 30m, 0.25mm ID, 0.25 μ m (cat.# 13103)
Oven temp.: 120°C (hold 1 min.) to 175°C @ 1.5°C/min.
Carrier gas: helium
Linear velocity: 25cm/sec. set @ 120°C
Det.: MSD @ 220°C

Chiral Analyses; Steroids

Ibuprofen (Underivatized)

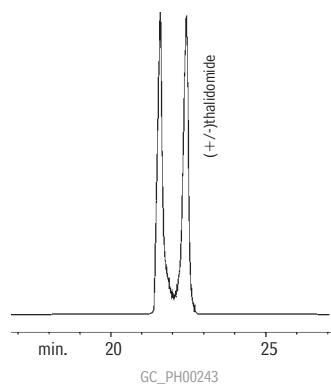
RtTM- β DEXsm



Column: RtTM- β DEXsm, 30m, 0.32mm ID, 0.25 μ m (cat.# 13104)
 Inj.: On-column, 125ng each enantiomer
 Oven temp.: 175°C to 200°C @ 2°C/min.
 Inj./det. temp.: 200°C/230°C
 Carrier gas: helium
 Linear velocity: 60cm/sec.
 Det.: GC/FID
 Split ratio: 13:1 using cup splitter inlet liner (cat.# 20709)

Thalidomide (Underivatized)

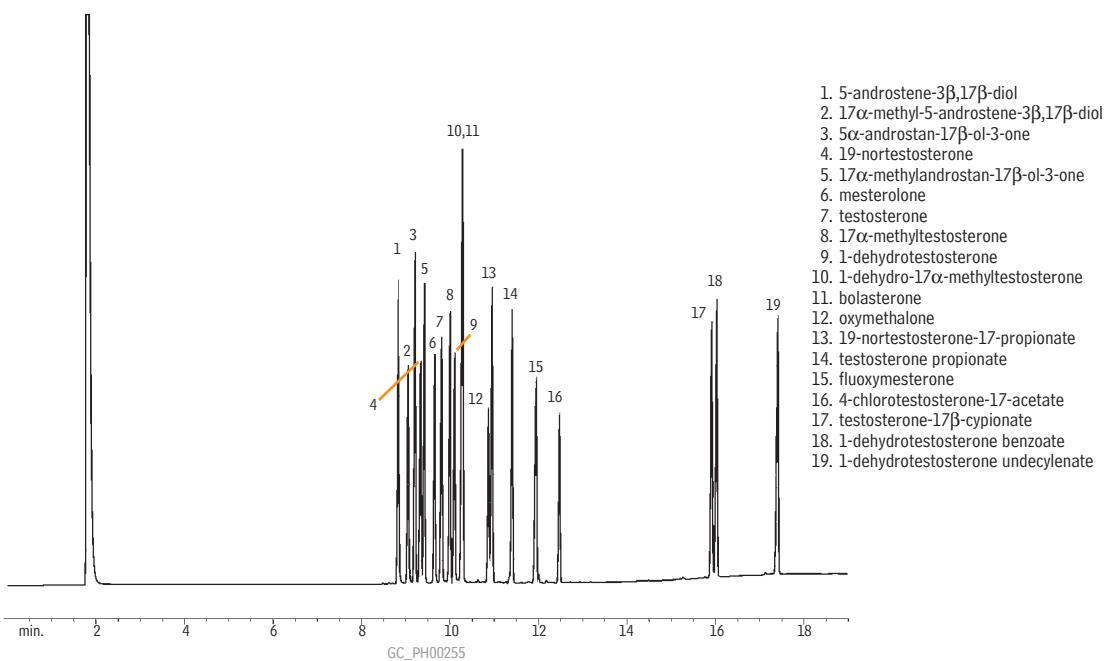
RtTM- β DEXcst



Column: RtTM- β DEXcst, 30m, 0.32mm ID, 0.25 μ m (cat.# 13102)
 Inj.: On-column, approximately 15ng each enantiomer
 Oven temp.: 200°C to 230°C @ 1°C/min.
 Inj./det. temp.: 200°C/230°C
 Carrier gas: hydrogen
 Linear velocity: 80cm/sec.
 Detector type: GC/FID
 Split ratio: 13:1 using cup splitter inlet liner (cat.# 20709)

Steroids, Anabolic (Underivatized)

Rtx[®]-5



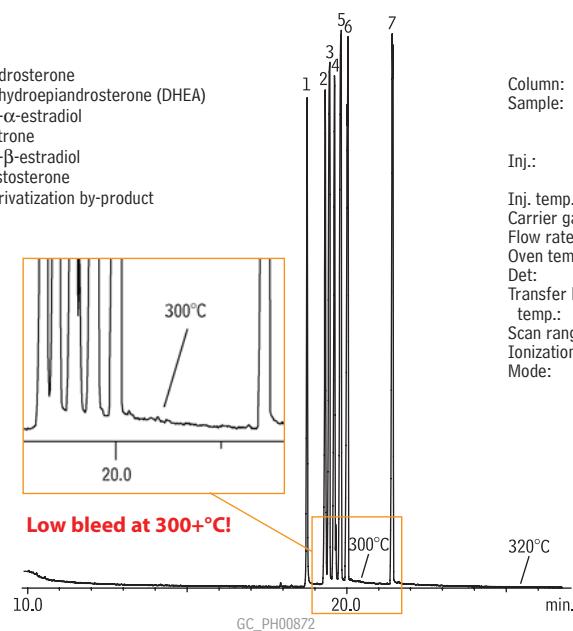
Column: Rtx[®]-5, 30m, 0.25mm ID, 0.10 μ m (cat.# 10208)
 Sample: 0.5 μ L split injection of anabolic steroids
 Conc.: 1000ng/ μ L
 Oven temp.: 180°C to 340°C @ 10°C/min. (hold 3 min.)
 Inj./det. temp.: 280°C/340°C
 Carrier gas: helium
 Linear velocity: 35cm/sec, set @ 180°C
 FID sensitivity: 1.28 x 10¹⁰ AFS
 Split ratio: 50:1

Steroids; Antidepressants

Steroids: Sex Hormones

Rxi®-1ms

1. androsterone
2. dehydroepiandrosterone (DHEA)
3. 17- α -estradiol
4. estrone
5. 17- β -estradiol
6. testosterone
7. derivatization by-product



Rxi® Technology!

Column:
Sample:

Rxi®-1ms, 30m, 0.25mm ID, 0.25 μ m (cat.# 13223)
100 μ g/ml each hormone in methanol or ethanol; compounds derivatized
using 2% methoxylamine HCl (CH₃ONH₂) in pyridine,

then N-trimethylsilylimidazole (TMSI), then analyzed
1.0 μ L splitless (hold 0.5 min.), 3.5mm single gooseneck inlet liner

(cat.# 20961)

1.0 μ L splitless (hold 0.5 min.), 3.5mm single gooseneck inlet liner

(cat.# 20961)

250°C

helium, constant flow

1mL/min.

100°C to 320°C @ 10°C/min. (hold 10 min.)

MS: Shimadzu 17A with QP5000

Transfer line

temp.:

280°C

Scan range:

40-700amu

Ionization:

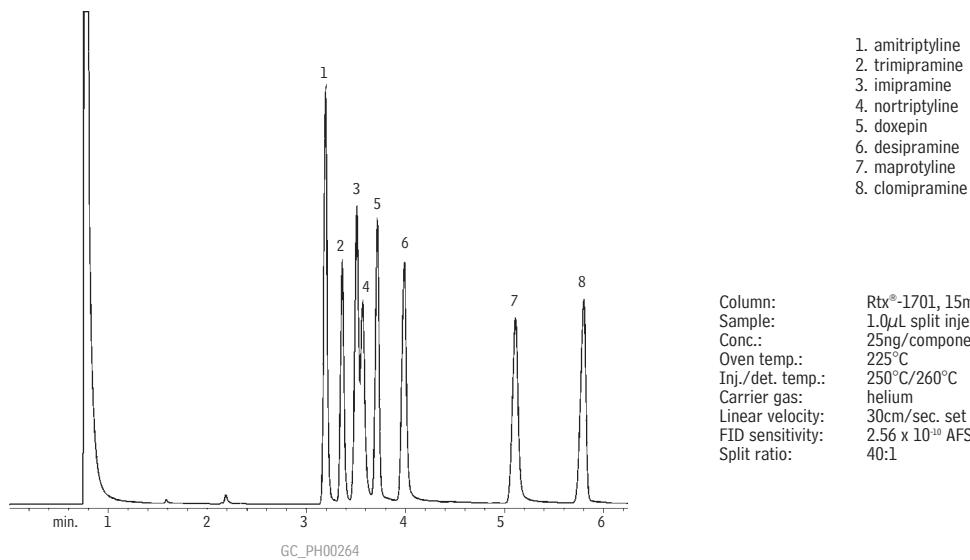
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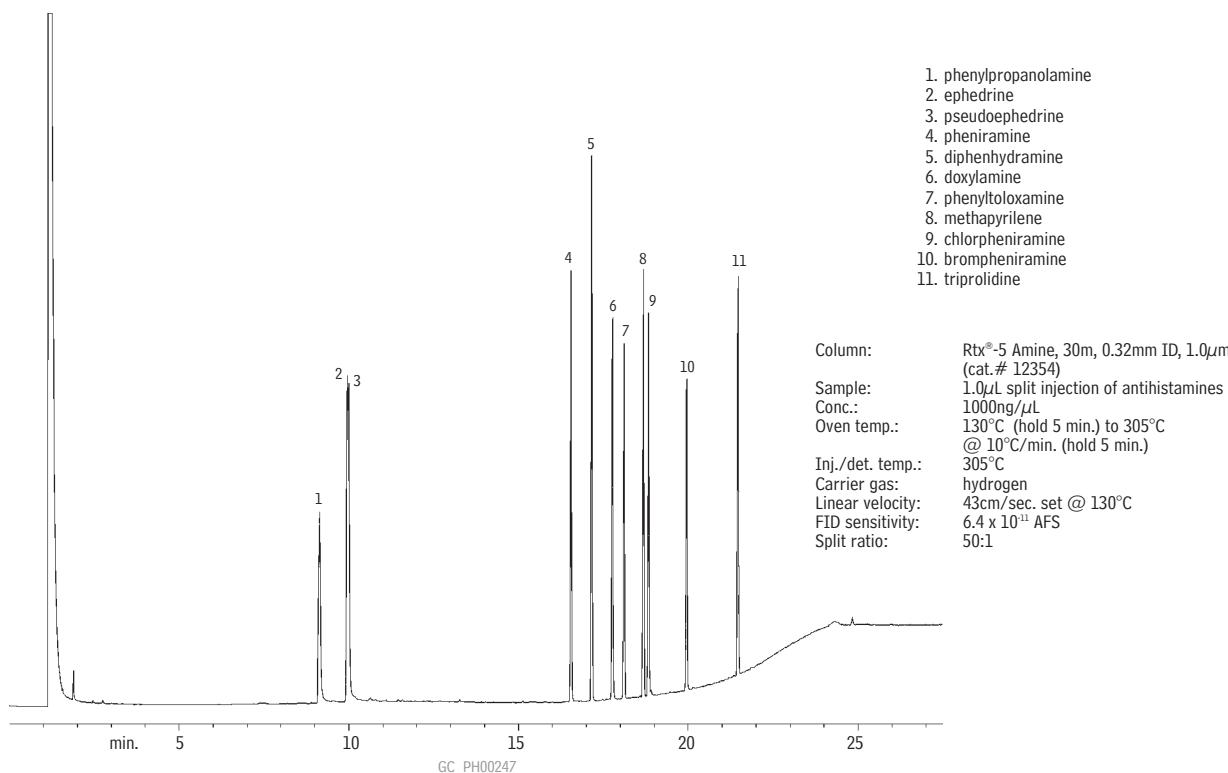
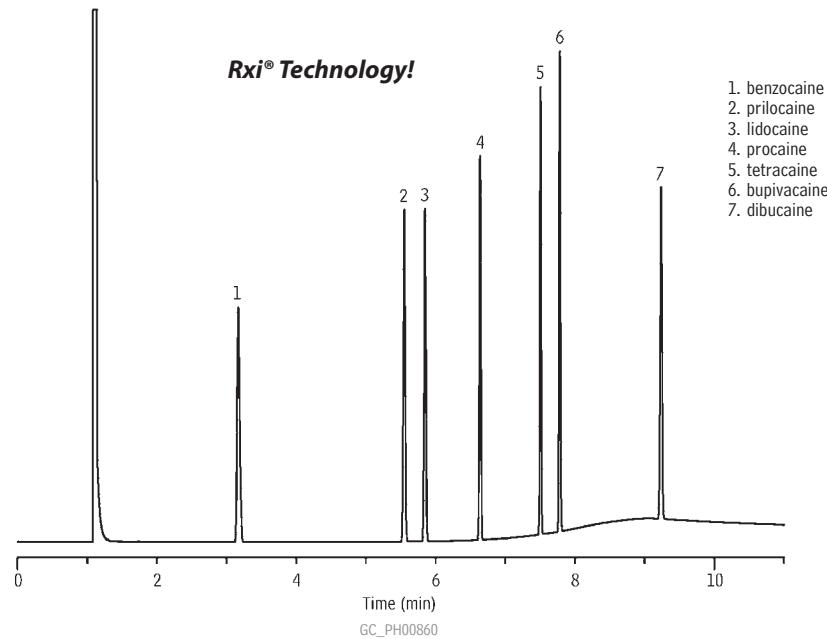
Mode:

scan

Antidepressants (Basic Drugs) (Underderivatized)

Rtx®-1701



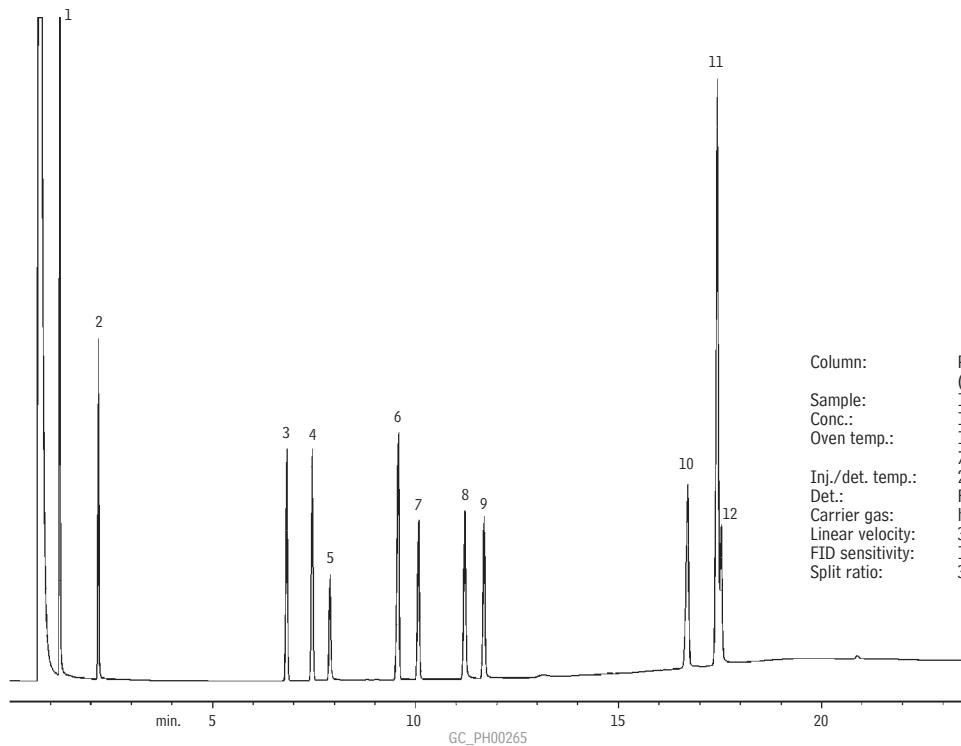
Underivatized Antihistamines (Basic Drugs)**Rtx®-5 Amine****Local Anesthetics****Rxi®-5ms**

Column: Rxi®-5ms, 30m, 0.53mm ID, 1.00 μ m (cat.# 13455)
Sample: 50 μ g/mL each component in methanol
Inj.: 1.0 μ L split (10:1), 4mm split inlet liner with wool (cat.# 20781)
Inj. temp.: 250°C
Carrier gas: helium, constant flow
Flow rate: 5.0mL/min.
Oven temp.: 200°C (hold 4 min.) to 320°C @ 30°C/min. (hold 3 min.)
Det.: FID @ 300°C

Antiepileptics

Antiepileptics (Underivatized)

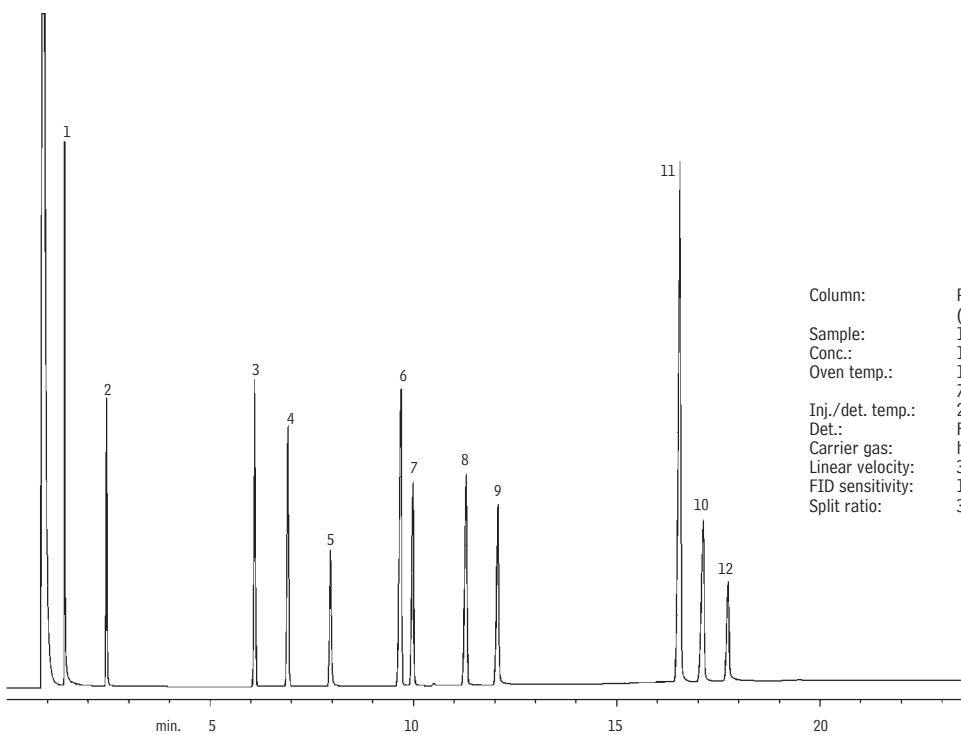
Rtx®-20



1. valproic acid
2. ethosuximide
3. methsuximide
4. phenoxsuximide
5. desmethyl methsuximide
6. mephénytoin
7. ethotoin
8. PEMA
9. phenobarbital
10. primidone
11. carbamazepine
12. diphenylhydantoin

Antiepileptics (Underivatized)

Rtx®-1701



Organic Volatile Impurities: Retention Time Index

	ICH Class	G16 Stabilwax®	G16 Rtx®-WAX	G43 Rtx®-1301	G27 Rxi®-5ms	G1 Rtx®-1	NA Rtx®-200
Retention time data collected using the following conditions:							
Column dimensions		30m, 0.25mm ID, 0.5µm df		30m, 0.25mm ID, 1.0µm df		60m, 0.53mm ID, 3.00µm df	
Phase ratio		125	63			43	
Oven program		40°C, hold 1 min., to 190°C @ 4°C/min., hold 15 min.			30°C, hold 4 min., to 220°C @ 4°C/min		
Carrier gas		helium	helium	helium	helium	helium	helium
Carrier flow (mL/min.)		1.2	1.2	1.2	1.1	6.3	7.8
Dead time (min.)		1.38 @ 45°C	1.40 @ 45°C	1.40 @ 45°C	1.49 @ 45°C	2.54 @ 35°C	2.22 @ 35°C

Compound

						Retention Time	
1,1,1-trichloroethane	1	3.96	3.49	5.43	5.40	10.82	8.35
1,1,2-trichloroethene	2	15.72	14.28	10.99	9.77	16.75	14.94
1,1-dichloroethene	1	2.23	2.04	2.79	4.41	5.73	4.16
1,2-dichloroethane	1	8.80	7.68	6.15	5.46	10.38	9.74
cis-1,2-dichloroethene	2	6.50	5.65	4.79	2.88	8.71	7.11
trans-1,2-dichloroethene	2	3.63	3.20	3.55	3.54	7.17	5.16
1,2-dimethoxyethane	2	4.80	4.18	6.03	5.54	10.98	10.63
1,4-dioxane	2	8.55	7.49	7.86	7.26	13.54	14.34
1-butanol	3	11.13	10.08	7.18	5.76	11.49	10.13
1-pentanol	3	14.95	13.75	11.19	9.44	16.99	14.95
1-propanol	3	7.69	6.80	4.20	3.37	6.81	6.13
2-butanol	3	7.25	6.44	5.08	4.16	8.51	7.69
2-ethoxyethanol	2	13.99	12.70	8.69	7.36	13.91	13.99
2-methoxyethanol	2	12.42	11.11	6.02	5.14	9.83	10.74
2-methyl-1-propanol	3	9.32	8.40	6.00	4.79	*	*
2-propanol	3	4.81	4.25	3.00	2.55	4.91	4.69
3-methyl-1-butanol	3	13.42	12.25	9.86	8.26	15.28	13.55
acetic acid	3	22.47	20.34	6.52	4.61	8.84	8.96
acetone	3	3.02	2.64	2.89	2.50	4.64	7.68
acetonitrile	2	6.91	5.83	3.28	2.47	4.32	8.89
anisole	3	18.65	17.09	17.12	16.28	25.00	22.84
benzene	1	5.23	4.54	5.98	3.83	11.63	9.17
butyl acetate	3	8.86	7.88	12.12	11.38	19.43	19.63
carbon tetrachloride	1	3.96	3.49	5.61	5.90	11.89	7.42
chlorobenzene	2	13.91	12.54	13.55	13.14	21.56	18.48
chloroform	2	7.31	6.41	5.23	4.64	9.18	6.66
cumene	3	12.36	11.17	16.66	16.69	25.88	20.90
cyclohexane	2	2.16	2.01	5.37	5.89	*	*
dichlormethane	2	5.01	4.33	3.31	3.06	5.87	4.88
dimethylsulfoxide	3	26.47	24.43	16.62	13.01	18.81	30.95
ethanol	3	4.98	4.37	2.52	2.19	4.03	3.80
ethyl acetate	3	4.08	3.56	4.87	4.44	9.04	10.35
ethyl benzene	2	10.72	9.58	13.86	13.81	22.54	18.18
ethyl ether	3	1.72	1.63	2.58	2.67	5.34	3.87
ethyl formate	3	3.16	2.78	3.00	2.78	5.46	6.48
ethylene glycol	2	28.06	26.23	10.77	6.63	12.59	13.86
formamide	2	32.99	30.93	11.85	7.30	12.72	19.93
formic acid	3	24.64	22.09	5.19	2.60	5.59	5.06
heptane	3	1.98	1.86	6.34	6.98	14.18	7.84
hexane	2	1.65	1.58	3.77	4.11	9.06	4.86
isobutyl acetate	3	6.99	6.18	10.39	9.69	17.35	18.02
isopropyl acetate	3	4.26	3.74	6.19	5.71	11.47	12.38
methanol	2	4.23	3.64	1.96	1.80	3.14	2.93
methyl acetate	3	3.19	2.80	3.17	2.93	5.80	7.10
methylbutyl ketone	2	9.10	8.05	11.81	10.50	17.94	20.81
methylcyclohexane	2	2.50	2.30	7.31	7.95	15.49	9.21
methylethyl ketone	3	4.33	3.76	4.90	4.09	7.99	11.55
methylisobutyl ketone	3	6.84	5.97	9.64	8.49	15.35	18.41
m-xylene	2	11.21	10.04	15.46	14.17	23.01	18.78
N,N-dimethylacetamide	2	20.75	19.01	12.95	13.96	21.42	30.00
N,N-dimethylformamide	2	18.04	16.26	13.09	10.23	16.52	26.19
nitromethane	2	11.82	10.31	4.84	3.53	6.30	12.01
N-methylpyrrolidone	2	29.84	27.86	25.09	21.85	29.99	38.08
o-xylene	2	12.79	11.51	15.46	15.26	24.23	20.33
pentane	3	1.49	1.45	2.39	2.62	5.36	3.29
propyl acetate	3	5.98	5.29	8.03	7.44	*	*
p-xylene	2	10.98	9.82	14.29	15.27	22.99	18.69
pyridine	2	12.64	11.24	9.60	8.57	15.40	16.45
sulfolane	2	47.62	43.31	34.02	28.90	36.76	48.67
tert-butylmethyl ether	3	1.94	1.82	3.50	3.59	7.52	5.73
tetrahydrofuran	3	3.63	3.19	5.12	4.90	9.81	9.48
tetralin	2	25.12	23.48	27.49	27.44	37.27	31.72
toluene	2	7.86	6.91	9.80	9.66	17.36	14.00
1,1-diethoxypropane	—	5.42	4.84	11.39	11.38	19.82	15.08
2,2-dimethoxypropane	—	3.11	2.79	5.48	5.55	11.37	8.67
2-chloropropane	—	1.96	1.82	2.67	2.66	5.20	4.61
2-methylpentane	—	1.58	1.52	3.22	3.56	7.72	4.32
acetaldehyde	—	2.05	1.85	1.86	1.84	3.14	3.90
chloroethane	—	1.83	1.71	2.14	2.10	3.97	3.55
chloromethane	—	1.63	1.55	1.70	1.70	3.01	2.73
ethylene oxide	—	2.05	1.86	1.89	2.02	3.59	3.92
formaldehyde	—	2.25	1.57	1.68	1.58	2.66	2.59
isoamyl acetate	—	10.51	9.43	14.84	14.18	22.80	22.62
isooctane	—	1.85	1.75	5.84	6.59	13.66	8.07
isopropyl ether	—	1.86	1.76	4.03	4.23	9.03	5.83
methyl cyclopentane	—	1.91	1.79	4.50	4.93	10.41	5.81
methyl isopropyl ketone	—	4.93	4.29	6.58	5.69	11.04	14.47
methylal	—	2.26	2.06	2.84	2.82	5.65	5.09
trichloroethene	—	6.50	5.70	7.07	7.05	13.58	9.75
water	—	8.24	7.18	1.74	1.68	2.75	2.57

Organic Volatile Impurities/Residual Solvents

Residual Solvents Class 1

Rtx®-624 column.

new!

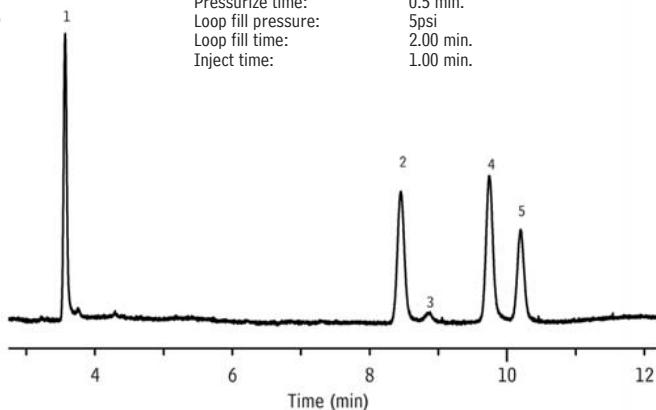
Column: Rtx®-624, 30m, 0.32mm ID, 1.8 μ m (cat.# 10970)
 Sample: USP <467> Class 1 standard solution (cat.# 36279) in 20mL headspace vial
 Inj.: headspace injection (split ratio 1:5), 1mm split liner, Siltek® deactivated (cat.# 20972-214.1)
 Inj. temp.: 140°C
 Carrier gas: helium, constant flow
 Flow rate: 2.16mL/min., 35.3cm/sec.
 Oven temp.: 40°C for 20 min. to 240°C @ 10°C/min. (hold for 20 min.)
 Det.: FID @ 240°C

Headspace Conditions

Instrument: Tekmar HT3
 Transfer line temp.: 105°C
 Valve oven temp.: 105°C
 Sample temp.: 80°C
 Sample equil. time: 45 min.
 Vial pressure: 10psi
 Pressurize time: 0.5 min.
 Loop fill pressure: 5psi
 Loop fill time: 2.00 min.
 Inject time: 1.00 min.

1. 1,1-dichloroethene
2. 1,1,1-trichloroethane
3. carbon tetrachloride
4. benzene
5. 1,2-dichloroethane

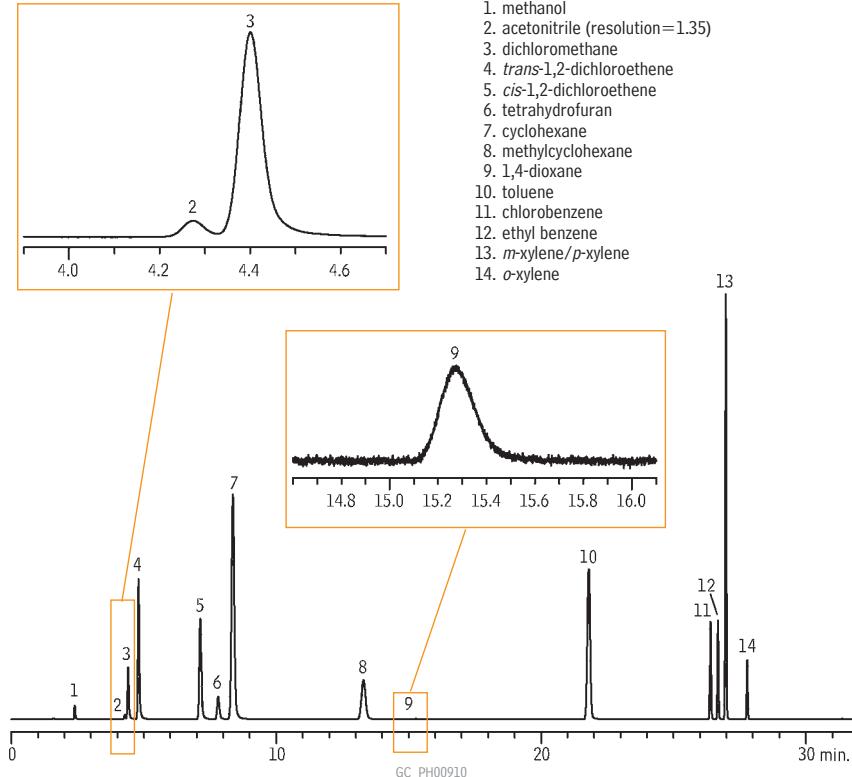
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Residual Solvents Class 2 Mixture A

Rtx®-624

new!



Column: Rtx®-624, 30m, 0.32 ID, 1.8 μ m (cat.# 10970)
 Sample: USP <467> Class 2 Mixture A standard solution (cat.# 36271) in 20mL headspace vial
 Inj.: headspace injection (split ratio 1:5), 1mm split liner, Siltek® deactivated (cat.# 20972-214.1)
 Inj. temp.: 140°C
 Carrier gas: helium, constant flow
 Flow rate: 2.16mL/min., 35.3cm/sec.
 Oven temp.: 40°C for 20 min. to 240°C @ 10°C/min. (hold for 20 min.)
 Det.: FID @ 240°C

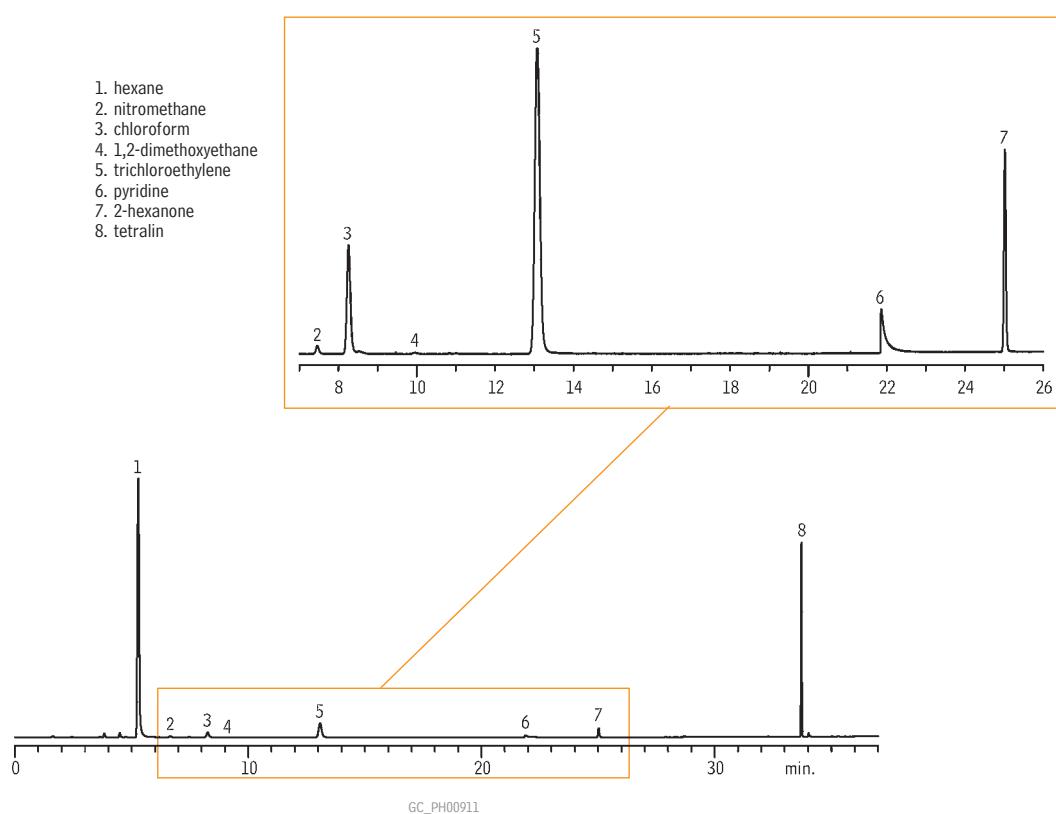
Headspace Conditions

Instrument: Tekmar HT3
 Transfer line temp.: 105°C
 Valve oven temp.: 105°C
 Sample temp.: 80°C
 Sample equil. time: 45 min.
 Vial pressure: 10psi
 Pressurize time: 0.5 min.
 Loop fill pressure: 5psi
 Loop fill time: 2.00 min.
 Inject time: 1.00 min.

Organic Volatile Impurities/Residual Solvents

Residual Solvents Class 2 Mixture B
Rtx®-624

new!



Column: Rtx®-624, 30m, 0.32mm ID, 1.8 μ m (cat.# 10970)
Sample: USP <467> Class 2 Mixture B standard solution (cat.# 36280) in 20mL headspace vial
Inj.: headspace injection (split ratio 1:5), 1mm split liner Siltek® deactivated (cat.# 20972-214.1)
Inj. temp.: 140°C
Carrier gas: helium, constant flow
Flow rate: 2.16mL/min., 35.3cm/sec.
Oven temp.: 40°C for 20 min. to 240°C @ 10°C/min. (hold for 20 min.)
Det.: FID @ 240°C

Headspace Conditions
Instrument: Tekmar HT3
Transfer line temp.: 105°C
Valve oven temp.: 105°C
Sample temp.: 80°C
Sample equil. time: 45 min.
Vial pressure: 10psi
Pressurize time: 0.5 min.
Loop fill pressure: 5psi
Loop fill time: 2.00 min.
Inject time: 1.00 min.

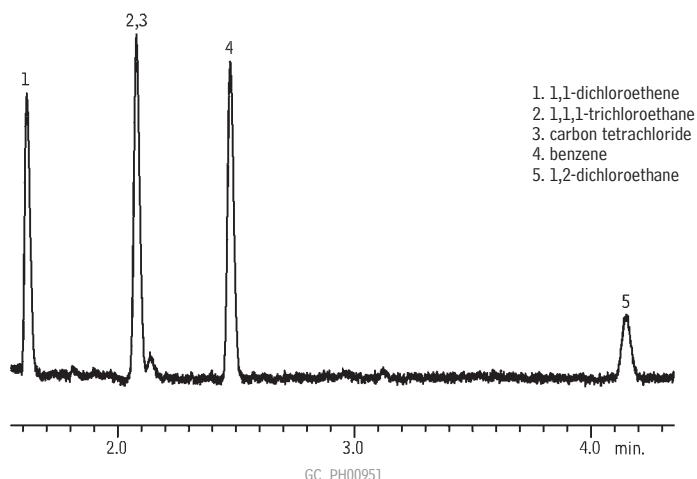
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Organic Volatile Impurities/Residual Solvents

Residual Solvents Class 1

Stabilwax® (G16)

new!



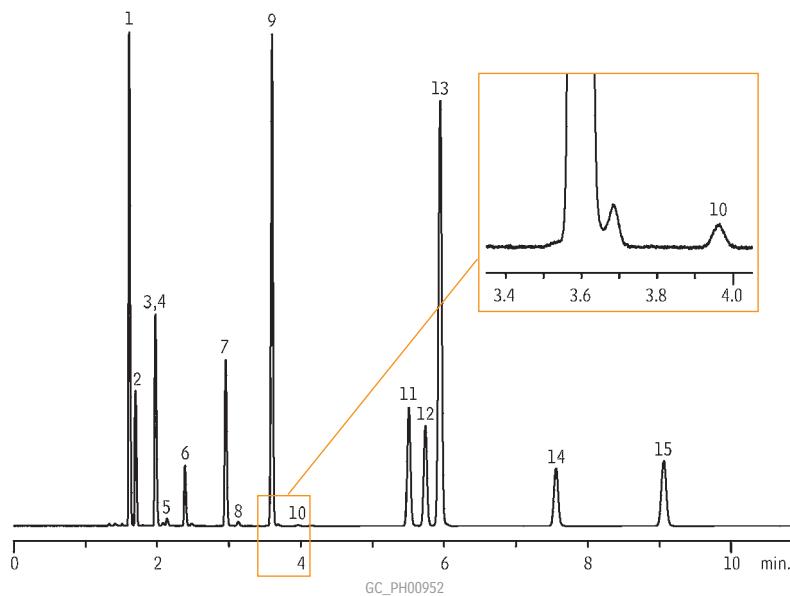
1. 1,1-dichloroethene
2. 1,1,1-trichloroethane
3. carbon tetrachloride
4. benzene
5. 1,2-dichloroethane

Column: Stabilwax®, 30m, 0.32mm ID, 0.25µm (cat.# 10624) Headspace Conditions
 Sample: USP Stock Mixture USP<467> Residual Instrument: Overbrook Scientific HT200H
 Solvents Class 1 Mix (cat.# 36279) in Syringe temp.: 100°C
 20mL headspace vial (cat.# 24685), Sample temp.: 80°C
 water diluent Sample equil. time.: 45 min.
 Inj.: headspace injection (split ratio 1:5), Injection vol.: 1.0mL
 2mm splitless liner IP deactivated Injection speed: setting 8
 (cat.# 20712) Injection dwell: 5 sec.
 Inj. temp.: 140°C
 Carrier gas: helium, constant flow
 Flow rate: 2.15mL/min., 35.2cm/sec.
 Oven temp.: 50°C for 20 min. to 165°C @ 6°C/min.
 (hold for 20 min.)
 Det.: FID @ 250°C

Residual Solvents Class 2

Stabilwax® (G16)

new!



1. cyclohexane
2. methylcyclohexane
3. *trans*-1,2-dichloroethene
4. tetrahydrofuran
5. methanol
6. dichlormethane
7. *cis*-1,2-dichloroethene
8. acetonitrile
9. toluene
10. 1,4-dioxane
11. ethyl benzene
12. *p*-xylene
13. *m*-xylene
14. *o*-xylene
15. chlorobenzene

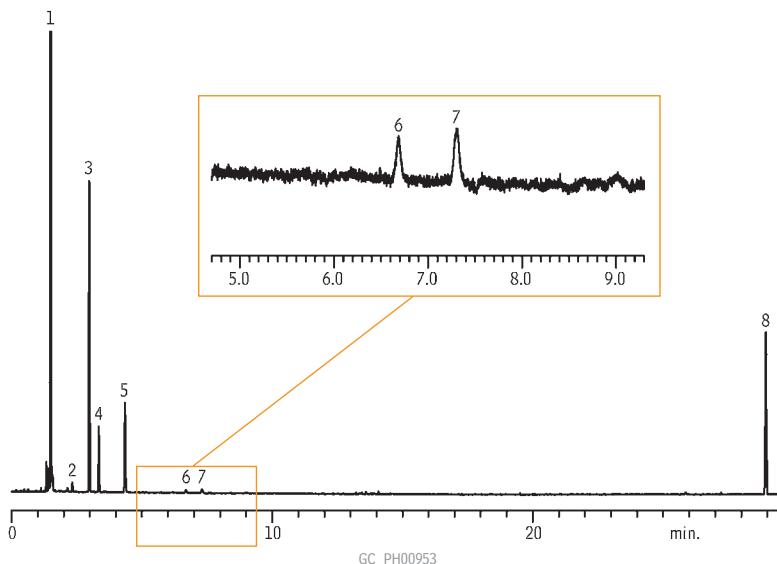
Column: Stabilwax®, 30m, 0.32mm ID, 0.25µm (cat.# 10624)
 Sample: USP Stock Standard Residual Solvents Class 2 Mix A (cat.# 36271) in 20mL headspace vial (cat.# 24685), water diluent
 Inj.: headspace injection (split ratio 1:5), 2mm splitless liner IP deactivated (cat.# 20712)
 Inj. temp.: 140°C
 Carrier gas: helium, constant flow
 Flow rate: 2.15mL/min., 35.2cm/sec.
 Oven temp.: 50°C for 20 min. to 165°C @ 6°C/min.
 (hold for 20 min.)
 Det.: FID @ 250°C

Headspace Conditions
 Instrument: Overbrook Scientific HT200H
 Syringe temp.: 100°C
 Sample temp.: 80°C
 Sample equil. time.: 45 min.
 Injection vol.: 1.0mL
 Injection speed: setting 8
 Injection dwell: 5 sec.

Organic Volatile Impurities/Residual Solvents

Residual Solvents Class 2 Stabilwax® (G16)

new!



1. hexane
2. 1,2-dimethoxyethane
3. trichloroethylene
4. chloroform
5. 2-hexanone
6. nitromethane
7. pyridine
8. tetralin

Column: Stabilwax®, 30m, 0.32mm ID, 0.25 μ m (cat.# 10624)
 Sample: USP Stock Standard Residual Solvents Class 2 Mix B (cat.# 36272) in 20mL headspace vial (cat.# 24685), water diluent
 Inj.: headspace injection (split ratio 1:5), 2mm splitless liner IP deactivated (cat.# 20712)
 Inj. temp.: 140°C
 Carrier gas: helium, constant flow
 Flow rate: 2.15mL/min., 35.2cm/sec.
 Oven temp.: 50°C for 20 min. to 165°C @ 6°C/min. (hold for 20 min.)
 Det.: FID @ 250°C

Headspace Conditions
 Instrument: Overbrook Scientific HT200H
 Syringe temp.: 100°C
 Sample temp.: 80°C
 Sample equil. time.: 45 min.
 Injection vol.: 1.0mL
 Injection speed: setting 8
 Injection dwell: 5 sec.

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Organic Volatile Impurities/Residual Solvents

Organic Volatile Impurities

Rtx®-200 & Rtx®-WAX



Columns: Rtx®-200, 60m, 0.25mm ID, 1.0 μ m (cat.# 15056)
 Rtx®-Wax, 2m, 0.18mm ID, 0.3 μ m (custom)
 Sample: 0.2 μ L mix of 69 neat organic volatile impurities
 Instrument: Agilent 6890 with LECO liquid nitrogen cryojet modulator
 Inj.: split/不分流, split ratio 600:1; gas saver: 20mL/min. after 1 min.;
 4mm ID split inlet liner w/wool (cat.# 20781); injection with band formation (fast injection)
 Inj. temp.: 250°C
 Carrier gas: helium, constant flow
 Flow rate: 1.5mL/min.
 Oven temp.: Rtx®-200: 35°C (9 min.) to 220°C @ 3°C/min. (hold 1 min.);
 Rtx®-Wax: 65°C (9 min.) to 250°C @ 3°C/min. (hold 1 min.)
 Modulation: modulator offset: 30°C; 2nd dimension separation: 4 sec.; hot pulse: 0.3 sec.;
 cool between stages: 1.7 sec.
 Det: FID @ 250°C; hydrogen: 40mL/min.; air: 450mL/min.; make-up gas: 45mL/min.; sampling rate: 200Hz

did you know?

GCxGC Separations

Separation of the complete list of International Conference on Harmonization Class 1, Class 2, and Class 3 organic volatiles requires at least two, and often three, separate analyses on differing capillary GC columns. While many laboratories do not monitor for the complete list, separation of OVIs still is a challenge, often characterized by long runtimes and incomplete separations.

Using comprehensive GCxGC, it is possible to resolve all of these target compounds, in a single analysis, with less than a 1-hour run time. In this approach, results for which are shown above, two columns of differing selectivity are used to separate the compounds in a 2-dimensional plot. Various detectors also can be employed, including time-of-flight mass spectrometry, to yield reliable information for the entire target compound list in a single analysis.

For more about GCxGC, visit our website and review the article on pages 4-5 of Restek Advantage 2005, vol. 1 (lit. cat.# 59077), or enter GCxGC in the search feature.

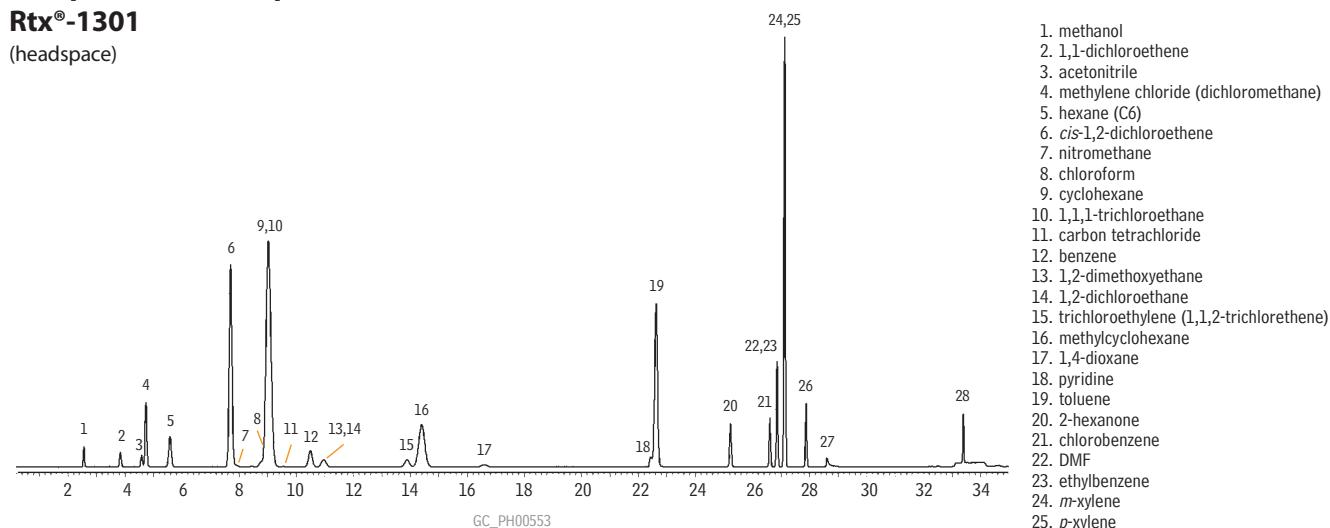
Organic Volatile Impurities/Residual Solvents

Residual Solvents

European Pharmacopoeia Class 1 and Class 2

Rtx®-1301

(headspace)



Column: Rtx®-1301, 30m, 0.53mm ID x 3.0 μ m (cat.# 16085)

Sample: Headspace injection of 28 Class 1 and 2 residual solvents for pharmaceutical processing. Prepared at the regulatory limit concentration, using samples shaken and heated at 80°C for 15 min., 1mL headspace injection.

Oven temp.: 40°C (hold 20 min.) to 240°C @ 10°C/min. (hold 20 min.)

Inj./det. temp.: 200°C/250°C

FID sensitivity: 1.1 x 10⁻¹¹ AFS

Carrier gas: hydrogen @ 35cm/sec.

Split ratio: 2:1

1. methanol
2. 1,1-dichloroethene
3. acetonitrile
4. methylene chloride (dichloromethane)
5. hexane (C6)
6. cis-1,2-dichloroethene
7. nitromethane
8. chloroform
9. cyclohexane
10. 1,1,1-trichloroethane
11. carbon tetrachloride
12. benzene
13. 1,2-dimethoxyethane
14. 1,2-dichloroethane
15. trichloroethylene (1,1,2-trichlorethane)
16. methylcyclohexane
17. 1,4-dioxane
18. pyridine
19. toluene
20. 2-hexanone
21. chlorobenzene
22. DMF
23. ethylbenzene
24. m-xylene
25. p-xylene
26. o-xylene
27. N,N-dimethylacetamide
28. 1,2,3,4-tetrahydronaphthalene

Organic Volatile Impurities

USP <467>

Rtx®-G43

(static headspace)

Column: Rtx®-G43, 30m, 0.53mm ID, 3.0 μ m (cat.# 16085-126)
Sample: USP <467> Calibration Mixture #5 (cat.# 36007) in DMSO stock standard. To each 22mL headspace vial 5mL water, ~ 1.0g of sodium sulfate and 100 μ L of stock standard were added.
The preparation yielded the following concentrations,

	Retention Time (min.)	Sample Concentration (μ g/mL)
1. dichloromethane	5.110	12.0
2. chloroform	9.285	1.2
3. benzene	11.173	0.04
4. trichloroethylene	14.647	1.6
5. 1,4-dioxane	17.436	7.6

Inj.: static headspace injection (see static headspace conditions)

Inj. temp.: 180°C

Carrier gas: helium, split 2:1

Linear velocity: 5mL/min., constant flow

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

Det.: FID @ 250°C

hydrogen flow: 40mL/min.

air flow: 450mL/min.

make-up flow: 45mL/min.

Static Headspace (Loop) Conditions:

Instrument: Teldyne Tekmar HT3

Valve oven temp.: 150°C

Transfer line temp.: 150°C

Standby flow rate: 10mL/min.

Platen/sample temp.: 80°C

Platen temp equil. time: 2.00 min.

Sample equil. time: 15.00 min.

Mixer time: 2.00 min.

Mixing level: 5

Mixer stabilize time: 0.50 min.

Pressurize: 15 psi

Pressurize time: 2.00 min.

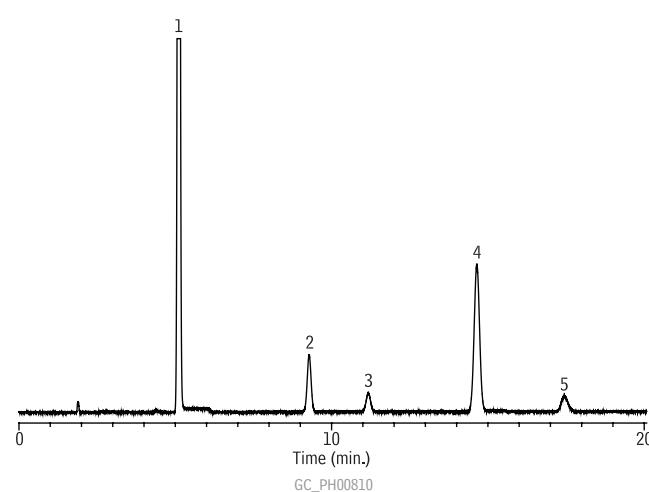
Pressurize equil. time: 0.50 min.

Loop fill pressure: 5 psi

Loop fill time: 2.00 min.

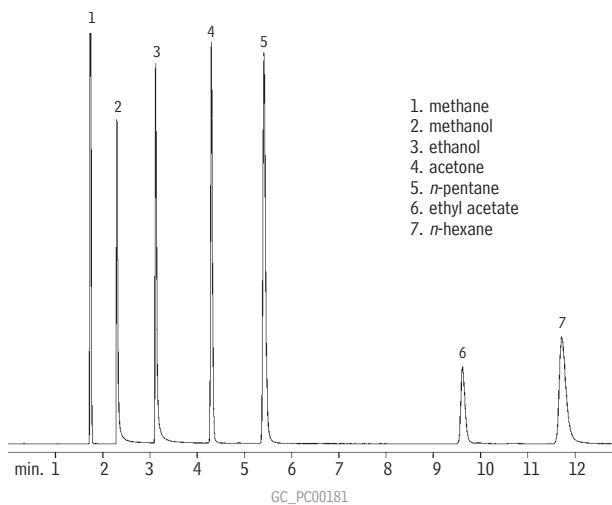
Loop fill equil. time: 0.50 min.

Inject time: 1.00 min.



Solvents

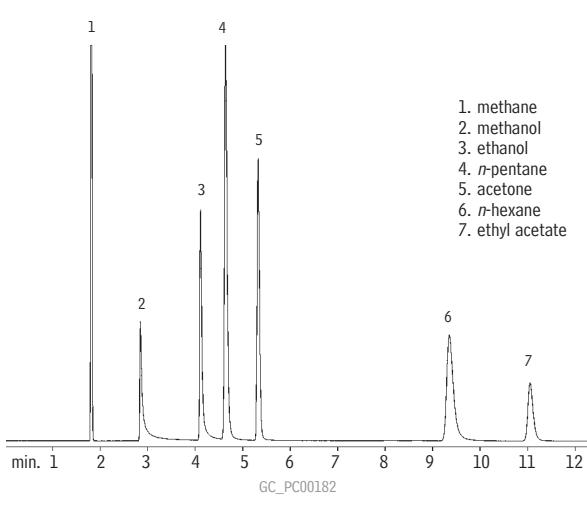
Solvents, Polar RtTM-QPLOT



- 1. methane
- 2. methanol
- 3. ethanol
- 4. acetone
- 5. n-pentane
- 6. ethyl acetate
- 7. n-hexane

Column: RtTM-QPLOT, 30m, 0.32mm ID (cat.# 19718)
Sample: 20 μ L split injection, 50ppm (w/v) each in helium,
Cyclo splitter[®] inlet liner (cat.# 20755)
Oven temp.: 150°C
Inj./det. temp.: 200°C
Carrier gas: hydrogen
Det.: FID
Split ratio: 20/1

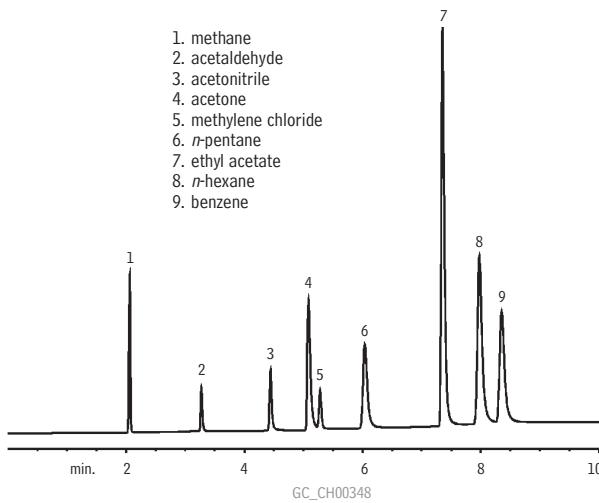
Solvents, Polar RtTM-UPLot



- 1. methane
- 2. methanol
- 3. ethanol
- 4. n-pentane
- 5. acetone
- 6. n-hexane
- 7. ethyl acetate

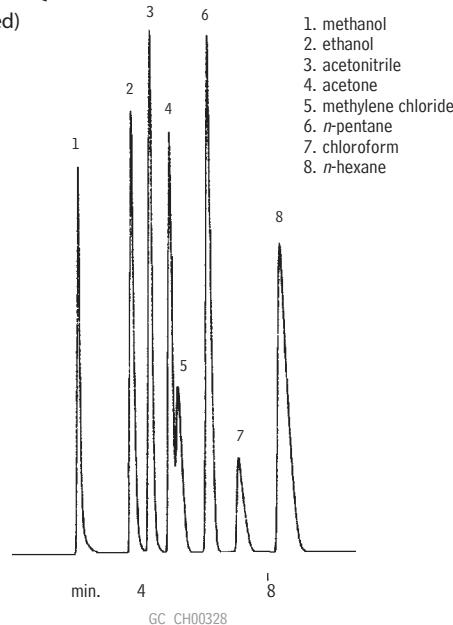
Column: RtTM-UPLot, 30m, 0.32mm ID (cat.# 19724)
Sample: 20 μ L split injection, 50ppm (w/v) each in helium,
Cyclo splitter[®] inlet liner (cat.# 20755)
Oven temp.: 150°C
Inj./det. temp.: 200°C
Carrier gas: hydrogen
Detector: FID
Split ratio: 20/1

Solvents RtTM-QPLOT



Column: RtTM-QPLOT, 30m, 0.53mm ID (cat.# 19716)
Sample: 70 μ L split injection of solvent mixture
Oven temp.: 100°C to 220°C @ 15°C/min. (hold 2 min.)
Inj./det. temp.: 220°C
Carrier gas: helium
Linear velocity: 23.6cm/sec. set @ 100°C
FID sensitivity: 1.28 x 10¹⁰ AFS
Split ratio: 7.7:1
Split: 44.5cc/min.
Column flow: 6.6cc/min.

Solvents HayeSep[®] Q (micropacked)

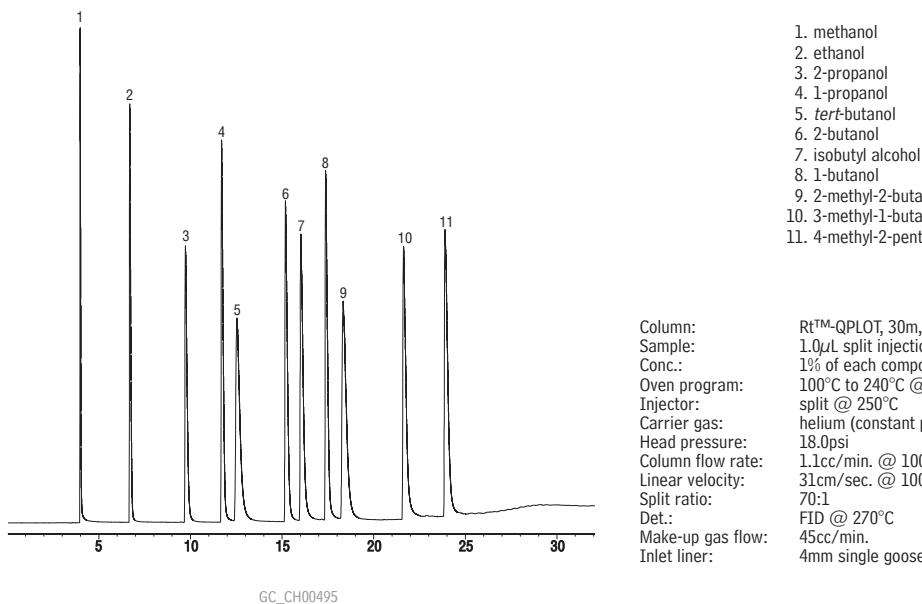


- 1. methanol
- 2. ethanol
- 3. acetonitrile
- 4. acetone
- 5. methylene chloride
- 6. n-pentane
- 7. chloroform
- 8. n-hexane

Column: HayeSep[®] Q, 2m, 1mm ID (cat.# 19017)
Sample: 1 μ L direct injection of a neat solvent mixture
Oven temp.: 80°C to 180°C @ 16°C/min. (hold 5 min.)
Inj./det. temp.: 200°C
Carrier gas: helium
Flow: 20mL/min. set @ 40°C
FID sensitivity: 512 x 10¹¹ AFS

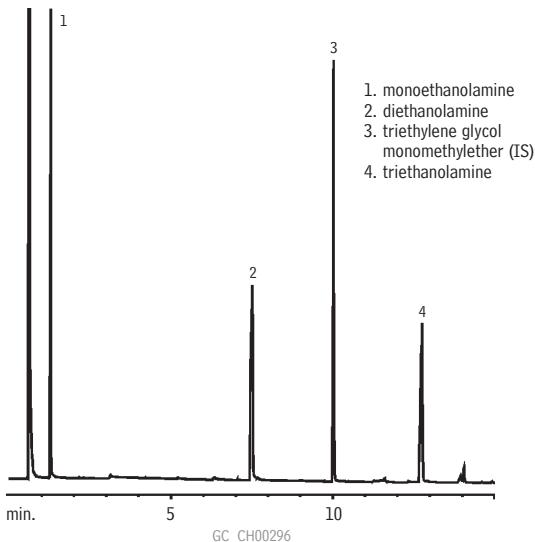
Alcohols

RtTM-QPLOT



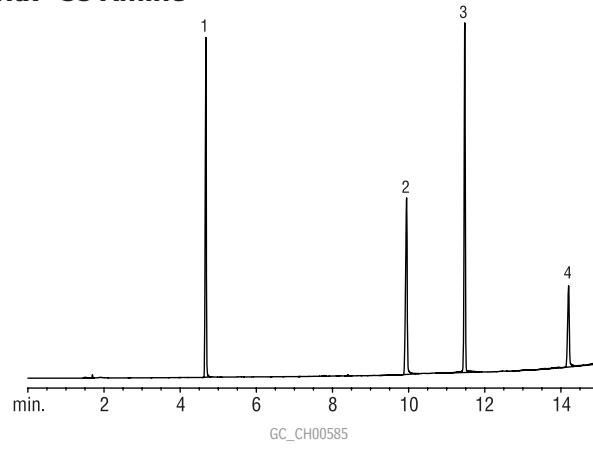
Ethanolamines

Rtx[®]-5 Amine



Ethanolamines

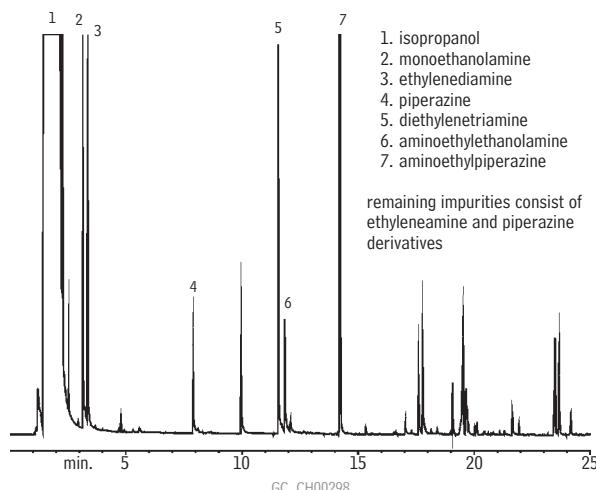
Rtx[®]-35 Amine



Amines; Amines & Phenols

Ethyleneamines

Rtx[®]-5 Amine

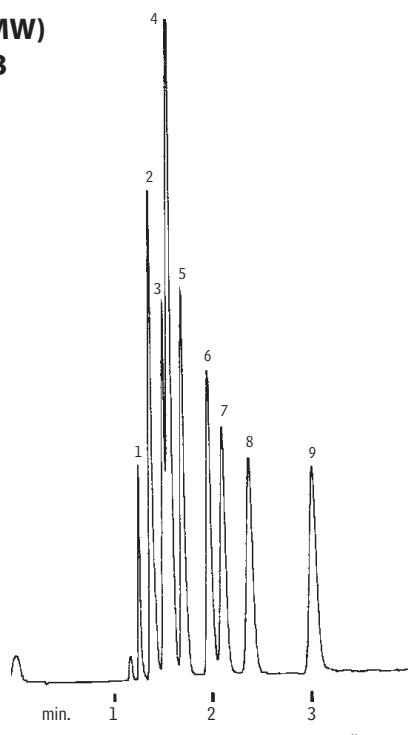


Column: Rtx[®]-5 Amine, 30m, 0.25mm ID, 0.50 μ m (cat.# 12338)
 Sample: 3.0 μ L split injection of ethyleneamine industrial sample
 On-column conc.: ~5-80ng
 Oven temp.: 40°C (hold 4 min.) to 315°C
 @ 10°C/min. (hold 5 min.)
 Inj./det. temp.: 315°C
 Carrier gas: hydrogen
 Linear velocity: 43cm/sec. set @ 40°C
 FID sensitivity: 6.4 x 10¹¹ AFS
 Split ratio: 20:1

Amines (low MW)

Stabilwax[®]-DB

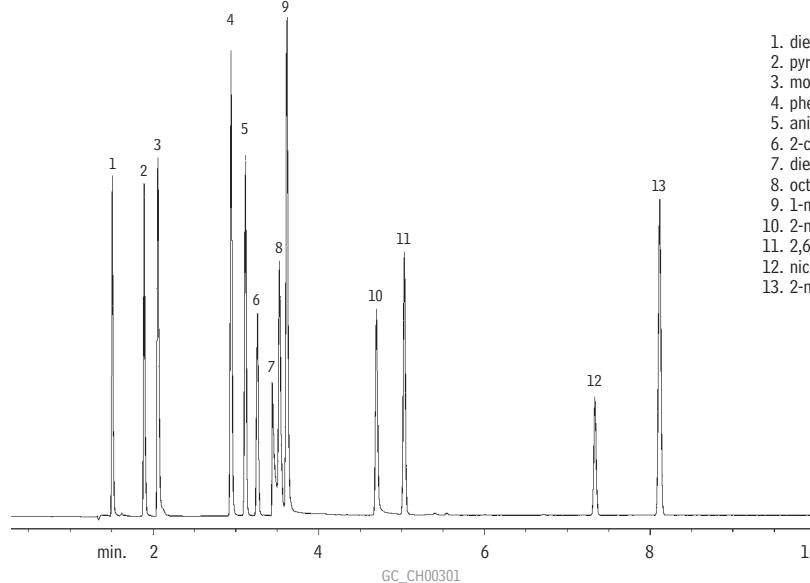
1. trimethylamine
 2. dimethylamine
 3. ethylamine
 4. methylamine
 5. isopropylamine
 6. n-propylamine
 7. tert-butylamine
 8. diethylamine
 9. sec-butylamine



Column: Stabilwax[®]-DB, 30m, 0.53mm ID, 1.0 μ m (cat.# 10855)
 Sample: 1.0 μ L direct injection of amines in water
 Oven temp.: 45°C
 Inj./det. temp.: 250°C
 Carrier gas: hydrogen
 Linear velocity: 40cm/sec. (flow rate: 5cc/min.)
 FID sensitivity: 1 x 10¹¹ AFS
 Recommended inlet liner: Uniliner[®]

Amines & Phenols

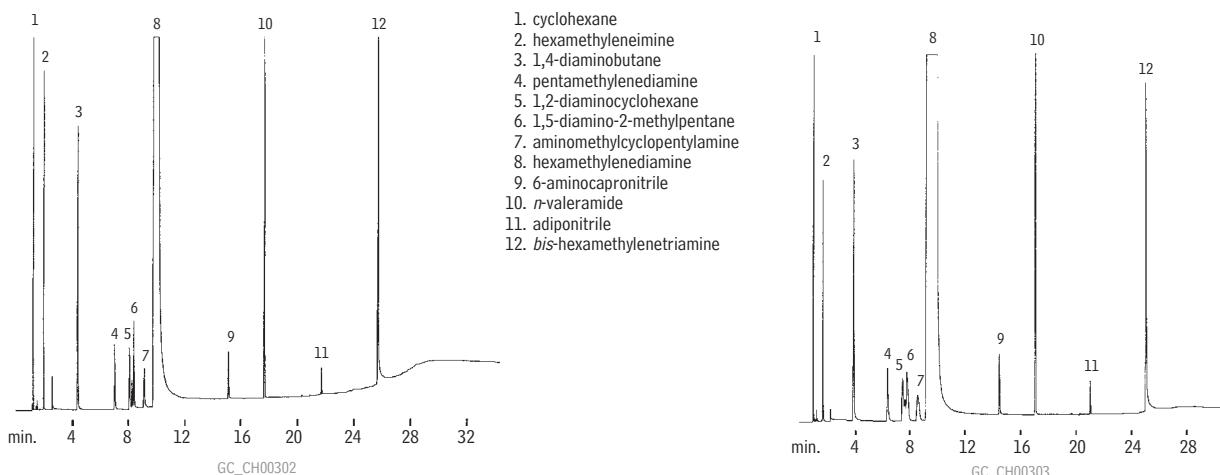
Rtx[®]-5 Amine



1. diethylamine
 2. pyridine
 3. morpholine
 4. phenol
 5. aniline
 6. 2-chlorophenol
 7. diethylenetriamine
 8. octylamine
 9. 1-methyl-2-pyrrolidinone
 10. 2-nitrophenol
 11. 2,6-dimethylaniline
 12. nicotine
 13. 2-nitroaniline

Column: Rtx[®]-5 Amine, 30m, 0.32mm ID, 1.0 μ m (cat.# 12354)
 Sample: 1.0 μ L split injection of amines and phenols in water
 On-column conc.: 22ng
 Oven temp.: 120°C to 220°C @ 10°C/min.
 Inj./det. temp.: 305°C
 Carrier gas: hydrogen
 Linear velocity: 38cm/sec. set @ 120°C
 FID sensitivity: 6.4 x 10¹¹ AFS
 Split ratio: 25:1

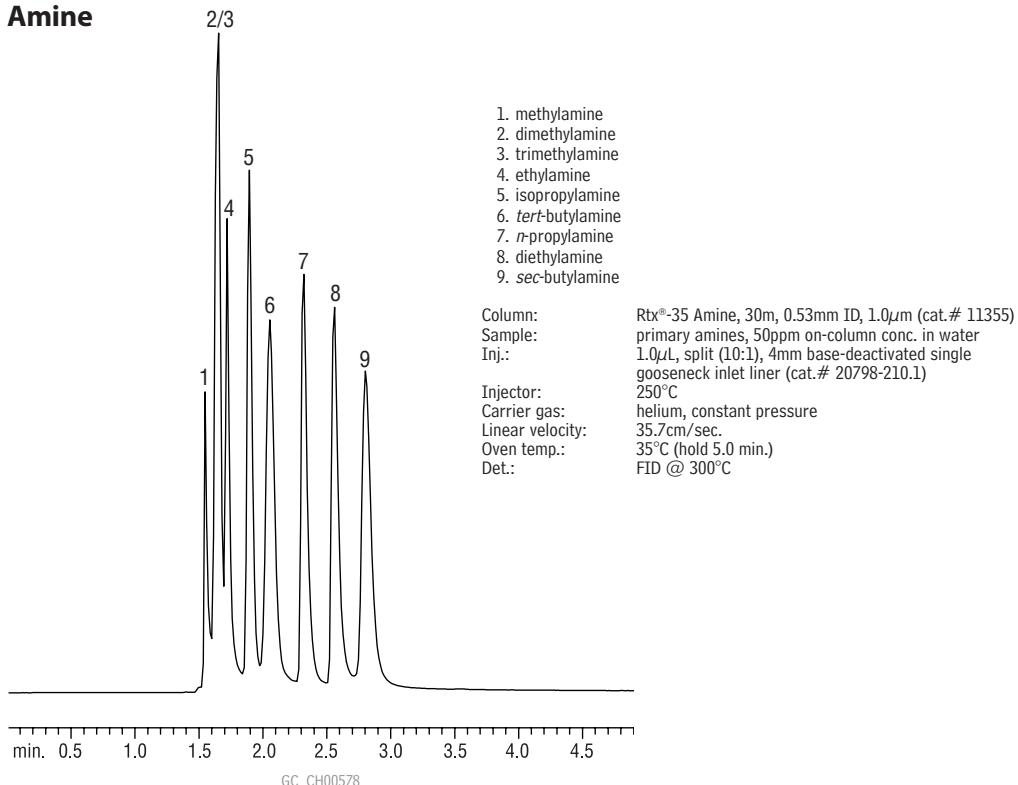
Hexamethylenediamine Stabilwax®-DB



Column: Stabilwax®-DB, 30m, 0.32mm ID, 0.25 μ m (cat.# 10824)
 Sample: 0.4 μ L direct injection of a neat hexamethylenediamine sample
 On-column conc.: 10 to 1000ng/component
 Oven temp.: 95°C (hold 6 min.) to 235°C @ 7°C/min. (hold 4 min.)
 Inj./det. temp.: 250°C
 Carrier gas: hydrogen
 Linear velocity: 40cm/sec.
 FID sensitivity: 2 x 10⁻¹¹ AFS

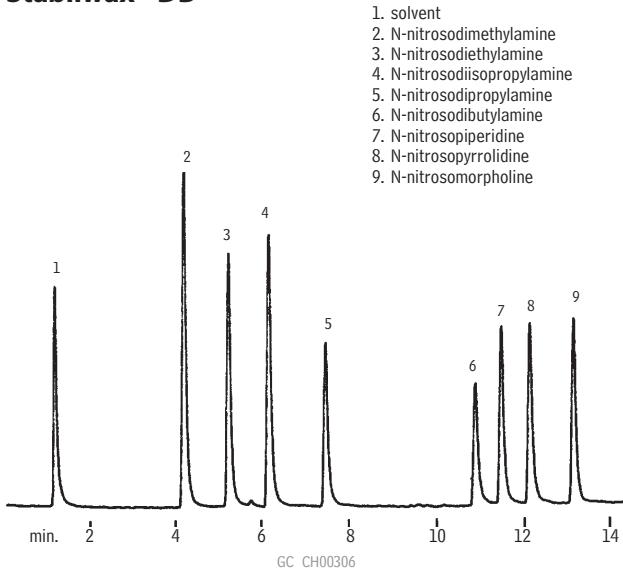
Column: Stabilwax®-DB, 30m, 0.53mm ID, 0.5 μ m (cat.# 10840)
 Sample: 0.2 μ L direct injection of a neat hexamethylenediamine sample onto a Uniliner® inlet liner
 Oven temp.: 95°C (hold 6 min.) to 235°C @ 7°C/min. (hold 2 min.)
 Inj./det. temp.: 255°C
 Carrier gas: hydrogen
 Linear velocity: 40cm/sec. (flow rate: 5cc/min.)
 FID sensitivity: 64 x 10⁻¹¹ AFS

Amines, Primary Rtx®-35 Amine



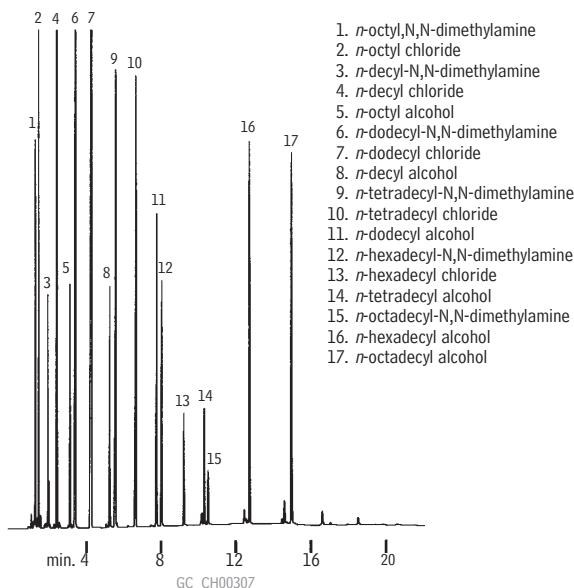
Nitrosamines; Amines/Alcohols/Chlorides; Chlorofluorocarbons

Nitrosamines Stabilwax®-DB



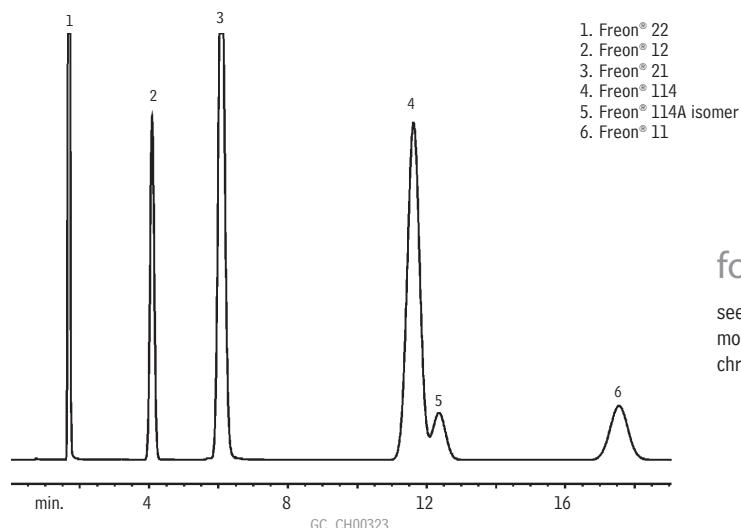
Column: Stabilwax®-DB, 60m, 0.53mm ID, 1.0 μ m (cat.# 10858)
Sample: Direct injection of nitrosamines
Conc.: 1.0 μ g/mL
Oven temp.: 100°C (hold 1 min.) to 170°C @ 5°C/min.
Inj./det. temp.: 200°C
Carrier gas: helium
Linear velocity: 100cm/sec. (flow rate: 15cc/min.)
Det.: TSD

Amines/Alcohols/Chlorides Stabilwax®



Column: Stabilwax®, 30m, 0.53mm ID, 0.25 μ m (cat.# 10625)
Inj.: 0.5 μ L split injection
Oven temp.: 100°C to 250°C @ 8°C/min. (hold 5 min.)
Inj./det. temp.: 250°C
Carrier gas: hydrogen
Linear velocity: 40cm/sec. (flow rate: 5.2cc/min.)
FID sensitivity: 128 x 10⁻¹¹ AFS
Split ratio: 40:1

Chlorofluorocarbons 5% Krytox on 60/80 CarboBlack B (packed)



for more info

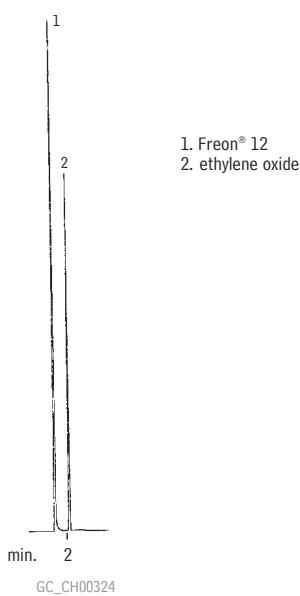
see pages 684 & 733 for
more chlorofluorocarbon
chromatograms.

Column: 5% Krytox on 60/80 CarboBlack B, 3.05m, $\frac{1}{8}$ " OD,
2.1mm ID SilcoSmooth™ stainless steel tubing
(cat.# 80127-800)
Inj.: 1 μ L injected, concentration 20% each component
Oven temp.: 50°C
Inj./det. temp.: 200°C/250°C
Carrier gas: nitrogen @ 30mL/min.
Det.: FID

Chlorofluorocarbons; Cresylic Acids

Freon® 12 & Ethylene Oxide

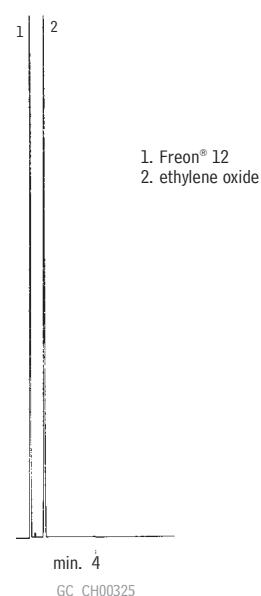
Rtx®-1



Column: Rtx®-1, 30m, 0.53mm ID, 5.0 μ m (cat.# 10179)
Sample: 50 μ L split injection of Freon® 12 and ETO
Oven temp.: 25°C
Inj./det. temp.: 290°C
Carrier gas: hydrogen
Linear velocity: 40cm/sec.
FID sensitivity: 4 x 10⁻¹¹ AFS
Split vent: 40:1

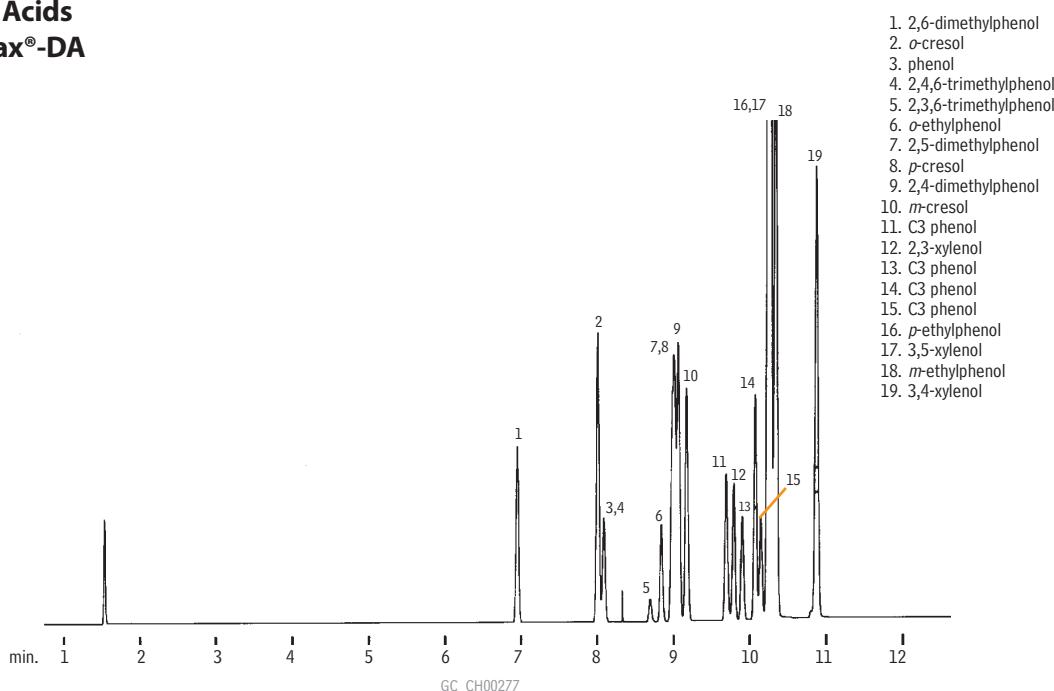
Freon® 12 & Ethylene Oxide

Rtx®-200



Column: Rtx®-200, 30m, 0.53mm ID, 3.0 μ m (cat.# 15085)
Sample: 50 μ L direct injection of Freon® 12 and ETO
Oven temp.: 25°C
Inj./det. temp.: 290°C
Carrier gas: hydrogen
Linear velocity: 40cm/sec. (flow rate: 5.2cc/min.)

Cresylic Acids Stabilwax®-DA



Column: Stabilwax®-DA, 30m, 0.25mm ID, 0.50 μ m (cat.# 11038)
Sample: Wet needle split injection of cresylic acids
Oven temp.: 180°C (hold 2 min.) to 260°C @ 2°C/min.
Inj./det. temp.: 250°C
Carrier gas: hydrogen
Linear velocity: 40cm/sec. (flow rate: 3.2cc/min.)
FID sensitivity: 64 x 10⁻¹¹ AFS
Split ratio: 40:1

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2,3-dimethylpentane	.638, 642	EPTC	.483, 589, 601	eucalyptol	.644, 667, 677
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methyl isobutyl ketone	.640, 641, 702	neryl acetate	.659, 660, 662, 663	octanoic acid	.60, 664, 666
methyl mercaptan	.669, 696	nicotine	.57, 708, 712, 713, 730	octanol	.659, 660, 663
methyl methacrylate	.87, 568 - 571	2-nitroaniline	.39, 57, 76, 584 - 588, 590, 591, 730	3-octanol	.55, 659 - 661
methyl methanesulfonate	.586	3-nitroaniline	.39, 76, 584 - 588, 590, 591	3-octanone	.55, 661
methyl myristate	.60, 666	4-nitroaniline	.39, 76, 584 - 588, 590, 591	1-octen-3-ol	.55, 660, 661

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(+/-)l-octen-3-ol	.645	phenobarbital	.710, 711, 720
octyl acetate	.659	phenol	.39, 57, 76, 575, 583 - 588, 590, 591, 664, 730, 733
3-octyl acetate	.659	phenol-d6	.39, 76, 578, 584 - 588, 590, 591, 601
octyl alcohol	.55, 661	phenothiazine	.712 - 714
n-octyl alcohol	.732	phensuximide	.720
octylamine	.57, 730	phentermine	.708, 709
n-octyl chloride	.732	phenylacetaldehyde	.55, 661
n-octyl-N,N-dimethylamine	.732	1,4-phenylenediamine	.586
n-octyl phenol	.623	phenylephrine	.708, 715
tert-octyl phenol	.623	2-phenylethanol	.60, 664, 666
oleic acid	.681	2-phenylethyl acetate	.664
omethoate	.602, 603	2-phenylethyl decanoate	.664
Ordram	.609	phenylethylamine	.708
oxadiazon	.609	phenylpropanolamine	.708, 709, 715, 719
oxychlordane	.672	phenyltoloxamine	.712, 713, 715, 719
oxycodone	.705	phorate	.77, 483, 598 - 601
oxygen	.96, 116, 682, 683	phosmet	.77, 598 - 600
oxymethalone	.717	phosphamidon	.77, 598 - 600, 672
oxymorphone	.705	phosphamidon isomer	.77, 598 - 600
Paarlan	.609	phthalide	.664
palmitic acid	.681	picloram	.606, 608
palmitoleic acid	.681	picloram methyl ester	.605, 606
papaverine	.712, 713	2-picoline	.87, 569, 570, 586
parathion-ethyl	.77, 598 - 600	α -pinene	.658 - 660, 663
parathion-methyl	.77, 598 - 600	(+/-) α -pinene	.644
PBDEs	.618	β -pinene	.658 - 660, 663
PBEB	.619	(+/-) β -pinene	.644
pebulate	.589	piperazine	.730
PEMA	.720	piperitone	.660
pendimethalin	.483, 601	pirimiphos methyl	.602, 603, 672
pentachloroanisole	.605, 606, 608	prazepam	.712 - 714
pentachlorobenzene	.586	prilocaine	.704, 705, 719
2,2',3,4,5'-pentachlorobiphenyl	.617	primidone	.710, 711, 720
2,2',4,5,5'-pentachlorobiphenyl	.617	procaine	.704, 705, 719
2,3,3',4',6-pentachlorobiphenyl	.617	prochlorperazine	.714
pentachloroethane	.87, 568 - 571, 586	α -prodine	.705
pentachloronitrobenzene	.586	profenos	.602, 603
pentachlorophenol	.39, 76, 575, 583 - 591	promazine	.714
pentadecane	.35	promethazine	.714
n-pentadecane	.694, 695	prometon	.483, 583, 589, 601, 604, 608
pentafluorobenzene	.87, 568 - 570	prometryne	.589, 604, 608
(+/-) δ -pentalactones	.645	pronamide	.589
pentamethylenediamine	.59, 731	propachlor	.483, 589, 601, 609
pentanal	.54	propadiene	.95, 115, 684, 685, 687
pentane	.110, 114, 115, 117, 694, 696	propanal	.54
n-pentane	.95, 97, 115, 626, 638, 684 - 687, 694, 695, 728	propane	.95, 114, 115, 117, 638, 684 - 687, 696
1-pentanol	.55, 661	n-propane	.695
pentatriacontane	.627	1-propanol	.639, 729
n-pentatriacontane	.628	2-propanol	.631, 729
1-pentene	.114, 115	n-propanol	.71, 74, 572, 573, 665, 676, 699
cis-2-pentene	.114, 115, 638	propargyl alcohol	.87, 569, 570
trans-2-pentene	.114, 115, 638	propazine	.483, 589, 601, 604, 608, 609
pentobarbital	.710, 711	propene	.685
n-pentyl phenol	.623	4-propenyl-2,6-dimethoxyphenol	.664
cis-permethrin	.589	propionic acid	.60, 649, 664, 666
trans-permethrin	.589	propionitrile	.568, 571
perylene-d12	.39, 76, 576 - 578, 584 - 591, 601, 672	propiovanillone	.664
PETN	.86, 625	n-propyl acetate	.87, 569, 570
petroleum wax	.691	n-propylamine	.730, 731
α -phellandrene	.659, 660, 663	propylbenzene	.670
phenacetin	.586, 704, 705	n-propylbenzene	.87 - 89, 565 - 571, 638, 639, 688, 694, 695
phenanthrene	.39, 41, 76, 85, 578 - 582, 584 - 591	propylene	.95, 114, 115, 117, 638, 641, 684, 685, 687, 696
phenanthrene-d10	.39, 76, 576 - 578, 583 - 591, 601, 672	propylene glycol	.634, 635, 700
phencyclidine	.706, 712	1,2-propylene glycol	.635
phendimetrazine	.708	1,3-propylene glycol	.635
pheniramine	.715, 719	propyne	.95, 684, 687
phenmetrazine	.708		
		propyzamide	.586, 589
		Prowl	.609
		pseudoephedrine	.708, 709, 719
		pulegone	.660
		pyrazophos	.602, 603
		pyrene	.39, 41, 76, 85, 578 - 582, 584 - 591
		pyrene-d10	.39, 76, 576, 584, 585, 587 - 589
		pyridine	.33, 34, 39, 57, 74, 76, 87, 569, 570, 584 - 588, 590, 723, 725, 727, 730
		pyrilamine	.712, 713, 715
		quinalphos	.603
		quinclorac	.606
		quinclorac methyl ester	.606
		RDX	.86, 625
		rhamnitol	.674, 675
		ribitol	.674, 675
		Ro-Neet	.609
		ronnel	.77, 598 - 600
		(+)-(2R,4S)-cis-rose oxide	.644
		(-)(2S,4R)-cis-rose oxide	.644
		(+)-(2S,4S)-trans-rose oxide	.644
		(-)(2R,4R)-trans-rose oxide	.644
		sabinene	.644, 658 - 660, 663
		trans-sabinenehydrate	.659, 660
		safrole	.586
		scopolamine	.712, 713
		secbumeton	.604, 608, 609
		secobarbital	.710, 711
		Sencor	.609
		siloxane	.664
		Silvex	.606
		simazine	.483, 589, 601, 604, 608, 609, 621
		simetryne	.589, 604, 608
		sinapic acid	.664
		β -sitosterol	.52, 673
		Sonar	.589
		stearic acid	.681
		stigmasterol	.52, 673
		stirofos	.77, 589, 598 - 600
		styrene	.51, 87 - 89, 565 - 571, 638 - 641, 670, 671
		sulfotep	.77, 598 - 600
		Sutan	.609
		syringealdehyde	.664
		2,4,5-T	.606 - 608
		2,4,5-T methyl ester	.605, 606
		talbutal	.711
		TBP	.603
		1,2,3,4-TCDD	.622
		1,2,3,7-TCDD	.622
		1,2,3,8-TCDD	.622
		1,2,6,7-TCDD	.622
		1,2,7,8-TCDD	.622
		1,4,7,8-TCDD	.622
		2,3,7,8-TCDD	.84, 622
		TCDF	.84
		tebuthiuron	.589
		temazepam	.712 - 714
		TEPP	.77, 598 - 600
		terbacil	.589, 609
		terbufos	.77, 483, 583, 589, 598 - 601
		terbumeton	.609
		terbutylazine	.604, 608, 609
		terbutryne	.589, 604, 608
		p-terphenyl-d14	.39, 76, 577, 578, 584 - 588, 590, 591, 601
		(-/-)terpinen-4-ol	.644
		α -terpinene	.659, 660, 663
		γ -terpinene	.658 - 660, 663
		terpinene-4-ol	.659, 660, 663

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(+/-)- α -terpineol	644	toluene	51, 66, 73, 74, 87 - 89, 565 - 571, 626, 628, 629, 631, 638 - 642, 670, 671, 687 - 690, 694, 695, 702, 704, 722, 724, 727	trimipramine	712, 713, 718
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γ -terpineol	668	2,4,5-TP (Silvex)	606 - 608	trinitrotoluene86, 625
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testosterone propionate717	triacosan664	tripelennamine712, 713
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1,2,4,5-tetrachlorobenzene586	triazolam712 - 714	triprolidine715, 719
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2,2,5,5'-tetrachlorobiphenyl617	2,4,6-tribromophenol39, 76, 578, 583 - 588, 590, 591, 601	(S)- γ -undecalactone648
2,3',4,4'-tetrachlorobiphenyl617	tributyl phosphate77, 598 - 600, 602	undecanal54
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1,1,2,2-tetrachloroethane87 - 89, 565 - 571, 638, 640, 641	trichlorfon77, 598 - 600	1-undecanol35
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2,3,5,6-tetrachlorophenol39, 76, 584 - 588, 590	2,2',5-trichlorobiphenyl617	valeric acid649, 664
2,4,5,6-tetrachloro- <i>m</i> -xylene79, 81, 592 - 597, 617	2,4',5-trichlorobiphenyl617	<i>n</i> -valeric acid649
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<i>n</i> -tetradecyl chloride732	1,2,3-trichloropropane87 - 89, 565 - 571, 620, 621, 636, 637	vinylcyclohexene51
<i>n</i> -tetradecyl-N,N-dimethylamine732	1,1,1-trichloropropanone621	4-vinylguaiacol664
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