GC CHROMATOGRAMS

GC Chromatograms by Column Phase Index 543-544

EPA Method Chart 544

Environmental 545-610
Air, Brominated Flame Retardants, Chlorinated Disinfection Byproducts, Diesel Range Organics (DRO), Dioxins, Endocrine Disruptors, Explosives, Gasoline Range Organics (GRO), Glycols, Haloacetic Acids, Herbicides, Organo Tins, PCB Mixtures, Pesticides, Semivolatiles, Volatiles

Foods, Flavors & Fragrances 611-641
Antioxidants/Preservatives, Chiral Separations, Cholesterols, Essential Oils, FAMEs, Fatty Acids, Flavors, Food Contaminants, Food Testing, Fragrances, Sterols, Sugars, Triglycerides

Personal Care & Cleaning Products 642-643
Cleaning Solvents

Petroleum & Petrochemicals 644-664
Chlorofluorocarbon Gases, Fuels, Hydrocarbon Gases, Hydrocarbons, Hydrocarbons (Simulated Distillation), Hydrocarbons (High-Temperature), Permanent Gases, Sulfur Compounds

Clinical, Forensic & Toxicology 665-674
Abused Inhalants, Alkyl Nitrates, Anesthetics, Arson Accelerants, Blood Alcohols, Cannabinoids, Cocaine, GHB/GBL, Glycols, Opiates, Solvents

Forensic/Pharmaceutical 675-683
Acidic/Neutral Drugs, Barbiturates, Basic Drugs, Benzodiazepines, Cold Medications, Phenothiazines, Sympathomimetic Amines

Pharmaceutical 684-700
Anesthetics, Antiepileptics, Basic Drugs, Chiral Analyses, Organic Volatile Impurities/Residual Solvents, Pesticides in Dietary Supplements, PGIs, Steroids

Solvents & Chemicals 701-707
Alcohols, Aldehydes, Amines, Chlorides, Chlorofluorocarbons, Cresylic Acids, Ketones, Nitrosamines, Phenols, Solvents

GC Chromatograms by Column Phase (Alphabetical Order)

Capillary Columns

FAMEWAX
FAMEs 70, 620, 622
MXT®-1 Sim Dist
hydrocarbons (high temp.) 660
MXT®-1HT Sim Dist
hydrocarbons (high temp.) 78, 79, 658, 659
MXT®-5
phenols 553
MXT®-500 Sim Dist
hydrocarbons (high temp.) 660
MXT®-Biodiesel TG
biodiesel oils 81, 644, 645
Rt®-2330
dioxins (TCDDs) 591
FAMEs 621
sugars 640
Rt®-2560
FAMEs ....57, 69, 617 - 619
Rt®-βDEXcst
flavors, fragrances 613
pharmaceuticals 686, 687
Rt®-βDEXsa
flavors, fragrances 612, 613
Rt®-βDEXse
fruit juices 614
Rt®-βDEXsm
flavors, fragrances 612
pharmaceuticals 687
Rt®-γDEXsa
fruit juices 614
Rt®-TCEP
aromatics 655
oxygenates 80
Rtx®-1
air (Mass APH) 610
air (TO-14/TO-15 compounds) 409, 606, 608, 609
chlorofluorocarbons 707
essential oils 626, 627
fatty acids (free) 615
flavor volatiles 628
fragrances 641
hydrocarbons 658
hydrocarbons (gases) 650
ozone precursors 606
simulated distillation 661
sulfur compounds 664
Rtx®-5
chlorinated disinfection byproducts 589
chlorophenoxyacid herbicides 580
diesel range organics (DRO) 600
drugs of abuse 673
endocrine disruptors 592
essential oils 625
gasoline range organics (GRO) 596, 597, 599
haloacetic acids 603
pharmaceuticals (basic) 677, 681, 682
phenols 553
steroids 687
sterol 623
sympathomimetic amines 677
Rtx®-5 Amine
amines 64, 703, 704
amines, phenols 705
cold medications 683
pharmaceuticals (basic) 676, 683, 691
sympathomimetic amines 676
Rtx®-5MS
endocrine disruptors 592
food contaminants 638
volatiles (food packaging) 633, 634
Rtx®-5Sil MS
phenols 560
polycyclic aromatic hydrocarbons 555
semivolatiles 560
Rtx®-20
antiepileptics 692
antioxidants 611
Rtx®-35
barbiturates 678, 679
endocrine disruptors 592
nitrogen herbicides 581
organo tins 593
pharmaceuticals (acidic, neutral) 678, 679
pharmaceuticals (basic) 681
Rtx®-35 Amine
amines 704
cold medications 683
pharmaceuticals (basic) 65, 675, 683
sympathomimetic amines 675
Rtx®-50
antioxidants 611
triazine herbicides 581
Rtx®-65TG
food testing 623
triglycerides 72, 624
Rtx®-200
benzodiazepines 682
chlorinated disinfection byproducts 589
chlorofluorocarbons 707
dietary supplements 685
explosives 593
fatty acids (free) 615
glycols 601
haloacetic acids 603
pharmaceuticals (basic) 676, 680, 682
phenols 553
potential genotoxic impurities 690
solvents (organic volatile impurities) 699
sympathomimetic amines 676
triazine herbicides 581
Rtx®-225
sugars 640
Rtx®-440
cocaine 672
organochlorine pesticides 53
Rtx®-502.2
air toxins 607
gasoline range organics (GRO) 595, 597
Rtx®-1301
chlorinated disinfection byproducts 590
flavor volatiles 630
solvents (organic volatile impurities) 700
Rtx®-1614
brominated flame retardants 92, 588
Rtx®-1701
antiepileptics 692
barbiturates 678
fragrances 641
pharmaceuticals (basic) 691
Rtx®-2887
simulated distillation 77, 660
Rtx®-BAC1/Rtx®-BAC2
alkyl nitrates 671
anesthetics 671
blood alcohol 82, 667
butyrolactone, butanediol 669
GHB, GBL 669
glycols 602, 668
inhalants (abused) 670
solvents 672
Rtx®-Biodiesel TG
biodiesel oils 644
Rtx®-CLPesticides/Rtx®-CLPesticides2
dibromoethane (EDB), dibromochloropropane (DBCP) ....684 - 695
haloacetic acids 604
herbicides 579
nitrogen, phosphorus pesticides & herbicides 578
organochlorine pesticides 89, 569, 570
organophosphorus pesticides ....575 - 577
PCBs 584, 585
pesticides & herbicides 571, 572
Rtx®-DHA
hydrocarbons (detailed gasoline analysis) 75, 657
Rtx®-Dioxin2
TCDD 96
TCDF 96
Rtx®-G27/Rtx®-G43
solvents (organic volatile impurities) 85, 700
Rtx®-OPPesticides/Rtx®-OPPesticides2
organophosphorus pesticides 91, 573, 574
triazine herbicides 582
Rtx®-PCB
PCBs 93, 586, 587
Rtx®-TNT/Rtx®-TNT2
explosives 594
Rtx®-VMS
solvents 642, 643
volatiles ....100, 467, 548 - 551
Rtx®-Volatile Amines
amines 63
Rtx®-VRX
volatiles 101
Rtx®-WAX
FAMEs 619, 621
glycols 601
solvents 58, 642
solvents (organic volatile impurities) 699
Rtx®-XLB
PCBs 583
semivolatiles 567
Rxi®-1ms
diesel, motor oil 598, 666
fragrance allergens 61
hydrocarbons (accelerants) 665, 666
microbial volatile organic compounds 605
pesticides (Minnesota Ag List) 497
petroleum hydrocarbons 598
phthalate & adipate esters 554
steroids (sex hormones) 688
sulfur compounds 664
Rxi®-5HT
bleed profile 47
diesel 663
gasoline range organics (GRO) 663
hydrocarbons (accelerants) 663
hydrocarbons (crude oil) 663, 664
mineral oil & motor oil 663
Rxi®-5ms
bleed profile 39
cholesterols 625
drugs (acidic, neutral) 679
drugs (basic) 680
GBL 668
local anesthetics 691
pesticides (organochlorine & organophosphorus) 635
polycyclic aromatic hydrocarbons 559
pyridine 38
semivolatiles 568
test mixes 39

GC Chromatograms by Column Phase *(cont'd)*

Rxi®-5Sil MS
amphetamines 675
benzodiazepines 682
cannabinoids 674
cocaine & metabolites 673
dietary supplements 684, 685
dioxins & furans 95
opiates, extracted from blood 674
organochlorine pesticides 639
polycyclic aromatic hydrocarbons 97, 555, 556, 636
semivolatile organics .....43, 87, 561 - 566
sympathomimetic amines 675
Rxi®-17
fragrance allergens 61
Rxi®-17Sil MS
benzofluoranthenes 558
polycyclic aromatic hydrocarbons 45, 73, 98, 557, 558, 637, 638
Rxi®-624Sil MS
basic compounds 46
potential genotoxic impurities (PGIs) 689, 690
residual solvents 83, 694, 695
volatile organics 103, 547
Stabilwax®
acrylamide 639
amines, alcohols, chlorides 706
essential oils 626, 627
FAMEs 59, 621, 646
flavor volatiles 628
glycols 602
residual solvents 84, 697, 698
Stabilwax®-DA
cresylic acids 707
fatty acids (free) 615, 616
flavor volatiles 67, 629, 631
Stabilwax®-DB
amines .....66, 704 - 706

Packed/Micropacked Columns

CarboBlack B
blood alcohol 667
flavor volatiles 630
D3606 Application Column
gasoline 128, 656
HayeSep® Q
solvents 702
5% Krytox®/CarboBlack B
chlorofluorocarbons 706
Molesieve 5A
permanent gases 647
Molesieve 13X
permanent gases 647
Refinery Gas Column Set
hydrocarbon gases 129
Res-Sil® C Packing
OPN 129
n-Octane 129
Rt®-1200/Bentone® 34
aromatics (BTEX) 655
Rt®-XLSulfur
sulfur compounds 131, 664
sulfurs in beverages 632
Rtx®-1 on Chromosorb® WAW
hydrocarbons (motor oil, aviation gas) 656
Rtx®-1 SimDist 2887
simulated distillation 661, 662
ShinCarbon ST
chlorofluorocarbons 649
hydrocarbon gases 647, 652
permanent gases 130, 647
10% TCEP
aromatics, aliphatics 654
20% TCEP
hydrocarbons (motor oil, aviation gas) 656

PLOT Columns

Rt®-Alumina BOND/CFC
chlorinated fluorocarbons 74
Rt®-Alumina BOND/KCl
hydrocarbon gases 650, 651, 653
Rt®-Alumina BOND/Na_2SO_4
hydrocarbon gases 649, 652, 653
natural gas 651
Rt®-Msieve 5A PLOT
permanent gases 109, 648
Rt®-Q-BOND
solvents 111, 701
Rt®-QS-BOND
hydrocarbon gases 652, 654
ketones 703
solvents 702
Rt®-S-BOND
solvents 701
Rt®-U-BOND
aldehydes 703

GC & HPLC Chromatograms
Compound Index
starting on page 752

EPA Methods Chart

Method #	Method Title	Page #
502.2	Volatile Organic Compounds	595
504.1	1,2-dibromoethane & 1,2-dibromo-3-chloropropane	552
505	Organohalide Pesticides & PCBs	571
506	Semivolatile Organics	554
508.1	Chlorinated Pesticides	572
524.2	Volatile Organics	551
525.2	Semivolatile Organics	568
526	Semivolatile Organics (screening)	560
528	Phenols	560
551.1	Chlorinated Disinfection Byproducts	589, 590
552.2	Haloacetic Acids	603, 604
604	Phenols	553
610	Polycyclic Aromatic Hydrocarbons	555-559
615	Chlorophenoxyacid Herbicides	580
619	Nitrogen/Phosphorus Herbicides & Pesticides	578, 581
624	Purgeable Halocarbons	467
1613	Dioxins	591
1614	Brominated Flame Retardants	588
8021	Volatile Organics	101
8081	Chlorinated Pesticides	53, 569, 570
8082	PCBs	584-587
8095	Explosives	594
8100	Polycyclic Aromatic Hydrocarbons	557
8140/8141/8141A	Organophosphorus Pesticides	573-575
8151A	Chlorophenoxyacid Herbicides	579
8260	Volatile Organics	547-550
8270	Semivolatile Organics	561-567
8270 Appendix IX	Semivolatile Organics	566
	TO-14	606, 608
	TO-15	608, 609

Volatile Organic Compounds Retention Time Index: Rtx®-VMS

Data collected using a 60m, 0.25mm ID, 1.4µm 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.

for more info

See pages 548–551 for Rtx®-VMS volatile organics chromatograms.

Compound	Rtx®-VMS Ret. Time
dichlorodifluoromethane	5.52
chloromethane	6.26
vinyl chloride	6.54
water	6.70
bromomethane	7.61
methanol	7.93
2-methylbutane	7.96
chloroethane	8.00
trichlorofluoromethane	8.41
n-pentane	8.61
diethylether	9.59
1,1-dichloroethene	9.64
carbon disulfide	9.65
Freon® 113	9.70
ethanol	9.74
iodomethane	9.99
3-chlorotrifluoropropane	10.45
chloro-methyl-methylether	10.54
acrolein	10.57
2-methylpentane	10.59
allyl chloride	10.72
methylene chloride	10.98
3-methylpentane	11.09
acetone	11.24
trans-1,2-dichloroethene	11.24
methyl *tert*-butyl ether	11.42
2-propanol	11.52
tert-butyl alcohol	11.56
methyl acetate	11.63
hexane	11.64
acetonitrile	12.22
chloroprene	12.30
1,1-dichloroethane	12.42
acrylonitrile	12.60
diisopropyl ether	12.62
2,4-dimethylpentane	12.68
vinyl acetate	13.02
ethyl-*tert*-buyl ether	13.08
1-propanol	13.18
cis-1,2-dichloroethene	13.32
allyl alcohol	13.35
2,2-dichloropropane	13.48
bromochloromethane	13.62
chloroform	13.75
cyclohexane	13.84
methyl acrylate	13.87
carbon tetrachloride	13.94
tetrahydrofuran	14.03
1,1,1-trichloroethane	14.06
ethyl acetate	14.13
2-butanone	14.18
dibromofluoromethane	14.18
1,1-dichloropropene	14.20
propargyl alcohol	14.35
1-chlorobutane	14.51
2,2,4-trimethylpentane	14.53
propionitrile	14.59
benzene	14.60
n-heptane (C7)	14.62
methacrylonitrile	14.64

Compound	Rtx®-VMS Ret. Time
benzene-d6	14.72
pentafluorobenzene	14.75
1,2-dichloroethane-d4	14.79
1,2-dichloroethane	14.90
tert-amyl-methyl ether	15.00
isobutyl alcohol	15.06
fluorobenzene	15.16
isopropyl acetate	15.34
formic acid	15.37
trichloroethene	15.39
1,4-difluorobenzene	15.58
n-butanol	15.60
methyl cyclohexane	15.78
acetic acid	15.93
dibromomethane	16.05
1,2-dichloropropane	16.17
bromodichloromethane	16.23
methyl methacrylate	16.28
α,α,α-trifluorotoluene	16.45
1,4-dioxane	16.49
n-propyl acetate	16.70
2-chloroethyl-vinyl-ether	16.92
2-chloroethanol	16.93
cis-1,3-dichloropropene	17.04
1-bromo-2-chloroethane	17.05
n-octane	17.17
toluene-d8	17.28
toluene	17.36
propionic acid	17.61
chloroacetonitrile	17.64
4-methyl-2-pentanone	17.76
2-bromo-1-chloropropane	17.81
2-nitropropane	17.83
pyridine	17.86
1,1-dichloropropanone	17.88
trans-1,3-dichloropropene	17.88
tetrachloroethene	17.89
ethyl methacrylate	17.92
1,1,2-trichloroethane	18.11
dibromochloromethane	18.40
1,3-dichloropropane	18.49
isobutyric acid	18.55
1,2-dibromoethane	18.78
n-butyl acetate	18.80
2-hexanone	18.82
butyric acid	19.17
1-chloro-3-fluorobenzene	19.17
ethylbenzene	19.36
chlorobenzene	19.39
1-chloro-4-fluorobenzene	19.39
ethylbenzene-d10	19.40
1-chlorohexane	19.41
1,1,1,2-tetrachloroethane	19.44
m-xylene	19.53
p-xylene	19.54
chlorobenzene-d5	19.55
1-chloro-2-fluorobenzene	19.67
o-xylene	20.13
stryrene	20.17
isovaleric acid	20.18

Compound	Rtx®-VMS Ret. Time
bromoform	20.30
isopropylbenzene	20.51
1,2-butanediol	20.82
valeric acid	20.89
1,4-dichlorobutane	20.90
bromobenzene	20.91
4-bromo-1-fluorobenzene	20.95
cis-1,4-dichloro-2-butene	20.97
n-decane	21.04
n-propylbenzene	21.07
1,1,2,2-tetrachloroethane	21.10
1,3,5-trimethylbenzene	21.30
1-ethyl-4-methylbenzene	21.33
1-ethyl-3-methylbenzene	21.34
1,2,3-trichloropropane	21.39
trans-1,4-dichloro-2-butene	21.40
2-chlorotoluene	21.40
4-chlorotoluene	21.61
cyclohexane	21.78
tert-butylbenzene	21.81
1-ethyl-2-methylbenzene	21.82
1,2,4-trimethylbenzene	21.88
pentachloroethane	21.92
1,3-dichloro-2-propanol	22.05
sec-butylbenzene	22.06
isocaproic acid	22.09
p-isopropyltoluene	22.22
1,3-dichlorobenzene	22.53
caproic acid	22.55
1,4-dichlorobenzene	22.64
n-butylbenzene	22.88
malononitrile	22.89
benzyl chloride	23.23
1,2-dichlorobenzene-d4	23.36
1,2-dichlorobenzene	23.38
hexachloroethane	23.63
1-octanol	23.70
bis-(2-chloro-isopropyl) ether	24.06
4-bromo-1-chlorobenzene	24.09
benzyl alcohol	24.23
heptanoic acid	24.29
n-dodecane	24.54
3-bromochlorobenzene	24.61
1,2-dibromo-3-chloropropane	24.78
2-bromochlorobenzene	25.54
hexachlorobutadiene	25.99
nitrobenzene	26.02
1,2,4-trichlorobenzene	26.19
benzyl acetate	26.29
n-tridecane	26.51
naphthalene	27.01
1,2,3-trichlorobenzene	27.46
n-tetradecane	28.83
2-methylnaphthalene	30.36
1-methylnaphthalene	30.96
n-pentadecane	31.65
2-chloronaphthalene	33.36

Volatile Organic Compounds Retention Time Index: Rxi®-624Sil MS*

Data collected using a 30 m x 0.25 mm x 1.400 µm Rxi®-624Sil MS column; Oven: 35°C (hold 5 min.) @ 11°C/min. to 60°C @ 20°C/min. to 220°C; Carrier gas: helium; Regulation: constant flow; Flow: 1.17 mL/min.; GC Temperature: 35°C; Inlet Pressure: 7.94 PSI; Outlet Pressure: 0.00 PSI; Dead Time: 1.780 min.; Linear Velocity: 32.68 cm/sec.; Detector 1: Mass Spectrometer
*Modeled by Pro *ez*GC software.

for **more** info

See pages 547 for an Rxi®-624Sil MS volatile organics chromatogram.

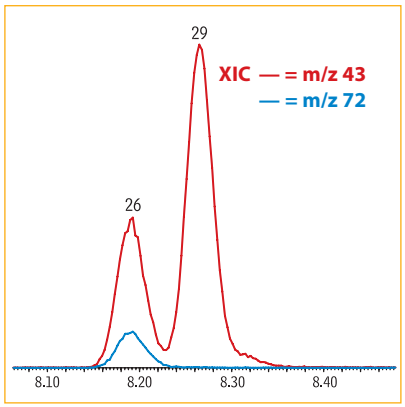
Compound	Rxi®-624Sil MS Ret. Time
dichlorodifluoromethane	2.178
chloromethane	2.438
water	2.588
vinyl chloride	2.63
methanol	2.985
ethylene oxide	3.127
bromomethane	3.192
chloroethane	3.395
trichlorofluoromethane	3.834
n-pentane	4.032
ethanol	4.199
diethylether	4.387
2-methylbutane	4.501
acrolein	4.677
1,1-dichloroethene	4.848
Freon 113	4.929
acetone	4.971
iodomethane	5.135
2-propanol	5.323
carbon disulfide	5.323
acetonitrile	5.581
methyl acetate	5.676
allyl chloride	5.693
methylene chloride	5.939
2-methylpentane	6.01
tert-butyl alcohol	6.19
acrylonitrile	6.414
methyl-d3-*tert*-butyl-ether	6.435
methyl *tert*-butyl-ether	6.477
trans-1,2-dichloroethene	6.48
3-methylpentane	6.503
hexane	7.023
1,1-dichloroethane	7.291
allyl alcohol	7.309
vinyl acetate	7.33
diisopropyl ether	7.386
chloroprene	7.407
1-propanol	7.431
ethyl *tert*-buyl ether	7.978
TB(d9)A	8.133
cis-1,2-dichloroethene	8.204
2-butanone	8.208
2,2-dichloropropane	8.208
ethyl acetate	8.283
propionitrile	8.297
methyl acrylate	8.336
methacrylonitrile	8.499
bromochloromethane	8.528
tetrahydrofuran	8.542
chloroform	8.678
dibromofluoromethane	8.871
1,1,1-trichloroethane	8.872
pentafluorobenzene	8.937

Compound	Rxi®-624Sil MS Ret. Time
cylcohexane	8.959
1-chlorobutane	9.032
carbon tetrachloride	9.055
1,1-dichloropropene	9.067
benzene-d6	9.255
1,2-dichloroethane-d4	9.28
benzene	9.296
1,2-dichloroethane	9.365
isopropyl acetate	9.376
2,2,4-trimethylpentane	9.455
isobutyl alcohol	9.456
tert-amyl-methyl ether	9.457
n-heptane	9.537
fluorobenzene	9.636
1,4-difluorobenzene	9.784
1-butanol	9.911
trichloroethene	10.013
methyl cyclohexane	10.268
tert-amyl ethyl ether	10.27
1,2-dichloropropane	10.28
α,α,α-trifluorotoluene	10.325
methyl methacrylate	10.327
1,4-dioxane	10.379
n-propyl acetate	10.383
dibromomethane	10.443
bromodichloromethane	10.532
2-nitropropane	10.736
chloroacetonitrile	10.764
2-chloroethyl-vinyl-ether	10.792
1-bromo-2-chloroethane	10.843
epichlorhydrin	10.875
cis-1,3-dichloropropene	10.938
2,4-dimethylpentane	10.961
4-methyl-2-pentanone	11.062
1,1-dichloropropanone	11.105
pyridine	11.135
toluene-d8	11.185
toluene	11.246
n-octane	11.345
trans-1,3-dichloropropene	11.441
ethyl methacrylate	11.471
2-bromo-1-chloropropane	11.497
1,1,2-trichloroethane	11.619
tetrachloroethene	11.699
1,3-dichloropropane	11.761
n-butyl acetate	11.792
dibromochloromethane	11.82
1,2-dibromoethane	11.934
1-chloro-3-fluorobenzene	12.119
1-chloro-4-fluorobenzene	12.338
chlorobenzene-D5	12.386
chlorobenzene	12.415
ethylbenzene-d10	12.44

Compound	Rxi®-624Sil MS Ret. Time
1-chlorohexane	12.442
1,1,1,2-tetrachloroethane	12.503
ethylbenzene	12.512
m-xylene	12.636
p-xylene	12.636
n-nonane	12.668
1-chloro-2-fluorobenzene	12.703
o-xylene	12.99
stryrene	13.01
n-amyl acetate	13.148
bromoform	13.177
isopropylbenzene	13.327
cis-1,4-dichloro-2-butene	13.382
1,4-dichlorobutane	13.439
4-bromo-1-fluorobenzene	13.485
1,1,2,2-tetrachloroethane	13.6
bromobenzene	13.612
trans-1,4-dichloro-2-butene	13.635
1,2,3-trichloropropane	13.655
n-propylbenzene	13.698
2-chlorotoluene	13.78
1,3,5-trimethylbenzene	13.858
n-decane	13.867
4-chlorotoluene	13.886
tert-butylbenzene	14.131
pentachloroethane	14.16
1,2,4-trimethylbenzene	14.182
sec-butylbenzene	14.325
n-butylcyclohexane	14.4
1,3-dichlorobenzene	14.431
p-isopropyltoluene	14.453
1,4-dichlorobenzene-d4	14.497
1,4-dichlorobenzene	14.519
n-butylbenzene	14.796
1,2-dichlorobenzene-d4	14.814
1,2-dichlorobenzene	14.823
hexachloroethane	15.06
1-octanol	15.07
4-bromo-1-chlorobenzene	15.467
1,2-dibromo-3-chloropropane	15.476
nitrobenzene	15.638
tetraethyl lead	15.652
2-bromochlorobenzene	15.761
n-tetradecane	15.783
n-dodecane	15.784
1,2,4-trichlorobenzene	16.176
hexachlorobutadiene	16.293
naphthalene	16.418
1,2,3-trichlorobenzene	16.608
2,5-dibromotoluene	17.488
2-methylnaphthalene	17.558
1-methyl-naphthalene	17.754

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

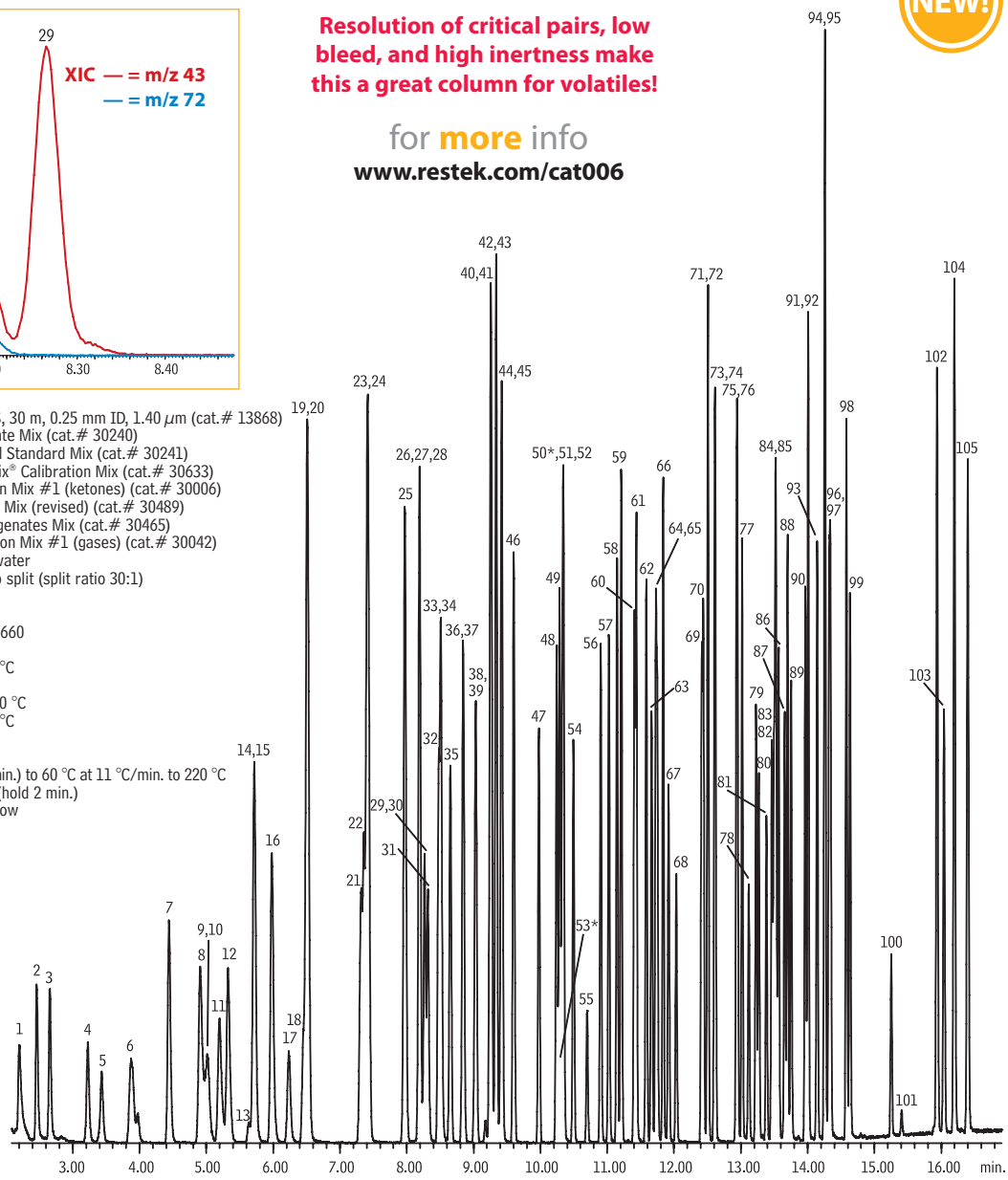
NEW!



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

for **more** info
www.restek.com/cat006

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



GC_EV1169

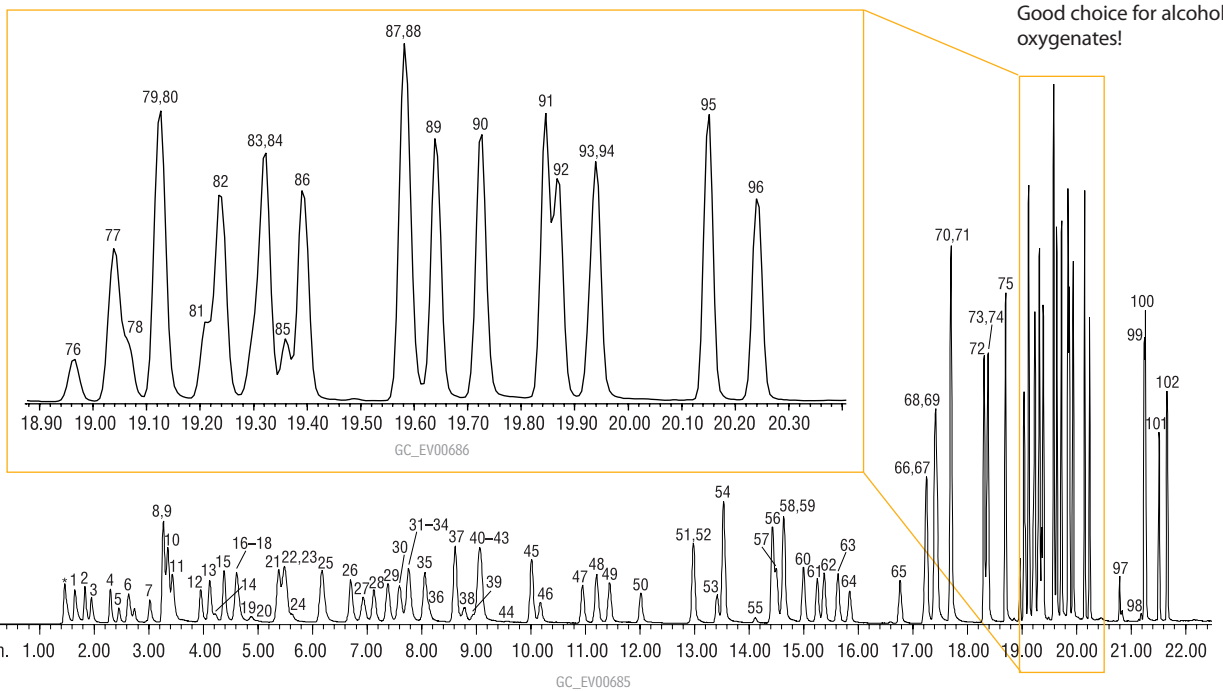
Peaks	RT (min.)
1. Dichlorodifluoromethane (CFC-12)	2.198
2. Chloromethane	2.459
3. Vinyl chloride	2.659
4. Bromomethane	3.226
5. Chloroethane	3.434
6. Trichlorofluoromethane (CFC-11)	3.876
7. Diethyl ether (ethyl ether)	4.440
8. 1,1-Dichloroethene	4.909
9. 1,1,2-Trichlorotrifluoroethane (CFC-113)	4.998
10. Acetone	5.029
11. Iodomethane	5.195
12. Carbon disulfide	5.323
13. Acetonitrile	5.637
14. Allyl chloride	5.715
15. Methyl acetate	5.723
16. Methylene chloride	5.981
17. *tert*-Butyl alcohol	6.234
18. Acrylonitrile	6.451
19. Methyl *tert*-butyl ether (MTBE)	6.509
20. *trans*-1,2-Dichloroethene	6.512
21. 1,1-Dichloroethane	7.315
22. Vinyl acetate	7.359
23. Diisopropyl ether (DIPE)	7.407
24. Chloroprene	7.429
25. Ethyl *tert*-butyl ether (ETBE)	7.970
26. 2-Butanone (MEK)	8.193
27. *cis*-1,2-Dichloroethene	8.193
28. 2,2-Dichloropropane	8.193
29. Ethyl acetate	8.265
30. Propionitrile	8.276
31. Methyl acrylate	8.318
32. Methacrylonitrile	8.476
33. Bromochloromethane	8.507
34. Tetrahydrofuran	8.521
35. Chloroform	8.651
36. 1,1,1-Trichloroethane	8.843
37. Dibromofluoromethane	8.848
38. Carbon tetrachloride	9.026
39. 1,1-Dichloropropene	9.037
40. 1,2-Dichloroethane-d4	9.246
41. Benzene	9.262
42. 1,2-Dichloroethane	9.334
43. Isopropyl acetate	9.340
44. Isobutyl alcohol	9.421
45. *tert*-Amyl methyl ether (TAME)	9.421
46. Fluorobenzene	9.598
47. Trichloroethene	9.976
48. 1,2-Dichloropropane	10.243
49. Methyl methacrylate	10.290
50. 1,4-Dioxane (ND)	10.299*
51. Dibromomethane	10.326
52. Propyl acetate	10.346
53. 2-Chloroethanol (ND)	10.368*
54. Bromodichloromethane	10.496
55. 2-Nitropropane	10.698
56. *cis*-1,3-Dichloropropene	10.904
57. 4-Methyl-2-pentanone (MIBK)	11.026
58. Toluene-D8	11.148
59. Toluene	11.210
60. *trans*-1,3-Dichloropropene	11.407
61. Ethyl methacrylate	11.435
62. 1,1,2-Trichloroethane	11.585
63. Tetrachloroethene	11.662
64. 1,3-Dichloropropane	11.729
65. 2-Hexanone	11.749
66. Butyl acetate	11.837
67. Dibromochloromethane	11.921
68. 1,2-Dibromoethane (EDB)	12.035
69. Chlorobenzene-d5	12.412
70. Chlorobenzene	12.440
71. Ethylbenzene	12.507
72. 1,1,1,2-Tetrachloroethane	12.507
73. *m*-Xylene	12.612
74. *p*-Xylene	12.612
75. *o*-Xylene	12.935
76. Styrene	12.949
77. *n*-Amyl acetate	13.018
78. Bromoform	13.118
79. Isopropylbenzene (cumene)	13.226
80. *cis*-1,4-Dichloro-2-butene	13.268
81. 4-Bromofluorobenzene	13.385
82. 1,1,2,2-Tetrachloroethane	13.456
83. *trans*-1,4-Dichloro-2-butene	13.496
84. Bromobenzene	13.515
85. 1,2,3-Trichloropropane	13.526
86. *n*-Propylbenzene	13.565
87. 2-Chlorotoluene	13.657
88. 1,3,5-Trimethylbenzene	13.699
89. 4-Chlorotoluene	13.751
90. *tert*-Butylbenzene	13.965
91. Pentachloroethane	14.007
92. 1,2,4-Trimethylbenzene	14.010
93. *sec*-Butylbenzene	14.140
94. 4-Isopropyltoluene (*p*-cymene)	14.254
95. 1,3-Dichlorobenzene	14.263
96. 1,4-Dichlorobenzene-D4	14.321
97. 1,4-Dichlorobenzene	14.340
98. *n*-Butylbenzene	14.579
99. 1,2-Dichlorobenzene	14.635
100. 1,2-Dibromo-3-chloropropane (DBCP)	15.252
101. Nitrobenzene	15.407
102. 1,2,4-Trichlorobenzene	15.935
103. Hexachloro-1,3-butadiene	16.040
104. Naphthalene	16.196
105. 1,2,3-Trichlorobenzene	16.396

* ND = not detected; retention time determined by wet needle injection

Volatile Organics
US EPA Method 8260 (80 ppb Standard)
Rtx®-VMS

restek
innovation!

Good choice for alcohols & oxygenates!



Column:	Rtx®-VMS, 30m, 0.25mm ID, 1.4µm (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. diethylether
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. dibromofluoromethane
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. 1,1,1,2-tetrachloroethane
70. *m*-xylene
71. *p*-xylene
72. *o*-xylene
73. bromoform
74. stryrene
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.

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

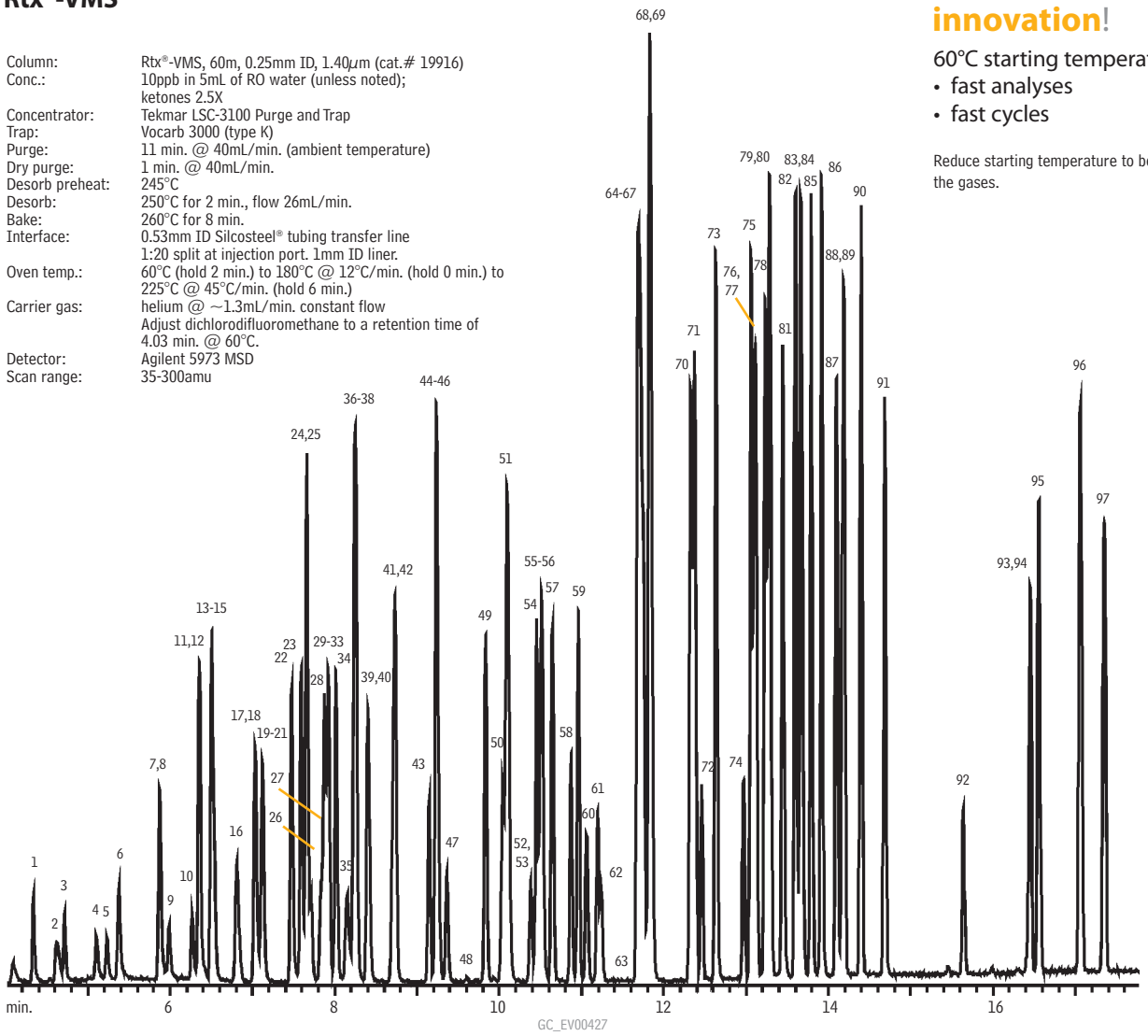
Volatile Organics
US EPA Method 8260B
Rtx®-VMS

Column:	Rtx®-VMS, 60m, 0.25mm ID, 1.40µm (cat.# 19916)
Conc.:	10ppb in 5mL of RO water (unless noted); ketones 2.5X
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.
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

restek
innovation!

60°C starting temperature
- fast analyses
- fast cycles

Reduce starting temperature to best focus the gases.



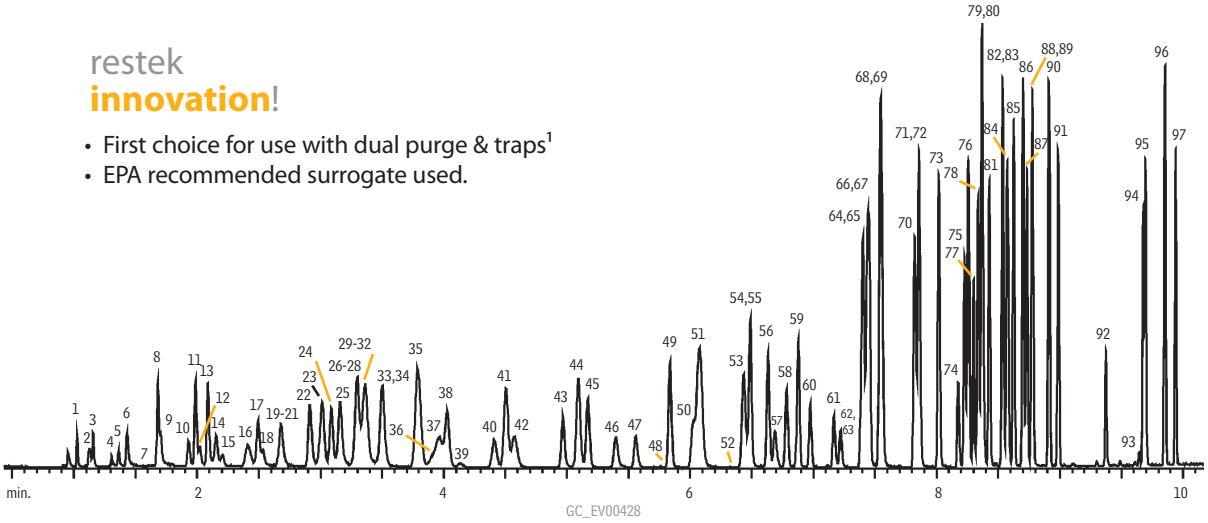
1. dichlorodifluoromethane
2. chloromethane
3. vinyl chloride
4. bromomethane
5. chloroethane
6. trichlorofluoromethane
7. ethanol (2500ppb)
8. 1,1-dichloroethene
9. carbon disulfide (40ppb)
10. allyl chloride
11. methylene chloride
12. acetone
13. *trans*-1,2-dichloroethene
14. *tert*-butyl alcohol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

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

Volatile Organics
US EPA Method 8260B
Rtx®-VMS

restek
innovation!

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

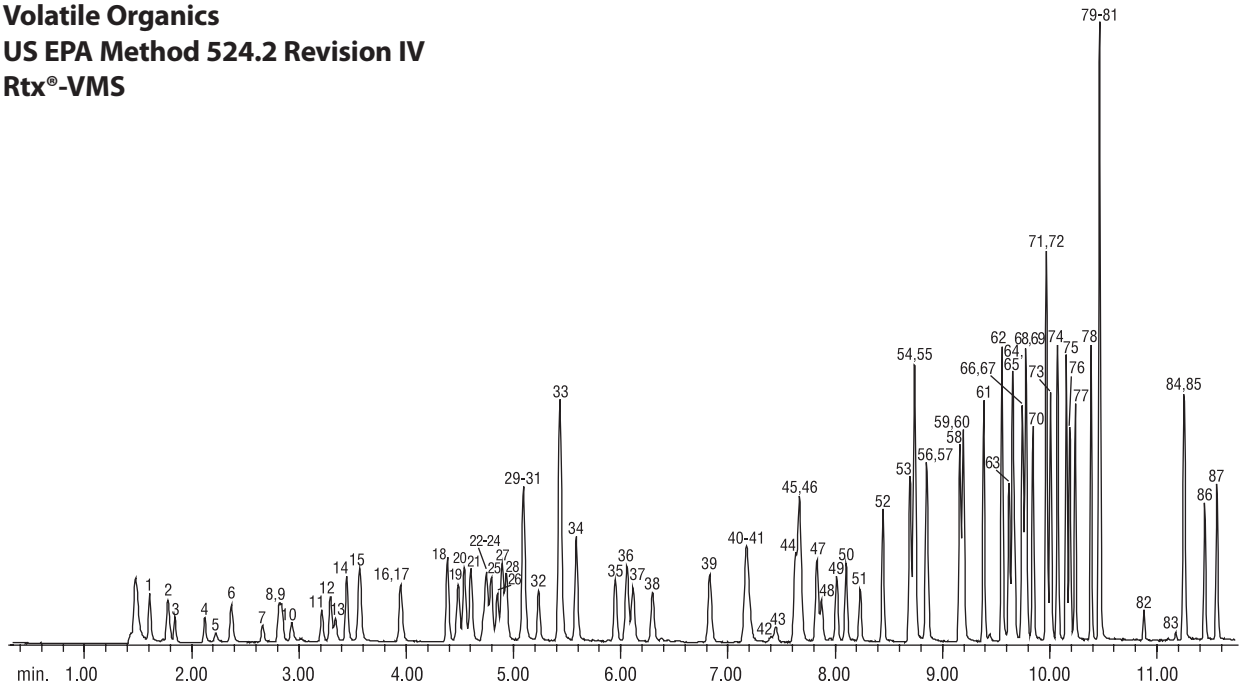


Column:	Rtx®-VMS, 20m, 0.18mm ID, 1.00µm (cat.# 49914)
Conc.:	10ppb in 5mL of RO water unless otherwise noted; ketones at 2.5X
Concentrator:	Tekmar LSC-3100 Purge and Trap
Trap:	Vocarb 3000 (type K)
Purge:	11 min. @ 40mL/min. (ambient temperature)
Dry purge:	1 min. @ 40mL/min.
Desorb preheat:	245°C
Desorb:	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 Adjust dichlorodifluoromethane to a retention time of 1.03 min. @ 50°C.
Detector:	Agilent 5973 MSD
Scan range:	35-300amu

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

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

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



GC_EV00718

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)

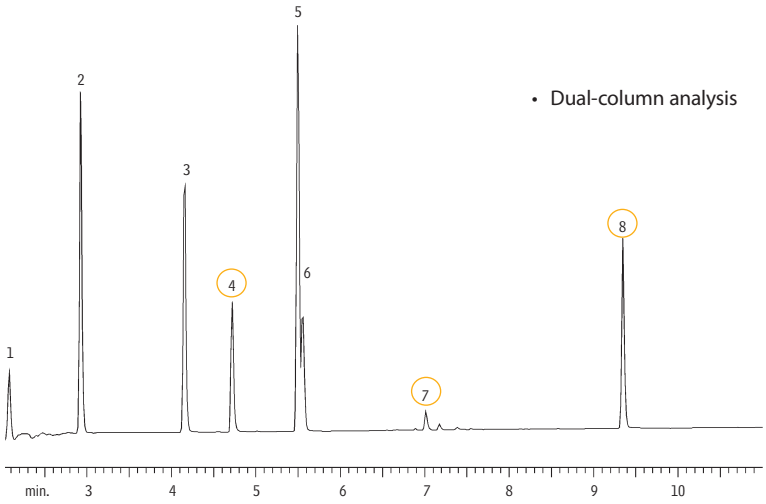
Column:	Rtx®-VMS, 30m, 0.25mm ID, 1.4µm (cat.# 19915)
Sample:	502.2 Calibration Mix #1 (cat.# 30042) Drinking Water VOA MegaMix®, 524.2 Rev 4 (cat.# 30601) 524 Internal Standard/Surrogate Mix (cat.# 30201) Ketone Mix, EPA Method 524.2 Rev 4.1 (cat.# 30602) Compounds at 20 ppb each in 5mL RO water (ketones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

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

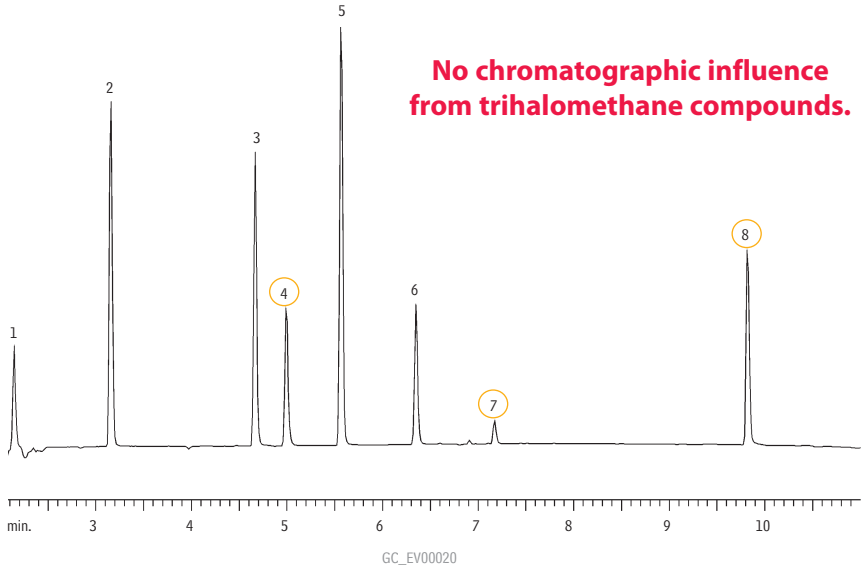
*Peaks 42 & 43 share an ion (43).

EDB/DBCP
US EPA Method 504.1
Rtx®-CLPesticides & Rtx®-CLPesticides2

Rtx®-CLPesticides



Rtx®-CLPesticides2



1. chloroform
2. bromodichloromethane
3. chlorodibromomethane
4. 1,2-dibromoethane (EDB)
5. 1,1,1,2-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.	Direct injection using a Uniliner® inlet liner (cat.#20335)
On-column conc.:	10pg 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

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.

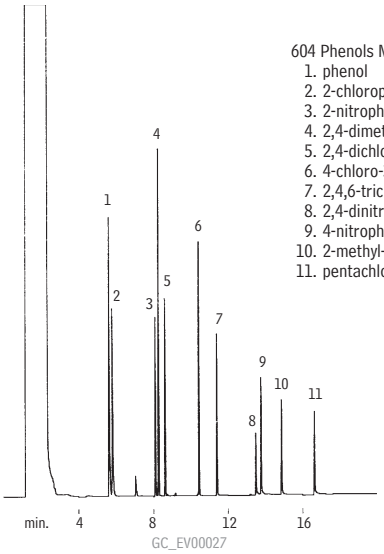
Applications Note
lit. cat.# 59539

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

- Triazine herbicides **(lit. cat.# 59101)**
- PCBs **(lit. cat.# 59120)**
- Chlorinated pesticides **(lit. cat.# EVAN1197)**
- Chlorinated pesticides, PCBs, & chlorinated herbicides **(lit. cat.# EVFL1013)**

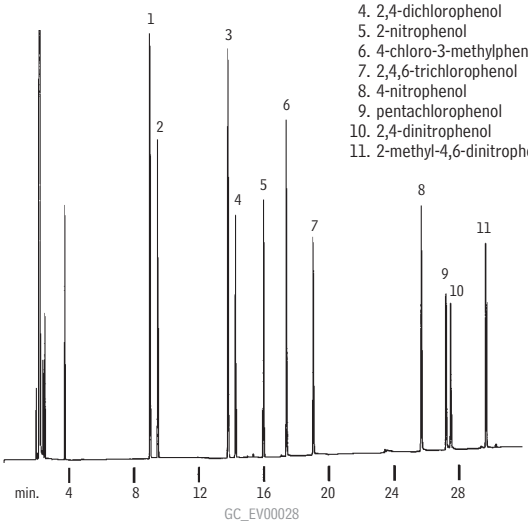
Download your free copy of the literature listed here from **www.restek.com**

Phenols
US EPA Method 604
MXT®-5



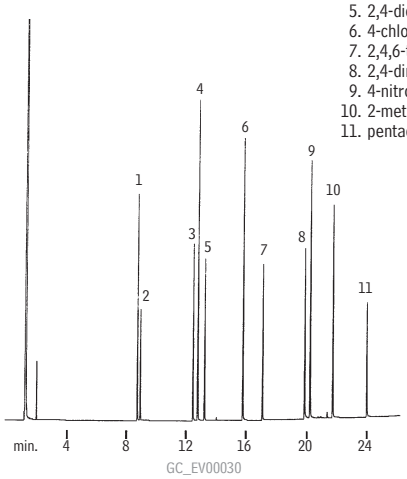
Column:	MXT®-5, 30m, 0.28mm ID, 0.25µm (cat.# 70224)
Inj.:	1.0µL splitless injection of phenols
Conc.:	25ng/µL per component
Oven temp.:	40°C to 250°C @ 10°C/min.
Inj./det. temp.:	280°C/300°C
Carrier gas:	hydrogen
Linear velocity:	50cm/sec. set @ 40°C
FID sensitivity:	2.56 x 10^{-10} AFS

Phenols
US EPA Method 604
Rtx®-200



Column:	Rtx®-200, 30m, 0.32mm ID, 0.25µm (cat.# 15024)
Inj.:	1.0µL 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

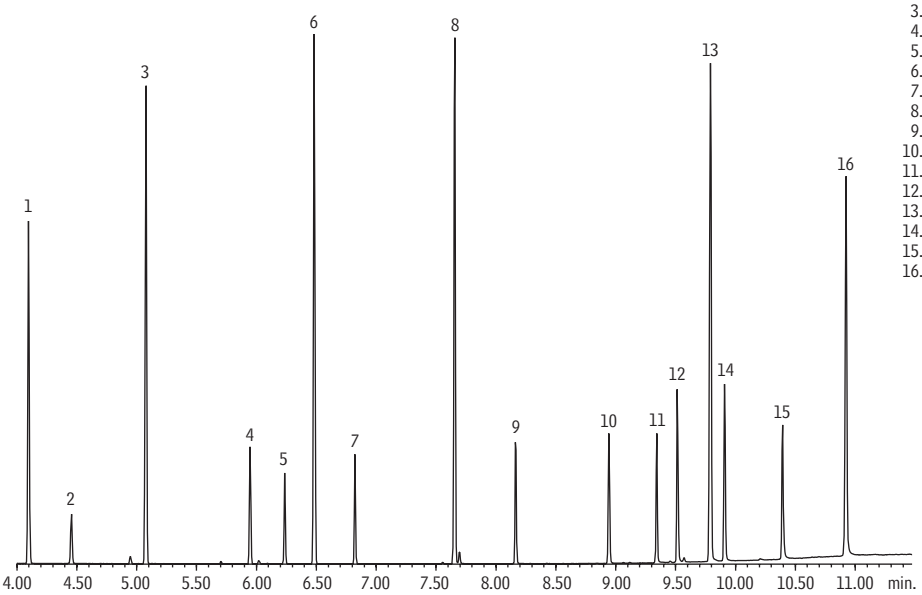
Phenols
US EPA Method 604
Rtx®-5



Column:	Rtx®-5, 30m, 0.25mm ID, 0.25µm (cat.# 10223)
Inj.:	1.0µL split injection of phenols.
Conc.:	3-5ng/µL 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

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

Rxi® Technology!
Exceptionally inert, ultra low- bleed capillary columns.



GC_EV00832

1. 1,4-dichlorobenzene-d4 (IS)
2. nitrobenzene-d5 (SS)
3. naphthalene-d8 (IS)
4. 2-fluorobiphenyl (SS)
5. dimethylphthalate
6. acenaphthene-d10 (IS)
7. diethylphthalate
8. phenanthrene-d10 (IS)
9. di-*n*-butylphthalate
10. *p*-terphenyl-d14 (SS)
11. benzyl butyl phthalate
12. bis(2-ethylhexyl)adipate
13. chrysene-d12 (IS)
14. bis(2-ethylhexyl)phthalate
15. di-*n*-octylphthalate
16. perylene-d12 (IS)

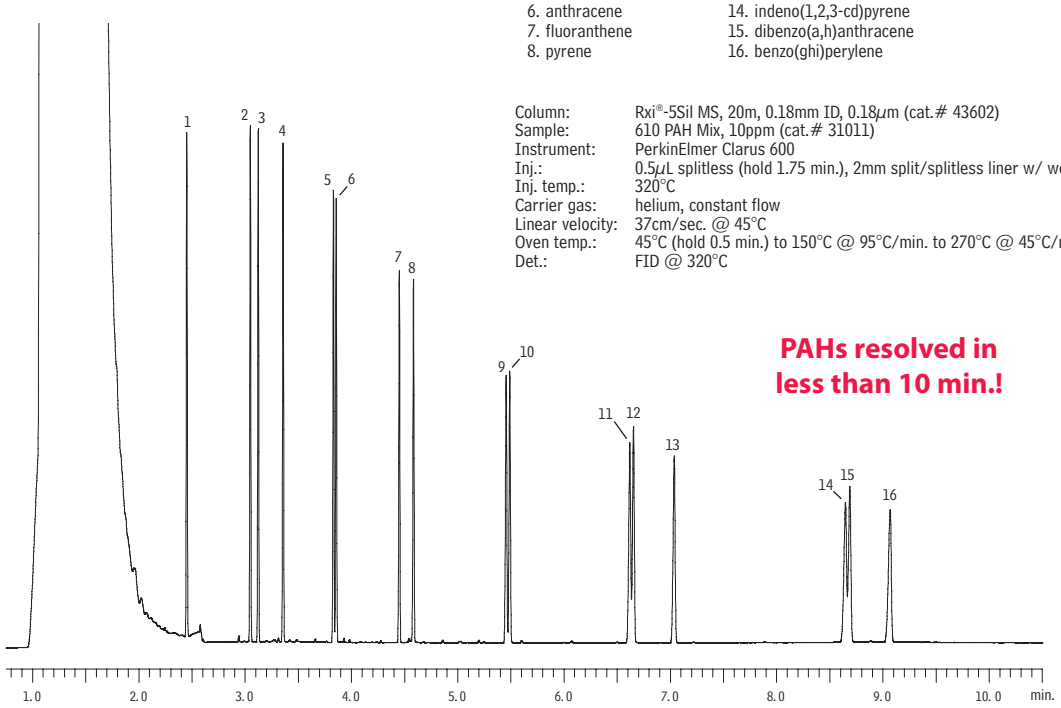
Column:	Rxi®-1ms, 30m, 0.25mm ID, 0.25µm (cat.# 13323)
Sample:	US EPA Method 506 mix: 506 Calibration Mix (cat.# 31845), SV Internal Standard Mix (cat.# 31206), B/N Surrogate Mix (4/89 SOW) (cat.# 31024)
Inj.:	1.0µL, 5µg/mL each analyte (internal standards 25µg/mL), split (10:1) 4mm Drilled Uniliner® 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

Polycyclic Aromatic Hydrocarbons
US EPA Method 610
Rxi®-5Sil MS (20m x 0.18 mm x 0.18 µm)

NEW!

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:	Rxi®-5Sil MS, 20m, 0.18mm ID, 0.18µm (cat.# 43602)
Sample:	610 PAH Mix, 10ppm (cat.# 31011)
Instrument:	PerkinElmer Clarus 600
Inj.:	0.5µL splitless (hold 1.75 min.), 2mm split/splitless liner w/ wool (cat.# 21718)
Inj. temp.:	320°C
Carrier gas:	helium, constant flow
Linear velocity:	37cm/sec. @ 45°C
Oven temp.:	45°C (hold 0.5 min.) to 150°C @ 95°C/min. to 270°C @ 45°C/min. to 300°C @ 7°C/min.
Det.:	FID @ 320°C

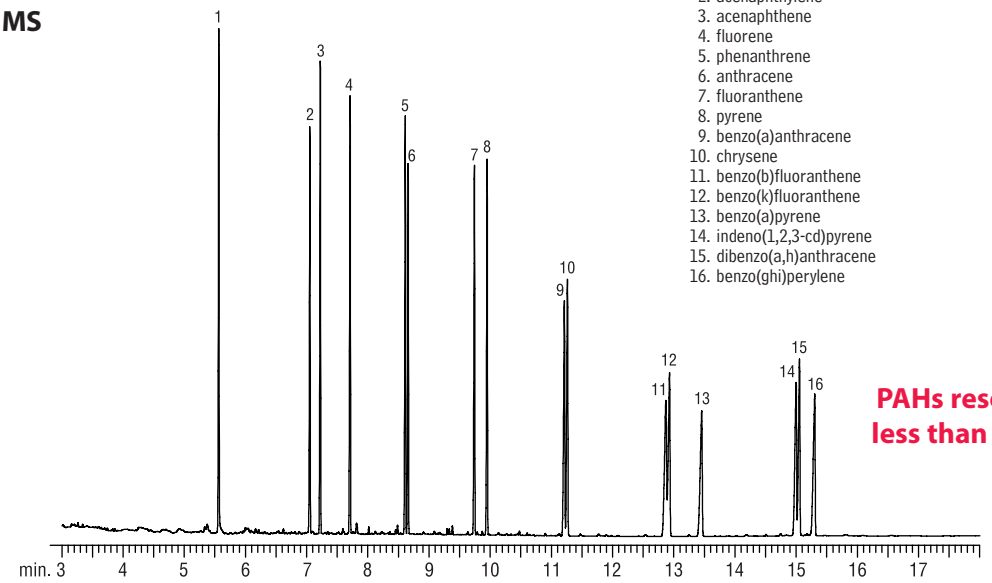


PAHs resolved in less than 10 min.!

GC_EV01037

Polycyclic Aromatic Hydrocarbons
US EPA Method 610
Rtx®-5Sil MS

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



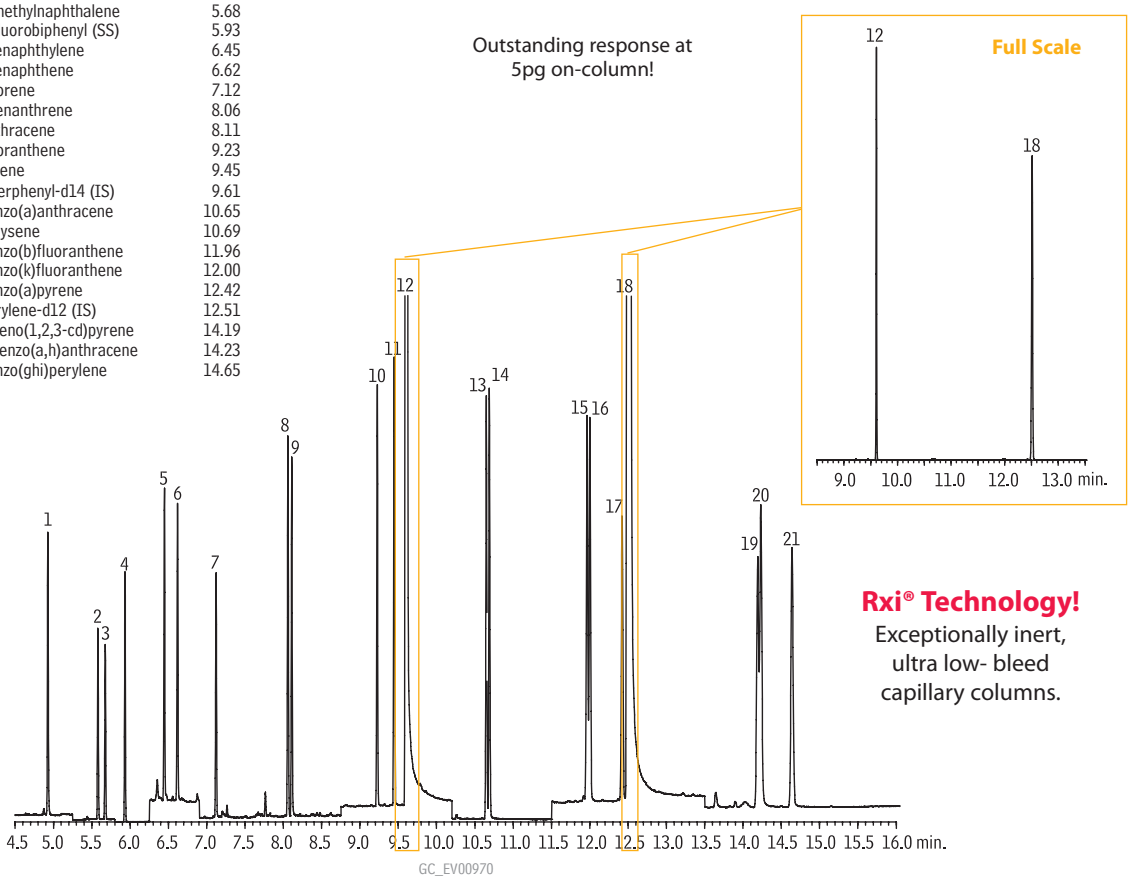
PAHs resolved in less than 16 min.!

GC_EV00595

Column:	Rtx®-5Sil MS, 30m, 0.25mm ID, 0.25µm (cat.# 12723)
Sample:	50µg/mL 610 PAH Mix (cat.# 31011) in methylene chloride
Inj.:	1.0µL splitless (hold 2 min.), 2mm splitless inlet liner w/wool (cat.# 20829)
Inj. temp.:	330°C
Carrier gas:	hydrogen, 4mL/min. constant flow
Oven temp.:	40°C (hold 2 min.) to 250°C @ 25°C/min. to 265°C @ 5°C/min. to 300°C (hold 4 min.) @ 25°C/min.
Det.:	FID @ 350°C

Polycyclic Aromatic Hydrocarbons
Rxi®-5Sil MS

Peak List	Retention Time
1. naphthalene	4.93
2. 2-methylnaphthalene	5.58
3. 1-methylnaphthalene	5.68
4. 2-fluorobiphenyl (SS)	5.93
5. acenaphthylene	6.45
6. acenaphthene	6.62
7. fluorene	7.12
8. phenanthrene	8.06
9. anthracene	8.11
10. fluoranthene	9.23
11. pyrene	9.45
12. *p*-terphenyl-d14 (IS)	9.61
13. benzo(a)anthracene	10.65
14. chrysene	10.69
15. benzo(b)fluoranthene	11.96
16. benzo(k)fluoranthene	12.00
17. benzo(a)pyrene	12.42
18. perylene-d12 (IS)	12.51
19. indeno(1,2,3-cd)pyrene	14.19
20. dibenzo(a,h)anthracene	14.23
21. benzo(ghi)perylene	14.65



Rxi® Technology!
Exceptionally inert, ultra low- bleed capillary columns.

Column:	Rxi®-5Sil MS, 30m, 0.25mm ID, 0.25µm (cat.# 13623)
Sample:	PAH mix, 1µL of 0.005µg/mL (IS 2µg/mL) SV Calibration Mix #5 (cat.# 31011) 1-methylnaphthalene (cat.# 31283) 2-methylnaphthalene (cat.# 31285) 2-fluorobiphenyl (cat.# 31091)
Inj.:	1.0µL (5pg on-column concentration), 4mm Drilled Uniliner® (hole near top) inlet liner w/wool (cat.# 21055-200.5), pulsed splitless: pulse 20psi @ 0.2 min., 60mL/min. @ 0.15 min.
Inj. temp.:	300°C
Carrier gas:	helium, constant flow
Flow rate:	1.4mL/min.
Oven temp.:	50°C (hold 0.5 min.) to 290°C @ 25°C/min. to 320°C @ 5°C/min.
Det.:	MS
Transfer line temp:	290°C
Ionization:	EI
Mode:	SIM

Single Ion Monitoring Program

Group	Time	Ion(s)	Dwell (ms)
1	4.00	128	100
2	5.25	142	100
3	5.80	172	100
4	6.25	152	100
5	6.90	166	100
6	7.60	178	100
7	8.75	202, 244	100
8	10.2	228	100
9	11.5	252, 264	100
10	13.5	276, 278	100

free literature

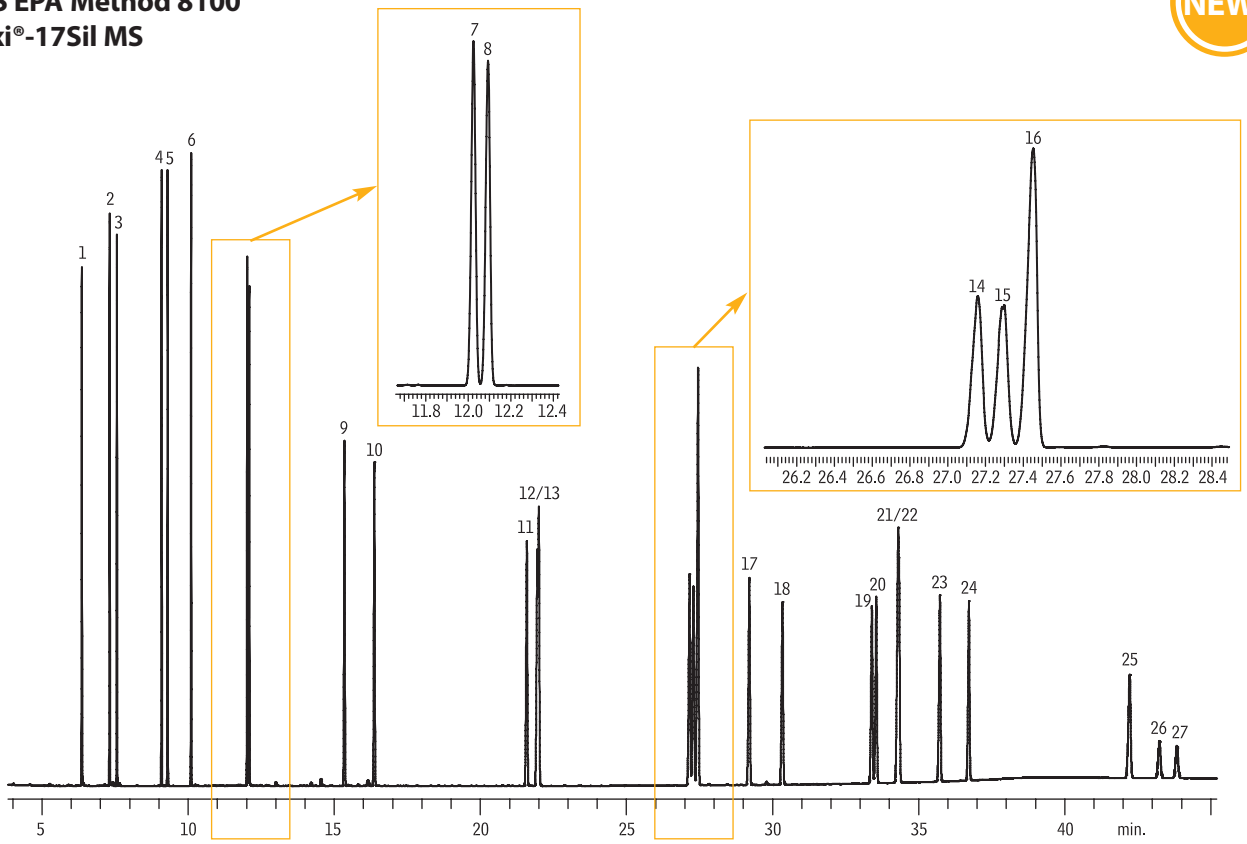
Accurately Quantify PAHs Down to 5 pg On-Column: GC/MS Sim Analysis with the New Rxi®-5Sil MS Column
Polycyclic aromatic hydrocarbons (PAHs) are common environmental pollutants, affecting air, water, and soil quality. Although naturally occurring, human impact has created a steady increase in environmental levels of PAHs and their byproducts. PAHs are typically formed through the incomplete combustion of organic materials, such as wood, coal, and oil, but are also used in manufacturing of some medicines, plastics, and pesticides. Many PAHs are known or suspected carcinogens. The United States Environmental Protection Agency currently lists and mandates testing of the 16 PAHs they deem most hazardous.

Download your free copy from **www.restek.com**

Applications Note
lit. cat.# EVAN1284

Polycyclic Aromatic Hydrocarbons
US EPA Method 8100
Rxi®-17Sil MS

NEW!



GC_EV1160

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

Column	Rxi®-17Sil MS, 30 m, 0.25 mm ID, 0.25 µm (cat.# 14123)
Sample	SV Calibration Mix #5 / 610 PAH Mix (cat.# 31011) EPA Method 8310 PAH Mixture (cat.# 31841)
Diluent:	dichloromethane
Conc.:	10 ppm
Injection	
Inj. Vol.:	0.5 µL splitless (hold 1.75 min.)
Liner:	Auto SYS XL PSS Split/Splitless w/Wool (cat.# 21718)
Inj. Temp.:	320 °C
Purge Flow:	75 mL/min.
Oven	
Oven Temp:	65 °C (hold 0.5 min.) to 220 °C at 15 °C/min. to 330 °C at 4 °C/min. (hold 15 min.)
Carrier Gas	He, constant flow
Flow Rate:	2.0 mL/min.
Detector	FID @ 320 °C
Instrument	PE Clarus 600 GC
Acknowledgement	Instrument provided by PerkinElmer

Restek Customer Service

In the U.S.

Call: 800-356-1688 (ext. 3) or 814-353-1300 (ext. 3)

Monday–Friday 8:00 a.m.–6:00 p.m. ET

Fax: 814-353-1309—24-hours a day

Online: www.restek.com—24-hours a day

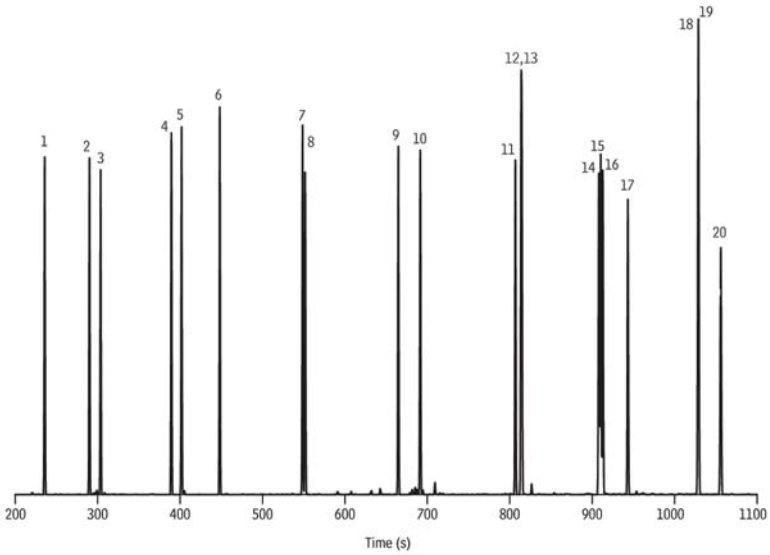
Outside the U.S.

Contact your Restek representative:
Refer to our list on pages 4-5 or visit our website at www.restek.com

Mike Shuey, Customer Service

Polycyclic Aromatic Hydrocarbons
Rxi®-17Sil MS (15 m x 0.25 mm x 0.25 µm)

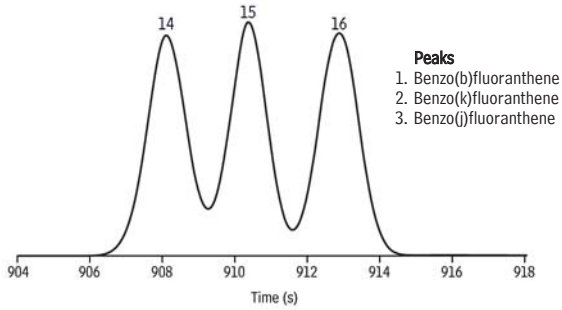
NEW!



GC_EV1186

Peaks
1. Naphthalene
2. 2-Methylnaphthalene
3. 1-Methylnaphthalene
4. Acenaphthylene
5. Acenaphthene
6. Fluorene
7. Phenanthrene
8. Anthracene
9. Fluoranthene
10. Pyrene
11. Benzo(a)anthracene
12. Chrysene
13. Triphenylene
14. Benzo(b)fluoranthene
15 Benzo(k)fluoranthene
16. Benzo(j)fluoranthene
17. Benzo(a)pyrene
18. Indeno(1,2,3-cd)pyrene
19. Dibenz(a,h)anthracene
20. Benzo(ghi)perylene

Benzofluoranthenes
Rxi®-17Sil MS (15 m x 0.25 mm x 0.25 µm)

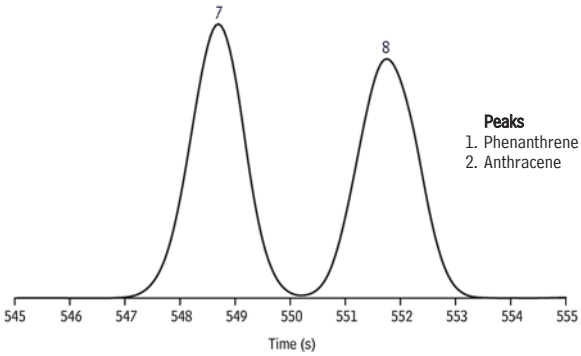


GC_EV1189

Peaks
1. Benzo(b)fluoranthene
2. Benzo(k)fluoranthene
3. Benzo(j)fluoranthene

Column	Rxi®-17Sil MS, 15 m, 0.25 mm ID, 0.25 µm (cat.# 14120)
Sample	
Diluent:	Methylene chloride
Conc.:	20 ng/µL
Injection	
Inj. Vol.:	1 µL split (split ratio 20:1)
Liner:	4mm Split Precision® Liner w/Wool (cat.# 21022)
Inj. Temp.:	275 °C
Split Vent	
Flow Rate:	42 mL/min.
Oven	
Oven Temp:	80 °C (hold 1 min.) to 320 °C at 15 °C/min. (hold 2 min.)
Carrier Gas	H_2, constant flow
Flow Rate:	2 mL/min.
Detector	FID @ 340 °C
Constant Column + Constant Make-up:	50 mL/min.
Make-up Gas Type:	N_2
Data Rate:	20 Hz
Instrument	Agilent/HP6890 GC

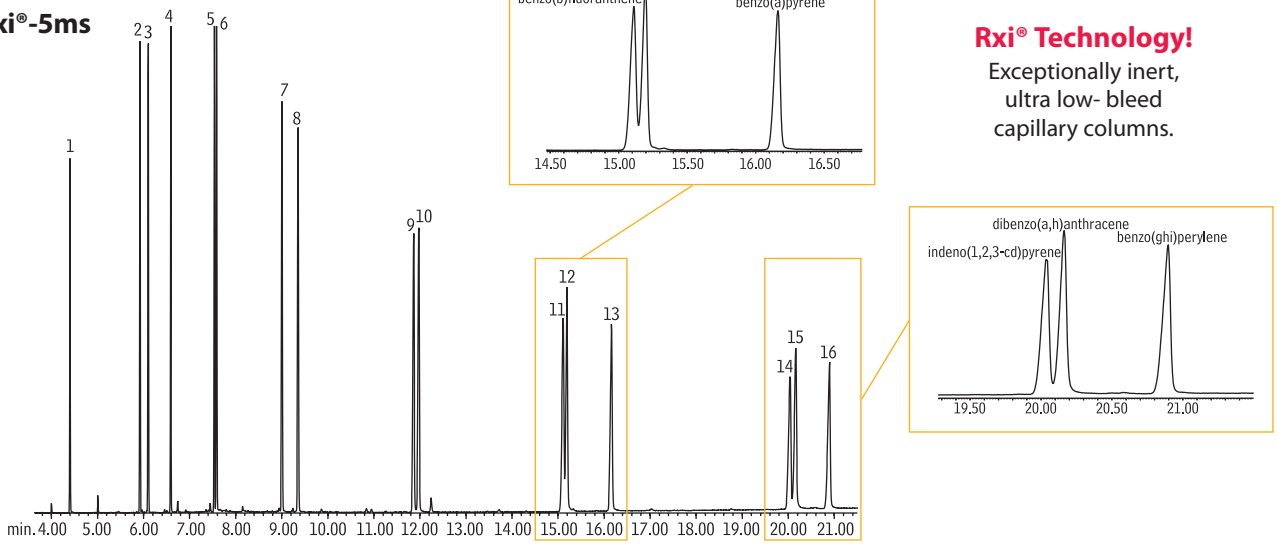
Phenanthrene and Anthracene
Rxi®-17Sil MS (15 m x 0.25 mm x 0.25 µm)



GC_EV1188

Peaks
1. Phenanthrene
2. Anthracene

Polycyclic Aromatic Hydrocarbons
US EPA Method 610
Rxi®-5ms

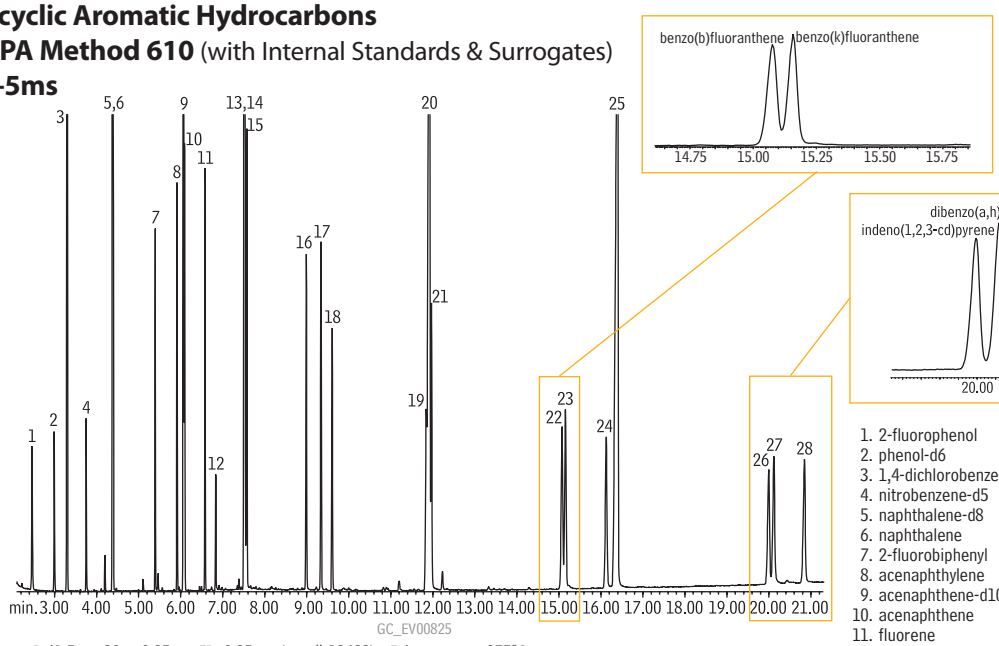


Rxi® Technology!
Exceptionally inert, ultra low- bleed capillary columns.

Column:	Rxi®-5ms, 30m, 0.25mm ID, 0.25µm (cat.# 13423)
Sample:	SV Calibration Mix #5/610 PAH Mix (cat.# 31011)
Inj.:	1.0µL, 10ppm each analyte (10ng on column), splitless (hold 0.1 min.) 4mm Drilled Uniliner® inlet liner (hole near bottom) (cat.# 20771)
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!
Exceptionally inert, ultra low- bleed capillary columns.

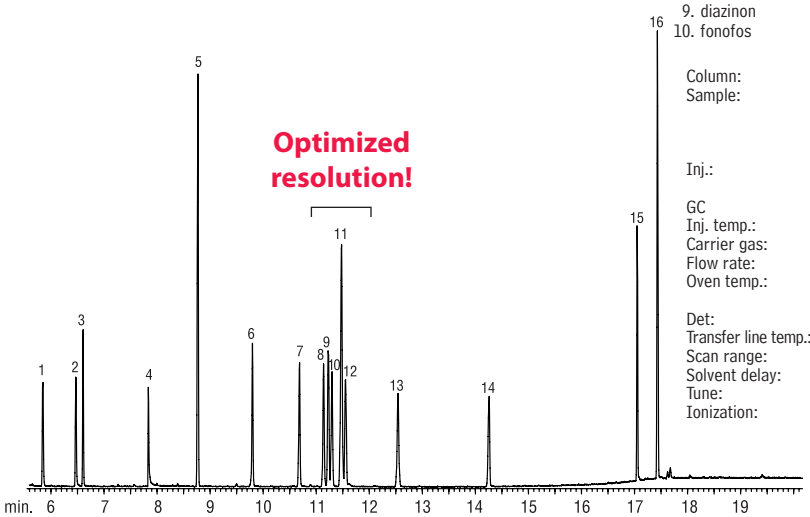
Column:	Rxi®-5ms, 30m, 0.25mm ID, 0.25µm (cat.# 13423)
Sample:	SV Calibration Mix #5/610 PAH Mix (cat.# 31011), Acid Surrogate Mix (4/89 SOW) (cat.# 31025), B/N Surrogate Mix (4/89 SOW) (cat.# 31024), SV Internal Standard Mix (cat.# 31206)
Inj.:	1.0µL, 10ppm each analyte (10ng on column; 40ng each internal standard), splitless (hold 0.1 min.) 4mm Drilled Uniliner® inlet liner (hole near bottom) (cat.# 20771)
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. *p*-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

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

1. nitrobenzene
2. 2,4-dichlorophenol
3. 1,3-dimethyl-2-nitrobenzene (SS)
4. 2,4,6-trichlorophenol
5. acenaphthene-d10 (IS#1)
6. azobenzene*
7. prometon
8. terbufos
9. diazinon
10. fonofos
11. phenanthrene-d10 (IS#2)
12. disulfoton
13. acetochlor
14. cyanazine
15. triphenylphosphate (SS)
16. chrysene-d12

* Compound listed in method, 1,2-diphenylhydrazine, decomposes to azobenzene.

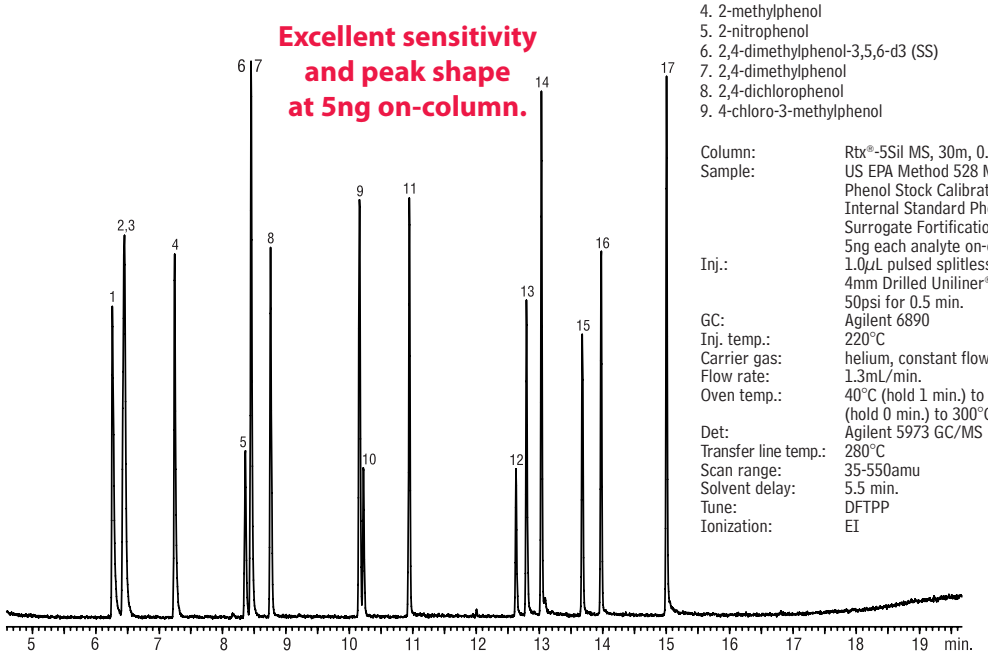


GC_EV00656

Column:	Rtx®-5Sil MS, 30m, 0.25mm ID, 0.25µm (cat.# 12723)
Sample:	US EPA Method 526 Mix 1µL 10ppm (20ppm IS) Primary Dilution Standard/Semivolatiles/EPA 526 (cat.# 31691) Surrogate Standard/Method 526 (cat.# 31693) Internal Standard/Method 526 (cat.# 31692)
Inj.:	1.0µL splitless (hold 0.3 min.), 4mm Drilled Uniliner® inlet liner (cat.# 21055)
GC	Agilent 6890
Inj. temp.:	300°C
Carrier gas:	helium, constant flow
Flow rate:	0.8mL/min.
Oven temp.:	50°C (hold 1 min.) to 200°C @ 20°C/min. (hold 5 min.) to 310°C @ 30°/min. (hold 3 min.)
Det:	Agilent 5973 GC/MS
Transfer line temp.:	280°C
Scan range:	35-550amu
Solvent delay:	5.5 min.
Tune:	DFTPP
Ionization:	EI

Phenols
US EPA Method 528
Rtx®-5Sil MS

1. phenol
2. 2-chlorophenol-3,4,5,6-d4 (SS)
3. 2-chlorophenol
4. 2-methylphenol
5. 2-nitrophenol
6. 2,4-dimethylphenol-3,5,6-d3 (SS)
7. 2,4-dimethylphenol
8. 2,4-dichlorophenol
9. 4-chloro-3-methylphenol
10. 1,2-dimethyl-3-nitrobenzene (IS#1)
11. 2,4,6-trichlorophenol
12. 2,4-dinitrophenol
13. 4-nitrophenol
14. 2,3,4,5-tetrachlorophenol (IS#2)
15. 2-methyl-4,6-dinitrophenol
16. 2,4,6-tribromophenol (SS)
17. pentachlorophenol



GC_EV00664

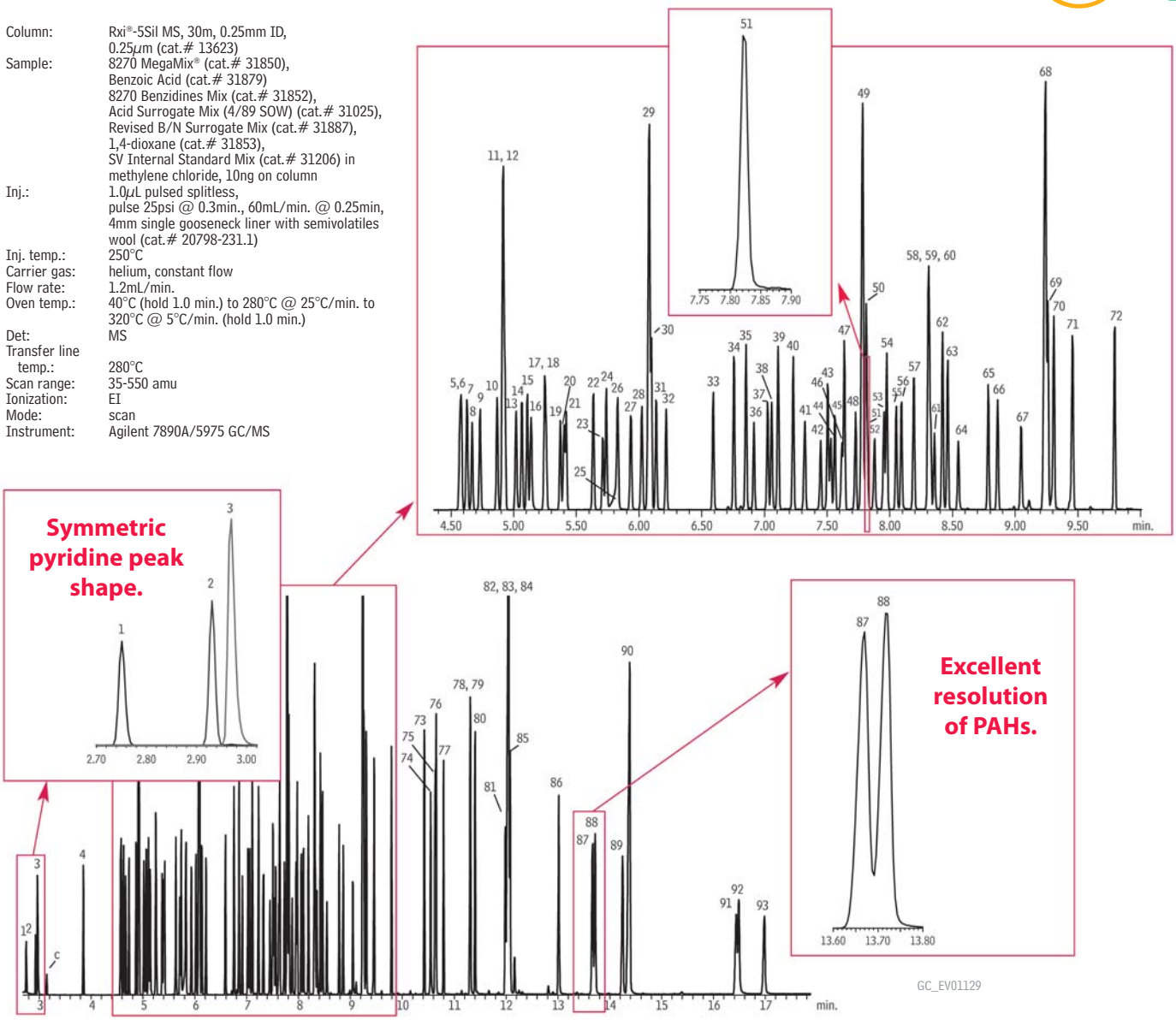
Column:	Rtx®-5Sil MS, 30m, 0.25mm ID, 0.25µm (cat.# 12723)
Sample:	US EPA Method 528 Mix 1µL 5ppm standard Phenol Stock Calibration Solution (cat.# 31694) Internal Standard Phenols Method 528 (cat.# 31696) Surrogate Fortification Standard/Phenols (cat.# 31692) 5ng each analyte on-column
Inj.:	1.0µL pulsed splitless (hold 0.5 min.), 4mm Drilled Uniliner® inlet liner (cat.# 21055), pulsed pressure 50psi for 0.5 min.
GC:	Agilent 6890
Inj. temp.:	220°C
Carrier gas:	helium, constant flow
Flow rate:	1.3mL/min.
Oven temp.:	40°C (hold 1 min.) to 220°C @ 12°C/min. (hold 0 min.) to 300°C @ 30°C/min. (hold 1 min.)
Det:	Agilent 5973 GC/MS
Transfer line temp.:	280°C
Scan range:	35-550amu
Solvent delay:	5.5 min.
Tune:	DFTPP
Ionization:	EI

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

Restek's New Semivolatiles Wool High 2,4-DNP response (RF = 0.269).

NEW!

Column:	Rxi®-5Sil MS, 30m, 0.25mm ID, 0.25µm (cat.# 13623)
Sample:	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) in methylene chloride, 10ng on column
Inj.:	1.0µL pulsed splitless, pulse 25psi @ 0.3min., 60mL/min. @ 0.25min, 4mm single gooseneck liner with semivolatiles wool (cat.# 20798-231.1)
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 1.0 min.)
Det:	MS
Transfer line temp.:	280°C
Scan range:	35-550 amu
Ionization:	EI
Mode:	scan
Instrument:	Agilent 7890A/5975 GC/MS



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

c = toluene

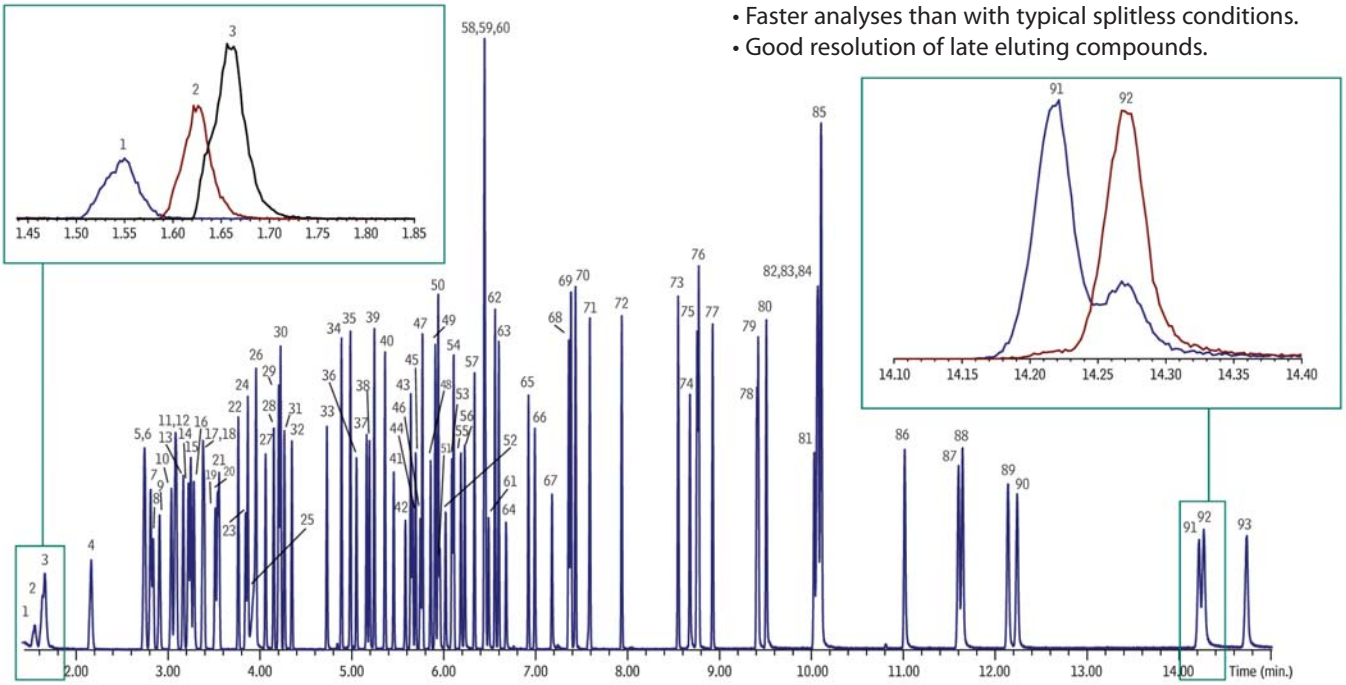
Semivolatiles
EPA Method 8270
Rxi®-5Sil MS (Split Injection)

NEW!

Peaks
1. 1,4-Dioxane
2. N-Nitrosodimethylamine
3. Pyridine
4. 2-Fluorophenol (SS)
5. Phenol-d6 (SS)
6. Phenol
7. Aniline
8. Bis(2-chloroethyl) ether
9. 2-Chlorophenol
10. 1,3-Dichlorobenzene
11. 1,4-Dichlorobenzene-D4 (IS)
12. 1,4-Dichlorobenzene
13. Benzyl Alcohol
14. 1,2-Dichlorobenzene
15. 2-Methylphenol
16. Bis(2-chloroisopropyl) ether
17. 4-Methylphenol/3-Methylphenol
18. N-Nitrosodi-N-propylamine
19. Hexachloroethane
20. Nitrobenzene-D5 (SS)
21. Nitrobenzene
22. Isophorone
23. 2-Nitrophenol
24. 2,4-Dimethylphenol
25. Benzoic acid
26. Bis(2-chloroethoxy)methane
27. 2,4-Dichlorophenol
28. 1,2,4-Trichlorobenzene
29. Naphthalene-D8 (IS)
30. Naphthalene
31. 4-Chloroaniline
32. Hexachlorobutadiene
33. 4-Chloro-3-methylphenol
34. 2-Methylnaphthalene
35. 1-Methylnaphthalene
36. Hexachlorocyclopentadiene
37. 2,4,6-Trichlorophenol
38. 2,4,5-Trichlorophenol
39. 2-Fluorobiphenyl (SS)
40. 2-Chloronaphthalene
41. 2-Nitroaniline
42. 1,4-Dinitrobenzene
43. Dimethyl phthalate
44. 1,3-Dinitrobenzene
45. 2,6-Dinitrotoluene
46. 1,2-Dinitrobenzene
47. Acenaphthylene
48. 3-Nitroaniline
49. Acenaphthene-d10 (IS)
50. Acenaphthene
51. 2,4-Dinitrophenol
52. 4-Nitrophenol
53. 2,4-Dinitrotoluene
54. Dibenzofuran
55. 2,3,5,6-Tetrachlorophenol
56. 2,3,4,6-Tetrachlorophenol
57. Diethyl Phthalate
58. 4-Chlorophenyl phenyl ether
59. Fluorene
60. 4-Nitroaniline
61. 4,6-Dinitro-2-methylphenol
62. N-Nitrosodiphenylamine (Diphenylamine)
63. 1,2-Diphenylhydrazine (as Azobenzene)
64. 2,4,6-Tribromophenol (SS)
65. 4-Bromophenyl phenyl ether
66. Hexachlorobenzene
67. Pentachlorophenol
68. Phenanthrene-D10 (IS)
69. Phenanthrene
70. Anthracene
71. Carbazole
72. di-*n*-Butyl phthalate
73. Fluoranthene
74. Benzidine
75. Pyrene-d10 (SS)
76. Pyrene
77. *p*-Terphenyl-d14 (SS)
78. 3,3'-Dimethylbenzidine
79. Butyl benzyl phthalate
80. Bis(2-ethylhexyl) adipate
81. 3,3'-Dichlorobenzidine
82. Benz[a]anthracene
83. Bis(2-ethylhexyl)phthalate
84. Chrysene-D12 (IS)
85. Chrysene
86. Di-*n*-octyl phthalate
87. Benzo[b]fluoranthene
88. Benzo[k]fluoranthene
89. Benzo[a]pyrene
90. Perylene-D12 (IS)
91. Dibenz[a,h]anthracene
92. Indeno[1,2,3-cd]pyrene
93. Benzo[ghi]perylene

Great peak shape for early eluters—even with 80°C initial oven temp!

Analyze more samples per shift with fast split injection
- Faster analyses than with typical splitless conditions.
- Good resolution of late eluting compounds.



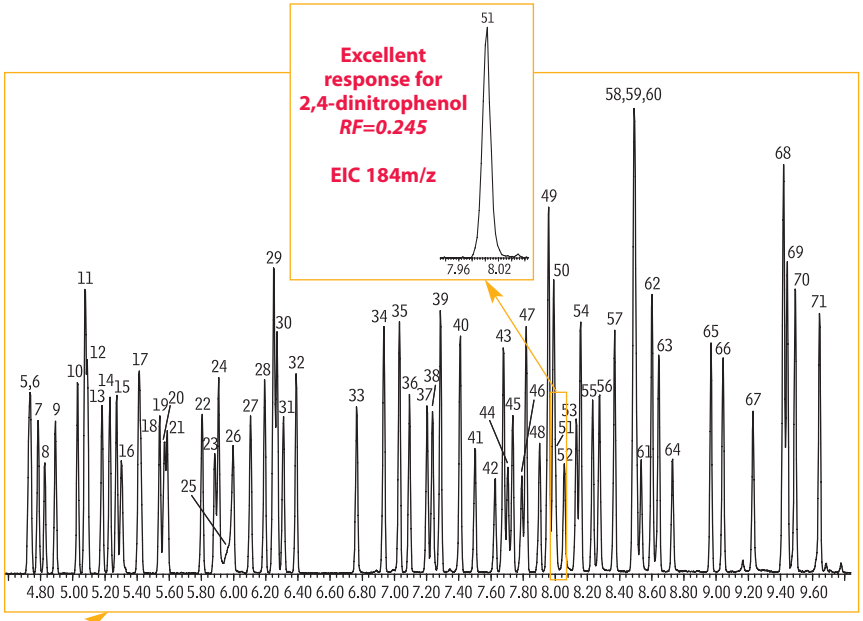
GC_EV1182

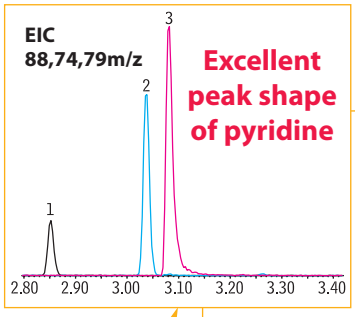
Column	Rxi®-5Sil MS, 30 m, 0.25 mm ID, 0.25 µm (cat.# 13623)
Sample	8270 MegaMix® (cat.# 31850) Benzoic acid (cat.# 31879) 8270 Benzidines Mix (cat.# 31852) Acid Surrogate Mix (4/89 SOW) (cat.# 31025) 1,4-dioxane (cat.# 31853) Revised B/N Surrogate Mix (cat.# 31887) SV Internal Standard Mix (cat.# 31206)
Diluent:	Methylene chloride
Conc.:	40 µg/mL (4 ng on-column)
Injection	
Inj. Vol.:	1.0 µL split (split ratio 10:1)
Liner:	4mm Split Precision® Liner w/ Semivolatiles Wool (cat.# 21023-231.5)
Inj. Temp.:	270 °C
Split Vent Flow Rate:	60 mL/min.

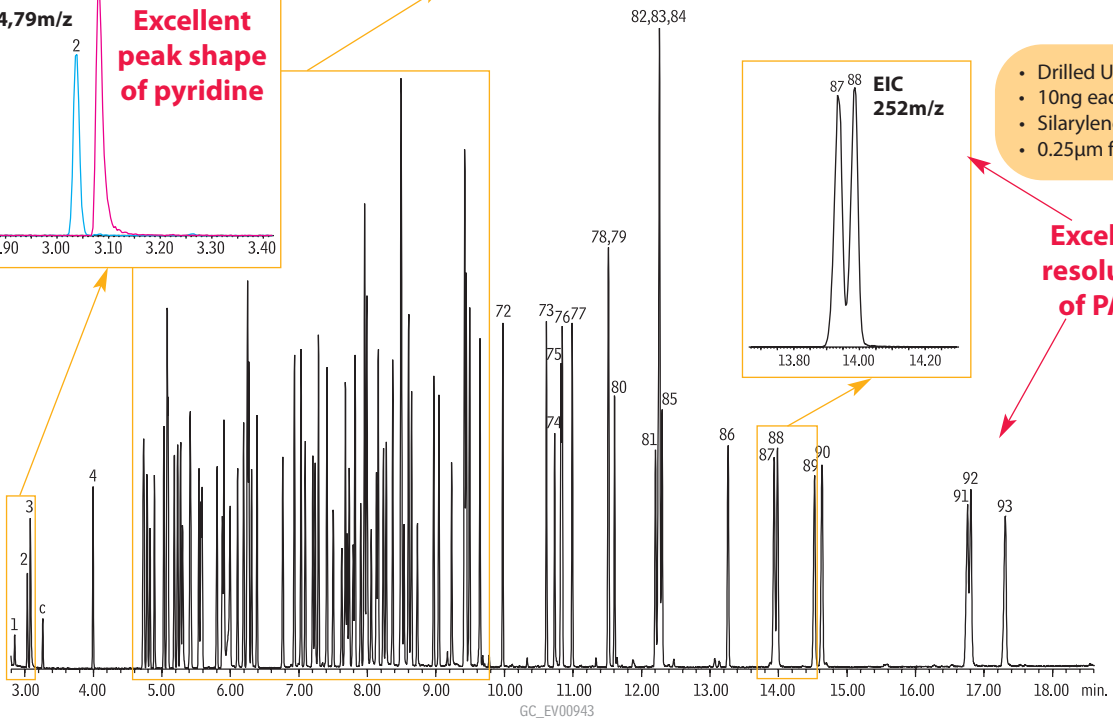
Oven	
Oven Temp:	80 °C (hold 1 min.) to 280 °C at 25 °C/min. to 320 °C at 5 °C/min.
Carrier Gas	He, constant flow
Flow Rate:	1.2 mL/min.
Detector	MS
Mode:	Scan
Transfer Line Temp.:	280 °C
Analyzer Type:	Quadrupole
Source Temp.:	250 °C
Quad Temp.:	150 °C
Tune Type:	DFTPP
Ionization Mode:	EI
Scan Range:	35-400 amu
Instrument	Agilent 7890A GC & 5975C MSD

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

Column:	Rxi®-5Sil MS, 30m, 0.25mm ID, 0.25µm (cat.# 13623)
Sample:	US EPA Method 8270D Mix, 1µL of 10µg/mL (IS 40µg/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.:	1.0µL (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
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 1 min.)
Det.:	MS
Transfer line temp:	280°C
Scan range:	35-550amu
Ionization:	EI
Mode:	scan







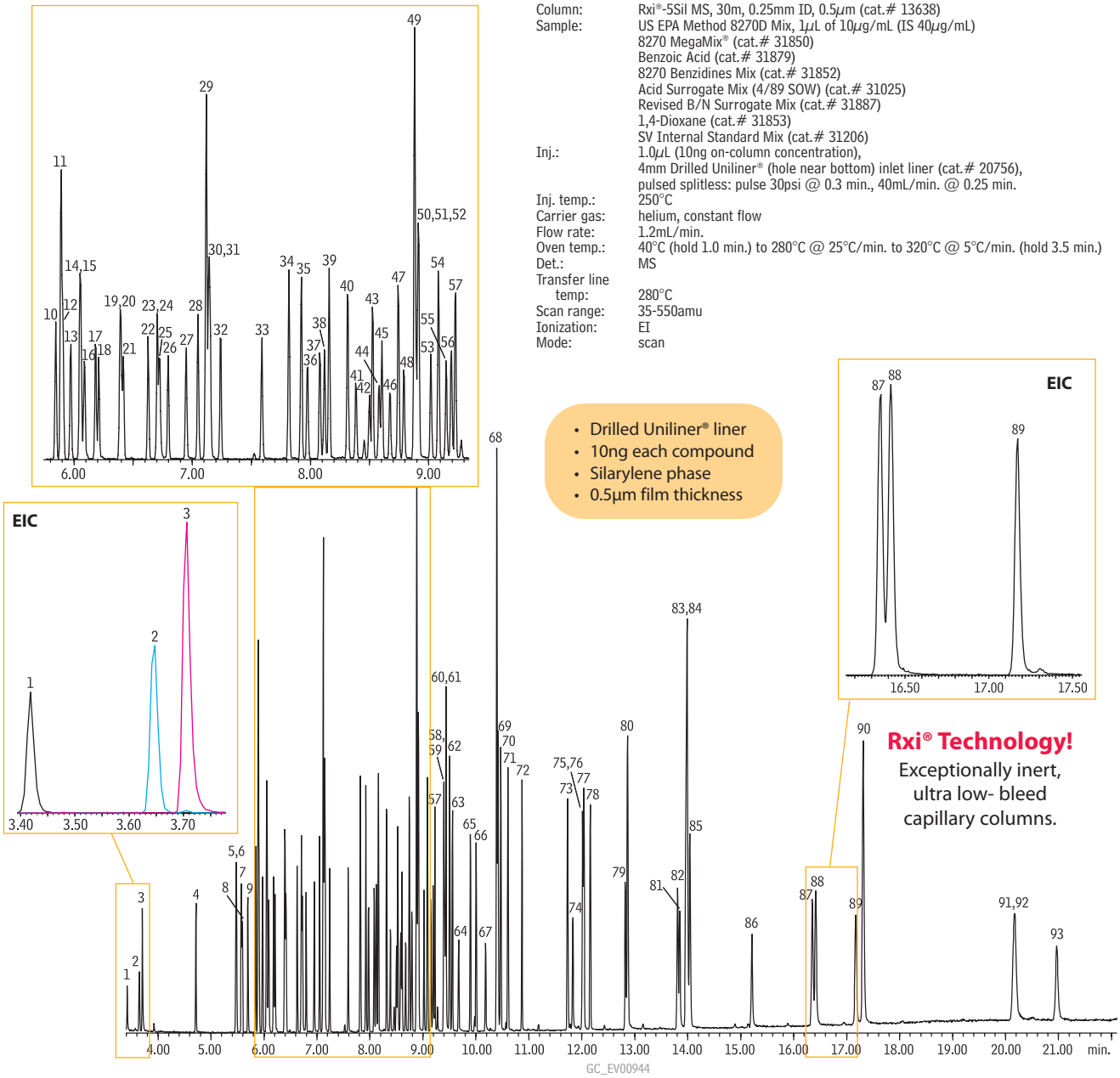
- Drilled Uniliner® liner,
- 10ng each compound
- Silarylene phase
- 0.25µm film thickness

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

c = contaminant

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

Column:	Rxi®-5Sil MS, 30m, 0.25mm ID, 0.5µm (cat.# 13638)
Sample:	US EPA Method 8270D Mix, 1µL of 10µg/mL (IS 40µg/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.:	1.0µL (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

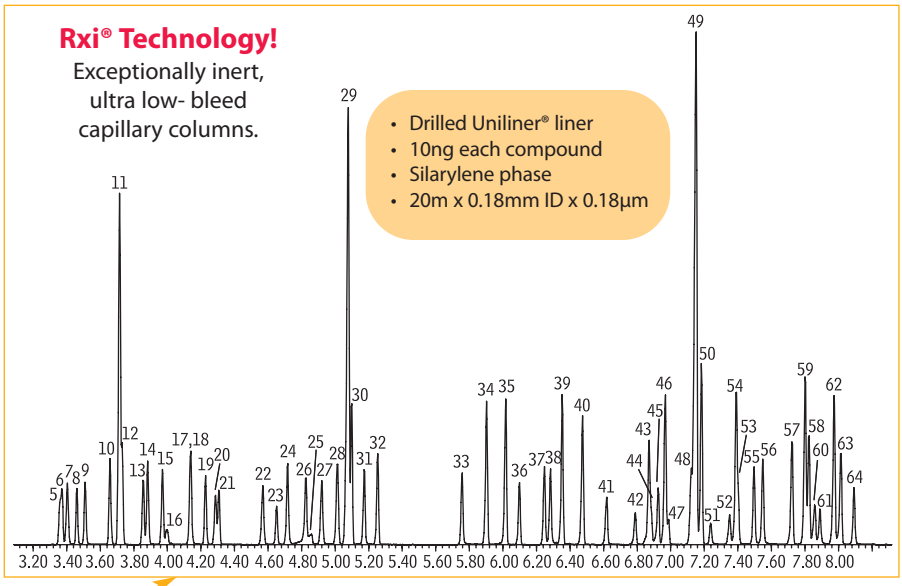


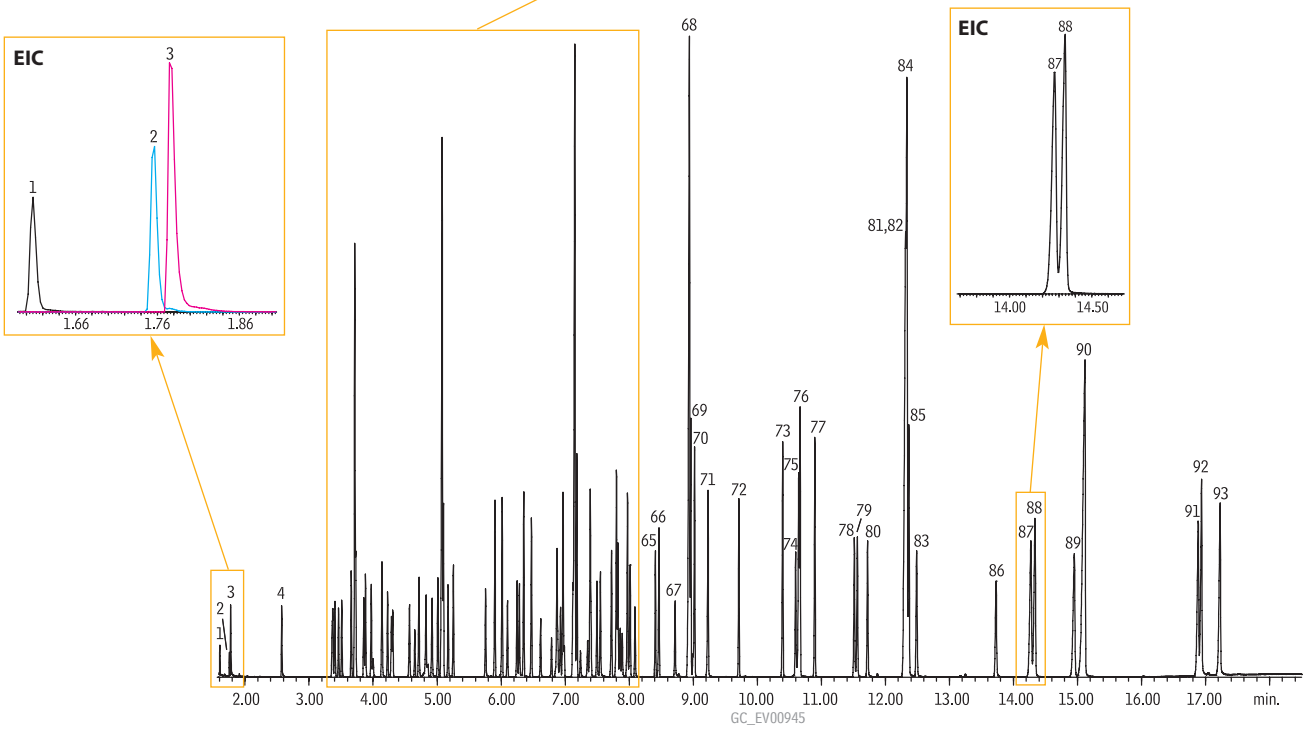
- Drilled Uniliner® liner
- 10ng each compound
- Silarylene phase
- 0.5µm film thickness

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

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

Column:	Rxi®-5Sil MS, 20m, 0.18mm ID, 0.18µm (cat.# 43602)
Sample:	US EPA Method 8270D Mix, 1µL of 10µg/mL (IS 40µg/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.:	1.0µL (10ng on-column concentration), 4mm Drilled Uniliner® (hole near bottom) inlet liner (cat.# 20756), pulsed splitless: pulse 30psi @ 0.2 min., 60mL/min. @ 0.15 min.
Inj. temp.:	250°C
Carrier gas:	helium, constant flow
Flow rate:	1.0mL/min.
Oven temp.:	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.)
Det.:	MS
Transfer line temp:	280°C
Scan range:	35-550amu
Ionization:	EI
Mode:	scan



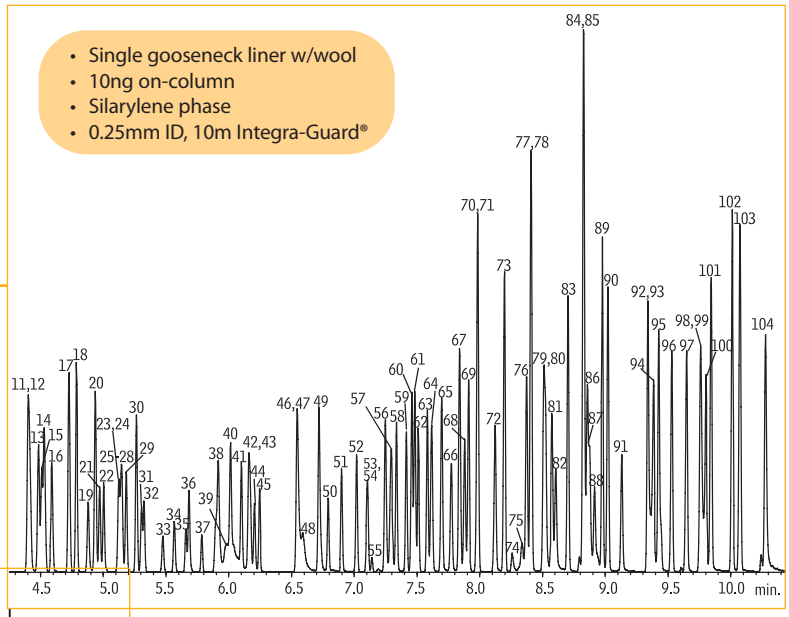


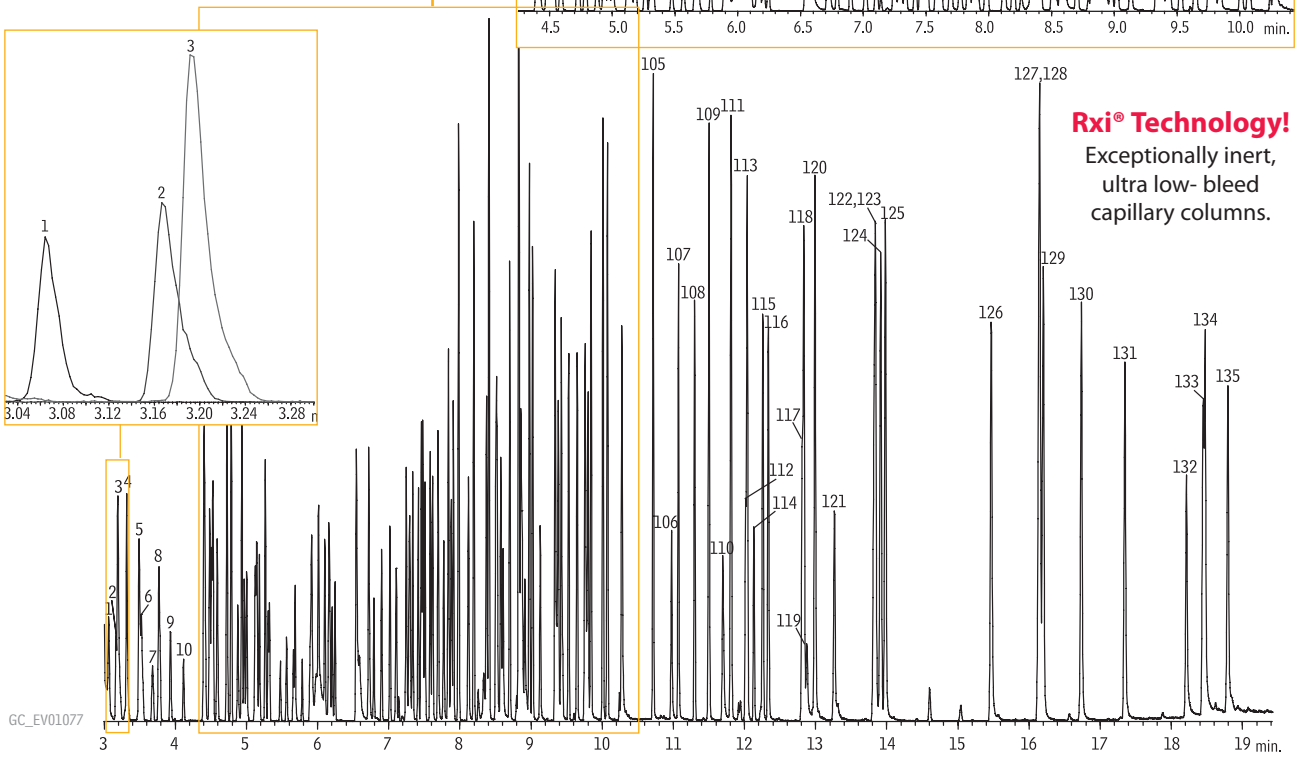
1. 1,4-dioxane
2. *n*-nitrosodimethylamine
3. pyridine
4. 2-fluorophenol (SS)
5. phenol-d6 (SS)
6. phenol
7. aniline
8. bis(2-chloroethyl) ether
9. 2-chlorophenol
10. 1,3-dichlorobenzene
11. 1,4-dichlorobenzene-d4 (IS)
12. 1,4-dichlorobenzene
13. benzyl alcohol
14. 1,2-dichlorobenzene
15. 2-methylphenol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

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

- Single gooseneck liner w/wool
- 10ng on-column
- Silarylene phase
- 0.25mm ID, 10m Integra-Guard®

Column: Rxi®-5Sil MS, 30m, 0.25mm ID, 0.25µm, w/10m Integra-Guard™ (cat.# 13623-127)
Sample: 8270 MegaMix® (cat.# 31850), Appendix IX Mix #1 (cat.# 31625), Appendix IX Mix #2 (cat.# 31806), Revised B/N Surrogate Mix (cat.# 31887), Acid Surrogate Mix (4/89 SOW) (cat.# 31025), 8270 Benzidines Mix (cat.# 31852) in methylene chloride, 10ng on-column
Inj.: 1.0µL pulsed splitless, pulse 20psi @ 0.3 min., 60mL/min. @ 0.25 min. 4mm single gooseneck inlet liner w/wool (cat.# 22405)
Inj. temp.: 275°C
Carrier gas: helium, constant flow
Flow rate: 1.2mL/min.
Oven temp.: 50°C (hold 0.5 min.) to 260°C @ 20°C/min. to 280°C @ 5°C/min. to 340°C (hold 2 min.) @ 18°C/min.
Det: MS
Transfer line temp.: 280°C
Scan range: 35-550
Ionization: EI
Mode: scan





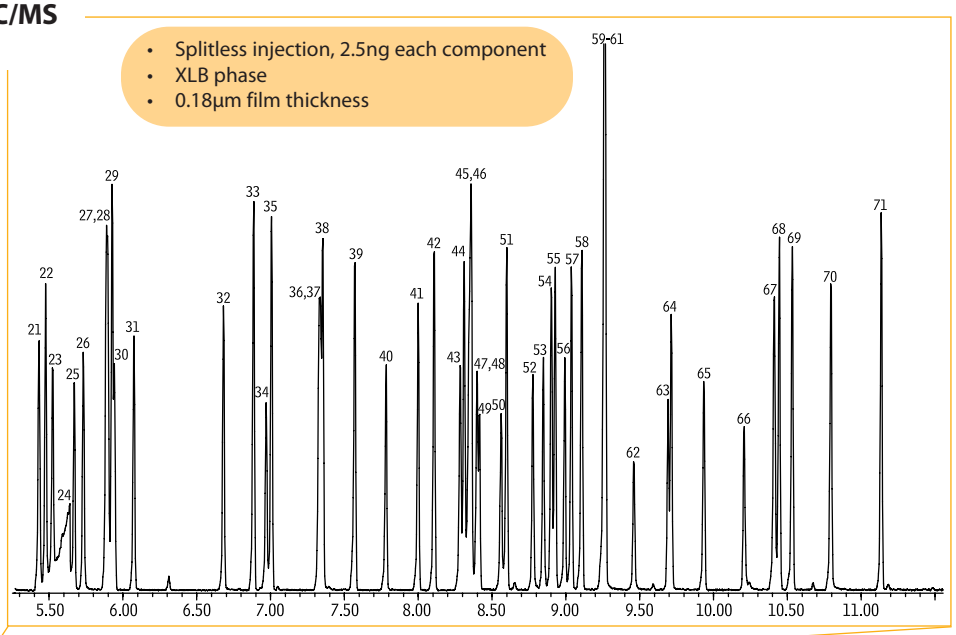
Rxi® Technology!
Exceptionally inert, ultra low- bleed capillary columns.

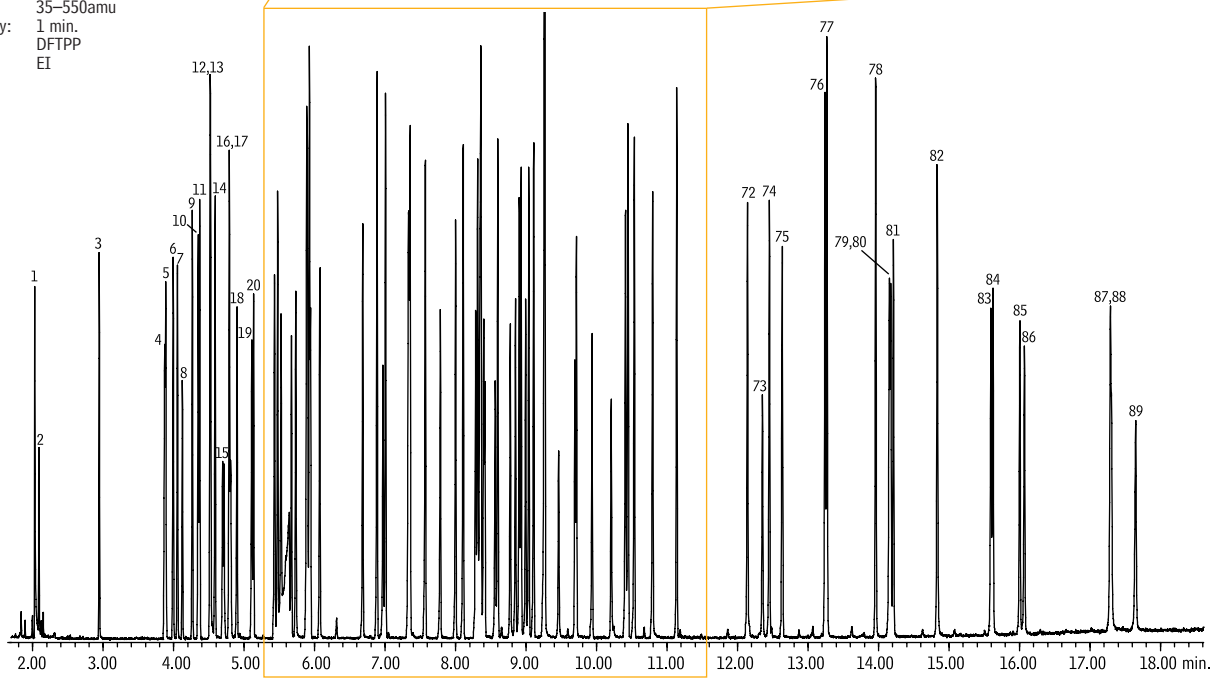
1. 1,4-dioxane
2. N-nitrosodimethylamine
3. pyridine
4. ethyl methacrylate
5. 2-picoline
6. N-nitrosomethylethylamine
7. methyl methanesulfonate
8. 2-fluorophenol
9. N-nitrosodiethylamine
10. ethyl methanesulfonate
11. benzaldehyde
12. phenol
13. aniline
14. bis(2-chloroethyl)ether
15. pentachloroethane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

Semivolatile Organics
US EPA Method 8270D by GC/MS
Rtx®-XLB

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

Column:	Rtx®-XLB, 20m, 0.18mm ID, 0.18µm (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.:	0.5µL, 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

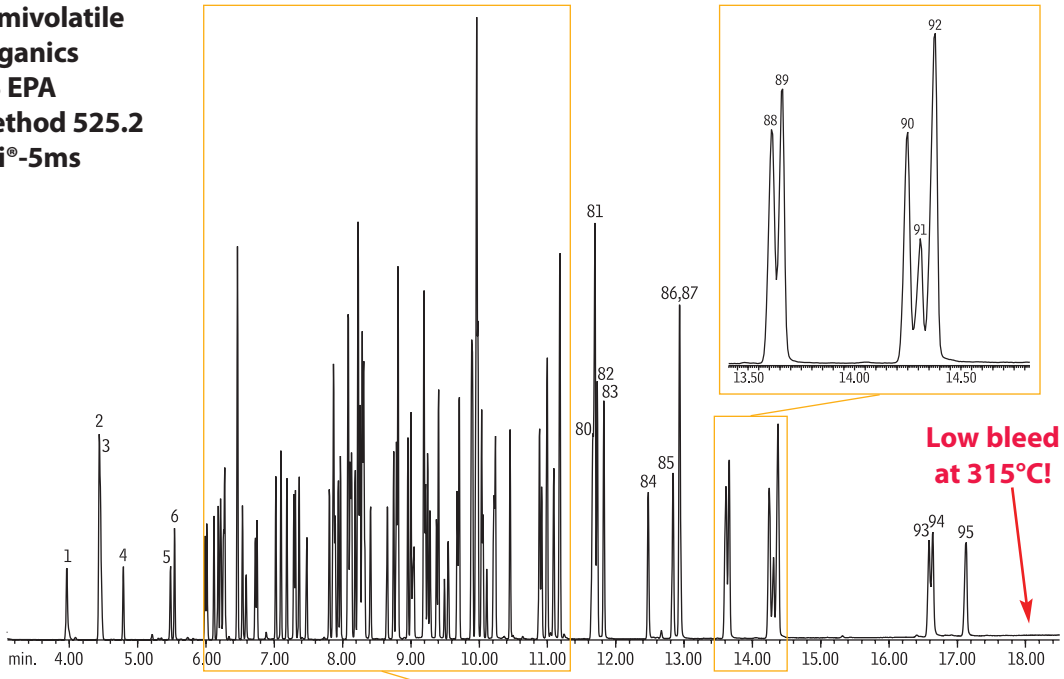


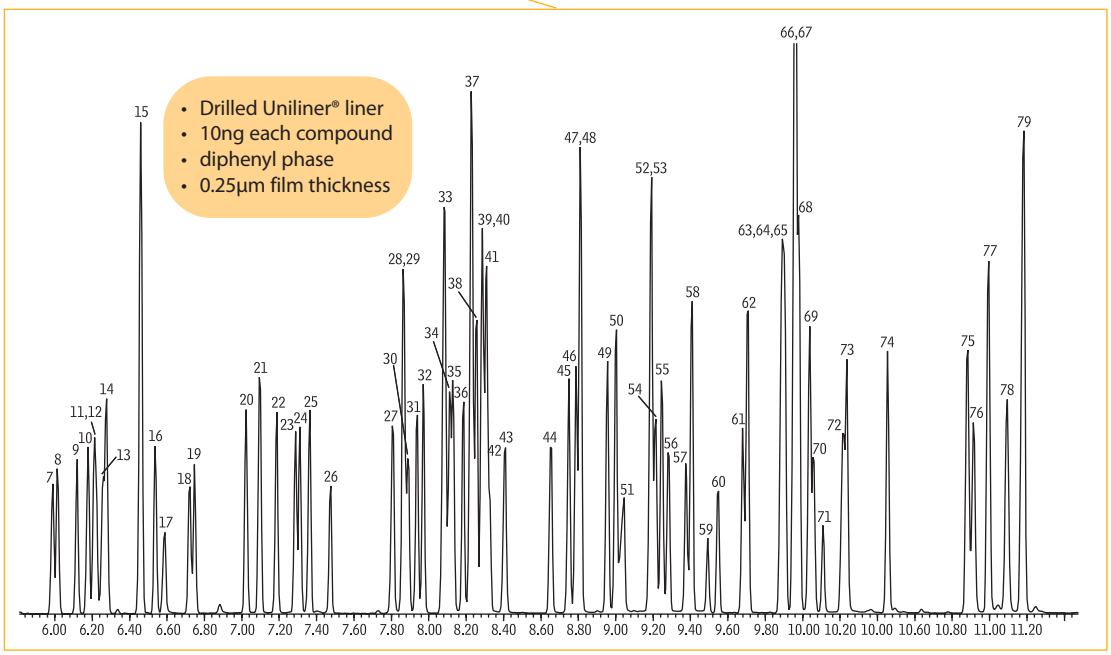


GC_EV00747

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

Semivolatile Organics US EPA Method 525.2 Rxi®-5ms





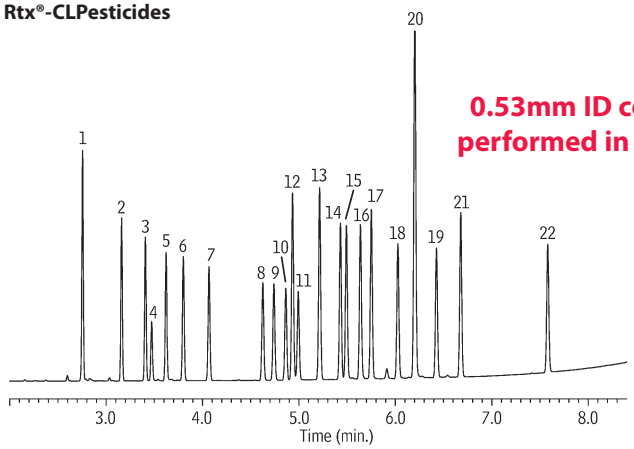
1. isophorone
2. 2-nitro-*m*-xylene (SS)
3. naphthalene
4. dichlorvos (DDVP)
5. hexachlorocyclopentadiene
6. EPTC
7. mevinphos
8. butylate
9. vernolate
10. dimethyl phthalate
11. pebulate
12. etridiazole (Terrazole®)
13. 2,6-dinitrotoluene
14. acenaphthylene
15. acenaphthene-d10 (IS)
16. chlorneb
17. tebuthiuron
18. 2,4-dinitrotoluene
19. molinate
20. diethyl phthalate
21. fluorene
22. propachlor
23. ethoprop (ethoprophos)
24. cycloate
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. triademefon
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. chlorobenzilate
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(ghi)perylene

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

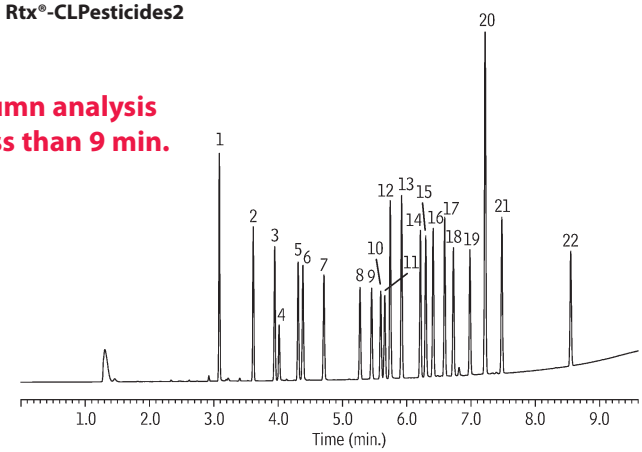
Rxi® Technology!
Exceptionally inert, ultra low- bleed capillary columns.

Organochlorine Pesticide Mix AB #2
US EPA Method 8081
Rtx®-CLPesticides and Rtx®-CLPesticides2 (0.53mm ID Column Set)

Rtx®-CLPesticides



Rtx®-CLPesticides2

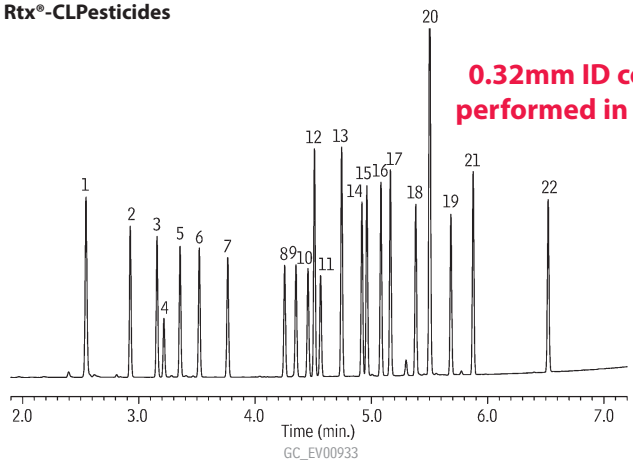


Columns: Rtx®-CLPesticides, 30m, 0.53mm ID, 0.50µm (cat.# 11140) and Rtx®-CLPesticides2, 30m, 0.53mm ID, 0.42µm (cat.# 11340) with 5m x 0.53mm ID Rxi® deactivated guard tubing (cat.# 10054), connected using Siltek® Treated Universal "Y" Press-Tight® connector (cat.# 20486)
Sample: Organochlorine Pesticide Mix AB #2, 8-80µg/mL each component in hexane/toluene (cat.# 32292), Pesticide Surrogate Mix, 200µg/mL each component in acetone (cat.# 32000)
Inj.: 1.0µL 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 320°C (hold 2 min.) @ 20°C/min.
Det.: µ-ECD @ 330°C

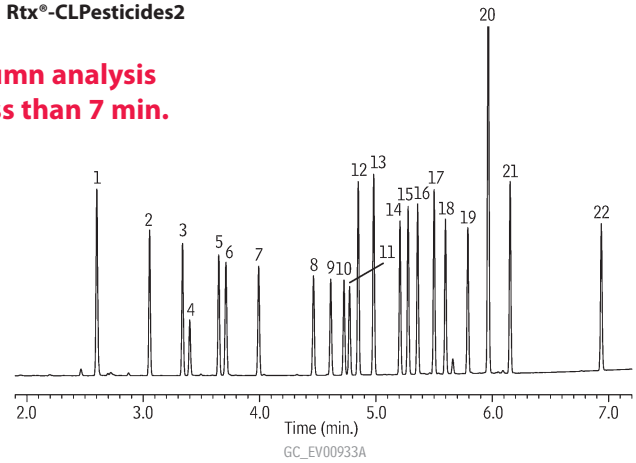
1. 2,4,5,6-tetrachloro-*m*-xylene (SS)
2. α-BHC
3. γ-BHC
4. β-BHC
5. δ-BHC
6. heptachlor
7. aldrin
8. heptachlor epoxide (isomer B)
9. γ-chlordane
10. α-chlordane
11. endosulfan I
12. 4,4'-DDE
13. dieldrin
14. endrin
15. 4,4'-DDD
16. endosulfan II
17. 4,4'-DDT
18. endrin aldehyde
19. endosulfan sulfate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

Organochlorine Pesticide Mix AB #2
US EPA Method 8081
Rtx®-CLPesticides and Rtx®-CLPesticides2 (0.32mm ID Column Set)

Rtx®-CLPesticides



Rtx®-CLPesticides2

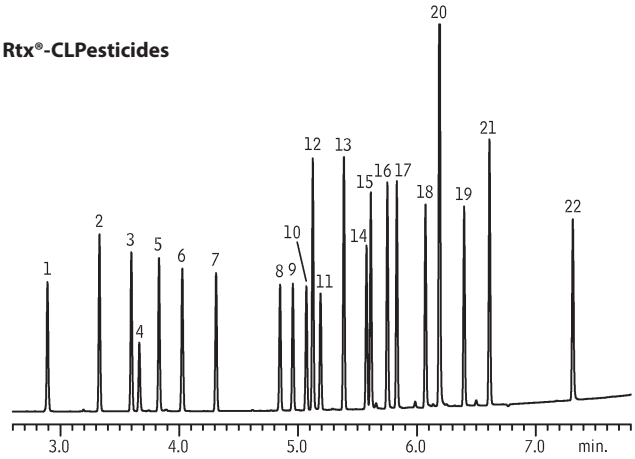


Columns: Rtx®-CLPesticides, 30m, 0.32mm ID, 0.32µm (cat.# 11141) and Rtx®-CLPesticides2, 30m, 0.32mm ID, 0.25µm (cat.# 11324) with 5m x 0.32mm ID Rxi® deactivated guard tubing (cat.# 10039), connected using Deactivated Universal "Y" Press-Tight® connector (cat.# 20405-261)
Sample: Organochlorine Pesticide Mix AB #2, 8-80µg/mL each component in hexane/toluene (cat.# 32292), Pesticide Surrogate Mix, 200µg/mL each component in acetone (cat.# 32000)
Inj.: 1.0µL 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.: µ-ECD @ 330°C

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

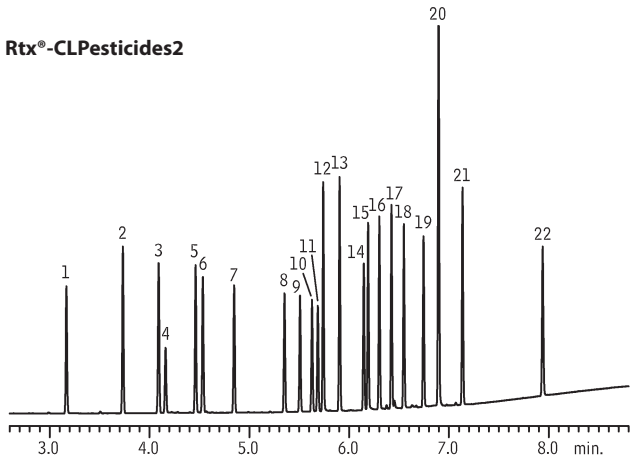
Organochlorine Pesticide Mix AB #2
US EPA Method 8081
Rtx®-CLPesticides and Rtx®-CLPesticides2 (0.25mm ID column set)

Rtx®-CLPesticides



GC_EV00940

Rtx®-CLPesticides2



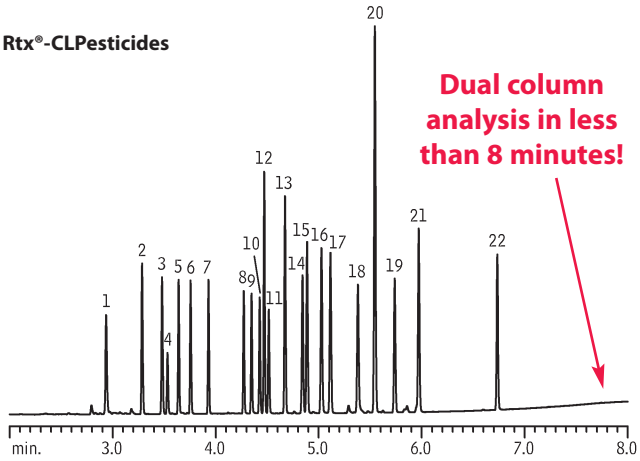
GC_EV00941

Columns:	Rtx®-CLPesticides, 30m, 0.25mm ID, 0.25µm (cat.# 11123) and Rtx®-CLPesticides2, 30m, 0.25mm ID, 0.20µm (cat.# 11323) with 5m x 0.25mm ID Rxi® deactivated guard tubing (cat.# 10029), connected using Siltek®-treated Universal "Y" Press-Tight® Connector (cat.# 20486)
Sample:	Organochlorine Pesticide Mix AB #2, 8–80µg/mL each component in hexane/toluene (cat.# 32292), Pesticide Surrogate Mix, 200µg/mL each component in acetone (cat.# 32000)
Inj.:	0.5µL 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.:	µ-ECD @ 330°C

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

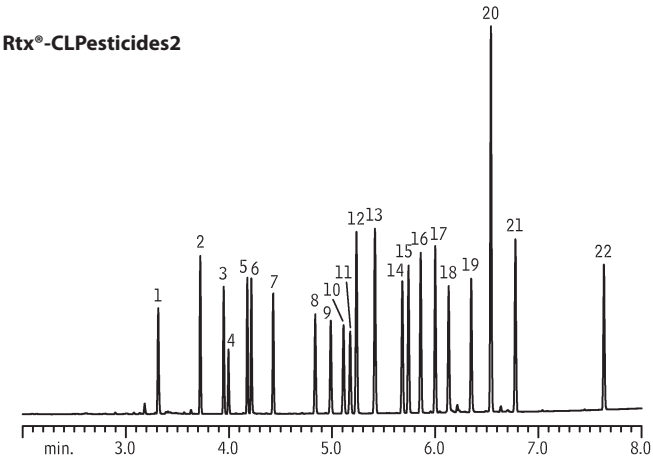
Organochlorine Pesticides
US EPA Method 8081
Rtx®-CLPesticides and Rtx®-CLPesticides2 (0.18mm ID column set)

Rtx®-CLPesticides



GC_EV00892

Rtx®-CLPesticides2



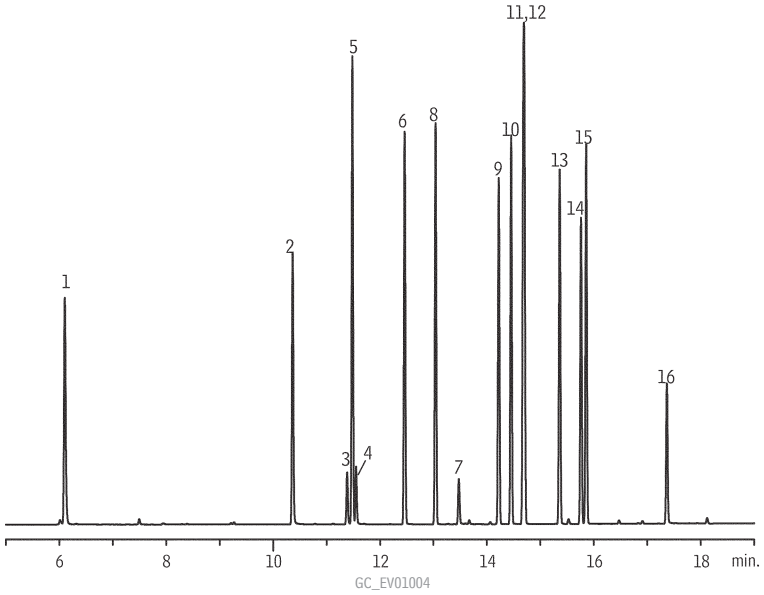
GC_EV00893

Columns:	Rtx®-CLPesticides, 20m, 0.18mm ID, 0.18µm (cat.# 42102) and Rtx®-CLPesticides2, 20m, 0.18mm ID, 0.14µm (cat.# 42302) with 5m x 0.53mm ID intermediate-polarity deactivated guard tubing (cat.# 10045), connected using SeCure® "Y" Connector Kit (cat.# 20276) with Universal "Y" Press-Tight® Connector
Sample:	Organochlorine Pesticide Mix AB #2 (cat.# 32292), 8-80µg/mL each component in hexane/toluene, Pesticide Surrogate Mix (cat.# 32000), 200µg/mL each component in acetone
Inj.:	0.5µL 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.:	µ-ECD @ 350°C

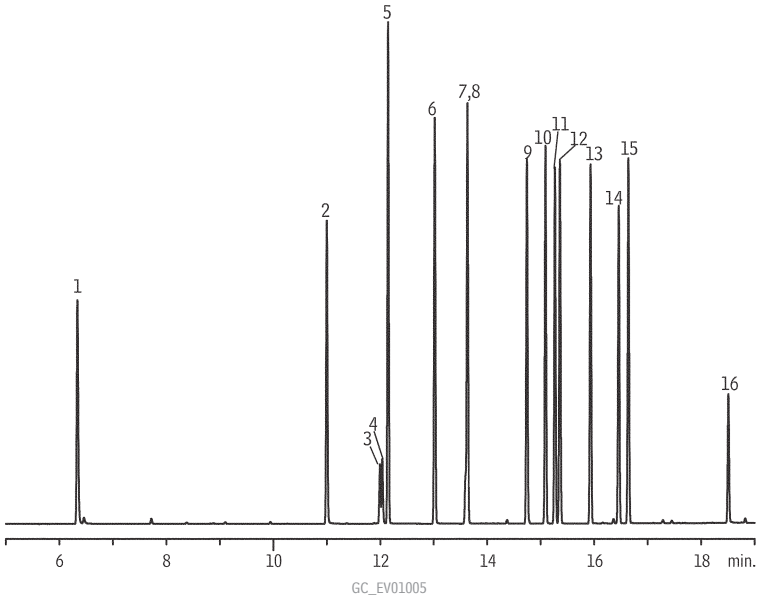
1. 2,4,5,6-tetrachloro-*m*-xylene (SS)
2. α-BHC
3. γ-BHC
4. β-BHC
5. δ-BHC
6. heptachlor
7. aldrin
8. heptachlor epoxide
9. γ-chlordane
10. α-chlordane
11. endosulfan I
12. 4,4'-DDE
13. dieldrin
14. endrin
15. 4,4'-DDD
16. endosulfan II
17. 4,4'-DDT
18. endrin aldehyde
19. endosulfan sulfate
20. methoxychlor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

Pesticides & Herbicides
US EPA Method 505
Rtx®-CLPesticides & Rtx®-CLPesticides2

Rtx®-CLPesticides



Rtx®-CLPesticides2

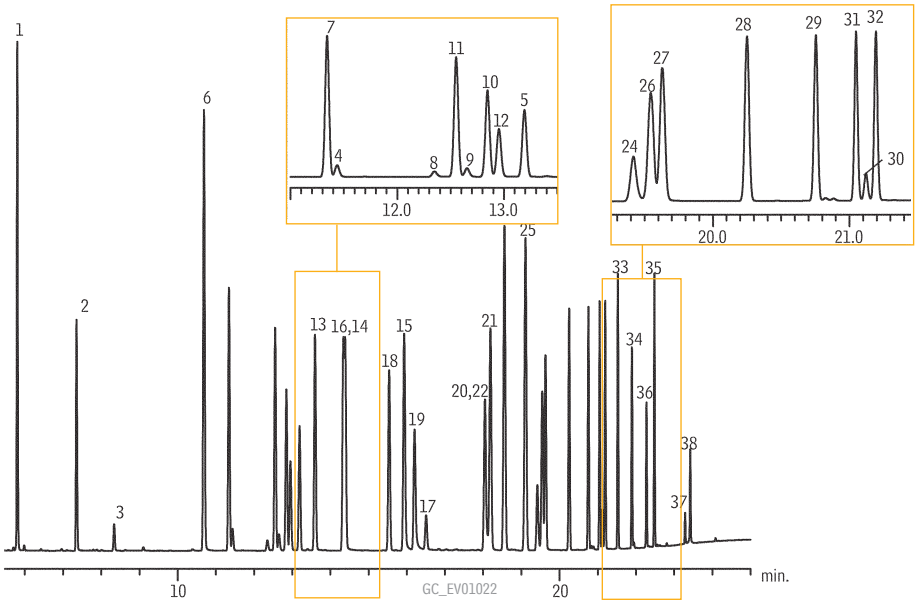


1. hexachlorocyclopentadiene
2. hexachlorobenzene
3. simazine
4. atrazine
5. γ-BHC
6. heptachlor
7. alachlor
8. aldrin
9. heptachlor epoxide
10. γ-chlordane
11. *trans*-nonachlor
12. α-chlordane
13. dieldrin
14. endrin
15. *cis*-nonachlor
16. methoxychlor

Column:	Rtx®-CLPesticides2, 30m, 0.32mm ID, 0.25μm (cat.# 11324) and Rtx®-CLPesticides, 30m, 0.32mm ID, 0.32μm (cat.# 11141) with 5m x 0.32mm ID Rxi® deactivated guard tubing (cat.# 10039), connected using Universal "Y" Press-Tight® Connector (cat.# 20405-261)
Sample:	200ng/mL 505 Organohalide Pesticide Mix (cat.# 32024), 4.2μg/mL Simazine (cat.# 32236), 4.2μg/mL Atrazine (cat.# 32208) in methanol
Inj.:	2μL splitless (hold 0.75 min.), 4mm cyclo double gooseneck liner (cat.# 20896)
Inj. temp.:	250°C
Carrier gas:	helium, constant flow
Linear velocity:	40cm/sec. @ 90°C
Oven temp.:	90°C (hold 1 min.) to 310°C (hold 5 min.) @ 10°C/min.
Det. temp.:	μ-ECD @ 325°C

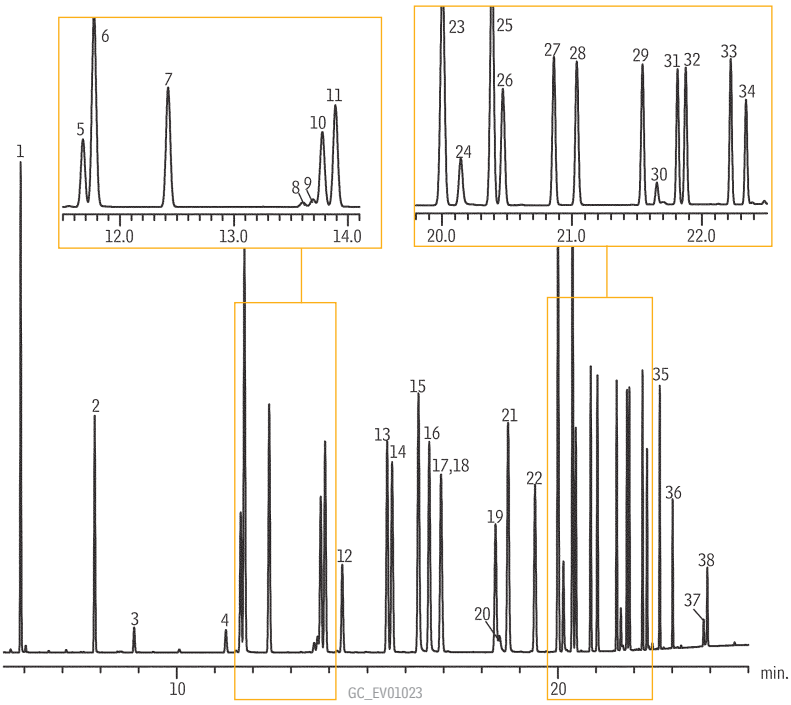
Pesticides & Herbicides
US EPA Method 508.1
Rtx®-CLPesticides & Rtx®-CLPesticides2

Rtx®-CLPesticides



1. hexachlorocyclopentadiene
2. etridiazole
3. chloroneb
4. propachlor
5. trifluralin
6. hexachlorobenzene
7. α-BHC
8. simazine
9. atrazine
10. pentachloronitrobenzene (IS)
11. γ-BHC
12. β-BHC
13. δ-BHC
14. heptachlor
15. chlorothalonil
16. metribuzin
17. alachlor
18. aldrin
19. 4,4'-dibromobiphenyl (SS)
20. metachlor
21. DCPA
22. heptachlor epoxide
23. γ-chlordane
24. cyanazine
25. α-chlordane
26. endosulfan I
27. 4,4'-DDE
28. dieldrin
29. endrin
30. chlorobenzilate
31. 4,4'-DDD
32. endosulfan II
33. 4,4'-DDT
34. endrin aldehyde
35. endosulfan sulfate
36. methoxychlor
37. *cis*-permethrin
38. *trans*-permethrin

Rtx®-CLPesticides2

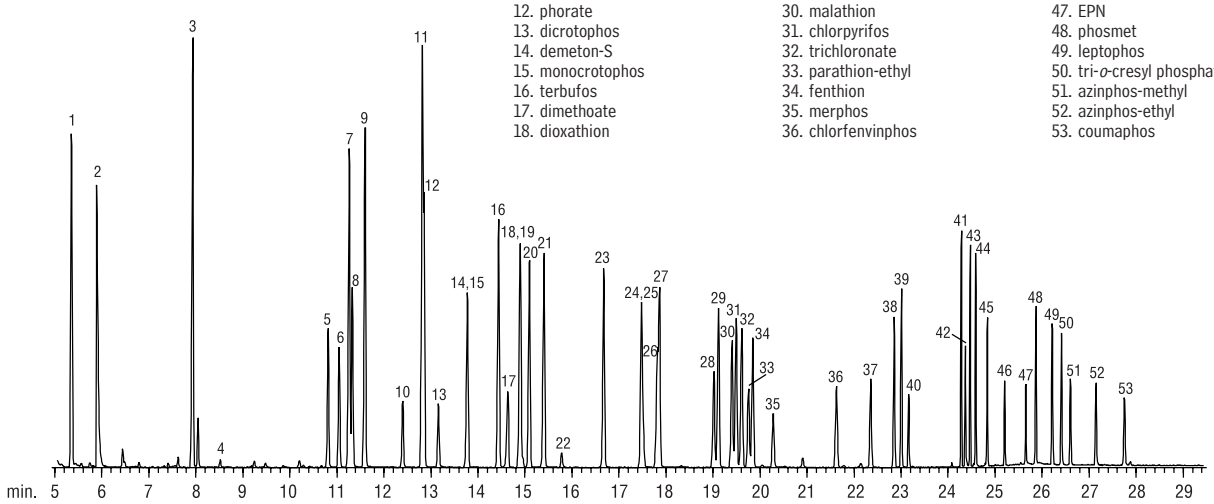


Column:	Rtx®-CLPesticides2, 30m, 0.32mm ID, 0.25µm (cat.# 11324) and Rtx®-CLPesticides, 30m, 0.32mm ID, 0.32µm (cat.# 11141) with 5m x 0.32mm ID Rxi® deactivated guard tubing (cat.# 10039), connected using Universal "Y" Press-Tight® Connector (cat.# 20405-261)
Sample:	50ng/mL 508.1 Calibration Mix #1 (cat.# 32094), 100ng/mL 508.1 Calibration Mix #2 (cat.# 32095), 100ng/mL 508.1 Calibration Mix #3 (cat.# 32096), 50ng/mL 508.1 Internal Standard (cat.# 32091), 250ng/mL 508.1 Surrogate (cat.# 32092), 500ng/mL Atrazine (cat.# 32208), 500ng/mL Simazine (cat.# 32236) in ethyl acetate
Inj.:	2µL splitless (hold 0.75 min.), 4mm cyclo double gooseneck liner (cat.# 20896)
Inj. temp.:	250°C
Carrier gas:	helium, constant flow
Linear velocity:	26cm/sec. @ 80°C
Oven temp.:	80°C (hold 0.5 min.) to 155°C (hold 1 min.) @ 19°C/min. to 210°C @ 4°C/min. to 310°C (hold 0.5 min.) @ 25°C/min.
Detector temp.:	µ-ECD @ 325°C

Organophosphorus Pesticides
US EPA Method 8141A
Rtx®-OPPesticides2

Best column for most resolved compounds for Method 8141A.

1. dichlorvos
2. hexamethylphosphoramide
3. mevinphos
4. trichlorfon
5. TEPP
6. demeton-O
7. thionazin
8. tributyl phosphate (IS)
9. ethoprop
10. naled
11. sulfotepp
12. phorate
13. dicrotophos
14. demeton-S
15. monocrotophos
16. terbufos
17. dimethoate
18. dioxathion
19. fonophos
20. diazinon
21. disulfoton
22. phosphamidon isomer
23. dichlorofenthion
24. chlorpyrifos methyl
25. phosphamidon
26. parathion-methyl
27. ronnel
28. fenitrothion
29. aspon
30. malathion
31. chlorpyrifos
32. trichloronate
33. parathion-ethyl
34. fenthion
35. merphos
36. chlorfenvinphos
37. crotoxyphos
38. stirofos
39. 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



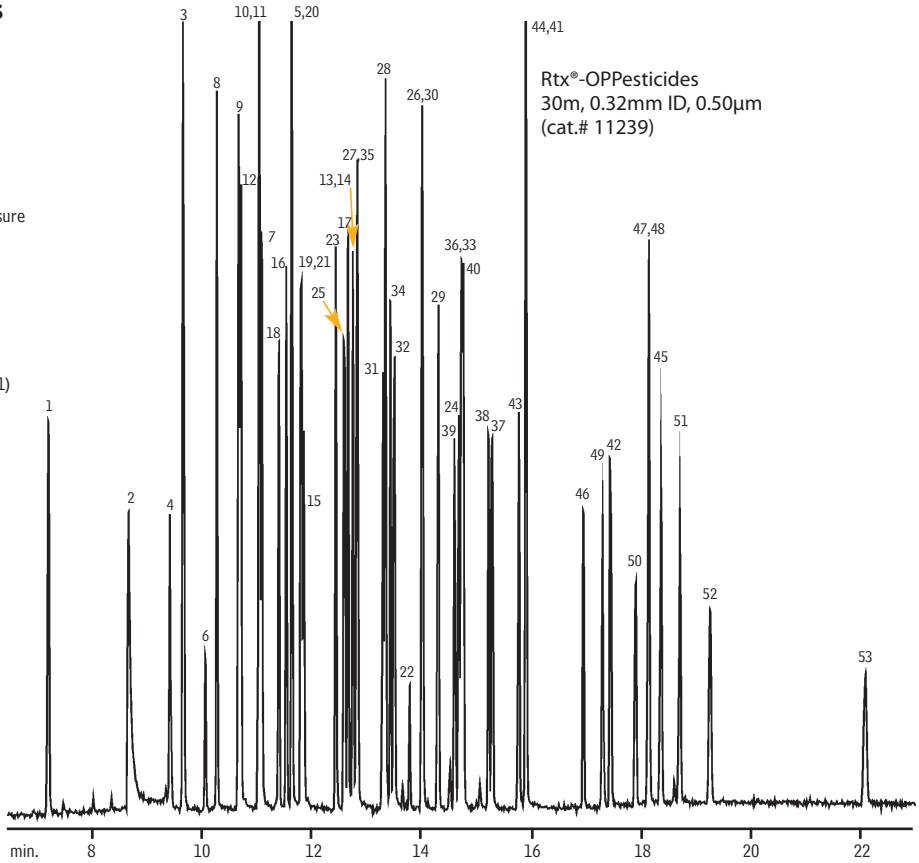
GC_EV00602

Column:	Rtx®-OPPesticides2, 30m, 0.25mm ID, 0.25µm (cat.# 11243)
Sample:	US EPA Method 8141A Custom Standard Mix 1µL 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) *Custom Mixes: Call Restek for Information*
Inj.:	1.0µL 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

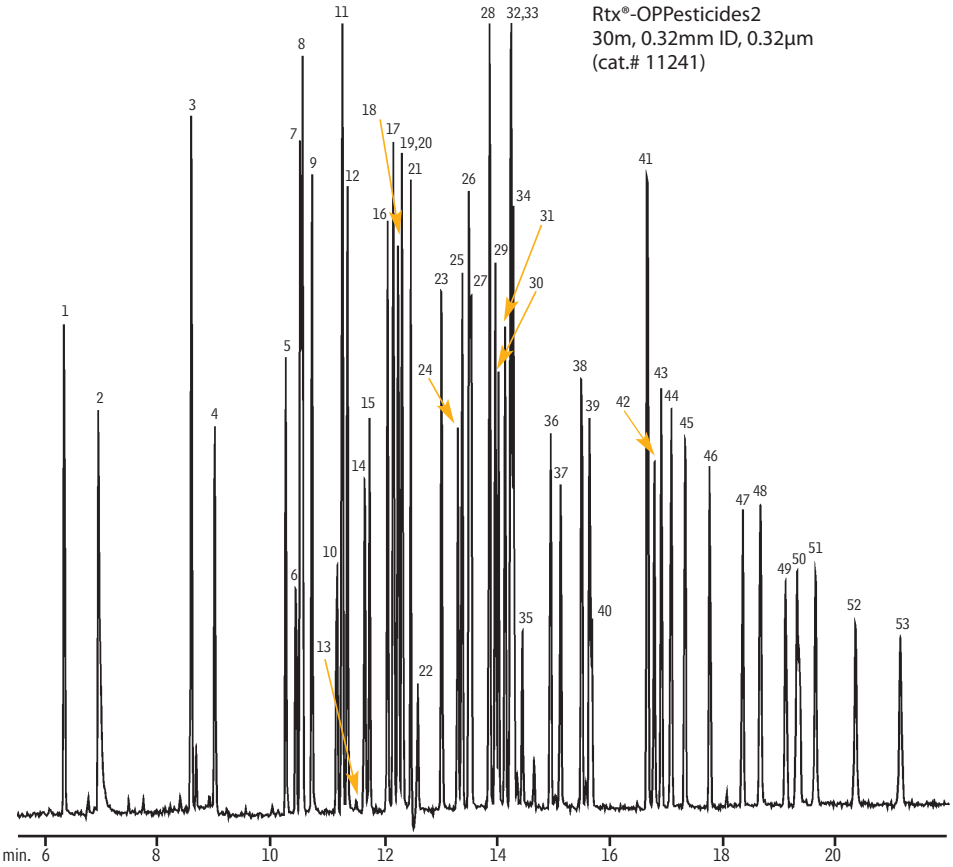
Organophosphorus Pesticides US EPA Method 8141A Rtx®-OPPesticides & Rtx®-OPPesticides2

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 (100ng/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)



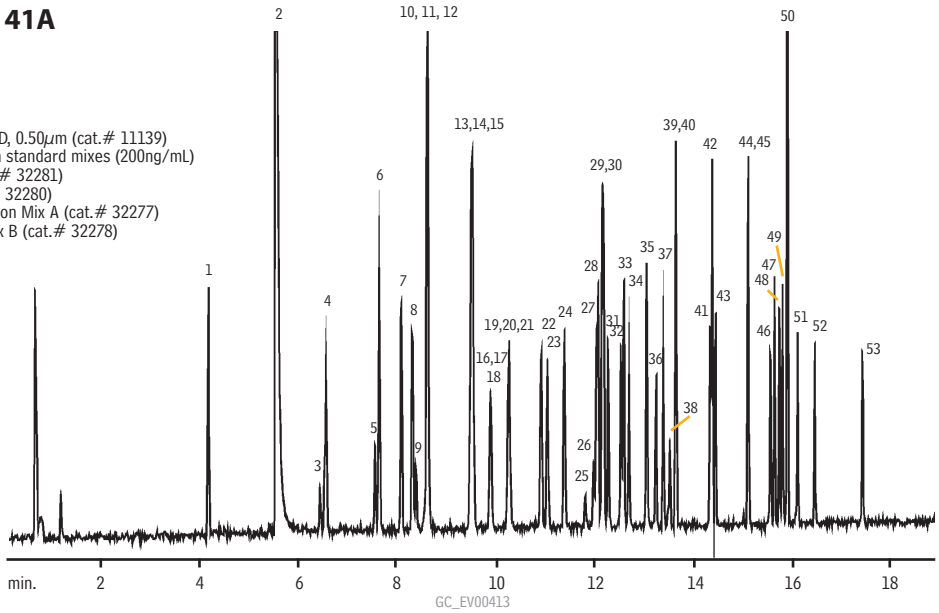
1. dichlorvos
2. hexamethylphosphoramide
3. mevinphos
4. trichlorfon
5. TEPP
6. demeton-O
7. tributyl phosphate (SS)
8. thionazin
9. ethoprop
10. naled
11. sulfotepp
12. phorate
13. dicrotophos
14. monocrotophos
15. demeton-S
16. terbufos
17. dimethoate
18. diazinon
19. dioxathion
20. fonophos
21. disulfoton
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. chlorfenvinphos
37. crotoxyphos
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



GC_EV00394

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

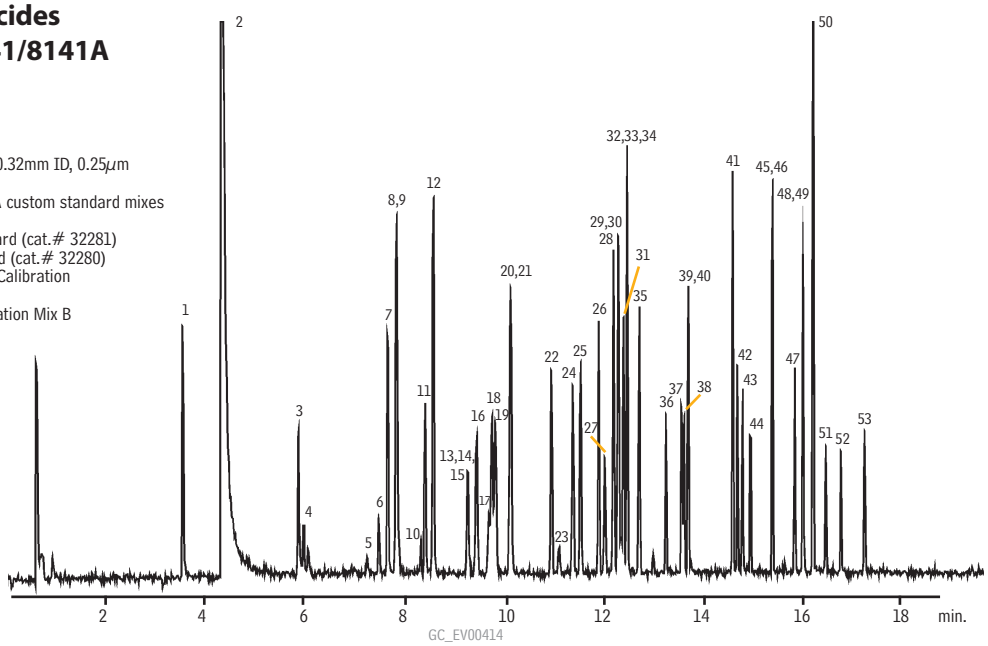
Column: Rtx®-CLPesticides, 30m, 0.32mm ID, 0.50µm (cat.# 11139)
Sample: 1µL US EPA Method 8141A custom standard mixes (200ng/mL)
Triphenylphosphate Standard (cat.# 32281)
Tributylphosphate Standard (cat.# 32280)
8140/8141 OP Pesticides Calibration Mix A (cat.# 32277)
8141 OP Pesticides Calibration Mix 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
2. hexamethylphosphoramide
3. trichlorfon
4. mevinphos
5. demeton-O
6. thionazin
7. ethoprop
8. phorate
9. naled
10. tributyl phosphate (SS)
11. TEPP
12. sulfotepp
13. demeton-S
14. terbufos
15. fonophos
16. dicrotophos
17. diazinon
18. disulfoton
19. dioxathion
20. monocrotophos
21. dimethoate
22. dichlorofenthion
23. chlorpyrifos methyl
24. ronnel
25. phosphamidon isomer
26. merphos
27. chlorpyrifos
28. fenthion
29. aspon
30. parathion-methyl
31. trichloronate
32. malathion
33. fenitrothion
34. phosphamidon
35. parathion-ethyl
36. chlorfenvinphos
37. tokuthion
38. merphos oxone
39. crotoxyphos
40. stirofos
41. bolstar
42. famphur
43. carbophenothion
44. fensulfothion
45. triphenyl phosphate (SS)
46. leptophos
47. ethion
48. phosmet
49. EPN
50. tri-*o*-cresyl phosphate
51. azinphos-methyl
52. azinphos-ethyl
53. coumaphos

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

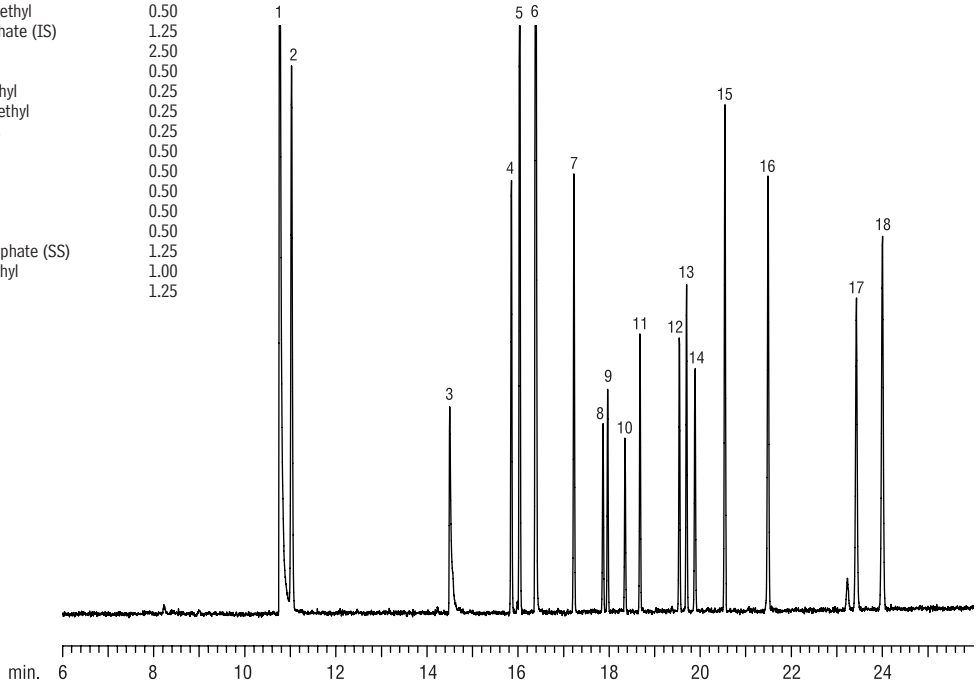
Column: Rtx®-CLPesticides2, 30m, 0.32mm ID, 0.25µm (cat.# 11324)
Sample: 1µL US EPA Method 8141A custom standard mixes (200ng/mL)
Triphenylphosphate Standard (cat.# 32281)
Tributylphosphate Standard (cat.# 32280)
8140/8141 OP Pesticides Calibration Mix A (cat.# 32277)
8141 OP Pesticides Calibration Mix 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
2. hexamethylphosphoramide
3. mevinphos
4. trichlorfon
5. demeton-O
6. thionazin
7. tributyl phosphate (SS)
8. ethoprop
9. TEPP
10. naled
11. phorate
12. sulfotepp
13. demeton-S
14. dicrotophos
15. dioxathion
16. terbufos
17. monocrotophos
18. fonophos
19. diazinon
20. disulfoton
21. dimethoate
22. dichlorofenthion
23. phosphamidon isomer
24. chlorpyrifos methyl
25. ronnel
26. parathion-methyl
27. phosphamidon
28. aspon
29. chlorpyrifos
30. trichloronate
31. merphos
32. fenitrothion
33. fenthion
34. malathion
35. parathion-ethyl
36. chlorfenvinphos
37. crotoxyphos
38. tokuthion
39. merphos oxone
40. stirofos
41. famphur
42. bolstar
43. carbophenothion
44. fensulfothion
45. triphenyl phosphate (SS)
46. ethion
47. EPN
48. phosmet
49. leptophos
50. tri-*o*-cresyl phosphate
51. azinphos-methyl
52. azinphos-ethyl
53. coumaphos

Organophosphorus Pesticides (European)
Rtx®-CLPesticides

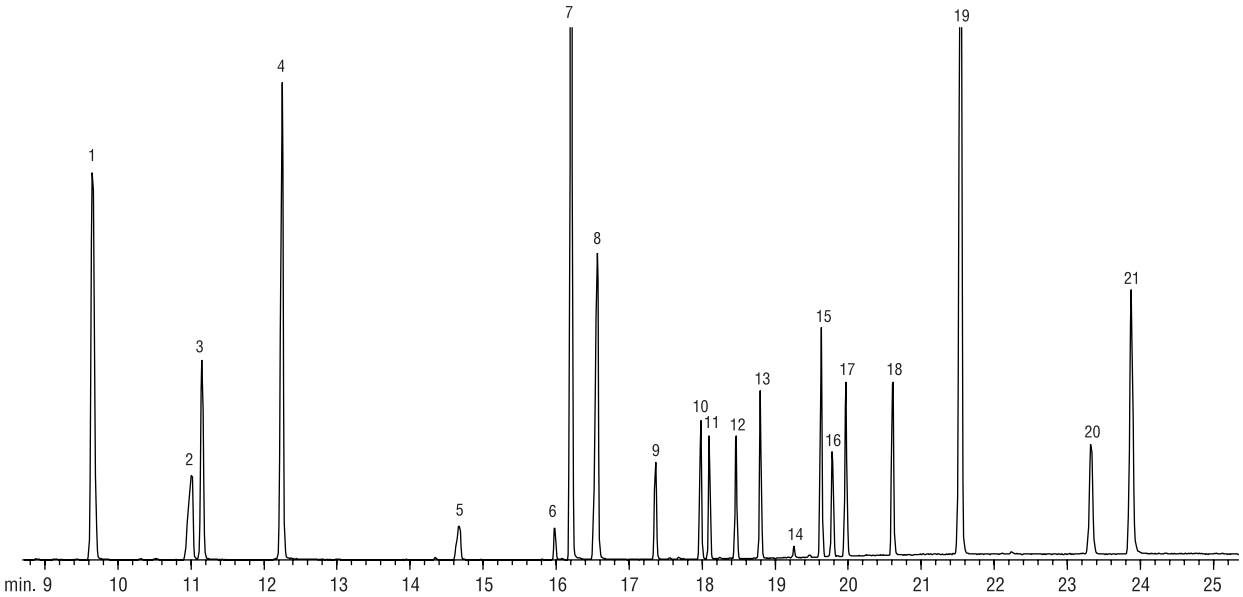
	Concentration on-column (ng)
1. methamidophos	1.25
2. dichlorvos	1.25
3. acephate	0.50
4. demeton-S-methyl	0.50
5. tributylphosphate (IS)	1.25
6. omethoate	2.50
7. dimethoate	0.50
8. tolclofos-methyl	0.25
9. pirimiphos methyl	0.25
10. chlorpyriphos	0.25
11. malathion	0.50
12. tokuthion	0.50
13. methidathion	0.50
14. profenfos	0.50
15. ethion	0.50
16. triphenylphosphate (SS)	1.25
17. azinphos-methyl	1.00
18. pyrazophos	1.25



GC_EV00676

Column:	Rtx®-CLPesticides, 30m, 0.32mm ID, 0.50µm (cat.# 11139)
Sample:	European OPP Mix (cat.# 32418) 100–1000µg/mL in acetone
Inj.:	0.5µL 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



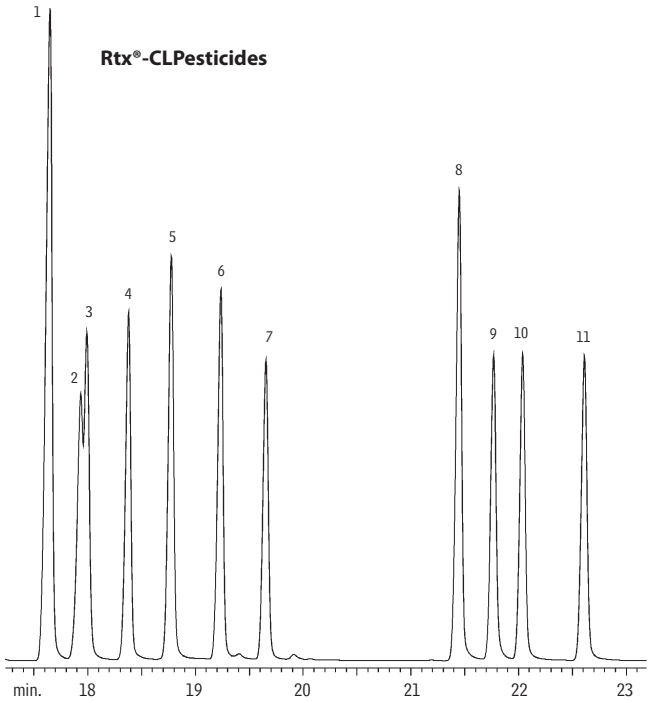
GC_EV00648

Column:	Rtx®-CLPesticides, 30m, 0.25mm ID, 0.25µm (cat.# 11123)
Sample:	Custom European Mix 1-bromo-2-nitrobenzene (cat.# 32279) 4-chloro-3-nitrobenzotrifluoride (cat.# 32282) tributylphosphate (cat.# 32280) triphenylphosphate (cat.# 32281)
Inj.:	1.0µL 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

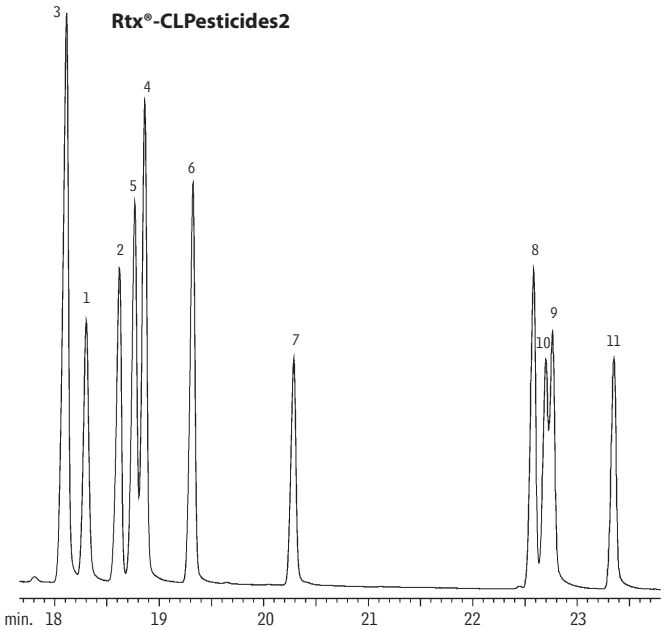
*This mix was prepared for FPD analyses. Peaks will be equivalent height with FPD detection if linear velocity is set at 28cm/sec. (0.32mm ID column).

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. chlorpyrifos	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

Nitrogen/Phosphorus Pesticides & Herbicides
US EPA Method 619
Rtx®-CLPesticides & Rtx®-CLPesticides2 (dual column analysis)



	CAS No.
1. prometon	1610-18-0
2. simazine	122-34-9
3. atraton	1610-17-9
4. propazine	139-40-2
5. atrazine	1912-24-9
6. terbuthylazine	5915-41-3
7. secbumeton	26259-45-0
8. simetryne	1014-70-6
9. ametryne	834-12-8
10. prometryne	7287-19-6
11. terbutryne	886-50-0

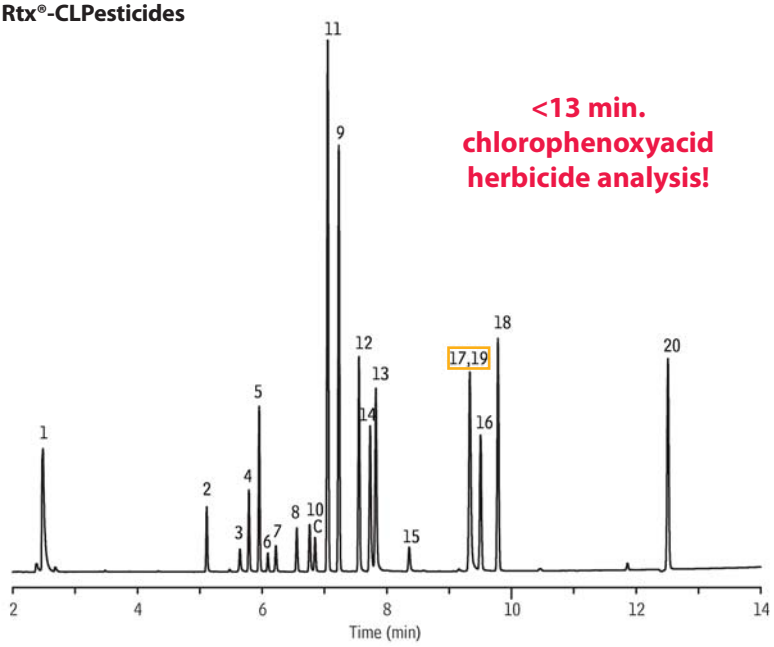


GC_EV00056

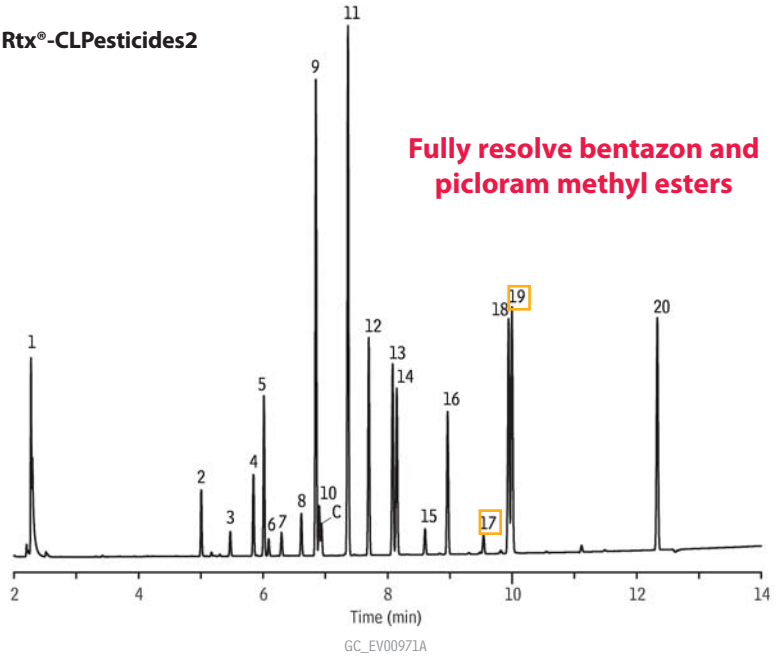
Columns:	Rtx®-CLPesticides, 30m, 0.32mm ID, 0.50µm (cat.# 11139) and Rtx®-CLPesticides2, 30m, 0.32mm ID, 0.25µm (cat.# 11324) with a 5m, 0.32mm ID guard column (cat.# 10044) and a "Y" Press-Tight® connector (cat.# 20403)
Inj.:	Direct injection using a Uniliner® inlet liner (cat.# 20964) and adaptor for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

Herbicides
US EPA Method 8151A
Rtx®-CLPesticides & Rtx®-CLPesticides2

Rtx®-CLPesticides



Rtx®-CLPesticides2



1. dalapon methyl ester
2. 3,5-dichlorobenzoic acid methyl ester (SS)
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. 4,4'-DBOB (IS)
10. 2,4-D methyl ester
11. pentachloroanisole
12. 2,4,5-TP methyl ester
13. 2,4,5-T methyl ester
14. chloramben methyl ester
15. 2,4-DB methyl ester
16. dinoseb methyl ester
17. bentazon methyl ester
18. DCPA
19. picloram methyl ester
20. acifluorfen methyl ester

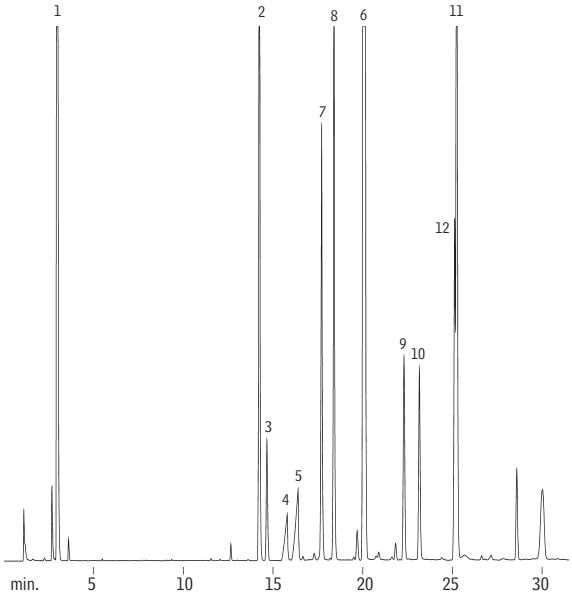
C. contaminant

Column:	Rtx®-CLPesticides2, 30m, 0.32mm ID, 0.25µm (cat.# 11324) and Rtx®-CLPesticides, 30m, 0.32mm ID, 0.32µm (cat.# 11141), with 5m x 0.32mm ID Rxi® deactivated guard tubing (cat.# 10039), connected using Deactivated Universal "Y" Press-Tight® Connector (cat.# 20405-261)
Sample:	200ng/mL Herbicide Mix #1 (cat.# 32055) in hexane 1,000ng/mL Herbicide Mix #2 (cat.# 32057) in hexane 20,000ng/mL Herbicide Mix #3 (cat.# 32059) in hexane 200ng/mL Herbicide Mix #4 (cat.# 32062) in hexane 250ng/mL Herbicide Internal Standard (cat.# 32053) in hexane 400ng/mL Herbicide Surrogate (cat.# 32050) in hexane
Inj.:	1.0µL splitless (hold 0.75 min.), 4mm Cyclo Double Gooseneck inlet liner (cat.# 20895)
Inj. temp.:	250°C
Carrier gas:	helium, constant pressure
Flow rate:	36cm/sec. @ 70°C
Oven temp.:	70°C (hold 0.5 min.) to 190°C @ 25°C/min. (hold 1 min.) to 300°C @ 11°C/min. (hold 5 min.)
Det.:	µ-ECD @ 325°C

Chlorophenoxyacid Herbicides
US EPA Method 615
Rtx®-5

Analysis optimized using Pro *ez*GC 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



GC_EV00095

Column:	Rtx®-5, 30m, 0.53mm ID, 0.50µm (cat.# 10240)
Sample:	0.5µL direct injection of chlorophenoxy herbicides, on-column concentration 10–10,000µg/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

Pro *ez*GC

Pro *ez*GC software will save you time and money by greatly enhancing your productivity and increasing sample throughput.

Pro *ez*GC Method Development Software (cat.# 21487)

See below for details.

Pro *ez*GC Methods Development Software

- Optimize temperature and flow programs with a single analysis.
- Reduce analysis time and improve sample resolution.
- Model retention gap and guard column applications, including Restek Integra-Guard® columns.
- Optimize dual-column run conditions, columns in parallel or in series.

Take the guesswork out of selecting the best column and conditions for your GC analysis. Pro *ez*GC software accurately predicts separations on any capillary column, and is useful for selecting a column and conditions from a single GC run. Using your retention data, or the extensive library, you can automatically evaluate thousands of combinations of column dimensions, oven temperature programs, and carrier gas pressure programs to determine the best separation with the fastest analysis time.

Increase productivity by improving separations and shortening analysis time with optimized temperature and carrier gas programs. Pro *ez*GC software for Windows® operating systems accurately models analyses when using guard columns and capillary restrictors, even when their IDs differ from the analytical column. The power of Pro *ez*GC software is especially helpful when modeling two columns connected in series or two columns connected in parallel to two separate detectors.

Pro *ez*GC includes a master set of retention index libraries at no extra charge! These libraries contain more than 3,000 compounds analyzed on the most commonly used stationary phases, in ten application areas, including pesticides, PCBs, dioxins/furans, flavor and fragrance compounds, drugs of abuse, FAMEs, semivolatile and volatile pollutants, petroleum hydrocarbons, and solvents and chemicals. The libraries permit computer simulation without entering actual laboratory data.

Description	qty.	cat.#
Pro *ez*GC Method Development Software CD-ROM	ea.	21487

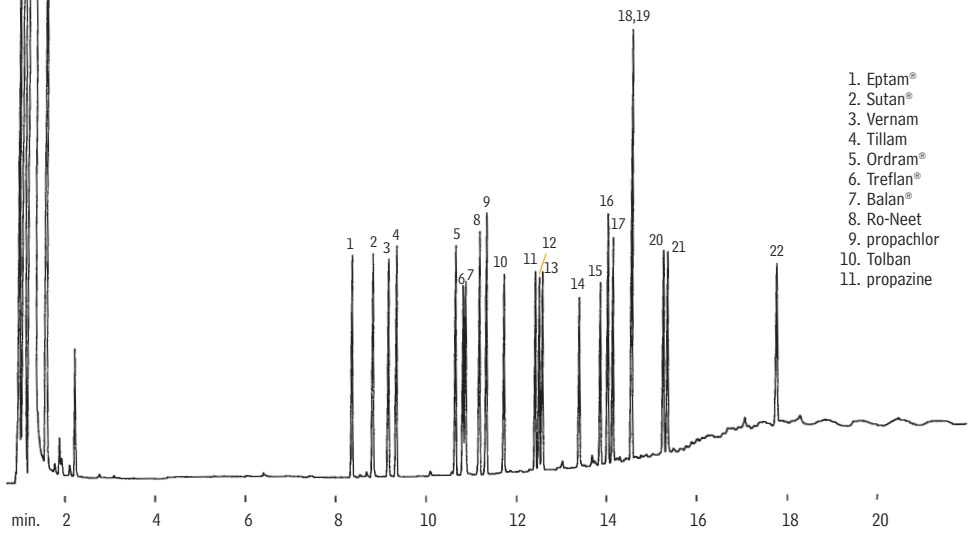
For Fast GC, Windows® NT, 2000, XP, Vista, or Windows® 7 (compatibility mode).

Pro ezGC software will save you time and money by greatly enhancing your productivity and increasing sample throughput.

An unbeatable price to enhance analysis speed & resolution!

Nitrogen-Containing Herbicides
Rtx®-35

Column: Rtx®-35, 30m, 0.53mm ID, 0.50µm (cat.# 10440)
Inj.: 0.2µL direct injection, Uniliner® inlet liner, approximately 10ng per component.
Oven temp.: 60°C (hold 1 min.) to 290°C @ 15°C/min. (hold 5 min.)
Inj./det. temp.: 290°C
Carrier gas: helium
Linear velocity: 40cm/sec. (flow rate: 5.2cc/min.)
FID sensitivity: 16 x 10^{-11} AFS

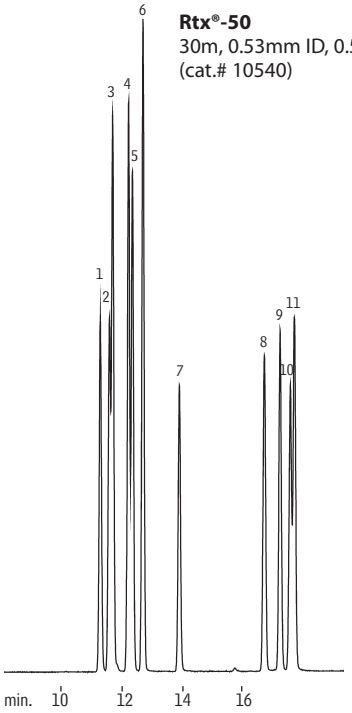


1. Eptam®
2. Sutan®
3. Vernam
4. Tillam
5. Ordram®
6. Treflan®
7. Balan®
8. Ro-Neet
9. propachlor
10. Tolban
11. propazine
12. atrazine
13. simazine
14. terbacil
15. Sencor®
16. Dual®
17. Paarlan
18. Prowl
19. bromacil
20. oxadiazon
21. GOAL®
22. hexazinone

GC_EV00088

Triazine Herbicides
US EPA Method 619
Rtx®-50, Rtx®-200

Rtx®-50
30m, 0.53mm ID, 0.50µm
(cat.# 10540)

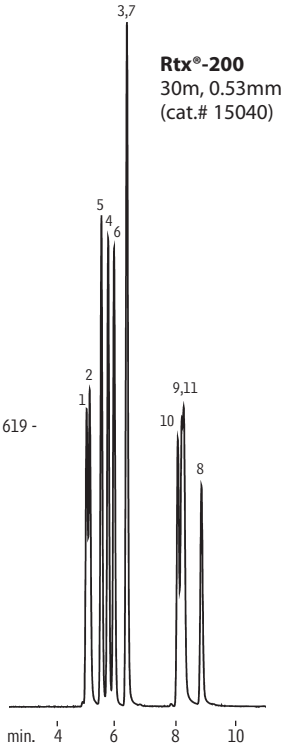


GC_EV00058

1. atraton
2. prometon
3. terbutylazine
4. atrazine
5. simazine
6. propazine
7. secbumeton
8. terbutryne
9. ametryne
10. simetryne
11. prometryne

Sample: 0.5µL direct injection of EPA Method 619 - triazine herbicides.
Conc.: on-column, 50ng
Oven temp.: 150°C to 250°C @ 4°C/min. (hold 5 min.)
Inj./det. temp.: 250°C/275°C
Detector: TSD
Carrier gas: helium
Linear velocity: 40cm/sec. set @ 150°C

Rtx®-200
30m, 0.53mm ID, 0.50µm
(cat.# 15040)

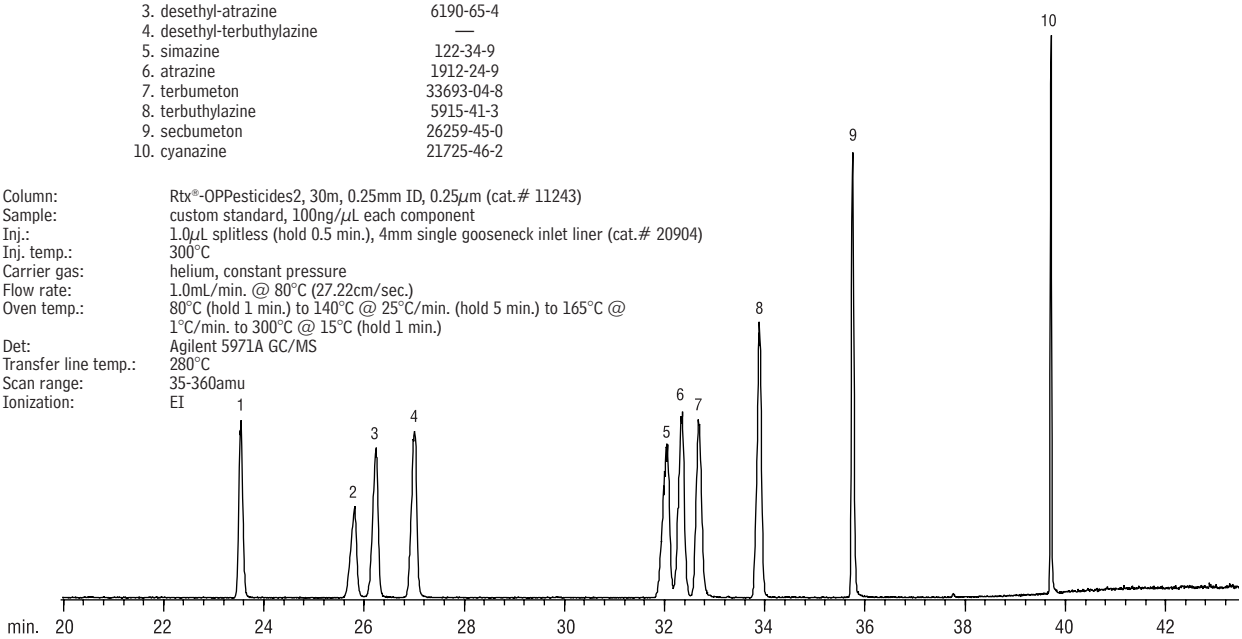


GC_EV00059

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-terbuthylazine	—
5. simazine	122-34-9
6. atrazine	1912-24-9
7. terbumeton	33693-04-8
8. terbuthylazine	5915-41-3
9. secbumeton	26259-45-0
10. cyanazine	21725-46-2

Column:	Rtx®-OPPesticides2, 30m, 0.25mm ID, 0.25µm (cat.# 11243)
Sample:	custom standard, 100ng/µL each component
Inj.:	1.0µL 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



GC_EV00626

Terry Reid, Technical Service

Technical Service

Do you have a technical question? Restek's Technical Service group has answers! Drawing from our extensive libraries of technical information and many years of collective chromatography experience, the experts in Technical Service can help you from set-up to method development.

Contact us:

For quick answers to commonly asked questions any time of the day, visit **www.restek.com/answers** or contact us directly:

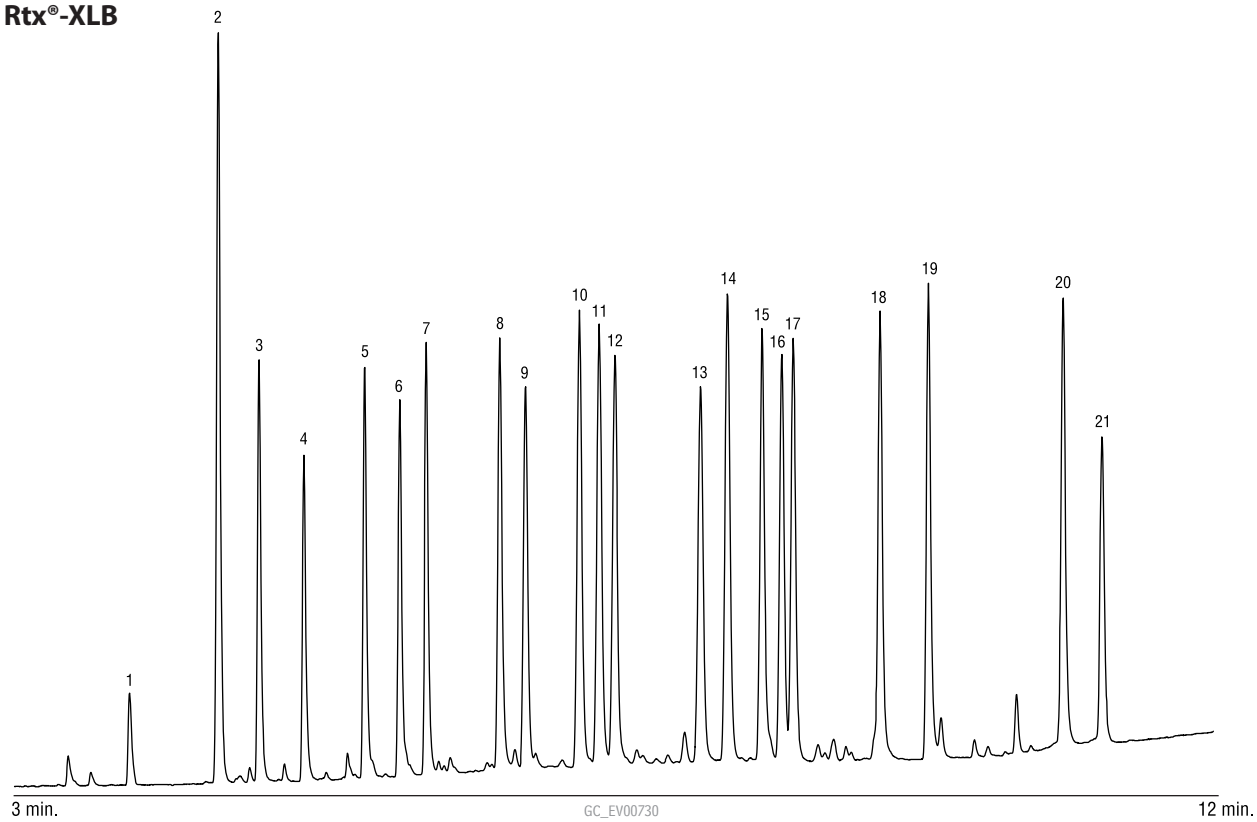
In the U.S.

Phone: 1-800-356-1688, ext. 4
Fax: 814-353-1568
e-mail: support@restek.com

Outside the U.S.

Contact your Restek representative.

PCB Congeners
Rtx®-XLB



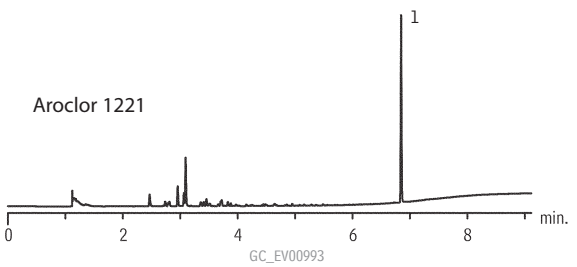
Column:	Rtx®-XLB, 30m, 0.32mm ID, 0.50µm (cat.# 12839)
Sample:	200ppb each PCB congener in hexane (cat.# 32416), 200ppb 2,4,5,6-tetrachloro-*m*-xylene (SS) (cat.# 32027), 100ppb decachlorobiphenyl (IS) (cat.# 32289)
Inj.:	1.0µL splitless (hold 0.75 min.), 4mm Drilled Uniliner® inlet liner (cat.# 21055)
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

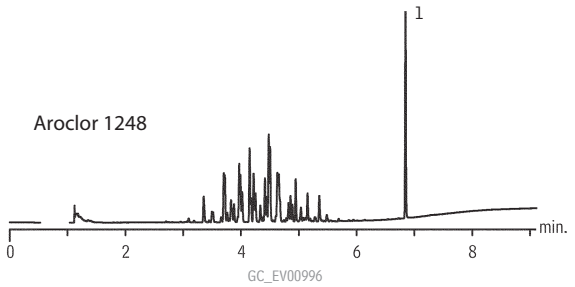
Compound	RT (min.)
1. 2-chlorobiphenyl (BZ #1)	3.86
2. 2,4,5,6 tetrachloro-*m*-xylene (SS)	4.53
3. 2,3-dichlorobiphenyl (BZ #5)	4.83
4. 2,2',5-trichlorobiphenyl (BZ #18)	5.17
5. 2,4',5-trichlorobiphenyl (BZ #31)	5.63
6. 2,2',5,5'-tetrachlorobiphenyl (BZ #52)	5.89
7. 2,2',3,5'-tetrachlorobiphenyl (BZ #44)	6.09
8. 2,3',4,4'-tetrachlorobiphenyl (BZ #66)	6.64
9. 2,2',4,5,5'-pentachlorobiphenyl (BZ #101)	6.84
10. 2,2',3,4,5'-pentachlorobiphenyl (BZ #87)	7.24
11. 2,3,3',4',6-pentachlorobiphenyl (BZ #110)	7.39
12. 2,2',3,5,5',6-hexachlorobiphenyl (BZ #151)	7.51
13. 2,2',4,4',5,5'-hexachlorobiphenyl (BZ #153)	8.15
14. 2,2',3,4,5,5'-hexachlorobiphenyl (BZ #141)	8.35
15. 2,2',3,4,4',5'-hexachlorobiphenyl (BZ #138)	8.61
16. 2,2',3,4',5,5',6-heptachlorobiphenyl (BZ #187)	8.76
17. 2,2',3,4,4',5',6-heptachlorobiphenyl (BZ #183)	8.84
18. 2,2',3,4,4',5,5'-heptachlorobiphenyl (BZ #180)	9.50
19. 2,2',3,3',4,4',5-heptachlorobiphenyl (BZ #170)	9.86
20. 2,2',3,3',4,4',5,5',6-nonachlorobiphenyl (BZ #206)	10.87
21. decachlorobiphenyl (SS)	11.17

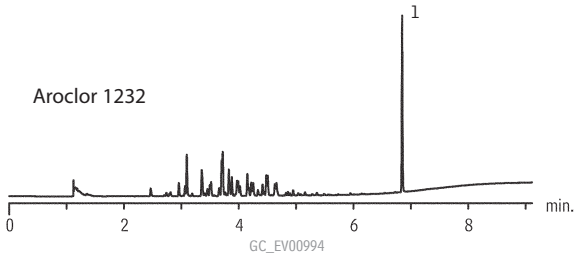
Aroclor PCBs
US EPA Method 8082
Rtx®-CLPesticides

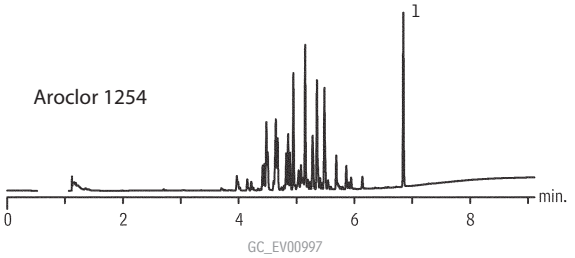
Rtx®-CLPesticides
30m, 0.32mm ID, 0.32µm (cat.# 11141)

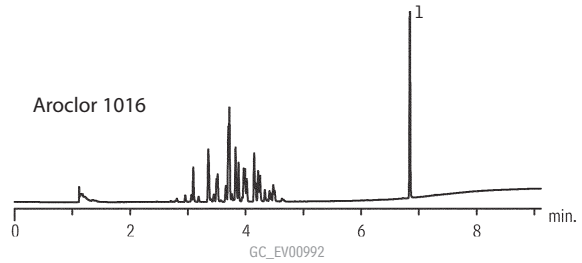
1. decachlorobiphenyl (DCB)

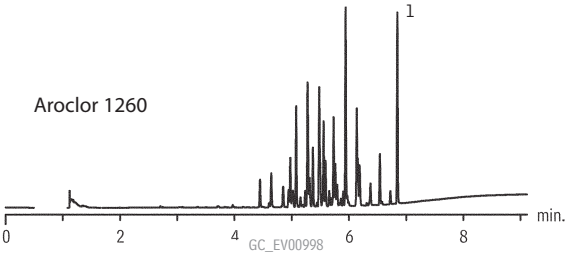


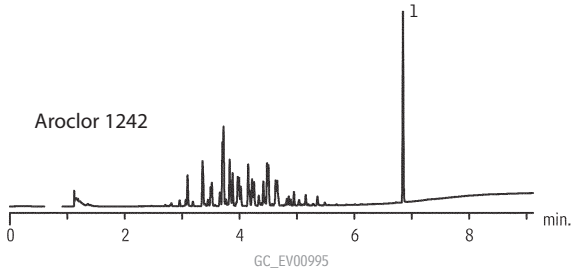










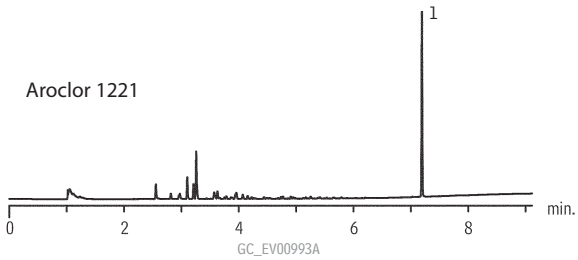


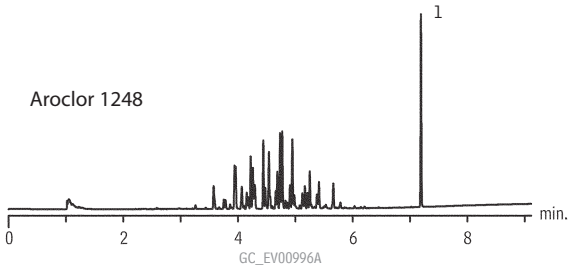
Column:	Rtx®-CLPesticides, 30m, 0.32mm ID, 0.32µm (cat.# 11141)
Sample:	1,000µg/mL each Aroclor compound in hexane diluted to 1,000ppb, decachlorobiphenyl (BZ #209) 200µg/mL in acetone (cat.# 32029) diluted to 100ppb
Inj.:	1.0µL pulsed splitless @ 30psi (hold 0.3 min.), 4mm cyclo double gooseneck inlet liner (cat.# 20895)
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.:	µ-ECD @ 330°C

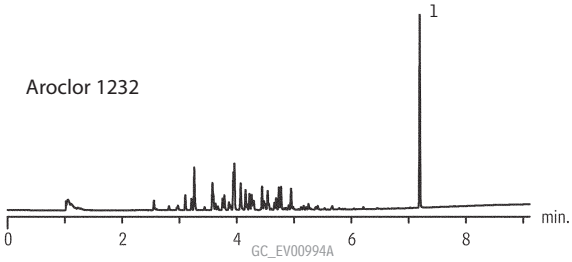
Aroclor PCBs
US EPA Method 8082
Rtx®-CLPesticides2

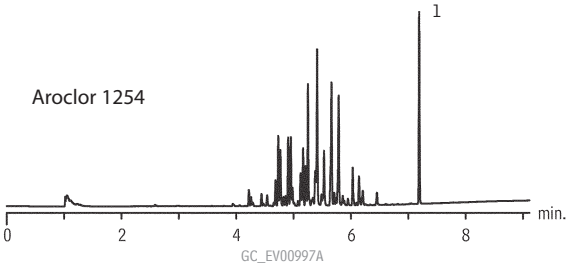
Rtx®-CLPesticides2
30m, 0.32mm ID, 0.25µm (cat.# 11324)

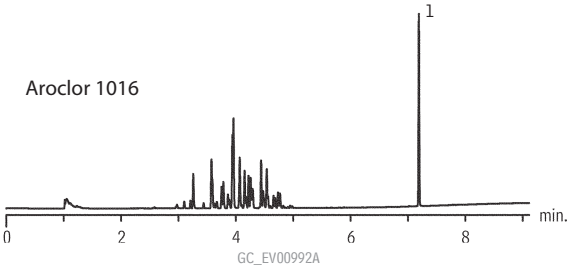
1. decachlorobiphenyl (DCB)

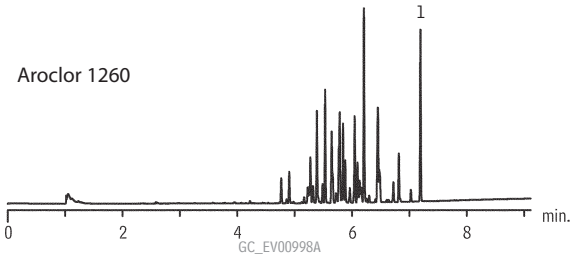


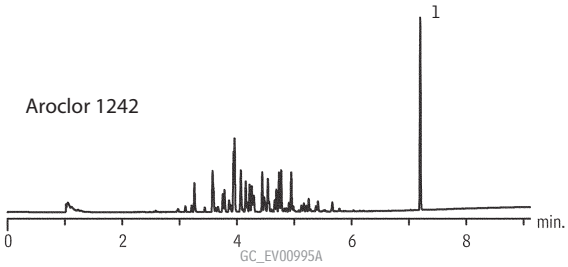










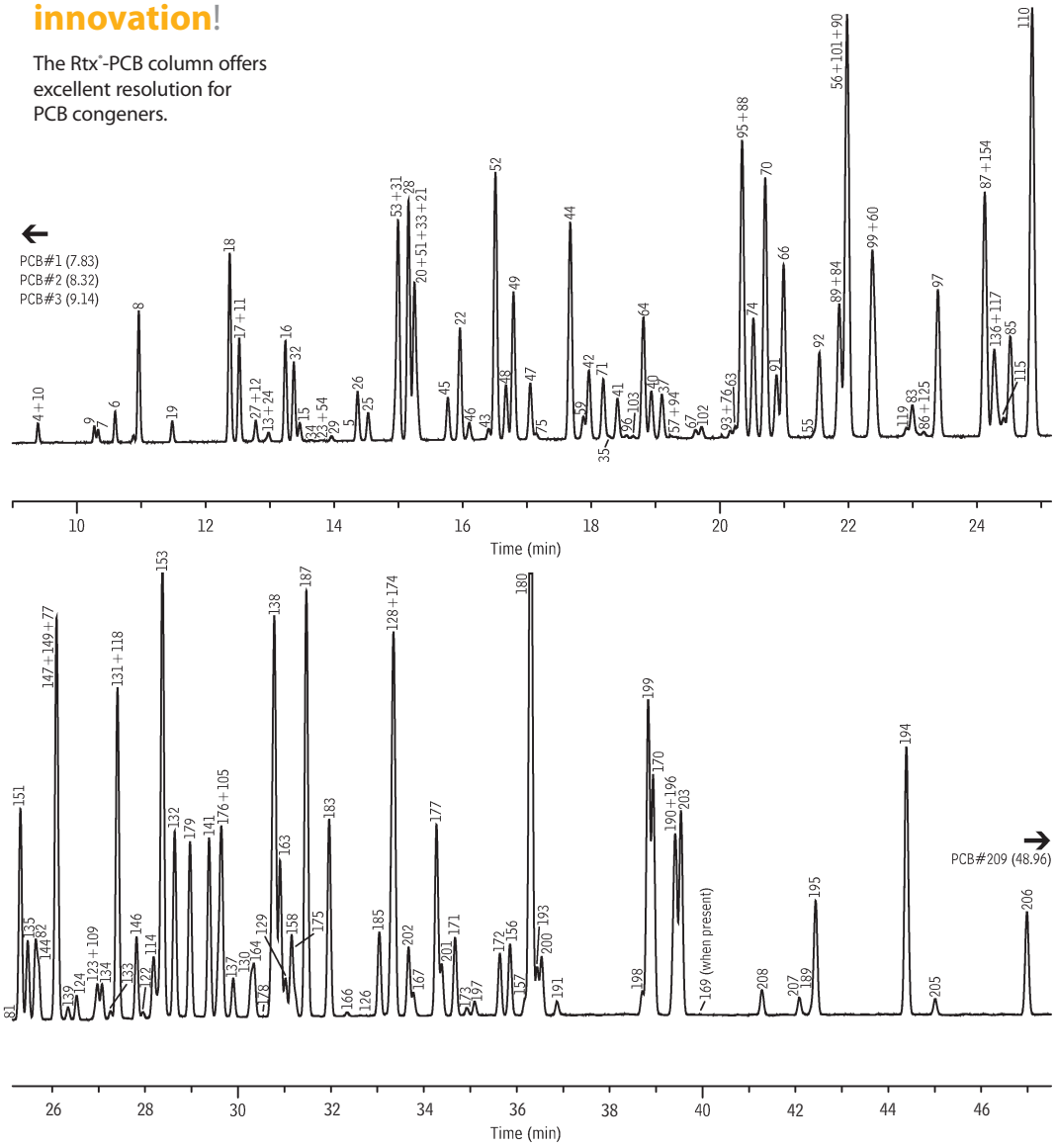


Column:	Rtx®-CLPesticides2, 30m, 0.32mm ID, 0.25µm (cat.# 11324)
Sample:	1,000µg/mL each Aroclor compound in hexane diluted to 1,000ppb, decachlorobiphenyl (BZ #209) 200µg/mL in acetone (cat.# 32029) diluted to 100ppb
Inj.:	1.0µL pulsed splitless @ 30psi (hold 0.3 min.), 4mm cyclo double gooseneck inlet liner (cat.# 20895)
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.:	µ-ECD @ 330°C

Aroclor 1242/1254/1262 PCBs
US EPA Method 8082
Rtx®-PCB

restek
innovation!

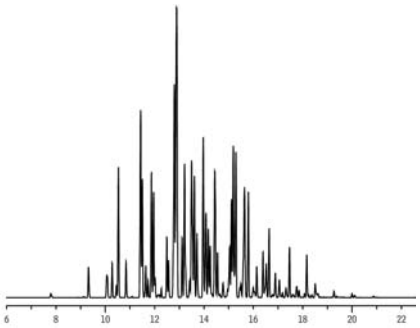
The Rtx®-PCB column offers excellent resolution for PCB congeners.



GC_EV00768

Column:	Rtx®-PCB, 40m, 0.18mm ID, 0.18µm (cat.# 41303)
Sample:	300ng/mL Aroclor 1242/1254/1262 in hexane: Aroclor 1242 (cat.# 32009), Aroclor 1254 (cat.# 32011), Aroclor 1262 (cat.# 32409)
Inj.:	1.0µL 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

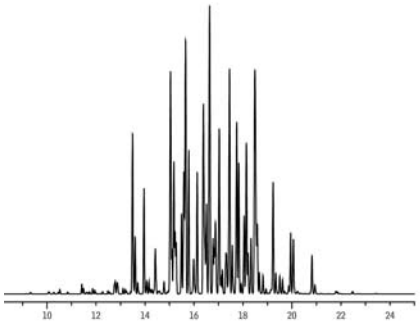
Aroclor 1242 PCBs
Rtx®-PCB



GC_EV00752

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

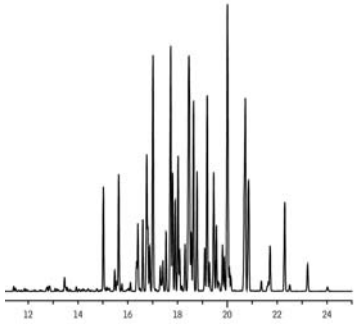
Aroclor 1254 PCBs
Rtx®-PCB



GC_EV00753

Sample: 200ng/mL Aroclor 1254 (cat.# 32011)
Column: Rtx®-PCB, 30m, 0.25mm ID, 0.25µm (cat.# 13223)
Inj.: 1.0µL 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

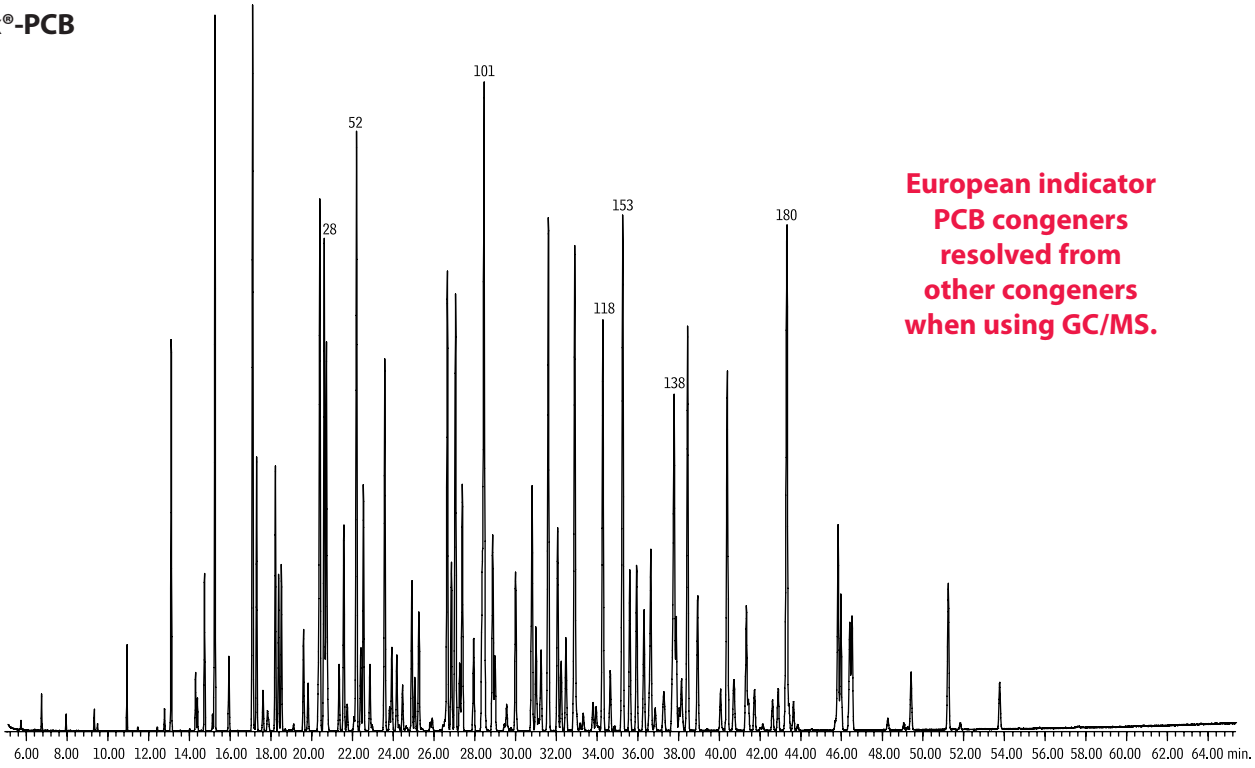
Aroclor 1260 PCBs
Rtx®-PCB



GC_EV00754

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

Aroclor 1242/1254/1262 PCBs
US EPA Method 8082
Rtx®-PCB



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

GC_EV00767

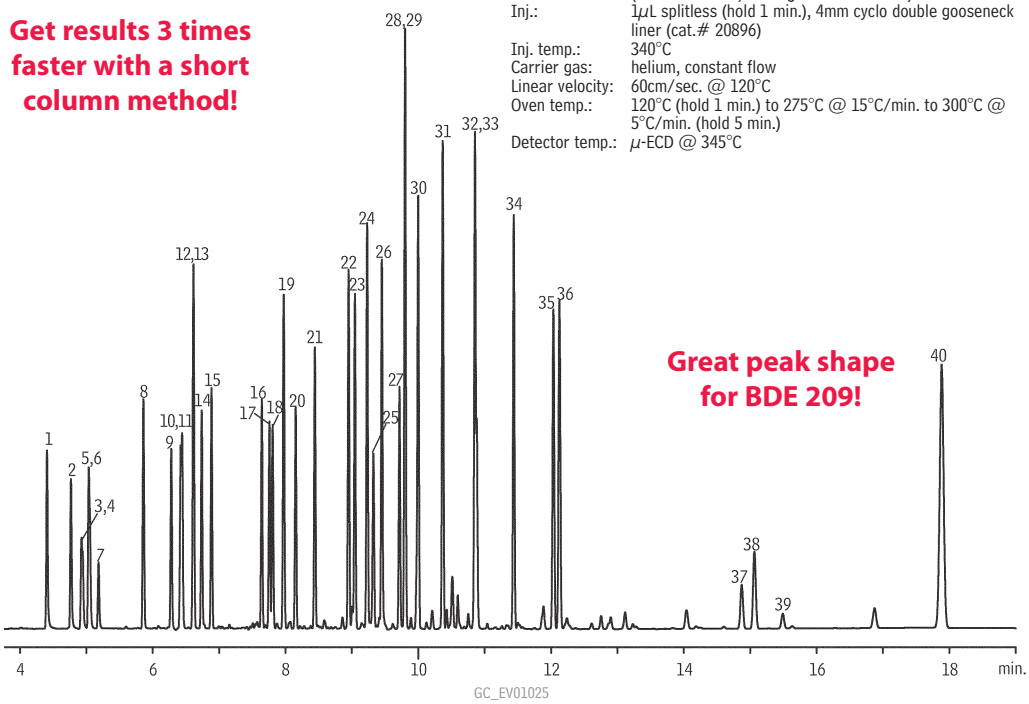
Column: Rtx®-PCB, 60m, 0.25mm ID, 0.25µm (cat.# 13226)
Sample: Aroclor 1242 (cat.# 32009), 1254 (cat.# 32011), 1262 (cat.# 32409), 333ppm each
Inj.: 1.0µL splitless (hold 0.75 min.), 4mm single gooseneck inlet liner w/wool (cat.# 22405)
Inj. temp.: 280°C
Carrier gas: helium, constant flow
Flow rate: 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

Brominated Flame Retardants
Rtx®-1614

Column: Rtx®-1614, 15m, 0.25mm ID, 0.10µm (cat.# 10296)
Sample: 100-300ppb PBDE PAR Solution (cat.# EO-5113, Cambridge Isotope Laboratories Inc.), 500ppb decabromodiphenyl ether (cat.# BDE-209, Wellington Laboratories)
Inj.: 1µL splitless (hold 1 min.), 4mm cyclo double gooseneck liner (cat.# 20896)
Inj. temp.: 340°C
Carrier gas: helium, constant flow
Linear velocity: 60cm/sec. @ 120°C
Oven temp.: 120°C (hold 1 min.) to 275°C @ 15°C/min. to 300°C @ 5°C/min. (hold 5 min.)
Detector temp.: µ-ECD @ 345°C

Get results 3 times faster with a short column method!

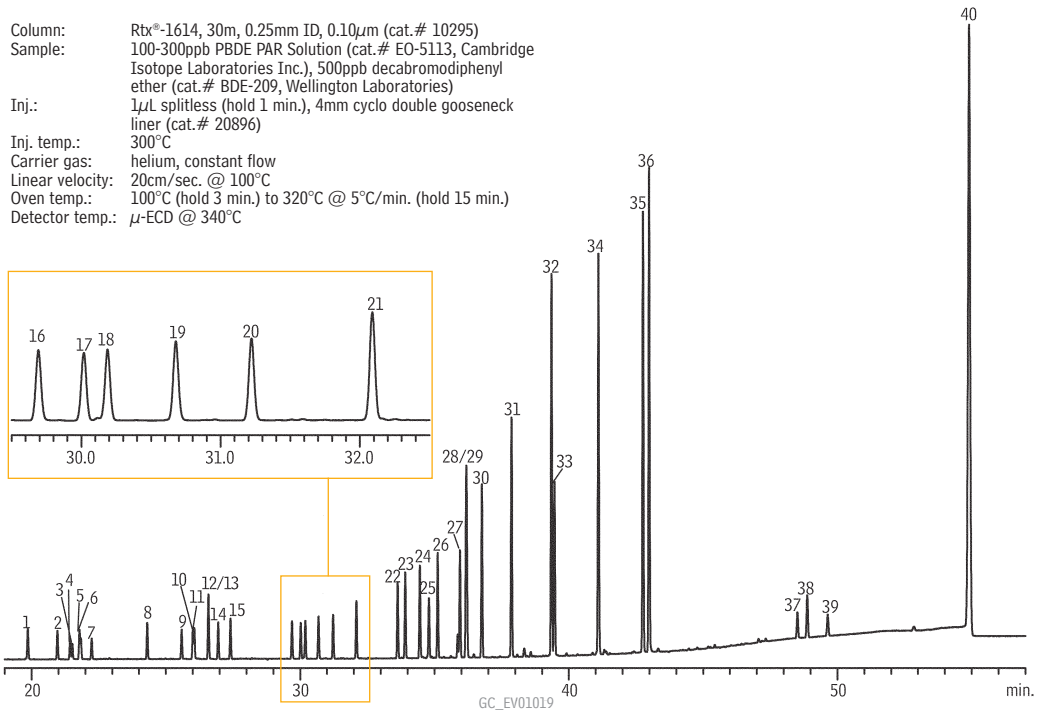
Great peak shape for BDE 209!



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

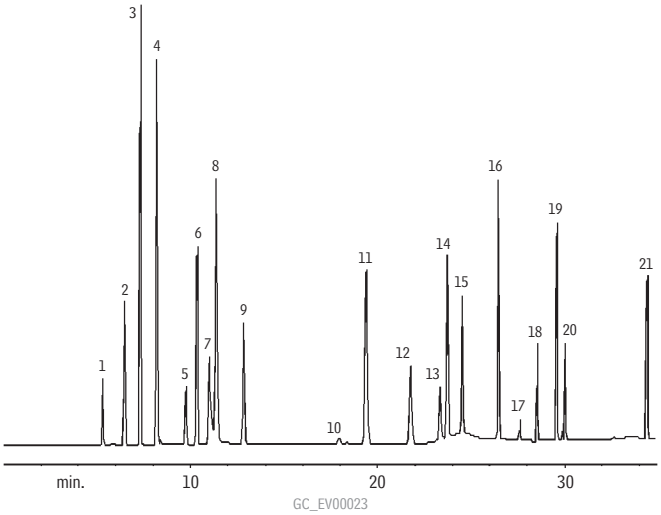
Brominated Flame Retardants
Rtx®-1614

Column: Rtx®-1614, 30m, 0.25mm ID, 0.10µm (cat.# 10295)
Sample: 100-300ppb PBDE PAR Solution (cat.# EO-5113, Cambridge Isotope Laboratories Inc.), 500ppb decabromodiphenyl ether (cat.# BDE-209, Wellington Laboratories)
Inj.: 1µL splitless (hold 1 min.), 4mm cyclo double gooseneck liner (cat.# 20896)
Inj. temp.: 300°C
Carrier gas: helium, constant flow
Linear velocity: 20cm/sec. @ 100°C
Oven temp.: 100°C (hold 3 min.) to 320°C @ 5°C/min. (hold 15 min.)
Detector temp.: µ-ECD @ 340°C



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

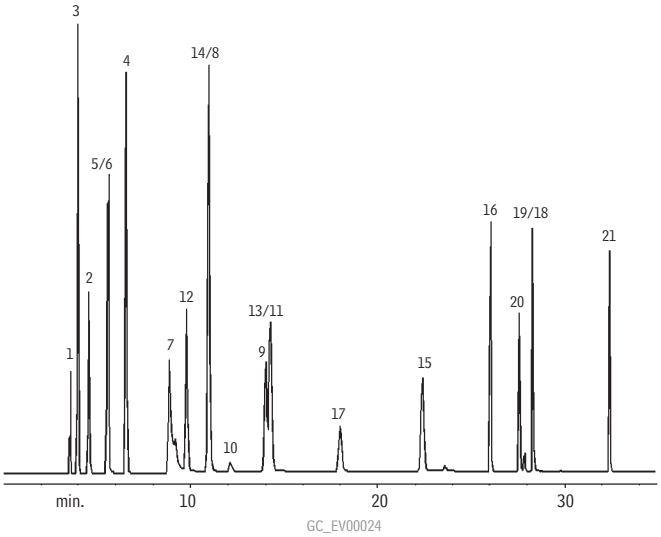
Chlorinated Disinfection Byproducts
US EPA Method 551.1
Rtx®-5



Column:	Rtx®-5, 30m, 0.25mm ID, 1.0µm (cat.# 10253)
Inj.:	1.0µL 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)

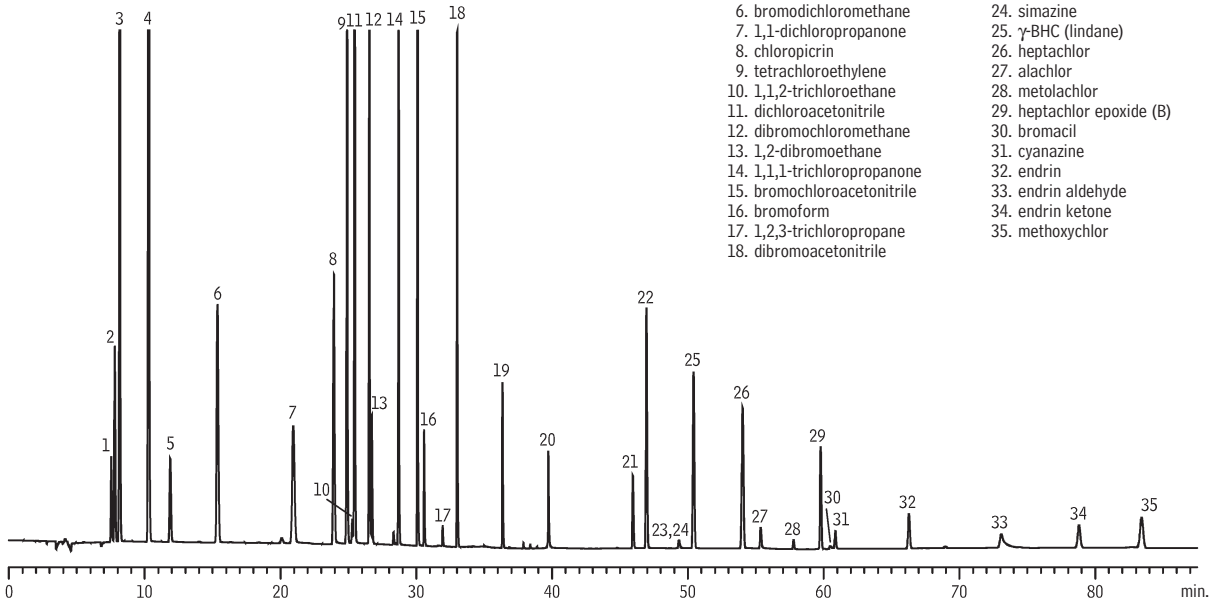
Chlorinated Disinfection Byproducts
US EPA Method 551.1
Rtx®-200



Column:	Rtx®-200, 30m, 0.25mm ID, 1.0µm (cat.# 15053)
Inj.:	1.0µL 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 Solvents, and Halogenated Pesticides
US EPA Method 551.1
Rtx®-1301

1. chloroform
2. 1,1,1-trichloroethane
3. carbon tetrachloride
4. trichloroacetonitrile
5. trichloroethylene
6. bromodichloromethane
7. 1,1-dichloropropanone
8. chloropicrin
9. tetrachloroethylene
10. 1,1,2-trichloroethane
11. dichloroacetonitrile
12. dibromochloromethane
13. 1,2-dibromoethane
14. 1,1,1-trichloropropanone
15. bromochloroacetonitrile
16. bromoform
17. 1,2,3-trichloropropane
18. dibromoacetonitrile
19. 1,2-dibromo-3-chloropropane
20. hexachlorocyclopentadiene
21. trifluralin
22. hexachlorobenzene
23. atrazine
24. simazine
25. γ-BHC (lindane)
26. heptachlor
27. alachlor
28. metolachlor
29. heptachlor epoxide (B)
30. bromacil
31. cyanazine
32. endrin
33. endrin aldehyde
34. endrin ketone
35. methoxychlor



GC_EV00758

Column:	Rtx®-1301, 30m, 0.25mm ID, 1.0µm (cat.# 16053)
Sample:	5-10µg/mL each analyte (Method 551.1 Pesticide/Herbicide Mix (cat.# 32438) and Disinfection Byproducts & Chlorinated Solvents Mix (cat.# 30615)
Inj.:	1.0µL 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

Restek Customer Service

In the U.S.

Call: 800-356-1688 (ext. 3) or 814-353-1300 (ext. 3)

Monday–Friday 8:00 a.m.–6:00 p.m. ET

Fax: 814-353-1309—24-hours a day

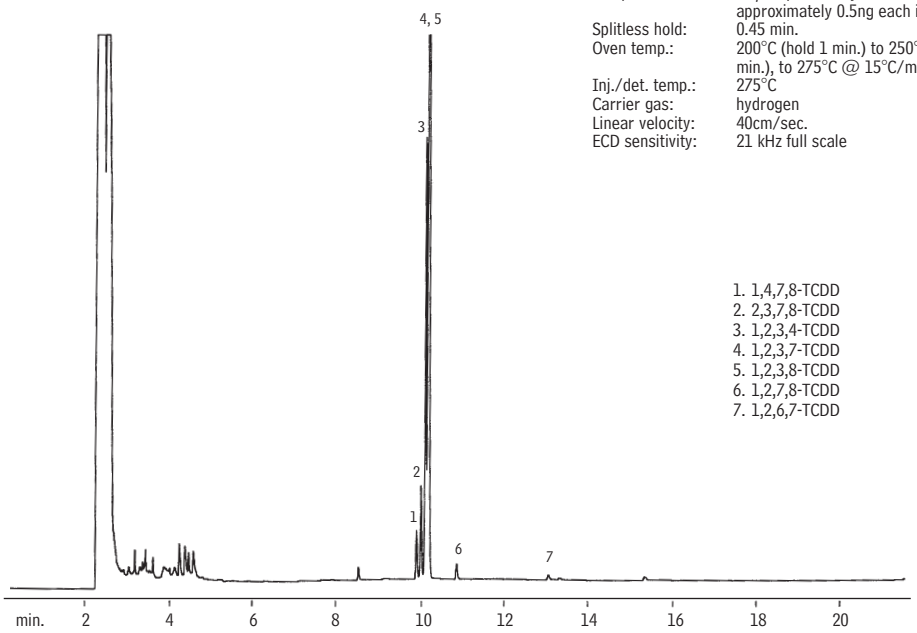
Online: www.restek.com—24-hours a day

Outside the U.S.

Contact your Restek representative:
Refer to our list on pages 4-5 or visit our website at www.restek.com

Mike Shuey, Customer Service

TCDD Isomers
Rt®-2330



GC_EV00108

Column: Rt®-2330, 60m, 0.25mm ID, 0.20µm (cat.# 10726)
Sample: 2.0µL splitless injection of TCDD isomers, approximately 0.5ng each isomer
Splitless hold: 0.45 min.
Oven temp.: 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

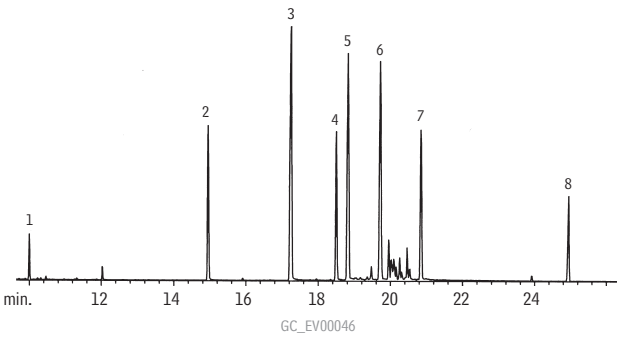
1. 1,4,7,8-TCDD
2. 2,3,7,8-TCDD
3. 1,2,3,4-TCDD
4. 1,2,3,7-TCDD
5. 1,2,3,8-TCDD
6. 1,2,7,8-TCDD
7. 1,2,6,7-TCDD

also available

For Rtx®-Dioxin2 columns, designed specifically for dioxin/furan analysis, see **page 96.**

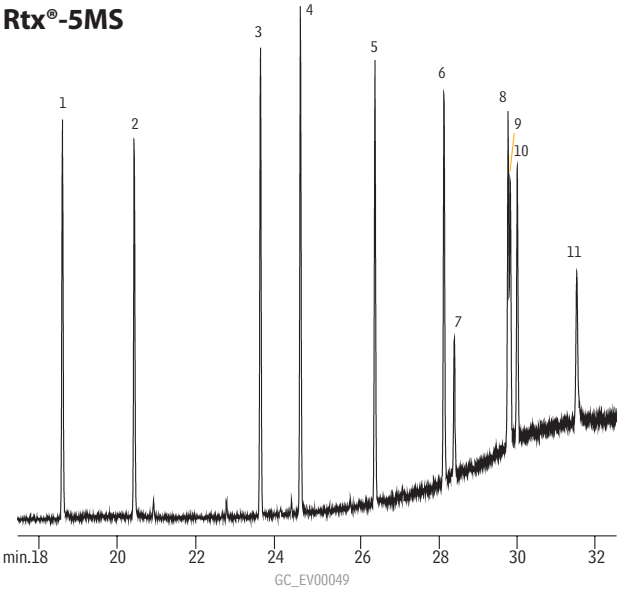
Endocrine Disruptors: Alkyl Phenols
Rtx®-5MS

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, 0.25µm (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

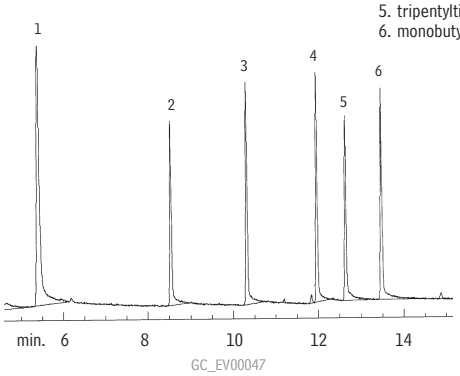


1. dimethyl phthalate
2. diethyl phthalate
3. isobutyl phthalate
4. dibutyl phthalate
5. dipentyl phthalate
6. dihexyl phthalate
7. benzylethyl phthalate
8. diheptyl phthalate
9. 2-ethylhexyl phthalate
10. cyclohexyl phthalate
11. dioctyl phthalate

Column:	Rtx®-5MS, 30m, 0.25mm ID, 0.50µm (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

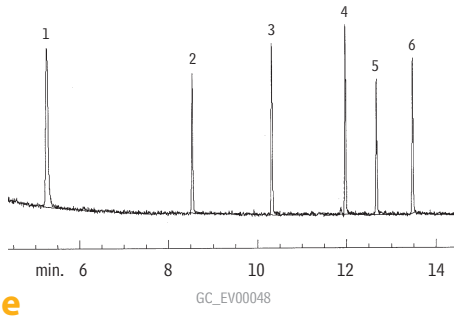
1. tetrapropyltin
2. tetrabutyltin
3. tributyltin
4. dibutyltin
5. tripentyltin
6. monobutyltin



Column:	Rtx®-5, 30m, 0.32mm ID, 0.50µm (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

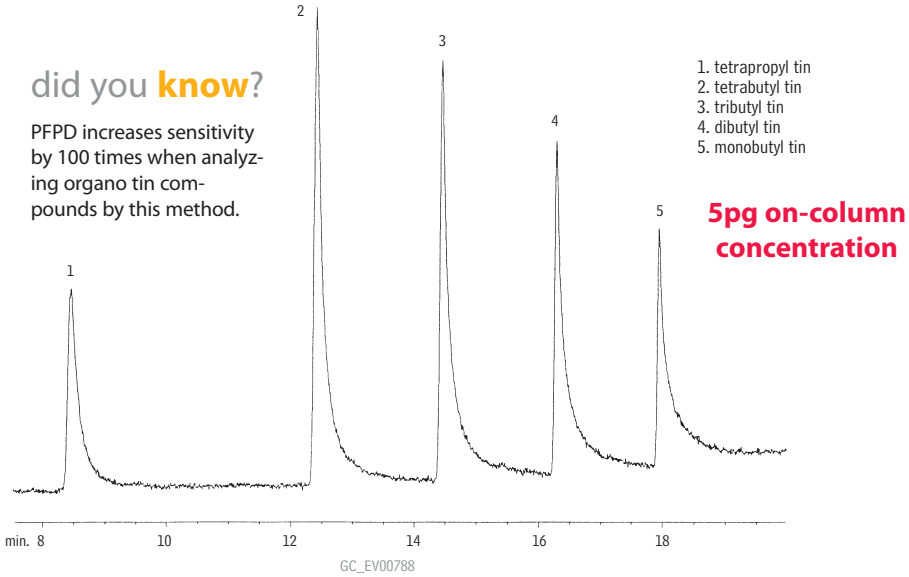


Column:	Rtx®-35, 30m, 0.32mm ID, 0.50µm (cat.# 10439)
Conc.:	500pg on-column direct injection
Oven temp.:	100°C (hold 1 min.) to 285°C @ 10°C/min.
Inj./det. temp.:	250°C
Carrier gas:	helium
Linear velocity:	45cm/sec.
Detector:	FPD with 610nm filter

also **available**

Butyl tin reference materials—see **page 496.**

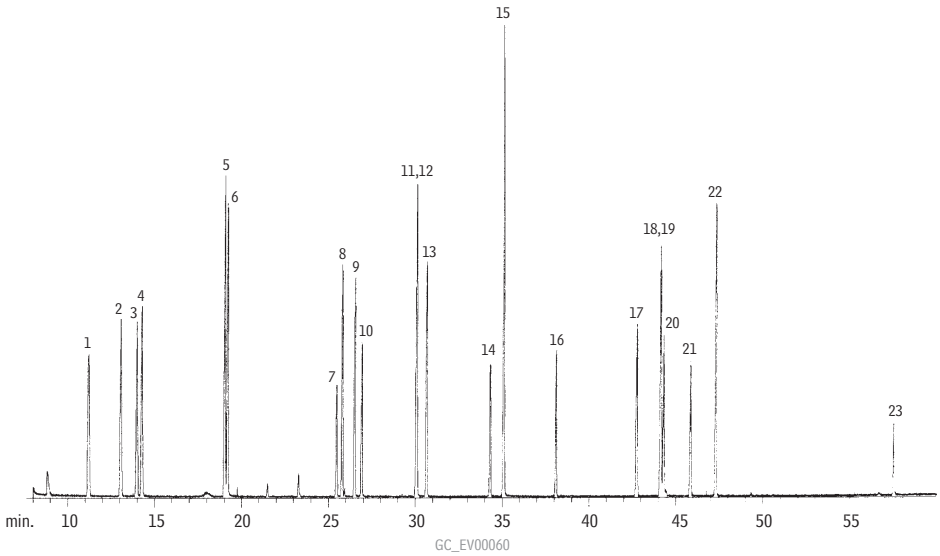
Organo Tins
Rtx®-35



Column:	Rtx®-35, 30m, 0.32mm ID, 1.0µm (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, 0.25µm (cat.# 15023)
Inj.:	1.0µL splitless injection
Conc.:	20ng/µL
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.

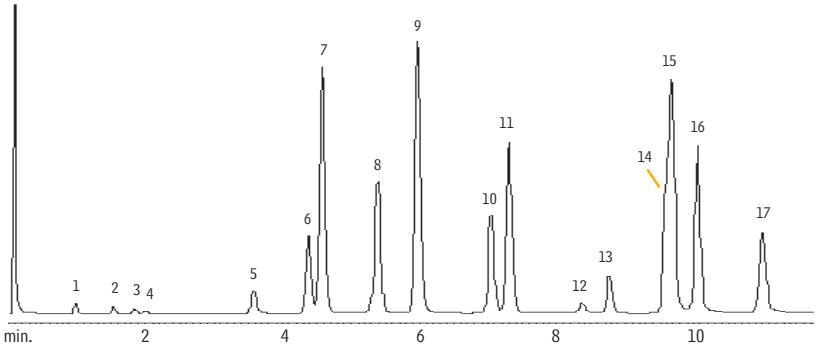
1. 2-nitrotoluene
2. 3-nitrotoluene
3. 4-nitrotoluene
4. 2,3-diaminotoluene
5. 2,6-diaminotoluene
6. 2,4-diaminotoluene
7. 1,4-dinitrobenzene
8. 2,6-dinitrotoluene
9. 2-amino-6-nitrotoluene
10. 1,3-dinitrobenzene
11. 2,4-dinitrotoluene
12. 2-amino-4-nitrotoluene
13. 2,3-dinitrotoluene
14. 3,4-dinitrotoluene
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

restek
innovation!

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

Rtx®-TNT

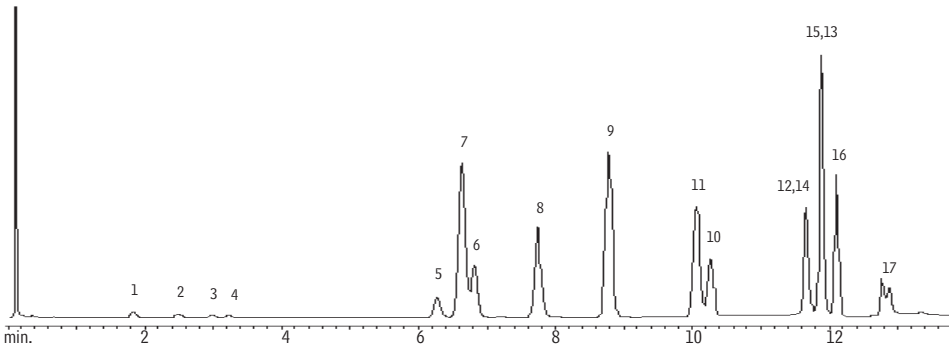


GC_EV00406

Column:	Rtx®-TNT, 6m, 0.53mm ID, 1.50µm (cat.# 12998)
Inj.:	direct injection using a 1mm Siltek® Uniliner® inlet liner (cat.# 21052-214.1)
On-column conc.:	est. 200-1,000pg/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



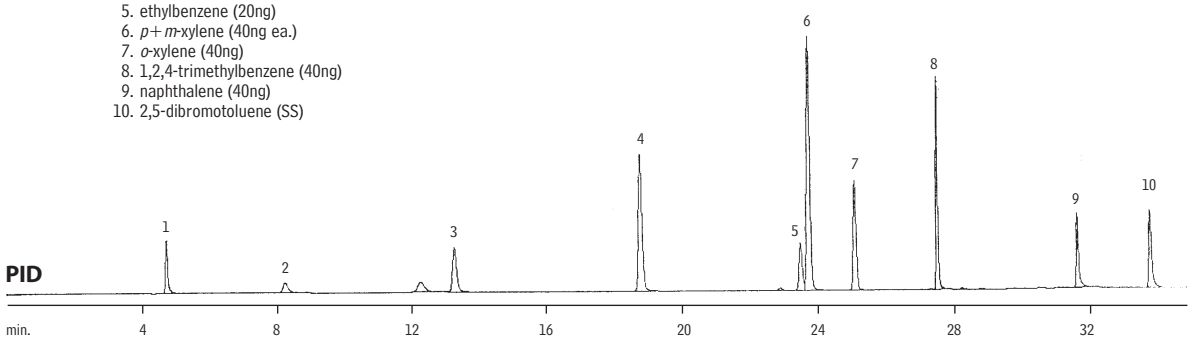
GC_EV00407

Column:	Rtx®-TNT2, 6m, 0.53mm ID, 1.50µm (cat.# 12999)
Inj.:	direct injection using a 1mm Siltek® Uniliner® (cat.# 21052-214.1)
On-column conc.:	est. 200-1,000pg/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

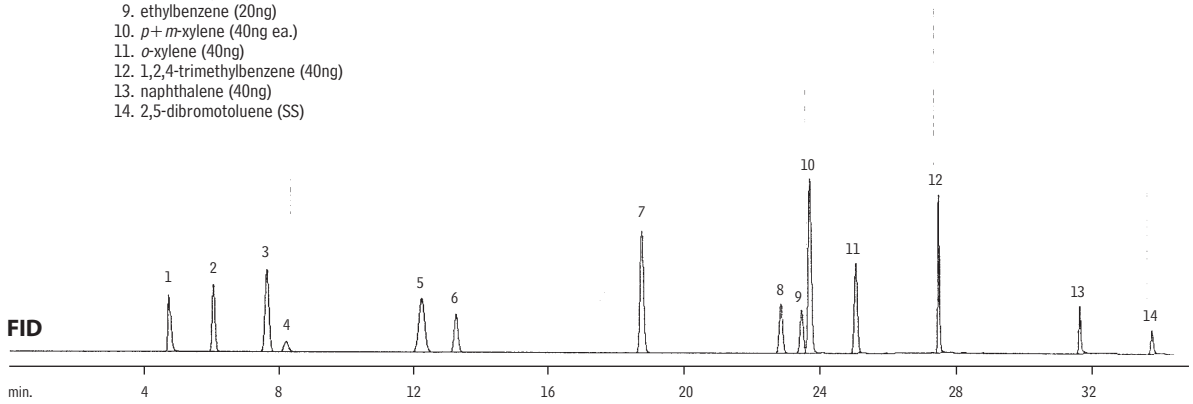
Volatile Petroleum Hydrocarbons (VPH)
Massachusetts Department of Environmental Protection
Rtx®-502.2

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)



GC_EV00063

Column:	Rtx®-502.2, 105m, 0.53mm ID, 3.0µm (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°C @ 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

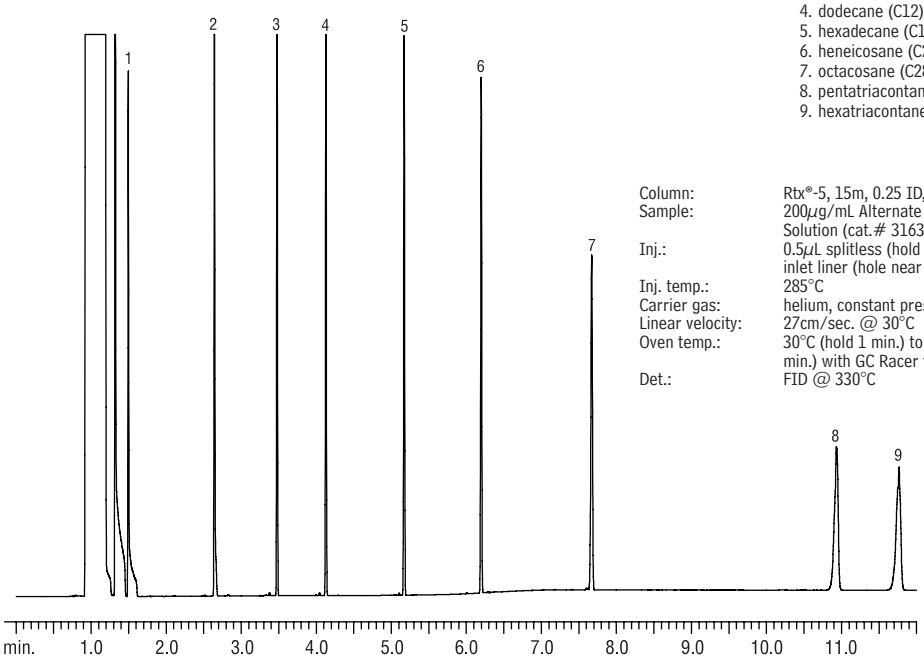
Massachusetts VPH affords more reliable quantification of volatile petroleum hydrocarbons, relative to older "analytical window" methods, and has been adopted by other states and in Canada. This 2-page note offers valuable tips for selecting a trap and a capillary GC column compatible with the methodology.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

Download your free copy from **www.restek.com**

Applications Note
lit. cat.# 59150

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

1. hexane (C6)
2. octane (C8)
3. decane (C10)
4. dodecane (C12)
5. hexadecane (C16)
6. heneicosane (C21)
7. octacosane (C28)
8. pentatriacontane (C35)
9. hexatriacontane (C36)

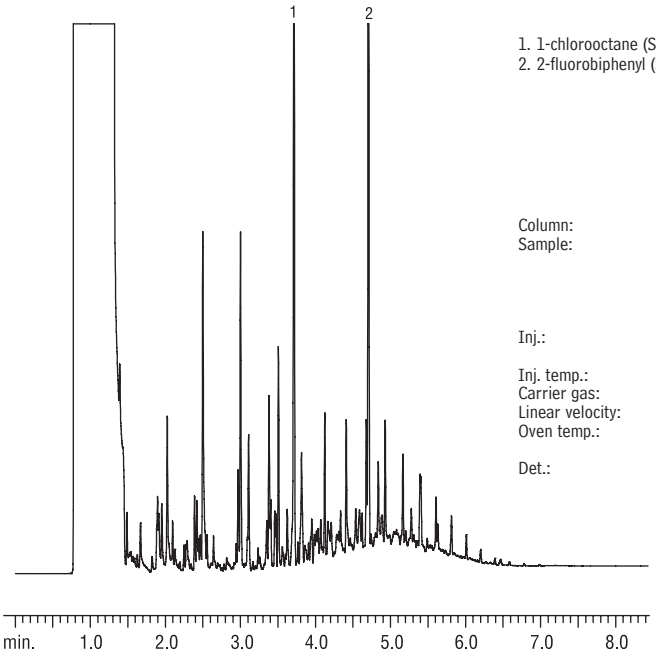


Column:	Rtx®-5, 15m, 0.25 ID, 0.25µm (cat.# 10220)
Sample:	200µg/mL Alternate BP/CN Distribution Marker Stock Solution (cat.# 31639) in pentane
Inj.:	0.5µL splitless (hold 0.2 min.), 4mm drilled Uniliner® inlet liner (hole near bottom) (cat.# 20756)
Inj. temp.:	285°C
Carrier gas:	helium, constant pressure
Linear velocity:	27cm/sec. @ 30°C
Oven temp.:	30°C (hold 1 min.) to 330°C @ 60°C/min. (hold 6 min.) with GC Racer for Agilent 5890 Series II GC
Det.:	FID @ 330°C

GC_EV00690

Texas UST: diesel/gas composites
Rtx®-5

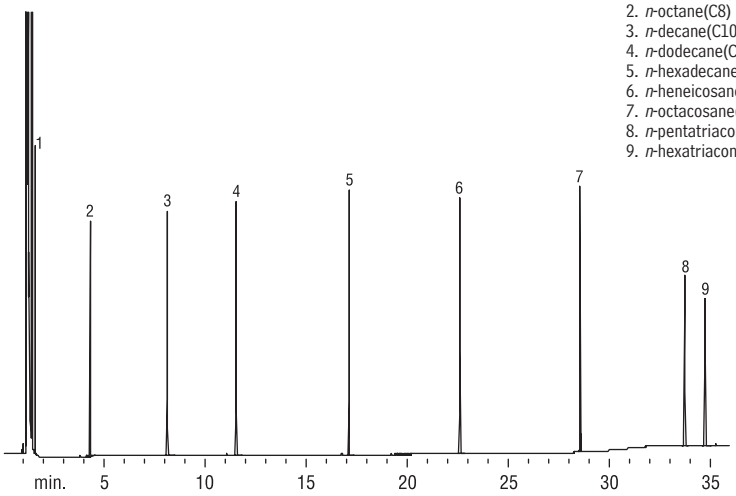
1. 1-chlorooctane (SS)
2. 2-fluorobiphenyl (SS)



Column:	Rtx®-5, 15m, 0.25mm ID, 0.25µm (cat.# 10220)
Sample:	1,000µg/mL unleaded gas and diesel fuel #2 composites standard (cat.# 31483) in pentane 250µg/mL 2-fluorobiphenyl standard (cat.# 31096) in dichloromethane 250µg/mL 1-chlorooctane (cat.# 30084) in P&T methanol
Inj.:	0.5µL splitless (hold 0.2 min.), 4mm drilled Uniliner® inlet liner (hole near bottom) (cat.# 20756)
Inj. temp.:	285°C
Carrier gas:	helium, constant pressure
Linear velocity:	27cm/sec. @ 30°C
Oven temp.:	30°C (hold 1 min.) to 330°C @ 60°C/min. (hold 6 min.) with GC Racer for Agilent 5890 Series II GC
Det.:	FID @ 330°C

GC_EV00692

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



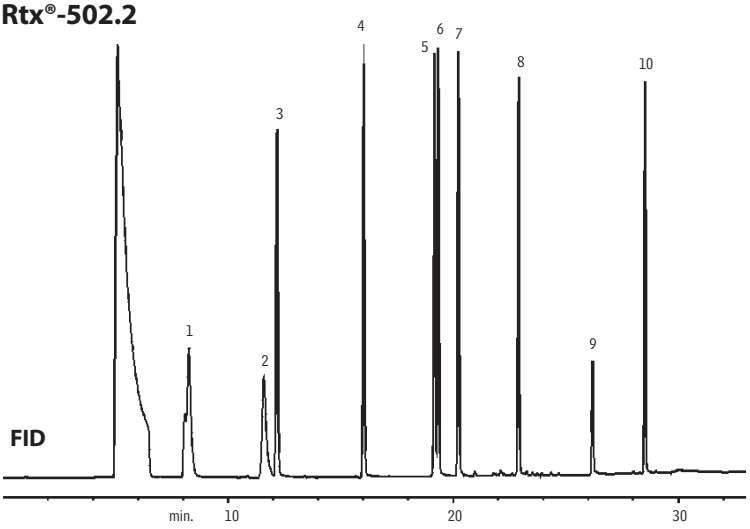
1. *n*-hexane(C6)
2. *n*-octane(C8)
3. *n*-decane(C10)
4. *n*-dodecane(C12)
5. *n*-hexadecane(C16)
6. *n*-heneicosane(C21)
7. *n*-octacosane(C28)
8. *n*-pentatriacontane
9. *n*-hexatriacontane(C36)

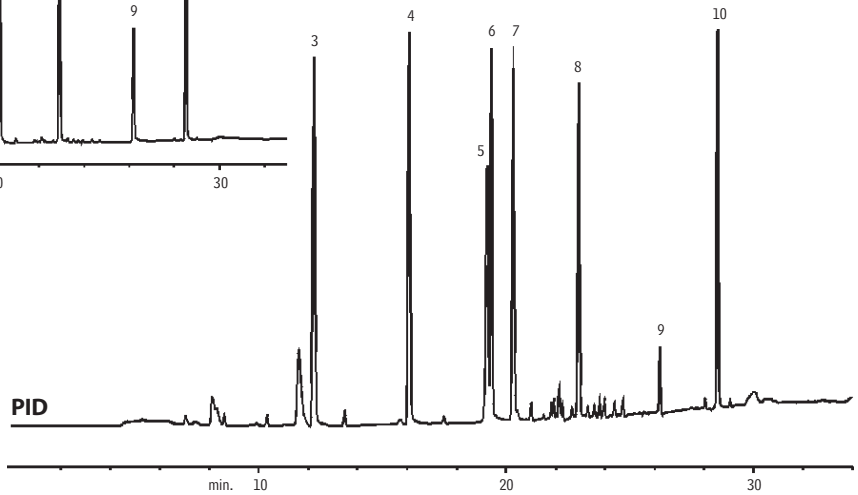
GC_EV00691

Column:	Rtx®-5, 30m, 0.25mm ID, 0.50µm (cat.# 10238)
Sample:	1µL Alternate Boiling Point/Carbon Number Distribution Marker Stock Solution (cat.# 31639), 200µg/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

Column:	Rtx®-502.2, 105m, 0.53mm ID, 3.0µm (cat.# 10910)
Sample:	GRO Mix (WISC) + C12 (cat.# 30069)
Conc.:	200ppb each in 5mL of H_2O.
Oven temp.:	40°C (hold 1 min.) to 100°C @ 5°C/min. to 240°C @ 8°C/min. (hold 8 min.)
Inj./det. temp.:	200°C/250°C
Carrier gas:	helium
Flow rate:	10mL/min.
Trap:	Tenax®, silica gel, charcoal
Purge:	12 min. @ 40mL/min.
Desorb preheat:	175°C
Desorb temp.:	180°C
Desorb time:	2 min.
Desorb flow:	10mL/min.
FID sensitivity:	16 x 10^{-11} AFS

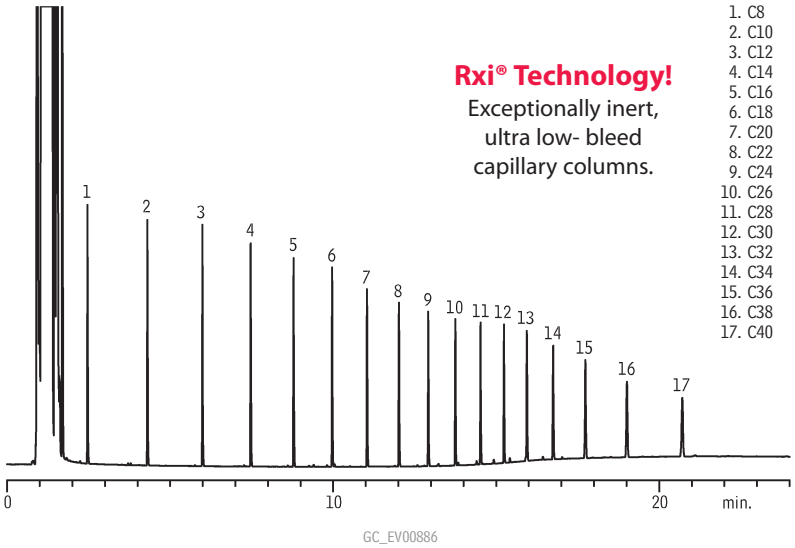




1. 3-methylpentane
2. 2,2,4-trimethylpentane (isooctane)
3. benzene
4. toluene
5. ethylbenzene
6. *m*-xylene
7. *o*-xylene
8. 1,2,4-trimethylbenzene
9. dodecane
10. naphthalene

GC_EV00071

Petroleum Hydrocarbons (TPH)
Rxi®-1ms



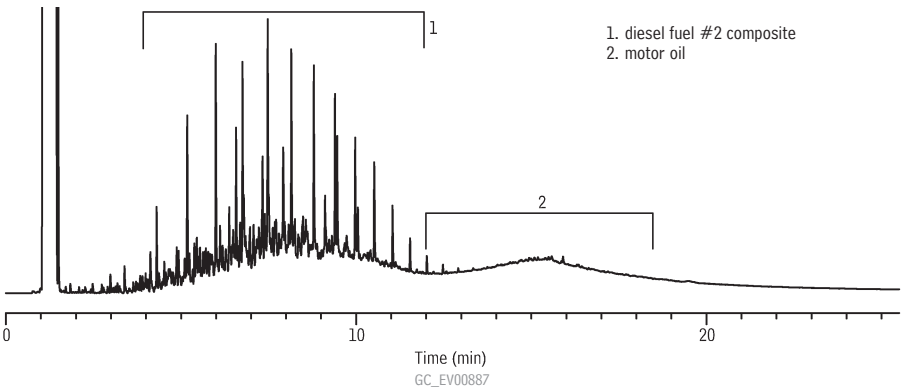
Rxi® Technology!
Exceptionally inert, ultra low- bleed capillary columns.

Column:	Rxi®-1ms, 20m, 0.18mm ID, 0.18µm (cat.# 13302)
Sample:	Florida TRPH Standard (cat.# 31266), 500µg/mL each component in hexane
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

*GC courtesy of Shimadzu Scientific.

Lubrication Range Organics
Diesel Fuel #2/Motor Oil
Rxi®-1ms

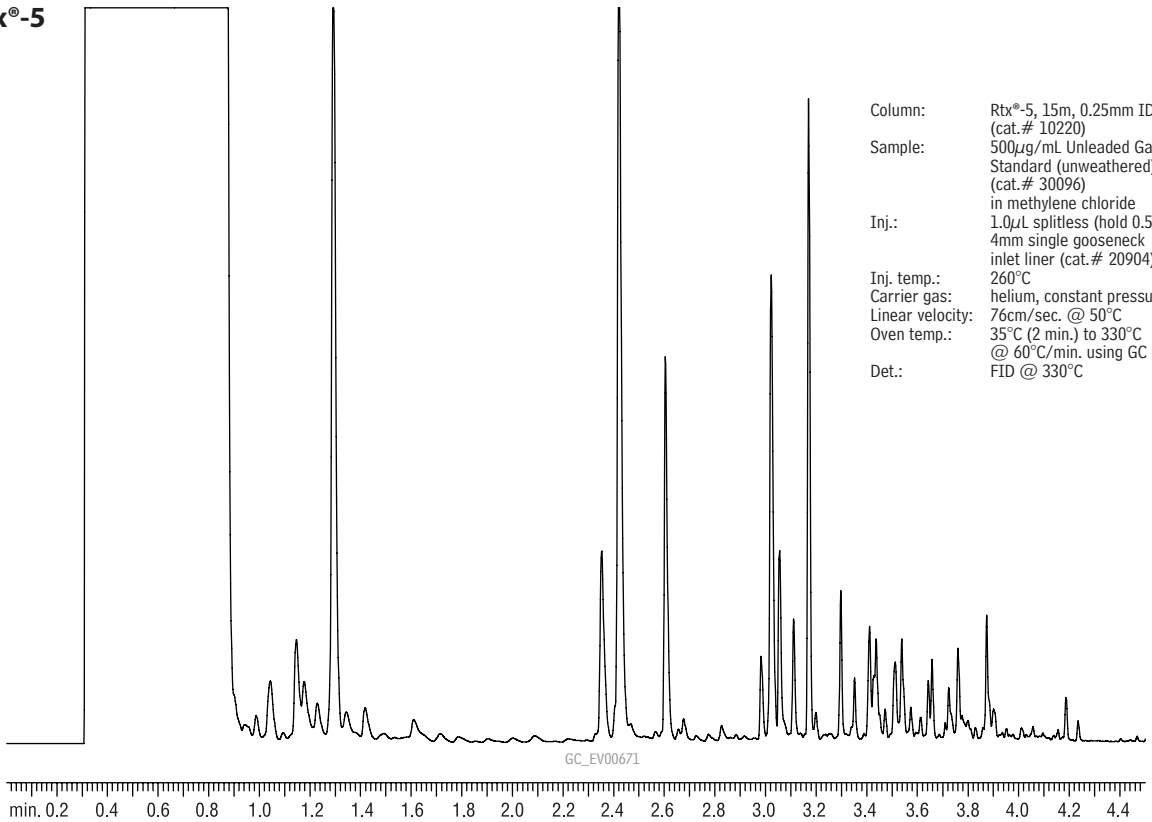
Rxi® Technology!
Exceptionally inert, ultra low- bleed capillary columns.



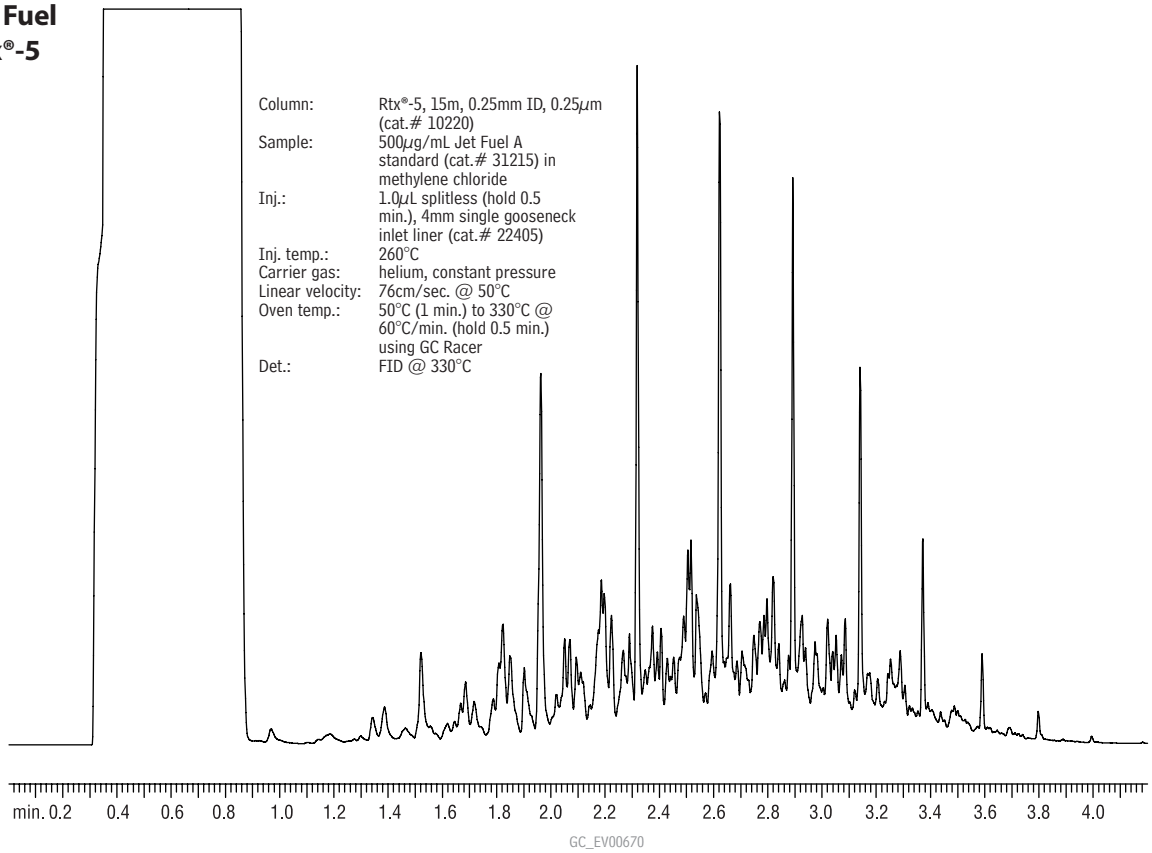
1. diesel fuel #2 composite
2. motor oil

Column:	Rxi®-1ms, 20m, 0.18mm ID, 0.18µm (cat.# 13302)
Sample:	Diesel #2/Motor Oil (cat.# 31682) 5,000µg/mL each component in hexane
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

Unleaded Gasoline
Rtx®-5



Jet Fuel
Rtx®-5

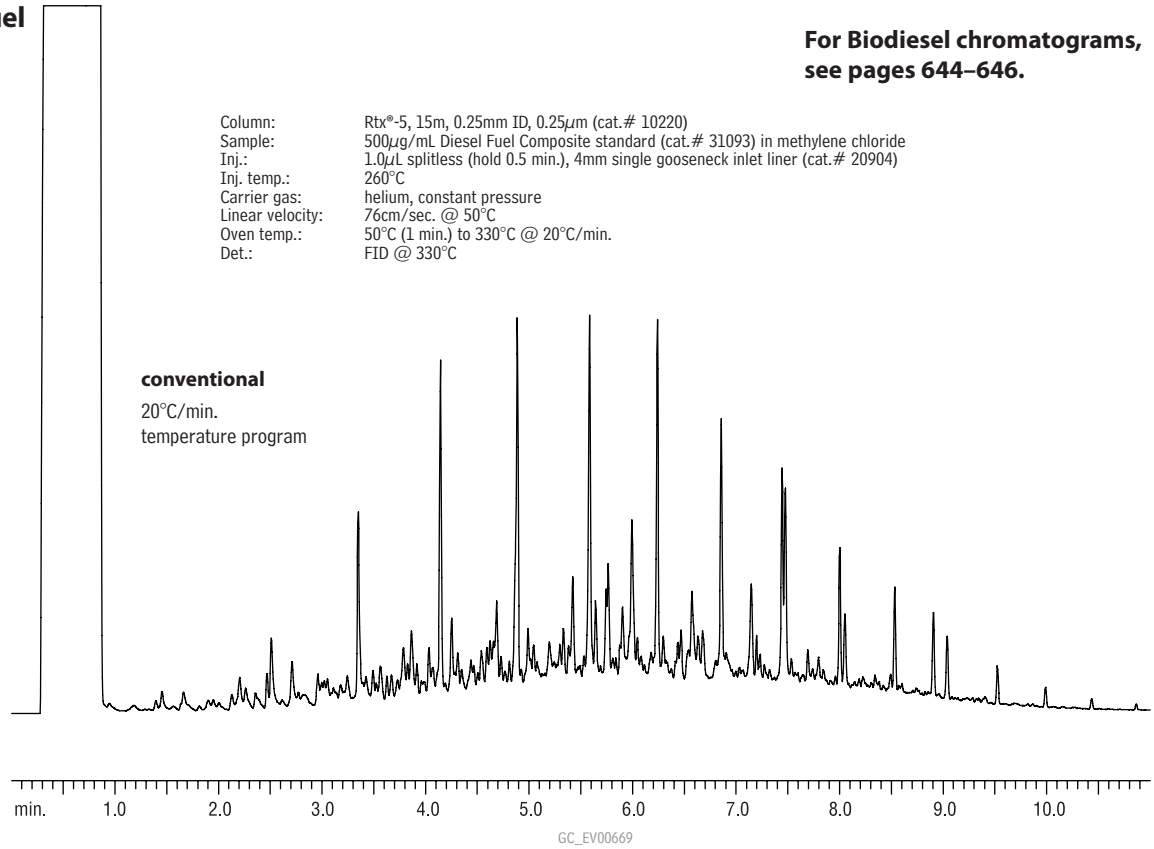


Diesel Range Organics (DRO)

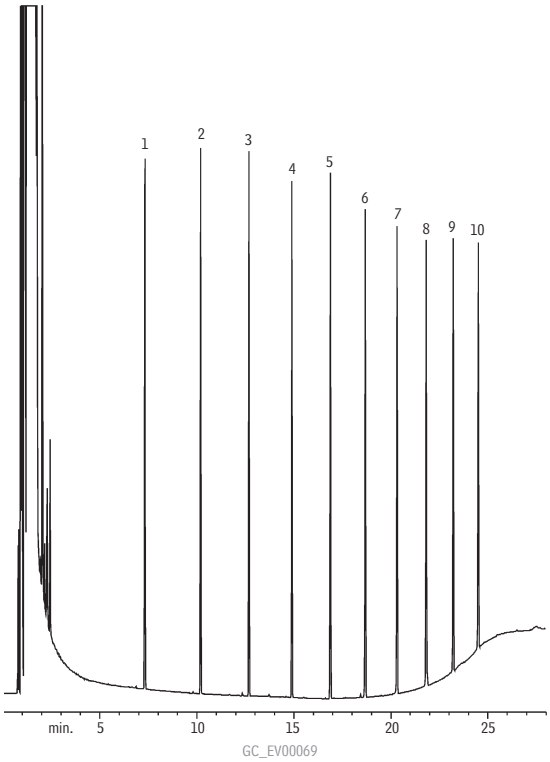
Diesel Fuel
Rtx®-5

For Biodiesel chromatograms, see pages 644–646.

Column:	Rtx®-5, 15m, 0.25mm ID, 0.25µm (cat.# 10220)
Sample:	500µg/mL Diesel Fuel Composite standard (cat.# 31093) in methylene chloride
Inj.:	1.0µL 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



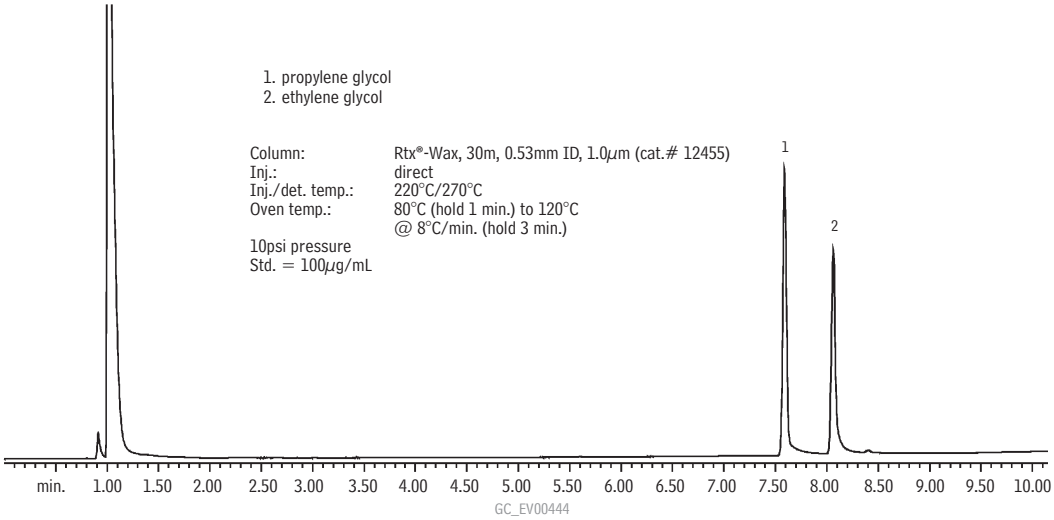
DRO Mix
Rtx®-5



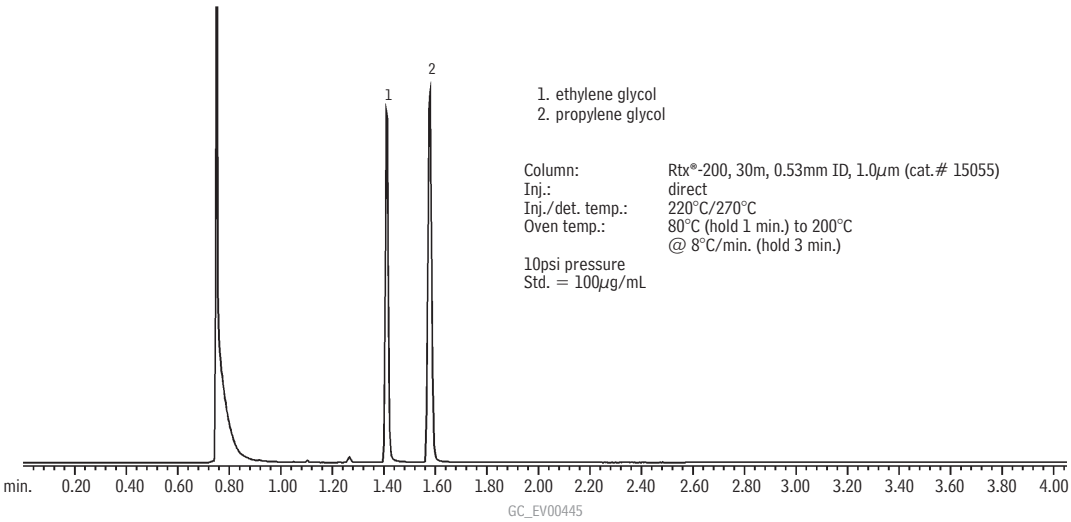
1. C10
2. C12
3. C14
4. C16
5. C18
6. C20
7. C22
8. C24
9. C26
10. C28

Column:	Rtx®-5, 30m, 0.53mm ID, 1.0µm (cat.# 10255)
Sample:	Direct injection of DRO Mix (cat.# 31064)
Conc.:	50ng/µL
Oven temp.:	40°C (hold 2 min.) to 310°C @ 12°C/min. (hold 10 min.)
Inj./det. temp.:	280°C/310°C
Carrier gas:	helium @ 65cm/sec.
FID sensitivity:	8 x 10^{-11} AFS

Glycols
Rtx®-Wax



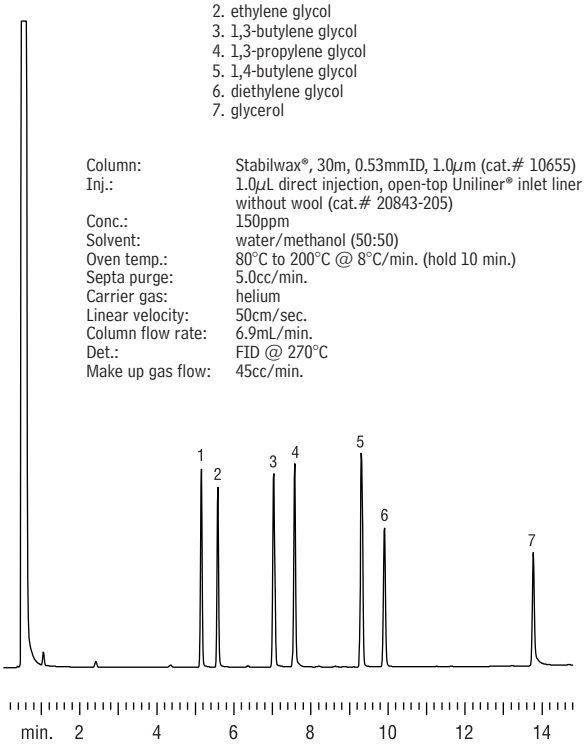
Glycols
Rtx®-200



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, 1.0µm (cat.# 10655)
Inj.:	1.0µL 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.

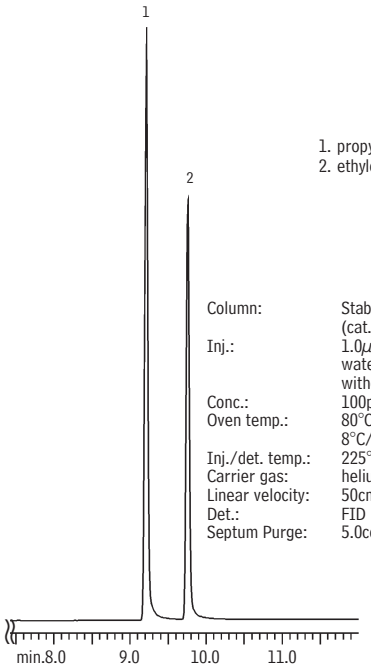


GC_EV00476

Glycols
Stabilwax®

1. propylene glycol
2. ethylene glycol

Column:	Stabilwax®, 30m, 0.53mm ID, 1.0µm (cat.# 10655)
Inj.:	1.0µL 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.



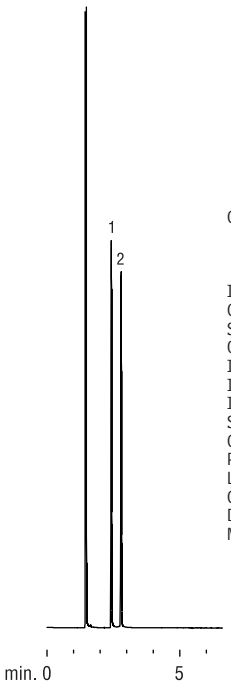
GC_EV00546

Glycols
Rtx®-BAC1 & Rtx®-BAC2

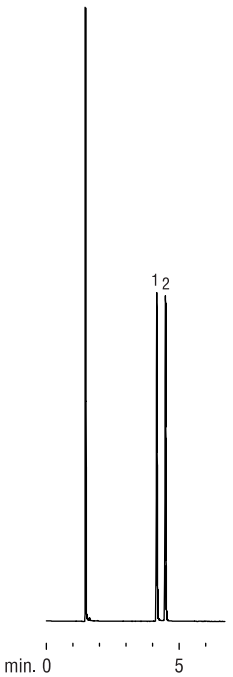
1. ethylene glycol
2. propylene glycol

Columns:	Rtx®-BAC1, 30m, 0.32mm ID, 1.8µm (cat.# 18003) Rtx®-BAC2, 30m, 0.32mm ID, 1.2µm (cat.# 18002)
Inj.:	0.5µL 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.

Rtx®-BAC1

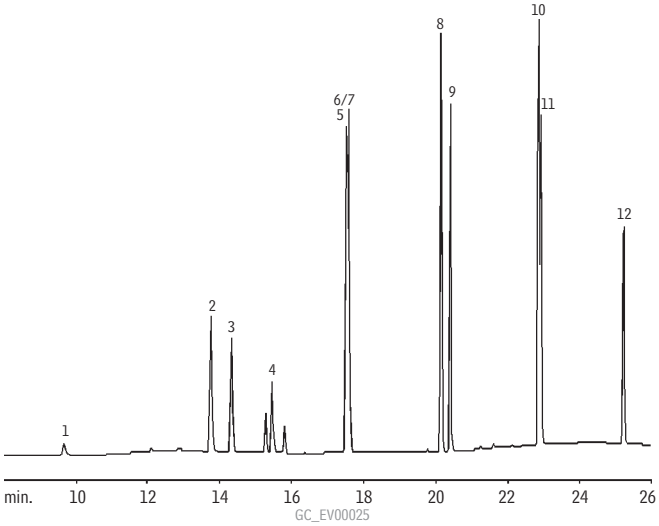


Rtx®-BAC2



GC_EV00474

Haloacetic Acids
US EPA Method 552.2
Rtx®-5

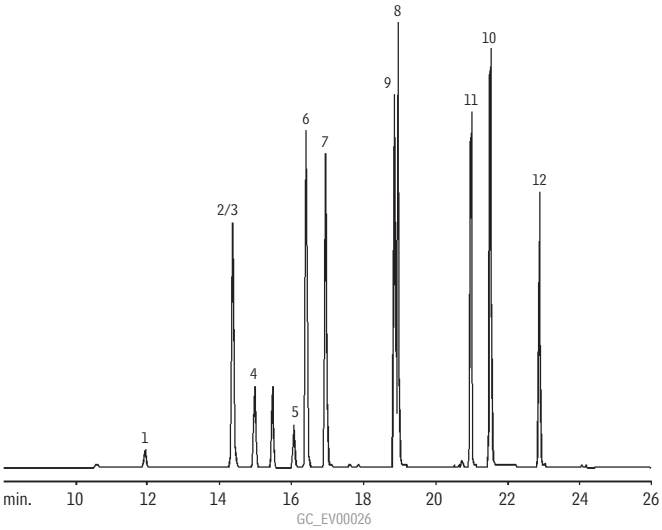


Column:	Rtx®-5, 30m, 0.25mm ID, 1.0µm (cat.# 10253)
Inj.:	1.0µL split injection, 1ng on-column concentration
Oven temp.:	50°C (hold 10 min.) to 225°C @ 8°C/min.
Inj./det. temp.:	200°C/290°C
Carrier gas:	helium
Linear velocity:	30cm/sec. @ 50°C
ECD sensitivity:	20kHz full scale
Split ratio:	10:1

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

(All compounds derivatized)

Haloacetic Acids
US EPA Method 552.2
Rtx®-200

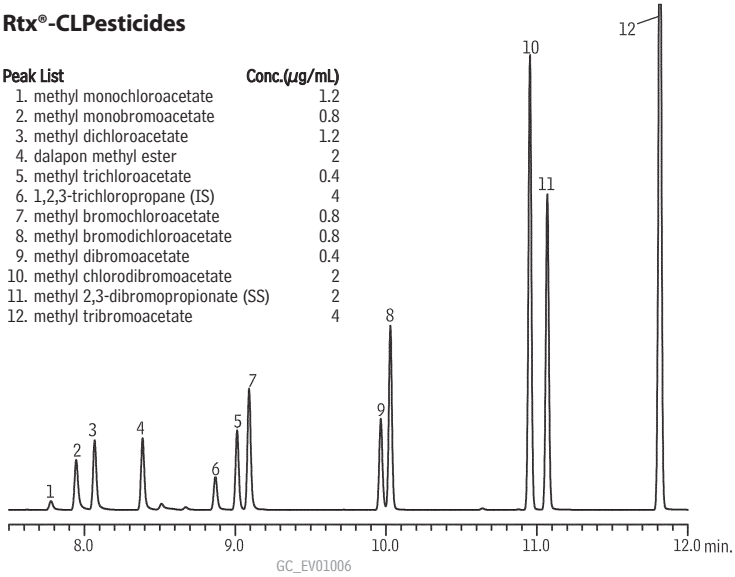


Column:	Rtx®-200, 30m, 0.25mm ID, 1.0µm (cat.# 15053)
Inj.:	1.0µL split injection, 1ng on-column concentration
Oven temp.:	50°C (hold 10 min.) to 225°C @ 8°C/min.
Inj./det. temp.:	200°C/290°C
Carrier gas:	helium
Linear velocity:	30cm/sec. @ 50°C
ECD sensitivity:	20kHz full scale
Split ratio:	10:1

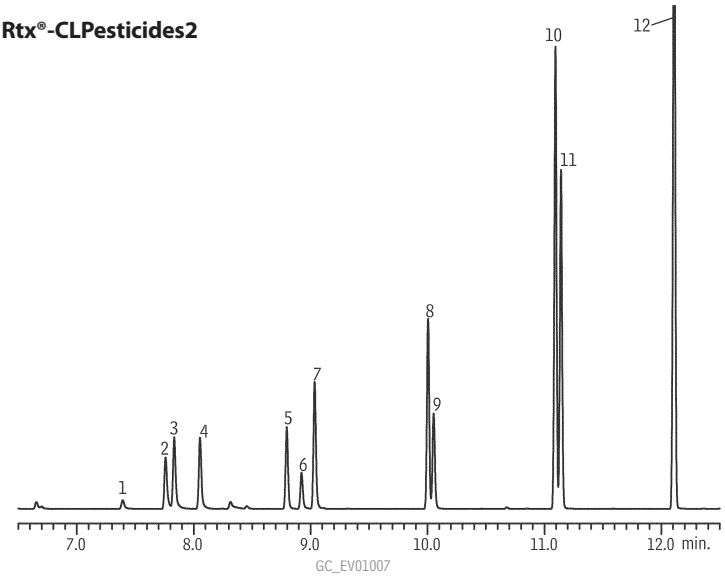
Haloacetic Acids & Dalapon
US EPA Method 552.2
Rtx®-CLPesticides & Rtx®-CLPesticides2

Rtx®-CLPesticides

Peak List	Conc.(µg/mL)
1. methyl monochloroacetate	1.2
2. methyl monobromoacetate	0.8
3. methyl dichloroacetate	1.2
4. dalapon methyl ester	2
5. methyl trichloroacetate	0.4
6. 1,2,3-trichloropropane (IS)	4
7. methyl bromochloroacetate	0.8
8. methyl bromodichloroacetate	0.8
9. methyl dibromoacetate	0.4
10. methyl chlorodibromoacetate	2
11. methyl 2,3-dibromopropionate (SS)	2
12. methyl tribromoacetate	4



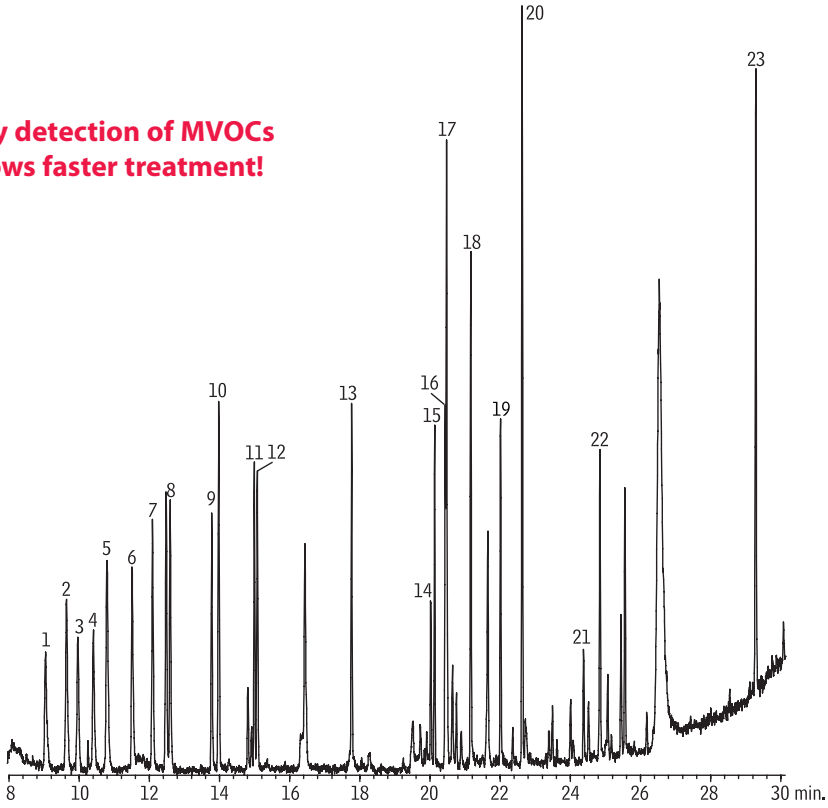
Rtx®-CLPesticides2



Column:	Rtx®-CLPesticides2, 30m, 0.32mm ID, 0.25µm (cat.# 11324) and Rtx®-CLPesticides, 30m, 0.32mm ID, 0.32µm (cat.# 11141) with 5m x 0.32mm ID Rxi® deactivated guard tubing (cat.# 10039), connected using Universal "Y" Press-Tight® Connector (cat.# 20405-261)
Sample:	Haloacetic Acid Methyl Ester Mix #2 (cat.# 31647), Dalapon Methyl Ester (cat.# 32057), Methyl-2,3-dibromopropionate (cat.# 31656), 552.2 Internal Standard (cat.# 31648), diluted in methyl *tert*-butyl ether (MTBE)
Inj.:	1µL splitless (hold 0.75 min.), 4mm cyclo double gooseneck liner (cat.# 20896)
Inj. temp.:	250°C
Carrier gas:	helium, constant flow
Linear velocity:	25cm/sec. @ 35°C
Oven temp.:	35°C (hold 4 min.) to 250°C (hold 5 min.) @ 15°C/min.
Detector temp.:	µ-ECD @ 300°C

Microbial Volatile Organic Compounds (MVOCs)
Rxi®-1ms

Early detection of MVOCs allows faster treatment!



GC_AR01030

Compound	Rt (min.)
1. 2-butanone	9.047
2. 2-methyl-furan	9.640
3. 3-methyl-furan	9.962
4. 2-methyl-1-propanol	10.405
5. 2-methyl-2-butanol	10.791
6. 1-butanol	11.506
7. 3-methyl-2-butanol	12.092
8. 2-pentanol	12.592
9. 2-methyl-1-butanol	13.779
10. dimethyl-disulfide	13.979
11. 3-hexanone	14.994
12. 2-hexanone	15.080
13. 2-heptanone	17.767
14. 1-octen-3-ol	20.019
15. 3-octanone	20.133
16. 3-octanol	20.433
17. 2-pentyl-furan	20.476
18. 2-ethyl-1-hexanol	21.163
19. 1-octanol	22.013
20. 2-isopropyl-3-methoxypyrazine	22.628
21. isoborneol	24.379
22. α-terpineol	24.844
23. geosmin	28.347

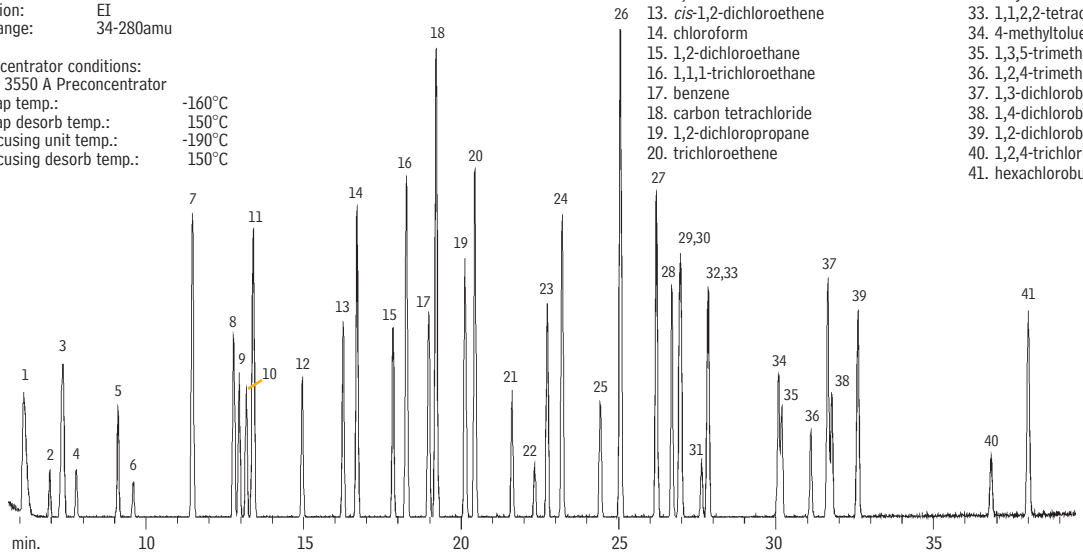
Column:	Rxi®-1ms, 60m, 0.25mm ID, 1.00µm (cat.# 13356)
Sample:	Microbial volatile organic compounds, 2ppbv, 60% RH
Inj.:	1.0µL split (split ratio 1:1), 1mm split inlet liner (cat.# 20972)
Inj. temp.:	200°C
Carrier gas:	helium, constant flow
Flow rate:	1.5mL/min.
Oven temp.:	10°C (hold 1 min.) to 235°C @ 8°C/min.
Det:	Agilent 6890/5973 GC/MS 5 min. solvent delay
Transfer line temp.:	260°C
Scan range:	35 to 350amu
Ionization:	EI
Mode:	scan
Other:	Nutech 8900DS Preconcentrator Conditions: Sample = 200mL from canister Cryotrap1 = -160°C Desorb = 20°C Cryotrap2 = 20°C Desorb = 200°C Cryofocuser = 200°C Desorb = 200°C

US EPA TO-14 Compounds
Rtx®-1

Column: Rtx®-1, 60m, 0.32mm ID, 3.0µm (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. trichloroethene
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

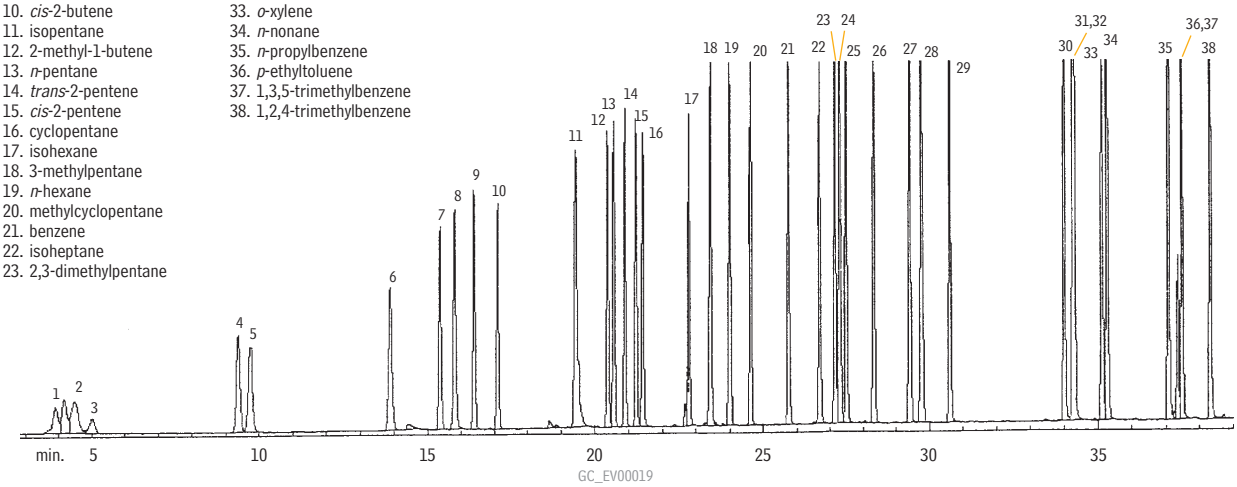


GC_EV00018

Ozone Precursors
Rtx®-1

Column: Rtx®-1, 60m, 0.32mm ID, 3.0µm (cat.# 10187)
Sample: 0.5L of C2-C9 gas standard cryogenically concentrated; 15nL/component desorbed 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 x 10^{-12} AFS

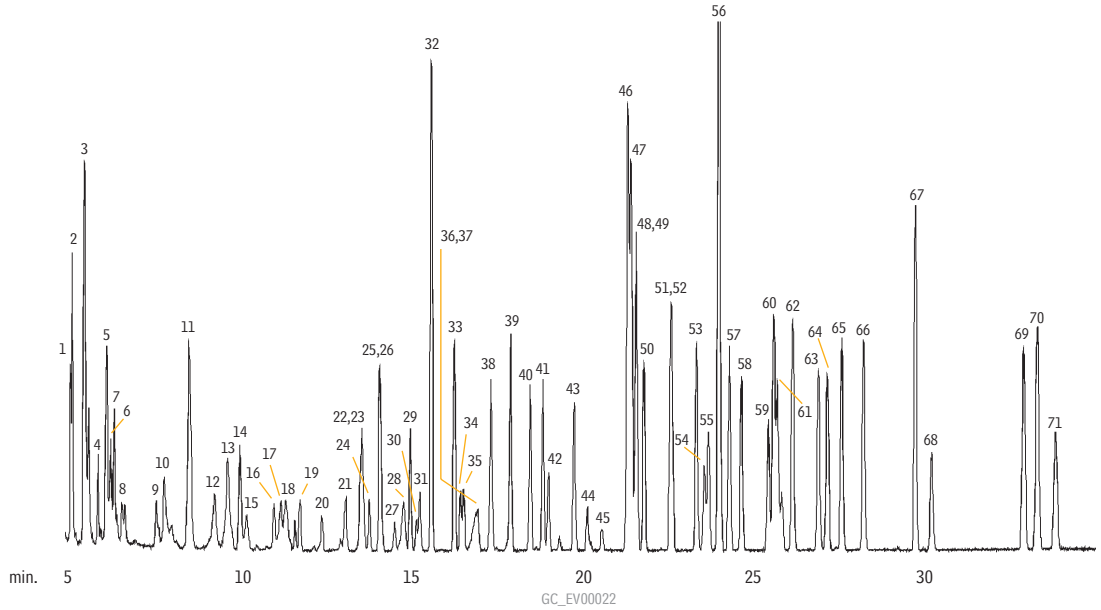
1. ethylene
2. acetylene
3. ethane
4. propylene
5. propane
6. isobutane
7. 1-butene
8. *n*-butane
9. *trans*-2-butene
10. *cis*-2-butene
11. isopentane
12. 2-methyl-1-butene
13. *n*-pentane
14. *trans*-2-pentene
15. *cis*-2-pentene
16. cyclopentane
17. isohexane
18. 3-methylpentane
19. *n*-hexane
20.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



GC_EV00019

Permission to publish this chromatogram granted by Radian Corporation.

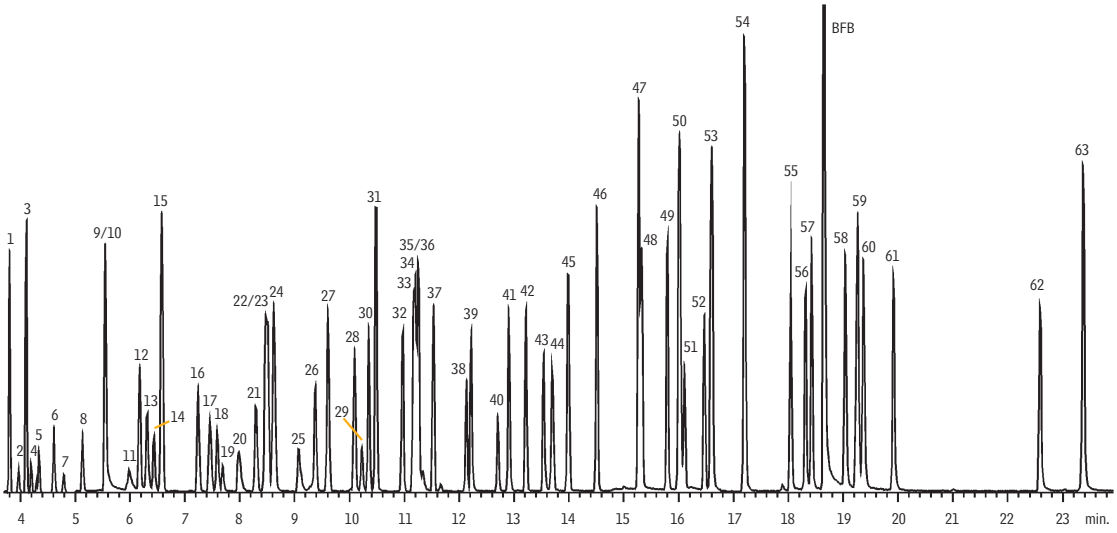
Air Toxins
Rtx®-502.2



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

Column:	Rtx®-502.2, 60m, 0.32mm ID, 1.8μm (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.

US EPA TO-14/TO-15 Compounds
Rtx®-1



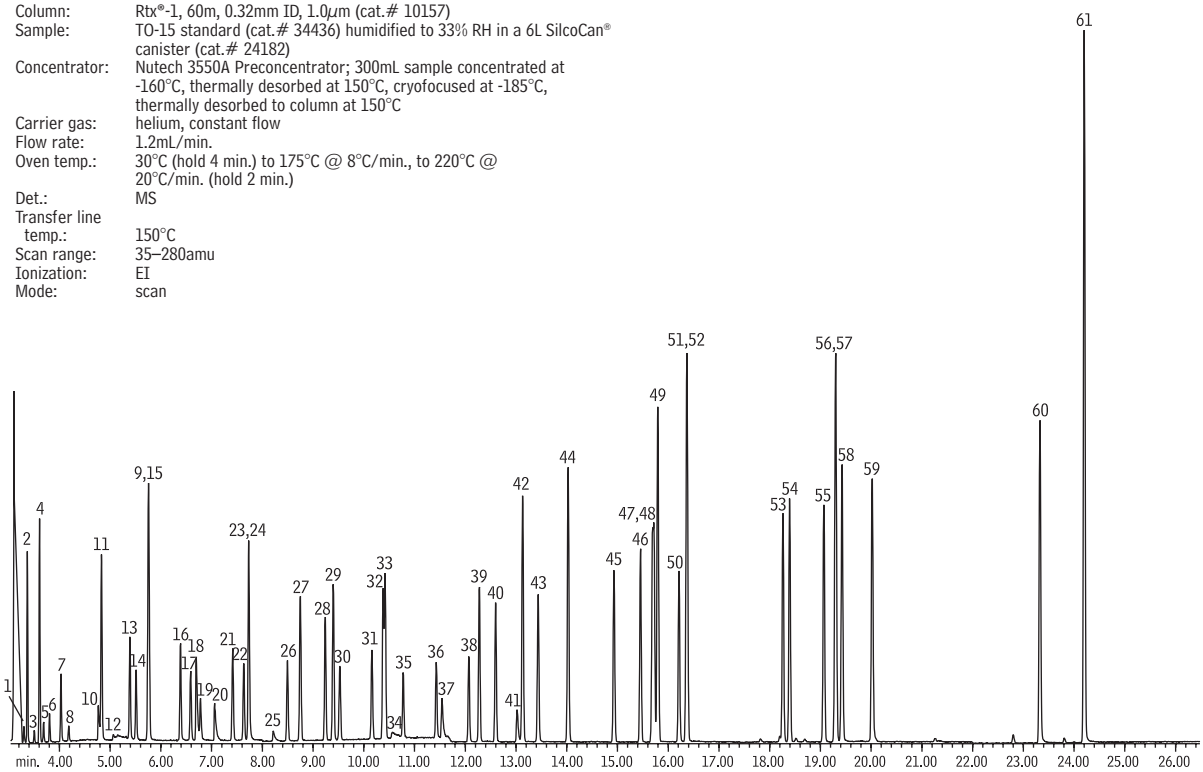
Column:	Rtx®-1, 60m, 0.32mm ID, 1.0µm (cat.# 10157)
Sample:	200mL of 10ppbv TO-15 standard, injected into TO-Can® canister and humidified to 70% RH.
Concentrator:	Nutech 3550 Preconcentrator 200mL of sample concentrated at -160°C, thermally desorbed at 150°C, and cryofocused at -185°C
Oven temp.:	30°C (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
2. chloromethane
3. dichlorotetrafluoroethane
4. vinyl chloride
5. 1,3-butadiene
6. bromomethane
7. chloroethane
8. bromoethene
9. acetone
10. trichlorofluoromethane
11. isopropyl alcohol
12. 1,1-dichloroethene
13. methylene chloride
14. 3-chloropropene
15. carbon disulfide
16. Freon® TF
17. *trans*-1,2-dichloroethene
18. 1,1-dichloroethane
19. methyl *tert*-butyl ether
20. methyl ethyl ketone
21. *cis*-1,2-dichloroethene
22. bromochloromethane (IS)
23. *n*-hexane
24. chloroform
25. tetrahydrofuran
26. 1,2-dichloroethane
27. 1,1,1-trichloroethane
28. benzene
29. carbon tetrachloride
30. cyclohexane
31. 1,4-difluorobenzene (IS)
32. 1,2-dichloropropane
33. bromodichloromethane
34. trichloroethene
35. 1,4-dioxane
36. 2,2,4-trimethylpentane
37. *n*-heptane
38. *cis*-1,3-dichloropropene
39. methyl isobutyl ketone
40. *trans*-1,3-dichloropropene
41. 1,1,2-trichloroethane
42. toluene
43. methyl butyl ketone
44. dibromochloromethane
45. 1,2-dibromoethane
46. tetrachloroethene
47. chlorobenzene-d5 (IS)
48. chlorobenzene
49. ethylbenzene
50a. *m*-xylene
50b. *p*-xylene
51. bromoform
52. styrene
53. 1,1,2,2-tetrachloroethane
54. *o*-xylene
55. 2-chlorotoluene
56. 4-ethyltoluene
57. 1,3,5-trimethylbenzene
58. 1,2,4-trimethylbenzene
59. 1,3-dichlorobenzene
60. 1,4-dichlorobenzene
61. 1,2-dichlorobenzene
62. 1,2,4-trichlorobenzene
63. hexachlorobutadiene

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

US EPA TO-15 Compounds
Rtx®-1

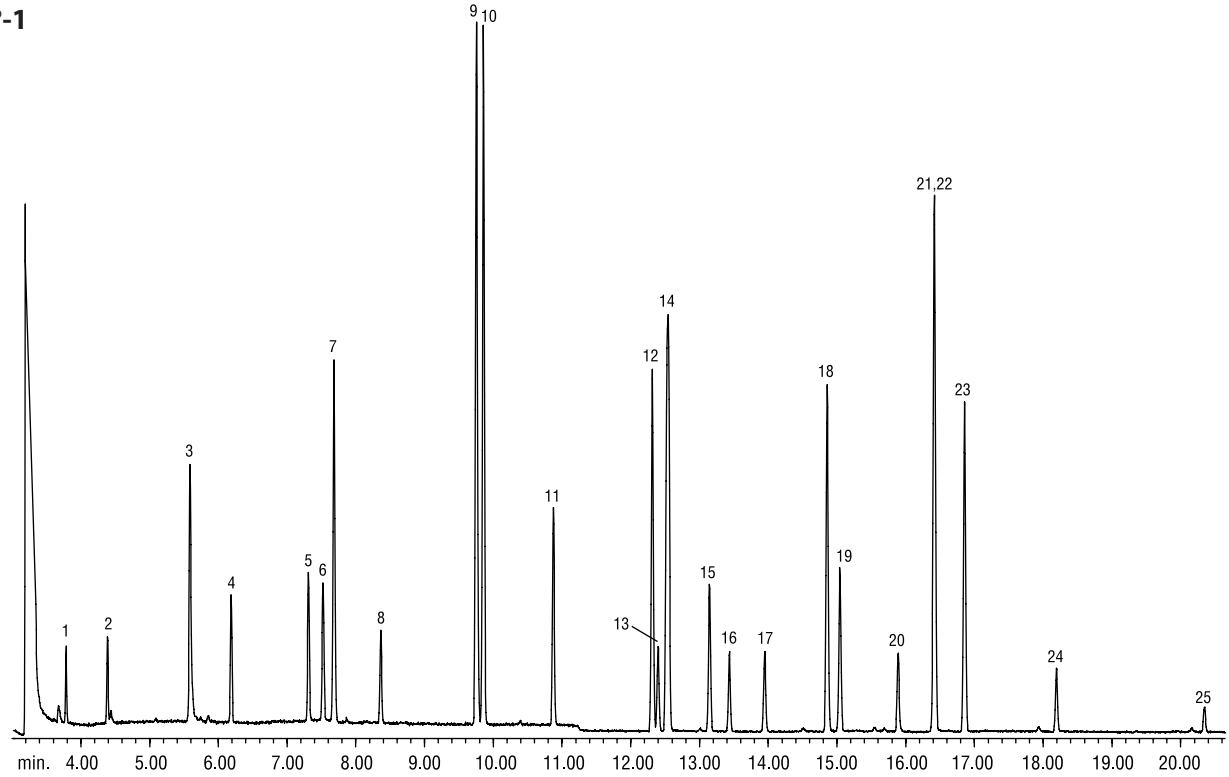
Column:	Rtx®-1, 60m, 0.32mm ID, 1.0µm (cat.# 10157)
Sample:	TO-15 standard (cat.# 34436) humidified to 33% RH in a 6L SilcoCan® canister (cat.# 24182)
Concentrator:	Nutech 3550A Preconcentrator; 300mL sample concentrated at -160°C, thermally desorbed at 150°C, cryofocused at -185°C, thermally desorbed 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



GC_AR00748

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

Massachusetts APH Mix
Rtx®-1



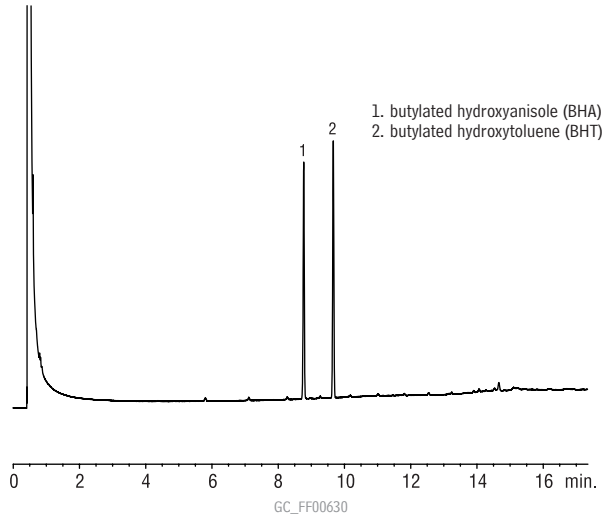
GC_AR00697

Column:	Rtx®-1, 60m, 0.32mm ID, 1.0µm (cat.# 10157)
Sample:	Massachusetts APH Mix, (cat.# 34540)
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

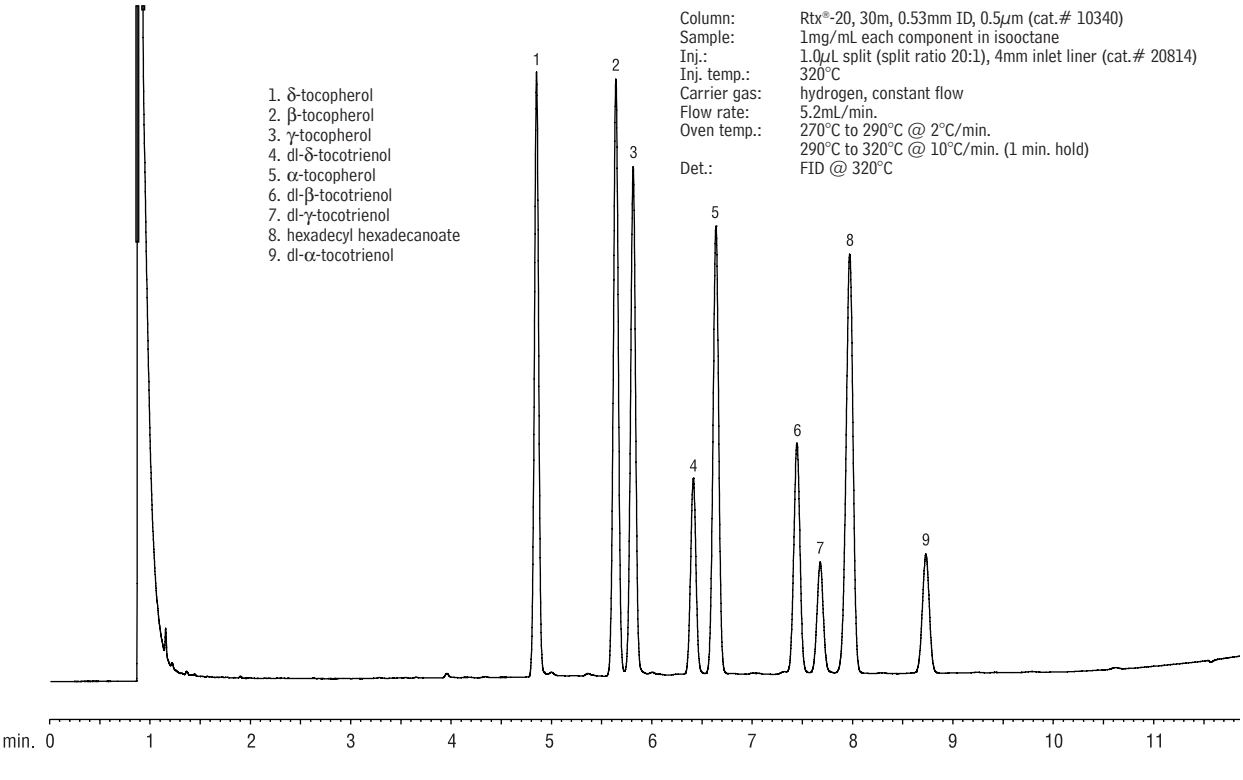
14a. *m*-xylene
14b. *p*-xylene
15. *o*-xylene
16. nonane
17. isopropylbenzene
18. 1-methyl-3-ethylbenzene
19. 1,3,5-trimethylbenzene
20. decane
21. 1,2,3-trimethylbenzene
22. *p*-isopropyltoluene
23. butylcyclohexane
24. undecane
25. dodecane

BHA and BHT
Rtx®-50



Column:	Rtx®-50, 30m, 0.53mm ID, 0.50µm (cat.# 10540)
Sample:	50ppm each in methanol
Inj.:	1.0µL 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

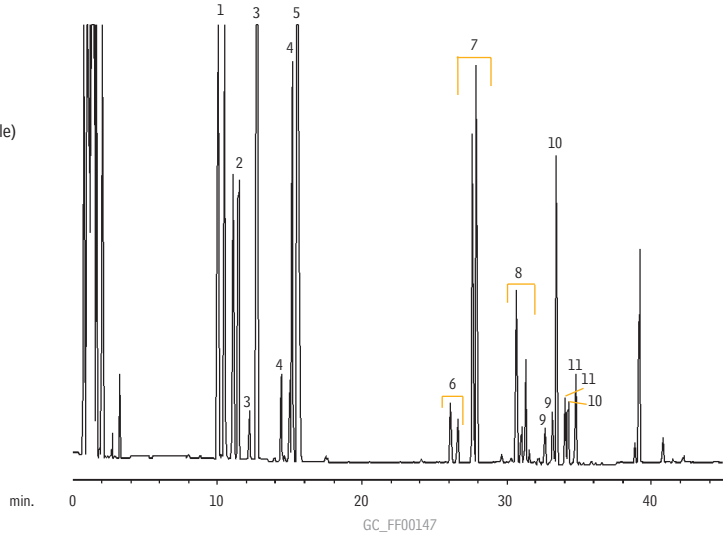
Tocopherols and Tocotrienols
Rtx®-20



Column:	Rtx®-20, 30m, 0.53mm ID, 0.5µm (cat.# 10340)
Sample:	1mg/mL each component in isooctane
Inj.:	1.0µL split (split ratio 20:1), 4mm inlet liner (cat.# 20814)
Inj. temp.:	320°C
Carrier gas:	hydrogen, constant flow
Flow rate:	5.2mL/min.
Oven temp.:	270°C to 290°C @ 2°C/min. 290°C to 320°C @ 10°C/min. (1 min. hold)
Det.:	FID @ 320°C

Rosemary Oil
Rt®-βDEXsm

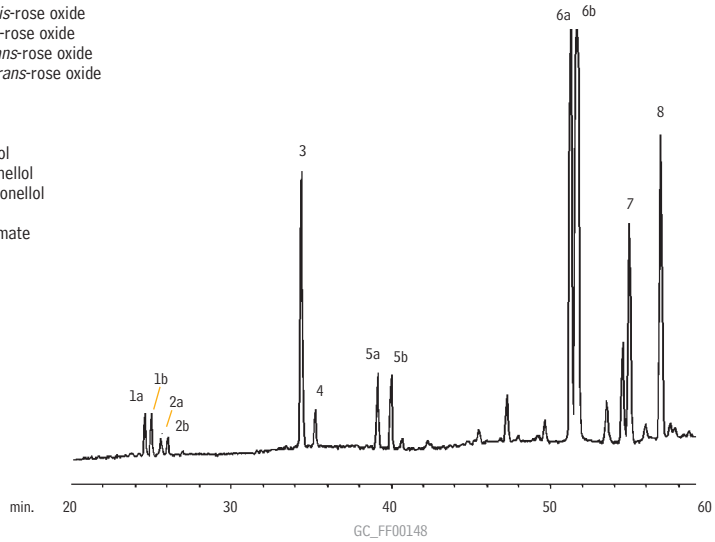
1. (-/+)α-pinene
2. (+/-)camphene
3. (+/-)β-pinene
4. (-/+)limonene
5. eucalyptol (1,8-cineole)
6. (-/+)linalool
7. (+/-)camphor
8. (-/+)terpinen-4-ol
9. (+/-)isoborneol
10. (+/-)borneol
11. (+/-)α-terpineol



Column:	Rt®-βDEXsm, 30m, 0.32mm ID, 0.25μm (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

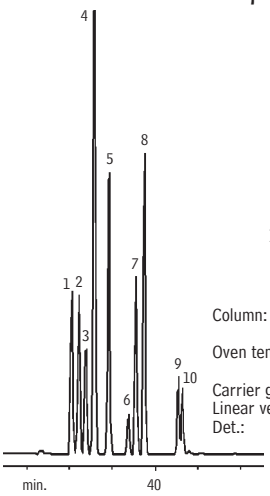
Geranium Oil (Commercial)
Rt®-βDEXsa

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®-βDEXsa, 30m, 0.25mm ID, 0.25μm (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

Irone Isomers - Rt®-βDEXcst



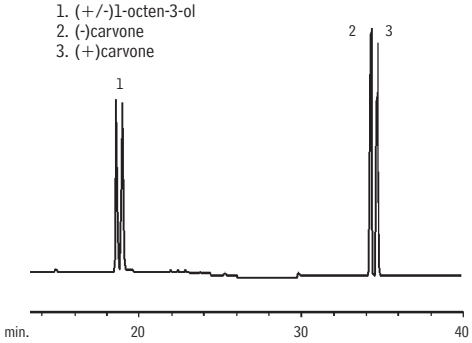
1. (-)-(2R,6R)-*trans*-α-irone
2. (+)-(2S,6S)-*trans*-α-irone
3. (+)-(2R,6R)-*trans*-γ-irone
4. (-)-(2S,6S)-*trans*-γ-irone
5. (+)-(2R,6S)-*cis*-α-irone
6. (+)-(2R,6S)-*cis*-γ-irone
7. (-)-(2S,6R)-*cis*-γ-irone
8. (-)-(2S,6R)-*cis*-α-irone
9. (+)-(2R)-β-irone
10. (-)-(2R)-β-irone

Column:	Rt®-βDEXcst, 30m, 0.32mm ID, 0.25μm (cat.# 13102)
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

GC_FF00150

1-octen-3-ol and carvone - Rt®-βDEXsa

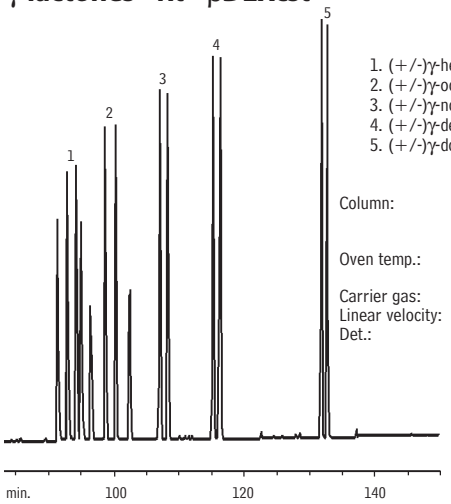
1. (+/-)1-octen-3-ol
2. (-)carvone
3. (+)carvone



GC_FF00151

Column:	Rt®-βDEXsa, 30m, 0.32mm ID, 0.25μm (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®-βDEXcst

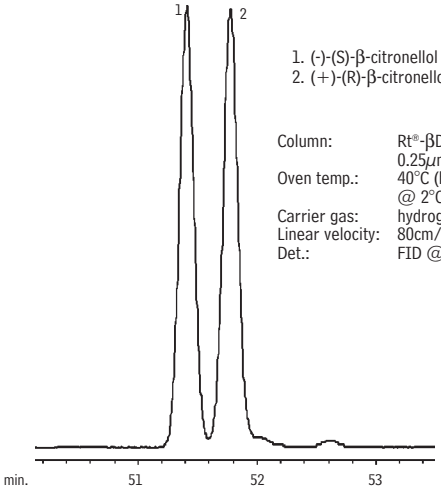


1. (+/-)γ-heptalactone
2. (+/-)γ-octalactone
3. (+/-)γ-nonalactone
4. (+/-)γ-decalactone
5. (+/-)γ-dodecalactone

Column:	Rt®-βDEXcst, 30m, 0.32mm ID, 0.25μm (cat.# 13102)
Oven temp.:	60°C (hold 1 min.) to 200°C @ 1°C/min.
Carrier gas:	hydrogen
Linear velocity:	40cm/sec. set @ 60°C
Det.:	FID @ 220°C

GC_FF00152

β-citronellol - Rt®-βDEXsa

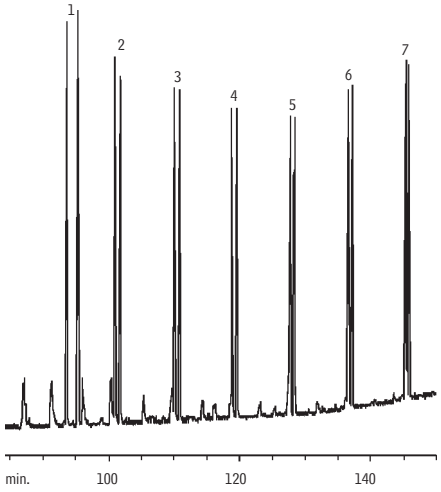


1. (-)-(S)-β-citronellol
2. (+)-(R)-β-citronellol

Column:	Rt®-βDEXsa, 30m, 0.32mm ID, 0.25μm (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

GC_FF00153

δ-lactones - Rt®-βDEXcst

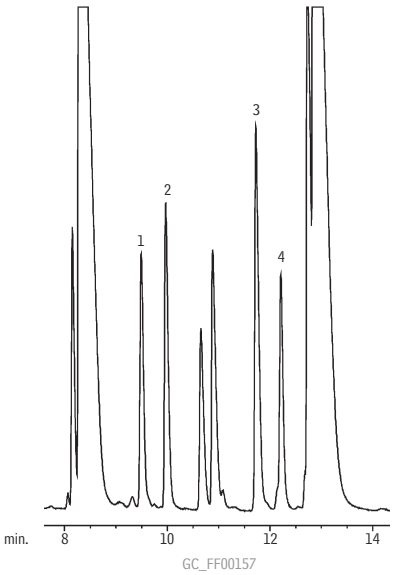


1. (+/-)δ-pentalactone
2. (+/-)δ-hexalactone
3. (+/-)δ-heptalactone
4. (+/-)δ-octalactone
5. (+/-)δ-nonalactone
6. (+/-)δ-decalactone
7. (+/-)δ-dodecalactone

Column:
Rt®-βDEXcst, 30m, 0.32mm ID, 0.25μm (cat.# 13102)
Oven temp.:
60°C (hold 1 min.) to 200°C @ 1°C/min.
Carrier gas:
hydrogen
Linear velocity:
40cm/sec. set @ 60°C
Det.:
FID @ 220°C

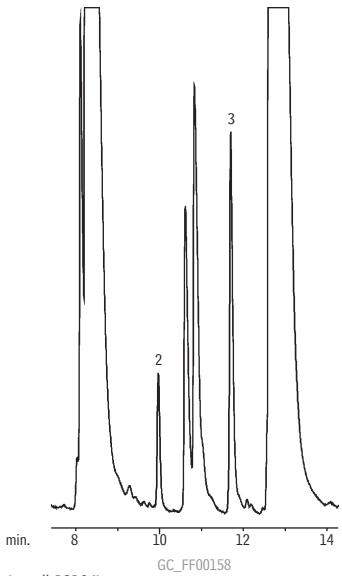
GC_FF00154

Apple Juice with Standards
Rt®-βDEXse



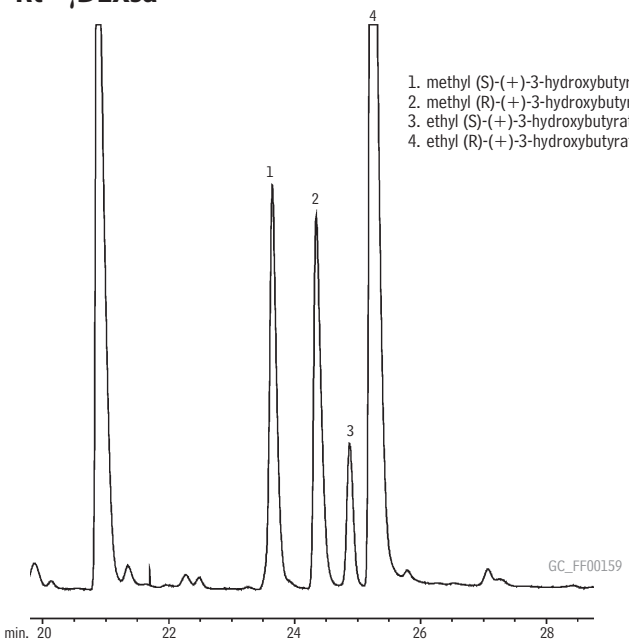
1. (R)-ethyl 2-methylbutyrate
2. (S)-ethyl 2-methylbutyrate
3. (R)-2-methylbutyrate
4. (S)-2-methylbutyrate

Apple Juice
Rt®-βDEXse



Column:	Rt®-βDEXse, 30m, 0.32mm ID, 0.25μm (cat.# 13106)
Inj.:	1.0μL split injection
On-column conc. (standards):	~50ng
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.

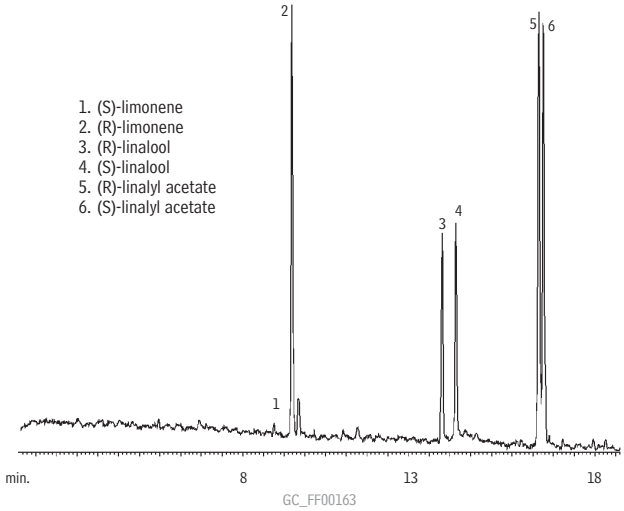
Grape Juice Extract
Rt®-γDEXsa



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

Column:	Rt®-γDEXsa, 30m, 0.32mm ID, 0.25μm (cat.# 13112)
Inj.:	1.0μL 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

Bergamot Flavor
Rt®-βDEXse

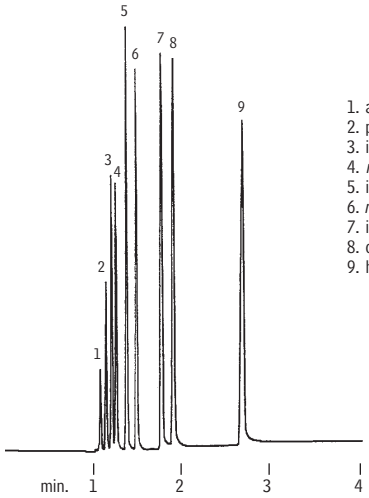


1. (S)-limonene
2. (R)-limonene
3. (R)-linalool
4. (S)-linalool
5. (R)-linalyl acetate
6. (S)-linalyl acetate

Column:	Rt®-βDEXse, 30m, 0.32mm ID, 0.25μm (cat.# 13106)
Oven temp.:	40°C (hold 1 min.) to 200°C @ 4°C/min.
Carrier gas:	helium, 60cm/sec. set @ 40°C
Det.:	MS @ 220°C

Fatty Acids (Free)
Rtx®-200

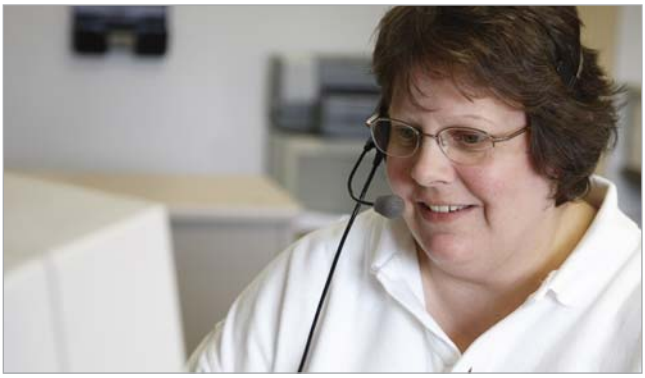
No derivatization needed!



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

GC_CH00282

Column:	Rtx®-200, 30m, 0.25mm ID, 0.25µm (cat.# 15023)
Sample:	0.8µL split injection of a free fatty acid standard
Conc.:	approximately 10 to 20ng/µL
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 10^{-11} AFS
Split vent:	40cc/min.



Paula Zuchowski, Customer Service

Restek Customer Service

In the U.S.

Call: 800-356-1688 (ext. 3) or 814-353-1300 (ext. 3)

Monday–Friday 8:00 a.m.–6:00 p.m. ET

Fax: 814-353-1309—24-hours a day

Online: www.restek.com—24-hours a day

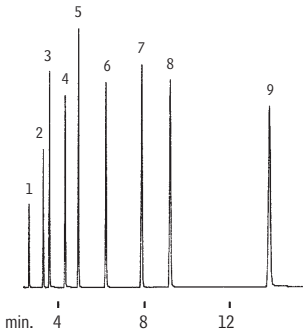
Outside the U.S.

Contact your Restek representative:
Refer to our list on pages 4-5 or visit our website at www.restek.com

Fatty Acids (Free)
Stabilwax®-DA

No derivatization needed!

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



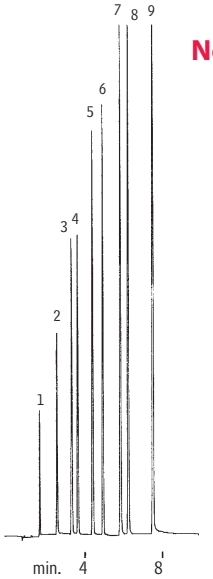
GC_CH00280

Column:	Stabilwax®-DA, 30m, 0.25mm ID, 0.25µm (cat.# 11023)
Sample:	1.0µL split injection of a free acid standard
Conc.:	approximately 10 to 20ng/µL
Oven temp.:	145°C
Inj./det. temp.:	250°C
Carrier gas:	hydrogen
Linear velocity:	40cm/sec.
FID sensitivity:	2 x 10^{-11} 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. isocaproic acid
8. caproic acid
9. heptanoic acid

No derivatization needed!

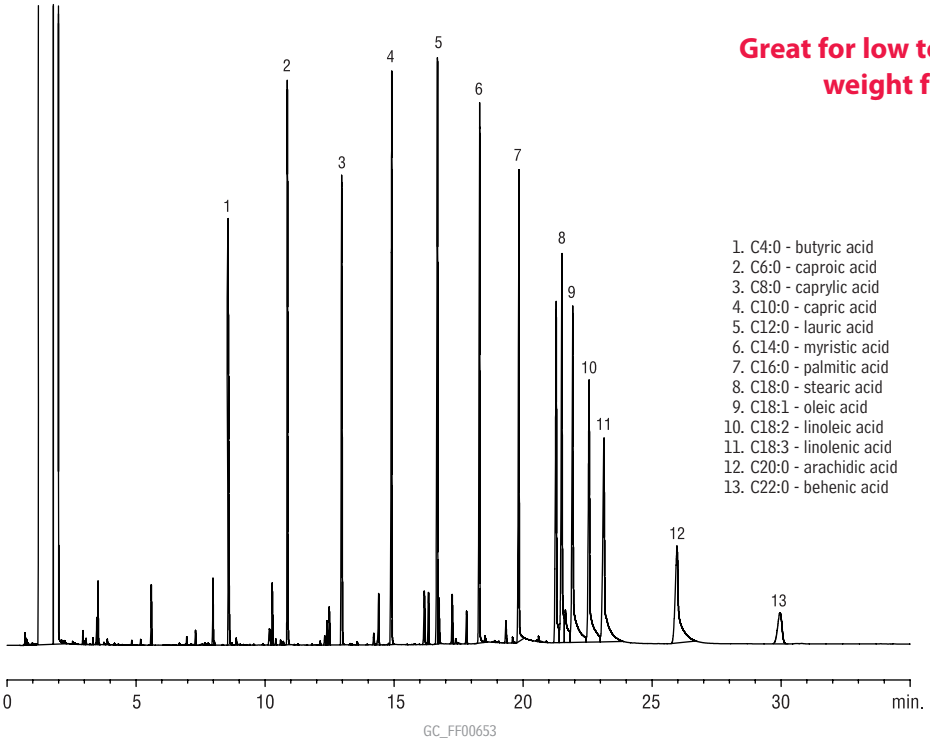


GC_CH00281

Column:	Rtx®-1, 30m, 0.53mm ID, 5.0µm (cat.# 10179)
Sample:	0.2µL injection of a 10–20ng/µL 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 10^{-11} AFS

Fatty Acids (Free)
Stabilwax®-DA

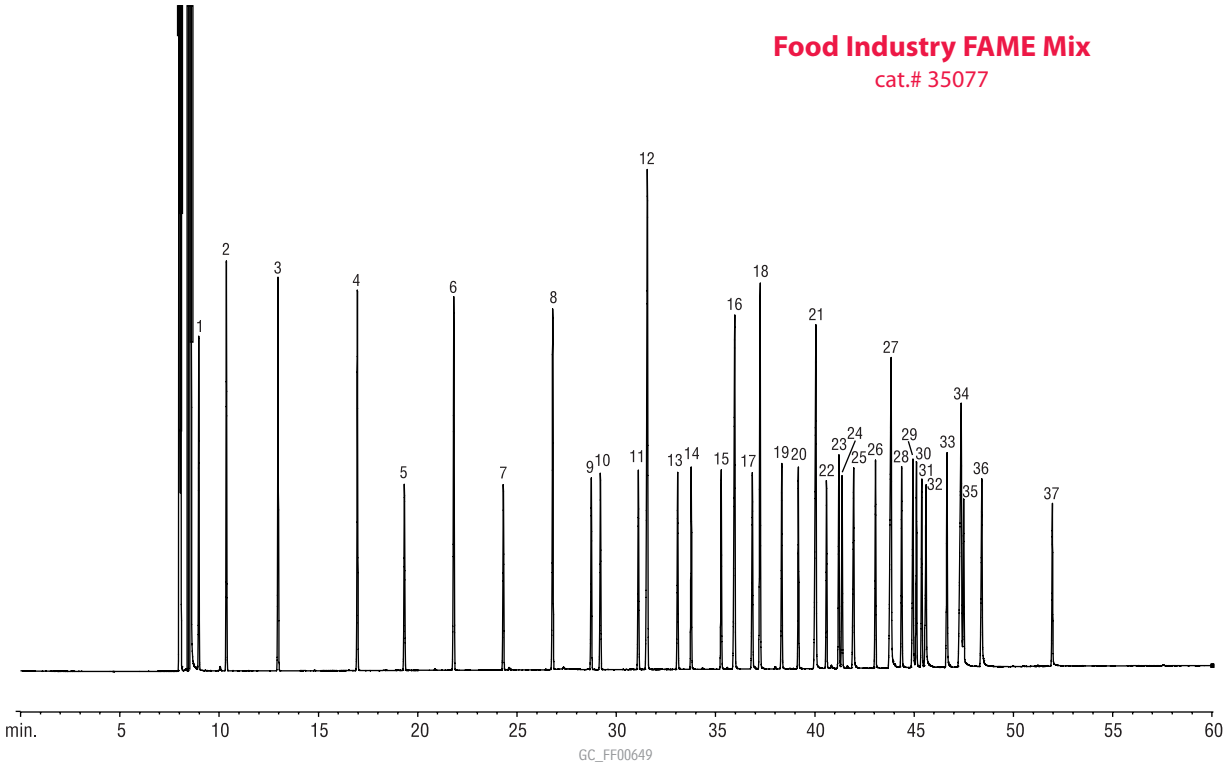
Great for low to high molecular weight fatty acids.



1. C4:0 - butyric acid
2. C6:0 - caproic acid
3. C8:0 - caprylic acid
4. C10:0 - capric acid
5. C12:0 - lauric acid
6. C14:0 - myristic acid
7. C16:0 - palmitic acid
8. C18:0 - stearic acid
9. C18:1 - oleic acid
10. C18:2 - linoleic acid
11. C18:3 - linolenic acid
12. C20:0 - arachidic acid
13. C22:0 - behenic acid

Column:	Stabilwax®-DA, 30m, 0.32mm ID, 0.25µm (cat.# 11024)
Sample:	1.0µL 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.)

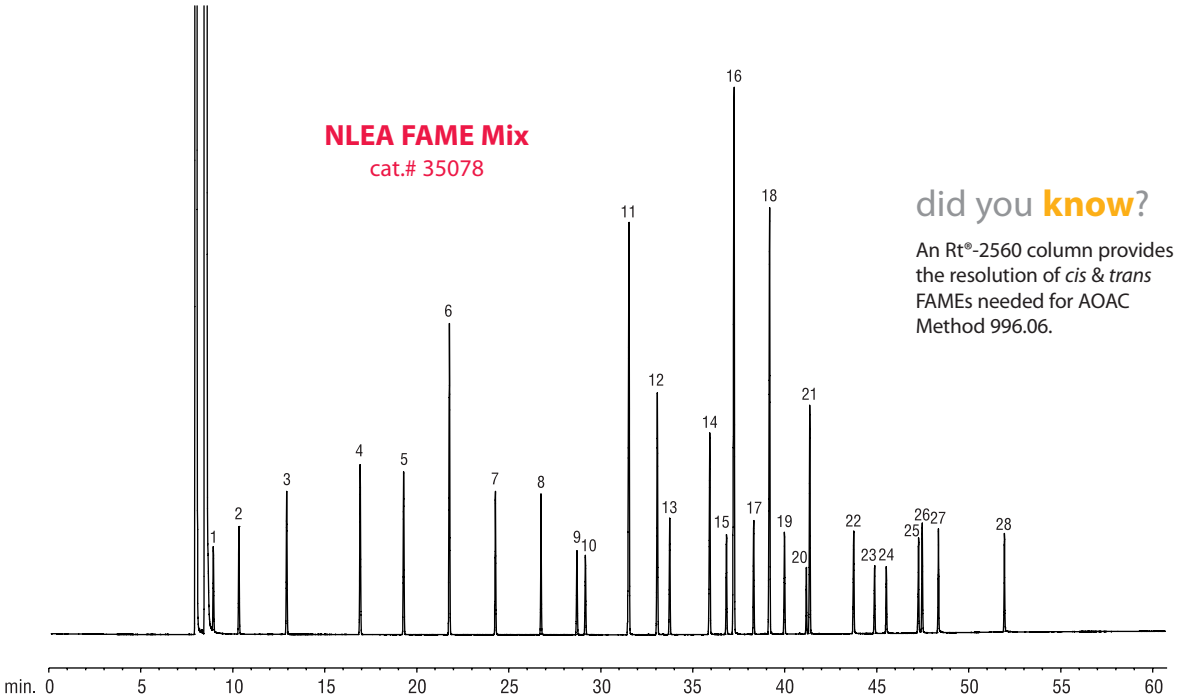
FAMEs (AOAC 996.06 Standard)
Rt®-2560



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 (*cis*-9)	2.0
10. C15:0 methyl pentadecanoate	2.0
11. C15:1 methyl pentadecenoate (*cis*-10)	2.0
12. C16:0 methyl palmitate	6.0
13. C16:1 methyl palmitoleate (*cis*-9)	2.0
14. C17:0 methyl heptadecanoate	2.0
15. C17:1 methyl heptadecenoate (*cis*-10)	2.0
16. C18:0 methyl stearate	4.0
17. C18:1 methyl elaidate (*trans*-9)	2.0
18. C18:1 methyl oleate (*cis*-9)	4.0
19. C18:2 methyl linoleaidate (*trans*-9,12)	2.0
20. C18:2 methyl linoleate (*cis*-9,12)	2.0
21. C20:0 methyl arachidate	4.0
22. C18:3 methyl γ-linolenate (*cis*-6,9,12)	2.0
23. C20:1 methyl eicosenoate (*cis*-11)	2.0
24. C18:3 methyl linolenate (*cis*-9,12,15)	2.0
25. C21:0 methyl heneicosanoate	2.0
26. C20:2 methyl eicosadienoate (*cis*-11,14)	2.0
27. C22:0 methyl behenate	4.0
28. C20:3 methyl eicosatrienoate (*cis*-8,11,14)	2.0
29. C22:1 methyl erucate (*cis*-13)	2.0
30. C20:3 methyl eicosatrienoate (*cis*-11,14,17)	2.0
31. C20:4 methyl arachidonate (*cis*-5,8,11,14)	2.0
32. C23:0 methyl tricosanoate	2.0
33. C22:2 methyl docosadienoate (*cis*-13,16)	2.0
34. C24:0 methyl lignocerate	4.0
35. C20:5 methyl eicosapentaenoate (*cis*-5,8,11,14,17)	2.0
36. C24:1 methyl nervonate (*cis*-15)	2.0
37. C22:6 methyl docosahexaenoate (*cis*-4,7,10,13,16,19)	2.0

Column:	Rt®-2560, 100m, 0.25mm ID, 0.2µm (cat.# 13199)
Sample:	Food Industry FAME Mix (cat.# 35077), 30mg/mL total FAMEs in methylene chloride
Inj.:	2.0µL 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

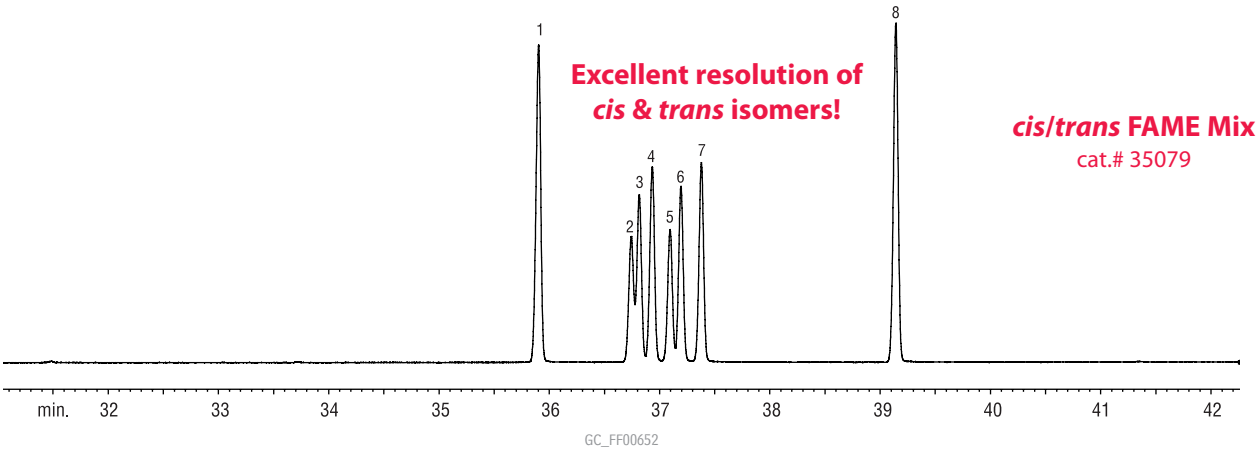
FAMEs (NLEA Mix)
Rt®-2560



Column:	Rt®-2560, 100m, 0.25mm ID, 0.20µm (cat.# 13199)
Sample:	NLEA FAME Mix (cat.# 35078), 30mg/mL total FAMEs in methylene chloride
Inj.:	1.0µL 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)

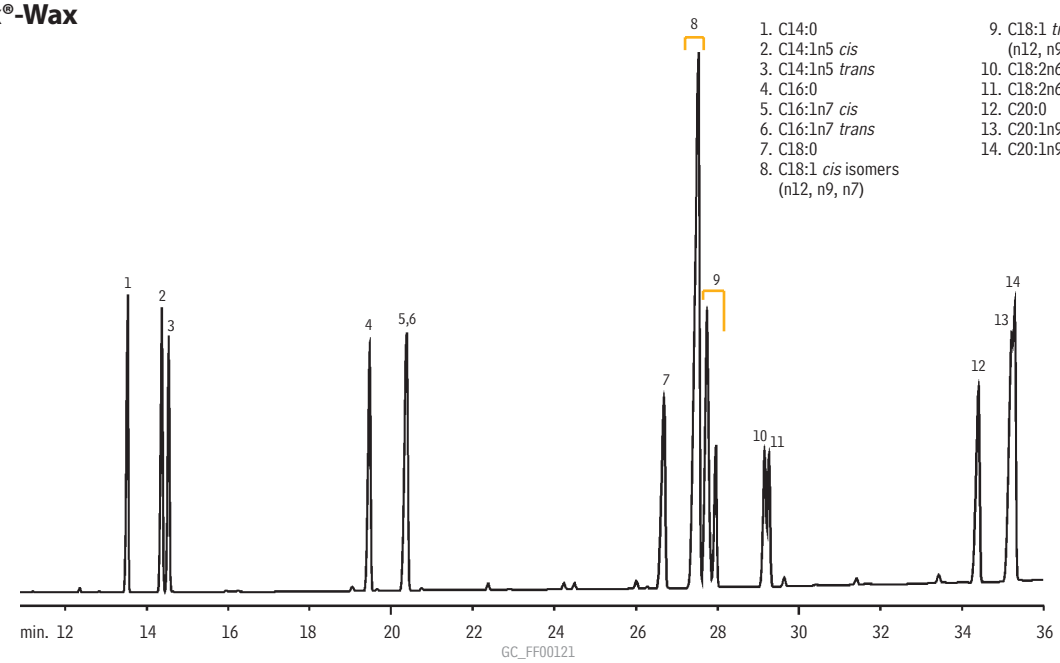
FAMEs (*cis*/*trans* isomers)
Rt®-2560



Column:	Rt®-2560, 100m, 0.25mm ID, 0.2µm (cat.# 13199)
Sample:	*cis*/*trans* FAME Mix (cat.# 35079), 10mg/mL total FAMEs in methylene chloride
Inj.:	1.0µL 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 (*trans*-6)	8.0
3. C18:1 methyl elaidate (*trans*-9)	10.0
4. C18:1 methyl transvaccenate (*trans*-11)	12.0
5. C18:1 methyl petroselinate (*cis*-6)	8.0
6. C18:1 methyl oleate (*cis*-9)	10.0
7. C18:1 methyl vaccenate (*cis*-11)	12.0
8. C18:2 methyl linoleate (*cis*-9,12)	20.0

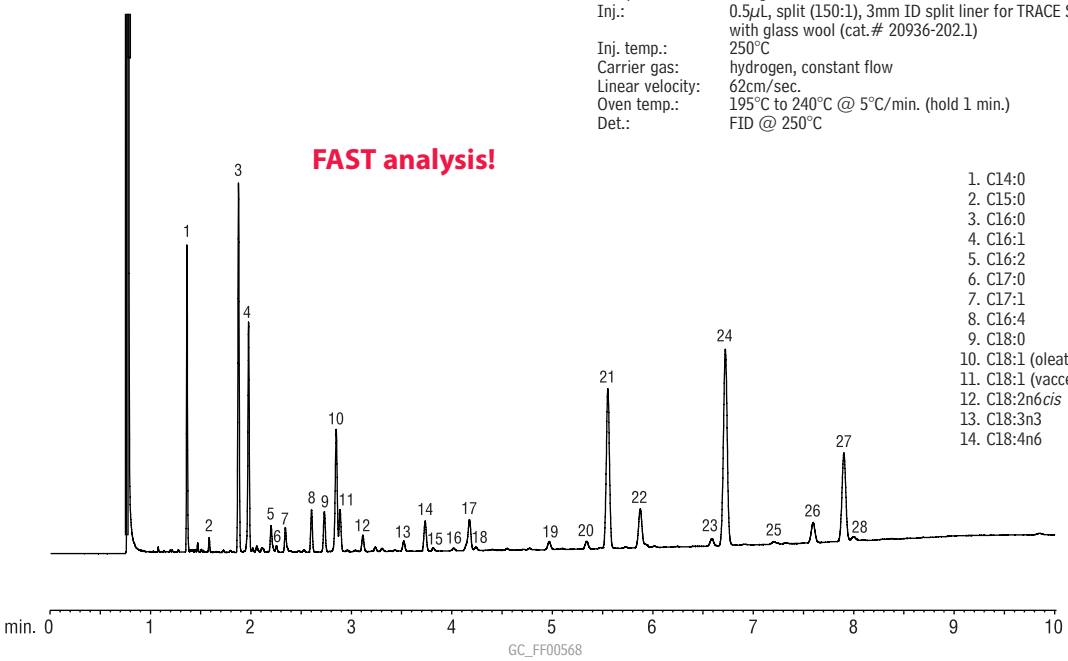
FAMEs (*cis*/*trans* isomers)
Rtx®-Wax



Column:	Rtx®-Wax, 60m, 0.25mm ID, 0.25µm (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 (Marine Oil Standard)
FAMEWAX

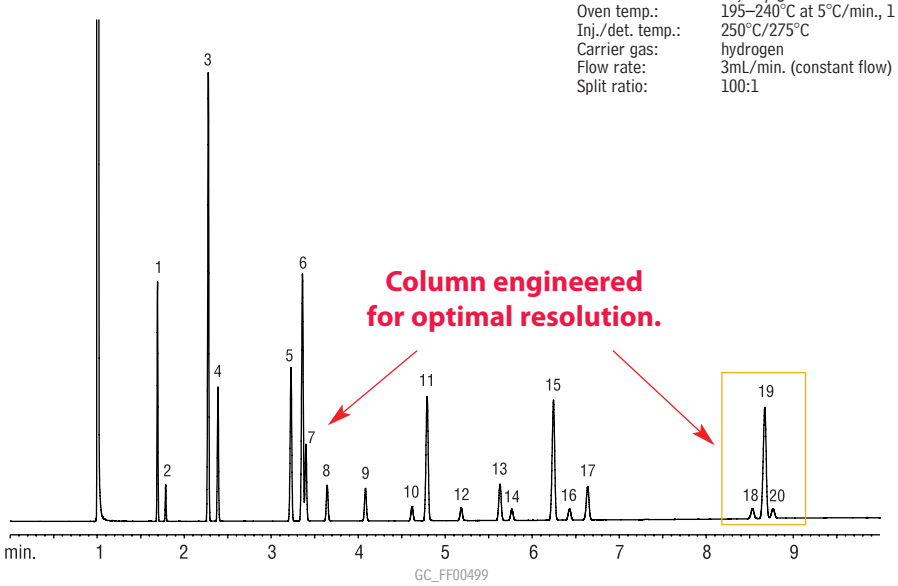
Column:	FAMEWAX, 30m, 0.32mm ID, 0.25µm (cat.# 12498)
Sample:	12mg/mL total FAMEs
Inj.:	0.5µL, split (150:1), 3mm ID split liner for TRACE Series GCs, packed with glass wool (cat.# 20936-202.1)
Inj. temp.:	250°C
Carrier gas:	hydrogen, constant flow
Linear velocity:	62cm/sec.
Oven temp.:	195°C to 240°C @ 5°C/min. (hold 1 min.)
Det.:	FID @ 250°C



1. C14:0
2. C15:0
3. C16:0
4. C16:1
5. C16:2
6. C17:0
7. C17:1
8. C16:4
9. C18:0
10. C18:1 (oleate)
11. C18:1 (vaccenate)
12. C18:2n6*cis*
13. C18:3n3
14. C18:4n6
15. C18:4n3
16. C20:0
17. C20:1n7
18. C20:1n9
19. C20:4n6
20. C20:4n3
21. C20:5n3
22. C22:1n7
23. C21:5n3
24. C23:0 (IS)
25. C22:5n6
26. C22:5n3
27. C22:6n3
28. C24:1

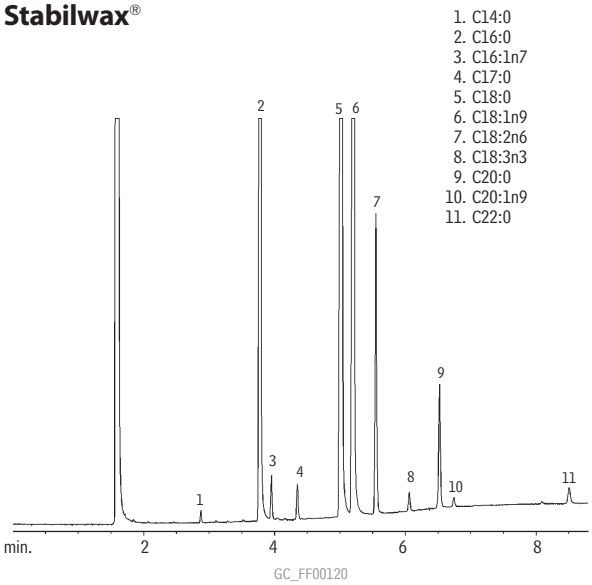
FAMEs (Marine Oil Standard)
FAMEWAX

Column:	FAMEWAX, 30m, 0.32mm ID, 0.25µm (cat.# 12498)
Inj.:	1µL
Conc.:	10,000µg/mL in isooctane (total FAMES; see breakdown in peak list)
Oven temp.:	195–240°C at 5°C/min., 1 min. hold
Inj./det. temp.:	250°C/275°C
Carrier gas:	hydrogen
Flow rate:	3mL/min. (constant flow)
Split ratio:	100:1



Peak List	Conc. (µg/mL)
1. C14:0	600
2. C14:1	100
3. C16:0	1,600
4. C16:1	500
5. C18:0	800
6. C18:1 (oleate)	1,300
7. C18:1 (vaccenate)	400
8. C18:2	200
9. C18:3	200
10. C20:0	100
11. C20:1	900
12. C20:2	100
13. C20:4	300
14. C20:3	100
15. C20:5	1,000
16. C22:0	100
17. C22:1	300
18. C24:0	100
19. C22:6	1,200
20. C24:1	100

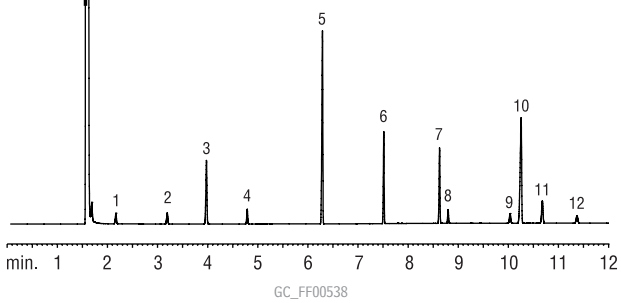
FAMEs (Cocoa Butter)
Stabilwax®



Column:	Stabilwax®, 30m, 0.25mm ID, 0.25µm (cat.# 10623)
Sample:	1.0µL split injection of a FAME reference standard for cocoa butter.
Oven temp.:	200°C to 250°C @ 8°C/min. (hold 3 min.)
Inj./det. temp.:	250°C
Carrier gas:	hydrogen
Linear velocity:	31.4cm/sec. set @ 200°C
FID sensitivity:	8 x 10^{-11} AFS
Split ratio:	45:1

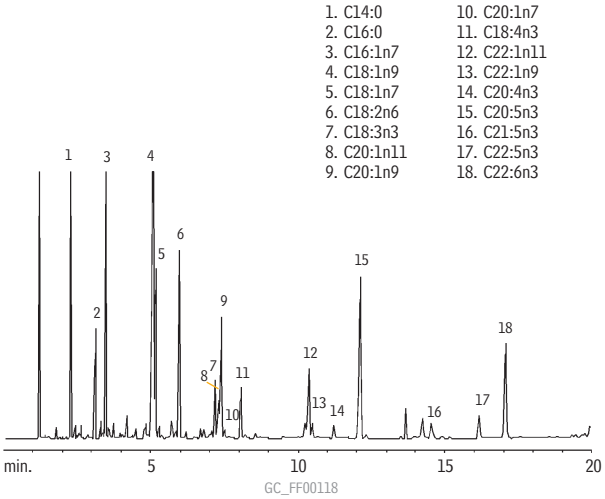
FAMEs (Saw Palmetto)
Rtx®-Wax

Peak List	Conc. (mg/mL)
1. methyl caproate (C6:0)	0.4
2. methyl caprylate (C8:0)	0.4
3. methyl nonanoate (C9:0)	2.0
4. methyl caprate (C10:0)	0.4
5. methyl laurate (C12:0)	5.0
6. methyl myristate (C14:0)	2.0
7. methyl palmitate (C16:0)	2.0
8. methyl palmitoleate (C16:1)	0.4
9. methyl stearate (C18:0)	0.4
10. methyl oleate (C18:1)	5.0
11. methyl linoleate (C18:2)	1.0
12. methyl linolenate (C18:3)	0.4



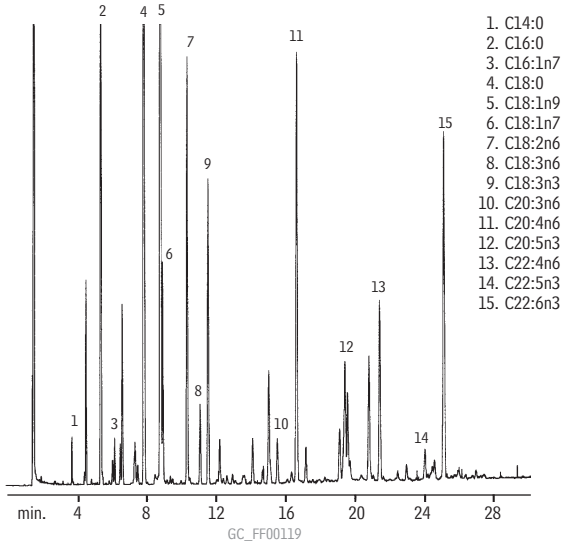
Column:	Rtx®-Wax, 30m, 0.25mm, 0.25µm (cat.# 12423)
Sample:	1µL split injection of saw palmetto standard
Conc.:	see peak list
Oven temp.:	120°C (hold 3 min.) to 220°C at 20°C/min. (hold 12 min.)
Inj./det. temp.:	250°C/300°C
Carrier gas:	helium
Linear velocity:	1mL/min. (34 cm/sec.)
Split ratio:	100:1

FAMEs (PUFA, marine source)
Rt®-2330



Column:	Rt®-2330, 30m, 0.25mm ID, 0.20µm (cat.# 10723)
Sample:	0.5µL 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 10^{-11} AFS
Split ratio:	35:1

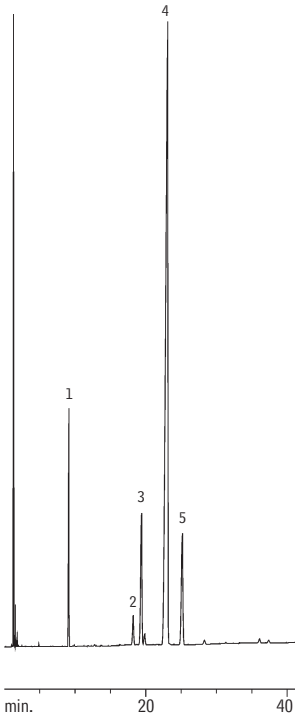
FAMEs (PUFA, animal source)
Rt®-2330



Column:	Rt®-2330, 30m, 0.32mm ID, 0.20µm (cat.# 10724)
Sample:	0.1µL split injection of PUFA 2 mix
Oven temp.:	160°C to 250°C @ 2°C/min. (hold 10 min.)
Inj./det. temp.:	260°C
Carrier gas:	hydrogen
Linear velocity:	40cm/sec.
FID sensitivity:	8 x 10^{-11} AFS
Split ratio:	20:1

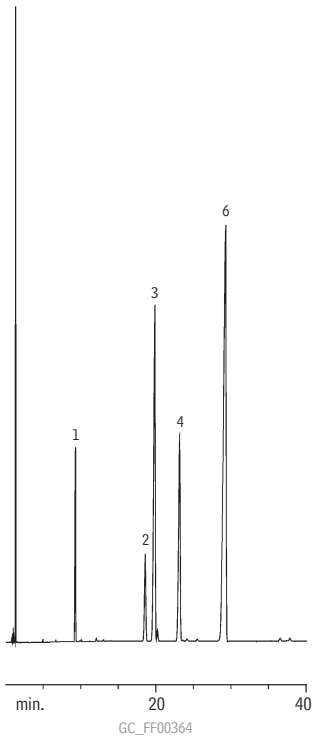
FAMEs (Evening Primrose Oil)
FAMEWAX

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



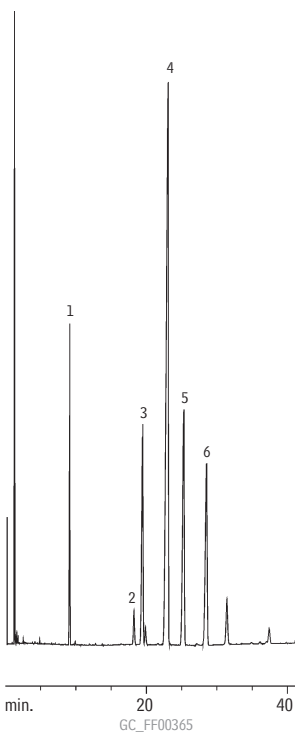
FAMEs (Flax Seed Oil)
FAMEWAX

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



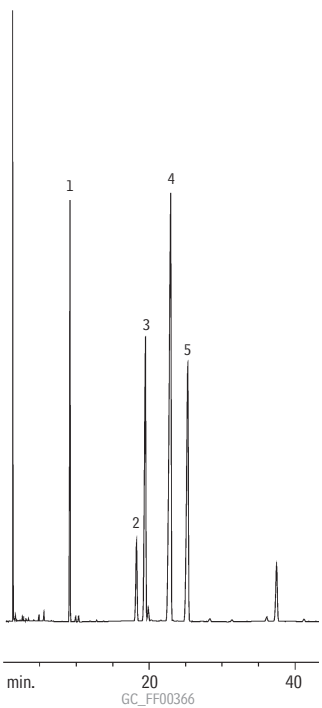
FAMEs (Black Currant Seed Oil)
FAMEWAX

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



FAMEs (Borage Seed Oil)
FAMEWAX

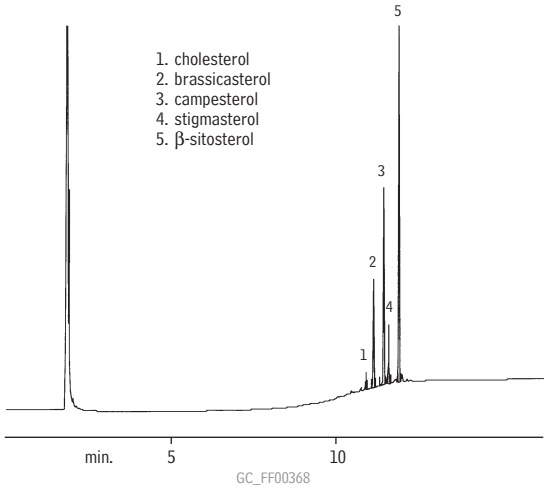
1. C16:0
2. C18:0
3. C18:1n9
4. C18:2n6
5. C18:3n6



Column and conditions for all four oils analyses:

Column:	FAMEWAX, 30m, 0.25mm ID, 0.25μm (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.

Phytosterols (Saw Palmetto)
Rtx®-5

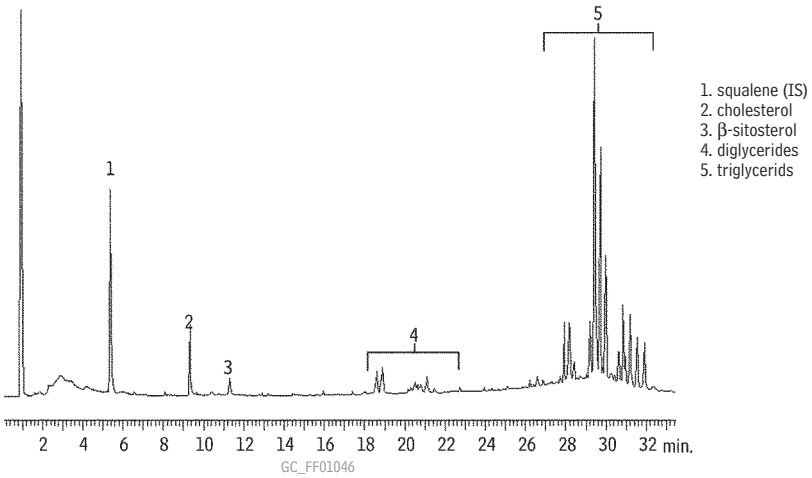


Column:	Rtx®-5, 60m, 0.25mm ID, 0.25µm (cat.# 10226)
Inj.:	1µL splitless injection*
Oven temp.:	200°C (hold 1 min.) to 340°C @ 15°C/min. (hold 10 min.)
Inj./FID temp.:	345°C/355°C

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

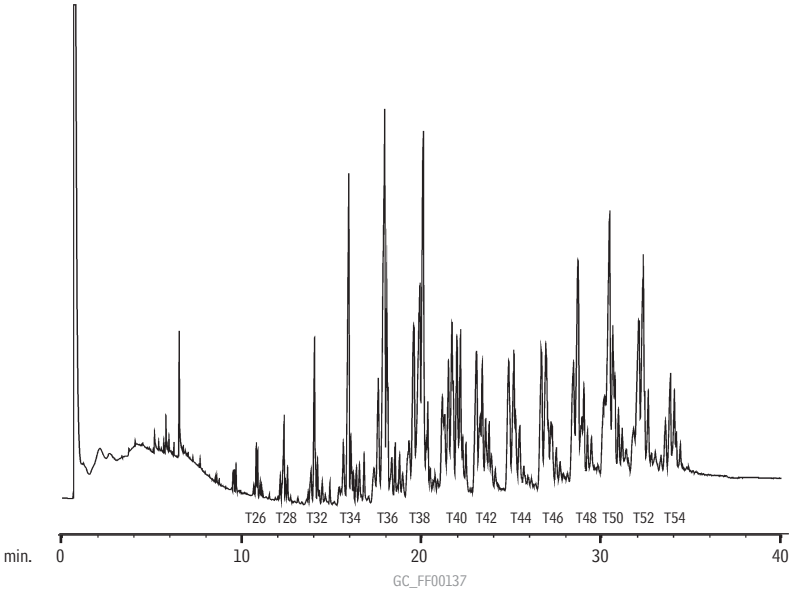
Chromatogram provided by the Institute for Nutraceutical Advancement (INA)

Egg Pasta: Sterols & Glycerides
Rtx®-65TG



Column:	Rtx®-65TG, 30m, 0.25mm ID, 0.10µm (cat.# 17008)
Sample:	50µg/mL fat extract from egg pasta in diethyl ether solution with 3,000ppm squalene (IS)
Inj.:	0.5µL, split (1:80), 70°C (hold 12 sec.) at 99°C up to 370°C (hold 5 min.)
Carrier gas:	hydrogen
Flow rate:	1.5mL/min.
Oven temp.:	220°C (hold 2.0 min.) to 360°C @ 5°C/min. (hold 5 min.)
Det:	FID @ 370°C

Triglycerides (Butter)
Rtx®-65TG



Column:	Rtx®-65TG, 30m, 0.25mm ID, 0.10µm (cat.# 17008)
Sample:	0.2µL cold on-column injection of 1% butterfat in isooctane
Oven temp.:	80°C (hold 1 min.) to 240°C @ 30°C/min. to 360°C @ 4°C/min. (hold 5 min.)
Det. temp.:	380°C
Carrier gas:	hydrogen
Linear velocity:	70cm/sec.
FID sensitivity:	16 x 10^{-11} AFS
SPI injector:	high performance capillary insert 60°C, 300°C/min. to 400°C (hold 5 min.)


Al Carusone, Technical Service

Technical Service

Do you have a technical question? Restek's Technical Service group has answers! Drawing from our extensive libraries of technical information and many years of collective chromatography experience, the experts in Technical Service can help you from set-up to method development.

Contact us:

For quick answers to commonly asked questions any time of the day, visit **www.restek.com/answers** or contact us directly:

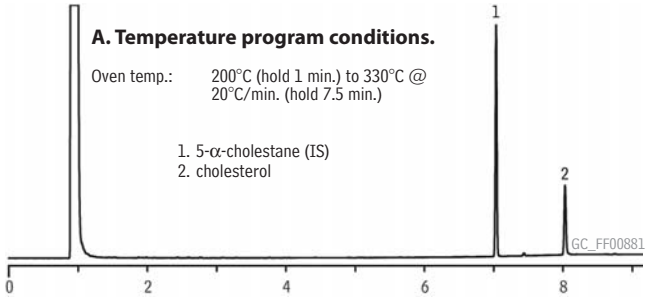
In the U.S.

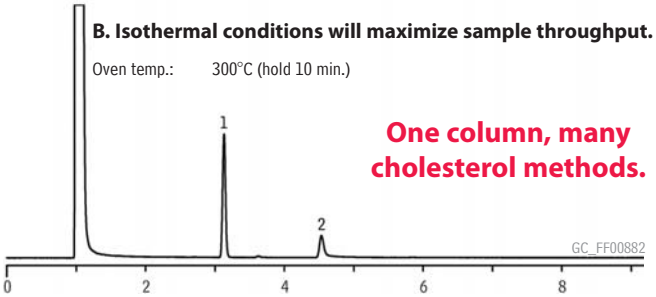
Phone: 1-800-356-1688, ext. 4
Fax: 814-353-1568
e-mail: support@restek.com

Outside the U.S.

Contact your Restek representative.

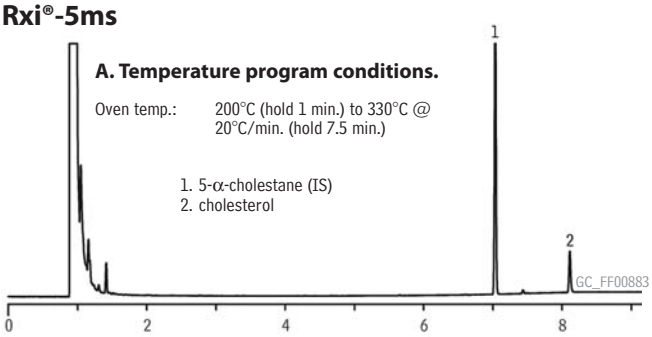
Underivatized Cholesterol
Rxi®-5ms

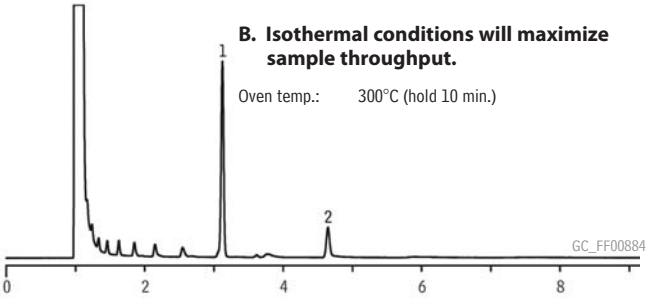




Column: Rxi®-5ms, 15m, 0.25mm ID, 0.25μm (cat.# 13420)
Sample: 1,000μg/mL cholesterol in DMF, 1000μg/mL 5-α-cholestane in hexane; 25ng cholesterol, 150ng 5-α-cholestane on column
Inj.: 1.0μL, split (20:1), single gooseneck inlet liner w/wool (cat.# 22405)
Inj. temp.: 250°C
Carrier gas: helium, constant pressure (9.7psi @ 200°C)
Linear velocity: 24cm/sec.
Oven temp.: see above
Det.: FID @ 340°C

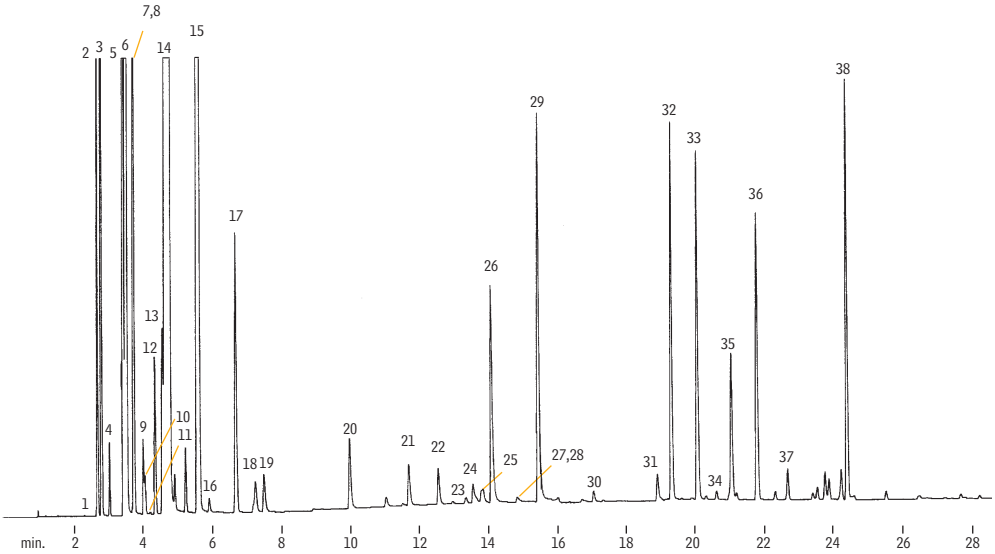
Derivatized Cholesterol
Rxi®-5ms





Column: Rxi®-5ms, 15m, 0.25mm ID, 0.25μm (cat.# 13420)
Sample: 1,000μg/mL cholesterol in hexane, 1000μg/mL 5-α-cholestane in hexane; 50ng derivatized cholesterol, 150ng 5-α-cholestane on column
Inj.: 1.0μL, 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

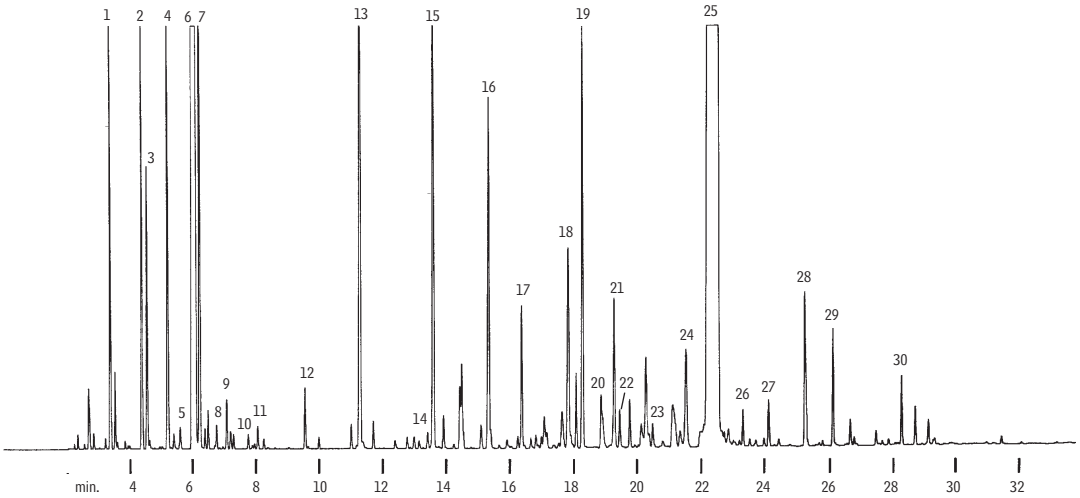
Lemon Oil
Rtx®-5



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. *p*-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

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 x 10^{-11} AFS
Split ratio: 100:1

Spearmint Oil (Native)
Stabilwax®

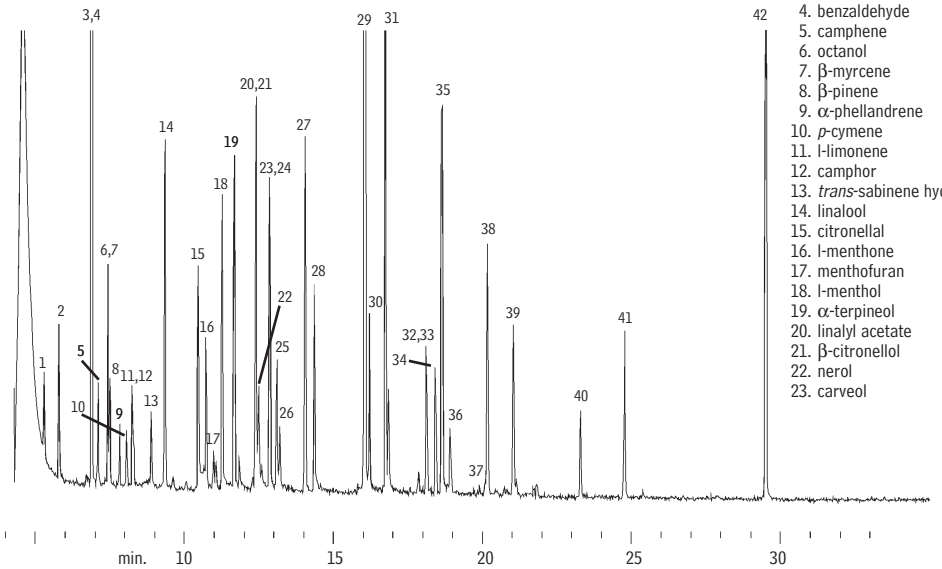


GC_FF00140

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 x 10^{-11} AFS
Split ratio:	100:1

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

Synthetic Essential Oil Mixture
Rtx®-1

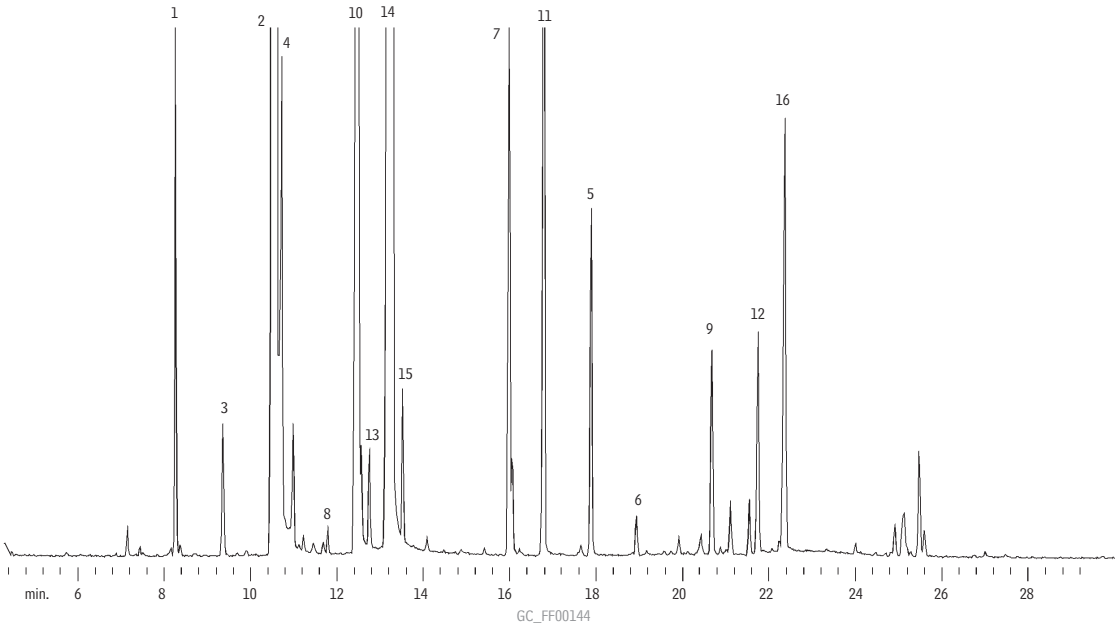


GC_FF00534

1. ethyl butyrate
2. *trans*-2-hexenol
3. α-pinene
4. benzaldehyde
5. camphene
6. octanol
7. β-myrcene
8. β-pinene
9. α-phellandrene
10. *p*-cymene
11. l-limonene
12. camphor
13. *trans*-sabinene hydrate
14. linalool
15. citronellal
16. l-menthone
17. menthofuran
18. l-menthol
19. α-terpineol
20. linalyl acetate
21. β-citronellol
22. nerol
23. carveol
24. anisaldehyde
25. carvone
26. geraniol
27. anethole
28. cinnamic alcohol
29. eugenol
30. neryl acetate
31. geranyl acetate
32. vanillin
33. coumarin
34. α-ionone
35. ethyl vanillin
36. β-caryophyllene
37. α-caryophyllene
38. β-ionone
39. valencene
40. ethyl laurate
41. amyl cinnamic aldehyde
42. nootketone

Column:	Rtx®-1, 60m, 0.25mm ID, 0.25µm (cat.# 10126)
Sample:	1.0µL 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 10^{-11} AFS
Split vent:	100cc/min.

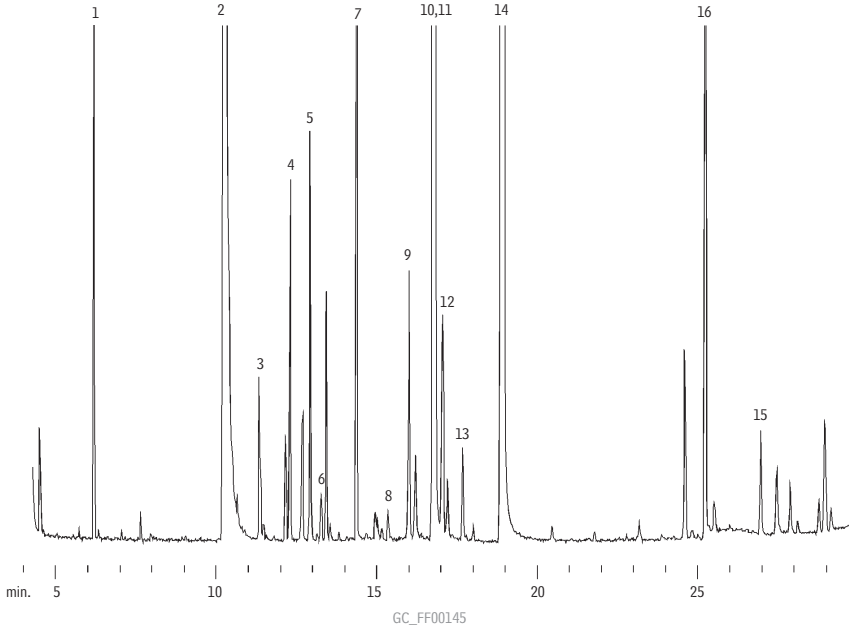
Citronella Java Oil
Rtx®-1



Column:	Rtx®-1, 60m, 0.25mm ID, 0.25µm (cat.# 10126)
Sample:	1.0µL 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.

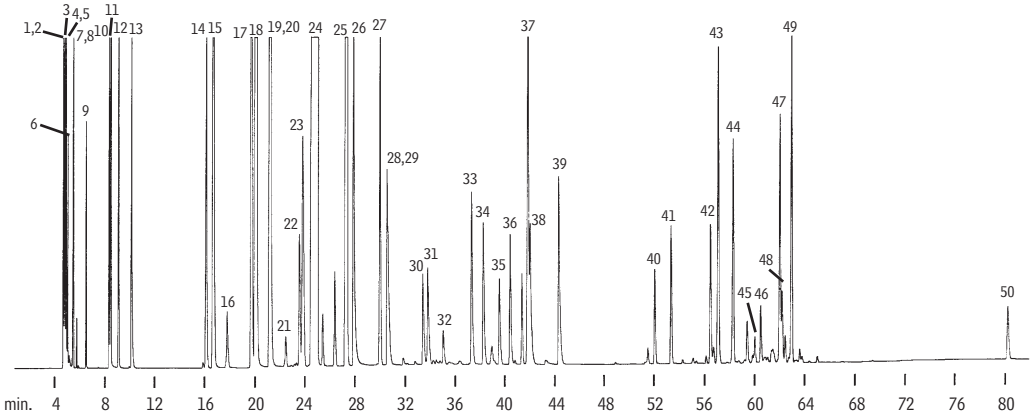
1. limonene
2. citronellal
3. linalool
4. borneol
5. γ-elemene
6. β-caryophyllene
7. neryl acetate
8. α-terpineol
9. germancrene-Δ
10. β-citronellol
11. geranyl acetate
12. δ-cadenene
13. nerol
14. geraniol
15. eugenol
16. α-bergamotene

Citronella Java Oil
Stabilwax®



Column:	Stabilwax®, 60m, 0.25mm ID, 0.25µm (cat.# 10626)
Sample:	1.0µL 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.

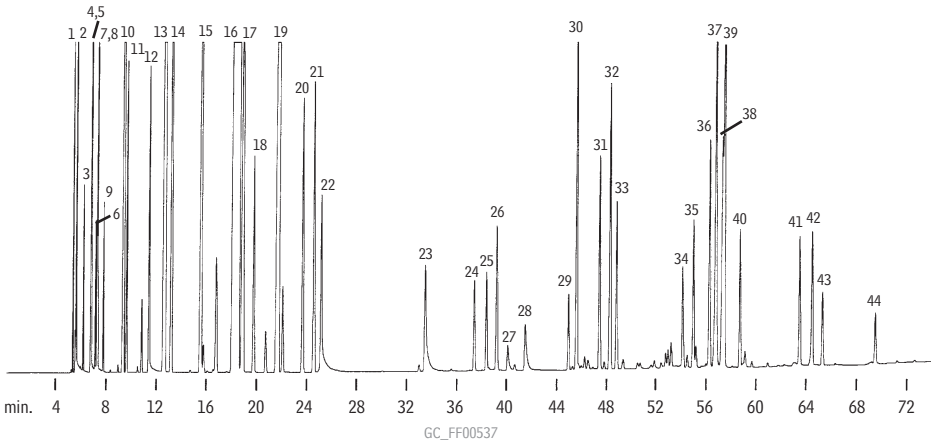
Flavor Volatiles
Rtx®-1



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

Column:	Rtx®-1, 60m, 0.53mm ID, 0.50μm (cat.# 10143)
Sample:	0.8μL 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 10^{-11} AFS
Split ratio:	20:1

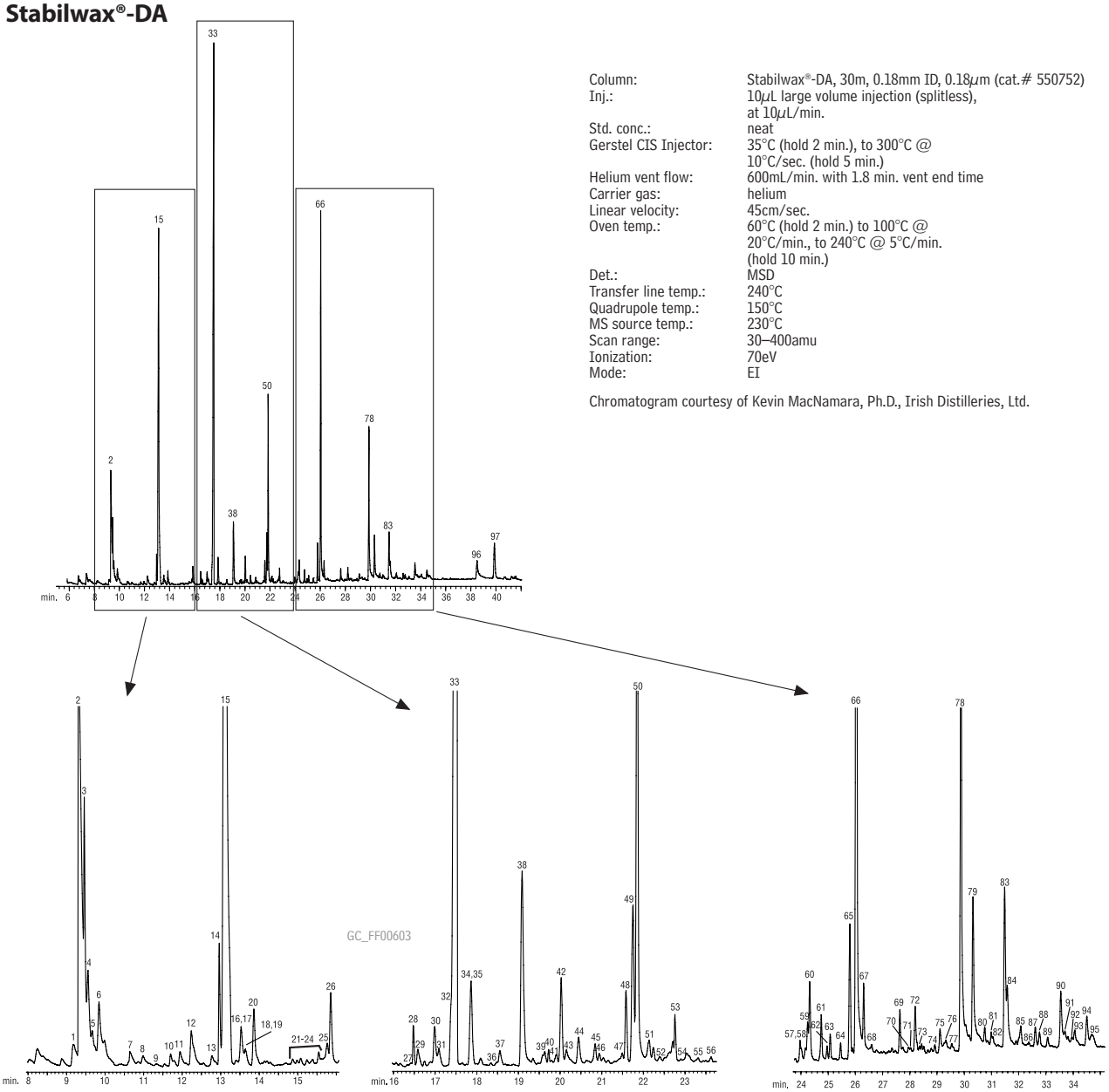
Flavor Volatiles
Stabilwax®



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

Column:	Stabilwax®, 60m, 053mm ID, 0.50μm (cat.# 10643)
Sample:	0.8μL 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 10^{-11} AFS
Split ratio:	20:1

Malt Whiskey
Stabilwax®-DA



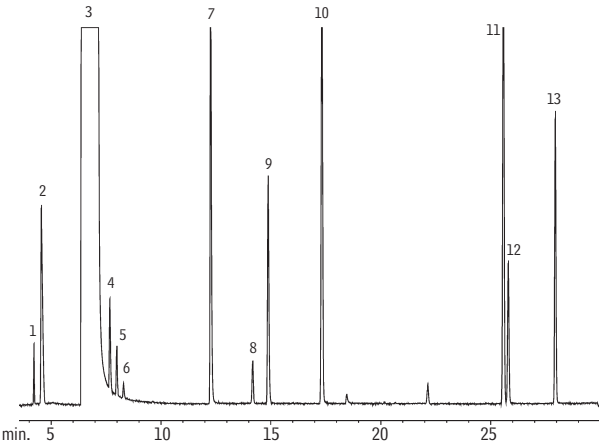
Column:	Stabilwax®-DA, 30m, 0.18mm ID, 0.18μm (cat.# 550752)
Inj.:	10μL large volume injection (splitless), at 10μL/min.
Std. conc.:	neat
Gerstel CIS Injector:	35°C (hold 2 min.), to 300°C @ 10°C/sec. (hold 5 min.)
Helium vent flow:	600mL/min. with 1.8 min. vent end time
Carrier gas:	helium
Linear velocity:	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
2. acetic acid
3. siloxane
4. 1-hydroxy-2,3-butadione
5. 1-hydroxy-2-propanone acetate
6. furfural
7. formic acid
8. propionic acid
9. isobutyric acid
10. dimethyl sulfoxide
11. 5-methyl furfural
12. methyl decanoate + unknown
13. butyric acid
14. siloxane
15. ethyl decanoate
16. furfuryl alcohol
17. isoamyl octanoate
18. isovaleric acid
19. 2-methylbutyric acid
20. diethyl succinate
21. 3-methyl-2(5H)-furanone (possible)
22. valeric acid
23. ethyl undecanoate
24. isobutyl decanoate
25. 2(5H)-furanone
26. unknown
27. di(ethyleneglycol) butyl ether
28. siloxane
29. methyl dodecanoate
30. 2-phenylethyl acetate
31. methylcyclopentenolone
32. hexanoic acid
33. ethyl dodecanoate
34. isoamyl decanoate
35. guaiacol
36. dodecyl acetate (possible)
37. whiskey lactone (1)
38. 2-phenylethanol
39. heptanoic acid
40. siloxane
41. dimethoxybenzene or 4-methyl-guaiacol
42. whiskey lactone (2)
43. dodecanol
44. unknown
45. phenol
46. methyl tetradecanoate
47. nerolidol
48. diethyl malate
49. ethyl tetradecanoate
50. octanoic acid
51. unknown
52. *p*-cresol
53. siloxane
54. diethyl octanedioate
55. monomethyl succinate (possible)
56. 3,5-dimethyl-2,4(5H)furandione
57. nonanoic acid
58. diethyl 2-hydroxyglutarate
59 unknown
60. tetradecanol
61. 4-vinylguaiacol
62. diethyl nonanedioate
63. methyl hexadecanoate
64. ethyl γ-lactone 2-hydroxyglutarate
65. ethyl hexadecanoate
66. decanoic acid
67. ethyl 9-hexadecanoate
68. triacosan
69. unknown
70. phthalide
71. diethyl phthalate
72. hexadecanol
73. 4-hydroxycinnamic acid (decomp.)
74. methyl stearate
75. benzoic acid
76. methyl 8-octadecenoate
77. ethyl stearate
78. dodecanoic acid
79. hydroxymethylfurfural
80. ethyl linoleate
81. 4-allyl-2,6-dimethoxyphenol
82. diisobutyl phthalate
83. vanillin
84. sinapic acid (decomp.)
85. 2-phenylethyl decanoate
+2 unknowns
86. 4-propenyl-2,6-dimethoxyphenol
87. ethyl vanillate
88. acetovanillone
89. vanillin methyl ketone
90. tetradecanoic acid
91. ethyl homovanillate
92. propiovanillone
93. fatty acid ester
94. (similar to 4-allyl-2,6-dimethoxyphenol)
95. unknown
96. hexadecanoic acid
97. syringaldehyde

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



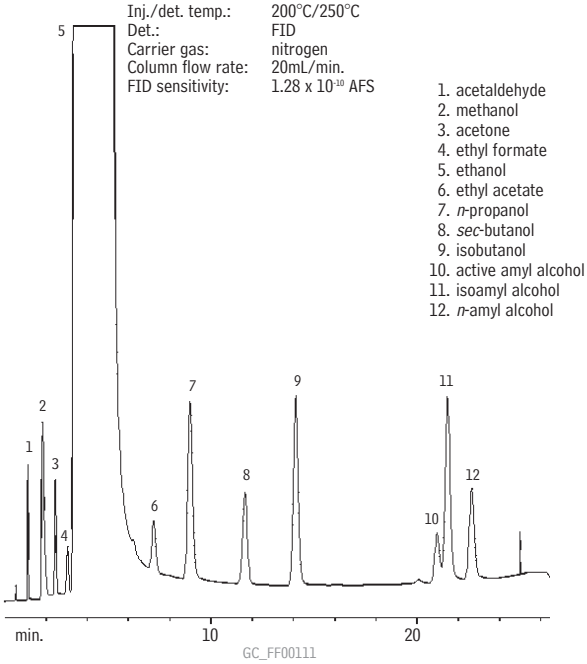
GC_FF00110

Column:	Rtx®-1301, 60m, 0.25mm ID, 1.4µm (cat.# 16016)
Inj.:	1.0µL 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, 1/8" OD, 2mm ID SilcoSmooth® tubing (cat.# 80105)
Inj.:	0.5µL 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

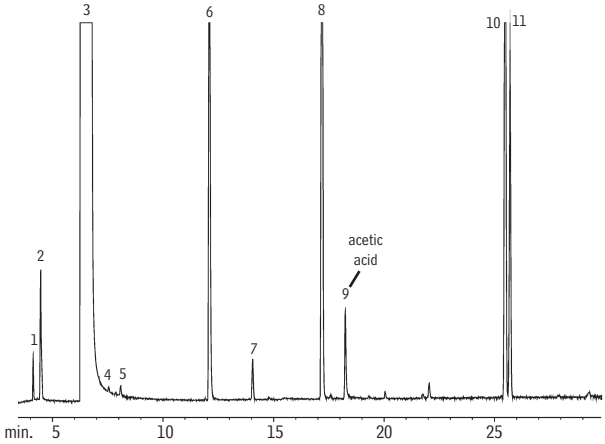
1. acetaldehyde
2. methanol
3. acetone
4. ethyl formate
5. ethanol
6. ethyl acetate
7. *n*-propanol
8. *sec*-butanol
9. isobutanol
10. active amyl alcohol
11. isoamyl alcohol
12. *n*-amyl alcohol



GC_FF00111

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

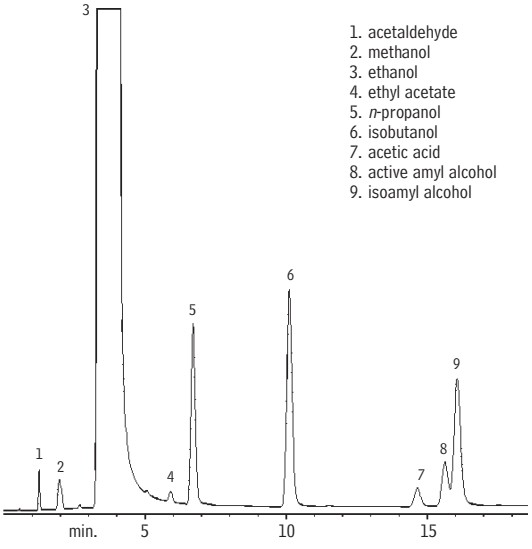


GC_FF00112

Column:	Rtx®-1301, 60m, 0.25mm ID, 1.4µm (cat.# 16016)
Inj.:	1.0µL 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

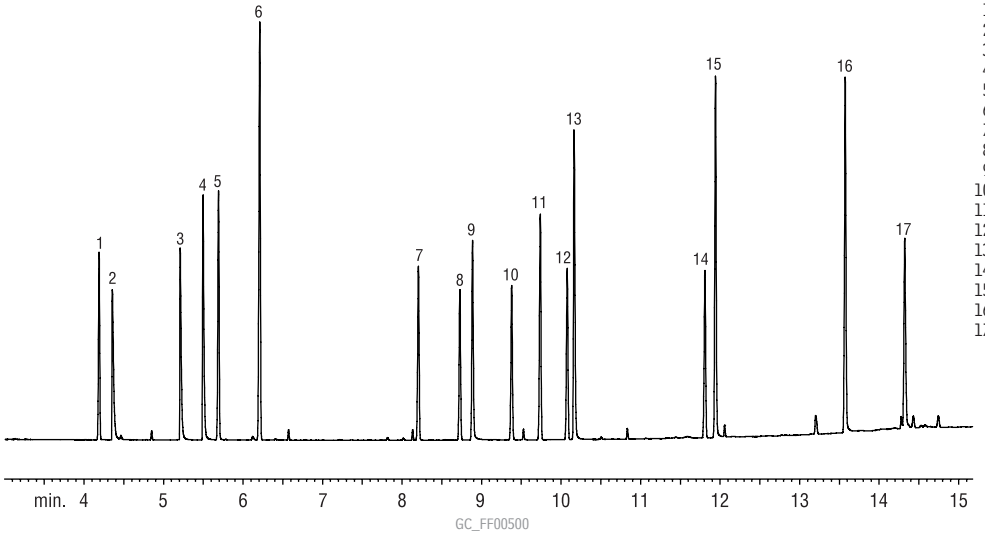
1. acetaldehyde
2. methanol
3. ethanol
4. ethyl acetate
5. *n*-propanol
6. isobutanol
7. acetic acid
8. active amyl alcohol
9. isoamyl alcohol



GC_FF00113

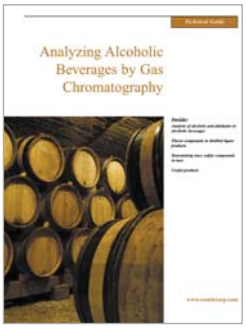
Column:	5% Carbowax® 20M 80/120 CarboBlack B, 2m, 1/8" OD, 2mm ID SilcoSmooth® tubing (cat.# 80105)
Inj.:	0.5µL on-column injection, neat
Oven temp.:	70°C to 150°C @ 4°C/min.
Inj./det. temp.:	200°C/250°C
Det.:	FID
Carrier gas:	nitrogen
Column flow rate:	20mL/min.
FID sensitivity:	1.28 x 10^{-10} AFS

Alcoholic Beverage Standard: Acids and Esters
Stabilwax®-DA



Peak List	Conc. (ppm)
1. ethyl octanoate	100
2. acetic acid	100
3. propionic acid	100
4. isobutyric acid	100
5. 3-decanol	50
6. ethyl decanoate	50
7. ethyl laurate	50
8. *cis*-lactone	100
9. 2-phenylethanol	50
10. *trans*-lactone	100
11. methyl myristate	50
12. ethyl myristate	50
13. octanoic acid	100
14. ethyl palmitate	50
15. decanoic acid	100
16. dodecanoic acid	100
17. vanillin	100

Column:	Stabilwax®-DA, 30m, 0.18mm ID, 0.18µm (cat.# 550752)
Inj.:	1µL splitless (hold 0.5 min.) at conc. shown in peak list, in ethyl acetate, 4mm ID splitless liner w/wool (cat.# 20814-202.1)
Inj. temp.:	240°C
Carrier gas:	hydrogen
Make-up gas:	nitrogen
Linear velocity:	28psi @ 240°C
Oven temp.:	70°C to 240°C at 12°C/min. (hold 3 min.)
Det.:	FID



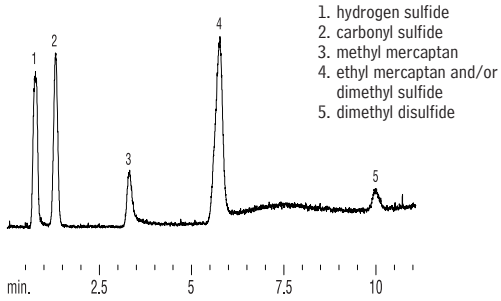
free literature

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

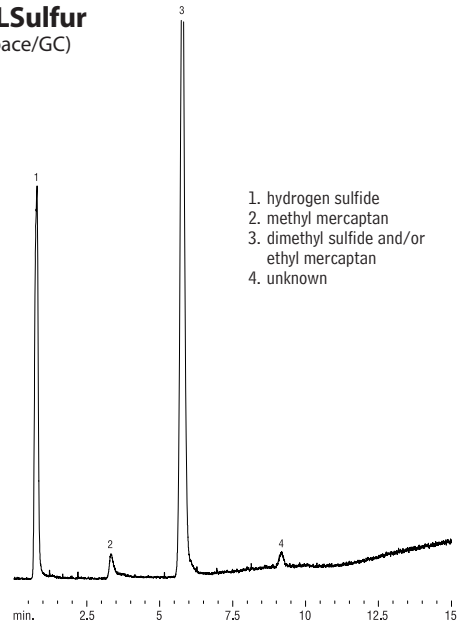
Sulfur Compounds in Beverage Grade CO_2
Rt®-XLSulfur



GC_FF00491

Column:	Rt®-XLSulfur, 100/120 mesh, 1m, 0.75mm ID Sulfinert® tubing (cat.# 19806)
Conc.:	sulfur standard @ 20ppb each in CO_2
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

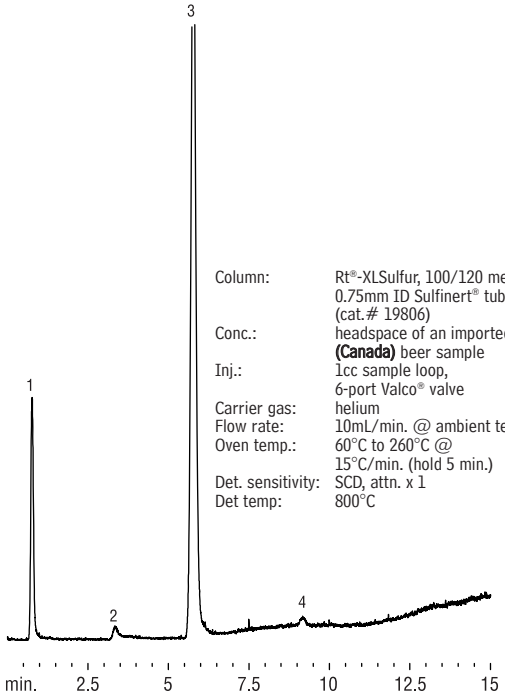
Sulfur Compounds in Beer
Rt®-XLSulfur
(Headspace/GC)



GC_FF00494

Column:	Rt®-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

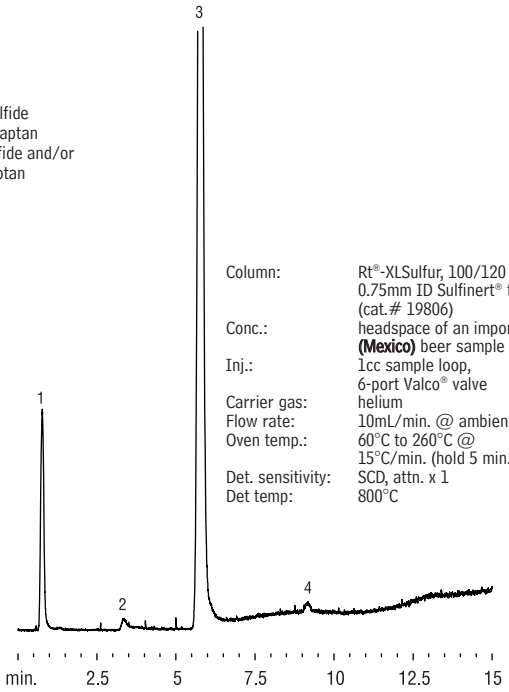
Sulfur Compounds in Beer
Rt®-XLSulfur
(Headspace/GC)



Column:	Rt®-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

GC_FF00487

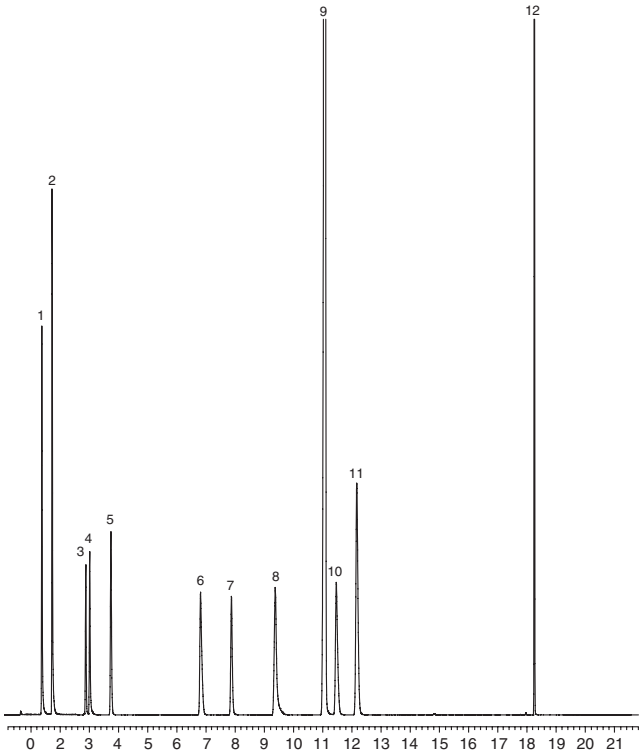
Sulfur Compounds in Beer
Rt®-XLSulfur
(Headspace/GC)



Column:	Rt®-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

GC_FF00483

Food Packaging Volatiles
Rtx®-5MS



GC_FF00457

Volatiles Standard

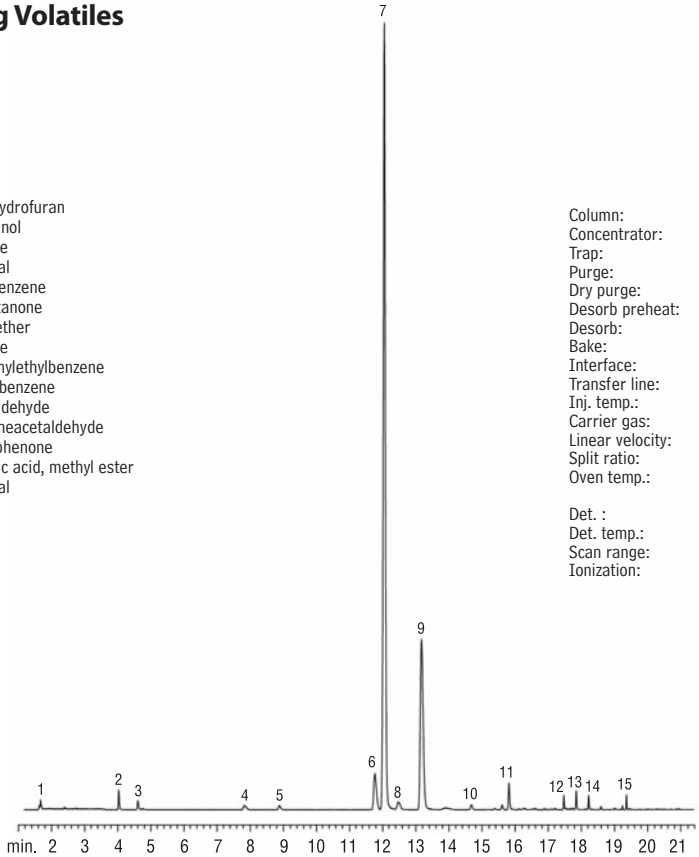
1. isopropanol
2. methylene chloride
3. 2-methyl-1-propanol
4. tetrahydrofuran
5. benzene
6. toluene
7. hexanal
8. furfural
9. 4-heptanone (IS)
10. butyl ether
11. styrene
12. dodecane

Column:	Rtx®-5MS, 30m, 0.25mm ID, 1µm (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, 1µm (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

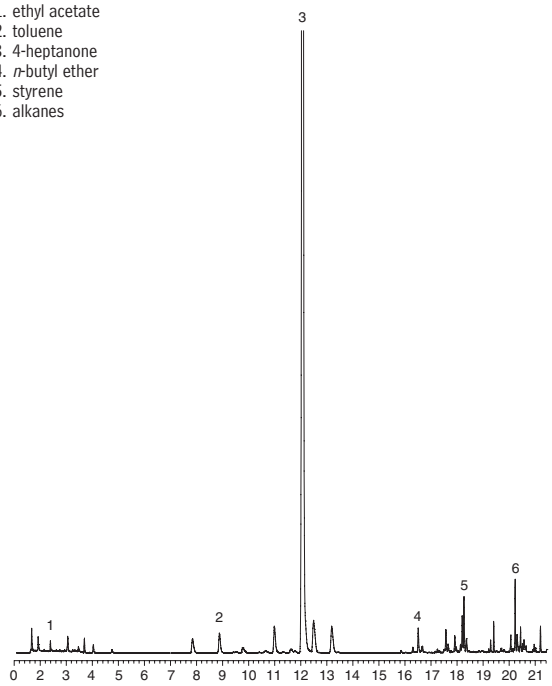


GC_FF00459

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



GC_FF00462

Column:	Rtx®-5MS, 30m, 0.25mm ID, 1µm (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:	

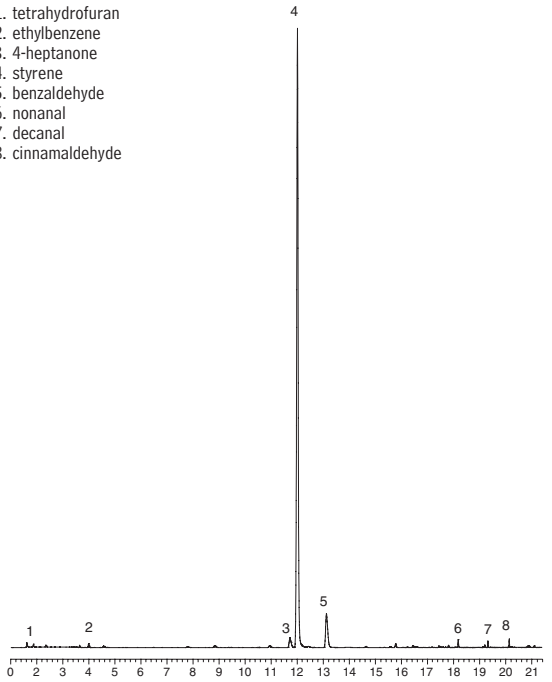
Sample Conditions:

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.# 22501)

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



GC_FF00461

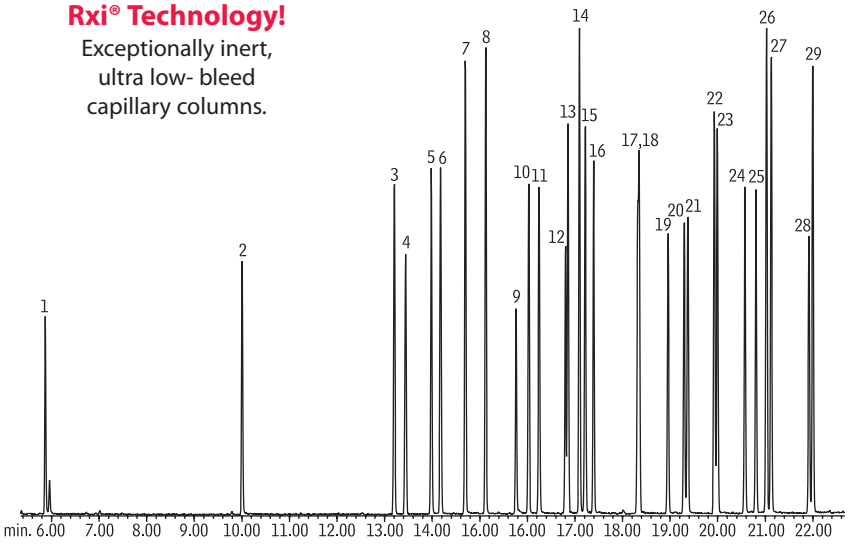
Column:	Rtx®-5MS, 30m, 0.25mm ID, 1µm (cat.# 12653)
GC:	Agilent 6890
Oven temp.:	50°C to 92°C @ 3°C/min., to 220°C @ 20°C/min. (hold 1 min.)
Inj. temp.:	250°C
Carrier gas:	helium
Linear velocity:	36cm/sec. (1mL/min.)
Det. sensitivity:	NA
Split ratio:	20:1
Det.:	MSD (Agilent 5973)
Det. temp.:	280°C
Scan 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.# 22501)

Organochlorine and Organophosphorus Pesticides
FAPAS® Proficiency Testing
Rxi®-5ms

Rxi® Technology!
Exceptionally inert, ultra low- bleed capillary columns.



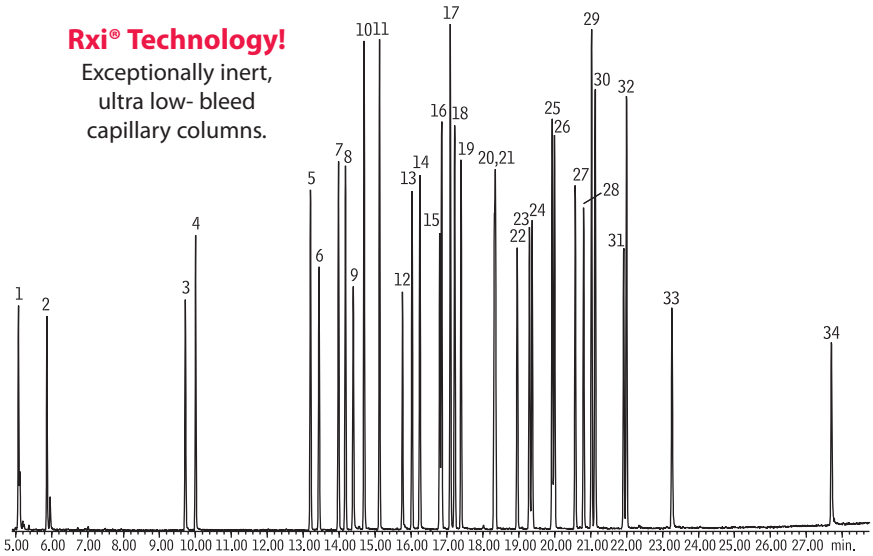
GC_FF00826

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. dieldrin
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, 0.25μm (cat.# 13423)
Sample:	FAPAS Series 5 OC Pesticide Mix 1 (cat.# 32412), FAPAS Series 9 OP Pesticide Mix 1 (cat.# 32413)
Inj.:	1.0μL, 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!
Exceptionally inert, ultra low- bleed capillary columns.



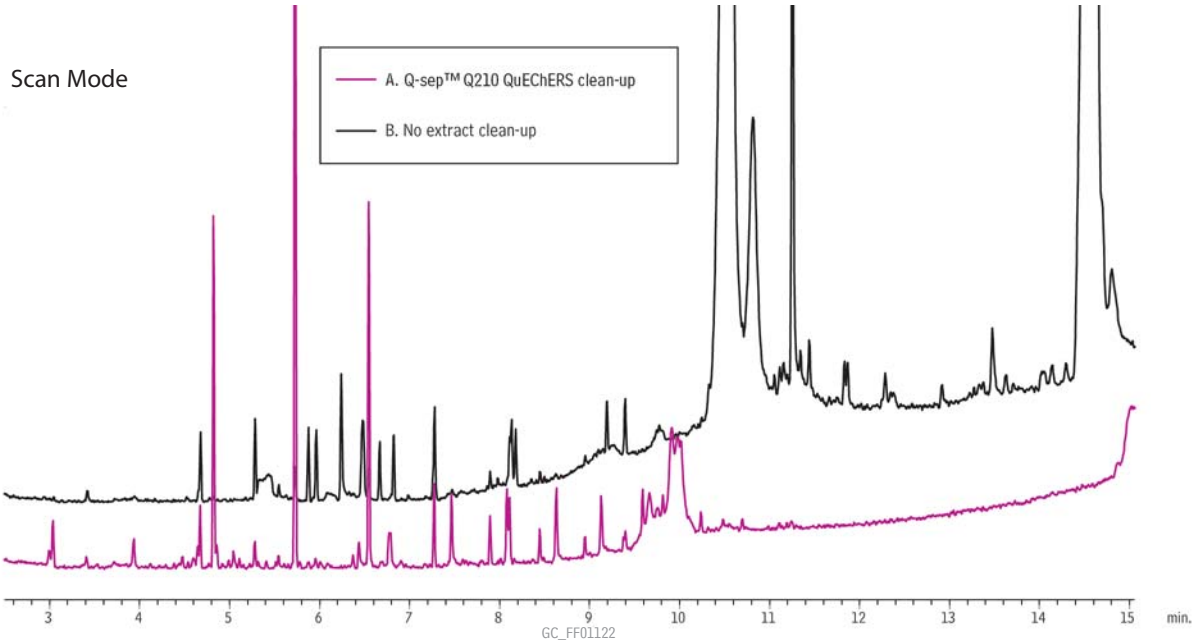
GC_FF00827

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. dieldrin
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, 0.25μm (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.:	1.0μL, 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

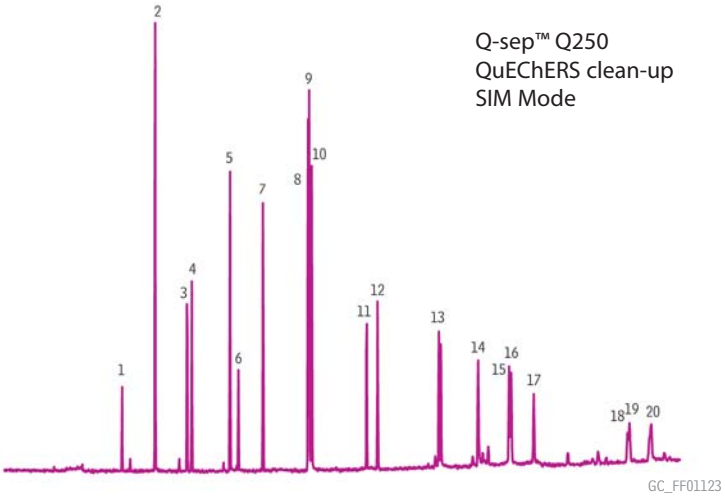
Polycyclic Aromatic Hydrocarbons in Infant Formula with and without QuEChERS dSPE Clean-up Rxi®-5Sil MS

NEW!



Compound list and ions monitored (SIM mode)

Compound	m/z
1. decafluorobiphenyl (SS)	265
2. naphthalene	128
3. 2-methylnaphthalene	142
4. 1-methylnaphthalene	142
5. acenaphthylene	152
6. acenaphthene	152
7. fluorine	166
8. phenanthrene-d10 (IS)	188
9. phenanthrene	178
10. anthracene	178
11. fluoranthene	202
12. pyrene	202
13. benzo(a)anthracene	228
14. chrysene	228
15. benzo(b)fluoranthene	252
16. benzo(k)fluoranthene	252
17. benzo(a)pyrene	252
18. indeno(1,2,3-cd)pyrene	276
19. dibenzo(a,h)anthracene	278
20. benzo(ghi)perylene	276

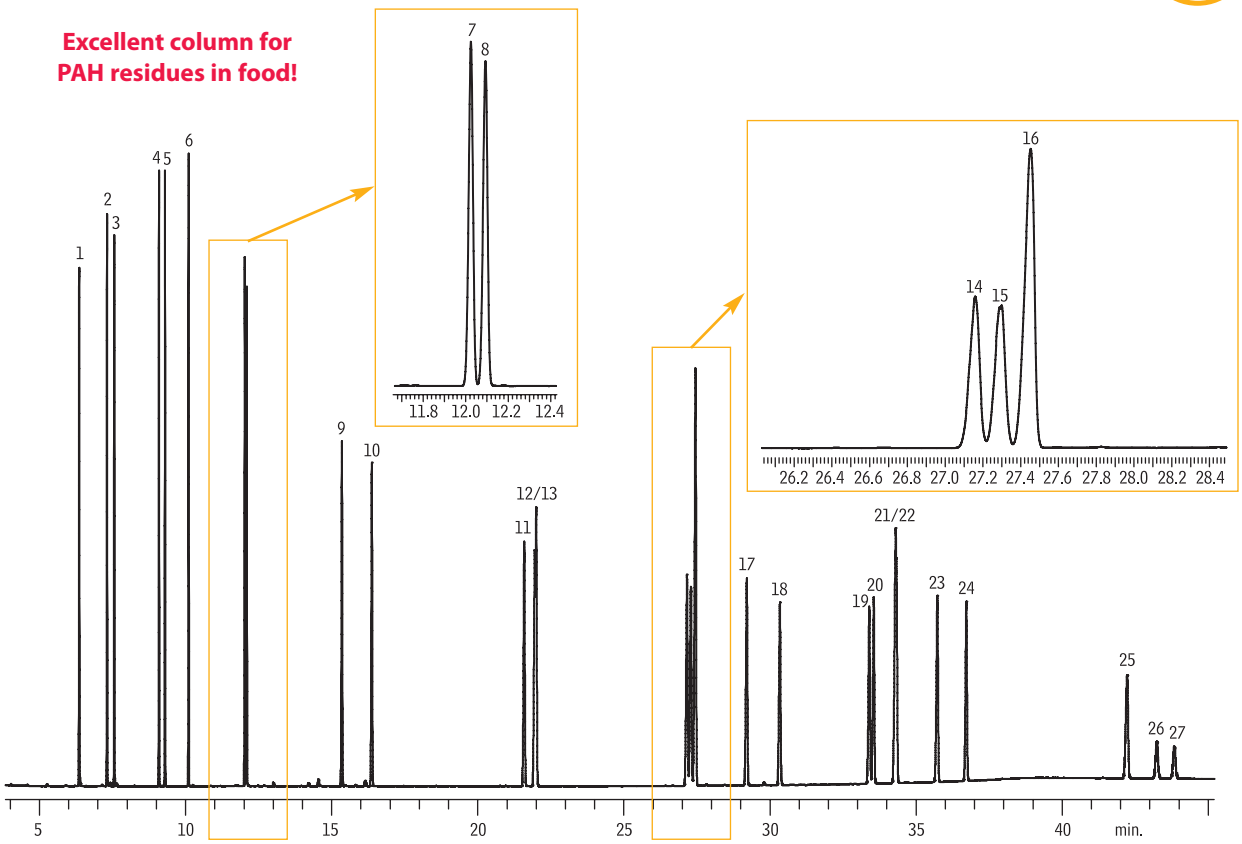


Column:	Rxi®-5Sil MS, 30m, 0.25mm ID, 0.25µm (cat.# 13623)
Sample:	liquid infant formula spiked at 1µg/mL with decafluorobiphenyl (cat.# 31842) and EPA Method 8310 PAH Mixture (cat.# 31841) and at 0.5µg/mL with internal standard phenanthrene-d10 (cat.# 31045), then extracted with acetonitrile and Q-sep™ Q110 QuEChERS extraction tube (cat.# 26213) A. extract with clean-up using Q-sep™ Q210 QuEChERS dSPE clean-up tube (cat.# 26215) B. extract without clean-up
Inj.:	1.0µL splitless (hold 0.15 min.), 3.5mm single gooseneck liner with w/wool (cat.# 22286-200.1)
Inj. temp.:	300°C
Carrier gas:	helium, constant flow
Flow rate:	1.4mL/min.
Oven temp.:	50°C (hold 0.5 min.) to 290°C @ 25°C/min. to 320°C @ 5°C/min. (hold 5 min.)
Det:	MS
Mode:	scan (SIM shown below)
Transfer line temp.:	290°C
Analyzer Type:	Quadrupole
Scan range:	100-350amu
Ionization:	EI
Instrument:	Shimadzu 2010 GC & QP2010 Plus MS

Polycyclic Aromatic Hydrocarbons
Rxi®-17Sil MS

NEW!

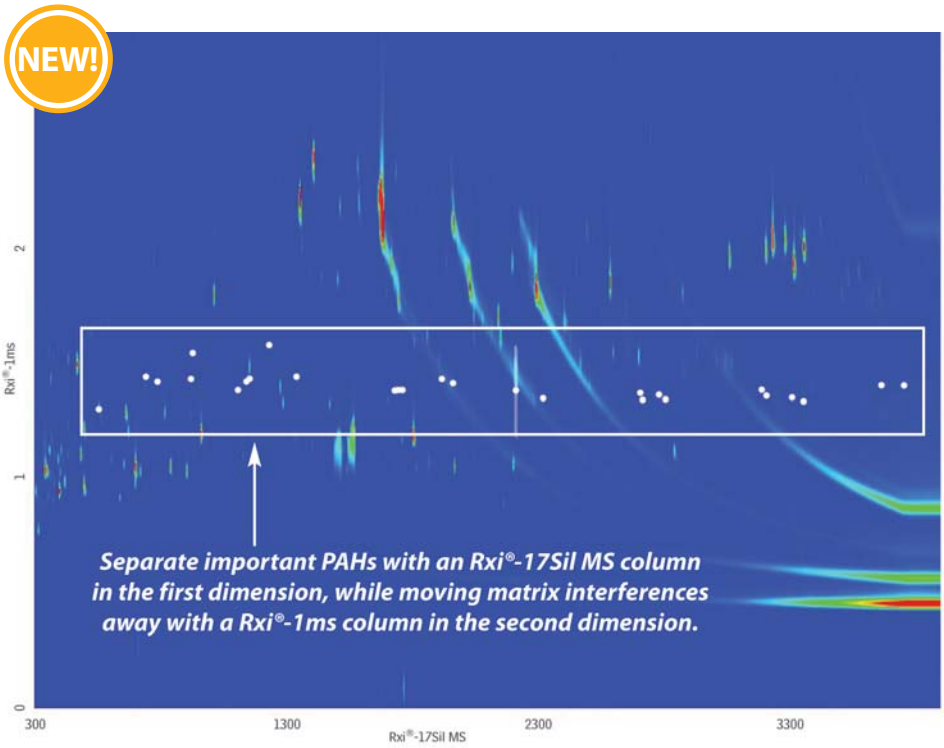
Excellent column for PAH residues in food!



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

Column	Rxi®-17Sil MS, 30 m, 0.25 mm ID, 0.25 µm (cat.# 14123)
Sample	SV Calibration Mix #5 / 610 PAH Mix (cat.# 31011) EPA Method 8310 PAH Mixture (cat.# 31841)
Diluent:	dichloromethane
Conc.:	10 ppm
Injection	
Inj. Vol.:	0.5 µL splitless (hold 1.75 min.)
Liner:	Auto SYS XL PSS Split/Splitless w/Wool (cat.# 21718)
Inj. Temp.:	320 °C
Purge Flow:	75 mL/min.
Oven	
Oven Temp:	65 °C (hold 0.5 min.) to 220 °C at 15 °C/min. to 330 °C at 4 °C/min. (hold 15 min.)
Carrier Gas	He, constant flow
Flow Rate:	2.0 mL/min.
Detector	FID @ 320 °C
Instrument	PE Clarus 600 GC
Acknowledgement	Instrument provided by PerkinElmer

QuEChERS Extract of NIST SRM 2974a Freeze-Dried Mussel Tissue (GCxGC contour plot)



GC_FF1197

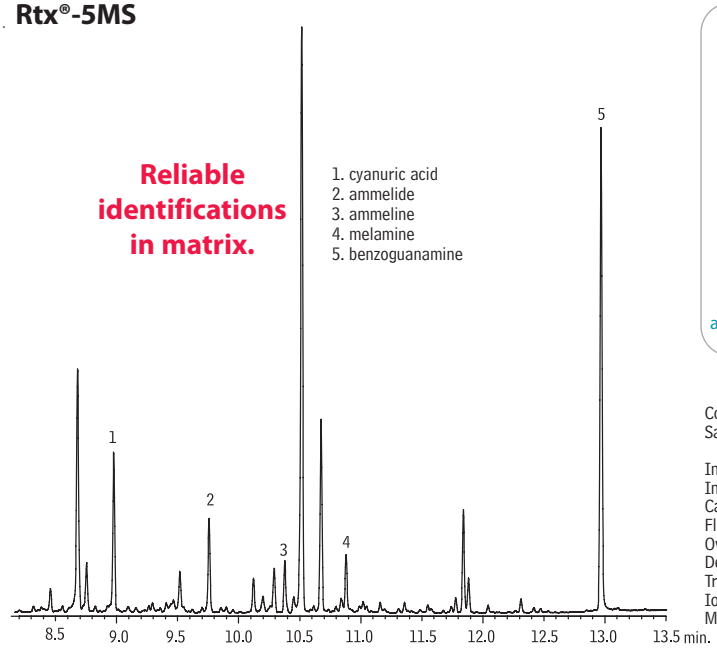
Column	Rxi®-17Sil MS 30 m, 0.25 mm ID, 0.25 µm (cat.# 14123) Rxi®-1ms 1.2 m, 0.15 mm ID, 0.15 µm (cat.# custom)
Sample	NIST SRM 2974a freeze-dried mussel tissue with incurred residues
Diluent:	Acetonitrile
Injection	
Inj. Vol.:	1 µL splitless (hold 1 min.)
Liner:	Gooseneck Splitless (4mm) w/Semivolatiles Wool (cat.# 20798-231.1)
Inj. Temp.:	250 °C
Purge Flow:	40 mL/min.
Oven	
Oven Temp:	Rxi®-17Sil MS: 90 °C (hold 1 min.) to 320 °C at 3.75 °C/min. (hold 2.67 min.) Rxi®-1ms: 95 °C (hold 1 min.) to 325 °C at 3.75 °C/min. (hold 2.67 min.)
Carrier Gas	He
Modulation	
Modulator Temp. Offset:	20 °C
Second Dimension Separation Time:	3 sec.
Hot Pulse Time:	0.9 sec.
Cool Time between Stages:	0.6 sec.
Detector	TOFMS
Transfer Line Temp.:	300 °C
Analyzer Type:	TOF
Source Temp.:	250 °C
Electron Energy:	70 eV
Mass Defect:	-20 mu/100 u
Solvent Delay Time:	5 min.
Tune Type:	PFTBA
Ionization Mode:	EI
Acquisition Range:	45 to 550 amu
Spectral Acquisition Rate:	100 spectra/sec
Instrument	LECO Pegasus 4D GCxGC-TOFMS

Notes PAHs (shown in box) elute in a relatively narrow band and are identified by the white peak marker dots.

Peaks

1. Naphthalene
2. 2-Methylnaphthalene
3. 1-Methylnaphthalene
4. Biphenyl
5. 2,6-Dimethylnaphthalene
6. Acenaphthylene
7. Acenaphthene
8. 2,3,5-Trimethylnaphthalene
9. Fluorene
10. Phenanthrene
11. Anthracene
12. 1-Methylphenanthrene
13. Fluoranthene
14. Pyrene
15. Benzo(a)anthracene
16. Chrysene
17. Benzo(b)fluoranthene
18. Benzo(k)fluoranthene
19. Benzo(j)fluoranthene
20. Benzo(e)pyrene
21. Benzo(a)pyrene
22. Perylene
23. Dibenz(a,h)anthracene
24. Indeno(1,2,3-cd)pyrene
25. Benzo(ghi)perylene

Melamine Spike in Cat Food
Rtx®-5MS

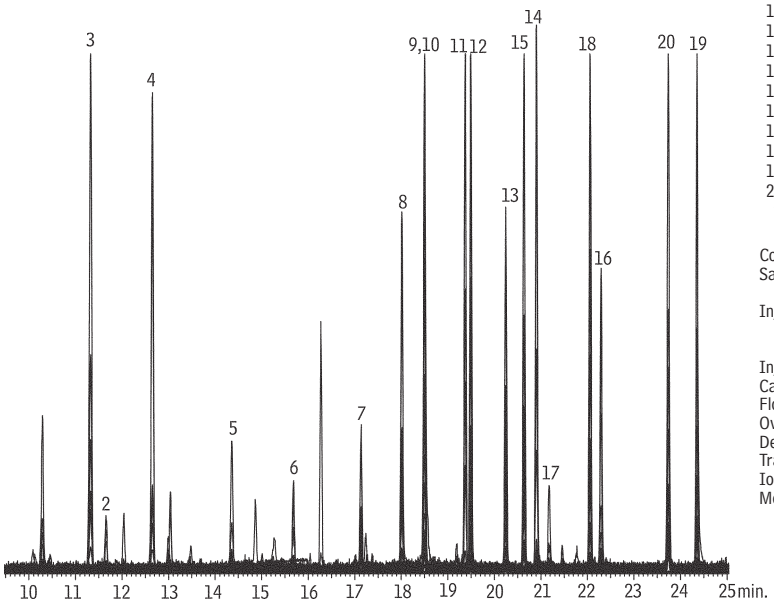


GC_FF00977

Column:	Rtx®-5MS, 30m, 0.25mm ID, 0.25µm (cat.# 12623)
Sample:	melamine, cyanuric acid, ammelide, ammeline, benzoguanamine in dry cat food (10µg/mL prederivatized)
Inj.:	1µL, splitless (hold 1 min.), 3.5mm splitless inlet liner (cat.# 22286)
Inj. temp.:	280°C
Carrier gas:	helium, constant flow
Flow rate:	1mL/min.
Oven temp.:	75°C to 320°C @ 15°C/min. (hold 4 min.)
Det:	MS
Transfer line temp.:	290°C
Ionization:	EI
Mode:	SIM

Organochlorine Pesticides
Rxi®-5Sil MS

NEW!



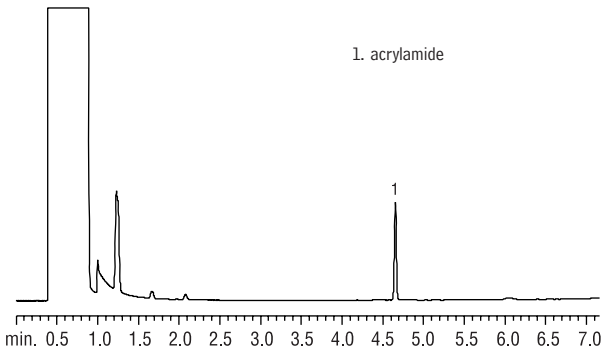
GC_FF01044

Compound	Quant. ion	Q1	Q3
*1. α-BHC	219	181	109
2. γ-BHC	219	181	109
3. β-BHC	219	181	109
4. δ-BHC	219	181	109
5. heptachlor	272	237	100
6. aldrin	263	293	220
7. heptachlor epoxide	263	237	81
8. γ-chlordane	272	237	65
9. α-chlordane	272	237	65
10. endosulfan I	195	207	241
11. 4,4'-DDE	246	318	176
12. dieldrin	79	263	277
13. endrin	263	281	81
14. 4,4'-DDD	235	165	199
15. endosulfan II	195	207	-
16. 4,4'-DDT	235	165	199
17. endrin aldehyde	67	250	345
18. endosulfan sulfate	272	229	239
19. methoxychlor	227	274	-
20. endrin ketone	67	317	281

* not present

Column:	Rxi®-5Sil MS, 30m, 0.25mm ID, 0.25µm (cat.# 13623)
Sample:	10µg/mL Organochlorine Pesticide Mix AB # 3 (cat.# 32415) in olive oil
Inj.:	1µL, splitless (hold 0.5 min.), 3.5mm single gooseneck liner (cat.# 20962) packed with wool
Inj. temp.:	225°C
Carrier gas:	helium, constant flow
Flow rate:	1mL/min.
Oven temp.:	130°C to 330°C @ 5°C/min.
Det:	MS
Transfer line temp.:	320°C
Ionization:	EI
Mode:	SIM

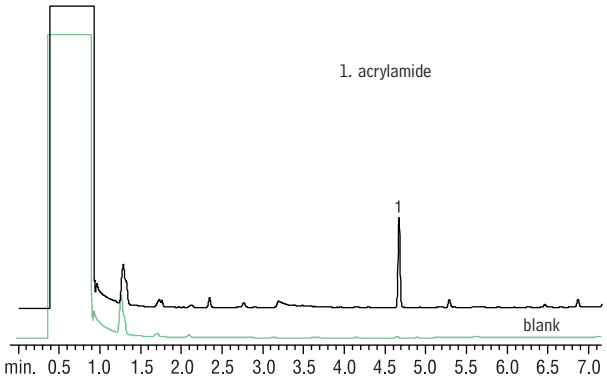
Acrylamide (Reference Standard)
Stabilwax®



GC_FF00642

Column:	Stabilwax®, 15m, 0.53mm ID, 0.50µm (cat.# 10637)
Sample:	25µg/mL acrylamide standard in water
Inj.:	1.0µL, 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®

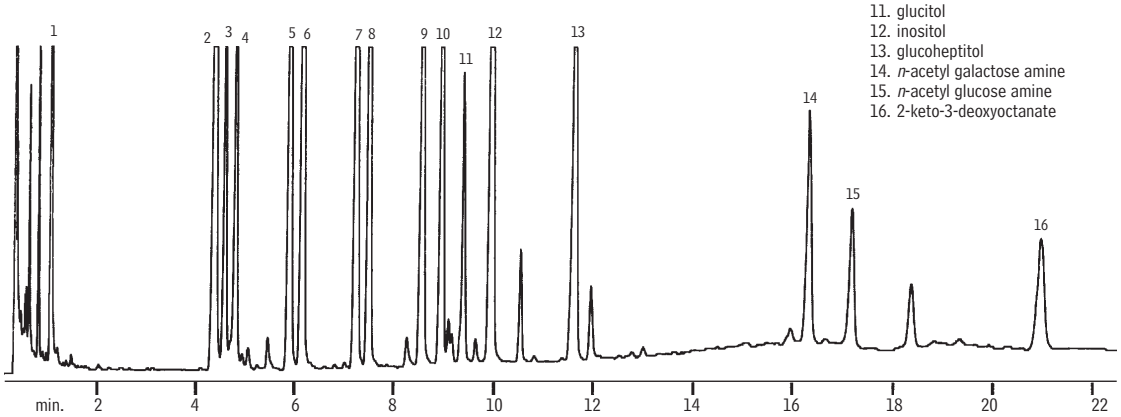


GC_FF00643

Column:	Stabilwax®, 15m, 0.53mm ID, 0.50µm (cat.# 10637)
Sample:	1g of potato chips spiked with 100µg acrylamide
Inj.:	1.0µL, 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

Sugars (Alditol Acetates)
Rt®-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

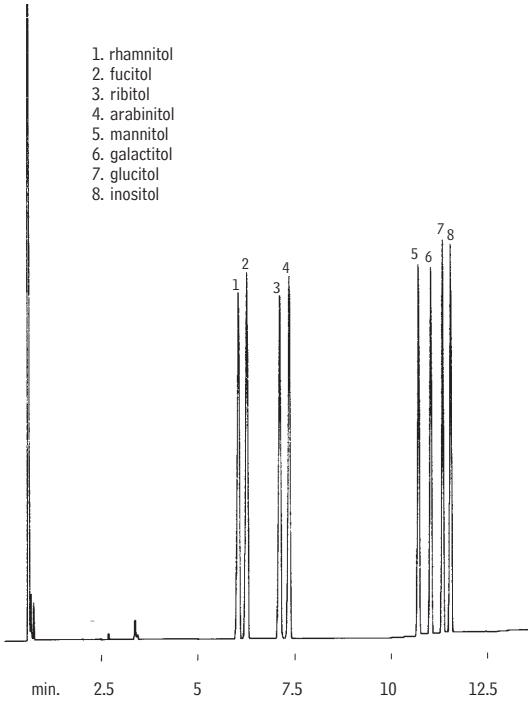


GC_FF00127

Column:	Rt®-2330, 15m, 0.32mm ID, 0.20μm (cat.# 10721)
Inj.:	0.6μL 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 10^{-11} AFS
Split ratio:	20:1

Sugars (Alditol Acetates)
Rtx®-225

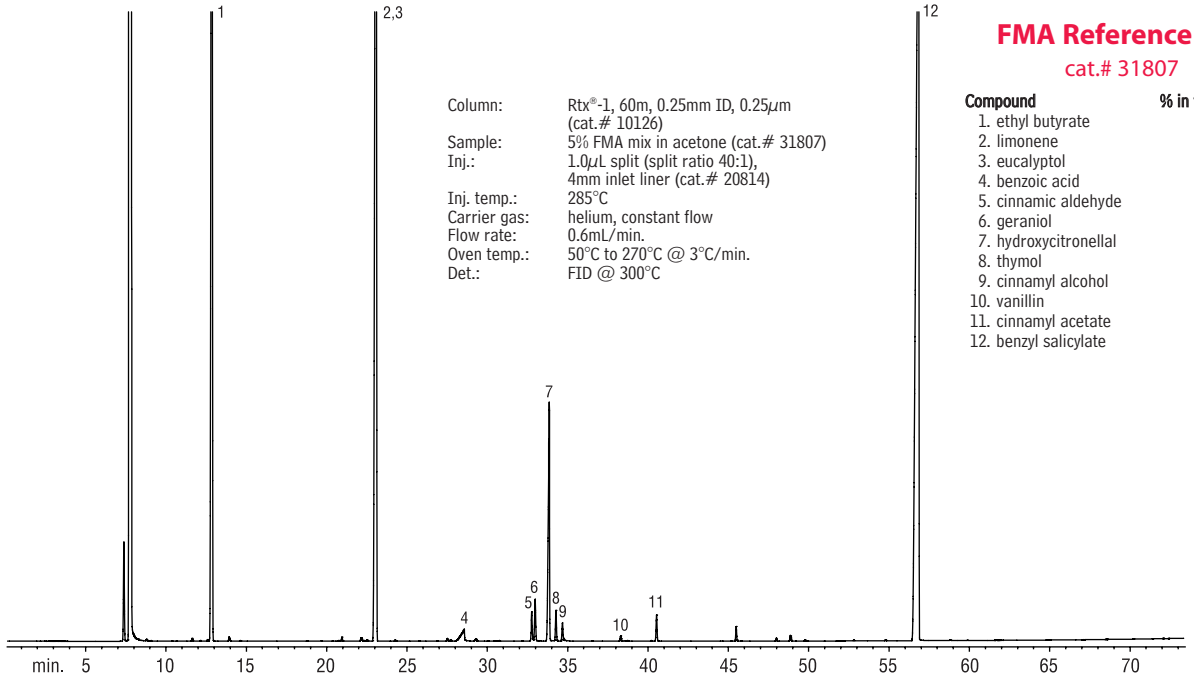
1. rhamnitol
2. fucitol
3. ribitol
4. arabinitol
5. mannitol
6. galactitol
7. glucitol
8. inositol



GC_FF00128

Column:	Rtx®-225, 15m, 0.25mm ID, 0.25μm (cat.# 14020)
Inj.:	0.5μL split injection
Oven temp.:	190°C (hold 5 min.) to 250°C @ 8°C/min. (hold 5 min.)
Inj./det. temp.:	260°C
Carrier gas:	hydrogen
Linear velocity:	42cm/sec. set @ 40°C
FID sensitivity:	16 x 10^{-11} AFS
Split ratio:	50:1

5% Fragrance Materials Association Mix
Rtx®-1



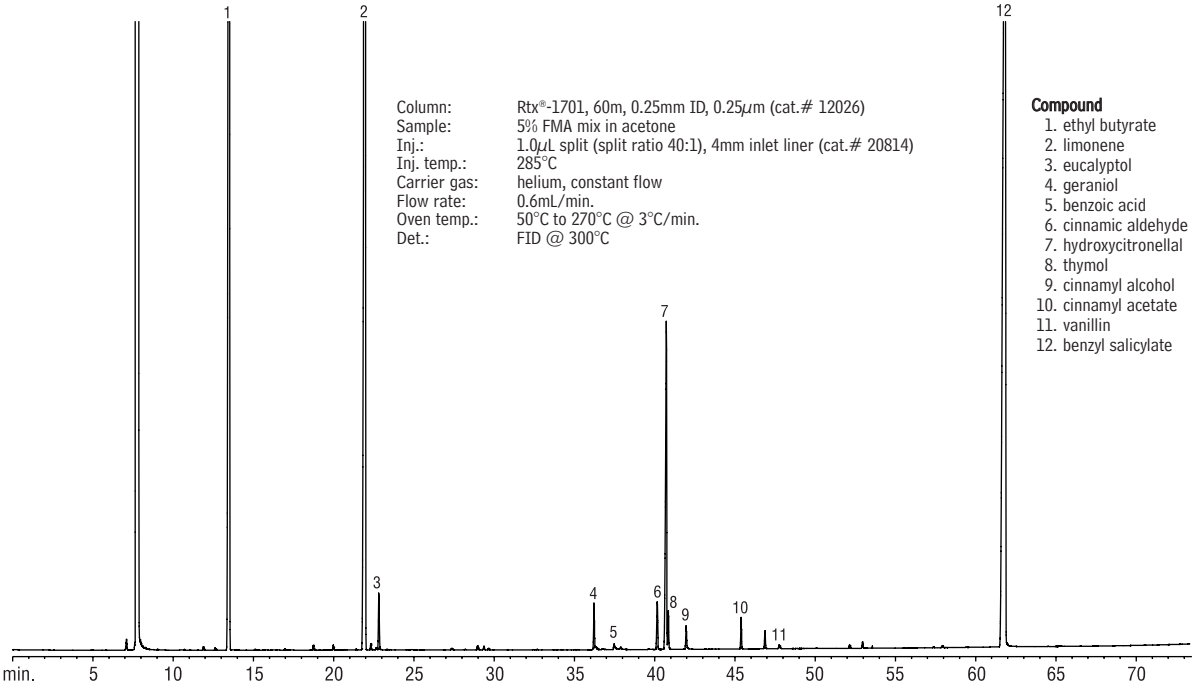
GC_FF00657

Column: Rtx®-1, 60m, 0.25mm ID, 0.25µm (cat.# 10126)
Sample: 5% FMA mix in acetone (cat.# 31807)
Inj.: 1.0µL split (split ratio 40:1), 4mm inlet liner (cat.# 20814)
Inj. temp.: 285°C
Carrier gas: helium, constant flow
Flow rate: 0.6mL/min.
Oven temp.: 50°C to 270°C @ 3°C/min.
Det.: FID @ 300°C

FMA Reference Mix
cat.# 31807

Compound	% in the FMA mix
1. ethyl butyrate	35.7
2. limonene	20.0
3. eucalyptol	0.5
4. benzoic acid	1.0
5. cinnamic aldehyde	0.5
6. geraniol	0.6
7. hydroxycitronellal	5.0
8. thymol	0.3
9. cinnamyl alcohol	0.3
10. vanillin	0.1
11. cinnamyl acetate	0.3
12. benzyl salicylate	35.7

5% Fragrance Materials Association Mix
Rtx®-1701



GC_FF00658

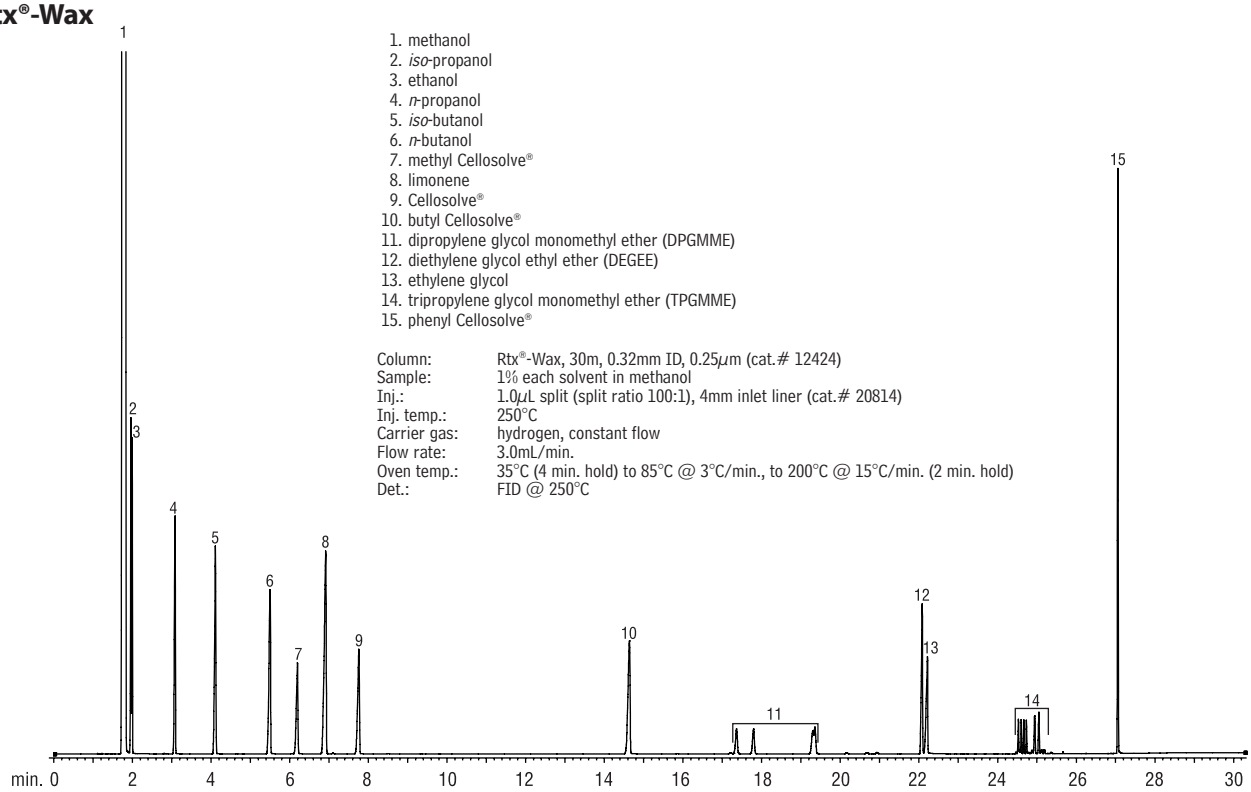
Column: Rtx®-1701, 60m, 0.25mm ID, 0.25µm (cat.# 12026)
Sample: 5% FMA mix in acetone
Inj.: 1.0µL split (split ratio 40:1), 4mm inlet liner (cat.# 20814)
Inj. temp.: 285°C
Carrier gas: helium, constant flow
Flow rate: 0.6mL/min.
Oven temp.: 50°C to 270°C @ 3°C/min.
Det.: FID @ 300°C

Compound	% in FMA Mix
1. ethyl butyrate	35.7
2. limonene	20.0
3. eucalyptol	0.5
4. geraniol	0.6
5. benzoic acid	1.0
6. cinnamic aldehyde	0.5
7. hydroxycitronellal	5.0
8. thymol	0.3
9. cinnamyl alcohol	0.3
10. cinnamyl acetate	0.3
11. vanillin	0.1
12. benzyl salicylate	35.7

Cleaning Solvents
Rtx®-Wax

1. methanol
2. *iso*-propanol
3. ethanol
4. *n*-propanol
5. *iso*-butanol
6. *n*-butanol
7. methyl Cellosolve®
8. limonene
9. Cellosolve®
10. butyl Cellosolve®
11. dipropylene glycol monomethyl ether (DPGMME)
12. diethylene glycol ethyl ether (DEGEE)
13. ethylene glycol
14. tripropylene glycol monomethyl ether (TPGMME)
15. phenyl Cellosolve®

Column:	Rtx®-Wax, 30m, 0.32mm ID, 0.25µm (cat.# 12424)
Sample:	1% each solvent in methanol
Inj.:	1.0µL split (split ratio 100:1), 4mm inlet liner (cat.# 20814)
Inj. temp.:	250°C
Carrier gas:	hydrogen, constant flow
Flow rate:	3.0mL/min.
Oven temp.:	35°C (4 min. hold) to 85°C @ 3°C/min., to 200°C @ 15°C/min. (2 min. hold)
Det.:	FID @ 250°C

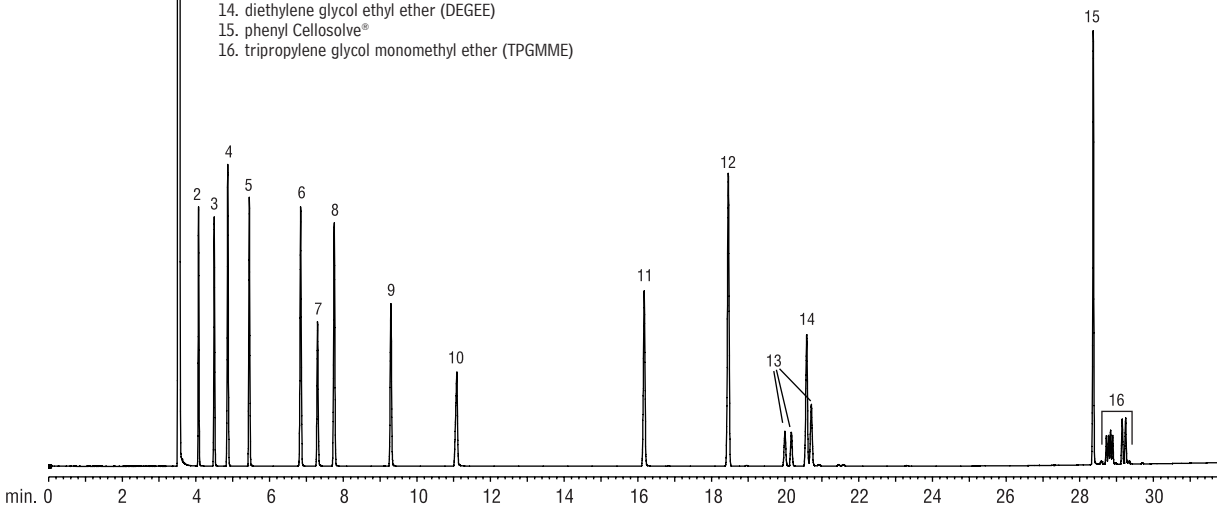


GC_FF00644

Cleaning Solvents
Rtx®-VMS

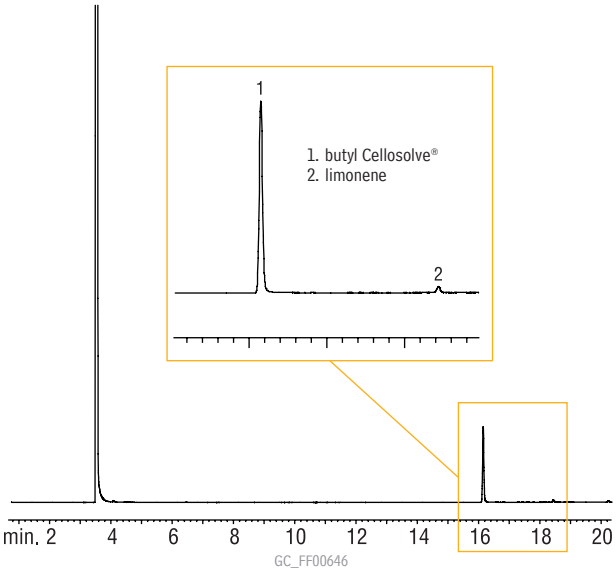
1. methanol
2. ethanol
3. *iso*-propanol
4. *tert*-butanol
5. *n*-propanol
6. *iso*-butanol
7. methyl Cellosolve®
8. *n*-butanol
9. Cellosolve®
10. ethylene glycol
11. butyl Cellosolve®
12. limonene
13. dipropylene glycol monomethyl ether (DPGMME)
14. diethylene glycol ethyl ether (DEGEE)
15. phenyl Cellosolve®
16. tripropylene glycol monomethyl ether (TPGMME)

Column:	Rtx®-VMS, 60m, 0.25mm ID, 1.4µm (cat.# 19916)
Sample:	1% each solvent in methanol
Inj.:	1.0µL 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



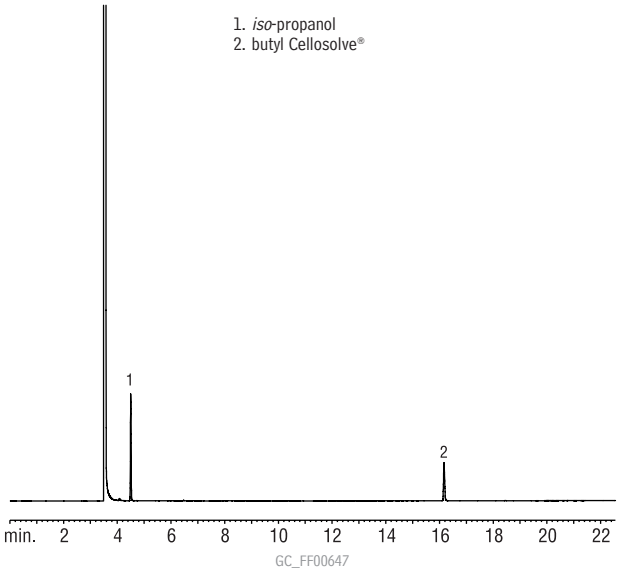
GC_FF00645

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



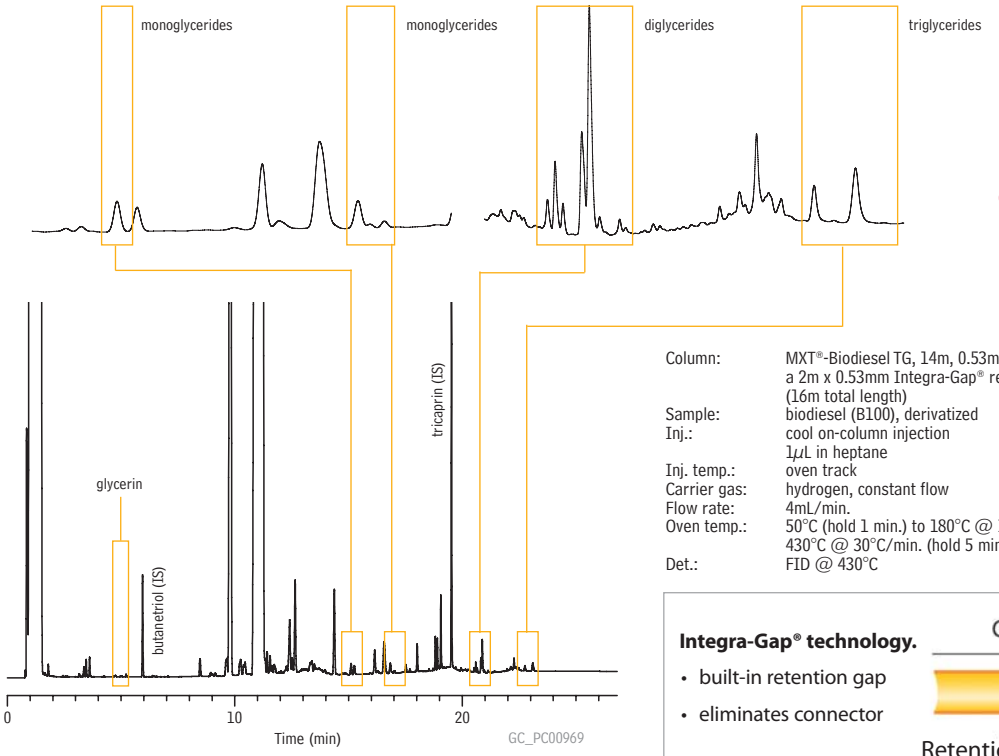
Column:	Rtx®-VMS, 60m, 0.25mm ID, 1.4µm (cat.# 19916)
Sample:	approx. 5% cleaner in methanol
Inj.:	1.0µL split (split ratio 100:1), 4mm inlet liner (cat.# 20814)
Inj. temp.:	250°C
Carrier gas:	hydrogen, constant flow
Flow rate:	1.5mL/min.
Oven temp.:	60°C (1 min. hold) to 138°C @ 4°C/min. to 145°C @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

Total Glycerin in Biodiesel
MXT®-Biodiesel TG

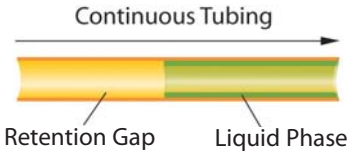


The best solution for analyzing total glycerin in biodiesel!

Column:	MXT®-Biodiesel TG, 14m, 0.53mm ID, 0.16µm (cat.# 70289) with a 2m x 0.53mm Integra-Gap® retention gap (16m total length)
Sample:	biodiesel (B100), derivatized
Inj.:	cool on-column injection 1µL in heptane
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

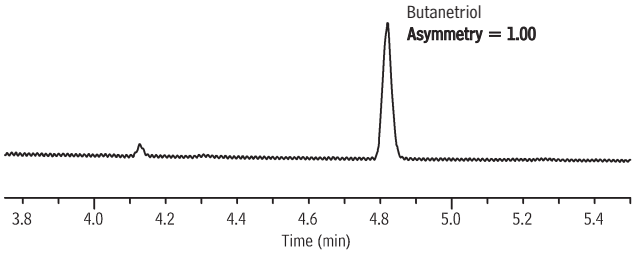
Integra-Gap® technology.

- built-in retention gap
- eliminates connector

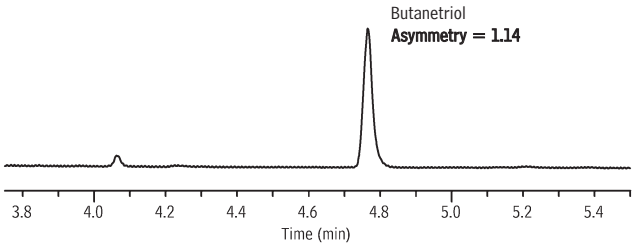


Biodiesel Oil (B100)
Rtx®-Biodiesel TG

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



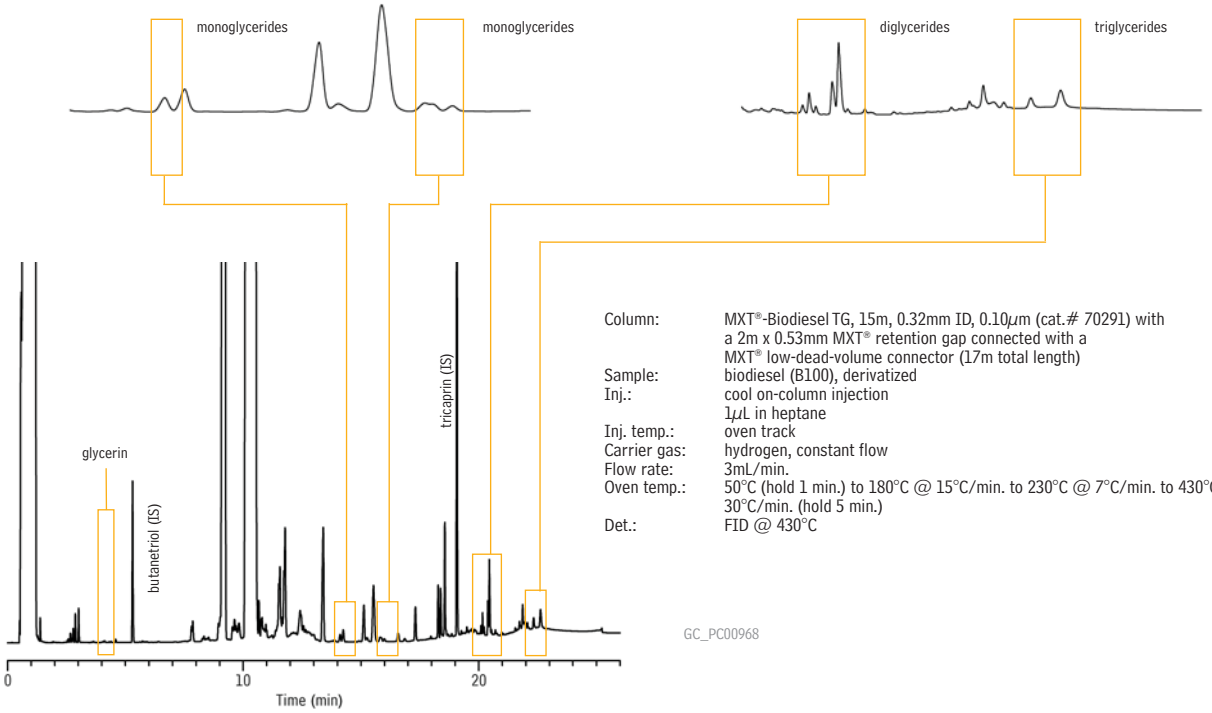
B. Rtx®-Biodiesel TG with Universal Press-Tight®Connector and 2 meters of 0.53mm ID Hydroguard® tubing



GC_PC00905

Columns:	A. Rtx®-Biodiesel TG, 10m, 0.32mm ID, 0.10µm connected to 2m x 0.53mm Hydroguard® tubing using Alumaseal® connector B. Rtx®-Biodiesel TG, 10m, 0.32mm ID, 0.10µm 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.:	1µL, 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 1min.) 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

B100
MXT®-Biodiesel TG

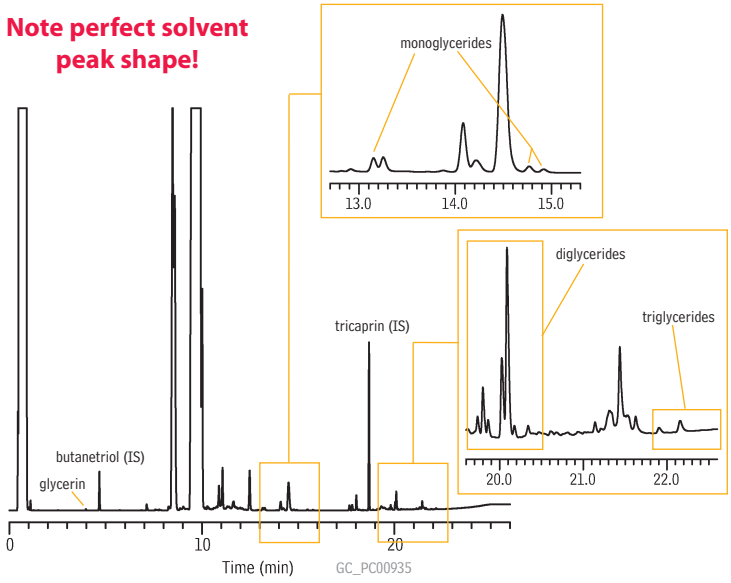


Column: MXT®-Biodiesel TG, 15m, 0.32mm ID, 0.10µm (cat.# 70291) with a 2m x 0.53mm MXT® retention gap connected with a MXT® low-dead-volume connector (17m total length)
Sample: biodiesel (B100), derivatized
Inj.: cool on-column injection 1µL in heptane
Inj. temp.: oven track
Carrier gas: hydrogen, constant flow
Flow rate: 3mL/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

GC_PC00968

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

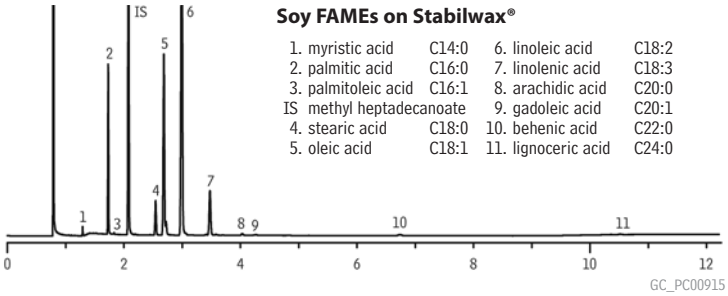
Note perfect solvent peak shape!

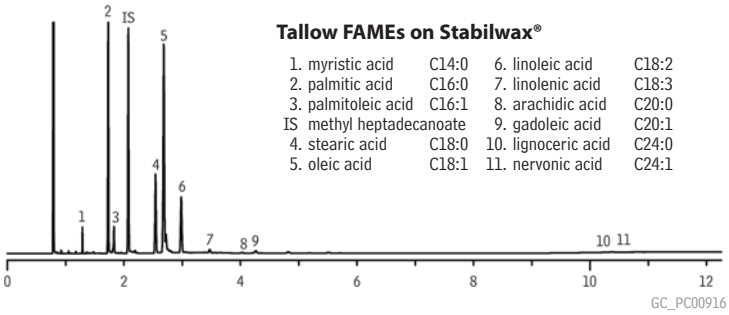


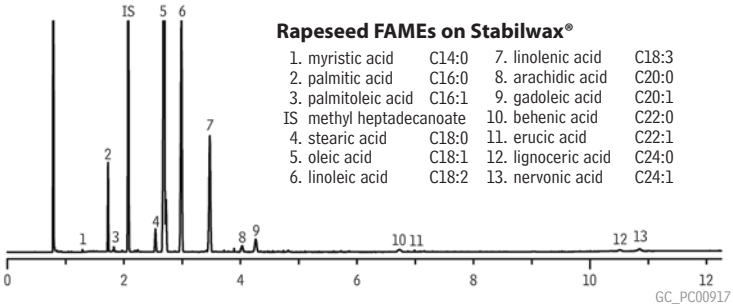
GC_PC00935

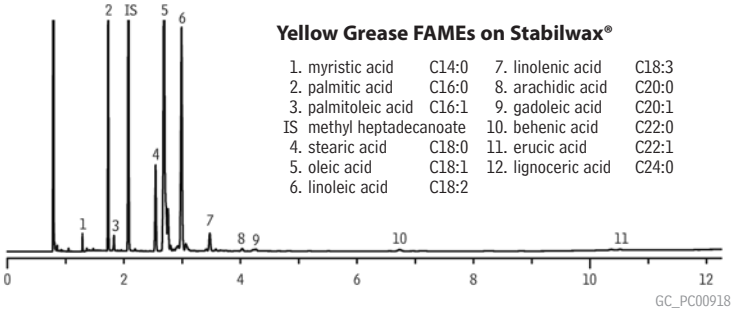
Column: MXT®-Biodiesel TG, 10m, 0.32mm ID, 0.1µm with 2m x 0.53mm retention gap (cat.# 70290)
Sample: B100 + IS butanetriol & tricaprin derivatized with MSTFA as per ASTM D-6584
Inj.: 1.0µL cool on-column
Inj. temp.: oven track
Carrier gas: hydrogen, constant flow
Flow rate: 4mL/min.
Oven temp.: 50°C (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

FAMEs in Biodiesel Oils
Stabilwax®



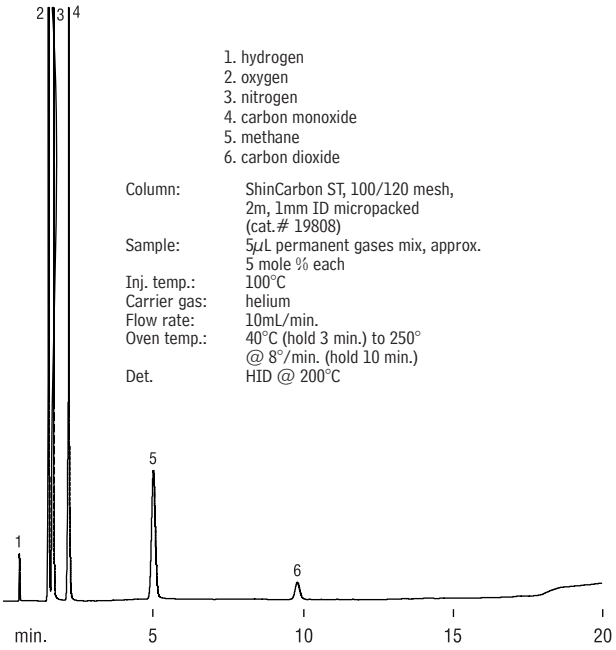






Column:	Stabilwax®, 30m, 0.32mm ID, 0.25µm (cat.# 10624)
Sample:	various sources of biodiesel (B100), prepared according to European Method EN 14103
Inj.:	1.0µL split (split ratio 100:1), Cyclosplitter® inlet liner (cat.# 20706)
Inj. temp.:	250°C
Carrier gas:	hydrogen, constant flow, 3mL/min.
Linear 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)

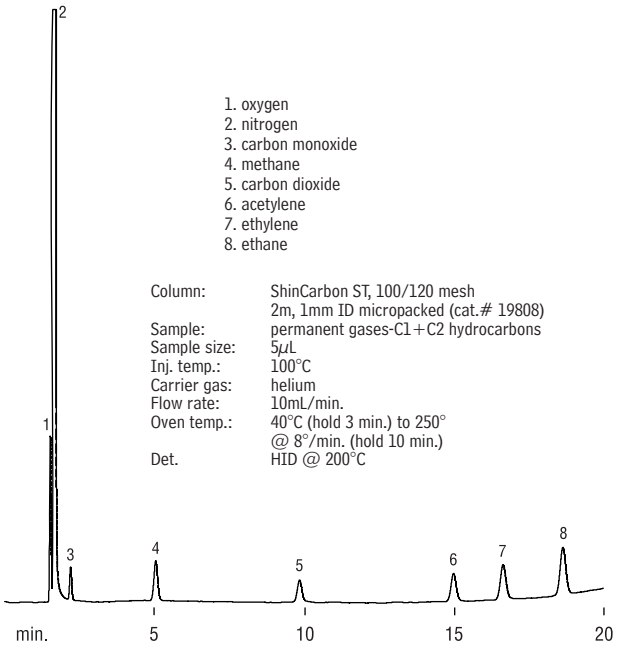


1. hydrogen
2. oxygen
3. nitrogen
4. carbon monoxide
5. methane
6. carbon dioxide

Column:	ShinCarbon ST, 100/120 mesh, 2m, 1mm ID micropacked (cat.# 19808)
Sample:	5µL permanent gases mix, approx. 5 mole % each
Inj. temp.:	100°C
Carrier gas:	helium
Flow rate:	10mL/min.
Oven temp.:	40°C (hold 3 min.) to 250° @ 8°/min. (hold 10 min.)
Det.	HID @ 200°C

GC_PC00666

Permanent Gases, C1+C2 hydrocarbons
ShinCarbon ST
(micropacked)



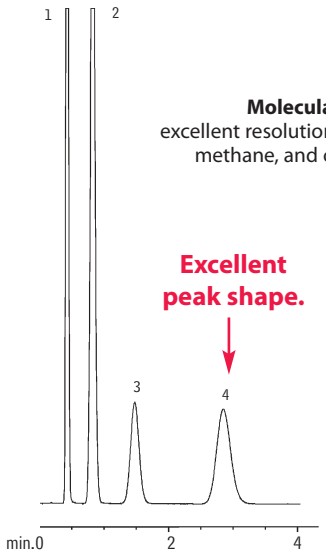
1. oxygen
2. nitrogen
3. carbon monoxide
4. methane
5. carbon dioxide
6. acetylene
7. ethylene
8. ethane

Column:	ShinCarbon ST, 100/120 mesh 2m, 1mm ID micropacked (cat.# 19808)
Sample:	permanent gases-C1+C2 hydrocarbons
Sample size:	5µL
Inj. temp.:	100°C
Carrier gas:	helium
Flow rate:	10mL/min.
Oven temp.:	40°C (hold 3 min.) to 250° @ 8°/min. (hold 10 min.)
Det.	HID @ 200°C

GC_PC00665

Permanent Gases
Molecular Sieve 5A and Molecular Sieve 13X
(packed)

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

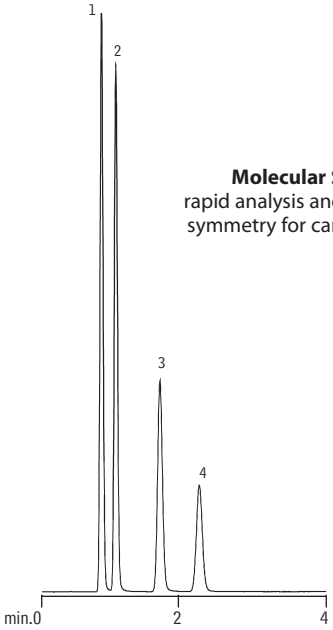


Molecular Sieve 5A:
excellent resolution of oxygen, nitrogen, methane, and carbon monoxide.

Excellent peak shape.

10µL helium, 5–10% each component

Oven temp.:	50°C
Inj./det. temp.:	150°C/200°C
Carrier gas:	hydrogen
Flow:	30mL/min.
Det.:	TCD



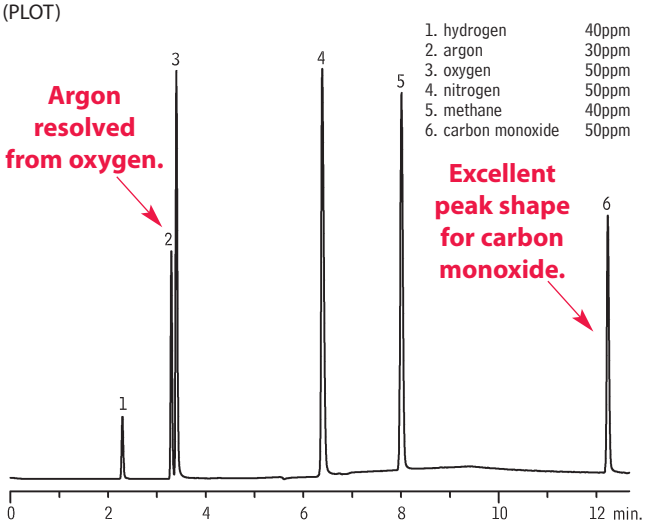
Molecular Sieve 13X:
rapid analysis and excellent peak symmetry for carbon monoxide.

GC_PC00166

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

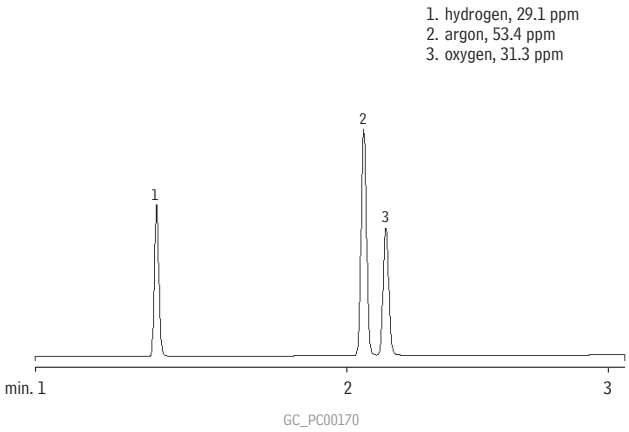
Molecular Sieve 13X 80/100 mesh
2m x 1/8" x 2mm (ID) SilcoSmooth® tubing (cat.# 80439-800)

Permanent Gases
Rt®-Msieve 5A
(PLOT)



Column:	Rt®-Msieve 5A, 30m, 0.53mm ID, 50µm (cat.# 19723)
Sample:	permanent gases (ppm)
Inj.:	5µL sample loop, 6-port Valco® valve, valve temp.: ambient
Inj. temp.:	200°C
Carrier gas:	helium, constant flow
Flow:	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

Permanent Gases
Rt®-MSieve 5A
(PLOT)

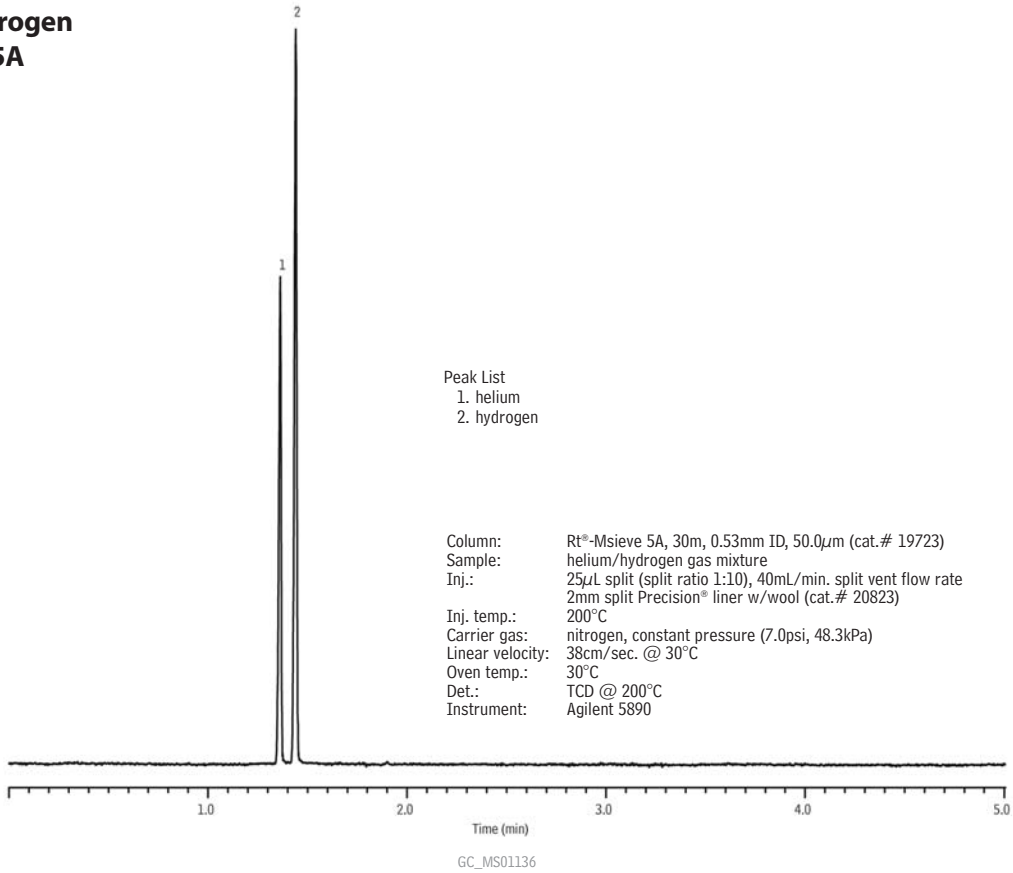


Column:	Rt®-Msieve 5A, 30m, 0.53mm ID, 50µm (cat.# 19723)
Sample:	0.5mL (sample loop injection)
Column temp.:	27°C
Carrier gas:	helium
Linear velocity:	34cm/sec.
Det.:	Valco® HID

Chromatogram courtesy of Larry McElmurry, Mobile Analytical Labs.

Helium/Hydrogen
Rt®-Msieve 5A
(PLOT)

NEW!



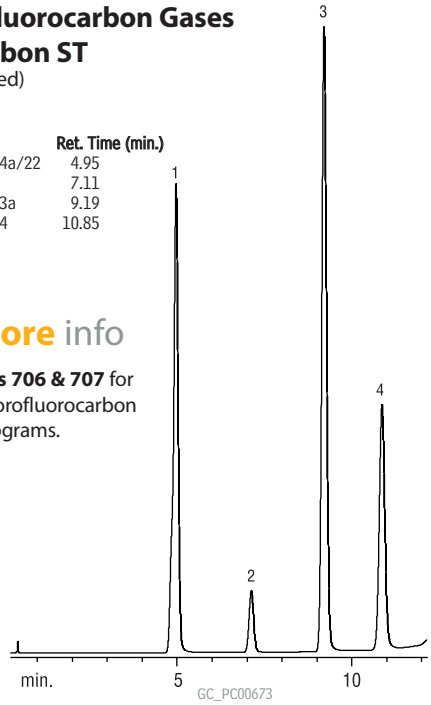
Column:	Rt®-Msieve 5A, 30m, 0.53mm ID, 50.0µm (cat.# 19723)
Sample:	helium/hydrogen gas mixture
Inj.:	25µL split (split ratio 1:10), 40mL/min. split vent flow rate 2mm split Precision® liner w/wool (cat.# 20823)
Inj. temp.:	200°C
Carrier gas:	nitrogen, constant pressure (7.0psi, 48.3kPa)
Linear velocity:	38cm/sec. @ 30°C
Oven temp.:	30°C
Det.:	TCD @ 200°C
Instrument:	Agilent 5890

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 706 & 707** for more chlorofluorocarbon chromatograms.



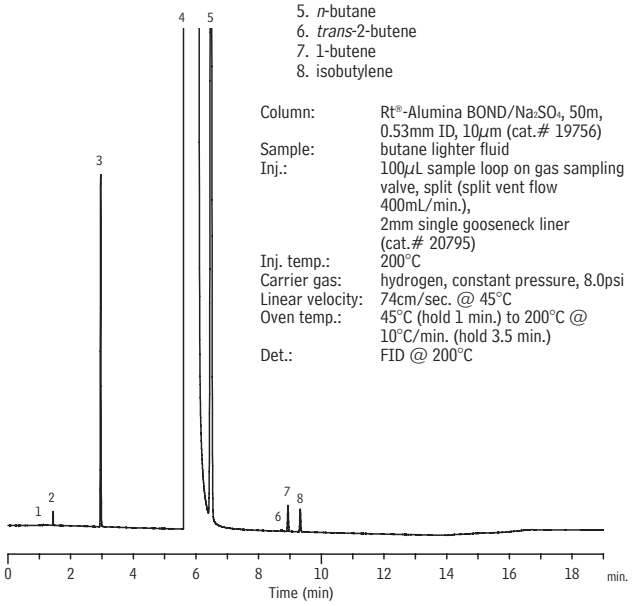
Column: ShinCarbon ST, 100/120 mesh, 1m, 1mm ID Silcosteel® micropacked column (cat.# 19809)
Sample: fluorocarbon blend, 5µL ~1-3% each
Inj. temp.: 200°C
Det.: FID @ 250°C
Carrier gas: helium
Linear velocity: 10mL/min.
Oven temp.: 125°C to 320°C @ 16°C/min.

Butane Lighter Fluid
Rt®-Alumina BOND/Na_2SO_4
(PLOT)

NEW!

1. methane
2. ethane
3. propane
4. isobutane
5. *n*-butane
6. *trans*-2-butene
7. 1-butene
8. isobutylene

Column: Rt®-Alumina BOND/Na_2SO_4, 50m, 0.53mm ID, 10µm (cat.# 19756)
Sample: butane lighter fluid
Inj.: 100µL sample loop on gas sampling valve, split (split vent flow 400mL/min.), 2mm single gooseneck liner (cat.# 20795)
Inj. temp.: 200°C
Carrier gas: hydrogen, constant pressure, 8.0psi
Linear velocity: 74cm/sec. @ 45°C
Oven temp.: 45°C (hold 1 min.) to 200°C @ 10°C/min. (hold 3.5 min.)
Det.: FID @ 200°C

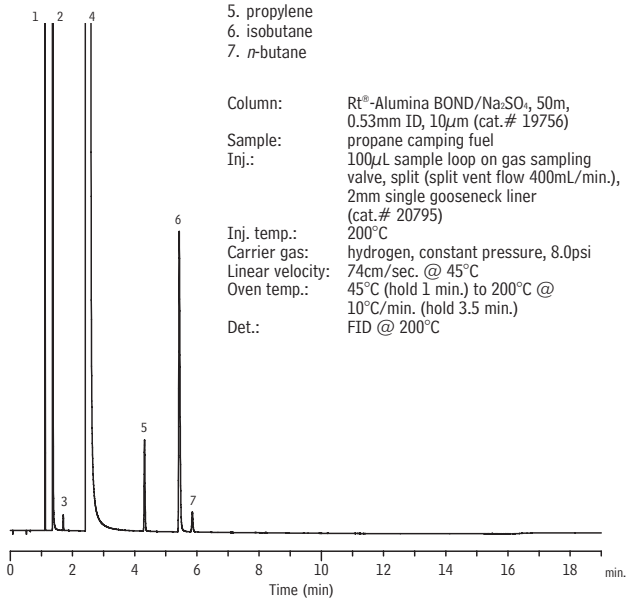


Propane Camping Fuel
Rt®-Alumina BOND/Na_2SO_4
(PLOT)

NEW!

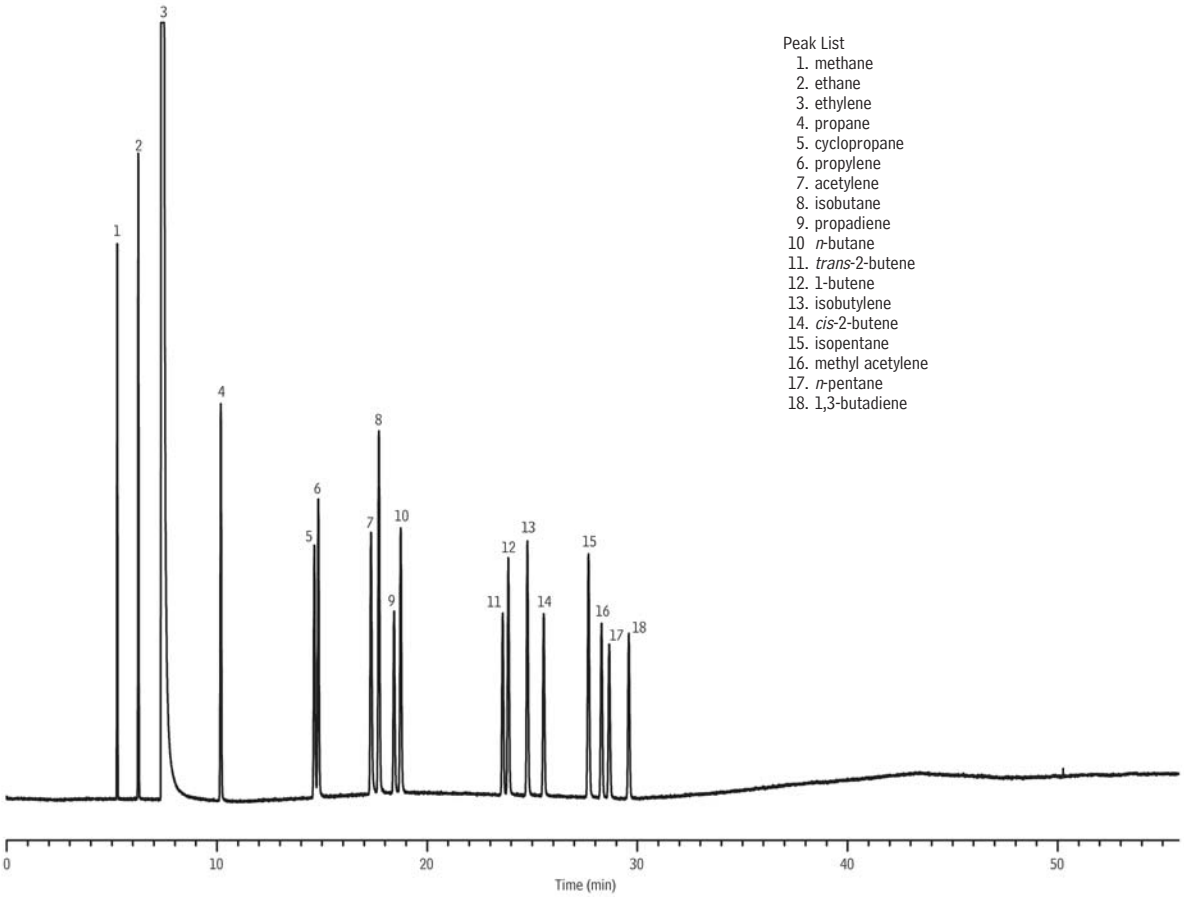
1. methane
2. ethane
3. ethylene
4. propane
5. propylene
6. isobutane
7. *n*-butane

Column: Rt®-Alumina BOND/Na_2SO_4, 50m, 0.53mm ID, 10µm (cat.# 19756)
Sample: propane camping fuel
Inj.: 100µL sample loop on gas sampling valve, split (split vent flow 400mL/min.), 2mm single gooseneck liner (cat.# 20795)
Inj. temp.: 200°C
Carrier gas: hydrogen, constant pressure, 8.0psi
Linear velocity: 74cm/sec. @ 45°C
Oven temp.: 45°C (hold 1 min.) to 200°C @ 10°C/min. (hold 3.5 min.)
Det.: FID @ 200°C



Ethylene and C1-C5 Hydrocarbons
ASTM D6159-97
Rt®-Alumina BOND/KCl, Rtx®-1
(PLOT)

NEW!

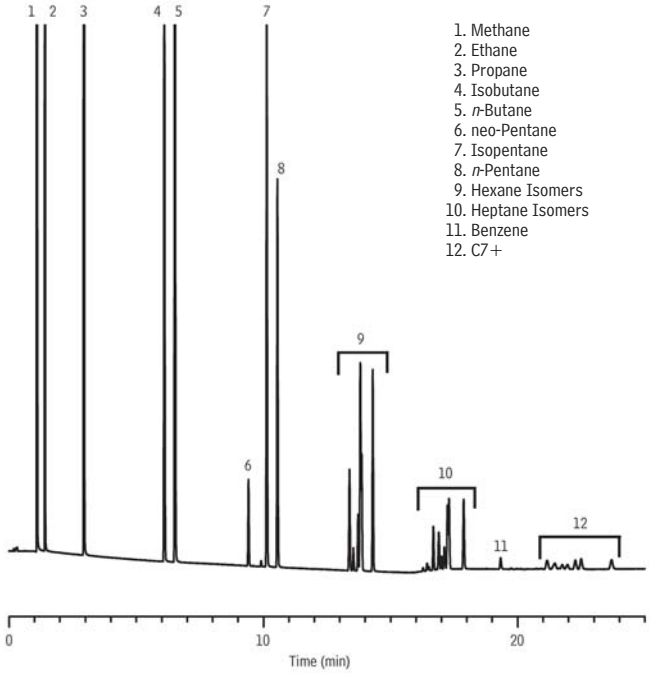


GC_PC01110

Column:	Rt®-Alumina BOND/KCl, 50m, 0.53mm ID, 10.0µm (cat.# 19760) in series with Rtx®-1, 30m, 0.53mm ID, 5.0µm (cat.# 10179), connected using a Universal Press-Tight® Connector (cat.# 20401)
Sample:	ethylene and C1-C5 hydrocarbons
Inj.:	1µL split, 60mL/min. split vent flow rate 2mm splitless liner (cat.# 20712)
Inj. temp.:	200°C
Carrier gas:	helium, constant pressure (8.0psi, 55.2kPa)
Linear velocity:	25.4cm/sec. @ 35°C
Oven temp.:	35°C (hold 2 min.) to 190°C @ 4°C/min. (hold 15 min.) (conditions as per ASTM D6159-97)
Det.:	FID @ 200°C
Instrument:	Agilent 5890

Natural Gas
Rt®-Alumina BOND/KCl
(PLOT)

NEW!

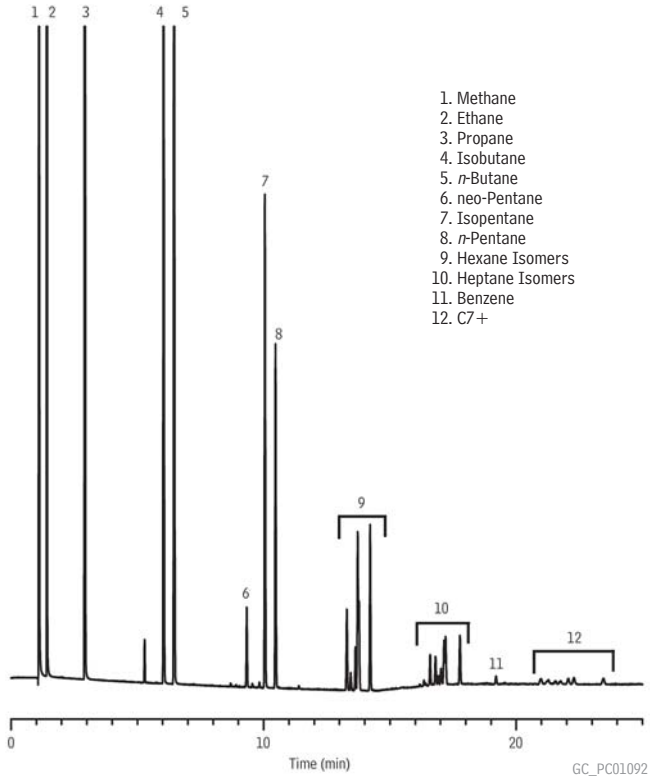


GC_PC01091

Column	Rt®-Alumina BOND/KCl, 50 m, 0.53 mm ID, 10 µm (cat.# 19760)
Sample	natural gas
Injection	
Inj. Vol.:	500 µL split
Liner:	Gooseneck Splitless (2mm) (cat.# 20795)
Inj. Temp.:	200 °C
Split Vent Flow Rate:	50 mL/min.
Oven	
Oven Temp:	45 °C (hold 1 min.) to 200 °C at 10 °C/min. (hold 8.5 min.)
Carrier Gas	H_2, constant pressure (8.0 psi, 55.2kPa)
Linear Velocity:	45 cm/sec. @ 45 °C
Detector	FID @ 200 °C
Make-up Gas Type:	N_2
Data Rate:	20 Hz
Instrument	HP5890 GC

Natural Gas
Rt®-Alumina BOND/Na_2SO_4
(PLOT)

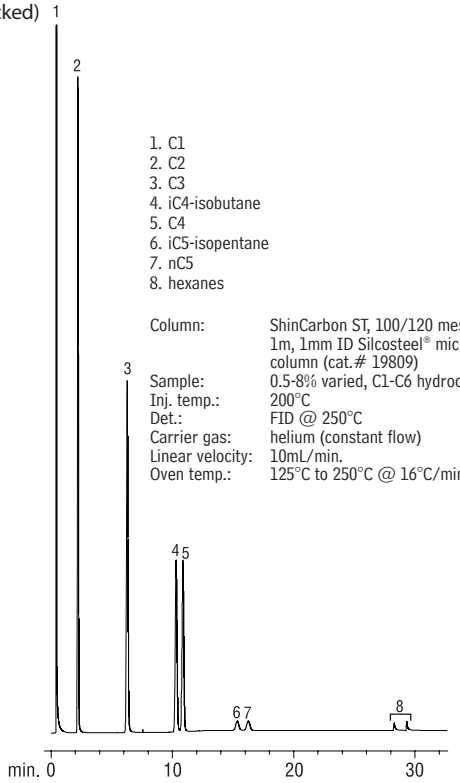
NEW!



GC_PC01092

Column	Rt®-Alumina BOND/Na_2SO_4, 50 m, 0.53 mm ID, 10 µm (cat.# 19756)
Sample	natural gas
Injection	
Inj. Vol.:	500 µL split
Liner:	Gooseneck Splitless (2mm) (cat.# 20795)
Inj. Temp.:	200 °C
Split Vent Flow Rate:	50 mL/min.
Oven	
Oven Temp:	45 °C (hold 1 min.) to 200 °C at 10 °C/min. (hold 8.5 min.)
Carrier Gas	H_2, constant pressure (8.0 psi, 55.2kPa)
Linear Velocity:	45 cm/sec. @ 45 °C
Detector	FID @ 200 °C
Make-up Gas Type:	N_2
Data Rate:	20 Hz
Instrument	HP5890 GC

Natural Gas
ShinCarbon ST
(micropacked)

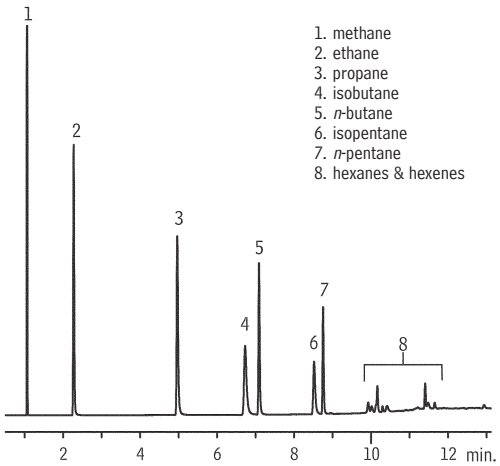


1. C1
2. C2
3. C3
4. iC4-isobutane
5. C4
6. iC5-isopentane
7. nC5
8. hexanes

Column:	ShinCarbon ST, 100/120 mesh 1m, 1mm ID Silcosteel® micropacked column (cat.# 19809)
Sample:	0.5-8% varied, C1-C6 hydrocarbons
Inj. temp.:	200°C
Det.:	FID @ 250°C
Carrier gas:	helium (constant flow)
Linear velocity:	10mL/min.
Oven temp.:	125°C to 250°C @ 16°C/min.

GC_PC00672

Natural Gas #2
Rt®-QS-BOND
(PLOT)



1. methane
2. ethane
3. propane
4. isobutane
5. *n*-butane
6. isopentane
7. *n*-pentane
8. hexanes & hexenes

GC_PC01013

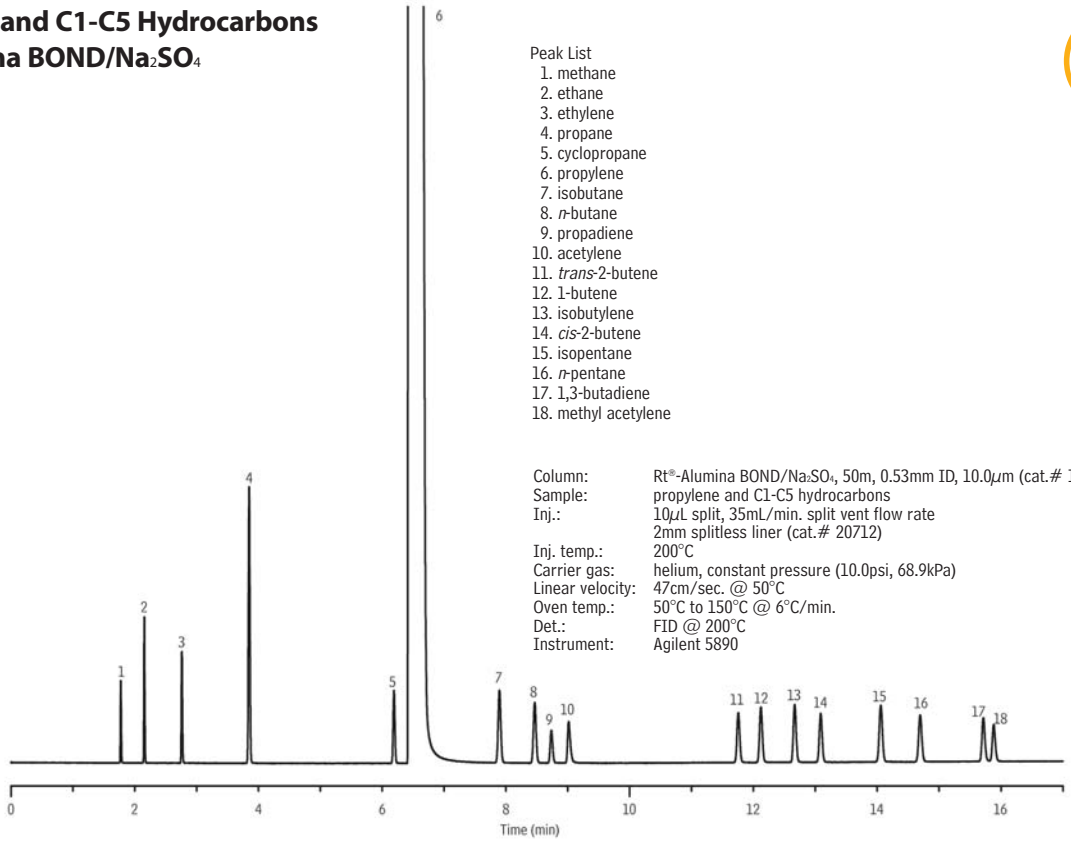
Column:	Rt®-QS-BOND, 30m, 0.53mm ID (cat.# 19738)
Sample:	natural gas mix (mole%)
Inj.:	20µL split (split ratio 10:1), 4mm Siltek® single gooseneck liner (cat.# 20798-214.1)
Inj. temp.:	240°C
Carrier gas:	helium, constant flow
Flow rate:	5.7mL/min. @ 40°C
Oven temp.:	40°C (hold 2 min.) to 225°C @ 20°C/min. (hold 5 min.)
Det.:	FID @ 240°C

Propylene and C1-C5 Hydrocarbons
Rt®-Alumina BOND/Na_2SO_4
(PLOT)

NEW!

Peak List
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. isobutylene
14. *cis*-2-butene
15. isopentane
16. *n*-pentane
17. 1,3-butadiene
18. methyl acetylene

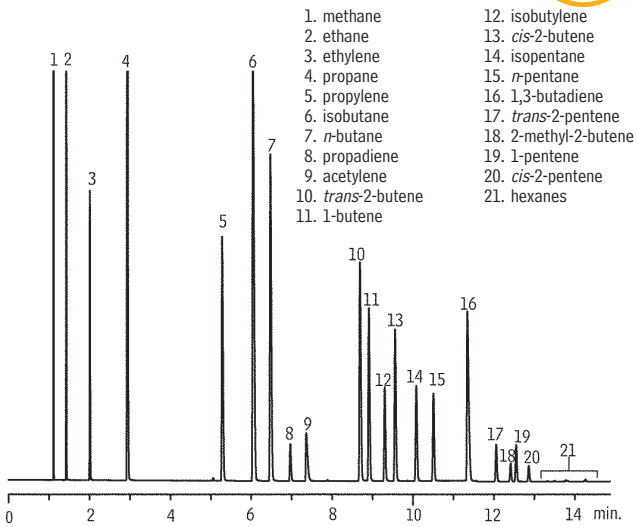
Column:	Rt®-Alumina BOND/Na_2SO_4, 50m, 0.53mm ID, 10.0µm (cat.# 19756)
Sample:	propylene and C1-C5 hydrocarbons
Inj.:	10µL split, 35mL/min. split vent flow rate 2mm splitless liner (cat.# 20712)
Inj. temp.:	200°C
Carrier gas:	helium, constant pressure (10.0psi, 68.9kPa)
Linear velocity:	47cm/sec. @ 50°C
Oven temp.:	50°C to 150°C @ 6°C/min.
Det.:	FID @ 200°C
Instrument:	Agilent 5890



GC_PC01142

Refinery Gas
Rt®-Alumina BOND/Na_2SO_4
(PLOT)

NEW!



GC_PC01085

Column:	Rt®-Alumina BOND/Na_2SO_4, 50m, 0.53mm ID, 10µm (cat.# 19756)
Sample:	refinery gas
Inj.:	10µL split (split vent flow 80mL/min.), 2mm single gooseneck liner (cat.# 20795)
Inj. temp.:	200°C
Carrier gas:	hydrogen, constant pressure, 8.0psi
Linear velocity:	74cm/sec. @ 45°C
Oven temp.:	45°C (hold 1 min.) to 200°C @ 10°C/min. (hold 3.5 min.)
Det.:	FID @ 200°C

Diane Thompson, Customer Service

Restek Customer Service

In the U.S.

Call: 800-356-1688 (ext. 3) or 814-353-1300 (ext. 3)

Monday–Friday 8:00 a.m.–6:00 p.m. ET

Fax: 814-353-1309—24-hours a day

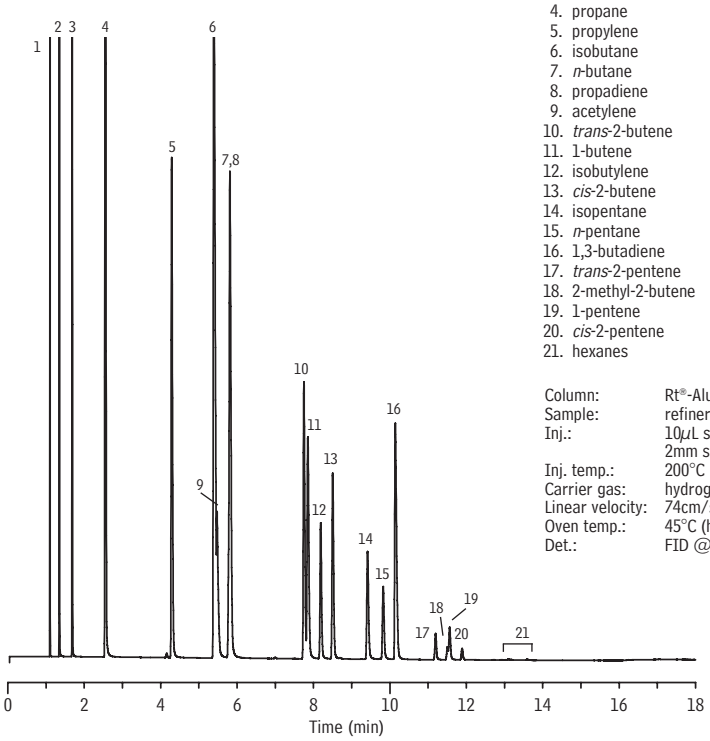
Online: www.restek.com—24-hours a day

Outside the U.S.

Contact your Restek representative:
Refer to our list on pages 4-5 or visit our website at www.restek.com

Refinery Gas
Rt®-Alumina BOND/KCl
(PLOT)

NEW!



1. methane
2. ethane
3. ethylene
4. propane
5. propylene
6. isobutane
7. n-butane
8. propadiene
9. acetylene
10. trans-2-butene
11. 1-butene
12. isobutylene
13. cis-2-butene
14. isopentane
15. n-pentane
16. 1,3-butadiene
17. trans-2-pentene
18. 2-methyl-2-butene
19. 1-pentene
20. cis-2-pentene
21. hexanes

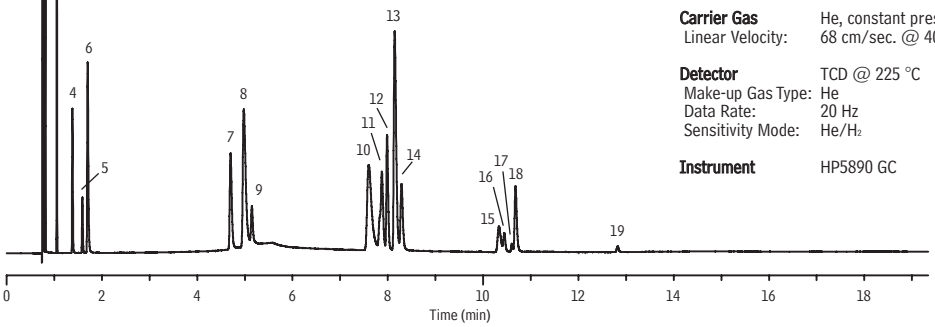
Column:	Rt®-Alumina BOND/KCl, 50m, 0.53mm ID, 10µm (cat.# 19760)
Sample:	refinery gas
Inj.:	10µL split (split vent flow 80mL/min.), 2mm single gooseneck liner (cat.# 20795)
Inj. temp.:	200°C
Carrier gas:	hydrogen, constant pressure, 8.0psi
Linear velocity:	74cm/sec. @ 45°C
Oven temp.:	45°C (hold 1 min.) to 200°C @ 10°C/min. (hold 3.5 min.)
Det.:	FID @ 200°C

GC_PC01088

Refinery Gas Mixture
Rt®-QS-BOND
(PLOT)

NEW!

Peaks
1. Air
2. Methane
3. Carbon dioxide
4. Ethylene
5. Acetylene
6. Ethane
7. Propylene
8. Propane
9. Propadiene
10. Isobutane
11. Isobutylene/1-Butene
12. 1,3-Butadiene
13. *n*-Butane/*cis*-2-Butene
14. *trans*-2-Butene
15. Isopentane
16. 1-Pentene
17. 2-Methyl-2-butene
18. *n*-Pentane/*cis*-2-Pentene
19. *n*-Hexane



GC_PC1143

Column Rt®-QS-BOND, 30 m, 0.53 mm ID, 20 µm (cat.# 19738)
Sample refinery gas standard

Injection
Inj. Vol.: 20 µL split
Liner: 2mm Splitless (cat.# 20712)
Inj. Temp.: 200 °C
Split Vent Flow Rate: 35 mL/min.

Oven
Oven Temp: 40 °C (hold 2 min.) to 225 °C at 15 °C/min. (hold 5 min.)

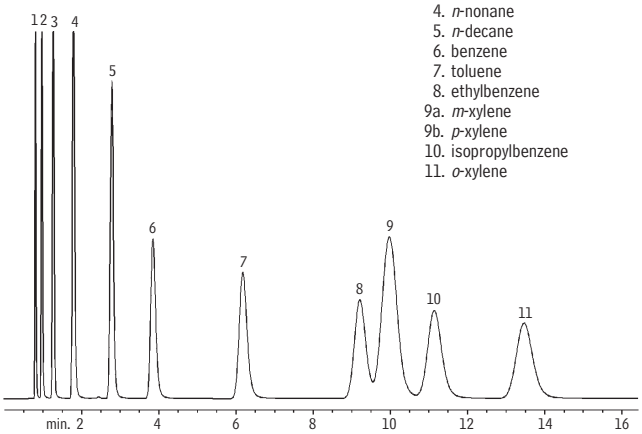
Carrier Gas He, constant pressure (11.5 psi, 79.3kPa)
Linear Velocity: 68 cm/sec. @ 40 °C

Detector TCD @ 225 °C
Make-up Gas Type: He
Data Rate: 20 Hz
Sensitivity Mode: He/H_2

Instrument HP5890 GC

Aromatics, Aliphatics
10% TCEP 100/120 Chromosorb® PAW
(packed)

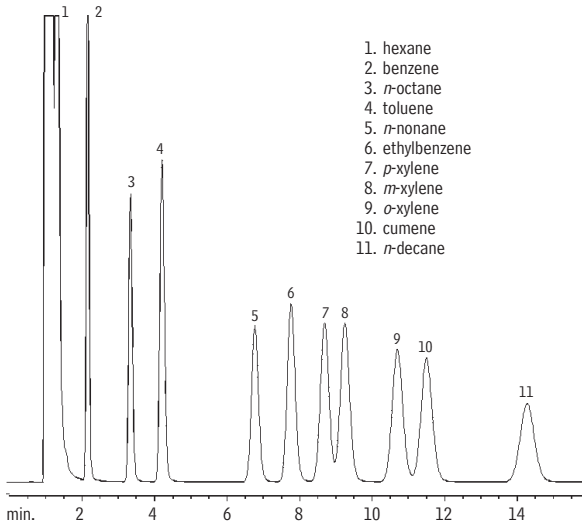
1. *n*-hexane
2. *n*-heptane
3. *n*-octane
4. *n*-nonane
5. *n*-decane
6. benzene
7. toluene
8. ethylbenzene
9a. *m*-xylene
9b. *p*-xylene
10. isopropylbenzene
11. *o*-xylene



GC_PC00217

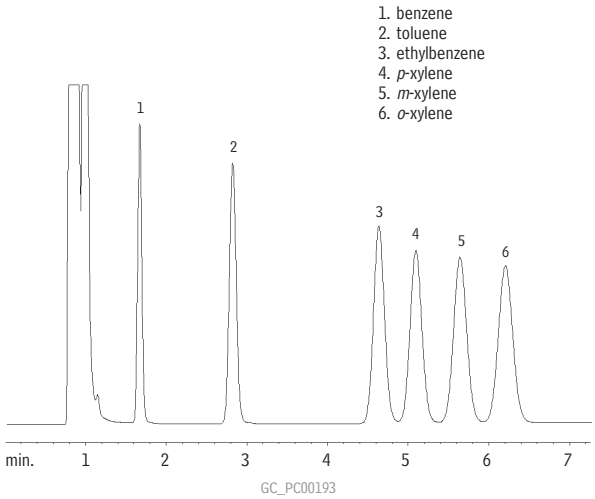
Column: 10% TCEP on 100/120 Chromosorb® PAW, 2.5m, 1/8" OD, 2mm ID SilcoSmooth® tubing (cat.# 80126)
Sample size: 0.1mL neat
Oven temp.: 80°C
Inj./det. temp.: 200°C/250°C
Carrier gas: nitrogen
Flow rate: 20mL/min.
FID sensitivity: 128 x 10^{-10} AFS

Aromatics (Xylene Isomers plus Cumene)
5% Rt®-1200/1.75% Bentone® 34
(packed)



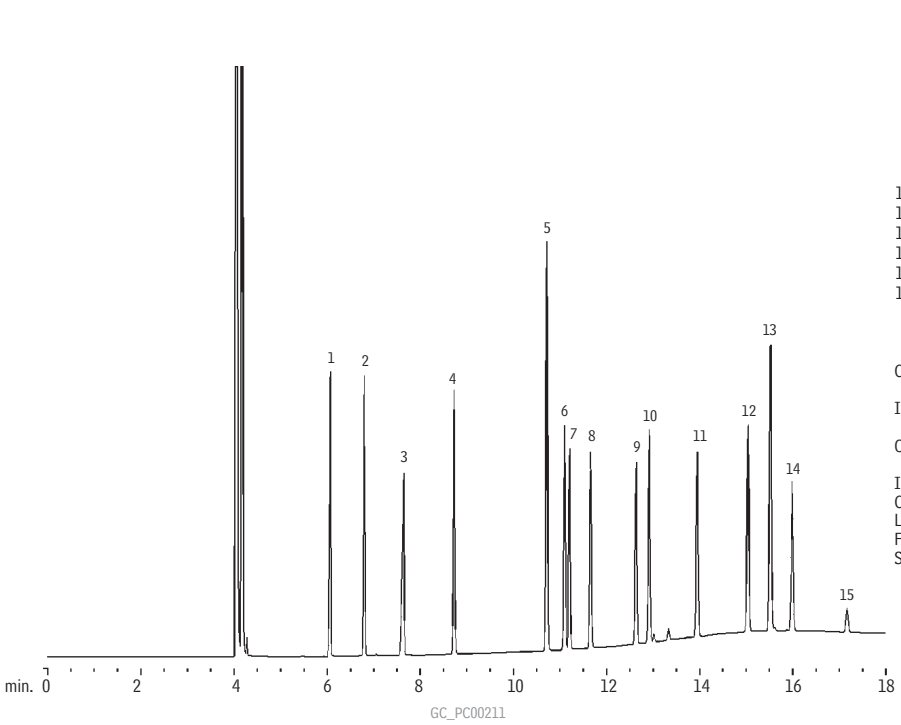
Column:	5% Rt®-1200/1.75% Bentone® 34 on 100/120 Silcoport®, 1.8m, 1/8" OD, 2mm ID SilcoSmooth® tubing (cat.# 80125)
Sample size:	0.1µL
Conc.:	0.5µg/µL in hexane
Oven temp.:	75°C
Inj./det. temp.:	200°C
Carrier gas:	nitrogen
Flow rate:	20mL/min.
FID sensitivity:	32 x 10^{-11} AFS

Aromatics (Xylene Isomers /BTEX)
5% Rt®-1200/5% Bentone® 34
(packed)



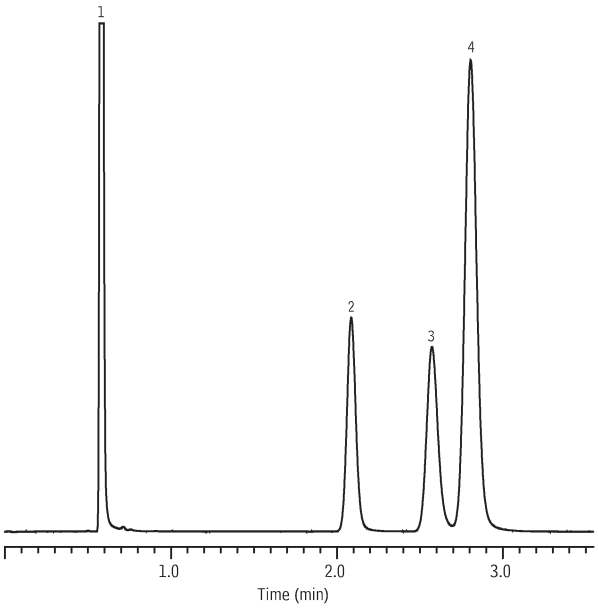
Column:	5% Rt®-1200/5% Bentone® 34 100/120 Silcoport®, 2m, 1/8" OD, 2mm ID SilcoSmooth® tubing (cat.# 80129)
Sample size:	0.1µL
Conc.:	0.5µg/µL in hexane
Oven temp.:	100°C
Inj./det. temp.:	200°C
Carrier gas:	nitrogen
Flow rate:	20mL/min.
FID sensitivity:	32 x 10^{-11} AFS

Aromatics
Rt®-TCEP



Column:	Rt®-TCEP, 60m, 0.25mm ID, 0.40µm (cat.# 10999)
Inj.:	1.0µL 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 x 10^{-11} AFS
Split flow:	46mL/min.

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



GC_PC00775

1. nonaromatics
2. benzene
3. methyl ethyl ketone (IS)
4. toluene

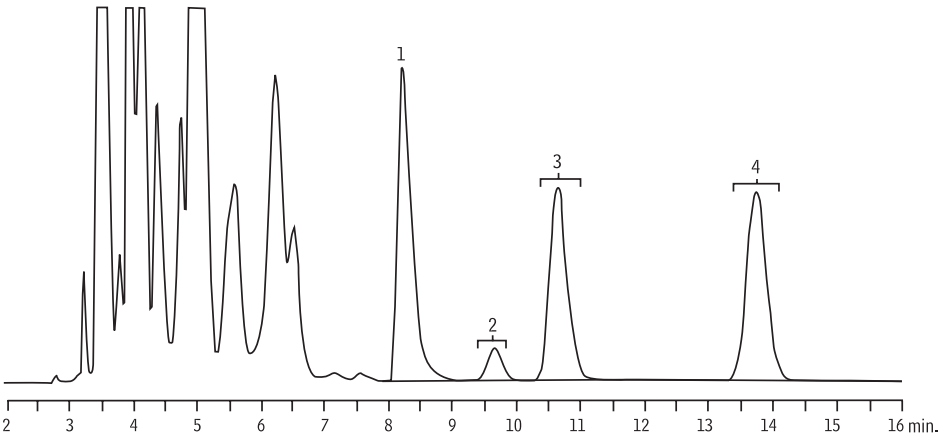
Column:
A: 10% Rtx®-1 on 60/80 Chromosorb® WAW, 0.8m, 1/16 inch, 1mm ID Silcosteel® tubing

B: 20% TCEP on 80/100 Chromosorb® PAW, 4.0m, 1/16 inch, 1mm ID Silcosteel® tubing connected in series and using Micropacked Column On-Column Injection Kit

Sample:	benzene, toluene, methyl ethyl ketone in pentane
Inj.:	1.0µL, on-column, 4mm ID splitless inlet liner (cat.# 20772)
Carrier gas:	hydrogen, constant flow
Flow rate:	9.0mL/min.
Inj. temp.:	200°C
Oven temp.:	145°C
Det.:	FID @ 200°C

Gasoline
ASTM D3606 Modified (for Gasoline Containing Ethanol)
(packed)

NEW!



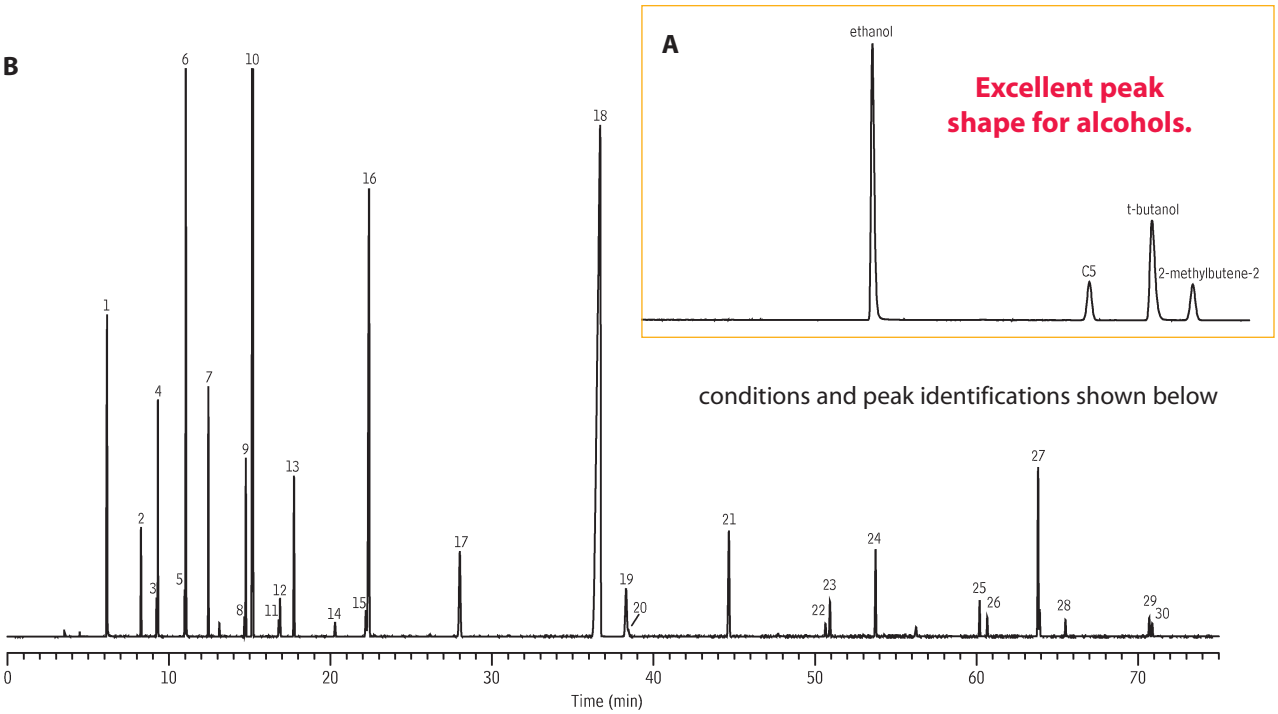
GC_PC01079

1. ethanol
2. benzene
3. 2-butanol
4. toluene

Column:	D3606 Application Column (2 column set, cat.# 83606-800) Column 1: nonpolar Rtx®-1, 6' (1.8m), 1/8" OD, 2.0mm ID Column 2: proprietary packing material, 16' (4.9m), 1/8" OD, 2.0mm ID
Sample:	1.5µL gasoline with internal standard
Inj.:	200°C
Backflush:	3 min.
Carrier gas:	helium, constant flow
Flow rate:	20mL/min.
Oven temp.:	135°C, isothermal
Det.:	TCD @ 200°C

Chromatogram courtesy of Boguslaw Dudek, Conoco Phillips, Linden, NJ.

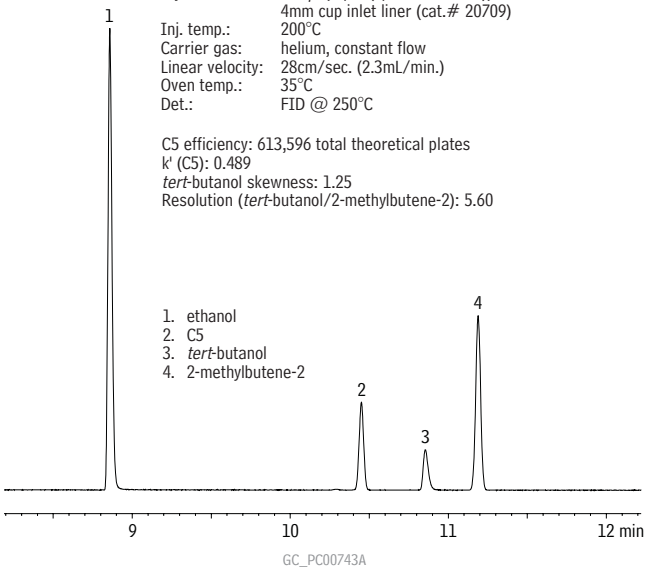
Fast Detailed Hydrocarbons Analysis (DHA)
Rtx®-DHA-100/Rtx®-5 DHA Tuning Column



Detailed Hydrocarbons Analysis (DHA)
Rtx®-DHA-100/Rtx®-5 DHA Tuning Column

Column: Rtx®-DHA-100, 100m, 0.25mm ID, 0.5µm (cat.# 10148) plus Rtx®-5 DHA tuning column, 2.62m, 0.25mm ID, 1.0µm, connected via Press-Tight® connector (cat.# 20446)
Sample: custom detailed hydrocarbons analysis (DHA) mix, neat
Inj.: 0.01µL, 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



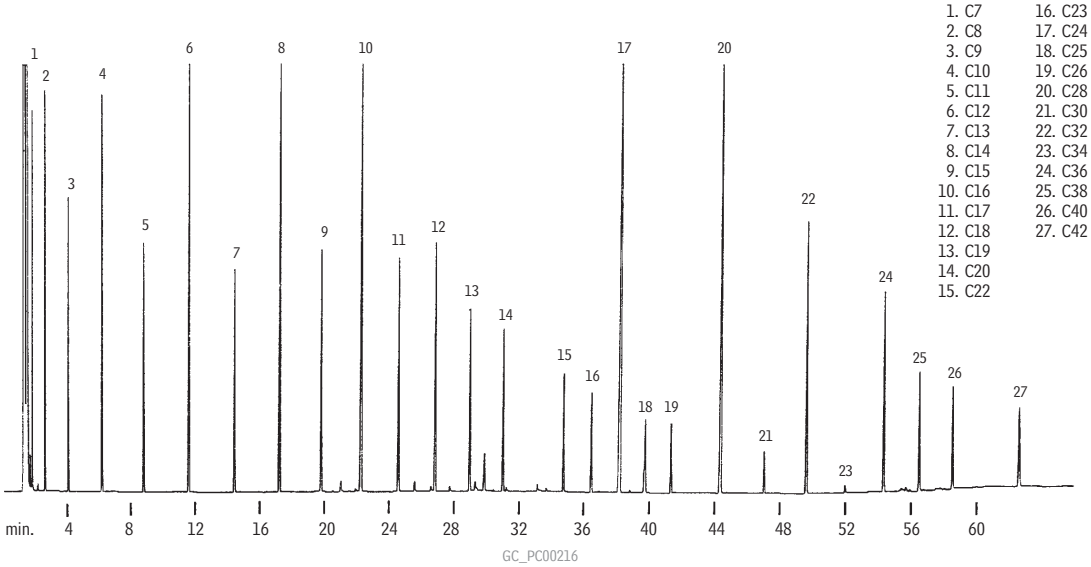
Column: Rtx®-DHA-100 100m, 0.25mm ID, 0.5µm (cat.# 10148) plus Rtx®-5 DHA tuning column (cat.# 10165), connected via angled Press-Tight® connector (cat.# 20446)
Sample: DHA/oxygenates setup blend
Inj.: 0.01µL, split (split ratio 150:1), 4mm ID cup inlet liner (cat.# 20709)
A: front slice of DHA/oxygenates 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: R = 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, C7-C42
Rtx®-1



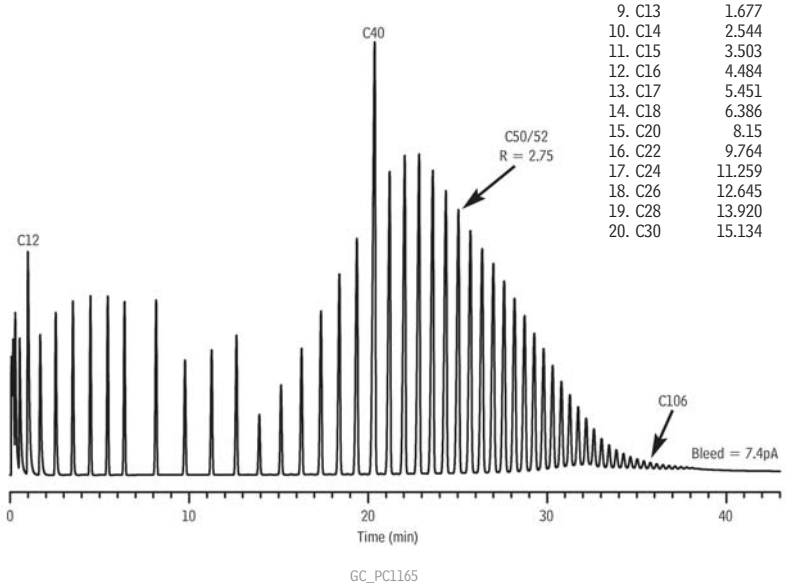
Column:	Rtx®-1, 30m, 0.53mm ID, 0.25µm (cat.# 10125)
Sample:	0.2µL injection of a synthetic hydrocarbon mix, ~ 0.1mg/mL per component
Inj.:	Direct injection using a Uniliner® inlet liner
Oven temp.:	40°C to 340°C @ 5°C/min.
Inj./det. temp.:	340°C
Carrier gas:	hydrogen
Linear velocity:	40cm/sec. set @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

C5-C106 Hydrocarbons on MXT®-1HT SimDist at 430 °C

NEW!

Lowest bleed product on the market!

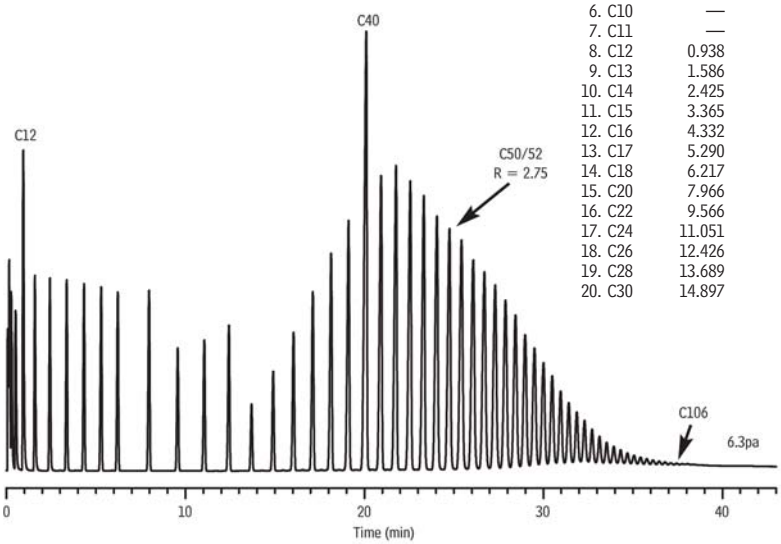
Peaks	RT (min.)	Peaks	RT (min.)	Peaks	RT (min.)
1. C5	—	21. C32	16.280	41. C72	30.789
2. C6	—	22. C34	17.364	42. C74	31.265
3. C7	—	23. C36	18.392	43. C76	31.725
4. C8	—	24. C38	19.371	44. C78	32.173
5. C9	—	25. C40	20.363	45. C80	32.609
6. C10	—	26. C42	21.199	46. C82	33.033
7. C11	—	27. C44	22.041	47. C84	33.454
8. C12	0.988	28. C46	22.843	48. C86	33.858
9. C13	1.677	29. C48	23.609	49. C88	34.256
10. C14	2.544	30. C50	24.340	50. C90	34.643
11. C15	3.503	31. C52	25.041	51. C92	35.024
12. C16	4.484	32. C54	25.712	52. C94	35.395
13. C17	5.451	33. C56	26.365	53. C96	35.758
14. C18	6.386	34. C58	26.990	54. C98	36.115
15. C20	8.15	35. C60	27.594	55. C100	36.460
16. C22	9.764	36. C62	28.173	56. C102	36.803
17. C24	11.259	37. C64	28.733	57. C104	37.139
18. C26	12.645	38. C66	29.274	58. C106	37.465
19. C28	13.920	39. C68	29.797		
20. C30	15.134	40. C70	30.303		



Column	MXT®-1HT SimDist, 5 m, 0.53 mm ID, 0.10 µm (cat.# 70112)
Sample	custom C5-C106 hydrocarbon standard
Diluent:	carbon disulfide
Conc.:	1%
Injection	
Inj. Vol.:	0.5 µL cold on-column
Temp. Program:	53°C to 430°C at 10°C/min. (hold 5 min.)
Oven	
Oven Temp:	50 °C to 430 °C at 10 °C/min. (hold 5 min.)
Carrier Gas	He, constant flow
Flow Rate:	18 mL/min.
Detector	FID @ 430 °C
Make-up Gas	
Flow Rate:	24 mL/min.
Constant Column + Constant Make-up:	42 mL/min.
Make-up	
Gas Type:	N_2
Data Rate:	20 Hz
Instrument	Shimadzu 2010 GC

C5-C106 Hydrocarbons on MXT®-1HT SimDist at 450 °C

NEW!

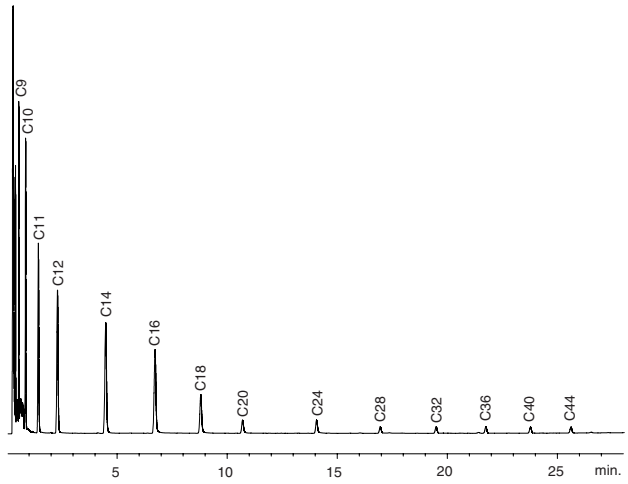


GC_PC1164

Peaks	RT (min.)	Peaks	RT (min.)	Peaks	RT (min.)
1. C5	—	21. C32	16.035	41. C72	30.489
2. C6	—	22. C34	17.110	42. C74	30.906
3. C7	—	23. C36	18.133	43. C76	31.414
4. C8	—	24. C38	19.108	44. C78	31.862
5. C9	—	25. C40	20.096	45. C80	32.294
6. C10	—	26. C42	20.923	46. C82	32.719
7. C11	—	27. C44	21.759	47. C84	33.132
8. C12	0.938	28. C46	22.556	48. C86	33.529
9. C13	1.586	29. C48	23.317	49. C88	33.927
10. C14	2.425	30. C50	24.051	50. C90	34.310
11. C15	3.365	31. C52	24.752	51. C92	34.689
12. C16	4.332	32. C54	25.422	52. C94	35.059
13. C17	5.290	33. C56	26.079	53. C96	35.423
14. C18	6.217	34. C58	26.701	54. C98	35.773
15. C20	7.966	35. C60	27.305	55. C100	36.120
16. C22	9.566	36. C62	27.878	56. C102	36.463
17. C24	11.051	37. C64	28.439	57. C104	36.793
18. C26	12.426	38. C66	28.975	58. C106	37.118
19. C28	13.689	39. C68	29.499		
20. C30	14.897	40. C70	30.002		

Column MXT®-1HT SimDist, 5 m, 0.53 mm ID, 0.10 µm (cat.# 70112)
Sample custom C5-C106 hydrocarbon standard
Diluent: carbon disulfide
Conc.: 1%
Injection
Inj. Vol.: 0.5 µL cold on-column
Temp. Program: 53°C to 450°C at 10°C/min. (hold 5 min.)
Oven
Oven Temp: 50 °C to 450 °C at 10 °C/min. (hold 5 min.)
Carrier Gas He, constant flow
Flow Rate: 18 mL/min.
Detector FID @ 450 °C
Make-up
Gas Flow Rate: 24 mL/min.
Constant Column + Constant Make-up: 42 mL/min.
Make-up
Gas Type: N_2
Data Rate: 20 Hz
Instrument Shimadzu 2010 GC

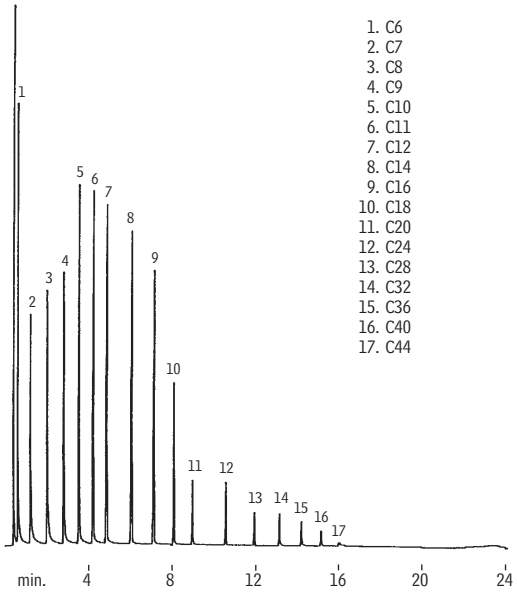
Hydrocarbons (C10-C44) MXT®-1HT Sim Dist



GC_PC00529

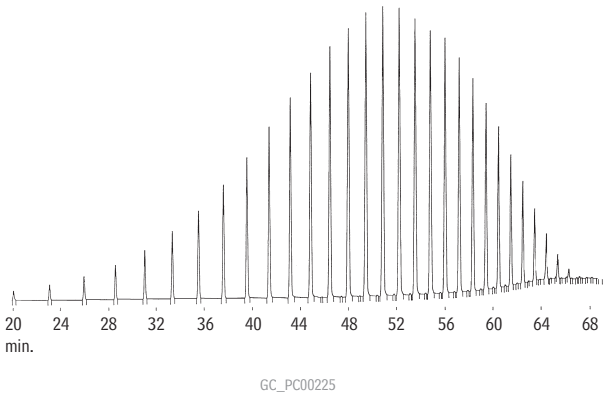
Column: MXT®-1HT Sim Dist, 5m, 0.53mm ID, 0.10µm (cat.# 70100)
Sample: 0.2µL hydrocarbon standard (cat.# 31222)
Solvent: carbon disulfide
Oven temp.: 40°C to 430°C @ 10°C/min. (hold 30 min.)
Injector: on-column (track oven)
Carrier gas: helium (constant pressure)
Head pressure: 1.0psi
Linear velocity: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

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



Column:	MXT®-1 Sim Dist, 6m, 0.53mm ID, 0.15µm (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

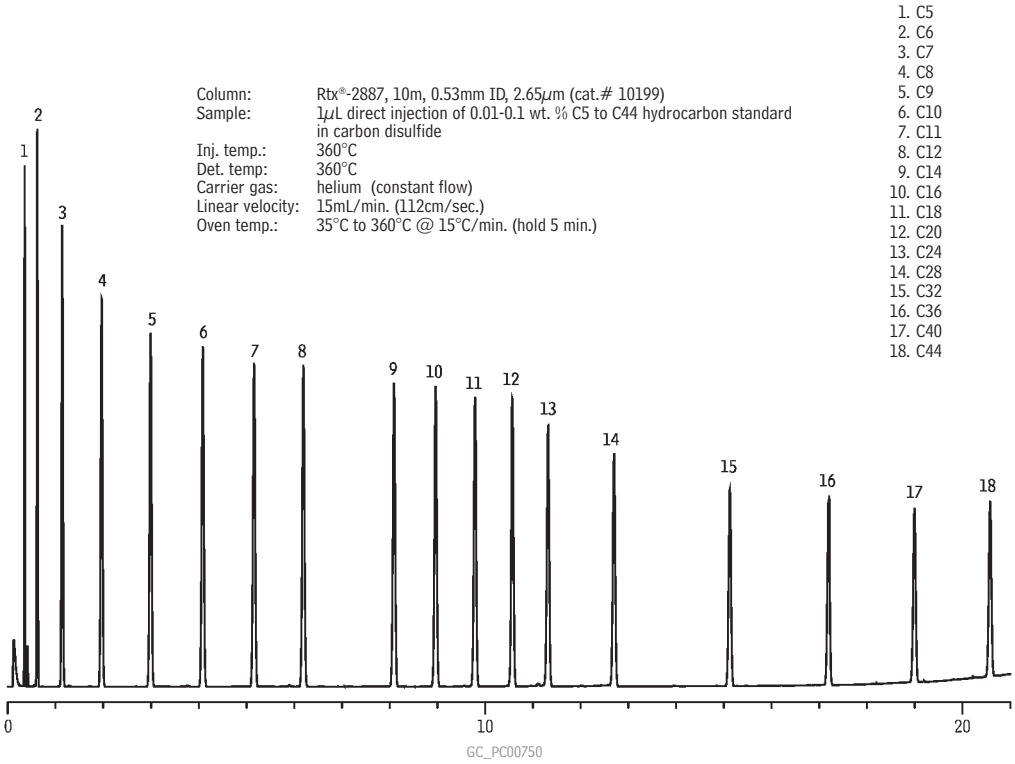
Simulated Distillation (High-Temperature) MXT®-500 Sim Dist



Column:	MXT®-500 Sim Dist, 6m, 0.53mm ID, 0.15µm (cat.# 70104)
Sample:	cold on-column injection of Polywax® 655 in CS_2
Oven temp.:	40°C to 430°C @ 6°C/min.
Carrier gas:	helium
Linear velocity:	40cm/sec.
FID sensitivity:	2 x 10^{-11}AFS

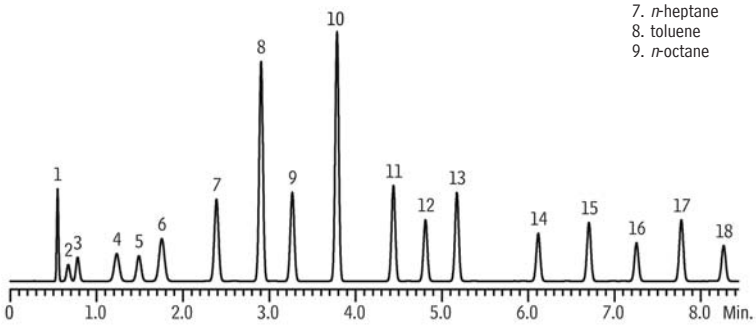
Simulated Distillation Rtx®-2887

Column:	Rtx®-2887, 10m, 0.53mm ID, 2.65µm (cat.# 10199)
Sample:	1µL 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.)



Simulated Distillation
Rtx®-1 (Hydrogen Carrier Gas)

1. ethanol
2. isopentane
3. *n*-pentane
4. 2-methylpentane
5. *n*-hexane
6. 2,4-dimethylpentane
7. *n*-heptane
8. toluene
9. *n*-octane
10. *p*-xylene
11. *n*-propylbenzene
12. *n*-decane
13. butylbenzene
14. *n*-dodecane
15. *n*-tridecane
16. *n*-tetradecane
17. *n*-pentadecane
18. *n*-hexadecane

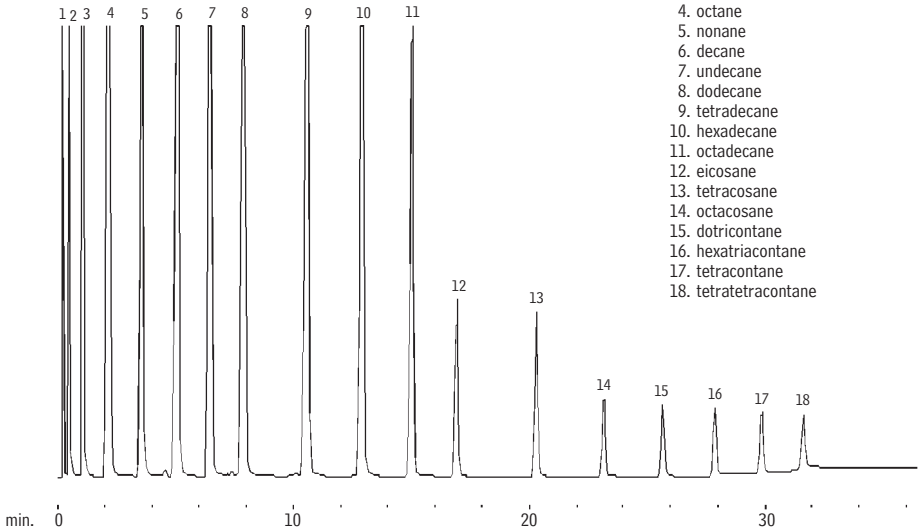


GC_PC00852

Column:	Rtx®-1, 30m, 0.53mm ID, 5.0µm (cat.# 10179)
Sample:	custom paraffin mix, neat, 2.7-12.9% each component
Inj.:	0.1µL 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)

1. pentane
2. hexane
3. heptane
4. octane
5. nonane
6. decane
7. undecane
8. dodecane
9. tetradecane
10. hexadecane
11. octadecane
12. eicosane
13. tetracosane
14. octacosane
15. dotricontane
16. hexatriacontane
17. tetracontane
18. tetratetracontane

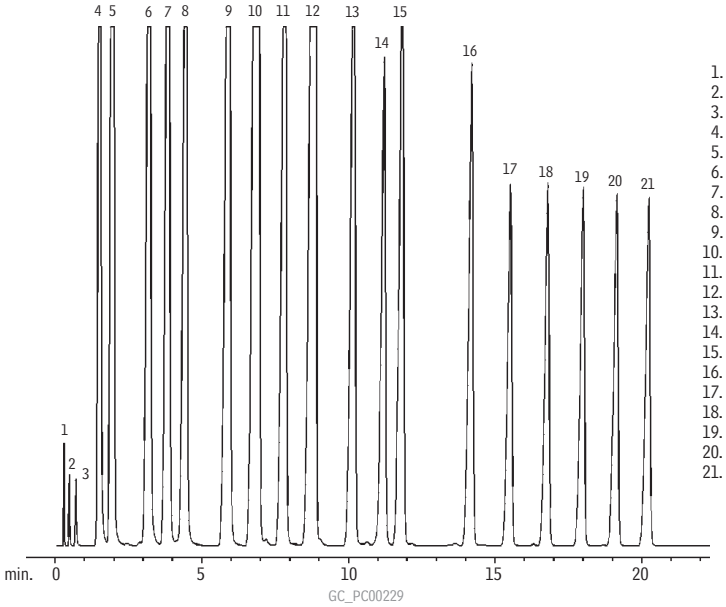


GC_PC00228

Column:	Rtx®-1 SimDist 2887, SilcoSmooth® stainless steel, 25", 1/8", 2mm ID (cat.# 80000)
Inj.:	1.0µL 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 CS_2) and cat.# 31675 (5% each, neat) meet requirements of ASTM D2887-01.

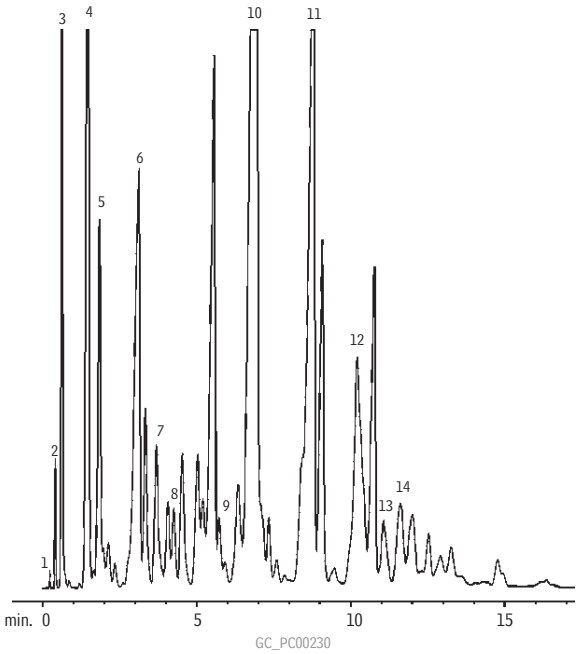
Simulated Distillation (ASTM D-3710 Calibration)
Rtx®-1 SimDist 2887
(packed)



1. *n*-propane
2. 2-methyl propane
3. *n*-butane
4. 2-methylbutane
5. *n*-pentane
6. 2-methylpentane
7. *n*-hexane
8. 2,4-dimethylpentane
9. *n*-heptane
10. toluene
11. *n*-octane
12. *p*-xylene
13. *n*-propylbenzene
14. *n*-decane
15. *n*-butylbenzene
16. *n*-dodecane
17. *n*-tridecane
18. *n*-tetradecane
19. *n*-pentadecane
20. *n*-hexadecane
21. *n*-heptadecane

Column:	Rtx®-1 SimDist 2887, SilcoSmooth® stainless steel, 25", 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 x 10^{-11} AFS

Simulated Distillation (ASTM D-3710, Gasoline)
Rtx®-1 SimDist 2887
(packed)

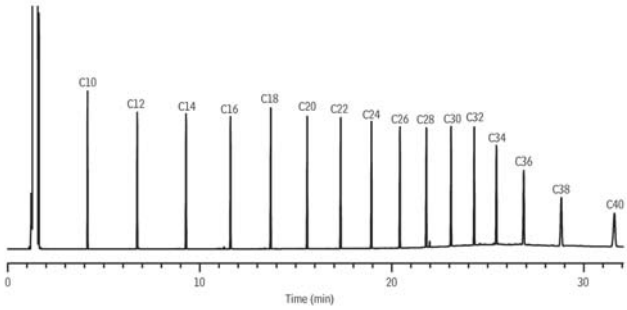


1. *n*-propane
2. 2-methyl propane
3. *n*-butane
4. 2-methylbutane
5. *n*-pentane
6. 2-methylpentane
7. *n*-hexane
8. 2,4-dimethylpentane
9. *n*-heptane
10. toluene
11. *p*-xylene
12. *n*-propylbenzene
13. *n*-decane
14. *n*-butylbenzene

Column:	Rtx®-1 SimDist 2887, SilcoSmooth® stainless steel, 25", 1/8", 2mm ID (cat.# 80000)
Sample:	1.0µL 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 x 10^{-11} AFS

Crude Oil on Rxi®-5HT

NEW!



GC_PC1159

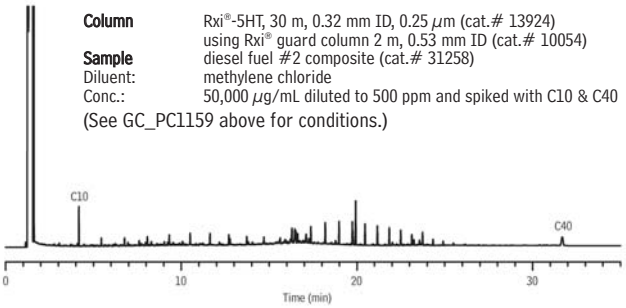
Column	Rxi®-5HT, 30 m, 0.32 mm ID, 0.25 µm (cat.# 13924) using Rxi® Guard Column 2 m, 0.53 mm ID (cat.# 10054)
Sample	System Performance Test Standard Mixture of *n*-Alkanes (cat.# 31678)
Diluent:	Hexane
Conc.:	50 µg/mL
Injection	
Inj. Vol.:	1 µL cold on-column
Temp. Program:	53°C to 300°C at 10°C/min. (hold 20 min.)
Oven	
Oven Temp:	50 °C to 300 °C at 10 °C/min. (hold 20 min.)
Carrier Gas	H_2, constant flow
Linear Velocity:	40 cm/sec. @ 50 °C
Dead Time:	1.25 min. @ 50 °C
Detector	FID @ 330 °C
Make-up Gas Flow Rate:	30 mL/min.
Make-up Gas Type:	N_2
Data Rate:	20 Hz
Instrument	Agilent/HP6890 GC

Diesel on Rxi®-5HT

NEW!

Column	Rxi®-5HT, 30 m, 0.32 mm ID, 0.25 µm (cat.# 13924) using Rxi® guard column 2 m, 0.53 mm ID (cat.# 10054)
Sample	diesel fuel #2 composite (cat.# 31258)
Diluent:	methylene chloride
Conc.:	50,000 µg/mL diluted to 500 ppm and spiked with C10 & C40

(See GC_PC1159 above for conditions.)



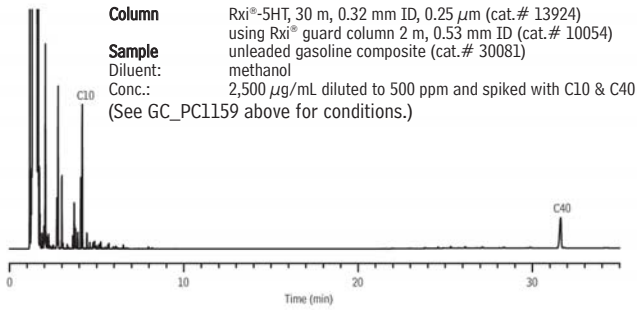
GC_PC1160

Gasoline on Rxi®-5HT

NEW!

Column	Rxi®-5HT, 30 m, 0.32 mm ID, 0.25 µm (cat.# 13924) using Rxi® guard column 2 m, 0.53 mm ID (cat.# 10054)
Sample	unleaded gasoline composite (cat.# 30081)
Diluent:	methanol
Conc.:	2,500 µg/mL diluted to 500 ppm and spiked with C10 & C40

(See GC_PC1159 above for conditions.)



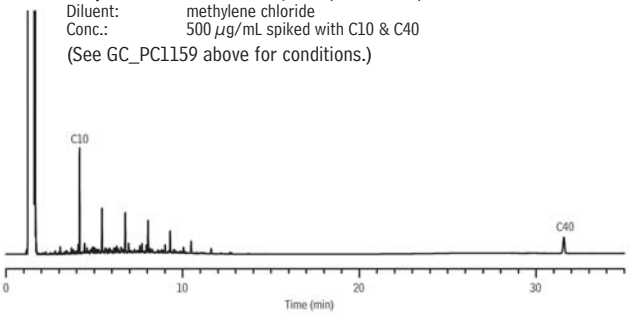
GC_PC1161

Kerosene on Rxi®-5HT

NEW!

Column	Rxi®-5HT, 30 m, 0.32 mm ID, 0.25 µm (cat.# 13924) using Rxi® guard column 2 m, 0.53 mm ID (cat.# 10054)
Sample	kerosene composite (cat.# 31094)
Diluent:	methylene chloride
Conc.:	500 µg/mL spiked with C10 & C40

(See GC_PC1159 above for conditions.)



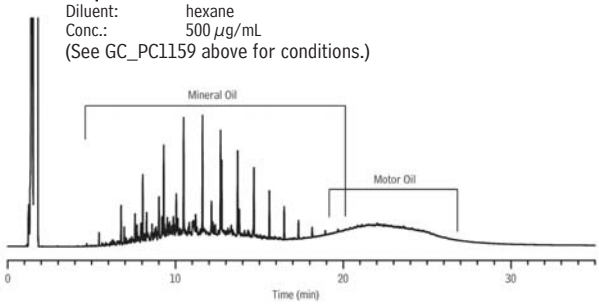
GC_PC1162

Mineral Oil & Motor Oil on Rxi®-5HT

NEW!

Column	Rxi®-5HT, 30 m, 0.32 mm ID, 0.25 µm (cat.# 13924) using Rxi® Guard Column 2 m, 0.53 mm ID (cat.# 10054)
Sample	custom mineral oil and motor oil standard
Diluent:	hexane
Conc.:	500 µg/mL

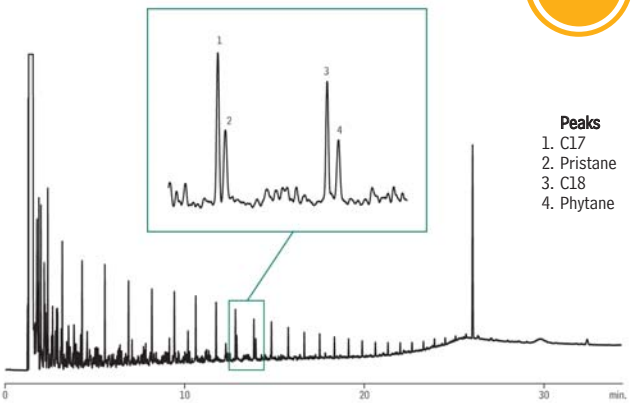
(See GC_PC1159 above for conditions.)



GC_PC1163

Midrange Crude on Rxi®-5HT

NEW!



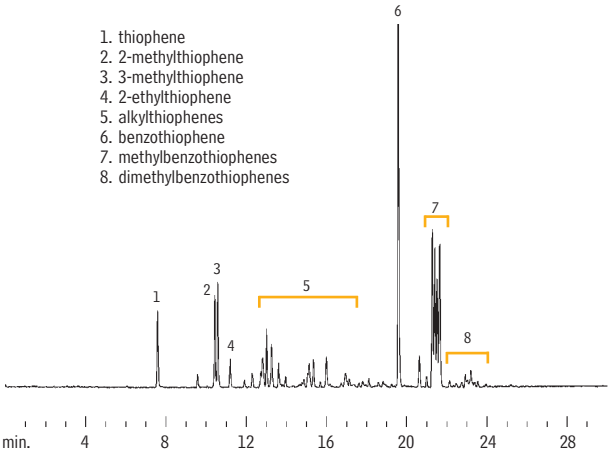
Peaks
1. C17
2. Pristane
3. C18
4. Phytane

GC_PC1172

Column	Rxi®-5HT, 30 m, 0.32 mm ID, 0.10 µm (cat.# 13909) using retention gap 2 m, 0.53 mm ID,
Sample	Midrange crude
Conc.:	500 µg/mL
Injection	
Inj. Vol.:	1.0 µL cold on-column
Oven	
Oven Temp:	50 °C to 300 °C at 10 °C/min. (hold 10 min.)
Carrier Gas	H_2, constant flow
Linear Velocity:	40 cm/sec.
Detector	FID @ 330 °C
Instrument	Agilent/HP6890 GC
Acknowledgement	Sample courtesy of Exxon Mobil Corporation

Sulfur in Gasoline
Rtx®-1

1. thiophene
2. 2-methylthiophene
3. 3-methylthiophene
4. 2-ethylthiophene
5. alkylthiophenes
6. benzothiophene
7. methylbenzothiophenes
8. dimethylbenzothiophenes



GC_PC00198

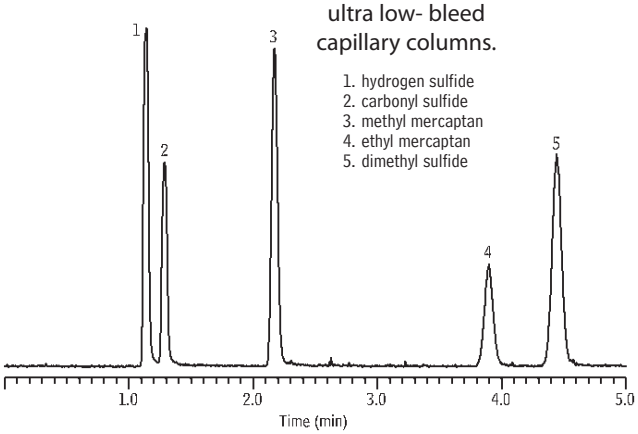
Column:	Rtx®-1, 30m, 0.32mm ID, 4.0µm (cat.# 10198)
Sample:	1.0µL split injection of gasoline containing 300ppm total sulfur
Oven temp.:	40°C (hold 3 min.) to 275°C @ 10°C/min. (hold 5 min.)
Inj./det. temp.:	275°C
Det.:	SCD
Carrier gas:	helium
Linear velocity:	70cm/sec. (flow rate: 2.5mL/min.)
Split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

Sulfur Compounds
Rxi®-1ms

Rxi® Technology!

Exceptionally inert, ultra low- bleed capillary columns.

1. hydrogen sulfide
2. carbonyl sulfide
3. methyl mercaptan
4. ethyl mercaptan
5. dimethyl sulfide



GC_AR00861

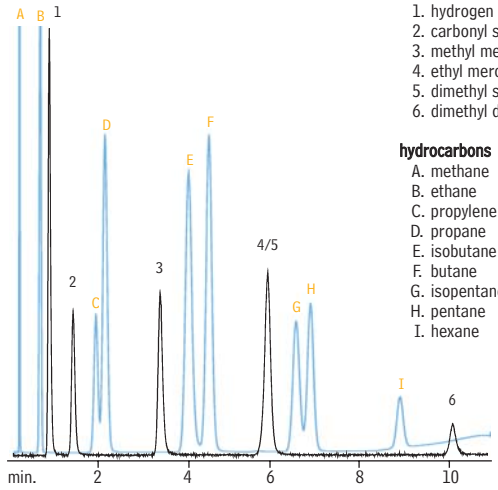
Column:	Rxi®-1ms, 30m, 0.32mm ID, 4.00µm (cat.# 13396)
Sample:	hydrogen sulfide, carbonyl sulfide, methyl mercaptan, ethyl mercaptan, dimethyl sulfide, 100 ppbv each in helium
Inj.:	1mL splitless, direct
Sample loop temp.:	30°C
Carrier gas:	helium, constant pressure
Linear velocity:	48cm/sec. @ 30°C
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)

sulfurs
1. hydrogen sulfide
2. carbonyl sulfide
3. methyl mercaptan
4. ethyl mercaptan
5. dimethyl sulfide
6. dimethyl disulfide

hydrocarbons
A. methane
B. ethane
C. propylene
D. propane
E. isobutane
F. butane
G. isopentane
H. pentane
I. hexane

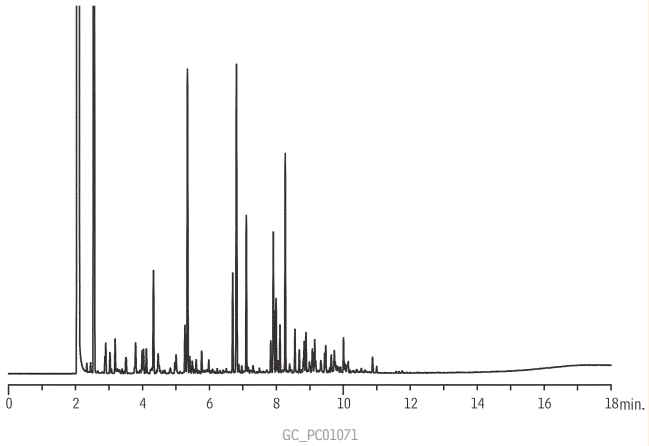


GC_PC00436

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

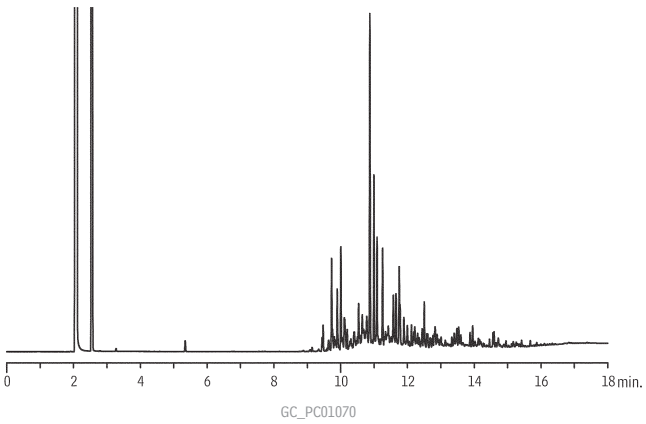
Sulfur standards courtesy of DCG Partnership 1 Ltd., Pearland, TX.

Unleaded Gasoline
Rxi®-1ms



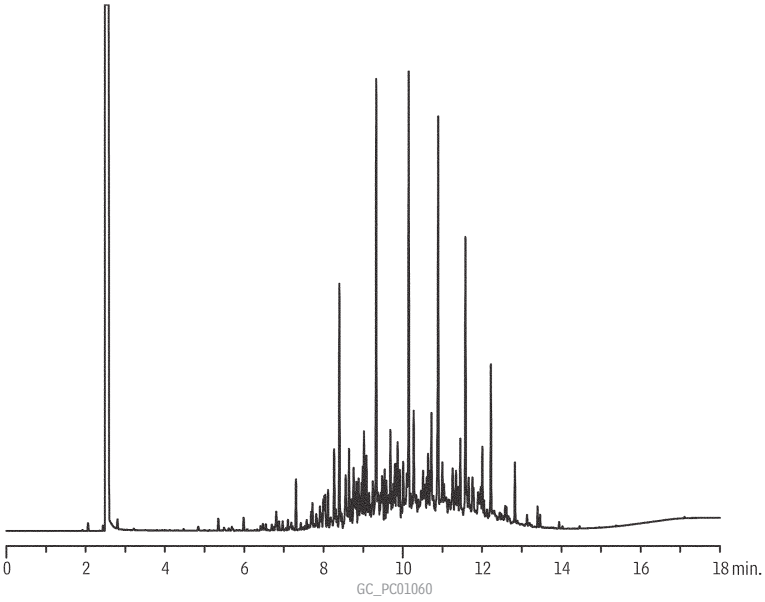
Column:	Rxi®-1ms, 30m, 0.25mm ID, 0.25µm (cat.# 13323)
Sample:	5,000µg/mL unleaded gasoline, unweathered, in methanol (cat.# 30096)
Inj.:	1µL split (split ratio 20:1), 4mm single gooseneck liner w/ wool (cat.# 22405)
Inj. temp.:	250°C
Carrier gas:	helium, constant flow
Linear velocity:	28cm/sec. @ 50°C
Oven temp.:	50°C (hold 2 min.) to 75°C @ 10°C/min. to 300°C @ 20°C/min. (hold 5 min.)
Det.:	FID @ 300°C

99% Weathered Unleaded Gasoline
Rxi®-1ms



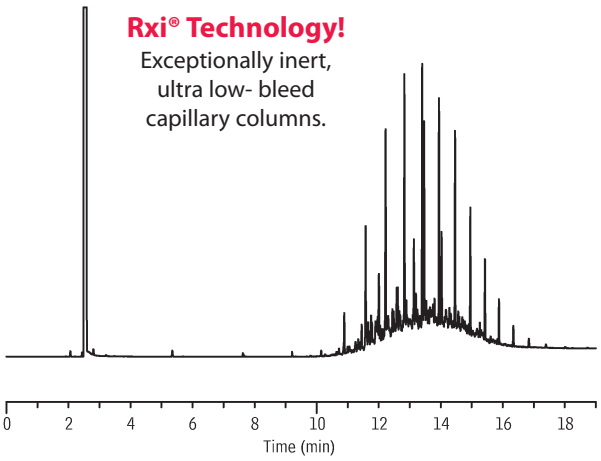
Column:	Rxi®-1ms, 30m, 0.25mm ID, 0.25µm (cat.# 13323)
Sample:	5,000µg/mL unleaded gasoline, 99% weathered, in methanol (cat.# 30436)
Inj.:	1µL split (split ratio 20:1), 4mm single gooseneck liner w/ wool (cat.# 22405)
Inj. temp.:	250°C
Carrier gas:	helium, constant flow
Linear velocity:	28cm/sec. @ 50°C
Oven temp.:	50°C (hold 2 min.) to 75°C @ 10°C/min. to 300°C @ 20°C/min. (hold 5 min.)
Det.:	FID @ 300°

Unweathered Kerosene
Rxi®-1ms



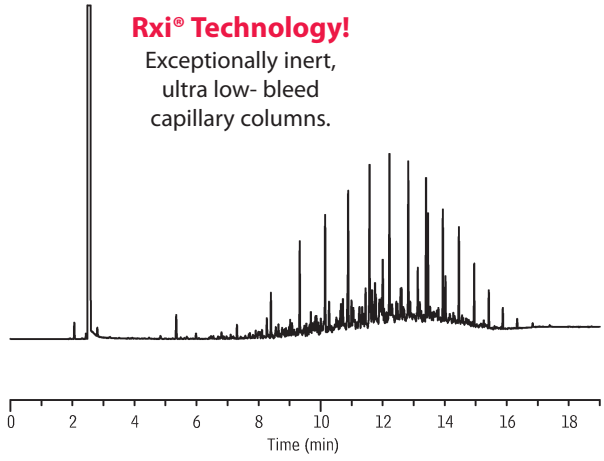
Column:	Rxi®-1ms, 30m, 0.25mm ID, 0.25µm (cat.# 13323)
Sample:	5,000µg/mL kerosene, unweathered, in methylene chloride (cat.# 31229)
Inj.:	1µL split (split ratio 20:1), 4mm single gooseneck liner w/ wool (cat.# 22405)
Inj. temp.:	250°C
Carrier gas:	helium, constant flow
Linear velocity:	28cm/sec. @ 50°C
Oven temp.:	50°C (hold 2 min.) to 75°C @ 10°C/min. to 300°C @ 20°C/min. (hold 5 min.)
Det.:	FID @ 300°C

50% Weathered Diesel Fuel #2
Rxi®-1ms



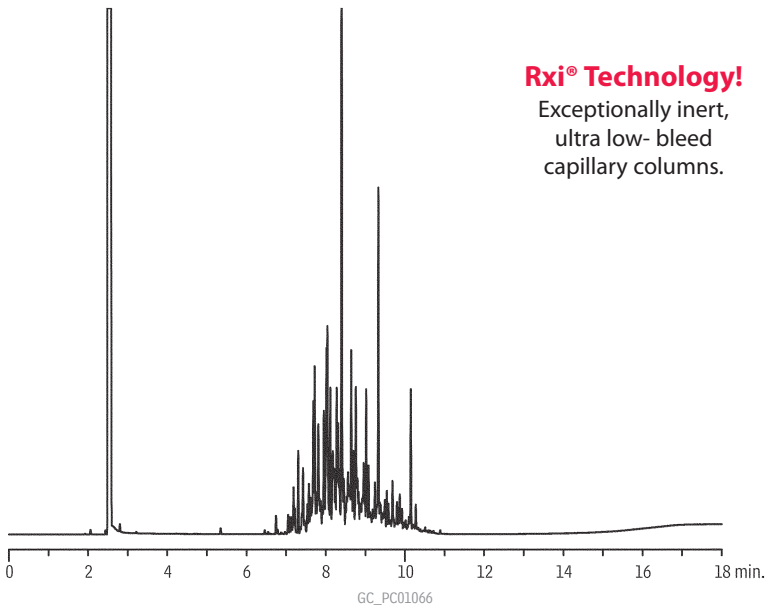
Column:	Rxi®-1ms, 30m, 0.25mm ID, 0.50µm (cat.# 13338)
Sample:	5,000µg/mL diesel fuel #2, 50% weathered (cat.# 31235) in methylene chloride
Inj.:	1.0µL split (split ratio 20:1), 4mm single gooseneck w/wool inlet liner (cat.# 22405)
Inj. temp.:	250°C
Carrier gas:	helium, constant flow
Linear velocity:	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



Column:	Rxi®-1ms, 30m, 0.25mm ID, 0.50µm (cat.# 13338)
Sample:	5,000µg/mL diesel fuel #2, unweathered (cat.# 31233) in methylene chloride
Inj.:	1.0µL 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
Rxi®-1ms



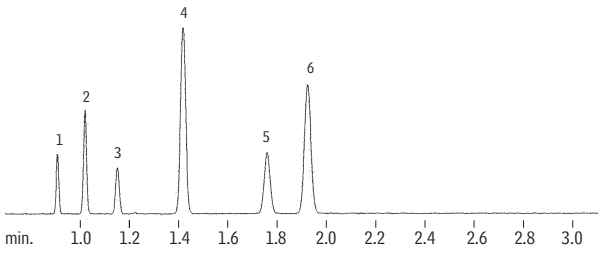
Column:	Rxi®-1ms, 30m, 0.25mm ID, 0.25µm (cat.# 13323)
Sample:	5,000µg/mL mineral spirits, unweathered, in methylene chloride (cat.# 31225)
Inj.:	1µL split (split ratio 20:1), 4mm single gooseneck liner w/ wool (cat.# 22405)
Inj. temp.:	250°C
Carrier gas:	helium, constant flow
Linear velocity:	28cm/sec. @ 50°C
Oven temp.:	50°C (hold 2 min.) to 75°C @ 10°C/min. to 300°C @ 20°C/min. (hold 5 min.)
Det.:	FID @ 300°C

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

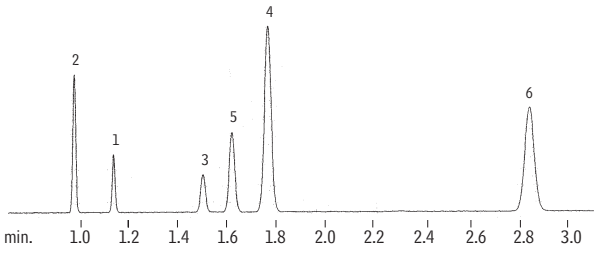
(headspace analysis)

	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)



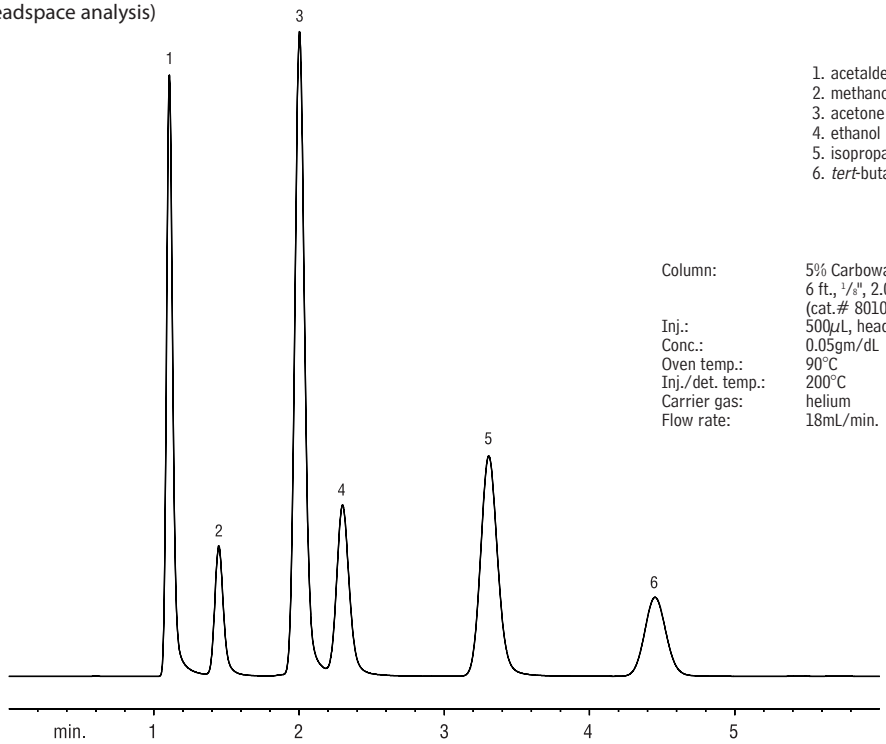
GC_PH00241

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)



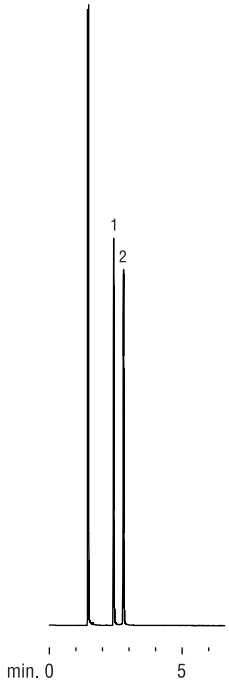
1. acetaldehyde
2. methanol
3. acetone
4. ethanol
5. isopropanol
6. *tert*-butanol

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.

GC_PH00478

Glycols
Rtx®-BAC1 & Rtx®-BAC2

Rtx®-BAC1

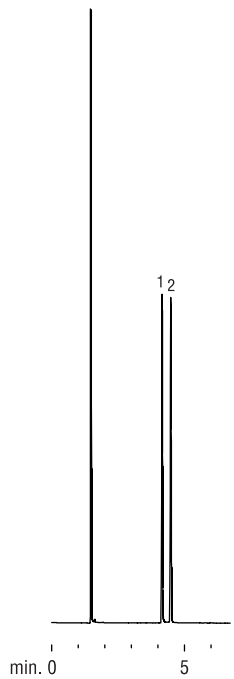


1. ethylene glycol
2. propylene glycol

Columns:	Rtx®-BAC1, 30m, 0.32mm ID, 1.8µm (cat.# 18003) Rtx®-BAC2, 30m, 0.32mm ID, 1.2µm (cat.# 18002)
Inj.:	0.5µL 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

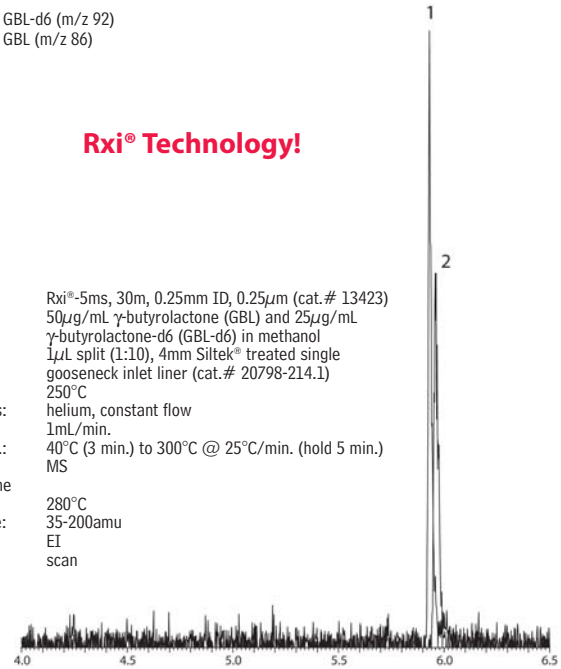
Rtx®-BAC2



γ-butyrolactone and γ-butyrolactone-d6
Rxi®-5ms

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

Rxi® Technology!

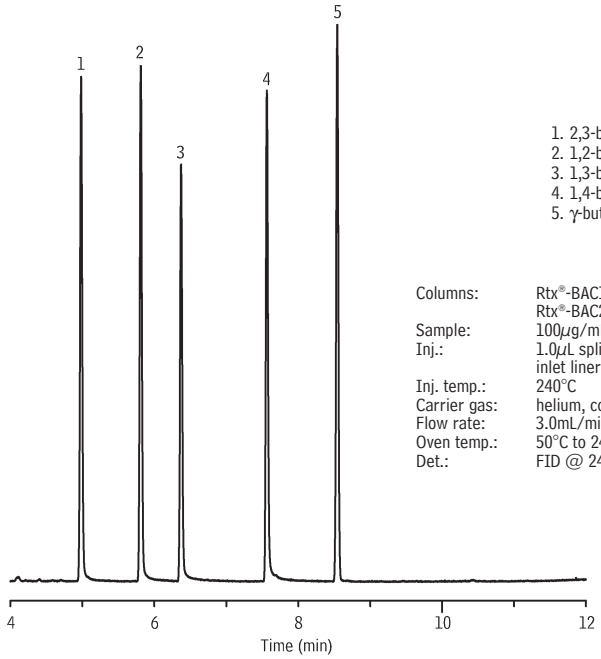


Column:	Rxi®-5ms, 30m, 0.25mm ID, 0.25µm (cat.# 13423)
Sample:	50µg/mL γ-butyrolactone (GBL) and 25µg/mL γ-butyrolactone-d6 (GBL-d6) in methanol
Inj.:	1µL split (1:10), 4mm Siltek® treated single gooseneck inlet liner (cat.# 20798-214.1)
Inj. temp.:	250°C
Carrier gas:	helium, constant flow
Flow rate:	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

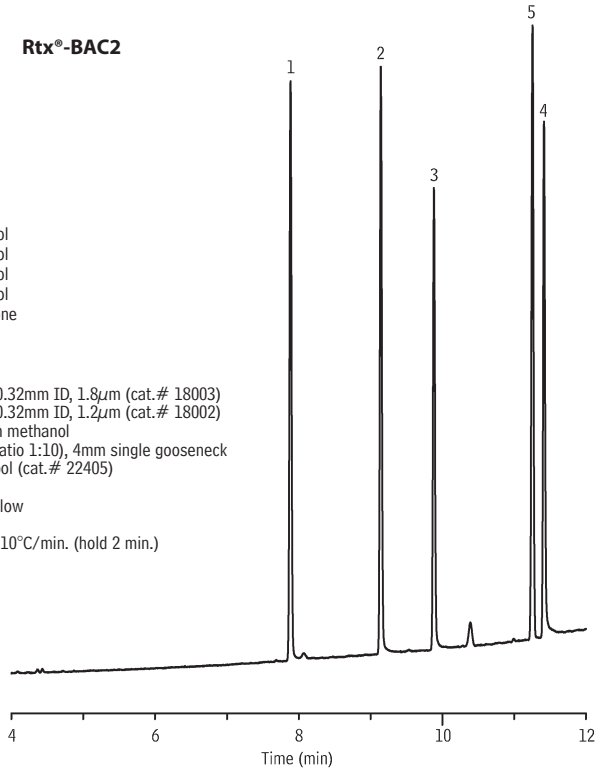
GC_PH00869

γ-butyrolactone & 1,4-butanediol
Rtx®-BAC1 & Rtx®-BAC2

Rtx®-BAC1



Rtx®-BAC2



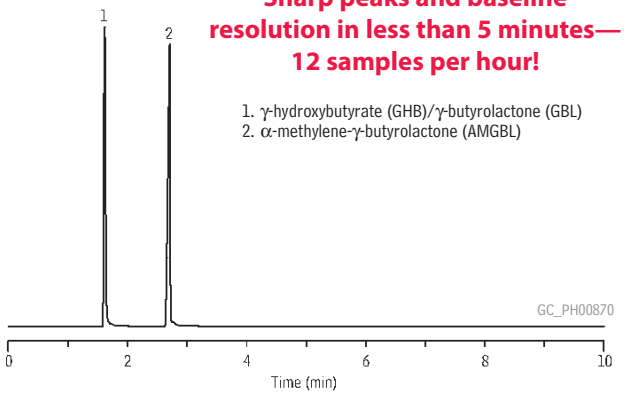
1. 2,3-butanediol
2. 1,2-butanediol
3. 1,3-butanediol
4. 1,4-butanediol
5. γ-butyrolactone

Columns:	Rtx®-BAC1, 30m, 0.32mm ID, 1.8μm (cat.# 18003) Rtx®-BAC2, 30m, 0.32mm ID, 1.2μm (cat.# 18002)
Sample:	100μg/mL each in methanol
Inj.:	1.0μL split (split ratio 1:10), 4mm single gooseneck inlet liner with wool (cat.# 22405)
Inj. temp.:	240°C
Carrier gas:	helium, constant flow
Flow rate:	3.0mL/min.
Oven temp.:	50°C to 240°C @ 10°C/min. (hold 2 min.)
Det.:	FID @ 240°C

γ-hydroxybutyrate (GHB) and γ-butyrolactone (GBL)
Rtx®-BAC1 and Rtx®-BAC2 (dual column analysis)

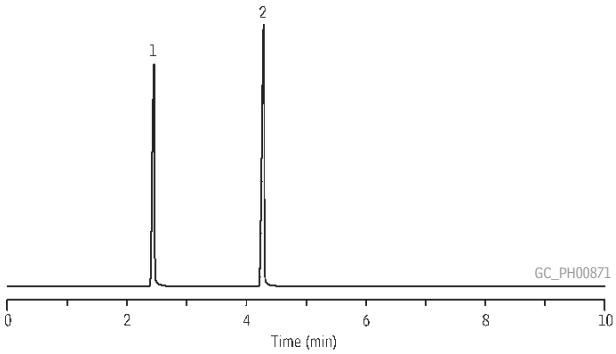
Rtx®-BAC1

Sharp peaks and baseline resolution in less than 5 minutes—12 samples per hour!



1. γ-hydroxybutyrate (GHB)/γ-butyrolactone (GBL)
2. α-methylene-γ-butyrolactone (AMGBL)

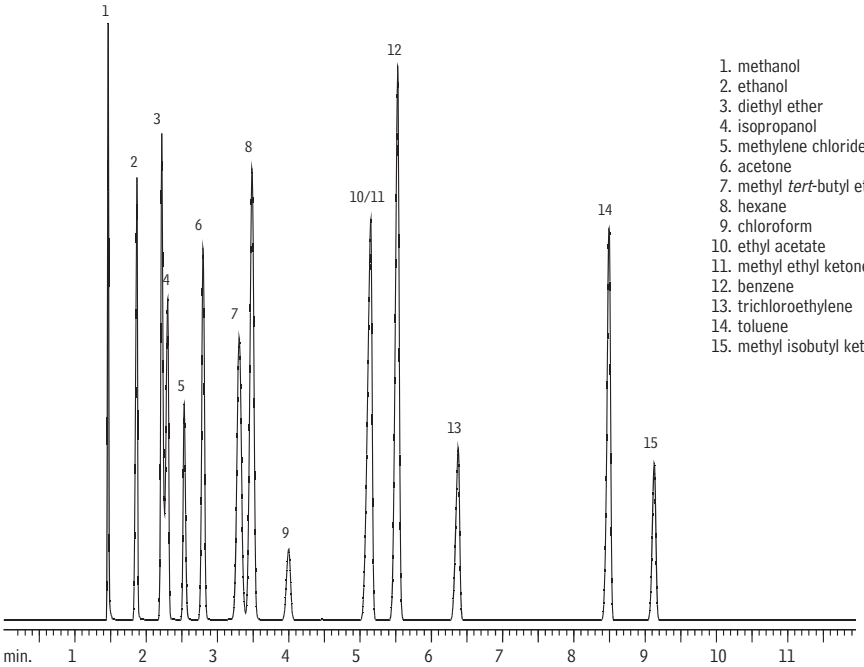
Rtx®-BAC2



Columns:	Rtx®-BAC1, 30m, 0.32mm ID, 1.8μm (cat.# 18003) and Rtx®-BAC2, 30m, 0.32mm ID, 1.2μm (cat.# 18002), connected via universal "Y" Press-Tight® connector (cat.# 20405)
Sample:	GHB, GBL, α-methylene-γ-butyrolactone (AMGBL), 10μg/mL each in water
Inj.:	1.0mL headspace, split (split ratio 1:10), 1mm split inlet liner (cat.# 20972)
Inj. temp.:	200°C
Carrier gas:	helium, constant pressure
Linear velocity:	44cm/sec. @ 50°C
Oven temp.:	50°C (3 min.) to 150°C @ 20°C/min. (hold 7 min.)
Det:	FID @ 240°C
Headspace autosampler:	Teledyne/Tekmar HT3
Sample/platen temp.:	100°C
Sample equilibration:	15 min.
Mixing time:	5 min.
Vial pressure:	10psig
Vial pressurization time:	2 min.
Loop fill time:	2 min.
Transfer line temp.:	120°C

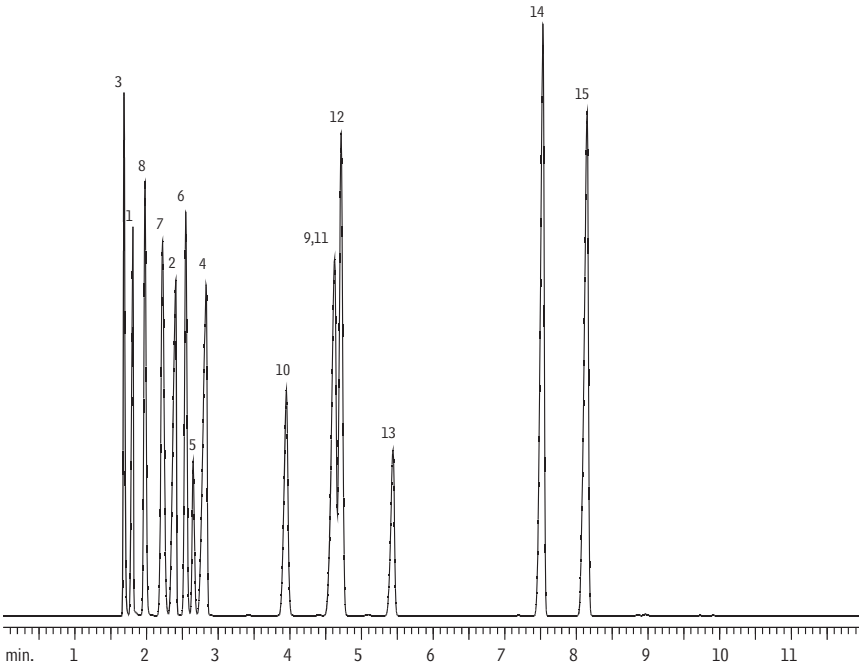
Abused Inhalants
Rtx®-BAC1 & Rtx®-BAC2

Rtx®-BAC1



1. methanol
2. ethanol
3. diethyl ether
4. isopropanol
5. methylene chloride
6. acetone
7. methyl *tert*-butyl ether
8. hexane
9. chloroform
10. ethyl acetate
11. methyl ethyl ketone
12. benzene
13. trichloroethylene
14. toluene
15. methyl isobutyl ketone

Rtx®-BAC2

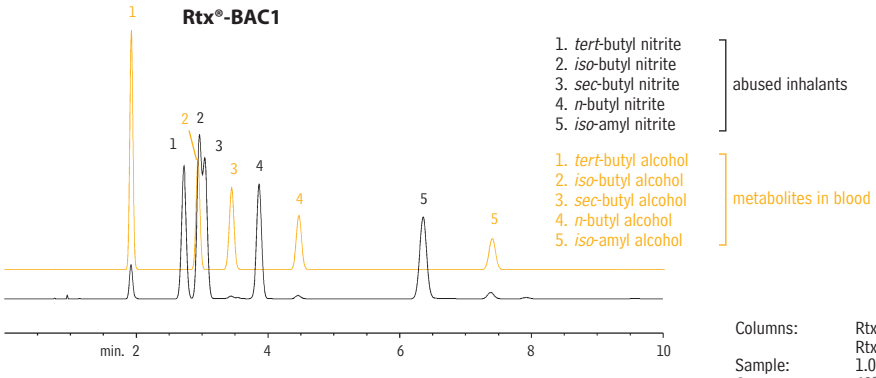


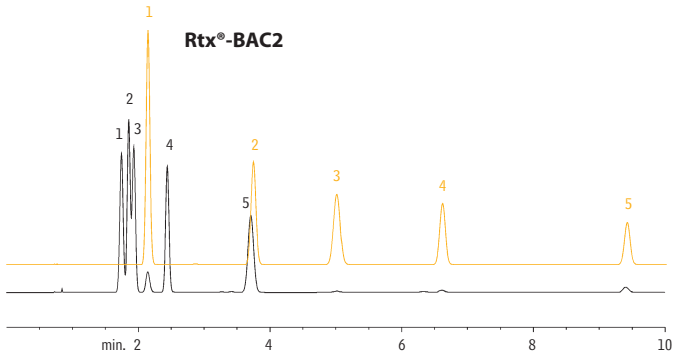
GC_PH00446

Columns:	Rtx®-BAC1, 30m, 0.32mm ID, 1.80µm (cat.# 18003) Rtx®-BAC2, 30m, 0.32mm ID, 1.20µm (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:	250µL 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



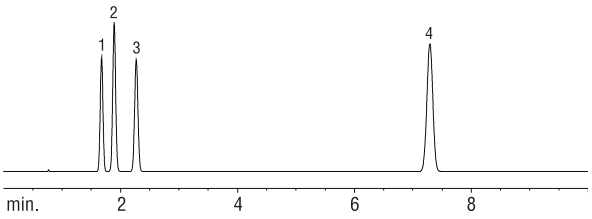


GC_PH00790

Columns: 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.

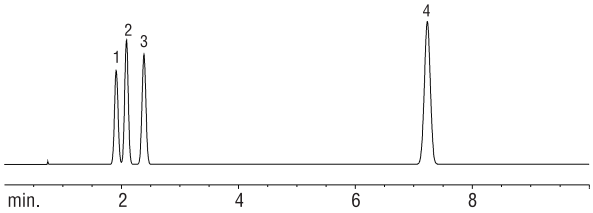
Anesthetics
Rtx®-BAC1 & Rtx®-BAC2
(headspace analysis)

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



GC_PH00501

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



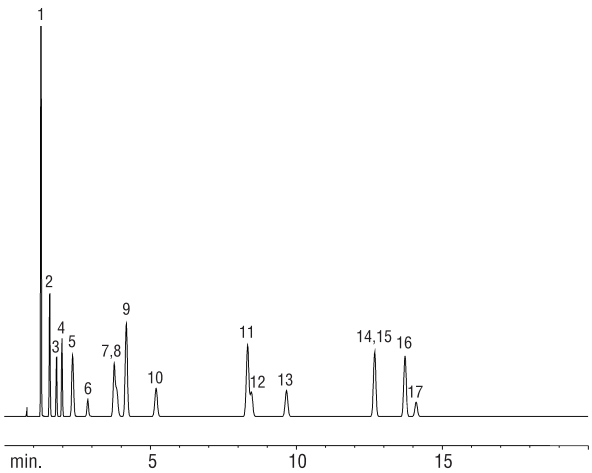
GC_PH00502

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

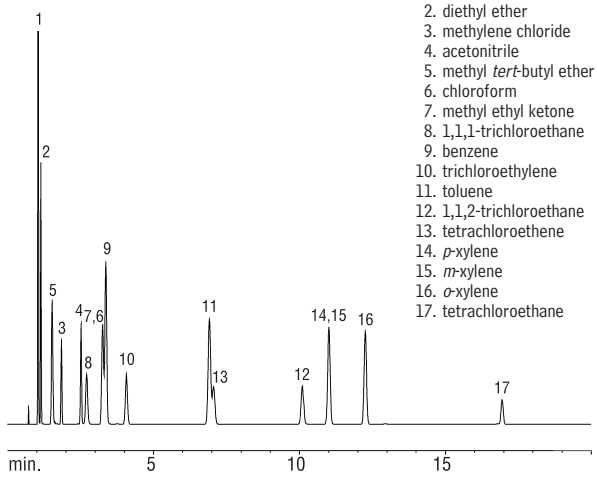
Solvents
Rtx®-BAC1 & Rtx®-BAC2
(headspace analysis)

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



GC_PH00509

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

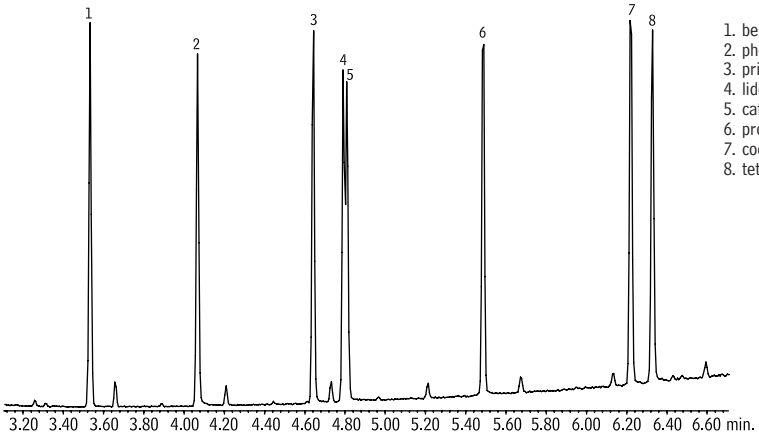


GC_PH00510

1. ethyl chloride
2. diethyl ether
3. methylene chloride
4. acetonitrile
5. methyl *tert*-butyl ether
6. chloroform
7. methyl ethyl ketone
8. 1,1,1-trichloroethane
9. benzene
10. trichloroethylene
11. toluene
12. 1,1,2-trichloroethane
13. tetrachloroethene
14. *p*-xylene
15. *m*-xylene
16. *o*-xylene
17. tetrachloroethane

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.
Det.:	FID

Cocaine & Cocaine Adulterants
Rtx®-440



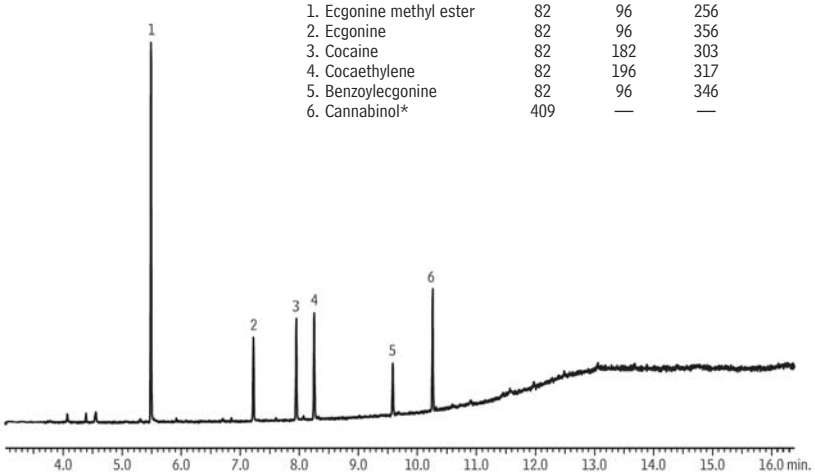
GC_PH00770

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

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

Cocaine and Metabolites (TMS Derivatives)
Rxi®-5Sil MS (100 ng/mL)

Peaks	m/z 1	m/z 2	m/z 3
1. Ecgonine methyl ester	82	96	256
2. Ecgonine	82	96	356
3. Cocaine	82	182	303
4. Cocaethylene	82	196	317
5. Benzoylecgonine	82	96	346
6. Cannabinol*	409	—	—

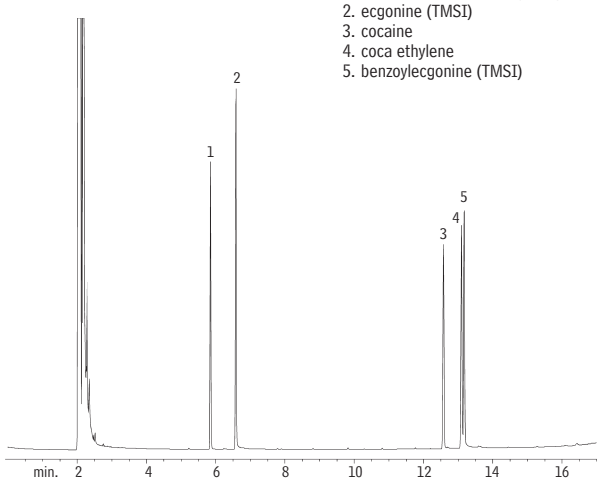


GC_CF1149

Column	Rxi®-5Sil MS, 30 m, 0.25 mm ID, 0.25 µm (cat.# 13623)
Sample	
Diluent:	Butyl chloride
Conc.:	100 ng/mL
Injection	
Inj. Vol.:	1 µL splitless (hold 1 min.)
Liner:	Single Gooseneck w/Wool (cat.# 22286-200.1)
Inj. Temp.:	250 °C
Purge Flow:	20 mL/min.
Oven	
Oven Temp:	100 °C to 200 °C at 30 °C/min. to 300 °C at 15 °C/min.
Carrier Gas	He, constant linear velocity
Linear Velocity:	40 cm/sec., 12.5 psi, 86.2kPa @ 100 °C
Detector	MS
Mode:	SIM
Transfer Line Temp.:	310 °C
Source Temp.:	250 °C
Solvent Delay Time:	4 min.
Tune Type:	PFTBA
Ionization Mode:	EI
Instrument	Shimadzu 2010 GC & QP2010+ MS
Notes	Samples were prepared as follows: Standards brought to dryness under nitrogen, then 50 µL BSTFA + 1%TMCS (cat.# 35606) added. 50 µL pyridine was then added, and samples were incubated at 70°C for 30 min. After incubation, samples were diluted with butyl chloride. * Used as derivitazation check

Cocaine & Metabolites (TMS Derivatives)
Rtx®-5

1. ecgonine methyl ester (TMSI)
2. ecgonine (TMSI)
3. cocaine
4. coca ethylene
5. benzoylecgonine (TMSI)

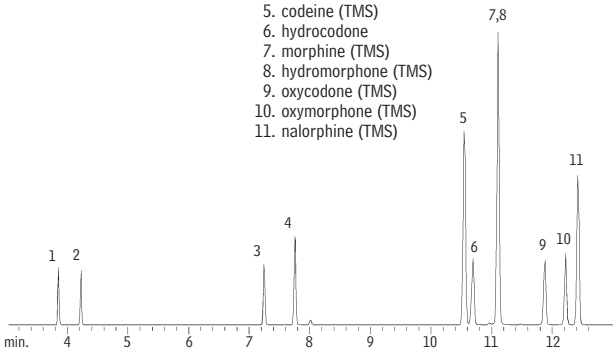


GC_PH00254

Column:	Rtx®-5, 30m, 0.25mm ID, 0.25µm (cat.# 10223)
Sample:	1.0µL 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 10^{-10} AFS
Split ratio:	30:1

Opiates (TMS Derivatives)
Rtx®-5

1. meperidine
2. alphaprodine
3. methadone
4. levorphanol (TMS)
5. codeine (TMS)
6. hydrocodone
7. morphine (TMS)
8. hydromorphone (TMS)
9. oxycodone (TMS)
10. oxymorphone (TMS)
11. nalorphine (TMS)



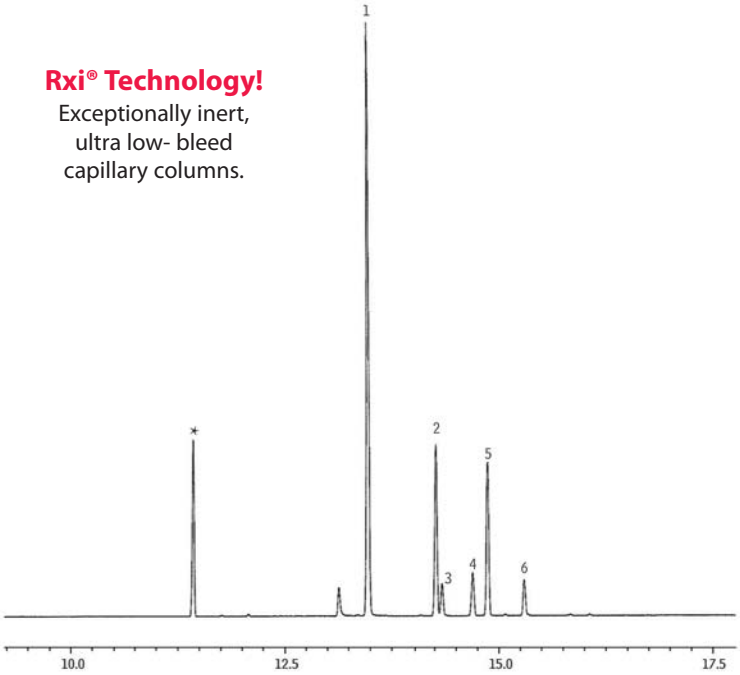
GC_PH00233

Column:	Rtx®-5, 30m, 0.25mm ID, 0.25µm (cat.# 10223)
Sample:	2.0µL split injection of opiates
Conc:	2,000ng/µL
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

Extracted Opiates from Blood
Rxi®-5Sil MS

NEW!

Rxi® Technology!
Exceptionally inert, ultra low- bleed capillary columns.



GC_CF1150

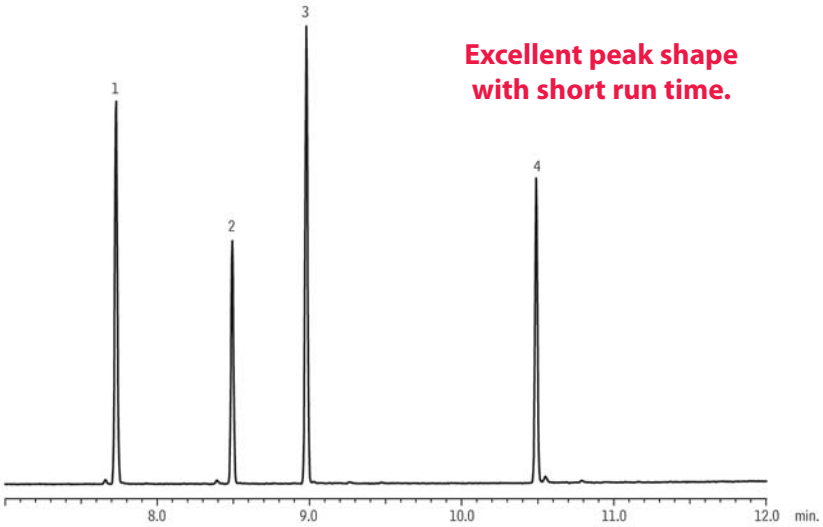
Peaks
1. Hydrocodone
2. Codeine
3. Oxycodone
4. Hydromorphone
5. 6-Monoacetylmorphine
6. Morphine
* Matrix

Column	Rxi®-5Sil MS, 30 m, 0.25 mm ID, 0.25 µm (cat.# 13623)
Sample	
Diluent:	Ethyl acetate
Conc.:	100 ng/mL propionic anhydride derivatives
Injection	
Inj. Vol.:	1 µL splitless (hold 1 min.)
Liner:	Gooseneck Splitless (4mm) w/Wool (cat.# 22405)
Inj. Temp.:	250 °C
Purge Flow:	100 mL/min.
Oven	
Oven Temp:	65 °C (hold 1 min.) to 315 °C at 15 °C/min.
Carrier Gas	He, constant flow
Flow Rate:	1 mL/min.
Linear Velocity:	35 cm/sec. @ 65 °C
Detector	MS
Mode:	SIM
Transfer Line Temp.:	250 °C
Analyzer Type:	Quadrupole
Solvent Delay Time:	7 min.
Tune Type:	PFTBA
Ionization Mode:	EI
Notes	Opiates were spiked into a blood sample and extracted by SPE, then derivatized with propionic anhydride.
Acknowledgement	Data courtesy of Miami Dade County Medical Examiner Department

Derivatized Cannabinoids (5 µg/mL)
Rxi®-5Sil MS

NEW!

Excellent peak shape with short run time.



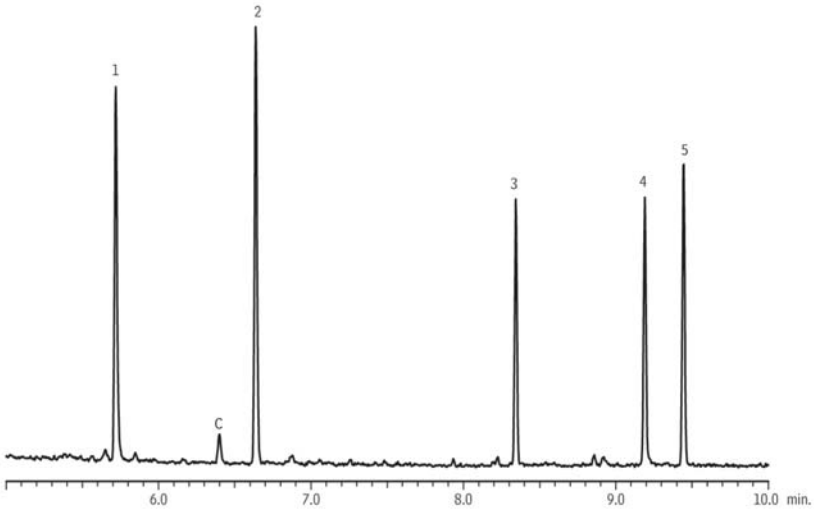
GC_CF1145

Peaks
1. Cannabidiol
2. delta 9 THC
3. Cannabinol
4. THC-COOH; THCA

Column	Rxi®-5Sil MS, 30 m, 0.25 mm ID, 0.25 µm (cat.# 13623)
Sample	
Diluent:	Ethyl acetate
Conc.:	5 µg/mL TMS derivatives
Injection	
Inj. Vol.:	1 µL splitless (hold 1 min.)
Liner:	3.5mm Gooseneck Splitless w/Wool (cat.# 22286-200.1)
Inj. Temp.:	250 °C
Purge Flow:	21.4 mL/min.
Oven	
Oven Temp:	150 °C to 330 °C at 15 °C/min. (hold 3 min.)
Carrier Gas	He, constant linear velocity
Linear Velocity:	40 cm/sec., 13.8 psi, 95.1kPa @ 150 °C
Detector	MS
Mode:	Scan
Transfer Line Temp.:	280 °C
Analyzer Type:	Quadrupole
Source Temp.:	200 °C
Electron Energy:	70 eV
Solvent Delay Time:	4 min.
Tune Type:	PFTBA
Ionization Mode:	EI
Scan Range:	200-500 amu
Scan Rate:	5 scans/sec.
Instrument	Shimadzu 2010 GC & QP2010+ MS

Derivatized Amphetamines (500 ng/mL)
Rxi®-5Sil MS

NEW!



GC_CF1144

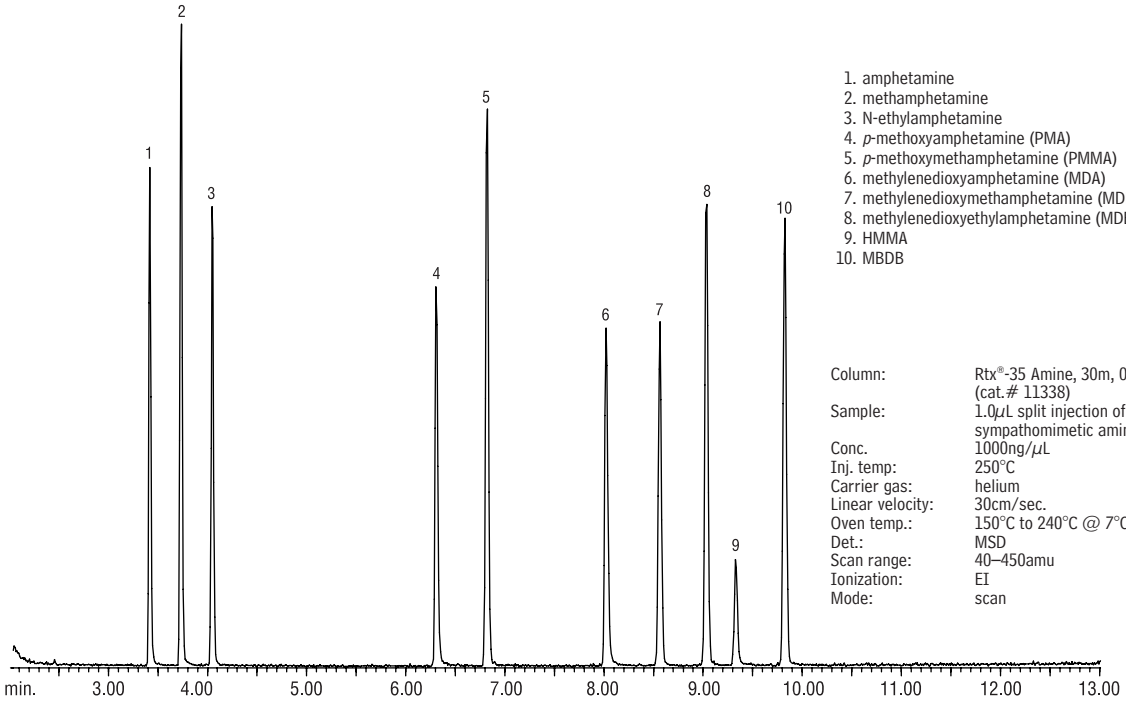
Peaks
1. Amphetamine
2. Methamphetamine
3. MDA
4. MDMA
5. MDEA

C-contaminant

Column	Rxi®-5Sil MS, 30 m, 0.25 mm ID, 0.25 µm (cat.# 13623)
Sample	
Diluent:	Butyl chloride
Conc.:	500 ng/mL HFAA derivatives
Injection	
Inj. Vol.:	1 µL splitless (hold 1 min.)
Liner:	3.5mm Gooseneck Splitless w/Wool (cat.# 22286-200.1)
Inj. Temp.:	250 °C
Purge Flow:	28 mL/min.
Oven	
Oven Temp:	75 °C to 300 °C at 15 °C/min.
Carrier Gas	He, constant linear velocity
Linear Velocity:	45 cm/sec., 13.5 psi, 93.1kPa @ 75 °C
Detector	MS
Mode:	Scan
Transfer Line Temp.:	250 °C
Analyzer Type:	Quadrupole
Source Temp.:	200 °C
Electron Energy:	70 eV
Solvent Delay Time:	4 min.
Tune Type:	PFTBA
Ionization Mode:	EI
Scan Range:	40-300 amu
Scan Rate:	5 scans/sec.
Instrument	Shimadzu 2010 GC & QP2010+ MS

Rx

Sympathomimetic Amines (Basic Drugs) (Underivatized)
Rtx®-35 Amine



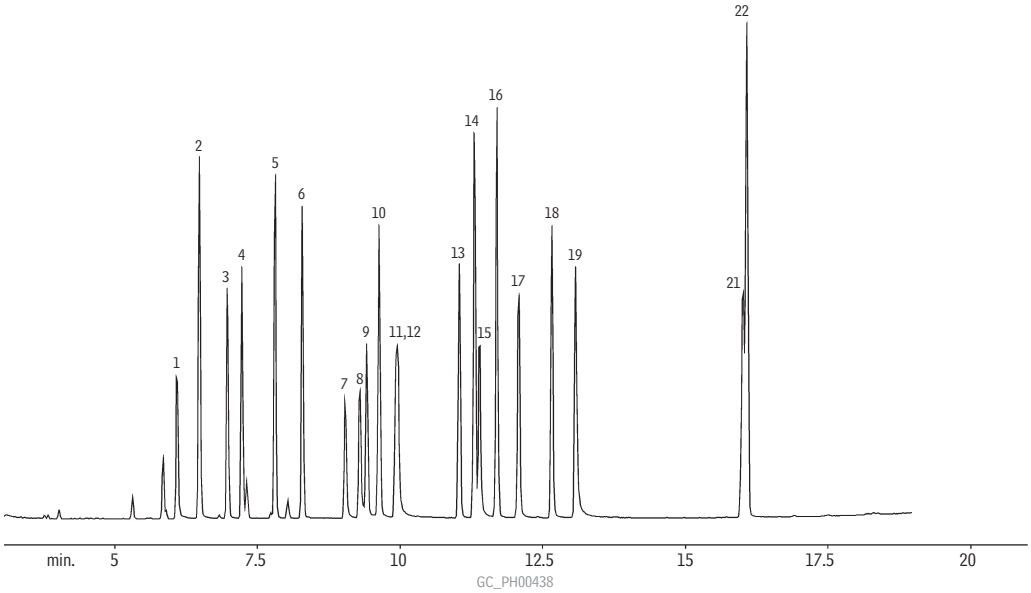
GC_PH00574

1. amphetamine
2. methamphetamine
3. N-ethylamphetamine
4. *p*-methoxyamphetamine (PMA)
5. *p*-methoxymethamphetamine (PMMA)
6. methylenedioxyamphetamine (MDA)
7. methylenedioxymethamphetamine (MDMA)
8. methylenedioxyethylamphetamine (MDEA)
9. HMMA
10. MBDB

Column:	Rtx®-35 Amine, 30m, 0.25mm ID, 0.50µm (cat.# 11338)
Sample:	1.0µL split injection of underivatized sympathomimetic amines
Conc.	1000ng/µL
Inj. temp:	250°C
Carrier gas:	helium
Linear velocity:	30cm/sec.
Oven temp.:	150°C to 240°C @ 7°C/min.
Det.:	MSD
Scan range:	40–450amu
Ionization:	EI
Mode:	scan

Rx

Sympathomimetic Amines (Basic Drugs) (Underivatized)
Rtx®-5 Amine

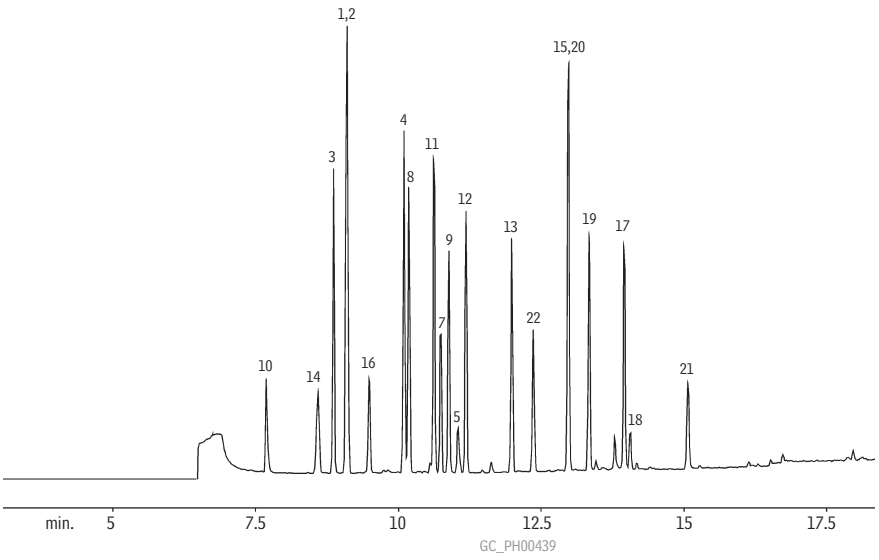


Column:	Rtx®-5 Amine, 30m, 0.25mm ID, 0.50µm (cat.# 12338)
Instrument:	Varian 3400 GC coupled with Varian Saturn 2000 MS detector
Inj.:	1µL, split, split vent flow rate 45mL/min.
Inj. temp.:	250°C
Carrier gas:	helium
Det.:	mass spectroscopy data collected using a scan range of 40 amu through 600 amu.
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. methylenedioxyamphetamine
16. diethylpropion
17. methylenedioxymethamphetamine
18. methylenedioxyethylamphetamine
19. 4-methyl-2,5-dimethoxyamphetamine
20. phenylephrine
21. caffeine
22. benzphetamine

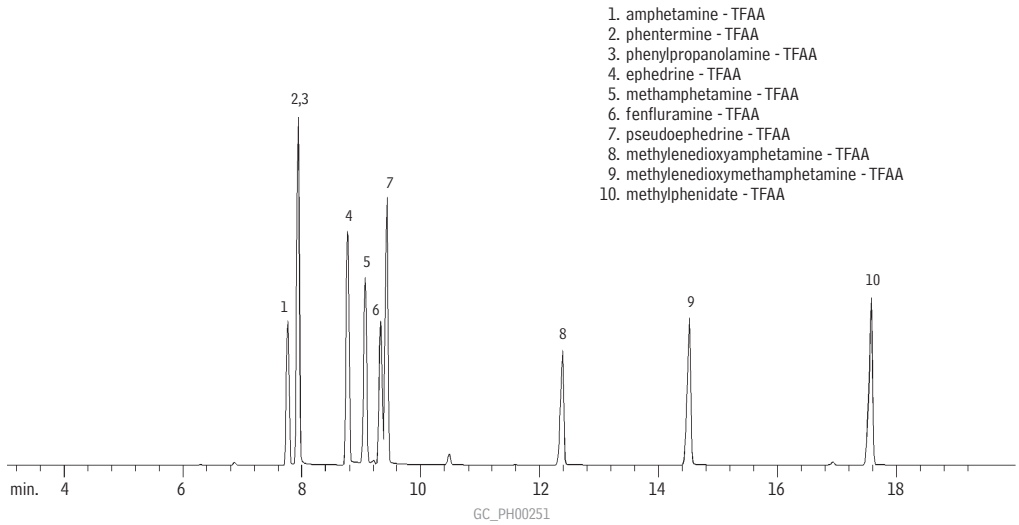
Sympathomimetic Amines (Basic Drugs) (HFBA Derivatized)
Rtx®-200



Column:	Rtx®-200, 30m, 0.25mm ID, 0.50µm (cat.# 15038)
Instrument:	Varian 3400 GC coupled with Varian Saturn 2000 MS detector
Inj.:	1µL, 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.

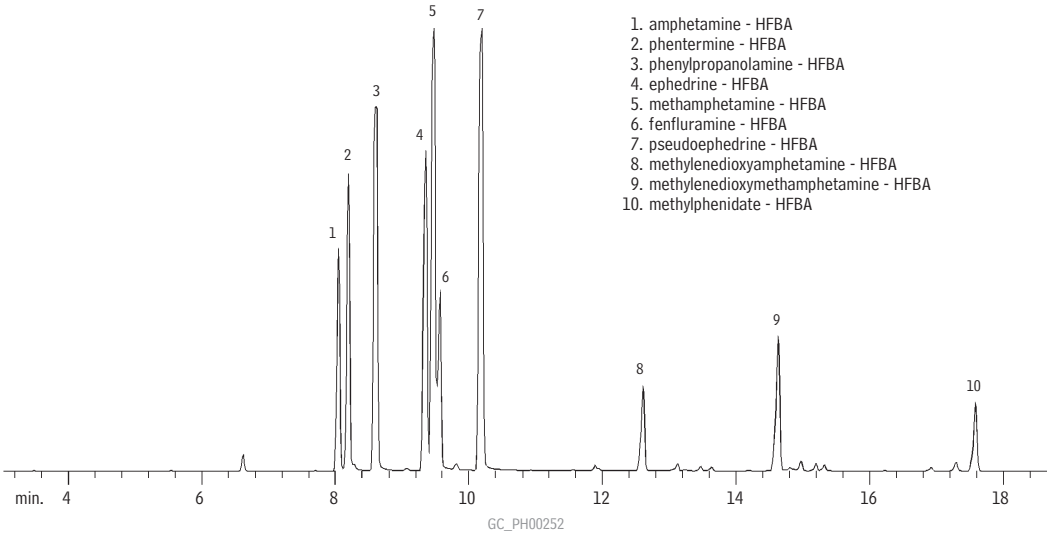
Ionization performed in the EI Auto mode.

Sympathomimetic Amines (Basic Drugs) (TFAA Derivatives)
Rtx®-5



Column:	Rtx®-5, 30m, 0.25mm ID, 0.25µm (cat.# 10223)
Sample:	1.0µL splitless injection of derivatized sympathomimetic amines
Conc.:	approximately 2.5ng/µL
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.

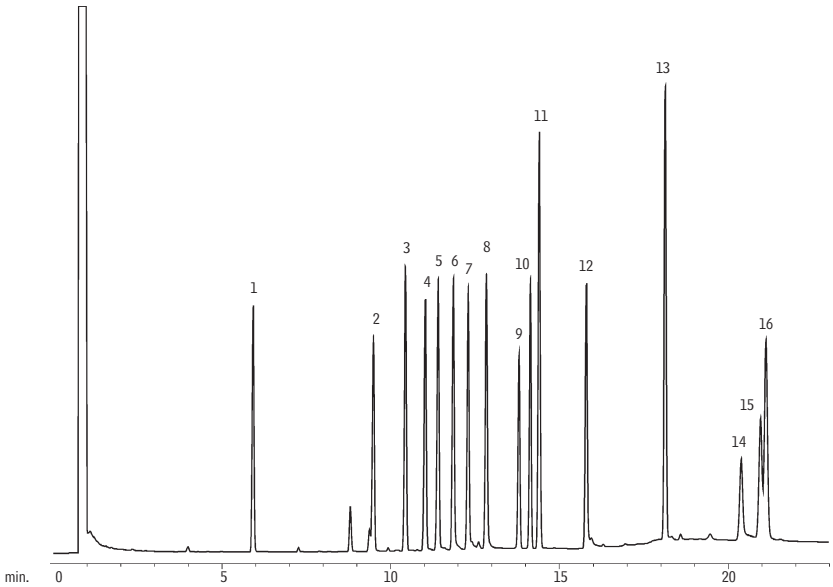
Sympathomimetic Amines (Basic Drugs) (HFBA Derivatives)
Rtx®-5



Column:	Rtx®-5, 30m, 0.25mm ID, 0.25µm (cat.# 10223)
Sample:	1.0µL splitless injection of sympathomimetic amines
Conc.:	approximately 2.5ng/µL.
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.

Rx

Barbiturates (Acidic/Neutral Drugs) (Underivatized)
Rtx®-35

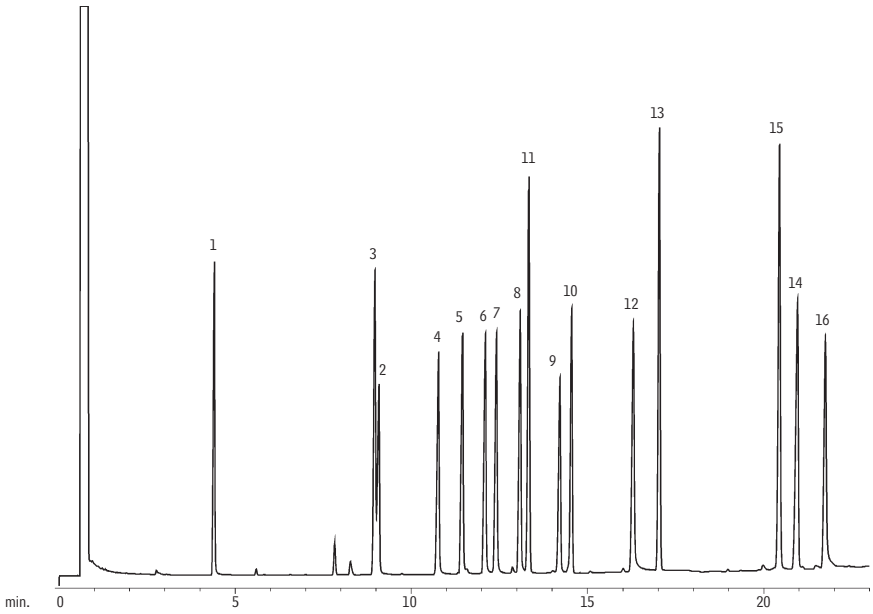


GC_PH00262

Column:	Rtx®-35, 30m, 0.53mm ID, 1.0µm (cat.# 10455)
Sample:	1.0µL splitless injection of acidic/neutral drugs
Conc.:	50µg/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

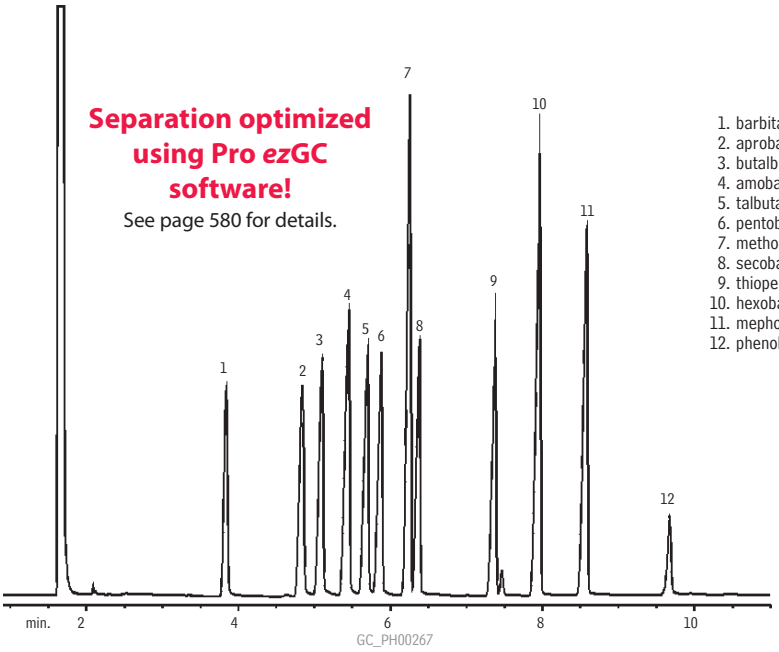
Barbiturates (Acidic/Neutral Drugs) (Underivatized)
Rtx®-1701



GC_PH00263

Column:	Rtx®-1701, 15m, 0.53mm ID, 0.50µm (cat.# 12037)
Sample:	1.0µL splitless injection of acidic/neutral drugs
Conc.:	50µg/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.

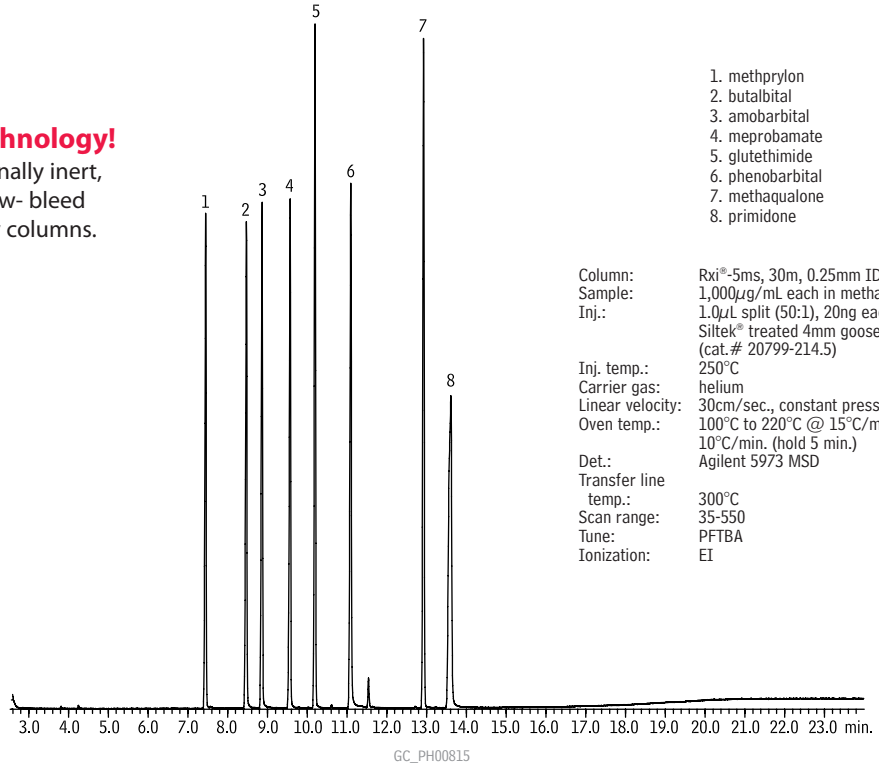
Barbiturates (Acidic/Neutral Drugs) (Underivatized)
Rtx®-35



Column:	Rtx®-35, 30m, 0.32mm ID, 0.50µm (cat.# 10439)
Sample:	1.0µL split injection of barbiturates
Oven temp.:	210°C (hold 2 min.) to 300°C @ 7°C/min. (hold 2 min.)
Inj./det. temp.:	300°C
Carrier gas:	helium
Linear velocity:	35cm/sec. set @ 210°C
FID sensitivity:	5.12 x 10^{-10} AFS
Split vent:	30:1

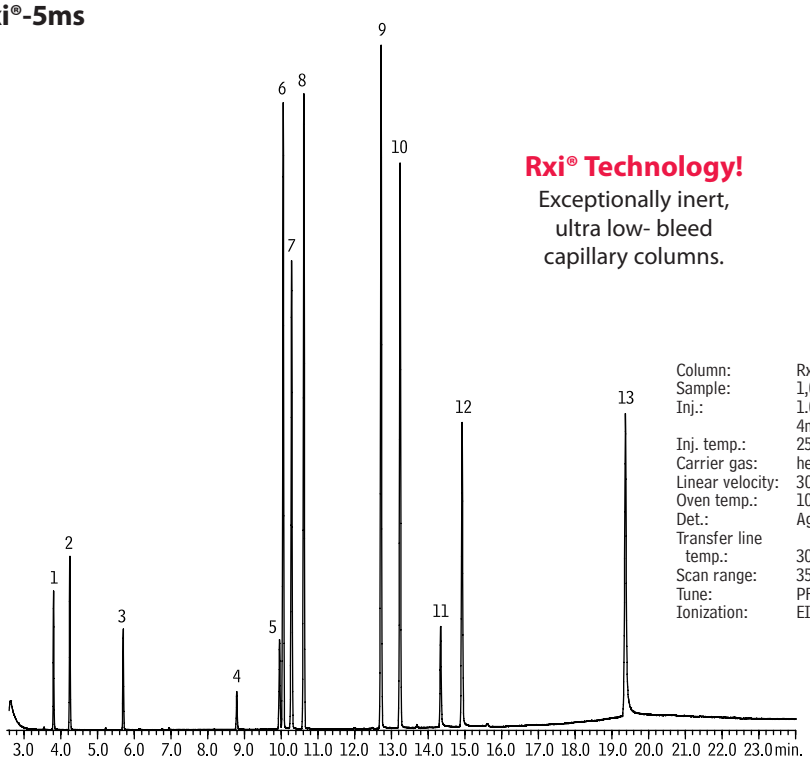
Acidic/Neutral Drugs
Rxi®-5ms

Rxi® Technology!
Exceptionally inert, ultra low- bleed capillary columns.



Column:	Rxi®-5ms, 30m, 0.25mm ID, 0.25µm (cat.# 13423)
Sample:	1,000µg/mL each in methanol
Inj.:	1.0µL split (50:1), 20ng each compound on column; Siltek® treated 4mm gooseneck splitless inlet liner (cat.# 20799-214.5)
Inj. temp.:	250°C
Carrier gas:	helium
Linear velocity:	30cm/sec., constant pressure
Oven temp.:	100°C to 220°C @ 15°C/min., to 330°C @ 10°C/min. (hold 5 min.)
Det.:	Agilent 5973 MSD
Transfer line temp.:	300°C
Scan range:	35-550
Tune:	PFTBA
Ionization:	EI

Basic Drugs (Underivatized)
Rxi®-5ms



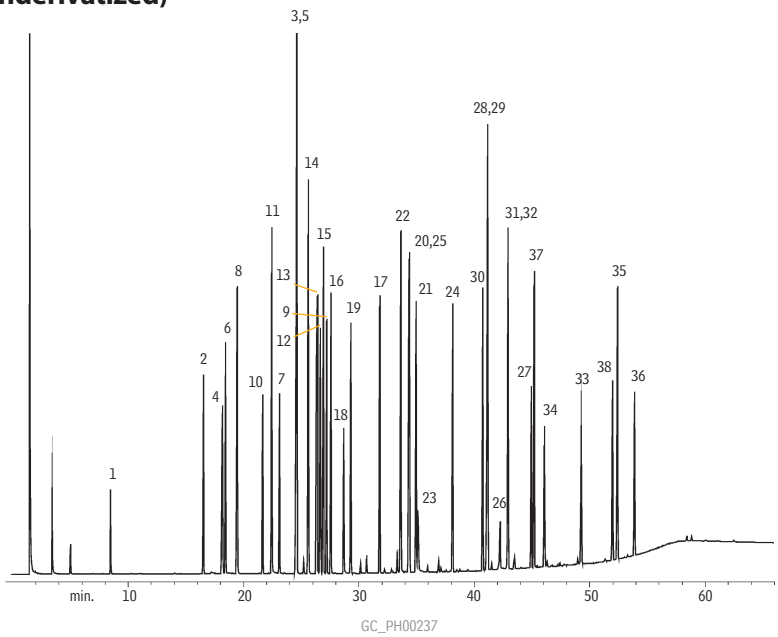
Rxi® Technology!
Exceptionally inert, ultra low- bleed capillary columns.

1. amphetamine
2. methamphetamine
3. nicotine
4. cotinine
5. caffeine
6. benzphetamine
7. ketamine
8. phencyclidine
9. methadone
10. cocaine
11. codeine
12. scopolamine
13. alprazolam

Column:	Rxi®-5ms, 30m, 0.25mm ID, 0.25µm (cat.# 13423)
Sample:	1,000µg/mL each in methanol
Inj.:	1.0µL split (50:1), 20ng each compound on column; Siltek® treated 4mm gooseneck splitless inlet liner (cat.# 20799-214.5)
Inj. temp.:	250°C
Carrier gas:	helium
Linear velocity:	30cm/sec., constant pressure
Oven temp.:	100°C to 220°C @ 15°C/min., to 330°C @ 10°C/min. (hold 5 min.)
Det.:	Agilent 5973 MSD
Transfer line temp.:	300°C
Scan range:	35-550
Tune:	PFTBA
Ionization:	EI

Rx

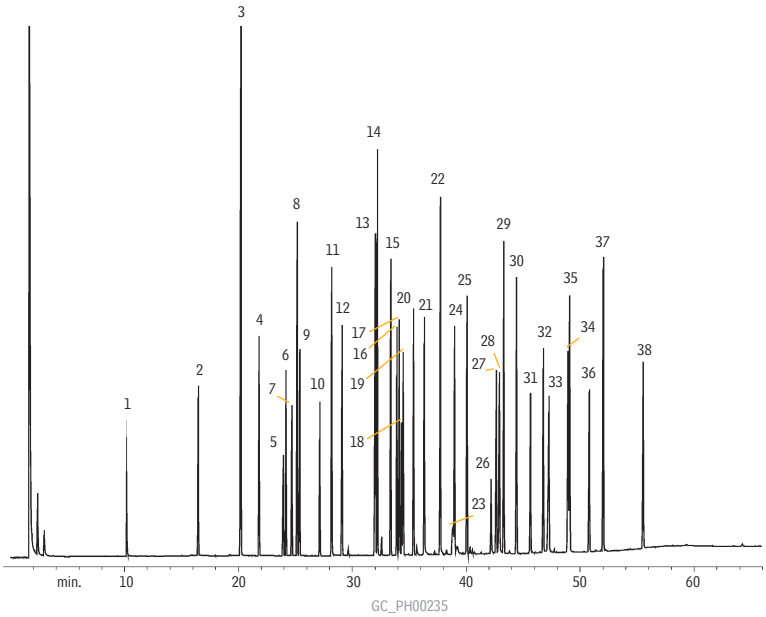
Basic Drugs (Underivatized)
Rtx®-200



1. nicotine
2. benzocaine
3. cotinine
4. meperidine
5. caffeine
6. benzphetamine
7. ketamine
8. diphenhydramine
9. lidocaine
10. phenyltoloxamine
11. tripelennamine
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

Column:	Rtx®-200, 30m, 0.25mm ID, 0.25µm (cat.# 15023)
Sample:	1.0µL split injection of a basic drug sample (1mg/mL)
Conc.:	1,000ng/µL
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

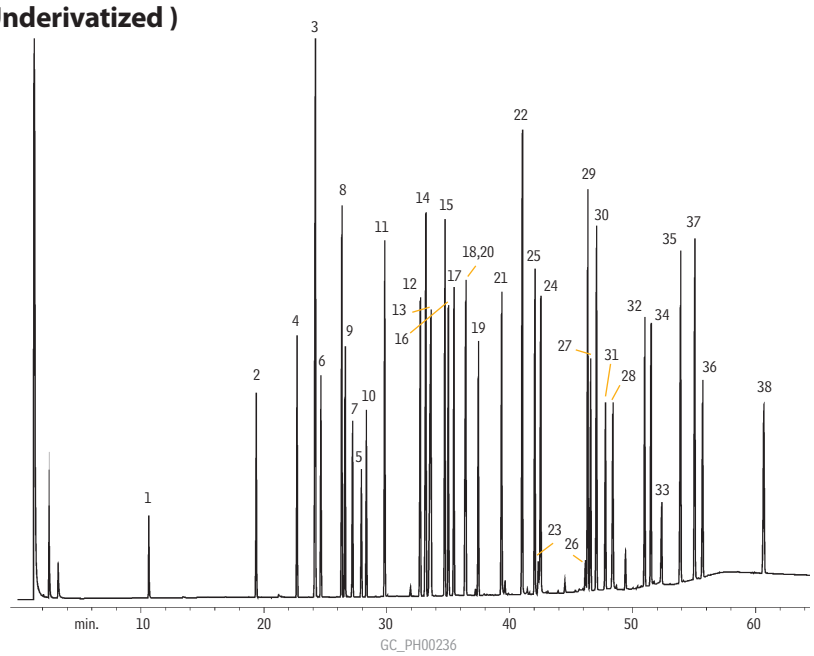
Basic Drugs (Underivatized)
Rtx®-5



Column:	Rtx®-5, 30m, 0.25mm ID, 0.25µm (cat.# 10223)
Sample:	1.0µL split injection of a basic drug sample
Conc.:	1,000ng/µL
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. tripelennamine
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

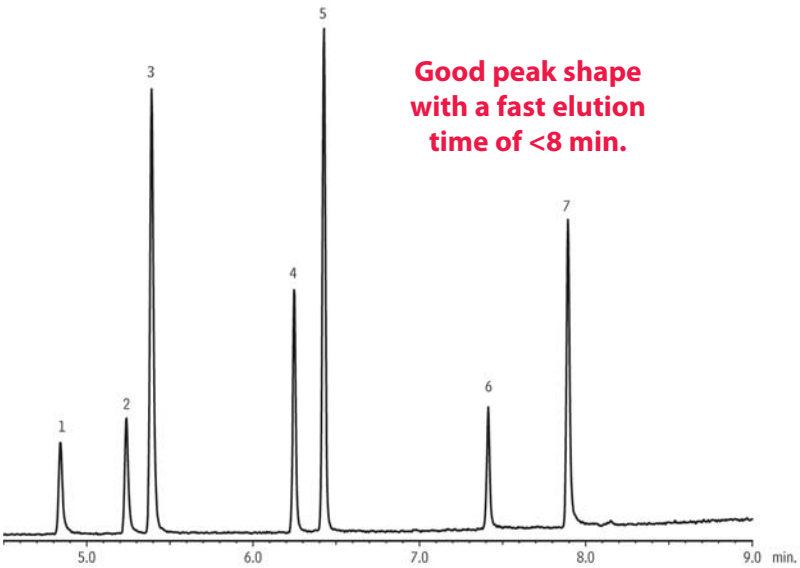


Column:	Rtx®-35, 30m, 0.25mm ID, 0.25µm (cat.# 10423)
Sample:	1.0µL split injection of a basic drug sample
Conc.:	1,000ng/µL
Oven temp.:	100°C to 325°C @ 4°C/min. (hold 10 min.)
Inj./det. temp.:	250°C/320°C
Carrier gas:	helium
Linear velocity:	30cm/sec. set @ 100°C
FID sensitivity:	1.28 x 10^{-10} AFS
Split ratio:	50:1

Benzodiazepines (15 µg/mL)
Rxi®-5Sil MS

NEW!

Rx

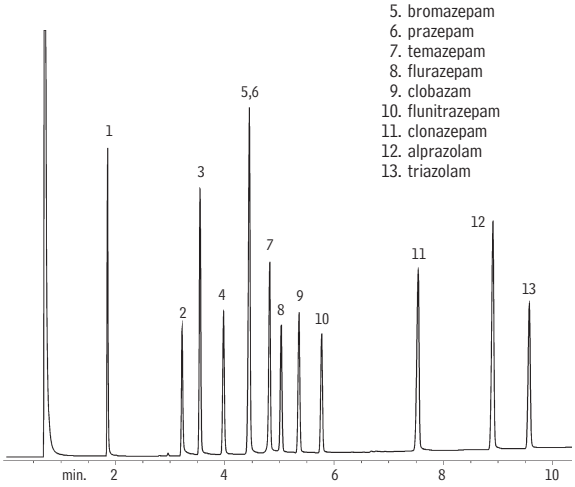


Peaks
1. Oxazepam
2. Lorazepam
3. Diazepam
4. Flunitrazepam
5. Prazepam
6. Clonazepam
7. Alprazolam

Column	Rxi®-5Sil MS, 30 m, 0.25 mm ID, 0.25 µm (cat.# 13623)
Sample	
Diluent:	Butyl chloride
Conc.:	15 µg/mL
Injection	
Inj. Vol.:	1 µL splitless (hold 1 min.)
Liner:	3.5mm Gooseneck Splitless w/Wool (cat.# 22286-200.1)
Inj. Temp.:	280 °C
Purge Flow:	32.2 mL/min. (20:1 split)
Oven	
Oven Temp:	200 °C to 330 °C at 15 °C/min. (hold 3 min.)
Carrier Gas	He, constant linear velocity
Linear Velocity:	50 cm/sec., 23.7 psi, 163.4kPa @ 200 °C
Detector	MS
Mode:	Scan
Transfer Line Temp.:	280 °C
Analyzer Type:	Quadrupole
Source Temp.:	200 °C
Electron Energy:	70 eV
Solvent Delay Time:	4 min.
Tune Type:	PFTBA
Ionization Mode:	EI
Scan Range:	50-350 amu
Scan Rate:	5 scans/sec.
Instrument	Shimadzu 2010 GC & QP2010+ MS

Benzodiazepines (Basic Drugs) (Underivatized)
Rtx®-200

1. medazepam
2. lorazepam
3. diazepam
4. desmethyl diazepam
5. bromazepam
6. prazepam
7. temazepam
8. flurazepam
9. clobazam
10. flunitrazepam
11. clonazepam
12. alprazolam
13. triazolam

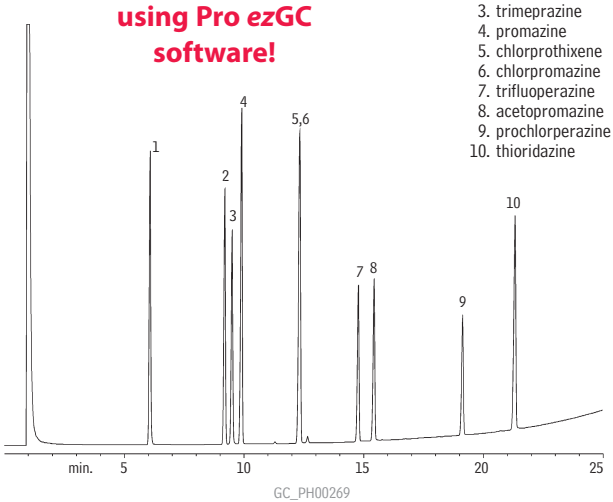


Column:	Rtx®-200, 15m, 0.32mm ID, 0.25µm (cat.# 15021)
Sample:	1.0µL split injection of benzodiazepines
Conc.:	15ng/component
Oven temp.:	225°C to 325°C @ 8°C/min.
Inj./det. temp.:	250°C/320°C
Carrier gas:	helium
Linear velocity:	35cm/sec. set @ 225°C
FID sensitivity:	5.12 x 10^{-10} AFS
Split ratio:	60:1

Phenothiazines (Basic Drugs) (Underivatized)
Rtx®-5

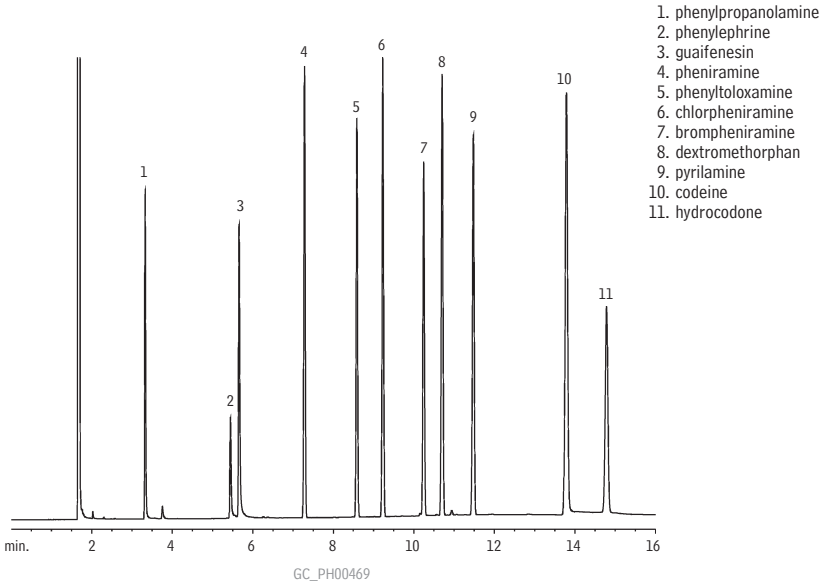
Separation optimized using Pro *ez*GC software!

1. phenothiazine
2. promethazine
3. trimeprazine
4. promazine
5. chlorprothixene
6. chlorpromazine
7. trifluoperazine
8. acetopromazine
9. prochlorperazine
10. thioridazine



Column:	Rtx®-5, 15m, 0.32mm ID, 0.50µm (cat.# 10236)
Sample:	1.0µL split injection of phenothiazines
Conc.:	2,000ng/µL
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

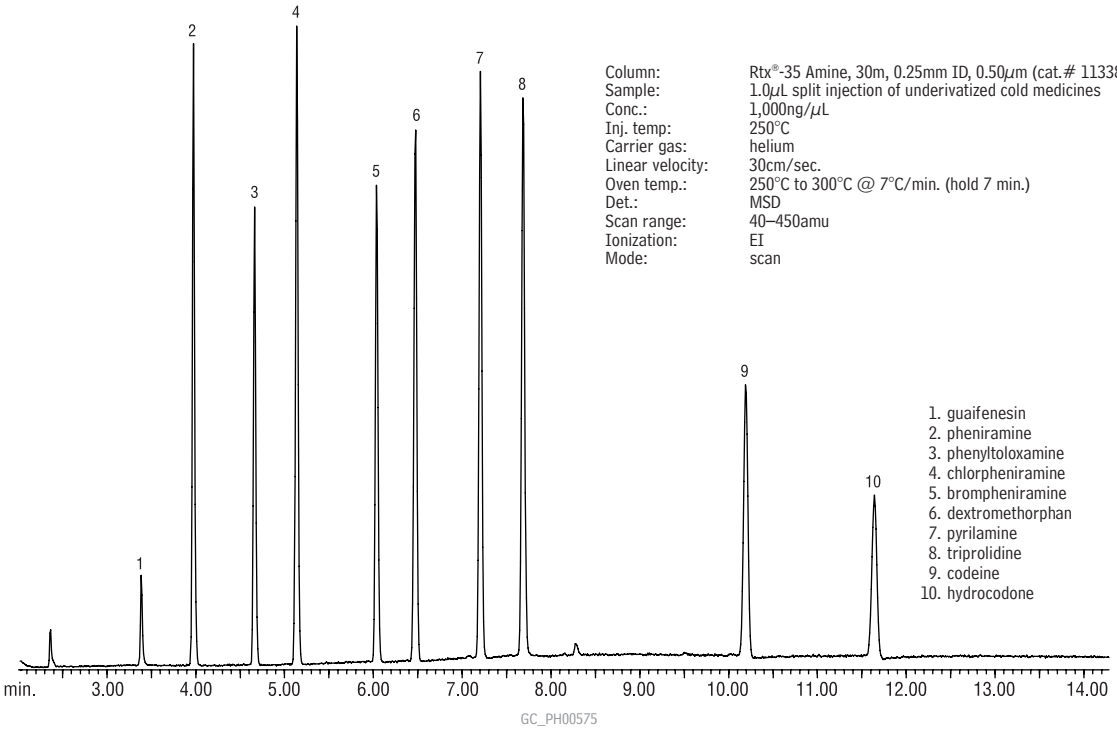
Cold Medications (Basic Drugs) (Underivatized)
Rtx®-5 Amine



Column:	Rtx®-5 Amine, 30m, 0.53mm ID, 1.0µm (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:	1µL
Split vent flow:	88mL/min.
Split ratio:	20:1

Rx

Cold Medications (Basic Drugs) (Underivatized)
Rtx®-35 Amine

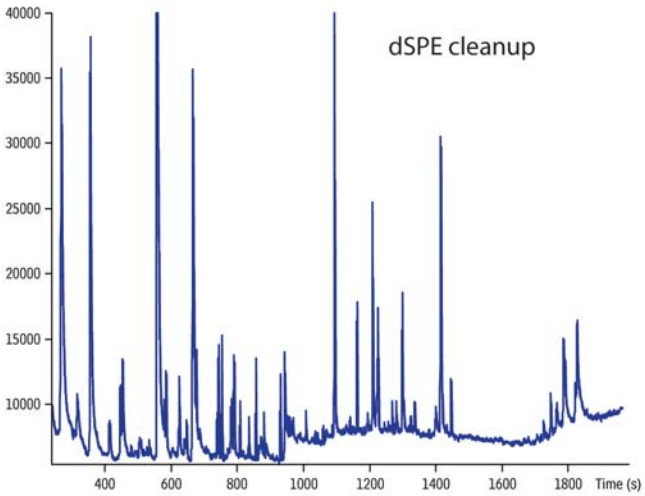


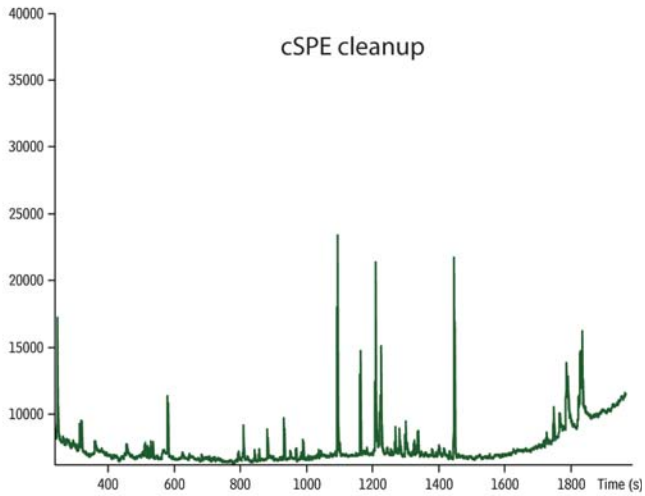
Column:	Rtx®-35 Amine, 30m, 0.25mm ID, 0.50µm (cat.# 11338)
Sample:	1.0µL split injection of underivatized cold medicines
Conc.:	1,000ng/µL
Inj. temp:	250°C
Carrier gas:	helium
Linear velocity:	30cm/sec.
Oven temp.:	250°C to 300°C @ 7°C/min. (hold 7 min.)
Det.:	MSD
Scan range:	40–450amu
Ionization:	EI
Mode:	scan

dSPE vs. cSPE Sample Cleanup of Dandelion Root Powder (Dietary Supplement)
Rxi®-5Sil MS

NEW!

Rx





GC_FF1171

Column	Rxi®-5Sil MS, 30 m, 0.25 mm ID, 0.25 µm (cat.# 13623)
Sample	Dandelion Root powder spiked with 46 pesticides QuEChERS Internal Standard Mix for GC/MS Analysis (cat.# 33267) anthracene for quality control (cat.# 33264)
Conc.:	80 pg/µL
Injection	
Inj. Vol.:	1 µL splitless (hold 1.5 min.)
Liner:	5mm Splitless with wool (cat.# 22975-200.1)
Inj. Temp.:	250 °C
Oven	
Oven Temp:	90 °C (hold 1.5 min.) to 340 °C at 8 °C/min.
Carrier Gas	He, constant flow
Flow Rate:	1.5 mL/min.
Detector	MS
Mode:	
Analyzer Type:	TOF
Source Temp.:	225 °C
Electron Energy:	70 eV
Ionization Mode:	EI
Acquisition Range:	45-550 amu
Acquisition Rate:	5 spectra/sec.
Instrument	LECO Pegasus 4D GCxGC-TOFMS
Notes	Sample Preparation: Wetting: 1 g of Dandelion Root powder combined with 9 mL of water, shaken well, fortified with pesticides and QuEChERS Internal Standard Mix for GC/MS Analysis (cat.# 33267), soak for 2 hours. Extraction: 10 mL acetonitrile added then addition of Q-sep™ Q110 (cat.# 26235), centrifuge with Q-sep™ 3000 Centrifuge (cat.# 26230). dSPE: cleanup procedure according to EN 15662 method, add control standard anthracene (cat.# 33264) to 1 mL extract, add this to Q-sep™ Q110 dSPE tube (cat.# 26235), shake, centrifuge. cSPE: add control standard anthracene (cat.# 33264) to 1 mL extract, add magnesium sulfate to cartridge, use 6mL Combo SPE Cartridge containing 500mg CarboPrep® 90/500mg PSA (cat.# 26194), concentrate via evaporation.

free literature

Developing New Methods for Pesticides in Dietary Supplements
Advantages of the QuEChERS Approach

QuEChERS is a simple, effective approach to sample prep that can be applied to the analysis of pesticides in dietary supplements. Here we demonstrate a QuEChERS, cSPE, GC-TOFMS procedure that results in good recoveries for a wide range of pesticides in dandelion root.

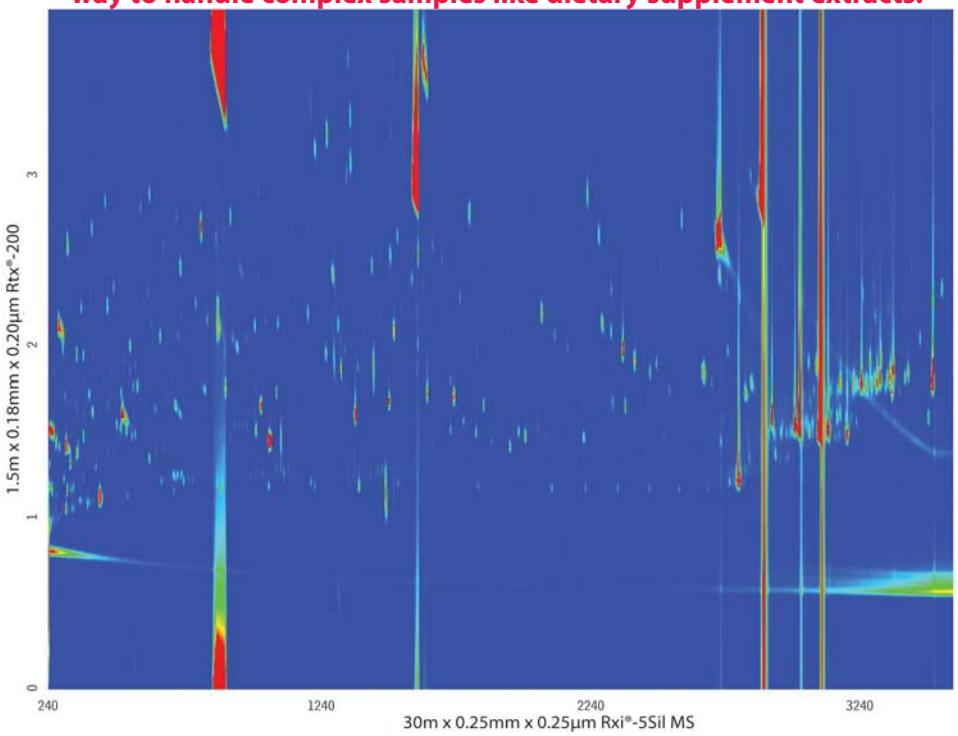
Download your copy from **www.restek.com**

Applications Note
lit. cat.# PHAN1242

Dietary Supplement (Finished Product) QuEChERS Extract Cleaned with Cartridge SPE (GCxGC-TOFMS Contour Plot)

NEW!

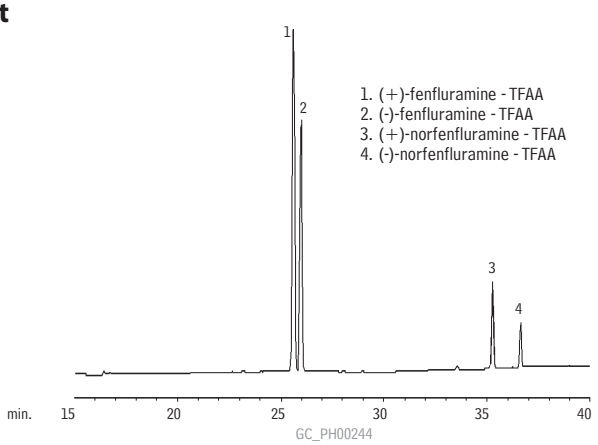
GCxGC with orthogonal Rxi®-5Sil MS and Rtx®-200 columns is a powerful way to handle complex samples like dietary supplement extracts.



GC_FF1191

Column	Rxi®-5Sil MS 30 m, 0.25 mm ID, 0.25 µm (cat.# 13623) Rtx®-200 1.5 m, 0.18 mm ID, 0.20 µm (cat.# 45001)
Sample	
Diluent:	Toluene
Injection	
Inj. Vol.:	1 µL splitless (hold 1 min.)
Liner:	Gooseneck Splitless (4mm) w/Wool (cat.# 22405)
Inj. Temp.:	250 °C
Purge Flow:	40 mL/min.
Oven	
Oven Temp:	Rxi®-5Sil MS: 80 °C (hold 1 min.) to 310 °C at 4 °C/min. (hold 1.5 min.) Rtx®-200: 90 °C (hold 1 min.) to 320 °C at 4 °C/min. (hold 1.5 min.)
Carrier Gas	He, constant flow
Flow Rate:	1.8 mL/min.
Modulation	
Modulator Temp. Offset:	25 °C
Second Dimension Separation Time:	4 sec.
Hot Pulse Time:	1.2 sec.
Cool Time between Stages:	0.8 sec.
Detector	TOFMS
Transfer Line Temp.:	290 °C
Analyzer Type:	TOF
Source Temp.:	225 °C
Electron Energy:	70 eV
Mass Defect:	-20 mu/100 u
Solvent Delay Time:	4 min.
Ionization Mode:	EI
Acquisition Range:	45 to 550 amu
Spectral Acquisition Rate:	100 spectra/sec
Instrument	LECO Pegasus 4D GCxGC-TOFMS
Notes	See application note PHAN1251 for extraction and cleanup details. A 1.5 m length of the Rtx®-200 column was trimmed from a 10 m column. Columns were connected with a Universal Press-Tight® Connector (cat.# 20429).

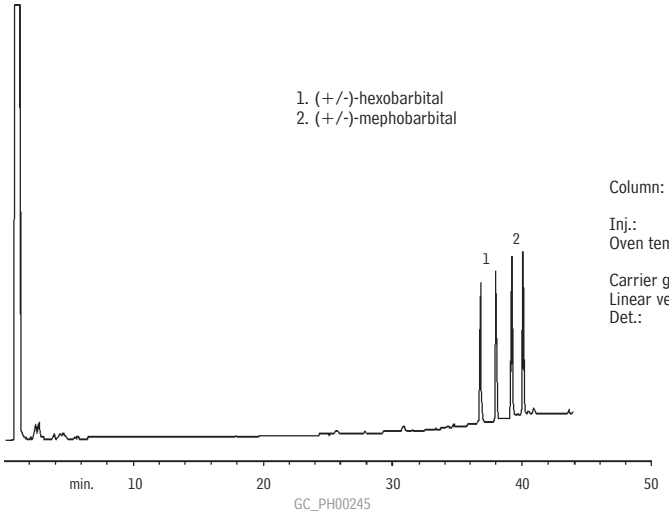
Fenfluramine (TFAA Derivative)
Rt®-βDEXcst



Column:	Rt®-βDEXcst, 30m, 0.32mm ID, 0.25µm (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

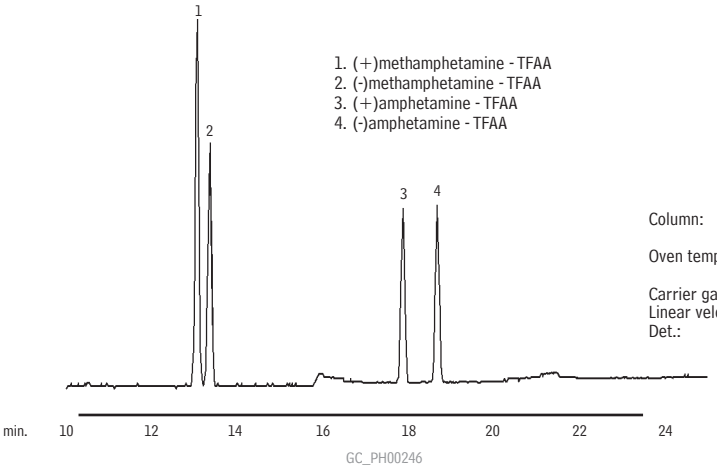
Rx

Barbiturates (Underivatized)
Rt®-βDEXcst



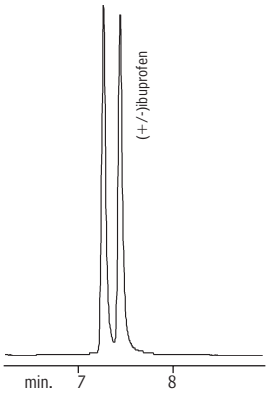
Column:	Rt®-βDEXcst, 30m, 0.32mm ID, 0.25µm (cat.# 13102)
Inj.:	on-column, 25ng/enantiomer
Oven temp.:	60°C (hold 1 min.) to 220°C @ 3°C/min.
Carrier gas:	hydrogen
Linear velocity:	80cm/sec. set @ 60°C
Det.:	FID @ 220°C

Amphetamine and Methamphetamine (TFAA Derivatives)
Rt®-βDEXcst



Column:	Rt®-βDEXcst, 30m, 0.25mm ID, 0.25µm (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

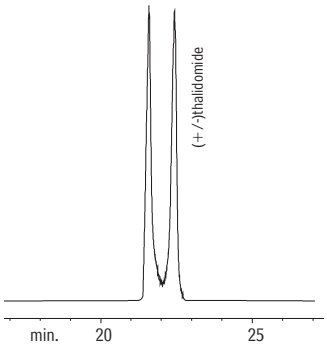
Ibuprofen (Underivatized)
Rt®-βDEXsm



GC_PH00242

Column:	Rt®-βDEXsm, 30m, 0.32mm ID, 0.25μm (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)
Rt®-βDEXcst

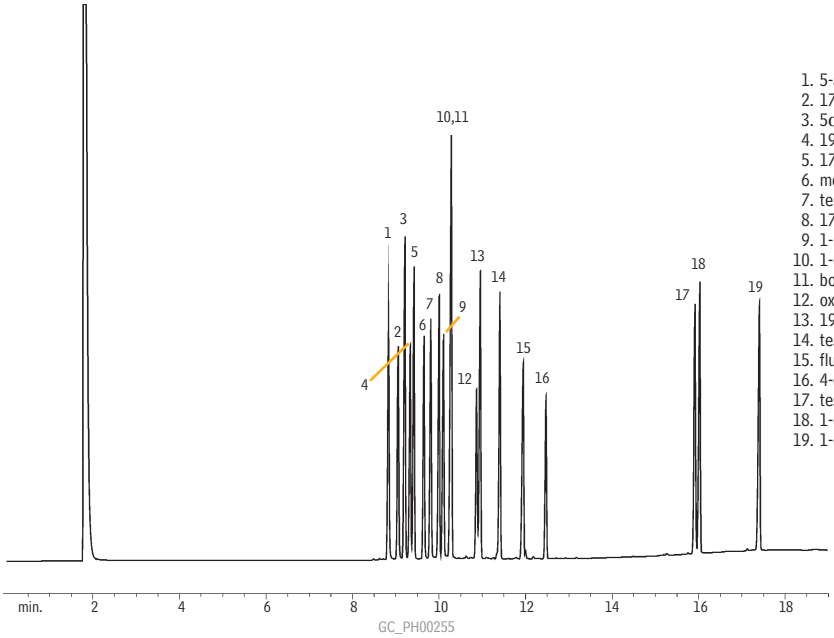


GC_PH00243

Column:	Rt®-βDEXcst, 30m, 0.32mm ID, 0.25μm (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)

Rx

Steroids, Anabolic (Underivatized)
Rtx®-5



GC_PH00255

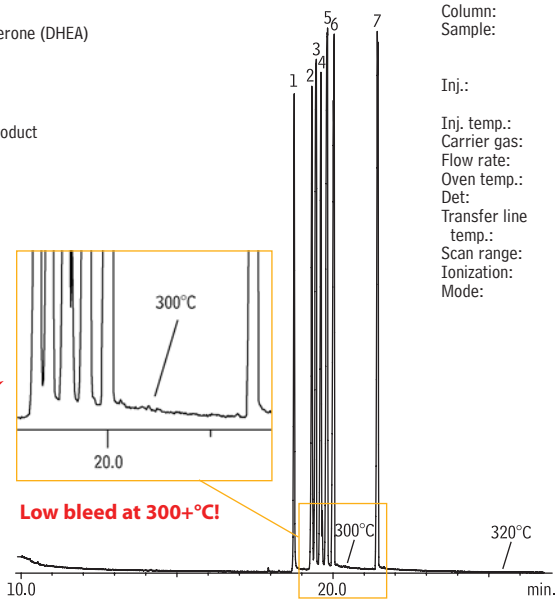
1. 5-androstene-3β,17β-diol
2. 17α-methyl-5-androstene-3β,17β-diol
3. 5α-androstan-17β-ol-3-one
4. 19-nortestosterone
5. 17α-methylandrostan-17β-ol-3-one
6. mesterolone
7. testosterone
8. 17α-methyltestosterone
9. 1-dehydrotestosterone
10. 1-dehydro-17α-methyltestosterone
11. bolasterone
12. oxymethalone
13. 19-nortestosterone-17-propionate
14. testosterone propionate
15. fluoxymesterone
16. 4-chlorotestosterone-17-acetate
17. testosterone-17β-cypionate
18. 1-dehydrotestosterone benzoate
19. 1-dehydrotestosterone undecylenate

Column:	Rtx®-5, 30m, 0.25mm ID, 0.10μm (cat.# 10208)
Sample:	0.5μL split injection of anabolic steroids
Conc.:	1,000ng/μL
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 10^{10} AFS
Split ratio:	50:1

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

Column:	Rxi®-1ms, 30m, 0.25mm ID, 0.25μm (cat.# 13323)
Sample:	100μg/mL each hormone in methanol or ethanol; compounds derivatized using 2% methoxylamine HCl (CH_3ONH_2) in pyridine, then N-trimethylsilylimidazole (TMSI), then analyzed
Inj.:	1.0μL splitless (hold 0.5 min.), 3.5mm single gooseneck inlet liner (cat.# 20961)
Inj. temp.:	250°C
Carrier gas:	helium, constant flow
Flow rate:	1mL/min.
Oven temp.:	100°C to 320°C @ 10°C/min. (hold 10 min.)
Det:	MS: Shimadzu 17A with QP5000
Transfer line temp.:	280°C
Scan range:	40-700amu
Ionization:	EI
Mode:	scan



GC_PH00872

Excellent resolution of closely eluting hormones.

Rxi® Technology!
Exceptionally inert, ultra low- bleed capillary columns.

Stu Kline, Customer Service

Restek Customer Service

In the U.S.

Call: 800-356-1688 (ext. 3) or 814-353-1300 (ext. 3)

Monday–Friday 8:00 a.m.–6:00 p.m. ET

Fax: 814-353-1309—24-hours a day

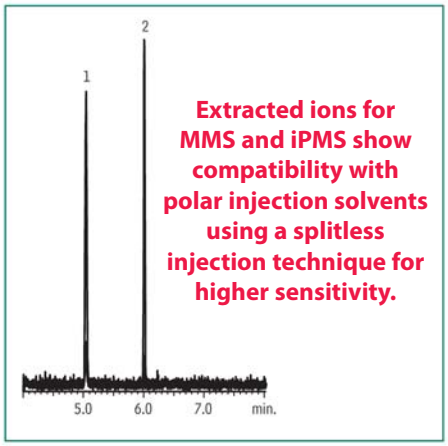
Online: www.restek.com—24-hours a day

Outside the U.S.

Contact your Restek representative:
Refer to our list on pages 4-5 or visit our website at www.restek.com

Mesylate, Besylate, and Tosylate Genotoxic Impurities
Rxi®-624Sil MS (extracted ion chromatograms)

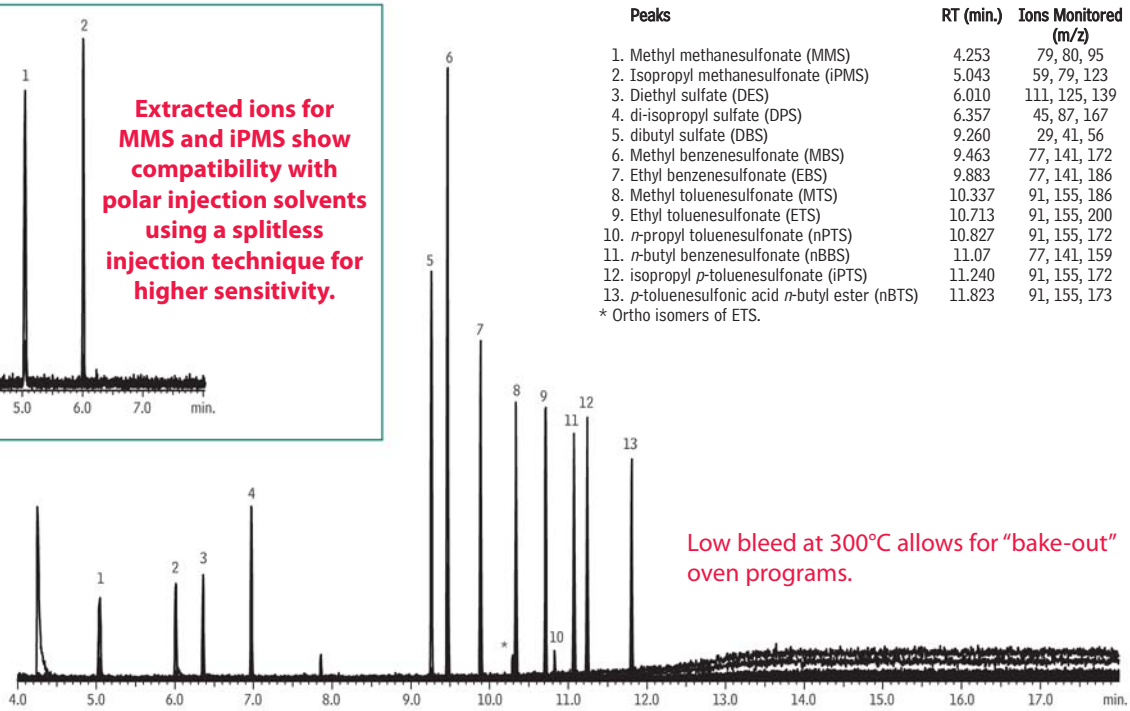
NEW!



Extracted ions for MMS and iPMS show compatibility with polar injection solvents using a splitless injection technique for higher sensitivity.

Peaks	RT (min.)	Ions Monitored (m/z)
1. Methyl methanesulfonate (MMS)	4.253	79, 80, 95
2. Isopropyl methanesulfonate (iPMS)	5.043	59, 79, 123
3. Diethyl sulfate (DES)	6.010	111, 125, 139
4. di-isopropyl sulfate (DPS)	6.357	45, 87, 167
5. dibutyl sulfate (DBS)	9.260	29, 41, 56
6. Methyl benzenesulfonate (MBS)	9.463	77, 141, 172
7. Ethyl benzenesulfonate (EBS)	9.883	77, 141, 186
8. Methyl toluenesulfonate (MTS)	10.337	91, 155, 186
9. Ethyl toluenesulfonate (ETS)	10.713	91, 155, 200
10. *n*-propyl toluenesulfonate (nPTS)	10.827	91, 155, 172
11. *n*-butyl benzenesulfonate (nBBS)	11.07	77, 141, 159
12. isopropyl *p*-toluenesulfonate (iPTS)	11.240	91, 155, 172
13. *p*-toluenesulfonic acid *n*-butyl ester (nBTS)	11.823	91, 155, 173

* Ortho isomers of ETS.



Low bleed at 300°C allows for "bake-out" oven programs.

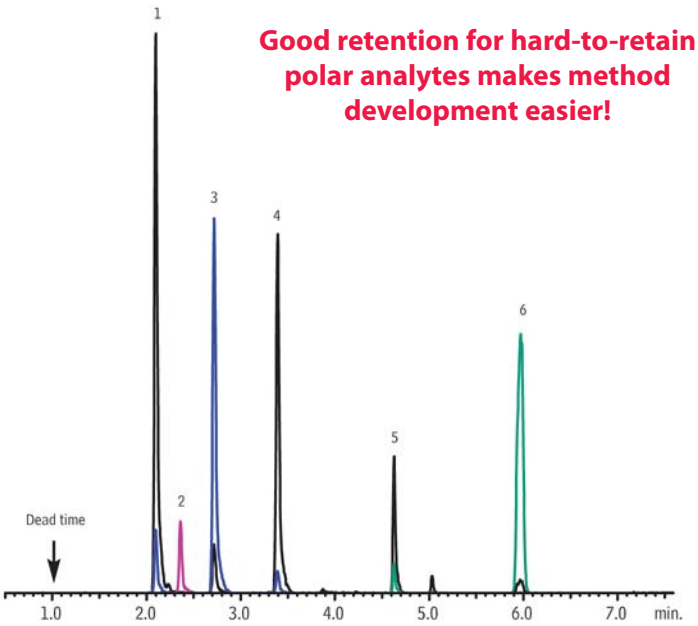
GC_PH1165

Column	Rxi®-624Sil MS, 20 m, 0.18 mm ID, 1.00 µm (cat.# 13865)
Sample	
Diluent:	90:10 acetonitrile:water
Conc.:	500 ng/mL
Injection	
Inj. Vol.:	1 µL splitless (hold 0.5 min.)
Liner:	3.5mm Single Gooseneck Liner with wool placed 3cm from top (middle) (cat.# 22286)
Inj. Temp.:	220 °C
Purge Flow:	3 mL/min.
Oven	
Oven Temp:	80 °C (hold 2 min.) to 300 °C at 20 °C/min. (hold 5 min.)
Carrier Gas	He, constant flow
Linear Velocity:	45 cm/sec.
Detector	MS
Mode:	SIM
Transfer Line Temp.:	200 °C
Analyzer Type:	Quadrupole
Source Temp.:	280 °C
Solvent Delay Time:	4 min.
Ionization Mode:	EI
Instrument	Shimadzu 2010 GC & QP2010+ MS
Acknowledgement	In collaboration with Merck and Company

Alkyl Halide Genotoxic Impurities
Rxi®-624Sil MS (High Concentration Injection)

NEW!

Rx



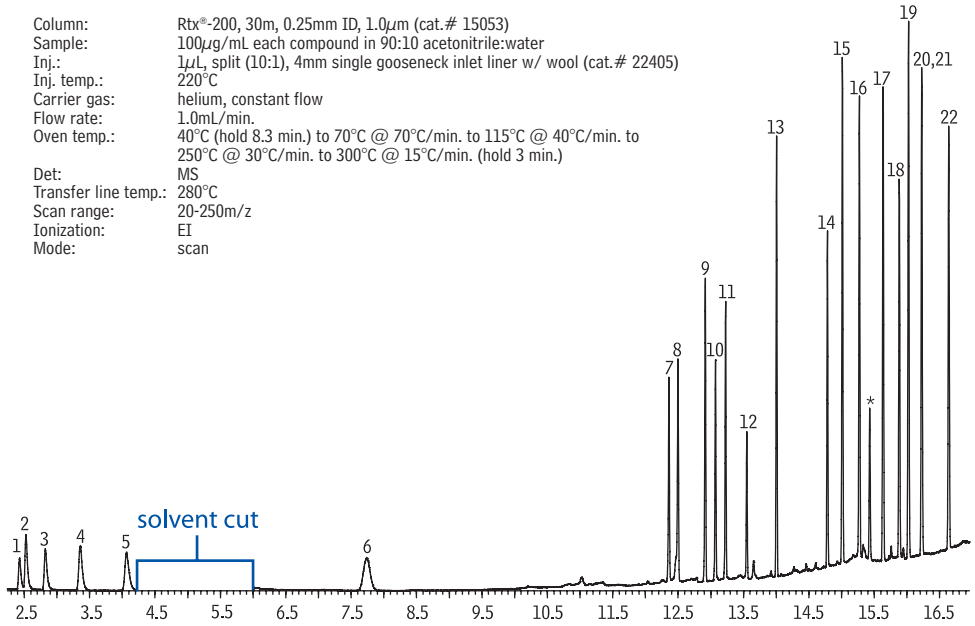
GC_PH1166

Peaks	RT (min.)	Conc. (µg/mL)
1. 2-Chloropropane	2.10	1
2. Bromoethane	2.36	1
3. 1-Chloropropane	2.72	1
4. 2-Bromopropane	3.393	1
5. Butyl chloride	4.627	1
6. 1-Bromobutane	5.973	1

Column	Rxi®-624Sil MS, 20 m, 0.18 mm ID, 1.00 µm (cat.# 13865)
Sample	
Diluent:	DMSO
Conc.:	1 µg/mL
Injection	
Inj. Vol.:	1 µL splitless (hold 0.5 min.)
Liner:	3.5mm Single Gooseneck Liner with wool placed 3cm from top (middle) (cat.# 22286)
Inj. Temp.:	220 °C
Purge Flow:	3 mL/min.
Oven	
Oven Temp:	40 °C (hold 3 min.) to 200 °C at 20 °C/min.
Carrier Gas	He, constant flow
Linear Velocity:	40 cm/sec.
Detector	MS
Mode:	Scan
Transfer Line Temp.:	200 °C
Analyzer Type:	Quadrupole
Source Temp.:	280 °C
Solvent Delay Time:	0.5 min.
Ionization Mode:	EI
Scan Range:	30-300 amu
Scan Rate:	5 scans/sec.
Instrument	Shimadzu 2010 GC & QP2010+ MS
Notes:	Ions monitored 42, 43, 57, 108 m/z

Potential Genotoxic Impurities (PGIs)
Rtx®-200

Column:	Rtx®-200, 30m, 0.25mm ID, 1.0µm (cat.# 15053)
Sample:	100µg/mL each compound in 90:10 acetonitrile:water
Inj.:	1µL, split (10:1), 4mm single gooseneck inlet liner w/ wool (cat.# 22405)
Inj. temp.:	220°C
Carrier gas:	helium, constant flow
Flow rate:	1.0mL/min.
Oven temp.:	40°C (hold 8.3 min.) to 70°C @ 70°C/min. to 115°C @ 40°C/min. to 250°C @ 30°C/min. to 300°C @ 15°C/min. (hold 3 min.)
Det:	MS
Transfer line temp.:	280°C
Scan range:	20-250m/z
Ionization:	EI
Mode:	scan



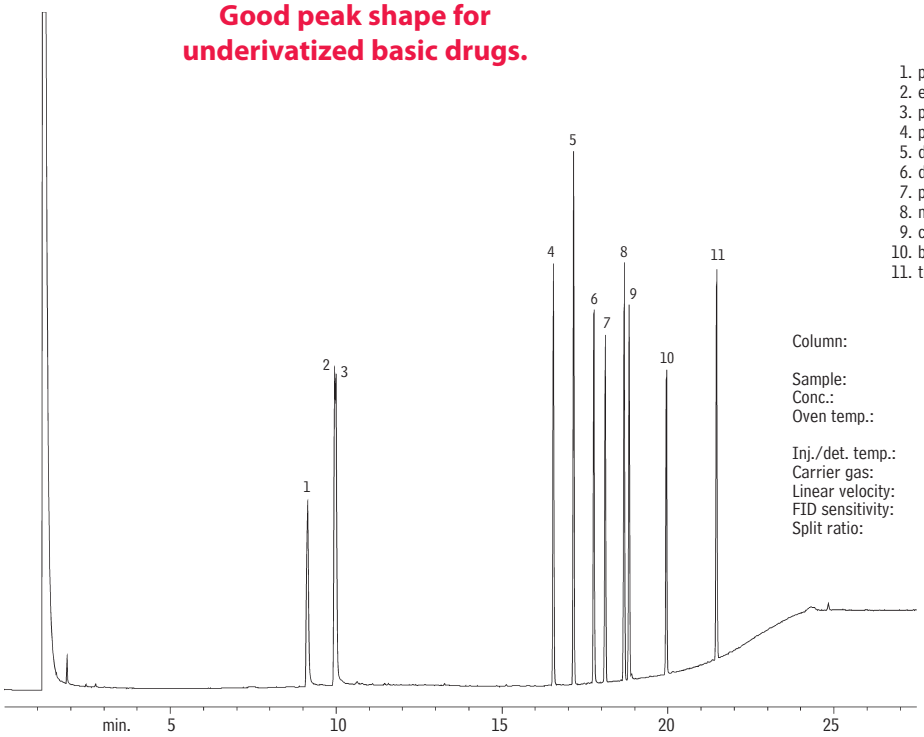
GC_PH01076

1. 1-chloropropane
2. bromoethane
3. 2-chloropropane
4. 1-bromopropane
5. 2-bromopropane
6. 1-bromobutane
7. dimethyl sulfate
8. methyl methanesulfonate
9. ethyl methanesulfonate
10. isopropyl methanesulfonate
11. diethyl sulfate
12. di-isopropyl sulfate
13. di-*n*-propyl sulfate
14. dibutyl sulfate
15. methylbenzene sulfonate
16. ethylbenzene sulfonate
17. methyl toluenesulfonate
18. ethyl toluenesulfonate
19. *n*-butyl benzenesulfonate
20. *n*-propyl toluenesulfonate
21. isopropyl toluenesulfonate
22. *n*-butyl toluenesulfonate

*ortho isomer of ethyl toluenesulfonate

Underivatized Antihistamines (Basic Drugs)
Rtx®-5 Amine

Good peak shape for underivatized basic drugs.



GC_PH00247

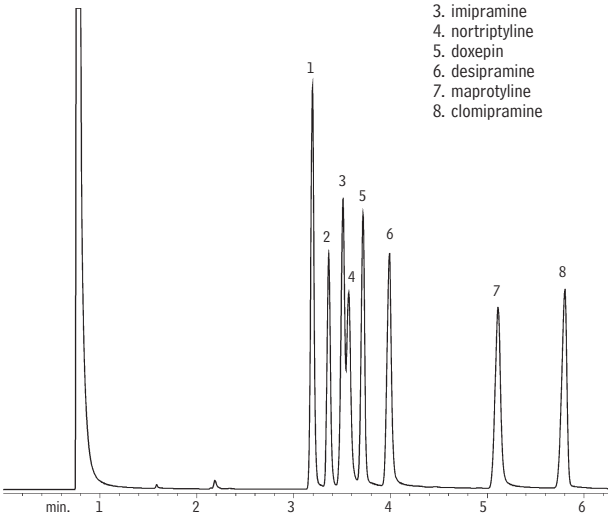
1. phenylpropanolamine
2. ephedrine
3. pseudoephedrine
4. pheniramine
5. diphenhydramine
6. doxylamine
7. phenyltoloxamine
8. methapyrilene
9. chlorpheniramine
10. brompheniramine
11. triprolidine

Column:	Rtx®-5 Amine, 30m, 0.32mm ID, 1.0µm (cat.# 12354)
Sample:	1.0µL split injection of antihistamines
Conc.:	1,000ng/µL
Oven temp.:	130°C (hold 5 min.) to 305°C @ 10°C/min. (hold 5 min.)
Inj./det. temp.:	305°C
Carrier gas:	hydrogen
Linear velocity:	43cm/sec. set @ 130°C
FID sensitivity:	6.4 x 10^{-11} AFS
Split ratio:	50:1

Rx

Antidepressants (Basic Drugs) (Underivatized)
Rtx®-1701

1. amitriptyline
2. trimipramine
3. imipramine
4. nortriptyline
5. doxepin
6. desipramine
7. maprotyline
8. clomipramine



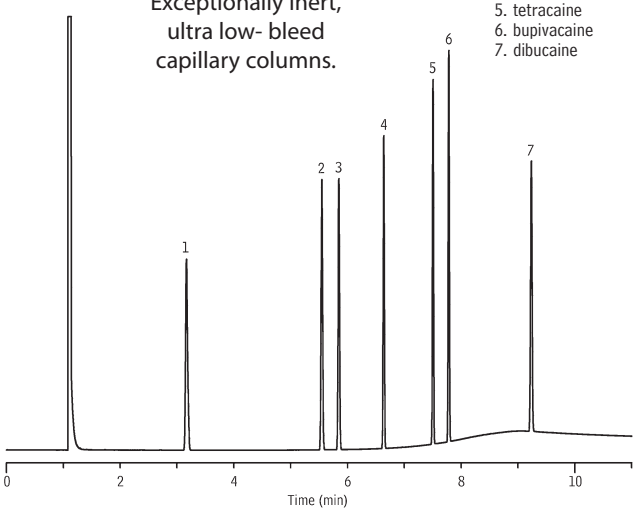
GC_PH00264

Column:	Rtx®-1701, 15m, 0.25mm ID, 0.25µm (cat.# 12020)
Sample:	1.0µL split injection of antidepressants
Conc.:	25ng/component
Oven temp.:	225°C
Inj./det. temp.:	250°C/260°C
Carrier gas:	helium
Linear velocity:	30cm/sec. set @ 225°C
FID sensitivity:	2.56 x 10^{-10} AFS
Split ratio:	40:1

Local Anesthetics
Rxi®-5ms

Rxi® Technology!
Exceptionally inert, ultra low- bleed capillary columns.

1. benzocaine
2. prilocaine
3. lidocaine
4. procaine
5. tetracaine
6. bupivacaine
7. dibucaine

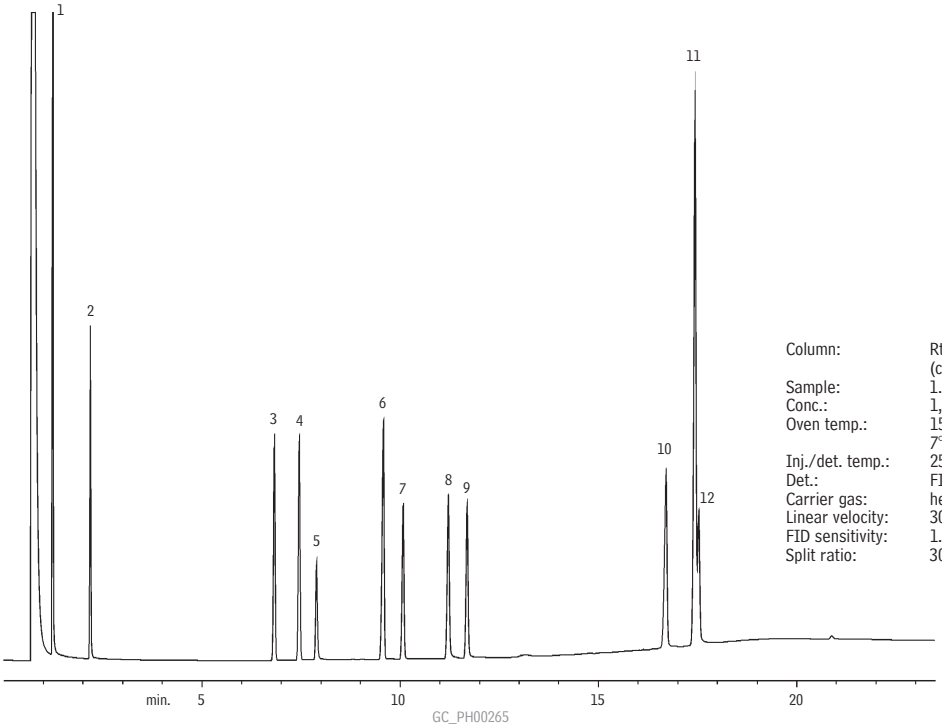


GC_PH00860

Column:	Rxi®-5ms, 30m, 0.53mm ID, 1.00µm (cat.# 13455)
Sample:	50µg/mL each component in methanol
Inj.:	1.0µL 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

Rx

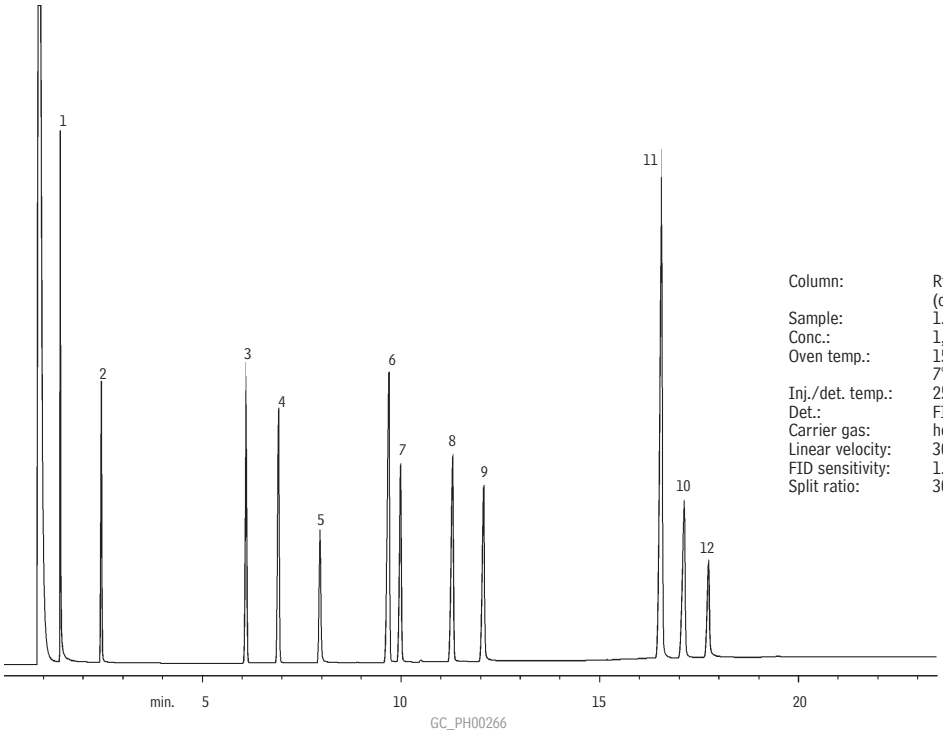
Antiepileptics (Underivatized)
Rtx®-20



Column:	Rtx®-20, 15m, 0.32mm ID, 0.50µm (cat.# 10336)
Sample:	1.0µL split injection of antiepileptic drugs
Conc.:	1,000ng/µL
Oven temp.:	150°C to 280°C @ 7°C/min. (hold 5 min.)
Inj./det. temp.:	250°C/270°C
Det.:	FID
Carrier gas:	helium
Linear velocity:	30cm/sec. set @ 150°C
FID sensitivity:	1.28 x 10^{-10} AFS
Split ratio:	30:1

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

Antiepileptics (Underivatized)
Rtx®-1701



Column:	Rtx®-1701, 15m, 0.32mm ID, 0.50µm (cat.# 12036)
Sample:	1.0µL split injection of antiepileptic drugs
Conc.:	1,000ng/µL
Oven temp.:	150°C to 280°C @ 7°C/min. (hold 5 min.)
Inj./det. temp.:	250°C/270°C
Det.:	FID
Carrier gas:	helium
Linear velocity:	30cm/sec. set @ 150°C
FID sensitivity:	1.28 x 10^{-10} AFS
Split ratio:	30:1

Organic Volatile Impurities: Retention Time Index

Reduce method development time—use a retention time index for column selection.

Rxi®-624Sil MS
20 m x 0.18 mm x 1.0 µm df
Dead Time 0.81 minutes Constant Flow
Initial 45°C (hold 5 min.) 7C/min. to 220°C (hold 5 min.)

for more info

See **pages 694-695** for Rxi®-624Sil MS chromatograms.

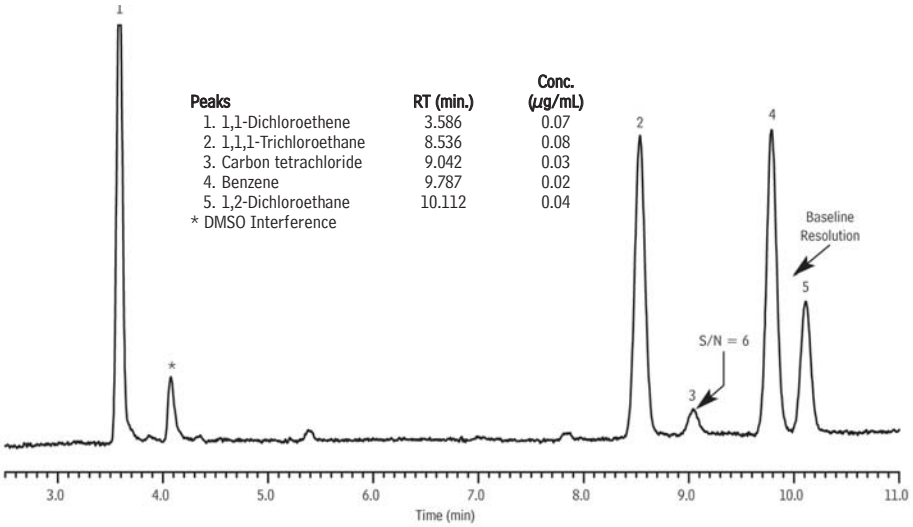
Compound	MS ion	char.ion	45(5)7/220(5)
formaldehyde	29	30,31	1.16
methanol	31	29,30,33	1.36
pentane	43	41,42,72,57,29	1.74
ethanol	31	45,46,27	1.76
diethylether	59	74,45	1.87
2-chloropropane	43	73,63,80,27	1.95
acetone	43	58,27,39	2.06
methylal	45	75,29,31	2.07
1,1-dichloroethene	61	96,61,63	2.08
2-propanol	45	43,27,59	2.15
ethyl formate	45	31,29,27,74	2.2
methyl acetate	43	74,59,29	2.33
acetonitrile	41	40,39,38	2.33
2-methylpentane	43	42,41,71,86	2.48
methylene chloride	84	49,86,51,88	2.5
methyl *tert*-buyl ether	73	57,41,43,45	2.7
trans-1,2-dichloroethene	61	96,98,63	2.76
hexane	57	41,86,43	3.05
isopropyl ether	45	43,87,69	3.22
1-propanol	31	42,59,27	3.22
methyl cyclopentane	56	41,69,84	3.76
nitromethane	61	46,30	3.83
2-butanone (MEK)	72	43,57 (use 43)	3.9
cis-1,2-dichloroethene	96	96,61,98	3.96
ethyl acetate	43	61,70	4
2-butanol	45	59,31	4.21
tetrahydrofuran	42	72,71,41 (use 72)	4.34
chloroform	83	83,85,47,87,118	4.51
1,1,1-trichloroethane	97	97,99,61	4.76
2,2-dimethoxypropane	73	89,43,42,31	4.81
cyclohexane	56	84,41,27	4.88
carbon tetrachloride	117	117,119	5.04
isobutyl alcohol	42	43,31,41,33	5.31
2-methoxyethanol	45	47,76	5.31
1,2-dimethoxyethane	45	60,58,90	5.41
benzene	78	78	5.41

Compound	MS ion	char.ion	45(5)7/220(5)
1,2-dichloroethane	62	62,98	5.55
isopropyl acetate	43	61,87	5.59
isooctane	57	56,41	5.63
methyl isopropyl ketone	43	41,86	6
n-heptane (C7)	43	57,71,100	6.06
1-butanol	56	41,43,55	6.67
trichloroethene	95	95,97,134,132	6.73
methyl cyclohexane	83	55,98	7.17
1,4-dioxane	88	58,43,57	7.43
propyl acetate	43	61,73	7.61
2-ethoxyethanol	59	31,45,72	8.12
pyridine	79	52,50,51	9.04
hexanone (MIBK)	43	58,56,85,100	9.17
isoamyl alcohol	55	42,41,43,70	9.33
toluene	91	92,65,51	9.37
ethylene glycol	31	33	9.69
isobutyl acetate	43	56,73	9.91
1-pentanol	42	55,70,41	10.43
formamide	45	29,44	10.49
1,1-diethoxypropane	59	47,87,103	10.79
2-hexanone (MBK)	43	58,57,100	10.88
butyl acetate	43	56	11.31
dimethyl formamide (DMF)	73	44,58	11.68
chlorobenzene	112	112,77,114	12.35
ethylbenzene	91	91,106	12.64
p-xylene	106	106,91	12.93
m-xylene	106	106,91	12.93
isoamyl acetate	43	55,70	13.28
o-xylene	106	106,91	13.74
dimethyl sulfoxide	78	63,45	14.06
N,N-dimethylacetamide	87	44,43,72	14.45
isopropylbenzene (cumene)	105	120,77	14.55
anisole	108	78,65,51	14.72
1-methyl-2-pyrrolidinone	99	98,44,42	19.54
1,2,3,4-tetrahydronaphthalene	104	132,117,91,65	21.39
sulfolane	41	56,55,120	24.77

Rx

Class 1 Residual Solvents for Water-Soluble Articles on Rxi®-624Sil MS

NEW!

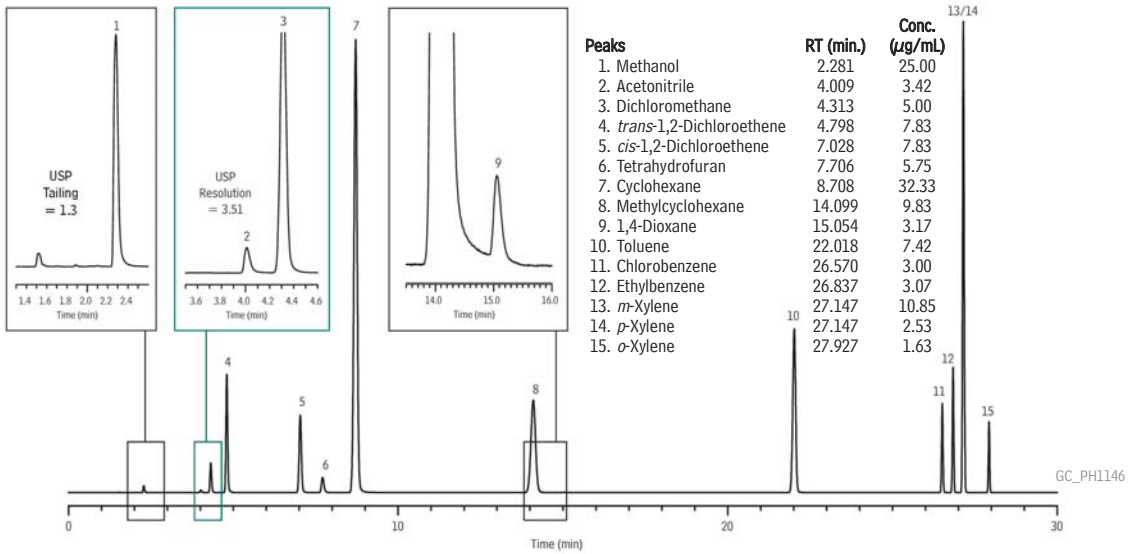


Peaks	RT (min.)	Conc. (µg/mL)
1. 1,1-Dichloroethene	3.586	0.07
2. 1,1,1-Trichloroethane	8.536	0.08
3. Carbon tetrachloride	9.042	0.03
4. Benzene	9.787	0.02
5. 1,2-Dichloroethane	10.112	0.04
* DMSO Interference		

Column Rxi®-624Sil MS, 30 m, 0.32 mm ID, 1.80 µm (cat.# 13870)
Sample Residual Solvents - Class 1 (cat.# 36279)
Diluent: water
Injection headspace-loop split (split ratio 5:1)
Liner: 1mm Split (cat.# 20972)
Headspace-Loop
Inj. Port Temp.: 140 °C
Instrument: Tekmar HT3
Inj. Time: 1 min.
Transfer Line Temp.: 110 °C
Valve Oven Temp.: 110 °C
Sample Temp.: 80 °C
Sample Equil. Time: 60 min.
Vial Pressure: 10 psi
Pressurize Time: 0.5 min.
Pressure Equilibration Time: 0.05 min.
Loop Pressure: 5 psi
Loop Fill Time: 0.1 min.
Oven
Oven Temp: 40 °C (hold 20 min.) to 240 °C at 10 °C/min. (hold 20 min.)
Carrier Gas He, constant flow
Linear Velocity: 35 cm/sec.
Dead Time: 1.45 min. @ 40 °C
Detector FID @ 250 °C
Data Rate: 5 Hz
Instrument Agilent/HP6890 GC
Acknowledgement Teledyne Tekmar

Class 2 - Mix A Residual Solvents for Water-Soluble Articles on Rxi®-624Sil MS

NEW!

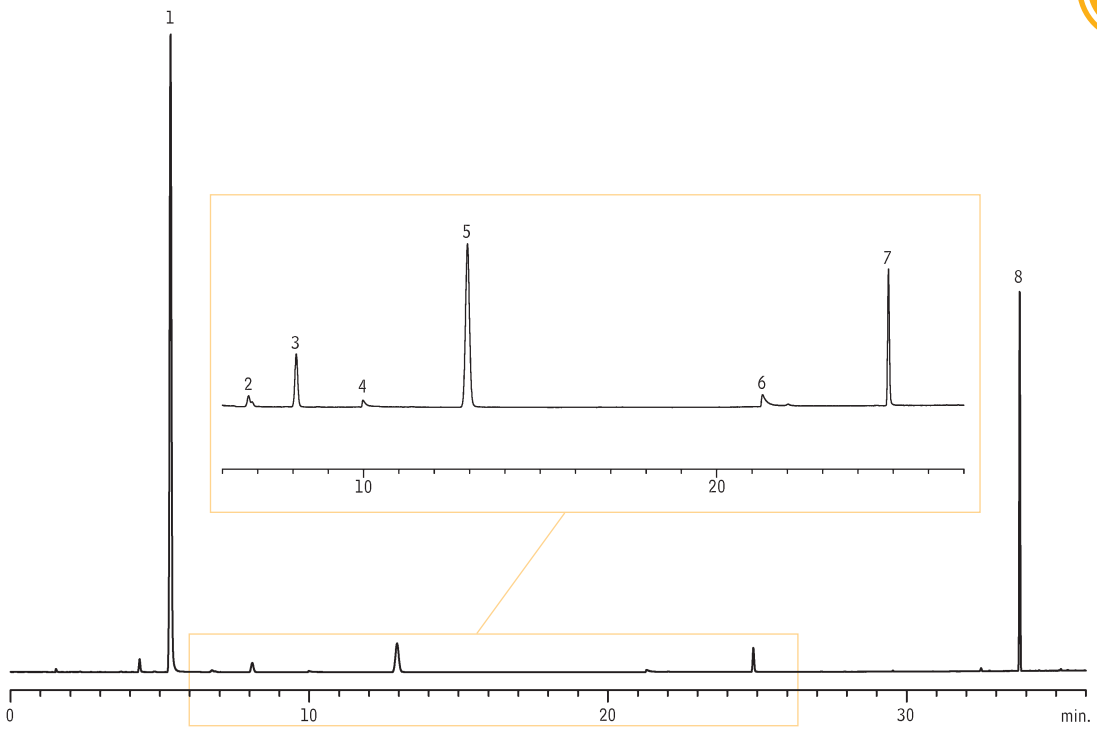


Peaks	RT (min.)	Conc. (µg/mL)
1. Methanol	2.281	25.00
2. Acetonitrile	4.009	3.42
3. Dichloromethane	4.313	5.00
4. *trans*-1,2-Dichloroethene	4.798	7.83
5. *cis*-1,2-Dichloroethene	7.028	7.83
6. Tetrahydrofuran	7.706	5.75
7. Cyclohexane	8.708	32.33
8. Methylcyclohexane	14.099	9.83
9. 1,4-Dioxane	15.054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

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

Class 2—Mix B Residual Solvents for Water-Soluble Articles on Rxi®-624Sil MS

NEW!



GC_PH1148

Peaks	RT (min.)	Conc. (µg/mL)
1. Hexane	5.355	2.42
2. Nitromethane	6.793	0.42
3. Chloroform	8.092	0.50
4. 1,2-Dimethoxyethane	9.980	0.83
5. Trichloroethene	12.941	0.67
6. Pyridine	21.303	1.67
7. 2-Hexanone	24.862	0.42
8. Tetralin	33.781	0.83

Column: Rxi®-624Sil MS, 30 m, 0.32mm ID, 1.80 µm (cat.# 13870)

Sample: Residual Solvents Class 2 - Mix B (cat.# 36280)
Diluent: water
Injection: headspace-loop split (split ratio 5:1)
Liner: 1 mm Split (cat.# 20972)

Headspace-Loop
Inj. Port Temp.: 140 °C
Instrument: Tekmar HT3
Inj. Time: 1 min.
Transfer Line Temp.: 110 °C
Valve Oven Temp.: 110 °C
Sample Temp.: 80 °C
Sample Equil. Time: 60 min.
Vial Pressure: 10 psi
Pressurize Time: 0.5 min.
Pressure Equilibration Time: 0.05 min.
Loop Pressure: 5 psi
Loop Fill Time: 0.1 min.

Oven
Oven Temp: 40 °C (hold 20 min.) to 240 °C at 10 °C/min. (hold 20 min.)
Carrier Gas: He, constant flow
Linear Velocity: 35 cm/sec.
Dead Time: 1.45 min. @ 40 °C
Detector: FID @ 250 °C
Data Rate: 5 Hz

Instrument: Agilent/HP6890 GC
Acknowledgement: Teledyne Tekmar

free literature

Residual Solvent Analysis
Implementing USP <467>

Download your copy from
www.restek.com

Applications Note
lit. cat.# PHFL1018A

Organic Volatile Impurities: Retention Time Index

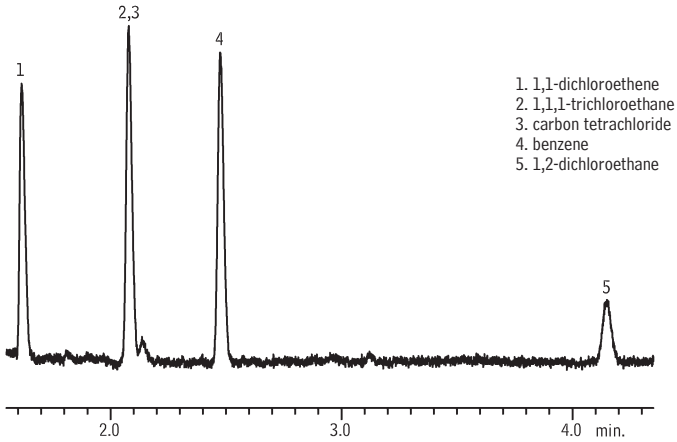
Reduce method development time—use a retention time index for column selection.

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

Carrier gas: helium Compound	ICH Class	G16 Stabilwax® Retention Time	G16 Rtx®-WAX Retention Time	G43 Rtx®-1301 Retention Time	G27 Rxi®-5ms Retention Time	G1 Rtx®-1 Retention Time	NA Rtx®-200 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	*	*
dichloromethane	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	14.29	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	14.17	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

* Not determined

Residual Solvents Class 1
Stabilwax® (G16)



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

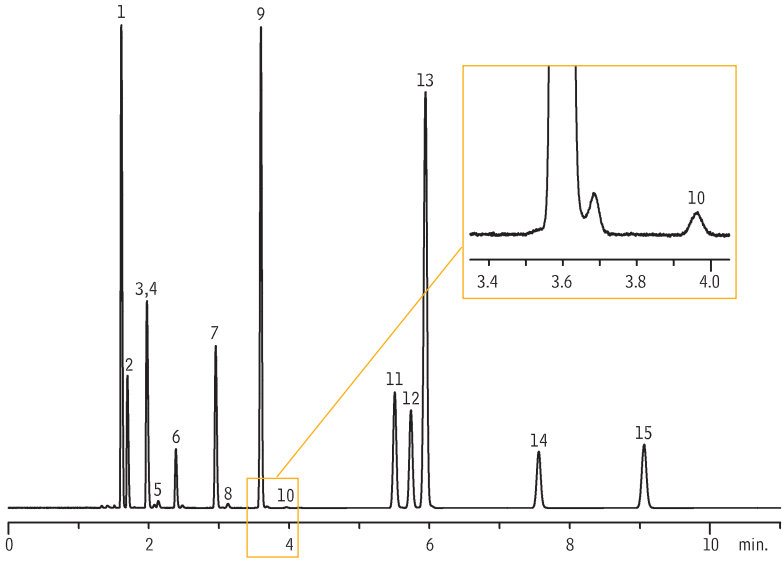
GC_PH00951

Column:	Stabilwax®, 30m, 0.32mm ID, 0.25µm (cat.# 10624)
Sample:	USP Stock Mixture USP<467> Residual Solvents Class 1 Mix (cat.# 36279) 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.

Residual Solvents Class 2 Mix A
Stabilwax® (G16)



GC_PH00952

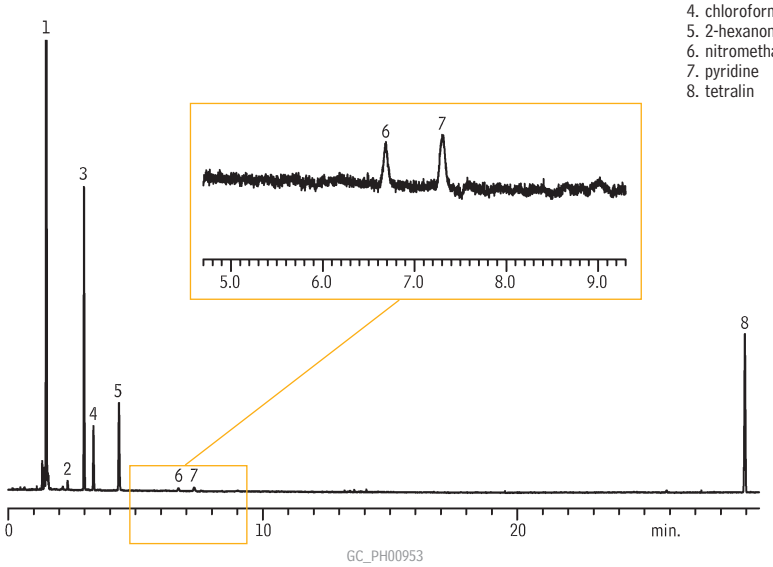
1. cyclohexane
2. methylcyclohexane
3. *trans*-1,2-dichloroethene
4. tetrahydrofuran
5. methanol
6. dichloromethane
7. *cis*-1,2-dichloroethene
8. acetonitrile
9. toluene
10. 1,4-dioxane
11. ethyl benzene
12. *p*-xylene
13. *m*-xylene
14. *o*-xylene
15. chlorobenzene

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.

Residual Solvents Class 2 Mix B
Stabilwax® (G16)



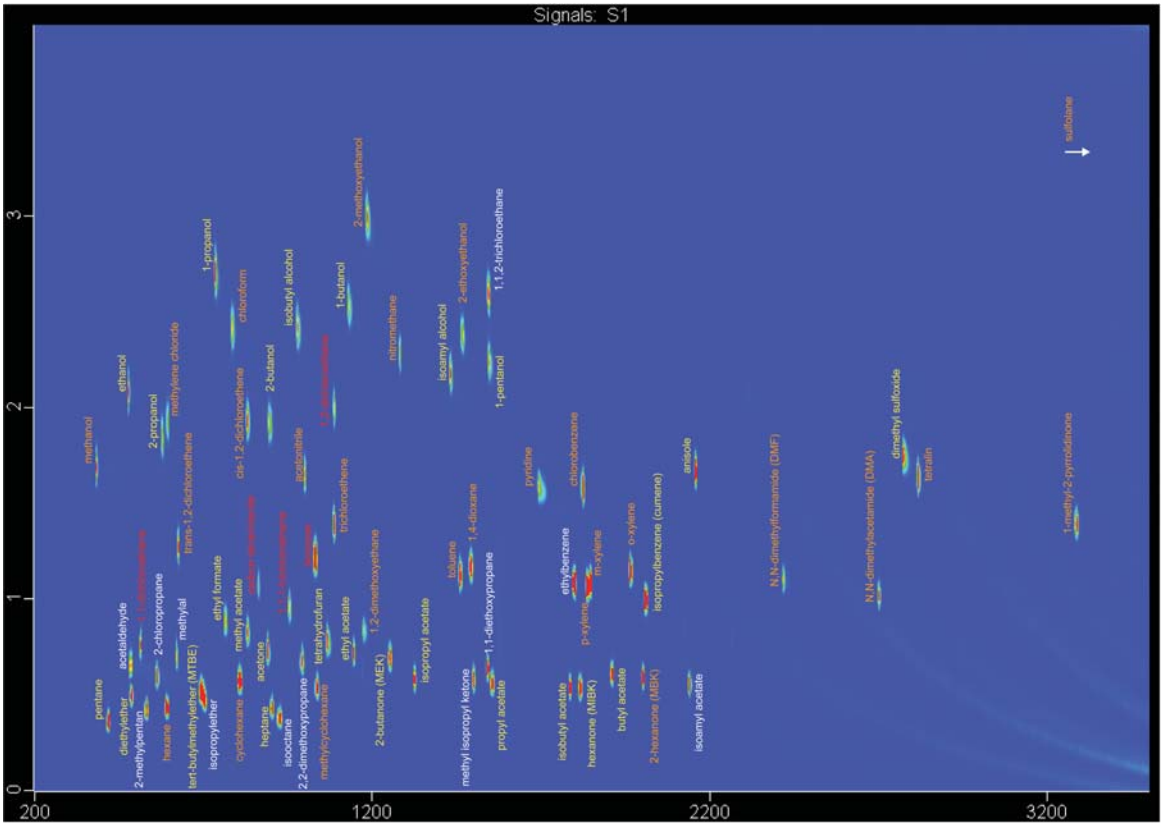
1. hexane
2. 1,2-dimethoxyethane
3. trichloroethylene
4. chloroform
5. 2-hexanone
6. nitromethane
7. pyridine
8. tetralin

Column:	Stabilwax®, 30m, 0.32mm ID, 0.25µm (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.

Organic Volatile Impurities
Rtx®-200 & Rtx®-WAX (GCxGC)



GC_PH00888

Columns:	Rtx®-200, 60m, 0.25mm ID, 1.0µm (cat.# 15056) Rtx®-Wax, 2m, 0.18mm ID, 0.3µm (custom)
Sample:	0.2µL mix of 69 neat organic volatile impurities
Instrument:	Agilent 6890 with LECO liquid nitrogen cryojet modulator
Inj.:	split/splitless, 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

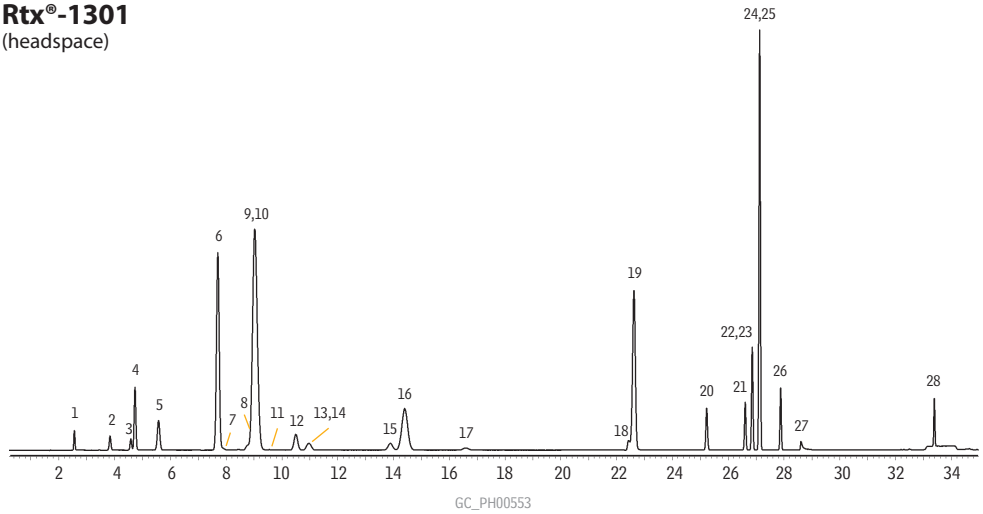
Separation of the complete list of International Conference on Harmonization Class 1, Class 2, and Class 3 organic volatiles requires at least two, and often three, separate analyses on differing capillary GC columns. While many laboratories do not monitor for the complete list, separation of OVIs still is a challenge, often characterized by long run times 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, two columns of differing selectivity are used to separate the compounds in a 2-dimensional plot, as shown above. 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 search for GCxGC.

Rx

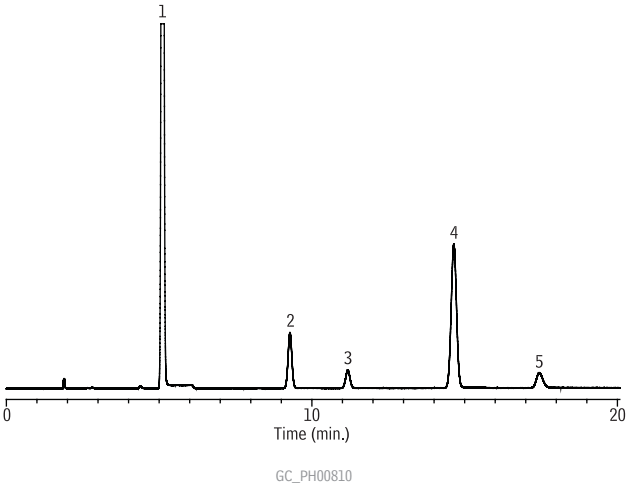
Residual Solvents
European Pharmacopoeia Class 1 and Class 2
Rtx®-1301
(headspace)



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-trichlorethene)
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

Column:	Rtx®-1301, 30m, 0.53mm ID x 3.0µm (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

Organic Volatile Impurities
USP <467>
Rtx®-G43
(static headspace)



Column:	Rtx®-G43, 30m, 0.53mm ID, 3.0µm (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 100µL of stock standard were added. The preparation yielded the following concentrations,

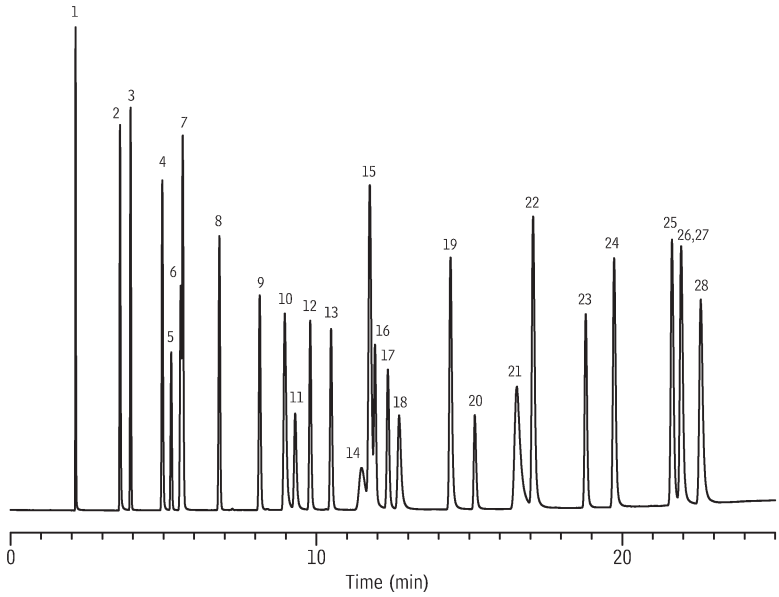
	Retention Time (min.)	Sample Concentration (µg/mL)
1. dichloromethane	5.110	12.0
2. chloroform	9.285	1.2
3. benzene	11.173	0.04
4. trichloroethylene	14.647	1.6
5. 1,4-dioxane	17.436	7.6

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:	Teledyne 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:	15psi
Pressurize time:	2.00 min.
Pressurize equil. time:	0.50 min.
Loop fill pressure:	5psi
Loop fill time:	2.00 min.
Loop fill equil. time:	0.50 min.
Inject time:	1.00 min.

Solvent Mixture
Rt®-Q-BOND
(PLOT)

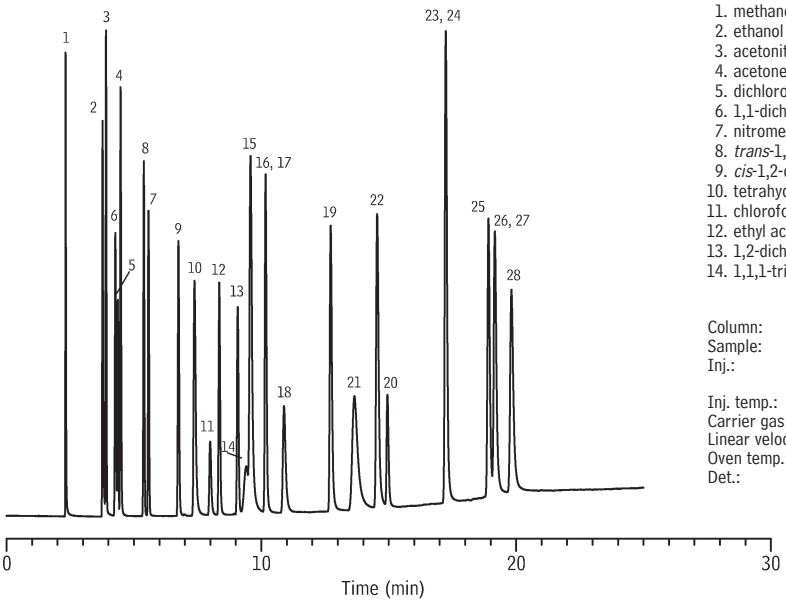


GC_PC01082

1. methanol
2. ethanol
3. acetonitrile
4. acetone
5. dichloromethane
6. 1,1-dichloroethene
7. nitromethane
8. *trans*-1,2-dichloroethylene
9. *cis*-1,2-dichloroethylene
10. tetrahydrofuran
11. chloroform
12. ethyl acetate
13. 1,2-dichloroethane
14. 1,1,1-trichloroethane
15. benzene
16. 1,2-dimethoxyethane
17. trichloroethylene
18. 1,4-dioxane
19. pyridine
20. dimethylformamide
21. methylcyclohexane
22. toluene
23. 2-hexanone
24. chlorobenzene
25. ethylbenzene
26. *m*-xylene
27. *p*-xylene
28. *o*-xylene

Column:	Rt®-Q-BOND, 30m, 0.53mm ID, 20µm (cat.# 19742)
Sample:	solvent mixture
Inj.:	1.0µL, split (split vent flow 100mL/min.), 4mm single gooseneck liner (cat.# 20798)
Inj. temp.:	200°C
Carrier gas:	hydrogen, constant pressure, 4.2psi
Linear velocity:	40cm/sec. @ 120°C
Oven temp.:	120°C to 240°C @ 5°C/min. (hold 5.0 min.)
Det.:	FID @ 240°C

Solvent Mixture
Rt®-S-BOND
(PLOT)



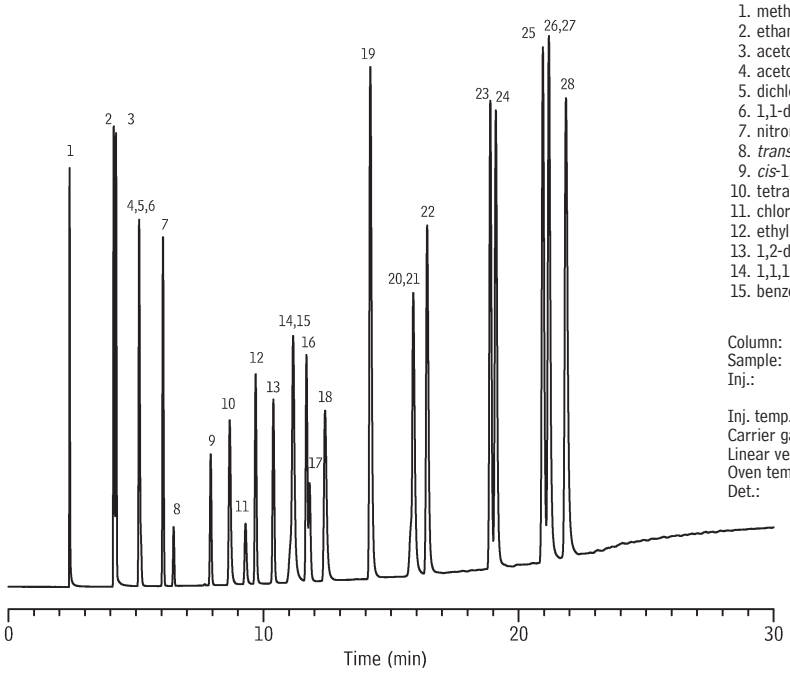
GC_PC01080

1. methanol
2. ethanol
3. acetonitrile
4. acetone
5. dichloromethane
6. 1,1-dichloroethene
7. nitromethane
8. *trans*-1,2-dichloroethylene
9. *cis*-1,2-dichloroethylene
10. tetrahydrofuran
11. chloroform
12. ethyl acetate
13. 1,2-dichloroethane
14. 1,1,1-trichloroethane
15. benzene
16. 1,2-dimethoxyethane
17. trichloroethylene
18. 1,4-dioxane
19. pyridine
20. dimethylformamide
21. methylcyclohexane
22. toluene
23. 2-hexanone
24. chlorobenzene
25. ethylbenzene
26. *m*-xylene
27. *p*-xylene
28. *o*-xylene

Column:	Rt®-S-BOND, 30m, 0.53mm ID, 20µm (cat.# 19746)
Sample:	solvent mixture
Inj.:	1.0µL, split (split vent flow 100mL/min.), 4mm single gooseneck liner (cat.# 20798)
Inj. temp.:	200°C
Carrier gas:	hydrogen, constant pressure, 4.2psi
Linear velocity:	40cm/sec. @ 120°C
Oven temp.:	120°C to 220°C @ 5°C/min. (hold 5.0 min.)
Det.:	FID @ 220°C

Solvent Mixture
Rt®-QS-BOND
(PLOT)

NEW!

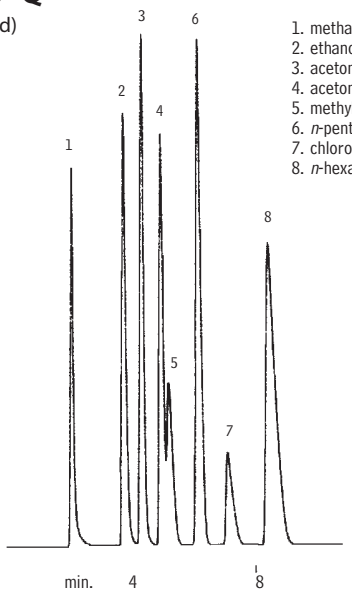


GC_PC01081

1. methanol
2. ethanol
3. acetonitrile
4. acetone
5. dichloromethane
6. 1,1-dichloroethene
7. nitromethane
8. *trans*-1,2-dichloroethylene
9. *cis*-1,2-dichloroethylene
10. tetrahydrofuran
11. chloroform
12. ethyl acetate
13. 1,2-dichloroethane
14. 1,1,1-trichloroethane
15. benzene
16. 1,2-dimethoxyethane
17. trichloroethylene
18. 1,4-dioxane
19. pyridine
20. dimethylformamide
21. methylcyclohexane
22. toluene
23. 2-hexanone
24. chlorobenzene
25. ethylbenzene
26. *m*-xylene
27. *p*-xylene
28. *o*-xylene

Column:	Rt®-QS-BOND, 30m, 0.53mm ID, 20µm (cat.# 19738)
Sample:	solvent mixture
Inj.:	1.0µL, split (split vent flow 100mL/min.), 4mm single gooseneck liner (cat.# 20798)
Inj. temp.:	200°C
Carrier gas:	hydrogen, constant pressure, 4.2psi
Linear velocity:	40cm/sec. @ 120°C
Oven temp.:	120°C to 240°C @ 5°C/min. (hold 5.0 min.)
Det.:	FID @ 240°C

Solvents
HayeSep® Q
(micropacked)



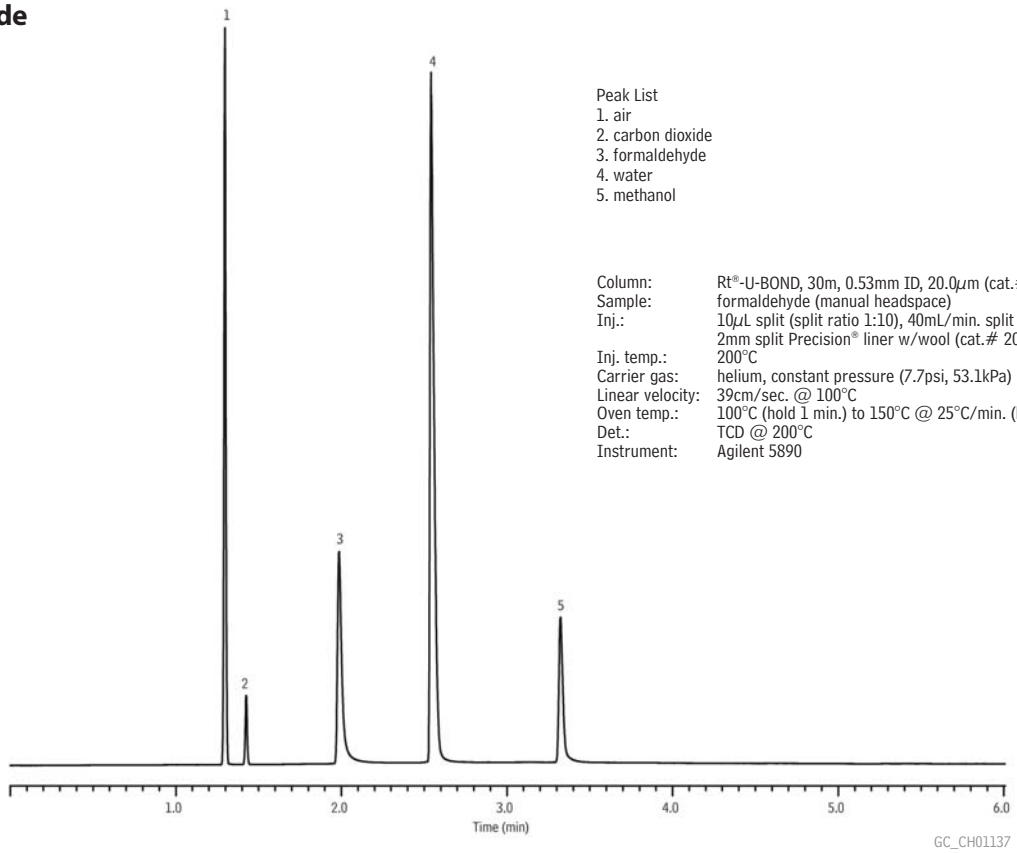
GC_CH00328

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:	1µL 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 10^{-11} AFS

Formaldehyde
Rt®-U-BOND
(PLOT)

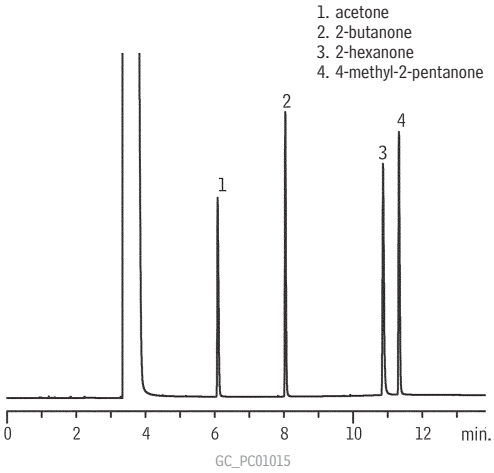
NEW!



Peak List
1. air
2. carbon dioxide
3. formaldehyde
4. water
5. methanol

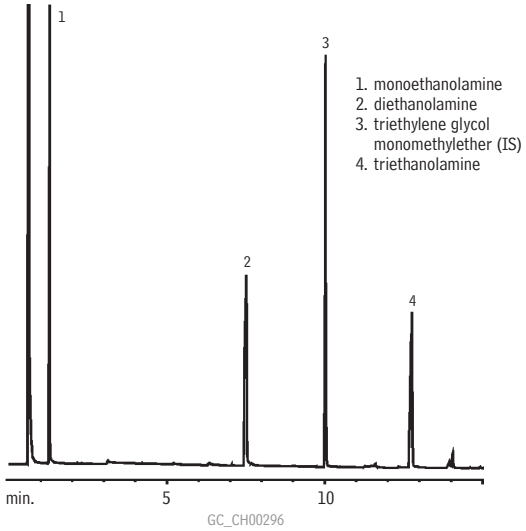
Column:	Rt®-U-BOND, 30m, 0.53mm ID, 20.0µm (cat.# 19750)
Sample:	formaldehyde (manual headspace)
Inj.:	10µL split (split ratio 1:10), 40mL/min. split vent flow rate 2mm split Precision® liner w/wool (cat.# 20823)
Inj. temp.:	200°C
Carrier gas:	helium, constant pressure (7.7psi, 53.1kPa)
Linear velocity:	39cm/sec. @ 100°C
Oven temp.:	100°C (hold 1 min.) to 150°C @ 25°C/min. (hold 3 min.)
Det.:	TCD @ 200°C
Instrument:	Agilent 5890

Ketones
Rt®-QS-BOND
(PLOT)



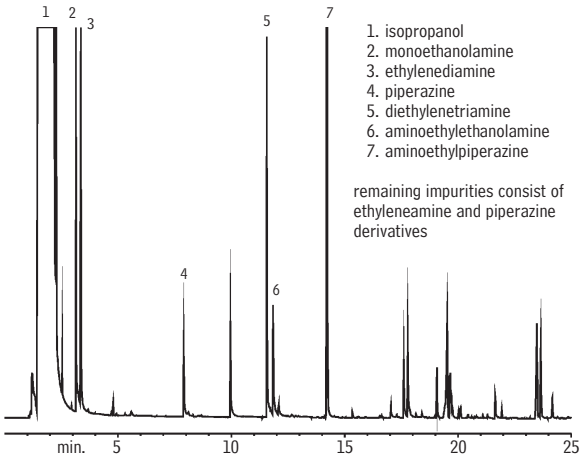
Column:	Rt®-QS-BOND, 30m, 0.53mm ID (cat.# 19738)
Sample:	1,000µg/mL VOA Calibration Mix #1 (ketones) (cat.# 30006) in methanol:water, 90:10 (v/v)
Inj.:	1µL split (split ratio 50:1), 4mm Siltek® single gooseneck liner (cat.# 20798-214.1)
Inj. temp.:	240°C
Carrier gas:	helium, constant flow
Flow rate:	5.7mL/min. @ 40°C
Oven temp.:	60°C to 225°C @ 15°C/min. (hold 10 min.)
Det.:	FID @ 240°C

Ethanolamines
Rtx®-5 Amine



Column:	Rtx®-5 Amine, 15m, 0.25mm ID, 0.50µm (cat.# 12335)
Sample:	1.0µL split injection of ethanolamine mix in methanol
On-column conc.:	34ng
Oven temp.:	50°C (hold 2 min.) to 180°C @ 10°C/min. (hold 2 min.)
Inj./det. temp.:	280°C/300°C
Carrier gas:	hydrogen
Linear velocity:	43cm/sec. set @ 50°C
FID sensitivity:	6.4 x 10^{-11} AFS
Split ratio:	58:1

Ethyleneamines
Rtx®-5 Amine



1. isopropanol
2. monoethanolamine
3. ethylenediamine
4. piperazine
5. diethylenetriamine
6. aminoethylethanolamine
7. aminoethylpiperazine

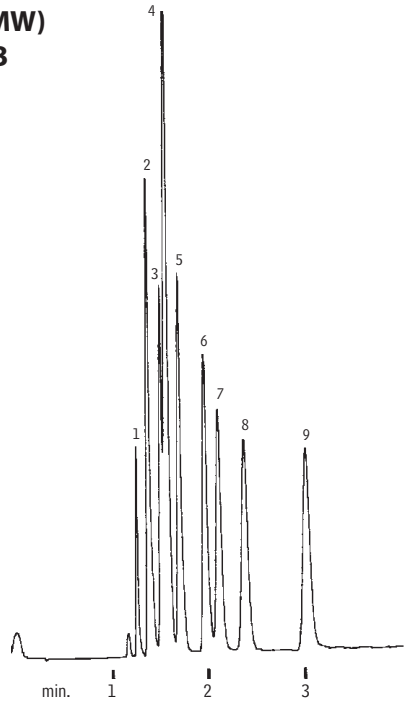
remaining impurities consist of ethyleneamine and piperazine derivatives

GC_CH00298

Column:	Rtx®-5 Amine, 30m, 0.25mm ID, 0.50µm (cat.# 12338)
Sample:	3.0µL 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 10^{-11} AFS
Split ratio:	20:1

Amines (low MW)
Stabilwax®-DB

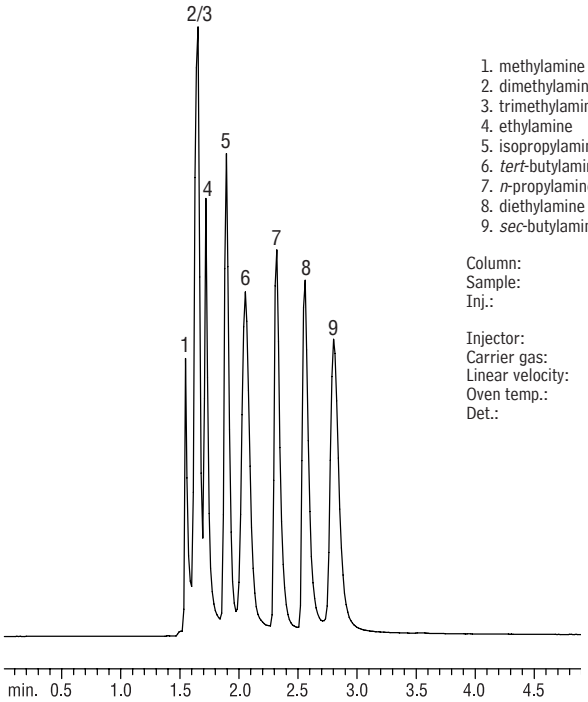
1. trimethylamine
2. dimethylamine
3. ethylamine
4. methylamine
5. isopropylamine
6. *n*-propylamine
7. *tert*-butylamine
8. diethylamine
9. *sec*-butylamine



GC_CH00304

Column:	Stabilwax®-DB, 30m, 0.53mm ID, 1.0µm (cat.# 10855)
Sample:	1.0µL 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 10^{-11} AFS
Recommended inlet liner:	Uniliner®

Amines, Primary
Rtx®-35 Amine

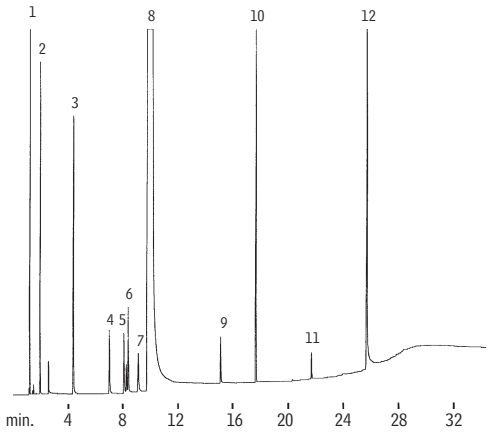


GC_CH00578

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

Column:	Rtx®-35 Amine, 30m, 0.53mm ID, 1.0µm (cat.# 11355)
Sample:	primary amines, 50ppm on-column conc. in water
Inj.:	1.0µL, split (10:1), 4mm base-deactivated single gooseneck inlet liner (cat.# 20798-210.1)
Injector:	250°C
Carrier gas:	helium, constant pressure
Linear velocity:	35.7cm/sec.
Oven temp.:	35°C (hold 5.0 min.)
Det.:	FID @ 300°C

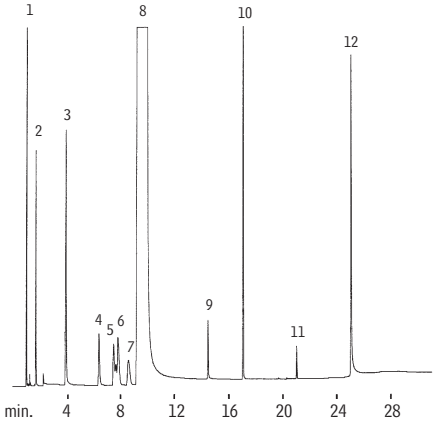
Hexamethylenediamine (HMD)
Stabilwax®-DB



GC_CH00302

1. cyclohexane
2. hexamethyleneimine
3. 1,4-diaminobutane
4. pentamethylenediamine
5. 1,2-diaminocyclohexane
6. 1,5-diamino-2-methylpentane
7. aminomethylcyclopentylamine
8. hexamethylenediamine
9. 6-aminocapronitrile
10. *n*-valeramide
11. adiponitrile
12. bis-hexamethylenetriamine

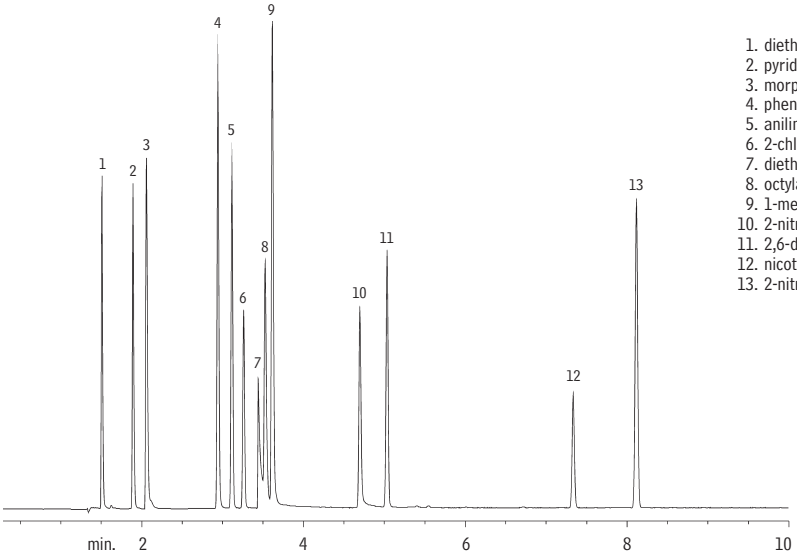
Column:	Stabilwax®-DB, 30m, 0.32mm ID, 0.25µm (cat.# 10824)
Sample:	0.4µL direct injection of a neat hexamethylenediamine (HMD) sample
On-column conc.:	10 to 1,000ng/component
Oven temp.:	95°C (hold 6 min.) to 235°C @ 7°C/min. (hold 4 min.)
Inj./det. temp.:	250°C
Carrier gas:	hydrogen
Linear velocity:	40cm/sec.
FID sensitivity:	2 x 10^{-11} AFS



GC_CH00303

Column:	Stabilwax®-DB, 30m, 0.53mm ID, 0.5µm (cat.# 10840)
Sample:	0.2µL 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 & Phenols
Rtx®-5 Amine



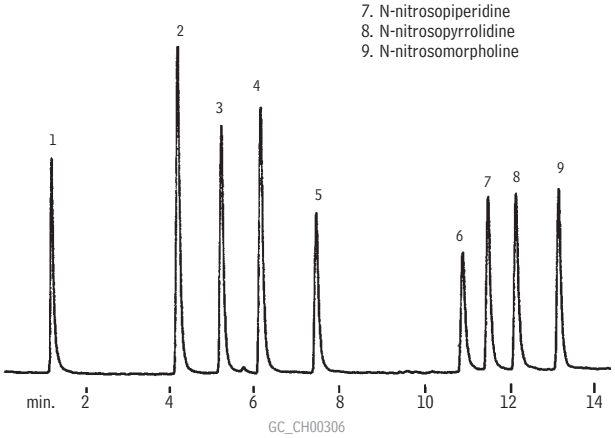
GC_CH00301

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, 1.0µm (cat.# 12354)
Sample:	1.0µL 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 10^{-11} AFS
Split ratio:	25:1

Nitrosamines
Stabilwax®-DB

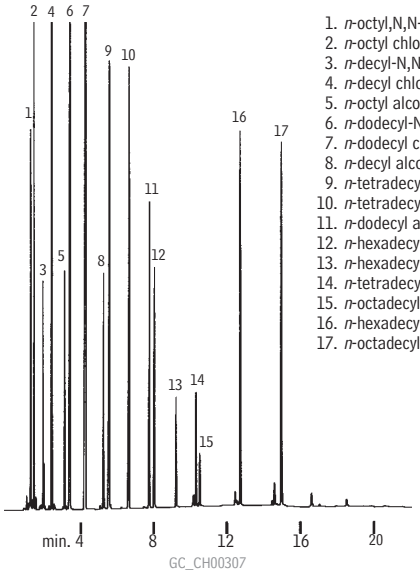
1. solvent
2. N-nitrosodimethylamine
3. N-nitrosodiethylamine
4. N-nitrosodiisopropylamine
5. N-nitrosodipropylamine
6. N-nitrosodibutylamine
7. N-nitrosopiperidine
8. N-nitrosopyrrolidine
9. N-nitrosomorpholine



Column:	Stabilwax®-DB, 60m, 0.53mm ID, 1.0µm (cat.# 10858)
Sample:	direct injection of nitrosamines
Conc.:	1.0µg/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®

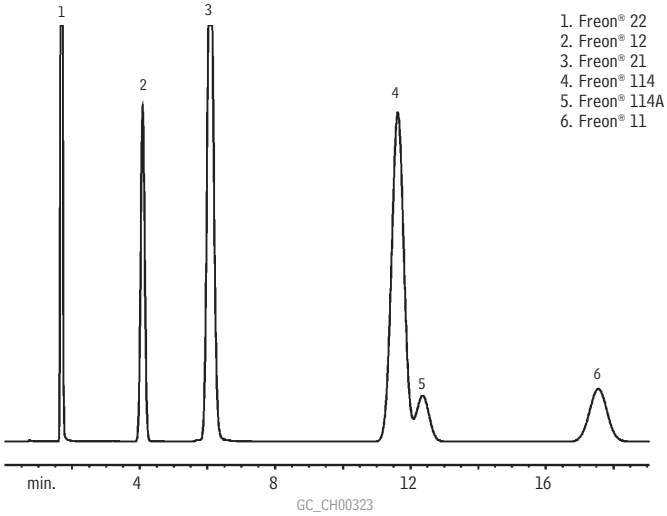
1. *n*-octyl,N,N-dimethylamine
2. *n*-octyl chloride
3. *n*-decyl-N,N-dimethylamine
4. *n*-decyl chloride
5. *n*-octyl alcohol
6. *n*-dodecyl-N,N-dimethylamine
7. *n*-dodecyl chloride
8. *n*-decyl alcohol
9. *n*-tetradecyl-N,N-dimethylamine
10. *n*-tetradecyl chloride
11. *n*-dodecyl alcohol
12. *n*-hexadecyl-N,N-dimethylamine
13. *n*-hexadecyl chloride
14. *n*-tetradecyl alcohol
15. *n*-octadecyl-N,N-dimethylamine
16. *n*-hexadecyl alcohol
17. *n*-octadecyl alcohol



Column:	Stabilwax®, 30m, 0.53mm ID, 0.25µm (cat.# 10625)
Inj.:	0.5µL 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)

1. Freon® 22
2. Freon® 12
3. Freon® 21
4. Freon® 114
5. Freon® 114A isomer
6. Freon® 11

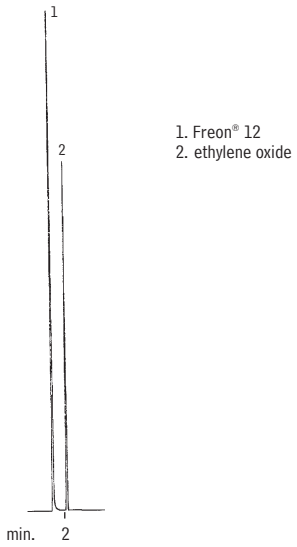


for **more** info

see **pages 649 & 707** for more chlorofluorocarbon chromatograms.

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

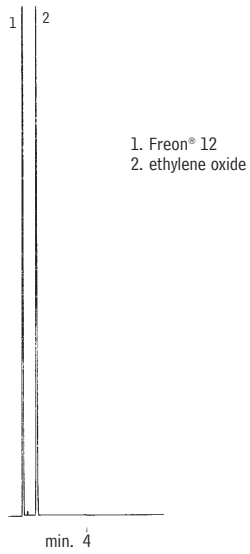
Freon® 12 & Ethylene Oxide
Rtx®-1



GC_CH00324

Column:	Rtx®-1, 30m, 0.53mm ID, 5.0µm (cat.# 10179)
Sample:	50µL 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

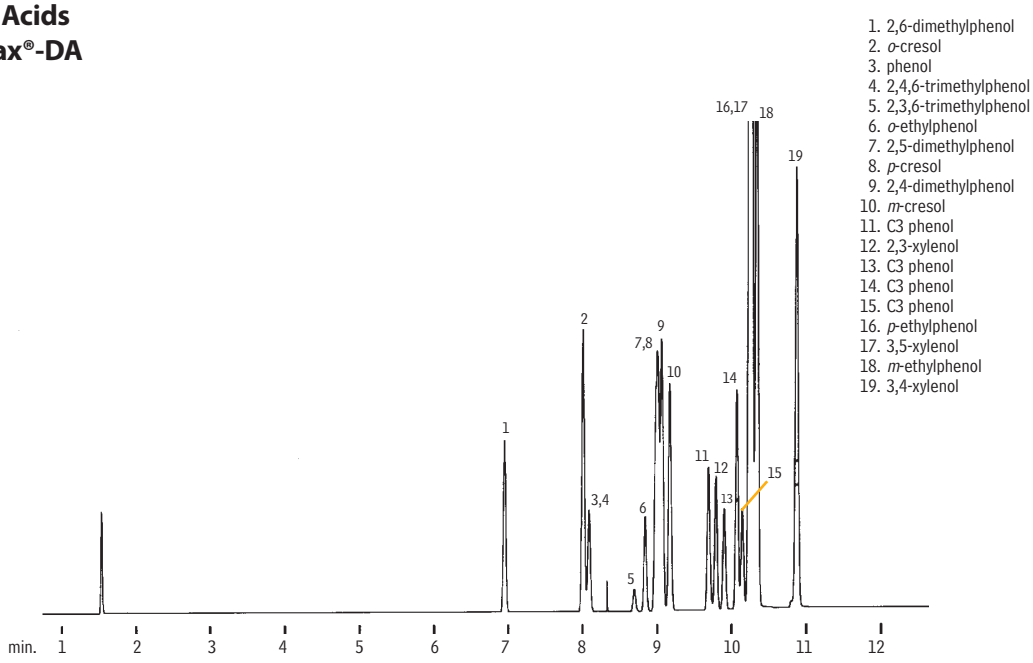
Freon® 12 & Ethylene Oxide
Rtx®-200



GC_CH00325

Column:	Rtx®-200, 30m, 0.53mm ID, 3.0µm (cat.# 15085)
Sample:	50µL 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



GC_CH00277

Column:	Stabilwax®-DA, 30m, 0.25mm ID, 0.50µm (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