

# GC CHROMATOGRAMS

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## 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®-55Sil 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
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**Rxi®-175Sil 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
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## Packed/Micropacked Columns

**CarboBlack B**

blood alcohol	.667
flavor volatiles	.630

**D3606 Application Column**

gasoline	.128, 656
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**HayeSep® Q**

solvents	.702
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**5% Krytox®/CarboBlack B**

chlorofluorocarbons	.706
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**Molesieve 5A**

permanent gases	.647
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**Molesieve 13X**

permanent gases	.647
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**Refinery Gas Column Set**

hydrocarbon gases	.129
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**Res-Sil® C Packing**

OPN	.129
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**n-Octane**

Rt®-1200/Bentone® 34	.129
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**Rt®-1200/Bentone® 34**

aromatics (BTEX)	.655
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**Rt®-XLSulfur**

sulfur compounds	.131, 664
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sulfurs in beverages	.632
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**Rtx®-1 on Chromosorb® WAW**

hydrocarbons (motor oil, aviation gas)	.656
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**Rtx®-1 SimDist 2887**

simulated distillation	.661, 662
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**ShinCarbon ST**

chlorofluorocarbons	.649
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hydrocarbon gases	.647, 652
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permanent gases	.130, 647
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**10% TCEP**

aromatics, aliphatics	.654
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**20% TCEP**

hydrocarbons (motor oil, aviation gas)	.656
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## PLOT Columns

**Rt®-Alumina BOND/CFC**

chlorinated fluorocarbons	.74
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**Rt®-Alumina BOND/KCI**

hydrocarbon gases	.650, 651, 653
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**Rt®-Alumina BOND/Na:SO<sub>2</sub>**

hydrocarbon gases	.649, 652, 653
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natural gas	.651
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**Rt®-Msieve 5A PLOT**

permanent gases	.109, 648
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**Rt®-Q-BOND**

solvents	.111, 701
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**Rt®-QS-BOND**

hydrocarbon gases	.652, 654
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ketones	.703
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solvents	.702
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**Rt®-S-BOND**

solvents	.701
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**Rt®-U-BOND**

aldehydes	.703
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604	Phenols	553
610	Polycyclic Aromatic Hydrocarbons	555-559
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## Looking for more?

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

## 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 ezGC software.

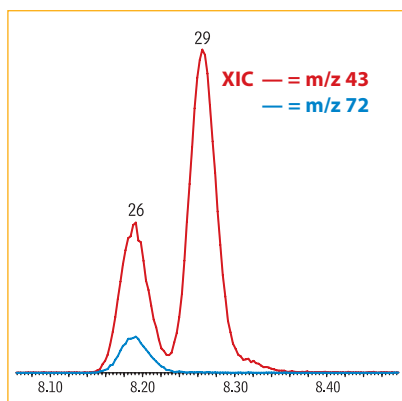
for **more** info

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

Rxi®-624Sil MS		Rxi®-624Sil MS		Rxi®-624Sil MS	
Compound	Ret. Time	Compound	Ret. Time	Compound	Ret. Time
dichlorodifluoromethane	2.178	cyclohexane	8.959	1-chlorohexane	12.442
chloromethane	2.438	1-chlorobutane	9.032	1,1,1,2-tetrachloroethane	12.503
water	2.588	carbon tetrachloride	9.055	ethylbenzene	12.512
vinyl chloride	2.63	1,1-dichloropropene	9.067	<i>m</i> -xylene	12.636
methanol	2.985	benzene-d6	9.255	<i>p</i> -xylene	12.636
ethylene oxide	3.127	1,2-dichloroethane-d4	9.28	<i>n</i> -nonane	12.668
bromomethane	3.192	benzene	9.296	1-chloro-2-fluorobenzene	12.703
chloroethane	3.395	1,2-dichloroethane	9.365	<i>o</i> -xylene	12.99
trichlorofluoromethane	3.834	isopropyl acetate	9.376	stryrene	13.01
<i>n</i> -pentane	4.032	2,2,4-trimethylpentane	9.455	<i>n</i> -amyl acetate	13.148
ethanol	4.199	isobutyl alcohol	9.456	bromoform	13.177
diethylether	4.387	<i>tert</i> -amyl-methyl ether	9.457	isopropylbenzene	13.327
2-methylbutane	4.501	<i>n</i> -heptane	9.537	<i>cis</i> -1,4-dichloro-2-butene	13.382
acrolein	4.677	fluorobenzene	9.636	1,4-dichlorobutane	13.439
1,1-dichloroethene	4.848	1,4-difluorobenzene	9.784	4-bromo-1-fluorobenzene	13.485
Freon 113	4.929	1-butanol	9.911	1,1,2,2-tetrachloroethane	13.6
acetone	4.971	trichloroethene	10.013	bromobenzene	13.612
iodomethane	5.135	methyl cyclohexane	10.268	<i>trans</i> -1,4-dichloro-2-butene	13.635
2-propanol	5.323	<i>tert</i> -amyl ethyl ether	10.27	1,2,3-trichloropropane	13.655
carbon disulfide	5.323	1,2-dichloropropane	10.28	<i>n</i> -propylbenzene	13.698
acetonitrile	5.581	$\alpha,\alpha,\alpha$ -trifluorotoluene	10.325	2-chlorotoluene	13.78
methyl acetate	5.676	methyl methacrylate	10.327	1,3,5-trimethylbenzene	13.858
allyl chloride	5.693	1,4-dioxane	10.379	<i>n</i> -decane	13.867
methylene chloride	5.939	<i>n</i> -propyl acetate	10.383	4-chlorotoluene	13.886
2-methylpentane	6.01	dibromomethane	10.443	<i>tert</i> -butylbenzene	14.131
<i>tert</i> -butyl alcohol	6.19	bromodichloromethane	10.532	pentachloroethane	14.16
acrylonitrile	6.414	2-nitropropane	10.736	1,2,4-trimethylbenzene	14.182
methyl-d3- <i>tert</i> -butyl-ether	6.435	chloroacetonitrile	10.764	<i>sec</i> -butylbenzene	14.325
methyl <i>tert</i> -butyl-ether	6.477	2-chloroethyl-vinyl-ether	10.792	<i>n</i> -butylcyclohexane	14.4
<i>trans</i> -1,2-dichloroethene	6.48	1-bromo-2-chloroethane	10.843	1,3-dichlorobenzene	14.431
3-methylpentane	6.503	epichlorohydrin	10.875	<i>p</i> -isopropyltoluene	14.453
hexane	7.023	<i>cis</i> -1,3-dichloropropene	10.938	1,4-dichlorobenzene-d4	14.497
1,1-dichloroethane	7.291	2,4-dimethylpentane	10.961	1,4-dichlorobenzene	14.519
allyl alcohol	7.309	4-methyl-2-pentanone	11.062	<i>n</i> -butylbenzene	14.796
vinyl acetate	7.33	1,1-dichloropropanone	11.105	1,2-dichlorobenzene-d4	14.814
diisopropyl ether	7.386	pyridine	11.135	1,2-dichlorobenzene	14.823
chloroprene	7.407	toluene-d8	11.185	hexachloroethane	15.06
1-propanol	7.431	toluene	11.246	1-octanol	15.07
ethyl <i>tert</i> -butyl ether	7.978	<i>n</i> -octane	11.345	4-bromo-1-chlorobenzene	15.467
TB(d9)A	8.133	<i>trans</i> -1,3-dichloropropene	11.441	1,2-dibromo-3-chloropropane	15.476
<i>cis</i> -1,2-dichloroethene	8.204	ethyl methacrylate	11.471	nitrobenzene	15.638
2-butanone	8.208	2-bromo-1-chloropropane	11.497	tetraethyl lead	15.652
2,2-dichloropropane	8.208	1,1,2-trichloroethane	11.619	2-bromochlorobenzene	15.761
ethyl acetate	8.283	tetrachloroethene	11.699	<i>n</i> -tetradecane	15.783
propionitrile	8.297	1,3-dichloropropane	11.761	<i>n</i> -dodecane	15.784
methyl acrylate	8.336	<i>n</i> -butyl acetate	11.792	1,2,4-trichlorobenzene	16.176
methacrylonitrile	8.499	dibromochloromethane	11.82	hexachlorobutadiene	16.293
bromochloromethane	8.528	1,2-dibromoethane	11.934	naphthalene	16.418
tetrahydrofuran	8.542	1-chloro-3-fluorobenzene	12.119	1,2,3-trichlorobenzene	16.608
chloroform	8.678	1-chloro-4-fluorobenzene	12.338	2,5-dibromotoluene	17.488
dibromofluoromethane	8.871	chlorobenzene-D5	12.386	2-methylnaphthalene	17.558
1,1,1-trichloroethane	8.872	chlorobenzene	12.415	1-methyl-naphthalene	17.754
pentafluorobenzene	8.937	ethylbenzene-d10	12.44		

## 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](http://www.restek.com/cat006)

**Column:**  
**Sample:**

Rxi®-624Sil MS, 30 m, 0.25 mm ID, 1.40 µm (cat.# 13868)  
8260A Surrogate Mix (cat.# 30240)  
8260A Internal Standard Mix (cat.# 30241)  
8260B MegaMix® Calibration Mix (cat.# 30633)  
VOA Calibration Mix #1 (ketones) (cat.# 30006)  
8260B Acetate Mix (revised) (cat.# 30489)  
California Oxygenates Mix (cat.# 30465)  
502.2 Calibration Mix #1 (gases) (cat.# 30042)

**Conc.:**  
**Injection**  
**Inj. Temp.:**  
**Purge and Trap**

25 ppb in RO water  
purge and trap split (split ratio 30:1)  
225 °C

**Instrument:**  
**Trap Type:**  
**Purge:**  
**Desorb Preheat Temp.:**  
**Desorb:**  
**Bake:**  
**Interface Connection:**

OI Analytical 4660  
10 Trap  
11 min. @ 20 °C  
180 °C  
0.5 min. @ 190 °C  
5 min. @ 210 °C  
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:**

**Flow Rate:**

He, constant flow  
1.0 mL/min.

**Detector:**

**Mode:**

**Transfer Line Temp.:**

**Analyzer Type:**

**Source Temp.:**

**Quad Temp.:**

**Electron Energy:**

**Solvent Delay Time:**

**Tune Type:**

**Ionization Mode:**

**Scan Range:**

**Instrument:**

**Notes**

**Other Purge and Trap Conditions:**

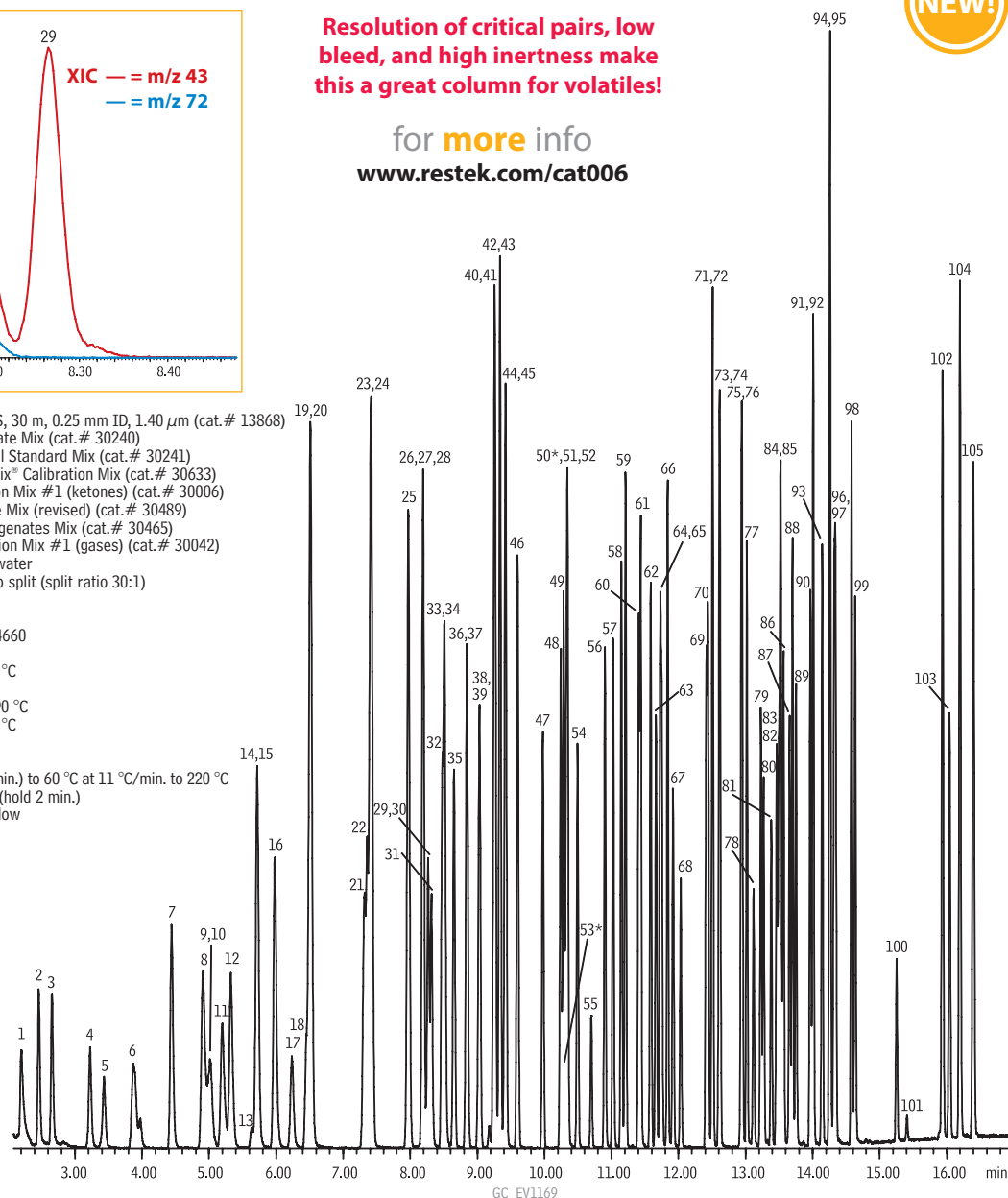
**Sample Inlet:**

**Sample:**

**Water Management:**

**Purge**

110 °C, Desorb 0 °C, Bake, 240 °C



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

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

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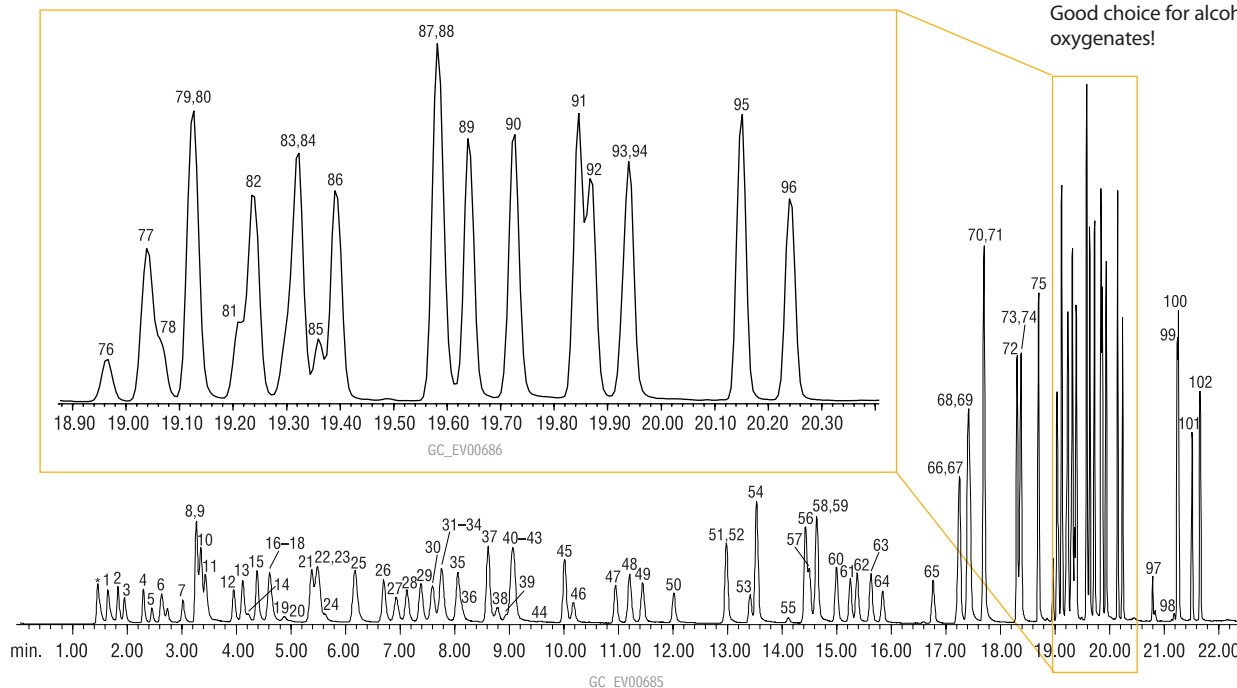
## Volatile Organics

## US EPA Method 8260 (80 ppb Standard)

## Rtx®-VMS

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innovation!

Good choice for alcohols &amp; 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.).  
 Agilent 5971A GC/MS  
 Det.:  
 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-dichloroethane
  9. carbon disulfide
  10. Freon® 113
  11. iodomethane
  12. allyl chloride
  13. methylene chloride
  14. acetone
  15. *trans*-1,2-dichloroethane
  16. methyl-*d*3-*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-dichloroethane
  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-*d*4
  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-dichloropropene
  49. bromodichloromethane
  50. methyl methacrylate
  51. *cis*-1,3-dichloropropene

52. 2-chloroethyl vinyl ether
53. toluene-*d*8
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-*d*5
67. chlorobenzene
68. ethylbenzene
69. 1,1,1,2-tetrachloroethane
70. *m*-xylene
71. *p*-xylene
72. *o*-xylene
73. bromoform
74. styrene
75. isopropylbenzene
76. 4-bromo-1-fluorobenzene (SS)
77. bromobenzene
78. *cis*-1,4-dichloro-2-butene
79. 1,4-dichlorobutane
80. *n*-propylbenzene
81. 1,1,2,2-tetrachloroethane
82. 2-chlorotoluene
83. 1,2,3-trichloropropane
84. 1,3,5-trimethylbenzene
85. *trans*-1,4-dichloro-2-butene
86. 4-chlorotoluene
87. *tert*-butylbenzene
88. pentachloroethane
89. 1,2,4-trimethylbenzene
90. *sec*-butylbenzene
91. *p*-isopropyltoluene
92. 1,3-dichlorobenzene
93. 1,4-dichlorobenzene-*d*4
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

## 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.

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Applications Note  
 lit. cat.# 59856

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

# Volatile Organics US EPA Method 8260B Rtx®-VMS

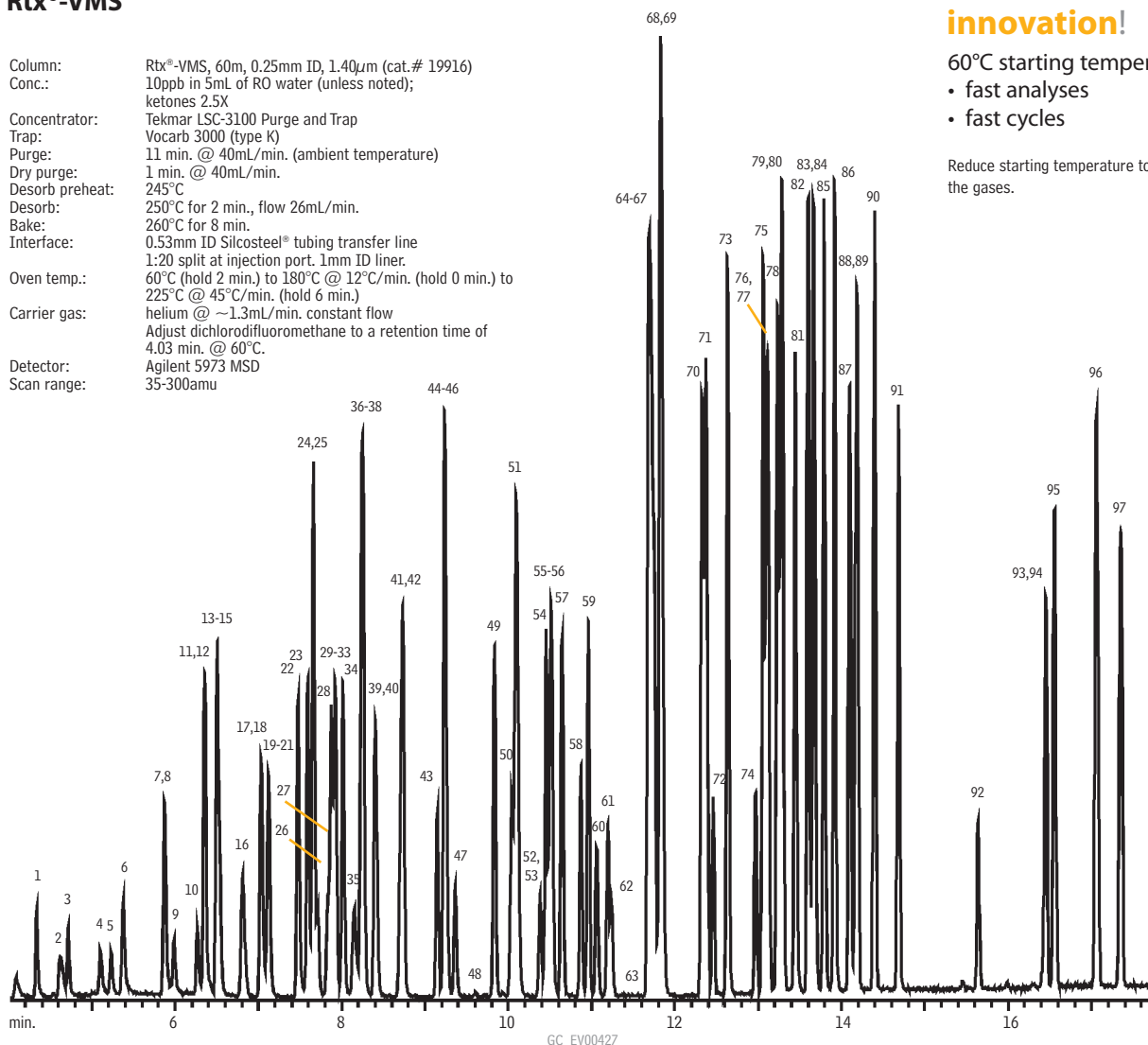
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60°C starting temperature

- fast analyses
- fast cycles

Reduce starting temperature to best focus the gases.

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



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

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

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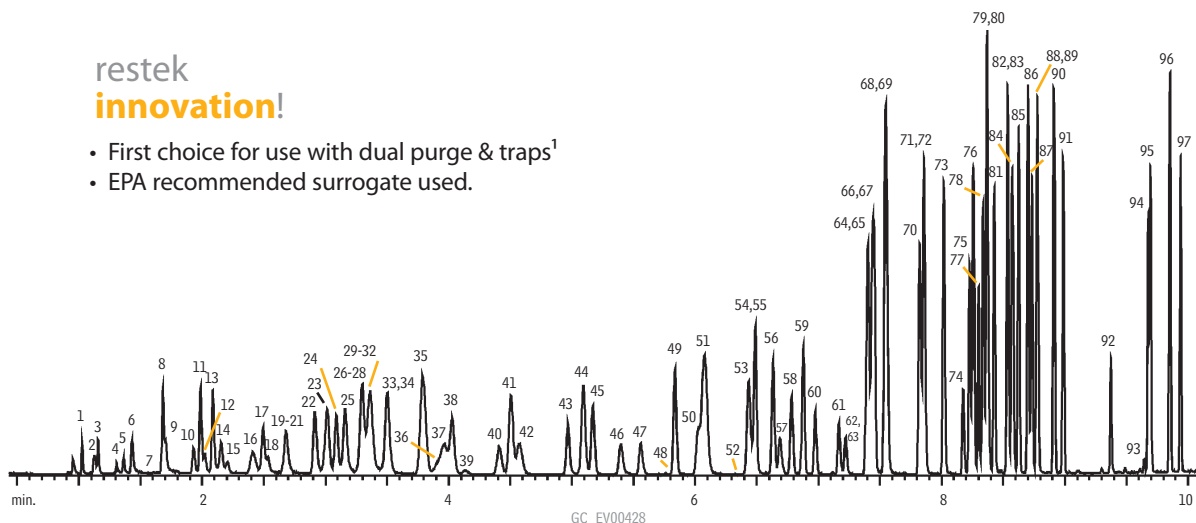
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# Volatile Organics US EPA Method 8260B Rtx®-VMS

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- First choice for use with dual purge & traps<sup>1</sup>
- 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: Vocabarb 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

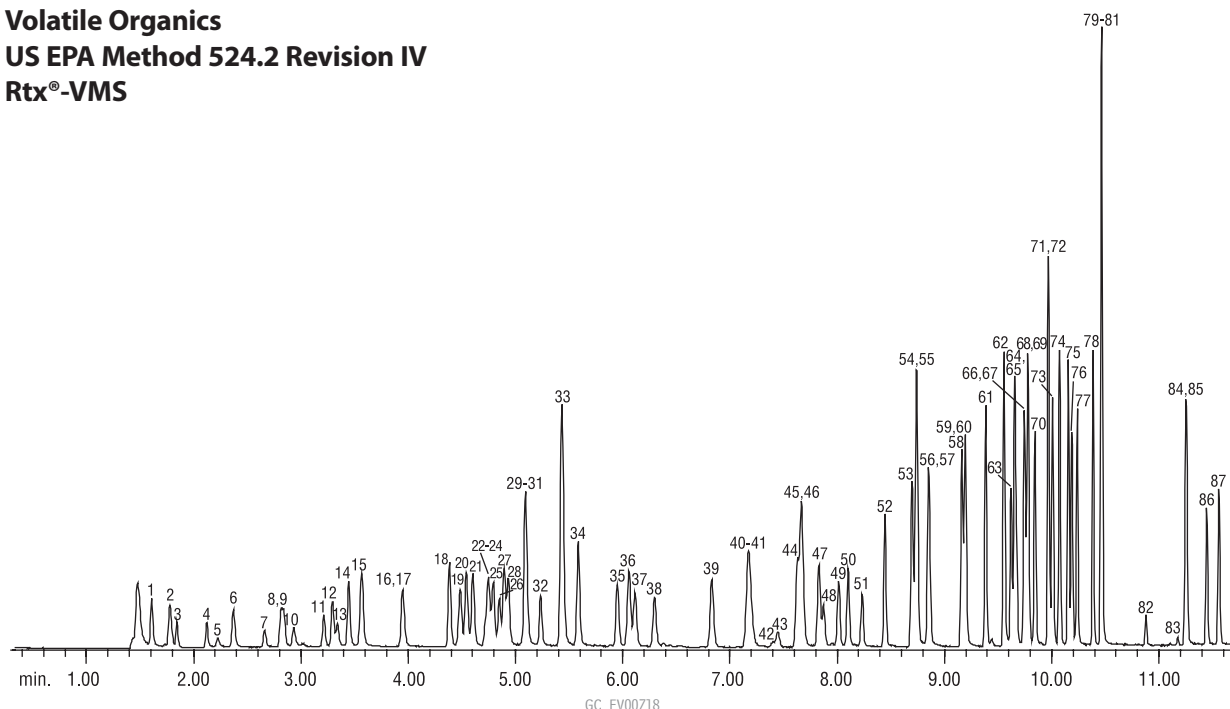
1. dichlorodifluoromethane	26. ethyl acetate	51. toluene	76. <i>n</i> -propylbenzene
2. chloromethane	27. carbon tetrachloride	52. pyridine (250ppb)	77. 1,1,2,2-tetrachloroethane
3. vinyl chloride	28. methyl acrylate	53. tetrachloroethene	78. 2-chlorotoluene
4. bromomethane	29. propargyl alcohol (500ppb)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

<sup>1</sup>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



## Purge and Trap Conditions:

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

## Column:

## Sample:

Inj. temp.:  
 Carrier gas:  
 Flow rate:  
 Dead time:  
 Oven temp.:

Det:  
 Transfer line temp.:  
 Scan range:  
 Tune  
 Ionization:

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

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

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

## Chromatogram Search Tool

Search by compound name, synonym,  
 CAS # or keyword

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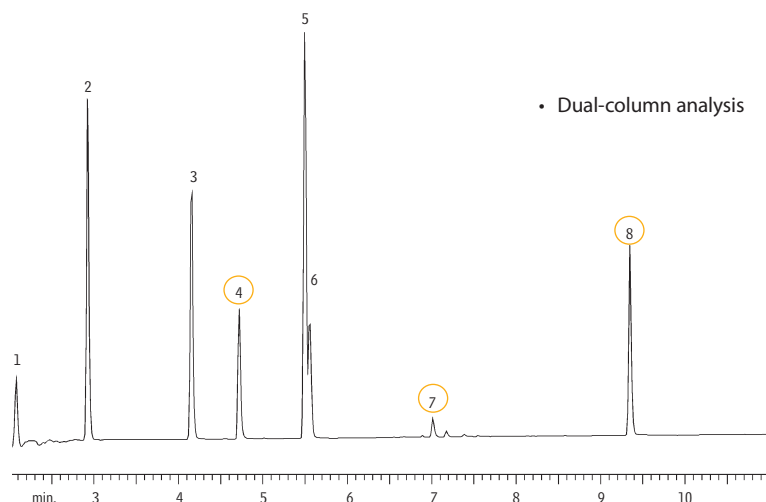


EDB/DBCP

US EPA Method 504.1

Rtx®-CLPesticides & Rtx®-CLPesticides2

Rtx®-CLPesticides



free literature

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

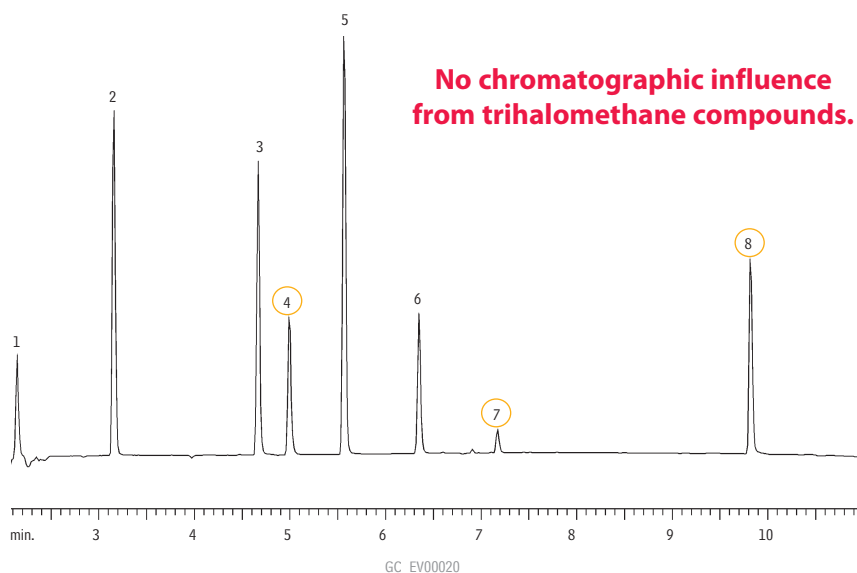
*A versatile column pair for analyzing  
organochlorine pesticides, herbicides, or PCBs*

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

Applications Note

**lit. cat.# 59539**

Rtx®-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:

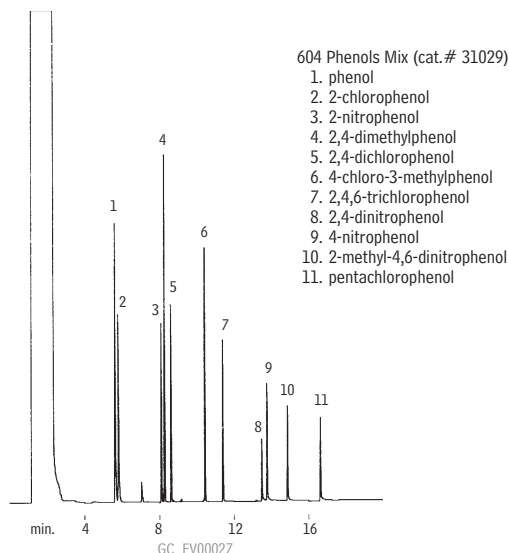
Rtx®-CLPesticides, 30m, 0.32mm ID, 0.50µm (cat.# 11139),  
Rtx®-CLPesticides2, 30m, 0.32mm ID, 0.25µm (cat.# 11324),  
0.32mm ID guard column (cat.# 10044),  
universal angled "Y" Press-Tight® connector (cat.# 20403)  
Direct injection using a Uniliner® inlet liner (cat.#20335)  
Inj. 10pg each compound.  
On-column conc.: 35°C (hold 2 min.) to 300°C @ 12°C/min.  
Oven temp.: 200°C/300°C  
Inj./det. temp.: helium, 12psi constant pressure  
Carrier gas:

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

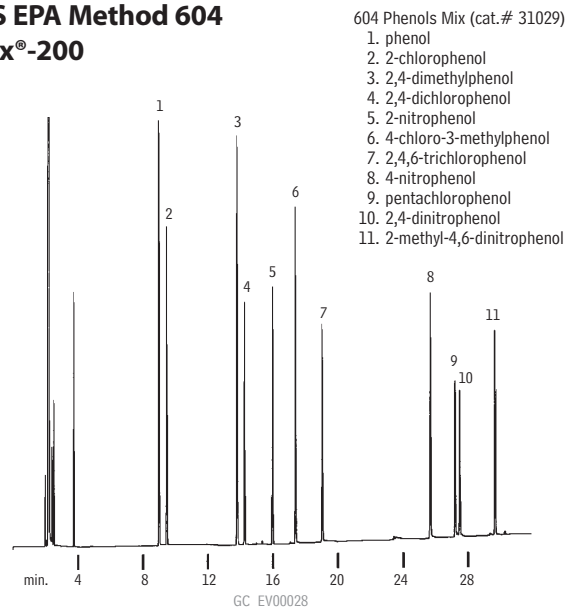
- Triazine herbicides (**lit. cat.# 59101**)
- PCBs (**lit. cat.# 59120**)
- Chlorinated pesticides (**lit. cat.# EVAN1197**)
- Chlorinated pesticides, PCBs, & chlorinated herbicides (**lit. cat.# EVFL1013**)

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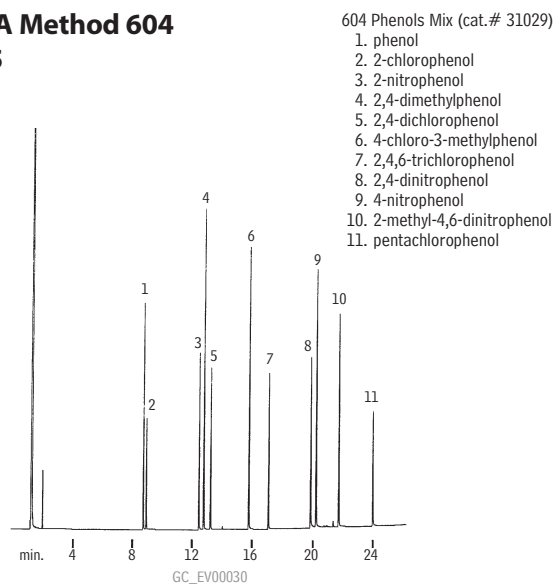


**Phenols**  
**US EPA Method 604**  
**MXT®-5**

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<sup>-10</sup> 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<sup>-11</sup> AFS  
 Split ratio: 40:1

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Solutions Online[www.restek.com/enviro](http://www.restek.com/enviro)**Phenols**  
**US EPA Method 604**  
**Rtx®-5**

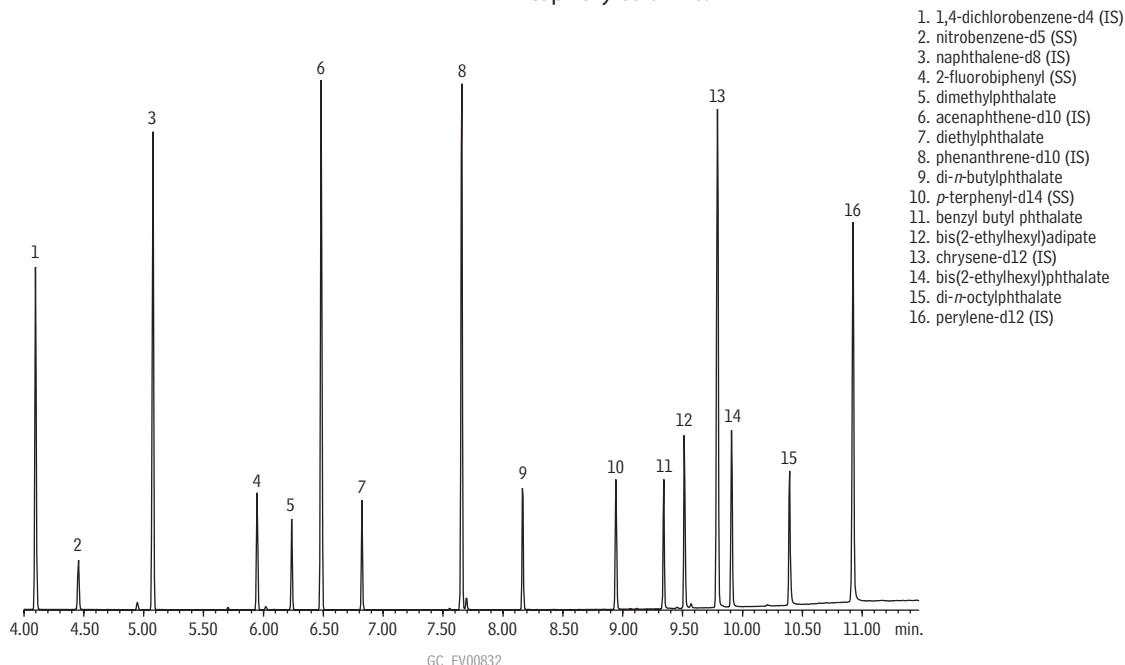
Column: Rtx®-5, 30m, 0.25mm ID, 0.25µm (cat.# 10223)  
 Inj.: 1.0µL split injection of phenols.  
 Conc.: 3-5ng/µL per component.  
 Oven temp.: 50°C (hold 4 min.) to 250°C @ 8°C/min.  
 Inj./det. temp.: 250°C  
 Carrier gas: hydrogen  
 Linear velocity: 40cm/sec. set @ 110°C  
 FID sensitivity: 8 x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

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

**Rxi® Technology!**

Exceptionally inert,  
ultra low- bleed  
capillary columns.



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

**Chromatogram Search Tool**

Search by compound name, synonym,  
CAS # or keyword

[www.restek.com/chromatograms](http://www.restek.com/chromatograms)

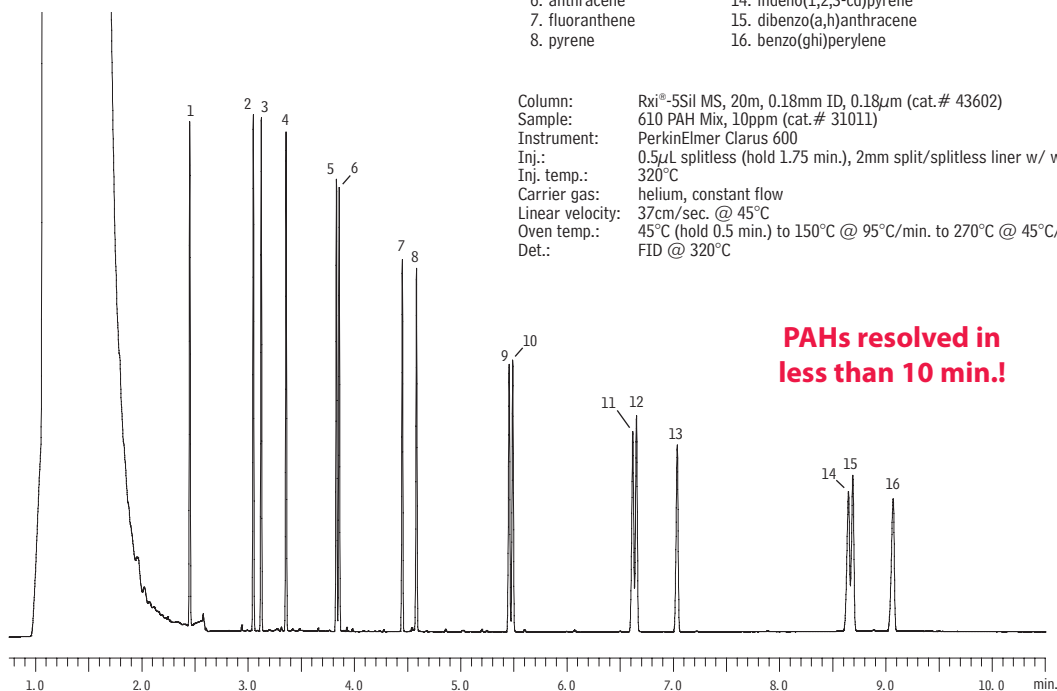


# Polycyclic Aromatic Hydrocarbons US EPA Method 610 Rxi®-5Sil MS (20m x 0.18 mm x 0.18 µm)

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

NEW!

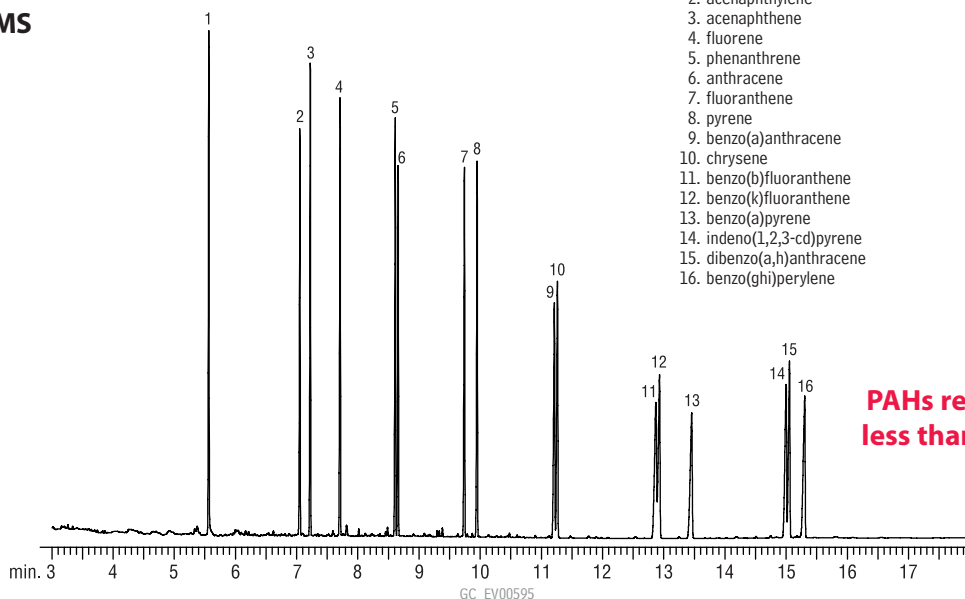


Column: Rxi®-5Sil MS, 20m, 0.18mm ID, 0.18µm (cat.# 43602)  
 Sample: 610 PAH Mix, 10ppm (cat.# 31011)  
 Instrument: PerkinElmer Clarus 600  
 Inj.: 0.5µL splitless (hold 1.75 min.), 2mm split/splitless liner w/ wool (cat.# 21718)  
 Inj. temp.: 320°C  
 Carrier gas: helium, constant flow  
 Linear 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.!**

# 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



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

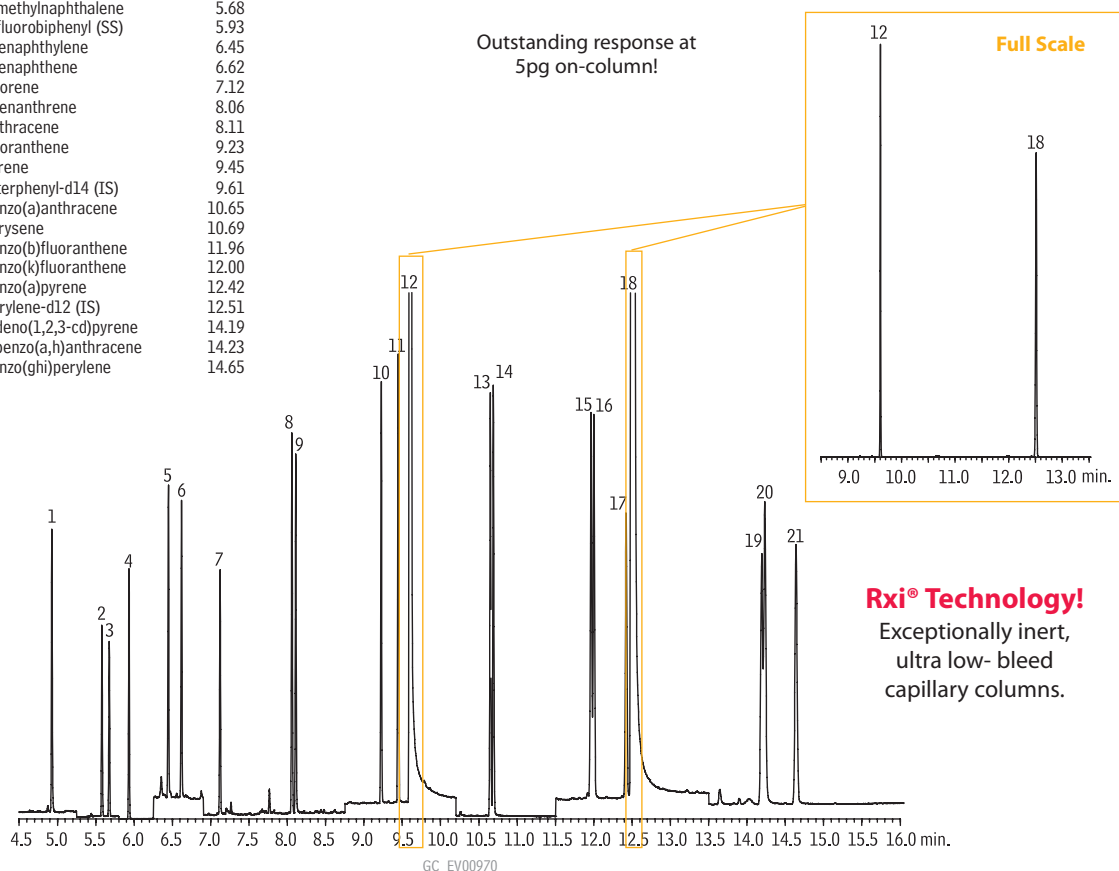
**PAHs resolved in  
less than 16 min.!**



## Polycyclic Aromatic Hydrocarbons

### Rxi®-5Sil MS

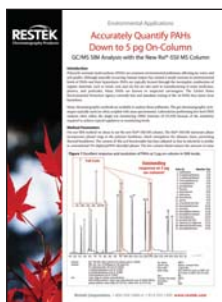
Peak List	Retention Time
1. naphthalene	4.93
2. 2-methylnaphthalene	5.58
3. 1-methylnaphthalene	5.68
4. 2-fluorobiphenyl (SS)	5.93
5. acenaphthylene	6.45
6. acenaphthene	6.62
7. fluorene	7.12
8. phenanthrene	8.06
9. anthracene	8.11
10. fluoranthene	9.23
11. pyrene	9.45
12. <i>p</i> -terphenyl-d14 (IS)	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



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

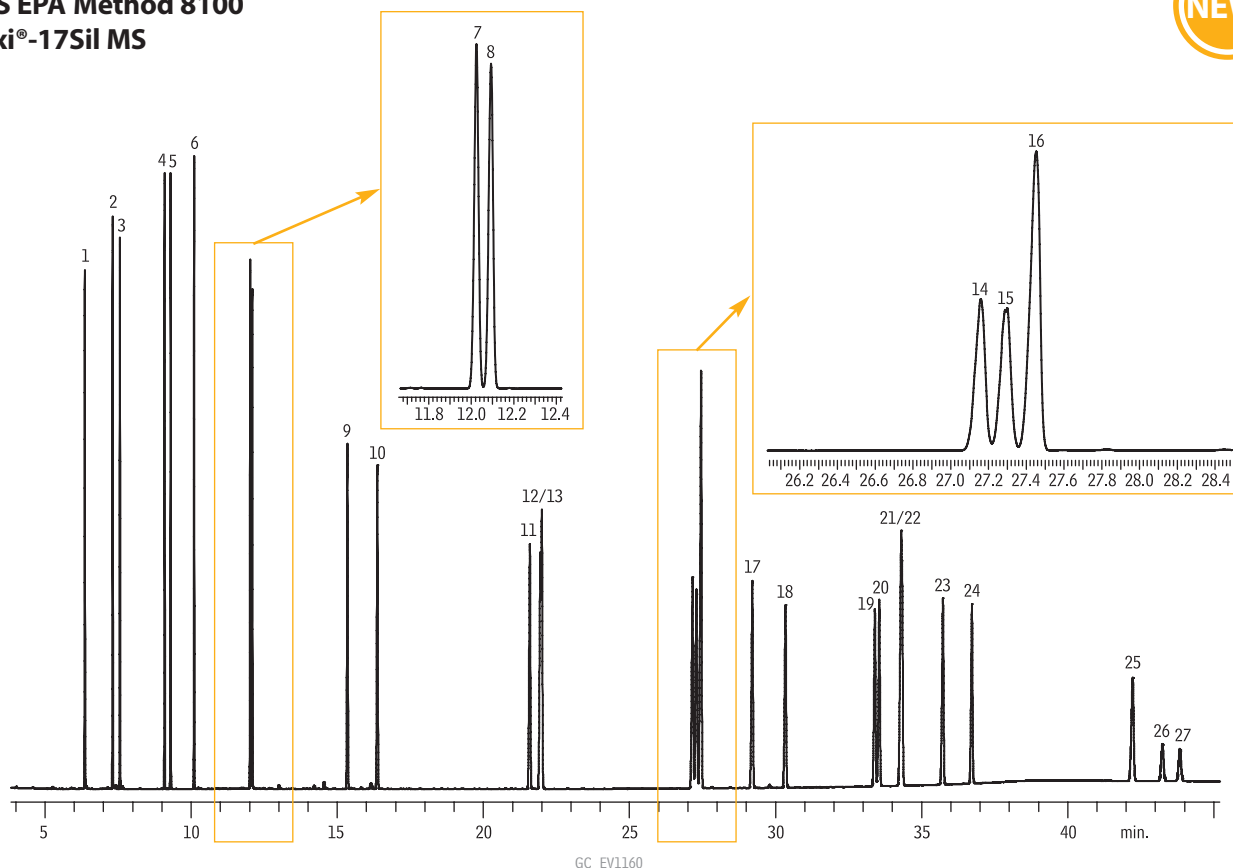
Polycyclic aromatic hydrocarbons (PAHs) are common environmental pollutants, affecting air, water, and soil quality. Although naturally occurring, human impact has created a steady increase in environmental levels of PAHs and their byproducts. PAHs are typically formed through the incomplete combustion 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.

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Applications Note  
lit. cat.# EVAN1284

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

NEW!



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. Dibenzo[a,h]acridine
20. Dibenzo[a,j]acridine
21. Indeno[1,2,3-cd]pyrene
22. Dibenzo[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 Sample

Diluent:  
Conc.:  
**Injection**  
Inj. Vol.:  
Liner:  
Inj. Temp.:  
Purge Flow:  
**Oven**  
Oven Temp:  
**Carrier Gas**  
Flow Rate:  
**Detector**  
**Instrument**  
**Acknowledgement**

Rxi®-17Sil MS, 30 m, 0.25 mm ID, 0.25  $\mu$ m (cat.# 14123)  
SV Calibration Mix #5 / 610 PAH Mix (cat.# 31011)  
EPA Method 8310 PAH Mixture (cat.# 31841)  
dichloromethane  
10 ppm

0.5  $\mu$ L splitless (hold 1.75 min.)  
Auto SYS XL PSS Split/Splitless w/Wool (cat.# 21718)  
320 °C  
75 mL/min.  
65 °C (hold 0.5 min.) to 220 °C at 15 °C/min. to 330 °C at 4 °C/min. (hold 15 min.)  
He, constant flow  
2.0 mL/min.  
FID @ 320 °C  
PE Clarus 600 GC  
Instrument provided by PerkinElmer

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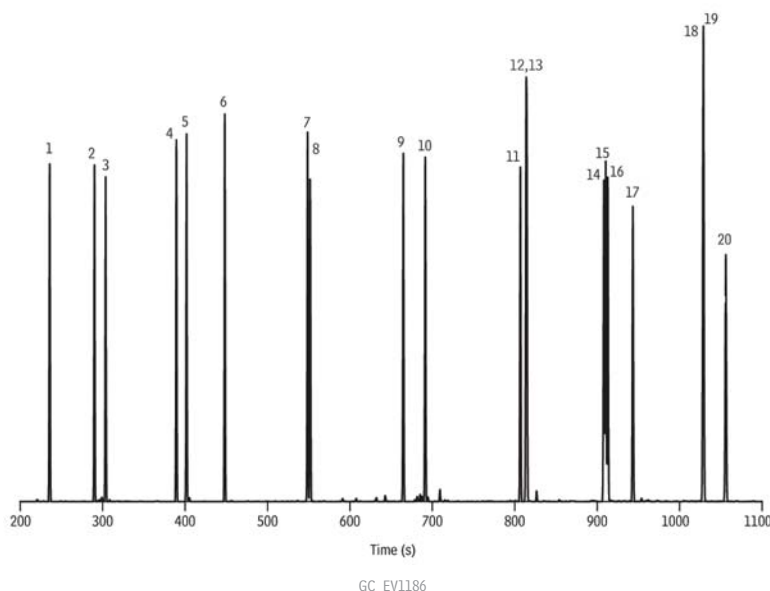
**11/12**

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**557**

**Polycyclic Aromatic Hydrocarbons**

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

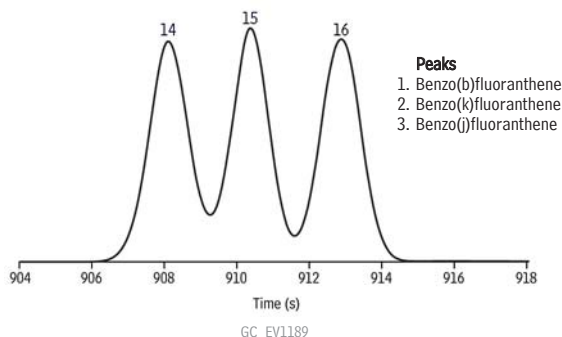


**Peaks**

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. Dibenzo(a,h)anthracene
20. Benzo(ghi)perylene

**Benzofluoranthenes**

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



**Peaks**

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

**Column**  
**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<sub>2</sub>, constant flow

**Flow Rate:**

2 mL/min.

**Detector**

FID @ 340 °C

**Constant Column +**

Constant Make-up: 50 mL/min.

**Make-up**

Gas Type: N<sub>2</sub>

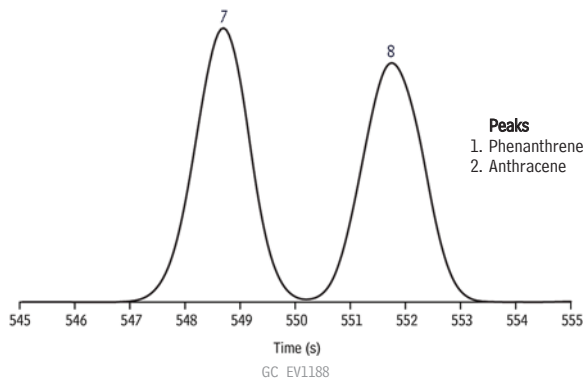
Data Rate: 20 Hz

**Instrument**

Agilent/HP6890 GC

**Phenanthrene and Anthracene**

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



**Peaks**

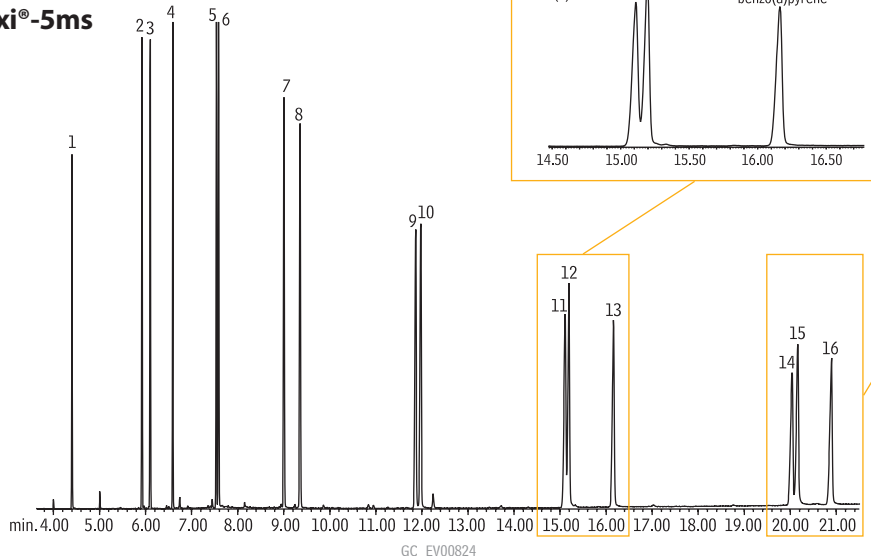
1. Phenanthrene
2. Anthracene



# Polycyclic Aromatic Hydrocarbons

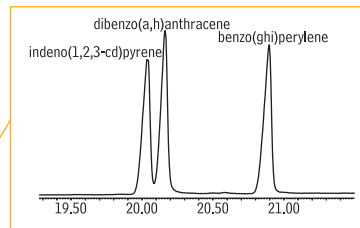
## US EPA Method 610

Rxi®-5ms



**Rxi® Technology!**

Exceptionally inert,  
ultra low- bleed  
capillary columns.

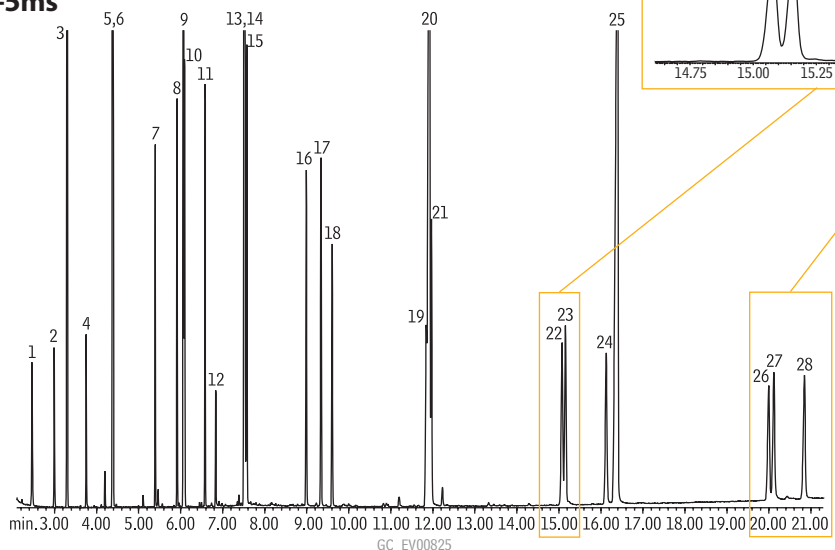


- |                   |                            |
|-------------------|----------------------------|
| 1. naphthalene    | 9. benzo(a)anthracene      |
| 2. acenaphthylene | 10. chrysene               |
| 3. acenaphthene   | 11. benzo(b)fluoranthene   |
| 4. fluorene       | 12. benzo(k)fluoranthene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

# Polycyclic Aromatic Hydrocarbons

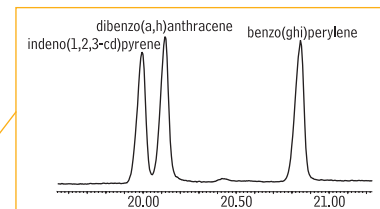
## US EPA Method 610 (with Internal Standards & Surrogates)

Rxi®-5ms



**Rxi® Technology!**

Exceptionally inert,  
ultra low- bleed  
capillary columns.



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

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.)  
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

RESTEK

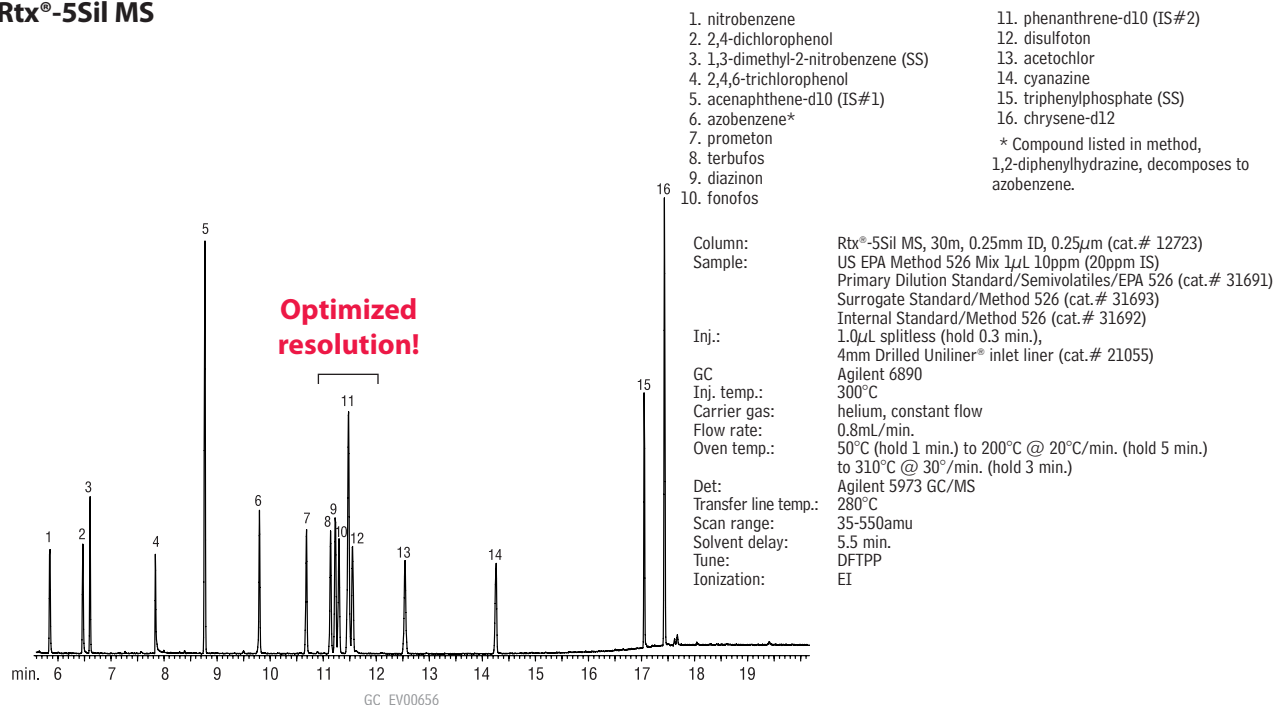
HROMalytic +61(0)3 9762 2034  
ECHnology Pty Ltd

Australian Distributors  
Importers & Manufacturers  
www.chromtech.net.au

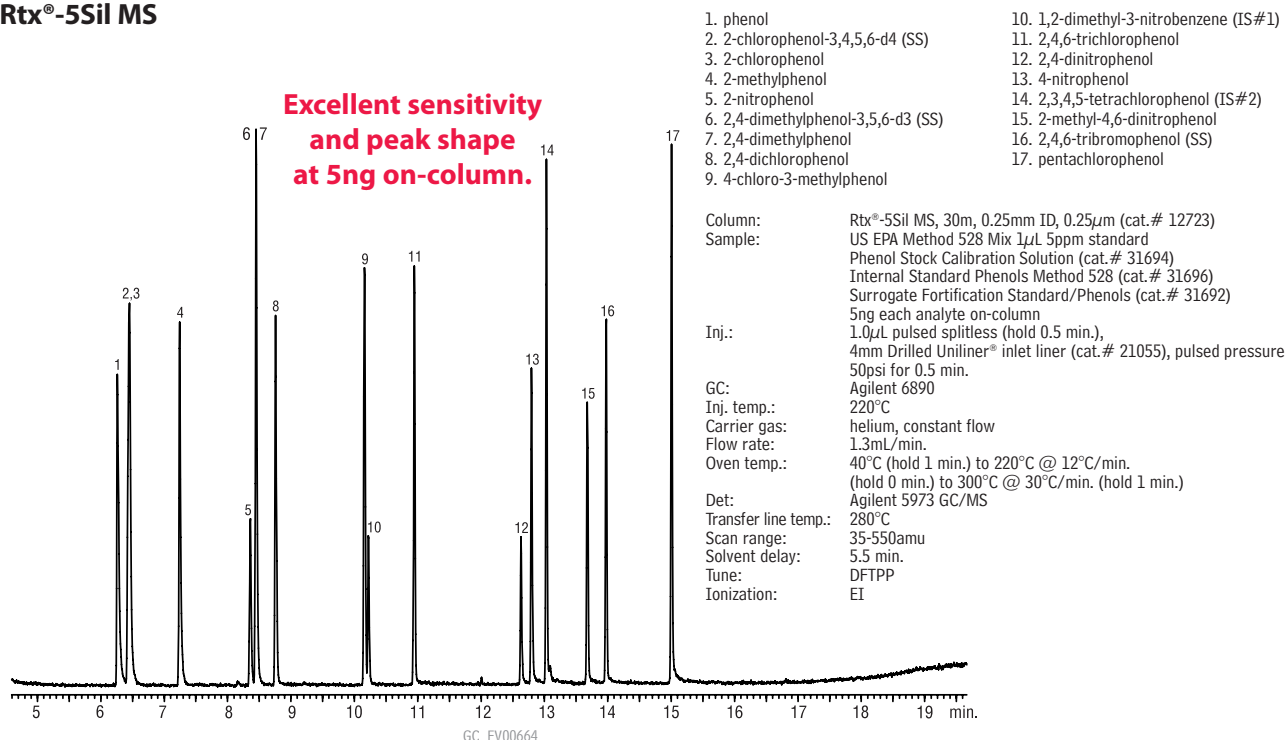
11/12

www.restek.com 559

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



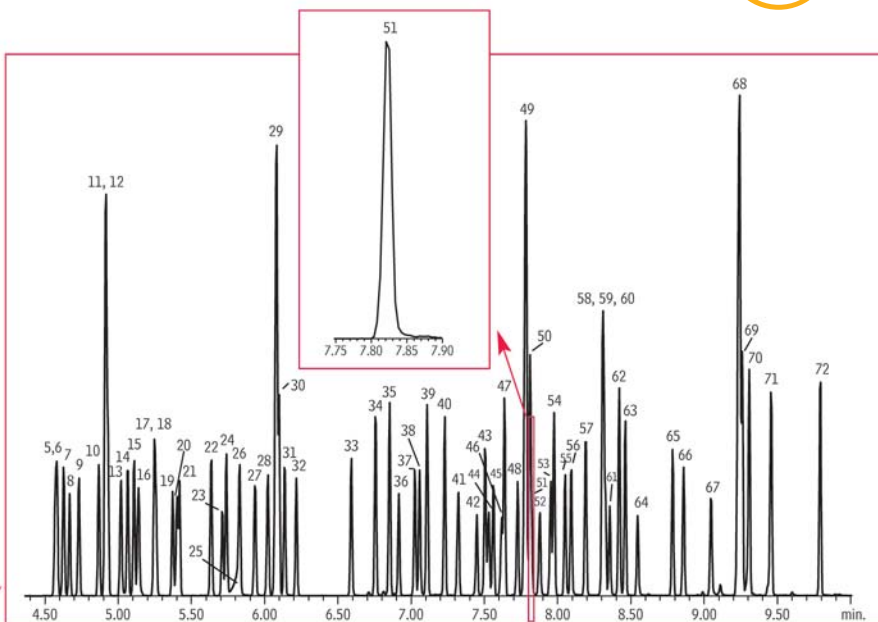
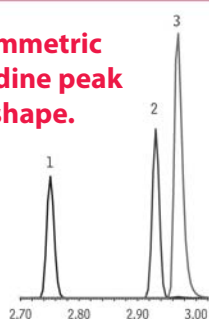
**Phenols**  
**US EPA Method 528**  
**Rtx®-5Sil MS**



Semivolatile Organics  
US EPA Method 8270  
Rxi®-5Sil MSRestek'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

Symmetric  
pyridine peak  
shape.Excellent  
resolution  
of PAHs.

GC\_EV01129

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

c = toluene



## Semivolatiles

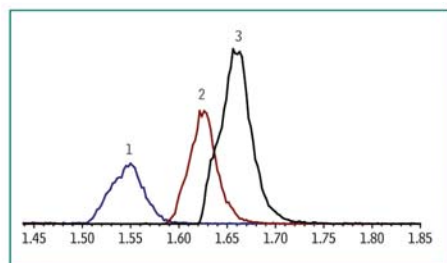
## EPA Method 8270

## Rxi®-5Sil MS (Split Injection)

## Peaks

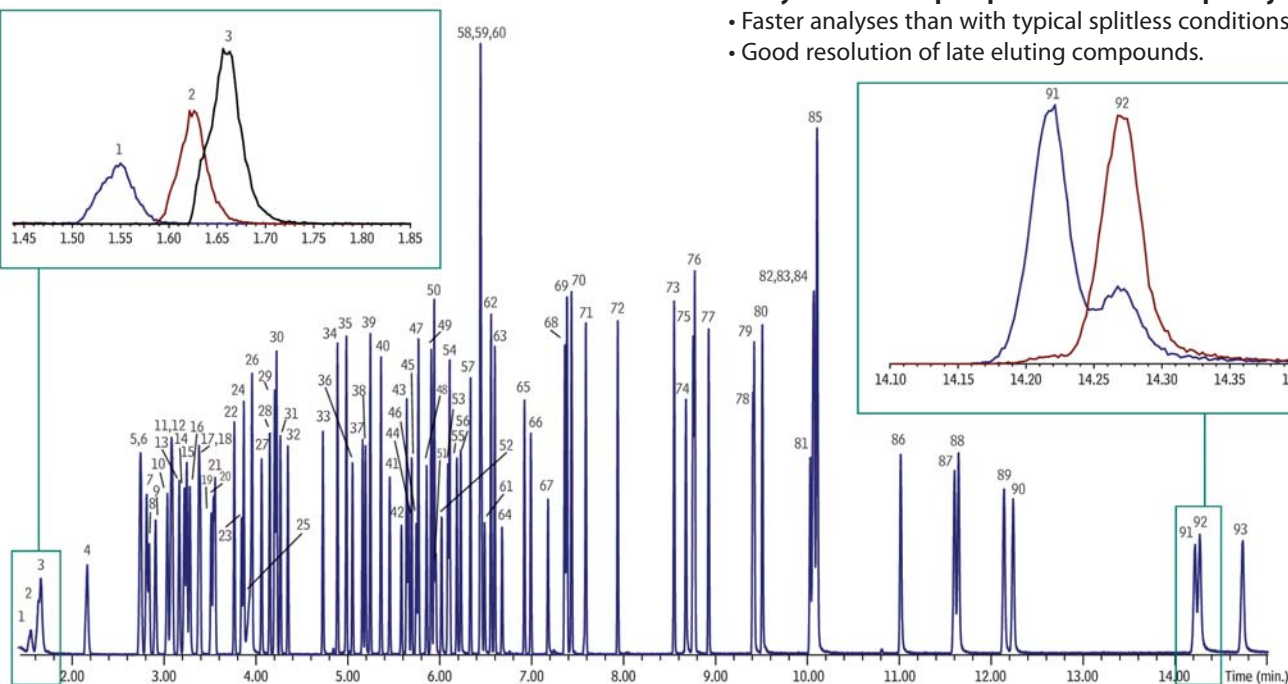
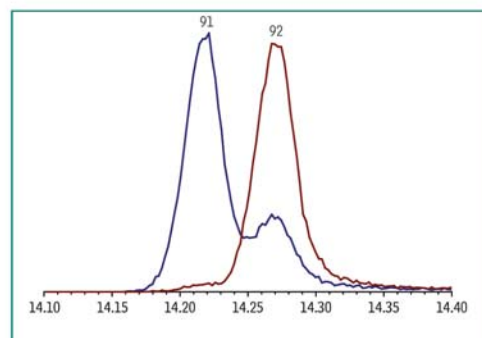
- |                                   |                                |   |                                |
|-----------------------------------|--------------------------------|---|--------------------------------|
| 1. 1,4-Dioxane                    | 24. 2,4-Dimethylphenol         | 48. 3-Nitroaniline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

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)  
 Methylene chloride  
 40 µg/mL (4 ng on-column)

**Diluent:**  
**Conc.:**  
**Injection** 1.0 µL split (split ratio 10:1)  
**Inj. Vol.:** 4mm Split Precision® Liner w/ Semivolatiles Wool (cat.# 21023-231.5)  
**Liner:** 270 °C  
**Inj. Temp.:**  
**Split Vent**  
**Flow Rate:** 60 mL/min.

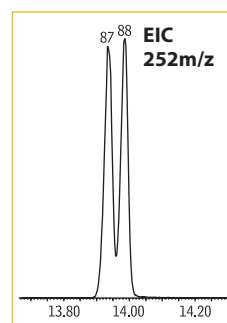
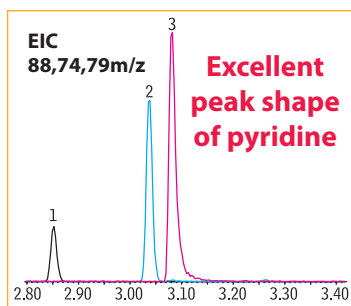
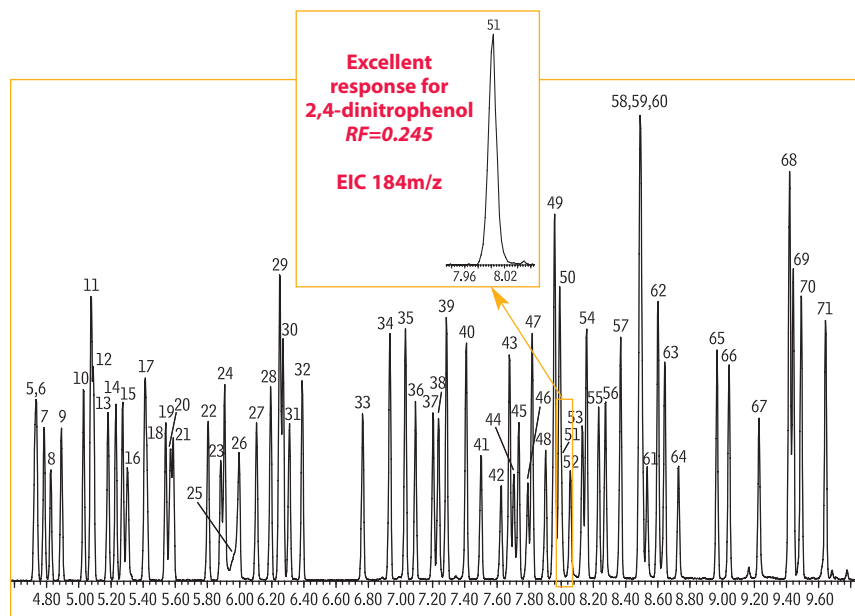
**Oven**  
 Oven Temp: 80 °C (hold 1 min.) to 280 °C at 25 °C/min. to 320 °C at 5 °C/min.  
**Carrier Gas** He, constant flow  
 Flow Rate: 1.2 mL/min.  
**Detector** MS  
 Mode: Scan  
 Transfer  
 Line Temp.: 280 °C  
 Analyzer Type: Quadrupole  
 Source Temp.: 250 °C  
 Quad Temp.: 150 °C  
 Tune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

## Semivolatile Organics

## US EPA Method 8270

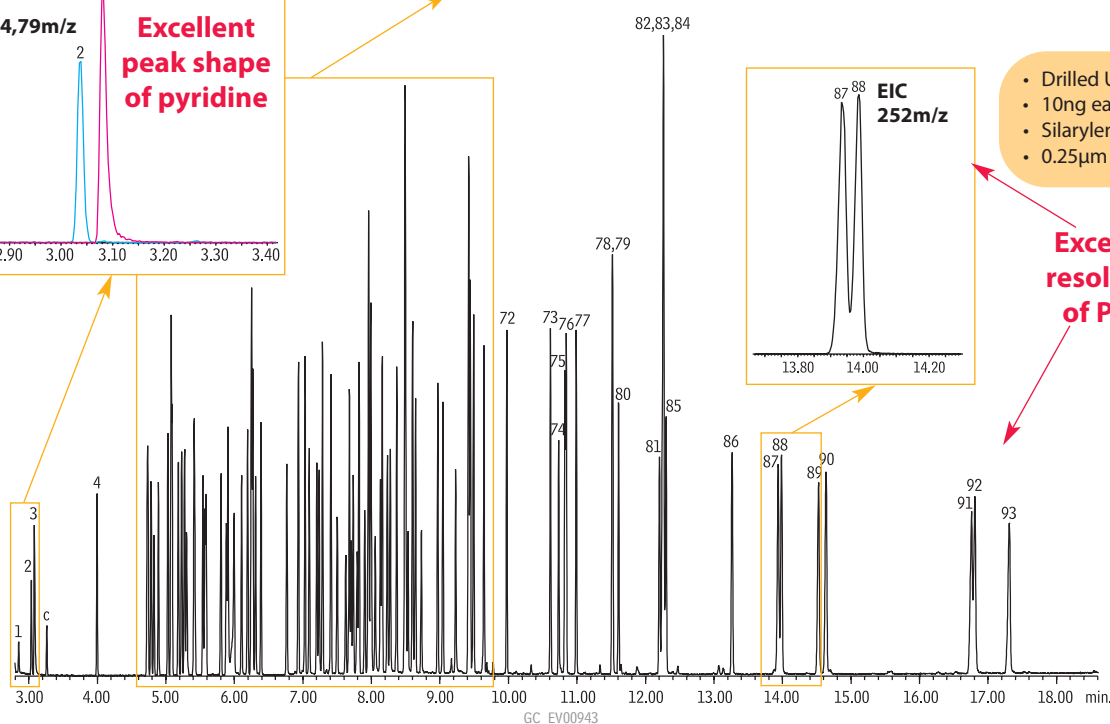
## Rxi®-5Sil MS

Column: Rxi®-5Sil MS, 30m, 0.25mm ID,  
0.25 $\mu$ m (cat.# 13623)  
Sample: US EPA Method 8270D Mix, 1 $\mu$ L of  
10 $\mu$ g/mL (IS 40 $\mu$ g/mL)  
8270 MegaMix® (cat.# 31850)  
Benzoic Acid (cat.# 31879)  
8270 Benzidines Mix (cat.# 31852)  
Acid Surrogate Mix (4/89 SOW) (cat.# 31025)  
Revised B/N Surrogate Mix (cat.# 31887)  
1,4-Dioxane (cat.# 31853)  
SV Internal Standard Mix (cat.# 31206)  
Inj.: 1.0 $\mu$ L (10ng on-column concentration),  
4mm Drilled Uniliner® (hole near bottom)  
inlet liner (cat.# 20756),  
pulsed splitless: pulse 25psi @ 0.2 min.,  
60mL/min. @ 0.15 min.  
Inj. temp.: 250°C  
Carrier gas: helium, constant flow  
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
- 0.25 $\mu$ m film thickness

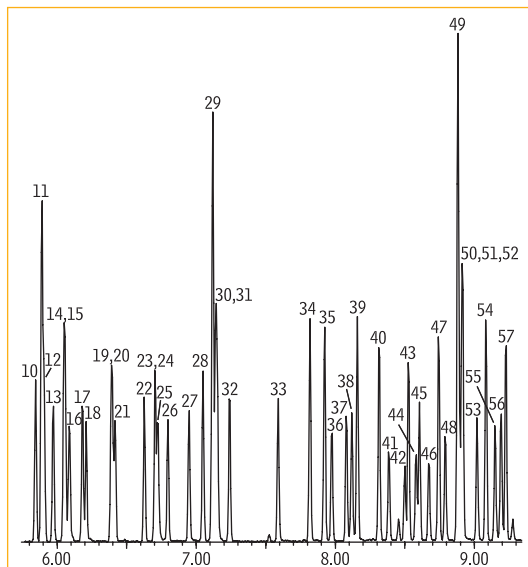
Excellent  
resolution  
of PAHs



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

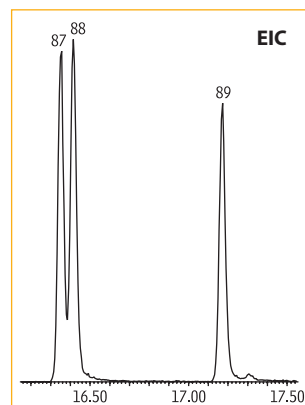
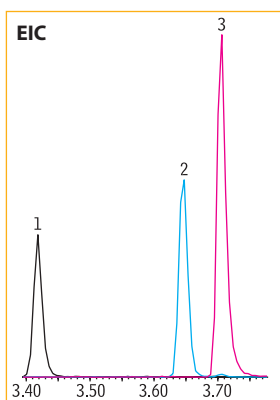
c = contaminant

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

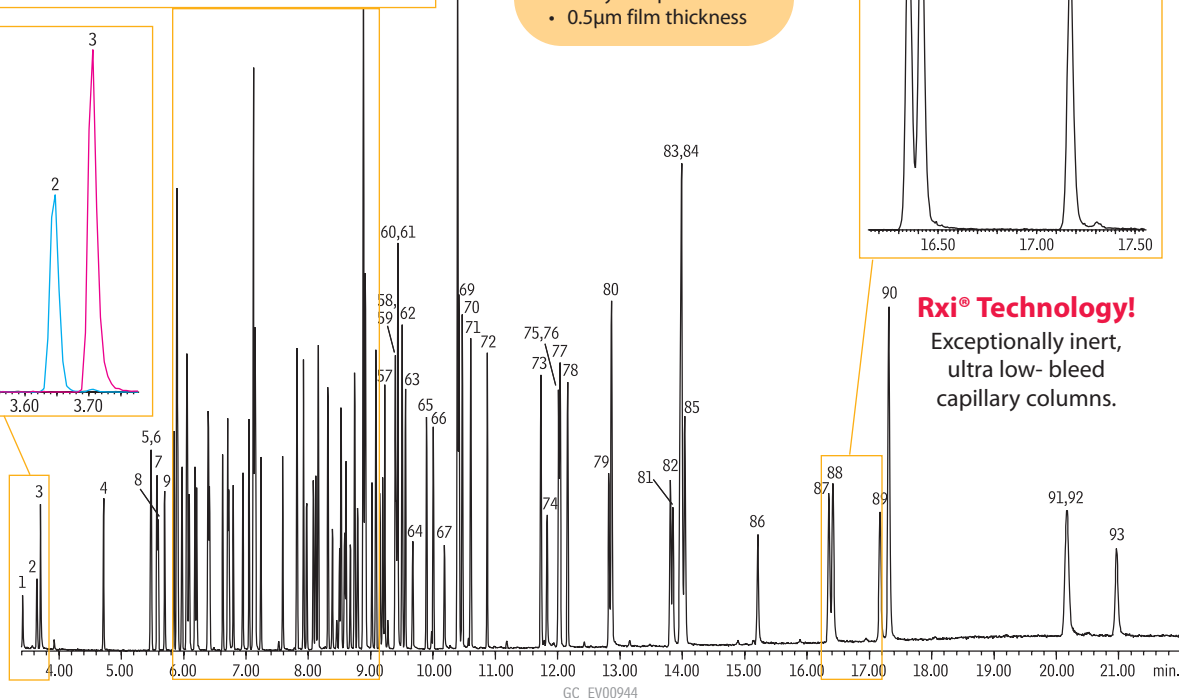


Column: Rxi®-5Sil MS, 30m, 0.25mm ID, 0.5µm (cat.# 13638)  
Sample: US EPA Method 8270D Mix, 1µL of 10µg/mL (IS 40µg/mL)  
8270 MegaMix® (cat.# 31850)  
Benzoic Acid (cat.# 31879)  
8270 Benzidines Mix (cat.# 31852)  
Acid Surrogate Mix (4/89 SOW) (cat.# 31025)  
Revised B/N Surrogate Mix (cat.# 31887)  
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



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



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

## Semivolatile Organics

## US EPA Method 8270

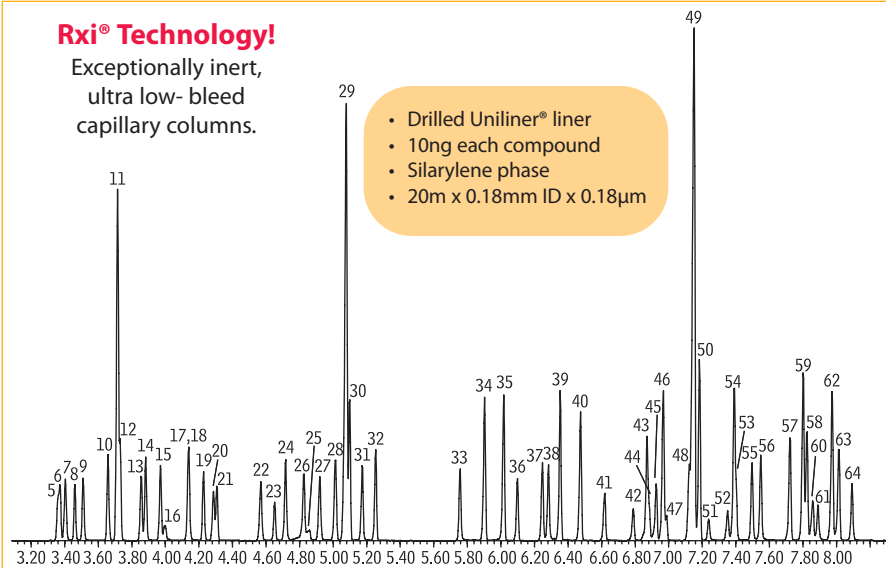
## Rxi®-5Sil MS

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) 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.: 250°C  
 Inj. temp.: helium, constant flow  
 Carrier gas: 1.0mL/min.  
 Flow rate: 50°C (hold 0.5 min.) to 260°C @ 20°C/min. to 280°C @ 5°C/min. to 330°C @ 20°C/min. (hold 1.0 min.)  
 Oven temp.: MS  
 Det.: MS  
 Transfer line temp: 280°C  
 Scan range: 35-550amu  
 Ionization: EI  
 Mode: scan

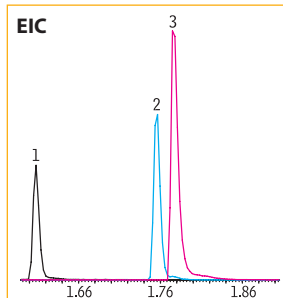
## Rxi® Technology!

Exceptionally inert,  
ultra low- bleed  
capillary columns.

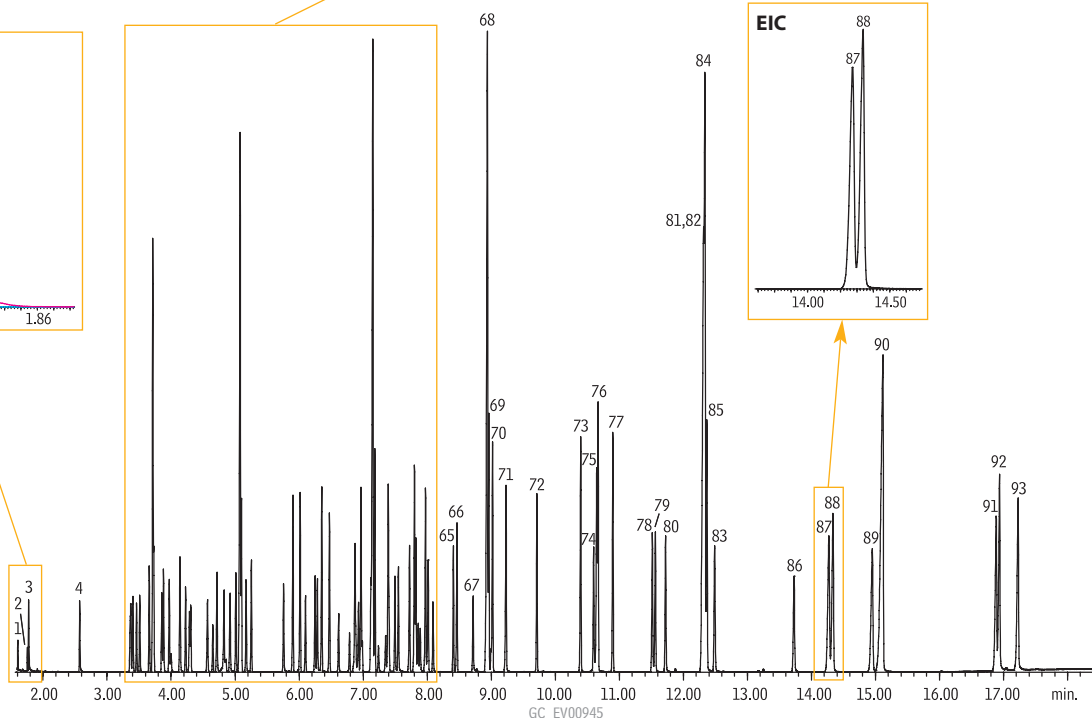
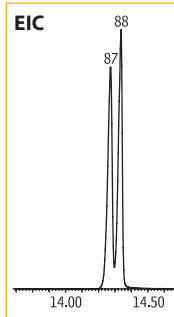
- Drilled Uniliner® liner
- 10ng each compound
- Silarylene phase
- 20m x 0.18mm ID x 0.18µm



## EIC



## EIC



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



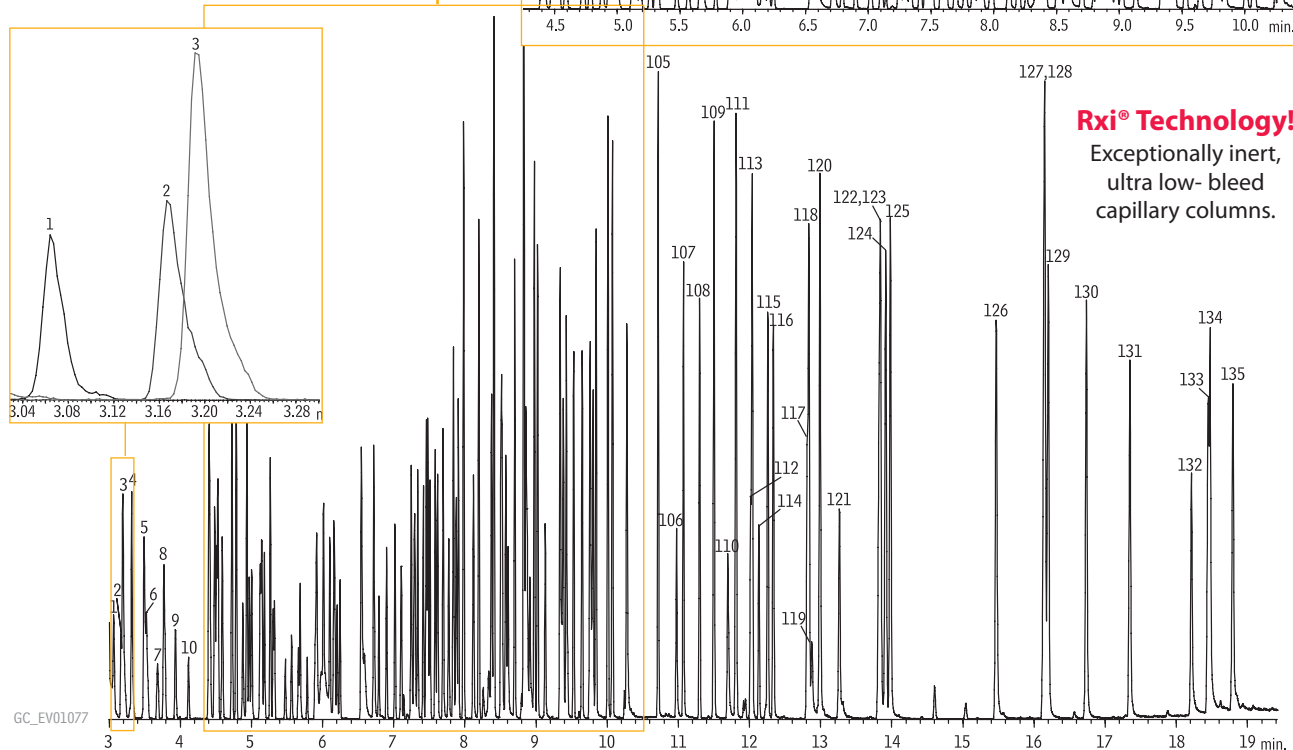
# Semivolatile Organics

## US EPA Method 8270-Appendix IX

### Rxi®-5Sil MS

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

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



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

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

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

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

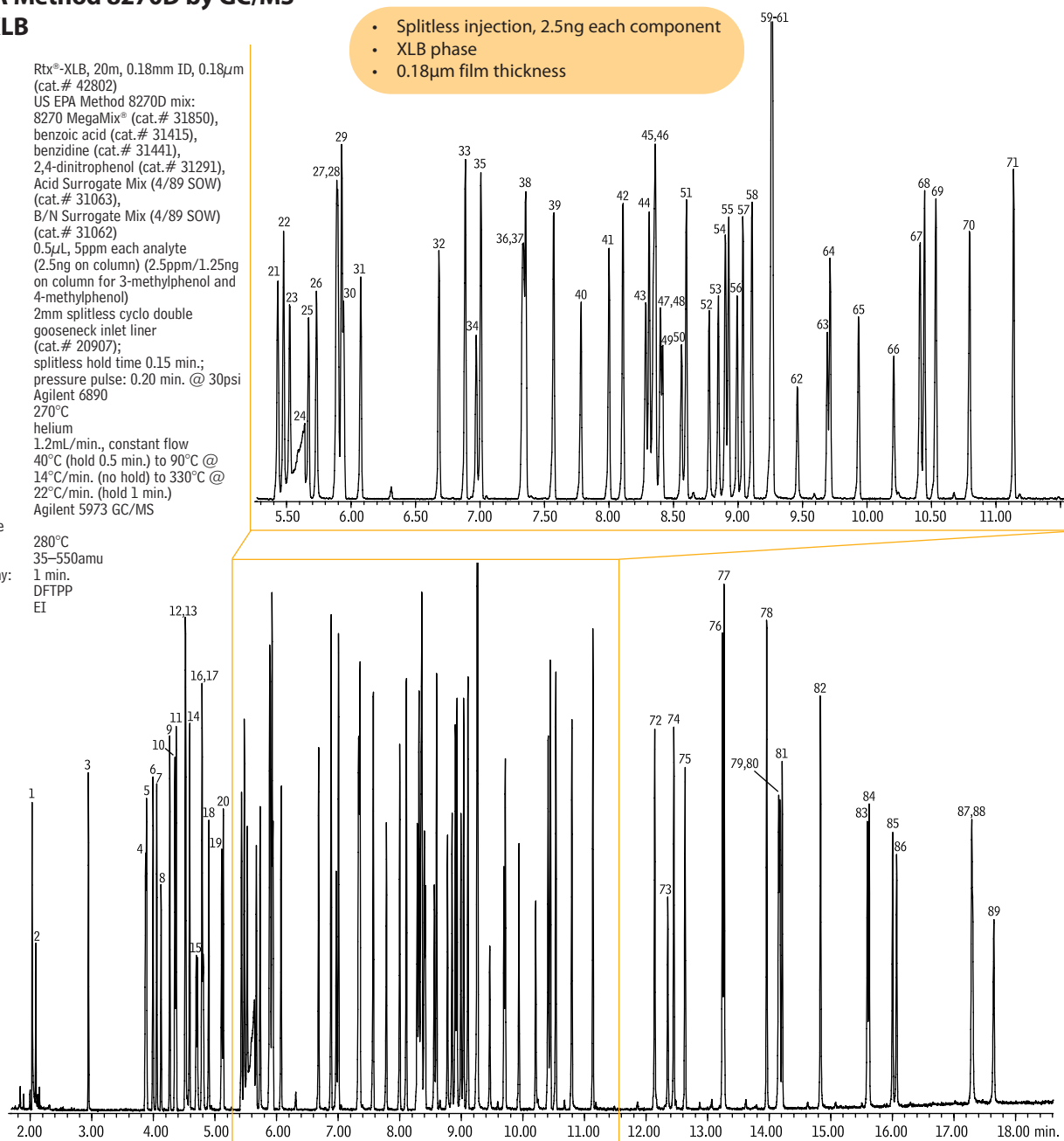
Scan range: 35–550amu

Solvent delay: 1 min.

Tune: DFTPP

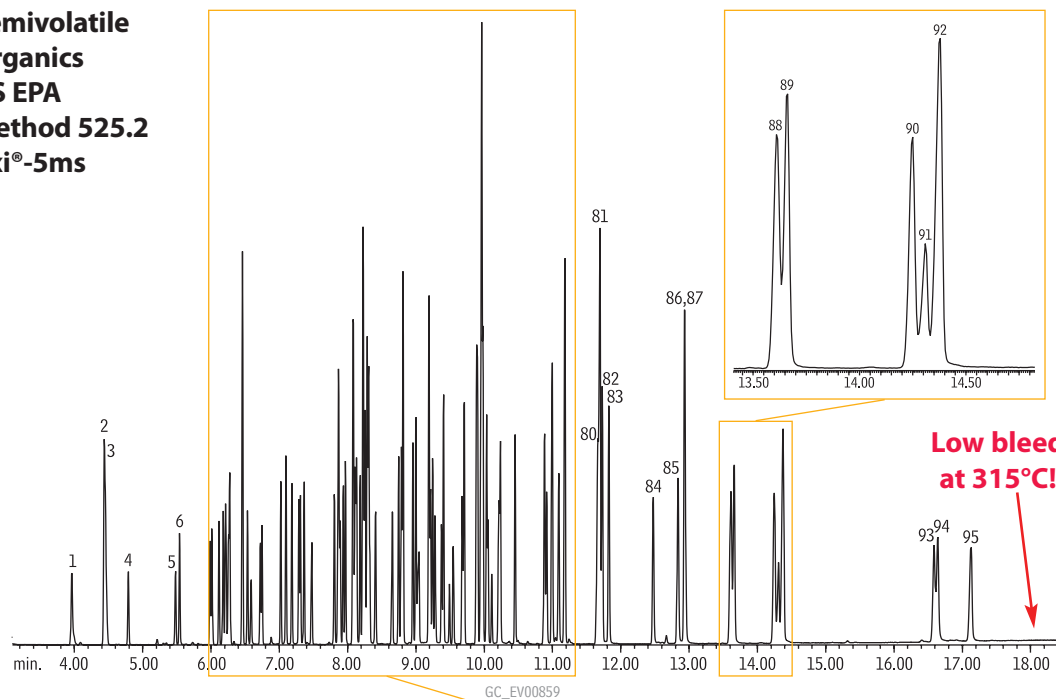
Ionization: EI

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

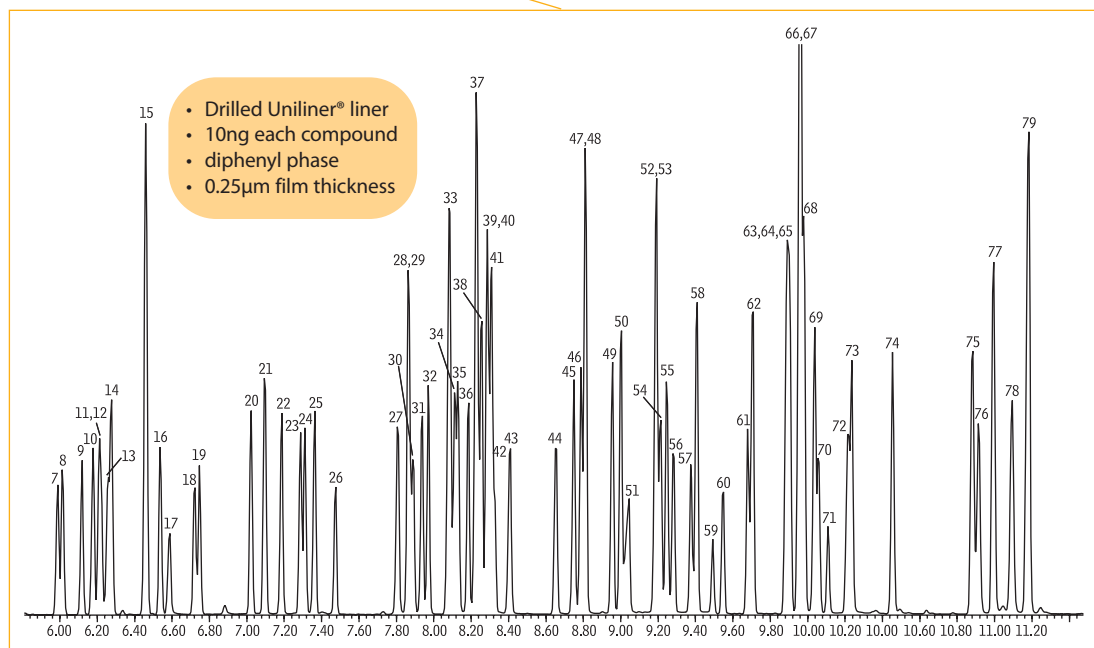


- |                                 |                                |                               |                                 |                                |
|---------------------------------|--------------------------------|-------------------------------|---------------------------------|--------------------------------|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

## 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. pyrene-d12 (SS)
93. indeno(1,2,3-*cd*)pyrene
94. dibenzo(a,h)anthracene
95. benzo(ghi)perylene



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

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

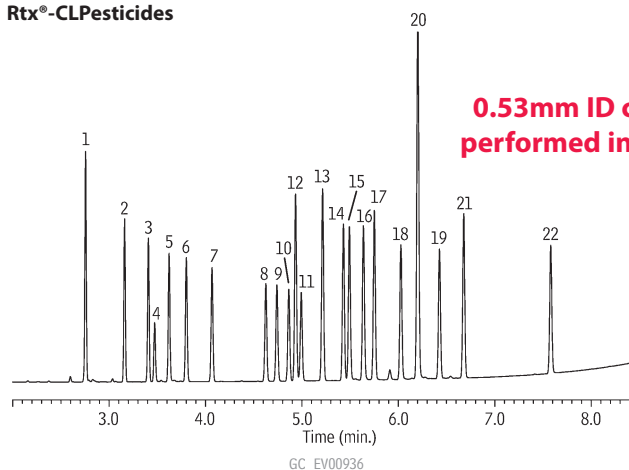
**Rxi® Technology!**  
 Exceptionally inert,  
 ultra low- bleed  
 capillary columns.

## Organochlorine Pesticide Mix AB #2

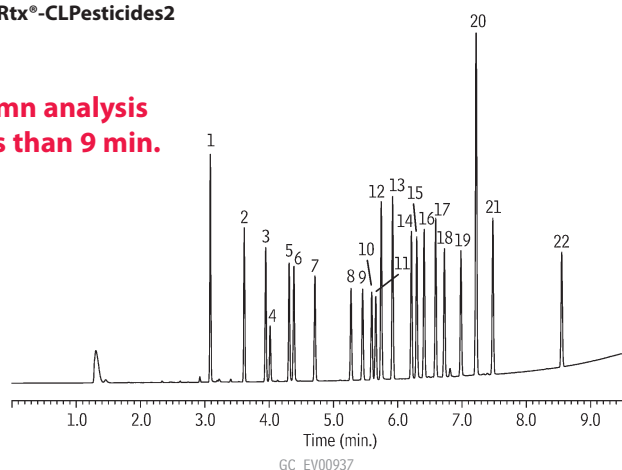
## US EPA Method 8081

## 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

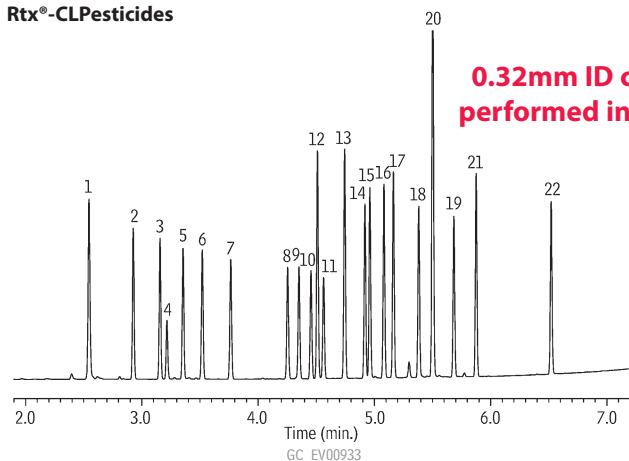
- |   |                             |
|---|-----------------------------|
| 1. 2,4,5,6-tetrachloro- <i>m</i> -xylene (SS) | 12. 4,4'-DDE                |
| 2. α-BHC                                      | 13. dieldrin                |
| 3. γ-BHC                                      | 14. endrin      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

## Organochlorine Pesticide Mix AB #2

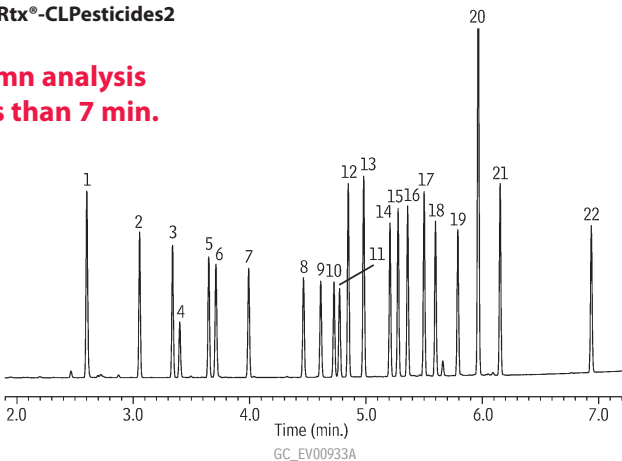
## US EPA Method 8081

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

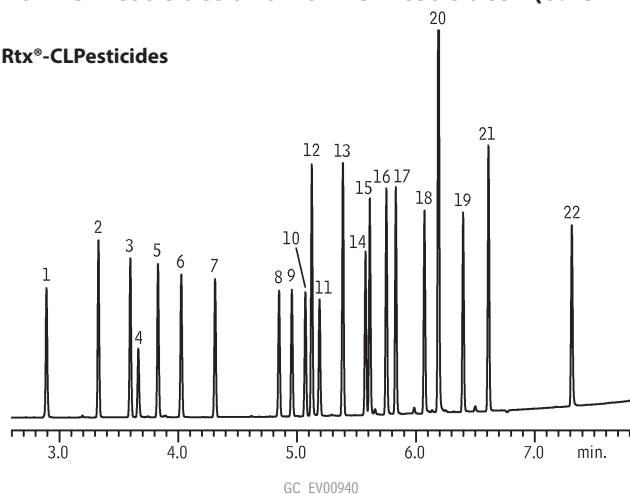


**Organochlorine Pesticide Mix AB #2**

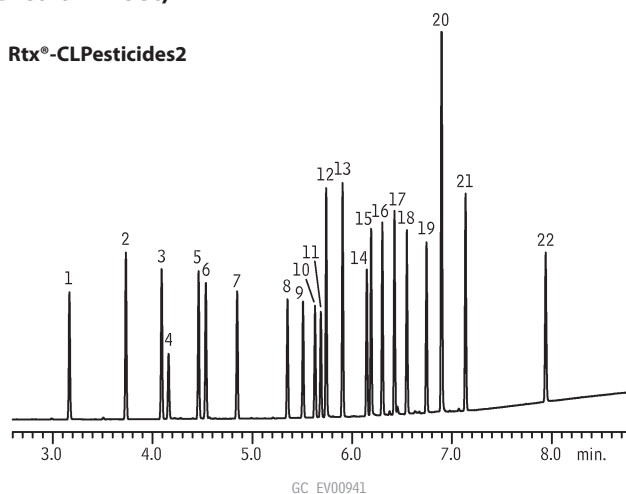
**US EPA Method 8081**

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

**Rtx®-CLPesticides**



**Rtx®-CLPesticides2**



**Columns:** Rtx®-CLPesticides, 30m, 0.25mm ID, 0.25 $\mu$ m (cat.# 11123) and Rtx®-CLPesticides2, 30m, 0.25mm ID, 0.20 $\mu$ m (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, 8–80 $\mu$ g/mL each component in hexane/toluene (cat.# 32292), Pesticide Surrogate Mix, 200 $\mu$ g/mL each component in acetone (cat.# 32000)

**Inj.:** 0.5 $\mu$ L splitless (hold 0.5 min.), 2mm Cyclo Double Gooseneck inlet liner (cat.# 20908)

**Inj. temp.:** 250°C

**Carrier gas:** helium, constant flow

**Linear velocity:** 41cm/sec. @ 125°C

**Oven temp.:** 125°C to 200°C @ 45°C/min. to 230°C @ 12.5°C/min. to 330°C (hold 2 min.) @ 30°C/min.

**Det.:**  $\mu$ -ECD @ 330°C

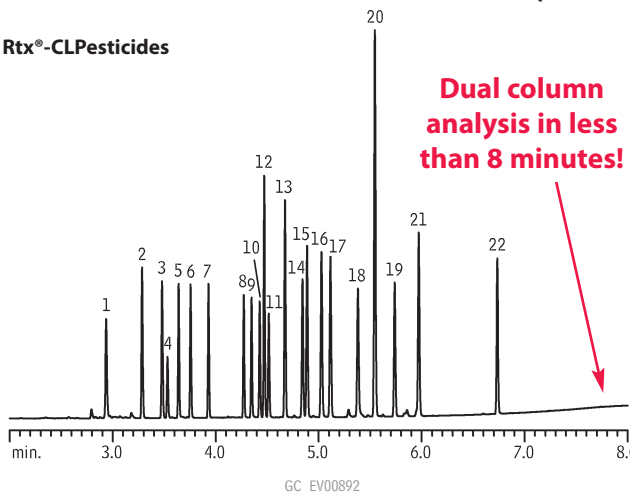
- |   |                             |
|---|-----------------------------|
| 1. 2,4,5,6-tetrachloro- <i>m</i> -xylene (SS) | 12. 4,4'-DDE                |
| 2. $\alpha$ -BHC                              | 13. dieldrin                |
| 3. $\gamma$ -BHC                              | 14. endrin      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

**Organochlorine Pesticides**

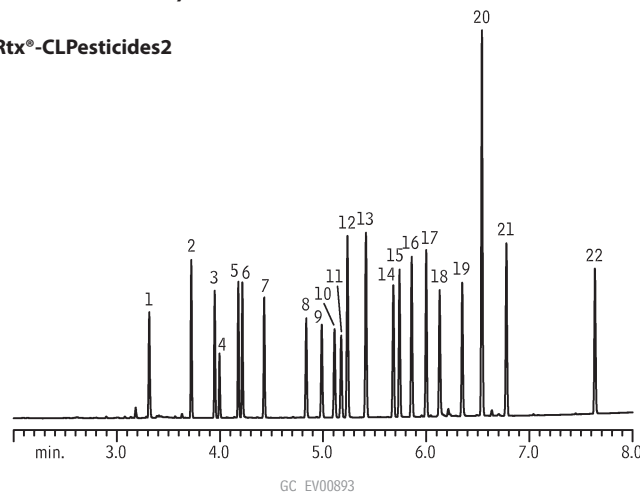
**US EPA Method 8081**

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

**Rtx®-CLPesticides**



**Rtx®-CLPesticides2**



**Columns:** Rtx®-CLPesticides, 20m, 0.18mm ID, 0.18 $\mu$ m (cat.# 42102) and Rtx®-CLPesticides2, 20m, 0.18mm ID, 0.14 $\mu$ m (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), 8–80 $\mu$ g/mL each component in hexane/toluene, Pesticide Surrogate Mix (cat.# 32000), 200 $\mu$ g/mL each component in acetone

**Inj.:** 0.5 $\mu$ L splitless (hold 0.75 min.), 2mm single gooseneck inlet liner (cat.# 20796)

**Inj. temp.:** 250°C

**Carrier gas:** helium, constant flow

**Linear velocity:** 20cm/sec. @ 140°C

**Oven temp.:** 140°C (hold 1 min.) to 250°C @ 35°C/min. (hold 1 min.) to 330°C @ 35°C/min. (hold 3 min.)

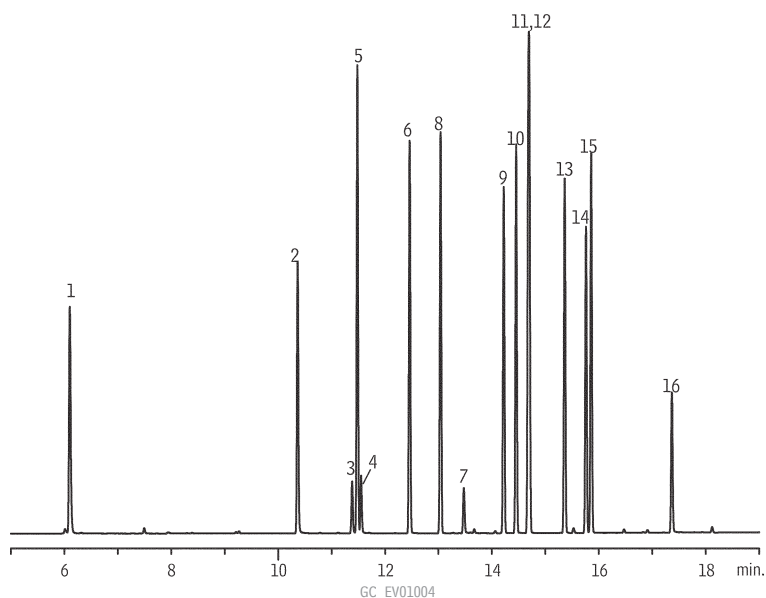
**Det.:**  $\mu$ -ECD @ 350°C

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

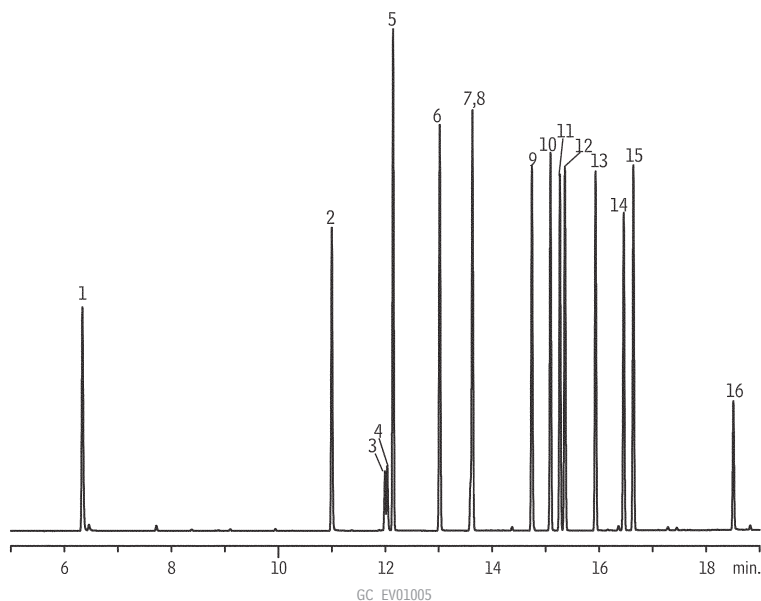
**Pesticides & Herbicides**  
**US EPA Method 505**  
**Rtx®-CLPesticides & Rtx®-CLPesticides2**



Rtx®-CLPesticides



Rtx®-CLPesticides2



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

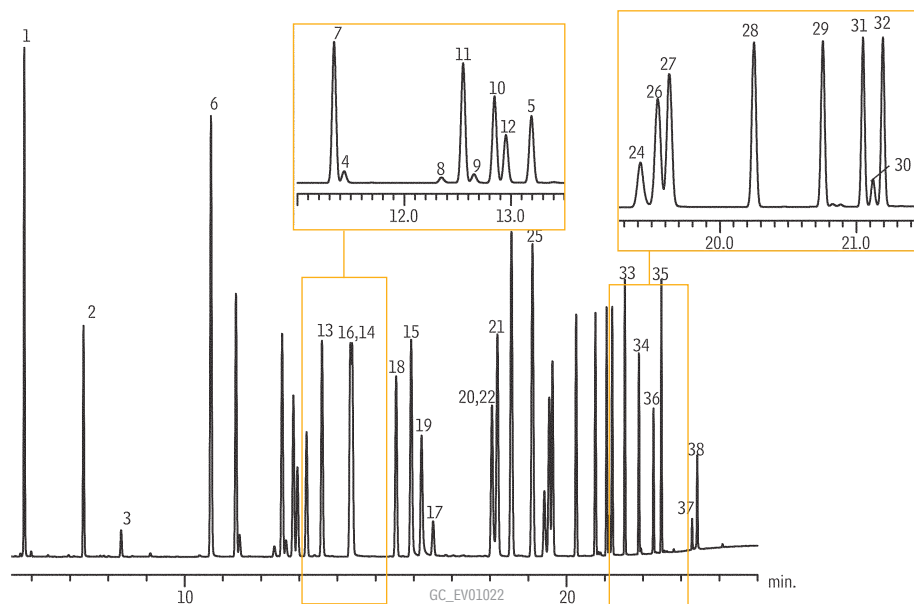
Column: Rtx®-CLPesticides2, 30m, 0.32mm ID, 0.25 $\mu$ m (cat.# 11324) and  
 Rtx®-CLPesticides, 30m, 0.32mm ID, 0.32 $\mu$ m (cat.# 11141) with  
 5m x 0.32mm ID Rxi® deactivated guard tubing (cat.# 10039),  
 connected using Universal "Y" Press-Tight® Connector (cat.# 20405-261)  
 Sample: 200ng/mL 505 Organohalide Pesticide Mix (cat.# 32024), 4.2 $\mu$ g/mL Simazine (cat.# 32236),  
 4.2 $\mu$ g/mL Atrazine (cat.# 32208) in methanol  
 Inj.: 2 $\mu$ L 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.:  $\mu$ -ECD @ 325°C

Pesticides & Herbicides

US EPA Method 508.1

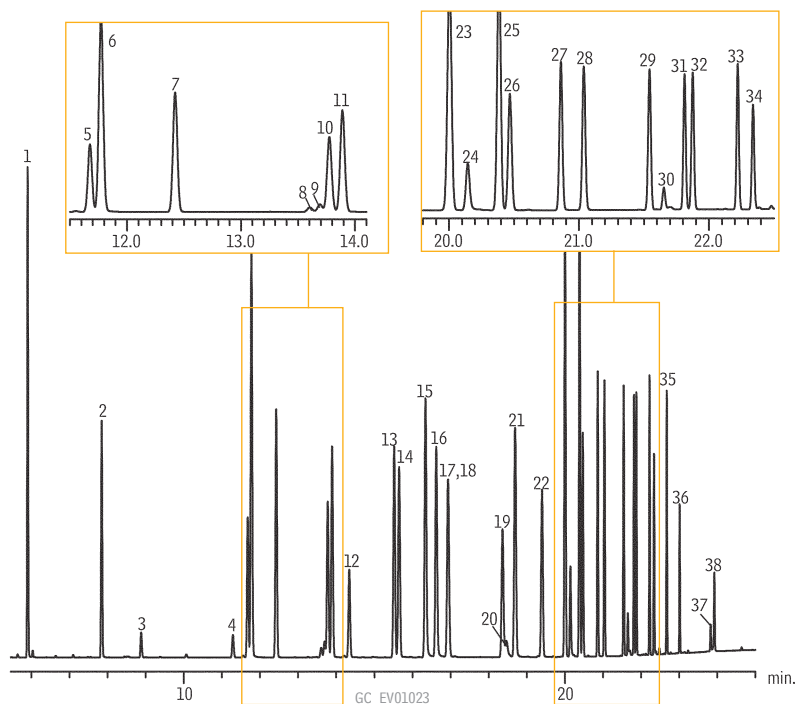
Rtx®-CLPesticides & Rtx®-CLPesticides2

Rtx®-CLPesticides



1. hexachlorocyclopentadiene
2. etridiazole
3. chloroneb
4. propachlor
5. trifluralin
6. hexachlorobenzene
7.  $\alpha$ -BHC
8. simazine
9. atrazine
10. pentachloronitrobenzene (IS)
11.  $\gamma$ -BHC
12.  $\beta$ -BHC
13.  $\delta$ -BHC
14. heptachlor
15. chlorothalonil
16. metribuzin
17. alachlor
18. aldrin
19. 4,4'-dibromobiphenyl (SS)
20. metachlor
21. DCPA
22. heptachlor epoxide
23.  $\gamma$ -chlordane
24. cyanazine
25.  $\alpha$ -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, 0.25 $\mu$ m (cat.# 11324) and  
Rtx®-CLPesticides,  
30m, 0.32mm ID, 0.32 $\mu$ m (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.: 2 $\mu$ L splitless (hold 0.75 min.), 4mm cyclo double  
goose-neck liner (cat.# 20896)

Inj. temp.: 250°C

Carrier gas: helium, constant flow

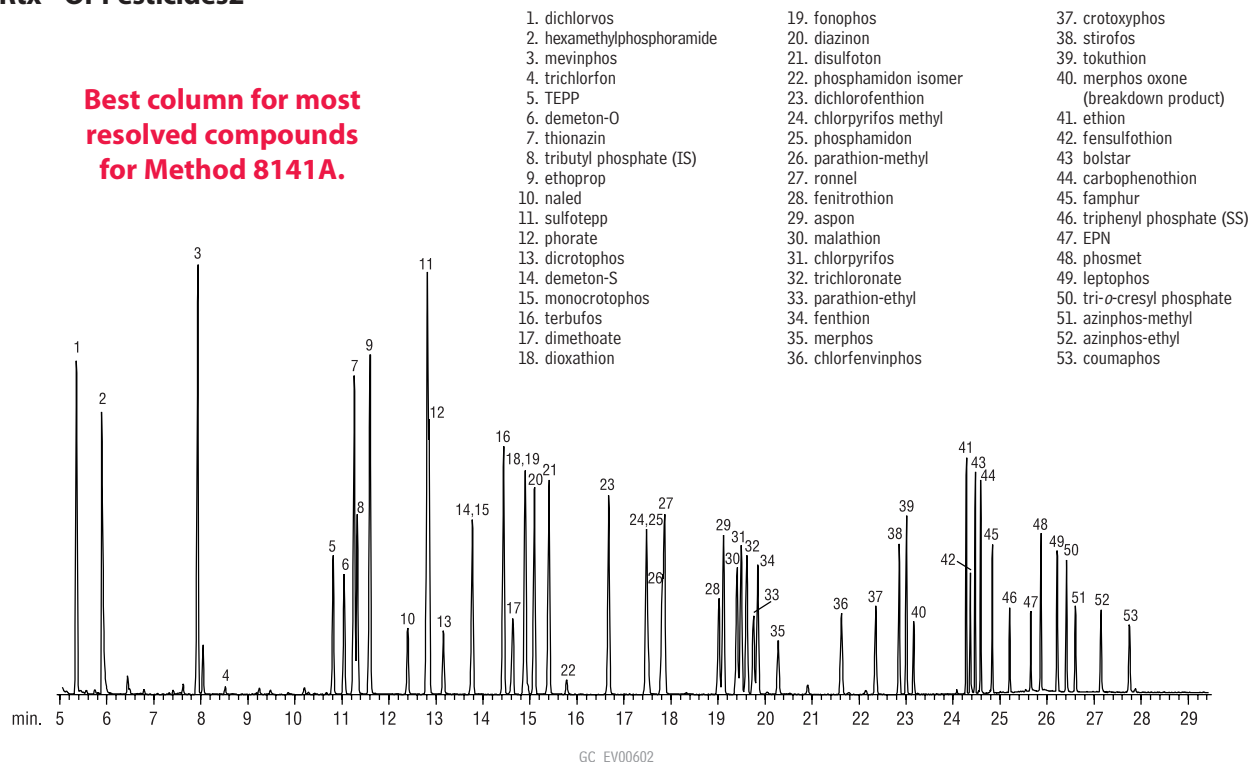
Linear velocity: 26cm/sec. @ 80°C

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.:  $\mu$ -ECD @ 325°C

Organophosphorus Pesticides  
US EPA Method 8141A  
Rtx®-OPPesticides2

**Best column for most  
resolved compounds  
for Method 8141A.**



Column: Rtx®-OPPesticides2, 30m, 0.25mm ID, 0.25 $\mu$ m (cat.# 11243)  
 Sample: US EPA Method 8141A Custom Standard Mix 1 $\mu$ L 100ppm  
 (100ng on column)  
 Triphenylphosphate Standard (cat.# 32281)  
 Tributylphosphate Standard (cat.# 32280)  
 8140/8141 OP Pesticides Calibration Mix A (cat.# 32277)  
 8141 OP Pesticides Calibration Mix B (cat.# 32278)  
*Custom Mixes: Call Restek for Information*  
 Inj.: 1.0 $\mu$ L splitless (hold 0.4 min.), 4mm double  
 gooseneck inlet liner (cat.# 20785)

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

## Chromatogram Search Tool

Search by compound name, synonym,  
CAS # or keyword  
[www.restek.com/chromatograms](http://www.restek.com/chromatograms)





## Organophosphorus Pesticides

## US EPA Method 8141A

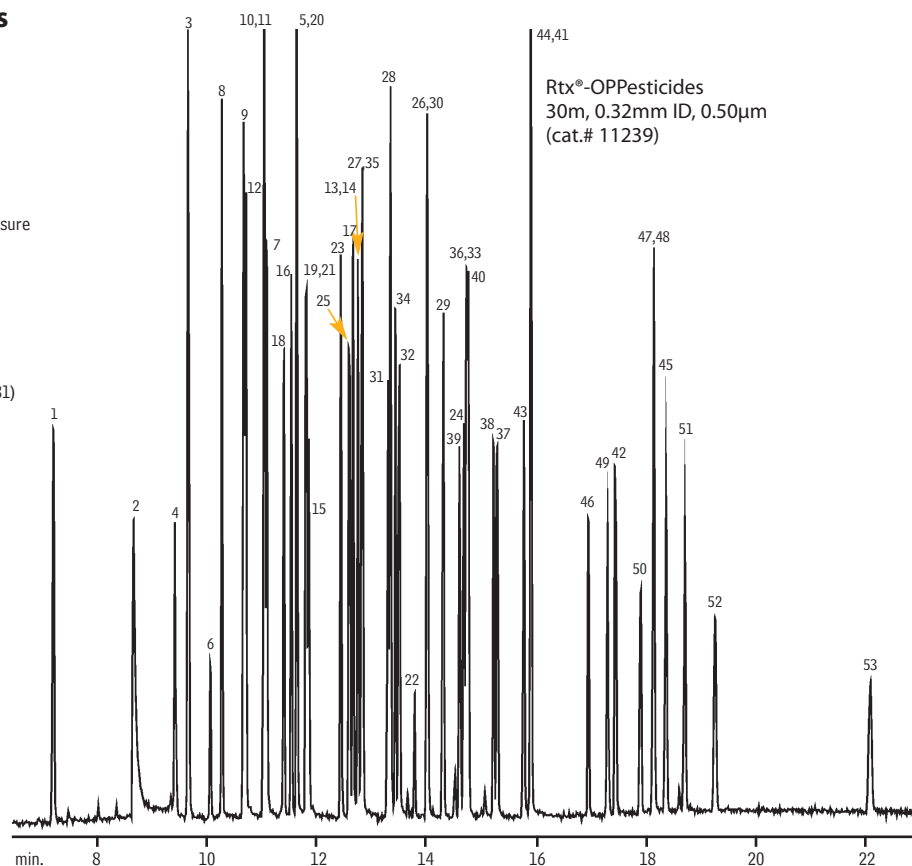
## Rtx®-OPPesticides &amp;

## Rtx®-OPPesticides2

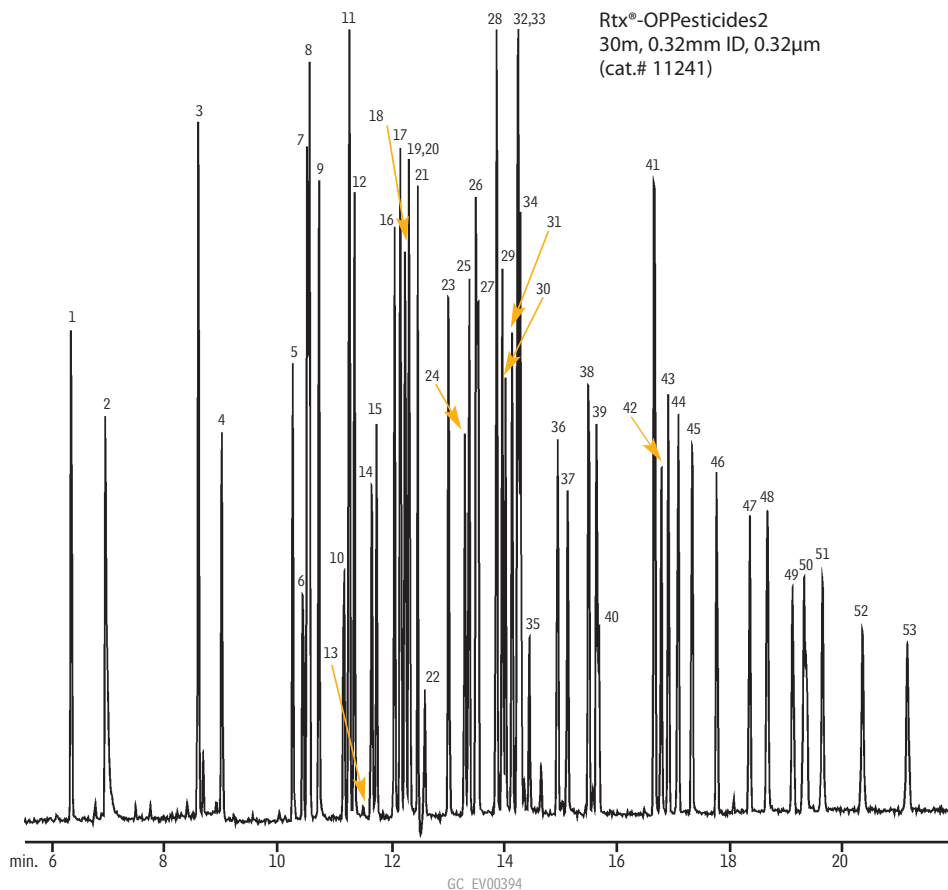
## Dual-column injector

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. fensulfotthion
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



Rtx®-OPPesticides  
 30m, 0.32mm ID, 0.50µm  
 (cat.# 11239)



Rtx®-OPPesticides2  
 30m, 0.32mm ID, 0.32µm  
 (cat.# 11241)

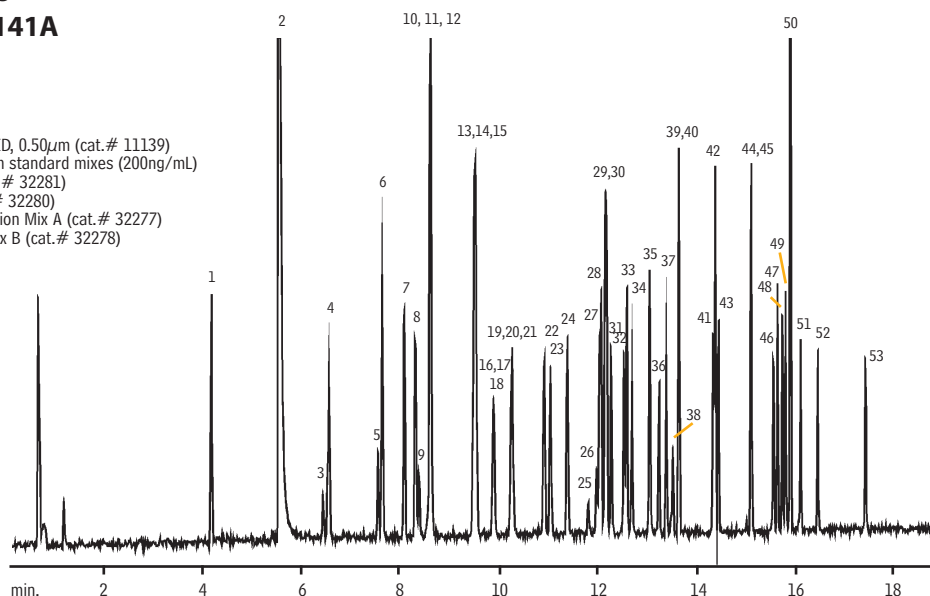
## Organophosphorus Pesticides

### US EPA Method 8140/8141/8141A

#### Rtx®-CLPesticides

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

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



GC\_EV00413

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

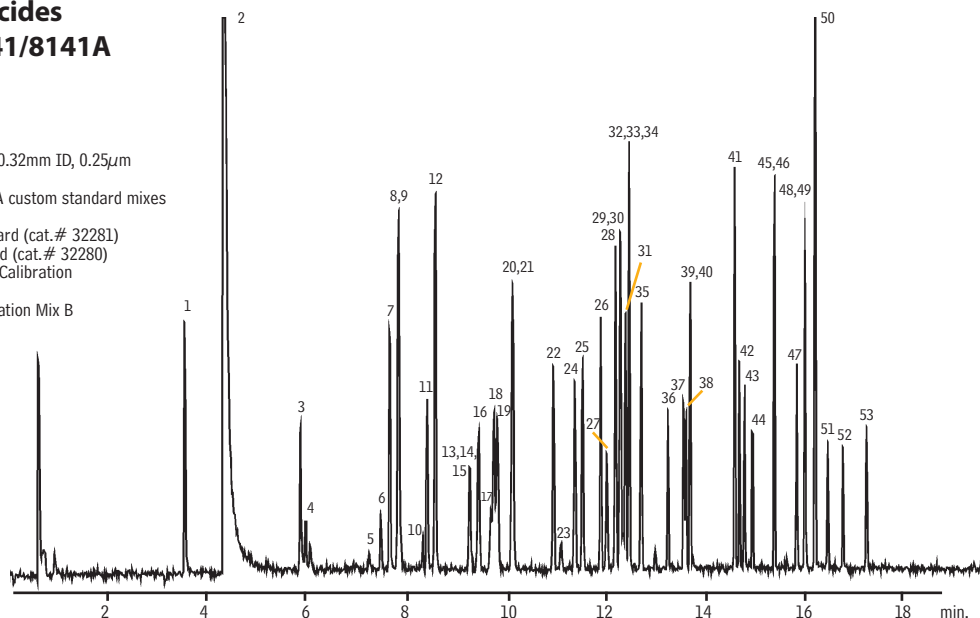
## Organophosphorus Pesticides

### US EPA Method 8140/8141/8141A

#### Rtx®-CLPesticides2

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

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



GC\_EV00414

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

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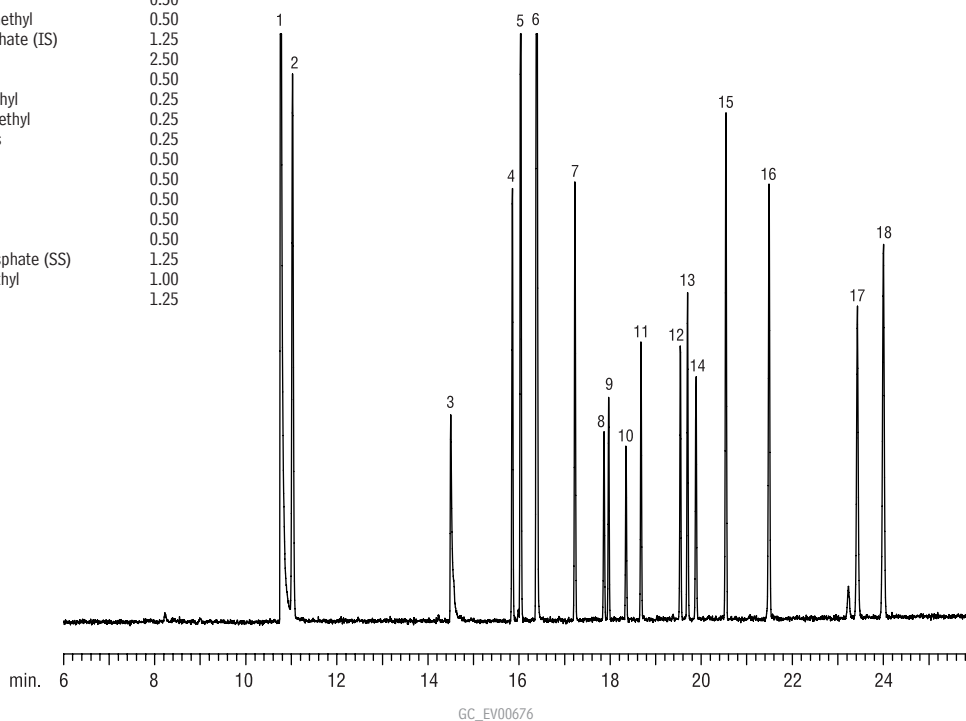
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11/12

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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. chlorpyrifos	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

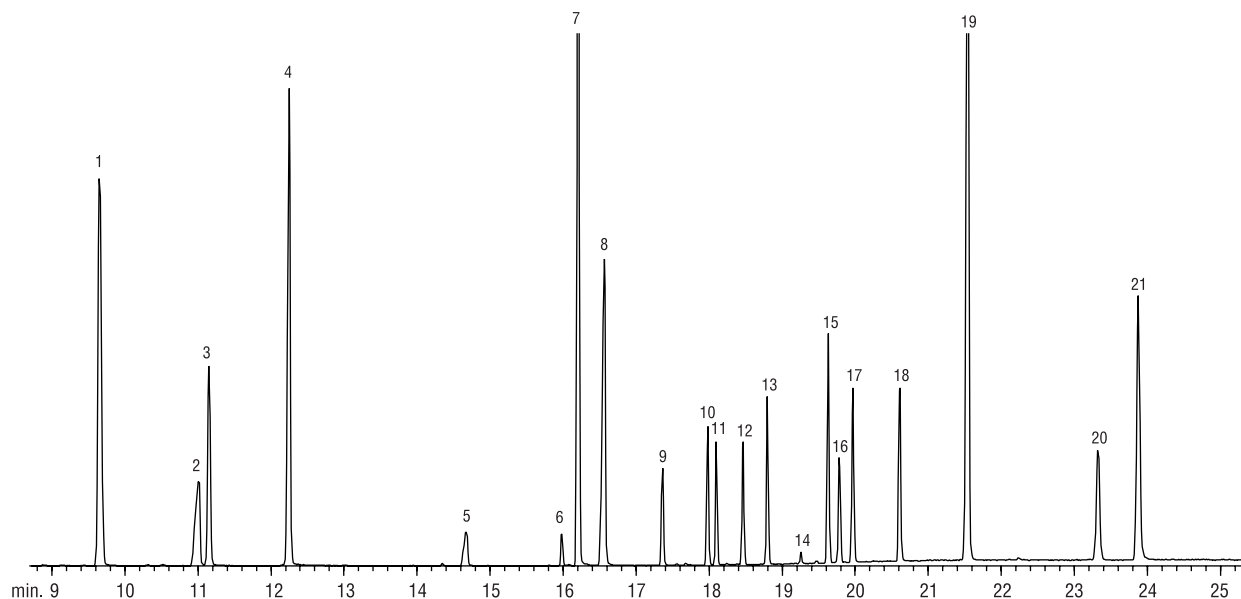


Column: Rtx®-CLPesticides, 30m, 0.32mm ID, 0.50µm (cat.# 11139)  
 Sample: European OPP Mix (cat.# 32418)  
 100–1000µg/mL in acetone  
 Inj.: 0.5µL direct, open-top Siltek® Drilled Uniliner®  
 inlet liner (cat.# 21055-214.5)  
 Inj. temp.: 250°C  
 Carrier gas: helium, constant pressure  
 Linear velocity: 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

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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

## Chromatogram Search Tool

Search by compound name, synonym,  
CAS # or keyword

[www.restek.com/chromatograms](http://www.restek.com/chromatograms)

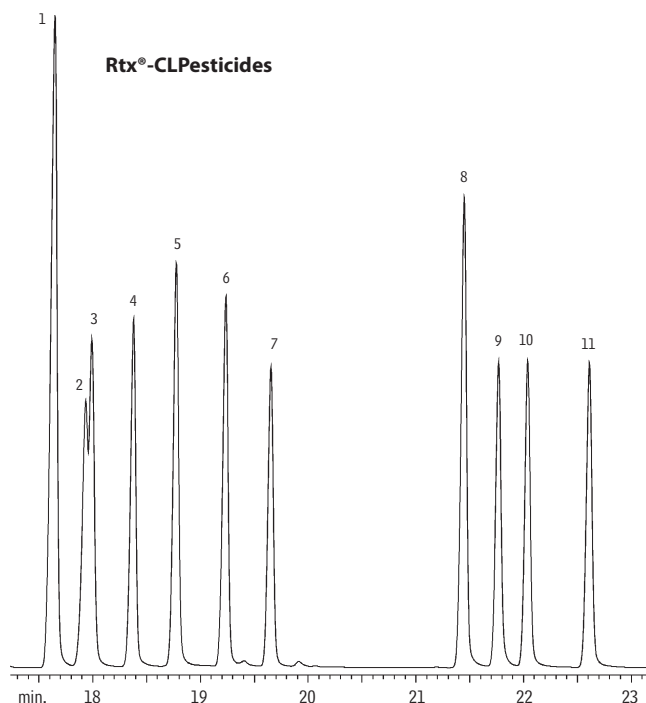




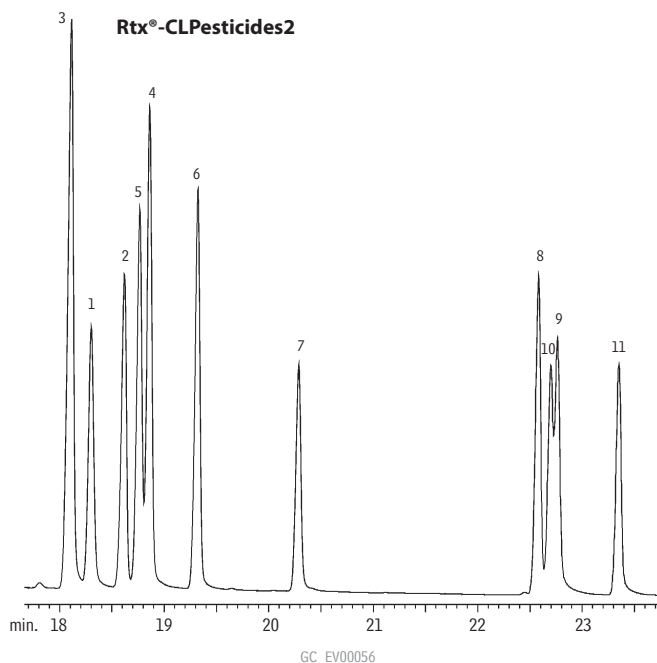
Nitrogen/Phosphorus Pesticides & Herbicides

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. terbutylazine	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



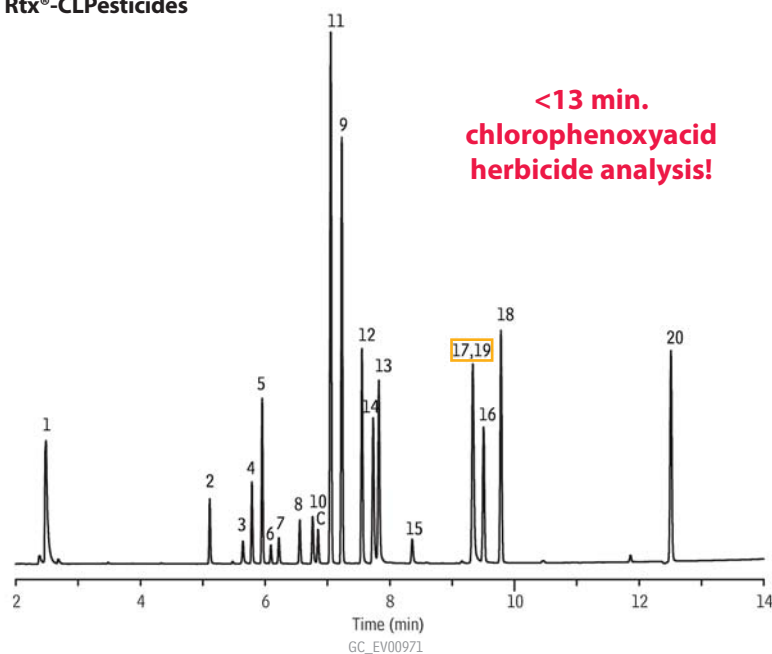
Columns: Rtx®-CLPesticides, 30m, 0.32mm ID, 0.50 $\mu$ m (cat.# 11139) and Rtx®-CLPesticides2, 30m, 0.32mm ID, 0.25 $\mu$ m (cat.# 11324) with a 5m, 0.32mm ID guard column (cat.# 10044) and a "Y" Press-Tight® connector (cat.# 20403)  
 Inj.: Direct injection using a Uniliner® inlet liner (cat.# 20964) 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

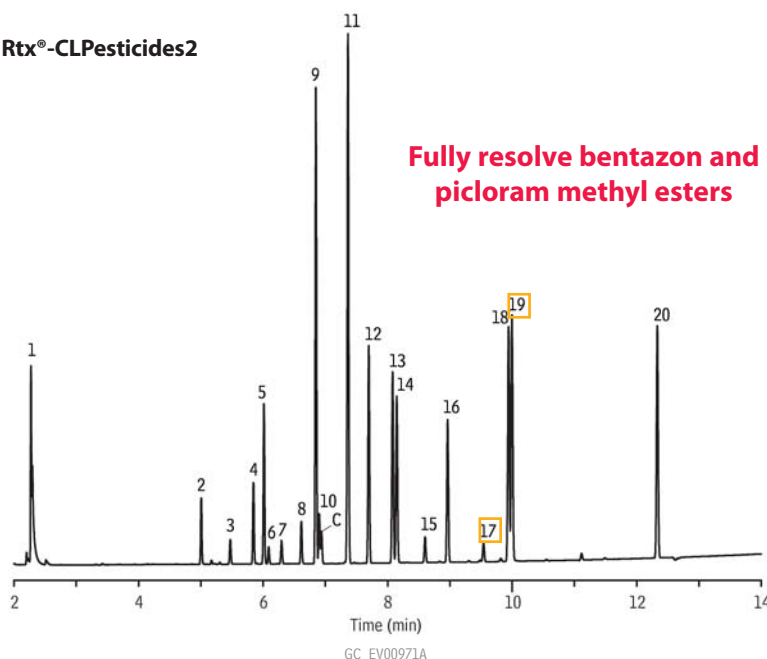
## Rtx®-CLPesticides &amp; Rtx®-CLPesticides2

## Rtx®-CLPesticides



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

## Rtx®-CLPesticides2



Column: Rtx®-CLPesticides2, 30m, 0.32mm ID, 0.25 $\mu$ m (cat.# 11324) and Rtx®-CLPesticides, 30m, 0.32mm ID, 0.32 $\mu$ m (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.: 1.0 $\mu$ L 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.:  $\mu$ -ECD @ 325°C

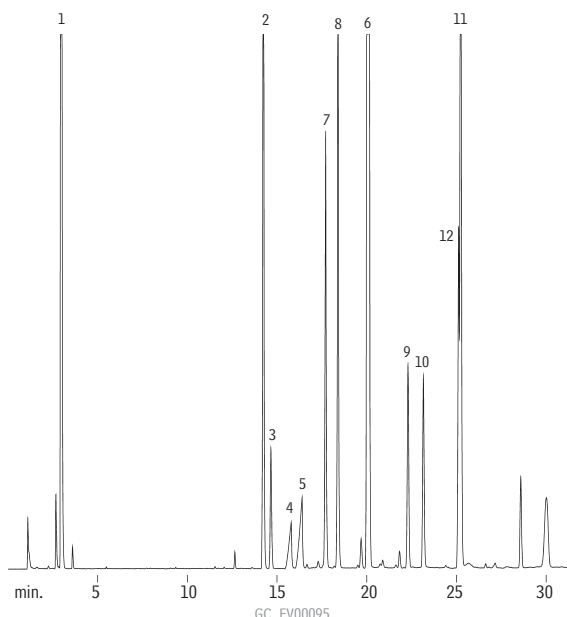
## Chlorophenoxyacid Herbicides

## US EPA Method 615

Rtx®-5

Analysis optimized  
using Pro ezGC  
software!

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



Column: Rtx®-5, 30m, 0.53mm ID, 0.50µm (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 ezGC

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

**Pro ezGC Method Development Software (cat.# 21487)**

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Description	qty.	cat.#
Pro ezGC Method Development Software CD-ROM	ea.	21487



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

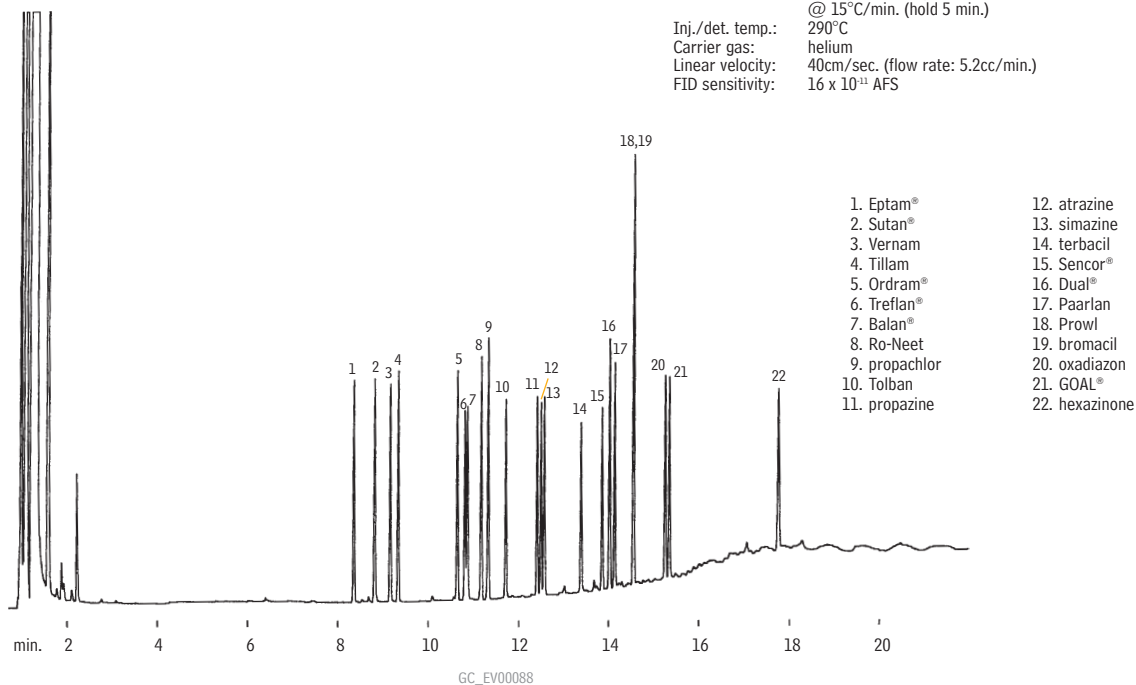
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## Nitrogen-Containing Herbicides

Rtx®-35

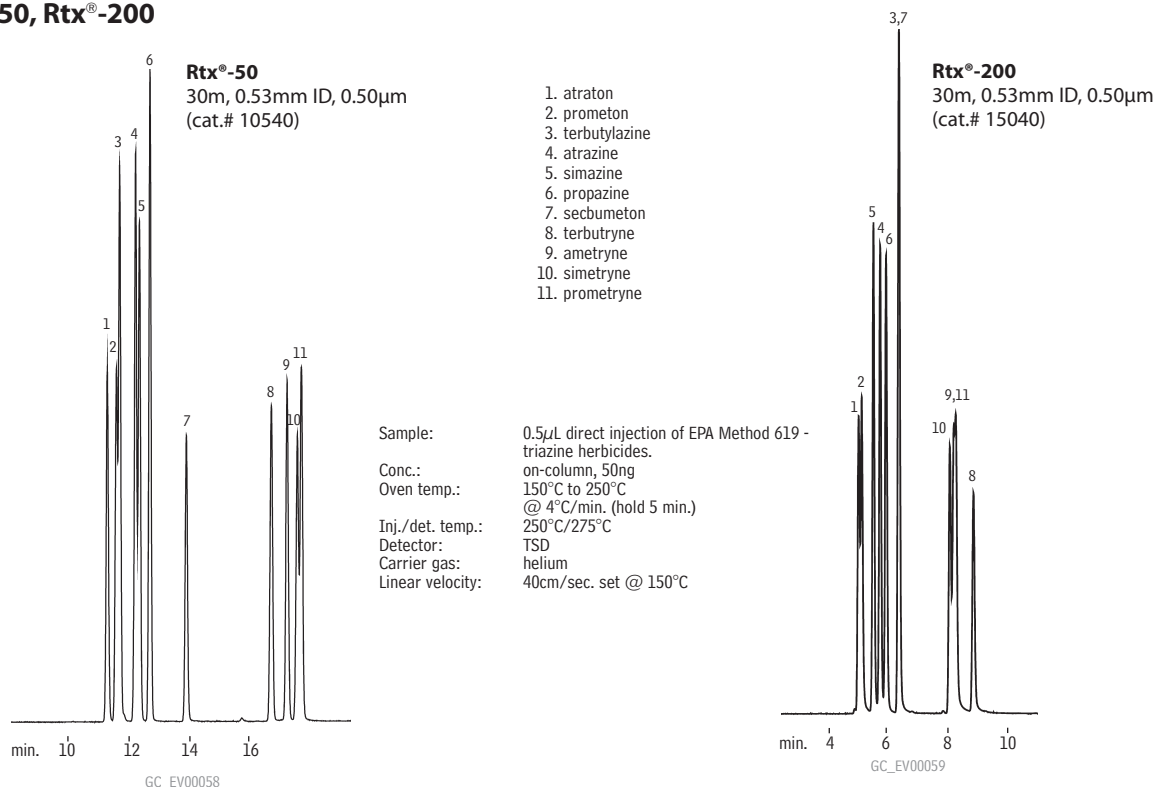
Column: Rtx®-35, 30m, 0.53mm ID, 0.50µm (cat.# 10440)  
 Inj.: 0.2µL direct injection, Uniliner® inlet liner,  
 approximately 10ng per component.  
 Oven temp.: 60°C (hold 1 min.) to 290°C  
 @ 15°C/min. (hold 5 min.)  
 Inj./det. temp.: 290°C  
 Carrier gas: helium  
 Linear velocity: 40cm/sec. (flow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



## Triazine Herbicides

US EPA Method 619

Rtx®-50, Rtx®-200



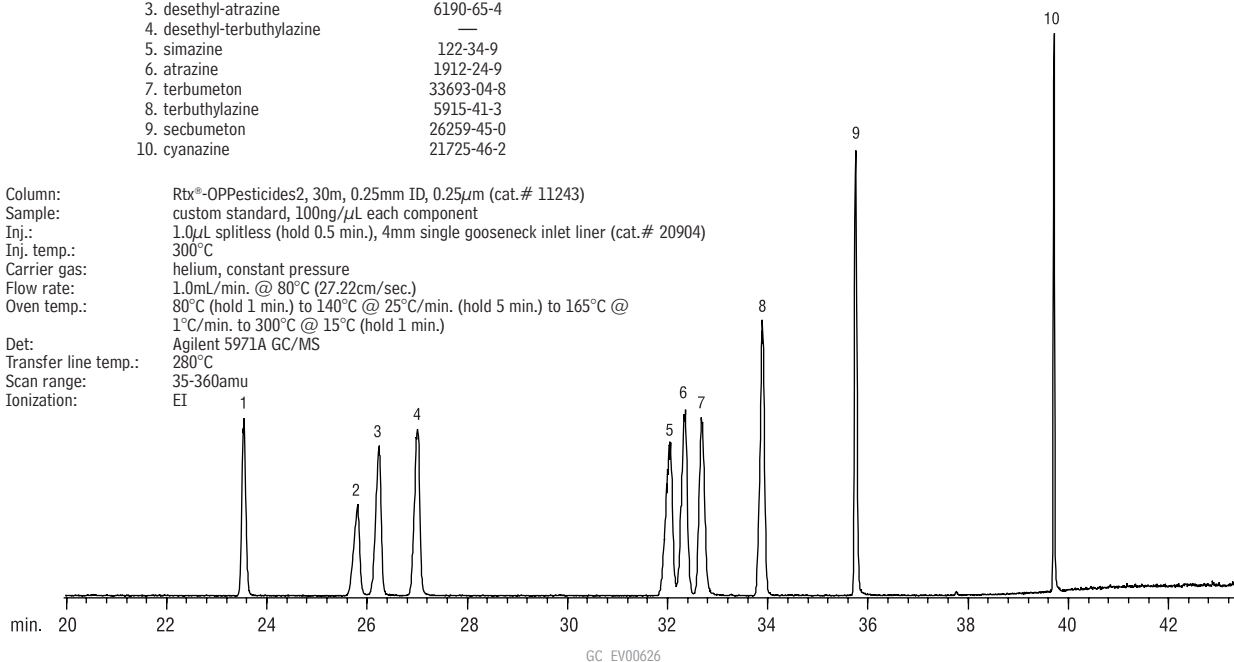


## Triazine Herbicides (French) &amp; Degradation Products

## Rtx®-OPPesticides2

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

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



Terry Reid, Technical Service

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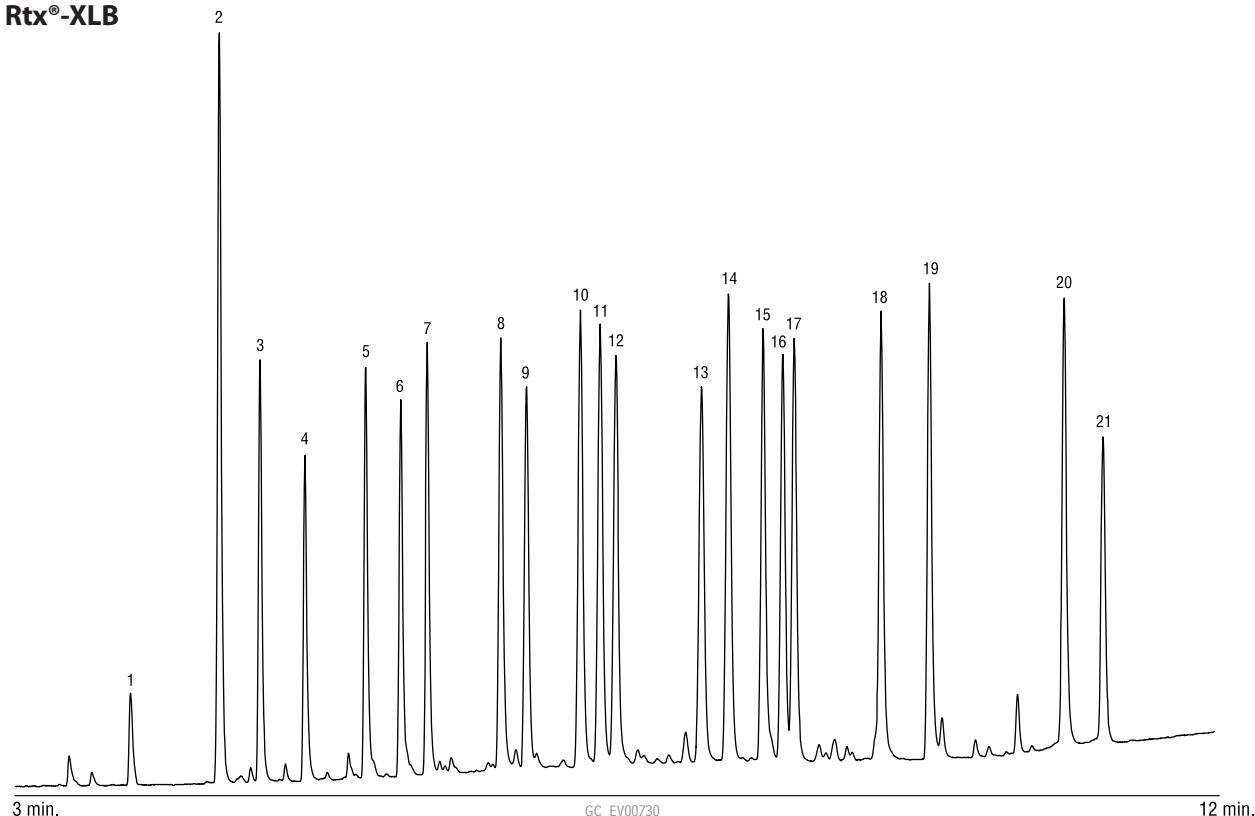
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 e-mail: [support@restek.com](mailto:support@restek.com)

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PCB Congeners  
Rtx®-XLB

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

Compound	RT (min.)
1. 2-chlorobiphenyl (BZ #1)	3.86
2. 2,4,5,6 tetrachloro- <i>m</i> -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



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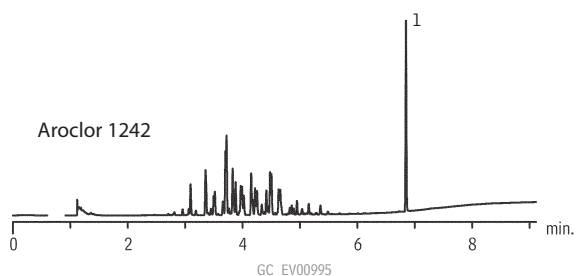
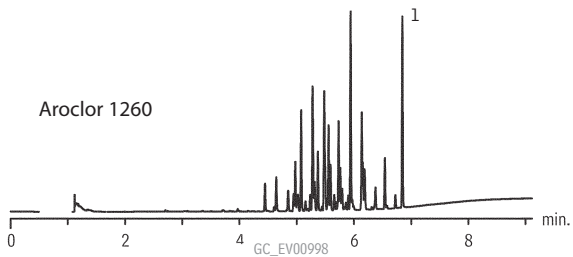
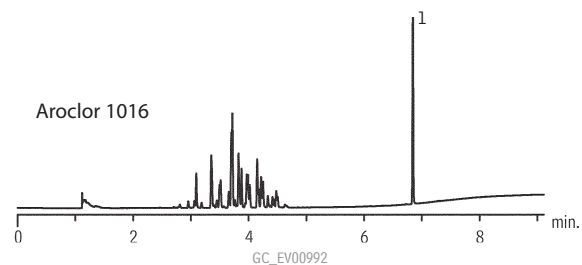
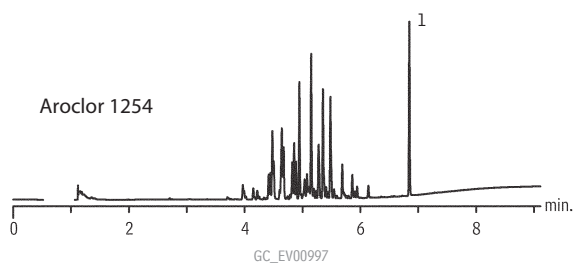
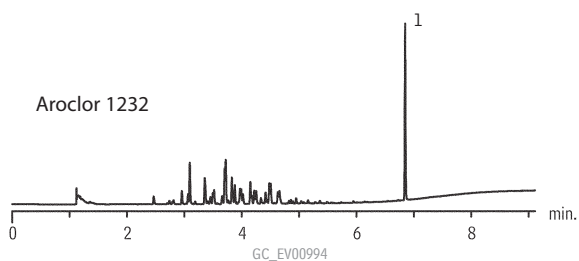
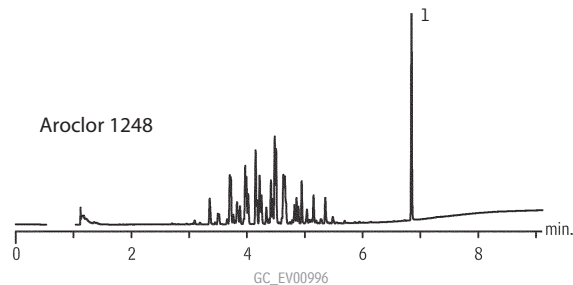
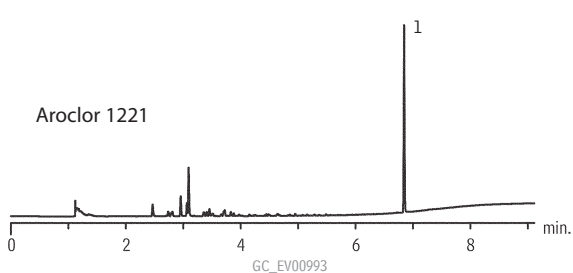
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**Aroclor PCBs**  
**US EPA Method 8082**  
**Rtx®-CLPesticides**

**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

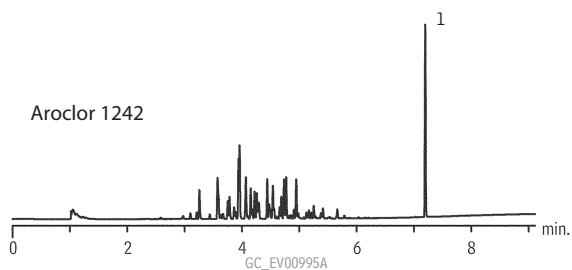
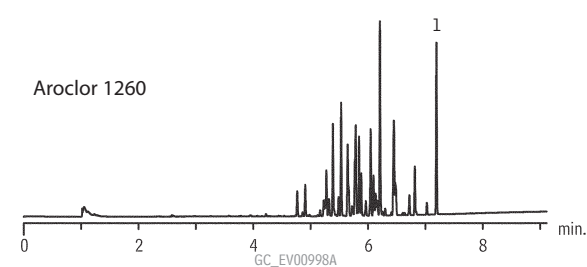
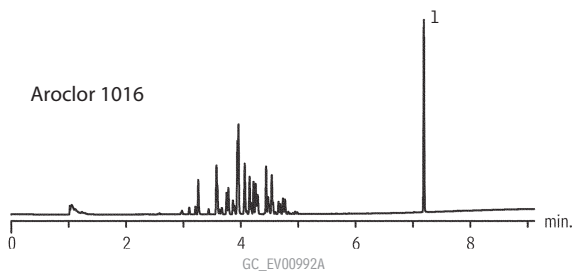
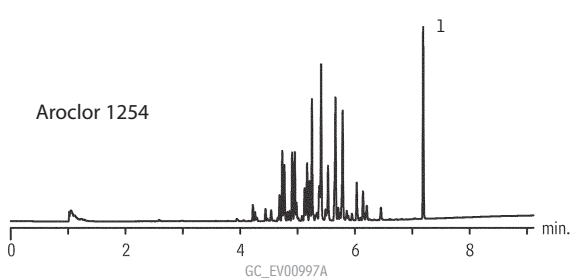
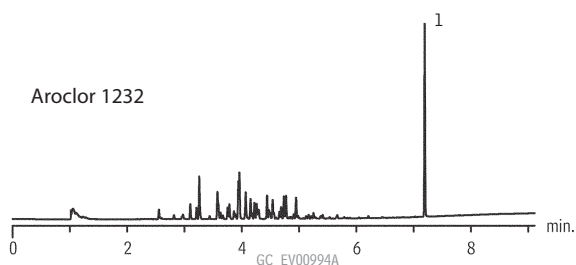
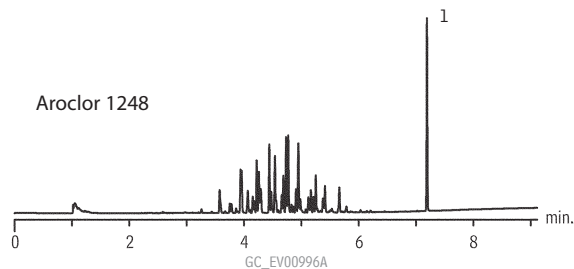
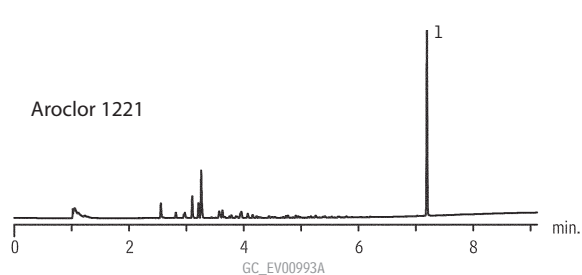
## US EPA Method 8082

### Rtx®-CLPesticides2

#### Rtx®-CLPesticides2

30m, 0.32mm ID, 0.25µm (cat.# 11324)

1. decachlorobiphenyl (DCB)

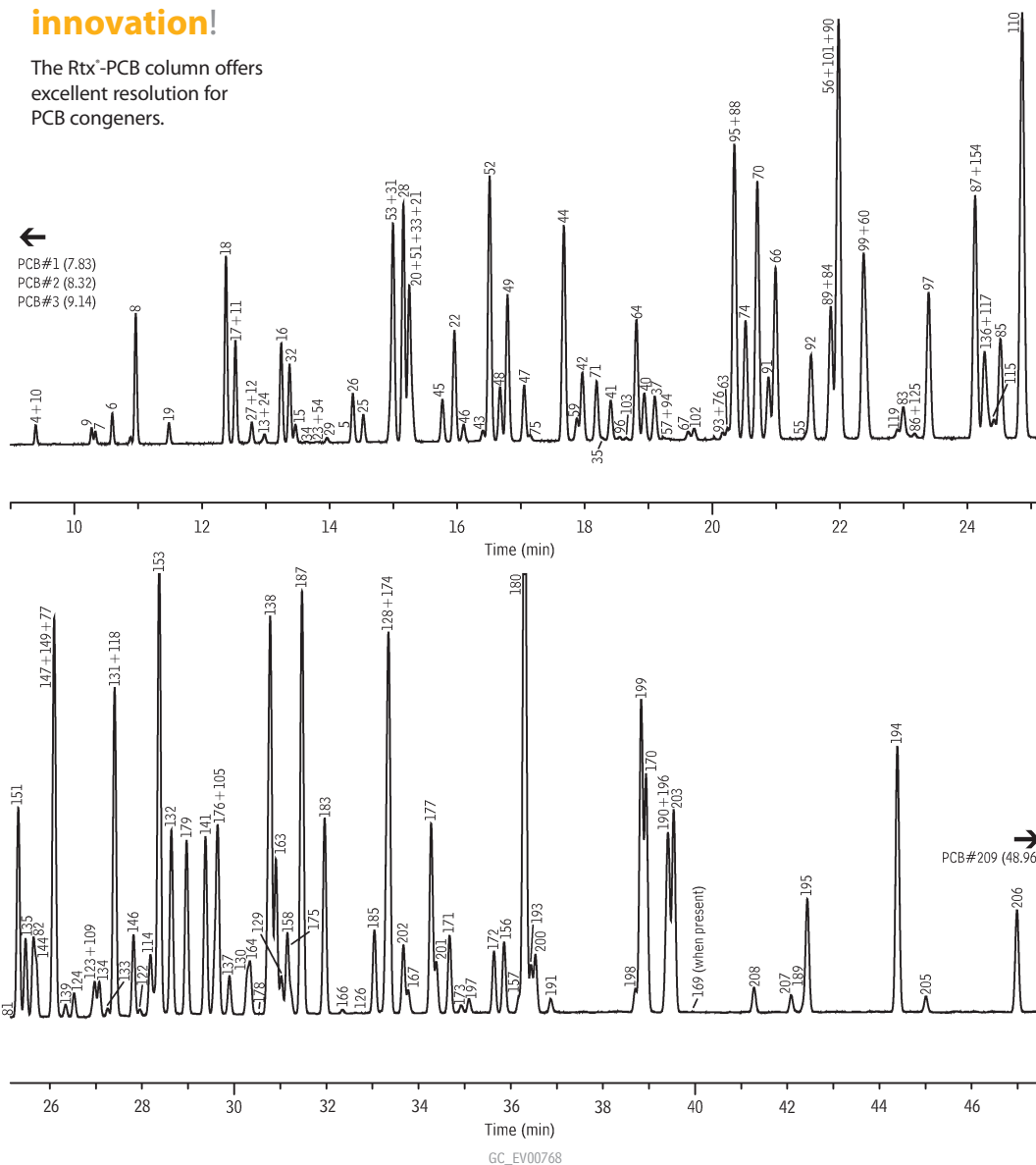


Column: Rtx®-CLPesticides2, 30m, 0.32mm ID, 0.25µm (cat.# 11324)  
 Sample: 1,000µg/mL each Aroclor compound in hexane diluted to 1,000ppb,  
 decachlorobiphenyl (BZ #209) 200µg/mL in acetone (cat.# 32029)  
 diluted to 100ppb  
 Inj.: 1.0µL pulsed splitless @ 30psi (hold 0.3 min.),  
 4mm cyclo double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



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

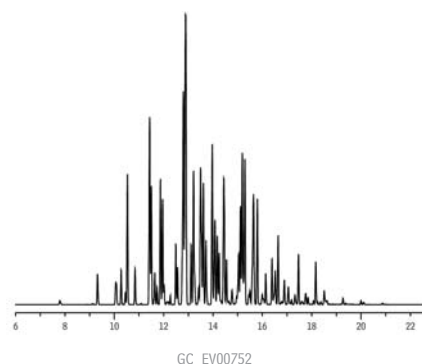
## Chromatogram Search Tool

Search by compound name, synonym,  
CAS # or keyword

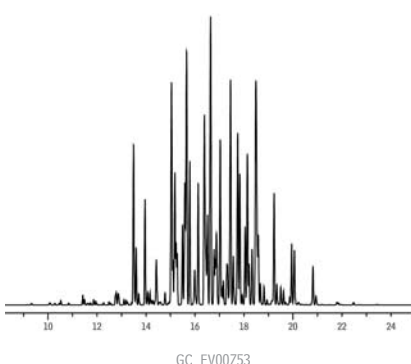
[www.restek.com/chromatograms](http://www.restek.com/chromatograms)



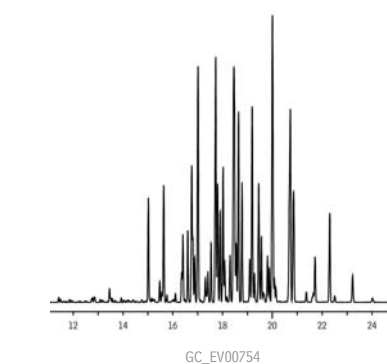


**Aroclor 1242 PCBs**  
**Rtx®-PCB**

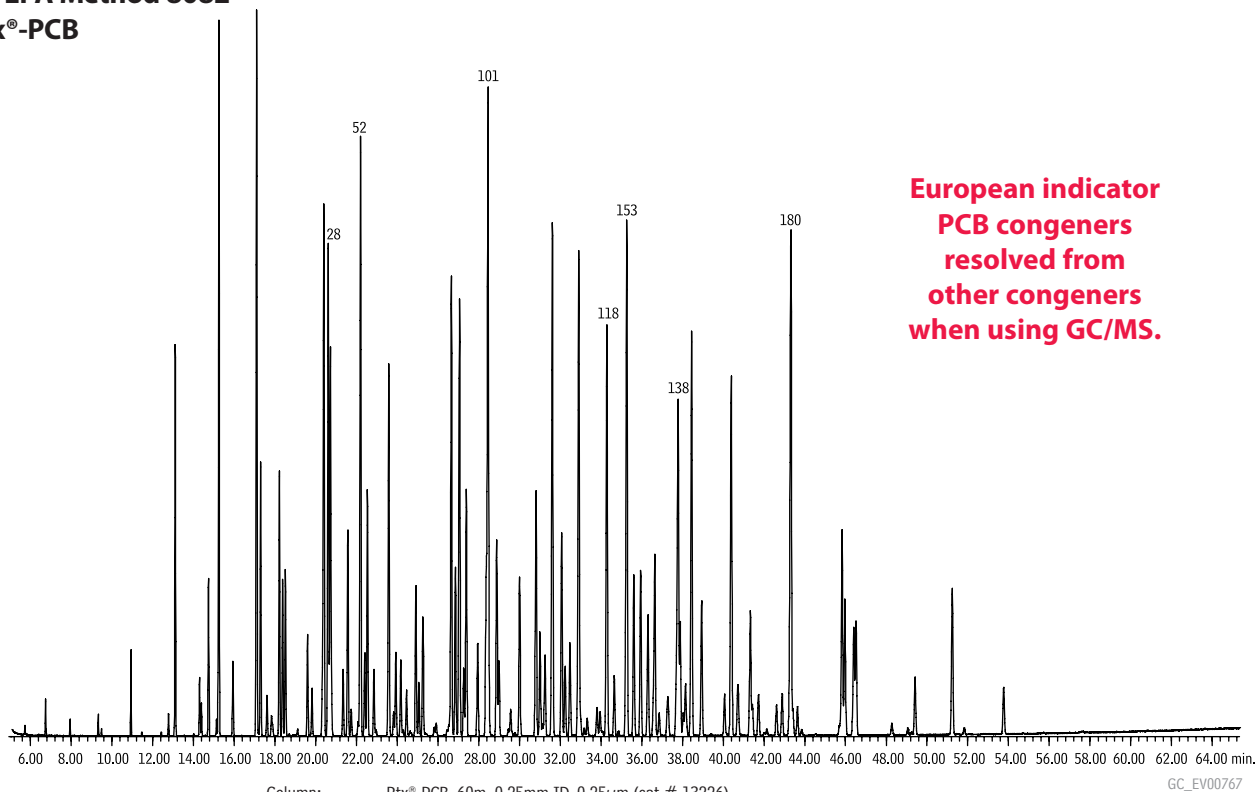
Sample: 200ng/mL Aroclor 1242 (cat.# 32009)

**Aroclor 1254 PCBs**  
**Rtx®-PCB**

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

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

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

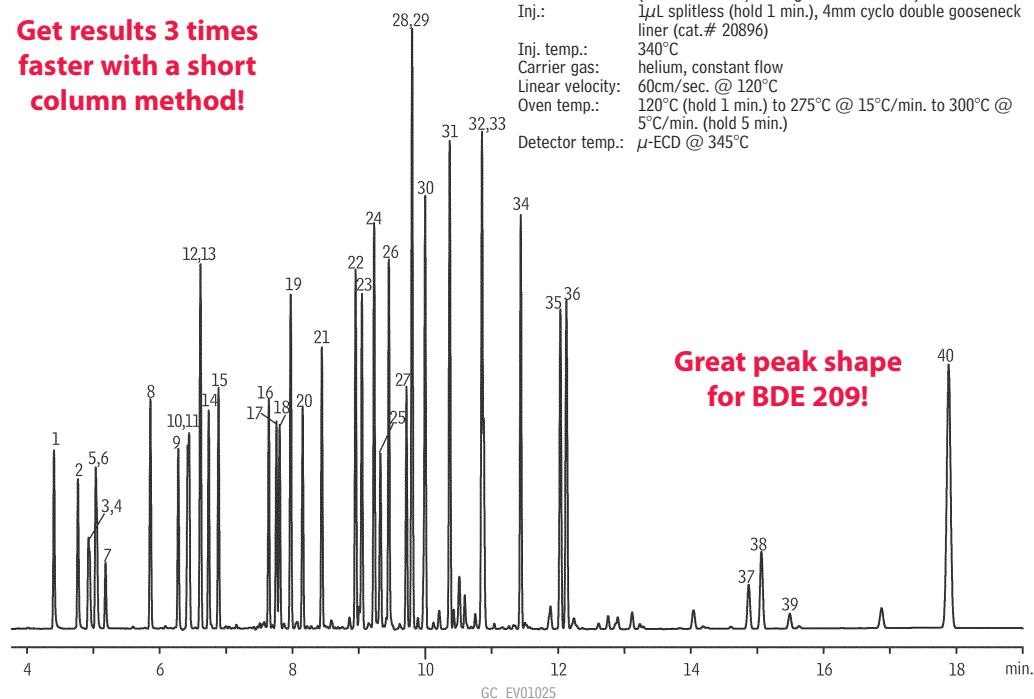
**European indicator  
PCB congeners  
resolved from  
other congeners  
when using GC/MS.**

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

Get results 3 times  
faster with a short  
column method!

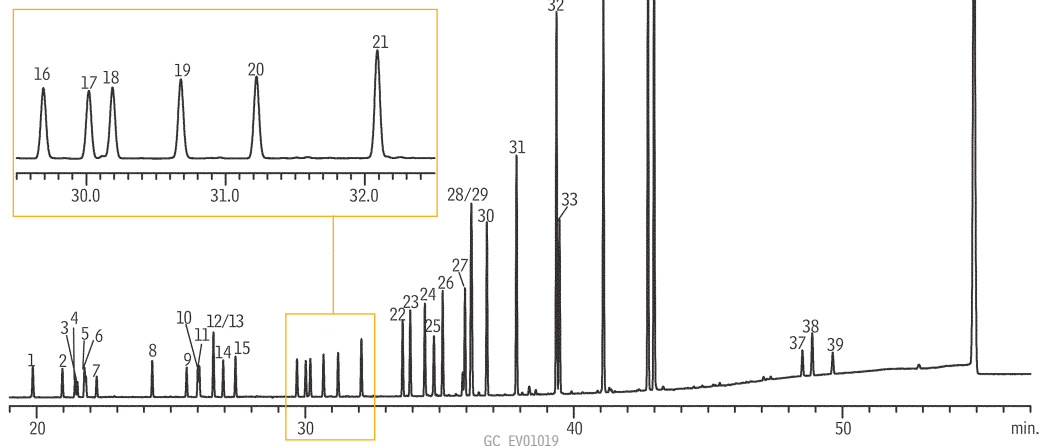


1. BDE-10
2. BDE-7
3. BDE-8
4. BDE-11
5. BDE-12
6. BDE-13
7. BDE-15
8. BDE-30
9. BDE-32
10. BDE-17
11. BDE-25
12. BDE-28
13. BDE-33
14. BDE-35
15. BDE-37
16. BDE-75
17. BDE-49
18. BDE-71
19. BDE-47
20. BDE-66
21. BDE-77
22. BDE-100
23. BDE-119
24. BDE-99
25. BDE-116
26. BDE-118
27. BDE-85
28. BDE-155
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, 0.10 $\mu$ m (cat.# 10295)  
Sample: 100-300ppb PBDE PAR Solution (cat.# EO-5113, Cambridge Isotope Laboratories Inc.), 500ppb decabromodiphenyl ether (cat.# BDE-209, Wellington Laboratories)  
Inj.: 1 $\mu$ L 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.:  $\mu$ -ECD @ 340°C

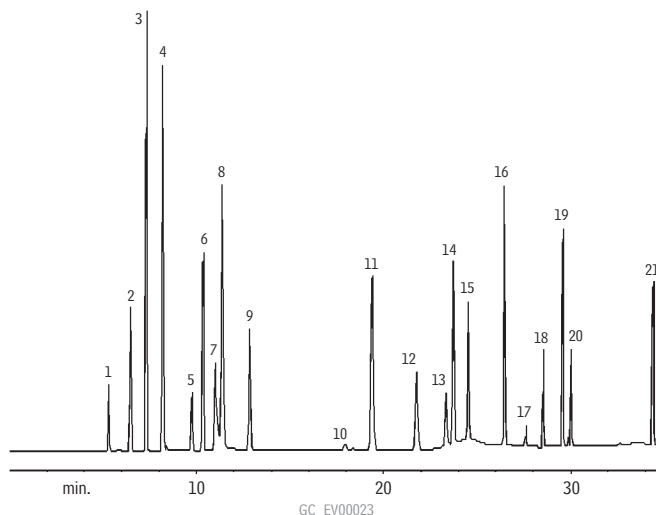


1. BDE-10
2. BDE-7
3. BDE-8
4. BDE-11
5. BDE-12
6. BDE-13
7. BDE-15
8. BDE-30
9. BDE-32
10. BDE-17
11. BDE-25
12. BDE-28
13. BDE-33
14. BDE-35
15. BDE-37
16. BDE-75
17. BDE-49
18. BDE-71
19. BDE-47
20. BDE-66
21. BDE-77
22. BDE-100
23. BDE-119
24. BDE-99
25. BDE-116
26. BDE-118
27. BDE-85
28. BDE-155
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



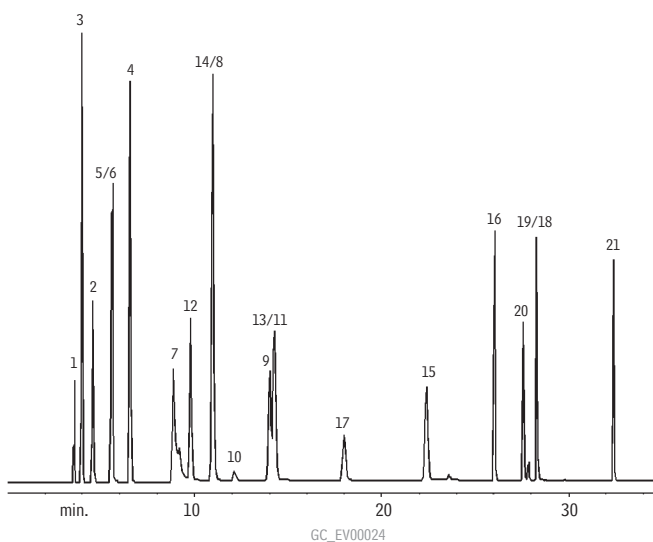
Column: Rtx®-5, 30m, 0.25mm ID, 1.0µm (cat.# 10253)  
Inj.: 1.0µL split injection, 1ng on-column concentration  
Oven temp.: 35°C (hold 22 min.) to 200°C @ 10°C/min.  
Inj./det. temp.: 200°C/290°C  
Carrier gas: helium  
Linear velocity: 30cm/sec. @ 50°C  
ECD sensitivity: 20kHz full scale  
Split ratio: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



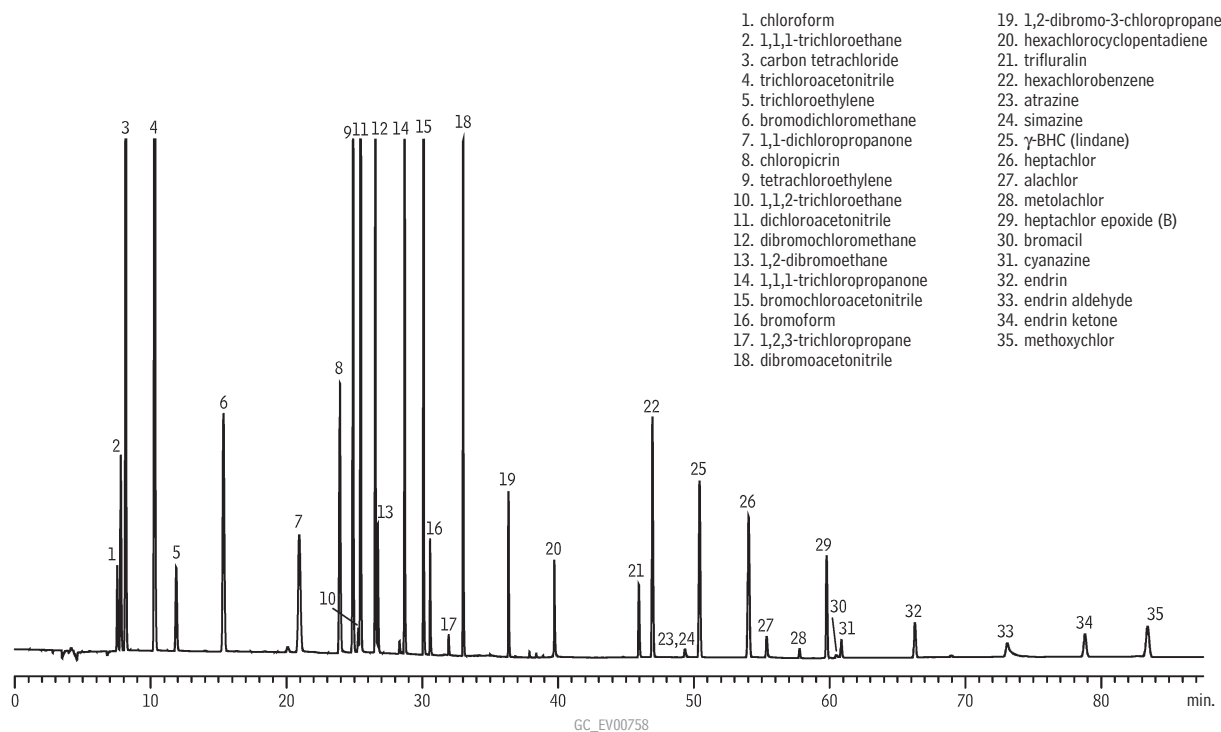
Column: Rtx®-200, 30m, 0.25mm ID, 1.0µm (cat.# 15053)  
Inj.: 1.0µL split injection, 1ng on-column concentration  
Oven temp.: 35°C (hold 22 min.) to 200°C @ 10°C/min.  
Inj./det. temp.: 200°C/290°C  
Carrier gas: helium  
Linear velocity: 30cm/sec. @ 50°C  
ECD sensitivity: 20kHz full scale  
Split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

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, Chlorinated Solvents, and Halogenated Pesticides

US EPA Method 551.1

Rtx®-1301



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

## Restek Customer Service

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Fax: 814-353-1309—24-hours a day

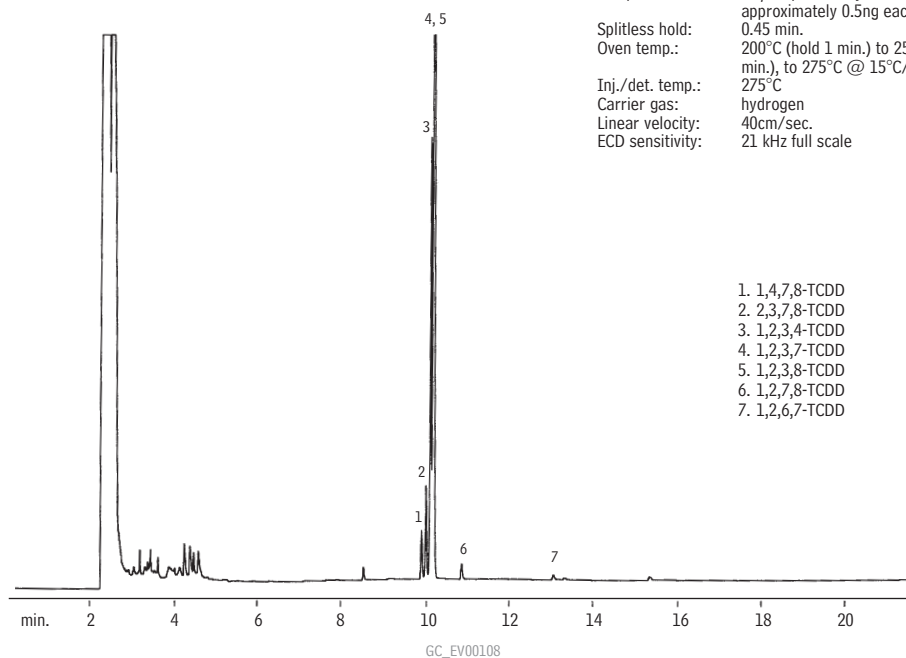
Online: [www.restek.com](http://www.restek.com)—24-hours a day

### Outside the U.S.

Contact your Restek representative:  
 Refer to our list on pages 4-5 or visit our website at [www.restek.com](http://www.restek.com)



Mike Shuey, Customer Service

TCDD Isomers  
Rt®-2330

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

## Get More!

Environmental  
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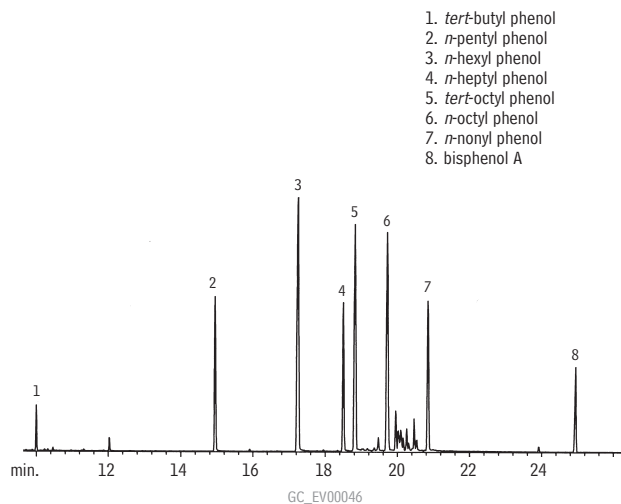
11/12

[www.restek.com](http://www.restek.com) 591



## Endocrine Disruptors: Alkyl Phenols

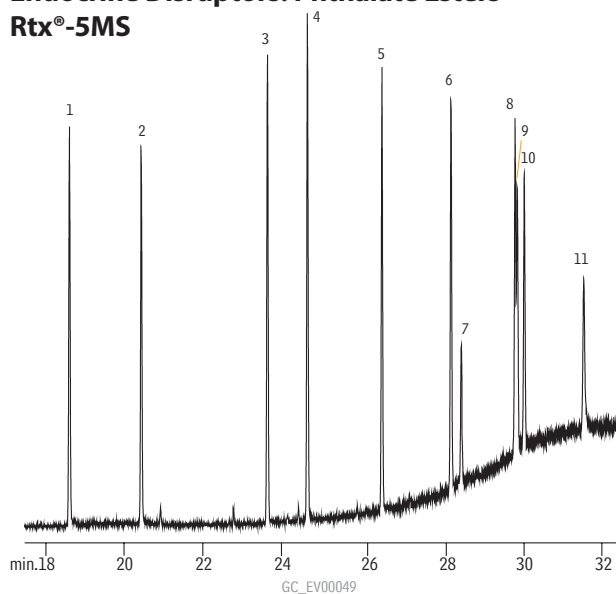
Rtx®-5MS



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

## Endocrine Disruptors: Phthalate Esters

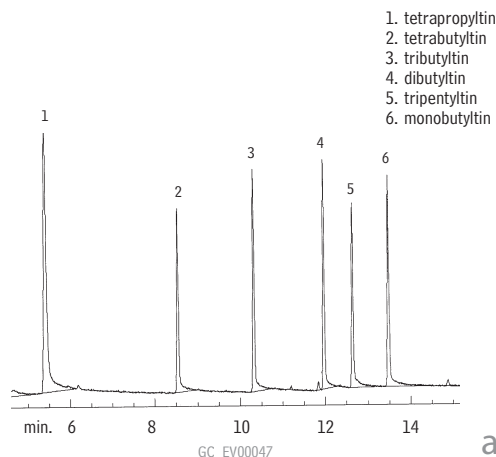
Rtx®-5MS



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

Endocrine Disruptors:  
Butyl Tins (hexyl derivatives)

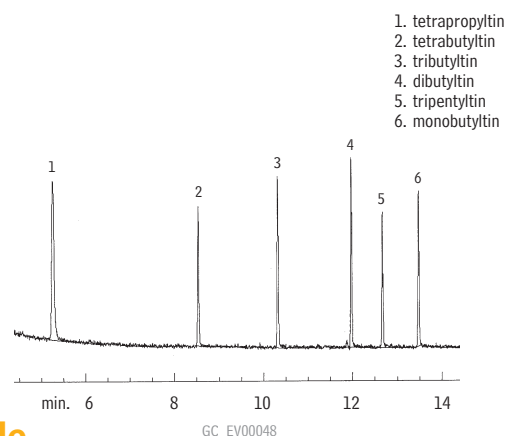
Rtx®-5



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

Endocrine Disruptors:  
Butyl Tins (hexyl derivatives)

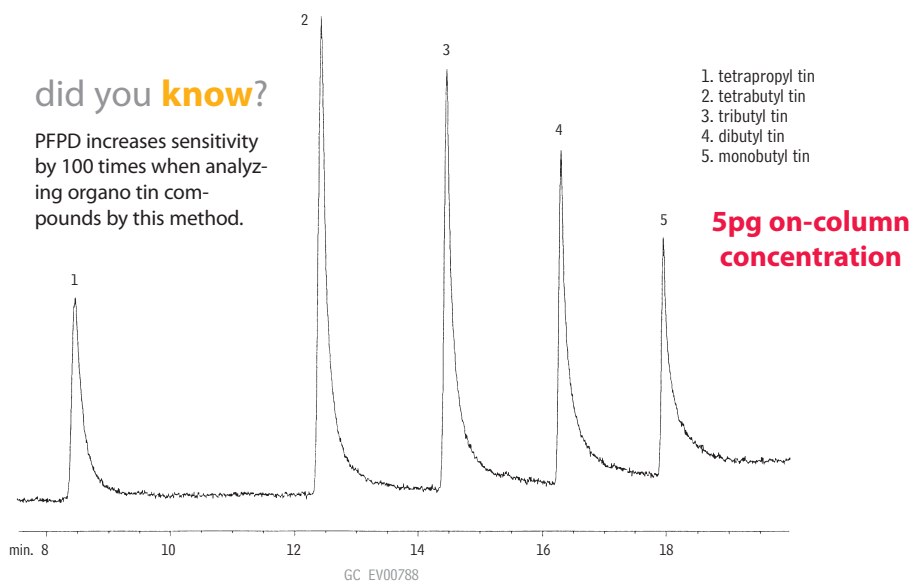
Rtx®-35



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

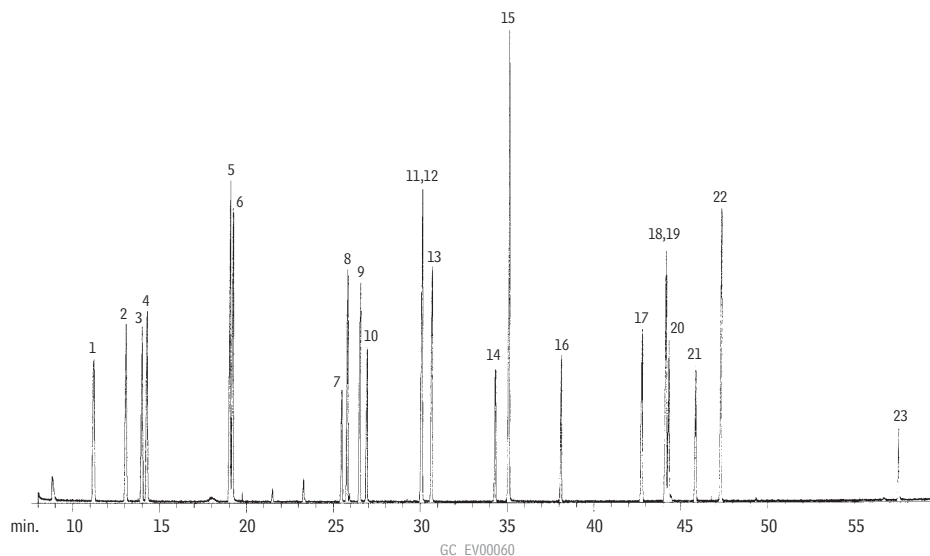
also available

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

Organo Tins  
Rtx®-35

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

\*Peak tailing is a function of this detector.

Explosives  
Rtx®-200

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

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

## Explosives

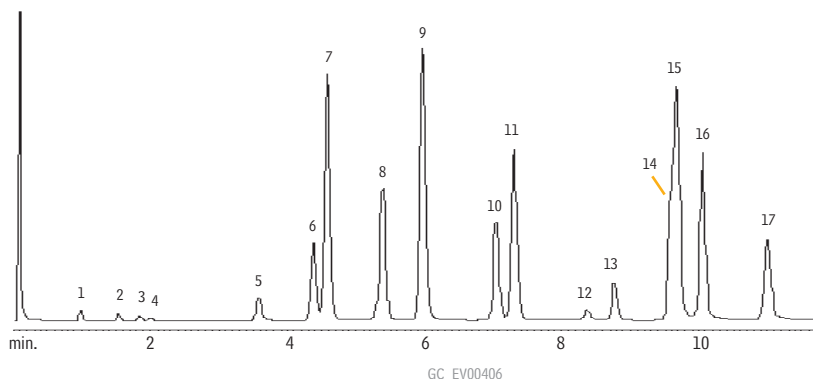
## US EPA Method 8095

## Rtx®-TNT &amp; Rtx®-TNT2

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innovation!

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

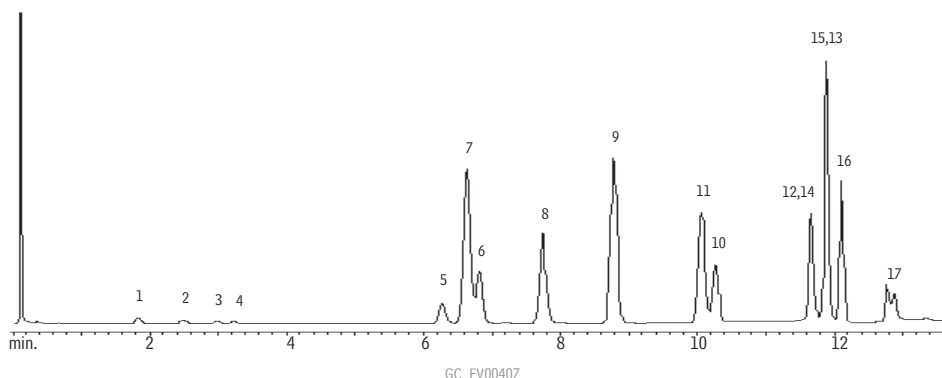
## Rtx®-TNT



Column: Rtx®-TNT, 6m, 0.53mm ID, 1.50 $\mu$ m (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

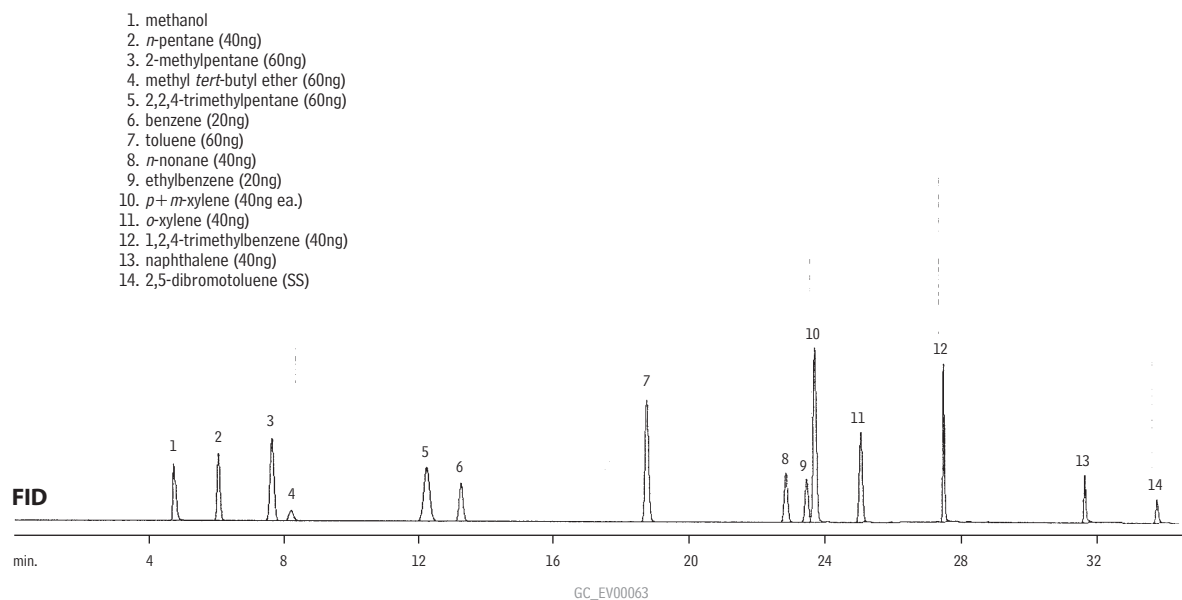
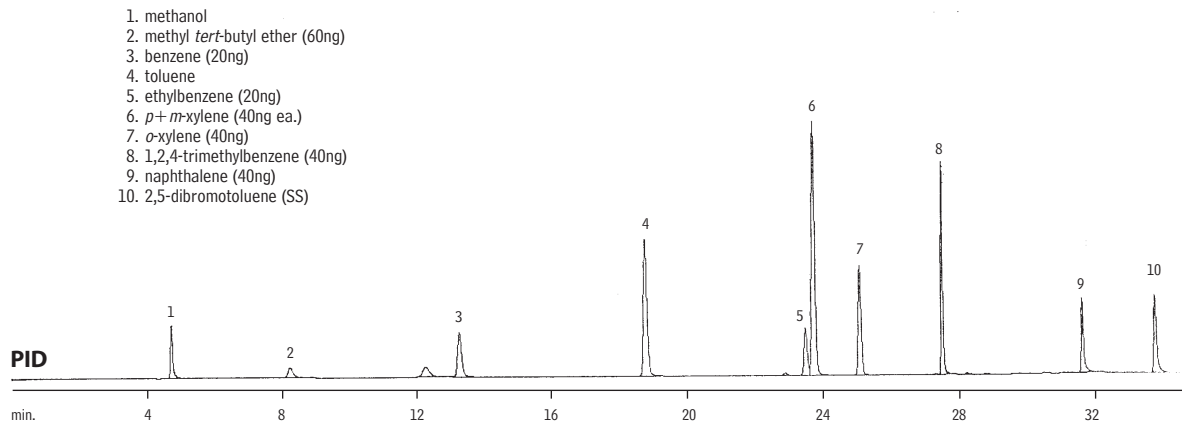
## Rtx®-TNT2



Column: Rtx®-TNT2, 6m, 0.53mm ID, 1.50 $\mu$ m (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.**



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°C @ 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.

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Applications Note  
lit. cat.# 59150

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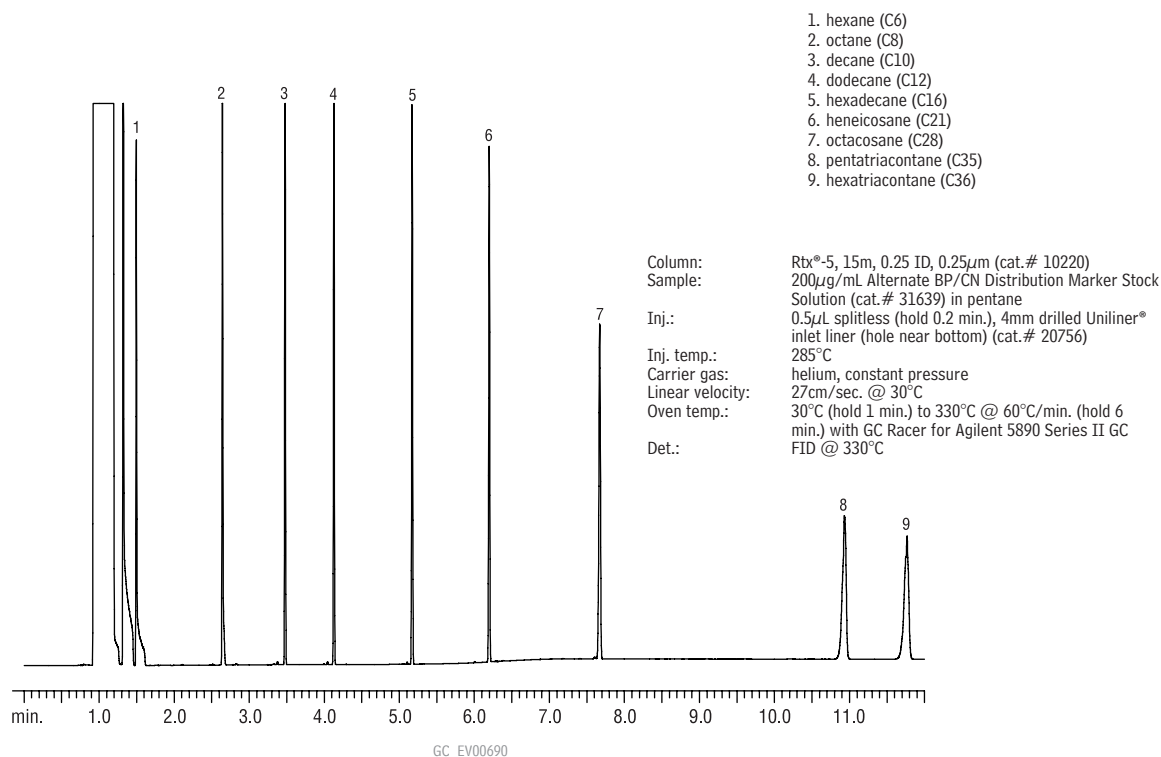
11/12

[www.restek.com](http://www.restek.com)

**595**

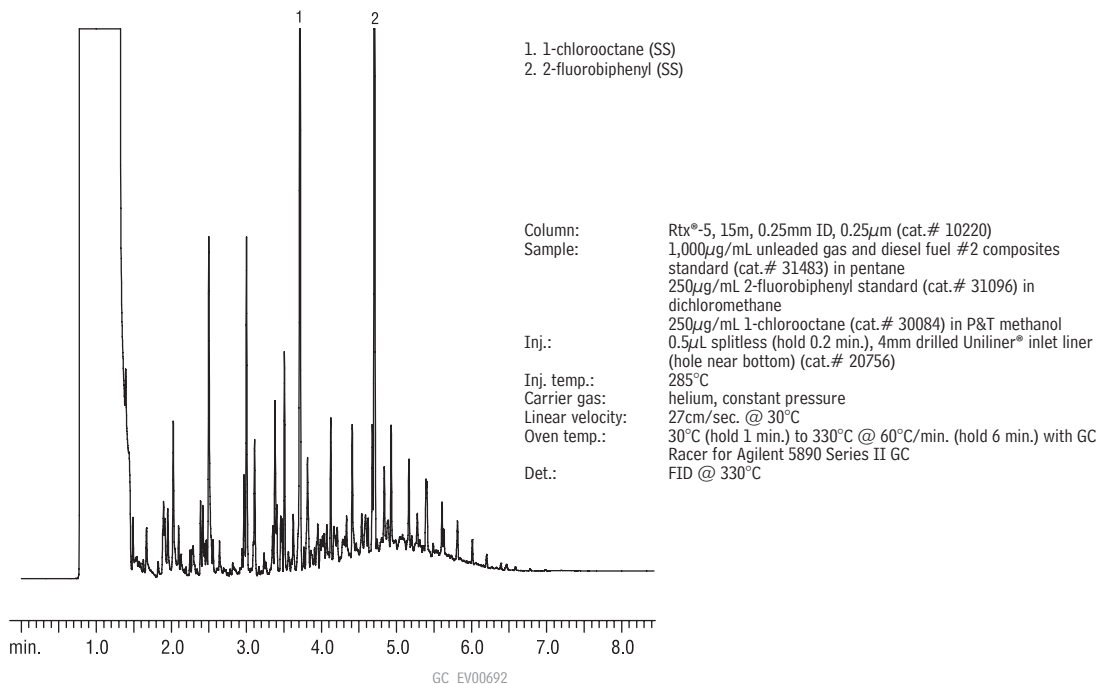
**Texas UST: Alternate Boiling Point/Carbon Number Distribution Marker**

**Rtx®-5**



**Texas UST: diesel/gas composites**

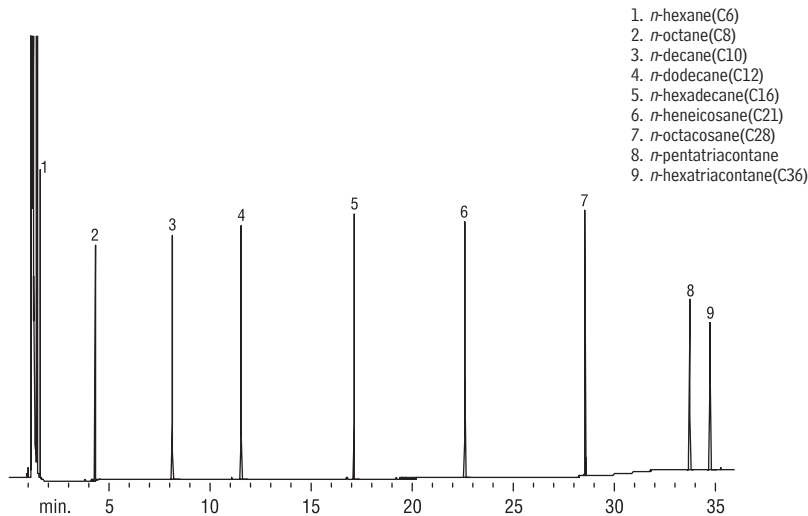
**Rtx®-5**





## Texas UST: Alternate Boiling Point/Carbon Number Distribution Marker

Rtx®-5

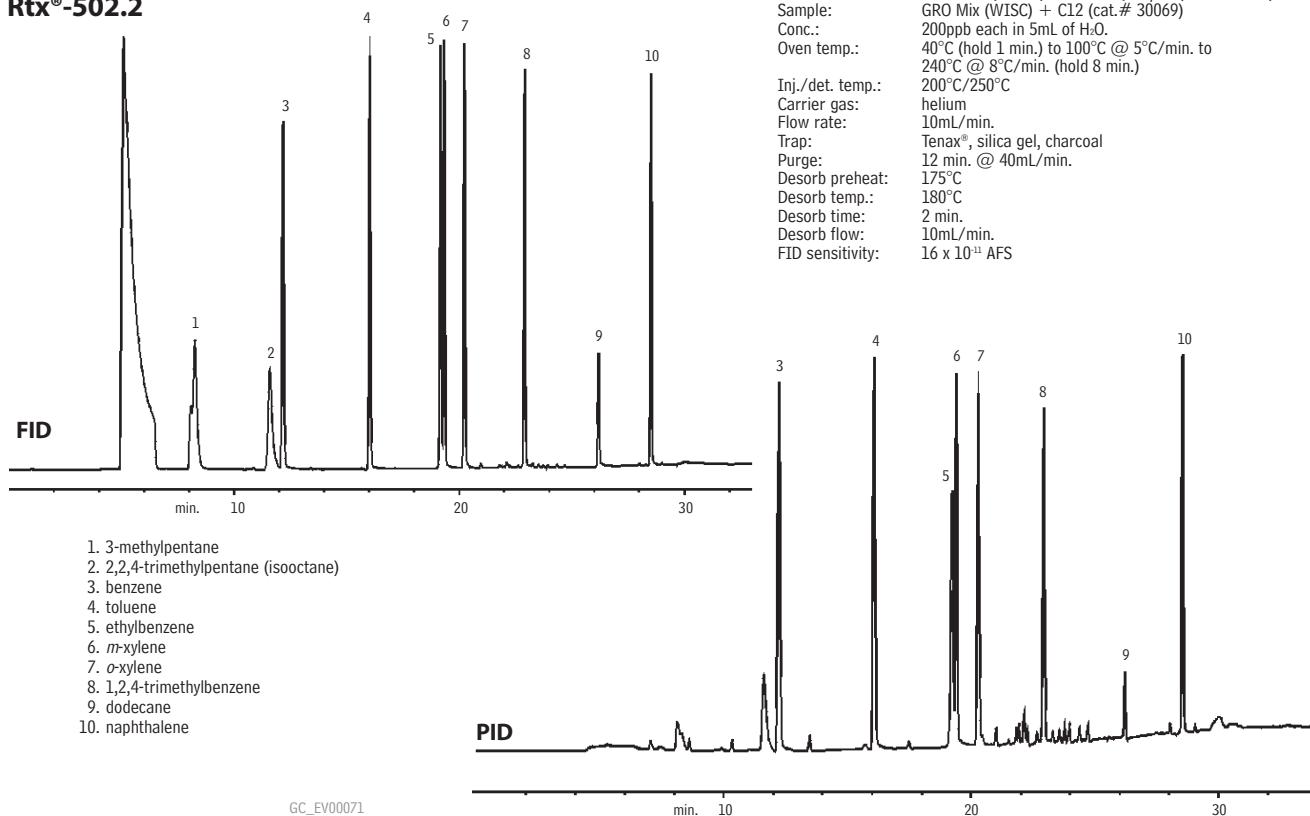


Column: Rtx®-5, 30m, 0.25mm ID, 0.50µm (cat.# 10238)  
Sample: 1µL Alternate Boiling Point/Carbon Number Distribution Marker Stock Solution (cat.# 31639), 200µg/mL each component in pentane  
Carrier gas: hydrogen @ 40cm/sec.  
Oven temp.: 40°C (hold 2 min.) to 330°C @ 10°C/min. (hold 5 min.)  
Inj.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

## Wisconsin GRO Mix, plus C12

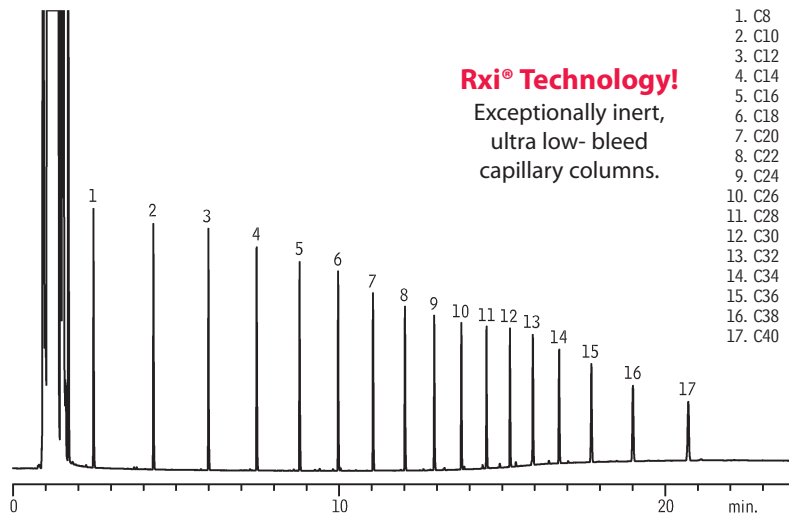
Rtx®-502.2

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<sub>2</sub>O.  
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<sup>-11</sup> AFS



Petroleum Hydrocarbons (TPH)

Rxi®-1ms



**Rxi® Technology!**

Exceptionally inert,  
ultra low- bleed  
capillary columns.

1. C8
2. C10
3. C12
4. C14
5. C16
6. C18
7. C20
8. C22
9. C24
10. C26
11. C28
12. C30
13. C32
14. C34
15. C36
16. C38
17. C40

GC\_EV00886

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

\*GC courtesy of Shimadzu Scientific.

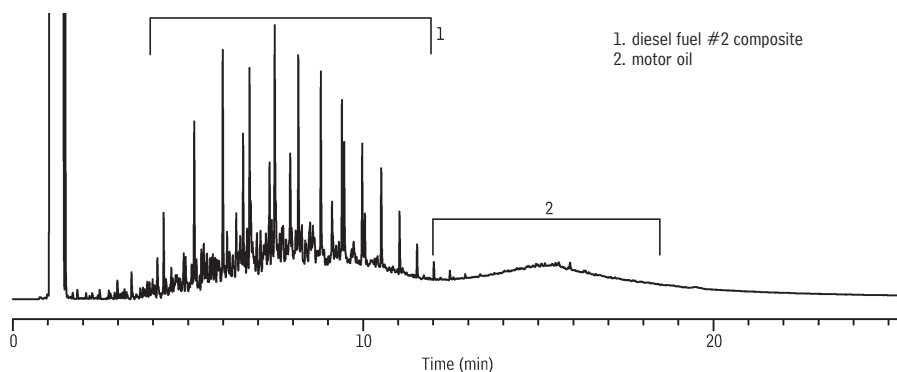
Lubrication Range Organics

Diesel Fuel #2/Motor Oil

Rxi®-1ms

**Rxi® Technology!**

Exceptionally inert,  
ultra low- bleed  
capillary columns.



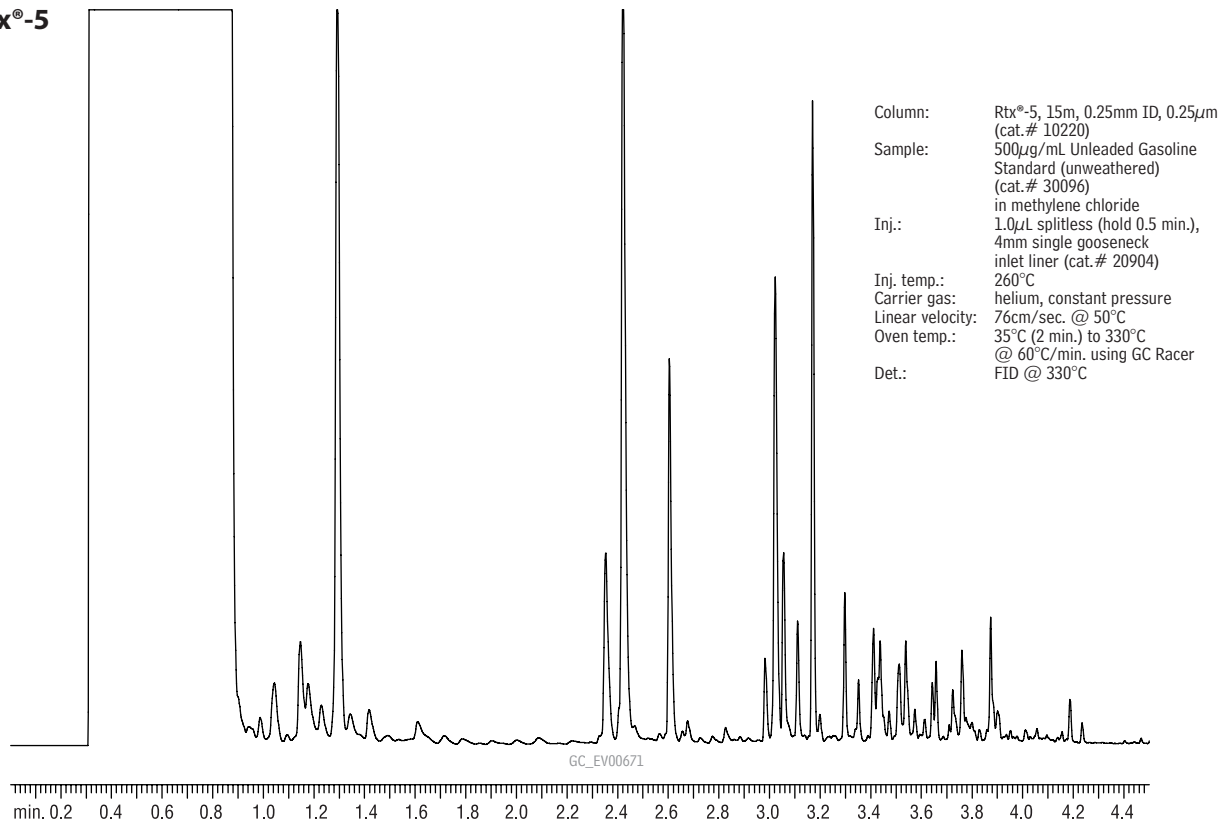
1. diesel fuel #2 composite
2. motor oil

Time (min)  
GC\_EV00887

Column: Rxi®-1ms, 20m, 0.18mm ID, 0.18 $\mu$ m (cat.# 13302)  
Sample: Diesel #2/Motor Oil (cat.# 31682) 5,000 $\mu$ g/mL each component in hexane  
Inj.: 0.5 $\mu$ L, split, split ratio 20:1, 3.5mm Precision® inlet liner (cat.# 21021)  
Instrument: Shimadzu GC-2010  
Inj. temp.: 275°C  
Carrier gas: hydrogen, constant pressure  
Linear velocity: 55cm/sec. @ 40°C  
Oven temp.: 40°C (hold 1 min.) to 330°C @ 20°C/min. (hold 10 min.)  
Det.: FID @ 350°C

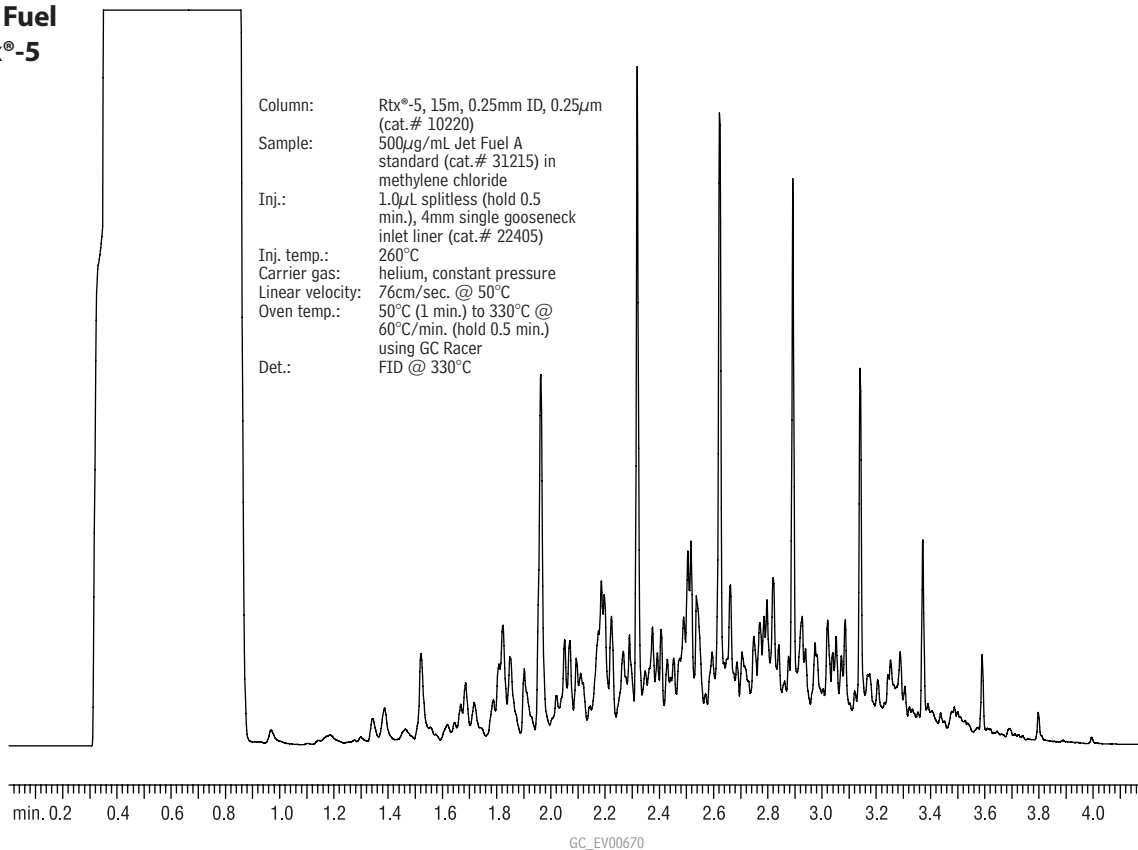
**Unleaded Gasoline**

**Rtx®-5**



**Jet Fuel**

**Rtx®-5**

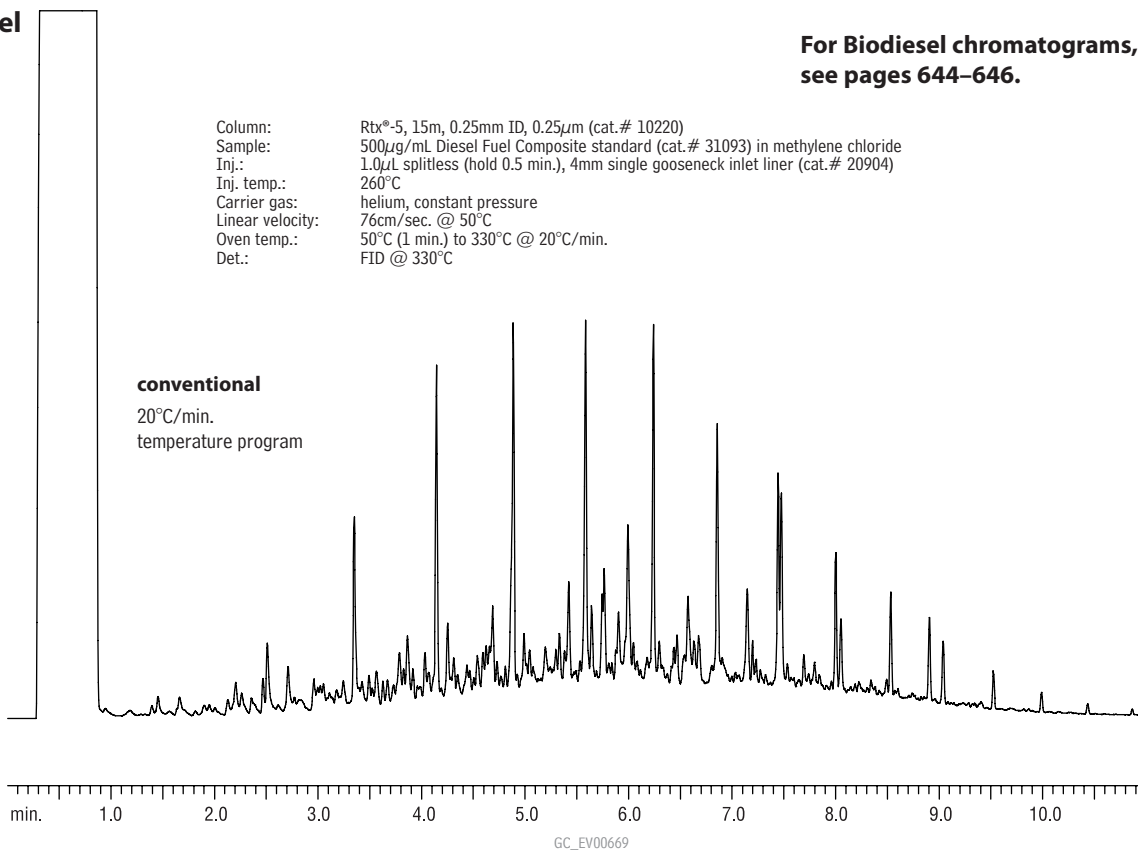


**Diesel Fuel  
Rtx®-5**

For Biodiesel chromatograms,  
see pages 644–646.

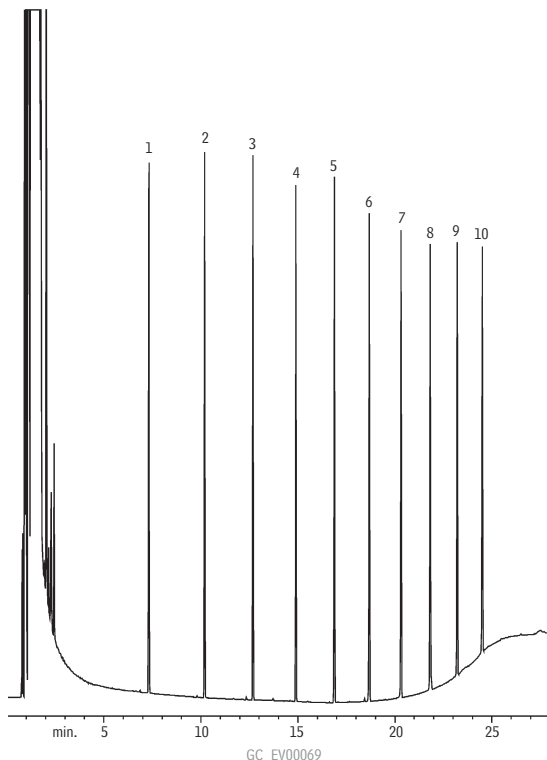
Column: Rtx®-5, 15m, 0.25mm ID, 0.25 $\mu$ m (cat.# 10220)  
Sample: 500 $\mu$ g/mL Diesel Fuel Composite standard (cat.# 31093) in methylene chloride  
Inj.: 1.0 $\mu$ L splitless (hold 0.5 min.), 4mm single gooseneck inlet liner (cat.# 20904)  
Inj. temp.: 260°C  
Carrier gas: helium, constant pressure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

**conventional**  
20°C/min.  
temperature program



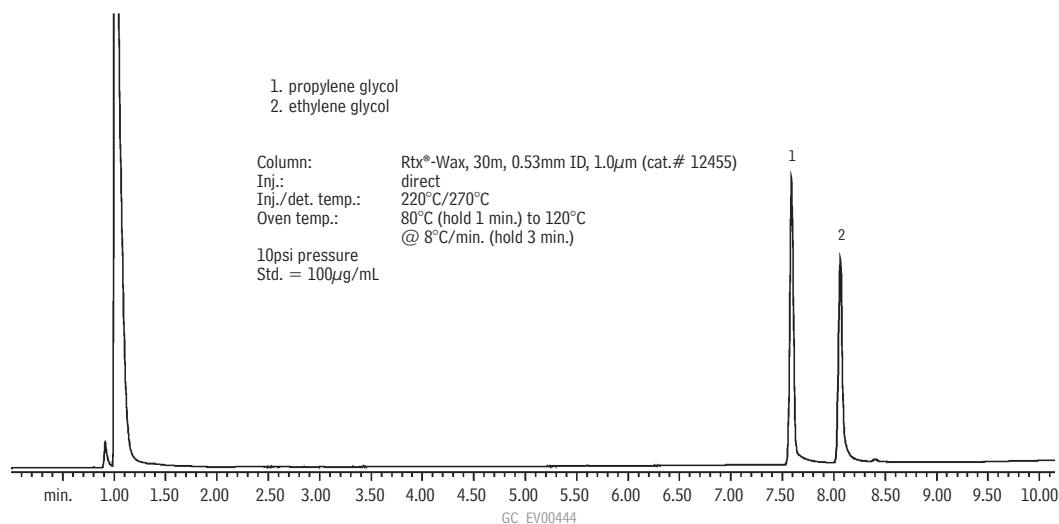
**DRO Mix  
Rtx®-5**

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

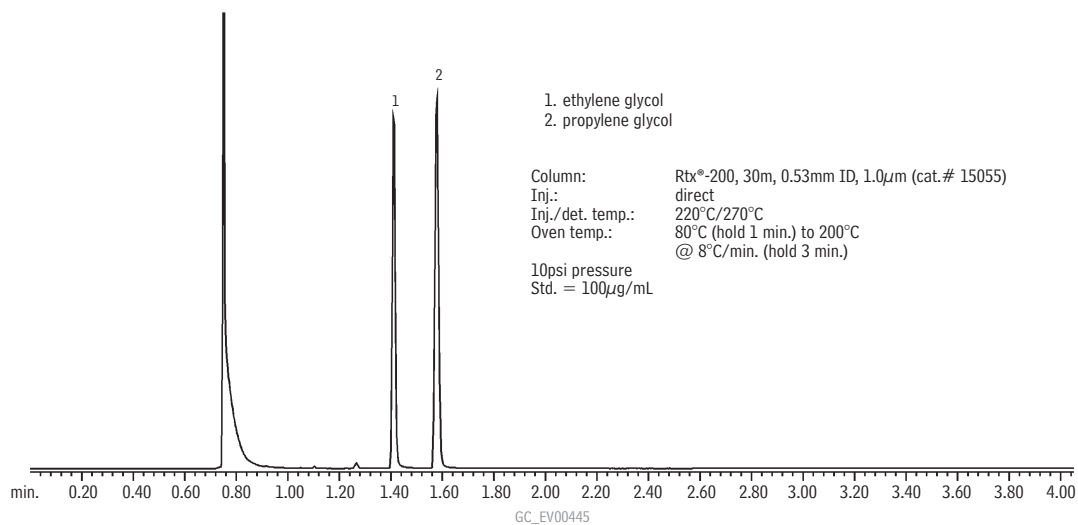


Column: Rtx®-5, 30m, 0.53mm ID, 1.0 $\mu$ m (cat.# 10255)  
Sample: Direct injection of DRO Mix (cat.# 31064)  
Conc.: 50ng/ $\mu$ L  
Oven temp.: 40°C (hold 2 min.) to 310°C  
@ 12°C/min. (hold 10 min.)  
Inj./det. temp.: 280°C/310°C  
Carrier gas: helium @ 65cm/sec.  
FID sensitivity: 8 x 10<sup>-11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

## Glycols Rtx®-Wax



## Glycols Rtx®-200



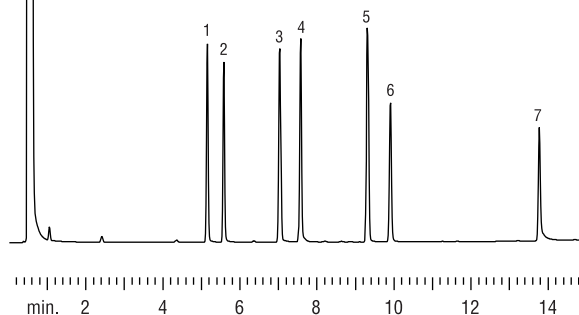


## Glycols

Glycols  
Stabilwax®

- 1,2-propylene glycol
- ethylene glycol
- 1,3-butylene glycol
- 1,3-propylene glycol
- 1,4-butylene glycol
- diethylene glycol
- glycerol

Column: Stabilwax®, 30m, 0.53mm ID, 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.

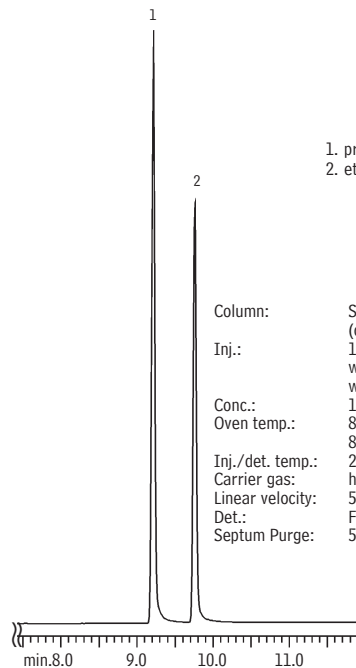


GC\_EV00476

Glycols  
Stabilwax®

- propylene glycol
- 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

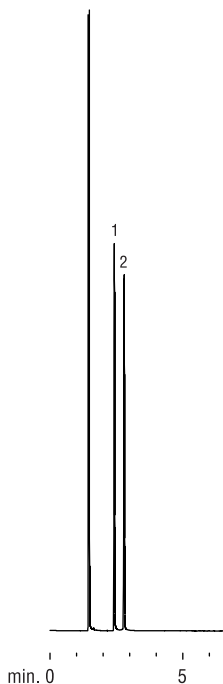
## Glycols

## Rtx®-BAC1 &amp; Rtx®-BAC2

## Rtx®-BAC1

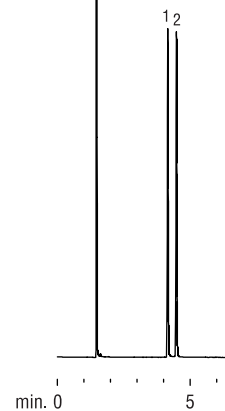
- ethylene glycol
- propylene glycol

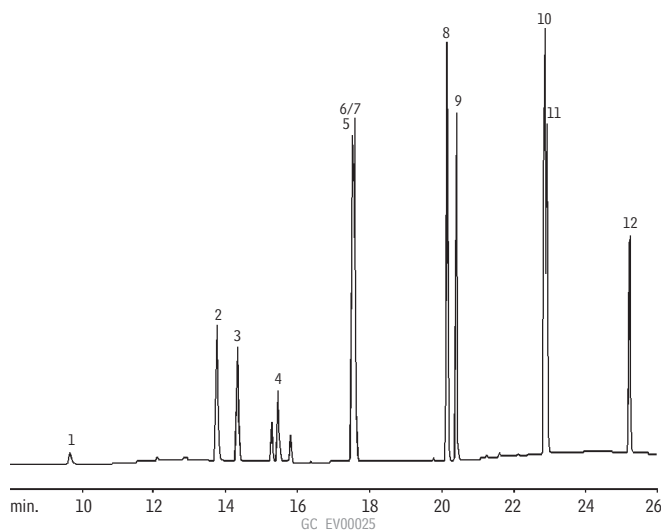
Columns: Rtx®-BAC1, 30m, 0.32mm ID, 1.8µm (cat.# 18003)  
 Rtx®-BAC2, 30m, 0.32mm ID, 1.2µm (cat.# 18002)  
 Inj.: 0.5µL split injection  
 Conc.: 1%  
 Solvent: methanol  
 Oven temp.: 100°C to 240°C @ 5°C/min. (hold 5 min.)  
 Inj. temp.: 240°C  
 Inj. mode: 100:1 split  
 Inlet liner: 4mm single gooseneck (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

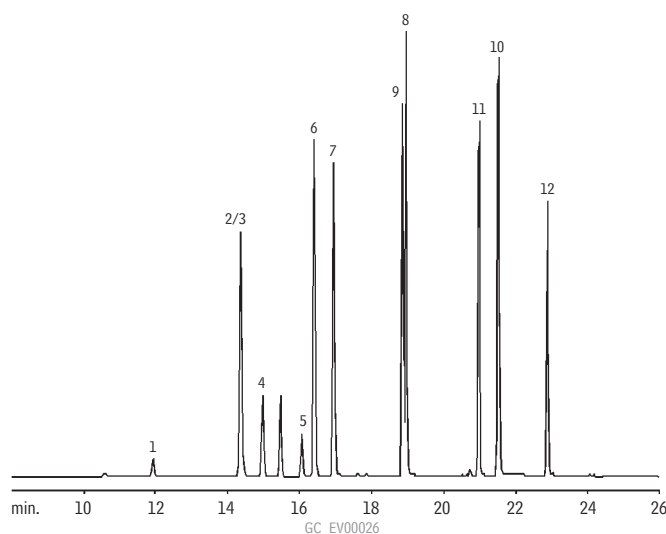
## Rtx®-BAC2



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)

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

(All compounds derivatized)

## Haloacetic Acids

## Haloacetic Acids &amp; Dalapon

## US EPA Method 552.2

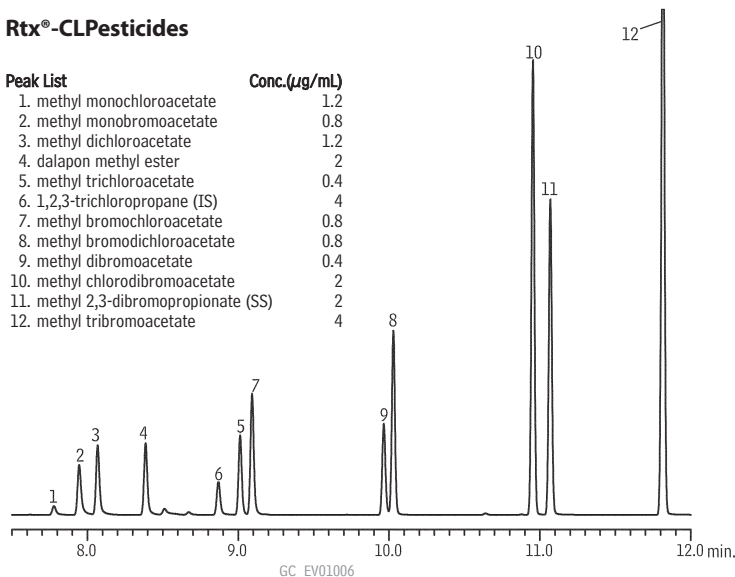
## Rtx®-CLPesticides &amp; Rtx®-CLPesticides2

## Rtx®-CLPesticides

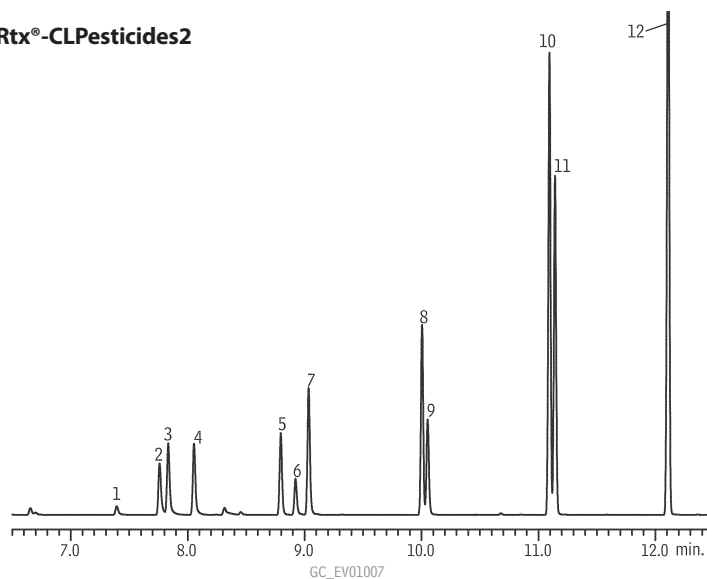
## Peak List

## 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.

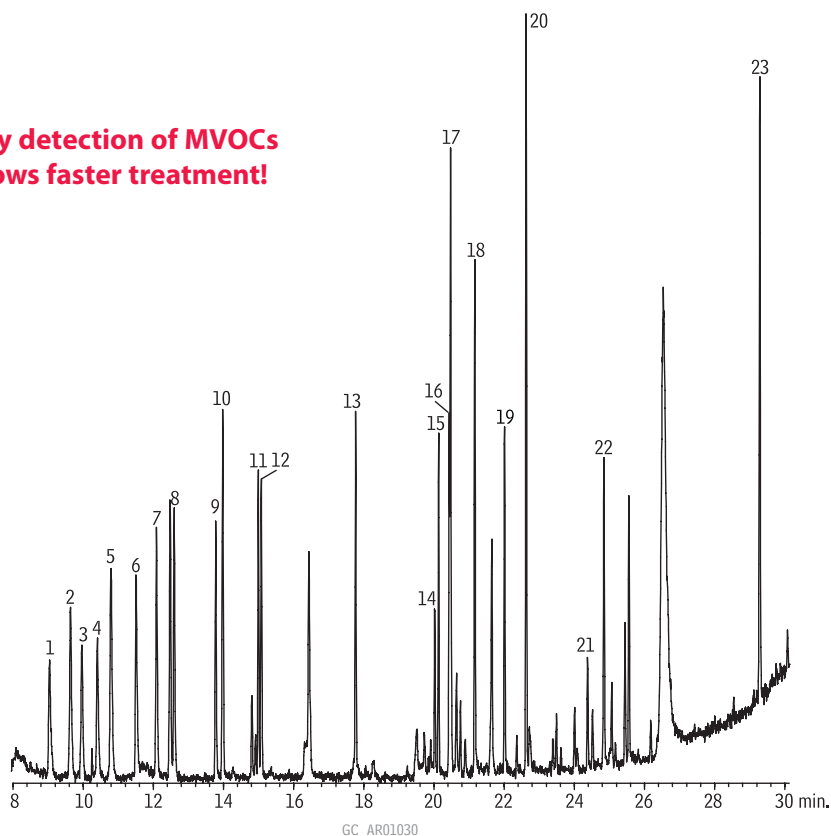
Detector temp.: µ-ECD @ 300°C

## Microbial Volatile Organic Compounds (MVOCs)

Rxi®-1ms



Early detection of MVOCs  
allows faster treatment!



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

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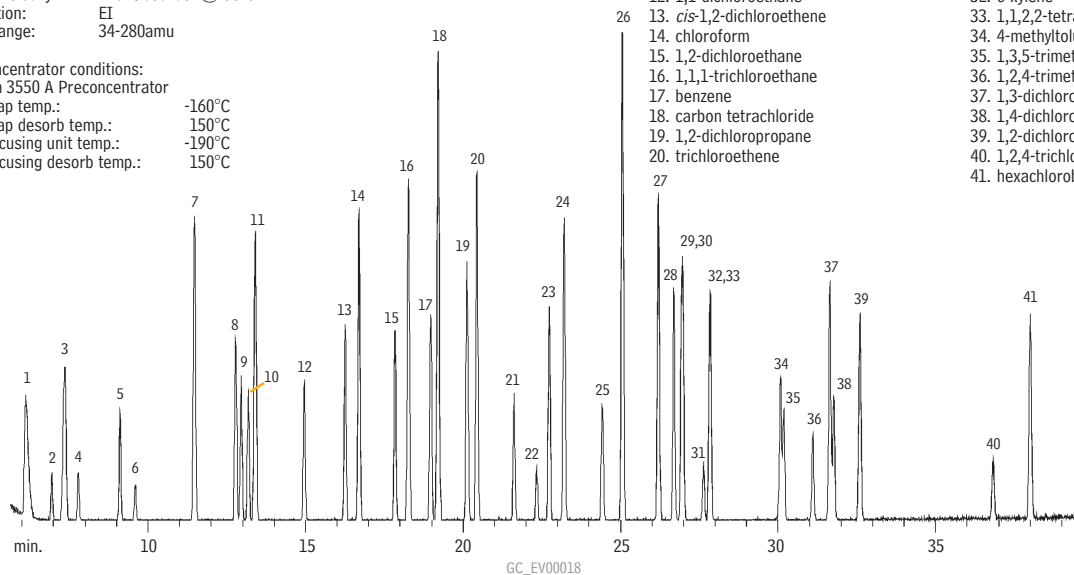
605

## 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



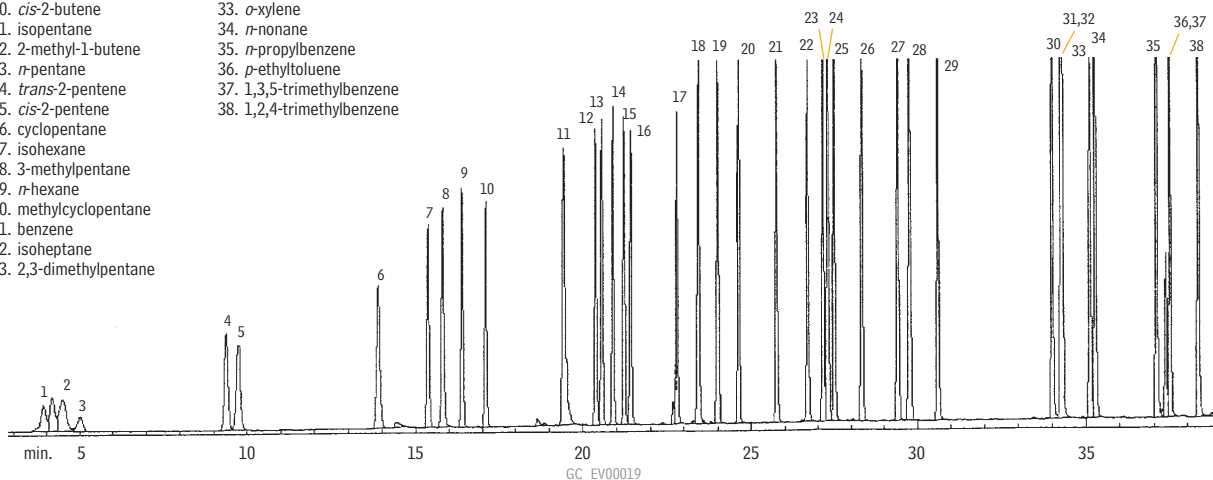
1. dichlorodifluoromethane
2. chloromethane
3. 1,2-dichlorotetrafluoroethane
4. vinyl chloride
5. bromomethane
6. chloroethane
7. trichlorofluoromethane
8. 1,1-dichloroethene
9. methylene chloride
10. 3-chloropropene
11. 1,1,2-trichloro-1,2,2-trifluoroethane
12. 1,1-dichloroethane
13. *cis*-1,2-dichloroethene
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

## 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<sup>12</sup> AFS

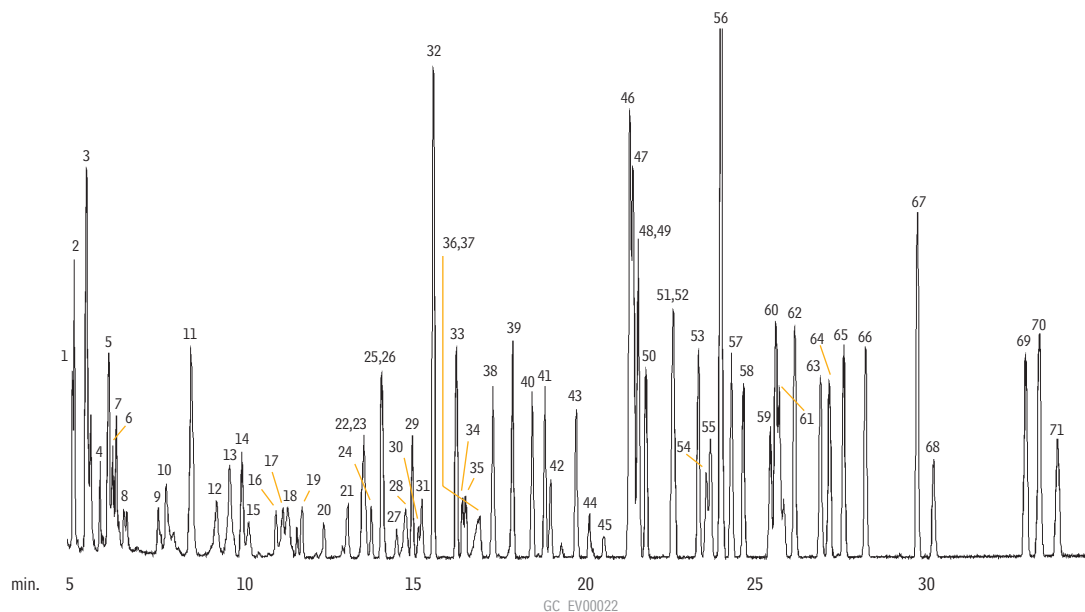
1. ethylene
2. acetylene
3. ethane
4. propylene
5. propane
6. isobutane
7. 1-butene
8. *n*-butane
9. *trans*-2-butene
10. *cis*-2-butene
11. isopentane
12. 2-methyl-1-butene
13. *n*-pentane
14. *trans*-2-pentene
15. *cis*-2-pentene
16. cyclopentane
17. isohexane
18. 3-methylpentane
19. *n*-hexane
20. 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



Permission to publish this chromatogram granted by Radian Corporation.



# Air Toxins Rtx®-502.2



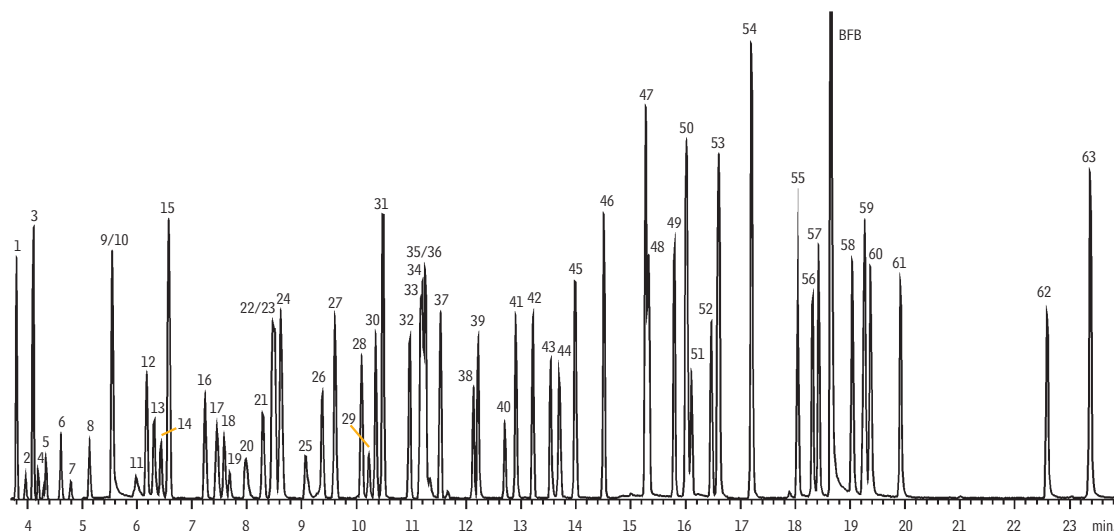
- |                              |                                      |                           |                               |
|------------------------------|--------------------------------------|---------------------------|-------------------------------|
| 1. chlorodifluoromethane     | 19.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

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

Permission to publish this chromatogram granted by Tekmar Company.

## US EPA TO-14/TO-15 Compounds

Rtx®-1



GC\_EV00379

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

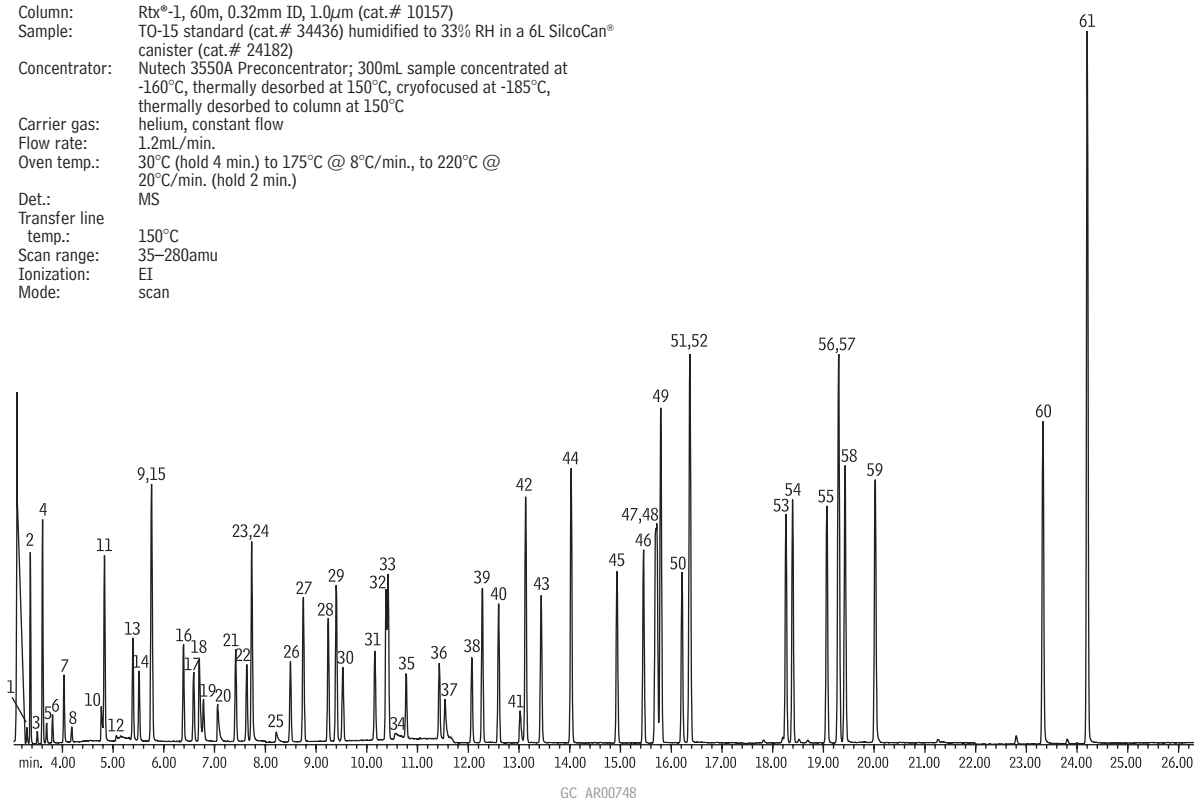
Chromatogram courtesy of Gina Maio, Severn Trent Laboratories, Inc., Burlington, VT.

## US EPA TO-15 Compounds

Rtx®-1



Column: Rtx®-1, 60m, 0.32mm ID, 1.0µm (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



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

## Chromatogram Search Tool

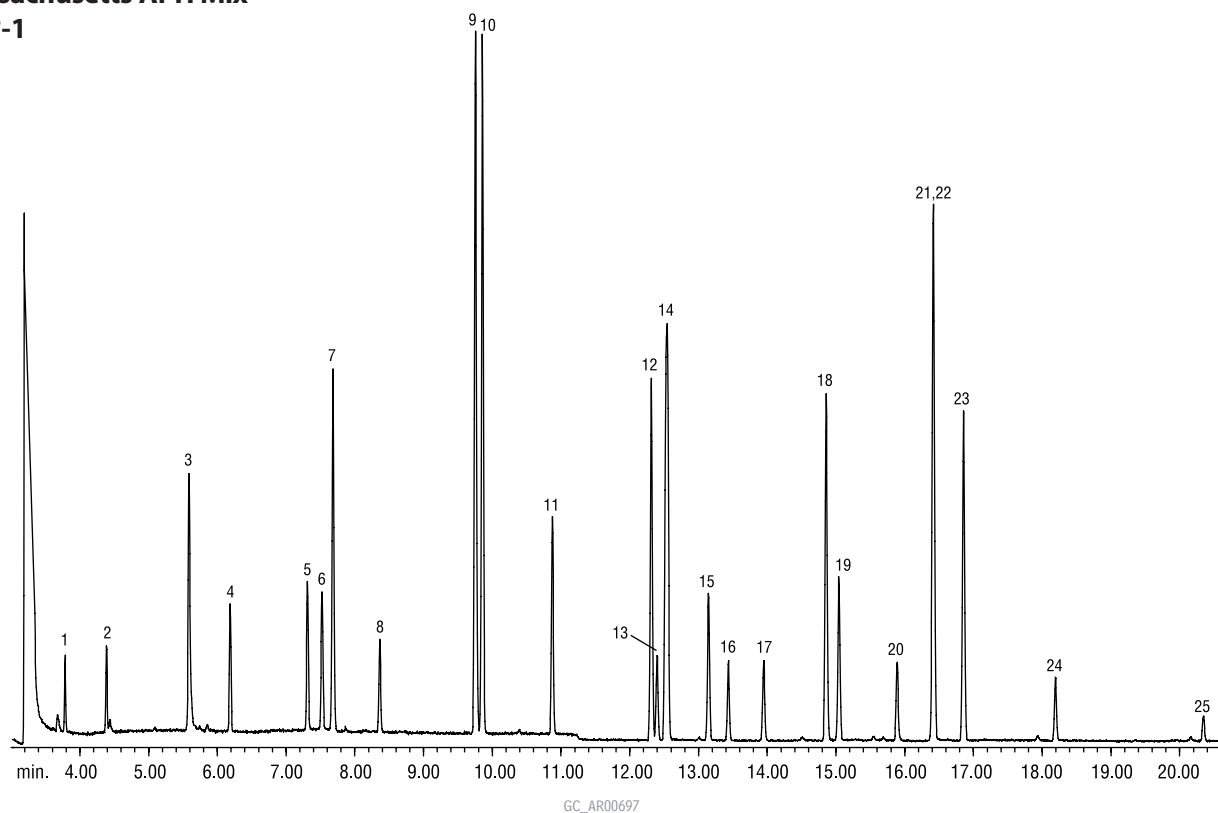
Search by compound name, synonym,  
 CAS # or keyword

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## Massachusetts APH Mix

Rtx®-1



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



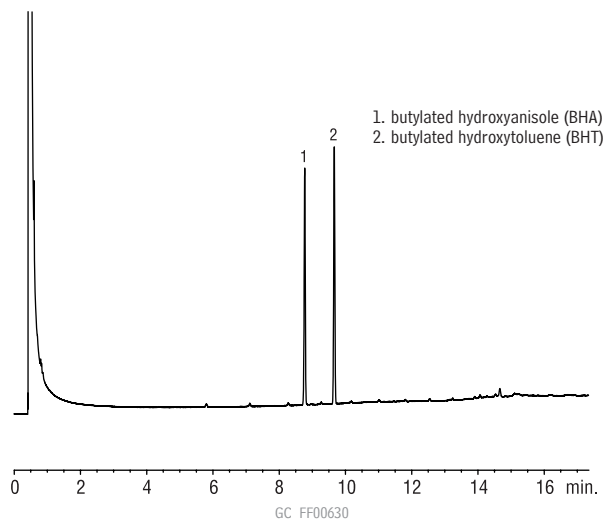
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## BHA and BHT

### 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

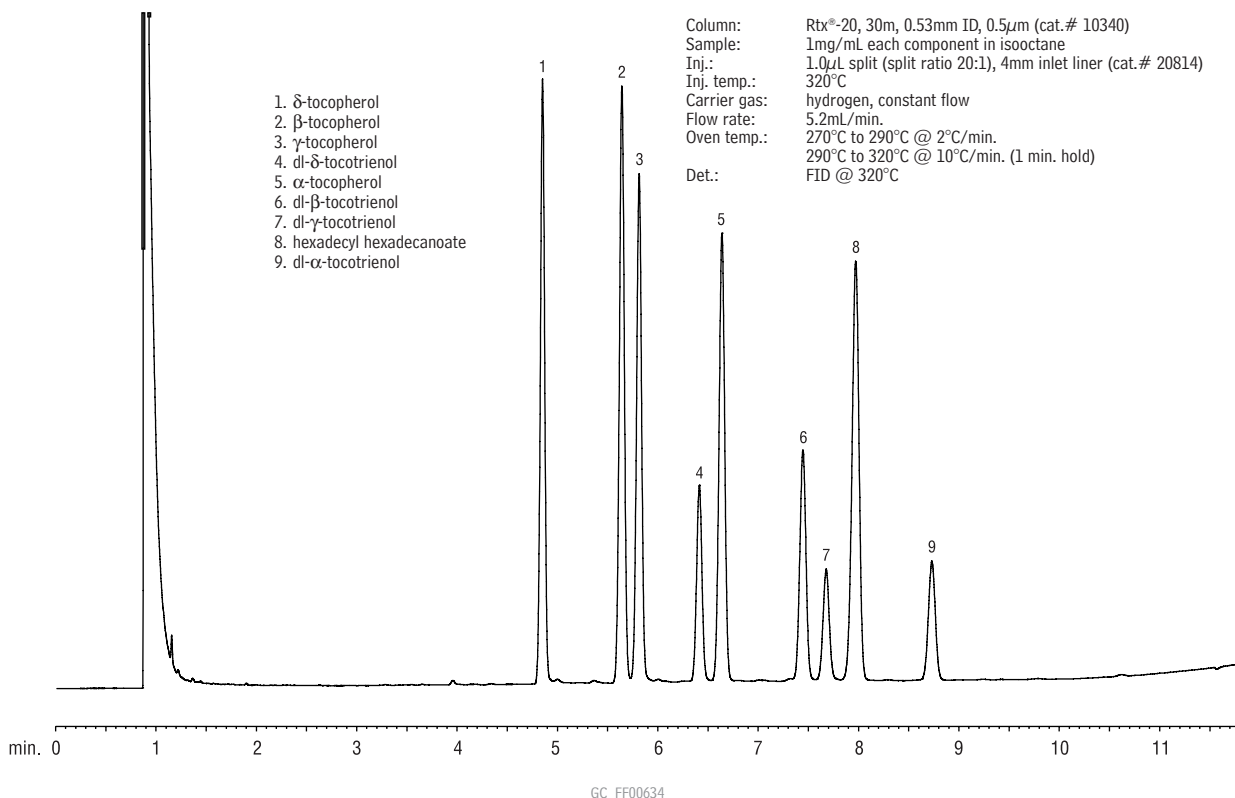
## Chromatogram Search Tool

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CAS # or keyword

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## Tocopherols and Tocotrienols

### Rtx®-20



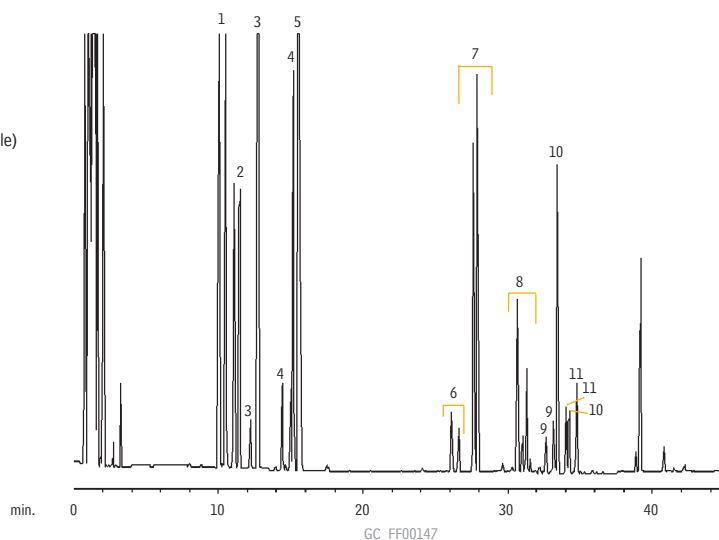


## Chiral Separations

## 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

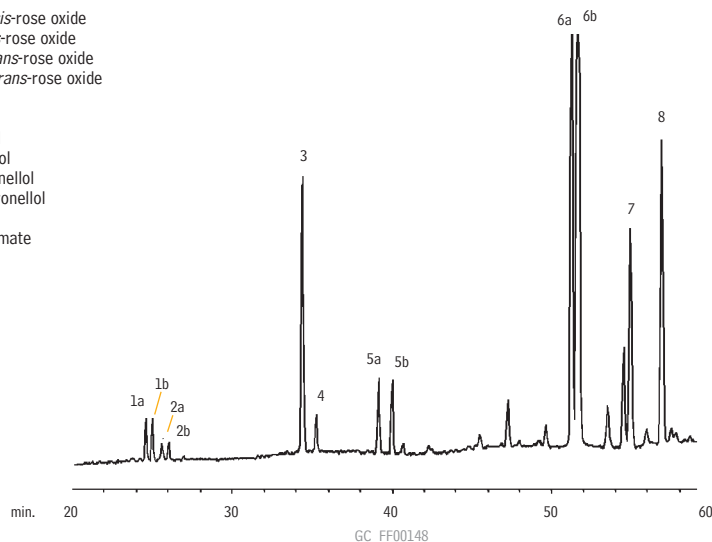


Column: Rt®-βDEXsm, 30m, 0.32mm ID, 0.25μm  
(cat. # 13104)  
Oven temp.: 40°C (hold 1 min.) to 200°C  
@ 2°C/min. (hold 3 min.)  
Carrier gas: hydrogen  
Linear velocity: 80cm/sec.  
Det.: FID @ 220°C

## Geranium Oil (Commercial)

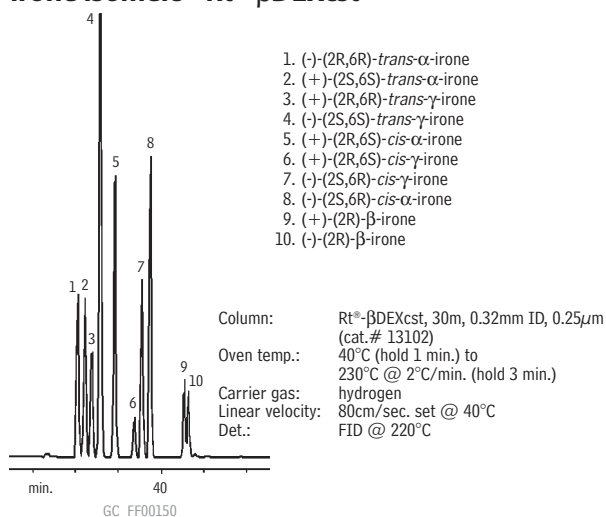
Rt®-βDEXsa

- 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

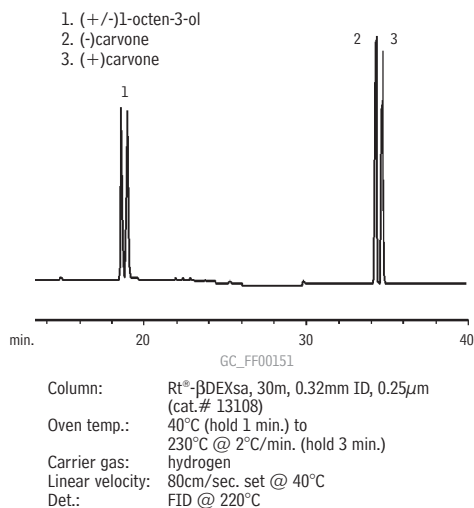


## ChromaBLOGraphy

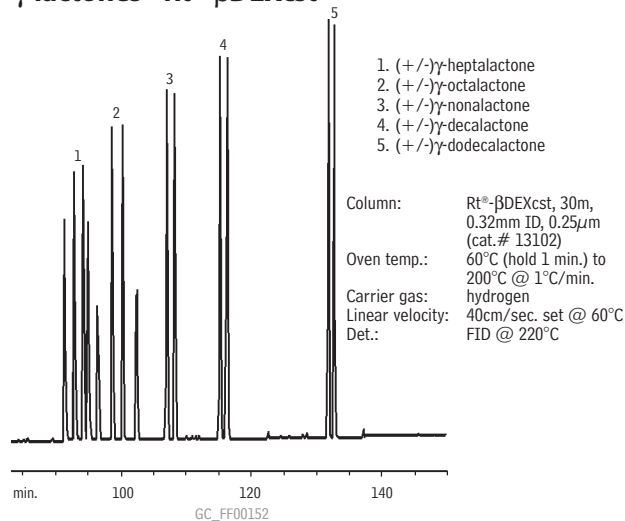
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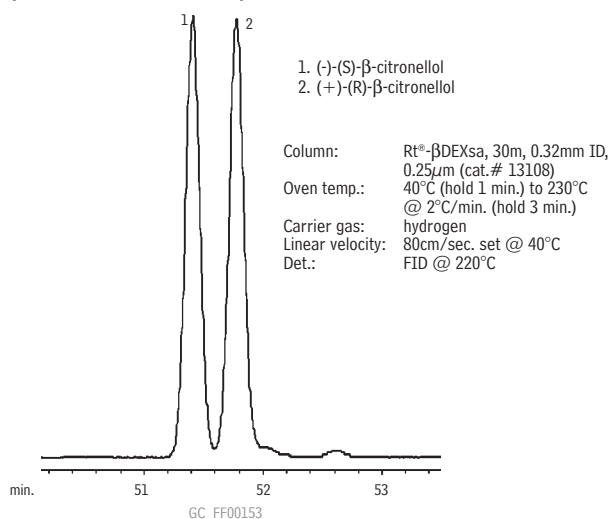
## 1-octen-3-ol and carvone - Rt®-βDEXsa



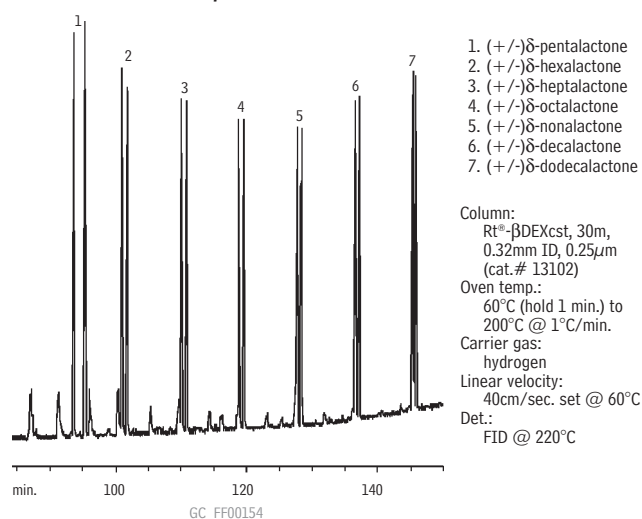
## γ-lactones - Rt®-βDEXcst



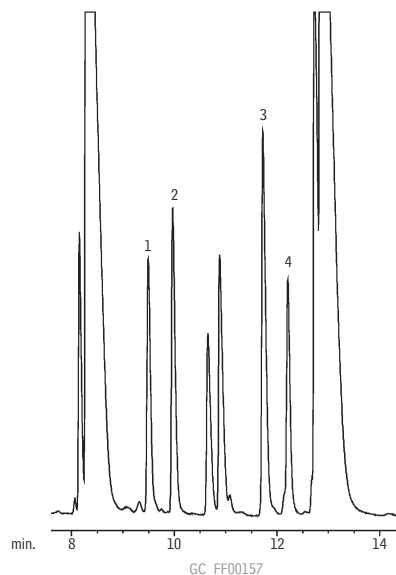
## β-citronellol - Rt®-βDEXsa



## δ-lactones - Rt®-βDEXcst



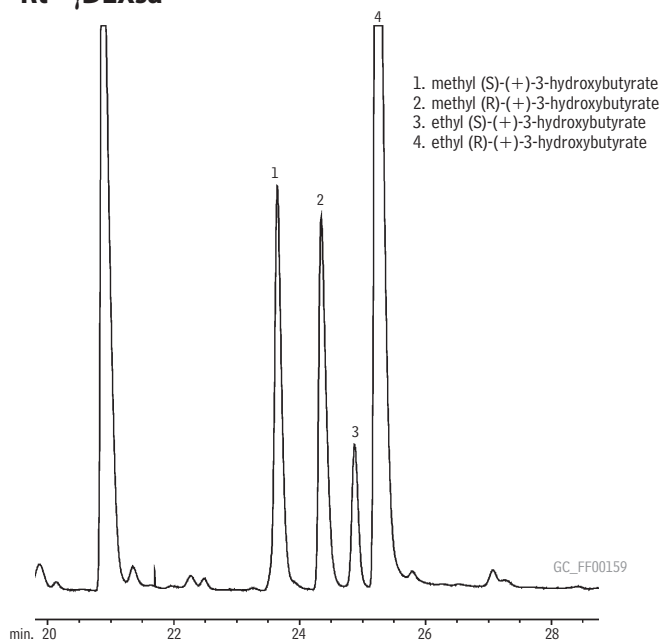
## Chiral Separations

Apple Juice with Standards  
Rt®-βDEXse

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

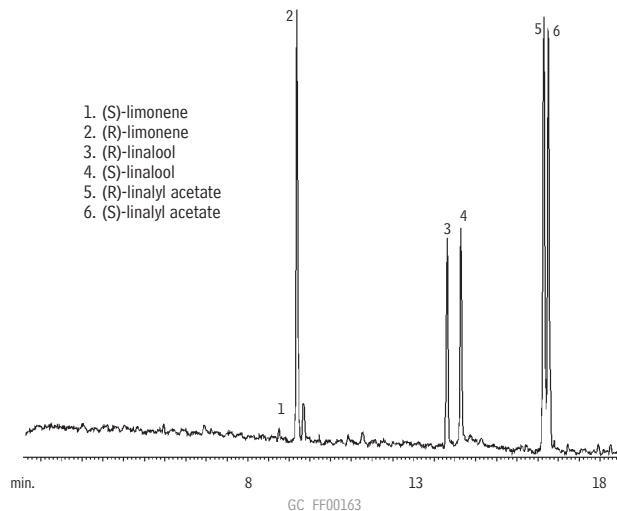
Apple Juice  
Rt®-βDEXse

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

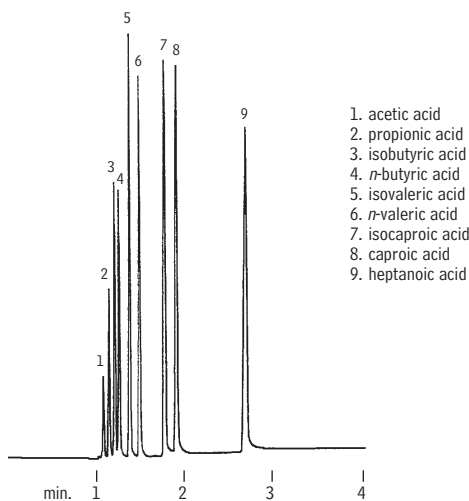
Bergamot Flavor  
Rt®-βDEXse

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)

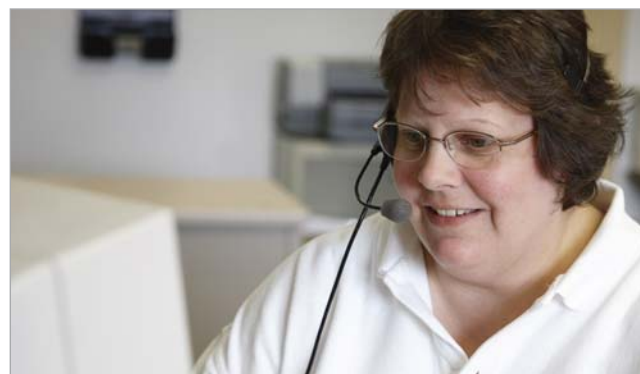
Rtx®-200

No derivatization  
needed!

GC\_CH00282

Column: Rtx®-200, 30m, 0.25mm ID, 0.25 $\mu$ m (cat.# 15023)  
 Sample: 0.8 $\mu$ L split injection of a free fatty acid standard  
 Conc.: approximately 10 to 20ng/ $\mu$ L  
 Oven temp.: 90°C  
 Inj./det. temp.: 250°C  
 Carrier gas: hydrogen  
 Linear velocity: 40cm/sec. (flow rate: 1.4cc/min.)  
 FID sensitivity: 4 x 10<sup>-11</sup> AFS  
 Split vent: 40cc/min.

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



Paula Zuchowski, Customer Service

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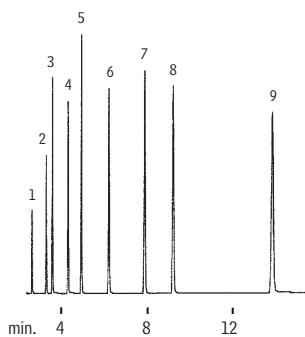
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Contact your Restek representative:

Refer to our list on pages 4-5 or visit our website at [www.restek.com](http://www.restek.com)

## Fatty Acids (Free)

Stabilwax®-DA

No derivatization  
needed!

GC\_CH00280

Column: Stabilwax®-DA, 30m, 0.25mm ID, 0.25 $\mu$ m (cat.# 11023)  
 Sample: 1.0 $\mu$ L split injection of a free acid standard  
 Conc.: approximately 10 to 20ng/ $\mu$ L  
 Oven temp.: 145°C  
 Inj./det. temp.: 250°C  
 Carrier gas: hydrogen  
 Linear velocity: 40cm/sec.  
 FID sensitivity: 2 x 10<sup>-11</sup> AFS  
 Split ratio: 50:1

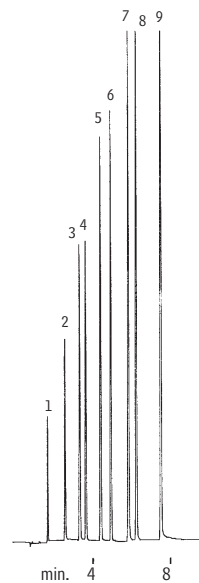
1. acetic acid
2. propionic acid
3. isobutyric acid
4. *n*-butyric acid
5. isovaleric acid
6. *n*-valeric acid
7. isocaproic acid
8. caproic acid
9. heptanoic acid

## Fatty Acids (Free)

Rtx®-1

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\_CH00281

Column: Rtx®-1, 30m, 0.53mm ID, 5.0 $\mu$ m (cat.# 10179)  
 Sample: 0.2 $\mu$ L injection of a 10–20ng/ $\mu$ L free fatty acid standard in water.  
 Inj.: direct injection using a Uniliner® inlet liner  
 Oven temp.: 60°C to 180°C @ 15°C/min.  
 Inj./det. temp.: 250°C  
 Carrier gas: hydrogen  
 Linear velocity: 50cm/sec. (flow rate: 6cc/min.)  
 FID sensitivity: 4 x 10<sup>-11</sup> AFS

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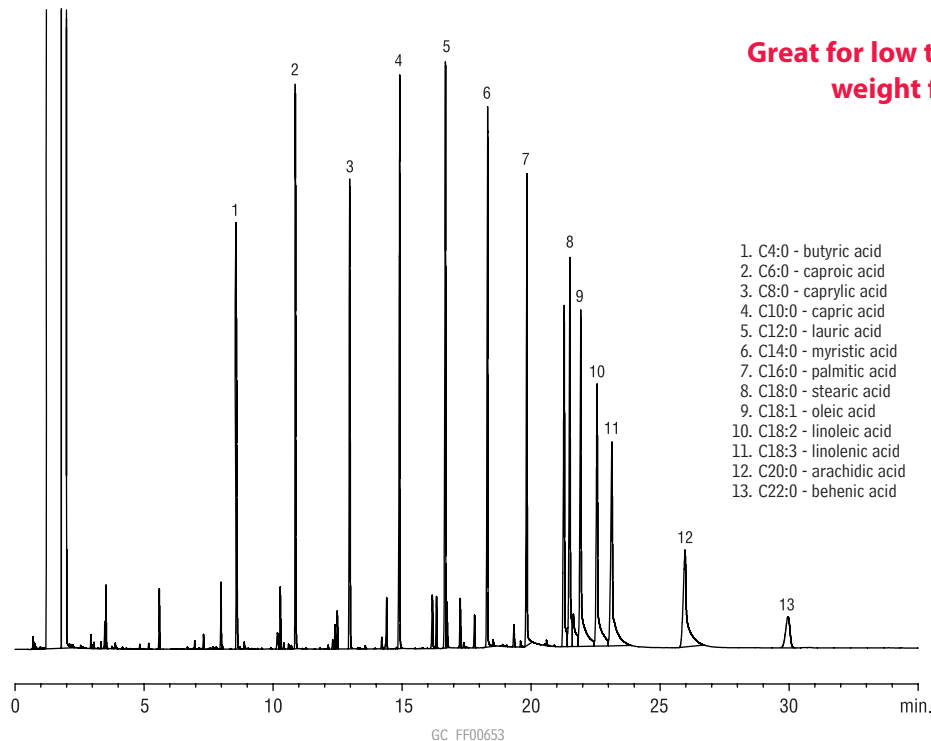
11/12

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## Fatty Acids

## Fatty Acids (Free)

## Stabilwax®-DA



Great for low to high molecular weight fatty acids.

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.)

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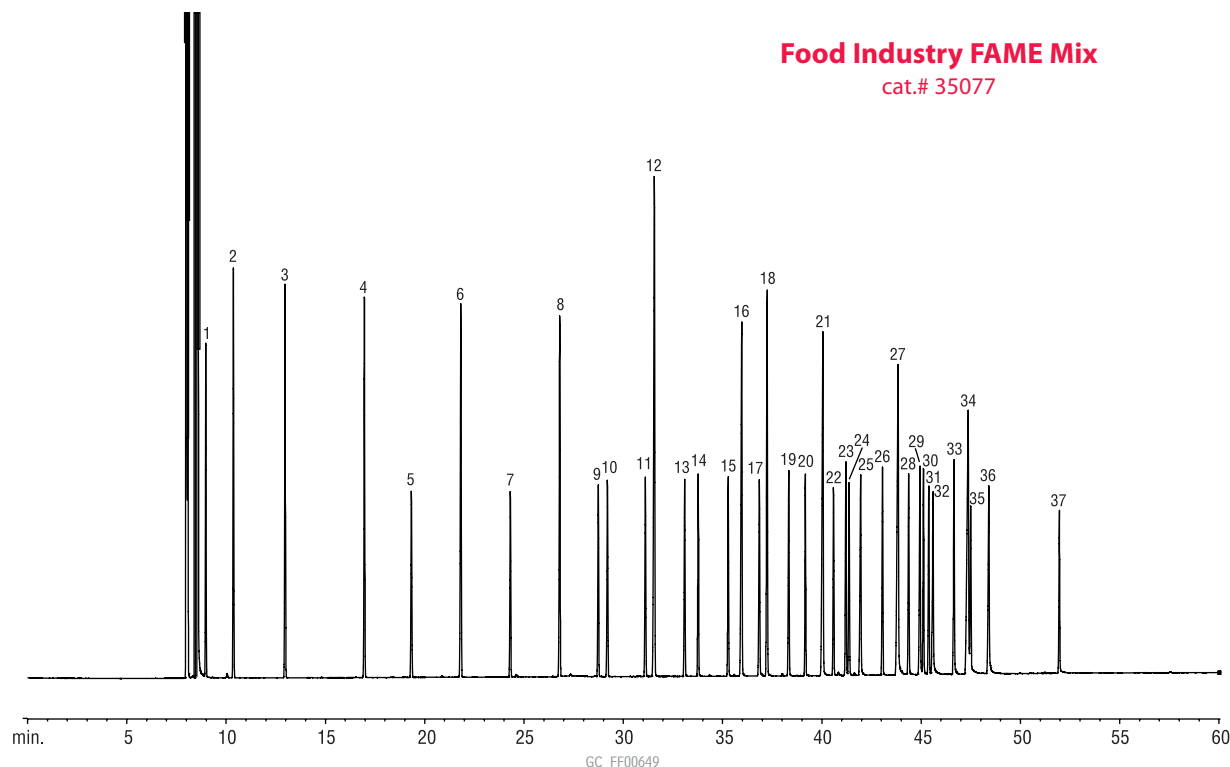


## FAMEs (AOAC 996.06 Standard)

Rt®-2560

## Food Industry FAME Mix

cat.# 35077



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

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

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Technical Literature

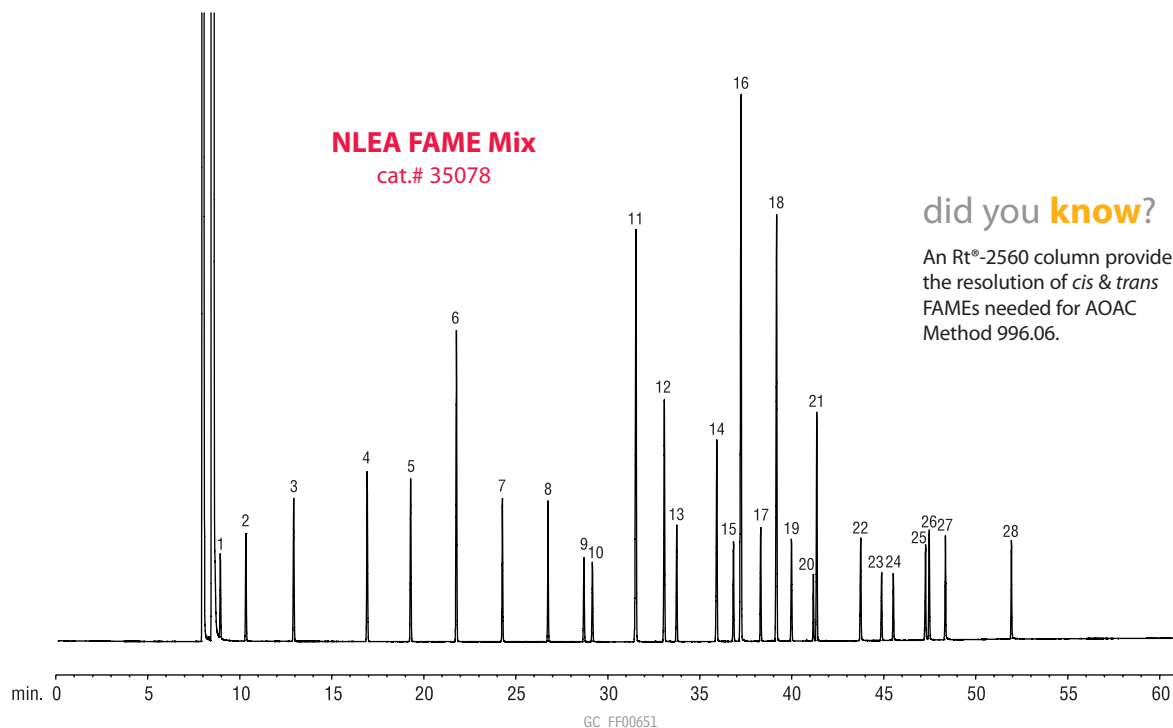
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## FAMEs (NLEA Mix)

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 linolelaidate (*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)

## Chromatogram Search Tool

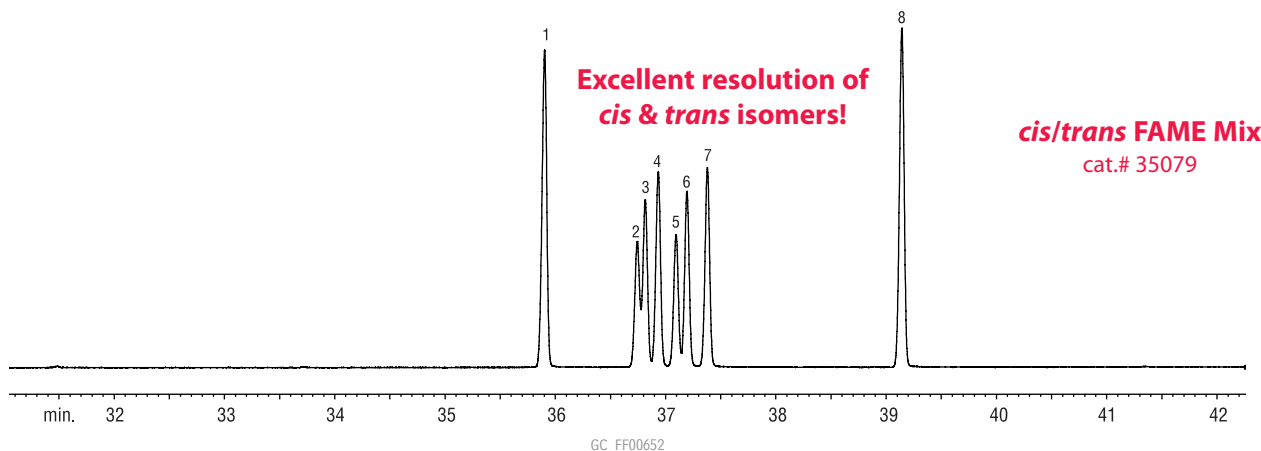
Search by compound name, synonym,  
CAS # or keyword

[www.restek.com/chromatograms](http://www.restek.com/chromatograms)



FAMES (*cis/trans* isomers)

Rt®-2560

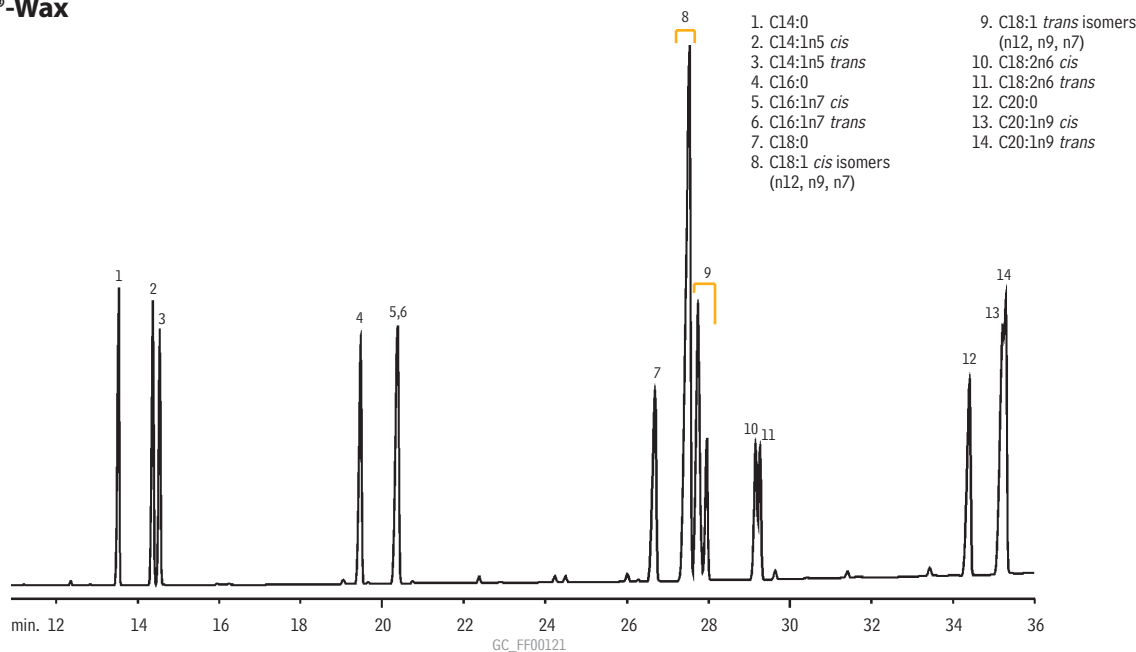


Column: Rt®-2560, 100m, 0.25mm ID, 0.2µm (cat.# 13199)  
 Sample: *cis/trans* FAME Mix (cat.# 35079), 10mg/mL total FAMES in methylene chloride  
 Inj.: 1.0µL split (split ratio 20:1), 4mm inlet liner (cat.# 20814)  
 Inj. temp.: 225°C  
 Carrier gas: hydrogen, constant flow  
 Flow rate: 1.2mL/min.  
 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 ( <i>trans</i> -6)	8.0
3. C18:1 methyl elaidate ( <i>trans</i> -9)	10.0
4. C18:1 methyl transvacenate ( <i>trans</i> -11)	12.0
5. C18:1 methyl petroselinate ( <i>cis</i> -6)	8.0
6. C18:1 methyl oleate ( <i>cis</i> -9)	10.0
7. C18:1 methyl vaccenate ( <i>cis</i> -11)	12.0
8. C18:2 methyl linoleate ( <i>cis</i> -9,12)	20.0

FAMES (*cis/trans* isomers)

Rtx®-Wax

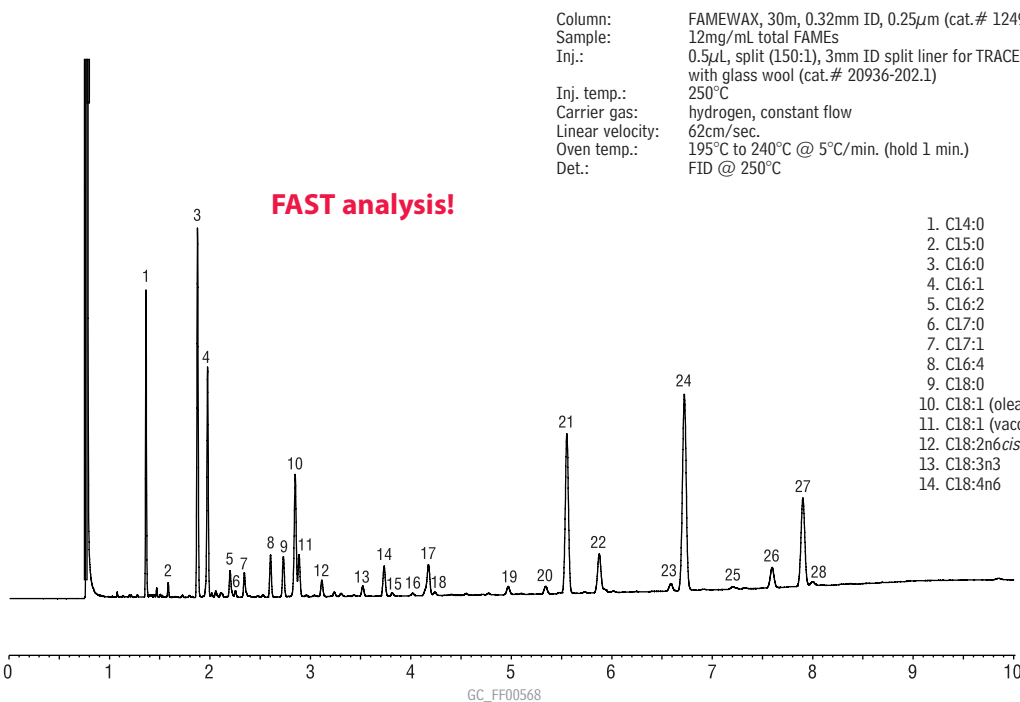


Column: Rtx®-Wax, 60m, 0.25mm ID, 0.25µm (cat.#12426)  
 On-column conc.: 40–75ng  
 Oven temp.: 165°C to 250°C @ 2°C/min.  
 Inj./det. temp.: 220°C/250°C  
 Carrier gas: helium  
 Linear velocity: 20cm/sec. set @ 165°C  
 Split ratio: 50:1

## FAMEs

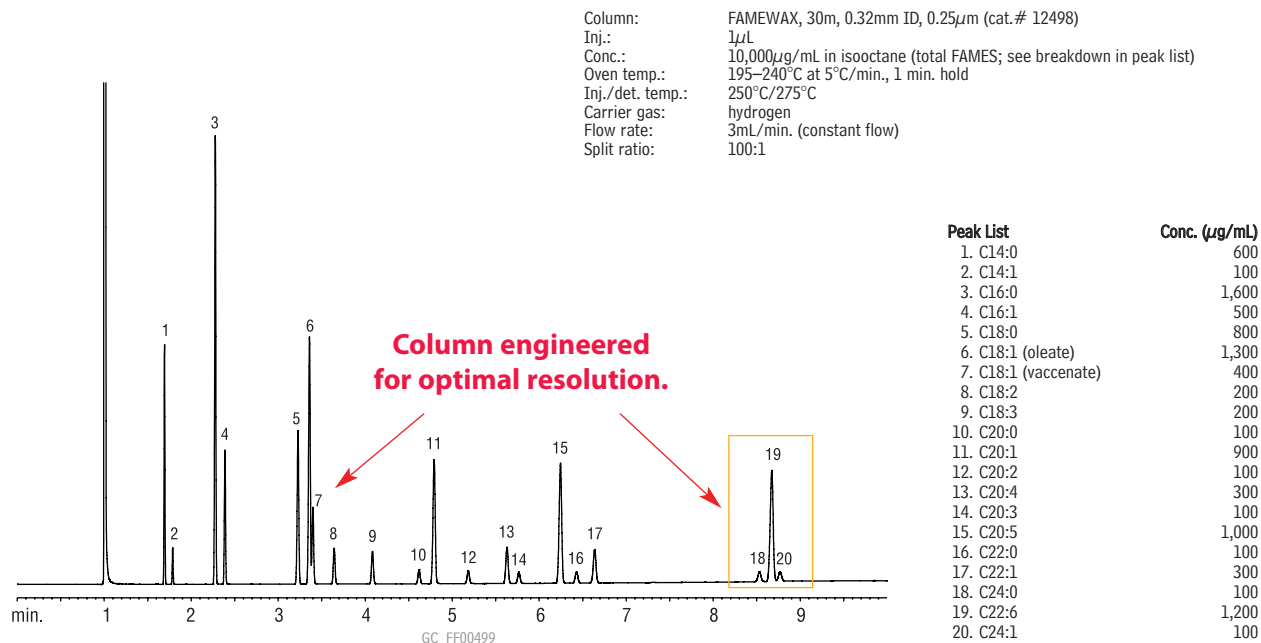
## FAMEs (Marine Oil Standard)

## FAMEWAX



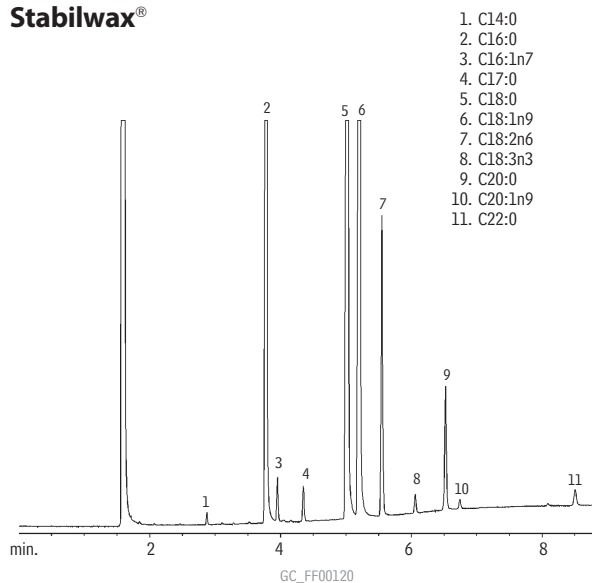
## FAMEs (Marine Oil Standard)

## FAMEWAX



## FAMES (Cocoa Butter)

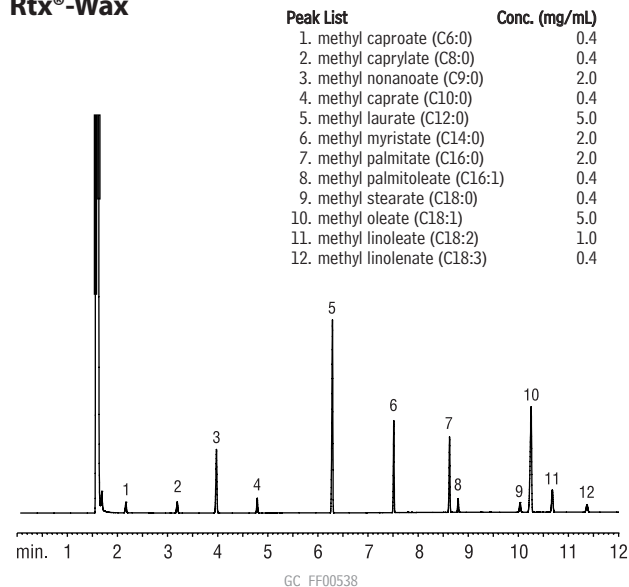
## Stabilwax®



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<sup>-11</sup> AFS  
Split ratio: 45:1

## FAMES (Saw Palmetto)

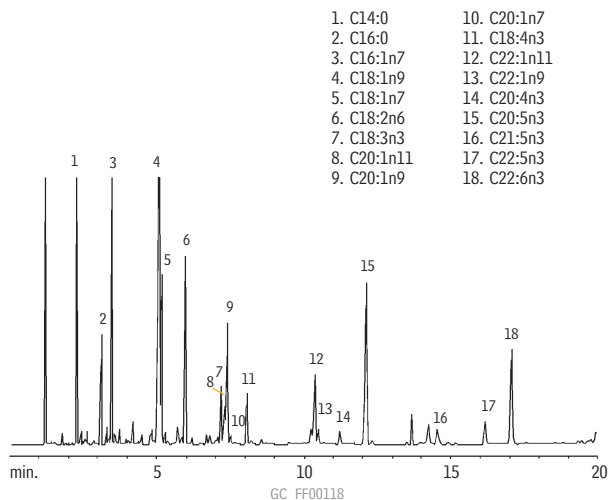
## Rtx®-Wax



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)

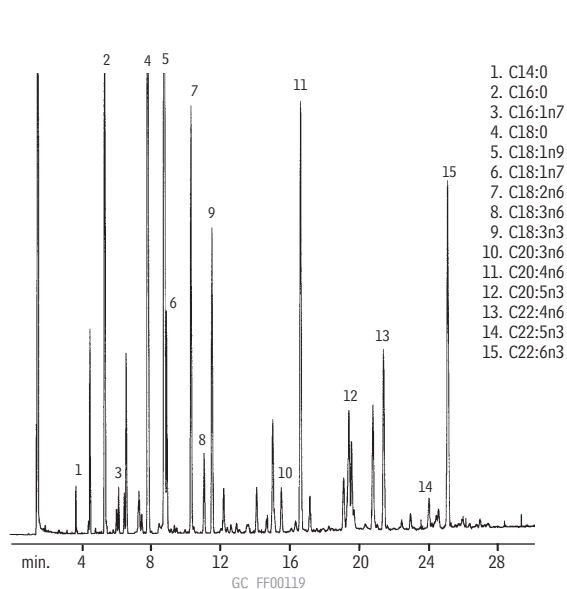
## Rt®-2330



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<sup>-11</sup> 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<sup>-11</sup> AFS  
Split ratio: 20:1

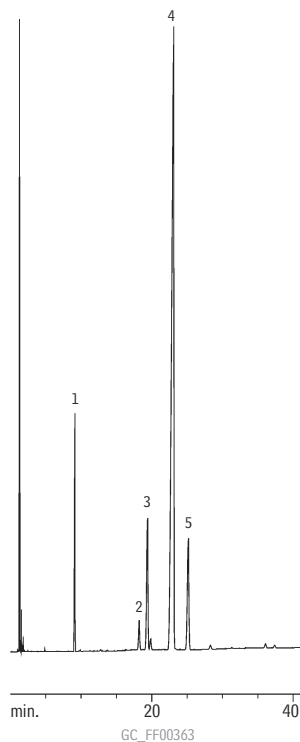


## FAMEs

## FAMEs (Evening Primrose Oil)

## FAMEWAX

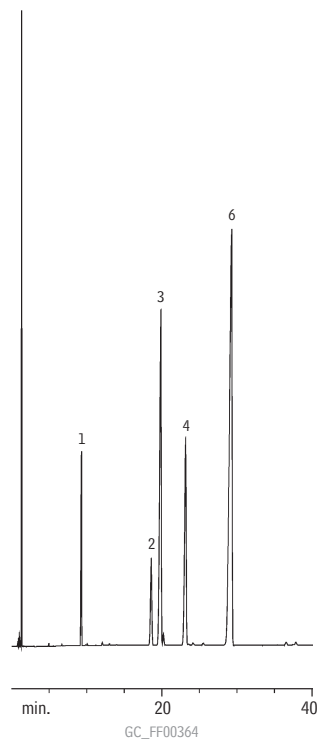
1. C16:0
2. C18:0
3. C18:1n9
4. C18:2n6
5. C18:3n6



## FAMEs (Flax Seed Oil)

## FAMEWAX

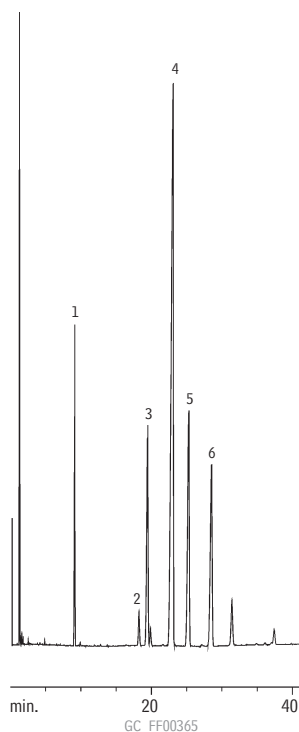
1. C16:0
2. C18:0
3. C18:1n9
4. C18:2n6
5. C18:3n6
6. C18:3n3



## FAMEs (Black Currant Seed Oil)

## FAMEWAX

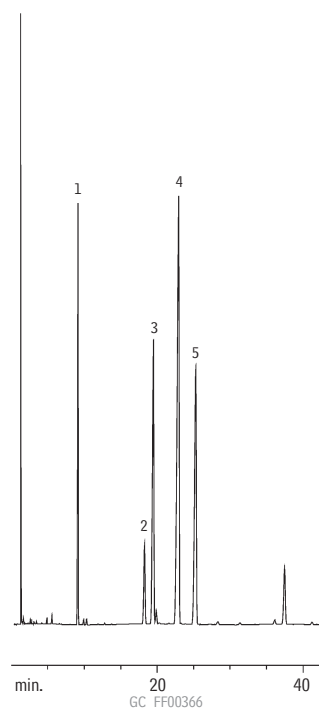
1. C16:0
2. C18:0
3. C18:1n9
4. C18:2n6
5. C18:3n6
6. C18:3n3



## FAMEs (Borage Seed Oil)

## FAMEWAX

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

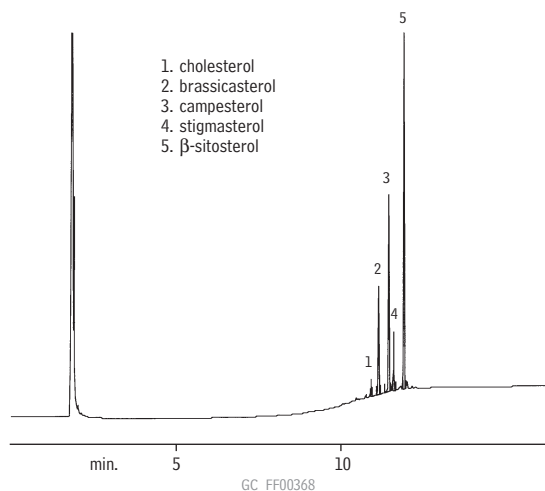


## Column and conditions for all four oils analyses:

Column: FAMEWAX, 30m, 0.25mm ID, 0.25 $\mu$ m (cat.# 12497)  
 Oven temp.: 165°C (hold 30 min.) to 220°C @ 1.5°C/min. (hold 15 min.)  
 Inj. temp.: 225°C  
 Det. temp.: 230°C  
 Carrier gas: helium @ 40cm/sec.

## 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)

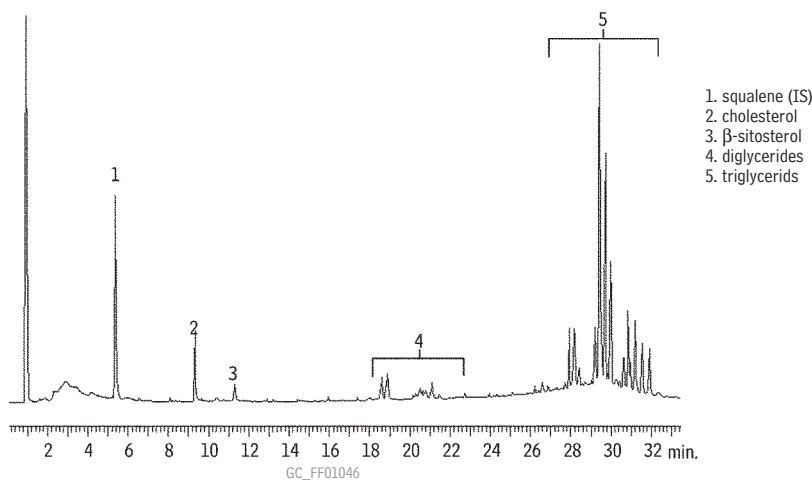
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## Egg Pasta: Sterols & Glycerides

Rtx®-65TG

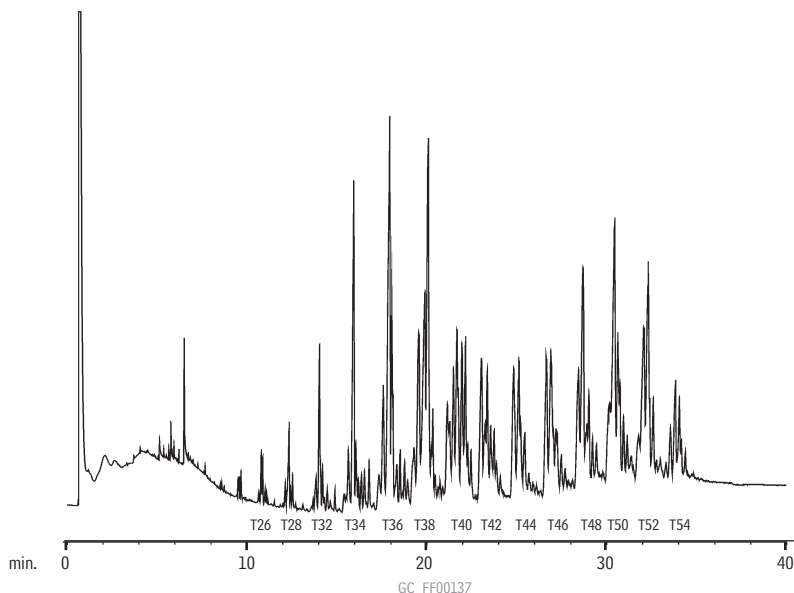


Column: Rtx®-65TG, 30m, 0.25mm ID, 0.10μm (cat.# 17008)  
Sample: 50μg/mL fat extract from egg pasta in diethyl ether solution with 3,000ppm squalene (IS)  
Inj.: 0.5μL, split (1:80), 70°C (hold 12 sec.) at 99°C up to 370°C (hold 5 min.)  
Carrier gas: hydrogen  
Flow rate: 1.5mL/min.  
Oven temp.: 220°C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

## Triglycerides

## 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<sup>11</sup> AFS  
 SPI injector: high performance capillary insert 60°C,  
 300°C/min. to 400°C (hold 5 min.)



Al Carusone, Technical Service

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Fax: 814-353-1568

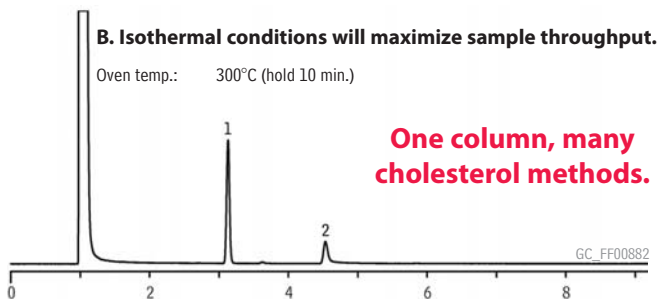
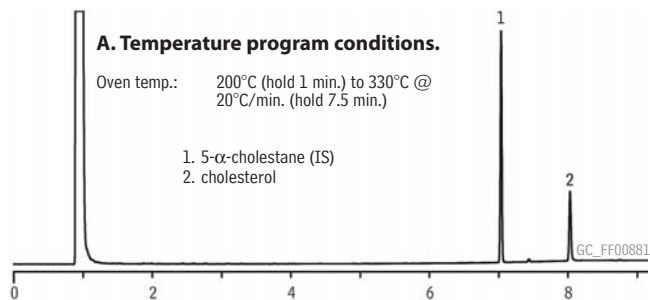
e-mail: [support@restek.com](mailto:support@restek.com)

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## Underivatized Cholesterol

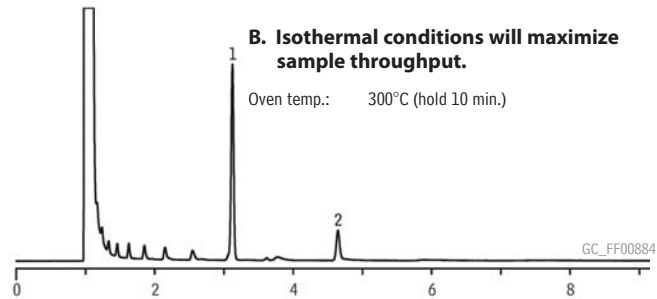
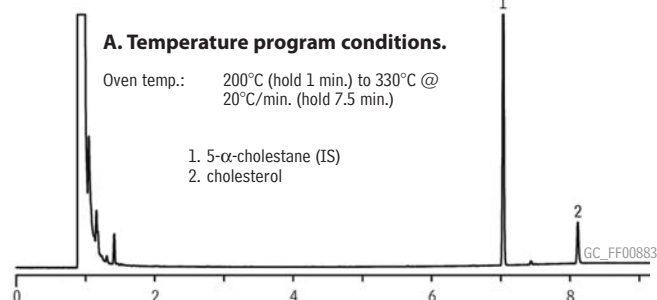
Rxi®-5ms



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

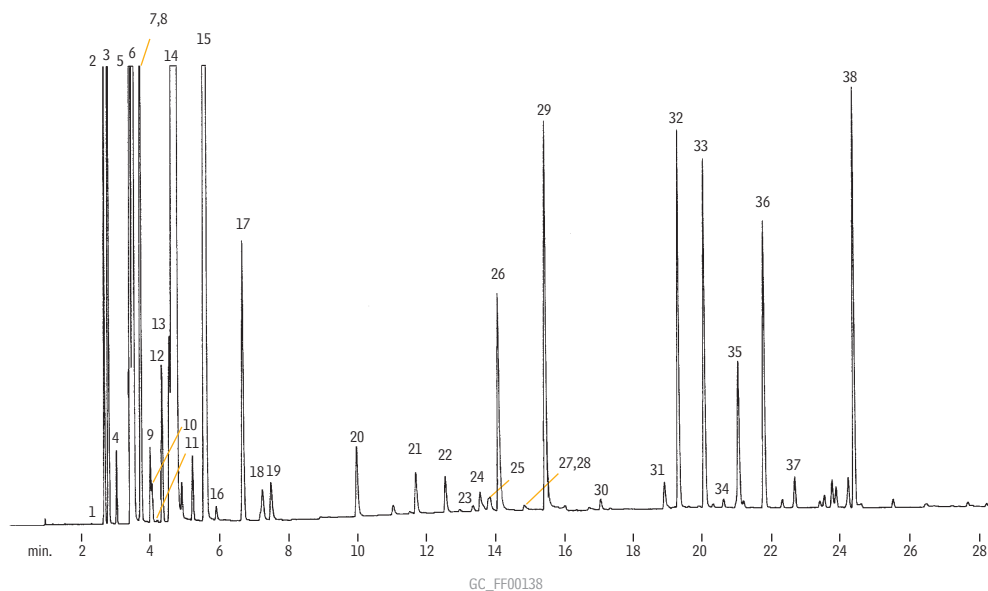
Rxi®-5ms



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



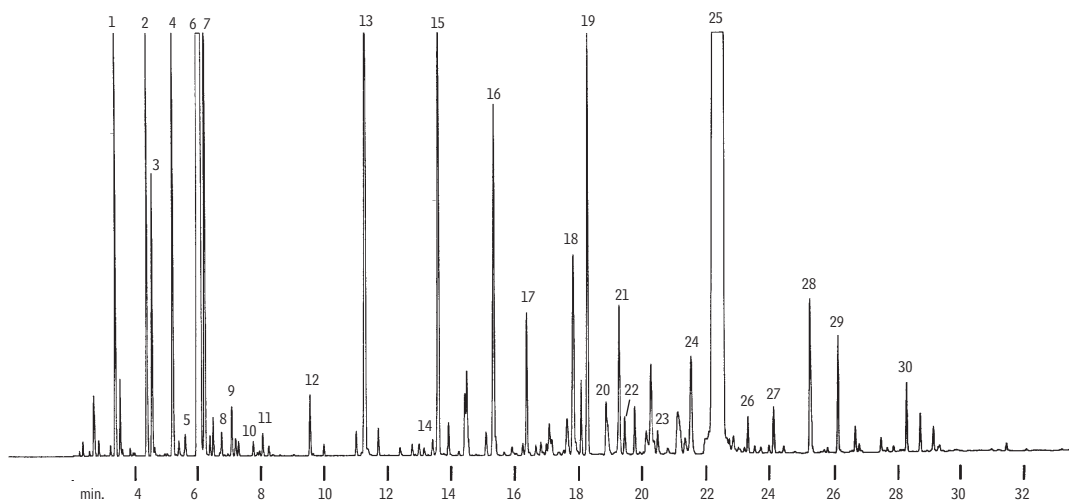
Column: Rtx®-5, 30m, 0.32mm ID, 0.25μm (cat.# 10224)  
 Sample: Wet needle split injection of a neat lemon oil  
 Oven temp.: 75°C (hold 8 min.) to 250°C @ 4°C/min.  
 Inj./det. temp.: 250°C  
 Carrier gas: hydrogen  
 Linear velocity: 40cm/sec. (flow rate: 3.2cc/min.)  
 FID sensitivity: 2 x 10<sup>-11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

1. heptanol
2. α-thujene
3. α-pinene
4. camphene
5. sabinene
6. β-pinene
7. 6-methyl-5-hepten-2-one
8. myrcene
9. octanal
10. α-phellandrene
11. 3-carene
12. α-terpinene
13. 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

## Essential Oils

## 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<sup>-11</sup> AFS

Split ratio: 100:1

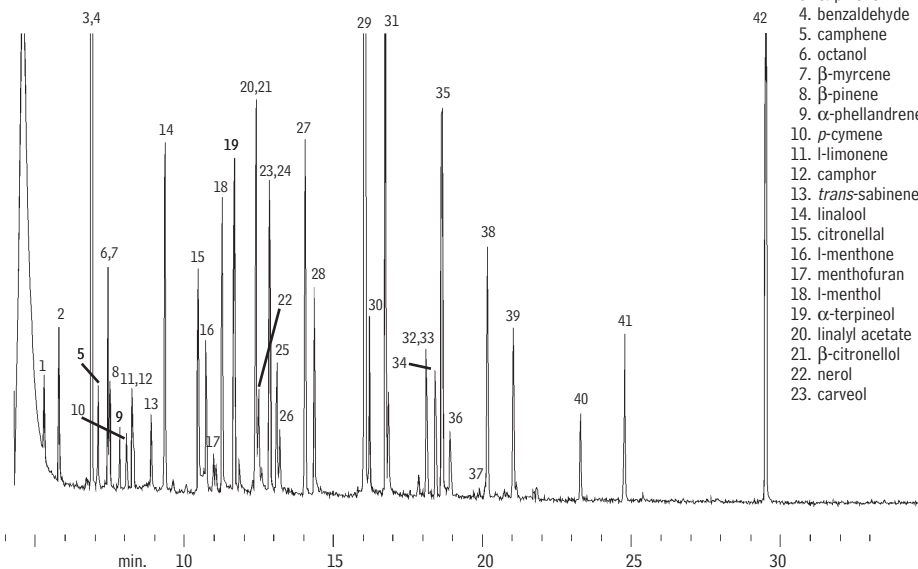
1. α-pinene
2. β-pinene
3. sabinene
4. myrcene
5. α-terpinene
6. l-limonene
7. 1,8-cineole
8. cis-ocimene
9. γ-terpinene
10. p-cymene

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

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<sup>-11</sup> AFS

Split vent: 100cc/min.

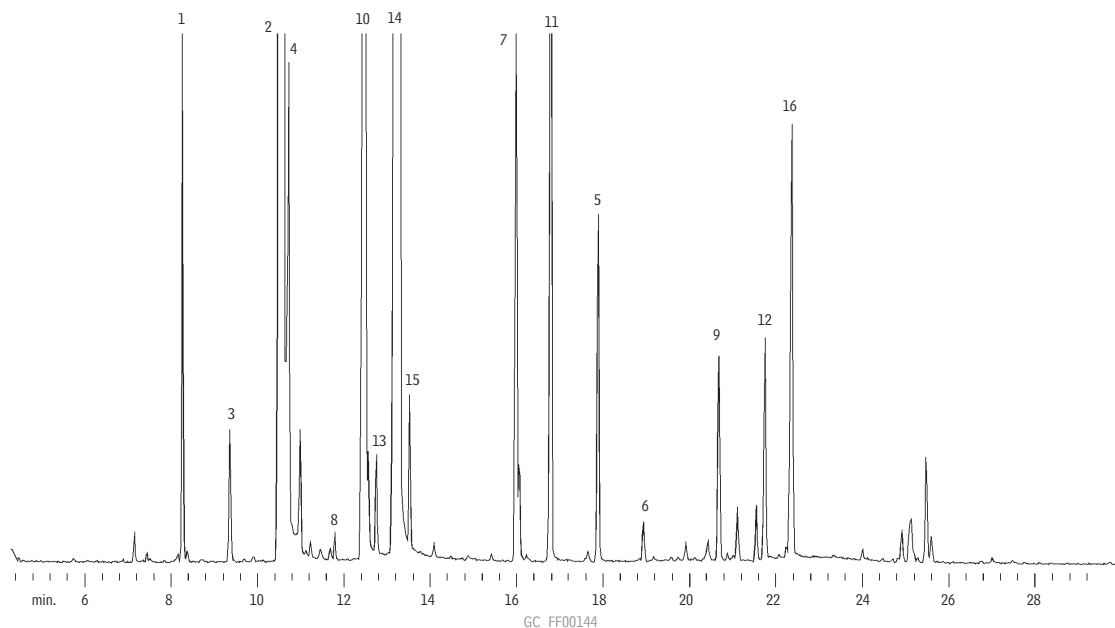
1. ethyl butyrate
2. trans-2-hexenol
3. α-pinene
4. benzaldehyde
5. camphene
6. octanol
7. β-myrcene
8. β-pinene
9. α-phellandrene
10. p-cymene
11. l-limonene
12. camphor
13. trans-sabinene hydrate
14. linalool
15. citronellal
16. l-menthone
17. menthofuran
18. l-menthol
19. α-terpineol
20. linalyl acetate
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



## Citronella Java Oil

Rtx®-1

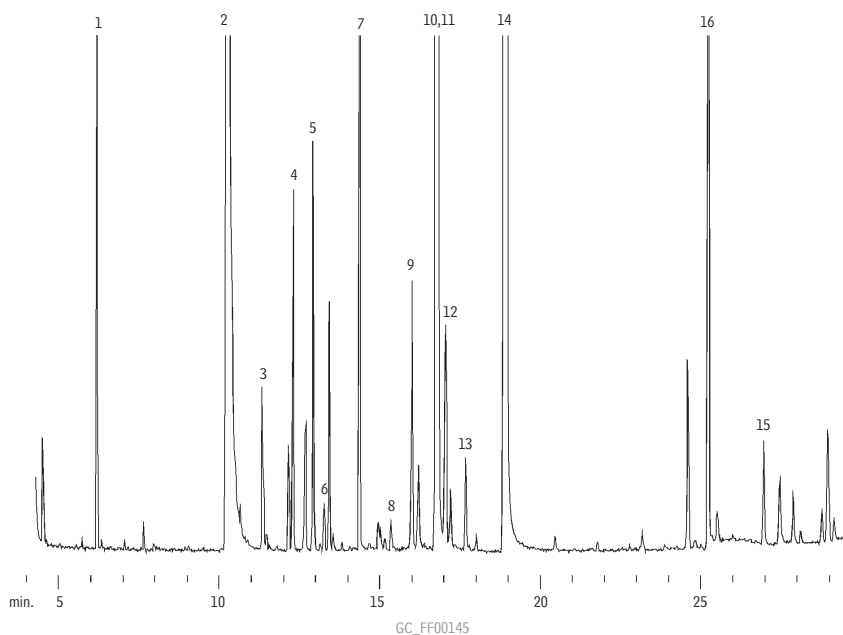


Column: Rtx®-1, 60m, 0.25mm ID, 0.25 $\mu$ m (cat.# 10126)  
 Sample: 1.0 $\mu$ L split injection of citronella Java oil  
 Oven temp.: 100°C to 260°C @ 4°C/min. (hold 1 min.)  
 Inj./det. temp.: 250°C/280°C  
 Det. type: MSD  
 Carrier gas: helium  
 Linear velocity: 30cm/sec. set @ 50°C  
 Split vent: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

1. limonene
2. citronellal
3. linalool
4. borneol
5.  $\gamma$ -elemene
6.  $\beta$ -caryophyllene
7. neryl acetate
8.  $\alpha$ -terpineol
9. germacrene- $\Delta$
10.  $\beta$ -citronellol
11. geranyl acetate
12.  $\delta$ -cadenene
13. nerol
14. geraniol
15. eugenol
16.  $\alpha$ -bergamotene

## Citronella Java Oil

Stabilwax®

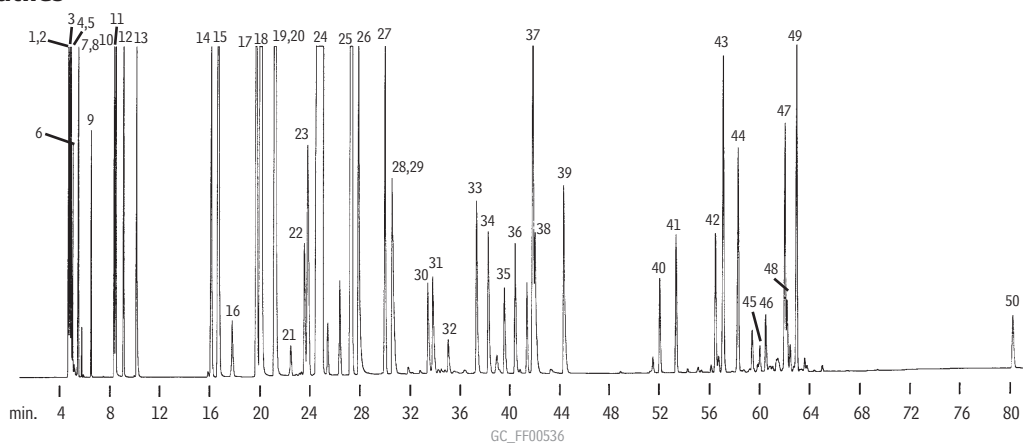


Column: Stabilwax®, 60m, 0.25mm ID, 0.25 $\mu$ m (cat.# 10626)  
 Sample: 1.0 $\mu$ L split injection of citronella Java oil  
 Oven temp.: 100°C to 260°C @ 4°C/min. (hold 1 min.)  
 Inj./det. temp.: 250°C/280°C  
 Det. type: MSD  
 Carrier gas: helium  
 Linear velocity: 30cm/sec. set @ 50°C  
 Split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

## Flavors

## Flavor Volatiles

## Rtx®-1

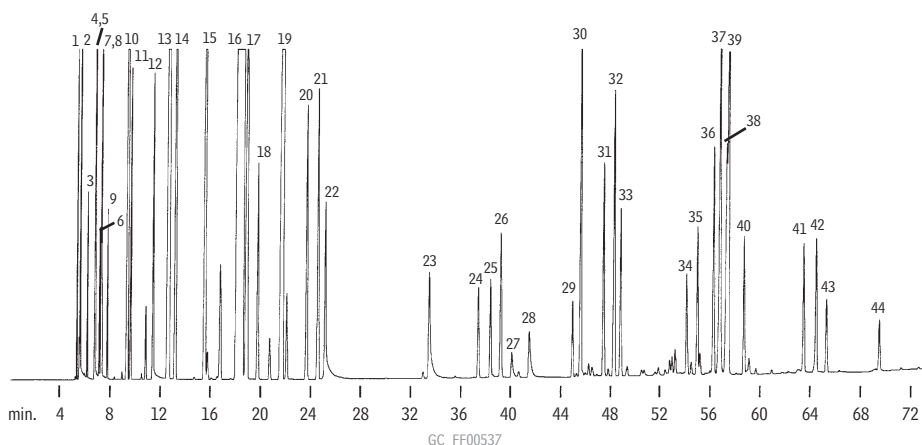


- |                       |                             |                                   |                                     |  |
|-----------------------|-----------------------------|-----------------------------------|-------------------------------------|--|
| 1. methanol           | 11. ethyl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

Column: Rtx®-1, 60m, 0.53mm ID, 0.50 $\mu$ m (cat.# 10143)  
 Sample: 0.8 $\mu$ L split injection of a flavor volatiles test mix  
 Oven temp.: 70°C (hold 15 min.) to 190°C @ 2°C/min. (hold 5 min.)  
 Inj./det. temp.: 220°C/260°C  
 Carrier gas: helium  
 Linear velocity: 20cm/sec. set @ 70°C  
 FID sensitivity: 64 x 10<sup>-11</sup> AFS  
 Split ratio: 20:1

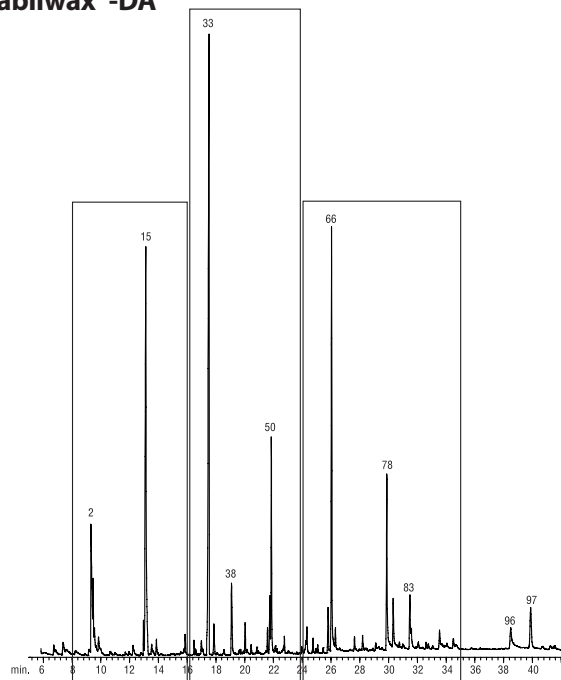
## Flavor Volatiles

## Stabilwax®



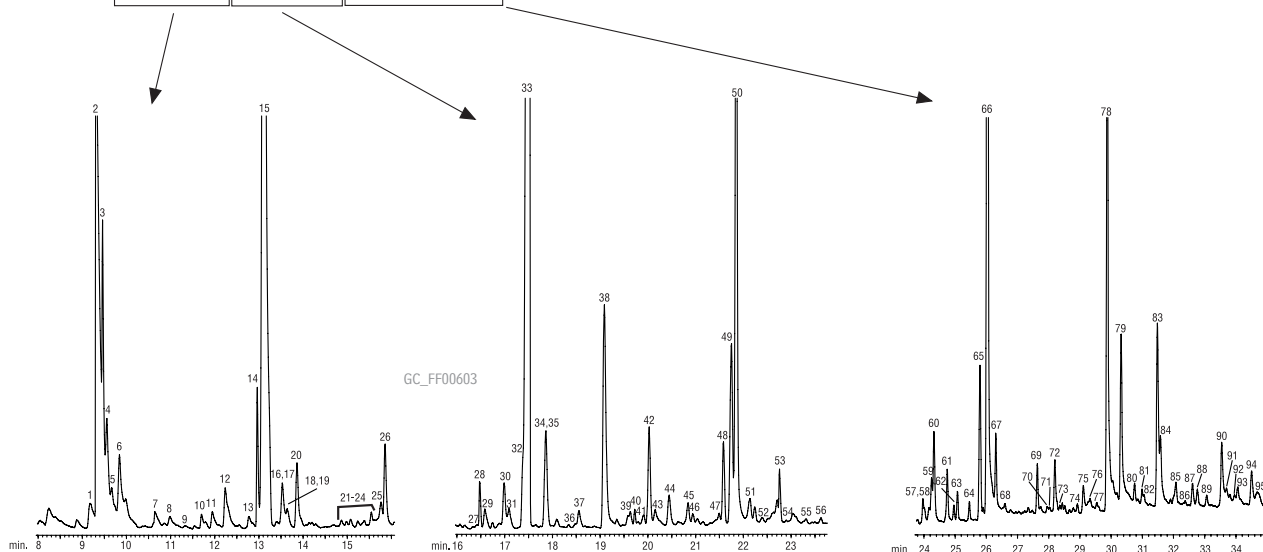
- |                       |                             |                                   |  |                      |
|-----------------------|-----------------------------|-----------------------------------|--|----------------------|
| 1. hexane             | 10. $\alpha$ -pinene        | 19. $\gamma$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

Column: Stabilwax®, 60m, 0.53mm ID, 0.50 $\mu$ m (cat.# 10643)  
 Sample: 0.8 $\mu$ L split injection of a flavor volatiles test mix  
 Oven temp.: 70°C (hold 15 min.) to 190°C @ 2°C/min. (hold 5 min.)  
 Inj./det. temp.: 220°C/260°C  
 Carrier gas: helium  
 Linear velocity: 20cm/sec. set @ 70°C  
 FID sensitivity: 64 x 10<sup>-11</sup> AFS  
 Split ratio: 20:1

Malt Whiskey  
Stabilwax®-DA

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

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

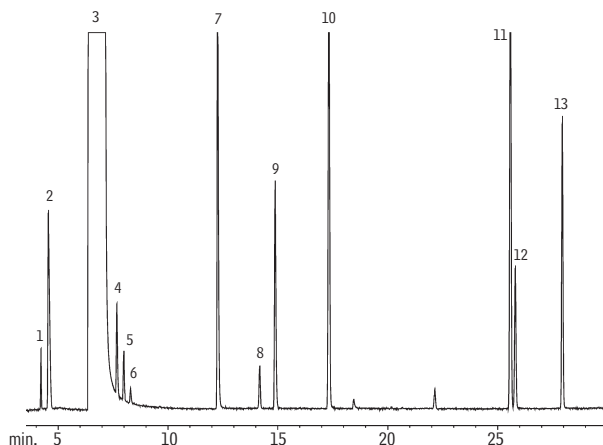


- |  |   |  |                                      |  |
|--|---|--|--------------------------------------|--|
| 1. ethyl octanoate                     | 23. ethyl undecanoate                     | 44. unknown                                    | 66. decanoic acid                    | 87. ethyl vanillate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

## Flavors: Beverage Analysis

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

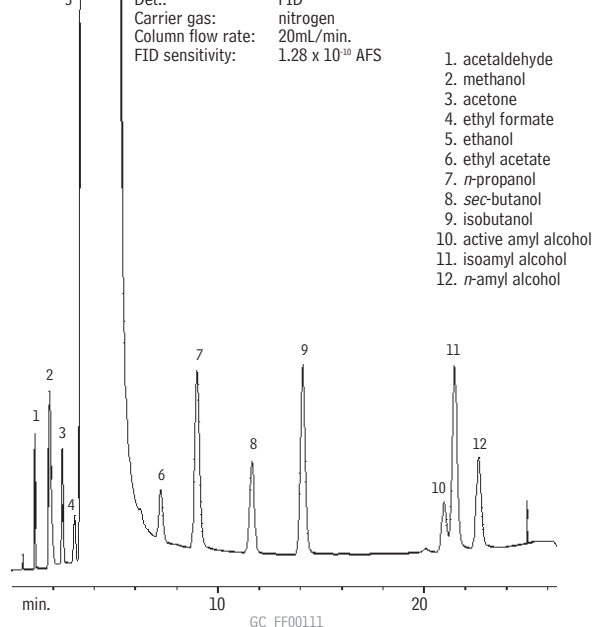


GC\_FF00110

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<sup>-10</sup> AFS

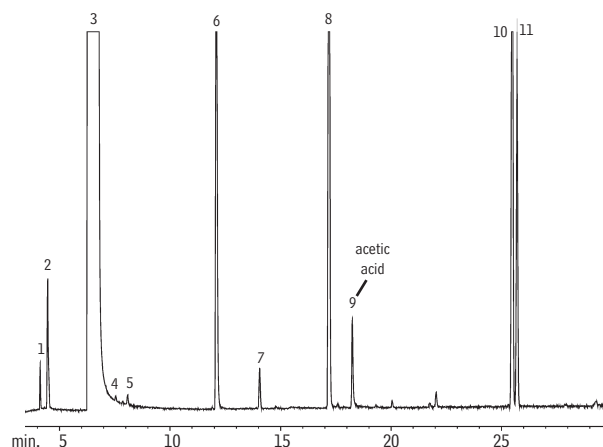


GC\_FF00111

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

Scotch  
Rtx®-1301

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

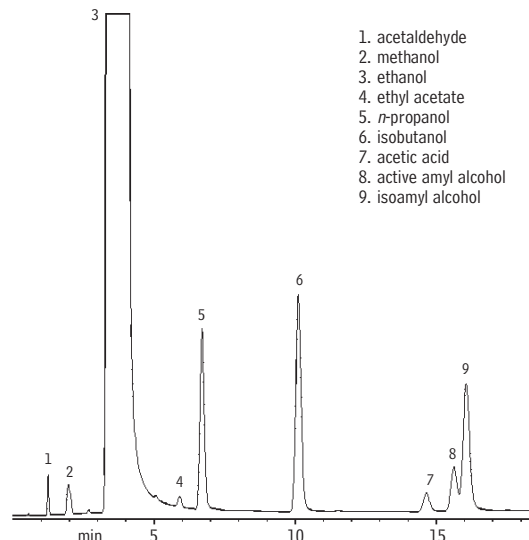


GC\_FF00112

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

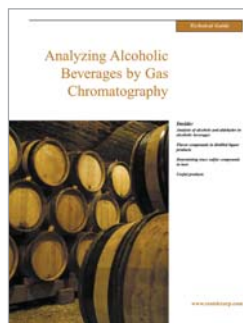
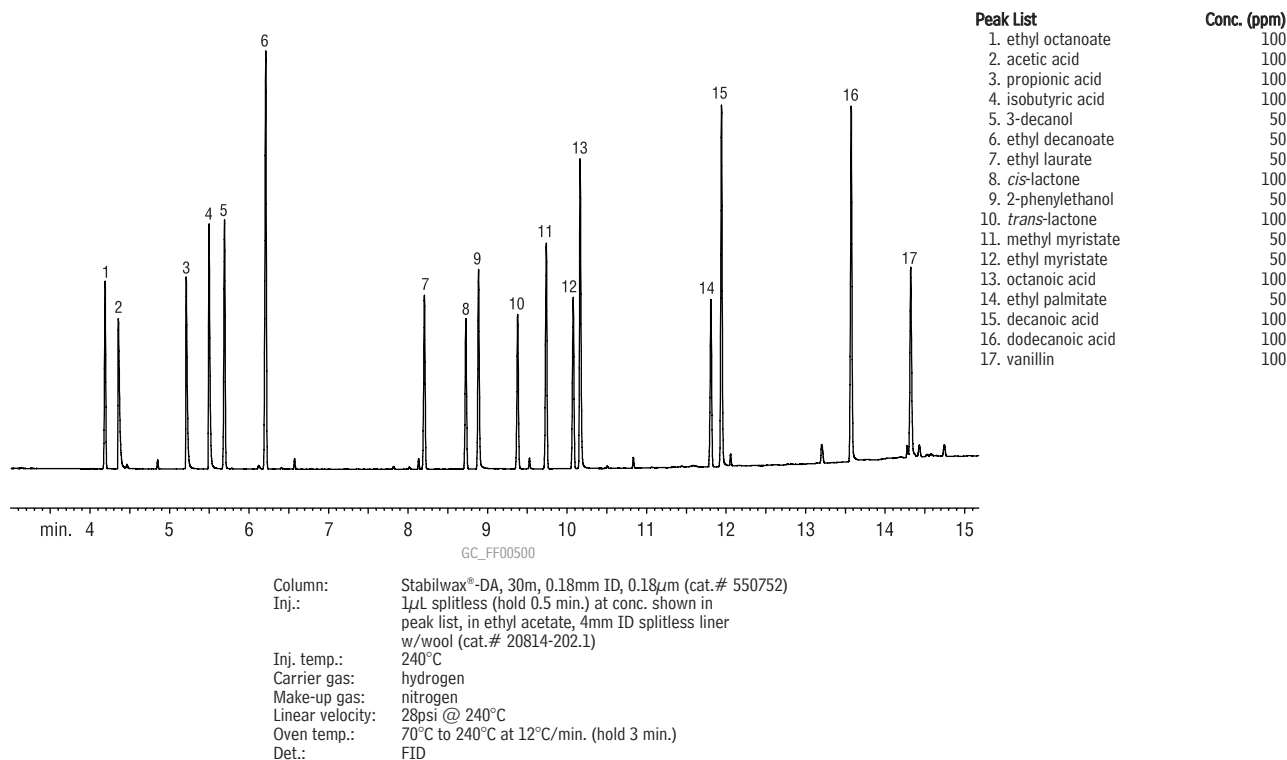


GC\_FF00113

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<sup>-10</sup> AFS

## Alcoholic Beverage Standard: Acids and Esters

## Stabilwax®-DA



## free literature

## Analyzing Alcoholic Beverages by Gas Chromatography

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

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

Technical Guide

lit. cat.# 59462

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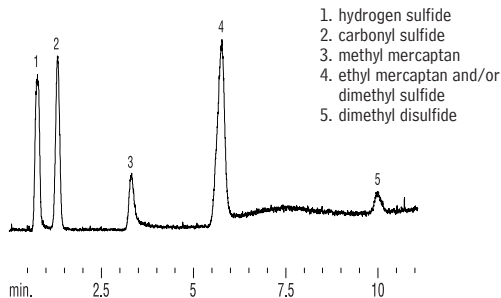




## Food Contaminants

Sulfur Compounds in Beverage Grade CO<sub>2</sub>

## Rt®-XLSulfur



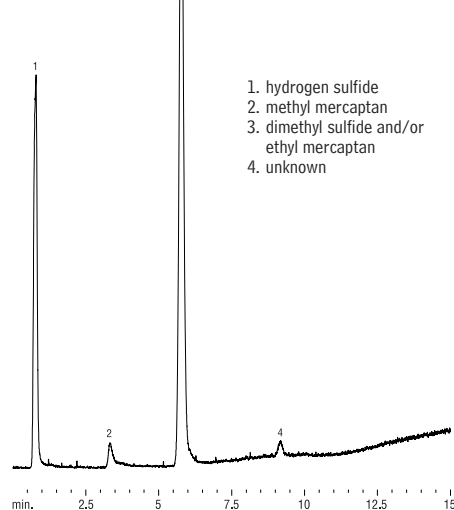
GC\_FF00491

Column: Rt®-XLSulfur, 100/120 mesh, 1m, 0.75mm ID  
Sulfinert® tubing (cat.# 19806)  
Conc.: sulfur standard @ 20ppb each in CO<sub>2</sub>  
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)



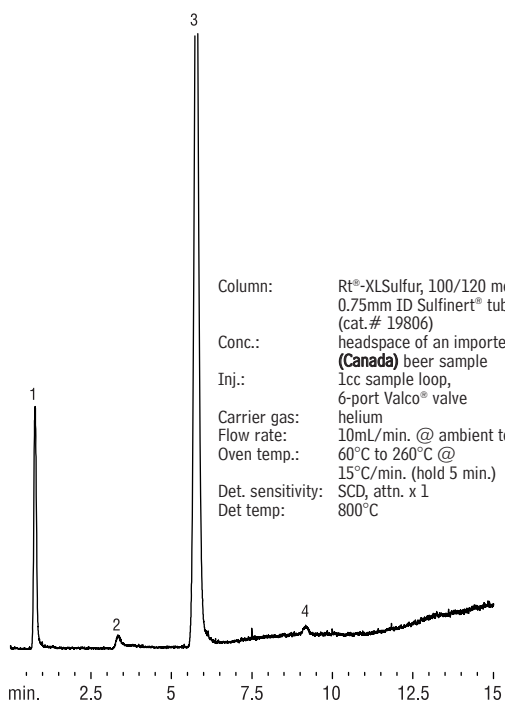
GC\_FF00494

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)



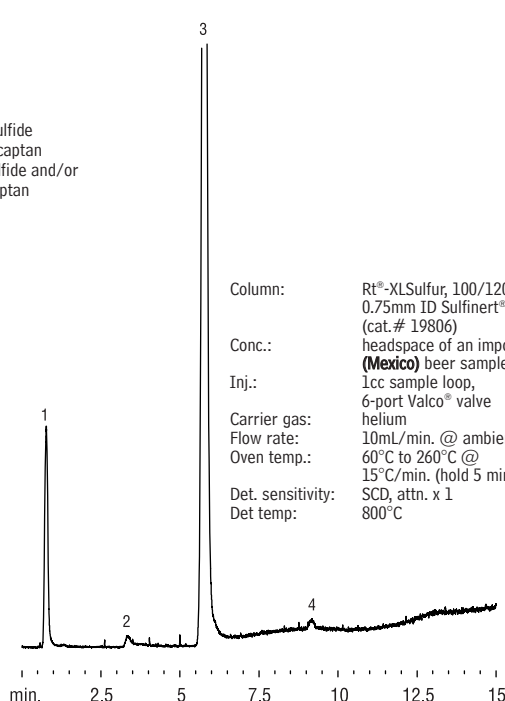
GC\_FF00487

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

## Sulfur Compounds in Beer

## Rt®-XLSulfur

(Headspace/GC)

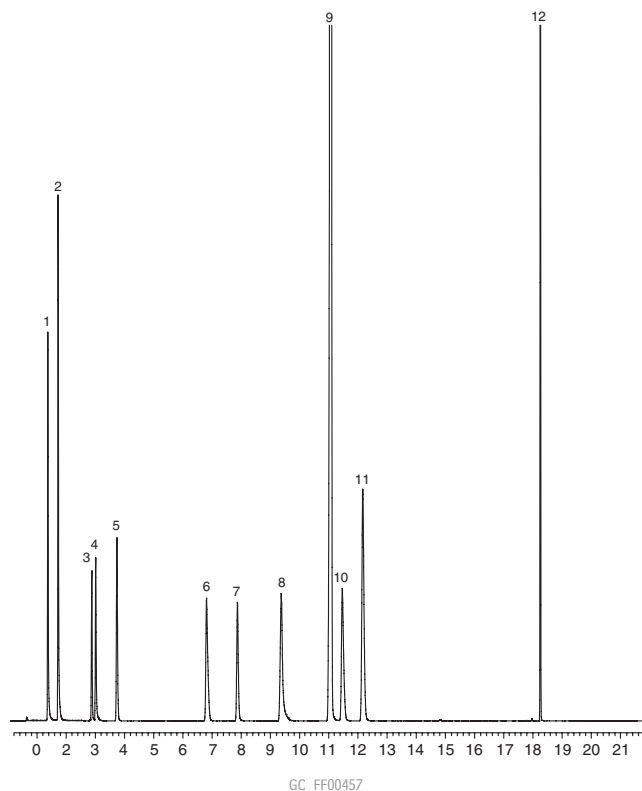


GC\_FF00483

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

## Food Packaging Volatiles

Rtx®-5MS



## Volatiles Standard

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

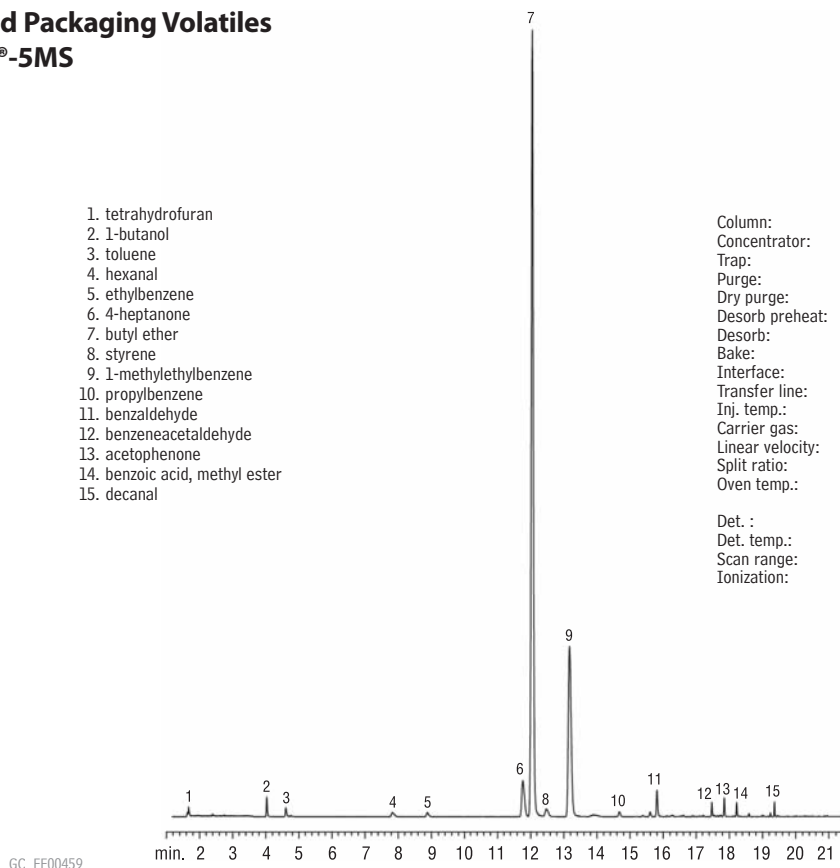
Column: Rtx®-5MS, 30m, 0.25mm ID, 1 $\mu$ m (cat.# 12653)  
 Concentrator: Tekmar LSC-3100 purge & trap  
 Trap: Vocab 3000, type K  
 Purge: 10 min. @ 40mL/min. @ 60°C  
 Dry purge: 3 min. @ 40mL/min.  
 Desorb preheat: 220°C  
 Desorb: 245°C, 2 min., 40mL/min.  
 Bake: 230°C, 6 min.  
 Interface: 1:20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

## Food Packaging Volatiles

Rtx®-5MS

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

Column: Rtx®-5MS, 30m, 0.25mm ID, 1 $\mu$ m (cat.# 12653)  
 Concentrator: Tekmar LSC-3100 purge & trap  
 Trap: Vocab 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



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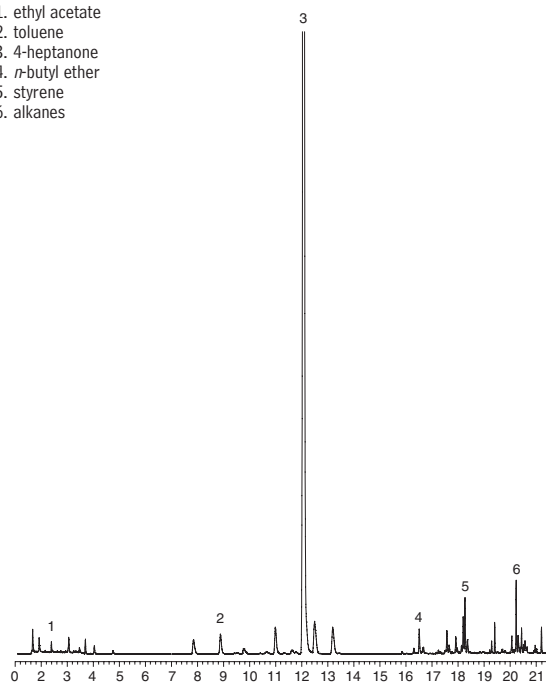
## Food Contaminants

## Food Packaging Volatiles by Purge &amp; Trap GC/MS

## Rtx®-5MS

(Purge &amp; 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, 1 $\mu$ m (cat.# 12653)  
 GC: Agilent 6890  
 Oven temp.: 50°C to 92°C @ 3°C/min., to 220°C @ 20°C/min. (hold 1 min.)  
 Injector temp.: 250°C  
 Carrier gas: helium  
 Linear velocity: 36cm/sec. (1mL/min.)  
 Det. sensitivity: NA  
 Split ratio: 20:1  
 Det.: MSD (Agilent 5973)  
 Det. temp.: 280°C  
 Scan range: 35-260amu  
 Ionization: EI @ 70eV  
 Mode:

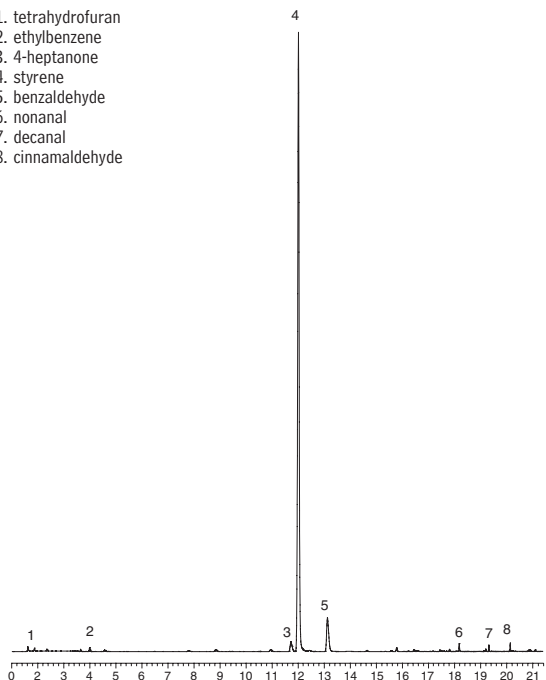
Sample Conditions:  
 Sample: Overwrap, inner bowl  
 Concentrator: Tekmar LSC-3100 purge & trap  
 Trap: Vocarb 3000, type K  
 Purge: 10 min. @ 40mL/min., at 60°C  
 Dry purge: 3 min. @ 40mL/min.  
 Desorb preheat: 220°C  
 Desorb: 245°C, 2 min., 40mL/min.  
 Bake: 230°C, 6 min.  
 Interface: 1:20 split at injection port with 1mm ID inlet liner  
 Transfer line: 0.53mm ID Silcosteel® MXT® tubing (cat.# 22501)

## Food Packaging Volatiles by Purge &amp; Trap GC/MS

## Rtx®-5MS

(Purge &amp; 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, 1 $\mu$ m (cat.# 12653)  
 GC: Agilent 6890  
 Oven temp.: 50°C to 92°C @ 3°C/min., to 220°C @ 20°C/min. (hold 1 min.)  
 Inj. temp.: 250°C  
 Carrier gas: helium  
 Linear velocity: 36cm/sec. (1mL/min.)  
 Det. sensitivity: NA  
 Split ratio: 20:1  
 Det.: MSD (Agilent 5973)  
 Det. temp.: 280°C  
 Scan range: 35-260amu  
 Ionization: EI @ 70eV  
 Mode:

Sample Conditions:  
 Sample: Overwrap, lid of bowl  
 Concentrator: Tekmar LSC-3100 purge & trap  
 Trap: Vocarb 3000, type K  
 Purge: 10 min. @ 40mL/min., at 60°C  
 Dry purge: 3 min. @ 40mL/min.  
 Desorb preheat: 220°C  
 Desorb: 245°C, 2 min., 40mL/min.  
 Bake: 230°C, 6 min.  
 Interface: 1:20 split at injection port with 1mm ID inlet liner  
 Transfer line: 0.53mm ID Silcosteel® MXT® tubing (cat.# 22501)

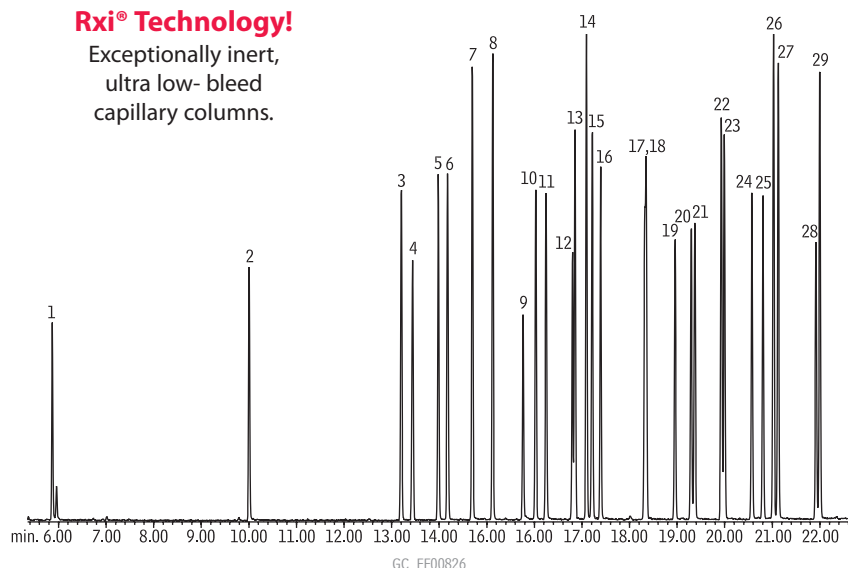
## Organochlorine and Organophosphorus Pesticides

## FAPAS® Proficiency Testing

## Rxi®-5ms

## Rxi® Technology!

Exceptionally inert,  
ultra low- bleed  
capillary columns.



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

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

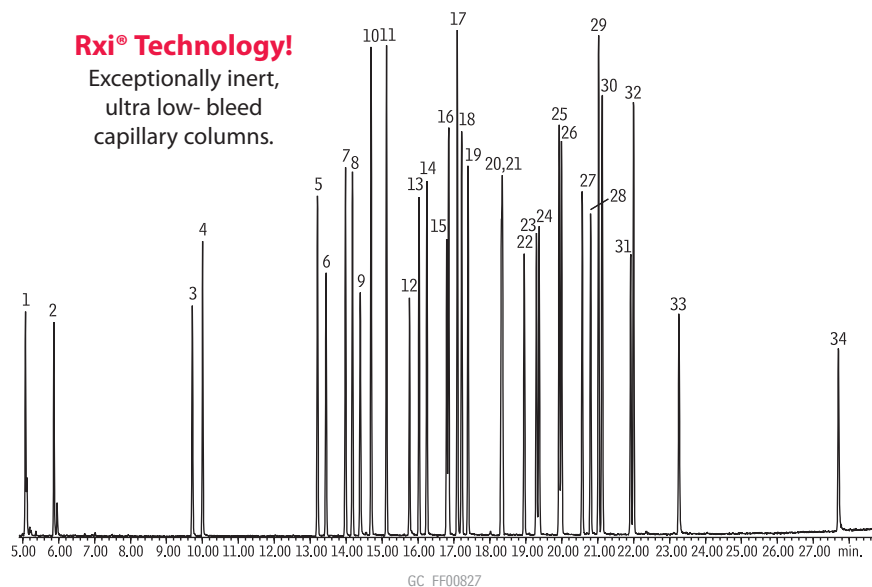
## Organochlorine and Organophosphorus Pesticides

## FAPAS® Proficiency Testing

## Rxi®-5ms

## Rxi® Technology!

Exceptionally inert,  
ultra low- bleed  
capillary columns.

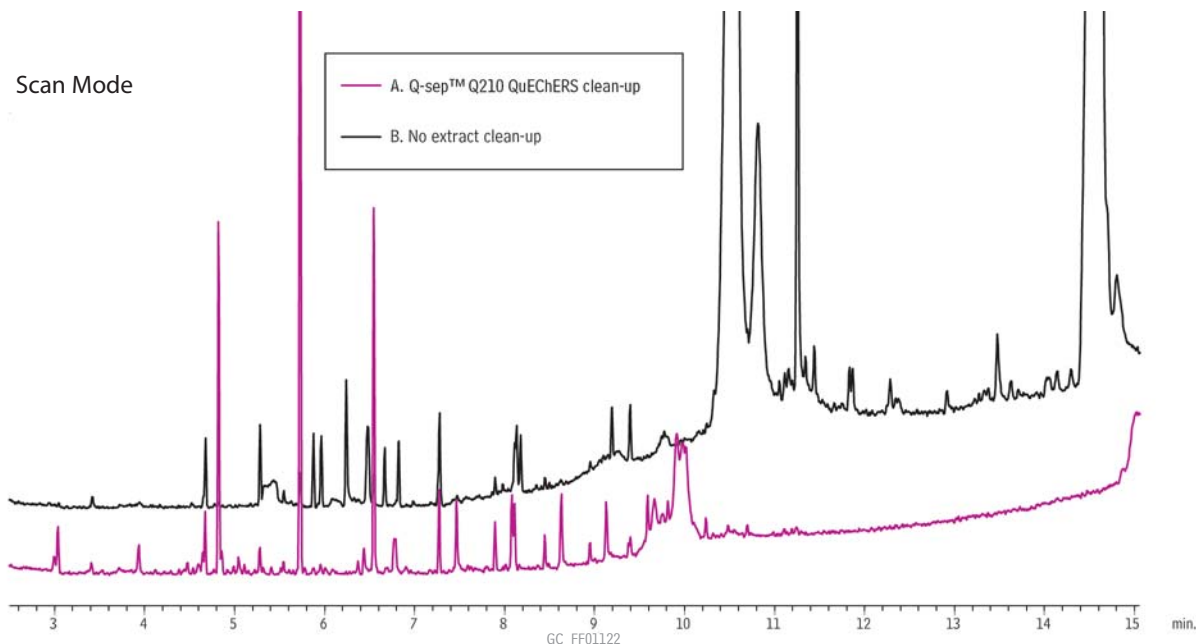


- |                         |                             |
|-------------------------|-----------------------------|
| 1. naphthalene-d8       | 18. aldrin                  |
| 2. dichlorvos           | 19. chlorpyrifos            |
| 3. acenaphthene-d10     | 20. heptachlor epoxide      |
| 4. methacrifos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

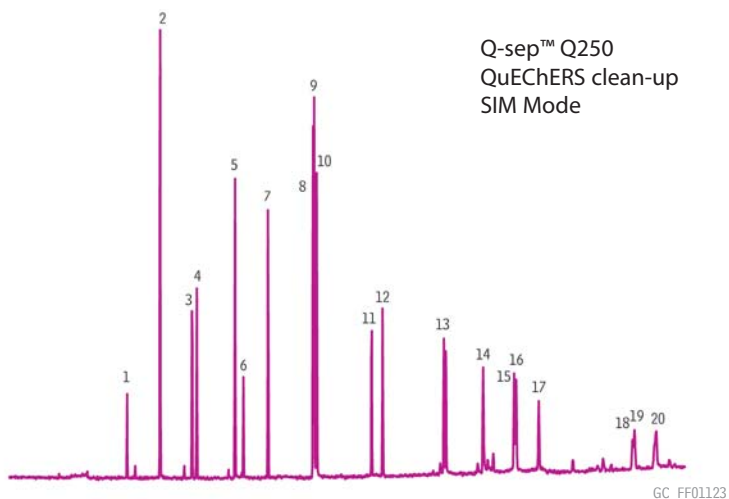
# Polycyclic Aromatic Hydrocarbons in Infant Formula with and without QuEChERS dSPE Clean-up Rxi®-5Sil MS

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

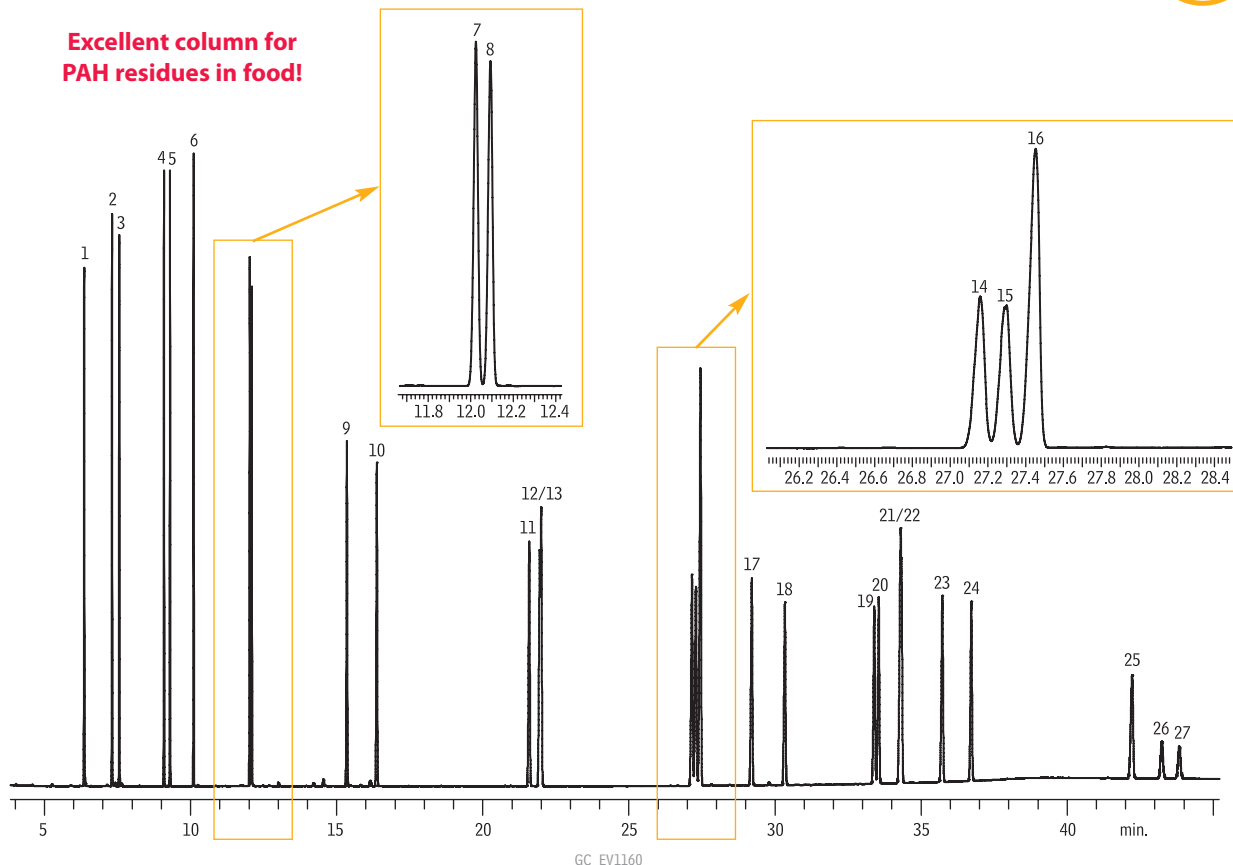
Ionization: EI

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. Dibenzo[a,h]acridine
20. Dibenzo[a,j]acridine
21. Indeno[1,2,3-cd]pyrene
22. Dibenzo[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 Sample

Diluent:  
Conc.:  
**Injection**  
Inj. Vol.:  
Liner:  
Inj. Temp.:  
Purge Flow:  
**Oven**  
Oven Temp.:  
**Carrier Gas**  
Flow Rate:  
**Detector**  
**Instrument**  
**Acknowledgement**

Rxi®-17Sil MS, 30 m, 0.25 mm ID, 0.25  $\mu$ m (cat.# 14123)  
SV Calibration Mix #5 / 610 PAH Mix (cat.# 31011)  
EPA Method 8310 PAH Mixture (cat.# 31841)  
dichloromethane  
10 ppm

0.5  $\mu$ L splitless (hold 1.75 min.)  
Auto SYS XL PSS Split/Splitless w/Wool (cat.# 21718)  
320  $^{\circ}$ C  
75 mL/min.  
65  $^{\circ}$ C (hold 0.5 min.) to 220  $^{\circ}$ C at 15  $^{\circ}$ C/min. to 330  $^{\circ}$ C at 4  $^{\circ}$ C/min. (hold 15 min.)  
He, constant flow  
2.0 mL/min.  
FID @ 320  $^{\circ}$ C  
PE Clarus 600 GC  
Instrument provided by PerkinElmer

## Chromatogram Search Tool

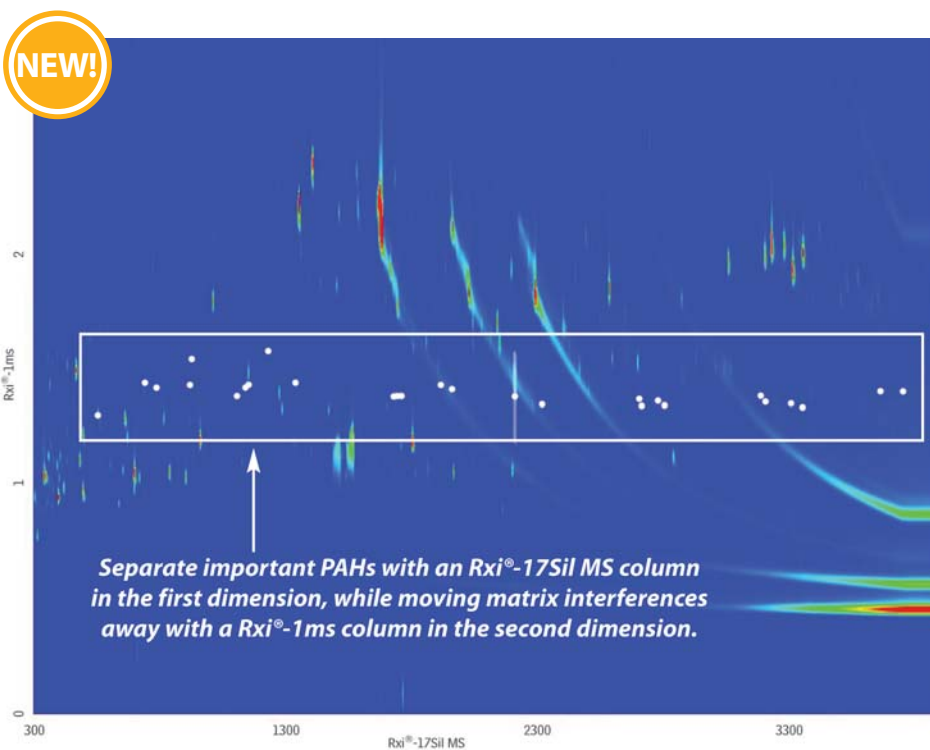
Search by compound name, synonym,  
CAS # or keyword

[www.restek.com/chromatograms](http://www.restek.com/chromatograms)





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



GC\_FF1197

## 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. Dibenzo(a,h)anthracene
24. Indeno(1,2,3-cd)pyrene
25. Benzo(ghi)perylene

**Column** Rxi®-17Sil MS 30 m, 0.25 mm ID, 0.25  $\mu$ m (cat.# 14123)  
Rxi®-1ms 1.2 m, 0.15 mm ID, 0.15  $\mu$ m (cat.# custom)

**Sample** NIST SRM 2974a freeze-dried mussel tissue with incurred residues

**Diluent:** Acetonitrile

**Injection** 1  $\mu$ L splitless (hold 1 min.)

**Inj. Vol.:** Gooseneck Splitless (4mm) w/Semivolatiles Wool (cat.# 20798-231.1)

**Liner:** 250 °C

**Purge Flow:** 40 mL/min.

**Oven** 250 °C

**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

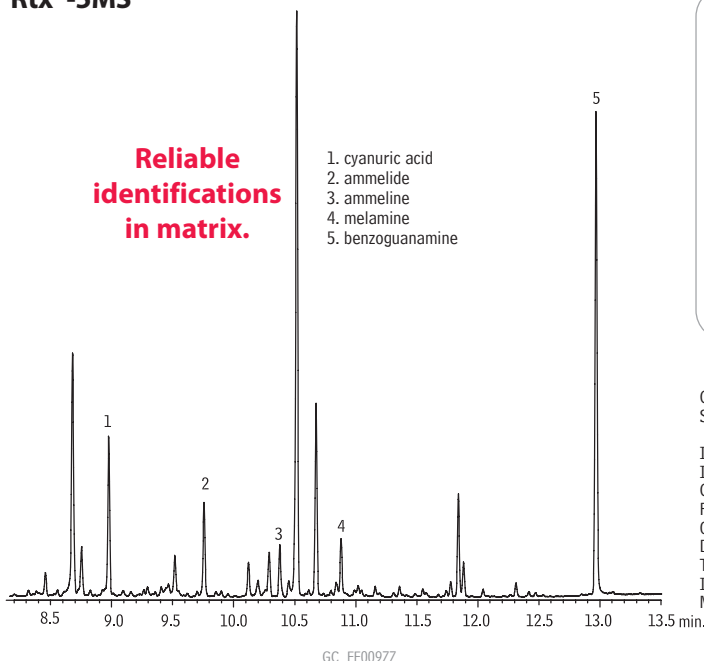
**Spectral** Acquisition Rate: 100 spectra/sec

**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.

## Melamine Spike in Cat Food

Rtx®-5MS



GC\_FF00977

## Get More!

High Sensitivity  
Melamine GC/MS  
Analysis of Cat FoodModified Conditions Save Costs  
and Reduce Maintenanceread the full article  
at [www.restek.com/melamine](http://www.restek.com/melamine)

**Column:** Rtx®-5MS, 30m, 0.25mm ID, 0.25 $\mu$ m (cat.# 12623)

**Sample:** melamine, cyanuric acid, ammelide, ammeline, benzoguanamine in dry cat food (10 $\mu$ g/mL prederivatized)

**Inj.:** 1 $\mu$ L, 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

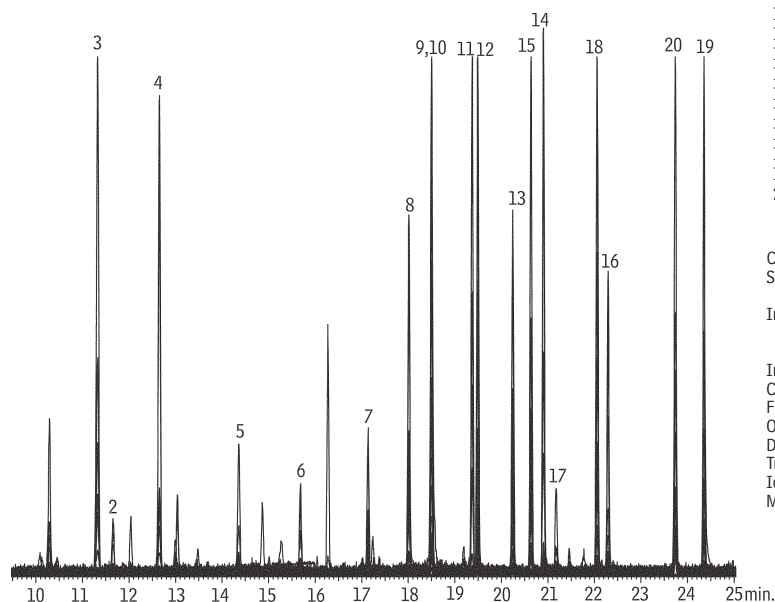
**Mode:** SIM

## Organochlorine Pesticides

Rxi®-5Sil MS

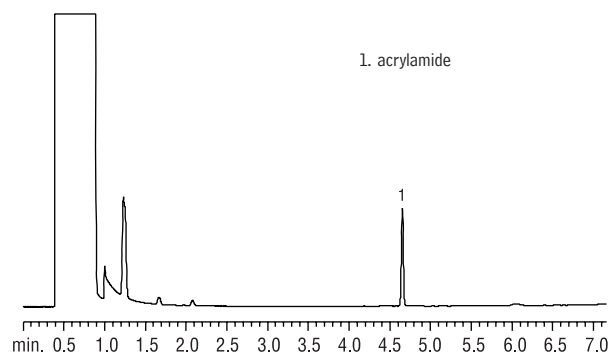
NEW!

Compound	Quant. ion	Q1	Q3
*1. $\alpha$ -BHC	219	181	109
2. $\gamma$ -BHC	219	181	109
3. $\beta$ -BHC	219	181	109
4. $\delta$ -BHC	219	181	109
5. heptachlor	272	237	100
6. aldrin	263	293	220
7. heptachlor epoxide	263	237	81
8. $\gamma$ -chlordane	272	237	65
9. $\alpha$ -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			



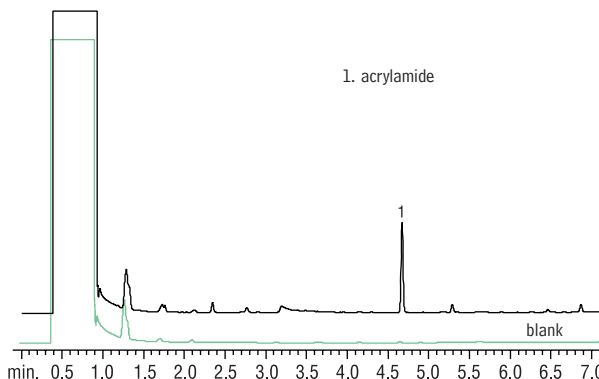
GC\_FF01044

Column: Rxi®-5Sil MS, 30m, 0.25mm ID, 0.25 $\mu$ m (cat.# 13623)  
 Sample: 10 $\mu$ g/mL Organochlorine Pesticide Mix AB # 3 (cat.# 32415) in olive oil  
 Inj.: 1 $\mu$ L, 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, 0.50 $\mu$ m (cat.# 10637)  
 Sample: 25 $\mu$ g/mL acrylamide standard in water  
 Inj.: 1.0 $\mu$ L, 0.5 min hold  
 Liner: 2mm splitless with wool (cat.# 20830)  
 Inj. temp.: 260°C  
 Carrier gas: helium, constant pressure  
 Linear velocity: 62cm/sec. @ 100°C  
 Oven temp.: 100°C (hold 0.5 min.) to 200°C @ 15°C/min.  
 Det.: FID @ 260°C

Acrylamide (Potato Chip Extract)  
Stabilwax®

GC\_FF00643

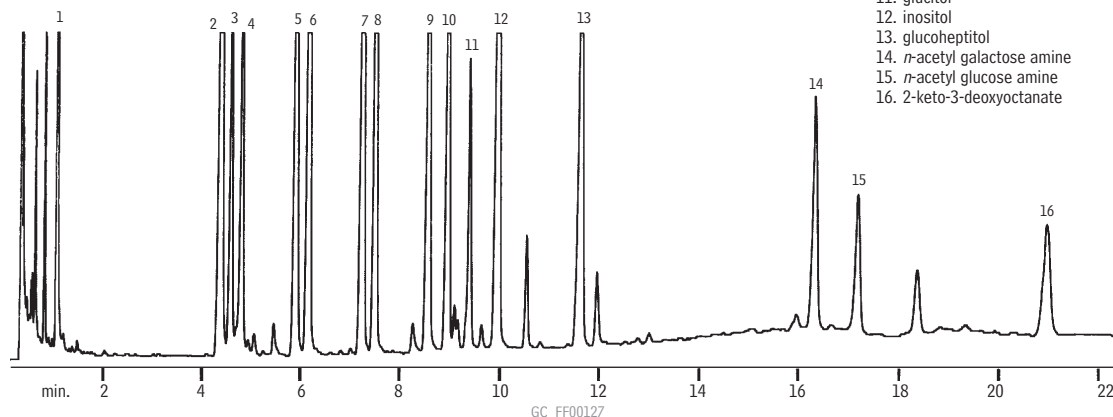
Column: Stabilwax®, 15m, 0.53mm ID, 0.50 $\mu$ m (cat.# 10637)  
 Sample: 1g of potato chips spiked with 100 $\mu$ g acrylamide  
 Inj.: 1.0 $\mu$ L, 0.5 min. hold  
 Liner: 2mm splitless with wool (cat.# 20830)  
 Inj. temp.: 260°C  
 Carrier gas: helium, constant pressure  
 Linear velocity: 62cm/sec.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

## Sugars

## 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

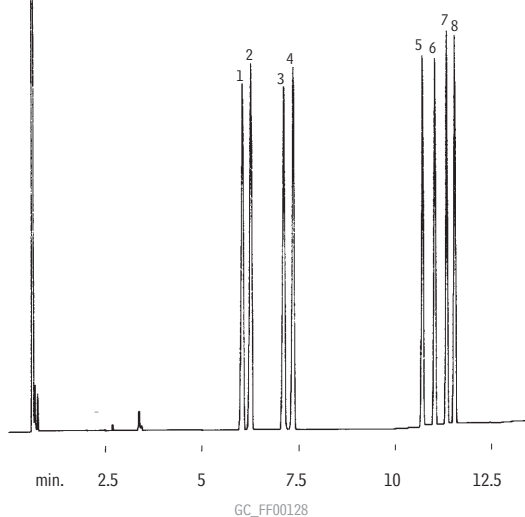


Column: Rt®-2330, 15m, 0.32mm ID, 0.20 $\mu$ m (cat.# 10721)  
 Inj.: 0.6 $\mu$ L split injection  
 Oven temp.: 175°C (hold 2 min.) to 240°C @ 8°C/min. (hold 1 min.) to 265°C @ 8°C/min. (hold 12 min.)  
 Inj./det. temp.: 275°C  
 Carrier gas: helium  
 Linear velocity: 80cm/sec. (flow rate: 10cc/min.)  
 FID sensitivity: 2 x 10<sup>-11</sup> AFS  
 Split ratio: 20:1

## Sugars (Alditol Acetates)

Rtx®-225

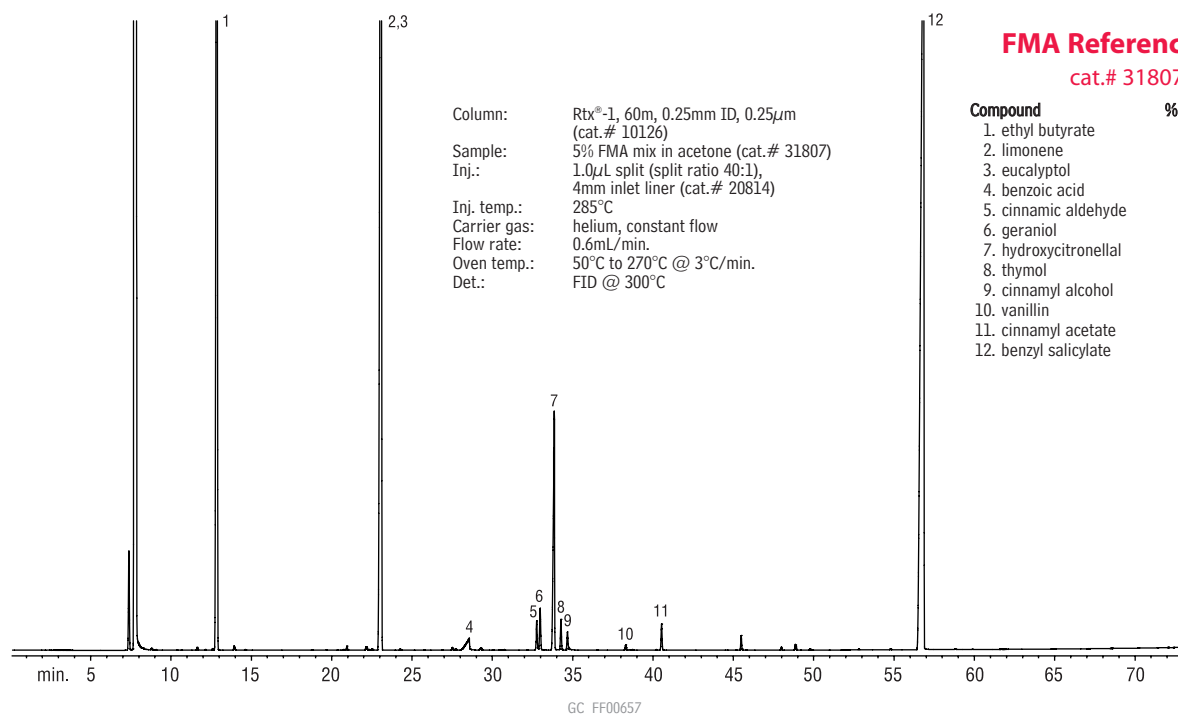
1. rhamnitol
2. fucitol
3. ribitol
4. arabinitol
5. mannitol
6. galactitol
7. glucitol
8. inositol



Column: Rtx®-225, 15m, 0.25mm ID, 0.25 $\mu$ m (cat.# 14020)  
 Inj.: 0.5 $\mu$ L 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<sup>-11</sup> AFS  
 Split ratio: 50:1

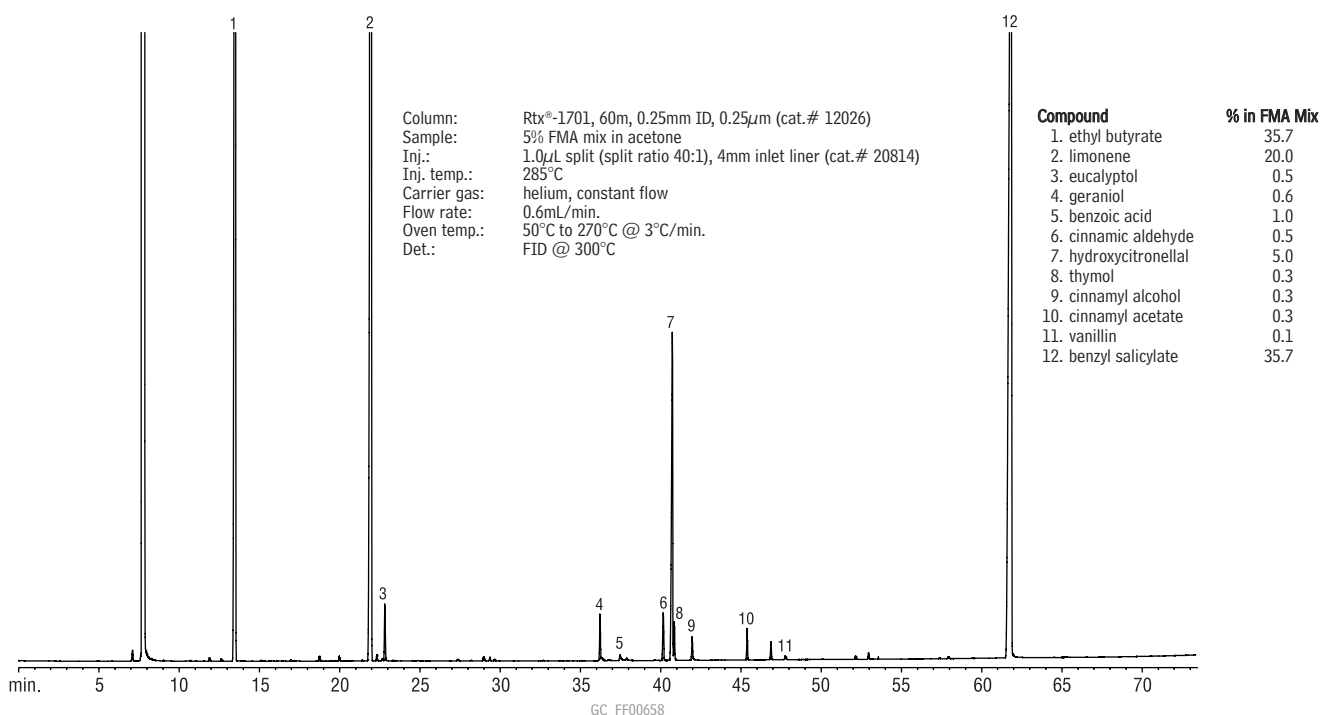
## 5% Fragrance Materials Association Mix

Rtx®-1



## 5% Fragrance Materials Association Mix

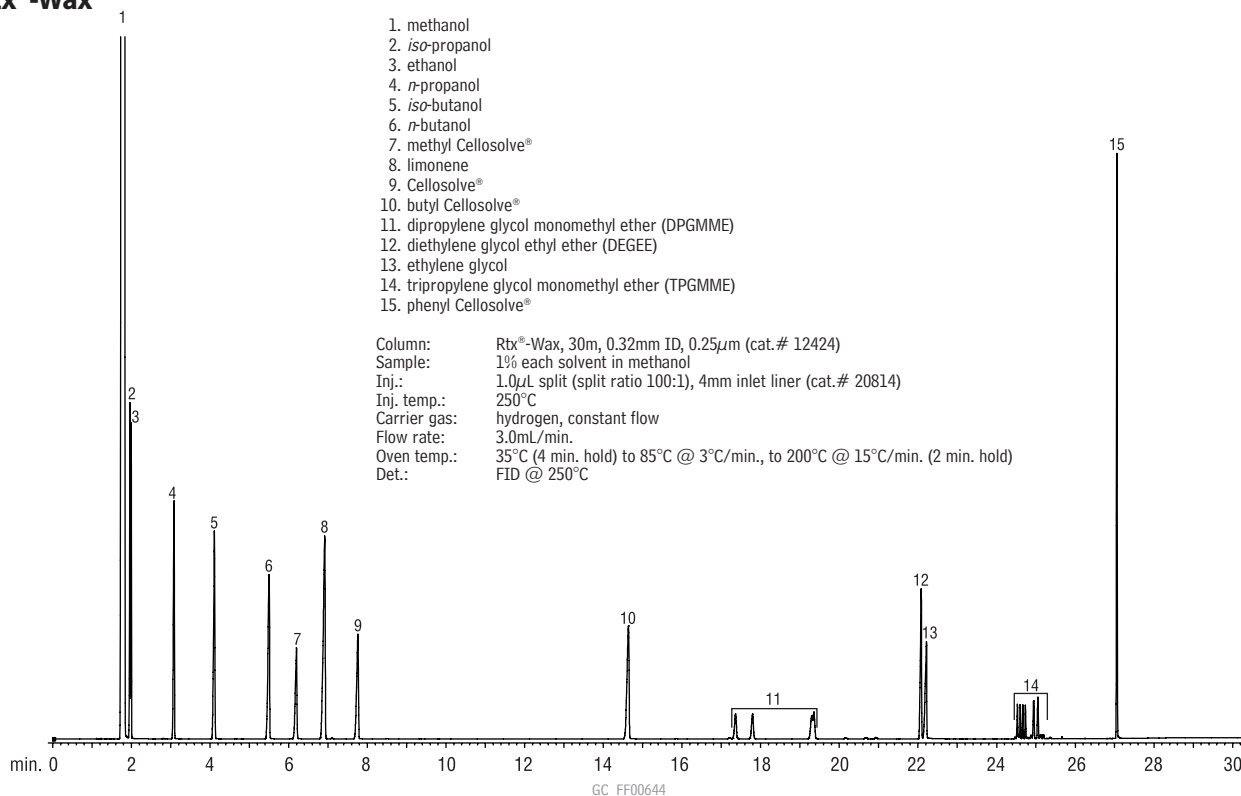
Rtx®-1701



## Cleaning Solvents

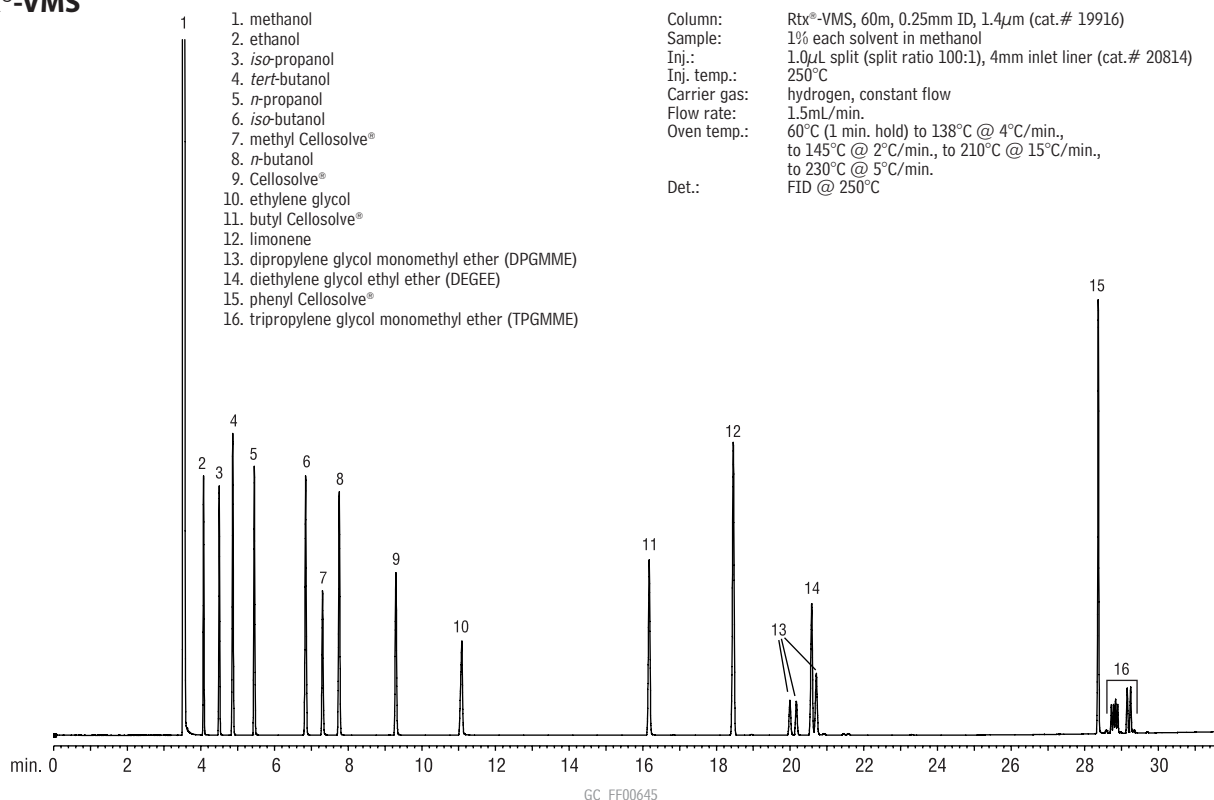
## Cleaning Solvents

## Rtx®-Wax



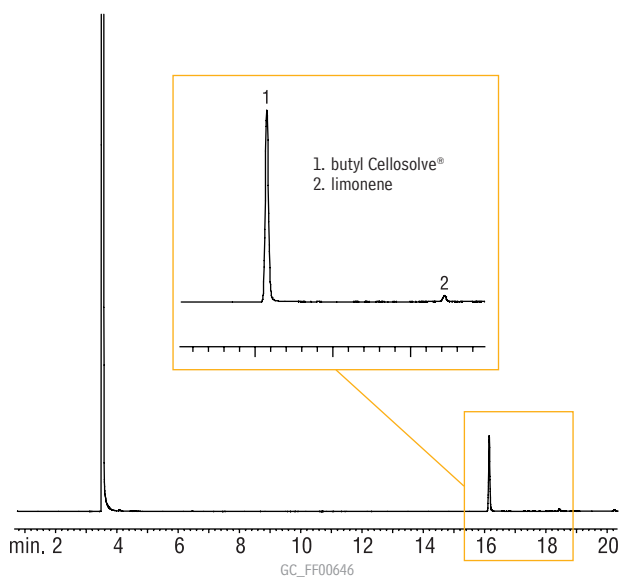
## Cleaning Solvents

## Rtx®-VMS



## Cleaning Solvents (All-Purpose Cleaner)

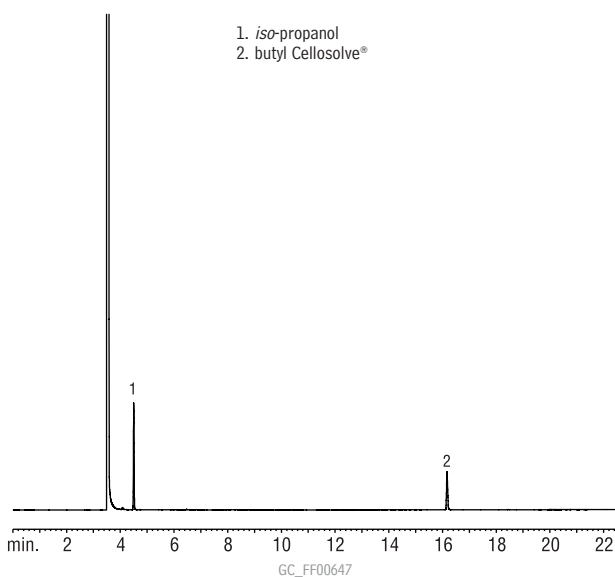
## Rtx®-VMS



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

## Cleaning Solvents (Glass Cleaner)

## Rtx®-VMS



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

Chromatogram  
Search Tool

Search by compound name, synonym,  
CAS # or keyword

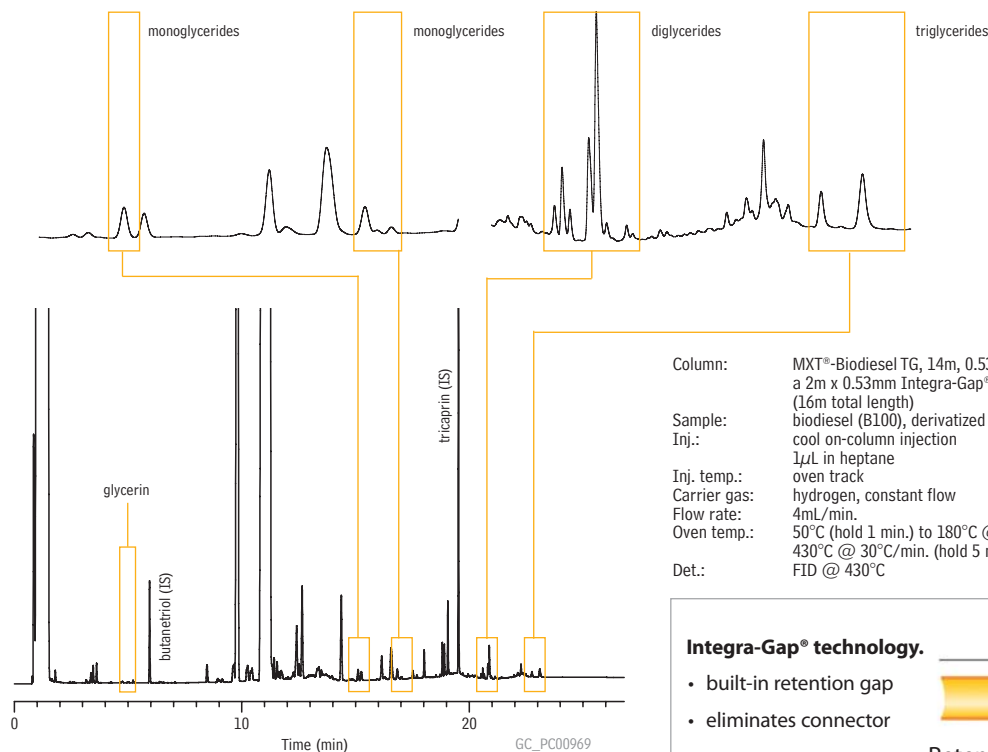
[www.restek.com/chromatograms](http://www.restek.com/chromatograms)





## Total Glycerin in Biodiesel

## MXT®-Biodiesel TG

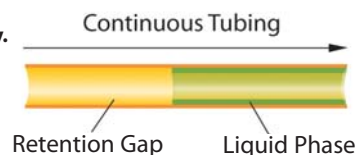


**The best solution  
for analyzing total  
glycerin in biodiesel!**

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

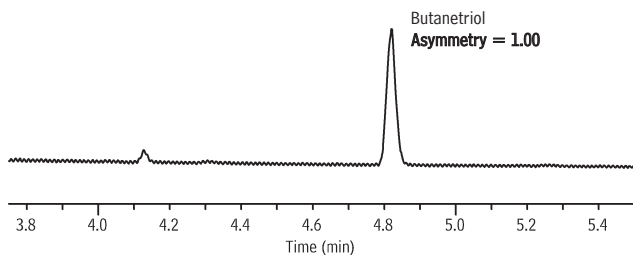
- built-in retention gap
- eliminates connector



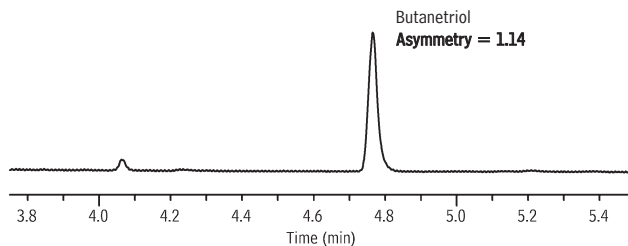
## Biodiesel Oil (B100)

## Rtx®-Biodiesel TG

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

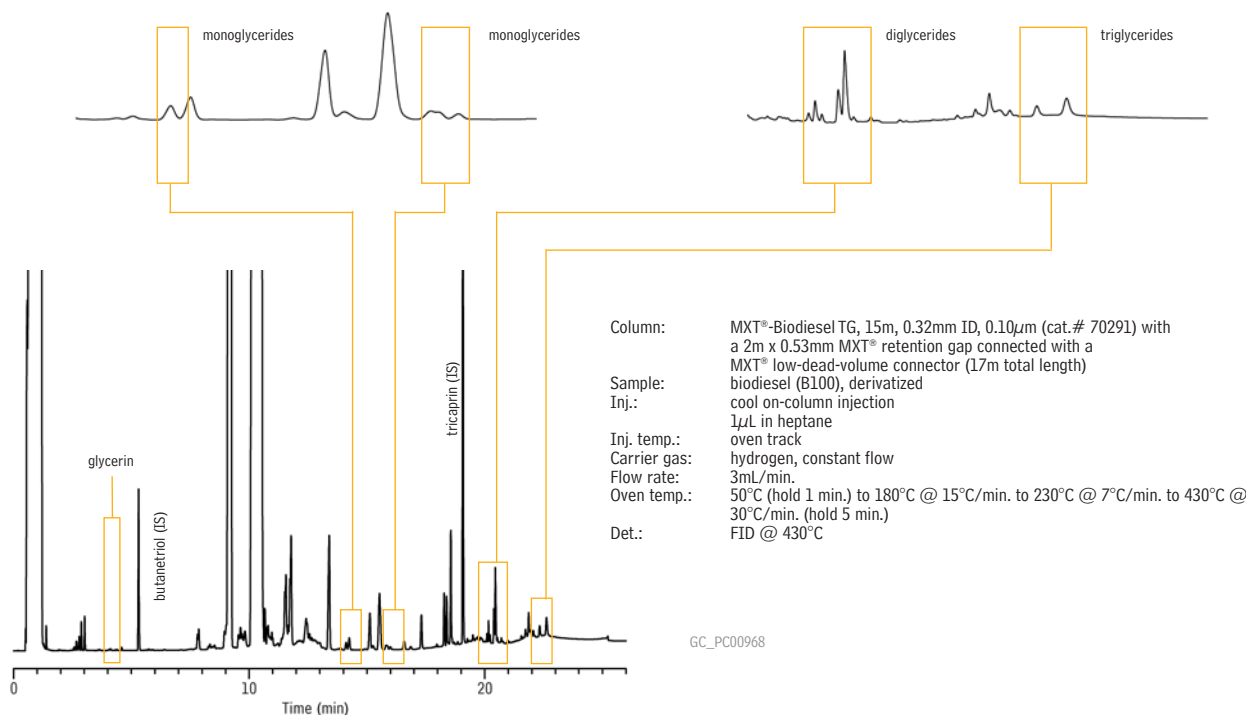


**B. Rtx®-Biodiesel TG  
with Universal Press-Tight® Connector and  
2 meters of 0.53mm ID Hydroguard® tubing**



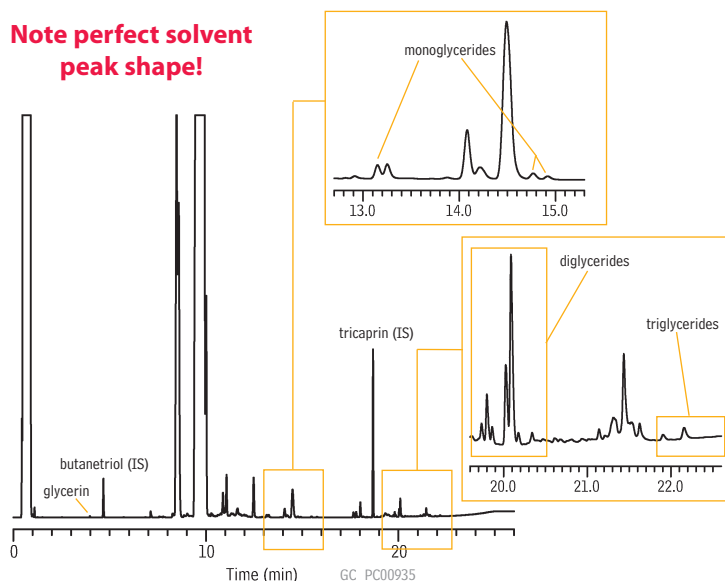
Columns: A. Rtx®-Biodiesel TG, 10m, 0.32mm ID, 0.10 $\mu$ m connected to 2m x 0.53mm Hydroguard® tubing using Alumaseal® connector  
 B. Rtx®-Biodiesel TG, 10m, 0.32mm ID, 0.10 $\mu$ m connected to 2m x 0.53mm Hydroguard® tubing using Universal Press-Tight® connector  
 Sample: biodiesel (B100) with butanetriol at 12.5ppm (12.5ng on-column)  
 Inj.: 1 $\mu$ L, cool on-column injection  
 Inj. temp.: oven track mode  
 Carrier gas: hydrogen, constant flow 4cc/min.  
 Linear velocity: 79cm/sec.  
 Oven temp.: 50°C (hold 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



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

**Note perfect solvent peak shape!**



Column: MXT®-Biodiesel TG, 10m, 0.32mm ID, 0.1 $\mu$ m with 2m x 0.53mm retention gap (cat.# 70290)

Sample: B100 + IS butanetriol & tricaprins derivatized with MSTFA as per ASTM D-6584

Inj.: 1.0 $\mu$ L cool on-column

Inj. temp.: oven track

Carrier gas: hydrogen, constant flow

Flow rate: 4mL/min.

Oven temp.: 50°C (hold 1 min.) to 180°C @ 15°C/min., to 230°C @ 7°C/min., to 430°C @ 30°C/min. (hold 5 min.)

Det.: FID @ 430°C

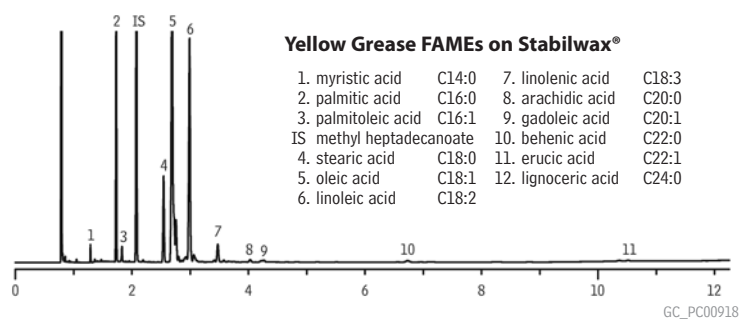
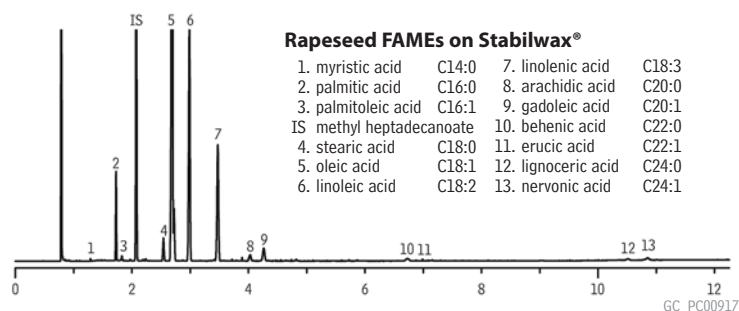
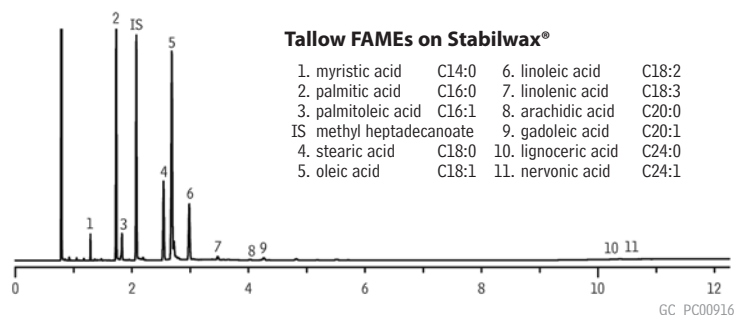
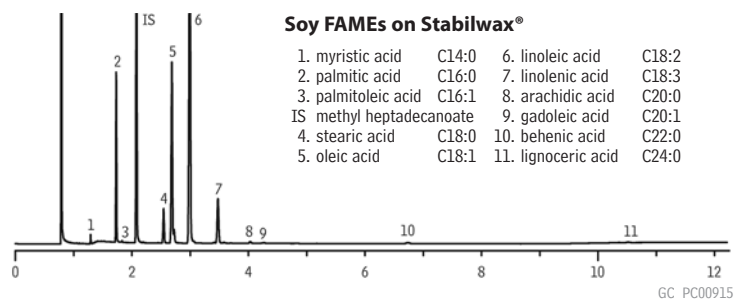
# Get More!

Biodiesel Solutions  
Online

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## FAMES in Biodiesel Oils

## Stabilwax®

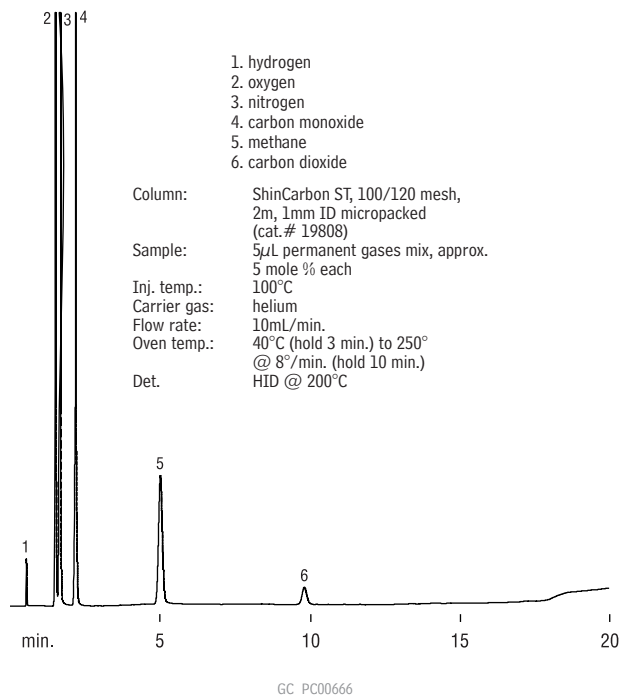


Column: Stabilwax®, 30m, 0.32mm ID, 0.25µm (cat.# 10624)  
 Sample: various sources of biodiesel (B100), prepared according to European Method EN 14103  
 Inj.: 1.0µL split (split ratio 100:1), Cyclosplitter® inlet liner (cat.# 20706)  
 Inj. temp.: 250°C  
 Carrier gas: hydrogen, constant flow, 3mL/min.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

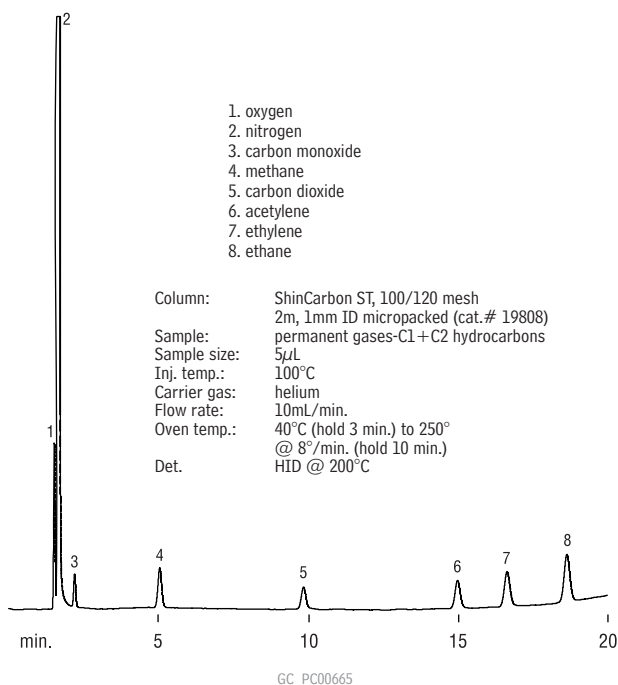
(micropacked)



## Permanent Gases, C1+C2 hydrocarbons

### ShinCarbon ST

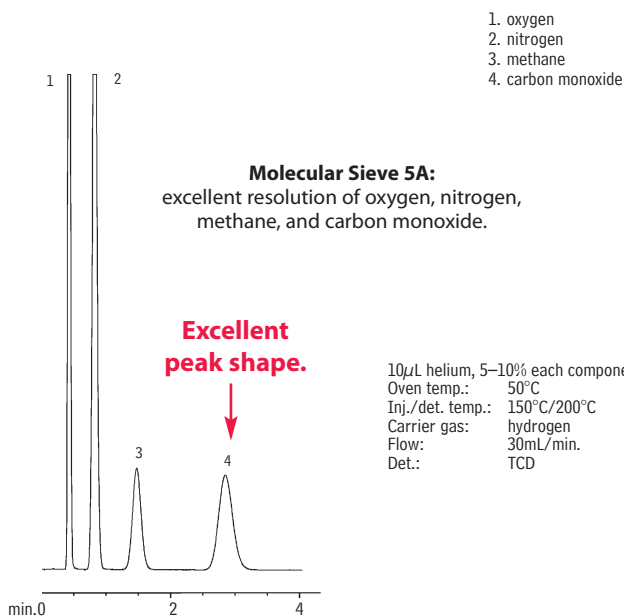
(micropacked)



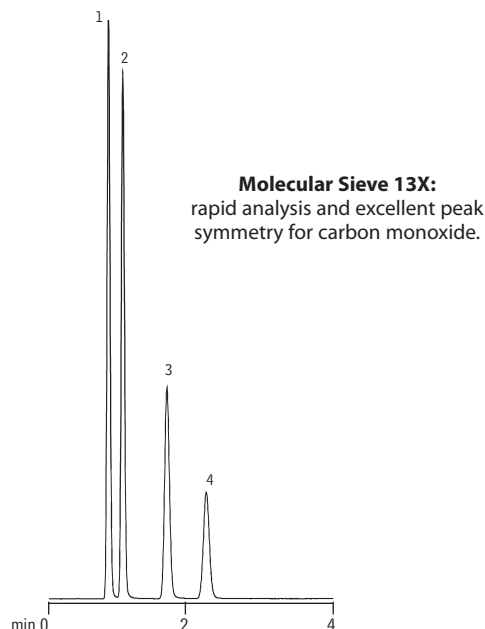
## Permanent Gases

### Molecular Sieve 5A and Molecular Sieve 13X

(packed)



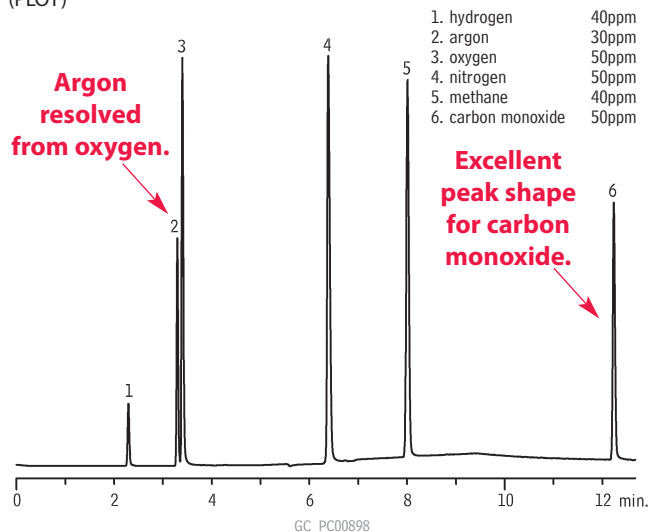
Molecular Sieve 5A 80/100 mesh  
1m x 1/8" x 2mm ID SilcoSmooth® tubing (cat.# 80440-800)



## Permanent Gases

### Rt®-Msieve 5A

(PLOT)

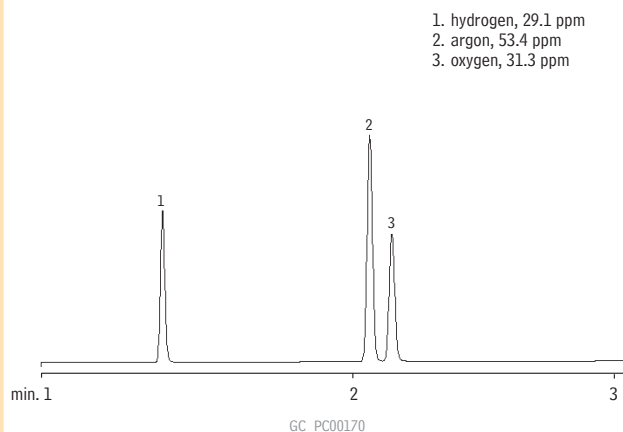


Column: Rt®-Msieve 5A, 30m, 0.53mm ID, 50µm (cat.# 19723)  
Sample: permanent gases (ppm)  
Inj.: 5µL sample loop, 6-port Valco® valve, valve temp.: ambient  
Inj. temp.: 200°C  
Carrier gas: helium, constant flow  
Flow: 5mL/min.  
Oven temp.: 27°C (hold 5 min.) to 100°C @ 10°C/min. (hold 5 min.)  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

## Permanent Gases

### Rt®-Msieve 5A

(PLOT)



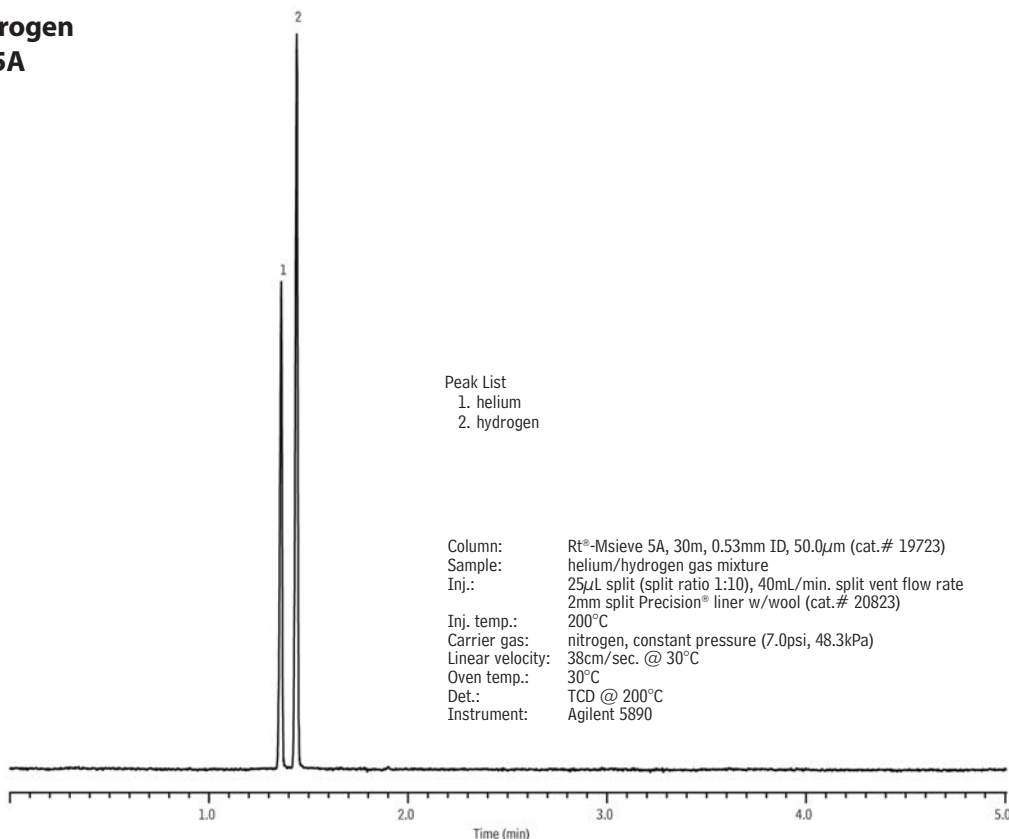
Column: Rt®-Msieve 5A, 30m, 0.53mm ID, 50µm (cat.# 19723)  
Sample: 0.5mL (sample loop injection)  
Column temp.: 27°C  
Carrier gas: helium  
Linear velocity: 34cm/sec.  
Det.: Valco® HID

Chromatogram courtesy of Larry McElmurry, Mobile Analytical Labs.

## Helium/Hydrogen

### Rt®-Msieve 5A

(PLOT)



NEW!

## Chlorofluorocarbon Gases

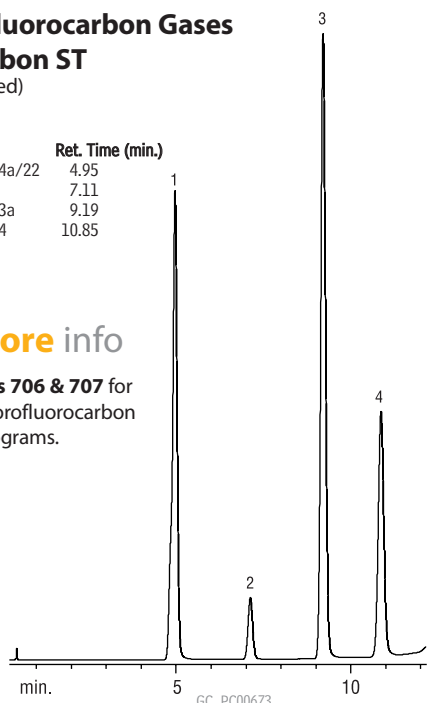
### ShinCarbon ST

(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.



GC\_PC00673  
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.

## ChromaBLOGraphy

Topical and timely insights from top chromatographers.

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## Butane Lighter Fluid

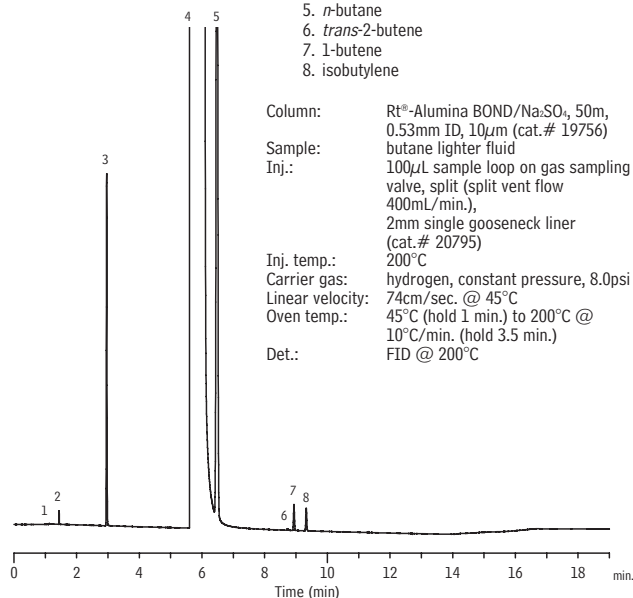
### Rt®-Alumina BOND/Na<sub>2</sub>SO<sub>4</sub>

(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<sub>2</sub>SO<sub>4</sub>, 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



GC\_PC01083

## Propane Camping Fuel

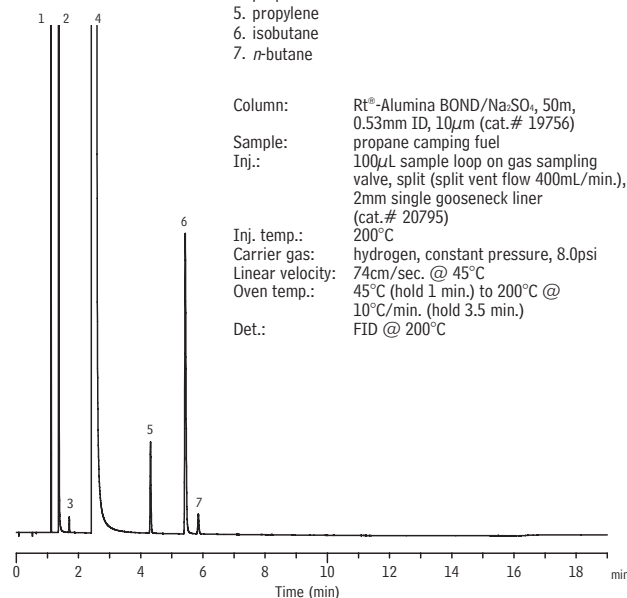
### Rt®-Alumina BOND/Na<sub>2</sub>SO<sub>4</sub>

(PLOT)

**NEW!**

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

Column: Rt®-Alumina BOND/Na<sub>2</sub>SO<sub>4</sub>, 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



GC\_PC01084

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**11/12**

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## Hydrocarbon Gases

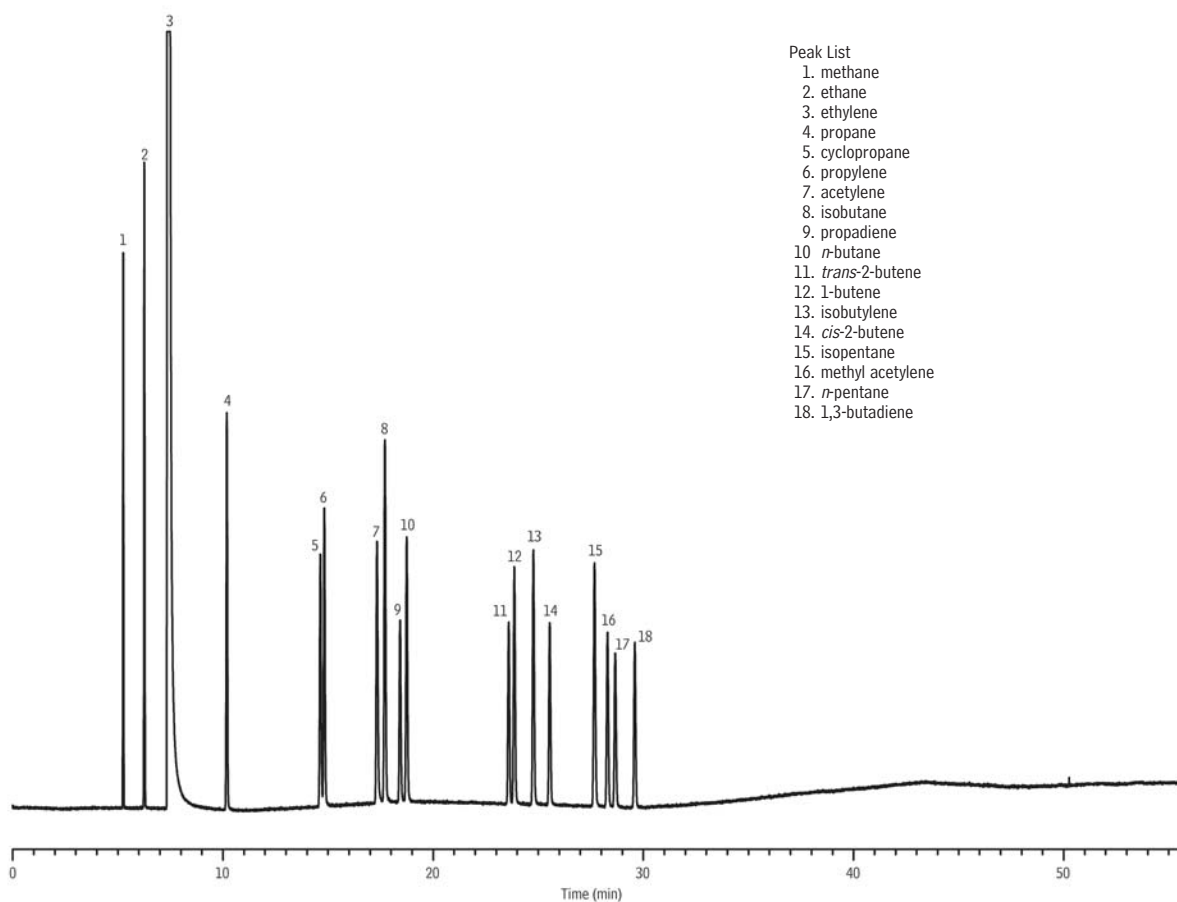
## Ethylene and C1-C5 Hydrocarbons

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

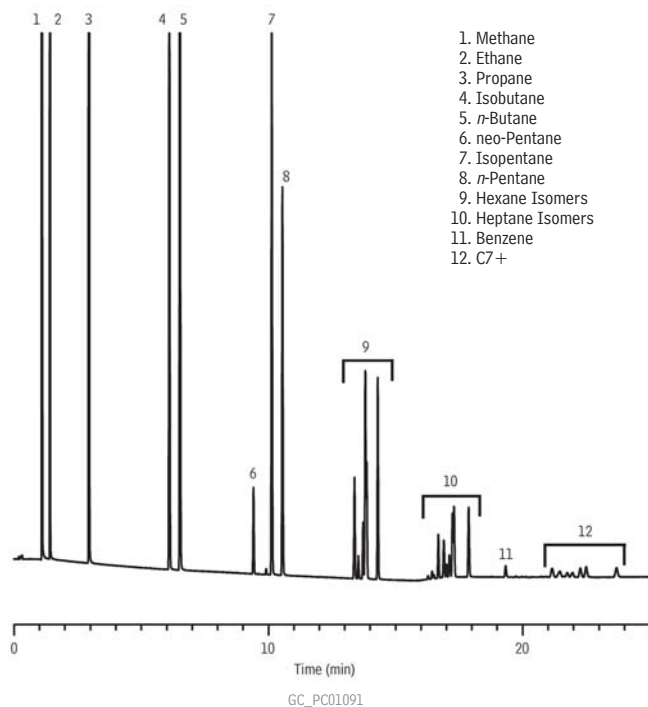
Instrument: Agilent 5890

NEW!

## Natural Gas

### Rt®-Alumina BOND/KCl

(PLOT)



Column Sample Rt®-Alumina BOND/KCl, 50 m, 0.53 mm ID, 10 µm (cat. # 19760)  
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<sub>2</sub>, constant pressure (8.0 psi, 55.2kPa)  
Linear Velocity: 45 cm/sec. @ 45 °C

#### Detector

Make-up FID @ 200 °C  
Gas Type: N<sub>2</sub>  
Data Rate: 20 Hz

#### Instrument

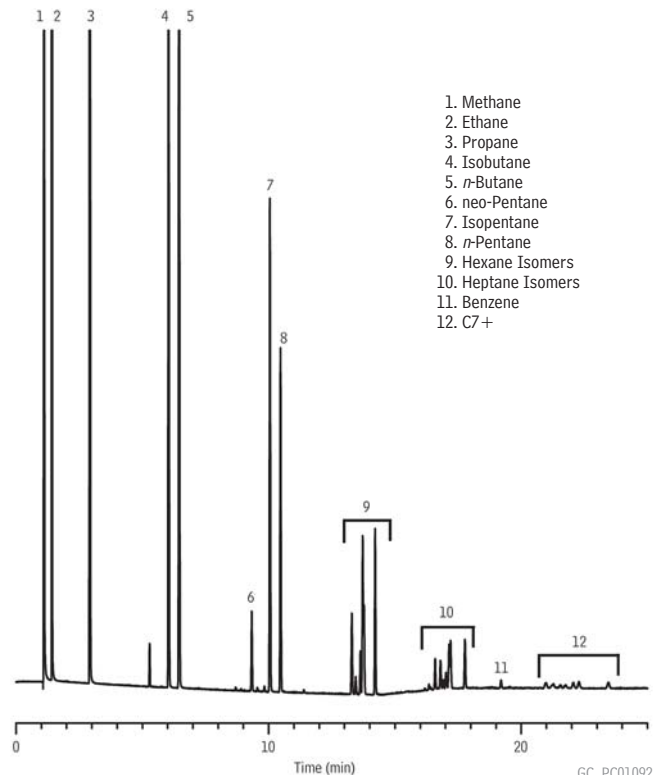
HP5890 GC



## Natural Gas

### Rt®-Alumina BOND/Na<sub>2</sub>SO<sub>4</sub>

(PLOT)



Column Sample Rt®-Alumina BOND/Na<sub>2</sub>SO<sub>4</sub>, 50 m, 0.53 mm ID, 10 µm (cat. # 19756)  
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<sub>2</sub>, constant pressure (8.0 psi, 55.2kPa)  
Linear Velocity: 45 cm/sec. @ 45 °C

#### Detector

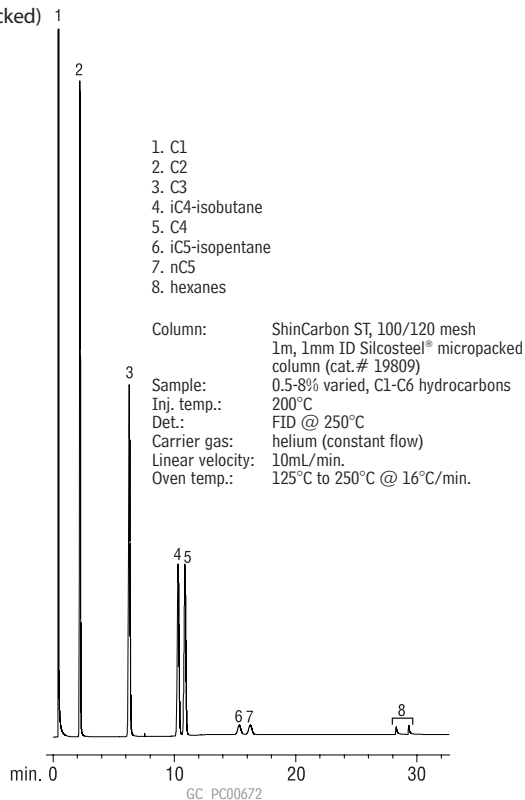
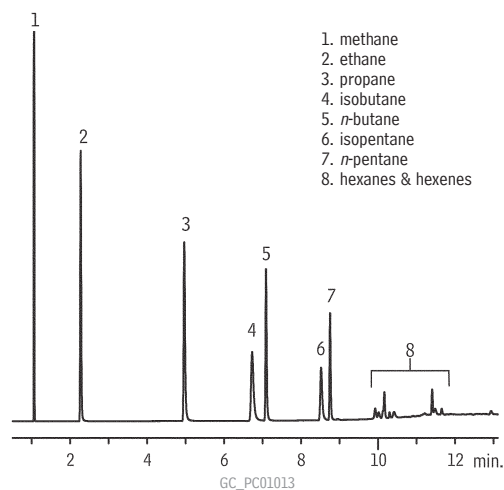
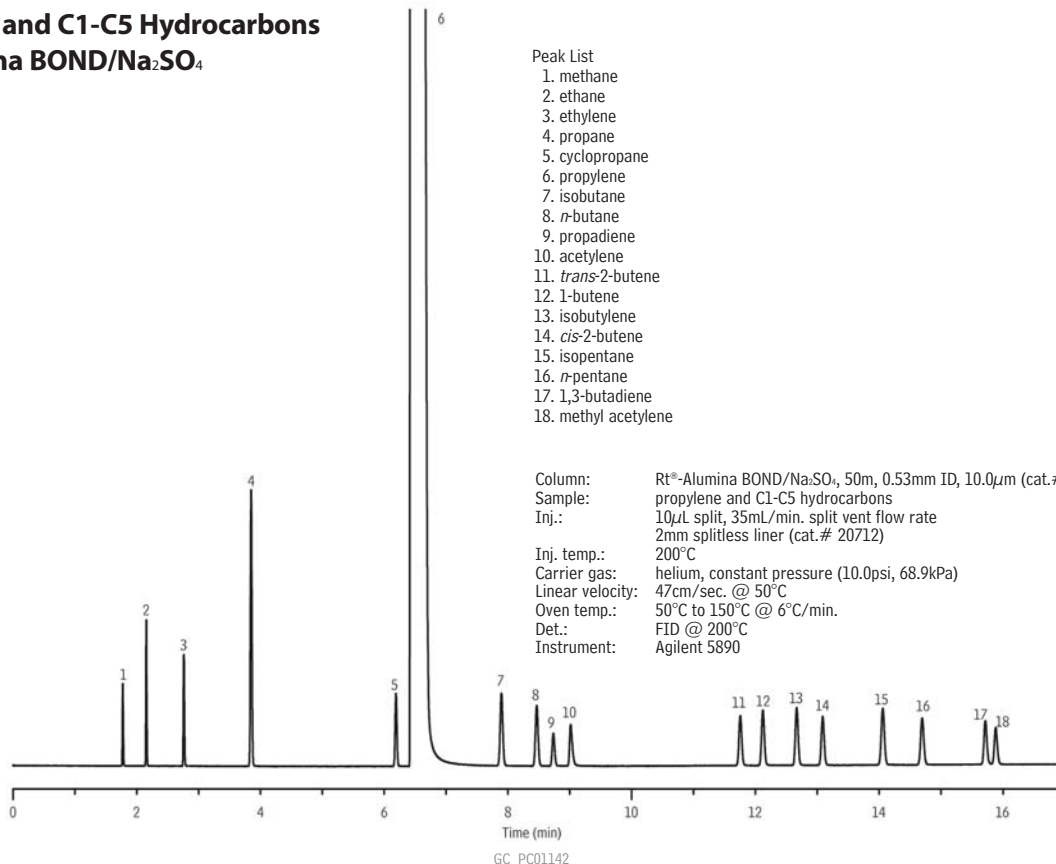
Make-up FID @ 200 °C  
Gas Type: N<sub>2</sub>  
Data Rate: 20 Hz

#### Instrument

HP5890 GC

NEW!

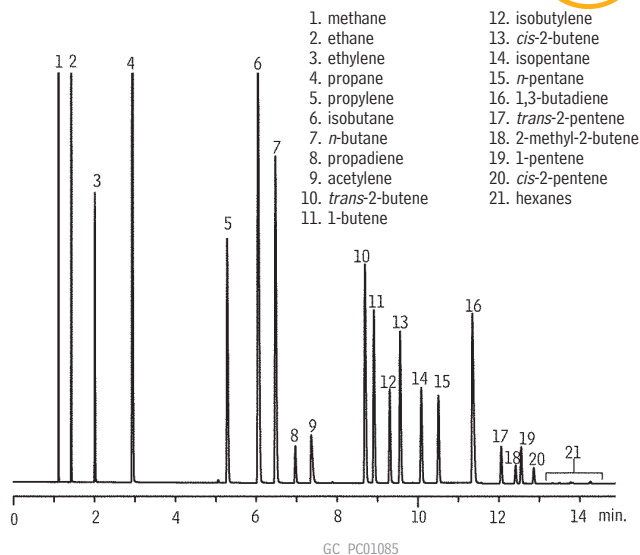
## Hydrocarbon Gases

Natural Gas  
ShinCarbon ST  
(micropacked)Natural Gas #2  
Rt®-QS-BOND  
(PLOT)Propylene and C1-C5 Hydrocarbons  
Rt®-Alumina BOND/Na<sub>2</sub>SO<sub>4</sub>  
(PLOT)

## Refinery Gas

**Rt®-Alumina BOND/Na<sub>2</sub>SO<sub>4</sub>**  
(PLOT)

NEW!



Column: Rt®-Alumina BOND/Na<sub>2</sub>SO<sub>4</sub>, 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

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Fax: 814-353-1309—24-hours a day

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### Outside the U.S.

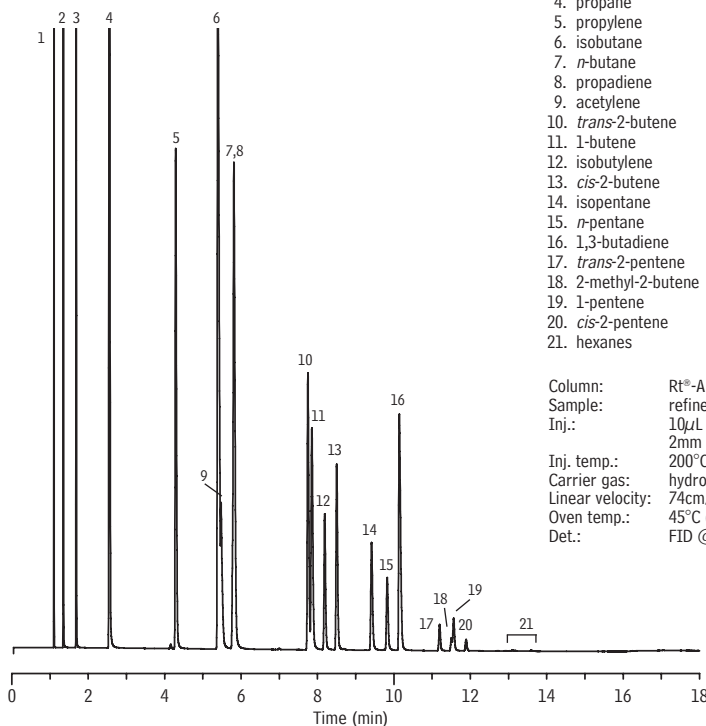
Contact your Restek representative:

Refer to our list on pages 4-5 or visit our website at [www.restek.com](http://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

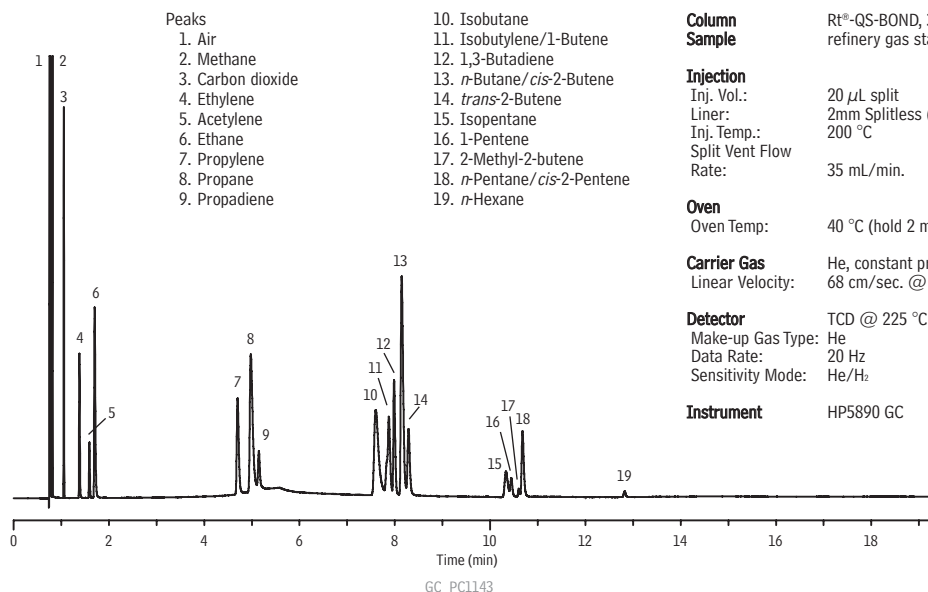
Column: Rt®-Alumina BOND/KCl, 50m, 0.53mm ID, 10μm (cat.# 19760)  
Sample: refinery gas  
Inj.: 10μL split (split vent flow 80mL/min.), 2mm single gooseneck liner (cat.# 20795)  
Inj. temp.: 200°C  
Carrier gas: hydrogen, constant pressure, 8.0psi  
Linear velocity: 74cm/sec. @ 45°C  
Oven temp.: 45°C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

**Refinery Gas Mixture**

**Rt®-QS-BOND**

(PLOT)

**NEW!**



**Column Sample**

Rt®-QS-BOND, 30 m, 0.53 mm ID, 20  $\mu$ m (cat.# 19738)  
 refinery gas standard

**Injection**

Inj. Vol.: 20  $\mu$ L 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**

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

**Detector**

TCD @ 225 °C  
 Make-up Gas Type: He  
 Data Rate: 20 Hz  
 Sensitivity Mode: He/H<sub>2</sub>

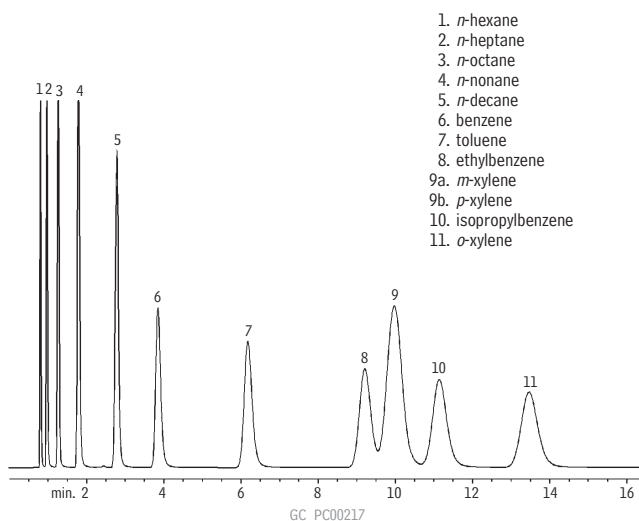
**Instrument**

HP5890 GC

**Aromatics, Aliphatics**

**10% TCEP 100/120 Chromosorb® PAW**

(packed)



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<sup>-10</sup> AFS

**Chromatogram  
 Search Tool**

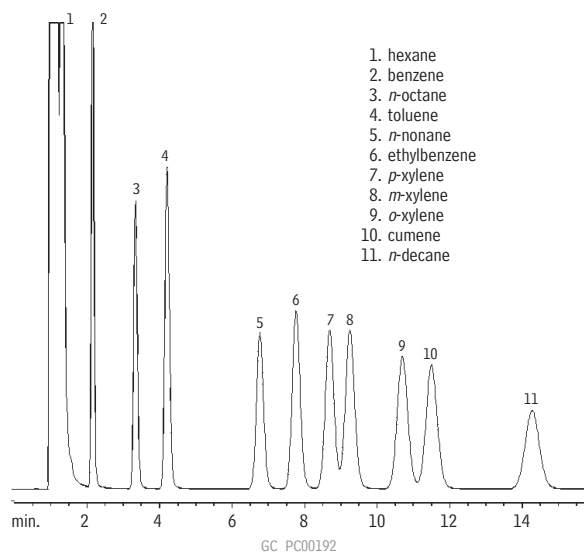
Search by compound name, synonym,  
 CAS # or keyword

[www.restek.com/chromatograms](http://www.restek.com/chromatograms)



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

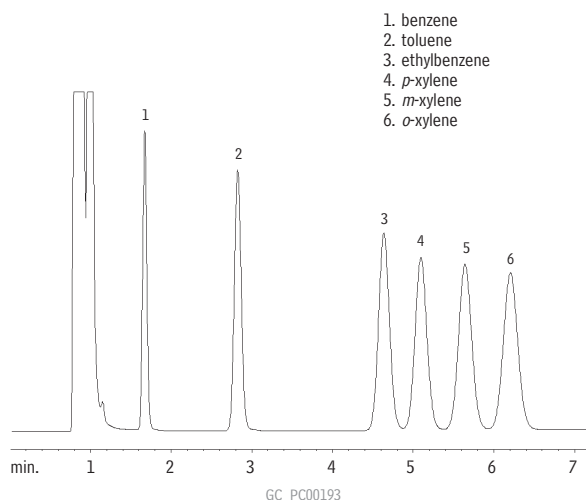
(packed)



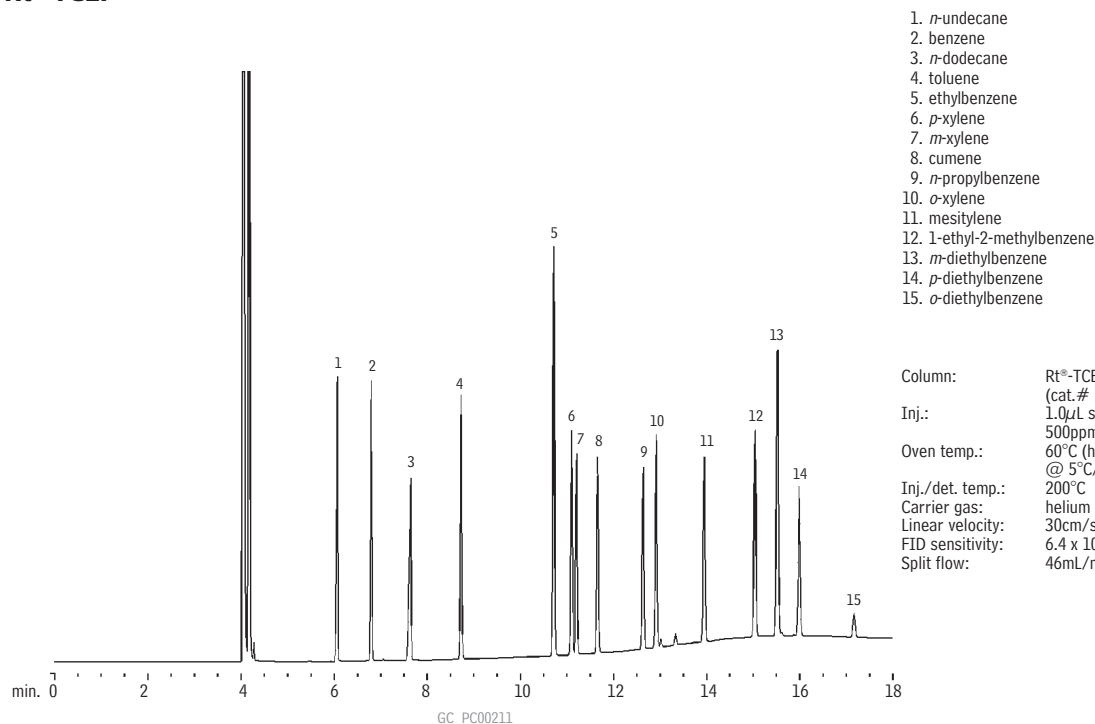
Column: 5% Rt®-1200/1.75% Bentone® 34 on 100/120 Silcoport®, 1.8m, 1/8" OD, 2mm ID SilcoSmooth® tubing (cat.# 80125)  
 Sample size: 0.1µL  
 Conc.: 0.5µg/µL in hexane  
 Oven temp.: 75°C  
 Inj./det. temp.: 200°C  
 Carrier gas: nitrogen  
 Flow rate: 20mL/min.  
 FID sensitivity: 32 x 10<sup>-11</sup> 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<sup>-11</sup> 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<sup>-11</sup> AFS  
 Split flow: 46mL/min.



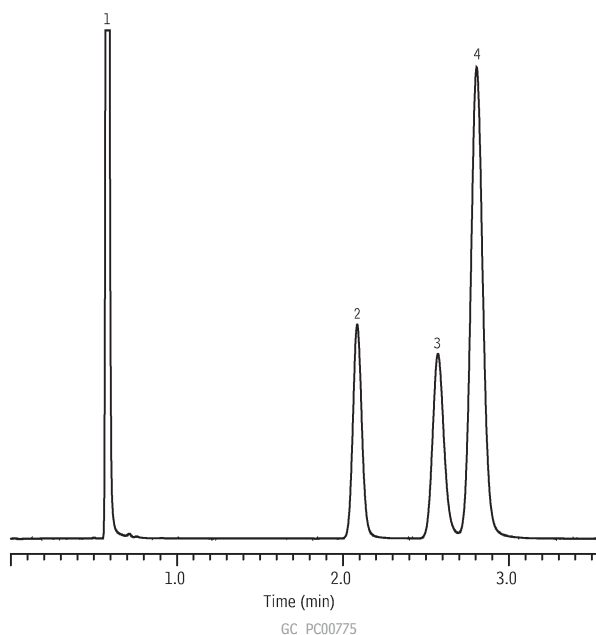
## Hydrocarbons

## Motor Oil &amp; Aviation Gas

## ASTM Method D3606-99

## 10% Rtx®-1 &amp; 20% TCEP

(micropacked)



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

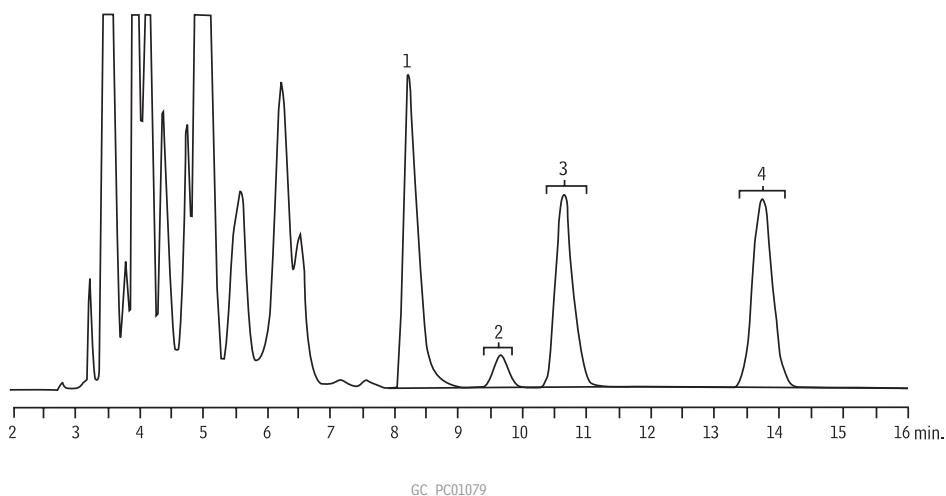
B: 20% TCEP on 80/100 Chromosorb® PAW, 4.0m, 1/16 inch, 1mm ID Silcosteel® tubing connected in series and using Micropacked Column On-Column Injection Kit

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)

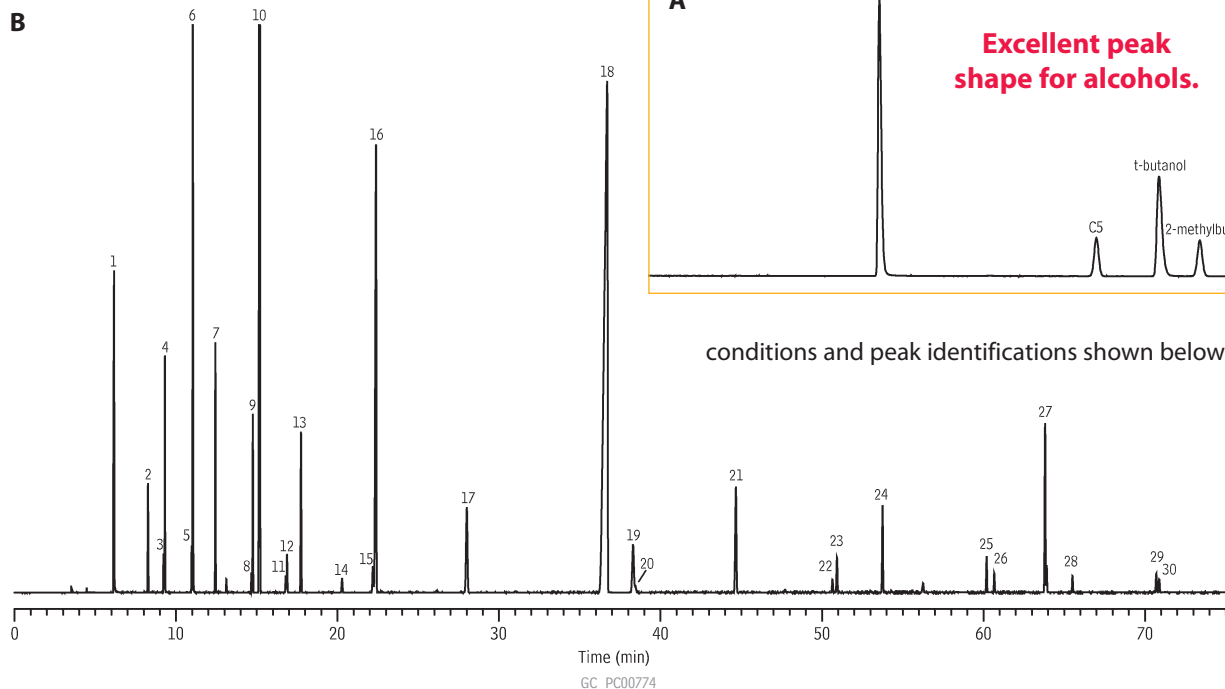


1. ethanol
2. benzene
3. 2-butanol
4. toluene

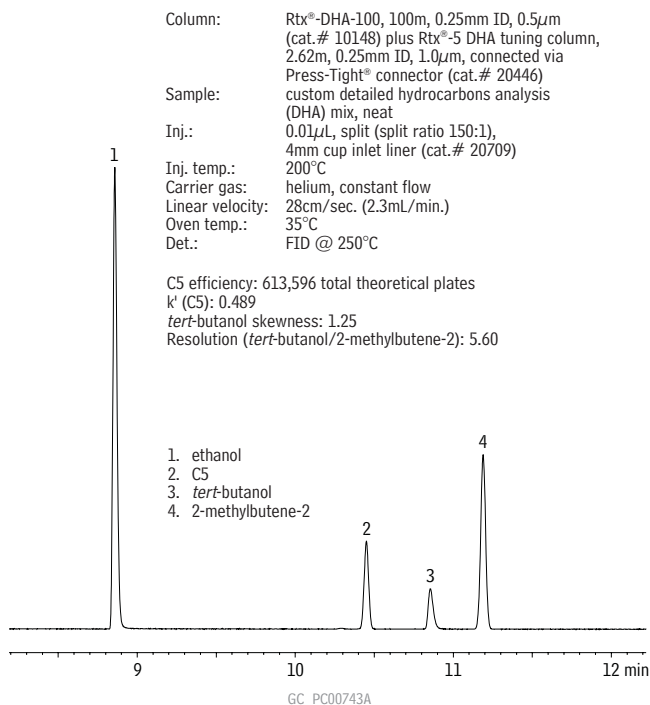
Column: D3606 Application Column (2 column set, cat.# 83606-800)  
 Column 1: nonpolar Rtx®-1, 6' (1.8m), 1/8" OD, 2.0mm ID  
 Column 2: proprietary packing material, 16' (4.9m), 1/8" OD, 2.0mm ID  
 Sample: 1.5µL gasoline with internal standard  
 Inj.: 200°C  
 Backflush: 3 min.  
 Carrier gas: helium,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

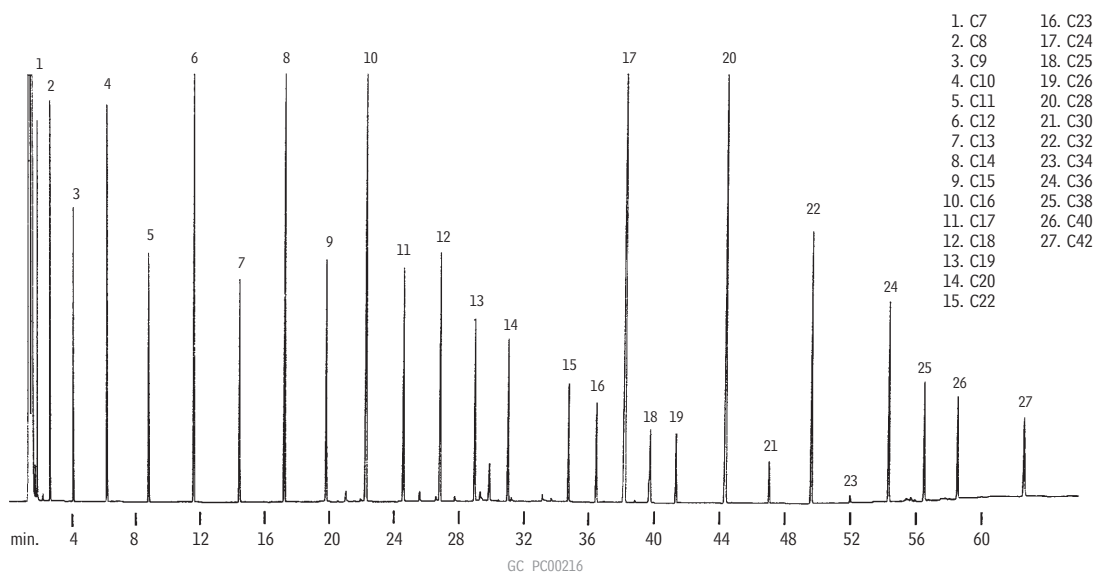
- ethanol
- C5
- tert-butanol
- 2-methylbutene-2
- 2,3-dimethylbutane
- methyl tert-butyl ether (MTBE)
- C6
- 1-methylcyclopentane
- benzene
- cyclohexane
- 3-ethylpentane
- 1,2-dimethylcyclopentane
- C7
- 2,2,3-trimethylpentane
- 2,3,3-trimethylpentane
- toluene
- C8
- ethylbenzene
- p-xylene
- 2,3-dimethylheptane
- C9
- 5-methylnonane
- 1,2-methylethylbenzene
- C10
- C11
- 1,2,3,5-tetramethylbenzene
- naphthalene
- C12
- 1-methylnaphthalene
- C13

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

## Hydrocarbons

## Hydrocarbons, C7-C42

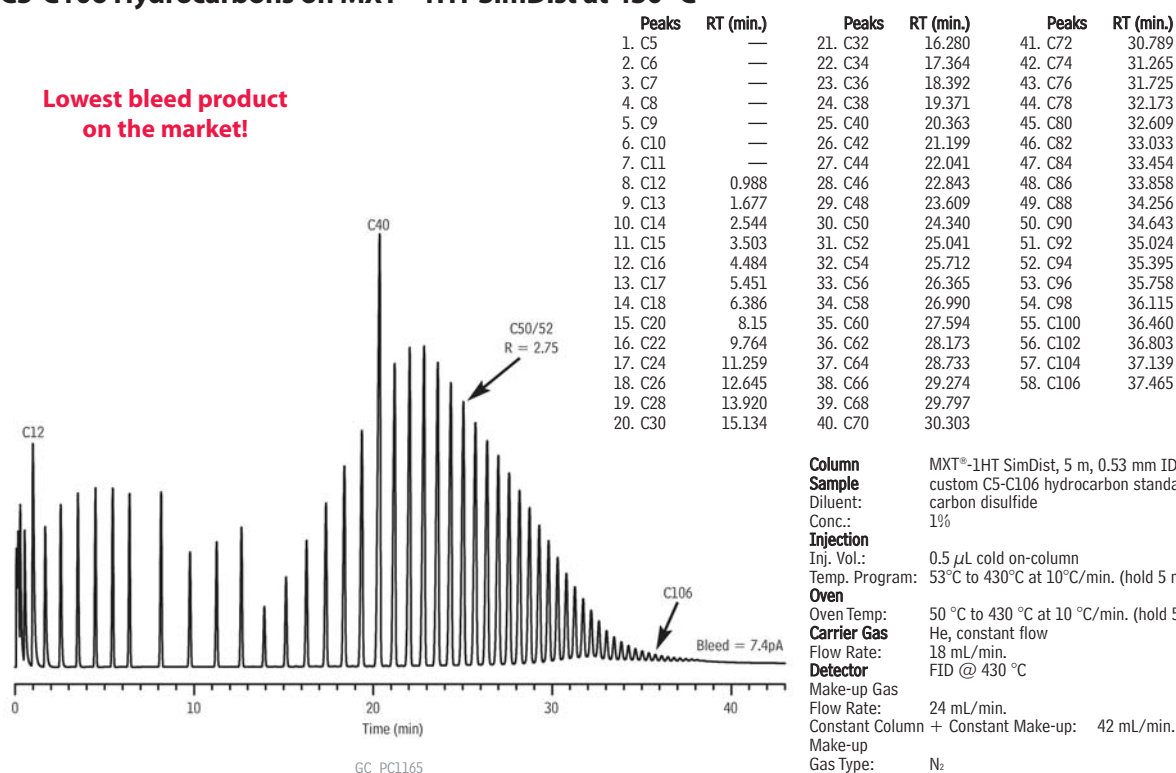
Rtx®-1



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<sup>-11</sup> AFS

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

Lowest bleed product  
on the market!

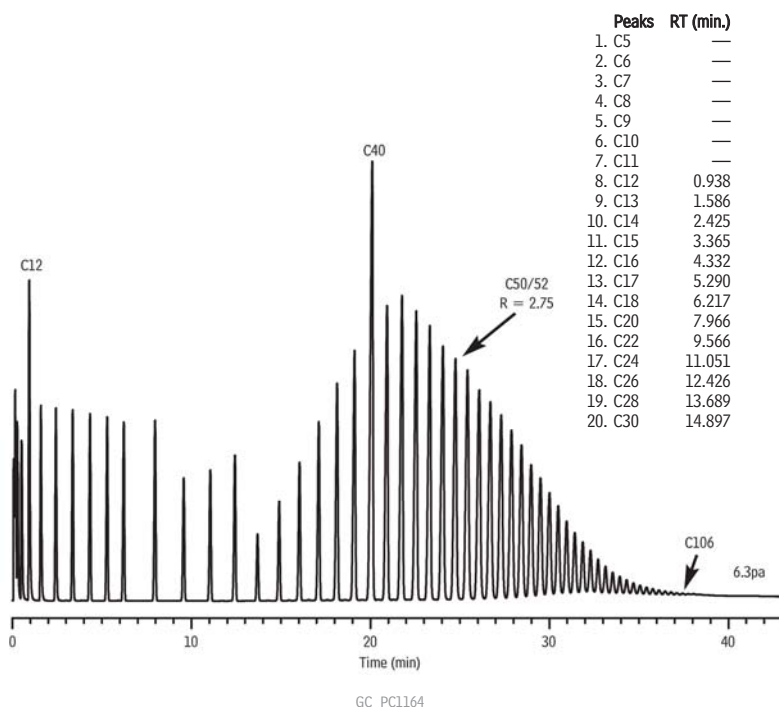


**Column** MXT®-1HT SimDist, 5 m, 0.53 mm ID, 0.10 µm (cat.# 70112)  
**Sample** custom C5-C106 hydrocarbon standard  
**Diluent:** carbon disulfide  
**Conc.:** 1%  
**Injection**  
 Inj. Vol.: 0.5 µL cold-on-column  
 Temp. Program: 53°C to 430°C at 10°C/min. (hold 5 min.)  
**Oven**  
 Oven Temp: 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<sub>2</sub>  
 Data Rate: 20 Hz  
**Instrument** Shimadzu 2010 GC

NEW!

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

NEW!

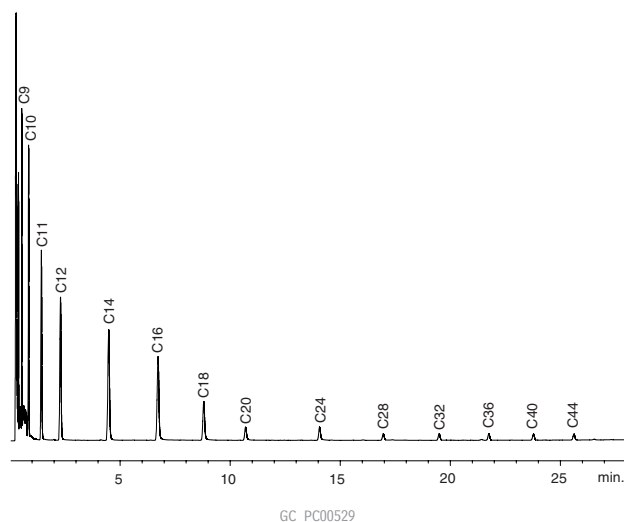


Peaks	RT (min.)
1. C5	—
2. C6	—
3. C7	—
4. C8	—
5. C9	—
6. C10	—
7. C11	—
8. C12	0.938
9. C13	1.586
10. C14	2.425
11. C15	3.365
12. C16	4.332
13. C17	5.290
14. C18	6.217
15. C20	7.966
16. C22	9.566
17. C24	11.051
18. C26	12.426
19. C28	13.689
20. C30	14.897

Peaks	RT (min.)
21. C32	16.035
22. C34	17.110
23. C36	18.133
24. C38	19.108
25. C40	20.096
26. C42	20.923
27. C44	21.759
28. C46	22.556
29. C48	23.317
30. C50	24.051
31. C52	24.752
32. C54	25.422
33. C56	26.079
34. C58	26.701
35. C60	27.305
36. C62	27.878
37. C64	28.439
38. C66	28.975
39. C68	29.499
40. C70	30.002

Peaks	RT (min.)
41. C72	30.489
42. C74	30.906
43. C76	31.414
44. C78	31.862
45. C80	32.294
46. C82	32.719
47. C84	33.132
48. C86	33.529
49. C88	33.927
50. C90	34.310
51. C92	34.689
52. C94	35.059
53. C96	35.423
54. C98	35.773
55. C100	36.120
56. C102	36.463
57. C104	36.793
58. C106	37.118

**Column** MXT®-1HT SimDist, 5 m, 0.53 mm ID, 0.10  $\mu$ m (cat. # 70112)  
**Sample** custom C5-C106 hydrocarbon standard  
**Diluent:** carbon disulfide  
**Conc.:** 1%  
**Injection**  
 Inj. Vol.: 0.5  $\mu$ L 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<sub>2</sub>  
 Data Rate: 20 Hz  
**Instrument** Shimadzu 2010 GC

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

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

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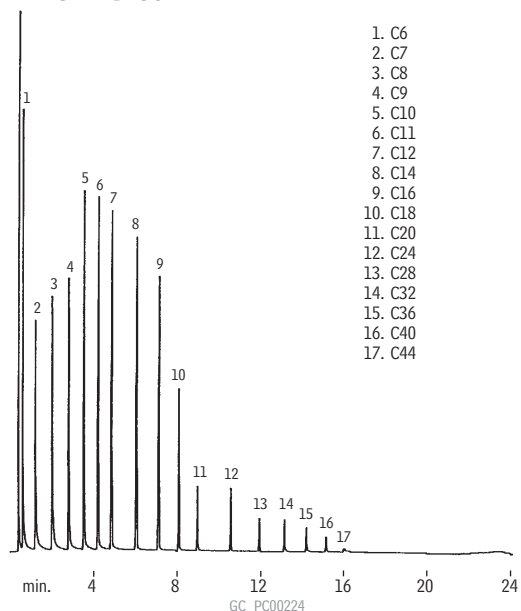
Australian Distributors  
 Importers & Manufacturers  
[www.chromtech.net.au](http://www.chromtech.net.au)

11/12

[www.restek.com](http://www.restek.com)

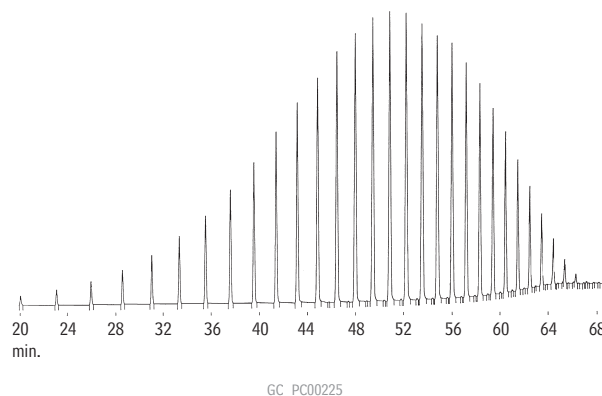
659

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



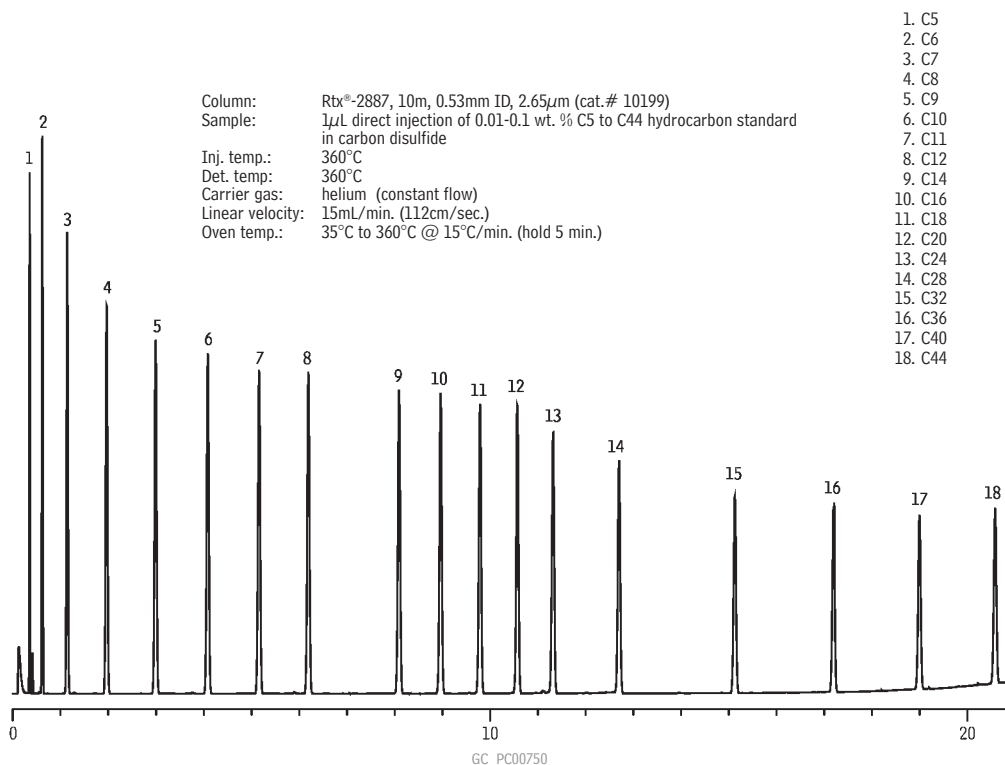
Column: MXT®-1 Sim Dist, 6m, 0.53mm ID, 0.15µm (cat.# 70101)  
Sample: wet needle on-column injection of ASTM D2887 standard  
Oven temp.: -12°C to 430°C @ 20°C/min.  
Inj./det. temp.: -17°C to 433°C/430°C  
Carrier gas: hydrogen  
Linear velocity: 40cm/sec.  
FID sensitivity: 128 x 10<sup>-11</sup>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

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



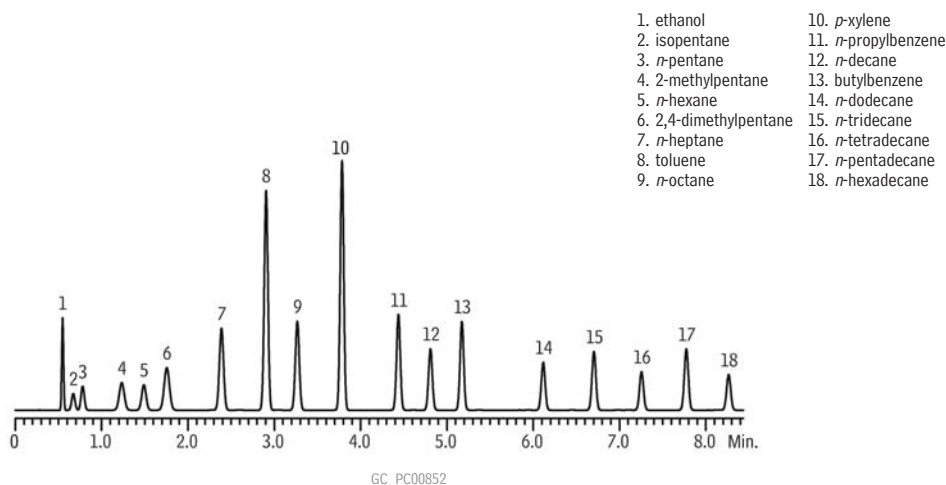
Column: MXT®-500 Sim Dist, 6m, 0.53mm ID, 0.15µm (cat.# 70104)  
Sample: cold on-column injection of Polywax® 655 in CS<sub>2</sub>  
Oven temp.: 40°C to 430°C @ 6°C/min.  
Carrier gas: helium  
Linear velocity: 40cm/sec.  
FID sensitivity: 2 x 10<sup>-11</sup> AFS

**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.)

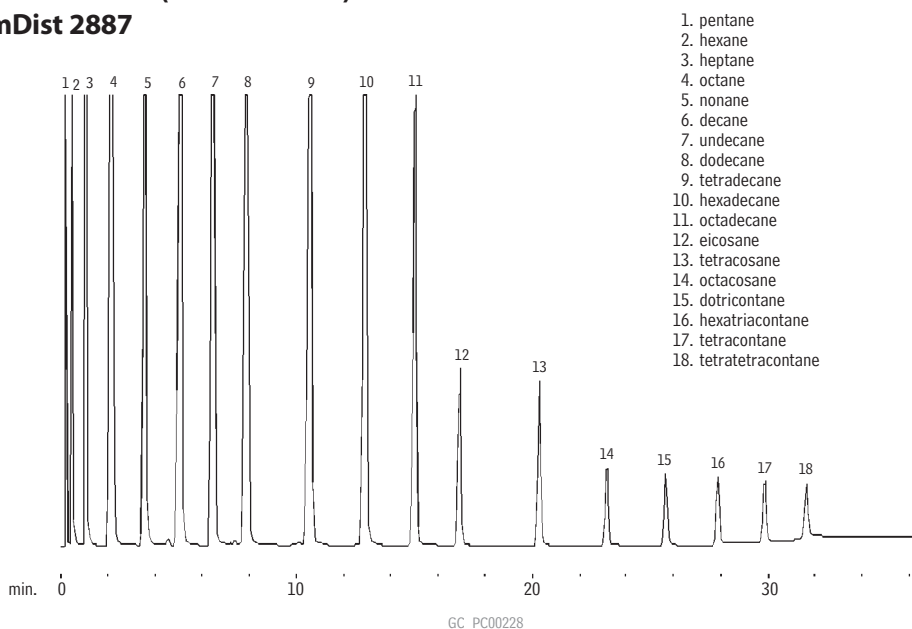
**Simulated Distillation**  
**Rtx®-1 (Hydrogen Carrier Gas)**



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)



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<sup>-11</sup> AFS

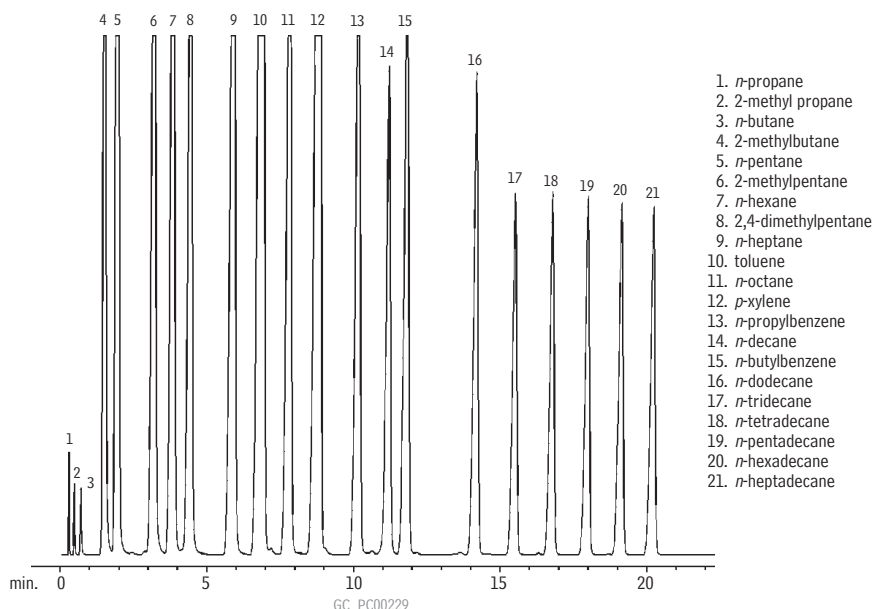
cat.# 31674 (1% each listed analyte in CS<sub>2</sub>) and cat.# 31675 (5% each, neat)  
 meet requirements of ASTM D2887-01.



**Simulated Distillation (ASTM D-3710 Calibration)**

**Rtx®-1 SimDist 2887**

(packed)

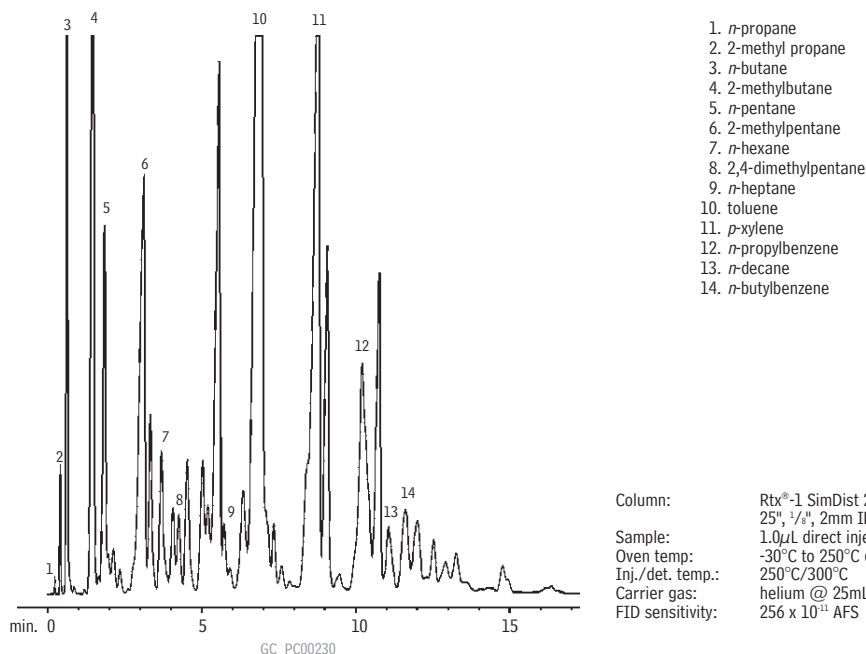


Column: Rtx®-1 SimDist 2887, SilcoSmooth® stainless steel, 25', 1/8", 2mm ID (cat. # 80000)  
 Sample: D-3710 Calibration Mix, C3, C4, C16, & C17 added  
 Oven temp: -30°C to 250°C @ 10°C/min.  
 Inj./det. temp.: 250°C/300°C  
 Carrier gas: helium @ 25mL/min.  
 FID sensitivity: 256 x 10<sup>-11</sup>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

**Simulated Distillation (ASTM D-3710, Gasoline)**

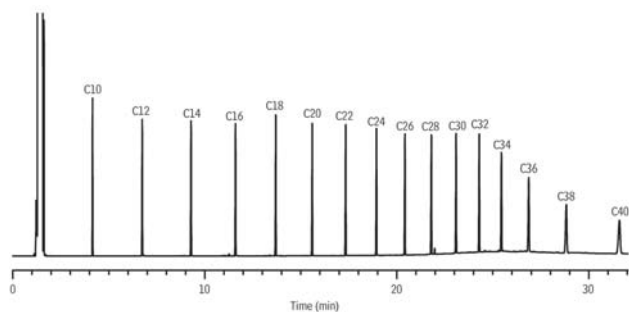
**Rtx®-1 SimDist 2887**

(packed)



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<sup>-11</sup> AFS

### Crude Oil on Rxi®-5HT

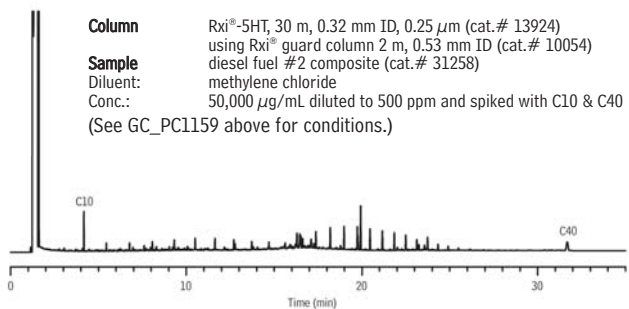


GC\_PC1159

**Column** Rxi®-5HT, 30 m, 0.32 mm ID, 0.25  $\mu$ m (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  $\mu$ g/mL  
**Injection**  
**Inj. Vol.:** 1  $\mu$ L 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<sub>2</sub>, 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<sub>2</sub>  
**Data Rate:** 20 Hz  
**Instrument** Agilent/HP6890 GC

NEW!

### Diesel on Rxi®-5HT

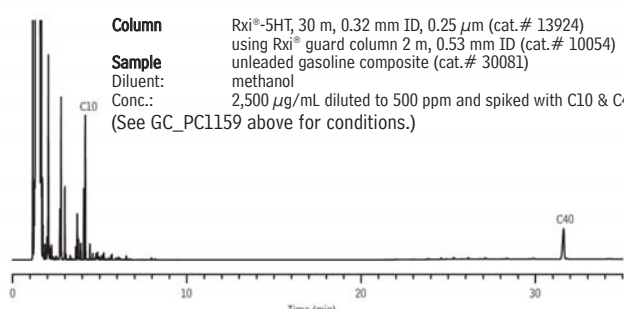


GC\_PC1160

**Column** Rxi®-5HT, 30 m, 0.32 mm ID, 0.25  $\mu$ m (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  $\mu$ g/mL diluted to 500 ppm and spiked with C10 & C40  
(See GC\_PC1159 above for conditions.)

NEW!

### Gasoline on Rxi®-5HT

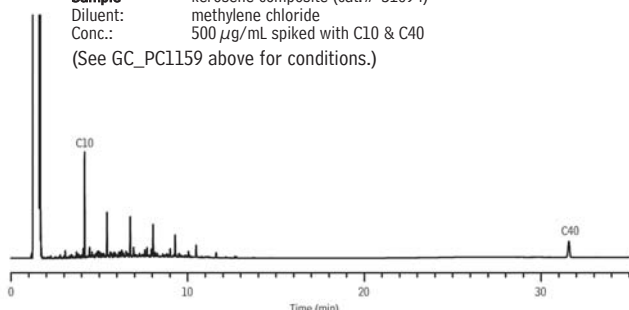


GC\_PC1161

**Column** Rxi®-5HT, 30 m, 0.32 mm ID, 0.25  $\mu$ m (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  $\mu$ g/mL diluted to 500 ppm and spiked with C10 & C40  
(See GC\_PC1159 above for conditions.)

NEW!

### Kerosene on Rxi®-5HT

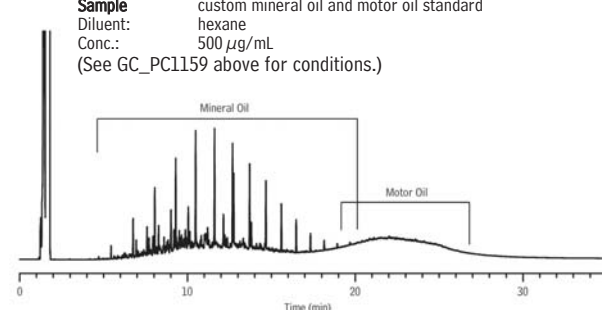


GC\_PC1162

**Column** Rxi®-5HT, 30 m, 0.32 mm ID, 0.25  $\mu$ m (cat.# 13924)  
using Rxi® guard column 2 m, 0.53 mm ID (cat.# 10054)  
**Sample** kerosene composite (cat.# 31094)  
**Diluent:** methylene chloride  
**Conc.:** 500  $\mu$ g/mL spiked with C10 & C40  
(See GC\_PC1159 above for conditions.)

NEW!

### Mineral Oil & Motor Oil on Rxi®-5HT



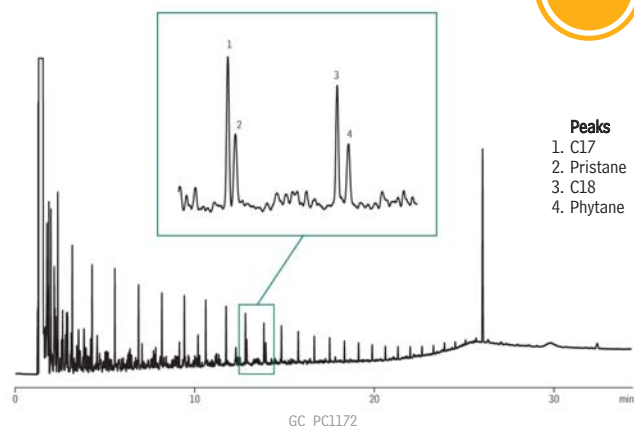
GC\_PC1163

**Column** Rxi®-5HT, 30 m, 0.32 mm ID, 0.25  $\mu$ m (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  $\mu$ g/mL  
(See GC\_PC1159 above for conditions.)

NEW!

## Midrange Crude on Rxi®-5HT

NEW!



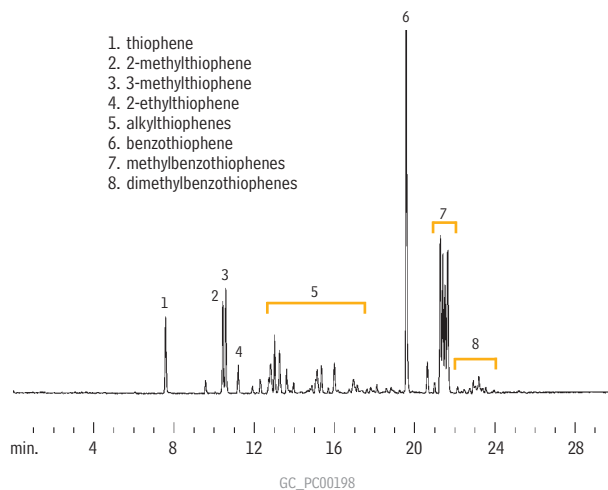
## Peaks

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

**Column** Rxi®-5HT, 30 m, 0.32 mm ID, 0.10  $\mu$ m (cat.# 13909)  
using retention gap 2 m, 0.53 mm ID,  
**Sample** Midrange crude  
**Conc.:** 500  $\mu$ g/mL  
**Injection**  
**Inj. Vol.:** 1.0  $\mu$ L cold on-column  
**Oven**  
**Oven Temp:** 50 °C to 300 °C at 10 °C/min. (hold 10 min.)  
**Carrier Gas** H<sub>2</sub>, 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

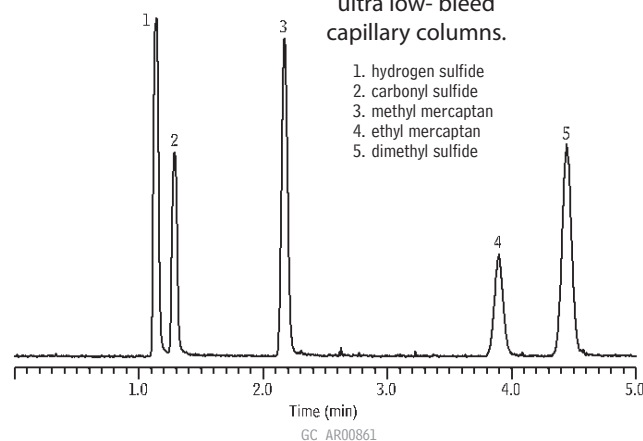
**Column:** Rtx®-1, 30m, 0.32mm ID, 4.0 $\mu$ m (cat.# 10198)  
**Sample:** 1.0 $\mu$ L split injection of gasoline containing 300ppm total sulfur  
**Oven temp.:** 40°C (hold 3 min.) to 275°C @ 10°C/min. (hold 5 min.)  
**Inj./det. temp.:** 275°C  
**Det.:** SCD  
**Carrier gas:** helium  
**Linear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

## Sulfur Compounds

Rxi®-1ms

Rxi® Technology!

Exceptionally inert,  
ultra low- bleed  
capillary columns.

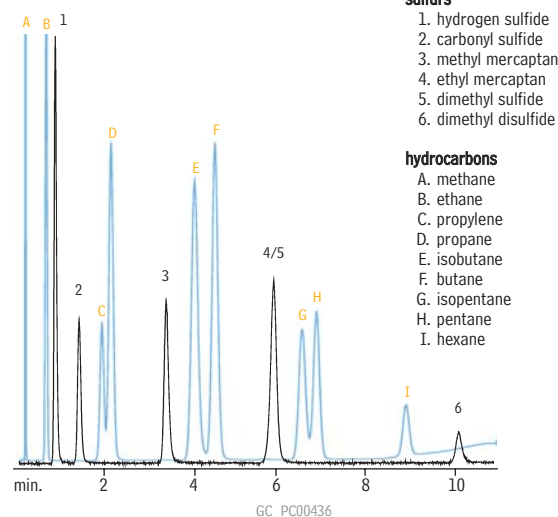


1. hydrogen sulfide
2. carbonyl sulfide
3. methyl mercaptan
4. ethyl mercaptan
5. dimethyl sulfide

**Column:** Rxi®-1ms, 30m, 0.32mm ID, 4.00 $\mu$ m (cat.# 13396)  
**Sample:** hydrogen sulfide, carbonyl sulfide, methyl mercaptan, ethyl mercaptan, dimethyl sulfide, 100 ppbv each in helium  
**Inj.:** 1mL splitless, direct  
**Sample loop temp.:** 30°C  
**Carrier gas:** helium, constant pressure  
**Linear velocity:** 48cm/sec. @ 30°C  
**Oven temp.:** 30°C  
**Det.:** sulfur chemiluminescence detector  
**Det. temp.:** 800°C

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

## Sulfur Compounds

Rt®-XLSulfur  
(micropacked)

## sulfurs

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

## hydrocarbons

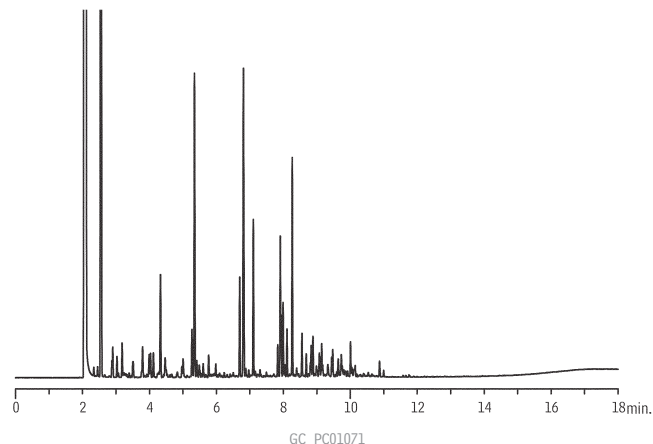
- A. methane
- B. ethane
- C. propylene
- D. propane
- E. isobutane
- F. butane
- G. isopentane
- H. pentane
- I. hexane

**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

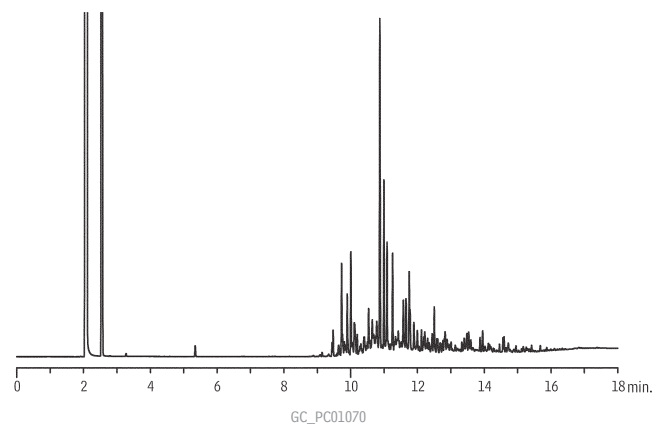
Rxi®-1ms



Column: Rxi®-1ms, 30m, 0.25mm ID, 0.25 $\mu$ m (cat.# 13323)  
 Sample: 5,000 $\mu$ g/mL unleaded gasoline, unweathered, in methanol (cat.# 30096)  
 Inj.: 1 $\mu$ L 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

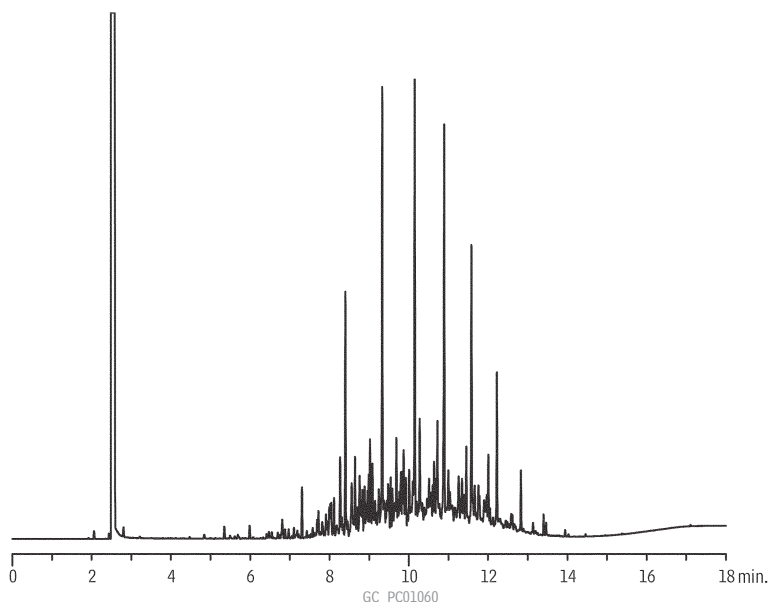
Rxi®-1ms



Column: Rxi®-1ms, 30m, 0.25mm ID, 0.25 $\mu$ m (cat.# 13323)  
 Sample: 5,000 $\mu$ g/mL unleaded gasoline, 99% weathered, in methanol (cat.# 30436)  
 Inj.: 1 $\mu$ L 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

## Unweathered Kerosene

Rxi®-1ms

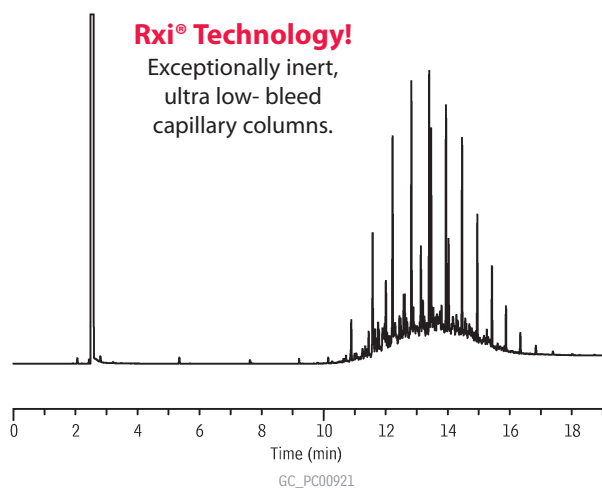


Column: Rxi®-1ms, 30m, 0.25mm ID, 0.25 $\mu$ m (cat.# 13323)  
 Sample: 5,000 $\mu$ g/mL kerosene, unweathered, in methylene chloride (cat.# 31229)  
 Inj.: 1 $\mu$ L split (split ratio 20:1), 4mm single gooseneck liner w/ wool (cat.# 22405)  
 Inj. temp.: 250°C  
 Carrier gas: helium, constant flow  
 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

## Arson Accelerants

## 50% Weathered Diesel Fuel #2

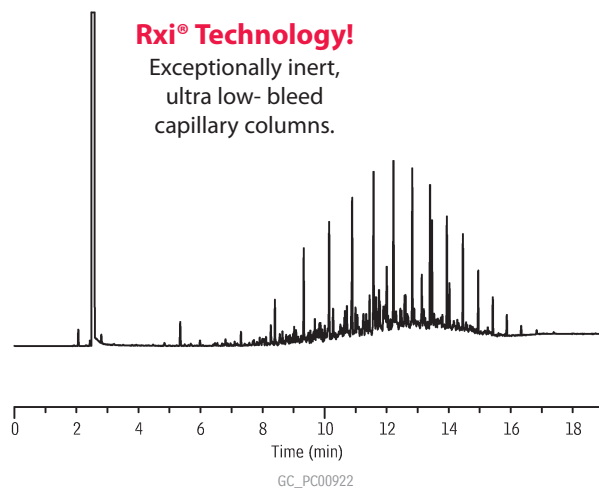
Rxi®-1ms



Column: Rxi®-1ms, 30m, 0.25mm ID, 0.50 $\mu$ m (cat.# 13338)  
 Sample: 5,000 $\mu$ g/mL diesel fuel #2, 50% weathered (cat.# 31235) in methylene chloride  
 Inj.: 1.0 $\mu$ L split (split ratio 20:1), 4mm single gooseneck w/wool inlet liner (cat.# 22405)  
 Inj. temp.: 250°C  
 Carrier gas: helium, constant flow  
 Linear velocity: 28cm/sec. @ 50°C  
 Oven temp.: 50°C (hold 2 min.) to 75°C @ 10°C/min., 300°C @ 20°C/min. (hold 5 min.)  
 Det.: FID @ 300°C

## Unweathered Diesel Fuel #2

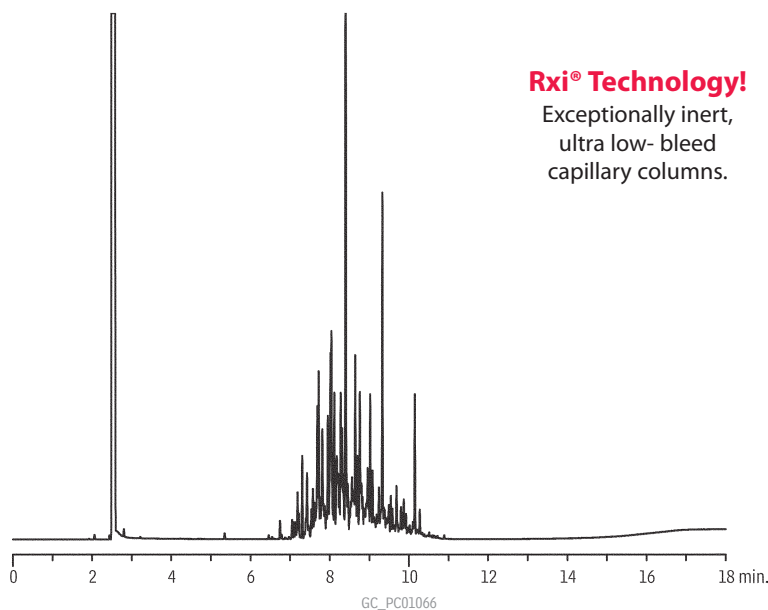
Rxi®-1ms



Column: Rxi®-1ms, 30m, 0.25mm ID, 0.50 $\mu$ m (cat.# 13338)  
 Sample: 5,000 $\mu$ g/mL diesel fuel #2, unweathered (cat.# 31233) in methylene chloride  
 Inj.: 1.0 $\mu$ L split (split ratio 20:1), 4mm single gooseneck w/wool inlet liner (cat.# 22405)  
 Inj. temp.: 250°C  
 Carrier gas: helium, constant flow  
 Linear velocity: 28cm/sec. @ 50°C  
 Oven temp.: 50°C (hold 2 min.) to 75°C @ 10°C/min., 300°C @ 20°C/min. (hold 5 min.)  
 Det.: FID @ 300°C

## Mineral Spirits

Rxi®-1ms



Column: Rxi®-1ms, 30m, 0.25mm ID, 0.25 $\mu$ m (cat.# 13323)  
 Sample: 5,000 $\mu$ g/mL mineral spirits, unweathered, in methylene chloride (cat.# 31225)  
 Inj.: 1 $\mu$ L 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)

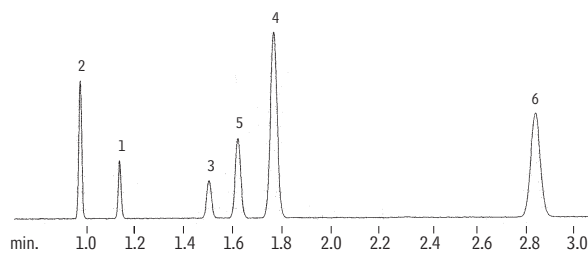
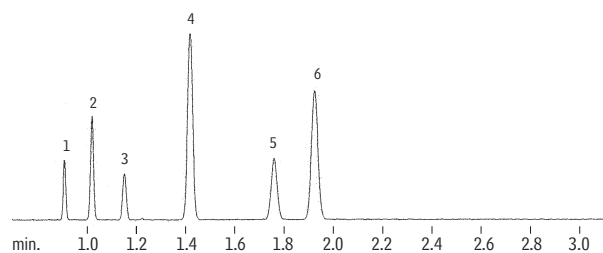
(headspace analysis)

1. methanol
2. acetaldehyde
3. ethanol
4. isopropanol
5. acetone
6. *n*-propanol

Conc.  
w/v  
0.1%  
0.2%  
0.2%  
0.1%  
0.01%  
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

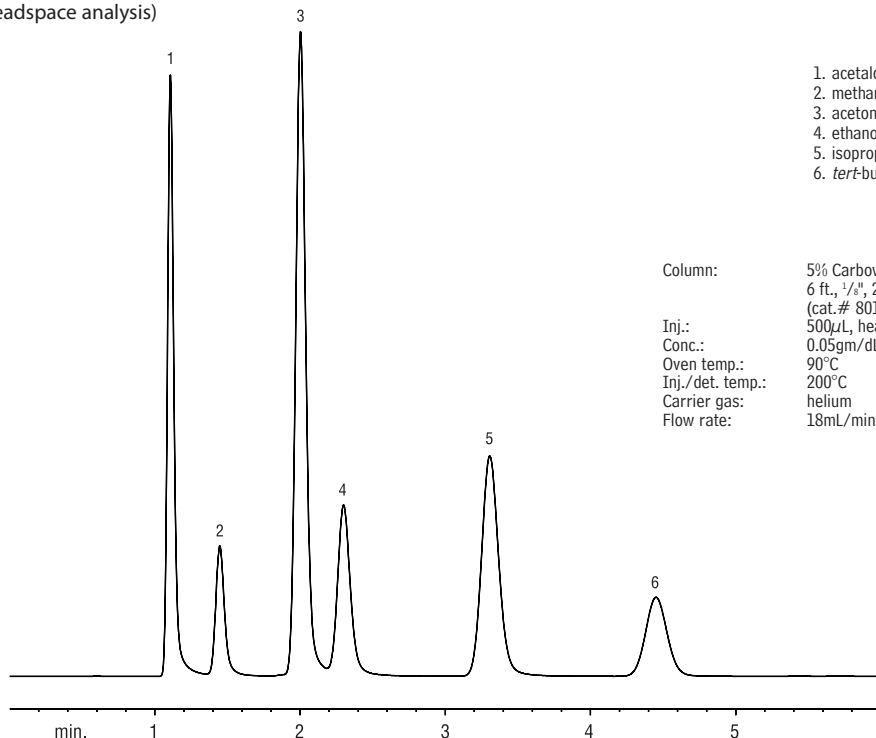
Oven temp.: 40°C  
Inj. temp.: 200°C  
Carrier gas: helium  
Sample equilibration: 70°C, 15 min.  
Vial pressure: 30psi  
Vial pressurization time: 0.15 min.

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

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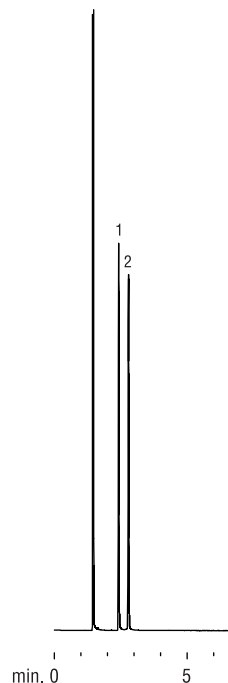
667



**Glycols**

**Rtx®-BAC1 & Rtx®-BAC2**

**Rtx®-BAC1**

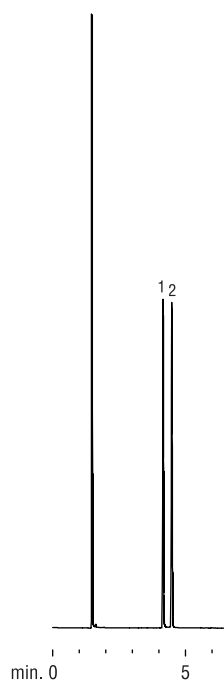


1. ethylene glycol
2. propylene glycol

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

GC\_EV00474

**Rtx®-BAC2**

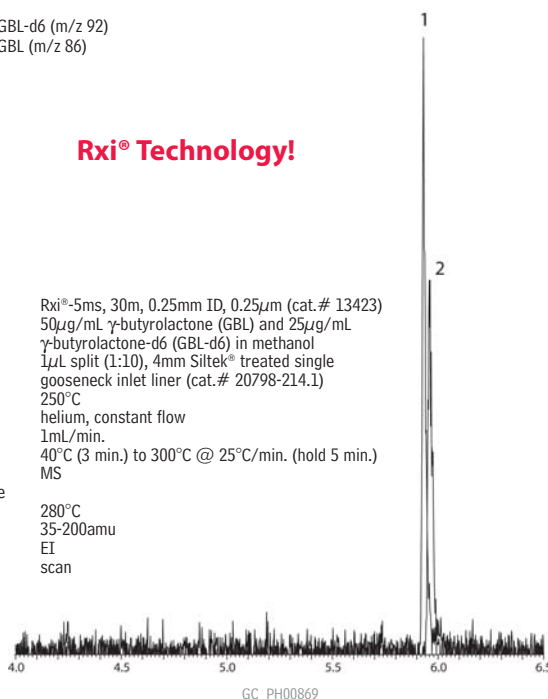


**$\gamma$ -butyrolactone and  $\gamma$ -butyrolactone-d6  
Rxi®-5ms**

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

**Rxi® Technology!**

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



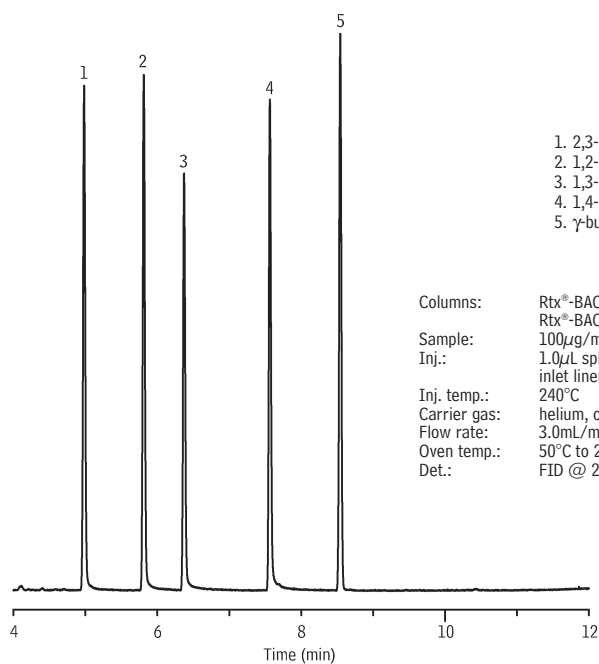
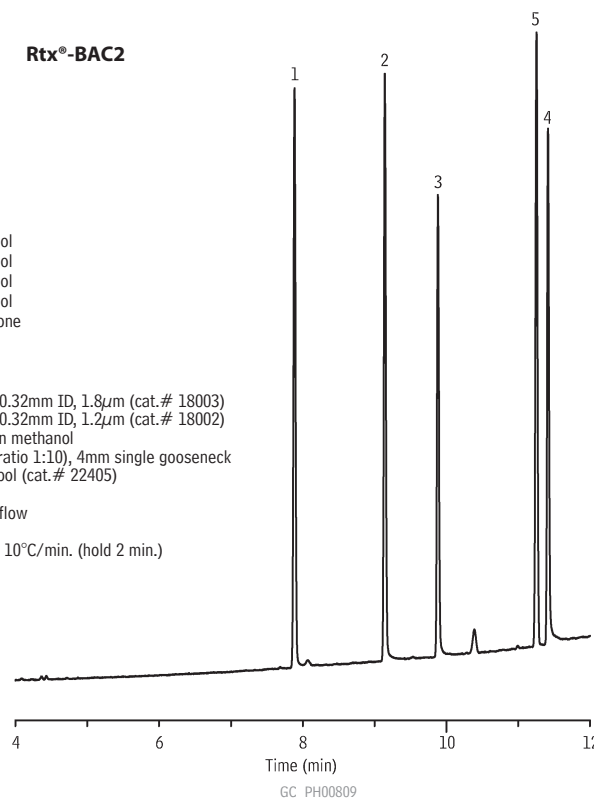
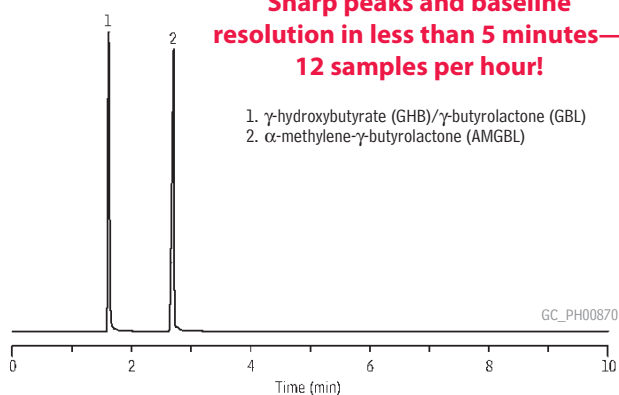
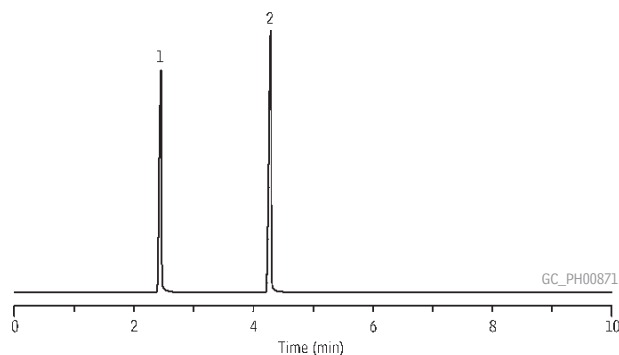
GC\_PH00869

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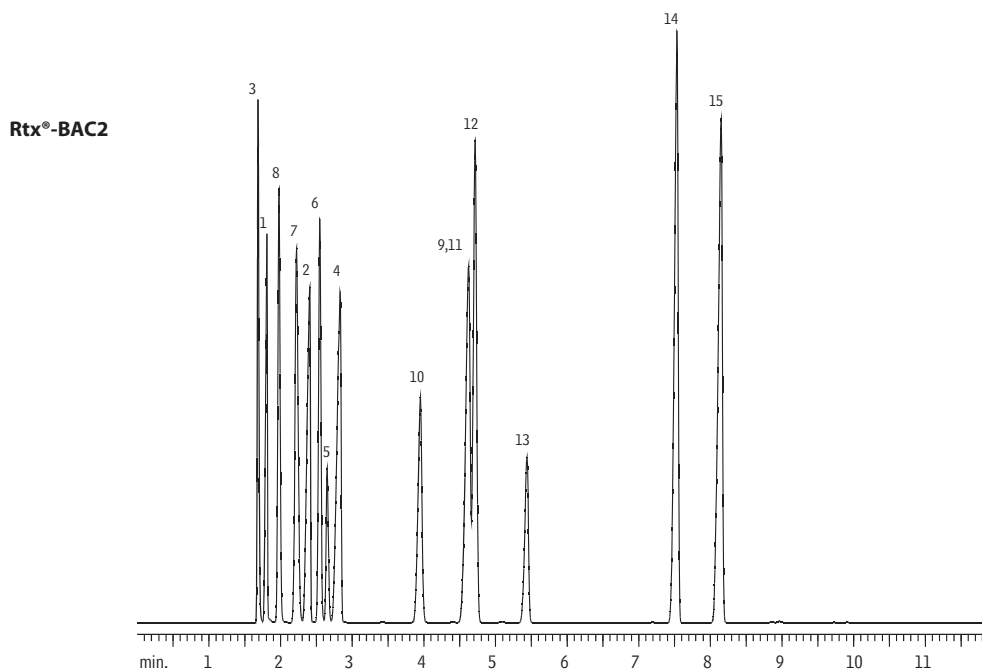
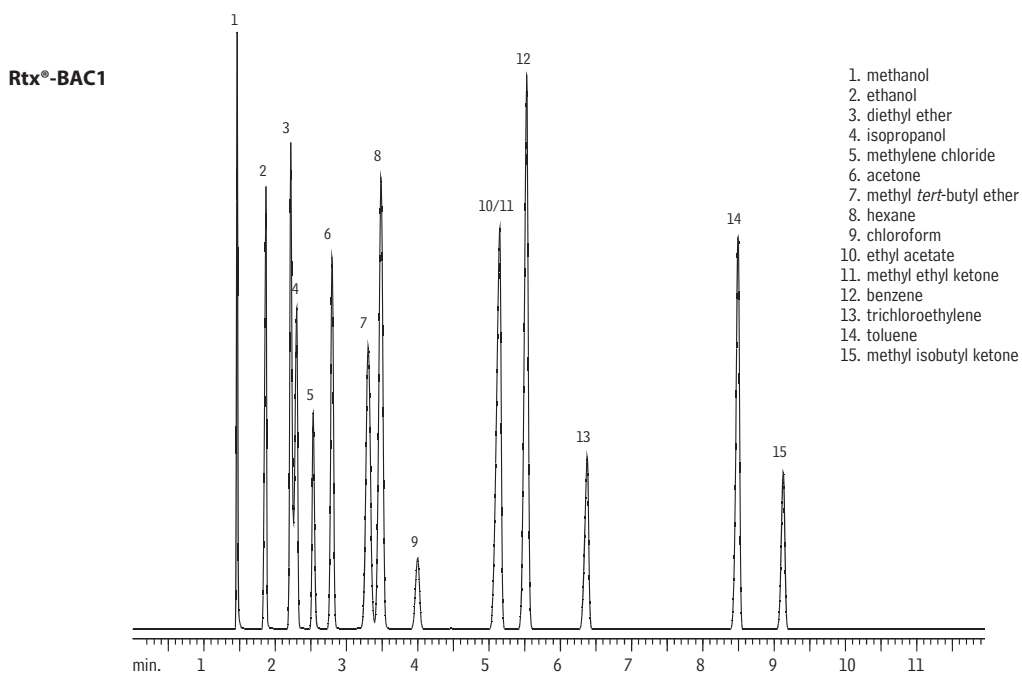
**$\gamma$ -butyrolactone & 1,4-butanediol****Rtx®-BAC1 & Rtx®-BAC2****Rtx®-BAC1****Rtx®-BAC2** **$\gamma$ -hydroxybutyrate (GHB) and  $\gamma$ -butyrolactone (GBL)****Rtx®-BAC1 and Rtx®-BAC2 (dual column analysis)****Rtx®-BAC1****Rtx®-BAC2**

Columns: Rtx®-BAC1, 30m, 0.32mm ID, 1.8 $\mu$ m (cat.# 18003) and  
Rtx®-BAC2, 30m, 0.32mm ID, 1.2 $\mu$ m (cat.# 18002),  
connected via universal "Y" Press-Tight® connector (cat.# 20405)  
Sample: GHB, GBL,  $\alpha$ -methylene- $\gamma$ -butyrolactone (AMGBL), 10 $\mu$ g/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

## Abused Inhalants

## Rtx®-BAC1 &amp; Rtx®-BAC2



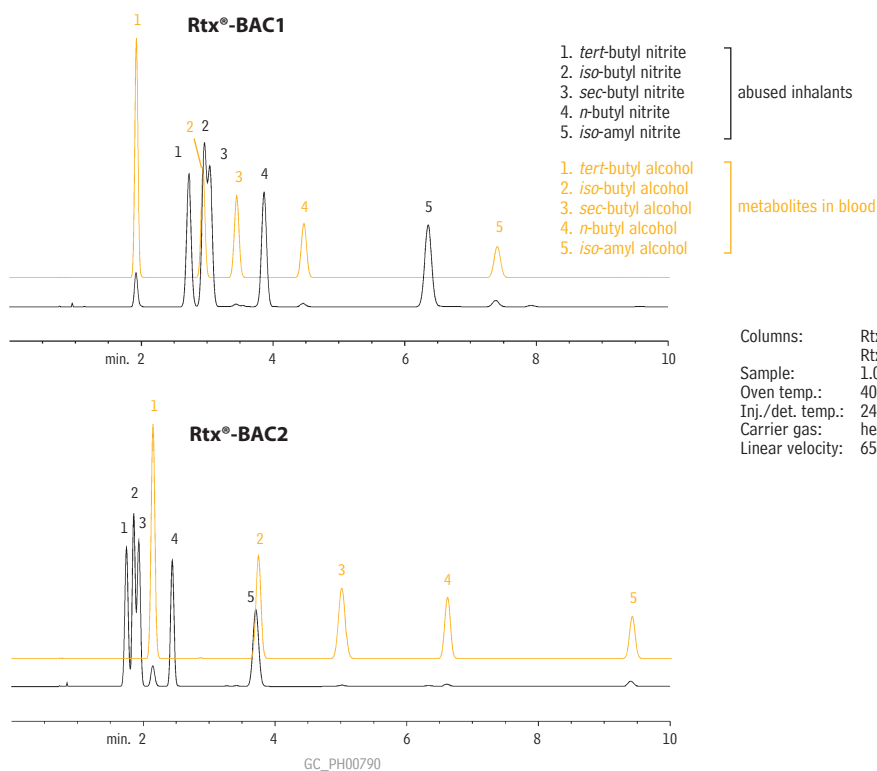
GC\_PH00446

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

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

## Alkyl Nitrites

## Rtx®-BAC1 &amp; Rtx®-BAC2

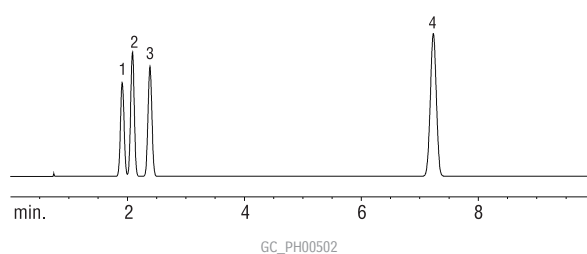
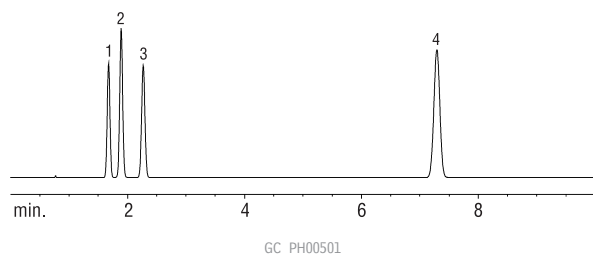


Columns: Rtx®-BAC1, 30m, 0.53mm ID, 3.0 $\mu$ m (cat.# 18001)  
Rtx®-BAC2, 30m, 0.53mm ID, 2.0 $\mu$ m (cat.# 18000)  
Sample: 1.0mL headspace sample  
Oven temp.: 40°C (hold 5 min.) to 240°C @ 5°C/min.  
Inj./det. temp.: 240°C  
Carrier gas: helium  
Linear velocity: 65cm/sec.

## Anesthetics

## Rtx®-BAC1 &amp; Rtx®-BAC2

(headspace analysis)

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

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

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

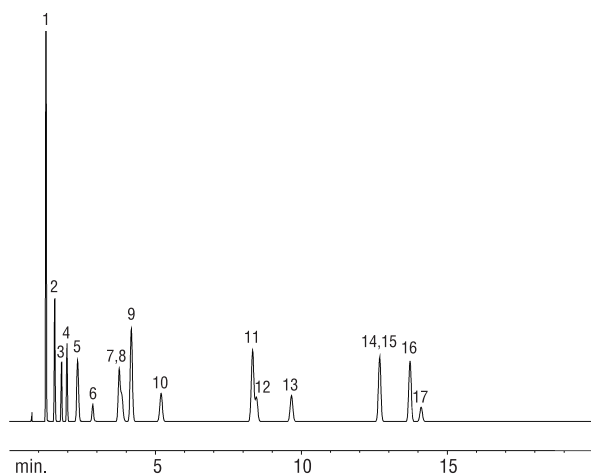
## Solvents

### Rtx®-BAC1 & Rtx®-BAC2

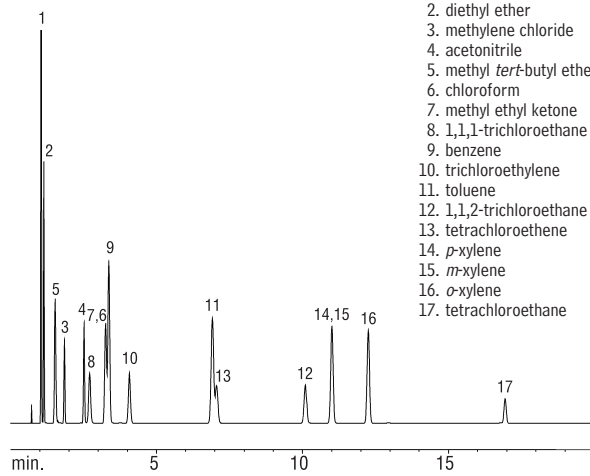
(headspace analysis)

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

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



GC\_PH00509



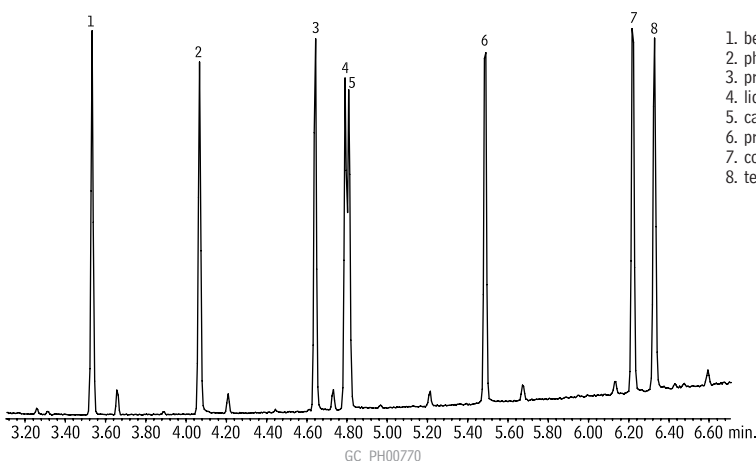
GC\_PH00510

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

## Chromatogram Search Tool

Search by compound name, synonym,  
CAS # or keyword

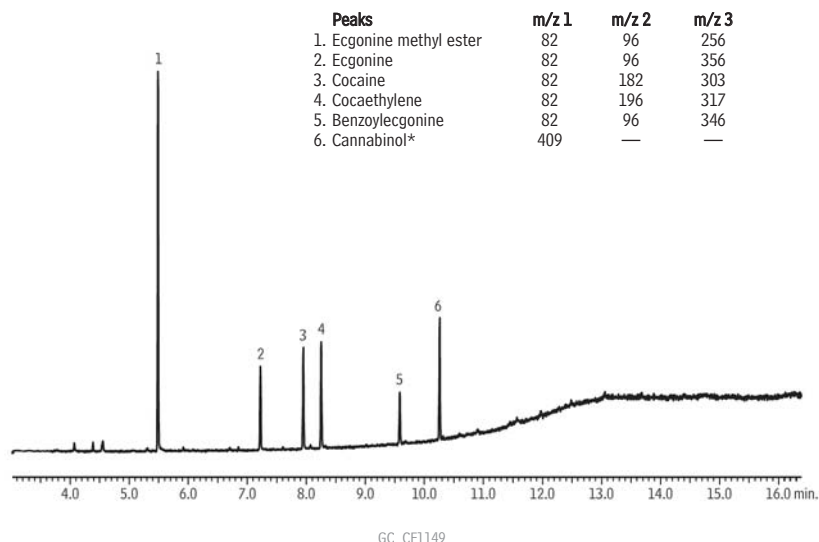
[www.restek.com/chromatograms](http://www.restek.com/chromatograms)



## Cocaine and Metabolites (TMS Derivatives)

Rxi®-5Sil MS (100 ng/mL)

NEW!



**Column** Rxi®-5Sil MS, 30 m, 0.25 mm ID, 0.25  $\mu$ m (cat.# 13623)

**Sample** Butyl chloride

**Diluent:** 100 ng/mL

**Injection**

Inj. Vol.: 1  $\mu$ L 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

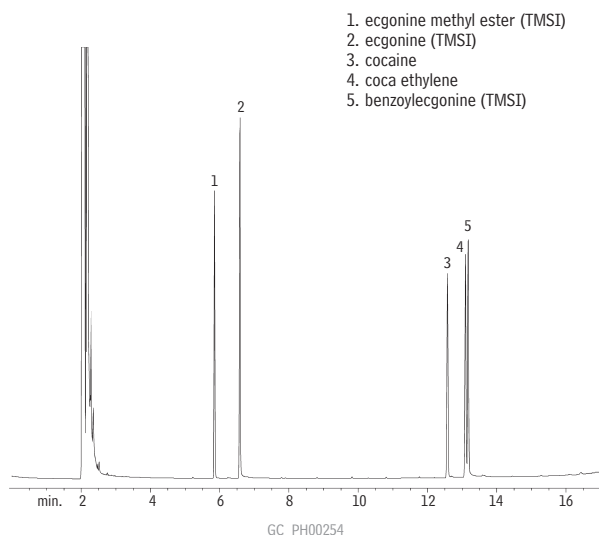
**Instrument** Shimadzu 2010 GC & QP2010+ MS

**Notes** Samples were prepared as follows: Standards brought to dryness under nitrogen, then 50  $\mu$ L BSTFA + 1%TMCS (cat.# 35606) added. 50  $\mu$ L pyridine was then added, and samples were incubated at 70°C for 30 min. After incubation, samples were diluted with butyl chloride.

\* Used as derivatization check

## Cocaine &amp; Metabolites (TMS Derivatives)

Rtx®-5



Column: Rtx®-5, 30m, 0.25mm ID, 0.25 $\mu$ m (cat.# 10223)

Sample: 1.0 $\mu$ L split injection of cocaine and cocaine metabolites

Oven temp.: 150°C to 320°C @ 10°C/min.

Inj./det. temp.: 250°C/300°C

Carrier gas: helium

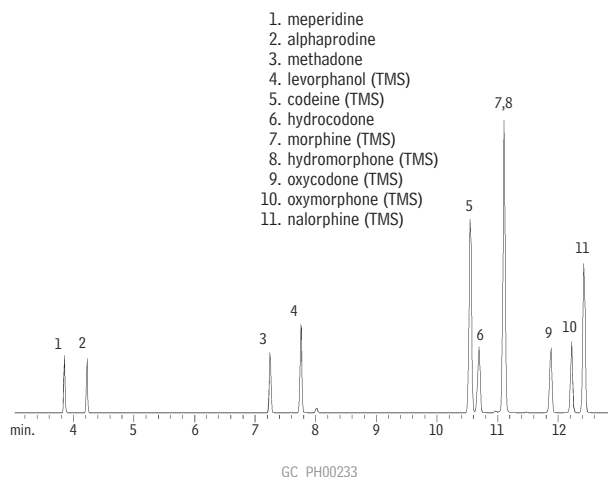
Linear velocity: 30cm/sec. set @ 50°C

FID sensitivity: 2.56 x 10<sup>-10</sup> AFS

Split ratio: 30:1

## Opiates (TMS Derivatives)

Rtx®-5



Column: Rtx®-5, 30m, 0.25mm ID, 0.25 $\mu$ m (cat.# 10223)

Sample: 2.0 $\mu$ L split injection of opiates

Conc: 2,000ng/ $\mu$ L

Oven temp.: 200°C to 325°C @ 7°C/min.

Inj./det. temp.: 250°C/300°C

Det. type: MS

Ionization: EI

Carrier gas: helium

Mode: full scan

Linear velocity: 30cm/sec. set @ 200°C

Split ratio: 50:1

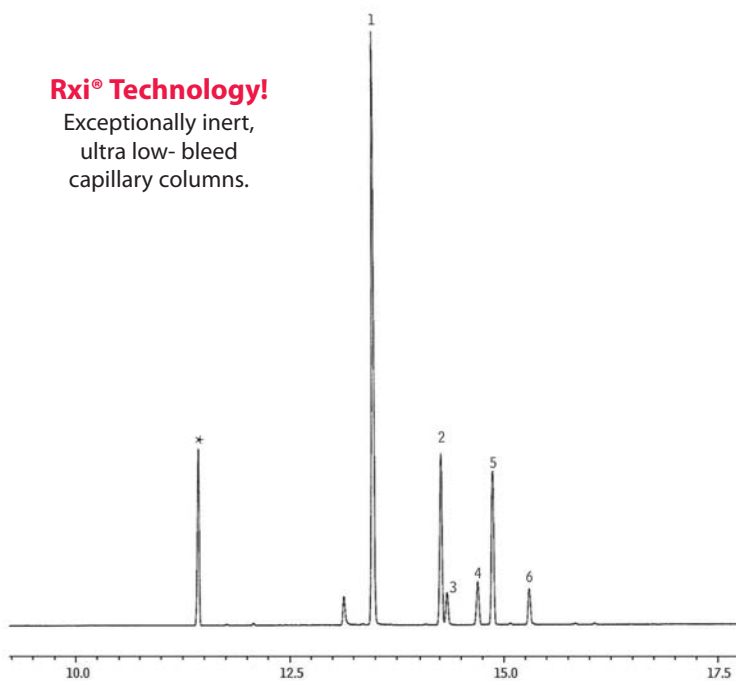


**Extracted Opiates from Blood**  
**Rxi®-5Sil MS**

**NEW!**

**Rxi® Technology!**

Exceptionally inert,  
ultra low- bleed  
capillary columns.



GC\_CF1150

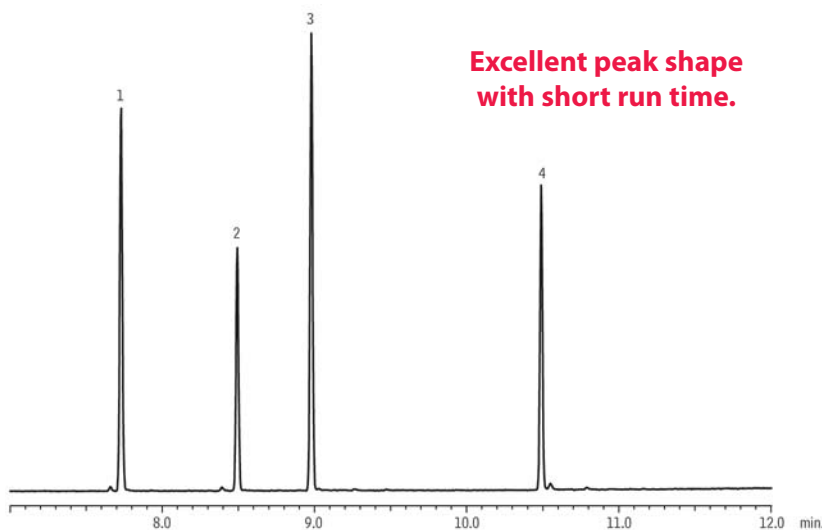
- Peaks**
1. Hydrocodone
  2. Codeine
  3. Oxycodone
  4. Hydromorphone
  5. 6-Monoacetylmorphine
  6. Morphine
- \* Matrix

**Column** Rxi®-5Sil MS, 30 m, 0.25 mm ID, 0.25  $\mu$ m (cat.# 13623)  
**Sample**  
**Diluent:** Ethyl acetate  
**Conc.:** 100 ng/mL propionic anhydride derivatives  
**Injection**  
**Inj. Vol.:** 1  $\mu$ L 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  $\mu$ g/mL)**  
**Rxi®-5Sil MS**

**NEW!**

**Excellent peak shape  
with short run time.**



GC\_CF1145

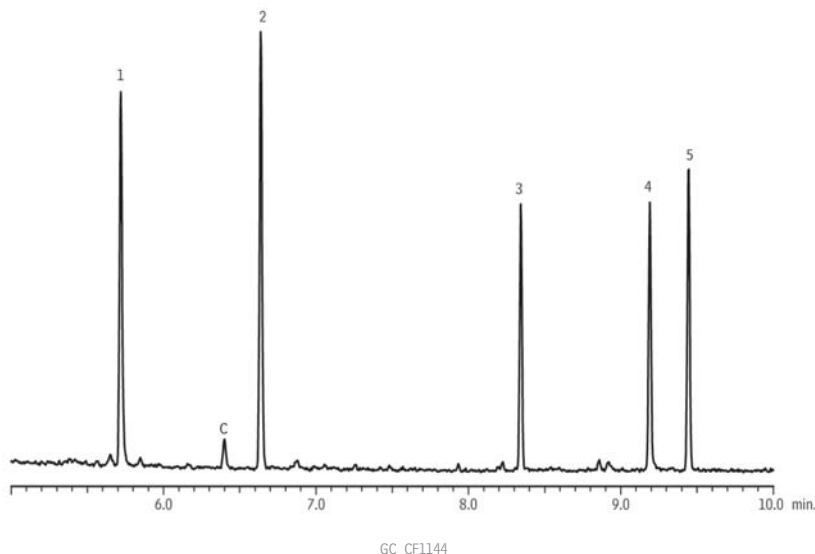
- Peaks**
1. Cannabidiol
  2. delta 9 THC
  3. Cannabinol
  4. THC-COOH; THCA

**Column** Rxi®-5Sil MS, 30 m, 0.25 mm ID, 0.25  $\mu$ m (cat.# 13623)  
**Sample**  
**Diluent:** Ethyl acetate  
**Conc.:** 5  $\mu$ g/mL TMS derivatives  
**Injection**  
**Inj. Vol.:** 1  $\mu$ L 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!



## Peaks

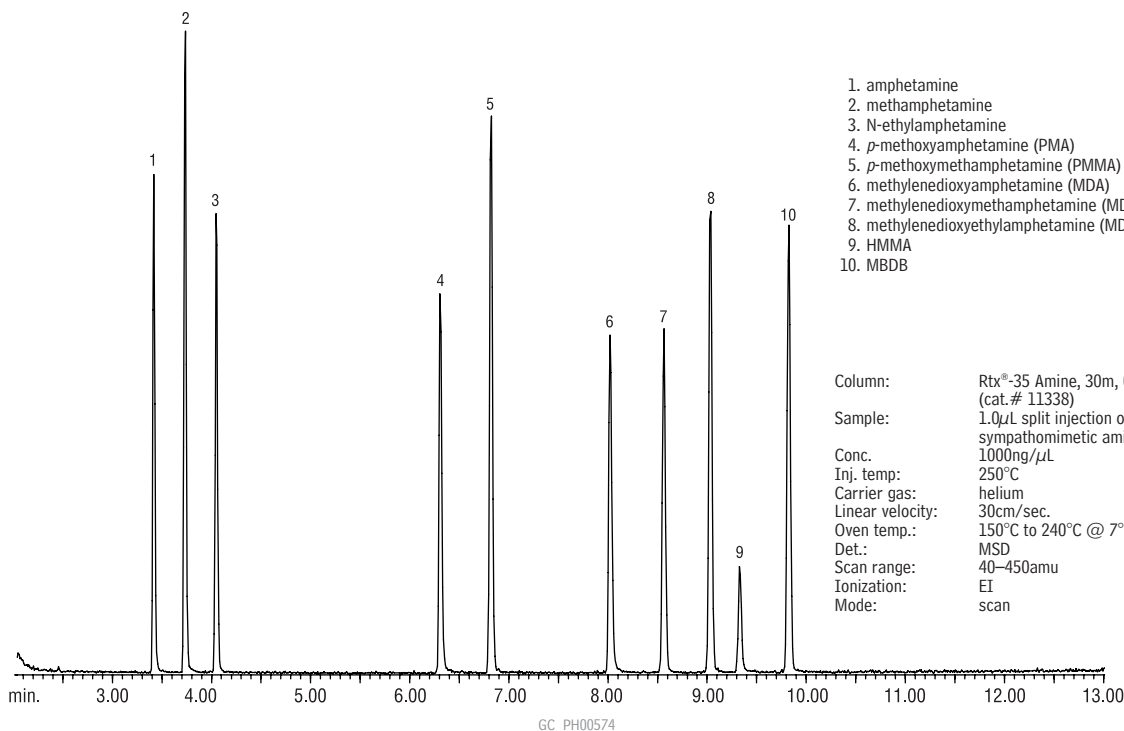
1. Amphetamine
2. Methamphetamine
3. MDA
4. MDMA
5. MDEA
- C-contaminant

**Column** Rxi®-5Sil MS, 30 m, 0.25 mm ID, 0.25  $\mu$ m (cat.# 13623)  
**Sample**  
 Diluent: Butyl chloride  
 Conc.: 500 ng/mL HFAA derivatives  
**Injection**  
 Inj. Vol.: 1  $\mu$ L splitless (hold 1 min.)  
 Inj. 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**  
 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



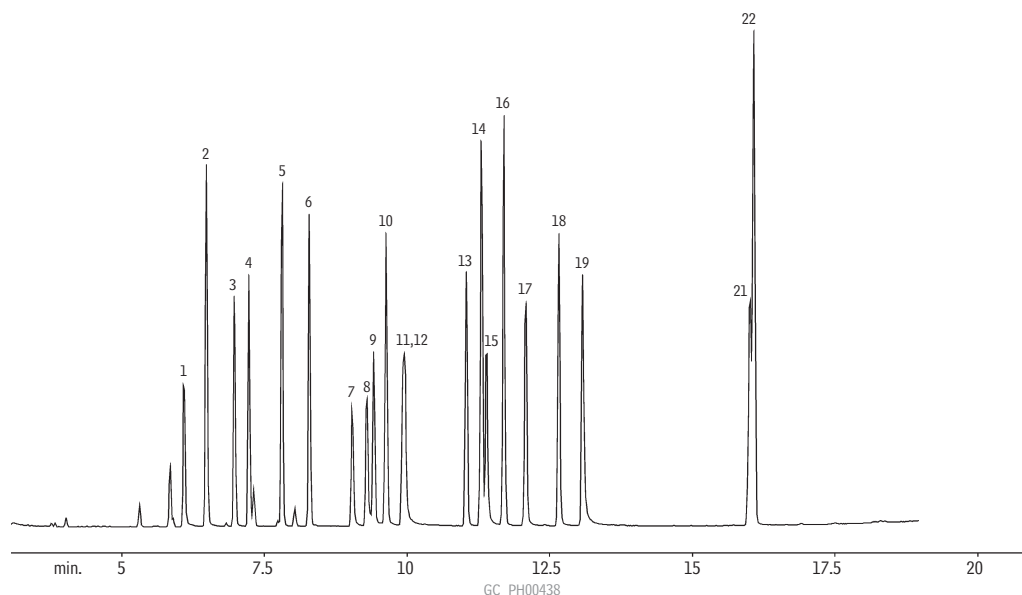
1. amphetamine
2. methamphetamine
3. N-ethylamphetamine
4. *p*-methoxyamphetamine (PMA)
5. *p*-methoxymethamphetamine (PMMA)
6. methylenedioxyamphetamine (MDA)
7. methylenedioxymethamphetamine (MDMA)
8. methylenedioxyethylamphetamine (MDEA)
9. HMMA
10. MBDB

**Column:** Rtx®-35 Amine, 30m, 0.25mm ID, 0.50 $\mu$ m (cat.# 11338)  
**Sample:** 1.0 $\mu$ L split injection of underivatized sympathomimetic amines  
 Conc. 1000ng/ $\mu$ L  
 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

## Sympathomimetic Amines

## Sympathomimetic Amines (Basic Drugs) (Underivatized)

## Rtx®-5 Amine



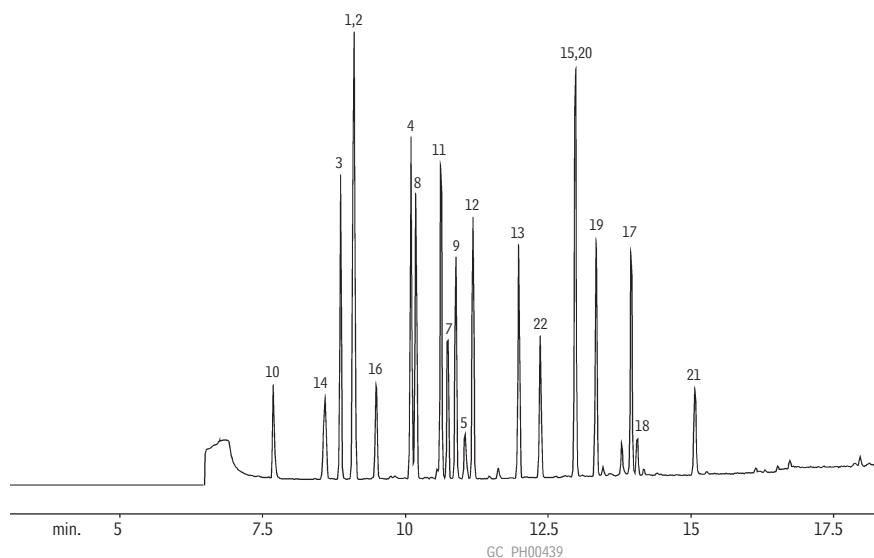
Column: Rtx®-5 Amine, 30m, 0.25mm ID, 0.50 $\mu$ m (cat.# 12338)  
 Instrument: Varian 3400 GC coupled with Varian Saturn 2000 MS detector  
 Inj.: 1 $\mu$ L, split, split vent flow rate 45mL/min.  
 Inj. temp.: 250°C  
 Carrier gas: helium  
 Det.: mass spectroscopy data collected using a scan range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

Ionization performed in the EI Auto mode.

1. phenylethylamine
2. amphetamine
3. phentermine
4. methamphetamine
5. fenfluramine
6. mephentermine
7. cathinone
8. phenylpropanolamine
9. methcathinone
10. nicotine
11. ephedrine
12. pseudoephedrine
13. phenmetrazine
14. phenidimetrazine
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

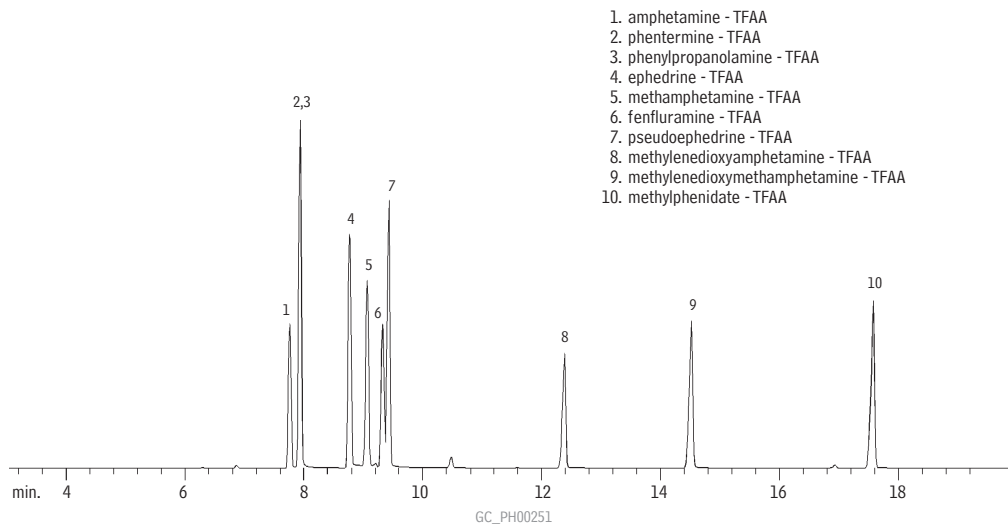


Column: Rtx®-200, 30m, 0.25mm ID, 0.50 $\mu$ m (cat.# 15038)  
 Instrument: Varian 3400 GC coupled with Varian Saturn 2000 MS detector  
 Inj.: 1 $\mu$ L, split, split vent flow rate 45mL/min.  
 Inj. temp.: 250°C  
 Carrier gas: helium  
 Det.: mass spectroscopy data collected using a scan range of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

Ionization performed in the EI Auto mode.

## Sympathomimetic Amines (Basic Drugs) (TFAA Derivatives)

Rtx®-5

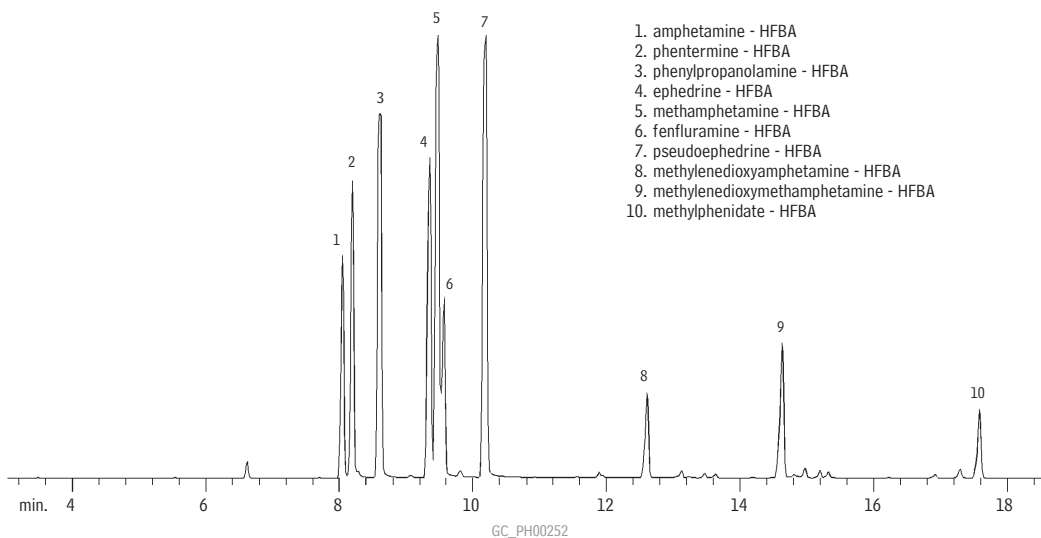


Column: Rtx®-5, 30m, 0.25mm ID, 0.25 $\mu$ m (cat.# 10223)  
 Sample: 1.0 $\mu$ L splitless injection of derivatized sympathomimetic amines  
 Conc.: approximately 2.5ng/ $\mu$ L  
 Oven temp.: 40°C (hold 1 min.) to 150°C @ 30°C/min.,  
 to 300°C @ 5°C/min.  
 Inj. temp.: 225°C  
 Interface temp.: 275°C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

Rx

## Sympathomimetic Amines (Basic Drugs) (HFBA Derivatives)

Rtx®-5

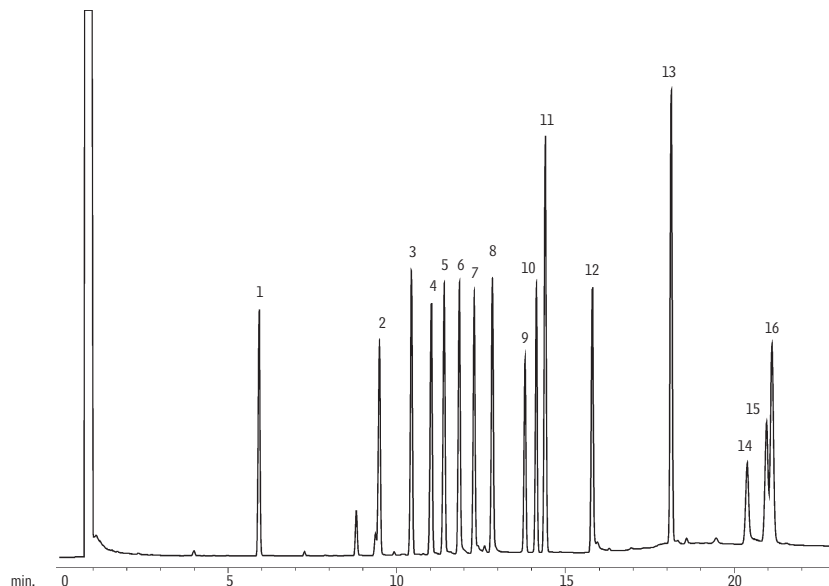


Column: Rtx®-5, 30m, 0.25mm ID, 0.25 $\mu$ m (cat.# 10223)  
 Sample: 1.0 $\mu$ L splitless injection of sympathomimetic amines  
 Conc.: approximately 2.5ng/ $\mu$ L  
 Oven temp.: 40°C (hold 1 min.) to 150°C @ 30°C/min.,  
 to 300°C @ 5°C/min.  
 Inj. temp.: 225°C  
 Interface temp.: 275°C  
 Det.: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

## Barbiturates

## Barbiturates (Acidic/Neutral Drugs) (Underivatized)

Rtx®-35



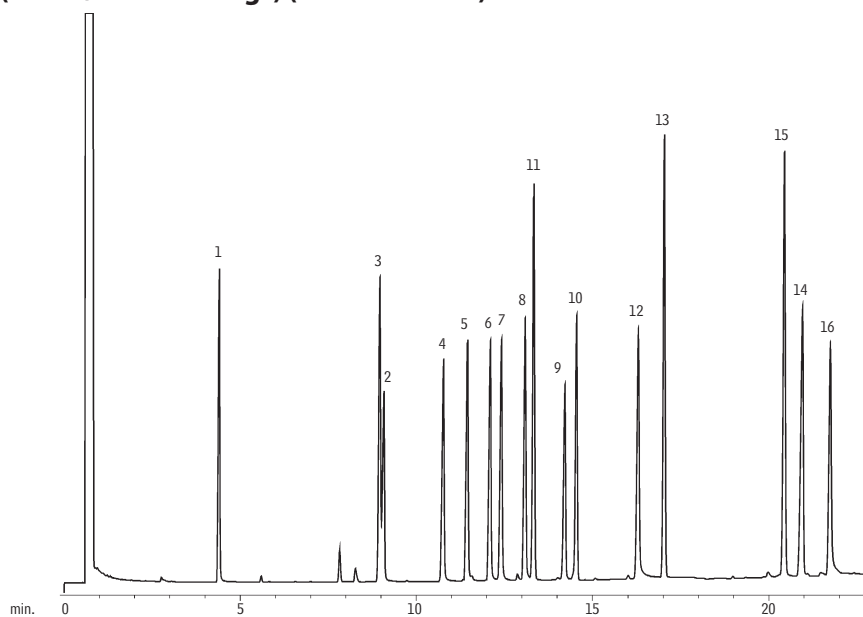
GC\_PH00262

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<sup>-10</sup> 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. carisoprodol
11. glutethimide
12. phenobarbital
13. methaqualone
14. primidone
15. carbamazepine
16. diphenylhydantoin

## Barbiturates (Acidic/Neutral Drugs) (Underivatized)

Rtx®-1701

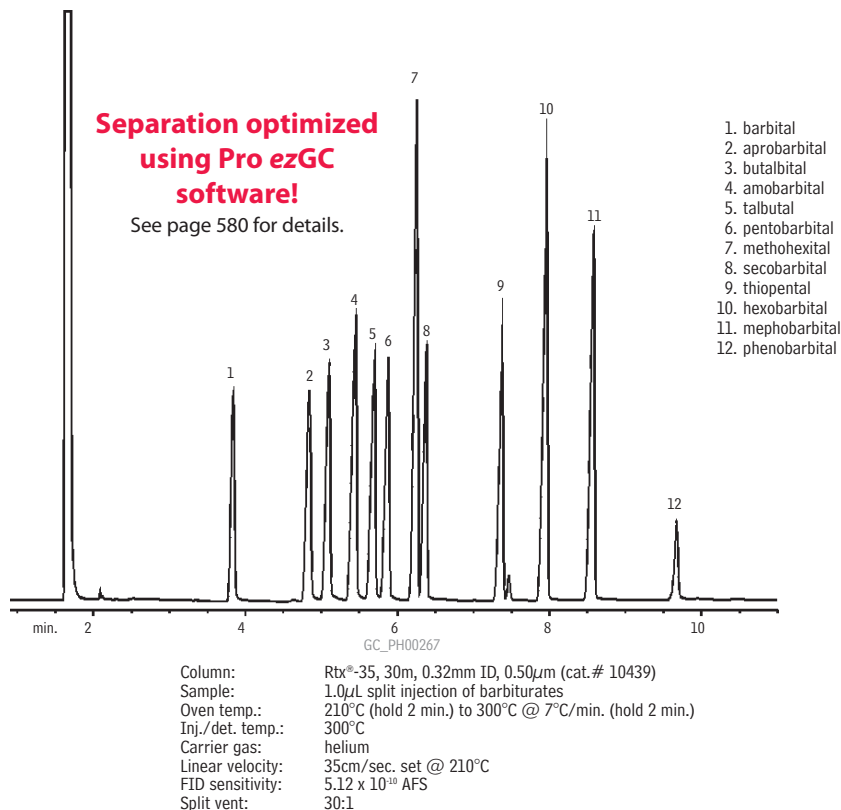


GC\_PH00263

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<sup>-10</sup> AFS  
 Splitless hold time: 0.5 min.

## Barbiturates (Acidic/Neutral Drugs) (Underivatized)

Rtx®-35



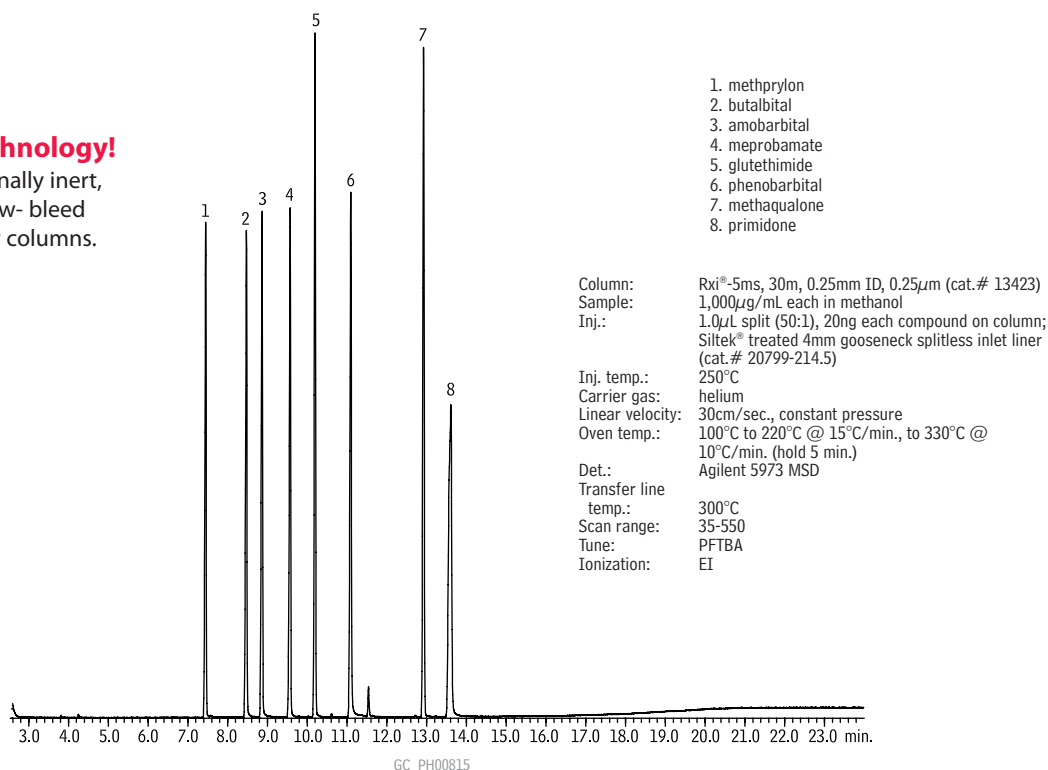
R<sub>x</sub>

## Acidic/Neutral Drugs

Rxi®-5ms

### Rxi® Technology!

Exceptionally inert,  
ultra low- bleed  
capillary columns.

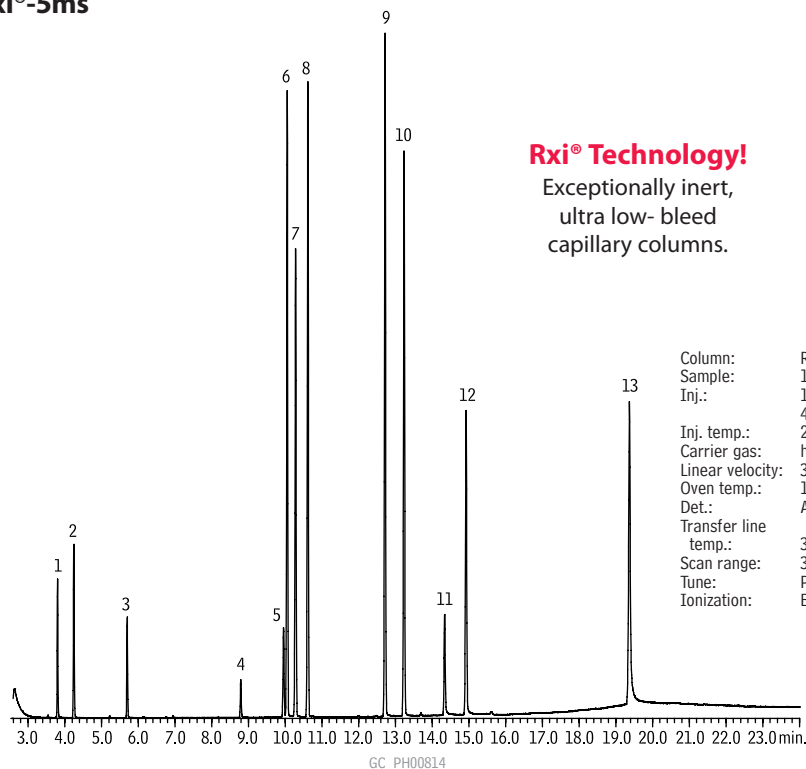




## Basic Drugs

## Basic Drugs (Underivatized)

## Rxi®-5ms



## Rxi® Technology!

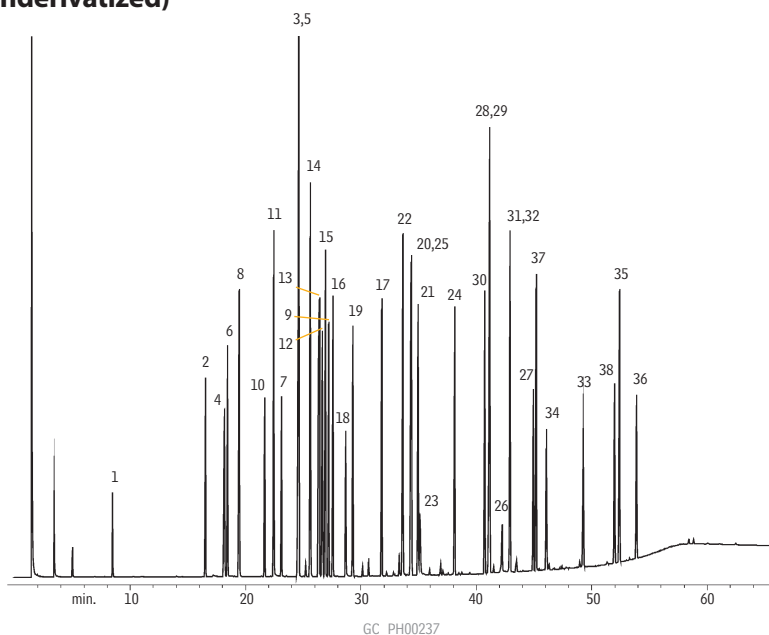
Exceptionally inert,  
ultra low- bleed  
capillary columns.

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

## Basic Drugs (Underivatized)

## Rtx®-200

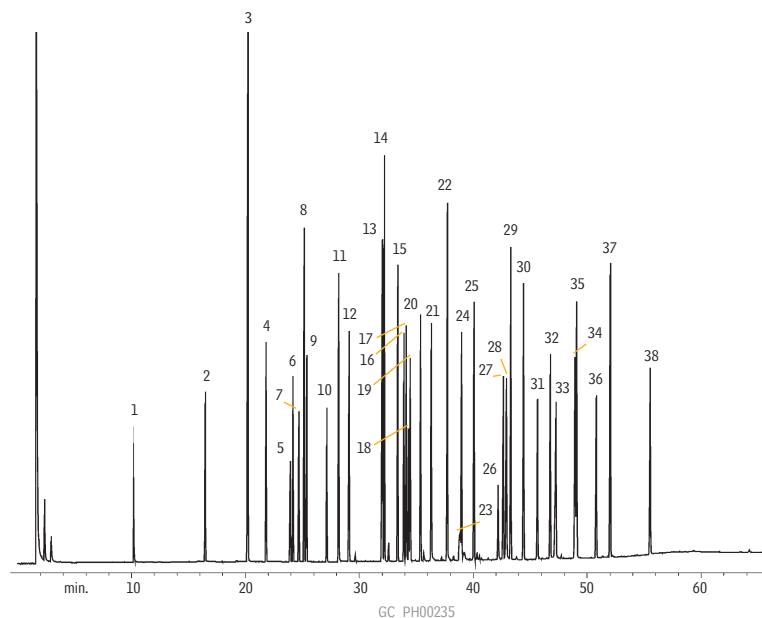


Column: Rtx®-200, 30m, 0.25mm ID, 0.25µm (cat.# 15023)  
 Sample: 1.0µL split injection of a basic drug sample (1mg/mL)  
 Conc.: 1,000ng/µL  
 Oven temp.: 100°C to 325°C @ 4°C/min. (hold 10 min.)  
 Inj./det. temp.: 250°C/320°C  
 Carrier gas: helium  
 Linear velocity: 30cm/sec. set @ 100°C  
 FID sensitivity: 1.28 x 10<sup>-10</sup> 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. tripeleminamine
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®-5

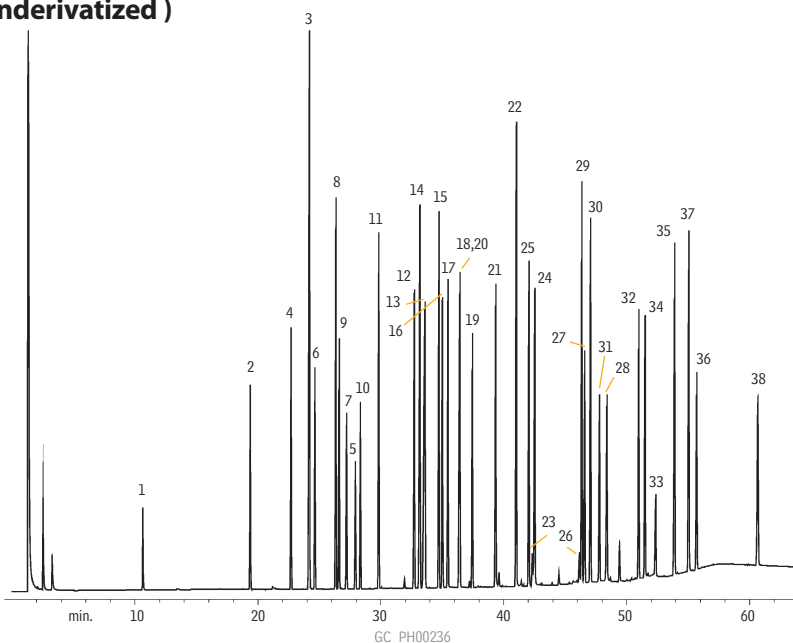


Column: Rtx®-5, 30m, 0.25mm ID, 0.25 $\mu$ m (cat.# 10223)  
 Sample: 1.0 $\mu$ L split injection of a basic drug sample  
 Conc.: 1,000ng/ $\mu$ L  
 Oven temp.: 100°C to 325°C @ 4°C/min. (hold 10 min.)  
 Inj./det. temp.: 250°C/320°C  
 Carrier gas: helium  
 Linear velocity: 30cm/sec. set @ 100°C  
 FID sensitivity: 1.28 x 10<sup>-10</sup> 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. tripeleonnamine
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

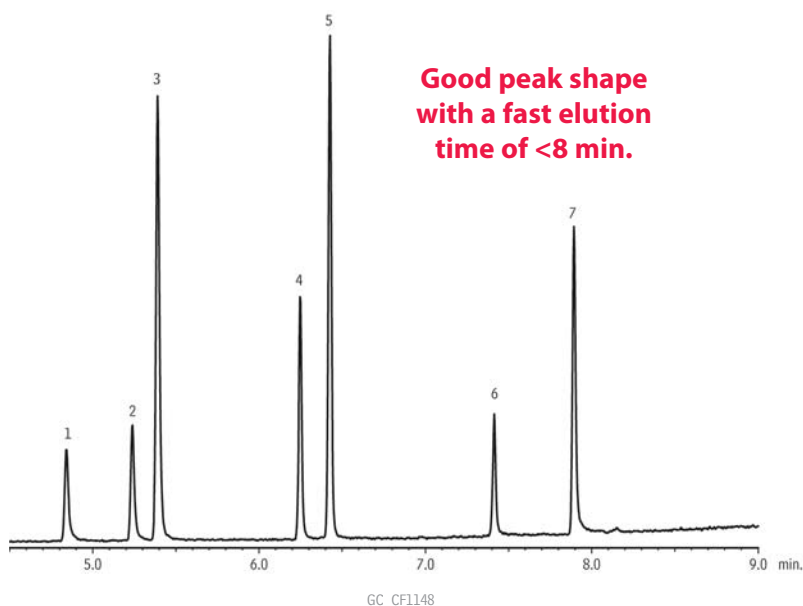


Column: Rtx®-35, 30m, 0.25mm ID, 0.25 $\mu$ m (cat.# 10423)  
 Sample: 1.0 $\mu$ L split injection of a basic drug sample  
 Conc.: 1,000ng/ $\mu$ L  
 Oven temp.: 100°C to 325°C @ 4°C/min. (hold 10 min.)  
 Inj./det. temp.: 250°C/320°C  
 Carrier gas: helium  
 Linear velocity: 30cm/sec. set @ 100°C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

## Benzodiazepines (15 µg/mL)

Rxi®-5Sil MS

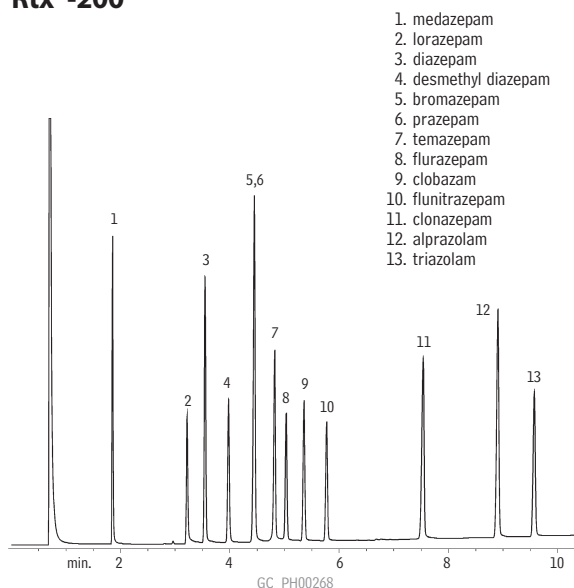
NEW!



## Peaks

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

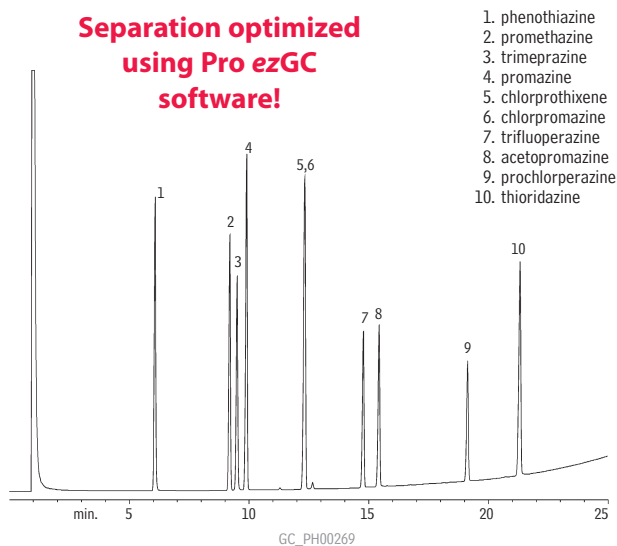
<b>Column</b>	Rxi®-5Sil MS, 30 m, 0.25 mm ID, 0.25 µm (cat.# 13623)
<b>Sample</b>	
Diluent:	Butyl chloride
Conc.:	15 µg/mL
<b>Injection</b>	
Inj. Vol.:	1 µL splitless (hold 1 min.)
Liner:	3.5mm Gooseneck Splitless w/Wool (cat.# 22286-200.1)
Inj. Temp.:	280 °C
Purge Flow:	32.2 mL/min. (20:1 split)
<b>Oven</b>	
Oven Temp:	200 °C to 330 °C at 15 °C/min. (hold 3 min.)
<b>Carrier Gas</b>	He, constant linear velocity
Linear Velocity:	50 cm/sec., 23.7 psi, 163.4kPa @ 200 °C
<b>Detector</b>	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.
<b>Instrument</b>	Shimadzu 2010 GC & QP2010+ MS

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

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<sup>-10</sup> AFS  
 Split ratio: 60:1

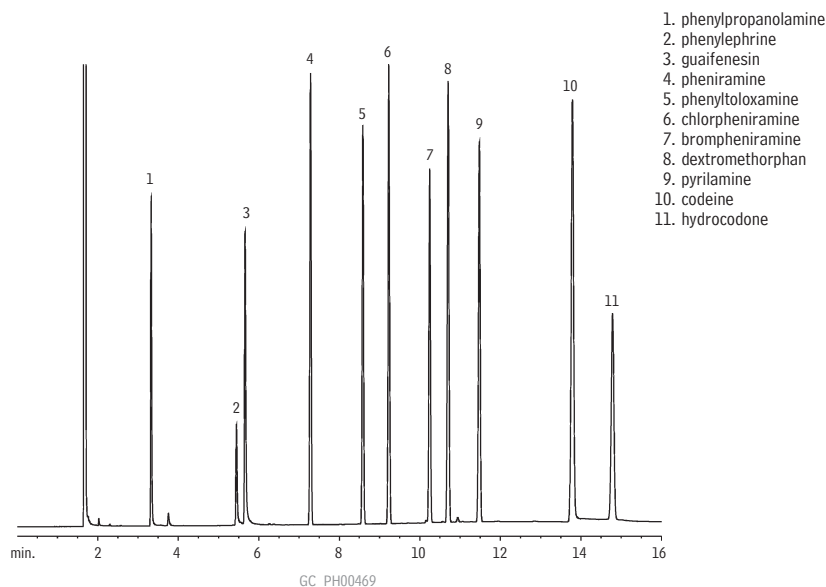
Phenothiazines (Basic Drugs) (Underivatized)  
Rtx®-5

Separation optimized  
using Pro ezGC  
software!



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<sup>-10</sup> AFS  
 Split ratio: 30:1

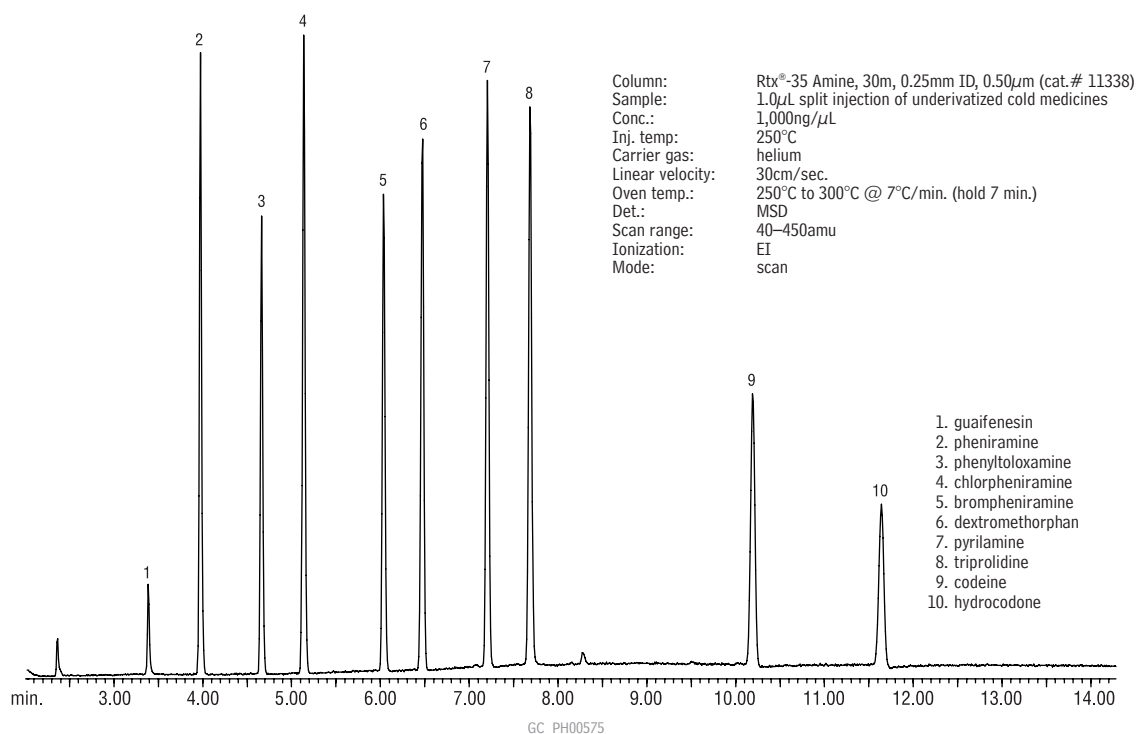
**Cold Medications (Basic Drugs) (Underivatized)**  
**Rtx®-5 Amine**



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

R<sub>x</sub>

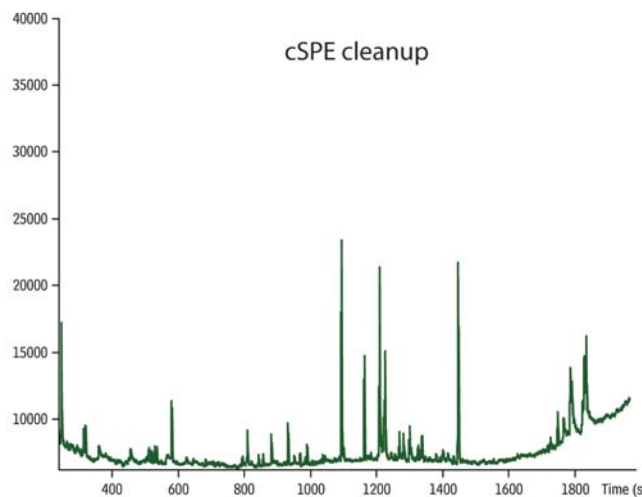
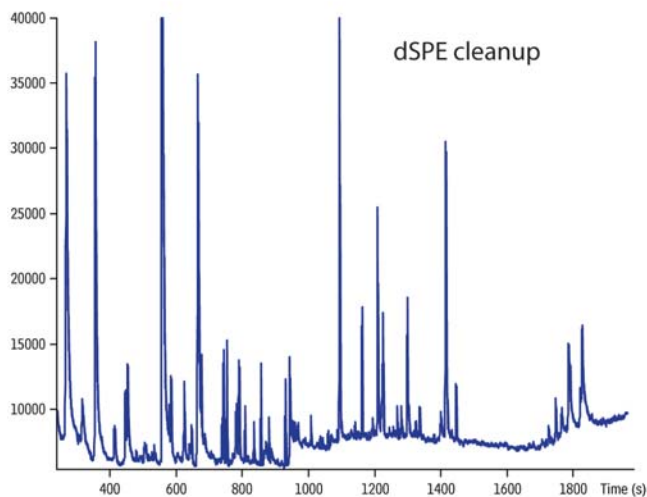
**Cold Medications (Basic Drugs) (Underivatized)**  
**Rtx®-35 Amine**



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!



GC\_FF1171

**Column  
Sample**

Rxi®-5Sil MS, 30 m, 0.25 mm ID, 0.25  $\mu$ m (cat. # 13623)  
Dandelion Root powder spiked with 46 pesticides  
QuEChERS Internal Standard Mix for GC/MS Analysis (cat. # 33267)  
anthracene for quality control (cat. # 33264)  
80 pg/ $\mu$ L

**Conc.:  
Injection**

Inj. Vol.: 1  $\mu$ L 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:**

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**

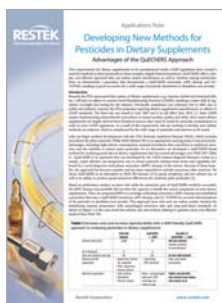
Sample Preparation:

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.

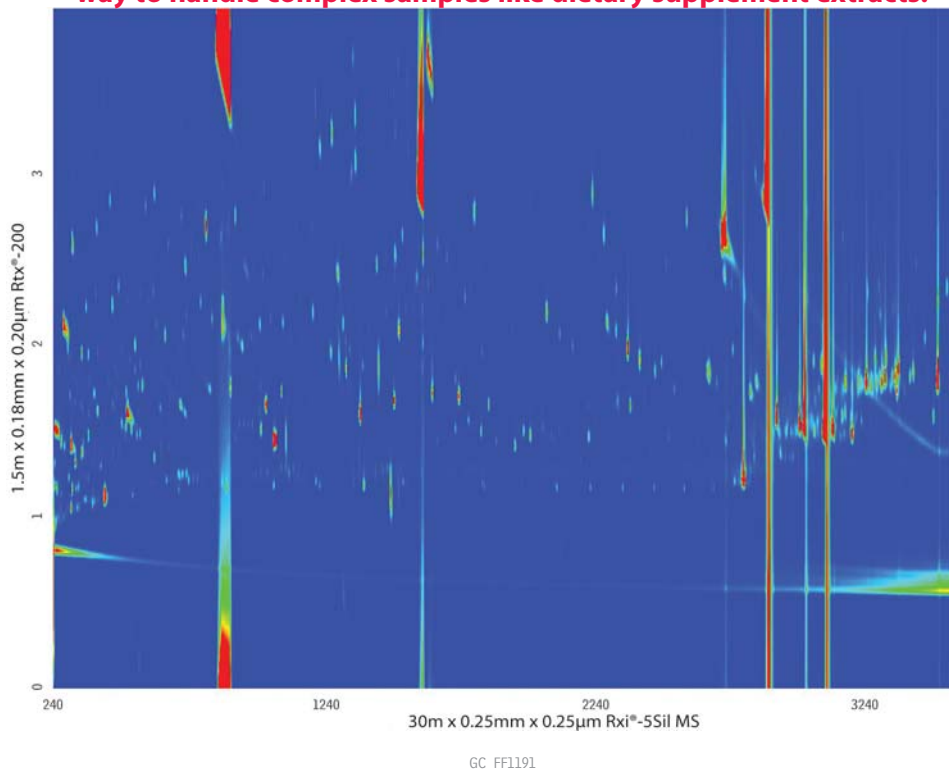
Download your copy from [www.restek.com](http://www.restek.com)

Applications Note  
lit. cat. # PHAN1242

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



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



**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**  
Flow Rate: He, constant flow  
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**  
Transfer TOFMS  
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 Notes**  
LECO Pegasus 4D GCxGC-TOFMS  
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).

Restek is your complete source for analyzing pesticides in dietary supplements.

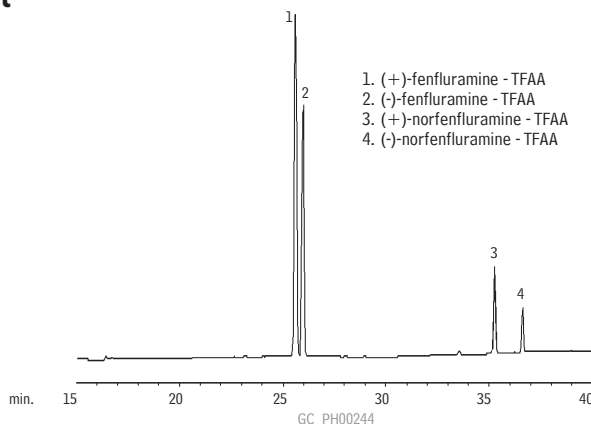
[www.restek.com/dietary](http://www.restek.com/dietary)





## Fenfluramine (TFAA Derivative)

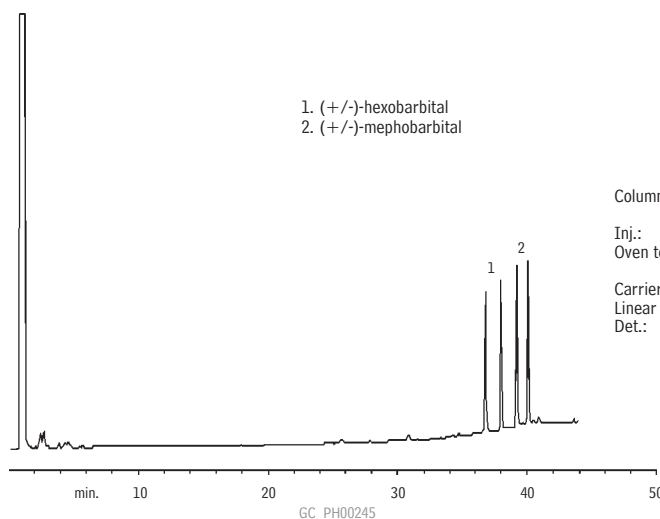
Rt®-βDEXcst



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

## Barbiturates (Underivatized)

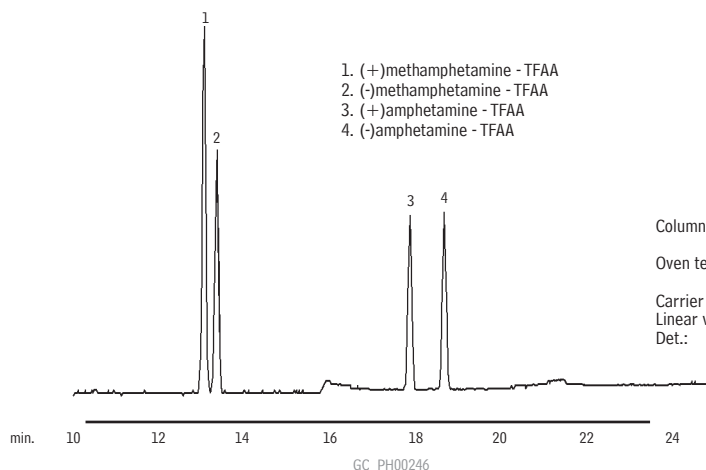
Rt®-βDEXcst



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

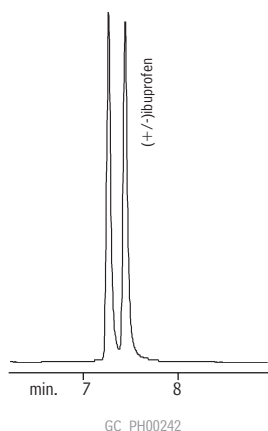
## Amphetamine and Methamphetamine (TFAA Derivatives)

Rt®-βDEXcst



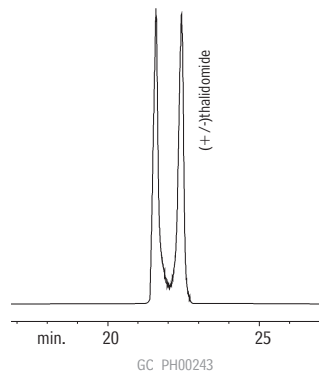
Column: Rt®-βDEXcst, 30m, 0.25mm ID, 0.25μm (cat.# 13103)  
Oven temp.: 120°C (hold 1 min.) to 175°C @ 1.5°C/min.  
Carrier gas: helium  
Linear velocity: 25cm/sec. set @ 120°C  
Det.: MSD @ 220°C

**Ibuprofen (Underivatized)**  
**Rt®-βDEXsm**



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)

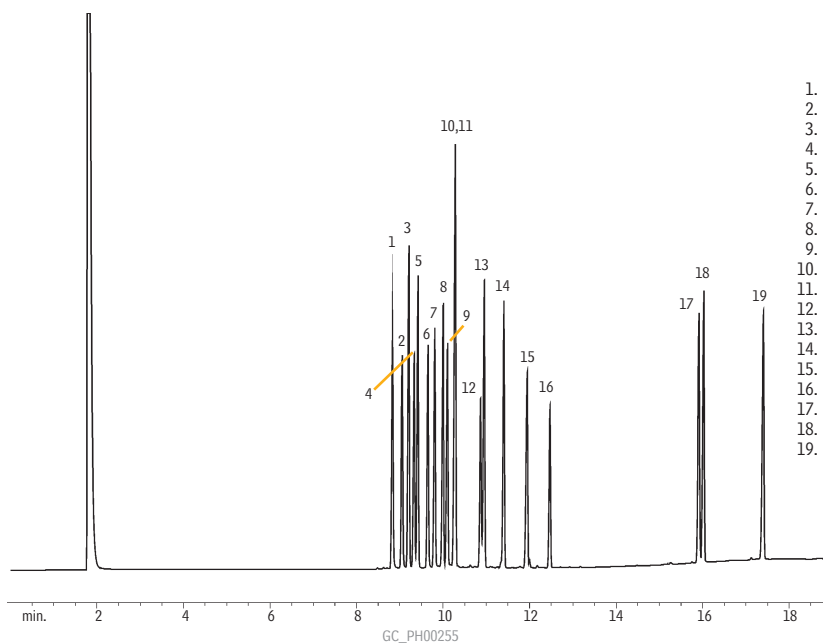
**Thalidomide (Underivatized)**  
**Rt®-βDEXcst**



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)

R<sub>x</sub>

**Steroids, Anabolic (Underivatized)**  
**Rtx®-5**



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. mestrolone
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

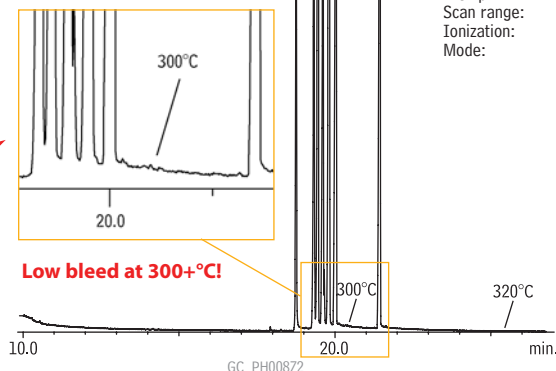
Column: Rtx®-5, 30m, 0.25mm ID, 0.10μm (cat.# 10208)  
Sample: 0.5μL split injection of anabolic steroids  
Conc.: 1,000ng/μL  
Oven temp.: 180°C to 340°C @ 10°C/min. (hold 3 min.)  
Inj./det. temp.: 280°C/340°C  
Carrier gas: helium  
Linear velocity: 35cm/sec. set @ 180°C  
FID sensitivity: 1.28 x 10<sup>-10</sup> AFS  
Split ratio: 50:1

**Steroids: Sex Hormones**  
**Rxi®-1ms**

1. androsterone
2. dehydroepiandrosterone (DHEA)
3. 17- $\alpha$ -estradiol
4. estrone
5. 17- $\beta$ -estradiol
6. testosterone
7. derivatization by-product

Column: Rxi®-1ms, 30m, 0.25mm ID, 0.25 $\mu$ m (cat.# 13323)  
Sample: 100 $\mu$ g/mL each hormone in methanol or ethanol; compounds derivatized using 2% methoxyamine HCl (CH<sub>3</sub>ONH<sub>2</sub>) in pyridine, then N-trimethylsilylimidazole (TMSI), then analyzed 1.0 $\mu$ L splitless (hold 0.5 min.), 3.5mm single gooseneck inlet liner (cat.# 20961)  
Inj.:  
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

**Excellent resolution of closely eluting hormones.**



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**Rxi® Technology!**

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capillary columns.



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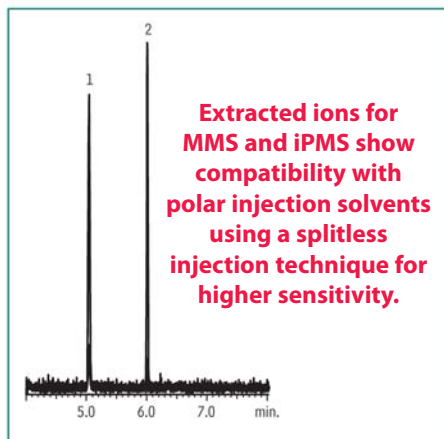
Fax: 814-353-1309—24-hours a day

Online: [www.restek.com](http://www.restek.com)—24-hours a day

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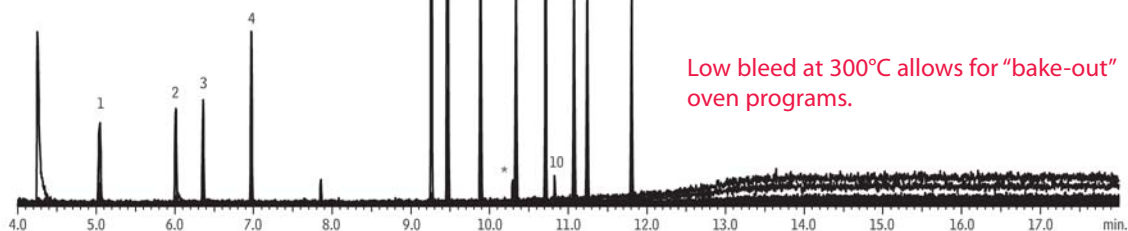
Contact your Restek representative:  
Refer to our list on pages 4-5 or visit our website at [www.restek.com](http://www.restek.com)

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

**NEW!**


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. <i>n</i> -propyl toluenesulfonate (nPTS)	10.827	91, 155, 172
11. <i>n</i> -butyl benzenesulfonate (nBBS)	11.07	77, 141, 159
12. isopropyl <i>p</i> -toluenesulfonate (iPTS)	11.240	91, 155, 172
13. <i>p</i> -toluenesulfonic acid <i>n</i> -butyl ester (nBTS)	11.823	91, 155, 173

\* Ortho isomers of ETS.

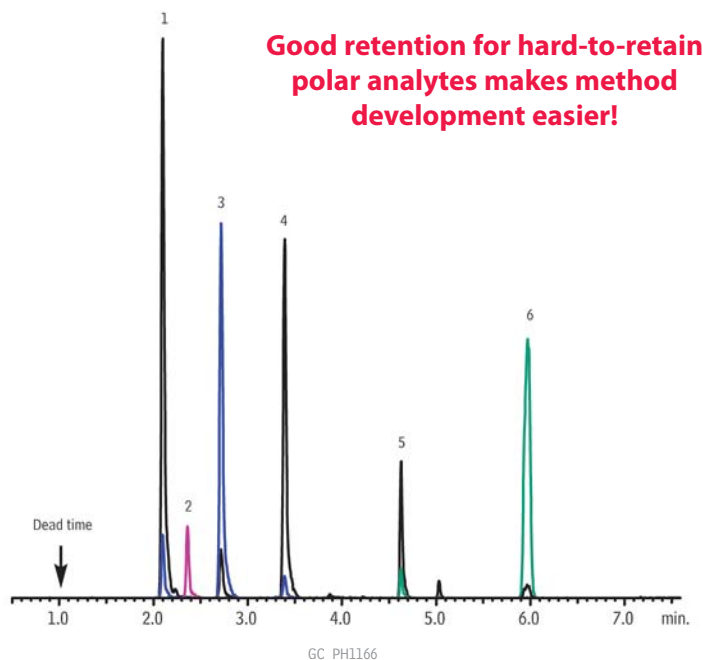


GC\_PH1165

<b>Column</b>	Rxi®-624Sil MS, 20 m, 0.18 mm ID, 1.00 µm (cat.# 13865)
<b>Sample</b>	
Diluent:	90:10 acetonitrile:water
Conc.:	500 ng/mL
<b>Injection</b>	
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.
<b>Oven</b>	
Oven Temp:	80 °C (hold 2 min.) to 300 °C at 20 °C/min. (hold 5 min.)
<b>Carrier Gas</b>	He, constant flow
Linear Velocity:	45 cm/sec.
<b>Detector</b>	MS
Mode:	SIM
Transfer Line	
Temp.:	200 °C
Analyzer Type:	Quadrupole
Source Temp.:	280 °C
Solvent Delay	
Time:	4 min.
Ionization	
Mode:	EI
<b>Instrument</b>	Shimadzu 2010 GC & QP2010+ MS
<b>Acknowledgement</b>	In collaboration with Merck and Company

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

NEW!



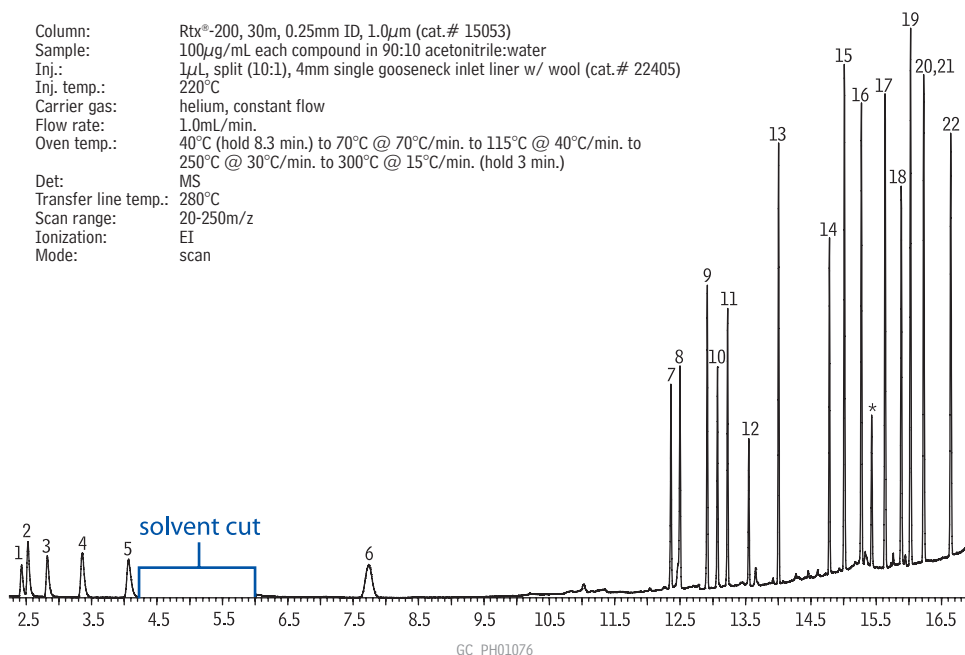
Peaks	RT (min.)	Conc. (µg/mL)
1. 2-Chloropropane	2.10	1
2. Bromoethane	2.36	1
3. 1-Chloropropane	2.72	1
4. 2-Bromopropane	3.393	1
5. Butyl chloride	4.627	1
6. 1-Bromobutane	5.973	1

**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



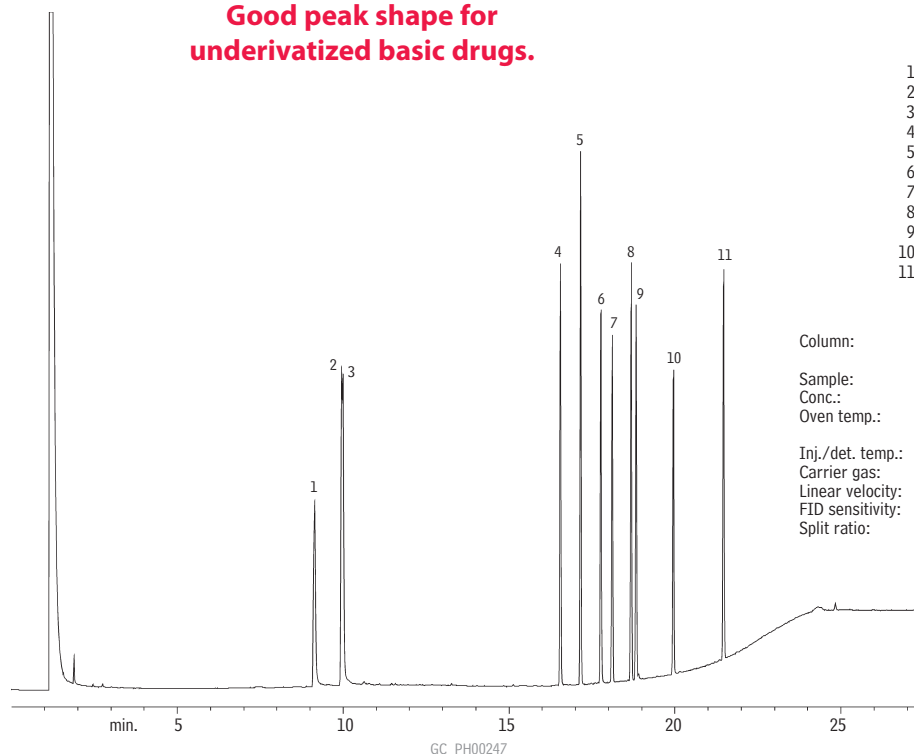
- 1-chloropropane
- bromoethane
- 2-chloropropane
- 1-bromopropane
- 2-bromopropane
- 1-bromobutane
- dimethyl sulfate
- methyl methanesulfonate
- ethyl methanesulfonate
- isopropyl methanesulfonate
- diethyl sulfate
- di-isopropyl sulfate
- di-n-propyl sulfate
- dibutyl sulfate
- methylbenzene sulfonate
- ethylbenzene sulfonate
- methyl toluenesulfonate
- ethyl toluenesulfonate
- n-butyl benzenesulfonate
- n-propyl toluenesulfonate
- isopropyl toluenesulfonate
- n-butyl toluenesulfonate

\*ortho isomer of ethyl toluenesulfonate

## Underivatized Antihistamines (Basic Drugs)

## Rtx®-5 Amine

Good peak shape for  
underivatized basic drugs.



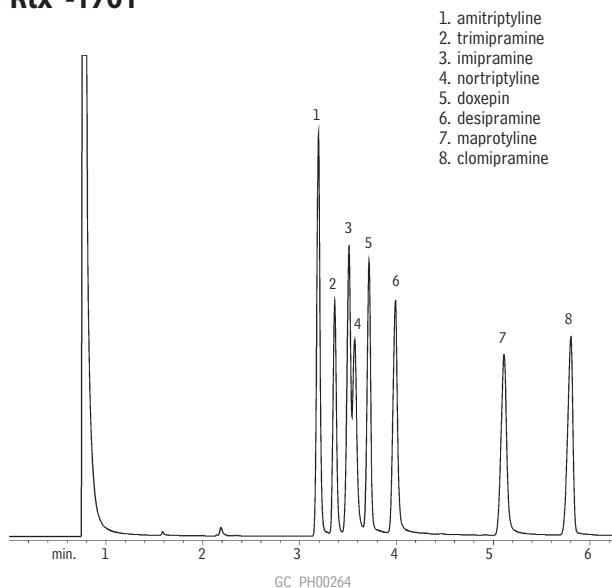
1. phenylpropanolamine
2. ephedrine
3. pseudoephedrine
4. pheniramine
5. diphenhydramine
6. doxylamine
7. phenyltoloxamine
8. methapyrilene
9. chlorpheniramine
10. brompheniramine
11. triprolidine

Column: Rtx®-5 Amine, 30m, 0.32mm ID, 1.0 $\mu$ m (cat.# 12354)  
 Sample: 1.0 $\mu$ L split injection of antihistamines  
 Conc.: 1,000ng/ $\mu$ L  
 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<sup>-12</sup> AFS  
 Split ratio: 50:1

R<sub>x</sub>

## Antidepressants (Basic Drugs) (Underivatized)

## Rtx®-1701



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

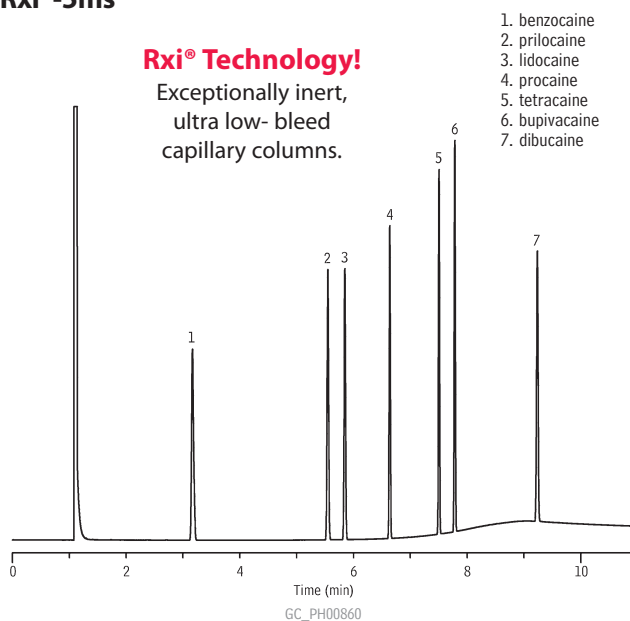
Column: Rtx®-1701, 15m, 0.25mm ID, 0.25 $\mu$ m (cat.# 12020)  
 Sample: 1.0 $\mu$ L split injection of antidepressants  
 Conc.: 25ng/component  
 Oven temp.: 225°C  
 Inj./det. temp.: 250°C/260°C  
 Carrier gas: helium  
 Linear velocity: 30cm/sec. set @ 225°C  
 FID sensitivity: 2.56 x 10<sup>-10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

## Local Anesthetics

## Rxi®-5ms

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

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

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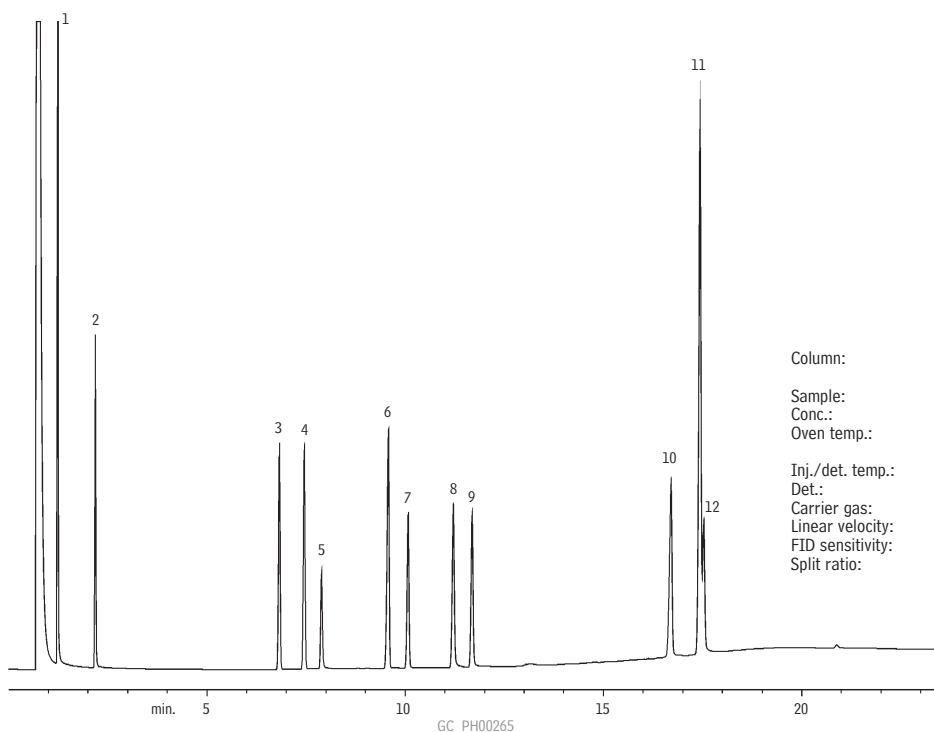
691



## Antiepileptics

## Antiepileptics (Underivatized)

Rtx®-20

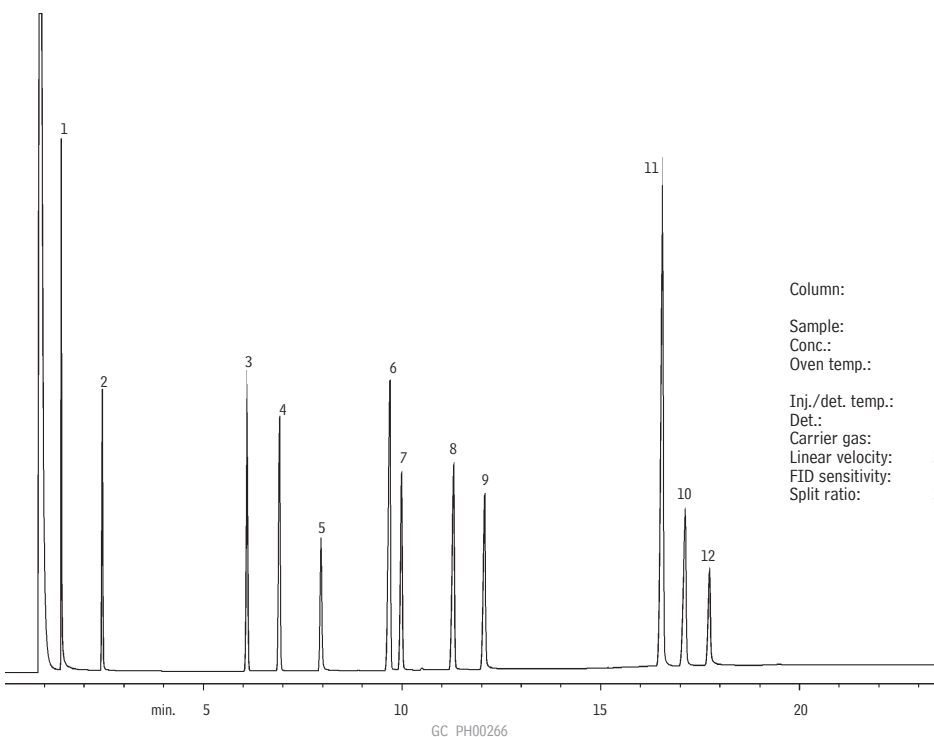


Column: Rtx®-20, 15m, 0.32mm ID, 0.50 $\mu$ m (cat.# 10336)  
 Sample: 1.0 $\mu$ L split injection of antiepileptic drugs  
 Conc.: 1,000ng/ $\mu$ L  
 Oven temp.: 150°C to 280°C @ 7°C/min. (hold 5 min.)  
 Inj./det. temp.: 250°C/270°C  
 Det.: FID  
 Carrier gas: helium  
 Linear velocity: 30cm/sec.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

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

## Antiepileptics (Underivatized)

Rtx®-1701



Column: Rtx®-1701, 15m, 0.32mm ID, 0.50 $\mu$ m (cat.# 12036)  
 Sample: 1.0 $\mu$ L split injection of antiepileptic drugs  
 Conc.: 1,000ng/ $\mu$ L  
 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<sup>-10</sup> 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.) 7°C/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-butyl 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

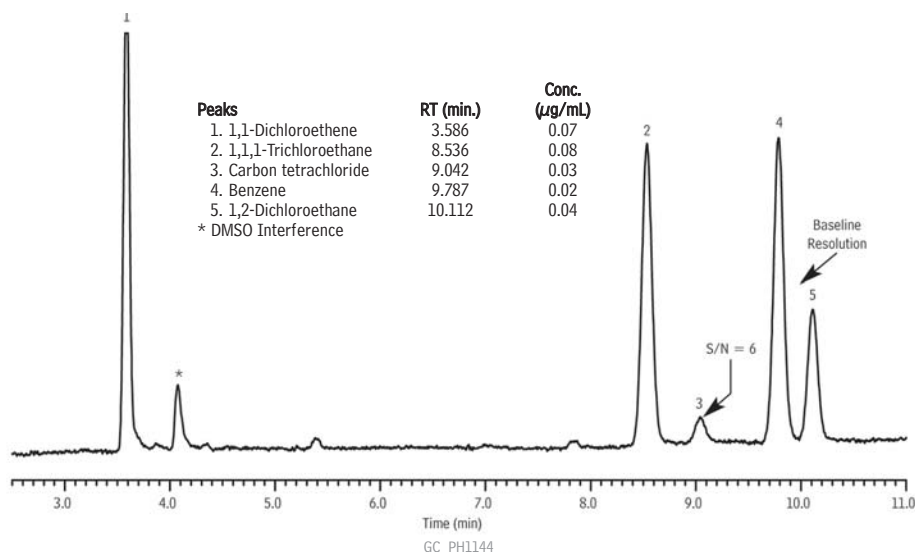
Rx

## Chromatogram Search Tool

Search by compound name, synonym,  
CAS # or keyword[www.restek.com/chromatograms](http://www.restek.com/chromatograms)

NEW!

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

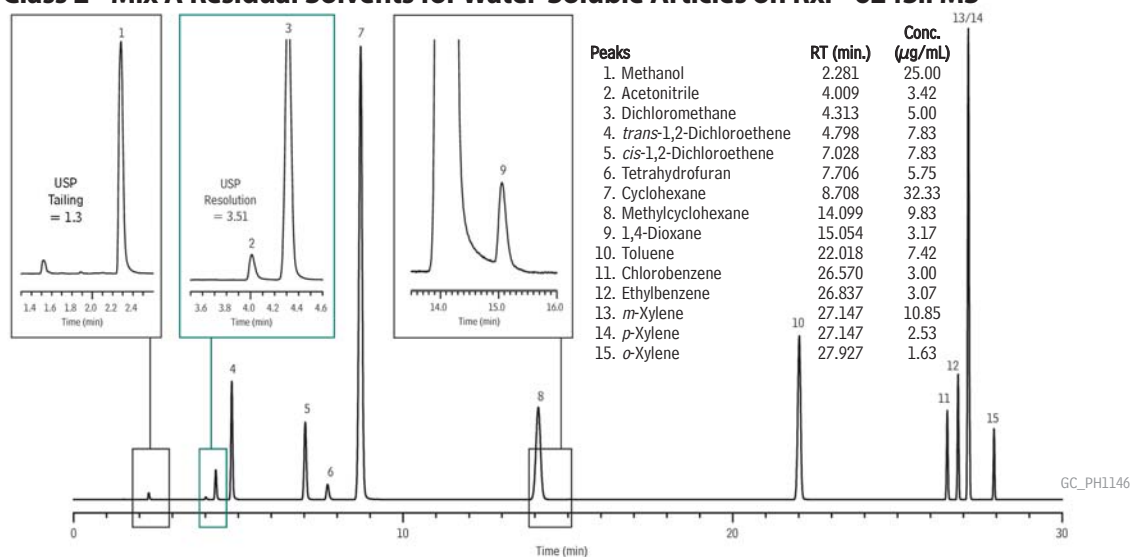


**Column** Rxi®-624Sil MS, 30 m, 0.32 mm ID, 1.80 µm (cat.# 13870)  
**Sample** Residual Solvents - Class 1 (cat.# 36279)  
**Diluent:** water  
**Injection** headspace-loop split (split ratio 5:1)  
**Liner:** 1mm Split (cat.# 20972)  
**Headspace-Loop**  
 Inj. Port Temp.: 140 °C  
 Instrument: Tekmar 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!

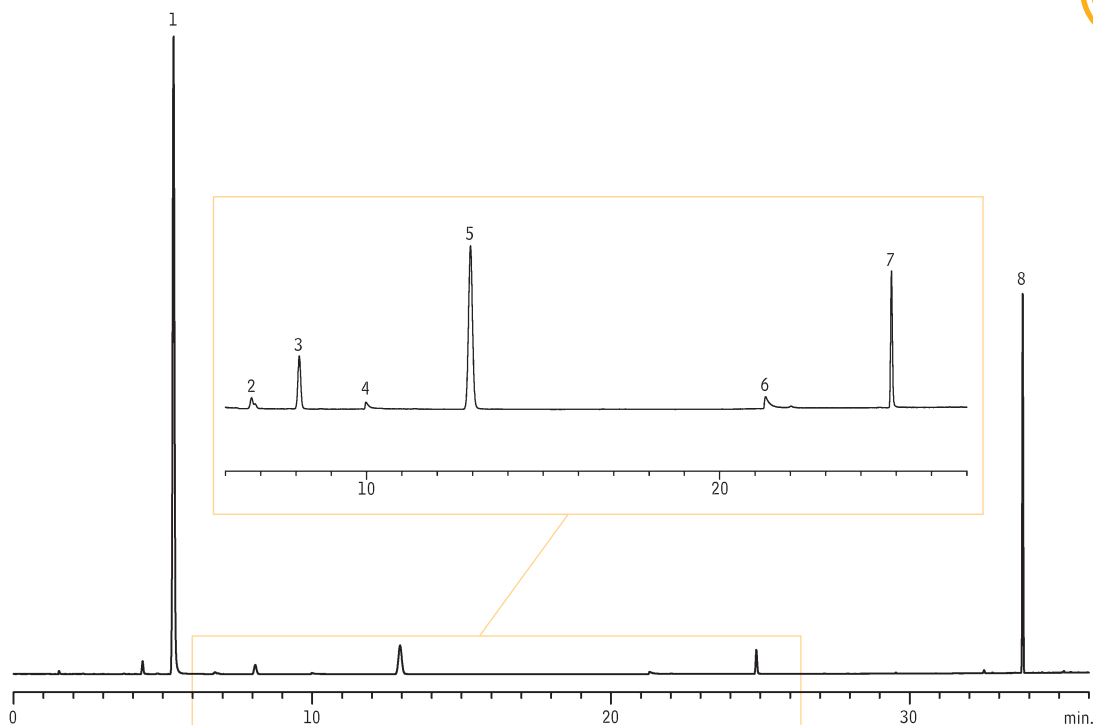


**Column** Rxi®-624Sil MS, 30 m, 0.32 mm ID, 1.80 µm (cat.# 13870)  
**Sample** Residual Solvents Class 2 - Mix A (cat.# 36271)  
**Diluent:** water  
**Injection** headspace-loop split (split ratio 5:1)  
**Liner:** 1mm Split (cat.# 20972)  
**Headspace-Loop**  
 Inj. Port Temp.: 140 °C  
 Instrument: 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

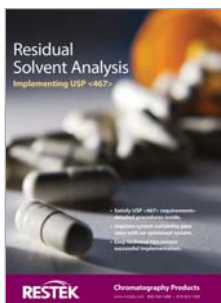
Peaks	RT (min.)	Conc. (µg/mL)
1. Hexane	5.355	2.42
2. Nitromethane	6.793	0.42
3. Chloroform	8.092	0.50
4. 1,2-Dimethoxyethane	9.980	0.83
5. Trichloroethene	12.941	0.67
6. Pyridine	21.303	1.67
7. 2-Hexanone	24.862	0.42
8. Tetralin	33.781	0.83

**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>

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Applications Note  
 lit. cat.# PHFL1018A

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## Organic Volatile Impurities: Retention Time Index

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

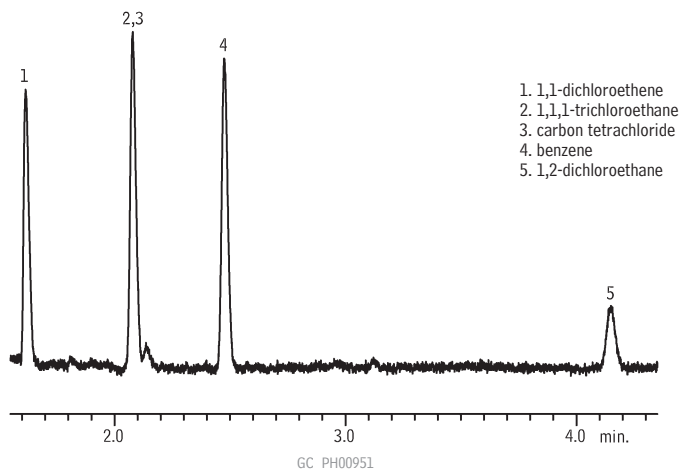
Retention time data collected using the following conditions:

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

Carrier gas: helium	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
Compound							
1,1,1-trichloroethane	1	3.96	3.49	5.43	5.40	10.82	8.35
1,1,2-trichloroethane	2	15.72	14.28	10.99	9.77	16.75	14.94
1,1-dichloroethane	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-dichloroethane	2	6.50	5.65	4.79	2.88	8.71	7.11
trans-1,2-dichloroethane	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)**



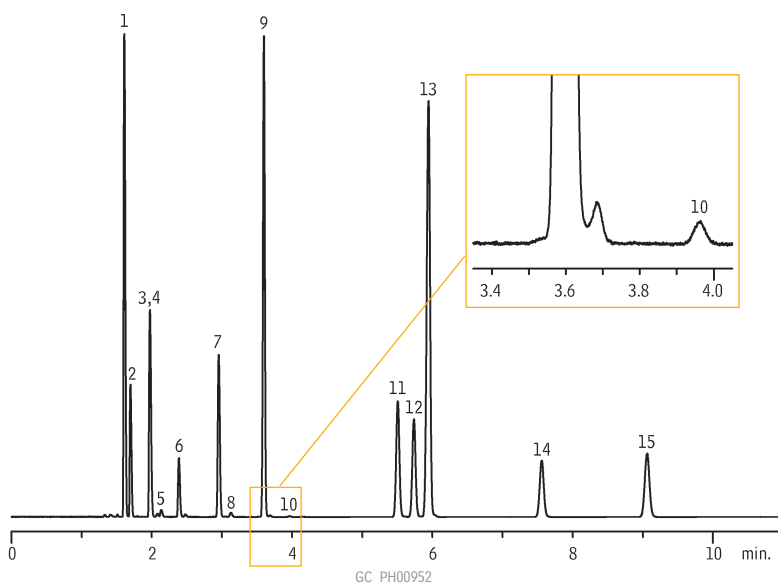
1. 1,1-dichloroethene
2. 1,1,1-trichloroethane
3. carbon tetrachloride
4. benzene
5. 1,2-dichloroethane

GC\_PH00951

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

R<sub>x</sub>

**Residual Solvents Class 2 Mix A**  
**Stabilwax® (G16)**



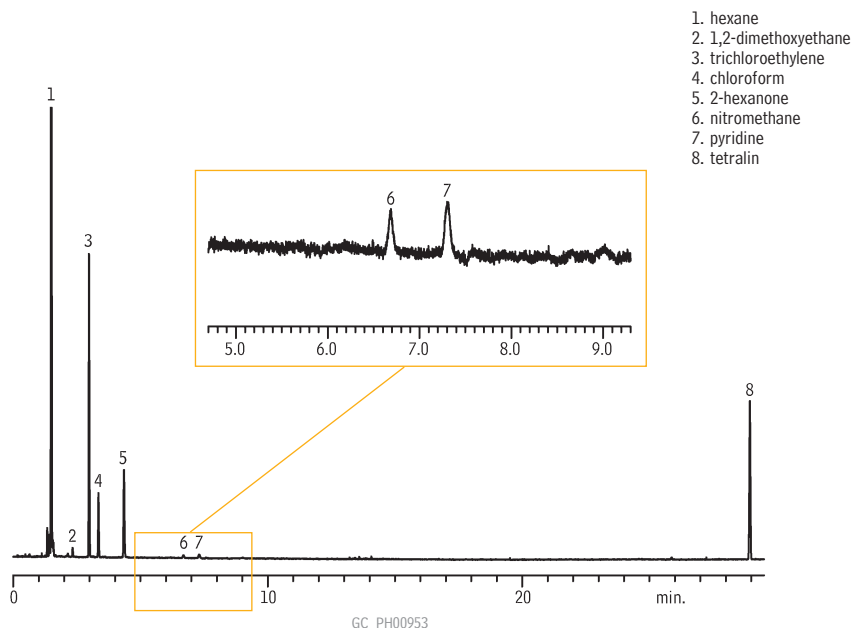
1. cyclohexane
2. methylcyclohexane
3. *trans*-1,2-dichloroethene
4. tetrahydrofuran
5. methanol
6. dichloromethane
7. *cis*-1,2-dichloroethene
8. acetonitrile
9. toluene
10. 1,4-dioxane
11. ethyl benzene
12. *p*-xylene
13. *m*-xylene
14. *o*-xylene
15. chlorobenzene

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)



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.

# At Risk for Melamine

Meet new FDA guidance for melamine contamination  
in at-risk pharmaceutical components.

## Melamine Analysis Kit.....cat. # 33254 (see page 535)

Detect melamine and related compounds by GC/MS with a complete analysis kit. Consistent with FDA procedure and new guidance for at-risk pharmaceutical components.

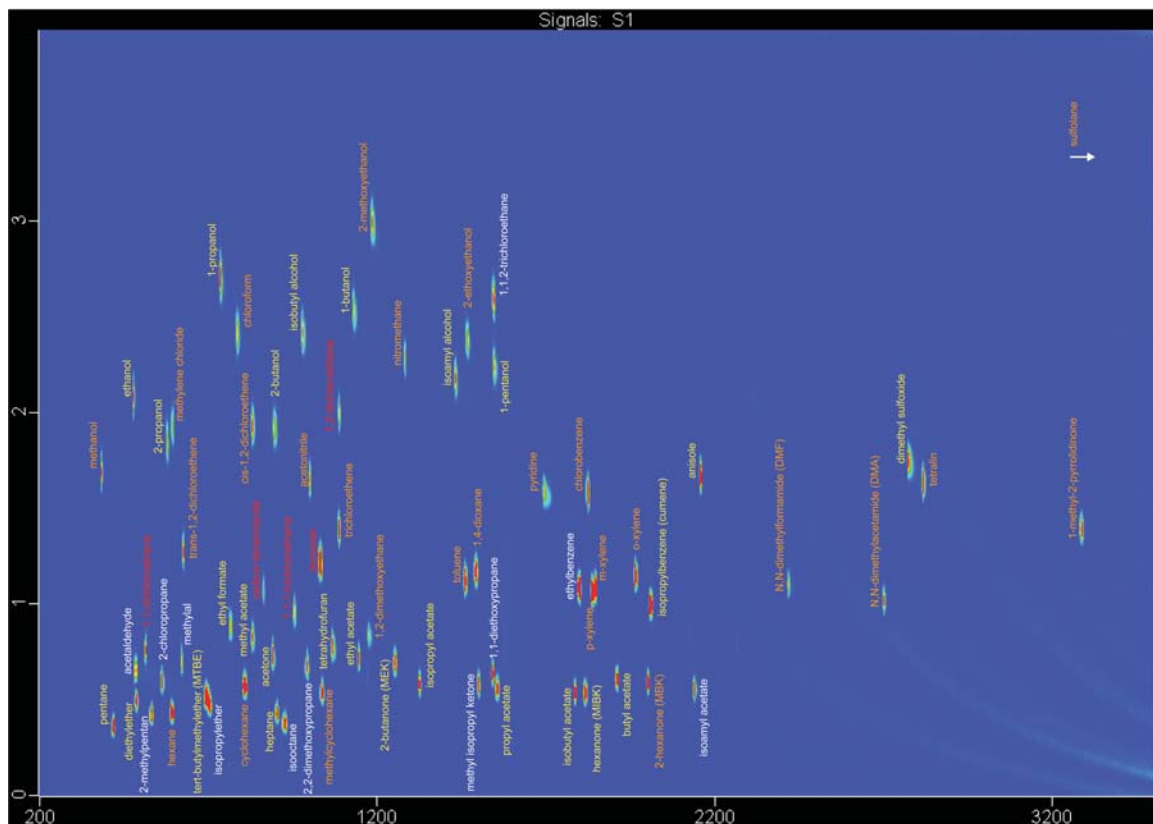
Kit includes (also sold individually):

- **Rxi®-5SiI MS with 5 meter Integra Guard® Column**
- **Standards**
- **Derivatization Reagent**
- **Accessory Tubes and Syringe Filters**
- **Easy-to-Follow Instructions** with procedural check list to simplify laboratory documentation!



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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.

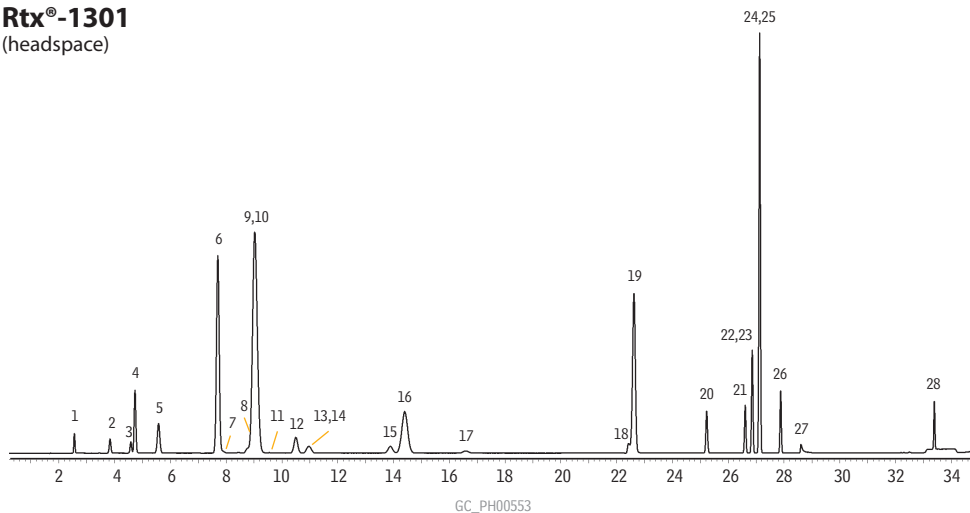
For more about GCxGC, visit our website and search for GCxGC.

## 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-trichloroethene)
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

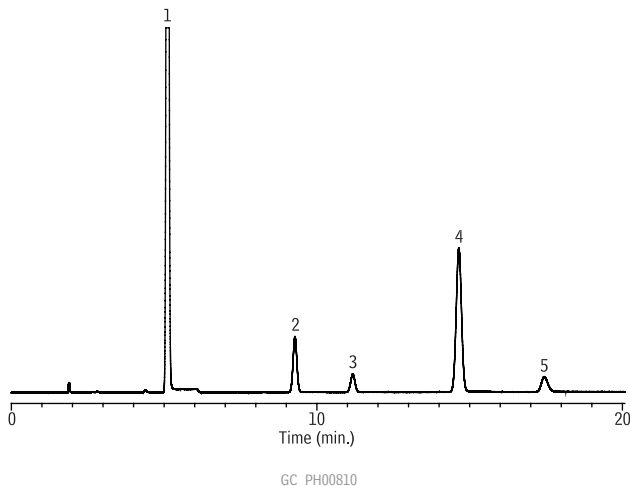
Column: Rtx®-1301, 30m, 0.53mm ID x 3.0µm (cat.# 16085)  
 Sample: headspace injection of 28 Class 1 and 2 residual solvents for pharmaceutical processing, prepared at the regulatory limit concentration, using samples shaken and heated at 80°C for 15 min., 1mL headspace injection  
 Oven temp.: 40°C (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<sup>-11</sup> 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.

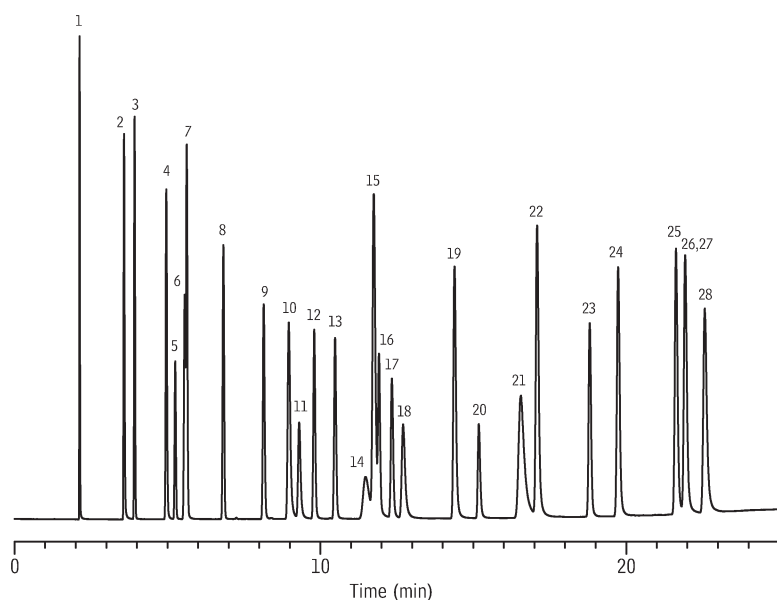
Static Headspace (Loop) Conditions:  
 Instrument: Teledyne Tekmar HT3  
 Valve oven temp.: 150°C  
 Transfer line temp.: 150°C  
 Standby flow rate: 10mL/min.  
 Platen/sample temp.: 80°C  
 Platen temp equil. time: 2.00 min.  
 Sample equil. time: 15.00 min.  
 Mixer time: 2.00 min.  
 Mixing level: 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)

NEW!



GC\_PC01082

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

Column: Rt®-Q-BOND, 30m, 0.53mm ID, 20 $\mu$ m (cat. # 19742)  
 Sample: solvent mixture  
 Inj.: 1.0 $\mu$ L, 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

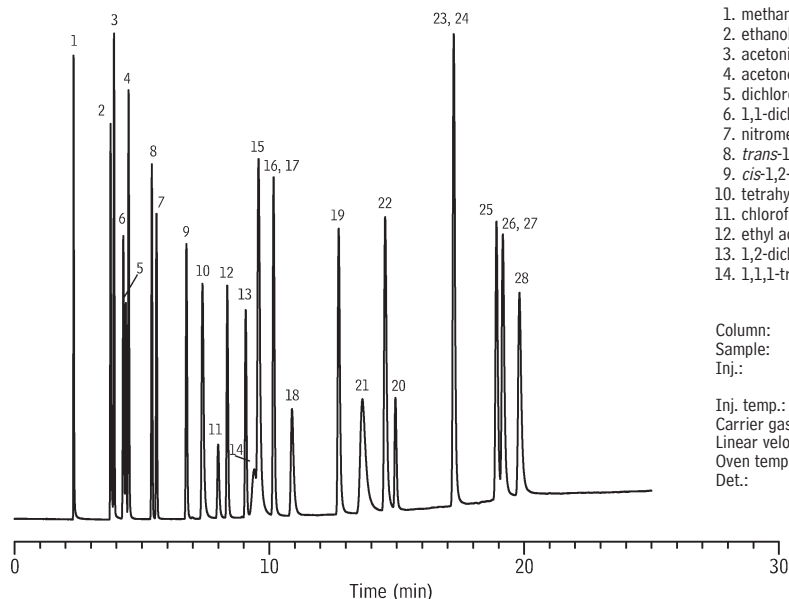


## Solvent Mixture

## Rt®-S-BOND

(PLOT)

NEW!



GC\_PC01080

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

Column: Rt®-S-BOND, 30m, 0.53mm ID, 20 $\mu$ m (cat. # 19746)  
 Sample: solvent mixture  
 Inj.: 1.0 $\mu$ L, 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

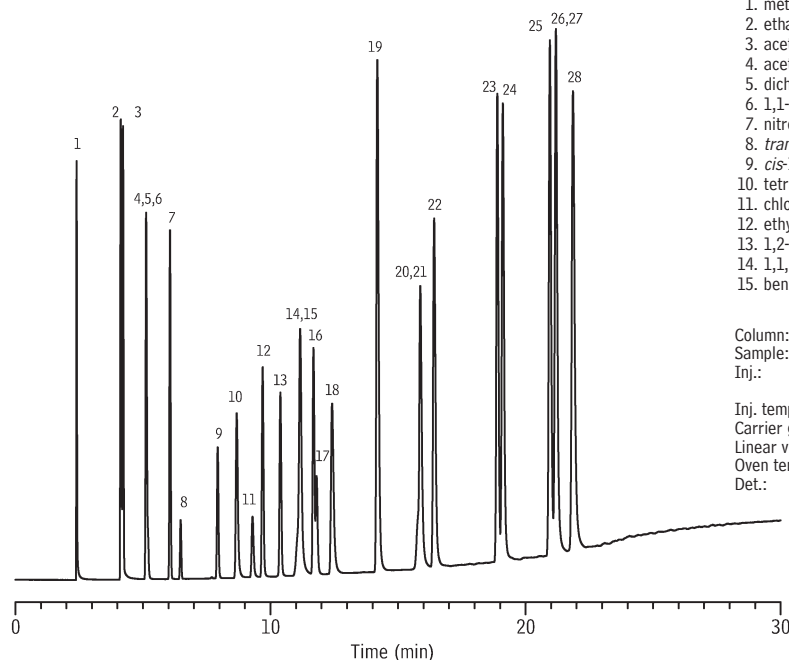
## Solvents

## Solvent Mixture

## Rt®-QS-BOND

(PLOT)

NEW!



GC\_PC01081

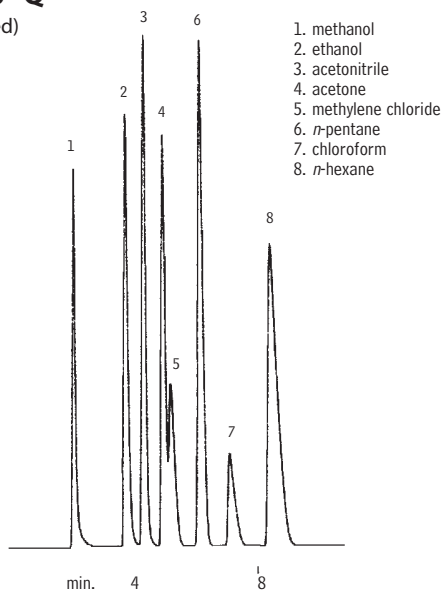
- |                                       |                         |
|---------------------------------------|-------------------------|
| 1. methanol                           | 16. 1,2-dimethoxyethane |
| 2. ethanol                            | 17. trichloroethylene   |
| 3. acetonitrile         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

Column: Rt®-QS-BOND, 30m, 0.53mm ID, 20 $\mu$ m (cat.# 19738)  
 Sample: solvent mixture  
 Inj.: 1.0 $\mu$ L, 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

Column: HayeSep® Q, 2m, 1mm ID (cat.# 19017)  
 Sample: 1 $\mu$ L direct injection of a neat solvent mixture  
 Oven temp.: 80°C to 180°C @  
 16°C/min. (hold 5 min.)  
 Inj./det. temp.: 200°C  
 Carrier gas: helium  
 Flow: 20mL/min. set @ 40°C  
 FID sensitivity: 512 x 10<sup>-11</sup> AFS

Chromatogram  
Search Tool

Search by compound name, synonym,  
CAS # or keyword

[www.restek.com/chromatograms](http://www.restek.com/chromatograms)

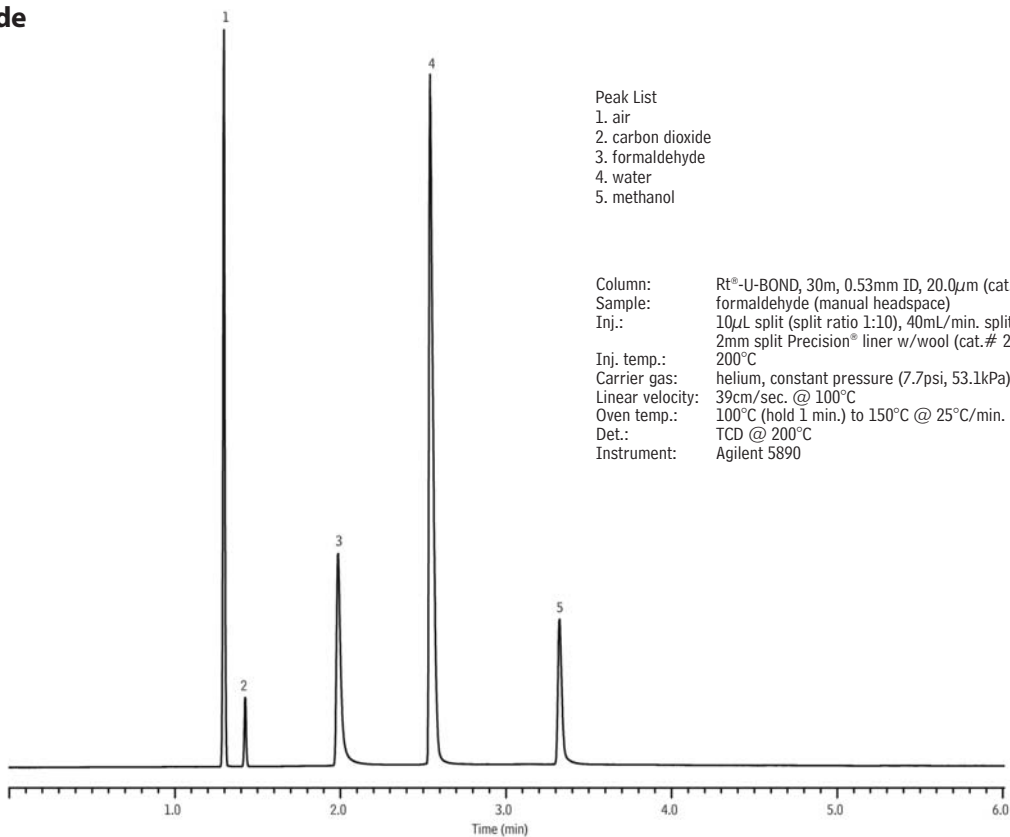


## Formaldehyde

## Rt®-U-BOND

(PLOT)

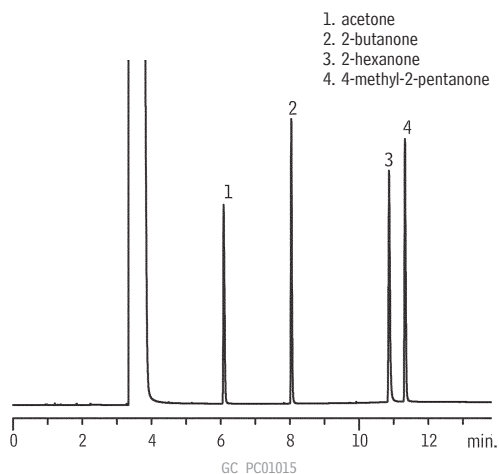
NEW!



## Ketones

## Rt®-QS-BOND

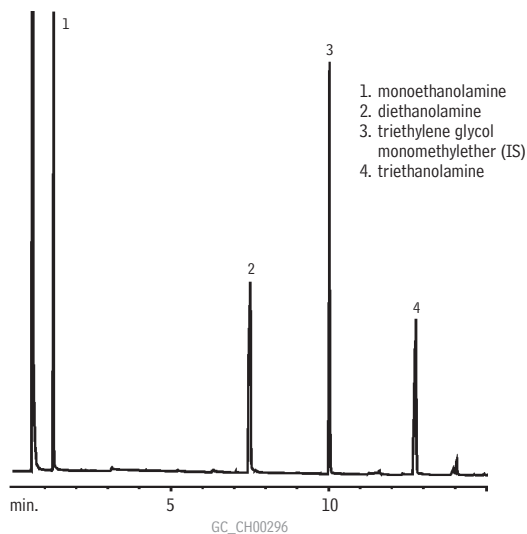
(PLOT)



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<sup>-11</sup> AFS  
 Split ratio: 58:1

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11/12

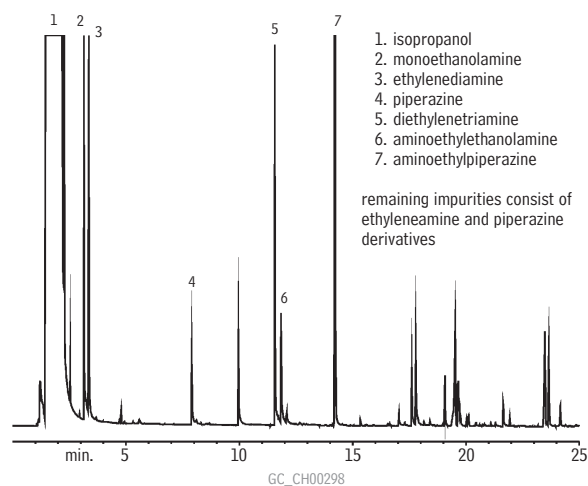
www.restek.com 703



## Amines

## Ethyleneamines

## Rtx®-5 Amine



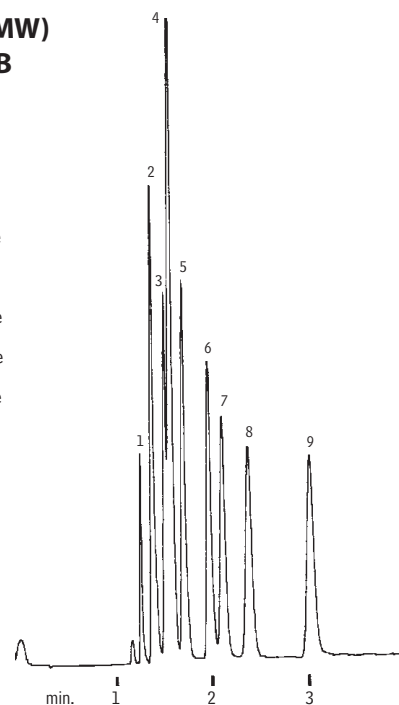
Column: Rtx®-5 Amine, 30m, 0.25mm ID, 0.50 $\mu$ m (cat.# 12338)  
 Sample: 3.0 $\mu$ L split injection of ethyleneamine industrial sample  
 On-column conc.: ~5-80ng  
 Oven temp.: 40°C (hold 4 min.) to 315°C @ 10°C/min. (hold 5 min.)  
 Inj./det. temp.: 315°C  
 Carrier gas: hydrogen  
 Linear velocity: 43cm/sec. set @ 40°C  
 FID sensitivity: 6.4 x 10<sup>-11</sup> 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

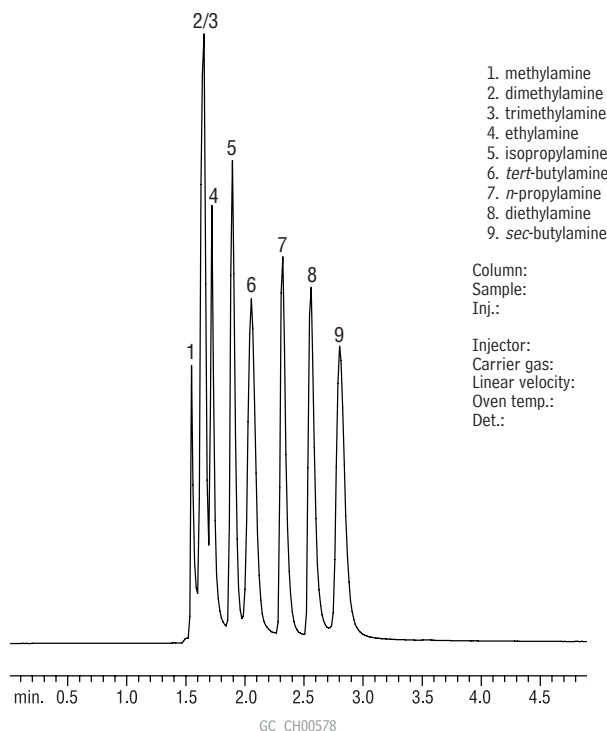
GC\_CH00304



Column: Stabilwax®-DB, 30m, 0.53mm ID, 1.0 $\mu$ m (cat.# 10855)  
 Sample: 1.0 $\mu$ L direct injection of amines in water  
 Oven temp.: 45°C  
 Inj./det. temp.: 250°C  
 Carrier gas: hydrogen  
 Linear velocity: 40cm/sec. (flow rate: 5cc/min.)  
 FID sensitivity: 1 x 10<sup>-11</sup> AFS  
 Recommended inlet liner: Uniliner®

## Amines, Primary

## Rtx®-35 Amine

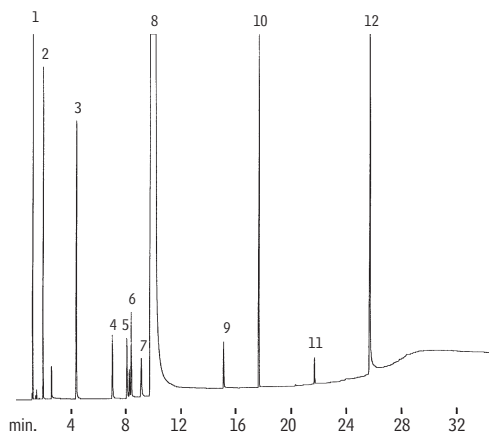


1. methylamine
2. dimethylamine
3. trimethylamine
4. ethylamine
5. isopropylamine
6. *tert*-butylamine
7. *n*-propylamine
8. diethylamine
9. *sec*-butylamine

Column: Rtx®-35 Amine, 30m, 0.53mm ID, 1.0 $\mu$ m (cat.# 11355)  
 Sample: primary amines, 50ppm on-column conc. in water  
 Inj.: 1.0 $\mu$ L, 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)

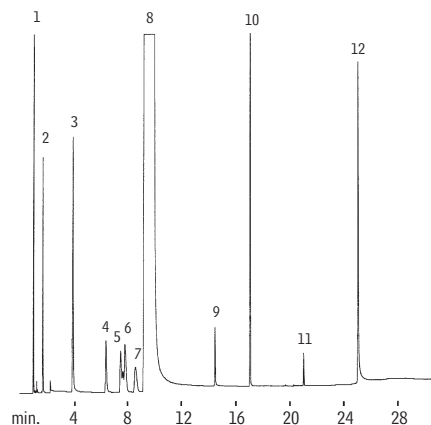
## Stabilwax®-DB



GC\_CH00302

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<sup>-11</sup> AFS

1. cyclohexane
2. hexamethyleimine
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

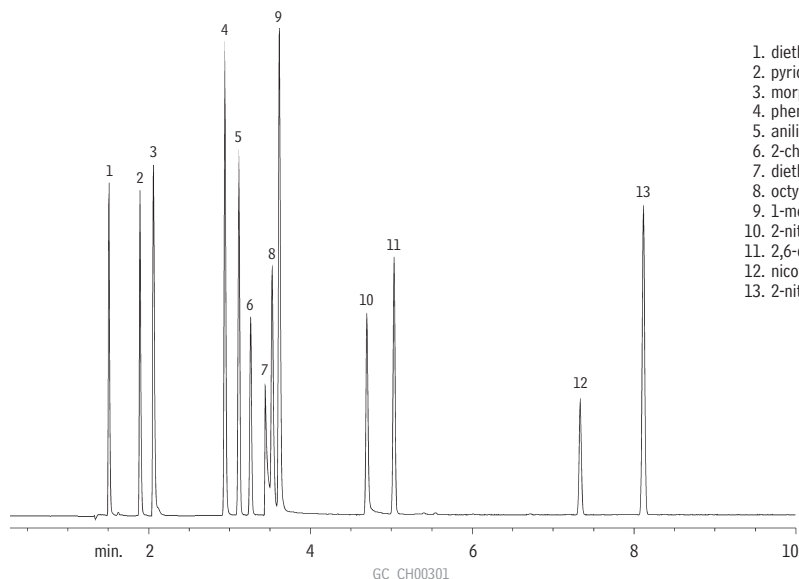


GC\_CH00303

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<sup>-11</sup> AFS

## Amines &amp; Phenols

## Rtx®-5 Amine

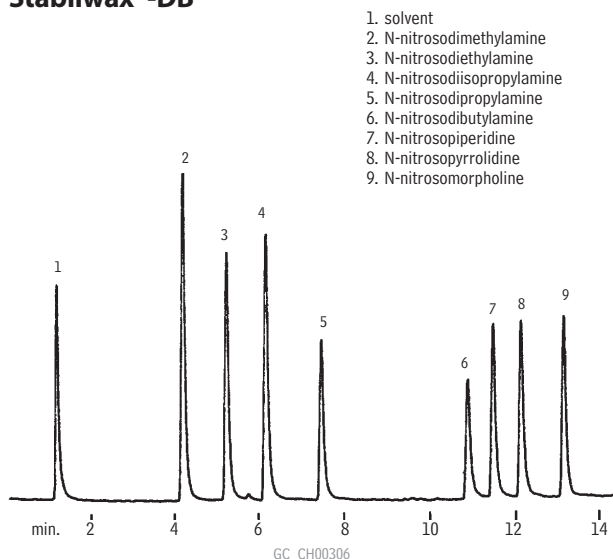


GC\_CH00301

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<sup>-11</sup> AFS  
 Split ratio: 25:1

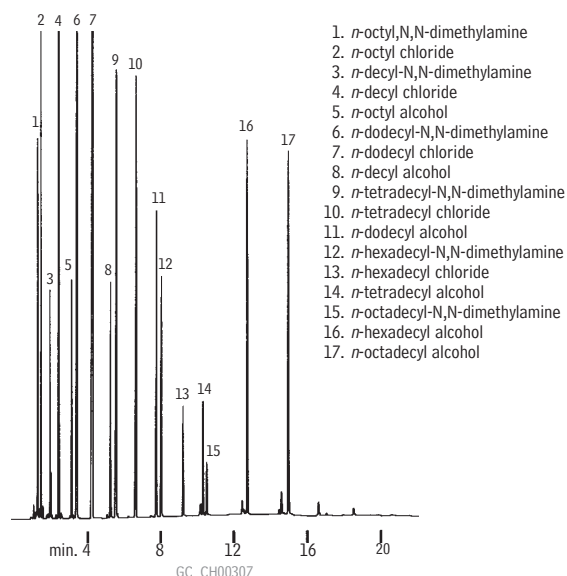
1. diethylamine
2. pyridine
3. morpholine
4. phenol
5. aniline
6. 2-chlorophenol
7. diethylenetriamine
8. octylamine
9. 1-methyl-2-pyrrolidinone
10. 2-nitrophenol
11. 2,6-dimethylaniline
12. nicotine
13. 2-nitroaniline

### Nitrosamines Stabilwax®-DB



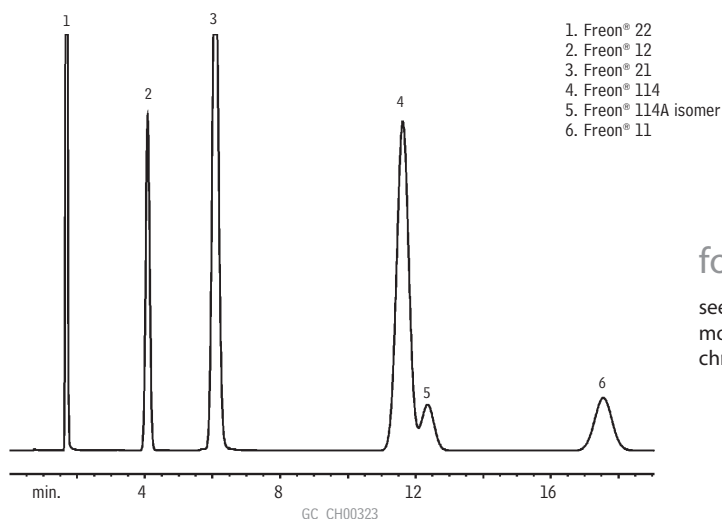
Column: Stabilwax®-DB, 60m, 0.53mm ID, 1.0 $\mu$ m (cat. # 10858)  
 Sample: direct injection of nitrosamines  
 Conc.: 1.0 $\mu$ g/mL  
 Oven temp.: 100°C (hold 1 min.) to 170°C @ 5°C/min.  
 Inj./det. temp.: 200°C  
 Carrier gas: helium  
 Linear velocity: 100cm/sec. (flow rate: 15cc/min.)  
 Det.: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

### Amines/Alcohols/Chlorides Stabilwax®



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

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

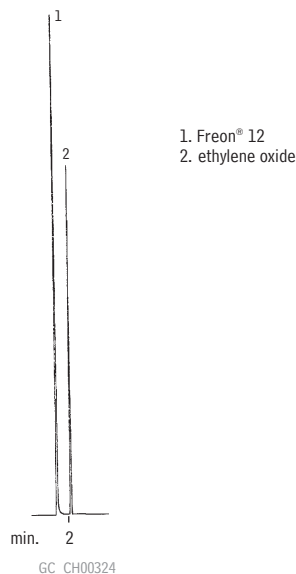


Column: 5% Krytox on 60/80 CarboBlack B, 3.05m, 1/8" OD, 2.1mm ID SilcoSmooth® stainless steel tubing (cat. # 80127-800)  
 Inj.: 1 $\mu$ L injected, concentration 20% each component  
 Oven temp.: 50°C  
 Inj./det. temp.: 200°C/250°C  
 Carrier gas: nitrogen @ 30mL/min.  
 Det.: FID

for **more** info

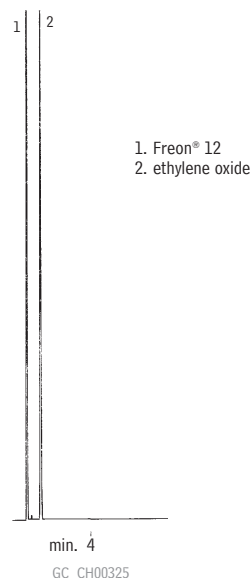
see **pages 649 & 707** for more chlorofluorocarbon chromatograms.

**Freon® 12 & Ethylene Oxide**  
**Rtx®-1**



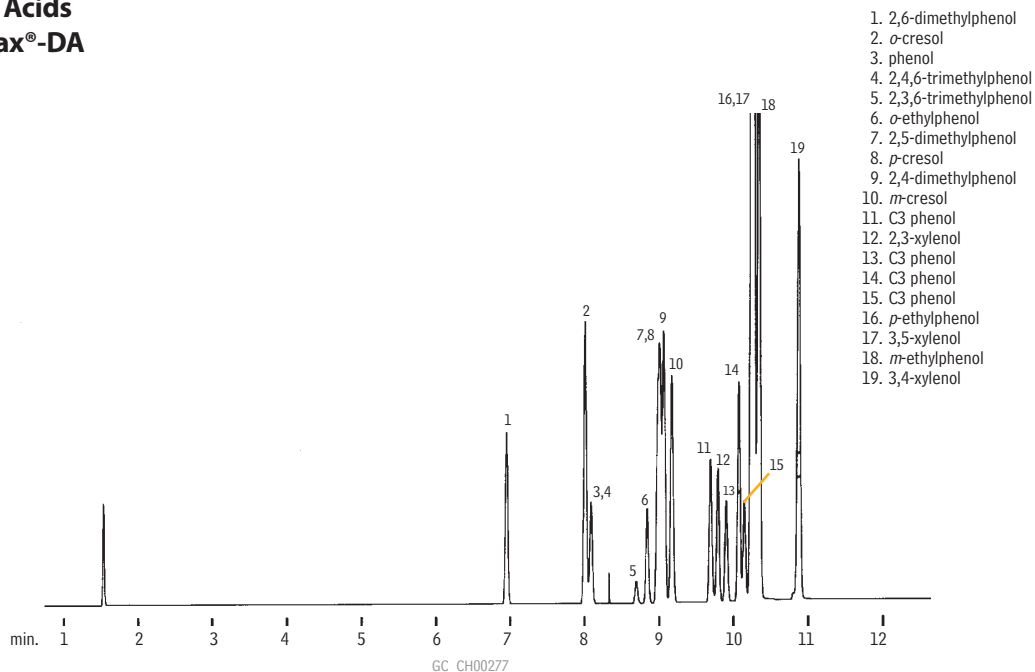
Column: Rtx®-1, 30m, 0.53mm ID, 5.0µm (cat.# 10179)  
 Sample: 50µL split injection of Freon® 12 and ETO  
 Oven temp.: 25°C  
 Inj./det. temp.: 290°C  
 Carrier gas: hydrogen  
 Linear velocity: 40cm/sec.  
 FID sensitivity:  $4 \times 10^{-11}$  AFS  
 Split vent: 40:1

**Freon® 12 & Ethylene Oxide**  
**Rtx®-200**



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**



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:  $64 \times 10^{-11}$  AFS  
 Split ratio: 40:1