

# GC AND GC/MS

Your Essential Resource for Columns & Supplies





## GC Applications

### Industry-specific applications from your partner in chromatography

With over 40 years of chromatography expertise, Agilent is a great resource for all types of applications. In fact, we're developing new ones every day.

Simply turn to the pages listed below for the most current applications based on your area of specialization.

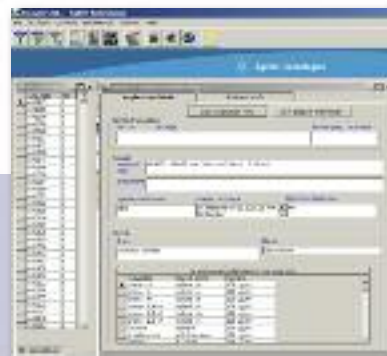
**Environmental** – you'll learn how to perform critical analyses – such as measuring the levels of atmospheric halocarbons and identifying organochlorine pesticides in soil – while meeting your increasing demands for speed and accuracy. **Turn to page 429.**

**Food, Flavors, and Fragrances** – we'll discuss how to ensure quality, safety, and regulatory compliance for fragrances, perfumes, and essential oils. Applications focus on chiral compounds, menthol, and FAMES. **Turn to page 478.**

**Industrial Chemicals** – we'll help you maintain product quality – and production efficiency – by sharing the latest applications for alcohols, halogenated hydrocarbons, aromatic solvents, phenols, and inorganic gases. **Turn to page 501.**

**Life Sciences** – we'll bring you fully up-to-date on the newest screening methods for controlled substances such as amphetamines, narcotics, and alcohol. We'll also review the latest techniques for monitoring residual solvents. **Turn to page 535.**

**Energy and Fuels** – here you'll find applications – such as the analysis of sulfur compounds in propylene – that you can use right away to meet regulatory requirements, improve efficiency, and maintain good environmental stewardship. **Turn to page 552.**



#### TIPS & TOOLS



Search the ScanView database to find almost 2000 GC applications and standard methods of all types, old and new. Get your free copy of ScanView at [www.agilent.com/chem/scanview](http://www.agilent.com/chem/scanview)

## Environmental Applications, Hydrocarbons

**Methyl Tert-Butyl Ether (MTBE) FID,  
Extended 8020 Analysis**

**Column:** DB-MTBE  
124-0034  
30 m x 0.45 mm, 2.55 µm

**Carrier:** Helium at 10 mL/min

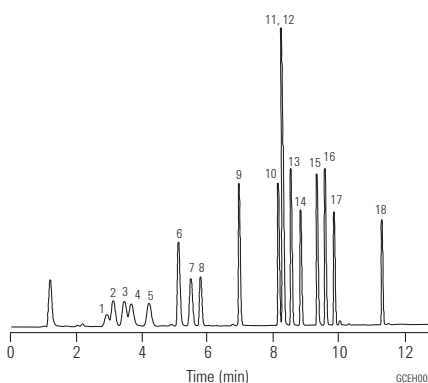
**Oven:** 35 °C for 4 min  
35-200 °C at 20 °C/min  
200 °C for 5 min

**Sampler:** Purge and Trap (O.I.A. 4560)  
Trap: Tenax only  
Preheat: 175 °C  
Desorb: 180 °C for 3 min

**Injection:** LVI (Low Volume Injector), 150 °C

**Detector:** FID (O.I.A. 4410), 200 °C

**Sample:** 40 ppb per component in 5 mL water



1. Methyl-tert-butyl-ether (MTBE)
2. 2-Methylpentane
3. 3-Methylpentane
4. Diisopropyl ether (DIPE)
5. Ethyl-tert-butyl ether (ETBE)
6. Benzene
7. tert-Amyl methyl ether (TAME)
8.  $\alpha, \alpha, \alpha$ -Trifluorotoluene
9. Toluene
10. Ethylbenzene
11. m-Xylene
12. p-Xylene
13. o-Xylene
14. Cumene
15. 1,3,5-Trimethylbenzene
16. 1,2,4-Trimethylbenzene
17. 1,1,2,3-Trimethylbenzene
18. Naphthalene

**Unleaded Gasoline**

**Column:** DB-VRX  
124-1534  
30 m x 0.45 mm, 2.55 µm

**Carrier:** Helium at 109 cm/sec (10.4 mL/min), measured at 40 °C

**Oven:** 40 °C for 2 min  
40-200 °C at 12 °C/min  
200 °C for 5 min

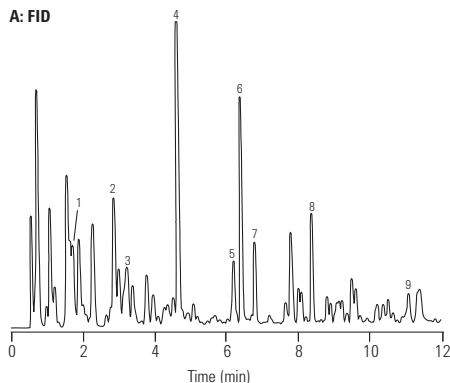
**Sampler:** Purge and Trap (O.I.A. 4560)  
Trap: BTEX (Supelco) at 50 °C during purge  
Preheat:  
Desorb: 270 °C for 1 min

**Injection:** LVI (Low Volume Injector)

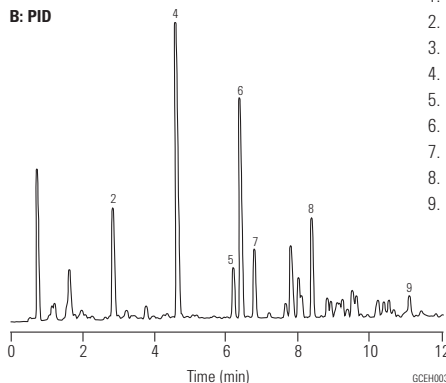
**Detector:** A: FID, 250 °C  
B: PID (O.I.A. 4430), 200 °C

**Sample:** 115 ppb gasoline in 5 mL water

A: FID



B: PID



1. 3-Methylpentane
2. Benzene
3. iso-Octane
4. Toluene
5. Ethylbenzene
6. m, p-Xylene
7. o-Xylene
8. 1,2,4-Trimethylbenzene
9. Naphthalene

**Determination of Chlorophenols in Water and Soil**

**Column:** VF-5ms  
CP8961  
60 m x 0.32 mm, 0.25 µm

Oven: 60 °C, 30 °C/min to 300 °C

Carrier: He 80 kPa, 0.8 bar, 5.7 psi

Injection: Splitless, initial time: 1 min; Splitflow: 50 mL/min  
250 °C  
2 µL

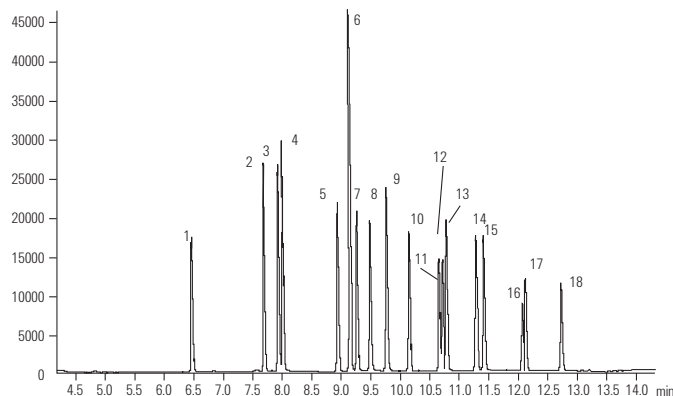
Detector: MS  
280 °C

Sample: Isohexane

Sample Conc: Standard, 1 µg/mL, derivatization with acetic acid anhydride

- |                           |                               |
|---------------------------|-------------------------------|
| 1. Phenol                 | 10. 2,4,6-trichlorophenol     |
| 2. 2-chlorophenol         | 11. 2,3,6-trichlorophenol     |
| 3. 3-chlorophenol         | 12. 2,3,5-trichlorophenol     |
| 4. 4-chlorophenol         | 13. 2,4,5-trichlorophenol     |
| 5. 2,6-dichlorophenol     | 14. 2,3,4-trichlorophenol     |
| 6. 2,4+2,5-dichlorophenol | 15. 3,4,5-trichlorophenol     |
| 7. 3,5-dichlorophenol     | 16. 2,3,5,6-tetrachlorophenol |
| 8. 2,3-dichlorophenol     | 17. 2,3,4,6-tetrachlorophenol |
| 9. 3,4-dichlorophenol     | 18. 2,3,4,5-tetrachlorophenol |

Dr. Weßling, Laboratorien GmbH



**PBDEs by ECD**

**Column:** DB-XLB  
15 m x 0.18 mm, 0.07 µm  
Agilent Technologies custom column

Carrier: Hydrogen at 72 cm/sec at 100 °C (4.0 mL/min), constant flow mode

Oven: 100 °C for 0.5 min  
100 °C to 300 °C at 30 °C/min  
300 °C for 5 min

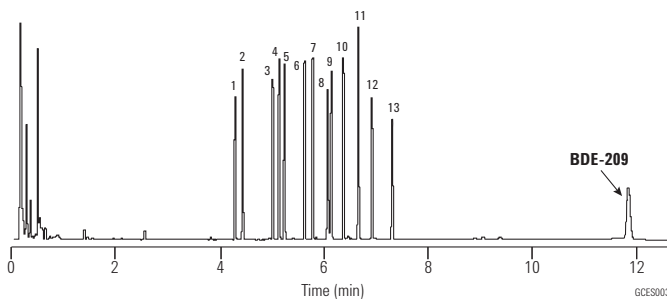
Injection: Split, 250 °C  
Split ratio 20:1

Detector: ECD, 300 °C  
Peak, Congener (2.5 mg/mL)

Sample: 1 µL

- |                                   |   |
|-----------------------------------|---|
| 1. 2,2',4-TriBDE (BDE-17)         | 8. 2,2',3,4,4'-PentaBDE (BDE-85)        |
| 2. 2,4,4'-TriBDE (BDE-28)         | 9. 2,2',4,4',5,6'-HexaBDE (BDE-154)     |
| 3. 2,3',4',6-Tetra-BDE (BDE-71)   | 10. 2,2',4,4',5,5'-HexaBDE (BDE-153)    |
| 4. 2,2',4,4'-Tetra-BDE (BDE-47)   | 11. 2,2',3,4,4',5'-HexaBDE (BDE-138)    |
| 5. 2,3',4,4'-TetraBDE (BDE-66)    | 12. 2,2',3,4,4',5',6-HeptaBDE (BDE-183) |
| 6. 2,2',4,4',6-PentaBDE (BDE-100) | 13. 2,3,3',4,4',5,6-HeptaBDE (BDE-190)  |
| 7. 2,2',4,4',5-PentaBDE (BDE-99)  | 14. DecaBDE (BDE-209) (12.5 mg/mL)      |

Special thanks to AccuStandard, Inc. of New Haven, CT, for PBDE standards.



### Diesel Fuel

**Column:** DB-5ms  
125-5532  
30 m x 0.53 mm, 1.50 µm

**Carrier:** Helium at 48.5 cm/sec, measured at 60 °C

**Oven:** 60 °C for 2 min  
60-300 °C at 12 °C/min  
300 °C for 10 min

**Injection:** Direct, 280 °C

**Detector:** FID, 250 °C  
Nitrogen makeup gas at 30 mL/min

**Sample:** 1 µL injection in hexane  
A - Standard, 50 ng/component  
B - Sample, 0.6 mg/mL

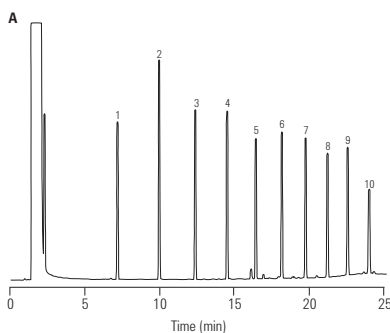
#### Suggested Supplies

**Septum:** 11 mm Advanced Green septa, 5183-4759

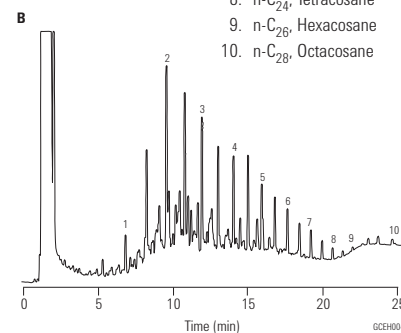
**Liner:** Direct connect, single taper, deactivated, 4 mm id, G1544-80730

**Syringe:** 10 µL tapered, FN 23-26s/42/HP, 5181-1267

**Diesel Fuel Standard  
50 ng/component**



**Diesel Fuel  
0.6 mg/mL**



1. n-C<sub>10</sub>, Decane
2. n-C<sub>12</sub>, Dodecane
3. n-C<sub>14</sub>, Tetradecane
4. n-C<sub>16</sub>, Hexadecane
5. n-C<sub>18</sub>, Octadecane
6. n-C<sub>20</sub>, Eicosane
7. n-C<sub>22</sub>, Docosane
8. n-C<sub>24</sub>, Tetracosane
9. n-C<sub>26</sub>, Hexacosane
10. n-C<sub>28</sub>, Octacosane

### Analysis of Polycyclic Aromatic Hydrocarbons

**Column:** VF-Xms  
CP8805  
30 m x 0.25 mm, 0.10 µm

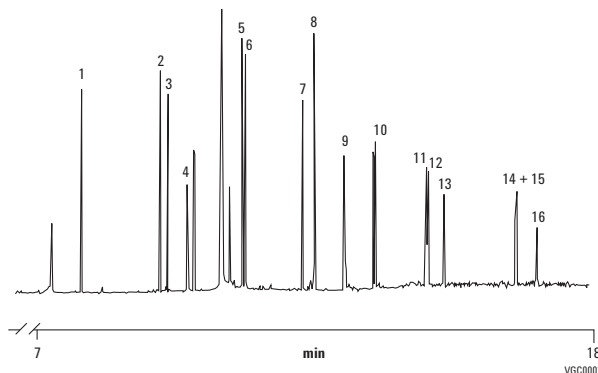
**Sample:** 1 µL ca. 3 ng per component on-column

**Carrier:** Helium, 60 kPa

**Injection:** Split, T=275 °C

**Detector:** Ion Trap MS

1. Naphthalene
2. Acenaphthylene
3. Acenaphthene
4. Fluorene
5. Phenanthrene
6. Anthracene
7. Fluoranthene
8. Pyrene
9. Chrysene
10. Benzo(a)anthracene
11. Benzo(k)fluoranthene
12. Benzo(b)fluoranthene
13. Benzo(a)pyrene
14. Indeno(1,2,3-cd)pyrene
15. Dibenzo(a,h)anthracene
16. Benzo(g,h,i)perylene

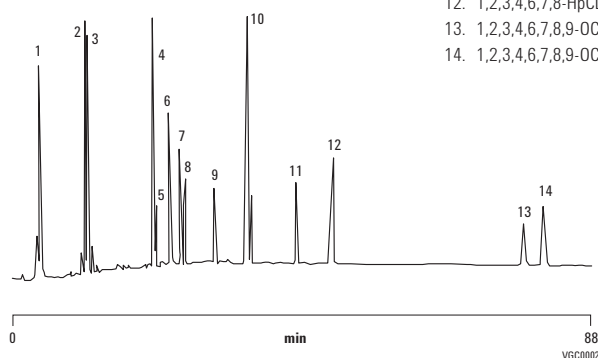


**Dioxins and Dibenzofurans**

**Column:** CP-Sil 88  
CP6173  
50 m x 0.25 mm, 0.20 µm

Sample: 1.0 µL Toluene  
Sample Conc: 100 – 400 pg/µl  
Carrier: Helium, 170 kPa (1.7 bar, 24 psi)  
Oven: 100 °C to 180 °C to 230 °C, 3 °C/min  
Injection: Splitless  
Detector: MSD

1. 2,3,7-8-TCDD
2. 2,3,7,8-TCDF
3. 1,2,3,7,8-PeCDF
4. 1,2,3,4,7,8-HxCDF
5. 1,2,3,6,7,8-HxCDF
6. 2,3,4,7,8-PeCDF
7. 1,2,3,4,7,8-HxCDD + 1,2,3,7,8-PeCDD
8. 1,2,3,6,7,8-HxCDD
9. 1,2,3,7,8,9-HxCDD
10. 1,2,3,4,6,7,8-HxCDF
11. 2,3,4,6,7,8-HpCDD
12. 1,2,3,4,6,7,8-HpCDD
13. 1,2,3,4,6,7,8,9-OCDF
14. 1,2,3,4,6,7,8,9-OCDD

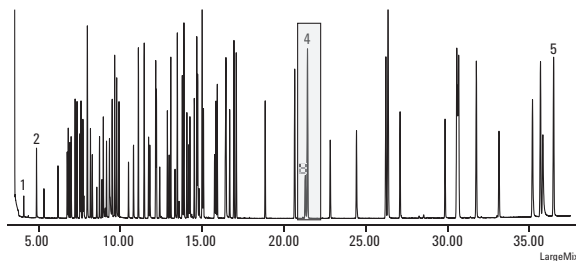


**Large Mix 5 ng Column AccuStandard 8720 Mixes  
1, 2, 3, 4a, 4b, 5 & 6 (93 compounds)**

**Column:** DB-5ms Ultra Inert  
122-5532UI  
30 m x 0.25 mm, 0.25 µm

Oven: 40 °C (1 min) to 100 °C (15 °C/min),  
10 °C/min to 210 °C (1 min),  
5 °C/min to 310 °C (8 min)  
Injection: Splitless @ 260 °C, purge flow 50 °C mL/min  
at 0.5 min, gas saver 80 mL/min on at 1 min  
Detector: MSD; Transfer line 290 °C,  
Source 300 °C, Quad 180 °C

1. n-Nitrosodimethylamine
2. 2-methyl pyridine
3. Benzidine
4. Fluoranthene
5. Benzo (g,h,i) perylene



**Polybrominated Diphenyl Ethers (PBDEs)**

**Column:** DB-5ms Ultra Inert  
122-5512UI  
15 m x 0.25 mm, 0.25 µm

**Instrument:** Agilent 6890N/5973B MSD

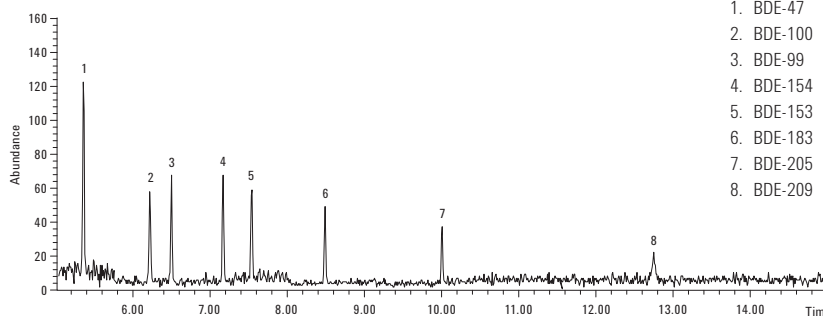
**Sampler:** Agilent 7683B, 5.0 µL syringe (P/N 5188-5246),  
1.0 µL splitless injection,  
5 ng each component on-column

**Carrier:** Helium 72 cm/s, constant flow

**Inlet:** Pulsed splitless; 325 °C,  
20 psi until 1.5 min,  
purge flow 50 mL/min at 2.0 min

**Oven:** 150 to 325 °C (17 °C/min), hold 5 min

**Detector:** MSD source at 300 °C,  
quadropole at 150 °C,  
transfer line at 300 °C,  
scan range 200-1000 amu



1. BDE-47
2. BDE-100
3. BDE-99
4. BDE-154
5. BDE-153
6. BDE-183
7. BDE-205
8. BDE-209

**Suggested Supplies**

**Liner:** Direct connect, dual taper, deactivated, 4 mm id, G1544-80700

**Syringe:** Autosampler syringe, 0.5 µL, 23 g, cone, 5188-5246

**15+1 EU Priority PAHs****Resolution of Critical Pairs on an Agilent J&W DB-EUPAH Column**

**Column:** DB-EUPAH  
121-9627  
20 m x 0.18 mm, 0.14 µm

**Instrument:** Agilent 6890N/5975B MSD

**Sampler:** Agilent 7683B, 5.0 µL syringe,  
0.5 µL splitless injection, injection speed 75 µL/min

**Carrier:** Helium, ramped flow 1.0 mL/min (0.2 min),  
5 mL/min<sup>2</sup> to 1.7 mL/min

**Inlet:** 325 °C splitless, purge flow 60 mL/min at 0.8 min

**Oven:** 45 °C (0.8 min) to 200 °C (45 °C/min),  
2.5 °C/min to 225 °C, 3 °C/min to 266 °C,  
5 °C/min to 300 °C, 10 °C/min to 320 °C (4.5 min)

**Detector:** MSD source at 300 °C, quadrupole at 180 °C,  
transfer line at 330 °C, scan range 50-550 AMU

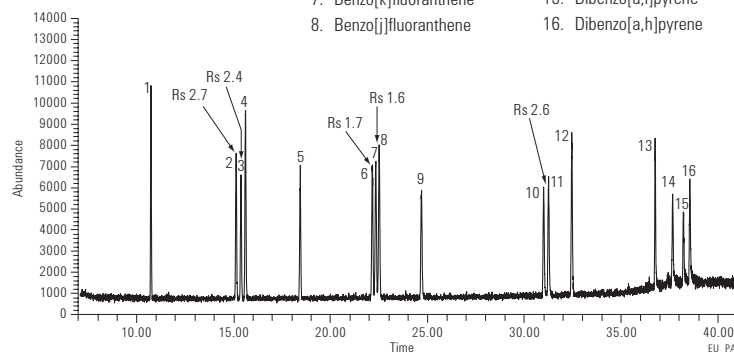
**Suggested Supplies**

**Septum:** 11 mm Advanced Green septa, 5183-4759

**Liner:** Direct connect, dual taper, deactivated, 4 mm id, G1544-80700

**Syringe:** 5 µL tapered, FN 23-26s/42/HP, 5181-1273

- |                          |                            |
|--------------------------|----------------------------|
| 1. Benzo[c]fluorene      | 9. Benzo[a]pyrene          |
| 2. Benzo[a]anthracene    | 10. Indeno[1,2,3-cd]pyrene |
| 3. Cyclopenta[c,d]pyrene | 11. Dibenz[a,h]anthracene  |
| 4. Chrysene              | 12. Benzo[g,h,i]perylene   |
| 5. 5-Methylchrysene      | 13. Dibenzo[a,e]pyrene     |
| 6. Benzo[b]fluoranthene  | 14. Dibenzo[a,e]pyrene     |
| 7. Benzo[k]fluoranthene  | 15. Dibenzo[a,i]pyrene     |
| 8. Benzo[j]fluoranthene  | 16. Dibenzo[a,h]pyrene     |



All 15+1 EU regulated priority PAHs are well resolved with the DB-EUPAH column. Challenging benzo[b,k,j]fluoranthene isomers are baseline resolved, allowing for accurate quantitation of each isomer. In addition, baseline resolution is achieved for critical pairs benz[a]anthracene and cyclopenta[c,d]pyrene, cyclopenta[c,d]pyrene and chrysene, and indeno[1,2,3-cd]pyrene and dibenz[a,h]anthracene. This application demonstrates that the DB-EUPAH column can provide excellent sensitivity and selectivity for the analysis of EU regulated PAHs.

# Environmental Applications, Pesticides and Herbicides

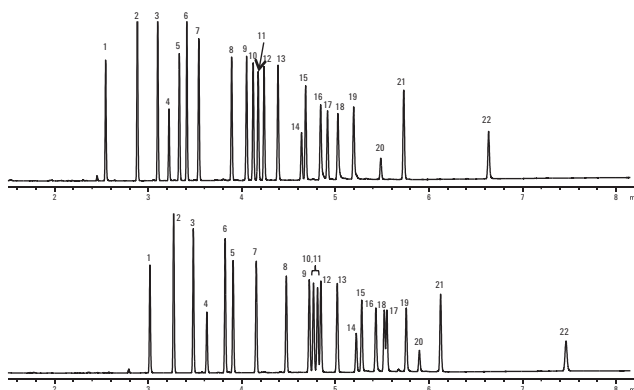
## Fast CLP Pesticides

**Column:** DB-CLP1  
123-8232  
30 m x 0.32 mm, 0.25 µm

**Column:** DB-CLP2  
123-8336  
30 m x 0.32 mm, 0.5 µm

**Instrument:** Agilent 7890 GC with dual µECD  
**Carrier:** Helium, constant flow 3.5 mL/min  
**Oven:** 150 °C (hold 0.2 min),  
45 °C/min to 250 °C,  
18 °C/min to 300 °C,  
30 °C/min to 330 °C, hold 2.5 min  
**Sampler:** Agilent 7693  
**Injection:** 1 µL splitless  
**Detector:** µECD @ 340 °C  
**Sample:** 50 ng/mL CLP Pesticides

- |                         |                        |
|-------------------------|------------------------|
| 1. Tetrachloro-m-xylene | 12. 4,4'-DDE           |
| 2. α-BHC                | 13. Dieldrin           |
| 3. γ-BHC                | 14. Endrin             |
| 4. β-BHC                | 15. 4,4'-DDD           |
| 5. Heptachlor           | 16. Endosulfan II      |
| 6. δ-BHC                | 17. 4,4'-DDT           |
| 7. Aldrin               | 18. Endrin aldehyde    |
| 8. Heptachlor epoxide   | 19. Endosulfan sulfate |
| 9. γ-Chlordane          | 20. Methoxychlor       |
| 10. α-Chlordane         | 21. Endrin ketone      |
| 11. Endosulfan I        | 22. Decachlorobiphenyl |





### Organochlorine Pesticides, EPA Method 8081B

**Column:** DB-CLP1  
123-8232  
30 m x 0.32 mm, 0.25 µm

**Column:** DB-CLP2  
123-8336  
30 m x 0.32 mm, 0.25 µm

**Instrument:** Agilent 7890 GC with dual µECD

**Carrier:** Helium at 43,5 cm/sec (constant flow)

**Oven:** 80 °C (hold 0.5 min) to 150 °C at 20 °C/min,  
5 °C/min to 235 °C, 15 °C/min to 300 °C, hold 5 min

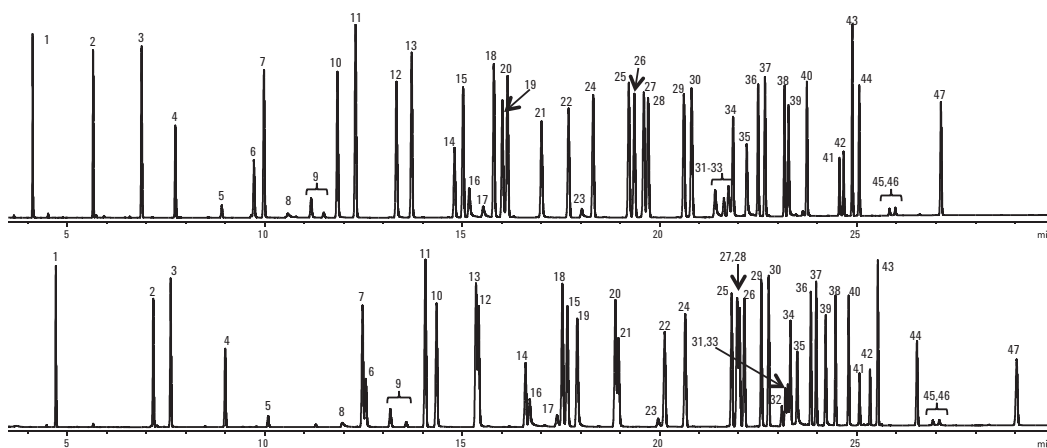
**Sampler:** Agilent 7693

**Injection:** 2 µL splitless

**Detector:** µECD @ 325 °C

**Sample:** 50 ng/mL 8081B analytes

- |                                |                                |
|--------------------------------|--------------------------------|
| 1. 1,2-Dibromo-3-chloropropane | 16. Dichlone                   |
| 2. Hexachlorocyclopentadiene   | 17. Alachlor                   |
| 3. 1-Bromo-2-nitrobenzene      | 18. δ-BHC                      |
| 4. Etriazole                   | 19. Chlorothalonil             |
| 5. Chloroneb                   | 20. Aldrin                     |
| 6. Trifluralin                 | 21. DCPA                       |
| 7. TCMX                        | 22. Isodrin                    |
| 8. Propachlor                  | 23. Kelthane                   |
| 9. Diallate isomers (250ng/mL) | 24. Heptachlor epoxide         |
| 10. Hexachlorobenzene          | 25. γ-Chlordane                |
| 11. α-BHC                      | 26. trans-Nonachlor            |
| 12. Pentachloronitrobenzene    | 27. α-Chlordane                |
| 13. γ-BHC                      | 28. Endosulfan I               |
| 14. β-BHC                      | 29. 4,4'-DDE                   |
| 15. Heptachlor                 | 30. Dieldrin                   |
|                                | 31. Chlorobenzilate (250ng/mL) |
|                                | 32. Perthane (250ng/mL)        |
|                                | 33. Chloropropylate (250ng/mL) |
|                                | 34. Endrin                     |
|                                | 35. Nitrofen                   |
|                                | 36. 4,4'-DDD                   |
|                                | 37. Endosulfan II              |
|                                | 38. 4,4'-DDT                   |
|                                | 39. Endrin aldehyde            |
|                                | 40. Endosulfan sulfate         |
|                                | 41. Captafol                   |
|                                | 42. Methoxychlor               |
|                                | 43. Endrin ketone              |
|                                | 44. Mirex                      |
|                                | 45. cis-Permethrin             |
|                                | 46. trans-Permethrin           |
|                                | 47. ΩΩΩDecachlorobiphenyl      |



### DB-624UI Organic Acid Performance

**Column:** DB-Select 624 Ultra Inert  
122-0334UI  
30 m x 0.25 mm, 1.4 µm

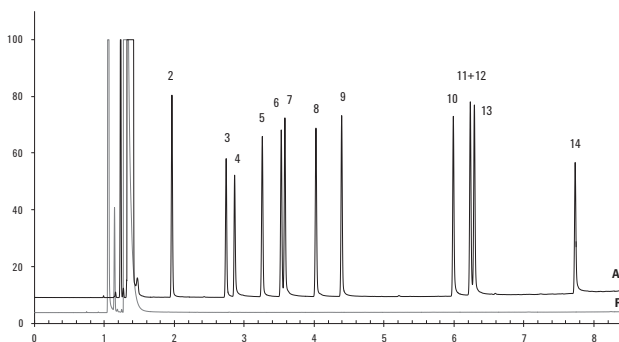
**Carrier:** Hydrogen 42 cm/s

**Oven:** 70 °C isothermal

**Inlet:** Split, 116:1 at 250 °C

**Detector:** FID at 260 °C

1. Formic acid
2. Acetic acid
3. Propionic acid
4. Acrylic acid
5. Isobutyric acid
6. n-Butyric acid
7. Methacrylic acid
8. Isopentanoic acid
9. n-Pentanoic acid
10. n-Heptanoic acid
11. Levulinic acid
12. 2-Propyl pentanoic acid
13. 2-Ethyl hexanoic acid
14. Citronellic acid



**US EPA Method 551.1**

**Column A:** HP-1ms Ultra Inert  
19091S-733UI  
30 m x 0.25 mm, 1.00 µm

**Column B:** DB-1301  
122-1333  
30 m x 0.25 mm, 1.00 µm

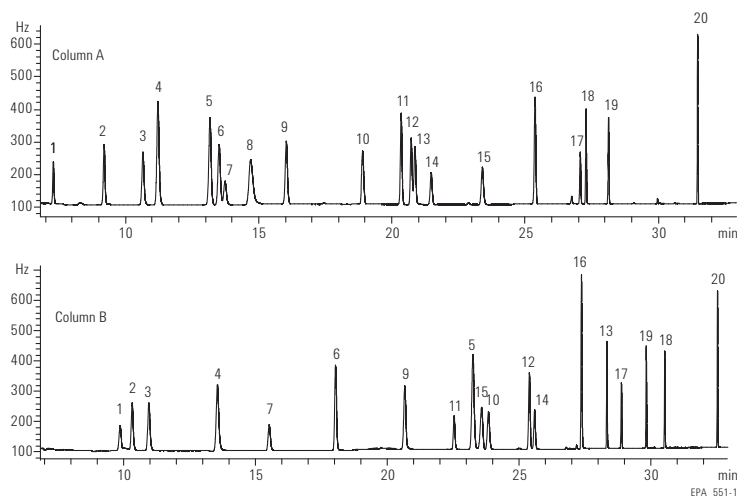
**Instrument:** Agilent 7890A GC  
**Sampler:** Agilent 7683B, 5.0 µL syringe  
(Agilent p/n 5181-1273) 0.5 µL splitless injection  
**Carrier:** Helium 25 cm/s, constant flow  
**Inlet:** Splitless; 200 °C, purge flow 20 mL/min at 0.25 min  
**Retention Gap:** 1 m, 0.32 mm id deactivated fused silica  
high-temperature tubing (Agilent p/n 160-2855-5)  
**Oven:** 33 °C (14 min) to 60 °C (5 °C/min), hold 5 min,  
15 °C/min to 275 °C, hold 20 min  
**Detector:** Dual G2397A µECD; 300 °C,  
const col + makeup (N<sub>2</sub>) = 30 mL/min

This application successfully demonstrates the use of the HP-1ms Ultra Inert column for primary analysis of EPA 551.1 chlorinated solvents, trihalomethanes and disinfection by-products. The excellent peak shape of the chloral hydrate and resolution between bromodichloromethane and trichloroethylene emphasize the high column inertness of the HP-1ms Ultra Inert column, making it an excellent choice for EPA Method 551.1 analysis.

**Suggested Supplies**

**Septum:** 11 mm Advanced Green septa, 5183-4759  
**Liner:** Direct connect, dual taper, deactivated, 4 mm id, G1544-80700  
**Syringe:** 5 µL tapered, FN 23-26s/42/HP, 5181-1273

- |                             |                                 |
|-----------------------------|---------------------------------|
| 1. Chloroform               | 11. Chloropicrin                |
| 2. 1,1,1-Trichloroethane    | 12. Dibromochloromethane        |
| 3. Carbon tetrachloride     | 13. Bromochloroacetonitrile     |
| 4. Trichloroacetonitrile    | 14. 1,2-Dibromoethane           |
| 5. Dichloroacetonitrile     | 15. Tetrachloroethylene         |
| 6. Bromodichloromethane     | 16. 1,1,1-Trichloro-2-propanone |
| 7. Trichloroethylene        | 17. Bromoform                   |
| 8. Chloral hydrate          | 18. Dibromoacetonitrile         |
| 9. 1,1-Dichloro-2-propanone | 19. 1,2,3-Trichloropropane      |
| 10. 1,1,2-Trichloroethane   | 20. 1,2-Dibromo-3-chloropropane |



**TIPS & TOOLS**

Learn more about the Agilent 7890A GC System at [www.agilent.com/chem/7890A](http://www.agilent.com/chem/7890A)



**Analysis of Semivolatiles**

**Column A:** DB-5.625  
122-5632  
30 m x 0.25 mm, 0.50  $\mu\text{m}$

**Column B:** DB-5.625  
121-5622  
20 m x 0.18 mm, 0.36  $\mu\text{m}$

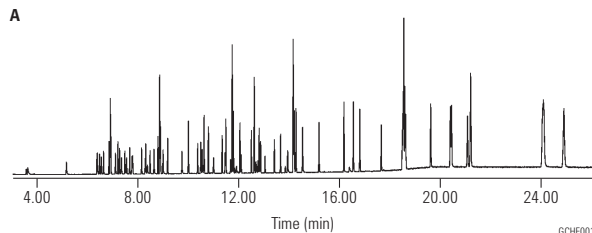
Carrier: He constant-flow mode, 1.1 mL/min

Oven: 40 °C (1 min), 25 °C/min to 320 °C  
4.80 min hold

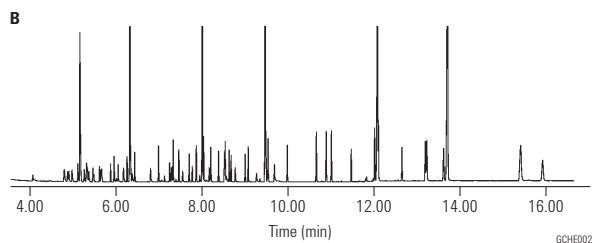
Injection: Splitless 0.5  $\mu\text{L}$  injected at 300 °C, QuickSwap pressure  
5.0 psi during acquisition, 80.0 psi during backflush  
with inlet set to 1.0 psi during backflush

Detector: Agilent 5975C Performance Turbo MSD equipped with  
6 mm large-aperture drawout lens, P/N G2589-20045

Translating 0.25 mm id column method to 0.18 mm id format results in  
32% reduction in analysis time. Resolution of 77 peaks of interest is also  
maintained for the faster 0.18 mm id separation.



U.S. EPA Method 8270, 5 ng/mL System Performance Check Compounds  
Chromatogram using a DB-5.625, 30 m x 0.25 mm, 0.5  $\mu\text{m}$



U.S. EPA Method 8270, 5 ng/mL System Performance Check Compounds  
Chromatogram using a DB-5.625, 20 m x 0.18 mm, 0.36  $\mu\text{m}$

**Pesticides, EPA 508.1**

**Column:** DB-35ms  
123-3832  
30 m x 0.32 mm, 0.25 µm

**Column:** DB-XLB  
123-1236  
30 m x 0.32 mm, 0.50 µm

**Carrier:** Helium at 45 cm/sec (EPC in constant flow mode)

**Oven:** 75 °C for 0.5 min  
75-300 °C at 10 °C/min  
300 °C for 2 min

**Injection:** Splitless, 250 °C  
30 sec purge activation time

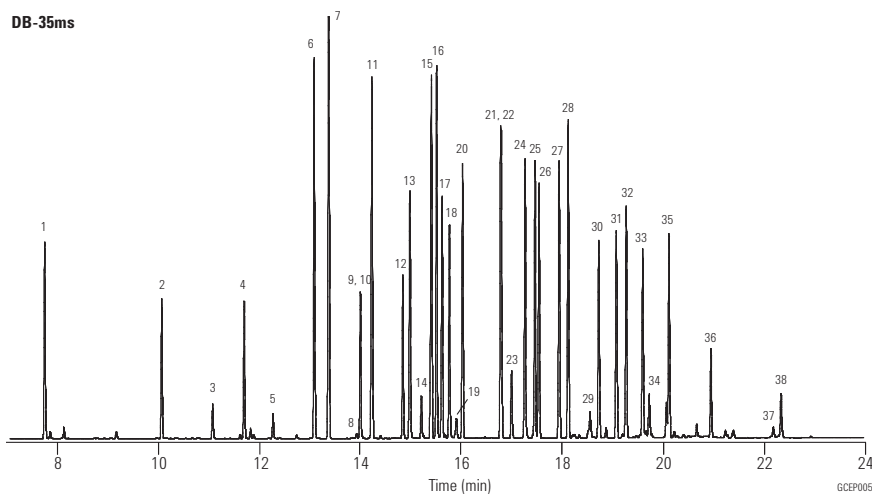
**Detector:** µECD, 350 °C  
Nitrogen makeup gas  
(column + makeup flow = 30 mL/min constant flow)

**Sample:** 50 µg per component

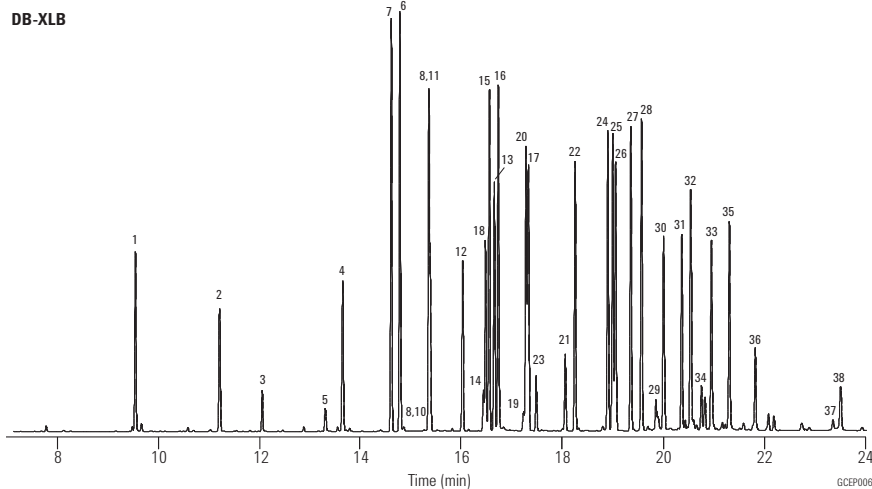
**Suggested Supplies**

**Septum:** 11 mm Advanced Green septa, 5183-4759  
**Liner:** Direct connect, single taper, deactivated, 4 mm id, G1544-80730  
**Syringe:** 10 µL tapered, FN 23-26s/42/HP, 5181-1267

**DB-35ms**



**DB-XLB**



1. Hexachlorocyclopentadiene
2. Etridiazole
3. Chloroneb
4. Trifluralin
5. Propachlor
6. Hexachlorobezene
7. α-BHC
8. Atrazine
9. Pentachloronitrobenzene
10. Simazine
11. γ-BHC
12. β-BHC
13. Heptachlor
14. Alachlor
15. δ-BHC
16. Chlorothalonil
17. Aldrin
18. Metribuzin
19. Metolachlor
20. DCPA
21. 4,4'-Dibromobiphenyl
22. Heptachlor epoxide
23. Cyanazine
24. γ-Chlordane
25. α-Chlordane
26. Endosulfan I
27. 4,4'-DDE
28. Dieldrin
29. Chlorobenzilate
30. Endrin
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

### Phenoxy Acid Herbicides – Methyl Derivatives, EPA 8151A

**Column:** DB-35ms  
123-3832  
30 m x 0.32 mm, 0.25 µm

**Carrier:** Helium at 45 cm/sec (EPC in constant flow mode)

**Oven:** 50 °C for 0.5 min  
50-100 °C at 25 °C/min  
100-320 °C at 12 °C/min  
320 °C for 2 min

**Injection:** Splitless, 250 °C  
30 sec purge activation time

**Detector:** µECD, 350 °C  
Nitrogen makeup gas  
(column + makeup flow = 30 mL/min constant flow)

**Sample:** 50 pg per component

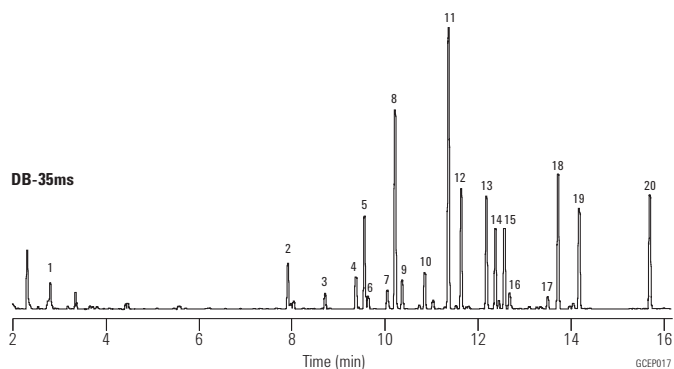
#### Suggested Supplies

**Septum:** 11 mm Advanced Green septa, 5183-4759

**Liner:** Splitless, single taper, deactivated, 4 mm id, 5181-3316

**Syringe:** 10 µL tapered, FN 23-26s/42/HP, 5181-1267

- |  |                       |
|--|-----------------------|
| 1. Dalapon                               | 11. Pentachlorophenol |
| 2. 3,5-Dichlorobenzoic acid              | 12. 2,4,5-T,P         |
| 3. 4-Nitrophenol                         | 13. 2,4,5-T           |
| 4. Methyl-2,4-dichlorophenylacetate (SS) | 14. Chloramben        |
| 5. Dicamba                               | 15. Dinoseb           |
| 6. MCPP                                  | 16. 2,4-DB            |
| 7. MCPA                                  | 17. Bentazone         |
| 8. 4,4'-Dibromooctafluorobiphenyl (IS)   | 18. DCPA              |
| 9. Dichloroprop                          | 19. Picloram          |
| 10. 2,4-D                                | 20. Acifluorofen      |



**Direct Comparison for Rapid CLP  
(Contract Laboratory Program)  
Pesticide Analysis**

**Column:** DB-17ms  
121-4722  
20 m x 0.18 mm, 0.18 µm

**Column:** DB-XLB  
121-1222  
20 m x 0.18 mm, 0.18 µm

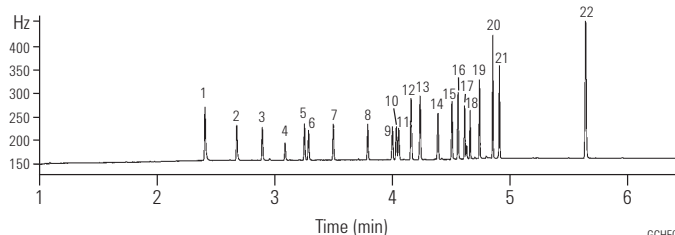
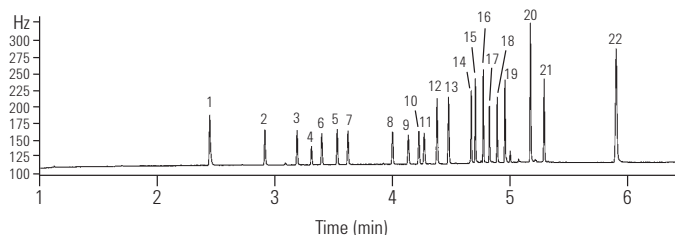
**Carrier:** Hydrogen (69 cm/sec at 120 °C,  
ramped at 99 mL/min to  
106 cm/sec at 4.4 minutes)

**Oven:** 120 °C (0.32 min);  
120 °C/min to 160 °C;  
30 °C/min to 258 °C (0.18 min);  
38.81 °C/min to 300 °C (1.5 min)

**Injection:** Split/splitless; 220 °C,  
pulsed splitless  
(35 psi for 0.5 min,  
purge flow of 40 mL/min  
on at 1 minute, gas saver flow  
20 mL/min on 3 minutes)

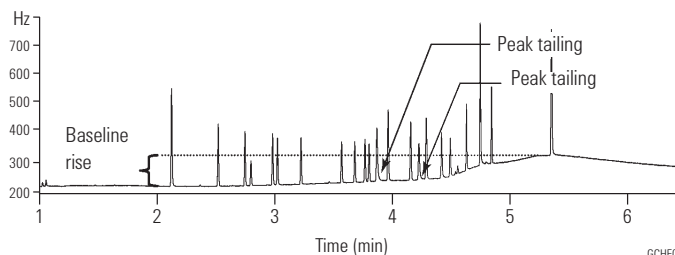
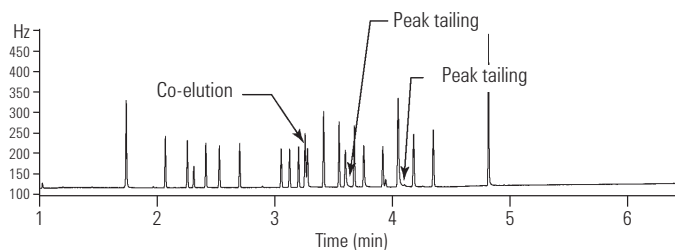
**Detector:** µECD 320 °C;  
nitrogen makeup;  
constant column + makeup flow  
60 mL/min

**DB-17ms primary column  
DB-XLB confirmatory column**



1. Tetrachloro-m-xylene
2. α-BHC
3. γ-BHC
4. β-BHC
5. δ-BHC
6. Heptachlor
7. Aldrin
8. Heptachlor Epoxide
9. γ-Chlordane
10. α-Chlordane
11. Endosulfan I
12. 4,4' DDE
13. Dieldrin
14. Endrin
15. 4,4' DDD
16. Endosulfan II
17. 4,4' DDT
18. Endrin Aldehyde
19. Endosulfan Sulfate
20. Methoxychlor
21. Endrin Ketone
22. Decachlorobiphenyl

**Vendor R primary column, 20 m x 0.18 mm, 0.18 µm  
Vendor R confirmatory column, 20 m x 0.18 mm, 0.14 µm**



Agilent's DB-17ms primary column and DB-XLB confirmatory column sufficiently resolved all the peaks of interest in less than 6 minutes with sharp, symmetrical peaks and minimal baseline drift. In contrast, vendor R's primary analysis column resolved only 20 of 22 peaks with visible peak tailing. Vendor R's confirmatory column resolved all 22 peaks of interest but with peak tailing and an unacceptable level of temperature dependent baseline drift.

**Aroclors 1016-1268 (without 1221)**

**Column:** DB-XLB  
121-1232  
30 m x 0.18 mm, 0.18 µm

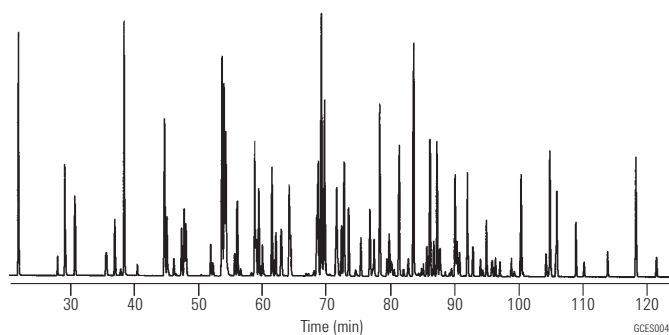
**Carrier:** Helium at 37 cm/sec, measured at 150 °C

**Oven:** 100 °C for 1 min  
100-265 °C at 1.2 °C/min

**Injection:** Hot on-column, 250 °C

**Detector:** MSD, 340 °C transfer line, SIM

**Sample:** 1 µL in isooctane, 12.5 ppm



**Suggested Supplies**

- Septum:** 11 mm Advanced Green septa, 5183-4759
- Liner:** Direct connect, single taper, deactivated, 4 mm id, G1544-80730
- Syringe:** 10 µL tapered, FN 23-26s/42/HP, 5181-1267

**CLP Pesticides**

**Column:** DB-35ms  
123-3832  
30 m x 0.32 mm, 0.25 µm

**Column:** DB-XLB  
123-1236  
30 m x 0.32 mm, 0.50 µm

**Carrier:** Helium at 45 cm/sec  
(EPC in constant flow mode)

**Oven:** 110 °C for 0.5 min  
110-320 °C at 15 °C/min  
320 °C for 2 min

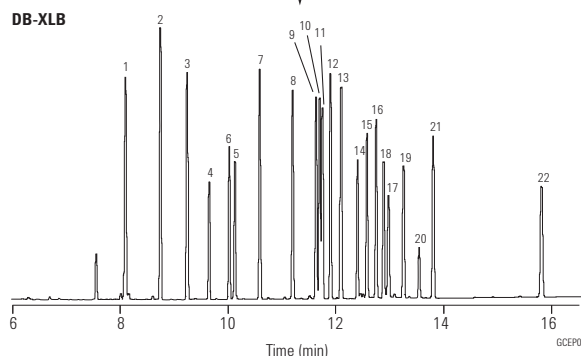
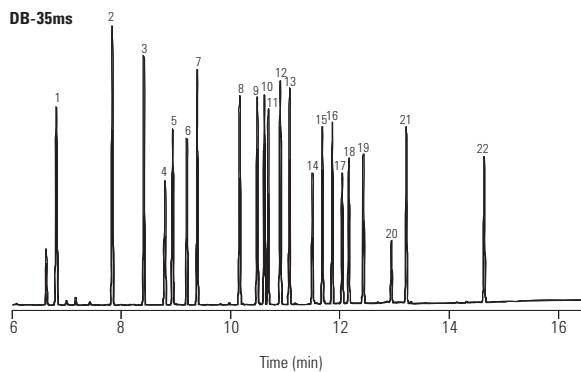
**Injection:** Splitless, 250 °C  
30 sec purge activation time

**Detector:** µECD, 350 °C  
Nitrogen makeup gas  
(column + makeup flow = 30 mL/min  
constant flow)

**Sample:** 50 pg per component

**Suggested Supplies**

- Septum:** 11 mm Advanced Green septa, 5183-4759
- Liner:** Splitless, single taper, deactivated, 4 mm id, 5181-3316
- Syringe:** 10 µL tapered, FN 23-26s/42/HP, 5181-1267



**Complete resolution and confirmation  
of 22 CLP Pesticides in under 16 minutes!**

1. Tetrachloro m-xylene (SS)
  2. α-BHC
  3. γ-BHC
  4. β-BHC
  5. Heptachlor
  6. δ-BHC
  7. Aldrin
  8. Heptachlor epoxide
  9. γ-Chlordane
  10. α-Chlordane
  11. Endosulfan I
  12. 4,4'-DDE
  13. Dieldrin
  14. Endrin
  15. 4,4'-DDD
  16. Endosulfan II
  17. 4,4'-DDT
  18. Endrin aldehyde
  19. Endosulfan sulfate
  20. Methoxychlor
  21. Endrin ketone
  22. Decachlorobiphenyl (SS)
- SS - Surrogate Standard

**High Speed VOC, EPA Method 8260**

**Column:** DB-VRX  
121-1524  
20 m x 0.18 mm, 1.00 µm

**Carrier:** Helium at 55 cm/sec (1.5 mL/min)

**Oven:** 45 °C for 3.0 min  
45-190 °C at 36 °C/min  
190-225 °C at 20 °C/min  
225 °C for 0.5 min

**Sampler:** Purge and trap (Tekmar 3100)  
Purge: 11 min  
Trap: Vocarb 3000  
Preheat: 245 °C  
Desorb: 250 °C for 1 min  
Bake: 260 °C for 10 min  
Line & valve: 100 °C

**Injection:** Split, 150 °C  
Split ratio 60:1

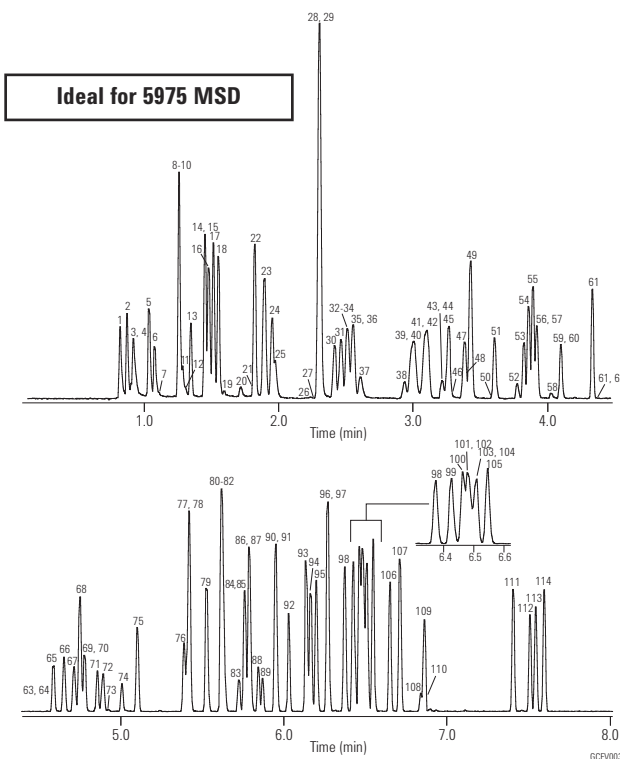
**Detector:** Agilent 5975 MSD  
Scan range: 35-260 amu  
Scan rate: 3.25 scans/sec  
Quad temperature: 150 °C  
Source temperature: 200 °C  
Transfer line temp: 200 °C

**Sample:** 5 mL  
• Halogenated and aromatic analytes at 40 ppb  
• Internal standards at 20 ppb  
• Polar analytes (i.e., ethers, alcohols and ketones at 100-800 ppb)

**Suggested Supplies**

**Septum:** 11 mm Advanced Green septa, 5183-4759  
**Liner:** Direct, 1.5 mm id, 18740-80200  
**Seal:** Gold plated seal, 18740-20885

- |                               |                               |
|-------------------------------|-------------------------------|
| 1. Dichlorodifluoromethane    | 43. Crotonaldehyde            |
| 2. Chloromethane              | 44. 2-Chloroethanol           |
| 3. Hydroxypropionitrile       | 45. 1,1-Dichloropropene       |
| 4. Vinyl chloride             | 46. 1-Butanol                 |
| 5. Bromomethane               | 47. Carbon tetrachloride      |
| 6. Chloroethane               | 48. Chloroacetonitrile        |
| 7. Ethanol                    | 49. Benzene                   |
| 8. Acetonitrile               | 50. tert-Amylmethyl ether     |
| 9. Acrolein                   | 51. Fluorobenzene (IS)        |
| 10. Trichlorofluoromethane    | 52. 2-Pentanone               |
| 11. Isopropyl alcohol         | 53. Dibromomethane            |
| 12. Acetone                   | 54. 1,2-Dichloropropane       |
| 13. Ethyl ether               | 55. Trichloroethene           |
| 14. 1,1-Dichloroethene        | 56. Bromodichloromethane      |
| 15. tert-Butyl alcohol        | 57. 2-Nitropropane            |
| 16. Acrylonitrile             | 58. 1,4-Dioxane               |
| 17. Methylene chloride        | 59. Epichlorohydrin           |
| 18. Allyl chloride            | 60. Methyl methacrylate       |
| 19. Allyl alcohol             | 61. cis-1,3-Dichloropropene   |
| 20. 1-Propanol                | 62. Propiolactone             |
| 21. Propargyl alcohol         | 63. Bromoacetone              |
| 22. trans-1,2-Dichloroethene  | 64. Pyridine                  |
| 23. MTBE                      | 65. trans-1,3-Dichloropropene |
| 24. 1,1-Dichloroethane        | 66. 1,1,2-Trichloroethane     |
| 25. Propionitrile             | 67. Toluene-d8 (IS)           |
| 26. 2-Butanone                | 68. Toluene                   |
| 27. Diisopropyl ether         | 69. 1,3-Dichloropropane       |
| 28. cis-1,2-Dichloroethene    | 70. Paraldehyde               |
| 29. Methacrylonitrile         | 71. Ethyl methacrylate        |
| 30. Bromochloromethane        | 72. Dibromochloromethane      |
| 31. Chloroform                | 73. 3-Chloropropionitrile     |
| 32. 2,2-Dichloropropane       | 74. 1,2-Dibromoethane         |
| 33. Ethyl acetate             | 75. Tetrachloroethene         |
| 34. Ethyl-tert-butyl ether    | 76. 1,1,1,2-Tetrachloroethane |
| 35. Methyl acrylate           | 77. 1-Chlorohexane            |
| 36. Dibromofluoromethane (IS) | 78. Chlorobenzene             |
| 37. Isobutanol                | 79. Ethylbenzene              |
| 38. Dichloroethane-d4 (IS)    | 80. Bromoform                 |
| 39. Pentafluorobenzene        | 81. m-Xylene                  |
| 40. 1,2-Dichloroethane        | 82. p-Xylene                  |
| 41. 1,1,1-Trichloroethane     | 83. trans-Dichlorobutene      |
| 42. 1-Chlorobutane            | 84. 1,3-Dichloro-2-propanol   |



- |                               |                                  |
|-------------------------------|----------------------------------|
| 85. Styrene                   | 100. sec-Butylbenzene            |
| 86. 1,1,2,2-Tetrachloroethane | 101. 1,3-Dichlorobenzene         |
| 87. o-Xylene                  | 102. Benzylchloride              |
| 88. 1,2,3-Trichloropropane    | 103. 1,4-Dichlorobenzene-d4 (IS) |
| 89. cis-Dichlorobutene        | 104. 1,4-Dichlorobenzene         |
| 90. 4-Bromofluorobenzene (IS) | 105. Isopropyltoluene            |
| 91. Isopropylbenzene          | 106. 1,2-Dichlorobenzene         |
| 92. Bromobenzene              | 107. Butylbenzene                |
| 93. Propylbenzene             | 108. 1,2-Dibromo-3-chloropropane |
| 94. 2-Chlorotoluene           | 109. Hexachloroethane            |
| 95. 4-Chlorotoluene           | 110. Nitrobenzene                |
| 96. 1,3,5-Trimethylbenzene    | 111. 1,2,4-Trichlorobenzene      |
| 97. Pentachloroethane         | 112. Naphthalene                 |
| 98. tert-Butylbenzene         | 113. Hexachlorobutadiene         |
| 99. 1,2,4-Trimethylbenzene    | 114. 1,2,3-Trichlorobenzene      |



**PBDEs**

**Column:** DB-XLB  
122-1231  
30 m x 0.25 mm, 0.10 µm

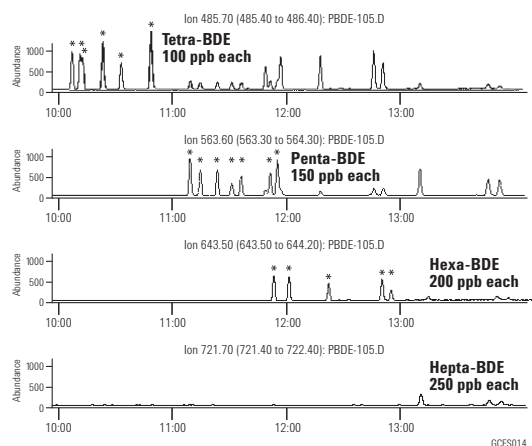
**Carrier:** Helium at 38 cm/sec at 100 °C (1.2 mL/min), constant flow mode

**Oven:** 100 °C for 1 min; 100 °C to 340 °C at 20 °C/min, 340 °C for 12 min

**Injection:** Cool on-column, oven-track mode

**Detector:** Agilent 5973 MSD, 325 °C transfer line, EI SIM  
(ions monitored: 231.8, 248.0, 327.9, 398.6, 400.5,  
405.8, 845.7, 563.6, 643.5, 721.4, 799.3)

**Sample:** 0.5 µL



For a complete Application Note, visit [www.agilent.com/chem](http://www.agilent.com/chem), select "Online Literature" from the Literature Library and type 5989-0094EN into the "Keyword" field.

**EPA Volatiles by GC/MS (Split Injector)**

**Column:** DB-VRX  
122-1564  
60 m x 0.25 mm, 1.40 µm

**Carrier:** Helium at 30 cm/sec, measured at 45 °C

**Oven:** 45 °C for 10 min  
45-190 °C at 12 °C/min  
190 °C for 2 min  
190-225 °C at 6 °C/min  
225 °C for 1 min

**Sampler:** Purge and trap (O.I.A. 4560)  
**Purge:** Helium for 11 min at 40 mL/min  
**Trap:** Tenax/Silica Gel/Carbosieve  
**Preheat:** 175 °C  
**Desorb:** 220 °C for 0.6 min

**Injection:** Split, 110 °C  
Split flow 30 mL/min

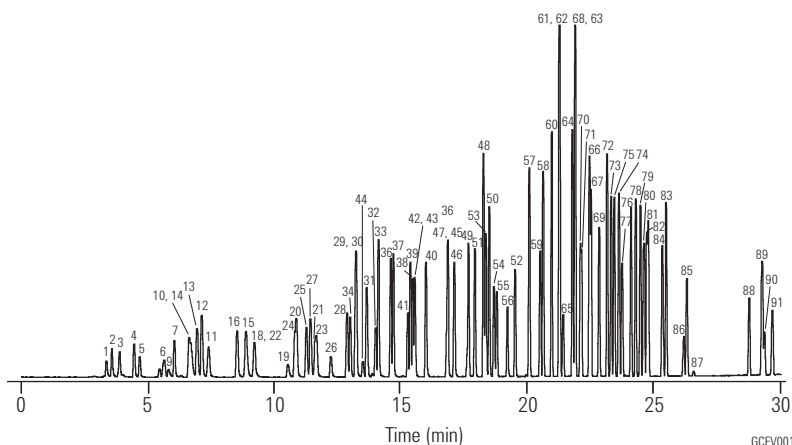
**Detector:** MSD, 235 °C transfer line  
Full scan 35-260 amu (m/z 44 subtracted)

**Suggested Supplies**

**Septum:** 11 mm Advanced Green septa, 5183-4759

**Liner:** Direct, 1.5 mm id, 18740-80200

**Seal:** Gold plated seal kit, 5188-5367



GCEV001

- |                              |                                   |                                 |
|------------------------------|-----------------------------------|---------------------------------|
| 1. Dichlorodifluoromethane   | 32. Carbon tetrachloride          | 63. o-Xylene                    |
| 2. Chloromethane             | 33. Benzene                       | 64. Styrene                     |
| 3. Vinyl chloride            | 34. 1,2-Dichloroethane            | 65. Bromoform                   |
| 4. Bromomethane              | 35. 2,2-Dimethylhexane            | 66. Isopropylbenzene            |
| 5. Chloroethane              | 36. Fluorobenzene (IS)            | 67. 4-Bromofluorobenzene (SS)   |
| 6. Trichlorofluoromethane    | 37. 1,4-Difluorobenzene (IS)      | 68. 1,1,2,2-Tetrachloroethane   |
| 7. Diethyl ether             | 38. Trichloroethene               | 69. Bromobenzene                |
| 8. 1,1-Dichloroethene        | 39. 1,2-Dichloropropane           | 70. 1,2,3-Trichloropropane      |
| 9. Acetone                   | 40. Methyl methacrylate           | 71. trans-1,4-Dichloro-2-butene |
| 10. Iodomethane              | 41. Dibromomethane                | 72. n-Propylbenzene             |
| 11. Carbon disulfide         | 42. Bromodichloromethane          | 73. 2-Chlorotoluene             |
| 12. Allyl chloride           | 43. 2-Nitropropane                | 74. 1,3,5-Trimethylbenzene      |
| 13. Methylene chloride       | 44. Chloroacetonitrile            | 75. 4-Chlorotoluene             |
| 14. Acrylonitrile            | 45. cis-1,3-Dichloropropene       | 76. tert-Butylbenzene           |
| 15. Methyl-tert-butyl ether  | 46. 4-Methyl-2-pentanone          | 77. Pentachloroethane           |
| 16. trans-1,2-Dichloroethene | 47. 1,1-Dichloro-2-propanone      | 78. 1,2,4-Trimethylbenzene      |
| 17. Hexane                   | 48. Toluene                       | 79. sec-Butylbenzene            |
| 18. 1,1-Dichloroethane       | 49. trans-1,3-Dichloropropene     | 80. 1,3-Dichlorobenzene         |
| 19. 2-Butanone               | 50. Ethyl methacrylate            | 81. p-Isopropyltoluene          |
| 20. cis-1,2-Dichloroethane   | 51. 1,1,2-Trichloroethane         | 82. 1,4-Dichlorobenzene         |
| 21. 2,2-Dichloropropane      | 52. Tetrachloroethene             | 83. n-Butylbenzene              |
| 22. Propionitrile            | 53. 1,3-Dichloropropane           | 84. 1,2-Dichlorobenzene         |
| 23. Methyl acrylate          | 54. 2-Hexanone                    | 85. Hexachloroethane            |
| 24. Methacrylonitrile        | 55. Dibromochloromethane          | 86. 1,2-Dibromo-3-chloropropane |
| 25. Bromochloromethane       | 56. 1,2-Dibromoethane             | 87. Nitrobenzene                |
| 26. Tetrahydrofuran          | 57. 1-Chloro-3-fluorobenzene (IS) | 88. 1,2,4-Trichlorobenzene      |
| 27. Chloroform               | 58. Chlorobenzene                 | 89. Hexachlorobutadiene         |
| 28. Pentafluorobenzene (IS)  | 59. 1,1,1,2-Tetrachloroethane     | 90. Naphthalene                 |
| 29. 1,1,1-Trichloroethane    | 60. Ethylbenzene                  | 91. 1,2,3-Trichlorobenzene      |
| 30. 1-Chlorobutane           | 61. m-Xylene                      |                                 |
| 31. 1,1-Dichloropropene      | 62. p-Xylene                      |                                 |

**EPA Method 525.2**

**Column:** DB-5ms  
122-5532  
30 m x 0.25 mm, 0.25 µm

**Carrier:** Helium at 32 cm/sec, measured at 45 °C, constant flow mode

**Oven:** 45 °C for 1 min  
45-130 °C at 30 °C/min  
130 °C for 3 min  
130-180 °C at 12 °C/min  
180-240 °C at 7 °C/min  
240-325 °C at 12 °C/min  
325 °C for 5 min

**Injection:** Splitless, 300 °C  
1.0 min purge activation time  
Focus liner

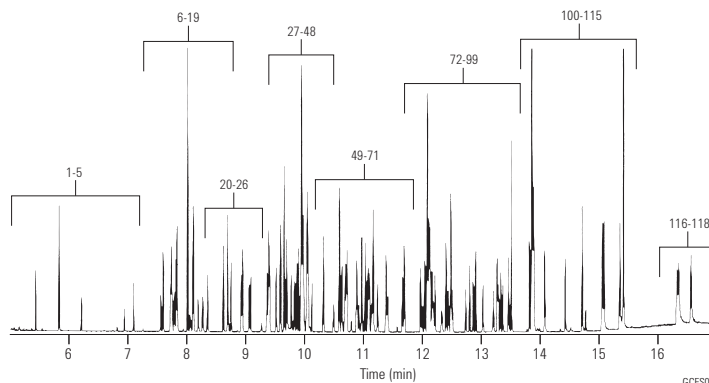
**Detector:** MSD, 325 °C transfer line  
Full scan m/z 45-450

**Sample:** Composite mixture of AccuStandard  
Method 525.2 standards (M-525.2-SV-ASL,  
M-525.2-FS-ASL, M-525.2-CP-ASL,  
M-525.2-NP1-ASL, M-525.2-NP2-ASL):  
target compounds at 2 ng/µL, IS/SS at 5 ng/µL

**Suggested Supplies**

**Septum:** 11 mm Advanced Green septa, 5183-4759  
**Liner:** Direct connect, single taper, deactivated, 4 mm id, G1544-80730  
**Syringe:** 10 µL tapered, FN 23-26s/42/HP, 5181-1267

Compound	RT	m/z	Compound	RT	m/z	Compound	RT	m/z
1. Isophorone	5.85	82	51. Alachlor	16.14	160	85. 2,2',4,4',5,6'-Hexachlorobiphenyl	19.90	360
2. 1,3-Dimethyl-2-nitrobenzene (SS)	6.65	134	52. Simetryn	16.23	213	86. Dieldrin	19.92	79
3. Dichlorvos	7.41	109	53. Ametryn	16.33	227/170	87. Carboxin	19.97	143
4. Hexachlorocyclo-pentadiene	8.87	237	54. Heptachlor	16.36	100	88. Endrin	20.43	67/81
5. EPTC	9.17	128	55. Prometryne	16.40	241/184	89. Chlorobenzilate	20.56	139
6. Mevinphos	10.09	127	56. Prebane (Terbutryne)	16.72	226/185	90. Endosulfan II	20.68	195
7. Butylate	10.18	57/146	57. Bromacil	16.79	205	91. p,p'-DDD	20.77	235/165
8. Vernolate	10.42	128	58. Di-n-butyl phthalate	16.90	149	92. Endrin aldehyde	21.01	67
9. Dimethyl phthalate	10.45	163	59. 2,2',4,4'-Tetrachlorobiphenyl	17.02	292	93. Norflurazon	21.36	145
10. Terrazole (Etridazole)	10.47	211/183	60. Metolachlor	17.11	162	94. Benzyl butyl phthalate	21.49	149
11. 2,6-Dinitrotoluene	10.56	165	61. Dursban (Chlorpyrifos)	17.15	197/97	95. Endosulfan sulfate	21.53	272
12. Tillam (Pebulate)	10.61	128	62. Cyanazine	17.23	225/68	96. p,p'-DDT	21.61	235/165
13. Acenaphthylene	10.65	152	63. Dacthal (DCPA methyl ester)	17.27	301	97. Hexazinone	21.68	171
14. Acenaphthene-d10 (IS)	11	164	64. Aldrin	17.29	66	98. Bis[2-ethylhexyl] adipate	21.87	129
15. Chloroneb	11.17	191	65. Triadimefon	17.43	57	99. Triphenylphosphate (SS)	21.98	326/325
16. 2-Chlorobiphenyl	11.19	188	66. Diphenamid	17.73	72/167	100. Endrin ketone (breakdown product)	22.52	67/317
17. Tebuthiuron	11.37	156	67. MGK-264 (Isomer A)	17.78	164/66	101. 2,2',3,3',4,4',6-Heptachlorobiphenyl	22.59	394/396
18. 2,4-Dinitrotoluene	11.51	165	68. MGK-264 (Isomer B)	18.11	164	102. Benz[a]anthracene	22.66	228
19. Molinate	11.68	126	69. Heptachlor epoxide	18.28	81	103. Chrysene-d12 (IS)	22.68	240
20. Diethyl phthalate	12.21	149	70. 2,2',3',4,6-Pentachlorobiphenyl	18.34	326	104. 2,2',3,3',4,5',6,6'-Octachlorobiphenyl	22.70	430/428
21. Fluorene	12.35	166	71. Merphos	18.36	209/153	105. Methoxychlor	22.73	227
22. Propachlor	12.46	120	72. γ-Chlordane	18.88	373	106. Chrysene	22.74	228
23. Ethoprop	12.82	158	73. Tetrachlorvinphos (Stirifos)	18.95	109	107. Bis[2-ethylhexyl] phthalate	23.10	149
24. Cycloate	12.86	83/154	74. Butachlor	19.03	176/160	108. Fenarimol	23.80	139
25. Chlorpropham	13.08	127	75. Pyrene-d10 (SS)	19.13	212	109. cis-Permethrin	24.38	183
26. Trifluralin	13.14	306	76. Pyrene	19.18	202	110. trans-Permethrin	24.50	183
27. α-BHC	13.69	181	77. α-Chlordane	19.21	375/373	111. Benzo[b]fluoranthene	25.06	252
28. 2,3-Dichlorobiphenyl	13.74	222/152	78. Endosulfan I	19.22	195	112. Benzo[k]fluoranthene	25.12	252
29. Hexachlorobenzene	13.77	284	79. trans-Nonachlor	19.28	409	113. Fluridone	25.66	328
30. Gesatamine (Atraton)	13.99	196/169	80. Fenamiphos	19.33	303/154	114. Benzo[a]pyrene	25.67	252
31. Prometon	14.14	225/168	81. Napropamide	19.39	72	115. Perylene-d12 (SS)	25.78	264
32. Atrazine	14.26	200/215	82. Tricyclazole	19.61	189	116. Indeno[1,2,3-c,d]pyrene	27.63	276
33. Simazine	14.27	201/186	83. p,p'-DDE	19.76	246	117. Dibenz[a,h]anthracene	27.69	278
34. β-BHC	14.28	181	84. DEF	19.84	57/169	118. Benzo[g,h,i]perylene	28.11	276
35. Pentachlorophenol	14.35	266						
36. Propazine	14.35	214/172						
37. γ-BHC	14.52	181						
38. Terbufos	14.62	57						
39. Pronamide	14.69	173						
40. Diazinon	14.76	137/179						
41. Phenanthrene-d10 (IS)	14.85	188						
42. Chlorothalonil	14.89	266						
43. Phenanthrene	14.92	178						
44. Terbacil	15.02	161						
45. Methyl paraoxon	15.04	109						
46. Disulfoton	15.05	88						
47. Anthracene	15.06	178						
48. δ-BHC	15.20	181						
49. 2,4,5-Trichlorobiphenyl	15.59	256						
50. Metribuzin	15.95	198						



**Pesticides and Fire Retardants (US EPA 527)**

**Column:** DB-5ms Ultra Inert  
122-5532UI  
30 m x 0.25 mm, 0.25 µm

**Carrier:** Helium, 52 cm/sec, constant flow

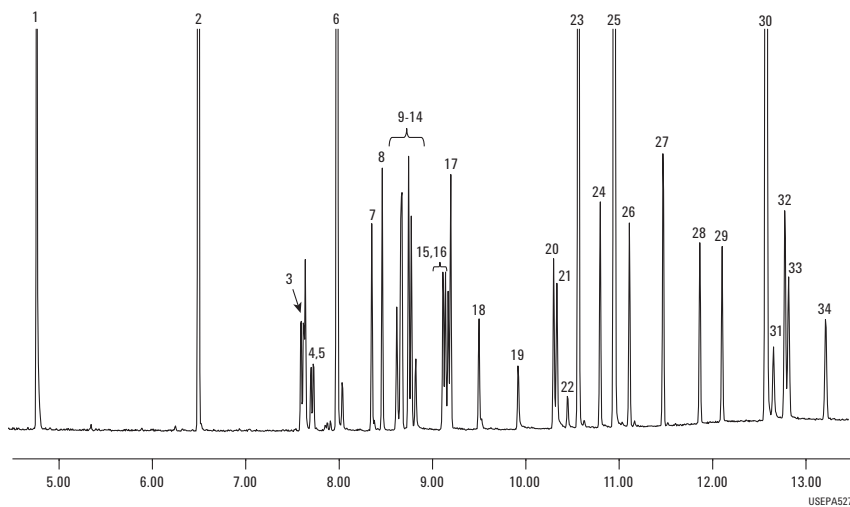
**Oven:** 60 °C (1 min) to 210 °C (25 °C/min), 20 °C/min to 310 °C (3 min)

**Injection:** Splitless, 250 °C, purge flow 50 mL/min @ 1 in, gas saver 80 mL/min on @ 3 min

**Detector:** Transfer line 290 °C, source 300 °C, quad 180 °C

**Sample:** Pesticide/PBDE standards, 1 ng with 5 ng IS/SS on-column

1. 1,2-Dimethyl-2-nitrobenzene
2. Acenaphthalene-D10
3. Dimethoate
4. Atrazine
5. Propazine
6. Anthracene-D10
7. Vinclozoline
8. Prometryne
9. Bromacil
10. Malathion
11. Thiazopyr
12. Dursban
13. Benthicarb
14. Parathion
15. Terbus sulfone
16. Bioallethrin
17. Oxychlorthane
18. Fenamiphos
19. Nitrophen
20. Norflurazone
21. Kepone
22. Hexazinone
23. Triphenyl phosphate
24. Bifenthrin
25. Chrysene-D12
26. BDE-47
27. Mirex
28. BDE-100
29. BDE-99
30. Perylene-D12
31. Fenvalerate
32. Esfenvalerate
33. Hexabromobiphenyl
34. BDE-153



**Organochlorine Pesticides I EPA Method 8081A**

**Column:** DB-35ms  
122-3832  
30 m x 0.25 mm, 0.25 µm

**Carrier:** Helium at 35 cm/sec, measured at 50 °C

**Oven:** 50 °C for 1 min  
50-100 °C at 25 °C/min  
100-300 °C at 5 °C/min  
300 °C for 5 min

**Injection:** Splitless, 250 °C  
30 sec purge activation time

**Detector:** MSD, 300 °C transfer line  
Full scan at m/z 50-500

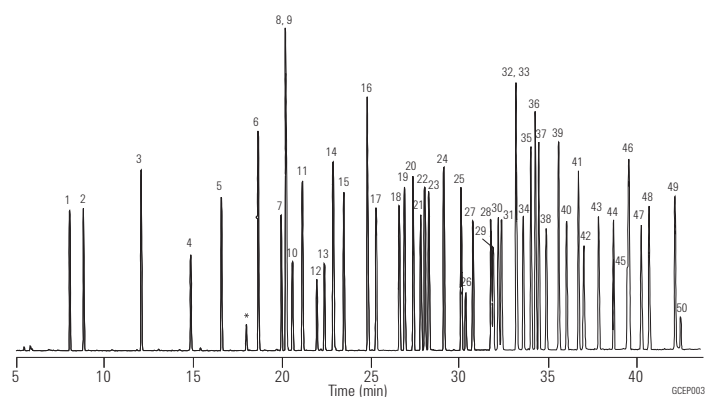
**Sample:** 1 µL of 35 µg/mL composite 8081A standards, AccuStandard Inc.

**Suggested Supplies**

**Septum:** 11 mm Advanced Green septa, 5183-4759

**Liner:** Splitless, single taper, deactivated, 4 mm id, 5181-3316

**Syringe:** 10 µL tapered, FN 23-26s/42/HP, 5181-1267



1. 1,2-Dibromo-3-chloropropane
  2. 4-Chloro-3-nitrobenzotrifluoride (SS)
  3. Hexachloropentadiene
  4. 1-Bromo-2-nitrobenzene (IS)
  5. Terrazole
  6. Chloroneb
  7. Trifluralin
  8. 2-Bromobiphenyl (SS)
  9. Tetrachloro m-xylene (SS)
  10.  $\alpha$ ,  $\alpha$ -Dibromo-m-xylene
  11. Propachlor
  12. Di-allate A
  13. Di-allate B
  14. Hexachlorobenzene
  15.  $\alpha$ -BHC
  16. Pentachloronitrobenzene (IS)
  17.  $\gamma$ -BHC
  18.  $\beta$ -BHC
  19. Heptachlor
  20. Alachlor
  21.  $\delta$ -BHC
  22. Chlorothalonil
  23. Aldrin
  24. Dacthal
  25. Isodrin
  26. Kelthane
  27. Heptachlor epoxide
  28.  $\gamma$ -Chlordane
  29. trans-Nonachlor
  30.  $\alpha$ -Chlordane
  31. Endosulfan I
  32. Captan
  33. p,p'-DDE
  34. Dieldrin
  35. Chlorobenzilate
  36. Perthane
  37. Chloropropylate
  38. Endrin
  39. p,p'-DDD
  40. Endosulfan II
  41. p,p'-DDT
  42. Endrin aldehyde
  43. Endosulfan sulfate
  44. Dibutylchloredate (SS)
  45. Captafol
  46. Methoxychlor
  47. Endrin ketone
  48. Mirex
  49. cis-Permethrin
  50. trans-Permethrin
- \* Breakdown Products  
SS - Surrogate Standard  
IS - Internal Standard

Standards used were a composite of individual solutions supplied courtesy of AccuStandard Inc., 25 Science Park, New Haven, CT 06511, 800-442-5290.

### Chlorinated Pesticides, EPA Method 508

**Column:** HP-5ms  
19091S-433  
30 m x 0.25 mm, 0.25 µm

**Carrier:** Helium, 24 psi, 45 cm/sec (80 °C) constant flow

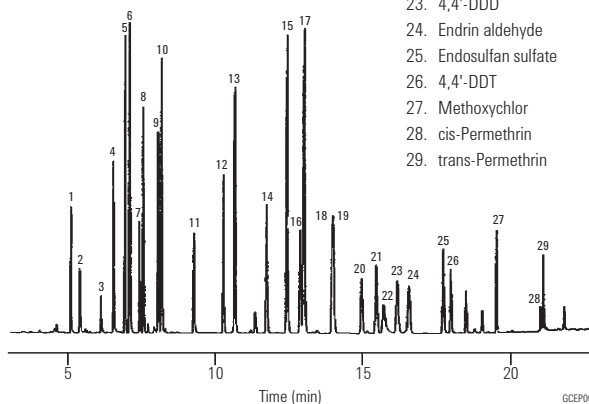
**Oven:** 80 °C for 1 min  
80-180 °C at 30 °C/min  
180-205 °C at 3 °C/min  
205 °C for 4 min  
205-290 °C at 2 °C/min  
290 °C for 2 min

**Injection:** Splitless  
1 min purge delay

**Detector:** ECD, 320 °C  
Makeup gas Nitrogen, 60 mL/min  
Anode purge 3 mL/min

**Sample:** 1 µL

- |                     |                        |
|---------------------|------------------------|
| 1. Etridiazole      | 12. Aldrin             |
| 2. Chloroneb        | 13. DCPA               |
| 3. Propachlor       | 14. Heptachlor epoxide |
| 4. Trifluralin      | 15. γ-Chlordane        |
| 5. α-BHC            | 16. Endosulfan I       |
| 6. Hexachlorobezene | 17. α-Chlordane        |
| 7. β-BHC            | 18. Dieldrin           |
| 8. δ-BHC            | 19. 4,4'-DDE           |
| 9. γ-BHC            | 20. Endrin             |
| 10. Chlorothalonil  | 21. Endosulfan II      |
| 11. Heptachlor      | 22. Chlorobenzilate    |
|                     | 23. 4,4'-DDD           |
|                     | 24. Endrin aldehyde    |
|                     | 25. Endosulfan sulfate |
|                     | 26. 4,4'-DDT           |
|                     | 27. Methoxychlor       |
|                     | 28. cis-Permethrin     |
|                     | 29. trans-Permethrin   |



#### Suggested Supplies

**Septum:** 11 mm Advanced Green septa, 5183-4759

**Liner:** Direct connect, single taper, deactivated, 4 mm id, G1544-80730

**Syringe:** 10 µL tapered, FN 23-26s/42/HP, 5181-1267

### Organohalide Pesticides in Water, EPA Method 505

**Column:** HP-5ms  
19091S-433  
30 m x 0.25 mm, 0.25 µm

**Carrier:** Helium at 2.0 mL/min, constant flow, 42 cm/sec (22.4 psi at 80 °C)

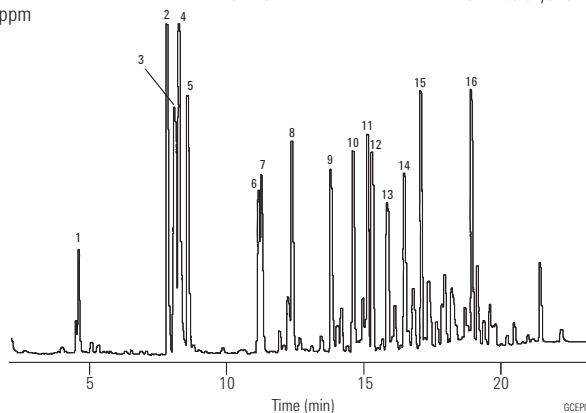
**Oven:** 80 °C for 1 min  
80-175 °C at 30 °C/min  
175 °C for 4 min  
175-215 °C at 6 °C/min  
215 °C for 2 min  
215-290 °C at 15 °C/min  
290 °C for 5 min

**Injection:** Splitless, 250 °C  
1 min purge delay

**Detector:** ECD, 300 °C  
Makeup gas: N<sub>2</sub>, 60 mL/min  
Anode purge 6 mL/min

**Sample:** 1 µL injection volume  
16 components EPA-505 targeted pesticides and 14 ppb Aroclor 1260 in hexane.  
Concentration of pesticides: 50 ppb each except 1.25 ppm for atrazine and simazine.

- |                              |                       |
|------------------------------|-----------------------|
| 1. Hexachlorocyclopentadiene | 9. Heptachlor epoxide |
| 2. Hexachlorobenzene         | 10. δ-Chlordane       |
| 3. Simazine                  | 11. α-Chlordane       |
| 4. Atrazine                  | 12. trans-Nonachlor   |
| 5. Lindane                   | 13. Dieldrin          |
| 6. Heptachlor                | 14. Endrin            |
| 7. Alachlor                  | 15. cis-Nonachlor     |
| 8. Adrin                     | 16. Methoxychlor      |



#### Suggested Supplies

**Septum:** 11 mm Advanced Green septa, 5183-4759

**Liner:** Direct connect, single taper, deactivated, 4 mm id, G1544-80730

**Syringe:** 10 µL tapered, FN 23-26s/42/HP, 5181-1267

### Organochlorine Pesticides I

**Column:** DB-5  
125-5037  
30 m x 0.53 mm, 0.50 µm

**Carrier:** Helium at 30 cm/sec (4.0 mL/min)

**Oven:** 150-275 °C at 4 °C/min  
275 °C for 30 min

**Injection:** Splitless, 250 °C

**Detector:** ECD, 300 °C  
Nitrogen makeup gas at 30 mL/min

**Sample:** 0.7 µL of 100 pg/µL standard in isoctane

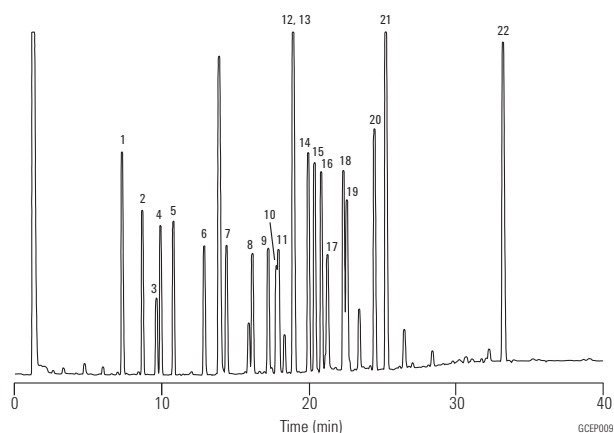
- |                                      |                             |
|--------------------------------------|-----------------------------|
| 1. 2,4,5,6-Tetrachloro-m-xylene (IS) | 12. Dieldrin                |
| 2. α-BHC                             | 13. p,p'-DDE                |
| 3. β-BHC                             | 14. Endrin                  |
| 4. γ-BHC                             | 15. Endosulfan II           |
| 5. δ-BHC                             | 16. p,p'-DDD                |
| 6. Heptachlor                        | 17. Endrin aldehyde         |
| 7. Aldrin                            | 18. Endosulfan sulfate      |
| 8. Heptachlor epoxide                | 19. p,p'-DDT                |
| 9. γ-Chlordane                       | 20. Endrin ketone           |
| 10. Endosulfan I                     | 21. Methoxychlor            |
| 11. α-Chlordane                      | 22. Decachlorobiphenyl (IS) |

#### Suggested Supplies

**Liner:** Splitless, single taper, deactivated, 4 mm id, 5181-3316

**Septum:** 11 mm Advanced Green septa, 5183-4759

**Syringe:** 10 µL tapered, FN 23-26s/42/HP, 5181-1267



### Organochlorine Pesticides II

**Column:** DB-608  
125-6837  
30 m x 0.53 mm, 0.50 µm

**Carrier:** Helium at 30 cm/sec (4.0 mL/min)

**Oven:** 150-275 °C at 4 °C/min  
275 °C for 30 min

**Injection:** Splitless, 250 °C

**Detector:** ECD, 300 °C  
Nitrogen makeup gas at 30 mL/min

**Sample:** 0.7 µL of 100 pg/µL standard in isoctane

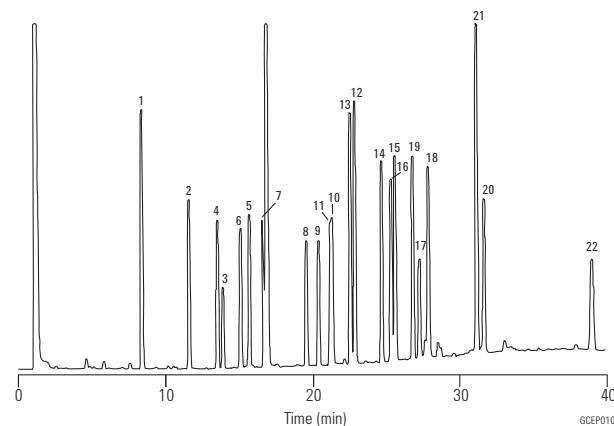
- |                                      |                             |
|--------------------------------------|-----------------------------|
| 1. 2,4,5,6-Tetrachloro-m-xylene (IS) | 12. Dieldrin                |
| 2. α-BHC                             | 13. p,p'-DDE                |
| 3. β-BHC                             | 14. Endrin                  |
| 4. γ-BHC                             | 15. Endosulfan II           |
| 5. δ-BHC                             | 16. p,p'-DDD                |
| 6. Heptachlor                        | 17. Endrin aldehyde         |
| 7. Aldrin                            | 18. Endosulfan sulfate      |
| 8. Heptachlor epoxide                | 19. p,p'-DDT                |
| 9. γ-Chlordane                       | 20. Endrin ketone           |
| 10. Endosulfan I                     | 21. Methoxychlor            |
| 11. α-Chlordane                      | 22. Decachlorobiphenyl (IS) |

#### Suggested Supplies

**Liner:** Splitless, single taper, deactivated, 4 mm id, 5181-3316

**Seal:** 11 mm Advanced Green septa, 5183-4759

**Syringe:** 10 µL tapered, FN 23-26s/42/HP, 5181-1267



### Organochlorine Pesticides III

**Column:** DB-1701  
125-0737  
30 m x 0.53 mm, 0.50 µm

**Carrier:** Helium at 30 cm/sec (4.0 mL/min)

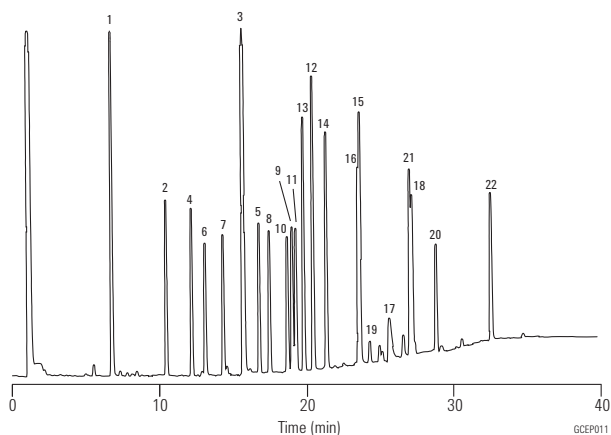
**Oven:** 150-275 °C at 4 °C/min  
275 °C for 30 min

**Injection:** Splitless, 250 °C

**Detector:** ECD, 300 °C  
Nitrogen makeup gas at 30 mL/min

**Sample:** 0.7 µL of 100 pg/µL standard in isoctane

- |                                      |                             |
|--------------------------------------|-----------------------------|
| 1. 2,4,5,6-Tetrachloro-m-xylene (IS) | 12. Dieldrin                |
| 2. α-BHC                             | 13. p,p'-DDE                |
| 3. β-BHC                             | 14. Endrin                  |
| 4. γ-BHC                             | 15. Endosulfan II           |
| 5. δ-BHC                             | 16. p,p'-DDD                |
| 6. Heptachlor                        | 17. Endrin aldehyde         |
| 7. Aldrin                            | 18. Endosulfan sulfate      |
| 8. Heptachlor epoxide                | 19. p,p'-DDT                |
| 9. γ-Chlordane                       | 20. Endrin ketone           |
| 10. Endosulfan I                     | 21. Methoxychlor            |
| 11. α-Chlordane                      | 22. Decachlorobiphenyl (IS) |



#### Suggested Supplies

- Septum:** 11 mm Advanced Green septa, 5183-4759
- Liner:** Splitless, single taper, deactivated, 4 mm id, 5181-3316
- Syringe:** 10 µL tapered, FN 23-26s/42/HP, 5181-1267

### Organochlorine Pesticides IV

**Column:** DB-35  
125-1937  
30 m x 0.53 mm, 0.50 µm

**Carrier:** Helium at 30 cm/sec (4.0 mL/min)

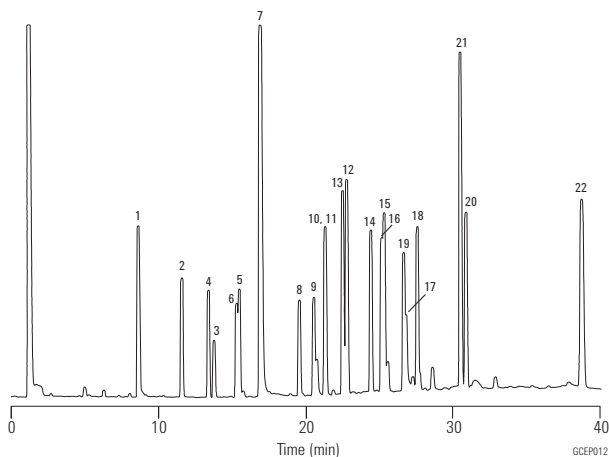
**Oven:** 150-275 °C at 4 °C/min  
275 °C for 30 min

**Injection:** Splitless, 250 °C

**Detector:** ECD, 300 °C  
Nitrogen makeup gas at 30 mL/min

**Sample:** 0.7 µL of 100 pg/µL standard in isoctane

- |                                      |                             |
|--------------------------------------|-----------------------------|
| 1. 2,4,5,6-Tetrachloro-m-xylene (IS) | 12. Dieldrin                |
| 2. α-BHC                             | 13. p,p'-DDE                |
| 3. β-BHC                             | 14. Endrin                  |
| 4. γ-BHC                             | 15. Endosulfan II           |
| 5. δ-BHC                             | 16. p,p'-DDD                |
| 6. Heptachlor                        | 17. Endrin aldehyde         |
| 7. Aldrin                            | 18. Endosulfan sulfate      |
| 8. Heptachlor epoxide                | 19. p,p'-DDT                |
| 9. γ-Chlordane                       | 20. Endrin ketone           |
| 10. Endosulfan I                     | 21. Methoxychlor            |
| 11. α-Chlordane                      | 22. Decachlorobiphenyl (IS) |



#### Suggested Supplies

- Septum:** 11 mm Advanced Green septa, 5183-4759
- Liner:** Splitless, single taper, deactivated, 4 mm id, 5181-3316
- Syringe:** 10 µL tapered, FN 23-26s/42/HP, 5181-1267



**Organochlorine Pesticides, DB-5/DB-1701P**

**Column:** DB-5  
123-5032  
30 m x 0.32 mm, 0.25 µm

**Column:** DB-1701P  
123-7732  
30 m x 0.32 mm, 0.25 µm

**Column:** Guard Column  
160-2535-10  
30 m x 0.32 mm, 0.25 µm

**Carrier:** Helium at 29.2 cm/sec, measured at 150 °C

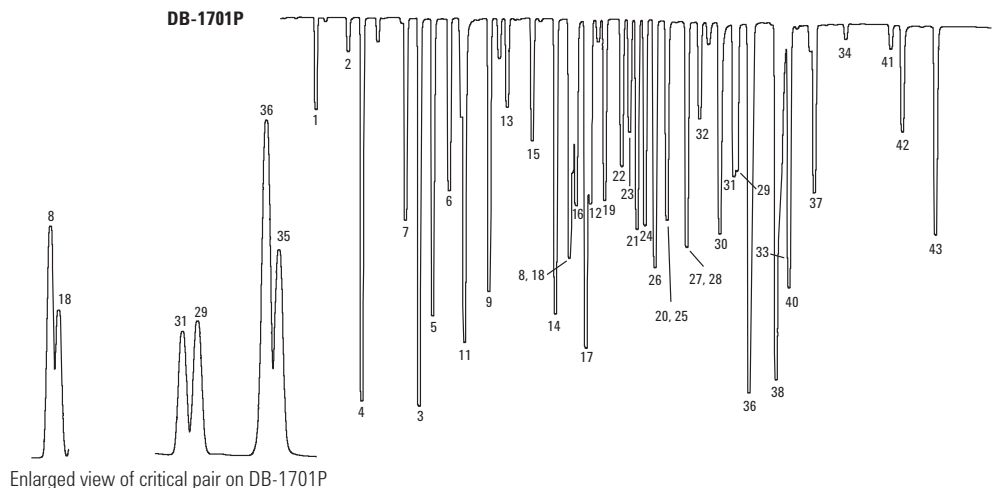
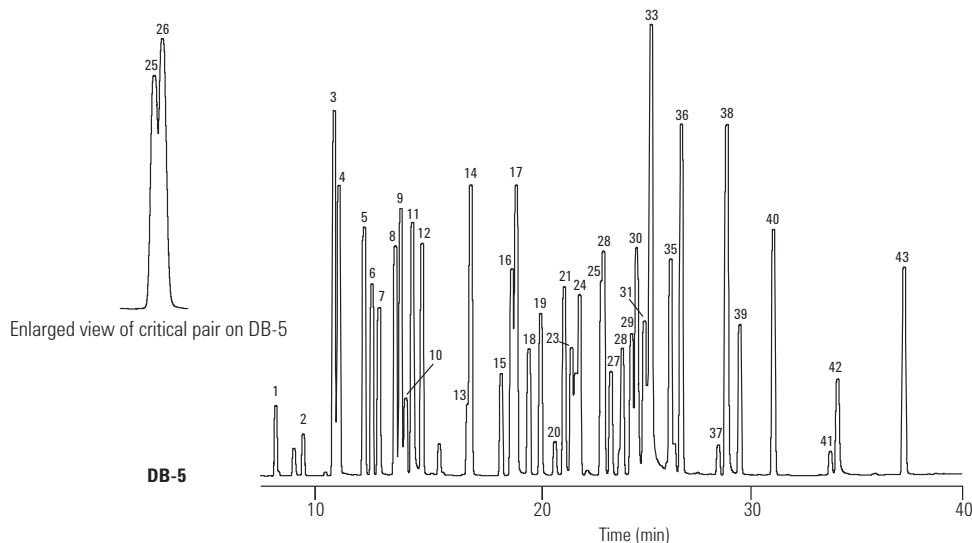
**Oven:** 60 °C for 0.5 min  
60-140 °C at 20 °C/min  
140-280 °C at 11 °C/min  
280 °C for 23 min

**Injection:** Splitless, 200 °C

**Detector:** ECD, 325 °C  
Nitrogen makeup gas at 30 mL/min

**Sample:** 2.0 µL, 20-200 pg/µL

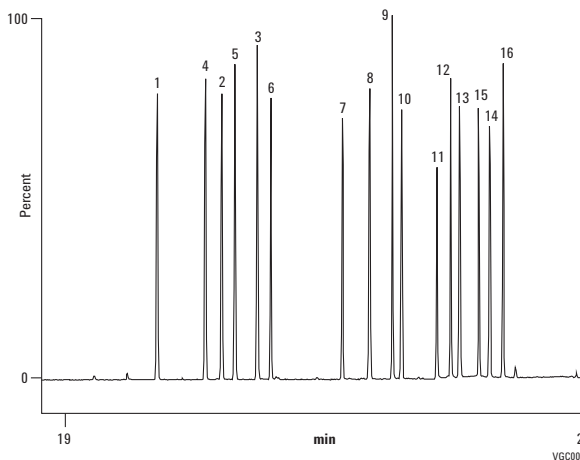
- |                              |                             |
|------------------------------|-----------------------------|
| 1. Etridiazole               | 22. o,p'-DDE                |
| 2. Chloroneb                 | 23. Endosulfan I            |
| 3. Propachlor                | 24. α-Chlordane             |
| 4. Tetrachloro-m-xylene (IS) | 25. Dieldrin                |
| 5. Trifluralin               | 26. p,p'-DDE                |
| 6. α-BHC                     | 27. o,p'-DDD                |
| 7. Hexachlorobenzene         | 28. Endrin                  |
| 8. β-BHC                     | 29. Endosulfan II           |
| 9. γ-BHC                     | 30. Chlorobenzilate         |
| 10. Pentachloronitrobenzene  | 31. p,p'-DDD                |
| 11. p,p'-Dichlorobiphenyl    | 32. o,p'-DDT                |
| 12. δ-BHC                    | 33. Endrin aldehyde         |
| 13. Heptachlor               | 34. Endrin ketone           |
| 14. Alachlor                 | 35. Carbophenothion         |
| 15. Aldrin                   | 36. p,p'-DDT                |
| 16. Chlorpyrifos             | 37. Endosulfan sulfate      |
| 17. DCPA                     | 38. Hexabromobenzene (HBB)  |
| 18. Isodrin                  | 39. Methoxychlor            |
| 19. Heptachlor epoxide       | 40. Mirex                   |
| 20. Captan                   | 41. cis-Permethrin          |
| 21. γ-Chlordane              | 42. trans-Permethrin        |
|                              | 43. Decachlorobiphenyl (IS) |



**Organochlorine Pesticides**

**Column:** VF-17ms  
CP8982  
30 m x 0.25 mm, 0.25 µm

Sample: 1.0 µL  
Sample Conc: 200 µg/mL  
Carrier: Helium, 70 kPa  
Injection: Splitter, 1:100  
Detector: MS, Ion Trap, TIC



1. α-BHC
2. β-BHC
3. δ-BHC
4. γ-BHC (lindane)
5. Heptachlor
6. Aldrin
7. Heptachlorepoxyde
8. Endosulfan I
9. 4,4'-DDE
10. Dieldrin
11. Endrin
12. 4,4'-DDD
13. Endosulfan II
14. Endrin aldehyde
15. 4,4'-DDT
16. Endosulfan sulfate

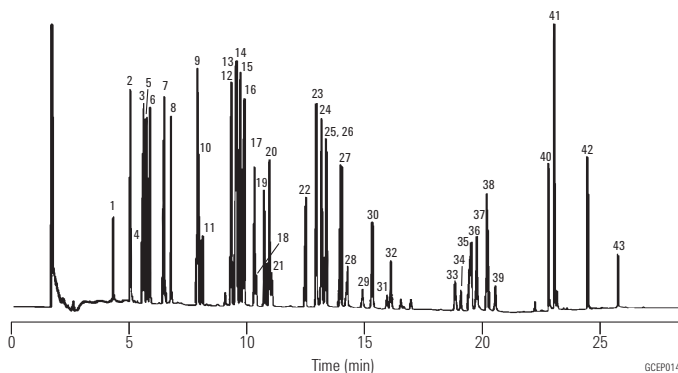
**Nitrogen/Phosphorus Containing Pesticides,  
EPA Method 507**

**Column:** HP-5ms  
19091S-433  
30 m x 0.25 mm, 0.25 µm

Carrier: Helium, 30 cm/sec (13.6 psi) pressure program  
Oven: 80-178 °C at 30 °C/min  
178 °C for 4 min  
178-205 °C at 2 °C/min  
205-310 °C at 30 °C/min  
310 °C for 4 min  
Injection: Splitless, 260 °C  
1 min purge delay  
Detector: NPD, 290 °C  
Helium makeup gas at 30 mL/min

**Suggested Supplies**

**Septum:** 11 mm Advanced Green septa, 5183-4759  
**Liner:** Direct connect, single taper, deactivated, 4 mm id, G1544-80730  
**Syringe:** 10 µL tapered, FN 23-26s/42/HP, 5181-1267



- |                  |                  |
|------------------|------------------|
| 1. Dichlorvos    | 22. Metribuzin   |
| 2. EPTC          | 23. Simetryn     |
| 3. Butylate      | 24. Alachlor     |
| 4. Mevinphos     | 25. Ametryn      |
| 5. Vernolate     | 26. Prometryn    |
| 6. Pebulate      | 27. Terbutryn    |
| 7. Tebuthiuron   | 28. Bromacil     |
| 8. Molinate      | 29. Metolachlor  |
| 9. Ethoprop      | 30. Triademefon  |
| 10. Cycloate     | 31. MGK-264      |
| 11. Chlorpropham | 32. Diphenamid   |
| 12. Atraton      | 33. Stirofos     |
| 13. Simazine     | 34. Butachlor    |
| 14. Prometon     | 35. Fenamiphos   |
| 15. Atrazine     | 36. Napropamide  |
| 16. Propazine    | 37. Tricyclazole |
| 17. Terbufos     | 38. Merphos      |
| 18. Pronamide    | 39. Carboxin     |
| 19. Diazinon     | 40. Norflurazon  |
| 20. Disulfoton   | 41. Hexazinone   |
| 21. Terbacil     | 42. Fenarimol    |
|                  | 43. Fluridone    |

### Herbicides I

**Column:** DB-XLB  
122-1232  
30 m x 0.25 mm, 0.25 µm

**Carrier:** Helium at 32 cm/sec, measured at 50 °C

**Oven:** 50 °C for 1 min  
50-180 °C at 10 °C/min  
180-230 °C at 5 °C/min  
230-320 °C at 10 °C/min  
320 °C for 2 min

**Injection:** Splitless, 250 °C  
30 sec purge activation time

**Detector:** MSD, 300 °C transfer line  
Full scan 50-400

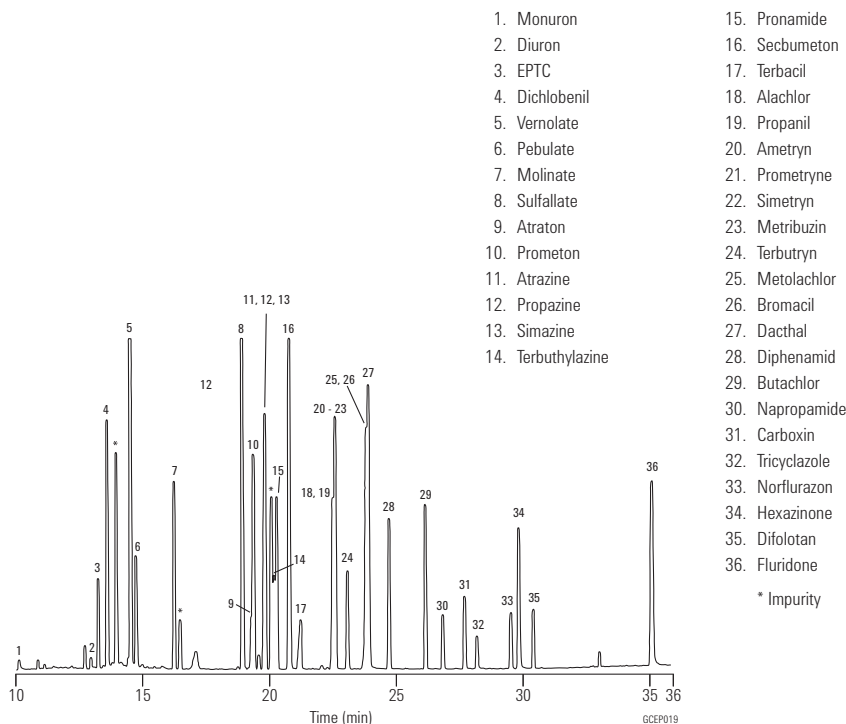
**Sample:** 2 µL x 10-50 ng/µL solution  
in acetone

#### Suggested Supplies

**Septum:** 11 mm Advanced Green septa, 5183-4759

**Liner:** Splitless, single taper, deactivated, 4 mm id, 5181-3316

**Syringe:** 10 µL tapered, FN 23-26s/42/HP, 5181-1267



### Herbicides II

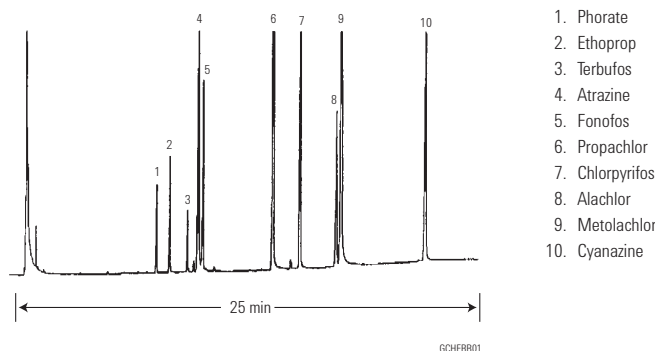
**Column:** DB-210  
122-0232  
30 m x 0.25 mm, 0.25 µm

**Carrier:** Helium at 35 cm/sec

**Oven:** 140-215 °C at 3 °C/min

**Injection:** Split 1:50, 1 µL

**Detector:** ECD, 300 °C  
Nitrogen makeup gas at 30 mL/min



**C<sub>1</sub> and C<sub>2</sub> Halocarbons (Freons)**

**Column:** GS-GasPro  
113-4362  
60 m x 0.32 mm

**Carrier:** Helium at 35 cm/sec,  
constant velocity

**Oven:** 40 °C for 2 min,  
40-120 °C at 10 °C/min  
120 °C for 3 min  
120-200 °C at 10 °C/min

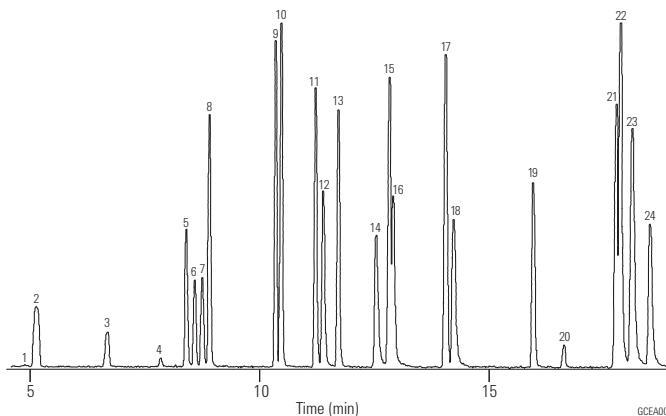
**Injection:** Splitless, 250 °C  
0.20 min purge activation time

**Detector:** MSD, 280 °C,  
full scan 45-180 amu

**Sample:** 1.0 µL of 100 ppm mixture  
of AccuStandard M-REF &  
M-REF-X in methanol

	Freon #	Freon #
1. Chlorotrifluoromethane*	13	13. 1,1-Difluoroethane
2. Trifluoromethane	23	14. 1,2-Dichloro-1,1,2,2-tetrafluoroethane
3. Bromotrifluoromethane	13B1	15. 2-Chloro-1,1,1,2-tetrafluoroethane
4. Chloropentafluoroethane	115	16. 1-Chloro-1,1-difluoroethane
5. Pentafluoroethane	125	17. Dichlorofluoromethane
6. 1,1,1-Trifluoroethane	143a	18. Trichlorofluoromethane
7. Dichlorodifluoromethane	12	19. Chloroethane
8. Chlorodifluoromethane	22	20. Dichloromethane
9. 1,1,1,2-Tetrafluoroethane	134a	21. 1,1-Dichloro-1-fluoroethane
10. Chloromethane	40	22. 2,2-Dichloro-1,1,1-trifluoroethane
11. 1,1,2,2-Tetrafluoroethane	134	23. 1,1,2-Trichloro-1,2,2-trifluoroethane
12. Bromochlorodifluoromethane	12B1	24. 1,2-Dibromo-1,1,2,2-tetrafluoroethane

\*Peak not shown



**Suggested Supplies**

- Septum:** 11 mm Advanced Green septa, 5183-4759
- Liner:** Splitless, single taper, deactivated, 4 mm id, 5181-3316
- Seal:** Gold plated seal, 18740-20885
- Syringe:** 10 µL tapered, FN 23-26s/42/HP, 5181-1267

**Nitrogen Containing Herbicides (EPA Method 507)**

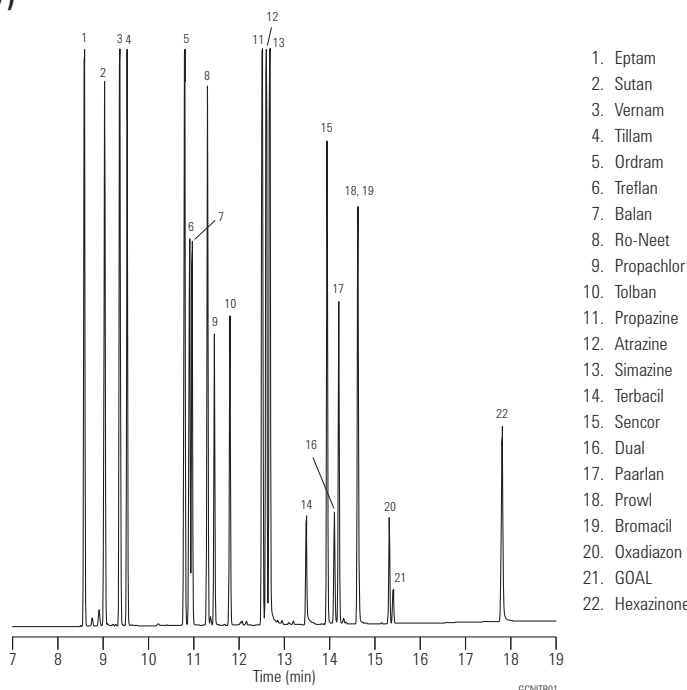
**Column:** DB-35  
125-1937  
30 m x 0.53 mm, 0.50 µm

**Carrier:** Helium at 38 cm/sec (5 mL/min),  
measured at 150 °C

**Oven:** 60 °C for 1 min  
60-290 °C at 15 °C/min  
290 °C for 5 min

**Injection:** Megabore Direct, 290 °C, 1 µL of 3 ng/µL standard

**Detector:** NPD, 290 °C



- 1. Eptam
- 2. Sutan
- 3. Vernam
- 4. Tillam
- 5. Ordram
- 6. Treflan
- 7. Balan
- 8. Ro-Neet
- 9. Propachlor
- 10. Tolban
- 11. Propazine
- 12. Atrazine
- 13. Simazine
- 14. Terbacil
- 15. Sencor
- 16. Dual
- 17. Paarlan
- 18. Prowl
- 19. Bromacil
- 20. Oxadiazon
- 21. GOAL
- 22. Hexazinone

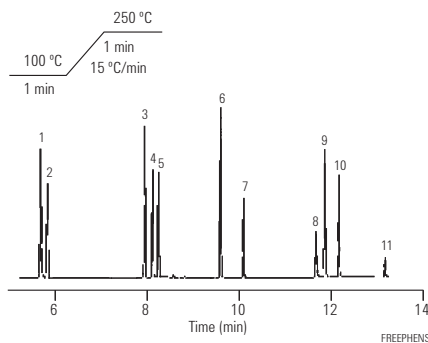
**Free Phenols**

**Column:** HP-50+  
19091L-433  
30 m x 0.25 mm, 0.25 µm

**Carrier:** Hydrogen, constant flow 45 cm/sec

**Injection:** Split 100:1

**Detector:** FID 300 °C



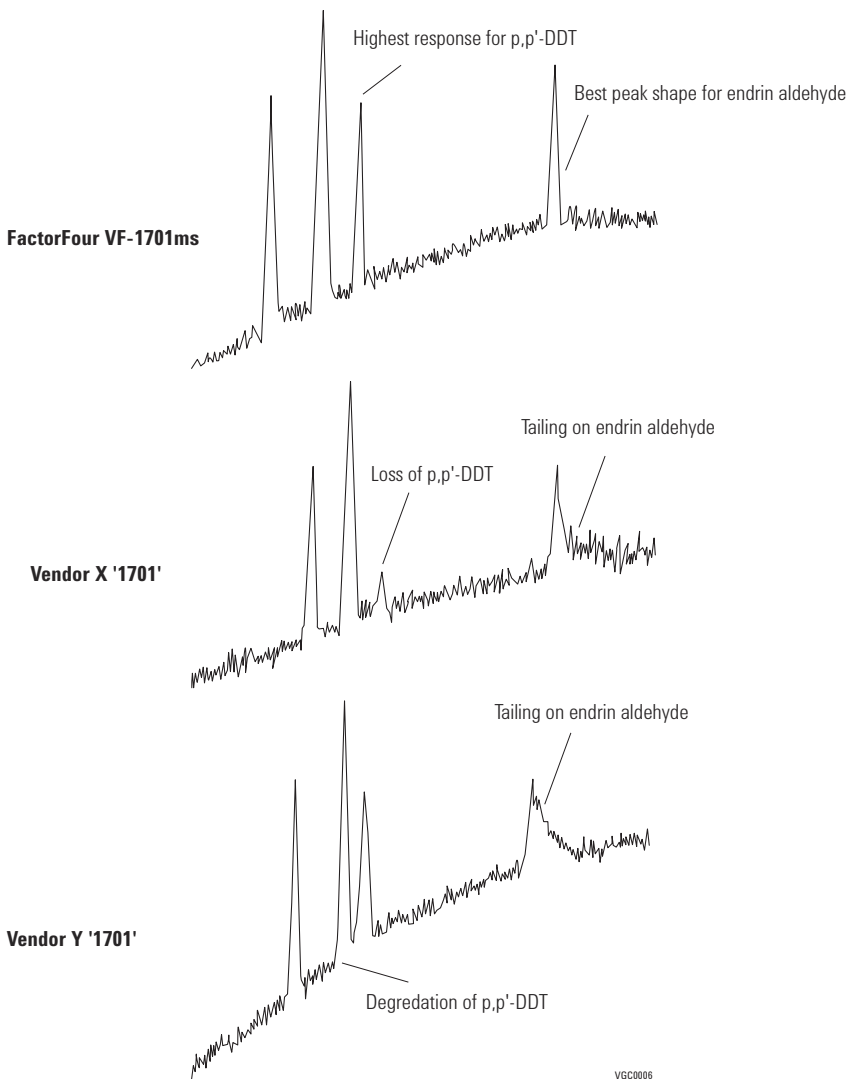
1. Phenol
2. 2-chlorophenol
3. 2,4-dimethylphenol
4. 2-nitrophenol
5. 2,4-dichlorophenol
6. 4-chloro-3-methylphenol
7. 2,4,6-trichlorophenol
8. 2,4-dinitrophenol
9. 4-nitrophenol
10. 2-methyl-4,6-dinitrophenol
11. Pentachlorophenol

**EPA 625 Halogenated Pesticides on "1701" Type Phases**

**Column:** VF-1701 Pesticides  
CP9070  
30 m x 0.25 mm, 0.25 µm

**Oven:** 150 °C, 5 °C/min to 275 °C

**Injection:** Split, T=275 °C  
ECD: T=275 °C, 2 µg



### Organochlorine Pesticides to EPA 625 via GC/MS

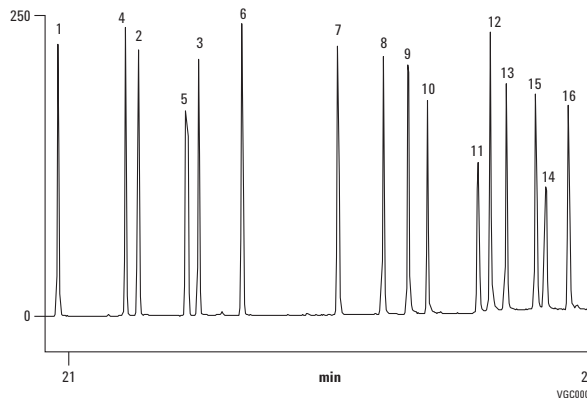
**Column:** VF-35ms  
CP8877  
30 m x 0.25 mm, 0.25 µm

**Carrier:** Helium, approx. 1.0 mL/min, 60 kPa

**Oven:** 45 °C + 10 °C/min to 325 °C

**Injection:** Split/splitless, in split mode, 1:100

**Detector:** Ion Trap MS



1. α-BHC
2. β-BHC
3. δ-BHC
4. γ-BHC (lindane)
5. Heptachlor
6. Aldrin
7. Heptachlorepoixide
8. Endosulfan I
9. 4,4'-DDE
10. Dieldrin
11. Endrin
12. 4,4'-DDD
13. Endosulfan II
14. Endrin aldehyde
15. 4,4'-DDT
16. Endosulfan sulfate

### Organochlorine Pesticides I EPA Method 8081A

**Column:** DB-35ms  
122-3832  
30 m x 0.25 mm, 0.25 µm

**Carrier:** Helium at 35 cm/sec, measured at 50 °C

**Oven:** 50 °C for 1 min  
50-100 °C at 25 °C/min  
100-300 °C at 5 °C/min  
300 °C for 5 min

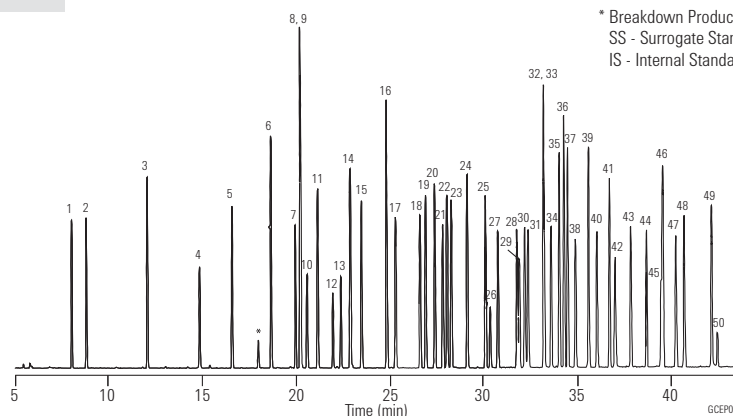
**Injection:** Splitless, 250 °C  
30 sec purge activation time

**Detector:** MSD, 300 °C transfer line  
Full scan at m/z 50-500

**Sample:** 1 µL of 35 µg/mL composite 8081A standards, AccuStandard Inc.

- |  |                             |
|--|-----------------------------|
| 1. 1,2-Dibromo-3-chloropropane           | 26. Kelthane                |
| 2. 4-Chloro-3-nitrobenzotrifluoride (SS) | 27. Heptachlor epoxide      |
| 3. Hexachloropentadiene                  | 28. γ-Chlordane             |
| 4. 1-Bromo-2-nitrobenzene (IS)           | 29. trans-Nonachlor         |
| 5. Terrazole                             | 30. α-Chlordane             |
| 6. Chloroneb                             | 31. Endosulfan I            |
| 7. Trifluralin                           | 32. Captan                  |
| 8. 2-Bromobiphenyl (SS)                  | 33. p,p'-DDE                |
| 9. Tetrachloro m-xylene (SS)             | 34. Dieldrin                |
| 10. α, α-Dibromo-m-xylene                | 35. Chlorobenzilate         |
| 11. Propachlor                           | 36. Perthane                |
| 12. Di-allate A                          | 37. Chloropropylate         |
| 13. Di-allate B                          | 38. Endrin                  |
| 14. Hexachlorobenzene                    | 39. p,p'-DDD                |
| 15. α-BHC                                | 40. Endosulfan II           |
| 16. Pentachloronitrobenzene (IS)         | 41. p,p'-DDT                |
| 17. γ-BHC                                | 42. Endrin aldehyde         |
| 18. β-BHC                                | 43. Endosulfan sulfate      |
| 19. Heptachlor                           | 44. Dibutylchlorendate (SS) |
| 20. Alachlor                             | 45. Captafol                |
| 21. δ-BHC                                | 46. Methoxychlor            |
| 22. Chlorothalonil                       | 47. Endrin ketone           |
| 23. Aldrin                               | 48. Mirex                   |
| 24. Dacthal                              | 49. cis-Permethrin          |
| 25. Isodrin                              | 50. trans-Permethrin        |

\* Breakdown Products  
SS - Surrogate Standard  
IS - Internal Standard



Standards used were a composite of individual solutions supplied courtesy of AccuStandard Inc., 25 Science Park, New Haven, CT 06511, 800-442-5290.

#### Suggested Supplies

**Septum:** 11 mm Advanced Green septa, 5183-4759

**Liner:** Splitless, single taper, deactivated, 4 mm id, 5181-3316

**Syringe:** 10 µL tapered, FN 23-26s/42/HP, 5181-1267

### Organochlorine Pesticides II EPA Method 8081A

**Column:** DB-5ms  
122-5532  
30 m x 0.25 mm, 0.25 µm

**Carrier:** Helium at 35 cm/sec, measured at 50 °C

**Oven:** 50 °C for 1 min  
50-100 °C at 25 °C/min  
100-300 °C at 5 °C/min  
300 °C for 5 min

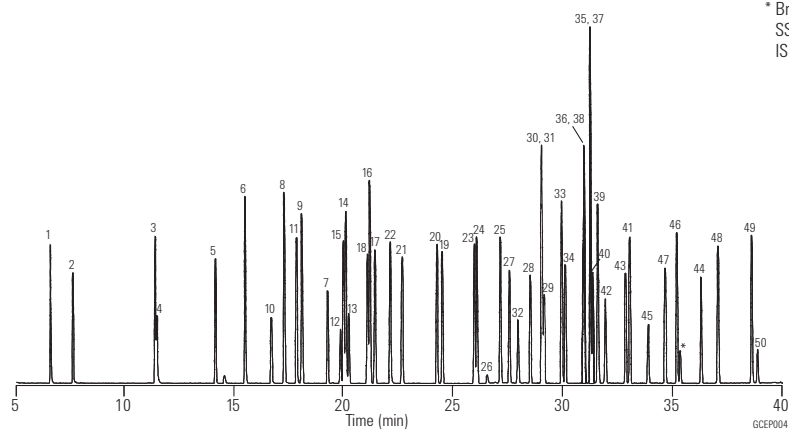
**Injection:** Splitless, 250 °C  
30 sec purge activation time

**Detector:** MSD, 300 °C transfer line  
Full scan at m/z 50-500

**Sample:** 1 µL of 35 µg/mL composite 8081A standards, AccuStandard Inc.

- |  |                             |
|--|-----------------------------|
| 1. 1,2-Dibromo-3-chloropropane           | 26. Kelthane                |
| 2. 4-Chloro-3-nitrobenzotrifluoride (SS) | 27. Heptachlor epoxide      |
| 3. Hexachloropentadiene                  | 28. γ-Chlordane             |
| 4. 1-Bromo-2-nitrobenzene (IS)           | 29. trans-Nonachlor         |
| 5. Terrazole                             | 30. α-Chlordane             |
| 6. Chloroneb                             | 31. Endosulfan I            |
| 7. Trifluralin                           | 32. Captan                  |
| 8. 2-Bromobiphenyl (SS)                  | 33. p,p'-DDE                |
| 9. Tetrachloro m-xylene (SS)             | 34. Dieldrin                |
| 10. α, α-Dibromo-m-xylene                | 35. Chlorobenzilate         |
| 11. Propachlor                           | 36. Perthane                |
| 12. Di-allate A                          | 37. Chloropropylate         |
| 13. Di-allate B                          | 38. Endrin                  |
| 14. Hexachlorobenzene                    | 39. p,p'-DDD                |
| 15. α-BHC                                | 40. Endosulfan II           |
| 16. Pentachloronitrobenzene (IS)         | 41. p,p'-DDT                |
| 17. γ-BHC                                | 42. Endrin aldehyde         |
| 18. β-BHC                                | 43. Endosulfan sulfate      |
| 19. Heptachlor                           | 44. Dibutylchlorendate (SS) |
| 20. Alachlor                             | 45. Captafol                |
| 21. δ-BHC                                | 46. Methoxychlor            |
| 22. Chlorothalonil                       | 47. Endrin ketone           |
| 23. Aldrin                               | 48. Mirex                   |
| 24. Dacthal                              | 49. cis-Permethrin          |
| 25. Isodrin                              | 50. trans-Permethrin        |

Standards used were a composite of individual solutions supplied courtesy of AccuStandard Inc., 25 Science Park, New Haven, CT 06511, 800-442-5290.



\* Breakdown Products  
SS - Surrogate Standard  
IS - Internal Standard

## Environmental Applications, Semivolatiles

## Agilent's Ultra Inert Test Probe Mixture

**Column:** DB-5ms Ultra Inert  
122-5532UI  
30 m x 0.25 mm, 0.25 µm

**Carrier:** Hydrogen, constant pressure, 38 cm/s

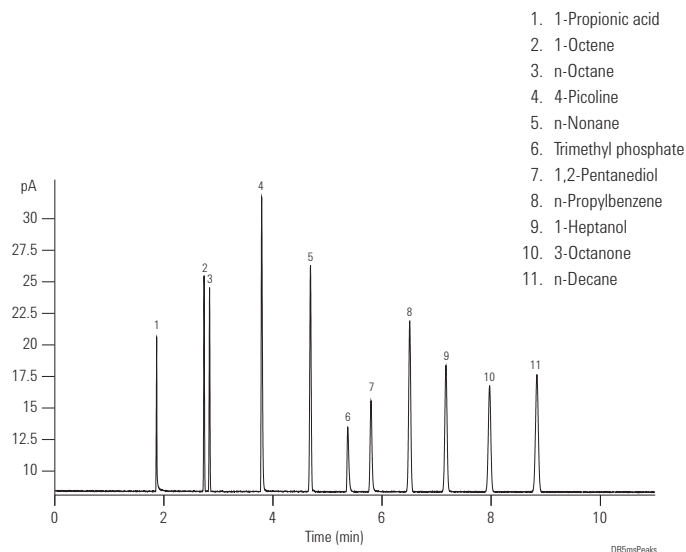
**Oven:** 65 °C isothermal

**Sampler:** Agilent 7683B, 0.5 µL syringe  
(P/N 5188-5246), 0.02 µL split injection

**Injection:** Split/splitless; 250 °C, 1.4 mL/min; split column flow  
900 mL/min; gas saver flow 75 mL/min at 2.0 min

**Detector:** FID at 325 °C; 450 mL/min air, 40 mL/min hydrogen,  
45 mL/min nitrogen makeup

A properly deactivated DB-5ms Ultra Inert column delivers symmetrical peak shapes, along with increased peak heights, which allow for accurate integration and detection of trace analytes.



## Trace Level Polycyclic Aromatic Hydrocarbon (PAH) Analyses

**Column:** DB-5ms Ultra Inert  
122-5532UI  
30 m x 0.25 mm, 0.25 µm

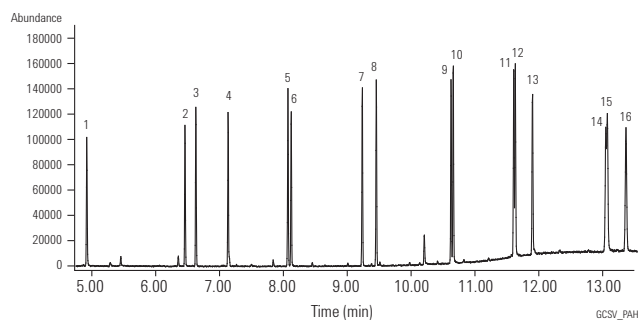
**Carrier:** Helium constant flow 30 cm/s

**Oven:** 40 °C (1 min) to 100 °C (15 °C/min)  
10 °C to 210 °C (1 min)  
5 °C/min. to 310 °C (8 min)

**Injection:** Split/splitless; 260 °C, 53.7 mL/min. total flow,  
purge flow 50 mL/min. on at 0.5 min.,  
gas saver flow 80 mL/min. on at 3.0 min.

**Detector:** MSD source at 300 °C  
Quadrapole at 180 °C  
Transfer line at 290 °C  
Scan range 50-550 AMU

- |                   |                            |
|-------------------|----------------------------|
| 1. Naphthalene    | 9. Benz[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[g,h,i]perylene   |



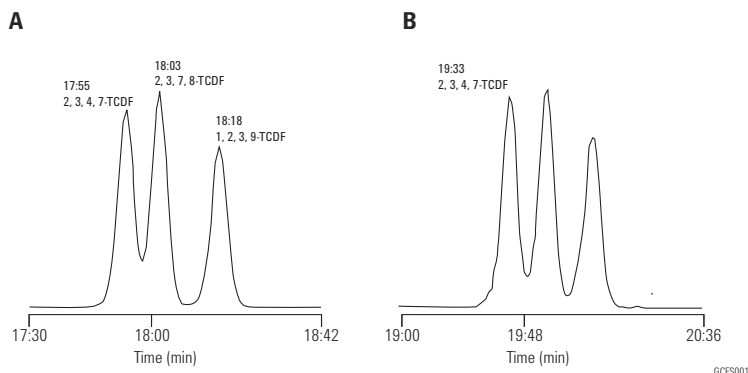


### Tetrachlorodibenzo-p-furans

**Column A:** DB-225  
122-2232  
30 m x 0.25 mm, 0.25 µm

**Column B:** DB-225ms  
122-2932  
30 m x 0.25 mm, 0.25 µm

Carrier: Helium at 12 mL/min  
Oven: 160-250 °C at 7 °C/min  
250 °C until compounds elute  
Injection: Splitless, 240 °C  
Detector: VG Autospec Ultima



Note the separation between 2,3,7,8-TCDF and 2,3,4,7-TCDF on DB-225 is also easily achievable (and actually a little better!) on DB-225ms.

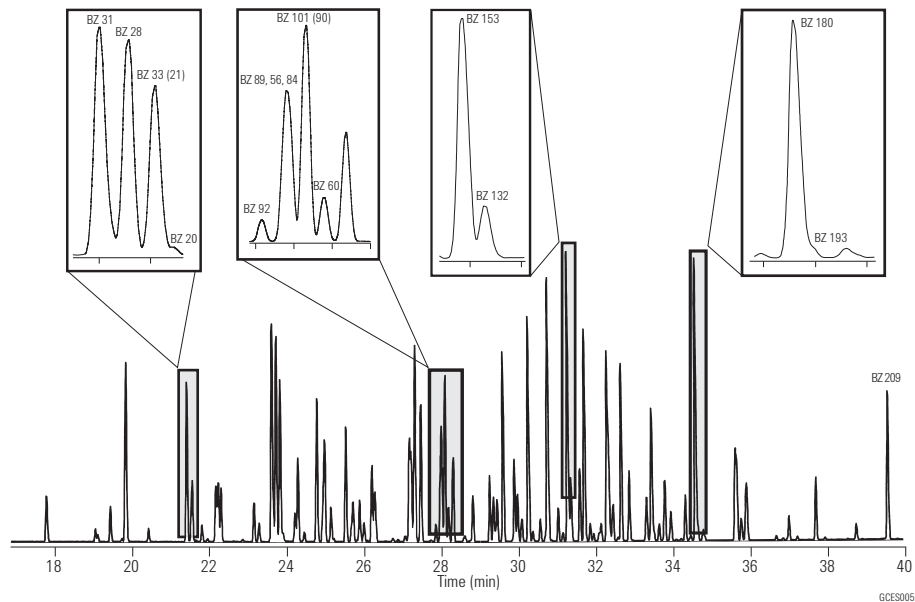
### Congeners in DIN Method PCBs

**Column:** DB-XLB  
122-1236  
30 m x 0.25 mm, 0.50 µm

Carrier: Helium at 34.2 cm/sec,  
measured at 150 °C  
Oven: 100 °C for 1 min  
100-320 °C at 5.6 °C/min  
Injection: Hot on-column, 250 °C  
Split flow 100 mL/min  
Detector: MSD, 300 °C transfer line  
SIM of 221.9, 255.9,  
291.9, 325.8, 359.8,  
395.8, 429.7, 463.7  
Sample: 2 µL dilute Aroclor mixture

#### Suggested Supplies

**Septum:** 11 mm Advanced Green septa, 5183-4759  
**Liner:** Direct connect, single taper, deactivated, 4 mm id, G1544-80730  
**Syringe:** 10 µL tapered, FN 23-26s/42/HP, 5181-1267



**Extended Temperature Program  
Resolving Congeners 52 and 138**

**Column:** DB-XLB  
122-1236  
30 m x 0.25 mm, 0.50 µm

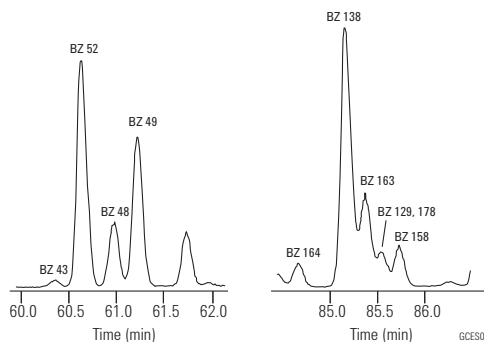
Carrier: Helium at 34.2 cm/sec, measured at 150 °C

Oven: 100 °C for 1 min  
100-275 °C at 1.6 °C/min

Injection: Hot on-column, 250 °C  
Split flow 100 mL/min

Detector: MSD, 300 °C transfer line  
SIM of 221.9, 255.9, 291.9, 325.8, 359.8, 395.8,  
429.7, 463.7

Sample: 2 µL dilute Aroclor mixture



**PCBs by EPA Method 8082**

**Column:** DB-35ms  
123-3832  
30 m x 0.32 mm, 0.25 µm

**Column:** DB-XLB  
123-1236  
30 m x 0.32 mm, 0.50 µm

Carrier: Helium at 45 cm/sec (EPC in constant flow mode)

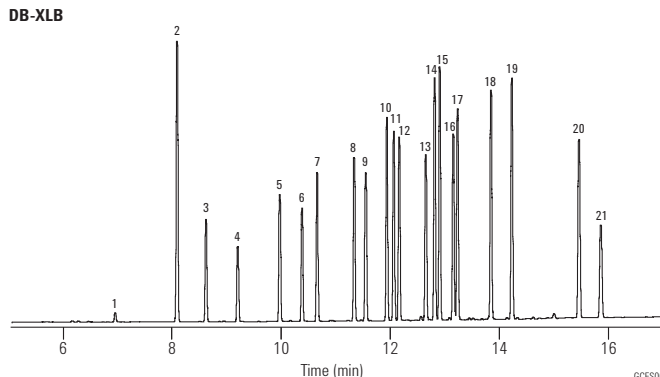
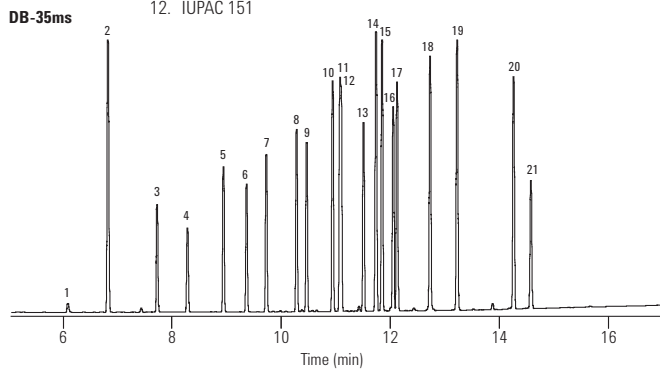
Oven: 110 °C for 0.5 min  
110-320 °C at 15 °C/min  
320 °C for 5 min

Injection: Splitless, 250 °C  
30 sec purge activation time

Detector: µECD, 350 °C  
Nitrogen makeup gas  
(column + makeup flow = 30 mL/min constant flow)

Sample: 50 µg per component

- |                                 |  |
|---------------------------------|--|
| 1. IUPAC 1                      | 13. IUPAC 153                                    |
| 2. Tetrachloro-m-xylene (IS/SS) | 14. IUPAC 141                                    |
| 3. IUPAC 5                      | 15. IUPAC 137                                    |
| 4. IUPAC 18                     | 16. IUPAC 187                                    |
| 5. IUPAC 31                     | 17. IUPAC 183                                    |
| 6. IUPAC 52                     | 18. IUPAC 180                                    |
| 7. IUPAC 44                     | 19. IUPAC 170                                    |
| 8. IUPAC 66                     | 20. IUPAC 206                                    |
| 9. IUPAC 101                    | 21. Decachlorobiphenyl (IS/SS)                   |
| 10. IUPAC 87                    | IS/SS - Internal Standard/<br>Surrogate Standard |
| 11. IUPAC 110                   |  |
| 12. IUPAC 151                   |  |



**Suggested Supplies**

- Septum:** 11 mm Advanced Green septa, 5183-4759  
**Liner:** Splitless, single taper, deactivated, 4 mm id, 5181-3316  
**Syringe:** 10 µL tapered, FN 23-26s/42/HP, 5181-1267

### Pyrethrins

**Column:** DB-1  
123-1032  
30 m x 0.32 mm, 0.25 µm

**Carrier:** Helium at 39 cm/sec, measured at 150 °C

**Oven:** 180 °C for 11 min  
180-200 °C at 10 °C/min  
200 °C for 8 min  
200-210 °C at 10 °C/min  
210 °C for 18 min  
210-245 °C at 30 °C/min  
245 °C for 4 min

**Injection:** Split, 250 °C  
Split ratio 1:20

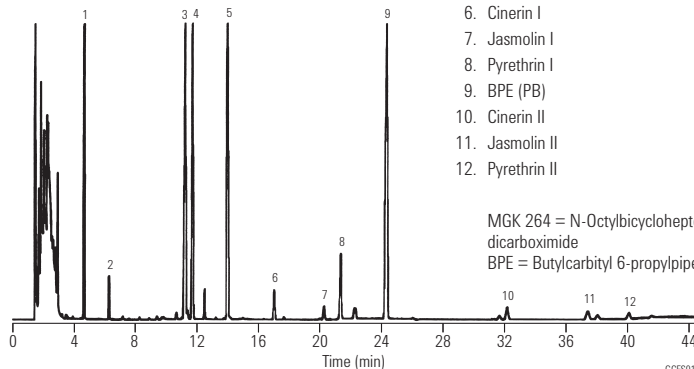
**Detector:** FID, 300 °C  
Helium makeup gas at 30 mL/min

**Sample:** 1 µL

1. Heptadecane
2. Octadecane
3. Endo-MGK 264
4. Exo-MGK 264
5. Methoprene
6. Cinerin I
7. Jasmolin I
8. Pyrethrin I
9. BPE (PB)
10. Cinerin II
11. Jasmolin II
12. Pyrethrin II

MGK 264 = N-Octylbicycloheptene dicarboximide  
BPE = Butylcarbityl 6-propylpiperonyl ether

Chromatogram courtesy of Khan Nguyen and Richard Moorman of Sandoz Agro Inc.



### Organotin Compounds I

**Column:** HP-1  
19091Z-012  
25 m x 0.32 mm, 0.17 µm

**Carrier:** Helium, 100 kPa

**Injection:** Splitless

**Oven:** 50 °C for 1 min  
50-260 °C at 15 °C/min

**Detector:** AED, 330 °C

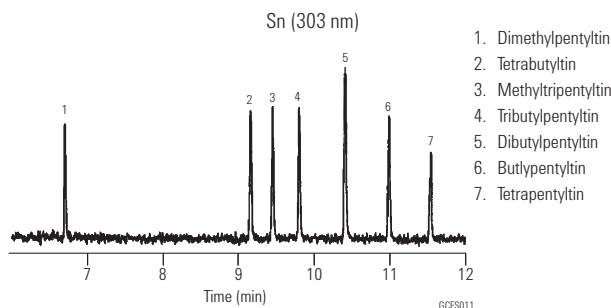
**Sample:** 1 µL

#### Suggested Supplies

**Septum:** 11 mm Advanced Green septa, 5183-4759

**Liner:** Direct connect, single taper, deactivated, 4 mm id, G1544-80730

**Syringe:** 10 µL tapered, FN 23-26s/42/HP, 5181-1267



### Organotin Compounds II

**Column:** HP-5  
19091J-002  
25 m x 0.20 mm, 0.11 µm

**Carrier:** Helium, 0.75 mL/min constant flow

**Detector:** AED, 300 °C  
Hg selective at 254 nm

**Oven:** 60-360 °C at 5 °C/min

**Sample:** 1 µL

**Injection:** Splitless, 300 °C

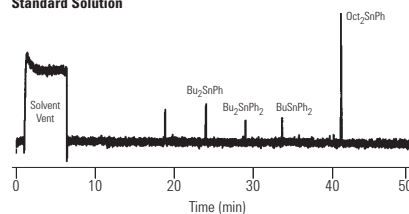
#### Suggested Supplies

**Septum:** 11 mm Advanced Green septa, 5183-4759

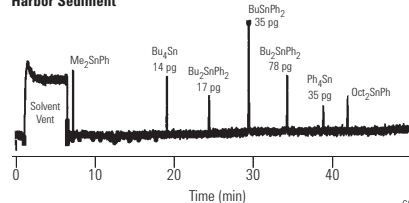
**Liner:** Direct connect, single taper, deactivated, 4 mm id, G1544-80730

**Syringe:** 10 µL tapered, FN 23-26s/42/HP, 5181-1267

#### Standard Solution



#### Harbor Sediment



## Semivolatile Compounds, US EPA Method 8270

**Column:** HP-5ms  
19091S-133  
30 m x 0.25 mm, 0.50 µm

**Carrier:** Ramped flow 1.2 mL/min for 0.0 min  
Ramp at 99 mL/min to 2.0 mL/min  
2.0 mL/min for 0.35 min  
Ramp at 10 mL/min to 1.2 mL/min

**Oven:** 40 °C for 1.0 min  
40-100 °C at 15 °C/min  
100-240 °C at 20 °C/min  
240-310 °C at 10 °C/min

**Injection:** Splitless, 250 °C  
30 mL/min purge flow at 0.35 min

**Detector:** 5973 MSD, 310 °C transfer line  
Scan range 35-500 amu, 3.25 scans/sec

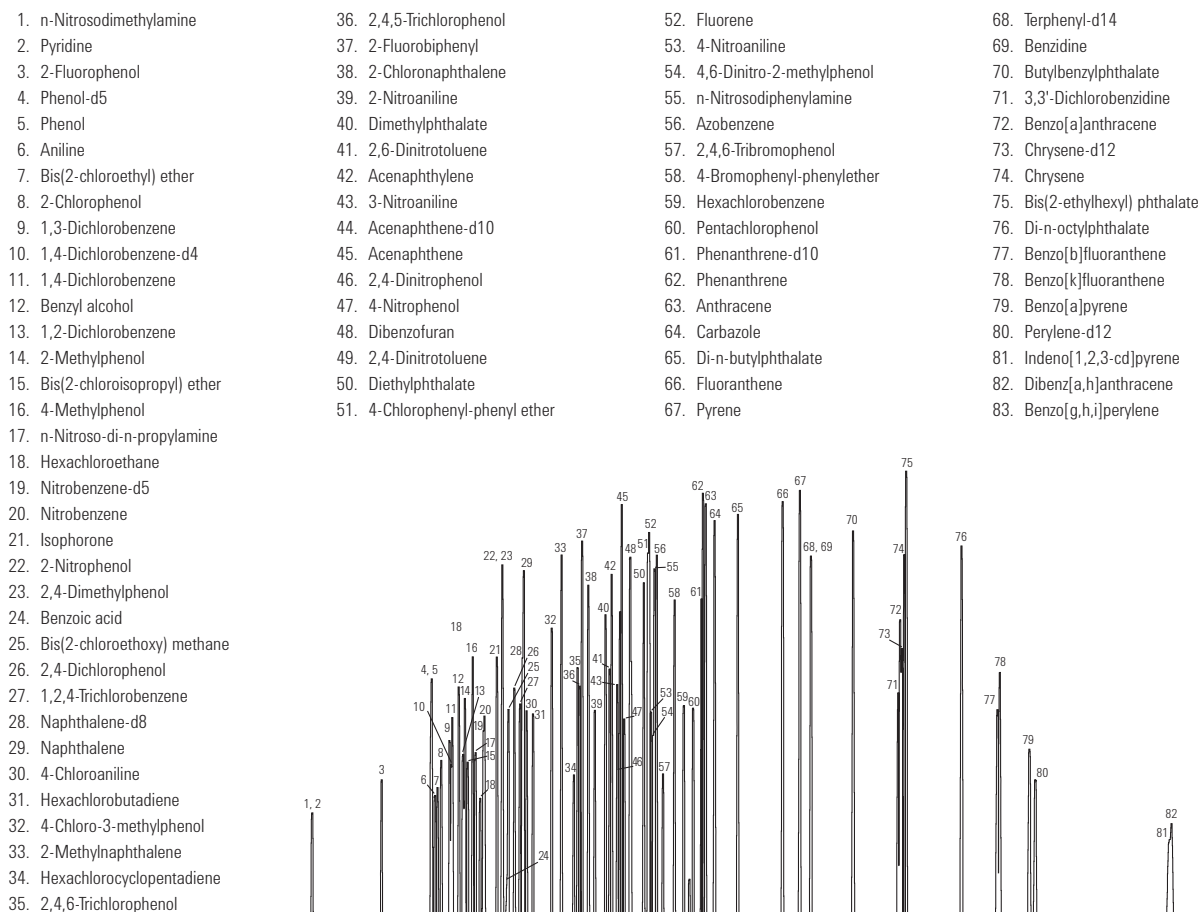
**Sample:** 1 µL of 50 ng standard

## Suggested Supplies

**Septum:** 11 mm Advanced Green septa, 5183-4759

**Liner:** Splitless, single taper, deactivated, 4 mm id, 5181-3316

**Syringe:** 10 µL tapered, FN 23-26s/42/HP, 5181-1267



GCES015

A variety of Agilent HP-5ms and DB-5ms columns can be used for 8270 and similar semivolatiles applications. The column shown above was chosen to maximize inertness and robustness to residues with a thicker 0.5 µm film, but the price paid is a slightly longer run time.

An HP-5ms, 30 m x 0.25 mm id, 0.25 µm, P/N 19091S-433 would give shorter run times, with slightly less inertness and robustness.

A DB-5ms, 30 m x 0.25 mm id, 0.25 µm, P/N 122-5532, would give slightly less inertness, but offer better resolution of PAHs such as Benzo[b]fluoranthene and Benzo[k]fluoranthene. A DB-5ms, 20 m x 0.18 mm x 0.18 µm, P/N 121-5522, can offer significantly reduced run times with a modest loss of inertness.

**EPA Method 8061 (Phthalate Esters)**

**Column:** DB-5ms  
121-5522  
20 m x 0.18 mm, 0.18 µm

**Carrier:** Helium at 49 cm/sec, measured at 80 °C  
constant flow program

**Oven:** 80 °C for 0.5 min  
80-160 °C at 30 °C/min  
160-320 °C at 15 °C/min

**Injection:** Splitless, 300 °C  
30 sec purge activation time

**Detector:** MSD, 325 °C transfer line  
Full scan m/z 50-400

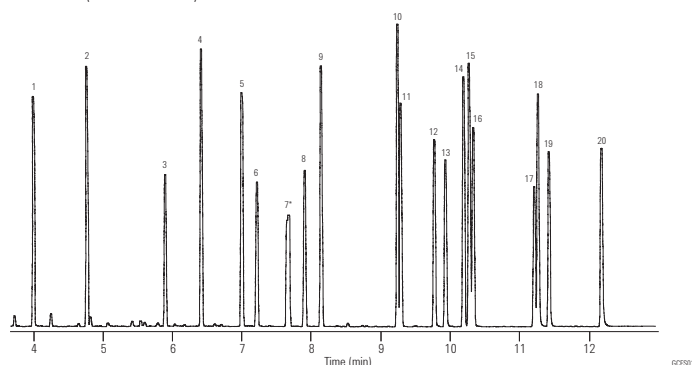
**Sample:** 1 µL of 20 ng/µL  
Method 8061 mixture (Accustandard) in hexane

**Suggested Supplies**

**Septum:** 11 mm Advanced Green septa, 5183-4759  
**Liner:** Splitless, single taper, deactivated, 4 mm id, 5181-3316  
**Syringe:** 10 µL tapered, FN 23-26s/42/HP, 5181-1267

- |                                       |                                    |
|---------------------------------------|------------------------------------|
| 1. Dimethyl phthalate                 | 11. Butyl benzyl phthalate         |
| 2. Diethyl phthalate                  | 12. Hexyl 2-ethylhexyl phthalate   |
| 3. Benzyl benzoate (IS)               | 13. Bis(2-n-butoxyethyl) phthalate |
| 4. Diisobutyl phthalate               | 14. Dicyclohexyl phthalate         |
| 5. Di-n-butyl phthalate               | 15. Bis(2-ethylhexyl) phthalate    |
| 6. Bis(4-methoxyethyl) phthalate      | 16. Diphenyl phthalate (SS)        |
| 7. Bis(4-methyl-2-pentyl) phthalate * | 17. Diphenyl isophthalate (SS)     |
| 8. Bis(2-ethoxyethyl) phthalate       | 18. Di-n-octyl phthalate           |
| 9. Diamyl phthalate                   | 19. Dibenzyl phthalate (SS)        |
| 10. Dihexyl phthalate                 | 20. Dinonyl phthalate              |

\* Two isomers  
IS - Internal Standard  
SS - Surrogate Standard

**US EPA Method 8270 Short Mix**

**Column:** DB-5ms Ultra Inert  
122-5532UI  
30 m x 0.25 mm, 0.25 µm

**Carrier:** Helium constant flow 30 cm/s

**Oven:** 40 °C (1 min) to 100 °C (15 °C/min),  
10 °C to 210 °C (1 min),  
5 °C/min to 310 °C (8 min)

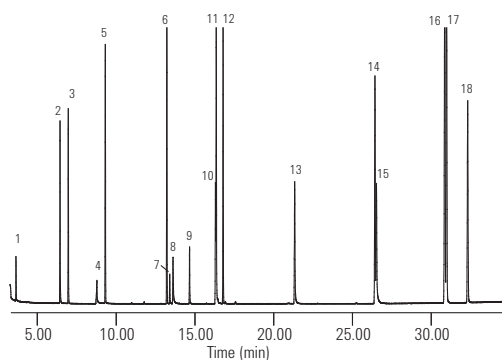
**Injection:** Split/splitless; 260 °C, 53.7 mL/min  
total flow, purge flow 50 mL/min on  
at 0.5 min, gas saver flow 80 mL/min  
on at 3.0 min

**Detector:** MSD source at 300 °C, quadrupole  
at 180 °C, transfer line at 290 °C,  
full scan m/z 50-550

**Sample:** 1.0 µL splitless injection,  
5 ng each component on-column

**Suggested Supplies**

**Liner:** Direct connect, dual taper, deactivated, 4 mm id, G1544-80700  
**Syringe:** Autosampler syringe, 0.5 µL, 23g, cone, 5188-5246



1. N-nitrosodimethylamine
2. Aniline
3. 1,4 dichlorobenzene-D4
4. 1,4 dichlorobenzene
5. Naphthalene-D8
6. Acenaphthene-D10
7. 2,4-dinitrophenol
8. 4-nitrophenol
9. 2-methyl-4,6-dinitrophenol
10. Pentachlorophenol
11. 4-aminobiphenyl
12. Phenanthrene- D10
13. Benzidine
14. Chrysene-D12
15. 3,3'-dichlorobenzidine
16. Benzo [b] fluoranthene
17. Benzo [k] fluoranthene
18. Perylene-D12

Semivolatile analysis using methods similar to US EPA Method 8270 is becoming increasingly important in environmental laboratories worldwide. Acidic compounds such as benzoic acid or 2,4-dinitrophenol – along with strong bases such as pyridine or benzidine – are examples of active species found in the semivolatile sample set. This DB-5ms Ultra Inert column demonstrates excellent inertness performance for these difficult analytes.

**Phenols**

**Column:** DB-5ms  
122-5532  
30 m x 0.25 mm, 0.25 µm

**Column:** DB-XLB  
122-1232  
30 m x 0.25 mm, 0.25 µm

**Carrier:** He at 1.2 mL/min Constant Flow

**Oven:** 40 °C for 2.00 min  
40-100 °C at 40 °C/min  
100 °C for 0.50 min  
100-140 °C at 2 °C/min  
140-340 °C at 30 °C/min

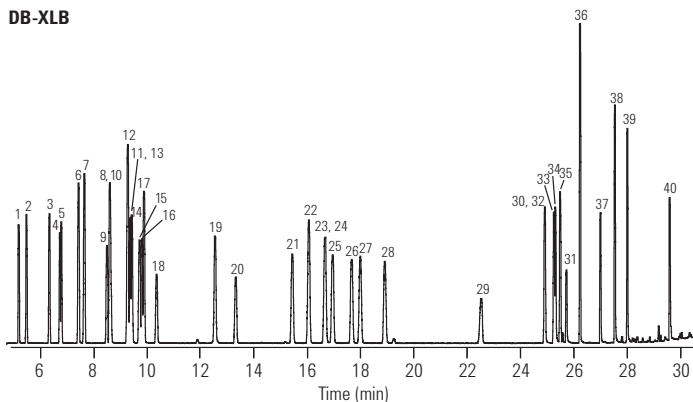
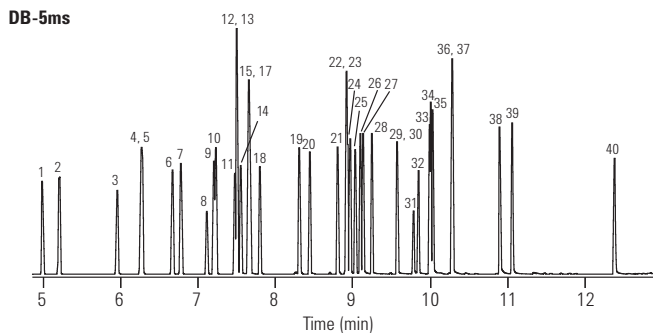
**Injection:** Pulsed Splitless, 200 °C  
Pulse Pressure & Time: 25.0 psi for 1.00 min  
Purge Flow & Time: 50.0 mL/min for 0.25 min  
Gas Saver Flow & Time: 20.0 mL/min for 3.00 min

**Detector:** MSD, 320 °C Transfer Line  
Quadrapole at 150 °C  
Source at 230 °C

**Suggested Supplies**

**Septum:** 11 mm Advanced Green septa, 5183-4759  
**Liner:** Direct connect, single taper, deactivated, 4 mm id, G1544-80730  
**Syringe:** 10 µL tapered, FN 23-26s/42/HP, 5181-1267

1. Phenol
2. 2-Chlorophenol
3. 2-Methylphenol
4. 4-Methylphenol
5. 3-Methylphenol
6. 2-Chloro-5-methylphenol
7. 2,6-Dimethylphenol
8. 2-Nitrophenol
9. 2,4-Dimethylphenol
10. 2,5-Dimethylphenol
11. 2,4-Dichlorophenol
12. 2,3-Dimethylphenol
13. 2,5-Dichlorophenol
14. 2,3-Dichlorophenol
15. 2-Chlorophenol
16. 4-Chlorophenol
17. 3,4-Dimethylphenol
18. 2,6-Dichlorophenol
19. 4-Chloro-2-methylphenol
20. 4-Chloro-3-methylphenol
21. 2,3,5-Trichlorophenol
22. 2,4-Dibromophenol
23. 2,4,6-Trichlorophenol
24. 2,4,5-Trichlorophenol
25. 2,3,4-Trichlorophenol
26. 3,5-Dichlorophenol
27. 2,3,6-Trichlorophenol
28. 3,4-Dichlorophenol
29. 3-Nitrophenol
30. 2,5-Dinitrophenol
31. 2,4-Dinitrophenol
32. 4-Nitrophenol
33. 2,3,5,6-Tetrachlorophenol
34. 2,3,4,5-Tetrachlorophenol
35. 2,3,4,6-Tetrachlorophenol
36. 3,4,5-Trichlorophenol
37. 2-Methyl-4,6-dinitrophenol
38. Pentachlorophenol
39. Dinoseb
40. 2-Cyclohexyl-4,6-dinitrophenol



GCE5019

**PAHs**

**Column:** DB-17ms  
122-4732  
30 m x 0.25 mm, 0.25 µm

**Carrier:** Helium at: 34.1 cm/sec, measured at 150 °C

**Oven:** 95 °C for 0.5 min  
95-340 °C at 5 °C/min  
340 °C for 5 min

**Injection:** Split, 300 °C  
Split ratio 1:40

**Detector:** MSD, 340 °C transfer line  
Scan 80-330 amu

**Sample:** 2 µL, PAH standard

**Suggested Supplies**

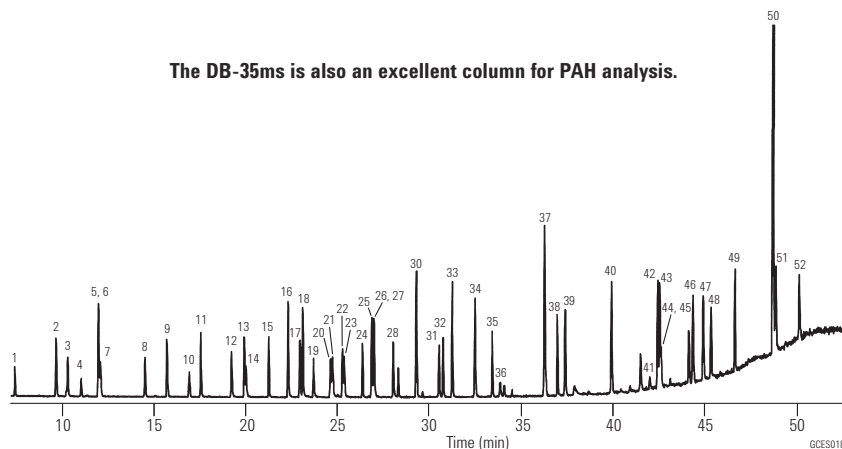
**Septum:** 11 mm Advanced Green septa, 5183-4759

**Liner:** Direct connect, single taper, deactivated, 4 mm id, G1544-80730

**Syringe:** 10 µL tapered, FN 23-26s/42/HP, 5181-1267

	Ions		Ions
1. Naphthalene	128	27. 3,6-Dimethylphenanthrene	206, 191
2. 2-Methylnaphthalene	142, 141	28. 1,3-Dinitronaphthalene	126, 218
3. 1-Methylnaphthalene	142, 141	29. 1,5-Dinitronaphthalene	218, 114
4. Azulene	128	30. Fluoranthene	202
5. Acenaphthene	154	31. 2,2'-Dinitrobiphenyl	198, 139
6. Biphenyl	154	32. Pyrene	202
7. 2,6-Dimethylnaphthalene	156, 155	33. 2-Methylfluoranthene	216, 215
8. Acenaphthalene	152	34. 2,3-Benzofluorene	216, 215
9. Dibenzofuran	168, 139	35. Dodecahydrotriphenylene	240, 198
10. Dibenzo-p-dioxin	184	36. 1-Amino-4-nitronaphthalene	188, 115
11. Fluorene	166, 165	37. 9-Phenylanthracene	254, 253
12. 1-Nitronaphthalene	127, 173	38. 1,2-Benzanthracene	228
13. 9,10-Dihydroanthracene	179, 180	39. Chrysene	240
14. 2-Nitronaphthalene	127, 173	40. Benz[a]anthracene-7,12-dione	258, 202
15. 2-Nitrobiphenyl	152, 115	41. 2,7-Dinitrofluorene	256, 163
16. Dibenzothiophene	184	42. Benzo[b]fluoroanthene	252
17. Phenanthrene	178	43. Benzo[k]fluoroanthene	252
18. Anthracene	178	44. 7,12-Dimethylbenz[a]anthracene	256, 241
19. 3-Nitrobiphenyl	199, 152	45. Benzo[e]pyrene	252
20. 4-Nitrobiphenyl	199, 152	46. Benzo[a]pyrene	252
21. 5,6-Benzoquinoline	179	47. Perylene	252
22. Carbazole	167	48. 3-Methylcholanthrene	268
23. 2-Methylanthracene	192, 191	49. 9,10-Diphenylanthracene	330
24. 1,2,3,4-Tetrahydrofluoranthene	178, 206	50. 1,2,3,4-Dibenzanthracene	278
25. 2-Phenylnaphthalene	204	51. 1,2,5,6-Dibenzanthracene	278
26. 9-Methylanthracene	192, 191	52. Benzo[g,h,i]perylene	276

The DB-35ms is also an excellent column for PAH analysis.



### High Resolution Phenol Analysis by GC/MS

**Column:** VF-5ms, CP8944, 30 m x 0.25 mm, 0.25  $\mu$ m

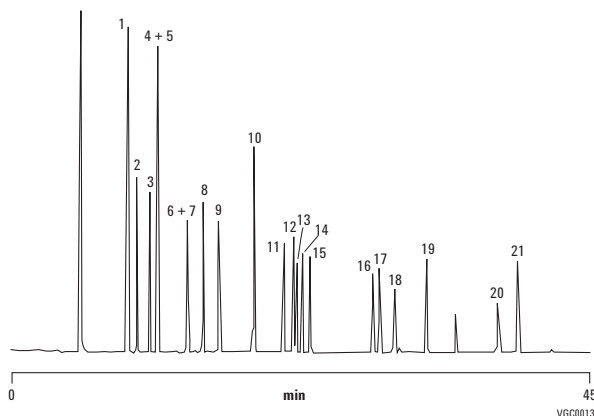
Sample Conc: Approx. 5-10 ng per component on-column

Carrier: Helium, 70 kPa

Injection: Split, 1:200, T=275 °C

Detector: Ion Trap MS

1. Phenol
2. 2-Chlorophenol
3. o-Cresol
4. m-Cresol
5. p-Cresol
6. 2-Nitrophenol
7. 2,4-Dimethylphenol
8. 2,4-Dichlorophenol
9. 2,6-Dichlorophenol
10. 4-Chloro-3-methylphenol
11. 2,3,5-Trichlorophenol
12. 2,4,6-Trichlorophenol
13. 2,4,5-Trichlorophenol
14. 2,3,4-Trichlorophenol
15. 2,3,6-Trichlorophenol
16. 4-Nitrophenol
17. 2,4-Dinitrophenol
18. 2,3,5,6 Tetrachlorophenol
19. 2-Methyl-4,6-dinitrophenol
20. Pentachlorophenol
21. 2-Se-butyl-4,6-dinitrophenol



### Phenols According to EPA Method 8040

**Column:** CP-Sil 8 CB  
CP7454  
50 m x 0.32 mm, 0.25  $\mu$ m

Sample Conc: 1 ppm

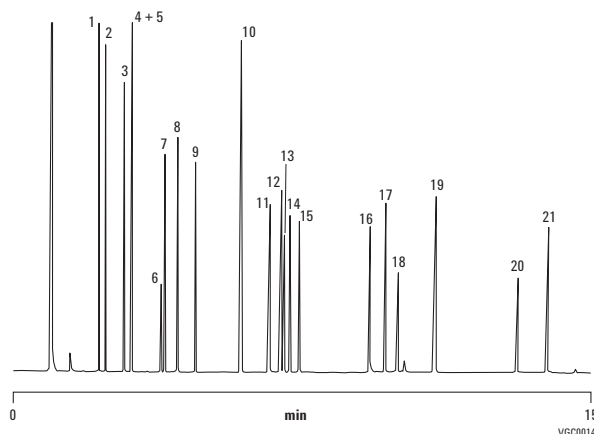
Oven: 80 °C to 200 °C, 8 °C/min

Carrier: H<sub>2</sub>, 150 kPa (1.5 bar, 21 psi)

Injection: Split, 100 mL/min

Detector: FID

1. Phenol
2. 2-Chlorophenol
3. o-Cresol
4. m-Cresol
5. p-Cresol
6. 2-Nitrophenol
7. 2,4-Dimethylphenol
8. 2,4-Dichlorophenol
9. 2,6-Dichlorophenol
10. 4-Chloro-3-methylphenol
11. 2,3,5-Trichlorophenol
12. 2,4,6-Trichlorophenol
13. 2,4,5-Trichlorophenol
14. 2,3,4-Trichlorophenol
15. 2,3,6-Trichlorophenol
16. 4-Nitrophenol
17. 2,4-Dinitrophenol
18. 2,3,5,6-Tetrachlorophenol
19. 2-Methyl-4,6-dinitrophenol
20. Pentachlorophenol
21. 2-Sec-butyl-4,-dinitrophenol (Dinoseb)





**EPA Method 552.2**

**Column:** DB-35ms  
123-3832  
30 m x 0.32 mm, 0.25 µm

**Column:** DB-XLB  
123-1236  
30 m x 0.32 mm, 0.50 µm

**Carrier:** Helium at 45 cm/sec  
(EPC in constant flow mode)

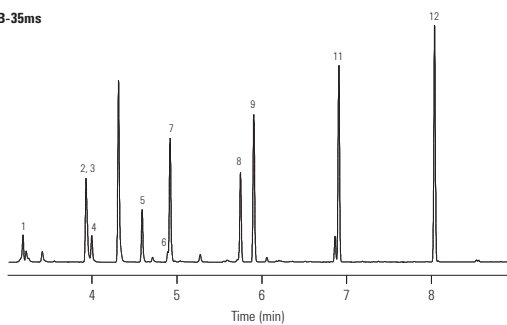
**Oven:** 40 °C for 0.5 min  
40-200 °C at 15 °C/min  
200 °C for 2 min

**Injection:** Splitless, 250 °C  
30 sec purge activation time

**Detector:** µECD, 350 °C  
Nitrogen makeup gas  
(column + makeup flow = 30 mL/min constant flow)

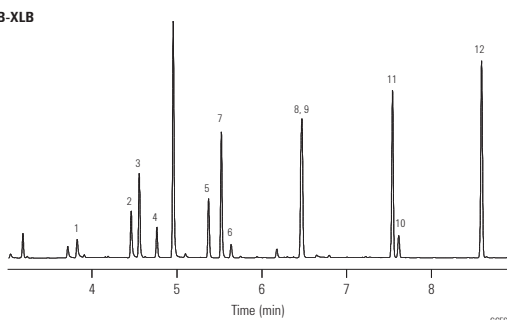
**Sample:** 50 pg per component

DB-35ms



1. Chloroacetic acid
  2. Bromoacetic acid
  3. Dichloroacetic acid
  4. Dalapon
  5. Trichloroacetic acid
  6. 1,2,3-Trichloropropane (IS)
  7. Bromochloroacetic acid
  8. Bromodichloroacetic acid
  9. Dibromoacetic acid
  10. 2,3-Dibromopropionic acid (SS)
  11. Chlorodibromoacetic acid
  12. Tribromoacetic acid
- IS - Internal Standard  
SS - Surrogate Standard

DB-XLB



GCES020

**Suggested Supplies**

**Septum:** 11 mm Advanced Green septa, 5183-4759

**Liner:** Direct connect, dual taper, deactivated, 4 mm id,  
G1544-80700

**Syringe:** 10 µL tapered, FN 23-26s/42/HP, 5181-1267

# Environmental Applications, Volatiles

## Extended Analyte List for EPA Method 8021

**Column:** DB-624  
124-1374  
75 m x 0.45 mm, 2.55 µm

**Column:** DB-VRX  
124-1574  
75 m x 0.45 mm, 2.55 µm

**Carrier:** Helium at 9 mL/min, measured at 35 °C

**Oven:** 35 °C for 12 min  
35-60 °C at 5 °C/min  
60 °C for 1 min  
60-200 °C at 17 °C/min  
200 °C for 5 min

**Sampler:** Purge and Trap (O.I.A. 4560)  
**Trap:** Vocarb 3000  
**Preheat:** 175 °C  
**Desorb:** 260 °C for 1 min

**Injection:** J&W LVI (Low Volume Injector), 150 °C

**Detector:** A: PID (O.I.A. 4430), 200 °C Helium makeup gas at 20 mL/min  
B: ELCD (O.I.A. 4420), with NiCat reaction tube in the halogen mode, 950 °C reactor temperature

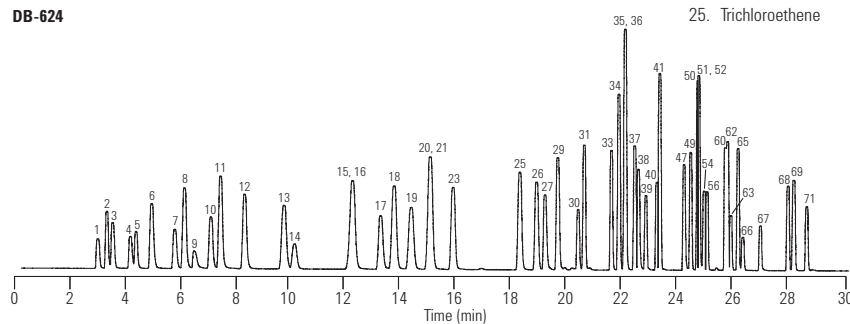
**Sample:** 20 ppb per component in 5 mL water

### Suggested Supplies

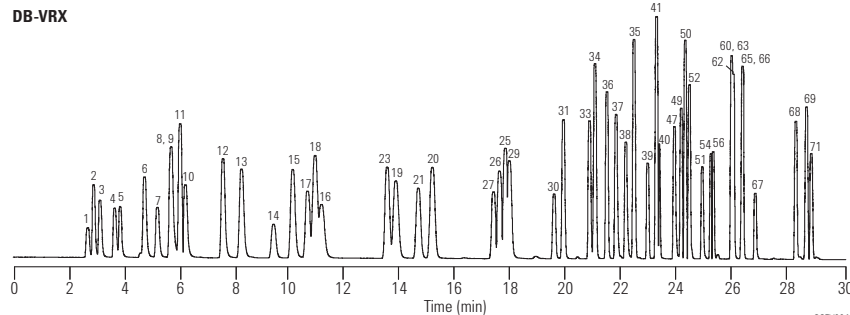
**Liner:** Direct, 1.5 mm id, 18740-80200  
**Seal:** Gold plated seal, 18740-20885  
**Septum:** 11 mm Advanced Green septa, 5183-4759

- |                              |                                   |
|------------------------------|-----------------------------------|
| 1. Dichlorodifluoromethane   | 26. 1,2-Dichloropropane           |
| 2. Chloromethane             | 27. Dibromomethane                |
| 3. Vinyl chloride            | 28. Trifluorotoluene (IS)         |
| 4. Bromomethane              | 29. Bromodichloromethane          |
| 5. Chloroethane              | 30. 2-Chloroethyl vinyl ether     |
| 6. Trichlorofluoromethane    | 31. cis-1,3-Dichloropropene       |
| 7. 2-Chloropropane (IS)      | 32. Toluene                       |
| 8. 1,1-Dichloroethene        | 33. trans-1,3-Dichloropropene     |
| 9. Iodomethane               | 34. 1,1,2-Trichloroethane         |
| 10. Allyl chloride           | 35. Tetrachloroethene             |
| 11. Methylene chloride       | 36. 1,3-Dichloropropane           |
| 12. trans-1,2-Dichloroethene | 37. Dibromochloromethane          |
| 13. 1,1-Dichloroethane       | 38. 1,2-Dibromoethane             |
| 14. Chloroprene              | 39. 1-Chloro-3-fluorobenzene (IS) |
| 15. cis-1,2-Dichloroethene   | 40. Chlorobenzene                 |
| 16. 2,2-Dichloropropane      | 41. 1,1,1,2-Tetrachloroethane     |
| 17. Bromochloromethane       | 42. Ethylbenzene                  |
| 18. Chloroform               | 43. m-Xylene                      |
| 19. 1,1,1-Trichloroethane    | 44. p-Xylene                      |
| 20. Carbon tetrachloride     | 45. Styrene                       |
| 21. 1,1-Dichloropropene      | 46. o-Xylene                      |
| 22. Benzene                  | 47. Bromoform                     |
| 23. 1,2-Dichloroethane       | 48. Isopropylbenzene              |
| 24. Fluorobenzene (IS)       | 49. cis-1,4-Dichlorobutene        |
| 25. Trichloroethene          | 50. 1,1,2,2-Tetrachloroethane     |

DB-624



DB-VRX



GCEV004

**Fast VOC Analysis**

**Column:** DB-624  
121-1324  
20 m x 0.18 mm, 1.00 µm

**Carrier:** Helium at 37 cm/sec, (constant flow mode)

**Oven:** 35 °C for 4 min  
35-200 °C at 15 °C/min  
200 °C for 0.1 min  
60-200 °C at 17 °C/min

**Sampler:** Purge and trap (Tekmar LSC 3000)  
Purge: Helium for 11 min at 50 mL/min  
Preheat: 250 °C  
Desorb: 260 °C for 2 min  
Line & valve: 100 °C

**Detector:** MSD, 250 °C transfer line  
Full scan 35 -260 amu  
3.25 scans per second

**Sample:** 10 ppb per component in 25 mL water

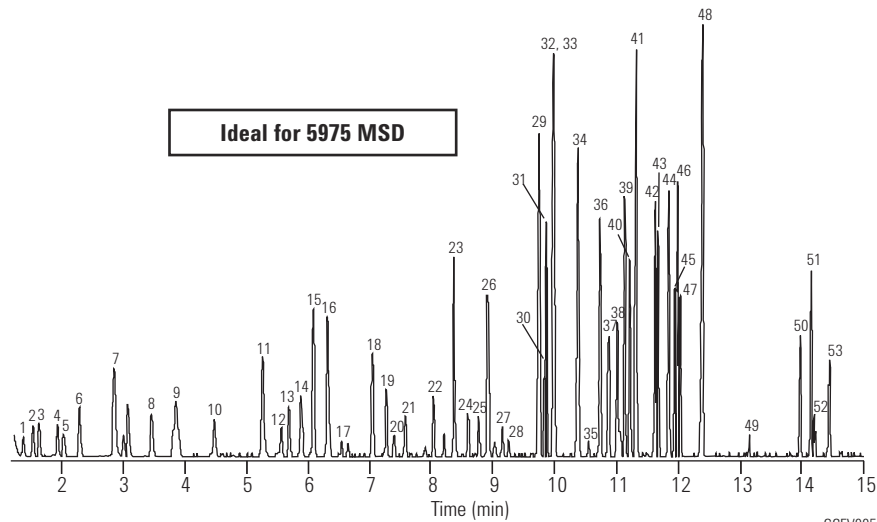
**Suggested Supplies**

**Septum:** 11 mm Advanced Green septa, 5183-4759

**Liner:** Direct, 1.5 mm id, 18740-80200

**Seal:** Gold plated seal, 18740-20885

- |                             |                                 |
|-----------------------------|---------------------------------|
| 1. Dichlorofluoromethane    | 21. Bromodichloromethane        |
| 2. Chloromethane            | 22. cis-1,3-Dichloropropene     |
| 3. Vinyl chloride           | 23. Toluene                     |
| 4. Bromomethane             | 24. trans-1,3-Dichloropropene   |
| 5. Chloroethane             | 25. 1,1,2-Trichloroethane       |
| 6. Trichlorofluoromethane   | 26. Tetrachloroethene           |
| 7. 1,1-Dichloroethene       | 27. Dibromochloromethane        |
| 8. Methylene chloride       | 28. 1,2-Dibromomethane          |
| 9. trans-1,2-Dichloroethene | 29. Chlorobenzene               |
| 10. 1,1-Dichloroethane      | 30. 1,1,1,2-Tetrachloroethane   |
| 11. 2,2-Dichloropropane     | 31. Ethylbenzene                |
| 12. Bromochloromethane      | 32. m-Xylene                    |
| 13. Chloroform              | 33. p-Xylene                    |
| 14. 1,1,1-Trichloroethane   | 34. o-Xylene                    |
| 15. Carbon tetrachloride    | 35. Bromoform                   |
| 16. Benzene                 | 36. Isopropylbenzene            |
| 17. Fluorobenzene           | 37. Bromofluorobenzene          |
| 18. Trichloroethene         | 38. Bromobenzene                |
| 19. 1,2-Dichloropropane     | 39. n-Propylbenzene             |
| 20. Dibromomethane          | 40. 2-Chlorotoluene             |
|                             | 41. 1,3,5-Trimethylbenzene      |
|                             | 42. tert-Butylbenzene           |
|                             | 43. 1,2,4-Trimethylbenzene      |
|                             | 44. sec-Butylbenzene            |
|                             | 45. 1,3-Dichlorobenzene         |
|                             | 46. 4-Isopropyltoluene          |
|                             | 47. 1,4-Dichlorobenzene         |
|                             | 48. 1,2-Dichlorobenzene         |
|                             | 49. 1,2-Dibromo-3-chloropropane |
|                             | 50. 1,2,4-Trichlorobenzene      |
|                             | 51. Hexachlorobutadiene         |
|                             | 52. Naphthalene                 |
|                             | 53. 1,2,3-Trichlorobenzene      |



**EPA Method 551**

**Column:** DB-1  
122-1033  
30 m x 0.25 mm, 1.00 µm

**Carrier:** Helium at 24.8 cm/sec, measured at 150 °C

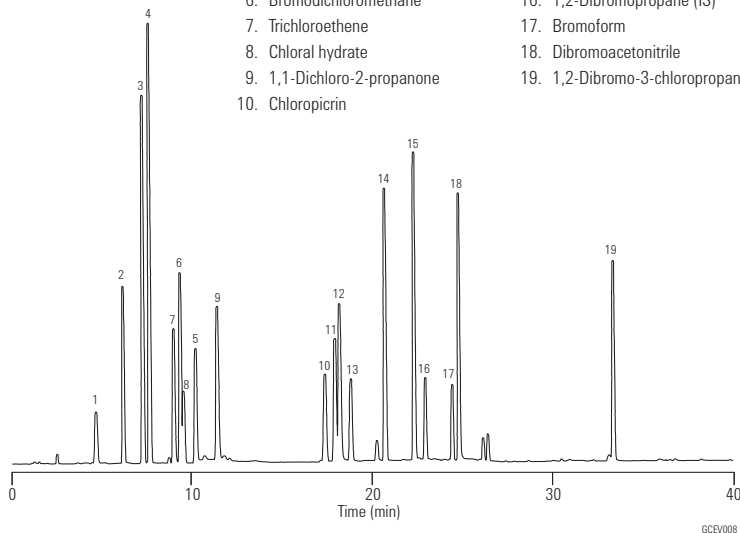
**Oven:** 35 °C for 9 min  
35-40 °C at 10 °C/min  
40 °C for 3 min  
40-150 °C at 6 °C/min  
150 °C for 1 min

**Injection:** Splitless, 200 °C  
15 sec purge activation time

**Detector:** ECD, 300 °C

**Sample:** 1 µL of 50 pg/µL, AccuStandard

- |                             |                                 |
|-----------------------------|---------------------------------|
| 1. Chloroform               | 11. Dibromochloromethane        |
| 2. 1,1,1-Trichloroethane    | 12. Bromochloroacetonitrile     |
| 3. Carbon tetrachloride     | 13. 1,2-Dibromoethane           |
| 4. Trichloroacetonitrile    | 14. Tetrachloroethene           |
| 5. Dichloroacetonitrile     | 15. 1,1,1-Trichloropropanone    |
| 6. Bromodichloromethane     | 16. 1,2-Dibromopropane (IS)     |
| 7. Trichloroethene          | 17. Bromoform                   |
| 8. Chloral hydrate          | 18. Dibromoacetonitrile         |
| 9. 1,1-Dichloro-2-propanone | 19. 1,2-Dibromo-3-chloropropane |
| 10. Chloropicrin            |                                 |



**Suggested Supplies**

- Septum:** 11 mm Advanced Green septa, 5183-4759
- Liner:** Splitless, single taper, deactivated, 4 mm id, 5181-3316
- Seal:** Gold plated seal, 18740-20885
- Syringe:** 10 µL tapered, FN 23-26s/42/HP, 5181-1267

**European Red List Volatiles**

**Column:** DB-5.625  
122-5632  
30 m x 0.25 mm, 0.50 µm

**Column:** DB-624  
122-1334  
30 m x 0.25 mm, 1.40 µm

**Carrier:** Helium at 35 cm/sec, measured at 40 °C

**Oven:** 40 °C for 2 min  
40-140 °C at 12 °C/min

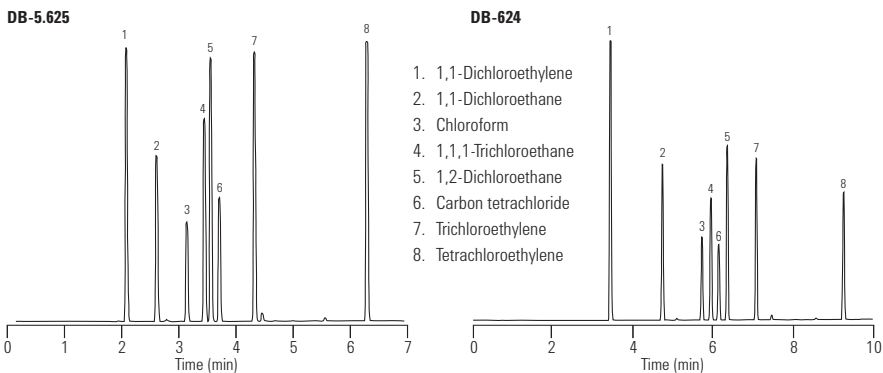
**Injection:** Split, 250 °C  
Split ratio 1:50

**Detector:** FID, 300 °C  
Nitrogen makeup gas at 30 mL/min

**Sample:** 1 µL of headspace of neat mixture

**Suggested Supplies**

- Septum:** 11 mm Advanced Green septa, 5183-4759
- Liner:** Direct, 1.5 mm id, 18740-80200
- Seal:** Gold plated seal, 18740-20885



**EPA Volatiles by GC/MS (Split Injector)**

**Column:** DB-VRX  
122-1564  
60 m x 0.25 mm, 1.40 µm

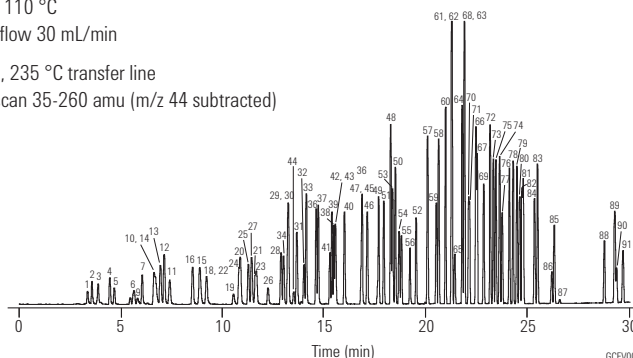
**Carrier:** Helium at 30 cm/sec, measured at 45 °C

**Oven:** 45 °C for 10 min  
45-190 °C at 12 °C/min  
190 °C for 2 min  
190-225 °C at 6 °C/min  
225 °C for 1 min

**Sampler:** Purge and trap (O.I.A. 4560)  
Purge: Helium for 11 min at 40 mL/min  
Trap: Tenax/Silica Gel/Carbosieve  
Preheat: 175 °C  
Desorb: 220 °C for 0.6 min

**Injection:** Split, 110 °C  
Split flow 30 mL/min

**Detector:** MSD, 235 °C transfer line  
Full scan 35-260 amu (m/z 44 subtracted)



**Column:** DB-624  
122-1364  
60 m x 0.25 mm, 1.40 µm

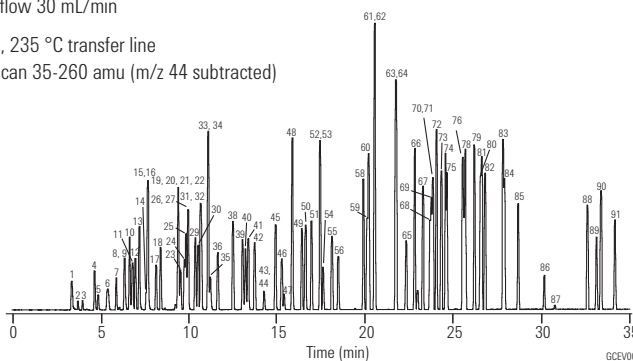
**Carrier:** Helium at 31 cm/sec, measured at 40 °C

**Oven:** 45 °C for 3 min  
45-90 °C at 8 °C/min  
90 °C for 4 min  
90-200 °C at 6 °C/min  
200 °C for 5 min

**Sampler:** Purge and trap (O.I.A. 4560)  
Purge: Helium for 11 min at 40 mL/min  
Trap: Tenax/Silica Gel/Carbosieve  
Preheat: 175 °C  
Desorb: 220 °C for 0.6 min

**Injection:** Split, 110 °C  
Split flow 30 mL/min

**Detector:** MSD, 235 °C transfer line  
Full scan 35-260 amu (m/z 44 subtracted)



- |                              |                              |                                   |                                 |   |
|------------------------------|------------------------------|-----------------------------------|---------------------------------|---|
| 1. Dichlorodifluoromethane   | 21. 2,2-Dichloropropane      | 41. Dibromomethane                | 61. m-Xylene                    | 81. p-Isopropyltoluene  |
| 2. Chloromethane             | 22. Propionitrile            | 42. Bromodichloromethane          | 62. p-Xylene                    | 82. 1,4-Dichlorobenzene                                       |
| 3. Vinyl chloride            | 23. Methyl acrylate          | 43. 2-Nitropropane                | 63. o-Xylene                    | 83. n-Butylbenzene  |
| 4. Bromomethane              | 24. Methacrylonitrile        | 44. Chloroacetonitrile            | 64. Styrene                     | 84. 1,2-Dichlorobenzene                                       |
| 5. Chloroethane              | 25. Bromochloromethane       | 45. cis-1,3-Dichloropropene       | 65. Bromoform                   | 85. Hexachloroethane  |
| 6. Trichlorofluoromethane    | 26. Tetrahydrofuran          | 46. 4-Methyl-2-pentanone          | 66. Isopropylbenzene            | 86. 1,2-Dibromo-3-chloropropane                               |
| 7. Diethyl ether             | 27. Chloroform               | 47. 1,1-Dichloro-2-propanone      | 67. 4-Bromofluorobenzene (SS)   | 87. Nitrobenzene  |
| 8. 1,1-Dichloroethane        | 28. Pentafluorobenzene (IS)  | 48. Toluene                       | 68. 1,1,2,2-Tetrachloroethane   | 88. 1,2,4-Trichlorobenzene                                    |
| 9. Acetone                   | 29. 1,1,1-Trichloroethane    | 49. trans-1,3-Dichloropropene     | 69. Bromobenzene                | 89. Hexachlorobutadiene                                       |
| 10. Iodomethane              | 30. 1-Chlorobutane           | 50. Ethyl methacrylate            | 70. 1,2,3-Trichloropropane      | 90. Naphthalene   |
| 11. Carbon disulfide         | 31. 1,1-Dichloropropene      | 51. 1,1,2-Trichloroethane         | 71. trans-1,4-Dichloro-2-butene | 91. 1,2,3-Trichlorobenzene                                    |
| 12. Allyl chloride           | 32. Carbon tetrachloride     | 52. Tetrachloroethene             | 72. n-Propylbenzene             |   |
| 13. Methylene chloride       | 33. Benzene                  | 53. 1,3-Dichloropropane           | 73. 2-Chlorotoluene             | IS - Internal Standard  |
| 14. Acrylonitrile            | 34. 1,2-Dichloroethane       | 54. 2-Hexanone                    | 74. 1,3,5-Trimethylbenzene      | SS - Surrogate Standard                                       |
| 15. Methyl-tert-butyl ether  | 35. 2,2-Dimethylhexane       | 55. Dibromochloromethane          | 75. 4-Chlorotoluene             | <b>Note:</b> Some compounds not present in both chromatograms |
| 16. trans-1,2-Dichloroethene | 36. Fluorobenzene (IS)       | 56. 1,2-Dibromoethane             | 76. tert-Butylbenzene           |   |
| 17. Hexane                   | 37. 1,4-Difluorobenzene (IS) | 57. 1-Chloro-3-fluorobenzene (IS) | 77. Pentachloroethane           |   |
| 18. 1,1-Dichloroethane       | 38. Trichloroethene          | 58. Chlorobenzene                 | 78. 1,2,4-Trimethylbenzene      |   |
| 19. 2-Butanone               | 39. 1,2-Dichloropropane      | 59. 1,1,1,2-Tetrachloroethane     | 79. sec-Butylbenzene            |   |
| 20. cis-1,2-Dichloroethene   | 40. Methyl methacrylate      | 60. Ethylbenzene                  | 80. 1,3-Dichlorobenzene         |   |

**High Speed VOC, EPA Method 8260**

**Column:** DB-VRX  
121-1524  
20 m x 0.18 mm, 1.00 µm

**Carrier:** Helium at 55 cm/sec (1.5 mL/min)

**Oven:** 45 °C for 3.0 min  
45-190 °C at 36 °C/min  
190-225 °C at 20 °C/min  
225 °C for 0.5 min

**Sampler:** Purge and trap (Tekmar 3100)  
Purge: 11 min  
Trap: Vocarb 3000  
Preheat: 245 °C  
Desorb: 250 °C for 1min  
Bake: 260 °C for 10 min  
Line & valve: 100 °C

**Injection:** Split, 150 °C  
Split ratio 60:1

**Detector:** Agilent 5975 MSD,  
Scan range: 35-260 amu  
Scan rate: 3.25 scans/sec  
Quad temperature: 150 °C  
Source temperature: 200 °C  
Transfer line temp: 200 °C

**Sample:** 5 mL  
• Halogenated and aromatic analytes at 40 ppb  
• Internal standards at 20 ppb  
• Polar analytes (i.e., ethers, alcohols and ketones at 100-800 ppb)

**Suggested Supplies**

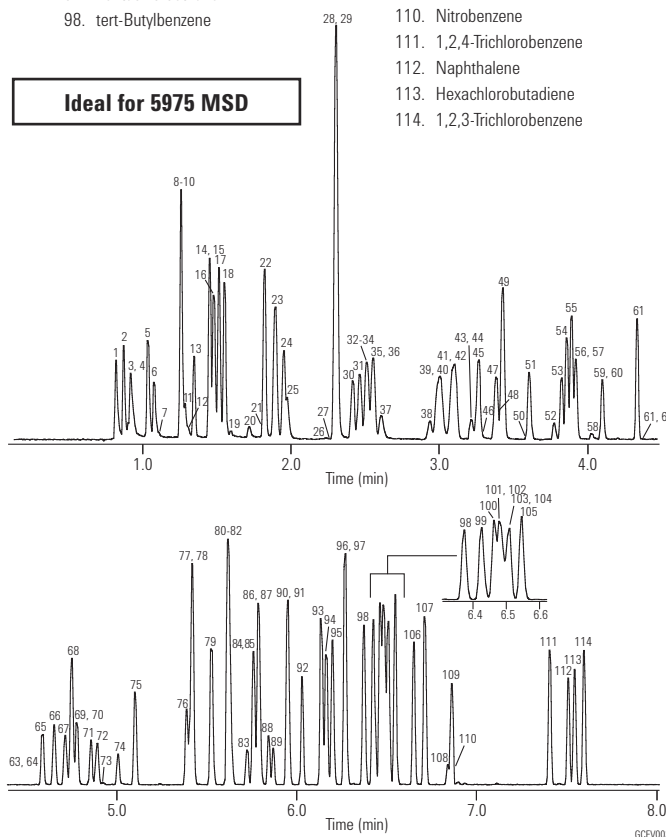
**Septum:** 11 mm Advanced Green septa, 5183-4759

**Liner:** Direct, 1.5 mm id, 18740-80200

**Seal:** Gold plated seal, 18740-20885

- |                               |                               |
|-------------------------------|-------------------------------|
| 1. Dichlorodifluoromethane    | 44. 2-Chloroethanol           |
| 2. Chloromethane              | 45. 1,1-Dichloropropene       |
| 3. Hydroxypropionitrile       | 46. 1-Butanol                 |
| 4. Vinyl chloride             | 47. Carbon tetrachloride      |
| 5. Bromomethane               | 48. Chloroacetonitrile        |
| 6. Chloroethane               | 49. Benzene                   |
| 7. Ethanol                    | 50. tert-Amylmethyl ether     |
| 8. Acetonitrile               | 51. Fluorobenzene (IS)        |
| 9. Acrolein                   | 52. 2-Pentanone               |
| 10. Trichlorofluoromethane    | 53. Dibromomethane            |
| 11. Isopropyl alcohol         | 54. 1,2-Dichloropropane       |
| 12. Acetone                   | 55. Trichloroethene           |
| 13. Ethyl ether               | 56. Bromodichloromethane      |
| 14. 1,1-Dichloroethene        | 57. 2-Nitropropane            |
| 15. tert-Butyl alcohol        | 58. 1,4-Dioxane               |
| 16. Acrylonitrile             | 59. Epichlorohydrin           |
| 17. Methylene chloride        | 60. Methyl methacrylate       |
| 18. Allyl chloride            | 61. cis-1,3-Dichloropropene   |
| 19. Allyl alcohol             | 62. Propiolactone             |
| 20. 1-Propanol                | 63. Bromoacetone              |
| 21. Propargyl alcohol         | 64. Pyridine                  |
| 22. trans-1,2-Dichloroethene  | 65. trans-1,3-Dichloropropene |
| 23. MTBE                      | 66. 1,1,2-Trichloroethane     |
| 24. 1,1-Dichloroethane        | 67. Toluene-d8 (IS)           |
| 25. Propionitrile             | 68. Toluene                   |
| 26. 2-Butanone                | 69. 1,3-Dichloropropane       |
| 27. Diisopropyl ether         | 70. Paraldehyde               |
| 28. cis-1,2-Dichloroethene    | 71. Ethyl methacrylate        |
| 29. Methacrylonitrile         | 72. Dibromochloromethane      |
| 30. Bromochloromethane        | 73. 3-Chloropropionitrile     |
| 31. Chloroform                | 74. 1,2-Dibromoethane         |
| 32. 2,2-Dichloropropane       | 75. Tetrachloroethene         |
| 33. Ethyl acetate             | 76. 1,1,1,2-Tetrachloroethane |
| 34. Ethyl-tert-butyl ether    | 77. 1-Chlorohexane            |
| 35. Methyl acrylate           | 78. Chlorobenzene             |
| 36. Dibromofluoromethane (IS) | 79. Ethylbenzene              |
| 37. Isobutanol                | 80. Bromoform                 |
| 38. Dichloroethane-d4 (IS)    | 81. m-Xylene                  |
| 39. Pentafluorobenzene        | 82. p-Xylene                  |
| 40. 1,2-Dichloroethane        | 83. trans-Dichlorobutene      |
| 41. 1,1,1-Trichloroethane     | 84. 1,3-Dichloro-2-propanol   |
| 42. 1-Chlorobutane            | 85. Styrene                   |
| 43. Crotonaldehyde            | 86. 1,1,2,2-Tetrachloroethane |

- |                               |                                  |
|-------------------------------|----------------------------------|
| 87. o-Xylene                  | 99. 1,2,4-Trimethylbenzene       |
| 88. 1,2,3-Trichloropropane    | 100. sec-Butylbenzene            |
| 89. cis-Dichlorobutene        | 101. 1,3-Dichlorobenzene         |
| 90. 4-Bromofluorobenzene (IS) | 102. Benzylchloride              |
| 91. Isopropylbenzene          | 103. 1,4-Dichlorobenzene-d4 (IS) |
| 92. Bromobenzene              | 104. 1,4-Dichlorobenzene         |
| 93. Propylbenzene             | 105. Isopropyltoluene            |
| 94. 2-Chlorotoluene           | 106. 1,2-Dichlorobenzene         |
| 95. 4-Chlorotoluene           | 107. Butylbenzene                |
| 96. 1,3,5-Trimethylbenzene    | 108. 1,2-Dibromo-3-chloropropane |
| 97. Pentachloroethane         | 109. Hexachloroethane            |
| 98. tert-Butylbenzene         | 110. Nitrobenzene                |



## Environmental Applications, Air Analysis

## EPA Air Analysis Compendium Method TO-14 Standard

**Column:** DB-1  
123-1063  
60 m x 0.32 mm, 1.00 µm

**Carrier:** Helium at 25 cm/sec measured off of CO<sub>2</sub>  
at 35 °C constant flow mode

**Oven:** 35 °C for 5 min  
35-120 °C at 5 °C/min  
120-220 °C at 30 °C/min  
220 °C for 5 min

**Injection:** Entech 7100 cryogenic sample preconcentrator

**Detector:** MSD  
Full scan of m/z 40-250

**Sample:** 400 mL of a 10 ppbV TO-14 standard  
and 100 mL of a 20 ppbV IS/SS standard

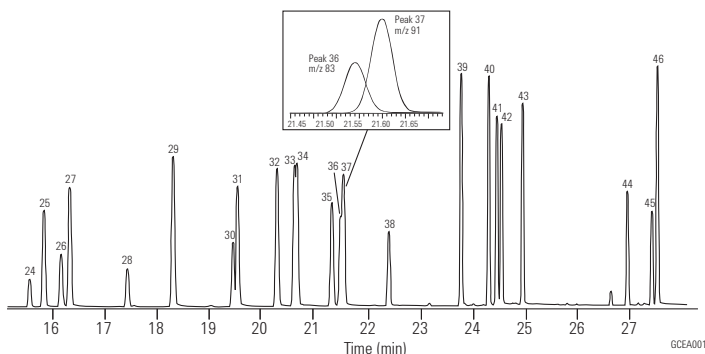
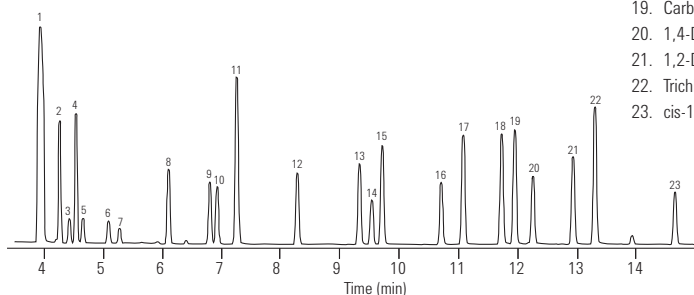
## Suggested Supplies

**Septum:** 11 mm Advanced Green septa, 5183-4759

**Liner:** Direct, 1.5 mm id, 18740-80200

**Seal:** Gold plated seal, 18740-20885

- |   |                               |
|---|-------------------------------|
| 1. CO <sub>2</sub>                                    | 24. trans-1,3-Dichloropropene |
| 2. Freon 12 (Dichlorodifluoromethane)                 | 25. 1,1,2-Trichloroethane     |
| 3. Chloromethane                                      | 26. Toluene-d8 (SS)           |
| 4. Freon 114 (1,2-Dichloro-1,1,2,2-tetrafluoroethane) | 27. Toluene                   |
| 5. Vinyl chloride                                     | 28. 1,2-Dibromoethane         |
| 6. Bromomethane                                       | 29. Tetrachloroethene         |
| 7. Chloroethane                                       | 30. Chlorobenzene-d5 (SS)     |
| 8. Freon 11 (Trichlorofluoromethane)                  | 31. Chlorobenzene             |
| 9. 1,1-Dichloroethene                                 | 32. Ethylbenzene              |
| 10. Methylene chloride                                | 33. m-Xylene                  |
| 11. Freon 113 (1,1,2-Trichloro-1,2,2-trifluoroethane) | 34. p-Xylene                  |
| 12. 1,1-Dichloroethane                                | 35. Styrene                   |
| 13. cis-1,2-Dichloroethene                            | 36. 1,1,2,2-Tetrachloroethane |
| 14. Bromochloromethane (IS)                           | 37. o-Xylene                  |
| 15. Chloroform  | 38. 4-Bromofluorobenzene (SS) |
| 16. 1,2-Dichloroethane                                | 39. 1,3,5-Trimethylbenzene    |
| 17. 1,1,1-Trichloroethane                             | 40. 1,2,4-Trimethylbenzene    |
| 18. Benzene   | 41. 1,3-Dichlorobenzene       |
| 19. Carbon tetrachloride                              | 42. 1,2-Dichlorobenzene       |
| 20. 1,4-Difluorobenzene (IS)                          | 43. 1,4-Dichlorobenzene       |
| 21. 1,2-Dichloropropane                               | 44. 1,2,4-Trichlorobenzene    |
| 22. Trichloroethene                                   | 45. 1,2-Dibromobenzene (IS)   |
| 23. cis-1,3-Dichloropropene                           | 46. Hexachloro-1,3-butadiene  |



Agilent wishes to thank Entech Instruments for providing this chromatogram.

### Formaldehyde, 50ppb

**Column:** DB-5ms  
123-5563  
60 m x 0.32 mm, 1.00 µm

**Carrier:** Helium, 1.5 mL/min

**Oven:** 35 °C for 5 min  
35-85 °C at 10 °C/min

**Sampler:** Entech 7100 cryogenic sample preconcentrator

**Detector:** GC/MS 6890/5973N  
Scan 29-180 amu 0-6 min  
33-280 amu 6-30 min  
Electron Impact 70 eV

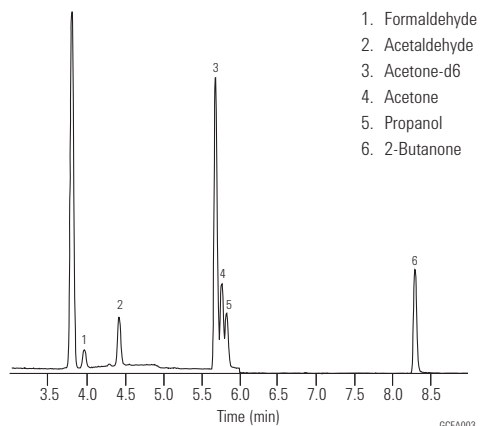
**Sample:** 100 cc 50 ppb Formaldehyde/20 ppb others

#### Suggested Supplies

**Septum:** 11 mm Advanced Green septa, 5183-4759

**Liner:** Direct, 1.5 mm id, 18740-80200

**Seal:** Gold plated seal, 18740-20885



Agilent wishes to thank Entech Instruments for providing this chromatogram.

### Sulfur in Air

**Column:** DB-5ms  
123-5563  
60 m x 0.32 mm, 1.00 µm

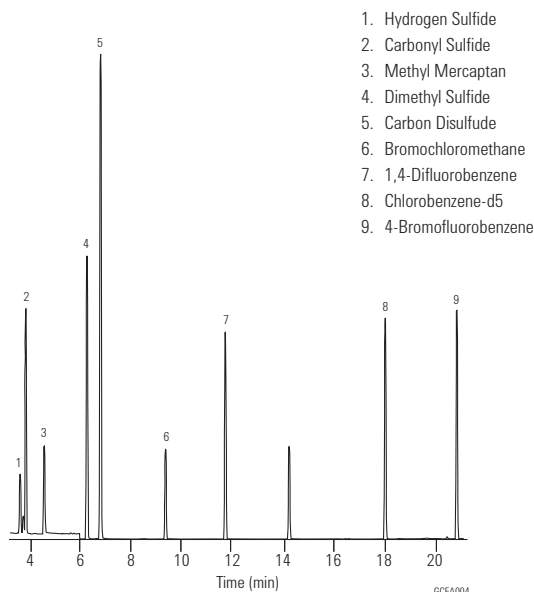
**Carrier:** Helium, 1.5 mL/min

**Oven:** 35 °C for 5 min  
35-140 °C at 6 °C/min  
140-220 °C at 15 °C/min  
220 °C for 3 min

**Sampler:** Entech 7100 cryogenic sample preconcentrator

**Detector:** GC/MS 6890/5973N  
Scan 29-180 amu 0-6 min  
33-280 amu 6-30 min  
Electron Impact 70 eV

**Sample:** 400 cc 10 ppb Sulfurs



Agilent wishes to thank Entech Instruments for providing this chromatogram.



**N<sub>2</sub>O I**

**Column:** HP PLOT Q  
19095P-Q04  
30 m x 0.53 mm, 40.00 μm

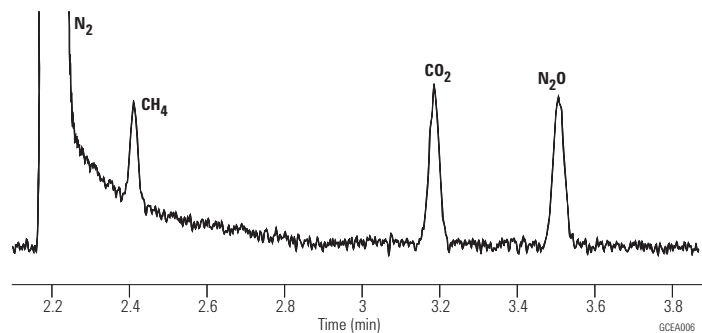
Carrier: Helium, 5 psi (approximately 8 mL/min)

Oven: 35 °C isothermal

Injection: 250 μL, injected  
Split ratio 1:3

Detector: TCD, 200 °C

Sample: approximately 200 ppmV methane  
200 ppmV CO<sub>2</sub>  
250 ppmV N<sub>2</sub>O (nitrogen balance gas)

**N<sub>2</sub>O II**

**Column:** HP PLOT  
19095P-MS6  
30 m x 0.53 mm, 25.00 μm

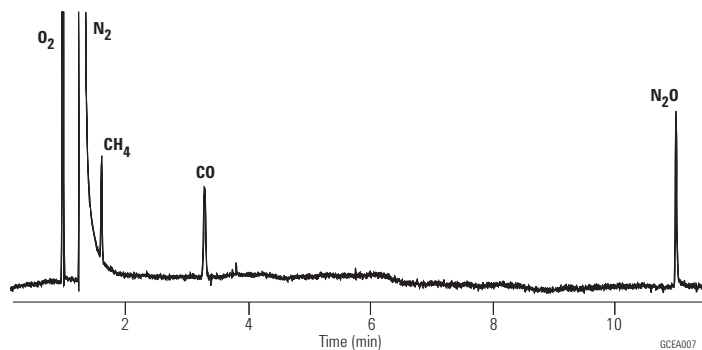
Carrier: Helium, 6 psi (approximately 10 mL/min)

Oven: 50 °C (5 min), 25 °C/min to 200 °C and hold

Injection: 250 μL injected  
Split ratio 1:4

Detector: TCD, 250 °C  
Column compensation on

Sample: approximately 200 ppmV methane  
200 ppmV CO<sub>2</sub>  
250 ppmV N<sub>2</sub>O (nitrogen balance gas)

**N<sub>2</sub>O III**

**Column:** GS-CarbonPLOT  
113-3133  
30 m x 0.32 mm, 3.00 μm

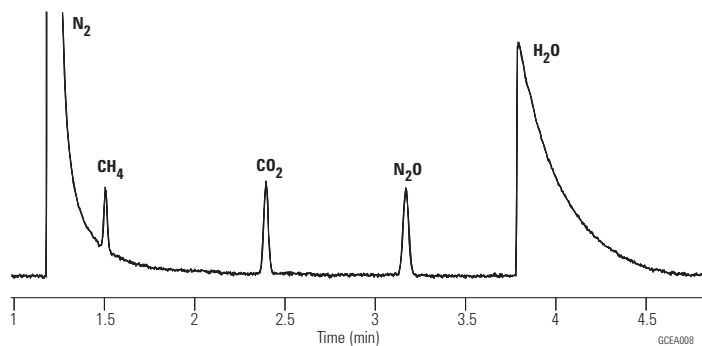
Carrier: Helium, 12 psi (approximately 3 mL/min)

Oven: 35 °C isothermal

Injection: 250 μL injected  
Split ratio 1:4

Detector: TCD, 200 °C

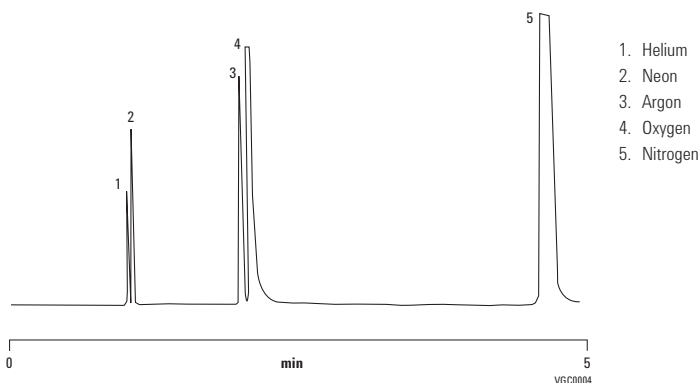
Sample: approximately 200 ppmV methane  
200 ppmV CO<sub>2</sub>  
250 ppmV N<sub>2</sub>O (nitrogen balance gas)



**Permanent Gases on a Thick Film Molsieve Column**

**Column:** Molsieve 5Å  
CP7538  
25 m x 0.53 mm, 50.00 µm

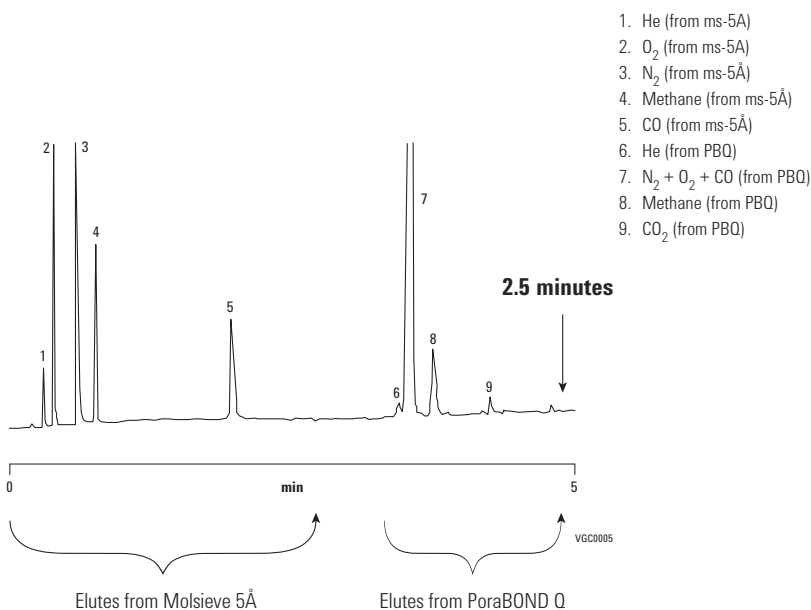
Sample: 10 µL  
Sample Conc: % range  
Carrier: H<sub>2</sub>  
Oven: 30 °C  
Injection: Split, 100 mL/min  
Detector: TCD



**Fast Analysis of Permanent Gases and CO<sub>2</sub> using Tandem PLOT Columns**

**Column:** CP-Sil PAH UltiMetal  
CP7429

Sample: 10 µL  
Sample Conc: % level  
Carrier: H<sub>2</sub>, 60 kPa  
Oven: 45 °C  
Injection: Split 50 mL/min  
Detector: µ-TCD



### EPA Air Analysis Method TO-15 (1 ppbV Standard)

**Column:** DB-5ms  
123-5563  
60 m x 0.32 mm, 1.00 µm

**Carrier:** Helium, 1.5 mL/min

**Oven:** 35 °C for 5 min  
35-140 °C at 6 °C/min  
140-220 °C at 15 °C/min  
220 °C for 3 min

**Sampler:** Entech 7100 cryogenic sample preconcentrator

### Suggested Supplies

**Septum:** 11 mm Advanced Green septa, 5183-4759

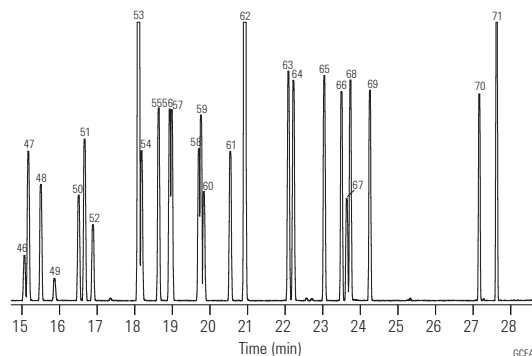
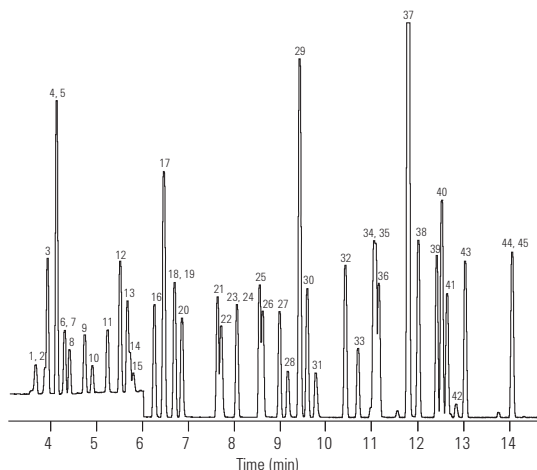
**Liner:** Direct, 1.5 mm id, 18740-80200

**Seal:** Gold plated seal, 18740-20885

**Detector:** GC/MS 6890/5973N  
Scan 29-180 amu 0-6 min  
33-280 amu 6-30 min  
Electron Impact 70 eV

**Sample:** 400 mL sample load,  
All compounds at 10 ppbV except Formaldehyde (50 ppbV),  
Acetaldehyde (20 ppbV), Propanol (20 ppbV), Acetone (30 ppbV),  
2-Butanone (30 ppbV)

	Quantitation Ion		Quantitation Ion		Quantitation Ion
1. Formaldehyde	30	26. n-Hexane	57	51. Tetrachloroethene	166
2. Propene	41	27. cis-1,2-Dichloroethene	96	52. 1,2-Dibromoethane	107
3. Dichlorodifluoromethane	85	28. Ethyl acetate	43	53. Chlorobenzene-d5 (IS)	117
4. Chloromethane	50	29. Bromochloromethane (IS)	128	54. Chlorobenzene	112
5. Dichlorotetrafluoroethane	85	30. Chloroform	83	55. Ethylbenzene	91
6. Acetaldehyde	29	31. Tetrahydrofuran	42	56. m-Xylene	91
7. Vinyl chloride	62	32. 1,1,1-Trichloroethane	97	57. p-Xylene	91
8. 1,3-Butadiene	39	33. 1,2-Dichloroethane	62	58. Styrene	104
9. Bromomethane	94	34. Benzene	78	59. o-Xylene	91
10. Chloroethane	64	35. Carbon tetrachloride	117	60. Bromoform	173
11. Bromoethene	106	36. Cyclohexane	56	61. 1,1,2,2-Tetrachloroethane	83
12. Trichlorofluoromethane	101	37. 1,4-Difluorobenzene (IS)	114	62. 4-Bromofluorobenzene	95
13. Acetone	58	38. 2,2,4-Trimethylpentane (Isooctane)	57	63. 4-Ethyltoluene	105
14. Propanal	29	39. n-Heptane	41	64. 1,3,5-Trimethylbenzene	105
15. Isopropyl alcohol	45	40. Trichloroethene	130	65. 1,2,4-Trimethylbenzene	105
16. 1,1-Dichloroethene	61	41. 1,2-Dichloropropane	63	66. 1,3-Dichlorobenzene	146
17. 1,1,2-Trichloro-1,2,2-trifluoroethane	101	42. 1,4-Dioxane	88	67. Benzyl chloride	91
18. Methylene chloride	49	43. Bromodichloromethane	83	68. 1,4-Dichlorobenzene	146
19. 3-Chloro-1-propene (Allyl chloride)	76	44. 4-Methyl-2-pentanone (MIBK)	43	69. 1,2-Dichlorobenzene	146
20. Carbon disulfide	76	45. cis-1,3-Dichloropropene	75	70. 1,2,4-Trichlorobenzene	180
21. trans-1,2-Dichloroethene	96	46. trans-1,3-Dichloropropene	75	71. Hexachlorobutadiene	225
22. tert-Butyl methyl ether (MTBE)	73	47. Toluene	91		
23. 1,1-Dichloroethane	63	48. 1,1,2-Trichloroethane	97		
24. Vinyl acetate	43	49. 2-Hexanone	43		
25. 2-Butanone (MEK)	72	50. Dibromochloromethane	129		



Agilent wishes to thank Entech Instruments for providing this chromatogram.

# Food, Flavor, and Fragrance Applications

## DB-624UI 1 µL/L Fermented Beverage Standard Mix

**Column:** DB-624UI  
123-1334UI  
30 m x 0.32 mm, 1.8 µm

**Carrier:** Helium, 2.3 mL/min, constant flow set a 35 °C

**Oven:** 35 °C for 5 min  
10 °C/min to 100 °C for 1.5 min  
15 °C/min to 220 °C for 3.0 min  
25 °C/min to 250 °C for 2.8 min

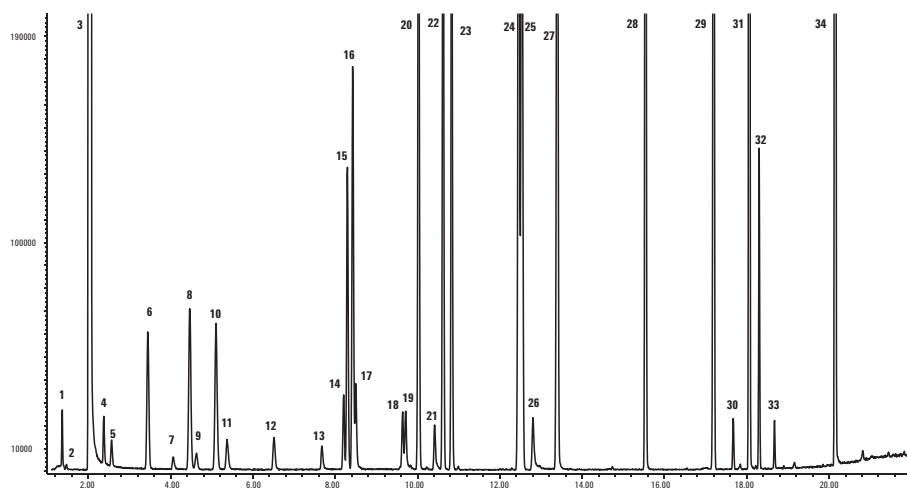
**Inlet:** Split/splitless, 220 °C, 1 µL, split 20:1

**MSD Restrictor:** Scan mode 30-400 amu, source temp 230 °C,  
quad temp 150 °C, transfer line temp 260 °C

**Instrument:** Agilent 7890/5975C equipped with MMI and FID

**Sampler:** Agilent 7697A headspace with 111 position tray, 1 mL sample loop

1. acetyl aldehyde
2. methanol
3. ethanol
4. acetone
5. isopropanol
6. isobutyl aldehyde
7. 1-propanol
8. butyl aldehyde
9. 2,3 butanedione (VDK)
10. ethyl acetate
11. 2-butanol
12. isobutyl alcohol
13. 1-butanol
14. 2,3 pentanedione (VDK)
15. ethyl propanoate
16. propyl acetate
17. 3 pentanol
18. isoamyl alcohol
19. active amyl alcohol
20. isobutyl acetate
21. 1-pentanol
22. ethyl butanonate
23. hexanal
24. isoamyl acetate
25. active amyl acetate
26. 1-hexanol
27. heptanal
28. octanal
29. 1,3,5-trioxane imp
30. 1,3,5-trioxane imp
31. ethyl caprylate
32. 1-phenyl ethyl acetate
33. benzaldehyde, 3 methoxy
34. ethyl caprate



**Spearmint Oil**

**Column A: DB-1**  
**122-1032**  
**30 m x 0.25 mm, 0.25 µm**

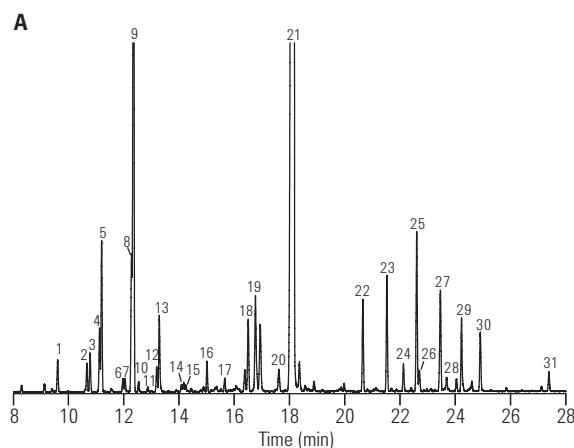
**Column B: DB-1**  
**121-1022**  
**20 m x 0.18 mm, 0.18 µm**

Carrier: A: Helium 25 cm/sec measured at 40 °C  
 B: Hydrogen 47 cm/sec measured at 40 °C

Oven: A: 40 °C hold 1 min, 5 °C/min to 290 °C  
 B: 40 °C hold 0.38 min, 13 °C/min to 290 °C hold 13.09 min

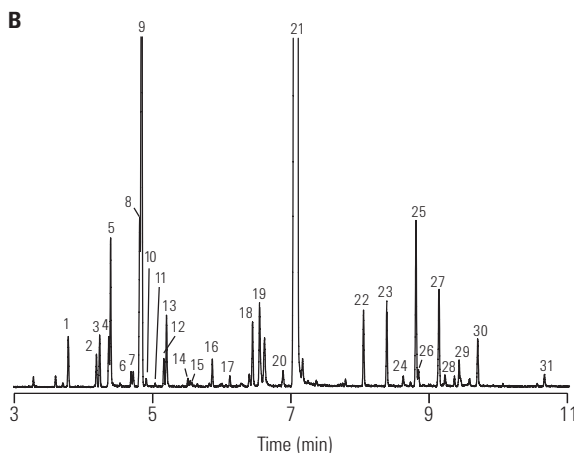
Injection: 250 °C, Split 40:1, 1 µL injection

**Original Method with a DB-1, 30 m x 0.25 mm, 0.25 µm column and Helium carrier**



1. α-Pinene
2. Sabinene
3. β-Pinene
4. 3-Octanol
5. Myrcene
6. α-Terpinene
7. p-Cymene
8. 1,8-Cineol
9. Limonene
10. cis-Occimene
11. trans-Occimene
12. γ-Terpinene
13. trans-Sabinene hydrate
14. Terpinolene
15. Linalool
16. 3-Octyl acetate
17. Isomenthone
18. Terpinen-4-ol
19. Dihydrocarvone
20. trans-Carveol
21. l-Carvone
22. trans-Dihydrocarveol acetate
23. cis-Carvyl acetate
24. cis-Jasmone
25. β-Bourbonene
26. α-Bourbonene
27. β-Caryophyllene
28. α-Copaene
29. trans-β-Farnesene
30. Germacrene-d
31. Viridiflorol

**Faster Method with a high efficiency DB-1, 20 m x 0.18 mm, 0.18 µm column and Hydrogen carrier**



Using hydrogen as a carrier gas in conjunction with the high efficiency column resulted in an overall speed gain of 61% compared to the original method. In addition, the resolution was well maintained throughout the method translation process.

SPEARMINT

### Lavender Oil Characterization

**Column:** DB-1ms Ultra Inert  
122-0132UI  
30 m x 0.25 mm, 0.25 µm

**Instrument:** Agilent 7890A/5975B MSD  
and a 6890N FID equipped

**Sampler:** Agilent 7683B, 5.0 µL syringe (P/N 5188-5246),  
1.0 µL injection

**Carrier:** Helium 40 cm/s, constant flow MSD system,  
35 cm/s FID system

**Inlet:** 200:1 split

**Oven:** 62 °C 12.5 min hold, 3 °C/min to 92 °C,  
then 5 °C/min to 165 °C, then 100 °C/min  
to 310 °C, 2.5 min hold

**Detector:** MSD source at 300 °C, quadrupole at 180 °C,  
transfer line at 280 °C, scan range 45-450 amu

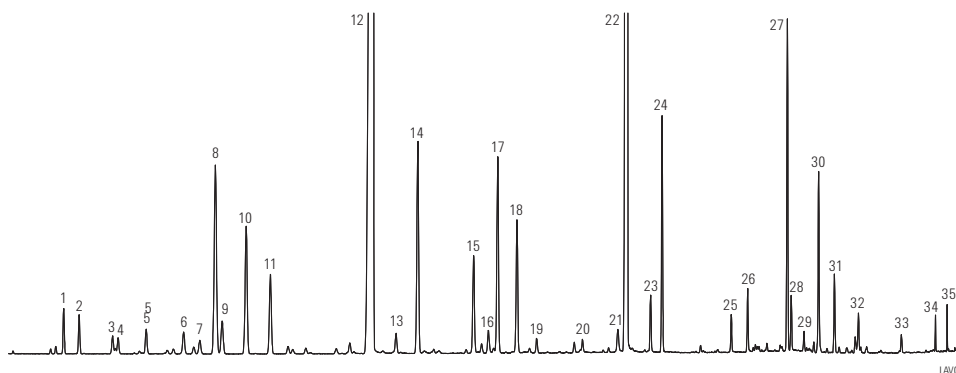
- |                        |                         |
|------------------------|-------------------------|
| 1. α-Pinene            | 19. Hexyl butyrate      |
| 2. Camphene            | 20. Cumic aldehyde      |
| 3. 1-Octen-3-ol        | 21. cis-Geraniol        |
| 4. 3-Octanone          | 22. Linalool acetate    |
| 5. β-Myrcene           | 23. Borneol acetate     |
| 6. 3-Carene            | 24. Lavandulyl acetate  |
| 7. α-Cymene            | 25. Nerol acetate       |
| 8. Eucalyptol          | 26. Geranyl Acetate     |
| 9. D-Limonene          | 27. Caryophyllene       |
| 10. β-trans-Ocimene    | 28. α-Santolene         |
| 11. β-cis-Ocimene      | 29. α-Bergamotene       |
| 12. β-Linalool         | 30. β-Farnesene         |
| 13. Octen-1-ol acetate | 31. Germacrene D        |
| 14. Camphor            | 32. γ-Cardinene         |
| 15. Borneol            | 33. Caryophyllene oxide |
| 16. Lavandulol         | 34. tau-Cardinol        |
| 17. Terpinen-4-ol      | 35. α-Bisabolol         |
| 18. α-Terpinol         |                         |

#### Suggested Supplies

**Septum:** 11 mm Advanced Green septa, 5183-4759

**Liner:** Split liner, single taper MS certified liner with restriction to hold glass wool,  
5188-6576

**Syringe:** 5 µL tapered, FN 23-26s/42/HP, 5181-1273



GC/MS total ion chromatogram of lavender oil sample on an Agilent J&W DB-1ms Ultra Inert 30 m x 0.25 mm, 0.25 µm capillary GC column (P/N 122-0132UI). The well-resolved, sharp peaks observed on the column ensure reliable analysis and fingerprinting of lavender oils.

**Essential Oils**

**Column: DB-WAX  
121-7022  
20 m x 0.18 mm, 0.18 µm**

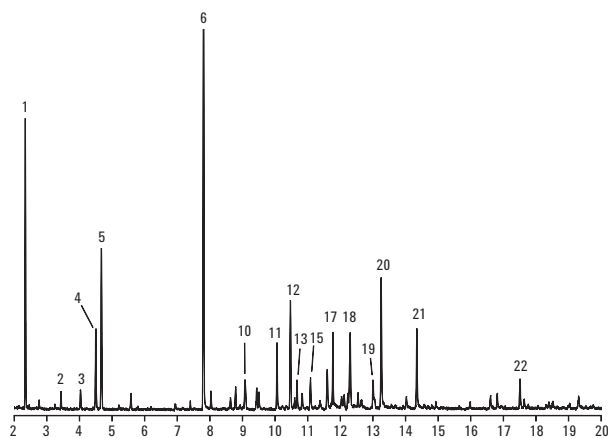
Carrier: Hydrogen @ 44.3 cm/sec  
Measured @ 45 °C

Injection: Split 1:30, 250 °C  
1 µL of 1:35 oil in acetone

Oven: 45 °C hold 0.77 min  
7.79 °C/min to 250 °C

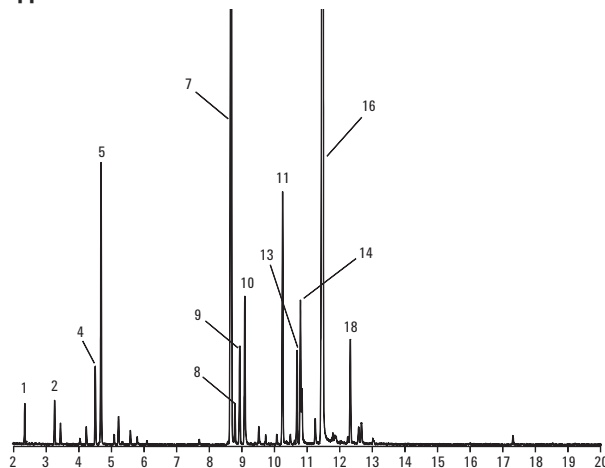
Detector: MSD full scan at m/z 40-500  
250 °C transfer line

**Wild chamomile**



1. α-Pinene
2. β-Pinene
3. β-Myrcene
4. D-Limonene
5. Eucalyptol
6. 2,4-Hexadienal
7. Menthone
8. γ-Terpinene
9. Menthofuran
10. Iso-Menthone
11. Δ-Carane
12. Bornyl acetate
13. β-Caryophyllene
14. Isomenthol
15. Citronellyl formate
16. Menthol
17. t-β-Farnesene
18. γ-Cadinene
19. δ-Cadinene
20. Citronellol
21. Nerol
22. β-Maaliene

**Peppermint**



### Fragrance Reference Standard

**Column:** DB-1  
122-1032  
30 m x 0.25 mm, 0.25 µm

**Carrier:** Helium at 25 cm/sec, measured at 150 °C

**Oven:** 40 °C for 1 min  
40-290 °C at 5 °C/min

**Injection:** Split, 250 °C  
Split ratio 1:50

**Detector:** MSD, 300 °C transfer line

**Sample:** 1 µL of a 1:20 dilution of neat sample in acetone

#### Suggested Supplies

**Septum:** 11 mm Advanced Green septa, 5183-4759

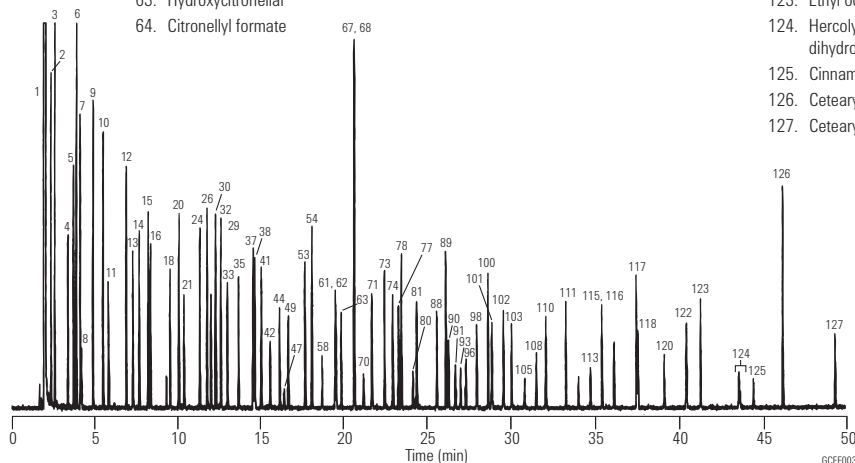
**Liner:** Split, single taper, low pressure drop, glass wool, 5183-4647

**Seal:** Gold plated seal, 18740-20885

**Syringe:** 5 µL tapered, FN 23-26s/42/HP, 5181-1273

Many thanks to Carl Frey, Manager of Analytical Services, Dragoco, and Kevin Myung, Director of Flavor and Perfumery Research, Bush Boake Allen, Inc. for contributing to this work.

- |  |                             |                                  |  |
|--|-----------------------------|----------------------------------|--|
| 1. Acetone                             | 33. 2,6-Dimethylhept-5-enal | 66. Bornyl acetate               | 97. trans-Nerolidol                                    |
| 2. 2,3-Butanedione (diacetyl)          | 34. γ-Terpinene             | 67. Vertenex (isomer 1)          | 98. n-Amyl salicylate                                  |
| 3. Ethyl acetate                       | 35. Octanol                 | 68. Ethyl nonanoate              | 99. Phenylethyl tiglate                                |
| 4. 2,3-Pentanedione (acetyl propionyl) | 37. Ethyl heptanoate        | 69. Geranyl formate              | 100. Ethyl dodecanoate                                 |
| 5. Ethyl propionate                    | 38. Linalool                | 70. Vertenex (isomer 2)          | 101. Benzophenone                                      |
| 6. Methyl butyrate                     | 39. Benzene ethanol         | 71. γ-Nonalactone                | 102. Dibenzyl ether                                    |
| 7. 3-Methylbutyl alcohol               | 41. Rose oxide, cis-rose    | 72. Citronellyl acetate          | 103. γ-Dodecalactone                                   |
| 8. 2-Methylbutyl alcohol               | 42. Rose oxide, trans-rose  | 73. Neryl acetate                | 104. Citronellyl tiglate                               |
| 9. Isobutyl acetate                    | 43. Camphor                 | 74. Geranyl acetate              | 105. Evernyl   |
| 10. Ethyl butyrate                     | 44. Citronellal             | 76. Diphenyl oxide               | 106. Geranyl tiglate                                   |
| 11. Furfural                           | 45. Benzyl acetate          | 78. Ethyl decanoate              | 107. Geranyl-2-methyl valerate                         |
| 12. Ethyl isovalerate                  | 46. Menthone                | 79. α-Copaene                    | 108. Celestocide                                       |
| 13. Hexanol                            | 47. Isoborneol              | 80. Florazone (isomer 1)         | 109. Heptadec-1-ene                                    |
| 14. Allyl butyrate                     | 48. Isomenthone             | 81. Florazone (isomer 2)         | 110. Benzyl benzoate                                   |
| 15. Ethyl pentanoate                   | 49. Borneol                 | 82. β-Caryophyllene              | 111. Ethyl tetradecanoate                              |
| 16. Hexylene glycol                    | 51. Terpinen-4-ol           | 83. Citronellyl propionate       | 112. Benzyl salicylate                                 |
| 17. α-Thujone                          | 52. α-Terpineol             | 85. 3,7-Guaiadiene               | 113. Tonalid   |
| 18. Benzaldehyde                       | 53. Ethyl octanoate         | 88. Dodecanol                    | 114. Nonadec-1-ene                                     |
| 19. α-Pinene                           | 54. Octyl acetate           | 89. Ethyl undecanoate            | 115. Isopropylmyristate                                |
| 20. Camphene                           | 56. Fenchyl acetate         | 90. Eugenyl acetate              | 116. Ethyl pentadecanoate                              |
| 21. 3,5,5-Trimethylhexanol             | 57. Citronellol             | 91. Frambione (raspberry ketone) | Nonadecane   |
| 22. Sabinene                           | 58. Neral                   | 93. Isoamyl salicylate           | 117. Ethyl hexadecanoate                               |
| 23. β-Pinene                           | 59. Carvone                 | 94. δ-Cadinene                   | 118. Musk T (ethylene brassylate)                      |
| 24. Ethyl hexanoate                    | Phenylethyl acetate         | 95. cis-Nerolidol                | 119. Eicosane  |
| 25. Myrcene                            | 60. Geraniol                | 96. Rosatol (rosetone)           | 120. Cinnamyl phenyl acetate                           |
| 26. Hexyl acetate                      | 61. Linalyl acetate         | Geranyl butyrate                 | 121. Heneicosane                                       |
| 27. cis-Linalool oxide                 | 62. Geranial                |                                  | 122. Phenyl ethyl cinnamate                            |
| 28. Methyl-cresol                      | 63. Hydroxycitronellal      |                                  | 123. Ethyl octadecanoate                               |
| 29. Benzyl alcohol                     | 64. Citronellyl formate     |                                  | 124. Herculyn D (tetrahydro & dihydro methyl abietate) |
| 30. para-Cymene                        |                             |                                  | 125. Cinnamyl cinnamate                                |
| 31. 1,8-Cineol                         |                             |                                  | 126. Cetearyl octanoate                                |
| 32. Limonene                           |                             |                                  | 127. Cetearyl decanoate                                |





### Fragrance Reference Standard

**Column:** DB-WAX  
122-7032  
30 m x 0.25 mm, 0.25 µm

**Carrier:** Helium at 25 cm/sec,  
measured at 150 °C

**Oven:** 45 °C for 2 min  
45-250 °C at 3 °C/min  
250 °C for 34 min

**Injection:** Split, 250 °C  
Split ratio 1:50

**Detector:** MSD, 250 °C transfer line

**Sample:** 1 µL of a 1:20 dilution of neat sample in acetone

### Suggested Supplies

**Septum:** 11 mm Advanced Green septa, 5183-4759

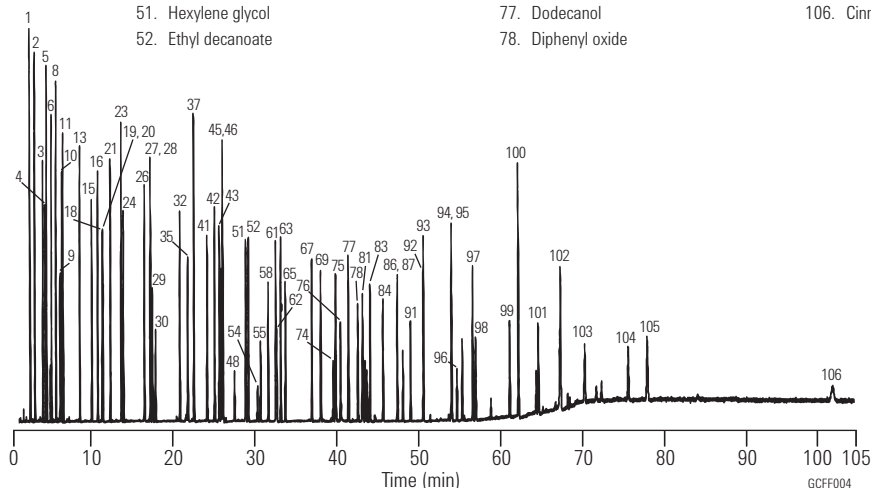
**Liner:** Split, single taper, low pressure drop, glass wool, 5183-4647

**Seal:** Gold plated seal, 18740-20885

**Syringe:** 5 µL tapered, FN 23-26s/42/HP, 5181-1273

Many thanks to Carl Frey, Manager of Analytical Services, Dragoco, and Kevin Myung, Director of Flavor and Perfumery Research, Bush Boake Allen, Inc. for contributing to this work.

- |  |   |                          |                                   |
|--|---|--------------------------|-----------------------------------|
| 1. Acetone                             | 27. 2,6-Dimethylhept-5-enal (Melona!TM) | 53. Citronellyl acetate  | 79. Citronellyl tiglate           |
| 2. Ethyl acetate                       | 28. Rose oxide, cis-rose                | 54. Isoborneol           | 80. Eugenyl methyl ether          |
| 3. Ethyl propionate                    | 29. Hexanol                             | 55. Neral                | 81. γ-Nonalactone                 |
| 4. 2,3-Butanedione (diacetyl)          | 30. Rose oxide, trans-rose              | 56. α-Terpineol          | 83. Ethyl tetradecanoate          |
| 5. Methyl butyrate                     | 31. Methyl-para-cresol                  | 57. Geranyl formate      | 84. n-Amyl salicylate             |
| 6. Isobutyl acetate                    | 32. Ethyl octanoate                     | 58. Borneol              | 85. Geranyl tiglate               |
| 7. α-Pinene                            | 33. cis-Linalool oxide                  | 59. β-Bisabolene         | 86. Ethyl pentadecanoate          |
| 8. Ethyl butyrate                      | 34. Menthone                            | 60. Benzyl acetate       | 87. Isopropylmyristate            |
| 9. 2,3-Pentanedione (acetyl propionyl) | 35. Furfural                            | 61. Neryl acetate        | 90. Phenylethyl tiglate           |
| 10. Camphene                           | 36. trans-Linalool oxide                | 62. Geranial             | 91. Rosatol (rosetone)            |
| 11. Ethyl isovalerate                  | 37. Octyl acetate                       | 63. Ethyl undecanoate    | 92. Eugenyl acetate               |
| 12. β-Pinene                           | 38. Isomenthone                         | 64. δ-Cadinene           | 93. Ethyl hexadecanoate           |
| 13. Ethyl pentanoate                   | 39. α-Copaene                           | 65. Geranyl acetate      | 94. γ-Dodecalactone               |
| 14. Myrcene                            | 40. Camphor                             | 66. Citronellol          | 95. Dibenzyl ether                |
| 15. Allyl butyrate                     | 41. Benzaldehyde                        | 67. Ethyl dodecanoate    | 96. Tonalid                       |
| 16. Limonene                           | 42. Ethyl nonanoate                     | 68. Geraniol             | 97. Ethyl octadecanoate           |
| 17. 1,8-Cineol                         | 43. Linalool                            | 69. Benzyl alcohol       | 98. Benzophenone                  |
| 18. 3,5,5-Trimethylhexanol             | 44. Linalyl acetate                     | 70. Geranyl butyrate     | 99. Benzyl benzoate               |
| 19. 3-Methylbutyl alcohol              | 45. Vertenex (isomer 1)                 | 71. Nonadecane           | 100. Cetearyl octanoate           |
| 20. 2-Methylbutyl alcohol              | 46. Octanol                             | 72. Benzene ethanol      | 101. Musk T (ethylene brassylate) |
| 21. Ethyl hexanoate                    | 47. β-Caryophyllene                     | 73. Nonadec-1-ene        | 102. Cetearyl decanoate           |
| 22. γ-Terpinene                        | 48. Vertenex (isomer 2)                 | 74. Florazone (isomer 1) | 103. Frambione (raspberry ketone) |
| 23. p-Cymene                           | 49. Terpinen-4-ol                       | 75. Florazone (isomer 2) | 104. Cinnamyl phenyl acetate      |
| 24. Hexyl acetate                      | 50. Methyl benzoate                     | 76. Hydroxycitronellal   | 105. Phenyl ethyl cinnamate       |
| 25. Terpinolene                        | 51. Hexylene glycol                     | 77. Dodecanol            | 106. Cinnamyl cinnamate           |
| 26. Ethyl heptanoate                   | 52. Ethyl decanoate                     | 78. Diphenyl oxide       |                                   |



### Perfume

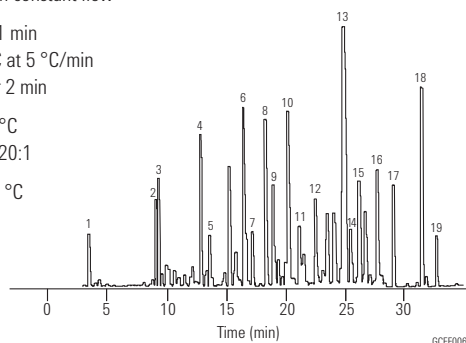
**Column:** HP-INNOWax  
19091N-133  
30 m x 0.25 mm, 0.25 µm

**Carrier:** Helium, 30 cm/sec  
0.9 mL/min constant flow

**Oven:** 80 °C for 1 min  
80-250 °C at 5 °C/min  
250 °C for 2 min

**Injection:** Split, 250 °C  
Split ratio 20:1

**Detector:** MSD, 280 °C



- |                          |                       |
|--------------------------|-----------------------|
| 1. Limonene              | 10. n-Amyl salicylate |
| 2. Linalool              | 11. Commamyl acetate  |
| 3. Linalyl acetate       | 12. Acetylcedrene     |
| 4. Benzyl acetate        | 13. Diethyl phthalate |
| 5. Citronellol           | 14. Tonalid           |
| 6. Benzene ethanol       | 15. Coumarin          |
| 7. α-Methyl Ionone       | 16. Musk xylene       |
| 8. Carvocrol and geraiol | 17. Benzyl benzoate   |
| 9. Isoamyl salicylate    | 18. Benzyl salicylate |
|                          | 19. Musk ketone       |

#### Suggested Supplies

- Septum:** 11 mm Advanced Green septa, 5183-4759
- Liner:** Split, single taper, low pressure drop, glass wool, 5183-4647
- Seal:** Gold plated seal, 18740-20885
- Syringe:** 5 µL tapered, FN 23-26s/42/HP, 5181-1273

### Chiral Compounds in Essential Oils and Fragrances

**Column:** HP Chiral β  
19091G-B233  
30 m x 0.25 mm, 0.25 µm

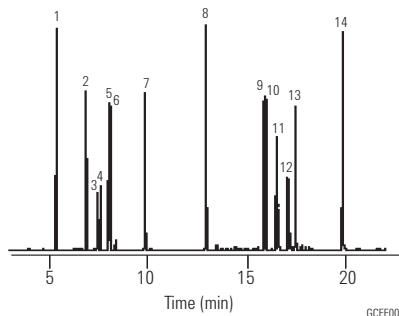
**Carrier:** Hydrogen, 39 cm/sec, constant pressure

**Oven:** 65 °C for 1 min  
65-170 °C at 5 °C/min

**Injection:** Split, 250 °C  
Split ratio 30:1

**Detector:** FID, 300 °C

**Sample:** 1 µL  
0.25 ng/µL each analyte in Hexane



1. 1,2-Dimethylbenzene
2. Myrcene
3. (-)-Camphene
4. (+)-Camphene
5. (+)-β-Pinene
6. 1S(-)-β-Pinene
7. Cineole
8. (R)-(+)-Citronellal
9. 1S,2R,5S-(+)-Menthhol
10. 1R,2S,5R(-)-Menthhol
11. α-Terpineol
12. (+/-)-Isoborneol
13. (+)-Borneol
14. trans-Cinnamaldehyde

### Menthol

**Column:** Cyclodex-β  
112-2532  
30 m x 0.25 mm, 0.25 µm

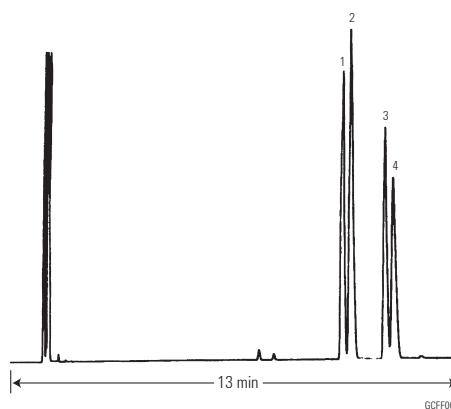
**Carrier:** Hydrogen, 55 cm/sec

**Oven:** 105 °C isothermal

**Injection:** Split, 250 °C  
Split ratio 1:100

**Detector:** FID, 300 °C  
Nitrogen makeup gas at 30 mL/min

**Sample:** 1 µL of 1 µg/µL each chloroform



1. (+)-Neomenthol
2. (-)- Neomenthol
3. (+)-Menthol
4. (-)-Menthol

**FAMES**

**Column:** DB-23  
122-2362  
60 m x 0.25 mm, 0.25 µm

**Carrier:** Hydrogen at 43 cm/sec,  
constant pressure mode

**Oven:** 130 °C for 1.0 min  
130-170 °C at 6.5 °C/min  
170-215 °C at 2.75 °C/min  
215 °C for 12 min  
215-230 °C at 40 °C/min  
230 °C for 3 min

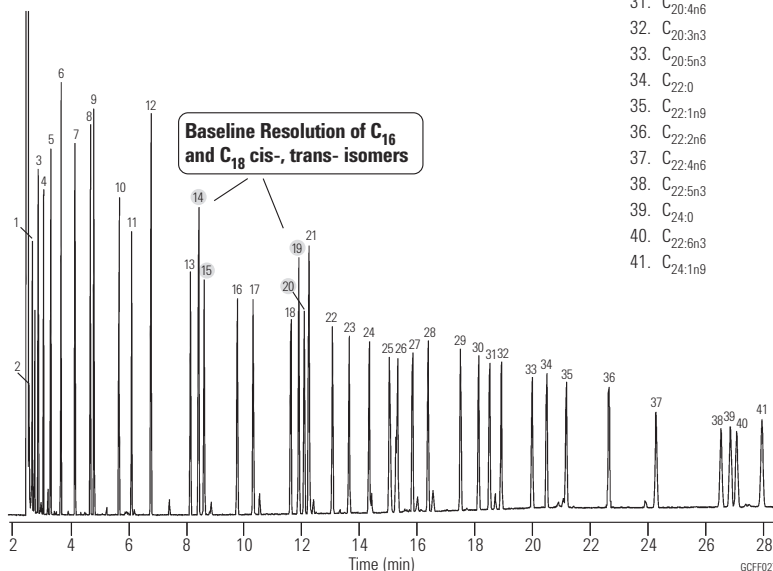
**Injection:** Split, 270 °C  
Split ratio 50:1

**Detector:** FID, 280 °C

- |                       |                                |                               |
|-----------------------|--------------------------------|-------------------------------|
| 1. C <sub>6:0</sub>   | 11. C <sub>14:1n5</sub>        | 21. C <sub>18:1n7</sub>       |
| 2. C <sub>7:0</sub>   | 12. C <sub>15:0</sub>          | 22. C <sub>18:2n6</sub>       |
| 3. C <sub>8:0</sub>   | 13. C <sub>16:0</sub>          | 23. C <sub>18:3n6</sub>       |
| 4. C <sub>9:0</sub>   | 14. C <sub>16:1n7(trans)</sub> | 24. C <sub>18:3n3</sub>       |
| 5. C <sub>10:0</sub>  | 15. C <sub>16:1n7(cis)</sub>   | 25. C <sub>18:2(d9,11)</sub>  |
| 6. C <sub>11:0</sub>  | 16. C <sub>17:0</sub>          | 26. C <sub>18:2(d10,12)</sub> |
| 7. C <sub>12:0</sub>  | 17. C <sub>17:1</sub>          | 27. C <sub>20:0</sub>         |
| 8. BHT                | 18. C <sub>18:0</sub>          | 28. C <sub>20:1n9</sub>       |
| 9. C <sub>13:0</sub>  | 19. C <sub>18:1n9(trans)</sub> | 29. C <sub>20:2n6</sub>       |
| 10. C <sub>14:0</sub> | 20. C <sub>18:1n9(cis)</sub>   | 30. C <sub>20:3n6</sub>       |

**Suggested Supplies**

- Septum:** 11 mm Advanced Green septa, 5183-4759  
**Liner:** Split, single taper, low pressure drop, glass wool, 5183-4647  
**Seal:** Gold plated seal, 18740-20885  
**Syringe:** 5 µL tapered, FN 23-26s/42/HP, 5181-1273



Chromatogram provided courtesy of Steve Watkins and Jeremy Ching, FAME Analytics, <http://www.fameanalytics.com>

**Analysis of Fragrance and Allergens**

**Column:** VF-WAXms  
CP9205  
30 m x 0.25 mm, 0.25 µm

**Oven:** 100 °C to 250 °C with 10 °C/min

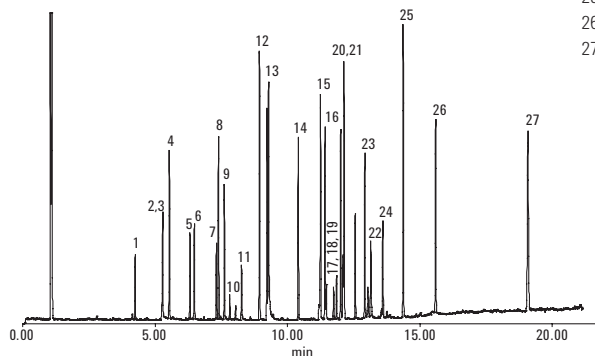
**Carrier:** Helium, 1.0 mL/min

**Injection:** Split 1:30, T = 250 °C

**Detector:** GC-MS Ion Trap  
Trap: 200 °C  
Manifold: 60 °C

**Sample:** 0.1 µL, Fragrances mixture (500 ppm)

- |                            |                            |                             |
|----------------------------|----------------------------|-----------------------------|
| 1. Linalool                | 9. Benzyl alcohol          | 17. Cinnamyl alcohol        |
| 2. Methyl heptin carbonate | 10. Cinnamaldehyde         | 18. Farnesol isomer I + II  |
| 3. Phenyl acetaldehyde     | 11. Hydroxy citronellal    | 19. Farnesol isomer III     |
| 4. Methyl chavicol         | 12. Methyl eugenol         | 20. iso-Eugenol             |
| 5. Methyl octin carbonate  | 13. Linal                  | 21. Hexyl cinnamic aldehyde |
| 6. Citronellol             | 14. Eugenol                | 22. Lyril (4,4-isomer)      |
| 7. Geraniol                | 15. Amyl cinnamyl aldehyde | 23. Coumarine               |
| 8. Methyl gamma ionone     | 16. Anisic alcohol         | 24. Amyl cinnamic alcohol   |
|                            |                            | 25. Benzyl benzoate         |
|                            |                            | 26. Benzyl salicylate       |
|                            |                            | 27. Benzyl cinnamate        |

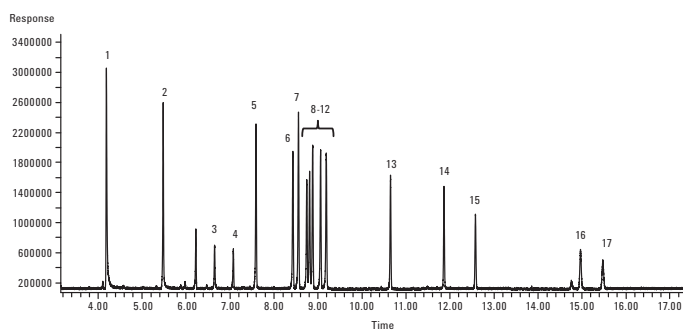


### Organophosphorus Pesticide Residues in Olive Oil Extract

**Column:** DB-35ms Ultra Inert  
122-3832UI  
30 m x 0.25 mm, 0.25 µm

**Instrument:** Agilent 7890/5975C  
**Sampler:** Agilent 7683B, 5.0 µL syringe (P/N 5181-1273)  
**CFT Device:** Purged 2-way splitter (P/N G3180B)  
Split Ratio MSD:FPD = 1:1  
**MSD Restrictor:** 1.43 m x 0.18 mm id deactivated fused silica tubing  
**FPD Restrictor:** 0.53 m x 0.18 mm id deactivated fused silica tubing  
**Aux EPC:** 3.8 psi constant pressure  
**Inlet:** 2 µL splitless; 250 °C, purge flow 60 mL/min at 0.25 min, gas saver on at 2 min 20 mL/min  
**Carrier:** Helium, constant pressure 28.85 psi at 95 °C  
**Oven:** 95 °C (0.5 min), 25 °C/min to 210 °C, 10 °C/min to 250 °C (0.5 min), 20 °C to 290 °C (4.5 min)  
**Postrun Backflush:** 7.5 min at 290 °C, Aux EPC pressure 54 psi during backflush, 2 psi inlet pressure during backflush  
**Detector:** MSD: 300 °C transfer line, 300 °C source, 150 °C quad  
FPD: 230 °C, Hydrogen 75 mL/min, Air 100 mL/min, Carrier + makeup (N<sub>2</sub>) 60 mL/min

- |                      |   |
|----------------------|---|
| 1. Methamidophos     | 10. Fenitrothion                        |
| 2. Acephate          | 11. Parathion                           |
| 3. Omethoate         | 12. Fenthion                            |
| 4. Diazinon          | 13. Methidathion                        |
| 5. Dimethoate        | 14. Carbophention                       |
| 6. Pirimiphos-methyl | 15. Triphenyl-phosphate (surrogate std) |
| 7. Parathion-methyl  | 16. Azinphos-methyl                     |
| 8. Malathion         | 17. Azinphos-ethyl                      |
| 9. Chlorpyrifos      |   |



GC/FPD chromatogram of a 100 ng/mL matrix-matched organophosphorus pesticide standard with analyte protectant analyzed on an Agilent J&W DB-35ms UI GC column.



#### TIPS & TOOLS

View the latest GC column focused applications, products and educational resources at [www.agilent.com/chem/myGCColumns](http://www.agilent.com/chem/myGCColumns)

### Fragrance Allergens

**Column:** HP-5ms  
19091S-433  
30 m x 0.25 mm, 0.25 µm

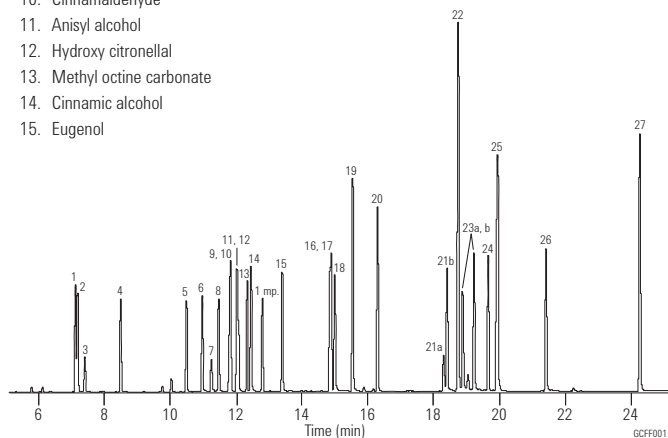
**Carrier:** Helium, 1.2 mL/min,  
constant pressure of 70 kPa

**Oven:** 50 °C - 1 min - 8 °C/min - 250 °C,  
250-300 °C @ 35 °C/min  
300 °C Hold, 5 min  
5973N MSD in scan (40-350 amu)  
Solvent Delay, 3.0 min

**Injection:** Split, 250 °C  
Split ratio 1:50

**Sample:** 1 µL, 50 ppm standard

- |                             |                            |                          |
|-----------------------------|----------------------------|--------------------------|
| 1. Limonene                 | 16. Coumarin               | 23a. Farnesol 1          |
| 2. Benzyl alcohol           | 17. Cinnamyl acetate       | 23b. Farnesol 1          |
| 3. Phenyl acetaldehyde      | 18. Isoeugenol             | 24. Hexyl cinnamaldehyde |
| 4. Linalool                 | 19. Alpha isomethyl ionone | 25. Benzyl benzoate      |
| 5. Methyl heptin carbonate  | 20. Lilial (BMHCA)         | 26. Benzyl salicylate    |
| 6. Citronellol              | 21a. Lyrall 1              | 27. Benzyl cinnamate     |
| 7. Neral                    | 21b. Lyrall 2              |                          |
| 8. Geraniol                 | 22. Amyl cinnamyl alcohol  |                          |
| 9. Citral (geranial)        |                            |                          |
| 10. Cinnamaldehyde          |                            |                          |
| 11. Anisyl alcohol          |                            |                          |
| 12. Hydroxy citronellal     |                            |                          |
| 13. Methyl octine carbonate |                            |                          |
| 14. Cinnamic alcohol        |                            |                          |
| 15. Eugenol                 |                            |                          |



#### Suggested Supplies

- Septum:** 11 mm Advanced Green septa, 5183-4759
- Liner:** Split, single taper, low pressure drop, glass wool, 5183-4647
- Seal:** Gold plated seal, 18740-20885
- Syringe:** 5 µL tapered, FN 23-26s/42/HP, 5181-1273

### Flavor Mixture

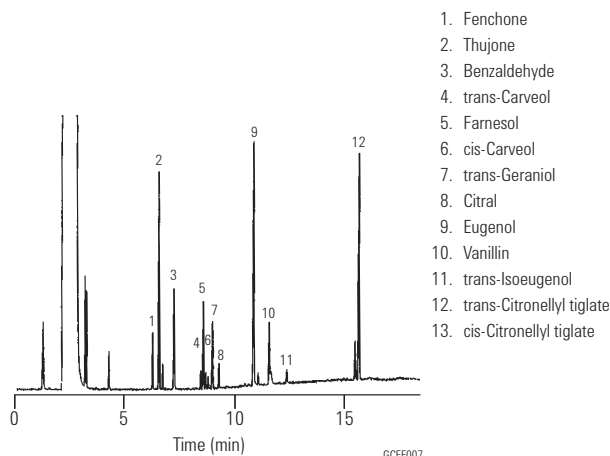
**Column:** ULTRA 2  
19091B-112  
25 m x 0.32 mm, 0.52 µm

**Carrier:** Helium, 90 kPa., 2.2 mL/min constant flow

**Oven:** 80 °C for 1 min  
80-210 °C at 8 °C/min  
210 °C for 2 min

**Injection:** Split, 250 °C  
Split ratio 20:1

**Detector:** IRD, 280 °C  
Wide Band MCT, 550 to 4000 cm-1



1. Fenchone
2. Thujone
3. Benzaldehyde
4. trans-Carveol
5. Farnesol
6. cis-Carveol
7. trans-Geraniol
8. Citral
9. Eugenol
10. Vanillin
11. trans-Isoeugenol
12. trans-Citronellyl tiglate
13. cis-Citronellyl tiglate

#### Suggested Supplies

- Septum:** 11 mm Advanced Green septa, 5183-4759
- Liner:** General purpose split/splitless liner, taper, glass wool, 5183-4711
- Seal:** Gold plated seal, 18740-20885
- Syringe:** 10 µL tapered, FN 23-26s/42/HP, 5181-1267

**Lemon Oil**

**Column:** DB-5  
127-5022  
20 m x 0.10 mm, 0.10 µm

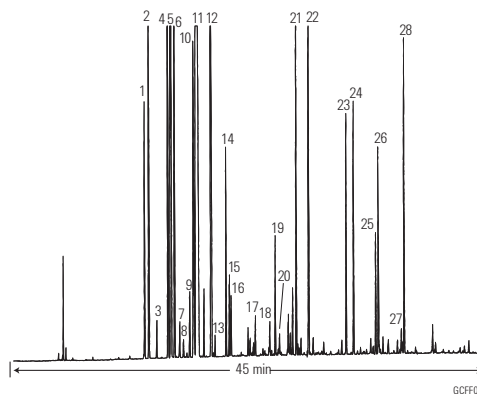
**Carrier:** Hydrogen at 60 cm/sec, measured at 40 °C

**Oven:** 40 °C for 3 min  
40-185 °C at 30 °C/min  
185 °C for 3 min

**Injection:** Split, 275 °C  
Split ratio 1:275

**Detector:** Nitrogen makeup gas at 30 mL/min

- |              |                   |                         |
|--------------|-------------------|-------------------------|
| 1. α-Thujone | 7. Octanal        | 13. Octanol             |
| 2. β-Thujone | 8. α-Phellandrene | 14. Terpinolene         |
| 3. Camphene  | 9. α-Terpinene    | 15. Linalool            |
| 4. Sabinene  | 10. r-Cymene      | 16. Nonanal             |
| 5. β-Pinene  | 11. δ-Limonene    | 17. Citronellal         |
| 6. Myrcene   | 12. γ-Terpinene   | 18. Terpinen-4-ol       |
|              |                   | 19. α-Terpineol         |
|              |                   | 20. Decanal             |
|              |                   | 21. Neral               |
|              |                   | 22. Geranial            |
|              |                   | 23. Nerylacetate        |
|              |                   | 24. Geranylacetate      |
|              |                   | 25. β-Caryophyllene     |
|              |                   | 26. trans-α-Bergamotene |
|              |                   | 27. α-Humulene          |
|              |                   | 28. β-Bisabolene        |



**Suggested Supplies**

- Septum:** 11 mm Advanced Green septa, 5183-4759
- Liner:** Split, single taper, low pressure drop, glass wool, 5183-4647
- Seal:** Gold plated seal, 18740-20885
- Syringe:** 5 µL tapered, FN 23-26s/42/HP, 5181-1273

**Fast analysis of lemon oil using Rapid-MS**

**Column:** Rapid MS

**Sample:** 0.3 µL

**Sample Conc:** Pure lemon oil

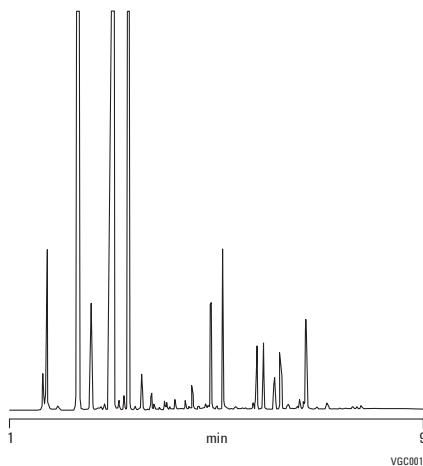
**Solvent:** Producto puro

**Carrier:** He, 100 kPa (1.0 bar, 14 psi)

**Oven:** 40 °C (2 min)  
200 °C, 20 °C/min

**Injection:** Split

**Detector:** Ion Trap



### Cold-Pressed Orange Oil

**Column:** DB-5  
127-5022  
20 m x 0.10 mm, 0.10 µm

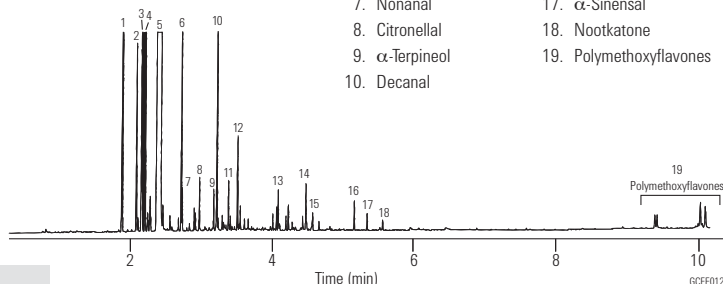
**Carrier:** Hydrogen at 60 cm/sec, measured at 70 °C

**Oven:** 70 °C for 1 min  
70-250 °C at 30 °C/min  
250-310 °C at 20 °C/min  
310 °C for 2 min

**Injection:** Split, 275 °C  
Split ratio 1:275

**Detector:** FID, 350 °C  
Nitrogen makeup gas at 30 mL/min

- |                |                         |
|----------------|-------------------------|
| 1. α-Pinene    | 11. Neral               |
| 2. Sabinene    | 12. Geranial            |
| 3. Myrcene     | 13. Dodecenal           |
| 4. Octanal     | 14. Valencene           |
| 5. Limonen     | 15. Cadinene            |
| 6. Linalool    | 16. β-Sinensal          |
| 7. Nonanal     | 17. α-Sinensal          |
| 8. Citronellal | 18. Nootkatone          |
| 9. α-Terpineol | 19. Polymethoxyflavones |
| 10. Decanal    |                         |



#### Suggested Supplies

- Septum:** 11 mm Advanced Green septa, 5183-4759  
**Liner:** Split, single taper, low pressure drop, glass wool, 5183-4647  
**Seal:** Gold plated seal, 18740-20885  
**Syringe:** 5 µL tapered, FN 23-26s/42/HP, 5181-1273

Chromatogram courtesy of Tastemaker

### Peppermint Oil

**Column:** DB-WAX  
122-7062  
60 m x 0.25 mm, 0.25 µm

**Carrier:** Helium at 25 cm/sec (0.73 mL/min)

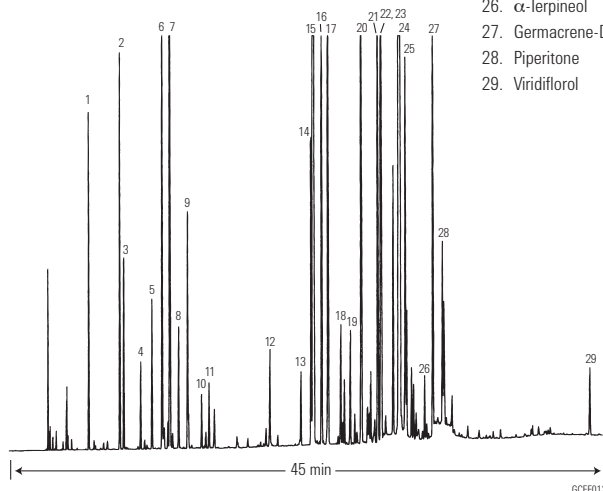
**Oven:** 75 °C for 8 min  
75-200 °C at 4 °C/min  
200 °C for 5 min

**Injection:** Split, 270 °C  
Split ratio 1:150

**Detector:** FID, 270 °C  
Nitrogen makeup gas at 30 mL/min

**Sample:** 1 µL neat

- |                   |                            |                     |
|-------------------|----------------------------|---------------------|
| 1. α-Pinene       | 9. Terpinene               | 17. d-Isomethone    |
| 2. β-Pinene       | 10. r-Cymene               | 18. β-Bourbonene    |
| 3. Sabinene       | 11. γ-Terpinolene          | 19. Linalool        |
| 4. Myrcene        | 12. 3-Octanol              | 20. Menthyl acetate |
| 5. α-Terpinene    | 13. 1-Octen-3-ol           | 21. Neomenthol      |
| 6. (+/-)-Limonene | 14. trans-Sabinene hydrate | 22. Terpinen-4-ol   |
| 7. 1,8-Cineol     | 15. (+/-)-Methone          | 23. β-Caryophyllene |
| 8. cis-OCimene    | 16. Methofuran             | 24. (+/-)-Menthol   |
|                   |                            | 25. Pulegone        |
|                   |                            | 26. α-Terpineol     |
|                   |                            | 27. Germacrene-D    |
|                   |                            | 28. Piperitone      |
|                   |                            | 29. Viridiflorol    |



Thanks to Mr. William Faas of A.M. Todd Company for providing the sample and assisting with peak identification.

#### Suggested Supplies

- Septum:** 11 mm Advanced Green septa, 5183-4759  
**Liner:** Split, single taper, low pressure drop, glass wool, 5183-4647  
**Seal:** Gold plated seal, 18740-20885  
**Syringe:** 5 µL tapered, FN 23-26s/42/HP, 5181-1273

### Spearmint Oil (Western)

**Column:** DB-WAX  
122-7062  
60 m x 0.25 mm, 0.25 μm

**Carrier:** Helium at 25 cm/sec (0.73 mL/min)

**Oven:** 75 °C for 8 min  
75-200 °C at 4 °C/min  
200 °C for 5 min

**Injection:** Split, 270 °C  
Split ratio 1:150

**Detector:** FID, 270 °C  
Nitrogen makeup gas at 30 mL/min

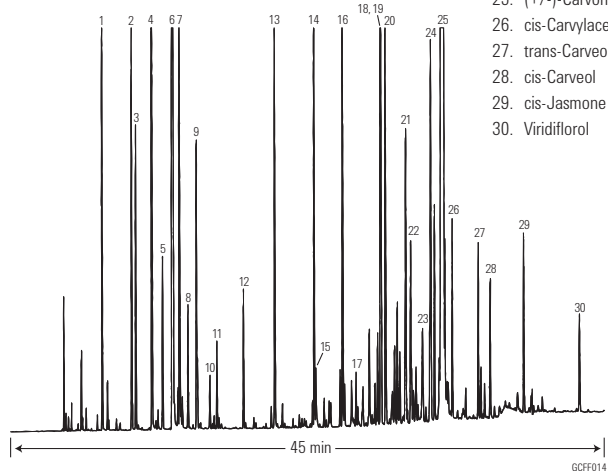
**Sample:** 1 μL neat

- |                    |                            |
|--------------------|----------------------------|
| 1. α-Pinene        | 13. 3-Octanol              |
| 2. β-Pinene        | 14. trans-Sabinene hydrate |
| 3. Sabinene        | 15. (+/-)-Methone          |
| 4. Myrcene         | 16. β-Bourbonene           |
| 5. α-Terpinene     | 17. Linalool               |
| 6. (+/-)-Limonene  | 18. Trepinen-4-ol          |
| 7. 1,8-Cineol      | 19. β-Caryophyllene        |
| 8. cis-OCimene     | 20. Dihydrocarvone         |
| 9. γ-Terpinene     | 21. trans-Dihydrocarvyl    |
| 10. r-Cymene       | 22. trans-β-Farnesene      |
| 11. Terpinolene    | 23. α-Terpineol            |
| 12. 3-Octylacetate | 24. Germacrene-D           |
|                    | 25. (+/-)-Carvone          |
|                    | 26. cis-Carvylacetate      |
|                    | 27. trans-Carveol          |
|                    | 28. cis-Carveol            |
|                    | 29. cis-Jasmone            |
|                    | 30. Viridiflorol           |

#### Suggested Supplies

- Septum:** 11 mm Advanced Green septa, 5183-4759  
**Liner:** Split, single taper, low pressure drop, glass wool, 5183-4647  
**Seal:** Gold plated seal, 18740-20885  
**Syringe:** 5 μL tapered, FN 23-26s/42/HP, 5181-1273

Thanks to Mr. William Faas of A.M. Todd Company for providing the sample and assisting with peak identification.



### Ylang Ylang Oil

**Column:** DB-XLB  
122-1232  
30 m x 0.25 mm, 0.25 μm

**Carrier:** Helium at 34 cm/sec, measured at 50 °C

**Oven:** 50 °C for 1 min  
50-250 °C at 3.5 °C/min

**Injection:** Split, 250 °C  
Split ratio 1:125

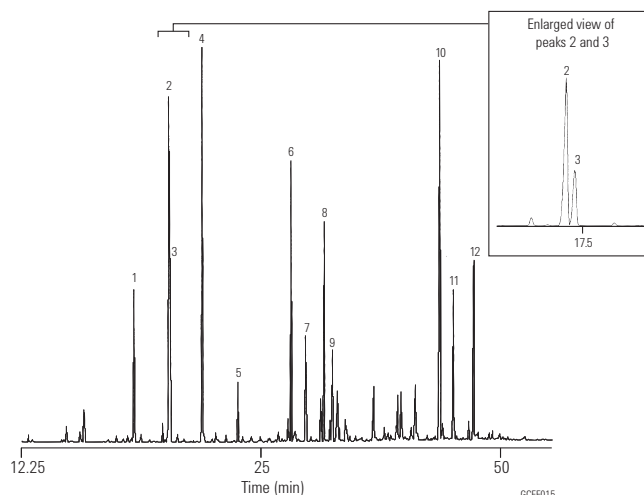
**Detector:** MSD, 310 °C transfer line  
full scan at m/z 35-550

**Sample:** 1 μL of 10% oil in methylene chloride

- |                    |                       |
|--------------------|-----------------------|
| 1. r-Methylansiole | 7. β-Caryophyllene    |
| 2. Linalool        | 8. Cinnamylacetate    |
| 3. Methylbenzoate  | 9. Germacrene-D       |
| 4. Benzylacetate   | 10. Benzyl benzoate   |
| 5. Geraniol        | 11. Faneosolacetate   |
| 6. Geranylacetate  | 12. Benzyl salicylate |

#### Suggested Supplies

- Septum:** 11 mm Advanced Green septa, 5183-4759  
**Liner:** Split, single taper, low pressure drop, glass wool, 5183-4647  
**Seal:** Gold plated seal, 18740-20885  
**Syringe:** 5 μL tapered, FN 23-26s/42/HP, 5181-1273



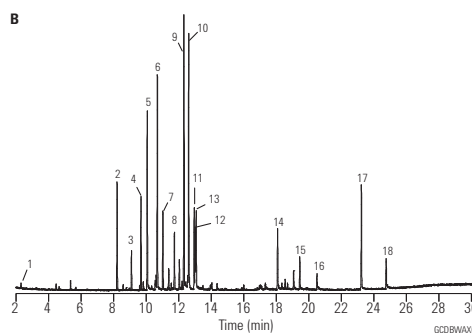
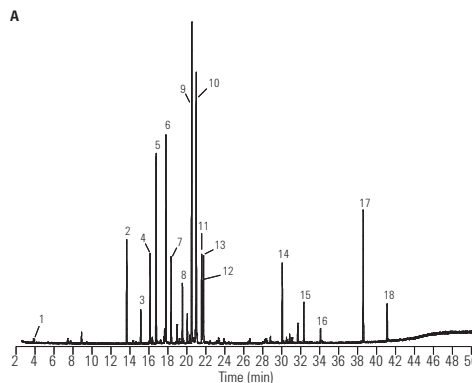


### Ylang Ylang Oil

**Column:** DB-WAX  
121-7022  
20 m x 0.18 mm, 0.18 μm

**Carrier:** A: Helium 26.3 cm/sec measured at 45 °C  
B: Hydrogen 44.3 cm/sec measured at 45 °C

**Oven:** A: 45 °C hold 1.28 min  
4.68 °C/min to 250 °C hold 21.81 min  
B: 45 °C hold 0.77 min  
7.79 °C/min to 250 °C hold 13.09 min



1. α-Pinene
2. Methyl-ρ-cresol
3. α-Copaene
4. α-Gurjunene
5. Linalool
6. β-Caryophyllene
7. Methyl benzoate
8. α-Caryophyllene
9. Germacrene-d
10. Benzyl acetate
11. Farnescene
12. δ-Cadinene
13. Geranial acetate
14. trans-Cinnamyl acetate
15. β-Bisbolene
16. Farnesyl acetate
17. Benzyl benzoate
18. Benzyl salicylate

### Rosemary Oil

**Column:** Cyclosil-B  
112-6632  
30 m x 0.25 mm, 0.25 μm

**Carrier:** Hydrogen at 40 cm/sec, measured at 60 °C

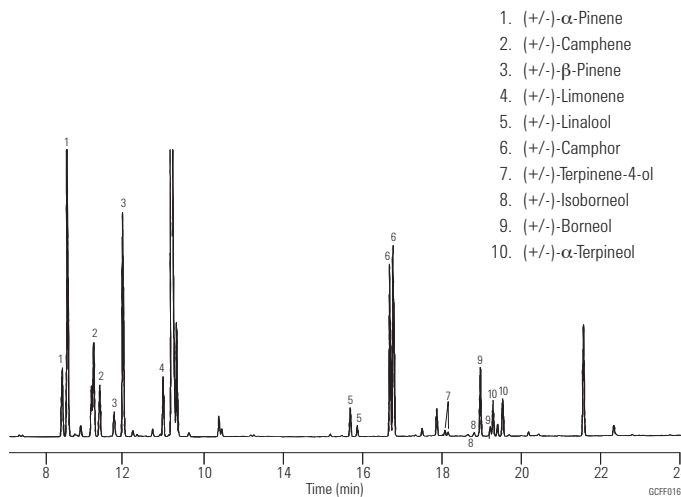
**Oven:** 55 °C for 1 min  
50-180 °C at 5 °C/min

**Injection:** Split, 250 °C  
Split ratio 50:1

**Detector:** FID, 340 °C

#### Suggested Supplies

- Septum:** 11 mm Advanced Green septa, 5183-4759
- Liner:** Split, single taper, low pressure drop, glass wool, 5183-4647
- Seal:** Gold plated seal, 18740-20885
- Syringe:** 5 μL tapered, FN 23-26s/42/HP, 5181-1273



1. (+/-)-α-Pinene
2. (+/-)-Camphene
3. (+/-)-β-Pinene
4. (+/-)-Limonene
5. (+/-)-Linalool
6. (+/-)-Camphor
7. (+/-)-Terpinene-4-ol
8. (+/-)-Isoborneol
9. (+/-)-Borneol
10. (+/-)-α-Terpineol

### Citrus Flavored Carbonated Beverage (Soda)

**Column:** Cyclosil-B  
112-6632  
30 m x 0.25 mm, 0.25 µm

**Carrier:** Helium at 37 cm/sec,  
measured at 40 °C

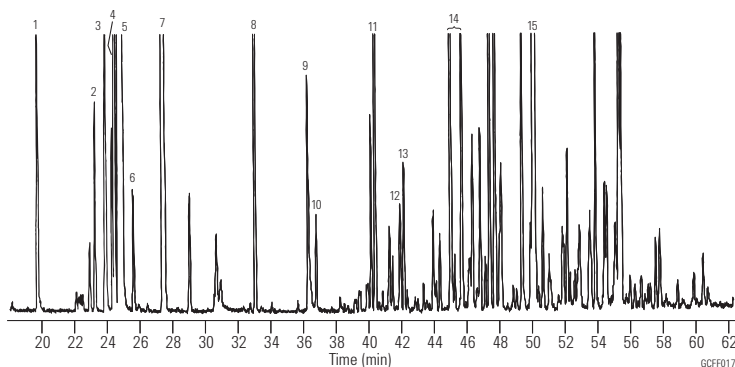
**Oven:** 40-190 °C at 2 min

**Sampler:** Headspace  
no stir, NaCl 1g/10 mL sample  
Adsorption: 27 °C for 68 min  
Desorption: 250 °C for 15 min

**Injection:** Split, 1:5  
Polyacrylate fiber, 85 µm

**Detector:** MSD, 280 °C transfer line

- |                      |                      |
|----------------------|----------------------|
| 1. S-(-)-Limonene    | 8. Linalool          |
| 2. p-Cymene          | 9. Decanol           |
| 3. (+)-Limonene      | 10. Terpinen-4-ol    |
| 4. Octanol           | 11. Phenethylalcohol |
| 5. γ-Terpinene       | 12. α-Terpineol      |
| 6. Nonanol           | 13. BHT              |
| 7. 2-Ethyl-1-Hexanol |                      |



#### Suggested Supplies

**Septum:** 11 mm Advanced Green septa, 5183-4759

**Liner:** Split, single taper, low pressure drop,  
glass wool, 5183-4647

**Seal:** Gold plated seal, 18740-20885

**Syringe:** 5 µL tapered, FN 23-26s/42/HP,  
5181-1273

### Alcohol Beverage Standard

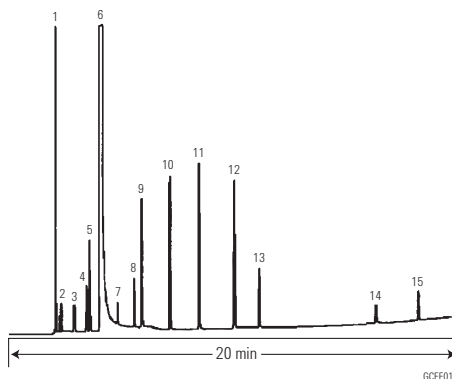
**Column:** HP-FFAP  
19091F-105  
50 m x 0.20 mm, 0.30 µm

**Carrier:** Hydrogen

**Oven:** 60 °C for 4 min  
60-200° C at 6 °C/min  
200 °C for 2 min

**Detector:** FID

1. Acetaldehyde
2. Acetone
3. Ethyl formate
4. Ethyl acetate
5. Methanol
6. Ethanol
7. Diacetyl
8. sec-Butanol
9. n-Propanol
10. Isobutanol
11. n-Butanol
12. Isoamyl alcohol
13. n-Amyl alcohol
14. Acetic acid
15. Propionic acid



**Bourbon**

**Column:** HP-INNOWax  
19091N-133  
30 m x 0.25 mm, 0.25 µm

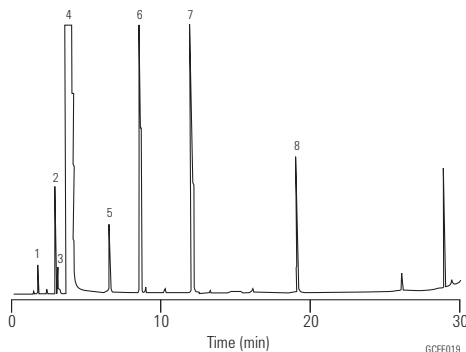
**Carrier:** Helium, 33 cm/sec, 15.5 psi (35°C)  
1.5 mL/min constant flow

**Oven:** 35 °C for 5 min  
35-150 °C at 5 °C/min  
150-250 °C at 20 °C/min  
250 °C for 2 min

**Injection:** Split, 220 °C  
Split ratio 25:1

**Detector:** FID 280 °C

**Sample:** 1 µL



1. Acetaldehyde
2. Ethyl acetate
3. Methanol
4. Ethanol
5. Acetic acid
6. n-Propanol
7. Isobutanol
8. 2-Methyl-1-butanol or 3-Methyl-1-Butanol

**Alditol Acetates**

**Column:** DB-225  
122-2231  
30 m x 0.25 mm, 0.15 µm

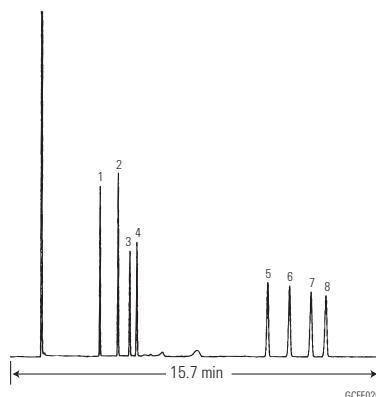
**Carrier:** Hydrogen a 36.5 cm/sec

**Oven:** 220 °C isothermal

**Injection:** Split, 225 °C  
Split ratio 1:50

**Detector:** FID, 250 °C  
Nitrogen makeup gas at 30 mL/min

**Sample:** 1 µL



1. Rhamnitol
2. Fucitol
3. Ribitol
4. Arabinitol
5. Mannitol
6. Galactitol
7. Glucitol
8. Inositol

**Strawberry Syrup**

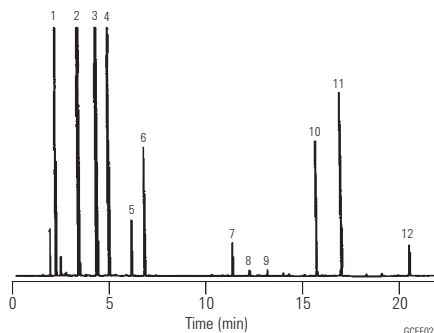
**Column:** HP-INNOWax  
19091N-213  
30 m x 0.32 mm, 0.50 µm

**Carrier:** Helium, 40 cm/sec, 11.7 psi (60°C)  
2.5 mL/min constant flow

**Oven:** 60 °C for 1 min  
60-250 °C at 10 °C/min  
250 °C for 2 min

**Injection:** Split, 220 °C  
Split ratio 60:1

**Detector:** FID 275 °C



1. Ethyl acetate
2. Ethyl butyrate
3. Isoamyl acetate
4. Amyl acetate
5. Isoamyl butyrate
6. Amyl butyrate
7. Ethyl benzoate
8. Citronellol
9. Geraniol
10. Ethyl-3-phenyl oxiran carboxylate
11. Strawberry aldehyde
12. Benzyl benzoate

### Separation of TMS-derivatized sugars using VF-1ms

**Column:** VF-1ms  
CP8912  
30 m x 0.25 mm, 0.25 µm

Sample: 5 µL, splitless 1 µL

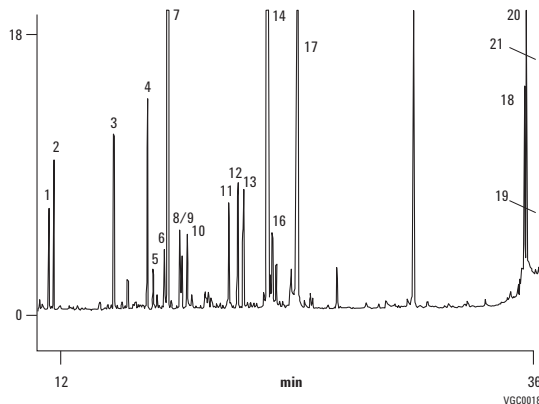
Sample Conc: 40 ppb

Carrier: He, 1.0 mL/min

Oven: 105 °C to 240 °C,  
4 °C/min to 300 °C,  
20 °C/min

Injection: Split; 1:15

Detector: MS



1. Threitol
2. Erythritol
3. Rhamnose 1
4. Rhamnose 2
5. Xylose 1
6. Arabitol
7. Ribitol
8. 3-O-Methylglucose 1
9. Xylose 2
10. Rhamnitol
11. 3-O-Methylglucose 2
12. Glucuron acid-1,5-lacton
13. Ribose 2
14. Manitol
15. Sorbitol (not identified)
16. Galactitol
17. Glucuron acid
18. Lactulose
19. Lactose
20. Sucrose
21. Threhalose

### Organic Acids

**Column:** DB-FFAP  
122-3232  
30 m x 0.25 mm, 0.25 µm

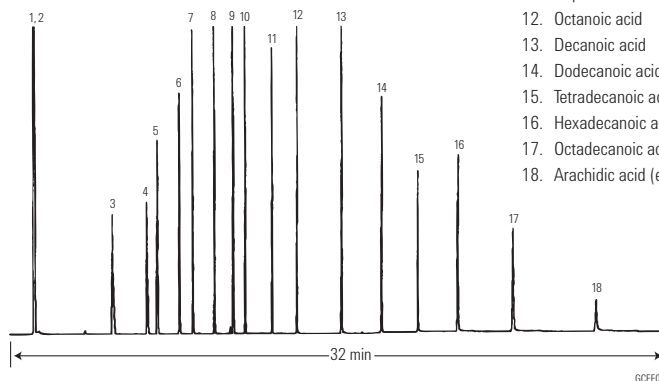
Carrier: Helium at 40 cm/sec, measured at 100 °C

Oven: 100 °C for 5 min  
100-250 °C at 10 °C/min  
250 °C for 12 min

Injection: Split, 250 °C  
Split ratio 1:50

Detector: FID, 300 °C  
Nitrogen makeup gas at 30 mL/min

1. Acetone
2. Formic acid
3. Acetic acid
4. Propionic acid
5. Isobutyric acid
6. Butyric acid
7. Isovaleric acid
8. Valeric acid (pentanoic acid)
9. Isocaproic acid
10. Caproic acid (hexanoic acid)
11. Heptanoic acid
12. Octanoic acid
13. Decanoic acid
14. Dodecanoic acid
15. Tetradecanoic acid
16. Hexadecanoic acid
17. Octadecanoic acid
18. Arachidic acid (eicosanoic acid)



#### Suggested Supplies

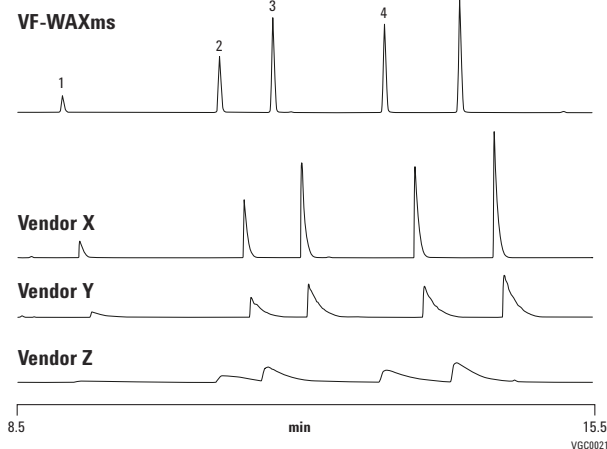
- Septum:** 11 mm Advanced Green septa, 5183-4759
- Liner:** Split, single taper, low pressure drop, glass wool, 5183-4647
- Seal:** Gold plated seal, 18740-20885
- Syringe:** 5 µL tapered, FN 23-26s/42/HP, 5181-1273

**Acids**

**Column:** VF-WAXms  
CP9205  
30 m x 0.25 mm, 0.25 µm

Sample: Acid sample, 0.1% (Cyclohexane), 1.0 µL  
Carrier: Hydrogen, 75 kPa  
Oven: 60 °C to 200 °C, 5 °C/min  
Injection: 250 °C, split 100 mL/min

1. Acetic acid
2. Propionic acid
3. Iso-butyric acid
4. Butyric acid
5. Iso-valeric acid



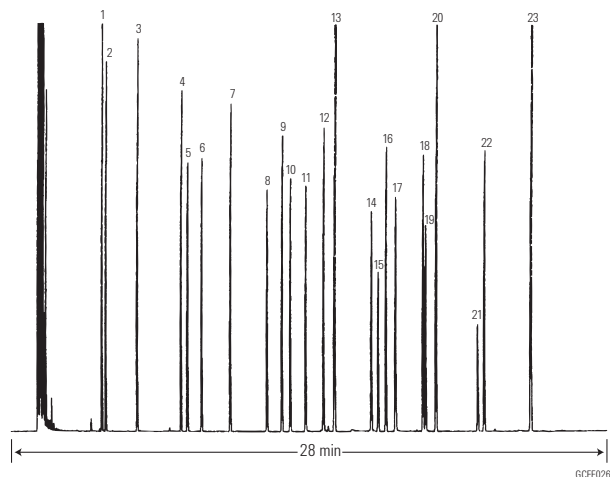
**Bacterial Fatty Acid Methyl Esters**

**Column:** DB-5  
122-5032  
30 m x 0.25 mm, 0.25 µm

Carrier: Hydrogen at 42 cm/sec  
Oven: 150 °C for 4 min  
150-250 °C at 4 °C/min  
Injection: Split ratio 1:100  
Detector: FID  
Nitrogen makeup gas at 30 mL/min

**Suggested Supplies**

- Septum:** 11 mm Advanced Green septa, 5183-4759  
**Liner:** Split, single taper, low pressure drop, glass wool, 5183-4647  
**Seal:** Gold plated seal, 18740-20885  
**Syringe:** 5 µL tapered, FN 23-26s/42/HP, 5181-1273



1. C<sub>11:0</sub> Methylundecanoate
2. 2-OH C<sub>10:0</sub> Methyl 2-hydroxydecanoate
3. C<sub>12:0</sub> Methyl laurate
4. C<sub>13:0</sub> Methyl tridecanoate
5. 2-OH C<sub>12:0</sub> Methyl 2-hydroxydodecanoate
6. 3-OH C<sub>12:0</sub> Methyl 3-hydroxydodecanoate
7. C<sub>14:0</sub> Methyl myristate
8. 12-Me C<sub>14:0</sub> Methyl 12-methyltetradecanoate
9. C<sub>15:0</sub> Methyl pentadecanoate
10. 2-OH C<sub>14:0</sub> Methyl 2-hydroxytetradecanoate
11. 3-OH C<sub>14:0</sub> Methyl 3-hydroxytetradecanoate
12. C<sub>16:1</sub> Methyl palmitoleate
13. C<sub>16:0</sub> Methyl palmitate
14. 14-Me C<sub>16:0</sub> Methyl 14-methylhexadecanoate
15. 9,10-diMe C<sub>16:0</sub> Methyl cis-9,10-methylene hexadecanoate
16. C<sub>17:0</sub> Methyl heptadecanoate
17. 2-OH C<sub>16:0</sub> Methyl 2-hydroxyhexadecanoate
18. C<sub>18:1</sub> Methyl oleate
19. C<sub>18:1</sub> Methyl elaidate
20. C<sub>18:0</sub> Methyl stearate
21. 9,10-diMe C<sub>18:0</sub> Methyl cis-9,10-methylene octadecanoate
22. C<sub>19:0</sub> Methyl nonadecanoate
23. C<sub>20:0</sub> Methyl arachidate

### Separation of cis-trans FAME isomers

**Column:** Select FAME  
CP7421  
200 m x 0.25 mm,

Sample: 0.5 µL

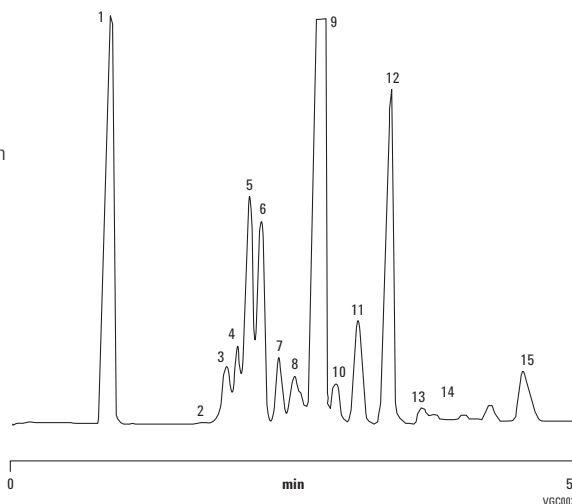
Sample Conc: 5 g approx. per component on the column

Carrier: Helium, 520 kPa

Oven: 185 °C

Injection: Split, 1:20

Detector: FID



1. C18:0
2. C18:1 7 trans
3. C18:1 8 trans
4. C18:1 9 trans
5. C18:1 10 trans
6. C18:1 11 trans
7. C18:1 12 trans
8. C18:1 13 trans + ?
9. C18:1 9 cls
10. C18:1 10 cls
11. C18:1 11 cls
12. C18:1 12 cls
13. C18:1 13 cls
14. C18:1 14 cls
15. C18:1 15 cls

### 69 Component FAME Mix

**Column:** HP-88  
112-8867  
60 m x 0.25 mm, 0.20 µm

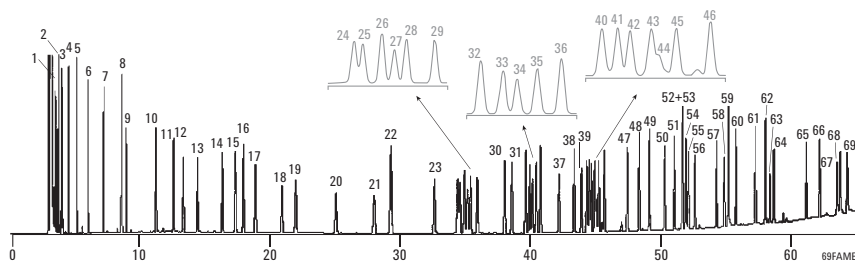
Carrier: He at 1.4 mL/min constant flow

Oven: 125 °C  
125 °C to 145 °C at 8 °C/min  
145 °C for 26 min  
145 °C to 220 °C at 2 °C/min  
220 °C for 1 min

Injection: Split, 250 °C  
Split ratio 50:1  
1 µL of 70 ppm each in CHCl<sub>3</sub>

Detector: FID, 260 °C

- |                 |                     |                        |                           |                            |
|-----------------|---------------------|------------------------|---------------------------|----------------------------|
| 1. nC6:0        | 16. C15:1 (14c)     | 31. C19:1 (10t)        | 46. C18:2 (10t,12c)       | 61. nC24:0                 |
| 2. nC7:0        | 17. nC16:0          | 32. nC19:0             | 47. nC21:0                | 62. C22:3 (13c,16c,19c)    |
| 3. nC8:0        | 18. C16:1 (9t)      | 33. C19:1 (7t)         | 48. C20:2 (11c,14c)       | 63. C22:4 (7c,10c,13c,16c) |
| 4. nC9:0        | 19. C16:1 (9c)      | 34. C18:2 (9c,12c)     | 49. C21:1 (12c)           | 64. C24:1 (15c)            |
| 5. nC10:0       | 20. nC17:0          | 35. C19:1 (7c)         | 50. C20:3 (8c,11c,14c)    | 65. C22:5 (DPA)            |
| 6. nC11:0       | 21. C17:1 (10t)     | 36. C19:1 (10c)        | 51. nC22:0                | 66. C22:6 (DHA)            |
| 7. nC12:0       | 22. C17:1 (10c)     | 37. C18:3 g(6c,9c,12c) | 52. C22:1 (13t)           | 67. C18:1-12 Hydroxy (9t)  |
| 8. C12:1 (11c)  | 23. nC18:0          | 38. nC20:0             | 53. C20:4 (5c,8c,11c,14c) | 68. C18:0 12 Hydroxy       |
| 9. nC13:0       | 24. C18:1 (6t)      | 39. C18:3 (9c,12c,15c) | 54. C20:3 (11c,14c,17c)   | 69. C18:1-12 Hydroxy (9c)  |
| 10. nC14:0      | 25. C18:1 (9t)      | 40. C20:1 (5c)         | 55. C21:2 (12c,15c)       |                            |
| 11. C14:1 (9t)  | 26. C18:1 (11t)     | 41. C19:2 (10c,13c)    | 56. C22:1 (13c)           |                            |
| 12. C14:1 (9c)  | 27. nC18:1 (6c)     | 42. C20:1 (11t)        | 57. nC23:0                |                            |
| 13. nC15:0      | 28. C18:1 (9c)      | 43. C18:2 CONJ         | 58. C20:5 (EPA)           |                            |
| 14. C15:1 (10t) | 29. C18:1 (11c)     | 44. C20:1 (8c)         | 59. C22:2 (13c,16c)       |                            |
| 15. C15:1 (10c) | 30. nC18:2 (9t,12t) | 45. C20:1 (11c)        | 60. C23:1 (14c)           |                            |



**FAME Standard**

**Column:** DB-WAX  
127-7012  
10 m x 0.10 mm, 0.10 µm

**Carrier:** Hydrogen at 77 cm/sec,  
measured at 40 °C

**Oven:** 40 °C for 0.5 min  
40-195 °C at 25 °C/min  
195-205 °C at 3 °C/min  
205-230 °C at 8 °C/min  
230 °C for 1 min

**Injection:** Split, 250 °C  
Split ratio 1:30

**Detector:** FID, 250 °C

**Suggested Supplies**

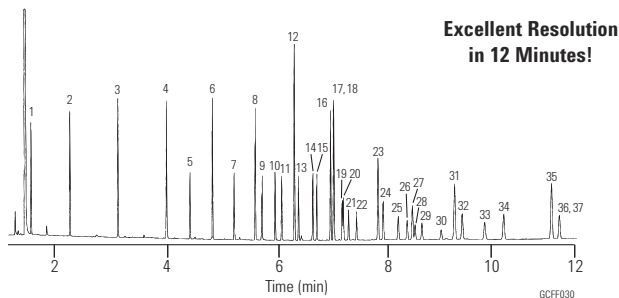
**Septum:** 11 mm Advanced Green septa,  
5183-4759

**Liner:** Split, single taper, low pressure drop,  
glass wool, 5183-4647

**Seal:** Gold plated seal, 18740-20885

**Syringe:** 5 µL tapered, FN 23-26s/42/HP,  
5181-1273

- |   |  |
|---|--|
| 1. Butyric acid methyl ester (C <sub>4,0</sub> )                | 20. Linolelaidic acid methyl ester (C <sub>18:2n6l</sub> )                       |
| 2. Caproic acid methyl ester (C <sub>6,0</sub> )                | 21. γ-Linolenic acid methyl ester (C <sub>18:3n3</sub> )                         |
| 3. Caprylic acid methyl ester (C <sub>8,0</sub> )               | 22. Linolenic acid methyl ester (C <sub>18:3n3</sub> )                           |
| 4. Capric acid methyl ester (C <sub>10,0</sub> )                | 23. Arachidic acid methyl ester (C <sub>20,0</sub> )                             |
| 5. Undecanoic acid methyl ester (C <sub>11,0</sub> )            | 24. cis-11-Eicosenoic acid methyl ester (C <sub>20,1</sub> )                     |
| 6. Lauric acid methyl ester (C <sub>12,0</sub> )                | 25. cis-11,14-Eicosadienoic acid methyl ester (C <sub>20,2</sub> )               |
| 7. Tridecanoic acid methyl ester (C <sub>13,0</sub> )           | 26. cis-8,11,14-Eicosatrienoic acid methyl ester (C <sub>20:3n6</sub> )          |
| 8. Myristic acid methyl ester (C <sub>14,0</sub> )              | 27. Heneicosanoic acid methyl ester (C <sub>21,0</sub> )                         |
| 9. Myristoleic acid methyl ester (C <sub>14,1</sub> )           | 28. cis-11,14,17-Eicosatrienoic acid methyl ester (C <sub>20:3n3</sub> )         |
| 10. Pentadecanoic acid methyl ester (C <sub>15,0</sub> )        | 29. Arachidonic acid methyl ester (C <sub>20:4n6</sub> )                         |
| 11. cis-10-Pentadecenoic acid methyl ester (C <sub>15,1</sub> ) | 30. cis-5,8,11,14,17-Eicosapentaenoic acid methyl ester (C <sub>20:5n3</sub> )   |
| 12. Palmitic acid methyl ester (C <sub>16,0</sub> )             | 31. Behenic acid methyl ester (C <sub>22,0</sub> )                               |
| 13. Palmitoleic acid methyl ester (C <sub>16,1</sub> )          | 32. Erucic acid methyl ester (C <sub>22:1n9</sub> )                              |
| 14. Heptadecanoic acid methyl ester (C <sub>17,0</sub> )        | 33. cis-13,16-Docosadienoic acid methyl ester (C <sub>22,2</sub> )               |
| 15. cis-10-Heptadecenoic acid methyl ester (C <sub>17,1</sub> ) | 34. Tricosanoic acid methyl ester (C <sub>23,0</sub> )                           |
| 16. Stearic acid methyl ester (C <sub>18,0</sub> )              | 35. Lignoceric acid methyl ester (C <sub>24,0</sub> )                            |
| 17. Oleic acid methyl ester (C <sub>18:1n9c</sub> )             | 36. cis-4,7,10,13,16,19-Docosahexaenoic acid methyl ester (C <sub>22:6n3</sub> ) |
| 18. Elaidic acid methyl ester (C <sub>18:1n9t</sub> )           | 37. Nervonic acid methyl ester (C <sub>24,1</sub> )                              |
| 19. Linoleic acid methyl ester (C <sub>18:2n6c</sub> )          |  |



**FAME Standard**

**Column:** DB-225  
127-2222  
20 m x 0.10 mm, 0.10 µm

**Carrier:** Hydrogen at 59.3 cm/sec,  
measured at 35 °C

**Oven:** 35 ° for 0.5 min  
35-195 °C at 25 °C/min  
195-205 °C at 3 °C/min  
205-230 °C at 8 °C/min  
230 °C for 1 min

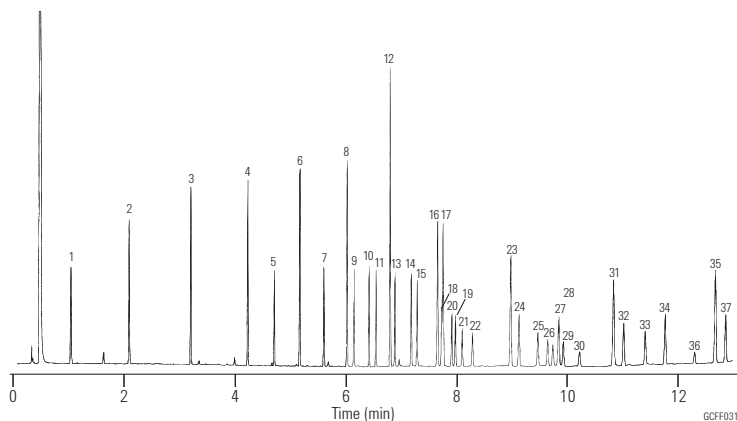
**Injection:** Split, 250 °C  
Split ratio 1:30

**Detector:** FID, 250 °C

**Suggested Supplies**

**Septum:** 11 mm Advanced Green septa, 5183-4759  
**Liner:** Split, single taper, low pressure drop, glass wool, 5183-4647  
**Seal:** Gold plated seal, 18740-20885  
**Syringe:** 5 µL tapered, FN 23-26s/42/HP, 5181-1273

- |  |   |
|--|---|
| 1. Butyric acid methyl ester (C4:0)                | 20. Linolelaic acid methyl ester (C18:2n6t)                         |
| 2. Caproic acid methyl ester (C6:0)                | 21. γ-Linolenic acid methyl ester (C18:3n6)                         |
| 3. Caprylic acid methyl ester (C8:0)               | 22. Linolenic acid methyl ester (C18:3n3)                           |
| 4. Capric acid methyl ester (C10:0)                | 23. Arachidic acid methyl ester (C20:0)                             |
| 5. Undecanoic acid methyl ester (C11:0)            | 24. cis-11-Eicosenoic acid methyl ester (C20:1)                     |
| 6. Lauric acid methyl ester (C12:0)                | 25. cis-11,14-Eicosadienoic acid methyl ester (C20:2)               |
| 7. Tridecanoic acid methyl ester (C13:0)           | 26. cis-8,11,14-Eicosatrienoic acid methyl ester (C20:3n6)          |
| 8. Myristic acid methyl ester (C14:0)              | 27. Heneicosanoic acid methyl ester (C21:0)                         |
| 9. Myristoleic acid methyl ester (C14:1)           | 28. cis-11,14,17-Eicosatrienoic acid methyl ester (C20:3n3)         |
| 10. Pentadecanoic acid methyl ester (C15:0)        | 29. Arachidonic acid methyl ester (C20:4n6)                         |
| 11. cis-10-Pentadecenoic acid methyl ester (C15:1) | 30. cis-5,8,11,14,17-Eicosapentaenoic acid methyl ester (C20:5n3)   |
| 12. Palmitic acid methyl ester (C16:0)             | 31. Behenic acid methyl ester (C22:0)                               |
| 13. Palmitoleic acid methyl ester (C16:1)          | 32. Erucic acid methyl ester (C22:1n9)                              |
| 14. Heptadecanoic acid methyl ester (C17:0)        | 33. cis-13,16-Docosadienoic acid methyl ester (C22:2)               |
| 15. cis-10-Heptadecenoic acid methyl ester (C17:1) | 34. Tricosanoic acid methyl ester (C23:0)                           |
| 16. Stearic acid methyl ester (C18:0)              | 35. Lignoceric acid methyl ester (C24:0)                            |
| 17. Oleic acid methyl ester (C18:1n9c)             | 36. cis-4,7,10,13,16,19-Docosahexaenoic acid methyl ester (C22:6n3) |
| 18. Elaidic acid methyl ester (C18:1n9t)           | 37. Nervonic acid methyl ester (C24:1)                              |
| 19. Linoleic acid methyl ester (C18:2n6c)          |   |





### Canola Oil Margarine Partially Hydrogenated FAMES AOCS Method 1c-89

**Column:** DB-23  
122-2362  
60 m x 0.25 mm, 0.25 µm

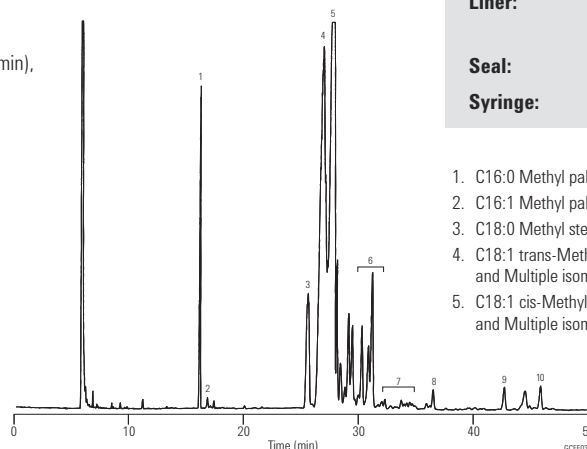
**Carrier:** Helium at 15 cm/sec (0.44 mL/min),  
measured at 150 °C

**Oven:** 150-200 °C at 1.3 °C/min  
200 °C for 10 min

**Injection:** Split, 210 °C  
Split 1:100

**Detector:** FID, 210 °C

**Sample:** 1 µL



#### Suggested Supplies

**Septum:** 11 mm Advanced Green septa, 5183-4759

**Liner:** Split, single taper, low pressure drop,  
glass wool, 5183-4647

**Seal:** Gold plated seal, 18740-20885

**Syringe:** 5 µL tapered, FN 23-26s/42/HP, 5181-1273

- |  |                                 |
|--|---------------------------------|
| 1. C16:0 Methyl palmitate                              | 6. C18:2 trans-Multiple isomers |
| 2. C16:1 Methyl palmitoleate                           | 7. C18:2 cis-Multiple isomers   |
| 3. C18:0 Methyl stearate                               | 8. C18:3 Methyl linolenate      |
| 4. C18:1 trans-Methyl elaidate<br>and Multiple isomers | 9. C20:0 Methyl arachidate      |
| 5. C18:1 cis-Methyl oleate<br>and Multiple isomers     | 10. C20:1 Methyl 11-eicosanoate |

### Butter Triglycerides I

**Column:** DB-5ht  
123-5731  
30 m x 0.32 mm, 0.10 µm

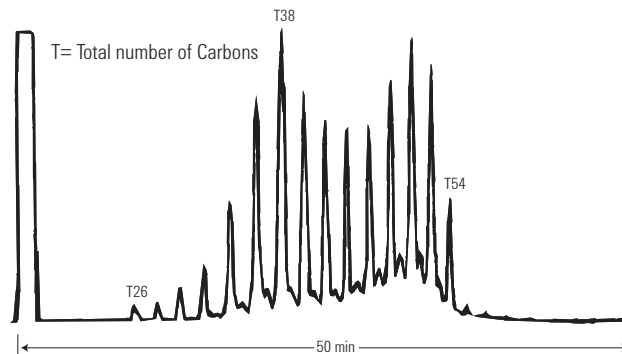
**Carrier:** Hydrogen at 55 cm/sec, measured at 250 °C

**Oven:** 35-250 °C at 70 °/min  
250-400 °C at 5 °C/min  
400 °C for 20 min

**Injection:** Cool on-column

**Detector:** FID, 400 °C  
Nitrogen makeup gas at 30 mL/min  
Baseline corrected

**Sample:** 1 µL of 9 µg/µL in toluene  
(approx. 1% w/w solution)



### Butter Triglycerides II

**Column:** DB-17ht  
123-1831  
30 m x 0.32 mm, 0.15 µm

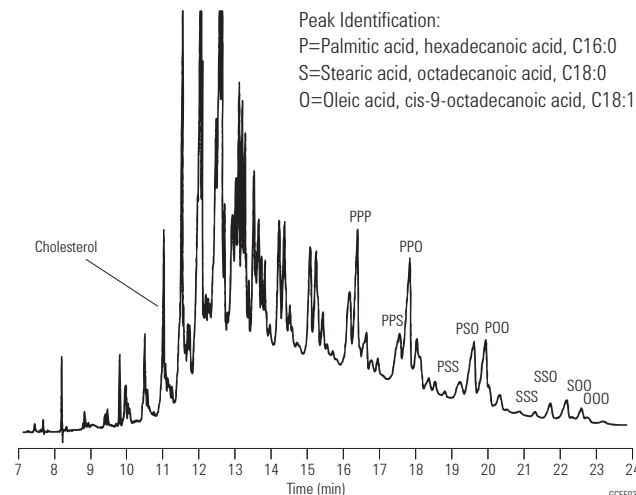
**Carrier:** Hydrogen at 40 cm/sec

**Oven:** 250-365 °C at 5 °C/min  
365 °C for 1 min

**Injection:** Cool on-column

**Detector:** FID, 400 °C  
Nitrogen makeup gas at 30 mL/min  
Baseline corrected

**Sample:** 1 µL of 9 µg/µL in toluene  
(approx. 1% w/w solution)



### Fast screening of FAME isomers in butter

**Column:** VF-23ms  
CP8822  
30 m x 0.25 mm, 0.25 µm

Sample: 0.5 µL ca. 5 ng per component on column

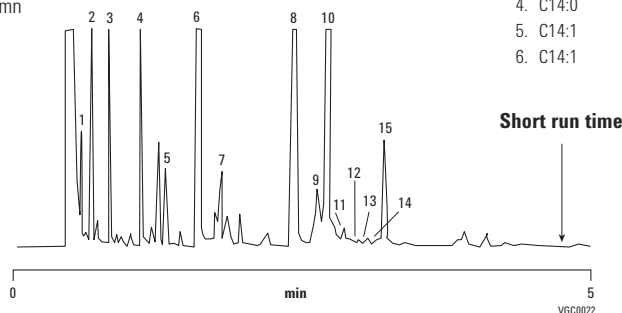
Carrier: Hydrogen, 70 kPa

Oven: 185 °C

Injection: Split, 1:100  
T=275 °C

Detector: FID

- |          |                             |
|----------|-----------------------------|
| 1. C8:0  | 7. C16:1 9-cis              |
| 2. C10:0 | 8. C16:1 9-cis              |
| 3. C12:0 | 9. C18:1 trans              |
| 4. C14:0 | 10. C18:1 9-cis             |
| 5. C14:1 | 11. C18:1 13-cis            |
| 6. C14:1 | 12. C18:2 9-trans, 12-trans |
|          | 13. C18:2 9-cis, 12-trans   |
|          | 14. C18:2 9-trans, 12-cis   |
|          | 15. C18:2 9-cis, 12-cis     |



### Pesticides in sunflower oil

**Column:** VF-5ms  
CP8960  
60 m x 0.25 mm, 0.25 µm

Sample: 5 µL, splitless

Sample Conc: 40 ppb

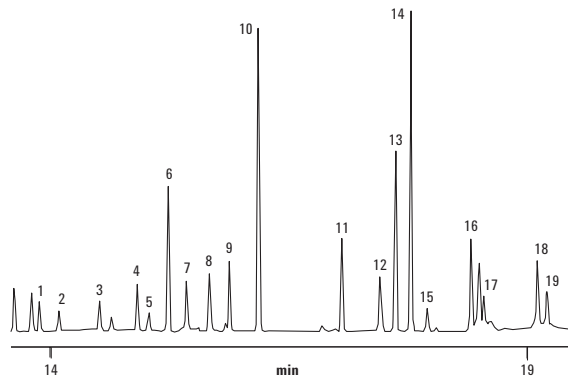
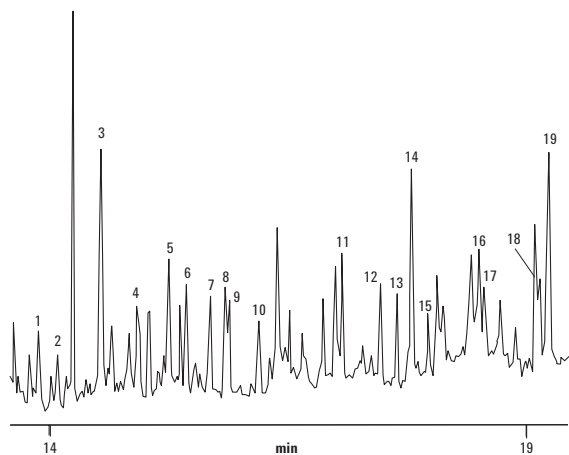
Carrier: He, 1.2 mL/min, constant flow

Oven: 70 °C (3.0 min), 25 °C to 190 °C/min (0.0 min)  
to 10 °C/min to 320 °C (10 min)

Injection: 1079 with carbofrit liner

Detector: Ion Trap in MS/MS, full scan (left chromatogram)  
MS/MS (right chromatogram)

- |                      |                        |                      |                        |
|----------------------|------------------------|----------------------|------------------------|
| 1. β-HCH             | 11. o,p'-DDE           | 1. β-HCH             | 11. o,p'-DDE           |
| 2. γ-HCH             | 12. α-Endosulfan       | 2. γ-HCH             | 12. α-Endosulfan       |
| 3. δ-HCH             | 13. p,p'-DDE           | 3. δ-HCH             | 13. p,p'-DDE           |
| 4. + Vinclozolin     | 14. o,p'-DDD           | 4. + Vinclozolin     | 14. o,p'-DDD           |
| 5. Pyrimiphos methyl | 15. Dieldrin           | 5. Methyl parathion  | 15. Dieldrin           |
| 6. + Malathion       | 16. p,p'-DDD           | 6. Pyrimiphos methyl | 16. p,p'-DDD           |
| 7. Chloropyrifos     | 17. b Endosulfan       | 7. + +Fenitrothion   | 17. b Endosulfan       |
| 8. Ethyl parathion   | 18. p,p'-DDT           | 8. Chloropyrifos     | 18. p,p'-DDT           |
| 9. Pyrimiphos ethyl  | 19. Endosulfan sulfate | 9. Pyrimiphos ethyl  | 19. Endosulfan sulfate |
| 10. Bromofos         |                        | 10. Promofos         |                        |



# Industrial Chemical Applications

## Alcohols I

**Column:** DB-624  
125-1334  
30 m x 0.53 mm, 3.00  $\mu$ m

**Carrier:** Helium at 30 cm/sec,  
measured at 40 °C

**Oven:** 40 °C for 5 min  
40-260 °C at 10 °C/min  
260 °C for 3 min

**Injection:** Split, 250 °C  
Split ratio 1:10

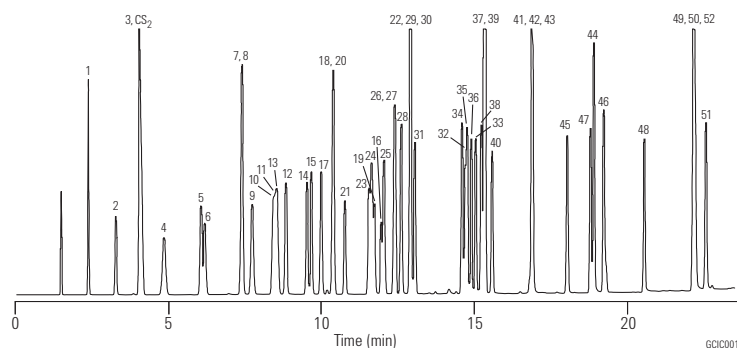
**Detector:** FID, 300 °C  
Nitrogen makeup gas at 30 mL/min

**Sample:** 1  $\mu$ L of 0.01-0.05% each solvent in CS<sub>2</sub>

### Suggested Supplies

**Septum:** 11 mm Advanced Green septa, 5183-4759  
**Liner:** Split, single taper, low pressure drop, glass wool, 5183-4647  
**Seal:** Gold plated seal kit, 5188-5367  
**Syringe:** 5  $\mu$ L tapered, FN 23-26s/42/HP, 5181-1273

- |  |  |
|--|--|
| 1. Methanol                                  | 27. 2-Penten-1-ol                      |
| 2. Ethanol                                   | 28. 3-Methyl-2-buten-1-ol              |
| 3. Isopropanol                               | 29. Cyclopentanol                      |
| 4. tert-Butanol                              | 30. 3-Hexanol                          |
| 5. 2-Propen-1-ol (allyl alcohol)             | 31. 2-Hexanol                          |
| 6. 1-Propanol                                | 32. 4-Hydroxy-4-methyl-2-pentanone     |
| 7. 2-Propyn-1-ol (propargyl alcohol)         | 33. Furfuryl alcohol                   |
| 8. sec-Butanol                               | 34. cis-3-Hexen-1-ol                   |
| 9. 2-Methyl-3-buten-2-ol                     | 35. 1-Hexanol                          |
| 10. Isobutanol                               | 36. cis-2-Hexen-1-ol                   |
| 11. 2-Methoxyethanol (methyl Cellosolve)     | 37. Cyclohexanol                       |
| 12. 3-Buten-1-ol                             | 38. 3-Heptanol                         |
| 13. 2-Methyl-2-butanol (tert-amyl alcohol)   | 39. 2-Heptanol                         |
| 14. 1-Butanol                                | 40. 2-Butoxyethanol (butyl Cellosolve) |
| 15. 2-Buten-1-ol (crotyl alcohol)            | 41. cis-4-Hepten-1-ol                  |
| 16. Ethylene glycol                          | 42. trans-2-Hepten-1-ol                |
| 17. 1-Penten-3-ol                            | 43. 1-Heptanol                         |
| 18. 2-Pentanol                               | 44. Benzyl alcohol                     |
| 19. Glycidol                                 | 45. 2-Ethyl-1-hexanol                  |
| 20. 3-Pentanol                               | 46. a-Methylphenyl alcohol             |
| 21. 2-Ethoxyethanol (Cellosolve)             | 47. 1-Octanol                          |
| 22. Propylene glycol                         | 48. 1-Nonanol                          |
| 23. 3-Methyl-1-butanol (isoamyl alcohol)     | 49. 2-Phenoxyethanol                   |
| 24. 2-Methyl-1-butanol (active amyl alcohol) | 50. a-Ethylphenethyl alcohol           |
| 25. 4-Methyl-2-pentanol                      | 51. b-Ethylphenethyl alcohol           |
| 26. 1-Pentanol                               | 52. 1-Decanol                          |



**Halogenated Hydrocarbons I**

**Column:** DB-624  
123-1334  
30 m x 0.32 mm, 1.80 µm

**Carrier:** Helium at 35 cm/sec

**Oven:** 35 °C for 5 min  
35-245 °C at 10 °C/min

**Injection:** Split, 250 °C  
Split ratio 1:50

**Detector:** FID, 300 °C  
Nitrogen makeup gas at 30 mL/min

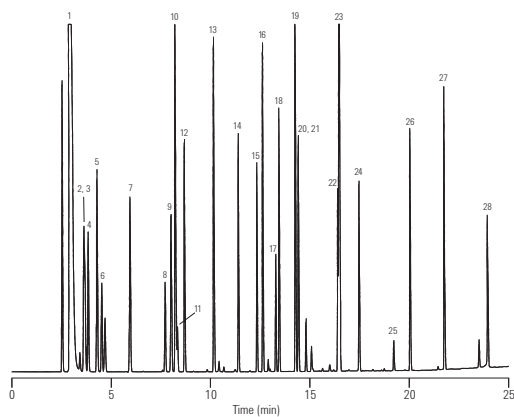
**Suggested Supplies**

**Septum:** 11 mm Advanced Green septa, 5183-4759

**Liner:** General purpose split/splitless liner, taper, glass wool, 5183-4711

**Seal:** Gold plated seal kit, 5188-5367

**Syringe:** 10 µL tapered, FN 23-26s/42/HP, 5181-1267



601034

- |   |  |
|---|--|
| 1. Pentane                                    | 15. trans-1,2-Dichloropropene          |
| 2. Iodomethane                                | 16. 1,1,2-Trichloroethane              |
| 3. 1,1-Dichloroethene                         | 17. 1,1,1,2-Tetrachloroethane          |
| 4. 1,1,2-Trichlorotrifluoroethane (Freon-113) | 18. 1,2-Dibromoethane (EDB)            |
| 5. 3-Chloropropene (allyl chloride)           | 19. 1-Chlorohexane                     |
| 6. Methylene chloride                         | 20. trans-1,4-Dichloro-2-butene        |
| 7. 1,1-Dichloroethane                         | 21. Iodoform                           |
| 8. Chloroform                                 | 22. Hexachlorobutadiene                |
| 9. 1,1,1-Trichloroethane                      | 23. 1,2,3-Trichloropropane             |
| 10. 1-Chlorobutane                            | 24. 1,1,2,2-Tetrachloroethane          |
| 11. Carbon tetrachloride                      | 25. Pentachloroethane                  |
| 12. 1,2-Dichloroethane                        | 26. 1,2-Dibromo-3-chloropropane (DBCP) |
| 13. 1,2-Dichloropropane                       | 27. Hexachloroethane                   |
| 14. cis-1,2-Dichloropropene                   | 28. Hexachlorocyclopentadiene          |

**Aromatic Solvents**

**Column:** DB-200  
122-2032  
30 m x 0.25 mm, 0.25 µm

**Carrier:** Helium at 31 cm/sec

**Oven:** 50 °C for 5 min  
50-160 °C at 10 °C/min

**Injection:** Split, 250 °C  
Split ratio 1:100

**Detector:** FID, 300 °C  
Nitrogen makeup gas at 30 mL/min

**Sample:** 0.5 µL of 0.5 µg/µL  
standard in hexane

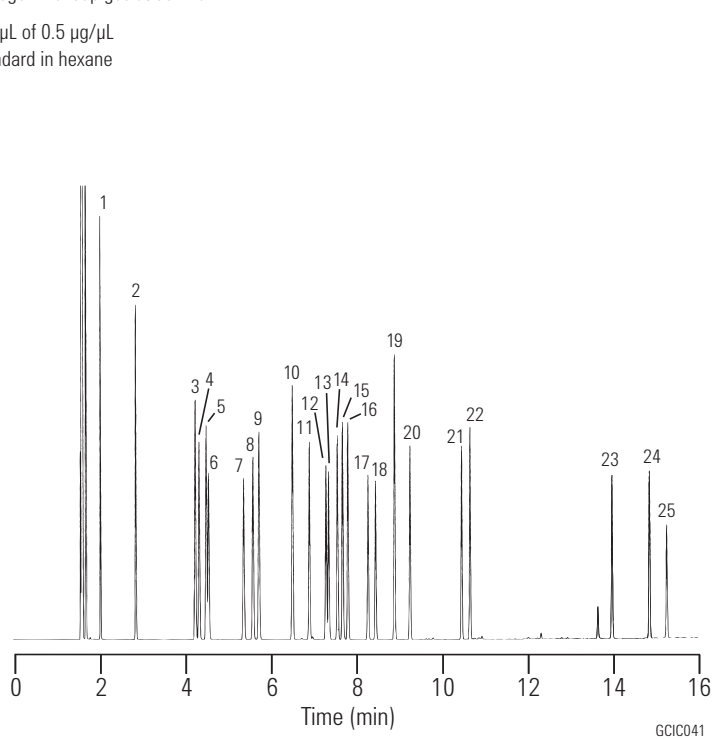
**Suggested Supplies**

**Septum:** 11 mm Advanced Green septa, 5183-4759

**Liner:** General purpose split/splitless liner, taper, glass wool, 5183-4711

**Seal:** Gold plated seal kit, 5188-5367

**Syringe:** 10 µL tapered, FN 23-26s/42/HP, 5181-1267



1. Benzene
2. Toluene
3. Ethylbenzene
4. Chlorobenzene
5. p-Xylene
6. m-Xylene
7. o-Xylene
8. Styrene
9. Isopropylbenzene
10. n-Propylbenzene
11. 2-Chlorotoluene
12. 3-Chlorotoluene
13. 4-Chlorotoluene
14. tert-Butylbenzene
15. sec-Butylbenzene
16. Isobutylbenzene
17. 1,3-Dichlorobenzene
18. 1,4-Dichlorobenzene
19. n-Butylbenzene
20. 1,2-Dichlorobenzene
21. 1,3-Diisopropylbenzene
22. 1,4-Diisopropylbenzene
23. 2-Nitrotoluene
24. 3-Nitrotoluene
25. 4-Nitrotoluene

**Phenols I**

**Column:** HP-5ms  
19091S-433  
30 m x 0.25 mm, 0.25 µm

**Carrier:** Helium, 33 cm/sec, constant flow

**Oven:** 35 °C for 5 min  
35-220 °C at 8 °C/min

**Injection:** Splitless, 250 °C

**Detector:** FID, 300 °C

**Sample:** 1 µL  
20 µg/mL phenols in methylene chloride

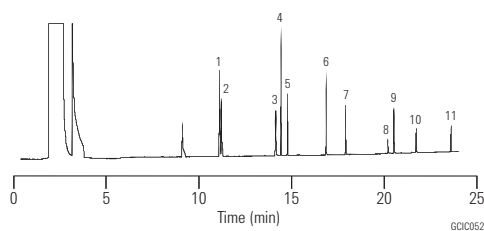
**Suggested Supplies**

**Septum:** 11 mm Advanced Green septa, 5183-4759

**Liner:** Direct connect, single taper, deactivated, 4 mm id, G1544-80730

**Seal:** Gold plated seal kit, 5188-5367

**Syringe:** 10 µL tapered, FN 23-26s/42/HP, 5181-1267



1. Phenol
2. 2-Chlorophenol
3. 2-Nitrophenol
4. 2,4-Dimethylphenol
5. 2,4-Dichlorophenol
6. 4-Chloro-3-methylphenol
7. 2,4,6-Trinitrophenol
8. 2,4-Dinitrophenol
9. 4-Nitrophenol
10. 2-Methyl-4,6-dinitrophenol
11. Pentachlorophenol

**Inorganic Gases**

**Column:** GS-GasPro  
113-4332  
30 m x 0.32 mm

**Carrier:** Helium at 53 cm/sec

**Oven:** 25 °C for 3 min  
25-200 °C at 10 °C/min  
200 °C Hold

**Injection:** Split, 200 °C  
Split ratio 1:50

**Detector:** TCD, 250 °C

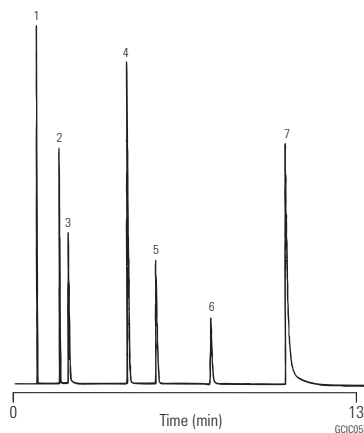
**Sample:** 50 µL

**Suggested Supplies**

**Septum:** 11 mm Advanced Green septa, 5183-4759

**Liner:** Direct, 1.5 mm id, 18740-80200

**Seal:** Gold plated seal kit, 5188-5367



1. Nitrogen
2. CO<sub>2</sub>
3. SF<sub>6</sub>
4. COS
5. H<sub>2</sub>S
6. Ethylene oxide
7. SO<sub>2</sub>

**Alcohols II**

**Column:** DB-WAXetr  
123-7354  
50 m x 0.32 mm, 1.00 µm

**Carrier:** Helium at 50 cm/sec,  
measured at 40 °C

**Oven:** 40 °C for 5 min  
40-230 °C at 10 °C/min  
230 °C for 5 min

**Injection:** Split, 250 °C  
Split ratio 1:5

**Detector:** FID, 250 °C  
Nitrogen makeup gas at 35 mL/min

**Sample:** 1 µL of 0.15%  
each solvent in CS<sub>2</sub>

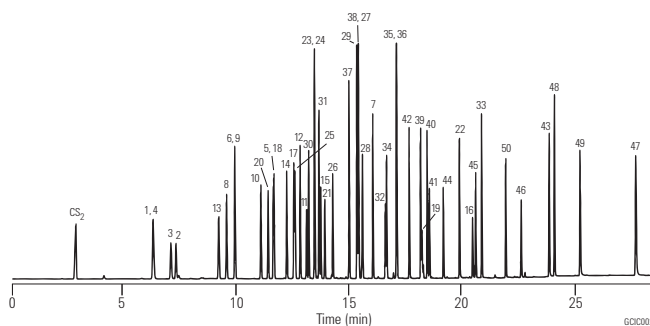
**Suggested Supplies**

**Septum:** 11 mm Advanced Green septa, 5183-4759

**Liner:** Split, single taper, low pressure drop, glass wool, 5183-4647

**Seal:** Gold plated seal kit, 5188-5367

**Syringe:** 5 µL tapered, FN 23-26s/42/HP, 5181-1273



- |  |  |
|--|--|
| 1. Methanol                                  | 26. 1-Pentanol                         |
| 2. Ethanol                                   | 27. 2-Penten-1-ol                      |
| 3. Isopropanol                               | 28. 3-Methyl-2-buten-1-ol              |
| 4. tert-Butanol                              | 29. Cyclopentanol                      |
| 5. 2-Propen-1-ol (allyl alcohol)             | 30. 3-Hexanol                          |
| 6. 1-Propanol                                | 31. 2-Hexanol                          |
| 7. 2-Propyn-1-ol (propargyl alcohol)         | 32. 4-Hydroxy-4-methyl-2-pentanone     |
| 8. sec-Butanol                               | 33. Furfuryl alcohol                   |
| 9. 2-Methyl-3-buten-2-ol                     | 34. cis-3-Hexen-1-ol                   |
| 10. Isobutanol                               | 35. cis-2-Hexen-1-ol                   |
| 11. 2-Methoxyethanol (methyl Cellosolve)     | 36. Cyclohexanol                       |
| 12. 3-Buten-1-ol                             | 37. 3-Heptanol                         |
| 13. 2-Methyl-2-butanol (tert-amyl alcohol)   | 38. 2-Heptanol                         |
| 14. 1-Butanol                                | 39. 2-Butoxyethanol (butyl Cellosolve) |
| 15. 2-Buten-1-ol (crotyl alcohol)            | 40. cis-4-Hepten-1-ol                  |
| 16. Ethylene glycol                          | 41. trans-2-Hepten-1-ol                |
| 17. 1-Penten-3-ol                            | 42. 1-Heptanol                         |
| 18. 2-Pentanol                               | 43. Benzyl alcohol                     |
| 19. Glycidol                                 | 44. 2-Ethyl-1-hexanol                  |
| 20. 3-Pentanol                               | 45. 1-Octanol                          |
| 21. 2-Ethoxyethanol (Cellosolve)             | 46. 1-Nonanol                          |
| 22. Propylene glycol                         | 47. 2-Phenoxyethanol                   |
| 23. 3-Methyl-1-butanol (isoamyl alcohol)     | 48. a-Ethylphenethyl alcohol           |
| 24. 2-Methyl-1-butanol (active amyl alcohol) | 49. b-Ethylphenethyl alcohol           |
| 25. 4-Methyl-2-pentanol                      | 50. 1-Decanol                          |

**Alcohols III**

**Column:** HP-InnoWax  
19095N-123  
30 m x 0.53 mm, 1.00 µm

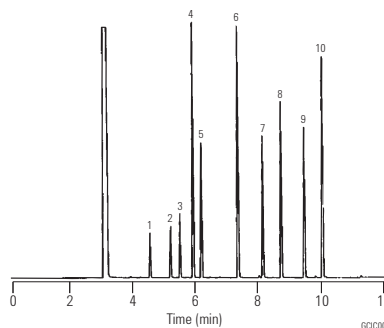
**Carrier:** Helium, 29 cm/sec, 3.0 psi (45 °C)

**Oven:** 45 °C for 1 min  
45-150 °C at 10 °C/min  
4 mL/min constant flow

**Injection:** Split, 250 °C  
Split ratio 25:1

**Detector:** FID 250 °C

**Sample:** 1 µL

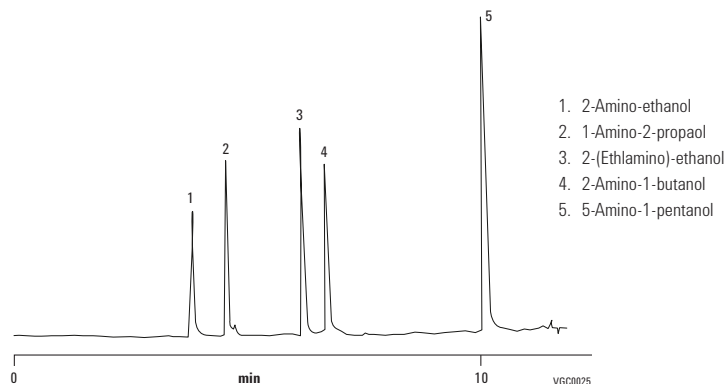


1. 1-Propanol
2. iso-Butanol
3. 3-Methyl-3-pentanol
4. 1-Butanol
5. 4-Methyl-2-pentanol
6. 1-Pentanol
7. 2-Ethyl-1-Butanol
8. 1-Hexanol
9. Cyclohexanol
10. 1-Heptanol

### Analysis of Amino Alcohols in Water

**Column:** CP-Sil 5 CB  
CP7640  
50 m x 0.53 mm, 2.00 µm

Sample: 0.2 µL  
Sample Conc: 1 ppm  
Solvent: Water  
Carrier: He, 0.7 mL/min, 70 kPa (0.7 bar, 9 psi)  
Oven: 65 °C to 100 °C, 10 °C/min  
Injection: Splitless  
Detector: MS

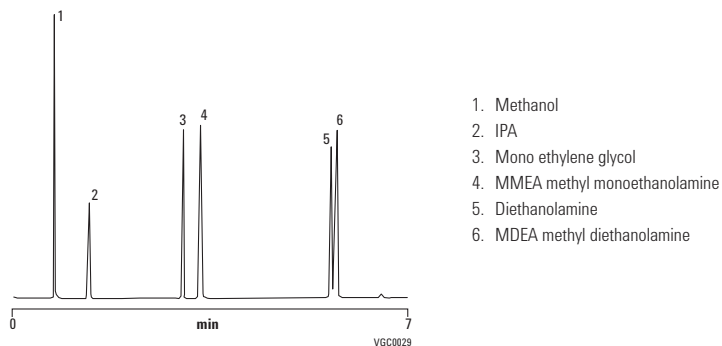


Victor Berezkin and Aleksey B. Lapin, Institute of Petrochemical Synthesis, Russian Academy of Science, Moscow, Russia.

### Amines and Alcohols

**Column:** CP-Volamine  
CP7446  
15 m x 0.32 mm,

Sample: 0.5 µL  
Sample Conc: 1000 ppm, approx. 5 ng per component on the column  
Solvent: methanol  
Carrier: Helium, 50 kPa, 55 cm/s  
Oven: 35 °C (0.5 min) to 240 °C, 30 °C/min  
Injection: Split  
Detector: MS

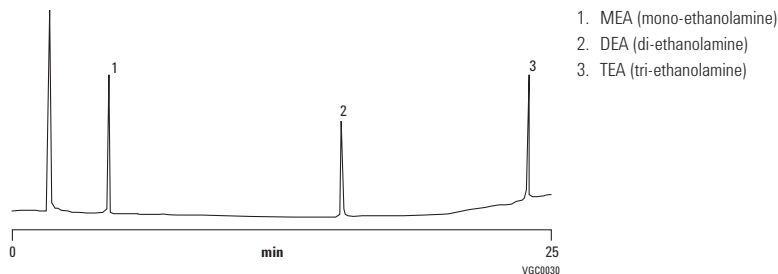


Courtesy of J. Luong, Dow Chemical Canada

### Analysis of Ethanolamines

**Column:** CP-Sil 8 CB for Amines  
CP7596  
30 m x 0.32 mm, 1.00 µm

Sample Conc: 5-10 ng per component on the column  
Solvent: methanol  
Carrier: Helium, 50 kPa (0.5 bar, 7 psi)  
Oven: 60 °C (5 min) to 220 °C, 6 °C/min  
Injection: Split  
Detector: FID





**Ethoxyethanol**

**Column:** HP-FFAP  
19095F-123  
30 m x 0.53 mm, 1.00 µm

**Carrier:** Helium, 10 mL/min

**Oven:** 60 °C for 1 min  
60-100 °C at 5 °C/min  
100-210 °C at 10 °C/min

**Injection:** Split ratio 10:1

**Detector:** TCD

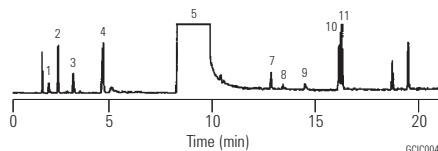
**Suggested Supplies**

**Septum:** 11 mm Advanced Green septa, 5183-4759

**Liner:** Split, single taper, low pressure drop, glass wool, 5183-4647

**Seal:** Gold plated seal, 18740-20885

**Syringe:** 5 µL tapered, FN 23-26s/42/HP, 5181-1273



- |                          |                                 |
|--------------------------|---------------------------------|
| 1. Ethylene oxide        | 7. Hydroxy acetate              |
| 2. Ethyl formate         | 8. Acetic acid                  |
| 3. Ethyl alcohol         | 9. Formic acid                  |
| 4. Water                 | 10. Ethylene glycol/monoformate |
| 5. 2-Ethoxyethanol       | 11. Ethylene glycol/monoacetate |
| 6. 2-Ethoxyethyl acetate |                                 |

**Organic Acids**

**Column:** DB-WAXetr  
125-7332  
30 m x 0.53 mm, 1.00 µm

**Carrier:** Helium at 37 cm/sec,  
measured at 40 °C

**Oven:** 125 °C for 5 min  
125-180 °C at 15 °C/min  
180 °C for 12 min

**Injection:** Split, 250 °C

**Detector:** FID, 250 °C

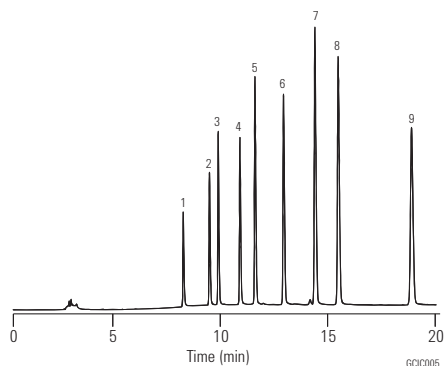
**Suggested Supplies**

**Septum:** 11 mm Advanced Green septa, 5183-4759

**Liner:** Split, single taper, low pressure drop, glass wool, 5183-4647

**Seal:** Gold plated seal, 18740-20885

**Syringe:** 5 µL tapered, FN 23-26s/42/HP, 5181-1273



1. Acetic acid
2. Propionic acid
3. Isobutyric acid
4. Butyric acid
5. Isovaleric acid
6. Valeric acid (pentanoic acid)
7. Isocaproic acid
8. Caproic acid (hexanoic acid)
9. Heptanoic acid

### Free Organic Acids/C4-C5 Isomers

**Column:** HP-INNOWax  
19091N-133  
30 m x 0.25 mm, 0.25 µm

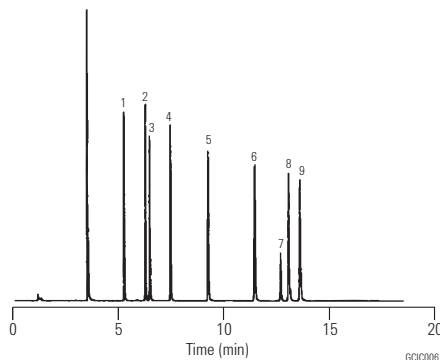
**Carrier:** Helium 42 cm/sec, 24 psi (120 °C)  
1.8 mL/min constant flow

**Oven:** 110 °C for 1 min  
110-133 at 2 °C/min  
133-160 °C at 3 °C/min

**Injection:** Split, 250 °C  
Split ratio 40:1

**Detector:** FID 300 °C

**Sample:** 1 µL



1. Isobutyric acid
2. Butyric acid
3. Valerolactone
4. 2-Methyl butyric acid
5. Valeric acid
6. 4-Pentenoic acid
7. trans-2-Methyl-2-butenic acid
8. trans-3-Pentenoic acid
9. trans-2-Pentenoic acid

### Volatile Amines

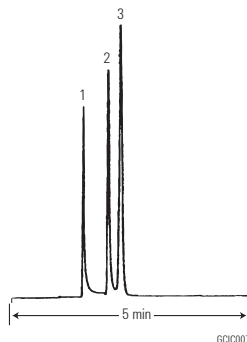
**Column:** DB-1  
125-1035  
30 m x 0.53 mm, 5.00 µm

**Oven:** 30 °C isothermal

**Sampler:** Headspace

**Injection:** Split ratio 1:10

**Detector:** FID  
Nitrogen makeup gas at 30 mL/min



1. Methylamine
2. Dimethylamine
3. Trimethylamine

### Trace Active Amines, 10 ng on-column

**Column:** HP-5ms  
19091S-213  
30 m x 0.32 mm, 1.00 µm

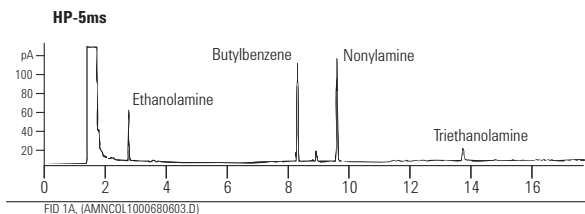
**Carrier:** Helium, constant pressure 9.79 psi

**Oven:** 75 °C for 0.5 min  
75-250 °C at 10 °C/min  
250-320 °C at 25 °C/min  
320 °C for 5 min

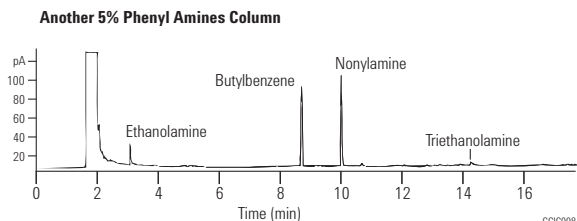
**Injection:** On-column  
Oven tracking mode

**Detector:** FID 300 °C

**Sample:** 0.5 µL of each standard in methanol



FID 1A, (AMNCDL1000680603.D)



GCIC008

**Primary Amines**

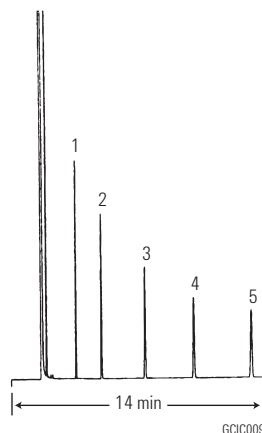
**Column:** CAM  
 112-2132  
 30 m x 0.25 mm, 0.25 µm

**Carrier:** Hydrogen at 40 cm/sec

**Oven:** 110 °C isothermal

**Injection:** Split

**Detector:** FID  
 Nitrogen makeup gas at 30 mL/min



- 1. n-Octylamine
- 2. n-Nonylamine
- 3. n-Decylamine
- 4. Benzylamine
- 5. Dicyclohexylamine

**Polyethyleneamines**

**Column:** DB-5ms  
 122-5536  
 30 m x 0.25 mm, 0.50 µm

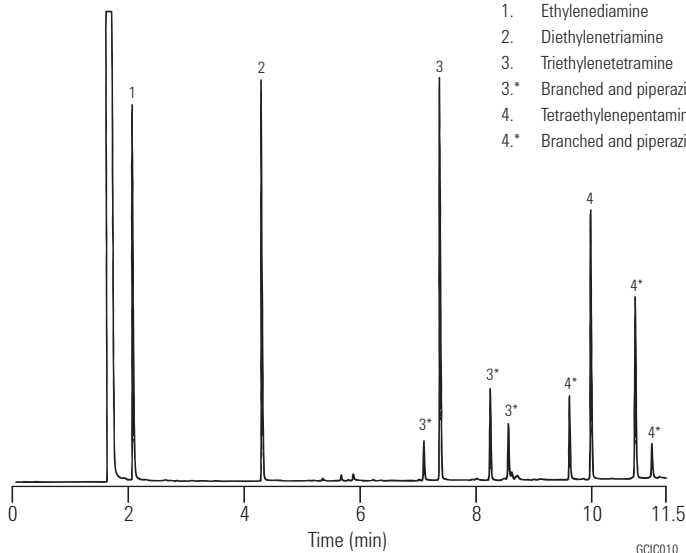
**Carrier:** Helium at 30 cm/sec, measured at 100 °C

**Oven:** 100 °C for 1 min  
 100-320 °C at 20 °C/min

**Injection:** Split, 250 °C  
 Split ratio 1:50

**Detector:** FID, 300 °C  
 Nitrogen makeup gas at 30 mL/min

**Sample:** 1 µL of 100 ng/µL standard in methanol



- 1. Ethylenediamine
- 2. Diethylenetriamine
- 3. Triethylenetetramine
- 3.\* Branched and piperazine analogs of peak #3
- 3.\*\* Branched and piperazine analogs of peak #3
- 4. Tetraethylenepentamine
- 4.\* Branched and piperazine analogs of peak #4
- 4.\*\* Branched and piperazine analogs of peak #4

**Amines and Nitriles**

**Column:** DB-5ms  
122-5536  
30 m x 0.25 mm, 0.50 µm

**Carrier:** Helium at 22 cm/sec, measured at 40 °C

**Oven:** 40 °C for 1 min  
40-260 °C at 10 °C/min

**Injection:** Split, 250 °C  
Split ratio 1:50

**Detector:** FID, 300 °C  
Nitrogen makeup gas at 30 mL/min

**Sample:** 1 µL of 100 ng/µL standard in methanol

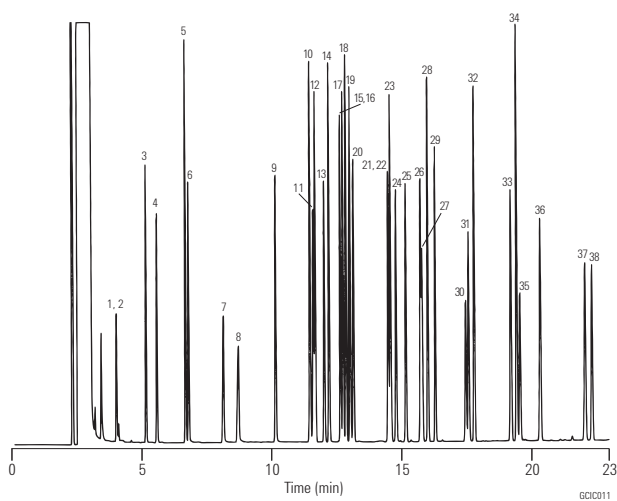
**Suggested Supplies**

**Septum:** 11 mm Advanced Green septa, 5183-4759

**Liner:** Split, single taper, low pressure drop, glass wool, 5183-4647

**Seal:** Gold plated seal, 18740-20885

**Syringe:** 5 µL tapered, FN 23-26s/42/HP, 5181-1273



- |                             |                          |
|-----------------------------|--------------------------|
| 1. Diethylamine             | 20. 2-Cyanopyridine      |
| 2. Propionitrile            | 21. 2-Chloroaniline      |
| 3. Diisopropylamine         | 22. n-Nonylamine         |
| 4. Triethylamine            | 23. 2,4-Dimethylaniline  |
| 5. Pyridine                 | 24. 4-Chlorobenzonitrile |
| 6. Pyrimidine               | 25. 2,6-Dimethylaniline  |
| 7. Pyrazole                 | 26. 3-Chloroaniline      |
| 8. Acrylamide               | 27. 4-Chloroaniline      |
| 9. Pyridazine               | 28. N,N-Diethylaniline   |
| 10. Aniline                 | 29. n-Decylamine         |
| 11. 3-Bromopyridine         | 30. 4-Bromoaniline       |
| 12. Benzonitrile            | 31. 3,4-Diaminotoluene   |
| 13. 3-Cyanopyridine         | 32. 2,6-Diethylaniline   |
| 14. Benzylamine             | 33. 2-Nitroaniline       |
| 15. n-Octylamine            | 34. Dicyclohexylamine    |
| 16. 1-Methyl-2-pyrrolidine  | 35. 3,4-Dichloroaniline  |
| 17. N,N-Dimethylbenzylamine | 36. 3-Nitroaniline       |
| 18. Phenylethylamine        | 37. 4-Nitroaniline       |
| 19. N-Benzylmethylamine     | 38. Diphenylaniline      |

**Amines in Water**

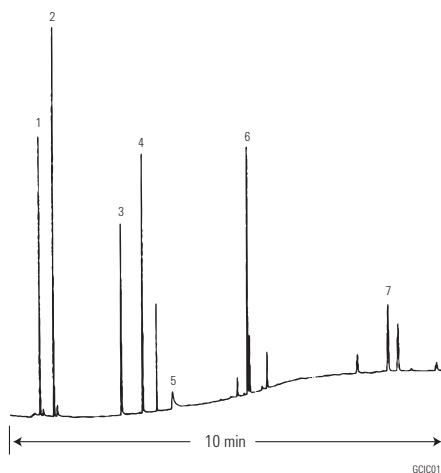
**Column:** CAM  
112-2132  
30 m x 0.25 mm, 0.25 µm

**Carrier:** Hydrogen at 38 cm/sec

**Oven:** 120-220 °C at 10 °C/min

**Injection:** Split

**Detector:** FID  
Nitrogen makeup gas at 30 mL/min



1. Ethylenediamine
2. Piperazine
3. Diethylenetriamine
4. N-(2-Aminoethyl) piperazine
5. Aminoethylethanolamine
6. Triethylenetetramine (4 isomers)
7. Tetraethylenepentamine (4 isomers)

**Aldehydes and Acids**

**Column:** HP-INNOWax  
19091N-213  
30 m x 0.32 mm, 0.50 µm

**Carrier:** Helium, 40 cm/sec, 11.7 psi (60 °C)

**Oven:** 60 °C for 1 min  
60-250 °C at 10 °C/min  
2.5 mL/min constant flow

**Injection:** Split, 250 °C  
Split ratio 40:1

**Detector:** FID 275 °C

**Sample:** 0.5 µL

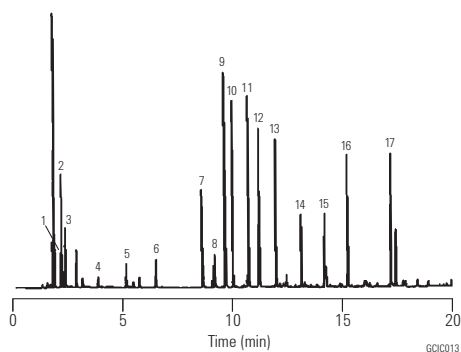
**Suggested Supplies**

**Septum:** 11 mm Advanced Green septa, 5183-4759

**Liner:** Split, single taper, low pressure drop, glass wool, 5183-4647

**Seal:** Gold plated seal, 18740-20885

**Syringe:** 5 µL tapered, FN 23-26s/42/HP, 5181-1273



- |                     |                      |
|---------------------|----------------------|
| 1. Butanal          | 10. iso-Butyric acid |
| 2. 2-Methyl butanal | 11. Butyric acid     |
| 3. Pentanal         | 12. iso-Valeric acid |
| 4. Hexanal          | 13. Valeric acid     |
| 5. Heptanal         | 14. Hexanoic acid    |
| 6. Octanal          | 15. Heptanoic acid   |
| 7. Acetic acid      | 16. Octanoic acid    |
| 8. Decanal          | 17. Decanoic acid    |
| 9. Propanoic acid   |                      |

**Aldehydes and Ketones**

**Column:** DB-1  
123-1034  
30 m x 0.32 mm, 3.00 µm

**Column:** DB-WAX  
123-7033  
30 m x 0.32 mm, 0.50 µm

**Carrier:** Helium at 32 cm/sec,  
measured at 40 °C

**Oven:** 40 °C for 5 min  
40-210 °C at 10 °C/min 40 °C for 5 min  
40-210 °C at 10 °C/min

**Suggested Supplies**

**Septum:** 11 mm Advanced Green septa, 5183-4759

**Liner:** Split, single taper, low pressure drop, glass wool, 5183-4647

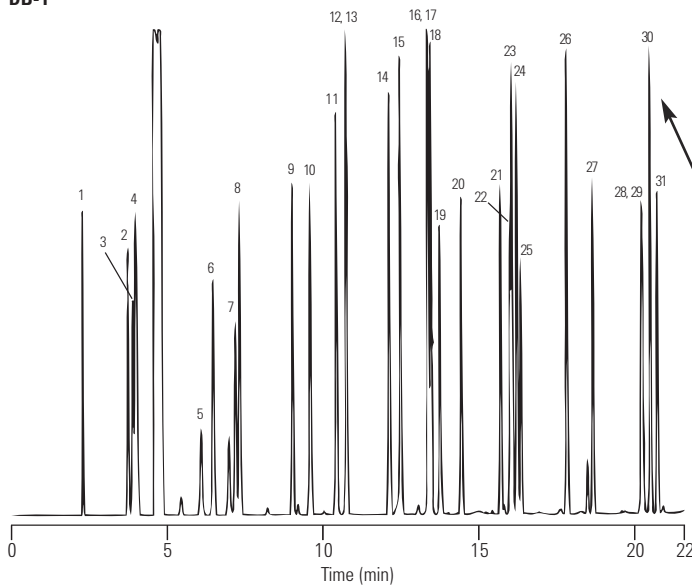
**Seal:** Gold plated seal, 18740-20885

**Syringe:** 5 µL tapered, FN 23-26s/42/HP, 5181-1273

**Injection:** Split, 250 °C  
Split ratio 1:100

**Detector:** FID, 300 °C  
Nitrogen makeup gas at 30 mL/min

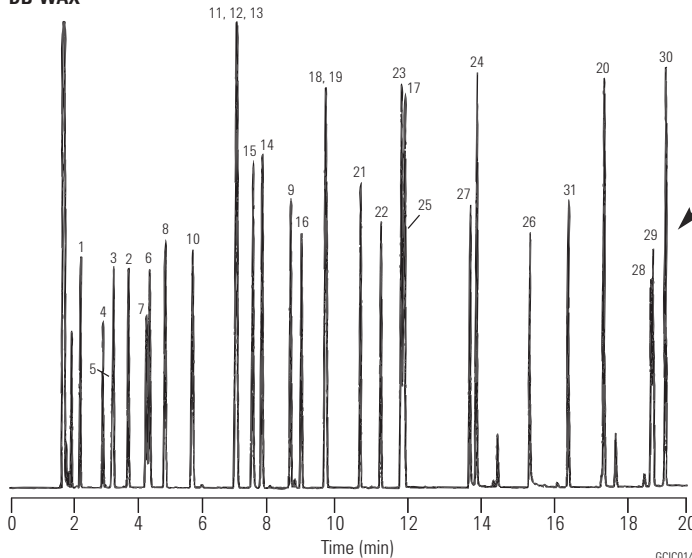
**DB-1**



1. Acetaldehyde
2. Acrolein
3. Acetone
4. Propionaldehyde
5. Isobutyraldehyde
6. Methacrolein
7. Butyraldehyde
8. 2-Butanone (MEK)
9. Crotonaldehyde
10. 3-Methyl-2-butanone
11. 2-Pentanone
12. 3-Pentanone
13. Valeraldehyde (pentanal)
14. 4-Methyl-2-pentanone (MIBK)
15. 2-Methyl-3-pentanone
16. 3-Hexanone
17. Cyclopentanone
18. 2-Hexanone
19. Hexanal
20. Furfural
21. 4-Heptanone
22. 3-Heptanone
23. 2-Heptanone
24. Cyclohexanone
25. Heptanal
26. Benzaldehyde
27. Octyl aldehyde
28. o-Tolualdehyde
29. m-Tolualdehyde
30. p-Tolualdehyde
31. Nonyl aldehyde

**DB-1 provides the best overall resolution; however, DB-WAX provides better resolution of o- and m-tolualdehyde.**

**DB-WAX**



G01C014

**Formaldehyde Underivatized**

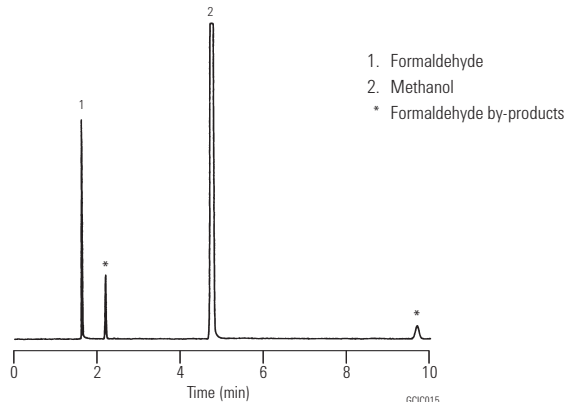
**Column:** DB-WAX  
123-7033  
30 m x 0.32 mm, 0.50 µm

**Carrier:** Helium at 36 cm/sec,  
measured at 35 °C

**Oven:** 35 °C isothermal

**Injection:** Split, 200 °C  
Split ratio 1:100

**Detector:** FID, 300 °C  
Nitrogen makeup gas at 30 mL/min

**DNPH Derivative**

**Column:** DB-1  
123-1012  
15 m x 0.32 mm, 0.25 µm

**Carrier:** Helium at 35 cm/sec,  
measured at 150 °C

**Oven:** 150-250 °C at 20 °C/min

**Injection:** Split, 300 °C  
Split ratio 1:100

**Detector:** ECD, 375 °C  
Nitrogen makeup gas at 35 mL/min

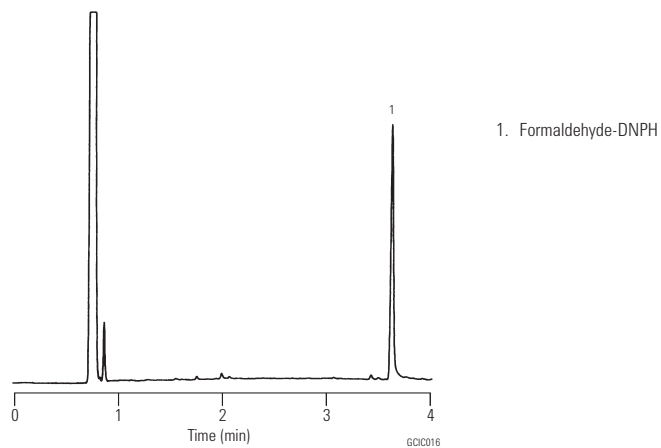
**Suggested Supplies**

**Septum:** 11 mm Advanced Green septa, 5183-4759

**Liner:** General purpose split/splitless liner, taper, glass wool, 5183-4711

**Seal:** Gold plated seal, 18740-20885

**Syringe:** 10 µL tapered, FN 23-26s/42/HP, 5181-1267



**PFBHA Derivative**

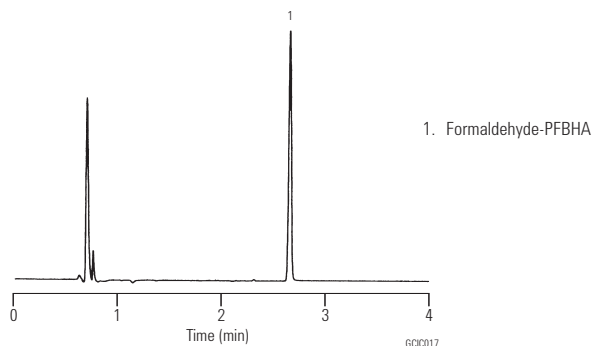
**Column:** DB-1  
123-1012  
15 m x 0.32 mm, 0.25 µm

**Carrier:** Helium at 40 cm/sec,  
measured at 60 °C

**Oven:** 60-100 °C at 10 °C/min

**Injection:** Split, 250 °C  
Split ratio 1:100

**Detector:** FID, 375 °C  
Nitrogen makeup gas at 35 mL/min



**Aromatics I**

**Column:** DB-1  
125-1034  
30 m x 0.53 mm, 3.00 µm

**Carrier:** Helium at 30 cm/sec,  
measured at 40 °C

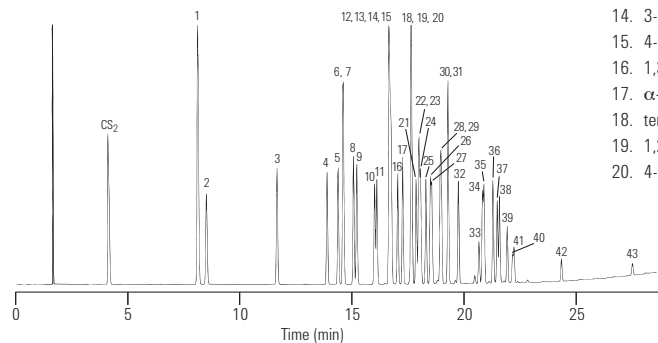
**Oven:** 40 °C for 5 min  
40-260 °C at 10 °C/min

**Injection:** Split, 250 °C  
Split ratio 1:10

**Detector:** FID, 300 °C  
Nitrogen makeup gas at 30 mL/min

**Suggested Supplies**

- Septum:** 11 mm Advanced Green septa, 5183-4759
- Liner:** General purpose split/splitless liner, taper, glass wool, 5183-4711
- Seal:** Gold plated seal, 18740-20885
- Syringe:** 10 µL tapered, FN 23-26s/42/HP, 5181-1267



- |   |  |
|---|--|
| 1. Benzene                                | 21. 1,3-Dichlorobenzene                    |
| 2. Fluorobenzene                          | 22. 1,4-Dichlorobenzene                    |
| 3. Toluene                                | 23. Isobutylbenzene                        |
| 4. Chlorobenzene                          | 24. sec-Butylbenzene                       |
| 5. Ethylbenzene                           | 25. 1,2,3-Trimethylbenzene (hemimellitene) |
| 6. m-Xylene                               | 26. 1,2-Dichlorobenzene                    |
| 7. p-Xylene                               | 27. Iodobenzene                            |
| 8. Styrene                                | 28. Styrene oxide                          |
| 9. o-Xylene                               | 29. Butylbenzene                           |
| 10. Isopropylbenzene (cumene)             | 30. 4-Chlorostyrene                        |
| 11. Bromobenzene                          | 31. Nitrobenzene                           |
| 12. Propylbenzene                         | 32. 4-tert-Butyltoluene                    |
| 13. 2-Chlorotoluene                       | 33. 1,3,5-Trichlorobenzene                 |
| 14. 3-Chlorotoluene                       | 34. 2-Nitrotoluene                         |
| 15. 4-Chlorotoluene                       | 35. 1,3-Diisopropylbenzene                 |
| 16. 1,3,5-Trimethylbenzene (mesitylene)   | 36. 1,4-Diisopropylbenzene                 |
| 17. α-Methylstyrene                       | 37. 1,2,4-Trichlorobenzene                 |
| 18. tert-Butylbenzene                     | 38. 3-Nitrotoluene                         |
| 19. 1,2,4-Trimethylbenzene (pseudocumene) | 39. 4-Nitrotoluene                         |
| 20. 4-Methylstyrene                       | 40. 1,2,3-Trichlorobenzene                 |
|   | 41. 1-Chloro-4-nitrobenzene                |
|   | 42. 1,2,4,5-Tetrachlorobenzene             |
|   | 43. Pentachlorobenzene                     |



## Aromatics II

**Column:** DB-WAX  
125-7032  
30 m x 0.53 mm, 1.00 µm

**Carrier:** Helium at 30 cm/sec, measured at 40 °C

**Oven:** 40 °C for 5 min  
40-230 °C at 10 °C/min  
230 °C for 7 min

**Injection:** Split, 250 °C  
Split ratio 1:10

**Detector:** FID, 300 °C  
Nitrogen makeup gas at 30 mL/min

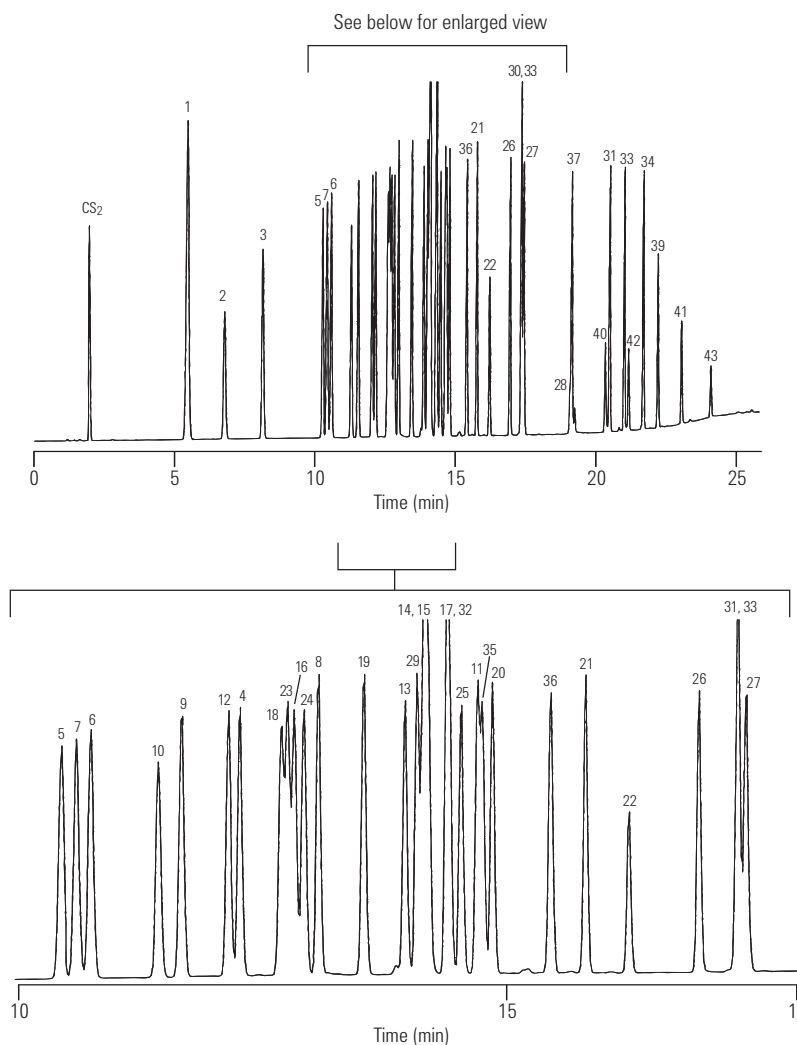
## Suggested Supplies

**Septum:** 11 mm Advanced Green septa, 5183-4759

**Liner:** General purpose split/splitless liner, taper, glass wool, 5183-4711

**Seal:** Gold plated seal, 18740-20885

**Syringe:** 10 µL tapered, FN 23-26s/42/HP, 5181-1267



1. Benzene
2. Fluorobenzene
3. Toluene
4. Chlorobenzene
5. Ethylbenzene
6. m-Xylene
7. p-Xylene
8. Styrene
9. o-Xylene
10. Isopropylbenzene (cumene)
11. Bromobenzene
12. Propylbenzene
13. 2-Chlorotoluene
14. 3-Chlorotoluene
15. 4-Chlorotoluene
16. 1,3,5-Trimethylbenzene (mesitylene)
17. α-Methylstyrene
18. tert-Butylbenzene
19. 1,2,4-Trimethylbenzene (pseudocumene)
20. 4-Methylstyrene
21. 1,3-Dichlorobenzene
22. 1,4-Dichlorobenzene
23. Isobutylbenzene
24. sec-Butylbenzene
25. 1,2,3-Trimethylbenzene (hemimellitene)
26. 1,2-Dichlorobenzene
27. Iodobenzene
28. Styrene oxide (peak not shown)
29. Butylbenzene
30. 4-Chlorostyrene
31. Nitrobenzene
32. 4-tert-Butyltoluene
33. 1,3,5-Trichlorobenzene
34. 2-Nitrotoluene
35. 1,3-Diisopropylbenzene
36. 1,4-Diisopropylbenzene
37. 1,2,4-Trichlorobenzene
38. 3-Nitrotoluene
39. 4-Nitrotoluene
40. 1,2,3-Trichlorobenzene
41. 1-Chloro-4-nitrobenzene
42. 1,2,4,5-Tetrachlorobenzene
43. Pentachlorobenzene

GCIC019

### Impurities in Styrene

**Column:** DB-WAXetr  
123-7363  
60 m x 0.32 mm, 0.50 µm

**Carrier:** Helium at 29.4 cm/sec, measured at 70 °C

**Oven:** 80 °C isothermal

**Injection:** Split, 230 °C  
Split ratio 1:150

**Detector:** FID, 240 °C

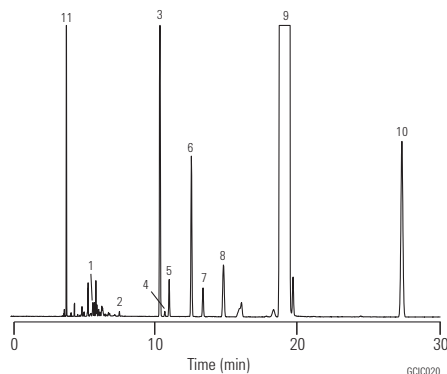
#### Suggested Supplies

**Septum:** 11 mm Advanced Green septa, 5183-4759

**Liner:** Split, single taper, low pressure drop, glass wool, 5183-4647

**Seal:** Gold plated seal, 18740-20885

**Syringe:** 5 µL tapered, FN 23-26s/42/HP, 5181-1273



1. Benzene
2. Toluene
3. Ethylbenzene
4. p-Xylene
5. m-Xylene
6. Isopropylbenzene
7. o-Xylene
8. n-Propylbenzene
9. Styrene
10. α-Methylstyrene
11. Heptane (IS)

### Impurities in Ethylbenzene

**Column:** HP-INNOWax  
19091N-216  
60 m x 0.32 mm, 0.50 µm

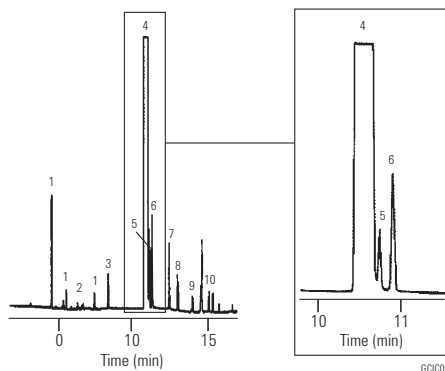
**Carrier:** Helium, 32 cm/sec, 19.9 psi (60 °C)  
2.5 mL/min constant flow

**Oven:** 60 °C for 1 min  
60-92 °C at 4 °C/min  
92 °C for 4.5 min  
92-220 °C at 20 °C/min

**Injection:** Split, 220 °C  
Split ratio 100:1  
ASTM Method D5060

**Detector:** FID 270 °C

**Sample:** 0.5 µL  
Neat, 99%+



1. Hydrocarbon
2. Benzene
3. Toluene
4. Ethylbenzene
5. p-Xylene
6. m-Xylene
7. Cumene
8. o-Xylene
9. Propylbenzene
10. Styrene

**Pyrolysates of Polystyrene**

**Column:** ULTRA 1  
19091A-105  
50 m x 0.20 mm, 0.33 µm

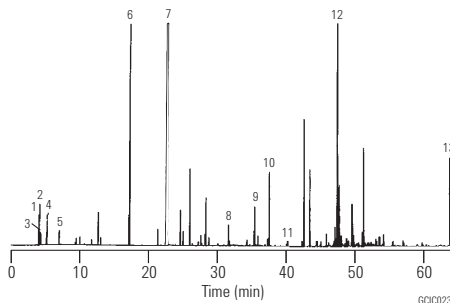
**Carrier:** Helium, 30 psi, 12 mL/min

**Oven:** 0-280 at 5 °C/min

**Injection:** Split, 280 °C  
Split ratio 30:1  
Pyrolyzer 600 °C

**Detector:** FID 300 °C

**Sample:** 100 mg pyrolyzed



1. Propylene
2. Propane
3. 1-Butene
4. Butene
5. Pentane
6. Toluene
7. Styrene
8.  $C_2H_5-C(Ph)=CH_2$
9.  $C_4H_9-CH_2CH_2-Ph$
10.  $C_4H_9-C(Ph)=CH_2$
11.  $C_4H_9-CH=C(Ph)CH_3$
12. Styrene dimer
13. Styrene trimer

**Esters I**

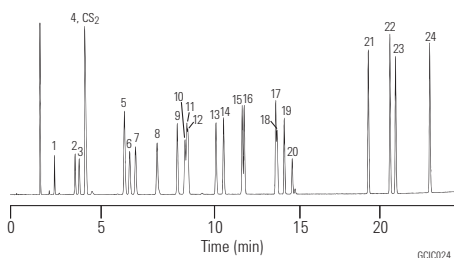
**Column:** DB-1  
125-1034  
30 m x 0.53 mm, 3.00 µm

**Carrier:** Helium at 30 cm/sec,  
measured at 40 °C

**Oven:** 40 °C for 5 min  
40-260 °C at 10 °C/min

**Injection:** Split, 250 °C  
Split ratio 1:10

**Detector:** FID, 300 °C  
Nitrogen makeup gas at 30 mL/min



**Suggested Supplies**

- Septum:** 11 mm Advanced Green septa, 5183-4759
- Liner:** General purpose split/splitless liner, taper, glass wool, 5183-4711
- Seal:** Gold plated seal, 18740-20885
- Syringe:** 10 µL tapered, FN 23-26s/42/HP, 5181-1267

1. Methyl formate
2. Ethyl formate
3. Methyl acetate
4. Vinyl acetate
5. Ethyl acetate
6. Propyl formate
7. Methyl propionate
8. Isopropyl acetate
9. Ethyl acrylate
10. tert-Butyl acetate
11. Ethyl propionate
12. Propyl acetate
13. sec-Butyl acetate
14. Isobutyl acetate
15. Propyl propionate
16. Butyl acetate
17. Isoamyl acetate
18. Amyl acetate
19. 2-Ethoxyethyl acetate
20. 2-Methylbutyl acetate
21. Methyl benzoate
22. Benzyl acetate
23. Ethyl benzoate
24. Propyl benzoate

### Esters II

**Column:** DB-624  
125-1334  
30 m x 0.53 mm, 3.00 µm

**Carrier:** Helium at 30 cm/sec,  
measured at 40 °C

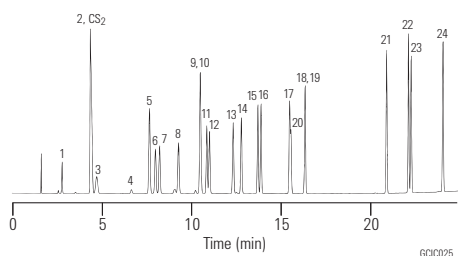
**Oven:** 40 °C for 5 min  
40-260 °C at 10 °C/min  
260 °C for 3 min

**Injection:** Split, 250 °C  
Split ratio 1:10

**Detector:** FID, 300 °C  
Nitrogen makeup gas at 30 mL/min

#### Suggested Supplies

**Septum:** 11 mm Advanced Green septa, 5183-4759  
**Liner:** General purpose split/splitless liner, taper, glass wool, 5183-4711  
**Seal:** Gold plated seal, 18740-20885  
**Syringe:** 10 µL tapered, FN 23-26s/42/HP, 5181-1267



- |                        |                           |
|------------------------|---------------------------|
| 1. Methyl formate      | 13. sec-Butyl acetate     |
| 2. Ethyl formate       | 14. Isobutyl acetate      |
| 3. Methyl acetate      | 15. Propyl propionate     |
| 4. Vinyl acetate       | 16. Butyl acetate         |
| 5. Ethyl acetate       | 17. Isoamyl acetate       |
| 6. Propyl formate      | 18. Amyl acetate          |
| 7. Methyl propionate   | 19. 2-Ethoxyethyl acetate |
| 8. Isopropyl acetate   | 20. 2-Methylbutyl acetate |
| 9. Ethyl acrylate      | 21. Methyl benzoate       |
| 10. tert-Butyl acetate | 22. Benzyl acetate        |
| 11. Ethyl propionate   | 23. Ethyl benzoate        |
| 12. Propyl acetate     | 24. Propyl benzoate       |

### Esters III

**Column:** HP-InnoWax  
19095N-123  
30 m x 0.53 mm, 1.00 µm

**Carrier:** Helium 29 cm/sec, 3.0 psi (45 °C)  
4 mL/min constant flow

**Oven:** 45 °C for 1 min  
45-200 °C at 5 °C/min

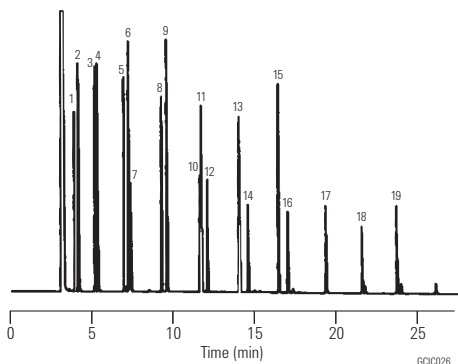
**Injection:** Split, 250 °C  
Split ratio 25:1

**Detector:** FID 250 °C

**Sample:** 1 µL

#### Suggested Supplies

**Septum:** 11 mm Advanced Green septa, 5183-4759  
**Liner:** General purpose split/splitless liner, taper, glass wool, 5183-4711  
**Seal:** Gold plated seal, 18740-20885  
**Syringe:** 10 µL tapered, FN 23-26s/42/HP, 5181-1267



- |                      |                           |
|----------------------|---------------------------|
| 1. Ethyl propionate  | 11. Propyl caproate       |
| 2. Propyl acetate    | 12. Methyl decanoate      |
| 3. Ethyl butyrate    | 13. Butyl caproate        |
| 4. Propyl propionate | 14. Methyl dodecanoate    |
| 5. Propyl butyrate   | 15. Butyl heptanoate      |
| 6. Ethyl valerate    | 16. Methyl tetradecanoate |
| 7. Butyl propionate  | 17. Methyl hexadecanoate  |
| 8. Propyl valerate   | 18. Methyl octadecanoate  |
| 9. Ethyl caproate    | 19. Methyl eicosenoate    |
| 10. Butyl valerate   |                           |

**Ethers**

**Column:** DB-624  
125-1334  
30 m x 0.53 mm, 3.00 µm

**Carrier:** Helium at 30 cm/sec,  
measured at 40 °C

**Oven:** 40 °C for 5 min  
40-260 °C at 10 °C/min  
260 °C for 3 min

**Injection:** Split, 250 °C  
Split ratio 1:10

**Detector:** FID, 300 °C  
Nitrogen makeup gas at 30 mL/min

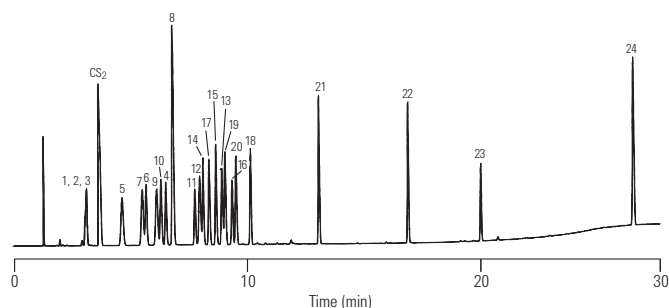
**Suggested Supplies**

**Septum:** 11 mm Advanced Green septa, 5183-4759

**Liner:** General purpose split/splitless liner, taper, glass wool, 5183-4711

**Seal:** Gold plated seal, 18740-20885

**Syringe:** 10 µL tapered, FN 23-26s/42/HP, 5181-1267



G01C027

- |   |  |
|---|--|
| 1. Furan                                    | 13. Diglyme (diethylene glycol dimethyl ether)   |
| 2. Ethyl vinyl ether                        | 14. Propyl ether                                 |
| 3. Ethyl ether                              | 15. Allyl ether                                  |
| 4. 1,3-Dioxalane                            | 16. 1,4-Dioxane                                  |
| 5. Methyl-tert-butyl ether (MTBE)           | 17. Butyl ethyl ether                            |
| 6. Allyl ethyl ether                        | 18. Epichlorohydrin                              |
| 7. Isopropyl ether                          | 19. Tetrahydropyran                              |
| 8. Tetrahydrofuran (THF)                    | 20. Acetal (acetaldehyde diethyl acetal)         |
| 9. tert-Amyl methyl ether                   | 21. Butyl ether                                  |
| 10. Butyl methyl ether                      | 22. Pentyl ether                                 |
| 11. Glyme (propylene glycol dimethyl ether) | 23. Triglyme (triethylene glycol dimethyl ether) |
| 12. tert-Amyl methyl ether                  | 24. Benzyl ether                                 |

**Glycols I**

**Column:** DB-WAX  
124-7032  
30 m x 0.45 mm, 0.85 µm

**Carrier:** Helium at 35 cm/sec,  
measured at 50 °C

**Oven:** 50 °C for 2 min  
50-220 °C at 10 °C/min

**Injection:** Megabore Direct, 250 °C

**Detector:** FID, 280 °C  
Nitrogen makeup gas at 30 mL/min

**Sample:** 1 µL

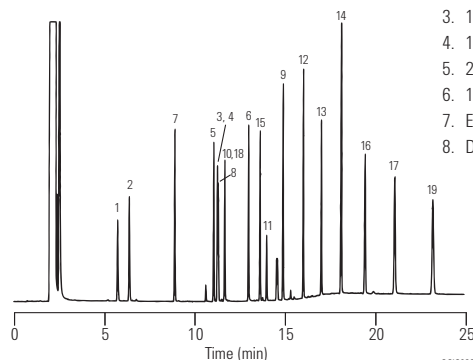
**Suggested Supplies**

**Septum:** 11 mm Advanced Green septa, 5183-4759

**Liner:** General purpose split/splitless liner, taper, glass wool, 5183-4711

**Seal:** Gold plated seal, 18740-20885

**Syringe:** 10 µL tapered, FN 23-26s/42/HP, 5181-1267



- |                                       |                                       |
|---------------------------------------|---------------------------------------|
| 1. Ethylene glycol monomethyl ether   | 9. 1,4-Butanediol                     |
| 2. Ethylene glycol monoethyl ether    | 10. Diethylene glycol monoethyl ether |
| 3. 1,3-Propanediol                    | 11. Dipropylene glycol                |
| 4. 1,2-Propanediol (propylene glycol) | 12. 1,5-Pentanediol                   |
| 5. 2,3-Butanediol                     | 13. 1,6-Hexanediol                    |
| 6. 1,3-Butanediol                     | 14. 1,7-Heptanediol                   |
| 7. Ethylene glycol monobutyl ether    | 15. Diethylene glycol monobutyl ether |
| 8. Diethylene glycol monomethyl ether | 16. 1,8-Octanediol                    |
|                                       | 17. 1,9-Nonanediol                    |
|                                       | 18. Ethylene glycol                   |
|                                       | 19. 1,10-Decanediol                   |

G01C028

### Glycols II

**Column:** DB-624  
125-1334  
30 m x 0.53 mm, 3.00 µm

**Carrier:** Helium at 30 cm/sec,  
measured at 40 °C

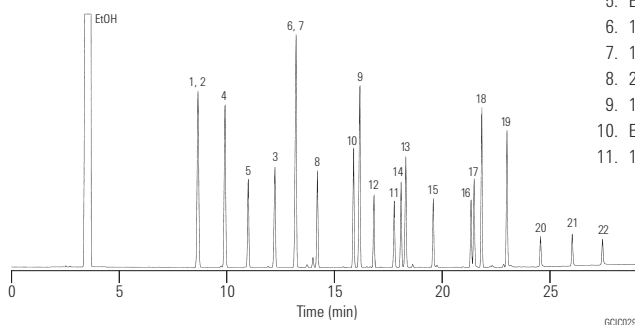
**Oven:** 40 °C for 5 min  
40-260 °C at 10 °C/min  
260 °C for 3 min

**Injection:** Split, 250 °C  
Split ratio 1:10

**Detector:** FID, 300 °C  
Nitrogen makeup gas at 30 mL/min

#### Suggested Supplies

**Septum:** 11 mm Advanced Green septa, 5183-4759  
**Liner:** Direct connect, dual taper, deactivated, 4 mm id, G1544-80700  
**Seal:** Gold plated seal, 18740-20885  
**Syringe:** 10 µL tapered, FN 23-26s/42/HP, 5181-1267



- |                                       |  |
|---------------------------------------|--|
| 1. Ethylene glycol monomethyl ether   | 12. Diethylene glycol monomethyl ether |
| 2. Glyme                              | 13. Diethylene glycol                  |
| 3. Ethylene glycol                    | 14. Diethylene glycol monoethyl ether  |
| 4. Diglyme                            | 15. 1,5-Pentanediol                    |
| 5. Ethylene glycol monoethyl ether    | 16. 1,6-Hexanediol                     |
| 6. 1,3-Propanediol                    | 17. Diethylene glycol monobutyl ether  |
| 7. 1,2-Propanediol (propylene glycol) | 18. Triglyme                           |
| 8. 2,3-Butanediol                     | 19. 1,7-Heptanediol                    |
| 9. 1,3-Butanediol                     | 20. 1,8-Octanediol                     |
| 10. Ethylene glycol monobutyl ether   | 21. 1,9-Nonanediol                     |
| 11. 1,4-Butanediol                    | 22. 1,10-Decanediol                    |

### Glycols III

**Column:** DB-1  
124-1032  
30 m x 0.45 mm, 1.27 µm

**Carrier:** Helium at 35 cm/sec,  
measured at 50 °C

**Oven:** 50 °C for 2 min  
50-260 °C at 10 °C/min

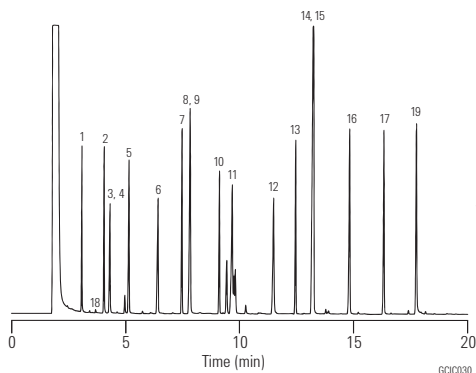
**Injection:** Split, 250 °C

**Detector:** FID, 280 °C  
Nitrogen makeup gas at 30 mL/min

**Sample:** 1 µL

#### Suggested Supplies

**Septum:** 11 mm Advanced Green septa, 5183-4759  
**Liner:** Direct connect, dual taper, deactivated, 4 mm id, G1544-80700  
**Seal:** Gold plated seal, 18740-20885  
**Syringe:** 10 µL tapered, FN 23-26s/42/HP, 5181-1267



- |                                       |                                       |
|---------------------------------------|---------------------------------------|
| 1. Ethylene glycol monomethyl ether   | 11. Dipropylene glycol                |
| 2. Ethylene glycol monoethyl ether    | 12. 1,5-Pentanediol                   |
| 3. 1,3-Propanediol                    | 13. 1,6-Hexanediol                    |
| 4. 1,2-Propanediol                    | 14. 1,7-Heptanediol                   |
| 5. 2,3-Butanediol                     | 15. Diethylene glycol monobutyl ether |
| 6. 1,3-Butanediol                     | 16. 1,8-Octanediol                    |
| 7. Ethylene glycol monobutyl ether    | 17. 1,9-Nonanediol                    |
| 8. Diethylene glycol monomethyl ether | 18. Ethylene glycol                   |
| 9. 1,4-Butanediol                     | 19. 1,10-Decanediol                   |
| 10. Diethylene glycol monoethyl ether |                                       |

**Triethylene Glycol and Impurities**

**Column:** DB-1  
124-1032  
30 m x 0.45 mm, 1.27  $\mu$ m

**Carrier:** Helium at 35 cm/sec,  
measured at 50 °C

**Oven:** 170 °C isothermal

**Injection:** Split, 250 °C  
Split ratio 1:50

**Detector:** FID, 280 °C  
Nitrogen makeup gas at 30 mL/min

**Sample:** 0.5  $\mu$ L

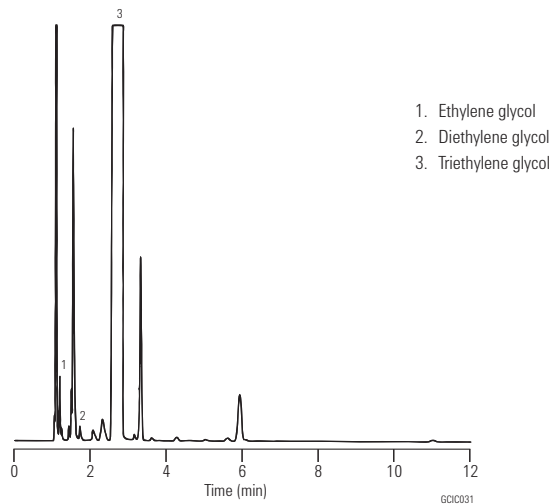
**Suggested Supplies**

**Septum:** 11 mm Advanced Green septa, 5183-4759

**Liner:** Split, single taper, low pressure drop, glass wool, 5183-4647

**Seal:** Gold plated seal, 18740-20885

**Syringe:** 5  $\mu$ L tapered, FN 23-26s/42/HP, 5181-1273

**Ethylene Glycol Mixture**

**Column:** ULTRA 1  
19091A-101  
12 m x 0.20 mm, 0.33  $\mu$ m

**Carrier:** Helium, 25 cm/sec

**Oven:** 100 °C for 0.5 min  
100-200 °C at 20 °C/min

**Injection:** Split, 250 °C  
Split ratio 100:1

**Detector:** FID

**Sample:** 1  $\mu$ L

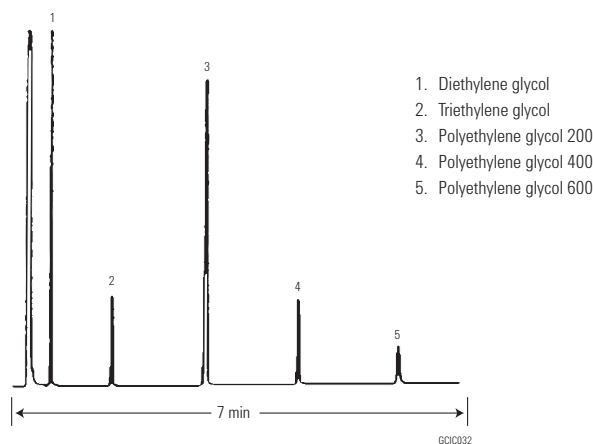
**Suggested Supplies**

**Septum:** 11 mm Advanced Green septa, 5183-4759

**Liner:** Liner, splitless, single-taper, glass wool, deactivated, 5062-3587

**Seal:** Gold plated seal, 18740-20885

**Syringe:** 10  $\mu$ L tapered, FN 23-26s/42/HP, 5181-1267



### Glycols/Diols

**Column:** HP-1  
19095Z-023  
30 m x 0.53 mm, 0.88 µm

**Carrier:** Helium

**Oven:** 50 °C for 3 min  
50-180 °C at 8 °C/min

**Injection:** On-column

**Detector:** FID 250 °C

**Sample:** 1 µL



1. Ethylene glycol
2. 1,3-Butanediol
3. Ethylene glycol phenyl ether
4. 1,7-Hepatanediol
5. 1,9-Nonanediol
6. 1,10-Decanediol

### Halogenated Hydrocarbons II

**Column:** DB-1  
123-1034  
30 m x 0.32 mm, 3.00 µm

**Carrier:** Helium at 35 cm/sec, measured at 35 °C

**Oven:** 35 °C for 5 min  
35-245 °C at 10 °C/min  
245 °C for 2 min

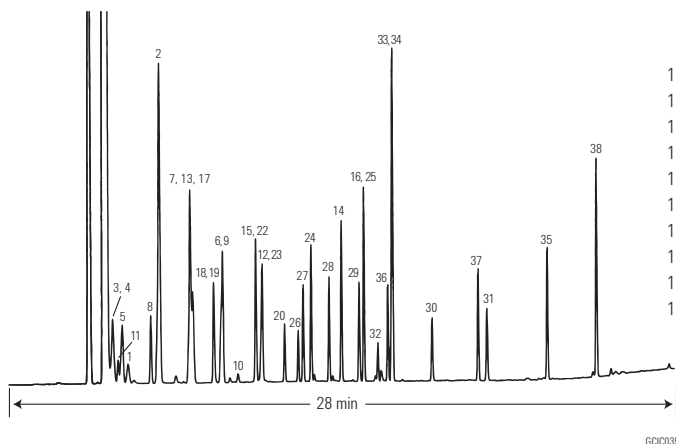
**Injection:** Split, 250 °C  
Split ratio 1:100

**Detector:** FID, 300 °C  
Nitrogen makeup gas at 30 mL/min

**Sample:** In pentane

#### Suggested Supplies

- Septum:** 11 mm Advanced Green septa, 5183-4759
- Liner:** General purpose split/splitless liner, taper, glass wool, 5183-4711
- Seal:** Gold plated seal, 18740-20885
- Syringe:** 10 µL tapered, FN 23-26s/42/HP, 5181-1267



1. 1,1,2-Trichlorotrifluoroethane (Freon-113)
2. 1,1-Dichloroethene
3. Bromoethane (ethyl bromide)
4. Iodomethane
5. 3-Chloropropene (allyl chloride)
6. 1-Chlorobutane
7. 2,2-Dichloropropane
8. trans-1,2-Dichloroethene
9. 1,1,1-Trichloroethane
10. Carbon tetrachloride
11. Methylene chloride
12. Trichloroethene
13. Chloroform
14. Tetrachloroethene
15. 1,2-Dichloropropane
16. 1-Chlorohexane
17. Bromochloromethane
18. 1,1-Dichloroethane
19. 1,2-Dichloroethane
20. Iodoform
21. cis-1,3-Dichloropropene
22. Dibromomethane
23. Bromodichloromethane
24. 1,3-Dichloropropane
25. 1,1-Dichloropropane
26. trans-1,3-Dichloropropene
27. 1,1,2-Trichloroethane
28. 1,2-Dibromoethane (EDB)
29. 1,1,1,2-Tetrachloroethane
30. Pentachloroethane
31. Hexachloroethane
32. Bromoform
33. trans-1,4-Dichloro-2-butene
34. 1,2,3-Trichloropropane
35. Hexachlorobutadiene
36. 1,1,2,2-Tetrachloroethane
37. 1,2-Dibromo-3-chloropropane (DBCP)
38. Hexachlorocyclopentadiene



**Chlorinated Isooctane**

**Column:** HP-INNOWax  
19091N-136  
60 m x 0.25 mm, 0.25 µm

**Carrier:** Helium, 33 cm/sec, 35.7 psi (80 °C) 2 mL/min

**Oven:** 80 °C isothermal

**Injection:** Split, 250 °C  
Split ratio 150:1

**Detector:** FID 300 °C

**Sample:** Monochloro isomers, 0.5 µL

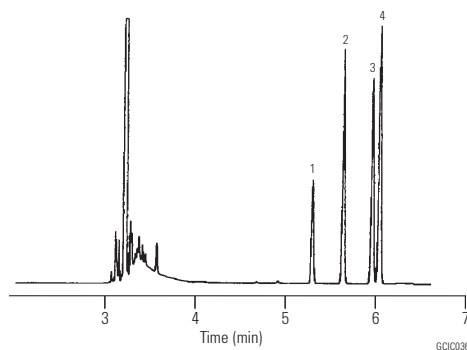
**Suggested Supplies**

**Septum:** 11 mm Advanced Green septa, 5183-4759

**Liner:** General purpose split/splitless liner, taper, glass wool, 5183-4711

**Seal:** Gold plated seal, 18740-20885

**Syringe:** 10 µL tapered, FN 23-26s/42/HP, 5181-1267



1. 1-Chloro isooctane
2. 4-Chloromethyl 2,2'-dimethyl pentane
3. 3-Chloro isooctane
4. 4-Chloro isooctane

**Solvents I**

**Column:** DB-WAXetr  
125-7332  
30 m x 0.53 mm, 1.00 µm

**Carrier:** Helium at 30 cm/sec,  
measured at 40 °C

**Oven:** 40 °C for 5 min  
40-140 °C at 5 °C/min

**Injection:** Split, 250 °C

**Detector:** FID, 250 °C

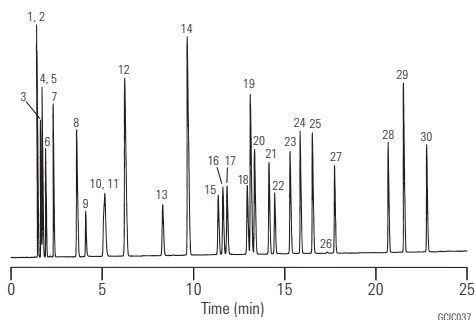
**Suggested Supplies**

**Septum:** 11 mm Advanced Green septa, 5183-4759

**Liner:** General purpose split/splitless liner, taper, glass wool, 5183-4711

**Seal:** Gold plated seal, 18740-20885

**Syringe:** 10 µL tapered, FN 23-26s/42/HP, 5181-1267



- |                                   |                            |
|-----------------------------------|----------------------------|
| 1. 3-Methylpentane                | 16. p-Xylene               |
| 2. Hexane                         | 17. m-Xylene               |
| 3. Isooctane                      | 18. Cumene                 |
| 4. Methyl-tert-butyl ether (MTBE) | 19. Dodecane               |
| 5. Heptane                        | 20. o-Xylene               |
| 6. Cyclohexane                    | 21. Propylbenzene          |
| 7. Octane                         | 22. Chlorobenzene          |
| 8. Nonane                         | 23. Mesitylene             |
| 9. Methanol                       | 24. Styrene                |
| 10. Ethanol                       | 25. 1,2,4-Trimethylbenzene |
| 11. Benzene                       | 26. Naphthalene            |
| 12. Decane                        | 27. 4-Chlorotoluene        |
| 13. Toluene                       | 28. 1,3-Dichlorobenzene    |
| 14. Undecane                      | 29. 1,4-Dichlorobenzene    |
| 15. Ethylbenzene                  | 30. 1,2-Dichlorobenzene    |

### Solvents II

**Column:** DB-WAXetr  
123-7354  
50 m x 0.32 mm, 1.00 µm

**Carrier:** Helium at 41 cm/sec, measured at 50 °C

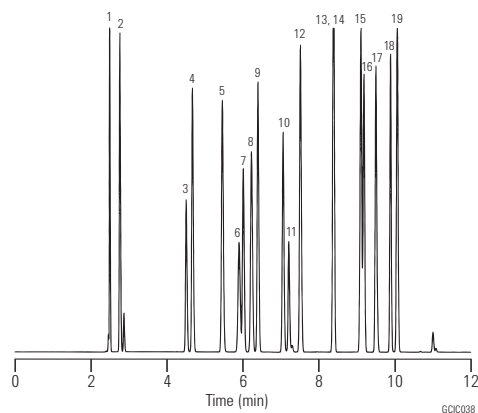
**Oven:** 50 °C for 5 min  
50-170 °C at 10 °C/min

**Injection:** Split, 250 °C  
Split ratio 1:100

**Detector:** FID, 280 °C  
Nitrogen makeup gas at 30 mL/min

#### Suggested Supplies

**Septum:** 11 mm Advanced Green septa, 5183-4759  
**Liner:** General purpose split/splitless liner, taper, glass wool, 5183-4711  
**Seal:** Gold plated seal, 18740-20885  
**Syringe:** 10 µL tapered, FN 23-26s/42/HP, 5181-1267



1. Hexane
2. Isooctane
3. Acetone
4. Ethyl formate
5. Tetrahydrofuran
6. Trichloroethane
7. Ethyl acetate
8. Isopropyl acetate
9. Methyl ethyl ketone
10. Isopropyl alcohol
11. Methylene chloride
12. Benzene
13. 2-Pentanone
14. Methyl isobutyl ketone
15. Isobutyl acetate
16. Chloroform
17. sec-Butyl alcohol
18. Toluene
19. n-Propanol

### Solvents III

**Column:** DB-200  
122-2033  
30 m x 0.25 mm, 0.50 µm

**Carrier:** Helium at 31 cm/sec

**Oven:** 45 °C for 7 min  
45-145 °C at 20 °C/min

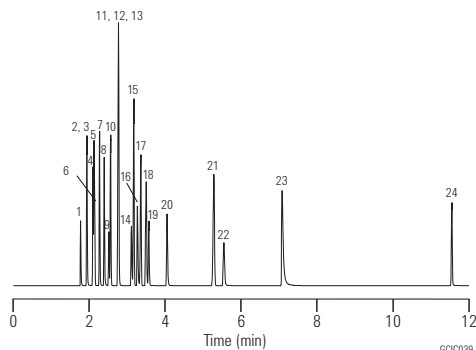
**Injection:** Split, 250 °C  
Split ratio 1:100

**Detector:** FID, 300 °C  
Nitrogen makeup gas at 30 mL/min

**Sample:** 0.5 µL of 0.5-1.0 µg/µL  
standard in water

#### Suggested Supplies

**Septum:** 11 mm Advanced Green septa, 5183-4759  
**Liner:** Split, single taper, low pressure drop, glass wool, 5183-4647  
**Seal:** Gold plated seal, 18740-20885  
**Syringe:** 5 µL tapered, FN 23-26s/42/HP, 5181-1273



- |                       |                               |
|-----------------------|-------------------------------|
| 1. Methanol           | 13. Acetone                   |
| 2. Ethanol            | 14. Acetonitrile              |
| 3. Ethyl ether        | 15. Benzene                   |
| 4. Isopropanol        | 16. Tetrahydrofuran (THF)     |
| 5. n-Hexane           | 17. Trichloroethylene         |
| 6. Methylene chloride | 18. n-Butanol                 |
| 7. tert-Butanol       | 19. Ethyl acetate             |
| 8. n-Propanol         | 20. Methyl ethyl ketone (MEK) |
| 9. Chloroform         | 21. Toluene                   |
| 10. Cyclohexane       | 22. 1,4-Dioxane               |
| 11. sec-Butanol       | 23. Pyridine                  |
| 12. n-Heptane         | 24. Dimethylformamide (DMF)   |

**Solvents IV**

**Column:** HP-1  
19091Z-205  
50 m x 0.20 mm, 0.50  $\mu$ m

**Carrier:** Helium, 30 psi

**Oven:** 70-200 °C at 5 °C/min  
200 °C for 2 min

**Injection:** Split

**Detector:** TCD

**Sample:** 1  $\mu$ L

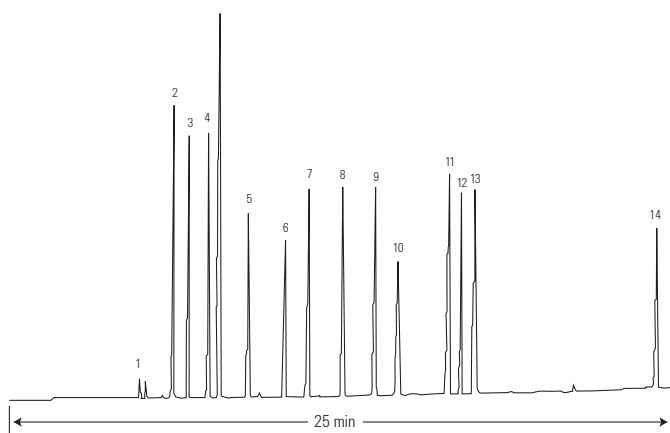
**Suggested Supplies**

**Septum:** 11 mm Advanced Green septa, 5183-4759

**Liner:** Split, single taper, low pressure drop, glass wool, 5183-4647

**Seal:** Gold plated seal, 18740-20885

**Syringe:** 5  $\mu$ L tapered, FN 23-26s/42/HP, 5181-1273



1. Isopropanol
2. Methyl ethyl ketone
3. Ethyl acetate
4. n-Butyl alcohol
5. Ethyl cellosolve
6. Methyl isobutyl ketone
7. Toluene
8. n-Butyl acetate
9. Diacetone alcohol
10. p-Xylene
11. Cellosolve acetate
12. o-Xylene
13. Butyl cellosolve
14. Butyl cellosolve acetate

GCIC040

**Common Industrial Solvents**

**Column:** HP-1  
19091Z-212  
25 m x 0.32 mm, 1.05  $\mu$ m

**Carrier:** Helium, 35 kPa

**Oven:** 30-140 °C at 10 °C/min

**Injection:** Split ratio 200:1

**Detector:** IRD, 200 °C

**Sample:** 1  $\mu$ L

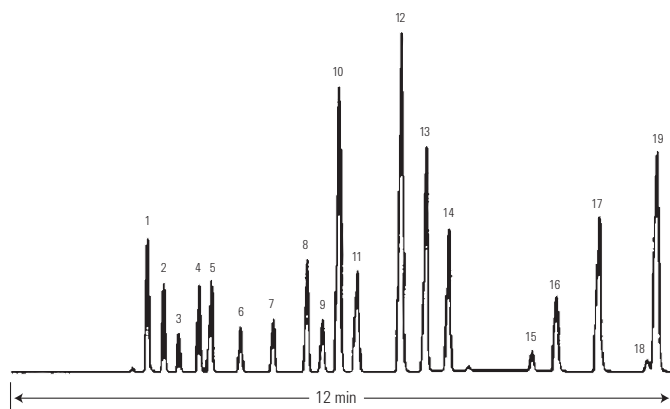
**Suggested Supplies**

**Septum:** 11 mm Advanced Green septa, 5183-4759

**Liner:** Split, single taper, low pressure drop, glass wool, 5183-4647

**Seal:** Gold plated seal, 18740-20885

**Syringe:** 5  $\mu$ L tapered, FN 23-26s/42/HP, 5181-1273



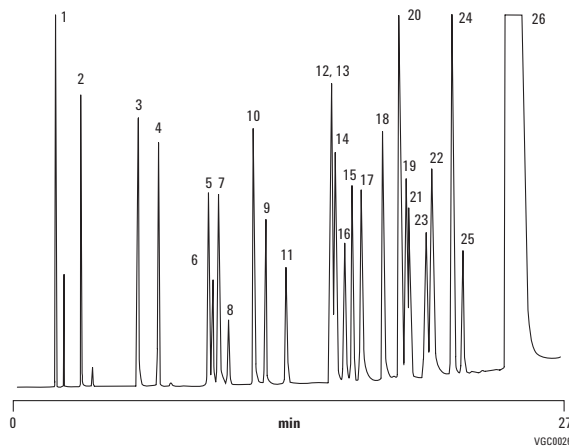
1. Methanol
2. Methyl formate
3. Ethanol
4. Acetone
5. Isopropanol
6. Dichloromethane
7. n-Propanol
8. Methyl ethyl ketone
9. sec-Butanol
10. Ethyl acetate
11. Isobutanol
12. Isopropyl acetate
13. Nitropropane
14. 1,4-Dioxane
15. Toluene
16. Mesityl oxide
17. Diacetone-alcohol
18. m-Xylene
19. Cyclohexanone

GCIC042

### Analysis of Solvents

**Column:** PoraBOND Q  
CP7354  
25 m x 0.53 mm, 10.00 µm

**Sample:** 5 µL  
**Sample Conc:** 0.1% per compound  
**Solvent:** DMSO  
**Carrier:** He, 25 kPa (0.25 bar, 3.5 psi)  
**Oven:** 100 °C (2 min) to 300 °C, 5 °C/min  
**Injection:** Split, T=250 °C  
**Detector:** FID, T=250 °C



1. Methane
2. Methanol
3. Ethanol
4. Acetonitrile
5. Acetone
6. Dichloromethane
7. 2-Propanol
8. Dimethyl sulfide
9. Diethyl ether
10. 1-propanol
11. Pentane
12. 2-Butanone
13. Trichloromethane
14. Tetrahydrofuran
15. Ethyl acetate
16. 2-Methoxyethanol
17. Isobutanol
18. Butanol
19. Hexane
20. Benzene
21. Trichloroethylene
22. Cyclohexane
23. 1,4-Dioxane
24. Pyridine
25. N,N-dimethylformamide
26. Dimethyl sulfoxide

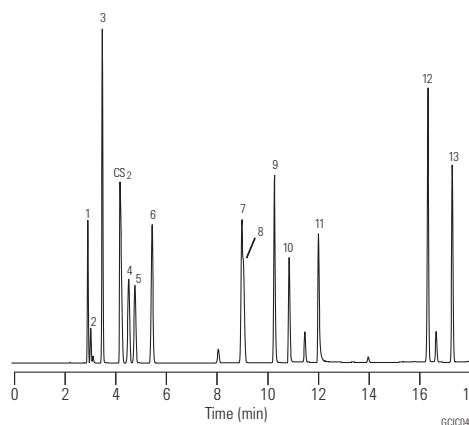
### Nitrogen Based Solvents I

**Column:** DB-1  
125-1034  
30 m x 0.53 mm, 3.00 µm

**Carrier:** Helium at 30 cm/sec,  
measured at 40 °C  
**Oven:** 40 °C for 5 min  
40-260 °C at 10 °C/min  
**Injection:** Split, 250 °C  
Split ratio 1:10  
**Detector:** FID, 300 °C  
Nitrogen makeup gas at 30 mL/min

#### Suggested Supplies

**Septum:** 11 mm Advanced Green septa, 5183-4759  
**Liner:** Split, single taper, low pressure drop, glass wool, 5183-4647  
**Seal:** Gold plated seal, 18740-20885  
**Syringe:** 5 µL tapered, FN 23-26s/42/HP, 5181-1273



1. Acetonitrile
2. Acrolein
3. Acrylonitrile
4. Propionitrile
5. Methacrolein
6. Methacrylonitrile
7. Triethylamine
8. Ethyl acrylate
9. Pyridine
10. DMF (dimethylformamide)
11. DMSO (dimethyl sulfoxide)
12. Benzonitrile
13. 1-Methyl-2-pyrrolidinone

**Nitrogen Based Solvents II**

**Column:** DB-624  
125-1334  
30 m x 0.53 mm, 3.00 µm

**Carrier:** Helium at 30 cm/sec,  
measured at 40 °C

**Oven:** 40 °C for 5 min  
40-260 °C at 10 °C/min  
260 °C for 3 min

**Injection:** Split, 250 °C  
Split ratio 1:10

**Detector:** FID, 300 °C  
Nitrogen makeup gas at 30 mL/min

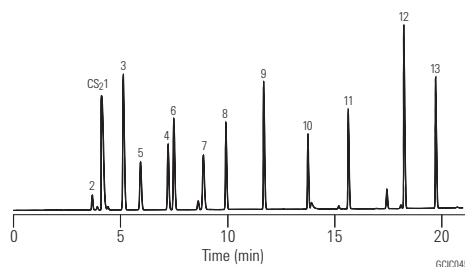
**Suggested Supplies**

**Septum:** 11 mm Advanced Green septa, 5183-4759

**Liner:** Split, single taper, low pressure drop, glass wool, 5183-4647

**Seal:** Gold plated seal, 18740-20885

**Syringe:** 5 µL tapered, FN 23-26s/42/HP, 5181-1273



1. Acetonitrile
2. Acrolein
3. Acrylonitrile
4. Propionitrile
5. Methacrolein
6. Methacrylonitrile
7. Triethylamine
8. Ethyl acrylate
9. Pyridine
10. DMF (dimethylformamide)
11. DMSO (dimethyl sulfoxide)
12. Benzoinitrile
13. 1-Methyl-2-pyrrolidinone

**Acrylate Impurities I**

**Column:** DB-200  
125-2032  
30 m x 0.53 mm, 1.00 µm

**Carrier:** Helium at 34.5 cm/sec  
measured at 35 °C

**Oven:** 35 °C for 5 min,  
35-200 °C at 10 °C/min

**Injection:** Split, 230 °C  
Split ratio 1:10

**Detector:** FID, 250 °C

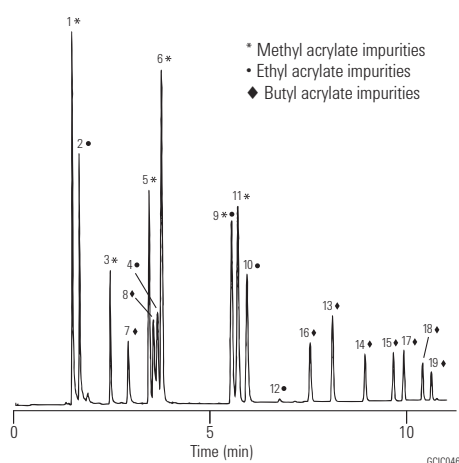
**Suggested Supplies**

**Septum:** 11 mm Advanced Green septa, 5183-4759

**Liner:** Split, single taper, low pressure drop, glass wool, 5183-4647

**Seal:** Gold plated seal, 18740-20885

**Syringe:** 5 µL tapered, FN 23-26s/42/HP, 5181-1273



1. Methanol
2. Ethanol
3. Methyl acetate
4. Ethyl acetate
5. Methyl acrylate
6. Methyl propionate
7. Isobutanol
8. Butanol
9. Ethyl acrylate
10. Ethyl propionate
11. Methyl methacrylate
12. Isopropyl acrylate
13. Isobutyl acetate
14. Butyl acetate
15. Isobutyl acrylate
16. Dibutyl ether
17. Isobutyl propionate
18. Butyl acrylate
19. Butyl propionate

### Acrylate Impurities II

**Column:** DB-1701  
125-0732  
30 m x 0.53 mm, 1.00 µm

**Carrier:** Helium at 36.8 cm/sec  
measured at 35 °C

**Oven:** 35 °C for 5 min,  
35-200 °C at 10 °C/min

**Injection:** Split, 230 °C  
Split ratio 1:10

**Detector:** FID, 250 °C

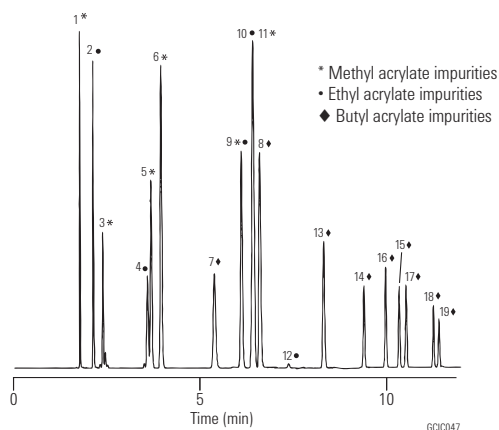
#### Suggested Supplies

**Septum:** 11 mm Advanced Green septa, 5183-4759

**Liner:** Split, single taper, low pressure drop, glass wool, 5183-4647

**Seal:** Gold plated seal, 18740-20885

**Syringe:** 5 µL tapered, FN 23-26s/42/HP, 5181-1273



1. Methanol
2. Ethanol
3. Methyl acetate
4. Ethyl acetate
5. Methyl acrylate
6. Methyl propionate
7. Isobutanol
8. Butanol
9. Ethyl acrylate
10. Ethyl propionate
11. Methyl methacrylate
12. Isopropyl acrylate
13. Isobutyl acetate
14. Butyl acetate
15. Isobutyl acrylate
16. Dibutyl ether
17. Isobutyl propionate
18. Butyl acrylate
19. Butyl propionate

### Acrylates

**Column:** HP-FFAP  
19095F-121  
10 m x 0.53 mm, 1.00 µm

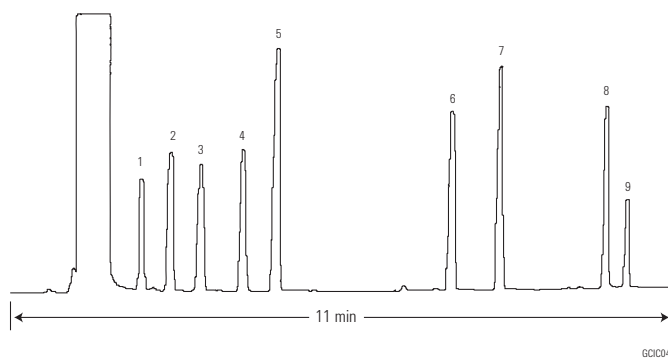
**Carrier:** Hydrogen

**Oven:** 35 °C for 1 min  
35-60 °C at 10 °C/min  
60-160 °C at 15 °C/min

**Injection:** On-column

**Detector:** FID

**Sample:** 1 µL



1. Methyl methacrylate
2. Ethyl methacrylate
3. sec-Butyl methacrylate
4. Allyl acrylate
5. n-Butyl acrylate
6. Hexyl methacrylate
7. Cyclohexyl methacrylate
8. Hydroxypropyl acrylate
9. Unknown

**Anilines**

**Column:** DB-35ms  
128-3822  
25 m x 0.20 mm, 0.33  $\mu$ m

**Carrier:** Helium at 35 cm/sec,  
measured at 50 °C

**Oven:** 50 °C for 2 min  
50-340 °C at 20 °C/min  
340 °C for 10 min

**Injection:** Splitless, 280 °C  
0.50 min purge activation time

**Detector:** FID, 320 °C  
Nitrogen makeup gas at 30 mL/min

**Sample:** 1  $\mu$ L of 5 ng  
on-column per component

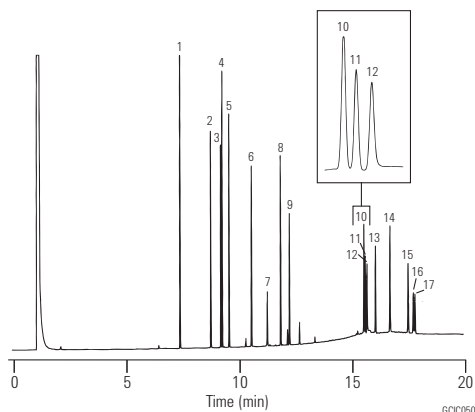
**Suggested Supplies**

**Septum:** 11 mm Advanced Green septa, 5183-4759

**Liner:** Splitless, single taper, deactivated, 4 mm id, 5181-3316

**Seal:** Gold plated seal, 18740-20885

**Syringe:** 10  $\mu$ L tapered, FN 23-26s/42/HP, 5181-1267



1. o-Toluidine
2. 4-Chloroaniline
3. 2-Methoxy-5-methylaniline
4. 2,4,5-Trimethylaniline
5. 4-Chloro-2-methylaniline
6. 2,4-Diaminotoluene
7. 2,4-Diaminoanisole
8. 2-Aminonaphthalene
9. 2-Methyl-5-nitroaniline
10. 4,4'-Oxydianiline
11. 4,4'-Methylenedianiline
12. Benzidine
13. 2-Aminoazotoluene
14. o-Tolidine
15. 4,4'-Thiodianiline
16. 3,3'-Dimethoxybenzidine
17. 3,3'-Dichlorobenzidine

**Substituted Anilines**

**Column:** DB-5ms  
122-5536  
30 m x 0.25 mm, 0.50  $\mu$ m

**Carrier:** Helium at 33.3 cm/sec,  
measured at 150 °C

**Oven:** 40 °C for 5 min  
40-290 °C at 12 °C/min  
290 °C for 10 min

**Injection:** Splitless, 250 °C  
30 sec purge activation time

**Detector:** MSD, 325 °C transfer line

**Sample:** 1  $\mu$ L of 25 ng/ $\mu$ L standard

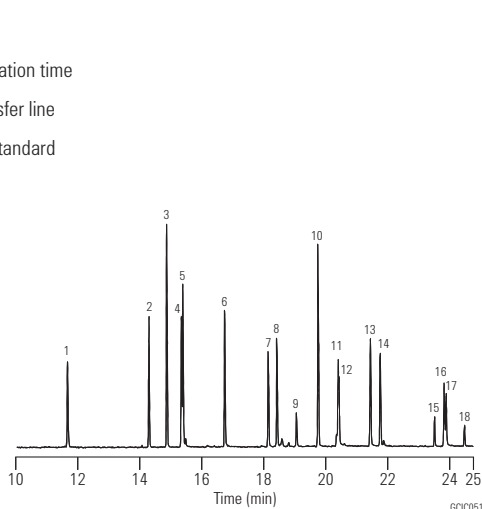
**Suggested Supplies**

**Septum:** 11 mm Advanced Green septa, 5183-4759

**Liner:** Splitless, single taper, deactivated, 4 mm id, 5181-3316

**Seal:** Gold plated seal, 18740-20885

**Syringe:** 10  $\mu$ L tapered, FN 23-26s/42/HP, 5181-1267



- |                                 | m/z |
|---------------------------------|-----|
| 1. Aniline                      | 93  |
| 2. 2-Chloroaniline              | 127 |
| 3. 2,6-Dimethylaniline          | 121 |
| 4. 3-Chloroaniline              | 127 |
| 5. 4-Chloroaniline              | 127 |
| 6. 4-Bromoaniline               | 171 |
| 7. 2-Nitroaniline               | 138 |
| 8. 3,4-Dichloroaniline          | 161 |
| 9. 3-Nitroaniline               | 65  |
| 10. 2,4,5-Trichloroaniline      | 195 |
| 11. 4-Chloro-2-nitroaniline     | 172 |
| 12. 4-Nitroaniline              | 138 |
| 13. 2-Chloro-4-nitroaniline     | 172 |
| 14. 2,6-Dichloro-4-nitroaniline | 176 |
| 15. 2-Chloro-4,6-dinitroaniline | 217 |
| 16. 2,6-Dibromo-4-nitroaniline  | 266 |
| 17. 2,4-Dinitroaniline          | 183 |
| 18. 2-Bromo-4,6-dinitroaniline  | 261 |

### Phenols II

**Column:** DB-5ms  
122-5536  
30 m x 0.25 mm, 0.50 µm

**Carrier:** Helium at 22 cm/sec,  
measured at 100 °C

**Oven:** 100 °C for 1 min  
100-270 °C at 10 °C/min

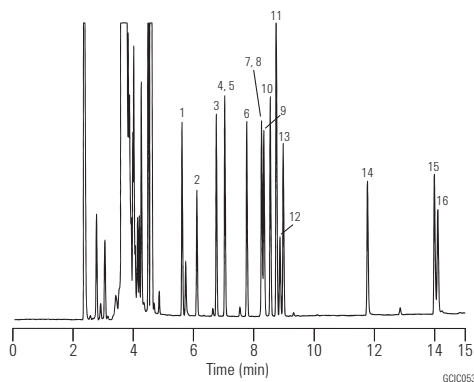
**Injection:** Split, 250 °C  
Split ratio 1:50

**Detector:** FID, 300 °C  
Nitrogen makeup gas at 30 mL/min

**Sample:** 1 µL of 50 ng/µL standard  
in toluene/p-xylene

#### Suggested Supplies

**Septum:** 11 mm Advanced Green septa, 5183-4759  
**Liner:** Direct connect, single taper, deactivated, 4 mm id, G1544-80730  
**Seal:** Gold plated seal, 18740-20885  
**Syringe:** 10 µL tapered, FN 23-26s/42/HP, 5181-1267



1. Phenol
2. 2-Chlorophenol
3. o-Cresol
4. m-Cresol
5. p-Cresol
6. 2,6-Xylenol
7. 2,4-Xylenol
8. 2,5-Xylenol
9. 2-Nitrophenol
10. 3,5-Xylenol
11. 2,3-Xylenol
12. 2,4-Dichlorophenol
13. 3,4-Xylenol
14. 2,4,6-Trichlorophenol
15. 2,4-Dinitrophenol
16. 1-Naphthol

### Phenols III

**Column:** DB-WAX  
122-7032  
30 m x 0.25 mm, 0.25 µm

**Carrier:** Hydrogen at 43 cm/sec

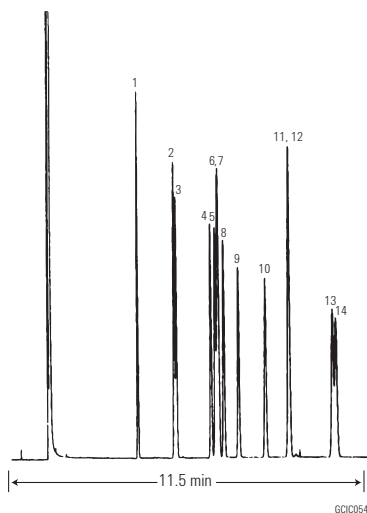
**Oven:** 165 °C isothermal

**Injection:** Split, 250 °C  
Split ratio 1:50

**Detector:** FID, 300 °C  
Nitrogen makeup gas at 30 mL/min

#### Suggested Supplies

**Septum:** 11 mm Advanced Green septa, 5183-4759  
**Liner:** Split, single taper, low pressure drop, glass wool, 5183-4647  
**Seal:** Gold plated seal, 18740-20885  
**Syringe:** 5 µL tapered, FN 23-26s/42/HP, 5181-1273



1. 2,6-Xylenol
2. 2-Cresol
3. Phenol
4. 2-Ethylphenol
5. 2,5-Xylenol
6. 4-Cresol
7. 2,4-Xylenol
8. 3-Cresol
9. 2-Isopropylphenol
10. 2,3-Xylenol
11. 3,5-Xylenol
12. 4-Ethylphenol
13. 3,4-Xylenol
14. 2,3,5-Trimethylphenol



**Halocarbons**

**Column:** GS-GasPro  
113-4332  
30 m x 0.32 mm

**Carrier:** Helium at 30 cm/sec

**Oven:** 130 °C for 4 min  
130-225 °C at 10 °C/min  
225 °C Hold

**Injection:** Split, 250 °C  
Split ratio 1:67

**Detector:** FID, 250 °C

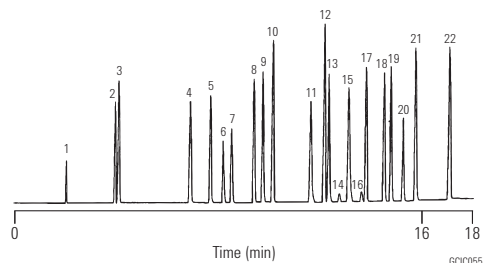
**Sample:** 1 µL

**Suggested Supplies**

**Septum:** 11 mm Advanced Green septa, 5183-4759

**Liner:** Direct, 1.5 mm id, 18740-80200

**Seal:** Gold plated seal, 18740-20885



- |   |   |
|---|---|
| 1. CH <sub>4</sub>                                  | 12. cis-ClCH=CHCl                                     |
| 2. CHClF <sub>2</sub> (Freon 22)                    | 13. CHCl <sub>3</sub>                                 |
| 3. CCl <sub>2</sub> F <sub>2</sub> (Freon 12)       | 14. ? from CCl <sub>4</sub>                           |
| 4. ClCF <sub>2</sub> CF <sub>2</sub> Cl (Freon 114) | 15. CCl <sub>4</sub>                                  |
| 5. CHCl <sub>2</sub> F (Freon 21)                   | 16. ? from CCl <sub>4</sub>                           |
| 6. CCl <sub>3</sub> F (Freon 11)                    | 17. CH <sub>3</sub> CH <sub>2</sub> I                 |
| 7. CF <sub>2</sub> Br <sub>2</sub> (Freon 12B2)     | 18. CH <sub>2</sub> Br <sub>2</sub>                   |
| 8. CH <sub>3</sub> I                                | 19. CHCl <sub>2</sub> Br                              |
| 9. CH <sub>2</sub> Cl <sub>2</sub>                  | 20. C <sub>4</sub> F <sub>9</sub> I                   |
| 10. trans-ClCH=CHCl                                 | 21. CHClBr <sub>2</sub>                               |
| 11. CF <sub>3</sub> CCl <sub>3</sub> (Freon 113)    | 22. CH <sub>3</sub> CH <sub>2</sub> CH <sub>2</sub> I |

**Ethylene Oxide**

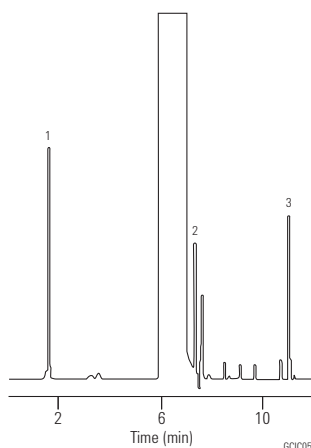
**Column:** DB-WAX  
122-7032  
30 m x 0.25 mm, 0.25 µm

**Carrier:** Helium at 1 mL/min

**Oven:** 60 °C for 2 min  
60-180 °C at 16 °C/min

**Injection:** Split, 250 °C  
Split ratio 1:50

**Detector:** FID, 300 °C  
Nitrogen makeup gas at 30 mL/min



1. Ethylene oxide
2. 2-Chloroethanol
3. Ethylene glycol (solvent: Dimethylformamide)

(Courtesy of J. Chromatogr. Sci., 28:97 [1990])

### Impurities in Mixed Xylenes

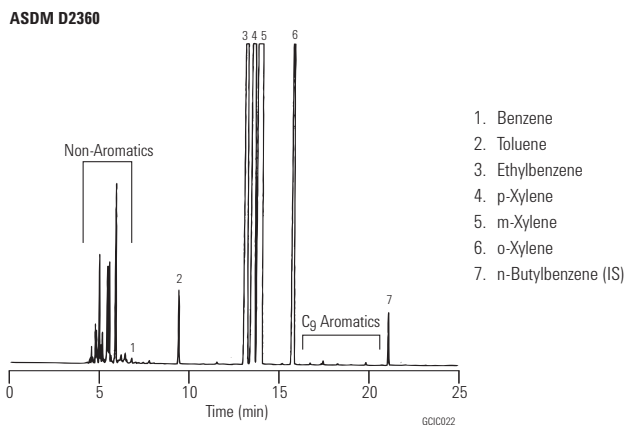
**Column:** DB-WAXetr  
123-7362  
60 m x 0.32 mm, 0.25 µm

**Carrier:** Helium at 20 cm/sec,  
measured at 145 °C

**Oven:** 60 °C for 10 min  
60-150 °C at 5 °C/min  
150 °C for 10 min

**Injection:** Split, 230 °C  
Split ratio 1:150

**Detector:** FID, 240 °C



### High Resolution Separation of Xylene Isomers

**Column:** CP-Chirasil-Dex CB  
CP7502  
25 m x 0.25 mm, 0.25 µm

**Sample:** 0.5 µL

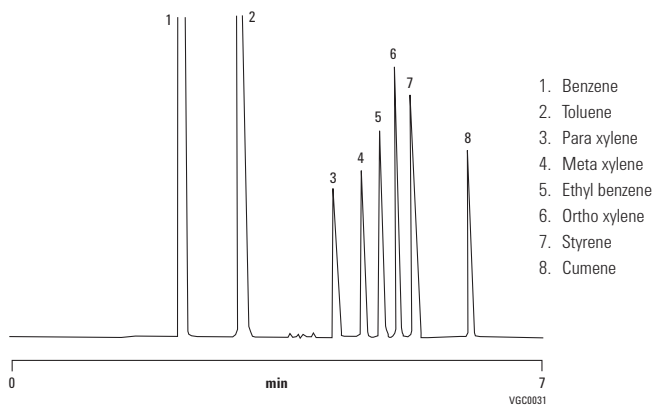
**Sample Conc:** 10-20%

**Carrier:** Helium, 40 kPa, 6 psi

**Oven:** 80 °C, (6 min) to 130 °C, 25 °C/min

**Injection:** Split, T = 210 °C, 1:20

**Detector:** FID, T=230 °C



### Halothane

**Column:** GS-GasPro  
113-4312  
15 m x 0.32 mm,

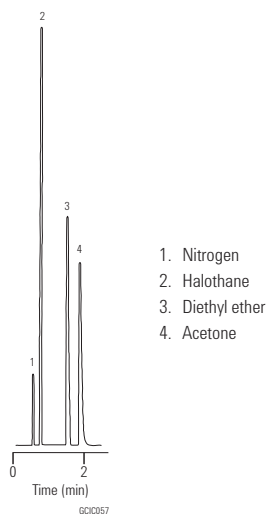
**Carrier:** Helium at 45 cm/sec

**Oven:** 240 °C, isothermal

**Injection:** Split, 200 °C  
Split ratio 1:100

**Detector:** FID, 200 °C

**Sample:** 0.2 µL



#### Suggested Supplies

**Septum:** 11 mm Advanced Green septa, 5183-4759

**Liner:** Direct, 1.5 mm id, 18740-80200

**Seal:** Gold plated seal, 18740-20885

### Inorganic Hydride Gases

**Column:** HP-1  
19091Z-205  
50 m x 0.20 mm, 0.50 µm

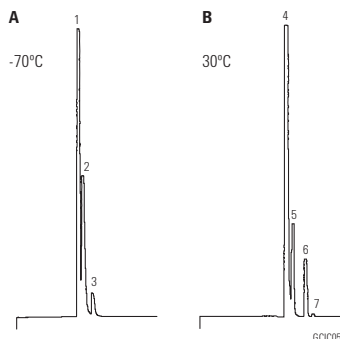
**Carrier:** Helium, 35 cm/sec

**Oven:** A: -70 °C isothermal  
B: 30 °C isothermal

**Injection:** Split ratio 25:1

**Detector:** FPD, 535 µm filter

**Sample:** 1 µL



1. Arsine 0.1%
2. Phosphine 0.1%
3. Selenide 0.1%
4. Diborane 0.10 ppm
5. Tetraborane 0.10 ppm
6. Pentaborane 0.10 ppm
7. Dihydropentaborane 0.60 ppm

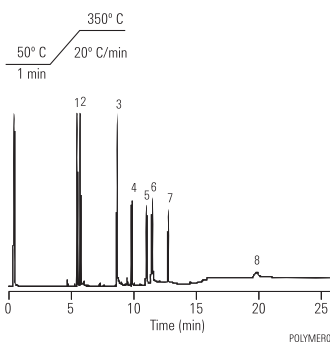
### Polymer Additives

**Column:** HP-35 (use only 10 meters)  
19091G-013  
30 m x 0.32 mm, 0.15 µm

**Carrier:** Helium, 6 psi (4 mL/min at 50 °C) hold for 5 min.  
ramp to 50 psi (21 mL/min at 350 °C) at 5 psi/min.

**Injection:** EPC on-column, oven track 0.5 µL injection

**Detector:** FID



1. BHT
2. BHEB
3. Tinuvin P
4. Isonox 129
5. Irgafos 168
6. Irganox 1076
7. MD 1024
8. Irganox 1010

### Fast Separation of Silanes

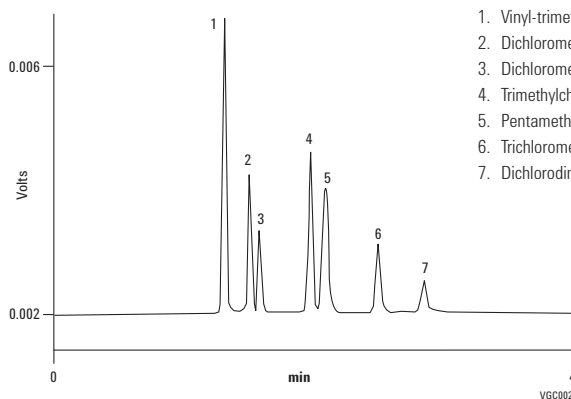
**Column:** VF-200ms  
CP8860  
30 m x 0.25 mm, 1.00 µm

**Carrier:** Hydrogen, ca 1.0 mL/min, 60 kPa

**Oven:** 50 °C

**Injection:** Split/splitless, in split mode, 1:100

**Detector:** FID



1. Vinyl-trimethyl silane
2. Dichloromethyl silane
3. Dichloromethane
4. Trimethylchloro silane
5. Pentamethyl disiloxane
6. Trichloromethyl silane
7. Dichlorodimethyl silane

### Sulfur Gases

**Column:** PoraPLOT U  
CP7584  
25 m x 0.53 mm, 20.00 µm

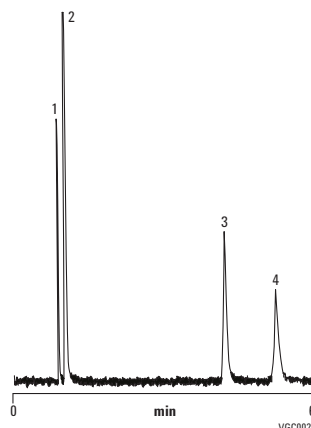
Sample: ±100 ppm

Carrier: H<sub>2</sub>

Oven: 50 °C

Injection: 100 mL/min

Detector: FPD



1. Hydrogen sulfide
2. Carbonyl sulfide
3. Sulfur dioxide
4. Methyl sulfide

### Analysis of Acetylenes Mixture

**Column:** Select AI203  
CP7432  
50 m x 0.53 mm,

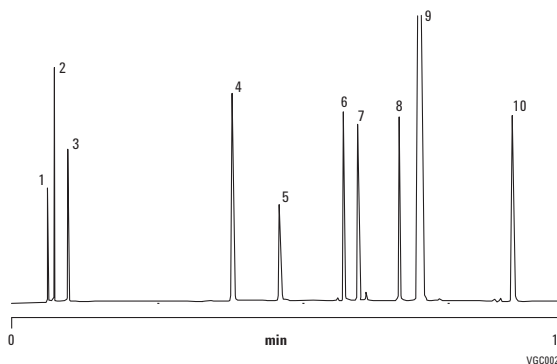
Sample Conc: Approx 100 ppm in nitrogen, synthetic standard

Carrier: Helium, 4 psig, 4 min to 11 psig, 0.5 psig/min, 2 min

Oven: 40 °C, 5 min to 160 °C, 10 °C/min to 200 °C,  
20 °C/min, hold 1 min

Injection: Split 60 mL/min

Detector: FID



1. Methane
2. Ethane
3. Ethylene
4. n-Butane
5. Propadiene
6. 1-Butene
7. Iso-butene
8. 1,2-Butadiene
9. 1,3-Butadiene
10. Ethyl acetylene

Courtesy of J. Luong, Dow Chemical Canada.

# Life Science Applications

## DB-Select 624 UI for Mega Bore Early Eluting Peaks

**Column:** DB-Select 624 UI for <467>  
125-0334UI  
30 m x 0.53 mm x 3.0  $\mu$ m

**Carrier:** Helium 44 cm/s (approx. 6 mL/min) set at 40 °C,  
EPC-Constant Flow

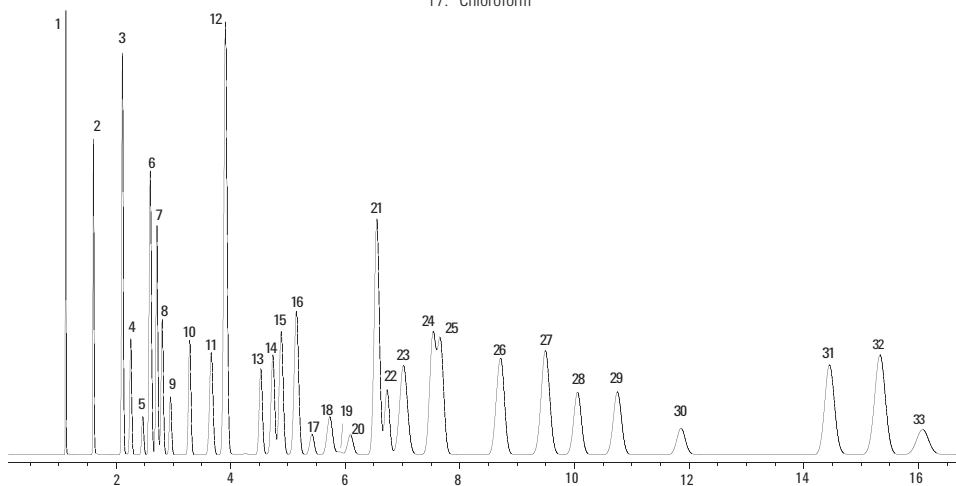
**Oven:** 40 °C 20 min hold, then 10°/min to 170 °C

**Injection:** 20 Hz

**Detector:** FID at 240 °C, H2 at 30 mL/min  
Air at 400 mL/min  
N2 makeup at 35 mL/min  
(constant column + makeup)

**Sample:** FIDSignal

- |                                |  |
|--------------------------------|--|
| 1. Methane                     | 18. 1,1,1-Trichloroethane              |
| 2. Methanol                    | 19. Cyclohexane                        |
| 3. Ethanol                     | 20. Carbon tetrachloride               |
| 4. Diethyl ether               | 21. Benzene                            |
| 5. 1,1-Dichloroethylene        | 22. 1,2-Dichloroethane                 |
| 6. 2-Propanol                  | 23. Isooctane (2,2,4-Trimethylpentane) |
| 7. Acetonitrile                | 24. 3-Methyl-2-butanone                |
| 8. Methyl acetate              | 25. n-Heptane                          |
| 9. Dichloromethane             | 26. Trichloroethylene                  |
| 10. trans-1,2-Dichloroethylene | 27. Methycyclohexane                   |
| 11. n-Hexane                   | 28. 1,4-Dioxane                        |
| 12. 1-Propanol                 | 29. Propy acetate                      |
| 13. Nitromethane               | 30. 2-Ethoxyethanol                    |
| 14. cis-1,2-Dichloroethylene   | 31. Pyridine excellent peak shape      |
| 15. Ethyl acetate              | 32. Toluene                            |
| 16. 2-Butanol                  | 33. 3-Methy-1-butanol                  |
| 17. Chloroform                 |  |



### Benzodiazepines I

**Column:** DB-5ms Ultra Inert  
122-5532UI  
30 m x 0.25 mm, 0.25 µm

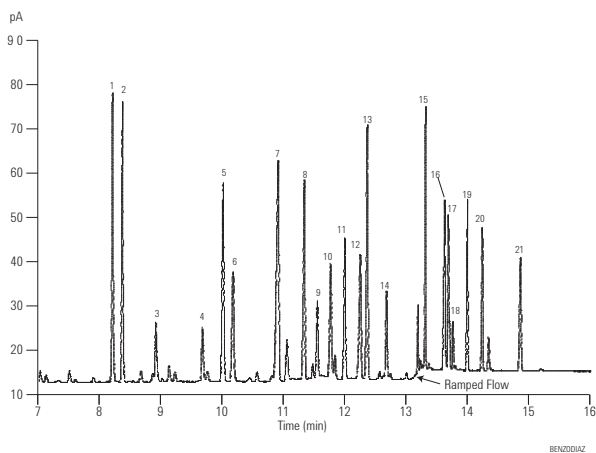
**Carrier:** Hydrogen, 53 cm/sec, constant flow  
1.6 for 11 min  
1.6 to 2.4 at 60 mL/min hold 2 min  
2.4 to 5.0 at 50 mL/min hold 9 min

**Oven:** 170 °C for 3.2 min  
170-250 °C at 24.7 °C/min, hold 5.3 min  
250-280 °C at 18.6 °C/min, hold 4.0 min  
280-325 °C at 50.0 °C/min, hold 4.0 min

**Injection:** Pulsed splitless, 280 °C  
20 psi pulse pressure for 0.38 min  
50 mL/min purge at 0.40 min  
Direct connect liner G1544-80730

**Detector:** FID, 350 °C

**Sample:** 1 µL of 5-10 ppm



1. Medazepam
2. Halazepam
3. Oxazepam
4. Lorazepam
5. Diazepam
6. Desalkyl Aurazepam
7. Nordazepam
8. Clonazam
9. Oxazepam
10. Temazepam
11. Flunitrazepam
12. Bromazepam
13. Prazepam
14. Lormetazepam
15. Nitrazepam
16. Chlordiazepoxide
17. Clonazepam
18. Demoxepam
19. Estazolam
20. Alprazolam
21. Triazolam

Analysis of benzodiazepines and other drugs is particularly challenging because of their high level of activity. For this reason, all aspects of the sample path – particularly the GC Column – must be as inert as possible.

### Amphetamines and Precursors – TMS Derivatives

**Column:** DB-5  
121-5023  
20 m x 0.18 mm, 0.40 µm

**Carrier:** Helium at 39 cm/sec, measured at 100 °C

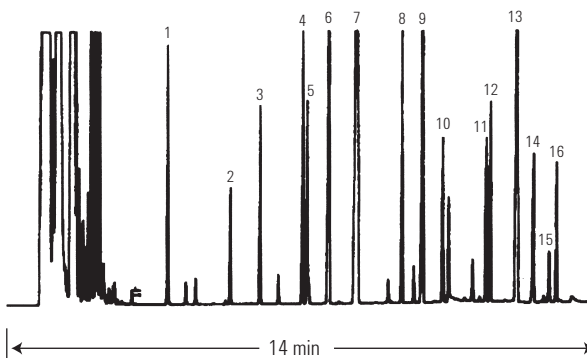
**Oven:** 100-240 °C at 10 °/min

**Injection:** Split, 250 °C  
Split ratio 1:100

**Detector:** FID, 300 °C  
Nitrogen makeup gas at 30 mL/min

**Sample:** 1 µL of 2 µg/µL each in pyridine

- |                        |   |
|------------------------|---|
| 1. Phenylacetone       | 9. Phenacetin                                     |
| 2. Dimethylamphetamine | 10. 3,4-Methylenedioxyamphetamine (MDA)           |
| 3. Amphetamine         | 11. 3,4-Methylenedioxymethylamphetamine           |
| 4. Phentermine         | 12. 4-Methyl-2,5-dimethoxyamphetamine (STP)       |
| 5. Methamphetamine     | 13. Phenyl ephedrine                              |
| 6. Methyl ephedrine    | 14. 3,4-Methylenedioxyethylamphetamine (MDE; Eve) |
| 7. Nicotinamine        | 15. Caffeine                                      |
| 8. Ephedrine           | 16. Benzphetamine                                 |



GCLS004

#### Suggested Supplies

- Septum:** 11 mm Advanced Green septa, 5183-4759
- Liner:** General purpose split/splitless liner, taper, glass wool, 5183-4711
- Seal:** Gold plated seal, 18740-20885
- Syringe:** 10 µL tapered, FN 23-26s/42/HP, 5181-1267

**Barbiturates**

**Column:** DB-35ms  
122-3832  
30 m x 0.25 mm, 0.25 µm

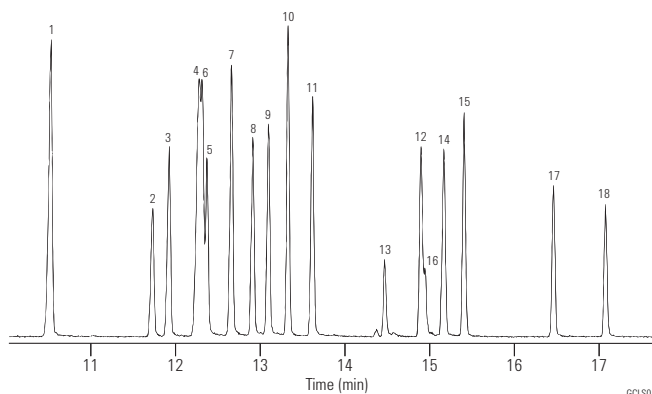
**Carrier:** Helium at 31 cm/sec, measured at 50 °C

**Oven:** 50 °C for 0.5 min  
50-150 °C at 25 °C/min  
150-300 °C at 10 °C/min

**Injection:** Splitless, 250 °C  
30 sec purge activation time

**Detector:** MSD, 280 °C transfer line  
full scan at m/z 40-270

- |                  |                         |
|------------------|-------------------------|
| 1. Barbital      | 10. Methohexital        |
| 2. Allobarbital  | 11. Secobarbital        |
| 3. Aprobarbital  | 12. Hexobarbital        |
| 4. Butabarbital  | 13. Thiopental          |
| 5. Butethal      | 14. Cyclopentylbarbital |
| 6. Butalbital    | 15. Mephobarbital       |
| 7. Amobarbital   | 16. Thiamylal           |
| 8. Talbutal      | 17. Phenobarbital       |
| 9. Pentobarbital | 18. Alphenal            |

**Suggested Supplies**

**Septum:** 11 mm Advanced Green septa, 5183-4759  
**Liner:** Splitless, single taper, deactivated, 4 mm id, 5181-3316  
**Seal:** Gold plated seal, 18740-20885  
**Syringe:** 10 µL tapered, FN 23-26s/42/HP, 5181-1267

**Narcotics**

**Column:** DB-5ms  
122-5532  
30 m x 0.25 mm, 0.25 µm

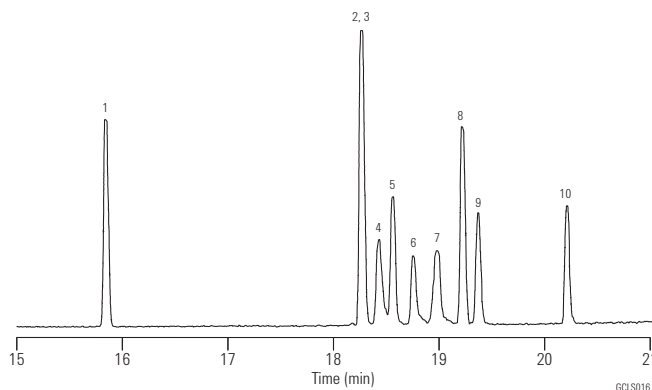
**Carrier:** Helium at 31 cm/sec, measured at 50 °C

**Oven:** 50 °C for 0.5 min  
50-150 °C at 25 °C/min  
150-325 °C at 10 °C/min

**Injection:** Splitless, 250 °C  
30 sec purge activation time

**Detector:** MSD, 300 °C transfer line  
full scan at m/z 40-380

- |                     |                         |
|---------------------|-------------------------|
| 1. Dextromethorphan | 6. Morphine             |
| 2. Codeine          | 7. Normorphine          |
| 3. Dihydrocodeine   | 8. 6-Acetylcodeine      |
| 4. Norcodeine       | 9. 6-Monoacetylmorphine |
| 5. Ethylmorphine    | 10. Heroin              |

**Suggested Supplies**

**Septum:** 11 mm Advanced Green septa, 5183-4759  
**Liner:** Direct connect, single taper, deactivated, 4 mm id, G1544-80730  
**Seal:** Gold plated seal, 18740-20885  
**Syringe:** 10 µL tapered, FN 23-26s/42/HP, 5181-1267

**Blood Alcohols I (Static Headspace/Split)**

**Column:** DB-ALC1  
125-9134  
30 m x 0.53 mm, 3.00 µm

**Carrier:** Helium at 80 cm/sec,  
measured at 40 °C

**Oven:** 40 °C Isothermal

**Sampler:** Headspace

**Injection:** Split, 250 °C  
Split ratio 1:10

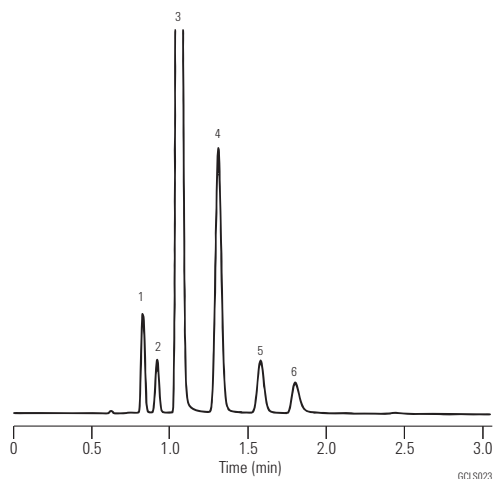
**Detector:** FID, 300 °C  
Nitrogen makeup gas  
at 23 mL/min

**Suggested Supplies**

**Septum:** 11 mm Advanced Green septa, 5183-4759

**Liner:** Direct, 1.5 mm id, 18740-80200

**Seal:** Gold plated seal, 18740-20885



1. Methanol
2. Acetaldehyde
3. Ethanol
4. Isopropanol
5. Acetone
6. 1-Propanol

**Blood Alcohols II (Static Headspace/Split)**

**Column:** DB-ALC2  
125-9234  
30 m x 0.53 mm, 2.00 µm

**Carrier:** Helium at 80 cm/sec,  
measured at 40 °C

**Oven:** 40 °C Isothermal

**Sampler:** Headspace

Oven: 70 °C  
Loop: 80 °C  
Transfer line: 90 °C  
Vial equil. time: 10 min  
Pressurization time: 0.20 min  
Loop fill time: 0.20 min  
Loop equil. time: 0.05 min  
Inject time: 0.1 - 0.2 min  
Sample loop size: 1.0 mL

**Injection:** Split, 250 °C  
Split ratio 1:10

**Detector:** FID, 300 °C  
Nitrogen makeup gas  
at 23 mL/min

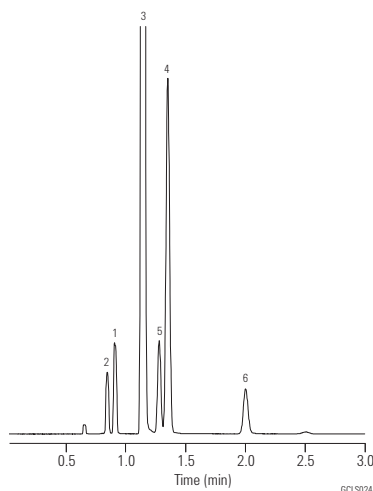
**Sample:** 0.1% Ethanol,  
0.001% Others

**Suggested Supplies**

**Septum:** 11 mm Advanced Green septa, 5183-4759

**Liner:** Direct, 1.5 mm id, 18740-80200

**Seal:** Gold plated seal, 18740-20885



1. Methanol
2. Acetaldehyde
3. Ethanol
4. Isopropanol
5. Acetone
6. 1-Propanol



**Residual Solvents, DMI Diluent**

**Column:** DB-624  
123-1364  
60 m x 0.32 mm, 1.80 µm

**Oven:** 50-60 °C, 1 °C/min  
60-115 °C, 9.2 °C/min  
115-220 °C, 35 °C/min  
220 °C – hold 6 min

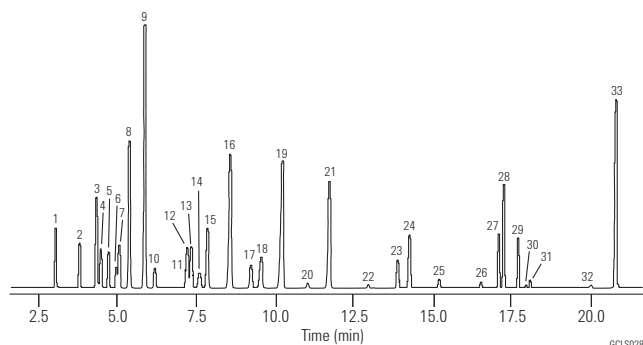
**Sampler:** Headspace  
Platen 140 °C  
Transfer line, valve 250 °C  
Sample loop 2 mL

**Injection:** Split, 250 °C  
Split ratio 1:18

**Detector:** FID, 270 °C  
Nitrogen makeup

**Sample:** 5,000 ppm standard

- |                                       |                          |  |
|---------------------------------------|--------------------------|--|
| 1. Methanol                           | 12. 2-Butanone (MEK)     | 23. MIBK (2-Pentanone)                   |
| 2. Ethanol                            | 13. Ethyl acetate        | 24. Toluene                              |
| 3. Acetone                            | 14. 2-Butanol            | 25. 1-Pentanol                           |
| 4. 2-Propanol                         | 15. Tetrahydrofuran      | 26. n,n-Dimethylformamide (DMF)          |
| 5. Acetonitrile                       | 16. Cyclohexane          | 27. Ethyl benzene                        |
| 6. Methylene chloride                 | 17. Isopropyl acetate    | 28. m,p-Xylene                           |
| 7. 2-Methyl-2-propanol (tert-butanol) | 18. 1,2-Dimethoxyethane  | 29. o-Xylene                             |
| 8. MTBE                               | 19. Heptane              | 30. Dimethyl sulfoxide (DMSO)            |
| 9. Hexane                             | 20. 1-Methoxy-2-propanol | 31. n,n-Dimethylacetamide                |
| 10. 1-Propanol                        | 21. Methylcyclohexane    | 32. n-Methylpyrrolidone                  |
| 11. DMI impurity                      | 22. 2-Ethoxyethanol      | 33. 1,3-Dimethyl-2-imidazolidinone (DMI) |



Special thanks to Julie Kancler, Brian Wallace, Teledyne.

**Suggested Supplies**

**Septum:** 11 mm Advanced Green septa, 5183-4759  
**Liner:** Direct, 1.5 mm id, 18740-80200  
**Seal:** Gold plated seal, 18740-20885

**Underivatized Drugs of Abuse – Agilent Fast Toxicology Analyzer**

**Column:** DB-35 ms Ultra Inert  
122-3812UI  
15 m x 0.25 mm, 0.25 µm

**Carrier:** Helium fixed pressure 35.0 psi

**Injection:** Splitless 1 µL 280 °C, total flow 56.4 mL/min,  
3 mL/min switched septum purge, gas saver off,  
50 mL/min after 0.4 min

**Liner:** Splitless, dual taper, deactivated, 4 mm id, 5181-3315

**Sample:** Agilent GC/MS Toxicology Checkout Mixture  
(P/N 5190-0471)

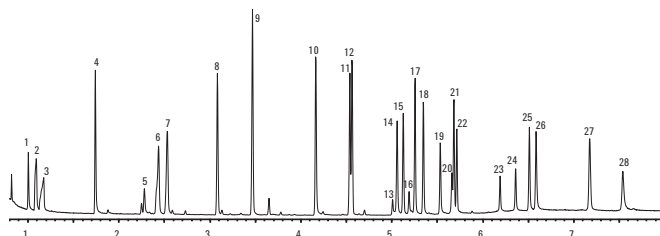
**Backflush:** Post run: 1 min 1 psi inlet, 75 psi aux EPC

**Oven:** 100 °C (0.25 min) to 345 °C  
(40 °C/min, 2.25 min hold)

**Detector:** MSD: Transfer line 300 °C, source 300 °C,  
quadrapole 180 °C scan mode  
NPD: Blos bead 300 °C H<sub>2</sub> 3 mL/min, 60 mL/min air,  
11 mL/min makeup and col flow

**CFT Device:** 2-Way splitter with solvent venting between MSD and  
NPD

- |   |                                |                      |
|---|--------------------------------|----------------------|
| 1. Amphetamine                          | 10. Methadone                  | 19. Oxycodone        |
| 2. Phentermine                          | 11. Cocaine                    | 20. Temazepam        |
| 3. Methamphetamine                      | 12. SKF-525a<br>(RTL Compound) | 21. Diacetylmorphine |
| 4. Nicotine                             | 13. Oxazepam                   | 22. Flunitrazepam    |
| 5. Methylenedioxyamphetamine (MDA)      | 14. Tetrahydrocannabinol       | 23. Nitrazepam       |
| 6. Methylenedioxymethamphetamine (MDMA) | 15. Codeine                    | 24. Clonazepam       |
| 7. Methylenedioxyethylamphetamine       | 16. Lorazepam                  | 25. Alprazolam       |
| 8. Meperidine                           | 17. Diazepam                   | 26. Verapamil        |
| 9. Phencyclidine                        | 18. Hydrocodone                | 27. Strychnine       |
|   |                                | 28. Trazodone        |



Example NPD chromatogram of underivatized drugs of abuse 5 ng/component on an Agilent J&W DB-35ms UI column.  
Component number 12 is used for retention time locking in the deconvolution reporting software database.

**Benzodiazepines II**

**Column:** DB-35ms  
122-3832  
30 m x 0.25 mm, 0.25 µm

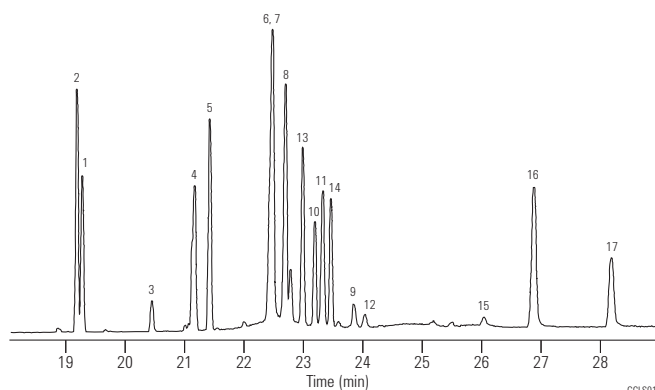
**Carrier:** Helium at 31 cm/sec, measured at 50 °C

**Oven:** 50 °C for 0.5 min  
50-150 °C at 25 °C/min  
150-340 °C at 10 °C/min  
340 °C for 6 min

**Injection:** Splitless, 250 °C  
30 sec purge activation time

**Detector:** MSD, 280 °C transfer line  
full scan at m/z 40-400

- |                      |                   |
|----------------------|-------------------|
| 1. Medazepam         | 10. Flunitrazepam |
| 2. Halazepam         | 11. Delorazepam   |
| 3. Oxazepam          | 12. Bromazepam    |
| 4. Lorazepam         | 13. Prazepam      |
| 5. Diazepam          | 14. Flurazepam    |
| 6. Demoxepam         | 15. Clonazepam    |
| 7. Desmethyldiazepam | 16. Alprazolam    |
| 8. Clobazam          | 17. Triazolam     |
| 9. Temazepam         |                   |

**Suggested Supplies**

**Septum:** 11 mm Advanced Green septa, 5183-4759  
**Liner:** Splitless, single taper, deactivated, 4 mm id, 5181-3316  
**Seal:** Gold plated seal, 18740-20885  
**Syringe:** 10 µL tapered, FN 23-26s/42/HP, 5181-1267

**Drug Screen**

**Column:** DB-1ms  
122-0132  
30 m x 0.25 mm, 0.25 µm

**Carrier:** Helium at 40 cm/sec,  
measured at 50 °C

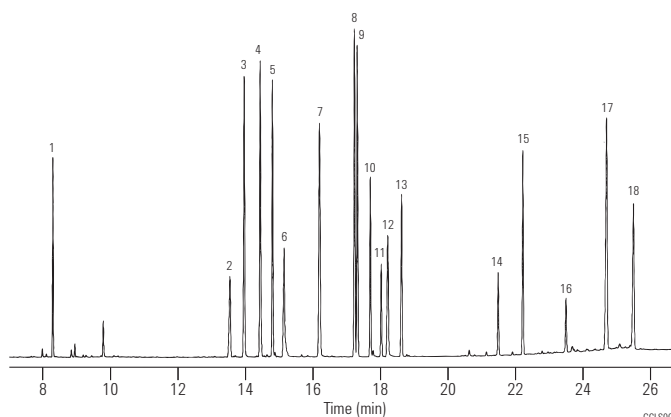
**Oven:** 50 °C for 1.0 min  
50-125 °C at 25 °C/min  
125-325 °C at 10 °C/min  
325 °C for 5 min

**Injection:** Cold Splitless  
Optic II injector, 50-250 °C at 10 °C/sec  
45 sec purge activation time

**Detector:** FID, 300 °C

**Sample:** 1 µL injection of 50-150 ppm standard

- |                                 |                  |
|---------------------------------|------------------|
| 1. Nicotine                     | 10. Cocaine      |
| 2. Caffeine                     | 11. Desipramine  |
| 3. Glutethimide                 | 12. Carbazepine  |
| 4. Lidocaine                    | 13. Trimipramine |
| 5. PCP                          | 14. Heroin       |
| 6. Phenobarbital                | 15. Fentanyl     |
| 7. Methadone primary metabolite | 16. Ibogaine     |
| 8. Methaqualone                 | 17. Triazolam    |
| 9. Methadone                    | 18. LSD          |



**Common Drug Screen**

**Column:** DB-5  
122-5032  
30 m x 0.25 mm, 0.25 µm

**Column:** DB-17  
122-1732  
30 m x 0.25 mm, 0.25 µm

**Carrier:** Hydrogen at 41 cm/sec,  
measured at 80 °C

**Oven:** 80 °C for 1 min  
80-280 °C at 10 °C/min  
280 °C for 9 min

**Injection:** Split, 250 °C  
Split ratio 1:40

**Detector:** FID, 300 °C

	DB-17 Time	DB-5 Time		DB-17 Time	DB-5 Time
1. Nicotine	9.87	8.57	18. Hexobarbital	17.52	15.22
2. Phenmetrazine	11.8	9.95	19. Doxylamine	17.69	15.87
3. Ibuprofen	12.06	10.64	20. Caffeine	18.05	13.11
4. Procaine	13.48	14.82	21. Chlorpheniramine	18.47	16.35
5. Allobarbitol	13.91	12.02	22. Methapyrilene	18.72	16.68
6. Aprobarbital	14.14	12.27	23. Thenyldiamine	18.87	16.85
7. Butabarbital	14.56	12.76	24. Phenobarbital	19.11	16.29
8. Secobarbital	14.87	14.31	25. Bromopheniramine	19.71	17.39
9. Pentobarbital	15.41	13.73	26. Chlorcyclizine	20.75	19.13
10. Phenacetin	15.72	12.94	27. Cocaine	21.32	18.88
11. Amobarbital	15.87	13.43	28. Pyrrobutamine	22.79	20.89
12. Benzphetamine	16.14	14.96	29. Codeine	24.27	20.66
13. Acetaminophen	16.34	11.12	30. Diazepam	25.27	21.13
14. Hydroxyphenamate	16.47	15.31	31. Morphine	25.36	21.12
15. Dimenhydrinate	16.93	13.79	32. Hydrocodone	25.98	21.26
16. Meprobamate	17.12	14.44	33. Oxymorphone	28.27	22.21
17. Benactyzine	17.26	14.71	34. Heroin	29.32	23.14

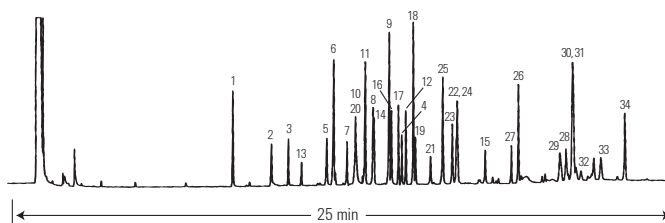
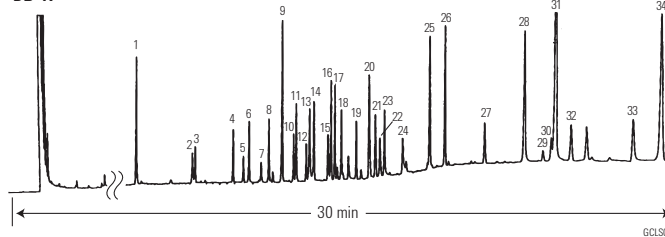
**Suggested Supplies**

**Septum:** 11 mm Advanced Green septa, 5183-4759

**Liner:** General purpose split/splitless liner, taper,  
glass wool, 5183-4711

**Seal:** Gold plated seal, 18740-20885

**Syringe:** 10 µL tapered, FN 23-26s/42/HP, 5181-1267

**DB-5****DB-17**

GCL5001

**Urine Drug Screen**

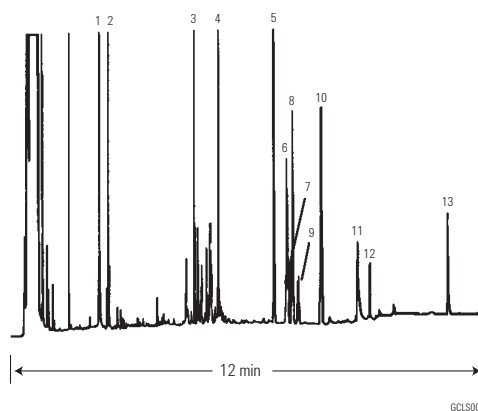
**Column:** ULTRA 2  
19091B-115  
50 m x 0.32 mm, 0.52 µm

**Carrier:** Hydrogen 80 cm/sec

**Oven:** 45 °C for 1.5 min  
45-300 °C at 6 °C/min

**Injection:** Splitless

**Detector:** FID



1. Amphetamine
2. Methamphetamine
3. Meperidine
4. Phencyclidine (PCP)
5. Methadone
6. Propoxyphene
7. Amitriptyline
8. Cocaine
9. Imipramine
10. Cyheptamide (ISTD)
11. Codeine
12. Diazepam
13. Flurazepam

**Analysis of Drugs of Abuse in Urine via GC/MS**

**Column:** VF-DA  
CP8964  
12 m x 0.20 mm, Optimized µm

**Sample:** 1 µL

**Solvent:** Methanol

**Carrier:** He, ca 1.0 mL/min

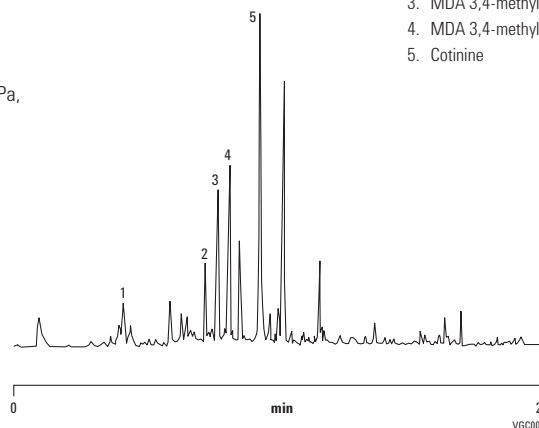
**Oven:** 70 °C, 1.2 min to 200 °C, 20 °C/min to 270 °C,  
7 °C/min to 320 °C, 20 °C/min

**Pressure:** 58.7 kPa, 2.2 min to 97 kPa, 58 kPa/min to 132 kPa,  
3 kPa/min to 180 kPa, 12 kPa/min

**Injection:** Splitless

**Detector:** MS

**Derivatization:** Acetic acid anhydride to form acetates



1. Amphetamine
2. MDA 3,4-methylenedioxyamphetamine
3. MDA 3,4-methylenedioxymethamphetamine
4. MDA 3,4-methylenedioxy-ethylamphetamine
5. Cotinine

**Anesthetics**

**Column:** DB-5ms EVDX  
128-8522  
25 m x 0.20 mm, 0.33 µm

**Carrier:** Helium at 35 cm/sec,  
measured at 55 °C

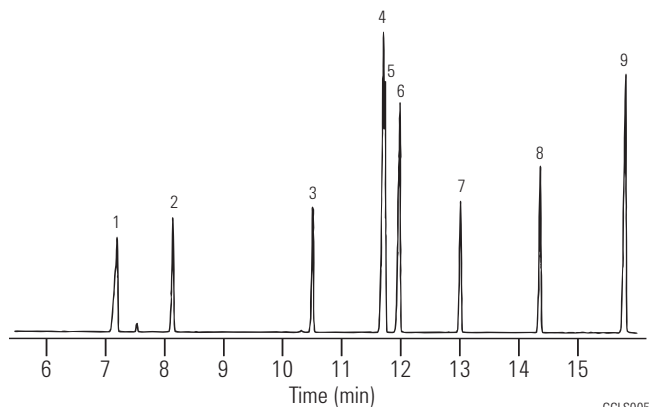
**Oven:** 55 °C for 1 min  
55-130 °C at 25 °C/min  
130-325 °C at 15 °C/min

**Injection:** Splitless, 250 °C  
45 sec purge activation time

**Detector:** MSD, 280 °C transfer line  
full scan at m/z 35-400

**Sample:** 1 µL of 50-100 ng/µL  
standard in methanol

- |                 |                |
|-----------------|----------------|
| 1. Salicylamide | 6. Mepivacaine |
| 2. Benzocaine   | 7. Tetracaine  |
| 3. Lidocaine    | 8. Butacaine   |
| 4. Procaine     | 9. Dibucaine   |
| 5. Nefopam      |                |

**Suggested Supplies**

**Septum:** 11 mm Advanced Green septa, 5183-4759

**Liner:** Splitless, single taper, deactivated, 4 mm id, 5181-3316

**Seal:** Gold plated seal, 18740-20885

**Syringe:** 10 µL tapered, FN 23-26s/42/HP, 5181-1267

**Anticonvulsants**

**Column:** DB-1  
125-1032  
30 m x 0.53 mm, 1.50 µm

**Carrier:** Helium at 8 mL/min

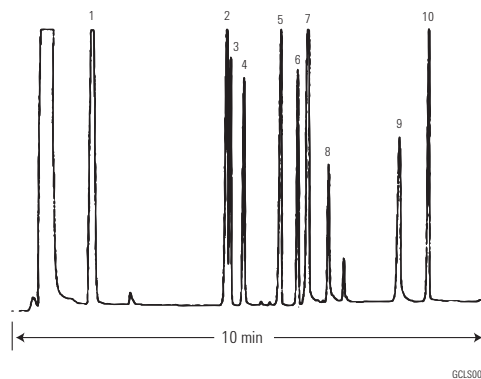
**Oven:** 160 °C for 2 min  
160-275 °C at 15 °C/min

**Injection:** Megabore Direct, 250 °C

**Detector:** FID, 300 °C  
Nitrogen makeup gas at 30 mL/min

**Sample:** 1 µL of 100 ng/µL in methanol

- |                             |                                |
|-----------------------------|--------------------------------|
| 1. Ethosuximide             | 6. Phenobarbital               |
| 2. Methsuximide             | 7. Primidone                   |
| 3. Phensuximide             | 8. Carbamazepine               |
| 4. N-Desmethyl methsuximide | 9. Phenytoin                   |
| 5. Phenylethylmalonamide    | 10. 5-Methyl-5-phenylhydantoin |

**Suggested Supplies**

**Septum:** 11 mm Advanced Green septa, 5183-4759

**Liner:** Direct connect, single taper, deactivated, 4 mm id, G1544-80730

**Seal:** Gold plated seal, 18740-20885

**Syringe:** 10 µL tapered, FN 23-26s/42/HP, 5181-1267

### Antihistamines

**Column:** DB-5  
**123-5032**  
**30 m x 0.32 mm, 0.25 µm**

**Carrier:** Helium at 40 cm/sec, measured at 55 °C

**Oven:** 55 °C for 1 min  
 55-175 °C at 30 °C/min  
 175-320 °C at 10 °C/min  
 320 °C for 1 min

**Injection:** Splitless, 250 °C  
 30 sec purge activation time

**Detector:** FID, 300 °C  
 Nitrogen makeup gas at 30 mL/min

**Sample:** 1 µL of 50 ng/µL each in methanol

- |                      |                    |
|----------------------|--------------------|
| 1. Pheniramine       | 13. Thonzylamine   |
| 2. Dimenhydrinate    | 14. Chlorcyclizine |
| 3. Diphenhydramine   | 15. Pyrilamine     |
| 4. Doxylamine        | 16. Triprolidine   |
| 5. Phenyltoloxamine  | 17. Promethazine   |
| 6. Tripelemamine     | 18. Antazoline     |
| 7. Methapyrilene     | 19. Clemizole      |
| 8. Chlorpheniramine  | 20. Hydroxyzine    |
| 9. Cyclizine         | 21. Mecizine       |
| 10. Carbinoxamine    | 22. Cinnanzine     |
| 11. Diphenylpyraline | 23. Buclizine      |
| 12. Bromopheniramine |                    |

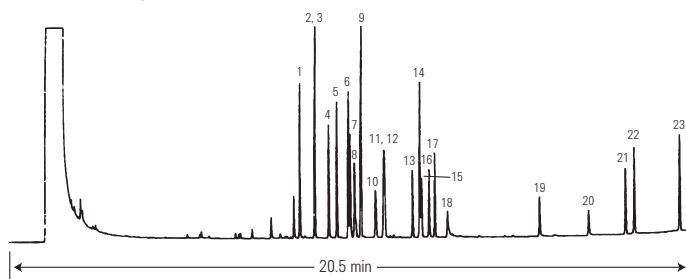
#### Suggested Supplies

**Septum:** 11 mm Advanced Green septa, 5183-4759

**Liner:** Splitless, single taper, deactivated, 4 mm id, 5181-3316

**Seal:** Gold plated seal, 18740-20885

**Syringe:** 10 µL tapered, FN 23-26s/42/HP, 5181-1267



GCL5007

### Antiepileptic Drugs

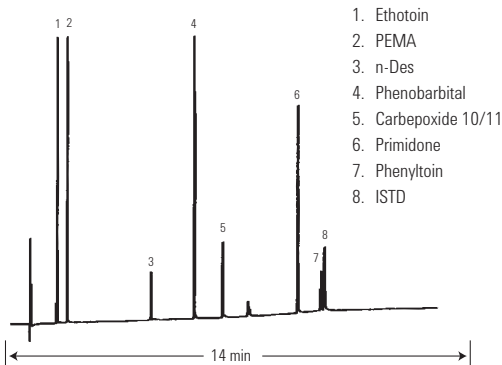
**Column:** ULTRA 2  
**19091B-012**  
**25 m x 0.32 mm, 0.17 µm**

**Carrier:** Helium, 14 psi

**Oven:** 100-230 °C at 15 °C/min

**Injection:** Split ratio 35:1

**Detector:** NPD



GCL5008

#### Suggested Supplies

**Septum:** 11 mm Advanced Green septa, 5183-4759

**Liner:** General purpose split/splitless liner, taper, glass wool, 5183-4711

**Seal:** Gold plated seal, 18740-20885

**Syringe:** 10 µL tapered, FN 23-26s/42/HP, 5181-1267

### Tricyclic Antipsychotics

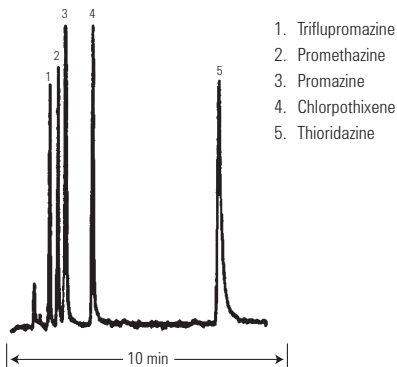
**Column:** ULTRA 2  
**19091B-101**  
**12 m x 0.20 mm, 0.33 µm**

**Carrier:** Hydrogen, 106 cm/sec

**Oven:** 250 °C for 3 min  
 250-290 °C at 10 °C/min  
 290 °C for 10 min

**Injection:** Split ratio 75:1

**Detector:** FPD



GCL5009

#### Suggested Supplies

**Septum:** 11 mm Advanced Green septa, 5183-4759

**Liner:** General purpose split/splitless liner, taper, glass wool, 5183-4711

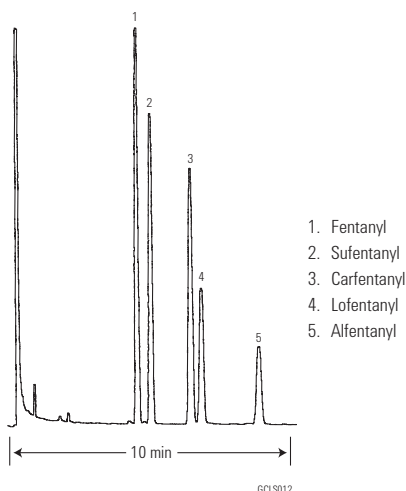
**Seal:** Gold plated seal, 18740-20885

**Syringe:** 10 µL tapered, FN 23-26s/42/HP, 5181-1267

**Fentanyl**

**Column:** DB-1701  
125-0732  
30 m x 0.53 mm, 1.00 µm

**Carrier:** Hydrogen at 15 mL/min  
**Oven:** 270 °C isothermal  
**Injection:** Split, 250 °C  
Split ratio 1:5  
**Detector:** FID, 300 °C  
Nitrogen makeup gas at 30 mL/min  
**Sample:** 0.8 µL

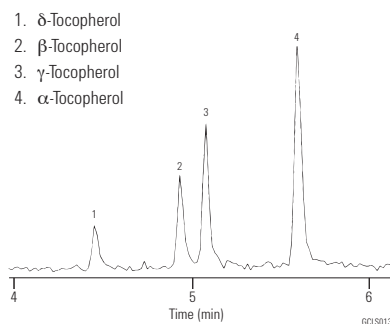
**Suggested Supplies**

**Septum:** 11 mm Advanced Green septa, 5183-4759  
**Liner:** Split, single taper, low pressure drop, glass wool, 5183-4647  
**Seal:** Gold plated seal, 18740-20885  
**Syringe:** 5 µL tapered, FN 23-26s/42/HP, 5181-1273

**Tocopherols**

**Column:** DB-17ms  
122-4732  
30 m x 0.25 mm, 0.25 µm

**Carrier:** Helium at 40 cm/sec, measured at 150 °C  
**Oven:** 300 °C for 1 min  
300-320 °C at 25 °C/min  
320 °C for 4 min  
**Injection:** Split, 310 °C  
Split ratio 1:25  
**Detector:** MSD, 310 °C transfer line  
full scan at m/z 45-550  
**Sample:** 1 µL of 1-10 ng/µL in isoctane

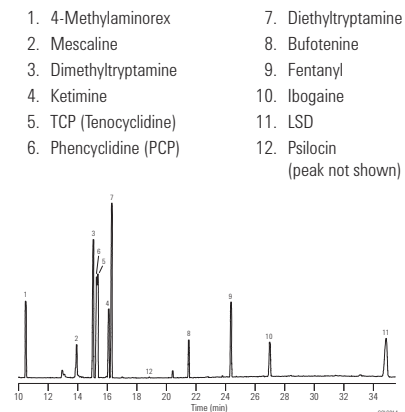
**Suggested Supplies**

**Septum:** 11 mm Advanced Green septa, 5183-4759  
**Liner:** Split, single taper, low pressure drop, glass wool, 5183-4647  
**Seal:** Gold plated seal, 18740-20885  
**Syringe:** 5 µL tapered, FN 23-26s/42/HP, 5181-1273

**Hallucinogens**

**Column:** DB-17ms  
122-4732  
30 m x 0.25 mm, 0.25 µm

**Carrier:** Helium at 30 cm/sec, measured at 50 °C  
**Oven:** 50 °C for 0.5 min  
50-125 °C at 25 °C/min  
125-255 °C at 10 °C/min  
255-320 °C at 25 °C/min  
320 °C for 16 min  
**Injection:** Splitless, 250 °C  
30 sec purge activation time  
**Detector:** MSD, 300 °C transfer line  
full scan at m/z 40-350  
**Sample:** 1 µL of 10-50 ng/µL standard in methanol

**Suggested Supplies**

**Septum:** 11 mm Advanced Green septa, 5183-4759  
**Liner:** Direct connect, single taper, deactivated, 4 mm id, G1544-80730  
**Seal:** Gold plated seal, 18740-20885  
**Syringe:** 10 µL tapered, FN 23-26s/42/HP, 5181-1267

### Sedative Hypnotics

**Column:** DB-5ms EVDX  
128-8522  
25 m x 0.20 mm, 0.33 µm

**Carrier:** Helium at 35 cm/sec, measured at 55 °C

**Oven:** 55 °C for 1 min  
55-130 °C at 25 °C/min  
130-325 °C at 15 °C/min  
325 °C for 4 min

**Injection:** Splitless, 250 °C  
45 sec purge activation time

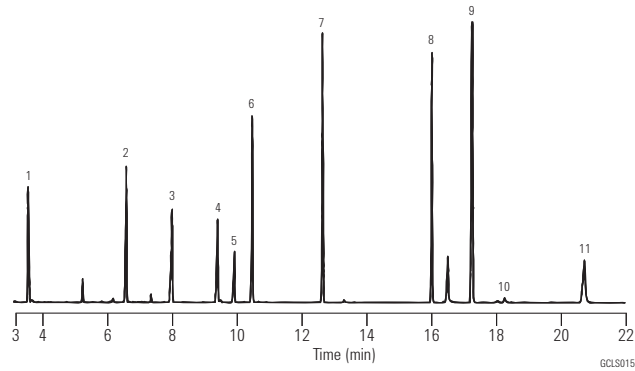
**Detector:** MSD, 280 °C transfer line  
full scan at m/z 35-400

**Sample:** 1 µL of 50-100 ng/µL standard in methanol

1. Ethchlorvynol
2. Ethinamate
3. Pyriithyldione
4. Talbutal
5. Meprobamate
6. Glutethimide
7. Methaqualone
8. Propiomazine
9. Haloperidol
10. Sulpiride
11. Droperidol

#### Suggested Supplies

- Septum:** 11 mm Advanced Green septa, 5183-4759
- Liner:** Direct connect, single taper, deactivated, 4 mm id, G1544-80730
- Seal:** Gold plated seal, 18740-20885
- Syringe:** 10 µL tapered, FN 23-26s/42/HP, 5181-1267



### Narcotics and Adulterants

**Column:** DB-5  
123-5032  
30 m x 0.32 mm, 0.25 µm

**Carrier:** Helium at 40 cm/sec, measured at 140 °C

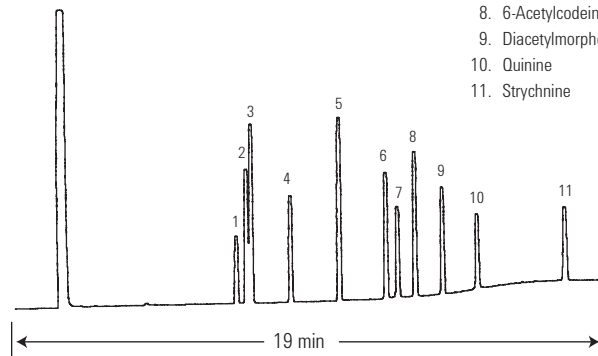
**Oven:** 140-320 °C at 12 °C/min  
320 °C for 4 min

**Injection:** Split, 250 °C  
Split ratio 1:75

**Detector:** FID, 300 °C  
Nitrogen makeup gas at 30 mL/min

**Sample:** 1 µL of 0.5 µg/µL each in methanol

1. Caffeine
2. Ketamine
3. Lidocaine
4. Procaine
5. Cocaine
6. Codeine
7. Morphine
8. 6-Acetylcodeine
9. Diacetylmorphone (Heroin)
10. Quinine
11. Strychnine





### Over-the-Counter Pain Killers – TMS Derivatives

**Column:** DB-5  
121-5023  
20 m x 0.18 mm, 0.40  $\mu$ m

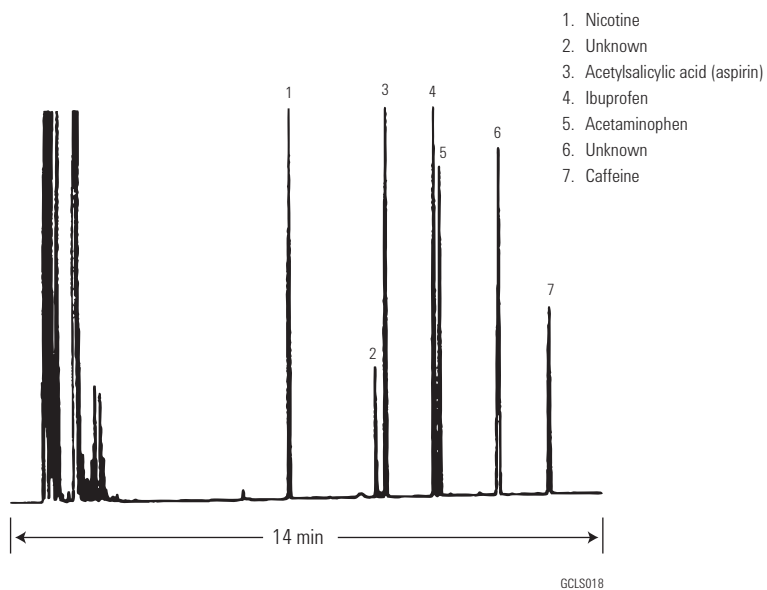
**Carrier:** Helium at 39 cm/sec, measured at 100 °C

**Oven:** 100-240 °C at 10 °C/min

**Injection:** Split, 250 °C  
Split ratio 1:100

**Detector:** FID, 300 °C  
Nitrogen makeup gas at 30 mL/min

**Sample:** 1  $\mu$ L of 2  $\mu$ g/ $\mu$ L each in pyridine



### Aspirin and Ibuprofen in Methanol

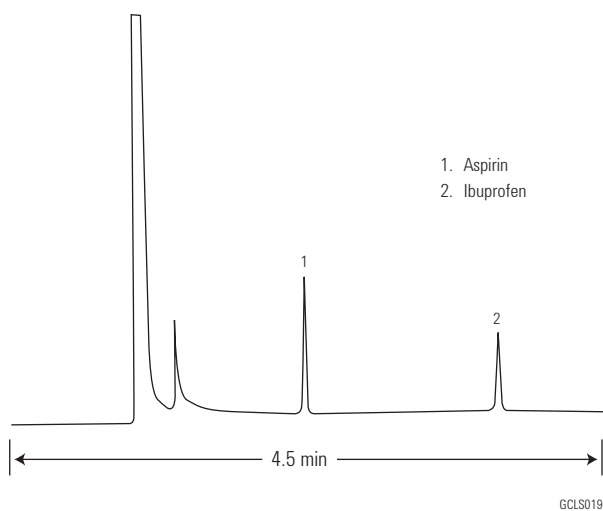
**Column:** DB-FFAP  
122-3232  
30 m x 0.25 mm, 0.25  $\mu$ m

**Carrier:** Hydrogen at 24 cm/sec, measured at 180 °C

**Oven:** 180 °C isothermal

**Injection:** Split, 250 °C  
Split ratio 1:50

**Detector:** FID, 300 °C  
Nitrogen makeup gas at 30 mL/min



**Free Steroids**

**Column:** DB-17  
122-1731  
30 m x 0.25 mm, 0.15  $\mu$ m

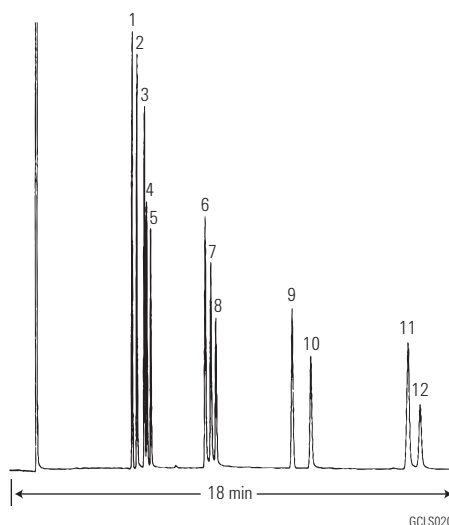
**Carrier:** Hydrogen at 44 cm/sec

**Oven:** 260 °C isothermal

**Injection:** Split, 250 °C  
Split ratio 1:100

**Detector:** FID, 300 °C  
Nitrogen makeup gas at  
30 mL/min

**Sample:** 1  $\mu$ L



1. Coprostone (5- $\beta$ -cholestane)
2. 5- $\beta$ -Androsterone
3. 5- $\alpha$ -Cholestane
4. Androsterone
5. Epiandrosterone (trans-androsterone)
6. 17- $\alpha$ -Estradiol
7.  $\beta$ -Estradiol
8. Estrone
9. Progesterone
10. Cholesterol
11. Estriol
12. Stigmasterol

**Anabolic Steroids**

**Column:** DB-1  
122-1031  
30 m x 0.25 mm, 0.10  $\mu$ m

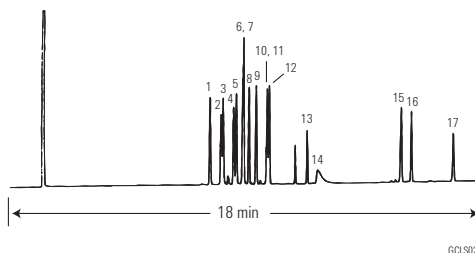
**Carrier:** Helium at 40 cm/sec, measured at 180 °C

**Oven:** 180-320 °C at 10 °C/min  
320 °C for 4 min

**Injection:** Split ratio 1:40

**Detector:** FID, Nitrogen makeup gas at 30 mL/min

**Sample:** 2  $\mu$ L of 0.125  $\mu$ g/ $\mu$ L each in methanol



1. Dehydroisoandrosterone (Prasterone)
2. 5 $\alpha$ -Androstan-17 $\alpha$ -ol-3-one (Stanolone)
3. 19-Nortestosterone (Nandrolone)
4. Mesterolone
5. Testosterone
6. 1-Dehydrotestosterone (Boldenone)
7. 17 $\alpha$ -Methyltestosterone
8. 1-Dehydro-17- $\alpha$ -methyltestosterone (Methandrostenolone)
9. Norethandrolone
10. 1-Dehydrotestosterone acetate
11. Oxymetholone
12. 19-Nortestosterone-17-propionate
13. 4-Chlortestosterone-17-acetate (Clostebol)
14. Stanozolol
15. 1-Dehydrotestosterone benzoate
16. 19-Nortestosterone-17-decanoate
17. 1-Dehydrotestosterone undecylenate

**Marijuana ( $\Delta$ 9-THC) and Major Metabolites – TMS Derivatives**

**Column:** DB-5  
123-5032  
30 m x 0.32 mm, 0.25  $\mu$ m

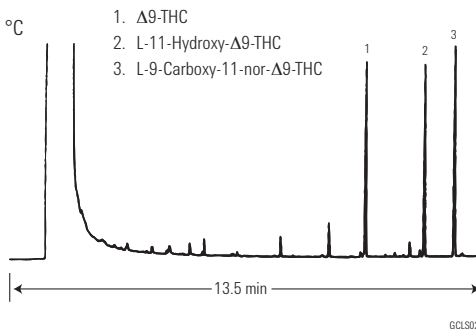
**Carrier:** Helium at 40 cm/sec, measured at 100 °C

**Oven:** 100 °C for 1 min  
100-175 °C at 30 °C/min  
175-295 °C at 12 °C/min

**Injection:** Splitless, 250 °C  
30 sec purge activation time

**Detector:** FID, 300 °C  
Nitrogen makeup  
gas at 30 mL/min

**Sample:** 1  $\mu$ L of 0.1  $\mu$ g/ $\mu$ L each in pyridine



1.  $\Delta$ 9-THC
2. L-11-Hydroxy- $\Delta$ 9-THC
3. L-9-Carboxy-11-nor- $\Delta$ 9-THC

**Suggested Supplies**

- Septum:** 11 mm Advanced Green septa, 5183-4759
- Liner:** Direct connect, single taper, deactivated, 4 mm id, G1544-80730
- Seal:** Gold plated seal, 18740-20885
- Syringe:** 10  $\mu$ L tapered, FN 23-26s/42/HP, 5181-1267

**Blood Pollutants I**

**Column:** HP-Blood Alcohol  
125-9134  
30 m x 0.53 mm, 3.00 µm

**Carrier:** Helium, 36 cm/sec, measured at 40 °C

**Oven:** 40 °C for 5 min  
40-210 °C at 10 °C/min

**Injection:** Split, 250 °C  
Split ratio 1:10

**Detector:** FID, 300 °C

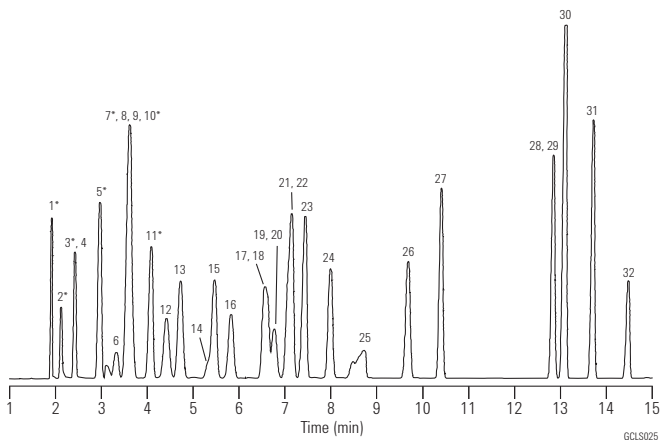
- |                       |                          |                                 |
|-----------------------|--------------------------|---------------------------------|
| 1. Methanol*          | 12. MTBE                 | 23. 1-Butanol                   |
| 2. Acetaldehyde*      | 13. Hexane               | 24. Heptane                     |
| 3. Ethanol*           | 14. Chloroform           | 25. Ethylene glycol             |
| 4. Diethyl ether      | 15. sec-Butyl alcohol    | 26. soamyl alcohol              |
| 5. Isopropyl alcohol* | 16. 2-Chlorobutane       | 27. Toluene                     |
| 6. Methylene Chloride | 17. MEK (2-Butanone)     | 28. Isopropyl amine (not shown) |
| 7. Acetone*           | 18. Ethyl acetate        | 29. Ethylbenzene                |
| 8. Acetonitrile       | 19. 1,1-Trichloroethane  | 30. m,p-Xylene                  |
| 9. Ethyl formate      | 20. Carbon tetrachloride | 31. o-Xylene                    |
| 10. t-Butyl alcohol*  | 21. 1-Chlorobutane       | 32. DMSO                        |
| 11. 1-Propanol        | 22. Benzene              |                                 |

**Suggested Supplies**

**Septum:** 11 mm Advanced Green septa, 5183-4759

**Liner:** Direct, 1.5 mm id, 18740-80200

**Seal:** Gold plated seal, 18740-20885

**Blood Pollutants II**

**Column:** HP-Blood Alcohol  
125-9234  
30 m x 0.53 mm, 2.00 µm

**Carrier:** Helium, 36 cm/sec, measured at 40 °C

**Oven:** 40 °C for 5 min  
40-210 °C at 10 °C/min

**Injection:** Split, 250 °C  
Split ratio 1:10

**Detector:** FID, 300 °C

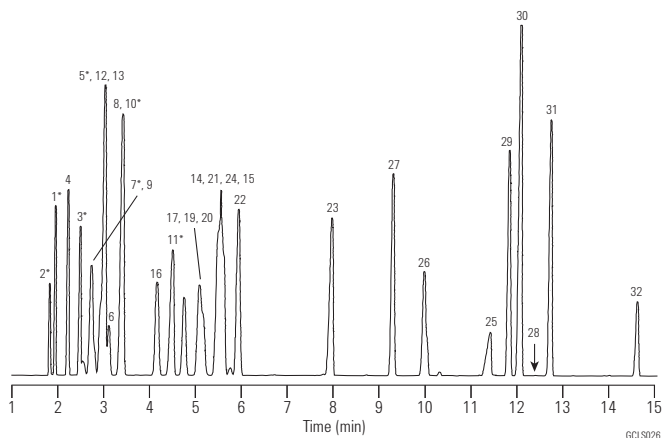
- |                       |                          |                                 |
|-----------------------|--------------------------|---------------------------------|
| 1. Methanol*          | 12. MTBE                 | 23. 1-Butanol                   |
| 2. Acetaldehyde*      | 13. Hexane               | 24. Heptane                     |
| 3. Ethanol*           | 14. Chloroform           | 25. Ethylene glycol             |
| 4. Diethyl ether      | 15. sec-Butyl alcohol    | 26. soamyl alcohol              |
| 5. Isopropyl alcohol* | 16. 2-Chlorobutane       | 27. Toluene                     |
| 6. Methylene Chloride | 17. MEK (2-Butanone)     | 28. Isopropyl amine (not shown) |
| 7. Acetone*           | 18. Ethyl acetate        | 29. Ethylbenzene                |
| 8. Acetonitrile       | 19. 1,1-Trichloroethane  | 30. m,p-Xylene                  |
| 9. Ethyl formate      | 20. Carbon tetrachloride | 31. o-Xylene                    |
| 10. t-Butyl alcohol*  | 21. 1-Chlorobutane       | 32. DMSO                        |
| 11. 1-Propanol        | 22. Benzene              |                                 |

**Suggested Supplies**

**Septum:** 11 mm Advanced Green septa, 5183-4759

**Liner:** Direct, 1.5 mm id, 18740-80200

**Seal:** Gold plated seal, 18740-20885



**Residual Solvents, USP 467**

**Column: DB-624  
125-1334  
30 m x 0.53 mm, 3.00 µm**

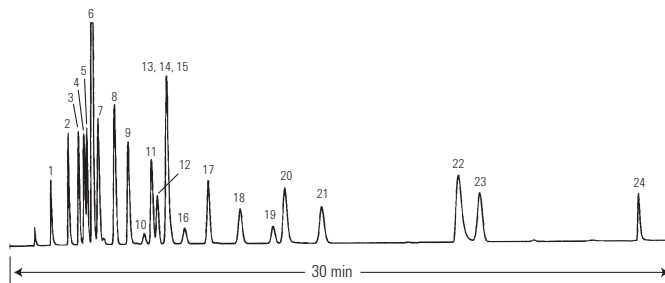
Carrier: Helium at 35 cm/sec, measured at 40 °C

Oven: 40 °C for 20 min  
40-90 °C at 5 °C/min

Injection: Megabore Direct, 250 °C  
5 m phenylmethylsilane deactivated  
retention gap

Detector: FID, 300 °C  
Nitrogen makeup gas at  
30 mL/min

- |                       |                               |                             |
|-----------------------|-------------------------------|-----------------------------|
| 1. Methanol           | 9. n-Hexane                   | 17. Benzene                 |
| 2. Ethanol            | 10. n-Propanol                | 18. n-Heptane               |
| 3. Ethyl ether        | 11. Methyl ethyl ketone (MEK) | 19. Trichloroethylene       |
| 4. Acetone            | 12. Ethyl acetate             | 20. n-Butanol               |
| 5. Isopropanol        | 13. Tetrahydrofuran (THF)     | 21. 1,4-Dioxane             |
| 6. Acetonitrile       | 14. Chloroform                | 22. Pyridine                |
| 7. Methylene chloride | 15. sec-Butanol               | 23. Toluene                 |
| 8. tert-Butanol       | 16. Cyclohexane               | 24. Dimethylformamide (DMF) |



GCLS027

## Residual Solvents

**Column:** DB-624  
123-1364  
60 m x 0.32 mm, 1.80 µm

**Carrier:** Helium, 35-40 cm/sec, set to yield same RT for Hexane on all columns.

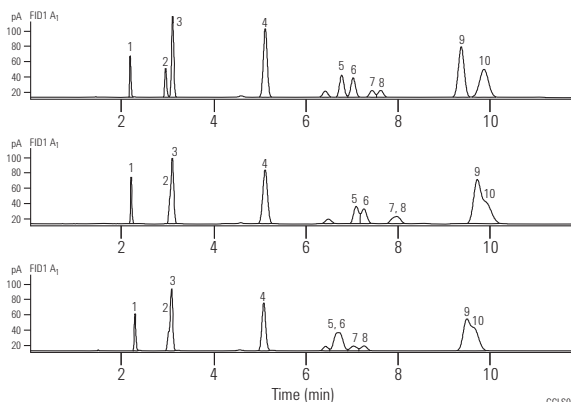
**Oven:** 40 °C Isothermal

**Sampler:** Ambient Headspace

**Injection:** Split ratio 1:8

**Detector:** FID, 240 °C

**Sample:** 4 µL



1. Methanol
2. Ethanol
3. Diethyl ether
4. Hexane
5. Ethyl Acetate
6. 2-Butanone
7. 2-Butanol
8. Chloroform
9. Benzene
10. Isooctane

Peak Numbers	Critical Pair	% Resolution*		
		DB-624	Manufacturer A's 624	Manufacturer B's 624
2,3	ethanol and diethyl ether	100%	0%	0%
5,6	ethyl acetate and 2-butanone	95%	38%	0%
7,8	2-butanol and chloroform	60%	0%	60%
9,10	benzene and isooctane	100%	0%	0%

\*Resolution calculated as follows: %R = 100% x valley height/average of peak height 1 + peak height 2

The three chromatograms above show how widely different the two other manufacturer's columns are compared to the DB-624, the original USP G-43 stationary phase column recommended for the analysis of these common organic volatile impurities in pharmaceutical samples.

Top Chromatogram: DB-624

Middle Chromatogram: Manufacturer A's "-624"

Bottom Chromatogram: Manufacturer B's "-624"

## TIPS &amp; TOOLS

For the latest residual solvent application for USP 467, request publication number 5989-8085EN.



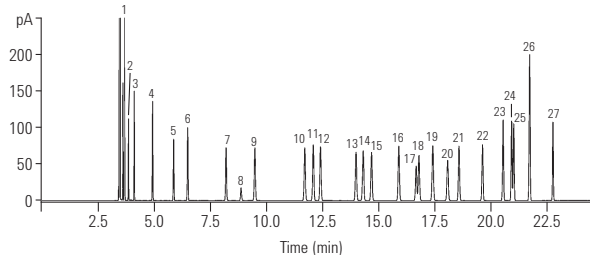
## Energy and Fuels Applications

## Fast Analysis of Aromatic Solvent

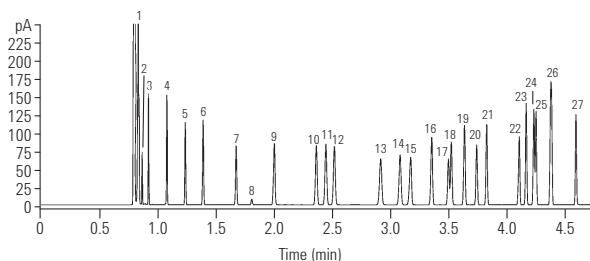
**Column:** HP-INNOWax  
19091N-577  
20 m x 0.18 mm, 0.18 µm

**Carrier:** Helium at 33 psi constant pressure mode  
**Oven:** 70 °C (3 min); 45 °C/min to 145 °C (1 min)  
**Injection:** Split/splitless at 250 °C  
100:1 to 600:1 split ratio  
**Detector:** FID at 250 °C  
**Sample:** 0.2 to 1.0 µL

## Unified aromatic solvent method



## Optimized unified aromatic solvent method



GCHE003

1. Heptane
2. Cyclohexane
3. Octane
4. Nonane
5. Benzene
6. Decane
7. Toluene
8. 1,4-Dioxan
9. Undecane
10. Ethylbenzene
11. p-Xylene
12. m-Xylene
13. Cumene
14. Dodecane
15. o-Xylene
16. Propylbenzene
17. p-Ethyltoluene
18. m-Ethyltoluene
19. t-Butylbenzene
20. s-Butylbenzene
21. Styrene
22. Tridecane
23. 1,3-Diethylbenzene
24. 1,2-Diethylbenzene
25. n-Butylbenzene
26. a-Methylstyrene
27. Phenylacetylene

This application showcases the practicality using High Efficiency GC columns in daily aromatic solvent analysis. The result: a three-fold reduction in run time (compared to a 0.32 mm id column) with no compromise in resolution.

## Refinery Gas I

**Column:** HP PLOT Q  
19095P-Q04  
30 m x 0.53 mm, 40.00  $\mu$ m

**Carrier:** Helium p=9.0 psi at 60 °C

**Oven:** 60 °C for 5 min  
60-200 °C at 20 °C/min  
200 °C for 1 min

**Injection:** Split, 250 °C  
Split flow 100 mL/min  
0.25 cc valve

**Detector:** TCD, 250 °C

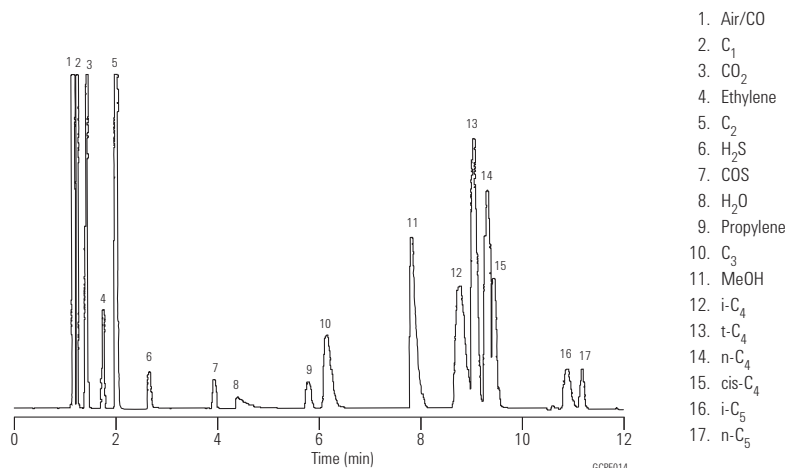
**Sample:** Refinery gas and others

## Suggested Supplies

**Septum:** 11 mm Advanced Green septa, 5183-4759

**Liner:** Direct, 1.5 mm id, 18740-80200

**Seal:** Gold plated seal, 18740-20885



## Unleaded Gasoline

**Column:** DB-Petro  
122-10A6  
100 m x 0.25 mm, 0.50  $\mu$ m

**Carrier:** Helium at 25.6 cm/sec

**Oven:** 0 °C for 15 min  
0-50 °C at 1 °C/min  
50-130 °C at 2 °C/min  
130-180 °C at 4 °C/min  
180 °C for 20 min

**Injection:** Split, 200 °C  
Split ratio 1:300

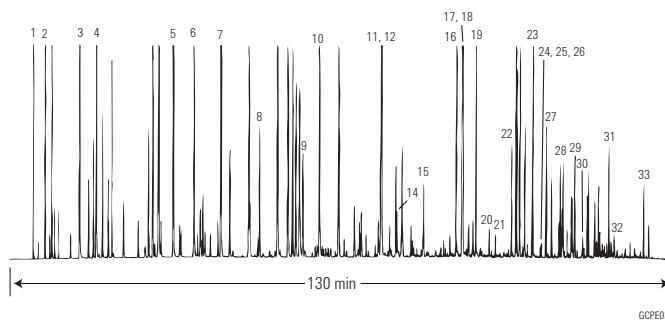
**Detector:** FID, 250 °C  
Nitrogen makeup gas  
at 30 mL/min

**Sample:** 1  $\mu$ L of neat sample

- |                       |                            |                                |
|-----------------------|----------------------------|--------------------------------|
| 1. Methane            | 12. 2,3,3-Trimethylpentane | 23. 1,2,4-Trimethylbenzene     |
| 2. n-Butane           | 13. 2-Methylheptane        | 24. Isobutylbenzene            |
| 3. Isopentane         | 14. 4-Methylheptane        | 25. sec-Butylbenzene           |
| 4. n-Pentane          | 15. n-Octane               | 26. n-Decane                   |
| 5. n-Hexane           | 16. Ethylbenzene           | 27. 1,2,3-Trimethylbenzene     |
| 6. Methylcyclopentane | 17. m-Xylene **            | 28. Butylbenzene               |
| 7. Benzene            | 18. p-Xylene               | 29. n-Undecane                 |
| 8. Cyclohexane        | 19. o-Xylene               | 30. 1,2,4,5-Tetramethylbenzene |
| 9. Isooctane          | 20. n-Nonane               | 31. Naphthalene                |
| 10. n-Heptane         | 21. Isopropylbenzene       | 32. Dodecane                   |
| 11. Toluene *         | 22. Propylbenzene          | 33. Tridecane                  |

\*Valley point with 12 = 78%

\*\*Valley point with 18 = 87%



**n-Paraffin Standard**

**Column:** DB-HT SimDis  
145-1001  
5 m x 0.53 mm, 0.15 µm

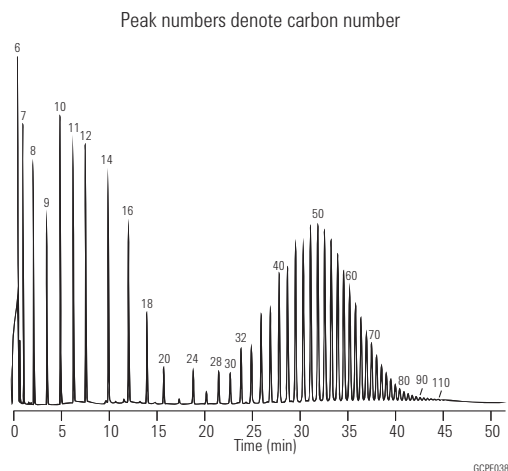
**Carrier:** Helium at 18 mL/min, measured at 35 °C

**Oven:** -30-430 °C at 10 °C/min

**Injection:** OPTIC PTV  
55-450 °C at 2 °C/sec

**Detector:** FID, 450 °C  
Nitrogen makeup gas at 15 mL/min

**Sample:** 0.5 µL of about 2% n-paraffins in CS<sub>2</sub>

**Volatile Sulfur Compounds**

**Column:** DB-1  
123-1035  
30 m x 0.32 mm, 5.00 µm

**Carrier:** Helium at 23 cm/sec (H<sub>2</sub>S at 50 °C)

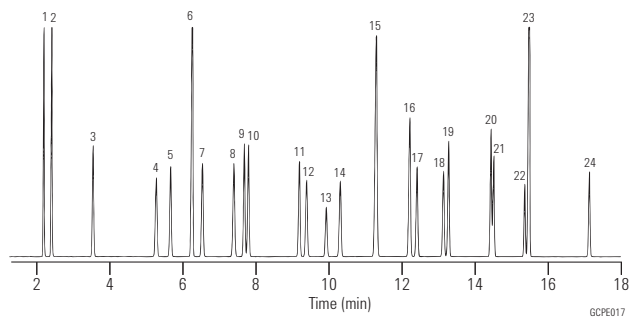
**Oven:** 50 °C for 4 min, 50-120 °C at 20 °C/min,  
120 °C for 4 min, 120-220 °C at  
25 °C/min, 220 °C for 2.5 min

**Injection:** Split, 200 °C  
Split ratio 1:10

**Detector:** PFPD (OI Analytical), 220 °C

**Sample:** 600 µL of sulfur gas standard  
3 ppmV each component

- |                             |                           |
|-----------------------------|---------------------------|
| 1. Hydrogen sulfide         | 13. Diethyl sulfide       |
| 2. Carbonyl sulfide         | 14. 1-Butanethiol         |
| 3. Methyl mercaptan         | 15. Methyl disulfide      |
| 4. Ethyl mercaptan          | 16. 2-Methylthiophene     |
| 5. Dimethyl sulfide         | 17. 3-Methylthiophene     |
| 6. Carbon disulfide         | 18. Tetrahydrothiophene   |
| 7. 2-Propanethiol           | 19. 1-Pentanethiol        |
| 8. 2-Methyl-2-propanethiol  | 20. 2-Ethylthiophene      |
| 9. 1-Propanethiol           | 21. 2,5-Dimethylthiophene |
| 10. Ethyl methyl sulfide    | 22. 1-Hexanethiol         |
| 11. Thiophene               | 23. Ethyl disulfide       |
| 12. 2-Methyl-1-propanethiol | 24. 1-Heptanethiol        |



Agilent wishes to thank Air Toxics, Ltd. (Folsom, CA) for providing the standard mixture shown in this chromatogram.



**Sulfur Compounds in Propylene (1 ppm)**

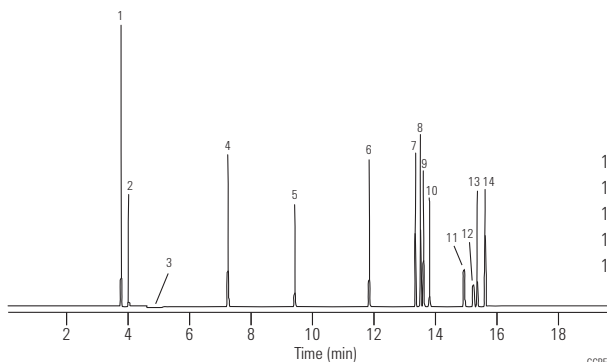
**Column:** GS-GasPro  
113-4332  
30 m x 0.32 mm

**Oven:** 60 °C for 2.5 min  
60-250 °C at 10 °C/min

**Injection:** OI Analytical Volatiles Inlet  
Split ratio 5:1  
200 µL gas sampling valve

**Detector:** OI Analytical Model 5380 PFPD

**Sample:** 1 ppm Sulfur compounds in Propylene



1. COS
2. H<sub>2</sub>S
3. Propylene
4. CS<sub>2</sub>
5. Methyl mercaptan
6. Ethyl mercaptan
7. Thiophene
8. Dimethyl sulfide
9. 2-Propanethiol
10. 1-Propanethiol
11. 2-Methyl-2-propanethiol
12. 2-Methyl-1-propanethiol
13. 1-Methyl-1-propanethiol
14. 1-Butanethiol

Chromatogram courtesy of OI Analytical.

GCPE020

**Sulfur Impurities in Propylene**

**Column:** Select Low Sulfur  
CP8575  
60 m x 0.32 mm

**Oven:** 65 °C for 4 min, 30 °C/min to 120 °C for 5 min

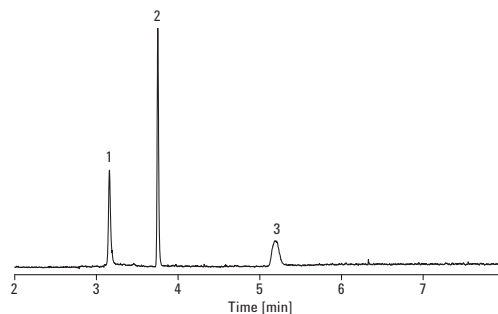
**Carrier:** Helium, constant flow, 2.0 mL/min

**Injection:** Gas sampling valve  
220 °C, split 1:10

**Detector:** SCD, 200 °C

**Sample:** Polypropylene matrix containing ~300 ppb H<sub>2</sub>S  
and CH<sub>3</sub>SH, ~500 ppb COS

**Injection Volume:** 1 mL



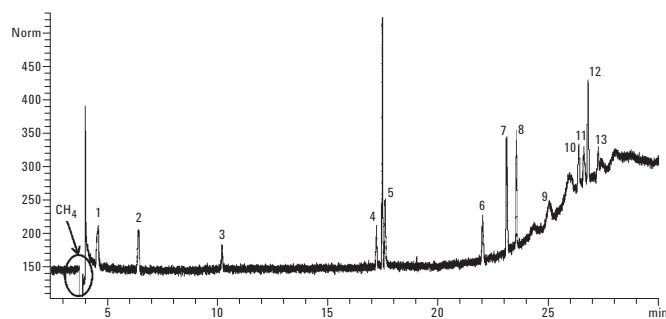
1. H<sub>2</sub>S
2. COS
3. CH<sub>3</sub>SH

## Trace Sulfur Compounds in Methane (50 ppbv)

Column: **Select Low Sulfur  
CP8575  
60 m x 0.32 mm**

Oven: 40 °C (6 min), to 120 °C at 6 °C/min,  
to 180 °C (5 min) at 10 °C/min

Sample: 1 mL, split ratio: 3:1



Compound	Signal/noise
1. Hydrogen sulfide	3.8
2. Carbonyl sulfide	4.0
3. Methylmercaptan	2.2
4. Ethylmercaptan	3.8
5. Dimethyl sulfide	6.3
6. 2-Propanethiol	4.3
7. Methyl ethyl sulfide	11
8. Thiophene	11
9. Tert-Butyl mercaptan	2.1
10. 2-Butanethiol	4.5
11. 2-Methyl-1 propanethiol	3.7
12. Diethylsulfide	9.8
13. 1-Butanethiol	2.4

## Trace Oxygenates in Light Hydrocarbon Matrices

Column: **DB-1  
125-102J  
25 m x 0.53 mm, 1.00 µm**

Column: **GS-OxyPLOT  
115-4912  
10 m x 0.53 mm,**

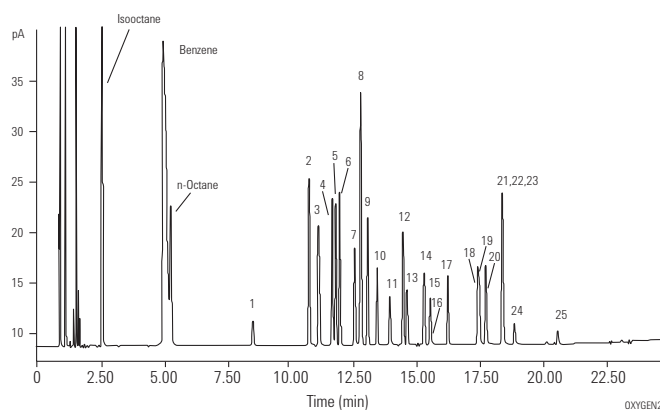
Carrier: Helium (tm = 0.96 min at 50 °C)

Oven: 50 °C for 5 min  
50 °C to 240 °C

Injection: Split

Detector: FID

1. Dimethyl ether	13. Acetone
2. Diethyl ether	14. Isovaleraldehyde
3. Acetaldehyde	15. Valeraldehyde
4. Ethyl t-butyl ether	16. Methyl ethyl ketone
5. Methyl t-butyl ether	17. Ethanol
6. Diisopropyl ether	18. n-Propanol
7. Propionaldehyde	19. Isopropanol
8. Tert-amyl methyl ether	20. Allyl alcohol
9. Propyl ether	21. Isobutanol
10. Isobutylaldehyde	22. t-Butyl alcohol
11. Butylaldehyde	23. s-Butyl alcohol
12. Methanol	24. n-Butyl alcohol
	25. 2-methyl-2 pentanol



**Selected Oxygenates**

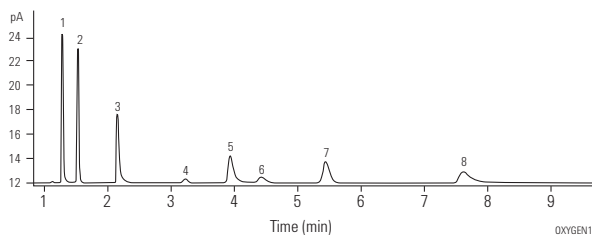
**Column:** GS-OxyPLOT  
115-4912  
10 m x 0.53 mm,

Carrier: Helium at 41 cm/s

Oven: 150 °C Isothermal

Injection: Split, 1:40, 250 °C

Detector: FID, 290 °C



1. n-Dodecane
2. Methyl t-butyl ether
3. n-Tridecane
4. Iso-Buteraldehyde
5. n-Tetradecane
6. Methanol
7. Acetone
8. n-Pentadecane

**Noble Gases**

**Column:** HP PLOT  
19095P-MSO  
30 m x 0.53 mm, 50.00 µm

Carrier: Helium, 4 mL/min

Oven: 35 °C for 3 min  
35-120 °C at 25 °C/min  
120 °C for 5 min

Injection: Split ratio 50:1

Detector: TCD

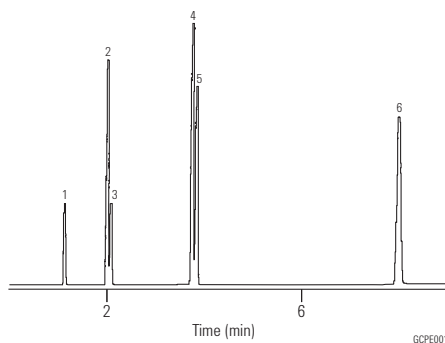
Sample: 250 µL

**Suggested Supplies**

**Septum:** 11 mm Advanced Green septa, 5183-4759

**Liner:** Direct, 1.5 mm id, 18740-80200

**Seal:** Gold plated seal, 18740-20885



1. Neon
2. Argon
3. Oxygen
4. Nitrogen
5. Krypton
6. Xenon

**Permanent Gases**

**Column:** HP PLOT Molesieve  
19091P-MS4  
30 m x 0.32 mm, 12.00 µm

Carrier: Helium, 2 mL/min

Oven: 40 °C Isothermal

Injection: Split ratio 75:1

Detector: TCD

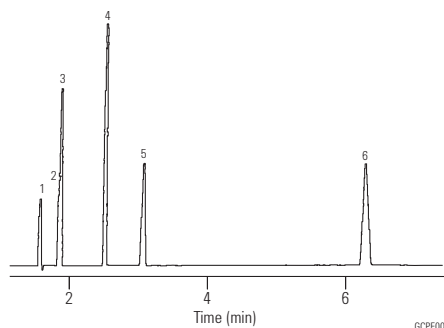
Sample: 250 µL

**Suggested Supplies**

**Septum:** 11 mm Advanced Green septa, 5183-4759

**Liner:** Direct, 1.5 mm id, 18740-80200

**Seal:** Gold plated seal, 18740-20885



1. Neon
2. Argon
3. Oxygen
4. Nitrogen
5. Methane
6. Carbon monoxide

### Baseline Resolution of Air/CO, CO<sub>2</sub>, and Methane in a Natural Gas Sample

**Column:** HP PLOT Q  
19095P-Q04  
30 m x 0.53 mm, 40.00 µm

**Carrier:** Helium (8.6 mL/min @ 60 °C)

**Oven:** 60 °C for 2 min  
60-240 °C at 30 °C/min  
240 °C for 1 min

**Injection:** Split ratio 12:1

**Detector:** TCD, 250 °C

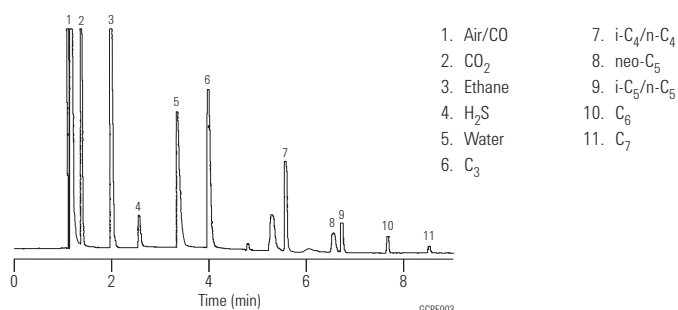
**Sample:** 0.25 cc natural gas sample, Methane, 80%+

#### Suggested Supplies

**Septum:** 11 mm Advanced Green septa, 5183-4759

**Liner:** Direct, 1.5 mm id, 18740-80200

**Seal:** Gold plated seal, 18740-20885



### Natural Gas

**Column:** HP PLOT Al<sub>2</sub>O<sub>3</sub> S  
19095P-S21  
15 m x 0.53 mm, 15.00 µm

**Carrier:** Helium, 50 cm/sec (100 °C), 6 mL/min

**Oven:** 100 °C for 1.5 min  
100-180 °C at 30 °C/min

**Injection:** Split, 250 °C  
Split ratio 50:1

**Detector:** FID, 250 °C

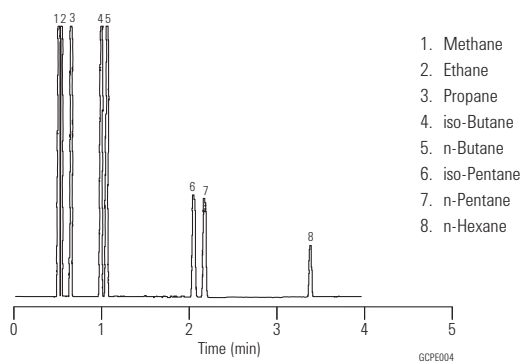
**Sample:** 5 µL  
Natural Gas P/N 5080-8756

#### Suggested Supplies

**Septum:** 11 mm Advanced Green septa, 5183-4759

**Liner:** Direct, 1.5 mm id, 18740-80200

**Seal:** Gold plated seal, 18740-20885



**Ethylene**

**Column:** HP PLOT Al<sub>2</sub>O<sub>3</sub> S  
19095P-S25  
50 m x 0.53 mm, 15.00 μm

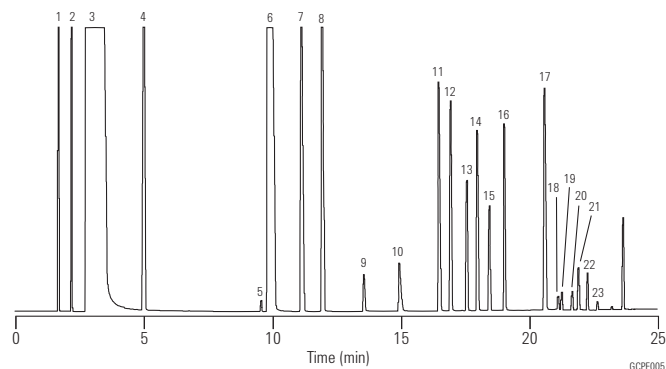
**Carrier:** Helium, 50 cm/sec (35 °C),  
7 mL/min constant flow

**Oven:** 35 °C for 2 min  
35-100 °C at 5 °C/min

**Injection:** Split, 250 °C  
Split ratio 65:1

**Detector:** FID, 250 °C

**Sample:** 5 μL  
Ethylene 98.4%



1. Methane
2. Ethane
3. Ethylene
4. Propane
5. Cyclopropane
6. Propylene
7. Isobutane
8. n-Butane
9. Propadiene
10. Acetylene
11. trans-2-Butene
12. Butene-1
13. Isobutylene
14. cis-2-Butene
15. Isopentane
16. n-Pentane
17. 1,3-Butadiene
18. Propyne
19. trans-2-Pentene
20. 2-Methyl-2-butene
21. Pentene-1
22. cis-2-Pentene
23. n-Hexane

**Impurities in Ethylene**

**Column:** GS-Alumina KCl  
115-3352  
50 m x 0.53 mm,

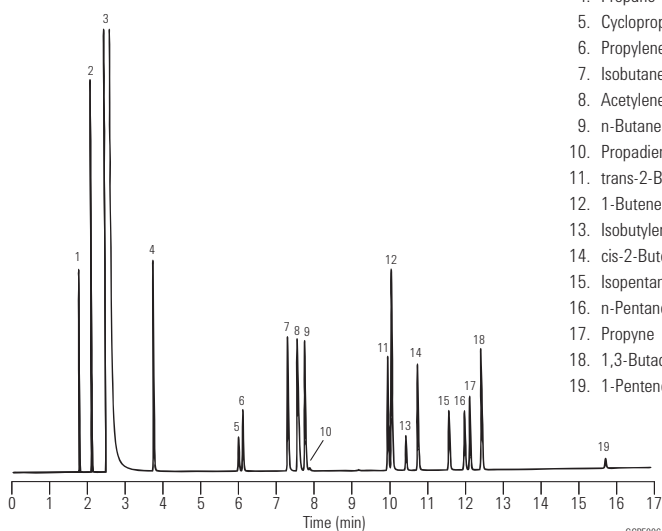
**Carrier:** Helium at 8 mL/min, measured at 35 °C

**Oven:** 35 °C for 2 min  
35-190 °C at 10 °C/min  
190 °C for 3 min

**Injection:** Split, 200 °C  
Split ratio 1:40

**Detector:** FID, 200 °C  
Nitrogen makeup gas at 20 mL/min

**Sample:** 0.2 mL of trace hydrocarbons  
in ethylene



1. Methane
2. Ethane
3. Ethylene
4. Propane
5. Cyclopropane
6. Propylene
7. Isobutane
8. Acetylene
9. n-Butane
10. Propadiene
11. trans-2-Butene
12. 1-Butene
13. Isobutylene
14. cis-2-Butene
15. Isopentane
16. n-Pentane
17. Propyne
18. 1,3-Butadiene
19. 1-Pentene

**Impurities in Propylene**

**Column:** GS-Alumina KCl  
115-3352  
50 m x 0.53 mm,

**Carrier:** Helium at 10 mL/min,  
measured at 35 °C

**Oven:** 35 °C for 2 min  
35-190 °C at 10 °C/min  
190 °C for 3 min

**Injection:** Split, 200 °C  
Split ratio 1:30

**Detector:** FID, 200 °C  
Nitrogen makeup gas  
at 20 mL/min

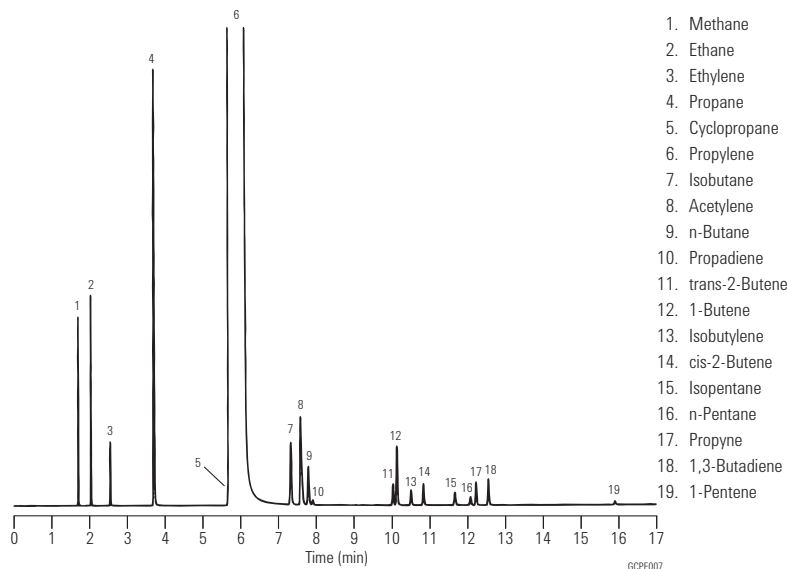
**Sample:** 0.2 mL of trace  
hydrocarbons in propylene

**Suggested Supplies**

**Septum:** 11 mm Advanced Green septa, 5183-4759

**Liner:** Direct, 1.5 mm id, 18740-80200

**Seal:** Gold plated seal, 18740-20885



1. Methane
2. Ethane
3. Ethylene
4. Propane
5. Cyclopropane
6. Propylene
7. Isobutane
8. Acetylene
9. n-Butane
10. Propadiene
11. trans-2-Butene
12. 1-Butene
13. Isobutylene
14. cis-2-Butene
15. Isopentane
16. n-Pentane
17. Propyne
18. 1,3-Butadiene
19. 1-Pentene

**Propylene**

**Column:** GS-Alumina  
115-3552  
50 m x 0.53 mm

**Carrier:** Helium at 10 mL/min,  
measured at 35 °C

**Oven:** 35 °C for 2 min  
35-190 °C at 10 °C/min  
190 °C for 3 min

**Injection:** Split, 200 °C  
Split ratio 1:30

**Detector:** FID, 200 °C  
Nitrogen makeup gas  
at 20 mL/min

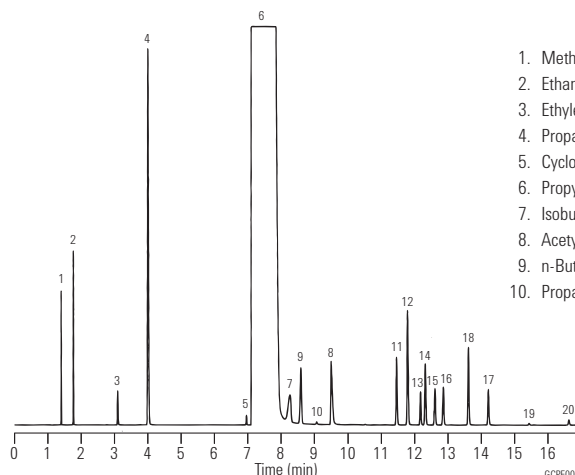
**Sample:** 0.2 mL of trace  
hydrocarbons in propylene

**Suggested Supplies**

**Septum:** 11 mm Advanced Green septa, 5183-4759

**Liner:** Direct, 1.5 mm id, 18740-80200

**Seal:** Gold plated seal, 18740-20885



- |                 |                    |
|-----------------|--------------------|
| 1. Methane      | 11. trans-2-Butene |
| 2. Ethane       | 12. 1-Butene       |
| 3. Ethylene     | 13. Isobutylene    |
| 4. Propane      | 14. cis-2-Butene   |
| 5. Cyclopropane | 15. Isopentane     |
| 6. Propylene    | 16. n-Pentane      |
| 7. Isobutane    | 17. Propyne        |
| 8. Acetylene    | 18. 1,3-Butadiene  |
| 9. n-Butane     | 19. 1-Pentene      |
| 10. Propadiene  | 20. n-Hexane       |

**1,3-Butadiene**

**Column:** DB-624  
128-1324  
25 m x 0.20 mm, 1.12 µm

**Carrier:** Helium at 1.0 mL/min

**Oven:** -20 °C for 3 min  
-20 °C-20 °C at 4 °C/min  
20 °C-200 °C at 8 °C/min  
200 °C for 10 min

**Injection:** Split, 250 °C  
Split ratio 1:150

**Detector:** FID, 250 °C

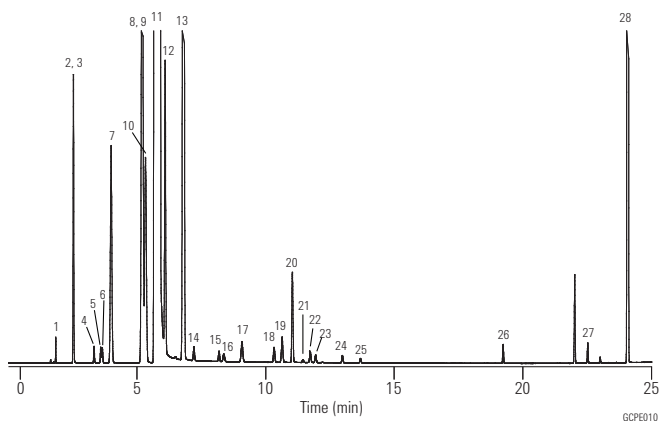
**Sample:** 0.5 µL

**Suggested Supplies**

**Septum:** 11 mm Advanced Green septa, 5183-4759

**Liner:** Direct, 1.5 mm id, 18740-80200

**Seal:** Gold plated seal, 18740-20885

**Refined Butadiene  
Standard Component****Gravimetric  
concentration (PPM)**

1. Acetylene	20.7
2. Propane	19.8
3. Propylene	296
4. Propadiene (allene)	21.1
5. Propyne (methylacetylene)	21
6. Cyclopropane	20
7. Isobutane	506
8. Butene-1	999
9. Isobutylene	495
10. n-Butane	494
11. 1,3-Butadiene	balance
12. trans-2-Butene	442
13. cis-2-Butene	1946
14. 1-Butyne (ethylacetylene)	20.2
15. 1,2-Butadiene	28.9
16. 3-Methyl-1-butene	19.8
17. Isopentane	50.1
18. Pentene-1	29.8
19. n-Pentane	50.1
20. 2-Butyne (dimethylacetylene)	150
21. trans-2-Pentene	5.57
22. Isoprene	20
23. cis-2-Pentene	13.9
24. trans-1,3-Pentadiene	13.8
25. cis-1,3-Pentadiene	7.73
26. Benzene	20.3
27. Toluene	20.2
28. Dimer (4-vinylcyclohexene-1)	

Agilent Technologies wishes to  
thank DCG Industries (Pearland, TX)  
for providing this chromatogram.

**1,3-Butadiene Purity**

**Column:** GS-Alumina  
115-3552  
50 m x 0.53 mm

**Carrier:** Helium, 6.0 mL/min  
(constant flow mode)

**Oven:** 45 °C for 3 min  
6 °C/min to 195 °C  
195 °C for 15 min

**Injection:** Split, 250 °C  
Split ratio 1:50

**Detector:** FID, 250 °C

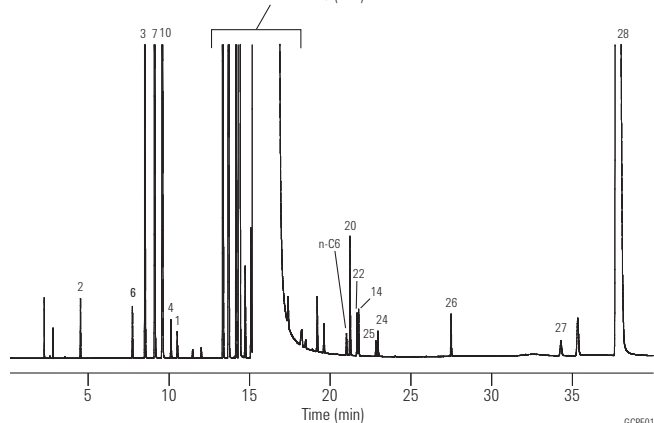
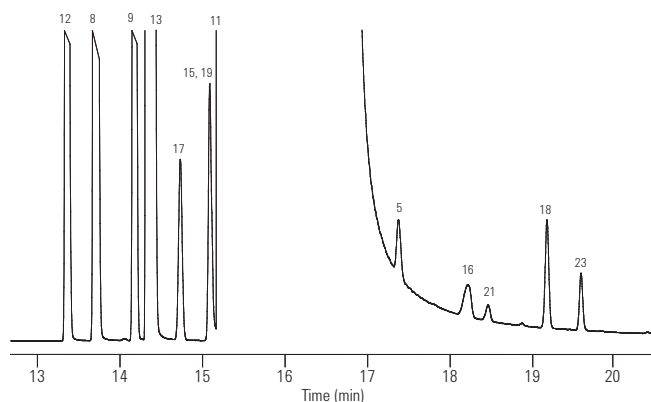
**Sample:** 0.5 µL

**Suggested Supplies**

**Septum:** 11 mm Advanced Green septa, 5183-4759

**Liner:** Direct, 1.5 mm id, 18740-80200

**Seal:** Gold plated seal, 18740-20885

**Refined Butadiene  
Standard Component**

Refined Butadiene Standard Component	Gravimetric concentration (PPM)
1. Acetylene	20.7
2. Propane	19.8
3. Propylene	296
4. Propadiene (allene)	21.1
5. Propyne (methylacetylene)	21
6. Cyclopropane	20
7. Isobutane	506
8. Butene-1	999
9. Isobutylene	495
10. n-Butane	494
11. 1,3-Butadiene	balance
12. trans-2-Butene	442
13. cis-2-Butene	1946
14. 1-Butyne (ethylacetylene)	20.2
15. 1,2-Butadiene	28.9
16. 3-Methyl-1-butene	19.8
17. Isopentane	50.1
18. Pentene-1	29.8
19. n-Pentane	50.1
20. 2-Butyne (dimethylacetylene)	150
21. trans-2-Pentene	5.57
22. Isoprene	20
23. cis-2-Pentene	13.9
24. trans-1,3-Pentadiene	13.8
25. cis-1,3-Pentadiene	7.73
26. Benzene	20.3
27. Toluene	20.2
28. Dimer (4-vinylcyclohexene-1)	



## Extended Hydrocarbon Analysis I

**Column:** GS-Alumina  
115-3532  
30 m x 0.53 mm

**Carrier:** Helium at 52 cm/sec (6.7 mL/min),  
measured at 100 °C

**Oven:** 100 °C for 1 min  
100-140 °C at 8 °C/min  
140 °C for 0.5 min  
140-200 °C at 30 °C/min

**Injection:** Split, 250 °C  
Split ratio 1:8

**Detector:** FID, 275 °C  
Nitrogen makeup gas at 29 mL/min

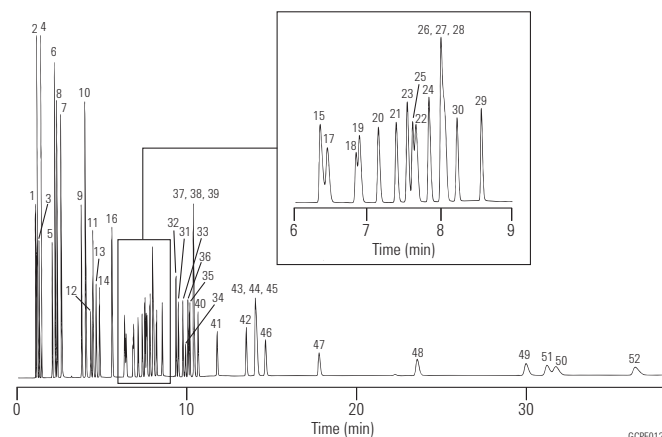
**Sample:** 300 µL injection of 100 ppm V  
SUMMA cannister mixture

### Suggested Supplies

**Septum:** 11 mm Advanced Green septa, 5183-4759

**Liner:** Direct, 1.5 mm id, 18740-80200

**Seal:** Gold plated seal, 18740-20885



- |                        |  |
|------------------------|--|
| 1. Methane             | 27. 2-Methylpentane                    |
| 2. Ethane              | 28. 3-Methylpentane                    |
| 3. Ethylene            | 29. Isoprene                           |
| 4. Propane             | 30. n-Hexane                           |
| 5. Propylene           | 31. 4-Methyl-1-pentene                 |
| 6. Isobutane           | 32. trans-2-Hexene                     |
| 7. Acetylene           | 33. 2-Methyl-1-pentene                 |
| 8. n-Butane            | 34. cis-2-Hexene                       |
| 9. trans-2-Butene      | 35. 2,4-Dimethylpentane                |
| 10. 1-Butene           | 36. Methylcyclohexane                  |
| 11. cis-2-Butene       | 37. 2,3-Dimethylpentane                |
| 12. Cyclopentane       | 38. 2-Methylhexane                     |
| 13. Isopentane         | 39. 3-Methylhexane                     |
| 14. n-Pentane          | 40. n-Heptane                          |
| 15. Propyne            | 41. Benzene                            |
| 16. 1,3-Butadiene      | 42. Isooctane (2,2,4-Trimethylpentane) |
| 17. Cyclopentene       | 43. 2,3,4-Trimethylpentane             |
| 18. 3-Methyl-1-butene  | 44. 3-Methylheptane                    |
| 19. trans-2-Pentene    | 45. 2-Methylheptane                    |
| 20. 2-Methyl-2-butene  | 46. n-Octane                           |
| 21. 1-Pentene          | 47. Toluene                            |
| 22. cis-2-Pentene      | 48. n-Nonane                           |
| 23. Methylcyclopentane | 49. Ethylbenzene                       |
| 24. 2,2-Dimethylbutane | 50. m-Xylene                           |
| 25. Cyclohexane        | 51. p-Xylene                           |
| 26. 2,3-Dimethylbutane | 52. o-Xylene                           |

## Extended Hydrocarbon Analysis II

**Column:** GS-GasPro  
113-4362  
60 m x 0.32 mm

**Carrier:** Helium at 40 cm/sec (3.3 mL/min),  
measured at 80 °C

**Oven:** 80 °C for 0.5 min  
80-175 °C at 25 °C/min  
175 °C for 2 min  
175-250 °C at 25 °C/min

**Injection:** Split, 250 °C  
Split ratio 1:17

**Detector:** FID, 275 °C  
Nitrogen makeup gas at 32 mL/min

**Sample:** 500 µL injection of 100 ppmV  
SUMMA cannister mixture

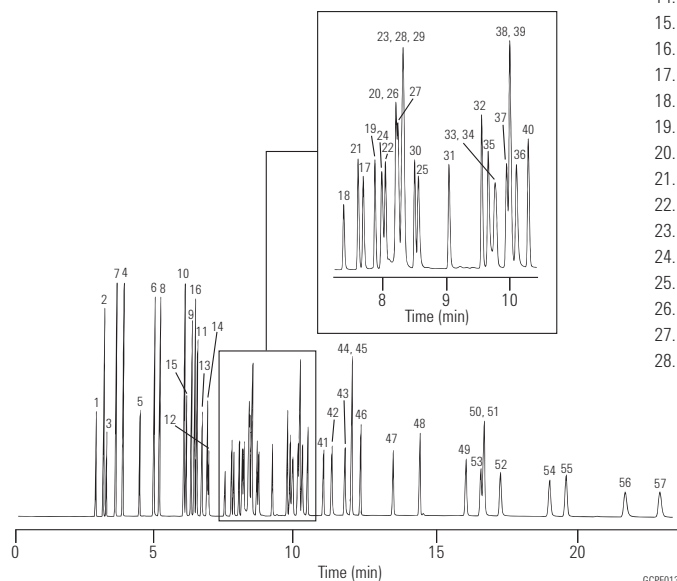
## Suggested Supplies

**Septum:** 11 mm Advanced Green septa, 5183-4759

**Liner:** Direct, 1.5 mm id, 18740-80200

**Seal:** Gold plated seal, 18740-20885

- |                        |  |
|------------------------|--|
| 1. Methane             | 29. Isoprene                           |
| 2. Ethane              | 30. n-Hexane                           |
| 3. Ethylene            | 31. 4-Methyl-1-pentene                 |
| 4. Propane             | 32. trans-2-Hexene                     |
| 5. Propylene           | 33. 2-Methyl-1-pentene                 |
| 6. Isobutane           | 34. cis-2-Hexene                       |
| 7. Acetylene           | 35. 2,4-Dimethylpentane                |
| 8. n-Butane            | 36. Methylcyclohexane                  |
| 9. trans-2-Butene      | 37. 2,3-Dimethylpentane                |
| 10. 1-Butene           | 38. 2-Methylhexane                     |
| 11. cis-2-Butene       | 39. 3-Methylhexane                     |
| 12. Cyclopentane       | 40. n-Heptane                          |
| 13. Isopentane         | 41. Benzene                            |
| 14. n-Pentane          | 42. Isooctane (2,2,4-Trimethylpentane) |
| 15. Propyne            | 43. 2,3,4-Trimethylpentane             |
| 16. 1,3-Butadiene      | 44. 3-Methylheptane                    |
| 17. Cyclopentene       | 45. 2-Methylheptane                    |
| 18. 3-Methyl-1-butene  | 46. n-Octane                           |
| 19. trans-2-Pentene    | 47. Toluene                            |
| 20. 2-Methyl-2-butene  | 48. n-Nonane                           |
| 21. 1-Pentene          | 49. Ethylbenzene                       |
| 22. cis-2-Pentene      | 50. m-Xylene                           |
| 23. Methylcyclopentane | 51. p-Xylene                           |
| 24. 2,2-Dimethylbutane | 52. o-Xylene                           |
| 25. Cyclohexane        | 53. Styrene                            |
| 26. 2,3-Dimethylbutane | 54. Isopropylbenzene (Cumene)          |
| 27. 2-Methylpentane    | 55. n-Propylbenzene                    |
| 28. 3-Methylpentane    | 56. 1,3,5-Trimethylbenzene             |
|                        | 57. 1,2,4-Trimethylbenzene             |



GCPE013

## Refinery Gas

**Column:** HP PLOT  $\text{Al}_2\text{O}_3$  S  
19095P-S25  
50 m x 0.53 mm, 15.00  $\mu\text{m}$

**Carrier:** Helium 7 mL/min

**Oven:** 100 °C Isothermal

**Injection:** Split, 250 °C  
Split ratio 100:1

**Detector:** FID, 250 °C

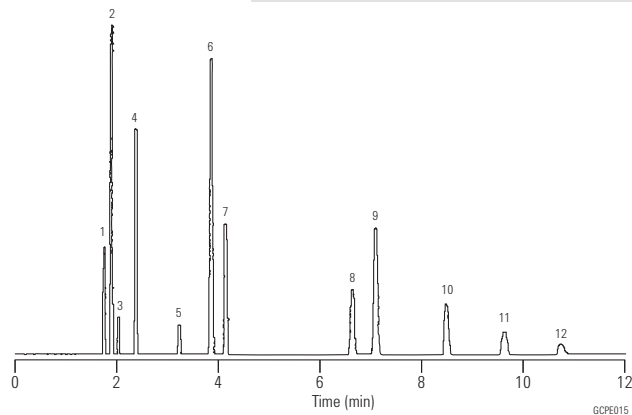
**Sample:** 5  $\mu\text{L}$

## Suggested Supplies

**Septum:** 11 mm Advanced Green septa, 5183-4759

**Liner:** Direct, 1.5 mm id, 18740-80200

**Seal:** Gold plated seal, 18740-20885



1. Methane
2. Ethane
3. Ethylene
4. Propane
5. Propylene
6. iso-Butane
7. n-Butane
8. trans-2-Butene
9. 1-Butene
10. cis-2 Butene
11. iso-Pentane
12. n-Pentane

Sulfur Gas Analysis  
in Light Hydrocarbon Streams I

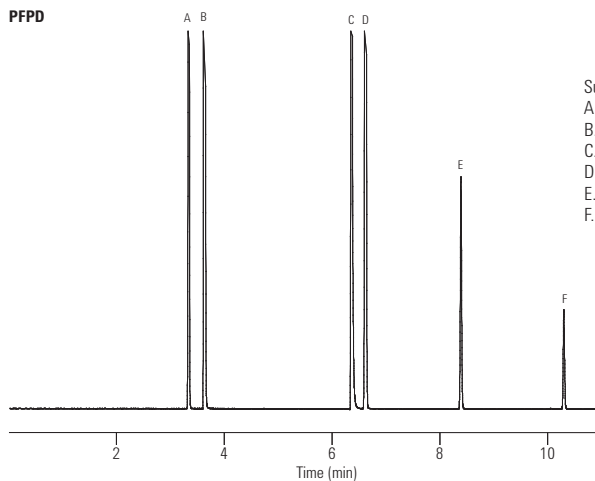
**Column:** GS-GasPro  
113-4332  
30 m x 0.32 mm

**Carrier:** Helium, 10 psig,  
2.0 mL/min @ 60 °C

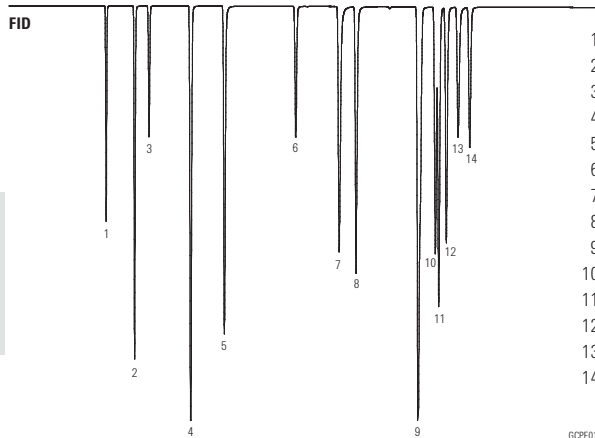
**Oven:** 60 °C for 2 min,  
20 °C/min to 260 °C and hold

**Injection:** Split, 200 °C  
Split ratio 1:20

**Detector:** Two separate analyses under  
identical conditions on FID  
and PFPD



- Sulfur compounds (PFPD)
- A. Carbonyl sulfide
  - B. Hydrogen sulfide
  - C. Sulfur dioxide
  - D. Carbon disulfide
  - E. Methyl mercaptan
  - F. Ethyl mercaptan



1. Methane
2. Ethane
3. Ethylene
4. Acetylene
5. Propane
6. Propylene
7. iso-Butane
8. n-Butane
9. 1-Butene/Methyl acetylene
10. trans-2-Butene
11. 1,3-Butadiene
12. cis-2-Butene
13. iso-Pentane
14. n-Pentane

## Suggested Supplies

**Septum:** 11 mm Advanced Green septa, 5183-4759

**Liner:** Direct, 1.5 mm id, 18740-80200

**Seal:** Gold plated seal, 18740-20885

### Sulfur Gas Analysis in Light Hydrocarbon Streams II

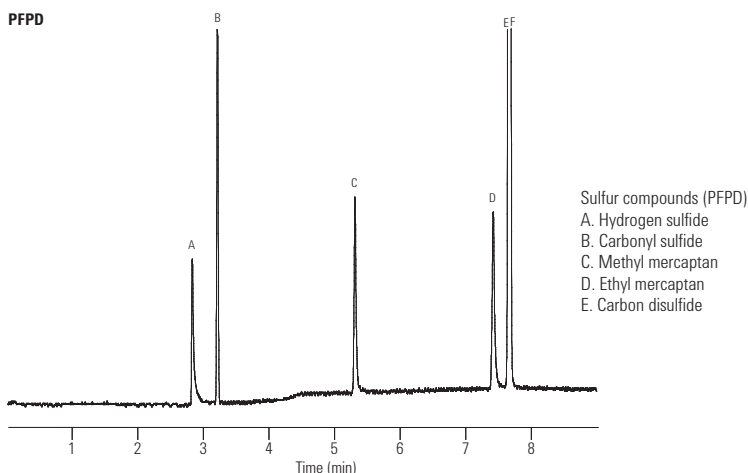
**Column:** GS-Q  
113-3432  
30 m x 0.32 mm, 0.20 µm

**Carrier:** Helium, 10 psig, 1.7 mL/min @ 100 °C

**Oven:** 100 °C for 2 min, 20 °C/min to 250 °C and hold

**Injection:** Split, 200 °C  
Split ratio 1:20

**Detector:** Two separate analyses under identical conditions on FID and PFPD

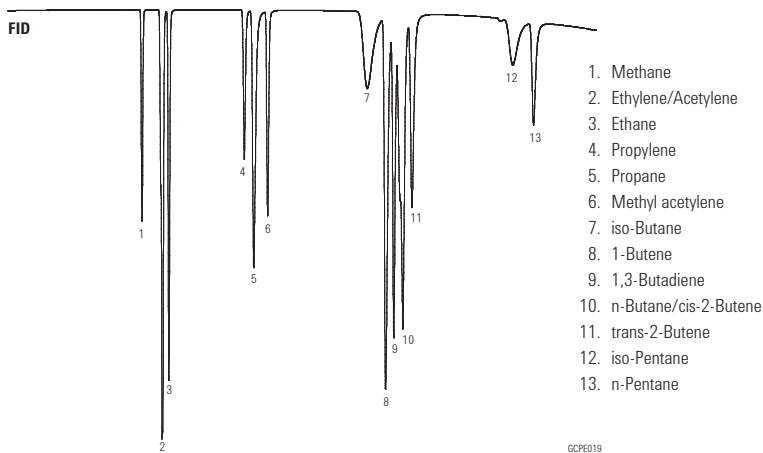


#### Suggested Supplies

**Septum:** 11 mm Advanced Green septa, 5183-4759

**Liner:** Direct, 1.5 mm id, 18740-80200

**Seal:** Gold plated seal, 18740-20885



GCPE019

### Sulfur Compounds in Propylene (1 ppm)

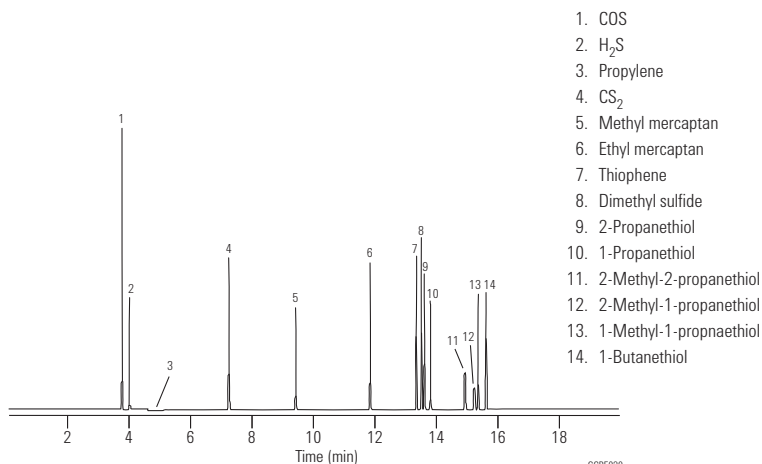
**Column:** GS-GasPro  
113-4332  
30 m x 0.32 mm

**Oven:** 60 °C for 2.5 min  
60-250 °C at 10 °C/min

**Injection:** OI Analytical Volatiles Inlet  
Split ratio 5:1  
200 µL gas sampling valve

**Detector:** OI Analytical Model 5380 PFPD

**Sample:** 1 ppm Sulfur compounds in Propylene



GCPE020

Chromatogram courtesy of OI Analytical.

**Mercaptans**

**Column:** GS-GasPro  
113-4332  
30 m x 0.32 mm

**Carrier:** Helium at 25 cm/sec

**Oven:** 175 °C for 2 min  
175-260 °C at 10 °C/min

**Injection:** Split  
Split flow 80 mL/min

**Detector:** FID

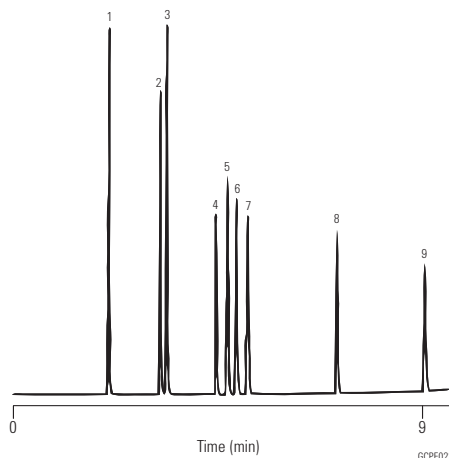
**Sample:** 0.2 mL

**Suggested Supplies**

**Septum:** 11 mm Advanced Green septa, 5183-4759

**Liner:** Direct, 1.5 mm id, 18740-80200

**Seal:** Gold plated seal, 18740-20885



1. Ethyl mercaptan
2. 2-Propyl mercaptan
3. 1-Propyl mercaptan
4. 2-Methyl-2-propyl mercaptan
5. 2-Methyl-1-propyl mercaptan
6. 1-Methyl-1-propyl mercaptan
7. 1-Butyl mercaptan
8. 1-Pentyl mercaptan
9. 1-Hexyl mercaptan

**Sulfur Compounds in Natural Gas – Synthetic Mixture**

**Column:** HP-1  
19091Z-205  
50 m x 0.20 mm, 0.50 µm

**Carrier:** Helium

**Oven:** 35 °C for 10 min  
35-300 °C at 7 °C/min

**Injection:** Split 100:1

**Detector:** FPD

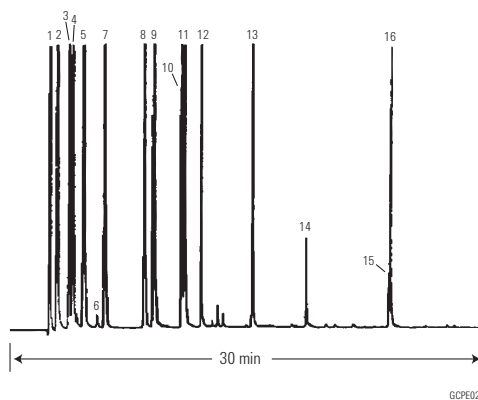
**Sample:** 0.5 mL

**Suggested Supplies**

**Septum:** 11 mm Advanced Green septa, 5183-4759

**Liner:** Direct, 1.5 mm id, 18740-80200

**Seal:** Gold plated seal, 18740-20885



1. Hydrogen sulfide
2. Methyl mercaptan
3. Ethyl mercaptan
4. Dimethyl sulfide
5. Isopropyl mercaptan
6. tert-Butyl mercaptan
7. n-Propyl mercaptan
8. Thiophene and sec-Butyl mercaptan
9. Isobutyl mercaptan
10. n-Butyl mercaptan
11. tert-Amyl mercaptan
12. Isoamyl mercaptan
13. n-Amyl mercaptan
14. n-Hexyl mercaptan
15. tert-Dibutyl disulfide
16. n-Octyl mercaptan

**Sulfur Compounds in Naphtha**

**Column:** HP-PONA  
19091S-001  
50 m x 0.20 mm, 0.50 µm

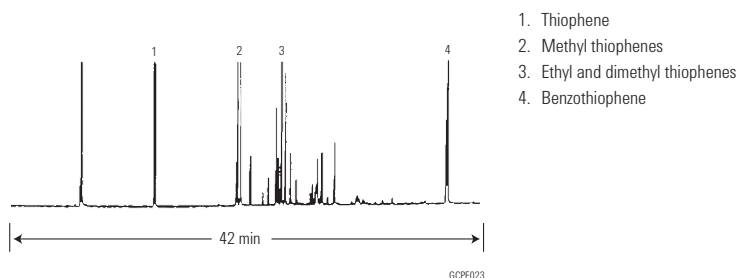
**Carrier:** Helium, 26 cm/sec

**Oven:** 35 °C for 15 min  
35-70 °C at 8 °C/min  
70-130 °C at 15 °C/min

**Injection:** Split ratio 400:1

**Detector:** FPD

**Sample:** 3 µL



1. Thiophene
2. Methyl thiophenes
3. Ethyl and dimethyl thiophenes
4. Benzothiophene

**Aromatics Analysis – ASTM D16 Analytes**

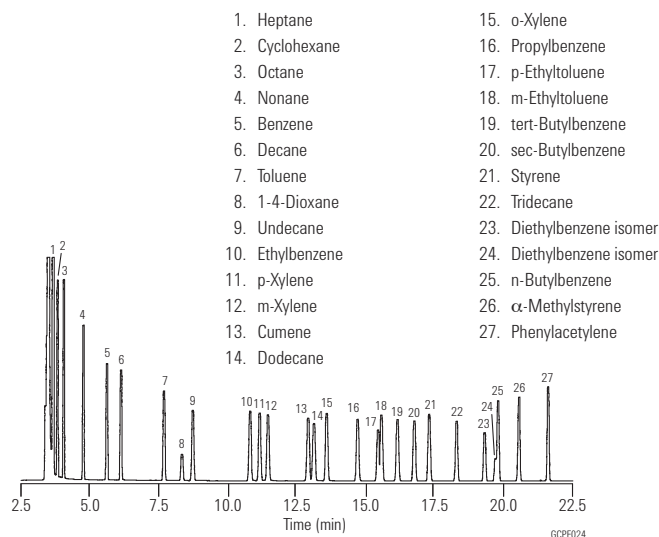
**Column:** HP-INNOWax  
19091N-216  
60 m x 0.32 mm, 0.50 µm

**Carrier:** Helium at 20 psi, constant pressure mode

**Oven:** 75 °C for 10 min  
3 °C/min to 100 °C  
10 °C/min to 145 °C

**Injection:** Split, 250 °C  
Split ratio 100:1 to 400:1

**Detector:** FID, 250 °C  
Data acquisition rate at 20 Hz



- |                  |                           |
|------------------|---------------------------|
| 1. Heptane       | 15. o-Xylene              |
| 2. Cyclohexane   | 16. Propylbenzene         |
| 3. Octane        | 17. p-Ethyltoluene        |
| 4. Nonane        | 18. m-Ethyltoluene        |
| 5. Benzene       | 19. tert-Butylbenzene     |
| 6. Decane        | 20. sec-Butylbenzene      |
| 7. Toluene       | 21. Styrene               |
| 8. 1-4-Dioxane   | 22. Tridecane             |
| 9. Undecane      | 23. Diethylbenzene isomer |
| 10. Ethylbenzene | 24. Diethylbenzene isomer |
| 11. p-Xylene     | 25. n-Butylbenzene        |
| 12. m-Xylene     | 26. α-Methylstyrene       |
| 13. Cumene       | 27. Phenylacetylene       |
| 14. Dodecane     |                           |

**Aromatics Analysis – Ethylbenzene Impurities**

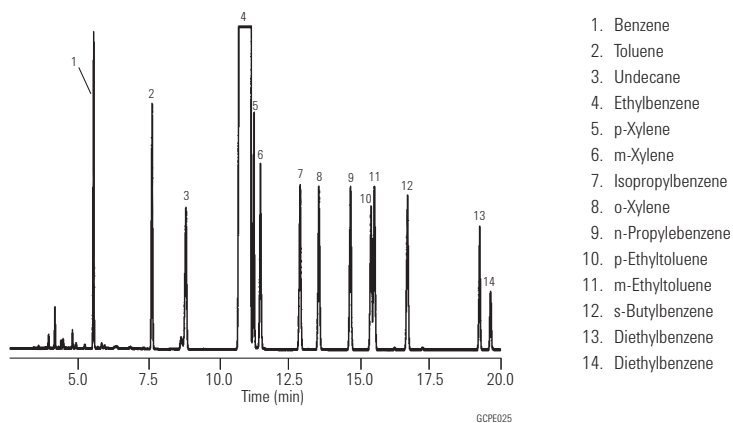
**Column:** HP-INNOWax  
19091N-216  
60 m x 0.32 mm, 0.50 µm

**Carrier:** Helium at 20 psi, constant pressure mode

**Oven:** 75 °C for 10 min  
3 °C/min to 100 °C  
10 °C/min to 145 °C

**Injection:** Split, 250 °C  
Split ratio 100:1 to 400:1

**Detector:** FID, 250 °C  
Data acquisition rate at 20 Hz



1. Benzene
2. Toluene
3. Undecane
4. Ethylbenzene
5. p-Xylene
6. m-Xylene
7. Isopropylbenzene
8. o-Xylene
9. n-Propylbenzene
10. p-Ethyltoluene
11. m-Ethyltoluene
12. s-Butylbenzene
13. Diethylbenzene
14. Diethylbenzene

**Impurities in p-Xylene – ASTM D3798**

**Column:** HP-INNOWax  
19091N-216  
60 m x 0.32 mm, 0.50 µm

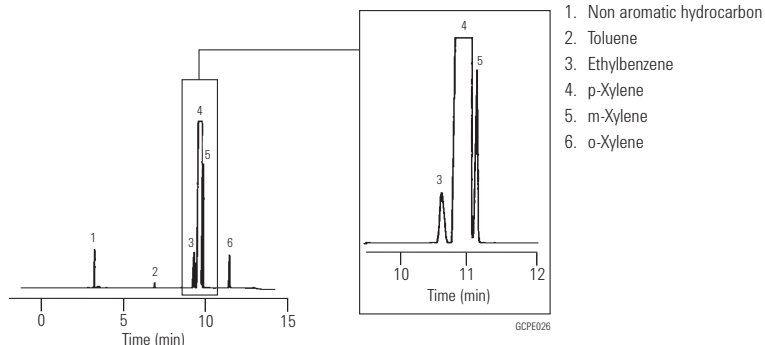
**Carrier:** Helium, 32 cm/sec, 19.9 psi (60 °C),  
2.5 mL/min constant flow

**Oven:** 60 °C for 1 min  
60-92 °C at 4 °C/min  
92 °C for 4.5 min  
92-220 °C at 20 °C/min  
220 °C for 5 min

**Injection:** Split, 220 °C  
Split ratio 100:1

**Detector:** FID, 270 °C

**Sample:** 0.5 µL  
Neat, 99%+

**Ethylene Oxide Synthetic Standard**

**Column:** HP PLOT Q  
19095P-Q04  
30 m x 0.53 mm, 40.00 µm

**Carrier:** Helium, 25 psi

**Oven:** 50 °C for 2 min  
50-250 °C at 15 °C/min

**Injection:** Split ratio 40:1

**Detector:** FID

**Sample:** 1 µL liquid injection  
sample 2000 ppm v/v

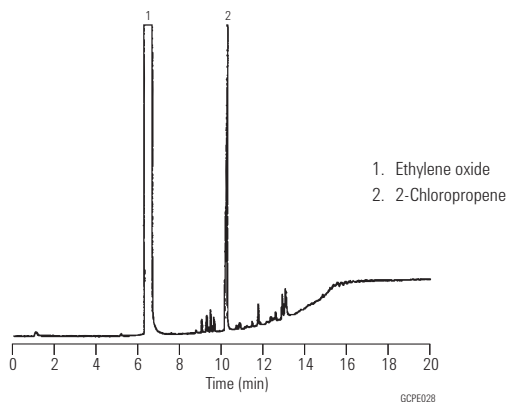
**Suggested Supplies**

**Septum:** 11 mm Advanced Green septa, 5183-4759

**Liner:** General purpose split/splitless liner, taper, glass wool, 5183-4711

**Seal:** Gold plated seal, 18740-20885

**Syringe:** 10 µL tapered, FN 23-26s/42/HP, 5181-1267



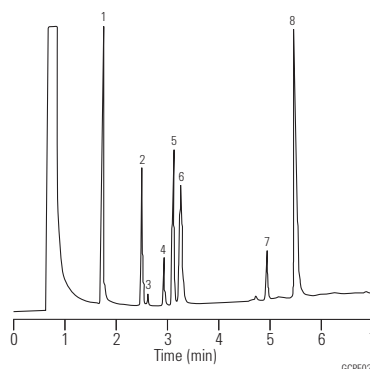
**Oxygenates**

**Column:** HP PLOT Q  
19095P-Q04  
30 m x 0.53 mm, 40.00 µm

**Carrier:** Helium, 25 psig

**Oven:** 150 °C for 2 min  
150-250 °C at 15 °C/min

**Detector:** FID



1. Ethanol
2. 2-Propanone
3. Dichloromethane
4. Acetic acid, methyl ester
5. Diethyl ether
6. Pentane
7. Acetic acid, ethyl ester
8. Hexane

**Oxygenates in Gasoline ASTM D5599 (GC-OFID)**

**Column:** HP-1  
19091Z-236  
60 m x 0.25 mm, 1.00 µm

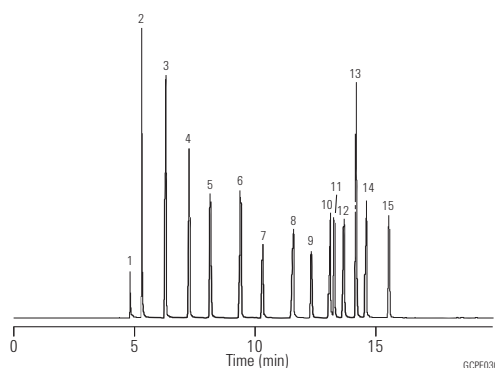
**Carrier:** Helium 30 cm/sec constant flow

**Oven:** 40 °C for 6 min  
40-50 °C at 5 °C/min  
50 °C for 4 min  
50-175 °C at 25 °C/min  
175 °C for 5 min

**Injection:** Split ratio 150:1

**Detector:** Wasson ECE OFID

**Sample:** 0.5 µL



1. Water
2. Methanol
3. Ethanol
4. 2-Propanol
5. t-Butanol
6. 1-Propanol
7. MTBE
8. sec-Butanol
9. DIPE
10. Isobutanol
11. ETBE
12. TAA
13. 1,2-Dimethoxyethane
14. 1-Butanol
15. TAME

**Denatured Fuel Ethanol – ASTM D5501**

**Column:** HP-1  
19091Z-530  
100 m x 0.25 mm, 0.50 µm

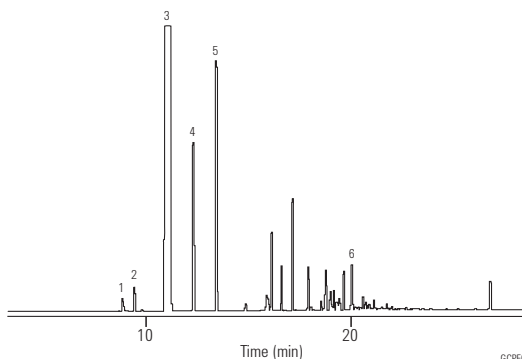
**Carrier:** Helium 24 cm/sec

**Oven:** 15 °C for 12 min  
15-250 °C at 19 °C/min  
250 °C for 20 min

**Injection:** Split ratio 200:1

**Detector:** FID 250 °C  
Nitrogen makeup  
gas at 30 mL/min

**Sample:** 0.5 µL



1. Methanol
2. n-Butane
3. Ethanol
4. Isopentane
5. n-Pentane
6. Other hydrocarbons



**PONA Mix as Specified by AFNOR Method #2**

**Column:** DB-Petro  
128-1056  
50 m x 0.20 mm, 0.50 µm

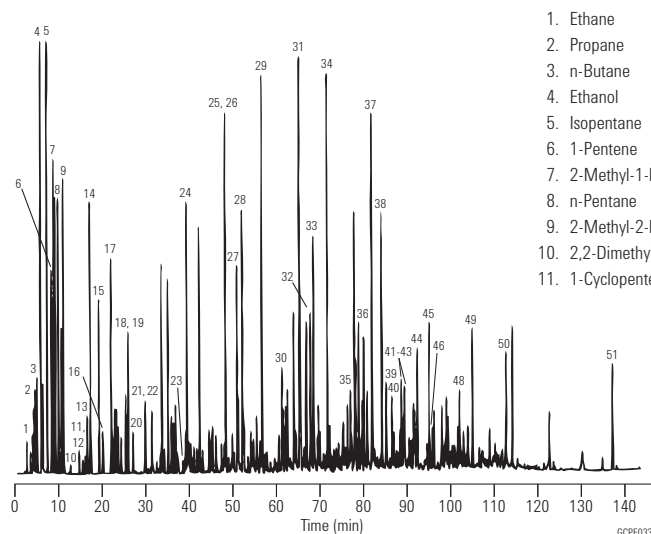
**Carrier:** Helium at 16.7 cm/sec,  
measured at 35 °C

**Injection:** Split, 250 °C  
Split ratio 1:200

**Sample:** 0.3 µL petroleum reformate

**Oven:** 10 °C for 15 min  
10-70 °C at 1.3 °C/min  
70-250 °C at 1.7 °C/min

**Detector:** FID, 250 °C  
Nitrogen makeup gas  
at 30 mL/min



- |                        |                             |                                |
|------------------------|-----------------------------|--------------------------------|
| 1. Ethane              | 12. Cyclopentane            | 31. m-Xylene                   |
| 2. Propane             | 13. 2,3-Dimethylbutane      | 32. p-Xylene                   |
| 3. n-Butane            | 14. 2-Methylpentane         | 33. o-Xylene                   |
| 4. Ethanol             | 15. 3-Methylpentane         | 34. n-Nonane                   |
| 5. Isopentane          | 16. 2-Methyl-1-pentene      | 35. n-Propylbenzene            |
| 6. 1-Pentene           | 17. n-Hexane                | 36. 1,3,5-Trimethylbenzene     |
| 7. 2-Methyl-1-butene   | 18. 2,2-Dimethylpentane     | 37. 1,2,4-Trimethylbenzene     |
| 8. n-Pentane           | 19. Methylcyclopentane      | 38. n-Decane                   |
| 9. 2-Methyl-2-butene   | 20. 2,4-Dimethylpentane     | 39. 1,2,3-Trimethylbenzene     |
| 10. 2,2-Dimethylbutane | 21. Benzene                 | 40. Indan                      |
| 11. 1-Cyclopentene     | 22. 1-Methyl-1-cyclopentene | 41. 1,3-Diethylbenzene         |
|                        | 23. Isooctane               | 42. 1-Methyl-3-propylbenzene   |
|                        | 24. n-Heptane               | 43. 1,3-Diethyl-5-ethylbenzene |
|                        | 25. Toluene                 | 44. 1,2-Diethyl-4-ethylbenzene |
|                        | 26. 2,3,3-Trimethylpentane  | 45. n-Undecane                 |
|                        | 27. 2-Methylheptane         | 46. 1,2,4,5-Tetramethylbenzene |
|                        | 28. 3-Methylheptane         | 47. 1,2,3,5-Tetramethylbenzene |
|                        | 29. n-Octane                | 48. Naphthalene                |
|                        | 30. Ethylbenzene            | 49. n-Dodecane                 |
|                        |                             | 50. 2-Methylnaphthalene        |
|                        |                             | 51. Tetradecane                |

**Aromatics in Finished Gasoline –  
ASTM Method 5769**

**Column:** DB-1  
122-1063  
60 m x 0.25 mm, 1.00 µm

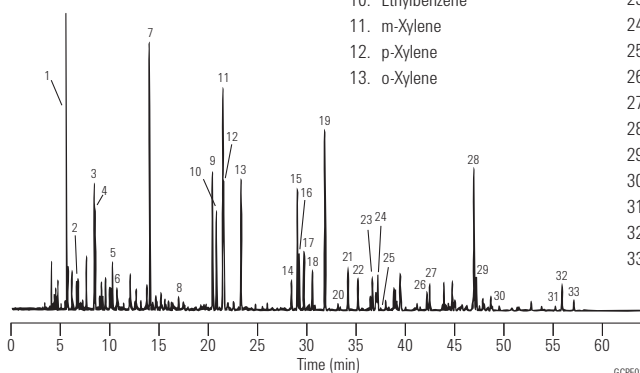
**Carrier:** Helium at 35 cm/sec,  
measured at 50 °C

**Oven:** 50 °C for 1 min  
50-190 °C at 2 °C/min  
190 °C for 1 min

**Injection:** Split, 250 °C  
Split ratio 1:100

**Detector:** MSD

**Sample:** 0.3 µL unleaded gasoline  
Calib std: ASTM/EPA gasoline  
refinery aromatics  
(AccuStandard M-GRA-CAL/IS-SET)



- |                                   |                                |
|-----------------------------------|--------------------------------|
| 1. Methyl-tert-butyl-ether (MTBE) | 14. n-Propylbenzene            |
| 2. n-Hexane                       | 15. 1-Methyl-3-ethylbenzene    |
| 3. Benzene-d6 (IS)                | 16. 1-Methyl-4-ethylbenzene    |
| 4. Benzene                        | 17. 1,3,5-Trimethylbenzene     |
| 5. Isooctane                      | 18. 1-Methyl-2-ethylbenzene    |
| 6. n-Heptane                      | 19. 1,2,4-Trimethylbenzene     |
| 7. Toluene                        | 20. n-Decane                   |
| 8. n-Octane                       | 21. 1,2,3-Trimethylbenzene     |
| 9. Ethylbenzene-d10 (IS)          | 22. Indan                      |
| 10. Ethylbenzene                  | 23. 1,4-Diethylbenzene         |
| 11. m-Xylene                      | 24. n-Butylbenzene (valley)    |
| 12. p-Xylene                      | 25. 1,2-Diethylbenzene         |
| 13. o-Xylene                      | 26. 1,2,4,5-Tetramethylbenzene |
|                                   | 27. 1,2,3,5-Tetramethylbenzene |
|                                   | 28. Naphthalene-d8 (IS)        |
|                                   | 29. Naphthalene                |
|                                   | 30. n-Dodecane                 |
|                                   | 31. Pentamethylbenzene         |
|                                   | 32. 2-Methylnaphthalene        |
|                                   | 33. 1-Methylnaphthalene        |

**Simulated Distillation**

**Column:** DB-2887  
125-2814  
10 m x 0.53 mm, 3.00 µm

**Carrier:** Helium at 7 mL/min

**Oven:** 35-350 °C at 15 °C/min

**Injection:** Direct

**Detector:** FID  
Nitrogen makeup gas  
at 30 mL/min

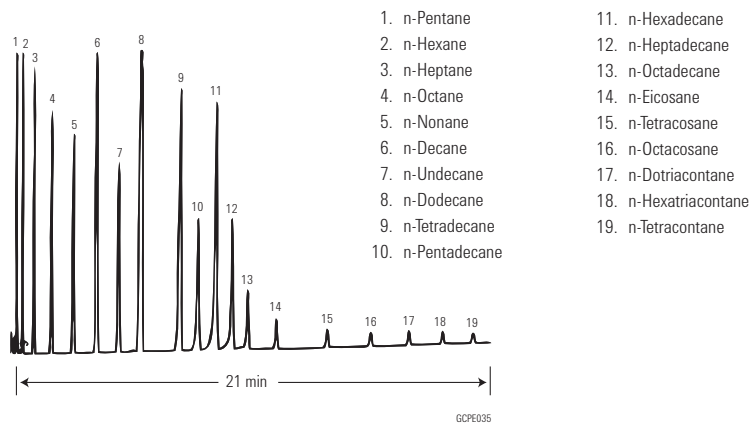
**Suggested Supplies**

**Septum:** 11 mm Certified BTO septa, 5183-4757

**Liner:** Direct connect, dual taper, deactivated, 4 mm id, G1544-80700

**Seal:** Gold plated seal, 18740-20885

**Syringe:** 10 µL tapered, FN 23-26s/42/HP, 5181-1267

**Reference Gas Oil**

**Column:** DB-2887  
125-2814  
10 m x 0.53 mm, 3.00 µm

**Carrier:** Helium at 7 mL/min

**Oven:** 35-350 °C at 15 °C/min

**Injection:** Direct

**Detector:** FID  
Nitrogen makeup gas  
at 30 mL/min

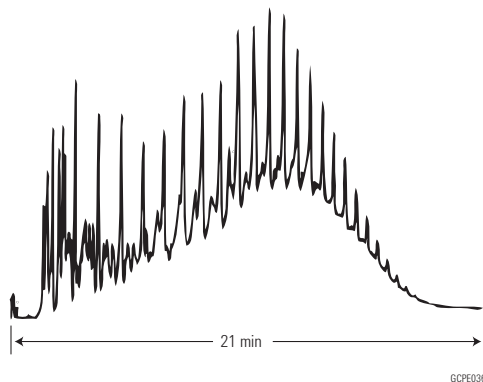
**Suggested Supplies**

**Septum:** 11 mm Advanced Green septa, 5183-4759

**Liner:** Direct connect, dual taper, deactivated, 4 mm id, G1544-80700

**Seal:** Gold plated seal, 18740-20885

**Syringe:** 10 µL tapered, FN 23-26s/42/HP, 5181-1267



### Regular Unleaded Gasoline (California Phase 1) – "Normal" GC Run I

**Column:** DB-Petro  
122-10A6  
100 m x 0.25 mm, 0.50  $\mu$ m

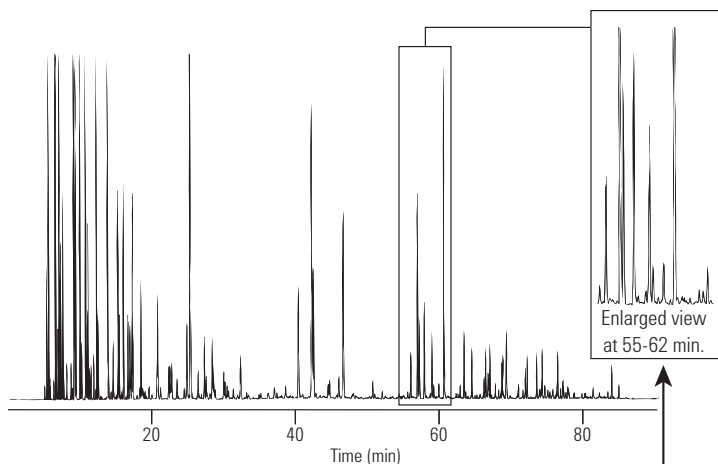
Carrier: Hydrogen at 31 cm/sec

Oven: 35 °C for 9.5 min  
35-45 °C at 13.3 °C/min  
45 °C for 11 min  
45-60 °C at 1.4 °C/min  
60 °C for 11 min  
60-220 °C at 2.7 °C/min  
220 °C for 3.6 min

Injection: Split ratio 1:200

Detector: FID, 300 °C

Sample: 0.2  $\mu$ L



Compare  
Resolution

### Regular Unleaded Gasoline (California Phase 1) – "Normal" GC Run II

**Column:** DB-1  
127-1046  
40 m x 0.10 mm, 0.20  $\mu$ m

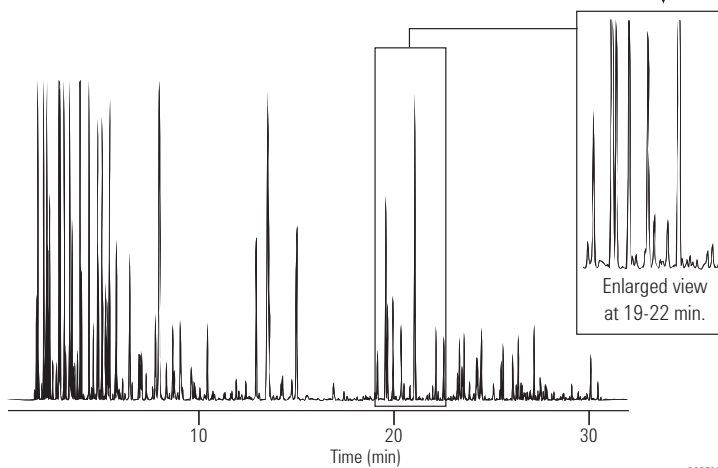
Carrier: Hydrogen at 34.8 cm/sec

Oven: 35 °C for 3.6 min  
35-45 °C at 36.1 °C/min  
45 °C for 4.2 min  
45-60 °C at 3.9 °C/min  
60 °C for 4.2 min  
60-220 °C at 6.9 °C/min  
220 °C for 1.4 min

Injection: Split ratio 1:400

Detector: FID, 300 °C

Sample: 0.2  $\mu$ L



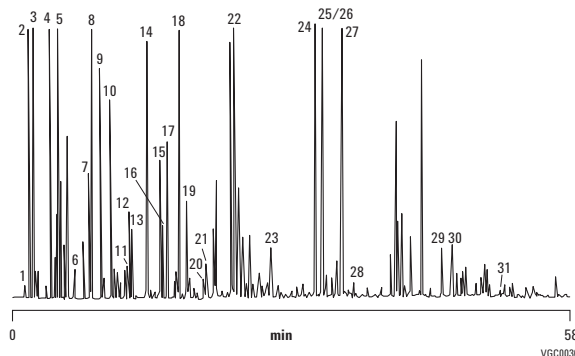
GCPE037

**Gasoline Unleaded ASTM D 5769**

**Column:** CP-Sil PONA CB  
CP7530  
100 m x 0.25 mm, 0.50 µm

Sample: 0.1 µL  
Carrier: Helium, 240 pKa (2.4 bar, 34 psi)  
Oven: 35 °C (7 min) to 250 °C, 3 °C/min  
Injection: Split 80 mL/min  
Detector: FID

1. Propane
2. Isobutane
3. Butane
4. 2-Methylbutane
5. Pentane
6. 2,2-Dimethylbutane
7. 2,3-Dimethylbutane
8. 2-Methylpentane
9. 3-Methylpentane
10. Hexane
11. 2,2-Dimethylpentane
12. Methylcyclopentane
13. 2,4-Dimethylpentane
14. Benzene
15. 2-Methylhexane
16. 2,3-Dimethylpentane
17. 3-Methylhexane
18. Tert. amyl methyl ether (TAME)
19. Unknown
20. 2,2-Dimethylhexane
21. Methylcyclohexane
22. Toluene
23. Octane
24. Ethylbenzene
25. p-Xylene
26. m-Xylene
27. o-Xylene
28. Nonane
29. Decane
30. 1,2,3-Trimethylbenzene
31. Undecane

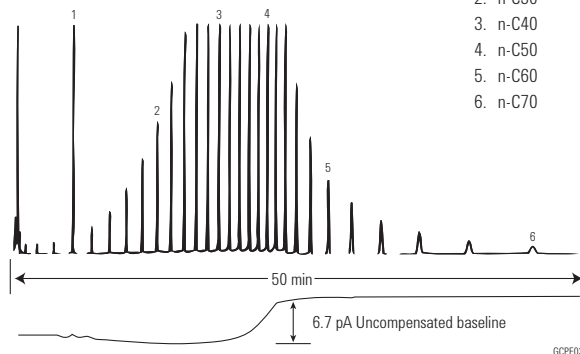


**Polyethylene**

**Column:** DB-1  
125-1011  
15 m x 0.53 mm, 0.15 µm

Carrier: Helium at 8 mL/min  
Oven: 120-360 °C at 10 °C/min  
Injection: Split ratio 1:500  
Detector: FID, 300 °C  
Nitrogen makeup gas at 30 mL/min  
Sample: 0.5 µL  
3% Solution in CS<sub>2</sub>

1. n-C20
2. n-C30
3. n-C40
4. n-C50
5. n-C60
6. n-C70



### Direct Injection of Gasoline and Diesel Fuel in Methylene Chloride

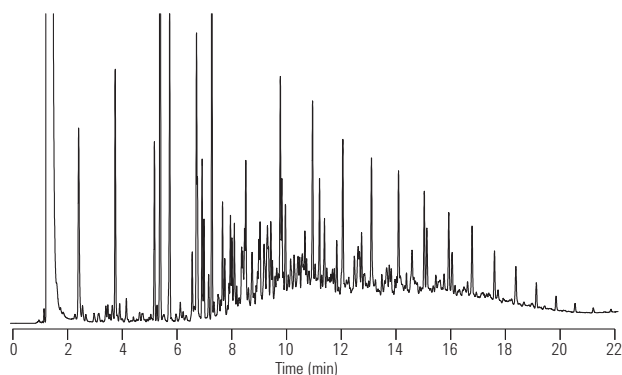
**Column:** DB-TPH  
124-1632  
30 m x 0.45 mm, 1.00  $\mu$ m

Carrier: Helium at 67 cm/sec, measured at 40 °C

Oven: 40 °C for 2 min  
40-280 °C at 12 °C/min

Injection: Megabore Direct, 250 °C

Detector: FID, 250 °C  
Nitrogen makeup gas at 30 mL/min



GCGAS001

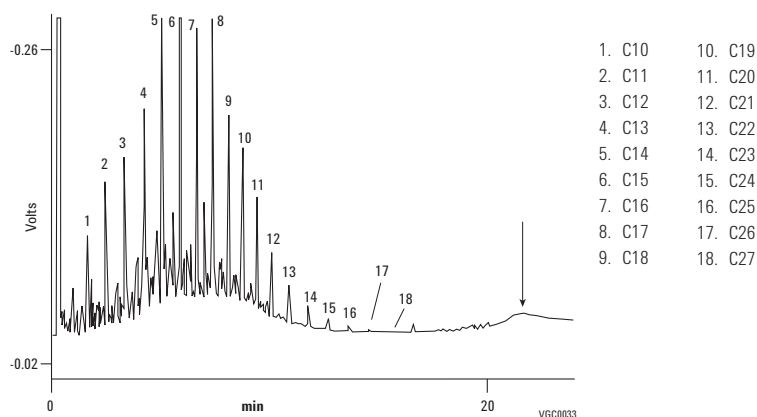
### Diesel Analysis

**Column:** VF-5ht Fused Silica  
CP9047  
15 m x 0.32 mm, 0.10  $\mu$ m

Carrier: H<sub>2</sub>, 60 kPa, 0.6 bar, 8.6 psi

Oven: 50 °C (1 min), 15 °C to 180 °C,  
7 °C to 230 °C, 30 °C to 380 °C

Detector: FID



VGC0033

### Analysis of Oxygenates in a C1 to C5 Hydrocarbon Mix

**Column:** Lowox  
CP8587  
10 m x 0.53 mm, 10.00  $\mu$ m

Sample: 1  $\mu$ L

Sample Conc: 0.01% per compound

Solvent: Cyclohexano

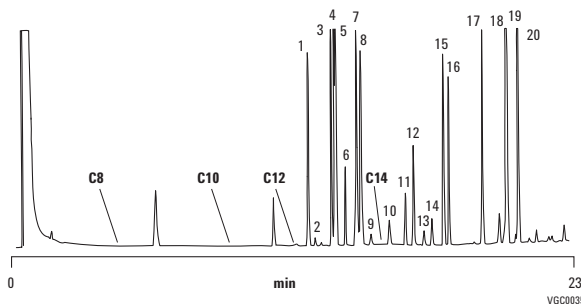
Carrier: He, 28.8 kPa (0.288 bar, 4.1 psi)

Oven: 50 °C (5 min) to 240 °C, 10 °C/min

Injection: Split, T=250 °C

Detector: FID, T=250 °C

- |                               |  |
|-------------------------------|--|
| 1. Acetaldehyde               | 11. Methanol                           |
| 2. Diethyl ether              | 12. Acetone                            |
| 3. Ethyl tert-butyl ether     | 13. Isovaleraldehyde                   |
| 4. Methyl tert-butyl ether    | 14. Valeraldehyde                      |
| 5. Diisopropyl ether          | 15. 2-Butanone                         |
| 6. Propionaldehyde (propanol) | 16. Ethanol                            |
| 7. Tert-amyl methyl ether     | 17. 1-Propanol                         |
| 8. Dipropyl ether             | 18. 2-Methyl-1-propanol (isobutanol)   |
| 9. Isobutyraldehyde           | 19. 2-Methyl-2-propanol (tert-butanol) |
| 10. Butyraldehyde             | 20. 1-Butanol                          |

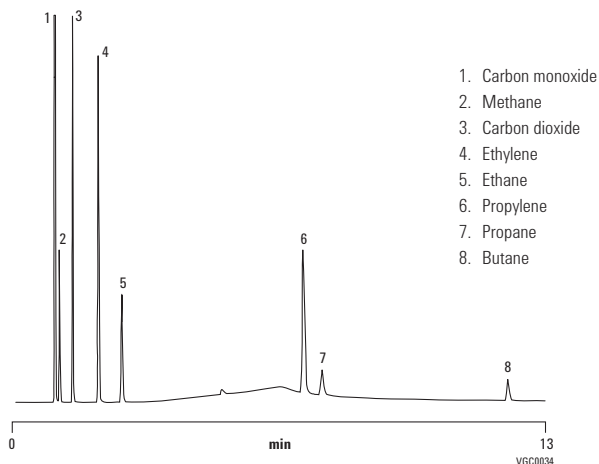


VGC0035

### Analysis of Gases C1 to C4

**Column:** PoraPLOT Q  
CP7554  
25 m x 0.53 mm, 20.00 µm

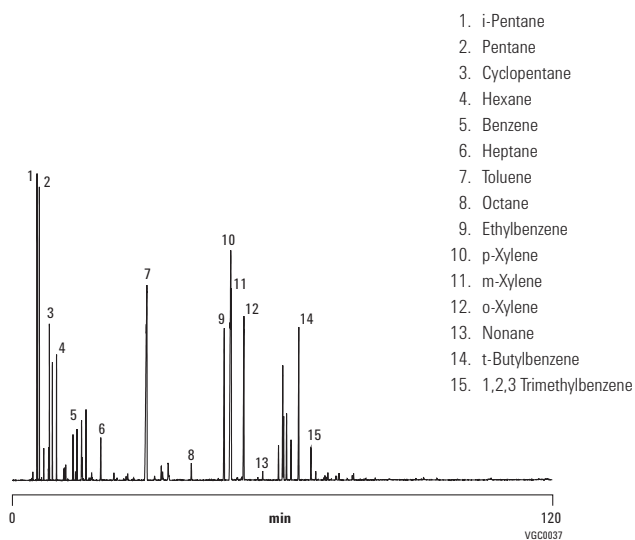
**Sample:** 50 µL  
**Carrier:** He, 65 kPa (0.65 bar, 8 psi)  
**Oven:** 40 °C (3 min) to 150 °C, 10 °C/min  
**Injection:** Split, 1:50, T=225 °C  
**Detector:** TCD, T=250 °C



### Detailed Hydrocarbon Analysis of Petroleum Naphthas Through N-nonane Using ASTM D-5134

**Column:** CP-Sil PONA para ASTM D-5134  
CP7531  
50 m x 0.21 mm, 0.50 µm

**Sample:** 0.2 µL  
**Carrier:** Helium  
**Oven:** 35 °C (30 min) @ 2 °C/min to 200 °C (10 min)  
**Injection:** Split/splitless 1177, full EFC control, 250 °C, split 200 mL/min  
**Detector:** FID, 250 °C



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# Ordering Information

## Easy Ordering Terms and Conditions

### Discounts and Delivery

Agilent Technologies specializes in fast delivery. In the US, if you call before 2 PM EST, we will ship your order that day. You may also request overnight express delivery before 6 PM EST and you will have your order the next day. Volume discounts on a variety of individual products are offered when the entire quantity is shipped to one address at one time.

A shipping and handling fee will be added to your order unless the purchase is over \$2000 US for orders place online or over \$4000 for orders place via phone. Special shipping (i.e., overnight in the US) is available in most regions at an additional cost.

Agilent is required to collect all state and local sales taxes unless the buyer's tax-exempt certificate is on file with Agilent Technologies. Please be prepared to provide a copy if it is not on file, when placing your order.

Please check with your Agilent Customer Service Representative, local Authorized Distributor, or the Agilent website for current prices, special offers, promotions and discounts when placing your order.

### Satisfaction Guaranteed

If you are not satisfied with your Agilent product within the first 60 days, you may return your purchase in its original condition for a full refund or credit. A return policy statement is included in every Agilent shipment and posted under Product Information on the website. In the US and Canada, please call for a Return Authorization form and return instructions at **1-800-227-9770**. If your Agilent product was purchased from a distributor, please contact the distributor.

### Shipping Damages

If items are damaged in transit, please follow the instructions below:

- If a shipment is visibly damaged upon arrival, do not accept it until the person making the delivery has endorsed the bill of lading with statement for the extent of the damage.
- If any damage is found after unpacking, retain all cartons and inner packaging and immediately request an inspection from the carrier.
- Notify the Agilent Customer Contact Center at **1-800-227-9770** about the damaged shipment so that we can make the appropriate sales adjustment and/or provide you with return instructions (Sales order number, product number and quantity damaged will be needed).

## Easy Ways To Order

- Phone: **1-800-227-9770** (option 1, 1) in the US and Canada – Mon-Fri, 8AM to 8PM EST
- Fax: **1-302-633-8901** in the US
- Email: **cag\_sales-na@agilent.com** in the US and Canada
- Online: **www.agilent.com/chem** in the US and Canada

## Payment Options

- In the US, Visa, MasterCard, Discover and American Express are accepted with a minimum order of \$20 (not applicable in all countries).
- Email [ePay@agilent.com](mailto:ePay@agilent.com) to make an electronic payment using the ACH/EFT (Automated Clearing House/Electronic Funds Transfer) method.
- Establish a charge account through your Agilent Customer Service Representative or Your Local Agilent sales office. An account number will be assigned to you for charging your purchases. Payment terms are net 30 days from the invoice date. All orders are subject to credit approval.

We will be happy to supply a price quote via, phone, email or fax if you need it in writing.

## Warranties

All Agilent Technologies products in this catalog are designed and manufactured to stringent standards under the Agilent quality system registered to ISO 9001. At Agilent, we back every product with a 90-day warranty and a money-back guarantee. If Agilent receives notice of defects during the warranty period, Agilent shall, at its option, either repair or replace products which prove to be defective. If Agilent is unable, within a reasonable time, to repair or replace any product to a condition as warranted, the buyer shall be entitled to a refund of the purchase price upon return of the product to Agilent. The warranty period for each product begins on the day of shipment.

This warranty shall not apply to any defect, failure, or damage caused by improper use or improper or inadequate maintenance or care. This warranty is exclusive and no other warranty, whether written or oral, is expressed or implied. Agilent specifically disclaims the implied warranties of merchantability and fitness for particular purposes. The remedies provided herein are the buyer's sole and exclusive remedies. In no event shall Agilent be liable for direct, indirect, special, incidental, or consequential damages (including loss of profits) whether based on contract, tort, or any other legal theory.

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