595 North Harrison Road
Bellefonte, PA 16823-0048 USA
Telephone 800-247-6628 ● 814-359-3441
Fax 800-447-3044 ● 814-359-3044
email: supelco@sial.com
sigma-aldrich.com/supelco

SUPELCO®

Bulletin 858D

# Petroleum/Chemicals Application Guide

***This guide contains up-to-date information about Supelco products and technology for separating hydrocarbons by chromatographic methods.***

**Key Words**

- petroleum
- chemicals
- hydrocarbons
- PIANO
- PONA
- SIMDIS
- ASTM
- Petrocol

## Applications



## Ordering Information



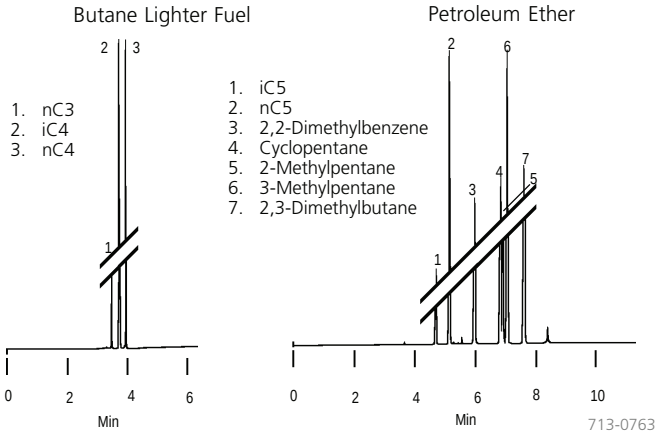
## Detailed Hydrocarbons Analyses

### Nonpolar 50-Meter Capillary Column for High Resolution of Hydrocarbons (ASTM D5134)

Information about the paraffin, isoparaffin, olefin, aromatic, and naphthene (PIANO) content of many products is critical for process control and product quality testing. We developed the 50m x 0.20mm ID Petrocol™ DH 50.2 column specifically for this type of application (Figures 1-5). This high efficiency, bonded, nonpolar (methyl silicone) phase column typically offers 5000 plates/meter.

**Figure 1. Simple Hydrocarbon Mixtures**

Column: **Petrocol DH 50.2, 50m x 0.20mm ID, 0.5µm film**
Cat. No.: **24133-U**
Oven: 35°C (30 min) to 200°C at 2°C/min
Carrier: helium, 20cm/sec (set at 35°C)
Det.: FID, 225°C
Inj.: 225°C

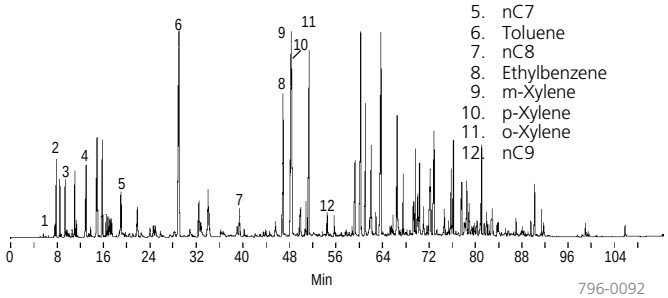



713-0763

**Figure 2. Unleaded Gasoline**

Column: **Petrocol DH 50.2, 50m x 0.20mm ID, 0.5µm film**
Cat. No.: **24133-U**
Oven: 35°C (30 min) to 200°C at 2°C/min
Carrier: helium, 20cm/sec (set at 35°C)
Det.: FID, 225°C
Inj.: 225°C

1. nC5
2. 2-Methylpentane
3. nC6
4. Benzene
5. nC7
6. Toluene
7. nC8
8. Ethylbenzene
9. m-Xylene
10. p-Xylene
11. o-Xylene
12. nC9




796-0092

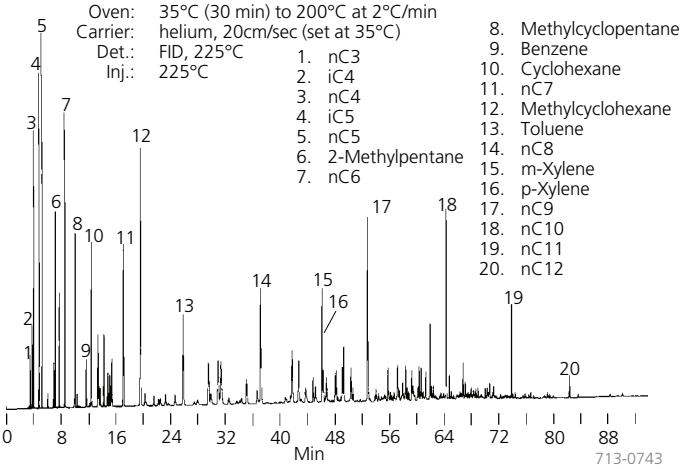


SUPELCO®

## Figure 3. Detailed Analysis of Qualitative Reference & Naphtha

Column: **Petrocol DH 50.2, 50m x 0.20mm ID, 0.5µm film**
Cat. No.: **24133-U**
Oven: 35°C (30 min) to 200°C at 2°C/min
Carrier: helium, 20cm/sec (set at 35°C)
Det.: FID, 225°C
Inj.: 225°C

1. nC3
2. iC4
3. nC4
4. iC5
5. nC5
6. 2-Methylpentane
7. nC6
8. Methylcyclopentane
9. Benzene
10. Cyclohexane
11. nC7
12. Methylcyclohexane
13. Toluene
14. nC8
15. m-Xylene
16. p-Xylene
17. nC9
18. nC10
19. nC11
20. nC12

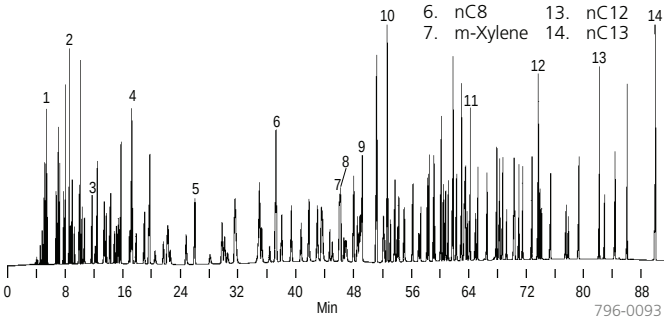



713-0743

## Figure 4. Quantitative PIANO Standard

Column: **Petrocol DH 50.2, 50m x 0.20mm ID, 0.5µm film**
Cat. No.: **24133-U**
Oven: 35°C (30 min) to 200°C at 2°C/min
Carrier: helium, 20cm/sec (set at 35°C)
Det.: FID, 225°C
Inj.: 225°C

1. nC5
2. nC6
3. Benzene
4. nC7
5. Toluene
6. nC8
7. m-Xylene
8. p-Xylene
9. o-Xylene
10. nC9
11. nC10
12. nC11
13. nC12
14. nC13

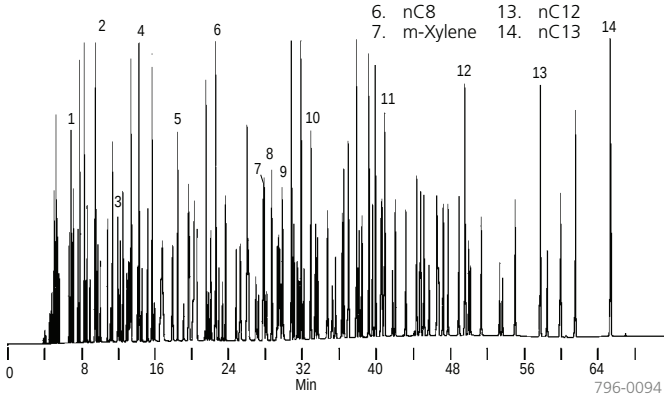



796-0093

## Figure 5. Quantitative PIANO Standard, Using Rapid Temperature Program

Column: **Petrocol DH 50.2, 50m x 0.20mm ID, 0.5µm film**
Cat. No.: **24133-U**
Oven: 35°C (5 min) to 200°C at 2°C/min
Carrier: helium, 20cm/sec (set at 35°C)
Det.: FID, 225°C
Inj.: 225°C

1. nC5
2. nC6
3. Benzene
4. nC7
5. Toluene
6. nC8
7. m-Xylene
8. p-Xylene
9. o-Xylene
10. nC9
11. nC10
12. nC11
13. nC12
14. nC13




796-0094

## Gasoline Range Petroleum Products

Petrocol DH columns (Figures 6-8) can separate more than 300 gasoline components in less than 110 minutes — under ambient initial temperature conditions. They are ideal for PONA, PNA, and PIANO analyses.■

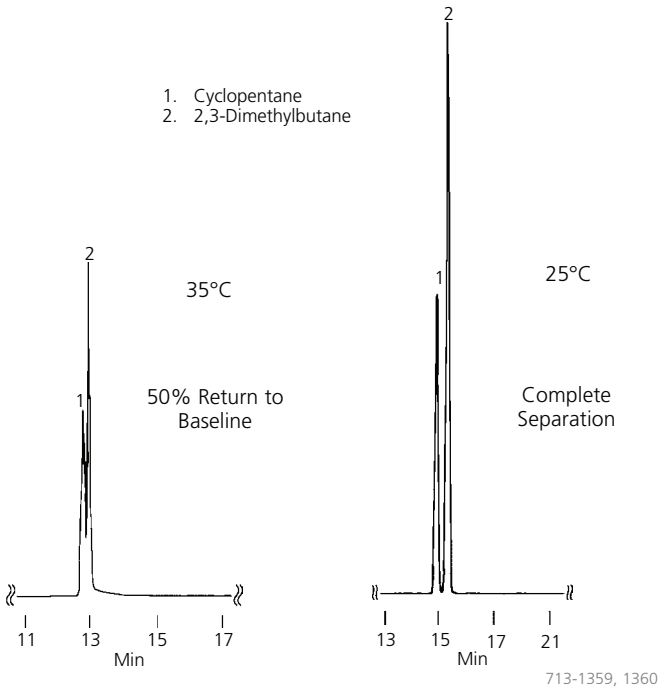
Nonpolar Petrocol DH columns provide greater separation of propane and C4 compounds, m- and p-xylene (Figure 6), and other light petroleum components. Because you can use Petrocol DH columns with modest split ratios (approximately 100:1), you can simultaneously monitor trace and concentrated sample components.

Our library of retention indices for more than 400 compounds is included with the column.

## Figure 6. 2,3-Dimethylbutane from Cyclopentane

Column: **Petrocol DH, 100m x 0.25mm ID, 0.50µm film**
Cat. No.: **24160-U**
Oven: 35°C or 25°C (15 min) to 200°C at 2°C/min, hold 5 min
Carrier: helium, 20cm/sec
Det.: FID
Inj.: synthetic blend (1% cyclopentane, 2% 2,3-dimethylbutane), split (100:1)

1. Cyclopentane
2. 2,3-Dimethylbutane



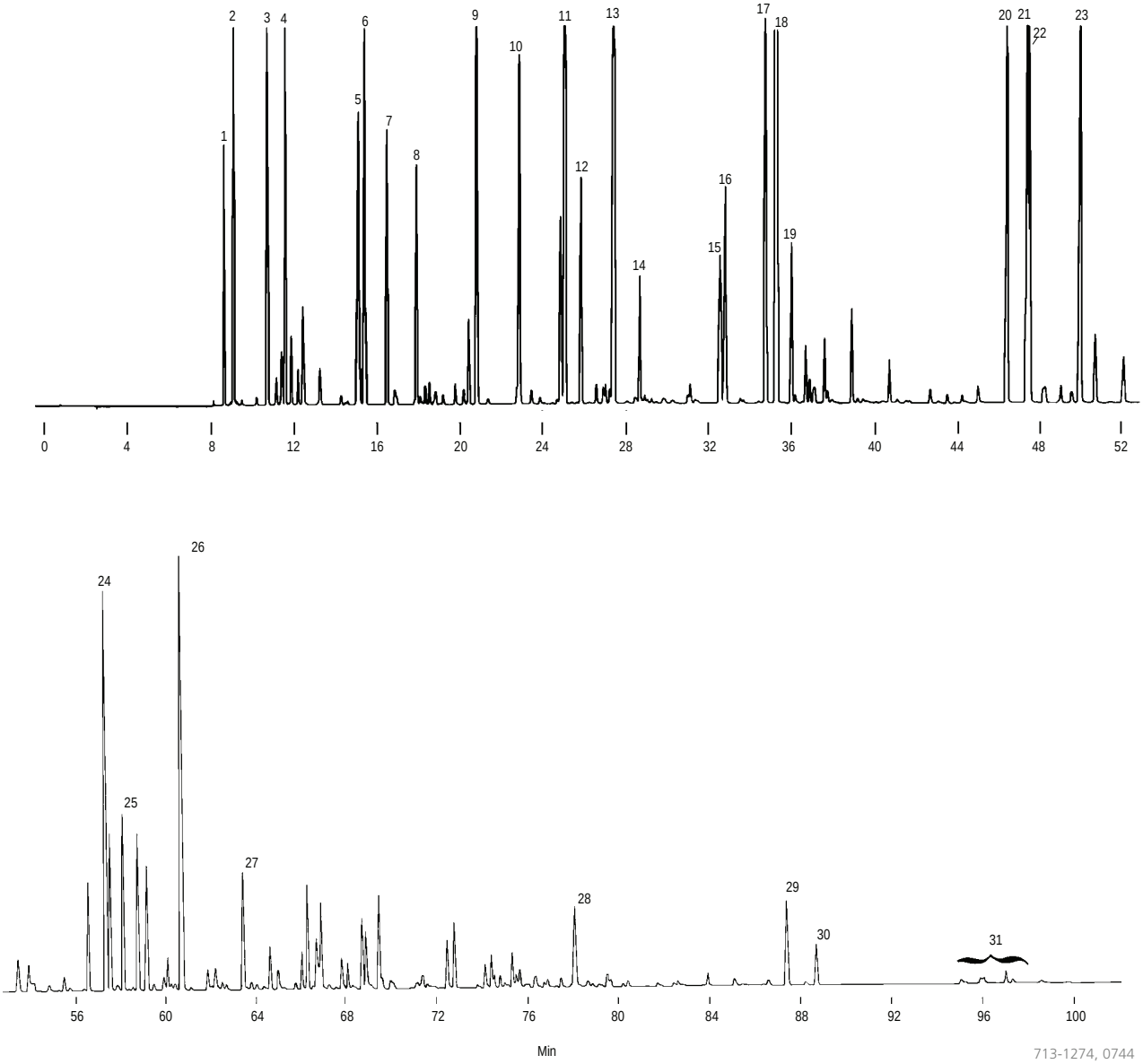

713-1359, 1360

■PONA: paraffins-olefins-naphthenes-aromatics
PNA: paraffins-naphthenes-aromatics
PIANO: paraffins-isoparaffins-aromatics-naphthenes-olefins

## Figure 7. Premium Unleaded Gasoline

Column: **Petrocol DH, 100m x 0.25mm ID, 0.50µm film**
Cat. No.: **24160-U**
Oven: 35°C (15 min) to 200°C at 2°C/min, hold 5 min
Carrier: helium, 20cm/sec
Det.: FID
Inj.: 0.1µL gasoline, split (100:1)

1. Isobutane
2. n-Butane
3. Isopentane
4. n-Pentane
5. 2,3-Dimethylbutane
6. 2-Methylpentane
7. 3-Methylpentane
8. n-Hexane
9. 2,4-Dimethylpentane
10. Benzene
11. 2-Methylhexane
12. 3-Methylhexane
13. 2,2,4-Trimethylpentane
14. n-Heptane
15. 2,5-Dimethylhexane
16. 2,4-Dimethylhexane
17. 2,3,4-Trimethylpentane
18. Toluene
19. 2,3-Dimethylhexane
20. Ethylbenzene
21. m-Xylene
22. p-Xylene
23. o-Xylene
24. 1-Methyl-3-ethylbenzene
25. 1,3,5-Trimethylbenzene
26. 1,2,4-Trimethylbenzene
27. 1,2,3-Trimethylbenzene
28. Naphthalene
29. 2-Methylnaphthalene
30. 1-Methylnaphthalene
31. Dimethylnaphthalenes

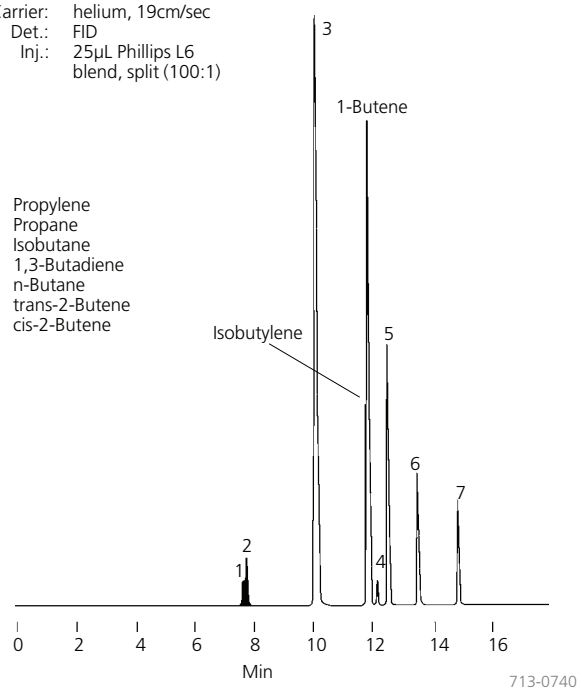



713-1274, 0744

## Figure 8. A Difficult Separation: Isobutylene from Butene-1

Column: **Petrocol DH, 100m x 0.25mm ID, 0.50µm film**
Cat. No.: **24160-U**
Oven: -20°C (10 min) to 200°C at 2°C/min
Carrier: helium, 19cm/sec
Det.: FID
Inj.: 25µL Phillips L6 blend, split (100:1)

1. Propylene
2. Propane
3. Isobutane
4. 1,3-Butadiene
5. n-Butane
6. trans-2-Butene
7. cis-2-Butene

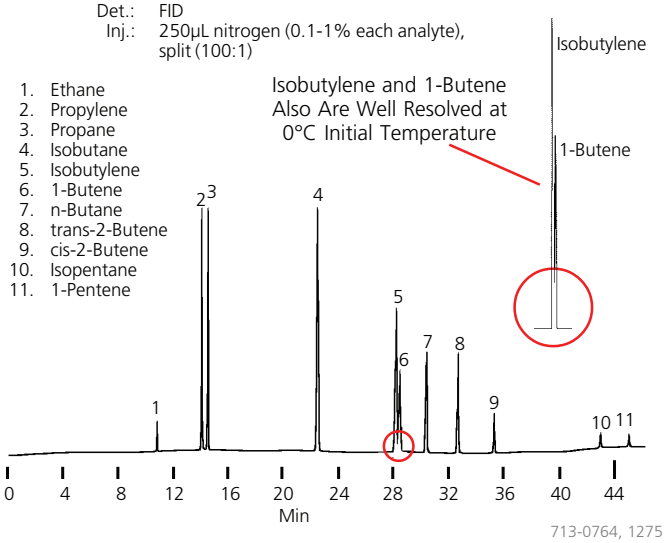



713-0740

## Figure 9. Light Hydrocarbons, Using Moderately Subambient Initial Temperature

Column: **Petrocol DH 150, 150m x 0.25mm ID, 1.0µm film**
Cat. No.: **24155**
Oven: -20°C (30 min) to 75°C at 5°C/min
Carrier: helium, 20cm/sec
Det.: FID
Inj.: 250µL nitrogen (0.1-1% each analyte), split (100:1)

1. Ethane
2. Propylene
3. Propane
4. Isobutane
5. Isobutylene
6. 1-Butene
7. n-Butane
8. trans-2-Butene
9. cis-2-Butene
10. Isopentane
11. 1-Pentene



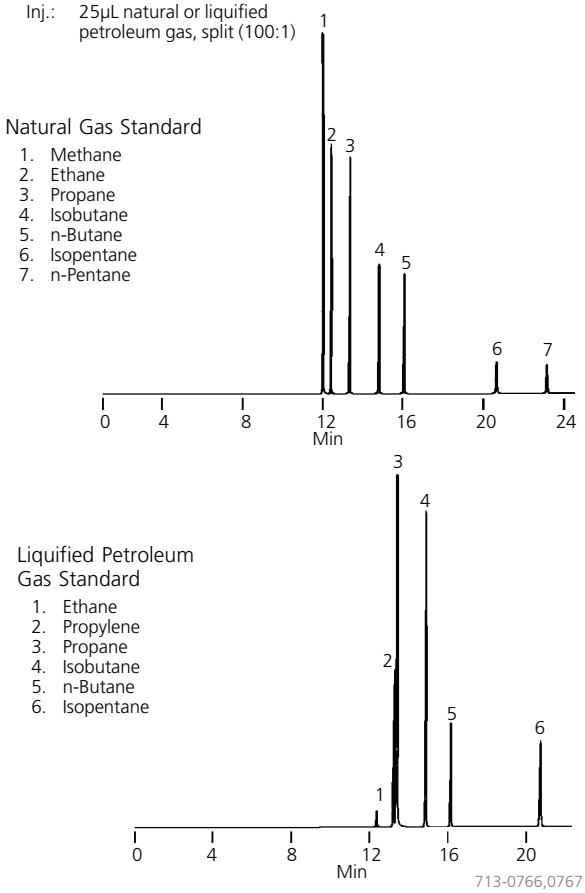

713-0764, 1275

## Figure 10. Gaseous Hydrocarbons from Liquid Hydrocarbons

Column: **Petrocol DH 150, 150m x 0.25mm ID, 1.0µm film**
Cat. No.: **24155**
Oven: 35°C
Carrier: helium, 20cm/sec
Det.: FID
Inj.: 25µL natural or liquified petroleum gas, split (100:1)

Natural Gas Standard
1. Methane
2. Ethane
3. Propane
4. Isobutane
5. n-Butane
6. Isopentane
7. n-Pentane

Liquified Petroleum Gas Standard
1. Ethane
2. Propylene
3. Propane
4. Isobutane
5. n-Butane
6. Isopentane




713-0766,0767

### Ambient Separations of Hydrocarbon Gases

Very high efficiency (typically 550,000 theoretical plates) and a low phase ratio (0.25mm ID, 1.0µm phase film) enable our 150-meter Petrocol DH 150 column to separate light hydrocarbons significantly better than other columns.

Use Petrocol DH columns to analyze hydrocarbon mixtures ranging from the light gases to the higher boiling components of gasoline and other samples of comparable boiling range (Figures 9-11). Perform most of these analyses using ambient or mildly subambient (0°C or -20°C) initial temperatures.

Perform separations that previously required special conditions, unusual columns, or prolonged analysis time.

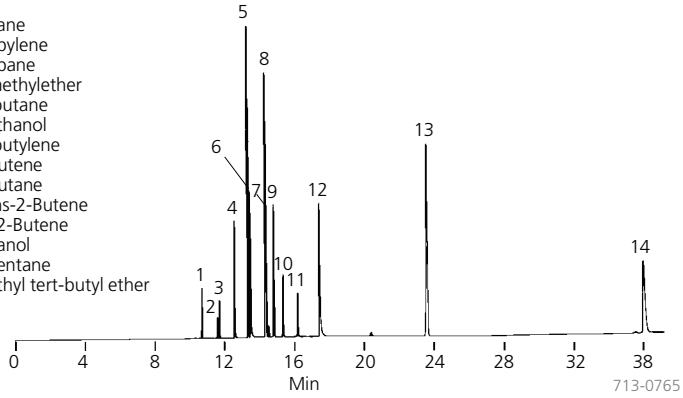
Head pressure of approximately 75psig will provide the optimum linear velocity, 20cm/sec, for helium carrier gas. If your instrument cannot provide this pressure, consider using hydrogen as the carrier gas (40-50psig will provide the optimum 40cm/sec linear velocity), or consult your instrument manufacturer about alternative pressure regulators or the use of EPC.

Using an ambient initial temperature, gasoline analyzed on a Petrocol DH 150 column shows near baseline resolution of the light hydrocarbons cyclopentane and 2,3-dimethylbutane, and the heavier m-xylene and p-xylene isomers (Figure 12). Under these conditions, separations of the light hydrocarbons through toluene are optimized by using the isothermal hold period. The subsequent temperature program provides excellent detail for the heavier compounds. Conditions can be varied (e.g., analysis time shortened) to meet specific needs.

## Figure 11. Oxygenated Compounds in a C4 Gas Stream, Using Ambient, Isothermal Temperature

Column: **Petrocol DH 150, 150m x 0.25mm ID, 1.0µm film**
Cat. No.: **24155**
Oven: 25°C
Carrier: helium, 20cm/sec
Det.: FID
Inj.: 50µL nitrogen (0.1-2% each analyte), split (100:1)

1. Ethane
2. Propylene
3. Propane
4. Dimethylether
5. Isobutane
6. Methanol
7. Isobutylene
8. 1-Butene
9. n-Butane
10. trans-2-Butene
11. cis-2-Butene
12. Ethanol
13. n-Pentane
14. Methyl tert-butyl ether

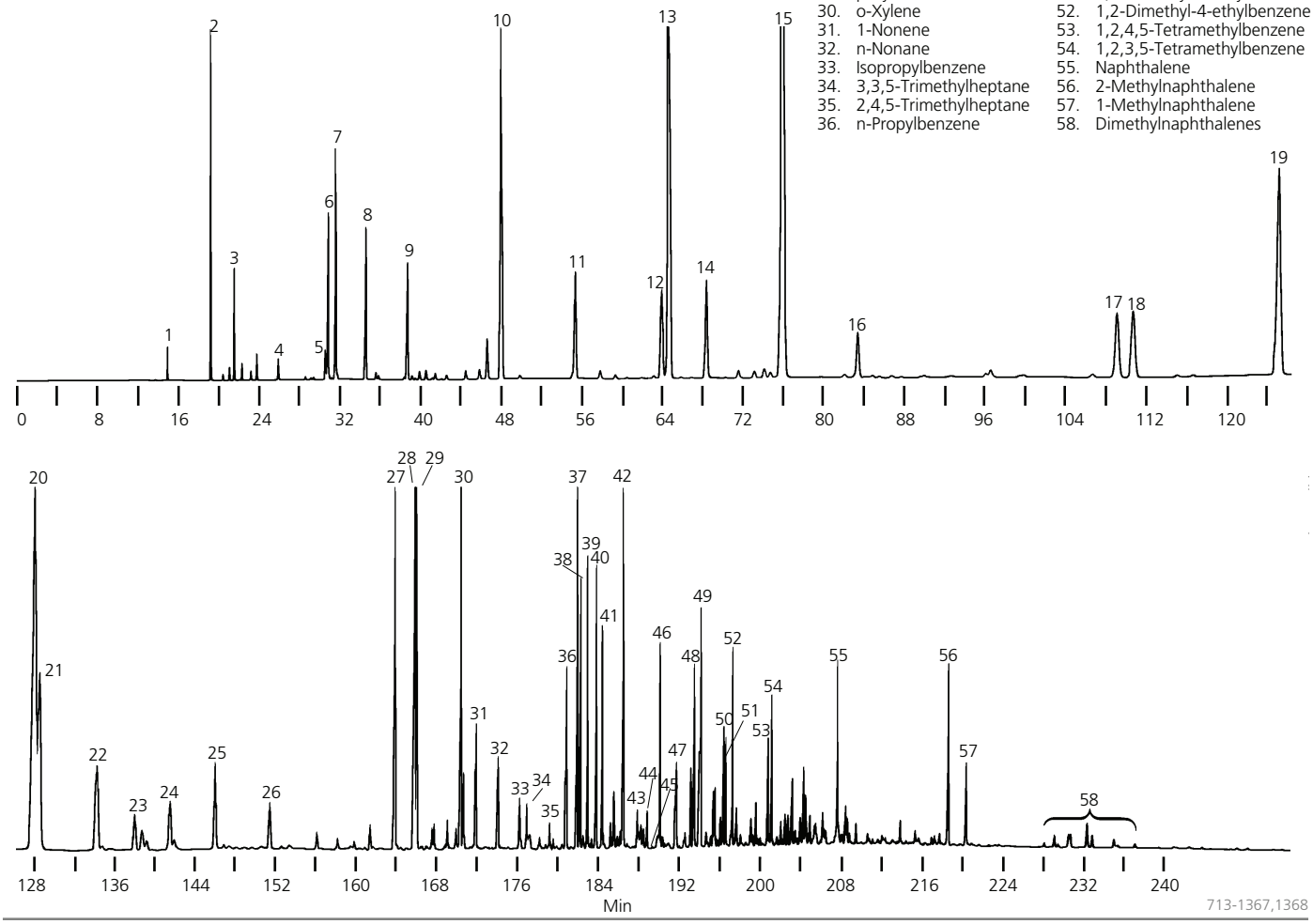



713-0765

## Figure 12. Detailed Analysis of Gasoline, Using Ambient Initial Temperature

Column: **Petrocol DH 150, 150m x 0.25mm ID, 1.0µm film**
Cat. No.: **24155**
Oven: 35°C (125 min) to 200°C at 2°C/min
Carrier: helium, 20cm/sec
Det.: FID
Inj.: 0.1µL unleaded gasoline, split (100:1)

1. n-Butane
2. Isopentane
3. n-Pentane
4. 2,2-Dimethylbutane
5. Cyclopentane
6. 2,3-Dimethylbutane
7. 2-Methylpentane
8. 3-Methylpentane
9. n-Hexane
10. 2,4-Dimethylpentane
11. Benzene
12. 2-Methylhexane
13. 2,3-Dimethylpentane
14. 3-Methylhexane
15. 2,2,4-Trimethylpentane
16. n-Heptane
17. 2,5-Dimethylhexane
18. 2,4-Dimethylhexane
19. 2,3,4-Trimethylpentane
20. Toluene
21. 2,3,3-Trimethylpentane
22. 2,3-Dimethylhexane
23. 2-Methylheptane
24. 3-Methylheptane
25. 2-Methyl-1-heptene
26. n-Octane
27. Ethylbenzene
28. m-Xylene
29. p-Xylene
30. o-Xylene
31. 1-Nonene
32. n-Nonane
33. Isopropylbenzene
34. 3,3,5-Trimethylheptane
35. 2,4,5-Trimethylheptane
36. n-Propylbenzene
37. 1-Methyl-3-ethylbenzene
38. 1-Methyl-4-ethylbenzene
39. 1,3,5-Trimethylbenzene
40. 3,3,4-Trimethylheptane
41. 1-Methyl-2-ethylbenzene
42. 1,2,4-Trimethylbenzene
43. Isobutylbenzene
44. sec-Butylbenzene
45. n-Decane
46. 1,2,3-Trimethylbenzene
47. Indane
48. 1,3-Diethylbenzene
49. n-Butylbenzene
50. 1,4-Dimethyl-2-ethylbenzene
51. 1,3-Dimethyl-4-ethylbenzene
52. 1,2-Dimethyl-4-ethylbenzene
53. 1,2,4,5-Tetramethylbenzene
54. 1,2,3,5-Tetramethylbenzene
55. Naphthalene
56. 2-Methylnaphthalene
57. 1-Methylnaphthalene
58. Dimethylnaphthalenes



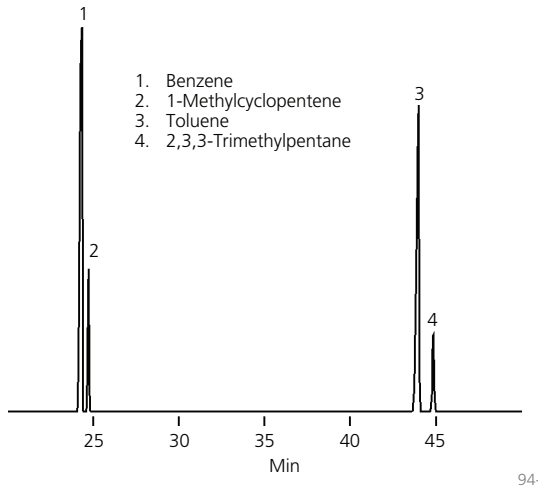

713-1367,1368

## Reproducible Results

The highly reproducible Petrocol DH Octyl capillary column is capable of resolving compounds of different classes to the baseline (Figures13 to 15). Table 1 summarizes some key shifts in elution order. As a general rule, polar compounds shift to shorter retention times relative to normal hydrocarbons.

### Figure 13. Key Hydrocarbon Pairs Completely Resolved

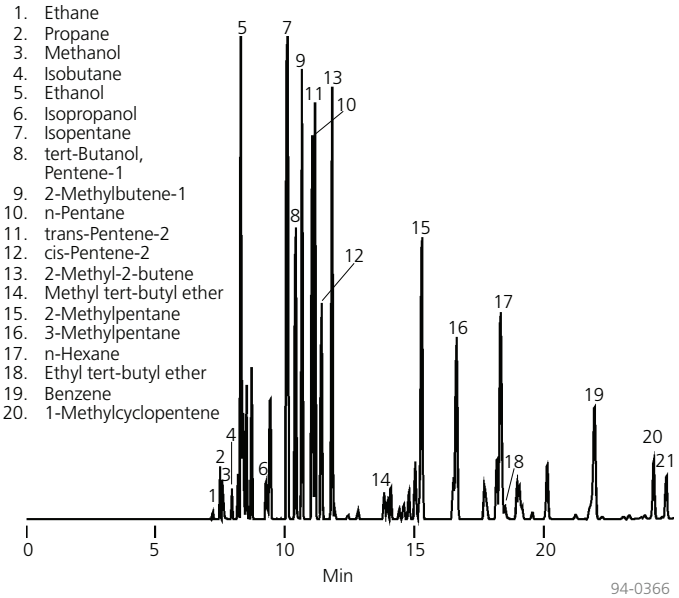
Column: **Petrocol DH Octyl, 100m x 0.25mm ID, 0.5µm film**
Cat. No.: **24282**
Oven: 110°C to 220°C at 8°C/min
Carrier: helium, 24cm/sec
Det.: FID, 250°C
Inj.: 0.1µL, split 215:1, 250°C




94-0364

### Figure 14. PONA V Mix

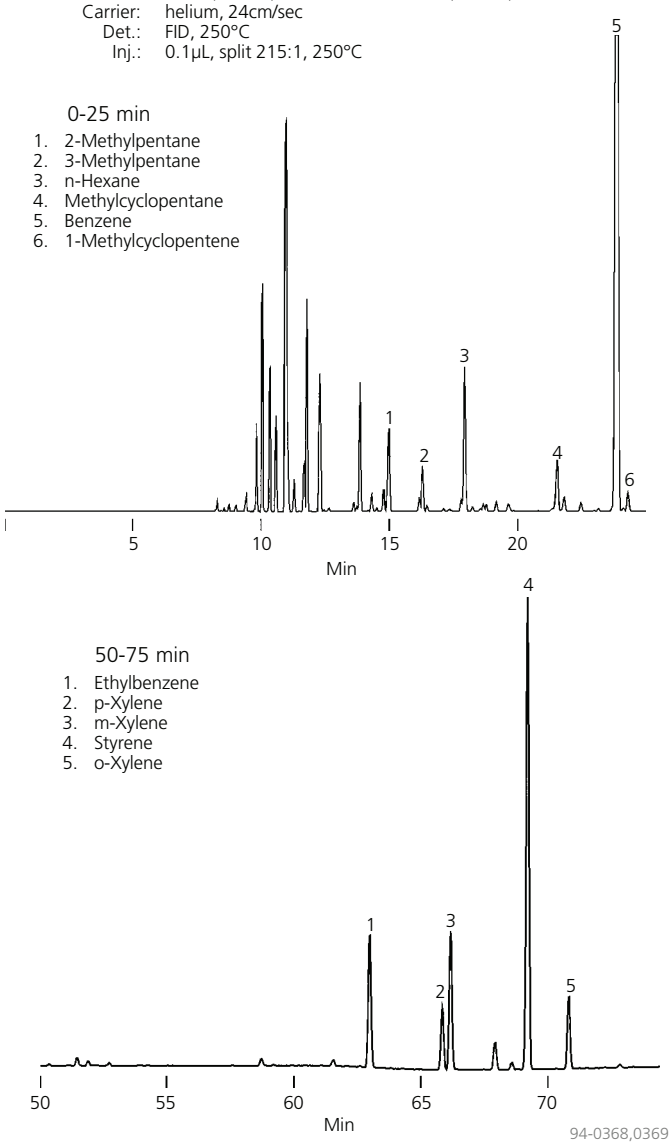
Column: **Petrocol DH Octyl, 100m x 0.25mm ID, 0.5µm film**
Cat. No.: **24282**
Oven: 35°C (15 min) to 200°C at 1°C/min (15 min)
Carrier: helium, 24cm/sec
Det.: FID, 250°C
Inj.: 0.1µL, split 215:1, 250°C




94-0366

### Figure 15. Pyrolysis Gasoline (Py Gas)

Column: **Petrocol DH Octyl, 100m x 0.25mm ID, 0.5µm film**
Cat. No.: **24282**
Oven: 35°C (15 min) to 200°C at 1°C/min (15 min)
Carrier: helium, 24cm/sec
Det.: FID, 250°C
Inj.: 0.1µL, split 215:1, 250°C




94-0368,0369

### Table 1. Comparison of Selected Elutions Between Petrocol DH Octyl and SPB-1 Columns

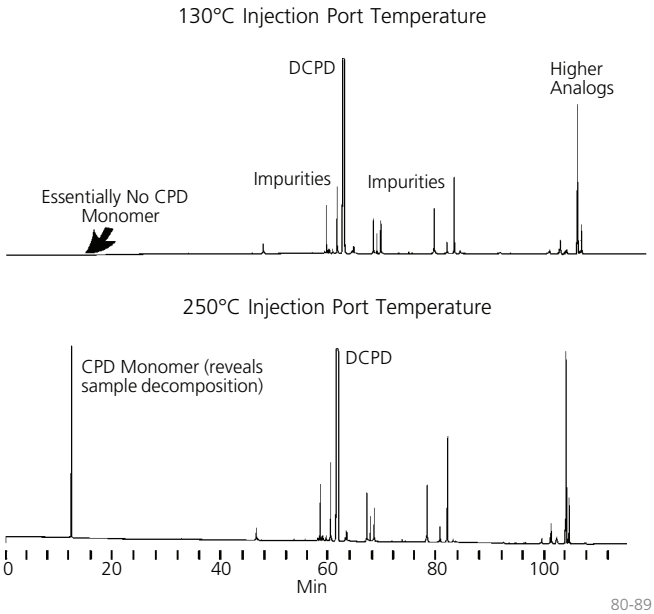
| Class | Compounds | Column | |
|---|---|---|---|
| | | SPB-1 | Petrocol DH Octyl |
| A<br>O | Benzene<br>1-Methylcyclopentene | Coelution | Baseline Resolution |
| A<br>I | Toluene<br>2,3,3-Trimethylpentane | Coelution | Baseline Resolution |
| A<br>A | p-Xylene<br>m-Xylene | Partial Resolution | Baseline Resolution (reversed) |
| P<br>O | n-Paraffin<br>trans-2-Olefin | Baseline Resolution | Coelution |
| OXY | Methanol | Partial Resolution | Baseline Resolution |

## Difficult Petroleum Analyses

Use a Petrocol DH column for analyses ranging from resolving closely eluting isomers or light hydrocarbon gases to detailed separations of highly complex mixtures — such as petroleum naphthas and reformates and liquified coal fractions (Figures 16-20).

### Figure 16. Monitor Dicyclopentadiene for Breakdown Products

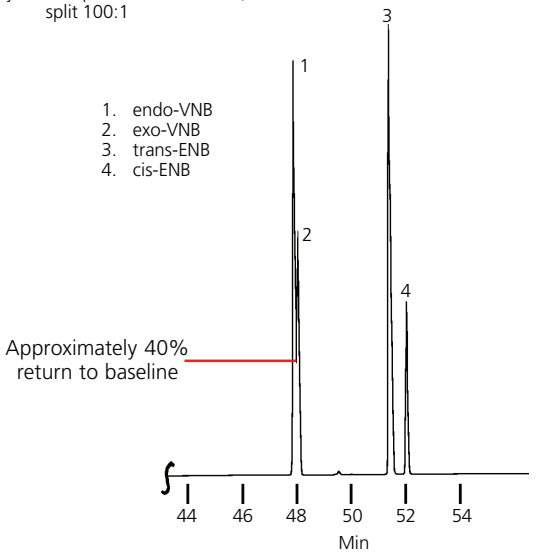
Column: **Petrocol DH, 100m x 0.25mm ID, 0.5µm film**
Cat. No.: **24160-U**
Oven: 35°C (15 min) to 230°C at 2°C/min (15 min)
Carrier: helium, 20cm/sec
Det.: FID
Inj.: 0.1µL DCPD, split 100:1




80-89

### Figure 17. Quantify ENB Isomers and VNB Isomers

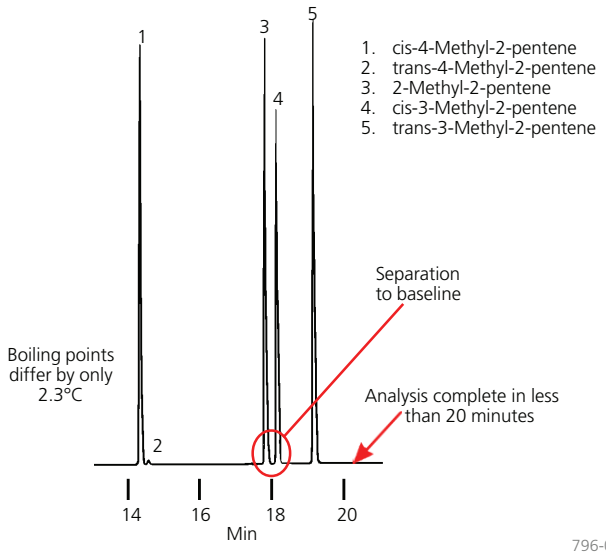
Column: **Petrocol DH, 100m x 0.25mm ID, 0.5µm film**
Cat. No.: **24160-U**
Oven: 35°C (15 min) to 200°C at 2°C/min
Det.: FID
Inj.: 0.05µL ENB/VNB mixture, split 100:1




796-0095

### Figure 18. Closely Eluting Hexene Isomerization Products

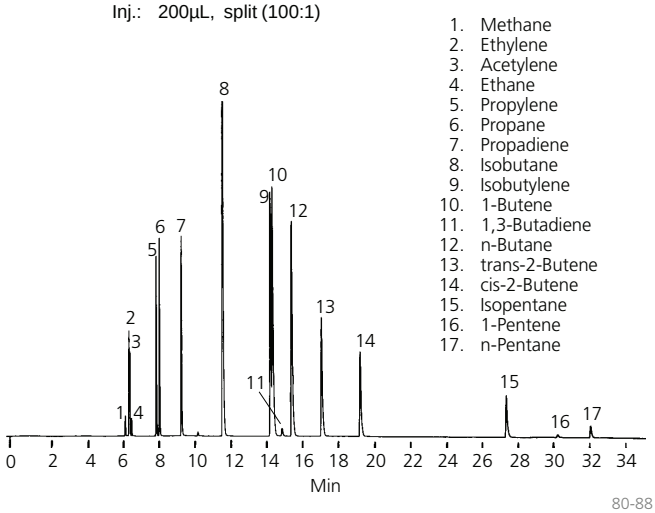
Column: **Petrocol DH, 100m x 0.25mm ID, 0.5µm film**
Cat. No.: **24160-U**
Oven: 35°C (15 min) to 45°C at 2°C/min (30 min)
Det.: FID
Inj.: 3µL mixed hexene isomers, split 100:1




796-0096

### Figure 19. Light Hydrocarbon Gases, Using a Subambient Initial Temperature

Column: **Petrocol DH, 100m x 0.25mm, 0.5µm film**
Cat. No.: **24160-U**
Oven: 15 min, at -25°C, then to 50°C at 2°C/min, hold 5 min
Carrier: helium, 22cm/sec (set at 35°C)
Det.: FID
Inj.: 200µL, split (100:1)

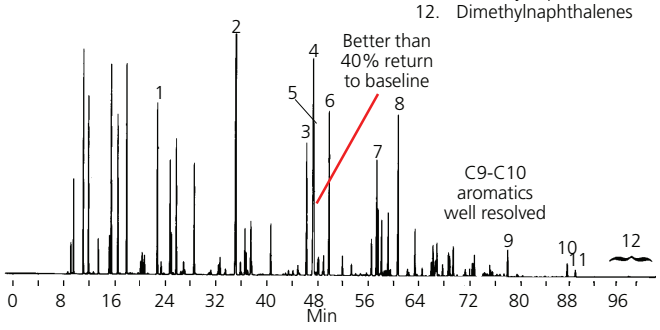



80-88

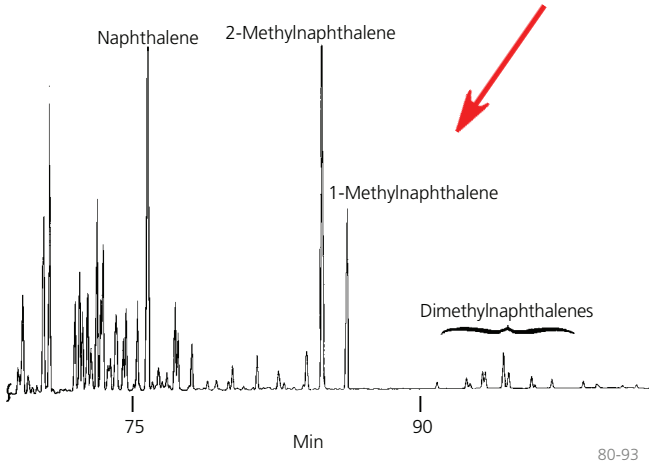
## Figure 20. Petroleum Reformate

Column: **Petrocol DH, 100m x 0.25mm ID, 0.5µm film**
Cat. No.: **24160-U**
Oven: 35°C (15 min) to 200°C at 2°C/min (30 min)
Det.: FID
Inj.: 0.1µL reformate, split 100:1

1. Benzene
2. Toluene
3. Ethylbenzene
4. m-Xylene
5. p-Xylene
6. o-Xylene
7. 1-Methyl-3-ethylbenzene
8. 1,2,4-Trimethylbenzene
9. Naphthalene
10. 2-Methylnaphthalene
11. 1-Methylnaphthalene
12. Dimethylnaphthalenes




Higher Resolution of Polynuclear Aromatic Hydrocarbons




80-93

# Light Hydrocarbons

## Monitor Light Hydrocarbons Without Using Cryogenics

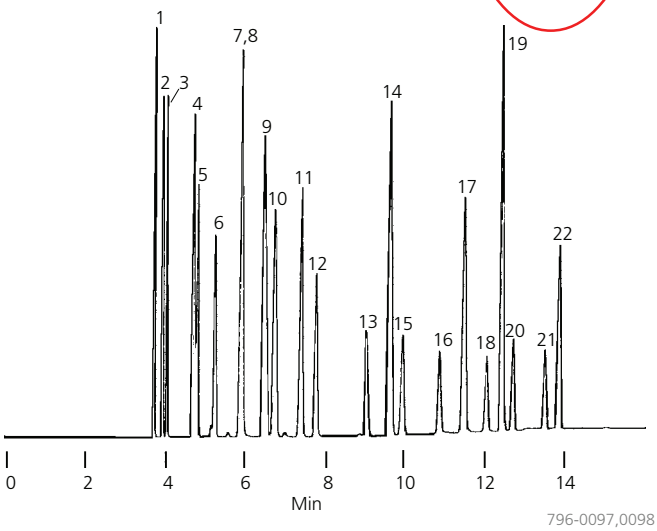
Because they do not require cooling to retain compounds with low (-40°C to 100°C) boiling temperatures, thick film SPB™-1 and SPB-5 capillary columns are more convenient to use than other types of columns.

Typical analyses are shown in Figures 21 and 22. When you need additional resolution, you still have the option of using subambient initial temperatures (Figure 21 inset).

## Figure 21. C1-C6 Hydrocarbons and C1-C4 Alcohols on a Thick Film Capillary Column

Column: **SPB-1, 60m x 0.53mm ID, 5µm film**
Cat. No.: **25349**
Oven: 30°C (5 min) to 200°C at 20°C/min (inset: initial temp. 0°C)
Carrier: helium, 19-21cm/sec
Det.: FID, 220°C
Inj.: 250µL (balance $N_2$), split 100:1, 200°C

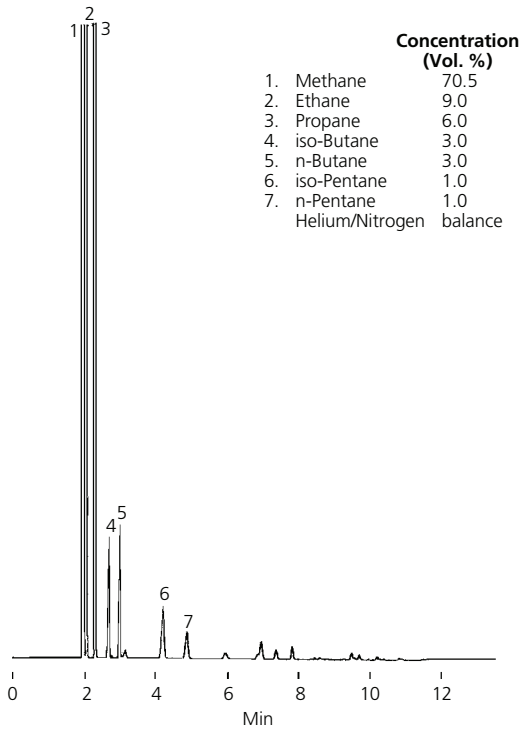
| Component | | Concentration (Vol. %) |
|---|---|---|
| 1. | Methane | 0.3 |
| 2. | Ethylene | 0.2 |
| 3. | Ethane | 0.2 |
| 4. | Propylene | 0.3 |
| 5. | Propane | 0.2 |
| 6. | Propadiene | 0.2 |
| 7. | iso-Butane | 0.2 |
| 8. | Methanol | 0.2 |
| 9. | Butene-1 | 0.3 |
| 10. | n-Butane | 0.2 |
| 11. | cis-2-Butene | 0.3 |
| 12. | Ethanol | 0.2 |
| 13. | iso-Propanol | 0.1 |
| 14. | n-Pentane | 0.4 |
| 15. | tert-Butanol | 0.1 |
| 16. | n-Propanol | 0.1 |
| 17. | Methyl tert-butyl ether | 0.3 |
| 18. | sec-Butanol | 0.1 |
| 19. | n-Hexane | 0.4 |
| 20. | iso-Butanol | 0.1 |
| 21. | n-Butanol | 0.1 |
| 22. | Benzene | 0.2 |
| | Nitrogen | balance |




796-0097,0098

## Figure 22. Natural Gas on a Thick Film Column

Column: **SPB-5, 30m x 0.53mm ID, 3µm film**
Cat. No.: **25343**
Oven: 30°C (5 min) to 200°C at 20°C/min
Carrier: helium, 19-21cm/sec
Det.: FID, 220°C
Inj.: 250µL (balance $N_2$), split 100:1, 200°C




| | | Concentration (Vol. %) |
|---|---|---|
| 1. | Methane | 70.5 |
| 2. | Ethane | 9.0 |
| 3. | Propane | 6.0 |
| 4. | iso-Butane | 3.0 |
| 5. | n-Butane | 3.0 |
| 6. | iso-Pentane | 1.0 |
| 7. | n-Pentane | 1.0 |
| | Helium/Nitrogen | balance |

796-0099

# High Boiling Hydrocarbons

## Better Quantification of High Boiling Compounds

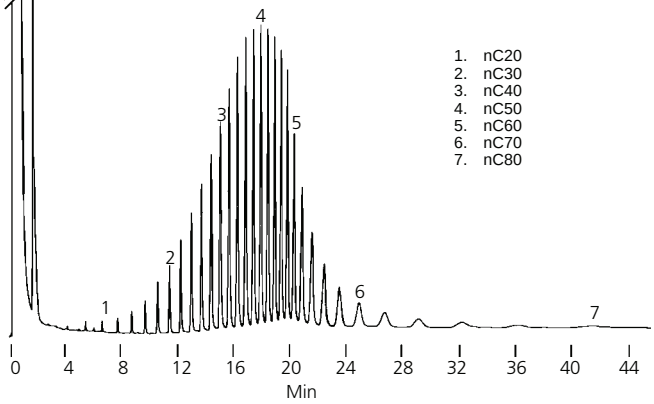
For analyses of paraffin mixtures, SPB-1 Thin Film bonded phase capillary columns (Figures 23-25) offer better sample resolution and more reliable quantification than packed columns.

When you use an SPB-1 Thin Film column with our cool on-column injection sleeve (designed for 1/4" packed column or capillary injection ports), you can virtually eliminate discrimination among sample components. Use a syringe with a 6" (15.24cm) needle to make injections.

## Figure 23. Polywax® 655

Column: **SPB-1 Thin Film, 15m x 0.53mm ID, 0.1µm film**
Cat. No.: **25360**
Oven: 50°C to 350°C at 15°C/min
Carrier: helium, 20mL/min (flow controlled)
Det.: FID, 370°C
Inj.: 1µL, cool on-column injection

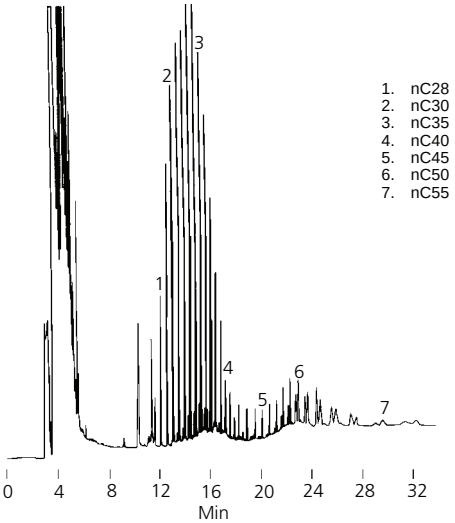
713-0752




1. nC20
2. nC30
3. nC40
4. nC50
5. nC60
6. nC70
7. nC80

## Figure 24. Shoe Polish

Column: **SPB-1 Thin Film, 15m x 0.53mm ID, 0.1µm film**
Cat. No.: **25360**
Oven: 50°C to 350°C at 15°C/min
Carrier: helium, 5mL/min (flow controlled)
Det.: FID, 370°C
Inj.: 1µL, cool on-column injection

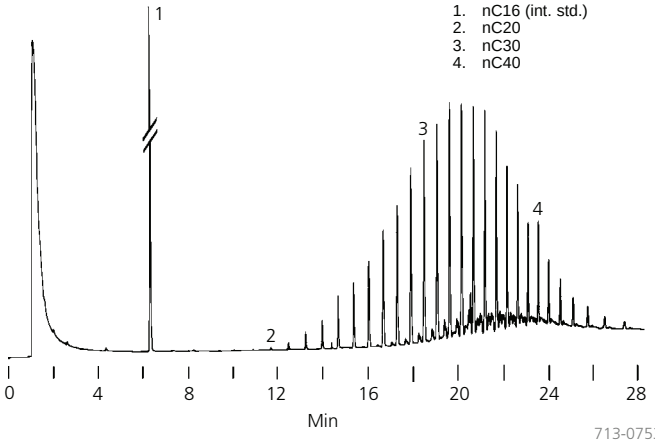



1. nC28
2. nC30
3. nC35
4. nC40
5. nC45
6. nC50
7. nC55

713-0751

## Figure 25. Paraffin Wax

Column: **SPB-1 Thin Film, 30m x 0.53mm ID, 0.1µm film**
Cat. No.: **25361**
Oven: 40°C to 350°C at 5°C/min
Carrier: helium, 5mL/min (flow controlled)
Det.: FID, 370°C
Inj.: 1µL, cool on-column injection




713-0753

## Oxygenates

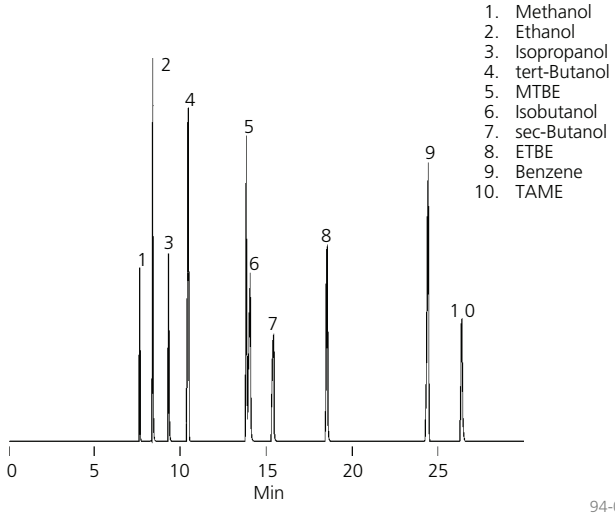
### Separate Oxygenated Compounds in Complex Hydrocarbon Matrices

Because of the high toxicity of organic bound lead, the US EPA has mandated the reduction and eventual elimination of lead compounds in gasoline. The compounds substituted for lead are usually oxygen-containing substances such as alcohols and ethers.

Separation of these oxygenates from the matrix can be a problem. Our Petrocol DH Octyl and Petrocol DH 150 capillary columns (Figures 26 to 28) are excellent for this type of analysis.

## Figure 26. Oxygenates Mix (Petrocol DH Octyl Column)

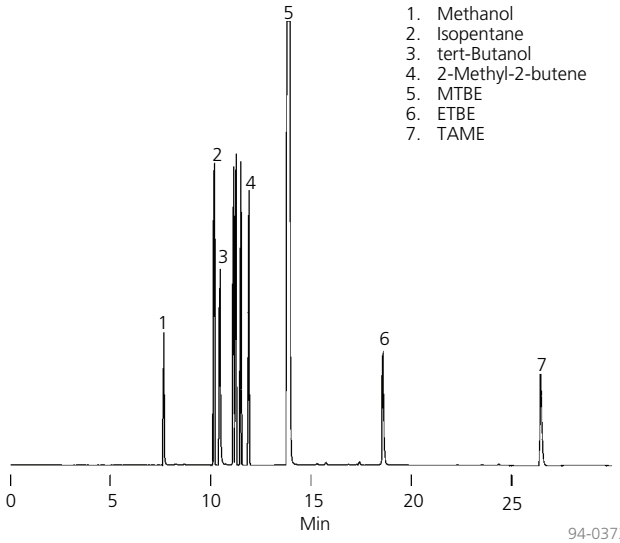
Column: **Petrocol DH Octyl, 100m x 0.25mm ID, 0.5µm film**
Cat. No.: **24282**
Oven: 35°C (15 min) to 200°C at 1°C/min (15 min)
Carrier: helium, 24cm/sec
Det.: FID, 250°C
Inj.: 0.1µL, split 215:1, 250°C




94-0372

## Figure 27. MTBE Contaminants (Petrocol DH Octyl Column)

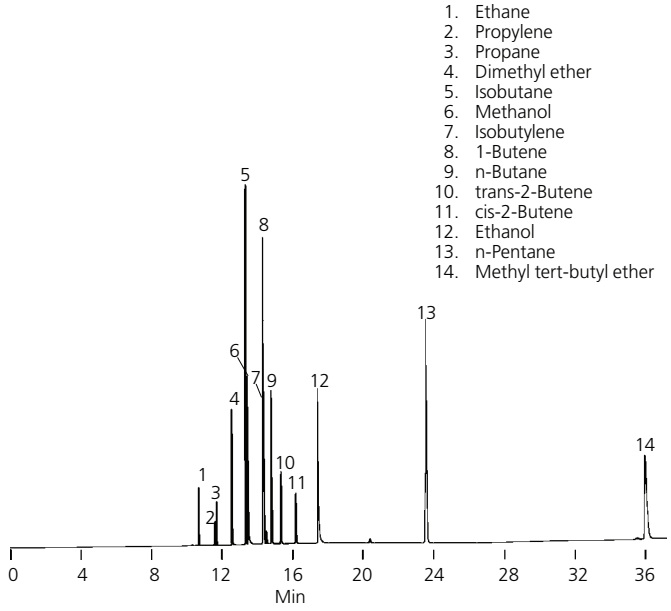
Column: **Petrocol DH Octyl, 100m x 0.25mm ID, 0.5µm film**
Cat. No.: **24282**
Oven: 35°C (15 min)
Carrier: helium, 24cm/sec (set at 35°C)
Det.: FID, 250°C
Inj.: 0.1µL, split 215:1, 250°C




94-0373

## Figure 28. Oxygenates (Petrocol DH 150 Column)

Column: **Petrocol DH 150, 150m x 0.25mm ID, 1.0µm film**
Cat. No.: **24155**
Oven: 25°C
Carrier: helium, 20cm/sec (set at 35°C)
Det.: FID, 200°C
Inj.: approx. 0.1-2% each component in 50µL nitrogen, split 100:1, 200°C




713-0765

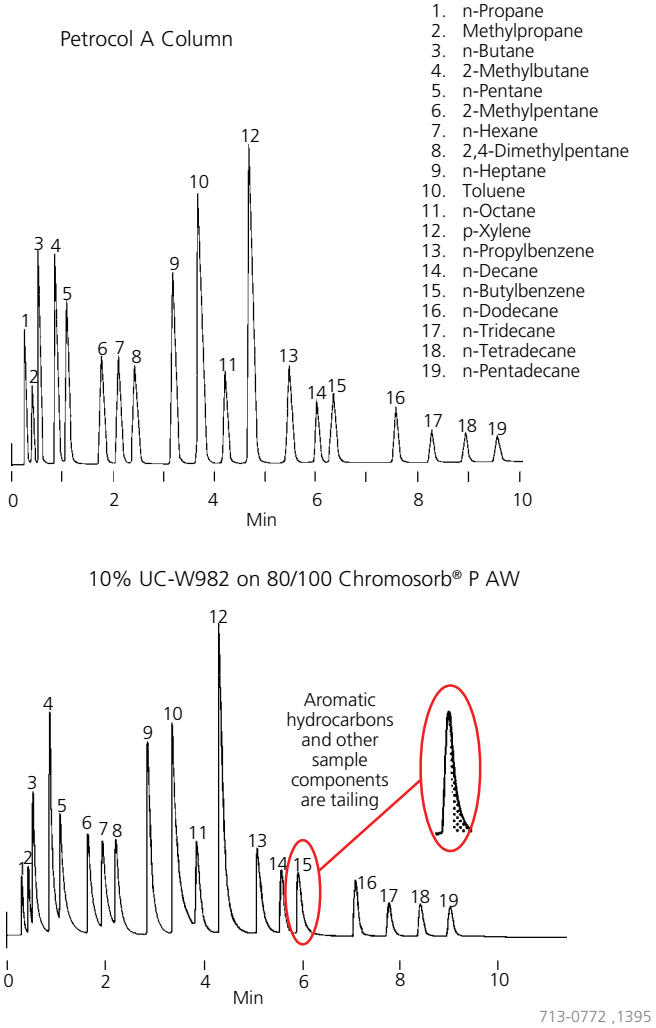
## Simulated Distillation

### Packed Columns for More Reliable SIMDIS Analyses

Petrocol A and Petrocol B packed columns were developed specifically for Methods D3710 and D2887, respectively, of the American Society for Testing and Materials (ASTM). These 20" x 1/8" stainless steel columns minimize peak tailing, column bleed, and the deviation of apparent boiling point from true boiling point (Figures 29-33).

### Figure 29. Petrocol A Column Minimizes Hydrocarbon Peak Tailing

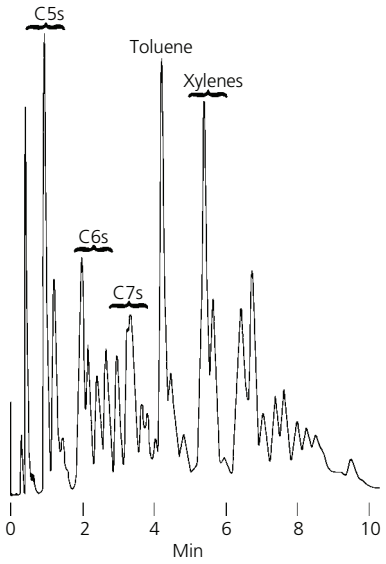
Column: **Petrocol A, 20" x 1/8" SS**
Cat. No.: **12445**
Col. Temp.: -20°C to 200°C at 20°C/min
Carrier: helium, 25mL/min
Det.: FID
Inj.: 0.1µL of D3710 Qualitative Mix (Cat. No. 48884)




713-0772 ,1395

### Figure 30. Gasoline by ASSTM D3710

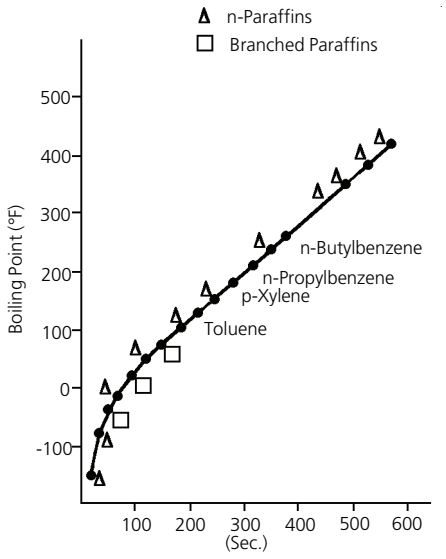
Column: **Petrocol A, 20" x 1/8" SS**
Cat. No.: **12445**
Col. Temp.: -20°C to 250°C at 15°C/min
Carrier: helium, 25mL/min
Det.: FID
Inj.: 0.1µL of gasoline




713-0771

### Figure 31. Hydrocarbon Boiling Point and Retention on a Petrocol A Column Are Closely Correlated

Column: **Petrocol A, 20" x 1/8" SS**
Cat. No.: **12445**
Col. Temp.: -20°C to 200°C at 20°C/min
Carrier: helium, 25mL/min
Det.: FID
Inj.: 0.1µL of D3710 Qualitative Mix (Cat. No. 48884)

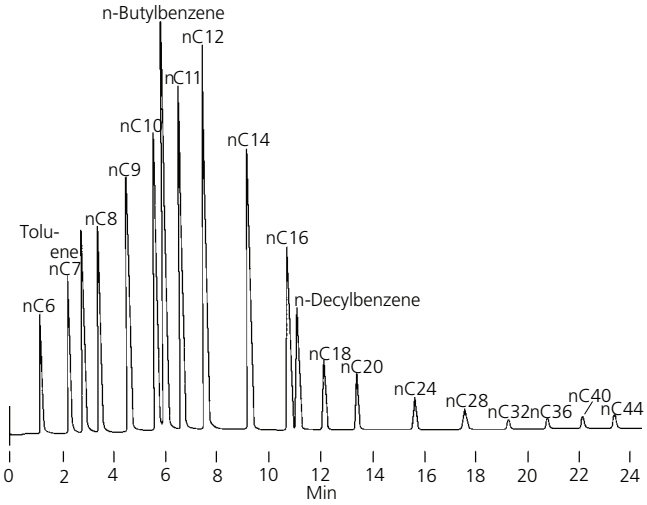



713-1393

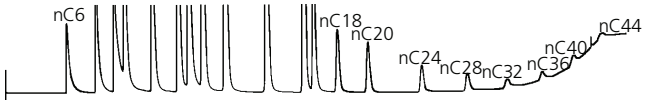
## Figure 32. Minimize Hydrocarbon Peak Tailing and Column Bleed for Method D2887

Column: **Petrocol B, 20" x 1/8" SS**
Cat. No.: **12449**
Col. Temp.: -25°C to 350°C at 15°C/min
Carrier: helium, 30mL/min
Det.: FID
Inj.: 0.1µL mixed aliphatics and aromatics

Petrocol B Column: Negligible Bleed at 350°C



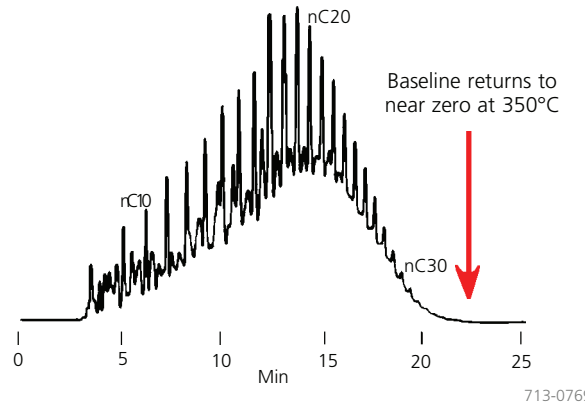

10% UC-W982 on 80/100 Chromosorb P AW:
High Bleed at 350°C




713-0770, 1394

## Figure 33. Negligible Column Bleed for Gas Oil Capillary Columns for SIMDIS Analysis

Column: **Petrocol B, 20" x 1/8" SS**
Cat. No.: **12449**
Col. Temp.: -25°C to 350°C at 15°C/min
Carrier: helium, 30mL/min
Det.: FID
Inj.: 0.1µL reference gas oil




713-0769

## Capillary Columns for SIMDIS Analysis

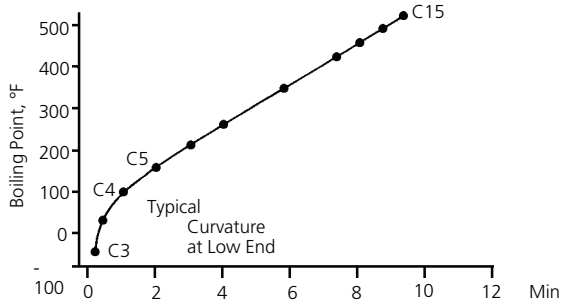
Petrocol 3710 and Petrocol 2887 capillary columns can improve your results for ASTM Methods D3710 and D2887, respectively (Figures 34-39 and Table 2). These columns offer important advantages over even the most reliable packed columns:

- Longer retention of early-eluting hydrocarbons — for a more linear boiling point/retention time curve (Figures 34-35)
- Low column bleed — for a sharp return to baseline and more reliable final boiling point data
- Symmetrical peaks
- Rapid conditioning (15 minutes to 1 hour)
- A potentially longer column lifetime, because the phase is bonded

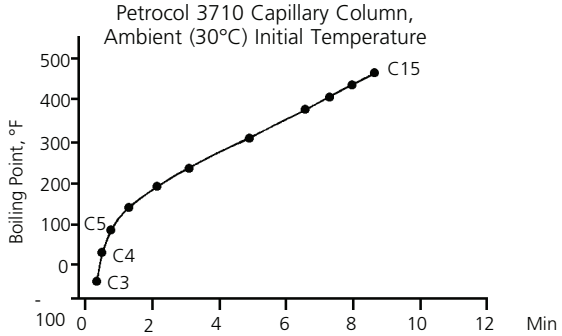
You can connect these capillary columns to packed column injection ports and detectors by using our inexpensive adapter kits. Use the columns with packed column flow controllers and most autosamplers. Petrocol capillary columns satisfy all column performance criteria in the ASTM methods.

## Figure 34. Petrocol 3710 Capillary Column Provides Near-Linear Correlation Between Hydrocarbon Boiling Point and Retention Time

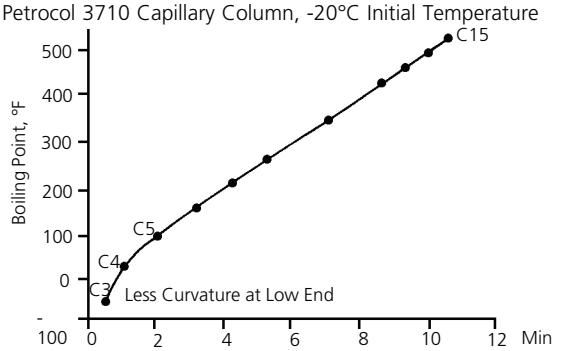
Packed Column, -20°C Initial Temperature




Petrocol 3710 Capillary Column,
Ambient (30°C) Initial Temperature

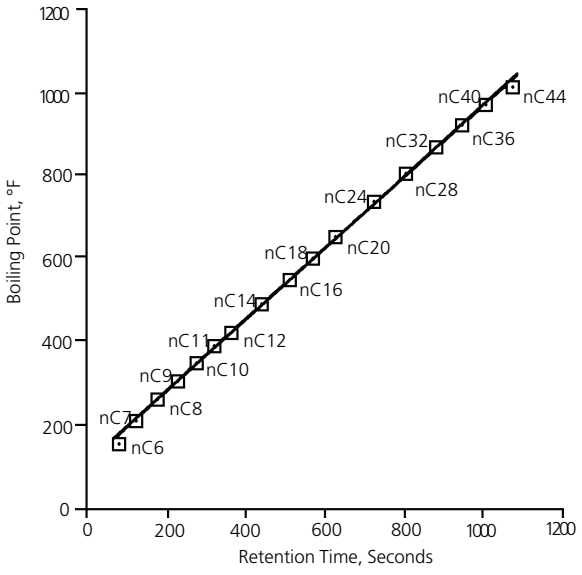



Petrocol 3710 Capillary Column, -20°C Initial Temperature




713-1397,1398,1399

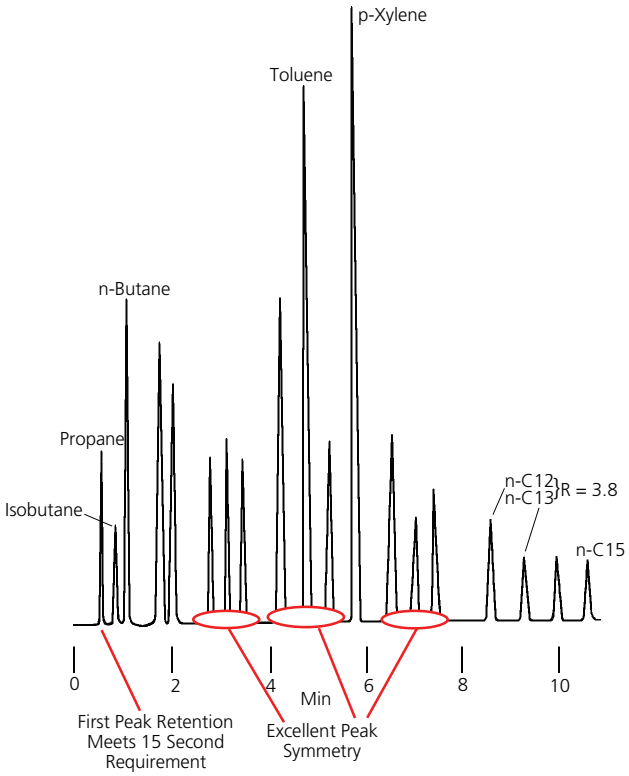
## Figure 35. Linear Boiling Point/Elution Time Relationship for n-Paraffins on a Petrocol 2887 Column




713-1401

## Figure 36. D3710 Qualitative SIMDIS Standard

Column: **Petrocol 3710, 10m x 0.75mm ID glass, 5.0µm film▲**
Col. Temp.: -20°C to 200°C at 20°C/min
Carrier: nitrogen, 15mL/min
Det.: FID
Inj.: 0.1µL D3710 Qualitative Mix (Cat. No. 48884)

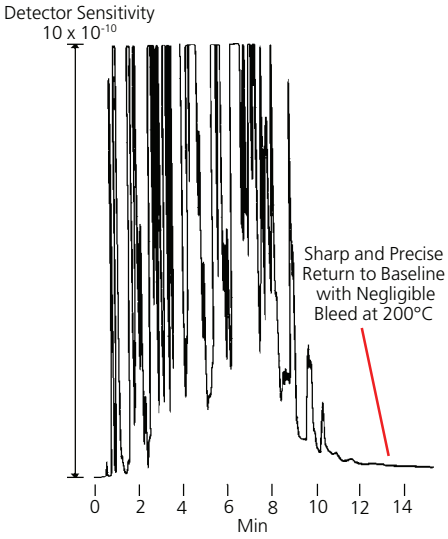



713-0773

▲This glass column is no longer available. Request the same dimensions in a fused silica column, as a custom column.

## Figure 37. SIMDIS Analysis of Gasoline

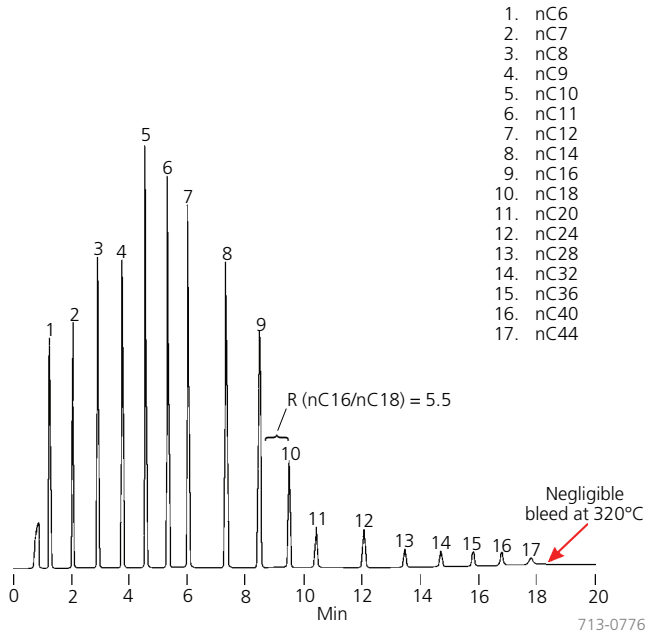
Column: **Petrocol 3710, 10m x 0.75mm ID glass, 5.0µm film▲**
Col. Temp.: -20°C to 200°C at 20°C/min
Carrier: nitrogen, 15mL/min
Det.: FID
Inj.: 0.1µL commercial gasoline




713-0775

## Figure 38. D2887 SIMDIS Calibration Blend

Column: **Petrocol 2887, 5m x 0.53mm ID, 0.5µm film**
Cat. No.: **25323**
Col. Temp.: -20°C to 320°C at 20°C/min, hold 5 min
Carrier: nitrogen, 6mL/min
Det.: FID
Inj.: 0.1µL Quantitative Calibration Mix (Cat. No. 48882), direct




713-0776

## Table 2. SIMDIS Data from Petrocol Capillary Columns and Packed Columns Show Good Agreement■

| Sample Volume % Off○ | Calc. Temp.(°F)▼ Petrocol 3710 Capillary Column | Packed Column | Relative Difference % | Boiling Pt. (°F)▲ Petrocol 2887 Capillary Column | ASTM Packed Column Consensus | Relative Difference % |
|---|---|---|---|---|---|---|
| IBP | 20 | 34 | 37.0 | 231 | 238 | 2.9 |
| 5 | 76 | 87 | 9.5 | 280 | 289 | 3.1 |
| 10 | 95 | 94 | 0.7 | 325 | 336 | 3.3 |
| 15 | 138 | 115 | 13.0 | 370 | 384 | 3.6 |
| 20 | 163 | 150 | 5.9 | 412 | 429 | 4.0 |
| 25 | 186 | 164 | 8.9 | 451 | — | — |
| 30 | 197 | 185 | 4.4 | 485 | 496 | 2.2 |
| 35 | 227 | 203 | 7.9 | 515 | — | — |
| 40 | 232 | 215 | 5.4 | 542 | 548 | 1.1 |
| 45 | 260 | 243 | 4.8 | 568 | — | — |
| 50 | 278 | 250 | 7.5 | 590 | 594 | 0.7 |
| 55 | 283 | 278 | 1.3 | 611 | — | — |
| 60 | 311 | 295 | 3.7 | 630 | 629 | 0.2 |
| 65 | 322 | 308 | 3.1 | 650 | — | — |
| 70 | 332 | 336 | 0.8 | 670 | 669 | 0.1 |
| 75 | 345 | 347 | 0.4 | 690 | — | — |
| 80 | 364 | 365 | 0.2 | 711 | 709 | 0.3 |
| 85 | 387 | 392 | 0.9 | 734 | 732 | 0.3 |
| 90 | 405 | 416 | 1.9 | 761 | 759 | 0.3 |
| 95 | 440 | 458 | 2.8 | 794 | 797 | 0.4 |
| FBP | 624 | 662 | 4.2 | 868 | 887 | 2.1 |

■ Means for 10 injections.

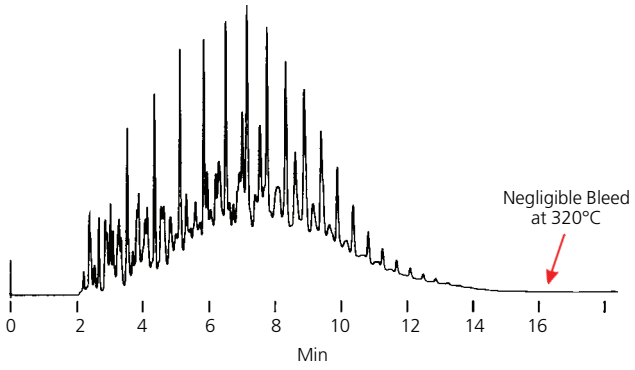
○ Each value represents 5% of the sample eluted from the column.

▼ Data obtained by using a commercial gasoline sample and Spectra-Physics D3710 SIMDIS software.

▲ Data obtained by using ASTM reference gas oil sample and Spectra-Physics D2887 SIMDIS software.

## Figure 39. Rapid Analysis of Reference Gas Oil, with Negligible Bleed

Column: **Petrocol 2887, 5m x 0.53mm ID, 0.5µm film**
Cat. No.: **25323**
Oven: -20°C to 320°C at 20°C/min, hold 5 min
Carrier: nitrogen, 6mL/min
Det.: FID, 350°C
Inj.: 0.1µL Reference Gas Oil (Cat. No. 48873), direct injection, 350°C




For more information, request Bulletin 864.

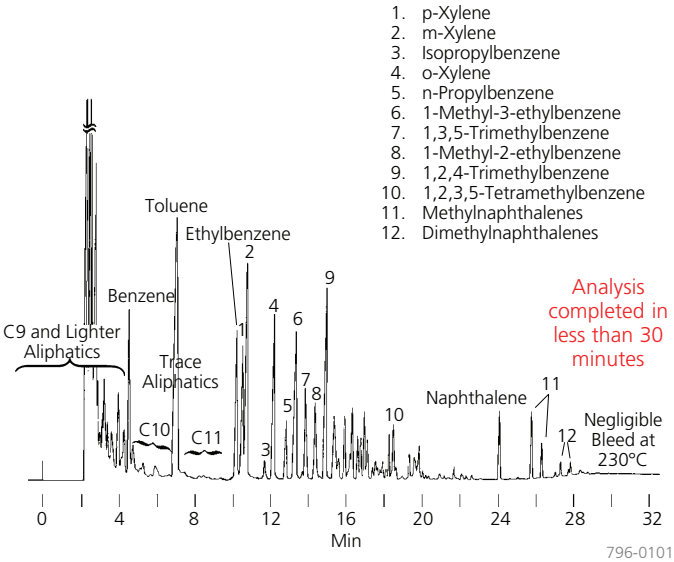
713-0774

## Aliphatics from Aromatics in Gasoline

Use a SUPELCOWAX™ 10 column to separate aliphatic and aromatic hydrocarbons. Nonane will elute before benzene, and the xylene isomers will be resolved (Figures 40 and 41).

## Figure 40. Aliphatics in Gasoline Elute Before Aromatics

Column: **SUPELCOWAX 10, 30m x 0.75mm ID, 1.0µm film▲**
Oven: 60°C (8 min) to 230°C at 8°C/min (8 min hold)
Carrier: helium, 4mL/min
Det.: FID
Inj.: 0.1µL super unleaded gasoline

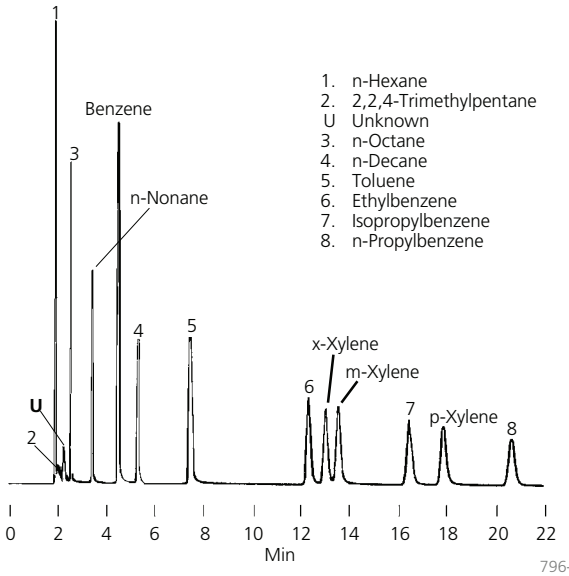



796-0101

▲This glass column is no longer available. Request the same dimensions in a fused silica column, as a custom column, or request Cat. No. 25301-U (30m x 0.53mm ID fused silica, 1.0µm film).

## Figure 41. Nonane Elutes Before Benzene; Xylene Isomers Easily Resolved

Column: **SUPELCOWAX 10, 30m x 0.75mm ID glass, 1.0µm film▲**
Oven: 50°C
Carrier: helium, 5.3mL/min, 50°C
Det.: FID
Inj.: 0.1µL $CS_2$ containing 1% each component, direct injection




796-0100

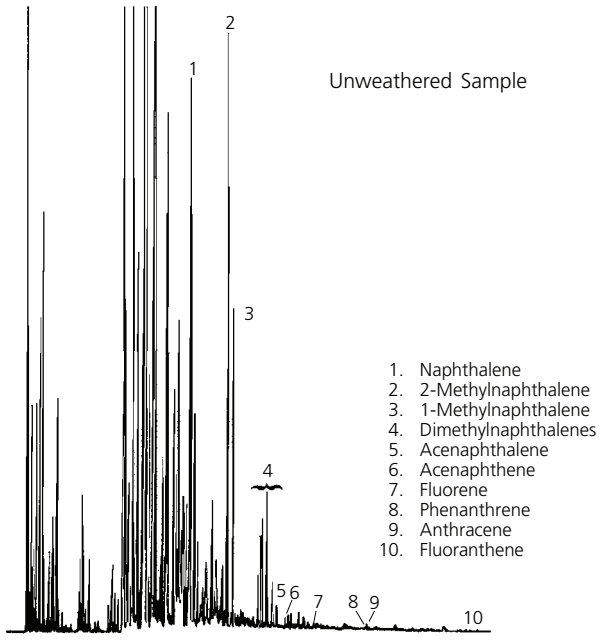
▲This glass column is no longer available. Request the same dimensions in a fused silica column, as a custom column, or request Cat. No. 25301-U (30m x 0.53mm ID fused silica, 1.0µm film).

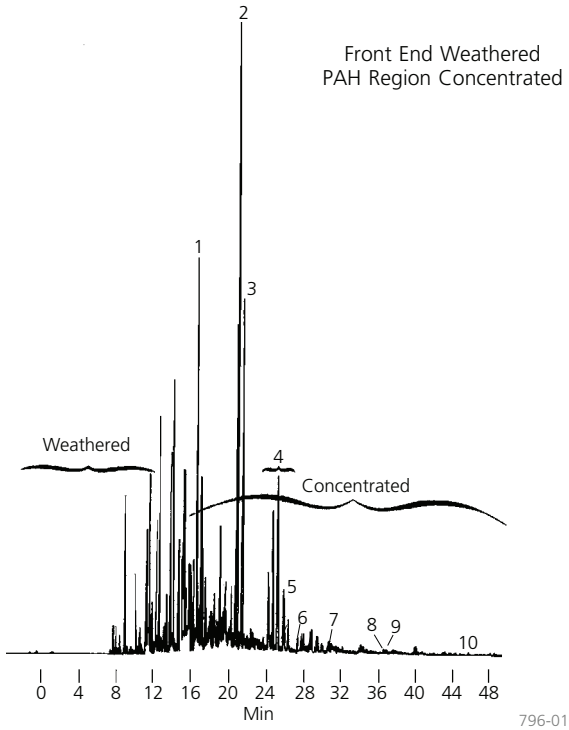
## Polynuclear Aromatic Hydrocarbons in Gasoline

SPB columns offer the efficiency and high thermal stability you need to isolate individual PAHs in gasoline (Figure 42).

## Figure 42. Gasoline Concentrated for Monitoring PAH Content

Column: **SPB-5, 30m x 0.25mm ID, 0.25µm film**
Cat. No.: **24034**
Oven: 35°C to 320°C at 4°C/min
Carrier: helium, 22.2cm/sec
Det.: FID
Inj.: 0.5µL unweathered or 0.02µL weathered super unleaded gasoline




796-0102,0103

## Trace Compounds in Petroleum Products

Use a SUPELCOWAX 10 column to detect 10ppm or less of sulfolane in aromatic-rich or raffinate petroleum fractions, or in water washes (Figure 43). Sulfolane is eluted after the dimethylnaphthalenes, ensuring minimal interference.

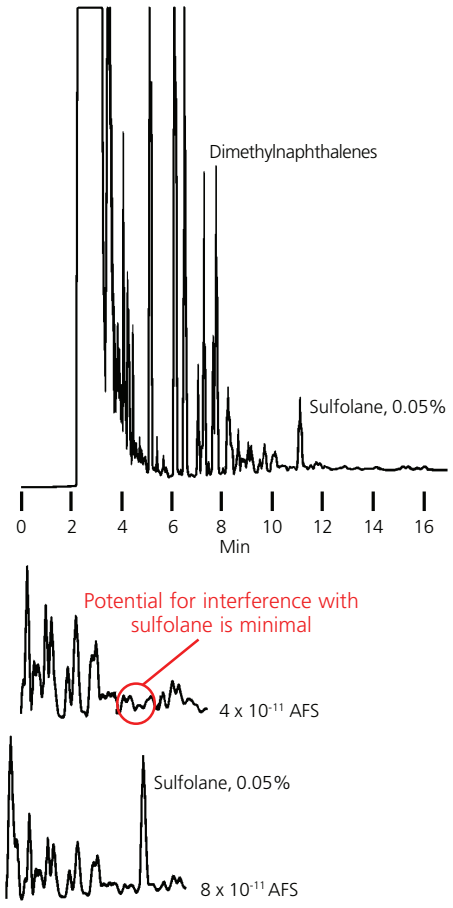
A 0.75mm ID SUPELCOWAX 10 capillary column (Figure 44) can replace several packed columns for monitoring impurities in aromatic petroleum products (ASTM Method D4534). It ensures:

- Faster analyses
- Greater resolution
- More stable baseline for trace analyses
- Separation of xylene isomers
- Rapid recycle times
- Longer column life

The wide bore SUPELCOWAX 10 column can be used with packed column injection and detector systems.

### Figure 43. Detect Low Levels of Sulfolane in Petroleum Streams

Column: **SUPELCOWAX 10, 30m x 0.75mm ID glass, 1.0µm film▲**
Oven: 175°C to 225°C at 5°C/min
Carrier: helium, 22.2cm/sec (6mL/min)
Det.: FID
Inj.: 1µL gasoline (w/o or w/0.05% sulfolane), direct injection



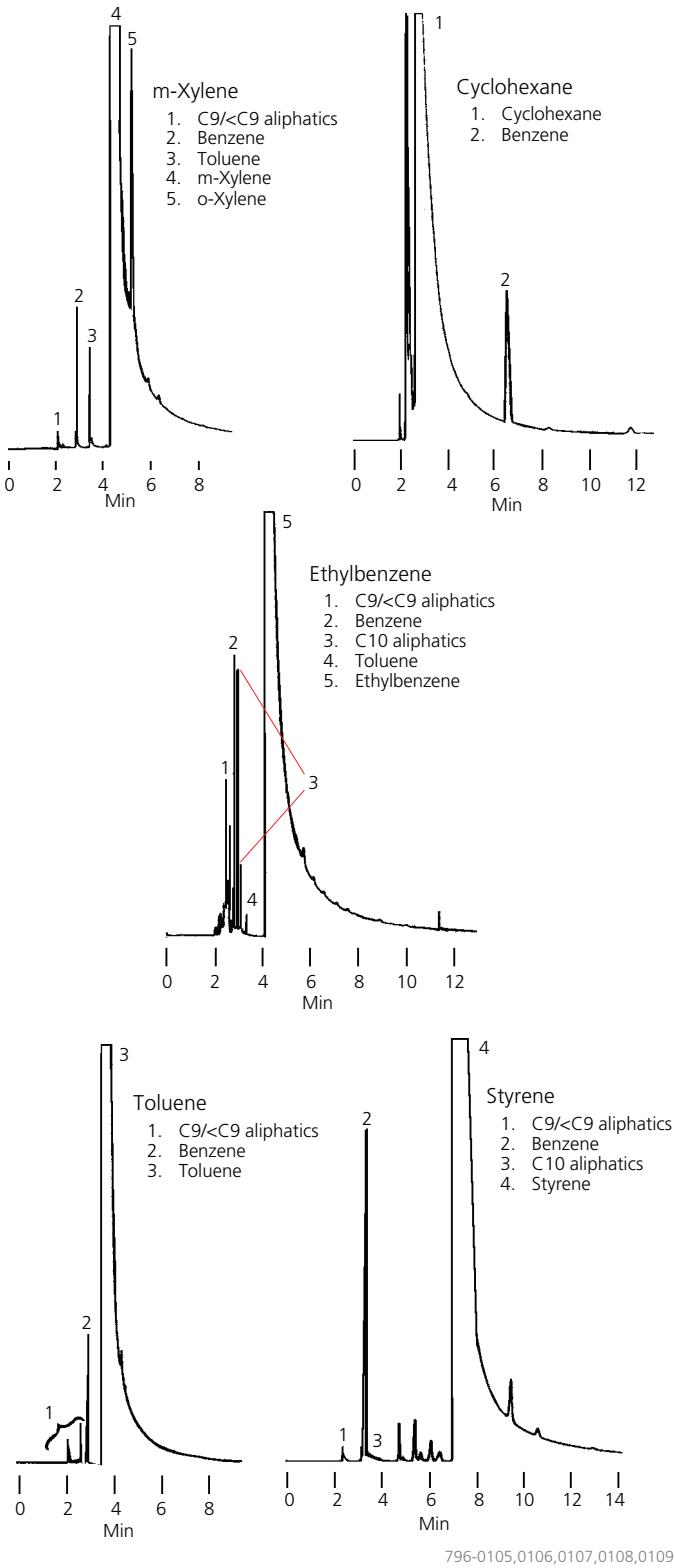

796-0104

▲This glass column is no longer available. Request the same dimensions in a fused silica column, as a custom column, or request Cat. No. 25301-U (30m x 0.53mm ID fused silica, 1.0µm film).

### Figure 44. Impurities in Aromatic Petroleum Products by ASTM Method D4534

**Major Component Overloaded to Detect Trace Components**

Column: **SUPELCOWAX 10, 30m x 0.75mm ID glass, 1.0µm film▲**
Oven: 100°C (40°C for cyclohexane)
Carrier: helium, 19.3cm/sec (3.5mL/min)
Det.: FID
Inj.: 0.1µL each major aromatic compound containing 1000ppm benzene, direct injection




796-0105,0106,0107,0108,0109

# Miscellaneous Petrochemicals Analyses

## More Sample Information from Complex Hydrocarbon Mixtures

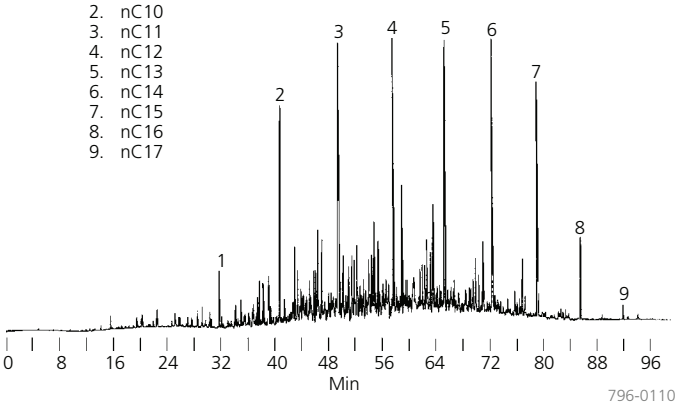
Our nonpolar Petrocol DH 50.2 and SPB-1 capillary columns provide excellent resolution of complex mixtures — such as charcoal lighter fluid, turpentine, and gasoline (Figures 45-47). These bonded phase columns offer a potentially long column life.

You can use 0.53mm ID SPB-1 columns in packed column instruments, with thermal conductivity or other less sensitive detectors. These wide bore capillary columns will give you more sample information than any packed column can provide.

### Figure 45. Charcoal Lighter Fluid

Column: **Petrocol DH 50.2, 50m x 0.20mm ID, 0.50µm film**
Cat. No.: **24133-U**
Oven: 35°C (5 min) to 200°C at 2°C/min
Carrier: helium, 19-21cm/sec
Det.: FID

1. nC9
2. nC10
3. nC11
4. nC12
5. nC13
6. nC14
7. nC15
8. nC16
9. nC17

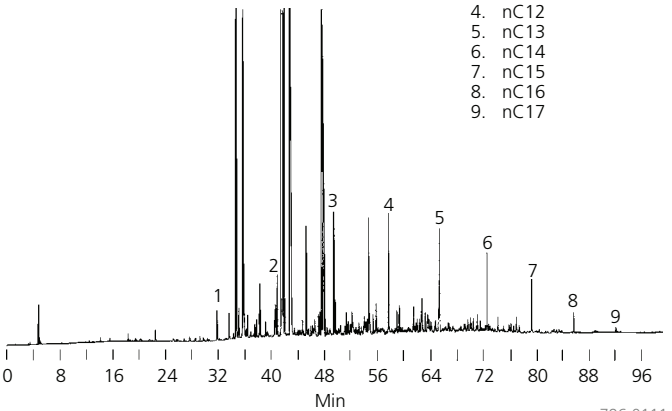



796-0110

### Figure 46. Turpentine

Column: **Petrocol DH 50.2, 50m x 0.20mm ID, 0.50µm film**
Cat. No.: **24133-U**
Oven: 35°C (5 min) to 200°C at 2°C/min
Carrier: helium, 19-21cm/sec
Det.: FID

1. nC9
2. nC10
3. nC11
4. nC12
5. nC13
6. nC14
7. nC15
8. nC16
9. nC17

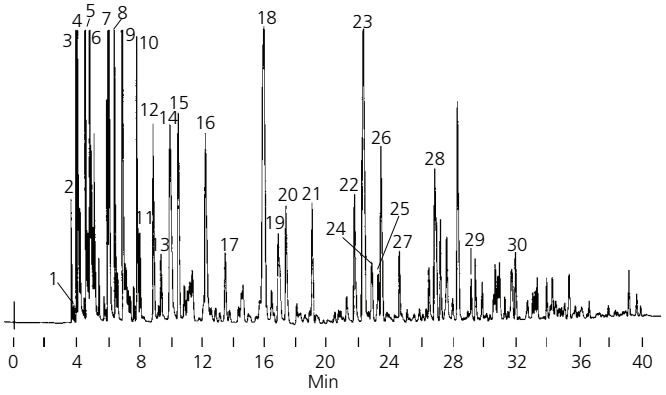



796-0111

### Figure 47. Gasoline on a Capillary Column in a Packed Column Chromatograph

Column: **SPB-1, 60m x 0.75mm ID glass, 1.0µm film▲**
Oven: 35°C (12 min) to 200°C at 4°C/min, hold
Carrier: helium,5cc/min (flow controlled)
Det.: TCD
Inj.: 0.4µL gasoline, direct injection

1. Air
2. Propane
3. Isobutane
4. n-Butane
5. Isopentane
6. n-Pentane
7. 2-Methylpentane
8. 3-Methylpentane
9. n-Hexane
10. Methylcyclopentane
11. 2,4-Dimethylpentane
12. Benzene
13. Cyclohexane
14. 2-Methylhexane
15. 3-Methylhexane
16. n-Heptane
17. 2,4-Dimethylhexane
18. Toluene
19. 2-Methylheptane
    4-Methylheptane
20. 3-Methylheptane
21. n-Octane
22. Ethylbenzene
23. m-Xylene
    p-Xylene
24. 2-Methyloctane
25. 3-Methyloctane
26. o-Xylene
27. n-Nonane
28. Propylbenzene
29. n-Decane
30. n-Undecane



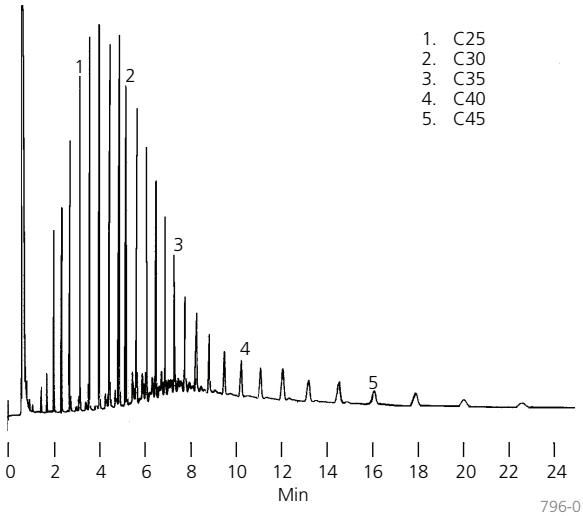

713-1351

▲This glass column is no longer available. Request the same dimensions in a fused silica column, as a custom column, or request Cat. No. 25418 (60m x 0.53mm ID fused silica, 1.0µm film).

Because our SPB-1 bonded phase columns are stable to 320°C, you can use them to resolve many high-boiling hydrocarbons (Figure 48). To minimize column bleed and avoid splitter discrimination, use a 0.5µm film, 0.53mm ID column and cool on-column injection. Stabilized, high polarity Nukol™ columns provide sharp separation of oxo-isooctyl isomers for accurate determination of 2-ethylhexanol (Figure 49). SPB-20 bonded phase columns resolve almost all alkylbenzene isomers to baseline (Figure 50). The Petrocol DH Octyl column completely separates methanol from isobutane (Figure 51).

## Figure 48. Petroleum Wax Components Resolved Without Splitter Discrimination

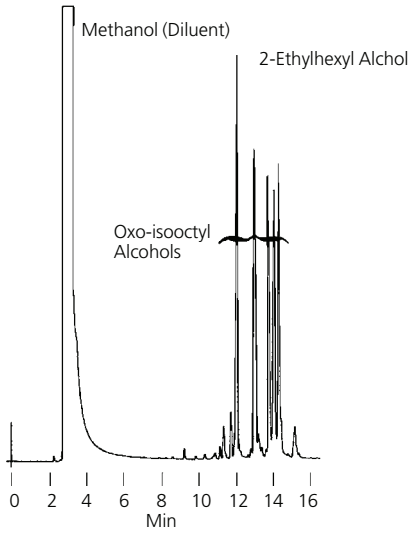
Column: **SPB-1, 30m x 0.53mm ID, 0.50µm film**
Cat. No.: **25315**
Oven: 200°C to 320°C at 16°C/min (hold 45 min)
Carrier: helium, 20mL/min
Det.: FID
Inj.: 10µg petroleum wax in 1µL n-dodecane




796-0104

## Figure 49. 2-Ethylhexyl Alcohol Isolated from Other Oxo-isooctyl Alcohol Isomers

Column: **Nukol, 30m x 0.53mm ID, 0.5µm film**
Cat. No.: **25327**
Oven: 90°C to 160°C at 4°C/min (hold 5 min)
Carrier: helium, 20cm/sec
Det.: FID
Inj.: 0.2µL $CH_3OH$, 2% isooctyl alcohols



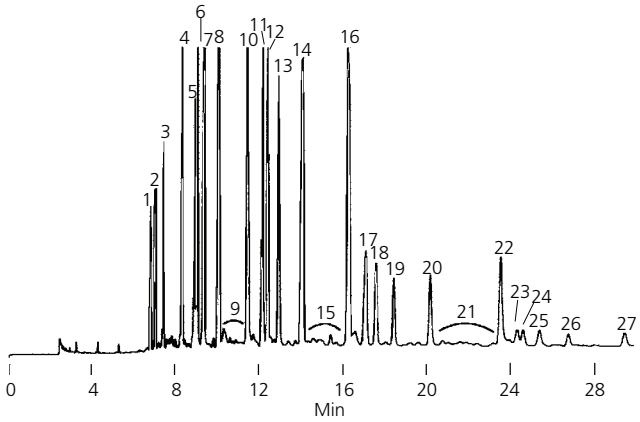

713-0794

## Figure 50. Complex Mixtures of Alkylbenzenes

Column: **SPB-20, 30m x 0.25mm ID, 0.25µm film**
Cat. No.: **24086**
Oven: 170°
Carrier: helium, 20cm/sec
Det.: FID
Inj.: 0.2µL mixed alkylbenzenes, split 100:1

1. 5øC10*
2. 4øC10
3. 3øC10
4. 2øC10
5. 6øC11
6. 5øC11
7. 4øC11
8. 3øC11
9. C10 tetralins
10. 2øC11
11. 6øC12
12. 5øC12
13. 4øC12
14. 3øC12
15. C11 tetralins
16. 2øC12
17. 6øC13, 7øC13
18. 5øC13
19. 4øC13
20. 3øC13
21. C12 tetralins
22. 2øC13
23. 7øC14
24. 6øC14
25. 5øC14
26. 4øC14
27. 3øC14

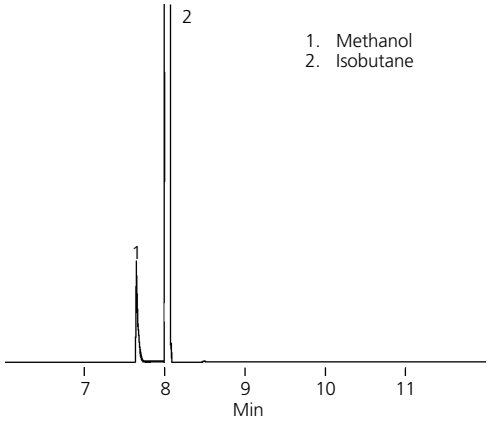
* Position of phenyl group, chain length




796-0112

## Figure 51. Methanol and Isobutane

Column: **Petrocol DH Octyl, 100m x 0.25mm ID, 0.5µm film**
Cat. No.: **24282**
Oven: 35°C
Carrier: helium, 24cm/sec
Det.: FID, 250°C
Inj.: 0.1µL, split 215:1, 250°C




94-0367

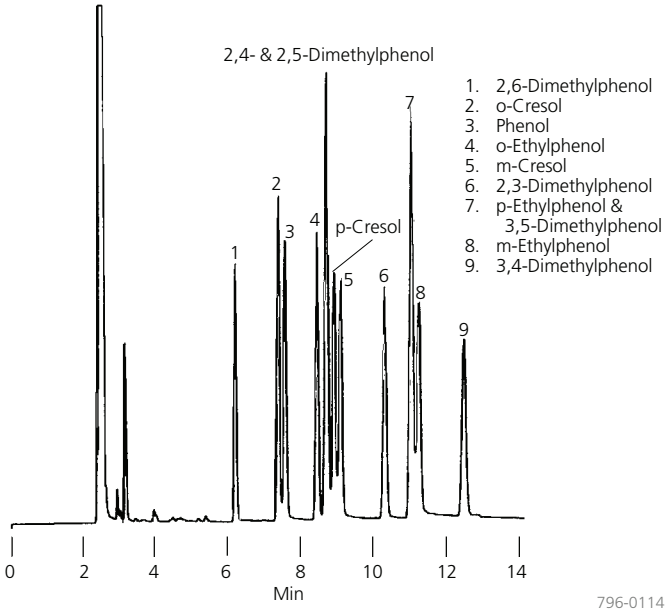
# Phenols / Polymers

## Cresol Isomers Separated, Using an Acidic, Bonded Phase Column

Phenols (and many other acidic polar compounds) are eluted from high efficiency Nukol bonded phase capillary columns as sharp, symmetrical peaks. A Nukol column will resolve p-cresol from the dimethylphenols (Figure 52).

## Figure 52. Resolve p-Cresol from Dimethylphenols

Column: **Nukol, 30m x 0.25mm ID, 0.25µm film**
Cat. No.: **24107**
Oven: 200°C
Carrier: helium, 20cm/sec
Det.: FID
Inj.: 1µL methylene chloride containing 1µg each phenol, split 100:1




796-0114

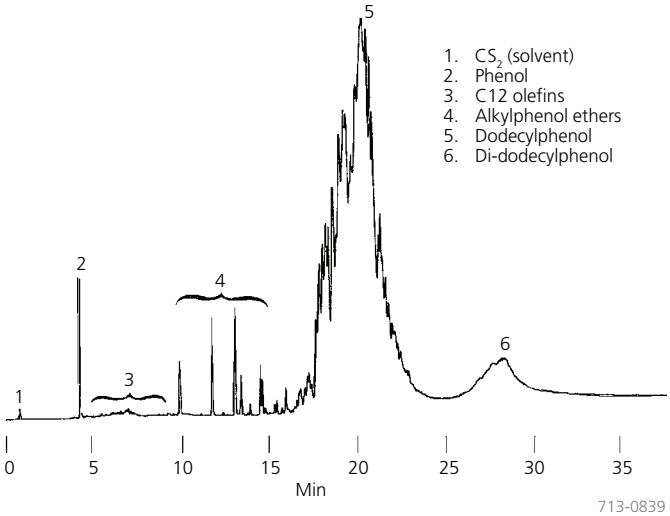
## Capillary Column Improves Analyses of Dodecylphenol Product

Our 0.53mm ID SPB-5 fused silica capillary column is ideal for this purpose. Compared to packed columns, the inert, bonded phase capillary column improves peak symmetry for the acidic sample components. Phenol elutes before the C12 olefins, rather than after them, for more reliable quantification of phenol and olefins (Figure 53).

This wide bore capillary column can be used in packed column instruments.

## Figure 53. Dodecylphenol Product Components Separate Well on a Bonded Phase Capillary Column

Column: **SPB-5, 30m x 0.53mm ID, 1.5µm film**
Cat. No.: **25305-U**
Oven: 80°C (2 min) to 300°C at 8°C/min
Carrier: helium, 7mL/min
Det.: FID, 325°C
Inj.: 0.2µL carbon disulfide:dodecylphenol product (2:1), direct injection, 300°C




713-0839

# Solvents

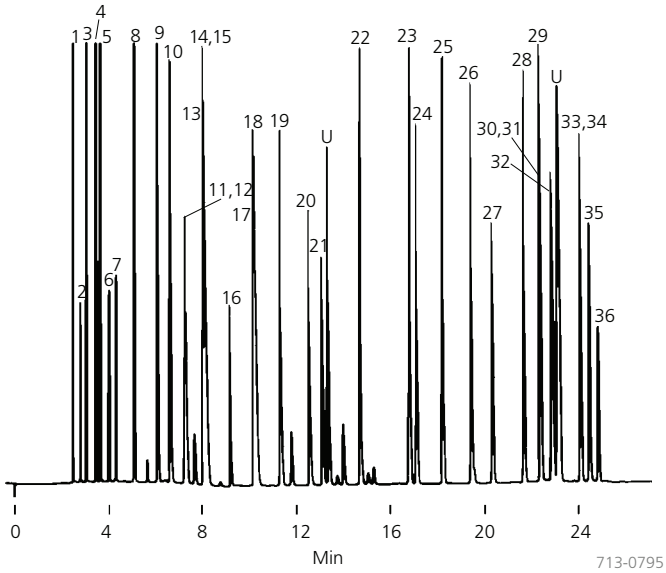
## Analyze Almost Any Combination of Solvents

You can easily separate complex mixtures of common solvents on our nonpolar SPB-1 or polar SUPELCOWAX 10 capillary column. (SPB-1 columns separate the alcohols by boiling point.) Compare the separations shown in Figures 54-56 to determine which column is best for your samples.

Furthermore, you can use 0.53mm ID columns in systems designed for packed columns.

### Figure 54. Industrial Solvents

Column: **SPB-1, 30m x 0.32mm ID, 1.0µm film**
Cat. No.: **24045-U**
Oven: 30°C (8 min) to 125°C at 4°C/min, hold 5 min
Carrier: helium, 25cm/sec (set at 30°C)
Det.: FID, 250°C
Inj.: 0.2µL approximately equal proportions of each component, split 200:1, 250°C



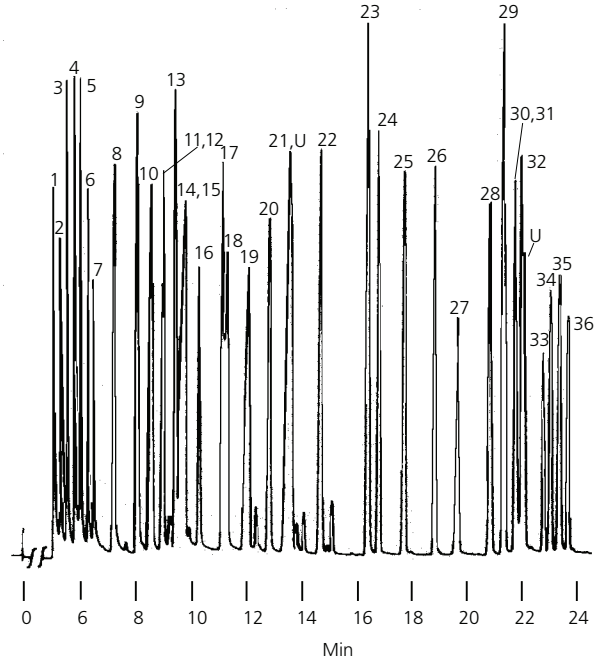

713-0795

### Solvents for Figures 54-56

1. Methanol
2. Methyl formate
3. Ethanol
4. Acetone
5. Isopropyl alcohol
6. Ethyl formate
7. Methylene chloride
8. n-Propyl alcohol
9. Methyl ethyl ketone
10. sec-Butyl alcohol
11. Ethyl acetate
12. Chloroform
13. Tetrahydrofuran
14. Methyl Cellosolve
15. Isobutyl alcohol
16. 1,1,1-Trichloroethane
17. Isopropyl acetate
18. n-Butyl alcohol
19. 2-Nitropropane
20. 1,4-Dioxane
21. Ethyl Cellosolve
U. Unknown
22. Methyl isobutyl ketone
23. Toluene
24. Isobutyl acetate
25. Mesityl oxide
26. n-Butyl acetate
27. Diacetone alcohol
28. 5-Methyl-2-hexanone
29. Ethylbenzene
30. m-Xylene
31. p-Xylene
32. Cyclohexanone
U. Unknown
33. o-Xylene
34. Cellosolve acetate
35. Butyl Cellosolve
36. Isoamyl acetate

### Figure 55. Solvents on a Capillary Column in a Packed Column GC

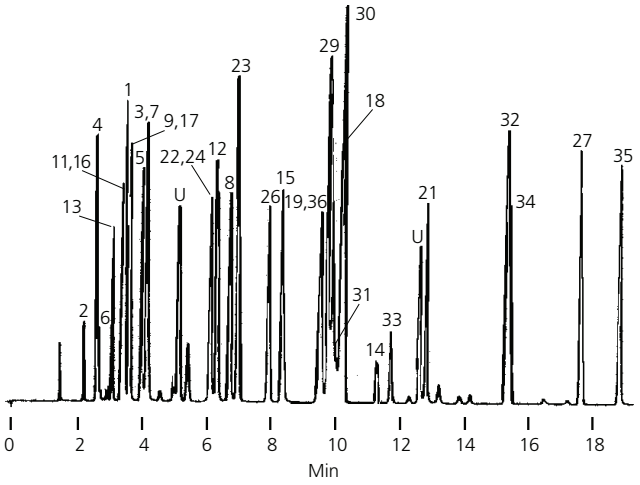
Column: **SPB-1, 60m x 0.75mm ID, 1.0µm film▲**
Oven: 30°C (8 min) to 125°C at 4°C/min (hold)
Carrier: helium, 20cm/sec
Det.: FID
Inj.: 0.5µL, approx. equal proportions of each component, direct injection




796-0115

### Figure 56. Solvents on a Capillary Column in a Packed Column GC

Column: **SUPELCOWAX 10, 30m x 0.53mm ID, 1.0µm film**
Cat. No.: **25301-U**
Oven: 50°C (4 min) to 175°C at 4°C/min (hold 4 min)
Carrier: helium, 5mL/min (flow controlled)
Det.: FID
Inj.: 0.1µL mixed neat solvents, direct injection




796-0116

▲This glass column is no longer available. Request the same dimensions in a fused silica column, as a custom column, or request Cat. No. 25418 (60m x 0.53mm ID fused silica, 1.0µm film).

## Eliminate Glycol Peak Tailing and Sample Decomposition

Use 0.53mm ID Nukol columns to analyze these highly polar compounds with good resolution and peak symmetry, and at low temperatures that eliminate decomposition (Figure 57).

## Capillary Chromatography for Glycols in a Packed Column Chromatograph

You can have the inertness and high resolution of capillary GC without using expensive, specialized equipment. Use 0.53mm ID Nukol columns in packed column chromatographs, with injectors and detectors designed for packed columns.

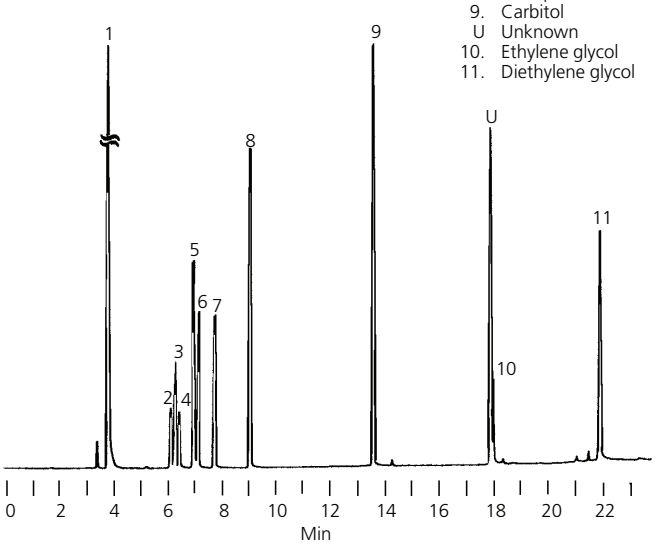
## Analyze Trace Solvents in Pharmaceutical Products

Figure 58 shows the elution of six volatile organic solvents, commonly used in manufacturing pharmaceuticals, separated on a thick film SPB-1 capillary column. The low parts-per-million concentrations are representative of residual solvent levels in bulk drug preparations.

### Figure 57. Nukol Column Provides Sharp Glycol Peaks

Column: **Nukol, 30m x 0.53mm ID, 0.5µm film**
Cat. No.: **25327**
Oven: 45°C (4 min) to 220°C at 10°C/min, hold 5 min
Carrier: helium, 20cm/sec (set at 155°C)
Det.: FID, 250°C
Inj.: 0.02µL ink solvents mixture, direct injection, 250°C

1. Heptane
2. Ethyl acetate
3. Isopropyl acetate
4. Methanol
5. Isopropanol
6. Ethanol
7. n-Propyl acetate
8. n-Propanol
9. Carbitol
U Unknown
10. Ethylene glycol
11. Diethylene glycol

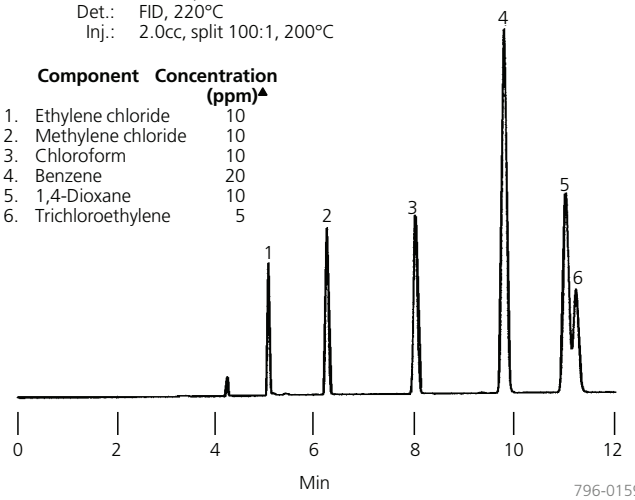



713-0793

### Figure 58. Solvents Commonly Used in Pharmaceuticals Manufacture

Column: **SPB-1, 60m x 0.53mm ID, 5µm film**
Cat. No.: **25349**
Oven: 30°C (5 min) to 200°C at 20°C/min
Carrier: helium, 19-21cm/sec
Det.: FID, 220°C
Inj.: 2.0cc, split 100:1, 200°C

| Component | Concentration (ppm)▲ |
|---|---|
| 1. Ethylene chloride | 10 |
| 2. Methylene chloride | 10 |
| 3. Chloroform | 10 |
| 4. Benzene | 20 |
| 5. 1,4-Dioxane | 10 |
| 6. Trichloroethylene | 5 |




796-0159

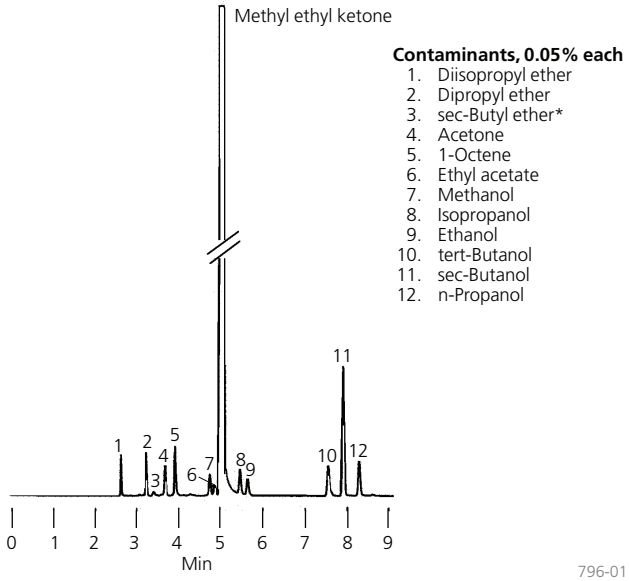
▲ Values are equivalent to headspace analysis for 10g of a pharmaceutical product.

## Impurities in Solvents

For monitoring impurities in ketones (ASTM Methods D2804, D3329, and D3893) and 2-ethylhexanol, SUPELCOWAX 10 and Nukol capillary columns improve peak resolution, shorten analysis times, and provide more repeatable results than packed columns (Figures 59 to 61).

### Figure 59. Trace Levels of Impurities in Methyl Ethyl Ketone, by Capillary GC

Column: **SUPELCOWAX 10, 30m x 0.32mm ID, 0.5µm film**
Cat. No.: **24084**
Oven: 50°C (4 min) to 100°C at 8°C/min
Carrier: helium, 25cm/sec
Det.: FID, 220°C
Inj.: 0.2µL MEK, split 100:1

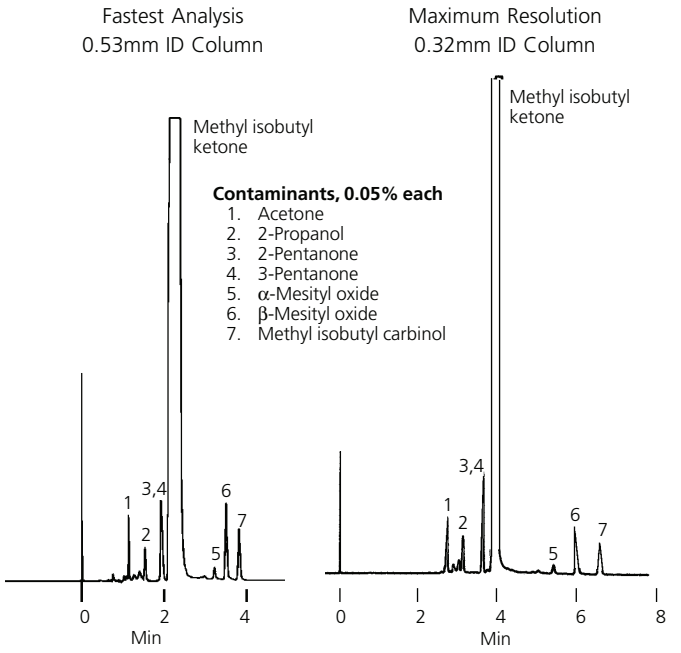



796-0118

*Contaminant in sec-butanol, not spiked in sample.

## Figure 60. Choose Maximum Resolution or Save Time When Monitoring Purity of Methyl Isobutyl Ketone

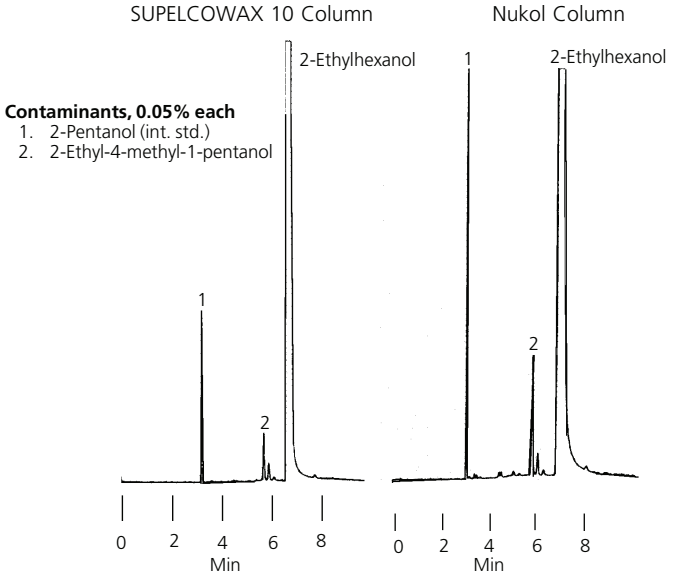
Column: **SUPELCOWAX 10, 30m x 0.32mm ID, 0.25µm film**
Cat. No.: **24080-U**
Oven: 70°C
Carrier: helium, 25cm/sec
Det.: FID
Inj.: 0.5µL MIBK, split 100:1




796-0119,0120

## Figure 61. Impurities from 2-Ethylhexanol

Columns: **30m x 0.32mm ID, 0.25µm film**
Cat. No.: **24080-U; 24131**
Oven: 120°C
Carrier: helium, 20cm/sec
Det.: FID
Inj.: 0.3µL 2-ethylhexanol, split 100:1




796-0121,0122

## Table 3. Capillary Column Ensures Consistent Measurements of Impurities in Solvents

| Solvent/Impurity | Variation in Measurement (% absolute) Injection* | Injection** | Column - Lab* | Lab** | Column |
|---|---|---|---|---|---|
| MIAK | 0.008 | 0.15 | 0.005 | 1.07 | 0.011 |
| Isopropyl alcohol | 0.001 | 0.014 | 0.001 | 0.05 | 0.006 |
| Mesityl oxide | 0.001 | 0.04 | 0.001 | 0.05 | 0.002 |
| Methyl isoamyl carbitol | 0.008 | 0.04 | 0.003 | 0.11 | 0.005 |
| Total ketones | 0.004 | 0.15 | 0.002 | 0.62 | 0.009 |
| MAK | 0.046 | 0.24 | 0.050 | 0.84 | 0.116 |
| Isopropyl alcohol | 0.006 | 0.02 | 0.005 | 0.05 | 0.022 |
| Methyl isobutyl carbitol | 0.001 | 0.01 | 0.004 | 0.07 | 0.019 |
| Total ketones | 0.024 | 0.05 | 0.023 | 0.61 | 0.035 |

* Value for SUPELCOWAX 10 capillary column.

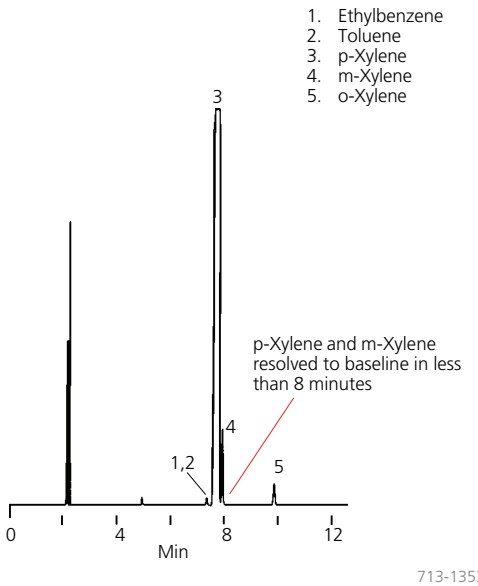
** ASTM specification for packed columns. Packed column specifications established at 0.1% each impurity, capillary column values determined at 0.05% each impurity.

## High Resolution or High Speed Analyses

When you need high resolution, a 0.20mm ID SUPELCOWAX 10 capillary column is ideal. Its high efficiency (approximately 25% greater than that of a 0.25mm ID column) lets you obtain the greatest resolution possible. When analysis time is most important, you can trade efficiency for more rapid separations (Figures 62 and 63).

## Figure 62. Trace Contaminants Completely Resolved from Major Sample Component

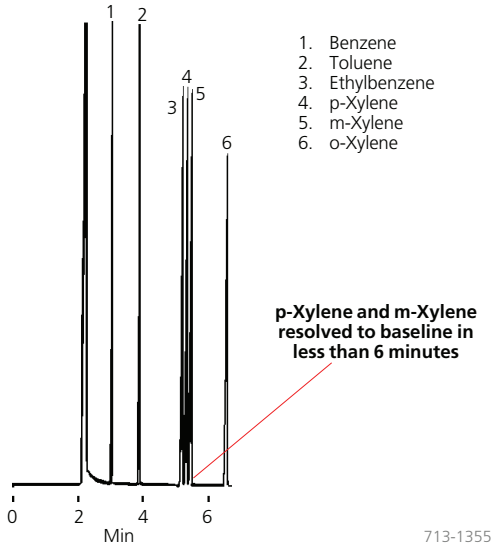
Column: **SUPELCOWAX 10, 30m x 0.20mm ID, 0.20µm film**
Cat. No.: **24169**
Oven: 60°C
Carrier: helium, 25cm/sec
Det.: FID
Inj.: 0.1µL p-xylene product, split (150:1)




713-1353

## Figure 63. Fastest Separation of Aromatic Compounds in Balanced Proportions

Column: **SUPELCOWAX 10, 30m x 0.20mm ID, 0.20µm film**
Cat. No.: **24169**
Oven: 75°C
Carrier: helium, 25cm/sec
Det.: FID
Inj.: 0.1µL hexane (1.7% each analyte), split (150:1)



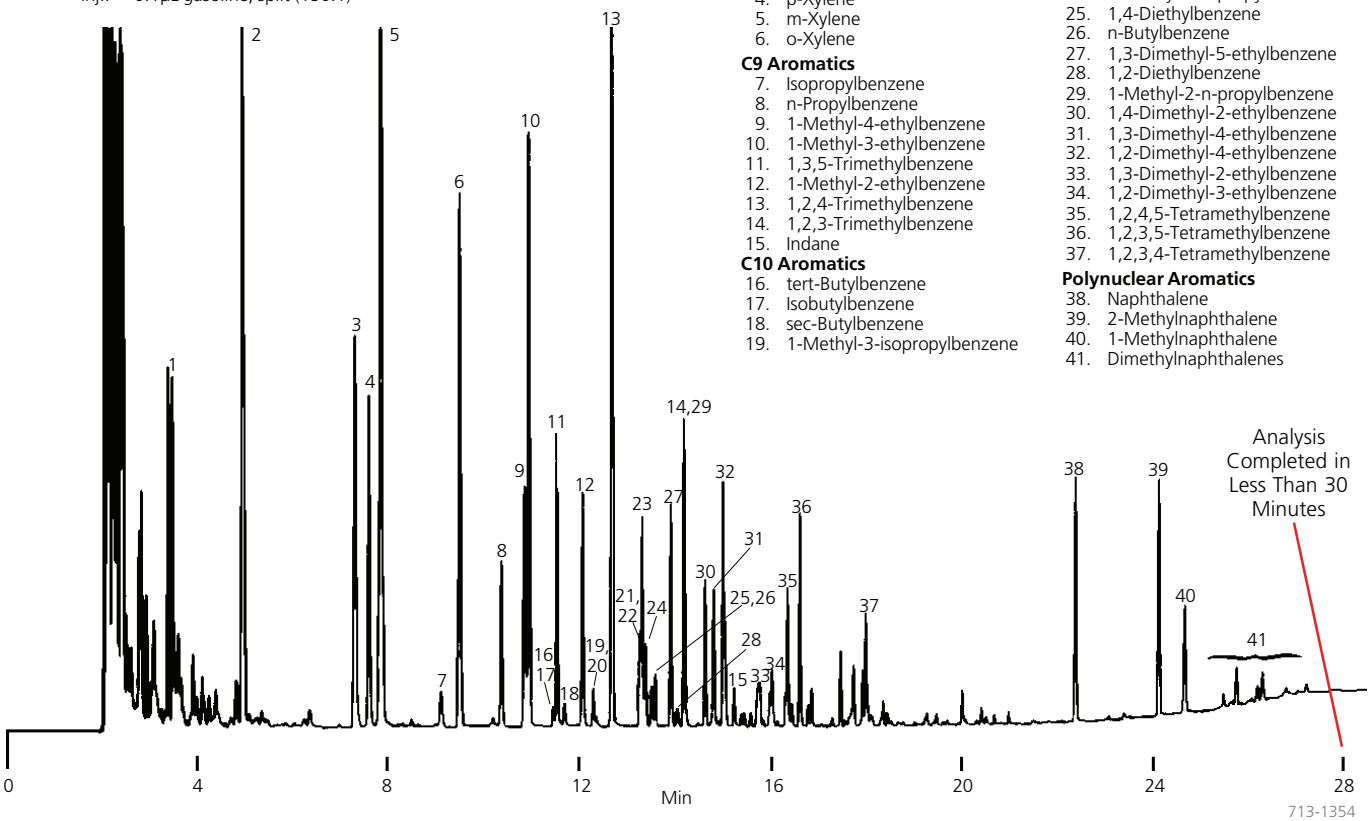

1. Benzene
2. Toluene
3. Ethylbenzene
4. p-Xylene
5. m-Xylene
6. o-Xylene

713-1355

Because aromatic and nonaromatic compounds have similar boiling points, they are hard to resolve on nonpolar columns. Using a narrow bore polar capillary column simplifies quantitative analysis of aromatic compounds. When gasoline is analyzed on a polar 30m x 0.20mm ID SUPELCOWAX 10 column, benzene and higher molecular weight aromatics are retained until after most nonpolar components (up to n-nonane) elute (Figure 64).

## Figure 64. Monitor Aromatic Components of Gasoline Rapidly and Efficiently

Column: **SUPELCOWAX 10, 30m x 0.20mm ID, 0.20µm film**
Cat. No.: **24169**
Oven: 60°C (8 min) to 210°C at 8°C/min
Carrier: helium, 25cm/sec
Det.: FID
Inj.: 0.1µL gasoline, split (150:1)




1. Benzene
2. Toluene

**C8 Aromatics**
3. Ethylbenzene
4. p-Xylene
5. m-Xylene
6. o-Xylene

**C9 Aromatics**
7. Isopropylbenzene
8. n-Propylbenzene
9. 1-Methyl-4-ethylbenzene
10. 1-Methyl-3-ethylbenzene
11. 1,3,5-Trimethylbenzene
12. 1-Methyl-2-ethylbenzene
13. 1,2,4-Trimethylbenzene
14. 1,2,3-Trimethylbenzene
15. Indane

**C10 Aromatics**
16. tert-Butylbenzene
17. Isobutylbenzene
18. sec-Butylbenzene
19. 1-Methyl-3-isopropylbenzene
20. 1-Methyl-4-isopropylbenzene
21. 1,3-Diethylbenzene
22. 1-Methyl-2-isopropylbenzene
23. 1-Methyl-3-n-propylbenzene
24. 1-Methyl-4-n-propylbenzene
25. 1,4-Diethylbenzene
26. n-Butylbenzene
27. 1,3-Dimethyl-5-ethylbenzene
28. 1,2-Diethylbenzene
29. 1-Methyl-2-n-propylbenzene
30. 1,4-Dimethyl-2-ethylbenzene
31. 1,3-Dimethyl-4-ethylbenzene
32. 1,2-Dimethyl-4-ethylbenzene
33. 1,3-Dimethyl-2-ethylbenzene
34. 1,2-Dimethyl-3-ethylbenzene
35. 1,2,4,5-Tetramethylbenzene
36. 1,2,3,5-Tetramethylbenzene
37. 1,2,3,4-Tetramethylbenzene

**Polynuclear Aromatics**
38. Naphthalene
39. 2-Methylnaphthalene
40. 1-Methylnaphthalene
41. Dimethylnaphthalenes

713-1354

# Aromatics / Aliphatics by Packed Column GC

## Aliphatics from Aromatics

Most packed columns allow aliphatics and aromatics to elute together. Our high polarity 1,2,3-tris (2-cyanoethoxy propane (TCEP), BC-120, and BC-150 packings retard the aromatics relative to the aliphatics (Figure 65). The BC-150 phase has a higher temperature limit (240°C) than the BC-120 or TCEP phases (125°C).

## Xylene Isomers

5% SP-1200/5% Bentone® 34 packing separates o-, m-, and p-xylene and ethylbenzene in less than 7 minutes. If styrene, isopropylbenzene, or n-propylbenzene are present, use 5% SP-1200/1.75% Bentone 34 (Figure 66).

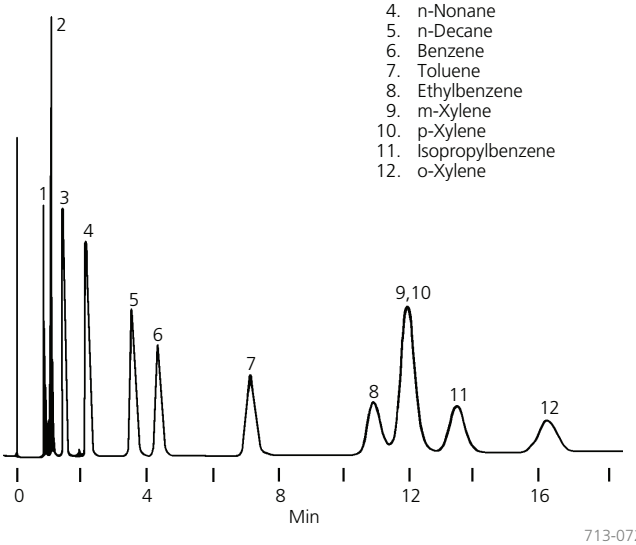
## Difficult-to-Resolve Aromatics

Both Carbopack™ F-TA and Carbopack C/0.1% SP-1000 columns will rapidly separate butylbenzenes and many other difficult-to-resolve isomers. Analyses on a Carbopack F-TA column require half as much time (Figure 67).

### Figure 65. Aromatics and Aliphatics

Packing: **GP 10% TCEP on 100/120 Chromosorb P AW**
Cat. No.: **12106-U** (packing, 20g/bottle)
Column: 8' x 1/8" stainless steel
Oven: 80°C
Carrier: nitrogen, 20mL/min
Det.: FID
Inj.: 0.2µL, approx. equal volumes each analyte

1. n-Hexane
2. n-Heptane
3. n-Octane
4. n-Nonane
5. n-Decane
6. Benzene
7. Toluene
8. Ethylbenzene
9. m-Xylene
10. p-Xylene
11. Isopropylbenzene
12. o-Xylene

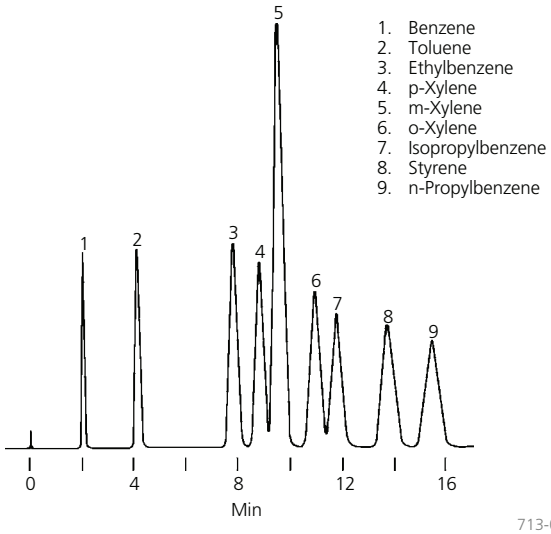



713-0724

### Figure 66. Xylene Isomers

Packing: **GP 5% SP-1200/1.75% Bentone 34 on 100/120 SUPELCOPORT**
Cat. No.: **12134** (20g)/bottle
Column: 6' x 1/8" stainless steel
Cat. No.: **12721** (general configuration stock column, other stock columns available)
Oven: 75°C
Carrier: nitrogen, 20mL/min
Det.: FID
Inj.: 0.10µL, approx. equal volumes each component

1. Benzene
2. Toluene
3. Ethylbenzene
4. p-Xylene
5. m-Xylene
6. o-Xylene
7. Isopropylbenzene
8. Styrene
9. n-Propylbenzene

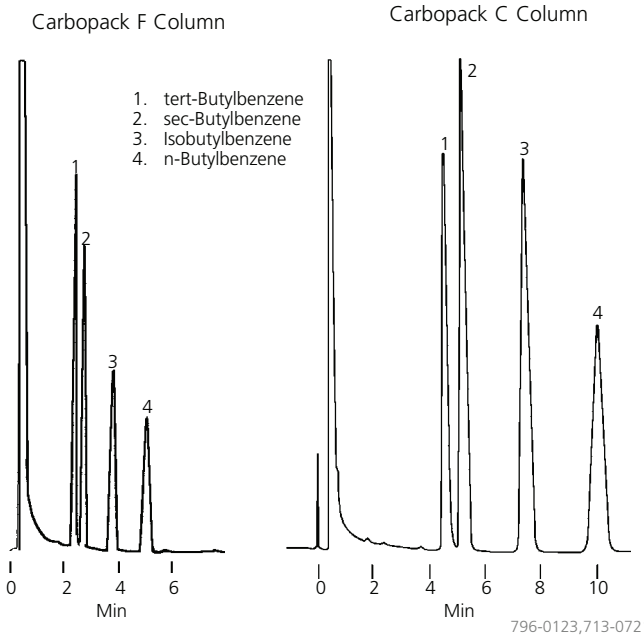



713-0722

### Figure 67. Analyses are Twice as Fast on a Carbopack F-TA Column

Cat. No.: 11820 (packing, 15g/bottle)
Column: 6' x 1/8" ID stainless steel
Cat. No.: 12495-U (general configuration stock column, other stock columns available)
Oven: 225°C
Carrier: nitrogen, 20mL/min
Det.: FID
Inj.: 1µL chloroform (~0.1% each analyte)

1. tert-Butylbenzene
2. sec-Butylbenzene
3. Isobutylbenzene
4. n-Butylbenzene



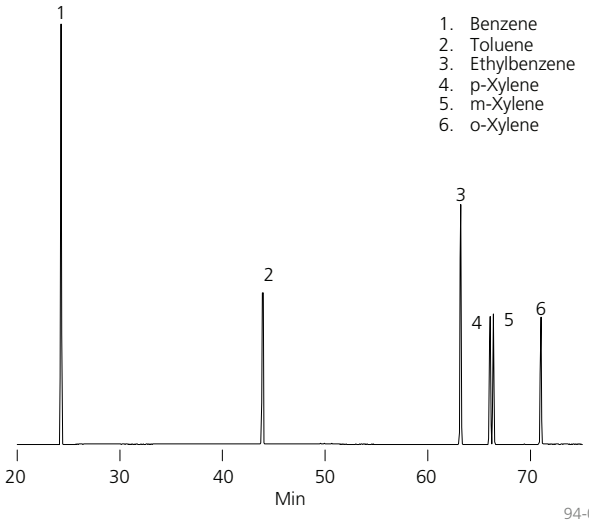

796-0123,713-0721

## Aromatics / Aliphatics by Capillary GC

The Petrocol DH Octyl capillary column (Figure 68) offers baseline resolution of the BTEX compounds, including the difficult-to-separate p- and m-xylene isomers.

### Figure 68. BTEX Compounds

Column: **Petrocol DH Octyl, 100m x 0.25mm ID, 0.5µm film**
Cat. No.: **24282**
Oven: 35°C (15 min) to 200°C at 1°C/min (15 min)
Carrier: helium, 24cm/sec
Det.: FID, 250°C
Inj.: 0.1µL, split 215:1, 250°C




94-0365

## C1-C6 Hydrocarbons by Packed Column GC

### Packings Specifically Prepared for Optimum Hydrocarbon Separations

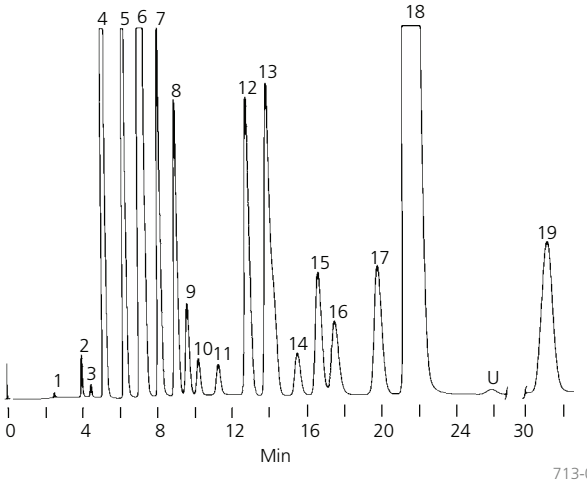
23% SP-1700 columns offer excellent resolution of concentrated C1-C6 hydrocarbons (Figure 69). Use these extremely durable columns between 0°C and 110°C, with sample valves or direct injections.

Carbopack C/0.19% picric acid packing is prepared specifically for separating C3 compounds or C4 unsaturates (Figure 70). Use this packing at temperatures to 120°C.

### Figure 69. C1-C6 Saturated and Unsaturated Hydrocarbons

Packing: **23% SP-1700 on 80/100 Chromosorb P AW**
Cat. No.: **11865** (25g) (packing only)
Column: 30' x 1/8" stainless steel
Cat. No.: **12809-U** (general configuration column)
Oven: 70°C
Carrier: helium, 25mL/min
Det.: FID
Inj.: 0.6µL ASTM Section L Blend No. 6, plus C5s

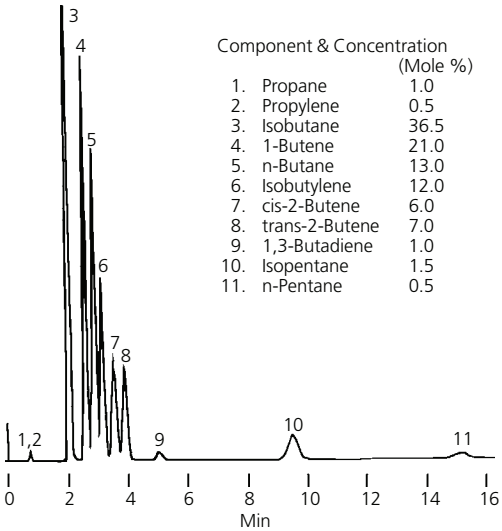
1. Ethane
2. Propane
3. Propylene
4. Isobutane
5. n-Butane
6. 1-Butene/Isobutylene
7. trans-2-Butene
8. cis-2-Butene
9. Isopentane
10. 1,3-Butadiene
11. n-Pentane
12. 1-Pentene
13. 2-Methyl-1-butene/trans-2-Pentene
14. cis-2-Pentene
15. 2-Methyl-2-butene
16. 2-Methyl-1-pentene
17. 3-Methyl-1-pentene
18. n-Hexane
U Unknown
19. 3-Methylhexane




713-0758

### Figure 70. C4 Unsaturates

Packing: **GP 80/100 Carbopack C/0.19% picric acid**
Cat. No.: **11824** (15g)
Column: 2m x 1/8" stainless steel
Cat. No.: **13867** (general configuration column)
Oven: 50°C
Carrier: nitrogen, 30mL/min
Det.: FID
Inj.: 5µL ASTM Section L Blend No. 6




713-0757

# Polymers by Gel Permeation Chromatography

## Silica-Based Columns

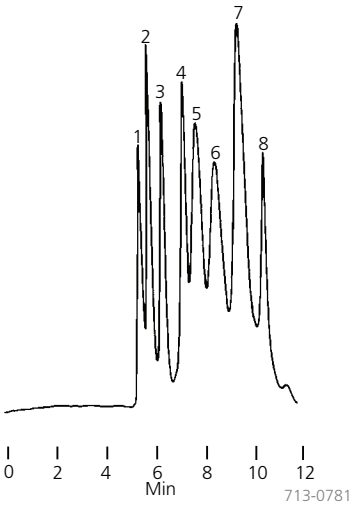
By combining a 100Å pore and a 300Å pore SUPELCOSIL™ column in series, you can separate compounds having molecular weights from 500 to over 500,000 Dalton (Figure 71).

SUPELCOSIL LC-Diol columns are suitable for separating water-soluble synthetic polymers, or for normal phase analyses (Figure 72).

### Figure 71. Polystyrene Standards by Molecular Weight

Column 1: **SUPELCOSIL LC-1, 25cm x 6.2mm ID, 5µm particles***
Cat. No.: **58961**
Column 2: **SUPELCOSIL LC-301, 25cm x 6.2mm ID, 5µm particles, 300Å pores***
Cat. No.: **58966**
Mobile Phase: tetrahydrofuran
Flow Rate: 1mL/min
Temp.: 45°C
Det.: UV, 254nm
Inj.: 10µL, polymer quantities listed

1. 1,800,000 (3.3µg)
2. 300,000 (3.3µg)
3. 100,000 (3.3µg)
4. 35,000 (5.0µg)
5. 17,500 (6.7µg)
6. 9,000 (6.7µg)
7. 2,000 (10.0µg)
8. Toluene (1.7µg)

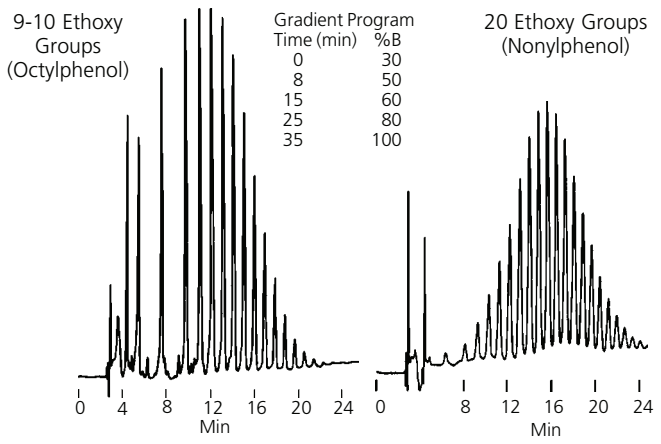



*Columns in series

713-0781

### Figure 72. Nonionic Surfactants Resolved Almost to Baseline (Normal Phase Analysis)

Column: **SUPELCOSIL LC-Diol, 25cm x 4.6mm ID, 5µm particles**
Cat. No.: **58201**
Mobile Phase: A = hexane:methylene chloride (95:5)
B = hexane:methylene chloride:methanol (50:40:10)
Flow Rate: 1mL/min
Temp.: 35°C
Det.: UV, 280nm
Inj.: 10µL methylene chloride containing 20µg surfactant




713-0782,1068

# Low Molecular Weight Compounds by Gas-Solid Chromatography

## Porous Polymers for Highly Consistent Performance

HayeSep® porous polymers are thoroughly cleaned, then conditioned for 12 hours under oxygen-free nitrogen before they are packaged. This careful preparation ensures materials that are highly consistent, with no shrinkage and minimum bleed. And they will perform more consistently than any other commercial polymer you are currently using (Figures 73-77).

**HayeSep N, P, Q, R, S, and T** polymers are interchangeable with the corresponding Porapak® polymers for separating low molecular weight mixtures containing halogenated or sulfur-containing compounds, water, alcohols, glycols, free fatty acids, esters, ketones, or aldehydes.

**HayeSep A** polymer separates permanent gases (hydrogen, nitrogen, oxygen, argon, carbon monoxide, nitric oxide) at ambient temperatures. Use it at higher temperatures to analyze C2 hydrocarbons, hydrogen sulfide, or water.

**HayeSep B** polymer is designed to separate C1 and C2 amines, and trace levels of ammonia and water. It does not require caustic washes before it is packed into a column.

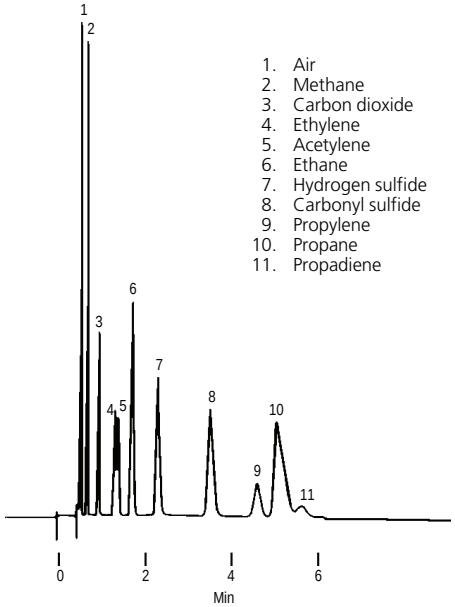
**HayeSep C** polymer is for analyses of polar molecules — such as hydrogen cyanide, ammonia, hydrogen sulfide, and water. Separation characteristics are similar to those of Chromosorb 104 polymer.

**HayeSep D** polymer exhibits superior separation characteristics for light gases. It can be used to isolate carbon monoxide and carbon dioxide from room air at ambient temperatures, or to elute acetylene before other C2 hydrocarbons. It is particularly useful for separations and analyses of water and hydrogen sulfide.

### Figure 73. Hydrocarbons and Sulfur Gases on HayeSep Q

Packing: **HayeSep Q**
Cat. No.: **10301-U** (packing)
Column: 8' x 1/8"
Oven: 90°C
Carrier: helium, 30cc/min

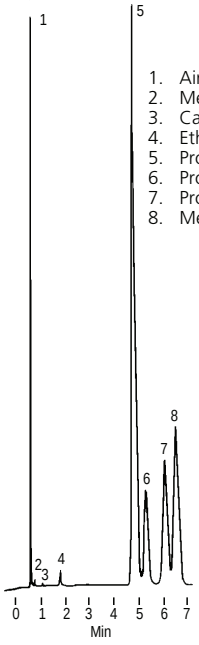
1. Air
2. Methane
3. Carbon dioxide
4. Ethylene
5. Acetylene
6. Ethane
7. Hydrogen sulfide
8. Carbonyl sulfide
9. Propylene
10. Propane
11. Propadiene




795-0251

## Figure 74. Mapp® Gas on HayeSep R

Packing: **HayeSep R**
Cat. No.: **10304** (packing)
Column: 10' x 1/8" stainless steel
Oven: 80°C
Carrier: helium, 30mL/min
Inj.: 15mL



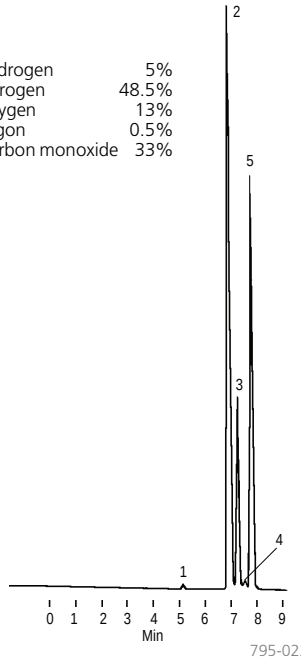

1. Air
2. Methane
3. Carbon dioxide
4. Ethane
5. Propylene
6. Propane
7. Propadiene
8. Methyl acetylene

795-0209

## Figure 75. Permanent Gases on HayeSep A

Packing: **80/100 HayeSep A**
Cat. No.: **10283** (packing)
Column: 36' x 1/8"
Oven: 25°C
Carrier: helium, 23cc/min
Det.: P.E. 900 T.C, 225ma
Inj.: 25mL air plus hydrogen and carbon monoxide

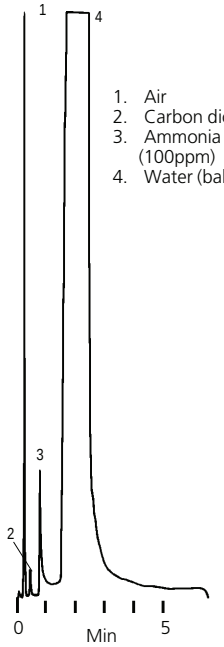
| | |
|---|---|
| 1. Hydrogen | 5% |
| 2. Nitrogen | 48.5% |
| 3. Oxygen | 13% |
| 4. Argon | 0.5% |
| 5. Carbon monoxide | 33% |




795-0226

## Figure 76. Trace Ammonia in Water on HayeSep C

Packing: **80/100 HayeSep C**
Cat. No.: **10289**
Column: 5' x 1/8"
Oven: 115°C
Det.: TCD
Inj.: 1µL



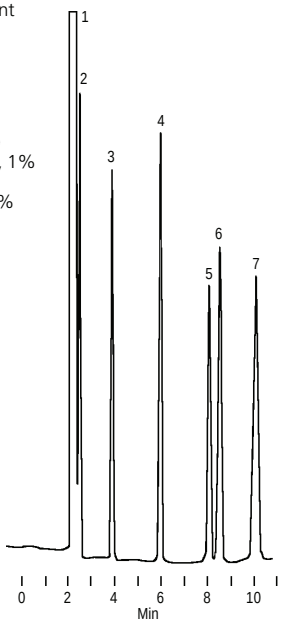

1. Air
2. Carbon dioxide
3. Ammonia (100ppm)
4. Water (balance)

796-0124

## Figure 77. Scott Mix 216 on HayeSep D

Packing: **HayeSep D**
Cat. No.: **10293** (packing)
Column: 20' x 1/8" Ni
Oven: 40°C (2 min) to 110°C at 24°C/min
Carrier: helium, 30mL/min
Det.: P.E. 900 T.C., 225ma, 140°C
Inj.: 100mL, Valco valve, ambient

1. Nitrogen (balance)
2. Carbon monoxide, 1%
3. Methane, 1%
4. Carbon dioxide, 1%
5. Acetylene, 1%
6. Ethylene, 1%
7. Ethane, 1%




795-0210

## Table 4. Characteristics of HayeSep Polymers

| HayeSep Polymer | Maximum Operating Temp. (°C) | Surface Area ($m^2$/gram) | Tapped Bulk Density (gram/cc) | Polarity (1 = lowest; 10 = highest) |
|---|---|---|---|---|
| A | 165 | 526 | 0.356 | 7 |
| B | 190 | 608 | 0.330 | 8 |
| C | 250 | 442 | 0.322 | 6 |
| D | 290 | 795 | 0.3311 | 1 |
| N | 165 | 405 | 0.355 | 9 |
| P | 250 | 165 | 0.420 | 3 |
| Q | 275 | 582 | 0.351 | 2 |
| R | 250 | 344 | 0.324 | 5 |
| S | 250 | 583 | 0.334 | 4 |
| T | 165 | 250 | 0.381 | 10 |

## Ordering Information:

# Capillary Columns for Petrochemical Analysis

## Amines: Carbowax Amine

**For primary, secondary, and tertiary amines** - The Carbowax Amine column is a specially prepared, base-deactivated polyethylene glycol column designed for the analysis of primary, secondary, and tertiary amines and other volatile basic analytes.

**Phase:** nonbonded; base-modified poly(ethylene glycol)
**Temp. Limits:** 60°C to 200°C

## Amines: PTA-5

This column is a specially prepared, base-deactivated poly(5% diphenyl/95% dimethylsiloxane) column designed for analyses of amines and other basic analytes.

**Phase:** bonded; base-modified poly(5% diphenyl/95% dimethylsiloxane)
**Temp. Limits:** -60°C to 320°C

| Length (m) | $D_f$ (µm) | Beta | Cat. No. |
|---|---|---|---|
| **Carbowax Amine** | | | |
| **0.53mm ID Fused Silica** | | | |
| 15 | 1.0 | 133 | **25352** |
| 30 | 1.0 | 133 | **25353** |
| 60 | 1.0 | 133 | **25354** |
| **PTA-5** | | | |
| **0.25mm ID Fused Silica** | | | |
| 30 | 0.50 | 125 | **24277** |
| 30 | 1.0 | 625 | **24330** |
| **0.32mm ID Fused Silica** | | | |
| 30 | 0.5 | 160 | **24331** |
| 30 | 1.0 | 80 | **24332** |
| 30 | 1.5 | 53 | **24333** |
| **0.53mm ID Fused Silica** | | | |
| 30 | 0.5 | 265 | **25437** |
| 30 | 1.5 | 88 | **25438** |
| 30 | 3.0 | 44 | **25439** |

## Aromatics: TCEP

This highly polar phase offers unique polarity for certain separations, despite its relatively low temperature limit and the fact that it is not a bonded phase. Because many aromatic compounds have retention indices greater than 1100 on TCEP, it is used for analyses of aromatics in mineral spirits and impurities in individual aromatics and oxygenates. Maximum, continuous isothermal operation of this column should be limited to under 100°C.

**Phase**: nonbonded; 1,2,3-tris-2-cyano-ethoxypropane
**Temp. Limits:** subambient to 145°C
**McReynolds Nos.:** x'y' z' u' s' = 594 857 759 1031 917

| Length (m) | $D_f$ (µm) | Beta | Cat. No. |
|---|---|---|---|
| **0.25mm ID Fused Silica** | | | |
| 60 | 0.44 | 142 | **24153** |
| **0.32mm ID Fused Silica** | | | |
| 60 | 0.51 | 157 | **24161** |

## Gases: Carboxen™-1006 PLOT▼

**For permanent gases and C1 – C3 light hydrocarbons** - The porous carbon molecular sieve (surface area ~ 750m²/gram) in Carboxen-1006 porous layer open tubular (PLOT) columns separates permanent gases and C1, C2, and C3 light hydrocarbons, using above-ambient initial temperatures. The columns also are ideal for resolving formaldehyde/water/methanol (formalin) mixtures and monitoring impurities in ethylene. Use Carboxen-1006 columns with high flow rates and rapid temperature programs, up to 250°C, to ensure excellent, fast separations.

## Gases: Carboxen-1010 PLOT▼

**For permanent gases, C2 and C3 hydrocarbons** - A carbon molecular sieve column for separating hydrogen, nitrogen, carbon monoxide, methane, carbon dioxide, and C2 and C3 hydrocarbons. Oxygen is separated from nitrogen.

- 0.53mm ID column can be used in packed column chromatographs.

## Gases: Mol Sieve 5A PLOT▼

**For permanent gases** - Oxygen, nitrogen, carbon monoxide and methane can be separated in less than 5 minutes. More difficult separations, such as argon from oxygen, can be achieved by using subambient temperatures (15°C or below).

- 0.53mm ID column can be used in packed column chromatographs.

## Gases: Supel-Q™ PLOT▼

**For many hydrocarbon and other compounds** - Supel-Q PLOT columns contain a porous divinylbenzene polymer that effectively resolves carbon dioxide and C1-C4 hydrocarbons at above ambient temperatures. It also is suitable for analyses of other gases, such as sulfur gases, and alcohols, ketones, aldehydes, and many polar compounds. Gasoline and other petroleum fractions can be analyzed as well. These columns exhibit very little bleed, even at the maximum temperature. Relative to packed columns (e.g., Porapak-Q), Supel-Q PLOT columns offer better resolution in less time.

- 0.53mm ID column can be used in packed column chromatographs.

| Dimensions (fused silica) | Max. Temp. (°C) | Cat. No. |
|---|---|---|
| **Carboxen-1006 PLOT** | | |
| 30m x 0.32mm ID | 250 | **24241-U** |
| 30m x 0.53mm ID | 250 | **25461** |
| **Carboxen-1010 PLOT** | | |
| 30m x 0.32mm ID | 250 | **24246** |
| 30m x 0.53mm ID | 250 | **25467** |
| **Mol Sieve 5A PLOT** | | |
| 30m x 0.32mm ID | 300 | **24243** |
| 30m x 0.53mm ID | 300 | **25463** |
| **Supel-Q PLOT** | | |
| 30m x 0.32mm ID | 250 | **24242** |
| 30m x 0.53mm ID | 250 | **25462** |

▼A proprietary procedure fixes particles to the fused silica tubing and ensures they will not be dislodged in normal use. Manufactured under US patents 5,599,445, 5,607,580, 5,609,756, 5,620,603, and 5,630,937.

## Gases: SCOT Stainless Steel

Support-coated open tubular (SCOT) columns are prepared by depositing a layer of liquid phase-coated support particles on the inner wall of the tubing. This technology, developed by Perkin-Elmer, makes available many phases that cannot be obtained on conventional wall-coated open tubular capillary columns. SCOT columns combine the sensitivity and excellent sample resolution of capillary GC with the extensive stationary phase library of packed column GC.

50' x 1/32'' OD x 0.02'' ID with 1/16'' connections

| Liquid Phase | Max. Temp. (°C) | Cont.▲ Isothermal | Beta | Cat. No. |
|---|---|---|---|---|
| **Stainless Steel SCOT Columns** | | | | |
| Bentone 34/DNDP○ | 150 | 80 | 45 | **25521** |
| BMEA | 100 | 50 | 40 | **25538** |
| Squalane | 120 | 80 | 50 | **25535** |
| TCEP | 150 | 100 | 40 | **25536** |

○Di-n-decylphthalate

▲This glass column is no longer available. Request the same dimensions in a fused silica column, as a custom column.

## High Temperature: HT-5

**For highest-temperature separations** - SGE aluminum-clad columns coated with a carborane phase, offering the highest maximum temperature of any commercially available column. They display low bleed for GC/MS and simulated distillation analyses.

**Phase:** bonded; siloxane-carborane (5% phenyl equivalent)
**Temp. Limits:** 10°C to 460°C

| Length (m) | $D_f$ (µm) | Beta | Cat. No. |
|---|---|---|---|
| **0.32mm ID Fused Silica** | | | |
| 12 | 0.10 | 800 | **25002** |
| 25 | 0.10 | 800 | **25003** |
| **0.53mm ID Fused Silica** | | | |
| 6 | 0.10 | 1325 | **25004** |
| 12 | 0.15 | 883 | **25005-U** |

## Hydrocarbons: Petrocol DH 50.2

**For detailed hydrocarbons analyses** - A narrow bore column for detailed hydrocarbon analyses of naphthas, gasolines, and similar samples, according to ASTM Test Method D5134.

**Phase:** bonded; poly(dimethylsiloxane)
**Temp. Limits:** -60°C to 320°C

## Hydrocarbons: Petrocol DH

**For PNA, PONA, PIANO-type analyses** - A highly reproducible column displaying more than 400,000 theoretical plates, designed for detailed analyses of petroleum products. Includes an extensive retention index data sheet of 400+ analytes.

**Phase:** bonded; poly(dimethylsiloxane)
**Temp. Limits:** -60°C to 320°C

## Hydrocarbons: Petrocol DH 150

**For detailed hydrocarbons analyses** - The longest capillary column commercially available as a stock item. Columns typically display more than 600,000 theoretical plates. For detailed purity analyses of light hydrocarbon gases and petroleum products (oxygenates, solvents, naphthas, gasolines, etc.).

## Hydrocarbons: Petrocol DH Octyl

**For detailed analyses of petroleum products** - This highly reproducible column offers unique selectivity not obtainable with poly(dimethylsiloxane) columns, such as baseline separations of benzene/1-methylcyclopentene and toluene/2,3,3-trimethylpentane.

**Phase:** bonded; poly(50% n-octyl/50% methylsiloxane)
**Temp. Limits:** -60°C to 220°C

| Length (m) | $D_f$ (µm) | Beta | Cat. No. |
|---|---|---|---|
| **Petrocol DH 50.2** | | | |
| **0.20mm ID Fused Silica** | | | |
| 50 | 0.50 | 100 | **24133-U** |
| **Petrocol DH** | | | |
| **0.25mm ID Fused Silica** | | | |
| 100 | 0.50 | 125 | **24160-U** |
| **Petrocol DH 150** | | | |
| **0.25mm ID Fused Silica** | | | |
| 150 | 1.0 | 63 | **24155** |
| **Petrocol DH Octyl** | | | |
| **0.25mm ID Fused Silica** | | | |
| 100 | 0.50 | 125 | **24282** |

## SIMDIS: Petrocol 2887

**For ASTM Test Method D2887** - Developed and tested to meet or exceed column performance requirements for simulated distillation of petroleum fractions having boiling points up to 1000°F, according to ASTM Test Method D2887.

**Phase:** bonded; poly(dimethylsiloxane)
**Temp. Limits:** subambient to 350°C

## SIMDIS: Petrocol EX2887

**For extended ASTM Test Method D2887** - A thin film version of the Petrocol 2887 column, developed for extended D2887 SIMDIS analysis of samples having final boiling points greater than 1000°F.

**Phase:** bonded; poly(dimethylsiloxane)
**Temp. Limits:** subambient to 380°C

| Length (m) | $D_f$ (µm) | Beta | Cat. No. |
|---|---|---|---|
| **Petrocol 2887** | | | |
| **0.53mm ID Fused Silica** | | | |
| 5■ | 0.50 | 265 | **25323** |
| 5◗ | 0.50 | 265 | **25380-U** |
| **Petrocol EX2887** | | | |
| **0.53mm ID Fused Silica** | | | |
| 5 | 0.10 | 1325 | **25337** |

■5" cage
◗8" cage

## SPB-1 Thin Film and SPB-1 Thick Film

Nonpolar methylsilicone columns that separate sample components according to boiling point. This bonded polymer matches the polarity of its nonbonded predecessors, SE-30 and SP-2100. The SPB-1 phase is used in many of our Petrocol specialty columns.

**Operating Conditions:** Chemically compatible with water and other injection solvents. Sensitive to strong inorganic acids and bases, stable to low levels of HCl in non-aqueous samples. Not damaged by organic acids or bases. Columns can be rinsed.

**Phase:** bonded; poly(dimethylsiloxane)
**Temp. Limits:** -60°C to 320°C
**McReynolds Nos.:** x' y' z' u' s' = 4 58 43 56 38

| Length (m) | $D_f$ (µm) | Beta | Cat. No. |
|---|---|---|---|
| **0.10mm ID Fused Silica** | | | |
| 15 | 0.10 | 250 | **24338** |
| **0.25mm ID Fused Silica** | | | |
| 30 | 0.10 | 625 | **24261** |
| **0.32mm ID Fused Silica** | | | |
| 30 | 0.10 | 800 | **24290** |
| 30 | 5.0 | 16 | **24296** |
| 60 | 5.0 | 16 | **24297** |
| **0.53mm ID Fused Silica** | | | |
| 15 | 0.10 | 1325 | **25360** |
| 30 | 0.10 | 1325 | **25361** |
| 15 | 3.0 | 44 | **25340** |
| 30 | 3.0 | 44 | **25341-U** |
| 60 | 3.0 | 44 | **25348** |
| 15 | 5.0 | 27 | **25344** |
| 30 | 5.0 | 27 | **25345-U** |
| 60 | 5.0 | 27 | **25349** |

## SPB-5 Thin Film and SPB-5 Thick Film

The low phenyl content, 5%, improves thermal stability of the phase, while still providing essentially a boiling point elution order, and a slight increase in selectivity, especially for aromatic compounds.

**Operating Conditions:** Chemically compatible with water and other injection solvents. Sensitive to strong inorganic acids and bases, stable to low levels of HCl in non-aqueous samples. Not damaged by organic acids or bases. Columns can be rinsed.

**Phase:** bonded; poly(5% diphenyl 95% dimethylsiloxane)
**Temp. Limits:** -60°C to 320°C
**McReynolds Nos.:** x' y' z' u' s' = 19 74 64 93 62

| Length (m) | $D_f$ (µm) | Beta | Cat. No. |
|---|---|---|---|
| **0.10mm ID Fused Silica** | | | |
| 15 | 0.10 | 250 | **24341** |
| **0.53mm ID Fused Silica** | | | |
| 15 | 3.0 | 44 | **25342** |
| 30 | 3.0 | 44 | **25343** |
| 60 | 3.0 | 44 | **25350** |
| 15 | 5.0 | 27 | **25346** |
| 30 | 5.0 | 27 | **25347** |
| 60 | 5.0 | 27 | **25351** |

## Solvents: OVI-G43

**For USP Analysis of organic volatile impurities (OVIs)** - This column is specially prepared and tested to meet the requirements of United States Pharmacopoeia (USP) Method 467 and the European Pharmacopoeia general method for determining residual organic solvents in pharmaceutical preparations. Use this column to separate OVIs for research purposes or qualitative analysis. The USP and European Pharmacopoeia methods also specify using a deactivated 5-meter guard column.

**Phase:** bonded; poly(6% cyanopropylphenyl/ 94% dimethylsiloxane)
**Temp. Limits:** -20°C to 260°C

| Length (m) | $D_f$ (µm) | Beta | Cat. No. |
|---|---|---|---|
| **0.53mm ID Fused Silica** | | | |
| 30 | 3.0 | 44 | **25396** |

| Description | Cat. No. |
|---|---|
| **Deactivated Guard Column for OVI-G43** | |
| 5m x 0.53mm ID | **25339** |
| **Other Columns for Residual Solvents Analysis** | |
| G27 (SPB-5) 30m x 0.53mm ID, 5.0µm | **25347** |
| G16 (SUPELCOWAX 10) 30m x 0.53mm ID, 1.0µm | **25301-U** |

## Sulfur Compounds (Volatile): SPB-1 SULFUR

A very thick film version of our SPB-1 columns, specially developed for analyses of sulfur gases and other volatile sulfur compounds. The column displays relatively low column bleed, even for the exceptionally thick film (4µm) of stationary phase, which makes it compatible for use with the Sievers Sulfur Chemiluminescence Detector (SCD) and other sulfur-specific detectors.

**Phase:** bonded; poly(dimethylpolysiloxane)
**Temp. Limits:** -60°C to 300°C

| Length (m) | $D_f$ (µm) | Beta | Cat. No. |
|---|---|---|---|
| **0.32mm ID Fused Silica** | | | |
| 30 | 4.0 | 20 | **24158** |

## Supelco Columns and Packings Used in Figures 1-75, Listed by Application
For columns of other dimensions, refer to pages 28-30, or see the current Supelco catalog.

| Description | Cat. No. |
|---|---|
| **Detailed Hydrocarbons Analyses** | |
| **Petrocol DH Fused Silica Capillary Column** | |
| 100m x 0.25mm ID, 0.50µm film | **24160-U** |
| **Petrocol DH 50.2 Fused Silica Capillary Column** | |
| 50m x 0.20mm ID, 0.50µm film | **24133-U** |
| **Petrocol DH 150 Fused Silica Capillary Column** | |
| 150m x 0.25mm ID, 1.0µm film | **24155** |
| **Petrocol DH Octyl Fused Silica Capillary Columns** | |
| 100m x 0.25mm ID, 0.5µm film | **24282** |
| **Light Hydrocarbons** | |
| **SPB-1 Thick Film Fused Silica Capillary Column** | |
| 60m x 0.53mm ID, 5µm film | **25349** |
| **SPB-5 Thick Film Fused Silica Capillary Column** | |
| 60m x 0.53mm ID, 3µm film | **25343** |
| **High Boiling Hydrocarbons** | |
| **SPB-1 Thin Film Fused Silica Capillary Columns** | |
| 15m x 0.53mm ID, 0.10µm film | **25360** |
| 30m x 0.53mm ID, 0.10µm film | **25361** |
| **Oxygenates** | |
| **Petrocol DH Octyl Fused Silica Capillary Columns** | |
| 100m x 0.25mm ID, 0.5µm film | **24282** |
| **Petrocol DH 150 Fused Silica Capillary Column** | |
| 150m x 0.25mm ID, 1.0µm film | **24155** |
| **Simulated Distillation By Packed Column GC** | |
| **Petrocol A Column** | |
| 20" x 1/8" stainless steel | **12445** |
| **Petrocol B Column** | |
| 20" x 1/8" stainless steel | **12449** |
| **Simulated Distillation By Capillary GC** | |
| **Petrocol 2887 Capillary Column** | |
| 5m x 0.53mm ID fused silica, 0.5µm film | **25323** |
| **Polynuclear Aromatic Hydrocarbons in Gasoline** | |
| **SPB-5 Fused Silica Capillary Column** | |
| 30m x 0.25mm ID, 0.25µm film | **24034** |
| **Miscellaneous Petrochemicals Analyses** | |
| **Petrocol DH 50.2 Fused Silica Capillary Column** | |
| 50m x 0.20mm ID, 0.50µm film | **24133-U** |
| **SPB-1 Capillary Columns** | |
| 60m x 0.75mm ID glass, 1.0µm film▲ | |
| 30m x 0.53mm ID fused silica, 0.50µm film | **25315** |
| **SPB-20 Fused Silica Capillary Column** | |
| 30m x 0.25mm ID, 0.25µm film | **24086** |
| **Nukol Fused Silica Capillary Column** | |
| 30m x 0.53mm ID, 0.50µm film | **25327** |
| **Petrocol DH Octyl Fused Silica Capillary Columns** | |
| 100m x 0.25mm ID, 0.5µm film | **24282** |
| **Phenols / Polymers** | |
| **Nukol Fused Silica Capillary Column** | |
| 30m x 0.25mm ID, 0.25µm film | **24107** |
| **SPB-5 Fused Silica Capillary Column** | |
| 30m x 0.53mm ID, 1.5µm film | **25305-U** |

| Description | Cat. No. |
|---|---|
| **Solvents** | |
| **SPB-1 Capillary Columns** | |
| 30m x 0.32mm ID fused silica, 1.0µm film | **24045-U** |
| **SUPELCOWAX 10 Capillary Columns** | |
| 30m x 0.53mm ID fused silica, 1.0µm film | **25301-U** |
| **Nukol Wide Bore Capillary Column** | |
| 30m x 0.53mm ID, 0.5µm film | **25327** |
| **SPB-1 Thick Film Fused Silica Capillary Columns** | |
| 60m x 0.53mm ID, 5µm film | **25349** |
| 30m x 0.53mm ID, 3µm film | **25341-U** |
| **Impurities in Solvents** | |
| **SUPELCOWAX 10 Fused Silica Capillary Columns** | |
| 30m x 0.32mm ID, 0.25µm film | **24080-U** |
| 30m x 0.32mm ID, 0.5µm film | **24084** |
| 15m x 0.53mm ID, 1µm film | **25300-U** |
| **Nukol Fused Silica Capillary Column** | |
| 30m x 0.32mm ID, 0.25µm film | **24131** |
| **High Resolution or High Speed Analyses** | |
| **SUPELCOWAX 10 Fused Silica Capillary Columns** | |
| 30m x 0.20mm ID, 0.20µm film | **24169** |
| 60m x 0.20mm ID, 0.20µm film | **24170** |
| **Aromatics / Aliphatics by Packed Column GC** | |
| **Packings (20g)** | |
| GP 10% TCEP on 100/120 Chromosorb® P AW | **12106-U** |
| GP 10% TCEP on 80/100 Chromosorb P AW | **12122** |
| GP 35% BC-120 on 100/120 Chromosorb P AW DMCS | **11834** |
| GP 35% BC-150 on 100/120 Chromosorb P AW DMCS | **11840-U** |
| 10% SP™-2100 on 100/120 SUPELCOPORT™ | **11989** |
| 10% SP-2100 on 80/100 SUPELCOPORT | **12140** |
| GP 5% SP-1200/1.75% Bentone® 34 on 100/120 SUPELCOPORT | **12134** |
| GP 5% SP-1200/5% Bentone 34 on 100/120 SUPELCOPORT | **12133** |
| **Packings (Other Quantities)** | |
| 80/100 Carbopack™ C/0.1% SP-1000 | |
| 15g | **11820** |
| 7g | **11908** |
| 60/80 Carbopack F-TA packing is available in packed columns only. | |
| **C1-C6 Hydrocarbons by Packed Column GC** | |
| 23% SP-1700 on 80/100 Chromosorb P AW packing in a 30' x 1/8" stainless steel column, general configuration (6" coil, 8" arms) | **12809-U** |
| Inquire about other configurations or lengths. | |
| **Packings** | |
| 23% SP-1700 on 80/100 Chromosorb P AW (25g) (21-22g fills a 30" x 1/8" column) | **11865** |
| GP 80/100 Carbopack C/0.19% picric acid (15g) | **11824** |

▲This glass column is no longer available. Request the same dimensions in a fused silica column (custom column).

## Low Molecular Weight Compounds by Gas-Solid Chromatography

## HayeSep Polymers

HayeSep porous polymers are thoroughly cleaned and conditioned before they are packaged, which ensures high consistency, and minimal shrinkage and bleed. Uses include the analysis of low molecular weight halogenated and sulfur-containing compounds, water, alcohols, glycols, free fatty acids, esters, ketones and aldehydes. These polymers also are used for separating hydrocarbons, ammonia, and other solvents. (Request HayeSep Application Bulletin available from Supelco).

### HayeSep A

Copolymer of high-purity divinylbenzene and ethylene glycol dimethacrylate. Separates permanent gases at ambient temperatures. Use at higher temperatures to analyze C2 hydrocarbons, hydrogen sulfide, and water.

### HayeSep B

Copolymer of divinylbenzene and polyethyleneimine. Separates C1 and C2 amines and trace levels of ammonia and water.

### HayeSep C

USP code [S10]. Copolymer of divinylbenzene and acrylonitrile. For the analysis of polar molecules. Separation characteristics are similar to those of Chromosorb 104.

### HayeSep D

High-purity divinylbenzene polymer. Exhibits superior separation characteristics for light gases, carbon monoxide, carbon dioxide, and acetylene (ahead of other C2 hydrocarbons). For the analysis of water and hydrogen sulfide.

### HayeSep N

Copolymer of divinylbenzene and ethylene glycol dimethylacrylate.

### HayeSep P

Copolymer of divinylbenzene and styrene.

### HayeSep Q

USP code [S3]. Divinylbenzene polymer.

### HayeSep R

USP code [S4]. Copolymer of divinyl-benzene and N-vinyl-2-pyrollidone.

### HayeSep S

USP code [S8]. Copolymer of divinyl-benzene and 4-vinyl-pyridine.

### HayeSep T

Polymer of ethylene glycol dimethacrylate.

## Accessories for Analyzing High Boiling Hydrocarbons (page 9)

| Description | Cat. No. |
|---|---|
| **Cool On-Column Injection Sleeve Kit** | **23630** |
| **Hamilton® 701 Syringe** | |
| With 6" fixed needle | **21574** |
| **Polywax® 655** | |
| 6 x 1mL | **48482** |

## HayeSep® Porous Polymers (75cc bottles)

| HayeSep Series | Mesh Size | Use | Max. Temp. (°C) | Cat.No. |
|---|---|---|---|---|
| HayeSep A | 60/80 | permanent gases | 165 | **10282** |
| | 80/100 | | | **10283** |
| | 100/120 | | | **10284** |
| HayeSep B | 60/80 | C1-C2 amines, | 190 | **10285** |
| | 80/100 | ammonia in $H_2O$ | | **10286** |
| | 100/120 | | | **10287** |
| HayeSep C | 60/80 | polar compounds | 250 | **10288** |
| | 80/100 | | | **10289** |
| | 100/120 | | | **10290** |
| HayeSep D | 60/80 | light gases, CO, $CO_2$ | 290 | **10291** |
| | 80/100 | | | **10292** |
| | 100/120 | | | **10293** |
| HayeSep DB• | 60/80 | light gases,CO, $CO_2$ | 290 | **10297-U** |
| | 80/100 | | | **10280-U** |
| | 100/120 | | | **10281-U** |
| HayeSep N | 60/80 | acetylene, ethylene | 165 | **10294** |
| | 80/100 | | | **10295** |
| | 100/120 | | | **10296** |
| HayeSep P | 60/80 | ammonia, | 250 | **10297** |
| | 80/100 | alcohols in water | | **10298** |
| | 100/120 | | | **10299** |
| HayeSep Q | 60/80 | hydrocarbons, | 275 | **10300-U** |
| | 80/100 | sulfur gases, | | **10301-U** |
| | 100/120 | general | | **10302** |
| HayeSep R | 60/80 | light hydrocarbons, | 250 | **10303** |
| | 80/100 | chlorinated | | **10304** |
| | 100/120 | compounds | | **10305-U** |
| HayeSep S | 60/80 | C2-C3 hydrocarbons | 250 | **10306** |
| | 80/100 | polar compounds | | **10307** |
| | 100/120 | | | **10308** |
| HayeSep T | 60/80 | light hydrocarbons | 165 | **10309** |
| | 80/100 | formaldehyde | | **10310** |
| | 100/120 | | | **10311** |

### Polymers by Gel Permeation Chromatography

#### SUPELCOSIL Silica-Based HPLC Columns

| Phase Particle, Pore Size | Column Length (cm) | Cartridge with Fittings 4.6mm ID Cartridge Cat. No. | 4.0mm ID Cartridge Cat. No. | 3.0mm ID Cartridge Cat. No. |
|---|---|---|---|---|
| **LC-1** | | | | |
| 5µm, 120Å | 5 | **58237** | | **58237C30** |
| | 15 | **58210U** | **58210C40** | **58210C30** |
| | 25 | **58296** | | |
| **LC-Diol** | | | | |
| 5µm, 120Å | 25 | **58201** | **58201C40** | **58201C30** |

#### SUPELCOSIL Preparative Scale HPLC Columns

| Phase Particle, Pore Size | Column Length (cm) | Cartridge with Fittings 6.2mm ID Cartridge Cat. No. |
|---|---|---|
| **LC-Si** | | |
| 5µm, 120Å | 25 | **58963** |
| **LC-1** | | |
| 5µm, 100Å | 25 | **58961** |
| **LC-Diol** | | |
| 5µm, 300Å | 25 | **58967** |
| **LC-3Si** | | |
| 5µm, 300Å | 25 | **58965** |
| **LC-301** | | |
| 5µm, 300Å | 25 | **58966** |
| **LC-3Diol** | | |
| 5µm, 300Å | 25 | **58968** |

•Deactivated for basic compounds.

## P-N-A, P-O-N-A, P-I-A-N-O Analyses

Use these mixes to determine retention times and indices and monitor response factors for components of complex mixtures of hydrocarbons. These standards are complex mixes of known quantities of hydrocarbons, accurately prepared by weight to **three decimal places.** Typical values are listed here; exact values will differ slightly from lot to lot.

- Formulations are weight percent.
- Each mix includes a detailed data sheet listing components by weight percent, mole percent, and liquid volume percent, retention times and retention indices for each component, and other information.
- A chromatogram from a 100-meter Petrocol DH capillary column (including conditions) is provided.
- Products are supplied in crimp-top vials with hole caps and septa. The shelf life of the unopened, refrigerated mixes is 1 year.

## Quantitative Reference Standards

| Mixes and Solutions | Composition | | Qty. | Cat. No. |
|---|---|---|---|---|
| n-Paraffins Mix[n] | *11 n-paraffins (typical values shown)* | | 0.1mL | **44585-U** |
| | n-Pentane, 11.393% | n-Undecane, 7.645% | | |
| | n-Hexane, 10.963% | n-Dodecane, 7.768 % | | |
| | n-Heptane, 12.239% | n-Tridecane, 6.371% | | |
| | n-Octane, 10.088% | n-Tetradecane, 5.903% | | |
| | n-Nonane, 13.204% | n-Pentadecane, 7.723% | | |
| | n-Decane, 6.703% | | | |
| Isoparaffins Mix[n] | *37 isoparaffins (typical values shown)* | | 0.1mL | **44586-U** |
| | Isopentane, 2.553% | 3-Methylheptane, 3.785% | | |
| | 2,3-Dimethylbutane, 1.438% | 3-Ethylhexane, 2.927% | | |
| | 2-Methylpentane, 4.356% | 2,5-Dimethylheptane, 3.081% | | |
| | 3-Methylpentane, 3.147% | 3,5-Dimethylheptane (D), 0.378% | | |
| | 2,2-Dimethylpentane, 4.189% | 3,3-Dimethylheptane, 3.258% | | |
| | 2,4-Dimethylpentane, 3.116% | 3,5-Dimethylheptane (L), 0.378% | | |
| | 2,2,3-Trimethylbutane, 3.149% | 2,3-Dimethylheptane, 1.540% | | |
| | 3,3-Dimethylpentane, 1.308% | 3,4-Dimethylheptane (D), 1.722% | | |
| | 2-Methylhexane, 3.551% | 3,4-Dimethylheptane (L), 2.022% | | |
| | 2,3-Dimethylpentane, 1.612% | 2-Methyloctane, 5.093% | | |
| | 3-Methylhexane, 4.456% | 3-Methyloctane, 2.731% | | |
| | 3-Ethylpentane, 1.600% | 3,3-Diethylpentane, 3.335% | | |
| | 2,2-Dimethylhexane, 1.439% | 2,2-Dimethyloctane, 3.126% | | |
| | 2,5-Dimethylhexane, 3.195% | 3,3-Dimethyloctane, 1.718% | | |
| | 2,2,3-Trimethylpentane, 3.185% | 2,3-Dimethyloctane, 1.646% | | |
| | 2,4-Dimethylhexane, 1.574% | 2-Methylnonane, 3.343% | | |
| | 2,3-Dimethylhexane, 1.365% | 3-Ethyloctane, 3.301% | | |
| | 2-Methylheptane, 4.641% | 3-Methylnonane, 3.387% | | |
| | 4-Methylheptane, 3.377% | | | |
| Naphthenes Mix[n] | *30 naphthenes (typical values shown)* | | 0.1mL | **44588** |
| | Cyclopentane, 5.805% | ccc-1,2,3-Trimethylcyclopentane, 1.622% | | |
| | Methylcyclopentane, 8.728% | Isopropylcyclopentane, 1.853% | | |
| | Cyclohexane, 5.758% | cis-1,2-Dimethylcyclohexane, 3.065% | | |
| | 1,1-Dimethylcyclopentane, 3.370% | n-Propylcyclopentane, 1.966% | | |
| | cis-1,3-Dimethylcyclopentane, 1.962% | ccc-1,3,5-Trimethylcyclohexane, 2.983% | | |
| | trans-1,3-Dimethylcyclopentane, 2.689% | 1,1,4-Trimethylcyclohexane, 4.873% | | |
| | trans-1,2-Dimethylcyclopentane, 3.087% | ctt-1,2,4-Trimethylcyclohexane, 1.501% | | |
| | Methylcyclohexane, 8.992% | ctc-1,2,4-Trimethylcyclohexane, 3.510% | | |
| | Ethylcyclopentane, 1.773% | 1,1,2-Trimethylcyclohexane, 3.324% | | |
| | ctc-1,2,4-Trimethylcyclopentane, 3.721% | Isobutylcyclopentane, 3.419% | | |
| | ctc-1,2,3-Trimethylcyclopentane, 3.419% | Isopropylcyclohexane, 3.437% | | |
| | cct-1,2,4-Trimethylcyclopentane, 1.438% | n-Butylcyclopentane, 3.420% | | |
| | trans-1,4-Dimethylcyclohexane, 3.713% | Isobutylcyclohexane, 3.805% | | |
| | 1-Ethyl-1-methylcyclopentane, 1.634% | t-1-Methyl-2-propylcyclohexane, 3.576% | | |
| | trans-1,2-Dimethylcyclohexane, 3.644% | t-1-Methyl-2-(4MP)cyclopentane, 1.636% | | |
| Olefins Mix[n] | *25 olefins (typical values shown)* | | 0.1mL | **44589** |
| | 3-Methyl-1-butene, 1.478% | trans-3-Heptene, 2.173% | | |
| | 1-Pentene, 5.640% | cis-3-Heptene, 4.587% | | |
| | 2-Methyl-1-butene, 1.880% | trans-2-Heptene, 2.206% | | |
| | 2-Methyl-1,3-butadiene, 2.389% | cis-2-Heptene, 4.338% | | |
| | trans-2-Pentene, 4.024% | 1-Octene, 8.220% | | |
| | cis-2-Pentene, 2.305% | trans-2-Octene, 2.206% | | |
| | 4-Methylpentene-1 | cis-2-Octene, 4.766% | | |
| | 1-Hexene, 7.693% | 1-Nonene, 9.192% | | |
| | trans-2-Hexene, 1.744% | trans-3-Nonene, 2.256% | | |
| | 2-Methylpentene-2, 4.054% | cis-3-Nonene, 1.946% | | |
| | cis-2-Hexene, 1.825% | trans-2-Nonene, 2.091% | | |
| | 1-Heptene, 8.716% | cis-2-Nonene, 1.881% | | |
| | 1-Decene, 7.665% | | | |

■ For information on a kit containing these products, see the following page (Cat. No. 44594-U).

| Mixes and Solutions | Composition | Qty. | Cat. No. |
|---|---|---|---|
| Aromatics Mix | *37 aromatics (typical values shown)*<br>Benzene, 3.139%<br>Toluene, 4.563%<br>Ethylbenzene, 1.570%<br>m-Xylene, 2.939%<br>p-Xylene, 2.982 %<br>o-Xylene, 3.208%<br>Isopropylbenzene, 3.127%<br>n-Propylbenzene, 1.705%<br>1-Methyl-3-ethylbenzene, 2.903%<br>1-Methyl-4-ethylbenzene, 3.166%<br>1,3,5-Trimethylbenzene, 3.427%<br>1-Methyl-2-ethylbenzene, 4.460%<br>1,2,4-Trimethylbenzene, 4.315%<br>tert-Butylbenzene, 2.667%<br>Isobutylbenzene, 0.845%<br>sec-Butylbenzene, 1.469%<br>1-Methyl-3-isopropylbenzene, 1.403%<br>1-Methyl-4-isopropylbenzene, 2.789%<br>1-Methyl-2-isopropylbenzene, 2.631%<br>1-Methyl-3-n-propylbenzene, 3.214%<br>1-Methyl-4-n-propylbenzene, 1.444%<br>n-Butylbenzene, 2.894%<br>1,3-Dimethyl-5-ethylbenzene, 1.306%<br>1,2-Diethylbenzene, 3.063%<br>1-Methyl-2-n-propylbenzene, 1.449%<br>1,4-Dimethyl-2-ethylbenzene, 2.985%<br>1,2-Dimethyl-4-ethylbenzene, 2.706%<br>1,3-Dimethyl-2-ethylbenzene, 2.702%<br>1,2-Dimethyl-3-ethylbenzene, 2.956%<br>1,2,4,5-Tetramethylbenzene, 1.966%<br>2-Methylbutylbenzene, 1.432%<br>n-Pentylbenzene, 1.466%<br>t-1-Butyl,3,5-dimethylbenzene, 2.920%<br>t-1-Butyl-4-ethylbenzene, 2.900%<br>1,3,5-Triethylbenzene, 1.850%<br>1,2,4-Triethylbenzene, 3.104%<br>n-Hexylbenzene, 4.641% | 0.1mL | **44587** |
| P-I-A-N-O Mix | *139 n-paraffins, isoparaffins, aromatics, naphthenes, and olefins*<br>A quantitative mix of the components in the five mixes described above and on the previous page. Data sheets for each class of compounds list weight percent, mole percent, and other information for each component.<br>Approximate weight percentages:<br>n-Paraffins, 18.9%<br>Isoparaffins, 18.8%<br>Aromatics, 23.3%<br>Naphthenes, 20.5%<br>Olefins, 18.5% | 0.1mL | **44593-U** |
| P-I-A-N-O Kit | *One of each of the following mixes*<br>n-Paraffins Mix (44585-U)<br>Isoparaffins Mix (44586-U)<br>Naphthenes Mix (44588)<br>Olefins Mix (44589)<br>Aromatics Mix (44587)<br>P-I-A-N-O Mix (44593-U) | | **44594-U** |

P000165

**Included with P-I-A-N-O Mix and P-I-A-N-O Kit, Data Disc Makes it Easier to Organize P-I-A-N-O Data**

The P-I-A-N-O CertaDisc Certification Worksheet and Database can greatly simplify the task of organizing certification data. A worksheet (Lotus 1-2-3 format) contains complete certification data for the n-paraffins, isoparaffins, aromatics, naphthenes, and olefins mixes, and for the P-I-A-N-O mixture. Calculations are easily performed with a few key-strokes. dBase III PLUS programs, designed for use with the Lotus worksheet, include information on all 139 compounds. The programs enable you to perform searches based on retention times, making it easier to identify peaks.

3½", 1.44 MEG disc. The disc is identified by product lot number.

## ASTM D5134

## Detailed Analysis of Petroleum Naphthas Through n-Nonane

| Mixes and Solutions | Composition | Qty. | Cat. No. |
|---|---|---|---|
| ASTM D5134 Qualitative Column Evaluation Mix | *Nominal 0.5-1.0% by weight in 2-methylpentane*<br>Use this mix of hydrocarbons for assessing column performance.<br>Toluene, 0.5% — 2,3,3-Trimethylpentane, 1% — 4-Methylheptane, 1%<br>n-Heptane, 1% — 2-Methylheptane, 1% — n-Octane, 1% | 1mL | **502103** |
| ASTM D5134 Splitter Linearity Check Mix | *Neat at 10% by weight, each component*<br>Use this quantitative mix of hydrocarbons to determine proper system performance and detector response factors.<br>n-Hexane — Benzene — 2,4-Dimethylhexane<br>n-Heptane — Toluene — 2-Methylheptane<br>n-Octane — 2-Methylhexane — 2,4-Dimethylheptane<br>n-Nonane | 500mg | **506753** |
| 2,3,3-Trimethylpentane | *Neat* | 500mg | **502081** |

## Highly Characterized Reference Materials

The following standards, taken from refinery process streams and exhaustively analyzed by GC/FID and GC/MS, are recommended for evaluating process performance, identifying sources of contamination, PIANO analysis, method development, and training. Each comes with a comprehensive data packet containing quantitative and qualitative data and chromatograms using a 100-meter Petrocol DH column.

| Description | Qty. | Cat. No. |
|---|---|---|
| Petroleum Refinery Reformate | 1mL | **47489** |
| Petroleum Refinery Pyrolysis Gasoline (Py Gas) | 1mL | **47490-U** |
| Petroleum Refinery Heavy Straight Run Naphtha | 1mL | **47488** |

## Qualitative Reference Materials

These refinery reference materials are the actual materials used in the ASTM D5134 round-robin method validation stage. They are referred to in the method, and are used for establishing component retention times for identification purposes. Each sample is accompanied by a comprehensive data booklet containing an expanded detailed chromatogram from a Petrocol DH 50.2 column, with identified peaks.

| Mixes and Solutions | Composition | Qty. | Cat. No. |
|---|---|---|---|
| ASTM D5134 Qualitative Reference Alkylate Standard | *Approximately 30 identified components. Neat fraction.*<br>Actual refinery alkylation product | 6 x 1mL | **48267-U** |
| ASTM D5134 Qualitative Reference Reformate Standard | *Approximately 70 identified components. Neat fraction.*<br>Actual refinery reformate product | 6 x 1mL | **48266** |
| ASTM D5134 Qualitative Reference Naphtha Standard | *Approximately 100 identified components. Neat fraction.*<br>Actual refinery naphtha product | 6 x 1mL | **48265-U** |
| ASTM D5134 Qualitative Reference Refinery Standards Kit | *2 x 1mL each of the three qualitative reference standards (alkylate, naphtha, and reformate)* | | **48268** |

We can custom-manufacture petroleum standards. Please inquire.

## ASTM D5442

**Analysis of Petroleum Waxes by GC -** Qualitative and quantitative mixes of n-paraffins used for determining column resolution, retention times, response factors, and internal standard preparation.

| Mixes and Solutions | Composition | Qty. | Cat. No. |
|---|---|---|---|
| ASTM D5442 Column Resolution Test Mix | *0.05 weight percent each of nC20 and nC24 in cyclohexane*<br>Use to determine column resolution. | 6 x 1mL | **506729** |
| **Retention Time Standards** | | | |
| ASTM D5442 C16-C44 Retention Time Mix | *Neat qualitative n-paraffins, each at 8.3 weight percent*<br>Use to establish retention times from C16 to C44<br>C16 C18 C20 C22 C24 C26 C28 C30 C32 C36 C40 C44 | 500mg | **502251** |
| ASTM D5442 C12-C60 Retention Time Mix | *Neat qualitative n-paraffins, each at 6.25 weight percent*<br>Use to establish retention times from C12 to C60<br>C12 C14 C16 C18 C20 C22 C24 C26 C28 C30 C32 C36 C40 C44 C50 C60 | 500mg | **500623** |
| **Quantitative Linearity Standards** | | | |
| ASTM D5442 C16-C44 Linearity Standard | *n-Paraffins, each at 0.01 weight percent*<br>Accurately prepared mix.<br>Use to determine response factors from C16 to C44.<br>C16 C18 C20 C22 C24 C26 C28 C30 C32 C36 C40 C44 | 1mL<br>6 x 1mL | **502278**<br>**502286** |
| ASTM D5442 C12-C60 Linearity Standard | *n-Paraffins, each at 0.01 weight percent*<br>Accurately prepared mix.<br>Use to determine response factors from C12 to C60.<br>C12 C14 C16 C18 C20 C22 C24 C26 C28 C30 C32 C36 C40 C44 C50 C60 | 1mL<br>6 x 1mL | **502243**<br>**502235** |
| **Internal Standards** | | | |
| ASTM D5442 n-Hexadecane Internal Standard | *n-Hexadecane (nC16), neat or in solution, added to the internal standard.* | 5mL | **506699** |

### Qualitative n-Paraffin Mixes

For determining retention indices and retention times.

| Chemical Name | Concentration | Qty. | Cat. No. |
|---|---|---|---|
| n-Paraffin Mix C5, C6, C7, C8 | *Neat, varied concentrations* 500mg | | **47100** |
| n-Paraffin Mix C7, C8, C9, C10 | *Neat, varied concentrations* 500mg | | **47101** |
| n-Paraffin Mix C10, C12, C14, C16 | *Neat, varied concentrations* 500mg | | **47102** |
| n-Paraffin Mix C18, C20, C22, C24 | *2% (wt./wt.) each n-paraffin in n-octane* | 5mL | **47108** |
| n-Paraffin Mix C22, C24, C28, C32 | *2% (wt./wt.) each n-paraffin in n-octane* | 5mL | **47106** |
| n-Paraffin Mix C24, C28, C32, C36 | *2% (wt./wt.) each n-paraffin in n-octane* | 5mL | **47107** |

### High Molecular Weight Hydrocarbon Standards

For high temperature SIMDIS or GC analyses. Polywax materials are polyethylene waxes having average molecular weights of 500 and 655 Dalton, respectively. Ethylene oligomers range in carbon number from approximately C20 to C100+ and are useful for establishing retention times.

| Description | Concentration | Qty. | Cat. No. |
|---|---|---|---|
| Pentacontane (nC50) | *Neat* | 50mg | **48595** |
| Hexacontane (nC60) | *Neat* | 50mg | **48893** |
| Polywax 500 | *Neat* | 5000mg | **48475** |
| Polywax 500 | *10,000µg/mL in p-xylene* | 6 x 1mL | **48480-U** |
| Polywax 655 | *Neat* | 5000mg | **48477** |
| Polywax 655 | *10mg/mL in p-xylene* | 6 x 1mL | **48482** |

## ASTM D3710

**Boiling Range Distribution of Gasoline (500°F maximum) -** These qualitative and quantitative hydrocarbon blends are prepared according to ASTM recommendations. Calibration mixes are either volume/volume or weight/weight formulations as indicated. Nominal concentration of actual values will differ from lot to lot. Qualitative calibration references are prepared to approximate weight/weight (±10%) specifications and, because of the presence of gases, are not intended for quantitative use. All calibration references are accompanied by a data sheet.

| Mixes and Solutions | Composition | | | Qty. | Cat. No. |
|---|---|---|---|---|---|
| ASTM D3710 Qualitative Calibration Mix *(w/w) indicated* | *Each of the following components in the approximate proportions* | | | 1 x 1mL<br>6 x 1mL | **50642**<br>**48884** |
| | n-Propane, 1.5%<br>2-Methylpropane, 1.5%<br>n-Butane, 4 5%<br>2-Methylbutane, 9.7%<br>n-Pentane, 7.6%<br>2-Methylpentane, 5.4%<br>n-Hexane, 5.4% | 2,4-Dimethylpentane, 5.4%<br>n-Heptane, 9.7%<br>Toluene, 10.8%<br>n-Octane, 5.4%<br>p-Xylene, 13.0%<br>n-Propylbenzene, 4.3% | n-Decane, 3.2%<br>n-Butylbenzene, 3.2%<br>n-Dodecane, 3.2%<br>n-Tridecane, 2.2%<br>n-Tetradecane, 2.2%<br>n-Pentadecane, 2.2% | | |
| ASTM D3710 Quantitative Calibration Mix | *Each of the following components in the proportions (v/v) indicated* | | | 1 x 1mL<br>6 x 1mL | **506435**<br>**48879** |
| | 2-Methylbutane, 10.5%<br>n-Pentane, 8.1%<br>2-Methylpentane, 5.8%<br>n-Hexane, 5.8%<br>2,4-Dimethylpentane, 5.8%<br>n-Heptane, 10.5% | Toluene, 11.6%<br>n-Octane, 5.8%<br>p-Xylene, 14.0%<br>n-Propylbenzene, 4.7%<br>n-Decane, 3.5% | n-Butylbenzene, 3.5%<br>n-Dodecane, 3.5%<br>n-Tridecane, 2.3%<br>n-Tetradecane, 2.3%<br>n-Pentadecane, 2.3% | | |
| ASTM D2887/D5307 Column Resolution Test Mix | *Each of the following components at 1% (w/v) in n-octane*<br>n-Hexadecane | n-Octadecane | | 6 x 1mL | **48889** |
| ASTM D2887 Quantitative Calibration Solution | *Prepared in carbon disulfide at 0.5 weight percent each component (except for nC16 and nC18, which are at 1 weight percent)*<br>Use for assessing column resolution as well as for quantitative analyses. | | | 1 x 1mL<br>6 x 1mL | **500631**<br>**500658** |
| | n-Pentane<br>n-Hexane<br>n-Heptane<br>n-Octane<br>n-Nonane<br>n-Decane<br>n-Undecane | n-Dodecane<br>n-Tetradecane<br>n-Pentadecane<br>n-Hexadecane<br>n-Heptadecane<br>n-Octadecane<br>n-Eicosane | n-Tetracosane<br>n-Octacosane<br>n-Dotriacontane<br>n-Hexatriacontane<br>n-Tetracontane<br>n-Tetratetracontane | | |

| Mixes and Solutions | Qty. | Cat. No. |
|---|---|---|
| ASTM D2887 Reference Gas Oil Sample, Lot 2■ | 1mL | **506419** |
| | 6 x 1mL | **48873** |

■This sample is a petroleum fraction having a boiling range from 250°F to 850°F, evaluated in round-robin studies by the ASTM. Use this sample and the supplied ASTM boiling range consensus values to evaluate system performance.

## ASTM D5307

***Boiling Range Distribution of Crude Petroleum***

| Mixes and Solutions | Composition | Qty. | Cat. No. |
|---|---|---|---|
| ASTM D5307 Crude Oil Quantitative Standard | *Equal weights of the hydrocarbons listed*<br>Use to determine detector response factors (slight warming of this mixture may be necessary to dissolve all components completely).<br>n-Decane, n-Undecane, n-Dodecane, n-Tridecane, n-Tetradecane, n-Pentadecane, n-Hexadecane, n-Heptadecane, n-Octadecane, n-Eicosane, n-Tetracosane, n-Octacosane, n-Dotriacontane, n-Hexatriacontane, n-Tetracontane, n-Tetratetracontane | 2mL | **48179** |
| ASTM D5307 Crude Oil Qualitative Standard | *Each of the hydrocarbons listed in the approximate proportions (w/w) indicated*<br>Combine with Cat. No. 48179 to prepare a calibration mixture covering C3 to C44 for calibrating retention times for boiling point correlation.<br>n-Propane, 10%, n-Butane, 15%, n-Pentane, 15%, n-Hexane, 15%, n-Heptane, 15%, n-Octane, 15%, n-Nonane, 15% | 1mL | **48182** |
| ASTM D5307 Crude Oil Internal Standard | *Equal weights of the hydrocarbons listed*<br>Add to the crude oil sample as the internal standard.<br>n-Tetradecane, n-Pentadecane, n-Hexadecane, n-Heptadecane | 25mL | **48479** |

## ASTM D5580

**Aromatics in Gasoline -** The calibration blends are provided with a chromatogram and data verifying the purity and identity of the raw material. All raw materials used are fully characterized, as described for ASTM D4815 methods (see page 40).

| Mixes and Solutions | Composition | Qty. | Cat. No. |
|---|---|---|---|
| D5580 Quantitative Calibration Mix 5 (With Internal Standard) | *Each component at the nominal weight percent indicated*<br>Benzene, 4.50<br>Toluene, 0.90<br>Ethylbenzene, 9.00<br>o-Xylene, 0.45<br>1,2,4-Trimethylbenzene, 2.25<br>Isooctane, 72.90<br>2-Hexanone (int. std.), 10.00 | 1mL | **47744-U** |
| D5580 Valve Timing Calibration Mix | *Each of the following components at the nominal weight percent indicated*<br>Benzene, 4.5<br>Toluene, 4.5<br>Ethylbenzene, 9.0<br>o-Xylene, 9.0<br>2-Hexanone (internal standard), 10.0<br>Isooctane, 63.0 | 1mL | **47731-U** |
| **Internal Standard**<br>2-Hexanone | *Neat* | 5mL | **47733-U** |

## WSPA RM-1 Gasoline Reference Material

This multipurpose reference material was developed by Scott Specialty Gases Inc. under the sponsorship of the Western States Petroleum Association (WSPA), based on specifications for California Phase II reformulated gasoline (RFG). Consensus values were established by 14 labs, including the California Air Resources Board (CARB) and are assured by WSPA. The specifications are shown below.

6 x 20mL **502227**

| ASTM Method | Constituents | Concentration | Units |
|---|---|---|---|
| **D4815** | Oxygenate (Methyl tert-butyl ether) | 2.07% | WO[n] |
| **D5580** | Total aromatics | 27.7% | w/w |
| **D5580** | Benzene | 0.982% | w/w |
| **D1319** | Olefins | 5.42% | LV[m] |
| **D2622/D5453** | Sulfur | 30.9ppm | w/w |
| **D5191** | Reid vapor pressure | 6.59 | psi |

■Weight percent oxygen.
○Liquid volume.

## ASTM D5769

### *Aromatics in Gasoline by GC/MS*

| Mixes and Solutions | Composition | Qty. | Cat. No. |
|---|---|---|---|
| ASTM D5769/EPA Aromatics Internal Standard Mix | *Each of the following components at the weight percent indicated*<br>Benzene-$d_6$, 40.0 Ethylbenzene-$d_{10}$, 40.0 Naphthalene-$d_8$, 20.0 | 1 x 5.0mL | **47327** |

## ASTM D5599

### Oxygenates in Gasoline by GC and OFID Detection

| Mixes and Solutions | Composition | Qty. | Cat. No. |
|---|---|---|---|
| 1,2-Dimethoxyethane (DME) | *Neat, Internal Standard* | 5mL | **47214** |

## ASTM D5441

### *Purity of Methyl tert-butyl ether (MTBE) by GC*

| Mixes and Solutions | Composition | Qty. | Cat. No. |
|---|---|---|---|
| **MTBE Quantitative Solutions and Neat Materials** | | | |
| | For analyses of oxygenates in gasoline. | | |
| tert-Amyl methyl ether | *2000µg/mL in methanol* | 1mL | **506737** |
| Methyl tert-butyl ether (MTBE) | *Neat* | 1000mg | **48027** |
| Methyl tert-butyl ether (MTBE) | *2000µg/mL in methanol* | 1mL | **48483** |
| **MTBE Contaminant Standards** | | | |
| ASTM D5441 MTBE Contaminants (High) Mix A | *Each component at 1% w/w in MTBE*<br>Use to identify and determine response factors for the common impurities in MTBE.<br>tert-Amyl methyl ether, 2-Methylbutane, trans-2-Pentene<br>tert-Butanol, 2-Methyl-2-butene, Triisobutylene (mixed isomers)<br>tert-Butyl ethyl ether, Pentane, 2,4,4-Trimethyl-1-pentene<br>Methanol, cis-2-Pentene | 1mL | **47942** |
| ASTM D5441 MTBE Contaminants (Low) Mix B | *Each component at 0.1% w/w in MTBE*<br>Use to identify and determine response factors for the common impurities in MTBE.<br>tert-Amyl methyl ether, 2-Methylbutane, trans-2-Pentene<br>tert-Butanol, 2-Methyl-2-butene, Triisobutylene (mixed isomers)<br>tert-Butyl ethyl ether, Pentane, 2,4,4-Trimethyl-1-pentene<br>Methanol, cis-2-Pentene | 1mL | **47943** |

## ASTM D4815

***Determination of Oxygenates (Ethers and Alcohols) in Gasoline by GC***

Along with valve timing and peak identification mixes, two sets of quantitative calibration mixes are available, both with and without the method-specified internal standard. The internal standard-free mixes are packaged in quantities of approximately 9.5mL to allow the addition of the internal standard. All components used in preparing these standards have been analyzed for purity, water content, and the presence of other method components to 0.01%. Blends have been prepared using precise gravimetric techniques exceeding the requirements of ASTM Method D4815. Corrections are made for common impurities. All calibration blends are provided with a chromatogram and data verifying the purity and identity of the raw materials.

| Mixes and Solutions | Composition | Qty. | Cat. No. |
|---|---|---|---|
| D4815 Quantitative Calibration Mix 1 (Without Internal Standard) | *Each component at the nominal weight percent indicated*<br>Ethanol, 3.00<br>tert-Butanol, 0.10<br>Methyl tert-butyl ether, 20.00<br>tert-Pentanol, 1.25<br>isooctane:xylene (65:35), 75.65 | 9.5mL | **47200** |
| D4815 Quantitative Calibration Mix 2 (Without Internal Standard) | *Each component at the nominal weight percent indicated*<br>Ethanol, 0.10<br>tert-Butanol, 3.00<br>Methyl tert-butyl ether, 15.00<br>tert-Pentanol, 5.00<br>isooctane:xylene (65:35), 76.90 | 9.5mL | **47201** |
| D4815 Quantitative Calibration Mix 3 (Without Internal Standard) | *Each component at the nominal weight percent indicated*<br>Ethanol, 6.00<br>tert-Butanol, 6.00<br>Methyl tert-butyl ether, 10.00<br>tert-Pentanol, 2.50<br>isooctane:xylene (65:35), 75.50 | 9.5mL | **47202** |
| D4815 Quantitative Calibration Mix 4 (Without Internal Standard) | *Each component at the nominal weight percent indicated*<br>Ethanol, 9.00<br>tert-Butanol, 8.00<br>Methyl tert-butyl ether, 5.00<br>tert-Pentanol, 3.75<br>isooctane:xylene (65:35), 74.25 | 9.5mL | **47203** |
| D4815 Quantitative Calibration Mix 5 (Without Intern ndard) | *Each component at the nominal weight percent indicated*<br>Ethanol, 12.00<br>tert-Butanol, 12.00<br>Methyl tert-butyl ether, 0.10<br>tert-Pentanol, 0.10<br>isooctane:xylene (65:35), 75.80 | 9.5mL | **47204** |
| 1,2-Dimethoxyethane (DME) | *Neat, internal standard* | 5mL | **47214** |
| ASTM D4815 Calibration Curve Verification Kit | *Each of the following products*<br>Quantitative Calibration Mix 1 (47200)<br>Quantitative Calibration Mix 2 (47201)<br>Quantitative Calibration Mix 3 (47202)<br>Quantitative Calibration Mix 4 (47203)<br>Quantitative Calibration Mix 5 (47204)<br>1,2-Dimethoxyethane (47214) | | **47210** |
| D4815 Quantitative Calibration Mix 1■ (With Internal Standard) | *Each component at the nominal weight percent indicated*<br>Ethanol, 12.85<br>tert-Butanol, 0.095<br>Methyl tert-butyl ether, 19.00<br>tert-Pentanol, 1.19<br>isooctane:xylene (65:35), 71.87<br>DME (internal standard), 5.00 | 1mL | **47205** |
| D4815 Quantitative Calibration Mix 2■ (With Internal Standard) | *Each component at the nominal weight percent indicated*<br>Ethanol, 0.095<br>tert-Butanol, 2.85<br>Methyl tert-butyl ether, 14.25<br>tert-Pentanol, 4.75<br>isooctane:xylene (65:35), 73.06<br>DME (internal standard), 5.00 | 1mL | **47206** |
| D4815 Quantitative Calibration Mix 3■ (With Internal Standard) | *Each component at the nominal weight percent indicated*<br>Ethanol, 5.70<br>tert-Butanol, 5.70<br>Methyl tert-butyl ether, 9.50<br>tert-Pentanol, 2.38<br>isooctane:xylene (65:35), 71.73<br>DME (internal standard), 5.00 | 1mL | **47207** |

■ For information on a kit containing this product, see the following page (Cat. No. 47211).

| Mixes and Solutions | Composition | Qty. | Cat. No. |
|---|---|---|---|
| D4815 Quantitative Calibration Mix 4 (With Internal Standard) | *Each component at the nominal weight percent indicated*<br>Ethanol, 8.55<br>tert-Butanol, 7.60<br>Methyl tert-butyl ether, 4.75<br>tert-Pentanol, 3.56<br>isooctane:xylene (65:35), 70.54<br>DME (internal standard), 5.00 | 1mL | **47208** |
| D4815 Quantitative Calibration Mix 5 (With Internal Standard) | *Each component at the nominal weight percent indicated*<br>Ethanol, 11.40<br>tert-Butanol, 11.40<br>Methyl tert-butyl ether, 0.095<br>tert-Pentanol, 0.095<br>isooctane:xylene (65:35), 72.01<br>DME (internal standard), 5.00 | 1mL | **47209** |
| ASTM D4815 Valve Timing Mix | *Each component at the nominal weight percent indicated*<br>Use for determining the proper backflush valve timing.<br>Methylcyclopentane, 10.0<br>Diisopropyl ether, 10.0<br>Ethyl tert-butyl ether, 10.0<br>Methyl tert-butyl ether, 10.0<br>n-Hexane, 60.0 | 1mL | **47212** |
| ASTM D4815 Qualitative Peak ID Mix | *Each component at the nominal weight percent indicated*<br>Use for determining relative retention times of selected oxygenates.<br>Methylcyclopentane, 4.0<br>Methanol, 7.3<br>Ethanol, 7.3<br>Isopropanol, 7.3<br>tert-Butanol, 7.3<br>n-Propanol, 7.3<br>Methyl tert-butyl ether, 4.0<br>sec-Butanol, 7.3<br>Diisopropyl ether, 4.0<br>Isobutanol, 7.3<br>Ethyl tert-butyl ether, 4.0<br>tert-Pentanol, 7.3<br>1,2-Dimethoxyethane (internal standard), 6.0<br>n-Butanol, 7.3<br>Benzene, 5.0<br>tert-Amyl methyl ether, 7.3 | 1mL | **47213** |
| ASTM D4815 Quantitative Calibration Kit | *Each of the following products*<br>Quantitative Calibration Mix 1 (47205)<br>Quantitative Calibration Mix 2 (47206)<br>Quantitative Calibration Mix 3 (47207)<br>Quantitative Calibration Mix 4 (47208)<br>Quantitative Calibration Mix 5 (47209)<br>Valve Timing Mix (47212)<br>Qualitative Peak ID Mix (47213) | | **47211** |

## USP Solvent Standards

Described in US Pharmacopoeia methods for determining residual organic solvents in pharmaceutical preparations.

| Description | | Qty. | Cat. No. |
|---|---|---|---|
| International USP 467 Mix | *8 analytes at concentrations indicated in methanol*<br>Acetonitrile (500µg/mL)<br>Benzene (1000µg/mL)<br>Chloroform (500µg/mL)<br>1,2-Dichloroethane (1000µg/mL)<br>1,4-Dioxane (1000µg/mL)<br>Trichloroethene (1000µg/mL)<br>Methylene chloride (5000µg/mL)<br>Pyridine (1000µg/mL) | 1mL | **47632-U** |
| USP Organic Volatile Impurities Mix | *5 analytes at concentrations indicated in dimethyl sulfoxide*<br>Benzene (1000µg/mL)<br>Chloroform (500µg/mL)<br>1,4-Dioxane (1000µg/mL)<br>Methylene chloride (1000µg/mL)<br>Trichloroethene (1000µg/mL) | 4 x 1mL | **47401** |
| USP Modified Organic Volatile Impurities Mix | *5 analytes at concentrations indicated in methanol***<br>Benzene (1000µg/mL)<br>Chloroform (500µg/mL) (5000µg/mL)<br>1,4-Dioxane (1000µg/mL)<br>Methylene chloride<br>Trichloroethene (1000µg/mL) | 1mL | **47398** |
| USP 467 OVI Mix (High Concentration), 23rd Ed. | *5 analytes at indicated concentrations in DMSO*<br>Benzene, 1000µg/mL<br>Chloroform, 500µg/mL<br>1,4-Dioxane, 1000µg/mL<br>Methylene chloride, 5000µg/mL<br>Trichloroethylene, 1000µg/mL | 1mL<br>4 x 1mL | **47538-U**<br>**47539-U** |
| USP 467 OVI Mix (Low Concentration), 23rd Ed. | *5 analytes at indicated concentrations in DMSO*<br>Benzene, 100µg/mL<br>Chloroform, 50µg/mL<br>1,4-Dioxane, 100µg/mL<br>Methylene chloride, 500µg/mL<br>Trichloroethylene, 100µg/mL | 1mL<br>4 x 1mL | **47540-U**<br>**47541-U** |

**Alternate solutions are available. Please inquire.

## Transportable Gases

We offer an expanded line of pure gases and gas mixtures in convenient transportable cylinders, manufactured for Supelco by Scott Specialty Gases. Scott's popular SCOTTY® products are available in a variety of sizes and cylinder capacities. The portability of SCOTTY gases makes these products suitable for many types of applications, both in the laboratory and in the field.

Supelco warrants that the Scott calibration gas products listed below meet the analytical specifications for the period of time stated on the cylinder and/or the Certificate of Analysis.

- No cylinder demurrage or rental
- Long-term guaranteed stability for extended shelf life
- Sufficient product in every cylinder for many applications
- Save on shipping costs
- "Go anywhere" portability makes calibration jobs easier
- Quality accessory equipment available
- High accuracy increases dependability
- A large number of calibration gases are available

## Specifications

**SCOTTY I**
Contents: 4 liters
Pressure: 120psig
Outlet Fitting: Aerosol-type push button with applicator tube
Weight: ~100g
Dimensions: 2.5 x 8 in.
D.O.T. Specs: 2Q

**SCOTTY II**
Contents: 14 liters
Pressure: 240psig
Outlet Fitting: CGA-160-1/8" NPT F
Weight: 1.5 lb.
Dimensions: 3 x 11 in.
D.O.T. Specs: 4B240

**SCOTTY IV**
Contents: 48 liters
Pressure: 300psig
Outlet Fitting: CGA-165
Weight: 1.75 lb.
Dimensions: 4 x 16.25 in.
D.O.T. Specs: 39 NRC

**SCOTTY HP**
Contents: 104 liters
Pressure: 1800psig
Outlet Fitting: CGA-180
Weight: 2.2 lb.
Dimensions: 3.25 x 12.25 in.
D.O.T. Specs: 3AL1800

## Scott Specialty Gases

Shelf life 1 year, unless otherwise noted.

| Gas Composition and Concentration | SCOTTY I Cat. No. | SCOTTY II Cat. No. | SCOTTY IV Cat. No. |
|---|---|---|---|
| **Pure Gases** | | | |
| Air, zero (THC < 1ppm) | **501212** | **501220** | **501239** |
| Argon 99.995% | **501247** | **501255** | ——— |
| Carbon dioxide 99.8%* | **501271** | **23402** | **501298** |
| Hydrogen 99.99% | ——— | **300100** | ——— |
| Methane 99.0% | ——— | **22562** | ——— |
| Oxygen 99.6% | ——— | **300500** | ——— |
| **Two-Component Mixtures** | | | |
| Benzene in air (1ppm) | ——— | ——— | **303402-U** |
| Benzene in air (10ppm) | ——— | ——— | ——— |
| Benzene in air (100ppm) | ——— | ——— | **303404** |
| 1,3-Butadiene in nitrogen (10ppm) | ——— | **303405** | **303406** |
| Carbon dioxide in helium (100ppm)*■ | ——— | **308200** | ——— |
| Carbon dioxide in nitrogen (100ppm) | ——— | **308300** | **501301** |
| Carbon dioxide in nitrogen (1000ppm) | ——— | **501336** | **501344** |
| Chlorine in nitrogen (10ppm)** See page 439. | | | |
| Ethylene in air (10ppm)* | ——— | **501379** | **501387** |
| Ethylene in helium (100ppm) | ——— | **22572** | ——— |
| Hydrogen in helium (100ppm)■ | ——— | **301200** | ——— |
| Hydrogen in nitrogen (1%) | **501409** | **501417** | **501425** |
| Hydrogen in nitrogen (100ppm) | ——— | **301300** | **501433** |
| Methane in helium (100ppm)■ | **501441** | **307200** | **501468** |
| Methane in nitrogen (100ppm)■ | ——— | **307300-U** | ——— |
| Methane in nitrogen (1%)■ | **501476** | **23443** | **501484** |
| Nitrogen in helium (100ppm) | ——— | **303200** | ——— |
| Nitrous oxide in nitrogen (1ppm)■ | ——— | **501514** | **501522** |

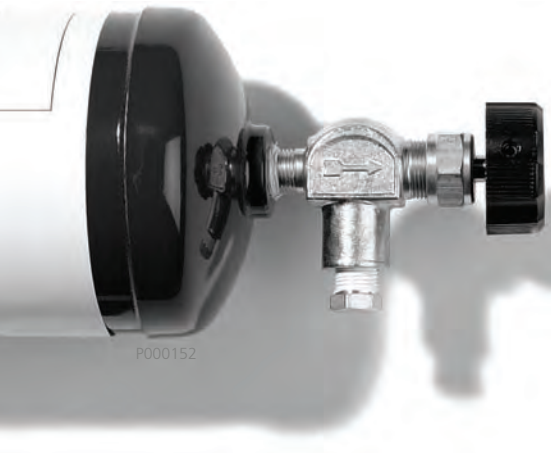
| Gas Composition and Concentration | SCOTTY I Cat. No. | SCOTTY II Cat. No. | SCOTTY IV Cat. No. |
|---|---|---|---|
| **Two-Component Mixtures (contd.)** | | | |
| Oxygen in helium (100ppm)■ | ——— | **305200** | ——— |
| Oxygen in nitrogen (2%)■ | **501530** | **501549** | **501557** |
| Oxygen in nitrogen (6%)■ | **501565** | **501573** | **501581** |
| 1,1,1-Trichloroethane in nitrogen (10ppm) | ——— | ——— | **303408** |
| Trichloroethylene in nitrogen (10ppm) | ——— | **303400** | **303401** |
| Vinyl chloride in nitrogen (1ppm | ——— | **22554** | **501603** |
| Vinyl chloride in nitrogen (10ppm) | ——— | **22553** | **501611** |
| Vinyl chloride in nitrogen (50ppm) | ——— | **22555-U** | ——— |
| Vinyl chloride in nitrogen (100ppm) | ——— | **22552** | ——— |
| Vinyl chloride in nitrogen (1000ppm) | ——— | **22556** | ——— |
| **Three-Component Mixtures** | | | |
| Carbon Dioxide and oxygen in nitrogen (1% / 20%) | ——— | **23441** | **501638** |
| **Multi-Component Mixtures** | | | |
| Carbon monoxide, carbon dioxide, hydrogen and oxygen each at 0.5% in nitrogen | **501646** | **23438** | **501654** |
| Carbon monoxide, carbon dioxide, methane, ethane, ethylene and acetylene each at 1% in nitrogen | **501662** | **23437** | **23462** |
| Methane, carbon monoxide, carbon dioxide, hydrogen and oxygen each at 1% in nitrogen | **501670** | **22561** | **23463** |
| Carbon monoxide, carbon dioxide, nitrogen, and oxygen each at 5%, methane and hydrogen each at 4% in helium | ——— | **501697** | ——— |
| Carbon monoxide at 7%, carbon dioxide at 15% and oxygen at 5% in nitrogen | **501719** | **23442** | ——— |
| Carbon monoxide and oxygen each at 7%, carbon dioxide at 15% and methane at 4.5% in nitrogen | ——— | **501743** | **501751** |
| Branched paraffins, each at 15ppm: iso-butane, 2-methylbutane, 2,2-dimethylpropane, 2-methylpentane, 3-methylpentane, 2,2-dimethylbutane in nitrogen | **22501** | **23445** | ——— |
| C1-C6 n-Paraffins, each at 15ppm: methane, ethane, propane, butane, pentane and hexane in nitrogen | **501778** | **23444** | **501786** |
| C1-C6 n-Paraffins, each at 100ppm: methane, ethane, propane, butane, pentane, hexane in nitrogen | **501840** | **330300** | **501859** |
| C1-C6 n-Paraffins, each at 100ppm: methane, ethane, propane, butane, pentane, hexane in helium | **501794** | **330200** | **501808** |
| C1-C6 n-Paraffins, each at 1000ppm: methane, ethane, propane, butane, pentane, hexane in helium | **501816** | **501824** | **501832** |
| C2-C4 Alkynes, each at 15ppm: acetylene, propyne, 1-butyne, 2-butyne in nitrogen | **22508** | ——— | ——— |
| C2-C6 Olefins, each at 100ppm: ethylene, propylene, 1-butene, 1-pentene, 1-hexene in nitrogen | ——— | **332300-U** | **501875** |
| C2-C6 Olefins, each at 100ppm: ethylene, propylene, 1-butene, 1-pentene, 1-hexene in helium | ——— | **332200** | **501867** |
| Methane, ethane, ethylene, acetylene, propane, propylene, propyne, n-butane each at 15ppm in nitrogen | **22566** | ——— | **23470-U** |
| n-Butane, iso-butane, cis-2-butene, trans-2-butene, 1-butene, iso-butylene, 1,3-butadiene, ethyl acetylene each at 15ppm in nitrogen | **22567** | ——— | **23471** |
| BTEX Mix**: benzene, ethylbenzene, toluene, m-xylene, o-xylene, p-xylene, each at 10ppm in nitrogen | ——— | ——— | **501883** |

| Gas Composition and Concentration | SCOTTY HP Cat. No. |
|---|---|
| Chlorine in nitrogen (10ppm)** | **501352** |

■ Custom concentrations available. Please inquire.

*Pressure restricted due to either vapor pressure restriction or flammable oxidizer restriction.

**Shelf life 6 months.




## Natural Gas Reference Standards

Prepared gravimetrically with weights traceable to the National Institute of Standards and Technology, then verified by analysis. In 14-liter SCOTTY II cylinders. Shelf life: 1 year.

| Component (mole percent) | GPA Standard | Calorimetric Standard | High Ethane Standard | Helium-Enriched Standard |
|---|---|---|---|---|
| Helium | 0.50 | – | – | 2.00 |
| Nitrogen | 5.00 | 2.50 | 9.00 | 1.60 |
| Carbon dioxide | 1.00 | 3.00 | 0.50 | 0.20 |
| Methane | 70.50 | 88.73 | 64.00 | 88.90 |
| Ethane | 9.00 | 3.50 | 12.50 | 3.00 |
| Propane | 6.00 | 1.00 | 7.00 | 1.70 |
| Isobutane | 3.00 | 0.40 | 3.00 | 1.00 |
| n-Butane | 3.00 | 0.40 | 3.00 | 1.00 |
| Isopentane | 1.00 | 0.15 | 0.50 | 0.30 |
| n-Pentane | 1.00 | 0.15 | 0.50 | 0.30 |
| Neopentane | – | 0.10 | – | – |
| n-Hexane | – | 0.05 | – | – |
| n-Heptane | – | 0.02 | – | – |

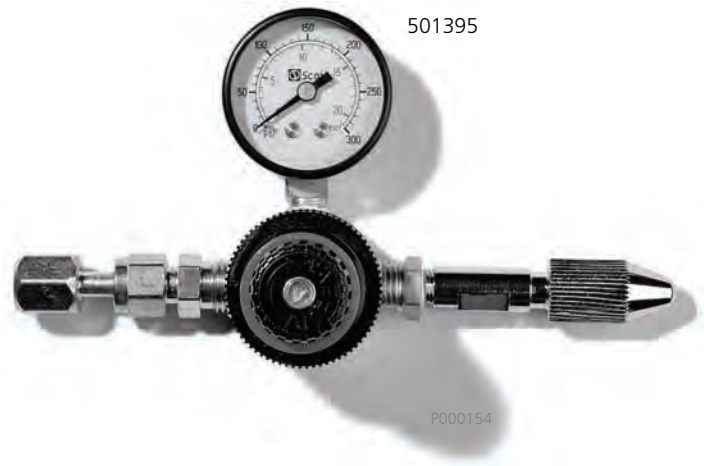
| Standard | BTU | Qty. | Cat. No. |
|---|---|---|---|
| GPA | 1298 | 785g | **303100-U** |
| Calorimetric | 1028 | 790g | **303101** |
| High Ethane | 1500 | 763g | **303102** |
| Helium-Enriched | 1083 | 774g | **303103** |

### Model 24 SCOTTY Single-Stage, General Purpose Regulator for SCOTTY II and IV Cylinders

Designed for noncorrosive service.

- Brass body with acetal resin bonnet/Viton diaphragm
- Tamper resistant, locking control knob
- Inlet connection 1/4 inch AN flare (CGA-165 or CGA-160)
- Maximum inlet pressure 300psig
- Delivery pressure range 1-60psig, can be preset
- Miniature

| Description | Cat. No. |
|---|---|
| **Model 24 Single-Stage Regulator** | |
| with CGA-160 (for SCOTTY II) | **507911** |
| with CGA-165 (for SCOTTY IV) | **501395** |

## Syringe Adapter for SCOTTY II and IV Cylinders•

Withdraw calibration gas into a syringe, through a silicone rubber septum. A vent at the septum permits purging prior to filling the syringe. Constructed of chromium-plated brass. Maximum pressure 240psi (16.9kg/cm$^2$). 1/8" NPT male fitting.

| Description | Cat. No. |
|---|---|
| Syringe Adapter | **609010** |
| Additional Septa (pk. of 10) | **608010** |

P000160

## Pressure Regulator for SCOTTY II and IV Cylinders•

Reliable pressure regulation to 1psig (0.07kg/cm$^2$), indicated on a 0-60psi (4.2kg/cm$^2$) gauge. Easily connects to SCOTTY cylinders with the 1/8" NPT connector provided. You can also attach the syringe adapter (Cat. No. 609010) to the regulator for low pressure sample removal. Aluminum body with acetyl resin bonnet. Maximum inlet pressure: 400psi (28.1kg/cm$^2$).

•**Note:** For safety reasons, this regulator does not fit higher pressure SCOTTY IV-EL cylinders.

| Description | Cat. No. |
|---|---|
| Regulator | **513010** |

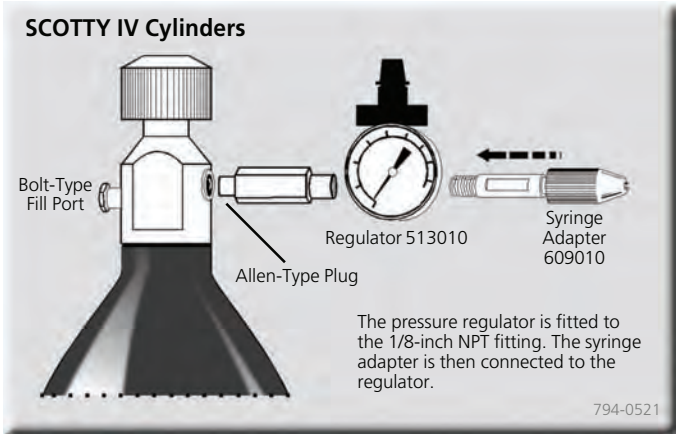
P000155

## Stand for SCOTTY IV Cylinders

Stabilizes your cylinder on a benchtop or other surface.

| Description | Cat. No. |
|---|---|
| Stand | **500410** |

P000158




## Using SCOTTY IV Cylinders

SCOTTY IV gas cylinders should be used with a pressure regulator and SCOTTY syringe adapter. SCOTTY IV cylinders are fitted with two ports, one of which is a 1/8-inch NPT port, as shown at left. Fit the pressure regulator to the 1/8-inch NPT port, then connect the syringe adapter to the regulator.

**Custom Gases -** We can provide custom gas blends to your specifications. To inquire, contact our Technical Service department.

## Environmental Standards

| Mixes and Solutions | Composition | | | Qty. | Cat. No. |
|---|---|---|---|---|---|
| **BTEX Standards*** | | | | | |
| UST BTEX Mix SS | *6 analytes, 200µg/mL each in methanol* | | | 1mL | **48026** |
| | | | | 1mL | **4S8026** |
| | Benzene | Toluene | o-Xylene | | |
| | Ethylbenzene | m-Xylene | p-Xylene | | |
| HC BTEX Mix | *6 analytes, 2000µg/mL each in methanol* | | | 1mL | **47993** |
| | Benzene | Toluene | o-Xylene | | |
| | Ethylbenzene | m-Xylene | p-Xylene | | |
| HC BTEX/MTBE Mix | *7 analytes, 2000µg/mL each in methanol* | | | 1mL | **47505-U** |
| | Benzene | Toluene | o-Xylene | | |
| | Ethylbenzene | m-Xylene | p-Xylene | | |
| | Methyl tert-butyl ether | | | | |
| **Gasoline Range Organics (GRO) Standards** | | | | | |
| Gasoline Additives Mix | *4 analytes, 200µg/mL each in methanol* | | | 1mL | **47905** |
| | 1,2-Dibromoethane | 1,2-Dichloroethane | Methyl tert-butyl ether | | |
| | Dibromomethane | | | | |
| Gasoline Range Organics (GRO) Mix | *9 analytes, 2000µg/mL each in methanol* | | | 1mL | **47576-U** |
| | Benzene | Naphthalene | 2,2,4-Trimethylbenzene | | |
| | Ethylbenzene | Toluene | m-Xylene | | |
| | 3-Methylpentane | 1,2,4-Trimethylbenzene | o-Xylene | | |
| PVOC Mix | *8 analytes, 2000µg/mL each in methanol* | | | 1mL | **47916** |
| | Benzene | Toluene | m-Xylene | | |
| | Ethylbenzene | 1,2,4-Trimethylbenzene | o-Xylene | | |
| | Methyl tert-butyl ether | 1,3,5-Trimethylbenzene | | | |
| EPA Gasoline Range Organics (GRO) Mix | *9 analytes at indicated concentrations in methanol* | | | 1mL | **47577-U** |
| | Benzene, 500µg/mL | 2-Methylpentane, 1500µg/mL | 2,2,4-Trimethylpentane, 1500µg/mL | | |
| | Ethylbenzene, 500µg/mL | Toluene, 1500µg/mL | m-Xylene, 1000µg/mL | | |
| | Heptane, 500µg/mL | 1,2,4-Trimethylbenzene, 1000µg/mL | o-Xylene, 1000µg/mL | | |
| UST Modified Gasoline Range Organics (GRO) | *10 analytes, 1000µg/mL each in methanol* | | | 1mL | **48167** |
| | Benzene | Toluene | m-Xylene | | |
| | Ethylbenzene | 1,2,4-Trimethylbenzene | o-Xylene | | |
| | Methyl tert-butyl ether | 1,3,5-Trimethylbenzene | p-Xylene | | |
| | Naphthalene | | | | |
| Revised PVOC/GRO Mix | *10 analytes, 2000µg/mL each in methanol* | | | 1mL | **47578-U** |
| | Benzene | Toluene | m-Xylene | | |
| | Ethylbenzene | 1,2,4-Trimethylbenzene | o-Xylene | | |
| | Methyl tert-butyl ether | 1,3,5-Trimethylbenzene | p-Xylene | | |
| | Naphthalene | | | | |

| Mixes and Solutions | Composition | Qty. | Cat. No. |
|---|---|---|---|
| **Surrogate Standards** | | | |
| α,α,α-Trifluorotoluene | *10,000µg/mL in methanol* | 1mL | **47582-U** |
| 1-Chlorooctane | *10,000µg/mL in methanol* | 1mL | **47583-U** |
| **Internal Standard** | | | |
| 1-Chloro-4-fluorobenzene | *5000µg/mL in methanol* | 1mL | **48194** |
| **Diesel Range Organics (DRO) Standards** | | | |
| UST Modified Diesel Range Organics (DRO) | *10 analytes, 1000µg/mL each in hexane* | 1mL | **48166** |
| | n-Decane | n-Octadecane | n-Tetracosane |
| | n-Dodecane | n-Eicosane | n-Hexacosane |
| | n-Tetradecane | n-Docosane | n-Octacosane |
| | n-Hexadecane | | |

*BTEX standards also are available in gas.

SS Separate Source standards. See our current catalog.

| Mixes and Solutions | Composition | Qty. | Cat. No. |
|---|---|---|---|
| **Internal Standard or Surrogate Standard for Diesel** | | | |
| 1-Chlorooctadecane | *10,000µg/mL in methylene chloride* | 1mL | **47584-U** |
| **Surrogate Standard for Diesel** | | | |
| *2-Fluorobiphenyl* | *10,000µg/mL in methylene chloride* | 1mL | **47581-U** |
| **Surrogate Standard** | | | |
| o-Terphenyl | *2000µg/mL in acetone* | 1mL | **48169** |
| | *10,000µg/mL in methylene chloride* | 1mL | **47580-U** |
| **Internal Standard for DRO** | | | |
| 5-α-Androstane | *2000µg/mL in methylene chloride* | 1mL | **48168** |
| **Fuel Standards** | | | |
| *Aviation Gasoline*■ | *20,000µg/mL in methanol* | 1mL | **47531-U** |
| Gasoline■ | *20,000µg/mL in methanol* | 1mL | **47516-U** |
| Jet (Turbine) Fuel■ | *20,000µg/mL in methanol* | 1mL | **47533-U** |
| JP-4 Military Fuel Standard | *10,000µg/mL in methylene chloride* | 1mL | **47585-U** |
| JP-5 Military Fuel Standard | *10,000µg/mL in methylene chloride* | 1mL | **47586-U** |
| JP-8 Military Fuel Standard | *10,000µg/mL in methylene chloride* | 1mL | **47587-U** |
| Kerosene Reference Standard | *50,000µg/mL in hexane* | 1mL | **47517-U** |
| No. 1 Fuel Oil■ | *20,000µg/mL in methanol* | 1mL | **47518-U** |
| No. 2 Fuel Oil■ | *20,000µg/mL in methanol* | 1mL | **47515-U** |
| No. 3 Fuel Oil■ | *50,000µg/mL in hexane* | 1mL | **47534-U** |
| No. 4 Fuel Oil■ | *50,000µg/mL in hexane* | 1mL | **47535-U** |
| No. 6 Fuel Oil | *20,000µg/mL in hexane:chloroform (50:50)* | 1mL | **47536-U** |

## State-Specific Petroleum Method Standards

### Massachusetts

EPA Matrix Spike Standard Mix — *31 analytes, 25µg/mL each in hexane* 1mL — **46859-U**

| | | |
|---|---|---|
| n-Nonane | n-Octacosane | Benzo(a)pyrene |
| n-Decane | n-Triacontane | Chrysene |
| n-Dodecane | n-Hexatriacontane | Dibenz(a,h)anthracene |
| n-Tetradecane | Acenaphthene | Fluorene |
| n-Hexadecane | Acenaphthylene | Fluoranthene |
| n-Octadecane | Anthracene | Indeno(1,2,3-cd)pyrene |
| n-Nonadecane | Benzo(a)anthracene | 2-Methylnaphthalene |
| n-Eicosane | Benzo(b)fluoranthene | Naphthalene |
| n-Docosane | Benzo(k)fluoranthene | Pyrene |
| n-Tetracosane | Benzo(ghi)perylene | Phenanthrene |
| n-Hexacosane | | |

### Florida

n-Hydrocarbons Mix — *17 analytes, 1000µg/mL each in methylene chloride:carbon disulfide (50:50)* — 1mL — **46855-U**

| | | |
|---|---|---|
| n-Octane | n-Eicosane | n-Dotriacontane |
| n-Decane | n-Docosane | n-Tetratriacontane |
| n-Dodecane | n-Tetracosane | n-Hexatriacontane |
| n-Tetradecane | n-Hexacosane | n-Octatriacontane |
| n-Hexadecane | n-Octacosane | n-Tetracontane |
| n-Octadecane | n-Triacontane | |

■Refinery grade.

**Trademarks**

Apiezon – Biddle Instruments
Bentone – National Lead Co., Baroid Sales Div.
Carbowax – Union Carbide Corp.
Cellosolve – Union Carbide Corp.
Chromosorb – Celite Corp.
dBase III Plus – Ashton-Tate Co.
Dexsil – Dexsil Chemical Corp.
Hamilton – Hamilton Co.
HayeSep – Hayes Separations Inc.
Lotus 1-2-3 – Lotus Development Co.
OV – Ohio Valley Specialty Chemical Co.
Polywax – Petrolite Specialty Polymers Group
Oxyblend, SCOTTY – Scott Specialty Gases, Inc.
UCON – Union Carbide Corp.
Viton – Dupont Dow Elastomers
Carbopack, Carboxen, ChromFax, Nukol, Petrocol, Progel, PTE, SP, SPB, Supelco, SUPELCOGEL, SUPELCOPORT, SUPELCOSIL, SUPELCOWAX, Supel-Q, VOCOL — Sigma-Aldrich Co.

Fused silica columns manufactured under HP US Pat. No. 4,293,415.

## Custom Chemical Standards

We can prepare chemical standards for your environmental, food and beverage, petroleum, chemical, or pharmaceutical applications, using carefully monitored raw materials and solvents. We ship most custom products within 7-10 working days of receiving the order.* Every custom standard includes a material safety data sheet (MSDS) and a certificate of composition; if testing is requested, we can provide a certificate of analysis.

### *Quality Control*

We offer three forms of quality control for custom-prepared standards:

***Gravimetric assurance (routine, no charge)***
Components are guaranteed to be within ± 0.5% of the amounts you specify. A Certificate of Composition is included.

***Qualitative testing (optional)****
Typically the method will be a verification of the GC or LC elution and of the number of components. We will provide a copy of the chromatogram.

***Quantitative testing (optional)****
Typically the standard will be compared to a separately prepared reference batch of the same formulation, using the internal standard method (GC), or the external standard method (LC). We will provide a copy of the chromatogram and a Quantitative Certificate of Analysis.

### *Packaging*

Typical packaging is 1mL, 2mL, 5mL, or 10mL flame-sealed amber ampuls. Other packaging is available (see below). Minimum order volume is 3mL, but this can be packaged in three 1mL ampuls or in a single ampul.

### *To Obtain a Quote*

**Telephone 814-359-5419 or 814-359-5752, or Fax 814-359-5750**

Within 24 hours we will confirm receipt of your request and provide a quote number.

## Materials Packaging Service

We can accept any materials repackaging job, large or small, simple or difficult. Our facilities and equipment enable us to package hygroscopic, light-sensitive, or other delicate materials under suitable conditions and into inert atmospheres. Our innovative ampul filling procedure eliminates product burning during the sealing process. We have experience repackaging biocides under ISO and cGMP requirements.

### *Bulk Liquids or Solids*

We can convert any volume of bulk liquid into smaller volumes, accurately and precisely dispensing your material into clear or amber glass ampuls, from 0.2mL to 20mL. We can weigh solids into glass vials or ampuls, with accuracy and precision to meet your most demanding needs.

### *Labeling and Certificates*

You choose the information to be included on your labels: ingredients,volume, company identification, etc. Labels can be sequentially numbered for inventory control or other needs. We can tailor certificates to your requirements—just tell us what you need.

### *Testing*

Testing can be performed by you or by Supelco (see above). We will provide evaluation samples before we ship your product.

### *Storage and Distribution*

We can inventory your product, then deliver it in a single shipment, or according to your schedule. We have more than 30 years of experience in shipping chemicals, domestically and internationally. We can ship anywhere, using the best and most cost-effective means.

### *To Obtain a Quote*

**Telephone 814-359-5450, Fax 814-359-5750, or email custompackaging@sial.com**

Within 24 hours we will confirm receipt of your request and provide a quote number.

*Qualitative and/or quantitative testing will add about one week to the delivery time for the product.



**Order/Customer Service** 800-247-6628, 800-325-3010 (US only) • Fax 800-325-5052 (US only) • E-mail supelco@sial.com
**Technical Service** 800-359-3041 (US only), 814-359-3041 • Fax 800-359-3044 (US only), 814-359-5468 • E-mail techservice@sial.com
**SUPELCO • 595 North Harrison Road, Bellefonte, PA 16823-0048 • 814-359-3441**

SIGMA-ALDRICH

*We are committed to the success of our Customers, Employees and Shareholders through leadership in **Life Science**, **High Technology** and **Service**.*

*The SIGMA-ALDRICH Family* SIGMA ALDRICH SUPELCO ISOTEC



T109858E
AYD