

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

Applications

Hydrocarbons Analyses	1-10
Oxygenates	10
Simulated Distillation	11-14
Aliphatics / Aromatics	14-15
Polynuclear Aromatic Hydrocarbons	15
Trace Petroleum Components	16
Miscellaneous Petrochemicals Analyses	17-19
Phenols / Polymers	19
Solvents	20-21
Impurities in Solvents	21-22
High Speed / High Resolution Separations	22-23
Packed Column Applications	24-25
Gel Permeation of Polymers	26
Low Molecular Weight Compounds	26-27

Ordering Information

Columns and Packings	28-32
Chemical Standards and Accessories	33-48

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

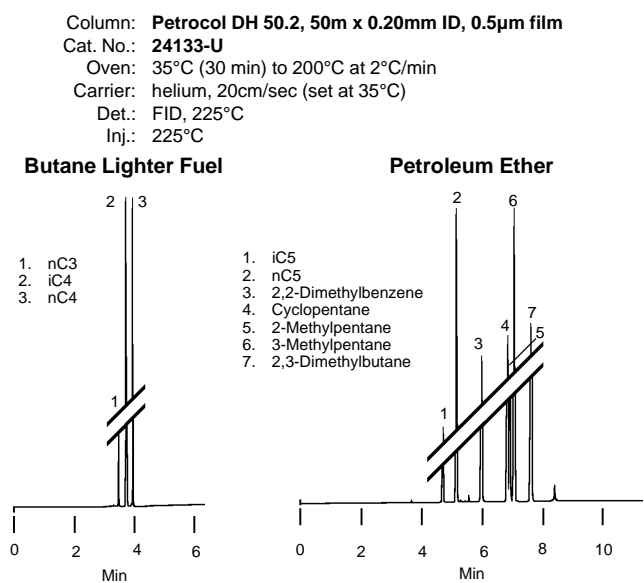


Figure 2. Unleaded Gasoline

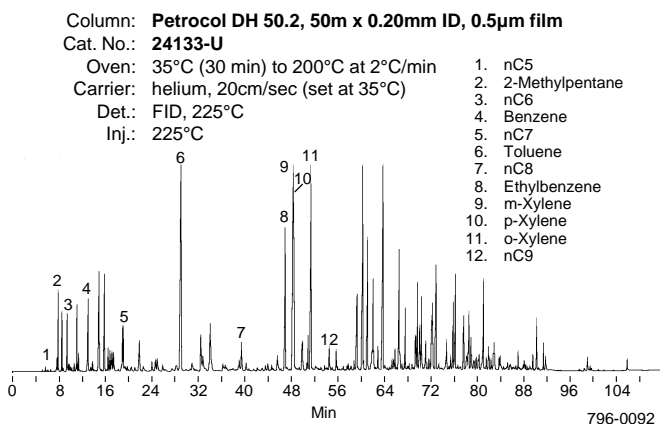


Figure 3. Detailed Analysis of Qualitative Reference & Naphtha

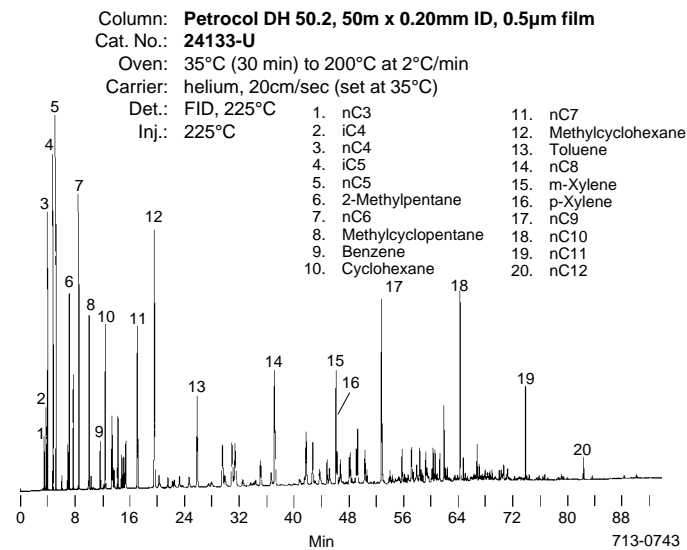


Figure 4. Quantitative PIANO Standard

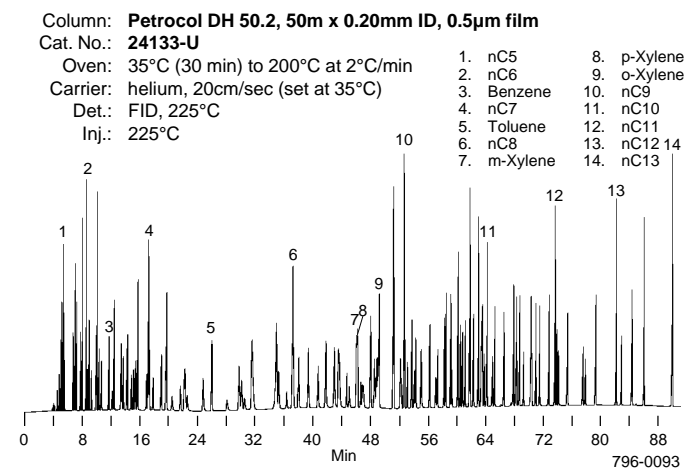
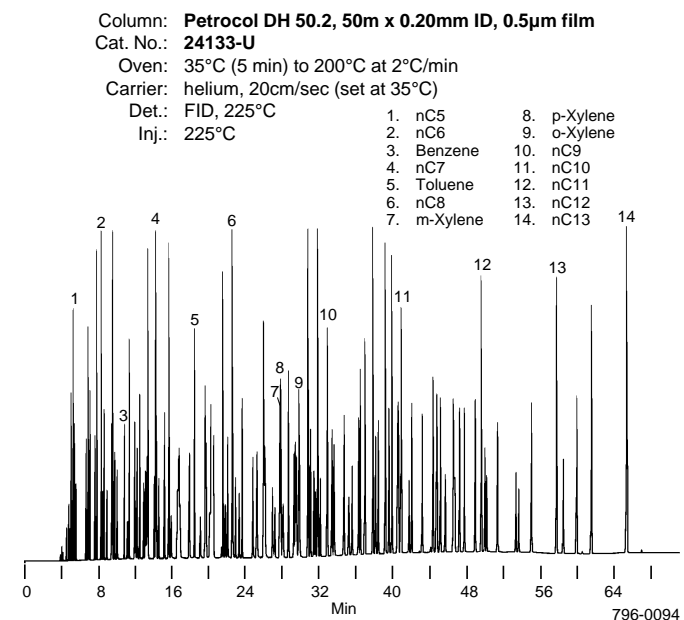


Figure 5. Quantitative PIANO Standard, Using Rapid Temperature Program



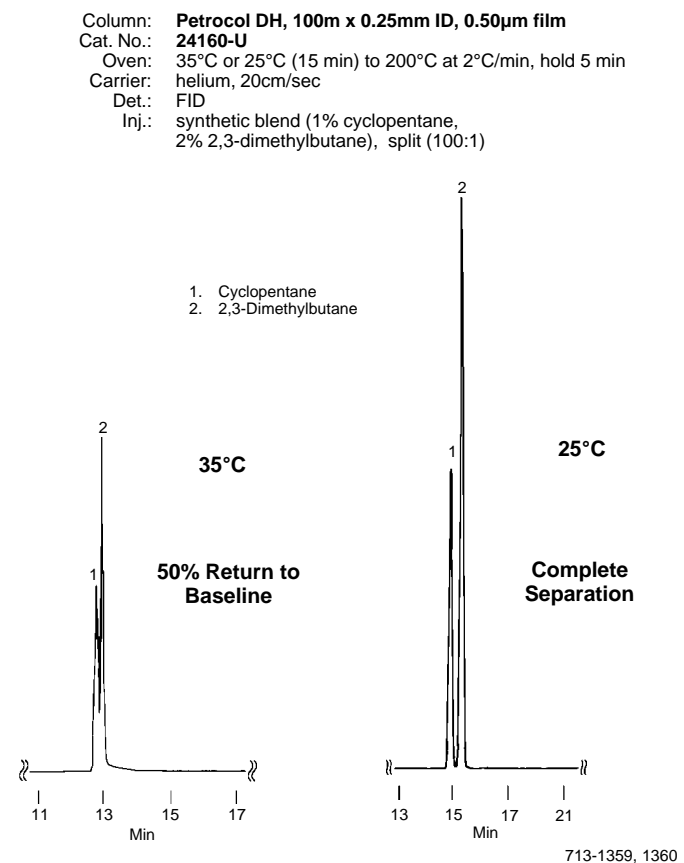
Gasoline Range Petroleum Products

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

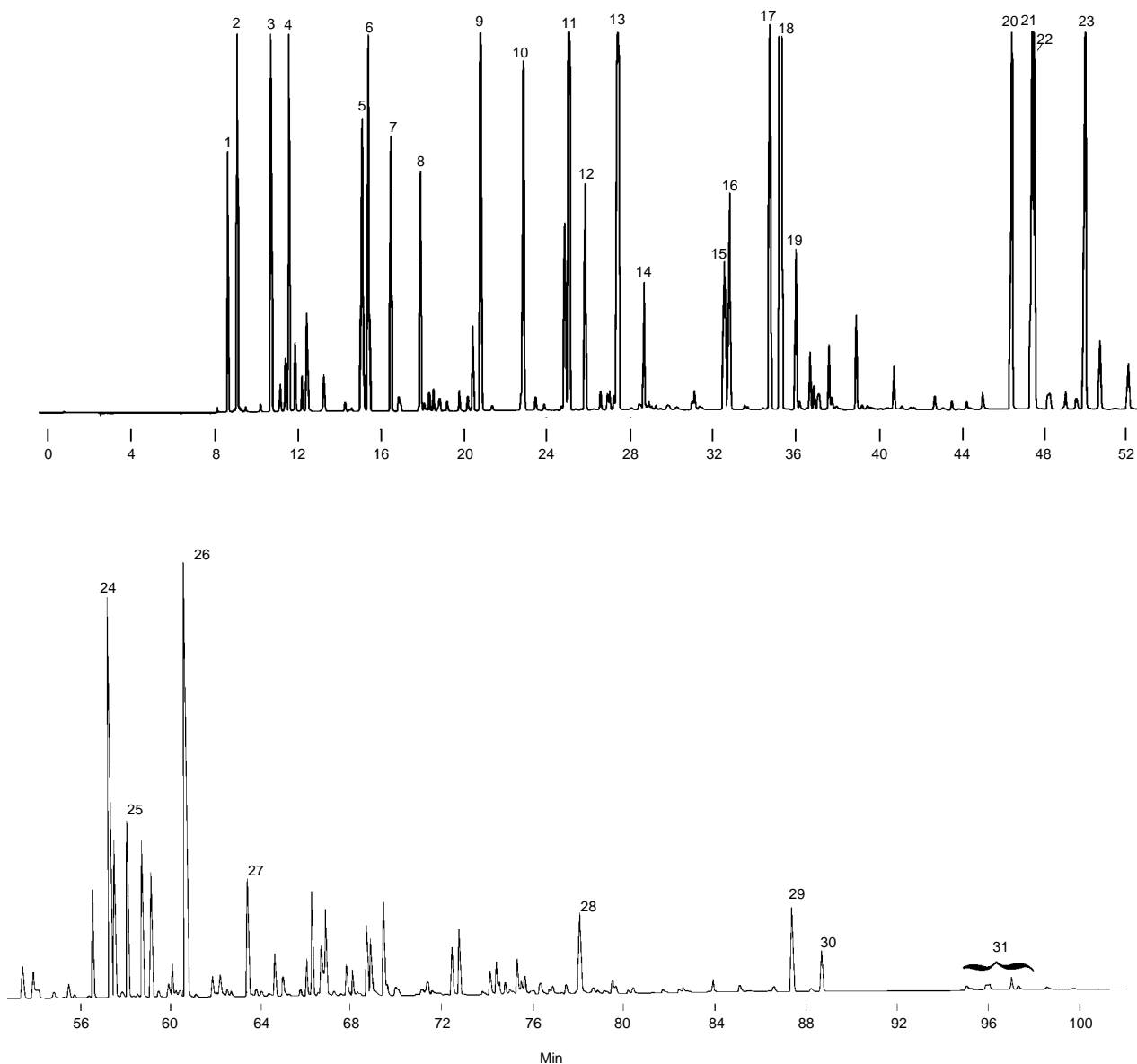


■PONA: paraffins-olefins-naphthenes-aromatics
 PNA: paraffins-naphthenes-aromatics
 PIANO: paraffins-isoparaffins-aromatics-naphthenes-olefins

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)

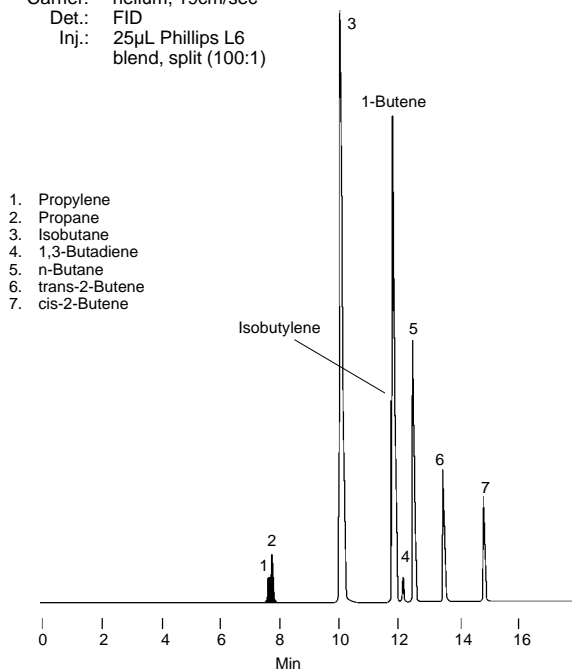
- | | |
|----------------------------|-----------------------------|
| 1. Isobutane | 17. 2,3,4-Trimethylpentane |
| 2. n-Butane | 18. Toluene |
| 3. Isopentane | 19. 2,3-Dimethylhexane |
| 4. n-Pentane | 20. Ethylbenzene |
| 5. 2,3-Dimethylbutane | 21. m-Xylene |
| 6. 2-Methylpentane | 22. p-Xylene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



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)



713-0740

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.

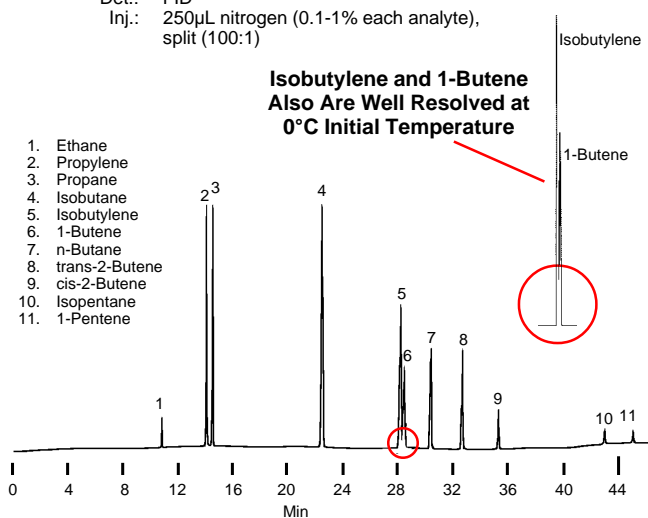
Perform separations that previously required special conditions, unusual columns, or prolonged analysis time.

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 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)



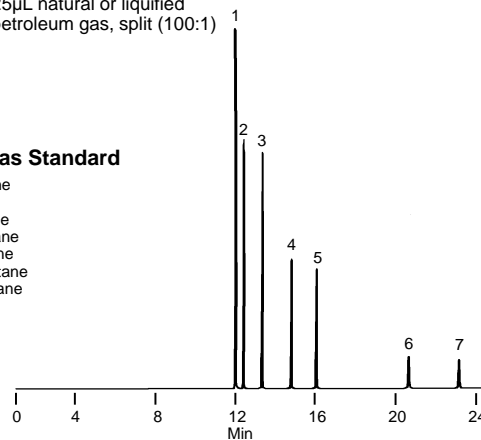
713-0764, 1275

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)

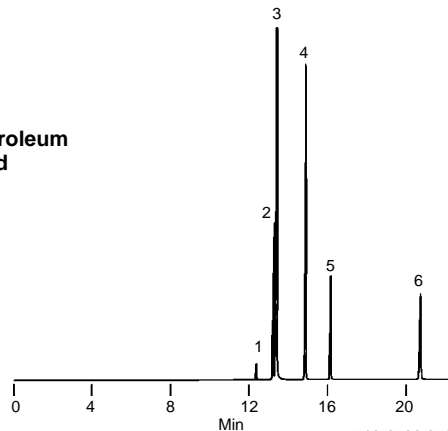
Natural Gas Standard

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



Liquified Petroleum Gas Standard

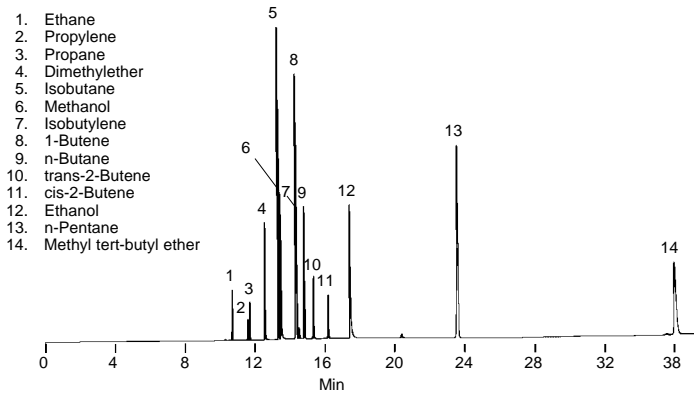
- 1. Ethane
- 2. Propylene
- 3. Propane
- 4. Isobutane
- 5. n-Butane
- 6. Isopentane



713-0766,0767

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)

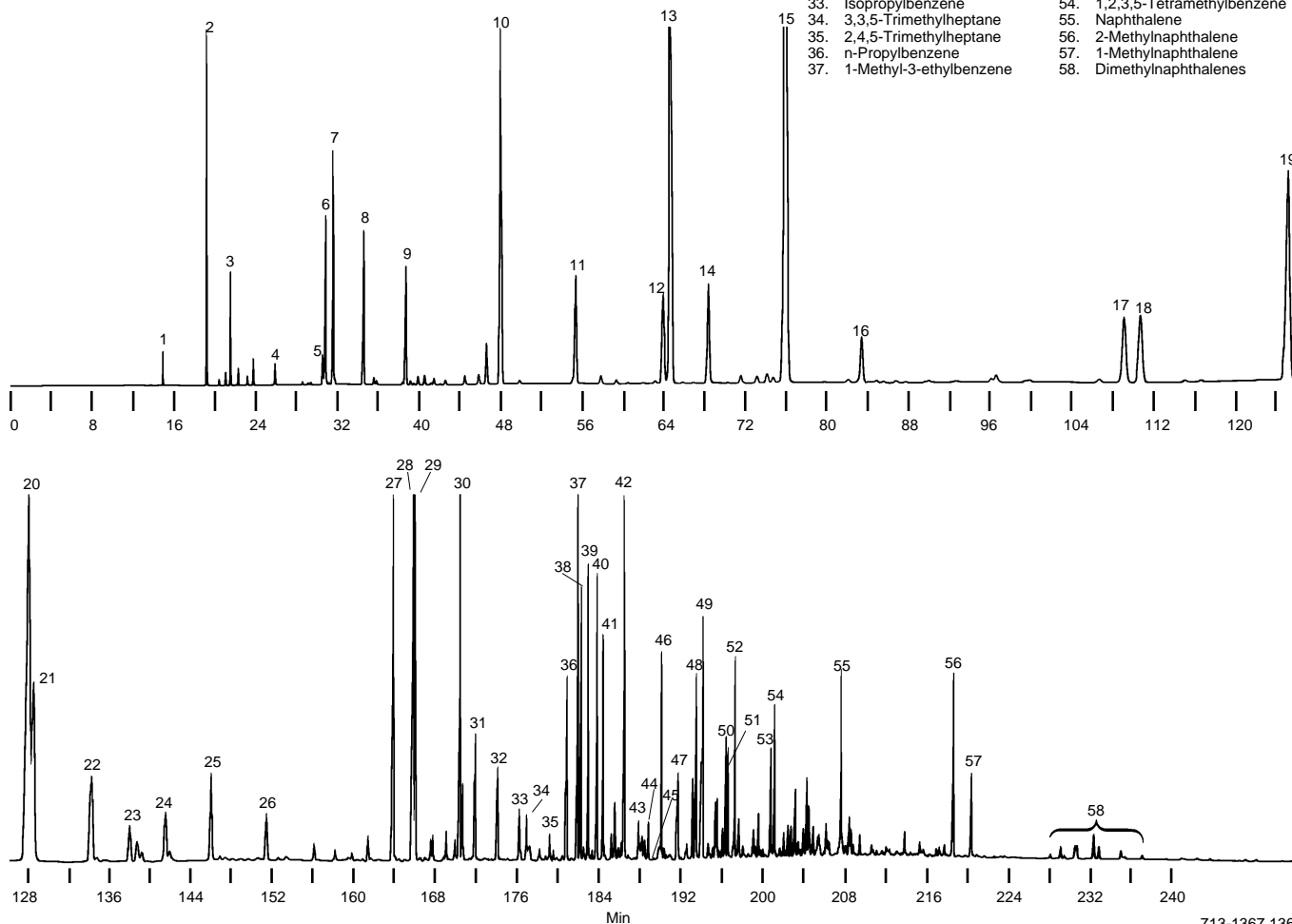


713-0765

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



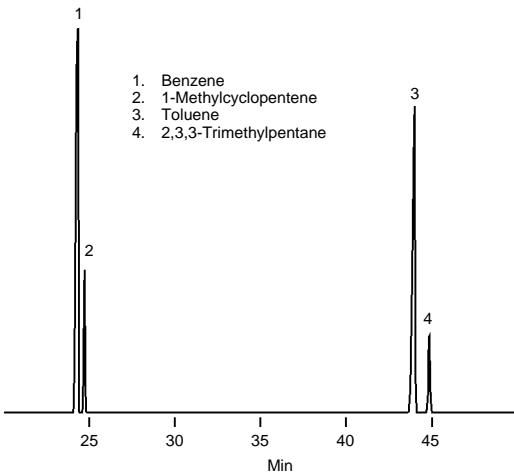
713-1367,1368

Reproducible Results

The highly reproducible Petrocol DH Octyl capillary column is capable of resolving compounds of different classes to the baseline (Figures 13 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

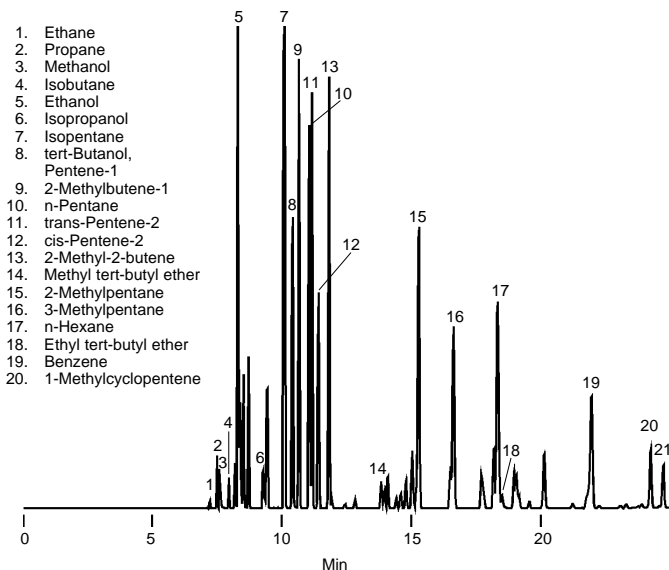
Column: Petrocol DH Octyl, 100m x 0.25mm ID, 0.5µm film
 Cat. No.: 24282
 Oven: 110°C to 220°C at 8°C/min
 Carrier: helium, 24cm/sec
 Det.: FID, 250°C
 Inj.: 0.1µL, split 215:1, 250°C



94-0364

Figure 14. PONA V Mix

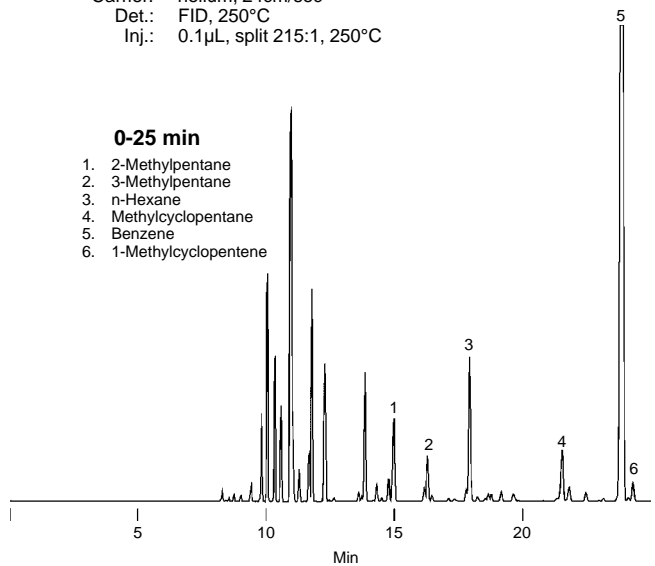
Column: Petrocol DH Octyl, 100m x 0.25mm ID, 0.5µm film
 Cat. No.: 24282
 Oven: 35°C (15 min) to 200°C at 1°C/min (15 min)
 Carrier: helium, 24cm/sec
 Det.: FID, 250°C
 Inj.: 0.1µL, split 215:1, 250°C



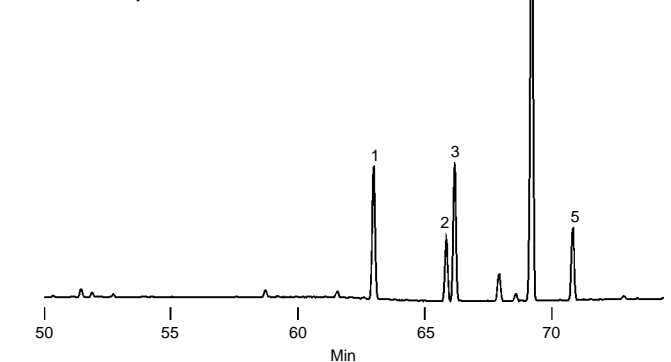
94-0366

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



50-75 min
 1. Ethylbenzene
 2. p-Xylene
 3. m-Xylene
 4. Styrene
 5. o-Xylene



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	Benzene	Coelution	Baseline Resolution
O	1-Methylcyclopentene		
A	Toluene	Coelution	Baseline Resolution
I	2,3,3-Trimethylpentane		
A	p-Xylene	Partial Resolution	Baseline Resolution (reversed)
A	m-Xylene		
P	n-Paraffin	Baseline Resolution	Coelution
O	trans-2-Olefin		
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

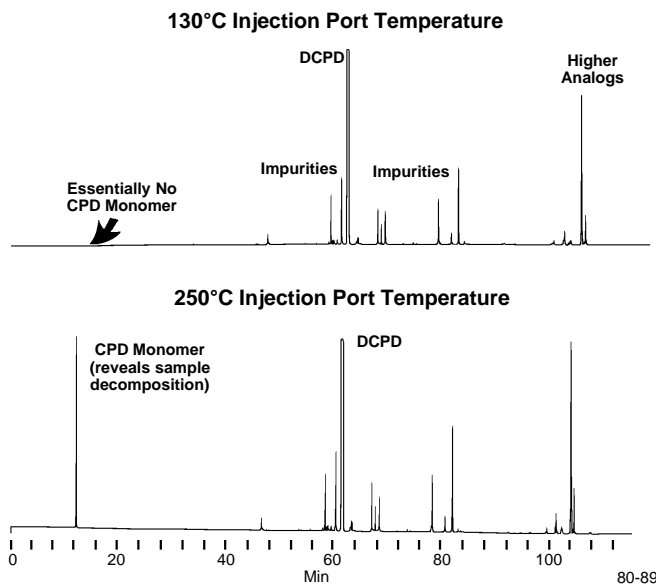
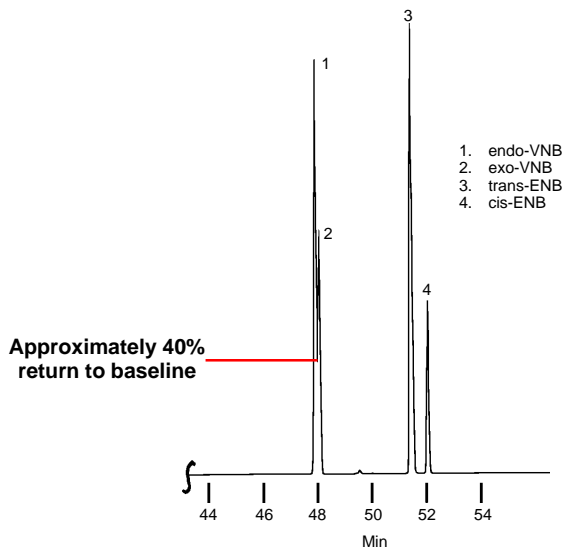


Figure 17. Quantify ENB Isomers and VNB Isomers

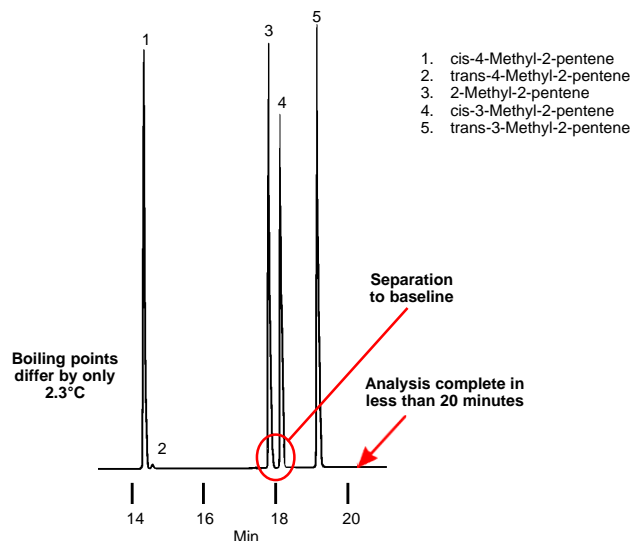
Column: Petrocol DH, 100m x 0.25mm ID, 0.5µm film
 Cat. No.: 24160-U
 Oven: 35°C (15 min) to 200°C at 2°C/min
 Det.: FID
 Inj.: 0.05µL ENB/VNB mixture, split 100:1



796-0095

Figure 18. Closely Eluting Hexene Isomerization Products

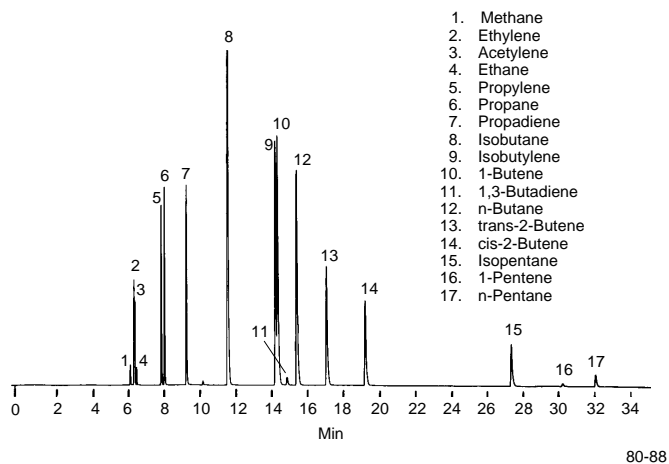
Column: Petrocol DH, 100m x 0.25mm ID, 0.5µm film
 Cat. No.: 24160-U
 Oven: 35°C (15 min) to 45°C at 2°C/min (30 min)
 Det.: FID
 Inj.: 3µL mixed hexene isomers, split 100:1



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)

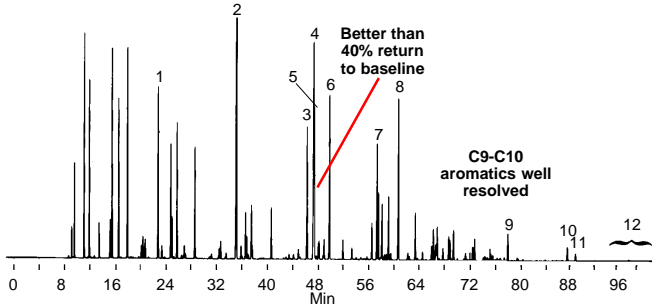


80-88

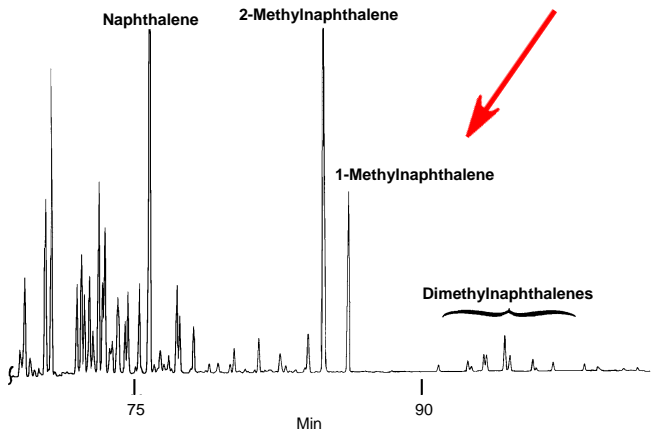
Figure 20. Petroleum Reformate

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

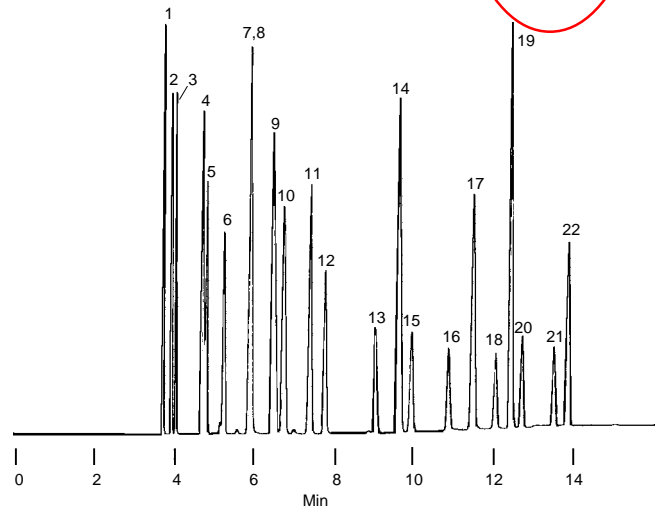
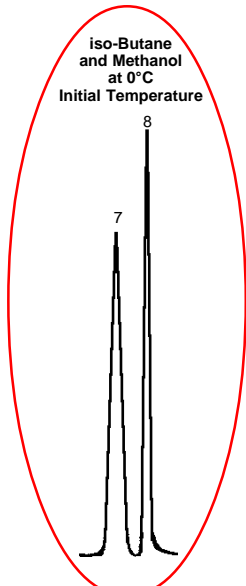
Because they do not require cooling to retain compounds with low (-40°C to 100°C) boiling temperatures, thick film SPB™-1 and SPB-5 capillary columns are more convenient to use than other types of columns.

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

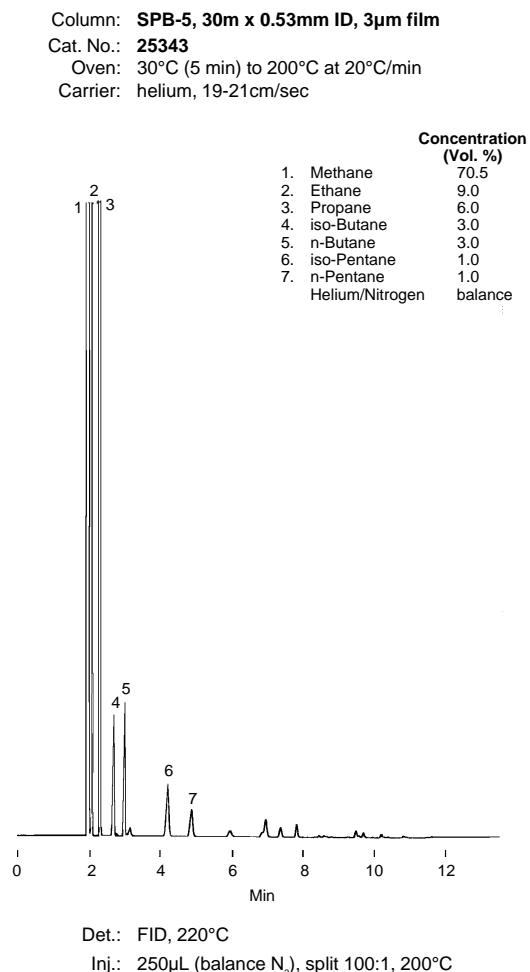
Column: SPB-1, 60m x 0.53mm ID, 5µm film
 Cat. No.: 25349
 Oven: 30°C (5 min) to 200°C at 20°C/min (inset: initial temp. 0°C)
 Carrier: helium, 19-21cm/sec
 Det.: FID, 220°C
 Inj.: 250µL (balance N₂), split 100:1, 200°C

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



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

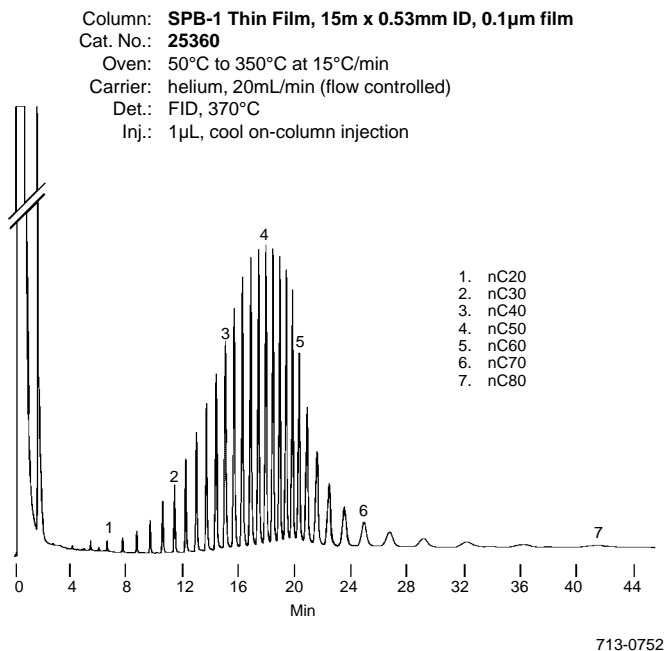


Figure 24. Shoe Polish

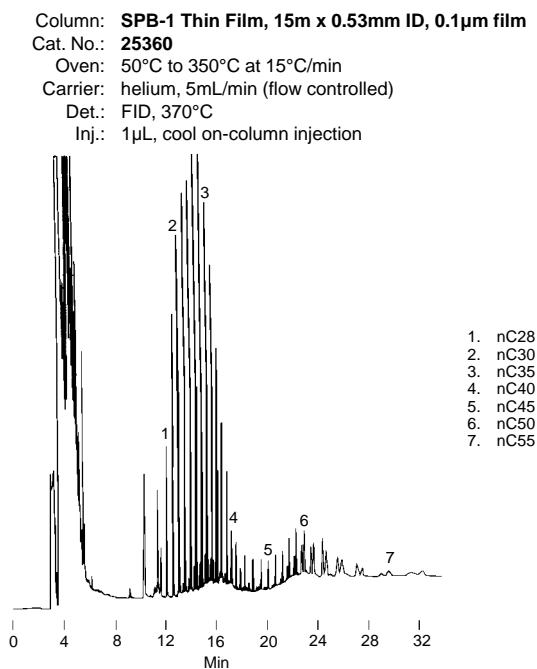


Figure 25. Paraffin Wax

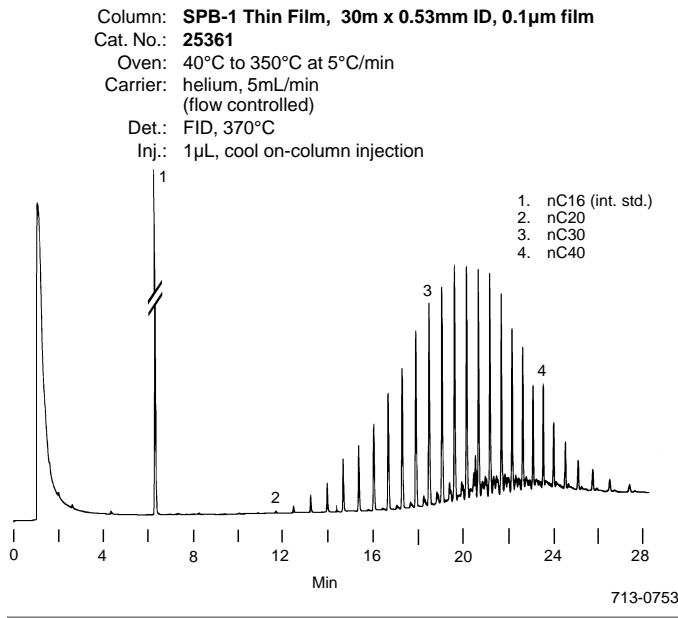
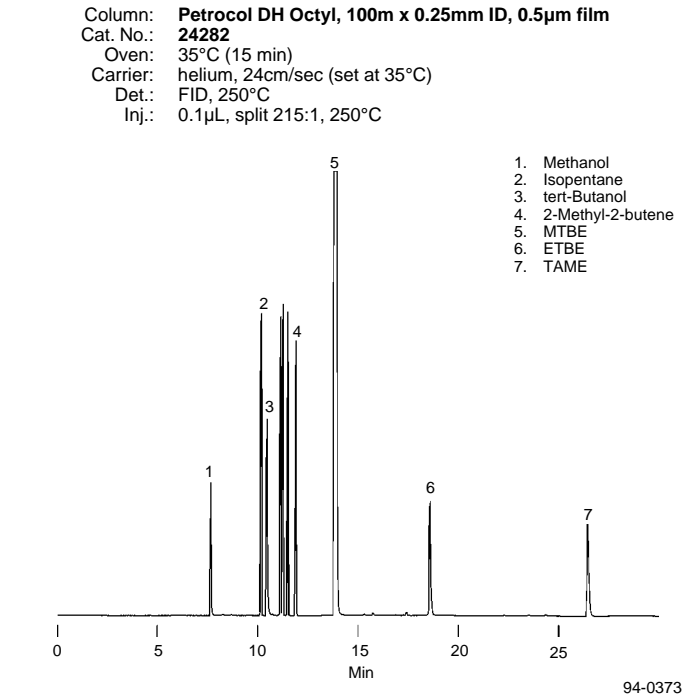


Figure 27. MTBE Contaminants (Petrocol DH Octyl Column)



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)

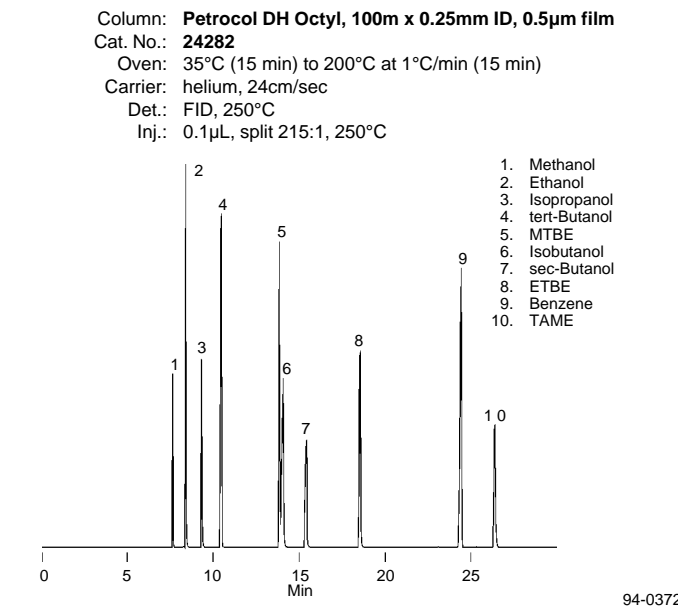
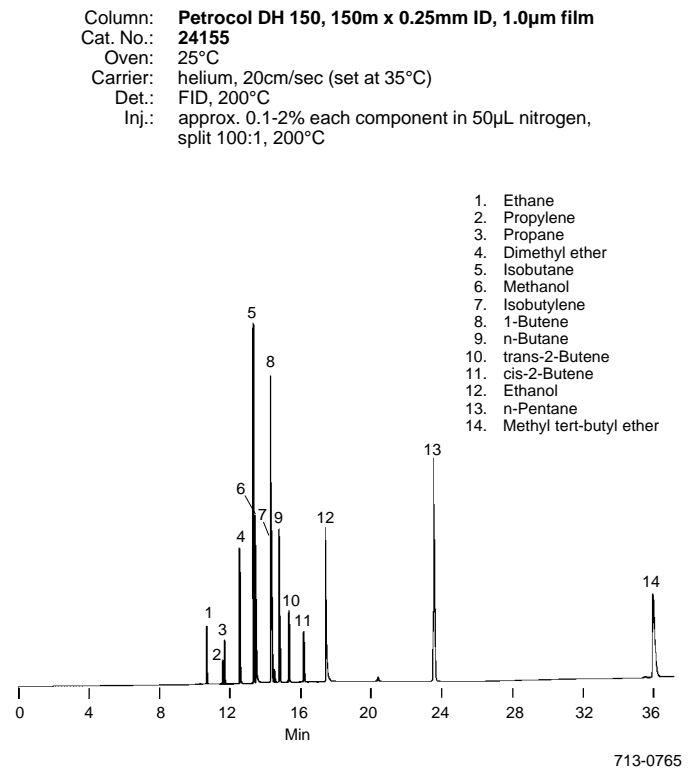


Figure 28. Oxygenates (Petrocol DH 150 Column)



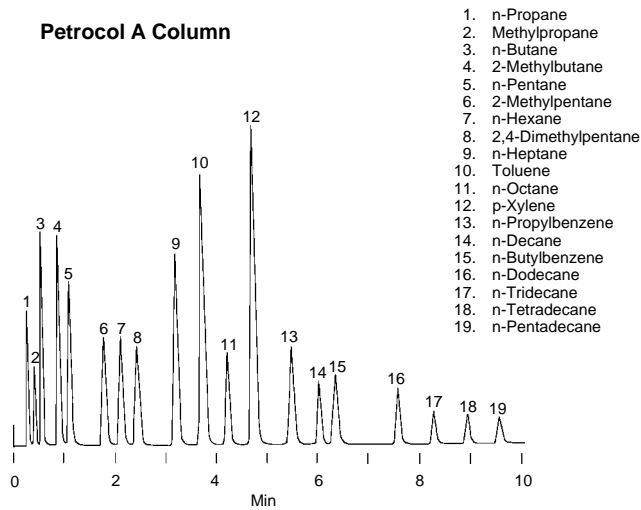
Simulated Distillation

Packed Columns for More Reliable SIMDIS Analyses

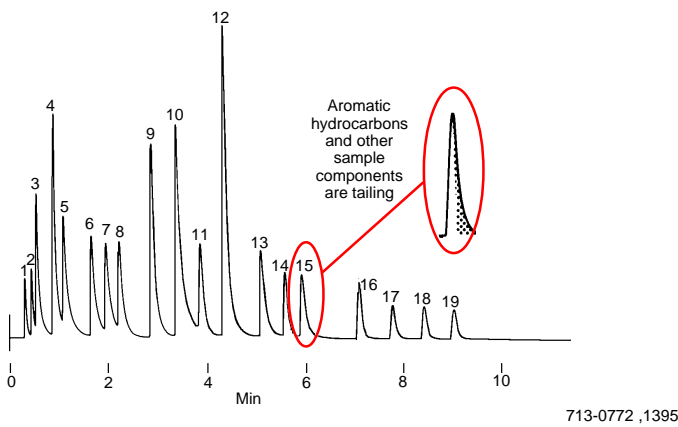
Petrocol A and Petrocol B packed columns were developed specifically for Methods D3710 and D2887, respectively, of the American Society for Testing and Materials (ASTM). These 20" x 1/8" stainless steel columns minimize peak tailing, column bleed, and the deviation of apparent boiling point from true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



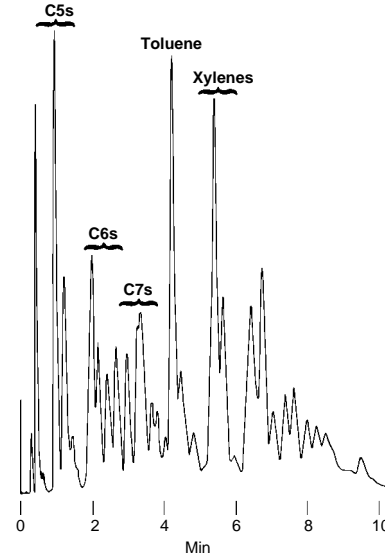
10% UC-W982 on 80/100 Chromosorb® P AW



713-0772 ,1395

Figure 30. Gasoline by ASSTM D3710

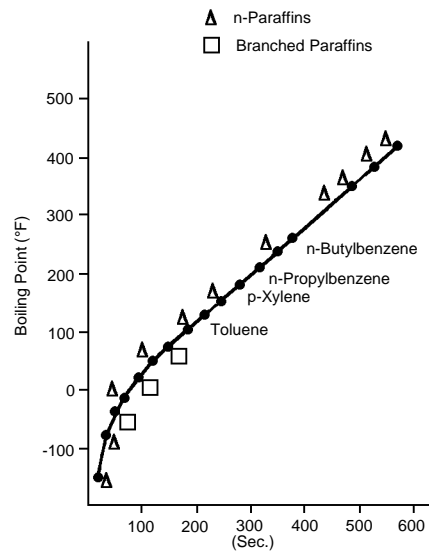
Column: **Petrocol A, 20" x 1/8" SS**
 Cat. No.: **12445**
 Col. Temp.: -20°C to 250°C at 15°C/min
 Carrier: helium, 25mL/min
 Det.: FID
 Inj.: 0.1µL of gasoline



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)

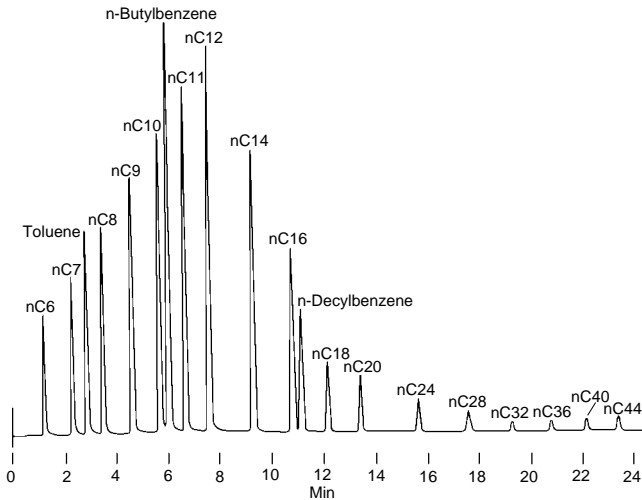


713-1393

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

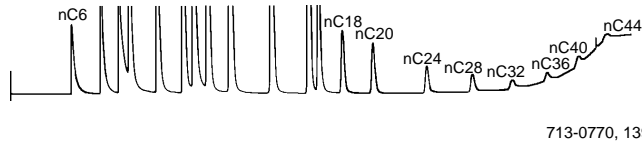
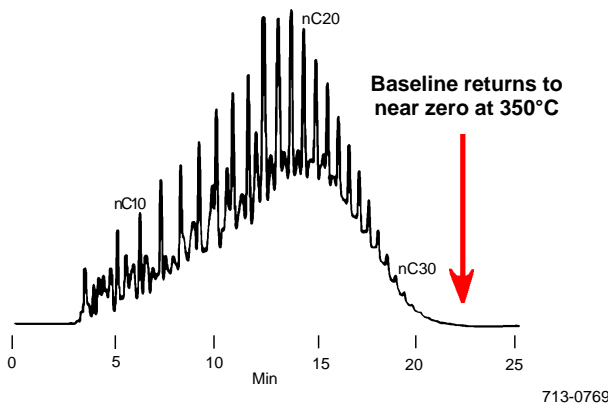


Figure 33. Negligible Column Bleed for Gas Oil Capillary Columns for SIMDIS Analysis

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



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

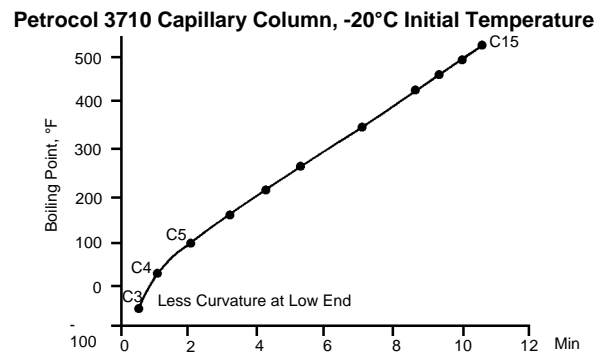
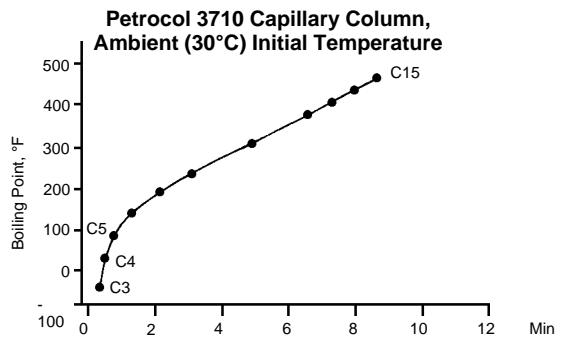
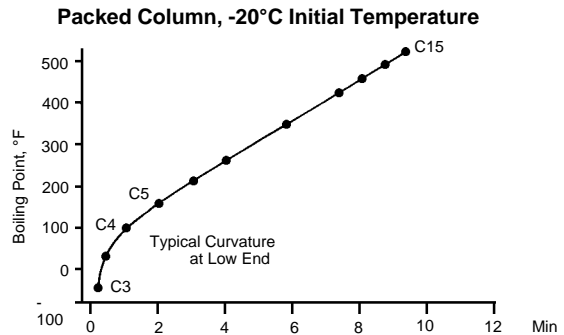
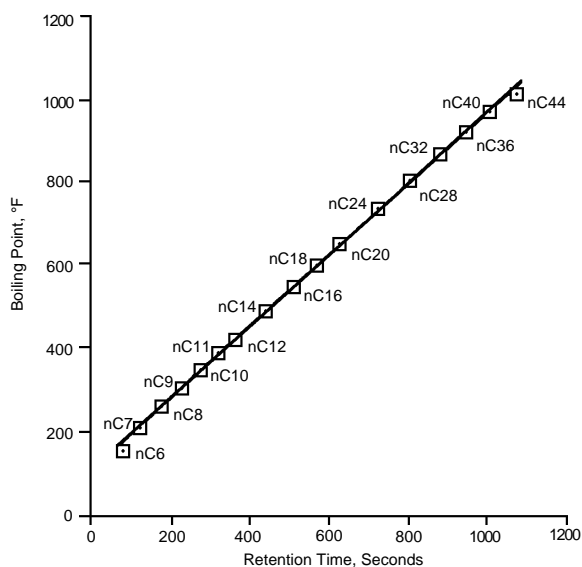


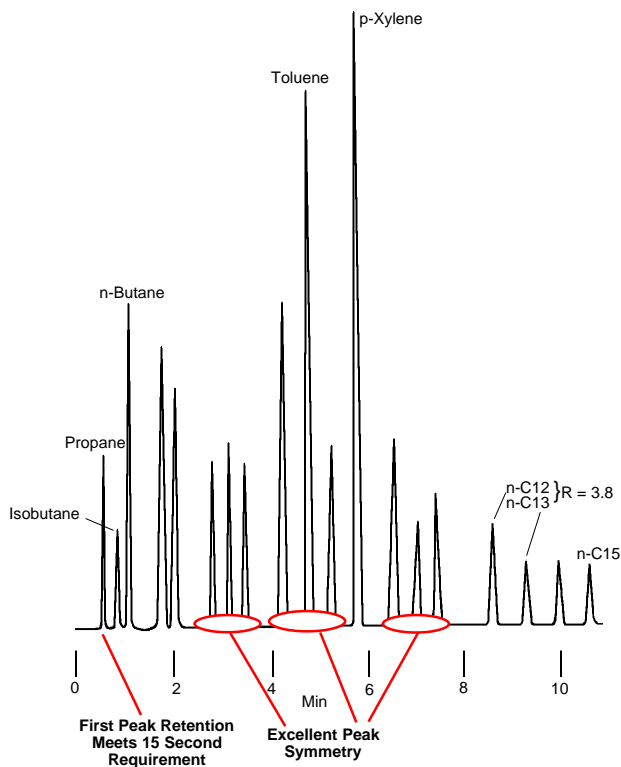
Figure 35. Linear Boiling Point/Elution Time Relationship for n-Paraffins on a Petrocol 2887 Column



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)

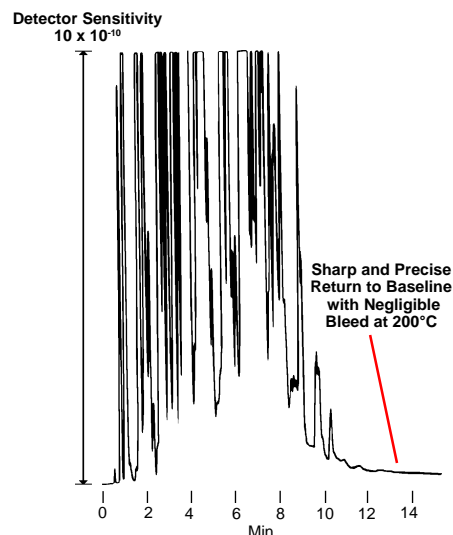


713-0773

[▲]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

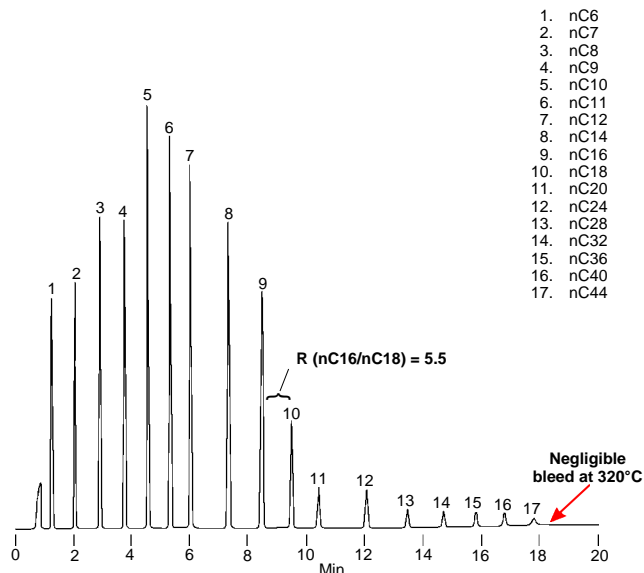
Column: Petrocol 3710, 10m x 0.75mm ID glass, 5.0µm film[▲]
 Col. Temp.: -20°C to 200°C at 20°C/min
 Carrier: nitrogen, 15mL/min
 Det.: FID
 Inj.: 0.1µL commercial gasoline



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) [▼]		Relative Difference %	Boiling Pt. (°F) [▲]		Relative Difference %
	Petrocol 3710 Capillary Column	Packed Column		Petrocol 2887 Capillary Column	ASTM Packed Column Consensus	
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.

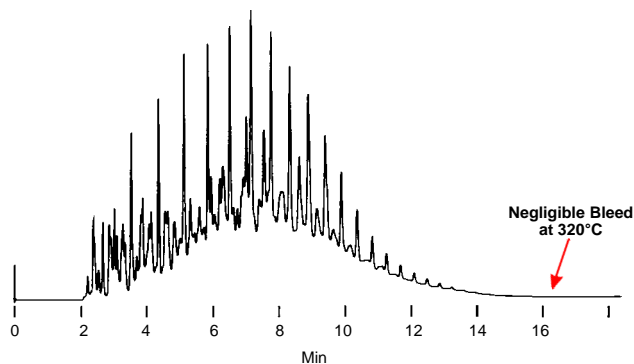
▲ Data obtained by using ASTM reference gas oil sample and Spectra-Physics D2887 SIMDIS software.

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 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

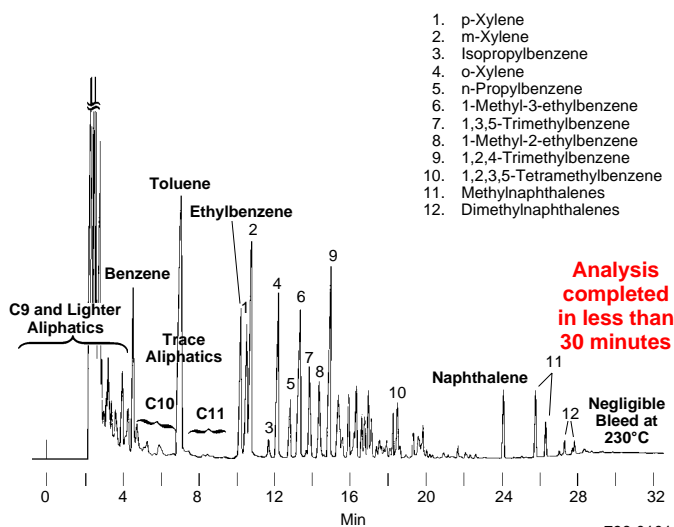


For more information, request Bulletin 864.

713-0774

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

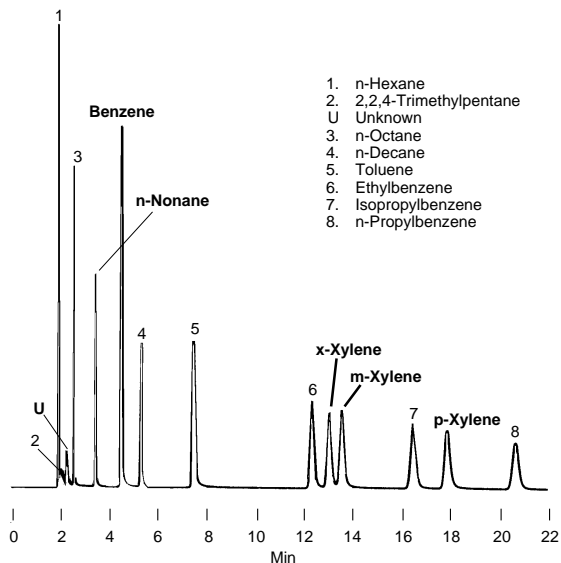


796-0101

[▲]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 CS₂ containing 1% each component, direct injection



796-0100

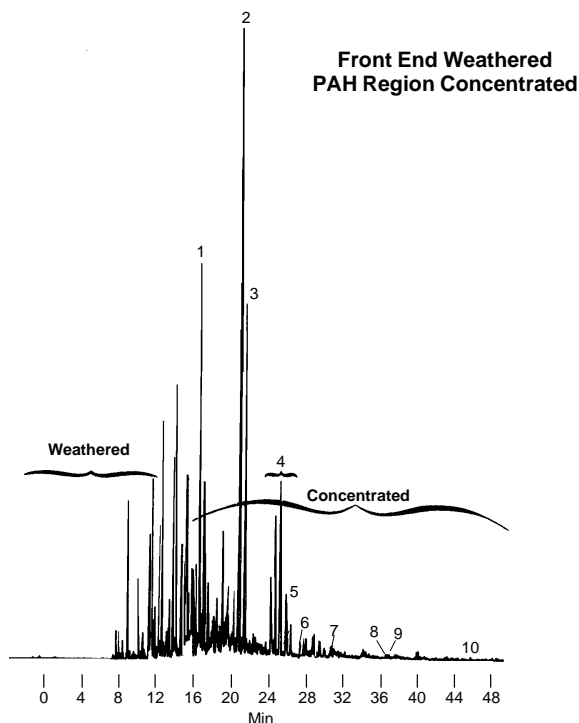
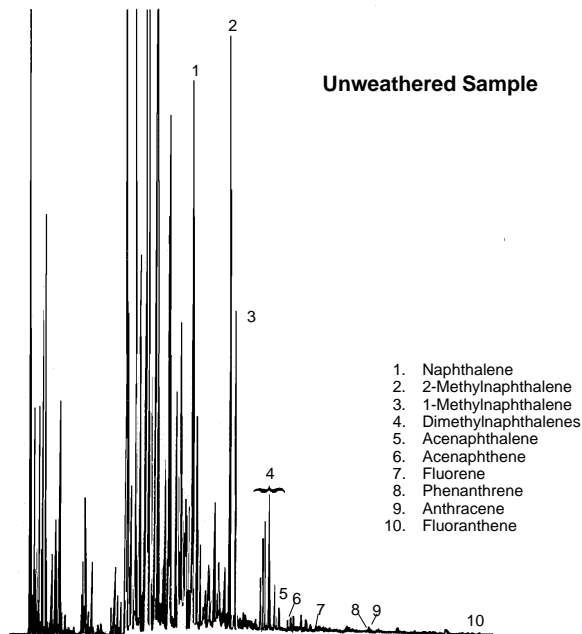
[▲]This glass column is no longer available. Request the same dimensions in a fused silica column, as a custom column, or request Cat. No. 25301-U (30m x 0.53mm ID fused silica, 1.0µm film).

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 SUPELCO WAX 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.

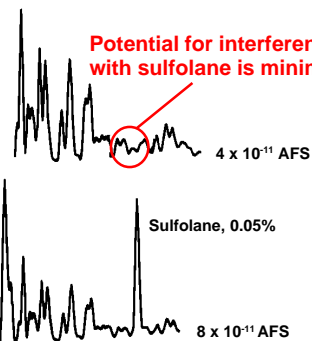
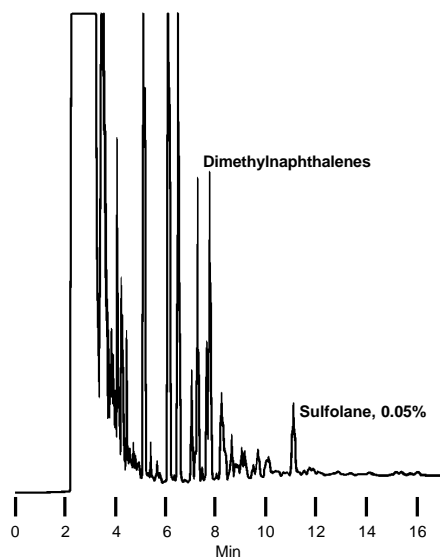
A 0.75mm ID SUPELCO WAX 10 capillary column (Figure 44) can replace several packed columns for monitoring impurities in aromatic petroleum products (ASTM Method D4534). It ensures:

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

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

Figure 43. Detect Low Levels of Sulfolane in Petroleum Streams

Column: SUPELCO WAX 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



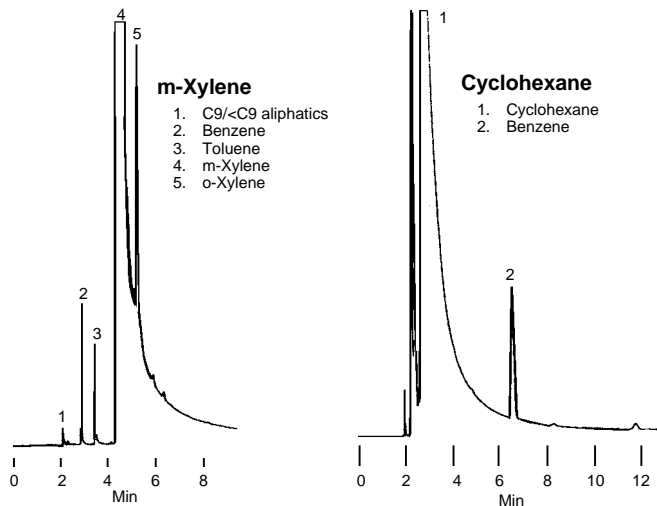
796-0104

[▲]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: SUPELCO WAX 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



Cyclohexane

1. Cyclohexane
2. Benzene

Ethylbenzene

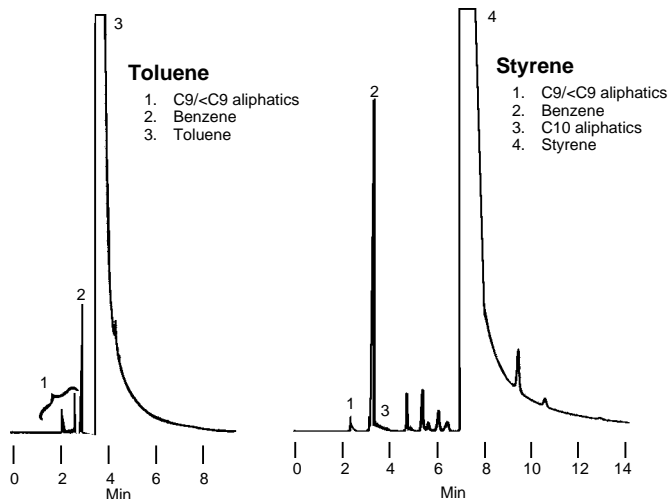
1. C9/<C9 aliphatics
2. Benzene
3. C10 aliphatics
4. Toluene
5. Ethylbenzene

Toluene

1. C9/<C9 aliphatics
2. Benzene
3. Toluene

Styrene

1. C9/<C9 aliphatics
2. Benzene
3. C10 aliphatics
4. Styrene



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

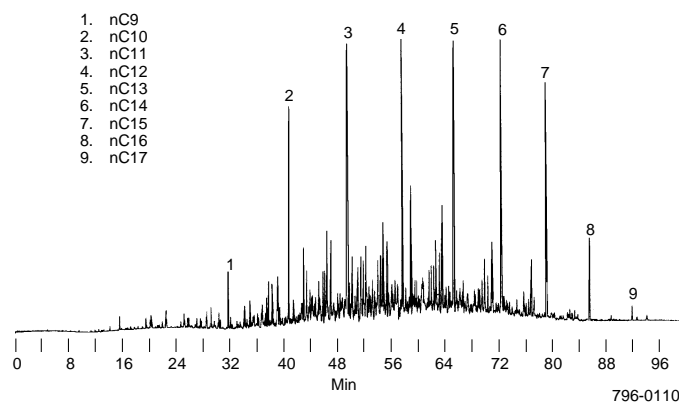


Figure 46. Turpentine

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

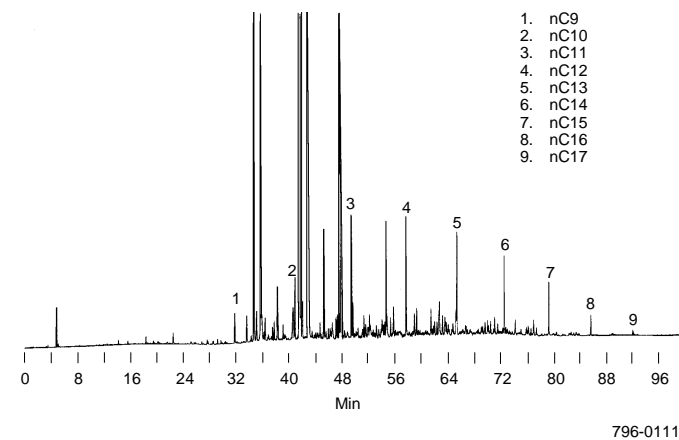
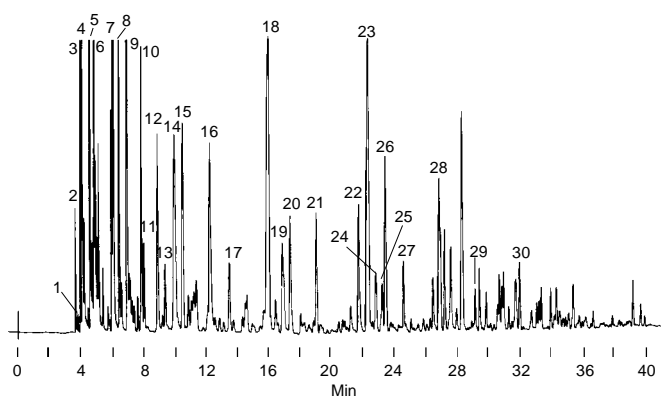


Figure 47. Gasoline on a Capillary Column in a Packed Column Chromatograph

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



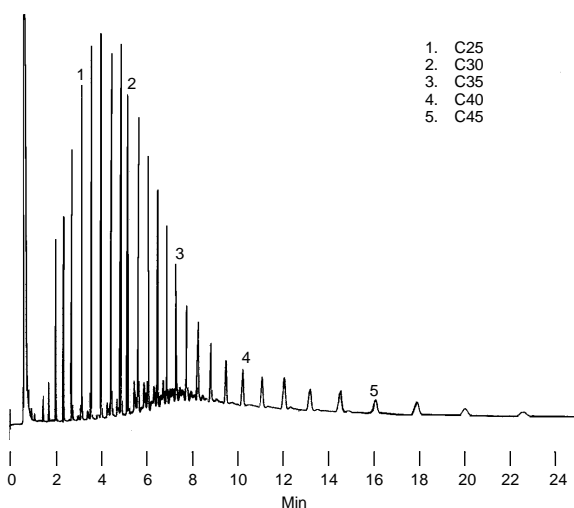
713-1351

[▲]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-isoctyl 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

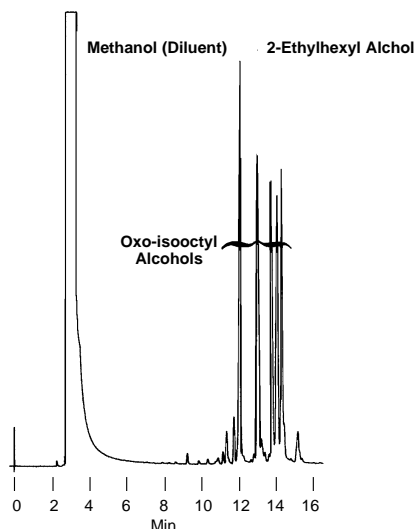


1. C25
2. C30
3. C35
4. C40
5. C45

796-0104

Figure 49. 2-Ethylhexyl Alcohol Isolated from Other Oxo-isoctyl 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 CH₃OH, 2% iso-octyl alcohols

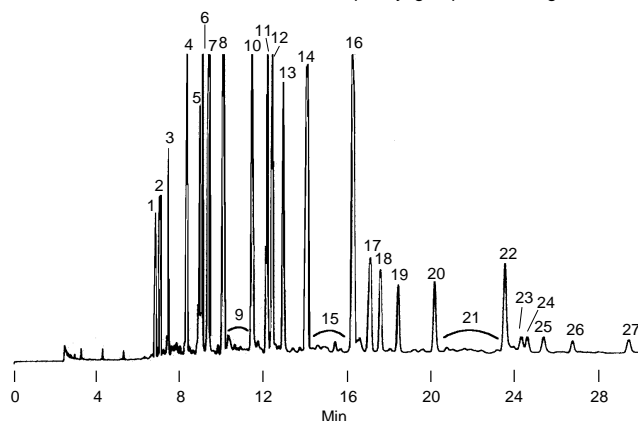


713-0794

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

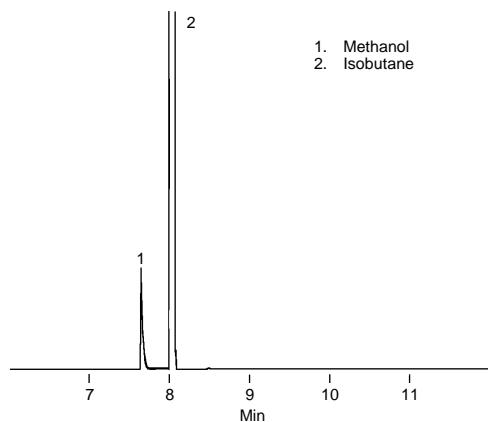
- | | |
|------------------|-------------------|
| 1. 5øC10* | 15. C11 tetralins |
| 2. 4øC10 | 16. 2øC12 |
| 3. 3øC10 | 17. 6øC13, 7øC13 |
| 4. 2øC10 | 18. 5øC13 |
| 5. 6øC11 | 19. 4øC13 |
| 6. 5øC11 | 20. 3øC13 |
| 7. 4øC11 | 21. C12 tetralins |
| 8. 3øC11 | 22. 2øC13 |
| 9. C10 tetralins | 23. 7øC14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

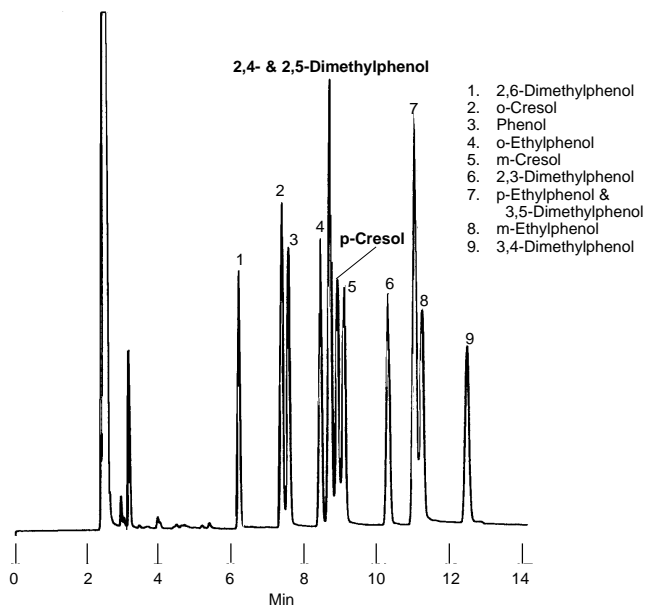
Phenols / Polymers

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

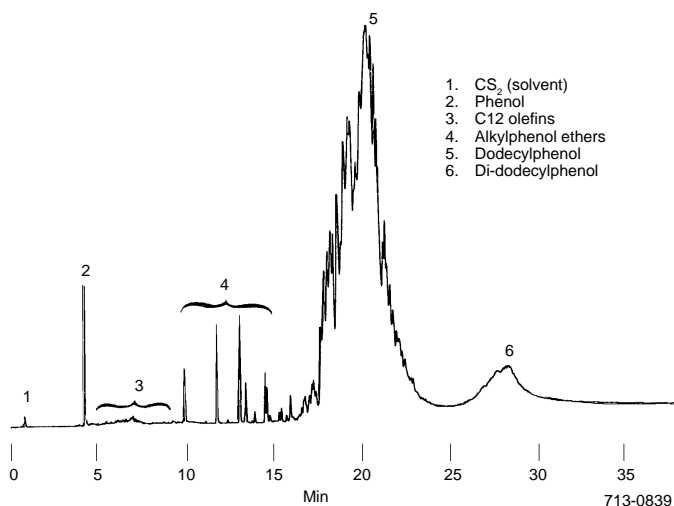
Capillary Column Improves Analyses of Dodecylphenol Product

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

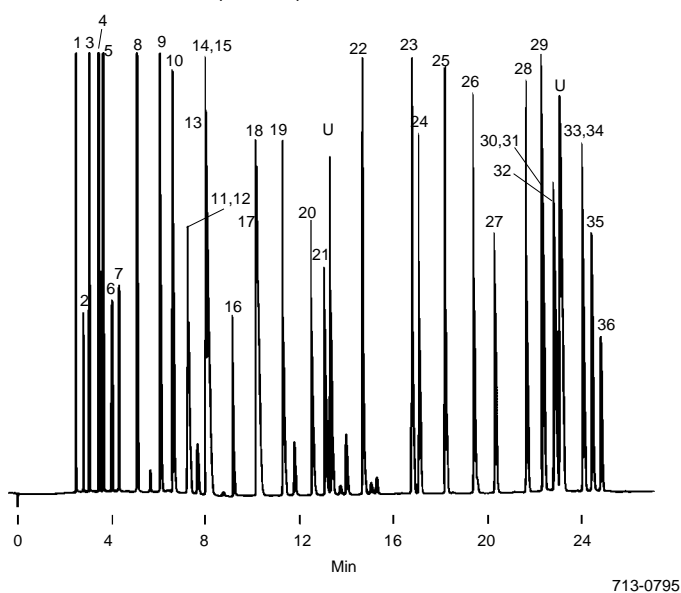
Analyze Almost Any Combination of Solvents

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



Solvents for Figures 54-56

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

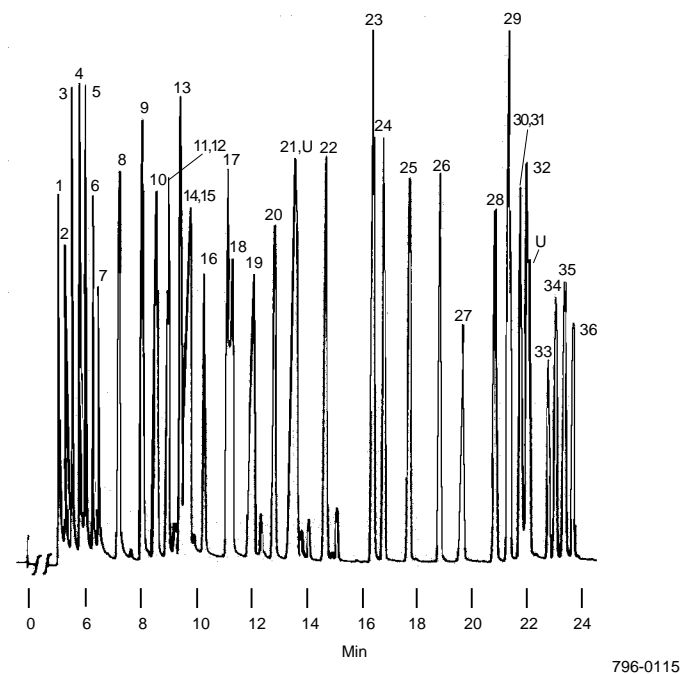
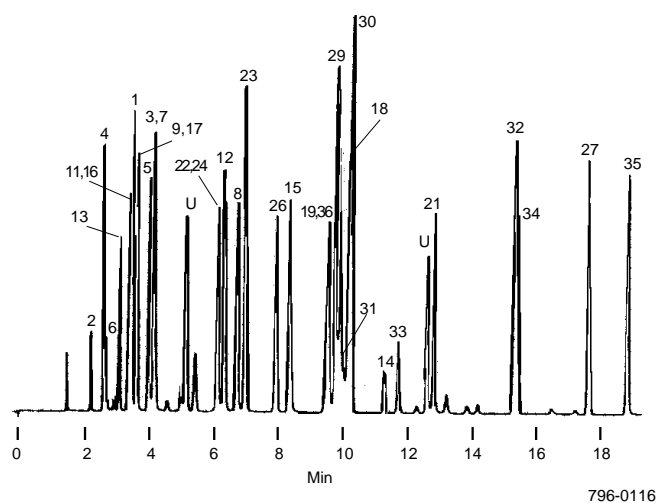


Figure 56. Solvents on a Capillary Column in a Packed Column GC

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



*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

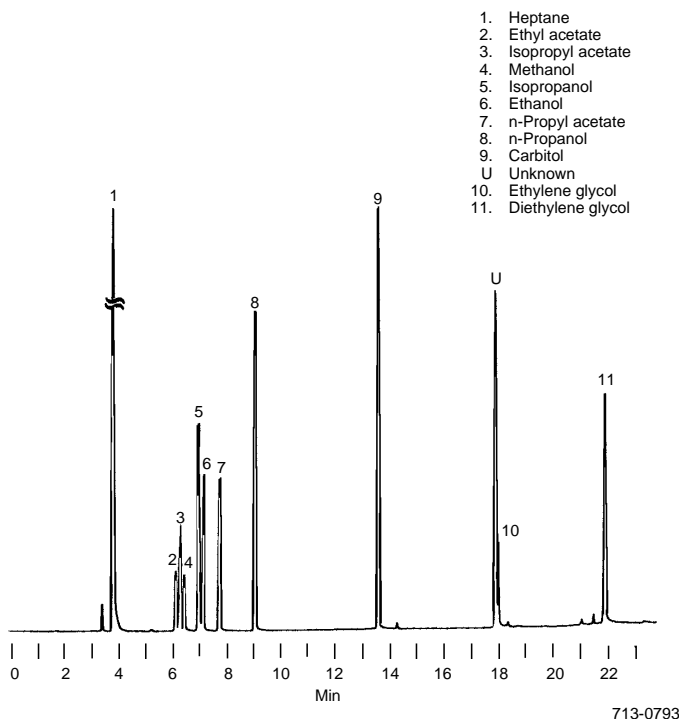
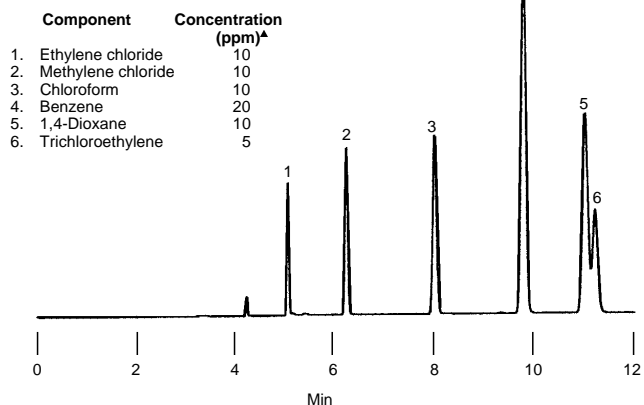


Figure 58. Solvents Commonly Used in Pharmaceuticals Manufacture

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



* 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

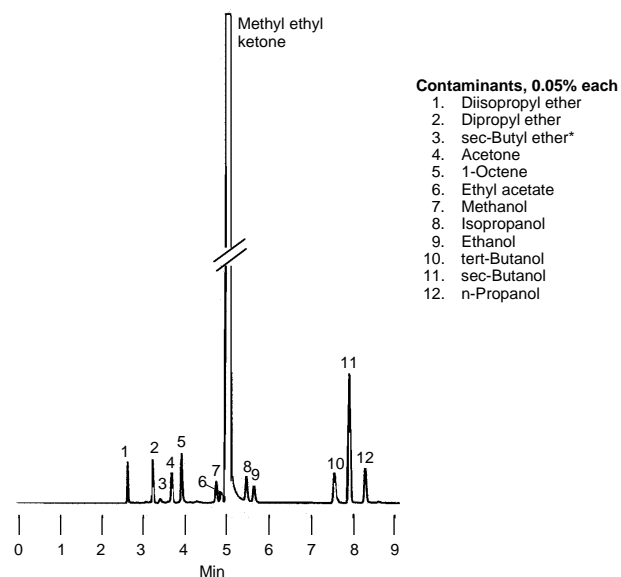


Figure 60. Choose Maximum Resolution or Save Time When Monitoring Purity of Methyl Isobutyl Ketone

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**

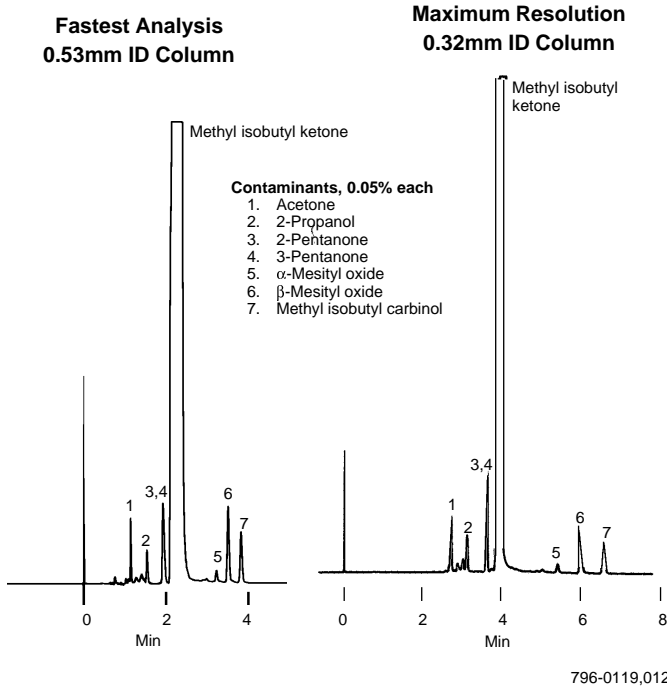


Figure 61. Impurities from 2-Ethylhexanol

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**

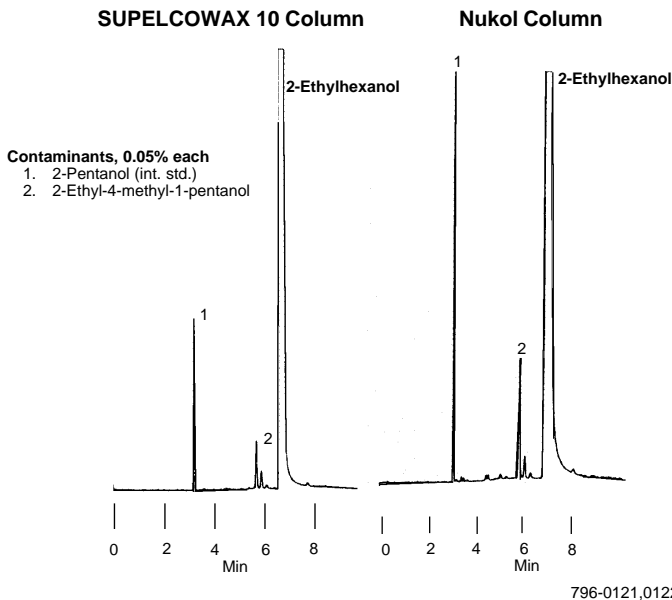


Table 3. Capillary Column Ensures Consistent Measurements of Impurities in Solvents

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)**

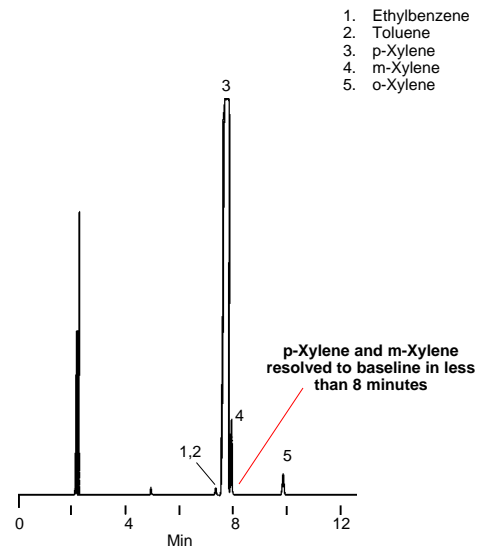
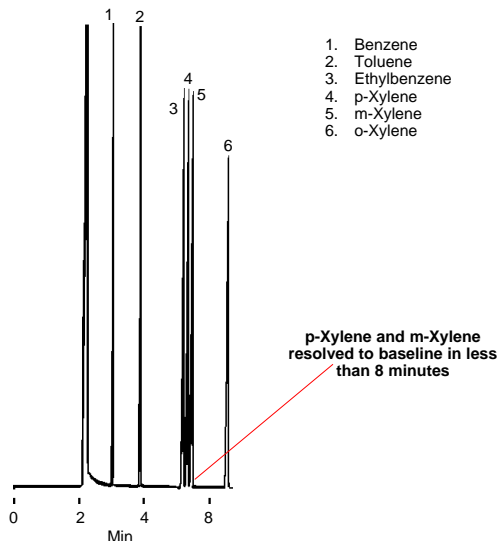


Figure 63. Fastest Separation of Aromatic Compounds in Balanced Proportions

Column: **SUPELLOWAX 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)**

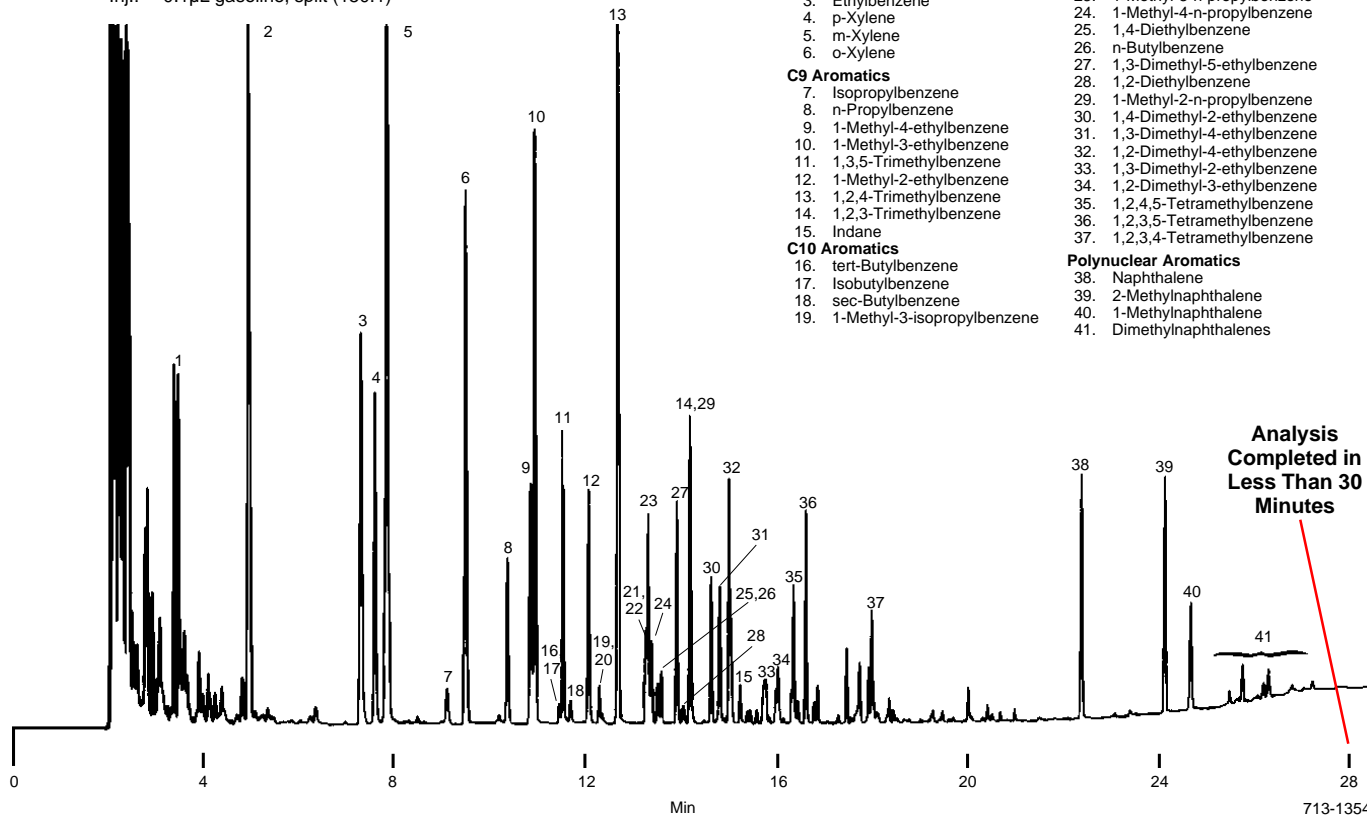


713-1355

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 SUPELLOWAX 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: **SUPELLOWAX 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)**



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

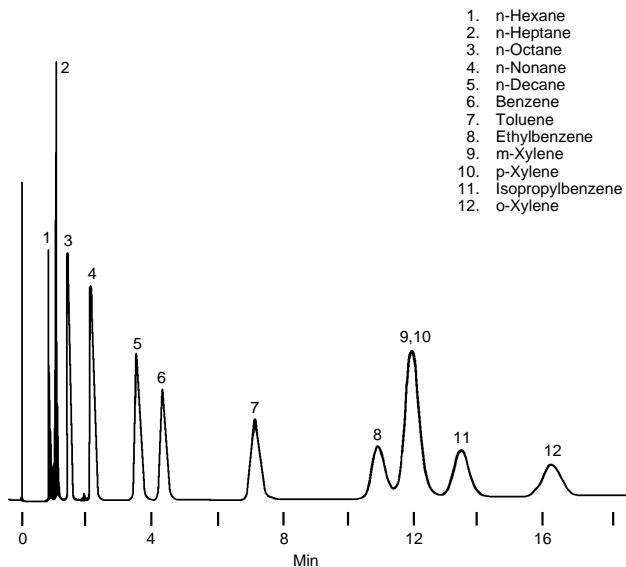
5% SP-1200/5% Bentone® 34 packing separates o-, m-, and p-xylene and ethylbenzene in less than 7 minutes. If styrene, isopropylbenzene, or n-propylbenzene are present, use 5% SP-1200/1.75% Bentone 34 (Figure 66).

Difficult-to-Resolve Aromatics

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

Figure 65. Aromatics and Aliphatics

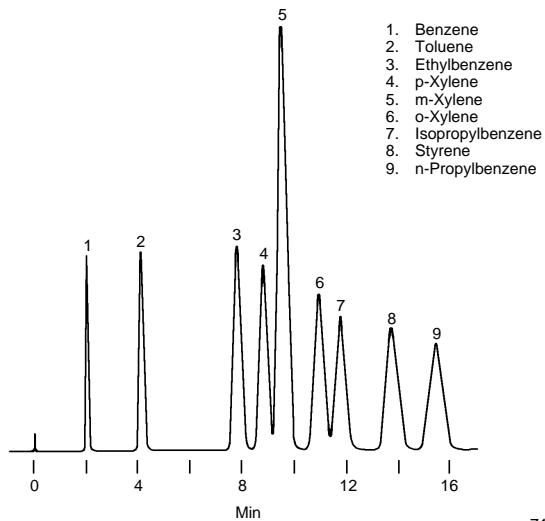
Packing: **GP 10% TCEP on 100/120 Chromosorb P AW**
 Cat. No.: **12106-U** (packing, 20g/bottle)
 Column: 8' x 1/8" stainless steel
 Oven: 80°C
 Carrier: nitrogen, 20mL/min
 Det.: FID
 Inj.: 0.2µL, approx. equal volumes each analyte



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

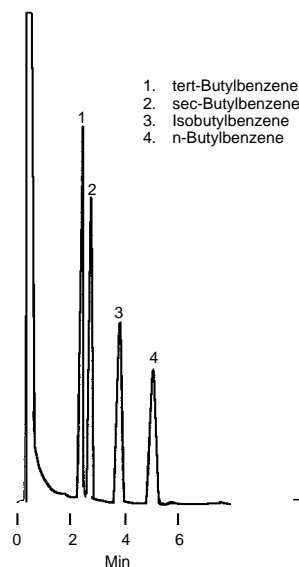


713-0722

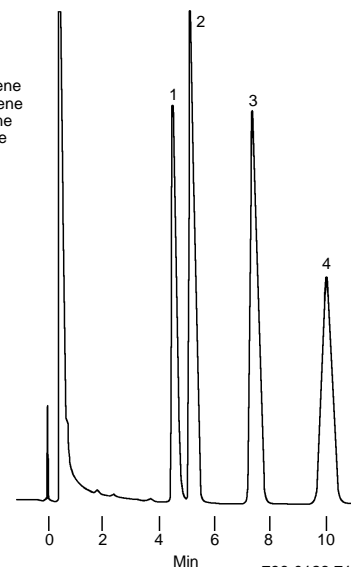
Figure 67. Analyses are Twice as Fast on a Carbowack F-TA Column

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)

Carbowack F Column



Carbowack C Column

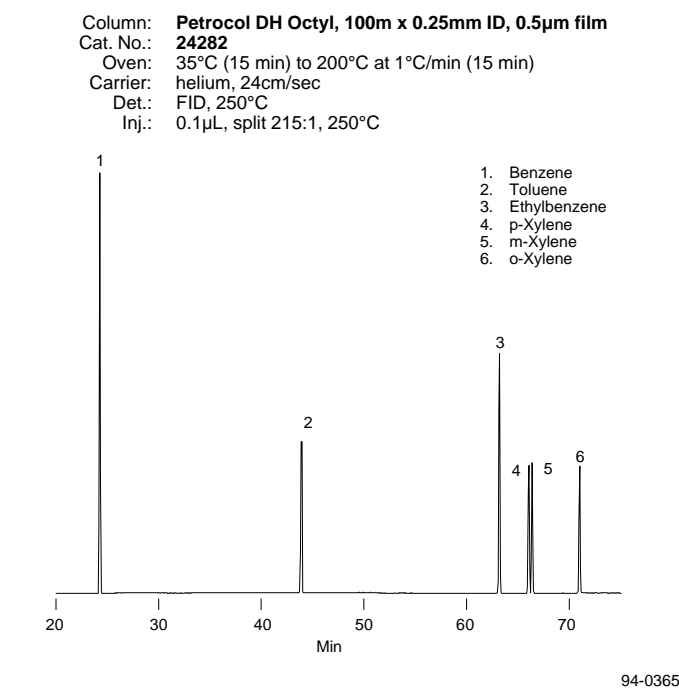


796-0123,713-0721

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



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

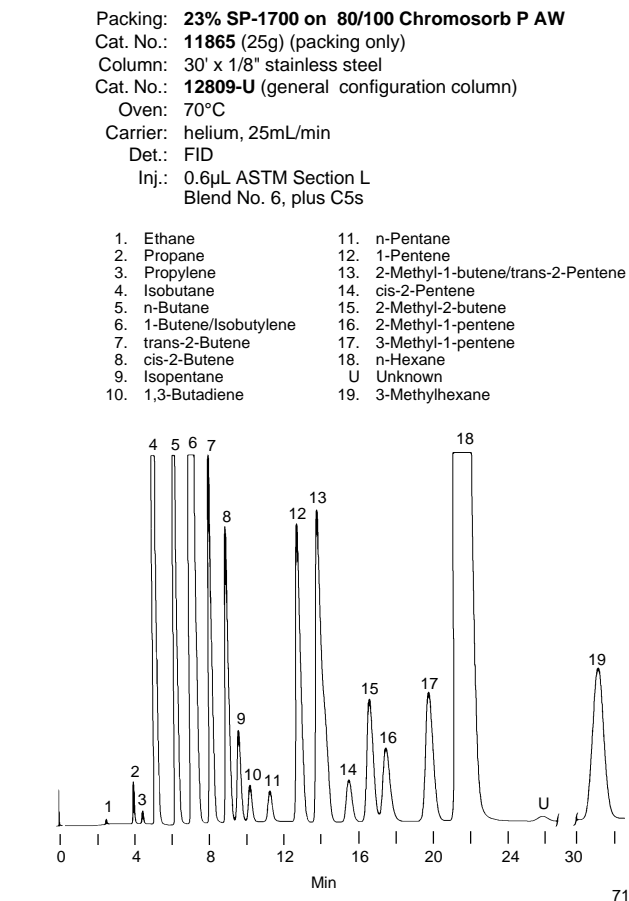
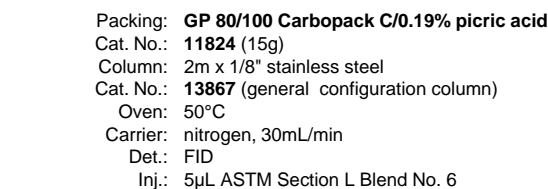


Figure 70. C4 Unsaturation



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

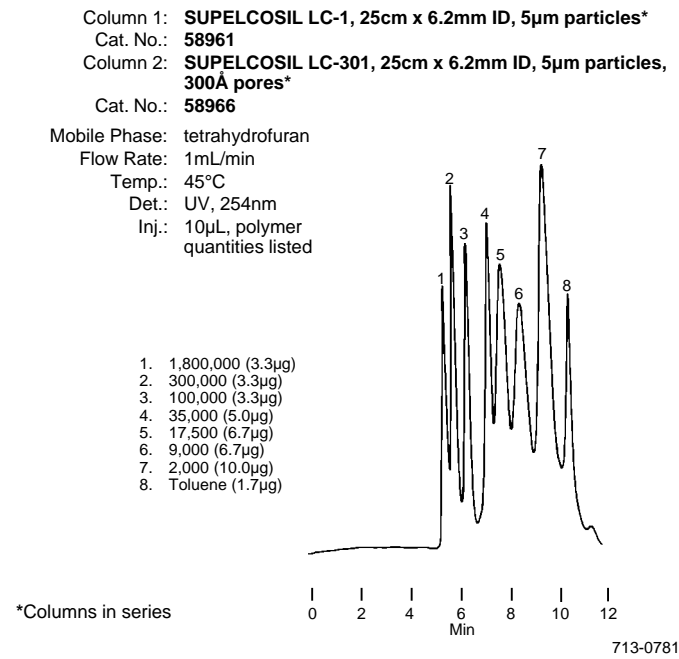
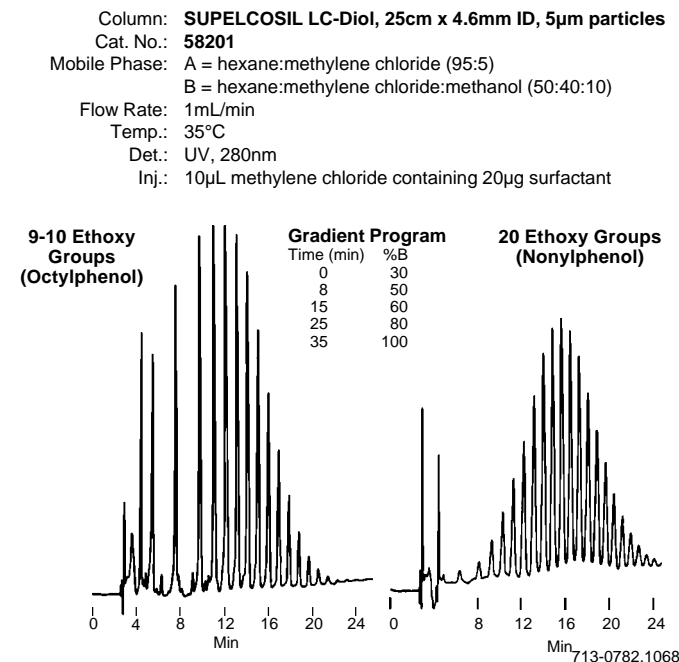


Figure 72. Nonionic Surfactants Resolved Almost to Baseline (Normal Phase Analysis)



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

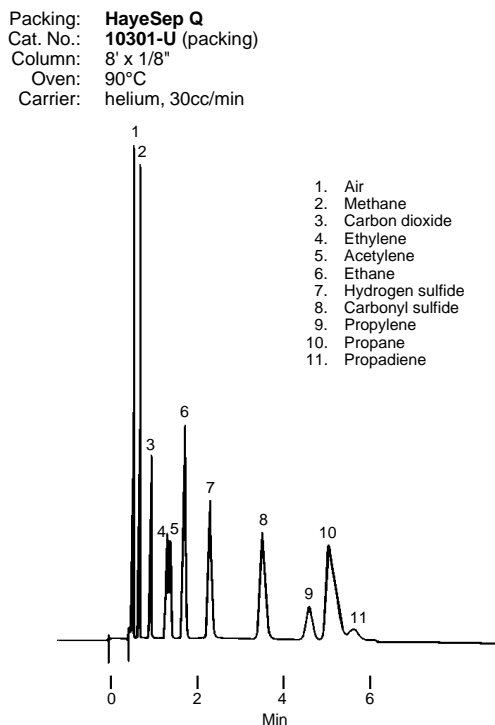
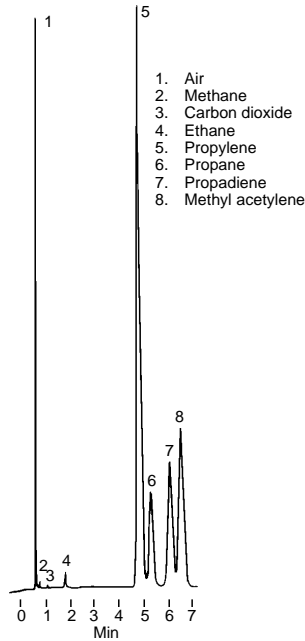


Figure 74. Mapp® Gas on HayeSep R

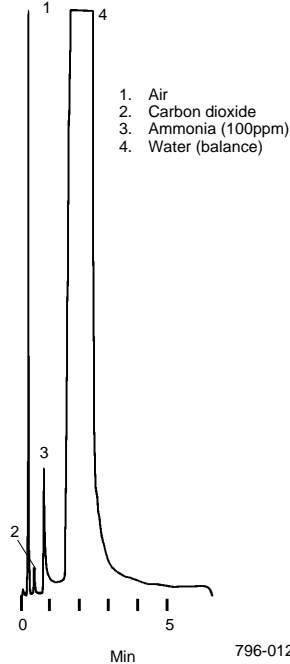
Packing: **HayeSep R**
 Cat. No.: **10304** (packing)
 Column: 10' x 1/8" stainless steel
 Oven: 80°C
 Carrier: helium, 30mL/min
 Inj.: 15mL



795-0209

Figure 76. Trace Ammonia in Water on HayeSep C

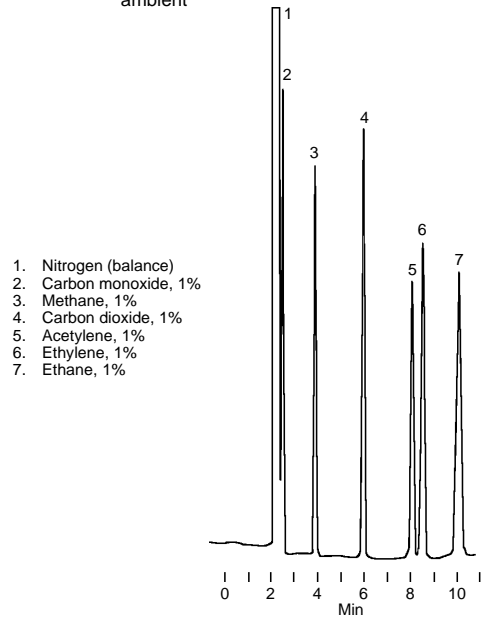
Packing: **80/100 HayeSep C**
 Cat. No.: **10289**
 Column: 5' x 1/8"
 Oven: 115°C
 Det.: TCD
 Inj.: 1µL



796-0124

Figure 77. Scott Mix 216 on HayeSep D

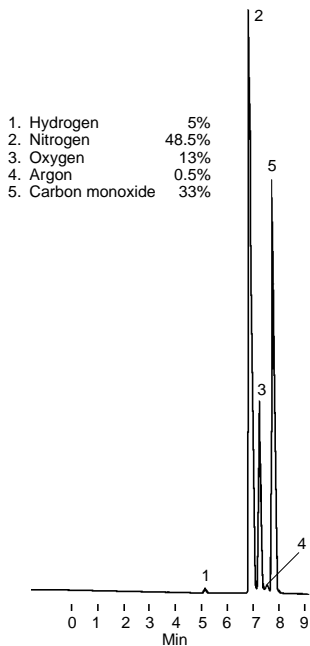
Packing: **HayeSep D**
 Cat. No.: **10293** (packing)
 Column: 20' x 1/8" Ni
 Oven: 40°C (2 min) to 110°C at 24°C/min
 Carrier: helium, 30mL/min
 Det.: P.E. 900 T.C., 225ma, 140°C
 Inj.: 100mL, Valco valve, ambient



795-0210

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



795-0226

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 hydrocarbon 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

Refer to SPB-1 and SUPELCOWAX 10 listings in our current catalog for additional 100-meter columns.

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			
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 (SUPELCO WAX 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.	Description	Cat. No.
Detailed Hydrocarbons Analyses		Solvents	
Petrocol DH Fused Silica Capillary Column 100m x 0.25mm ID, 0.50µm film	24160-U	SPB-1 Capillary Columns 30m x 0.32mm ID fused silica, 1.0µm film	24045-U
Petrocol DH 50.2 Fused Silica Capillary Column 50m x 0.20mm ID, 0.50µm film	24133-U	SUPELCOWAX 10 Capillary Columns 30m x 0.53mm ID fused silica, 1.0µm film	25301-U
Petrocol DH 150 Fused Silica Capillary Column 150m x 0.25mm ID, 1.0µm film	24155	Nukol Wide Bore Capillary Column 30m x 0.53mm ID, 0.5µm film	25327
Petrocol DH Octyl Fused Silica Capillary Columns 100m x 0.25mm ID, 0.5µm film	24282	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
Light Hydrocarbons		Impurities in Solvents	
SPB-1 Thick Film Fused Silica Capillary Column 60m x 0.53mm ID, 5µm film	25349	SUPELCOWAX 10 Fused Silica Capillary Columns 30m x 0.32mm ID, 0.25µm film	24080-U
SPB-5 Thick Film Fused Silica Capillary Column 60m x 0.53mm ID, 3µm film	25343	30m x 0.32mm ID, 0.5µm film	24084
		15m x 0.53mm ID, 1µm film	25300-U
High Boiling Hydrocarbons		Nukol Fused Silica Capillary Column 30m x 0.32mm ID, 0.25µm film	
SPB-1 Thin Film Fused Silica Capillary Columns 15m x 0.53mm ID, 0.10µm film	25360		24131
30m x 0.53mm ID, 0.10µm film	25361		
Oxygenates		High Resolution or High Speed Analyses	
Petrocol DH Octyl Fused Silica Capillary Columns 100m x 0.25mm ID, 0.5µm film	24282	SUPELCOWAX 10 Fused Silica Capillary Columns 30m x 0.20mm ID, 0.20µm film	24169
Petrocol DH 150 Fused Silica Capillary Column 150m x 0.25mm ID, 1.0µm film	24155	60m x 0.20mm ID, 0.20µm film	24170
Simulated Distillation By Packed Column GC		Aromatics / Aliphatics by Packed Column GC	
Petrocol A Column 20" x 1/8" stainless steel	12445	Packings (20g) GP 10% TCEP on 100/120 Chromosorb® P AW	12106-U
Petrocol B Column 20" x 1/8" stainless steel	12449	GP 10% TCEP on 80/100 Chromosorb P AW	12122
		GP 35% BC-120 on 100/120 Chromosorb P AW DMCS	11834
Simulated Distillation By Capillary GC		GP 35% BC-150 on 100/120 Chromosorb P AW DMCS	11840-U
Petrocol 2887 Capillary Column 5m x 0.53mm ID fused silica, 0.5µm film	25323	10% SP™-2100 on 100/120 SUPELCOPORT™	11989
		10% SP-2100 on 80/100 SUPELCOPORT	12140
Polynuclear Aromatic Hydrocarbons in Gasoline		GP 5% SP-1200/1.75% Bentone® 34 on 100/120 SUPELCOPORT	12134
SPB-5 Fused Silica Capillary Column 30m x 0.25mm ID, 0.25µm film	24034	GP 5% SP-1200/5% Bentone 34 on 100/120 SUPELCOPORT	12133
Miscellaneous Petrochemicals Analyses		Packings (Other Quantities)	
Petrocol DH 50.2 Fused Silica Capillary Column 50m x 0.20mm ID, 0.50µm film	24133-U	80/100 Carbopack™ C/0.1% SP-1000	11820
SPB-1 Capillary Columns 60m x 0.75mm ID glass, 1.0µm film [▲]		15g	11908
30m x 0.53mm ID fused silica, 0.50µm film	25315	7g	
SPB-20 Fused Silica Capillary Column 30m x 0.25mm ID, 0.25µm film	24086	60/80 Carbopack F-TA packing is available in packed columns only.	
Nukol Fused Silica Capillary Column 30m x 0.53mm ID, 0.50µm film	25327	C1-C6 Hydrocarbons by Packed Column GC	
Petrocol DH Octyl Fused Silica Capillary Columns 100m x 0.25mm ID, 0.5µm film	24282	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.	
Phenols / Polymers		Packings	
Nukol Fused Silica Capillary Column 30m x 0.25mm ID, 0.25µm film	24107	23% SP-1700 on 80/100 Chromosorb P AW (25g) (21-22g fills a 30" x 1/8" column)	11865
SPB-5 Fused Silica Capillary Column 30m x 0.53mm ID, 1.5µm film	25305-U	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 divinylbenzene and N-vinyl-2-pyrrolidone.

HayeSep S

USP code [S8]. Copolymer of divinylbenzene and 4-vinylpyridine.

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, ammonia in H ₂ O	190	10285
	80/100			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, alcohols in water	250	10297
	80/100			10298
	100/120			10299
HayeSep Q	60/80	hydrocarbons, sulfur gases, general	275	10300-U
	80/100			10301-U
	100/120			10302
HayeSep R	60/80	light hydrocarbons, chlorinated compounds	250	10303
	80/100			10304
	100/120			10305-U
HayeSep S	60/80	C2-C3 hydrocarbons polar compounds	250	10306
	80/100			10307
	100/120			10308
HayeSep T	60/80	light hydrocarbons formaldehyde	165	10309
	80/100			10310
	100/120			10311

Polymers by Gel Permeation Chromatography

SUPELCOSM 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

SUPELCOSM 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 [■]	<i>11 n-paraffins (typical values shown)</i> n-Pentane, 11.393% n-Hexane, 10.963% n-Heptane, 12.239% n-Octane, 10.088% n-Nonane, 13.204% n-Decane, 6.703%	0.1mL	44585-U
Isoparaffins Mix [■]	<i>37 isoparaffins (typical values shown)</i> Isopentane, 2.553% 2,3-Dimethylbutane, 1.438% 2-Methylpentane, 4.356% 3-Methylpentane, 3.147% 2,2-Dimethylpentane, 4.189% 2,4-Dimethylpentane, 3.116% 2,2,3-Trimethylbutane, 3.149% 3,3-Dimethylpentane, 1.308% 2-Methylhexane, 3.551% 2,3-Dimethylpentane, 1.612% 3-Methylhexane, 4.456% 3-Ethylpentane, 1.600% 2,2-Dimethylhexane, 1.439% 2,5-Dimethylhexane, 3.195% 2,2,3-Trimethylpentane, 3.185% 2,4-Dimethylhexane, 1.574% 2,3-Dimethylhexane, 1.365% 2-Methylheptane, 4.641% 4-Methylheptane, 3.377%	0.1mL	44586-U
Naphthenes Mix [■]	<i>30 naphthenes (typical values shown)</i> Cyclopentane, 5.805% Methylcyclopentane, 8.728% Cyclohexane, 5.758% 1,1-Dimethylcyclopentane, 3.370% cis-1,3-Dimethylcyclopentane, 1.962% trans-1,3-Dimethylcyclopentane, 2.689% trans-1,2-Dimethylcyclopentane, 3.087% Methylcyclohexane, 8.992% Ethylcyclopentane, 1.773% ctc-1,2,4-Trimethylcyclopentane, 3.721% ctc-1,2,3-Trimethylcyclopentane, 3.419% cct-1,2,4-Trimethylcyclopentane, 1.438% trans-1,4-Dimethylcyclohexane, 3.713% 1-Ethyl-1-methylcyclohexane, 1.634% trans-1,2-Dimethylcyclohexane, 3.644%	0.1mL	44588
Olefins Mix [■]	<i>25 olefins (typical values shown)</i> 3-Methyl-1-butene, 1.478% 1-Pentene, 5.640% 2-Methyl-1-butene, 1.880% 2-Methyl-1,3-butadiene, 2.389% trans-2-Pentene, 4.024% cis-2-Pentene, 2.305% 4-Methylpentene-1 1-Hexene, 7.693% trans-2-Hexene, 1.744% 2-Methylpentene-2, 4.054% cis-2-Hexene, 1.825% 1-Heptene, 8.716% 1-Decene, 7.665%	0.1mL	44589

[■] 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	<p><i>37 aromatics (typical values shown)</i></p> <p>Benzene, 3.139% Toluene, 4.563% Ethylbenzene, 1.570% m-Xylene, 2.939% p-Xylene, 2.982 % o-Xylene, 3.208% Isopropylbenzene, 3.127% n-Propylbenzene, 1.705% 1-Methyl-3-ethylbenzene, 2.903% 1-Methyl-4-ethylbenzene, 3.166% 1,3,5-Trimethylbenzene, 3.427% 1-Methyl-2-ethylbenzene, 4.460% 1,2,4-Trimethylbenzene, 4.315% tert-Butylbenzene, 2.667% Isobutylbenzene, 0.845% sec-Butylbenzene, 1.469% 1-Methyl-3-isopropylbenzene, 1.403% 1-Methyl-4-isopropylbenzene, 2.789% 1-Methyl-2-isopropylbenzene, 2.631%</p>	<p>0.1mL</p> <p>1-Methyl-3-n-propylbenzene, 3.214% 1-Methyl-4-n-propylbenzene, 1.444% n-Butylbenzene, 2.894% 1,3-Dimethyl-5-ethylbenzene, 1.306% 1,2-Diethylbenzene, 3.063% 1-Methyl-2-n-propylbenzene, 1.449% 1,4-Dimethyl-2-ethylbenzene, 2.985% 1,2-Dimethyl-4-ethylbenzene, 2.706% 1,3-Dimethyl-2-ethylbenzene, 2.702% 1,2-Dimethyl-3-ethylbenzene, 2.956% 1,2,4,5-Tetramethylbenzene, 1.966% 2-Methylbutylbenzene, 1.432% n-Pentylbenzene, 1.466% t-1-Butyl,3,5-dimethylbenzene, 2.920% t-1-Butyl-4-ethylbenzene, 2.900% 1,3,5-Triethylbenzene, 1.850% 1,2,4-Triethylbenzene, 3.104% n-Hexylbenzene, 4.641%</p>	44587
P-I-A-N-O Mix	<p><i>139 n-paraffins, isoparaffins, aromatics, naphthenes, and olefins</i></p> <p>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.</p> <p>Approximate weight percentages:</p> <p>n-Paraffins, 18.9% Isoparaffins, 18.8% Aromatics, 23.3%</p>	<p>0.1mL</p> <p>Naphthenes, 20.5% Olefins, 18.5%</p>	44593-U
P-I-A-N-O Kit	<p><i>One of each of the following mixes</i></p> <p>n-Paraffins Mix (44585-U) Isoparaffins Mix (44586-U) Naphthenes Mix (44588)</p>	<p>Olefins Mix (44589) Aromatics Mix (44587) P-I-A-N-O Mix (44593-U)</p>	44594-U

**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 keystrokes. 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.



P000165

ASTM D5134

Detailed Analysis of Petroleum Naphthas Through n-Nonane

Mixes and Solutions	Composition	Qty.	Cat. No.
ASTM D5134 Qualitative Column Evaluation Mix	<i>Nominal 0.5-1.0% by weight in 2-methylpentane</i> Use this mix of hydrocarbons for assessing column performance. Toluene, 0.5% 2,3,3-Trimethylpentane, 1% 4-Methylheptane, 1% n-Heptane, 1% 2-Methylheptane, 1% n-Octane, 1%	1mL	502103
ASTM D5134 Splitter Linearity Check Mix	<i>Neat at 10% by weight, each component</i> Use this quantitative mix of hydrocarbons to determine proper system performance and detector response factors. n-Hexane Benzene 2,4-Dimethylhexane n-Heptane Toluene 2-Methylheptane n-Octane 2-Methylhexane 2,4-Dimethylheptane n-Nonane	500mg	506753
2,3,3-Trimethylpentane	<i>Neat</i>	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	<i>Approximately 30 identified components. Neat fraction.</i> Actual refinery alkylation product	6 x 1mL	48267-U
ASTM D5134 Qualitative Reference Reformate Standard	<i>Approximately 70 identified components. Neat fraction.</i> Actual refinery reformate product	6 x 1mL	48266
ASTM D5134 Qualitative Reference Naphtha Standard	<i>Approximately 100 identified components. Neat fraction.</i> Actual refinery naphtha product	6 x 1mL	48265-U
ASTM D5134 Qualitative Reference Refinery Standards Kit	<i>2 x 1mL each of the three qualitative reference standards (alkylate, naphtha, and reformate)</i>		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	<i>0.05 weight percent each of nC20 and nC24 in cyclohexane</i> Use to determine column resolution.	6 x 1mL	506729
Retention Time Standards			
ASTM D5442 C16-C44 Retention Time Mix	<i>Neat qualitative n-paraffins, each at 8.3 weight percent</i> Use to establish retention times from C16 to C44 C16 C24 C32 C18 C26 C36 C20 C28 C40 C22 C30 C44	500mg	502251
ASTM D5442 C12-C60 Retention Time Mix	<i>Neat qualitative n-paraffins, each at 6.25 weight percent</i> Use to establish retention times from C12 to C60 C12 C24 C36 C14 C26 C40 C16 C28 C44 C18 C30 C50 C20 C32 C60 C22	500mg	500623
Quantitative Linearity Standards			
ASTM D5442 C16-C44 Linearity Standard	<i>n-Paraffins, each at 0.01 weight percent</i> Accurately prepared mix. Use to determine response factors from C16 to C44. C16 C24 C32 C18 C26 C36 C20 C28 C40 C22 C30 C44	1mL 6 x 1mL	502278 502286
ASTM D5442 C12-C60 Linearity Standard	<i>n-Paraffins, each at 0.01 weight percent</i> Accurately prepared mix. Use to determine response factors from C12 to C60. C12 C24 C36 C14 C26 C40 C16 C28 C44 C18 C30 C50 C20 C32 C60 C22	1mL 6 x 1mL	502243 502235
Internal Standards			
ASTM D5442 n-Hexadecane Internal Standard	<i>n-Hexadecane (nC16), neat or in solution, added to the internal standard.</i>	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	<i>Neat, varied concentrations</i>	500mg	47100
n-Paraffin Mix C7, C8, C9, C10	<i>Neat, varied concentrations</i>	500mg	47101
n-Paraffin Mix C10, C12, C14, C16	<i>Neat, varied concentrations</i>	500mg	47102
n-Paraffin Mix C18, C20, C22, C24	<i>2% (wt./wt.) each n-paraffin in n-octane</i>	5mL	47108
n-Paraffin Mix C22, C24, C28, C32	<i>2% (wt./wt.) each n-paraffin in n-octane</i>	5mL	47106
n-Paraffin Mix C24, C28, C32, C36	<i>2% (wt./wt.) each n-paraffin in n-octane</i>	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	<i>Each of the following components in the approximate proportions</i>	1 x 1mL	50642
		6 x 1mL	48884
	n-Propane, 1.5% 2-Methylpropane, 1.5% n-Butane, 4.5% 2-Methylbutane, 9.7% n-Pentane, 7.6% 2-Methylpentane, 5.4% n-Hexane, 5.4%		
	2,4-Dimethylpentane, 5.4% n-Heptane, 9.7% Toluene, 10.8% n-Octane, 5.4% p-Xylene, 13.0% n-Propylbenzene, 4.3%		
	n-Decane, 3.2% n-Butylbenzene, 3.2% n-Dodecane, 3.2% n-Tridecane, 2.2% n-Tetradecane, 2.2% n-Pentadecane, 2.2%		
ASTM D3710 Quantitative Calibration Mix	<i>Each of the following components in the proportions (v/v) indicated</i>	1 x 1mL	506435
		6 x 1mL	48879
	2-Methylbutane, 10.5% n-Pentane, 8.1% 2-Methylpentane, 5.8% n-Hexane, 5.8% 2,4-Dimethylpentane, 5.8% n-Heptane, 10.5%		
	Toluene, 11.6% n-Octane, 5.8% p-Xylene, 14.0% n-Propylbenzene, 4.7% n-Decane, 3.5%		
	n-Butylbenzene, 3.5% n-Dodecane, 3.5% n-Tridecane, 2.3% n-Tetradecane, 2.3% n-Pentadecane, 2.3%		
ASTM D2887/D5307 Column Resolution Test Mix	<i>Each of the following components at 1% (w/v) in n-octane</i>	6 x 1mL	48889
	n-Hexadecane n-Octadecane		
ASTM D2887 Quantitative Calibration Solution	<i>Prepared in carbon disulfide at 0.5 weight percent each component (except for nC16 and nC18, which are at 1 weight percent)</i>	1 x 1mL	500631
		6 x 1mL	500658
	Use for assessing column resolution as well as for quantitative analyses.		
	n-Pentane n-Hexane n-Heptane n-Octane n-Nonane n-Decane n-Undecane		
	n-Dodecane n-Tetradecane n-Pentadecane n-Hexadecane n-Heptadecane n-Octadecane n-Eicosane		
	n-Tetracosane n-Octacosane n-Dotriacontane n-Hexatriacontane n-Tetracontane 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 D5769**Aromatics in Gasoline by GC/MS**

Mixes and Solutions	Composition	Qty.	Cat. No.
ASTM D5769/EPA Aromatics Internal Standard Mix	<i>Each of the following components at the weight percent indicated</i> 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)	<i>Neat, Internal Standard</i>	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	<i>2000µg/mL in methanol</i>	1mL	506737
Methyl tert-butyl ether (MTBE)	<i>Neat</i>	1000mg	48027
Methyl tert-butyl ether (MTBE)	<i>2000µg/mL in methanol</i>	1mL	48483
MTBE Contaminant Standards			
ASTM D5441 MTBE Contaminants (High) Mix A	<i>Each component at 1% w/w in MTBE</i> Use to identify and determine response factors for the common impurities in MTBE. tert-Amyl methyl ether 2-Methylbutane trans-2-Pentene tert-Butanol 2-Methyl-2-butene Triisobutylene (mixed isomers) tert-Butyl ethyl ether Pentane 2,4,4-Trimethyl-1-pentene Methanol cis-2-Pentene	1mL	47942
ASTM D5441 MTBE Contaminants (Low) Mix B	<i>Each component at 0.1% w/w in MTBE</i> Use to identify and determine response factors for the common impurities in MTBE. tert-Amyl methyl ether 2-Methylbutane trans-2-Pentene tert-Butanol 2-Methyl-2-butene Triisobutylene (mixed isomers) tert-Butyl ethyl ether Pentane 2,4,4-Trimethyl-1-pentene 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)	<i>Each component at the nominal weight percent indicated</i> Ethanol, 3.00 tert-Butanol, 0.10 Methyl tert-butyl ether, 20.00	9.5mL	47200
D4815 Quantitative Calibration Mix 2 (Without Internal Standard)	<i>Each component at the nominal weight percent indicated</i> Ethanol, 0.10 tert-Butanol, 3.00 Methyl tert-butyl ether, 15.00	9.5mL	47201
D4815 Quantitative Calibration Mix 3 (Without Internal Standard)	<i>Each component at the nominal weight percent indicated</i> Ethanol, 6.00 tert-Butanol, 6.00 Methyl tert-butyl ether, 10.00	9.5mL	47202
D4815 Quantitative Calibration Mix 4 (Without Internal Standard)	<i>Each component at the nominal weight percent indicated</i> Ethanol, 9.00 tert-Butanol, 8.00 Methyl tert-butyl ether, 5.00	9.5mL	47203
D4815 Quantitative Calibration Mix 5 (Without Internal Standard)	<i>Each component at the nominal weight percent indicated</i> Ethanol, 12.00 tert-Butanol, 12.00 Methyl tert-butyl ether, 0.10	9.5mL	47204
1,2-Dimethoxyethane (DME)	<i>Neat, internal standard</i>	5mL	47214
ASTM D4815 Calibration Curve Verification Kit	<i>Each of the following products</i> Quantitative Calibration Mix 1 (47200) Quantitative Calibration Mix 2 (47201) Quantitative Calibration Mix 3 (47202)	Quantitative Calibration Mix 4 (47203) Quantitative Calibration Mix 5 (47204) 1,2-Dimethoxyethane (47214)	47210
D4815 Quantitative Calibration Mix 1 [■] (With Internal Standard)	<i>Each component at the nominal weight percent indicated</i> Ethanol, 12.85 tert-Butanol, 0.095 Methyl tert-butyl ether, 19.00	1mL	47205
D4815 Quantitative Calibration Mix 2 [■] (With Internal Standard)	<i>Each component at the nominal weight percent indicated</i> Ethanol, 0.095 tert-Butanol, 2.85 Methyl tert-butyl ether, 14.25	1mL	47206
D4815 Quantitative Calibration Mix 3 [■] (With Internal Standard)	<i>Each component at the nominal weight percent indicated</i> Ethanol, 5.70 tert-Butanol, 5.70 Methyl tert-butyl ether, 9.50	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)	<i>Each component at the nominal weight percent indicated</i> Ethanol, 8.55 tert-Butanol, 7.60 Methyl tert-butyl ether, 4.75	1mL	47208
D4815 Quantitative Calibration Mix 5 (With Internal Standard)	<i>Each component at the nominal weight percent indicated</i> Ethanol, 11.40 tert-Butanol, 11.40 Methyl tert-butyl ether, 0.095	1mL	47209
ASTM D4815 Valve Timing Mix	<i>Each component at the nominal weight percent indicated</i> Use for determining the proper backflush valve timing. Methylcyclopentane, 10.0 Diisopropyl ether, 10.0 Ethyl tert-butyl ether, 10.0	1mL	47212
ASTM D4815 Qualitative Peak ID Mix	<i>Each component at the nominal weight percent indicated</i> Use for determining relative retention times of selected oxygenates. Methylcyclopentane, 4.0 Methanol, 7.3 Ethanol, 7.3 Isopropanol, 7.3 tert-Butanol, 7.3 n-Propanol, 7.3 Methyl tert-butyl ether, 4.0 sec-Butanol, 7.3	1mL	47213
ASTM D4815 Quantitative Calibration Kit	<i>Each of the following products</i> Quantitative Calibration Mix 1 (47205) Quantitative Calibration Mix 2 (47206) Quantitative Calibration Mix 3 (47207) Quantitative Calibration Mix 4 (47208)	Quantitative Calibration Mix 5 (47209) Valve Timing Mix (47212) Qualitative Peak ID Mix (47213)	47211

USP Solvent Standards

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

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

Scott Specialty Gases

Shelf life 1 year, unless otherwise noted.

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

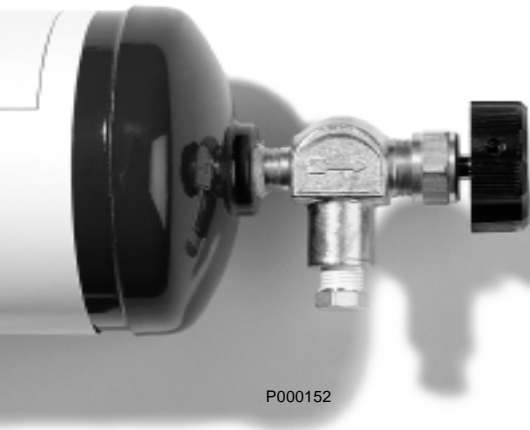
Gas Composition and Concentration	SCOTTY I Cat. No.	SCOTTY II Cat. No.	SCOTTY IV Cat. No.
Pure Gases			
Air, zero (THC < 1ppm)	501212	501220	501239
Argon 99.995%	501247	501255	_____
Carbon dioxide 99.8%*	501271	23402	501298
Hydrogen 99.99%	_____	300100	_____
Methane 99.0%	_____	22562	_____
Oxygen 99.6%	_____	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 Continued			
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
SCOTTY HP			
Gas Composition and Concentration	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	—	—

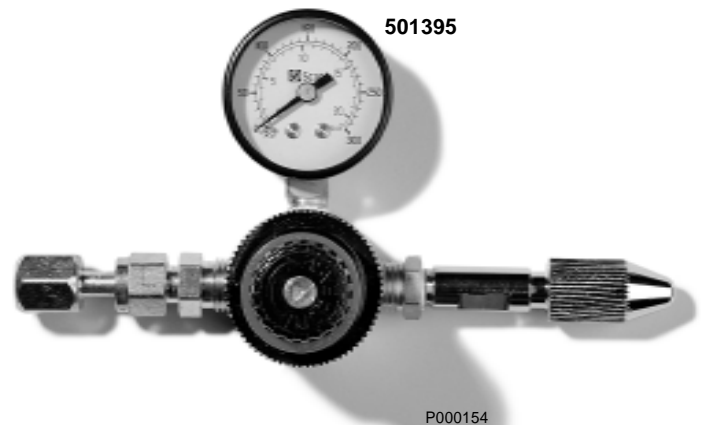
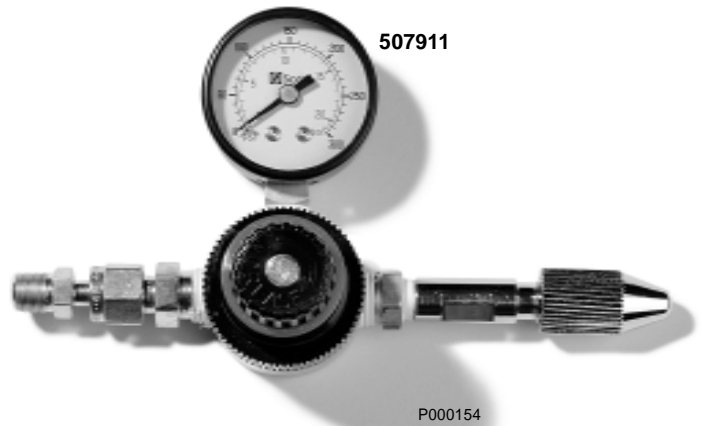
Standard	BTU	Qty.	Cat. No.
GPA	1298	785g	303100-U
Calorimetric	1028	790g	303101
High Ethane	1500	763g	303102
Helium-Enriched	1083	774g	303103

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

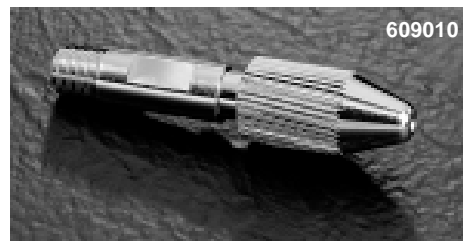
Description	Cat. No.
Model 24 Single-Stage Regulator with CGA-160 (for SCOTTY II)	507911
with CGA-165 (for SCOTTY IV)	501395



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/cm²). 1/8" NPT male fitting.

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



609010

P000160

Pressure Regulator for SCOTTY II and IV Cylinders*

Reliable pressure regulation to 1psig (0.07kg/cm²), indicated on a 0-60psi (4.2kg/cm²) 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/cm²).

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

Description	Cat. No.
Regulator	513010



513010

P000155

Stand for SCOTTY IV Cylinders

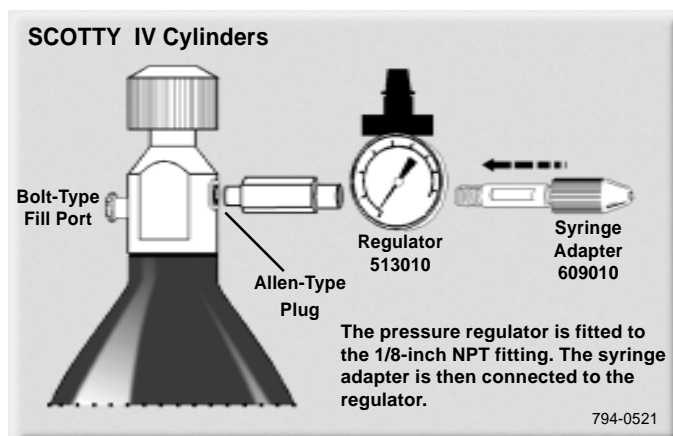
Stabilizes your cylinder on a benchtop or other surface.

Description	Cat. No.
Stand	500410



500410

P000158




794-0521

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 	<i>6 analytes, 200µg/mL each in methanol</i>	1mL	48026	
	Benzene Ethylbenzene	Toluene m-Xylene	1mL o-Xylene p-Xylene	4S8026
HC BTEX Mix	<i>6 analytes, 2000µg/mL each in methanol</i>	1mL	47993	
	Benzene Ethylbenzene	Toluene m-Xylene	o-Xylene p-Xylene	
HC BTEX/MTBE Mix	<i>7 analytes, 2000µg/mL each in methanol</i>	1mL	47505-U	
	Benzene Ethylbenzene Methyl tert-butyl ether	Toluene m-Xylene	o-Xylene p-Xylene	
Gasoline Range Organics (GRO) Standards				
Gasoline Additives Mix	<i>4 analytes, 200µg/mL each in methanol</i>	1mL	47905	
	1,2-Dibromoethane Dibromomethane	1,2-Dichloroethane	Methyl tert-butyl ether	
Gasoline Range Organics (GRO) Mix	<i>9 analytes, 2000µg/mL each in methanol</i>	1mL	47576-U	
	Benzene Ethylbenzene 3-Methylpentane	Naphthalene Toluene 1,2,4-Trimethylbenzene	2,2,4-Trimethylbenzene m-Xylene o-Xylene	
PVOC Mix	<i>8 analytes, 2000µg/mL each in methanol</i>	1mL	47916	
	Benzene Ethylbenzene Methyl tert-butyl ether	Toluene 1,2,4-Trimethylbenzene 1,3,5-Trimethylbenzene	m-Xylene o-Xylene	
EPA Gasoline Range Organics (GRO) Mix	<i>9 analytes at indicated concentrations in methanol</i>	1mL	47577-U	
	Benzene, 500µg/mL Ethylbenzene, 500µg/mL Heptane, 500µg/mL	2-Methylpentane, 1500µg/mL Toluene, 1500µg/mL 1,2,4-Trimethylbenzene, 1000µg/mL	2,2,4-Trimethylpentane, 1500µg/mL m-Xylene, 1000µg/mL o-Xylene, 1000µg/mL	
UST Modified Gasoline Range Organics (GRO)	<i>10 analytes, 1000µg/mL each in methanol</i>	1mL	48167	
	Benzene Ethylbenzene Methyl tert-butyl ether Naphthalene	Toluene 1,2,4-Trimethylbenzene 1,3,5-Trimethylbenzene	m-Xylene o-Xylene p-Xylene	
Revised PVOC/GRO Mix	<i>10 analytes, 2000µg/mL each in methanol</i>	1mL	47578-U	
	Benzene Ethylbenzene Methyl tert-butyl ether Naphthalene	Toluene 1,2,4-Trimethylbenzene 1,3,5-Trimethylbenzene	m-Xylene o-Xylene p-Xylene	

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

*BTEX standards also are available in gas.

 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	31 analytes, 25µg/mL each in hexane	1mL	46859-U
Spike Standard Mix	n-Nonane n-Decane n-Dodecane n-Tetradecane n-Hexadecane n-Octadecane n-Nonadecane n-Eicosane n-Docosane n-Tetracosane n-Hexacosane	n-Octacosane n-Triacontane n-Hexatriacontane Acenaphthene Acenaphthylene Anthracene Benzo(a)anthracene Benzo(b)fluoranthene Benzo(k)fluoranthene Benzo(ghi)perylene	Benzo(a)pyrene Chrysene Dibenz(a,h)anthracene Fluorene Fluoranthene Indeno(1,2,3-cd)pyrene 2-Methylnaphthalene Naphthalene Pyrene Phenanthrene
Florida			
n-Hydrocarbons Mix	17 analytes, 1000µg/mL each in methylene chloride:carbon disulfide (50:50)	1mL	46855-U
	n-Octane n-Decane n-Dodecane n-Tetradecane n-Hexadecane n-Octadecane	n-Eicosane n-Docosane n-Tetracosane n-Hexacosane n-Octacosane n-Triacontane	n-Dotriacontane n-Tetracontane n-Hexatriacontane n-Octatriacontane n-Tetracontane

[■]Refinery grade.

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Apiezon – Biddle Instruments
Bentone – National Lead Co., Baroid Sales Div.
Carbowax – Union Carbide Corp.
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Chromosorb – Celite Corp.
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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.
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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 1 mL, 2 mL, 5 mL, or 10 mL flame-sealed amber ampuls. Other packaging is available (see below). Minimum order volume is 3 mL, but this can be packaged in three 1 mL ampuls or in a single ampul.

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

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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.

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

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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.

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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

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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.

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