

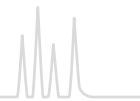


Capillary columns for special GC separations

Certain analytical separations can be accomplished more easily with chromatographic columns, that have been especially developed for that task, compared with standard columns. The

following table summarizes our program of GC speciality capillaries, the individual columns will be described in detail on the following pages.

Overview		
Separation/special application	Recommended capillary column	Page
Fast GC column with 0.10 mm ID	OPTIMA® 1, OPTIMA® 5, OPTIMA® δ-3, OPTIMA® δ-6 OPTIMA® 17, OPTIMA® 225, OPTIMA® FFAP PERMABOND® CW 20 M, PERMABOND® FFAP	340
Enantiomer separation cyclodextrin phases	FS-LIPODEX® A, FS-LIPODEX® B, FS-LIPODEX® C FS-LIPODEX® D, FS-LIPODEX® E, FS-LIPODEX® G	342
	FS-HYDRODEX β-PM, FS-HYDRODEX β-3 P, FS-HYDRODEX β-6TBDM, FS-HYDRODEX β-6TBDE, FS-HYDRODEX β-6TBDE, FS-HYDRODEX β-TBDAC, FS-HYDRODEX γ-DIMOM	344
Biodiesel		
Methanol analysis	OPTIMA® BioDiesel M	346
FAME analysis	OPTIMA® BioDiesel F	346
Glycerol and triglycerides	OPTIMA® BioDiesel G	346
Triglycerides		
	OPTIMA® 1-TG	348
	OPTIMA® 17-TG	348
High temperature GC		
	OPTIMA® 5 HT	349
Amines		
Polyfunctional amines	OPTIMA® 5 Amine	350
Amine separations	FS-CW 20 M-AM	351
Petrochemical products (complex hydrocarbon mixtures)		
	PERMABOND® P-100	352
Environmental analysis of volatile halogenated hydrocarbons		
	PERMABOND® SE-54 HKW	352
Silanes (monomeric, e.g., chlorosilanes)		
	PERMABOND® Silane	354
Diethylene glycol, e.g., for the quality control of wine		
	PERMABOND® CW 20 M-DEG	354



Fast GC

★ Key features

- Decreased column diameters, high heating rates and decreased column lengths for faster GC separations with high resolution efficiency
- Small inner diameters combined with very fast temperature programs can reduce the analysis time by up to 80 %
- High sensitivity detectors with small volume and very short response time, as well as very rapid data acquisition and processing
- Small inner diameters result in high column inlet pressures and a lower volume flow of the mobile phase: very fast injection of very small samples against a high pressure
- Amount of sample, which can be injected, is limited by the inner diameter and the thin film

✎ Temperature

- High heating rates place special demands on stationary phases. OPTIMA® columns meet exactly this requirement: very low bleeding, long lifetimes, even for continuous high heating rates

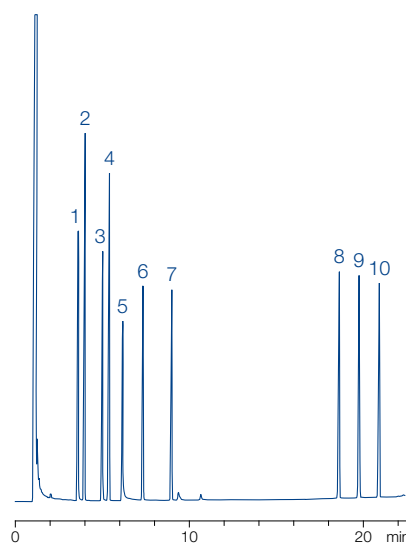
Comparison of a separation on a 50 m standard capillary with separation on a 10 m fast GC column
MN Appl. No. 211260

Peaks:

1. Octanol
2. Undecane
3. Dimethylaniline
4. Dodecane
5. Decylamine
6. Methyl decanoate
7. Methyl undecanoate
8. Henicosane
9. Docosane
10. Tricosane

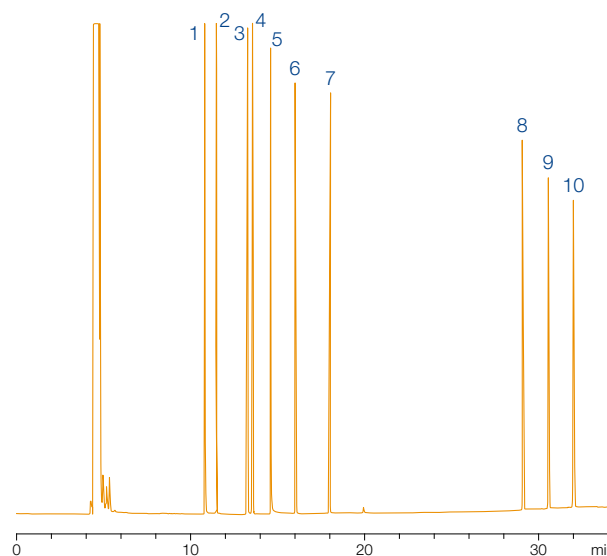
A) Fast GC column

Column: OPTIMA® 5, 10 m x 0.1 mm ID,
0.1 µm film
Injection 1 µL, split 1:40,
Carrier gas 0.75 bar He



B) standard GC column

Column: OPTIMA® 5, 50 m x 0.25 mm ID,
0.25 µm film
Injection 1 µL, split 1:35,
Carrier gas 1.5 bar He



Both separations:

Temperature: 80 °C → 320 °C (10 min), 8 °C/min

Detector: FID

While maintaining the temperature program and halving the pressure a time saving of 30 % results with identical separation efficiency.



Capillary columns for Fast GC



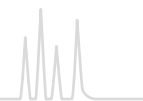
Ordering information

Columns for Fast GC

Phase	Maximum temperature	ID [mm]	Film thickness [µm]	REF (10 m)	REF (20 m)
OPTIMA® 1	340/360 °C	0.10	0.10	726024.10	726024.20
		0.10	0.40		726025.20
OPTIMA® 5	340/360 °C	0.10	0.10	726846.10	
			0.10		
OPTIMA® δ-3	340/360 °C	0.10	0.10	726410.10	726410.20
OPTIMA® δ-6	340/360 °C	0.10	0.10	726490.10	
OPTIMA® 17	320/340 °C	0.10	0.10	726848.10	
OPTIMA® 225	260/280 °C	0.10	0.10	726080.10	
OPTIMA® FFAP	250/260 °C	0.10	0.10	726180.10	
PERMABOND® CW 20 M	220/240 °C	0.10	0.10	723064.10	
PERMABOND® FFAP	220/240 °C	0.10	0.10	723180.10	723180.20
		0.10	0.25	723181.10	
OPTIMA® 5 Amine	300/320 °C	0.10	0.40	726361.10	
FS-CW 20 M-AM	220/240 °C	0.10	0.25	733111.10	
FS-LIPODEX® E	200/220 °C	0.10	0.10	723382.10	
FS-HYDRODEX β-6TBDM	230/250 °C	0.10	0.10	723383.10	

In addition to this standard program, all MN GC phases can be custom-made as fast GC columns

Further applications can be found online in our application database at www.mn-net.com/apps



LIPODEX® cyclodextrin phases for enantiomer separation

★ Key features

- Base material: cyclic oligosaccharides consisting of six (α -cyclodextrin), seven (β -cyclodextrin) or eight (γ -cyclodextrin) glucose units bonded through 1,4-linkages
- Regioselective alkylation and / or acylation of the hydroxyl groups leads to lipophilic phases with varying enantioselectivity, which are well suited for GC enantiomer analysis
- Important advantage: many compounds can be analyzed without derivatization (however, for certain substances enantioselectivity can be favorably influenced by formation of derivatives)

✓ Recommended application

- A large number of separations have been achieved, however, it is not possible to make a general prediction, which phase could solve a given separation task. Even for compounds with small structural differences or within homologous series the enantiodifferentiation can be quite different. The following table shows typical applications.

Note:

- Water as solvent is strictly forbidden for all cyclodextrin phases
- Dry the sample with our CHROMAFIX® Dry (Na_2SO_4) cartridges (see page 61)
- Use suitable nonpolar solvent

Phase	Cyclodextrin derivate	T _{max} [°C]	Recommended application
LIPODEX® A	hexakis-(2,3,6-tri-O-pentyl)- α -CD	200 / 220	carbohydrates, polyols, diols, hydroxycarboxylic acid esters, (epoxy-) alcohols, glycerol derivatives, spiroacetals, ketones, alkyl halides
LIPODEX® B	hexakis-(2,6-di-O-pentyl-3-O-acetyl)- α -CD	200 / 220	lactones, diols (cyclic carbonates), aminols, aldols (O-TFA), glycerol derivatives (cyclic carbonates)
LIPODEX® C	heptakis-(2,3,6-tri-O-pentyl)- β -CD	200 / 220	Alcohols, cyanhydrins, olefins, hydroxycarboxylic acid esters, alkyl halides
LIPODEX® D	heptakis-(2,6-di-O-pentyl-3-O-acetyl)- β -CD	200 / 220	aminols (TFA), β -amino acid esters, trans-cycloalkane-1,2-diols, trans-cycloalkane-1,2-diols, trans-cycloalkane-1,3-diols (TFA)
LIPODEX® E	octakis-(2,6-di-O-pentyl-3-O-butyl)- γ -CD	200 / 220	α -amino acids, α - and β -hydroxycarboxylic acid esters, alcohols (TFA), diols (TFA), ketones, pheromones (cyclic acetals), amines, alkyl halides, lactones
LIPODEX® G	octakis-(2,3-di-O-pentyl-6-O-methyl)- γ -CD	220 / 240	menthol isomers, ketones, alcohols, carboxylic acid esters, terpenes

Ordering information

LIPODEX®

	Length →		
	10 m 0.10 mm ID	25 m 0.25 mm ID	50 m 0.25 mm ID
FS-LIPODEX® A		723360.25	723360.50
FS-LIPODEX® B		723362.25	723362.50
FS-LIPODEX® C		723364.25	723364.50
FS-LIPODEX® D		723366.25	723366.50
FS-LIPODEX® E	723382.10	723368.25	723368.50
FS-LIPODEX® G		723379.25	723379.50

All columns with 0.4 mm OD



Capillary columns for enantiomer separation



Enantiomer separation of amino acid methyl esters (TFA)

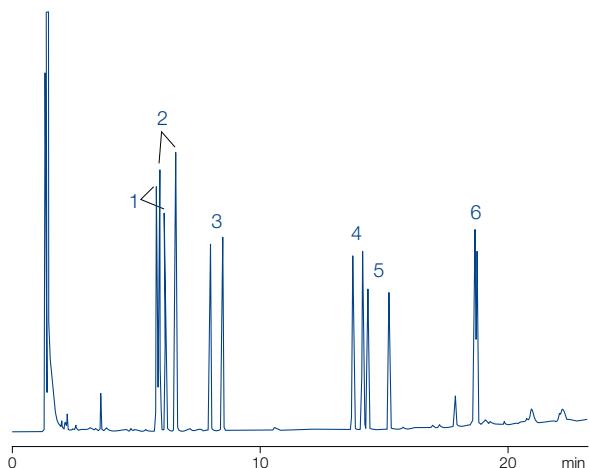
MN Appl. No. 202592

Column: FS-LIPODEX® E, 25 m x 0.25 mm ID
 Injection: 1 µL, split ~ 1: 100
 Carrier gas: 60 kPa H₂
 Temperature: 90 → 190 °C, 4 °C/min
 Detector: FID 250 °C

Peaks:

(D is eluted before L except for proline: L before D)

1. Alanine
2. Valine
3. Leucine
4. Proline
5. Aspartic acid
6. Phenylalanine



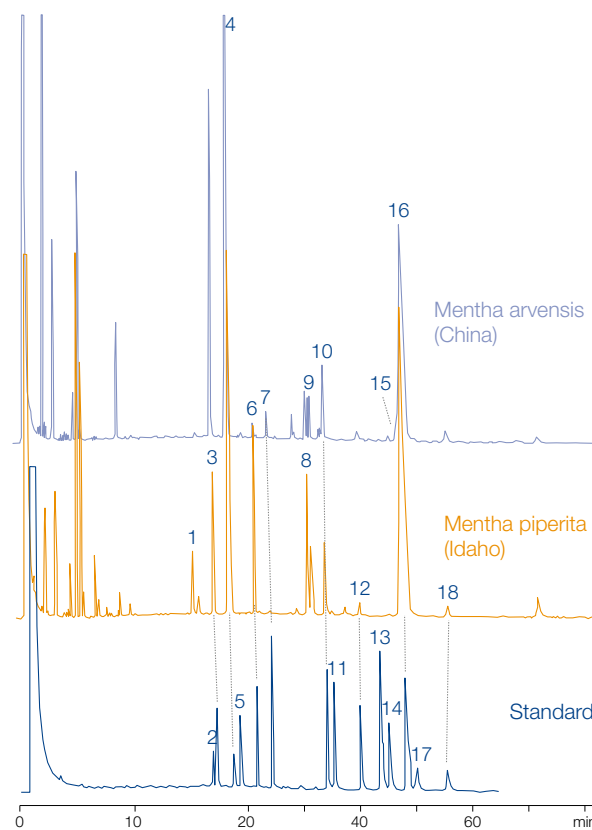
Separation of chiral constituents of peppermint oil

MN Appl. No. 250410

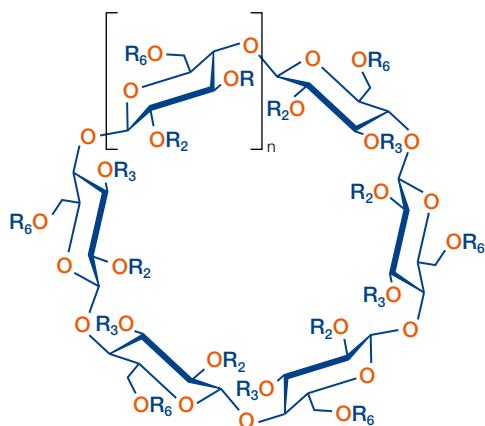
W. A. König et al., High Resol. Chromatogr. 20 (1997) 55–61
 Column: FS-LIPODEX® G, 25 m x 0.25 mm ID
 Carrier gas: 50 kPa H₂
 Temperature: 75 °C, isothermal
 Detector: FID

Peaks:

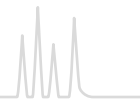
- | | |
|-------------------------------|-----------------------|
| 1. (+)-trans-Sabinene hydrate | 10. (+)-Neomenthol |
| 2. (+)-Menthone | 11. (-)-Neomenthol |
| 3. (+)-Isomenthone | 12. (+)-Neoisomenthol |
| 4. (-)-Menthone | 13. (+)-Menthol |
| 5. (-)-Isomenthone | 14. (-)-Neoisomenthol |
| 6. (+)-Menthofuran | 15. (+)-Piperitone |
| 7. (-)-Isopulegol | 16. (-)-Menthol |
| 8. (-)-Menthyl acetate | 17. (+)-Isomenthol |
| 9. (+)-Pulegone | 18. (-)-Isomenthol |



Cyclodextrin derivates



Further applications can be found online in our application database at www.mn-net.com/apps



HYDRODEX cyclodextrin phases for enantiomer separation

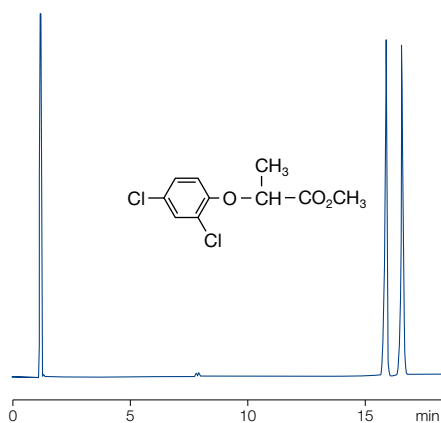
Recommended application

- Cyclodextrin derivatives (see page 343) with high melting point: for GC enantiomer separation diluted with polysiloxanes

Enantiomer separation of dichlorprop methyl ester

MN Appl. No. 202542

Column: FS-HYDRODEX β-3P, 25 m x 0.25 mm ID
 Injection: 0.1 μL (~1 % in CH₂Cl₂), split 130 mL/min
 Carrier gas: 60 kPa H₂ (1.9 mL/min)
 Temperature: 160 °C
 Detector: FID 250 °C



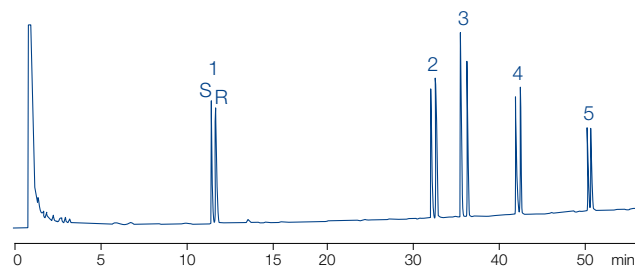
Separation of isomeric antiinflammatory drugs

MN Appl. No. 210150

Courtesy of Prof. W.A. König, Hamburg, Germany
 Column: FS-HYDRODEX β-6TBDM, 25 m x 0.25 mm ID
 Carrier gas: He
 Temperature: 135 °C → 200 °C, 1 °C/min
 Detector: FID

Peaks:

1. Ibuprofen
2. Flurbiprofen
3. Fenoprofen
4. Naproxen
5. Ketoprofen



Phase	Cyclodextrin derivative (diluted with optimized polysiloxane)	T _{max} [°C]	Recommended application
HYDRODEX β-PM	heptakis-(2,3,6-tri-O-methyl)-β-CD	230 / 250	hydroxycarboxylic acid esters, alcohols, diols, olefins, lactones, acetals
HYDRODEX β-3P	heptakis-(2,6-di-O-methyl-3-O-pentyl)-β-CD	230 / 250	terpenes, dienes, allenes, terpene alcohols, 1,2-epoxyalkanes, carboxylic acids (esters), hydroxycarboxylic acid esters, pharmaceuticals, pesticides
HYDRODEX β-6TBDM	heptakis-(2,3-di-O-methyl-6-O-t-butyl-dimethyl-silyl)-β-CD	230 / 250	γ-lactones, cyclopentanones, terpenes, esters, tartrates
HYDRODEX β-6TBDE	heptakis-(2,3-di-O-ethyl-6-O-t-butyl-dimethyl-silyl)-β-CD	230 / 250	essential oils
HYDRODEX β-TBDAC	heptakis-(2,3-di-O-acetyl-6-O-t-butyl-dimethyl-silyl)-β-CD	220 / 240	alcohols, esters, ketones, aldehydes, δ-lactones
HYDRODEX γ-TBDAC	octakis-(2,3-di-O-acetyl-6-O-t-butyl-dimethyl-silyl)-γ-CD	220 / 240	cyclic ketones, aromatic ketones, oxiranes, aromatic esters, aromatic amides
HYDRODEX γ-DIMOM	octakis-(2,3-di-O-methoxymethyl-6-O-t-butyl-dimethyl-silyl)-γ-CD	220 / 240	ketones, terpenes, cyclic ethers, alcohols, amines



Capillary columns for enantiomer separation



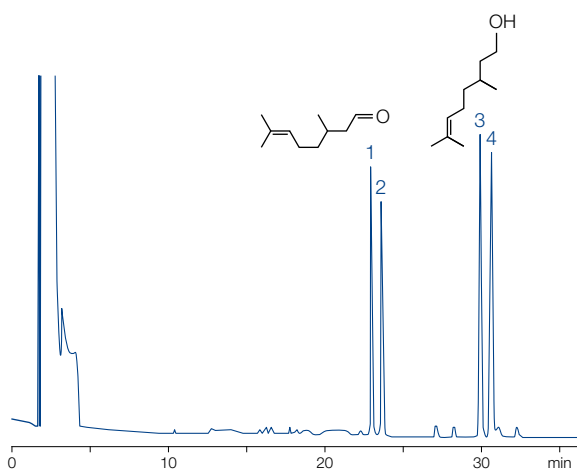
Separation of (R/S) citronellol + citronellal

MN Appl. No. 212440

Column: FS-HYDRODEX β -TBDac, 50 m x 0.25 mm ID
 Injection: 1 μ L, 1:1000 in CH₂Cl₂, split 25 mL/min
 Carrier gas: 1.5 bar H₂
 Temperature: 100 °C
 Detector: FID 220 °C

Peaks:

1. (R)/(S)-Citronellal
2. (S)/(R)-Citronellal
3. (S)-Citronellol
4. (R)-Citronellol



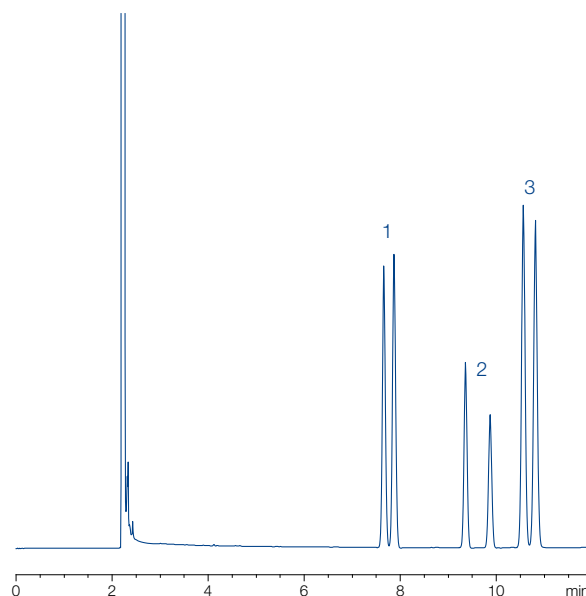
Separation of essential oils

MN Appl. No. 212980/212990/213000

Column: FS-HYDRODEX γ -TBDac, 50 m x 0.25 mm ID
 Injektor: 220 °C
 Carrier gas: 1.2 bar H₂
 Temperature: 125 °C
 Detector: FID 220 °C

Peaks:

1. Fenchone (1.5 mg/mL)
2. Menthone (0.5 mg/mL)
3. Menthol (2 mg/mL)

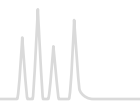


Ordering information

HYDRODEX

Length →	10 m 0.10 mm ID	25 m 0.25 mm ID	50 m 0.25 mm ID
FS-HYDRODEX β -PM		723370.25	723370.50
FS-HYDRODEX β -3P		723358.25	723358.50
FS-HYDRODEX β -6TBDM	723383.10	723381.25	723381.50
FS-HYDRODEX β -6TBDE		723386.25	
FS-HYDRODEX β -TBDac		723384.25	723384.50
FS-HYDRODEX γ -TBDac		723387.25	723387.50
FS-HYDRODEX γ -DIMOM		723388.25	723388.50
All columns with 0.4 mm OD			

Further applications can be found online in our application database at www.mn-net.com/apps



OPTIMA® BioDiesel for the analysis of biodiesel (DIN EN 14214 / ASTM D 6751)

OPTIMA® BioDiesel M for analysis of methanol in accordance with DIN EN 14110

★ Key features

- The methanol content in biodiesel as specified in DIN EN 14110 must not exceed 0.2 %. The column OPTIMA® BioDiesel M allows the GC headspace analysis of the methanol content in biodiesel in the concentration range from 0.01 to 0.5 % with 2-propanol as internal standard.

✍ Temperature

- T_{\max} 340 °C (long-term temperature),
 T_{\max} 360 °C (short-term max. temperature in a temperature program)

Similar phases

- Select™ Biodiesel for Methanol, Trace TR-BioDiesel (M)

OPTIMA® BioDiesel F for analysis of FAMES in accordance with DIN EN 14103:2011

★ Key features

- The analysis of biodiesel requires separation of typical FAMES between myristic acid (C_{14}) and nervonic acid ($C_{24:1}$) methyl esters. This analysis is possible on OPTIMA® BioDiesel F in only 22 min. Additionally, linolenic acid methyl ester can be determined due to the good resolution. The extended standard DIN EN 14103:2011 also covers smaller FAMES starting from C_6 (see application 214510 on opposite page). Change of the internal standard from C_{17} to C_{19} also allows the analysis of animal fats.

✍ Temperature

- T_{\max} 240 °C (long-term temperature),
 T_{\max} 250 °C (short-term max. temperature in a temperature program)

Similar phases

- Select™ Biodiesel for FAME, Trace TR-BioDiesel (F)

OPTIMA® BioDiesel G for analysis of glycerol and glycerides in accordance with DIN EN 14105

★ Key features

- The capillary column OPTIMA® BioDiesel G allows determination of free glycerol and residues of mono-, di- and triglycerides in FAMES intended as additives for mineral oils. The procedure can be applied for FAMES from rapeseed oil, sunflower oil and soy bean oil. Glycerol as well as mono- and diglycerides are derivatized to more volatile substances by addition of MSTFA in the presence of pyridine (see page 363).

✍ Temperature

- T_{\max} 380 °C (long-term temperature),
 T_{\max} 400 °C (short-term max. temperature in a temperature program)

Similar phases

- Select™ Biodiesel for Glycerides, Trace TR-BioDiesel (G), MET-Biodiesel



Capillary columns for biodiesel analysis



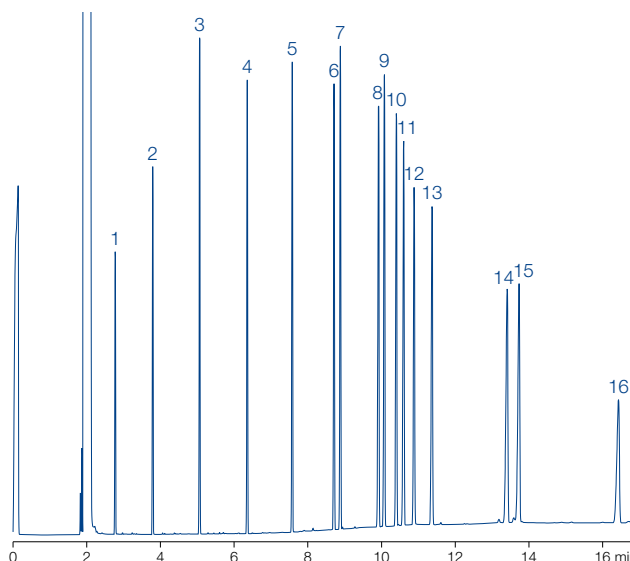
Analysis of FAMES from biodiesel in accordance with DIN EN 14103:2011

MN Appl. No. 214510

Column: OPTIMA® BioDiesel F, 30 m x 0.25 mm ID
 Sample: 50 µg/mL each in dichloromethane
 Injection: 10 µL, 250 °C, split 1:20
 Carrier gas: 1.2 bar He
 Temperature: 80 °C → 250 °C (8.5 min), 20 °C/min
 Detector: FID 260 °C

Peaks:

- | | |
|----------|---------------------|
| 1. C6:0 | 9. C18:1 |
| 2. C8:0 | 10. C18:2 |
| 3. C10:0 | 11. C19:0, int. st. |
| 4. C12:0 | 12. C18:3 |
| 5. C14:0 | 13. C20:0 |
| 6. C16:0 | 14. C22:0 |
| 7. C16:1 | 15. C22:1 |
| 8. C18:0 | 16. C24:0 |



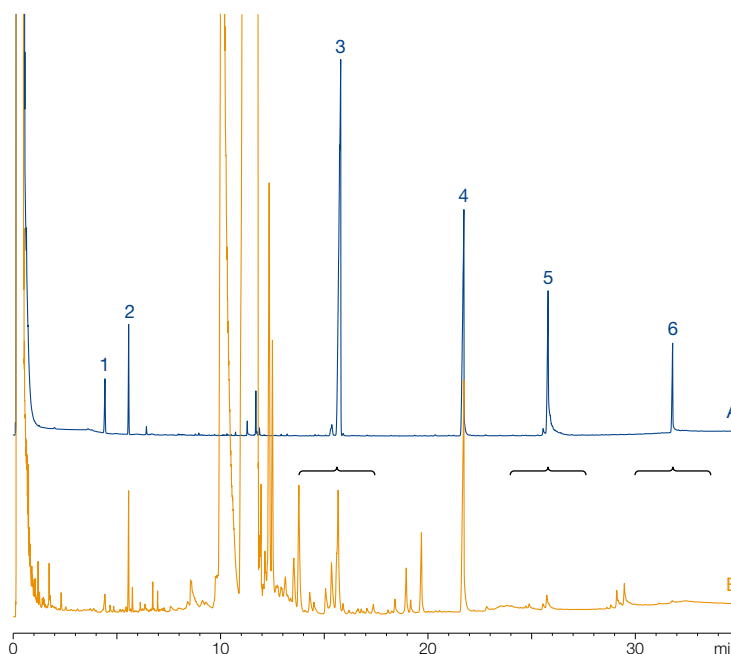
Analysis of glycerol and glycerides from biodiesel

MN Appl. No. 213640

Column: OPTIMA® BioDiesel G,
10 m x 0.25 mm ID
 Sample: A) standard in *n*-heptane
B) biodiesel
 Injection: 2 µL, 350 °C,
CIS (15 °C → 350 °C, 12 °C/s)
 Carrier gas: 0.8 bar H₂, split 1: 2.6
 Temperature: 50 °C (3.5 min) → 180 °C, 15 °C/min
→ 280 °C, 7 °C/min
→ 370 °C (10 min), 10 °C/min
 Detector: FID 380 °C

Peaks:

1. Glycerol (TMS)
2. Butanetriol (TMS), IS
3. Monoolein = glycerol monooleate (TMS)
+ monoacylglycerides
4. Tricaprin (glycerol tricaprinate), IS
5. Diolein = glycerol dioleate (TMS)
+ diacylglycerides
6. Triolein = glycerol trioleate
+ triacylglycerides



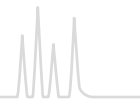
Ordering information

OPTIMA® BioDiesel

	Length → 10 m	30 m
OPTIMA® BioDiesel M		
0.32 mm ID (0.5 mm OD)		726905.30
OPTIMA® BioDiesel F		
0.25 mm ID (0.4 mm OD)		726900.30
OPTIMA® BioDiesel G		
0.25 mm ID (0.4 mm OD)	726903.10	



Capillary columns for triglyceride analysis



OPTIMA® 1-TG · 17-TG for triglyceride analysis · USP G1 / G2 / G38 (1-TG) · USP G3 (17-TG)

★ Key features

- Short capillary columns (max. 25 m and 0.32 mm ID) with low-bleeding stationary phases thermally stable with optimized deactivation

✓ Recommended application

- OPTIMA® 1-TG
100 % dimethylpolysiloxane offers separation according to carbon number
- OPTIMA® 17-TG
phenyl-methyl-polysiloxane (50 % phenyl) for separation according to degree of unsaturation

✍ Temperature

- T_{max} 370 °C (both phases)

Similar phases der OPTIMA® 1-TG:

- SPB-1 TG, DB-1 HT, 400-1 HT, HT-5

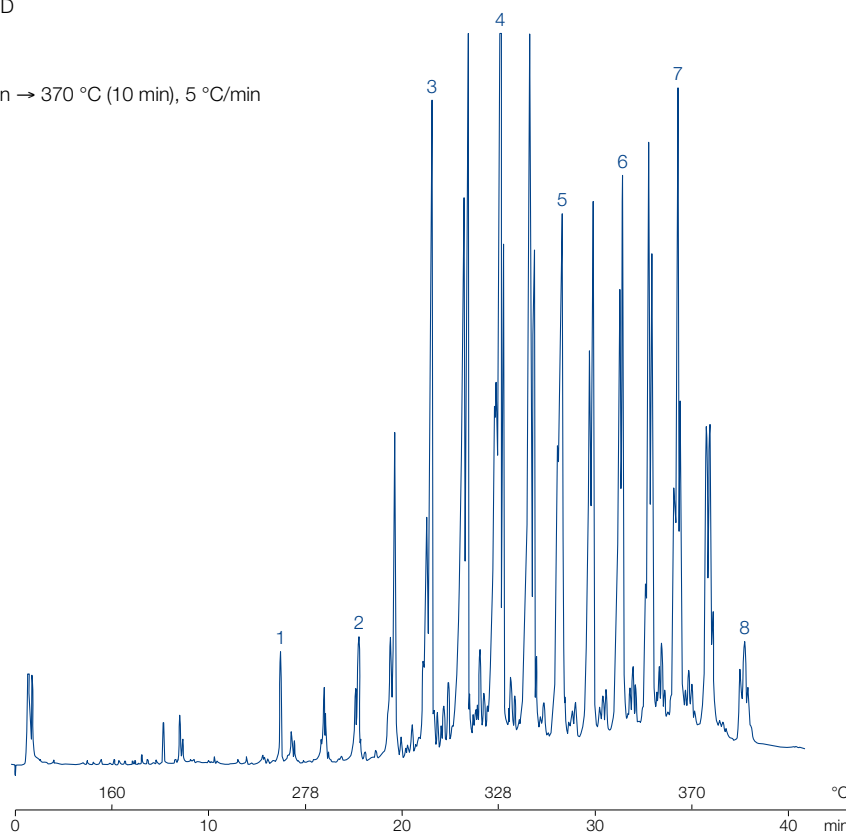
Triglycerides (from butter)

MN Appl. No. 201790

Column: OPTIMA® 1-TG, 25 m x 0.32 mm ID
 Injection: 0.5 µL
 Carrier gas: 80 kPa H₂
 Temperature: 80 °C (1 min) → 250 °C, 20 °C/min → 370 °C (10 min), 5 °C/min
 Detector: FID 380 °C

Peaks:

1. Cholesterol
2. T-30
3. T-34
4. T-38
5. T-42
6. T-46
7. T-50
8. T-54



Ordering information

OPTIMA® 1-TG · OPTIMA® 17-TG

	Length →	
	10 m	25 m
OPTIMA® 1-TG		
0.25 mm ID (0.4 mm OD)	726133.10	726133.25
0.32 mm ID (0.5 mm OD)	726132.10	726132.25
OPTIMA® 17-TG		
0.32 mm ID (0.5 mm OD)	726131.10	726131.25



Capillary columns for high temperature GC



OPTIMA® 5 HT for high temperature GC · USP G27 / G36

★ Key features

- Chemically bonded, cross-linked silarylene phase with polarity similar to a 5 % diphenyl - 95 % dimethylpolysiloxane phase
- Nonpolar phase, low bleeding

Similar phases

- DB-5HT, VF-5HT, HT-5, XTI-5HT, ZB-5HT

✓ Recommended application

- Ideal for MS detectors, can be rinsed with solvents
- For simulated distillation, hydrocarbon, fuel and oil analysis, high-boiling analytes

✍ Temperature

- T_{max} 380 °C (long-term temperature), T_{max} 400 °C (short-term max. temperature in a temperature program)

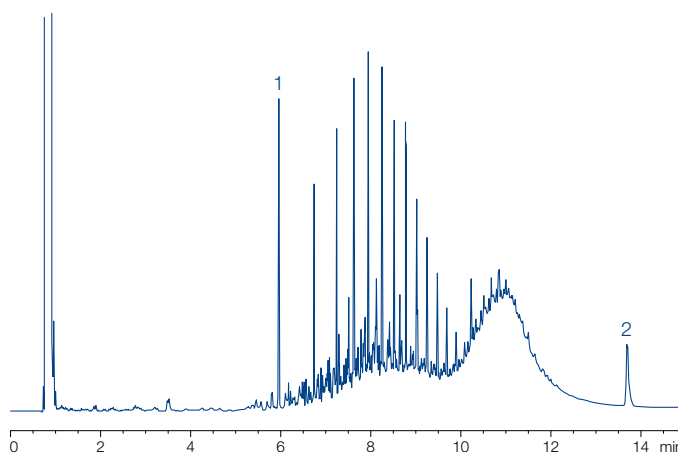
Separation of motor oil / mineral oil (type A + B), rapid determination in accordance with DIN H-53 / ISO DIS

MN Appl. No. 213400

Column: OPTIMA® 5 HT, 15 m x 0.32 mm ID, 0.25 µm film
 Sample: mineral oil type A + B (hydrocarbon index kit acc. to EN ISO 9377-2) in hexane
 Injection: 1 µL, splitless, 300 °C
 Carrier gas: 0.6 bar He
 Temperature: 40 °C (5 min) → 390 °C, 50 °C/min
 Detector: FID 280 °C

Peaks:

1. Decane (C10)
2. Tetracontane (C40)



Ordering information

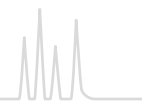
OPTIMA® 5 HT

	Length →	
	15 m	30 m
0.25 mm ID (0.4 mm OD)		
0.10 µm film	726102.15	726102.30
0.25 µm film	726106.15	726106.30
0.32 mm ID (0.5 mm OD)		
0.10 µm film	726104.15	726104.30
0.25 µm film	726108.15	726108.30

Further applications can be found online in our application database at www.mn-net.com/apps



Capillary columns for amine separation



OPTIMA® 5 Amine special column for analysis of amines · USP G27 / G36

★ Key features

- Nonpolar phase
- Improved linearity for analysis of active components at trace levels: no amine absorptions even for aliphatic and aromatic amines at concentrations of 100 pg/peak
- Tested with the OPTIMA® Amine test mixture (REF 722317), which contains, amongst others, diethanolamine and propanol-pyridine (this test mixture is supplied with each column)

✓ Recommended application

- Especially deactivated for the analysis of polyfunctional amines such as ethanalamines, amino-functionalized diols and similar compounds, which are important base materials in industrial chemistry, and show strong tailing on standard-deactivated columns

✍ Temperature

- T_{max} 300 °C (long-term temperature), T_{max} 320 °C (short-term max. temperature in a temperature program)

Similar phases

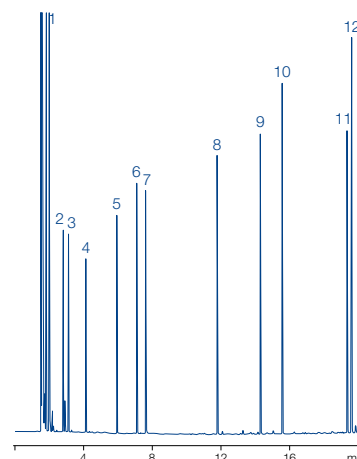
- Rtx®-5 Amine, PTA-5

Separation of secondary and tertiary amines MN Appl. No. 210280

Column: OPTIMA® 5 Amine, 30 m x 0.25 mm ID, 1.0 µm film
 Injection: 1 µL, split 1:100
 Carrier gas: 0.6 bar H₂
 Temperature: 100 °C (3 min) → 280 °C, 10 °C/min
 Detector: FID 280 °C

Peaks:

- | | |
|-------------------------------|-------------------------------|
| 1. Diethylamine | 7. Di-isobutylamine |
| 2. Di-isopropylamine | 8. Tri- <i>n</i> -butylamine |
| 3. Triethylamine | 9. Di-isohexylamine |
| 4. Di- <i>n</i> -propylamine | 10. Dicyclohexylamine |
| 5. Di- <i>n</i> -butylamine | 11. Dibenzylamine |
| 6. Tri- <i>n</i> -propylamine | 12. Tri- <i>n</i> -hexylamine |



Ordering information

OPTIMA® 5 Amine

	Length → 10 m	25 m	30 m
0.1 mm ID (0.4 mm OD)			
0.40 µm film	726361.10		
0.2 mm ID (0.4 mm OD)			
0.35 µm film		726355.25	
0.25 mm ID (0.4 mm OD)			
0.50 µm film			726354.30
1.00 µm film			726358.30
0.32 mm ID (0.5 mm OD)			
0.25 µm film			726360.30
1.00 µm film			726353.30
1.50 µm film			726356.30
0.53 mm ID (0.8 mm OD)			
1.00 µm film			726359.30
3.00 µm film			726357.30



Capillary columns for amine separation



FS-CW 20 M-AM polyethylene glycol 20 000, non-immobilized · USP G16

★ Key features

- Polyethylene glycol, basic for amine separations

✎ Temperature

- T_{\max} 220 °C (long-term temperature),
- T_{\max} 240 °C (short-term max. temperature in a temperature program)

Similar phases

- Carbowax™ Amine, CP-Wax 51, CAM, Stabilwax® DB

Ordering information

FS-CW 20 M-AM

	Length → 10 m	25 m	50 m
0.1 mm ID (0.4 mm OD) 0.25 µm film	733111.10		
0.25 mm ID (0.4 mm OD) 0.25 µm film		733110.25	733110.50
0.32 mm ID (0.5 mm OD) 0.25 µm film		733299.25	733299.50
0.35 µm film			733442.50
0.53 mm ID (0.8 mm OD) 1.00 µm film		733551.25	

Further applications can be found online in our application database at www.mn-net.com/apps



MACHEREY-NAGEL CHROMAFIL® syringe filters

Ideal for the filtration of GC, HPLC and UHPLC sample solutions

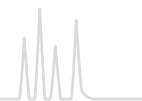
- Diverse membrane types and filter sizes for a variety of applications
- Optimal flow geometry because of star-shaped distribution device
- Lowest content of extractable substances
- Luer lock inlet, Luer outlet
- Prefiltration of solvents protects sensitive instrument parts and chromatography columns from solid contamination and increases their lifetime.

Find CHROMAFIL® products from page 81 onwards.





Capillary columns for hydrocarbons



PERMABOND® P-100 for analysis of petrochemical products · USP G1 / G2 / G38

★ Key features

- Extra long column with nonpolar dimethylpolysiloxane phase

✓ Recommended application

- High resolution and sufficient capacity for analysis of complex mixtures of hydrocarbons

✍ Temperature

- T_{max} 300 °C (long-term temperature), T_{max} 320 °C (short-term max. temperature in a temperature program)

Ordering information

PERMABOND® P-100

	Length → 100 m
0.25 mm ID (0.4 mm OD)	
0.50 µm film	723890.100

PERMABOND® SE-54-HKW for volatile halogenated hydrocarbons · USP G36

✓ Recommended application

- SE-54 optimized for volatile halogenated hydrocarbons

✍ Temperature

- T_{max} 300 °C (long-term temperature), T_{max} 320 °C (short-term max. temperature in a temperature program)

For the analysis of halogenated hydrocarbons, we recommend our optimized column PERMABOND® SE-54-HKW at 25 or 50 m length with our approved polysiloxane phase SE-54.

As an alternative, or to verify analytical results, the OPTIMA® 624 has proven itself as advantageous, especially for the determination of 1,1,2-trichlorotrifluoroethane (F 113) along with dichloromethane.

Both phases are also suited for the determination of vinyl chloride as well as for the separation of cis/trans isomers of 1,2-dichloroethene. The high film thickness secures a high capacity and an outstanding resolution. For GC/MS coupling, we recommend OPTIMA® 624 LB or OPTIMA® 624 with 0.2 or 0.25 mm ID

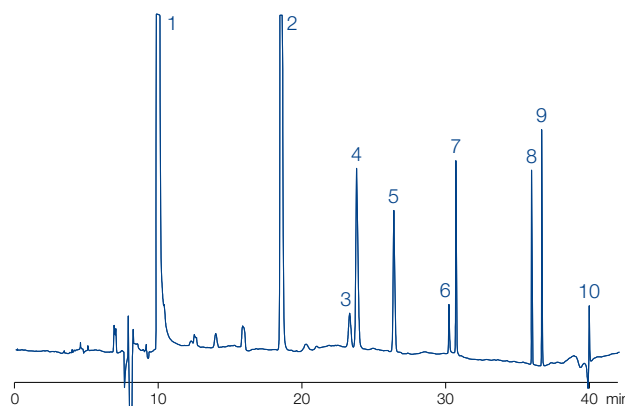
Volatile halogenated hydrocarbons

MN Appl. No. 212480

Column: PERMABOND® SE-54-HKW, 50 m x 0.32 mm ID
 Injection: 1 µL, split ~ 1:30
 Carrier gas: 0.9 bar He
 Temperature: 35 °C (25 min) → 160 °C (5 min), 10 °C/min
 Detector: ECD 300 °C

Peaks:

1. Dichloromethane (795 ng/mL)
2. Trichloromethane (75 ng/mL)
3. 1,1,1-Trichloroethane (67 ng/mL)
4. 1,2-Dichloroethane (100 ng/mL)
5. Tetrachloromethane (15.9 ng/mL)
6. Trichloroethene (14.6 ng/mL)
7. Bromodichloromethane (20 ng/mL)
8. Dibromochloromethane (122 ng/mL)
9. Tetrachloroethene (81 ng/mL)
10. Tribromomethane (28.9 ng/mL)





Capillary columns for hydrocarbons



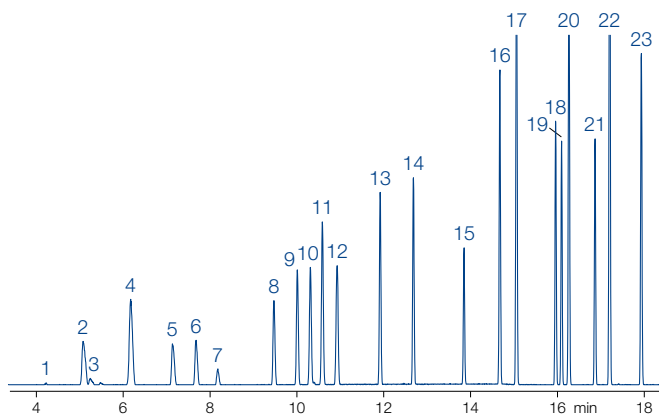
Volatile halogenated hydrocarbons and BTX

MN Appl. No. 200160

Column: OPTIMA® 624, 50 m x 0.25 mm ID, 1.40 µm film
 Injection: 1 µL, split 50 mL/min
 Carrier gas: 0.9 mL/min He (constant flow)
 Temperature: 40 °C (5 min) → 160 °C, 10 °C/min
 Detector: MSD 5971

Peaks:

- | | |
|---|-----------------------------------|
| 1. Vinyl chloride | 12. 1,2-Dichloroethane + benzene |
| 2. Trichlorofluoromethane (F 11) | 13. Trichloroethene |
| 3. Pentane | 14. Bromodichloromethane |
| 4. 1,1,2-Trichlorotrifluoroethane (F 113) | 15. Toluene |
| 5. Dichloromethane | 16. Tetrachloroethene |
| 6. <i>trans</i> -1,2-Dichloroethene | 17. Dibromochloromethane |
| 7. Hexane | 18. Chlorobenzene |
| 8. <i>cis</i> -1,2-Dichloroethene | 19. Ethylbenzene |
| 9. Trichloromethane | 20. <i>m</i> - + <i>p</i> -Xylene |
| 10. 1,1,1-Trichloroethane | 21. <i>o</i> -Xylene |
| 11. Tetrachloromethane | 22. Tribromomethane |
| | 23. Bromobenzene |

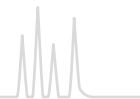


Ordering information

PERMABOND® SE-54-HKW

	Length →	
	25 m	50 m
0.32 mm ID (0.5 mm OD)		
1.80 µm film	723945.25	723945.50

Further applications can be found online in our application database at www.mn-net.com/apps



PERMABOND® Silane for silane analysis

✓ Recommended application

- Developed especially for the analysis of monomeric silanes and chlorosilanes (not for the separation of trimethylsilyl derivatives)
- Also suited for the separation of dimeric siloxanes and silazanes

✍ Temperature

- 0.32 mm ID: T_{\max} 260 °C (long-term temperature), T_{\max} 280 °C (short-term max. temperature in a temperature program)
- 0.53 mm ID: T_{\max} 240 and 260 °C, resp.

Ordering information

PERMABOND® Silane

	Length → 25 m	50 m
0.32 mm ID (0.5 mm OD)		723409.50
0.53 mm ID (0.8 mm OD)	723411.25	

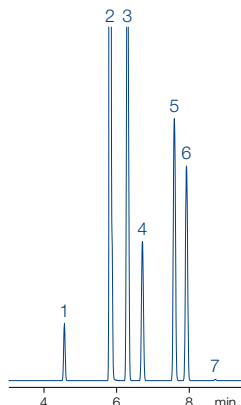
Chloromethylsilanes

MN Appl. No. 200090

Column: PERMABOND® Silane, 50 m x 0.32 mm ID
 Injection: 0.5 µL gas, split 80 mL/min
 Carrier gas: 1 mL/min He (constant flow)
 Temperature: 50 °C → 100 °C, 5 °C/min
 Detector: MSD 5971

Peaks:

1. Tetramethylsilane
2. Dichloromethane
3. Tetrachlorosilane
4. Chlorotrimethylsilane
5. Methyltrichlorosilane
6. Dichlorodimethylsilane
7. Hexamethyldisiloxane



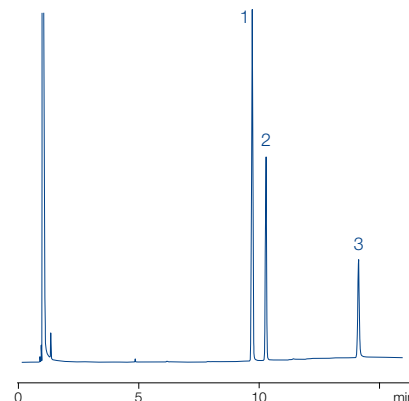
Diethylene glycol standard in wine

MN Appl. No. 201500

Column: PERMABOND® CW 20 M-DEG,
25 m x 0.25 mm ID
 Injection: 0.5 µL, split ~1:40
 Carrier gas: 1.2 bar N₂
 Temperature: 80 °C → 200 °C, 10 °C/min
 Detector: FID 260 °C

Peaks:

- DEG standard
1. 1,4-Butanediol
 2. Diethylene glycol
 3. Glycerol



PERMABOND® CW 20 M-DEG for determination of diethylene glycol · USP G16

★ Key features

- Polyethylene glycol 20 000 (diethylene glycol tested)

✓ Recommended application

- Determination of diethylene glycol (DEG), e.g., for the quality control of wine

✍ Temperature

- T_{\max} 220 °C (long-term temperature), T_{\max} 240 °C (short-term max. temperature in a temperature program)

Ordering information

PERMABOND® CW 20 M-DEG

	Length → 25 m
0.25 mm ID (0.4 mm OD)	
0.25 µm film	723063.25
0.32 mm ID (0.5 mm OD)	
0.25 µm film	723327.25

Further applications can be found online in our application database at www.mn-net.com/apps



Untreated capillaries

✓ Recommended application

- Capillary electrophoresis
- Preparation of capillary columns
- Capillary LC applications

Ordering information

Untreated capillaries

	Length → 1 m Pack of 3	10 m Pack of 1	25 m Pack of 1
Capillaries for electrophoresis			
0.025 mm ID (0.4 mm OD)	723793.1	723793.2	
0.05 mm ID (0.4 mm OD)	723790.1	723790.2	
0.075 mm ID (0.4 mm OD)	723791.1	723791.2	
0.10 mm ID (0.4 mm OD)	723792.1	723792.2	
Untreated capillaries			
0.20 mm ID (0.4 mm OD)		723148.10	723148.25
0.25 mm ID (0.4 mm OD)		723101.10	723101.25
0.32 mm ID (0.5 mm OD)		723151.10	723151.25
0.53 mm ID (0.8 mm OD)		723501.10	723501.25

Untreated capillaries are supplied without cage.

Deactivated capillary columns precolumns / guard columns

✓ Recommended application

- As precolumns / guard columns, whenever a larger contamination capacity is required
- Preparation of capillary columns

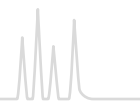
Ordering information

Deactivated capillary columns

	Length →	
	10 m	25 m
Methyl-Sil deactivated (T_{max} 320 °C)		
0.25 mm ID (0.4 mm OD)	723106.10	723106.25
0.32 mm ID (0.5 mm OD)	723346.10	723346.25
0.53 mm ID (0.8 mm OD)	723558.10	723558.25
Phenyl-Sil deactivated (T_{max} 320 °C)		
0.25 mm ID (0.4 mm OD)	723108.10	723108.25
0.32 mm ID (0.5 mm OD)	723348.10	723348.25
0.53 mm ID (0.8 mm OD)	723560.10	723560.25
CW deactivated (T_{max} 250 °C)		
0.25 mm ID (0.4 mm OD)	723105.10	723105.25
0.32 mm ID (0.5 mm OD)	723349.10	723349.25
0.53 mm ID (0.8 mm OD)	723562.10	723562.25

Untreated capillaries are supplied without cage.

For a considerably longer lifetime, even for contaminated or matrix-containing samples, MN offers the option of integrated precolumns. All capillary columns are available with a 10 m guard column with matched deactivation. For ordering, please add V1 at the end of the REF number. Guard column combinations with other lengths, IDs or different deactivation are available on request.



Retention gaps

★ Key features

- The retention gap technique in combination with on-column injection allows to concentrate a large sample volume in the capillary column.
- Choice of the retention gap depends on the solvent used: the flooded zone after injection should be between 20–30 cm/μL
- Me-Sil retention gap: only for use with *n*-hexane and diethyl ether
- Phe-Sil retention gap: for all solvents except methanol and water
- CW retention gap: for all solvents and especially for methanol and water

✎ Temperature

- T_{max} 250 °C (CW retention gaps),
- T_{max} 320 °C (Me-Sil and Phe-Sil retention gaps)

Note:

- Calculation example: length of flooded zone ~ 20–30 cm/μL, retention gap 10 m x 0.32 mm ID, capillary column: 25 m x 0.32 mm ID, max. injection volume ~ 30–50 μL
- A retention gap must be inert without any noticeable retention: Me-Sil retention gaps are more inert than Phe-Sil, while Phe-Sil is less susceptible to contamination
- Retention gaps can also be used as transfer lines or precolumns (contamination capacity about 5–10 μg).

Ordering information

Retention gaps

	Length →	
	10 m	25 m
Me-Sil retention gaps (T _{max} 320 °C)		
0.25 mm ID (0.4 mm OD)	723706.10	723706.25
0.32 mm ID (0.5 mm OD)	723707.10	723707.25
0.53 mm ID (0.8 mm OD)	723708.10	723708.25
Phe-Sil retention gaps (T _{max} 320 °C)		
0.25 mm ID (0.4 mm OD)	723709.10	723709.25
0.32 mm ID (0.5 mm OD)	723710.10	723710.25
0.53 mm ID (0.8 mm OD)	723711.10	723711.25
CW retention gaps (T _{max} 250 °C)		
0.25 mm ID (0.4 mm OD)	723712.10	723712.25
0.32 mm ID (0.5 mm OD)	723713.10	723713.25
0.53 mm ID (0.8 mm OD)	723714.10	723714.25

Retention gaps are supplied without cage.

For a considerably longer lifetime, even for contaminated or matrix-containing samples, MN offers the option of integrated precolumns. All capillary columns are available with a 10 m guard column with matched deactivation. For ordering, please add V1 at the end of the REF number. Guard column combinations with other lengths, IDs or different deactivation are available on request.