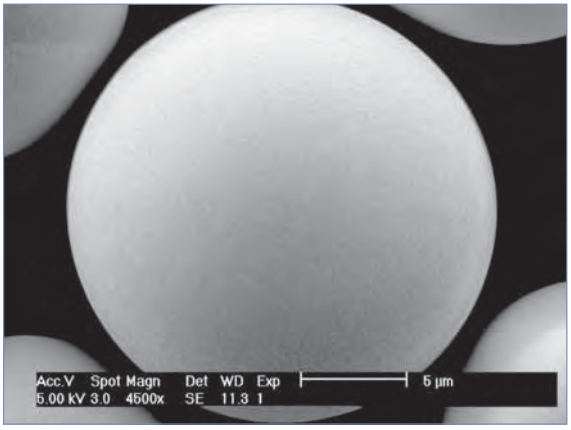
NUCLEODUR® high purity silica for HPLC

NUCLEODUR® is a fully synthetical type B silica (silica of 3rd generation) offering highly advanced physical properties like **totally spherical** particle shape, outstanding **surface microstructure**, high **pressure stability** and **low metal content**.

NUCLEODUR® as a state-of-the-art silica is the ideal base material for modern HPLC phases. It is the result of MACHEREY-NAGEL's pioneering research in chromatography for more than 40 years and succeeds MN's famous NUCLEOSIL® silica.

In RP liquid chromatography the efficiency of the packing is strongly affected by the quality of the base silica itself. Shortcomings in the surface geometry of the particles or metal contaminants are the main reasons for inadequate coverage with the covalently bonded alkylsilanes in the subsequent derivatization steps. It is well known, that poor surface coverage and, in consequence, high activity of residual free silanols often results in peak tailing or adsorption, particularly with basic compounds.

Particle shape and surface symmetry



NUCLEODUR® silicas are synthesized in a unique and carefully controlled manufacturing process which provides silica particles, which are totally spherical. The picture shows the outstanding smoothness of the NUCLEODUR® surface.

Purity

As already mentioned above, a highly pure silica is required for achieving symmetric peak shapes and maximum resolution. Inclusions of e.g. iron or alkaline earth metal ions on the silica surface are largely responsible for the unwanted interactions with ionizable analytes, e.g. amines or phenolic compounds.

NUCLEODUR® is virtually free of metal impurities and low acidic surface silanols. Elemental analysis data of NUCLEODUR® 5 µm measured by AAS are listed below.

Elementary analysis (metal ions) of NUCLEODUR® 100-5

Aluminium	< 5	ppm
Iron	< 5	ppm
Sodium	< 5	ppm
Calcium	< 10	ppm
Titanium	< 1	ppm
Zirconium	< 1	ppm
Arsenic	< 0.5	ppm
Mercury	< 0.05	ppm

Pressure stability

The totally spherical and 100% synthetic silica gel exhibits an outstanding mechanical stability, even at high pressures up to 800 bar and elevated eluent flow rates.

In addition, after several cycles of repeated packing, no significant drop in pressure can be observed. The latter is of prime importance for preparative and process-scale applications.

Physical properties of NUCLEODUR®

Surface (BET)	340 m^2/g
Pore size	110 Å
Pore volume	0.9 ml/g

NUCLEODUR® modifications

Several different surface modifications based on NUCLEODUR® silica have been developed over the last years providing a full range of specified HPLC phases and an ideal tool for every separation:

- NUCLEODUR® C_{18} Gravity and C_8 Gravity
- NUCLEODUR® C_{18} Isis
- NUCLEODUR® C_{18} Pyramid
- NUCLEODUR® Sphinx RP
- NUCLEODUR® CN and CN-RP
- NUCLEODUR® NH_2 and NH_2-RP
- NUCLEODUR® C_{18} ec and C_8 ec

For important properties of NUCLEODUR® phases please see our summary.

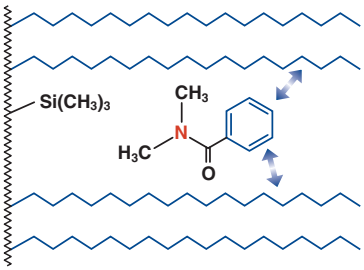
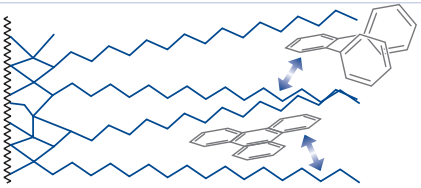
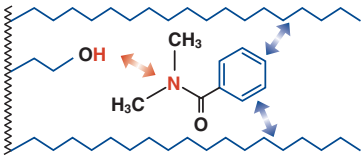
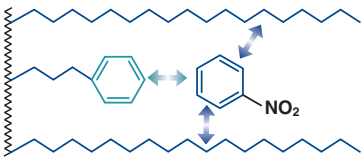
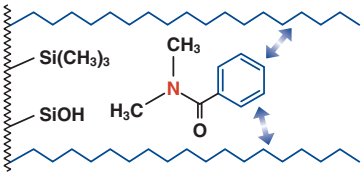
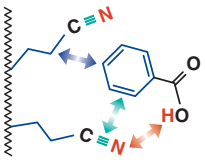
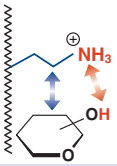
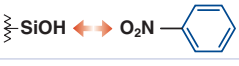
Columns for HPLC

Overview of NUCLEODUR® HPLC phases

Columns for HPLC

Phase	Specification	Characteristics* A	B	C	Stability	Structure
C_{18} Gravity	octadecyl phase, high density coating multi-endcapping 18 % C · USP **L1**	⬢⬢⬢⬢⬢	◖	⬢⬢◖	pH stability 1 – 11, suited for LC/MS	NUCLEODUR® $(Si\text{-}O_2)_n$
C_8 Gravity	octyl phase, high density coating multi-endcapping 11 % C · USP **L7**	⬢⬢◖	⬢	⬢◖	pH stability 1 – 11, suited for LC/MS	NUCLEODUR® $(Si\text{-}O_2)_n$
C_{18} Isis	octadecyl phase with specially crosslinked surface modification endcapping 20 % C · USP **L1**	⬢⬢⬢⬢◖	⬢⬢	⬢⬢⬢⬢◖	pH stability 1 – 10, suited for LC/MS	NUCLEODUR® $(Si\text{-}O_2)_n$
C_{18} Pyramid	C_{18} modification with polar endcapping 14 % C · USP **L1**	⬢⬢⬢⬢	⬢⬢◖	⬢⬢	stable in 100 % aqueous eluents without phase collapse, pH stability 1 – 9, suited for LC/MS	NUCLEODUR® $(Si\text{-}O_2)_n$ OH OH
Sphinx RP	bifunctional RP phase, balanced ratio of propyl-phenyl and C_{18} ligands; endcapping 15 % C; USP **L1** and **L11**	⬢⬢◖	⬢⬢◖	⬢	pH stability 1 – 10, suited for LC/MS	NUCLEODUR® $(Si\text{-}O_2)_n$
C_{18} ec	octadecyl phase, medium density coating endcapping 17.5 % C · USP **L1**	⬢⬢⬢⬢	⬢	⬢⬢⬢◖	pH stability 1 – 9	NUCLEODUR® $(Si\text{-}O_2)_n$ Si–OH Si–O–$Si(CH_3)_3$
C_8 ec	octyl phase, medium density coating endcapping 10.5 % C · USP **L7**	⬢⬢	⬢◖	⬢⬢◖	pH stability 1 – 9	NUCLEODUR® $(Si\text{-}O_2)_n$ Si–OH Si–O–$Si(CH_3)_3$
CN / CN-RP	cyano (nitrile) phase for NP and RP separations 7 % C · USP **L10**	⬢	⬢⬢⬢⬢	–	pH stability 1 – 8, suited for mobile phases with high contents of water	NUCLEODUR® $(Si\text{-}O_2)_n$ C≡N Si–OH C≡N Si–O–$Si(CH_3)_3$
NH_2 / NH_2-RP	amino phase for NP and RP separations 2.5 % C · USP **L8**	⬢	⬢⬢⬢⬢	–	pH stability 2 – 8, suited for mobile phases with high contents of water	NUCLEODUR® $(Si\text{-}O_2)_n$ NH_2 Si–OH NH_2 Si–OH
SiOH	unmodified USP **L3**	–	n.a.	–	pH stability 2 – 8	$(Si\text{-}O_2)_n$ Si–OH
	* A = hydrophobic selectivity, B = polar / ionic selectivity, C = steric selectivity					

An optimised phase for every separations

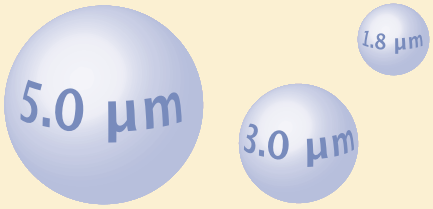
	Application	Similar phases**	Separation principle · Retention mechanism	
	in general compounds with ionizable functional groups such as basic pharmaceuticals and pesticides	**NUCLEOSIL® C_{18} HD** Waters Xterra® RP_{18} / MS C_{18}; Phenomenex Luna® C18 (2), Synergi™ und Max RP; Zorbax® Extend C18; Inertsil® ODS III; Purospher® RP-18, Star RP-18	**only hydrophobic interactions** (van der Waals interactions)	
	like C_{18} Gravity, however generally shorter retention times for nonpolar compounds	**NUCLEOSIL® C_8 HD** Waters Xterra® RP_8 / MS C_8; Phenomenex Luna® C8; Zorbax® Eclipse; XDB-C8		
	high steric selectivity, thus suited for separation of positional and structural isomers, planar / non-planar molecules	**NUCLEOSIL® C_{18} AB** Inertsil® ODS-P; YMC® Pro C18RS	**steric interactions** and **hydrophobic interactions**	
	basic pharmaceutical ingredients, very polar compounds, organic acids	Phenomenex Aqua®; YMC® AQ; Waters Atlantis® dC18	**hydrophobic interactions** and **polar interactions** (H bonds)	
	compounds with aromatic and multiple bond systems	no similar phases	**π-π interactions** and **hydrophobic interactions**	
	robust C_{18} phase for routine analyses	**NUCLEOSIL® C_{18}** Spherisorb® ODS II; Hypersil® ODS; Waters Symmetry® C18; Inertsil® ODS II; Kromasil® C18; LiChrospher® RP 18	**only hydrophobic interactions** (van der Waals interactions) some residual silanol interactions	
	robust C_8 phase for routine analyses	**NUCLEOSIL® C_8 ec / C_8** Spherisorb® C8; Hypersil® MOS; Waters Symmetry® C8; Kromasil® C8; LiChrospher® RP 8		
	polar organic compounds (basic drugs, molecules containing π electron systems	**NUCLEOSIL® CN / CN-RP**	**π-π interactions**, **polar interactions** (H bonds), **hydrophobic interactions**	
	sugars, sugar alcohols and other hydroxy compounds, DNA bases, polar compounds in general	**NUCLEOSIL® NH_2 / NH_2-RP**	**polar / ionic interactions**, **hydrophobic interactions**	
	polar organic compounds in general	**unmodified NUCLEOSIL®**	**polar / ionic interactions**	
		** phases which provide a similar selectivity based on chemical and physical properties		

Columns for HPLC

Particle size and separation efficiency

1.8 µm particles for increased separation efficiency

- decrease of analysis time (ultra fast HPLC)
- shorter columns with high separation efficiency
- significant improvement of resolution
- increased detection sensitivity
- suitable for **LC/MS** due to low bleeding characteristics
- all NUCLEODUR® premium phases are available in 1.8 µm: C_{18} Gravity, C_8 Gravity, C_{18} Isis, C_{18} Pyramid, Sphinx RP
- NUCLEODUR® 1.8 µm particles are fractionated to limit the increase in back pressure



Now available: 1.8 µm particle size!

Features of 1.8 µm NUCLEODUR® silica particles

- **increase of separation efficiency by higher number of theoretical plates (N)**
- **significant improvement in resolution**
- **low column back pressure**

Comparison of back pressure:

Eluent:	100 % methanol
Flow rate:	1.5 ml/min
Temperature:	22 °C
Column dimension:	50 x 4.6 mm

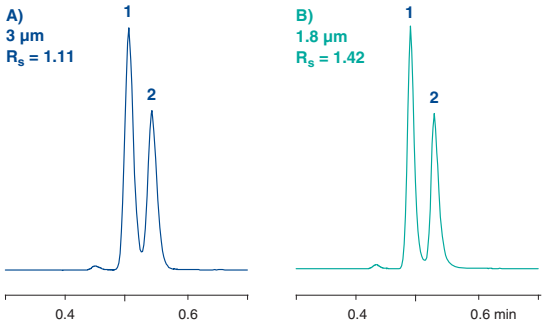
	NUCLEODUR® C_{18} Gravity	Competitor A
3 µm	70 bar	–
1.8 µm	130 bar	170 bar

- **shorter run times**

Resolution as a function of particle size

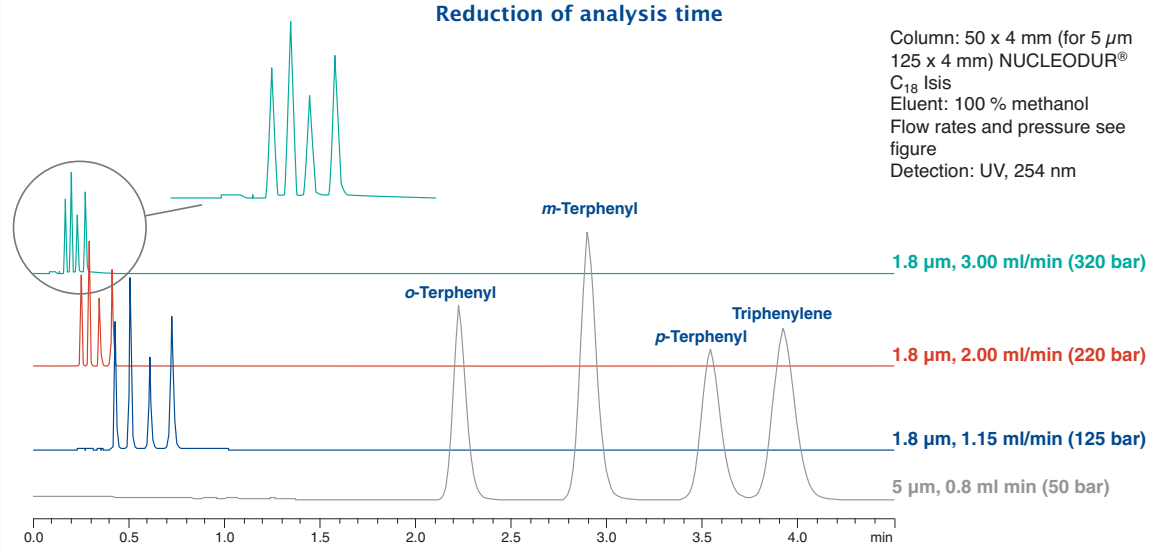
Column:	50 x 4 mm NUCLEODUR® C_{18} Gravity A) 3 µm, B) 1.8 µm
Eluent:	acetonitrile – water (80:20, v/v)
Flow rate:	2 ml/min
Pressure:	A) 80 bar, B) 160 bar
Detection:	UV, 254 nm

Peaks:
1. Naphthalene
2. Ethylbenzene



Reduction of analysis time

Column: 50 x 4 mm (for 5 µm 125 x 4 mm) NUCLEODUR® C_{18} Isis
Eluent: 100 % methanol
Flow rates and pressure see figure
Detection: UV, 254 nm



Columns for HPLC

1

1 HPLC columns with NUCLEODUR® Phasen

NUCLEODUR® C18 - C 8 Gravity nonpolar high density phases *MACHEREY-NAGEL*

- available as octadecyl (C18 -USP L!) and octyl (C8 - USP L7) modifications
- Pore size 110 Å; particle sizes 1.8µm, 3µm and 5µm for C18, 1.8 and 5µm for C8 7, 10, 12 and 16µm particles for preparative separations on request carbon content 18 %C for C18 , 11%C for C8
- ideal for method development
- allows HPLC at pH extremes (pH 1 - 11)
- suitable for **LC/MS** due to low bleeding characteristics
- recommended for overall sophisticated analytical separations
- optimal for: pharmaceuticals, e.g. analgesics, antiinflammatory drugs, antidepressants; herbicides; phytopharmaceuticals; immunosppressants

EC analytical columns NUCLEODUR® C8 Gravity, 1.8µm

particle size 1.8µm, 11% C *MACHEREY-NAGEL*

Type	Length mm	PK	Cat. No.
2 mm i.d.	30	1	**4.004 563**
3 mm i.d.	30	1	**4.004 564**
4 mm i.d.	30	1	**4.004 565**
4.6 mm i.d.	30	1	**4.004 566**
2 mm i.d.	50	1	**4.004 559**
3 mm i.d.	50	1	**4.004 560**
4 mm i.d.	50	1	**4.004 561**
4.6 mm i.d.	50	1	**4.004 562**

EC analytical columns NUCLEODUR® C8 Gravity, 5µm

particle size 5µm, 11% C *MACHEREY-NAGEL*

Type	Length mm	PK	Cat. No.
2 mm i.d.	50	1	**4.004 543**
3 mm i.d.	50	1	**4.004 544**
4 mm i.d.	50	1	**4.004 545**
4.6 mm i.d.	50	1	**4.004 546**
2 mm i.d.	125	1	**4.004 547**
3 mm i.d.	125	1	**4.004 548**
4 mm i.d.	125	1	**4.004 549**
4.6 mm i.d.	125	1	**4.004 550**
2 mm i.d.	150	1	**4.004 551**
3 mm i.d.	150	1	**4.004 552**
4 mm i.d.	150	1	**4.004 553**
4.6 mm i.d.	150	1	**4.004 554**
2 mm i.d.	250	1	**4.004 555**
3 mm i.d.	250	1	**4.004 556**
4 mm i.d.	250	1	**4.004 557**
4.6 mm i.d.	250	1	**4.004 558**

Guard columns for EC columns NUCLEODUR® C8 Gravity, 5µm

MACHEREY-NAGEL

Type	PK	Cat. No.
for 2 and 3 mm i.d.	3	**4.004 719**
for 4 and 4.6 mm i.d.	3	**4.004 720**

Guard columns for EC columns require guard column adapter EC (Cat. No. 7.081 898)

VarioPrep preparative columns NUCLEODUR® C8 Gravity

particle size 5µm, 11%C *MACHEREY-NAGEL*

Available on request.

EC analytical columns NUCLEODUR® C18 Gravity, 1.8µm

particle size 1.8µm, 18% C *MACHEREY-NAGEL*

Type	Length mm	PK	Cat. No.
2 mm i.d.	30	1	**4.004 392**
3 mm i.d.	30	1	**4.004 393**
4 mm i.d.	30	1	**4.004 394**
4.6 mm i.d.	30	1	**4.004 395**
2 mm i.d.	50	1	**4.004 396**
3 mm i.d.	50	1	**4.004 397**
4 mm i.d.	50	1	**4.004 398**
4.6 mm i.d.	50	1	**4.004 399**

1 EC analytical columns NUCLEODUR® C18 Gravity, 3µm

1

particle size 3µm, 18% C

MACHEREY-NAGEL

Type	Length mm	PK	Cat. No.
2 mm i.d.	50	1	**4.004 400**
3 mm i.d.	50	1	**4.004 401**
4 mm i.d.	50	1	**4.004 402**
4.6 mm i.d.	50	1	**4.004 403**
2 mm i.d.	125	1	**4.004 404**
3 mm i.d.	125	1	**6.232 333**
4 mm i.d.	125	1	**4.004 405**
4.6 mm i.d.	125	1	**4.004 406**
2 mm i.d.	150	1	**4.004 411**
3 mm i.d.	150	1	**4.004 412**
4 mm i.d.	150	1	**4.004 413**
4.6 mm i.d.	150	1	**4.004 414**
2 mm i.d.	250	1	**4.004 407**
3 mm i.d.	250	1	**4.004 408**
4 mm i.d.	250	1	**4.004 409**
4.6 mm i.d.	250	1	**4.004 410**

Guard columns for EC columns NUCLEODUR® C18 Gravity, 3µm

MACHEREY-NAGEL

Type	PK	Cat. No.
for 2 and 3 mm i.d.	3	**4.004 624**
for 4 and 4.6 mm i.d.	3	**4.004 625**

Guard columns for EC columns require guard column adapter EC (Cat. No. 7.081 898)

EC analytical columns NUCLEODUR® C18 Gravity, 5µm

particle size 5µm, 18% C

MACHEREY-NAGEL

Type	Length mm	PK	Cat. No.
2 mm i.d.	50	1	**4.004 422**
3 mm i.d.	50	1	**4.004 423**
4 mm i.d.	50	1	**4.004 424**
4.6 mm i.d.	50	1	**4.004 425**
2 mm i.d.	125	1	**4.004 415**
3 mm i.d.	125	1	**4.004 416**
4 mm i.d.	125	1	**4.004 417**
4.6 mm i.d.	125	1	**4.004 418**
2 mm i.d.	150	1	**4.004 426**
3 mm i.d.	150	1	**4.004 427**
4 mm i.d.	150	1	**4.004 428**
4.6 mm i.d.	150	1	**4.004 429**
2 mm i.d.	250	1	**4.004 419**
3 mm i.d.	250	1	**4.004 420**
4 mm i.d.	250	1	**6.224 511**
4.6 mm i.d.	250	1	**4.004 421**

Guard columns for EC columns NUCLEODUR® C18 Gravity, 5µm

MACHEREY-NAGEL

Type	PK	Cat. No.
for 2 and 3 mm i.d.	3	**7.510 912**
for 4 and 4.6 mm i.d.	3	**4.004 626**

Guard columns for EC columns require guard column adapter EC (Cat. No. 7.081 898)

VarioPrep preparative columns NUCLEODUR® C18 Gravity

Particle size 5µm, 18% C

MACHEREY-NAGEL

Type	Length mm	PK	Cat. No.
10 mm ID	50	1	**4.004 773**
10 mm ID	250	1	**4.004 775**
10mm i.d.	10	2	**4.004 780**

*10 x 8mm ID VarioPrep guard columns require the VP guard column holder 8mm (4.002 176) and fit on 10mm ID VP columns.

VarioPrep preparative columns NUCLEODUR® C18 Gravity

particle size 10µm, 18% C — *MACHEREY-NAGEL*

Type	Length mm	PK	Cat. No.
40 mm i.d.	250	1	**4.004 782**

NUCLEODUR® C18 Isis phase with high steric selectivity

MACHEREY-NAGEL

C18 phase with special polymeric, crosslinked surface modification - USP L1
pore size 110 Å, particle sizes 1.8µm, 3µm and 5µm; 20%C
high steric selectivity
outstanding surface deactivation
suitable for **LC/MS** due low bleeding characteristics
pH stability 1 - 10
broad range of application: steroids, (o,p,m-) substituted aromatics, fat-soluble vitamins

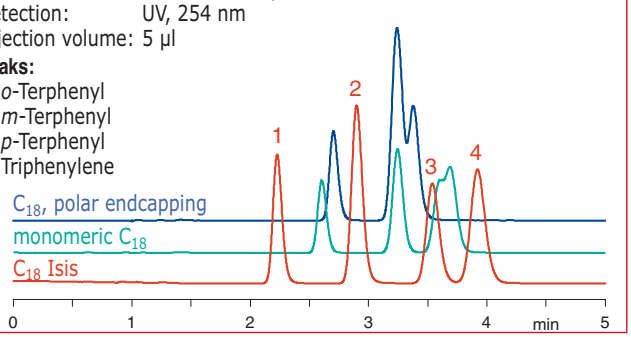
Surface modification

By use of specific C_{18} silanes and appropriate polymeric bonding technologies a dense shield of alkyl chains protects the subjacent silica matrix. Elemental analysis of NUCLEODUR® C_{18} Isis shows a carbon load of 20%.

The target crosslinking of the C_{18} chains on the surface enables the separation of compounds with similar molecular structure but different stereochemical properties. The technical term for this feature is steric selectivity.

Steric selectivity of NUCLEODUR® C_{18} Isis

Columns: 125 x 4 mm; **NUCLEODUR® C_{18} Isis**, **monomerically coated C_{18} phase**, **C_{18} phase with polar endcapping**
Eluent: methanol – water (90:10, v/v)
Flow rate: 1 ml/min, temperature 35 °C
Detection: UV, 254 nm
Injection volume: 5 µl
Peaks:
1. *o*-Terphenyl
2. *m*-Terphenyl
3. *p*-Terphenyl
4. Triphenylene

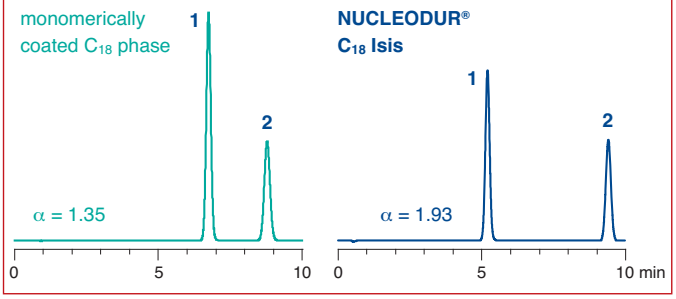


The separation of *o*-terphenyl and triphenylene is a concrete example to evaluate the selectivity potential of a reversed phase column in terms of the different shape of two molecules. The phenyl rings of *o*-terphenyl are twisted out of plane while triphenylene has a planar geometry.

The separation factor (α value) is a measure for the steric selectivity. As is shown in the following chromatograms the α value is considerable larger on NUCLEODUR® C_{18} Isis compared to a conventional C_{18} column.

Steric selectivity of NUCLEODUR® C_{18} Isis

Columns 125 x 4 mm; eluent methanol – water (80:20, v/v)
Flow rate: 1 ml/min, temperature 40 °C
Detection: UV, 254 nm, injection volume 1 µl
Peaks: 1. *o*-Terphenyl, 2. Triphenylene



EC analytical columns NUCLEODUR® C18 Isis, 1.8µm

particle size 1.8µm, 20% C — *MACHEREY-NAGEL*

Type	Length mm	PK	Cat. No.
2 mm i.d.	30	1	**4.004 501**
3 mm i.d.	30	1	**4.004 502**
4 mm i.d.	30	1	**4.004 503**
4.6 mm i.d.	30	1	**4.004 504**
2 mm i.d.	50	1	**4.004 497**
3 mm i.d.	50	1	**4.004 498**
4 mm i.d.	50	1	**4.004 499**
4.6 mm i.d.	50	1	**4.004 500**
2 mm i.d.	100	1	**4.006 019**

1 EC analytical columns NUCLEODUR® C18 Isis, 3µm

1

particle size 3µm, 20% C — *MACHEREY-NAGEL*

Type	Length mm	PK	Cat. No.
2 mm i.d.	50	1	**4.004 481**
3 mm i.d.	50	1	**4.004 482**
4 mm i.d.	50	1	**4.004 483**
4.6 mm i.d.	50	1	**4.004 484**
4.6 mm i.d.	100	1	**4.006 020**
2 mm i.d.	125	1	**4.004 485**
3 mm i.d.	125	1	**4.004 486**
4 mm i.d.	125	1	**4.004 487**
4.6 mm i.d.	125	1	**4.004 488**
2 mm i.d.	150	1	**4.004 489**
3 mm i.d.	150	1	**4.004 490**
4 mm i.d.	150	1	**4.004 491**
4.6 mm i.d.	150	1	**4.004 492**
2 mm i.d.	250	1	**4.004 493**
3 mm i.d.	250	1	**4.004 494**
4 mm i.d.	250	1	**4.004 495**
4.6 mm i.d.	250	1	**4.004 496**

Guard columns for EC columns NUCLEODUR® C18 Isis, 3µm

MACHEREY-NAGEL

Type	PK	Cat. No.
for 2 and 3 mm i.d.	3	**4.004 629**
for 4 and 4.6 mm i.d.	3	**4.004 630**

Guard columns for EC columns require the guard column adapter EC (Cat. No. 7.081 898).

EC analytical columns NUCLEODUR® C18 Isis, 5µm

particle size 5µm, 20% C — *MACHEREY-NAGEL*

Type	Length mm	PK	Cat. No.
2 mm i.d.	50	1	**4.004 505**
3 mm i.d.	50	1	**4.004 506**
4 mm i.d.	50	1	**4.004 507**
4.6 mm i.d.	50	1	**4.004 508**
4.6 mm i.d.	100	1	**4.006 021**
2 mm i.d.	125	1	**4.004 509**
3 mm i.d.	125	1	**4.004 510**
4 mm i.d.	125	1	**4.004 511**
4.6 mm i.d.	125	1	**4.004 512**
2 mm i.d.	150	1	**4.004 513**
3 mm i.d.	150	1	**4.004 514**
4 mm i.d.	150	1	**4.004 515**
4.6 mm i.d.	150	1	**4.004 516**
2 mm i.d.	250	1	**4.004 517**
3 mm i.d.	250	1	**4.004 518**
4 mm i.d.	250	1	**4.004 519**
4.6 mm i.d.	250	1	**4.004 520**

Guard columns for EC columns NUCLEODUR® C18 Isis, 5µm

MACHEREY-NAGEL

Type	PK	Cat. No.
for 2 and 3 mm i.d.	3	**4.004 640**
for 4 and 4.6 mm i.d.	3	**4.004 641**

Guard columns for EC columns require the guard column adapter EC (Cat. No. 7.081 898).

2 VarioPrep preparative columns NUCLEODUR® C18 Isis

2

particle size 5µm, 20% C — *MACHEREY-NAGEL*

Type	Length mm	PK	Cat. No.
21 mm i.d.	50	1	**4.004 801**
10 mm i.d.	250	1	**4.004 797**

VarioPrep columns for preparative HPLC NUCLEODUR® C18 Isis, 5µm

MACHEREY-NAGEL

Type	PK	Cat. No.
for 10 mm i.d.	2	**4.004 802**
for 21 mm i.d.	2	**4.004 803**

10 x 8mm ID VarioPrep guard columns require the VP 8mm guard column holder and are suited for 8 and 10mm ID VP columns,
20 x 16mm ID VarioPrep guard columns require the VP guard column holder 16mm and are used for 16 and 21mm ID VP columns.

NUCLEODUR® C18 Pyramid phase for highly aqueous eluents

MACHEREY-NAGEL

stabel in 100 % aqueous eluent systems- SUP L1
pore size 110 Å, particle sizes 1.8µm, 3µm and 5µm; 14 % C
7 and 10µm particles for preparative separations on request
interesting polar selectivity features
excellent base deactivation; suitable for **LC/MS** due low bleeding characteristics
pH stability 1 - 9
Ideal for: analgesics, penicillin antibiotics, nucleic acid bases, water-soluble vitamins, complexing agetns, organic acids

RP HPLC with highly aqueous eluents

Conventional reversed phase columns often display stability problems in eluent systems with high percentage of water (> 95%) as evidenced by a sudden decrease of retention time and overall poor reproducibility. This phenomenon is described as phase collapse caused by the mobile phase expelled from the pores due to the fact, that hydrophobic RP phases are incompletely wetted with the mobile phase.

Different approaches can be used to increase column stability with highly aqueous mobile phase systems. The most promising concepts are incorporating a polar group in the hydrophobic alkyl chain, or using hydrophilic endcapping procedures to improve the wettability of the reversed phase modification.

Stability features

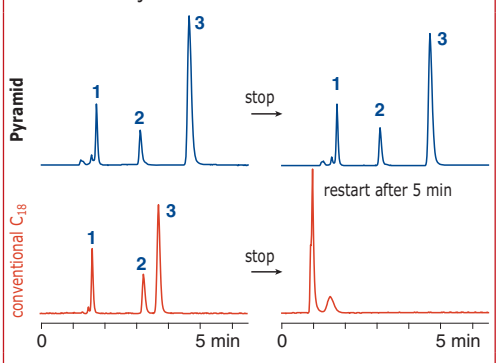
NUCLEODUR® C_{18} Pyramid is a silica phase with hydrophilic endcapping, designed especially for use in eluent systems of up to 100% water. The stability test shows the retention behaviour of tartaric, acetic and maleic acid under purely aqueous conditions on NUCLEODUR® C_{18} Pyramid in comparison with a conventionally bonded RP phase.

It can be shown that the retention times for NUCLEODUR® C_{18} Pyramid remain nearly unchanged between initial injection and restart after the flow has been stopped for 12 hours, whilst the performance of the conventional RP column collapsed totally after 5 min.

Retention characteristics

The polar surface derivatization exhibits retention characteristics, which differentiate the "Pyramid" from conventional C_{18} stationary phases. The chromatogram at right shows the improved retention behaviour of very polar compounds such as short chain organic acids, which are insufficiently retained on RP columns with predominantly hydrophobic surface properties.

Stability test

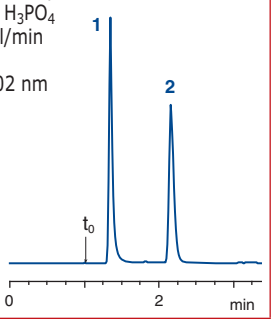


both columns 125 x 4 mm ID; 50 mM KH_2PO_4 pH 2.5, 0.7 ml/min; 25 °C; UV, 210 nm; injection volume 1 µl
Peaks: 1. tartaric acid, 2. acetic acid, 3. maleic acid
MN Appl. No. 120870

Separation of very polar compounds

Column: 125 x 4 mm NUCLEODUR® C_{18} Pyramid, 5 µm
Eluent: 0.2 % H_3PO_4
Flow rate: 1,0 ml/min
Temperature: 22 °C
Detection: UV, 202 nm
Injection volume: 2 µl

Peaks:
1. Formic acid
2. Acetic acid



MN Appl. No. 119170

EC analytical columns NUCLEODUR® C18 Pyramid, 1.8µm

particle size 1.8µm, 14% C

MACHEREY-NAGEL

Type	Length mm	PK	Cat. No.
2 mm i.d.	30	1	**4.004 473**
3 mm i.d.	30	1	**4.004 474**
4 mm i.d.	30	1	**4.004 475**
4.6 mm i.d.	30	1	**4.004 476**
2 mm i.d.	50	1	**4.004 477**
3 mm i.d.	50	1	**4.004 478**
4 mm i.d.	50	1	**4.004 479**
4.6 mm i.d.	50	1	**4.004 480**

1 EC analytical columns NUCLEODUR® C18 Pyramid, 3µm

1

particle size 3µm, 14% C

MACHEREY-NAGEL

Type	Length mm	PK	Cat. No.
2 mm i.d.	50	1	**4.004 469**
3 mm i.d.	50	1	**4.004 470**
4 mm i.d.	50	1	**4.004 471**
4.6 mm i.d.	50	1	**4.004 472**
2 mm i.d.	125	1	**4.004 458**
3 mm i.d.	125	1	**4.004 459**
4 mm i.d.	125	1	**4.004 460**
4.6 mm i.d.	125	1	**6.232 796**
2 mm i.d.	150	1	**4.004 461**
3 mm i.d.	150	1	**4.004 462**
4 mm i.d.	150	1	**4.004 463**
4.6 mm i.d.	150	1	**4.004 464**
2 mm i.d.	250	1	**4.004 465**
3 mm i.d.	250	1	**4.004 466**
4 mm i.d.	250	1	**4.004 467**
4.6 mm i.d.	250	1	**4.004 468**

Guard columns for EC columns NUCLEODUR® C18 Pyramid, 3µm

MACHEREY-NAGEL

Type	PK	Cat. No.
for 2 and 3 mm i.d.	3	**4.004 739**
for 4 and 4,6 mm i.d.	3	**4.004 740**

Guard columns for EC columns require guard column adapter EC (Cat. No. 7.081 898)

EC analytical columns NUCLEODUR® C18 Pyramid, 5µm

particle size 5µm, 14% C

MACHEREY-NAGEL

Type	Length mm	PK	Cat. No.
2 mm i.d.	50	1	**4.004 443**
3 mm i.d.	50	1	**4.004 444**
4 mm i.d.	50	1	**4.004 445**
4.6 mm i.d.	50	1	**4.004 446**
2 mm i.d.	125	1	**4.004 447**
3 mm i.d.	125	1	**4.004 448**
4 mm i.d.	125	1	**4.004 449**
4.6 mm i.d.	125	1	**4.004 450**
2 mm i.d.	150	1	**4.004 454**
3 mm i.d.	150	1	**4.004 455**
4 mm i.d.	150	1	**4.004 456**
4.6 mm i.d.	150	1	**4.004 457**
2 mm i.d.	250	1	**4.004 451**
3 mm i.d.	250	1	**4.004 452**
4 mm i.d.	250	1	**6.226 913**
4.6 mm i.d.	250	1	**4.004 453**

Guard columns for EC columns NUCLEODUR® C18 Pyramid, 5µm

MACHEREY-NAGEL

Type	PK	Cat. No.
for 2mm and 3mm i.d.	3	**4.004 721**
for 4mm and 4.6mm i.d.	3	**4.004 722**

Guard columns for EC columns require guard column adapter EC (Cat. No. 7.081 898)

VarioPrep preparative columns NUCLEODUR® C18 Pyramid

particle size 5µm, 14% C

MACHEREY-NAGEL

Type	Length mm	PK	Cat. No.
10 mm i.d.	250	1	**4.004 783**
21 mm i.d.	250	1	**4.004 785**

VarioPrep columns for preparative HPLC C18 Pyramid, 5µm

MACHEREY-NAGEL

Type	PK	Cat. No.
for 10 mm i.d.	2	**4.004 788**
for 21 mm i.d.	2	**4.004 789**

VarioPrep guard columns require the 8mm VP guard column holder and are suited for 8 and 10mm ID VP columns,
20 x 16mm ID VarioPrep guard columns require the 16mm VP guard column holder and are used for 16 and 21mm ID VP columns.

NUCLEODUR® Sphinx RP bifunctional RP phase

MACHEREY-NAGEL

distinct selectivity based on bifunctional surface coverage - USP L1 and USP L11
pore size 110 Å, particle sizes 1.8µm, 3µm and 5µm; 14 %C
high density of covalently bonded silanes for tailing-free peaks widens the scope for method development
pH stability 1 - 10
suitable for **LC/MS** due low bleeding characteristics
high reproducibility and consistent quality due to tight QC procedures
range of application: quinolone antibiotics, sulfonamides, xanthines, substituted aromatics

Alternative RP selectivity

NUCLEODUR® Sphinx RP is characterized by exceptional selectivity features generated by a well-balanced ratio of covalently bonded octadecyl and phenyl groups. The combination of classical hydrophobic with π–π interactions (aromatic ring system) expands the scope of selectivity in comparison with conventional reversed phase packings. NUCLEODUR® Sphinx RP is particularly suited for the separation of molecules containing aromatic and multiple bonds. For the separation of polar compounds NUCLEODUR® Sphinx RP can be especially recommended and can also outperform many customary C_{18} phases.

In addition, exhaustive endcapping steps minimize unwanted surface silanol activity and guarantee excellent peak shapes even for strongly basic analytes.

Different from standard phenyl phases, NUCLEODUR® Sphinx RP is far more stable towards hydrolysis and is also suggested for LC/MS applications.

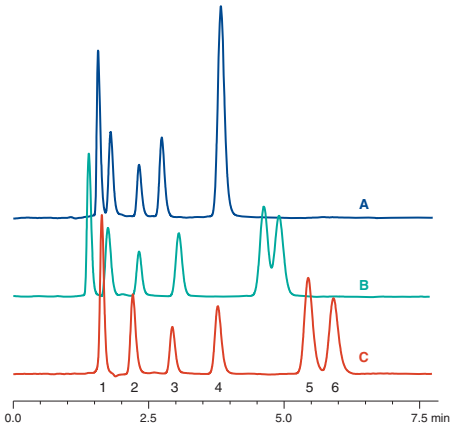
Due to the additional intermolecular interactions NUCLEODUR® Sphinx RP is an interesting replenishment to the high density bonded phases NUCLEODUR® C_8/C_{18} Gravity and the polar endcapped NUCLEODUR® C_{18} Pyramid.

Separation of flavonoids on 3 different NUCLEODUR® phases

Columns: 150 x 4.6 mm
A) NUCLEODUR® C_8 Gravity, 5 µm
B) NUCLEODUR® C_{18} Gravity, 5 µm
C) NUCLEODUR® Sphinx RP, 5 µm
Eluent: water – methanol (40:60, v/v), 1 ml/min, 30 °C
Detection: UV, 270 nm; injection volume: 3 µl

Peaks:
1. Catechin, 2. Rutin, 3. Fisetin, 4. Quercetin
5. Kaempferol, 6. Isorhamnetin

MN Appl. No. 119830



1 EC analytical columns NUCLEODUR® Sphinx RP, 1.8µm

1

particle size 1.8µm, 14% C — *MACHEREY-NAGEL*

Type	Length mm	PK	Cat. No.
2 mm i.d.	30	1	**4.004 598**
3 mm i.d.	30	1	**4.004 599**
4 mm i.d.	30	1	**4.004 600**
4.6 mm i.d.	30	1	**4.004 601**
2 mm i.d.	50	1	**4.004 602**
3 mm i.d.	50	1	**4.004 603**
4 mm i.d.	50	1	**4.004 604**
4.6 mm i.d.	50	1	**4.004 605**

EC analytical columns NUCLEODUR® Sphinx RP, 3µm

particle size 3µm, 14% C — *MACHEREY-NAGEL*

Type	Length mm	PK	Cat. No.
2 mm i.d.	50	1	**4.004 586**
3 mm i.d.	50	1	**4.004 587**
4 mm i.d.	50	1	**4.004 588**
4.6 mm i.d.	50	1	**4.004 589**
2 mm i.d.	125	1	**4.004 590**
3 mm i.d.	125	1	**4.004 591**
4 mm i.d.	125	1	**4.004 592**
4.6 mm i.d.	125	1	**4.004 593**
2 mm i.d.	150	1	**4.004 582**
3 mm i.d.	150	1	**4.004 583**
4 mm i.d.	150	1	**4.004 584**
4.6 mm i.d.	150	1	**4.004 585**
2 mm i.d.	250	1	**4.004 594**
3 mm i.d.	250	1	**4.004 595**
4 mm i.d.	250	1	**4.004 596**
4.6 mm i.d.	250	1	**4.004 597**

Guard columns for EC columns NUCLEODUR® Spinx RP, 3µm

MACHEREY-NAGEL

Type	PK	Cat. No.
for 2 and 3 mm i.d.	3	**4.004 696**
for 4 and 4.6 mm i.d.	3	**4.004 697**

Guard columns for EC columns require guard column adapter EC (Cat. No. 7.081 898)

EC analytical columns NUCLEODUR® Sphinx RP, 5µm

particle size 5µm, 14% C — *MACHEREY-NAGEL*

Type	Length mm	PK	Cat. No.
2 mm i.d.	50	1	**4.004 567**
3 mm i.d.	50	1	**4.004 568**
4 mm i.d.	50	1	**4.004 569**
4.6 mm i.d.	50	1	**4.004 570**
2 mm i.d.	125	1	**4.004 571**
3 mm i.d.	125	1	**4.004 572**
4 mm i.d.	125	1	**4.004 573**
4.6 mm i.d.	125	1	**4.004 574**
2 mm i.d.	150	1	**4.004 575**
3 mm i.d.	150	1	**4.004 576**
4 mm i.d.	150	1	**6.225 971**
4.6 mm i.d.	150	1	**4.004 577**
2 mm i.d.	250	1	**4.004 578**
3 mm i.d.	250	1	**4.004 579**
4 mm i.d.	250	1	**4.004 580**
4.6 mm i.d.	250	1	**4.004 581**

Guard columns for EC columns NUCLEODUR® Spinx RP, 5µm

MACHEREY-NAGEL

Type	PK	Cat. No.
for 2 and 3 mm i.d.	3	**4.004 681**
for 4 and 4,6 mm i.d.	3	**4.004 682**

Guard columns for EC columns require guard column adapter EC (Cat. No. 7.081 898)

VarioPrep preparative columns NUCLEODUR® Sphinx RP

particle size 5µm, 14% C

MACHEREY-NAGEL

Type	Length mm	PK	Cat. No.
10 mm i.d.	50	1	**4.004 790**
10 mm i.d.	250	1	**4.004 791**

VarioPrep columns for preparative HPLC NUCLEODUR® Sphinx RP, 5µm

MACHEREY-NAGEL

Type	PK	Cat. No.
10 mm i.d.	2	**4.004 795**

10 x 8mm ID VarioPrep guard columns require the 8mm VP guard column holder and are suited for 8 and 10mm ID VP columns,

NUCLEODUR® C18 ec - C8 ec nonpolar phases for routine analyses

available with medium density octadecyl (C18 - USP L1) and octyl (C8 - USP L7) modification
pore size 110 Å, particle sizes, 3µm and 5µm;
7µm, 10µm, 12µm, 16µm, 20µm, 30µm und 50µm for preparative separations on request
for daily routine analysis and up-scaling for preparative HPLC
pH stability 1 - 9
carbon content 17.5%C for C18 , 10.5%C for C8
high reproducibility from lot to lot
for standard routine applications in reversed phase chromatography

MACHEREY-NAGEL

NUCLEODUR® C_{18} ec for daily routine analysis and up-scaling in preparative HPLC

The efficiency of a separation is controlled by particle size and selectivity of the stationary phase. The exceptional surface coverage of monomeric bonded alkylsilanes, combined with an exhaustive endcapping, results in a surface with lowest silanol activity. This allows the tailing-free elution of polar compounds such as basic drugs. NUCLEODUR® C_{18} ec is also ideal for scale-up purposes.

Chemical stability

The utmost purity of the base silica and the exceptional silane bonding chemistry minimizes the risk of dissolution, or hydrolysis at pH extremes.

High loadability

Loadability, probably the most important feature for preparative LC, is determined by pore size, pore volume and surface area of the packing.

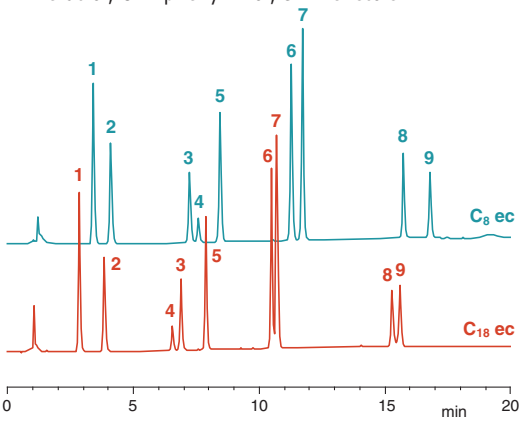
NUCLEODUR® octyl phases

Based on the same totally spherical and highly pure silica the C_8 phases exhibit the same excellent chemical and mechanical stability features as the C_{18} counterparts. Due to the shorter chain and less hydrophobic properties of the stationary phase the retention of nonpolar compounds is decreased, and in consequence a reduction in time of analysis can be achieved. Moreover a stronger polar selectivity, particularly with the separation of ionizable analytes is frequently observed (as distinct from the C_{18} phases).

Separation of phenols

Columns: 250 x 4 mm NUCLEODUR® 100-5 C_8 ec / C_{18} ec
Eluent: A) water, B) methanol
Gradient for C_8: 2 min 20 % B, then to 60 % B in 12 min; gradient for C_{18}: 2 min 25 % B, then to 65 % B in 12 min
Flow rate 1.0 ml/min, temperature 25 °C
Detection UV 275 nm, injection volume 10 µl

Peaks:
1. Resorcinol; 2. Pyrocatechol; 3. 4-Methoxyphenol
4. Phenol; 5. 2-Methoxyphenol; 6. 2-Ethoxyphenol
7. Veratrol; 8. Biphenyl-2-ol; 9. Phenetole



MN Appl. No. 120890/120891

Some general principles are:

- High density C_8 and C_{18} phases allow tailing-free elution even for very polar compounds
- Octyl phases (C_8) show superior polar selectivity
- Octadecyl phases (C_{18}) show superior hydrophobic selectivity
- Hydrophobic compounds show shorter retention times on C_8 phases

1 EC analytical columns NUCLEODUR® 100-3 C8 ec, 3 µm

1

Octyl phases, 10.5% C, particle size 3µm

MACHEREY-NAGEL

Type	Length mm	PK	Cat. No.
2 mm i.d.	50	1	**4.004 388**
3 mm i.d.	50	1	**4.004 389**
4 mm i.d.	50	1	**4.004 390**
4.6 mm i.d.	50	1	**4.004 391**
2 mm i.d.	125	1	**4.004 379**
3 mm i.d.	125	1	**4.004 380**
4 mm i.d.	125	1	**4.004 381**
4.6 mm i.d.	125	1	**4.004 382**
4.6 mm i.d.	150	1	**4.004 383**
2 mm i.d.	250	1	**4.004 384**
3 mm i.d.	250	1	**4.004 385**
4 mm i.d.	250	1	**4.004 386**
4.6 mm i.d.	250	1	**4.004 387**

Guard columns for EC columns NUCLEODUR® 100-3 C8 ec, 3 µm

MACHEREY-NAGEL

Type	PK	Cat. No.
for 2 and 3 mm i.d.	3	**4.004 607**
for 4 and 4.6 mm i.d.	3	**4.004 608**

Guard columns for EC columns require guard column adapter EC (Cat. No. 7.081 898)

EC analytical columns NUCLEODUR® 100-5 C8 ec, 5 µm

Octyl phases, 10.5% C, particle size 5µm.

MACHEREY-NAGEL

Type	Length mm	PK	Cat. No.
2 mm i.d.	50	1	**4.004 521**
3 mm i.d.	50	1	**4.004 522**
4 mm i.d.	50	1	**4.004 523**
4.6 mm i.d.	50	1	**4.004 524**
2 mm i.d.	125	1	**4.004 525**
3 mm i.d.	125	1	**4.004 526**
4 mm i.d.	125	1	**4.004 527**
4.6 mm i.d.	125	1	**4.004 528**
4.6 mm i.d.	150	1	**4.004 529**
2 mm i.d.	250	1	**4.004 530**
3 mm i.d.	250	1	**4.004 531**
4 mm i.d.	250	1	**4.004 532**
4.6 mm i.d.	250	1	**6.228 531**

Guard columns for EC Columns NUCLEODUR® 100-5 C8 ec, 5 µm

MACHEREY-NAGEL

Type	PK	Cat. No.
for 2mm and 3mm i.d. EC columns	3	**4.004 708**
for 4mm and 4.6mm i.d. EC columns	3	**4.004 709**

2 VarioPrep preparative columns NUCLEDUR® 100-5 C8 ec, 5 µm

2

Octyl phases, 10.5% C,
particle size 5µm.

MACHEREY-NAGEL

Type	Length mm	PK	Cat. No.
10 mm i.d.	50	1	**4.004 767**
10 mm i.d.	250	1	**4.004 761**

VarioPrep columns for preparative HPLC, NUCLEODUR® 100-5 C8 ec, 5 µm

MACHEREY-NAGEL

Type	PK	Cat. No.
for 10mm i.d.	2	**4.004 771**
for 21mm i.d.	2	**4.004 772**

10 x 8mm ID VarioPrep guard columns require the 8mm VP guard column holder and are suited for 8mm and 10mm ID VP columns,
20 x 16mm ID VarioPrep guard columns require the 16mm VP guard column holder and are used for 16mm and 21mm ID VP columns.

EC analytical columns NUCLEODUR® 100-3 C18 ec, 3 µm

Octadecyl phases, 17.5% C — *MACHEREY-NAGEL*

Type	Length mm	PK	Cat. No.
2 mm i.d.	50	1	**4.004 375**
3 mm i.d.	50	1	**4.004 376**
4 mm i.d.	50	1	**4.004 377**
4.6 mm i.d.	50	1	**4.004 378**
4.6 mm i.d.	100	1	**4.006 933**
2 mm i.d.	125	1	**9.003 796**
3 mm i.d.	125	1	**9.003 797**
4 mm i.d.	125	1	**9.003 798**
4.6 mm i.d.	125	1	**9.003 799**
4.6 mm i.d.	150	1	**9.003 800**
2 mm i.d.	250	1	**9.003 801**
3 mm i.d.	250	1	**9.003 802**
4 mm i.d.	250	1	**9.003 803**
4.6 mm i.d.	250	1	**9.003 804**

Guard columns for EC columns NUCLEODUR® 100-3 C18 ec, 3 qm

MACHEREY-NAGEL

Type	PK	Cat. No.
for 3 mm i.d.	3	**9.003 794**
for 4 mm i.d.	3	**9.003 795**

Guard columns for EC columns require guard column adapter EC (Cat. No. 7.081 898)

EC analytical columns NUCLEODUR® 100-5 C18 ec, 5µm

Octadecyl phases, 17.5% C, particle size 5µm — *MACHEREY-NAGEL*

1

Type	Length mm	PK	Cat. No.
2 mm i.d.	50	1	**4.004 368**
3 mm i.d.	50	1	**4.004 369**
4 mm i.d.	50	1	**4.004 370**
4.6 mm i.d.	50	1	**4.004 371**
4.6 mm i.d.	100	1	**4.006 934**
2 mm i.d.	125	1	**9.003 816**
3 mm i.d.	125	1	**9.003 817**
4 mm i.d.	125	1	**9.003 818**
4.6 mm i.d.	125	1	**9.003 819**
4.6 mm i.d.	150	1	**9.003 820**
2 mm i.d.	250	1	**9.003 821**
3 mm i.d.	250	1	**9.003 822**
4 mm i.d.	250	1	**9.003 823**
4.6 mm i.d.	250	1	**9.003 824**

Guard columns for EC columns NUCLEODUR® 100-5 C18 ec, 5µm

MACHEREY-NAGEL

Type	PK	Cat. No.
for 3 mm i.d.	3	**9.003 814**
for 4 mm i.d.	3	**9.003 815**

Guard columns for EC columns require guard column adapter EC (Cat. No. 7.081 898)

1 VarioPrep preparative columns NUCLEODUR® 100-5 C18 ec, 5µm

Octadecyl phases, 17.5% C. Particle size 5µm — *MACHEREY-NAGEL*

Type	Length mm	PK	Cat. No.
10 mm i.d.	250	1	**4.004 752**

VarioPrep preparative columns NUCLEODUR® 100-7 C18 ec, 7µm

Octadecyl phases, 17.5% C, particle size 7µm — *MACHEREY-NAGEL*

Type	Length mm	PK	Cat. No.
10 mm i.d.	50	1	**4.004 759**
10 mm i.d.	250	1	**4.004 757**

1 VarioPrep preparative columns NUCLEODUR® 100-10 C18 ec, 10µm

1

Octadecyl phases, 17.5% C, particle size 10µm — *MACHEREY-NAGEL*

Type	Length mm	PK	Cat. No.
10 mm i.d.	50	1	**4.004 749**
21 mm i.d.	50	1	**4.004 751**
10 mm i.d.	250	1	**4.004 745**

VarioPrep columns for preparative HPLC, NUCLEODUR® 100-5, 100-7, 100-10, C18 ec

MACHEREY-NAGEL

Type	PK	Cat. No.
for 10mm i.d.	2	**4.004 769**
for 20mm i.d.	2	**4.004 770**

10 x 8mm ID VarioPrep guard columns require the 8mm VP guard column holder and are suited for 8mm and 10mm ID VP columns,
20 x 16mm ID VarioPrep guard columns require the 16mm VP guard column holder and are used for 16mm and 21mm ID VP columns.

NUCLEODUR® CN/CN-RP cyano-modified high purity silica phase

MACHEREY-NAGEL

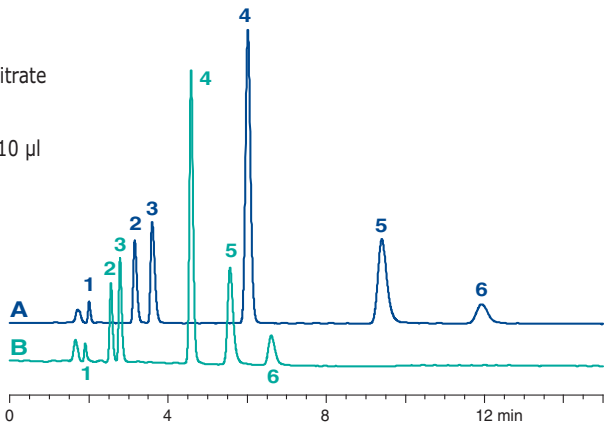
pore size 110 Å, particle sizes 3µm and 5µm; 7%C - USP L10
multi-mode columns (RP and NP)
widens the scope in selectivity
differnet retention characteristics compared to C8 and C18
stable against hydrolysis at low pH values, working range pH 1-8
high reproducibility from lot to lot
ideal for: tricyclic antidepressants, steroids, organic acids

Separation of cold medicine ingredients on two different NUCLEODUR® phases

Columns:
A) 250 x 4 mm NUCLEODUR® 100-5 C_{18} ec
B) 250 x 4 mm NUCLEODUR® 100-5 CN-RP
Eluent: acetonitrile – 100 mM sodium citrate pH 2.5 (15:85, v/v)
Flow rate: 1.0 ml/min, temperature 25 °C
Detection: UV, 270 nm, injection volume: 10 µl

Peaks:
1. Maleic acid
2. Norephedrine
3. Ephedrine
4. Acetaminophen
5. Chlorpheniramine
6. Brompheniramine

MN Appl. No. 119340



2 EC analytical columns NUCLEODUR® 100-3 CN-RP, 3µm

2

eluent in column acetonitrile, particle size 3µm. — *MACHEREY-NAGEL*

Type	Length mm	PK	Cat. No.
2 mm i.d.	50	1	**4.004 442**
3 mm i.d.	125	1	**4.004 441**
4 mm i.d.	150	1	**4.004 439**
4.6 mm i.d.	150	1	**4.004 440**

Guard columns for EC columns NUCLEODUR® 100-3 CN-RP, 3µm

MACHEREY-NAGEL

Type	PK	Cat. No.
for 2 and 3 mm i.d.	3	**4.004 663**
for 4 and 4.6 mm i.d.	3	**4.004 664**

Guard columns for EC columns require guard column adapter EC (Cat. No. 7.081 898)

1

1 EC analytical columns NUCLEODUR® 100-5 CN-RP, 5µm

eluent in column acetonitrile, particle size 5µm — *MACHEREY-NAGEL*

Type	Length mm	PK	Cat. No.
4 mm i.d.	125	1	**4.004 436**
4.6 mm i.d.	125	1	**4.004 437**
4.6 mm i.d.	150	1	**4.004 438**
4 mm i.d.	250	1	**4.004 434**
4.6 mm i.d.	250	1	**4.004 435**

Guard columns for EC columns NUCLEODUR® 100-5 CN-RP, 5µm

MACHEREY-NAGEL

Type	PK	Cat. No.
for 4mm and 4.6mm i.d.	3	**4.004 655**

Guard columns for EC columns require guard column adapter EC (Cat. No. 7.081 898)

EC analytical columns NUCLEODUR® 100-5 CN, 5µm

eluent in column *n*-heptane, particle size 5µm. — *MACHEREY-NAGEL*

Type	Length mm	PK	Cat. No.
4 mm i.d.	125	1	**4.004 432**
4.6 mm i.d.	125	1	**4.004 433**
4 mm i.d.	250	1	**4.004 430**
4.6 mm i.d.	250	1	**4.004 431**

Guard columns for EC columns NUCLEODUR® 100-5 CN, 5µm

MACHEREY-NAGEL

Type	PK	Cat. No.
for 4 and 4.6 mm i.d.	3	**4.004 654**

Guard columns for EC columns require guard column adapter EC (Cat. No. 7.081 898)

NUCLEODUR® NH2/NH2 -RP amino-modified high purity silica phase

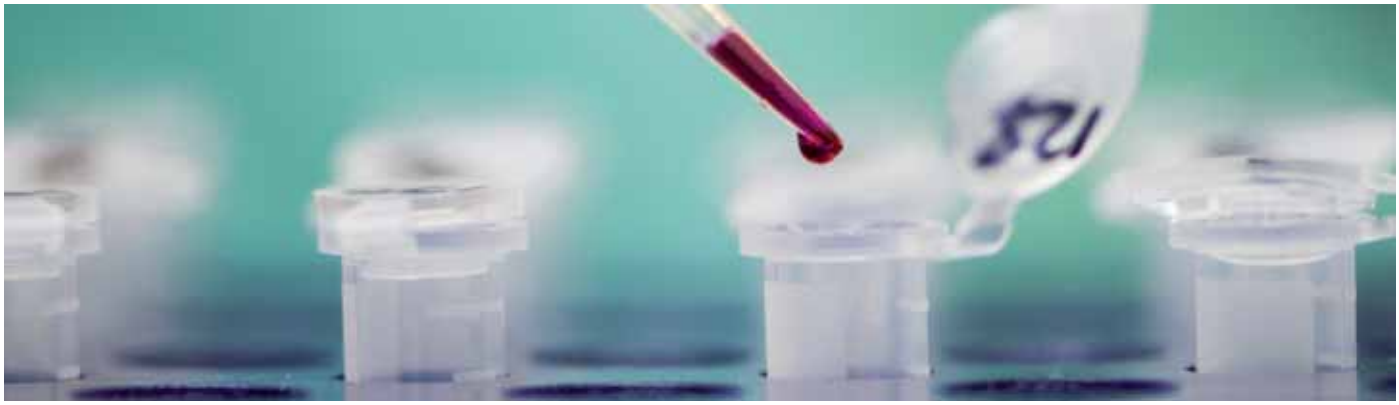
pore size 110 Å, particle sizes 3 and 5µm; 2.5%C; not endcapped - USP L8 — *MACHEREY-NAGEL*
multi-mode columns (RP and NP)

normal phase chromatography (NP) with hexan, dichloromethane or 2-propanol as mobile phase for polar compounds such as substituted anilines, esters, chlorinated pesticides

reversed phase chromatography (RP) of polar compounds like sugars in aqueous-organic eluent systems

ion exchange chromatography of anions and organic acids using common buffers and organic modifiers
stable against hydrolysis at low pH, working range pH 2-8, 100% stable in water, suitable for LC-MS

Ideal for:
polar compounds under RP conditions (sugars, DNA bases), hydrocarbons under NP conditions
Eluent in column is *n*-heptane for the NP mode - RP columns are delivered in acetonitrile - water. For changing the solvent system a rinsing step with THF may be necessary.

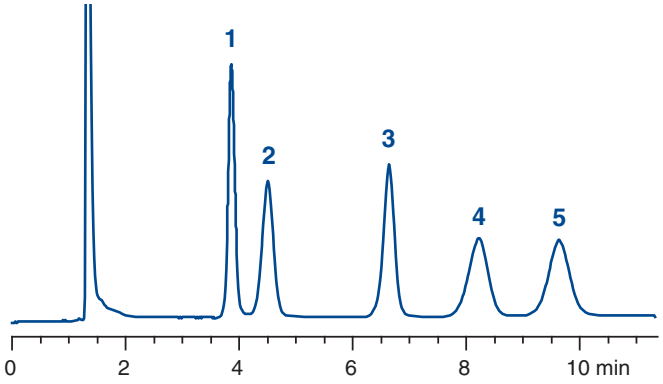


Reversed phase separation of sugars

Column: 250 x 4 mm NUCLEODUR® 100-5 NH_2-RP
Eluent: acetonitrile – water (79:21, v/v)
Flow rate: 2 ml/min
Detection: RI

Peaks:
1. Fructose
2. Glucose
3. Saccharose
4. Maltose
5. Lactose

MN Appl. No. 122160



1 EC analytical columns NUCLEODUR® 100-3 NH2-RP, 3µm

NEW!

1

eluent in column acetonitrile, particle size 3µm. *MACHEREY-NAGEL*

Type	Length mm	PK	Cat. No.
4,6 mm ID	150	1	**9.003 875**

Guard columns for EC columns NUCLEODUR® 100-3 NH2-RP, 3µm

NEW!

MACHEREY-NAGEL

Type	PK	Cat. No.
for 4.6 mm ID	1	**9.003 878**

Guard columns for EC columns require guard column adapter EC (Cat. No. 7.081 898)

EC analytical columns NUCLEODUR® 100-5 NH2-RP, 5µm

eluent in column acetonitrile, particle size 5µm. *MACHEREY-NAGEL*

Type	Length mm	PK	Cat. No.
4 mm i.d.	125	1	**4.004 538**
4.6 mm i.d.	125	1	**4.004 539**
4.6 mm i.d.	150	1	**4.004 540**
4 mm i.d.	250	1	**4.004 541**
4.6 mm i.d.	250	1	**4.004 542**

Guard columns for EC columns NUCLEODUR® 100-5 NH2-RP, 5µm

MACHEREY-NAGEL

Type	PK	Cat. No.
for 4mm and 4.6mm i.d.	3	**4.004 628**

Guard columns for EC columns require guard column adapter EC (Cat. No. 7.081 898)

EC analytical columns NUCLEODUR® 100-5 NH2, 5µm

eluent in column *n*-heptane, particle size 5µm. *MACHEREY-NAGEL*

Type	Length mm	PK	Cat. No.
4 mm i.d.	125	1	**4.004 533**
4.6 mm i.d.	125	1	**4.004 534**
4.6 mm i.d.	150	1	**4.004 535**
4 mm i.d.	250	1	**4.004 536**
4.6 mm i.d.	250	1	**4.004 537**

Guard columns for EC columns NUCLEODUR® 100-5 NH2, 5µm

MACHEREY-NAGEL

Type	PK	Cat. No.
for 4 and 4.6 mm i.d.	3	**4.004 627**

Guard columns for EC columns require guard column adapter EC (Cat. No. 7.081 898)

Unmodified NUCLEODUR® for normal phase separations

totally spherical high purity silica - USP L3 pore size 110 Å, pore volume 0.9ml/g, surface (BET) 340m²/g, density 0.47g/ml, pressure stability 800 bar, pH stability 2 - 8; available particle sizes 3µm and 5µm; larger particles (10, 12, 16, 20 , 30 and 50µm) for preparative applications are available as bulk materials. *MACHEREY-NAGEL*

1

1 EC analytical columns NUCLEODUR® 100-3 SioH (unmodified), 3µm

NEW!

particle size 3µm *MACHEREY-NAGEL*

Type	Length mm	PK	Cat. No.
4.6 mm ID	150	1	**9.003 876**

Guard columns for EC columns NUCLEODUR® 100-3 SioH (unmodified), 3µm

NEW!

MACHEREY-NAGEL

Type	Length mm	PK	Cat. No.
for 4.6 mm i.d.	8	3	**4.004 606**

Guard columns for EC columns require guard column adapter EC (Cat. No. 7.081 898)

EC analytical columns NUCLEODUR® 100-5 SioH (unmodified), 5µm

particle size 5µm. *MACHEREY-NAGEL*

Type	Length mm	PK	Cat. No.
4.6 mm i.d.	150	1	**4.004 374**
4 mm i.d.	250	1	**4.004 372**
4.6 mm i.d.	250	1	**4.004 373**

Guard columns for EC-columns NUCLEODUR® 100-5 SioH (unmodified), 5µm

MACHEREY-NAGEL

Type	PK	Cat. No.
for 4 and 4.6 mm i.d.	3	**4.004 623**

Guard columns for EC columns require guard column adapter EC (Cat. No. 7.081 898)

2

2 VarioPrep preparative columns NUCLEODUR® 100-5 SioH (unmodified), 5µm

particle size 5µm. *MACHEREY-NAGEL*

Type	Length mm	PK	Cat. No.
10 mm i.d.	250	1	**4.004 743**

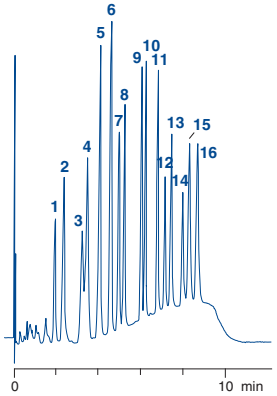
NUCLEOSIL® 100-5 C18 PAH special octadecyl phase for PAH analysis

base material NUCLEOSIL® silica, particle size 5µm, pore size 110 Å; polymeric coating - USP L1; eluent in column acetonitrile/water 70:30 *MACHEREY-NAGEL*
allows efficient gradient separation of the 16 PAH in accordance with EPA
detection of the separated PAH by UV (250 to 280nm), with diode array or with fluorescence detection at different wavelegths for excitation and emission (acenaphthylene cannot be analysed with fluorescence detection).

Rapid separation of 16 PAH according to EPA

Column: 50 x 4 mm NUCLEOSIL® 100-5 C_{18} PAH
Eluents: A) water; B) acetonitrile
Gradient: from 55 to 100 % B in 2.5 min; then 3.5 min at 100 % B; finally in 0.1 min from 100 to 55 % B
Flow rate: 1 ml/min; pressure 25 – 30 bar
Temperature: 25 °C
Detection: UV, 260 nm
Injection volume: 10 µl

Peaks:
1. Naphthalene
2. Acenaphthylene
3. Acenaphthene
4. Fluorene
5. Phenantrene
6. Anthracene
7. Fluoranthene
8. Pyrene
9. Benz[a]anthracene
10. Chrysene
11. Benzo[b]fluoranthene
12. Benzo[k]fluoranthene
13. Benzo[a]pyrene
14. Dibenz[ah]anthracene
15. Benzo[ghi]perylene
16. Indeno[1,2,3-cd]pyrene



MN Appl. No. 115030

EC analytical columns NUCLEOSIL® 100-5 C18 PAH, 5µm

octadecyl phase PAH, particle size 5µm. *MACHEREY-NAGEL*

Type	Length mm	PK	Cat. No.
4 mm ID	50	1	**4.002 491**
3 mm ID	150	1	**4.002 493**
4 mm ID	150	1	**4.002 494**
2 mm i.d.	250	1	**7.089 855**
3 mm ID	250	1	**4.002 372**
4 mm ID	250	1	**4.002 373**
4,6 mm ID	250	1	**4.002 374**

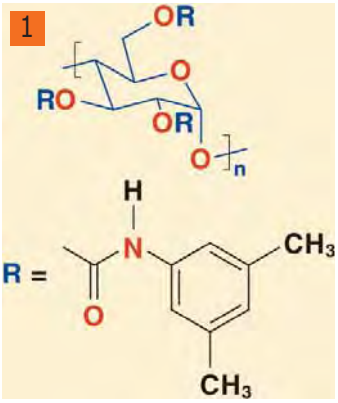
Guard columns for EC columns NUCLEOSIL® 100-5 C18 PAH, 5µm

MACHEREY-NAGEL

On request.

1 HPLC columns for enantiomer separation

NUCLEOCEL *ALPHA* enantiomer separation based on amylose derivatives *MACHEREY-NAGEL*



base material silica,
chiral selector amylose-(3.5-dimethylphenylcarbamate) - USP L51
similar phases: Chiralpak® AD, Kromasil®, AmyCoat®, Europak 01
high resolution type (S), 5µm particle size, allows use of shorter columns (150mm) for faster separations, pressure stability up to ~ 150 bar
(2000 psi)

NUCLEOCEL *ALPHA* for normal phase applications:
eluent in column *n*-heptane - propanol-2 (90:10, v/v)
typical eluents are heptane - propanol mixtures

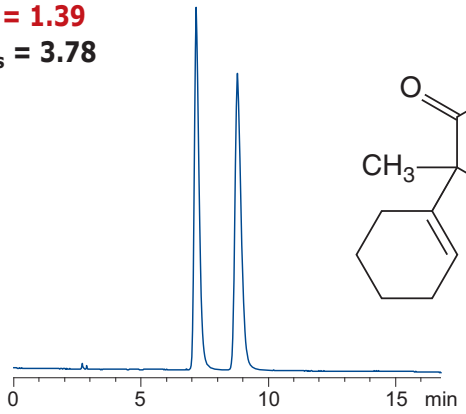
NUCLEOCEL *ALPHA-RP* for reversed phase applications:
eluent in column acetonitrile - water (50:50), v/v)
designed for use either in polar organic mode or with eluents containing high concentrations of chaotropic salts such as perchlorate

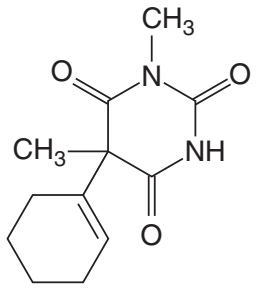
recommended application: pharmaceutically active compounds, chiral pollutants (e. g. herbicides, PCB), chiral compounds in food (dyes, preservatives), chiral catalysts and bioorganic compounds

Enantiomer separation of hexobarbital

Column: 250 x 4.6 mm NUCLEOCEL *ALPHA S*
Eluent: *n*-heptane – 2-propanol (80:20, v/v)
Flow rate: 1 ml/min
Temperature: 22 °C
Detection: UV, 210 nm
Injection volume: 5 µl
Concentration: 1 µg/µl

α = 1.39
R_s = 3.78





MN Appl. No. 121940

EC analytical columns NUCLEOCEL *ALPHA S*, 5µm

eluent in column n-heptane - propanol-2, particle size 5µm. *MACHEREY-NAGEL*

Type	Length mm	PK	Cat. No.
4,6 mm ID	150	1	**4.002 477**
4,6 mm ID	250	1	**4.002 478**

Guard columns for EC columns Nucleocel *ALPHA S*, 5µm

MACHEREY-NAGEL

Type	PK	Cat. No.
for 4,6 mm i.d	1	**4.002 509**

Guard columns for EC columns require guard column adapter EC (Cat. No. 7.081 898)

EC analytical columns NUCLEOCEL® *ALPHA-RP S*, 5µm

eluent in column acetonitrile - water, particle size 5µm — *MACHEREY-NAGEL*

Type	Length mm	PK	Cat. No.
4,6 mm ID	150	1	**4.002 479**
4,6 mm ID	250	1	**4.002 480**

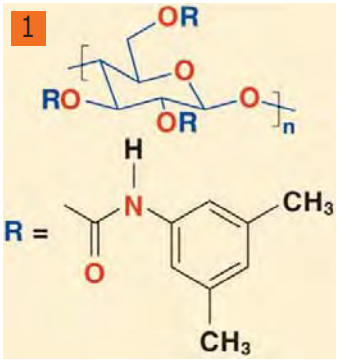
Guard columns for EC columns NUCLEOCEL® *ALPHA-RP S*, 5µm

MACHEREY-NAGEL

Type	PK	Cat. No.
for 4.6 mm i.d.	1	**4.002 510**

Guard columns for EC columns require guard column adapter EC (Cat. No. 7.081 898)

1



1 HPLC columns for enantiomer separation

NUCLEOCEL *DELTA* enantiomer separation based on cellulose derivatives — *MACHEREY-NAGEL*

base material silica,
chiral selector Cellulosetris-(3.5-dimethylphenylcarbamate) - USP L40
similar phases: Chiralcel® OD, Kromasil®, CelluCoat™, Eurocel® 01
standard particle size 10µm

S-Type for high resolution, allows use of shorter columns (150 mm) for faster separations,
pressure stability up to ~ 150 bar (2000 psi)

NUCLEOCEL *DELTA* for normal phase applications:
eluent in column *n*-heptane - propanol-2 (90:10, v/v)
typical eluents are heptane - propanol mixtures

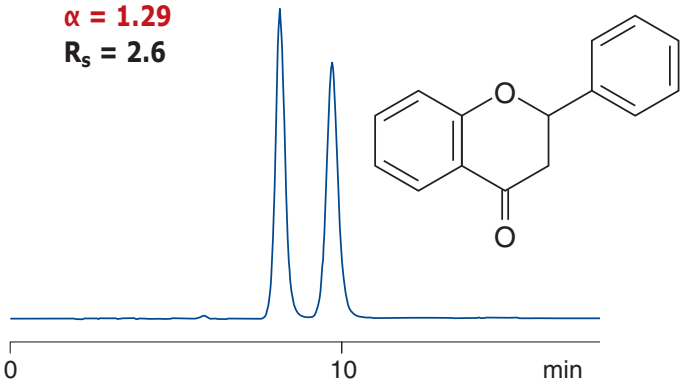
NUCLEOCEL *DELTA-RP* for reversed phase applications:
eluent in column acetonitrile - water (40:60), v/v)
designed for use either in polar organic mode or with eluents containing high concentrations of chaotropic salts such as perchlorate

recommended applications: pharmaceutically active compounds, chiral pollutants (e. g. herbicides, PCB), chiral compounds in food (dyes, preservatives), chiral catalysts and bioorganic compounds.

Enantiomer separation of flavanone

Column: 250 x 4.6 mm NUCLEOCEL *DELTA S*
Eluent: *n*-heptane – 2-propanol (90:10, v/v)
Flow rate: 1 ml/min
Temperature: 25 °C
Detection: UV, 254 nm
Injection volume: 5 µl
Concentration: 1 µg/µl

MN Appl. No. 121260



EC analytical columns NUCLEOCEL® *DELTA S*, 5µm

eluent in column *n*-heptane - propanol-2, particle size 5µm — *MACHEREY-NAGEL*

Type	Length mm	PK	Cat. No.
4,6 mm ID	150	1	**4.002 446**
4,6 mm ID	250	1	**4.002 445**

Guard columns for EC colums NUCLEOCEL® *DELTA S*, 5µm

MACHEREY-NAGEL

Type	PK	Cat. No.
for 4.6 mm i.d.	1	**4.002 511**

Guard columns for EC columns require guard column adapter EC (Cat. No. 7.081 898)

EC analytical columns NUCLEOCEL® *DELTA-RP S*, 5µm

eluent in column acetonitrile - water, particle size 5µm. *MACHEREY-NAGEL*

Type	Length mm	PK	Cat. No.
4,6 mm i.d.	150	1	**4.002 449**
4,6 mm i.d.	250	1	**4.002 448**

Guard columns for EC columns NUCLEOCEL® *DELTA-RP S*, 5µm

MACHEREY-NAGEL

Type	PK	Cat. No.
for 4.6 mm i.d.	1	**4.002 512**

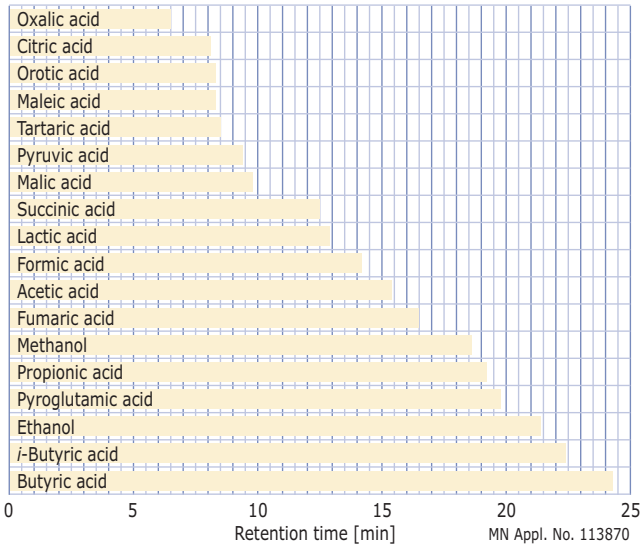
Guard columns for EC columns require guard column adapter EC (Cat. No. 7.081 898)

NUCLEOGEL® SUGAR 810 separation of sugars

sulphonated polystyrene/divinylbenzene resins in diffent ionic forms and RP chromatography *MACHEREY-NAGEL*
separation mechanism includes ion exclusion, ion exchange, size exclusion, ligand exchange as well as NP and RP chromatography
H^+ form: separation of sugars, sugar alcohols and organic acids - USP L17 - eluent in column 0.01 N H_2SO_4
Ca^{2+} form: separation of mono-, di- and oligosaccharides - USP L19
eluent in column water

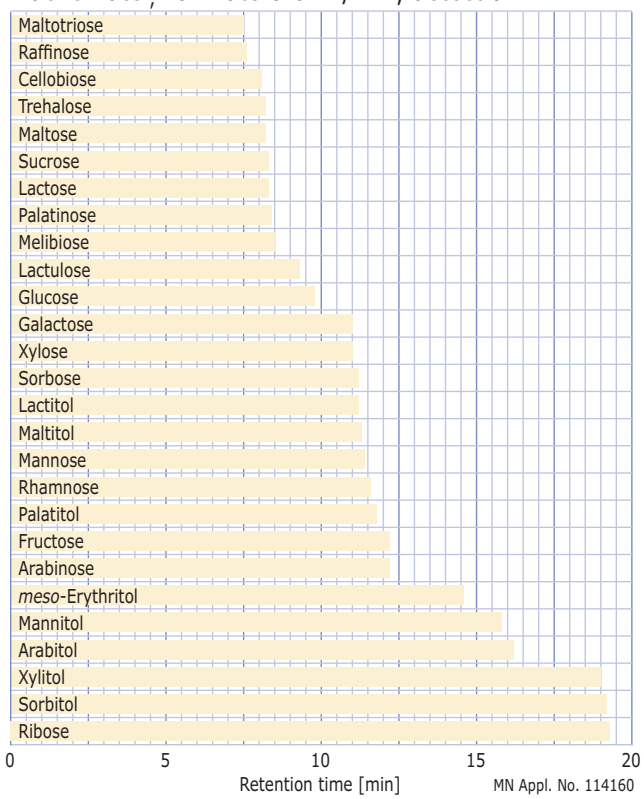
Organic acids and alcohols

Column: 300 x 7.8 mm NUCLEOGEL® SUGAR 810 H
Injection volume: 5 µl
Eluent: 5 mmol H_2SO_4
Flow rate: 0.6 ml/min
Temperature: 35 °C
Detection: RI



Sugars and sugar alcohols

Column: 300 x 7.8 mm NUCLEOGEL® SUGAR 810 Ca
Eluent water, flow rate 0.6 ml/min, detection RI



NUCLEOGEL® SUGAR 810 H

Valco type columns for separation of sugars, sugar alcohols and organic acids - USP L17 eluent in column 0.01N H_2SO_4 *MACHEREY-NAGEL*

Type	Length mm	PK	Cat. No.
7,8 mm ID	300	1	**4.002 276**

Guard columns for NUCLEOGEL® SUGAR 810 H columns

MACHEREY-NAGEL

Type	PK	Cat. No.
for 7,8 mm i.d.	2	**4.002 277**

This guard columns require the CC column holder 30mm (Cat. No. 4.002 762).

NUCLEOGEL® SUGAR 810 Ca

Valco type columns for separation of mono-, di- and oliogosaccharides - USP L19 eluent in column water.

MACHEREY-NAGEL

Type	Length mm	PK	Cat. No.
7,8 mm ID	300	1	**4.002 274**

Guard columns for NUCLEOGEL® SUGAR 810 Ca columns

MACHEREY-NAGEL

Type	PK	Cat. No.
for 7.8 mm i.d.	2	**4.002 275**

This guard columns require the CC column holder 30 mm (Cat. No. 4.002 762).

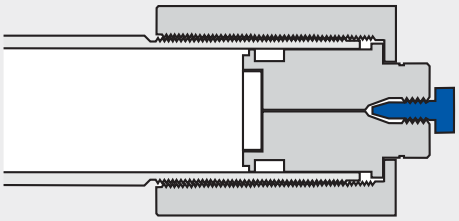
MN column systems

VarioPrep columns

MACHEREY-NAGEL

column system for preparative HPLC manufactured from stainless steel with two adjustable end fittings, allows compensation of a dead volume, which could result at the column inlet after some time of operation, without need for opening the column, packed with NUCLEODUR® and NUCLEOSIL® spherical silica.

Available standard dimensions of VarioPrep columns with axially adjustable end fitting

ID [mm]	Length [mm] 10*	15*	50	75	100	125	150	250	500	End fitting design
8	x		x		x	x	x	x		
10			x		x	x	x	x		
16	x		x		x	x	x	x		
21			x	x	x	x	x	x		
32		x			x		x	x		
40			x		x	x	x	x	x	
50		x			x		x	x		
80								x	x	

* 10 x 8, 10 x 16, 15 x 32 and 15 x 50 mm ID columns are used as guard columns and require adequate holders.

1

1 VarioPrep guard column holders and replacement parts

O-rings available on request.

MACHEREY-NAGEL

Description	PK	Cat. No.
VP guard column holder 8 mm for VarioPrep columns with 8 and 10 mm ID	1	**4.002 176**
VP guard column holder 16 mm for VarioPrep columns with 16 and 21 mm ID	1	**4.002 175**

1 Accessories for VarioPrep

MACHEREY-NAGEL

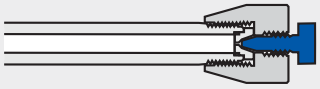
Description	PK	Cat. No.
VP plunger fitting 10 mm	1	**4.002 209**
VP nut 10 mm, without sealing ring	1	**4.002 210**
VP sealing element set 10 mm	1	**4.002 218**
VP sealing ring set 10 mm	1	**4.002 212**
VP MN Inert sealing combination 10 mm	1	**4.002 211**
VP plunger fitting 21 mm, without sealing ring	1	**4.002 215**
VP nut 21 mm	1	**4.002 216**
VP sealing element set 21 mm	1	**4.002 213**
VP sealing ring set 21 mm	1	**4.002 214**
VP MN Inert sealing combination 21 mm	1	**4.002 217**

MN column systems

EC standard columns for analytical HPLC *MACHEREY-NAGEL*

analytical column system manufactured from stainless steel M 8 outer threads on both ends combination of sealing element and very fine-meshed stainless steel screen, PTFE sealing ring and fitting adaptor column heads SW 12 with inner threads M8 x 0.75 and UNF 10-32, as built -in guard columns use ChromCart® guard column cartridges with 8mm lenght with the guard column adaptor EC, packed with NUCLEODUR® spherical silica.

Available standard dimensions of EC columns · please ask for availability of certain phases

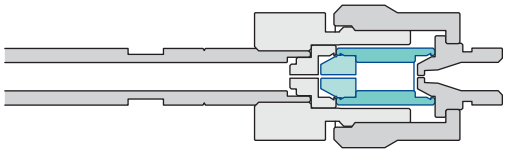
ID [mm]	Length [mm] 8*	20	30	50	75	100	125	150	200	250	300	End fitting design
2	–	x	x	x	x	x	x	x	x	x	x	
3	x	x	x	x	x	x	x	x	x	x	x	
4	x	x	x	x	x	x	x	x	x	x	x	
4,6	–	x	x	x	x	x	x	x	x	x	x	

* Please note that 3 mm ID guard column cartridges are applicable for 2 mm ID and 3 mm ID EC columns, while 4 mm ID guard column cartridges are also used for 4.6 mm ID EC columns.

Installation of the EC guard column adaptor (Cat.No. 7.081 898)




EC column with CC guard column



Accessories and replacement parts for EC columns

MACHEREY-NAGEL

Description	PK	Cat. No.
Guard column adapter EC	1	**7.081 898**
1/16" nut for connecting 1/16" capillaries	5	**4.002 179**
1/16" ferrule	5	**4.002 180**
1/16" end cap, plastic	4	**4.002 178**
EC fitting adaptor	1	**4.002 219**
EC column head (nut)	1	**4.002 220**
EC PTFE sealing ring	4	**4.002 221**
3-part sealing combination for EC columns	1	**4.002 222**

1 CHROMABOND® Flash cartridges for Biotage® systems

product range designed for use in Flash systems of Biotage AB *MACHEREY-NAGEL*
(Flash 12i™ and FlashMaster™) without additional connectors or capillaries

on request all column types listed below can be packed with any CHROMABOND® adsorbent (please note that other packings often result in differing adsorbent weights).

CHROMABOND® Flash RS columns for Teledyne Isco® systems (RS) on request.

Description	Column Length cm	Int. dia. mm	Capacity g	PK	Cat. No.
CHROMABOND® Flash FM 15/2 SiOH	9.0	15.80	2.0	50	**4.003 785**
CHROMABOND® Flash FM 25/5 SiOH	10.0	20.50	5.0	50	**4.003 792**
CHROMABOND® Flash FM 25/10 SiOH	10.0	20.50	10.0	50	**4.003 693**
CHROMABOND® Flash FM 70/10 SiOH	15.4	26.80	10.0	30	**4.003 787**
CHROMABOND® Flash FM 70/20 SiOH	15.4	26.80	20.0	30	**4.003 799**
CHROMABOND® Flash FM 70/25 SiOH	15.4	26.80	25.0	30	**4.003 793**
CHROMABOND® Flash FM 150/25 SiOH	17.0	38.20	25.0	20	**4.003 694**
CHROMABOND® Flash FM 150/50 SiOH	17.0	38.20	50.0	20	**4.003 789**
CHROMABOND® Flash FM 150/70 SiOH	17.0	38.20	70.0	10	**4.003 784**
CHROMABOND® Flash FM 15/2 C18 ec	9.0	15.80	2.0	50	**4.003 791**
CHROMABOND® Flash FM 25/5 C18 ec	10.0	20.50	5.0	20	**4.003 786**
CHROMABOND® Flash FM 70/10 C18 ec	15.4	26.80	10.0	20	**4.003 788**
CHROMABOND® Flash FM 150/50 C18 ec	17.0	38.20	50.0	10	**4.003 790**

Silica adsorbents for low pressure column chromatography

standard silica 60, pore size ~ 60 Å; pore volume ~ 0.75ml/g; spec. surface BET ~ 500m²/g. highly porous, amorphous silicic acid in the form of hard, opalescent particles, prepared by precipitation of water glass with sulphuric acid. For higher demands on the performance of column packings we recommend our high-purity irregular Polygoprep silicas. Silica FIA for the fluorescence indicator adsorption procedure for the determination of hydrocarbon groups in the testing of liquid fuels in accordance with DIN 51791 and ASTM D 1319-58T. The FIA method determines saturated hydrocarbons, olefins and aromatic hydrocarbons of a sample chromatographically by adsorption and desorption in a column filled with FIA silica, in the presence of a fluorescent dye mixture. *MACHEREY-NAGEL*

Description	Particle size	Weight kg	PK	Cat. No.
Silica 60, 0.015 - 0.04 mm		1	1	**4.004 999**
Silica 60, 0.025 - 0.04 mm		1	1	**4.004 948**
Silica 60, 0.04 - 0.063 mm	230 - 400 mesh	1	1	**4.004 968**
Silica 60 M, 0.04 - 0.063 mm	230 - 400 mesh	1	1	**4.004 971**
Silica 60, 0.05 - 0.1 mm	130 -270 mesh	1	1	**4.004 974**
Silica 60, 0.05 - 0.2 mm	70 -270 mesh	1	1	**4.004 954**
Silica 60, 0. 063 - 0.2 mm	70 - 230 mesh	1	1	**4.004 957**
Silica 60, < 0.063 mm	+ 230 mesh	1	1	**4.004 977**
Silica 60, < 0.08 mm	+ 190 mesh	1	1	**4.004 951**
Silica 60, 0.1 - 0.2 mm	70 - 130 mesh	1	1	**4.004 960**
Silica 60, 0.2 - 0.5 mm	35 - 70 mesh	1	1	**4.004 962**
Silica 60, 0.5 - 1.0 mm	18 - 35 mesh	1	1	**4.004 965**
Silica 60, 0.015 - 0.04 mm		5	1	**4.005 001**
Silica 60, 0.025 - 0.04 mm		5	1	**4.004 950**
Silica 60, 0.04 - 0.063 mm	230 - 400 mesh	5	1	**4.004 970**
Silica 60 M, 0.04 - 0.063 mm	230 - 400 mesh	5	1	**4.004 973**
Silica 60, 0.05 - 0.1 mm	130 - 270 mesh	5	1	**4.004 976**
Silica 60, 0.05 - 0.2 mm	70 - 270 mesh	5	1	**4.004 956**
Silica 60, 0. 063 - 0.2 mm	70 - 230 mesh	5	1	**4.004 959**
Silica 60, < 0.063 mm	+ 230 mesh	5	1	**4.004 979**
Silica 60, < 0.08 mm	+ 190 mesh	5	1	**4.004 953**
Silica 60, 0.1 - 0.2 mm	70 - 130 mesh	5	1	**4.004 961**
Silica 60, 0.2 - 0.5 mm	35 - 70 mesh	5	1	**4.004 964**
Silica 60, 0.5 - 1.0 mm	18 - 35 mesh	5	1	**4.004 967**
Silica 60, 0.015 - 0.04 mm		25	1	**4.005 000**
Silica 60, 0.025 - 0.04 mm		25	1	**4.004 949**
Silica 60, 0.04 - 0.063 mm	230 - 400 mesh	25	1	**4.004 969**
Silica 60 M, 0.04 - 0.063 mm	230 - 400 mesh	25	1	**4.004 972**
Silica 60, 0.05 - 0.1 mm	130 - 270 mesh	25	1	**4.004 975**
Silica 60, 0.05 - 0.2 mm	70 - 270 mesh	25	1	**4.004 955**
Silica 60, 0. 063 - 0.2 mm	70 - 230 mesh	25	1	**4.004 958**
Silica 60, < 0.063 mm	+ 230 mesh	25	1	**4.004 978**
Silica 60, < 0.08 mm	+ 190 mesh	25	1	**4.004 952**
Silica 60, 0.2 - 0.5 mm	35 - 70 mesh	25	1	**4.004 963**
Silica 60, 0.5 - 1.0 mm	18 - 35 mesh	25	1	**4.004 966**
Silicia FIA fine	0,071 - 0,16 mesh	1	1	**4.004 980**
Silicia FIA coarse	0,071 - 0,63 mesh	1	1	**4.004 981**

Florisil® adsorbent for column chromatography

hard granular magnesia silica gel: MgO 15.5±0.5% - SiO_2 84.0±0.5% - Na_2SO_4 <= 1.0%; 60/100 mesh
typical applications: sample preparation (SPE); clean-up of pesticide residues, separation of chlorinated pesticides, extraction of steroids, sex hormones, antibiotics, lipids etc.

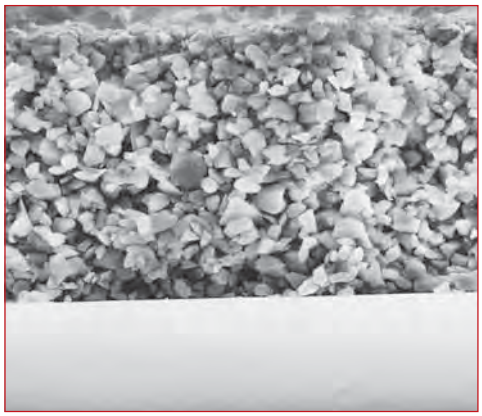
MACHEREY-NAGEL

Description	Particle size	Weight kg	PK	Cat. No.
Florisil® standard 60 / 100 mesh	0.15 / 0.25 mm	1	1	**6.232 873**
Florisil® standard 60 / 100 mesh	0.15 / 0.25 mm	5	1	**4.005 002**

MN ready-to-use layers for TLC

Advantages

- **continuous high quality**
  guaranteed by stringent production control including standardised lot tests, surface checks for roughness or cracks as well as hardness and adherence checks
- **comprehensive range of phases for TLC / HPTLC**
  there is no universal TLC plate which meets all possible types of analyses. Our versatile range of TLC ready-to-use layers covers many different types of applications.
- **immediately ready for chromatographic separation**
  coatings or impregnations are not necessary
- **homogeneous, smooth, well adhering layers**
  an important criterium especially for reproducible quantitative evaluation



Electron microscopic photograph of a cross section through a glass plate with silica layer (magnification x 500)

1 2 Chromatographic columns with Frit, PTFE- /or Valve Stopcock

NEW!

Length mm	Int. dia. mm	Capacity ml	Description	PK	Cat. No.
200	10	15	without frit NS 14/23	1	**4.008 398**
400	20	125	without frit NS 29/32	1	**4.008 399**
600	30	430	without frit NS 29/32	1	**4.008 400**
200	10	15	with frit (P=0) NS 14/23	1	**4.008 401**
200	15	35	with frit (P=0) NS 14/23	1	**4.008 403**

3 4 5 Chromatographic columns with Frit, PTFE- /or Valve Stopcock

NEW!

DURAN® tubing.
Chromatography columns with sintered frit, porosity 0.
Available in three versions:
- with beaded rim and PTFE stopcock
- with NS socket and PTFE stopcock
- with NS socket and valve stopcock (bore 0 - 2.5mm)

Lenz

Length mm	Int. dia. mm	Capacity ml	Description	Stopcock	PK	Cat. No.
200	15	35	beaded rim	PTFE	1	**6.205 017**
400	20	125	beaded rim	PTFE	1	**6.202 416**
600	30	430	beaded rim	PTFE	1	**6.202 417**
800	40	1000	beaded rim	PTFE	1	**6.202 418**
100	10	8	socket NS 14/23	PTFE	1	**6.225 859**
200	10	15	socket NS 14/23	PTFE	1	**9.025 912**
300	10	23	socket NS 14/23	PTFE	1	**9.025 913**
200	15	35	socket NS 14/23	PTFE	1	**9.025 914**
400	20	125	socket NS 29/32	PTFE	1	**6.203 961**
600	30	430	socket NS 29/32	PTFE	1	**6.303 297**
200	15	35	socket NS 29/32	Valve	1	**6.223 574**

Stands and fittings - please see page 148

1

1 Chromatography columns, ground glass joint, PTFE Stopcock

Made of DURAN® tubing. *Lenz*
With PTFE stopcock.
With NS ground socket neck as indicated
Indents are moulded in above the stopcock for holding cotton wool plug supports.

Length mm	Int. dia. mm	Capacity ml	Description	PK	Cat. No.
200	10	15	with NS 14 / 23 socket	1	**9.025 932**
400	20	125	with NS 29 / 32 socket	1	**9.025 934**
600	30	430	with NS 29 / 32 socket	1	**9.025 936**

2

2 Ion exchange papers

A thin (0.20mm) DEAE cellulose paper-a weakly basic anion exchanger with diethylaminoethyl functional groups. The ion exchange capacity is 1.7µeq/cm2 and flow rate is 95mm/30 min. For use with reverse transcriptase assays and DNA polymerase. *GE Healthcare*

Grade	Dia. mm	PK	Cat. No.
DE81	23	400	**9.950 335**

3

3 Glass wool

Extra fine. In packs as outlined below.

Capacity g	PK	Cat. No.
30	1	**9.114 303**
1000	1	**9.114 310**

4

4 Quartz wool

Silica. Fibre thickness 4µm to 12µm. Supplied in packs as outlined below. *proQuarz GmbH*

Capacity g	PK	Cat. No.
25	1	**9.114 321**
100	1	**9.114 330**
500	1	**9.114 331**

5

5 HPLC bottles, DURAN® complete system 4-port screw cap

For sterile transfer of media or for feeding solvent to HPLC instruments. The bottle is pressure/vacuum resistant from -1 to +1.5 bar (tested by TÜV in accordance with EN 1596, GS marked). Complete with a 4-port screw cap (autoclavable, reusable) made from PP, 4 connection screw caps (black, M8 thread) and silicone seal. Suitable for tube diameters of 1.6mm and 3.2mm. Spare parts are available individually. Further connection system components for the GL45 thread are available upon request (Tubing not included). Neutral/Type I glass acc. to USP/EP. With Retrace Code (Batch Identification), with certificate available via the internet. *DURAN Group*

Capacity ml	PK	Cat. No.
500	1	**9.072 526**
1000	1	**9.072 525**

1 Flexible connecting system for DURAN® GL 45 flasks (HPLC)

DURAN Group

Materials used: PP and PTFE. Flexible modular system. Four different tube diameters (1.6mm; 3.0mm; 3.2mm and 6.0mm) can be connected. Sterile pressure equalisation is possible through use of a membrane filter. Unused ports can be provided with a blind cap. Typical applications: safe transfer of liquid media within a closed and sterile system (evaporation is reduced). Temperature resistant up to max. 140°C.

Ordering example
You would like to fit two bottles with a 3-port connection system. You would like to work with two different tube diameters (1.6 mm and 3 mm) and pressure equalisation. Consequently, you need the following individual components:
Screw cap GL 45 3-port (Art. No. 7.623 018) 1 pack (2 per pack);
Screw cap GL 14 (Art. No. 6.227 781) 2 packs (2 per pack);
Insert for screw cap GL14 1.6mm inner diameter (Art. No. 6.229 494) 2 packs (1 per pack);
Insert for screw cap GL14 3.0mm inner diameter (Art. No. 6.229 495) 2 packs (1 per pack);
Pressure equalisation set (complete) (Art. No. 6.228 023) 2 packs (1 per pack).

Description	PK	Cat. No.
Scew cap GL 45, 2 port x GL 14	1	**6.227 780**
Screw cap GL 45, 3 port x GL 14	1	**7.623 018**
Screw cap GL 14 for tubing connector	1	**6.227 781**
Liner for GL 14 screw cap, 1.6mm i.d. hole	1	**6.229 494**
Liner for GL 14 screw cap, 3mm i.d. hole	1	**6.229 495**
Liner for GL 14 screw cap, 3.2mm i.d. hole	1	**6.230 213**
Liner for GL 14 screw cap, 6mm i.d. hole	1	**6.227 782**
Screw cap, GL 14, red	1	**7.623 838**
Pressure equalising set, 0.2 µm filter, for 2- / 3-Port screw cap	1	**6.228 023**
Replacement 0.2 µm membrane filter for pressure equalising set	1	**6.230 844**
Bottle 1000 ml, GL 45, DURAN® pressure resistant up to +1,5 bar	1	**9.971 704**
Bottle 500 ml, GL 45, DURAN® pressure resistant up to +1,5 bar	1	**9.071 707**

2 Accessories for connecting system for DURAN® GL 45 bottles, DURAN®

DURAN Group

Description	PK	Cat. No.
Screw cap HPLC GL 45, 4 Port complete	1	**6.226 328**
Spare set for HPLC screw cap	1	**6.226 329**
Pressure equilization, 0.2µm for 4-Port-cap, incl. membrane filter	1	**6.226 915**
Spare membrane filter for pressure equilization, 0,2 µm	1	**6.230 844**
Bottle 1000 ml, GL 45, DURAN® pressure resistant up to +1,5 bar	1	**9.971 704**
Bottle 500 ml, GL 45, DURAN® pressure resistant up to +1,5 bar	1	**9.071 707**

Scrubber Adapter for Bottles, PTFE

BOLA

Consisting of PTFE body with connecting nut and two lateral GL18 threaded necks, a 300mm long FEP inlet tube and a gas distributor with frit. Easy in- and outlet of gas by means of rigid-walled tubing (e.g. PTFE) which can be connected to the threaded necks using Bola Laboratory Screw Joints. Elastic tubing can be connected by means of hose connectors. Inlet tube can be individually shortened. Special feature: the body of the adapter can be turned independently from the connecting nut. This means, that the completely assembled adaptor can be removed and fixed onto another bottle without the risk of disarranging the tubing. Suitable for bottles from Duran Group (formerly Schott, Mainz) with GL45 or GLS80 threads and capacities between 100ml and 5000ml.

9.110 310

9.110 311

Thread	Tube length mm	PK	Cat. No.	
GL45	300	1	**9.110 310**	3
GLS 80	300	1	**9.110 311**	4

Safety Caps

Scat

The integral air filter blocks hazardous vapours and cleans the inflowing air from dust and dirt particles. With various connectors for capillaries and tubes. Safety Caps are available for most common glass bottles (e.g. thread size GL45). They can be customised for other container sizes by using different adapters. Especially recommended for HPLC use: Solvents stay clean and components of solvent mixtures can not evaporate. Optimum protection against health hazards caused by evaporation and insufficient sealing.

Key advantages:
- no evaporation of hazardous gases
- no contamination of solvents
- no crimping of connection tubing
- easy container exchange
- no air intake (HPLC)
- cost efficiency (save expensive solvents by avoiding evaporation)

Safety Caps

Scat

Safe solvent supply. With integral air filter vent. For maximum efficiency, we recommend that the vent is changed every 6 months. The filter membrane absorbs dust and dirt particles to protect your solvent reservoirs. The vent is universally suitable for all Safety Caps. It also works with your current Safety Caps, simply replace the old vent with the new one.

Description	Connections	PK	Cat. No.	
Safety Caps I, GL45	1 capillary (3.2mm o.d.)	1	**9.139 850**	1
Safety Caps II, GL45	2 capillaries (3.2mm o.d.)	1	**9.139 851**	
Safety Caps III, GL45	3 capillaries (3.2mm o.d.)	1	**9.139 852**	
Safety Caps IV, GL45	4 capillaries (3.2mm o.d.)	1	**9.139 853**	2
Safety Caps VI, GL45	6 capillaries (3.2mm o.d.)	1	**9.139 854**	
Safety Caps I, with 1 stopcock, GL45	1 capillary (3.2mm o.d.)	1	**9.139 855**	
Safety Caps II, with 2 stopcocks, GL45	2 capillaries (3.2mm o.d.)	1	**9.139 856**	
Safety Caps III, with 3 stopcocks, GL45	3 capillaries (3.2mm o.d.)	1	**9.139 857**	
Safety Caps IV, with 4 stopcocks, GL45	4 capillaries (3.2mm o.d.)	1	**9.139 858**	
Safety Caps VI, with 6 stopcocks, GL45	6 capillaries (3.2mm o.d.)	1	**9.139 859**	
Safety Caps II, combined, GL45 (1with stopcock / 1 without stopcock)	2 capillaries (3.2mm o.d.)	1	**9.139 860**	
Safety Caps III, combined, GL45 (2 with stopcocks / 1 without stopcock)	3 capillaries (3.2mm o.d.)	1	**9.139 861**	
Safety Caps I, for 3/16", GL45	1 capillary (3/16" o.d.)	1	**9.139 862**	
Safety Caps II for NS 29/32 bottles	2 capillaries (3.2mm o.d.)	1	**9.139 863**	

1

9.139 850

2

9.139 853

3

3 SafetyCaps Basic fire-resistant

Scat

For GL45 necked solvent reservoirs in HPLC devices
- fire-resistant
- orange
- optionally available with 1 to 6 connectors

Description	Connections	PK	Cat. No.
SafetyCap I GL45	1 x connector 3.2mm o.d.	1	**4.005 770**
SafetyCap II GL45	2 x connector 3.2mm o.d.	1	**4.005 780**
SafetyCap III GL45	3 x connector 3.2mm o.d.	1	**4.005 781**
SafetyCap IV GL45	4 x connector 3.2mm o.d.	1	**4.005 776**
SafetyCap VI GL45	6 x connector 3.2mm o.d.	1	**4.005 779**

E & OE.

1 SafetyCapsBasic with shutoff and fire-resistant

For GL45-necked, solvent reservoirs in HPLC devices *Scat*
- with shutoff
- fire-resistant
- orange
- optionally available with 1 to 6 connectors

Description	Connections	PK	Cat. No.
SafetyCap I GL45	1 x connector 3.2mm o.d. with shutoff	1	**4.005 772**
SafetyCap II GL45	2 x connectors 3.2mm o.d. each with shutoff	1	**4.005 785**
SafetyCap II GL45	3 x connectors 3.2mm o.d. each with shutoff	1	**4.005 786**
SafetyCap IV GL45	4 x connectors 3.2mm o.d. each with shutoff	1	**4.005 777**
SafetyCap VI GL45	6 x connectors 3.2mm o.d. each with shutoff	1	**4.005 778**

2 Pressure relief valve for SafetyCaps

Pressure relief valve for SafetyCaps, with integral air filter. *Scat*
The valve opens when the HPLC pump is operated, and allows air to flow into the bottle - this prevents a vacuum buiding up in the bottle. As soon as the pump stops, the membrane immediately seals shut and no dangerous solvent vapours can escape.

Description	PK	Cat. No.
Pressure relief valve for SafetyCaps	1	**9.139 864**
Pressure relief valve for SafetyCaps (refill pack)	10	**4.005 886**

3 Fire-resistant pressure relief valve, orange, for SafetyCaps

The valve opens when the HPLC pump is operated, and allows air to flow into the bottle - this prevents vacuum building up within the bottle. As soon as the pump stops, the membrane immediately seals shut and no dangerous solvent vapours can escape. *Scat*

Description	PK	Cat. No.
pressure relief valve SafetyCaps, with integral air filter	1	**4.005 769**

SafetyWasteCaps

For safe disposal of liquid waste. Safety Waste Caps have a connection for exhaust vent filter. The exhaust vent filter absorbs 99% of all volatile substances that can evaporate from the containers during solvent disposal. For optimum protection of health and environment. Safety Waste Caps are manufactured of pure PTFE and HDPE, ensuring maximum chemical resistance against organic solvents and other aggressive chemicals. *Scat*

Please order exhaust vent filter separately.

Thread	Connections	PK	Cat. No.	
GL45	3 connectors Ø 2.3/3.2mm o.d.	1	**9.139 865**	1
GL45	2 connectors Ø 2,3/3.2mm o.d., 1 tubing Ø 6.4mm i.d.	1	**9.139 866**	2
GL80	4 connectors Ø 2.3/3.2mm o.d., 1 tubing Ø 6.4mm i.d.	1	**9.139 869**	

1

9.139 865

2

9.139 866

3 SafetyWasteCaps fire-resistant, orange

For GL45 necked, solvent reservoirs in HPLC systems. Stopper systems - made up of a cap and safety funnel (on request) - offer great flexibility in the area of application and use. Through the use of pure PTFE and HDPE, SafetyWasteCaps are resistant to aggressive media, e.g. organic solvents, acids and bases. *Scat*

Description	Description	PK	Cat. No.
SafetyWasteCap GL45	1 x safety funnel with mesh sieve, 1 x connector 2.3/3.2mm o.d. 1 x connection tubing 6.4mm i.d.	1	**4.005 773**
SafetyWasteCap GL45	2 x connectors 2.3/3.2mm o.d. 1 x connector 6.4mm i.d.	1	**4.005 788**
SafetyWasteCap GL45	3 x connectors 2.3/3.2mm o.d.	1	**4.005 783**
SafetyWasteCap GL45	4 x connectors 2.3/3.2mm o.d. 1 x connector 6.4mm i.d.	1	**4.005 787**

3

4

4 SafetyWasteCaps, B-thread

B-thread with tube connection. *Scat*

Thread	Connections	PK	Cat. No.
53B	4 x connector 2.3/3.2mm o.d. 1 x connector 6.4 mm i.d.	1	**4.005 441**
83B	4 x connector 2.3/3.2mm o.d. 1 x connector 6.4mm i.d.	1	**4.005 438**

1 Safety Waste Caps S-thread with tube connection

Scat

- different thread diameters
- optional 1 to 4 connections
- exhaust filter
- safety funnel
- level control

Thread	Connections	PK	Cat. No.
S51	2 x connectors 2.3 / 3.2mm o.d., 1 x connector 6.4mm i.d.	1	**4.005 583**
S55	2 x connectors 2.3 / 3.2mm o.d., 1 x connector 6.4mm i.d.	1	**4.005 584**
S60/61	3 x connectors 2.3 / 3.2mm o.d.	1	**9.139 867**
S60/61	2 x connectors 2.3 / 3.2mm o.d., 1 x connector 6.4mm i.d.	1	**9.139 868**
S70/71	2 x connectors 2.3 / 3.2mm o.d., 1 x connector 6.4mm i.d.	1	**4.005 585**
S90	4 x connectors 2.3 / 3.2mm o.d., 1 x connector 6.4mm i.d.	1	**9.139 870**

1

2 Safety Waste Caps with safety funnel

Scat

Press the locking mechanism to open the funnel when disposing liquid waste. When releasing, the funnel will close automatically and seal the container safely. With integral exhaust filter, for optimum protection against hazardous vapours and gases. Each cap has different connectors for multiple capillaries.

Thread	Connections	PK	Cat. No.
S 50	2 x connectors 2.3/3.2mm o.d.	1	**9.139 874**
S 55	2 x connectors 2.3/3.2mm o.d.	1	**9.139 875**
S 60 / 61	2 x connectors 2.3/3.2mm o.d.	1	**9.139 876**
S 65	4 x connectors 2.3/3.2mm o.d.	1	**9.139 877**
S 70 / 71	4 x connectors 2.3/3.2mm o.d.	1	**9.139 878**
83B	4 x connectors 2.3/3.2mm o.d.	1	**9.139 879**
S 90	4 x connectors 2.3/3.2mm o.d.	1	**9.139 880**
S 95	4 x connectors 2.3/3.2mm o.d.	1	**9.139 881**

2

3 4 Safety Waste Caps with mechanical level control

Scat

- proven SCAT technology for SafetyWasteCaps
- different thread diameters
- choice of 1 to 4 connections
- exhaust filter
- safety funnel
- mechanical level control
- option: SafeLock
- supplied as a set with connectors

Thread	Connections	PK	Cat. No.
S55	2 x connectors 2.3/3.2mm o.d., 1 x connector 6.4 mm i.d.	1	**4.005 612**
S60/61	2 x connectors 2.3/3.2mm o.d., 1 x connector 6.4 mm i.d.	1	**4.005 613**
S90	4 x connectors 2.3/3.2mm o.d., 1 x connector 6.4 mm i.d.	1	**4.005 616**

3

4

1

1 Fittings and Ferrules for Safety Waste Caps

Scat

Description	PK	Cat. No.
PP Fittings, universal	5	**4.005 944**
PP Fittings, universal	10	**9.139 884**
PTFE ferrules, 1.6mm i.d.	5	**4.005 941**
PTFE ferrules, 1.6mm i.d.	10	**9.139 885**
PTFE ferrules, 2.3mm i.d.	5	**4.005 942**
PTFE ferrules, 2.3mm i.d.	10	**9.139 886**
PTFE ferrules, 3.2mm i.d.	5	**4.005 943**
PTFE ferrules, 3.2mm i.d.	10	**9.139 887**

2

2 PTFE fitting with integral ferrule

Scat

Description	PK	Cat. No.
for tubing 1.6mm o.d.	5	**4.005 938**
for tubing, 1.6mm o.d.	10	**4.005 444**
for tubing 2.3mm o.d.	5	**4.005 939**
for tubing, 2.3mm o.d.	10	**4.005 445**
for tubing 3.2 mm o.d.	5	**4.005 940**
for tubing, 3.2mm o.d.	10	**4.005 446**
for tubing, 4.76mm ($^{3}/_{16}$") o.d.	1	**4.005 448**
for tubing, 6.35mm (¼") o.d.	1	**4.005 447**

3

3 PTFE-Plugs

Closure screwplugs

Scat

For	PK	Cat. No.
standard capillary connectors 3.2mm i.d., PTFE	5	**4.005 946**
standard capillary connectors 3.2mm i.d., PTFE	10	**4.005 881**
standard capillary connectors 3.2mm i.d., PTFE	50	**4.005 947**
connectors, 4.76mm (3/16") i.d., PTFE	5	**4.005 945**
connectors, 4.76mm (3/16") i.d., PTFE	10	**4.005 880**
connectors 6.35mm i.d., PTFE	1	**4.005 883**
exhaust air filter connector	1	**4.005 504**

Side collectors for Safety Waste Caps

Side collectors for tube connectors.

Scat

Description	PK	Cat. No.
2 x connectors 3.2mm o.d., 1 x tube 6.4 i.d.	1	**4.005 859**
3 x tube 6.4mm i.d.	1	**4.005 864**
2 x tube 6.4mm i.d.	1	**4.005 865**
3 x connectors 3.2mm o.d.	1	**9.139 888**

4

4 Collectors for Safety Waste Caps

With fittings and ferrules 3.2mm. Straight manifold for tubing connector.

Scat

Description	PK	Cat. No.
3 connection collector for 3 capillaries with 3.2mm o.d.	1	**9.139 888**
8 connection collector for 8 capillaries with 3.2mm o.d.	1	**9.139 889**

1 Charcoal filters for Safety Waste Caps

3 sizes of absorbent charcoal filters (with capacity for 3, 6 or 9 months respectively) available.

Scat

Filter packing g	PK	Cat. No.
24	1	**9.139 871**
48	1	**9.139 872**
100	1	**9.139 873**

1

2 Exhaust air filter for Safety Waste Caps with splash guard

The filter cleans the exhaust air of solvent vapours. With a specific surface area of 1200m²/g, our special, activated charcoal-based, granulate is the optimum filter medium for almost all solvent vapours - 99% of all volatile substances are absorbed.

Scat

Size	Filter packing g	Description	PK	Cat. No.
Exhaust air filter S small	24	with splash guard	1	**4.005 634**
Exhaust air filter M medium	48	with splash guard	1	**4.005 631**
Exhaust air filter L large	100	with splash guard	1	**4.005 635**

2

3 Exhaust air filter supply pack for Safety Waste Caps

Exhaust air filter supply pack (blue)

Scat

Description	Filter packing g	PK	Cat. No.
Supply pack S	24	4	**4.005 884**
Supply pack M	48	3	**4.005 885**

3

4 Level control, electronic, contactless

Monitor up to 15 containers simultaneously

Scat

External devices, e.g. pumps or valves, can additionally be controlled via a contact switch (floating output contact). All signal boxes are delivered with power supply (110/230V).

Disk sensor

Level control without contacting the contents of the container. The sensitivity of the sensor can be adjusted to different wall thicknesses. Suitable for all containers made in glass and non-conductive plastic. Not suitable for stainless steel containers and canisters made of electro-conductive plastic.

Cable for transmission to signal box and for the connection of peripheral devices.

Combine the extension cable to monitor containers at a distance of up to 200m. Control the connected device via a switch cable with a potential free contact.

4

Description	Description	PK	Cat. No.
Full level SafetySet	Signal box with disk fill level senor (1 channel), 220V EU power supply, signal cable 3 meters, Fastening material for sensor	1	**4.005 638**
Low level SafetySet	Signal box with disk low level senor (1 channel), 220V EU power supply, signal cable 3 meters, Fastening material for sensor	1	**4.005 797**

1

1 Exhaust air filters, fire-resistant, for Safety Waste Caps

Orange, fire-resistant exhaust air filter. For flammable liquids. *Scat*

Description	PK	Cat. No.
Exhaust air filter Size S (24g), fire-resistant	1	**4.005 782**
Exhaust air filter Size M (48g), fire-resistant	1	**4.005 784**

2

2 Thread adapters for Safety Waste Caps, PTFE

Scat

Description	PK	Cat. No.
Adapter GL38 (f) - GL45 (m)	1	**9.139 882**
Adapter GL40 (f) - GL45 (m)	1	**9.139 883**

3

3 Inlet filter for solvents

HPLC solvent filter *Scat*

Description	PK	Cat. No.
HPLC solvent filter, PP, for 1/8" dia. (3.2mm o.d.)	5	**4.005 890**
HPLC solvent filter, PFA/PTFE, for 1/8" (3.2mm o.d.)	5	**4.005 891**

4

5

4 5 Safety funnel, electroconductive HDPE

NEW!

HDPE safety funnel, black, electroconductive. *Scat*
- earthing cable included
- for all types of chemicals
- different thread sizes
- with or without mesh sieve
- for barrels
- supplied as a set with connectors

Thread	Description	PK	Cat. No.
GL45	with splash guard	1	**4.005 515**
GL45	with stainless steel mesh sieve	1	**4.005 756**
S55	with splash guard	1	**4.005 518**
S55	with stainless steel mesh sieve	1	**4.005 759**
S60/61	with splash guard	1	**4.005 514**
S60/61	with stainless steel mesh sieve	1	**4.005 755**
S65	with splash guard	1	**4.005 519**
S65	with stainless steel mesh sieve	1	**4.005 760**
83B	with splash guard	1	**4.005 520**
83B	with stainless steel mesh sieve	1	**4.005 761**
S60/61	with Canister 10 L and level control	1	**4.005 954**
S60/61	with Canister 20 L and level control	1	**4.005 955**

1 2 3 Safety funnel, electroconductive HDPE

NEW!

Scat

Optimised for applications, black, electroconductive.
- high quality HDPE construction
- suitable for all types of chemicals
- different thread sizes
- adapter for barrels available
- vials can be disposed of completely with the funnel with cap
- all models have removable sieves, for cleaning
- low profile - ideal for working in confined areas
- ball valve, diameter 180mm
- flip cap, diameter 135mm
- stem length 200mm

Thread	Dia. mm	Description	PK	Cat. No.
GL45	180	with stem	1	**9.042 852**
GL45	135	with stem	1	**9.042 865**
S50	180	with stem	1	**9.042 859**
S51	180	with stem	1	**9.042 854**
S55	180	with stem	1	**9.042 855**
S55	135	with stem	1	**9.042 864**
S55	135	without stem	1	**9.042 861**
S60/61	180	with stem	1	**9.042 851**
S60/61	135	with stem	1	**7.626 422**
S60/61	135	without stem	1	**9.042 860**
S65	180	with stem	1	**9.042 856**
S65	135	with stem	1	**9.042 866**
S65	135	without stem	1	**9.042 863**
S70/71	180	with stem	1	**9.042 858**
S90	180	with stem	1	**9.042 853**
83B	180	with stem	1	**9.042 857**
	180	Replacement sieve	1	**9.042 850**
	135	Replacement sieve	1	**9.042 867**

1

2

3

4 Stainless steel sieve

Black, electroconductive, for all safety funnels.

Scat

Description	PK	Cat. No.
Stainless steel mesh	1	**4.005 537**

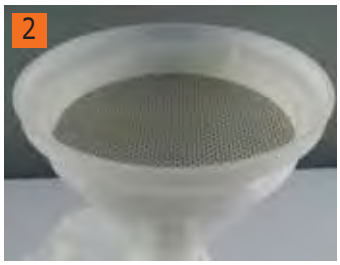
4

1 Safety funnels, white, non-electroconductive HDPE

- for all types of chemicals
- different thread sizes
- with or without anti-flash mesh
- for barrels

Scat

Thread	Description	PK	Cat. No.
GL45	with splash guard	1	**4.005 621**
GL45	with stainless steel mesh	1	**4.005 741**
S55	with splash guard	1	**4.005 624**
S55	with stainless steel mesh	1	**4.005 744**
S60/61	with splash guard	1	**4.005 620**
S60/61	with stainless steel mesh	1	**4.005 740**
S65	with splash guard	1	**4.005 625**
S65	with stainless steel mesh	1	**4.005 745**
83B	with splash guard	1	**4.005 628**
83B	with stainless steel mesh	1	**4.005 748**

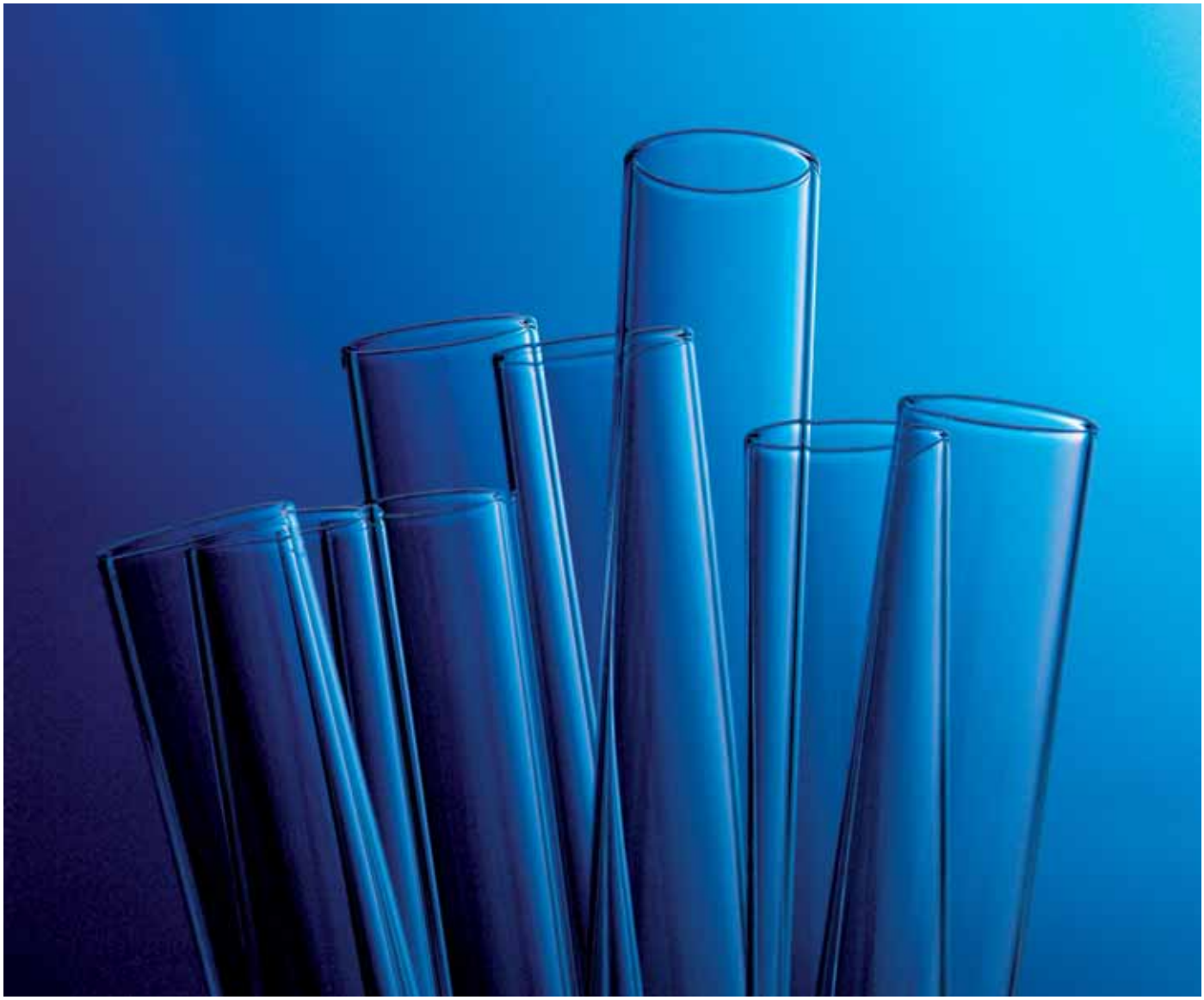


2 Stainless steel mesh sieve

White sieve for all safety funnels.

Scat

Description	PK	Cat. No.
Stainless steel mesh sieve for all white safety funnels	1	**4.005 540**



Summary of MN phases for GC

MN offers more than 40 different phases for gas chromatography from very nonpolar to polar columns.

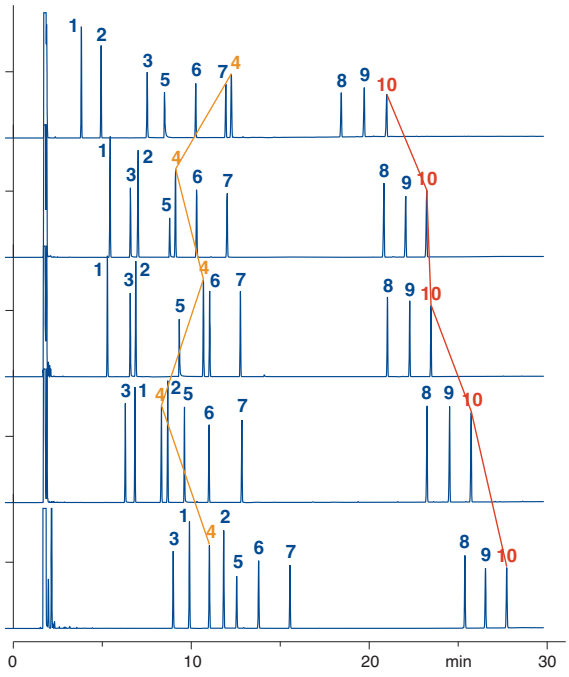
Nonpolar stationary phases (e.g. 100 % dimethylpolysiloxane phases) separate by volatility (i.e. boiling point) only. Typical analytes are linear hydrocarbons (*n*-alkanes).

Polar phases offer additional interactions, which may improve a separation. When increasing the polarity, e.g. by introducing phenyl and / or cyanopropyl groups, separation is increasingly influenced by differences in dipole moment and by charge transfer effects (e.g. for 5 – 50 % diphenylpolysiloxane phases). Typical analytes are hydrocarbons, which contain oxygen, sulphur, nitrogen, phosphorus or halogen atoms, unsaturated molecules which can be polarised and aromatics.

For components featuring different hydrogen bonding capacities and the ability to form strong hydrogen bonds, polyethylene glycol phases (WAX) are the best choice for a separation. Typical analytes are alcohols and carboxylic acids.

Selectivity has to be optimized for the critical pair of components or for the main component. You should always select the least polar column which solves your separation task. About 70 % of all separations can be performed on non- to midpolar columns. These columns generally feature high temperature stability.

Comparison of separation properties of selected OPTIMA® phases



OPTIMA® 225
max. temp. 260/280 °C

OPTIMA® 1701
max. temp. 320/340 °C

OPTIMA® 17
max. temp. 320/340 °C

OPTIMA® 5
max. temp. 340/360 °C

OPTIMA® 1
max. temp. 340/360 °C

increasing polarity

All columns:	0.5 µm film, 30 m x 0.32 mm ID
Sample:	MN-OPTIMA® test mixture
Injection:	1.0 µl, split 1:50
Carrier gas:	80 kPa N_2
Temperature:	80 °C → $_{max}$ T (isothermal), 8 °C/min
Detector:	FID, 260 – 300 °C, 2^6

Peaks:

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

Each column is individually tested and supplied with test certificate and test chromatogram, but without fittings or ferrules. Column ends are melted or closed with septa, and thus protected from atmospheric oxygen. Additionally, we include the corresponding test mixture with each column.

On request, all columns can be supplied with a 5 inch / 13 cm cage for the Agilent GC 6850.

Summary of MN phases for GC

Phase	Composition	max. temperature [1]	USP	Similar phases [2]	Page
Standard phases					
OPTIMA® 1	100 % dimethylpolysiloxane	340/360 °C	G1 G2 G38	PERMABOND® SE-30, OV-1, DB-1, SE-30, HP-1, SPB-1, CP-Sil 5 CB, Rtx®-1, 007-1, BP1, MDN-1, AT™-1, ZB-1, OV-101	86
OPTIMA® 1 MS Accent	100 % dimethylpolysiloxane	340/360 °C	G1 G2 G38	Ultra-1, DB-1MS, HP-1MS, Rtx®-1MS, Equity™-1, AT™-1MS, VF-1MS, CP-Sil 5 CB MS	88
OPTIMA® 5	5 % phenyl – 95 % methylpolysiloxane	340/360 °C	G27 G36	PERMABOND® SE-52, SE-54, SE-52, DB-5, HP-5, SPB-5, CP-Sil 8, Rtx®-5, 007-5, BP5, MDN-5, AT™-5, ZB-5	89
OPTIMA® 5 MS	5 % diphenyl - 95 % dimethylpolysiloxane	340/360 °C	G27 G36	DB-5MS, HP-5MS, Ultra-2, Equity™-5, CP-Sil 8CB low bleed/MS, Rtx®-5SIL-MS, Rtx®-5MS, 007-5MS, BPX5, MDN-5S, AT™-5MS, VF-5MS	90
OPTIMA® 5 MS Accent	silarylene phase with selectivity similar to 5 % diphenyl – 95 % dimethylpolysiloxanphasee	340/360 °C	G27 G36		91
OPTIMA® 17	phenylmethylpolysiloxane, 50 % phenyl	320/340 °C	G3	OV-17, DB-17, HP-50+, HP-17, SPB-50, SP-2250, Rtx®-50, CP-Sil 24 CB, 007-17, ZB-50	92
OPTIMA® 624	6 % cyanopropylphenyl – 94 % dimethylpolysiloxane	280/300 °C	G43	HP-624, HP-VOC, DB-624, DB-VRX, SPB-624, CP-624, Rtx®-624, Rtx®-Volatiles, 007-624, BP624, VOCOL	94
OPTIMA® 624 *LB*	as above, low bleed phase	280/300 °C	G43		
OPTIMA® 1701	14 % cyanopropylphenyl – 86 % dimethylpolysiloxane	300/320 °C	G46	OV-1701, DB-1701, CP-Sil 19 CB, HP-1701, Rtx®-1701, SPB-1701, 007-1701, BP10, ZB-1701	93
OPTIMA® 225	50 % cyanopropylmethyl – 50 % phenylmethylpolysiloxane	260/280 °C	G7 G19	DB-225, HP-225, OV-225, Rtx®-225, CP-Sil 43, 007-225, BP225	95
OPTIMA® WAX	polyethylene glycol 20000 Dalton	240/250 °C	G16	PERMABOND® CW 20 M, DB-Wax, Supelcowax™, HP-Wax, HP-INNOWax, Rtx®-Wax, CP-Wax 52 CB, Stabilwax, 007-CW, BP20, AT™-Wax, ZB-Wax	96
OPTIMA® FFAP	polyethylene glycol-2-nitro-terephthalate	250/260 °C	G25 G35	PERMABOND® FFAP, DB-FFAP, HP-FFAP, CP-SIL 58 CB, 007-FFAP, CP-FFAP CB, Nukol	97
Phases for special separations					
OPTIMA® 5 Amine	5 % phenyl – 95 % methylpolysiloxane, specially deactivated for amine separations	300/320 °C	G27 G36	Rtx-5 Amine, PTA-5	98
LIPODEX® E	octakis-(2,6-di-O-pentyl-3-O-butyryl)-γ-cyclodextrin for enantiomer separation	200/220 °C	–	–	99
HYDRODEX β-6TBDM	heptakis-(2,3-di-O-methyl-6-O-t-butyldimethyl-silyl)-β-cyclodextrin for enantiomer separation	230/250 °C	–	–	100
HYDRODEX β-TBDAc	heptakis-(2,3-di-O-acetyl-6-O-t-butyldimethyl-silyl)-β-cyclodextrin for enantiomer separation	220/240 °C	–	–	100

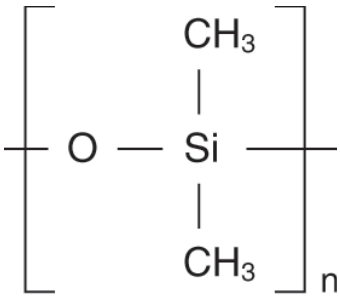
[1] first temperature for isothermal operation, second value for short isotherms in a temperature programme. Please note, that for columns with 0.53 mm ID and for columns with thicker films temperature limits are generally lower. For details refer to the description of individual phases.

[2] phases which provide a similar selectivity based on chemical and physical properties

1 OPTIMA® 1 high performance capillary columns for GC

100% dimethylpolysiloxane *MACHEREY-NAGEL*

1



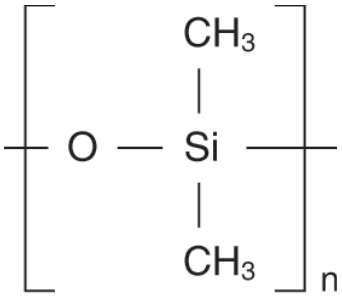
nonpolar phase
separation of components according to boiling points
thick film columns ≥3µm film are expecially recommended for solvent analysis
similar phases: Permabond® SE-30 , OV-1, DB-1, SE-30, HP-1, SPB-1, CP-Sil 5 CB, Rtx-1, 007-1, BP1, MDN-1, AT-1, ZB-1, OV-101

for columns with 0.25 to 0.32mm ID and films <3µm the max. temperature for isothermal operation is 340°C, the max. temperature for short isotherms in a temperature programme is 360°C
for 0.53mm ID columns with films < 3µm the max. temperatures are 320 and 340°C, resp.
for thick film columns with films > 3µm the max. temperatures are 300 and 320°C, resp.

Type	Film thickness µm	Length m	PK	Cat. No.
0.25 mm i.d. (0.4 mm o.d.)	0.10	25	1	**9.003 657**
0.25 mm i.d. (0.4 mm o.d.)	0.25	25	1	**9.003 662**
0.25 mm i.d. (0.4 mm o.d.)	0.50	25	1	**9.003 667**
0.25 mm i.d. (0.4 mm o.d.)	1.00	25	1	**9.003 671**
0.25 mm i.d. (0.4 mm o.d.)	0.10	30	1	**9.003 658**
0.25 mm i.d. (0.4 mm o.d.)	0.25	30	1	**9.003 663**
0.25 mm i.d. (0.4 mm o.d.)	0.50	30	1	**9.003 668**
0.25 mm i.d. (0.4 mm o.d.)	1.00	30	1	**9.003 672**
0.25 mm i.d. (0.4 mm o.d.)	0.25	50	1	**9.003 664**
0.25 mm i.d. (0.4 mm o.d.)	0.50	50	1	**9.003 669**
0.25 mm i.d. (0.4 mm o.d.)	1.00	50	1	**9.003 673**
0.25 mm i.d. (0.4 mm o.d.)	0.10	60	1	**9.003 659**
0.25 mm i.d. (0.4 mm o.d.)	0.25	60	1	**9.003 665**
0.25 mm i.d. (0.4 mm o.d.)	0.50	60	1	**9.003 670**
0.25 mm i.d. (0.4 mm o.d.)	1.00	60	1	**9.003 674**
0.32 mm i.d. (0.5 mm o.d.)	0.10	25	1	**9.003 676**
0.32 mm i.d. (0.5 mm o.d.)	0.25	25	1	**9.003 682**
0.32 mm i.d. (0.5 mm o.d.)	0.35	25	1	**9.003 686**
0.32 mm i.d. (0.5 mm o.d.)	0.50	25	1	**9.003 691**
0.32 mm i.d. (0.5 mm o.d.)	1.00	25	1	**9.003 697**
0.32 mm i.d. (0.5 mm o.d.)	3.00	25	1	**9.003 701**
0.32 mm i.d. (0.5 mm o.d.)	5.00	25	1	**9.003 706**
0.32 mm i.d. (0.5 mm o.d.)	0.10	30	1	**9.003 677**
0.32 mm i.d. (0.5 mm o.d.)	0.25	30	1	**9.003 683**
0.32 mm i.d. (0.5 mm o.d.)	0.35	30	1	**9.003 687**
0.32 mm i.d. (0.5 mm o.d.)	0.50	30	1	**9.003 692**
0.32 mm i.d. (0.5 mm o.d.)	1.00	30	1	**9.003 698**
0.32 mm i.d. (0.5 mm o.d.)	3.00	30	1	**9.003 702**
0.32 mm i.d. (0.5 mm o.d.)	5.00	30	1	**9.003 707**
0.32 mm i.d. (0.5 mm o.d.)	0.10	50	1	**9.003 678**
0.32 mm i.d. (0.5 mm o.d.)	0.25	50	1	**9.003 684**
0.32 mm i.d. (0.5 mm o.d.)	0.35	50	1	**9.003 688**
0.32 mm i.d. (0.5 mm o.d.)	0.50	50	1	**9.003 693**
0.32 mm i.d. (0.5 mm o.d.)	1.00	50	1	**9.003 699**
0.32 mm i.d. (0.5 mm o.d.)	3.00	50	1	**9.003 703**
0.32 mm i.d. (0.5 mm o.d.)	5.00	50	1	**9.003 708**
0.32 mm i.d. (0.5 mm o.d.)	0.10	60	1	**9.003 679**
0.32 mm i.d. (0.5 mm o.d.)	0.25	60	1	**9.003 685**
0.32 mm i.d. (0.5 mm o.d.)	0.35	60	1	**9.003 689**
0.32 mm i.d. (0.5 mm o.d.)	0.50	60	1	**9.003 694**
0.32 mm i.d. (0.5 mm o.d.)	1.00	60	1	**9.003 700**
0.32 mm i.d. (0.5 mm o.d.)	3.00	60	1	**9.003 704**
0,53 mm ID (0,8 mm o.d.)	0.50	25	1	**4.003 149**
0,53 mm ID (0,8 mm o.d.)	1.00	25	1	**4.003 164**
0,53 mm ID (0,8 mm o.d.)	2.00	25	1	**4.003 152**
0.53 mm i.d. (0.8 mm o.d.)	5.00	25	1	**4.003 265**
0,53 mm ID (0,8 mm o.d.)	0.50	30	1	**4.003 150**
0,53 mm ID (0,8 mm o.d.)	1.00	30	1	**4.003 165**
0,53 mm ID (0,8 mm o.d.)	2.00	30	1	**4.003 153**
0.53 mm i.d. (0.8 mm o.d.)	5.00	30	1	**4.003 266**
0.53 mm i.d. (0.8 mm o.d.)	5.00	50	1	**4.003 267**

Custom-made columns to your specifications available on request.
Each column is individually tested and supplied with test certificate and test chromatogram, but without fittings or ferrules.
Column ends are melted or closed with septa, and thus protected from atmospheric oxygen. Additionally, we supply the corresponding test mixture with each column.

1



1 OPTIMA® 1 MS Accent ultra-low bleed capillary columns for GC

100 % dimethylpolysiloxan *MACHEREY-NAGEL*

nonpolar phase with ultra-low bleeding, ideal for ion trap and quadrupol MS detectors increased sensitivity due to an unmatched low background level perfect inertness for basic compounds
solvent rinsing for removal of impurities applicable
application areas: all-round phase for environmental analyses, trace analyses, EPA methods, pesticides, PCB, food and drug analyses
similar phases: Ultra-1, DB-1 MS, HP-1 MS, Rtx-1 MS, Equity?1, AT-1 MS, VF-1 MS, CP-Sil 5 CB MS
max. temperature for isothermal operation 340°C, max. temperature for short isotherms in a temperature programme 360°C

Type	Film thickness µm	Length m	PK	Cat. No.
0,25 mm ID (0,4 mm AD)	0.25	30	1	**4.003 001**
0,25 mm ID (0,4 mm AD)	0.50	30	1	**4.003 003**
0,25 mm ID (0,4 mm AD)	0.25	60	1	**4.003 002**
0,25 mm ID (0,4 mm AD)	0.50	60	1	**4.003 004**
0,32 mm ID (0,5 mm AD)	0.25	30	1	**4.002 998**
0,32 mm ID (0,5 mm AD)	0.50	30	1	**4.003 005**
0,32 mm ID (0,5 mm AD)	0.25	60	1	**4.002 999**
0,32 mm ID (0,5 mm AD)	0.50	60	1	**4.003 006**

Each column is individually tested and supplied with test certificate and test chromatogram, but without fittings or ferrules. Column ends are melted or closed with septa, and thus protected from atmospheric oxygen.
Additionally, we supply the corresponding test mixture with each column.

EPA 8140 / 8141 / 8141 A org. P pesticides

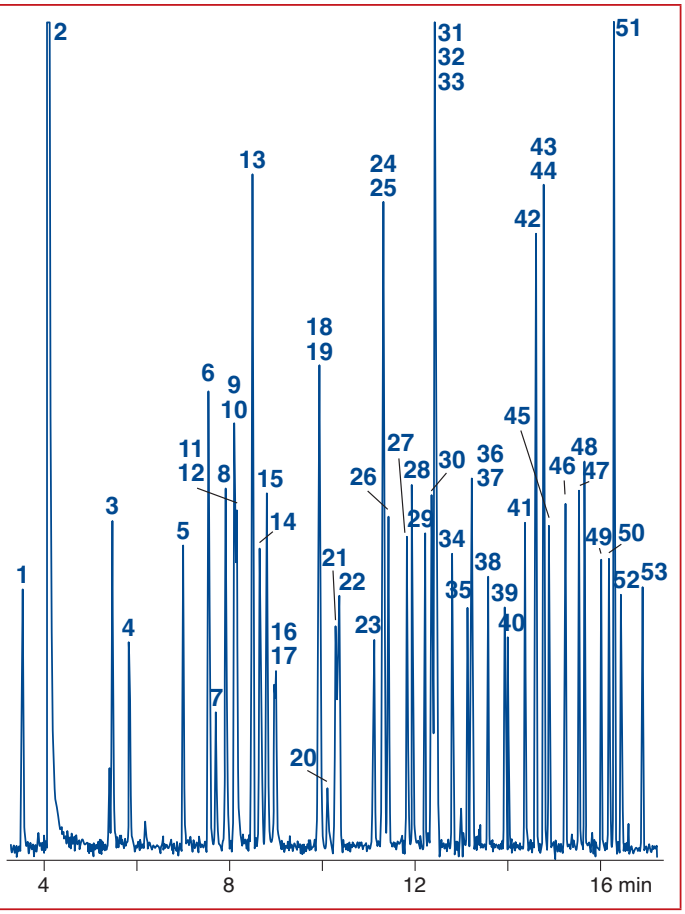
Column: OPTIMA® 1 MS Accent, 0.50 µm film, 30 m x 0.32 mm ID

Sample: 0.2 µg/ml in hexane, 8140/8141 OP pesticides calibration mix A + 8141 OP pesticides calibration mix B;
IS triphenyl phosphate and tributyl phosphate

Injection splitless (for 1 min); inj. temperature 250 °C
Carrier gas He, 1 ml/min, constant pressure
Temperature 100 °C → 180 °C, 10 °C/min (2 min) → 300 °C, 18 °C/min (3 min)
Detector: FPD (flame photometric detector), 280 °C

Peaks:
1. Dichlorvos, 2. Hexamethylphosphoramide, 3. Mevinphos, 4. Trichlorfon, 5. TEPP, 6. Thionazin, 7. Demeton-O, 8. Ethoprop 9. Tributyl phosphate (IS), 10. Dicrotophos, 11. Monocrotophos, 12. Naled, 13. Sulfotepp, 14. Phorate, 15. Dimethoate, 16. Demeton-S, 17. Dioxathion, 18. Terbufos, 19. Fonophos, 20. Phosphamidon-Isomer, 21. Diazinon, 22. Disulfoton, 23. Phosphamidon, 24. Dichlorofenthion, 25. Parathion-methyl, 26. Chlorpyrifos methyl, 27. Ronnel, 28. Fenitrothion, 29. Malathion, 30. Fenthion, 31. Aspon, 32. Parathion-ethyl, 33. Chlorpyrifos, 34. Trichloronate, 35. Chlorfenvinphos, 36. Merphos, 37. Crotoxyphos, 38. Stirofos, 39. Tokuthion, 40. Merphos oxidation product, 41. Fensulfothion, 42. Famphur, 43. Ethion, 44. Bolstar, 45. Carbophenothion, 46. Triphenyl phosphate (IS), 47. Phosmet, 48. EPN, 49. Azinphos-methyl, 50. Leptophos, 51. Tri-*o*-cresyl phosphate, 52. Azinphos-ethyl, 53. Coumaphos

MN Appl. No. 213030



1 OPTIMA® 5 capillary columns for GC

5% phenyl - 95% dimethylpolysiloxane *MACHEREY-NAGEL*

USP G27, G36 nonpaolar standard phase with large range of application similar phases: Permabond® SE-52 , SE-54, SE-52, DB-5, HP-5, SPB-5, CP-Sil 8, Rtx-5, 007-5, BP5, MDN-5, AT-5, ZB-5 for columns with 0.1 to 0.32mm ID and films <3µm the max. temperature for isothermal operation is 340°C, the max. temperature for short isotherms in a temperature programme is 360°C for 0.53mm ID columns with films < 3µm the max. temperatures are 320 and 340°C, resp. for thick film columns with films ≥ 3µm the max. temperatures are 300 and 320°C, resp.

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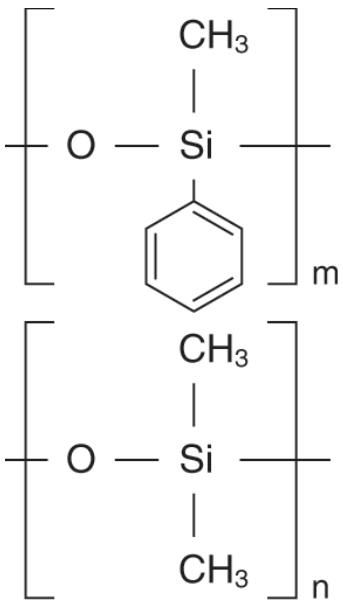

Type	Film thickness µm	Length m	PK	Cat. No.
0.10 mm i.d. (0.4 mm o.d.)	0.10	10	1	**4.003 235**
0.25 mm i.d. (0.4 mm o.d.)	0.10	25	1	**9.003 709**
0.25 mm i.d. (0.4 mm o.d.)	0.25	25	1	**9.003 715**
0.25 mm i.d. (0.4 mm o.d.)	0.35	25	1	**9.003 719**
0.25 mm i.d. (0.4 mm o.d.)	0.50	25	1	**9.003 723**
0.25 mm i.d. (0.4 mm o.d.)	1.00	25	1	**9.003 727**
0.25 mm i.d. (0.4 mm o.d.)	0.10	30	1	**9.003 710**
0.25 mm i.d. (0.4 mm o.d.)	0.25	30	1	**9.003 716**
0.25 mm i.d. (0.4 mm o.d.)	0.35	30	1	**9.003 720**
0.25 mm i.d. (0.4 mm o.d.)	0.50	30	1	**9.003 724**
0.25 mm i.d. (0.4 mm o.d.)	1.00	30	1	**9.003 728**
0.25 mm i.d. (0.4 mm o.d.)	0.10	50	1	**9.003 711**
0.25 mm i.d. (0.4 mm o.d.)	0.25	50	1	**9.003 717**
0.25 mm i.d. (0.4 mm o.d.)	0.35	50	1	**9.003 721**
0.25 mm i.d. (0.4 mm o.d.)	0.50	50	1	**9.003 725**
0.25 mm i.d. (0.4 mm o.d.)	1.00	50	1	**9.003 729**
0.25 mm i.d. (0.4 mm o.d.)	0.10	60	1	**9.003 712**
0.25 mm i.d. (0.4 mm o.d.)	0.25	60	1	**9.003 718**
0.25 mm i.d. (0.4 mm o.d.)	0.35	60	1	**9.003 722**
0.25 mm i.d. (0.4 mm o.d.)	0.50	60	1	**9.003 726**
0.25 mm i.d. (0.4 mm o.d.)	1.00	60	1	**9.003 730**
0.32 mm i.d. (0.5 mm o.d.)	0.10	25	1	**9.003 733**
0.32 mm i.d. (0.5 mm o.d.)	0.25	25	1	**9.003 738**
0.32 mm i.d. (0.5 mm o.d.)	0.35	25	1	**9.003 742**
0.32 mm i.d. (0.5 mm o.d.)	0.50	25	1	**9.003 746**
0.32 mm i.d. (0.5 mm o.d.)	1.00	25	1	**9.003 751**
0.32 mm i.d. (0.5 mm o.d.)	3.00	25	1	**9.003 755**
0.32 mm i.d. (0.5 mm o.d.)	5.00	25	1	**9.003 760**
0.32 mm i.d. (0.5 mm o.d.)	0.10	30	1	**9.003 734**
0.32 mm i.d. (0.5 mm o.d.)	0.25	30	1	**9.003 739**
0.32 mm i.d. (0.5 mm o.d.)	0.35	30	1	**9.003 743**
0.32 mm i.d. (0.5 mm o.d.)	0.50	30	1	**9.003 747**
0.32 mm i.d. (0.5 mm o.d.)	1.00	30	1	**9.003 752**
0.32 mm i.d. (0.5 mm o.d.)	3.00	30	1	**9.003 756**
0.32 mm i.d. (0.5 mm o.d.)	5.00	30	1	**9.003 761**
0.32 mm i.d. (0.5 mm o.d.)	0.10	50	1	**9.003 735**
0.32 mm i.d. (0.5 mm o.d.)	0.25	50	1	**9.003 740**
0.32 mm i.d. (0.5 mm o.d.)	0.35	50	1	**9.003 744**
0.32 mm i.d. (0.5 mm o.d.)	0.50	50	1	**9.003 748**
0.32 mm i.d. (0.5 mm o.d.)	1.00	50	1	**9.003 753**
0.32 mm i.d. (0.5 mm o.d.)	3.00	50	1	**9.003 757**
0.32 mm i.d. (0.5 mm o.d.)	0.10	60	1	**9.003 736**
0.32 mm i.d. (0.5 mm o.d.)	0.25	60	1	**9.003 741**
0.32 mm i.d. (0.5 mm o.d.)	0.35	60	1	**9.003 745**
0.32 mm i.d. (0.5 mm o.d.)	0.50	60	1	**9.003 749**
0.32 mm i.d. (0.5 mm o.d.)	1.00	60	1	**9.003 754**
0.32 mm i.d. (0.5 mm o.d.)	3.00	60	1	**9.003 758**
0.53 mm i.d. (0.8 mm o.d.)	0.50	25	1	**4.003 155**
0.53 mm i.d. (0.8 mm o.d.)	1.00	25	1	**4.003 168**
0.53 mm i.d. (0.8 mm o.d.)	2.00	25	1	**4.003 158**
0.53 mm i.d. (0.8 mm o.d.)	5.00	25	1	**4.003 261**
0.53 mm i.d. (0.8 mm o.d.)	0.50	30	1	**4.003 156**
0.53 mm i.d. (0.8 mm o.d.)	1.00	30	1	**4.003 169**
0.53 mm i.d. (0.8 mm o.d.)	2.00	30	1	**4.003 159**
0.53 mm i.d. (0.8 mm o.d.)	5.00	30	1	**4.003 262**
0.53 mm i.d. (0.8 mm o.d.)	2.00	50	1	**4.003 160**
0.53 mm i.d. (0.8 mm o.d.)	5.00	50	1	**4.003 263**
0.53 mm i.d. (0.8 mm o.d.)	2.00	60	1	**4.003 161**

Custom-made columns to your specifications available on request.
Each column is individually tested and supplied with test certificate and test chromatogram, but without fittings or ferrules. Column ends are melted or closed with septa, and thus protected from atmospheric oxygen.
Additionally, we supply the corresponding test mixture with each column.

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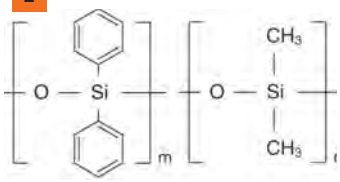


1 OPTIMA® 5 MS capillary columns for GC

5% diphenyl - 95% dimethylpolysiloxane *MACHEREY-NAGEL*

nonpolar phase with low bleeding
ideal for GC/MS and ECD applications and general analyses at trace level
perfect inertness for basic compounds
similar phases: DB-5 MS, HP-5 MS, Ultra-2, Equity-5, CP-Sil 8 CB low bleed/MS, Rtx-5SIL-MS, Rtx-5 MS, 007-5 MS, BPX5, MDN-5S, AT-5 MS, VF-5 MS

max. temperature for isothermal operation: 340°C,
max. temperature for short isotherms in a temperature programme: 360°C

Type	Film thickness µm	Length m	PK	Cat. No.
0.25 mm i.d. (0.4 mm o.d.)	0.25	30	1	**7.080 092**
0.25 mm i.d. (0.4 mm o.d.)	0.50	30	1	**4.003 099**
0.25 mm i.d. (0.4 mm o.d.)	1.00	30	1	**4.003 101**
0.25 mm i.d. (0.4 mm o.d.)	0.25	60	1	**4.003 098**
0.25 mm i.d. (0.4 mm o.d.)	0.50	60	1	**4.003 100**
0.32 mm i.d. (0.5 mm o.d.)	1.00	25	1	**4.003 091**
0.32 mm i.d. (0.5 mm o.d.)	0.25	30	1	**6.700 690**
0.32 mm i.d. (0.5 mm o.d.)	0.50	30	1	**4.003 093**
0.32 mm i.d. (0.5 mm o.d.)	1.00	50	1	**4.003 092**
0.32 mm i.d. (0.5 mm o.d.)	1.00	60	1	**7.080 742**

Custom-made columns to your specifications available on request.
Each column is individually tested and supplied with test certificate and test chromatogram, but without fittings or ferrules. Column ends are melted or closed with septa, and thus protected from atmospheric oxygen.
Additionally, we supply the corresponding test mixture with each column.

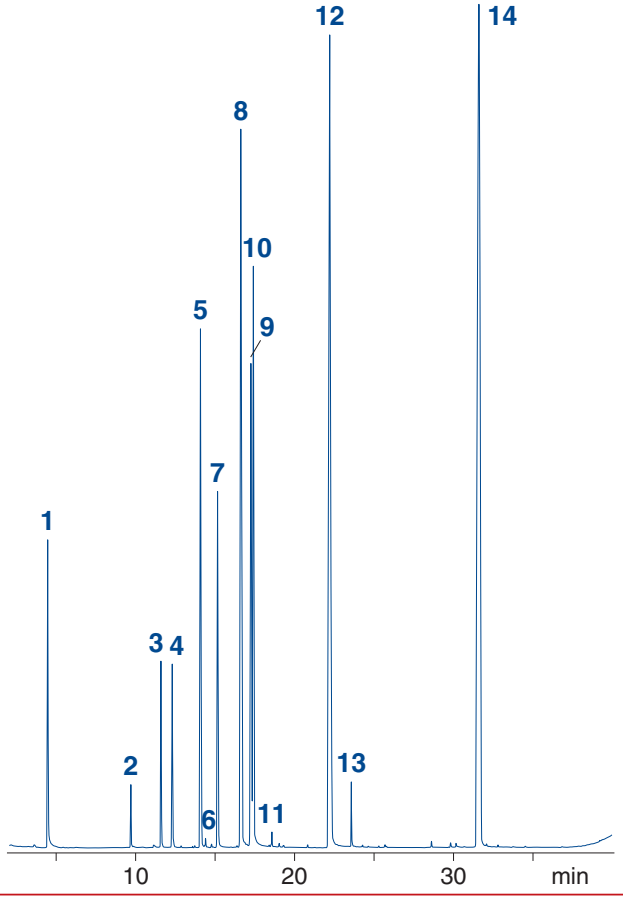
Analysis of various phenols

Column: OPTIMA® 5 MS, 30 m x 0.25 mm ID, 0.25 µm film, max. temperature 340/360 °C
Sample: 5 ppm each except *N*-*i*-propylaniline (9.4 ppm)
Method: SPME
Temperature: 40 °C (2 min) → 240 °C, 6 °C/min → 320 °C, 20 °C/min
Detector: MSD

Peaks:
1. Toluene-D_8
2. Phenol
3. 2-Methylphenol (*o*-Cresol)
4. Nitrobenzene-D_5
5. *N*-*i*-Propylaniline
6. 2,4-Dichlorophenol
7. 4-Chlorophenol
8. 4-Bromo-2-chlorophenol
9. 3-Bromophenol
10. 4-Chloro-3-methylphenol
11. 2,4-Dibromophenol
12. 2-Hydroxybiphenyl
13. 2-Cyclohexylphenol
14. Hexafluorobisphenol A

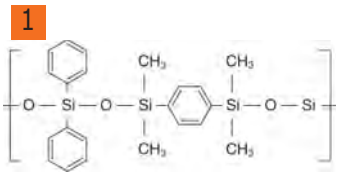
courtesy of Riedel-de-Haën, Seelze, Germany

MN Appl. No. 210110



1 OPTIMA® 5 MS Accent capillary columns for GC

silarylene phase *MACHEREY-NAGEL*



with polarity similar to a 5 % diphenyl -95 % dimethylpolysiloxane phase.
USP G27, G36
lowest column bleed, nonpolar phase, ideal for ion trap and quadrupol MS detectors solvent rinsing for removal of impurities applicable
application areas: all-round phase for environmental analyses, trace analyses, EPA methods, pesticides, PCB, food and drug analyses
similar phases: DB-5 MS, HP-5 MS, Ultra-2, Equity-5, CP-Sil 8 CB low bleed/MS, Rtx-5SIL-MS, Rtx-5 MS, 007-5 MS, BPX5, MDN-5S, AT-5 MS, VF-5 MS

max. temperature for isothermal operation: 340°C,
max. temperature for short isotherms in a temperature programme: 360°C
for cloumns with film thicknesses > 5.5 µm the max. temperatures are 320 and 340°C

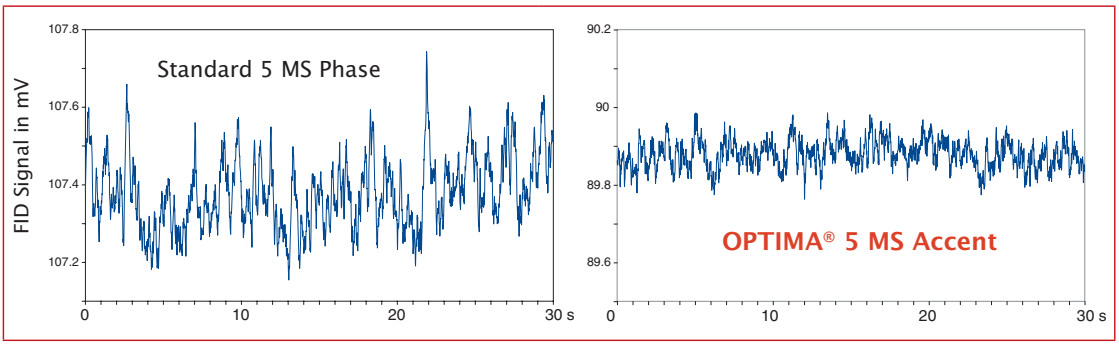
Type	Film thickness µm	Length m	PK	Cat. No.
0,25 mm i.d. (0,4 mm o.d.)	0.25	30	1	**4.003 017**
0,25 mm i.d. (0,4 mm o.d.)	0.50	30	1	**4.003 019**
0,25 mm i.d. (0,4 mm o.d.)	1.00	30	1	**4.003 021**
0,25 mm i.d. (0,4 mm o.d.)	0.25	60	1	**4.003 018**
0,25 mm i.d. (0,4 mm o.d.)	0.50	60	1	**4.003 020**
0,25 mm i.d. (0,4 mm o.d.)	1.00	60	1	**4.003 022**
0,32 mm i.d. (0,5 mm o.d.)	1.00	25	1	**4.003 011**
0,32 mm i.d. (0,5 mm o.d.)	0.25	30	1	**4.003 009**
0,32 mm i.d. (0,5 mm o.d.)	0.50	30	1	**4.003 013**
0,32 mm i.d. (0,5 mm o.d.)	0.25	60	1	**4.003 010**
0,32 mm i.d. (0,5 mm o.d.)	1.00	60	1	**4.003 012**

Each column is individually tested and supplied with test certificate and test chromatogram, but without fittings or ferrules. Column ends are melted or closed with septa, and thus protected from atmospheric oxygen.
Additionally, we supply the corresponding test mixture with each column.

The bleed comparison test of the OPTIMA® 5-MS Accent with a conventional 5-MS phase shows the outstanding performance of the silarylene phase.

Background noise at 340 °C

The unmatched low background level of the OPTIMA® 5 MS Accent, which is approximately three times lower compared to a 5 MS brand column, provides significantly increased sensitivity and allows the application in trace analyses particularly of high-boiling compounds.



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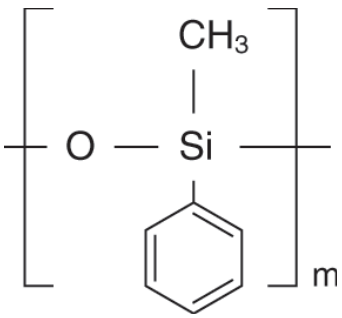


1 OPTIMA® 17 capillary columns for GC

phenylmethylpolysiloxane (50 % phenyl) *MACHEREY-NAGEL*

medium polar phase
preferred applications: steroids, pesticides, drug analyses
USP G3
similar phases: OV-17, DB-17, HP50+, HP17, SPB-50, SP-2250, Rtx-50, CP-Sil 24 CB, 007-17, ZB50

max. temperature for isothermal operation: 320°C, max. temperature for short isotherms in a temperature programme: 340°C, for 0.53mm ID columns the max. temperatures are 300 and 320°C, resp.

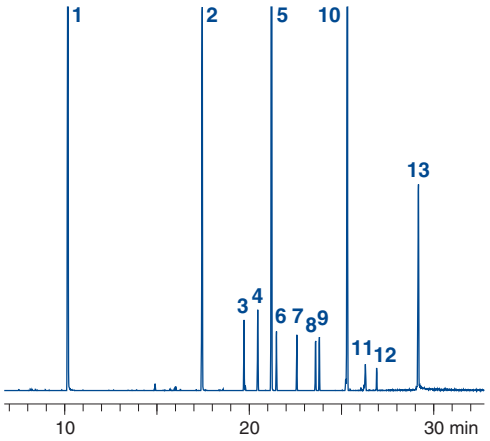
Type	Film thickness µm	Length m	PK	Cat. No.
0.10 mm i.d. (0.4 mm o.d.)	0.10	10	1	**4.003 236**
0,25 mm i.d. (0.4 mm o.d.)	0.15	25	1	**4.003 181**
0,25 mm i.d. (0.4 mm o.d.)	0.25	25	1	**4.003 026**
0,25 mm i.d. (0.4 mm o.d.)	0.50	25	1	**4.003 046**
0,25 mm i.d. (0.4 mm o.d.)	0.15	30	1	**4.003 182**
0,25 mm i.d. (0.4 mm o.d.)	0.25	30	1	**4.003 027**
0,25 mm i.d. (0.4 mm o.d.)	0.50	30	1	**4.003 047**
0,25 mm i.d. (0.4 mm o.d.)	0.15	50	1	**4.003 183**
0,25 mm i.d. (0.4 mm o.d.)	0.25	50	1	**4.003 028**
0,25 mm i.d. (0.4 mm o.d.)	0.50	50	1	**4.003 048**
0,25 mm i.d. (0.4 mm o.d.)	0.15	60	1	**4.003 184**
0,25 mm i.d. (0.4 mm o.d.)	0.25	60	1	**4.003 029**
0,25 mm i.d. (0.4 mm o.d.)	0.50	60	1	**4.003 049**
0.32 mm i.d. (0.5 mm o.d.)	0.25	25	1	**4.003 112**
0.32 mm i.d. (0.5 mm o.d.)	0.35	25	1	**4.003 194**
0.32 mm i.d. (0.5 mm o.d.)	0.50	25	1	**4.003 185**
0.32 mm i.d. (0.5 mm o.d.)	0.15	30	1	**4.003 193**
0.32 mm i.d. (0.5 mm o.d.)	0.25	30	1	**4.003 113**
0.32 mm i.d. (0.5 mm o.d.)	0.35	30	1	**4.003 195**
0.32 mm i.d. (0.5 mm o.d.)	0.50	30	1	**4.003 186**
0.32 mm i.d. (0.5 mm o.d.)	0.25	50	1	**4.003 114**
0.32 mm i.d. (0.5 mm o.d.)	0.35	50	1	**4.003 196**
0.32 mm i.d. (0.5 mm o.d.)	0.50	50	1	**4.003 187**
0.32 mm i.d. (0.5 mm o.d.)	0.25	60	1	**4.003 115**
0.32 mm i.d. (0.5 mm o.d.)	0.35	60	1	**4.003 197**
0.32 mm i.d. (0.5 mm o.d.)	0.50	60	1	**4.003 188**
0.53 mm i.d. (0.8 mm o.d.)	1.00	25	1	**4.003 191**
0.53 mm i.d. (0.8 mm o.d.)	1.00	30	1	**4.003 192**

In addition to this standard programme we will be happy to supply columns custom-made to your specifications.

Analysis of pesticides

Column: OPTIMA® 17, 0.20 µm film, 25 m x 0.20 mm ID, max. temperature 320/340 °C,
Sample: pesticide standard of the cantonal laboratory Schaffhausen (Switzerland), 0.1 mg/ml or 0.01 mg/ml each
Inj. volume: 1.0 µl
Carrier gas: He, 25 cm/s, 3 s without split
Temperature: 100 °C (3 min), 8 °C/min → 250 °C, 10 °C/min → 320 °C
Detector: MSD HP 5971

MN Appl. No. 200930



Peaks:
1. Dichlorphos
2. Naled
3. Vinclozolin
4. Chlorthalonil
5. Chlorpyrifos
6. Dichlofluanid
7. Procymidon
8. Captan
9. Folpet
10. Carbophenothion
11. Iprodion
12. Captafol
13. Coumaphos

1 OPTIMA® 1701 capillary columns for GC

14 % Cyanopropyl-phenyl - 86 % Dimethylpolysiloxane *MACHEREY-NAGEL*

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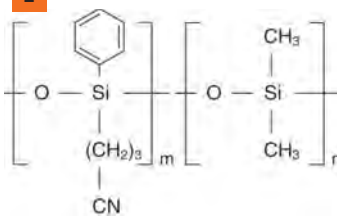


USP G46
medium polar phase
special selectivity due to high cyanopropyl content
reference column for structure identification, e.g. in combination with OPTIMA® 5
film thickness 1 µm for solvent analyses
similar phases: OV-1701, DB-1701, CP?Sil 19 CB, HP-1701, Rtx-1701, SPB-1701, 007-1701, BP10, ZB-1701

max. temperature for isothermal operation: 300°C, max. temperature for short isotherms in a temperature programme: 320°C
for 0.53mm ID columns the max. temperatures are 280 and 300°C, resp.

Type	Film thickness µm	Length m	PK	Cat. No.
0.25 mm i.d. (0.4 mm o.d.)	0.25	25	1	**4.003 035**
0.25 mm i.d. (0.4 mm o.d.)	0.25	30	1	**4.003 036**
0.25 mm i.d. (0.4 mm o.d.)	0.50	30	1	**4.003 039**
0.25 mm i.d. (0.4 mm o.d.)	1.00	30	1	**4.003 272**
0.25 mm i.d. (0.4 mm o.d.)	0.25	50	1	**4.003 037**
0.25 mm i.d. (0.4 mm o.d.)	0.25	60	1	**4.003 038**
0.25 mm i.d. (0.4 mm o.d.)	0.50	60	1	**4.003 040**
0.32.mm i.d. (0.5 mm o.d.)	0.25	25	1	**4.003 103**
0.32.mm i.d. (0.5 mm o.d.)	0.35	25	1	**4.003 222**
0.32.mm i.d. (0.5 mm o.d.)	0.50	25	1	**4.003 107**
0.32.mm i.d. (0.5 mm o.d.)	1.00	25	1	**4.003 268**
0.32.mm i.d. (0.5 mm o.d.)	0.25	30	1	**4.003 104**
0.32.mm i.d. (0.5 mm o.d.)	0.35	30	1	**4.003 223**
0.32.mm i.d. (0.5 mm o.d.)	0.50	30	1	**4.003 108**
0.32.mm i.d. (0.5 mm o.d.)	1.00	30	1	**4.003 269**
0.32.mm i.d. (0.5 mm o.d.)	0.25	50	1	**4.003 105**
0.32.mm i.d. (0.5 mm o.d.)	0.35	50	1	**4.003 224**
0.32.mm i.d. (0.5 mm o.d.)	1.00	50	1	**4.003 109**
0.32.mm i.d. (0.5 mm o.d.)	1.00	50	1	**4.003 270**
0.32.mm i.d. (0.5 mm o.d.)	0.25	60	1	**4.003 106**
0.32.mm i.d. (0.5 mm o.d.)	0.35	60	1	**4.003 225**
0.32.mm i.d. (0.5 mm o.d.)	0.50	60	1	**7.088 327**
0.32.mm i.d. (0.5 mm o.d.)	1.00	60	1	**4.003 271**
0.53.mm i.d. (0.8 mm o.d.)	1.00	25	1	**4.003 172**
0.53.mm i.d. (0.8 mm o.d.)	2.00	25	1	**4.003 178**
0.53.mm i.d. (0.8 mm o.d.)	1.00	30	1	**4.003 173**
0.53.mm i.d. (0.8 mm o.d.)	2.00	30	1	**4.003 179**
0.53.mm i.d. (0.8 mm o.d.)	2.00	50	1	**4.003 180**

Custom-made columns to your specifications on request.
Each column is individually tested and supplied with test certificate and test chromatogram, but without fittings or ferrules.
Column ends are melted or closed with septa, and thus protected from Additionally, we supply the corresponding test mixture with each column.

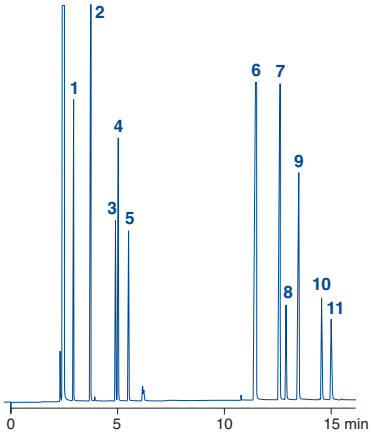
Analysis of aromatic hydrocarbons

Column: OPTIMA® 1701, 0.25 µm film, 25 m x 0.32 mm ID, max. temp. 300/320 °C
Inj. volume: 1 µl
Carrier gas: 0.6 bar N_2
Split: 1:40
Temperature: 60 °C → 120 °C, 4 °C/min
Detector: FID 260 °C

Peaks:

1. Benzene
2. Toluene
3. Ethylbenzene
4. *p*-Xylene
5. *o*-Xylene
6. Phenol
7. 2-Methylphenol
8. 2,6-Dimethylphenol
9. 4-Methylphenol
10. 2,4-Dimethylphenol
11. 2,4,6-Trimethylphenol

MN Appl. No. 200400



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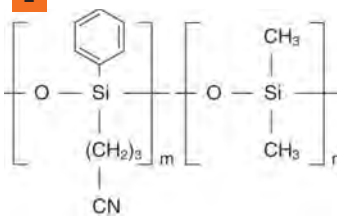


1 OPTIMA® 624 capillary columns for GC

6% cyanopropyl-phenyl - 94% dimethylpolysiloxane *MACHEREY-NAGEL*

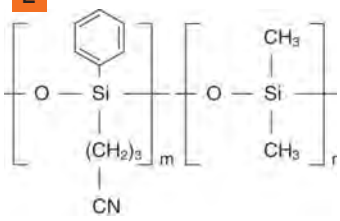
USP G43
medium polar phase
recommended for environmental analyses
similar phases: HP-624, HP-VOC, DB-624, DB-VRX, SPB-624, CP-624, Rtx-624, Rtx-Volatiles, 007-624, BP624, VOCOL

max. temperature for isothermal operation: 280°C, max. temperature for short isotherms in a temperature programme: 300°C

Type	Film thickness µm	Length m	PK	Cat. No.
0.25 mm i.d. (0.4 mm o.d.)	1.40	30	1	**4.003 211**
0.25 mm i.d. (0.4 mm o.d.)	1.40	50	1	**4.003 212**
0.25 mm i.d. (0.4 mm o.d.)	1.40	60	1	**4.003 213**
0.32 mm i.d. (0.5 mm o.d.)	1.80	30	1	**4.003 217**
0.32 mm i.d. (0.5 mm o.d.)	1.80	50	1	**4.003 218**
0.32 mm i.d. (0.5 mm o.d.)	1.80	60	1	**4.003 219**
0.53 mm i.d. (0.8 mm o.d.)	3.00	25	1	**4.003 220**
0.53 mm i.d. (0.8 mm o.d.)	3.00	30	1	**4.003 221**

Custom-made columns to your specifications avaialble on request.
Each column is individually tested and supplied with test certificate and test chromatogram, but without fittings or ferrules.
Column ends are melted or closed with septa. Additionally, we supply the corresponding test mixture with each column.

2



2 OPTIMA® 624 *LB* capillary columns for GC

6% cyanopropyl-phenyl - 94% dimethylpolysiloxane *MACHEREY-NAGEL*

USP G 43
medium polar phase
low bleed columns for halogenated hydrocarbons, volatiles, aromatic compounds, solvents etc.
similar phases: HP-624, HP-VOC, DB-624, DB-VRX, SPB-624, CP-624, Rtx-624, Rtx-Volatiles, 007-624, BP624, VOCOL

max. temperature for isothermal operation: 280°C, max. temperature for short isotherms in a temperature programme: 300°C

Type	Film thickness µm	Length m	PK	Cat. No.
0.32 mm i.d. (0.5 mm o.d.)	1.80	30	1	**4.003 214**
0.32 mm i.d. (0.5 mm o.d.)	1.80	50	1	**4.003 215**

Custom-made columns to your specifications available on request.
Each column is individually tested and supplied with test certificate and test chromatogram, but without fittings or ferrules.
Column ends are melted or closed with septa. Additionally, we supply the corresponding test mixture with each column.

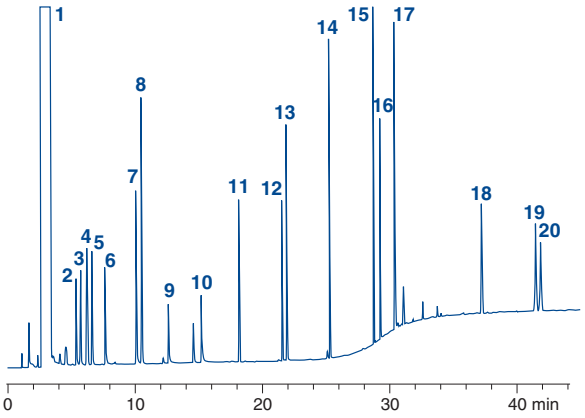
Solvents and semi-volatiles

Column: OPTIMA® 624 *LB*, 1.8 µm film, 30 m x 0.32 mm ID; Retention Gap Phe-Sil 0.5 m x 0.53 mm
Carrier gas: 1.1 bar He
Temperature: 45 °C (3 min) → 150 °C (6 °C/min) → 300 °C (18 °C/min), 20 min 300 °C
Injection: 1 µl (10 ppm per substance in acetone), cold on-column
Detection: FID 280 °C

Peaks:

1. Acetone
2. Ethyl acetate
3. Tetrahydrofuran
4. Cyclohexane
5. Methyl-2-butanol-2
6. Butanol-1
7. Pyridine
8. Toluene
9. Dimethylformamide
10. Dimethylsulphoxide
11. Decane
12. Octanol-1
13. Acetophenone
14. Butyrophenone
15. Heptanophenone
16. Methoxy-5-indole
17. Dibenzylamine
18. Methyl eicosanoate
19. Methyl *cis*-13-docosenoate
20. Methyl docosanoate

MN Appl. No. 212520



1 OPTIMA® 225 capillary columns for GC

50% cyanopropylmethyl - 50% phenylmethylpolysiloxane *MACHEREY-NAGEL*

USP G7/G19
middle polar phase
recommended for fatty acid analyses
similar phases: DB-225, HP-225, OV-225, Rtx-225, CP-Sil 43, 007-225, BP225

max. temperature for isothermal operation: 260°C, max. temperature for short isotherms in a temperature programme: 280°C

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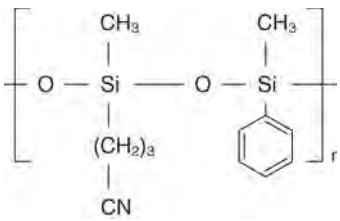


Type	Film thickness µm	Length m	PK	Cat. No.
0,10 mm ID (0,4 mm AD)	0.10	10	1	**4.003 050**
0,25 mm ID (0,4 mm AD)	0.25	30	1	**4.003 066**
0,25 mm ID (0,4 mm AD)	0.25	50	1	**4.003 067**
0,25 mm ID (0,4 mm AD)	0.25	60	1	**4.003 068**
0,32 mm ID (0,5 mm AD)	0.25	30	1	**4.003 117**
0,32 mm ID (0,5 mm AD)	0.25	50	1	**4.003 118**
0,32 mm ID (0,5 mm AD)	0.25	60	1	**4.003 119**

Custom-made columns to your specifications available on request.
Each column is individually tested and supplied with test certificate and test chromatogram, but without fittings or ferrules.
Column ends are melted or closed with septa. Additionally, we supply the corresponding test mixture with each column.

Analysis of FAME in porcine fat

Column: OPTIMA® 225, 0.25 µm film, 25 m x 0.32 mm ID, max. temperature 260/280 °C
Carrier gas: 60 kPa H_2, injection volume 1 µl, split 1:40
Temperature: 50 °C (2 min) → 125 °C, 30 °C/min → 160 °C, 5 °C/min → 180 °C, 20 °C/min → 200 °C, 3 °C/min → 220 °C, 20 °C/min (10 min)
Detector: FID 260 °C

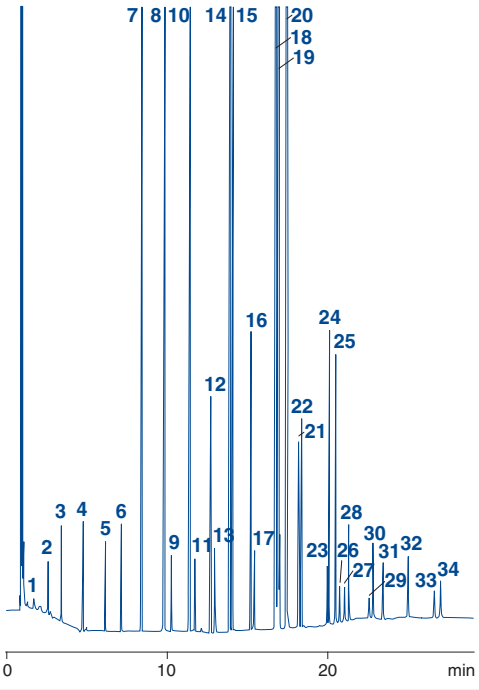
Peaks:

1. C4:0
2. C5:0
3. C6:0
4. C8:0
5. C10:0
6. C11:0
7. C12:0
8. C13:0
9. C13:1
10. C14:0
11. C14:1
12. C15:0
13. C15:1
14. C16:0
15. C16:1
16. C17:0
17. C17:1
18. C18:0
19. C18:1
20. C18:2
21. C18:3
22. C19:0
23. C20:0
24. C20:1
25. C20:2
26. C20:4
27. C20:3
28. C20:5
29. C22:0
30. C22:1
31. C22:2
32. C22:6
33. C24:0
34. C24:1

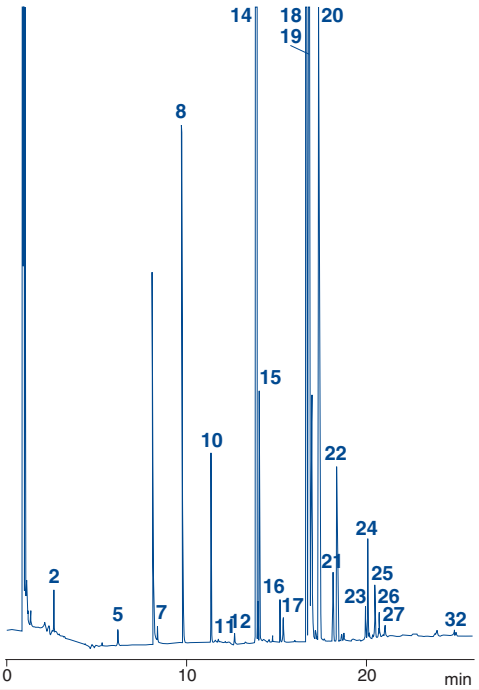
courtesy of Dr. Bantleon, Mr. Leusche, Mr. Hagemann, VFG-Labor, Versmold, Germany

MN Appl. No. 210060

FAME standard



FAME in porcine fat



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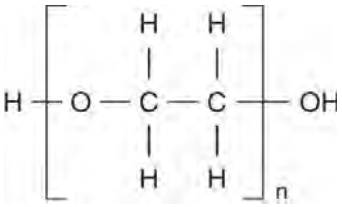


1 OPTIMA® WAX capillary columns for GC

polyethylene glycol 20000 daltons *MACHEREY-NAGEL*

USP G16
polar phase
recommended for solvent analysis and alcohols
suitable for aqueous solutions
similar phases: Premabond® CW 20 M_, DB-Wax, Supelcowax, HP-Wax, HP-INNOWAX, Rtx-Wax, CP-Wax 52 CB, Stabilwax, 007-CW, BP20, AT-Wax, ZB-Wax

max. temperature for isothermal operation 240°C, max. temperature for short isotherms in a temperature programme: 250°C,
for 0.53 mm ID columns the max. temperatures are 220 and 240°C, resp.

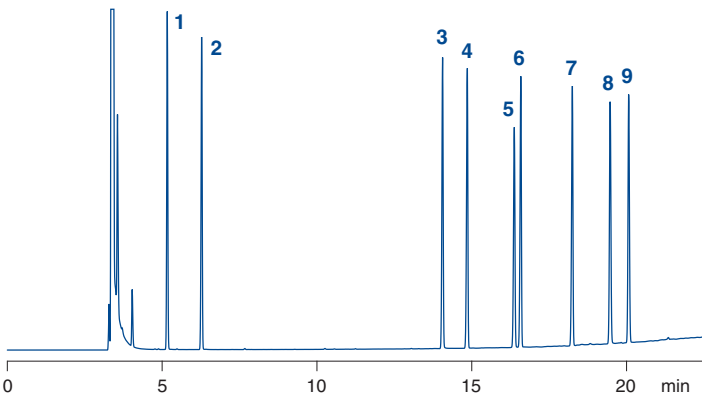
Type	Film thickness µm	Length m	PK	Cat. No.
0.25 mm i.d. (0.4 mm o.d.)	0.25	25	1	**9.003 762**
0.25 mm i.d. (0.4 mm o.d.)	0.25	30	1	**9.003 763**
0.25 mm i.d. (0.4 mm o.d.)	0.25	50	1	**9.003 764**
0.25 mm i.d. (0.4 mm o.d.)	0.25	60	1	**9.003 765**
0.32 mm i.d. (0.5 mm o.d.)	0.25	25	1	**9.003 766**
0.32 mm i.d. (0.5 mm o.d.)	0.50	25	1	**9.003 770**
0.32 mm i.d. (0.5 mm o.d.)	0.25	30	1	**9.003 767**
0.32 mm i.d. (0.5 mm o.d.)	0.50	30	1	**9.003 771**
0.32 mm i.d. (0.5 mm o.d.)	0.25	50	1	**9.003 768**
0.32 mm i.d. (0.5 mm o.d.)	0.50	50	1	**9.003 772**
0.32 mm i.d. (0.5 mm o.d.)	0.25	60	1	**9.003 769**
0.32 mm i.d. (0.5 mm o.d.)	0.50	60	1	**9.003 773**
0,53 mm ID (0,8 mm AD)	1.00	25	1	**4.003 175**
0,53 mm ID (0,8 mm AD)	1.00	30	1	**4.003 176**
0,53 mm ID (0,8 mm AD)	2.00	30	1	**4.003 174**

Custom-made columns to your specifications available on request.
Each column is individually tested and supplied with test certificate and test chromatogram, but without fittings or ferrules.
Column ends are melted or closed with septa. Additionally, we supply the corresponding test mixture with each column.

Modified Grob test

Column: OPTIMA® WAX, 0.5 µm film, 50 m x 0.32 mm ID, max. temperature 250/260 °C
Inj. volume: 1 µl
Carrier gas: 1,2 bar He
Split: 1:20
Temperature: 80 °C → 250 °C, 8 °C/min
Detector: FID 250 °C

Peaks:
1. Decane
2. Undecane
3. Octanol
4. Methyl decanoate
5. Dicyclohexylamine
6. Methyl undecanoate
7. Methyl dodecanoate
8. 2,6-Dimethylaniline
9. 2,6-Dimethylphenol

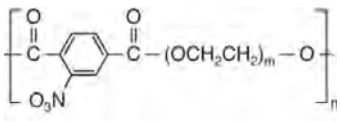


MN Appl. No. 211170

1 OPTIMA® FFAP capillary columns for GC

polyethylene glycol 2-nitroterephthalate *MACHEREY-NAGEL*

1



close equivalent USP G25/G35
polar phase
recommended for FAME, free carboxylic acids
similar phases: Permabond FFAP , DB-FFAP, HP-FFAP, CP-Sil 58 CB, 007-FFAP, CP-FFAP CB, Nukol

for columns with 0.10 to 0.32mm ID the max. temperature for isothermal operation is 250°C, the max. temperature for short isotherms in a temperature programme is 260°C for 0.53mm ID columns the max. temperatures are 220 and 240°C, resp.

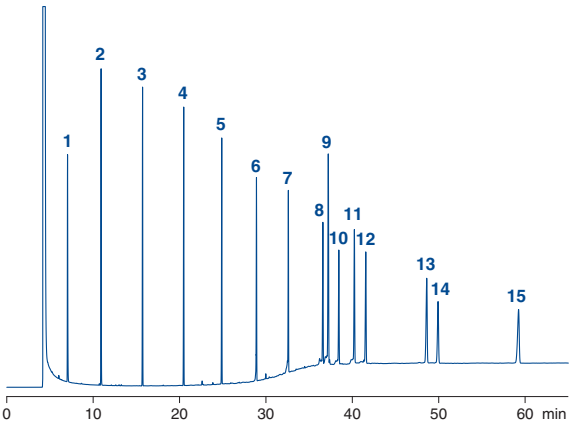
Type	Film thickness µm	Length m	PK	Cat. No.
0.10 mm i.d. (0.4 mm o.d.)	0.10	10	1	**4.003 079**
0.25 mm i.d. (0.4 mm o.d.)	0.25	25	1	**9.003 774**
0.25 mm i.d. (0.4 mm o.d.)	0.25	30	1	**9.003 775**
0.25 mm i.d. (0.4 mm o.d.)	0.25	50	1	**9.003 776**
0.25 mm i.d. (0.4 mm o.d.)	0.25	60	1	**9.003 777**
0.32 mm i.d. (0.5 mm o.d.)	0.25	25	1	**9.003 778**
0.32 mm i.d. (0.5 mm o.d.)	0.50	25	1	**9.003 782**
0.32 mm i.d. (0.5 mm o.d.)	0.25	30	1	**9.003 779**
0.32 mm i.d. (0.5 mm o.d.)	0.50	30	1	**9.003 783**
0.32 mm i.d. (0.5 mm o.d.)	0.25	50	1	**9.003 780**
0.32 mm i.d. (0.5 mm o.d.)	0.50	50	1	**9.003 784**
0.32 mm i.d. (0.5 mm o.d.)	0.25	60	1	**9.003 781**
0.53 mm i.d. (0.8 mm o.d.)	1.00	25	1	**4.003 111**
0.53 mm i.d. (0.8 mm o.d.)	0.50	30	1	**4.003 110**

Custom-made columns to your specifications on request.
Each column is individually tested and supplied with test certificate and test chromatogram, but without fittings or ferrules. Column ends are melted or closed with septa, and thus protected from atmospheric oxygen.
Additionally, we supply the corresponding test mixture with each column.

FAME test

Column: OPTIMA® FFAP, 0.25 µm film, 60 m x 0.32 mm ID, max. temperature 250/260 °C
Carrier gas: 1.2 bar He, split
Temperature: 55 °C → 250 °C, 6 °C/min
Injection: 1,0 µl, 220 °C
Detector: FID 220 °C

Peaks:
1. C4
2. C6
3. C8
4. C10
5. C12
6. C14
7. C16
8. C18
9. C18:1 *cis/trans*
10. C18:2
11. C18:3
12. C20
13. C22
14. C22:1
15. C24



MN Appl. No. 211140

OPTIMA® 5 Amine GC capillary columns for amine separation

especially deactivated for the analysis of polyfunctional amines such as ethanolamines, amino-functionalised diols and similar compounds, which are important base materials in industrial chemistry, and shows strong tailing on standard-deactivated columns; similar phases: Rtx-5 Amine, PTA-5; USP G27/G36; improved linearity for analyses 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, which among others also contains diethanolamine and propanol-pyridine (this test mixture is supplied with each column). Max. temperature for isothermal operation: 300°C, max. temperature for short isotherms in a temperature programme: 320°C. *MACHEREY-NAGEL*

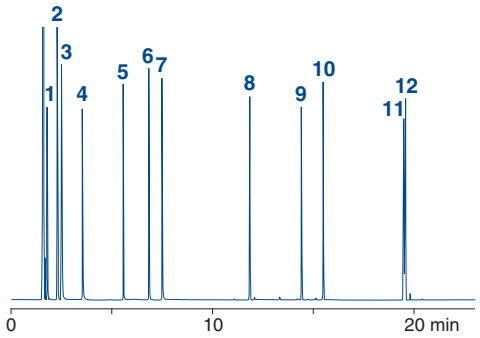
Type	Film thickness µm	Length m	PK	Cat. No.
0.25 mm i.d. (0.4 mm o.d.)	0.50	30	1	**6.900 659**
0.25 mm i.d. (0.4 mm o.d.)	1.00	30	1	**4.003 123**
0.32 mm i.d. (0.5 mm o.d.)	0.25	30	1	**4.003 125**

Separation of secondary and tertiary amines

Column: OPTIMA® 5 Amine, 0.5 µm film, 30 m x 0.25 mm ID, max. temperature 300/320 °C
Injection volume: 1 µl
Carrier gas: 0,6 bar H_2, Split 1:100
Temperature: 100 °C (3 min) → 280 °C, 10 °C/min
Detector: FID 280 °C

Peaks:
1. Diethylamine
2. Di-isopropylamine
3. Triethylamine
4. Di-*n*-propylamine
5. Di-*n*-butylamine
6. Tri-*n*-propylamine
7. Di-isobutylamine
8. Tri-*n*-butylamine
9. Di-isohexylamine
10. Dicyclohexylamine
11. Dibenzylamine
12. Tri-*n*-hexylamine

MN Appl. No. 210280



GC Capillary columns for special separations

LIPODEX® cyclodextrin phase for enantiomer separation *MACHEREY-NAGEL*

base material: cyclic oligosaccharide consisting of eight glucose units bonded through α-1.4-linkages (γ-cylodextrin) regioselective alkylation and acylation of the hydroxyl groups leads to a lipophilic phase, which is well suited for GC enantiomer analyses; important advantage: many compounds can be analysed without derivatisation (however, for certain substances enantioselectivity can be favourably influenced by formation of derivatives)

LIPODEX® E is suitable for a broad application range.

LIPODEX® E · octakis-(2.6-di-O-pentyl-3-O-butyryl)-γ-cyclodextrin

recommended for α-amino acids, α- and β-hydroxycarboxylic acid esters, alcohols (TFA), diols (TFA), ketones, pheromones (cyclic acetals), amines, alkyl halides, lactones. *MACHEREY-NAGEL*

max. temperature for isothermal operation: 200°C, max. temperature for short isotherms in a temperature programme: 220°C

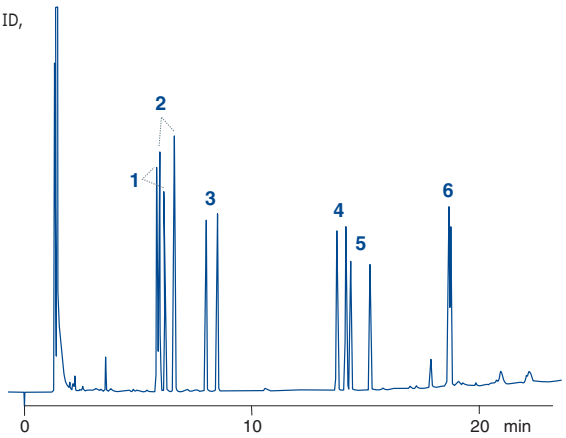
Type	Diam.	Length m	PK	Cat. No.
FS-LIPODEX E	0,25 mm ID (0,4 mm AD)	25	1	**4.002 925**
FS-LIPODEX E	0,25 mm ID (0,4 mm AD)	50	1	**4.002 926**

Enantiomer separation of amino acid methyl esters (TFA)

Column: FS-LIPODEX® E, 25 m x 0.25 mm ID, max. temp. 200/220 °C
Volume: 1 µl
Carrier gas: 60 kPa H_2
Split: ~ 1:100
Temperature: 90 → 190 °C, 4 °C/min
Detector: FID, 250 °C, AT 2

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

MN Appl. No. 202592



HYDRODEX cyclodextrin phases for enantiomer separation

cyclodextrin derivatives with high melting point: for GC-enantiomer separation diluted with polysiloxanes *MACHEREY-NAGEL*

HYDRODEX β-6TBDM
Heptakis-(2.3-di-O-methyl-6-O-t-butyldimethyl-silyl)-β-cyclodextrin

phase diluted with optimised polysiloxane *MACHEREY-NAGEL*
recommended for γ-lactones, cyclopentanones, terpenes, esters, tartrates

max. temperature for isothermal operation: 230°C, max. temperature for short isotherms in a temperature programme: 250°C

Type	Diam.	Length m	PK	Cat. No.
FS-HYDRODEX BETA-6TBDM	0,25 mm ID (0,4 mm AD)	25	1	**4.002 931**
FS-HYDRODEX BETA-6TBDM	0,25 mm ID (0,4 mm AD)	50	1	**4.002 932**

HYDRODEX β-TBDAC
Heptakis-(2.3-di-O-acetyl-6-O-t-butyldimethyl-silyl)-β-cyclodextrin

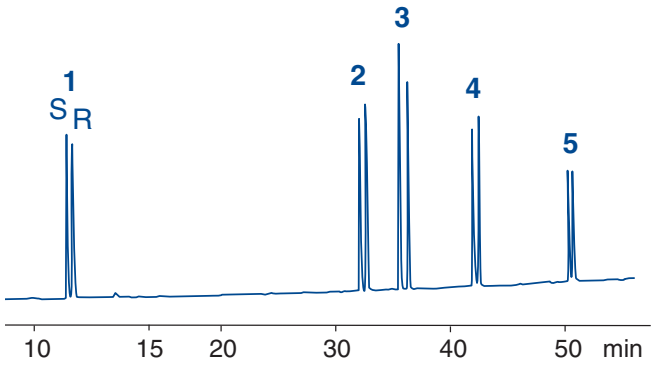
phase diluted with optimised polysiloxane *MACHEREY-NAGEL*
recommended for alcohols, esters, ketones, aldehydes, δ-lactones
max. temperature for isothermal operation: 220°C, max. temperature for short isotherms in a temperature programme: 240°C

Type	Diam.	Length m	PK	Cat. No.
FS-HYDRODEX BETA-TBDAC	0,25 mm ID (0,4 mm AD)	25	1	**4.002 935**
FS-HYDRODEX BETA-TBDAC	0,25 mm ID (0,4 mm AD)	50	1	**4.002 936**

Separation of isomeric antiinflammatory drugs

Courtesy of Prof. W.A. König, Hamburg, Germany
Column: HYDRODEX β-6TBDM, 25 m x 0.25 mm ID, max. temperature 250 °C
Carrier gas: He
Temperature: 135 °C → 200 °C, 1 °C/min
Detector: FID

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

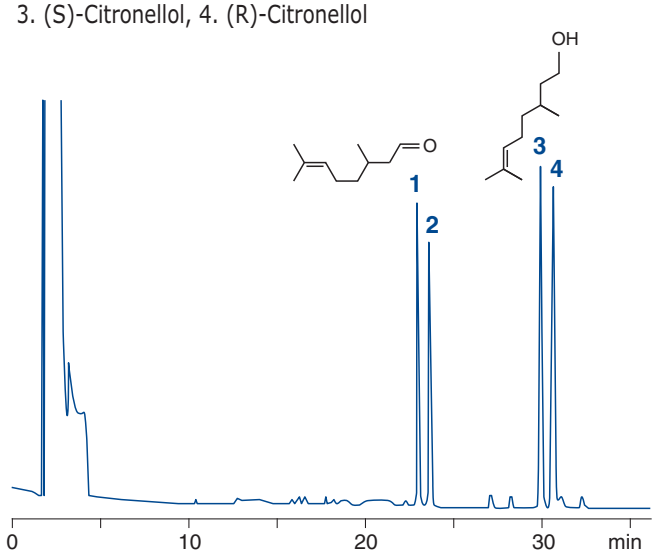


MN Appl. No. 250180

Separation of (R/S) citronellol + citronellal

Column: FS-HYDRODEX β-TBDAc, 50 m x 0.25 mm ID, max. temperature 220/240 °C
Carrier gas: 1.5 bar H_2, split 25 ml/min
Temperature: 100 °C
Injection: 1 µl, 1:1000 in CH_2Cl_2
Detector: FID, 220 °C

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



MN Appl. No. 212440

Reagents and methods for derivatisation

Derivatisation reagents *MACHEREY-NAGEL*

for improved volatility, better thermal stability or low limit of detection in gas chromatography prerequisite: quantitative, rapid and reproducible formation of only on derivative halogen atoms introduced by derivatisation (e.g. trifluoroacetates) allow specific detection (ECD) with the advantage of high sensitivity elution order and fragmentation patterns in MS can be influenced by a specific derivatisation
reagents for **silylation - alkylation (methylation) - acylation** are available

These products contain harmful substances which must be specially labelled as hazardous. For detailed information please see the MSDS, which can be downloaded under www.mn-net.com.

Selection guide for derivatisation of important functional groups in GC

Function	method	derivative	recommended reagents
Alcohols, phenols	silylation	R'O – TMS	MSTFA
	acylation	R'O – CO – R	HFBA, MBTFA
R'OH	alkylation	R'O – R	TMSH
sterically hindered	silylation	R'O – TMS	BSTFA, SILYL-991
Amines	silylation	R' – NR'' – TMS	MSTFA, SILYL-991
primary, secondary	acylation	R' – NR'' – CO – R	HFBA, MBTFA
hydrochlorides	silylation	R' – NR'' – TMS	MSTFA
Amides	silylation	not stable	
	acylation	R' – CO – NH – CO – R	MBTFA, HFBA
Amino acids	silylation	R' – CH(NH – TMS) – CO – O – TMS	BSTFA, MSTFA
	alkylation (a) + acylation (b)	R' – CH(NH – CO – R) – CO – O – R	a) TMSH b) HFBA, MBTFA
Carboxylic acids	silylation	R' – CO – O – TMS	MSTFA
(fatty acids)		susceptible to hydrolysis	
	alkylation	R' – CO – O – R	TMSH
Carbohydrates	silylation		MSTFA
	acylation		MBTFA
Steroids	acylation		MBTFA, HFBA

Derivatisation method development kit

Which type of derivatisation is best suited for your sample (alkylation, acylation or silylation)? *MACHEREY-NAGEL*

Content	PK	Cat. No.
2 x 1 ml each for TMSH, MSTFA, MBTFA	1	**4.001 514**

Acylation kit

Which is the proper reagent for acylation? *MACHEREY-NAGEL*

Content	PK	Cat. No.
2 x 1 ml each for MBTFA , TFAA, MBHFBA	1	**6.207 118**

Alkylation kit

Which is the proper reagent for methylation? *MACHEREY-NAGEL*

Content	PK	Cat. No.
3x1 ml each for TMSH, DMF-DMA	1	**4.001 513**

Silylation kit

Which is the proper reagent for silylation? *MACHEREY-NAGEL*

Content	PK	Cat. No.
2 x 1 ml each for MSTFA, BSTFA, TSIM, MSHFBA	1	**6.704 458**

Acylation reagents for GC - Anhydrides

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by-products of acylation with anhydrides: corresponding acids
excess reagent and the acid formed have to be removed
Acylation with fluorinated acid anhydrides can be used for alcohols, phenols, carboxylic acids, amines, amino acids and steroids forming volatile, stable derivatives suited for FID as well as for ECD detection.

Heptafluorobutyric acid anhydride (HFBA)
m.w. 410.06, Bp 106 - 107°C (760mm Hg),
C_3F_7 - CO - O - CO - C_3F_7
density d20°/4° = 1.665

	Capacity ml	PK	Cat. No.
HFBA	1	20	**4.001 480**
HFBA	10	1	**4.001 479**
HFBA	10	5	**4.001 481**

Methods for acylation

Acylation with fluorinated acid anhydrides:

Acylation with HFBA can be used for alcohols, phenols, carboxylic acids, amines, amino acids and steroids forming volatile, stable derivatives suited for FID as well as for ECD detection.

Procedure:
Dissolve 0.1 to 1 mg of the sample in 0.1 ml solvent, add 0.1 ml HFBA and heat to 60 – 70 °C for 1 – 2 hours. If the sample need not be concentrated prior to the analysis and if there is no danger of catalytically induced side reactions, pyridine is used as solvent. The reaction solution can be injected directly into the gas chromatograph. Otherwise use a volatile solvent and evaporate solvent, excess derivatisation reagent and free acid in a stream of nitrogen. Dissolve the residue in 50 µl hexane, chloroform etc. and inject aliquot portions.

MN Appl. No. 213042

Acylation with fluorinated acid amides:

This method is recommended for alcohols, primary and secondary amines as well as thiols under mild, neutral conditions. MBTFA also forms very volatile derivatives with carbohydrates [J. Sullivan and L. Schewe, J. Chromatogr. Sci. 15 (1977) 196 – 197].

Procedure:
Add 0.5 ml MBTFA to about 2 mg sample. If there is no reaction at ambient temperature, heat the reaction mixture to 120 °C. Compounds which are difficult to dissolve, can be trifluoracetylated in suitable solvent mixtures. It is recommended to use a ratio of solvent to MBTFA of 4 : 1. The reaction mixture can be chromatographed directly.

MN Appl. No. 213051

Acylation reagents for GC - Bisacylamides

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by-products: corresponding neutral acylamides, which can be easily removed due to their high volatility; because of neutral conditions and favourable chromatographic properties often removal of the bisacylamide is not necessary. Thus sample preparation is much more convenient.

Acylation with fluorinated acid amides is recommended for alcohols, primary and secondary amines as well as for thiols under mild, neutral conditions. MBTFA also forms very volatile derivatives with carbohydrates.

MBTFA /MBHFBA
N-methyl-bis(trifluoroacetamide) MBTFA
m.w. 223.08, Bp 123 - 124°C (760mm Hg), density d20°/4° = 1.55,
CF_3 - CO - $N(CH_3)$ - CO - CF_3

	Capacity ml	PK	Cat. No.
MBTFA	1	20	**7.401 143**
MBTFA	10	1	**7.510 796**
MBTFA	10	5	**6.228 605**

Due to their purpose, derivatisation reagents are very reactive substances. For this reason they should be stored cool and protected from moisture.
The derivatisation reagents are supplied in vials with crimp caps for easy access with a syringe. Vials with pierced sealing disks have limited stability and should be used soon.

Alkylation reagents for GC - Trimethylsulphonium hydroxide

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TMSH (0.2M in methanol) M.G. 94.06

	Capacity ml	PK	Cat. No.
TMSH	1	10	**7.086 147**
TMSH	1	20	**7.083 308**
TMSH	10	5	**4.001 512**

Silylation reagents

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Usually the term silylation in GC stands for replacement of active hydrogen atoms by a trimethylsilyl group (TMS derivative). Sometimes, however, trialkylsilyl groups or dimethylalkylsilyl groups with longer alkyl chains are used for derivatisation. The trialkylsilyl group increases volatility and enhances thermal stability of the sample. Silylation can be catalysed either acidic by addition of TMCS or basic by addition of pyridine (e. g. for sterically hindered functionalities like tert. alcohols)

Silylation reagents - BSTFA, SILYL-991

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N,O-bis-trimethylsilyl-trifluoroacetamide
m.w. 257.4, Bp 40°C (12mm Hg), density d20°/4° = 0.961
BSTFA: R = CF_3
powerful trimethylsilyl donor with approximately the same donor strength as the non-fluorinated analogue BSA
advantage of BSTFA over BSA: greater volatility of its reaction products (particularly useful for GC of some lower boiling TMS amino acids.

BSTFA is nonpolar (less polar than MSTFA), and can be mixed with acetonitrile for improved solubility. For silylating fatty acid amides, hindered hydroxyls and other compounds, which are difficult to silylate (like secondary alcohols and amines), we recommend BSTFA + 1% trimethylchlorosilane (TMCS), available under the designation SILYL-991.

Description	Capacity ml	PK	Cat. No.
BSTFA	1	20	**4.001 486**
BSTFA	10	1	**6.803 320**
BSTFA	10	5	**4.001 487**
SILYL-991 (BSTFA - TMCS (99:1)	1	20	**4.001 511**
SILYL-991 (BSTFA - TMCS (99:1)	50	1	**4.001 510**
SILYL-991 (BSTFA - TMCS (99:1)	100	1	**4.001 509**

Due to their purpose, derivatisation reagents are very reactive substances. For this reason they should be stored cool and protected from moisture.
The derivatisation reagents are supplied in vials with crimp caps for easy access with a syringe. Vials with pierced sealing disks have limited stability and should be used immediately.

Silylation with BSTFA or SILYL-991 (BSTFA + 1 % TMCS)

Procedure:
Add 0.5 ml silylation reagent to 1 – 10 mg sample; if necessary, add some solvent (normally pyridine or DMF [dimethylformamide] are used). Heat to 60 – 80 °C for 20 min to increase the reaction rate.

BSTFA MN Appl. No. 213092 · SILYL-991 MN Appl. No. 213093