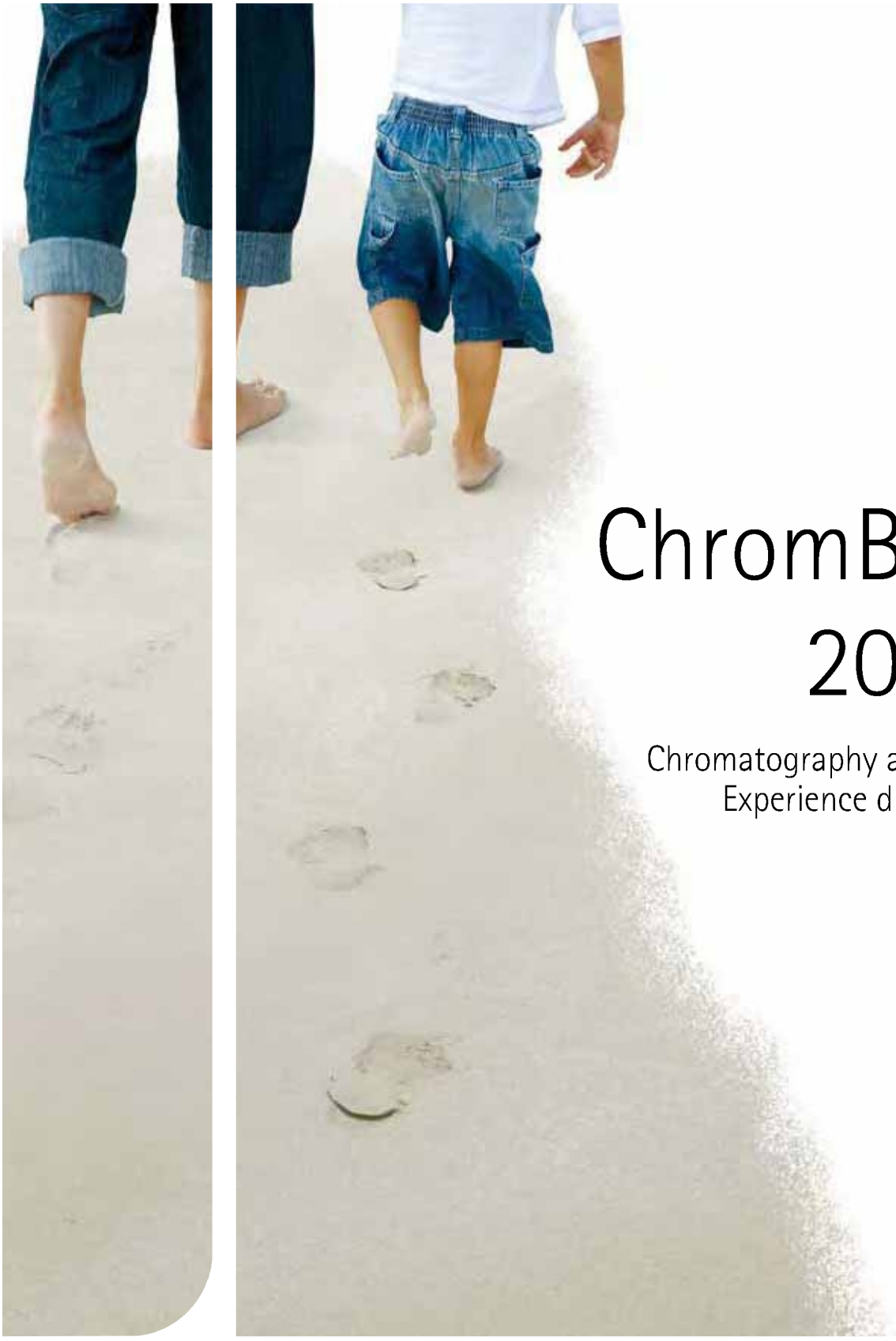

ChromBook 2008|09

Chromatography at Merck –
Experience drives Innovation

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MERCK

Experience drives Innovation

Since the early days of chromatography, Merck has introduced numerous products that have been recognized as milestones in the development of chromatography technologie. From the very beginning, our highest priorities have been a strong customer focus and the development of customized solutions for all applications. Our history shows that we have never rested on our laurels but have always translated our expertise into innovation.

1904 One year after Tswett's invention, Merck offered an aluminium oxide for adsorption chromatography

1934 Aluminum oxide standardized acc. to Brockman

1958 Silica gel for thin-layer chromatography acc. to Stahl

1969 LiChrosorb® – first totally porous 10µm silica gel for HPLC

1972 Mechanically packed Lobar® glass columns

1973 Development of spherical LiChrospher® silica gels for HPLC

1975 Hibar® stainless-steel HPLC columns and the first HPTLC pre-coated plates

1976 LiChroprep® silica gels for preparative column-liquid chromatography

1982 LiChroCART® HPLC cartridge column technology

1988 Reproducibility specified selectivity for LiChrospher® sorbents

1989 Tentacle media for biochromatography

1996 Purospher® the first ultra pure HPLC column material based on tetraalkoxysilane

2000 Chromolith® – the first silica gel based monolithic column for High Speed HPLC

2002 Ultra Thin Layer Chromatography – the first TLC plate based on a monolithic silica gel

2005 Chromolith® 10mm and 25mm ID – the first silica gel based monolithic HPLC column for Ultra-High-throughput Purification

2006 Chromolith® 3mm ID – the first monolithic silica gel column in new dimension for LC-MS

2008 Chromolith® 2mm ID

Chromatography at Merck

The Tswett Medal. On the occasion of the "75th anniversary of the discovery of chromatography by M.S. Tswett", the Academy of Sciences of the USSR issued a commemorative medal, which it awarded to the Merck KGaA – the only German company to receive such an honour – in 1980 in recognition of its services to the development of chromatography.

Today, Merck is one of the market leaders in the field of liquid chromatography and has a clear commitment to the further development of sorbents, analytical and preparative columns, sample preparation, Thin Layer Chromatography and biochromatography products.

The introduction of Chromolith® HPLC columns has put Merck right at the cutting edge of HPLC technology. In 2001, Chromolith® won the Pittsburg Conference "Pittcon Editors Gold Award", followed by the R&D 100 Award", given by the American R&D Magazine for the 100 best new products worldwide.

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Mobile Phases for HPLC and TLC

Analytical HPLC has taken on a position of central importance in research and development, in pharmaceutical quality control and in environmental analysis.

The various tasks involved place high requirements on the performance of the solvents used.

A high degree of UV-transmittance, low particle count, low acidity and alkalinity combined with low evaporation residue are the basic preconditions for reproducible separations. The requirements are ideally fulfilled by LiChrosolv® solvents prepared using specially selected raw materials and are purified in a multi-stage purification process with the highest batch-to batch consistency. LiChrosolv® HPLC are manufactured to completely eliminate any trace contamination, which may cause a misinterpretation of results when using UV- or fluorescence detectors.

The combination of classical Liquid Chromatography (LC) with Mass Spectrometer (MS) is fast becoming the dominant analytical tool for researchers in virtually every field of chemical analysis. LC-MS combines the advantages of a chromatographic separation with mass detection by MS: low detection limits and qualified analysis of molecular structures e.g. identification and characterization of metabolites. LiChrosolv® hypergrade is designed with high UV-Transmittance and low amounts of metal ions.

Application oriented qualities ensure that costly repeat analysis or loss of valuable samples can be avoided.

Solvent Management System

Returnable stainless steel barrels are available for Merck's high purity solvents

- No container material interaction
- Greater stability
- Less waste disposal
- Numerous withdrawal equipment
- Reduced chance of contamination
- Safer working improvement

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LiChrosolv®

Solvents for analytical chromatography

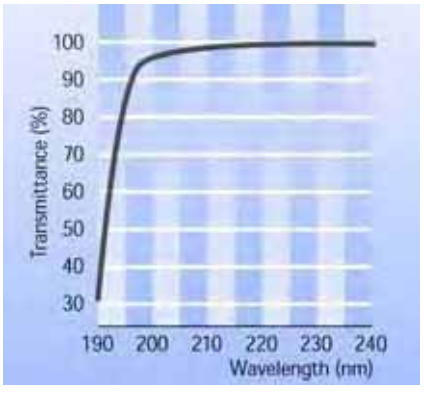
Modern analytical HPLC is often carried out using gradient methods. For this reason, we also provide our solvents in both isocratic and gradient quality. Thus, gradient effects in these solvents are minimised for example when carrying out enantiomeric separation on chiral phases or circulating amino phases.

Especially in the case of the high purity solvents of the LiChrosolv® range, we offer, in addition to the broad product range, volumes of 1 l; 2.5 l and 4 l in glass vessels, 5 l in Aluminium bottles and 10 l, 30 l and 185 l in stainless steel returnable barrels. Higher volumes on request. The advantages of such barrels are described in our product information "Tailor made solvents in tailor made packaging". A perfect solvent programme should of course include a perfect and contamination-free withdrawal system. A corresponding product data sheet is available on request.

Specifications of LiChrosolv® Gradient Grade products

Item	Product	Evap. Residue max.[mg/l]	Gradient at nm [max. mAU]			Fluorescence[1] at nm [max. ppb]	
			210	235	254	254	365
1.00030	Acetonitrile	4	2.0	-	0.5	1.0	0.5
1.11727	Ethanol	5	-	5.0	2.0	-	-
1.06007	Methanol	4	-	2.0	1.0	1.0	1.0
1.01040	2-Propanol	5	-	2.5	2.0	-	-
1.15333	Water	5	5.0	-	0.5	1.0	0.5

[1] calculated as Quinine in 0.05 mol/l H_2SO_4



*UV-Spectrum Acetonitrile LiChrosolv® hypergrade
Optical path: 1 cm
Reference: Water LiChrosolv®

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Ordering information of LiChrosolv®

Designation	Ordering No.	Purity (GC) min. [%]	Evap. Residue max. [mg/l]	Water max. [%]	Acidity max. [meq/g]	Alka-linity max. [meq/g]	UV-transmission at nm [%]			Content
Acetone	1.00020.1000 1.00020.2500 1.00020.4000 1.00020.5000	99.8	2	0.05	0.0002	0.0002	335 (50 %)	340 (80 %)	350 (98 %)	1 l 2.5 l 4 l 5 l
Acetonitrile hypergrade for LC/MS*	1.00029.1000 1.00029.2500 1.00029.9010 1.00029.9030	99.9	1	0.01	0.0001	0.0002	191 (25 %)	195 (85 %)	200 (96 %)	1 l 2.5 l 10 l 30 l
Acetonitrile gradient grade Reag. Ph Eur	1.00030.1000 1.00030.2500 1.00030.4000 1.00030.5000 1.00030.9010 1.00030.9030 1.00030.9185	99.9	2	0.02	0.0002	0.0002	193 (60 %)	195 (80 %)	230 (98 %)	1 l 2.5 l 4 l 5 l 10 l 30 l 185 l
Acetonitrile isocratic grade	1.14291.1000 1.14291.2500 1.14291.4000 1.14291.5000 1.14291.9010 1.14291.9030 1.14291.9185	99.8	4	0.05	0.0005	0.0002	195 (70 %)	200 (90 %)	240 (98 %)	1 l 2.5 l 4 l 5 l 10 l 30 l 185 l
Benzene	1.01768.1000	99.8	2	0.03	0.0002	0.0002	285 (70 %)	290 (90 %)	340 (98 %)	1 l
1-Butanol	1.01988.1000 1.01988.2500	99.8	2	0.05	0.0002	0.0002	230 (75 %)	240 (85 %)	310 (99 %)	1 l 2.5 l
tert-Butyl methyl ether	1.01845.1000 1.01845.2500	99.8	2	0.02	0.0002	0.0002	240 (60 %)	255 (85 %)	280 (98 %)	1 l 2.5 l
Chloroform, stabilised	1.02444.1000 1.02444.2500 1.02444.4000	99.8	5	0.01	0.0002	0.0002	255 (70 %)	260 (85 %)	300 (98 %)	1 l 2.5 l 4 l
1-Chloro-butane	1.01692.1000	99.8	2	0.01	0.0002	0.0002	227 (60 %)	232 (80 %)	250 (98 %)	1 l
Cyclohexane	1.02827.1000 1.02827.2500	99.9	2	0.01	0.0002	0.0002	230 (75 %)	240 (90 %)	260 (99 %)	1 l 2.5 l
1,2-Dichloro-ethane	1.13713.1000	99.8	2	0.02	0.0002	0.0002	240 (85 %)	245 (90 %)	270 (99 %)	1 l
Dichloro-methane, stabilised	1.06044.1000 1.06044.2500 1.06044.4000	99.9	5	0.01	0.0002	0.0002	240 (70 %)	245 (90 %)	260 (99 %)	1 l 2.5 l 4 l
1,4-Dioxane	1.03132.1000 1.03132.2500	99.8	2	0.02	0.0002	0.0002	245 (50 %)	270 (80 %)	300 (98 %)	1 l 2.5 l
Ethanol gradient grade	1.11727.1000 1.11727.2500 1.11727.4000	99.9	2	0.1	0.0002	0.0002	225 (60 %)	240 (85 %)	260 (98 %)	1 l 2.5 l 4 l
Ethylacetate	1.00868.1000 1.00868.2500 1.00868.4000	99.8	2	0.05	0.0002	0.0002	260 (50 %)	265 (80 %)	270 (98 %)	1 l 2.5 l 4 l
n-Heptane	1.04390.1000 1.04390.2500 1.04390.9010 1.04390.9030	99.3	2	0.005	0.0002	0.0002	210 (50 %)	220 (80 %)	245 (98 %)	1 l 2.5 l 10 l 30 l

LiChrosolv®

Solvents for analytical chromatography

Designation	Ordering No.	Purity (GC) min. [%]	Evap. Residue max. [mg/l]	Water max. [%]	Acidity max. [meq/g]	Alka-linity max. [meq/g]	UV-transmission at nm [%]			Content
n-Hexane	1.04391.1000 1.04391.2500 1.04391.4000 1.04391.5000 1.04391.9010	98.0	1	0.01	0.0002	0.0002	210 (50 %)	220 (80 %)	245 (98 %)	1 l 2.5 l 4 l 5 l 10 l
Isohexane	1.04335.2500	99.0	2	0.005	0.0002	0.0002	210 (60 %)	220 (80 %)	245 (98 %)	2.5 l
Isooctane	1.04717.1000 1.04717.2500	99.0	2	0.01	0.0005	0.0002	210 (50 %)	220 (80 %)	270 (98 %)	1 l 2.5 l
Methanol hypergrade for LC/MS	1.06035.1000 1.06035.2500	99.9	1	0.01	0.0002	0.0002	210 (35 %)	220 (60 %)	230 (75 %)	1 l 2.5 l
Methanol gradient grade Reag. Ph Eur	1.06007.1000 1.06007.2500 1.06007.4000 1.06007.5000 1.06007.9010 1.06007.9030 1.06007.9185	99.9	2	0.02	0.0005	0.0002	220 (55 %)	235 (83 %)	260 (98 %)	1 l 2.5 l 4 l 5 l 10 l 30 l 185 l
Methanol	1.06018.1000 1.06018.2500 1.06018.5000 1.06018.9010 1.06018.9030 1.06018.9185	99.8	3	0.03	0.0005	0.0002	225 (50 %)	240 (80 %)	265 (98 %)	1 l 2.5 l 5 l 10 l 30 l 185 l
1-Propanol	1.01024.1000 1.01024.2500	99.8	2	0.02	0.0005	0.0002	230 (70 %)	240 (80 %)	270 (98 %)	1 l 2.5 l
2-Propanol gradient grade	1.01040.1000 1.01040.2500 1.01040.5000 1.01040.9010 1.01040.9030	99.9	2	0.05	0.0005	0.0002	220 (80 %)	230 (90 %)	250 (98 %)	1 l 2.5 l 5 l 10 l 30 l
Carbon tetra-chloride	1.02223.1000	99.9	5	0.01	0.0002	0.0002	270 (50 %)	275 (80 %)	290 (98 %)	1 l
Tetrahydro-furane	1.08101.1000 1.08101.2500 1.08101.4000 1.08101.9010	99.9	1	0.02	0.0005	0.0002	260 (80 %)	270 (90 %)	310 (99 %)	1 l 2.5 l 4 l 10 l
Toluene	1.08327.1000 1.08327.2500 1.08327.4000	99.9	2	0.05	0.0005	0.0002	300 (70 %)	310 (80 %)	350 (98 %)	1 l 2.5 l 4 l
1,2,4-Trichloro-benzene	1.15224.1000	99.0	2	0.01	0.002	0.0002	315 (50 %)	320 (80 %)	385 (98 %)	1 l
Water gradient grade	1.15333.1000 1.15333.2500 1.15333.9010 1.15333.9030	-	5							1 l 2.5 l 10 l 30 l

LiChrosolv® hypergrade

A new standard in HPLC solvents

Solvents for LC-MS; 0.2 µm filtered

The determination of polycyclic aromatic hydrocarbons (PAHs) in environmental samples is one of the more complex problems to be solved by HPLC. LiChrosolv® hypergrade is a highly efficient solvents for compounds to be determined in the low ppb trace range and can be used for both, the isocratic separation of 6 PAHs according to German DIN method and the gradient separation of 16 PAHs according to EPA 610 (analysis of drinking water) and 550 + benzo(e)pyrene + perylene (analysis of waste water). Particularly when using wavelength switching fluorescence detection, reliable results are highly dependent on the degree of purity of the solvents used.

The LiChrosolv® hypergrade grade provides the highest degree of application reliability in HPLC gradient technology with subsequent UV- or fluorescence detection. A new standard for the unlimited application of high performance HPLC has been set.

Acetonitrile LiChrosolv® hypergrade has been manufactured using particularly high performance processes and has been tested using highly sensitive analytical methods for its suitability in the anayl-sis of pesticides and PAHs by HPLC. By using the method of total fluorimetry in quality assurance, we are able to specify emission intensities in the range from 250 to 700 nm at excitation wavelength between 240 and 600 nm smaller than those produced by the standards quinine (1ng/ml; 0.05 mol/l H_2SO_4) and PAH (1:100000; Acetonitrile; NIST SRM 1647b).

The optimised validation of the UV-VIS measuring technique enables us to described practically ideal transmittance values.

Classical LC/MS combines the advantages of a chromatographic separation with mass detection: low detection limits and qualified analysis of molecular structures e.g. identification and characterization of metabolites demanding specific solvents grades for reliable analytical results. LiChrosolv® hyper-grades are designed with high UV-transmittance, excellent baseline in gradient elution, low amounts of metal ions and very low total ionic current (TIC).

Specifications of LiChrosolv® hypergrade solvents

Item	Purity [%]	Evaporation residue max. [mg/l]	Water max. [%]	Acidity max. [meq/g]	Alkalinity max. [meq/g]	UV-transmission at nm
Acetonitrile	99.9	1	0.01	0.0001	0.0002	191 nm (25 %) 195 nm (85 %) 200 nm (96 %) 215 nm (98 %) 230 nm (99 %)
Suitability for LC/MS (Bruker esquire 3000 plus); ESI (+):						
Intensity of background mass peak based on 100 ppb reserpine Na K			≤ 20 % < 100 ppb < 10 ppb			
Methanol	99.9	1	0.01	0.0002	0.0002	210 nm (35 %) 220 nm (60 %) 230 nm (75 %) 260 nm (98 %)

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LiChrosolv® hypergrade

A new standard in HPLC solvents

Ordering information of LiChrosolv® hypergrade

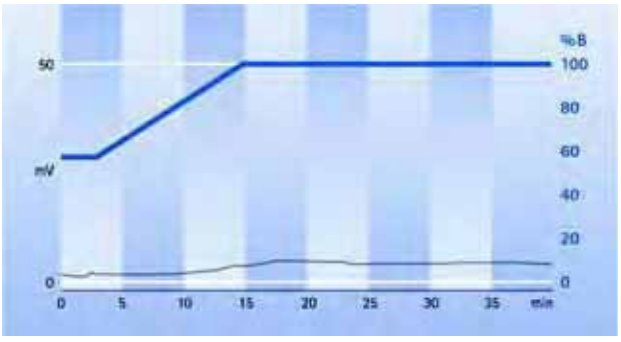
Item	Ordering No.	Content
Acetonitrile	1.00029.1000	1 l white glass
Acetonitrile	1.00029.2500	2.5 l white glass
Acetonitrile	1.00029.9010	10 l
Acetonitrile	1.00029.9030	30 l
Methanol	1.06035.1000	1 l white glass
Methanol	1.06035.2500	2.5 l white glass

Ordering information of LiChrosolv® Ready to use Mixture

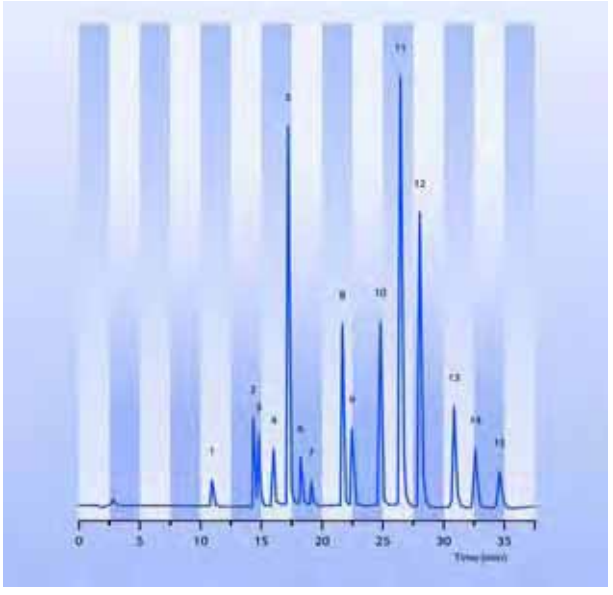
Designation	Ordering No.	Assay TFA	Content
Acetonitrile + 0.1% TFA (v/v)	4.80448.2500 4.80448.9030 4.80448.9185	0.095 - 0.105%	2.5 l 30 l 185 l
Water + 0.1% TFA (v/v)	4.80112.2500 4.80112.9030 4.80112.9185	0.095 - 0.105%	2.5 l 30 l 185 l
Methanol + Water 30:70 (v/v)	4.80508.9030		30 l
Acetonitrile + Water 60:40 (v/v)	4.80853.4004		4 l
Acetonitrile + Water 80:20 (v/v)	4.80159.2500		2.5 l
Acetonitrile + 0.05% TFA (v/v)	4.80672.2500	0.045 - 0.055%	2.5 l
Water + 0.05% TFA (v/v)	on request	0.045 - 0.055%	2.5 l

Separation examples with LiChrosolv® hypergrade
16 PAH acc. to EPA 610/550 + benzo(e)pyrene + perylene by fluorescence detection

Column	**LiChroCART® 250-4 LiChrospher® PAH, 5 µm**		
Mobile phase	A: Acetonitrile hypergrade LiChrosolv® B: Water LiChrosolv®		
Gradient	0-3 min 60 % A 3-15 min 60 % A - 100 % A 15-50 min 100 % A		
Flow rate	1.0 ml/min		
Detection	Programmed fluorescence detection:		
	Peak No.	Ex nm	Em nm
	1, 3, 4	280	330
	5	246	370
	6	250	406
	7	280	450
	8	270	390
	9, 10	265	380
	11 - 15	290	430
	16, 17	290	410
	18	300	500
Temperature	20°C		



[1] Blank value of Acetonitrile LiChrosolv® hypergrade in PAH determination according to EPA 610



[2] Application: Determination of 16 pAH acc. to EPA 610/550
Programmed fluorescence detection

Prepsolv®

Solvents for preparative chromatography

In order to facilitate scale-up from analytical to a preparative scale, Prepsolv® HPLC solvents are available for the special requirements of preparative chromatography. These are characterised by an extremely low evaporation residue (< 1 mg/l) and a low water content. Preparative chromatography installations using significant quantities of high quality solvents have to ensure that the solvents are delivered and used in the right way to ensure optimum results. Merck provides all relevant solvents for large-scale application in returnable stainless steel barrels preferentially in 30 and 185 l or 1,000 l stainless steel containers, which are inert to the chemical contents, strong for repeated transport and are provided complete with two types of opening for versatility of connection. The extensive range of withdrawal systems ensure that the solvents can always be safely and easily used without any risk of contamination. If desired Merck will supply tailor-made volumes to fit the need of the individual customer.

1,000 l stainless steel container

Specifications of Prepsolv® solvents

Item	Purity (GC) min. [%]	Evap. residue max. [mg/l]	Water max. [%]	Acidity max. [meq/g]	Alkalinity max. [meq/g]	UV-transmission at nm	
						50 %	98 %
Acetonitrile	99.8	1	0.05	0.0005	0.0002	220	240
Methanol	99.8	1	0.05	0.0005	0.0002	225	265
2-Propanol	99.8	1	0.05	0.0005	0.0002	220	260

Ordering information of Prepsolv®

Item	Ordering No.	Content	Packaging
Acetonitrile	1.13358.2500	2.5 l	glass bottle
	1.13358.9030	30 l	stainless steel returnable barrel
	1.13358.9185	185 l	stainless steel returnable barrel
	1.13358.9910	1,000 l	stainless steel 1,000 l container
Ethylacetate	1.13353.9030	30 l	stainless steel returnable barrel
n-Hexane	1.04394.9030	30 l	stainless steel returnable barrel
Methanol	1.13351.2500	2.5 l	glass bottle
	1.13351.9030	30 l	stainless steel returnable barrel
	1.13351.9185	185 l	stainless steel returnable barrel
2-Propanol	1.13350.2500	2.5 l	glass bottle
	1.13350.9910	100 l	stainless steell 1,000 l container

LiChropur® reagents for analytical HPLC

Ion pair reagents and buffers

Ion pair reagents – what are they?

These are strong hydrophobic ions which form neutral ion pairs which oppositely charged sample molecules. In this way, the simultaneous separation of charged and non-charged molecules is possible.

LiChropur® reagents have been selected with particular respect to the high degree of UV-transmittance even at low detection wavelengths.

Which columns and eluents can be used with these reagents?

They can be used basically with all stationary phases; the eluent should contain at least 10 % water as otherwise there is a danger of precipitation (especially if acetonitrile is the organic component).

When using long-chained ion pair reagents such as cetyltrimethylammonium hydrogen sulphate or the sodium salt of dodecanesulphonic acid, the column used for the separation should be reserved for this exclusive purpose as irreversible adsorption can take place on the stationary phase leading to changes in separation behaviour.

What concentrations ca be used?

In practice, a concentration of 5 x 10^{-3} mol/l has proved valuable for short-chained ion pair reagents and 5 x 10^{-4} mol/l for long-chained ion pair reagents.

How can buffers be prepared?

Instructions for preparing buffer solutions with LiChropur® ion pair reagents are included in the product package (according to chromatographic requirements, these instructions may be altered).

Ordering information of ion pair reagents for analytical HPLC LiChropur®

Designation	Ordering No.	Package	Quantity
1-Butanesulfonic acid sodium salt	1.18303.0025	Glass	25 g
1-Pentanesulfonic acid sodium salt	1.18304.0025	Glass	25 g
1-Hexanesulfonic acid sodium salt	1.18305.0025	Glass	25 g
1-Heptanesulfonic acid sodium salt	1.18306.0025	Glass	25 g
1-Octanesulfonic acid sodium salt	1.18307.0025	Glass	25 g
1-Dodecanesulfonic acid sodium salt	1.18308.0025	Glass	25 g
1-Dodecylhydrogensulfate sodium salt	1.18309.0024	Glass	25 g
Tetramethylammonium hydrogen sulfate	1.18310.0025	Glass	25 g
Tetrabutylammonium hydrogen sulfate	1.18312.0025	Glass	25 g
Cetyltrimethylammonium hydrogen sulfate	1.18313.0025	Glass	25 g

1.18305

Ordering information of Buffer salts for HPLC LiChropur®

Designation	Ordering No.	Package	Quantity
di-Potassium hydrogen phosphate trihydrate	1.19754.0250	Glass	250 g
di-Sodium hydrogen phosphate dihydrate	1.19753.0250	Glass	250 g

1.19754

Sample Preparation

The number of samples to be analysed is constantly on the increase: Comprehensive control of the most important parameters helps to ensure product quality, prevent damage and maintain quality of life. The development of high performance analytical instruments, highly sensitive detectors and the advances in the compilation and collation of measurement data contribute much to this.

In order to be able to utilise the possibilities offered by instrument analysis, the sample must be optimally prepared. This is often the most time-consuming and critical step of the entire analysis. Selective and specific sample preparation ensures rational, economic and meaningful analysis.

The goals of sample preparation are:

- The removal of interfering sample components.
- Selective enrichment of the substances to be analysed.

If no sample preparation is carried out, the HPLC as well as the GC column may become blocked and in extreme cases this can lead to the irreversible adsorption of substances onto the column. Analyte enrichment can increase the detection sensitivity of the detector by a factor of 100 to 5,000. Only then can the substances be identified and quantitatively determined in the required concentration range: If this enrichment step cannot be carried out reliable analysis in the trace range is not possible.

Apart from products for purely mechanical sample preparation procedures, e.g. filtration, we developed, in the mid 70s, the Extrelut® sorbents and columns specially for sample preparation of aqueous matrices; thus we introduced the efficient method of liquid-liquid extraction. With the LiChrolut® sorbents and extraction columns for solid-phase extraction, a further efficient alternative to classical extraction using a separating funnel is on offer. LiChrospher® ADS represents the third line of products for sample preparation, namely LC-integrated sample preparation.

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EXtrelut®

Liquid-liquid extraction in its most effective form

EXtrelut® NT simplifies liquid-liquid extraction by replacing separation funnels. Using a single step is more efficient, saves solvent, material and time.

Classical extraction using a separation funnel is often associated with certain disadvantages: Formation of emulsion, poor phase separation, high solvent consumption, low degree of automation and high personnel costs.

In contrast liquid-liquid extraction is more efficient using EXtrelut® NT. The simple and excellent performance of EXtrelut® NT eliminates emulsions and therefore higher recoveries and cleaner extracts can be achieved.

The capacity of EXtrelut® NT prepacked columns for aqueous samples is specified by the designation, i.e.

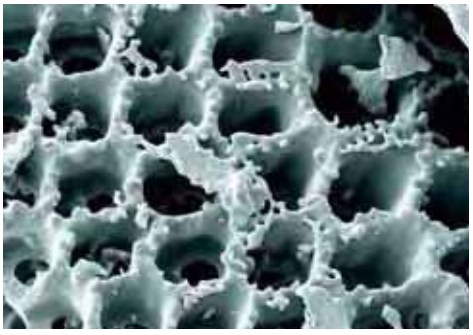
EXtrelut® NT1 can take up a maximum of 1 ml of aqueous sample,

EXtrelut® NT3 three ml and

EXtrelut® NT20 up to 20 ml of sample.

Significantly smaller samples must be appropriately diluted. If larger volumes are applied, the columns are overloaded; water breaks through into the solvent. Elution is carried out with 2-3 times the sample volume. The liquid may simply be allowed to run through the column. The column outlet cannula regulates the solvent flow appropriately.

Depending on the application requirements three types of columns are available:



Diatomaceous Earth for EXtrelut® NT

Specifications of EXtrelut® NT

Characteristics:	Specially processed, wide-pore kieselguhr with a high pore volume; chemically inert; naturally occuring product
Capacity limit with aqueous sample:	1 ml (EXtrelut® NT1), 3 ml (EXtrelut® NT3) and 20 ml (EXtrelut® NT20) without any breakthrough
pH range:	pH 1-13
Uniform batch-to-batch quality	

are available as glass columns. This is particularly recommended if high degrees of purity have to be achieved for subsequent analyses. The column filling is kept between two pure paper filters.

EXtrelut®NT20 is a special polyethylene column which avoids contamination of the sample that might otherwise occur when using conventional plastics and plasticisers. This also applies to the special adhesive-free glass fibre and pure paper filters.

Ordering information of EXtrelut® NT

EXtrelut® NT prepacked columns

Designation	Ordering No.	Contents of one package
EXtrelut®NT1 glass coloumns for 0.1 to 1 ml sample solution	1.15094.0001	100 columns
EXtrelut®NT3 glass columns for 1 to 3 ml sample solution	1.15095.0001	50 columns
EXtrelut®NT 20 polyethylene columns including special outlet cannulae for up to 20 ml sample solution	1.15096.0001	25 columns

These products are not intended for use as in-vitro diagnostics in terms of European Directive 98/79/EC. They are for research purposes only, for investigating in-vitro samples derived from the human body without any medical objective.

1.15094

1.15095

1.15096

EXtrelut® NT refill packs and bulk materials

EXtrelut®NT20 refill packs have an absorption capacity (g of aqueous sample/g EXtrelut® NT support) of the respective EXtrelut® NT batch but with a different weight. These are defined in such a way that at least 20 ml of aqueous sample (+ 10 % reserve) can be absorbed. Thus, one complete refill pack should be used for every EXtrelut® NT20 column. The individual packs allow the content to be emptied without any remaining residues. Refill packs also include glass fibre (24 mm) and pure paper filters (10 mm) for the EXtrelut®NT20 columns.

EXtrelut®NT packing material is available in 1 kg quantity. The absorption capacity of this packing material should first be established by carrying out pre-testing of the respective batch. This filling material is ideal for applications which require large volume columns.

EXtrelut® NT packing material

Designation	Ordering No.	Contents of one package
EXtrelut®NT bulk packing for preparing large-volume-columns	1.15092.1000	1 kg
EXtrelut®NT refill packs for refilling 50 EXtrelut®NT20 columns (incl. Replacement filters)	1.15093.0001	50 bags

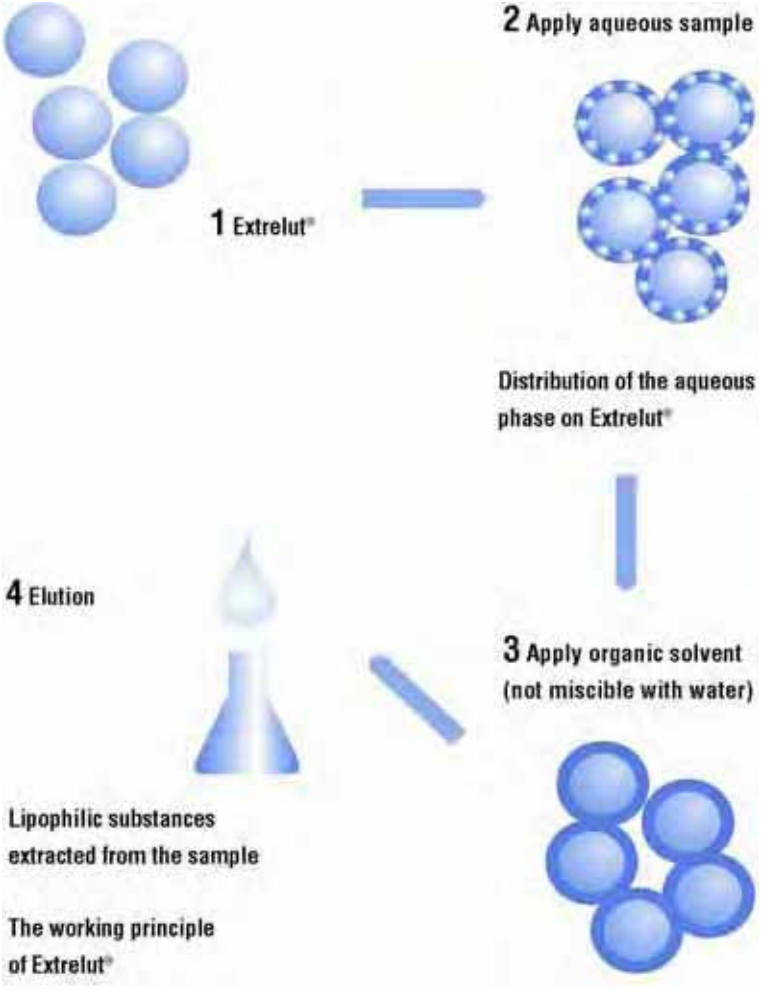
1.15093

EXtrelut® NT accessories

Designation	Ordering No.	Contents of one package
EXtrelut® NT accessories cannulae 0.60/30 with Luer tip for EXtrelut® NT1 and NT3	1.15373.0001	100 pieces
EXtrelut® NT collection tubes with tapered bottom and screw cap (normal capacity 15 ml) for EXtrelut® NT1 and NT3	1.15622.0001	30 pieces
Replacement filter for EXtrelut® NT1 (10 mm Ø)	1.14236.0001	100 pieces
Replacement filter for EXtrelut® NT3 (15 mm Ø)	1.14237.0001	100 pieces
Replacement filter for EXtrelut® NT20 (24 mm Ø)	1.14567.0001	50 pieces

EXtrelut® NT Working principle

The aqueous sample is applied to the EXtrelut® NT sorbent. It distributes itself in the form of a thin film over the chemically inert matrix and thus acts as a stationary phase. Subsequently, elution takes place using organic solvents that are nonmiscible with water, solvents like e.g. diethyl ether, ethyl acetate or halogenated hydrocarbons. All the lipophilic substances are extracted from the aqueous into the organic phase. During this process the aqueous phase remains on the stationary phase. The eluate is free from emulsions and can be evaporated for further analysis.



The working principle of Extrelut®

Important EXtrelut® NT extraction parameters

EXtrelut NT® extraction columns	Outlet cannulae	Maximum sample volume [2] (ml)	Waiting period [3] (before elution) (min)	Recommended elution volume [4] (ml)
EXtrelut® NT 1	0.60 x 30 mm	1	5 - 10	6
EXtrelut® NT 3	0.60 x 30 mm	3	5 - 10	15
EXtrelut® NT 20 [1]	0.70 x 30 mm	20	10 - 15	40

1. When using EXtrelut® NT 20 columns, elution times are between 5 and 20 min depending on the type of aqueous solution, the pH and the solvent. 40 ml of eluent gives 25 ml of eluate. The dead volume of the column is about 15 ml. Sometimes the eluate may be turbid when mixtures with high contents of hydrophilic components are used. Such turbidity does not interfere with the subsequent concentrating step.
2. In order to prevent that water breaks through the sample, don't overload the column.
3. Shorter waiting times can affect the recoveries adversely.
4. The recommended sample volumes must be adhered to. Solutions of smaller volumes must be diluted to give indicated volumes.

Application example of EXtrelut® NT

EXtrelut® NT has been used for quite some time for the sample preparation of urine, whole blood, plasma, serum, gastric juice, liquor, amniotic fluid, faeces, animal and plant tissue. Other applications are in the areas of environmental and residue analysis, e.g. the analysis of industrial, domestic and waste water. The fractionated elution of acidic and basic substances like e.g. drugs and their metabolites from body fluids is also possible.

Determination of antiepileptic drugs (AEDs) in serum

500 µl serum
500 µl phosphate buffer*

↓ *Apply in sequence onto the column*

EXtrelut® NT1

↓ *Wait 8 minutes*

1 ml dichloromethane / 2-propanol (9+1)

↓ *Wait 10 minutes then elute with*

6 ml dichloromethane / 2-propanol (9+1)

↓ *Evaporate to dryness under nitrogen stream*

Redissolve residue in 1 ml of methanol

↓

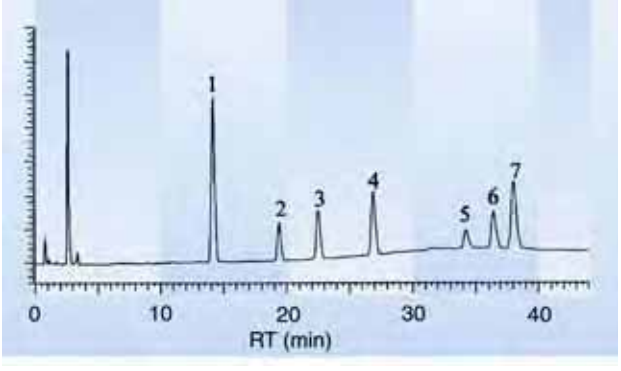
Inject 10 µl into HPLC column

** = 17.6 g NaH_2PO_4, 4.5 g Na_2HPO_4 2 H_2O, 1.5 g NaN_3, dissolve in 1 l water (pH 6.0-6.1)*

Important EXtrelut® NT extraction parameters

HPLC separation of AEDs after sample preparation with EXtrelut® NT1

HPLC conditions			
HPLC	LaChrom® system		
Column	LiChroCART® 250-4 LiChrospher® RP-select B 5 µm Cat. No. 1.50839		
Mobile phase	A. Water LiChrosolv®, Cat. No. 1.15333 Acetonitrile LiChrosolv® (1+1), Cat. No. 1.00030 B: Water LiChrosolv®, Cat. No. 1.15333		
Gradient	Time/min 0 30 44 44.1 50 51 75	%A 10 60 60 100 100 10 10	%B 90 40 40 0 0 90 90
Flow	1 ml/min		
Temperature	30 °C		
Detection	UV 205 nm		



Recoveries (mean values N = 3)

1	Ethosuximide*	14.1 min	84 ± 7 %
2	Primidone	19.4 min	100 ± 2 %
3	a-Methyl-a-propylsuccinimide	22.5 min	Internal standard
4	Phenobarbital	26.9 min	96 ± 2 %
5	Hexobarbital	34.2 min	99 ± 2 %
6	Carbamazepine	36.4 min	97 ± 1 %
7	Phenytoin	38.0 min	100 ± 1 %
	*ethosuximide is volatile on evaporation		

LiChrolut®

Solid-phase extraction (SPE) with LiChrolut® – the reliable and rapid route to successful sample preparation

The primary goal of solid-phase extraction with LiChrolut® is the selective extraction of the components of interest from a complex sample or much larger sample volume prior to actual analysis (e.g. HPLC, GC, TLC). As solid-phase extraction works on the principle of liquid chromatography, this is achieved by using strong but reversible interactions between the analyte and surface of the stationary phase. Typical interactions are e.g. hydrophobic (Van-der-Waals forces), polar (hydrogen bonding, dipole-dipole forces) or ion exchange interactions. Interaction between stationary phase and matrix should not occur. It is thus meaningful to carry out appropriate sample pretreatment as this emphasises the differences in chemical properties between the substance to be analysed and matrix components so that these are then achieved by altering the pH or the ionic strength of the sample solution. Under these conditions, the analyte is enriched as a narrow zone on the stationary phase. Subsequent to a washing step, which serves to remove possible adsorbed sample components, the actual selective elution of the analytes takes place.

Solid-phase extraction with LiChrolut® offers the analyt

- Rapid sample preparation within minutes.
- Higher recoveries without the formation of emulsion.
- High precison of analytical results by use of disposable cartridges.
- Saving of solvent and hence reduction in both materials costs and cost of disposal.
- Possibilities for automating the entire process.
- Optimised, validated and certified manufacturing.

Specifications of LiChrolut®

Characteristics:	High porosity synthetic silica gel particles
Particle size:	40-63 µm
Pore size:	60 Å
Specific surface area:	~ 600 m^2/g
Stability:	pH 2-8
Wide spectra of chemically modified phases:	Si 60 high purity, NH_2, CN, RP-18e, RP-18, SCX (strong cation exchanger), TSC (Tox Screening Cation)

Specifications of Florisil

Characteristics:	magnesia-loaded silica gel
Particle size:	150-250 µm

→ LiChrolut® EN - highest capacity for solid-phase extraction 27

LiChrolut®

Solid-phase extraction (SPE) with LiChrolut®
– the reliable and rapid route to successful sample preparation

Ordering Information of LiChrolut®

Designation	Ordering No.	filling amount	tube size	Contents of one package
Florisil (150-250 µm)	1.19127.0001	1.000 mg	6 ml PP	30 pieces
LiChrolut® CN (40-63 µm)	1.19698.0001	200 mg	3 ml PP	50 pieces
LiChrolut® CN (40-63 µm)	1.19699.0001	500 mg	3 ml PP	50 pieces
LiChrolut® EN (40-120 µm)	1.19693.0001	200 mg	3 ml Glas	30 pieces
LiChrolut® EN (40-120 µm)	1.19870.0001	200 mg	3 ml PP	30 pieces
LiChrolut® EN (40-120 µm)	1.19691.0001	500 mg	6 ml PP	30 pieces
LiChrolut® EN / RP-18 (top)	1.19912.0001	100 / 200 mg	6 ml PP	30 pieces
LiChrolut® RP-18 (40-63 µm)	1.19855.0001	100 mg	1 ml PP	100 pieces
LiChrolut® RP-18 (40-63 µm)	1.02014.0001	200 mg	3 ml PP	50 pieces
LiChrolut® RP-18 (40-63 µm)	1.02023.0001	500 mg	3 ml PP	50 pieces
LiChrolut® RP-18 (40-63 µm)	1.19687.0001	500 mg	6 ml PP	30 pieces
LiChrolut® RP-18 (40-63 µm)	1.02122.0001	1.000 mg	6 ml PP	30 pieces
LiChrolut® RP-18 (40-63 µm)	1.19686.0001	2.000 mg	6 ml PP	30 pieces
LiChrolut® RP-18 endcapped (40-63 µm)	1.19847.0001	200 mg	3 ml PP	50 pieces
LiChrolut® RP-18 endcapped (40-63 µm)	1.19849.0001	500 mg	3 ml PP	50 pieces
LiChrolut® SCX (40-63 µm)	1.02016.0001	200 mg	3 ml PP	50 pieces
LiChrolut® SCX (40-63 µm)	1.02022.0001	500 mg	3 ml PP	50 pieces
LiChrolut® Si (40-63 µm)	1.02021.0001	200 mg	3 ml PP	50 pieces
LiChrolut® Si (40-63 µm)	1.02024.0001	500 mg	3 ml PP	50 pieces
LiChrolut® Si / Na_2SO_4 (top)	1.19120.0001	1,000 / 2,000 mg	6 ml PP	50 pieces
LiChrolut® TSC (40-63 µm)	1.19767.0001	300 mg	3 ml	50 pieces

1.02023

1.19128

1.02024

Characterisation of LiChrolut®

The LiChrolut® sorbents are subject to stringent quality control which begins with the selection of the raw materials. Continuous quality control of the raw material through immediate steps to the final product ensures the user constant batch-to-batch quality. The batch-to-batch reproducibility of LiChrolut® sorbents is ensured by one particular characteristic, the capacity. The capacity, measured in "mg analyte/g sorbent" means that under identical test conditions, the various batches adsorb and desorb the same quantity of analyte. In the case of LiChrolut® RP-phases and LiChrolut® EN this is characterised by the caffeine capacity for hydrophilic substances and by the diisodecylphthalate capacity (DIDP) for lipophilic substances. Capacity determination in the case of LiChrolut® NH_2 is carried out with 4-nitrophenol and benzyldimethyldodecylammonium bromide. The capacity of LiChrolut® SCX is determined with dopamine hydrochloride.

The multi-stage purification procedures carried out on LiChrolut® raw materials become particularly valuable when it comes to trace analysis. The proportion of elutable components is negligibly small, which results in more pure extracts. The specially developed, validated and certificated production processes ensure a high degree of purity of the LiChrolut® sorbents. As all stationary phases are monitored with the most sensitive analytical methods, it is ensured that the very narrow set tolerances can be adhered to, thus providing the user with a highly pure material of uniform quality.

LiChrolut® EN

– highest capacity for solid-phase extraction

LiChrolut® EN was especially developed for application in environmental analysis where on the one hand highly contaminated samples occur and on the other hand very polar organic compounds have to be analysed. Due to the extremely large specific surface (approximately 1.200 m^2/g according to the BET-method) the adsorption capacity for polar organic substances like e.g. triazines, phenylurea compounds, phenoxycarboxylic acids, phenols, naphthols, aromatic nitro compounds and anilines is excellent. In comparison to LiChrolut® RP-18, LiChrolut® EN has a tenfold higher capacity. Thus, only 200 mg of sorbent is sufficient for reproducible extractions and high recovery rates. LiChrolut® EN offers the following advantages:

- Use of common organic solvents, buffer solutions, acids and bases over the entire pH-range.
- Saving of solvent, as little solvent is required for conditioning and elution of the cartridge bed.
- Time saving, as less adsorbent requires less time for conditioning and drying.
- Improved analysis, as the reduced quantity of solvent required for elution leads to a lower degree of contamination and to an increase in detection sensitivity.

Specifications of LiChrolut® EN

Sorbent type:	Ethyl vinyl benzene divinyl benzene polymer (orange)
Particle shape:	irregular
Particle size distribution:	40 - 120 µm
Specific surface:	1200 m^2/g (according to BET)
Pore volume:	0.75mL/g
Stability:	pH 1 to pH 13
Capacity:	500 mg Caffeine/g sorbent (model substance for polar analytes) 500 mg Diisodecylphthalate DIDP/g sorbent (model substance for non-polar analytes).

Figure 1: Ensured capacity of LiChrolut® EN incomparison to LiChrolut® RP phases. The increase of sorbent capacity (by a factor of at least 10) in comparison to commonly used C-18 sorbent means that only 200 mg of LiChrolut® EN are necessary for the complete enrichment of different contaminants from water.

LiChrolut® EN

– highest capacity for solid-phase extraction

Ordering Information of LiChrolut® EN

LiChrolut® EN columns

Designation	Ordering No.	Filling amount	Tube size	Contents of one package
LiChrolut® EN (40-120 µm)	1.19693.0001	200 mg	3 ml Glas	30 pieces
LiChrolut® EN (40-120 µm)	1.19870.0001	200 mg	3 ml PP	30 pieces
LiChrolut® EN (40-120 µm)	1.19691.0001	500 mg	6 ml PP	30 pieces
LiChrolut® EN /RP-18 (top)	1.19912.0001	100/200 mg	6 ml PP	30 pieces

LiChrolut® EN sorbents

Designation	Ordering No.	Contents of one package
LiChrolut® EN for environmental analysis	1.19853.0020	20 g

Application of LiChrolut® EN

Analysis flow diagram – sample preparation of a drinking water samples

Anilines pH 9 with NaOH	Explosives pH 5.5 - 6.0	Solid phase extraction LiChrolut EN, 200 mg, 3 mL	Pesticides pH 5.5 - 6.0	Phenols pH 2 with 25 % HCl
3 mL ethyl acetate 3 mL methanol 3 mL Water	3 mL methanol 3 mL water	conditioning	3 mL methanol 3 mL water	3 mL ethyl acetate 9 mL water, pH 2
1000 mL sample within 2 h	1000 mL sample within 2 h	sample application	1000 ml sample within 2 h	1000 ml sample within 2 h
1 mL water	not required	wash	1 mL water	1 mL water, pH 2
1 min with nitrogen	not required	dry	10 min with nitrogen	5 min with nitrogen
2 x 1.5 ml methanol/ acetonitrile/acetone (50/50/1)	2 x 1.5 ml acetonitrile/ methanol (50/50)	elution	2 x 3 mL methanol/ ethyl acetate (50/50)	3 x 0.3 mL ethyl acetate

LiChrolut® EN

– highest capacity for solid-phase extraction

Typical applications LiChrolut® EN

general remark	mixed polarity copolymer; perfectly suited for mixed polar analytes (sorbent provides both polar and non-polar interaction sites), for trace analysis (extremely high surface area of 1200-1400 m^2/g!) and for extreme pH conditions (sorbent stability from pH 1-13)
typical analytes:	environmental pollutants: fungicides, herbicides, phenols, pesticides, parabens, hydrocarbons, pharma: antibiotics, barbiturates, benzodiazepines, caffeine, drugs and their metabolites, food & beverage: dyes, essential oils, organic acids, fat/water soluble vitamins, steroids, phthalate esters, surfactants, theophylline.
typical matrix:	polar; aqueous buffer, serum, plasma, urine, beverages, environmental samples (waste/drinking water, soil)
typical eluent:	organic solvent; alcohols, acetonitrile, hexane, methylene chloride, ethyl acetate

Pesticide recovery rates of samples of tap water (N = 10) containing the 33-multicomponent standard (c = 200 ng/l per pesticide)

Pesticide	Recovery rate ± rsd (%)	Pesticide	Recovery rate ± rsd (%)
1. Desisopropylatrazine	100 ± 2.7	18. Metobromuron	99 ± 3.2
2. Metamitron	98 ± 1.4	19. Metazachlor	108 ± 5.6
3. Chloridazon	96 ± 1.8	20. Methoprotryne	99 ± 3.8
4. Desethylatrazine	101 ± 2.6	21. Dimefuron	100 ± 1.7
5. Crimidine	86 ± 3.2	22. Sebutylazine	99 ± 1.7
6. Carbetamide	87 ± 3.8	23. Propazine	102 ± 1.9
7. Bromacil	103 ± 3.4	24. Terbutylazine	98 ± 1.5
8. Simazine	99 ± 1.7	25. Linuron	97 ± 1.9
9. Cyanazine	100 ± 1.9	26. Chloroxuron	101 ± 1.1
10. Desethylterbutylazine	95 ± 2.2	27. Prometryne	95 ± 2.3
11. Karbutilate	82 ± 4.7	28. Chlorpropham	101 ± 2.8
12. Methabenzthiazuron	94 ± 2.4	29. Terbutryne	96 ± 1.6
13. Chlortoluron	100 ± 2.5	30. Metolachlor	102 ± 1.5
14. Atrazine	100 ± 3.8	31. Pencycuron	91 ± 2.5
15. Monolinuron	98 ± 1.8	32. Bifenox	102 ± 4.1
16. Isoproturon	101 ± 3.8	33. Pendimethalin	98 ± 5.0
17. Diuron	102 ± 5.0		

LiChrolut® extraction unit and drying attachment

All the individual steps associated with solid-phase extraction can be carried out using the LiChrolut® extraction unit rapidly and reliably. This transparent and vacuum-suitable unit made of glass can be used to prepare up to 12 samples simultaneously. It has the following characters:

- Control of the vacuum via a manometer located at the front.
- Individual and easy setting of the various flow rates using valves.
- Glass vessel, lid and standard accessories consist of inert and easily cleaned materials.
- Standard accessories enable various sized collection vessels from volumetric flasks to autosampler vials to be used.

1.19852

1.19851

Ordering information of LiChrolut® extraction unit and drying attachment

Designation	Ordering No.	Contents of one package
LiChrolut® extraction unit, complete	1.19851.0001	1 lid with 12 standard valves and seal, 1 glass chamber with gauge and vacuum valve, 12 standard stainless steel cannules, 1 collecting rack (base plate with 3 support rods, center plate, top plate with 10 mm boring and 12 clamps), 1 rack for volumetric flasks, 1 rack for test tubes 16 mm, 1 rack for autosampler vials
LiChrolut® drying attachment, complete	1.19852.0001	1 piece
Disposable fluoroplastic liners	1.19874.0001	100 pieces
Large volume capillaries	1.19902.0001	6 pieces stainless steel, electro-polished 2.0 o.d. x 1,5 i.d. x 300 mm lg
PTFE adapter Adapter (PTFE) Luer inlet for solvent reservoir, suitable for LiChrolut® columns of various sizes	1.02206.0001	10 pieces for 1.19828 and 1.19878 and all 1 and 3 ml PP SPE columns
Frits (PTFE) for 3 ml glass columns, porosity 10 µm	1.19891.0001	100 pieces

The LiChrolut® operating principle

Four steps are necessary for solid-phase extraction. These should be optimised in order to obtain maximum recovery.

1. Conditioning the sorbent

In the case of chemically modified silica gels, solvation with an organic solvent (acetonitrile or methanol) is necessary prior to the actual conditioning i.e. the preparation of the sorbent for the sample milieu with water or buffer solution (in order to be accessible for the analyte). This is a pre-requisite for reproducible sorption of the analyte. Excess organic solvent is removed using water or a buffer solution.

2. Application of the sample

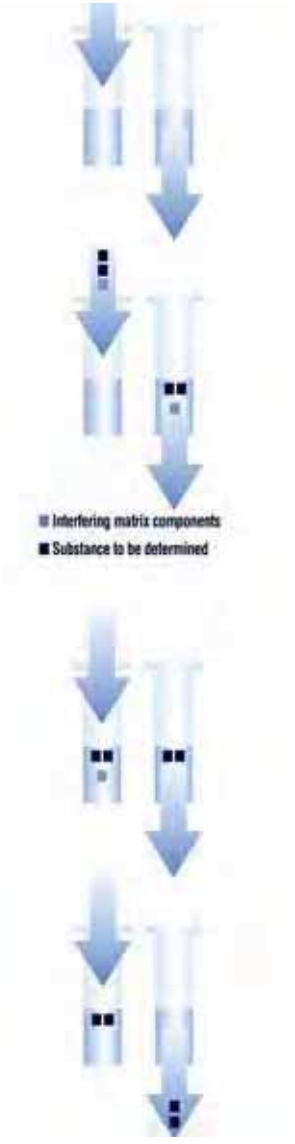
The sample solution is forced (by vacuum or pressure) through the conditioned extraction cartridge. In this process the substance to be analysed concentrates itself as a narrow zone on the sorbent. In the ideal case no matrix components will be adsorbed and run through the extraction cartridge to waste.

3. Washing

Other interfering matrix components are removed from the surface of the stationary phase with a small volume of water or buffer. A water buffer mixture containing a small quantity of methanol can also be used.

4. Elution of adsorbed analytes

In this final step of solid-phase extraction, the substance to be analysed is desorbed with a suitable solvent and eluted as a narrow zone. Subsequent to concentration or dilution of the eluate, analysis can follow immediately. The solvent should be so selected that the reaction between analyte and sorbent is weakened and a distribution of the analyte throughout the eluent takes place. Thus, for optimal choice of the solvent, extensive knowledge of the analyte and sufficient information regarding structure, solubility, polarity and lipophilic properties (distribution coefficients) are necessary.



The following tables expand this general principle to provide more pecific informtion for non-polar, polar and ionic compounds.

LiChrolut® selection guide

	LiChrolut® extraction column	typical sample matrix	typical sample subsances	typical elution solvent
Non-polar extraction	RP-18 RP-18e (endcapped) CN	Aqueous buffer solution	Aromatic ring systems, com-pounds with alkyl chains Aromatic ring systems	Acetonitrile, methanol, ethyl acetate
Polar extraction	Si CN NH_2	Hexane, oils, chlorin-ated hydrocarbons	Hydroxyl groups, amines, compounds with hetero atoms (S,N,O)	Methanol, 2-propanol
Cation exchange extraction	SCX (strong)	Methanolic/aqueous buffer with low ionic strength; 2 pH units under pK value of the sample substance	Cations: amines, pyrimi-dines	Aqueous buffer of high ionic strength (0.1 mol/l); 2 pH units over pK value of the sample substance
Mixed mode extraction	TSC	Body fluids**	Cationic and neutral analytes	Chloroform-acetone, NH_3-ethyl-acetate or NH3-methanol
Anion exchange extraction	SAX (strong) NH_2 (weak)	Methanolic/aqueous buffer wit low ionic strength; 2 pH units under pK value of the sample substance	Anions: carboxylic acids, sulfonic acids, phosphates	Aqueous buffer of high ionic strength (0.1 mol/l); 2 pH units over pK value of the sample substance
Non-polar extraction on a polymer phase	EN	Drinking, ground and surface water	Polar contaminants: pesti-cides, phenols, explosives, anilines	Ethyl acetate, methanol,acetonitrile: methanol (1:1)
Non-polar extraction on a polymer phase	EN	Body fluids**	Pharmaceuticals	Acetonitrile, methanol
Medium polar extraction of environmental pollutants	Florisil	Waste/ground/drinking water, soil samples	Herbicides, pestizides, PCBs, PCPs, dioxins, phe-nols, nitro compounds, HCHs	n-Hexane, dichloromethane

***These products are not intended for use as in-vitro diagnostics in terms of European Directive 98/79/EC. They are for research purposes only, for investigating in-vitro samples derived from the human body without any medical objective.*

For complete information please go to **Internet** site: www.merck.de/chromatography where you will find detailed information about products, an application guide to solid phase extraction and valuable product selection and trouble shooting information.

LiChrospher® ADS

For direct in-line sample preparation of untreated bio-fluids

LC-integrated sample preparation with LiChrospher® ADS is less expensive, less time consuming and more precise in comparison to conventional off-line sample preparation.

LiChrospher® ADS allows the direct extraction and enrichment of hydrophobic, low molecular analytes from untreated samples such as haemolysed blood, plasma, serum, milk, salivary fluid, fermentation broth, supernatants of cell cultures and tissue as well as food homogenates.

LiChrospher® ADS allows fully automated preparation of the sample prior to the analytes being separated in the column. This allows the untreated bio-fluid to be directly injected without negative effects on either the column or the results achieved.

LiChrospher® ADS sorbents belong to the family of restricted access materials (RAM) with two chemically different surfaces.

Extraction and fractionation with LiChrospher® ADS is based on the simultaneous performance of two chromatographic processes: reversed phase/ion-pair chromatography and size exclusion chromatography.

Three types of ADS precolumns are available showing different hydrophobicity and retention and extraction properties for non polar sample compounds:

LiChrospher® RP-4 ADS, LiChrospher® RP-8 ADS and LiChrospher® RP-18 ADS

LiChrospher® ADS Specifications

Sorbent Characteristic:	Spherical silica gel particles with tow chemical different surface modifications: 1. Exterior surface: DIOL modification 2. Interior surface (surface of pores): C-4, C-8, or C-18 modification ADS = Alkyl-DIOL-Silica
Particle size:	25 µm
Pore diameter:	60 Å (6 nm)

LiChrospher® ADS

For direct in-line sample preparation of untreated bio-fluids

Ordering information of LiChrospher® ADS

Packing material	Ordering No.	Particle size	Dimensions Length	Dimensions i.d.	Contents of one package
LiChrospher® RP-4 ADS cartridge set	1.50206.0001	25 µm	25 mm	4 mm	1 LiChroCART® 25-4 LiChrospher® RP-4 ADS 1 manu-CART® holder 25-4
LiChrospher® RP-4 ADS	1.50208.0001	25 µm	25 mm	4 mm	3 pieces
LiChrospher® RP-8 ADS cartridge set	1.50207.0001	25 µm	25 mm	4 mm	1 LiChroCART® 25-4 LiChrospher® RP-8 ADS 1 manu-CART® holder 25-4
LiChrospher® RP-8 ADS	1.50209.0001	25 µm	25 mm	4 mm	3 pieces
LiChrospher® RP-18 ADS cartridge set	1.50187.0001	25 µm	25 mm	4 mm	1 LiChroCART® 25-4 LiChrospher® RP-18 ADS 1 manu-CART® holder 25-4
LiChrospher® RP-18 ADS	1.50947.0001	25 µm	25 mm	4 mm	3 pieces
LiChrospher® ADS cartridge Kit	1.50210.0001	25 µm	25 mm	4 mm	1 LiChroCART® 25-4 LiChrospher® RP-4 ADS 1 LiChroCART® 25-4 LiChrospher® RP-8 ADS 1 LiChroCART® 25-4 LiChrospher® RP-18 ADS 1 manu-CART® holder 25-4
In-line filter holder	1.51193.0001				1 piece
LiChrospher® ADS In-line filter (replacement pack)	1.51192.0001				5 pieces

These products are not intended for use as in-vitro diagnostics in terms of European Directive 98/79/EC.
They are for research purposes only, for investigating in-vitro samples derived from the human body without any medical objective.

Characterisation of LiChrospher® ADS
Analysis of Biofluids

The task:	HPLC analysis of low molecular compounds (e.g. drugs, metabolites) in biological samples (e.g. blood, plasma, serum, milk, fermentation broth, supernatants of cell culture or tissue homogenates) Remove macromolecular compounds (e.g. proteins) prior to HPLC-analysis, as they are irreversibly bound or precipitated.
This leads to:	irreversible increase in back pressure loss of capacity drop in selectivity serious damage of HPLC column
The solution: LiChrospher® ADS:	Especially designed as precolumn packing(s) for coupled-column LC-analysis Outer particle surface is non-adsorptive towards matrix components due to its electroneutral and hydrophilic modification Inner pore surface is accessible only for low molecular compounds (MW < 15000 Dalton) and retention (extraction, enrichment) is due to classical (conventional) RP-partitioning Extraction and enrichment can be optimised by using either C-18, C-8 or C-4 modified LiChrospher® ADS

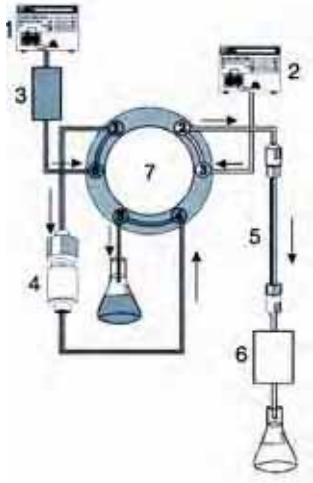
LiChrospher® ADS

For direct in-line sample preparation of untreated bio-fluids

The working principle

1. Sample Injection and fractionation

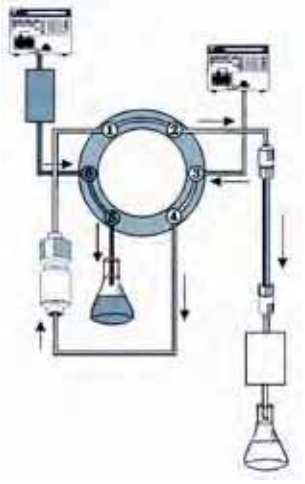
The sample is injected directly onto the precolumn. In an ideal situation the precolumn packing only retains, i.e. extracts and enriches the analyte(s) while all other sample components (unwanted matrix) are discharged to waste with the eluent delivered by pump 1.



1 = Pump 1
2 = Pump 2
3 = Sample injector
4 = Precolumn LiChroCART® 25-4 LiChrospher® ADS
5 = Analytical HPLC column
6 = detector
7= Six-port-valve

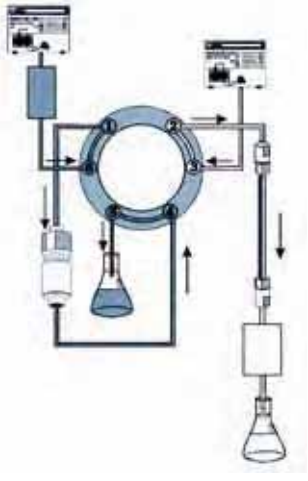
2. Transfer of the analytes to the analytical column

A conventional, manually or electrically driven six-port valve is used to couple the precolumn and a analytical column in series. An eluent delivered by pump 2 flushes the precolumn under reversal of the flow direction (back-flush peak compression). The stronger elution power of this eluent causes the analyte(s) to be desorbed from the precolumn and to be transferred on top of the analytical column.



3. HPLC-Separation

After switching back into the original valve position the analytes are separated in a conventional manner. While separation and detection take place, the precolumn is re-equilibrated with the initial eluent to be ready for the next sample injection.

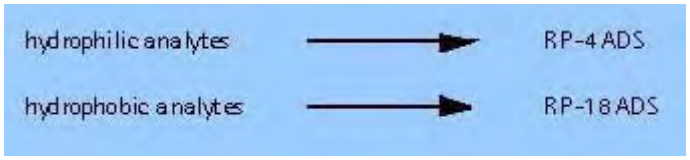


LiChrospher® ADS

For direct in-line sample preparation of untreated bio-fluids

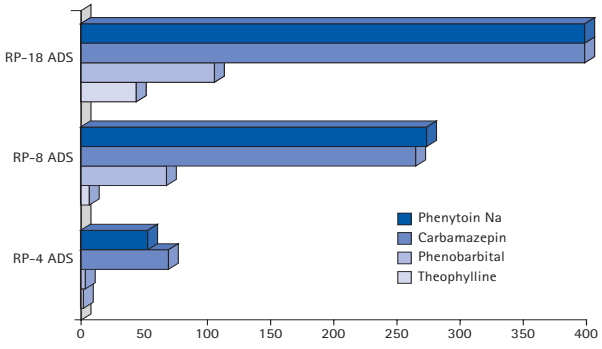
LiChrospher® ADS: Choose the right column

Three types of ADS precolumns are available showing different hydrophobicity and retention and extraction properties for non polar sample compounds:



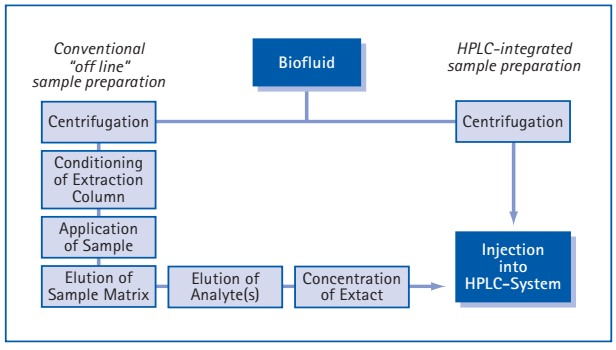
The selection of a LiChrospher® RP ADS precolumn with a low hydrophobicity has a further advantage with respect to the transfer step. E.g. if the sample cleanup is performed using a LiChrospher® RP-8 ADS precolumn and the analyte separation is achieved using a RP-18 column, then it is possible to lower the amount of organic modifier so that the transferred analyte fraction is enriched at the top of the analytical column.

Grafik 39 · ADS Choose.eps



Conventional "off line" sample preparation versus LC-integrated sample preparation

Grafik 40 · Offline–online.eps



The main advantages of LC-integrated sample preparation with LiChrospher® ADS are:

- No manual or robotic sample clean-up
- Direct injection of untreated biological fluids
- Fully automated, saving time and money
- Quantitative elimination of protein matrix
- On-column enrichment of analytes
- Classical reversed-phase or ion-pair chromatography during sample clean-up
- Quantitative, matrix-independent recovery
- Improved precision accuracy and sensitivity
- Increased analytical capacity
- High number of analysis cycles
- Low cost per sample

LiChrospher® ADS Instrumental Set-up

The LiChroCART® 25-4 LiChrospher® ADS precolumn is connected via a 6-port switching valve to a conventional analytical column. The 6-port valve used for column swtiching has - in contrast to a application valve - no direct sample or syringe inlet but an additional connection between connecting positions 4 - 5 or 5 - 6 subject to a 60 degree rotation. The valve can be operated manually, pneumatically or electrically.

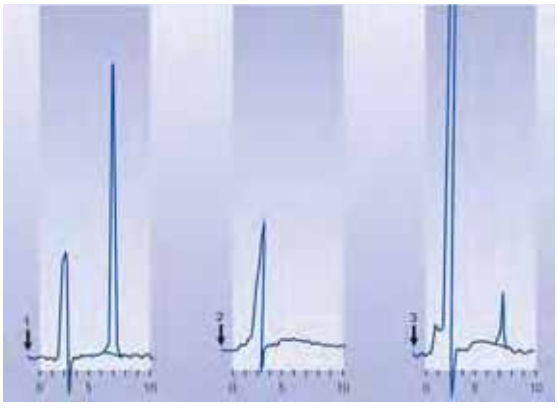
LiChrospher® ADS

For direct in-line sample preparation of untreated bio-fluids

Application of LiChrospher® ADS
Epirubicin in liver tumor

Precolumn	LiChrospher® RP-4 ADS, 20 x 4 mm i.d.
Analytical column	LiChrospher® 60 RP select B, 250 x 4 mm i.d.
Loading	95 % water, 5 5 methanol; 10 min at 1 ml/min
Transfer	30 % acetonitrile, 70 % water (0.1 % TEA, pH 2.0 with TCA) 5 min at 1 ml/min
Separation	30 % acetonitrile, 70 % water (0.1 % TEA, pH 2.0 with TCA) 10 min at 1 ml/min
Detection	Fluorescence Ex 445 nm, Em 560 nm
Sample	50 µl

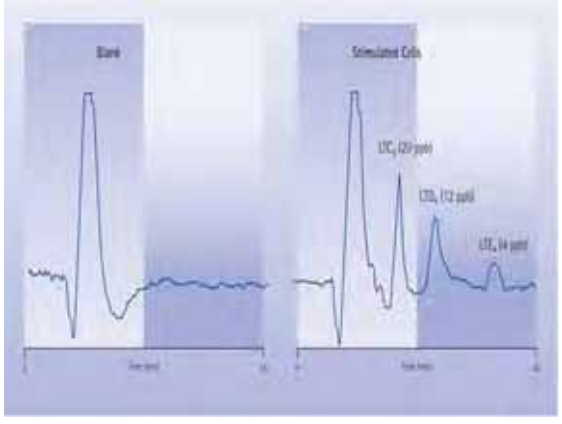
1. Standard: 4´-Epirubicin-HCl (31 ng/ml)
2. Supernantant of liver homogenate (protein 207 mg/ml)
3. Supernantant of liver tumor homogenate protein 1.34 mg/ml) after tumor chemoembolization with Lipiodol / 4´-Epirubicin-emulsion



HPLC / Integrated BioDetection of biomarkers in biological samples

On-line coupling of Bioassays to HPLC

Precolumn	LiChrospher® RP-4 ADS, 10 x 2.1 mm i.d.
Analytical column	Chromasil C4 100 x 2.1 mm i.d.
Mobile phase	Acetonitrile / 20 mM phosphate buffer pH 7.4 (30:70)
Flow rate	0.2 ml/min
Injection	500 µl
Label	Biodipy-LTE4
Antibody:	Monoclonal anti-LTD4
Reagent flow	0.4 ml/min for both antibody and label
Detection	Fluorescence Ex 544 nm, Em 572 nm
Sample	Sulfidpeptide leukotrienes



ProteoExtract® Kits:
Perfection in Sample Preparation

Proteomics related research reflects the increasing awareness of networks of cellular proteins as a pool for potential drug targets or for biological markers to detect disease conditions. This research area demands highly sophisticated sample preparation techniques from a variety of sources. ProteoExtract® Kits cover the different steps of the proteomics workflow, from protein extraction and abundant protein removal to digestion of proteins and selective capturing of phosphopeptides in order to provide valuable samples for downstream analytical applications like 2D Gel electrophoresis, Liquid chromatography and Mass Spectrometry.

Content

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ProteoExtract®
Phosphopeptide Enrichment Kits 46

for highly specific depletion of either albumin or albumin and IgG from serum, plasma or cerebrospinal fluid. Selective removal of these high-abundance proteins improves the detection of low-abundance protein of interest.

Specifications and Product features

Kit configuration	Contains columns and buffer for processing 12 samples
Sample type	Serum, plasma, CSF from human, rabbit, rat, mouse, pig
Sample volume	20-60µl
Binding capacity	0.7mg IgG, 2mg albumin
Background binding	<10%
Efficiency	>85%
Downstream applications	Gelelectrophoresis, LC/MS, SELDI, MALDI-TOF MS

Application

Sample complexity is significantly reduced, enabling the detection of low-abundance proteins. Removal Kits utilize a new albumin specific affinity resin and a unique immobilized protein A polymeric resin for highest specificity. The depletion procedure is performed using pre-filled disposable gravity-flow columns, allowing the parallel processing of multiple samples. The kits will also efficiently remove albumin from other species including rabbit, rat and mouse making it well suited for many proteomics studies.

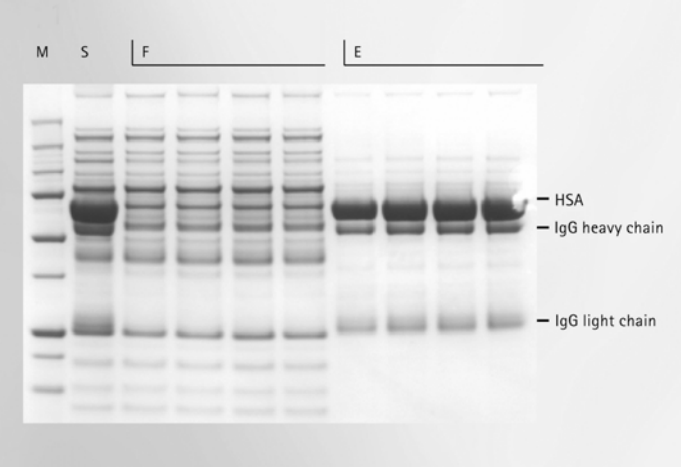

Fig. 1: Specific removal of albumin and IgG from human serum samples:
35 µl serum was processed with ProteoExtract albumin/IgG removal kit, analyzed on SDS-PAGE and visualized by Coomassie staining. Densitometric analysis of the eluate fraction (E) demonstrates that 88 % ± 5 % albumin and 90 % ± 4 % immunoglobulin are removed from the crude serum (S) using the ProteoExtract Kits.
M: Marker proteins; S: Crude human plasma; F: Flowthrough; Data shown in four replicates.

Ordering information of ProteoExtract® Kits

Designation	Ordering No.	Contents
ProteoExtract® Albumin Removal Kit	122640	12 samples
ProteoExtract® Albumin/IgG Removal Kit	122642	12 samples

These products are not intended for use as in-vitro diagnostics in terms of European Directive 98/79/EC. They are for research purposes only, for investigating in-vitro samples derived from the human body without any medical objective.

ProteoExtract® kits are marketed by Merck Biosciences and - in the US - EMD Biosciences.
For ordering please find contact numbers on page 266.

for (C-PEK) are designed for fast and reproducible extraction of total proteins from mammalian cells, tissue, bacteria or yeast samples to display complete proteomes.
C-PEKs provide a straight forward two-step isolation of complete proteomes in a single microcentrifuge tube.

Specifications and Product features

Kit configuration	Contains reagents for processing 20 samples
Sample type	mammalian cells, tissue, bacteria or yeast
Sample volume	2x 10^8 mammalian cells, 500mg tissue, 100ml of cell culture
Downstream applications	Gelelectrophoresis, immunoblots

Application

The kits extraction procedure yields a complete proteome for rapid analysis of protein expression patterns and monitoring protein modifications. The kits utilize optimised reagents for improved protein solubilization resulting in an increased total number of spots on 2DE gels. The samples are ready-to-use for 2DE, no concentration step is needed.

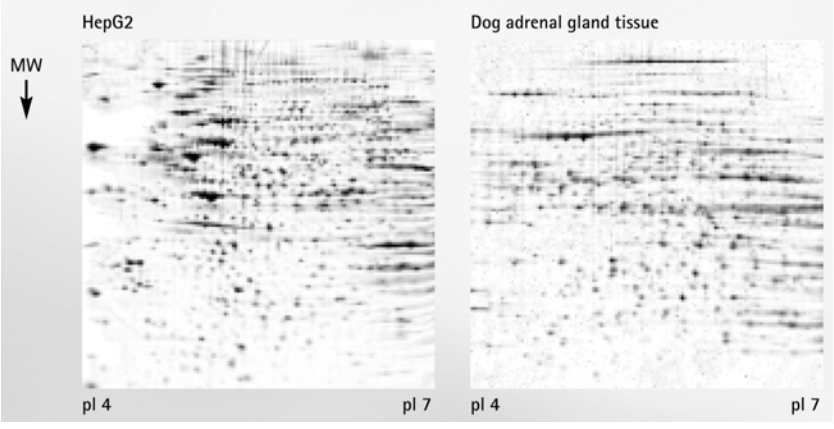

Fig. 2: Rapid extraction of complete proteomes:
The procedure of the kits yield virtually all proteins in one extract.
Images represent complete proteomes obtained from cells (HepG2) and tissue (adrenal gland).
150 µg total protein was separated by twodimensional Gelelectrophoresis and visualized by silver staining.

Ordering information of ProteoExtract® Kits

Designation	Ordering No.	Contents
ProteoExtract® Complete Mammalian Kit	539779	for 20 samples
ProteoExtract® Complete Yeast Kit	539775	for 20 samples
ProteoExtract® Complete Bacterial Kit	539770	for 20 samples

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For ordering please find contact numbers on page 266.

(P-PEK) are designed for the fractionation of complex protein mixtures from mammalian cells, tissue, bacteria or yeast samples revealing distinct partial proteomes with reduced complexity. P-PEKs fractionate proteins based on differential solubility into optionally two to four distinct fractions.

Specifications and Product features

Kit configuration	Contains reagents for processing 20 samples
Sample type	mammalian cells, tissue, bacteria or yeast
Sample volume	2x 10^8 mammalian cells, 500mg tissue, 100ml of cell culture
Fractions	2 - 4 fractions
Downstream applications	Gelelectrophoresis, immunoblots

Application

The reduction of the total proteome complexity by fractionation considerably enhances the total number of proteins detected. The kits extraction procedure yields protein fractions enriched in subsets of cellular proteins and thus enhances the total number of proteins detected.

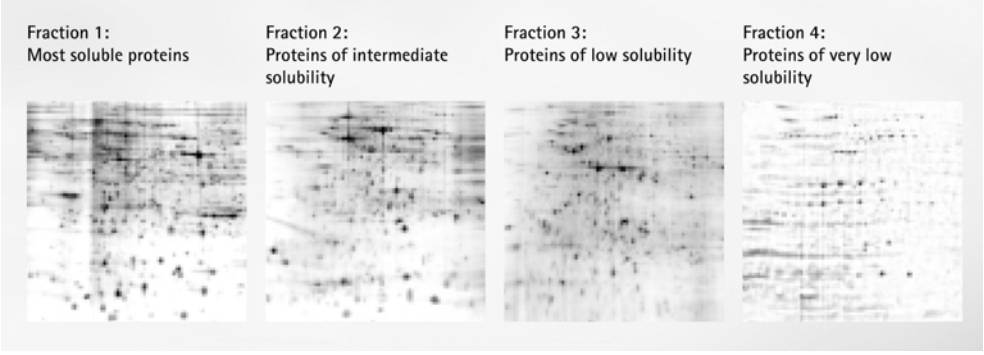

Fig. 3: Proteome fractionation through solubility of proteins:
Human HepG2 cells were extracted sequentially following the procedure of the mammalian Partial Proteome Extraction kit. Each fraction was subjected to twodimensional Gelelectrophoresis and visualized by silver staining. Image analysis revealed that three times as many spots are detectable in the four gels as compared to complete extraction (see also Fig.2).

Ordering information of ProteoExtract® Kits

Designation	Ordering No.	Contents
ProteoExtract® Partial Mammalian Kit	539789	for 20 samples
ProteoExtract® Partial Yeast Kit	539785	for 20 samples
ProteoExtract® Partial Bacterial Kit	539780	for 20 samples

These products are not intended for use as in-vitro diagnostics in terms of European Directive 98/79/EC. They are for research purposes only, for investigating in-vitro samples derived from the human body without any medical objective.

ProteoExtract® kits are marketed by Merck Biosciences and - in the US - EMD Biosciences.
For ordering please find contact numbers on page 266.

ProteoExtract®
Subcellular Proteome Extraction Kit

(S-PEK) is designed for standardized isolation of proteins according to their subcellular localization in different cell compartments of mammalian cells. S-PEK utilizes proprietary chemistries to yield four sub-proteomes enriched in cytosolic, membrane/organelle, nuclear and cytoskeletal proteins.

Specifications and Product features

Kit configuration	Contains reagents for processing 20 samples
Sample type	Mammalian tissue culture cells, mammalian dissociated tissue
Sample volume	10^6-10^7 cells, 25-50 mg tissue
Fractions received	4 fractions: cytosolic, membrane/organelles, nuclear, cytoskeletal
Downstream applications	1 & 2DE, ELISA, SELDI, activity assays, arrays

Application

The especially mild extraction procedure of the kit yields proteins in their functional & native state making it particularly well suited for sensitive proteomics application like subcellular redistribution assays to monitor protein translocation, signalling proteins after phosphorylation, enzyme activity assays including reporter gene assays and kinase assays, profiling using SELDI or micro-arrays.

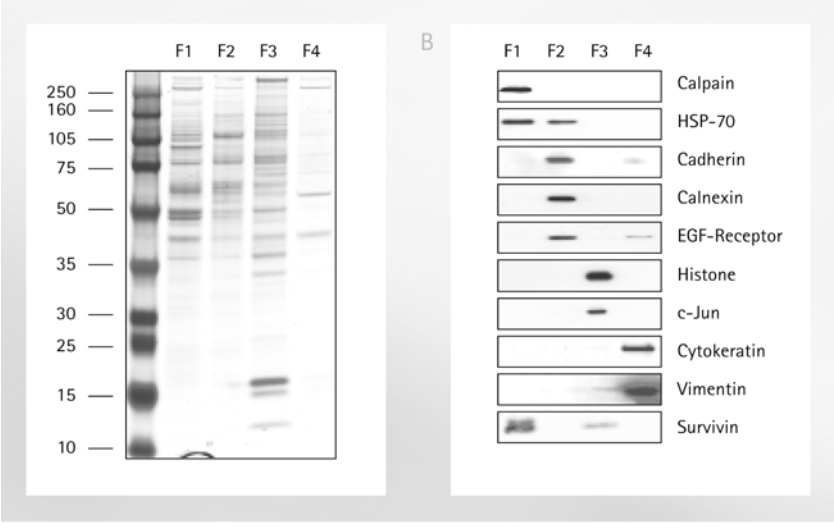

Fig. 4: Distinct protein profiles of different subcellular compartments:
Onedimensional Gelelectrophoresis of four subcellular fractions:
Cytosol (F1), Membrane/Organelle (F2), Nucleus (F3) and Cytoskeleton (F4).
Section B shows the immunoblots of the corresponding fractions using specific antibodies for the assigned marker proteins. The marker proteins are detected in the corresponding fractions as expected. Survivin is an apoptosis inhibitor to be localized in the cytosol and nucleus.

Ordering information of ProteoExtract® Kits

Designation	Ordering No.	Contents
ProteoExtract® Subcellular Proteome Extraction Kit	539790	for 20 samples

These products are not intended for use as in-vitro diagnostics in terms of European Directive 98/79/EC. They are for research purposes only, for investigating in-vitro samples derived from the human body without any medical objective.

ProteoExtract® kits are marketed by Merck Biosciences and - in the US - EMD Biosciences.
For ordering please find contact numbers on page 266.

(M-PEK) is designed for the isolation of native membrane proteins from mammalian cells and tissue. M-PEK extracts proteins from mammalian samples based on the actual association of proteins with cellular membranes. The procedure does not require ultracentrifugation or incubation of samples at elevated temperatures.

Specifications and Product features

Kit configuration	Contains reagents for processing 20 samples
Sample type	Adherent & suspension tissue culture cells, mammalian tissue
Sample volume	2-5x 10^6 cells 25-50mg tissue
Processing time	1-1.5h from sample to membrane protein fraction
Downstream applications	1 & 2DE, co-immunoprecipitation ELISA, enzyme activity assays

Application

The mild extraction procedure yield membrane proteins in their native functional state. The kits straight forward two-step procedure results in 3-5 fold enrichment of membrane proteins, allows processing of multiple samples in parallel and thus making it particularly suitable for a variety of assays including enzyme activity assays like kinase assays, assaying post-translational modifications of membrane proteins, such as phosphorylation, SELDI-profiling of integral and membrane associated proteins, NHS ester labeling of membrane proteins for array detection and others.

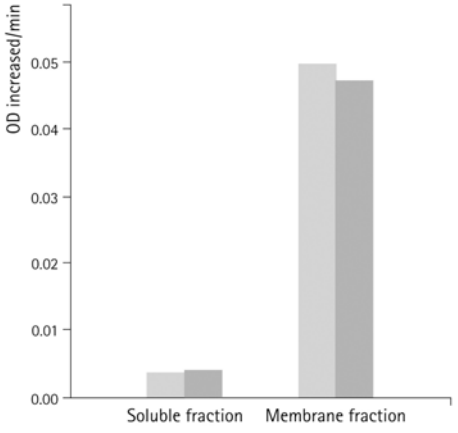

Fig. 5: Mild extraction of membrane proteins:
HEK293 cells were used for membrane protein extraction following the kits procedure. The two fractions were assayed for endogeneous alkaline phosphatase activity. The activity profile reveals the selective separation of this GPI-anchored membrane protein and demonstrates its active and thus functional state.

Ordering information of ProteoExtract® Kits

Designation	Ordering No.	Contents
ProteoExtract® Native Membrane Protein Extraction Kit	444810	for 20 samples

These products are not intended for use as in-vitro diagnostics in terms of European Directive 98/79/EC. They are for research purposes only, for investigating in-vitro samples derived from the human body without any medical objective.

ProteoExtract® kits are marketed by Merck Biosciences and - in the US - EMD Biosciences.
For ordering please find contact numbers on page 266.

provides all reagents needed for tryptic digests of three sample types: polyacrylamid-gel spots, protein solutions or protein suspensions of tissue homogenates. Each protocol is optimised using affinity purified Trypsin which ensures efficient digestion of protein samples whatever their origin.

Specifications and Product features

Kit configuration	Contains reagents for 100 samples
Sample type	PA Gel spot, protein in solution, protein tissue homogenate
Sample volume	25µl (100µg protein)
Processing time	3h to complete digest
Downstream applications	LC/MS, peptide arrays

Application

High digestion efficiency using the kit results in a superior yield of tryptic peptides - even with hard to digest proteins, and thus showing improved LC-MS peak patterns and a 20 to 30% increased sequence coverage after MS analysis. As a consequence comprehensive analysis of post-translational modifications such as phosphorylation site identification is possible.

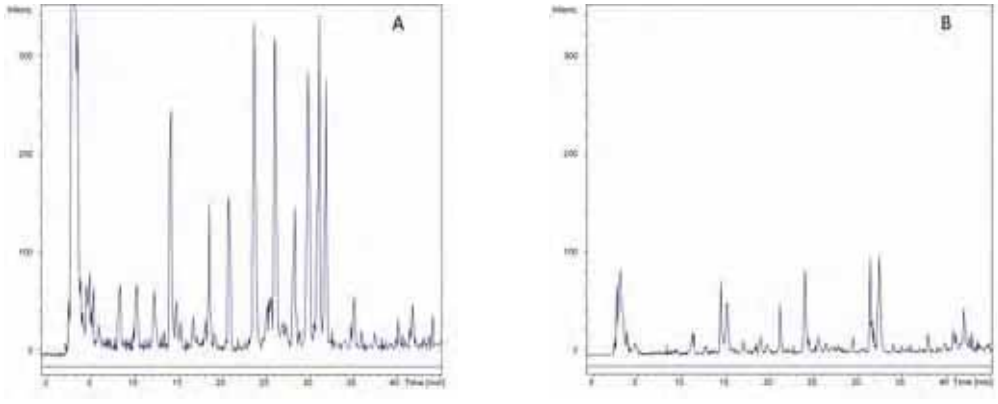

Fig. 6: **Enhanced detection due to high yield of tryptic peptides:**
Ovalbumin, a hard to digest protein from chicken egg, was used as a sample for Proteoextract All-in-one Trypsin digestion kit (A) and a competitor product (B).
The base peak chromatograms of nanoLC/MS runs compare the two samples and clearly demonstrate the high yield of peptides detectable by MS using the ProteoExtract kit.

Ordering information of ProteoExtract® Kits

Designation	Ordering No.	Contents
ProteoExtract® All-in-One Trypsin Digestion Kit	650212	for 100 samples

These products are not intended for use as in-vitro diagnostics in terms of European Directive 98/79/EC. They are for research purposes only, for investigating in-vitro samples derived from the human body without any medical objective.

ProteoExtract® kits are marketed by Merck Biosciences and - in the US - EMD Biosciences.
For ordering please find contact numbers on page 266.

enables the user to isolate both specifically and quantitatively phosphorylated peptides derived from cleaved or digested protein samples or from kinase reactions designed for phosphorylation site identification. Two new kits are offered: one is based on Titanium Dioxide and the other is a Zr- IMAC method combined with a pre-treatment step to decrease acidic peptides that cause high background. The enriched fraction can be directly analyzed by mass spectrometry.

Specifications and Product features

Kit configuration	contains reagents for the specific isolation of phosphopeptides
Sample type	Proteolytic digests of protein samples (gel spots, protein solutions)
Sample volume	up to 2.5 nmole phosphopeptides
Processing time	approx. 30min to isolate phosphorylated peptide species
Downstream applications	LC/MS or MALDI-MS

Application

The ProteoExtract® Phosphopeptide Enrichment TiO_2 Kit uses a novel titanium dioxide material to enable identification of large numbers of phosphorylated species from complex protein mixtures. The titanium dioxide is highly selective for phosphorylated peptides in the presence of abundant non-phosphorylated peptides. Enrichment and selectivity for phosphopeptides is further improved by using a Dihydroxybenzoic Acid (2,5-DHB) "displacer" concentration that is directly compatible with LC-MS and MALDI-MS analysis.

The ProteoExtract® Phosphopeptide Enrichment SCIMAC Kit utilizes two sequential chromatography steps. First, samples are applied to a strong cation exchange resin. This resin depletes acidic peptides that interfere with down-stream purification and analysis. The eluate from the cation exchange resin is subsequently applied to a Zr- IMAC resin. The IMAC resin selectively captures phosphorylated peptides with a unique metal affinity resin.

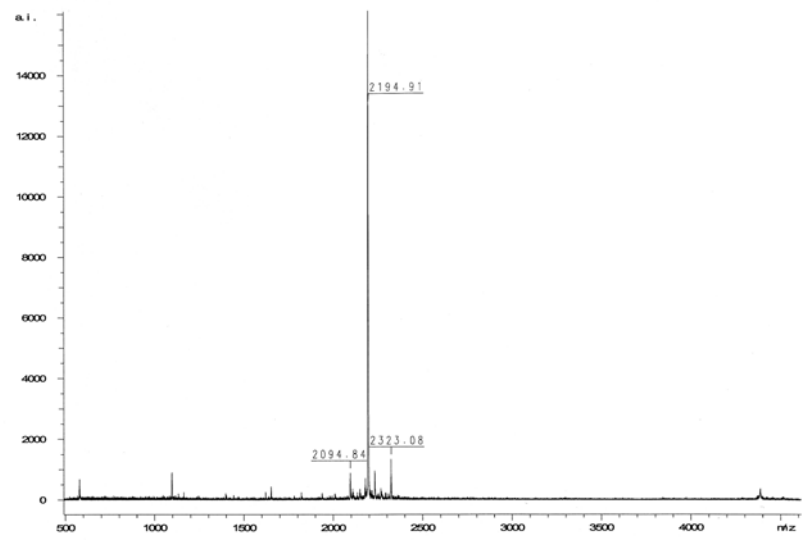

Fig. 7: Specific and sensitive phosphopeptide enrichment with reduced background from complex mixtures.
A complex peptide mixture derived from a tryptic digest of porcine liver extract was spiked with alpha-casein and two synthetic phosphopeptides and subsequently processed using kit protocol for Titanium dioxide. Mass spectrometry analysis was performed using an ESI-LC/MS equipment operated in positive mode. Only monophosphorylated phosphopeptides were detectable under these conditions.
A: Unprocessed sample
B: Enrichment of phosphopeptides using Titanium dioxide. The predominant signals derive from phosphopeptide ions (marked with arrows) and the majority of non-phosphorylated peptides was completely removed.

Ordering information of ProteoExtract® Kits

Designation	Ordering No.	Contents
ProteoExtract® Phosphopeptide Enrichment TiO_2 Kit	539722	for 100 samples
ProteoExtract® Phosphopeptide Enrichment SCIMAC Kit	539723	for 100 samples

These products are not intended for use as in-vitro diagnostics in terms of European Directive 98/79/EC. They are for research purposes only, for investigating in-vitro samples derived from the human body without any medical objective.

ProteoExtract® kits are marketed by Merck Biosciences and - in the US - EMD Biosciences.
For ordering please find contact numbers on page 266.

Chromolith® HPLC Columns

Chromolith® HPLC columns provide excellent separations in a fraction of the time that a standard particulate column will take, because they are made from highly porous monolithic rods of silica with a revolutionary bimodal pore structure. **The column is no longer packed with small particles but consists of a single piece of high-purity polymeric silica gel.**

The Chromolith® HPLC columns are available as "ready-to-use columns" (no cartridge holder required).

Chromolith® HPLC columns are manufactured from the same metal-free silanes from which high-purity particulate silica columns (eg. Purospher®) are made. This minimizes the time required to adapt an existing method from a particulate column to a Chromolith® column.

Longer Lifetime and Less Matrix-Sensitivity with biological samples are advantages of Chromolith® columns reported by customers. Because of the rigid monolithic silica structure, column lifetime is substantially enhanced.

Speed of analysis and lower operating pressure are the most important benefits of Chromolith® columns. Compared with a 5µm particulate column, the speed of analysis can be typically 4-times faster.

Alternatively, multiple columns can be coupled together to give efficiencies up to 100,000 plates at normal pressures!

With Chromolith® HPLC columns, flow gradient methods are particularly attractive.

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Chromolith® Si 62
Chromolith® Guard Cartridges and Cartridge Kit 64
Chromolith® Column Coupler 66

Chromolith® SemiPrep 100-10 mm RP-18 endcapped
Perfect Scale-up from analytical to preparative LC 68

Chromolith® CapRod
Monolithic Capillary 71

Chromolith® HPLC Columns

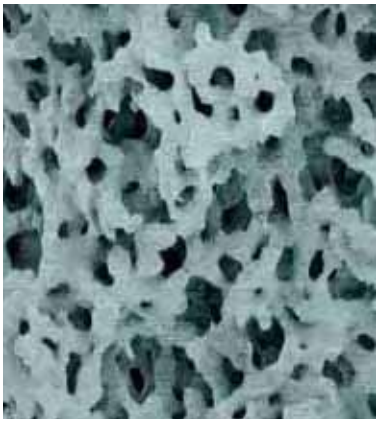
Speed and Performance in Monolithic Form

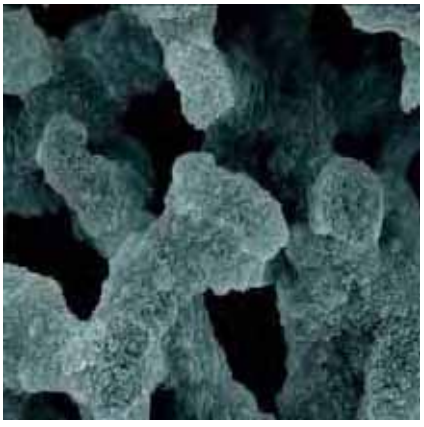
Chromolith® HPLC columns provide excellent separations in a fraction of the time that a standard particulate column will take, because they are made from highly porous monolithic rods of silica with a revolutionary bimodal pore structure. The column is no longer packed with small particles but consists of a single piece of high-purity polymeric silica gel.

This revolutionary bimodal pore structure provides a unique combination of macropores and mesopores.

The **Macropores** allow rapid flow of the mobile phase at low pressure. Their average size is 2 µm.

The **Mesopores** form the fine porous structure (average pore size 13 nm) and create the large uniform surface area on which adsorption takes place, thereby enabling high performance chromatographic separation.





Benefits of Chromolith® HPLC Columns at a glance

1. Speed of Analysis
   - Separations two times faster at half the column back-pressure compared to 5 µm columns
   - Higher sample throughput - separations up to 9 times faster if required
   - Fast column re-equilibration between analyses
2. Improved HPLC system security
   - Significantly increased column lifetime
   - Reduced maintenance on HPLC pump and injector seals
   - Reduced need for sample preparation as columns very resistant to blocking (even with biological samples)
3. Column length no longer pressure limited
   - Very high separation efficiency by column coupling
4. Standard HPLC instruments are ideally suited for use with Chromolith® HPLC columns
   - Chromolith® columns cladded in PEEK are very easy-to-use and handle
5. Cost savings from increased sample throughput can justify the expense of a method revalidation within one month

Characterisation of Chromolith® HPLC Columns

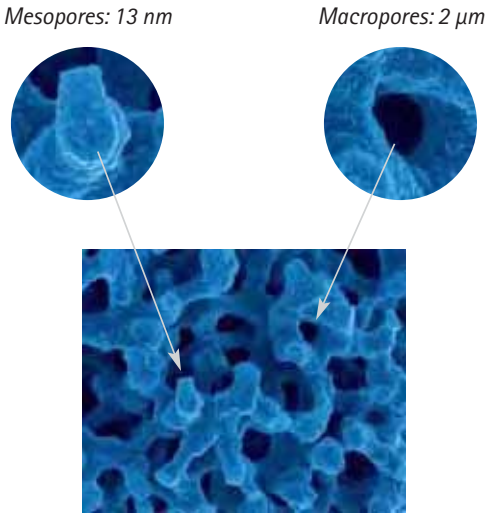
The use of HPLC columns containing the classic 3 or 5 µm small silica particles often results in high back pressure. This high back pressure may damage both the column and the HPLC system; therefore, classic HPLC columns have limited length and a limited number of theoretical plates. Attempts have been made to increase the plate count by decreasing the particle size, but this results in unacceptable back pressure and limits the variety of separations that can satisfactorily be achieved.

Particularly in industry, chromatographers are trying to find ways of balancing the need to analyse more samples with the limited financial and human resources available. Many of today's scientists wish to speed-up the entire separation process and therefore accelzeration of the analysis processes has become one of the most important issues in the high performance liquid chromatography. Laboratory automation of HPLC systems has come a long way toward improving sample throughput by enabling 24 hours a day operation. The systems, however, are still limited by the separation technology itself, that is, the separation columns available.

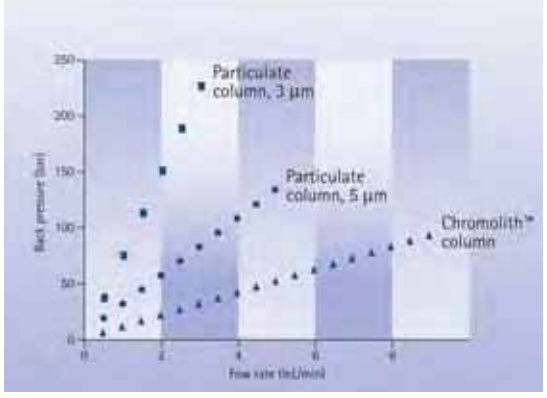
Chromolith®HPLC columns provide excellent separations in a fraction of the time that a standard particulate column will take, because they are made from highly porous monolithic rods of silica with a revolutionary bimodal pore structure. The column is no longer packed with small particles but consists of a single piece of high-purity polymeric silica gel.

Speed of Analysis

Macropores reduce the column back-pressure and allow the use of faster flow rates, thereby considerably reducing the analysis time. Mesopores form the fine porous structure and provide the very large active surface area for high efficiency separations.



Total porosity > 80 %



Column back pressure at different flow rates
Comparison of a Chromolith® Performance column vs. equivalent classical particulate HPLC columns

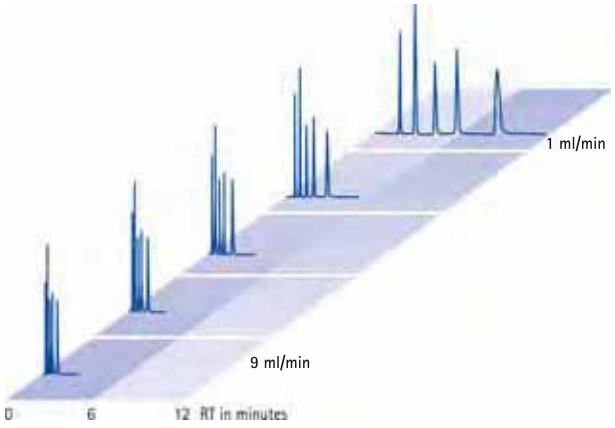
Chromolith® HPLC Columns

Speed and Performance in Monolithic Form

With Chromolith® columns flow rates can now easily be varied from 1 mL up to 9 mL per minute with the same high quality resolution.

A mixture of five beta-blocking drugs demonstrates the extreme time savings and high separation efficiency made possible with Chromolith® columns. Due to excellent mass transfer properties of the monolithic skeleton, high-speed separation is possible even at high flow rate. The beta-blockers were well separated with excellent peak symmetry. At 9 mL/min, the analysis time is less than 1 minute and the column back-pressure is only 153 bar.

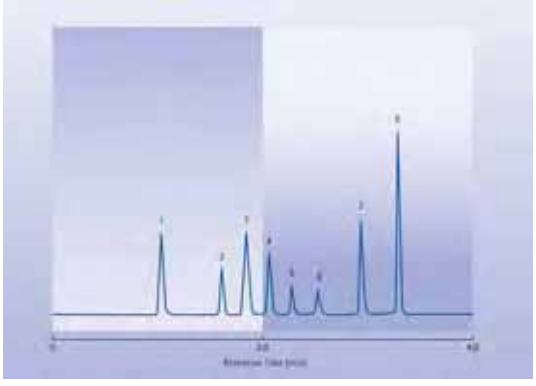
Column	Chromolith® Performance RP-18 endcapped (100 mm x 4.6 mm)
Mobile Phase	Isocratic acetonitrile / 0.1 % trifluoroacetic acid in water, 20/80 (v/v)
Pressure	Total pressure (including HPLC system) 25°C, UV 220 nm, 5 µL Injection
Analytes	• 63 µg/ml Atenolol • 29 µg/ml Pindolol • 108 µg/ml Metoprolol • 104 µg/ml Celiprolol • 208 µg/ml Bisoprolol



Flow Programming

Chromolith® columns are very responsive to changes in flow rate.
Flow rates can be changed in mid flow to either enhance the peak definition of the target compound or to shorten the total separation time once the target compound has successfully eluted. This is of particular value to more clearly separate two closely eluting peaks without affecting significantly the total run time. Likewise, it can also reduce total run time when certain compounds elute much later than all the other components of the sample.

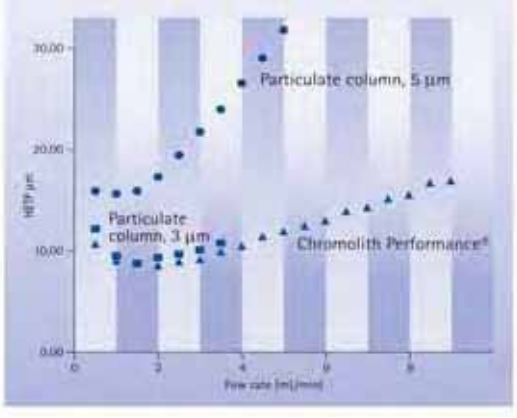
Column	Chromolith® Performance RP-18 endcapped (100 mm x 4.6 mm)			
Mobile Phase	A: Acetonitrile B: 0.1 % Phosphoric acid in water			
Double gradient	Time	%A	%B	Flow rate
	0 min	35	65	3 ml/min
	1.8 min	46	54	3 ml/min
	2.2 min	80	20	5 ml/min
	3 min	80	20	5 ml/min
Pressure	90 bar maximum total pressure			
Temperature	22 °C			
Detection	UV 254 nm			
Injection volume	10 µL			
Sample	1. Phenol 2. 2-Chlorophenol 3. 2-Nitrophenol 4. 2,4-Dinitrophenol 5. Chloro-3-methylphenol 6. 2,4-Dinitro-6-methylphenol 7. 2,4,6-Trichlorophenol 8. Pentachlorphenol			



High separation efficiency

Even the traditional plate count method of measuring quality shows that Chromolith® is better than a standard 5 µm particulate column and as good as a 3.5 µm, but with the ability to continue up to 9 mL/min without reaching HPLC system pressure limits.

The van Deemter plot of the Chromolith® column demonstrates clearly that separation efficiency does not decrease significantly when the flow rate is increased, as is the case with particulate columns. It is therefore possible to operate monolithic columns at high flow rates with minimal loss of peak resolution.



A van Deemter plot of the height equivalent to a theoretical plate (HETP) vs. flow rate for a Chromolith® Performance column and equivalent classical particulate HPLC columns

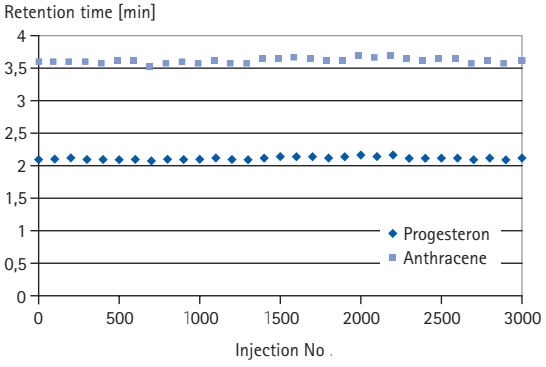
For complex separations it is still necessary to use long columns in order to provide the separation efficiency required for resolution of all compounds of interest. Chromolith® HPLC columns can be connected in series to produce a column with high plate count at low back-pressure. (Please see Chromolith® column coupler).
With particulate columns further column length is prevented by excessive back pressure.

Robustness, Reliability and Versatility

Long column lifetime and high resistance to column blockage reduce costs per analysis and enhance data integrity.

Chromolith® HPLC columns have demonstrated immense robustness and set a new standard for long column lifetime. The rigid monolithic silica skeleton with 2 µm macropores is the reason for this improved performance.

The following diagram shows the results of a stability test with 3,000 injections and 50,000 column volumes of mobile phase.



Cost savings

Using Chromolith® the time of analysis is much shorter than when using a particulate column. The cost per analysis can usually be halved at least, thereby paying back method revalidation expenses in about 3 weeks.

1 hour HPLC lab time in USA typically	costs	$ 100	per hour
Revalidating one HPLC method requires 3 weeks lab time and	costs	$ 12,000	per revalidation
New faster Chromolith® HPLC method cuts analysis time by 50 % saving 4 hours per day	saves	$ 400	per day
Run the new faster Chromolith method for 30 days	total savings	$ 12,000	after 30 days, revalidation has paid for itself
After running the new faster Chromolith® method for one year	total savings	$ 80,000	assuming only 200 days

Chromolith® RP-18 endcapped

For more information on new 2 mm and 3 mm i.d. products, ask for the latest Chromolith® brochure

Chromolith® RP-18 endcapped columns are the fastest C18 columns in the world. They offer:

- high throughput at high flow rates with the best overall column quality
- the possibility of flow gradients
- added column performance by column coupling
- a rigid monolithic structure for a longer lifetime
- less matrix-sensitivity

As the chemical basis of the Chromolith® RP-18 endcapped columns from the starting materials up to the surface modification procedures is the same as with the high-end conventional packed columns they possess a selectivity comparable to high-quality C18 endcapped packed reversed-phase columns. Therefore the chromatographer can use the standard methods when developing a new protocol.

Chromolith® columns for reversed phase chromatography are based on a high-purity silica, the gold standard in HPLC, to reduce the negative effect of trace metals. They are chemically modified with n-alkyl chains with a high ligand density and then fully endcapped in order to reduce the effect of unmodified silanol groups.

Specifications of Chromolith® RP-18 endcapped

Silica type:	High-purity
Particle size	Monolithic
Macropore size	2 µm
Mesopore size	13 nm (130 Å)
Pore volume	1 ml/g
Total porosity	> 80 %
Surface area	300 m^2/g
Surface modification	RP-18 endcapped
Carbon content	18 %

Ordering information of Chromolith® RP-18 endcapped

Product name and description	Ordering No.	Diameter	Length	Contents of one package
Chromolith® Performance RP-18 endcapped	1.02129.0001	4.6 mm	100 mm	one HPLC column
Chromolith® SpeedRod RP-18 endcapped	1.51450.0001	4.6 mm	50 mm	one HPLC column
Chromolith® Flash RP-18 endcapped	1.51463.0001	4.6 mm	25 mm	one HPLC column
Chromolith® Performance RP-18 endcapped Validation Kit	1.51466.0001	4.6 mm	100 mm	three HPLC columns
Chromolith® Performance RP-18 endcapped	1.52001.0001	3 mm	100 mm	one HPLC column

→ Chromolith® RP-8 endcapped 60
→ Chromolith® Si 62
→ Chromolith® Guard Cartridges and Cartridge Kit 64
→ Chromolith® Column Coupler 66
→ Chromolith® SemiPrep 100-10 mm RP-18 endcapped Perfect Scale-up from analytical to preparative LC 68
→ Chromolith® CapRod Monolithic Capillary 71
→ Chromolith® prep Chromolith® - increase in speed, efficiency and productivity 197

Chromolith® RP-18 endcapped

For more information on new 2 mm and 3 mm i.d. products, ask for the latest Chromolith® brochure

Chromolith® RP-18 endcapped Products

Three different column length of Chromolith® RP-18 endcapped are available: such as the Chromolith® Flash RP-18e, the Chromolith® SpeedROD RP-18e and the Chromolith® Performance RP-18e columns, which are opening the door to high-speed separations!

Chromolith® Flash (25 mm length)	for ultra-fast separation of simple mixtures
Chromolith® SpeedROD (50 mm length)	for fast separation of simple mixtures
Chromolith® Performance (100 mm length)	for rapid separation of more complex mixtures

Chromolith® Flash RP-18 endcapped (25-4.6 mm)

Chromolith® Flash RP-18 endcapped columns are very short and perfect for ultra-fast analysis simple mixtures.

The length of the column is 25 mm and therefore the number of theoretical plates of the Chromolith® Flash RP-18 endcapped column is sufficient for easy separations. The major focus of the Chromolith® Flash RP-18endcapped columns is clearly on the speed of analysis, since it provides the chromatographer with the fastest HPLC column, which is available on the market!

Chromolith® SpeedROD RP-18 endcapped (50-4.6 mm)

Chromolith® SpeedROD RP-18 endcapped columns are short and perfect for fast analysis.

Chromolith® SpeedROD RP-18 endcapped HPLC columns are ideal for use in rapid screening of samples especially for the in-process control as well as in research laboratories or those specialising in organic synthesis, e.g. combinatorial chemistry.

Chromolith® Performance RP-18 endcapped (100-4.6 mm and 100-3 mm)

Chromolith® Performance RP-18 endcapped columns provide rapid high quality separation of complex multi-component mixtures. They are therefore perfect for use as a routine analytical tool in the quality control laboratory or in research laboratories where more complex mixtures are being analysed.

Chromolith® RP-18 endcapped

For more information on new 2 mm and 3 mm i.d. products, ask for the latest Chromolith® brochure

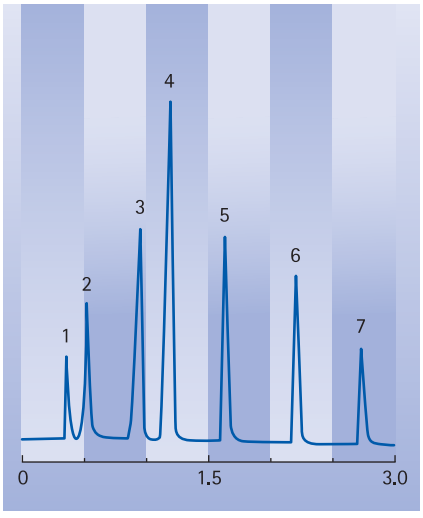
Chromolith® Performance RP-18 endcapped Validation Kit

For correct method validation, it is essential to assess all possible sources of variations. To assist the validation process, the Chromolith® Validation Kit includes three columns from three different production batches, in order to compare the batch-to-batch reproducibility and quality. The Chromolith® Performance RP-18 endcapped Validation Kit is therefore perfect for use as an appropriate tool in quality control laboratories or in validation laboratories. The cost and time savings through use of Chromolith® columns can repay the expense of a method revalidation within one month.

Separation examples

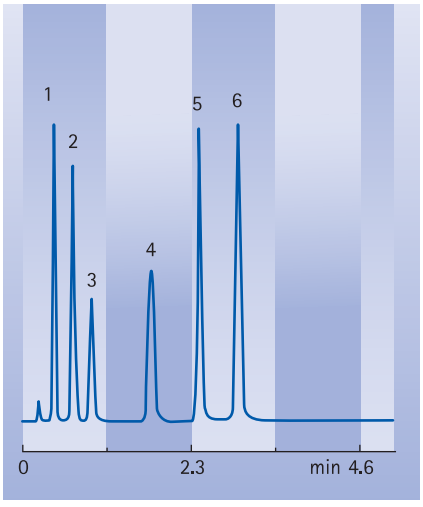
Chromolith® Performance RP-18 endcapped

Column	**Chromolith® Performance RP-18 endcapped, 100-4.6 mm**		
Mobile phase	A: Acetonitrile B: 20 mM Phosphate buffer pH 4,5		
Gradient	Time/min 0,0 3,0	%A 20 60	%B 80 40
Flow rate	4 ml/min		
Detection	230 nm		
Temp.	22 °C		
Inj.Volume	10 µl		
Sample	1. Ascorbic acid 2. 4-Hydroxybenzoic acid 3. Benzoic acid 4. Sorbic acid 5. Methyl 4-hydroxybenzoate 6. Ethyl 4-hydroxybenzoate 7. Propyl 4-hydroxybenzoate		100 µg/ml 100 µg/ml 100 µg/ml 50 µg/ml 100 µg/ml 150 µg/ml 100 µg/ml



Chromolith® SpeedROD RP-18 endcapped

Column	**Chromolith® SpeedROD RP-18 endcapped, 50-4.6 mm**		
Mobile phase	A: Acetonitrile B: 0,01M Phosphate buffer pH 5,0		
Gradient	Time/min 0,0 2,5 2,6 5,0	%A 3 3 8 8	%B 97 97 92 92
Flow rate	4 ml/min		
Detection	227 nm		
Temp.	ambient		
Inj.Volume	10 µl		
Sample	1. Acesulfame-K 2. Saccharin 3. Benzoic acid 4. Sorbic acid 5. Caffeine 6. Aspartame		23 µg/ml 29 µg/ml 13 µg/ml 14 µg/ml 47 µg/ml 100 µg/ml

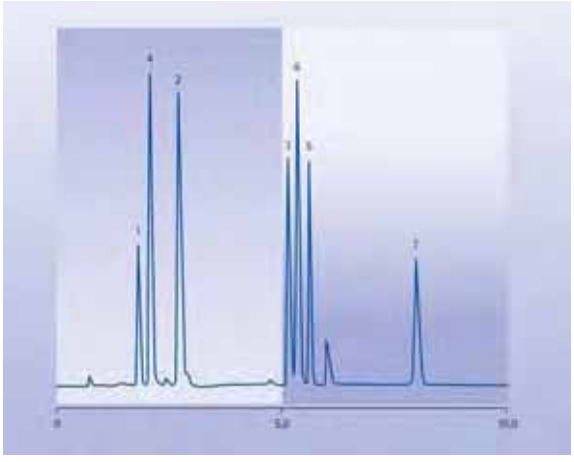


Chromolith® RP-18 endcapped

For more information on new 2 mm and 3 mm i.d. products, ask for the latest Chromolith® brochure

Separation of Carbidopa

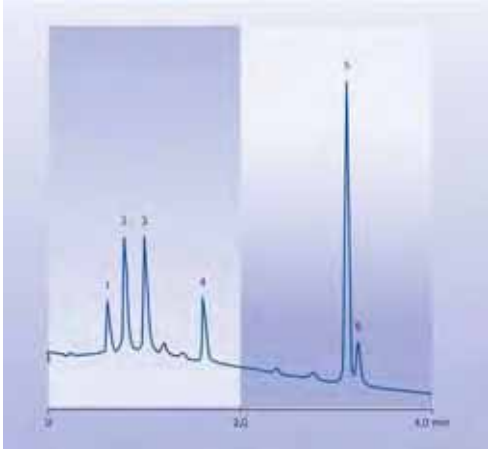
Column	Chromolith® Performance RP-18 endcapped, 100-4.6 mm (Cat. No. 1.02129)	
Mobile Phase	A: Methanol (LiChrosolv® Cat. No. 1.06007) B: 0.1% TFA in water (LiChrosolv® Cat. No. 4.80112)	
Gradient	0.0 min 100% B 1.0 min 100% B 10 min 80% B	
Flow rate	2 ml/min	
Detection	UV 282 nm	
Temperature	ambient	
Inject. volume	5 µl	
Sample	1. 2,4,5 Trihydroxyphenalalanine 2. Levodopa 3. Methyldopa 4. Dopamine 5. Carbidopa 6. 3,4-Dihydroxyphenylacetic acid 7. 3-o-Methylcarbidopa	125 µg/ml 235 µg/ml 160 µg/ml 190 µg/ml 175 µg/ml 185 µg/ml 105 µg/ml



Developed by ChromSword Auto software

Separation of Alkaloids

Column	Chromolith® SpeedROD RP-18 endcapped, 50-4.6 mm (Cat. No. 1.51450)
Mobile Phase	A: Acetonitrile (LiChrosolv® Cat. No.100030) B: 0.1% phosphoric acid
Gradient	0.0 min 95% B; 4.0 min 70% B
Flow rate	4.0 ml/min
Detection	UV 254 nm
Temperature	ambient
Inject. volume	10 µl
Sample	1. Codeine; 2. Quinidine; 3. Quinine; 4. Strychnine; 5. Papaverine; 6. Noscapine

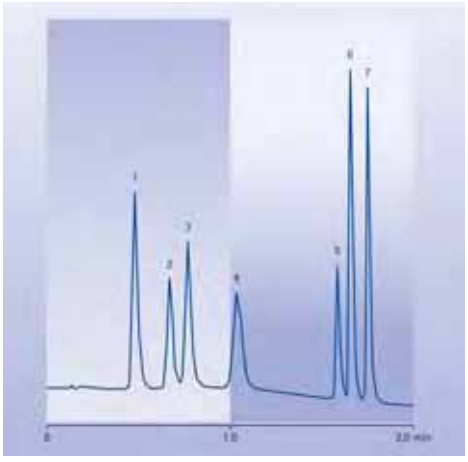


Chromolith® RP-18 endcapped

For more information on new 2 mm and 3 mm i.d. products, ask for the latest Chromolith® brochure

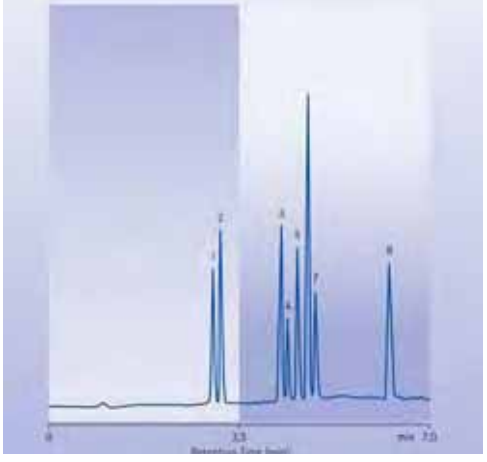
Separation of Sulfonamides

Column	Chromolith® SpeedROD RP-18 endcapped, 50-4.6 mm (Cat. No. 1.51450)
Mobile Phase	A: Acetonitrile (LiChrosolv® Cat. No.100030) B: 0.1% TFA (LiChrosolv® Cat. No. 4.80112)
Gradient	0.0 min 95% B; 0.4 min 95% B; 1.2 min 70% B; 2.2 min 70% B
Flow rate	6.0 ml/min
Detection	UV 270 nm
Temperature	ambient
Inject. volume	10 µl
Sample	1. Sulfadiazine; 2. Sufathiazole; 3. Sulfamerazine; 4. Sulfadimidine; 5. Sulfasoxazole; 6. Sulfamethoxazole; 7. Sulfadimethoxine



Separation of Steroids

Column	2 columns of Chromolith® Performance RP-18 endcapped (Cat. No. 1.02129)
Mobile Phase	A: Acetonitrile (LiChrosolv® Cat. No.100030) B: Water (LiChrosolv® Cat. No. 1.15333)
Gradient	0 min 80% B; 7.0 min 10% B
Flow rate	3.0 ml/min
Detection	UV 220 nm
Temperature	ambient
Inject. volume	10 µl
	1. Prednisolone; 2. Cortisone; 3. Nortestosterone; 4. Estradiol; 5. Testosterone; 6. Corticosterone; 7. Estrone; 8. Progesterone



Chromolith® RP-8 endcapped

The Chromolith® RP-8 endcapped HPLC columns offer all the benefits of the monolithic silica technology for reversed phase chromatography:

- high throughput at high flow rates with the best overall column quality
- the possibility of flow gradients
- added column performance by column coupling
- a rigid structure for a longer lifetime
- less matrix-sensitivity

In contrast to the most commonly used reversed phase columns, the Chromolith® RP-18 endcapped, the Chromolith® RP-8 endcapped with its shorter alkyl chain offers less retention and a slightly different selectivity. Therefore it is possible that a baseline separation can be achieved on the RP-8 endcapped bonded column whereas no separation at all is observed under identical elution conditions on a RP-18 endcapped bonded silica column.

Specifications of Chromolith® RP-8 endcapped

Silica type:	High-purity
Particle size	Monolithic
Macropore size	2 µm
Mesopore size	13 nm (130 Å)
Pore volume	1 ml/g
Total porosity	> 80 %
Surface area	300 m^2/g
Surface modification	RP-8 endcapped
Carbon content	11 %

Ordering information of Chromolith® RP-8 endcapped

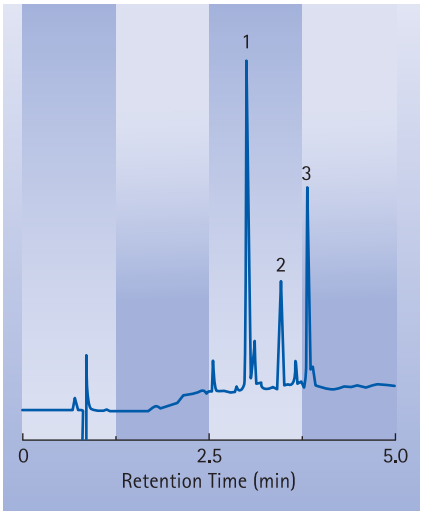
Product name and description	Ordering No.	Diameter	Length	Contents of one package
Chromolith® Performance RP-8 endcapped	1.51468.0001	4.6 mm	100 mm	one HPLC column

→ Chromolith® RP-18 endcapped 55
→ Chromolith® Si 62
→ Chromolith® Guard Cartridges and Cartridge Kit 64
→ Chromolith® Column Coupler 66
→ Chromolith® SemiPrep 100-10 mm RP-18 endcapped Perfect Scale-up from analytical to preparative LC 68
→ Chromolith® CapRod Monolithic Capillary 71

Chromolith® RP-8 endcapped

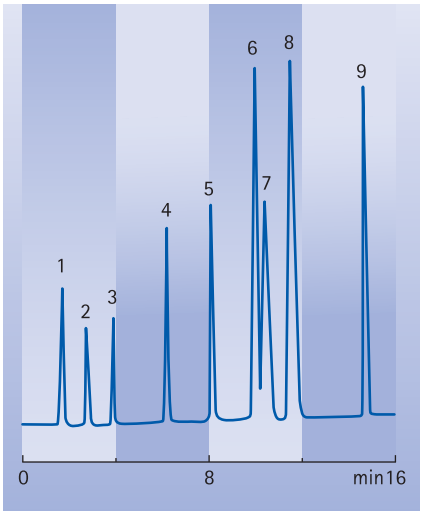
Separation examples
Chromolith® Performance RP-8 endcapped

Column	Chromolith® Performance RP-8 endcapped, 100-4.6mm		
Mobile phase	A: Acetonitrile/ water 90/ 10 + 0.1% TFA B: 0.1% TFA in water		
Gradient	Time/min 0.0 1.0 3.0	%A 45 90 90	%B 55 10 10
Flow rate	2 ml/min		
Pressure	30 - 40 bar		
Detection	214 nm		
Temp.	ambient		
Inj. Volume	30 µl		
Sample	1. (Sar1, Ala8)-Angiotensine II 2. (Sar1, Ile8)-Angiotensine II 3. Angiotensine I		87 µg/ml 87 µg/ml 47 µg/ml



Chromolith® Performance RP-8 endcapped

Column	Chromolith® Performance RP-8 endcapped, 100-4.6mm	
Mobile phase	A: Acetonitrile B: 20mM NaH_2PO_4 pH 2.5	
Gradient	Time/min 0 0.5 8.5 9.1 16	%A 2 18 18 32 32
Flow rate	1 ml/min	
Pressure	23 bar	
Detection	220 nm	
Temp.	ambient	
Inj. Volume	5 µl	
Sample	1. Malic acid 2. Succinic acid 3. Glutaric acid 4. 3,4-Dihydroxy-cinnamic acid 5. 4-Hydroxy-cinnamic acid 6. Sorbic acid 7. Benzoic acid 8. 2-Hydroxybenzoic acid 9. Cinnamic acid	0.92 mg/mL 1.70 mg/mL 1.20 mg/mL 0.02 mg/mL 0.03 mg/ml 0.20 mg/mL 0.04 mg/mL 0.15 mg/ml 0.04 mg/mL



Chromolith® Si

Based on a high-purity silica, Chromolith® Si has been developed as a monolithic normal-phase material suitable for separating polar non-ionic organic compounds, but with all of the benefits of the monolithic silica technology:

- high throughput at high flow rates with the best overall column quality
- the possibility of flow gradients
- added column performance by column coupling
- a rigid monolithic structure for a longer lifetime
- less matrix-sensitivity

Specifications of Chromolith® Si

Silica type:	High-purity
Particle size	Monolithic
Macropore size	2 µm
Mesopore size	13 nm (130 Å)
Pore volume	1 ml/g
Total porosity	> 80 %
Surface area	300 m^2/g

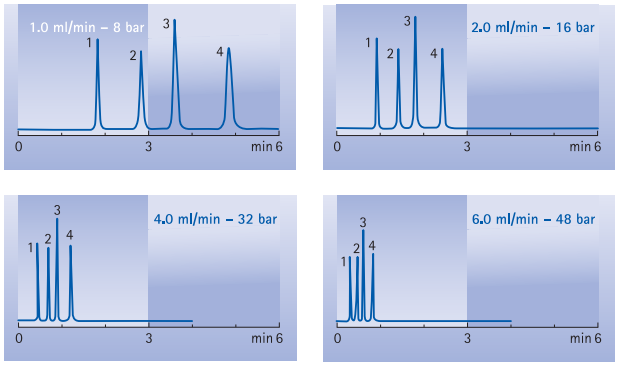
→ Chromolith® RP-18 endcapped 55
→ Chromolith® RP-8 endcapped 60
→ Chromolith® Guard Cartridges and Cartridge Kit 64
→ Chromolith® Column Coupler 66
→ Chromolith® SemiPrep 100-10 mm RP-18 endcapped Perfect Scale-up from analytical to preparative LC 68
→ Chromolith® CapRod Monolithic Capillary 71
→ Chromolith® prep Chromolith® - increase in speed, efficiency and productivity 197

Ordering information of Chromolith® Si

Product name and description	Ordering No.	Diameter	Length	Contents of one package
Chromolith® Performance Si	1.51465.0001	4.6 mm	100 mm	one HPLC column

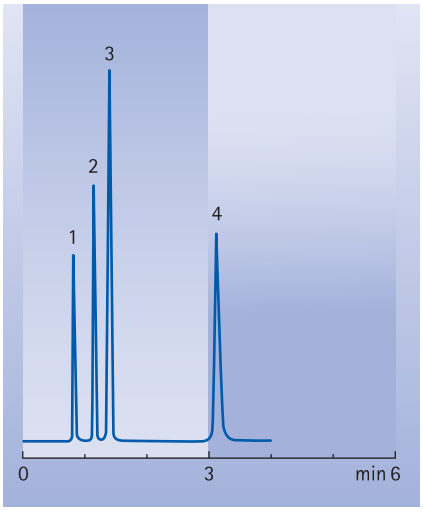
Separation examples
Chromolith® Performance Si

Column	Chromolith® Performance Si, 100-4.6 mm	
Mobile phase	n-Heptane/Dioxane 95/5 v/v	
Flow rate	2 ml/min	
Pressure	14 bar	
Detection	254 nm	
Temp.	ambient	
Inj. Volume	5 µl	
Sample	1. Anisole 2. 3-Nitroanisole 3. 4-Nitroanisole 4. 2-Nitroanisole	0.39 mg/ml 0.07 mg/ml 0.26 mg/ml 0.18 mg/ml



Chromolith® Performance Si

Column	Chromolith® Performance Si, 100-4.6 mm	
Mobile phase	n-Heptane/Dioxane 95/5 v/v	
Flow rate	2 ml/min	
Pressure	14 bar	
Detection	254 nm	
Temp.	ambient	
Inj. Volume	10 µl	
Sample	1. Toluene 2. Nitrobenzene 3. 2,3-Dimethylanthra-quinone 4. 2-Nitroacetanilide	0.16 mg/ml 0.02 mg/ml 0.02 mg/ml 0.10 mg/ml



Chromolith® Guard Cartridges and Cartridge Kit

Although the monolithic columns are well-known for their robustness and longevity, guard columns are available to protect these analytical columns even further. The guard columns are suitable for reversed-phase chromatography since they are chemically modified with hydrophobic n-octadecyl (C18) groups on the surface of the monolithic silica rod. A guard column directly in front of the main column protects the column against contamination of a chemical or mechanical nature. Guard columns should be frequently changed in order to avoid excessive accumulation of impurities.

The monolithic Guard columns are very easy to use. Due to the general benefits of the monolithic technology and the easy handling the Chromolith® guard columns, they are also popular for the protection of classical packed columns.

The Cartridge Kit is the starter kit which includes the Guard Cartridge Holder. The guard cartridges are available in two different lengths: 5 mm and 10 mm.

→ Chromolith® RP-18 endcapped 55
→ Chromolith® RP-8 endcapped 60
→ Chromolith® Si 62
→ Chromolith® Column Coupler 66
→ Chromolith® SemiPrep 100-10 mm RP-18 endcapped Perfect Scale-up from analytical to preparative LC 68
→ Chromolith® CapRod Monolithic Capillary 71

Chromolith® Guard Cartridges and Cartridge Kit

Ordering information of Chromolith® Guard Cartridges

Product name and description	Ordering No.	Diameter	Length	Contents of one package
Chromolith® Guard Cartridge RP-18 endcapped	1.51451.0001	4.6 mm	5 mm	three guard cartridges
Chromolith® Guard Cartridge Kit RP-18 endcapped	1.51470.0001	4.6 mm	5 mm	one starter kit with holder and three guard cartridges
Chromolith® Guard Cartridge RP-18 endcapped	1.51452.0001	4.6 mm	10 mm	three guard cartridges
Chromolith® Guard Cartridge Kit RP-18 endcapped	1.51471.0001	4.6 mm	10 mm	one starter kit with holder and three guard cartridges

Chromolith® Column Coupler

Chromolith® Performance RP-18 endcapped columns provide rapid high quality separation of complex mixtures. But, if necessary, the separation efficiency can be increased by coupling several columns together using the Chromolith® column coupler. With the column coupler it is possible to increase the plate count by coupling several columns in series producing a column with a theoretical plate count which is significantly higher compared to any particulate column available, while producing pressures still well below the HPLC system limit. This added column performance is the key to solve even very critical separation problems where resolution is the limiting factor! Therefore they are perfect for use to separate former non-separable complex mixtures.

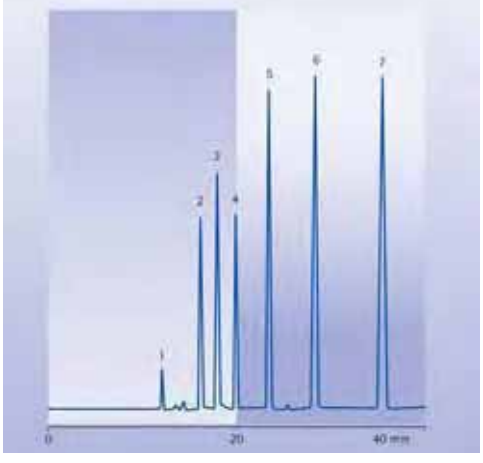
The table below shows the comparison between Chromolith® columns and particulate columns. As you can clearly see, the combination of two Chromolith® Performance RP-18 endcapped columns (linked by a column coupler) will result in a column with a separation efficiency of 19,000 theoretical plates per column, which is usually the maximum for particulate columns.

Typical column efficiency using the Chromolith® Column Coupler

Column	Length (mm)	Back pressure (bar) 3 ml/min 75 % acetonitrile, 25 % water	plate number per column (Anthracence)
Chromolith Performance 1x	100	30	10.000
Chromolith Performance 2x	200	60	19.000
Chromolith Performance 3x	300	90	27.000
Chromolith Performance 4x	400	120	35.000
Chromolith Performance 5x	500	150	41.000
Particulate Column (5 µm)	250	220	18.500
Particulate Column (3.5 µm)	150	400	19.000

Application of Chromolith® Column Coupler 81000 plates at 85 bar pressure

Column	10 columns of Chromolith® Performance RP-18e 100-4.6 mm
Mobile phase	80/20 Acetonitrile/water
Flow rate	1 ml/min
Detection	UV 254 nm
Temp.	ambient
Inj. Volume	10 ul
Sample	1. Thiourea 2. Benzene 3. Toluene 4. Ethylbenzene 5. Propylbenzene 6. Butylbenzene 7. Pentylbenzene



Chromolith® Column Coupler

Ordering information of Chromolith® Column Coupler

Product name and description	Ordering No.	Diameter	Length	Contents of one package
Chromolith® Column Coupler	1.51467.0001			one column coupler

Chromolith® SemiPrep 100-10 mm RP-18 endcapped

Perfect Scale-up from analytical to preparative LC

Optimum separation at flow rates exceeding 40 mL/min

Chromolith® SemiPrep 10 mm i.d. columns combine high separation speed with very high separation performance. They are the ideal alternative to particulate columns with 10 mm i.d. (and even 21.2 mm).

The Chromolith® SemiPrep columns have the same bimodal porous silica rod structure as the Chromolith® analytical columns with 4.6 mm i.d. The macropores are 2 µm diameter and the mesopores are 13 nm. The benefits include:

- Direct scale-up from analytical to semi-prep
- Faster sample throughput at lower operating pressure compared to semi-prep columns packed with 5 µm particles
- Sharp separations, even at high sample loading
- Excellent column lifetime, thanks to rugged monolithic silica structure

Chromolith® SemiPrep columns are optimised for LC/MS by a surface modification process minimising column bleed.

Specifications of Chromolith® SemiPrep 100-10 mm

Silica type	High purity (99.999 %)
Particle size	Monolithic
Macropore size	2 µm
Mesopore size	13 nm (130 Å)
Pore volume	1.0 ml/g
Surface area	300 m^2/g
Total porosity	> 80 %
Surface modification	RP-18 endcapped
Selectivity equivalent to	L1 (USP)
Carbon content	18 %
Surface coverage	3.6 µmol/m^2
Mobile phase compatibility	all standard HPLC solvents may be used with the following restrictions
Max. dichloromethane conc	5 %
Max. tetrahydrofuran conc.	50 %
Max. dimethylsulphoxide DMSO	5 % but OK as sample solvent
pH range	2 - 7.5
Max pressure	150 bar for 10 mm columns
Max temperature	45 °C

Ordering information of Chromolith® SemiPrep 100-10 mm

Product name and description	Ordering No.	Diameter	Length	Contents of one package
Chromolith® SemiPrep RP-18 endcapped	1.52016.0001	10 mm	100 mm	one HPLC column

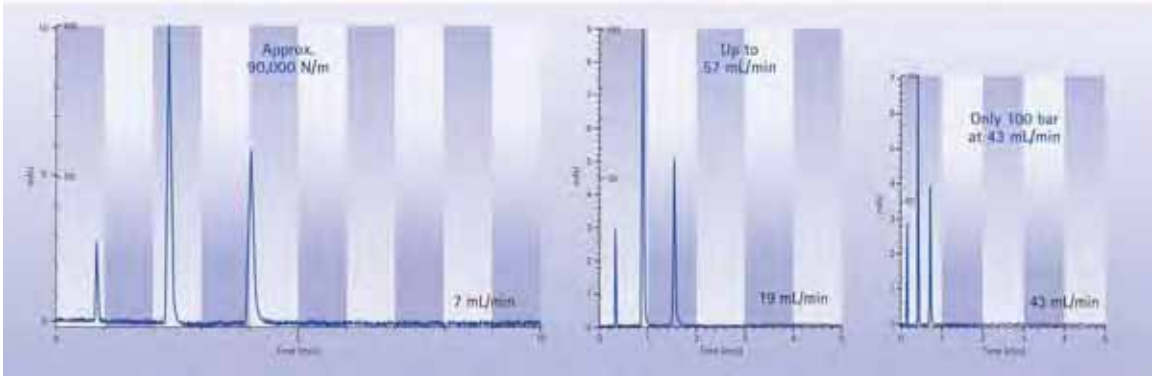
→ Chromolith® RP-18 endcapped 55
→ Chromolith® RP-8 endcapped 60
→ Chromolith® Si 62
→ Chromolith® Column Coupler 66
→ Chromolith® Guard Cartridges and Cartridge Kit 64
→ Chromolith® CapRod Monolithic Capillary 71
→ Chromolith® prep Chromolith® - increase in speed, efficiency and productivity 197

Chromolith® SemiPrep 100-10 mm RP-18 endcapped

Perfect Scale-up from analytical to preparative LC

Separation Examples

Separation of 1) thiourea, 2) progesterone and 3) anthracene with acetonitrile/water 60/40

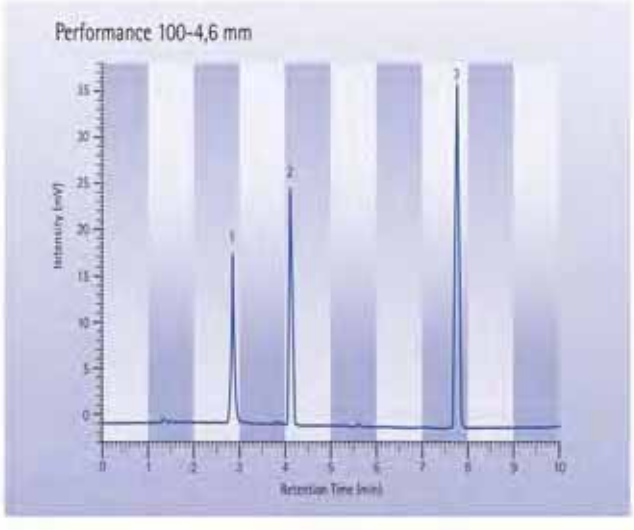


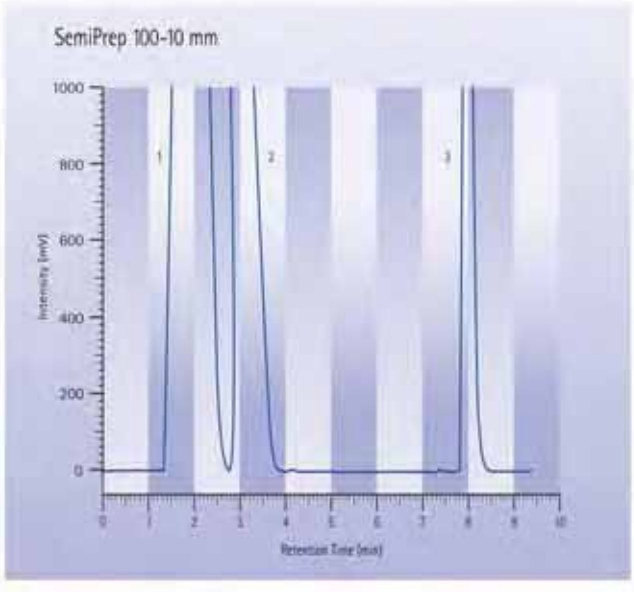
Accurate scale-up from analytical to preparative columns

25 mg injected onto a Chromolith® SemiPrep RP-18 endcapped column show the same excellent separation when compared with the corresponding analytical column.

Column:	Chromolith® Performance RP-18 endcapped 100-4.6 mm
Flow rate:	1 mL/min
Injection:	2 µL
Sample:	1. Nadolol 1 mg/mL 2. Metoprolol 1 mg/mL 3. Propanolol 0.5 mg/mL

Column:	Chromolith® SemiPrep RP-18 endcapped 100-10 mm
Flow rate:	4.7 mL/min
Injection:	100 µL
Sample:	1. Nadolol 100 mg/mL 2. Metoprolol 100 mg/mL 3. Propanolol 50 mg/mL





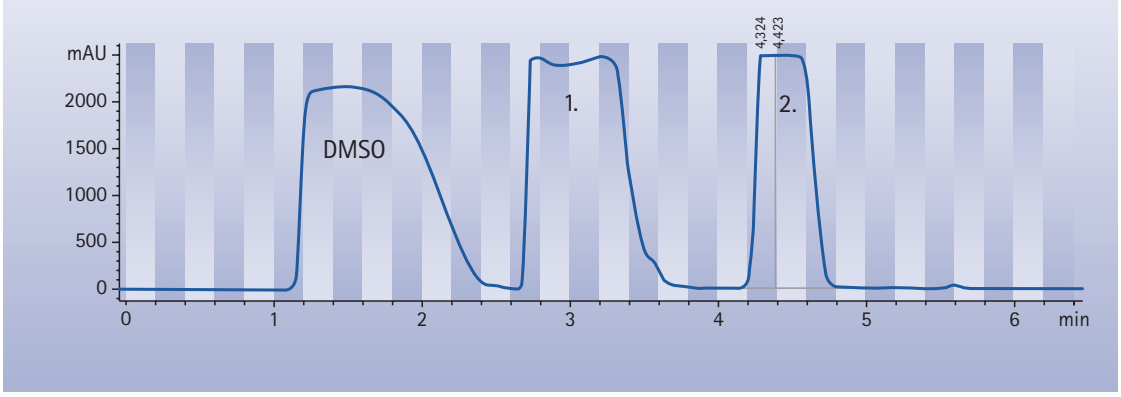
Chromolith® SemiPrep 100-10 mm RP-18 endcapped

Perfect Scale-up from analytical to preparative LC

Sample loadability

The sample loadability depends on many factors including the solubility of the sample in the mobile phase. The following example shows that the sample loadability on the Chromolith® SemiPrep column can exceed 80 mg. Here DMSO is used as solvent.

Separation of 80 mg/injection:



By courtesy of Dr. A. Espada and C. Anta, Lilly Spain

Chromatographic conditions:

Column:	Chromolith® SemiPrep RP-18e, 100-10 mm
Mobile phase:	A: Acetonitrile with 0.05% TFA B: Water with 0.05% TFA
Gradient:	0-1 min 5% A; 1-5 min 5-90% A; 5-5.2 min 95% A; 5.2-6.2 min 95% A
Flow rate:	8 mL/min
Detection:	UV 214 nm
Injection volume:	400 µL
Sample:	1. Propranolol 200 mg/mL 2. Nifedipine 200 mg/mL dissolved in DMSO/Methanol 1/1

Chromolith® CapRod

Monolithic Capillary

Chromolith®CapRod™ is a capillary column which combines the speed of monolithic silica technology with the sensitivity of nano-LC, hence enabling new productivity levels for high throughput, high sensitive proteomics-LC applications to be achieved.

The unique combination of two different types of pores (large macropores to allow rapid transit of the eluent and small mesopores to create a large surface area) means that Chromolith®CapRod™ provides excellent separations in a fraction of the time required by conventional particulate capillary columns.

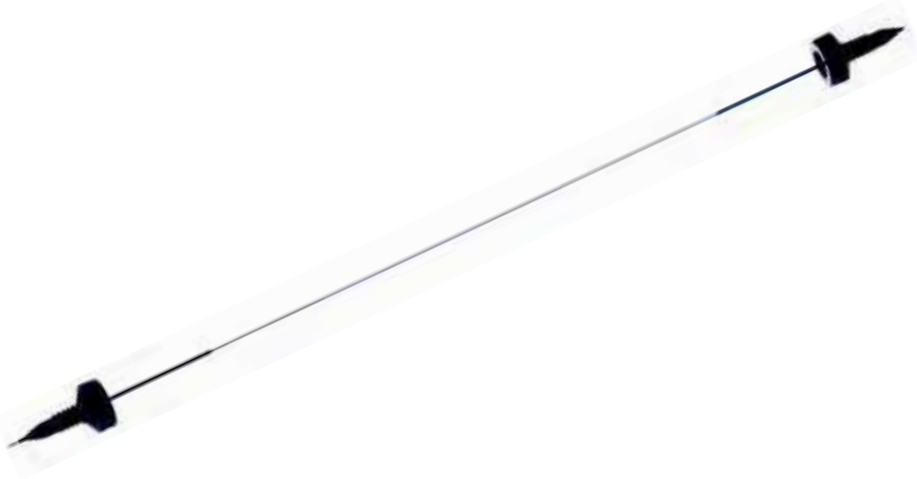
In contrast to classical micro-particulate sorbents, Chromolith®CapRod™ columns can be operated at comparatively high flow rates without loss of performance and other limitations due to column back pressure. Flow rates can be dramatically increased without compromising resolution. Separations can be achieved at 1-3 µl/min compared to 200-400 nl/min for conventional media on a standard nano-LC capillary.

Chromolith®CapRod™ is optimised for highly sensitive LC-MS detection.

Ion pairing agents such as TFA, which can suppress ion generation and therefore reduce MS sensitivity, are not longer required for sharp peaks. Formic acid can therefore be used routinely in the mobile phase without any loss of separation performance. Equipped with standard 1/16" PEEK fittings and sleeves, Chromolith®CapRod™ columns can easily be coupled directly to mass spectrometers, or other HPLC detectors.

Specifications of Chromolith® CapRod™

Sorbent	monolithic silica gel
Column inner diameter	0.1 mm (100 µm)
Column length	150 mm
Surface modification	RP-18 endcapped
Macropore size	2 µm
Mesopore size	13 nm
Surface area	300 m^2/g



→ Chromolith®RP-18 endcapped 55
→ Chromolith®RP-8 endcapped 60
→ Chromolith®Si 62
→ Chromolith®Guard Cartridges and Cartridge Kit 64
→ Chromolith®Column Coupler 66
→ Chromolith®SemiPrep 100-10 mm RP-18 endcapped Perfect Scale-up from analytical to preparative LC 68
→ Chromolith®prep Chromolith® - increase in speed, efficiency and productivity 197

Chromolith® CapRod
Monolithic Capillary

Ordering information of Chromolith® CapRod™

Designation	Ordering No.	Dimensions Length	Dimensions Inner Diameter	Contents of one package
Chromolith® CapRod™ RP-18 endcapped	1.50402.0001	150 mm	0.1 mm	1 Capillary, Sleeves, Fittings, Certificate of Analysis

Characterisation of Chromolith® CapRod™

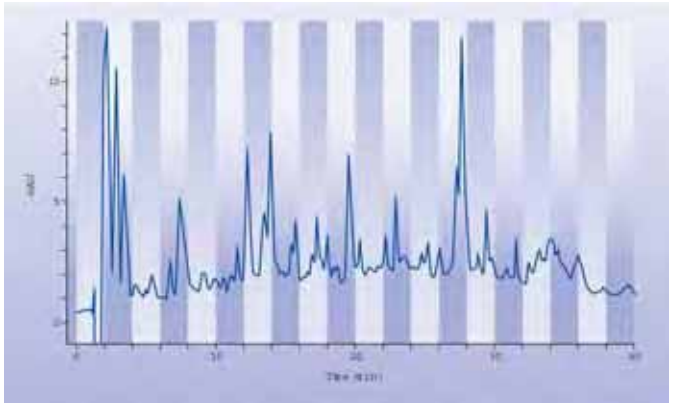
The new Chromolith® CapRod™ capillary column is designed for the efficient and selective separation of peptides and protein digests and is especially suited for capillary or nano-LC.

Based on proprietary sol-gel technology, highly porous monolithic rods of pure silica with a unique pore structure are formed.

Each column has a macropore and a mesopore structure which gives it very high porosity. The macropores form a network of pores through which the eluent can rapidly flow, hence dramatically reducing separation time. The mesopores form the fine pore structure of the capillary interior and create a very large surface area onto which adsorption of the target molecule can occur. The Chromolith® CapRod™ capillary column is supplied complete with sleeves and standard 1/16" PEEK fittings to allow for direct coupling to a mass spectrometer.

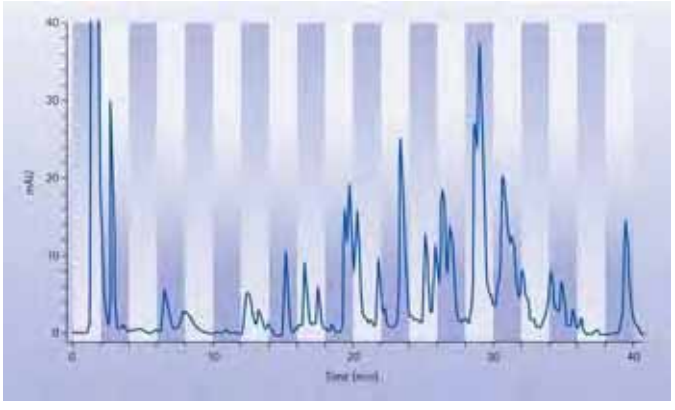
Separation examples for Chromolith® CapRod™ HPLC/MS of digested proteins

Column	Chromolith® CapRod RP-18 endcapped (150-0.1 mm) (Cat. No. 1.50402)
Mobile Phase:	A: 2% Acetonitrile (LiChrosolv® Cat. No. 1.00030) / 0.1% Formic acid; B: 80% Acetonitrile (LiChrosolv® Cat. No. 1.00030) / 0.08% Formic acid
Gradient:	Gradient from 2 % B to 40 % B in 35 min
Flow rate:	3 µl/min
Sample:	100 ng Protein mix (tryptic digest of Cytochrome C, Myoglobin, Carbonic Anhydras; Catalase)



Separation of digested Immunoglobulin

Column	Chromolith® CapRod RP-18 endcapped (150-0.1 mm) (Cat. No. 1.50402)
Mobile Phase:	A: 2% Acetonitrile (LiChrosolv® Cat. No. 1.00030) / 0.1% Formic acid; B: 80% Acetonitrile (LiChrosolv® Cat. No. 1.00030) / 0.08% Formic acid
Gradient:	Gradient from 2 % B to 40 % B in 35 min
Flow rate:	3 µl/min
Sample:	digested immunoglobulin



Particulate HPLC Columns and Sorbents

Merck offers a broad range of innovative and widely used packing materials for HPLC, manufactured the easy to use cartridge system LiChroCART® with its manu-CART® holder as well as packed in Hibar® columns.

In addition to proven and widely used packing materials like LiChrosorb®, LiChrospher® and Superspher® (irregular, regular and perfectly spherical silica gel sorbents), special sorbents like Aluspher® (Al_2O_3) and chiral phases are also available.

Highly pure stationary phases, like Purospher® and Purospher® STAR, ensure highest performance and efficient chromatography today and tomorrow.

Apart from selectivity, efficiency and stability the reproducibility is the most important task for successful chromatography.

By customised packings the full range of Merck sorbents are available in different column hardware.

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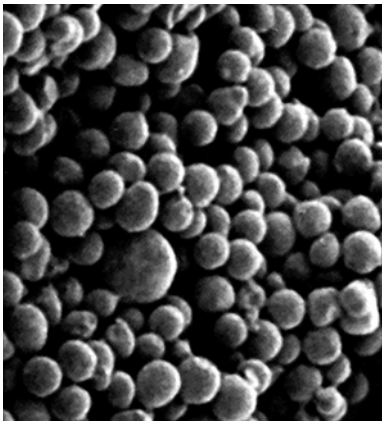
Purospher®
High-purity HPLC columns

Purospher® HPLC columns are based upon a high-purity, metal free silica for excellent separations with very good peak symmetry.

The base material for Purospher® high-purity HPLC columns is made from tetraalkoxysilane. Due to the absence of heavy metals in the silica matrix and in combination with a complete coverage of the silica surface, this stationary phase enables tailing-free chromatography of acidic, basic and chelating compounds. This is of particular advantage for method development.

The Purospher® product family comprises three different Purospher® HPLC packing materials:



Purospher® RP-18 is polar endcapped and suitable for separations of strong basic or chelating compounds (no acidic compounds) and separations of hydrophilic compounds with a high percentage of water in the mobile phase.

Purospher® RP-18 endcapped is suitable for separations of complex samples with simple eluents.

Purospher® RP-18 HC is not endcapped with very good suitability for separation of polar, not basic compounds e.g. explosives.

Purospher® STAR is the latest development of Merck's particulate HPLC sorbents and allows separations of neutral, acidic, basic or chelating compounds. The excellent stability up to pH 10.5 allows the separation of strong basic compounds with alkaline eluents. The wide range of sorbents allows method development of all applications.

Available Purospher® STAR sorbents are: RP-18 endcapped (3 µm or 5 µm); RP-8 endcapped (3 µm or 5 µm); NH_2, 5 µm and Si, 5 µm.

→ Purospher® STAR RP-18 endcapped Just the best choice 83
→ Purospher® STAR RP-8 endcapped 93
→ Purospher® STAR Silica and Amino-phase 96
→ Purospher® RP-18 endcapped Excellent peak symmetry with either basic or strongly acidic compounds 98
→ Purospher® RP-18 Allows simpler, time saving methods for reversed phase chromatography of basic compounds 100
→ Customized packings Always the right column 144
→ Accessories for Particulate HPLC Columns manu-CART® cartridge holder for LiChroCART® cartridges 149
→ Accessories for Particulate HPLC Columns The LiChroCART® cartridge - different lengths, different internal diameter 152

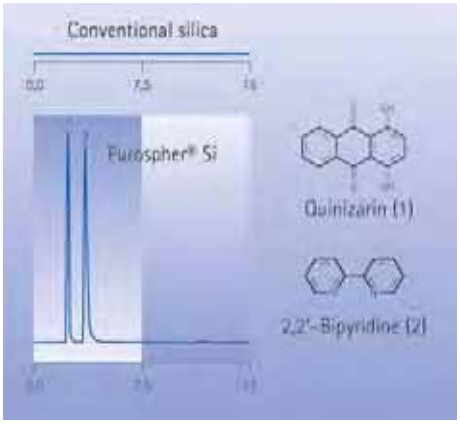
Metal impurities of silica

	Sodium (ppm)	Calcium (ppm)	Magnesium (ppm)	Iron (ppm)	Aluminia (ppm)
LiChrosorb®	340-400	1300	160-220	20-25	15-20
LiChrospher®	150-250	6-10	4-6	20-40	75-140
Purospher®	1	1	1	3	1

The prerequisite for a modern RP-sorbent is a highly purified silica as a starting material. Purospher® RP-18 has a total heavy-metal content of 5 ppm. Thus no chelate complexes can be formed, as the symmetrical elution of 2,2' bipyridine shows - a very sensitive metal-complexing agent.

Chromatographic conditions

Mobile phase	Heptane/Dioxane (90/10, V/V)
Flow rate	1 ml/min
Temperature	30 °C
Detection	UV 254 nm



Characterization of Purospher® HPLC columns

Although it is very important to control the physical and chemical properties of stationary phases, a consistently high level of reproducibility can only be ensured by a comprehensive chromatographic characterization.

With respect to consistent selectivity we apply different approaches of leading scientists in HPLC.

1. According to a proposal of Prof. Tanaka* Purospher® HPLC sorbents are characterised by a set of seven selected substances to describe retention capacity, hydrophobicity, steric selectivity and silanophilic properties.
2. The selectivity test of Prof. Engelhardt**, where the sorbent is controlled by injecting a mixture of 10 compounds.

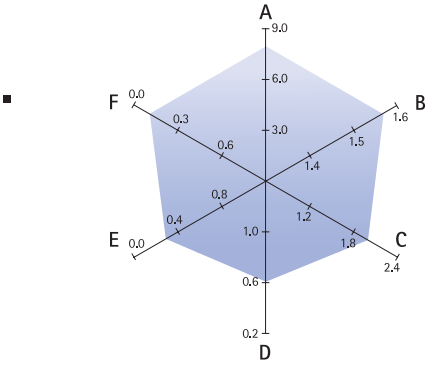
** Prof. Tanaka, Kyoto Institute of Technology, J. Chrom. Sci. 27, 725, 1989 ** Prof. Engelhardt, Universität des Saarlandes, Saarbrücken, Chromatographia 29, 59, 1990*

Tanaka* test

The Tanaka* test illustrates the overall chromatographic properties of stationary phases.

A set of seven selected substances is used to describe retention capacity, hydrophobicity, steric selectivity and silanophilic properties. To facilitate the illustration and to recognise the quality of a sorbent at one glance, the values of these parameters are outlined on the six axes of a hexagon. The more symmetrical the hexagon appears and the larger its area, the more balanced the stationary phase is in the sum of its chromatographic properties.

** Prof. Tanaka, Kyoto Institute of Technology, J. of Chrom. Sci. 27, 725, 1989*

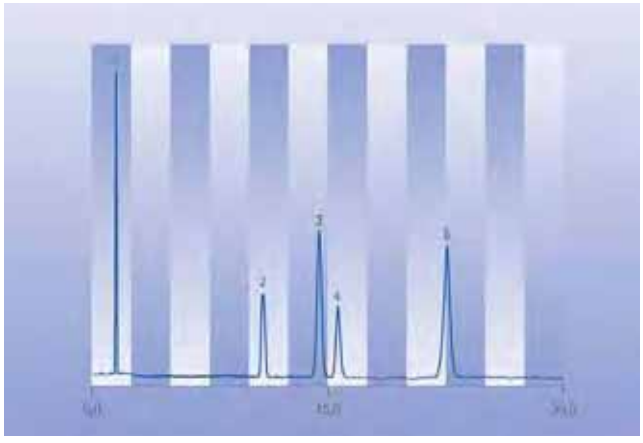


Parameter for the characterisation of Purospher® HPLC sorbents

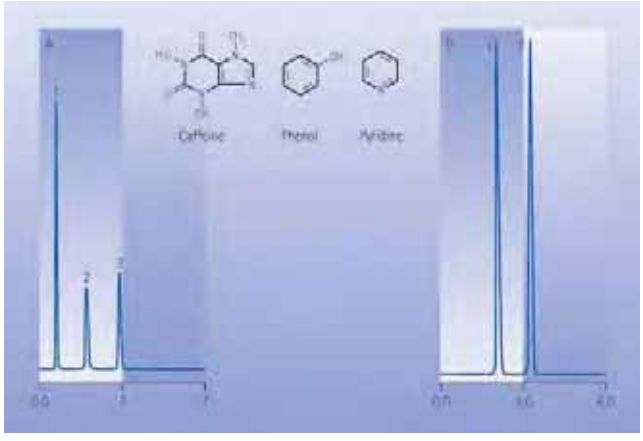
Parameters		property of the stationary phase	factors in preparation of the stationary phase
k (Pentylbenzene) 80% Methanol	Rentention Capacity (A)	amount of alkyl chains	silica surface surface coverage
k (Pentylbenzene) / k (Butylbenzene) 80% Methanol	Hydrophobicity (B):	hydrophobic capacity	surface coverage
k (Triphenylene) / k (o-Terphenyl) 80% Methanol	Steric selectivity (C):	steric selectivity	silane functionality surface coverage
k (Caffeine) / k (Phenol) 30% Methanol	Silanol capacity (D):	silanol capacity	residual silanols endcapping surface coverage
k (Benzylamine) / k (Phenol) 30% Methanol / 70% Phosphate buffer pH 7.6	Ion exchange capacity (E):	ion exchange capacity at pH 7	residual silanols active sites pH 7
k (Benzylamine) / k (Phenol) 30% Methanol / 70% Phosphate buffer pH 2.7	Ion exchange capacity (F):	ion exchange capacity at pH 3	active sites pH 3 treatment of basic silica

Tanaka test

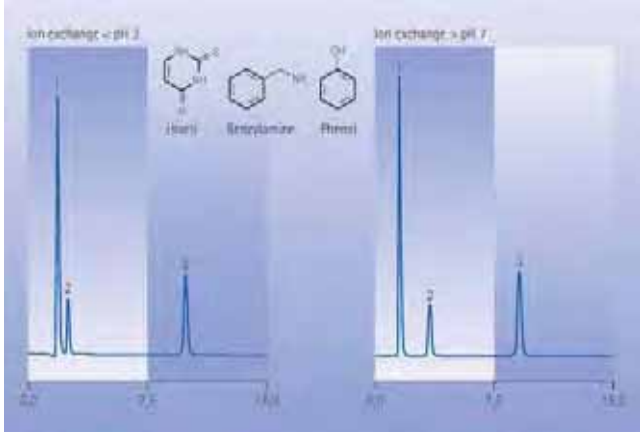
Tanaka 1 (Retention capacity, Hydrophobicity; Steric Selectivity)	
Column	LiChroCART® 150-4,6 Purospher® STAR RP-18 endcapped, 5µm
Mobile Phase	Methanol / Water 80:20
Flow rate	1.0 ml/min
Detection	UV 254 nm
Temperature	30° C
Inj. Volume	10 µl
Sample	1. Uracil 2. Butylbenzene 3. o-Terphenyl 4. Pentylbenzene 5. Triphenylene



Tanaka 2 (Silanophilic properties)	
Column	LiChroCART® 125-4 Purospher® STAR RP-18 e, 5 µm
Mobile Phase	A: Methanol / Water 30:70 (v/v) B: Acetonitrile / Water 30:70 (v/v)
Flow rate	1.0 ml/min
Detection	UV 254 nm
Sample	A: Uracil (1), Caffeine (2), Phenol (3) B: Pyridine (1), Phenol (2)



Tanaka 3+4 (Ion exchange properties)	
Column	LiChroCART® 125-4 Purospher® STAR RP-18 endcapped, 5 µm
Mobile Phase	methanol / 0,02 M phosphoric acid 30:70 (v/v)
Flow rate	0.6 ml/min
Detection	UV 254 nm
Sample	1. Uracil 2. Benzylamine 3. Phenol



Engelhardt** test

This test, developed by Prof. Engelhardt, is suitable for describing the properties of an RP-phase. Toluene and ethylbenzene demonstrate the hydrophobic properties; neutral polar interactions can be investigated using phenol and ethylbenzoate. The important behavioural characteristic with respect to basic compounds is shown by the injection of 5 different amines. Aniline is eluted before phenol and with excellent peak shape.

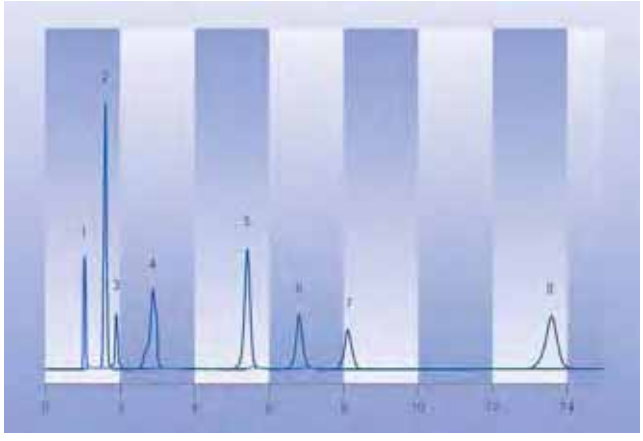
The most important criteria is the coelution of the isomers of ethylaniline, that indicates a good suppression of the silanolic activity.

Purospher® RP-18

Purospher® RP-18 shows no co-elution of p-, m- and o-ethyl aniline and polar interactions due to the amino endcapping of this phase.

The anilines are eluting with symmetric peaks, which shows its very good suitability for separation of strong bases.

Column	LiChroCART® 125-4 Purospher® RP-18	
Mobile phase	Methanol/Water 55/45 (v/v)	
Flow rate	1.0 mL/min	
Temperature	ambient	
Detection	UV 254 nm	
Sample	1. Thiourea	to
	2. Aniline	basic
	3. Phenol	acidic
	4. p-, m-, o-ethylaniline	basic
	5. N,N-Dimethylaniline	basic
	6. Ethylbenzoate	neutral
	7. Toluene	neutral
	8. Ethylbenzene	neutral



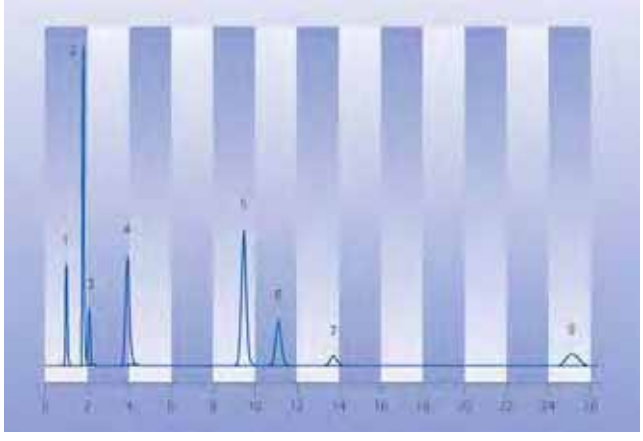
Purospher® RP-18 endcapped

Purospher® RP-18 endcapped shows perfect co-elution of p-, m- and o-ethyl aniline indicating no polar interactions.

The anilines are eluting as symmetric peaks which shows the very good suitability for separation of strong bases.

The retention time of ethyl benzene indicates the hydrophobic properties of the phase.

Column	LiChroCART® 125-4 Purospher® RP-18 endcapped	
Mobile phase	Methanol/Water 55/45 (v/v)	
Flow rate	1.0 mL/min	
Temperature	ambient	
Detection	UV 254 nm	
Sample	1. Thiourea	to
	2. Aniline	basic
	3. Phenol	acidic
	4. p-, m-, o-ethylaniline	basic
	5. N,N-Dimethylaniline	basic
	6. Ethylbenzoate	neutral
	7. Toluene	neutral
	8. Ethylbenzene	neutral

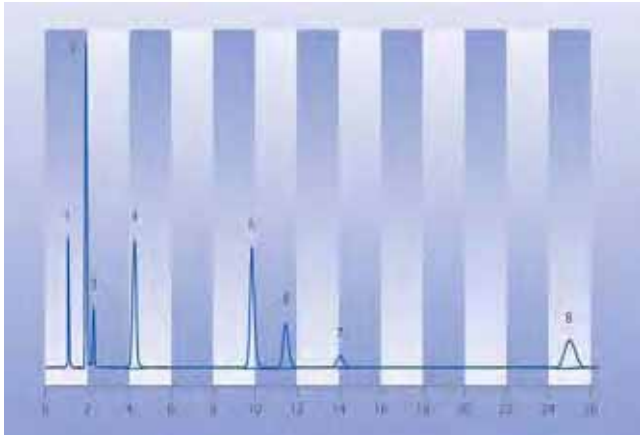


Purospher® RP-18 STAR endcapped

Purospher® RP-18 endcapped shows perfect co-elution of p-, m- and o-ethyl aniline indicating no polar interactions.

The anilines are eluting as symmetric peaks, which shows the very good suitability for separation of strong bases. Purospher® STAR RP-18 endcapped shows a analogue selectivity to Purospher® RP-18 endcapped.

Column	LiChroCART® 125-4 Purospher® STAR RP-18 endcapped	
Mobile phase	Methanol/Water 55/45 (v/v)	
Flow rate	1.0 mL/min	
Temperature	ambient	
Detection	UV 254 nm	
Sample	1. Thiourea	to
	2. Aniline	basic
	3. Phenol	acidic
	4. p-, m-, o-ethylaniline	basic
	5. N,N-Dimethylaniline	basic
	6. Ethylbenzoate	neutral
	7. Toluene	neutral
	8. Ethylbenzene	neutral



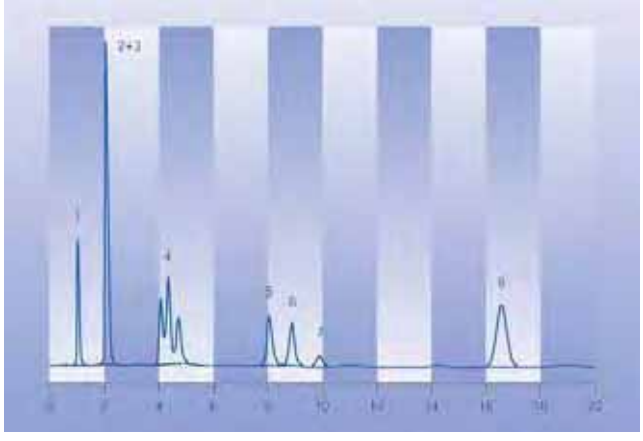
Purospher® RP-18 HC

Purospher® RP-18 HC shows very clear polar interactions, due to no endcapping.

Aniline and Phenol are eluting in one peak. Bases are eluting late.

Best suitability for separation of polar, not basic molecules e.g. explosives.

Column	LiChroCART® 125-4 Purospher® RP-18 HC	
Mobile phase	Methanol/Water 55/45 (v/v)	
Flow rate	1.0 mL/min	
Temperature	ambient	
Detection	UV 254 nm	
Sample	1. Thiourea	to
	2. Aniline	basic
	3. Phenol	acidic
	4. p-, m-, o-ethylaniline	basic
	5. N,N-Dimethylaniline	basic
	6. Ethylbenzoate	neutral
	7. Toluene	neutral
	8. Ethylbenzene	neutral



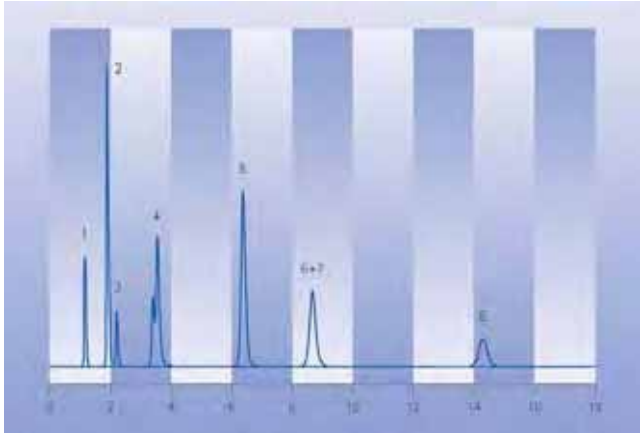
Purospher® STAR RP-8 endcapped

Purospher® STAR RP-8 endcapped shows no co-elution of p-, m- and o-ethyl aniline and polar interactions, because of the thin hydrophobic coverage with short C-chains.

The anilines are eluting as symmetric peaks, which shows the very good suitability for separation of strong bases.

Ethyl benzoate and toluene are eluting in one peak - this is typical for C-8 phases.

Column	LiChroCART® 125-4 STAR Purospher® RP-8 endcapped	
Mobile phase	Methanol/Water 55/45 (v/v)	
Flow rate	1.0 mL/min	
Temperature	ambient	
Detection	UV 254 nm	
Sample	1. Thiourea	to
	2. Aniline	basic
	3. Phenol	acidic
	4. p-, m-, o-ethylaniline	basic
	5. N,N-Dimethylaniline	basic
	6. Ethylbenzoate	neutral
	7. Toluene	neutral
	8. Ethylbenzene	neutral



Chromatographic properties of Purospher® stationary phases

	Peak symmetry of complexing agents	Polar interactions	Steric selectivity	CH2 group selectivity	Silanol group activity	Hydrophoby
Purospher® RP-18	+++	++	+++	+++	++	+
Purospher® RP-18 endcapped	+++	-	+++	+++	-	+++
Purospher® STAR RP-18 endcapped	+++	-	+++	+++	-	+++
Purospher® STAR RP-8 endcapped	+++	+	+	++	++	+
Purospher® RP-18 HC	+++	++	+++	+++	+	++

Purospher® STAR RP-18 endcapped

Just the best choice

Purospher® STAR RP-18 endcapped is the most modern high-purity silica sorbent for HPLC manufactured by Merck KGaA. It has the highest efficiency in terms of the number of theoretical plates; the ultra high purity of 99.9999 % ensures excellent peak symmetry for acidic, basic and even for chelating compounds.

In addition, Purospher® STAR RP-18 endcapped columns are available in a large number of different hardware formats.

The very good all-round retention characteristics, as demonstrated by the Tanaka Test, makes Purospher® STAR RP-18 endcapped a column packing material, which is truly **"Easy to Choose, Easy to Use"** - our recommendation as the first column of choice whenever a new HPLC method has to be developed.

With Purospher® STAR RP-18 endcapped, one single column type will be suitable for very many applications, thanks to its excellent performance and all-round characteristics.

Specifications of Purospher® STAR RP-18 endcapped

Sorbent characteristics:	High-purity silica gel particles with C 18 modification endcapped
Metal content:	Na, Ca, Mg, Al: 1 ppm; Fe: 3 ppm
Particle shape:	spherical
Particle size:	3 µm and 5 µm
Pore size:	120 Å (12 nm)
Pore volume:	1.1 ml/g
Spec. surface area:	330 m^2/g
Carbon load:	17 % C
Coverage of the surface:	3 $\mu mol/m^2$
Efficiency:	5 µm: > 90.000 N/m; 3 µm: > 130.000 N/m
pH range:	pH 1.5 - 10.5
Shipping eluent:	Acetonitrile/Water

→ Purospher® STAR RP-8 endcapped 93
→ Purospher® STAR Silica and Amino-phase 96
→ Hibar® pre-packed columns 205
→ Purospher® RP-18 endcapped Excellent peak symmetry with either basic or strongly acidic compounds 98
→ Purospher® RP-18 Allows simpler, time saving methods for reversed phase chromatography of basic compounds 100
→ Accessories for Particulate HPLC Columns The LiChroCART® cartridge - different lengths, different internal diameter 152
→ Accessories for Particulate HPLC Columns manu-CART® cartridge holder for LiChroCART® cartridges 149
→ Customized packings Always the right column 144

Purospher® STAR RP-18 endcapped

Just the best choice

Ordering information of Purospher® STAR RP-18 endcapped

Stainless steel cartridges LiChroCART®

The LiChroCART® columns (75, 125, 150 and 250 mm length) in the list below (2, 3, 4 and 4.6 mm i.d.) require part number 1.51486.0001 manu-CART® cartridge column holder, which can be used to hold one cartridge column with or without a 4-4 mm guard col-umn.

LiChroCART columns 250-10 mm require part number 1.51419.0001 manuCART® 10.

The short LiChroCART® columns (30 and 55 mm length) can be ordered as a set including the corresponding cartridge holder and one cartridge, or as a pack of 3 cartridges without cartridge holder.

The separate part numbers for the cartridge are as follows.

1.50227.0001 LiChroCART® cartridge holder for 30 mm cartridge
1.50226.0001 LiChroCART® cartridge holder for 55 mm cartridge

Packing material	Ordering No.	Particle size	Dimension Length	Dimension i.d.	Contents of one package
Purospher® STAR RP-18 endcapped Cartridge set	1.50237.0001	3 µm	30 mm	2 mm	1 set 1 LiChroCART® 30-2 and 1 manuCART® 30 mm
Pursopher® STAR RP-18 endcapped	1.50238.0001	3 µm	30 mm	2 mm	3 pieces
Purospher® STAR RP-18 endcapped	1.50240.0001	3 µm	55 mm	2 mm	1 set 1 LiChroCART® 55-2 and 1 manuCART® 55 mm
Purospher® STAR RP-18 endcapped Cartridge set	1.50241.0001	3 µm	55 mm	2 mm	3 pieces
Purospher® STAR RP-18 endcapped	1.50255.0001	5 µm	125 mm	2 mm	1 piece
Purospher® STAR RP-18 endcapped	1.50256.0001	5 µm	250 mm	2 mm	1 piece
Purospher® STAR RP-18 endcapped	1.50253.0001	5 µm	125 mm	3 mm	1 piece
Purospher® STAR RP-18 endcapped	1.50254.0001	5 µm	250 mm	3 mm	1 piece
Purospher® STAR RP-18 endcapped Cartridge set	1.50239.0001	3 µm	30 mm	4 mm	1 set 1 LiChroCART® 30-4 and 1 manuCART® 30 mm
Purospher® STAR RP-18 endcapped	1.50225.0001	3 µm	30 mm	4 mm	3 pieces
Purospher® STAR RP-18 endcapped Cartridge set	1.50242.0001	3 µm	55 mm	4 mm	1 set 1 LiChroCART® 55-4 and 1 manuCART® 55 mm
Purospher® STAR RP-18 endcapped	1.50231.0001	3 µm	55 mm	4 mm	3 pieces
Purospher® STAR RP-18 endcapped	1.51460.0001	3 µm	75 mm	4 mm	1 piece
Purospher® STAR RP-18 endcapped	1.50250.0001	5 µm	4 mm	4 mm	10 pieces
Purospher® STAR RP-18 endcapped	1.50251.0001	5 µm	125 mm	4 mm	1 piece

Additional dimensions available as customised packings see page 144

Purospher® STAR RP-18 endcapped cartridge set 30 mm
1 LichroCART® cartridge 30 mm length and 1 manu-CART® 30 mm

Purospher® STAR RP-18 endcapped cartridge set 55 mm
1 LichroCART® cartridge 55 mm length and 1 manu-CART® 55 mm

Purospher® STAR RP-18 endcapped

Just the best choice

Packing material	Ordering No.	Particle size	Dimension Length	Dimension i.d.	Contents of one package
Purospher® STAR RP-18 endcapped	1.50252.0001	5 µm	250 mm	4 mm	1 piece
Purospher® STAR RP-18 endcapped	1.50358.0001	5 µm	150 mm	4.6 mm	1 piece
Purospher® STAR RP-18 endcapped	1.50359.0001	5 µm	250 mm	4.6 mm	1 piece
Purospher® STAR RP-18 endcapped	1.50257.0001	5 µm	250 mm	10 mm	1 piece
Additional dimensions available as customised packings see page 144					

Stainless steel columns Hibar®

The Hibar® columns are complete with endfittings.

When using a guard column with a Hibar® column, we recommend part number 1.51487.0001 guard column cartridge holder for 4-4mm guard column cartridges LiChroCART®.

Packing material	Ordering No.	Particle size	Dimension Length	Dimension i.d.	Contents of one package
Purospher® STAR RP-18 endcapped	1.50036.0001	5 µm	125 mm	4 mm	1 piece
Purospher® STAR RP-18 endcapped	1.50037.0001	5 µm	250 mm	4 mm	1 piece
Purospher® STAR RP-18 endcapped	1.51455.0001	5 µm	150 mm	4.6 mm	1 piece
Purospher® STAR RP-18 endcapped	1.51456.0001	5 µm	250 mm	4.6 mm	1 piece
Additional dimensions available as customised packings see page 144					

Purospher® STAR RP-18 endcapped

Just the best choice

Characterisation of Purospher® STAR RP-18 endcapped

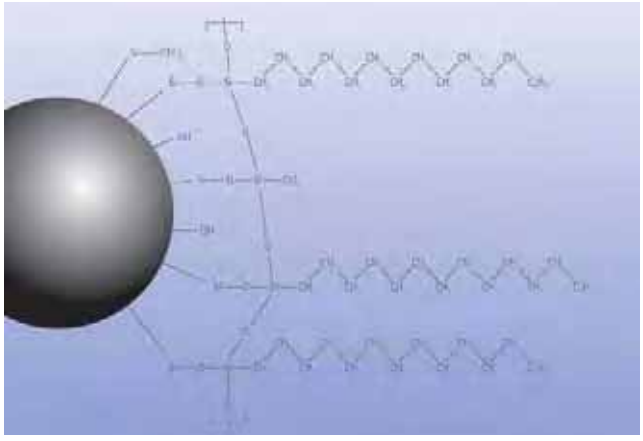
Purospher® STAR RP-18 endcapped HPLC columns are designed for universal use.

It doesn´t matter if four samples are basic, neutral, metal chelating or indeed any other format. You can be sure that Purospher® STAR can do it, naturally without peak tailing!

This is proved by many users, appreciate the excellent properties of Purospher® STAR RP-18 endcapped HPLC columns.

Surface modification of Puropsher® STAR RP-18 endcapped

The polymeric surface modification of Purospher® RP-18 endcapped provides a nearly perfect coverage of the surface. This prevents from polar interactions.



Highest Purity

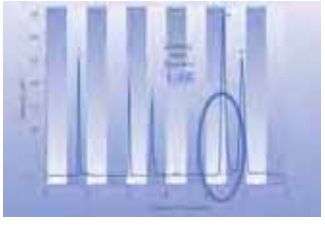
Due to the absence of metals in the silica matrix, in combination with a complete coverage of the silica surface, this stationary phase enables tailing-free chromatography of acidic, basic and chelating compounds.

There are differences in quality of so-called "high purity" HPLC column materials. The peak shape of the complexing agent Quinizarin is the best indicator for purity of silica.

The column comparison shown in the figures below demonstrates Purospher® STAR RP-18 endcapped with the best peak-symmetry for Quinizarin and the silica of highest purity.

Mobile phase	Methanol / Buffer pH 7,0 80 / 20 (5 mmol KH_2PO_4 and 5 mmol K_2HPO_4);
Flow rate	1.0 mL/min
Detection	UV 254 nm
Temperature	22 °C
Sample:	1. Uracil 2. Toluene 3. Ethylbenzene 4. Quinizarin 5. Amitriptyline

Purospher® STAR RP-18 endcapped



Column L

Column X

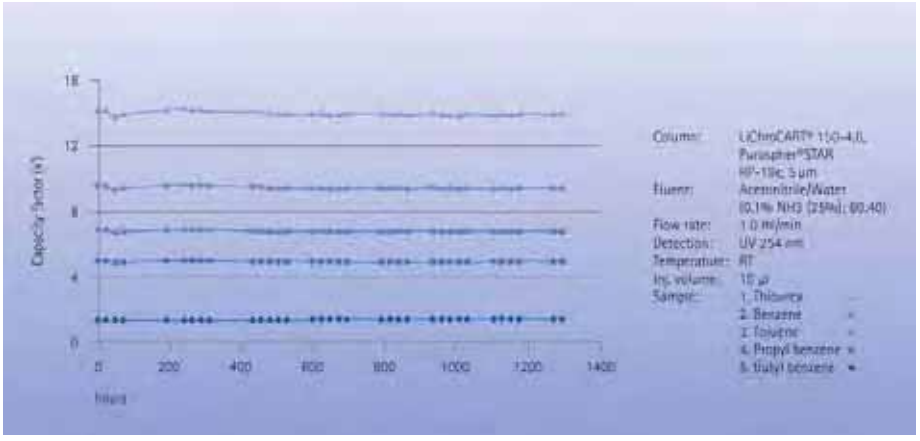
Column I

Purospher® STAR RP-18 endcapped

Just the best choice

Outstanding pH-stability

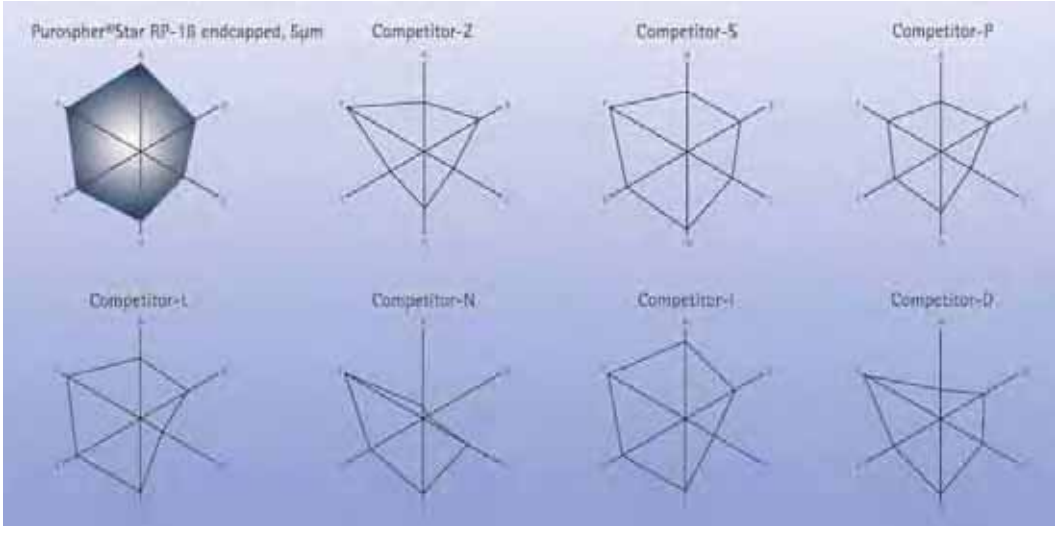
A column that is robust, stable in a range of eluent conditions has an extended column life and provides the required pH stability for 99% of common analysis. Purospher®STAR RP-18 endcapped has outstanding pH stability. Various studies have shown that Purospher® STAR RP-18 endcapped remains stable and reproducible in a pH range of **1.5 to 10.5**. This ensures a simple choice in most applications.



Excellently balanced

The Tanaka test is established world-wide as the best method of comparing the selectivity and performance of HPLC columns, This test summarises and visualises all the most important parameters required when choosing the right HPLC column and allows easy comparisons to be made.

A set of seven selected substances is used to describe capacity, hydrophobicity, steric selectivity and silanophilic properties. To facilitate the illustration and to recognise the quality of a sorbent at one glance, the values of these parameters are outlined on the six axes of a hexagon. The more symmetrical the hexagon appears and the larger its area, the more balanced the stationary phase is in the sum of its chromatographic properties.



A: K (Pentyl benzene)
B: α (Pentyl-/ Butyl benzene)
C: α (Triphenylene/ o-Terphenyl)
D: α (Caffeine/ Phenol)
E: α (Benzylamine/ Phenol; pH 7.6)
F: α (Benzylamine/ Phenol; pH 2.7)

Purospher® STAR RP-18 endcapped

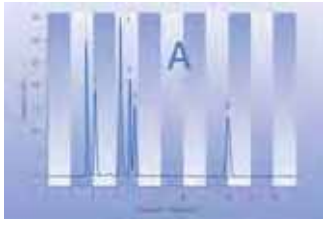
Just the best choice

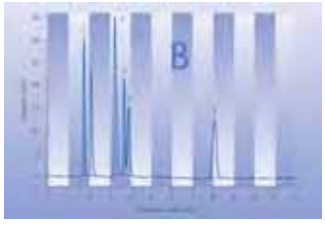
Use with 100 % aqueous phase

Standard reversed phase columns, particularly RP-18 columns, often suffer from phase collapse when used in combination with highly aqueous mobile phases.

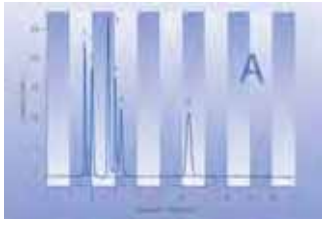
The outstanding performance of Purospher® STAR RP-18 endcapped enables the use with 100% aqueous mobile phases in combination with selectivity of a classical RP-18 stationary phase.

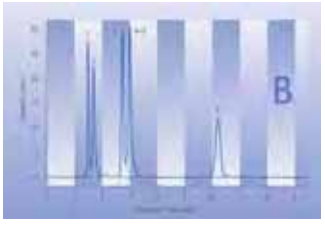
Experience the performance of Purospher® STAR RP-18 endcapped HPLC columns - the best choice.



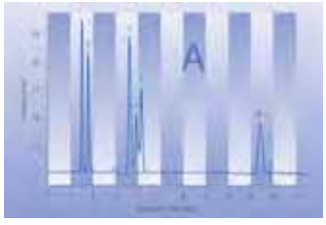


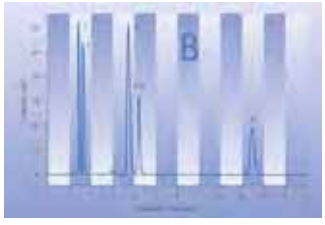
Purospher® STAR RP 18 endcapped



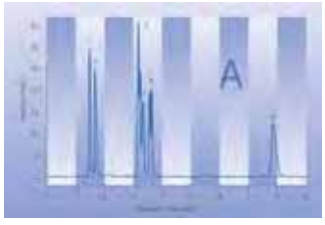


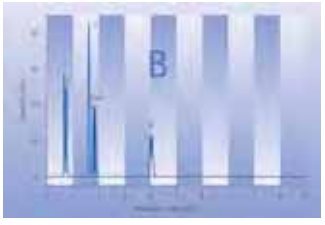
Colum I





Column X





Column L

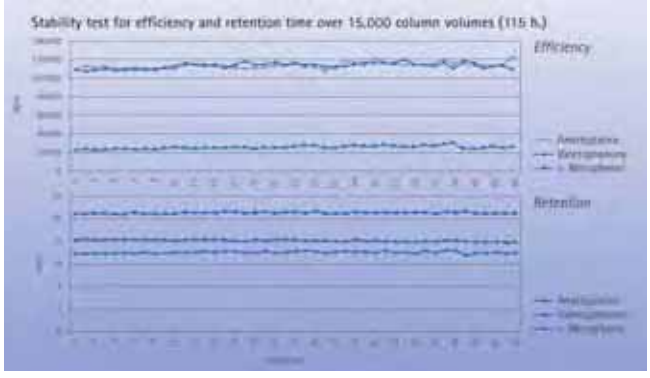
Chromatogram A shows the first separation with 1% acetic acid as mobile phase B shows the same separation after 3 hours.

Only Purospher® STAR RP-18 endcapped shows the same separation in Chromatogram B. In contrast to competitive columns Purospher® STAR RP-18 endcapped is suitable as aqua phase.

The combination of extremely high purity silica, best all-round retention characteristics, outstanding pH stability up to pH 10.5 and suitability for use with 100% aqueous mobile phases makes Purospher® STAR RP-18 endcapped an all-round top performance column, almost universal in its range of applications.

Stability test

Column	LiChroCART® 55-4 Purospher® STAR RP-18 endcapped 3 µm
Mobile phase	0.1 v/v% of H_3PO_4 in water / Methanol gradient
Temperature	60 °C
Flow rate	1.5 ml/min



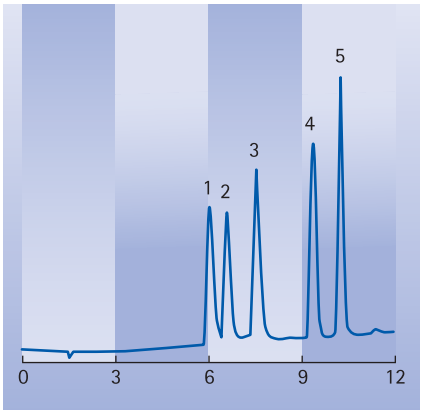
Purospher® STAR RP-18 endcapped

Just the best choice

Separation examples on Purospher® STAR RP-18 endcapped

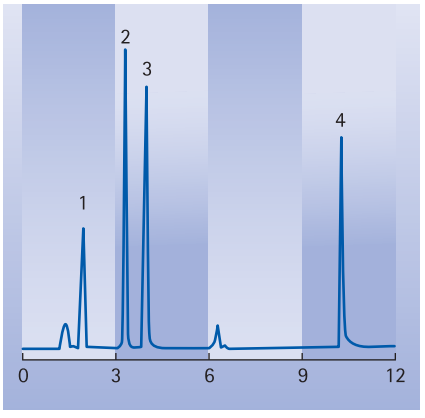
Triptylines

Column	LiChroCART® 150-4.6 Purospher® STAR RP-18 endcapped, 5 µm
Mobile phase	A: Methanol B: 0.02 M Phosphate buffer pH 7.5 Omin 80 % A, 15 min 100 % A
Flow rate	1.0 ml/min
Detection	UV 220 nm
Temperature	30 °C
Inj. Volume	10 µl
Sample	1. Protriptyline 2. Nortriptyline 3. Doxepin 4. Imipramine 5. Amitriptyline



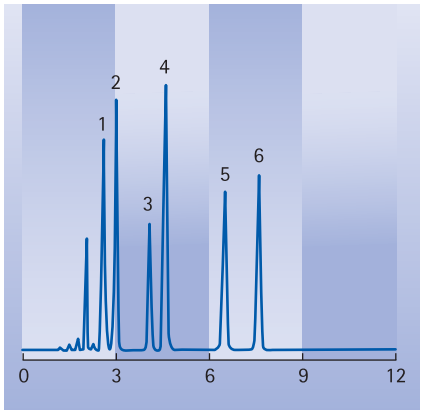
Flavonoids

Column	LiChroCART® 150-4.6 Purospher® STAR RP-18 endcapped, 5 µm
Mobile phase	A: Acetonitrile B: 0.1 % Phosphoric acid Omin 40 % A, 3 min 40 % A, 8 min 05 % A
Flow rate	1.0 ml/min
Detection	UV 365 nm
Temperature	30 °C
Inj. Volume	10 µl
Sample	1. Rutin 2. Morin 3. Quercetin 4. 3-Hydroxyflavon



Contents of Energy Drinks

Column	LiChroCART® 150-4.6 Purospher® STAR RP-18 endcapped, 5 µm	
Mobile phase	A: Acetonitrile B: 0.02 M Phosphate buffer pH 5.0 Omin 15 % A, 3 min 15 % A, 10 min 30 % A	
Flow rate	1.0 ml/min	
Detection	UV 227 nm	
Temperature	30 °C	
Inj. Volume	10 µl	
Sample	1. Acesulfame-K 2. Saccharin 3. Benzoic acid 4. Sorbic acid 5. Caffeine 6. Aspartame	23 µg/ml 29 µg/ml 13 µg/ml 14 µg/ml 47 µg/ml 100 µg/ml

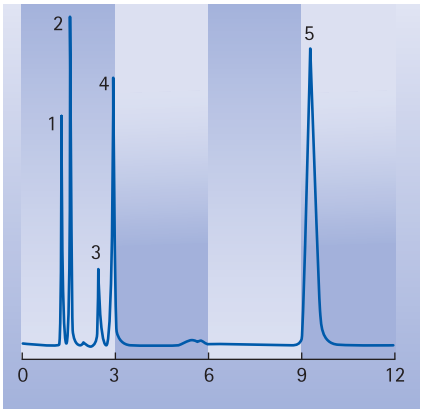


Purospher® STAR RP-18 endcapped

Just the best choice

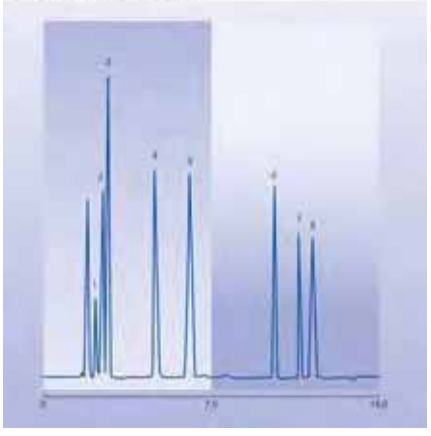
Separation of Catecholamines under aqueous conditions

Column	LiChroCART® 150-4.6 Purospher® STAR RP-18 endcapped, 5 µm	
Mobile phase	20 mM Potassium phosphate, pH 3.0/Methanol (97:3)	
Flow rate	1.5 ml/min	
Detection	270 nm	
Temperature	30 °C	
Inj. Volume	10 µl	
Sample	1. Norepinephrin	195 µg/ml
	2. Epinephrin	202 µg/ml
	3. Dopamin	214 µg/ml
	4. L-Dopa	205 µg/ml
	5. Serotonin	99 µg/ml



Separation of Catecholamines

Column	LiChroCART® 150-4.6 Purospher® STAR RP-18 endcapped, 5 µm	
Mobile phase	A: Acetonitrile B: 0.1 % phosphoric acid	
Gradient	0.0 min 0 % A 15.0 min 30 % A	
Flow rate	1.0 ml/min	
Detection	UV 210 nm	
Temperature	30 °C	
Inj. Volume	10 µl	
Sample	1. Norepinephrin	140 µg/ml
	2. Octopamine	160 µg/ml
	3. Epinephrin tartrate	190 µg/ml
	4. Dopamine	208 µg/ml
	5. DOPA	210 µg/ml
	6. Norephedrine	160 µg/ml
	7. Ephedrine hemihydrate	140 µg/ml
	8. N-Methylephedrine	170 µg/ml

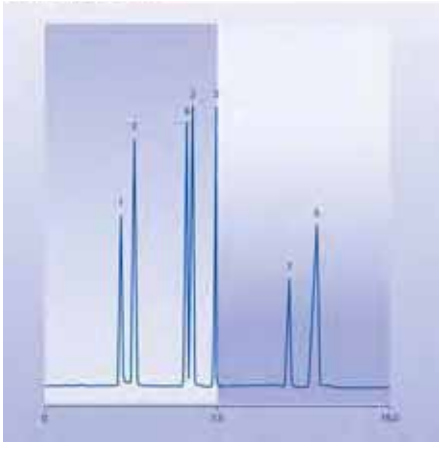


Purospher® STAR RP-18 endcapped

Just the best choice

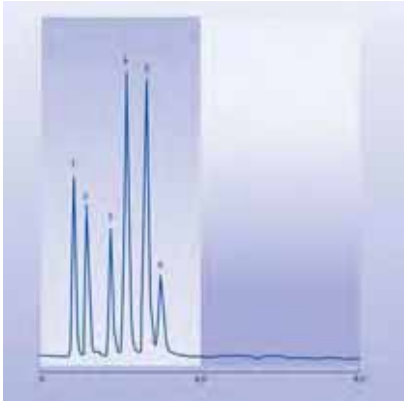
Separation of Carbidopa

Column	LiChroCART® 150-4.6 Purospher® STAR RP-18 endcapped, 5 µm	
Mobile phase	A: Methanol B: 20 mM Potassium dihydrogenphosphate buffer pH 4.3	
Gradient	0.0 - 2.4 min 1 % A 2.5 - 15.0 min 14 % A	
Flow rate	1.0 ml/min	
Detection	UV 282 nm	
Temperature	ambient	
Inj. Volume	5 µl	
Sample	1. 1,2,4,5 trihydroxyphenalalanine	125 µg/ml
	2. Levodopa	235 µg/ml
	3. Methyldopa	160 µg/ml
	4. Dopamine	190 µg/ml
	5. Carbidopa	175 µg/ml
	6. 3,4-dihydroxyphenylaceticacid	185 µg/ml
	7. 3-o-Methylcarbidopa	140 µg/ml



Separation of Beta-Blockers

Column	LiChroCART® 55-4 Purospher® STAR RP-18 endcapped, 3 µm
Mobile phase	Methanol/0.05 M phosphate buffer pH 3.0; 45:55 (v,v)
Flow rate	1.0 ml/min
Detection	UV 220 nm
Temperature	30 °C
Sample	1. Pafenolol
	2. Celiprolol
	3. Bisoprolol
	4. Metipranolol
	5. Propranolol
	6. Alprenolol

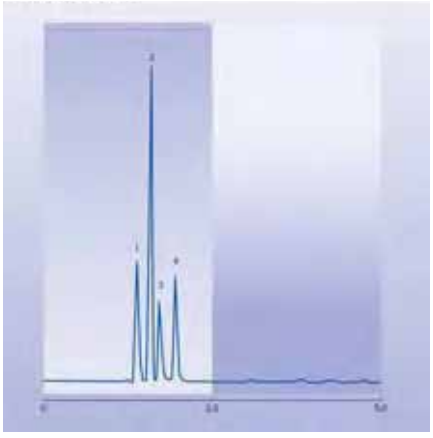


Purospher® STAR RP-18 endcapped

Just the best choice

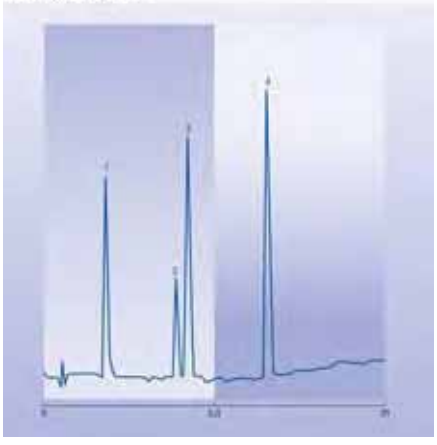
Separation of Sweeteners

Column	LiChroCART® 150-4.6 Purospher® STAR RP-18 endcapped, 5 µm
Mobile phase	Acetonitrile/ 0.1 % phosphoric acid; 40:60
Flow rate	1.0 ml/min
Detection	UV 210 nm
Temperature	30 °C
Inject. volume	10 µl
Sample	1. Acesulfame-K 2. Saccharin-Na 3. Diketopiperazine 4. Aspartame



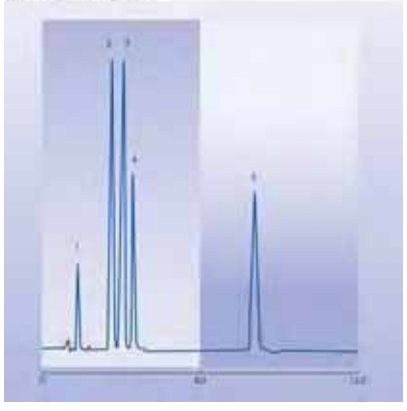
Separation of Peptides

Column	LiChroCART® 55-4 Purospher® STAR RP-18 endcapped, 3 µm
Mobile phase	A: Water + 0.1 % TFA B: Acetonitrile + 0.1 % TFA
Gradient	0.0 min 95 % A; 10 min 80 % A
Flow rate	1.0 ml/min
Detection	UV 254 nm
Temperature	23 °C
Sample	1. Ala - Tyr 2. Tyr - Tyr 3. Gly - Phe - Gly 4. Leu - tyr



Separation of Hormones

Column	LiChroCART® 125-4 Purospher® STAR RP-18 endcapped, 5 µm
Mobile phase	Acetonitrile/ 0.01 M Phosphate buffer pH 7.0; 54:46
Flow rate	1.0 ml/min
Detection	UV 220 nm
Temperature	30 °C
Sample	1. Prednisolone 2. Beta-Estradiol 3. 12-alpha-ethinyl-estradion 4. Estrone 5. Progesterone



Purospher® STAR RP-8 endcapped

Purospher®STAR RP-8 endcapped, like Purospher®STAR RP-18 endcapped, is one of the most modern high-purity silica sorbents for HPLC manufactured by Merck KGaA. It has the highest efficiency in terms of the number of theoretical plates; it has the widest pH range, even up to pH 10.5; it has the highest purity - trace metals levels are below 5ppm in total, ensuring excellent peak symmetry for acidic, basic and even for chelating compounds.

Purospher®STAR RP-8 endcapped columns are available in a large number of different hardware formats.

Specifications of Purospher® STAR RP-8 endcapped

Sorbent characteristics:	High-purity silica gel particles with C 8 modification endcapped
Metal content:	Na, Ca, Mg, Al: 1 ppm; Fe: 3 ppm
Particle shape:	spherical
Particle size:	3 µm and 5 µm
Pore size:	120 Å
Pore volume:	1.1 ml/g
Spec. surface area:	330 m^2/g
Carbon load:	11,2 % C
Efficiency:	5 µm: > 80.000 N/m; 3 µm: > 130.000 N/m
pH range:	pH 1.5 - 10.5
Shipping eluent:	Acetonitrile/Water

Ordering information of Purospher® STAR RP-8 endcapped
Stainless steel cartridges LiChroCART®

The LiChroCART® columns (75, 125, 150 and 250 mm length) in the list below (2, 3, 4 and 4.6 mm i.d.) require part number 1.51486.0001 manu-CART® cartridge column holder, which can be used to hold one cartridge column with or without a 4-4mm guard column.

LiChroCART® columns 250-10 mm require part number 1.51419.0001 manuCART® 10.

The short LiChroCART® columns (30 and 55 mm length) can be ordered as a set including the corresponding cartridge holder and one cartridge, or as a pack of 3 cartridges without cartridge holder.

The separate part numbers for the cartridge are as follows.

1.50227.0001 LiChroCART® cartridge holder for 30 mm cartridge
1.50226.0001 LiChroCART® cartridge holder for 55 mm cartridge

Packing material	Ordering No.	Particle size	Dimension Length	Dimension i.d.	Contents of one package
Purospher®STAR RP-8 endcapped custom packed	1.50229.7220	3 µm	30 mm	2 mm	1 piece
Purospher®STAR RP-8 endcapped custom packed	1.50234.7220	3 µm	55 mm	2 mm	1 piece
Purospher®STAR RP-8 endcapped custom packed	1.50302.7220	3 µm	30 mm	4 mm	1 piece
Purospher®STAR RP-8 endcapped custom packed	1.50228.7220	3 µm	55 mm	4 mm	1 piece
Purospher®STAR RP-8 endcapped custom packed	1.50171.7220	3 µm	75 mm	4 mm	1 piece
Purospher®STAR RP-8 encapped	1.50274.0001	5 µm	125 mm	2 mm	1 piece
Pursopher®STAR RP-8 encapped	1.50275.0001	5 µm	250 mm	2 mm	1 piece
Additional dimensions available as customised packings see page 144					

→ Customized packings
Always the right column 144

Purospher® STAR RP-8 endcapped

Packing material	Ordering No.	Particle size	Dimension Length	Dimension i.d.	Contents of one package
Purospher® STAR RP-8 endcapped	1.50038.0001	5 µm	125 mm	3 mm	1 piece
Purospher® STAR RP-8 endcapped	1.50273.0001	5 µm	250 mm	3 mm	1 piece
Purospher® STAR RP-8 endcapped	1.50270.0001	5 µm	4 mm	4 mm	10 pieces
Purospher® STAR RP-8 endcapped	1.50271.0001	5 µm	125 mm	4 mm	1 piece
Purospher® STAR RP-8 endcapped	1.50272.0001	5 µm	250 mm	4 mm	1 piece
Purospher® STAR RP-8 endcapped	1.50031.0001	5 µm	150 mm	4.6 mm	1 piece
Purospher® STAR RP-8 endcapped	1.50032.0001	5 µm	250 mm	4.6 mm	1 piece
Purospher® STAR RP-8 endcapped	1.50276.0001	5 µm	250 mm	10 mm	1 piece
Additional dimensions available as customised packings see page 144					

Stainless steel Hibar® columns

The Hibar® columns are complete with endfittings.

When using a guard column with a Hibar® column, we recommend part number 1.51487.0001 guard column cartridge holder for 4-4mm guard column cartridges LiChroCART®.

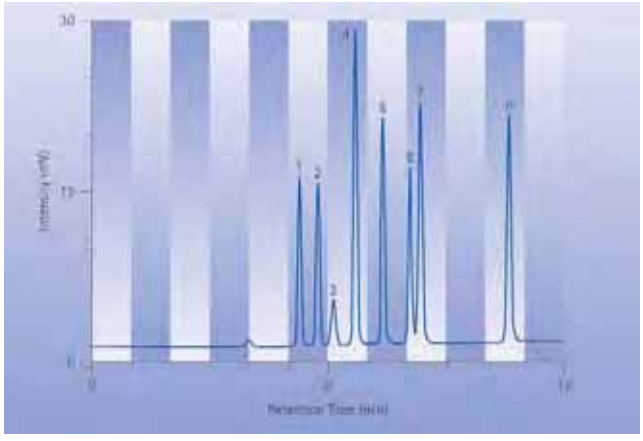
Packing material	Ordering No.	Particle size	Dimension Length	Dimension i.d.	Contents of one package
Purospher® STAR RP-8 endcapped	1.50033.0001	5 µm	125 mm	4 mm	1 piece
Purospher® STAR RP-8 endcapped	1.50035.0001	5 µm	250 mm	4 mm	1 piece
Purospher® STAR RP-8 endcapped	1.51453.0001	5 µm	150 mm	4.6 mm	1 piece
Purospher® STAR RP-8 endcapped	1.51454.0001	5 µm	250 mm	4.6 mm	1 piece
Additional dimensions available as customised packings see page 144					

Purospher® STAR RP-8 endcapped

Separation examples Purospher® STAR RP-8 endcapped

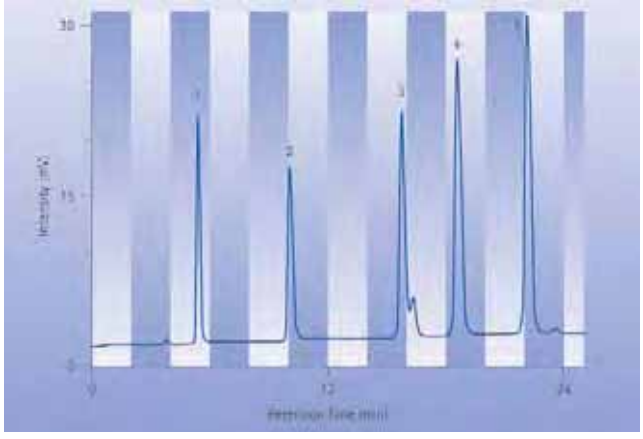
Caffein & derivatives

Column	LiChroCART® 125-4 Purospher® STAR RP-8 endcapped (5 µm)
Mobile phase	Methanol / Ammonia Acetate Buffer pH 3.5 (Gradient)
Flow rate	1.0 mL/min
Detection	UV 270 nm
Temp.	RT
Injection	10 µL
Sample	1. 1-Methylxanthine 2. 1,3-Dimethyl uric acid 3. Paracetamol 4. Theobromine 5. 1,7-Dimethyl uric aicd 6. 1,7-Dimethyl xanthine 7. Theophylline 8. Caffeine



Antidepressants

Column	LiChroCART® 125-4 Purospher® STAR RP-8 endcapped (5 µm)
Mobile phase	Methanol / Phosphate Buffer pH 7.0(Gradient)
Flow rate	1.0 mL/min
Detection	UV 254nm
Temp.	40 °C
Injection	10 µL
Sample	1. Doxylamine 2. Nortriptyline 3. Doxepine 4. Imipramine 5. Amitriptyline



Purospher® STAR Silica and Amino-phase

Purospher® STAR HPLC columns are also available as pure silica for normal phase HPLC and as amino-bonded phase, primarily for carbohydrate analysis. The particular benefits of these columns are:

The very high separation efficiency, as measured by the plate count.

The absence of metallic impurities, giving consistent symmetrical peaks.

The long lifetime of the columns.

Specifications of Purospher® STAR Silica and Purospher® STAR NH_2

	Purospher® STAR Silica	Purospher® STAR NH_2
Sorbent characteristics:	High-purity silica gel particles	with NH_2 (Amino) modification
Metal content:	Na, Ca, Mg, Al: 1 ppm; Fe: 3 ppm	Na, Ca, Mg, Al: 1 ppm; Fe: 3 ppm
Particle shape:	spherical	spherical
Particle size:	5 µm	5 µm
Pore size:	120 Å (12 nm)	120 Å (12 nm)
Pore volume:	1.1 ml/g	1.1 ml/g
Spec. surface area:	330 m^2/g	330 m^2/g
Carbon load:		3,5 %
Coverage of the surface:	3 µmol/m^2	3 µmol/m^2
Efficiency:	> 50.000 N/m	> 50.000 N/m
pH range:	pH 2 - 7.5	pH 2 - 7.5
Shipping eluent:	n-heptane	n-heptane

Ordering information of Purospher® STAR Silica and NH_2
Stainless steel cartridges LiChroCART®

The LiChroCART® columns (75, 125, 150 and 250 mm length) in the list below (4 and 4.6 mm i.d.) require part number 1.51486.0001 manu-CART® cartridge column holder, which can be used to hold one cartridge column with or without a 4-4 mm guard column.

Packing material	Ordering No.	Particle size	Dimension Length	Dimension i.d.	Contents of one package
Purospher® STAR Si	1.50249.0001	5 µm	4 mm	4 mm	10 pieces
Purospher® STAR Si	1.50268.0001	5 µm	125 mm	4 mm	1 piece
Purospher® STAR Si	1.50269.0001	5 µm	250 mm	4 mm	1 piece
Pursopher® STAR Si	1.50356.0001	5 µm	150 mm	4.6 mm	1 piece
Purospher® STAR Si	1.50357.0001	5 µm	250 mm	4.6 mm	1 piece
Purospher® STAR NH_2	1.50267.0001	5 µm	4 mm	4 mm	10 pieces

Additional dimensions available as customised packings see page 144

→ LiChrospher® 100 NH_2 A versatile sorbent for both reversed phase and straight phase chromatography 111

→ Customized packings Always the right column 144

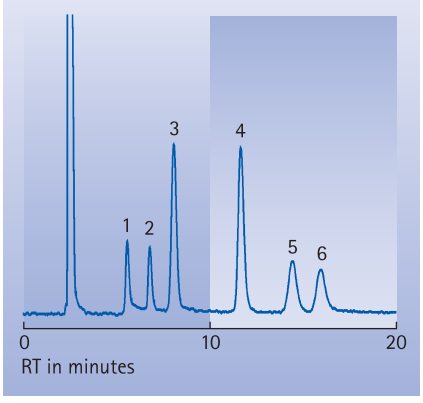
Purospher® STAR Silica and Amino-phase

Packing material	Ordering No.	Particle size	Dimension Length	Dimension i.d.	Contents of one package
Purospher® STAR NH_2	1.50244.0001	5 µm	125 mm	4 mm	1 piece
Purospher® STAR NH_2	1.50245.0001	5 µm	250 mm	4 mm	1 piece
Purospher® STAR NH_2	1.50247.0001	5 µm	150 mm	4.6 mm	1 piece
Purospher® STAR NH_2	1.50248.0001	5 µm	250 mm	4.6 mm	1 piece

Additional dimensions available as customised packings see page 144

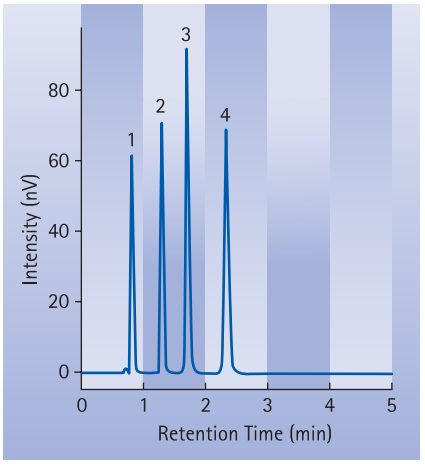
Separation examples on Purospher® STAR Silica and NH_2 Carbohydrates

Column	LiChroCART® 250-4 Purospher® STAR NH_2, 5 µm
Mobile phase	Acetonitrile / Water 75:25
Flow rate	1.0 ml/min
Detection	RI
Temperature	30 °C
Inj. Volume	10 µl
Sample	1. Xylose 2. Fructose 3. Glucose 4. Saccharose 5. Maltose 6. Lactose



Anisols

Column	LiChroCART® 125-4 Purospher® STAR Si, 5 µm
Mobile phase	Heptane/Dioxan 95/5 v/v
Flow rate	2 ml/min
Detection	UV 254 nm response fast
Temperature	RT
Inj. Volume	5 µl
Sample	1. Anisol 2. 3-Nitroanisol 3. 4-Nitroanisol 4. 2-Nitroanisol



Purospher® RP-18 endcapped

Excellent peak symmetry with either basic or strongly acidic compounds

→ Purospher® STAR RP-18 endcapped Just the best choice 83
→ Purospher® RP-18 Allows simpler, time saving methods for reversed phase chromatography of basic compounds 100
→ Aluspher® 100 RP-select B A stable reversed phase stationary phase optimized for applications up to pH 12 133
→ LiChrospher® 60 RP-select B Excellent separations even with basic compounds 121
→ Accessories for Particulate HPLC Columns The LiChroCART® cartridge - different lengths, different internal diameter 152
→ Accessories for Particulate HPLC Columns manu-CART® cartridge holder for LiChroCART® cartridges 149
→ Customized packings Always the right column 144

Purospher® RP-18 endcapped is a versatile HPLC column producing excellent peak shapes, designed for both the separation of basic compounds with simple neutral eluents and for the elution of strongly acidic compounds. Excellent separations in a shorter period of time with very good peak symmetry saves time and money.

The excellent balance of Purospher® RP-18 endcapped in the sum of its chromatographic properties is the key to better separations of complex samples with simpler, neutral eluents. Purospher® RP-18 endcapped is based upon a high-purity, metal free silica with a complete C18 coverage of the silica surface. This enables a peak-tailing free elution of acidic, basic and chelating compounds.

In addition, the good chemical stability of Purospher® RP-18 endcapped enables the use of mobile phase conditions at pH 8 for a long period of time.

Specifications of Purospher® RP-18 endcapped

Sorbent characteristics:	High-purity silica particles C 18 with special modification and deactivation of the surface
Metal content:	Na, Ca, Mg, Al: 1 ppm; Fe 3 ppm
Particle shape:	spherical
Particle size:	5 µm
Pore size:	90 Å (9 nm)
Pore volume:	1.05 ml/g
Spec. surface area:	480m^2/g
Carbon load:	18.0 % C
Efficiency :	80.000 N/m
pH range:	pH 2-8
Shipping eluent:	Acetonitrile/Water

Ordering information of Purospher® RP-18 endcapped

Stainless steel cartridges LiChroCART®

The LiChroCART® columns (125, 150 and 250 mm length) in the list below (3 and 4 mm i.d.) require part number 1.51486.0001 manu-CART® cartridge column holder, which can be used to hold one cartridge column with or without a 4-4mm guard column.

Packing material	Ordering No.	Particle size	Dimensions Length	Dimensions i.d.	Contents of one package
Purospher® RP-18 endcapped	1.50798.0001	5 µm	125 mm	3 mm	1 piece
Purospher® RP-18 endcapped	1.50799.0001	5 µm	125 mm	3 mm	3 pieces
Purospher® RP-18 endcapped	1.51384.0001	5 µm	250 mm	3 mm	1 piece
Purospher® RP-18 endcapped	1.50167.0001	5 µm	4 mm	4 mm	10 pieces
Purospher® RP-18 endcapped	1.50168.0001	5 µm	125 mm	4 mm	1 piece
Purospher® RP-18 endcapped	1.50169.0001	5 µm	250 mm	4 mm	1 piece
Additional dimensions available as customised packings see page 144					

Stainless steel column MicroCART®

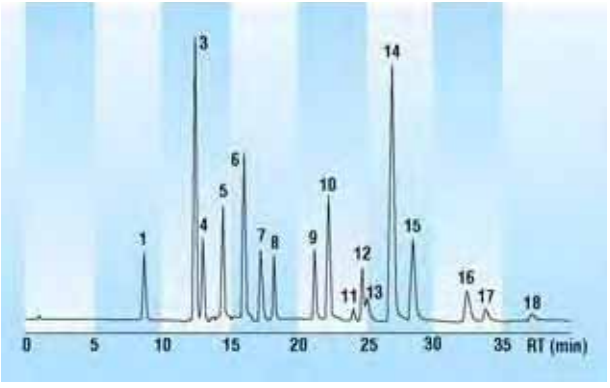
Packing materail	Ordering No.	Particle size	Dimensions Length	Dimensions i.d.	Contents of one package
Purospher® RP-18 endcapped	1.09018.0001	5 µm	150 mm	1mm	1 piece

Purospher® RP-18 endcapped

Excellent peak symmetry with either basic or strongly acidic compounds

Amines from Azo Dyes

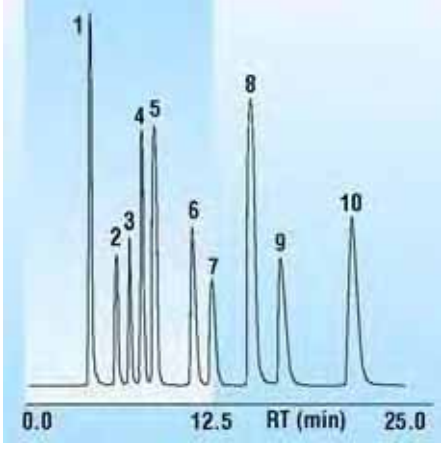
Column	LiChroCART® 125-4 Purospher® RP-18 endcapped, 5 µm
Mobile phase	A: Acetonitrile B: 20 mM Phosphate buffer pH 7.0 (H_3PO_4 with ammonia)
Gradient	0.0 - 19.9 min 25% A 19.9 - 20.0 min 28 - 60 % 20.0 - 30.0 min 60 % A
Flow rate	1.0 ml/min
Detection	UV 254nm
Temperature	55°C
Injection volume	10 µl



Sample	1. 2,4-Diaminoanisole	10. 4,4'-Thiodianiline
	2. 2,4-Diaminotoluene	11. 3,3'-Dimethylbenzidine
	3. 4,4'-Oxydianiline	12. 2-Naphthylamine
	4. Benzidine	13. 4-Chloro-o-toluidine
	5. o-Toluidine	14. 2,4,5-Trimethylaniline
	6. 4,4'-Diaminodiphenylmethane	15. 4,4'-Diamino-3,3'-dimethyldiphenylmethane
	7. p-Chloroaniline	16. 4-Aminobiphenyl
	8. p-Cresidine	17. 3,3'-Dichlorobenzidine
	9. 3,3'-Dimethoxybenzidine	18. 4,4'-Diamino-3,3'-dichlorodiphenylmethane

Beta-Blockers

Column	LiChroCART® 125-4 Purospher® RP-18 endcapped, 5 µm
Mobile phase	Methanol/0.05 M Phosphate buffer pH 3.0 45/55 (v/v)
Flow rate	0.5 ml/min
Detection	UV 265 nm
Temperature	32°C
Injection volume	2 µl
Sample	1. Practolol 2. Pafenolol 3. Metoprolol 4. Celiprolol 5. Carazolol 6. Bisoprolol 7. Metipranolol 8. Propanolol 9. Alprenolol 10. Carvedilol



Purospher® RP-18

Allows simpler, time saving methods for reversed phase chromatography of basic compounds

→ Purospher® STAR RP-18 endcapped Just the best choice 83
→ Purospher® RP-18 endcapped Excellent peak symmetry with either basic or strongly acidic compounds 98
→ Aluspher® 100 RP-select B A stable reversed phase stationary phase optimized for applications up to pH 12 133
→ LiChrospher® 60 RP-select B Excellent separations even with basic compounds 121
→ Accessories for Particulate HPLC Columns The LiChroCART® cartridge - different lengths, different internal diameter 152
→ Accessories for Particulate HPLC Columns manu-CART® cartridge holder for LiChroCART® cartridges 149
→ Customized packings Always the right column 144

Purospher® RP-18 is designed for the separation of problematic basic compounds with simple neutral eluents. This results in less time and cost because of simpler method optimization. In addition Purospher® RP-18 allows the separation of hydrophilic compounds with aqueous mobile phase.

Purospher® RP-18 is based upon a high-purity, metal free silica. The multi-step chemical modification and deactivation of the surface enables a peak-tailing free elution of basic and chelating compounds. Purospher® RP-18 is not suitable for the separation of acidic compounds.

The good chemical stability of Purospher® RP-18 enables the use of mobile phase conditions at pH 8 for a long period of time.

Specifications of Purospher® RP-18

Sorbent characteristics:	High-purity silica particles with C 18 modification and deactivation of the surface; amino shielding not suitable for acidic compounds!
Particle shape:	spherical
Particle size:	5 µm
Pore size:	90 Å (9 nm)
Pore volume:	1.05 ml/g
Spec. surface area:	480 m^2/g
Carbon load:	17 % C
pH-range:	pH 2-8
Efficiency:	80.000 N/m
Shipping eluent:	Acetonitrile/Water

Ordering information of Purospher® RP-18

Stainless steel cartridges LiChroCART®

The LiChroCART® columns (125 and 250 mm length) in the list below (4 mm i.d.) require part number 1.51486.0001 manu-CART® cartridge column holder, which can be used to hold one cartridge column with or without a 4-4mm guard column.

Packing material	Ordering No.	Particle size	Dimensions Length	Dimensions i.d.	Contents of one package
Purospher® RP-18	1.50141.0001	5 µm	4 mm	4 mm	10 pieces
Purospher® RP-18	1.50142.0001	5 µm	125 mm	4 mm	1 piece
Purospher® RP-18	1.50144.0001	5 µm	250 mm	4 mm	1 piece

Additional dimensions available as customised packings see page 144

Characterisation of Purospher® RP-18

The excessive endcapping of Purospher® RP-18 using polymeric coating and shielding of the group by including polar or even charged groups into carbon chains makes Purospher® RP-18 an excellent basic compatible RP sorbent for the separation of problematic basic compounds with simple neutral eluents as well as the separations of hydrophilic compounds with a high percentage of water in the mobile phase up to pure aqueous mobile phase conditions.

The multi-step chemical modification and deactivation of the surface is a decisive step in producing the high-performance sorbent. They allow only clear and controllable reactions between absorbent and sample. The effective amino shielding of the surface is demonstrated by co-elution of the three toluidines as shown in the first separation example.

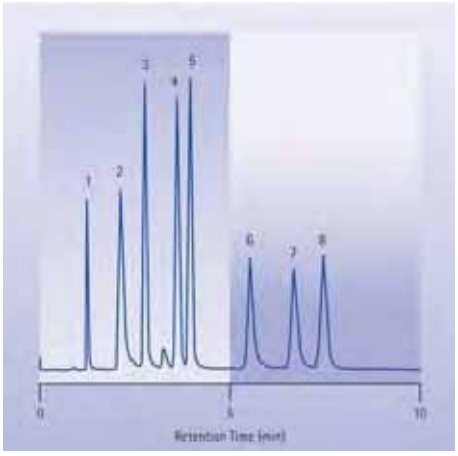
Purospher® RP-18

Allows simpler, time saving methods for reversed phase chromatography of basic compounds

Separation examples on Purospher® RP-18

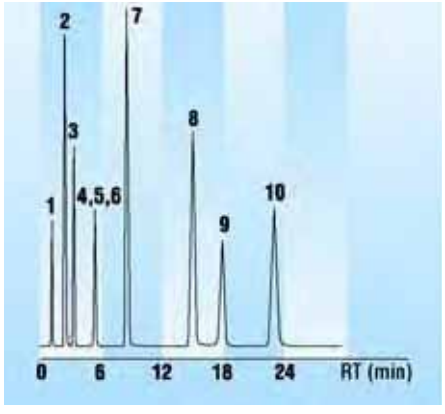
Nucleic Acids

Column	LiChroCART® 250-4 Purospher® RP-18 (5 µm),	
Mobile phase	1 % Acetic Acid	
Flow rate	1.0 ml/min	
Pressure	214 bar	
Detection	UV 254nm	
Temperature	22 °C	
Injection volume	1 µl	
Sample	1. Cytosine	5.5 µg/ml
	2. Adenine	10 µg/ml
	3. Guanine	14 µg/ml
	4. Uracil	10 µg/ml
	5. 5-Fluorouracil	24 µg/ml
	6. Hypoxanthine	11 µg/ml
	7. Xanthine	14 µg/ml
	8. Thymine	14 µg/ml



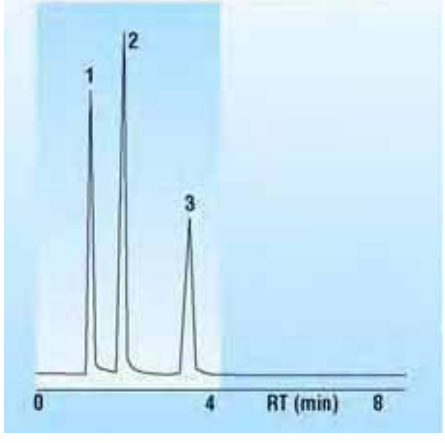
Toluidines

Column	LiChroCART® 125-4 Purospher® RP-18, 5 µm
Mobile phase	Acetonitrile/Water 30/70 (v/v)
Flow rate	1.0 ml/min
Detection	UV 254nm
Temperature	Room temperature
Injection volume	10 µl
Sample	1. Caffeine
	2. Aniline
	3. Pyridine
	4. o-Toluidine
	5. m-Toluidine
	6. p-Toluidine
	7. N-Methylaniline
	8. 2-Ethylaniline
	9. 3-Nitroanisole
	10. N,N-Dimethylaniline



Pyridine / Phenol Test

Column	LiChroCART® 125-4 Purospher® RP-18, 5 µm
Mobile phase	Acetonitrile/Water 30/70 (v/v)
Flow rate	1.0 ml/min
Detection	UV 254nm
Temperature	Room temperature
Injection volume	10 µl
Sample	1. Acetone
	2. Pyridine
	3. Phenol



Purospher® RP-18 HC

High resolution separation of explosives

→ Purospher® RP-18 endcapped
Excellent peak symmetry with either basic or strongly acidic compounds 98
→ Purospher® STAR RP-18 endcapped
Just the best choice 83
→ Purospher® STAR RP-8 endcapped 93
→ Purospher® STAR Silica and Amino-phase 96
→ Aluspher® 100 RP-select B
A stable reversed phase stationary phase optimized for applications up to pH 12 133
→ LiChrospher® 60 RP-select B
Excellent separations even with basic compounds 121
→ Accessories for Particulate HPLC Columns
The LiChroCART® cartridge - different lengths, different internal diameter 152
→ Accessories for Particulate HPLC Columns
manu-CART® cartridge holder for LiChroCART® cartridges 149
→ Customized packings
Always the right column 144

Purospher® RP-18 HC is excellently suitable for high resolution separation of explosives and related compounds.

The determination of explosives is of great importance, including the quantification of their by products like nitrotoluene and nitrophenol, as well as nitroaminotoluene and ami-notoluene.

Purospher® RP-18 HC is also suitable for the separation of picric acid from hexyl and ethylene-glycol dinitrate from ethyleneglycol nitrate.

Specifications of Purospher® RP-18 HC

Sorbent characteristics:	High-purity silica particles with dedicated RP-18 modification
Particle shape:	spherical
Particle size:	5 µm
Pore size:	90 Å (9 nm)
Pore volume:	1.05 ml/g
Spec. surface area:	470 m^2/g
Carbon load:	18.0 % C
pH range:	pH 2-8
Shipping eluent:	Acetonitrile/Water

Ordering information of Purospher® RP-18 HC

Stainless steel cartridges LiChroCART®

The LiChroCART® column (250 mm length) in the list below (250 mm i.d.) require part number 1.51486.0001 manu-CART® cartridge column holder, which can be used to hold one cartridge column with or without a 4-4mm guard column.

Packing material	Ordering No.	Particle size	Dimensions Length	Dimensions i.d.	Contents of one package
Purospher® RP-18	1.51436.0001	5 µm	250 mm	4 mm	1 piece

Additional dimensions available as customised packings see page 144

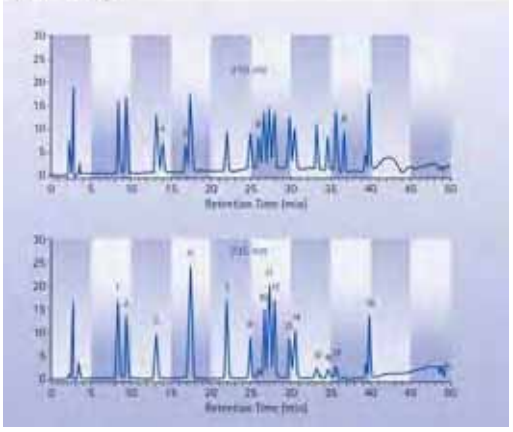
Purospher® RP-18 HC

High resolution separation of explosives

Separation examples on Purospher® RP-18 HC

Separation of explosives from drinking water

Column	LiChroCART® 250-4 Purospher® RP-18 HC, 5 µm	
Mobile phase	A: Acetonitrile / Methanol; 20 / 80, v/v B: Sodium dihydrogenphosphate buffer (c = 0.01 mol/L, pH 4.5)	
Gradient	0 min 35 % A; 28 min 55 % A; 40 min 85 % A; 50 min 85 % A; 51 min 35 % A; 71 min 35 % A	
Flow rate	0.8 ml/min	
Detection	DAD 210 and 235 nm	
Temperature	36 °C	
Injection volume	40 µl	
Sample	1. Octogen (HMX)	105 % recovery
	2. Picric acid	96 % recovery
	3. Hexogen (RDX)	107 % recovery
	4. Ethylene Glycol Dinitrate (EGDN)	61 % recovery
	5. Dethylene Glycol Dinitrate (DEGN)	95 % recovery
	6. 1,3,5-Trinitrobenzene	102 % recovery
	7. 1,3-Dinitrobenzene	96 % recovery
	8. Tetryl	91 % recovery
	9. Nitroglycerine	53 % recovery
	10. 2,4,6-Trinitrotoluene	99 % recovery
	11. 4-Amino-2,6-dinitrotoluene	106 % recovery
	12. 2-Amino-4,6-dinitrotoluene	107 % recovery
	13. 2,6-Dinitrotoluene	104 % recovery
	14. 2,4-Dinitrotoluene	104 % recovery
	15. 2-Nitrotoluene	85 % recovery
	16. 4-Nitrotoluene	88 % recovery
	17. 3-Nitrotoluene	86 % recovery
	18. Nitropenta (PETN)	106 % recovery
	19. Hexyl	73 % recovery



Sample preparation

Solid phase extraction with LiChrolut® EN (200 mg) (Cat. No. 1.19870):

Solvents: A: Methanol (LiChrosolv Cat. No. 1.06007), B: Acetonitrile (LiChrosolv Cat. No. 1.00030); C: Water (LiChrosolv Cat. No. 1.15333).

Sample preparement: Filtrate if necessary and add approx. 5 g NaCl/l water sample. Conditioning of extraction column: 3 mL A, 3 mL B, 10 mL C, do not allow column to dry out! Sample application: pass 1 l water sample through the extraction column within 1 hour by using LiChrolut® extraction unit (Cat. No. 1.19851) which is connected to thw water sample with PTFE hose (Cat. No. 1.22143) and a steel capillary (Cat. No. 1.19902). the teflon hose is placed through the adapter (Cat. No. 1.02206) which is plugged into the column. Drying step: 10 min by means of nitrogen and LiChrolut® drying unit (Cat. No. 1.19852).

Elution step: 1 x 2 mL, then 1 x 3 mL A/B (1:1), collect in a conical flask and gently evaporate the solvent by means of nitrogen up to a and volume of 0.5 mL. Fill up to 1.0 mL with C. Subsequently filtrate sample into a 1.5 mL sample vial (Cat. No. 1.18081) through a 0.2 µm. Anotop membrane filter (Cat. No. 1.11318).

Superspher®

For highly efficient HPLC of complex mixtures where high peak capacity required

Superspher® improves the separation efficiency of HPLC analysis.

This high performance spherical silica carrier with a mean particle size of 4 µm yields the best pressure/separation performance ratio in view of today´s generation of HPLC systems and according to theoretical calculation and practical experience.

The number of theoretical plates for Superspher® is < 100 000 N/m. Therefore, they are always first choice if complex mixtures demand high peak capacity.

A broad range of modifications on Superspher® are available: non-polar derivatives (RP-8, RP-8 endcapped, RP-18, RP-18 endcapped and RP-select B) and polar derivatives (Si 60).

Superspher® packing materials are available as LiChroCART® cartridge in different lengths and different internal diameters (4 mm, 3 mm and 2 mm).

LiChroCART® 3 mm i.d. and 2 mm i.d. narrow bore cartridges for HPLC saves costs by reducing the solvent consumption and allows the handling of very small quantities while increased sensitivity as well as resolution are achieved.

LiChroCART® cartridges 4 mm i.d., 3 mm i.d. and 2 mm i.d. are compatible to the manuCART® "4" this facilitate faster and more flexible method adaptation to smaller bore columns.

Specifications of Superspher®

Packing material	Characteristics	Spec. surface area S_{BET} (m^2/g)	Pore volume V_P (ml/g)	Particle size d_P (µm)	%C	Surface coverage (µmol/m^2)
Superspher® Si 60	spherical particles of silica medium pore size: 6 nm (60 Å)	700	0.85	4		
Superspher® 60 RP-8	spherical particles of silica with octyl derivative	350	1.25	4	12.5	4.04
Superspher® 60 RP-8 endcapped	spherical particles of silica with octyl derivative end-capped	350	1.25	4	13.0	4.44
Superspher® 100 RP-18	spherical particles of silica with octadecyl derivative	350	1.25	4	21.0	3.61
Superspher® 100 RP-18 endcapped	spherical particles of silica with octadecyl derivative endcapped	350	1.25	4	21.6	4.09
Superspher® 60 RP-select B	spherical particles of silica with octyl derivative, espe-cially suitable for the RP-separation of basic compounds	360	0.9	4	11.5	3.55

Ordering information of Superspher®
Stainless steel cartridges LiChroCART®

The LiChroCART® columns (75, 125, 150 and 250 mm length) in the list below (2, 3 and 4 mm i.d.) require part number 1.51486.0001 manu-CART® cartridge column holder, which can be used to hold one cartridge column with or without a 4-4mm guard column.

Packing material	Ordering No.	Particle size	Dimen-sions Length	Dimen-sions i.d.	Contents of one package
Superspher® Si 60	1.16054.0001	4 µm	125 mm	4 mm	1 piece
Superspher® Si 60	1.16009.0001	4 µm	250 mm	4 mm	1 piece
Superspher® 60 RP-8	1.16052.0001	4 µm	125 mm	4 mm	1 piece
Superspher® 60 RP-8	1.16010.0001	4 µm	250 mm	4 mm	1 piece

Additional dimensions available as customised packings see page 144
As guard column we recommend LiChroCART® 4-4 LiChrospher® guard cartridges.

→ Accessories for Particulate HPLC Columns The LiChroCART® cartridge - different lengths, different internal diameter 152

→ Accessories for Particulate HPLC Columns manu-CART® cartridge holder for LiChroCART® cartridges 149

→ Customized packings Always the right column 144

Superspher®

For highly efficient HPLC of complex mixtures where high peak capacity required

Packing material	Ordering No.	Particle size	Dimensions Length	Dimensions i.d.	Contents of one package
Superspher® 60 RP-8 endcapped	1.16854.0001	4 µm	125 mm	4 mm	1 piece
Superspher® 60 RP-8 endcapped	1.16857.0001	4 µm	250 mm	4 mm	1 piece
Superspher® 100 RP-18	1.50204.0001	4 µm	10 mm	2 mm	3 pieces
Superspher® 100 RP-18	1.50200.0001	4 µm	125 mm	2 mm	1 piece
Superspher® 100 RP-18	1.50792.0001	4 µm	125 mm	3 mm	1 piece
Superspher® 100 RP-18	1.51299.0001	4 µm	250 mm	3 mm	1 piece
Superspher® 100 RP-18	1.16039.0001	4 µm	25 mm	4 mm	3 pieces
Superspher® 100 RP-18	1.50980.0001	4 µm	75 mm	4 mm	3 pieces
Superspher® 100 RP-18	1.16051.0001	4 µm	125 mm	4 mm	1 piece
Superspher® 100 RP-18	1.16056.0001	4 µm	250 mm	4 mm	1 piece
Superspher® 100 RP-18 endcapped	1.50198.0001	4 µm	125 mm	2 mm	1 piece
Superspher® 100 RP-18 endcapped	1.50193.0001	4 µm	250 mm	2 mm	1 piece
Superspher® 100 RP-18 endcapped	1.16869.0001	4 µm	25 mm	4 mm	3 pieces
Superspher® 100 RP-18 endcapped	1.16855.0001	4 µm	125 mm	4 mm	1 piece
Superspher® 100 RP-18 endcapped	1.16858.0001	4 µm	250 mm	4 mm	1 piece
Superspher® 60 RP-select B	1.50205.0001	4 µm	10 mm	2 mm	3 pieces
Superspher® 60 RP-select B	1.50197.0001	4 µm	125 mm	2 mm	1 piece
Superspher® 60 RP-select B	1.51308.0001	4 µm	250 mm	2 mm	1 piece
Superspher® 60 RP-select B	1.50791.0001	4 µm	125 mm	3 mm	1 piece
Superspher® 60 RP-select B	1.51288.0001	4 µm	250 mm	3 mm	1 piece
Superspher® 60 RP-select B	1.50974.0001	4 µm	75 mm	4 mm	3 pieces
Superspher® 60 RP-select B	1.50975.0001	4 µm	125 mm	4 mm	1 piece
Superspher® 60 RP-select B	1.50973.0001	4 µm	250 mm	4 mm	1 piece

Additional dimensions available as customised packings see page 144
As guard column we recommend LiChroCART® 4-4 LiChrospher® guard cartridges.

Glass cartridges EcoCART®

EcoCART® columns require part number 1.51207.0001 EcoCART® cartridge holder.

Packing material	Ordering No.	Particle size	Dimensions Length	Dimensions i.d.	Contents of one package
Superspher® 100 RP-18 endcapped	1.51423.0001	4 µm	125 mm	3 mm	1 piece
Superspher® 60 RP-select B	1.51425.0001	4 µm	125 mm	3 mm	1 piece

Superspher®

For highly efficient HPLC of complex mixtures where high peak capacity required

Sorbents

Packing material	Ordering No.	Particle size	Package	Quantity
Superspher® Si 60	1.19609.0010	4 µm	Glass	10 g
Superspher® Si 60	1.19609.0100	4 µm	Glass	100 g
Superspher® 60 RP-8	1.19612.0010	4 µm	Glass	10 g
Superspher® 60 RP-8 endcapped	1.19617.0010	4 µm	Glass	10 g
Superspher® 60 RP-8 endcapped	1.19617.0100	4 µm	Glass	100 g
Superspher® 100 RP-18	1.19613.0010	4 µm	Glass	10 g
Superspher® 100 RP-18	1.19613.0100	4 µm	Glass	100 g
Superspher® 100 RP-18 endcapped	1.19618.0010	4 µm	Glass	10 g
Superspher® 100 RP-18 endcapped	1.19618.0100	4 µm	Glass	100 g
Superspher® 60 RP-select B	1.19643.0010	4 µm	Glass	10 g
Superspher® 60 RP-select B	1.19643.0100	4 µm	Glass	100 g

LiChrospher®

Spherical silica carrier for constant results on high level

LiChrospher® are reliable and versatile traditionally produced spherical silica carrier.

LiChrospher® silica carrier are available with different modifications.

The polar modified phases LiChrospher® CN, LiChrospher® NH_2 and LiChrospher® DIOL as well as LiChrospher® Si with no modification are best for normal phase HPLC.

Furthermore LiChrospher® PAH is highly efficient and selective for the separation of PAH; as well as LiChrospher® WP 300 RP-18 for the separation of peptides and low molecular weight proteins.

LiChrospher® packing materials are available as Hibar® RT column and as LiChroCART® cartridge in different lengths and different internal diameters (10 mm, 4 mm, 3 mm and 2 mm).

LiChroCART® 3 mm i.d. and 2 mm i.d. narrow bore cartridges for HPLC saves costs by reducing the solvent consumption and allows the handling of very small quantities while increased sensitivity as well as resolution are achieved.

LiChroCART® cartridges 4 mm i.d., 3 mm i.d. and 2 mm i.d. are compatible to the manuCART® "4" this facilitate faster and more flexible method adaptation to smaller bore columns.

LiChroCART® cartridges 10 mm i.d. have to be used with manuCART "10"-II.

Specifications of LiChrospher® packing materials

Packing material	Characteristics	Spec. surface area S_{BET} (m_2/g)	Pore volume V_P (ml/g)	Particle size d_P (µm)	% C	Surface coverage (µmol/m_2)
LiChrospher® Si 60	spherical particles of silica medium pore size: 6 nm (60 Å)	700	0.85	5, 10		
LiChrospher® Si 100	spherical particles of silica medium pore size: 10 nm (100 Å)	400	1.25	5, 10		
LiChrospher® 100 CN	spherical particles of silica with cyanopropyl function	350	1.25	5, 10	6.6	3.52
LiChrospher® 100 NH_2	spherical particles of silica with aminopropyl function	350	1.25	5, 10	4.6	4.10
LiChrospher® 100 DIOL	spherical particles of silica with vicinal hydroxyl function on C-chains	350	1.25	5, 10	8.0	3.87
LiChrospher® 100 RP-8	spherical particles of silica with octyl derivative	350	1.25	5, 10	12.5	4.04
LiChrospher® 100 RP-8 endcapped	spherical particles of silica with octyl derivative endcapped	350	1.25	5, 10	13.0	4.44
LiChrospher® 100 RP-18	spherical particles of silica with octadecyl derivative	350	1.25	5, 10	21.0	3.61
LiChrospher® 100 RP-18 endcapped	spherical particles of silica with octadecyl derivative endcapped	350	1.25	5, 10	21.6	4.09

LiChrospher®

Spherical silica carrier for constant results on high level

Packing material	Characteristics	Spec. surface area S_{BET} (m_2/g)	Pore volume V_P (ml/g)	Particle size d_P (µm)	% C	Surface coverage (µmol/m_2)
LiChrospher® 60 RP-select B	spherical particles of silica with octyl derivative, especially suitable for the RP-separation of basic compounds	350	0.9	5, 10	11.5	3.55
LiChrospher® WP 300 RP-18	spherical particles of silica with octadecyl derivative	80	1.0	5, 12, 15		

Fraction range of LiChrospher® packing materials

Packing material	Spec. surface area (m^2/g)	Spec. pore volume (ml/g)	Fractionation range (Polystyrene/THF) (g/mol)
LiChrospher® Si 60	700	0.85	100 - 2 ·10^4
LiChrospher® Si 100	400	1.25	200 - 7 ·10^4
LiChrospher® 100 DIOL	350	1.25	200 - 4 ·10^4
LiChrospher® 100 RP-18	350	1.25	200 - 4 ·10^4
LiChrospher® WP 300 RP-18	80	1.0	4000 - 6 ·10^5

Certified reproducibility of HPLC separations

The heart of each HPLC system is the column, where the separation of sample components takes place. Due to the chemical properties of silica, HPLC columns are subject to neutral wear, e.g. due to the irreversible adsorption of injected samples or sample matrix or due to mechanical and chemical instabilities of the stationary phase. As a consequence, altered selectivities, "ghost peaks", diminished separation power or excessively elevated column pressures will result, preventing further column use. Hence, changing HPLC columns is a permanent process. This need not necessarily be problematic if the new column is one of the same type and has the same properties as the preceding one. The certified reproducibility of HPLC columns prevents extensive method revision as well as additional costs.

Separation performance, selectivity and capacity

Reproducibility of HPLC columns means that reproducibility is the most important property of an HPLC column, independent of the respective production batch. All columns of the same type should be reproducible and therefore comparable in terms of separation performance, selectivity and retention behaviour. In its determination, a characteristic substance mixture is subjected to chromatography under buffered elution conditions. The resulting chromatographic parameters such as k-values, separation factors and the minimum number of theoretical plates are fixed.

- **retention factor k** (previously designated as capacity factor k´) of a neutral compound means: the defined hydrophobic character of the stationary phase.
- **separation factors α** (i.e. relative retention times, previously designated as selectivity) bring about a defined order of elution and defined peak distance from batch to batch and cartridge to cartridge.
- **minimum number of theoretical plates (N)** under buffered (not ideal) chromatographic conditions ensures separation performance.

Certified reproducibility of HPLC columns – No additional costs in method evaluation

The evaluation of quality control methods for certain products, e.g. in the pharmaceutical sector, constitutes a considerable cost factor. The fact that an analytical method once established is used in expensive registration procedures for many years (up to 10 and more) requires thorough and careful elaboration. In this context, the selection of the HPLC column is an important decision criterion. The column certificate places the highest demands on process control during the batch-to-batch production of column materials. This ensures the customer constant HPLC column quality over many years. Therefore, no additional costs will arise for the revision or re-registration of a particular analysis method.

LiChrospher® Si 60 and Si 100

For normal phase HPLC

LiChrospher® Si 60 and Si 100 are versatile HPLC sorbents based on spherical silica particles possessing polar properties.

Specifications of LiChrospher® Si 60 and Si 100

	LiChrospher® Si 60	LiChrospher® Si 100
Sorbent characteristics:	particles of silica	particles of silica
Particle shape:	spherical	spherical
Particle size:	5; 10 µm	5; 10 µm
Pore size:	60 Å (6 nm)	100 Å (10 nm)
Pore volume:	0.85 ml/g	1.25 ml/g
Spec. surface area:	700 m^2/g	400 m^2/g
Efficiency:	55 000 N/m; 20 000 N/m	55 000 N/m; 20 000 N/m
pH range:	2-7.5	2-7.5
Shipping eluent:	n-Heptane	n-Heptane

Ordering information of LiChrospher® Si

Stainless steel cartridges LiChroCART®

The LiChroCART® columns (125, 150 and 250 mm length) in the list below (4mm i.d.) require part number 1.51486.0001 manu-CART® cartridge column holder, which can be used to hold one cartridge column with or without a 4-4mm guard column.

LiChroCART® columns 250-10 mm require part number 1.51419.0001 manuCART® 10.

Packing material	Ordering No.	Particle size	Dimensions Length	Dimensions i.d.	Contents of one package
LiChrospher® Si 60	1.50955.0001	5 µm	4 mm	4 mm	10 pieces
LiChrospher® Si 60	1.50928.0001	5 µm	25 mm	4 mm	3 pieces
LiChrospher® Si 60	1.50820.0001	5 µm	125 mm	4 mm	1 piece
LiChrospher® Si 60	1.50830.0001	5 µm	250 mm	4 mm	1 piece
LiChrospher® Si 60	1.50840.0001	10 µm	250 mm	4 mm	1 piece
LiChrospher® Si 60	1.50850.0001	10 µm	250 mm	10 mm	1 piece

Additional dimensions available as customised packings see page 144

Stainless steel columns Hibar® RT

The Hibar® columns are complete with endfittings.

When using a guard column with a Hibar® column, we recommend part number 1.51487.0001 guard column cartridge holder for 4-4mm guard column cartridges LiChroCART®.

Packing material	Ordering No.	Particle size	Dimensions Length	Dimensions i.d.	Contents of one package
LiChrospher® Si 100	1.50316.0001	5 µm	250 mm	4 mm	1 piece

Additional dimensions available as customised packings see page 144

Sorbents

Packing material	Ordering No.	Particle size	Package	Quantity
LiChrospher® Si 60	1.19640.0010	5 µm	Glass	10 g
LiChrospher® Si 60	1.19629.0010	10 µm	Glass	10 g
LiChrospher® Si 100	1.16116.0010	5 µm	Glass	10 g
LiChrospher® Si 100	1.16112.0010	10 µm	Glass	10 g

→ Accessories for Particulate HPLC Columns The LiChroCART® cartridge - different lengths, different internal diameter 152

→ Accessories for Particulate HPLC Columns manu-CART® cartridge holder for LiChroCART® cartridges 149

→ LiChrosorb® A successful packing material from the start 130

→ Superspher® For highly efficient HPLC of complex mixtures where high peak capacity required 104

→ Purospher® STAR Silica and Amino-phase 96

→ Customized packings Always the right column 144

→ Standardised silica gels 184

→ LiChrospher® 190

LiChrospher® 100 CN

Excellent for complex samples with polar and hydrophobic characteristics

LiChrospher® 100 CN has both polar and hydrophobic properties, thus can be used as less polar alternative to LiChrospher® Si 60 in normal phase applications or as less hydrophobic alternative to LiChrospher® RP-8 in reversed phase applications. The combination of weak hydrophobic interactions and polar interactions enables successful separations of complex samples. In addition, the possibility of selective charged interactions makes it even more versatile.

Specifications of LiChrospher® 100 CN

Sorbent characteristics:	Particles of silica with g-Cyanopropyl function
Particle shape:	spherical
Particle size:	5; 10 µm
Pore size:	100 Å (10 nm)
Pore volume:	1.25 ml/g
Spec. surface area:	350 m^2/g
Carbon load:	6.6 % C
Coverage of the surface:	3.52 µmol/m^2
Efficiency:	40 000 N/m ; 15 000 N/m
pH range:	pH 2-7.5
Shipping eluent:	n-Heptane

Ordering information of LiChrospher® 100 CN

Stainless steel cartridges LiChroCART®

The LiChroCART® columns (125, 150 and 250 mm length) in the list below (4mm i.d.) require part number 1.51486.0001 manu-CART® cartridge column holder, which can be used to hold one cartridge column with or without a 4-4 mm guard column.

Packing material	Ordering No.	Particle size	Dimensions Length	Dimensions i.d.	Contents of one package
LiChrospher® 100 CN	1.50959.0001	5 µm	4 mm	4 mm	10 pieces
LiChrospher® 100 CN	1.50825.0001	5 µm	125 mm	4 mm	1 piece
LiChrospher® 100 CN	1.50892.0001	5 µm	250 mm	4 mm	1 piece
LiChrospher® 100 CN	1.50845.0001	10 µm	250 mm	4 mm	1 piece

Additional dimensions available as customised packings see page 144

Sorbents

Packing material	Ordering No.	Particle size	Package	Quantity
LiChrospher® 100 CN	1.19638.0010	5 µm	Glass	10 g
LiChrospher® 100 CN	1.19638.0100	5 µm	Glass	100 g
LiChrospher® 100 CN	1.19631.0010	10 µm	Glass	10 g

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→ Accessories for Particulate HPLC Columns manu-CART® cartridge holder for LiChroCART® cartridges 149

→ LiChrosorb® A successful packing material from the start 130

→ Superspher® For highly efficient HPLC of complex mixtures where high peak capacity required 104

→ Customized packings Always the right column 144

LiChrospher® 100 NH_2

A versatile sorbent for both reversed phase and straight phase chromatography

LiChrospher® 100 NH_2 possesses polar and hydrophobic properties and can be used for normal phase chromatography, reversed phase chromatography and ion exchange chromatography.

Typical applications are the separation of carbohydrates (mono-, di- and oilgosaccharides) with reversed phase chromatography or the separation of nucleotides with LiChrospher® NH_2 as weak anion exchanger.

Specifications of LiChrospher® 100 NH_2

Sorbent characteristics:	Particles of silica with γ-Aminopropyl function
Particle shape:	spherical
Particle size:	5; 10 µm
Pore size:	100 Å (10 nm)
Pore volume	1.25 ml/g
Spec. surface area:	350 m^2/g
Carbon load:	4.6 % C
Coverage of the surface:	4.1 µmol/m^2
Efficiency:	25 000 N/m ; 20 000 N/m
pH range:	pH 2-7.5
Shipping eluent:	n-Heptane

Ordering information of LiChrospher® 100 NH_2

Stainless steel cartridges LiChroCART®

The LiChroCART® columns (125, 150 and 250 mm length) in the list below (4mm i.d.) require part number 1.51486.0001 manu-CART® cartridge column holder, which can be used to hold one cartridge column with or without a 4-4mm guard column.

Packing material	Ordering No.	Particle size	Dimensions Length	Dimensions i.d.	Contents of one package
LiChrospher® 100 NH_2	1.50958.0001	5 µm	4 mm	4 mm	10 pieces
LiChrospher® 100 NH_2	1.50932.0001	5 µm	25 mm	4 mm	3 pieces
LiChrospher® 100 NH_2	1.50824.0001	5 µm	125 mm	4 mm	1 piece
LiChrospher® 100 NH_2	1.50834.0001	5 µm	250 mm	4 mm	1 piece
LiChrospher® 100 NH_2	1.50844.0001	10 µm	250 mm	4 mm	1 piece

Additional dimensions available as customised packings see page 144

Sorbents

Packing material	Ordering No.	Particle size	Package	Quantity
LiChrospher® 100 NH_2	1.16178.0010	5 µm	Glass	10 g
LiChrospher® 100 NH_2	1.16178.0100	5 µm	Glass	100 g

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The LiChroCART® cartridge - different lengths, different internal diameter 152

→ Accessories for Particulate HPLC Columns
manu-CART® cartridge holder for LiChroCART® cartridges 149

→ LiChrosorb®
A successful packing material from the start 130

→ Superspher®
For highly efficient HPLC of complex mixtures where high peak capacity required 104

→ Purospher® STAR
Silica and Amino-phase 96

→ Customized packings
Always the right column 144

LiChrospher® 100 DIOL

Excellent for complex samples with polar and hydrophobic characteristics and for exclusion chromatography

LiChrospher® 100 DIOL possesses both, polar and hydrophobic properties, thus can be used as less polar alternative to LiChrospher® Si 60 in normal phase applications or as less hydrophobic alternative with some limitations to LiChrospher® RP-8 in reversed phase applications. The combination of weak hydrophobic interactions and polar interactions enables successful separations of complex samples. In addition, LiChrospher® DIOL is also suitable for exclusion chromatography.

Specifications of LiChrospher® 100 DIOL

Sorbent characteristics:	Particles of silica with Diol function on c-chains
Particle shape:	spherical
Particle size:	5; 10 µm
Pore size:	100 Å (10 nm)
Pore volume	1.25 ml/g
Spec. surface area:	350 m^2/g
Carbon load:	8.0 % C
Coverage of the surface:	3.87 µmol/m^2
Efficiency:	45 000 N/m ; 20 000 N/m
pH range:	pH 2-7.5
Shipping eluent:	n-Heptane

Ordering information of LiChrospher® DIOL

Stainless steel cartridges LiChroCART®

The LiChroCART® columns (125, 150 and 250 mm length) in the list below (4mm i.d.) require part number 1.51486.0001 manu-CART® cartridge column holder, which can be used to hold one cartridge column with or without a 4-4mm guard column.

Packing material	Ordering No.	Particle size	Dimensions Length	Dimensions i.d.	Contents of one package
LiChrospher® 100 DIOL	1.50960.0001	5 µm	4 mm	4 mm	10 pieces
LiChrospher® 100 DIOL	1.50826.0001	5 µm	125 mm	4 mm	1 piece
LiChrospher® 100 DIOL	1.50836.0001	5 µm	250 mm	4 mm	1 piece

Additional dimensions available as customised packings see page 144

Sorbents

Packing material	Ordering No.	Particle size	Package	Quantity
LiChrospher® 100 DIOL	1.16152.0010	5 µm	Glass	10 g
LiChrospher® 100 DIOL	1.16152.0100	5 µm	Glass	100 g
LiChrospher® 100 DIOL	1.16151.0010	10 µm	Glass	10 g

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→ Accessories for Particulate HPLC Columns manu-CART® cartridge holder for LiChroCART® cartridges 149

→ LiChrosorb® A successful packing material from the start 130

→ Superspher® For highly efficient HPLC of complex mixtures where high peak capacity required 104

→ Customized packings Always the right column 144

LiChrospher® 100 RP-8 and RP-8 endcapped

For reproducible reversed phase separation

LiChrospher® 100 RP-8 and LiChrospher® 100 RP-8 endcapped are reliable and versatile traditionally produced spherical silica carrier with reversed phase properties.

They are well suited for the chromatography of acidic, neutral and weakly basic compounds, substances found frequently in all analytical fields.

The good column selectivity and performance makes sure that these parameters remain constant form batch to batch and from year to year.

The difference in polarities are clearly described by the selectivity pattern. This can save time and avoid errors when working on new methods.

Specifications of LiChrospher® 100 RP-8 and RP-8 endcapped

	LiChrospher® 100 RP-8	LiChrospher® 100 RP-8 end-capped
Sorbent characteristics:	Particles of silica with Octyl derivative	Particles of silica with Octyl derivative endcapped
Particle shape:	spherical	spherical
Particle size:	5; 10 µm	5; 10 µm
Pore size:	100 Å (10 nm)	100 Å (10 nm)
Pore volume:	1.25 ml/g	1.25 ml/g
Spec. surface area:	350 m^2/g	350 m^2/g
Carbon load:	12.5 % C	13.0 % C
Coverage of the surface:	4.04 µmol/m^2	4.44 µmol/m^2
Efficiency:	55 000 N/m; 25 000 N/m	55 000 N/m; 25 000 N/m
pH range:	pH 2-7.5	
Shipping eluent:	Acetonitrile/Water	

Ordering information of LiChrospher® 100 RP-8 and RP-8 endcapped

Stainless steel cartridges LiChroCART®

The LiChroCART® columns (75, 125, 150 and 250 mm length) in the list below (4 mm i.d.) require part number 1.51486.0001 manu-CART® cartridge column holder, which can be used to hold one cartridge column with or without a 4-4mm guard column. LiChroCART® columns 250-10 mm require part number 1.51419.0001 manuCART® 10.

Packing material	Ordering No.	Particle size	Dimensions Length	Dimensions i.d.	Contents of one package
LiChrospher® 100 RP-8	1.50956.0001	5 µm	4 mm	4 mm	10 pieces
LiChrospher® 100 RP-8	1.50930.0001	5 µm	25 mm	4 mm	3 pieces
LiChrospher® 100 RP-8	1.50986.0001	5 µm	75 mm	4 mm	3 pieces
LiChrospher® 100 RP-8	1.50822.0001	5 µm	125 mm	4 mm	1 piece
LiChrospher® 100 RP-8	1.50942.0001	5 µm	125 mm	4 mm	3 pieces
LiChrospher® 100 RP-8	1.50832.0001	5 µm	250 mm	4 mm	1 piece
LiChrospher® 100 RP-8	1.50982.0001	5 µm	250 mm	4 mm	3 pieces
LiChrospher® 100 RP-8	1.50842.0001	10 µm	250 mm	4 mm	1 piece
LiChrospher® 100 RP-8	1.50945.0001	10 µm	10 mm	10 mm	2 pieces

Additional dimensions available as customised packings see page 144

→ Accessories for Particulate HPLC Columns
The LiChroCART® cartridge - different lengths, different internal diameter 152

→ Accessories for Particulate HPLC Columns
manu-CART® cartridge holder for LiChroCART® cartridges 149

→ LiChrosorb®
A successful packing material from the start 130

→ Superspher®
For highly efficient HPLC of complex mixtures where high peak capacity required 104

→ Purospher® RP-18
Allows simpler, time saving methods for reversed phase chromatography of basic compounds 100

→ Purospher® RP-18 endcapped
Excellent peak symmetry with either basic or strongly acidic compounds 98

→ Purospher® STAR RP-8 endcapped 93

→ Customized packings
Always the right column 144

LiChrospher® 100 RP-8 and RP-8 endcapped

For reproducible reversed phase separation

Packing material	Ordering No.	Particle size	Dimensions Length	Dimensions i.d.	Contents of one package
LiChrospher® 100 RP-8 endcapped	1.50961.0001	5 µm	4 mm	4 mm	10 pieces
LiChrospher® 100 RP-8 endcapped	1.50827.0001	5 µm	125 mm	4 mm	1 piece
LiChrospher® 100 RP-8 endcapped	1.50837.0001	5 µm	250 mm	4 mm	1 piece
LiChrospher® 100 RP-8 endcapped	1.50847.0001	10 µm	250 mm	4 mm	1 piece

Additional dimensions available as customised packings see page 144

Stainless steel columns Hibar®

The Hibar® columns are complete with endfittings.

When using a guard column with a Hibar column, we recommend Part Number 1.51487.0001 guard column cartridge holder for 4-4 mm guard column cartridges LiChroCART®.

Packing material	Ordering No.	Particle size	Dimensions Length	Dimensions i.d.	Contents of one package
LiChrospher® 100 RP-8	1.50329.0001	5 µm	250 mm	4 mm	1 piece

Additional dimensions available as customised packings see page 144

Sorbents

Packing material	Ordering No.	Particle size	Package	Quantity
LiChrospher® 100 RP-8	1.16129.0010	5 µm	Glass	10 g
LiChrospher® 100 RP-8	1.16139.0010	10 µm	Glass	10 g
LiChrospher® 100 RP-8 endcapped	1.19636.0010	5 µm	Glass	10 g
LiChrospher® 100 RP-8 endcapped	1.19632.0010	10 µm	Glass	10 g

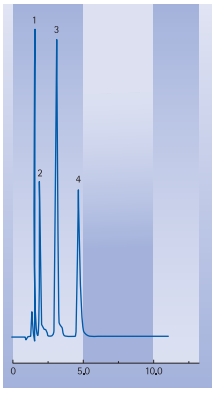
LiChrospher® 100 RP-8 and RP-8 endcapped

For reproducible reversed phase separation

Separation examples on LiChrospher® 100 RP-8

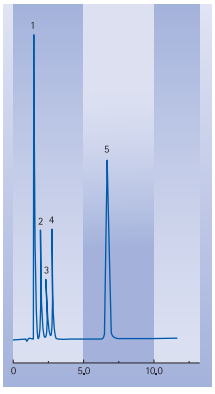
Nucleotides

Column	LiChrospher® 100 RP-8 (5 µm)
Mobile phase	Acetonitrile/0.05 M phosphate buffer pH 6.5 90/10 (v/v) + 0.001 mol/l $TBAHSO_4$
Flow rate	1.5 ml/min
Detection	UV 254 nm
Sample	1. NAD 2. Adenosine 3. NADH 4. NADPH



Digitalis

Column	LiChrospher® 100 RP-8 (5 µm)
Mobile phase	Acetonitrile/0.05 M phosphate buffer pH 3.5 32/68 (v/v)
Flow rate	1.5 ml/min
Detection	UV 254 nm
Sample	1. Digoxigenine 2. Lanatosid C 3. Digoxine 4. Gitoxigenine 5. Digitoxigenine



LiChrospher® 100 RP-18 and RP-18 endcapped

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→ Accessories for Particulate HPLC Columns manu-CART® cartridge holder for LiChroCART® cartridges 149
→ LiChrosorb® A successful packing material from the start 130
→ Superspher® For highly efficient HPLC of complex mixtures where high peak capacity required 104
→ Purospher® RP-18 Allows simpler, time saving methods for reversed phase chromatography of basic compounds 100
→ Purospher® RP-18 endcapped Excellent peak symmetry with either basic or strongly acidic compounds 98
→ Purospher® STAR RP-8 endcapped 93
→ Customized packings Always the right column 144
→ LiChrospher® 190

LiChrospher® 100 RP-18 and LiChrospher® 100 RP-18 endcapped are reliable and versatile traditionally produced spherical silica carrier with reversed phase properties.

They are well suited for the chromatography of acidic, neutral and weakly basic compounds, substances found frequently in all analytical fields.

The good column selectivity and performance makes sure that these parameters remain constant form batch to batch and from year to year.

The difference in polarities are clearly described by the selectivity pattern. This can save time and avoid errors when working on new methods.

Specifications of LiChrospher® 100 RP-18 and RP-18 endcapped

	LiChrospher® 100 RP-18	LiChrospher® 100 RP-18 endcapped
Sorbent characteristics:	Particles of silica with Octadecyl derivative	Particles of silica with Octadecyl derivative endcapped
Particle shape:	spherical	spherical
Particle size:	5; 10 µm	5; 10 µm
Pore size:	100 Å (nm)	100 Å (nm)
Pore volume:	1.25 ml/g	1.25 ml/g
Spec. surface area:	350 m^2/g	350 m^2/g
Carbon load:	21.0 % C	21.6 % C
Coverage of the surface:	3.61 µmol/m^2	4.09 µmol/m^2
Efficiency:	55 000 N/m; 20 000 N/m	55 000 N/m; 20 000 N/m
pH range:	pH 2-7.5	
Shipping eluent:	Acetonitrile/Water	

Ordering information of LiChrospher® 100 RP-18 and RP-18 endcapped

Stainless steel cartridges LiChroCART®

The LiChroCART® columns (75, 125, 150 and 250 mm length) in the list below (3 and 4 mm i.d.) require part number 1.51486.0001 manu-CART® cartridge column holder, which can be used to hold one cartridge column with or without a 4-4 mm guard column.

LiChroCART® columns 250-10 mm require part number 1.51419.0001 manuCART® 10.

Packing material	Ordering No.	Particle size	Dimensions Length	Dimensions i.d.	Contents of one package
LiChrospher® 100 RP-18	1.50957.0001	5 µm	4 mm	4 mm	10 pieces
LiChrospher® 100 RP-18	1.50931.0001	5 µm	25 mm	4 mm	3 pieces
LiChrospher® 100 RP-18	1.50987.0001	5 µm	75 mm	4 mm	3 pieces
LiChrospher® 100 RP-18	1.50159.0001	5 µm	125 mm	3 mm	1 piece
LiChrospher® 100 RP-18	1.50823.0001	5 µm	125 mm	4 mm	1 piece
LiChrospher® 100 RP-18	1.50943.0001	5 µm	125 mm	4 mm	3 pieces
LiChrospher® 100 RP-18	1.50154.0001	5 µm	250 mm	3 mm	1 piece
LiChrospher® 100 RP-18	1.50833.0001	5 µm	250 mm	4 mm	1 piece
LiChrospher® 100 RP-18	1.50983.0001	5 µm	250 mm	4 mm	3 pieces
LiChrospher® 100 RP-18	1.50843.0001	10 µm	250 mm	4 mm	1 piece

Additional dimensions available as customised packings see page 144

LiChrospher® 100 RP-18 and RP-18 endcapped

Packing material	Ordering No.	Particle size	Dimensions Length	Dimensions i.d.	Contents of one package
LiChrospher® 100 RP-18	1.50853.0001	10 µm	250 mm	10 mm	1 piece
LiChrospher® 100 RP-18 endcapped	1.50962.0001	5 µm	4 mm	4 mm	10 pieces
LiChrospher® 100 RP-18 endcapped	1.50936.0001	5 µm	25 mm	4 mm	3 pieces
LiChrospher® 100 RP-18 endcapped	1.50828.0001	5 µm	125 mm	4 mm	1 piece
LiChrospher® 100 RP-18 endcapped	1.50734.0001	5 µm	125 mm	4 mm	3 pieces
LiChrospher® 100 RP-18 endcapped	1.50838.0001	5 µm	250 mm	4 mm	1 piece
LiChrospher® 100 RP-18 endcapped	1.50995.0001	5 µm	250 mm	4 mm	3 pieces
LiChrospher® 100 RP-18 endcapped	1.50848.0001	10 µm	250 mm	4 mm	1 piece
LiChrospher® 100 RP-18 endcapped	1.50858.0001	10 µm	250 mm	10 mm	1 piece

Additional dimensions available as customised packings see page 144

Glass cartridges EcoCART®

EcoCART® glass cartridges require part number 1.51207 EcoCART® glass cartridge holder.

Packing material	Ordering No.	Particle size	Dimensions Length	Dimensions i.d.	Contents of one package
LiChrospher® 100 RP-18	1.51232.0001	5 µm	125 mm	3 mm	3 piece
LiChrospher® 100 RP-18 endcapped	1.51427.0001	5 µm	125 mm	3 mm	3 pieces

Additional dimensions available as customised packings see page 144

Stainless steel columns Hibar®

The Hibar® columns are complete with endfittings.

When using a guard column with a Hibar® column, we recommend part number 1.51487.0001 guard column cartridge holder for 4-4 mm guard column cartridges LiChroCART®.

Packing material	Ordering No.	Particle size	Dimensions Length	Dimensions i.d.	Contents of one package
LiChrospher® 100 RP-18	1.50477.0001	5 µm	125 mm	4 mm	1 piece
LiChrospher® 100 RP-18	1.50377.0001	5 µm	250 mm	4 mm	1 piece

Additional dimensions available as customised packings see page 144

Sorbents

Packing material	Ordering No.	Particle size	Package	Quantity
LiChrospher® 100 RP-18	1.16177.0010	5 µm	Glass	10 g
LiChrospher® 100 RP-18	1.16177.0100	5 µm	Glass	100 g
LiChrospher® 100 RP-18	1.16105.0010	10 µm	Glass	10 g
LiChrospher® 100 RP-18 endcapped	1.19637.0010	5 µm	Glass	10 g

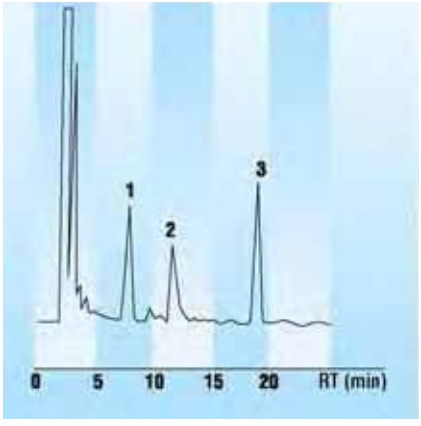
LiChrospher® 100 RP-18 and RP-18 endcapped

Packing material	Ordering No.	Particle size	Package	Quantity
LiChrospher® 100 RP-18 endcapped	1.19637.0100	5 µm	Glass	100 g
LiChrospher® 100 RP-18 endcapped	1.19633.0010	10 µm	Glass	10 g
LiChrospher® 100 RP-18 endcapped	1.19633.0100	10 µm	Glass	100 g

Separation examples on LiChrospher® 100 RP-18

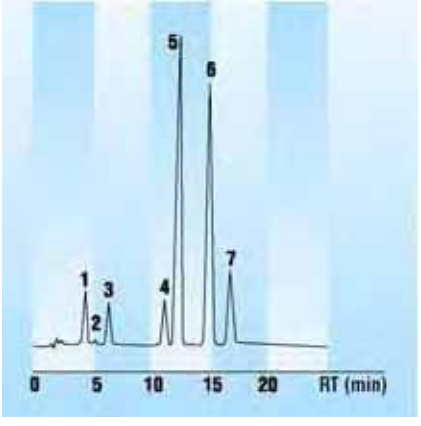
Pharmaceutical analysis: Acetyl salicylic acid

Column	LiChroCART® 250-4 LiChrospher® 100 RP-18, 5 µm
Mobile phase	0.01 mol/l sodiumdihydrogenphosphate pH 2.0 with phosphoric acid/Acetonitrile/Methanol 70/25/5 (v/v/v)
Flow rate	1.0 ml/min
Detection	UV 237nm
Temperature	Room temperature
Injection volume	100 µl
Sample	1. Acetylsalicylic acid 2. Salicylic acid 3. p-Hydroxybenzoic acid ethyl ester (internal standard)



Pharmaceutical analysis: 2-Oxoacids

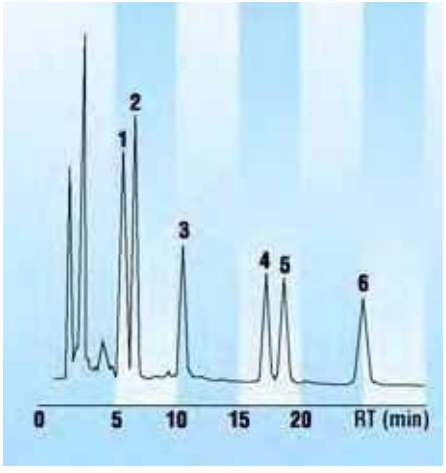
Column	LiChroCART® 250-4 LiChrospher® 100 RP-18, 5 µm
Mobile phase	Methanol/Water/Acetonitrile 35/45/20 (v/v/v)
Flow rate	1.0 ml/min
Detection	Fluorescence Ex 350 nm, Em 410 nm
Temperature	Room temperature
Injection volume	100 µl
Sample	1. Pyruvate 2. - 3. 2-Oxobutyric acid 4. 2-Oxoisovaleric acid (from valine) 5. 2-Oxoisocaproic acid (from leucine) 6. 2-Oxocaproic acid (internal standard) 7. 2-Oxo-3-methyl valeric acid (from isoleucine)



LiChrospher® 100 RP-18 and RP-18 endcapped

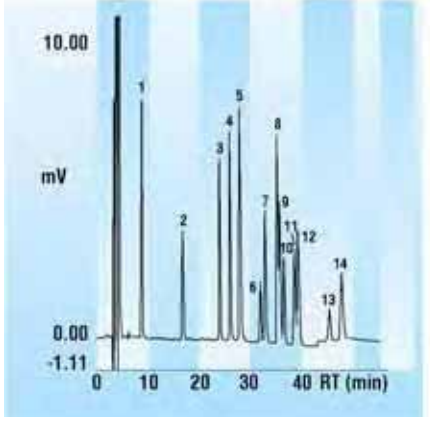
Pharmaceutical analysis: Corticoids

Column	LiChroCART® 125-4 LiChrospher® 100 RP-18, 5 µm
Mobile phase	Acetonitrile/0.5 mmol/l sodium acetate buffer 30/70 (v/v)
Flow rate	0.8 ml/min
Detection	UV 235 nm
Temperature	Room temperature
Injection volume	100 µl
Sample	1. Prednisolone 2. Cortisone 3. Dexamethasone 4. Prednisolone acetate 5. Hydrocortisone acetate 6. Cortisone acetate



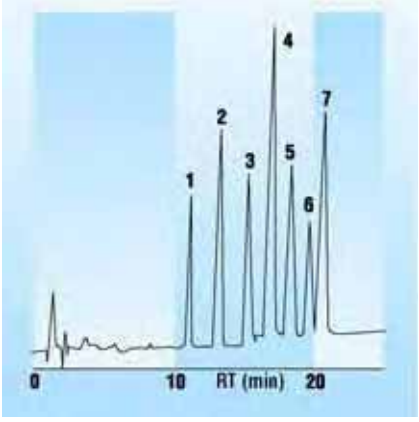
Environmental analysis: Explosives

Column	LiChroCART® 250-3 LiChrospher® 100 RP-18, 5 µm
Mobile phase	A: Methanol; B: Water
Gradient	0 min 26% A; 25 min 48% A; 55 min 48% A
Flow rate	0.4 ml/min
Detection	Diode array detection 200-320 nm Spectral band with 4 nm
Temperature	32°C
Injection volume	50 µl
Sample	1. Octogene 2. Hexogene 3. 2-Amino-6-nitotoluene 4. 4-Amino-2.nitrotoluene 5. 1,3-Dinitrotoluene 6. Nitrobenzene 7. Trinitrobenzene 8. 4-Amino-2,6-dinitrotoluene 9. 2-Amino-4,6-dinitrotoluene 10. 3,4-Dinitrotoluene 11. 2,6-Dinitrotoluene 12. 2,4-Dinitrotoluene 13. 2-Nitrotoluene 14. 4-Nitrotoluene



Environmental analysis: Naphtholes, chlorophenol and nitro-aromatics in water

Column	LiChroCART® 250-4 LiChrospher® 100 RP-18, 5 µm
Mobile phase	Acetonitrile/Water 40/60 (v/v)
Flow rate	1.0 ml/min
Detection	Diode array detector min 233 nm 15.70 min 263 nm 18.75 min 270 nm
Temperature	Room temperature
Injection volume	100 µl
Sample	1. 2-Naphthol 2. 1-Naphthol 3. 2,4-Dichlorophenol 4. 2,4-Dinitrotoluene 5. 2-Nitrotoluene 6. 4-Nitrotoluene 7. 2-Nitrotoluene



LiChrospher® 60 RP-select B

Excellent separations even with basic compounds

LiChrospher® RP-select B is a versatile reversed phase sorbent based on spherical silica particles with excellent properties for the determination of basic substances, but with still good properties for the determination neutral and acidic substances.

LiChrospher® 60 RP-select B is optimised in order to prevent any secondary interactions with basic substances and ensures that basic compounds are eluted as symmetrical substance peaks.

Highest reliability of your HPLC results

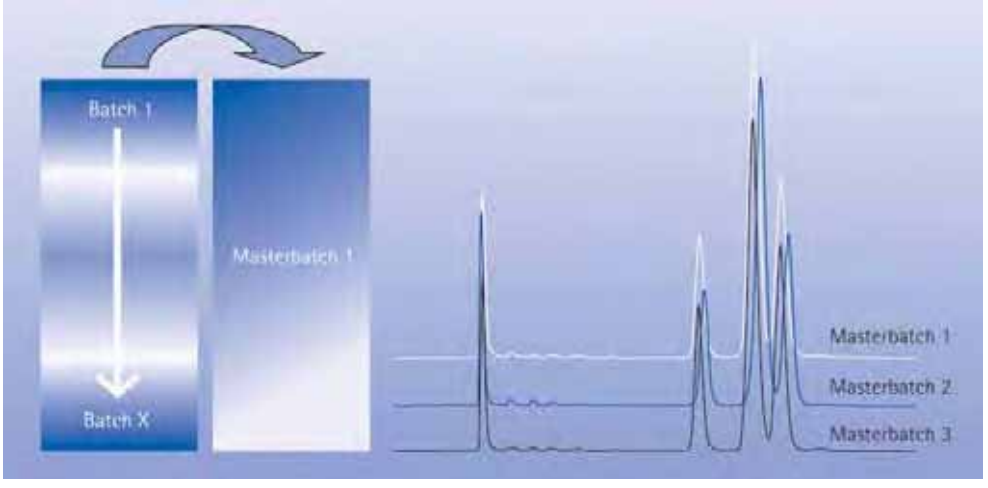
The basis for the success of your HPLC analysis is the safety of an HPLC method that provides highly reproducible results. LiChrospher® RP-select B meets your challenging demands regarding excellent batch-to-batch reproducibility of an HPLC sorbent.

A masterbatch concept, where several individual batches are used to produce a large batch ("the masterbatch") of the LiChrospher® RP-select B sorbent is being applied with the aim of eliminating the variations between the different individual batches. The superior reproducibility of the "master-batch LiChrospher® RP-select B" compared to small individual LiChrospher® RP-select B batches can be clearly demonstrated with the Tanaka test, a very demanding HPLC column test procedure.

Tanaka 1 – Test:

Eluent	Methanol/Water 80/20	
Flow rate	1 mL/min	
Inj.vol.:	5 µl	
Detection	UV 254 nm	
Temp.	22 °C	
Sample	0.01 mg/mL 0.7 mg/mL 0.035 mg/mL 1.3 mg/mL	Uracil Butyl benzene o-Terphenyl Pentyl benzene

HPLC chromatograms of separations of the Tanaka 1 test mixture using 3 masterbatches of LiChrospher® RP-select



→ Accessories for Particulate HPLC Columns The LiChroCART® cartridge - different lengths, different internal diameter 152

→ Accessories for Particulate HPLC Columns manu-CART® cartridge holder for LiChroCART® cartridges 149

→ LiChrosorb® A successful packing material from the start 130

→ Superspher® For highly efficient HPLC of complex mixtures where high peak capacity required 104

→ Purospher® RP-18 Allows simpler, time saving methods for reversed phase chromatography of basic compounds 100

→ Purospher® RP-18 endcapped Excellent peak symmetry with either basic or strongly acidic compounds 98

→ Purospher® STAR RP-8 endcapped 93

→ Aluspher® 100 RP-select B A stable reversed phase stationary phase optimized for applications up to pH 12 133

→ Customized packings Always the right column 144

→ LiChrospher® 190

LiChrospher® 60 RP-select B

Excellent separations even with basic compounds

Specifications of LiChrospher® 60 RP-select B

Sorbent characteristics:	Particles of silica with Octyl derivative
Particle shape:	spherical
Particle size:	5; 10 µm
Pore size:	60 Å (6 nm)
Pore volume:	0.9 ml/g
Spec. surface area:	360 m^2/g
Carbon load:	11.5 % C
Coverage of the surface:	3.55 µmol/m^2
Efficiency:	55 000 N/m; 25 000 N/m
pH range:	pH 2-7.5
Shipping eluent:	Acetonitrile/Water

Ordering information of LiChrospher® 60 RP-select B

Stainless steel cartridges LiChroCART®

The LiChroCART® columns (75, 125, 150 and 250 mm length) in the list below (3 and 4 mm i.d.) require part number 1.51486.0001 manu-CART® cartridge column holder, which can be used to hold one cartridge column with or without a 4-4mm guard column.

Packing material	Ordering No.	Particle size	Dimensions Length	Dimensions i.d.	Contents of one package
LiChrospher® 60 RP-select B	1.50963.0001	5 µm	4 mm	4 mm	10 pieces
LiChrospher® 60 RP-select B	1.50937.0001	5 µm	25 mm	4 mm	3 pieces
LiChrospher® 60 RP-select B	1.50993.0001	5 µm	75 mm	4 mm	3 pieces
LiChrospher® 60 RP-select B	1.50158.0001	5 µm	125 mm	3 mm	1 piece
LiChrospher® 60 RP-select B	1.50829.0001	5 µm	125 mm	4 mm	1 piece
LiChrospher® 60 RP-select B	1.50981.0001	5 µm	125 mm	4 mm	3 pieces
LiChrospher® 60 RP-select B	1.50155.0001	5 µm	250 mm	3 mm	1 piece
LiChrospher® 60 RP-select B	1.50839.0001	5 µm	250 mm	4 mm	1 piece
LiChrospher® 60 RP-select B	1.50984.0001	5 µm	250 mm	4 mm	3 pieces
LiChrospher® 60 RP-select B	1.50742.0001	10 µm	250 mm	4 mm	1 piece

Additional dimensions available as customised packings

Glass cartridges EcoCART®

Packing material	Ordering No.	Particle size	Dimensions Length	Dimensions i.d.	Contents of one package
LiChrospher® 60 RP-select B	1.51233.0001	5 µm	125 mm	3 mm	3 pieces

Additional dimensions available as customised packings see page 144

Sorbents

Packing material	Ordering No.	Particle size	Package	Quantity
LiChrospher® 60 RP-select B	1.19641.0010	5 µm	Glass	10 g
LiChrospher® 60 RP-select B	1.19642.0010	10 µm	Glass	10 g
LiChrospher® 60 RP-select B	1.19642.0100	10 µm	Glass	100 g

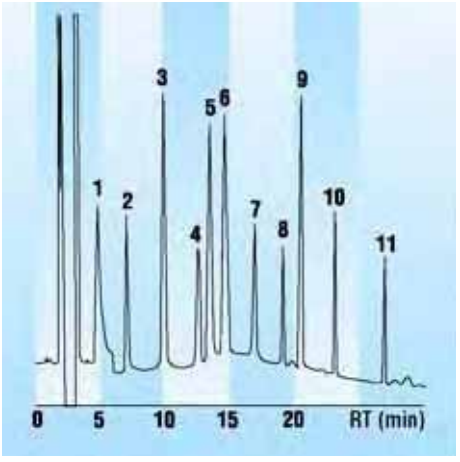
LiChrospher® 60 RP-select B

Excellent separations even with basic compounds

Separation examples on LiChrospher® 60 RP-select B

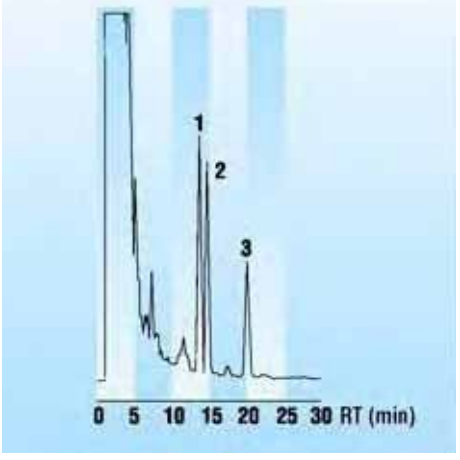
Environmental analysis: Phenols

Column	LiChroCART® 250-4 LiChrospher® 60 RP-select B, 5 µm	
Mobile phase	A: Water LiChrosolv® + 1% Acetic acid (96%) B: Acetonitrile LiChrosolv® + 1% Acetic acid (96%)	
Gradient	0 - 10 min 30% B 10 - 28 min 30 - 80% B 28 - 29 min 80 - 30% B 29 - 35 min 30% B	
Flow rate	1.0 ml/min	
Detection	Diode array 0.0 min 6.0 min 8.5 min 11.0 min 16.0 min 19.5 min 22.0 min 25.0 min	Detector 362 nm 273 nm 319 nm 278 nm 283 nm 269nm 293 nm 304 nm
Temperature	30 °C	
Injection volume	100 µl	
Sample	1. Picric acid 2. Phenol 3. 4-Nitrophenol 4. 2-Chlorophenol 5. 2,4-Dinitrophenol 6. 2-Nitrophenol	1. 2,4-Dimethylphenol 2. 4-Chloro-3-methylphenol 3. 2-Methyl-4,6-dinitrophenol 4. 2,4,6-Trichlorophenol 5. Pentachlorophenol



Environmental analysis: Fungicides in wine

Column	LiChroCART® 125-4 LiChrospher® 60 RP-select B, 5 µm
Mobile phase	Acetonitrile/Water 45/55 (v/v)
Flow rate	0.8 ml/min
Detection	UV 215
Temperature	Room temperature
Injection volume	50 µl
Sample	1. Iprpdione 2. Procymidone 3. Vinclozoline

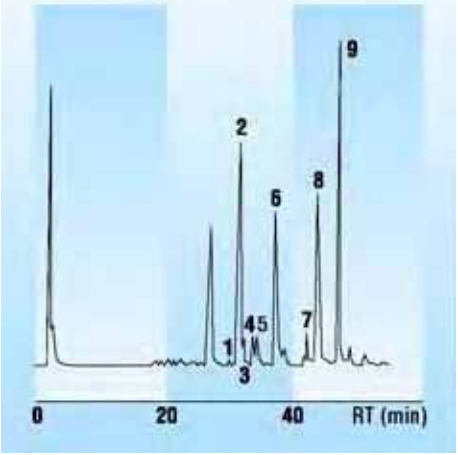


LiChrospher® 60 RP-select B

Excellent separations even with basic compounds

Alkaloids

Column	LiChroCART® 250-4 LiChrospher® 60 RP-select B, 5 µm
Mobile phase	A: 0.05 mol/l KH_2PO; B: Methanol
Gradient	0 - 35 min 90% A - 55% A 35 - 40 min 55% A - 40% A 40 - 60 min 40% A 60 - 70 min 40% A - 25% A 70 - 80 min 25% A - 20% A
Flow rate	0.7 ml/min
Detection	UV 285
Temperature	Room temperature
Injection volume	20 µl
Sample	1. a-Homochelidonine 2. Chelidonine 3. Protopine 4. Allocryptopine 5. Stylopine 6. Coptisine 7. Berberine 8. Sanguinarine 9. Chelerythrine



LiChrospher® WP 300 RP-18

High-resolution separations of peptides and tRNA molecules

LiChrospher® WP 300 RP-18 is a highly selective and reliable HPLC column for the separation of peptides and low molecular weight proteins.

LiChrospher® WP 300 RP-18 enables the tailing-free separation of basic compounds and is excellently suited for the separation of tRNA molecules. High recovery rates are achieved, especially in the case of highly hydrophobic peptides.

In addition, the same selectivity of LiChrospher® WP 300 RP-18 of 5, 12 and 15 µm ensures non-problematic preparative up-scaling.

Specifications of LiChrospher® WP 300 RP-18

Sorbent characteristics	Particles of silica with octadecyl derivative
Particle shape:	spherical
Particle size:	5, 12, 15 µm
Pore size:	300 Å (30 nm)
Spec. surface area:	80 m^2/g
pH range:	pH 2.0 - 7.5
Shipping eluent:	Acetonitrile/Water

Ordering information of LiChrospher® WP 300 RP-18

Stainless steel cartridges LiChroCART®

The LiChroCART® columns in the list below require part number 1.51486.0001 manu-CART® cartridge column holder, which can be used to hold one cartridge column with or without a 4-4mm guard column.

Packing material	Ordering No.	Particle size	Dimensions Length	Dimensions i.d.	Contents of one package
LiChrospher® WP 300 RP-18	1.50140.0001	5 µm	4 mm	4 mm	10 pieces
LiChrospher® WP 300 RP-18	1.50137.0001	5 µm	250 mm	4 mm	1 piece
LiChrospher® WP 300 RP-18 endcapped	1.50224.0001	5 µm	250 mm	4 mm	1 piece

Additional dimensions are available as customised packings **see page 144**

→ Accessories for Particulate HPLC Columns
The LiChroCART® cartridge - different lengths, different internal diameter 152

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Always the right column 144

→ LiChrospher® 190

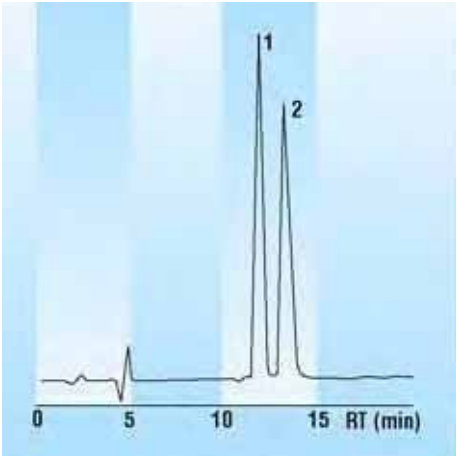
LiChrospher® WP 300 RP-18

High-resolution separations of peptides and tRNA molecules

Separation examples on LiChrospher® WP 300 RP-18

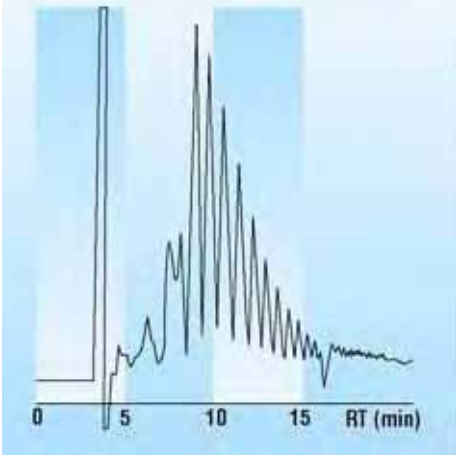
Angiotensin I and II

Column	LiChroCART® 250-4 LiChrospher® WP 300 RP-18, 5 µm
Mobile phase	A: Water + 0.1% TFA B: Acetonitrile + 0.1%TFA
Gradient	20 min 20% B - 60% B
Flow rate	0.6 ml/min
Detection	UV 214
Temperature	Room temperature
Injection volume	100 µl
Sample	1. Angiotensin II (human) 2. Angiotensin I (human) each 1 mg/ml



Poly-L-lysine peptides

Column	LiChroCART® 250-4 LiChrospher® WP 300 RP-18, 5 µm
Mobile phase	A: Water + 0.2% TFA B: Acetonitrile + 0.2%TFA
Gradient	60 min 0% B - 100% B
Flow rate	0.7 ml/min
Detection	UV 214
Temperature	Room temperature
Injection volume	100 µl
Sample	Poly-L-lysine hydrobromide Molecular weight 1000 - 4000 Dalton



LiChrospher® PAH

Indispensable in PAH trace analysis

LiChrospher® PAH is a highly efficient and selective HPLC column especially designed for the high resolution separation of 16 PAH (polycyclic aromatic hydrocarbons) according to EPA 610 and 550 + benzo(e)pyrene + perylene.

Polycyclic aromatic hydrocarbons (PAH) are derived from organic material by pyrolysis or incomplete combustion. The main sources are the exhaust fumes of private and industrial furnaces, car exhaust and tobacco smoke. Since some PAH are carcinogenic, their determination is of great importance.

LiChrospher® PAH is based on a special modified RP-18 silica gel to achieve highly resolved PAH separations. LiChrospher® PAH can be used for both the isocratic separation of 6 PAH according to the German DIN draft method and the gradient separation of 16 PAH according to EPA + benzo(e)pyrene + perylene.

LiChrospher® PAH obtains excellent results for the separation of 16 PAH (EPA 610) + benzo(e)pyrene + perylene:

- baseline separation at 25° or 20°C by gradient HPLC (esp.: benzo(e)pyrene, benzo(b)fluoranthene and perylene)
- programmed fluorescence detection
- first eluting PAH (naphthalene) at ca. 10 minutes
- separation within 30 minutes
- simple eluents and gradients

Specifications of LiChrospher® PAH

Sorbent characteristic	Particles of silica with octadecyl derivative
Particle shape:	spherical
Particle size:	5 µm
Pore size:	150 Å (15 nm)
Spec. surface area:	200 m^2/g
Carbon load:	20 %
pH range:	pH 2 - 7.5
Shipping eluent:	Acetonitrile/Water

Ordering information of LiChrospher® PAH

Stainless steel cartridges LiChroCART®

The LiChroCART® columns (75, 125, 150 and 250 mm length) in the list below (3 and 4 mm i.d.) require part number 1.51486.0001 manu-CART® cartridge column holder, which can be used to hold one cartridge column with or without a 4-4 mm guard column.

Packing material	Ordering No.	Particle size	Dimensions Length	Dimensions i.d.	Contents of one package
LiChrospher® PAH	1.50156.0001	5 µm	250 mm	3 mm	1 piece
LiChrospher® PAH	1.50148.0001	5 µm	4 mm	4 mm	10 pieces
LiChrospher® PAH	1.50149.0001	5 µm	250 mm	4 mm	1 piece

→ Accessories for Particulate HPLC Columns The LiChroCART® cartridge - different lengths, different internal diameter 152

→ Accessories for Particulate HPLC Columns manu-CART® cartridge holder for LiChroCART® cartridges 149

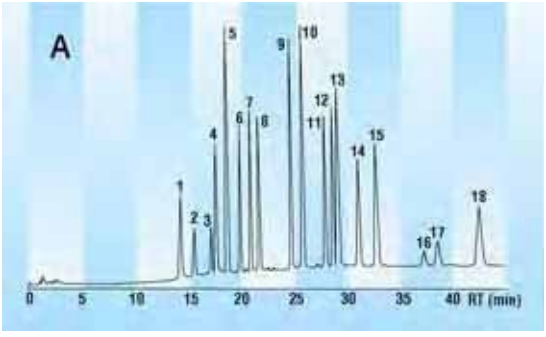
LiChrospher® PAH

Indispensable in PAH trace analysis

Separation examples on LiChrospher® PAH

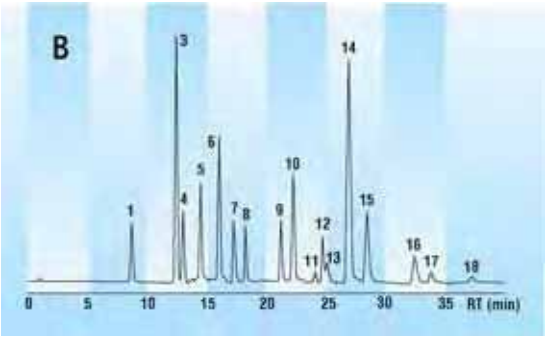
16 PAH acc. to EPA 610/550 + benzo(e)pyrene + perylene by UV detection

Column	LiChroCART® 250-3 LiChrospher® PAH, 5 µm
Mobile phase	A: Acetonitrile B: Water
Gradient	0 - 3 min 50% A 3 -10 min 50% A - 100% A 10 - 45 min 100% A
Flow rate	0.56 ml/min
Detection	UV 254
Temperature	20°C
Injection volume	20 µl



16 PAH acc. to EPA 610/550 + benzo(e)pyrene + perylene by fluorescence detection

Column	LiChroCART® 250-4 LiChrospher® PAH, 5 µm		
Mobile phase	A: Acetonitrile B: Water		
Gradient	0 - 3 min 60% A 3 -15 min 60% A - 100% A 15 - 50 min 100% A		
Flow rate	1.0 ml/min		
Detection	Programmed fluorescence detection:		
	Peak No.	Ex nm	Em nm
	1, 3, 4	280	330
	5	246	370
	6	250	406
	7	280	450
	8	270	390
	9, 10	265	380
	11 - 15	290	430
	16, 17	290	410
	18	300	500
Temperature	20°C		
Injection volume	10 µl		



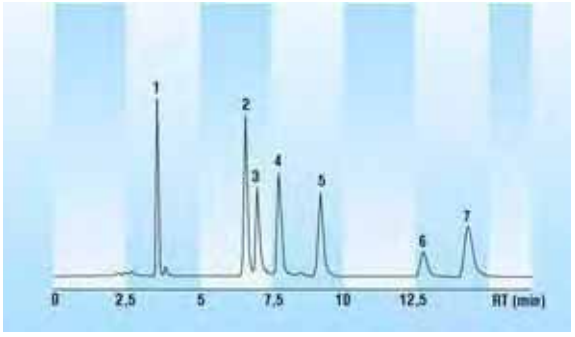
Sample		A	B
	1. Naphthalene	2.00 µg/ml	100.0 ng/ml
	2. Acenaphthylene	1.54 µg/ml	n.n.
	3. Acenaphthene	2.06 µg/ml	103.0 ng/ml
	4. Fluorene	0.48 µg/ml	24.0 ng/ml
	5. Phenanthrene	0.35 µg/ml	17.5 ng/ml
	6. Anthracene	0.08 µg/ml	4.0 ng/ml
	7. Fluoranthene	0.77 µg/ml	4.0 ng/ml
	8. Pyrene	0.85 µg/ml	42.5 ng/ml
	9. Benzo(a)anthracene	0.41 µg/ml	20.5 ng/ml
	10. Chrysene	0.37 µg/ml	18.5 ng/ml
	11. Benzo(e)pyrene	1.00 µg/ml	37.0 ng/ml
	12. Benzo(b)fluoranthene	0.42 µg/ml	21.0 ng/ml
	13. Perylene	1.00 µg/ml	36.0 ng/ml
	14. Benzo(k)fluoranthene	0.42 µg/ml	23.5 ng/ml
	15. Benzo(a)pyrene	0.49 µg/ml	24.5 ng/ml
	16. Dibenzo(a,h)anthracene	0.36 µg/ml	18.0 ng/ml
	17. Benzo(g,h,i)perylene	0.37 µg/ml	18.5 ng/ml
	18. Ideno(1,2,3-c,d)pyrene	0.43 µg/ml	21.5 ng/ml

LiChrospher® PAH

Indispensable in PAH trace analysis

6 PAH acc. to EU-proposal ISO/CD 7981 + perylene by UV detection

Column	LiChroCART® 250-3 LiChrospher® PAH, 5 µm	
Mobile phase	Acetonitrile	
Flow rate	1.0 ml/min	
Detection	UV 254	
Temperature	25°C	
Injection volume	30 µl	
Sample	1. Fluoranthene	1.04 µg/ml
	2. Benzo(b)fluoranthene	0.68 µg/ml
	3. Perylene	0.72 µg/ml
	4. Benzo(k)fluoranthene	0.65 µg/ml
	5. Benzo(a)pyrene	0.60 µg/ml
	6. Benzo(g,h,i)perylene	0.65 µg/ml
	7. Ideno(1,2,3-c,d)pyrene	0.58 µg/ml



LiChrosorb®

A successful packing material from the start

LiChrosorb® is one of the most successful and reliable packing materials used in HPLC for more than 25 years and documented in literature in the form of several thousand applications.

The totally porous irregular particles are finely classified in the 5, 7 and 10 µm range.

LiChrosorb® packing materials offers the compete programme of non-polar derivatives (RP-8, RP-18, RP-select B) polar derivatives (Si 60 and Si 100) and derivatives of medium polarity (NH2, CN and DIOL).

Additionally to the analytical cartridges and columns like LiChroCART® 250-4 or Hibar® RT 250-4 Merck offers semi-preparative cartridges LiChroCART® 250-10 as well as Hibar® RT columns 250-10 and packed with different LiChrosorb® packing materials on request.

Specifications of LiChrosorb® packing materials

Packing material	Characteristics	Spec. surface area S_{BET} (m^2/g)	Pore volume V_P (ml/g)	Particle size d_P (µm)	%C	Surface coverage (µmol/m^2)
LiChrosorb® Si 60	irregular particles of silica medium pore size: 6 nm (60Å)	500	0.75	7		
LiChrosorb® Si 100	irregular particles of silica medium pore size: 10 nm (100Å)	300	1.0	5, 7, 10		
LiChrosorb® CN	irregular particles of silica with cyanopropyl function	300	1.0	7	6.1	3.82
LiChrosorb® DIOL	irregular particles of silica with vicinal hydroxyl function on C-chains	300	1.0	5, 7	7.1	3.91
LiChrosorb® RP-8	irregular particles of silica with octyl derivative	300	1.0	5, 7, 10	9.5	3.4
LiChrosorb® RP-18	irregular particles of silica with octadecyl derivative	300	1.0	5, 7, 10	16.2	3.0
LiChrosorb® RP-select B	irregular particles of silica with octyl derivative, especially suitable for the RP-separation of basic compounds	300	0.75	5, 7, 10	11.4	4.21

→ Accessories for Particulate HPLC Columns The LiChroCART® cartridge - different lengths, different internal diameter 152

→ Accessories for Particulate HPLC Columns manu-CART® cartridge holder for LiChroCART® cartridges 149

→ Accessories for Particulate HPLC Columns The Hibar® column 154

→ Customized packings Always the right column 144

→ LiChroprep® 186

LiChrosorb®

A successful packing material from the start

Fraction range of LiChrosorb® materials

Packing material	Spec. surface area (m^2/g)	Spec. pore volume (ml/g)	Fractionation range (Polystyrene/THF) (g/mol)
LiChrosorb® Si 40	800	0.6	$50 - 4 \cdot 10^3$
LiChrosorb® Si 60	500	0.7	$80 - 2 \cdot 10^4$
LiChrosorb® Si 100	300	1.0	$200 - 4 \cdot 10^4$
LiChrosorb® RP-8	300	1.0	$100 - 4 \cdot 10^4$
LiChrosorb® RP-18	300	1.0	$100 - 4 \cdot 10^4$
LiChrosorb® DIOL	300	1.0	$100 - 4 \cdot 10^4$

Ordering information of LiChrosorb® packing materials

Stainless steel cartridges LiChroCART®

The LiChroCART® columns (125, 150 and 250 mm length) in the list below (4 mm i.d.) require part number 1.51486.0001 manu-CART® cartridge column holder, which can be used to hold one cartridge column with or without a 4-4 mm guard column.

LiChroCART® columns 250-10 mm require part number 1.51419.0001 manu-CART® 10.

Packing material	Ordering No.	Particle size	Dimensions Length	Dimensions i.d.	Contents of one package
LiChrosorb® Si 60	1.51343.0001	5 µm	125 mm	4 mm	1 piece
LiChrosorb® Si 60	1.51351.0001	5 µm	250 mm	4 mm	1 piece
LiChrosorb® Si 60	1.51352.0001	10 µm	250 mm	4 mm	1 piece
LiChrosorb® RP-8	1.51345.0001	5 µm	125 mm	4 mm	1 piece
LiChrosorb® RP-8	1.51353.0001	5 µm	250 mm	4 mm	1 piece
LiChrosorb® RP-8	1.51354.0001	10 µm	250 mm	4 mm	1 piece
LiChrosorb® RP-18	1.51349.0001	5 µm	125 mm	4 mm	1 piece
LiChrosorb® RP-18	1.51355.0001	5 µm	250 mm	4 mm	1 piece
LiChrosorb® RP-18	1.51356.0001	10 µm	250 mm	4 mm	1 piece
LiChrosorb® RP-select B	1.50859.0001	10 µm	250 mm	10 mm	1 piece

Additional dimensions available as customised packings see page 144

Stainless steel columns Hibar®

The Hibar® columns are complete with endfittings.

When using a guard column with a Hibar® column, we recommend part number 1.51487.0001 guard column cartridge holder for 4-4mm guard column cartridges LiChroCART®.

Packing material	Ordering No.	Particle size	Dimensions Length	Dimensions i.d.	Contents of one package
LiChrosorb® Si 60	1.50388.0001	5 µm	250 mm	4 mm	1 piece
LiChrosorb® RP-8	1.50432.0001	5 µm	125 mm	4 mm	1 piece
LiChrosorb® RP-8	1.50332.0001	5 µm	250 mm	4 mm	1 piece
LiChrosorb® RP-8	1.50318.0001	10 µm	250 mm	4 mm	1 piece
LiChrosorb® RP-18	1.50433.0001	5 µm	125 mm	4 mm	1 piece
LiChrosorb® RP-18	1.50333.0001	5 µm	250 mm	4 mm	1 piece
LiChrosorb® RP-18	1.50334.0001	10 µm	250 mm	4 mm	1 piece

Additional dimensions available as customised packings see page 144

LiChrosorb®

A successful packing material from the start

Sorbents

Packing material	Ordering No.	Particle size	Package	Quantity
LiChrosorb® Si 60	1.09335.0010	7 µm	Glass	10 g
LiChrosorb® Si 60	1.09335.0100	7 µm	Glass	100 g
LiChrosorb® Si 100	1.09308.0010	5 µm	Glass	10 g
LiChrosorb® Si 100	1.09308.0100	5 µm	Glass	100 g
LiChrosorb® Si 100	1.09309.0010	10 µm	Glass	10 g
LiChrosorb® CN	1.13969.0010	7 µm	Glass	10 g
LiChrosorb® DIOL	1.13972.0010	7 µm	Glass	10 g
LiChrosorb® RP-8	1.09332.0010	5 µm	Glass	10 g
LiChrosorb® RP-8	1.09341.0010	7 µm	Glass	10 g
LiChrosorb® RP-8	1.09318.0010	10 µm	Glass	10 g
LiChrosorb® RP-8	1.09318.0100	10 µm	Glass	100 g
LiChrosorb® RP-18	1.09333.0010	5 µm	Glass	10 g
LiChrosorb® RP-18	1.09333.0100	5 µm	Glass	100 g
LiChrosorb® RP-18	1.09334.0010	10 µm	Glass	10 g
LiChrosorb® RP-18	1.09334.0100	10 µm	Glass	100 g
LiChrosorb® RP-select B	1.19650.0010	5 µm	Glass	10 g

Aluspher® 100 RP-select B

A stable reversed phase stationary phase optimized for applications up to pH 12

Due to its stability, alumina, together with alkaline eluents, has enabled new applications to be found for HPLC. Advanced formulation technology enables the production of spherical alumina particles as a base for Aluspher® 100 Al and Aluspher® 100 RP select B.

Aluspher® 100 RP-select B is ideal when using basic eluents as ionisation of basic compounds is supressed and peak-tailing is avoided.

Aluspher® 100 RP-select B is a alkali-stable reversed phase stationary phase designed for the separation of neutral, basic and acidic compounds when using basic eluents.

Due to its stability in the pH range of pH 2-12 Aluspher® 100 RP-select B allows use of basic eluents like NaOH.

Specifications of Aluspher® 100 RP-select B

Sorbent characteristics:	Alumina particles, coated with polybutadiene (PBD)
Particle shape:	spherical
Particle size:	5 µm
Pore size:	100 Å (10 nm)
Spec. surface area:	170 m^2/g
pH range:	pH 2-12
Efficiency:	55.000 N/m
Shipping eluent:	Acetonitrile/Water

Ordering information of Aluspher® 100 RP-select B

Stainless steel cartridges LiChroCART®

The LiChroCART® columns (125, 150 and 250 mm length) in the list below (4.6 mm i.d.) require part number 1.51486.0001 manu-CART® cartridge column holder, which can be used to hold one cartridge column with or without a 4-4 mm guard column.

Packing material	Ordering No.	Particle size	Dimensions Length	Dimensions i.d.	Contents of one package
Aluspher® 100 RP-select B	1.51311.0001	5 µm	4 mm	4 mm	10 pieces
Aluspher® 100 RP-select B	1.51315.0001	5 µm	125 mm	4 mm	1 piece
Aluspher® 100 RP-select B	1.51318.0001	5 µm	250 mm	4 mm	1 piece

Additional dimensions available as customised packings see page 144

→ Accessories for Particulate HPLC Columns
The LiChroCART® cartridge - different lengths, different internal diameter 152

→ Accessories for Particulate HPLC Columns
manu-CART® cartridge holder for LiChroCART® cartridges 149

→ LiChrospher® 60 RP-select B
Excellent separations even with basic compounds 121

→ Customized packings
Always the right column 144

→ Aluminium oxide for preparative chromatography 182

Aluspher® 100 RP-select B

A stable reversed phase stationary phase optimized for applications up to pH 12

Characterization of Aluspher® 100 RP-select B

Aluspher® 100 RP-select B shows very good chromatographic properties for the separation of organic bases under neutral conditions. Fig. 1 shows the tailing free separation of four typical drugs with acetonitrile/water as mobile phase.

In general chromatographic separations with Aluspher® 100 RP-select B gives good peak symmetries under neutral conditions. If the selectivity for basic compunds is not good under neutral conditions (see example in Fig. 2a where peaks 3, 4 and 5 are not separated), then it is recommended to use a mobile phase at basic pH as in Fig. 2b. Retention is increased and selectivity and separation are improved.

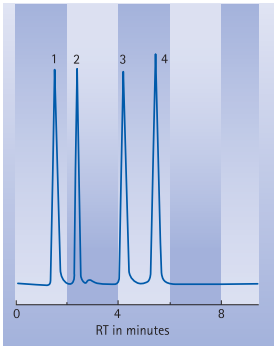


Fig.1
Separation of four basic drugs on Aluspher® RP-select B using a neutral mobile phase
Mobile phase: acetonitrile/water (40:60);
Flow rate: 1.0 ml/min;
Detection: UV 220 nm;
Sample: 1. Diphenhydramine; 2. Caffeine, 3. MPPH (methylphenylphenylhydatoin), 4. Diazepam

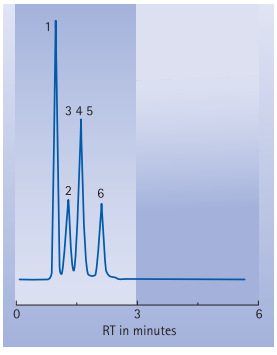


Fig.2 a

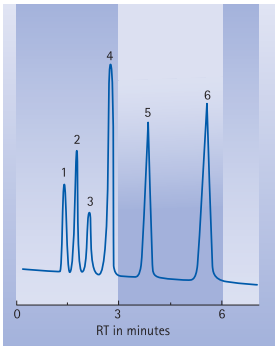


Fig.2 b

Separation of six organic bases on Aluspher® RP-select B using a neutral and an alkaline mobile phase
Mobile phase: A) acetonitrile/water (33:67); B) acetonitrile/0.025 M NaOH (33:67);
Flow rate: 1.0 ml/min;
Detection: UV 250 nm;
Sample: 1. Pyridine, 2. Aniline, 3. o-toluidine, 4. N-Methylaniline, 5. 2-Ethylaniline, 6. N,N-Dimethylaniline

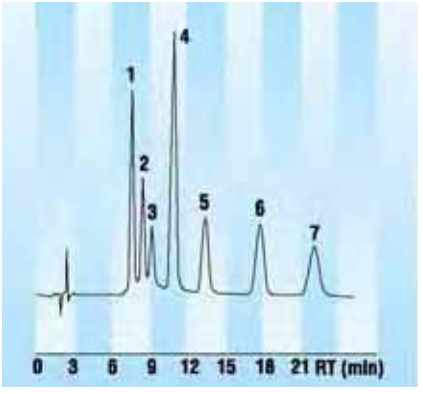
Aluspher® 100 RP-select B

A stable reversed phase stationary phase optimized for applications up to pH 12

Separation examples on Aluspher® 100 RP-select B

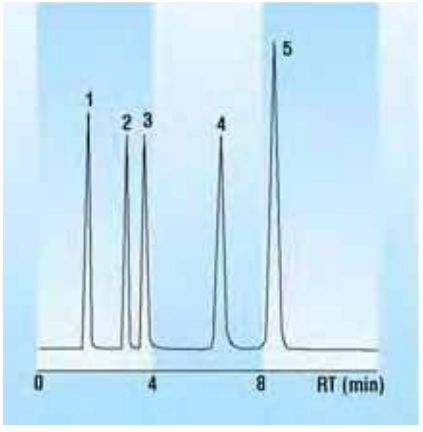
Separation of amphetamine compounds

Column	LiChroCART® 250-4 Aluspher® 100 RP-select B, 5 µm
Mobile phase	Methanol/0.025 M NaOH 25/75 (v/v)
Flow rate	1.0 ml/min
Detection	UV 215 nm
Temperature	Room temperature
Sample	1. Amphetamine 2. p-Methoxyamphetamine (PMA) 3. Methylendioxyamphetamine (MDA) 4. Methamphetamine 5. Methylendioxymethamphetamine (MDMA) 6. Ethylamphetamine 7. Methylendioxyethylamphetamine (MDEA)



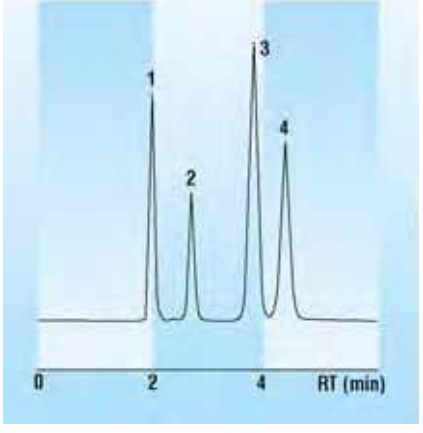
Separation of pharmaceuticals with non-buffered eluent

Column	LiChroCART® 250-4 Aluspher® 100 RP-select B, 5 µm
Mobile phase	Acetonitrile/Water 35/65 (v/v)
Flow rate	1.0 ml/min
Detection	UV 220 nm
Temperature	Room temperature
Sample	1. Levamisole 2. 5-Methyl-5-phenyldantoin (MPH) 3. 5-Phenyl-5-(2-pyridyl)-hydantoin (PPH) 4. 5-(p-Methylphenyl)-5-phenylhydantion (MPH) 5. Diazepam



Separation of beta-blockers with alkaline eluents

Column	LiChroCART® 250-4 Aluspher® 100 RP-select B, 5 µm
Mobile phase	Methanol/0.025 M NaOH 50/50 (v/v)
Flow rate	1.0 ml/min
Detection	UV 220 nm
Temperature	Room temperature
Sample	1. Sotalol 2. Atenolol 3. Metoprolol 4. Bisoprolol



Chiral stationary phases

Always the proper column for enantiomer analysis

Chirality has become vitally important in the pharmaceutical, chemical, and agricultural industries. The differences which make compounds chiral can produce critically different pharmacological effects in biological systems. As a result, demand for stereoselective separation techniques and analytical assays to evaluate the enantiomeric purity of chiral compounds has increased. Chiral chromatography has become a necessary tool - not only for the analytical determination of enantiomeric purity, but also for the isolation of pure enantiomers.

The chromatographic enantiomer separation by chiral stationary phase is an efficient and rapid method in the control of chiral pharmaceuticals or flavour ingredients. To provide always the proper column for any special demand, Merck offers different chiral stationary phases:

ChiraDex® for the chiral separation of hydrocarbons, steroids, phenol esters and derivatives, aromatic amines, heterocycles with 5-membered ring to 7-membered ring.

ChiraSep® DNBPG for the chiral separation of pharmaceutical, pesticides and flavours.

ChiraSpher® NT with broad enantioselectivity and very good selectivity for the separation of beta-blockers on top.

Specifications of ChiraDex®, ChiraSep® DNBPG and ChiraSpher® NT

	ChiraDex®
Sorbent characertistics:	Spherical silica particles with covalently bonded beta-cyclodextrin particles
Particle shape:	spherical
Particle size:	5 µm
Pore size:	100 Å (10nm)
Spec. surface area:	300 - 360 m^2/g
Chiral selector:	Beta-cyclodextrin

	ChiraSep® DNBPG
Sorbent characertistics:	Covalent bonded DNBPG to spherical aminopropyl silica particles
Particle shape:	spherical
Particle size:	5 µm
Pore size:	100 Å (10nm)
Spec. surface area:	350 m^2/g
Chiral selector:	R-(-)-N-(3,5-dinitrobenzoyl)phenylglycine (=DNBPG)

	ChiraSpher® NT
Sorbent characertistics:	Poly (N-acryloyl-S-phenylalanine ethyl ester) bonded to spherical silica
Particle shape:	spherical
Particle size:	5 µm
Pore size:	
Spec. surface area:	
Chiral selector:	Poly (N-acryloyl-S-phenylalanine ethyl ester)

→ ChiraDex® Specially for the separation of enantiomers 138
→ ChiraSep® DNBPG Economic separation of selected enantiomers 140
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→ Accessories for Particulate HPLC Columns The LiChroCART® cartridge - different lengths, different internal diameter 152
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→ Accessories for Particulate HPLC Columns The Hibar® column 154

Chiral stationary phases

Always the proper column for enantiomer analysis

Characterisation of chiral HPLC columns

The separation of enantiomers by chiral HPLC has proven to be a most useful method for the analysis of numerous different chiral substances. Of greatest importance is the separation of chiral drugs. Many drugs are administered as racemates. For some chiral drugs, the desired pharmacological effect is almost entirely due to one enantiomer while its other optical isomer may be responsible for significant undesirable side effects. The administration of only optical highly purified drugs is the major goal of pharmaceutical industry, to protect the patient against side-effects, caused by too high drug concentration or against toxic side effects. Chiral HPLC is a very efficient method for the separation of racemic drugs, to control the optical purity and is also a method for the preparation of optical pure drugs. Chiral HPLC is also a valuable tool for the enantioseparation of agrochemicals or flavour compounds.

Enantiomers may confer benefits over racemates for therapeutic uses:

Properties of racemate	Potential benefits of enantiomers
One enantiomer is exclusively active	reduced dose and load on metabolism
The other enantiomer is toxic	increased latitude in dose and broader use of the drug
Enantiomers have different pharmacokinetics	better control of kinetics and dose
Enantiomers metabolize at different rates in the same person	wider latitude in setting the dose; reduction in variability of patient´s responses
Enantiomers metabolize at different rates in the population	reduction in variability of patient´s responses; greater confidence in setting a single dose
One enantiomer prone to interaction with key detoxification pathways	reduced interactions with other common drugs
One enantiomer is agonist, the other antagonist	enhanced activity and reduction of dose
Enantiomers vary in spectra of pharmacological action and tissue specificity	increased specificity and reduced side effects for one enantiomer, use of other enantiomer for different indication

Very often the enantiomers of a drug show different biological activities and possible only one of the chiral columns fit.

Inclusion type phases: ChiraDex®, ChiraSpher® NT

π-donator / π-acceptor type phases: ChiraSep® DNBPG

ChiraDex®

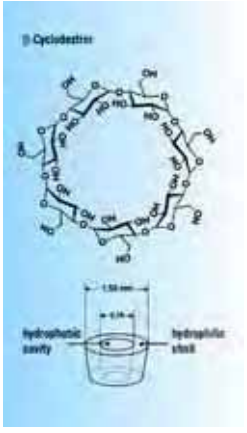
Specially for the separation of enantiomers

ChiraDex® is a versatile HPLC column characterised by broad enantioselectivity and can be used for the separation of enantiomers of numerous different classes of substances.

ChiraDex® is based on beta-cyclodextrin covalently linked to spherical particles of silica and is well suited for the chiral separation of hydrocarbons, steroids, phenol esters and derivatives, aromatic amines, heterocycles with 5-membered ring to 7-membered ring. Simply composed RP-eluents can be used in most separations.

Specifications of ChiraDex®

	ChiraDex®
Sorbent characteristics:	Silica particles with covalently bonded β-cyclodextrin
Particle shape:	spherical
Particle size:	5 µm
Pore size:	100 Å (10 nm)
Spec. surface area:	300-360 m^2/g
Chiral selector:	β-cyclodextrin
pH range:	pH 3 - 7.5
Shipping eluent:	Methanol/Water



→ ChiraSep® DNBPG Economic separation of selected enantiomers 140

→ ChiraSpher® NT Improved enantio-selectivity especially for pharmaceuticals 142

→ Accessories for Particulate HPLC Columns The LiChroCART® cartridge - different lengths, different internal diameter 152

→ Accessories for Particulate HPLC Columns manu-CART® cartridge holder for LiChroCART® cartridges 149

Ordering information of ChiraDex®

Stainless steel cartridges LiChroCART®

The LiChroCART® columns in the list below require part number 1.51486.0001 manu-CART® cartridge column holder, which can be used to hold one cartridge column with or without a 4-4 mm guard column.

Packing material	Ordering No.	Particle size	Dimensions Length	Dimensions i.d.	Contents of one package
ChiraDex®	1.50117.0001	5 µm	4 mm	4 mm	10 pieces
ChiraDex®	1.51333.0001	5 µm	250 mm	4 mm	1 piece

ChiraDex®

Specially for the separation of enantiomers

Characterization of ChiraDex®

ChiraDex® is characterised by broad enantioselectivity and can be used for the separation of enantiomers of numerous different classes of substances.

Cyclodextrins are cyclic oligosaccharins consisting of α-1,4-glycosidically linked D-glucose units. β-cyclodextrin consist of 7 glucose units, respectively.

Geometrically seen, cyclodextrins may be described as truncated cones, where all the secondary hydroxy groups are directed towards the larger opening, whereas the smaller opening at the other end is formed by primary hydroxy groups. Thus, a hydrophobic inner cavity results, contrasting with the two hydrophilic openings. Since cyclodextrins are made up of chiral D-glucose units, its structure may be regarded as a chiral selector. The enantiomers of a racemic substance mixture, due to their opposite configurations, can now be associated - to different degrees - with the cyclodextrin molecule. Thus, diastereomeric "inclusion complexes" are formed, based on hydrophobic interaction (between cavity and guest molecule) and stereo selective hydrogen bonds (between the C2 and C3 hydrogen groups of glucose molecules and the guest molecule).

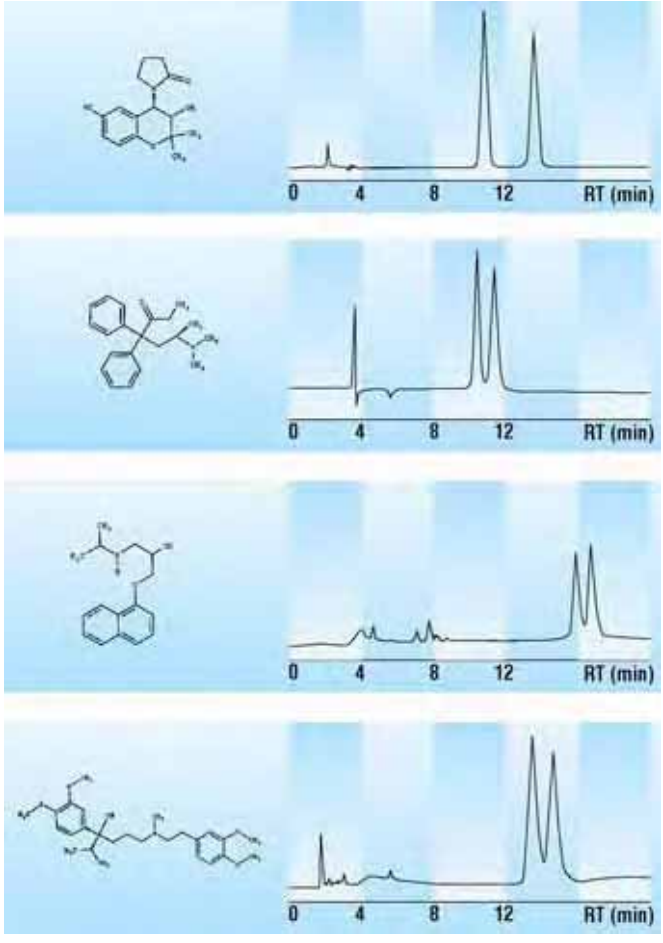
Separation examples of chiral pharmaceutical active ingredients on ChiraDex®

Cromakalim:	
Column	LiChroCART® 250-4 ChiraDex®
Mobile phase	Water/Methanol 80/20 (v/v)
Flow rate	0.8 ml/min
Detection	UV 254 nm

Methadone:	
Column	LiChroCART® 250-4 ChiraDex®
Mobile phase	Triethylammonium acetate solution (1%) pH 4.1/Acetonitrile 98/2 (v/v)
Flow rate	0.8 ml/min
Detection	UV 254 nm

Propanolol:	
Column	LiChroCART® 250-4 ChiraDex®
Mobile phase	Acetonitrile/Methanol/Acetic acid/ Ammonia (25%) 95/4.6/0.3/0.1(v/v/v/v)
Flow rate	0.7 ml/min
Detection	UV 254 nm

Verapamil:	
Column	LiChroCART® 250-4 ChiraDex®
Mobile phase	Methanol/Triethylammonium acetate solution (1%) pH 4.1 2/98 (v/v)
Flow rate	1.0 ml/min
Detection	UV 254 nm



ChiraSep® DNBPG

Economic separation of selected enantiomers

ChiraSep® DNBPG is a highly economic HPLC column for the separation of enantiomers with π-electrons.

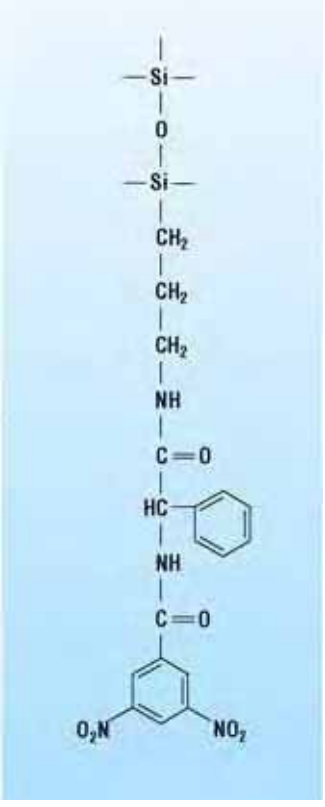
ChiraSep® DNBPG is a "Pirkle-phase" with π-(-)-N-(3,5-dinitrobenzoyl)phenylglycin as chiral selector and is excellent suited for the chiral separation of pharmaceutical, pesticides and flavours.

For separations of enantiomers on ChiraSep® DNBPG, normal phase eluents are used; binary or ternary mixtures of a hydrocarbon (e.g. n-hexane) and organic modifier (e.g. 2-propanol, acetonitrile) have been proved as well suited. The enantioselectivity of ChiraSep® DNBPG is clearly depended on the composition of the mobile phase.

Specifications of ChiraSep® DNBPG

Sorbent characteristics:	covalent bonded DNBPG to spherical aminopropyl silica particles
Particle shape:	spherical
Particle size:	5 µm
Pore size:	100 Å (10 nm)
Spec. surface area:	350 m^2/g
Chiral selector:	R-(-)-N-(3,5-dinitrobenzoyl) phenylglycine (=DNBPG)
pH range:	pH 2.0 -7.5
Shipping eluent:	n-Hexane/2-propanol

Chemical structure of ChiraSep® DNBPG



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Ordering information of ChiraSep® DNBPG

Stainless steel cartridges LiChroCART®

The LiChroCART® columns in the list below require part number 1.51486.0001 manu-CART® cartridge column holder, which can be used to hold one cartridge column with or without a 4-4 mm guard column.

Packing material	Ordering No.	Particle size	Dimensions Length	Dimensions i.d.	Contents of one package
ChiraSep® DNBPG custom packed	1.50173.7005	5 µm	4 mm	4 mm	10 pieces
ChiraSep® DNBPG custom packed	1.50174.7005	5 µm	250 mm	4 mm	1 piece

ChiraSep® DNBPG

Economic separation of selected enantiomers

Characterisation of ChiraSep® DNBPG

ChiraSep® DNBPG as a "brush-type phase" or "Pirkle-phase" is obtained by covalent linkage of the chiral selector R-(-)-N-(3,5-dinitrobenzoyl)phenylglycine (=DNBPG) onto spherical particles of aminopropyl silica gel.

For adsorption of the enantiomers, π-π-interactions with the π-acceptor-group DNBPG are responsible.ChiraSep® DNBPG is therefore suited for the separation of compounds with π-donor-groups. To effect such a π-π-interaction, a derivatisation is often necessary.

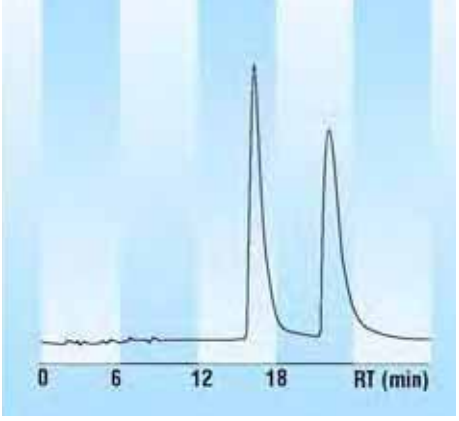
Enantiomers are additionally adsorbed to DNBPG via hydrogen bonds or dipole-dipole-interactions. ChiraSep® DNBPG is also well suited for the separation of atropisomer compounds.

As mobile phases binary or ternary normal phase eluents of e.g. n-hexane and organic modifier (e.g. 2-propanol or acetonitrile) are used.

Separation examples on ChiraSep® DNBPG

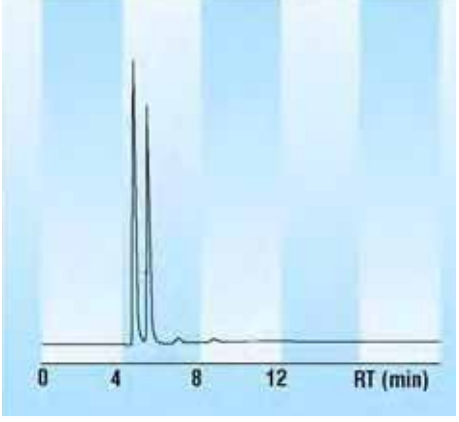
2,2-Dihydroxy-1,1-binaphthol

Column	LiChroCART® 250-4 ChiraSep® DNBPG
Mobile phase	n-Hexane/2-Propanol 90/10 (v/v)
Flow rate	1.0 ml/min
Detection	UV 254 nm
Temperature	24°C
Sample volume	10 µl
Sample	2,2-Dihydroxy-1,1-binaphthol (0.5 mg/ml)



Separation of Tröger´s base

Column	LiChroCART® 250-4 ChiraSep® DNBPG
Mobile phase	n-Hexane/2-Propanol 90/10 (v/v)
Flow rate	1.0 ml/min
Detection	UV 254 nm
Temperature	24°C
Sample volume	10 µl
Sample	Tröger´s base (0.5 mg/ml)



ChiraSpher® NT

Improved enantioselectivity especially for pharmaceuticals

ChiraSpher® NT is a versatile chiral HPLC column of high chemical stability and broad enantioselectivity.

ChiraSpher® NT is based on silica gel particles, coated with the optically active polymer poly(N-acryloyl-S-phenylalanine ethyl ester).

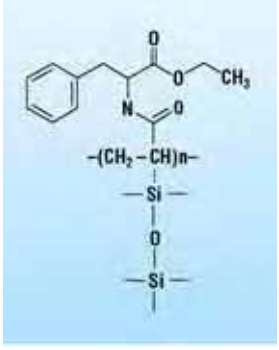
ChiraSpher® NT is characterised by improved enantioselectivity with very good selectivity for the separation of beta-blockers.

The column may be used with eluents of normal phase chromatography as well as reversed phase chromatography.

Specifications of ChiraSpher® NT

Sorbent characteristics:	Poly (N-acryloyl-S-phenylalanine ethyl ester) bonded to spherical silica
Particle size:	5 µm
pH range:	pH 2 - 7
Shipping eluent:	n-Hexane

Chemical structure of ChiraSpher®NT



Ordering information of ChiraSpher® NT

Stainless steel cartridges LiChroCART®

The LiChroCART® columns (250 mm length) in the list below (4 mm i.d.) require part number 1.51486.0001 manu-CART® cartridge column holder, which can be used to hold one cartridge column with or without a 4-4 mm guard column.

LiChroCART® columns 250-10 mm require part number 1.51419.0001 manuCART® 10.

Packing material	Ordering No.	Particle size	Dimensions Length	Dimensions i.d.	Contents of one package
ChiraSpher® NT	1.50103.0001	5 µm	250 mm	4 mm	1 piece
ChiraSpher® NT custom packed	1.50179.7006	5 µm	250 mm	10 mm	1 piece

Recommended guard cartridges LiChroCART®

Packing material	Ordering No.	Particle size	Dimensions Length	Dimensions i.d.	Contents of one package
LiChrospher® 100 DIOL	1.50960.0001	5 µm	4 mm	4 mm	10 pieces
LiChrospher® 100 DIOL custom packed	1.50178.7048	5 µm	10 mm	10 mm	2 pieces

→ ChiraDex® Specially for the separation of enantiomers 138
→ ChiraSep® DNBPG Economic separation of selected enantiomers 140
→ Accessories for Particulate HPLC Columns The LiChroCART® cartridge - different lengths, different internal diameter 152
→ Accessories for Particulate HPLC Columns manu-CART® cartridge holder for LiChroCART® cartridges 149
→ Accessories for Particulate HPLC Columns The Hibar® column 154

ChiraSpher® NT

Improved enantioselectivity especially for pharmaceuticals

Characterisation of ChiraSpher® NT

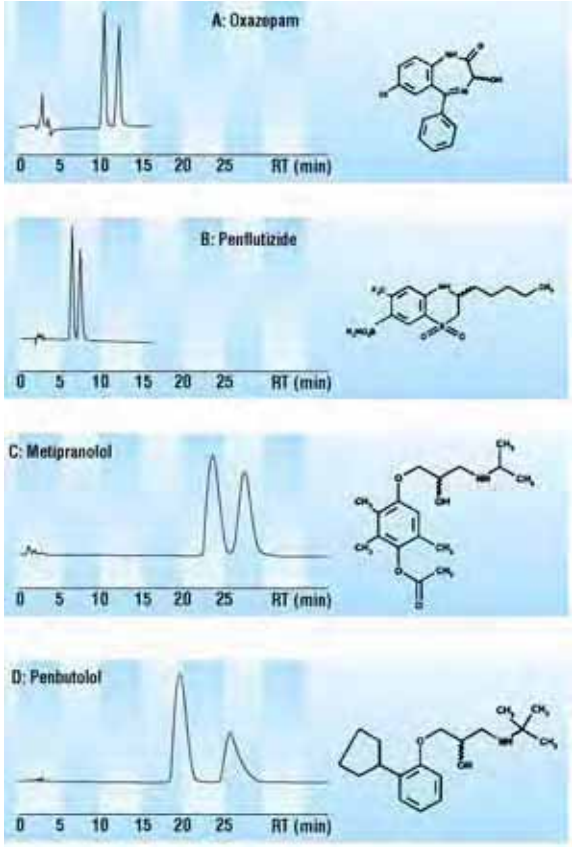
ChiraSpher® NT is based on silica gel particles, coated with the optically active polymer poly(N-acryloyl-(S)-phenylalanine ethyl ester). The sterioselective formation of the enantiomer interaction takes place in the chiral cavities of the polymer layer by means of hydrogen bonds and π-π-interactions.

ChiraSpher® NT is characterised by its high chemical stability and may be used with eluents of normal phase chromatography as well as solvents of reversed phase chromatography. The stationary phase prossess a high loading capacity and can therefore also be used for preparative separations.

Separation examples on ChiraSpher® NT

Separation of pharmaceutical active ingredients

Column	LiChroCART® 250-4 ChiraSpher® NT, 5 µm
Mobile phase	A: n-Heptane/Tetrahydrofuran 50/70 /v/v) B: n-Heptane/2-Propanol 97/3 (v/v) C, D: n-Heptane/Ethanol/Methanol + 0.05% Ammonia (25%) 55/40/5 (v/v/v)
Flow rate	1.0 ml/min
Detection	A, B: UV 254 nm C, D: UV 222 nm
Temperature	Room temperature



Enantioseparation of beta-blockers

Column	LiChroCART® 250-4 ChiraSpher® NT, 5 µm
Mobile phase	1. Ethanol + 0.04% Triethylamine (Pindolol) 2. Ethanol + 0.02% Triethylamine (Sotalol) 3. n-Heptane/Ethanol/Methanol + 0.05% Ammonia (25%) 55/40/5 (v/v/v) (Bisoprolol, Metipranolol, Metoprolol, Penbutolol, Propanolol)
Flow rate	1.0 ml/min
Detection	UV 222 nm
Temperature	Room temperature

Beta-blocker	Separation factor
Bisoprolol	1.14
Metipranolol	1.16
Metoprolol	1.14
Penbutolol	1.38
Pindolol	1.10
Propanolol	1.14
Sobatol	1.11

Customized packings

Always the right column

On top the very extensive column assortment Merck offers customised packed columns for highest flexibility and professional solutions.

Finding the right column for every separation is a tedious business. Merck, as manufacturer and supplier, can solve this problem for you - from one source.

The sorbents and the packed HPLC columns are tested before delivering. The sorbents manufactured by Merck are subjected to the most stringent controls; some 42 different parameters are tested for each sorbent. Each finished column is provided with an Analysis Certificate.

Easy ordering

Please combine the ordering number of the column hardware (LiChroCART®, Hibar® or Eco-CART®) and the sorbent number.

Example:

Customised packing ordering number of LiChroCART® 125-4	1.50170.
Sorbent number of Purospher® RP-18 HC, 5 µm	7131
Ordering number of LiChroCART® 125-4 Purospher® RP-18 HC, 5 µm	1.50170.7131

→ LiChrospher®
Si 60 and Si 100
For normal phase HPLC 109

→ LiChrosorb®
A successful packing material from the start 130

→ Purospher® RP-18
Allows simpler, time saving methods for reversed phase chromatography of basic compounds 100

→ Purospher® RP-18 endcapped
Excellent peak symmetry with either basic or strongly acidic compounds 98

→ Superspher®
For highly efficient HPLC of complex mixtures where high peak capacity required 104

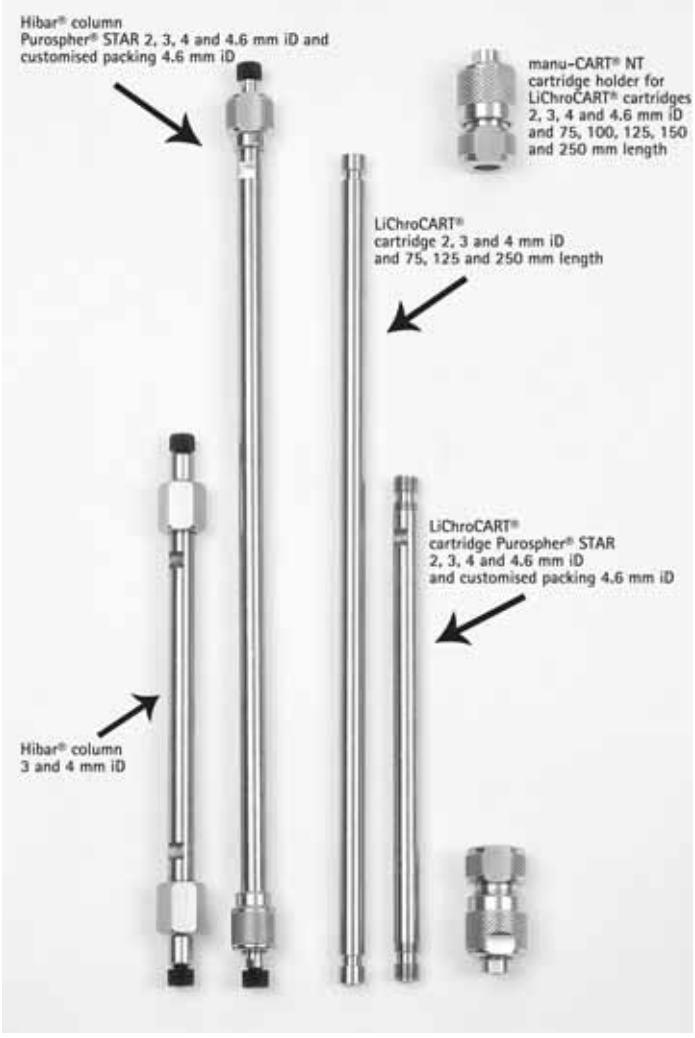
→ ChiraSep® DNBPG
Economic separation of selected enantiomers 140

→ ChiraSpher® NT
Improved enantio-selectivity especially for pharmaceuticals 142

→ Accessories for Particulate HPLC Columns
The LiChroCART® cartridge - different lengths, different internal diameter 152

→ Accessories for Particulate HPLC Columns
manu-CART® cartridge holder for LiChroCART® cartridges 149

→ Accessories for Particulate HPLC Columns
The Hibar® column 154



Ordering information of customised packings

Stainless steel cartridges LiChroCART®

The LiChroCART® columns (75, 125, 150 and 250 mm length) in the list below (2, 3, 4 and 4.6 mm i.d.) require part number 1.51486.0001 manu-CART® cartridge column holder, which can be used to hold one cartridge column with or without a 4-4 mm guard column.

LiChroCART® columns 250-10 mm require part number 1.51419.0001 manu-CART® 10.

The short LiChroCART® columns (30 and 55 mm length) can be ordered as a set including the corresponding cartridge holder and one cartridge, or as a pack of 3 cartridges without cartridge holder.

The separate part numbers for the cartridge are as follows.

1.50227.0001 LiChroCART® cartridge holder for 30 mm cartridge

1.50226.0001 LiChroCART® cartridge holder for 55 mm cartridge

	Ordering No.	Dimensions Length	Dimensions i.d.	Packing material
LiChroCART® 10-2	1.50201.*	10 mm	2 mm	*as specified (sorbent numbers)
LiChroCART® 30-2	1.50229.*	30 mm	2 mm	*as specified (sorbent numbers)
LiChroCART® 55-2	1.50234.*	55 mm	2 mm	*as specified (sorbent numbers)
LiChroCART® 125-2	1.50195.*	125 mm	2 mm	*as specified (sorbent numbers)
LiChroCART® 250-2	1.50190.*	250 mm	2 mm	*as specified (sorbent numbers)
LiChroCART® 30-3	1.50233.*	30 mm	3 mm	*as specified (sorbent numbers)
LiChroCART® 55-3	1.50236.*	55 mm	3 mm	*as specified (sorbent numbers)
LiChroCART® 125-3	1.50175.*	125 mm	3 mm	*as specified (sorbent numbers)
LiChroCART® 250-3	1.50177.*	250 mm	3 mm	*as specified (sorbent numbers)
LiChroCART® 4-4	1.50173.*	4 mm	4 mm	*as specified (sorbent numbers)
LiChroCART® 25-4	1.50172.*	25 mm	4 mm	*as specified (sorbent numbers)
LiChroCART® 30-4	1.50302.*	30 mm	4 mm	*as specified (sorbent numbers)
LiChroCART® 55-4	1.50228.*	55 mm	4 mm	*as specified (sorbent numbers)
LiChroCART® 75-4	1.50171.*	75 mm	4 mm	*as specified (sorbent numbers)
LiChroCART® 125-4	1.50170.*	125 mm	4 mm	*as specified (sorbent numbers)
LiChroCART® 250-4	1.50174.*	250 mm	4 mm	*as specified (sorbent numbers)
LiChroCART® 100-4,6	1.51448.*	100 mm	4.6 mm	*as specified (sorbent numbers)
LiChroCART® 125-4,6	1.51442.*	125 mm	4.6 mm	*as specified (sorbent numbers)
LiChroCART® 150-4,6	1.51432.*	150 mm	4.6 mm	*as specified (sorbent numbers)
LiChroCART® 250-4,6	1.51431.*	250 mm	4.6 mm	*as specified (sorbent numbers)
LiChroCART® 10-10	1.50178.*	10 mm	10 mm	*as specified (sorbent numbers)
LiChroCART® 75-10	1.51449.*	75 mm	10 mm	*as specified (sorbent numbers)
LiChroCART® 100-10	1.51445.*	100 mm	10 mm	*as specified (sorbent numbers)
LiChroCART® 125-10	1.51443.*	125 mm	10 mm	*as specified (sorbent numbers)
LiChroCART® 150-10	1.51444.*	150 mm	10 mm	*as specified (sorbent numbers)
LiChroCART® 250-10	1.50179.*	250 mm	10 mm	*as specified (sorbent numbers)

Validation kits

	Ordering No.	Packing material
LiChroCART 125-3 Validation kit customized packing	1.50417.*	3 HPLC column of different batches
LiChroCART 250-3 Validation kit customized packing	1.50418.*	
LiChroCART 125-4 Validation kit customized packing	1.50419.*	
LiChroCART 250-4 Validation kit customized packing	1.50420.*	
LiChroCART 125-4.6 Validation kit customized packing	1.50421.*	
LiChroCART 150-4.6 Validation kit customized packing	1.50422.*	
LiChroCART 250-4.6 Validation kit customized packing	1.50423.*	

Validation kits only available for sorbent number *7093 and *7079

Stainless steel columns Hibar®

The Hibar® columns are complete with endfittings.

When using a guard column with a Hibar® column, we recommend part number 1.51487.0001 guard column cartridge holder for 4-4mm guard column cartridges LiChroCART®.

	Ordering No.	Dimensions Length	Dimensions i.d.	Packing material
Hibar® 250-3	1.00423.*	250 mm	3 mm	*as specified (sorbent numbers)
Hibar® 30-4	1.51196.*	30 mm	4 mm	*as specified (sorbent numbers)
Hibar® 125-4	1.50181.*	125 mm	4 mm	*as specified (sorbent numbers)
Hibar® 250-4	1.50182.*	250 mm	4 mm	*as specified (sorbent numbers)
Hibar® 100-4,6	1.50013.*	100 mm	4.6 mm	*as specified (sorbent numbers)
Hibar® 125-4,6	1.50012.*	125 mm	4.6 mm	*as specified (sorbent numbers)
Hibar® 150-4,6	1.50009.*	150 mm	4.6 mm	*as specified (sorbent numbers)
Hibar® 250-4,6	1.00424.*	250 mm	4.6 mm	*as specified (sorbent numbers)
Hibar® 250-10	1.50183.*	250 mm	10 mm	*as specified (sorbent numbers)

Glass cartridges EcoCART®

	Ordering No.	Dimensions Length	Dimensions i.d.	Packing material
EcoCART® 125-3	1.50180.*	125 mm	3 mm	*as specified (sorbent numbers)

Ordering information of sorbent numbers

Please see „Example"

	Sorbent numbers
Purospher® STAR	
Purospher® STAR RP-18 endcapped, 3 µm	*.7184
Purospher® STAR RP-18 endcapped, 5 µm	.*7185
Purospher® STAR RP-18 endcapped, 10 µm	*.7186
Purospher® STAR RP-8 endcapped, 3 µm	*.7220
Purospher® STAR RP-8 endcapped, 5 µm	*.7194
Purospher® STAR NH_2, 5 µm	*.7177
Purospher® STAR Si, 3 µm	*.7174
Purospher® STAR Si, 5 µm	*.7175
Purospher® RP-18 endcapped	
Purospher® RP-18 endcapped, 5 µm	.7130
Purospher® RP-18 endcapped, 10 µm	.7207
Purospher® RP-18 HC	
Purospher® RP-18 HC	*.7131
Purospher® RP-18	
Purospher® RP-18, 5 µm	*.7127
Purospher® Si, 3 µm	*.7179
Purospher® Si, 5 µm	*.7180
Superspher®	
Superspher® 60 Si, 4 µm	*.7142
Superspher® 100 Si, 4 µm	*.7143
Superspher® 60 RP-8, 5 µm	*.7139
Superspher® 60 RP-8 endcapped, 4 µm	*.7140
Superspher® 60 RP-select B, 4 µm	*.7141
Superspher® 100 RP-18, 4 µm	*.7137
Superspher® 100 RP-18 endcapped, 4 µm	*.7138
LiChrospher®	
LiChrospher® Si 60, 5 µm	*.7109
LiChrospher® Si 60, 10 µm	*.7104
LiChrospher® Si 60, 12 µm	*.7106
LiChrospher® Si 60, 15 µm	*.7098
LiChrospher® Si 60, 25 µm	*.7096

	Sorbent numbers
LiChrospher® Si 100, 5 µm	*.7110
LiChrospher® Si 100, 10 µm	*.7101
LiChrospher® Si 100, 15 µm	*.7100
LiChrospher® Si 100, 25 µm	*.7097
LiChrospher® 100 CN, 5 µm	*.7071
LiChrospher® 100 CN, 10 µm	*.7070
LiChrospher® 100 DIOL, 5 µm	*.7075
LiChrospher® 100 DIOL, 10 µm	*.7073
LiChrospher® 100 NH_2, 5 µm	*.7076
LiChrospher® 100 NH_2, 10µm	*.7077
LiChrospher® 100 RP-8, 5 µm	*.7087
LiChrospher® 100 RP-8, 7 µm	*.7089
LiChrospher® 100 RP-8, 10 µm	*.7088
LiChrospher® 100 RP-8 endcapped, 5 µm	*.7092
LiChrospher® 100 RP-8 endcapped, 10 µm	*.7091
LiChrospher® 60 RP-select B, 5 µm	*.7093
LiChrospher® 60 RP-select B, 10 µm	*.7094
LiChrospher® 60 RP-select B, 15 µm	*.7209
LiChrospher® 60 RP-select B, 25 µm	*.7095
LiChrospher® 100 RP-18, 5 µm	*.7079
LiChrospher® 100 RP-18, 7 µm	*.7080
LiChrospher® 100 RP-18, 10 µm	*.7081
LiChrospher® 100 RP-18, 12 µm	*.7208
LiChrospher® 100 RP-18, 15 µm	*.7206
LiChrospher® 100 RP-18 endcapped, 5 µm	*.7085
LiChrospher® 100 RP-18 endcapped, 10 µm	*.7084
LiChrospher® 100 PAH, 5 µm	*.7078
LiChrospher® 300 WP RP-18, 5 µm	*.7116
LiChrospher® 300 WP RP-18, 12 µm	*.7114
LiChrospher® 300 WP RP-18, 15 µm	*.7115
LiChrospher® 300 WP RP-18 endcapped, 5 µm	*.7117
LiChrosorb®	
LiChrosorb® Si 60, 7µm	*.7065
LiChrosorb® Si 100, 5 µm	*.7062
LiChrosorb® Si 100, 10 µm	*.7063
LiChrosorb® RP-8, 5 µm	*.7057

	Sorbent number
LiChrosorb® RP-8, 10 µm	*.7059
LiChrosorb® RP-select B, 5 µm	*.7060
LiChrosorb® RP-18, 5 µm	*.7052
LiChrosorb® RP-18, 10 µm	*.7054

	Sorbent number
Aluspher®	
Aluspher® 100 RP-select B, 5 µm	*.7002

Chiral HPLC sorbents	
ChiraDex®, 5 µm	*.7004
ChiraSep® DNBPG, 5 µm	*.7005
ChiraSpher® NT, 5 µm	*.7006

Ordering information Nucleosil®
Stainless steel cartridges LiChroCART® (4 mm i.d.) packed with Nucleosil® sorbents

The LiChroCART® columns (125, 150 and 250 mm length) in the list below (4 mm i.d.) require part number 1.51486.0001 manu-CART® cartridge column holder, which can be used to hold one cartridge column with or without a 4-4 mm guard column.

Packing material	Ordering No.	Particle size	Dimensions Length	Dimensions i.d.	Contents of one package
Nucleosil® 100 C 18	1.51324.0003	5 µm	4 mm	4 mm	10 pieces
Nucleosil® 100 C 18	1.51329.0003	5 µm	125 mm	4 mm	1 piece
Nucleosil® 100 C 8	1.51402.0003	5 µm	125 mm	4 mm	1 piece
Nucleosil® 100 C 18	1.51388.0003	5 µm	250 mm	4 mm	1 piece
Nucleosil® 100 C 8	1.51387.0003	5 µm	250 mm	4 mm	1 piece
Nucleosil® 100 C 18	1.51378.0003	10 µm	250 mm	4 mm	1 piece
Nucleosil® 100 C 8	1.51377.0003	10 µm	250 mm	4 mm	1 piece
Additional dimensions available as customised packings					

Nucleosil® is a trademark of Macherey-Nagel, Düren

Accessories for Particulate HPLC Columns

manu-CART® cartridge holder for LiChroCART® cartridges

The „one-turn" cartridge system for simple, rapid „hands only" fitting of cartridges and precolumns.

manu-CART® cartridge holder for the LiChroCART® cartridge system are ingenious. They are re-usable and fit every cartridge length with different internal diameter. And a simple turn per-mits an easy and problem-free integration of a guard cartridge.

For coupling of two LiChroCART® cartridges a coupling unit can be used and for connecting a LiChro-CART® HPLC cartridge with a LiChroCART® 25-4 pre-cartridge the coupling kit.

The manu-CART® cartridge holder fits for 2, 3, 4 and 4.6 mm i.d. LiChroCART® cartridges and 75, 100, 125, 150 and 250 mm length

LiChroCART® HPLC cartridge (i.d. 2, 3, 4 and 4.6 mm) and LiChroCART® 4-4 (or 10-2) HPLC guard cartridge with manu-CART® NT
1.51486

Selection of manu-CART® cartridge holder

LiChroCART® cartridge	Cartridge holder	Ordering No.
25-4 and 25-2	manu-CART® 25 mm	1.50017.0001
30-2, 30-3 and 30-4	manu-CART® 30 mm	1.50227.0001
55-2, 55-3 and 55-4	manu-CART® 55 mm	1.50226.0001
75-4	manu-CART® NT	1.51486.0001
100-4.6	manu-CART® NT	1.51486.0001
125-2, 125-3, 125-4 and 125-4.6	manu-CART® NT	1.51486.0001
150-4.6	manu-CART® NT	1.51486.0001
250-2, 250-3, 250-4 and 250-4.6	manu-CART® NT	1.51486.0001
75-10, 100-10, 125-10, 150-10 and 250-10	manu-CART® 10-II	1.51419.0001

Accessories for Particulate HPLC Columns

manu-CART® cartridge holder for LiChroCART® cartridges

Ordering information for manu-CART® cartridge holder

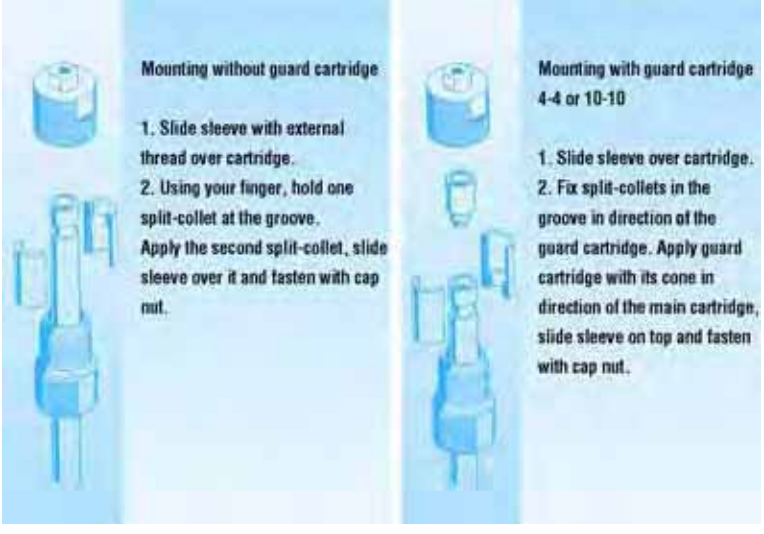
manu-CART® endfittings for stainless steel cartridges LiChroCART®

Designation	Ordering No.	Contents of one package
manu-CART® NT cartridge holder for 2, 3, 4 and 4.6 mm i.d. LiChroCART® cartridges	1.51486.0001	2 complete stainless steel units for mounting one LiChroCART® cartridge
manu-CART® "10" II cartridge holder for 10 mm i.d. LiChroCART® cartridges	1.51419.0001	2 complete stainless steel units for mounting one LiChroCART® cartridge
manu-CART® coupling kit for coupling with LiChroCART® 25-4 pre-cartridge	1.50082.0001	1 coupling unit 1 endfitting for LiChroCART® 25-4
manu-CART® coupling unit to connect two LiChroCART® cartridges	1.50083.0001	1 piece
manu-CART® holder 25-4 and 25-2	1.50017.0001	1 piece
manu-CART® holder 30 mm for 30-2, 30-3 and 30-4 LiChroCART® cartridges	1.50227.0001	1 piece
manu-CART® holder 55 mm for 55-2, 55-3 and 55-4 LiChroCART® cartridges	1.50226.0001	1 piece
Pressure cone for manu-CART® endfitting	1.51258.0001	2 pieces
Split collets for manu-CART® endfitting	1.51257.0001	4 pieces

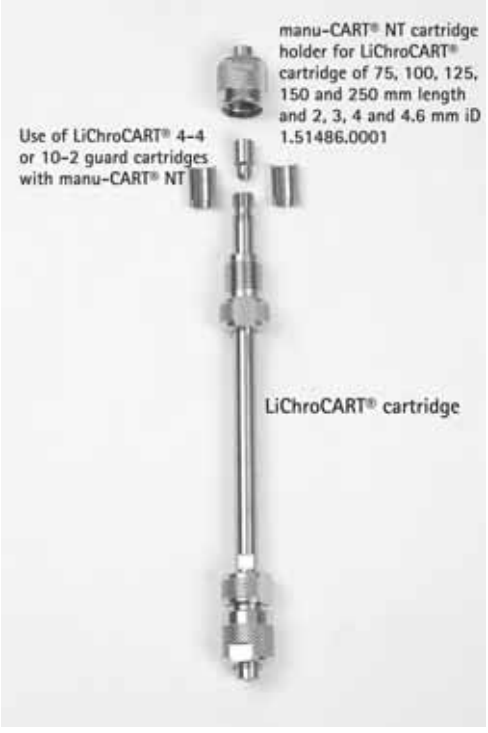
manu-CART® holder
30 mm for LiChroCART®
30-4, 30-3 and 30-2
1.50227

manu-CART® holder
55 mm for LiChroCART®
55-4, 55-3 and 55-2
1.50226

Mounting of patented manu-CART® endfittings nothing could be simplier



What can also be connected to manu-CART®?



1.50083
Coupling two LiChroCART® HPLC cartridges (of 75, 100, 125, 150 and 250 mm length) with coupling unit (1.50083)

1.50082
Connecting a LiChroCART® HPLC cartridge with a LiChroCART® 25-4 and 25-2 pre-cartridge with coupling kit (1.50082)

1.50017
Mounting a LiChroCART® 25-4 and 25-2 pre-cartridge with endfitting (from 1.50082) and cap nut (from 1.51486)

Accessories for Particulate HPLC Columns

The LiChroCART® cartridge – different lengths, different internal diameter

The cartridge concept is the opposite: Here the user works with re-usable endfittings which fit different cartridge lengths. Since these cartridge holders may remain in the system and the capillary connections do not need to be detached, the cartridges may be changed within the shortest possible time. Changing a separation cartridge from a length of 125 to 250 mm and back presents no problems. Furthermore, the adaptation of internal diameter (mm, 3 mm or 2 mm) and cartridge material (glass or stainless steel) to the analysis problem is possible within a few minutes. The endfittings are designed to allow the cartridges to be hand-sealed at normal working pressures of 150 to 200 bar without the need for any tools. Only at higher pressures may further tightening with a wrench become necessary.

Ordering information LiChroCART® accessories

Stainless steel cartridges LiChroCART® accessories

Designation	Ordering No.	Contents of one package
LiChroCART® frit elements for 4 mm and 4.6 mm i.d. cartridges	1.51496.0001	10 stainless steel frits with PFA ring seals 10 glass fibre filters (tool 1.15576.0001 not included)
LiChroCART® frit elements for 2 mm and 3 mm i.d. cartridges	1.51195.0001	10 stainless steel frits with PFA ring seals 10 glass fibre filters (tool 1.15576.0001 not included)
LiChroCART® Assembly tool for replacement of frits 2, 3, 4 and 4.6 mm i.d	1.15576.0001	1 centering sleeve 1 assembly tool 1 tool for replacement of sealing rings from LiChroCART® cartridges

Pore size of filters: 2 µm

Accessories for Particulate HPLC Columns

The LiChroCART® cartridge – different lengths, different internal diameter

Exchanging the sieve and glass fiber filter of LiChroCART® cartridges (using 1.15576.0001 tools)

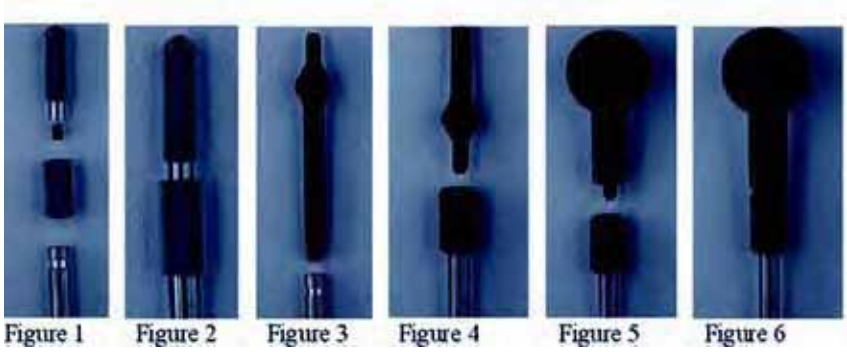


Fig. 1 Remove the manu-CART®"4" endfitting. Put them aside for re-use later. Screw the mini cork-screw tool into the teflon ring and pull gently to remove the filter.

Fig. 2 In case of a PFA filter take the stainless steel core in addition to guide the screw tool.

Fig. 3 Using a small spatula remove the remains of the glass fiber filter and any soiled packing material. Fill the void with freshly prepared packing material and smooth off the surface. Place a new filter on the top of the cartridge. Use the broad end of the plastic tool to push the filter into the cartridge.

Fig. 4 Place a teflon sealing element into the open end of the cartridge and press it firmly into its place by using the narrow end of the pastic tool and the plastic core for guiding.

Fig. 5 In case of a PFA element take the new plastic tool to have more power.

Fig. 6 Reassemble the manu-CART® endfitting and re-equilibrate the column.

Cartridges save costs

The HPLC cartridge is a sorbent-filled stainless steel tube closed at both ends by a filter element and fitted with a groove for the holding device. No threads are necessary. The connection pieces can be used over and over again. The cartridge is therefore more economical and in the long run the right concept for reducing analysis costs. Cartridge kits containing the cartridge, the holding devices and a precolumn, allow for a favourably priced start in the HPLC technique. This technology becomes uniquely advantageous by the use of statistically tested cartridges for the most frequently used RP-chromatography applications. Optimum control of the packing process is decisive in this case. Batch size, automation and packing technology for today's RP-materials have reached a standard permitting random testing. The reversed-phase cartridges offered in favourably priced 3-packs are the work horses of chromatography.

Cartridges with precolumns have longer lives

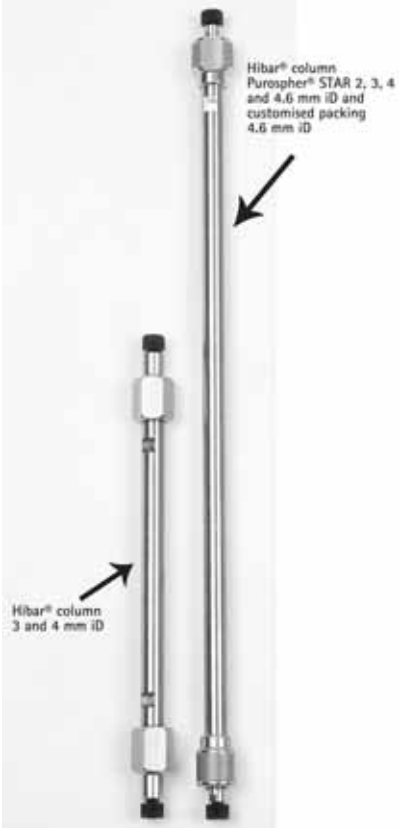
The flexibility of the cartridge system becomes obvious in the integration of precolumns. Without the need for additional precolumn holders and capillaries, 4-4 mm precolumns may be integrated into the system practically void volume-free. A simple turn of the split collets holding the cartridges in the fitting suffices. A precolumn change also presents no problems. In this way,the lifetime of the separation cartridge may be extended simply and cost-effectively

The fig. depicts a package LiChroCART® 4-4 precolumns

Accessories for Particulate HPLC Columns

The Hibar® column

The traditional heart of HPLC is the "ready-to-use" column with threads at both ends onto which reducers for capillary connection are screwed. As a rule, precolumns are coupled with the main column via capillaries. If the column is exhausted, the user has two possibilities: Refilling, provided aggressive eluents do not prevent this by causing corrosion or worn threads, or the whole column is discarded. Column refilling without tube revision is problematic in view of GLP since each column has a different "history" and a different pretreatment for each new assignment.



Ordering information Hibar® column accessories

Guard column holder for Hibar® columns

Designation	Ordering No.	Contents of one package (see figure on next page)
Precolumn holder for 4-4 LiChroCART® cartridges for capillary connection to Hibar® column	1.16217.0001	1 piece
Precolumn holder for 4-4 LiChroCART® cartridges for direct coupling to Hibar® column	1.51487.0001	1 piece
Precolumn holder for 4-4 LiChroCART® cartridges for direct coupling to Hibar® column	1.16333.0001	1 piece

Tools for Hibar® columns

Designation	Ordering No.	Diameter	Contents of one package
Hibar® replacement frits with PTFE sealing rings	1.51211.0001	4 mm	3 pieces
Hibar® replacement frits with PTFE sealing rings	1.51220.0001	10 mm	3 pieces
Hibar® frit extractor for removing frits from reducers	1.51210.0001	4 mm	1 piece

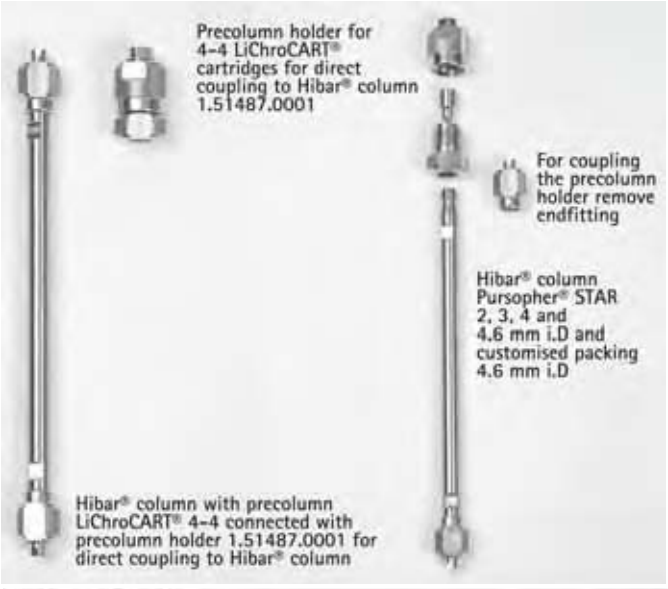
1.51211

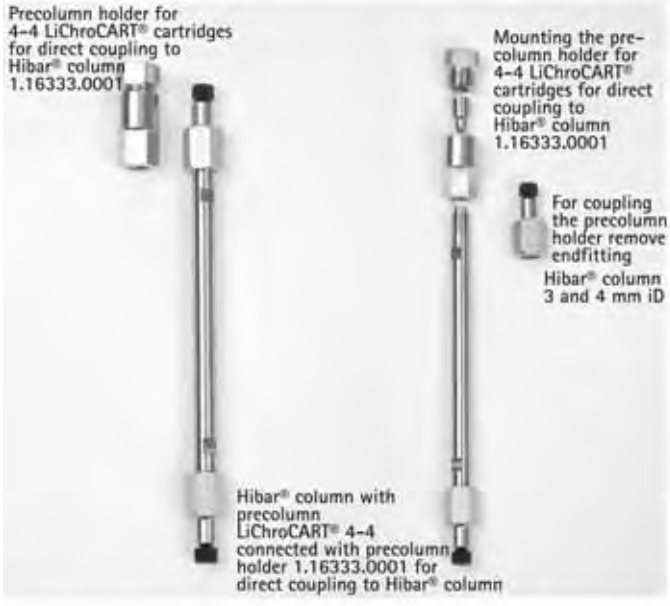
1.51220

1.51210

Accessories for Particulate HPLC Columns

The Hibar® column





Ordering information for capillaries, frits and fittings

Hibar® / LiChroCART® kits

Designation	Ordering No.	Contents of one package
HPLC Starter-Kit	1.13171.0001	4 knurled nuts for capillary connections (o.d. 1/16" or 0.5 mm) 10 PVDF double cones for capillary connections (o.d. 0.5 mm or i.d. 0.2 mm) 10 stainless steel filters with PTFE ring seal and 10 ceramic filters for HPLC cartridges LiChroCART® (i.d. 4 mm) 3 coupling units 6 pressure nuts 6 ferrules for capillaries (o.d. 1/16" or 0.5 mm) 1 capillary tubes each of 50, 80, 120 and 200 mm length 1 union (dead volume free) for capillaries (o.d. 1/16" or 0.5 mm) 8 nuts for capillary connections and 10 ferrules for capillary conection (o.d. 1/16") 3 stainless steel capillaries (o.d. 0.2 mm) 1000 mm length 2 knurled nuts (long necked) for 6-port injection valves (type Rheodyne 7125) 10 PVDF double cones for capillary connection (o.d. 1/16")
Mounting kit for capillary connection (o.d. 1/16")	1.51214.0001	1 capillary tube each (o.d.1/16", i.d. 0.25 mm) of 50, 80, 120 and 200 mm length 1 dead-volume free union for capillaries (o.d. 1/16" or 0.5 mm) 8 nuts for capillary connections (o.d. 1/16") 10 stainless steel ferrules for capillary connections
Coupling kit (dead volume free for capillaries (o.d. 1/16" or 0.5 mm)	1.51213.0001	3 coupling units 6 nuts 6 ferrules

1.13171.0001

1.51214

1.51213

Hibar® / LiChroCART® capillaries

Designation	Ordering No.	Length	Contents of one package
Stainless steel capillaries (o.d. 1/16", i.d. 0.25 mm)	1.51230.0001	80 mm	10 pieces
Stainless steel capillaries (o.d. 1/16", i.d. 0.25 mm)	1.51231.0001	120 mm	10 pieces

1.15547.0001

1.51236.0001

Designation	Ordering No.	Length	Contents of one package
Stainless steel capillaries (o.d. 0.5 mm, i.d. 0.20 mm)	1.15547.0001	250 mm	5 pieces
Stainless steel capillaries (o.d. 0.5 mm, i.d. 0.20 mm)	1.51236.0001	1000 mm	3 pieces
Stainless steel capillaries (o.d. 0.5 mm, i.d. 0.10 mm)	1.51247.0001	150 mm	5 pieces
Stainless steel capillaries (o.d. 0.5 mm, i.d. 0.10 mm)	1.51245.0001	1000 mm	1 piece

1.15545

Hibar® / LiChroCART® nuts andferrules

Designation	Ordering No.	Contents of one package
Dead-volume free coupling unit for capillary connection (o.d. 1/16" or 0.5 mm)	1.51252.0001	3 units
Nuts for capillary connections (o.d. 1/16")	1.51216.0001	10 nuts
Knurled nuts for capillary connection with PVDF double cones	1.15545.0001	4 knurled nuts
Knurled nuts with long bushing for Rheodyne	1.51237.0001	2 knurled nuts 6 PVDF double cones
Ferrules for capillary connections (o.d. 1/16")	1.51217.0001	20 ferrules (cone angle 18°)
PVDF double cones for capillary tubing (1/16") with knurled screw Ordering No. 1.15545 resp. 1.51216	1.51238.0001	10 PVDF double cones
PVDF double cones for capillary connection (o.d. 0.5 mm) with knurled nuts Ordering No. 1.15545	1.15546.0001	10 PVDF double cones
PVDF plugs	1.51218.0001	20 PVDF plugs

1.51237

1.51217

1.15546

1.51238

The inert cartridge system when metal ions must be excluded

EcoCART® is a easy-to-handle and fully inert glass cartridge system for narrow bore HPLC with a broad range of filling materials available.

The small inner diameter of 3 mm produces almost twice the peak height in comparison to 4 mm ID columns and increases therefore the detection sensitivity significantly. At the same time eluent consumption is halved.

The transparent tube allows the separation of coloured substances to be followed with the naked eye. Impurities at the column head can be recognised at an early stage. The extremely smooth glass surface is ideal for HPLC and involves no restrictions whatever regarding the eluents used.

The EcoCART® system is fully compatible to the manu-CART® cartridge holder system.

Mounting the EcoCART® glass cartridge

The EcoCART® cartridge is mounted onto the HPLC system with a special easy-to-handle holder. The holder consists of a clamping tube, guard cartridge adapter and two frequently used cap nuts from the manu-CART® connection. The LiChroCART® 4-4 cartridge can be used as the guard column.

Accessories for Particulate HPLC Columns

EcoCART® 125-3 glass cartridges

Ordering information of EcoCART® glass cartridge

Accessories for glass cartridge EcoCART®

Designation	Ordering No.	Contents of one package
Holder for EcoCART® 125-3 cartridge	1.51207.0001	1 clamping tube 2 manu-CART® cap nuts 1 guard cartridge adaptor
manu-CART® adaptor kit for EcoCART® 125-3 cartridge	1.51420.0001	1 clamping tube and 1 guard cartridge adaptor

LiChroTest®

Standard samples for HPLC System Qualification

The quality of analytical results is principally determined by the correct functioning of the analytical instruments employed. For this reason, the various quality assurance systems as well as the FDA require analytical instruments to be subjected to periodical qualification. Therefore, before starting a series of analyses, you first should estabish whether your HPLC system meets with your requirements. These "Operational Qualification" (OQ) and "Performance Qualification" (PQ) steps involve tests of the different modules on their specifications and a check on the entire system using a real application relevant to the laboratory-specific requirements. In order to facilitate this instrument qualification in the HPLC laboratory, Merck KGaA and VWR International have developed the LiChroTest® products. These enable time saving operational and performance qualification to be performed routineley and according to standardised methods.

Ordering information

PQ: Test Kit for HPLC System Performance Qualification

Ordering No.	Description
1.19156.0001	**LiChroTest® PQ** Performance qualification Kit for HPLC System Qualification Usable for all kinds of HPLC systems

PQ: LichroTest® Standard samples for HPLC System PerformanceQualification

Ordering No.	Description
1.19157.0001	**Set 1A: Precision and Linearity (PQ)** Refill pack for the LiChroTest® PQ Kit. 1.19156.0001 Dilution series of methyl paraben in methanol/water (50/50) (concentrations 50, 100, 150, 200 mg/l)
1.19165.0001	**Set 1: Precision and Linearity (PQ)** Refill pack for the old LiChroTest® PQ Kit. 1.15958.0001 Dilution series of methyl paraben in methanol/water (50/50) (concentrations, 1, 10, 100, 200 mg/l)
1.19158.0001	**Set 3: Precision (PQ)** 5 Standard samples of 100 mg/l methyl paraben in methanol/water (50/50) Refill pack for the LiChroTest® PQ set
1.19159.0001	**Set 3: Separation (Parabens) (PQ)** 5 Standard samples with 3 different parabens + t_o-marker in methanol/water (50/50), with sample chromatogram and analysis conditions

LiChroTest®

Standard samples for HPLC System Qualification

OQ: LiChroTest® Standard samples for HPLC System OperationalQualification

Ordering No.	Description
1.15201.0001	**Set 5: Autosampler Test (OQ)** 5 Standard samples with perylene in methanol for Checking injection precision (OQ) of LaChrom autosamplers
1.19161.0001	**Set 7: Precision (OQ)** 60 mg/l methyl paraben in methanol
1.19162.0001	**Set 8: Linearity (OQ)** Dilution series of methyl paraben in methanol (concentrations: 1.5, 7.5, 15, 75, 150 mg/l)
1.19163.0001	**Caffeine solution A for gradient test (OQ)** 20 mg/l caffeine in water (0.5 l)
1.19169.0001	**Caffeine solution B for gradient test (OQ)** 20 mg/l caffeine in methanol (0.5 l)

Characterisation of LiChroTest® Standard samples for HPLC System Qualification

For both, Operational Qualification and Performance Qualification, different test samples for checking precision, accuracy, linearity and sample-carry-over of the different HPLC modules or the complete system are available. Each set contains several ampoules of sample accompanied by a Certificate of Analysis that ensures uniform quality and traceability to international standards. These test samples can be used to perform a simple and standardised check of the critical parameters of HPLC system function.

LiChroTest® PQ

For Performance Qualification, the LiChroTest® PQ, a complete test kit for 8 different system tests, is ideal. The test procedure involved has been selected and optimised to include meaningful system performance paramters and to ensure ease-of-use, time saving and extensive automation. The kit comprises an HPLC column, test samples, a description of the qualification proc-ess and the test methods as well as an example test report which are suitable for use with any HPLC system. In this way, you can rapidly and routinely carry out fully automatic performance qualification of your HPLC instruments. The documentation completed in the course of the qualification procedure is very useful for passing future audits.

The following HPLC system tests can be carried out:

- Qualification of system communication
- Qualification of data processing
- Baseline noise and drift levels
- System suitability test: Peak width and symmetry
- Repeatability: Peak area and retention time
- Linearity
- Sample carry-over
- Qualification of system control

The LiChroTest® PQ kit contains ready to use methods for the LaChrom D-7000 HPLC System Manager software and for the EZChrom Elite chromatography data system in combination with LaChrom and LaChrom Elite systems.

The certified standard samples contained in the LiChroTest® PQ kit are available as refill packs

Six further UV/VIS standard solutions from Merck are also available for checking photometers, spectrophotometers and UV-detectors for wavelength accuracy, stray light, spectral resolution and absorption accuracy according to the European Pharmacopoeia (EP).

LiChroTest® is a further contribution from VWR International and Merck KGaA towards guaranteeing the quality of your analytical results and preparing you for your next audit.

LiChroTest® ensures that your HPLC system yields correct results

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General Information and Guidelines Analytical HPLC

In HPLC, a number of methods can be used to cut running costs, for example the optimisation of analysis time by using shorter columns or reduction of solvent consumption by using columns with a smaller internal diameter.

A Selection guide will help to select the suitable column for your application. A list of specification of column sorbents gives detailed information to all Merck analytical HPLC stationary phases. Guideline to care and use and LC-Troubleshooting contains important information to handling and use of HPLC columns.

General Information and Guidelines Analytical HPLC

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The following list contains columns that may be used for separations where the stationary phases are specified by USP. LiChrospher® is a spherical sorbent, LiChrosorb® a irregular one. LiChrospher® 60 RP-select B is a base-compatible C-8 phase.

L1: Octadecylsilane, chemically linked to porous silica or ceramic micro particles with 5 or 10 µm in diameter

LiChrosorb® RP-18 (5 µm)	see page 130
LiChrosorb® RP-18 (7 µm)	see page 130
LiChrosorb® RP-18 (10 µm)	see page 130
LiChrospher® RP-18 (5 µm)	see page 116
LiChrospher® RP-18 (10 µm)	see page 116
Purospher® RP-18 (5 µm)	see page 100
Purospher® RP-18 endcapped (5µm)	see page 98
Purospher® STAR RP-18 endcapped (3 µm)	see page 83
Purospher® STAR RP-18 endcapped (5 µm)	see page 83
Chromolith® RP-18 endcapped	see page 55

L3: Pourous silica particles 5–10 µm diameter

LiChrosorb® Si 60 (5 µm)	see page 130
LiChrosorb® Si 60 (10 µm)	see page 130
LiChrospher® Si 60 (5 µm)	see page 109
LiChrospher® Si 60 (10 µm)	see page 109
Purospher® STAR Si (5 µm)	see page 96
LiChrospher® Si 100	see page 109
Chromolith® Si	see page 62

L7: Octylsilane, chemically bound to porous silica of 5 – 10 µm diameter

LiChrosorb® RP-8 (5 µm)	see page 130
LiChrosorb® RP-8 (7 µm)	see page 130
LiChrosorb® RP-8 (10 µm)	see page 130
LiChrosorb® RP-select B (5 µm)	see page 130
LiChrospher® RP-8 (5 µm)	see page 113
LiChrospher® RP-8 (10 µm)	see page 113
LiChrospher® RP-select B (5 µm)	see page 121
LiChrospher® RP-select B (10 µm)	see page 121
Purospher® STAR RP-8 endcapped (3 µm)	see page 93
Purospher® STAR RP-8 endcapped (5 µm)	see page 93
Chromolith® RP-8 endcapped	see page 60

L8: Aminopropyl silane groups on porous silica of 10 µm diameter

LiChrospher® NH_2 (10 µm)	see page 111
Purospher® STAR NH_2 (5 µm)	see page 96

L10: Cyano groups bound to porous silica of 3 – 10 µm diameter

LiChrosorb® CN (5 µm)	see page 130
LiChrospher® CN (5 µm)	see page 110
LiChrospher® CN (10 µm)	see page 110

L20: Dihydroxypropane groups chemically bound to silica of 5 – 10 µm diameter

LiChrosorb® Diol (5 µm)	see page 130
LiChrospher® Diol (5 µm)	see page 112
LiChrospher® Diol (10 µm)	see page 112

L29: Alumina-based polybutadiene spherical particles 5 µm

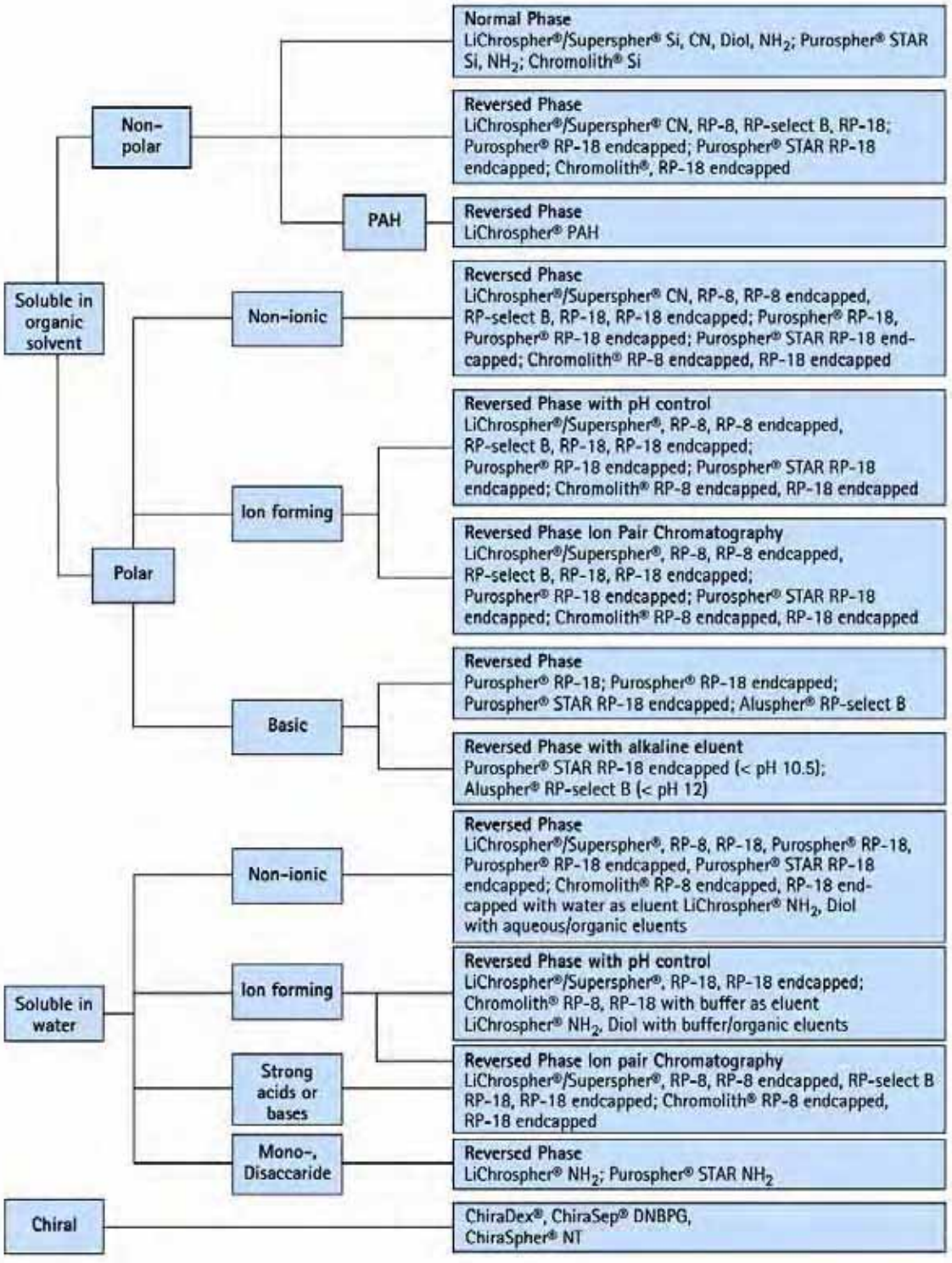
Aluspher® RP select B	see page 133

L45: Beta cyclodextrin bonded to porous silica particles 5 to 10 µm in diameter

ChiraDex® (5 µm)	see page 138

Selection of the right stationary phase

Sample of low molecular weight MW ≤ 1000



Selection guide

Selection by application

Pharmaceutical industry	Non-polar			Chromolith® Si; Purospher® STAR Si
	Polar			
		Basic compounds (Amine)		Purospher® RP-18
		basic, neutral and acidic compounds		Chromolith® RP-18 endcapped; Chromolith® RP-8 endcapped; Purospher® STAR RP-18 endcapped
			Amino acids	Superspher® RP-8
			Antibiotics	Chromolith® RP-18 endcapped; Purospher® STAR RP-18 endcapped
			Antiepileptics	Chromolith® RP-18 endcapped; Purospher® STAR RP-18 endcapped
			Beta-Blocker	Chromolith® RP-18 endcapped; Purospher® STAR RP-18 endcapped
			Carbohydrates	Purospher® STAR NH_2
			Carboxyllic acids	Chromolith® RP-8 endcapped; LiChrospher® RP-select B
			Nucleosides and Nucleotides	Chromolith® RP-18 endcapped; Purospher® RP-18 endcapped
			Steroides	Chromolith® RP-18 endcapped; Purospher® STAR RP-18 endcapped
Food & Berverage			Carbohydrates	Purospher® STAR NH_2
			Carboxyllic acids	Chromolith® RP-8 endcapped; LiChrospher® RP-select B
			Preservatives	Chromolith® RP-18 endcapped; Purospher® STAR RP-18 endcapped
			Sweeteners	Chromolith® RP-18 endcapped; Purospher® STAR RP-18 endcapped
			Vitamins	Chromolith® RP-18/RP-8 endcapped; Purospher® STAR RP-18/RP-8 endcapped
Environmental			Pesticides (Fungicides, Herbicides)	Chromolith® RP-18 endcapped; Purospher® RP-18 endcapped
			Explosives	Purospher® RP-18 HC
			PAH	LiChrospher® PAH

Selection guide

Selection of column dimension

Column dimension	Application	Reason
LiChroCART® 4-4 LiChroCART® 10-2, 10-10	Guard-column	Protection from mechanical contamination; sample contaminated to low extent
LiChroCART® 25-4 Hibar 30-4	Precolumn	Precolumn with full performance and high degree of retention for substances in adsorption and RP
LiChroCART® 30-4, 55-4 LiChroCART® 30-3, 55-3 LiChroCART® 30-2, 55-2	Columns for High Speed HPLC 30-2, 55-2 Ideal for combination with MS	Decrease of analysis time by factor 4.5 (55 mm) and 8 (30 mm) compared to 250 mm columns
LiChroCART® 75-4	Column for method development; column for rapid HPLC	Short retention time; rapid equilibration; low solvent consumption; low pressure drop
LiChroCART® 125-2 LiChroCART® 125-3 EcoCART® 125-3	Column for high detection sensitivity (mass selectivity)	Semi-micro column for low injection volumes and low peak dispersion; low solvent consumption
LiChroCART® 100-4.6, 125-4, 125-4.6, 150-4.6 Hibar® 100-4.6, 125-4, 125-4.6, 150-4.6	Standard column	Adequate performance for most applications (average performance 8000-10000 N/column)
LiChroCART® 250-3	Column for high detection sensitivity; high performance separation	Semi-micro column for low injection volumes and low peak dispersion; low solvent consumption; for complex samples
LiChroCART® 250-4, 250-4.6 Hibar® 250-4, 250-4.6	High performance separation	For very complex samples
LiChroCART® 50-10, 75-10, 100-10, 125-10, 150-10, 250-10 Hibar® 250-10	Semi-preparative separations 50-10, 75-10, 100-10 Ideal for high throughput purification in cominatorial chemistry	For mg quantities of pure substance on lab scale
Hibar® 30-25, 50-25, 100-25, 250-25	Semi-preparative separations	For g quantities on lab scale

Pressure limits for LiChroCART® cartridges and Hibar® columns

	max pressure
LiChroCART® cartridge	250 bar
Hibar® column	400 bar

Guidelines for typical flow rates and orientation values for the loading capacities of analytical and semi-preparative columns

Column dimensions (mm)	Typical flow rates (ml/min)	Sample amount (mg)	Sample volume (µl)
150-1	0.06	ca. 0.05	0.05 - 1
250-2	0.25	ca. 0.2	0.2 - 5
250-3	0.6	ca. 1	1 - 20
250-4	1	ca. 5	5 - 80
250-10	6	ca. 30	30 - 500
250-25	39	ca. 200	200 - 3000

Specifications of column sorbents

Polar stationary phases (normal phase chromatography)

(shipping eluent: n-Heptane/Dioxane (99/1))

Designation	Sorbent Characteristics	Particle size	Pore size	Pore volume	Spec. surface area	Efficiency
LiChrosorb® Si 60	irregular particles of silica	5, 7, 10 µm	60 Å	0.75 ml/g	500 m^2/g	55 000 N/m, 15 000 N/m
LiChrosorb® Si 100	irregular particles of silica	5, 7, 10 µm	100 Å	1.0 ml/g	300 m^2/g	
LiChrospher® Si 60	spherical particles of silica	5, 10 µm	60 Å	0.85 ml/g	700 m^2/g	55 000 N/m, 20 000 N/m
LiChrospher® Si 100	spherical particles of silica	5, 10 µm	100 Å	1.25 ml/g	400 m^2/g	55 000 N/m, 20 000 N/m
LiChrospher® Si 300	spherical particles of silica	10 µm	300 Å	0.78 ml/g	60 m^2/g	20 000 N/m
LiChrospher® Si 1000	spherical particles of silica	10 µm	1000 Å	0.78 ml/g	30 m^2/g	15 000 N/m
LiChropsher ® Si 4000	spherical particles of silica	10 µm	4000 Å	0.78 ml/g	10 m^2/g	15 000 N/m
Aluspher® AL	spherical particles of aluminia oxide	5 µm	100 Å		170 m^2/g	
Superspher® Si 60	spherical particles of silica	4 µm	60 Å	0.85 ml/g	700 m^2/g	100 000 N/m
Purospher® STAR Si	pherical particles of high purity silica	5 µm	120	1.1	330	50 000
Chromolith® Si	Monolithic high purity silica	2 µm	130	1 ml/g	300	

Medium polar stationary phases

(shipping eluent: n-Heptane/Dioxane (99/1))

Designation	Sorbent Characteristics	Particle size	Pore size	Pore volume	Spec. surface	% C	Surface coverage	Efficiency
LiChrosorb® CN	irregular particles of silica with γ-Cyanopropyl function	5, 7, 10 µm	100 Å	1.0 ml/g	300 m^2/g	6.1 %	3.82 µmol/m^2	40 000 N/m, 15 000 N/m
LiChrosorb® NH_2	irregular particles of silica with γ-Aminopropyl function	5, 7, 10 µm	100 Å	1.0 ml/g	300 m^2/g	3.5 %	3.54 µmol/m^2	25 000 N/m, 10 000 N/m
LiChrosorb® DIOL	irregular particles of silica with DIOL function on carbonchains	5, 7, 10 µm	100 Å	1.0 ml/g	300 m^2/g	7.1 %	3.91 µmol/m^2	40 000 N/m, 15 000 N/m
LiChrospher® CN	spherical particles of silica with γ-Cyanopropyl function	5, 10 µm	100 Å	1.25 ml/g	350 m^2/g	6.6 %	3.52 µmol/m^2	40 000 N/m, 15 000 N/m
LiChrospher® NH_2	spherical particles of silica with γ-Aminopropyl function	5, 10 µm	100 Å	1.25 ml/g	350 m^2/g	4.6 %	41 µmol/m^2	25 000 N/m, 20 000 N/m
LiChrospher® DIOL	sperical particles of silica with DIOL function on carbonchains	5, 10 µm	100 Å	1.25 ml/g	350 m^2/g	8.0 %	3.87 µmol/m^2	45 000 N/m, 20 000 N/m
Purospher® STAR NH_2	sperical particles of high purity silica with γ-Aminopropyl function	5 µm	120	1.1	330	3.5	3	50 000

Non-polar stationary phases (reversed phase chromatography)

(shipping eluent: acetronitrile/water)

Designation	Sorbent Characteristics	Particle size	Pore size	Pore volume	Spec. surface	% C	Surface coverage	Efficiency
LiChrosorb® RP-8	irregular particles of silica with octyl derivative	5, 7, 10 µm	100 Å	1.0 ml/g	300 m^2/g	9.5 %	3.4 µmol/m^2	55 000 N/m, 20 000 N/m
LiChrosorb® RP-select B	irregular particles of silica with octyl derivative	5, 7, 10 µm	60 Å	0.75 ml/g	300 m^2/g	11.4 %	4.21 µmol/m^2	55 000 N/m, 20 000 N/m
LiChrosorb® RP-18	irregular particles of silica with octyl derivative	5, 7, 10 µm	100 Å	1.0 ml/g	300 m^2/g	16.2 %	3.0 µmol/m^2	55 000 N/m, 20 000 N/m
LiChrospher® RP-8	spherical particles of silica with octyl derivative	5, 10 µm	100 Å	1.25 ml/g	350 m^2/g	12.5 %	4.04 µmol/m^2	55 000 N/m, 20 000 N/m
LiChrospher® RP-8 endcapped	spherical particles of silica with octyl derivative endcapped	5, 10 µm	100 Å	1.25 ml/g	350 m^2/g	13.0 %	4.44 µmol/m^2	55 000 N/m, 20 000 N/m
LiChrospher® RP-select B	spherical particles of silica with octyl derivative	5, 10 µm	60 Å	0.9 ml/g	360 m^2/g	11.5 %	3.55 µmol/m^2	55 000 N/m, 20 000 N/m
Lichrospher® RP-18	spherical particles of silica with octadecyl derivative	5, 10 µm	100 Å	1.25 ml/g	350 m^2/g	21.0 %	3.61 µmol/m^2	55 000 N/m, 20 000 N/m
LiChrospher® RP-18 endcapped	spherical particles of silica with octadecyl derivative endcapped	5, 10 µm	100 Å	1.25 ml/g	350 m^2/g	21.6 %	4.09 µmol/m^2	55 000 N/m, 20 000 N/m
LiChrospher® WP 300 RP-18	spherical particles of silica with octadecyl derivative	5, 12, 15 µm	300 Å	1.0	80 m^2/g	n.a.	n.a.	n.a
LiChrospher® PAH	spherical particles of silica with octadecyl derivative	5 µm	150 Å	n.a.	200 m^2/g	20 %	n.a.	80 000 N/m
Superspher® RP-8	spherical particles of silica with octyl derivative	4 µm	60 Å	1.25 ml/g	350 m^2/g	12.5 %	4.04 µmol/m^2	100 000 N/M
Superspher® RP-8 endcapped	spherical particles of silica with octyl derivative endcapped	4 µm	60 Å	1.25 ml/g	350 m^2/g	13.0 %	4.44 µmol/m^2	100 000 N/m
Superspher® RP-select B	spherical particles of silica with octyl derivative	4 µm	60 Å	0.9 ml/g	360 m^2/g	11.5 %	3.55 µmol/m^2	100 000 N/m
Superspher® RP-18	spherical particles of silica with octadecyl derivative	4 µm	100 Å	1.25 ml/g	350 m^2/g	21.0 %	3.61 µmol/m^2	100 000 N/m
Superspher® RP-18 endcapped	spherical particles of silica with octadecyl derivative	4 µm	100 Å	1.25 ml/g	350 m^2/g	21.6 %	4.09 µmol/m^2	100 000 N/m
Purospher® RP-18	spherical particles of high purity silica with octadecyl derivative	5 µm	90 Å	1.05 ml/g	480 m^2/g	17.0 %		80 000 N/m
Purospher® RP-18 endcapped	spherical particles of high purity silica with octadecyl derivative	5 µm	90 Å	1.05 ml/g	480 m^2/g	18.0 %		80 000 N/m
Purospher® STAR RP-8 endcapped	spherical particles of high purity silica with octyl derivative	3, 5 µm	120 Å	1.1 ml/g	330 m^2/g	11.2 %		130 000 N/m 80 000 N/m
Purospher® STAR RP-18 endcapped	spherical particles of high purity silica with octadecyl derivative	3, 5 µm	120 Å	1.1 ml/g	330 m^2/g	17.0 %	3 µmol/m^2	130 000 N/m 90 000 N/m
Purospher® HC	pherical particles of high purity silica with octadecyl derivative	5 µm	90 Å	1.05 ml/g	470 m^2/g	18.0 %		
Chromolith® RP-8 endcapped	Monolithic high purity silica with octyl derivative	2 µm	130	1	300	11.0 %		
Chromolith® RP-18 endcapped	Monolithic high purity silica with octadecyl derivative	2 µm	130	1	300	18.0 %		

Calculation of column void time

Knowledge of the void time tm is important for the calculation of chromatographic parameters like k and u. The void time may be calculated from the volume of the empty column Vempty the volume flow fv and the porosity of the carrier material. The total porosity of a column is the volume fraction occupied by the mobile phase.

$e = V_m/V_{empty}$

$t_m = V_{empty}\ e/f_v$

For totally porous materials like silica and modified silica, e is between 0.7 and 0.8.

The void time may also be determined by measuring the retention time of non-retarded sample substances. Suitable substances for measuring the void time are:

Determination of column void time

- Adsorption chromatography on silica gel:

UV detection: benzene, tetrachloroethylene;

RI detection: cyclohexane, benzene.

When using very weak solvents, benzene and tetrachloroethylene may also be retarded.

- Reversed-phase HPLC:

UV detection: thiourea.

RI detection: D_2O, CD_3OH, CD_3CN, eluent itself.

How to use the right column

The fundamental chromatographic equation is an aid for the selection of a suitable combination of stationary phase and column size.

$$R_s = \frac{1}{4}\left(\frac{k}{1+k}\right)\left(\frac{\alpha-1}{\alpha}\right)\sqrt{N}$$

The calculation of the individual contributions under different conditions shows what influence the different parameters exert.

Below table shows that with the correct choice of chromatographic system, good separtions can be achieved even at relative low plate numbers.

On the other hand even with extremely high plate numbers a satisfactory separation can not be obtained with poor separation factors.

Individual contributions of the chromatographic resolution

$k\ \left(\frac{k}{1+k}\right)$;	$\alpha\ \left(\frac{\alpha-1}{\alpha}\right)$;	$N\ \left(\frac{\sqrt{N}}{4}\right)$	R_s for N = 1,000	R_s for N = 5,000	R_s for N = 10,000
1 (0.5)	1.05 (0.05)	1,000 (7.9)	0.20	0.4	0.6
3 (0.75)		5,000 (17.7)	0.30	0.7	0.9
5 (0.83)		10,000 (25.0)	0.33	0.7	1.0
10 (0.91)			0.36	0.8	1.1
1	1.1 (0.09)		0.36	0.8	1.1
3			0.50	1.2	1.7
5			0.60	1.3	1.9
10			0.65	1.4	2.0
1	1.2 (0.16)		0.60	1.4	2.0
3			0.95	2.1	3.0
5			1.00	2.3	3.3
10			1.10	2.6	3.6
1	1.3 (0.23)		0.90	2.0	2.9
3			1.40	3.0	4.3
5			1.50	3.4	4.8
10			1.60	3.7	5.2
1	1.5 (0.33)		1.30	2.9	4.1
3			1.90	4.4	6.2
5			2.20	4.8	6.8
10			2.40	5.3	7.5

Care and use of particulate silica columns

Column hardware

Particulate silica columns are available as LiChroCART® cartridges or as Hibar® HPLC columns.

LiChroCART® cartridges are used with re-usable endfittings (manu-CART®) which fit different cartridge length and different inner diameter. For use of LiChroCART® 4-4 guard columns no additional holder is necessary; guard columns are directly integrated in the manu-CART® system.

Hibar® columns are fitted with endfittings and ready for capillary connection onto the HPLC system. For use with guard columns different precolumn holders are available.

The pressure limit for LiChroCART® cartridges is 250 bar, for Hibar® columns 400 bar.

Equilibrating the column

Take your time when equilibrating you column; this will save you time in troubleshooting.

Reversed phase columns are shipped in Acetonitrile / Water. Verify that your mobile phase is miscible with the shipping eluent. As it can dry out during stocking and shipping, thoroughly activate the packing by purging 10-20 column volumes of pure organic eluent before equilibrating the column with the mobile phase.

Polar columns (Si, NH_2, CN, Diol) are shipped with n-Heptane/Dioxane (99/1). If they are used with aqueous eluents, flush the column with Ethanol or 2-Propanol before you equilibrate with the mobile phase.

To equilibrate the column, gradually increase the flow rate in small steps from 0 mL/min to your conditions. Flush the column with your mobile phase until you get a stable baseline. Low concentrated mobile phases additives (ion pair reagents) may need longer equilibration time.

Mobile phases

Silica based particulate HPLC columns are compatible with all organic solvents in the below mentioned pH range. For best results highest quality solvents such as HPLC grade solvents (LiChrosolv®) should be used. All prepared buffers should be filtered through a 0.45 µm filter before using in the HPLC system. Always keep in mind that your column will collect any particulate material that enters the flow stream. The use of non-pure solvents causes adsorption of impurities on the column head. These impurities block adsorption sites, change the selectivity of a column and lead to peak splitting in the chromatogram. In gradient elution, they cause so-called ghost peaks that always appear at the same position in the chromatogram.

pH stability

In general silica based HPLC columns (like LiChrospher®, Superspher® and LiChrosorb®)are stable within a pH range of 2 to 7.5. Stationary phases based on ultra pure silica like Purospher® HPLC columns are pH stable up to pH 8 (Purospher® RP-18) or 10.5. Purospher® STAR RP-18 endcapped and RP-8 endcapped are stable in a pH range of 1.5 to 10.5. Alumina based HPLC columns like Aluspher® RP-select B provide a pH stability up to pH 12.

When measuring pH of mobile phases, the measurement should be done in the aqueous media before mixing the eluent with organic solvents. This will give more accurate and consistent value of pH than in a mixed mobile phase.

Storing the column

For short term storage (overnight), columns (RP) can be stored in the eluent. For middle term or long term storage the columns should be stored in an organic solvent. The water content should be less than 50%. The best solvent for storing silica columns is Acetonitrile. If your mobile phase contains buffer salt, flush the column with water before storing in organic eluent. Buffer salts are not soluble in Acetonitrile and can block capillary tubing and the column.

Column regeneration

To perform a solvent regeneration, the column should be transferred from the analytical HPLC system to a simple, inexpensive pump. Alternatively disconnect the detector from the column. The volume for complete regeneration is usually 20 column volumes.

Regeneration procedure for particulate silica columns

	Phase type	Solvent	Comments
Polar Phases	LiChrosorb® Si, Diol, CN, NH_2 LiChrospher® Si, Diol, CN, NH_2 Purospher STAR Si, NH_2	1. Heptane 2. Chloroform 3. Ethanol or 2-Propanol 4. Chloroform 5. Heptane 6. Mobile phase	Sequence with dry solvents
Non-Polar Phases	LiChrosorb® RP-8, RP-18, (Diol, CN, NH_2)* LiChrospher® RP-8, RP-18, (Diol, CN, NH_2)* Purospher STAR RP-8 end-capped ; RP-18 endcapped, (NH_2)*	1. Water 2. Acetonitrile 3. 2-Propanol + 0.1% formic acid 4. Heptane 5. 2-Propanol + 0.1% formic acid 6. Acetonitrile 7. Mobile phase	* If used in RP-mode

Empty column volumes

Column	Volume	Washing volume (10 column volume)
125-2	0.4	4 mL
250-2	0.8	8 mL
125-3	0.9	9 mL
250-3	1.8	18 mL
100-4.6	1.7 mL	17 mL
125-4	1.6 mL	16 mL
150-4.6	2.5 mL	25 mL
250-4	3.2 mL	32 mL
250-4.6	4 mL	40 mL

Guidelines to care and use

Care and use of Chromolith columns

Every Chromolith® column has been extensively tested and inspected to ensure highest quality. Please examine the column for possible damage caused in transit. If damage has occurred, immediately notify both your local Merck representative and the delivery carrier.

Column Hardware

Chromolith® columns are cladded with a mechanically stable and chemically robust PEEK-polymer. The end fittings are made of the same material. Do not remove the end fittings from the column.

Installation of the column

Connect your Chromolith® column with the flow arrow on the label pointing toward the detector. All connections must be made with Merck compatible fittings in order to avoid loss of efficiency due to increased dead volume.

The endfitting of Chromolith® columns can be connected with standard 1/16" fittings to all common HPLC systems. We strongly recommend you to use adjustable plastic ferrules in order to avoid possible damage to the plastic end-fitting of the Chromolith® column. Please note that the use of steel ferrules is not recommended because they can damage the column endfitting.

Before connecting the column outlet to the detector, flush the column with mobile phase.

Equilibrating the column

Chromolith® columns RP-8 endcapped and RP-18 endcapped are shipped in acetonitrile/water (60/40, v/v). Verify that your mobile phase is miscible with the shipping solvent before equilibrating your column for use.

As the column can dry out during stocking and shipping, thoroughly activate the column by equilibrating as follows:

Flush your RP-column for 5 minutes with 100% acetonitrile (flow rate: 3 ml/min). Continue conditioning the column with your mobile phase until you get a stable baseline.

Chromolith® Si columns are shipped with n-heptane.

Validating the Column Performance

Before running analyses, validate its performance of the column by measuring the efficiency on your own system using the test conditions and test sample similar to that shown on the certificate. Repeat this procedure periodically to check the column over time. (Please note that it is not unusual for the results measured to differ from those on the certificate of analysis; this is caused by differences in injection volume, dead-volume of connectors and capillary tubing, detector cell volume, detector response time, data system settings etc.)

Mobile Phase

Chromolith® columns can be used with all commonly used HPLC grade organic solvents, with the following restrictions. The mobile phase should NOT contain more than 50% Tetrahydrofurane (THF), 5 % Dichloromethane (DCM) or 5% Dimethylsulfoxide (DMSO). However pure DMSO can be used as solvent for samples.

Buffers, organic modifiers and ion pair reagents present no problems as long as the appropriate pH range is not exceeded. Ion pair reagents are often difficult to completely flush from the column. Therefore columns used with these reagents should be dedicated to the particular analysis involved.

Guidelines to care and use

pH-range

Do not exceed the pH range from 2.0 to 7.5 with Chromolith® columns. Higher pHs will dissolve the silica, creating voids in the column. Lower pHs can eventually strip away some of the bonded phase. These defects will cause changes in retention times and loss of resolution.

Do not use strong acids (e.g. hydrochloric, nitric, and sulfuric acids) in the column. Limit your use of strong bases (e.g. sodium, potassium, ammonium hydroxide) to amounts needed to adjust the pH of the mobile phase.

Verify that solvents are miscible when changing mobile phases and that no buffer precipitation will occur.

For best performance with RP-8 endcapped and RP-18 endcapped columns, we recommend the use of acetonitrile/water mobile phases.

Column Lifetime

Column lifetime is highly dependent on the sample and conditions, and cannot be generalised.

For samples with large quantities of contaminants, clean up your sample prior to analysis. Make sure that your sample and the mobile phase are clean and particle-free. We recommend the use of Chromolith® guard columns.

Always degas and filter mobile phases.

Reverse the flow periodically to prevent particles and non-eluting sample components from accumulating on the column. When reversing the flow, flush the column before connecting it to the detector.

Pressure

The maximum operating pressure for Chromolith® columns with 4.6 mm i.d. is 200 bar (3000 psi).

Temperature

The maximum operating temperature Chromolith® columns is 45°C. As with particulate columns, it is recommended that the mobile phase is thermostatted to the same temperature as the column by connecting a capillary with 0.2 mm I.D. and 1.6 mm O.D. in line before the column and placed inside the column oven.

Detector response time

Most HPLC detectors have a variable response time or time constant. In setting this parameter the "reaction speed" of the detector can be controlled by an electronic damping device. If the response time is too slow, peaks may appear broad and tailing. Chromolith® columns typically produce fast narrow peaks, particularly when run at flow rates faster than 1ml/min. Fast peaks on Chromolith® columns require a fast time constant, such as 0.1 second.

Please note - by reducing the time constant from 2 to 0.1 sec the plate count for Chromolith® columns may improve up to 100%!

Date system settings

Fast chromatographic peaks can be just a few seconds wide. For good integration of the peak area and good optical presentation of the chromatogram, the data system settings must enable approximately 20 data samples to be acquired during the peak width time. We recommend checking the data acquisition rate of the data system.

Storing the column

When storing the column for several days or longer, store RP-8 endcapped and RP-18 endcapped columns in 100% acetonitrile. If the mobile phase contained a buffer salt, flush the column with 10 column volumes of water before changing over to 100% acetonitrile. Confirm that the column end plugs are firmly in place. Chromolith® Si columns should be stored in organic solvents such as n-heptane.

Regeneration procedure for Chromolith® columns

	Phase type	Solvent	Comments
Polar Phases	Chromolith® Si	1. Heptane 2. Chloroform 3. Ethanol or 2-Propanol 4. Chloroform 5. Heptane 6. Mobile phase	Sequence with dry solvents
Non-Polar Phases	Chromolith® RP-8 endcapped; RP-18 endcapped	1. Water 2. Acetonitrile 3. 2-Propanol + 0.1% formic acid 4. Heptane 5. 2-Propanol + 0.1% formic acid 6. Acetonitrile 7. Mobile phase	

LC Troubleshooting

Problem	Possible cause	Solution
High pressure	Precolumn blocked	Change precolumn
	Column head blocked	Change filter of column head; flush column; change column
	Capillary blocked	Change capillary
No peaks; changing peakhight	No flow; leak	Check pump; check frit; check mobile phase composition; fix leak
	Sample injection is not reproducible	Check sample injection system
Noise or drift problems	Column is not in equilibrium	Flush column
	Impurities elute slowly from the column	Flush column with strong eluent
	Enrichment of impurities	Flush column; improve sample cleanup; use HPLC-grade solvents
	Differences in temperature (column or detector)	Use column thermostat
	Air bubbles	Degas mobile phase; use back-pressure regulator
	Detector lamp	Replace UV lamp (expected life time: 1000 h)
	Electrical interference	Use voltage stabilizer; check for local interference sources
Ghost peaks	Peaks from previous injection	Use longer run-time; flush column with strong solvent after each run; improve sample cleanup; use gradient elution
	Unknown sample compounds	Improve sample cleanup
	Column contamination	Flush column with strong solvent after each run; improve sample cleanup
	Solvent impurities	Use HPLC-grade solvents
	Mixing problems of mobile phase	Dissolve sample in mobile phase
	Oxidation of TFA (peptide mapping)	Prepare fresh daily; use antioxidant
Peaks with shoulders; Fronting	Precolumn defective or soiled	Change precolumn
	Cavity at column head (dead-volume) or channels in column packing	Change column
	Sample dissolved in wrong solvent	Dissolve sample in mobile phase or (if not possible) inject very small sample volume (1 µl)
	Interfering compounds; Impurities	Improve sample cleanup; check column with test mixture; use HPLC-grade solvents
	Column overload	Dilute sample
	Extra column effects	Check capillary connections

LC Troubleshooting

Problem	Possible cause	Solution
Peaks are broad	Precolumn or column defective or soiled	Change precolumn or column
	Column overload; injection volume too large	Reduce sample volume; dilute sample
	Sample dissolved in wrong solvent	Dissolve sample in mobile phase
	Too weak buffer	Use higher concentration or different buffer
	Extra column effects	Check capillary connections
	Leak between column and detector; large detector cell	Fix leak; use smaller cell
	Too low column temperature; high mobile phase viscosity	Increase column temperature
	Too long capillary connections	Use shorter capillaries with smaller i.D.; check for dead-volume
	Poor column efficiency	Use column with smaller particles
Peak tailing	Column overload	Decrease sample size; increase column diameter; use higher capacity stationary phase
	Interfering peaks; Impurities	Improve sample cleanup; adjust mobile phase; check column with test mixture; use HPLC-grade solvents
	Silanol interactions	Use modifier (triethylamine); increase buffer or salt concentration (ion-pair-chromatography); lower mobile phase pH; use base deactivated column
	Blocked column frit	Replace frit; add in-line filter; filter samples
	Extra column effects; dead-volume	Check capillary connections
	Column void or channeling	Replace column; use less aggressive conditions
Peak doubling or splitting	Sample volume too large; column overload	Reduce sample volume; dilute sample; inject sample prepared in mobile phase
	Sample dissolved in wrong solvent	Dissolve sample in mobile phase or (if not possible) inject very small sample volume (1 µl)
	Column void or channeling	Replace column; use less aggressive conditions
	Blocked column frit	Replace frit; add in-line filter; filter samples
	Unswept injector flowpath	Replace injector rotor
Increasing retention times	Flow rate is decreasing	Fix leaks; replace pump seals; remove bubbles; check for cavitation
	Active sites on silica packing	Use mobile phase modifier; add triethylamine; use base-deactivated column
	Loss of bonded stationary phase	Keep mobile phase pH between 2 and 7.5
	Mobile phase composition changing	Check pump; check frit; avoid evaporation or degradation of mobile phase
	Temperature decreasing	Use column thermostat

LC Troubleshooting

Problem	Possible cause	Solution
Decreasing retention times	Flow rate is increasing	Check pump; check flow
	Column overload	Decrease sample size;
	Loss of bonded stationary phase	Keep mobile phase pH between 2 and 7.5
	Mobile phase composition changing	Check pump; check frit; avoid evaporation or degradation of mobile phase
	Temperature increasing	Use column thermostat
	Column ageing	Replace column; use guard column
Retention times changing	Flow rate varying	Fix leaks; replace pump seals; remove bubbles; check for cavitation
	Insufficient column equilibration	Equilibrate with at least 10 column volume of mobile phase
	Insufficient buffer capacity	Use buffer concentration >20 mM and <50 mM
	Mobile phase composition changing; poor mixing	Check pump; check frit; avoid evaporation or degradation of mobile phase
	Column temperature varying	Use column thermostat
	Contamination build up	Flush column
	Change in column activation	Condition column with initial injection of concentrated sample; adjust mobile phase
Differences in selectivity	Differences in mobile phase composition	Check pump; check frit; avoid evaporation or degradation of mobile
	Too weak solvent	Use buffer or ion-pair system
	Sample dissolved in wrong solvent	Dissolve sample in mobile phase or (if not possible) inject very small sample volume (1 µl)
	Decreasing column life; contamination	Replace column; improve sample cleanup; check column with test mixture; use HPLC-grade solvents
	Temperature varying	Use column thermostat
	Column to column reproducibility	Replace column; check with manufacturer

Preparative Liquid Chromatography Sorbents and Columns

Preparative column chromatography is a separation and purification method that plays an important role in purifying value compounds in research, pilot plant operation and production.

This method can be used not only to purify substances to a high extent, but to do this in a rapid and economical way.

In practice, standardised sorbents are required. These provide a high degree of method reliability, direct transfer from analytical scale and optimised throughput per time.

Only silica gels with a defined pore structure fulfill the requirements of chromatography.

Smaller sized irregular and spherical silica gels are often packed into packing stands to achieve a high performance preparative chromatography.

Innovative new products like PharmPrep® HP can be used to increase purification productivity on production scale.

Preparative Liquid Chromatography Sorbents and Columns

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Aluminium oxide for preparative chromatography

M. S. Tswett used aluminium oxide as a sorbent when he discovered chromatography in the year 1903. One year after his invention, Merck started to offer aluminium oxide for adsorption chromatography.

The aluminium oxide crystal structure comprises octahedrally and tetrahedrally coordinated aluminium coupled by oxygen atoms. The aluminium oxide surface is covered by free hydroxyl groups. There are different acidic and basic centres (Broenstedt acid, Lewis acid and Lewis basic centres) that result in anion and cation exchange properties.

Aluminium oxide exhibits a higher pH-stability than silica gel, especially in the alkaline range. Aluminium oxide occurs in various crystal modifcations. For chromatography, γ-alumina with a pore diameter of 90 Å is most frequently used. Further types are ε-alumina with a pore diameter of 60 Å and α-alumina with a pore diameter of 150 Å, each of which possesses specific adsorption properties.

Standardised aluminium oxide 90, for adsorption analysis according to Brockmann, is a sorbent of medium polarity. It is frequently used when the cation exchange properties of basic alumina are required. Furthermore, aluminium oxide may be used as an alternative to activated carbon, when the organic character of activated carbon can be problematic.

Typical technical data of aluminium oxide packing materials

Packing material	Characteristics	Spec. surface area S_{BET} (m^2/g)	Pore volume V_P (ml/g)	Particle size d_P (µm)	pH	Activity
Aluminium oxide 60	irregular particles of alumina mean pore size: 6 nm (60Å)	~160	0.3	63-200	4,7,9	I
Aluminium oxide 90	irregular particles of alumina mean pore size: 9 nm (90Å)	90-120	0.3	63-200	4,7,9	I, II-III
Aluminium oxide 150	irregular particles of alumina mean pore size: 15 nm (150Å)	60-90	0.3	63-200	4,7,9	I-II

Chromatographic results strongly depend on the water content of the sorbent. Water adsorbed on the sorbent surface reduces the actitivity, i.e. the adsorption strength of the adsorption sites. In the 1940`s Brockmann and Schodder developed a method to determine a sorbent`s activity by using various different dyes (Chem. Ber., 74B, 73 (1941). They correlated sorbent activity to the retention factor (Rf) of these dyes. The table below shows the typical amounts of water that need to be added to a sorbent of acitivity I to reach the required Brockmann activity number.

% Water Added	Activity Grade (Brockmann)	Retention Factor (Rf) of Dye
0	I	0.15
3	II	0.22
6	III	0.33
10	IV	0.44
15	V	0.65

Aluminium oxide for preparative chromatography

Ordering information of aluminium oxide packing materials

Product	Ordering No.	Activity	pH*	Contents
Aluminium oxide 60, active, basic	1.01067.1000	I	9	1 kg
Aluminium oxide 60, active, basic	1.01067.2000	I	9	2 kg
Aluminium oxide 90, active, basic	1.01076.1000	I	9	1 kg
Aluminium oxide 90, active, basic	1.01076.2000	I	9	2 kg
Aluminium oxide 90, active, basic	1.01076.9020	I	9	20 kg
Aluminium oxide 90, active, neutral	1.01077.1000	I	7	1 kg
Aluminium oxide 90, active, neutral	1.01077.2000	I	7	2 kg
Aluminium oxide 90, active, neutral	1.01077.9020	I	7	20 kg
Aluminium oxide 90, active, acidic	1.01078.1000	I	4	1 kg
Aluminium oxide 90, active, acidic	1.01078.2000	I	4	2 kg
Aluminium oxide 90, active, acidic	1.01078.9020	I	4	20 kg
Aluminium oxide 90, standardised according to Brockmann	1.01097.1000	II-III	9	1 kg
Aluminium oxide 90, standardised according to Brockmann	1.01097.5000	II-III	9	5 kg
Aluminium oxide 90, standardised according to Brockmann	1.01097.9050	II-III	9	50 kg
Aluminium oxide 150, basic	1.01061.1000	I-II	9	1 kg
Aluminium oxide 150, basic	1.01061.2000	I-II	9	2 kg
Aluminium oxide 150, basic	1.01061.9025	I-II	9	25 kg

**pH of 10 % aqueous suspension*

Standardised silica gels

Standardised silica gels from Merck are produced using a traditional method in the world's largest and most modern production plant.

Standardised silica gels are widely used in separation processes to purify high value compounds in ton quantities.

Standardised silica gels are available in many particle size ranges all derived from a single base silica gel, produced only for chromatography.

Standardised silica gels offer easy development of your process from thin layer chromatography to any scale.

Standardised silica gels are available in a wide variety of pack sizes from 500 g to 400 kg to suit your specific needs. Typically, bottles and drums out of pure HDPE are used that are approved for pharmaceutical and food applications.

Typical technical data of standardised silica gel packing materials

Packing material	Characteristics	Spec. surface area S_{BET} (m^2/g)	Pore volume V_P (ml/g)	pH*	Water content (%)
Silica gel 40	irregular particles of silica; mean pore size: 4 nm (40Å)	600	0.6	7.0	< 7
Silica gel 60	irregular particles of silica; mean pore size: 6 nm (60Å)	500	0.8	7.0	< 7
Silica gel 100	irregular particles of silica; mean pore size: 10 nm (100Å)	360	0.8	7.0	< 7

**pH of 10 % aqueous suspension*

Standardised silica gels

Ordering information of silica gel packing materials

Product	Ordering No.	Particle size	Contents
Silica gel 40	1.10180.1000	63 - 200 µm (70 - 230 mesh ASTM)	1 kg
Silica gel 40	1.10180.5000	63 - 200 µm (70 - 230 mesh ASTM)	5 kg
Silica gel 40	1.10180.9025	63 - 200 µm (70 - 230 mesh ASTM)	25 kg
Silica gel 40	1.10181.1000	200 - 500 µm (35 - 70 mesh ASTM)	1 kg
Silica gel 40	1.10181.9025	200 - 500 µm (35 - 70 mesh ASTM)	25 kg
Silica gel 60	1.15111.1000	15 - 40 µm	1 kg
Silica gel 60	1.15111.2500	15 - 40 µm	2.5 kg
Silica gel 60	1.15111.9025	15 - 40 µm	25 kg
Silica gel 60	1.09389.5000	35 - 70 µm (200 - 400 mesh ASTM)	5 kg
Silica gel 60	1.09389.9025	35 - 70 µm (200 - 400 mesh ASTM)	25 kg
Silica gel 60	1.09385.1000	40 - 63 µm (230 - 400 mesh ASTM)	1 kg
Silica gel 60	1.09385.2500	40 - 63 µm (230 - 400 mesh ASTM)	2.5 kg
Silica gel 60	1.09385.5000	40 - 63 µm (230 - 400 mesh ASTM)	5 kg
Silica gel 60	1.09385.9025	40 - 63 µm (230 - 400 mesh ASTM)	25 kg
Silica gel 60	1.07729.1000	< 63 µm (> 230 mesh ASTM)	1 kg
Silica gel 60	1.07729.5000	< 63 µm (> 230 mesh ASTM)	5 kg
Silica gel 60	1.07729.9025	< 63 µm (> 230 mesh ASTM)	25 kg
Silica gel 60	1.15101.1000	63 - 100 µm (170 - 230 mesh ASTM)	1 kg
Silica gel 60	1.15101.9025	63 - 100 µm (170 - 230 mesh ASTM)	25 kg
Silica gel 60	1.07734.1000	63 - 200 µm (70 - 230 mesh ASTM)	1 kg
Silica gel 60	1.07734.2500	63 - 200 µm (70 - 230 mesh ASTM)	2.5 kg
Silica gel 60	1.07734.5000	63 - 200 µm (70 - 230 mesh ASTM)	5 kg
Silica gel 60	1.07734.9025	63 - 200 µm (70 - 230 mesh ASTM)	25 kg
Silica gel 60 extra pure	1.07754.0500	63 - 200 µm (70 - 230 mesh ASTM)	500 g
Silica gel 60 extra pure	1.07754.1000	63 - 200 µm (70 - 230 mesh ASTM)	1 kg
Silica gel 60	1.07733.0500	200 - 500 µm (35 - 70 mesh ASTM)	500 g
Silica gel 60	1.07733.1000	200 - 500 µm (35 - 70 mesh ASTM)	1 kg
Silica gel 60	1.07733.5000	200 - 500 µm (35 - 70 mesh ASTM)	5 kg
Silica gel 60	1.07733.9025	200 - 500 µm (35 - 70 mesh ASTM)	25 kg
Silica gel 100	1.10184.0500	63 - 200 µm (70 - 230 mesh ASTM)	500 g
Silica gel 100	1.10184.5000	63 - 200 µm (70 - 230 mesh ASTM)	5 kg
Silica gel 100	1.10184.9025	63 - 200 µm (70 - 230 mesh ASTM)	25 kg
Silica gel 100	1.10185.0500	200 - 500 µm (35 - 70 mesh ASTM	500 g
Silica gel 100	1.10185.9025	200 -500 µm (35 - 70 mesh ASTM)	25 kg
Silica gel 60 F_{254} adjusted to 40 % rel. humidity suitable for dry column chromatography	1.10757.1000	63 - 200 µm (70 - 230 mesh ASTM)	1 kg

LiChroprep®

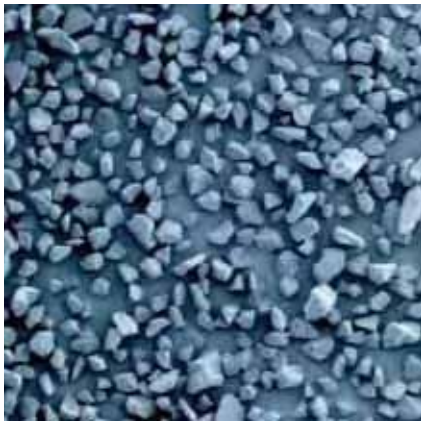
LiChroprep® is a proven, highly successful packing material providing fast, effective and reproducible separations. LiChroprep® is one of the most successful and reliable sorbents used in HPLC and medium pressure chromatography. It has a well documented history in the technical literature with several hundred applications described.

LiChroprep® is an irregular shaped silica gel packing material characterised by:

- A reproducible homogeneous silica gel matrix
- A narrow, well defined particle size distribution for high performance and high permeability
- Excellent selectivity and efficiency
- A large number of applications
- Large batch size
- Comprehensive regulatory documents are available

The totally porous irregular particles are tightly classified in the 15-25 µm, 25-40 µm and 40-63 µm ranges.

LiChroprep® is available in ready-to-use Hibar® RT 250-25 mm columns as well as in different bulk pack sizes. We also offer packing stand columns with 25, 50 and 100 mm inner diameter prepacked with LiChroprep® materials.



Typcial technical data of LiChroprep® packing materials

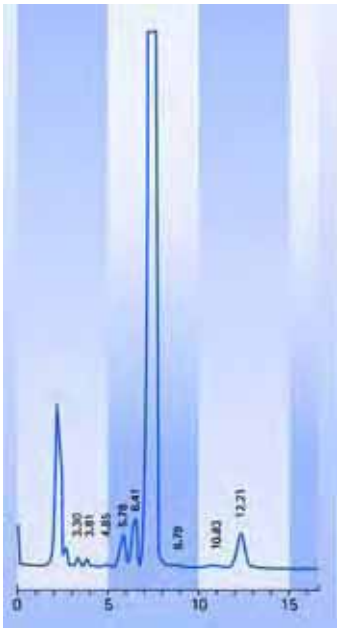
Packing material	Characteristics	Spec. surface area S_{BET}(m^2/g)	Pore volume V_P (ml/g)	Particle size d_P (µm)	%C	Surface coverage (µmol/m^2)
LiChroprep® Si 60	irregular particles of silica; mean pore size: 6 nm (60Å)	500	0.8	5-20 15-25 25-40 40-63		
LiChroprep® NH_2	irregular particles of silica with aminopropyl function	300	1.0	15-25 25-40 40-63	3.5	3.0
LiChroprep® DIOL	irregular particles of silica with vicinal hydroxyl function on C-chains; for special normal phase chromatography	300	1.0	15-25 25-40 40-63	7	3.9
LiChroprep® RP-18	irregular particles of silica with octadecyl derivative	300	1.0	15-25 25-40 40-63	16	3.0
LiChroprep® RP-select B	irregular particles of silica with octyl derivative, especially suitable for the RP-separation of basic compounds	500	0.8	15-40 25-40	11	4.2
LiChroprep® RP-8	irregular particles of silica with octyl derivative	500	1.0	15-25 25-40 40-63	13	3.4
LiChroprep® RP-2	irregular particles of silica with ethyl derivative	500	0.8	25-40	5	3.1
LiChroprep® CN	Irregular particles of silica with cyanopropyl function on C-chains; for normal and reverse phase chromatography	300	1.0	15-25 25-40 40-63	6	3.8
LiChroprep® Si 100	irregular particles of silica; mean pore size: 10 nm (100Å)	300	1.0	15-25 25-40 40-63		

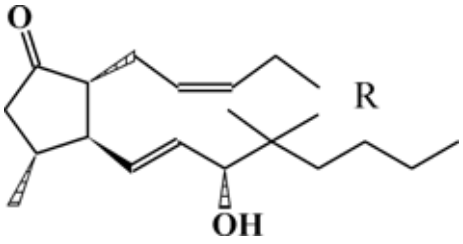
Ordering information of LiChroprep® packing materials

Product	Ordering No.	Particle size	Quantity
LiChroprep® Si 60	1.09319.0100	5-20 µm	100 g
LiChroprep® Si 60	1.09319.1000	5-20 µm	1 kg
LiChroprep® Si 60	1.09319.5000	5-20 µm	5 kg
LiChroprep® Si 60	1.09336.1000	15-25 µm	1 kg
LiChroprep® Si 60	1.09336.9025	15-25 µm	25 kg
LiChroprep® Si 60	1.09390.1000	25-40 µm	1 kg
LiChroprep® Si 60	1.13905.0250	40-63 µm	250 g
LiChroprep® Si 60	1.13905.1000	40-63 µm	1 kg
LiChroprep® Si 60	1.13905.9025	40-63 µm	25 kg
LiChroprep® Si 100	1.09295.0100	15-25 µm	100 g
LiChroprep® Si 100	1.09295.1000	15-25 µm	1 kg
LiChroprep® Si 100	1.13904.1000	25-40 µm	1 kg
LiChroprep® Si 100	1.09346.1000	40-63 µm	1 kg
LiChroprep® RP-18	1.13902.0100	5-20 µm	100 g
LiChroprep® RP-18	1.13901.0500	15-25 µm	500 g
LiChroprep® RP-18	1.13901.9010	15-25 µm	10 kg
LiChroprep® RP-18	1.09303.0100	25-40 µm	100 g
LiChroprep® RP-18	1.09303.0500	25-40 µm	500 g
LiChroprep® RP-18	1.09303.5000	25-40 µm	5 kg
LiChroprep® RP-18	1.09303.9025	25-40 µm	25 kg
LiChroprep® RP-18	1.13900.0250	40-63 µm	250 g
LiChroprep® RP-18	1.13900.1000	40-63 µm	1 kg
LiChroprep® RP-18	1.13900.9025	40-63 µm	25 kg
LiChroprep® DIOL	1.10978.0100	15-25 µm	100 g
LiChroprep® DIOL	1.13906.0100	25-40 µm	100 g
LiChroprep® DIOL	1.13973.0250	40-63 µm	250 g
LiChroprep® NH_2	1.09374.0100	15-25 µm	100 g
LiChroprep® NH_2	1.13925.0100	25-40 µm	100 g
LiChroprep® NH_2	1.13974.0250	40-63 µm	250 g
LiChroprep® NH_2	1.13974.1000	40-63 µm	1 kg
LiChroprep® CN	1.09375.0100	15-25 µm	100 g
LiChroprep® CN	1.13975.0100	25-40 µm	100 g
LiChroprep® CN	1.13959.0250	40-63 µm	250 g
LiChroprep® RP-select B	1.09367.0100	15-25 µm	100 g
LiChroprep® RP-select B	1.09302.0100	25-40 µm	100 g
LiChroprep® RP-select B	1.09302.1000	25-40 µm	1 kg
LiChroprep® RP-8	1.13903.0500	15-25 µm	500 g
LiChroprep® RP-8	1.09324.0100	25-40 µm	100 g
LiChroprep® RP-8	1.09324.0500	25-40 µm	500 g
LiChroprep® RP-8	1.09362.0250	40-63 µm	250 g
LiChroprep® RP-8	1.09362.1000	40-63 µm	1 kg
LiChroprep® RP-2	1.09304.0100	25-40 µm	100 g

Upscale of an analytical HPLC method to a preparative separating system

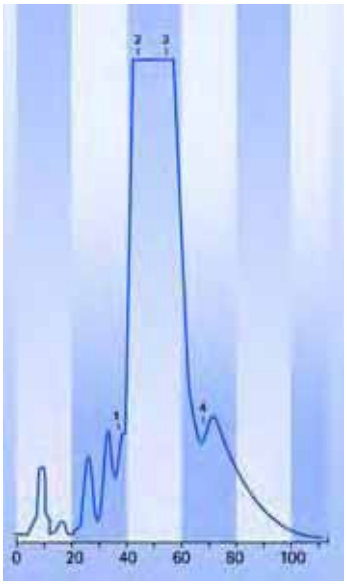
analytical





LiChrosorb® Si 60	LiChroprep® Si 60
10 µm	25-40 µm
250-4 mm	600-200 mm
n-Heptan/IPA/MeOH/THF	n-Heptan/IPA/MeOH/THF
96/2.4/1.0/0.6 (V/V)	96/2.4/1.0/0.6 (V/V)
1.5 ml/min	2.0 l/min
UV 204 nm	200 g Feed in 5 l Eluent

preparative

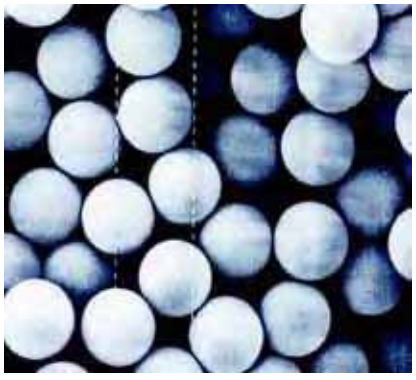


LiChrospher®

LiChrospher® for preparative high performance liquid chromatography is a spherical silica gel that is traditionally produced by using water glass as raw material.

LiChrospher® is available in two different particle sizes (12 and 15 µm) and with different chemistries to ensure a rapid and simple optimisation of the chromatographic system.

LiChrospher® is available in ready-to-use Hibar® RT columns of various lengths as well as in different bulk pack sizes. We also offer packing stand columns with 25, 50 and 100 mm inner diameter prepacked with LiChrospher®.



Typical technical data of LiChrospher® packing materials

Packing material	Characteristics	Spec. surface area S_{BET} (m^2/g)	Pore volume V_P (ml/g)	Particle size d_P (µm)	%C	Surface coverage (µmol/m^2)
LiChrospher® Si 60	spherical particles of silica; mean pore size: 6 nm (60Å)	700	0.9	12, 15		
LiChrospher® 100 RP-18	spherical particles of silica with octadecyl derivative	350	1.2	12	21.0	3.6
LiChrospher® 100 RP-18e	Endcapped spherical particles of silica with octadecyl derivative	350	1.2	12	21.0	3.6
LiChrospher® 60 RP-select B	spherical particles of silica with octyl derivative, especially suitable for the RP-separation of basic compounds	700	0.9	12, 15	11.5	3.6
LiChrospher® WP300 RP-18	Wide pore spherical particles, suitable for the separation of peptides and low molecular weight proteins (up to 20 kDa)	80	0.8	12	5.5	3.2
LiChrospher® 100 RP-8	spherical particles of silica with octyl derivative	350	1.2	12	11.5	3.6
LiChrospher® 100 NH_2	spherical particles of silica with aminopropyl derivative	350	1.2	12	3.5	3.0
LiChrospher® 100 CN	spherical particles of silica with cyanopropyl derivative; for normal and reverse phase chromatography	350	1.2	12	6.5	3.5
LiChrospher® 100 Diol	spherical particles of silica; mean pore size: 10 nm (100 Å); for special normal phase chromatography	350	1.2	12	8.0	3.8

→ Purospher® STAR RP-18 endcapped Just the best choice 83
→ Purospher® STAR RP-8 endcapped 93
→ Purospher® STAR Silica and Amino-phase 96
→ LiChrosorb® A successful packing material from the start 130
→ Superspher® For highly efficient HPLC of complex mixtures where high peak capacity required 104
→ LiChrospher® Spherical silica carrier for constant results on high level 107

Ordering information of LiChrospher®

Product	Ordering No.	Particle size	Quantity
LiChrospher® Si 60	1.19654.0100	12 µm	100 g
LiChrospher® Si 60	1.19654.1000	12 µm	1 kg
LiChrospher® Si 60	1.11024.0100	15 µm	100 g
LiChrospher® Si 60	1.11024.1000	15 µm	1 kg
LiChrospher® Si 60	1.11024.9025	15 µm	25 kg
LiChrospher® 100 RP-18	1.19656.0100	12 µm	100 g
LiChrospher® 100 RP-18	1.19656.0500	12 µm	500 g
LiChrospher® 100 RP-18e	1.19676.0100	12 µm	100 g
LiChrospher® 100 DIOL	1.19675.0100	12 µm	100 g
LiChrospher® 100 NH_2	1.19674.0100	12 µm	100 g
LiChrospher® 100 CN	1.19667.0100	12 µm	100 g
LiChrospher® 60 RP-select B	1.19655.0100	12 µm	100 g
LiChrospher® 60 RP-select B	1.19655.0500	12 µm	500 g
LiChrospher® 60 RP-select B	1.11023.0100	15 µm	100 g
LiChrospher® 60 RP-select B	1.11023.0500	15 µm	500 g
LiChrospher® WP 300 RP-18	1.19662.0100	12 µm	100 g
LiChrospher® WP 300 RP-18	1.19662.0500	12 µm	500 g
LiChrospher® WP 300 RP-18	1.19659.0100	15 µm	100 g
LiChrospher® WP 300 RP-18	1.19659.0500	15 µm	500 g
LiChrospher® 100 RP-8	1.19677.0100	12 µm	100 g

PharmPrep®

PharmPrep® is a new line of spherical silica sorbents, which have been designed for use in process liquid chromatography in the pharmaceutical industry.

The product line comprises two product groups: PharmPrep® CC and PharmPrep® HP.

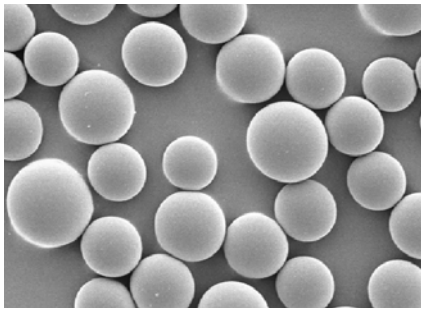
PharmPrep® CC, the first product of this family, is a traditionally produced silica and opens the possibility of using a spherical sorbent for performing process chromatography at any scale and at reasonable cost.

PharmPrep® CC exhibits as a spherical material low backpressures, allowing for fast elutions. It can easily be packed into columns with a high bulk density, which results in good loadabilities.

PharmPrep® CC is available in various bulk pack sizes from 100 g for testing up to 25 kg for processes.

PharmPrep® HP is Merck`s latest innovation. It is an ultrapure high performance spherical silica gel. Its uniqueness is a combination of:

- the ultrapure silica source
- the reproducible homogeneous silica gel matrix
- the narrow and well defined particle size distribution ensuring high packing stability and permeability
- the enhanced mechanical stability
- the high manufacturing quality and reproducibility

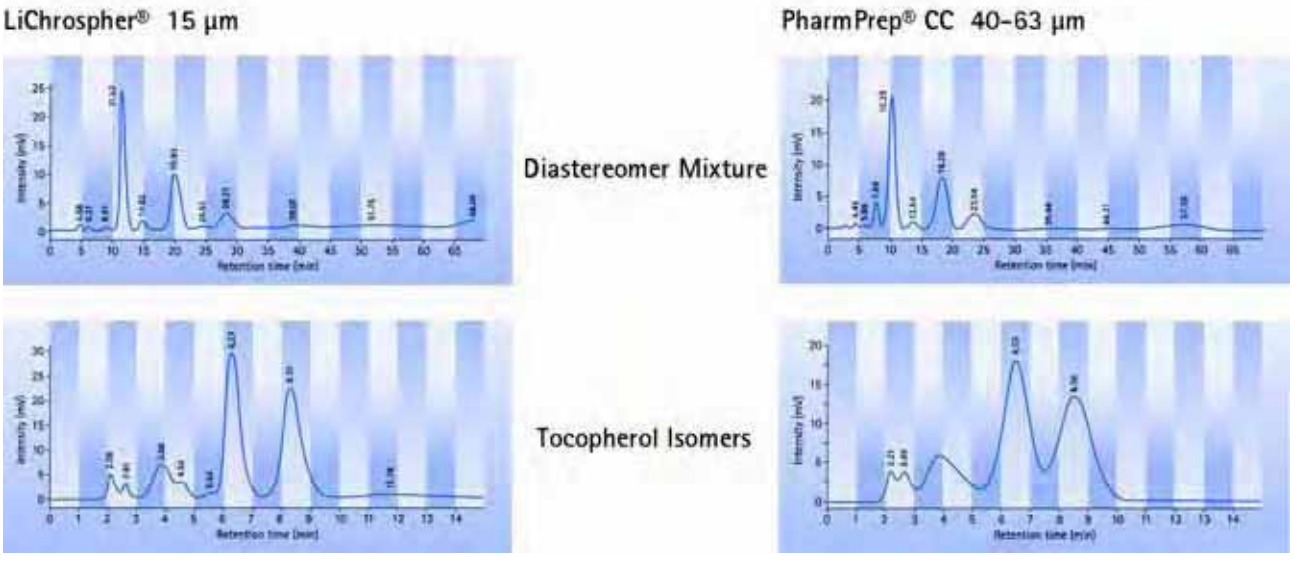


Typical technical data of PharmPrep® CC and PharmPrep® HP

Packing material	Characteristics	Spec. surface area S_{BET} (m^2/g)	Pore volume V_P (ml/g)	Particle size d_P (µm)	pH
PharmPrep® CC	spherical particles of silica; mean pore size: 6 nm (60Å)	500	0.8	25-40 40-63 63-200	7
PharmPrep® HP Si 100	spherical particles of ultrapure silica, mean pore size 10 nm (100 A)	330	0.9	10	7
PharmPrep® HP RP-18	spherical particles of ultapure silica with octadecyl derivative	330	0.9	10	7

Ordering information of PharmPrep® CC and PharmPrep® HP packing materials

Product	Ordering No.	Particle size	Contents
PharmPrep® CC	1.09371.0100	25-40 µm	100 g
PharmPrep® CC	1.09371.1000	25-40 µm	1 kg
PharmPrep® CC	1.09371.5000	25-40 µm	5 kg
PharmPrep® CC	1.09371.9025	25-40 µm	25 kg
PharmPrep® CC	1.09372.0100	40-63 µm	100 g
PharmPrep® CC	1.09372.1000	40-63 µm	1 kg
PharmPrep® CC	1.09372.5000	40-63 µm	5 kg
PharmPrep® CC	1.09372.9025	40-63 µm	25 kg
PharmPrep® CC	1.09373.0100	63-200 µm	100 g
PharmPrep® CC	1.09373.1000	63-200 µm	1 kg
PharmPrep® CC	1.09373.5000	63-200 µm	5 kg
PharmPrep® CC	1.09373.9025	63-200 µm	25 kg
PharmPrep® HP Si100	1.09321.0010	10 µm	10 g
PharmPrep® HP Si100	1.09321.0100	10 µm	100 g
PharmPrep® HP Si100	1.09321.1000	10 µm	1 kg
PharmPrep® HP Si100	1.09321.5000	10 µm	5 kg
PharmPrep® HP RP-18	1.09403.0010	10 µm	10 g
PharmPrep® HP RP-18	1.09403.0100	10 µm	100 g
PharmPrep® HP RP-18	1.09403.1000	10 µm	1 kg
PharmPrep® HP RP-18	1.09403.5000	10 µm	5 kg



Reverse phase silica gel for industrial processes

Silanised Silica 60 and Silica gel 60 RP-18 are alternative materials for the economic purification of products, where conventional RP-phases are too expensive.

Both derivatised silica gels show high loading capacities due to the high specific surface area of the basic silica 60.

Typical technical data of Silica gel 60 modified packing materials

Packing material	Characteristics	Spec. surface area S_{BET} (m^2/g)	Pore volume V_P (ml/g)	Particle size d_P (µm)
Silica 60 silanised	irregular particles of silica; mean pore size: 6 nm (60 Å)	500	0.8	63-200
Silica 60 RP-18	irregular particles of silica; mean pore size: 6 nm (60 Å)	500	0.8	40-63

Ordering information of Silica 60 modified packing materials

Product	Ordering No.	Particle size	Quantity
Silica gel 60 silanised (dimethylsilane derivate)	1.07719.0250	63-200 µm (70-230 mesh ASTM)	250 g
Silica gel 60 silanised (dimethylsilane derivate)	1.07719.1000	63-200 µm (70-230 mesh ASTM)	1 kg
Silica gel 60 RP-18	1.10167.1000	40-63 µm (230-400 mesh ASTM)	1 kg
Silica gel 60 RP-18	1.10167.5000	40-63 µm (230-400 mesh ASTM)	5 kg
Silica gel 60 RP-18	1.10167.9025	40-63 µm (230-400 mesh ASTM)	25 kg

Cellulose packing materials

Micro-crystalline cellulose is a hydrophilic polysaccharide packing material preferred for the raw separation of amino acids and related compounds. Cellulose is also used for the gentle purification of bio-molecules.

Because of the organic nature of cellulose, it can only be used in pre-swollen state and under gentle or hydrostatic pressure.

Ordering information of cellulose packing materials

Product	Ordering No.	Particle size	Quantity
Cellulose micro-crystalline Avicel®	1.02331.0500	20-160 µm	500 g
Cellulose micro-crystalline Avicel®	1.02331.2500	20-160 µm	2.5 kg
Cellulose micro-crystalline Avicel®	1.02331.9025	20-160 µm	25 kg

Florisil packing materials

Florisil® is a polar highly selective magnesium silicate of the approximate composition MgO/SiO_2 (15/85) which is particularly suitable for the separation of steroids, alkaloids, antibiotics etc. This stationary phase is also used for the sample preparation of environmental samples such as pesticide residue analysis, chlorinated hydrocarbons and pesticides.

For sample preparation in the case of pesticides, a specially purified and activated Florisil® is often used (cat. no. 1.12994). The normal activation temperature for Florisil® is 650 °C, whilst activation at 260 °C produces a less active material.

Typical technical data of Florisil® packing materials

Composition	MgO 15.5 % / SiO_2 84.0 % / Na_2SO_4 0.5%
pH	8.5
S_{BET}	300 m^2/g
Specific weight	2.5 g/ml
Porosity	56 %
Surface acidity (PK.)	1.5

Ordering information of Florisil®

Product	Ordering No.	Particle size	Quantity
Florisil®	1.12518.0100	150-250 µm (60 - 100 mesh ASTM)	100 g
Florisil®	1.12518.1000	150-250 µm (60 - 100 mesh ASTM)	1 kg
Florisil® for residual analysis	1.12994.0100	150-250 µm (60 - 100 mesh ASTM)	100 g
Florisil® for residual analysis	1.12994.1000	150-250 µm (60 - 100 mesh ASTM)	1 kg

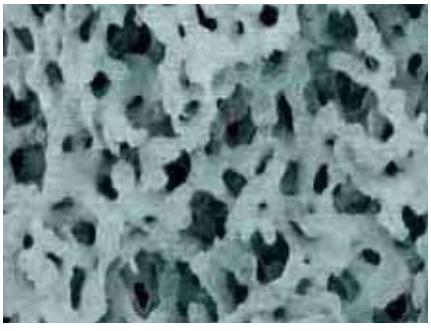
Chromolith® prep

Chromolith® – increase in speed, efficiency and productivity

Chromolith® prep monolithic stationary phases are new ultra-pure silica phases. Their special properties are due to a bimodal pore structure. This structure is based on the new "sol-gel" technology and consists of macropores and mesopores.

The combination of macro- and mesopores ensures high efficiency as well as high speed.

Fig. 1: Ready-to-use Chromolith® prep column



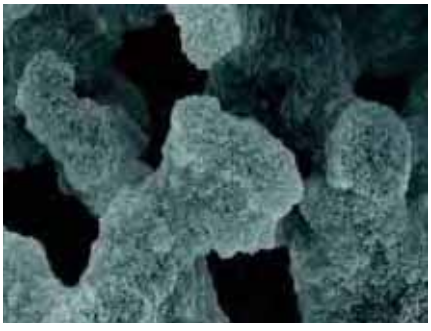


Fig. 2: Mesopores and macropores of Chromolith® prep Si

The mesopores with an average diameter of 12 nm form the fine porous structure of the column interior and create a very large surface area on which adsorption of the target compounds occurs.

The large macropores with a pore diameter of 3 µm form a dense network of pores and allow a high flow rate due to a low resistance factor. The resulting excellent accessibility of the mesopores (total porosity > 80 %) ensures fast adsorption and desorption kinetics due to short diffusion length inside the pores. This results in dramatically reduced separation times providing an essential increase in productivity.

Typical technical data of Chromolith® prep Si and RP-18e

Macropores [µm] Mesopores [nm]	3 12
Specific pore volume [ml/g]	1
Specific surface area [m^2/g]	350
Packing density [g/ml]	0.2
Total porosity	0.8
Surface pH	neutral
Dimension	100-25 mm
Maximum operating pressure	100 bar (1450 psi)

→ Chromolith® Si 62
→ Chromolith® RP-18 endcapped 55

The monolith is cladded with a polymeric material (PEEK) and can be connected directly to each HPLC system and used as "ready to use" column.

Ordering information of Chromolith® prep
Chromolith® prep Si 100–25 and RP–18e 100–25

Product	Ordering No.	Dimension	Content
Chromolith® prep Si 100-25	1.25251.0001	100-25 mm	1 piece + 2 connectors 1/8"- 1/16"
Chromolith® prep RP-18e 100-25	1.25252.0001	100-25 mm	1 piece + 2 connectors 1/8" - 1/16"
Chromolith® prep guard cartridge Si 10-25	1.25260.0001	10-25 mm	1 piece
Chromolith® prep guard cartridge RP-18e 10-25	1.25261.0001	10-25 mm	1 piece

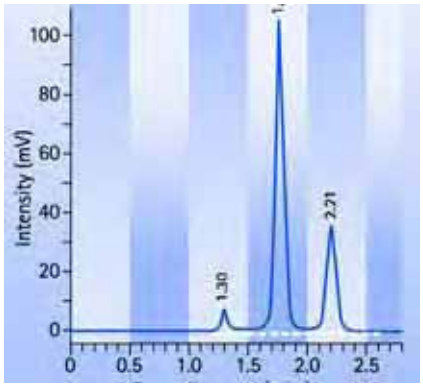
Chromolith® prep accessories

Product	Ordering No.	Diameter	Content
Chromolith® prep sealing set	1.25254.0001	25 mm	2 O-rings
Chromolith® prep tool set	1.25255.0001	25 mm	1 mounting tool filter 1 mounting tool 1 hook wrench
Chromolith® prep end cap set	1.25256.0001	25 mm	1 inlet cap complete 1 outlet cap
Chromolith® prep frit set	1.25257.0001	25 mm	10 frits
Chromolith® prep guard cartridge holder for diameter 25 mm	1.25258.0001	25 mm	1 piece
Chromolith® prep column coupler for diameter 25 mm	1.25259.0001	25 mm	1 piece

Various applications with Chromolith® prep monolithic columns (100–25 mm): Comparison of flow rates

Sample	Toluene, Dimethylphthalate and Dibutyl-phthalate
Column	Chromolith® prep (100-25 mm)
Solvent	n-Heptane / Dioxane (80/20 v/v)

Flow rate 40 ml/min



Flow rate 390 ml/min

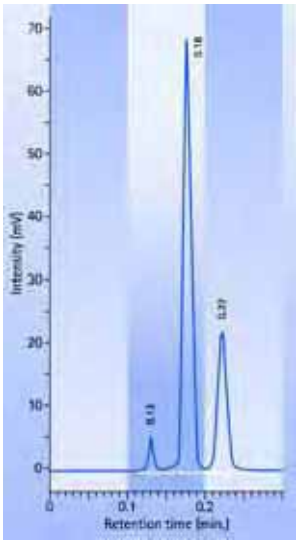
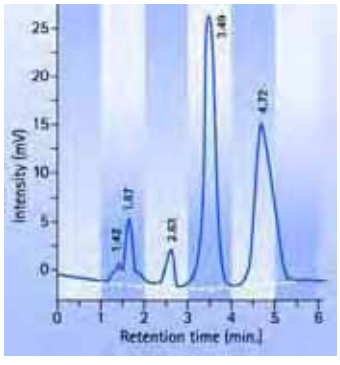


Fig. 3: separation at different flow rates 40 and 390 ml/min.

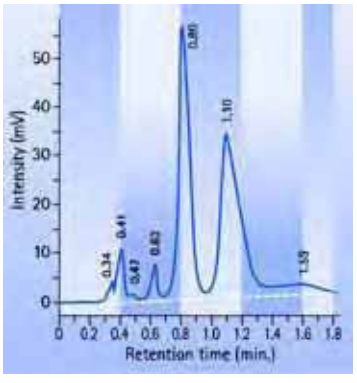
Chromolith® prep columns can be operated with a flow rate of up to 400 ml/min and pressures of up to 100 bar. This is a tenfold increase of flow rate compared to equivalent size particulate packed columns.

Separation of χ- and δ-Tocopherol from sunflower oil at different flow rates

Flow rate 40 ml/min.



Flow rate 160 ml/min



Column	Chromolith® prep Si (100-25mm)
Flow rate	140 ml/min
Injection	249 mg
Cycle Time	25 sec.
Sample	Fluoro-dihydro-oxyranyl-benzopyran

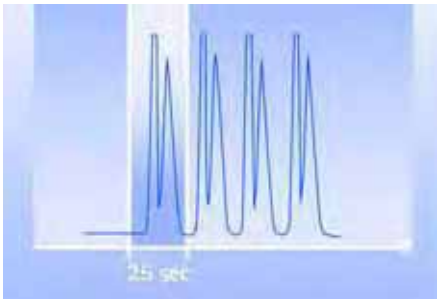


Fig. 4: separation of diastereomers with a productivity of 861g/d

CUSTOMER BENEFITS:

- No pressure drop at higher flow rate.
- The higher porosity assures fast adsorption and desorption kinetics.
- In comparison to particulate sorbents, monolithic column ensure shorter separation times which lead to less solvent consumption and shorter separation.
- Higher productivity and greater efficiency compared to particulate sorbents.

Preparative RP-Chromatography with Monolithic Columns

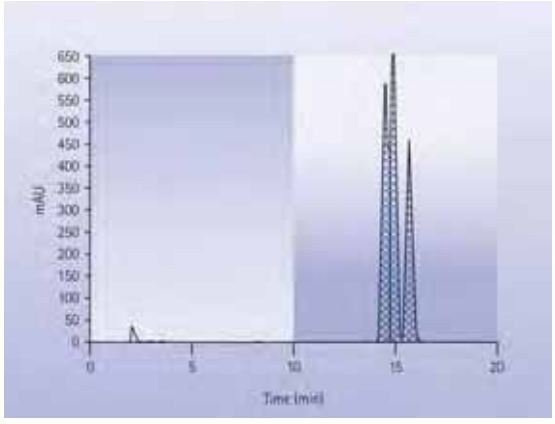
The selectivity of a Chromolith® prep RP-18 endcapped column is comparable to common RP-18 endcapped reversed phase columns. It provides you with an excellent tool to solve your separation problems regarding nonpolar basic and acidic compounds as well as peptides.

In most cases your existing methods from using particulate columns can easily be transferred to Chromolith® prep. However for some applications it is worth optimising the method to make use of the full potential of this enhanced technology.

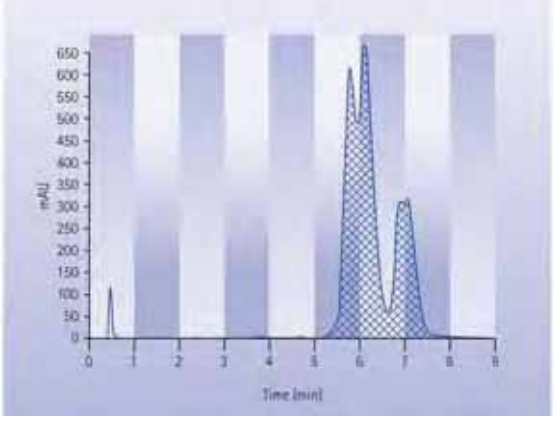
Chromolith® prep RP-18 endcapped 100-25 opens the door to high speed separation in preparative Chromatography

Comparison of Chromolith® prep RP-18 endcapped 100-25 with particulate material
Separation of Oxime-derivates

Column	Packing stand NW 50 (250-50) filled with Purospher® RP-18 endcapped, 10 µm
Sample	125 mg Oxime-derivates in 500 µl Acetonitrile
Flow rate	100 ml/min
Detection	UV 210 nm
Eluent A	Water + 0.05 % Trifluoric acid
Eluent B	Acetonitrile + 0.05 % Trifluoric acid
Gradient	linear in 30 min up to 100 % B



Column	Chromolith® prep RP-18 endcapped (100-25 mm)
Sample	125 mg Oxime-derivates in 500 µl Acetonitrile
Flow rate	100 ml/min
Detection	UV 210 nm
Eluent A	Water + 0.05 % Trifluoric acid
Eluent B	Acetonitrile + 0.05 % Trifluoric acid
Gradient	linear in 11 min up to 100 % B



The comparison of Chromolith® prep RP-18 endcapped with a particulate Purospher® RP-18 endcapped-column (250-50 mm) shows that both separations have a similar resolution under the same chromatographic conditions, however Chromolith® prep RP-18 endcapped has a better selectivity than Purospher® RP -18 endcapped as exhibited by the resolution of the additional isomer peak at 7 minutes.

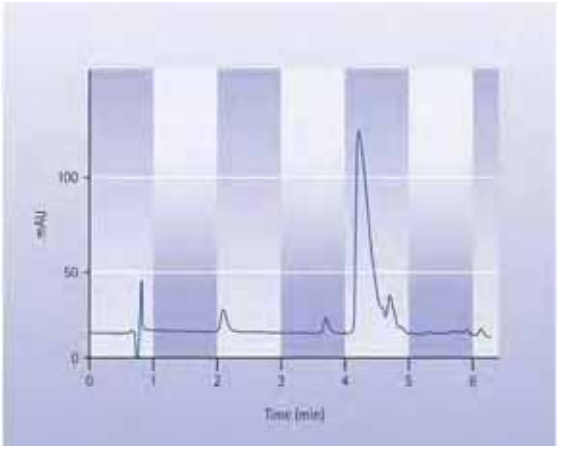
Chromolith® prep

Chromolith® – increase in speed, efficiency and productivity

Separation of Hirudin (filtrate of crude extract)

Without any sample preparation the crude sample was injected directly onto the Chromolith® prep RP-18 endcapped. The separation took only 5 minutes. It was possible to isolate the desired product from the impurities.

Column	Chromolith® prep RP-18 endcapped (100-25 mm)		
Sample	23 mg Hirudin (filtrate of crude extract) in 5 ml solution injected		
Flow rate	60 ml/min		
Detection	UV 254 nm		
Eluent A	Water + 0.1 % Formic acid		
Eluent B	Acetonitrile 100 %		
Gradient	Time (min.)	% A	% B
	0 10 10.1	90 70 90	10 30 10

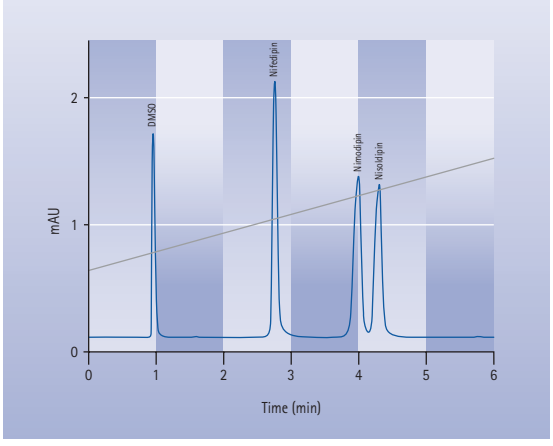


With monolithic silica rod technology it is possible to speed up your separation significantly!

Chromolith® prep RP-18 endcapped shows a significant reduction of back pressure

Separation of Dihydropyridines (Nifedipin, Nimodipin and Nisoldipin)

Column	Chromolith® prep RP-18 endcapped (100-25 mm)		
Sample	90 mg mixture of Nifedipin, Nimodipin and Nisoldipin		
Flow rate	100 ml/min		
Detection	UV 224 nm		
Eluent A	Water		
Eluent B	Acetonitrile		
Gradient	Time (min.)	% A	% B
	0 8 8.1	80 20 80	20 80 20



Lobar® – ready-to-use glass columns for medium – pressure chromatography

Ready-to-use glass columns with a broad range of frequently used stationary phases are available for convenient medium-pressure (up to 6 bar) preparative chromatography.

Lobar® columns are available in various dimensions for the purification of compounds up to gram size. Reliable LiChroprep® materials with a particle size 40 - 63 µm are used as stationary phases. Due to their packing technique Lobar® glass columns provide high reproducibility and nice performance. They are, of course, biocompatible as only materials such as Teflon®, ceramic frits and glass are used so that even the most sensitive samples can be purified.

Due to their simple, reliable and reproducible application, Lobar® glass columns have become highly accepted throughout the world, a fact that is reflected in numerous publications. A literature reference list containing several hundred references is available for those who are interested in the preparative purification of products using Lobar® glass columns and LiChroprep® stationary phases.

Please contact processing@merck.de for a copy of the reference list.

Benefits of Lobar® glass columns

- all wetted parts are biocompatible
- Lobar® columns are available in various dimensions
- Lobar® columns provide high reproducibility and performance

Typical technical data of Lobar® glass columns

Column type	Column length	Internal diameter	Sample amount		Contents of stationary phase
	(mm)	(mm)	(g)	(mL)	(g)
A	240	10	< 0.2	< 1	~ 20
B	310	25	< 1	< 5	~ 70
C	440	37	< 3	< 10	~ 220

Ordering information

Ready-to-use Lobar® glass columns

Sorbent	Ordering No.	Column type	Length	Internal diameter	Content
LiChroprep® Si 60	1.10400.0001	A	240 mm	10 mm	1 Piece
LiChroprep® Si 60	1.10401.0001	B	310 mm	25 mm	1 Piece
LiChroprep® Si 60	1.10402.0001	C	440 mm	37 mm	1 Piece
LiChroprep® RP-18	1.10624.0001	A	240 mm	10 mm	1 Piece
LiChroprep® RP-18	1.10625.0001	B	310 mm	25 mm	1 Piece
LiChroprep® RP-18	1.10626.0001	C	440 mm	37 mm	1 Piece

→ LiChroprep® 186

Lobar® – ready-to-use glass columns for medium – pressure chromatography

Accessories for Lobar® glass ready-to-use columns

Product	Ordering No.	Content
Lobar® glass columns basic equipment	1.10407.0001	5 m PTFE capillary tube (o.d. 1.5 mm, i.d. 1 mm) 1 glass capillary 3-way valve and Teflon stopcock (4) 1 glass syringe with Luer® connection (2 ml) 4 stainless steel cannulas (o.d. 1.5 mm) 3 stainless steel connecting capillaries (o.d. 1.5 mm, i.d. 1 mm) 1 pack emery paper (for holding the tubing) 1 awl (for PTFE tubes)
Lobar® assembly kit	1.15395.0001	2 adaptors for tube connection (o.d. 1/16")(PTFE body with PP nut) for direct connection to the Lobar® column 5 m PTFE tubing (o.d. 1/16", i.d. 0.8 mm) 1 dead-volume free coupling unit with 2 nuts (PP) 4 PTFE gripper with stainless steel retainer 1 PTFE connector for tubing connection (o.d. 1/16" or 1/8") complete with 6 fluoron seals and 2 PP nuts) 2 PTFE cones for PTFE connector 6 spare O-rings
Lobar® connectors (dead-volume free)	1.15455.0001	5 connectors with 10 nuts for tubing connector (o.d. 1/16") (PP)
Lobar® PTFE clamping rings with metal jackets	1.15396.0001	10 PTFE gripper with stainless steel retainer for tubing connector (o.d. 1/16")
Lobar® male nuts	1.15393.0001	10 nuts for tubing connection (o.d. 1/16") (PP)
Lobar® special tool for removing ceramic frits	1.16799.0001	2 tools 4 ceramic frits
Lobar® ceramic frit	1.16800.0001	10 ceramic frits

Hibar® pre-packed columns

After a separation has been optimized with an analytical column, the method parameters can be easily transferred by using a pre-packed Hibar® column with an internal diameter of 25 mm or 50 mm. This size is convenient for separations of mg up to grams range of final product.

Hibar® pre-packed columns are "ready-to-use" and can easily be connected to any HPLC system, using standard 1/16" capillary male connectors at both ends.

An extensive range of LiChrospher® or LiChroprep® sorbents are available. The sorbents produced by Merck are subjected to the most stringent controls; many different parameters are tested for each sorbent. These have proven their performance over many years.

Hibar® column 250 – 25 mm

Ordering information of Hibar® pre-packed columns, 25 mm internal diameter

Product	Ordering No.	Particle size	Dimension	Content
LiChrospher® 100 RP-8	1.51482.0001	5 µm	250-25 mm	1 column, 2 connectors 1/8" - 1/16"
LiChrospher® 100 RP-18	1.51483.0001	5 µm	250-25 mm	1 column, 2 connectors 1/8" - 1/16"
LiChrospher® 60 RP-select B	1.51484.0001	5 µm	250-25 mm	1 column, 2 connectors 1/8" - 1/16"
LiChrospher® Si 100	1.51485.0001	5 µm	250-25 mm	1 column, 2 connectors 1/8" - 1/16"
Purospher® STAR RP-18 endcapped	1.51110.0001	5 µm	125-25 mm	1 column, 2 connectors 1/8" - 1/16"
Purospher® STAR RP-18 endcapped	1.51489.0001	10 µm	250-25 mm	1 column, 2 connectors 1/8" - 1/16"
LiChrospher® 100 RP-18 endcapped	1.51478.0001	5 µm	250-25 mm	1 column, 2 connectors 1/8" - 1/16"

→ Purospher® STAR RP-18 endcapped Just the best choice 83
→ Purospher® STAR RP-8 endcapped 93
→ Purospher® STAR Silica and Amino-phase 96
→ LiChrosorb® A successful packing material from the start 130
→ Superspher® For highly efficient HPLC of complex mixtures where high peak capacity required 104
→ LiChrospher® Spherical silica carrier for constant results on high level 107

Hibar® customized pre-packed columns 25 and 50 mm internal diameter

If you require the versatility to quickly change columns but you prefer to purchase "ready to use" columns with specific sorbents, customized packing columns provide the perfect solution.

- Sorbents for universal and specific applications are available
- LiChrospher® and LiChroprep® packing materials for standard and specific applications are available
- Batch-to-batch reproducibility is our constant goal
- Columns are available with 25 and 50 mm internal diameter and in different lengths
- Short delivery times

Hibar® column 250-50 mm

Benefits of customised packing:

Quality:	Hibar®-customised packed columns are manufactured to strictly controlled conditions to ensure both excellent packing quality and reproducibility of a separation.
Economic:	The fully controlled gel bed compression at 50 mm internal diameter column leads to longer life time of the columns and improves the process economy. In addition with the hydraulics stand, it can be upgraded to Packing stand NW50.
Simple:	Columns are ready-to-use and can be easily connected with any HPLC system.
Problem free:	Methods developed on a particular sorbent at analytical scale can be directly scaled-up to preparative scale.

Ordering information of Hibar® customised pre-packed columns

Sorbent	Ordering No.	Dimension	Content
Customised packing for RP-materials	1.50099.0001	250-50 mm	1 column, connection set
Customised packing for Si, CN, Diol, NH_2 materials	1.50092.0001	250-50 mm	1 column, connection set
Customised packing	1.50004.0001	250-25 mm	1 column, 2 connectors 1/8" - 1/16"
Customised packing	1.50016.0001	125-25 mm	1 column, 2 connectors 1/8" - 1/16"
Customised packing	1.50018.0001	75-25 mm	1 column, 2 connectors 1/8" - 1/16"
Customised packing	1.50323.0001	30-25 mm	1 column, 2 connectors 1/8" - 1/16"

→ Hibar® pre-packed columns 205

Column Packing stands NW25, NW50 and NW100

Innovative column packing technology

Conventional packing methods for preparative columns use rapid filtration under pressure and at high linear flow rates. This technology often leads to bridging effects between the particles in the stationary phase with negative impact on the column performance. Our studies have shown that this undesirable side effect can be overcome by pulling instead of pushing.

The column packing technology is based on a combination of vacuum suction with subsequent column bed compression for stabilisation of the packing. A common water-jet pump is used to generate the vacuum. The gel slurry is sucked through a packing reservoir into the column tube by applying low pressure at the bottom end of the column.

This method allows exact adjustment of the desired packing volume or gel bed height. In the production environment the new technology facilitates the determination of the column geometry and thereby supports an easy and direct scale up from analytical to preparative scale.

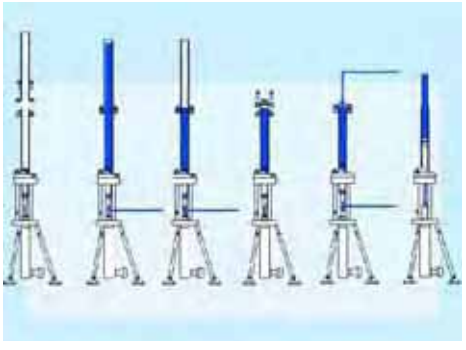
The column packing devices are available for columns of 25 mm, 50 mm and 100 mm internal diameter, covering the full range from semi-preparative to pilot-scale and production scale.

Packing stands NW25, NW50 and NW100
with water jacket (optional available)

Packing and unpacking the packing stands

According to the physical parameters of the stationary phase and the column size, the required volume of the gel slurry is prepared. Using a funnel, the suspended material is filled into the packing tube attached to the column. The vacuum is applied. After the suspension has been sucked into the column tube, the packing tube is removed and the upper column lid (flange) is sealed. Then the column bed is washed with 3 - 5 column volumes of a suitable solvent and simultaneously compressed in several steps a certain bed compression depending on the sorbent type (see operating instructions). In this way, a rapid sedimentation and homogeneous packing of the column is achieved. The column is ready for operation.

To unpack the column, the upper flange lid is removed and the material is pushed out by moving the piston upward with the hydraulic pump. The column is ready for the next filling procedure. The stationary phase may be kept for later use or disposed.



Packing of
a column

→ Hibar® customized pre-packed columns 25 and 50 mm internal diameter 206

Column Packing stands NW25, NW50 and NW100

Innovative column packing technology

Customer benefits at a glance:

- The vacuum packing technology permits a simple and flexible handling of preparative columns.
- The separation columns can be prepared rapidly on-site.
- The fully controlled gel bed compression leads to a longer lifetime of the columns and improved process economy.
- Even soft gels such as polymer-based gels can be packed with the packing devices.
- One single hydraulic packing stand can be used to pack an unlimited number of columns with the same internal diameter.
- Choose between an economic upper screw cap and the convenient chain closing system for the 50 and 100 mm packing stands.
- **Customised column lengths can be provided on request.**
- Columns with water jackets provide optimum separation stability and performance (optional available).

With the novel Merck packing stands NW25, NW50 and NW100 reproducible packing of preparative columns is no longer a secret.

Ordering information of packing stands NW25, NW50 and NW100

Packing stand NW25

Product	Ordering No.	Length	Internal Diameter	Bed length min – max	Content
Packing stand NW25 (260-25 mm)	1.25940.0001	260 mm	25 mm	220-223 mm	1 packing stand incl. hydraulic unit

Columns and accessories for packing stand NW25

Product	Ordering No.	Length	Internal Diameter	Bed length min – max	Content
Column 260-25 mm	1.25941.0001	260 mm	25 mm	185-220 mm	1 unit
Column 165-25 mm	1.25942.0001	165 mm	25 mm	88-125 mm	1 unit
Column tube 260-25 with water jacket	1.25950.0001	260 mm	25 mm	185-220 mm	1 unit
Hydraulic stand 25 mm	1.25946.0001				1 unit
Fritholder 25 mm	1.25010.0001				1 unit
Groove ring 25 mm	1.25013.0001				2 pieces
Sealing set column head 25 mm	1.25014.0001				1 frit 1 sealing ring
PEEK connection set for 25 and 50 mm	1.25914.0001				1 m PEEK capillary 1 1/8" nut 1 1/8" ferrule
Tripod for columns 25 and 50 mm	1.25961.0001				1 unit
Fitting set for 25 and 50 mm	1.25005.0001				1 unit

Column Packing stands NW25, NW50 and NW100

Innovative column packing technology

Packing stand NW50

Product	Ordering No.	Length	Internal Diameter	Bed length min – max	Content
Packing stand NW50 (250-50 mm)	1.25911.0001	250 mm	50 mm	185-220 mm	packing stand incl. hydraulic unit
Packing stand NW50 (250-50) with rapid chain clamp	1.25931.0001	250 mm	50 mm	185-220 mm	packing stand incl. hydraulic unit

Columns and accessories for packing stand NW50

Product	Ordering No.	Length	Internal Diameter	Bed length min – max	Content
Column 155-50 mm	1.25943.0001	155 mm	50 mm	117-125 mm	1 unit
Column 250-50 mm	1.25912.0001	250 mm	50 mm	185-220 mm	1 unit
Column 250-50 with rapid chain clamp	1.25932.0001	250 mm	50 mm	185-220 mm	1 unit
Column 250-50 with water jacket	1.25948.0001	250 mm	50 mm	185-220 mm	1 unit
Column 250-50 with water jacket and rapid chain clamp	1.25949.0001	250 mm	50 mm	185-220 mm	1 unit
Hydraulic stand 50 mm	1.25945.0001				1 unit
Hydraulic stand 50 mm for rapid chain clamp	1.25947.0001				1 unit
Fitting set for 25 and 50 mm	1.25005.0001				5 male nut 1/8" 10 ferrule 1/8" 5 capillary connector
Fritholder 50 mm	1.25908.0001				1 unit
Groove ring 50 mm	1.25909.0001				2 pieces
Sealing set column head 50 mm	1.25913.0001				1 frit 1 sealing ring
PEEK connection set for 25 and 50 mm	1.25914.0001				1 m PEEK capillary 1 1/8" nut 1 1/8" ferrule
Tripod for columns 25 and 50 mm	1.25961.0001				1 unit

Column Packing stands NW25, NW50 and NW100

Innovative column packing technology

Packing stand NW100

Product	Ordering No.	Length	Internal Diameter	Bed length min – max	Content
Packing stand NW100 (400-100 mm)	1.25930.0001	400 mm	100 mm	295-348 mm	packing stand incl. hydraulic unit
Packing stand NW100 (400-100 mm) with rapid chain clamp	1.25936.0001	400 mm	100 mm	295-348 mm	packing stand incl. hydraulic unit

Columns and accessories for packing stand NW100

Product	Ordering No.	Length	Internal Diameter	Bed length min – max	Content
Column 400-100 mm	1.25951.0001	400 mm	100 mm	295-348 mm	1 unit incl. tripod
Column 400-100 mm with rapid chain clamp	1.25952.0001	400 mm	100 mm	295-348 mm	1 unit incl. tripod
Column 400-100 mm with water jacket	1.25953.0001	400 mm	100 mm	295-348 mm	1 unit incl. tripod
Column 400-100 mm with water jacket and rapid chain clamp	1.25954.0001	400 mm	100 mm	295-348 mm	1 unit incl. tripod
Column 300-100 mm	1.25955.0001	250 mm	100 mm	195-248 mm	1 unit incl. tripod
Column 300-100 mm with rapid chain clamp	1.25956.0001	250 mm	100 mm	195-248 mm	1 unit incl. tripod
Column 300-100 mm with water jacket	1.25957.0001	250 mm	100 mm	195-248 mm	1 unit incl. tripod
Hydraulic stand 100 mm	1.25958.0001				1 unit
Hydraulic stand 100 mm for rapid chain clamp	1.25959.0001				1 unit
Fritholder 100 mm	1.25934.0001				1 unit
Groove ring (Variseal) 100 mm	1.25935.0001				2 pieces
Sealing set column head 100 mm	1.25937.0001				1 frit 1 teflon ring 1 distribution plate
PTFE tube (1 m x 1/4") flexible with stainless steal jacket	1.25938.0001				1 tube 1 1/4" nut 1 1/4" ferrule
Sealing set fritholder 100 mm	1.25960.0001				2 O-rings 2 PTFE lip seals

Column Packing stands NW25, NW50 and NW100

Innovative column packing technology

Interactive CD ROM of packing stands NW25, NW50 and NW100

To make column packing even easier, Merck has produced an interactive CD in English for this purpose. It explains, step-by-step, how columns for preparative chromatography are packed. The CD offers training to newcomers and useful information to experienced users.

Every working step is precisely explained and illustrated on the CD Rom "Packing Stands".

Also you can find on the CD a detailed spare parts list and the related order numbers.

To receive the CD, please send an e-mail to processing@merck.de.

Thin Layer Chromatography

Fast separations of a broad range of substances

Thin Layer Chromatography is a simple, fast and highly versatile separation tool for both qualitative and quantitative analysis. The field of application covers virtually all classes of substances including pesticides, steroids, alkaloids, lipids, nucleotides, glycosides, carbohydrates, fatty acids and many others.

- Cheap separation method without the need for sophisticated instruments
- No cumbersome sample preparation step needed because plates are disposable
- Sample components are stored on the plate allowing to repeat the analysis several times
- Multiple samples (up to 72) can be run simultaneously under identical conditions
- Easy 2 dimensional separation by using two distinct mobile phases in different directions

Thin Layer Chromatography can be a manual method as in classical TLC, or automated as in instrumented high-performance thin layer chromatography (HPTLC). Furthermore, it can be easily extended to preparative scale for PLC.

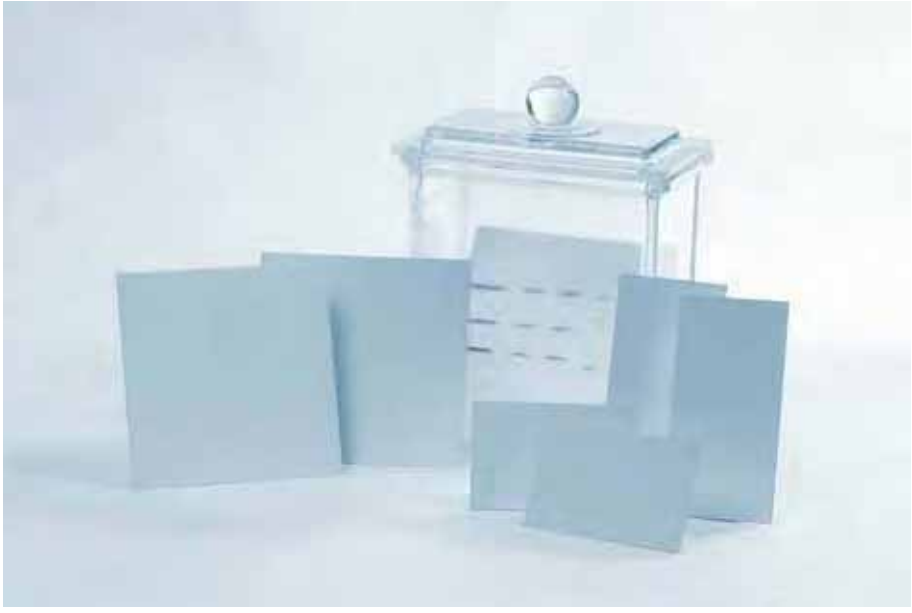
Unique quality from the pioneer in Thin Layer Chromatography

Merck always pioneered thin layer chromatography:
We introduced the first pre-coated plates and we regularly add innovative new products in order to meet the needs of todays demanding TLC or HPTLC applications.

Merck provides reliable TLC plates in a wide range of chemistries, sizes and backings to suite many application needs. Our thin layer plates combine robustness with highest surface homogeneity resulting in unsurpassed separation performance.

High Performance Thin Layer Chromatography (HPTLC) plates give even further increased sensitivity and standardization.

Merck quality is famous, proven by countless TLC applications in the literature.



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Classical silica TLC plates (TLC)

For versatile and reliable routine analysis of a broad range of substance

Silica gel is the most universal adsorbent used in TLC because it covers almost every type of separation by suitable choice of the mobile phase.

Merck classical silica TLC plates are based on proven Merck silica gel 60 with a pore diameter of 60 A, a pore volume of 0.8 ml/g and a specific surface of 520 m^2/g (BET). The unique polymeric binder results in a very adherent and hard surface that will not crack or blister and even allow writing with a pencil on the surface without risk to damage the layer. The smooth and dense plate surface guarantees sharp bands for maximum separation efficiency with lowest background noise u.g. when performing scanning densitometry.

Classical silica TLC plates have either a layer thickness of 250 µm (glass plates) or 200 µm (aluminium, plastic, plates) and a mean particle size of 10 -12 µm. They are available glass, aluminium or plastic backed in a broad range of different sizes to suite many application needs. The flexible backed aluminium or plastic plates can eas-ily be cut with scissors to match individual separation requirements.

The flexible backed aluminium or plastic plates can easily cut with scissors to individual sizes

For UV detection of colourless substances, plates with two kind of fluorescent indicators are available: green fluorescing F_{254} or blue fluorescing F_{254s}. In addition F_{254s} is highly stable in acidic solvent systems. Both indicators fluorescence in UV light at an excitation wavelength of 254 nm. Samples which absorb shortwave UV at 254 nm are detected due to fluorescence quenching.

The special developed *high-fluorescent* **LuxPlates®** contain a higher content of fluorescent indicator for further improved identification of separate zones. In addition the higher amount of binder results in a still more robust and abrasion-resistent surface.

Specifications of classical TLC plates

Mean particle size	10 - 12 µm
Particle size distribution	5 - 20 µm
Layer thickness	250 µm, glass 200 µm, aluminium, plastic
Typical plate height	30 µm
Typical migration distance	10 - 15 cm
Typical separation time	20 - 200 min
Number of samples per plate	10

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Classical silica TLC plates (TLC)

For versatile and reliable routine analysis of a broad range of substance

Ordering information

TLC silica gel 60, glass backed

Packing Material	Ordering No.	Format (cm)	Contents of one package
Silica gel 60	1.05729.0001	10 x 20	50 plates
	1.05721.0001	20 x 20	25 plates
	1.05626.0001	10 x 20	50 plates
	1.05724.0001	5 x 20	100 plates
	1.15326.0001	2.5 x 7.5	100 plates
Silica gel 60 F_{254}	1.05715.0001	20 x 20	25 plates
	1.05714.0001	5 x 20	100 plates
Silica gel 60 F_{254}	1.05808.0001	5 x 20	25 plates
	1.05719.0001	5 x 10	200 plates
	1.05789.0001	5 x 10	25 plates
	1.15327.0001	2.5 x 7.5	100 plates
	1.15341.0001	2.5 x 7.5	500 plates
Silica gel 60 WF_{254s}	1.16485.0001	20 x 20	25 plates
LuxPlate® silica gel 60 F_{254}	1.05805.0001	20 x 20	25 plates
	1.05804.0001	10 x 20	50 plates
	1.05802.0001	5 x 10	25 plates
	1.05801.0001	2.5 x 7.5	100 plates
Layer thickness: 250 µm			

TLC silica gel 60, aluminium backed

Packing Material	Ordering No.	Format (cm)	Contents of one package
Silica gel 60	1.05553.0001	20 x 20	25 plates
	1.16835.0001	5 x 10	50 plates
Silica gel 60 W	1.16487.0001	20 x 20	25 plates
Silica gel 60 F_{254}	1.05554.0001	20 x 20	25 plates
	1.05570.0001	10 x 20	25 plates
	1.16834.0001	5 x 10	50 plates
	1.05549.0001	5 x 7,5	20 plates
	1.05562.0001	500 x 20	1 roll
Silica gel 60 WF_{254s}	1.16484.0001	20 x 20	25 plates
Layer thickness: 200 µm			

Classical silica TLC plates (TLC)

For versatile and reliable routine analysis of a broad range of substance

TLC silica gel 60, plastic backed

Packing Material	Ordering No.	Format (cm)	Contents of one package
Silica gel 60	1.05748.0001	20 x 20	25 sheets
Silica gel 60 F_{254}	1.05735.0001	20 x 20	25 sheets
	1.05750.0001	4 x 8	50 sheets
	1.05749.0001	500 x 20	1 roll
Layer thickness: 200 µm			

TLC silica gel 40, glass backed

Packing Material	Ordering No.	Format (cm)	Contents of one package
Silica gel 40 F_{254}	1.05634.0001	20 x 20	25 plates
Layer thickness: 200 µm			

W: Water resistant

F_{254}: Green fluorescent indicator

F_{254s}: Blue fluorescent indicator

Applications of classical silica TLC

Unmodified silica gel covers more than 80% of thin layer chromatography applications for both adsorption- and partition thin layer chromatography. It allows separating a large range of different substances such as aflatoxins, alkaloids, anabolics, benzodiazepins, carbohydrates, fatty acids, glycosides, lipids, mycotoxins, nucleotides, peptides, pesticides, steroids, sulfonamids, surfactants, tetracyclines and many others making it suitable for:

- In-process control in drugs
- Purity checks of synthesis steps
- Identity testing of pharmaceutical compounds

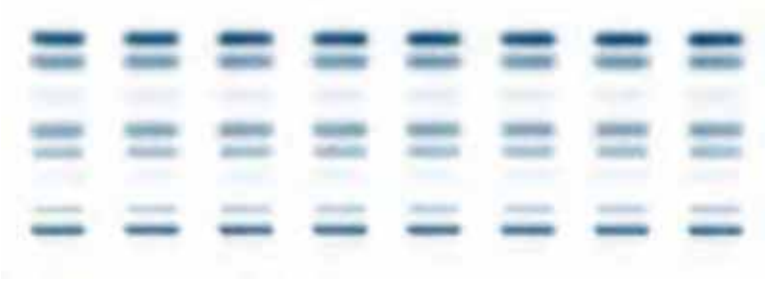


Fig. 1:
Merck TLC plates deliver highly reproducible sharp bands over the whole plate as demonstrated by the parallel separation of a lipophilic dye mixture on a silica gel 60 classical TLC plate

Classical silica TLC plates (TLC)

For versatile and reliable routine analysis of a broad range of substance

Compounds	1. Sulfadiazine 2. Sulfamerazine 3. Sulfisoxalozole 4. Sulfapyridine 5. Sulfanilamide (all 0.1 %)
Sample volume	0.75 µl
Mobile phase	Ethyl acetate / methanol / amonia solution 25 % (60/20/2 (v/v/v)
Detection	UV 254 nm (TLC/HPTLC Scanner 2/CAMAG)

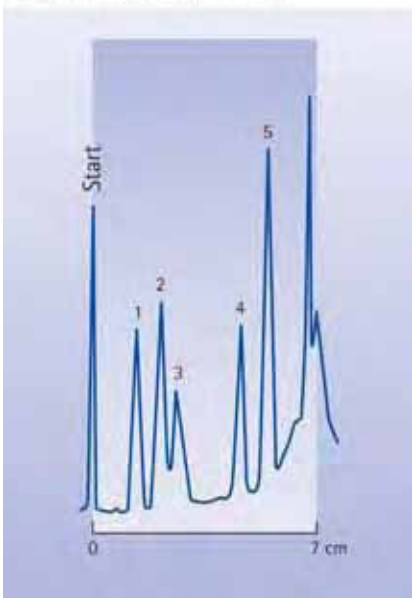


Fig. 2:
Analysis of a sulfonamide mixture on a TLC silica gel 60 reveals clear separation of five different isomers

Aluminium oxide TLC plates

For basic and neutral compounds using different pH conditions

Merck TLC aluminium oxide plates utilize neutral or basic aluminium oxide of 60 Å or 150 Å pore size with or without fluorescence indicator to suit different application needs. Aluminium oxide plates provide distinct separation features with regard to the pH range used: Under aqueous conditions basic compounds can be best separated on basic aluminium oxide plates, while neutral compounds are best separated on neutral plates.

Ordering information

TLC aluminium oxide 60

Packing Material	Ordering No.	Format (cm)	Layer thickness	Backing	Contents of one package
Aluminium oxide 60 F_{254} basic	1.05713.0001	20 x 20	250 µm	glass	25 plates
Aluminium oxide 60 F_{254} basic	1.05731.0001	5 x 20	250 µm	glass	100 plates
Aluminium oxide 60 F_{254} neutral	1.05550.0001	20 x 20	200 µm	aluminium	25 plates
Aluminium oxide 60 F_{254} neutral	1.05581.0001	20 x 20	200 µm	plastic	25 plates

TLC aluminium oxid 150

Packing Material	Ordering No.	Format (cm)	Layer thickness	Backing	Contents of one package
Aluminium oxide 150 F_{254} basic	1.05727.0001	20 x 20	250 µm	glass	25 plates
Aluminium oxide 150 F_{254} neutral	1.05551.0001	20 x 20	200 µm	aluminium	25 plates

Kieselguhr and mixed layer plates

For specific applications

Kieselguhr is a natural diatomaceous earth that can be used for the separation of polar or moderately polar substance.

Merck's mixed layer plates utilize a combination of classical silica gel 60 and kieselguhr providing good separation properties for certain special applications such as separation of inorganic ions, herbicides and some steroids.

Ordering information

TLC plates (glass), kieselguhr, silica gel/kieselguhr

Layer type	Ordering No.	Layer thickness	Format (cm)	Contents of one package
TLC plates Kieselguhr F_{254}	1.05738.0001	0.2 mm	20 x 20	25 plates
TLC aluminium plates Kieselguhr F_{254}	1.05568.0001	0.2 mm	20 x 20	25 plates
TLC aluminium plates silica gel 60/Kiesleguhr F_{254}	1.05567.0001	0.2 mm	20 x 20	25 sheets

High performance silica plates (HPTLC)

For fast analysis of complex samples for manual – or instrumental use

Merck HPTLC silica plates offer higher speed and higher sensitivity then classical TLC and are therefore optimal suited for sophisticated separations.

Using instrumental equipment HPTLC plates enable for modern, quantitative Thin Layer Chromatography.

HPTLC plates utilize an optimized silica 60 sorbent with a particle size of only 5-6 µm. The smaller particles give a smoother surface and a higher separation power than conventional TLC plates. Band diffusion is reduced giving raise to very compact sample bands or zones. These features and the thinner layer (< 200 µm) ultimately result in highly increased sensitivity and faster analysis.

HPTLC silica plates are available either glass or aluminium backed in a variety of different formats to suite various separation needs. Just as in the classical range, two kind of fluorescent indicators are used: the green fluorescing F_{254} and the blue fluorescing acid-stable F_{254s}. Both indicators fluorescence in UV light at an excitation wavelength of 254 nm.

Specifications of HPTLC versus classical TLC plates

	HPTLC	TLC
Mean particle size	5-6 µm	10 - 12 µm
Particle size distribution	4 - 8 µm	5 - 20 µm
Layer thickness	200 µm (100 µm)	250 µm (200 µm)
Typical plate height	12 µm	30 µm
Typical migration distance	3 - 6 cm	10 - 15 cm
Typical separation time	3 - 20 min	20 - 200 min
Number of samples per plate	< 36 (72)	< 10
Sample volume	0.1 - 0.5 µl	1 - 5 µl
Detection limits absorption	100 - 500 pg	1 - 5 ng
Detection limits fluorescence	5 - 10 pg	50 - 100 pg

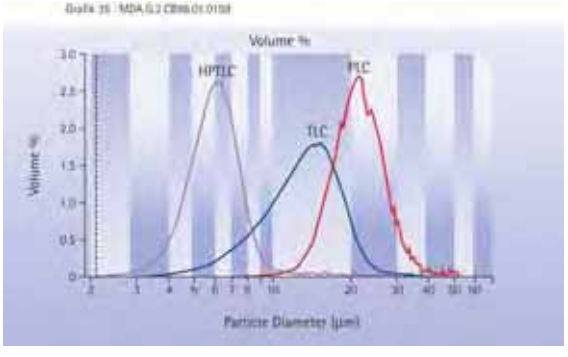


Fig. 3:
Comparison of the particle size distribution of TLC, HPTLC and PLC

HPTLC plates AMD with extra thin layer of only 100 µm have been specifically developed for even more demanding applications such as automated multiple development (AMD). It combines the repeatedly development of the plate in the same direction and reproducible gradient elution. AMD development provides extremely narrow bands, allowing the complete resolution of up to 40 components on 60 mm distance.

→ RP-modified silica plates (TLC and HPTLC) Free choice of solvent system for special separations and as pilot method for HPLC 226
→ CN-, Diol-, NH-modified plates (TLC and HPTLC) For special separation problems 229
→ Concentrating zone plates (TLC, HPTLC, PLC) Quick and easy sample application even of large volumes of diluted samples 234
→ ProteoChrom® HPTLC plates for peptide analysis 238

High performance silica plates (HPTLC)

For fast analysis of complex samples for manual – or instrumental use

HPTLC Premium Purity plate is designed for high performance, completely contamination free separations especially in demanding pharmacopoeia applications.

- Highly pure, exhibiting minimal background even with middle-polar solvent systems
- Identical separation performance as the related HPTLC plate product
- Especially suited for pharmacopoeia applications

HPTLC Premium Purity plate is based on the HPTLC Silica gel 60 F_{254} plate but in addition is carefully wrapped in dedicated plastic coated aluminium foil. The specially packing prevents any deposition of plasticizers such as phthalates from the wrapping material that could appear as unknown extra zone when using middle-polar solvent systems such as toluene / ethyl acetate (95/5) and which can be stained by derivatization reagents.

Ordering information

HPTLC silica gel 60, glass backed

Packing Material	Ordering No.	Format (cm)	Contents of one package
HPTLC silica gel 60	1.05641.0001	20 x 10	50 plates
	1.05631.0001	10 x 10	25 plates
	1.05633.0001	10 x 10	100 plates
HPTLC silica gel 60 F_{254}	1.05642.0001	20 x 10	50 plates
	1.05628.0001	10 x 10	25 plates
	1.05629.0001	10 x 10	100 plates
	1.05616.0001	5 x 10	25 plates
HPTLC silica gel 60 F_{254s}	1.15696.0001	20 x 10	25 plates
HPTLC silica gel 60 WR F_{254s}	1.15552.0001	20 x 10	25 plates
HPTLC silica gel 60 AMD extra thin layer*	1.11764.0001	20 x 10	25 plates
HPTLC silica gel 60 AMD WR F_{254s} extra thin layer*	1.12363.0001	20 x 10	25 plates
HPTLC silica gel 60 / Premium Purity Plate	1.05648.0001	20 x 10	50 plates

Layer thickness: 200 µm
***Layer thickness: 100 µm**

HPTLC silica gel 60, aluminium backed

Packing Material	Ordering No.	Format (cm)	Contents of one package
HPTLC silica gel 60	1.05547.0001	20 x 20	25 plates
HPTLC silica gel 60 F_{254}	1.05548.0001	20 x 20	25 plates
	1.05556.0001	5 x 7.5	20 plates

Layer thickness: 200 µm

High performance silica plates (HPTLC)

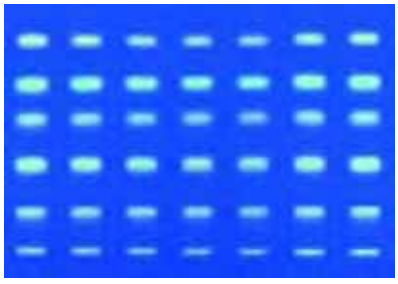
For fast analysis of complex samples for manual – or instrumental use

Application of high performance silica plates (HPTLC)

HPTLC plates are ideal for highly demanding, quantitative analysis such as:

- Identity testing in analysis of herbal medicines & medicinal plants
- Highly sophisticated, quantitative separations such as quality control of drugs using instrumental equipment
- Quality or purity testing of complex samples in pharmaceutical QC
- Trace analysis in food

A



B

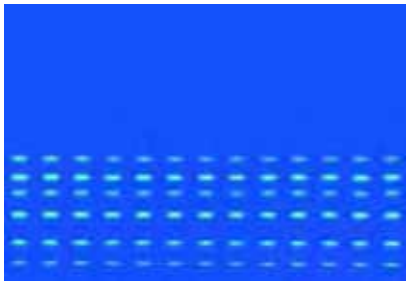


Fig. 4:
Comparison of the separation of dansyl amino acids on (A) a TLC silica gel 60 plate or (B) a HPTLC silica gel 60 plate under identical conditions.
The comparison clearly demonstrates that the HPTLC plate delivers sharper zones with shorter migration distances and hence running times. In addition the HPTLC plate allows to separate the double number of samples simultaneously.

Compounds	1. N-alpha-dansyl-L-asparagine 2. alpha-dansyl-L-arginine 3. Dansyl-L-cysteic acid 4. N-Dansyl-L-cysteic acid 5. Dansyl-glycine 6. N-N-Didansyl-L-tyrosine
Sample volume	TLC 4 µl; HPTLC 0.3 µl
Mobile phase	Ethylacetat/methanol/propionic acid (22/10/3)
Migration dis-tance	TLC: 10 cm; HPTLC: 5 cm
Analysis time	TLC: 42 min; HPTLC: 13 min 45 sec

In order to fully exploit the potential of HPTLC plates delivering reliable and reproducible quantitation appropriate instrumentation for sample application and data evaluation is essential.

Please refer to the comprehensive CAMAG product range under www.camag.ch.

High performance silica plates (HPTLC)

For fast analysis of complex samples for manual – or instrumental use

LiChrospher® HPTLC

Unique HPTLC LiChrospher® plates are the only Thin Layer Chromatography products based on spherical silica particles. They offer the ultimate in Thin Layer Chromatography performance and speed enabling high throughput analysis of complex samples.

- Further 20 % reduced running times
- Highly compact zones
- Lower detection limits

HPTLC LiChrospher® plates are based on LiChrospher® Merck proven spherical shaped silica 60 with a rather small particle size of 7 µm and narrow particle size distribution as it is normally used in HPLC. LiChrospher® possess a very similar broad selectivity as the respective HPTLC plate however plate height, separation numbers and velocity constants are even further improved.

Fig. 5A

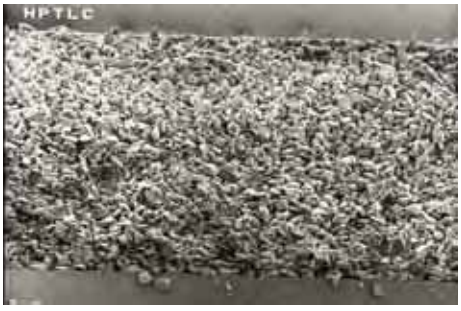


Fig. 5B

Scanning electron micrograph pictures of the cross section of (A) a LiChrospher® plate and (B) a HPTLC silica plate

Analysis times on a HPTLC LiChrospher® compared with a normal HPTLC plate

Eluent	Migration distance	LiChrospher® silica gel 60 F_{254s}	HPTLC silica gel 60 F_{254}
Toluene	4 cm	4 min	5 min, 45 sec
Ethyl acetate / toluene (95-5)	5 cm	6 min	7 min, 50 sec
Methyl ethyl ketone / 1-propanol/water/ acetic acid (40+40+20+5)	5 cm	20 min	26 min, 30 sec
n-hexane/toluene/acetone (70+20+10)	7 cm	13 min	19 min

LiChrospher® is a trademark of Merck KGaA, Darmstadt, Germany

High performance silica plates (HPTLC)

For fast analysis of complex samples for manual - or instrumental use

Ordering information

HPTLC LiChrospher® silica gel 60

Packing Material	Ordering No.	Format (cm)	Backing	Contents of one package
HPTLC LiChrospher® silica gel 60 F_{254}	1.15445.0001	20 x 10	glass	25 plates
HPTLC LiChrospher® silica gel 60 F_{254s}	1.05586.0001	20 x 20	aluminium	25 plates
HPTLC LiChrospher® silica gel 60 AMD WR F_{254s} extra thin*	1.05647.0001	20 x 10	glass	25 plates
*Layer thickness: 100 µm				

HPTLC LiChrospher® RP-modified silicagel 60

Packing Material	Ordering No.	Format (cm)	Backing	Contents of one package
HPTLC LiChrospher® silica gel 60 RP-18 WF_{254s}	1.05646.0001	20 x 10	glass	25 plates
Layer thickness: 200 µm				

Applications of LiChrospher® HPTLC

LiChrospher® HPTLC plates are suitable for a broad range of applications but especially for the analysis of highly complex low concentration samples

- Analysis of pesticides mixtures
- Assaying of pharmaceutical compounds

Sample	1. Hexazinone 2. Metoxuron 3. Monuron 4. Aldicarb 5. Azinphos-methyl 6. Prometryn 7. Pyridate 8. Trifluralin
Sample volume	50 ml
Mobile phase	Petroleum benzine 40-60 °C/ acetone 70/80
Detection	UV 254 nm

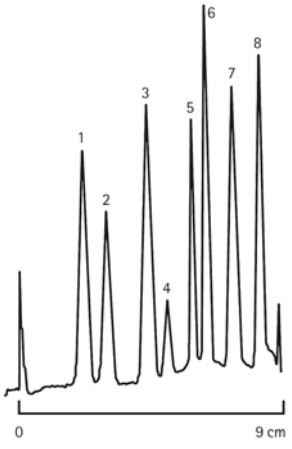


Fig. 6 A:

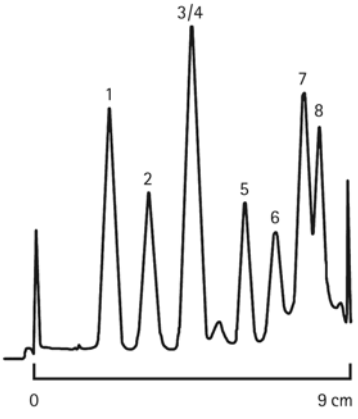


Fig. 6
Pesticide separation on (A) HPTLC LiChrospher® and on a conventional (B) HPTLC plate demonstrating that using LiChrospher® plates allows to separate more substances.B:

RP-modified silica plates (TLC and HPTLC)

Free choice of solvent system for special separations and as pilot method for HPLC

RP-modified silica layers are well suited for many separation problems that cannot be sufficiently solved by unmodified silica.

- Separation of extremely non-polar and highly polar substance using aqueous solvent systems
- Analysis of certain polar substance amendable for ion-pair chromatography, while neutral substance remain constant
- Less dependence on atmospheric humidity

In contrast to unmodified silica, RP-phases do not exhibit catalytic activity and are therefore the plates of choice for instable substance that might tend to oxidative degradation.

Furthermore, RP-modified silica plates provide ready correlation with HPLC columns and allow TLC to be used for method development and as pilot method for HPLC.

Merck RP-plates RP-2, RP-8 and RP-18 are based on silica gel 60 modified with aliphatic hydrocarbons of increasing hydrocarbon chain length resulting in increased hydrophobic.
The hydrocarbon chain length in combination with the degree of modification strongly affects retention: Retention of the sample and migration times increases with the higher degree of modification and with growing hydrocarbonchain in the order RP2, RP8, RP18 using the same solvent composition, while RF values decrease. Additionaly, with growing water content in the solvent system retention will increase.

The RP-2 sorbent exhibits higher polarity and high affinity of aqueous solutions tolerating up to 80 % water while the longer carbon chains RP-8 and R-18 can be run with up to 60 % or 40 % respectively water in the solvent system.

The special **HPTLC RP-18 W** with a defined lower degree of surface modification can be wetted and developed even with pure water.

The **RP-18 silica plates with concentrating zone** are especially suited for the high-resolution separation of polycyclic aromatic hydrocarbons (PAH).

→ Concentrating zone plates (TLC, HPTLC, PLC)
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Ordering information RP-modified silica plates

TLC RP-modified silica gel 60, glass backed

Packing Material	Ordering No.	Format (cm)	Contents of one package
Silica gel 60 RP-2 (silanized)	1.05746.0001	20 x 20	25 plates
Silica gel 60 RP-2 F_{254} (silanized)	1.05747.0001	20 x 20	25 plates
Silica gel 60 RP-8 F_{254s}	1.15388.0001	20 x 20	25 plates
	1.15424.0001	10 x 20	50 plates
	1.15684.0001	5 x 10	25 plates
Silica gel 60 RP-18 F_{254s}	1.15389.0001	20 x 20	25 plates
	1.15423.0001	10 x 20	50 plates
	1.15683.0001	5 x 20	50 plates
	1.15685.0001	5 x 10	25 plates

TLC RP-modified silica gel 60, aluminium backed

Packing Material	Ordering No.	Format (cm)	Contents of one package
Silica gel 60 RP-18 F_{254s}	1.05559.0001	20 x 20	20 plates
	1.05560.0001	5 x 7.5	20 plates

RP-modified silica plates (TLC and HPTLC)

Free choice of solvent system for special separations and as pilot method for HPLC

HPTLC RP-modified silica gel 60, glass backed

Packing Material	Ordering No.	Format (cm)	Contents of one package
HPTLC silica gel 60 RP-2 F_{254s}	1.13726.0001	10 x 10	25 plates
HPTLC silica gel 60 RP-8 F_{254s}	1.13725.0001	10 x 10	25 plates
HPTLC silica gel 60 RP-18	1.05914.0001	20 x 10	25 plates
HPTLC silica gel 60 RP-18 W	1.14296.0001	20 x 10	25 plates
HPTLC silica gel 60 RP-18 F_{254s}	1.13724.0001	10 x 10	25 plates
HPTLC silica gel 60 RP-18 W F_{254s}	1.13124.0001	10 x 10	25 plates

Layer thickness 200 µm
W: Fully wettable with water (can be used even with 100 % water in solvent system)

Application of RP-modified silica plates

RP-plates significantly broaden TLC applications and can be used for separation of amides, antibiotics, fatty acids:

Substances	1. Indeno-(1,2,3-c,d)pyrene 2. 3,4-Benzfluoranthene 3. Fluoranthene	0.05 % 0.05 % 0.05 %
Sample volume	100 nl	
Mobile phase	Acetonitrile - water (90+10)	
Migration distance	5 cm	
Detection	UV 366 nm (TLC/HPTLC Scanner, Camag)	
Chamber	Normal chamber without saturation	

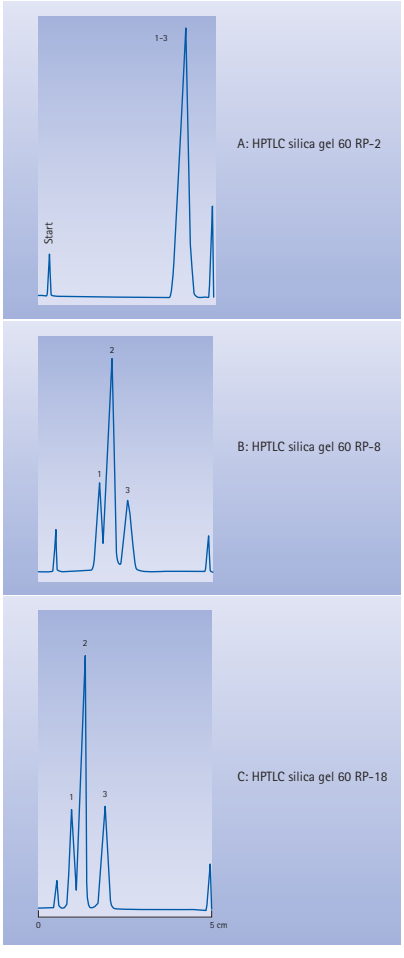


Fig. 7: Influence of the hydro carbon chain length on retention:Retention increases with growing hydrocarbon chain.

RP-modified silica plates (TLC and HPTLC)

Free choice of solvent system for special separations and as pilot method for HPLC

Substances	1. Dodecyl gallate 2. Butyl gallate 3. Ethyl gallate 4. Methyl gallate 5. Gallic acid
Sample volume	200 nl
Mobile phase	1 N acetic acid / methanol 70 + 30)
Migration distance	5 cm
Detection	UV 265 nm (TLC/HPTLC Scanner, Camag)

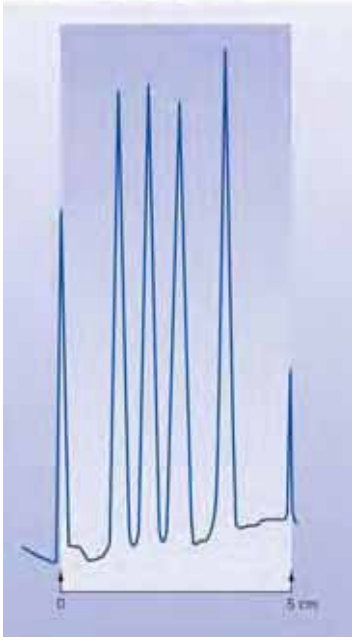


Fig. 8:
RP-modified silica plates are especially suited for the analysis of basic or acids substances as demonstrated by the good separation of gallic acid and its esters on HPTLC silica RP-18 WF254.

CN-, Diol-, NH-modified plates (TLC and HPTLC)

For special separation problems

NH_2-, CN- and Diol-modified silica sorbents are less polar then the classical silica phases and therefore well suited to separate hydrophilic or charged substances.

The CN-modified plate is based on a silica gel 60 modified with a cyano propyl group while the diol-modified plate utilize a silica surface modified by a vicinal diol alkyl ether. These moderately polar plates with it's intermediate properties fill a gap in the range of the silica plates allowing to be used for both normal phase and reversed phase systems. Due to their special features all kinds of solvent systems can be used.

Especially the dual personality of the silica-CN plate allows unqiue two-dimensional separations to be achieved by using normal phase mechanismn in the first direction followed by reversed phase mechanismn in the second direction.

The amino modified silica NH_2 plates provide weak basic ion exchange characteristics. These unique features enable for the separation of charged compounds such as nucleotides, purins, pyrimidines, phenols and sulfonic acids using simple eluent mixtures. In addition NH_2 modified silica plates allow for reagent free detection of certain chemical substances by thermochemical fluorescence activation.

Because most substance separated on these modified plates are colourless, our modified plates contain the blue fluorescing, acid stable UV indicator F_{254s}. Samples which absorb shortwave UV at 254 nm are detected due to fluorescence quenching.

Ordering information

TLC modified silica gel 60, aluminium backed

Packing Material	Ordering No.	Format (cm)	Contents of one package
Silica gel 60 NH_2 F_{254s}	1.05533.0001	20 x 20	20 plates

HPTLC modified silica gel 60, glass backed

Packing Material	Ordering No.	Format (cm)	Contents of one package
HPTLC silica gel 60 CN F_{254s}	1.12571.0001	20 x 10	25 plates
HPTLC silica gel 60 CN F_{254s}	1.16464.0001	10 x 10	25 plates
HPTLC silica gel 60 Diol F_{254s}	1.12668.0001	10 x 10	25 plates
HPTLC silica gel 60 Diol F_{254s}	1.05636.0001	20 x 10	25 plates
HPTLC silica gel 60 NH_2	1.12572.0001	20 x 10	25 plates
HPTLC silica gel 60 NH_2 F_{254s}	1.13192.0001	20 x 10	25 plates
HPTLC silica gel 60 NH_2 F_{254s}	1.15647.0001	10 x 10	25 plates
Layer thickness: 200 µm			

→ Classical silica TLC plates (TLC)
For versatile and reliable routine analysis of a broad range of substance 214

→ High performance silica plates (HPTLC)
For fast analysis of complex samples for manual - or instrumental use 220

Applications of CN-, Diol-, NH_2-modified silica

CN-, Diol- and NH_2-modified plates provide additional selectivities for a wide range of applications including:

- CN-silica: benzodiazepine derivatives, pesaticides, plasticizers, tetracyclines antibiotics, galic acid ester and other.
- Diol-silica: glycosides, anabolic steroids, aromatic amines and particularly dihydroxybenzoic acids.
- NH_2-silica: charged compounds, such as nucleotides, phenols, sulfons and carbons

Compounds	1. ApUpG 2. ApApU 3. ApApC 4. ApApA	0.1 % 0.1 % 0.1 % 0.1 %
Sample	300 nl	
Mobile phase	Ethanol-water (60/40 v/v) plus 0.2 mM lithium chloride	
Detection	UV 254 nm (TLC/HPTLC Scanner 2)	
Migration distance	7 cm	

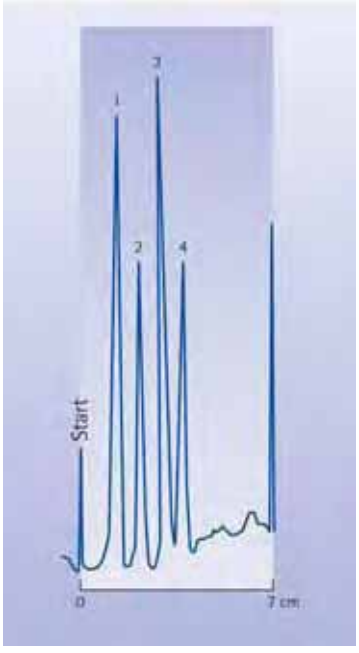


Fig. 9:
Separation of oligo-nucleotides on a HPTLC NH2-modified silica gel 60 plate

Cellulose TLC and HPTLC

For analysis of polar substances

Cellulose is an organic sorbent that is particularly suitable for the separation of hydrophilic substances by partition chromatography.

Merck's cellulose plate include classical TLC or HPTLC plates for demanding high-performance separations. Classical TLC cellulose layers are based on a microcrystalline cellulose for standard separations, while the HPTLC cellulose layers utilize high purity rod-shaped microcrystalline cellulose resulting in highly reduced diffusion of analytes for critical high performance separations.

Celluloses plates are available with or without fluorescent indicator. The fluorescent indicator used is a special fluorescent pigment that is stimulated to intense blue fluorescent remission at long wave UV light of 366 nm and at short UV light at 254 nm.

Ordering information

TLC cellulose, glass backed

Packing Material	Ordering No.	Format (cm)	Contents of one pack
Cellulose	1.05716.0001	20 x 20	25 plates
	1.05730.0001	10 x 20	50 plates
	1.05632.0001	10 x 10	100 plates
Cellulose F	1.05718.0001	20 x 20	25 plates
	1.05728.0001	10 x 20	50 plates

TLC cellulose, aluminium backed

Packing Material	Ordering No.	Format (cm)	Contents of one pack
Cellulose	1.05552.0001	20 x 20	25 plates
	1.05563.0001	500 x 20	1 roll
Cellulose F	1.05574.0001	20 x 20	25 plates

TLC cellulose, plastic backed

Packing Material	Ordering No.	Format (cm)	Contents of one pack
Cellulose	1.05577.0001	20 x 20	25 plates
Cellulose F	1.05565.0001	20 x 20	25 plates
Layer thickness: 100 µm			

HPTLC cellulose, glass backed

Packing Material	Ordering No.	Format (cm)	Contents of one pack
HPTLC cellulose	1.05786.0001	20 x 10	50 plates
	1.05787.0001	10 x 10	25 plates
HPTLC cellulose F	1.15036.0001	20 x 10	50 plates
	1.15035.0001	10 x 10	25 plates

Cellulose TLC and HPTLC

For analysis of polar substances

HPTLC cellulose, aluminium backed

Packing Material	Ordering No.	Format (cm)	Contents of one pack
HPTLC cellulose	1.16092.0001	20 x 20	25 plates

Layer thickness: 100 µm
F: Fluorescence indicator with exitation wavelenght 254/366 nm

Application of cellulose TLC and HPTLC

Typical applications of cellulose include the analysis of amino acids, carbohydrates, phosphates, nucleic acids and nucleic acids derivatives.

- Detection of abnormal increases of amino acids in clinical laboratories
- 2-dimensional separations such as amino acid "fingerprints"
- Metabolic studies

Compounds	1. $(NaPO_3)_3$ 2. $Na_5P_3O_{10}$ 3. $Na_4P_2O_7$ 4. Na_2HPO_4
Sample volume	250 nl
Mobile phase	dioxan sol. 160 g TCA, 8 ml 25 % ammonia in 1 l water; 70/30
Migration distance	7 cm
Detection	586 nm (TLC/HPTLC Scanner, Camag)

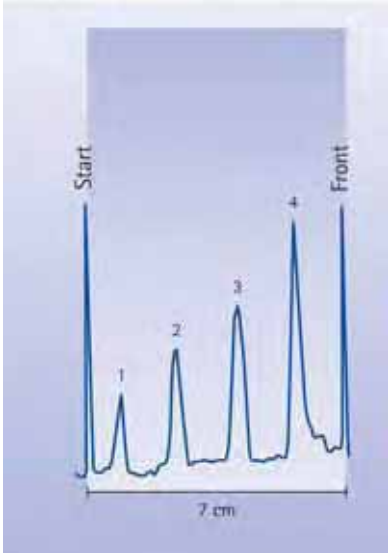


Fig. 10:
HPTLC cellulose is highly suited to separate polar compounds as demonstrated by the separation of phosphates

These products are not intended for use as in-vitro diagnostics in terms of European Directive 98/79/EC. They are for research purposes only, for investigating in-vitro samples derived from the human body without any medical objective.

PEI Cellulose for specific separations by ion-exchange chromatography

PEI Cellulose is polyethylenimine modified cellulose, which acts as a strongly basic anion exchanger.

Due to these special characteristics, it is mainly useful to analyse substance with exchange-active groups such as amino acids, peptides and nucleotides or nucleosides.

Ordering information
PEI cellulose TLC, glass & plastic backed

Packing Material	Ordering No.	Format (cm)	Backing	Contents of one package
PEI Cellulose F	1.05725.0001	20 x 20	glass	25 plates
PEI Cellulose F	1.05579.0001	20 x 20	plastic	25 plates
Layer thickness: 100 µm				

PEI cellulose plates should be stored at 0–4 °C to reduce deterioration.

Application of PEI Cellulose

PEI cellulose has specific uses such as the analysis of nucleotides, nucleoside and nucleobases, vanadyl mandelic acid and sugar phosphates.

These products are not intended for use as in-vitro diagnostics in terms of European Directive 98/79/EC. They are for research purposes only, for investigating in-vitro samples derived from the human body without any medical objective.

Concentrating zone plates (TLC, HPTLC, PLC)

Quick and easy sample application even of large volumes of diluted samples

Concentrating zone plates allow for easy application of large volumes of diluted samples offering:

- Highly facilitated sample loading
- Better resolution due to uniform sharp bands
- Includes a purification, sample preparation step

Merck's concentrating zone plates are based on different adsorption properties of two silica sorbents: a large pore concentrating sorbent where the samples are applied, and a selective separation layer for the separation. Independent of shape, size or position of the spots the sample always concentrates within minutes as narrow band at the interface of the two adsorbents where the separation starts (see Fig. 11).

In addition, the concentrating zone can serve as clean-up step for complex matrices, e.g. oils, cosmetics.

Analytical TLC and HPTLC concentration zone plates provide concentrating areas of 2.5 cm while the concentrating zone of preparative plates (PLC) is 4 cm in width.

The special **HPTLC RP-18 modified silica concentrating zone plate** is optimised for the high resolution separation of polycyclic aromatic hydrocarbons (PAH) according to DIN 38409-H13. Polycyclic aromatic hydrocarbons (PAH) are derived from organic material by pyrolysis or incomplete combustion. The main sources are the exhaust fumes of private and industrial furnaces, car exhaust and tobacco smoke. Since some PAH are carcinogenic, their determination is of great importance and maximum limits have been set e.g. for water.

Ordering information

TLC concentrating zone plates

Packing Material	Ordering No.	Format (cm)	Backing	Contents of one package
Silica gel 60 concentrating zone 2.5 x 20 cm	1.11845.0001	20 x 20	glass	25 plates
Silica gel 60 concentrating zone 2.5 x 10 cm	1.11844.0001	10 x 20	glass	50 plates
Silica gel 60 concentrating zone 2.5 x 20 cm*	1.05582.0001	20 x 20	aluminium	25 sheets
Silica gel 60 F_{254} concentrating zone 2.5 x 20 cm	1.11798.0001	20 x 20	glass	25 plates
Silica gel 60 F_{254} concentrating zone 2.5 x 10 cm	1.11846.0001	10 x 20	glass	50 plates
Silica gel 60 F_{254} concentrating zone 2.5 x 20 cm*	1.05583.0001	20 x 20	aluminium	25 sheets

Layer thickness: 250 µm
***Layer thickness: 200 µm**

→ Classical silica TLC plates (TLC)
For versatile and reliable routine analysis of a broad range of substance 214

→ High performance silica plates (HPTLC)
For fast analysis of complex samples for manual - or instrumental use 220

→ Preparative layer plates (PLC)
For enrichment of target analytes in mg quantities and cleaning 242

Concentrating zone plates (TLC, HPTLC, PLC)

Quick and easy sample application even of large volumes of diluted samples

HPTLC concentrating zone plates

Packing Material	Ordering No.	Format (cm)	Backing	Contents of one package
HPTLC Silica gel 60 concentrating zone 2.5 x 20 cm	1.13749.0001	20 x 10	glass	50 plates
HPTLC Silica gel 60 concentrating zone 2.5 x 10 cm	1.13748.0001	10 x 10	glass	25 plates
HPTLC Silica gel 60 F_{254} concentrating zone 2.5 x 20 cm	1.13728.0001	20 x 10	glass	50 plates
HPTLC Silica gel 60 F_{254} concentrating zone 2.5 x 10 cm	1.13727.0001	10 x 10	glass	25 plates
HPTLC Silica gel 60 F_{254} concentrating zone 2.5 x 5 cm	1.13187.0001	5 x 10	glass	25 plates
HPTLC Silica gel 60 RP-18 concentrating zone 2.5 x 20 cm	1.15037.0001	20 x 10	glass	25 plates
HPTLC Silica gel 60 RP-18 F_{254s} concentrating zone 2.5 x 20 cm	1.15498.0001	20 x 10	glass	25 plates
HPTLC Silica gel 60 plate RP-18 with concentrating zone 2.5 x 20 cm for PAH detection	1.15037.0001	20 x 10	glass	25 plates
Layer thickness: 200 µm				

PLC concentrating zone plates, glass backed

Packing Material	Ordering No.	Format (cm)	Backing	Contents of one package
Silica gel 60 F_{254} concentrating zone 4 x 20 cm	1.13794.0001	20 x 20	0.5 mm	20 plates
	1.13792.0001	20 x 20	1 mm	15 plates
	1.13793.0001	20 x 20	2 mm	12 plates

Application

Concentrating zone plates highly facilitate sample application, and are therefore used whenever manual sample application has to be achieved.

A B C

Fig. 11:
Stages of the development of a PLC concentration zone plate silica gel 60.
Separation of lipophilic dyes with toluene as mobile phase.

A: Sample application
B: Concentration
C: Separation

Ultra thin monolithic silica plate (UTLC)

Ultra fast and high sensitive analysis of sample volumes in the nl range

Merck's unique UTLC plate is the first Thin Layer Chromatography product with a layer thickness of only 10 µm. It combines all features of thin layer chromatography technique such as easy and fast separations with the sensitivity and speed of ultra-thin monolithic layers.

Merck's unique monolithic UTLC offers:

- Higly reduced migration distances and ultra fast development times
- Very low sample volumes for precious samples
- Increased sensitivity due to significantly reduced layer thickness
- Binder free and stable in pure water

UTLC plate is based on the proprietary Merck monolithic silica technology. The monolithic unmodified nano SiO_2-layer of 10 µm has mesopores of 3-4 nm and macropores of 1-2 µm providing a 25-fold increased sensitivity compared to classical HPTLC. It therefore enables to detect analyts in the pg range. UTLC brings miniaturization in Thin Layer Chromatography.

Specifications of ultra thin monolithic silica plate (UTLC)

Plate format	60 x 36 mm
Layer thickness	10 µm
Stationary phase	Silica SiO_2
Additions	No binder
Sample volume	Spot wise: 5 - 20 nl Band wise: up to 100 nl
Detection limit	10 pg
Migration distance	1 - 3 cm
Analysis time	1 - 6 min

Ordering information

UTLC monolithic silica plate, glass backed

Packing Material	Ordering No.	Layer thickness	Format (cm)	Contents of one package
UTLC monolithic silica	1.05007.0001	10 µm	6 x 3.6	25 plates

Ultra thin monolithic silica plate (UTLC)

Ultra fast and high sensitive analysis of sample volumes in the nl range

Application of ultra thin monolithic silica plate (UTLC) unmodified

UTLC is the first monolithic thin layer plate on the market and the first plate that allows separation in only 5 minutes and detection in the pg range. It is highly suited for small, simplier samples with low analyte concentration. Applications include steroids, azepams, amino acids, phthalates and phenols.

Sample substances:	1. Sico Fat Blue 50401N 2. Nitro Fast Blue 2B 3. Ceres violet I
Application volume:	10 nl (0.1% in toluene)
Spotting device:	Hamilton syringe (0.5 µl total volume)
Mobile phase:	Toluene
Migration distance:	1.5 cm (with chamber saturation)
Migration time:	165 s
Documentation:	Video documentation (ProViDoc, DESAGA, Wiesloch, Germany)
Evaluation:	TLC Scanner II (Camag, Muttenz, Switzerland)

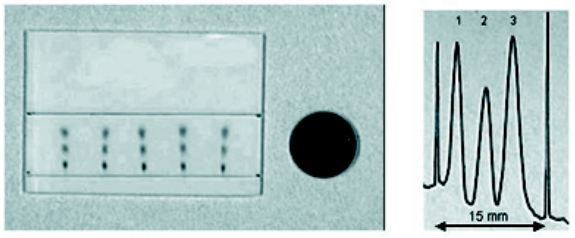


Fig. 12:
Separation of lipophilic dyes on a UTLC plate

Compounds	1. 4-Aminophenol 2. 2-Aminophenol 3. Biphenyldiol (2/2') 4. 2-Benzene-4-chlorophenol
Sample volume	10 nl (0.1% in acetonitrile)
Spotting device	Sample applicator ATS4 (Camag, Muttenz)
Mobile phase	Toluene/chloroform/methanol (80/10/10)
Migration distance	2 cm (with chamber saturation)
Migration time	240 s
Detection	Diode array spectro-photometer (J&M, Aalen, Germany) at UV 200 nm

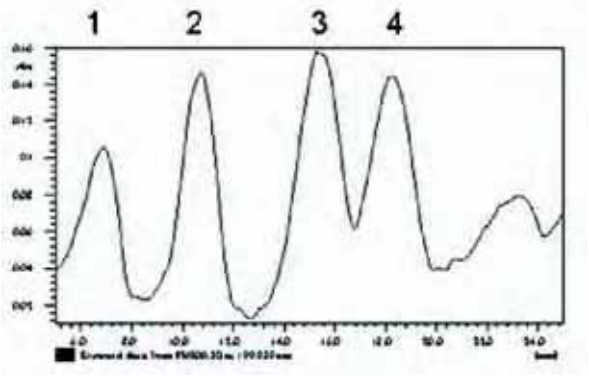


Fig. 14:
UTLC reveals excellent separation of phenols in only 4 minutes

ProteoChrom® HPTLC plates for peptide analysis

The new ProteoChrom® plates have been optimized for highly efficient separations especially for analysis of peptides and protein digests.

- Highly reproducible: optimized separation & staining procedures
- Convenient, easy-to-follow detailed protocols included
- Sensitive: extra thin layers of 100 µm
- Highly stable in water ideal for use with aqueous solvent systems

ProteoChrom® HPTLC Silica gel 60 F_{254} plates utilizes an extra thin layer of high performance Merck silica gel providing highly efficient separation characteristics for 1-D analysis ofpeptides and protein digests. Due to the special binder composition, the plates are highly stable in water. Up to 20 peptides can be resolved and as little as 1-2 ng per band can be visualized.

ProteoChrom® HPTLC Cellulose sheets utilize an extra thin layer of optimized microcrystalline cellulose. Specially developed protocols for development and staining enable for straightforward 2-D analysis in only 4 hours.

Each ProteoChrom® package includes an insert sheet with detailed instructions for solvent systems, running conditions and staining solution, enabling straightforward experiments without time-consuming optimization work.

The new ProteoChrom® plates open a new application field for Thin Layer Chromatography.

Ordering information

Packing Material	Ordering No.	Format (cm)	Contents on one package	Backing
ProteoChrom® HPTLC Silica gel 60 F_{254s}	1.05650.0001	20 x 10	25 plates	glass
ProteoChrom® HPTLC Cellulose	1.05651.0001	10 x 10	25 sheets	aluminium

Applications

Sample volume:	5 µl
Concentration:	2 mg/ml
Application system:	Automatic TLC Sampler 4 (CAMAG)
Mobile phases:	1st dimension: 2-butanol/pyridine/acetic acid/ water (30/20/6/24), 1D 2nd dimension: 2-butanol/pyridine/ammonia (25 %)/water (39/34/10/26), 2D
Migration distance:	5 cm
Migration time:	1st dimension: 44 min 2nd dimension: 50 min
Staining:	3A: Fluorescamine 3B: Ninhydrin

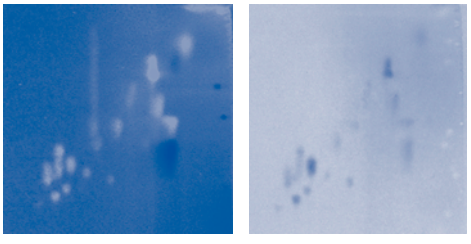


Fig. 15A Fig. 15B

Fig 15:
2-dimensional HPTLC of single protein digests.

Cytochrome C tryptic digests were 2-D separated on ProteoChrom® HPTLC Cellulose sheet followed by either fluorescamine staining (15A), or staining with ninhydring (15B)

ProteoChrom® HPTLC plates for peptide analysis

Sample volume:	1 A: 1.5 µl 1 B: 4 µl
Concentration:	2 mg/ml
Application system:	Automatic TLC Sampler 4 (CAMAG)
Mobile phases:	2-butanol/pyridine/ammonia (25 %) / water (39/34/10/26)
Migration distance:	5 cm
Developing time:	45 min
Staining/detection:	1 A: Fluorescamine 1 B: Ninhydrin

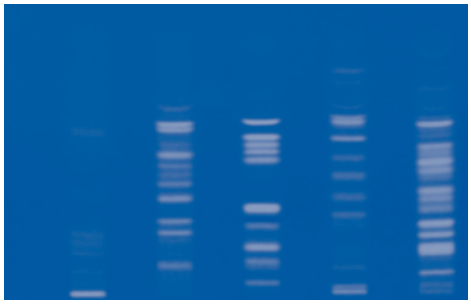


Fig. 16A

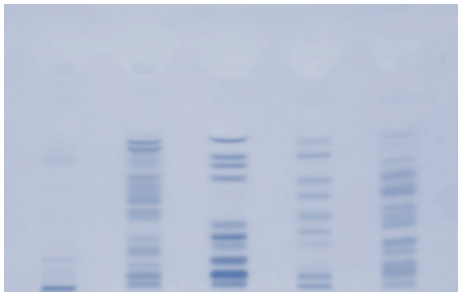


Fig. 16B

Fig 16: 1-D separation of single protein digests.
Tryptic digests of various proteins were separated on a ProteoChrom® HPTLC Silica gel 60 F254s plate followed by either fluorescamine staining (16A), or staining with ninhydring (16B).

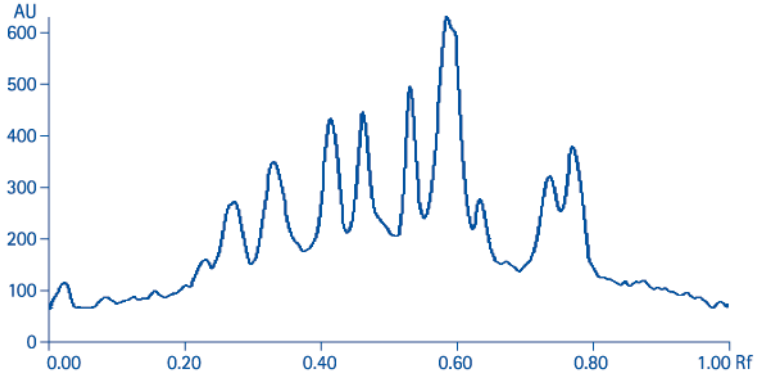


Fig 2: Densitogram of a tryptic digest of b-Casein
A tryptic digest of b-Casein was separated on a ProteoChrom® HPTLC Silica gel 60 F254s plate followed by fluorescamine staining and scanned with a CAMAG TLC Scanner III in fluorescence mode at UV 366.

Multiformat plates (TLC and HPTLC)

Multiple sizes in one single glass plate

Merck Multiformat glass plates are pre-scored for easy snapping with the fingers to smaller sizes.

- Easy snapping with the fingers
- Up to 7 formats in one plate

Multiformat plates utilize the same proven silica coating as the corresponding TLC or HPTLC plate delivering chromatograms that are identical to those on normal non-scored plates.

The number of possible plates depends on the scoring, for example: For a 20 x 20 cm plate scored in part of 5 x 10 up to seven different formats are possible:

20 cm x 20 cm, 15 cm x 20 cm, 10 cm x 20 cm, 5 cm x 20 cm, 10 cm x 15 cm, 10 cm x 10 cm, 5 cm x 10 cm

Ordering information

Packing Material	Ordering No.	Scored (cm)	Contents of one package (20 x 20 cm)	No. of plates possible
Multiformat silica gel 60 F_{254} ex 20 x 20	1.05620.0001	5 x 10	25 plates	200
Multiformat silica gel 60 F_{254} ex 20 x 20	1.05608.0001	5 x 20	20 plates	80
HPTLC Multiformat silica gel 60 F_{254} ex 10 x 10	1.05635.0001	5 x 5	25 plates	100
HPTLC Multiformat silica gel 60 F254 ex 10 x 10	1.05644.0001	5 x 5	100 plates	400

Application of Multiformat plates

Note: To prevent the glass backing from uncontrolled and irregular breaking avoid putting plates directely on hot metal plates, drying cabinets or plate heaters after development and / or staining. When heat drying is necessary, pleas use distance holders of low thermal conductivity between glass and hot metal plate i.e. glass rods or similar.

GLP plates (TLC and HPTLC)

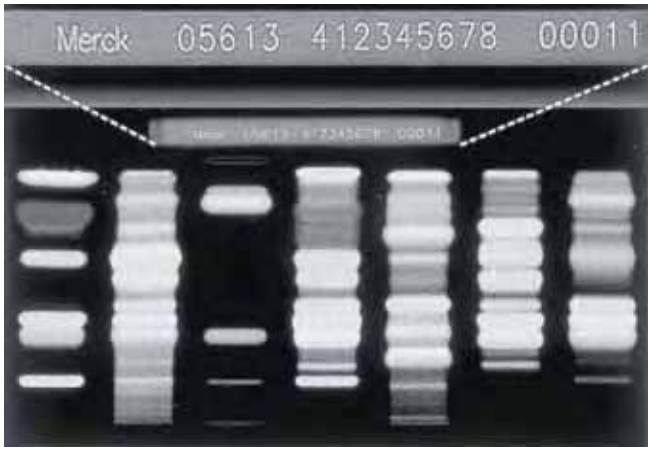
With individual laser coding for GLP applications

Laser coded GLP plates have been specifically developed for working according to GLP.

The plates carry item, batch and individual plate number on the top of every single plate enabling for convenient back tracing of article, batch, and individual plate number. Every plate can easily be documented and archived.

Based on the same proven Merck silica as TLC or HPTLC, GLP plates provide the same unsurpassed separation performance as the corresponding TLC or HPTLC plates.

GLP coded plates are available as TLC or HPTLC grade in various formats, without or with fluorescence indicator F_{254} that is stimulated to green emission at 254 nm.



Ordering information

GLP plates, glass backed

Packing Material	Ordering No.	Format (cm)	Contents of one package
TLC GLP silica gel 60 F_{254} [1)]	1.05566.0001	20 x 20	25 plates
	1.05702.0001	10 x 20	25 plates
HPTLC GLP silica gel 60 F_{254}	1.05564.0001	10 x 10	25 plates
HPTLC GLP silica gel 60	1.13326.0001	10 x 20	25 plates
HPTLC GLP silica gel 60 F_{254}	1.05613.0001	10 x 20	25 plates

[1)] Layer thickness: 250 µm

Preparative layer plates (PLC)

For enrichment of target analytes in mg quantities and cleaning

Preparative Thin Layer Plates allow the separation of mg up to g sample using up to 2 cm thick layers.

PLC plates are based on the same proven Merck silica-binder technology as analytical TLC plates. Merck's preparative plates are available with layers of silica gel, RP 18-modified silica or aluminium oxide in several layer thicknesses, ranging from 0.5 mm up to 2 mm with or without fluorescent indicator.

In PLC samples are typically applied as band across the whole width of the plate and substance are visualized almost exclusively by UV detection. The substance can be isolated by extraction after the spot has been scrapped from the layer.

Just as in analytical TLC, PLC plates with concentration zone highly facilitate sample applications.

Ordering information of preparative layer plates PLC

PLC silica 60, glass backed

Packing Material	Ordering No.		Format (cm)	Contents of one package
PLC silica gel 60	1.13894.0001	0.5 mm	20 x 20	20 plates
	1.05745.0001	2 mm	20 x 20	12 plates
PLC silica gel 60 F_{254}	1.05744.0001	0.5 mm	20 x 20	20 plates
	1.13895.0001	1 mm	20 x 20	15 plates
	1.05717.0001	2 mm	20 x 20	12 plates
PLC silica gel 60 $F_{254 + 366}$	1.05637.0001	2 mm	20 x 20	20 plates

PLC RP-modified silica 60, glass backed

Packing Material	Ordering No.		Format (cm)	Contents of one package
PLC silica RP-18 $F2_{54s}$	1.05434.0001	1 mm	20 x 20	15 plates

PLC aluminium oxide 60, glass backed

Packing Material	Ordering No.		Format (cm)	Contents of one package
PLC aluminium oxide 60 F_{254}	1.05788.0001	1.5 mm	20 x 20	12 plates

PLC aluminium oxide 150, glass backed

Packing Material	Ordering No.		Format (cm)	Contents of one package
PLC aluminium oxides 150 F_{254}	1.05726.0001	1.5 mm	20 x 20	12 plates

Applications

PLC plates are highly suitable for a variety of preparative applications including:

Cleaning and enrichment of synthetic reaction mixtures, natural products, plant extracts and bio-technological products.

Loose sorbents for preparation of TLC plates

Standardized sorbents for reliable results

Silica gel 60 sorbent is the most versatile and successful material used in Thin Layer Chromatography. Different grades of silical gel 60 sorbents with a particle size of 5-40 µm are offered: silica with gypsum as binder, silica without any foreign binder, silica gel with fluorescence indicator to suite a broad range of TLC and PLC needs.

In addition, high quality aluminium oxide, cellulose microcrystalline and kieselguhr is offered.

Ordering information

Silica gel 60 for TLC and PLC plates (particle size 5 – 50 µm)

Packing Material	Ordering No.	Method	Package	Contents of one package
Silica gel 60 G	1.07731.1000	Classical TLC	Plastic	1 kg
	1.07731.5000		Tin	5 kg
	1.07731.9025		Tin	25 kg
Silica gel 60 G F_{254}	1.07730.1000	Classical TLC	Plastic	1 kg
	1.07730.5000		Tin	5 kg
	1.07730.9025		Tin	25 kg
Silica gel 60 G* F_{254}	1.11678.1000	TLC	Plastic	1 kg
Silica gel 60 H	1.07736.1000	TLC	Plastic	1 kg
	1.07736.2500		Tin	2.5 kg
	1.07736.9025		Tin	25 kg
Silica gel 60 H*	1.11695.1000	TLC	Plastic	1 kg
Silica gel 60 H F_{254}	1.07739.1000		Plastic	1 kg
	1.07739.2500		Tin	2.5 kg
	1.07739.9025		Tin	25 kg
Silica gel 60 H F_{254} + F_{366}	1.07741.1000	TLC	Plastic	1 kg
Silica gel 60 P F_{254}	1.07747.1000	PLC	Plastic	1 kg
	1.07747.2500		Tin	2.5 kg
	1.07747.9025		Tin	25 kg
Silica gel 60 P F_{254} + F_{366}	1.07748.1000	PLC	Plastic	1 kg
	1.07748.2500		Tin	2.5 kg
Silica gel 60 P F_{254} with gypsum	1.07749.1000	PLC	Plastic	1 kg
	1.07749.2500		Tin	2.5 kg
	1.07749.9025		Tin	25 kg

* Mean particle size 15 µm

H: Without foreign binder
G: With gypsum
P: For preparative work

Loose sorbents for preparation of TLC plates

Standardized sorbents for reliable results

Aluminium oxides for TLC and PLC (particle size 5 – 40 µm)

Packing Material	Ordering No.	Method	pH of 10% aqueous suspen-sion	Package	Contents of one package
Aluminium oxide 60 G neutral	1.01090.2500	TLC	7.5	Plastic	2.5 kg
	1.01090.9025		7.5	Plastic	25 kg
Aluminium oxide 60 G F_{254} neutral	1.01092.0500	TLC	7.5	Plastic	500 g

Other sorbents for TLC

Packing Material	Ordering No.	Method	Package	Contents of one package
Cellulose microcrystalline	1.02330.0500	< 20 µm	Plastic	500 g
Kieselguhr G	1.08129.0500	5 - 40 µm	Plastic	500 g

Self-coating of layers is time consuming and requires experimental experience for high quality results. '
For analytical TLC, particularly for quantitative work we highly recommend the use of pre-coated plates.

Accessories

TLC Sprayer

Even and very finely divided spray solution is a prerequisite for optimal staining of TLC plates to visualize colourless substances.

The Merck TLC sprayer allows spraying derivatisation reagents homogenously onto the developed chromatograms to detect colourless substances. It is equipped with two different spray heads of 0.8 mm and 1.25 mm optimised for low - and for high viscosity solutions respectively. The elecropneumatically operated sprayer uses compressed air driven by accumulator power and inductive charging.

Our ready-to-use spray solutions come in special 100 ml packages, that can be screwed directly to the sprayer eliminating cumbersome pouring of the solutions.

Spray solution

The three most common spray solutions used in TLC are offered as ready-to-use solutions in optimised packing to fit directly onto the sprayer.

UV lamp

Two UV lamps, powered by five 1.5 V baby cells (UM2) are intended for the quick detection of substances under short - or long-wavelength UV light.

Ordering information of accessories

Accessories and auxiliaries

Product	Ordering No.	Contents of one package
Micro capillaries 2.0 µl	1.10290.0001	50 capillaries
UV lamp 254 nm	1.12537.0001	1 unit
UV lamp 366 nm	1.13203.0001	
TLC sprayer with two spray heads	1.08540.0001	1 unit
Spray heads for TLC sprayer	1.08541.0001	6 pieces: 5 x 0.8 mm bore 1 x 1.25 mm bore
Glass bottles 50 ml	1.10647.0001	10 bottles
Glass bottles 100 ml	1.10646.0001	10 bottles

Ready-to-use spray solutions

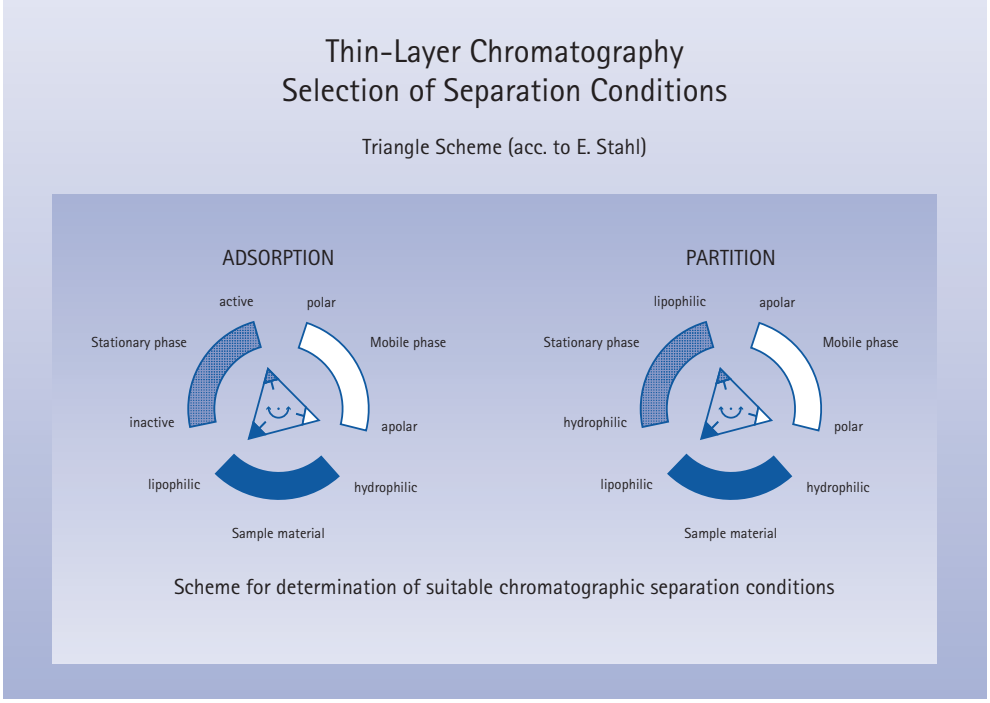
Solution	Ordering No.	Solvent	Package	Contents of one package
Dragendorff-Reagent	1.02035.0100	Acetic acid/ethyl acetate/water	glass	100 ml
Molybdatophosphoric acid	1.00480.0100	2-propanol	glass	100 ml
Ninhydrin	1.06705.0100	2-propanol	glass	100 ml

TLC performance is essentially determined by the stationary phase (e.g. silica, cellulose, ...) and the mobile phase.

Optimal chromatograms can be obtained by variation of these parameters.

Selection of separation conditions

The triangle scheme according to Stahl provides a basis tool for the selection of separation conditions for adsorption, (A) and for partition chromatography (B): By turning one selected parameter on the applicable position the other parameters are automatically defined.



Scheme for determination of suitable chromatographic separation conditions

The eluotropic series of solvents, where the solvents are listed in order of increasing elution power, is helpful in the choice of a suitable mobile phase for a particular separation problem. The following table lists an eluotropic series for silica gel as stationary phase (eluotropic series for silica gel acc. to Halpaap).

Solvent	Polarity index acc. to Synder	Dielectricity constant DK (20 resp. 25 °C)	Molar Mass (g/mol)	Boiling point (°C)	Vapour pressure (20 °C) (mbar)	MAK value 1994* (ml/m^3) = (ppm)
n-Heptane	-	1.9	100.21	98.4	48	500
n-Hexane	0.0	1.9	86.18	68.9	160	50
Cyclohexane	0.0	2.0	84.16	80.7	104	300
Isooctane	0.4	1.9	114.23	99.2	51	500
1,1,2-Trichlorotrifluoroethane	-	2.4	187.38	47.7	368	500
Carbon Tetrachloride	1.7	2.2	153.82	76.5	120	10
Toluene	2.3	2.4	92.14	110.6	29	100
tert-Butyl methyl ether	2.9	-	88.15	55.2	417	-
Chloroform	4.4	4.8	119.38	61.7	210	10
Dichloroethane	3.7	10.6	98.97	83.4	87	5
Dichloromethane	3.4	9.1	84.93	40.0	453	100
1-Butanol	3.9	17.8	74.12	117.2	6.7	100
Acetonitrile	6.2	37.5	41.05	81.6	97	40
2-Propanol	4.3	18.3	60.10	82.4	43	400
Ethyl acetate	4.3	6.0	88.10	77.1	97	400
Acetone	5.4	20.7	58.08	56.2	233	1000
Ethanol	5.2	24.3	46.07	78.5	59	1000
1,4-Dioxane	4.8	2.2	88.11	101.0	41	50
Tetrahydrofuran	4.2	7.4	72.11	66.0	200	200
Methanol	6.6	32.6	32.04	65.0	128	200
Water	9.0	80.2	18.01	100.0	23	-

*BIA-Report 1/94

Other parameters influencing performance

TLC is usually carried out in open separation system and a variety of further factors influence the quality of the result. Main factors are:

- Sample application
- Relative humidity
- Layer reproducibility
- Impurities of the solvent

Sample application

Samples can be applied as spot or narrow band. In both cases the size and width will influence the separation. As a general rule, samples should be applied as narrow as possible. Manual application is achieved with capillaries or pipette. For large sample volume concentrating zone plates will highly facilitate the sample application. For quantitative work semi automated or automated sample application is recommend for reliable, reproducible results.

Humidity

TLC plates, especially the widely used unmodified silica sorbent adsorb water. Change in relative humidity can effect a number of important factors e.g. Rf values, selectivity, solvent front migration and the position of multiple fronts. The relative humidity of the atmosphere is therefore critically for reproducible work. If constant humidity can not be ensured, we propose to pre-condition the plates 30 min over saturated salt solutions or sulphuric acid solutions of particular concentrations. The relative humidity above selected salt solutions is given in Table.

Saturated salt solution containing a large quantity of undissolved salt	Relative humidity above solution (20 °C) (%)
di-Sodium hydrogenphosphate $Na_2PO_4 \cdot 12\ H_2O$	95
Sodium carbonate $Na_2CO_3 \cdot 10\ H_2O$	92
Zinc sulfate $ZnSO_4 \cdot 7\ H_2O$	90
Potassium chloride KCl	86
Ammonium sulfate $(NH_4)_2SO_4$	80
Sodium chloride NaCl	76
Sodium chlorate $NaClO_3$	75
Sodium nitrite $NaNO_2$	65
Ammonium nitrate NH_4NO_3	63
Calcium nitrate $Ca(NO_3)_2 \cdot 4\ H_2O$	55
Sodium dichromate $Na_2Cr_2O_7 \cdot 2\ H_2O$	52
Potassium carbonate K_2CO_3	45
Zinc nitrate $Zn(NO_3)_2 \cdot 6\ H_2O$	42
Chromium trioxide CrO_3	35
Calcium chloride $CaCl_2 \cdot 6\ H_2O$	32
Potassium acetate $K(OOCCH_3)$	20
Lithium chloride $LiCl \cdot H_2O$	15

Thin Layer Chromatography and Pharmacopoeia (Ph EUR, BP, USP, DAB)

Traditionally TLC monographs in the pharmacopoeia refer to TLC products using silica G containing gypsum as binder or silica H without any foreign binder.

Pre-coated plates without binder or with gypsum have a very fragile surface and cannot be packed and transported without distortion of the layer. Therefore G and H plates are not available commercially but must be prepared from the corresponding loose silica gels G and H.

Merck plates contain an organic binder that was especially chosen to cause as less chromatographic deviations as possible in comparison to sorbents containing G or H.

There is no restriction by the PhEur to use pre-coated plates containing other organic binders then G or H presumed the chromatographic results are comparable to the results with "G" or "H" plates. The later has to be confirmed individually.

The following publications, available in german language only, feature monographs of PhEur on pre-coated TLC plates:
"P. Pachaly: DC-Atlas - Dünnschicht-Chromatographie in der Apotheke, Wissenschaftliche Verlagsgesellschaft Stuttgart 1999 (ISBN 3-8047-1623-7)". Includes many documented monographs of PhEur on Merck TLC plates.

Jürgen Wolf: Mikro-DC, PZ-Schriftenreihe, "Vorschriften auf Basis des PhEur, DAB und DAC". Govi-Verlag, Eschborn 1999, ISBN 3-7741-0736-X. This book features a broad range of monographs of the PhEur evaluated on Merck TLC aluminium sheets Si 60.

Gas Chromatography

Gas chromatography, in spite of other developments in analytical chemistry, remains one of the most frequently used analytical tools. It is applied in widely different areas such as medicine, biology, environmental sciences and most notably in an impressive number of industrial applications. No other analytical technique can provide the combination of resolving power with speed of analysis and sensitivity. Besides qualitative and quantitative information contained in the chromatogram, GC can rather easily be coupled with spectrometric techniques for structure confirmation or selective detection such as GC-MS (Mass spectrometers).

The performance of columns and chromatographic equipment has steadily been improved. The major breakthrough was the invention of capillary columns by Golay in 1958. The introduction of flexible fused silica columns by Dandeneau and Zerenner in 1979 meant a large step forward in the acceptance of capillary columns. Compared to packed columns the capillary columns give much better resolution in shorter analysis time. For analytical work capillary colums are normally used.

A wide range of universal and selective detectors with well adapted solvents (high purity solvents) are available, many of the eminently suited for residue and trace analysis. Autosamplers, that can run unattendedly, provide very good precision in sample introduction. Quantitative GC-results can be very accurate.

For all the reasons summed up above, it is clear that GC is the method of choice, provided that the sample has sufficient volatility and thermal stability in the selected temperature region.

Content

Gas Chromatography 250

High purity solvents for gas chromatography: SupraSolv® and UniSolv® 252

Merck - sorbents for packed columns 257

Merck - Derivatisation reagents 258

Merck - Reference substances 259

High purity solvents for gas chromatography:
SupraSolv® and UniSolv®

Tailor-Made Solvents for Gas Chromatography

GC-Analysis comprises sample preparation like extraction and concentration of the extracts before injection. Solvents are necessary with the highest possible degree of purity.

SupraSolv® and UniSolv® are the GC solvents of high batch consistency for all trace and environmental analyses.

They provide the analyst with the security and reliability so necessary for today's applications, especially when monitoring and determining environmentally relevant substances in soil and water samples, e.g. polycyclic aromatic hydrocarbons (PAH), polychlorinated biphenyls (PCB), polychlorinated dibenzodioxins (PCDD), pesticides, but also highly volatile chlorinated hydrocarbons (HVHC) present in ppb trace amounts only.

Whilst the demands placed on the selectivity and sensitivity of the detection procedures used for environmental pollutants are constantly increasing, the results obtained may be falsified by the tiniest traces of impurities in the solvents used. The specifications of the solvents have been especially adapted to the particular area of application.

- SupraSolv® for Gas Chromatography
- UniSolv® for organic trace analysis

Solvents for Gas Chromatography

Trade Name	Application	Instrumentation
SupraSolv® for Gas Chromatography	Sample preparation Analysis of medium to high boiling substances (e.g. pesticides)	Gas Chromatography suitable for Detection GC-ECD
UniSolv® for Organic Trace Analysis	„ONE FOR ALL" Sample preparation Analysis of low to high boiling substances (e.g. waste water and/or soil analysis)	Gas Chromatography suitable for Detection GC-ECD GC-FID GC-MS

Specifications
SupraSolv® for Gas Chromatography

GC-ECD retention time range	
• 1,2,4-Trichlorobenzene to Decachlorobiphenyle Individual signals (Lindane standard) Column HP Ultra 2	max. 3 pg/ml

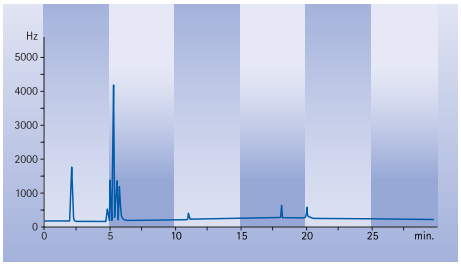


Fig. 1: GC-ECD,
n-Hexane SupraSolv® (1.04371),
batch chromatogram

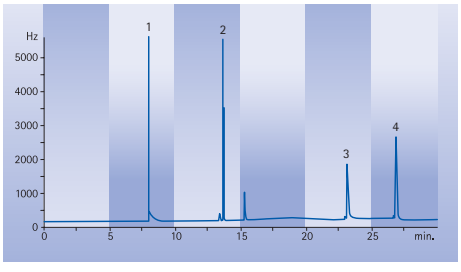


Fig. 2: GC-ECD,
Reference chromatogram
1 1,2,4-Trichlorobenzene
2 Lindane
3 Coumaphos
4 Decachlorobiphenyle

UniSolv® for Organic Trace Analysis

GC-ECD retention time range

- 1,2,4-Trichlorobenzene to Decachlorobiphenyle
  Individual signals (Lindane standard) max. 2 pg/ml
  Column HP Ultra 2 (see Fig. 1/2)
- Dichloromethane to 1,2,4-Trichlorobenzene
  Individual signals (Carbon tetrachloride standard) max. 1 ng/ml
  Column DB 624

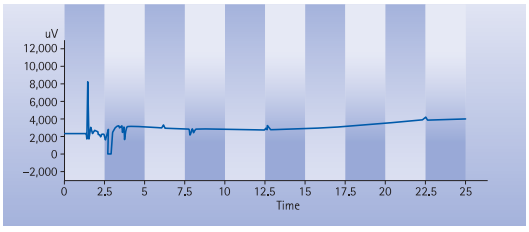


Fig. 3: GC-ECD,
n-Hexane UniSolv® (1.04369),
batch chromatogram

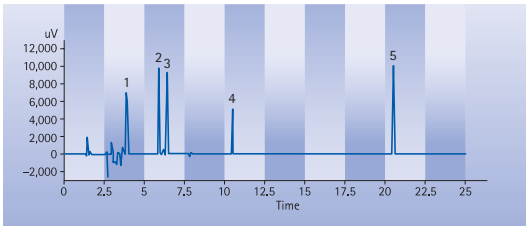


Fig. 4: GC-ECD,
Reference chromatogram
1 Dichloromethane
2 Chloroform
3 Carbon tetrachloride
4 Tetrachloro ethylene
5 Trichlorobenzene

GC-FID retention time range

- n-Undecane to n-Tetracontane
  Individual signals (n-Tetradecane standard) max. 2 ng/ml

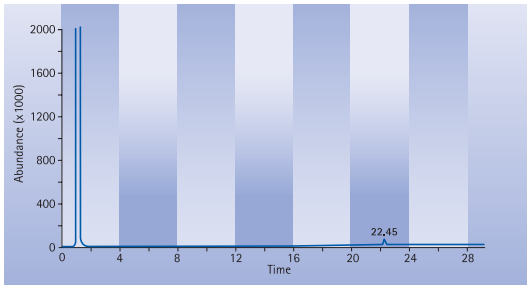


Fig. 5: GC-FID,
n-Hexane UniSolv® (1.04369),
batch chromatogram

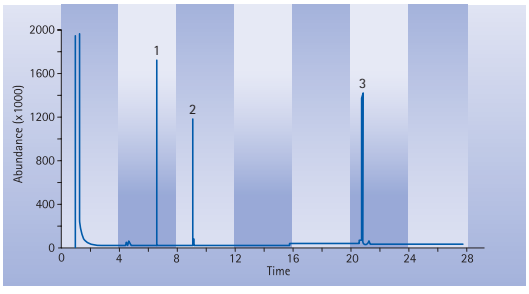


Fig. 6: GC-FID,
Reference chromatogram
1 n-Undecane
2 n-Tetradecane
3 n-Tetracontane

GC-MS retention time range

- n-Undecane to n-Tetracontane
  (scanning area 30-600 amu)
  Individual signals (n-Tetradecane standard) max. 2 ng/ml

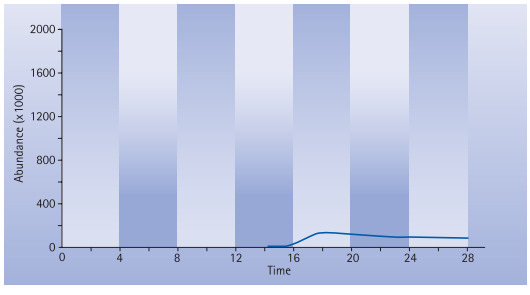


Fig. 7: GC-MS,
n-Hexane UniSolv® (1.04369),
batch chromatogram

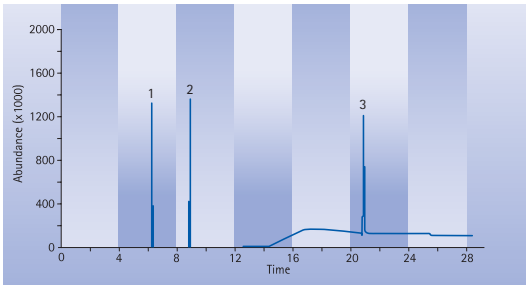


Fig. 8: GC-MS,
Reference chromatogram
1 n-Undecane
2 n-Tetradecane
3 n-Tetracontane

High purity solvents for gas chromatography:
SupraSolv® and UniSolv®

Ordering Information
SupraSolv® for Gas Chromatography

Designation	Ordering No.	evap. residue max. [mg/l]	Water max. [%]	Colour max. [Hazen]	Content
Acetone	1.00012.1000 1.00012.2500 1.00012.4000 1.00012.9010 1.00012.9030	3.0	0.05	10	1 l 2.5 l 4 l 10 l 30 l
Acetonitrile	1.00017.1000 1.00017.2500 1.00017.4000	3.0	0.05	10	1 l 2.5 l 4 l
Benzene	1.01792.1000	3.0	0.02	10	1 l
tert-Butyl methyl ether	1.01995.1000 1.01995.2500 1.01995.4000	3.0	0.02	10	1 l 2.5 l 4 l
Chloroform	1.02432.1000 1.02432.2500 1.02432.4000	5.0	0.01	10	1 l 2.5 l 4 l
Cyclohexane	1.02817.1000 1.02817.2500 1.02817.4000 1.02817.9010 1.02817.9030	3.0	0.01	10	1 l 2.5 l 4 l 10 l 30 l
Dichloromethane	1.06054.1000 1.06054.2500 1.06054.4000 1.06054.9010 1.06054.9030	5.0	0.01	10	1 l 2.5 l 4 l 10 l 30 l
N,N-Dimethylformamide	1.10983.1000 1.10983.2500	3.0	0.05	10	1 l 2.5 l
Ethyl acetate	1.10972.1000 1.10972.2500 1.10972.4000 1.10972.9010 1.10972.9030	3.0	0.02	10	1 l 2.5 l 4 l 10 l 30 l

1.04371
n-Hexane SupraSolv®

1.16740
Petroleum benzene (40–60°C) UniSolv®

High purity solvents for gas chromatography:
SupraSolv® and UniSolv®

Designation	Ordering No.	evap. residue max. [mg/l]	Water max. [%]	Colour max. [Hazen]	Content
n-Hexane	1.04371.1000 1.04371.2500 1.04371.4000 1.04371.9010 1.04371.9030	3.0	0.01	10	1 l 2.5 l 4 l 10 l 30 l
Isohexane	1.04340.2500	3.0	0.01	10	2.5 l
Isooctane	1.15440.1000 1.15440.2500	3.0	0.01	10	1 l 2.5 l
Methanol	1.06011.1000 1.06011.2500 1.06011.4000	3.0	0.1	10	1 l 2.5 l 4 l
Petroleum benzene (40-60 °C)	1.01772.1000 1.01772.2500 1.01772.4000 1.01772.9010 1.01772.9030	3.0	0.01	10	1 l 2.5 l 4 l 10 l 30 l
2-Propanol	1.00998.1000 1.00998.2500	3.0	0.1	10	1 l 2.5 l
Toluene	1.08389.1000 1.08389.2500 1.08389.4000 1.08389.9010 1.08389.9030	3.0	0.03	10	1 l 2.5 l 4 l 10 l 30 l

1.04369
n-Hexane Unisolv®

UniSolv® for organic trace analysis

Designation	Ordering No.	evap. residue max. [mg/l]	Water max. [%]	Colour max. [Hazen]	Content
n-Hexane	1.04369.1000 1.04369.2500 1.04369.9010	3.0	0.005	10	1 l 2.5 l 10 l
n-Pentane	1.07288.1000 1.07288.2500	3.0	0.01	10	1 l 2.5 l
Petroleum benzene (40-60 °C)	1.16740.1000 1.16740.2500	3.0	0.005	10	1 l 2.5 l
Toluene	1.08388.1000 1.08388.2500	3.0	0.005	10	1 l 2.5 l

1.07288
n-Pentane UniSolv®

Application

Determination of hydrocarbon oil index in water according to ISO 9377-2 (H 53, 2000) and in soil according to ISO 16703 (2002-03) by GC-FID.

Petroleum benzene, UniSolv®(1.16740) is used as an extracting agent. Due to the high quality of Petroleum benzene, UniSolv®analysis time can be reduced extremly (retention time within 14 minutes of hydrocarbon oil index C10-C40 including long-chain or branched aliphatic, alicyclic, aromatic or alkyl-substituted aromatic hydrocarbon) (see Figures below). Thus allows a high throughput of samples.

(Acknowledgement to CAL, Chemisch Analytisches Laboratorium GbR, Darmstadt, Germany, www.cal-darmstadt.de to make the chromatograms available for publishing)

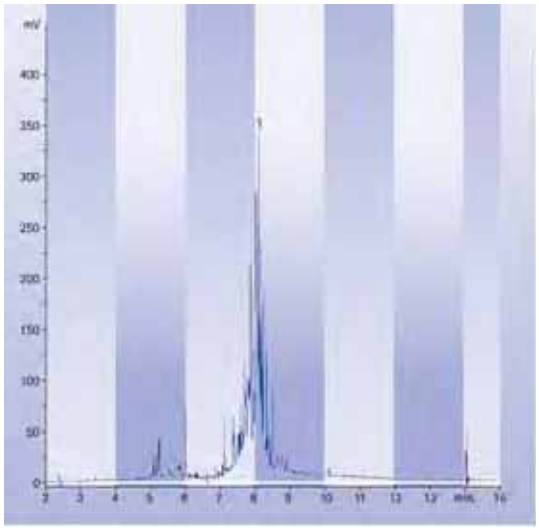


Fig. 1: Determinaton of hydrocarbon oil index (C10-C40) in soil, Petroleum benzene UniSolv®, measured value 173 mg/kg, GC-FID
1 hydrocarbon oil index (C10-C40) - 8.10 min.

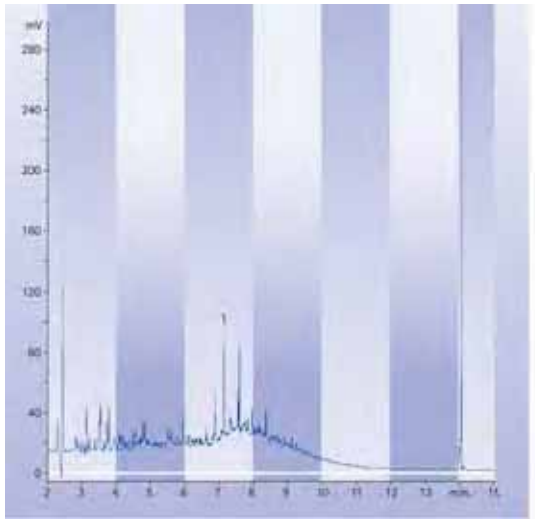


Fig. 2: Determination of hydrocarbon oil index (C10-C40) in water, Petroleum benzene UniSolv®, measured value 0,62 mg/l , GC-FID
1 hydrocarbon oil index (C10-C40) - 7.13 min.

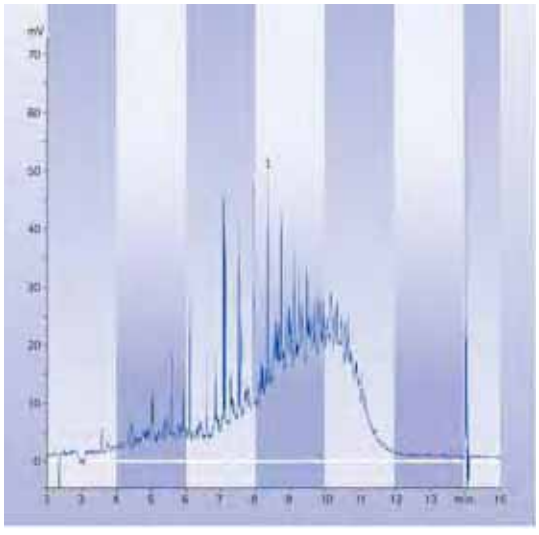


Fig. 3: GC-FID, Reference chromatogram of hydrocarbons C10-C40, Petroleum benzene UniSolv®
1 hydrocarbon oil index (C10-C40) - 8.36 min.

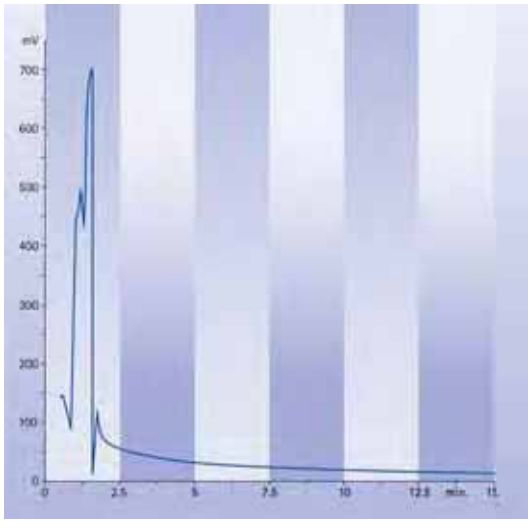


Fig. 4: Petroleum benzene UniSolv®, blank run

Merck – sorbents for packed columns

The chromatographic column can be filled by an adsorbent (Gas-Solid Chromatography, GSC). For GSC the most often used adsorbent is the active charcoal.

1.09678

1.09631

Ordering information of Merck – sorbents for packed columns

Sorbents for GSC – Active charcoal

Designation	Ordering No.	Particle size (mm)	Particle size (mesh)	Package	Content
Active charcoal	1.09631.0100	0.3 - 0.5	35 - 50	Glass	100 g
Active charcoal	1.09631.0500	0.3 - 0.5	35 - 50	Glass	500 g
Active charcoal	1.09624.0100	0.5 - 1.0	18 - 35	Glass	100 g
Active charcoal	1.09624.0500	0.5 - 1.0	18 - 35	Glass	500 g

Liquid stationary phases

Designation	Ordering No.	Solvent*	Temperature range (°C)	Package	Content
Dimethyl sulfoxide	1.09678.0100	A	0 - 40	Glass	100 ml
Dinonyl phthalate	1.09669.0100	A, C	20 - 130	Glass	100 ml
Polyethylene glycol 400 (Carbowax 400)	1.09726.0100	C	40 - 90	Glass	100 ml
Polyethylene glycol 1000 (Carbowax 1000)	1.09729.0100	C	40 - 130	Glass	100 g
Polyethylene glycol 4000 (Carbowax 4000)	1.09727.0100	C	50 - 150	Plastic	100 g
Silicone oil 550	1.09762.0100	C	20 - 130	Glass	100 ml
Squalane	1.09766.0100	C	20 - 120	Glass	100 ml
Triton®X-100	1.12298.0101	M	20 - 180	Glass	100 ml
Triton®X-100	1.12298.1001	M	20 - 180	Glass	1 l

* A = Acetone C = Chloroform M = Methanol

Merck – Derivatisation reagents

Many substances - e.g. readily decomposed or difficultly volatile compounds - can only be investigated chromatographically after conversion to stable, readily volatile derivatives. In many cases, however, a derivatisation reaction serves to increase the sensitivity of detection.

The following table provides an overview of the fields of application of the various derivatisation reagents. The table contains acylating, alkylating and silylating reagents and also several ancillary reagents.

1.09649

Ordering information of Merck – Derivatisation reagents

Silylation

Designation	Ordering No.	Package	Content
Bis(trimethylsilyl) acetamide, BSA	1.09649.0010	Glass	10 ml
Bis(trimethylsilyl) acetamide, BSA	1.09649.0025	Glass	25 ml
Bis(trimethylsilyl) trifluoroacetamide, BSTFA	1.10255.0005	Glass	5 ml
Bis(trimethylsilyl) trifluoroacetamide, BSTFA	1.10255.0025	Glass	25 ml
Chlorotrimethylsilane, TMCS	1.02333.0100	Glass	100 ml
Chlorotrimethylsilane, TMCS	1.02333.0250	Glass	250 ml
1,1,1,3,3,3-Hexamethyldisilazane, HMDS	1.12186.0025	Glass	25 ml
1,1,1,3,3,3-Hexamethyldisilazane, HMDS	1.12186.0100	Glass	100 ml
Hexamethyldisiloxane	1.04500.0100	Glass	100 ml
N-Methyl-N-(trimethylsilyl)2,2,2-trifluoroacetamide, MSTFA	1.11805.0005	Glass	5 ml
N-(Trimethylsilyl)imidazole, TMSI	1.09771.0005	Glass	5 ml

Acylation

Designation	Ordering No.	Package	Content
Heptafluorobutyric anhydride HFAA	1.09653.0010	Glass ampoule	10 ml
Trifluoroacetic anhydride, TFAA	1.12513.0010	Glass	10 ml

Application fields of the derivatisation reagents

Substances Reagent	Alcohols	Amines	Carboxylic acids
Bis(trimethylsilyl) acetamide	X	X	X
Bis(trimethyl) trifluoroacetamide	X	X	X
Chlorotrimethylsilane	X	X	X
Heptafluorobutyric anhydride	X	X	
Hexamethyldisilazane	X	X	
N-Methyl-bis(trifluoroacetamide)	X	X	
N-Methyl-N-(trimethylsilyl)-trifluoro acetamide			
Trifluoroacetic anhydride	X	X	
N-(Trimethylsilyl) acetamide	X	X	X
N-(Trimethylsilyl) diethylamine	X	X	
N-(Trimethylsilyl) imidazole		X	X

Merck – Reference substances

Under the designation "reference substance for GC" we offer a range of particularly pure substances, the great majority of which are completely synthetic in origin and, hence, largely free from isomers that are difficult to separate by GC. Their assay is generally greater than 90 % usually over 99.5 or 99.7 %. Each pack includes a gas chromatogram under the appropriate test conditions.

The reference substances can be used for the identification of unknown compounds in a gas chromatogram or as standards in quantitative GC analysis. They serve also for the characterisation of GC column properties.

The reference substances belonging to the hydrocarbon group are packed in pierceable ampoules, the fatty acid methyl esters and other reference substances in screw-capped glass vials.

Ordering information of Merck – Reference substances

Hydrocarbons

C 5

Designation	Ordering No.	Assay (%)	Empirical formula	Package	Content
Cyclopentane	1.09662.0005	≧ 99.5	C_5H_{10}	Glass	5 ml
2-Methylbutane	1.09643.0005	≧ 99.7	C_5H_{12}	Glass	5 ml
n-Pentane	1.09719.0005	≧ 99.7	C_5H_{12}	Glass	5 ml

C 6

Designation	Ordering No.	Assay (%)	Empirical formula	Package	Content
Benzene	1.09646.0005	≧ 99.9	C_6H_6	Glass	5 ml
Cyclohexane	1.09663.0005	≧ 99.7	C_6H_{12}	Glass	5 ml
n-Hexane	1.09687.0005	≧ 99.7	C_6H_{14}	Glass	5 ml

C 7

Designation	Ordering No.	Assay (%)	Empirical formula	Package	Content
2,3-Dimethylpentane	1.09679.0005	≧ 99.0	C_7H_{16}	Glass	5 ml
n-Heptane	1.09686.0005	≧ 99.5	C_7H_{16}	Glass	5 ml
Methylcyclohexane	1.09704.0005	≧ 99.5	C_7H_{14}	Glass	5 ml
3-Methylhexane	1.09703.0005	≧ 99.0	C_7H_{16}	Glass	5 ml
Toluene	1.09768.0005	≧ 99.7	C_7H_8	Glass	5 ml

C 8

Designation	Ordering No.	Assay (%)	Empirical formula	Package	Content
Ethylbenzene	1.09635.0005	≧ 99.5	C_8H_{10}	Glass	5 ml
3-Methylheptane	1.09699.0005	≧ 99.0	C_8H_{18}	Glass	5 ml
n-Octane	1.09716.0005	≧ 99.0	C_8H_{18}	Glass	5 ml
o-Xylene	1.09798.0005	≧ 99.0	C_8H_{10}	Glass	5 ml
m-Xylene	1.09797.0005	≧ 99.3	C_8H_{10}	Glass	5 ml
p-Xylene	1.09799.0005	≧ 99.5	C_8H_{10}	Glass	5 ml

C 9 – C 18

Designation	Ordering No.	Assay (%)	Empirical formula	Package	Content
n-Nonane	1.06833.0005	≧ 99.5	C_9H_{20}	Glass	5 ml
n-Decane	1.09603.0005	≧ 99.5	$C_{10}H_{22}$	Glass	5 ml
n-Undecane	1.09794.0005	≧ 99.5	$C_{11}H_{24}$	Glass	5 ml
n-Dodecane	1.09658.0005	≧ 99.0	$C_{12}H_{26}$	Glass	5 ml
n-Tridecane	1.09609.0005	≧ 99.5	$C_{13}H_{28}$	Glass	5 ml
n-Tetradecane	1.09608.0005	≧ 99.0	$C_{14}H_{30}$	Glass	5 ml
n-Pentadecane	1.09607.0005	≧ 99.5	$C_{15}H_{32}$	Glass	5 ml
n-Hexadecane	1.09605.0005	≧ 99.0	$C_{18}H_{34}$	Glass	5 ml
n-Heptadecane	1.09604.0005	≧ 99.3	$C_{17}H_{36}$	Glass	5 ml
n-Octadecane	1.09606.0005	≧ 99.3	$C_{18}H_{38}$	Glass	5 ml

Reference substances – Fatty acid methyl esters

Designation	Ordering No.	Assay (%)	Empirical formula	Package	Content
Methyl decanoate	1.09637.0005	≧ 99.5	$C_{11}H_{22}O_2$	Glass	5 ml
Methyl erucate	1.09757.0005	≧ 95.0	$C_{23}H_{44}O_2$	Glass	5 ml
Methyl laurate	1.09693.0005	≧ 99.0	$C_{13}H_{26}O_2$	Glass	5 ml
Methyl linoleate	1.09767.0005	≧ 98.0	$C_{19}H_{34}O_2$	Glass	5 ml
Methyl margarate	1.09754.0005	≧ 99.0	$C_{18}H_{36}O_2$	Glass	5 ml
Methyl myristate	1.09736.0005	≧ 99.5	$C_{15}H_{30}O_2$	Glass	5 ml
Methyl octanoate	1.09633.0005	≧ 99.5	$C_9H_{18}O_2$	Glass	5 ml
Methyl oleate	1.09743.0005	≧ 96.0	$C_{19}H_{36}O_2$	Glass	5 ml
Methyl stearate	1.09602.0005	≧ 99.0	$C_{19}H_{38}O_2$	Glass	5 g
Methyl tridecanoate	1.09782.0005	≧ 99.5	$C_{14}H_{28}O_2$	Glass	5 ml
Methyl valerate	1.09781.0005	≧ 99.5	$C_6H_{12}O_2$	Glass	5 ml

Miscellaneous reference substances

Designation	Ordering No.	Assay (%)	Empirical formula	Package	Content
D-Camphor	1.09656.0005	≧ 99.0	$C_{10}H_{16}O$	Glass	5 g
Cyclohexanol	1.09667.0005	≧ 99.0	$C_6H_{12}O$	Glass	5 ml
Cyclohexanone	1.09664.0005	≧ 99.8	$C_6H_{10}O$	Glass	5 ml
Ethyl methyl ketone	1.09709.0005	≧ 99.5	C_4H_8O	Glass	5 ml
Hexamethyldisiloxane	1.04500.0100	≧ 99.0	$C_6H_{18}OSi_2$	Glass	100 ml

Index of Ordering Numbers

Ordering No.	Page	Ordering No.	Page	Ordering No.	Page	Ordering No.	Page	Ordering No.	Page	Ordering No.	Page	Ordering No.	Page
1.00012.1000	254	1.02016.0001	26	1.05570.0001	215	1.06018.5000	10	1.09303.0100	188	1.09653.0010	258	1.11727.1000	9
1.00012.2500	254	1.02021.0001	26	1.05574.0001	231	1.06018.9010	10	1.09303.0500	188	1.09656.0005	260	1.11727.2500	9
1.00012.4000	254	1.02022.0001	26	1.05577.0001	231	1.06018.9030	10	1.09303.5000	188	1.09658.0005	260	1.11727.4000	9
1.00012.9010	254	1.02023	26	1.05579.0001	233	1.06018.9185	10	1.09303.9025	188	1.09662.0005	259	1.11764.0001	221
1.00012.9030	254	1.02023.0001	26	1.05581.0001	218	1.06035.1000	10	1.09304.0100	188	1.09663.0005	259	1.11798.0001	234
1.00017.1000	254	1.02024	26	1.05582.0001	234	1.06035.1000	12	1.09308.0010	132	1.09664.0005	260	1.11805.0005	258
1.00017.2500	254	1.02024.0001	26	1.05583.0001	234	1.06035.2500	10	1.09308.0100	132	1.09667.0005	260	1.11844.0001	234
1.00017.4000	254	1.02035.0100	245	1.05586.0001	224	1.06035.2500	12	1.09309.0010	132	1.09669.0100	257	1.11845.0001	234
1.00020.1000	9	1.02122.0001	26	1.05608.0001	240	1.06044.1000	9	1.09318.0010	132	1.09678.0100	257	1.11846.0001	234
1.00020.2500	9	1.02129.0001	55	1.05613.0001	241	1.06044.2500	9	1.09318.0100	132	1.09679.0005	259	1.12186.0025	258
1.00020.4000	9	1.02206.0001	30	1.05616.0001	221	1.06044.4000	9	1.09319.0100	188	1.09686.0005	259	1.12186.0100	258
1.00020.5000	9	1.02330.0500	244	1.05620.0001	240	1.06054.1000	254	1.09319.1000	188	1.09687.0005	259	1.12298.0101	257
1.00029.1000	12	1.02331.0500	195	1.05626.0001	215	1.06054.2500	254	1.09319.5000	188	1.09693.0005	260	1.12298.1001	257
1.00029.1000	9	1.02331.2500	195	1.05628.0001	221	1.06054.4000	254	1.09321.0010	193	1.09699.0005	259	1.12363.0001	221
1.00029.2500	12	1.02331.9025	195	1.05629.0001	221	1.06054.9010	254	1.09321.0100	193	1.09703.0005	259	1.12513.0010	258
1.00029.2500	9	1.02333.0100	258	1.05631.0001	221	1.06054.9030	254	1.09321.1000	193	1.09704.0005	259	1.12518.0100	196
1.00029.9010	12	1.02333.0250	258	1.05632.0001	231	1.06833.0005	260	1.09321.5000	193	1.09709.0005	260	1.12518.1000	196
1.00029.9010	9	1.02432.1000	254	1.05633.0001	221	1.07288.1000	255	1.09324.0100	188	1.09716.0005	259	1.12537.0001	245
1.00029.9030	12	1.02432.2500	254	1.05635.0001	240	1.07288.2500	255	1.09324.0500	188	1.09719.0005	259	1.12571.0001	229
1.00029.9030	9	1.02432.4000	254	1.05636.0001	229	1.07719.0250	194	1.09332.0010	132	1.09726.0100	257	1.12572.0001	229
1.00030.1000	9	1.02444.1000	9	1.05637.0001	242	1.07719.1000	194	1.09333.0010	132	1.09727.0100	257	1.12668.0001	229
1.00030.2500	9	1.02444.2500	9	1.05641.0001	221	1.07729.1000	185	1.09333.0100	132	1.09729.0100	257	1.12994.0100	196
1.00030.4000	9	1.02444.4000	9	1.05642.0001	221	1.07729.5000	185	1.09334.0010	132	1.09736.0005	260	1.12994.1000	196
1.00030.5000	9	1.02817.1000	254	1.05644.0001	240	1.07729.9025	185	1.09334.0100	132	1.09743.0005	260	1.13124.0001	227
1.00030.9010	9	1.02817.2500	254	1.05646.0001	224	1.07730.1000	243	1.09335.0010	132	1.09754.0005	260	1.13171.0001	156
1.00030.9030	9	1.02817.4000	254	1.05647.0001	224	1.07730.5000	243	1.09335.0100	132	1.09757.0005	260	1.13187.0001	235
1.00030.9185	9	1.02817.9010	254	1.05648.0001	221	1.07730.9025	243	1.09336.1000	188	1.09762.0100	257	1.13192.0001	229
1.00423.	146	1.02817.9030	254	1.05650.0001	238	1.07731.1000	243	1.09336.9025	188	1.09766.0100	257	1.13203.0001	245
1.00424.	146	1.02827.1000	9	1.05651.0001	238	1.07731.5000	243	1.09341.0010	132	1.09767.0005	260	1.13326.0001	241
1.00868.1000	9	1.02827.2500	9	1.05702.0001	241	1.07731.9025	243	1.09346.1000	188	1.09768.0005	259	1.13350.2500	14
1.00868.2500	9	1.03132.1000	9	1.05713.0001	218	1.07733.0500	185	1.09362.0250	188	1.09771.0005	258	1.13351.2500	14
1.00868.4000	9	1.03132.2500	9	1.05714.0001	215	1.07733.1000	185	1.09362.1000	188	1.09781.0005	260	1.13351.9030	14
1.00998.1000	255	1.04335.2500	10	1.05715.0001	215	1.07733.5000	185	1.09367.0100	188	1.09782.0005	260	1.13351.9185	14
1.00998.2500	255	1.04340.2500	255	1.05716.0001	231	1.07733.9025	185	1.09371.0100	193	1.09794.0005	260	1.13353.9030	14
1.01024.1000	10	1.04369.1000	255	1.05717.0001	242	1.07734.1000	185	1.09371.1000	193	1.09797.0005	259	1.13358.2500	14
1.01024.2500	10	1.04369.2500	255	1.05718.0001	231	1.07734.2500	185	1.09371.5000	193	1.09798.0005	259	1.13358.9030	14
1.01040.1000	10	1.04369.9010	255	1.05719.0001	215	1.07734.5000	185	1.09371.9025	193	1.09799.0005	259	1.13358.9185	14
1.01040.2500	10	1.04371.1000	255	1.05721.0001	215	1.07734.9025	185	1.09372.0100	193	1.10167.1000	194	1.13358.9910	14
1.01040.5000	10	1.04371.2500	255	1.05724.0001	215	1.07736.1000	243	1.09372.1000	193	1.10167.5000	194	1.13713.1000	9
1.01040.9010	10	1.04371.4000	255	1.05725.0001	233	1.07736.2500	243	1.09372.5000	193	1.10167.9025	194	1.13724.0001	227
1.01040.9030	10	1.04371.9010	255	1.05726.0001	242	1.07736.9025	243	1.09372.9025	193	1.10180.1000	185	1.13725.0001	227
1.01061.1000	183	1.04371.9030	255	1.05727.0001	218	1.07739.1000	243	1.09373.0100	193	1.10180.5000	185	1.13726.0001	227
1.01061.2000	183	1.04390.1000	9	1.05728.0001	231	1.07739.2500	243	1.09373.1000	193	1.10180.9025	185	1.13727.0001	235
1.01061.9025	183	1.04390.2500	9	1.05729.0001	215	1.07739.9025	243	1.09373.5000	193	1.10181.1000	185	1.13728.0001	235
1.01067.1000	183	1.04390.9010	9	1.05730.0001	231	1.07741.1000	243	1.09373.9025	193	1.10184.0500	185	1.13748.0001	235
1.01067.2000	183	1.04390.9030	9	1.05731.0001	218	1.07747.1000	243	1.09374.0100	188	1.10184.5000	185	1.13749.0001	235
1.01076.1000	183	1.04391.1000	10	1.05735.0001	216	1.07747.2500	243	1.09375.0100	188	1.10184.9025	185	1.13792.0001	235
1.01076.2000	183	1.04391.2500	10	1.05738.0001	219	1.07747.9025	243	1.09385.1000	185	1.10185.0500	185	1.13793.0001	235
1.01076.9020	183	1.04391.4000	10	1.05744.0001	242	1.07748.1000	243	1.09385.2500	185	1.10185.9025	185	1.13794.0001	235
1.01077.1000	183	1.04391.5000	10	1.05745.0001	242	1.07748.2500	243	1.09385.5000	185	1.10255.0005	258	1.13894.0001	242
1.01077.2000	183	1.04391.9010	10	1.05746.0001	226	1.07749.1000	243	1.09385.9025	185	1.10255.0025	258	1.13895.0001	242
1.01077.9020	183	1.04394.9030	14	1.05747.0001	226	1.07749.2500	243	1.09389.5000	185	1.10290.0001	245	1.13900.0250	188
1.01078.1000	183	1.04500.0100	258	1.05748.0001	216	1.07749.9025	243	1.09389.9025	185	1.10400.0001	203	1.13900.1000	188
1.01078.2000	183	1.04500.0100	260	1.05749.0001	216	1.07754.0500	185	1.09390.1000	188	1.10401.0001	203	1.13900.9025	188
1.01078.9020	183	1.04717.1000	10	1.05750.0001	216	1.07754.1000	185	1.09403.0010	193	1.10402.0001	203	1.13901.0500	188
1.01090.2500	244	1.04717.2500	10	1.05786.0001	231	1.08101.1000	10	1.09403.0100	193	1.10407.0001	204	1.13901.9010	188
1.01090.9025	244	1.05007.0001	236	1.05787.0001	231	1.08101.2500	10	1.09403.1000	193	1.10624.0001	203	1.13902.0100	188
1.01092.0500	244	1.05434.0001	242	1.05788.0001	242	1.08101.4000	10	1.09403.5000	193	1.10625.0001	203	1.13903.0500	188
1.01097.1000	183	1.05533.0001	229	1.05789.0001	215	1.08101.9010	10	1.09602.0005	260	1.10626.0001	203	1.13904.1000	188
1.01097.5000	183	1.05547.0001	221	1.05801.0001	215	1.08129.0500	244	1.09603.0005	260	1.10646.0001	245	1.13905.0250	188
1.01097.9050	183	1.05548.0001	221	1.05802.0001	215	1.08327.1000	10	1.09604.0005	260	1.10647.0001	245	1.13905.1000	188
1.01692.1000	9	1.05549.0001	215	1.05804.0001	215	1.08327.2500	10	1.09605.0005	260	1.10757.1000	185	1.13905.9025	188
1.01768.1000	9	1.05550.0001	218	1.05805.0001	215	1.08327.4000	10	1.09606.0005	260	1.10972.1000	254	1.13906.0100	188
1.01772.1000	255	1.05551.0001	218	1.05808.0001	215	1.08388.1000	255	1.09607.0005	260	1.10972.2500	254	1.13925.0100	188
1.01772.2500	255	1.05552.0001	231	1.05914.0001	227	1.08388.2500	255	1.09608.0005	260	1.10972.4000	254	1.13959.0250	188
1.01772.4000	255	1.05553.0001	215	1.06007.1000	10	1.08389.1000	255	1.09609.0005	260	1.10972.9010	254	1.13969.0010	132
1.01772.9010	255	1.05554.0001	215	1.06007.2500	10	1.08389.2500	255	1.09624.0100	257	1.10972.9030	254	1.13972.0010	132
1.01772.9030	255	1.05556.0001	221	1.06007.4000	10	1.08389.4000	255	1.09624.0500	257	1.10978.0100	188	1.13973.0250	188
1.01792.1000	254	1.05559.0001	226	1.06007.5000	10	1.08389.9010	255	1.09631.0100	257	1.10983.1000	254	1.13974.0250	188
1.01845.1000	9	1.05560.0001	226	1.06007.9010	10	1.08389.9030	255	1.09631.0500	257	1.10983.2500	254	1.13974.1000	188
1.01845.2500	9	1.05562.0001	215	1.06007.9030	10	1.08540.0001	245	1.09633.0005	260	1.11023.0100	191	1.13975.0100	188
1.01988.1000	9	1.05563.0001	231	1.06007.9185	10	1.08541.0001	245	1.09635.0005	259	1.11023.0500	191	1.14236.0001	21
1.01988.2500	9	1.05564.0001	241	1.06011.1000	255	1.09018.0001	98	1.09637.0005	260	1.11024.0100	191	1.14237.0001	21
1.01995.1000	254	1.05565.0001	231	1.06011.2500	255	1.09295.0100	188	1.09643.0005	259	1.11024.1000	191	1.14291.1000	9
1.01995.2500	254	1.05566.0001	241	1.06011.4000	255	1.09295.1000	188	1.09646.0005	259	1.11024.9025	191	1.14291.2500	9
1.01995.4000	254	1.05567.0001	219	1.06018.1000	10	1.09302.0100	188	1.09649.0010	258	1.11678.1000	243	1.14291.4000	9
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1,2-Dichloroethane 9
1,4-Dioxane 9
1-Butanol 9
1-Chlorobutane 9
1-Propanol 10
2-Oxoacids 118
2-Propanol 10

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