



Basic principles of TLC 208

MN ready-to-use layers for TLC

Summary	211
Standard silica layers	213
Unmodified silica layers for HPTLC	216
Modified silica layers for HPTLC	219
Aluminium oxide layers	224
Cellulose layers	225
Layers for special separations	226

Chromatography papers 229

TLC micro-sets

Introductory kits for TLC	230
Accessories for TLC	233
Visualization reagents	233

Adsorbents for TLC

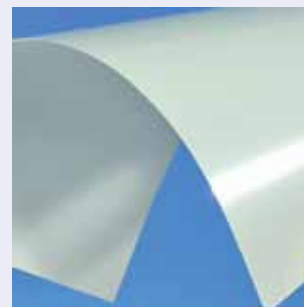
Silica, polyamide, cellulose, fluorescent indicators	234
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Glass plates



ALUGRAM® aluminium sheets



POLYGRAM® polyester sheets



Basic principles of TLC

Thin layer chromatography (TLC) and high performance thin layer chromatography (HPTLC), also called planar chromatography, are, like all chromatographic techniques, based on a multistage distribution process involving

- ◆ Suitable adsorbents (the stationary phase) coated as a thin layer onto a suitable support (e.g., glass plate, polyester or aluminium sheet)
- ◆ Solvents or solvent mixtures (the mobile phase or eluent)
- ◆ Sample molecules

The principle of TLC is known for more than 100 years [M. W. Beyerinck, Z. Phys. Chem. 3 (1889) 110]. The real break-through as an analytical method, however, came about 50 years ago as a consequence of the pioneering work of Egon Stahl [Thin layer chromatography, 2nd edition, Springer-Verlag Berlin, Reprint 1988].

Today TLC has gained increasing importance as an analytical separation technique, which is probably due to effects of instrumentation and automation [H. Jork, Laborpraxis 2 (1992) 110]. At the same time the applicability of thin layer chromatography was enhanced by development of new adsorbents and supports.

Today MACHEREY-NAGEL offers a versatile range of ready-to-use layers, which are the result of 50 years of continuous research and development.

Principle steps of a thin layer chromatographic separation

Sample preparation

For separation the sample must meet several requirements to obtain good results. Since the TLC plate is a disposable product, sample preparation in general is not as demanding as for other chromatographic methods. However, eventually several steps for sample pretreatment may be necessary. These include sampling, mechanical crushing, extraction steps, filtration and sometimes enrichment of interesting components or clean-up, i.e. removal of undesired impurities.

Our TLC micro-sets introduce some simple methods of sample pretreatment. The dyes or dye mixtures of the beginner's set do not require complicated procedures. The advanced sets require the user to carry out some additional steps for preparing a sample, thus introducing the user to techniques often performed in industrial laboratories.

Thorough preparation of samples is an important prerequisite for the success of a TLC separation. For our range of products for more demanding sample pretreatment please see the chapter "SPE" from page 2.

Sample application

The aim of a chromatographic separation determines how the sample should be applied to the TLC plate or sheet. The most frequent technique is application with a glass capillary as spot or short streak.

Features of modern TLC/HPTLC

The success of thin layer chromatography as a highly efficient microanalytical separation method is based on a large number of advantageous properties:

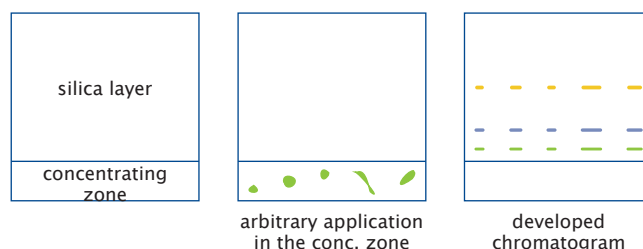
- ◆ High sample throughput in a short time
- ◆ Suitable for screening tests
- ◆ Pilot procedure for HPLC and flash chromatography
- ◆ After separation the analytical information can be stored for a longer period of time (the TLC ready-to-use layer acts as storage medium for data)
- ◆ Separated substances can be subjected to subsequent analytical procedures (e.g., IR, MS) at a later date
- ◆ Rapid and cost-efficient optimization of the separation due to easy change of mobile and stationary phase

For a better understanding of a thin layer chromatographic separation we describe here the basic steps:

- ◆ Sample preparation
- ◆ Sample application
- ◆ Development of a chromatogram, separation techniques
- ◆ Evaluation in TLC – visualization of separated substances, qualitative and quantitative determinations

Application as streak will yield better results especially for instrumental quantification. For both types of application some manual skill is required to obtain reproducible results. Substance zones which are too large from the beginning will cause poor separation since during chromatography they will become even larger and more diffuse.

A valuable aid for manual application especially of large volumes of very dilute samples is the concentrating zone (e.g., SILGUR-25 UV₂₅₄), which consists of a chromatographically inactive adsorbent (kieselguhr). The substances to be separated are concentrated to a small band in the concentrating zone and the separation starts at the beginning of the chromatographically active adsorbent silica.



Another method for sample concentration is a short pre-elution (few mm) with a solvent, in which all substances have a high R_f value.



If a quantitative evaluation with a TLC scanner is to follow the separation we recommend to use commercially available sample applicators for spotting. These range from simple spotting guides via nanoapplicators to completely automated spotting devices. Application as streak can be performed automatically by spraying of the sample without touching the layer of the TLC plate. Application as band over the whole width of the TLC plate is especially important for preparative TLC.

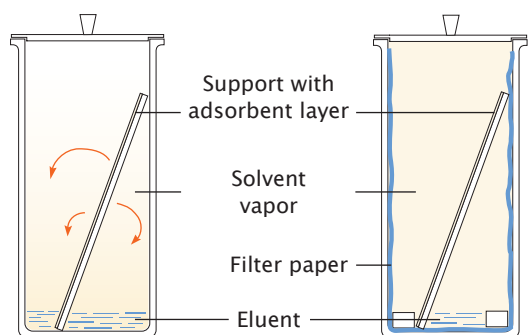
After application allow the solvent of the samples to evaporate completely (about 10 min) or blow with cold or hot air. Development of a chromatogram should never start before the solvent of the applied samples is evaporated completely.

Developing a chromatogram – separation techniques

The most frequently used separation technique is ascending TLC in a trough chamber (standard method, linear development). Usually it is applied as single development. However, multiple development, with or without change of eluent (step technique) can improve separation results. For 2-dimensional development only 1 spot of the sample is applied in one edge of a plate. After chromatography in the first direction the plate is dried, turned by 90° and developed in the 2nd dimension with another eluent. Thus complicated mixtures give 2-dimensional chromatograms taking advantage of the different separating properties of two eluents.

For selection and optimization of the eluent numerous publications are available. A generally applicable standardized optimization method is described by H. Keuker et al. [in "Proceedings of the International Symposium on Instrumental TLC", Brighton, Sussex, UK 1989, 105–114]

It is important to pay attention to the atmosphere in the developing chamber. If reproducible migration distances are required, saturation of the chamber atmosphere with eluent vapor is necessary. For this purpose the developing chamber is lined with well absorbing chromatography paper (e.g., MN 260) and charged with a correspondingly larger volume of eluent.



A) normal saturation, arrows show evaporation of the eluent from the layer

B) Chamber lined with filter paper, saturated with eluent vapor

Another interesting technique is the PMD technique (Programmed Multiple Development) [K. Burger, *Fresenius Z. Anal. Chem.* **318** (1984) 228–233], which is a true gradient development on silica for TLC. Contrary to the common multiple development every single run is slightly longer than the previous one. Thus broadening of substance zones during chromatography is easily compensated for. Usually, about 10 to 25 development cycles are run, generally with a universal gradient. Since this technique can be automated, you can also find the name AMD (Automated Multiple Development) [K. Burger, *Pflanzenschutz-Nachrichten Bayer* **41,2** (1988) 173].

It should be noted, that the considerable increase in performance with these techniques also requires a considerable increase in instrumental expense.

Evaluation of a thin layer chromatogram

Evaluation depends on the purpose of the chromatographic analysis. For qualitative determination often localization of substances is sufficient. This can be easily achieved by parallel runs with reference substances.

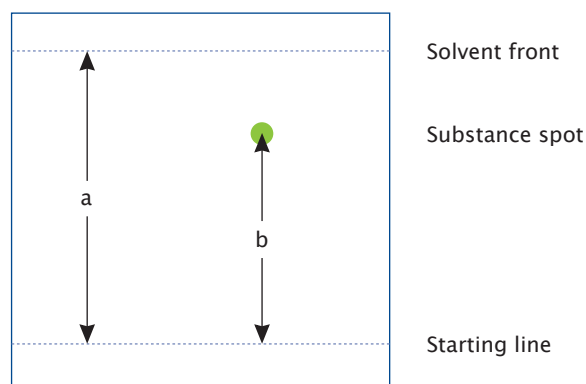
A parameter often used for qualitative evaluation is the R_f value (retention factor) or the 100fold value hR_f . The R_f value is defined as follows:

$$R_f = \frac{\text{distance starting line - middle of spot}}{\text{distance starting line - solvent front}} = \frac{b}{a}$$

i.e. the R_f values are between 0 and 1, best between 0.1 and 0.8 (i.e. 10–80 for hR_f). If reproducible R_f values are to be obtained, it is essential that several parameters such as chamber saturation, composition of solvent mixtures, temperature etc. are strictly controlled.

Quantitative evaluation is possible by suitable calibration measurements. For this purpose either the area of a substance spot is measured or a photometric evaluation is performed directly on the layer. The latter procedure, however, requires a higher instrumental expense.

The following paragraphs describe the most frequently used methods for evaluation in TLC.





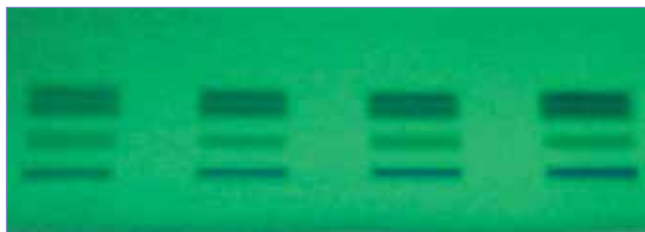
Basic principles of TLC

Qualitative detection

Qualitative evaluation is generally made directly on the TLC plate via characteristic R_f values of substances, i.e. the ratio of distance start – substance zone to distance start – solvent front and specific chemical reactions.

Visualization of separated substances

First of all it is necessary to recognize the position of a substance spot. Only in very few cases the sample is a dye which can be seen with the naked eye. Much more often for unspecific visualization substances can be viewed under UV light, since many substances show a UV absorption. If a fluorescent indicator is added to the layer, all substances absorbing in the respective region of wave length cause a quenching of the fluorescence, i.e. they appear as dark spots on the fluorescent layer. Customary fluorescent indicators are excited at 254 nm or (less frequently) at 366 nm with a mercury lamp. For our program of fluorescent indicators for TLC please see page 234.



Identification of separated substances is possible via the R_f value compared to the pure compound, which is often applied simultaneously on the same plate.

For a number of compounds their native fluorescence can be used for visualization, which is excited by UV light (mostly long-wave UV) (e.g., aflatoxins). This allows not only determination of the R_f value, but often enables a further qualitative assignment.

If these methods do not allow localization or characterization of a substance, post-chromatographic detection methods can be applied, chemical reactions on the TLC plate [H. Jork et al., *Dünnschicht-Chromatographie*, VCH Verlagsgesellschaft, 1989]. Quite unspecific reactions are iodine adsorption and the charring technique (spraying with sulfuric acid and heat treatment).

More reliable results are possible with specific reagents for spraying or dipping, which form colored or fluorescent compounds with the substances to be detected. Depending on the sensitivity of these reactions they are not only used for group or substance specific characterization (in addition to the R_f value) but also for quantification down to trace levels. As example take the ninhydrin reaction. Formation of a (usually red) zone with this detection method yields the information, that a certain group of substances, e.g., α -amino acids, are present. The R_f value allows further assignment to one or several single compounds. For identification of a substance a combination of different detection methods

can be useful. Thus almost all lipids can be converted to products with light green fluorescence by reaction with 2',7'-dichlorofluorescein. Adsorption of iodine vapor enables a differentiation between saturated and unsaturated lipids or lipids containing nitrogen. And finally the R_f value is a third means of identification.

Here are some general remarks concerning spraying: use all spray reagents under a fume hood. The developed, dried TLC plate or sheet is placed on a sheet of filter paper for spraying. Usually it is sufficient to fill the sprayer with about 5–10 mL solution. Spray from a distance of about 15 cm with the aid of a rubber ball or – if available – with pressurized air. It is always better to spray a layer twice very thinly and evenly (with intermediate drying), than to saturate the layer with excessive spray reagent. In the latter case spots tend to become diffuse. After visualization mark outlines of zones with a lead pencil, because some spots tend to fade after a while.

Especially for quantitative evaluation short dipping of the layer in the respective reagent solution is recommended. For this purpose automatic instruments are commercially available, which allow reproducible dipping.

When a substance is localized on the TLC plate (e.g., under UV), but not yet identified, TLC scanners allow recording of UV spectra of individual substance zones directly on the layer, or the zone is removed by scratching or cutting (for sheets), eluted and further analyzed, e.g., by FT-IR, RAMAN, NMR or mass spectroscopy.

Quantitative evaluation

Often TLC is considered to be only a semiquantitative analytical procedure. This is true for visual evaluation of spots, since the eye can only compare but not measure absolute values. If, however, a direct optical evaluation („in situ“ measurement) is performed on the TLC plate with a thin layer scanner, after measurement of calibration functions exact quantitative results are possible. Commercial scanners offer many features such as evaluation in absorption and fluorescence, unattended programmed scanning of lanes, multi-wave length measurement, background correction, selectable base line for integration, recording of spectra, evaluation of circular or anti-circular chromatograms with very high ease of operation. In addition to manual operation control by a computer is possible with respective data collection and storage. Usually wavelengths from 200 to 700 nm are available (visible and UV), e.g., all post-chromatographic (and of course all pre-chromatographic) visualization procedures are evaluated with the proper wavelength, which is determined with the instrument. Time requirements for all these possibilities are extremely low. Interlaboratory experiments with standard deviations of 2% show how excellent results are obtainable [Planar Chromatography, Vol. 1, ed. R. E. Kaiser, Dr. Alfred Hüthig Verlag, Heidelberg, 1986].



Advantages of MN plates and sheets for TLC

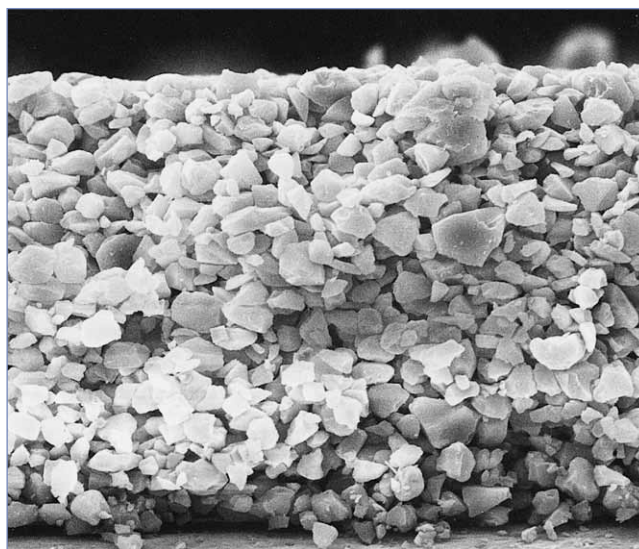
- ◆ **Continuous high quality**
 guaranteed by stringent production control including standardized lot tests, surface checks for roughness or cracks as well as hardness and adherence checks
- ◆ **Comprehensive range of phases for TLC / HPTLC**
 there is no universal TLC plate which meets all possible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



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

Adsorbents for MN plates and sheets for TLC

- ◆ **Classical adsorbents**
 for ~80% of all TLC separations silica 60 (mean pore diameter 60 Å = 6 nm) is used. Other classical adsorbents are aluminium oxide, cellulose, kieselguhr, ion exchangers and polyamide.
- ◆ **Special phases**
 reversed phases, mainly C18 (octadecyl) modified silica, but also cyano, amino, diol and RP-2 modified silica. Special layers for specific separations, like our CHIRALPLATE for enantiomer separation, complete the versatile range of TLC plates.
- ◆ **Particle size distribution and thickness of layer**
 are chosen to fit the given type of application (e.g., HPTLC, standard or preparative separations).
- ◆ Most MN ready-to-use layers are available with or without fluorescent indicator.



Electron microscope photograph of a cross section through an aluminium sheet with silica layer (magnification x 500)

Supports for ready to use layers for TLC

	Glass plates	POLYGRAM®	ALUGRAM® / ALUGRAM® Xtra
Physical properties of support materials			
Material	Glass	Polyester	Aluminium
Thickness (approx.)	1.3 mm	0.2 mm	0.15 mm
Weight, packaging and storage requirements	high	low	low
Torsional strength	ideal	low	relatively high
Temperature stability	high	max. 185 °C	high
Susceptible to breakage	yes	no	no
Can be cut with scissors	no	yes	yes
Chemical resistance of support materials			
against solvents	high	high	high
against mineral acids and conc. ammonia	high	high	low
Stability of the binder system of NP plates in water			
suitability for aqueous detection reagents	depending on phase	very suitable	ALUGRAM®: limited suitability; ALUGRAM® Xtra: very suitable



Summary of MN ready-to-use layers for TLC

Phase	Support*	Layer	Page
Standard silica			
ADAMANT	G	Silica 60, improved binder system, optimized particle size distribution	213
SIL G	G P A Ax	Silica 60, standard grade, particle size 5–17 µm	215
DURASIL	G	Silica 60, special binder system	215
SILGUR	G Ax	Silica 60 with kieselguhr concentrating zone	216
Unmodified silica for HPTLC			
Nano-SILGUR	G Ax	Nano silica 60 with kieselguhr concentrating zone	216
Nano-ADAMANT	G	Nano silica 60, improved binder system, optimized particle size distribution	217
Nano-SIL	G A Ax	Nano silica 60, standard grade, particle size 2–10 µm	218
Nano-DURASIL	G	Nano silica 60, special binder system	218
Modified silica for HPTLC			
Nano-SIL C18-50 / Nano-SIL C18-100	G	Nano silica with partial or complete C18 modification	219
RP-18 W/UV ₂₅₄	G A	Nano silica with partial octadecyl modification, wettable with water	220
RP-2/UV ₂₅₄	G A	Silanized silica = dimethyl-modified nano silica 60	220
Nano-SIL CN	G A	Cyano-modified nano silica	221
Nano-SIL NH ₂	G A	Amino-modified nano silica	222
Nano-SIL DIOL	G	Diol-modified nano silica	223
Aluminium oxide			
Alox-25 / Alox N	G P A	Aluminium oxide	224
Cellulose, unmodified and modified			
CEL 300	G P A	Native fibrous cellulose MN 300	225
CEL 400	G P	Microcrystalline cellulose MN 400 (AVICEL®)	225
CEL 300 PEI	P	Polyethyleneimine-impregnated cellulose ion exchanger	226
CEL 300 AC	P	Acetylated cellulose MN 300	226
Layers for special separations			
POLYAMIDE-6	P	Perlon = ε-aminopolycaprolactame	226
CHIRALPLATE	G	RP silica with Cu ²⁺ ions and chiral reagent, for enantiomer separation of amino acids	226
SIL N-HR	P	High purity silica 60, special binder system, higher gypsum content	227
SIL G-25 HR	G	High purity silica 60 with gypsum, recommended for aflatoxin analysis	227
SIL G-25 Tenside	G	Silica G with ammonium sulfate for separation of surfactants	228
Nano-SIL PAH	G	Nano silica with special impregnation for PAH analysis	228
IONEX-25 SA-Na	P	Mixed layer of strongly acidic cation exchanger and silica	228
IONEX-25 SB-AC	P	Mixed layer of strongly basic anion exchanger and silica	228
Alox/CEL-AC-Mix	G	Mixed layer of aluminium oxide and acetylated cellulose	229
SILCEL-Mix	G	Mixed layer of cellulose and silica	229

* **G** = glass plates **P** = POLYGRAM® polyester sheets
A = ALUGRAM® aluminium sheets **Ax** = ALUGRAM® Xtra aluminium sheets



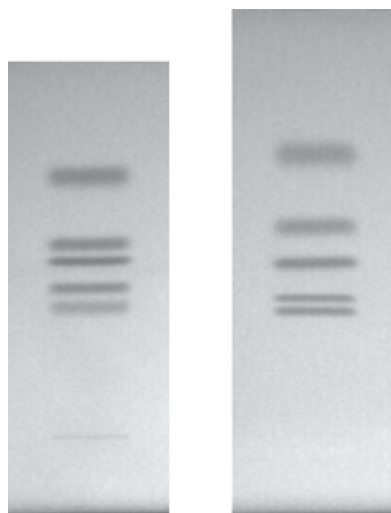
ADAMANT

unmodified standard silica layers

- ◆ Silica 60, specific surface (BET) $\sim 500 \text{ m}^2/\text{g}$, mean pore size 60 \AA , specific pore volume 0.75 mL/g , particle size $5\text{--}17 \text{ }\mu\text{m}$
 - **Outstanding hardness and abrasion resistance** due to an optimized binder system
 - **Increased separation efficiency** due to an optimized particle size distribution
 - **High suitability for trace analyses** resulting from a UV indicator with increased brilliance and a low-noise background of the layer

Separation of steroids

Layers: ADAMANT UV₂₅₄, SIL G/UV₂₅₄
 Eluent: chloroform – methanol (97:3, v/v)
 Developing time: 10 min
 Sample: 0.1% solution in CHCl₃
 Detection: UV



ADAMANT UV₂₅₄

SIL G/UV₂₅₄

<i>R_f</i>	ADAMANT	SIL G
Cortisone	0.37	0.27
Corticosterone	0.43	0.30
Testosterone	0.50	0.39
Deoxycorticosterone	0.55	0.46
Progesterone	0.73	0.62
Migration distance	5.0 cm	5.7 cm

MN Appl. No. 402930

Separation of barbiturates

Layer: ADAMANT UV₂₅₄
 Eluent: chloroform – acetone (95:5, v/v)
 Migration distance: 73 mm in 20 min
 Sample volume: 1 μL
 Detection: UV



Substance	<i>R_f</i>
Thiamylal (0.5%)	0.69
Thiopental (1.0%)	0.65
Hexobarbital (5.0%)	0.41
Pentobarbital (1.0%)	0.26
Phenobarbital (1.0%)	0.18

MN Appl. No. 402950

For more applications of ADAMANT ready-to-use layers, check our application database at www.mn-net.com/apps.

Ordering information

Plate size [cm]	2.5 x 7.5	5 x 10	5 x 20	10 x 10	10 x 20	20 x 20	Thickness of layer	Fluorescent indicator
Pack of [plates]	100	50	200	100	25	50	25	
Glass plates								
ADAMANT		821040	821040.200		821050		0.25 mm	-
ADAMANT UV ₂₅₄	821005	821010	821010.200	821015	821020	821025	821030	0.25 mm UV ₂₅₄



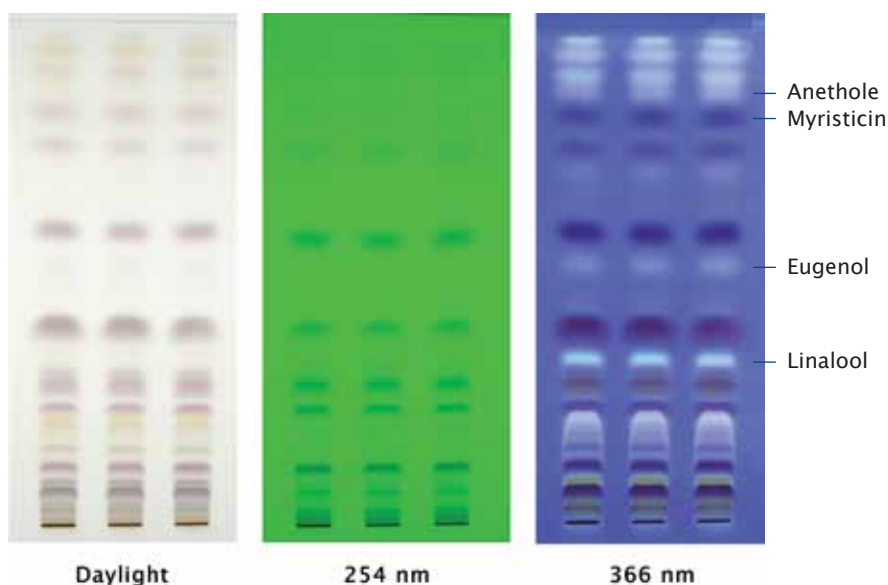
Standard silica layers for TLC

ALUGRAM® Xtra SIL G unmodified standard silica layers on aluminium

- ◆ Silica 60, specific surface (BET) ~ 500 m²/g, mean pore size 60 Å, specific pore volume 0.75 mL/g, particle size 5–17 µm; standard grade
 - Outstanding wettability for precise colorization results, even with 100% aqueous detection reagents
 - Excellent separation efficiency and reproducibility from lot to lot
 - Easy and reliable cutting due to an optimized binder system, no flaking of silica
- ◆ Binder: highly polymeric product, which is stable in almost all organic solvents and resistant towards aggressive visualization reagents; also completely stable in purely aqueous eluents

Thin Layer Chromatography

Separation of nutmeg ingredients



Sample: shake 1.0 g freshly powdered drug for 3 min with 4 mL methanol and filter; apply 10 µL
 Layer: ALUGRAM® Xtra SIL G UV₂₅₄
 Eluent: toluene – ethyl acetate (95:5, v/v)
 Migration distance: 15 cm
 Detection: 254 nm: underivatized
 daylight and 366 nm: spray with 5% ethanolic sulfuric acid, 1% vanillic acid and heat to 105 °C

The chromatograms show the following zones with increasing *R_f* values: linalool (bluish grey), eugenol (yellowish brown), myristicin (reddish brown), and anethole (pink-violet). Other colored zones may appear.



MN Appl. No. 403590

Ordering information

	Plate size [cm]	2.5 x 7.5	4 x 8	5 x 7.5	5 x 10	5 x 20	10 x 20	20 x 20	Thickness of layer	Fluorescent indicator
	Pack of [plates]	200	50	20	50	50	20	25		
ALUGRAM® Xtra aluminium sheets										
SIL G				818230.20	818261	818232		818233	0.20 mm	–
SIL G/UV ₂₅₄	818329	818331	818330.20	818360	818332	818362	818333		0.20 mm	UV ₂₅₄



SIL G

unmodified standard silica layers

- ☞ Silica 60, specific surface (BET) ~ 500 m²/g, mean pore size 60 Å, specific pore volume 0.75 mL/g, particle size 5–17 µm; standard grade
- ☞ Thickness of layer for analytical plates 0.25 mm, for **preparative plates** 0.5 and 1 mm; for 2 mm preparative layers a slightly coarser material is used
- ☞ Indicators: manganese activated zinc silicate with green fluorescence for short-wave UV (254 nm); special inorganic fluorescent pigment with blue fluorescence for long-wave UV (366 nm)
- ☞ Binders: highly polymeric products, which are stable in almost all organic solvents and resistant towards aggressive visualization reagents; binder system for POLYGRAM® sheets (as for ALUGRAM® Xtra sheets) is also completely stable in purely aqueous eluents

Ordering information

Glass plates								
Plate size [cm]	2.5 x 7.5	5 x 10		5 x 20	10 x 10	10 x 20	20 x 20	Thickness of layer
Pack of [plates]	100	50	200	100	25	50	25	
SIL G-25		809017	809017.200	809011		809012	809013	0.25 mm
SIL G-25 UV ₂₅₄	809028.100	809027	809027.200	809021	809020	809022	809023	0.25 mm
SIL G-25 UV ₂₅₄₊₃₆₆				809121		809122	809123	0.25 mm
Pack of [plates]	(preparative TLC)						20	
SIL G-50							809051	0.50 mm
SIL G-50 UV ₂₅₄							809053	0.50 mm
Pack of [plates]	(preparative TLC)						15	
SIL G-100							809061	1.00 mm
SIL G-100 UV ₂₅₄							809063	1.00 mm
Pack of [plates]	(preparative TLC)						12	
SIL G-200							809073	2.00 mm
SIL G-200 UV ₂₅₄							809083	2.00 mm
POLYGRAM® polyester sheets								
Plate size [cm]	2.5 x 7.5	4 x 8		5 x 20		20 x 20	40 x 20	
Pack of [plates]	200	50		50		25	25	
SIL G	805902	805032		805012		805013	805014	0.20 mm
SIL G/UV ₂₅₄	805901	805021		805022		805023	805024	0.20 mm
SIL G/UV ₂₅₄				Roll 500 x 20 cm			805017	0.20 mm
ALUGRAM® aluminium sheets								
Plate size [cm]	2.5 x 7.5	4 x 8	5 x 7.5	5 x 10	5 x 20	10 x 20	20 x 20	
Pack of [plates]	200	50	20	50	50	20	25	
SIL G			818030.20	818161	818032	818163	818033	0.20 mm
SIL G/UV ₂₅₄	818129	818131	818130.20	818160	818132	818162	818133	0.20 mm

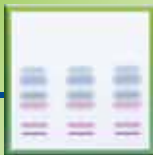
DURASIL

unmodified standard silica layers

- ☞ Silica 60, specific surface (BET) ~ 500 m²/g, mean pore size 60 Å, specific pore volume 0.75 mL/g, particle size 5–17 µm
- ☞ Hard, water-resistant and wettable layers due to a special binder system

Ordering information

Plate size [cm]	5 x 10		5 x 20	10 x 20	20 x 20	Thickness of layer	Fluorescent indicator
Pack of [plates]	50	200	100	50	25		
Glass plates							
DURASIL-25				812003	812004	0.25 mm	-
DURASIL-25 UV ₂₅₄	812005	812005.200	812006	812007	812008	0.25 mm	UV ₂₅₄



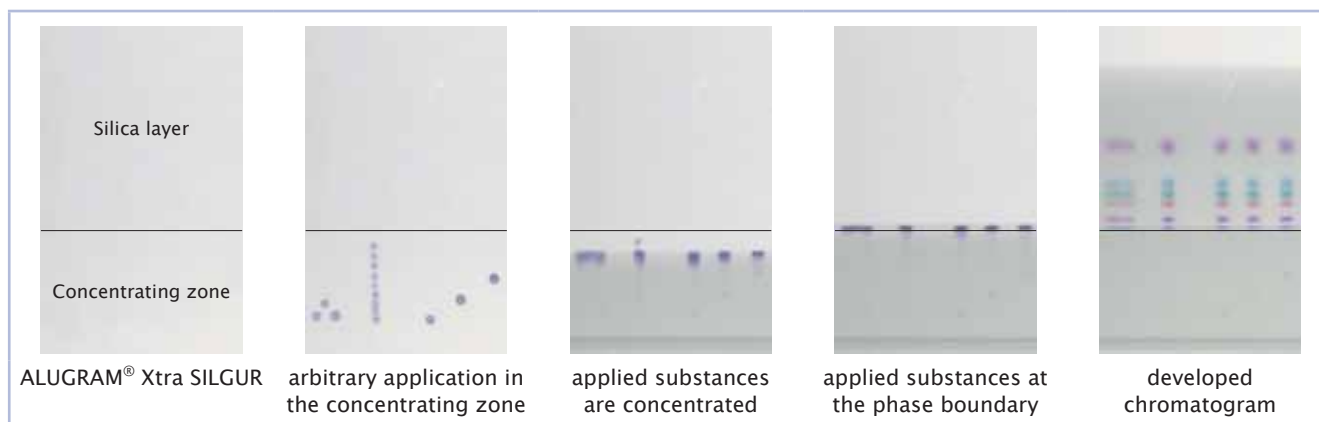
Silica layers with concentrating zone

SILGUR unmodified standard silica layers with concentrating zone

- ☐ Silica 60, specific surface (BET) ~ 500 m²/g, mean pore size 60 Å, specific pore volume 0.75 mL/g, particle size 5–17 µm
 - ☐ **Kieselguhr zone for rapid sample application:** because kieselguhr is completely inert towards a large number of compounds, the samples always form a narrow band at the interface of the two adsorbents, irrespective of shape, size or position of the spots in the concentrating zone (see page 208). Separation then takes place in the silica layer.
- Available as glass plate and as ALUGRAM® Xtra aluminium sheet with or without fluorescent indicator (for advantages of ALUGRAM® Xtra see page 214)

Ordering information

Plate size [cm]	10 x 20	20 x 20	Thickness of layer	Fluorescent indicator
Glass plates				
Pack of [plates]	50	25		
SILGUR-25	810012	810013	0.25 mm	-
SILGUR-25 UV ₂₅₄	810022	810023	0.25 mm	UV ₂₅₄
ALUGRAM® Xtra aluminium sheets · NEW!				
Pack of [plates]	20	25		
SILGUR	818412	818413	0.20 mm	-
SILGUR UV ₂₅₄	818422	818423	0.20 mm	UV ₂₅₄



Nano-SILGUR unmodified HPTLC silica layers with concentrating zone

- ☐ Nano silica 60, specific surface (BET) ~ 500 m²/g, mean pore size 60 Å, specific pore volume 0.75 mL/g, **particle size 2–10 µm**
- ☐ Narrow fractionation of the silica for sharper separations, shorter developing times, shorter migration distances, lower amount of samples and an increased detection sensitivity compared to SILGUR plates
- ☐ Kieselguhr zone for rapid sample application (see SILGUR above)

Ordering information

Plate size 10 x 10 cm, pack of 25 plates	Thickness of layer	Fluorescent indicator
Glass plates		
Nano-SILGUR-20	811032	0.20 mm
Nano-SILGUR-20 UV ₂₅₄	811042	0.20 mm
ALUGRAM® Xtra aluminium sheets · NEW!		
Nano-SILGUR	818432	0.20 mm
Nano-SILGUR UV ₂₅₄	818442	0.20 mm



Nano-ADAMANT

unmodified HPTLC silica layers

- ◆ Nano silica 60, specific surface (BET) ~ 500 m²/g, mean pore size 60 Å, specific pore volume 0.75 mL/g, particle size 2–10 μm
 - **Outstanding hardness and abrasion resistance** due to an optimized binder system
 - **Increased separation efficiency** due to an optimized particle size distribution
 - **High suitability for trace analyses** resulting from a UV indicator with increased brilliance and a low-noise background of the layer
- ◆ Narrow fractionation of the silica particles allows theoretical plate heights, which are one order of magnitude smaller than on standard silica layers with the advantage of sharper separations, shorter developing times, shorter migration distances, lower amount of samples, and increased detection sensitivity with equal selectivity.

Comparison of ADAMANT and Nano-ADAMANT plates for separation of anthraquinone dyes

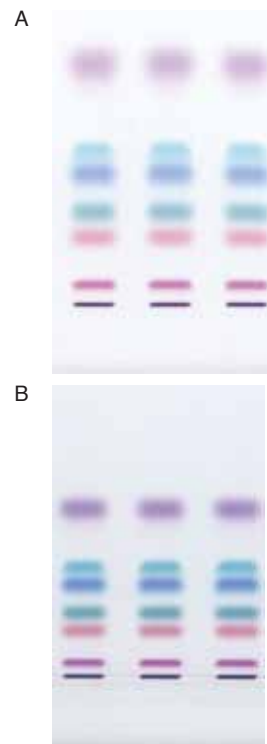
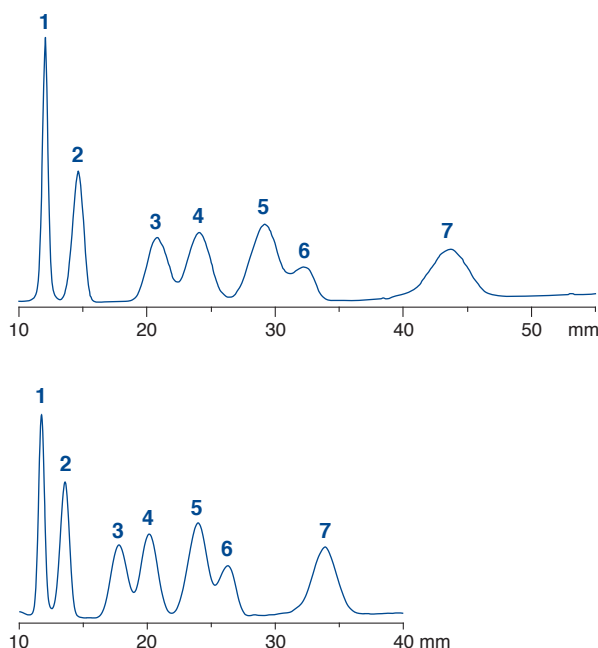
Layers: A) ADAMANT
B) Nano-ADAMANT

Sample: 1 μL, about 0.1 %
Eluent: toluene – cyclohexane (4:3, v/v)

Migration time: A) 30 min, B) 15 min

Peaks:

1. Blue 3
2. Violet 2
3. Red
4. Green
5. Blue 1
6. Greenish blue
7. Violet 1



Thin Layer Chromatography

Ordering information

	Plate size [cm]	10 x 10	10 x 20	Thickness of layer	Fluorescent indicator
	Pack of [plates]	25	50		
Glass plates					
Nano-ADAMANT		821140	821150	0.20 mm	-
Nano-ADAMANT UV ₂₅₄		821110	821120	0.20 mm	UV ₂₅₄



Nano silica layers for HPTLC

Nano-SIL

unmodified HPTLC silica layers

- ◆ Nano silica 60, specific surface (BET) ~ 500 m²/g, mean pore size 60 Å, specific pore volume 0.75 mL/g, **particle size 2–10 µm**
 indicator: manganese activated zinc silicate with green fluorescence for short-wave UV (254 nm)
 binder: highly polymeric product, which is stable in almost all organic solvents and resistant towards aggressive visualization reagents
- ◆ Narrow fractionation of the silica particles allows sharper separations, shorter developing times, shorter migration distances, smaller samples and an increased detection sensitivity compared to SIL G plates.
- ◆ Available as glass plate and as ALUGRAM® Xtra aluminium sheet with or without fluorescent indicator (advantages of ALUGRAM® Xtra see page 214)

Ordering information

	Plate size [cm]	5 x 5	5 x 20	10 x 10	10 x 20	20 x 20	Thickness of layer	Fluorescent indicator
	Pack of [plates]	100	50	25	50	25		
Glass plates								
Nano-SIL-20		811011		811012	811013		0.20 mm	-
Nano-SIL-20 UV ₂₅₄		811021		811022	811023		0.20 mm	UV ₂₅₄
ALUGRAM® Xtra aluminium sheets · NEW!								
Nano-SIL G			818240			818241	0.20 mm	-
Nano-SIL G/UV ₂₅₄			818342			818343	0.20 mm	UV ₂₅₄
ALUGRAM® aluminium sheets								
Nano-SIL G						818141	0.20 mm	-
Nano-SIL G/UV ₂₅₄						818143	0.20 mm	UV ₂₅₄

Nano-DURASIL

unmodified HPTLC silica layers

- ◆ Nano silica 60, specific surface (BET) ~ 500 m²/g, mean pore size 60 Å, specific pore volume 0.75 mL/g, **particle size 2–10 µm**
 indicator: manganese activated zinc silicate with green fluorescence for short-wave UV (254 nm)
 hard, water-resistant and wettable layers due to a special binder system
- ◆ Narrow fractionation of the silica particles allows sharper separations, shorter developing times, shorter migration distances, smaller samples and an increased detection sensitivity compared to DURASIL plates
 different selectivity compared to ADAMANT and SIL-G plates
 no reversed phase tendency, more polar than Nano-SIL

Ordering information

	Plate size [cm]	10 x 10	10 x 20	Thickness of layer	Fluorescent indicator
	Pack of [plates]	25	50		
Glass plates					
Nano-DURASIL-20		812010	812011	0.20 mm	-
Nano-DURASIL-20 UV ₂₅₄		812013	812014	0.20 mm	UV ₂₅₄



Nano-SIL C18

octadecyl-modified HPTLC silica layers

- ◆ Base material:
 - Nano silica 60, specific surface (BET) ~ 500 m²/g, mean pore size 60 Å, specific pore volume 0.75 mL/g, **particle size 2-10 μm**, pH stability 2-10
 - Indicator: acid-resistant product with a pale blue fluorescence for short-wave UV (254 nm); UV-absorbing substances appear as dark-blue to black spots on a light-blue background
- ◆ Partial (50%) or complete (100%) octadecyl modification, carbon content 7.5 and 14%, respectively
- ◆ Order of polarity: silica > DIOL > NH₂ > CN > RP-2 > **C18-50** > RP-18 W > **C18-100**
- ◆ Reversed phase separation mode with eluents from anhydrous solvents to mixtures with high concentrations of water (see table and figure below)
- ◆ **Recommended application:**
 Alkaloids, amino acids, preservatives, optical brighteners, barbiturates, polycyclic aromatic hydrocarbons (PAH), drugs, peptides, flavonoids, phenols, indole derivatives, steroids

Ordering information

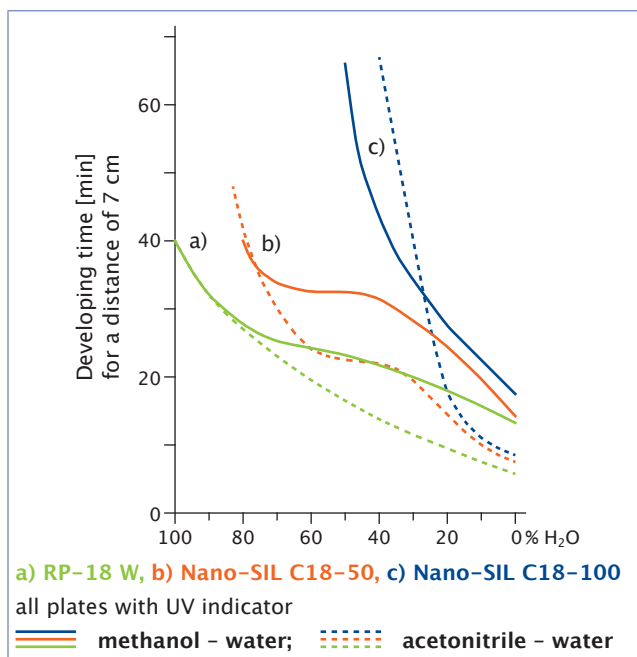
Plate size [cm]	10 x 10	Thickness of layer	Fluorescent indicator
Pack of [plates]	25		
Glass plates			
Nano-SIL C18-50	} 50% silanized	0.20 mm	-
Nano-SIL C18-50 UV ₂₅₄			UV ₂₅₄
Nano-SIL C18-100	} 100% silanized	0.20 mm	-
Nano-SIL C18-100 UV ₂₅₄			UV ₂₅₄

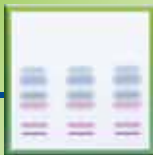
Migration of C18-50 and C18-100 silica layers as compared to RP-18 W plates

Eluent	v/v	Migration distances [mm/15 min]		
		C18-50	C18-100	RP-18 W
Methanol - H ₂ O	2:1	57	45	44
	1:1	52	21	40
	1:2	50	0	43
	1:3	40	0	45
	1:4	30	0	46
	0:1	0	0	54
Acetonitrile - H ₂ O	2:1	62	46	66
	1:1	52	30	54
	1:2	51	27	46
	1:3	48	15	44
	1:9	20	0	42
Trichloromethane		68	64	71

For numerous separations with MN RP plates please visit our on-line application data base at www.mn-net.com/apps.

Elution properties of MN RP plates in mixtures of methanol - water and acetonitrile - water





Modified RP silica layers for TLC and HPTLC

RP-18 W/UV₂₅₄

octadecyl-modified HPTLC silica layers

- ◊ Base material:
 - Nano silica 60, specific surface (BET) ~ 500 m²/g, mean pore size 60 Å, specific pore volume 0.75 mL/g, particle size 2-10 µm; for **preparative plates** (1 mm thickness of layer) standard silica 60, particle size 5-17 µm pH stability 2-10
 - Indicator: acid-resistant product with a pale blue fluorescence for short-wave UV (254 nm); UV-absorbing substances appear as dark-blue to black spots on a light-blue background
- ◊ Partial octadecyl (C18) modification, wettable with water, carbon content 14%
- ◊ Order of polarity: silica > DIOL > NH₂ > CN > RP-2 > C18-50 > **RP-18 W** > C18-100
- ◊ NP or RP separation with eluents from anhydrous solvents to mixtures with high concentrations of water (see table and figure on previous page); relative polarity of the eluent determines the polarity of the layer
- ◊ **Recommended application:** aminophenols, barbiturates, preservatives, nucleobases, polycyclic aromatic hydrocarbons, steroids, tetracyclines, plasticizers (phthalates)

Ordering information

Plate size [cm]	4 x 8	5 x 10	5 x 20	10 x 10	10 x 20	20 x 20	Thickness of layer	Fluorescent indicator
Glass plates								
Pack of [plates]			50	25	50	25		
RP-18 W/UV ₂₅₄			811073	811075	811072	811071	0.25 mm	UV ₂₅₄
Pack of [plates] (preparative TLC)						15		
RP-18 W/UV ₂₅₄						811074	1.00 mm	UV ₂₅₄
ALUGRAM® aluminium sheets								
Pack of [plates]	50	50	50	25		25		
RP-18 W/UV ₂₅₄	818144	818152	818145	818147		818146	0.15 mm	UV ₂₅₄

RP-2/UV₂₅₄

“silanized silica” = dimethyl-modified standard silica layers

- ◊ Base material:
 - Silica 60, specific surface (BET) ~ 500 m²/g, mean pore size 60 Å, specific pore volume 0.75 mL/g, particle size 5-17 µm, pH stability 2-10
 - Indicator: acid-resistant product with a pale blue fluorescence for short-wave UV (254 nm); UV-absorbing substances appear as dark-blue to black spots on a light-blue background
- ◊ Silanized silica with dimethyl modification, carbon content 4%
- ◊ Order of polarity: silica > DIOL > NH₂ > CN > **RP-2** > C18-50 > RP-18 W > C18-100
- ◊ Normal phase or reversed phase separation modes with purely organic, organic – aqueous or purely aqueous eluents
- ◊ **Recommended application:** active plant constituents, steroids

Ordering information

Plate size [cm]	10 x 20	20 x 20	Thickness of layer	Fluorescent indicator
Pack of [plates]	50	25		
Glass plates				
RP-2/UV ₂₅₄	811081	811082	0.25 mm	UV ₂₅₄
ALUGRAM® aluminium sheets				
RP-2/UV ₂₅₄		818171	0.15 mm	UV ₂₅₄

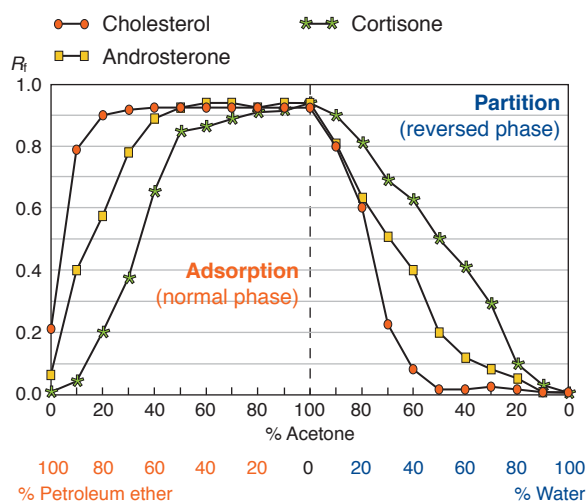


Nano-SIL CN

cyano-modified HPTLC silica layers

- ◆ Base material:
 - Nano silica 60, specific surface (BET) ~ 500 m²/g, mean pore size 60 Å, specific pore volume 0.75 mL/g, **particle size 2-10 µm**, pH stability 2-8
 - Indicator: acid-resistant product with a pale blue fluorescence for short-wave UV (254 nm); UV-absorbing substances appear as dark-blue to black spots on a light-blue background
- ◆ Cyanopropyl modification, carbon content 5.5 %
- ◆ Order of polarity: silica > DIOL > NH₂ > **CN** > RP-2 > C18-50 > RP-18 W > C18-100
- ◆ Available as glass plates or ALUGRAM[®] aluminium sheets
- ◆ NP or RP separation modes depending on the polarity of the developing solvent (see figure below)
- ◆ **Recommended application:** steroid hormones, phenols, preservatives

R_f values of different steroids as a function of eluent composition



Layer: Nano-SIL CN/UV
Polarity of the eluent governs the type of separation mechanism:

Eluent system petroleum ether (PE) – acetone (NP mode)
the higher the concentration of PE, the stronger are the adsorptive interactions of the steroids with the stationary phase

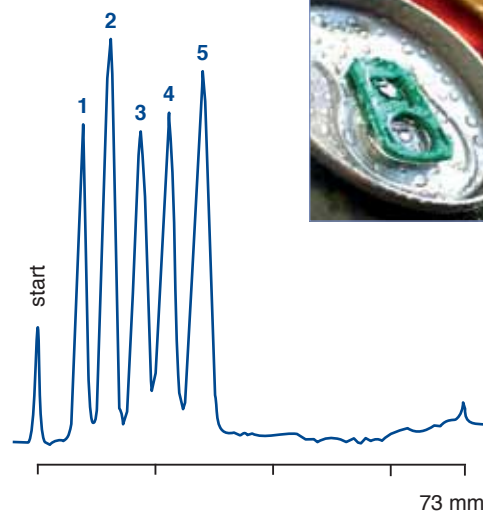
Eluent system acetone – water (RP mode)
the sequence of elution of the steroids is reversed, the most nonpolar compounds are most strongly retained

Separation of preservatives

Layer: Nano-SIL CN/UV
Sample volume: 400 nL
Eluent: ethanol – water – glacial acetic acid (20:80:0.2) with 0.1 mol/L tetraethylammonium chloride
Migration distance: 7.3 cm in 30 min
Detection: TLC scanner, UV 254 nm

Peaks:

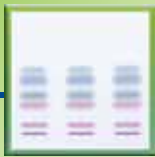
1. Propyl *p*-hydroxybenzoate
2. Ethyl *p*-hydroxybenzoate
3. Methyl *p*-hydroxybenzoate
4. Benzoic acid
5. Sorbic acid



MN Appl. No. 401440

Ordering information

Plate size [cm]	4 x 8	10 x 10	10 x 20	Thickness of layer	Fluorescent indicator
Pack of [plates]	50	25	25		
Glass plates					
Nano-SIL CN/UV		811115	811116	0.20 mm	UV ₂₅₄
ALUGRAM[®] aluminium sheets					
Nano-SIL CN/UV	818184			0.15 mm	UV ₂₅₄



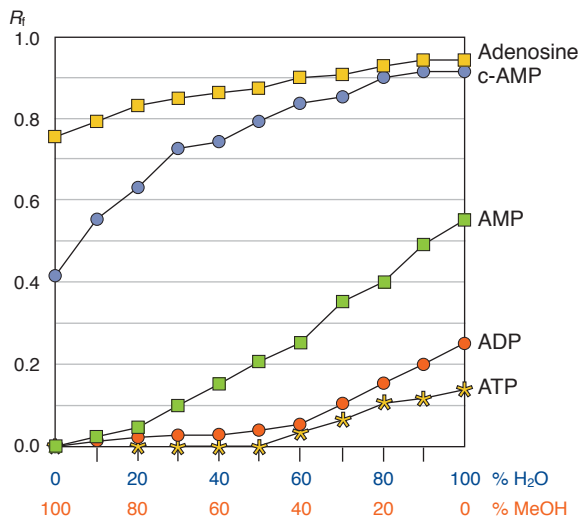
Modified silica layers for HPTLC

Nano-SIL NH₂

amino-modified HPTLC silica layers

- ◆ Base material:
 - Nano silica 60, specific surface (BET) ~ 500 m²/g, mean pore size 60 Å, specific pore volume 0.75 mL/g, particle size 2-10 µm, pH stability 2-8
 - Indicator: acid-resistant product with a pale blue fluorescence for short-wave UV (254 nm); UV-absorbing substances appear as dark-blue to black spots on a light-blue background
- ◆ Aminopropyl modification, carbon content 3.5 %
- ◆ Order of polarity: silica > DIOL > **NH₂** > CN > RP-2 > C18-50 > RP-18 W > C18-100
- ◆ Available with or without fluorescent indicator, as glass plates or ALUGRAM[®] aluminium sheets
- ◆ Layer can be wetted equally well with pure water as with organic solvents
- ◆ **Recommended application:**
Vitamins, sugars, steroids, purine derivatives, xanthenes, phenols, nucleotides and pesticides

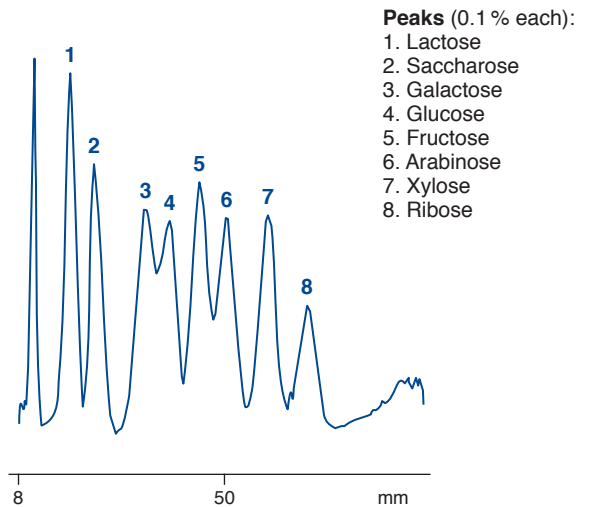
Influence of eluent composition on the separation of nucleotides



Layer: Nano-SIL NH₂/UV
 Eluent: MeOH – H₂O according to fig. + 0.18 mol/L NaCl
 Migration distance: 7 cm
 c-AMP, AMP: adenosine monophosphate
 ADP: adenosine diphosphate
 ATP: adenosine triphosphate

Separation of sugars

Layer: Nano-SIL NH₂/UV
 Eluent: ethyl acetate – pyridine – water – glacial acetic acid (60:30:10:5, v/v/v/v)
 Migration distance: 8 cm in 45 min, double development
 Sample volume: 0.5 µL
 Detection: dry layer at 160 °C for 5 min, TLC scanner, UV 254 nm



MN Appl. No. 401590

Ordering information

	Plate size [cm]	4 x 8	10 x 10	10 x 20	Thickness of layer	Fluorescent indicator
	Pack of [plates]	50	25	25		
Glass plates						
Nano-SIL NH ₂ /UV			811111	811112	0.20 mm	UV ₂₅₄
ALUGRAM[®] aluminium sheets						
Nano-SIL NH ₂ /UV		818182			0.15 mm	UV ₂₅₄



Nano-SIL DIOL

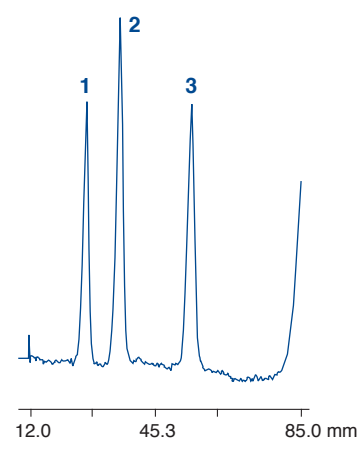
diol-modified HPTLC silica layers

- ◆ Base material:
 - Nano silica 60, specific surface (BET) ~ 500 m²/g, mean pore size 60 Å, specific pore volume 0.75 mL/g, **particle size 2-10 µm**, pH stability 2-8
 - Indicator: acid-resistant product with a pale blue fluorescence for short-wave UV (254 nm); UV-absorbing substances appear as dark-blue to black spots on a light-blue background
- ◆ Diol modification, carbon content 5.5%
- ◆ Order of polarity: silica > **DIOL** > NH₂ > CN > RP-2 > C18-50 > RP-18 W > C18-100
- ◆ Available as glass plates or ALUGRAM[®] aluminium sheets
- ◆ Layer can be wetted equally well by pure water as by organic solvents
- ◆ **Recommended application:**
 Steroids, pesticides and plant constituents; for critical separations an alternative to silica, since it is less sensitive to the water content of the environment; leads to more reproducible results compared to silica



Separation of herbicides

Layer: Nano-SIL DIOL/UV
 Sample volume: 2 µL
 Eluent: petroleum ether (40-60 °C) – acetone (80:20, v/v)
 Migration distance: 7 cm
 Detection: TLC scanner, 238 nm
Peaks:
 (0.07 % each in methanol)
 1. Metoxuron
 2. Monuron
 3. Metobromuron



MN Appl. No. 402340

Ordering information

	Plate size 10 x 10 cm, pack of 25 plates	Thickness of layer	Fluorescent indicator
Glass plates			
Nano-SIL DIOL/UV	811120	0.20 mm	UV ₂₅₄

HPTLC method development kits

- ◆ For selection of the optimum HPTLC plate for a given separation

Ordering information

Description	REF
Glass plates: 3 plates 10 x 10 cm (scored to 5 x 10 cm) each of Nano-SIL C18-100/UV ₂₅₄ , RP-18 W/UV ₂₅₄ , RP-2/UV ₂₅₄ , Nano-SIL CN/UV, Nano-SIL NH ₂ /UV, Nano-SIL DIOL/UV	811001
ALUGRAM[®] aluminium sheets: 5 sheets 4 x 8 cm each of RP-18 W/UV ₂₅₄ , RP-2/UV ₂₅₄ , Nano-SIL CN/UV, Nano-SIL NH ₂ /UV, Nano-SIL DIOL/UV	818001



Aluminium oxide layers for TLC

Alox

aluminium oxide layers for TLC

- Aluminium oxide, specific surface (BET) ~ 200 m²/g, mean pore size 60 Å; inert organic binder
Indicator manganese-activated zinc silicate

- Recommended application:**

Terpenes, alkaloids, steroids, aliphatic and aromatic compounds

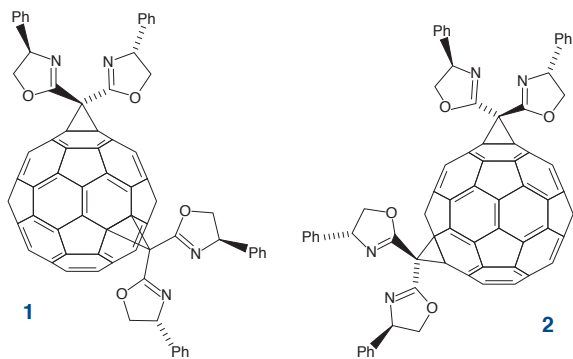
We recommend to activate aluminium oxide layers before use by heating 10 minutes at 120 °C.

Separation of bisadducts of fullerenes

F. Djojo, A. Hirsch, Chem. Eur. J. 4 (1998), 344–356

Layer: ALUGRAM® Alox N/UV₂₅₄
Eluent: toluene – ethyl acetate (95:5, v/v)
Detection: UV, 254 nm

Compound	R _f values
Bis[bis(4-phenyloxazolin)methane]fullerene 1	0.14
Bis[bis(4-phenyloxazolin)methane]fullerene 2	0.26



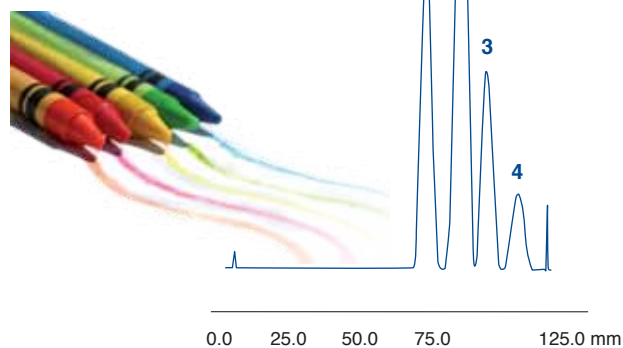
MN Appl. No. 401930

Separation of lipophilic dyes

Layer: Alox-25 UV₂₅₄
Sample volume: 1000 nL
Eluent: toluene – cyclohexane (2:1, v/v)
Migration distance: 10.8 cm in 15 min
Detection: TLC scanner, UV 254 nm

Peaks:

1. Indophenol
2. Sudan red G
3. Sudan blue II
4. Butter yellow



MN Appl. No. 403010

Ordering information

	Plate size [cm]	4 x 8	5 x 20	20 x 20	Thickness of layer	Fluorescent indicator
Glass plates						
	Pack of [plates]		100	25		
Alox-25 UV ₂₅₄			807021	807023	0.25 mm	UV ₂₅₄
	Pack of [plates] (preparative TLC)			15		
Alox-100 UV ₂₅₄				807033	1.00 mm	UV ₂₅₄
POLYGRAM® polyester sheets						
	Pack of [plates]	50	50	25		
Alox N/UV ₂₅₄		802021	802022	802023	0.20 mm	UV ₂₅₄
ALUGRAM® aluminium sheets						
	Pack of [plates]		50	25		
Alox N/UV ₂₅₄			818024	818023	0.20 mm	UV ₂₅₄



Cellulose MN 300

native fibrous cellulose layers for TLC

- ◆ Fiber length (95%) 2–20 μm, average degree of polymerization 400–500, specific surface acc. to Blaine 15000 cm²/g
 ≤ 20 ppm Fe, 6 ppm Cu, 7 ppm P; CH₂Cl₂ extract ≤ 0.25%; residue on ignition at 850 °C ≤ 1500 ppm
- ◆ **Recommended application:**
 Partition chromatography of polar substances such as amino acids, carboxylic acids or carbohydrates

Ordering information

Plate size [cm]	4 x 8	5 x 20	20 x 20	Thickness of layer	Fluorescent indicator
Glass plates					
Pack of [plates]			25		
CEL 300-10			808013	0.10 mm	-
CEL 300-10 UV ₂₅₄			808023	0.10 mm	UV ₂₅₄
CEL 300-25			808033	0.25 mm	-
CEL 300-25 UV ₂₅₄			808043	0.25 mm	UV ₂₅₄
Pack of [plates] (preparative TLC)			20		
CEL 300-50			808053	0.50 mm	-
CEL 300-50 UV ₂₅₄			808063	0.50 mm	UV ₂₅₄
POLYGRAM® polyester sheets					
Pack of [plates]	50	50	25		
CEL 300	801011		801013	0.10 mm	-
CEL 300 UV ₂₅₄		801022	801023	0.10 mm	UV ₂₅₄
ALUGRAM® aluminium sheets					
Pack of [plates]	50	50	25		
CEL 300	818155		818153	0.10 mm	-
CEL 300 UV ₂₅₄		818157	818156	0.10 mm	UV ₂₅₄

Cellulose MN 400 (AVICEL®)

microcrystalline cellulose layers for TLC

- ◆ Prepared by hydrolysis of high purity cellulose with HCl; average degree of polymerization 40–200
- ◆ **Recommended application:**
 Carboxylic acids, lower alcohols, urea and purine derivatives

Ordering information

Plate size [cm]	10 x 20	20 x 20	Thickness of layer	Fluorescent indicator
Pack of [plates]	50	25		
Glass plates				
CEL 400-10	808072	808073	0.10 mm	-
POLYGRAM® polyester sheets				
CEL 400		801113	0.10 mm	-
CEL 400 UV ₂₅₄		801123	0.10 mm	UV ₂₅₄



Cellulose layers for TLC

Thin Layer Chromatography

Cellulose MN 300 PEI

PEI-impregnated cellulose ion exchange layers

- Fibrous cellulose impregnated with polyethyleneimine
- Recommended application:** analysis of nucleic acids, and of mutagenic substances with the ^{32}P postlabeling procedure (see application 402260 at www.mn-net.com/apps)

Ordering information

Plate size [cm] Pack of [plates]	20 x 20 25	Thickness of layer	Fluorescent indicator
POLYGRAM® polyester sheets			
CEL 300 PEI	801053	0.10 mm	-
CEL 300 PEI/UV ₂₅₄	801063	0.10 mm	UV ₂₅₄

Acetylated cellulose MN 300

- Fibrous cellulose with 10% content of acetylated cellulose for reversed phase chromatography

Ordering information

Plate size [cm] Pack of [plates]	Acetyl content	20 x 20 25	Thickness of layer	Fluorescent indicator
POLYGRAM® polyester sheets				
CEL 300 AC-10%	10%	801033	0.10 mm	-

Polyamide-6

ε-aminopolycaprolactame layers for TLC

- Polyamide 6 = Nylon 6 = perlon = ε-aminopolycaprolactame
Separation mechanism based on hydrogen bonds to amide groups of the polymer matrix as well as on ionic, dipole and electron donor-acceptor interactions
- Recommended application:**
Natural compounds, phenols, carboxylic acids, aromatic nitro compounds and especially amino acids

Ordering information

Plate size [cm] Pack of [plates]	5 x 20 50	20 x 20 25	Thickness of layer	Fluorescent indicator
POLYGRAM® polyester sheets				
POLYAMIDE-6	803012	803013	0.10 mm	-
POLYAMIDE-6 UV ₂₅₄	803022	803023	0.10 mm	UV ₂₅₄

CHIRALPLATE

special layer for TLC enantiomer separation

- Reversed phase nano silica impregnated with Cu^{2+} ions and a chiral selector (a proline derivative, DP 31 43 726 and EP 0 143 147)
Separation based on ligand exchange, i.e. formation of ternary mixed-ligand complexes with the $\text{Cu}(\text{II})$ ions; differences in the stability of the diastereomeric complexes cause chromatographic separation
 - Recommended application:** enantiomer separation of amino acids, *N*-methylamino acids, *N*-formylamino acids, α-alkylamino acids, thiazolidine derivatives, dipeptides, lactones, α-hydroxycarboxylic acids
- A review on the application of CHIRALPLATE has been given by K. Günther [J. Chromatogr. **448** (1988) 11–30].

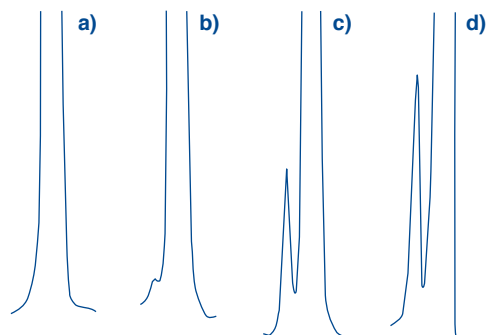


Enantiomer separation of amino acids

Quantitative determination (remission location curves) of TLC-separated enantiomers of *tert*-leucine:

Layer: CHIRALPLATE
 Eluent: methanol – water (10:80, v/v)
 Detection: dip in 0.3% ninhydrin solution
 quantification with scanner, 520 nm

- a) L-*tert*-leucine
- b) L-*tert*-leucine + 0.1% D-*tert*-leucine
- c) L-*tert*-leucine + 1% D-*tert*-leucine
- d) external reference sample



Ordering information

Plate size [cm]	5 x 20	10 x 10	10 x 20	20 x 20	Thickness of layer	Fluorescent indicator
Glass plates						
Pack of [plates]	4					
CHIRALPLATE			811056		0.25 mm	UV ₂₅₄
Pack of [plates]	50	25	25	25		
CHIRALPLATE	811057	811059	811055	811058	0.25 mm	UV ₂₅₄

SIL N-HR

unmodified standard silica layers

- High purity silica 60, specific surface (BET) ~ 500 m²/g, mean pore size 60 Å, specific pore volume 0.75 mL/g, particle size 5–17 μm
 Different binder system compared to SIL G results in different separation characteristics
- A special feature of the POLYGRAM® SIL N-HR is a **higher gypsum content**.

Ordering information

Plate size [cm]	5 x 20	20 x 20	Thickness of layer	Fluorescent indicator
Pack of [plates]	50	25		
POLYGRAM® polyester sheets				
SIL N-HR/UV ₂₅₄	804022	804023	0.20 mm	UV ₂₅₄

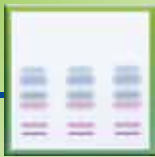
SIL G-25 HR

special layer for aflatoxin separation

- High purity silica 60 with gypsum and a very small quantity of a polymeric organic binder softer than the standard silica layer, i.e. spots can be scratched and the layer absorbs faster
- Recommended application:** aflatoxins

Ordering information

Plate size [cm]	20 x 20	Thickness of layer	Fluorescent indicator
Pack of [plates]	25		
Glass plates			
SIL G-25 HR	809033	0.25 mm	–
SIL G-25 HR/UV ₂₅₄	809043	0.25 mm	UV ₂₅₄



Layers for special TLC separations

SIL G-25 Tenside special layer for separation of surfactants

- ◆ Silica G impregnated with ammonium sulfate
 Recommended for the separation of detergents, alkanesulfonates, polyglycols etc.



Ordering information

	Plate size 20 x 20 cm, pack of 25 plates	Thickness of layer	Fluorescent indicator
Glass plates			
SIL G-25 Tenside	810063	0.25 mm	-

Nano-SIL PAH special HPTLC silica layer for PAH analysis

- ◆ Base material: nano silica 60, specific surface (BET) ~ 500 m²/g, mean pore size 60 Å, specific pore volume 0.75 mL/g, particle size 2–10 µm; impregnated with caffeine, an electron acceptor for PAH analysis based on charge–transfer complexes

Recommended application: 6 PAHs according to German drinking water specifications (TVO) in accordance with German standard DIN 38407 part 7 (see application 402400 at www.mn-net.com/apps)

Ordering information

	Plate size 10 x 20 cm, pack of 50 plates	Thickness of layer	Fluorescent indicator
Glass plates			
Nano-SIL PAH	811051	0.20 mm	-

IONEX special mixed layers of silica with ion exchange resins

- ◆ **IONEX-25 SA-Na:** mixture of silica and a strongly acidic cation exchanger coated to polyester sheets
 - ◆ **IONEX-25 SB-AC:** mixture of silica and a strongly basic anion exchanger coated to polyester sheets
- Both layers contain an inert organic binder

- ◆ **Recommended application:**
 Amino acids, e.g., in protein and peptide hydrolyzates, in seeds and fodder, in biological fluids; for racemate separation in peptide syntheses, for the separation of nucleic acid hydrolyzates, aminosugars, amino acids, antibiotics, inorganic phosphates, cations and other compounds with ionic groups

Ordering information

	Plate size [cm]	20 x 20	Thickness of layer	Fluorescent indicator
	Pack of	25		
POLYGRAM® polyester sheets				
IONEX-25 SA-Na	strongly acidic cation exchanger	806013	0.20 mm	-
IONEX-25 SB-AC	strongly basic anion exchanger	806023	0.20 mm	-



Mixed layers for TLC

- ◆ **Alox/CEL-AC-Mix-25:** mixed layer of aluminium oxide G and acetylated cellulose recommended for separation of PAH (see application 401040 at www.mn-net.com/apps)
- ◆ **SILCEL-Mix-25:** mixed layer of cellulose and silica recommended for separation of preservatives and other antimicrobial compounds (see application 401420 at www.mn-net.com/apps)

Ordering information

Plate size [cm]	20 x 20	Thickness of layer	Fluorescent indicator
Pack of [plates]	25		
Glass plates			
Alox/CEL-AC-Mix-25	810053	0.25 mm	-
SILCEL-Mix-25 UV ₂₅₄	810043	0.25 mm	UV ₂₅₄

Chromatography papers

- ◆ Paper chromatography is the oldest chromatographic technique separation due to partition of the analytes between special paper grades and the mobile phase, which penetrates the paper by capillary action ascending, descending and circular techniques are possible.

- ◆ *Please note:* always treat chromatography papers with care: never touch them with fingers, because this will contaminate the surface do not bend them sharply, because this will decrease the capillary action (preferably store them flat)

Chromatography papers possess a preferred direction of the fibers with higher absorption properties (with our sheets 58 x 60 cm, the longer edge). We recommend to use them in the direction of higher absorption.



Ordering information

Code	Weight [g/m ²]	Thickness [mm]	Description	Flow rate	Size [cm]	Pack of	REF
MN 214	140	0.28	smooth	90-100 mm/30 min	58 x 60	100 sheets	817001
MN 218	180	0.36	smooth	90-100 mm/30 min	58 x 60	100 sheets	817002
MN 260	90	0.20	smooth	120-130 mm/30 min	58 x 60	100 sheets	817003
MN 261	90	0.18	smooth	90-100 mm/30 min	58 x 60	100 sheets	817004
MN 827	270	0.70	soft carton	130-140 mm/10 min	58 x 60	100 sheets	817005
MN 866	650	1.70	soft carton	100-120 mm/10 min	38 x 38	100 sheets	817006
MN 866	650	1.70	soft carton	100-120 mm/10 min	80 x 80	100 sheets	817007
MN 214 ff	140	0.28	MN 214 defatted *	90-100 mm/30 min	56 x 58	100 sheets	817008

* This paper is extracted with organic solvents

For further papers, filters and membranes, feel free to ask for our catalog "Filtration"



Introductory kits for TLC

TLC micro-sets

introductory kits for science education

Beginner's set

features separations with simple developing solvents; samples are colored thus eliminating the need for visualization. All equipment needed is contained in the set.

Advanced sets

require some experience and skill from the user: some of the samples have to be pretreated before separation, and for identification of substances spray reagents have to be used

TLC wine set

chromatographic rapid test for evaluating the conversion of malic acid to lactic acid in wine (2nd fermentation), i.e. the optimum time for bottling of a wine

TLC micro-set A for beginners

This kit contains all chemicals and accessories for the following separations:

- ✓ Separation of the fat-soluble (lipophilic) dye mixture 1: butter yellow, indophenol, sudan blue II, sudan red G
- ✓ Separation of a mixture of anthraquinone dyes (test dye mixture 2): blue 1, blue 3, green, green blue, red, violet 1, violet 2
- ✓ Separation of a mixture of food dyes (test dye mixture 3): brilliant black BN (E151), fast red E, erythrosine (E127), yellow orange S (sunset yellow CFC, E110), naphthol red S, ponceau 4 R (E124), tartrazine (E102)
- ✓ Separation of dyes from felt tip pens

Contents of TLC micro-set A for beginners

1	manual
3	developing chambers
50	glass capillaries 1 µL
1	spotting guide
2	felt tip pens
1	measuring cylinder 10 mL
50	polyester sheets 4 x 8 cm each of POLYGRAM® SIL G/UV ₂₅₄ , Alox N/UV ₂₅₄ and CEL 300
8 mL	each of test dye mixture 1 (4 lipophilic dyes), test dyes sudan red G, and sudan blue II
8 mL	each of test dye mixture 2 (7 anthraquinone dyes), test dyes blue 1 and violet 2
8 mL	each of test dye mixture 3 (7 food dyes), test dyes yellow orange S, and brilliant black BN
100 mL	each of toluene, toluene – cyclohexane (2:1, v/v) ethanol, 2.5% sodium citrate solution 25% ammonia solution – 2-propanol (5:3, v/v)

TLC micro-set M

This kit is prerequisite for the separations with kits F1 to F3. In addition, it serves as basic equipment for the individual study of further thin layer chromatographic experiments.

Contents of TLC micro-set M (materials kit)

2 x 50	glass capillaries 1 µL
2	spotting guides
1	rubber cap for capillaries
1	measuring cylinder 10 mL
1	beaker 25 mL
2	developing chambers
1	glass laboratory sprayer with rubber bulb
1	plastic syringe 1 mL, 20 sheets filter paper MN 713 (15 x 21 cm)
50	polyester sheets 4 x 8 cm each of POLYGRAM® SIL G/UV ₂₅₄ , Alox N/UV ₂₅₄ and CEL 300

Ordering information

Designation	Pack of	REF
TLC micro-set A for beginners	1 kit	814000
Replacement parts for TLC micro-set A		
Test dye mixture 1*, solution of 4 lipophilic dyes in toluene (components see above)	8 mL	814001
Test dye mixture 2*, solution of 7 anthraquinone dyes in toluene – cyclohexane (2:2, v/v) (components see above)	8 mL	814002
Test dye mixture 3, aqueous solution of 7 food dyes (components see above)	8 mL	814003
Collection of 4 individual components of test dye mixture 1*	4 x 8 mL	814011
Collection of 7 individual components of test dye mixture 2*	7 x 8 mL	814012
Collection of 7 individual components of test dye mixture 3	7 x 8 mL	814013
Sodium citrate, 2.5 g in 100 mL bottles to fill up with distilled water	2.5 g	814029
TLC micro-set M (materials kit)	1 kit	814100

* These products contain harmful substances which must be specially labeled as hazardous. For detailed information please see MSDS.



TLC micro-set F1

This kit contains all chemicals required for the separation of

- ✓ amino acids (test mixture, consisting of alanine, arginine, tryptophan and valine)
- ✓ amino acids in urine
- ✓ the heavy metal cations copper(II) and manganese(II)

Contents of TLC micro-set F1

1 manual; 50 glass capillaries 1 μ L
50 polyester sheets 4 x 8 cm each of POLYGRAM® SIL G/UV₂₅₄ and CEL 300
100 mL each of *n*-butanol, ninhydrin spray reagent (0.2% in ethanol), acetone, 25% ammonia solution, rubenic acid spray reagent
50 mL each of 50% acetic acid, 18% hydrochloric acid
8 mL each of the amino acid test mixture (see left), tryptophan and arginine reference solutions
8 mL each of the heavy metal cation test mixture (see left), Mn²⁺, and Cu²⁺ reference solutions



TLC micro-set F2

This kit contains all chemicals required

- ✓ for analysis of edible fats
- ✓ for analysis of fats and cholesterol in blood

Contents of TLC micro-set F2

1 manual; 50 glass capillaries 1 μ L
50 polyester sheets 4 x 8 cm POLYGRAM® SIL G/UV₂₅₄
5 disposable pipettes 25 μ L,
5 sample vials N 11 (1.5 mL) with PE caps and seals,
3 sample vials 30 mL (for butter, margarine and edible oil)
100 mL each of cyclohexane and molybdatophosphoric acid spray reagent
2 x 50 mL acetone with calibrated pipette, 25 mL butan-2-one
8 mL cholesterol reference solution

TLC micro-set F3

This kit contains all chemicals required

- ✓ for separation of analgetics (pain relievers)
- ✓ for drug analysis as shown for cinchona bark

Contents of TLC micro-set F3

1 manual, 50 glass capillaries 1 μ L
50 polyester sheets 4 x 8 cm POLYGRAM® SIL G/UV₂₅₄
5 Aspirin® tablets, 5 Thomapyrin® tablets
20 folded filters MN 615 1/4, 11 cm diameter, 3 sample vials 8 mL (for Aspirin® sample, Thomapyrin® sample, cinchona bark extract),
5 g cinchona bark
100 mL each of ethanol, 2-propanol, toluene – diethyl ether (55:35, v/v), spray reagent for caffeine and spray reagent according to Dragendorff-Munier, 50 mL each of iron(III) chloride solution and potassium hexacyanoferrate(III) solution, 30 mL ethyl acetate, 25 mL each of 12.5% ammonia solution and diethylamine
8 mL each of caffeine, paracetamol, quinine reference solutions

All experiments with TLC micro-sets F1 – F3 require the materials kit (see previous page).



Introductory kits for TLC

Ordering information

Designation	Pack of	REF
TLC micro-set F1*	1 kit	814200
Refill reagents for TLC micro-set F1		
Amino acid test mixtures (components see previous page)	8 mL	814201
Collection of 4 individual components of the amino acid test mixture	4 x 8 mL	814202
Cation test mixture (components see previous page)	8 mL	814204
Collection of 2 individual components of the cation test mixture (Cu ²⁺ , Mn ²⁺)	2 x 8 mL	814205
TLC micro-set F2*	1 kit	814300
Refill reagents for TLC micro-set F2		
Cholesterol reference solution*	8 mL	814301
TLC micro-set F3*	1 kit	814400
Refill reagents for TLC micro-set F3		
Quinine reference solution*	8 mL	814405
Paracetamol reference solution*	8 mL	814406
Caffeine reference solution*	8 mL	814407
Refill packs TLC sheets for all TLC micro-sets		
TLC polyester sheets POLYGRAM® SIL G/UV ₂₅₄ , 4 x 8 cm	4 x 50	814025
TLC polyester sheets POLYGRAM® Alox N/UV ₂₅₄ , 4 x 8 cm	4 x 50	814026
TLC polyester sheets POLYGRAM® CEL 300, 4 x 8 cm	4 x 50	814027
TLC polyester sheets POLYGRAM® 4 x 8 cm: 100 x SIL G/UV ₂₅₄ ; 50 x Alox N/UV ₂₅₄ ; 50 x CEL 300	1 set	814028

* These products contain harmful substances which must be specially labeled as hazardous. For detailed information please see MSDS.

TLC wine set

This kit contains all chemicals and equipment required for determination of malic, lactic, and tartaric acid in wine (evaluation of the conversion of malic to lactic acid, 2nd fermentation)

Contents of the TLC wine set

detailed instruction leaflet
 50 polyester sheets 4 x 8 cm POLYGRAM® CEL 300
 cation exchanger, eluent, reference substances
 developing chamber, capillaries, spotting guide

Ordering information

Designation	Pack of	REF
TLC wine set		
*	1 set	814500

* This product contains harmful substances which must be specially labeled as hazardous. For detailed information please see MSDS.





TLC accessories

Designation	Pack of	REF
Simultaneous developing chamber for TLC, 20 x 20 cm, for up to 5 plates	1	814019
Simultaneous developing chamber for TLC, 10 x 10 cm, for up to 2 plates	1	814018
Developing chambers for TLC micro-sets	4	814021
Glass laboratory sprayer with rubber bulb	1	814101
Glass capillaries 1 µL	3 x 50	814022
Rubber caps for capillaries	2	814102
Plastic syringe, 1 mL content with graduation	1	814104
Spotting guides	2	814023
Measuring cylinders, glass, 10 mL content	2	814024
MN ALUGRAM® scissors, ground blade, black handle	1	818666
Filter paper MN 713, 15 x 21 cm	100	814103
Folded filters MN 615 1/4, 11 cm diameter	100	531011
Chromatography paper MN 260, 7.5 x 17 cm (for chamber saturation)	100	814030



Visualization reagents

- Small selection of frequently used spray reagents for postchromatographic detection reactions in TLC suited for spraying or dipping TLC plates
- A detailed description of many more detection procedures for TLC is available on request.

Ordering information

Spray reagent	Solvent	Detection of	Pack of	REF
Aniline phthalate	2-propanol - ethanol (1:1)	reducing sugars, oxohalic acids	100 mL	814919
Bromocresol green	2-propanol	organic acids	100 mL	814920
Reagent for caffeine	water - acetone	caffeine	100 mL	814401
2',7'-Dichlorofluorescein	2-propanol	lipids (saturated, unsaturated)	100 mL	814921
4-(Dimethylamino)-benzaldehyde according to Dragendorff-Munier	2-propanol	terpenes, sugars, steroids	100 mL	814922
Iron(III) chloride	water	alkaloids and other nitrogen compounds	100 mL	814402
Potassium hexacyanoferrate(III)	water	acetylsalicylic acid, paracetamol	100 mL	814404
Molybdato-phosphoric acid	ethanol	lipids, sterols, steroids, reducing compounds	100 mL	814302
Ninhydrin	ethanol	amino acids, amines and amino sugars	100 mL	814203
Rhodamin B	ethanol	lipids	100 mL	814923
Rubeanic acid	ethanol	heavy metal cations	100 mL	814206

These products contain harmful substances which must be specially labeled as hazardous. For detailed information please see MSDS.



Adsorbents for TLC · Fluorescent indicators

Silica

adsorbents for TLC

Pore size 60 Å, pore volume 0.75 mL/g, specific surface (BET) ~ 500 m²/g, pH 7 for a 10% aqueous suspension

- ◉ **Silica G:** standard grade, particle size 2–20 µm, Fe < 0.02%, Cl < 0.02%, 13% gypsum as binder, supplied with or without fluorescence indicator UV₂₅₄
- ◉ **Silica N:** standard grade, particle size 2–20 µm, Fe < 0.02%, Cl < 0.02%, no binder, supplied with or without fluorescence indicator UV₂₅₄
- ◉ **Silica G–HR:** high purity grade, particle size 3–20 µm, Fe < 0.002%, Cl < 0.008%, gypsum as binder, supplied without fluorescence indicator
- ◉ **Silica P:** preparative grade, particle size 5–50 µm, Fe < 0.02%, Cl < 0.02%, organic binder, supplied with fluorescence indicator UV₂₅₄
- ◉ **Silica P with gypsum:** preparative grade, particle size 5–50 µm, Fe < 0.02%, Cl < 0.02%, gypsum as binder, supplied with fluorescence indicator UV₂₅₄

Ordering information

Designation	Fluorescent indicator	1 kg	5 kg
Silica G	–	816310.1	816310.5
Silica G/UV ₂₅₄	UV ₂₅₄	816320.1	816320.5
Silica N	–	816330.1	816330.5
Silica N/UV ₂₅₄	UV ₂₅₄	816340.1	816340.5
Silica G–HR	–	816410.1	816410.5
Silica P/UV ₂₅₄	UV ₂₅₄	816380.1	816380.5
Silica P/UV ₂₅₄ with gypsum	UV ₂₅₄	816400.1	816400.5

Polyamide

adsorbents for TLC

- ◉ Polyamide 6 = nylon 6 = perlon = ε-aminopolycaprolactame

Ordering information

Designation	Fluorescent indicator	1 kg
Polyamide TLC 6	–	816610.1
Polyamide TLC 6 UV ₂₅₄	UV ₂₅₄	816620.1

Cellulose MN 301

native fibrous cellulose

- ◉ Native fibrous cellulose, standard grade; fiber length (95%) 2–20 µm, average degree of polymerization 400–500, specific surface acc. to Blaine 15000 cm²/g
≤ 20 ppm Fe, 6 ppm Cu, 7 ppm P, CH₂Cl₂ extract ≤ 0.25%, residue on ignition at 850 °C ≤ 1500 ppm

Ordering information

Designation	Fluorescent indicator	1 kg	5 kg
Cellulose MN 301	–	816250.1	816250.5

Fluorescent indicators

- ◉ UV indicators with efficient radiation for short-wave as well as long-wave UV ranges
UV₂₅₄: manganese activated zinc silicate with absorption maximum at 254 nm; green fluorescence; relatively susceptible towards acids; thus its fluorescence can be completely quenched by acidic solvents
UV₃₆₆: inorganic fluorescent pigment with absorption maximum at 366 nm; blue fluorescence

Ordering information

	Composition	Absorption maximum	Color of fluorescence	Pack of 100 g
Fluorescent indicator UV ₂₅₄	manganese-activated zinc silicate	254 nm	green	816710.01
Fluorescent indicator UV ₃₆₆	inorganic fluorescent pigment	366 nm	blue	816720.01