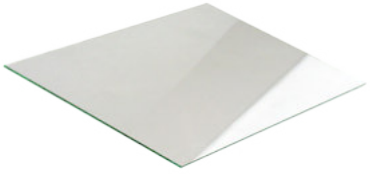
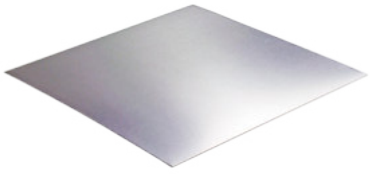
Contents



Glass plates



ALUGRAM® Xtra aluminum sheets
ALUGRAM® aluminum sheets

POLYGRAM® polyester sheets

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 aluminum sheet; also see page 272)
- Solvents or solvent mixtures (the mobile phase or eluent)
- Sample molecules

The principle of TLC is known for more than 100 years [11]. The real break-through as an analytical method, however, came about 50 years ago as a consequence of the pioneering work of Egon Stahl [12].

Today TLC has gained increasing importance as an analytical separation technique, which is probably due to effects of instrumentation and automation [13]. 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.

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

Principle steps of a TLC 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.

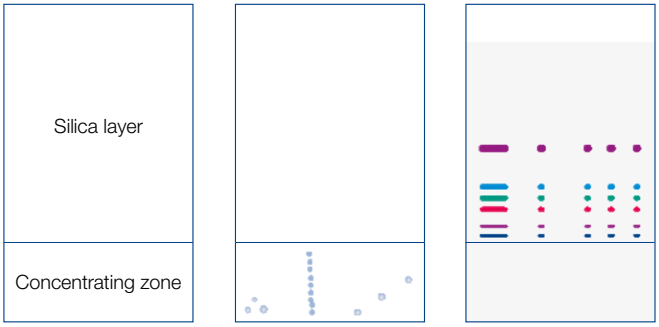
Thorough preparation of samples is an important prerequisite for the success of a TLC separation. For our range of products for more demanding sample pretreatment please see the chapter "SPE" from page 10.

Sample application

The most frequent technique is application with a glass capillary as spot or short streak.

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 UV_{254}), 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.

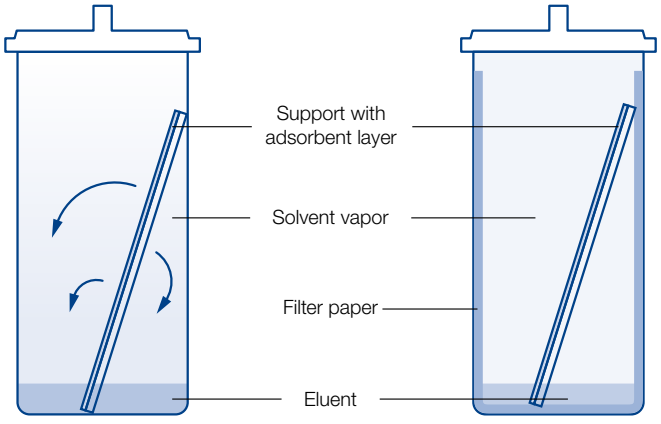
If a quantitative evaluation with a TLC scanner is to follow the separation we recommend to use commercially available sample applicators for spotting. These range from simple spotting guides via nanoapplicators to completely automated spotting devices. Application as streak can be performed automatically 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. [14].

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

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.

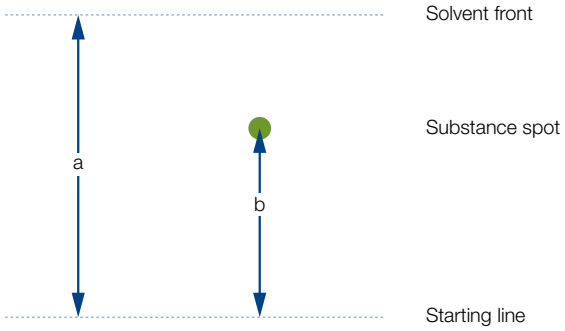
A parameter often used for qualitative evaluation is the R_f value (retention factor) or the 100-fold value hR_f. The R_f value is defined as follows:

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

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.

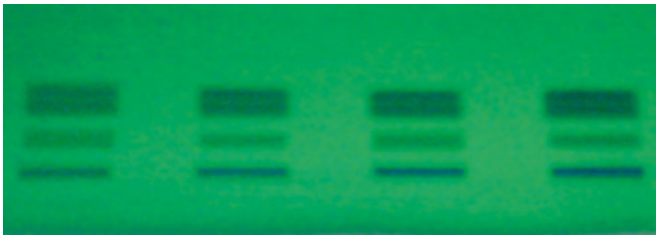


Qualitative detection

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 296.



Quenching of the fluorescence

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 [15]. 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 [16].

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 F1, F2 and F3

- 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 micro-set A for beginners

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

- Separation of the fat-soluble (lipophilic)
  Test 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)

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 (2:1, 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 bottle to fill up with distilled water	2.5 g	814029

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

Information about the advanced sets F1, F2 and F3 can be found on page 270 and page 271.

Introductory kits

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 µL

50 polyester sheets 4 x 8 cm each of POLYGRAM®: SIL G/UV_{254} and CEL 300

100 mL each of *n*-butanol, ninhydrin spray reagent (0.2 % in ethanol), acetone, 25 % ammonia solution, rubeanic 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), Cu^{2+} and Mn^{2+} 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 µL

50 polyester sheets 4 x 8 cm POLYGRAM®: SIL G/UV_{254}

5 disposable pipettes 25 µL

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 µL

50 polyester sheets 4 x 8 cm POLYGRAM®: SIL G/UV_{254}

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 je 100 mL Ethanol, 2-Propanol, Toluol – Diethylether (61:39, 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 TLC micro-set M on page 271).

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 kit	814028

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

Accessories for TLC micro-sets can be found under TLC accessories on page 295.
Spray reagents can be found on page 296.

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 M (materials kit)	1 kit	814100

Summary of MN ready-to-use layers

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

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 aluminum oxide, cellulose, kieselguhr, ion exchangers and polyamide

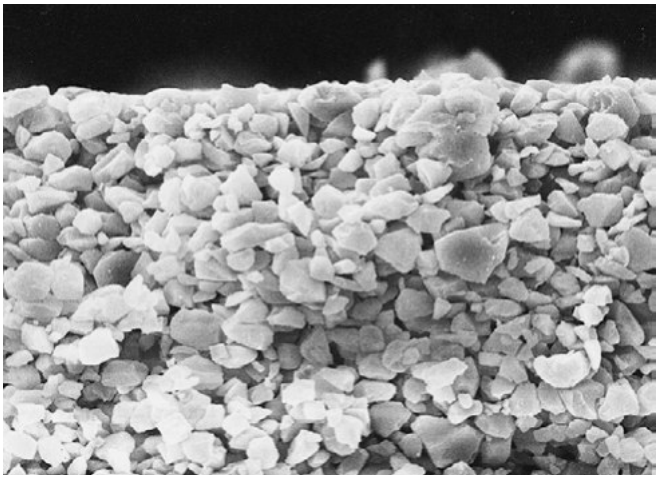
Special phases

- Modified silica, like C_{18} (octadecyl-) cyano-, amino-, diol-, RP-2
- Special layers for specific separations, like PAH- or enantiomer separation

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 a glass plate with silica layer (magnification x 500)



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

Supports for ready-to-use layers for TLC

	Glass plates G	POLYGRAM® P	ALUGRAM® A / ALUGRAM® Xtra Ax
Physical properties of support materials			
Material	glass	polyester	aluminum
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

Summary

Phase	Support*	Layer	Page
Standard silica particle size 5–17 µm			
ADAMANT	G	silica 60, improved binder system, optimized particle size distribution	274
SIL G	G P A Ax	silica 60, standard grade	276
DURASIL	G	silica 60, special binder system	277
SILGUR	G Ax	silica 60 with kieselguhr concentrating zone	279
Unmodified silica for HPTLC particle size 2–10 µm			
Nano-SILGUR	G Ax	nano silica 60 with kieselguhr concentrating zone	279
Nano-ADAMANT	G	nano silica 60, improved binder system, optimized particle size distribution	281
Nano-SIL	G A Ax	nano silica 60, standard grade	281
Nano-DURASIL	G	nano silica 60, special binder system	282
Modified silica for HPTLC particle size 2–10 µm			
Nano-SIL C18-50 / Nano-SIL C18-100	G	nano silica with partial or complete C_{18} modification	283
RP-18 W/UV_{254}	G A	nano silica with partial octadecyl modification, wettable with water	284
RP-2/UV_{254}	G A	silanized silica = dimethyl-modified nano silica 60	284
Nano-SIL CN	G A	cyano-modified nano silica	285
Nano-SIL NH_2	G A	amino-modified nano silica	286
Nano-SIL DIOL	G	diol-modified nano silica	287
Aluminum oxide			
Alox-25 / Alox N	G P A	aluminum oxide	288
Cellulose, unmodified and modified			
CEL 300	G P A	native fibrous cellulose MN 300	289
CEL 400	G P	microcrystalline cellulose MN 400 (AVICEL®)	289
CEL 300 PEI	P	polyethyleneimine-impregnated cellulose ion exchanger	290
CEL 300 AC	P	acetylated cellulose MN 300	290
POLYAMID-6			
POLYAMID-6	P	perlon = ε-polycaprolactame	290
Layers for special separations			
CHIRALPLATE	G	RP silica with Cu^{2+} ions and chiral reagent, for enantiomer separation of amino acids	291
SIL N-HR	P	high purity silica 60, special binder system, higher gypsum content	291
SIL G-25 HR	G	high purity silica 60 with gypsum, recommended for aflatoxin analysis	292
SIL G-25 Tenside	G	silica G with ammonium sulfate for separation of surfactants	292
Nano-SIL PAH	G	nano silica with special impregnation for PAH analysis	292
IONEX-25 SA-Na	P	mixed layer of strongly acidic cation exchanger and silica	293
IONEX-25 SB-AC	P	mixed layer of strongly basic anion exchanger and silica	293
Alox / CEL-AC-Mix	G	mixed layer of aluminum oxide and acetylated cellulose	293
SILCEL-Mix	G	mixed layer of cellulose and silica	293

* G = Glass plates P = POLYGRAM® polyester sheets A = ALUGRAM® aluminum sheets Ax = ALUGRAM® Xtra aluminum sheets

Unmodified TLC silica layers

ADAMANT G unmodified standard silica layers

Key features

- 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 analysis resulting from a UV indicator with increased brilliance and a lownoise background of the layer

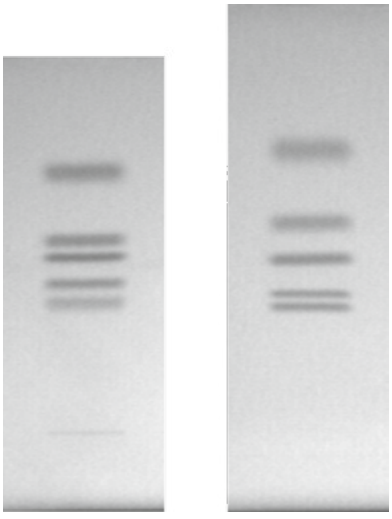
Technical characteristics

- Silica 60, mean pore size 60 Å, specific surface (BET) ~ 500 m^2/g, specific pore volume 0.75 mL/g, particle size 5–17 µm

Separation of steroids

MN Appl. No. 402930

Layers: ADAMANT UV_{254}, SIL G/UV_{254}
Sample: 0.1 % solution in $CHCl_3$
Eluent: chloroform – methanol (97:3, v/v)
Migration distance: ADAMANT 50 mm in 10 min, SIL G 57 mm in 10 min
Detection: UV



ADAMANT UV_{254} SIL G/UV_{254}

Substance	R_f ADAMANT	R_f 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

Separation of barbiturates

MN Appl. No. 402950

Layer: ADAMANT UV_{254}
Sample volume: 1 µL
Eluent: chloroform – acetone (95:5, v/v)
Migration distance: 70 mm in 20 min
Detection: UV

ADAMANT UV_{254}

Substance	R_f
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

Ordering information

Plate size [cm]	2.5 x 7.5	5 x 10	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		821060	0.25 mm	–
ADAMANT UV_{254}	821005	821010	821010.200	821015	821020	821025	821030	0.25 mm	UV_{254}

ALUGRAM® Xtra SIL G Ax unmodified standard silica layers on aluminum

Key features

- 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

Technical characteristics

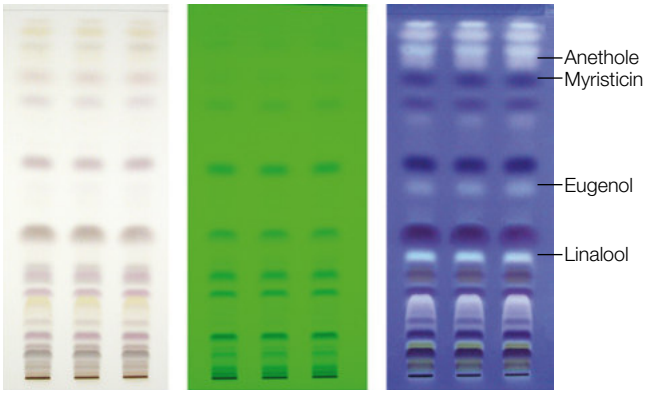
- Silica 60, mean pore size 60 Å, specific surface (BET) ~ 500 m^2/g, specific pore volume 0.75 mL/g, particle size 5–17 µm
- Binder: highly polymeric product, which is stable in almost all organic solvents and resistant towards aggressive visualization reagents, also completely stable in purely aqueous eluents

Separation of nutmeg ingredients

MN Appl. No. 403590

Layer:	ALUGRAM® Xtra SIL G UV_{254}
Sample:	shake 1.0 g freshly powdered drug for 3 min with 4 mL methanol and filter; apply 10 µL
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.



Daylight 254 nm 366 nm

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 aluminum 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}

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

Unmodified TLC silica layers

SIL G G P A unmodified standard silica layers

Technical characteristics

- Silica 60, mean pore size 60 Å, specific surface (BET) ~ 500 m^2/g, specific pore volume 0.75 mL/g, particle size 5–17 µm
- 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 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 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

Glass plates

Pack of [plates]	(preparative TLC)						20	
SIL G-50							809051	0.50 mm
SIL G-50 UV_{254}							809053	0.50 mm

Glass plates

Pack of [plates]	(preparative TLC)						15	
SIL G-100							809061	1.00 mm
SIL G-100 UV_{254}							809063	1.00 mm

Glass plates

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® aluminum 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

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

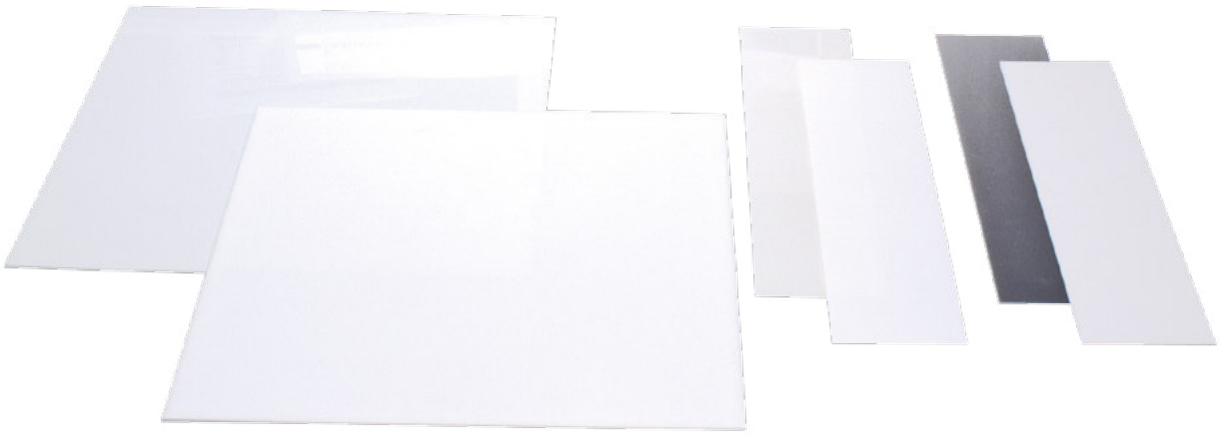
DURASIL G unmodified standard silica layers

Technical characteristics

- Silica 60, mean pore size 60 Å, specific surface (BET) ~ 500 m^2/g, 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 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}

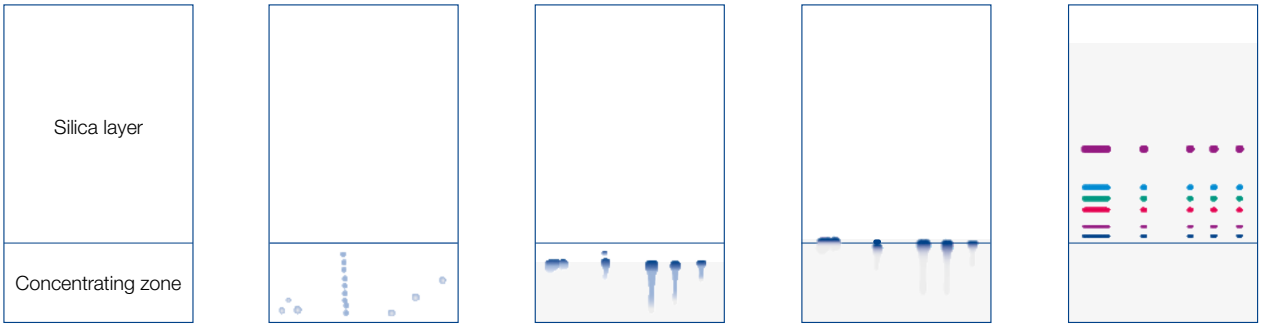


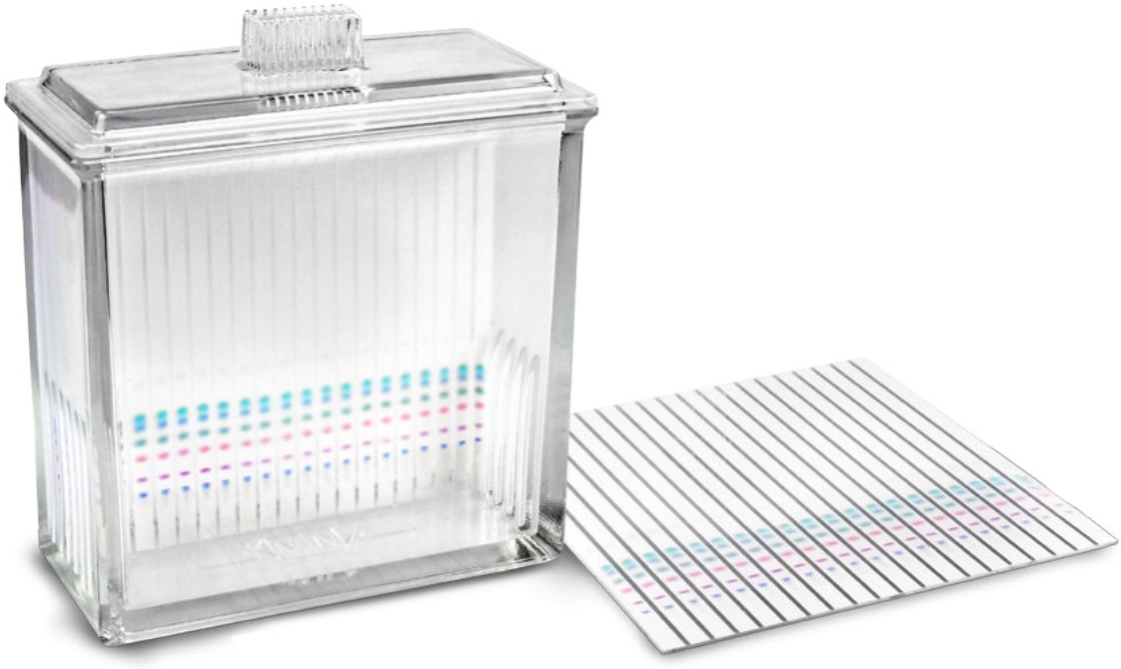
The most TLC layers are available as glass plate, polyester- or aluminum sheet (also see page 272 and 273).

MN TLC pre-coated layers – qualitative and individual tailored

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. Separation then takes place in the silica layer.





Silica layers with concentrating zone

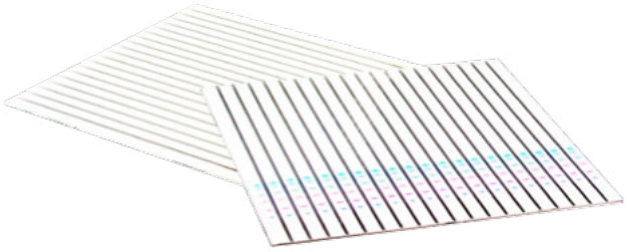
SILGUR G Ax unmodified standard silica layers with concentrating zone

Technical characteristics

- Silica 60, mean pore size 60 Å, specific surface (BET) ~ 500 m^2/g, specific pore volume 0.75 mL/g, particle size 5–17 µm
- Kieselguhr zone for rapid sample application (see page 278)
- Channel-plate with 19 channels help to prevent cross contamination by separating several samples
- More samples can be separated on a plate, and spot areas can be more easily determined

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}
Channel-Plates				
Pack of [plates]		25		
SILGUR-25-C UV_{254}		810123	0.25 mm	UV_{254}
ALUGRAM® Xtra aluminum sheets				
Pack of [plates]	20	25		
SILGUR	818412	818413	0.20 mm	–
SILGUR UV_{254}	818422	818423	0.20 mm	UV_{254}



Nano-SILGUR G Ax unmodified HPTLC silica layers with concentrating zone

Technical characteristics

- Nano silica 60, pore size 60 Å, specific surface (BET) ~ 500 m^2/g, mean specific pore volume 0.75 mL/g, particle size 2–10 µm
- Kieselguhr zone for rapid sample application (see page 278)

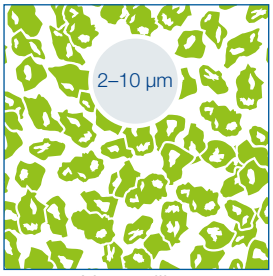
Ordering information

Plate size [cm]	10 x 10	Thickness of layer	Fluorescent indicator
Pack of [plates]	25		
Glass plates			
Nano-SILGUR-20	811032	0.20 mm	–
Nano-SILGUR-20 UV_{254}	811042	0.20 mm	UV_{254}
ALUGRAM® Xtra aluminum sheets			
Nano-SILGUR	818432	0.20 mm	–
Nano-SILGUR UV_{254}	818442	0.20 mm	UV_{254}

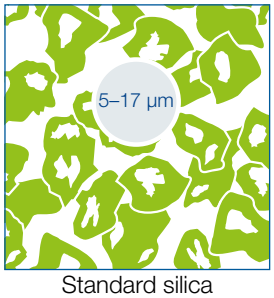
Sharper separation by nano silica

Nano silica for HPTLC

- Narrow fractionation of the silica particles allows theoretical plate heights, which are one order of magnitude smaller than on standard silica layers.



Nano silica



Standard silica

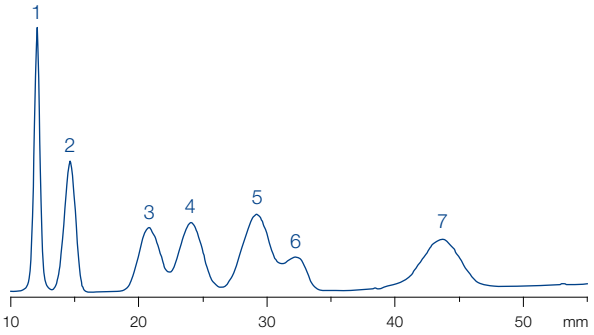
Advantages

- Shorter migration distances
- Lower amount of samples required
- Increased detection sensitivity with equal selectivity
- Less developing time

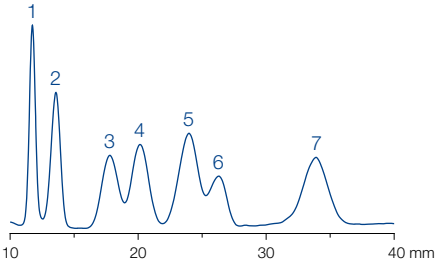
Comparison of ADAMANT and Nano-ADAMANT plates for separation of anthraquinone dyes

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



A)



B)

Nano-ADAMANT G unmodified HPTLC silica layers

Key features

- 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 lownoise background of the layer

Technical characteristics

- Nano silica 60, mean pore size 60 Å, specific surface (BET) ~ 500 m^2/g, specific pore volume 0.75 mL/g, particle size 2–10 µm

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-SIL G Ax A unmodified HPTLC silica layers

Technical characteristics

- Nano silica 60, mean pore size 60 Å, specific surface (BET) ~ 500 m^2/g, 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

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 aluminum sheets							
Nano-SIL G		818240			818241	0.20 mm	–
Nano-SIL G/UV_{254}		818342			818343	0.20 mm	UV_{254}
ALUGRAM® aluminum sheets							
Nano-SIL G					818141	0.20 mm	–
Nano-SIL G/UV_{254}					818143	0.20 mm	UV_{254}

Unmodified HPTLC silica layers

Nano-DURASIL G unmodified HPTLC silica layers

Technical characteristics

- Nano silica 60, mean pore size 60 Å, specific surface (BET) ~ 500 m^2/g, 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
- Different selectivity compared to ADAMANT and SIL-G plates no reversed phase tendency, more polar than Nano-SIL

Ordering information

Plate size [cm] Pack of [plates]	10 x 10 25	10 x 20 50	Thickness of layer	Fluorescent indicator
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 G octadecyl-modified HPTLC silica layers

Technical characteristics

- Nano silica 60, mean pore size 60 Å, specific surface (BET) ~ 500 m^2/g, specific pore volume 0.75 mL/g, pH stability 2–10, particle size 2–10 µm
- 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

Modification

- Partial (50 %) or complete (100 %) octadecyl modification, carbon content 7.5 and 14 %, respectively
- Order of polarity: silica > DIOL > NH_2 > CN > RP-2 > C18-50 > RP-18 W > C18-100

Recommended application

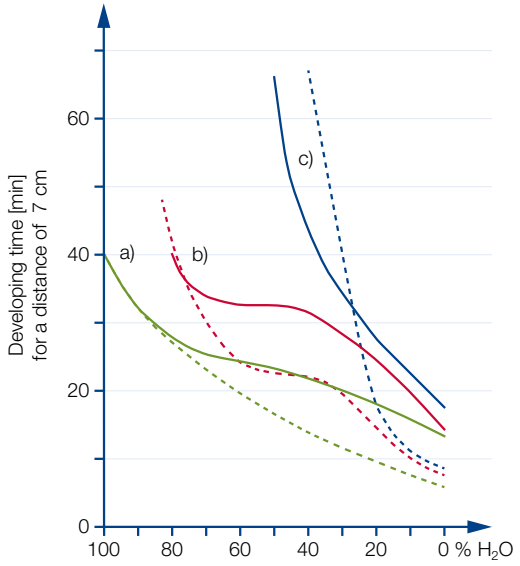
- Reversed phase separation mode with eluents from anhydrous solvents to mixtures with high concentrations of water (see table and figure below)
- Alkaloids, amino acids, preservatives, optical brighteners, barbiturates, polycyclic aromatic hydrocarbons (PAH), drugs, peptides, flavonoids, phenols, indole 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	811054	0.20 mm	–
Nano-SIL C18-50 UV_{254}	50 % silanized	811064	0.20 mm	UV_{254}
Nano-SIL C18-100	100 % silanized	811052	0.20 mm	–
Nano-SIL C18-100 UV_{254}	100 % silanized	811062	0.20 mm	UV_{254}

Eluent	v/v	Migration distances [mm/15 min]		
		C18-50	C18-100	RP-18 W
Methanol – H_2O	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_2O	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

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



a) RP-18 W, b) Nano-SIL C18-50, c) Nano-SIL C18-100 all plates with UV indicator
methanol – water; acetonitrile – water

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

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

Modified silica layers

RP-18 W/UV_{254} G A octadecyl-modified HPTLC silica layers

Technical characteristics

- Nano silica 60, mean pore size 60 Å, specific surface (BET) ~ 500 m^2/g, specific pore volume 0.75 mL/g, particle size 2–10 µm, for preparative plates (1 mm thickness of layer) standard silica 60, pH stability 2–10, particle size 5–17 µm
- 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

Modification

- Partial octadecyl (C_{18}) modification, wettable with water, carbon content 14 %
- Order of polarity: silica > DIOL > NH_2 > CN > RP-2 > C18-50 > RP-18 W > C18-100

Recommended application

- 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
- 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® aluminum 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/UV_{254} G A “silanized silica” = dimethyl-modified standard silica layers

Technical characteristics

- Silica 60, mean pore size 60 Å, specific surface (BET) ~ 500 m^2/g, specific pore volume 0.75 mL/g, pH stability 2–10, particle size 5–17 µm
- 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

Modification

- Silanized silica with dimethyl modification, carbon content 4 %
- Order of polarity: silica > DIOL > NH_2 > CN > RP-2 > C18-50 > RP-18 W > C18-100

Recommended application

- Normal phase or reversed phase separation modes with purely organic, organic - aqueous or purely aqueous eluents
- 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® aluminum sheets				
RP-2/UV_{254}		818171	0.15 mm	UV_{254}

Nano-SIL CN G A cyano-modified HPTLC silica layers

Technical characteristics

- Nano silica 60, mean pore size 60 Å, specific surface (BET) ~ 500 m^2/g, specific pore volume 0.75 mL/g, pH stability 2–8, particle size 2–10 µm
- 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

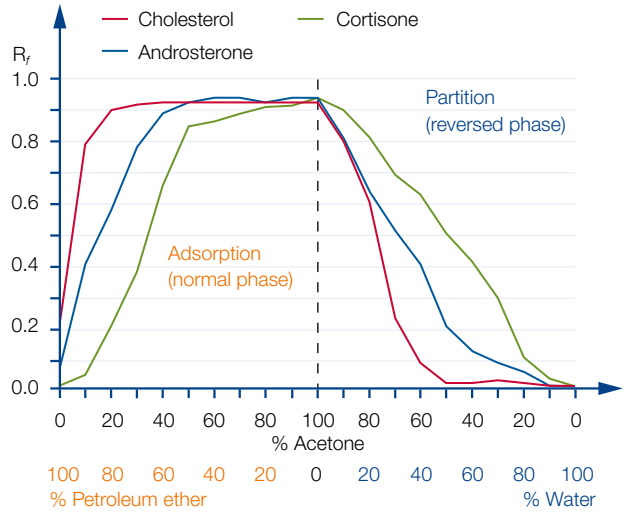
Modification

- Cyanopropyl modification, carbon content 5.5 %
- Order of polarity: silica > DIOL > NH_2 > CN > RP-2 > C18-50 > RP-18 W > C18-100

Recommended application

- NP or RP separation modes depending on the polarity of the developing solvent (see figure below)
- 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

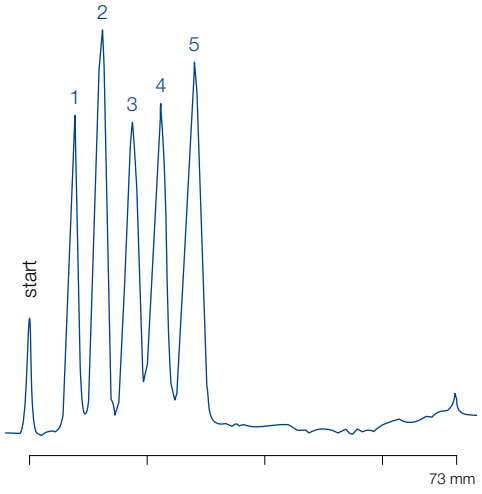
Separation of preservatives

MN Appl. No. 401440

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:	73 mm 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



Ordering information

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

Modified silica layers

Nano-SIL NH_2 G A amino-modified HPTLC silica layers

Technical characteristics

- Nano silica 60, mean pore size 60 Å, specific surface (BET) ~ 500 m^2/g, specific pore volume 0.75 mL/g, pH stability 2–8, particle size 2–10 µm
- 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

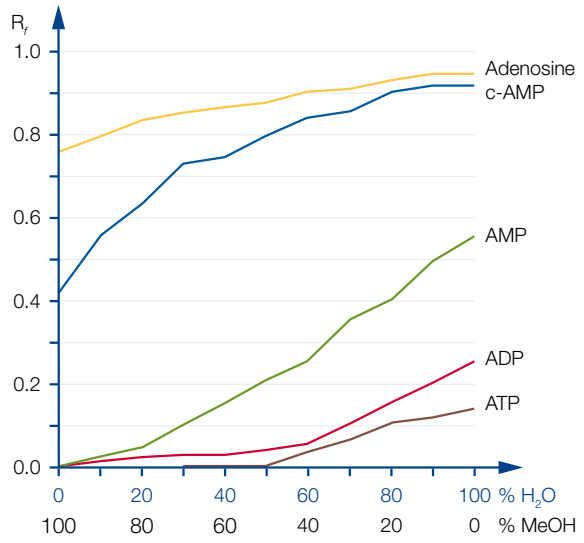
Modification

- Aminopropyl modification, carbon content 3.5 %
- Order of polarity: silica > DIOL > NH_2 > CN > RP-2 > C18-50 > RP-18 W > C18-100
- Layer can be wetted equally well with pure water as with organic solvents

Recommended application

- Vitamins, sugars, steroids, purine derivatives, xanthines, phenols, nucleotides and pesticides

Influence of eluent composition on the separation of nucleotides



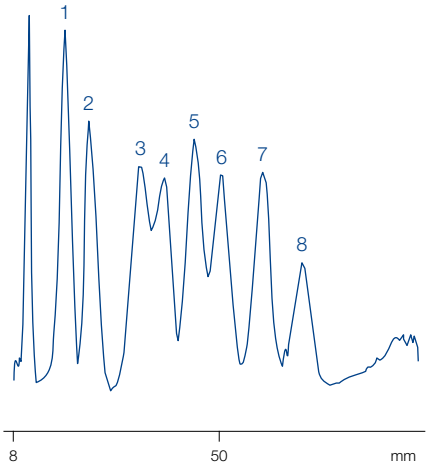
Layer:	Nano-SIL NH_2/UV
Eluent:	MeOH – H_2O according to fig. + 0.18 mol/L NaCl
Migration distance:	7 cm
c-AMP, AMP:	adenosine monophosphate
ADP:	adenosine diphosphate
ATP:	adenosine triphosphate

Separation of sugars

MN Appl. No. 401590

Layer:	Nano-SIL NH_2/UV
Sample volume:	0.5 µL
Eluent:	ethyl acetate – pyridine – water – glacial acetic acid (60:30:10:5, v/v/v/v)
Migration distance:	80 mm in 45 min, double development
Detection:	dry layer at 160 °C for 5 min, TLC scanner, UV 254 nm

Peaks (0.1 % each):
1. Lactose
2. Saccharose
3. Galactose
4. Glucose
5. Fructose
6. Arabinose
7. Xylose
8. Ribose



Ordering information

Plate size [cm] / Pack of [plates]	4 x 8 / 50	10 x 10 / 25	10 x 20 / 25	Thickness of layer	Fluorescent indicator
Glass plates					
Nano-SIL NH_2/UV		811111	811112	0.20 mm	UV_{254}
ALUGRAM® aluminum sheets					
Nano-SIL NH_2/UV	818182			0.15 mm	UV_{254}

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

Nano-SIL DIOL G diol-modified HPTLC silica layers

Technical characteristics

- Nano silica 60, mean pore size 60 Å, specific surface (BET) ~ 500 m^2/g, specific pore volume 0.75 mL/g, pH stability 2–8, particle size 2–10 µm
- 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

Modification

- Diol modification, carbon content 5.5 %
- Order of polarity: silica > DIOL > NH_2 > CN > RP-2 > C18-50 > RP-18 W > C18-100
- Layer can be wetted equally well with pure water as with organic solvents

Recommended application

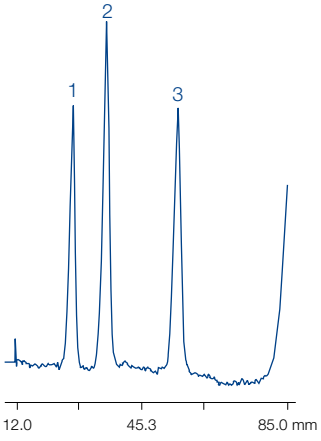
- Steroids, pesticides and plant constituents
- For critical separations an alternative to silica
- Since it is less sensitive to the water content of the environment, leads to more reproducible results compared to silica

Separation of herbicides

MN Appl. No. 401950

Layer:	Nano-SIL DIOL/UV
Sample volume:	2 µL
Eluent:	petroleum ether (40–60 °C) – acetone (80:20, v/v)
Migration distance:	70 mm
Detection:	TLC scanner, 230 nm

Peaks:
(0.07 % each in methanol)
1. Metoxuron
2. Monuron
3. Metobromuron



Ordering information

Plate size [cm]	10 x 10	Thickness of layer	Fluorescent indicator
Pack of [plates]	25		
Glass plates			
Nano-SIL DIOL/UV	811120	0.20 mm	UV_{254}

Further layers

Alox G P A aluminum oxide layers

Technical characteristics

- Aluminum oxide, mean pore size 60 Å, specific surface (BET) ~ 200 m^2/g
- Inert organic binder
- Indicator: manganese-activated zinc silicate

Recommended application

- Terpenes, alkaloids, steroids, aliphatic and aromatic compounds
- We recommend to activate aluminum oxide layers before use by heating 10 minutes at 120 °C

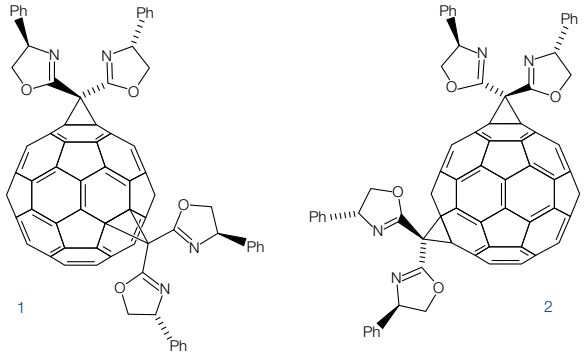
Separation of bisadducts of fullerenes

MN Appl. No. 401930

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

Layer: ALUGRAM® Alox N/UV_{254}
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

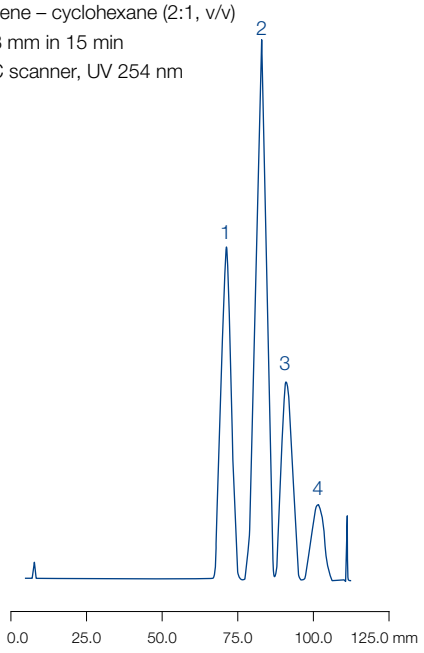


Separation of lipophilic dyes

MN Appl. No. 403010

Layer: Alox-25 UV_{254}
Sample volume: 1000 nL
Eluent: toluene – cyclohexane (2:1, v/v)
Migration distance: 108 mm in 15 min
Detection: TLC scanner, UV 254 nm

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



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® aluminum sheets					
Pack of [plates]		50	25		
Alox N/UV_{254}		818024	818023	0.20 mm	UV_{254}

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

Cellulose MN 300 G P A native fibrous cellulose layers

Technical characteristics

- Fiber length (95 %) 2–20 µm, average degree of polymerization 400–500, specific surface acc. to Blaine 15 000 cm^2/g, ≤ 20 ppm Fe, 6 ppm Cu, 7 ppm P; CH_2Cl_2- 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® aluminum 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®) G P microcrystalline cellulose layers

Technical characteristics

- 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}

Further layers

Cellulose MN 300 PEI P PEI-impregnated cellulose ion exchange layers

Technical characteristics

- Fibrous cellulose impregnated with polyethyleneimine

Recommended application

- Analysis of nucleic acids, and of mutagenic substances with the ^{32}P postlabelling procedure

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}

Cellulose MN 300 AC P acetylated cellulose layers

Technical characteristics

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

Recommended application

- 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	–

Polyamid-6 P ε-polycaprolactame layers

Technical characteristics

- 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				
POLYAMID-6	803012	803013	0.10 mm	–
POLYAMID-6 UV_{254}	803022	803023	0.10 mm	UV_{254}

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

CHIRALPLATE G special layer enantiomer separation

Technical characteristics

- Reversed phase nano silica impregnated with Cu^{2+} ions and a chiral selector (proline derivative)
- Separation based on ligand exchange, i.e. formation of ternary mixed-ligand complexes with the Cu(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

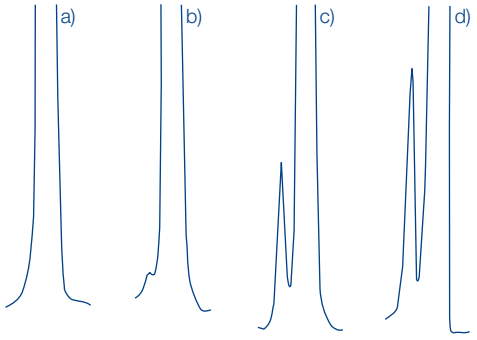
Enantiomer separation of amino acids

MN Appl. No. 400520

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 P unmodified standard silica layers

Technical characteristics

- High purity silica 60, mean pore size 60 Å, specific surface (BET) ~ 500 m^2/g, 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}

Layers for special TLC separations

SIL G-25 HR G special layer for aflatoxin separation

Technical characteristics

- 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}

SIL G-25 Tenside G special layer for separation of surfactants

Technical characteristics

- Silica G impregnated with ammonium sulfate

Recommended application

- Detergents, alkanesulfonates, polyglycols

Ordering information

Plate size [cm]	20 x 20	Thickness of layer	Fluorescent indicator
Pack of [plates]	25		
Glass plates			
SIL G-25 Tenside	810063	0.25 mm	–

Nano-SIL PAH G special HPTLC silica layer for PAH analysis

Technical characteristics

- Nano silica 60, mean pore size 60 Å, specific surface (BET) ~ 500 m^2/g, 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

Ordering information

Plate size [cm]	10 x 20	Thickness of layer	Fluorescent indicator
Pack of [plates]	50		
Glass plates			
Nano-SIL PAH	811051	0.20 mm	–

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

IONEX P 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 [plates]		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 G

Alox/CEL-AC-Mix-25:

- Mixed layer of aluminum oxide G and acetylated cellulose, recommended for separation of PAH

SILCEL-Mix-25:

- Mixed layer of cellulose and silica, recommended for separation of preservatives and other antimicrobial compounds

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}

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

Chromatography papers

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)

Direction

- 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/m²]	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”.

Accessories

- Beside ready-to-use layers for thin layer chromatography also accessories are required
- Selection of accessories for reliable separation in TLC

Ordering information

Designation	Pack of	REF
Simultaneous developing chamber for TLC, 20 x 20 cm	1	814019
Simultaneous developing chamber for TLC, 10 x 10 cm	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 post chromatographic 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 detection	water – acetone	caffeine	100 mL	814401
2',7'-Dichlorofluorescein	2-propanol	lipids (saturated, unsaturated)	100 mL	814921
4-(Dimethylamino)-benzaldehyde	2-propanol	terpenes, sugars, steroids	100 mL	814922
Reagent according to Dragendorff-Munier	water	alkaloids and other nitrogen compounds	100 mL	814402
Iron(III) chloride	water	phenolic compounds e.g., acetylsalicylic acid, paracetamol	100 mL	814403
Potassium hexacyanoferrate(III)	water		100 mL	814404
Molybdatophosphoric acid	ethanol	lipids, sterols, steroids, reducing compounds	100 mL	814302
Ninhydrin	ethanol	amino acids, amines and amino sugars	100 mL	814203
Rhodamine 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 SDS.

Fluorescent indicators

UV indicators with efficient radiation for short-wave as well as long-wave UV ranges

- UV_{254}: manganese-activated zinc silicate with absorption maximum at 254 nm, green fluorescence, relatively susceptible towards acids: its fluorescence can be completely quenched by acidic solvents
- UV_{366}: 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

Silica adsorbent for TLC

Pore size 60 Å, pore volume 0.75 mL/g, specific surface (BET) ~ 500 m^2/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
- Silica N: standard grade, particle size 2–20 µm, Fe < 0.02 %, Cl < 0.02 %, no binder
- Silica G-HR: high purity grade, particle size 3–20 µm, Fe < 0.002 %, Cl < 0.008 %, gypsum as binder
- Silica P: preparative grade, particle size 5–50 µm, Fe < 0.02 %, Cl < 0.02 %, organic binder
- Silica P with gypsum: preparative grade, particle size 5–50 µm, Fe < 0.02 %, Cl < 0.02 %, gypsum as binder

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 gypsums	UV_{254}	816400.1	816400.5

Polyamid adsorbent for TLC

Polyamide 6 = nylon 6 = perlon = ε-polycaprolactame

Ordering information

Designation	Fluorescent indicator	1 kg
Polyamid-DC 6	–	816610.1
Polyamid-DC 6 UV_{254}	UV_{254}	816620.1

Cellulose MN 301 native fibrous cellulose

- Standard grade, fiber length (95 %) 2–20 µm
- Average degree of polymerization 400–500, specific surface acc. to Blaine 15 000 cm^2/g
- ≤ 20 ppm Fe, 6 ppm Cu, 7 ppm P, CH_2Cl_2 extract ≤ 0.25 %, residue on ignition at 850 °C ≤ 1500 ppm

Ordering information

Designation	1 kg	5 kg
Cellulose MN 301	816250.1	816250.5