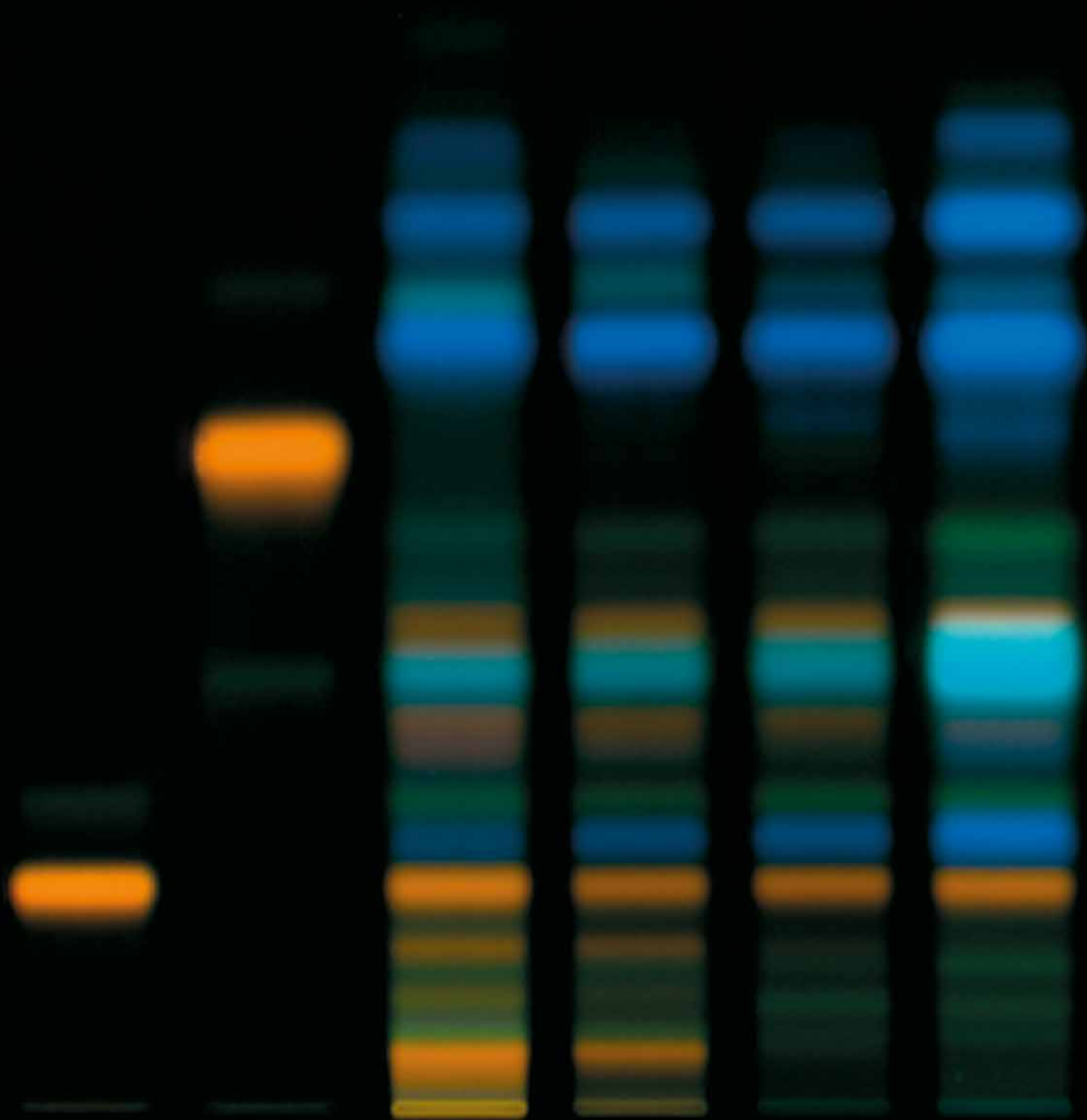


# INSTRUMENTAL THIN-LAYER CHROMATOGRAPHY



**CAMAG**<sup>®</sup>

WORLD LEADER IN PLANAR CHROMATOGRAPHY





## CAMAG – Your partner in all fields of Planar Chromatography

CAMAG has the tradition of serving planar chromatography since 1961. We develop and manufacture sophisticated instruments and associated software for the state-of-the-art analytical technique. Our products are marketed directly in Switzerland, through daughter companies in Germany and in the USA, and through carefully selected distributors worldwide. We see ourselves as a flexible, customer friendly, science based company that has made its mark as a reliable partner in all branches of planar chromatography. We provide competent customer support and technical service for our products as well as education and training for our customers' lab personnel.

CAMAG has everything your lab may need for planar chromatography. This catalog will help you to quickly find information about the products suitable for your tasks. The catalog may also serve as a short guide through all steps of the planar chromatography procedure. Methodological explanations are set apart from specific product information.

Please visit our homepage [www.camag.com](http://www.camag.com) for additional information and the latest news.

Our team is always available for individual questions and support.

### Terminology used in this catalog

In order to emphasize that the state-of-the-art method is something different from the simple thin-layer chromatography of yesterday, we are predominantly using the term Planar Chromatography but occasionally also TLC and HPTLC (High-Performance Thin-Layer Chromatography).

# Overview

Steps of the TLC/HPTLC procedure	What is important?
Sample Application	The samples are applied onto the layer as spots or bands. Precision of the applied volume, exact positioning and compactness of the application zones are decisive for the quality of the analysis.
Chromatogram Development	The developing solvent (mobile phase) is drawn through the layer (stationary phase) by capillary action. Thereby the analytes are separated into their components which remain in their position on the layer after the mobile phase has been evaporated.
Derivatization	Substances that do not respond to visible or UV light can be made detectable by in-situ derivatization. The required reagents are transferred onto the chromatogram by spraying or immersion.
Chromatogram Evaluation	<p>From UV inspection to densitometry</p> <p>UV absorbing substances can be detected under UV light.</p> <p>Chromatograms can be documented, archived and quantitated by electronic image acquisition.</p> <p>Chromatogram evaluation by scanning densitometry offers a maximum of quantitative precision plus spectral selectivity. Online coupling with mass spectrometry opens new possibilities of identification.</p>
Software	All steps in the procedure are managed by CAMAG HPTLC software. It collects and evaluates all data and generates analysis reports in conformity to cGMP/cGLP.
Basic Kits Consumables Accessories	With one of the basic kits a lab can efficiently start working with TLC/HPTLC.
CAMAG Services	CAMAG offers support with method development, training, instrument qualification, literature services and more.

What is offered by CAMAG?		Where can I find?
Nanomat 4 Automatic TLC Sampler 4 Linomat 5	Page 7 Page 8 Page 10	Sample Application 5–10
Developing Chambers smartAlert, smartCut Automatic Developing Chamber ADC 2 Automated Multiple Development AMD 2 HPTLC Vario System	Page 14 Page 15 Page 16 Page 17 Page 18	Chromatogram Development 11–18
Immersion Device TLC/HPTLC Sprayers TLC Plate Heater 3 TLC Spray Cabinet 2	Page 21 Page 21 Page 22 Page 22	Derivatization 19–22
UV Lamp 4, UV Cabinet 4   TLC Visualizer BioLuminizer  TLC Scanner 4 TLC-MS Interface 2	Page 24   Page 26 Page 28  Page 30 Page 32	Chromatogram Evaluation 23–32  UV-Inspection 24  Documentation 25–28  Densitometry 29–32
<i>visionCATS</i> winCATS	Page 34 Page 36	Software 33–36
Basic Kits Precoated Plates In-house preparation of plates	Page 38 Page 39 Page 40	Basic Kits 37–40 Consumables Accessories
Lab Services Qualification Literature Service	Page 42 Page 43 Page 44	CAMAG Services 41–44

## High-Performance Thin-Layer Chromatography

The high performance version of planar chromatography distinguishes the technique. HPTLC comprises the use of chromatographic layers of utmost separation efficiency and the employment of state-of-the-art instrumentation for all steps in the procedure, precise sample application, standardized reproducible chromatogram development and software controlled evaluation. Of course, conventional TLC, manually performed and using inexpensive equipment still has its place in almost all laboratories as a convenient tool for simple and rapid separations.

TLC/HPTLC as opposed to column chromatography (GC, HPLC) utilizes a flat (planar) stationary phase and an open system. The basic steps sample application, chromatogram development and evaluation as well as any optional ones are performed relatively independent in time and location, which, on the one hand offers unsurpassed flexibility but on the other hand makes total automation difficult. Since many samples can be processed in parallel, TLC/HPTLC is rapid and cost effective.

### Remarkable features of planar chromatography:

In addition to chromatogram detection/evaluation under visible or ultra-violet light, pre- and postchromatographic derivatization is readily available, for which a practically unlimited variety of reagents can be used, since it is performed in the absence of the mobile phase.

Unlike with column chromatography, the user has a complete overview of the chromatogram as all fractions remain stored on the plate and any substances remaining in the start position are detectable. It is another advantage of planar chromatography that sample preparation can often be simplified, due to the one-time use of the stationary phase.

Standardized HPTLC analysis methods – qualitative or quantitative – can be validated. For customers regulated by cGMP/cGLP, we offer Installation Qualification (IQ) and Operating Qualification (OQ) for our instruments.

CAMAG's modern software concept ensures the reliable operation of our HPTLC systems and the documentation/storage of operating parameters and results as required by the customer.

TLC-MS online coupling, the comparatively new hyphenation of HPTLC and mass spectrometry, has the potential to become an indispensable technique for many analytical laboratories.

## Important fields of application



### Pharmaceutical applications

- Quality control
- Content Uniformity Test (CUT)
- Identity- and purity checks
- Stability tests, etc.



### Herbals

- Identification
- Stability tests
- Detection of adulteration
- Assay of marker compounds, etc.



### Clinical applications

- Lipids
- Metabolism studies
- Drug screening
- Doping control, etc.



### Food and feed stuff

- Quality control
- Additives (e. g. vitamins)
- Pesticides
- Stability tests (expiration), etc.



### Cosmetics

- Identity of raw material
- Preservatives, coloring materials, etc.
- Screening for illegal ingredients, etc.



### Industrial applications

- Process development and optimization
- Process monitoring
- Cleaning validation, etc.



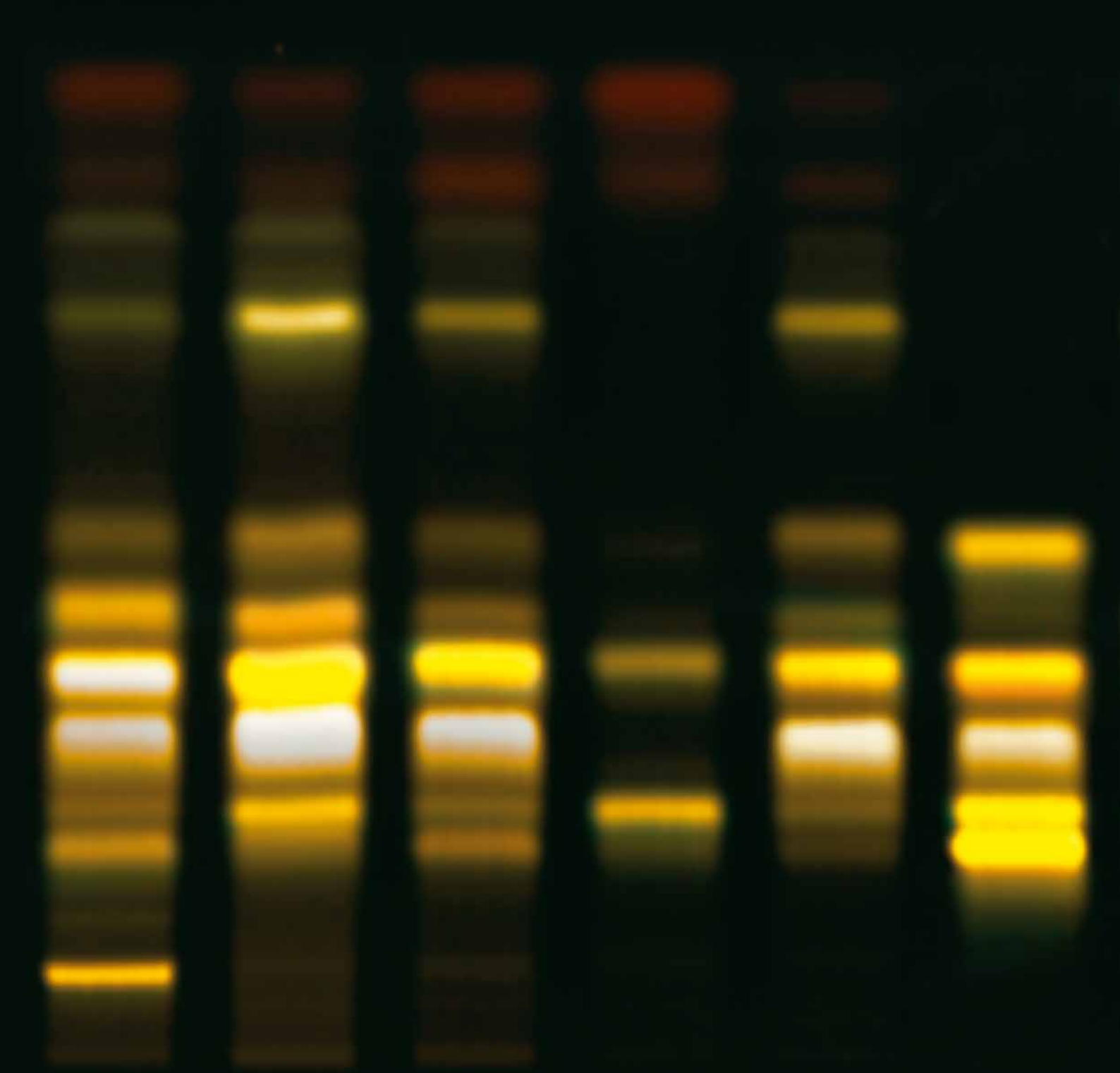
### Environment

- Water
- Soil
- Residue analysis, etc.



### Forensics

- Detection of document forgery
- Investigation of poisoning
- Dye stuff analyses, etc.



# Sample Application

Sample application determines  
quality and reproducibility of the analysis



# Sample Application – Variations

Sample application is the first step in the workflow of planar chromatography and it affects significantly the quality of the result at the end of the process. The choice of the application technique and the device depend on the requirements of precision, sample volumes, number of analyses and the desired grade of automation.

Spot wise sample application using a fixed volume capillary is the simplest way. Sample volumes of 0.5 to 5  $\mu\text{L}$  can be applied as spots onto conventional layers without intermediate drying, on HPTLC layers it is up to 1  $\mu\text{L}$  per spot. It is recommended to guide the capillary by means of a Nanomat.

Spraying-on samples as narrow bands allows the application of significantly larger volumes. Starting zones in the form of narrow bands ensure the best resolution that can be achieved with the chromatographic system selected.

Very large sample volumes or samples with a high matrix content can be sprayed-on in the form of rectangles which, prior to chromatography, are focused into narrow bands by a short development step with a solvent of high elution strength.

## Effect of the solvent and the technique of sample application on the chromatogram

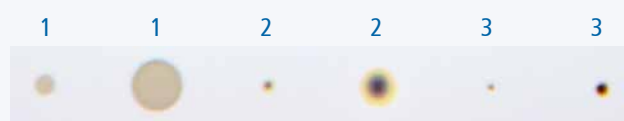
Mobile phase: toluene; detection: white light

Test dye mixture (0.5 and 5  $\mu\text{L}$ ) dissolved in

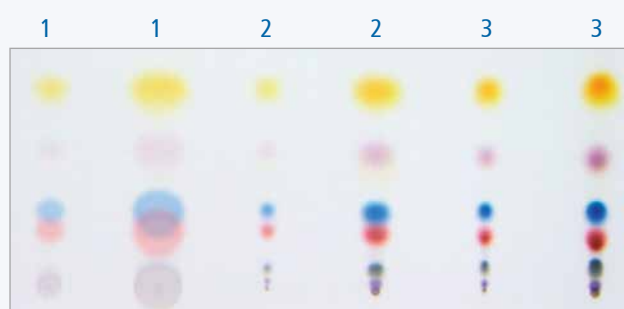
1: methanol

2: toluene

3: hexane



Contact application, prior to development



Developed plate after contact application of spots



Developed plate after spray-on application of bands





## CAMAG Nanomat 4 and Capillary Dispenser

The Nanomat 4 serves for easy application of samples in the form of spots onto TLC and HPTLC layers, precisely positioned and without damage to the layer. The actual sample dosage is performed with a disposable capillary pipette, which is precisely guided, thus ensuring that the chromatogram can be scanned automatically according to a programmed pattern.

### The Nanomat 4 is suitable for

- Conventional TLC plates including self-coated plates up to 20 × 20 cm
- HPTLC plates 10 × 10 cm and 20 × 10 cm
- TLC and HPTLC sheets up to 20 × 20 cm

### Capillary pipettes

The capillary pipettes are loaded into the dispenser in magazines. Capillaries of 0.5, 1.0, 2.0, and 5.0 µL volume are available. Each capillary size requires an appropriate dispenser magazine. With the Universal Capillary Holder capillary pipettes are taken from the dispenser, then filled with sample solution and placed against the applicator head of the Nanomat 4.

### Ordering information

#### 040.1500 CAMAG® Nanomat 4 Complete-Kit

022.4730 CAMAG® Nanomat 4,  
022.7655 Capillary Dispenser,  
022.7786 Universal Capillary Holder,  
022.7661 Dispenser Magazine for  
1 µL capillaries,  
022.7771 Disposable Capillary  
Pipettes 1 µL,  
pack of 5 × 100

022.7660 Dispenser Magazine for 0.5 µL  
capillaries, without capillaries  
022.7661 Dispenser Magazine for 1 µL  
capillaries, without capillaries  
022.7662 Dispenser Magazine for 2 µL  
capillaries, without capillaries  
022.7665 Dispenser Magazine for 5 µL  
capillaries, without capillaries

022.7770 Capillary Pipettes 0.5 µL  
pack of 5 × 100  
022.7771 Capillary Pipettes 1 µL  
pack of 5 × 100  
022.7772 Capillary Pipettes 2 µL  
pack of 5 × 100  
022.7775 Capillary Pipettes 5 µL  
pack of 5 × 100

Further information at [www.camag.com/nanomat](http://www.camag.com/nanomat)

## CAMAG Automatic TLC Sampler 4 (ATS 4)



Automatic sample application is a key factor for productivity of the HPTLC laboratory. The requirements for an instrument serving this purpose, i.e. precision, robustness during routine use and convenient handling are fully met by the Automatic TLC Sampler 4. The ATS 4 offers fully automatic sample application for qualitative and quantitative analyses as well as for preparative separations. It is suited for routine use and high sample throughput in mass analysis.

Samples are either applied as spots through contact transfer (0.1–5 µL) or as bands or rectangles (0.5 to > 50 µL) using the spray-on technique. Starting zones in the form of narrow bands offer the best separation attainable with a given chromatographic system. Application in the form of rectangles allows precise application of large volumes without damaging the layer. Prior to chromatography, these rectangles are focused into narrow bands with a solvent of high elution strength.

The ATS 4 allows “overspotting”, i.e. a sequential application from different vials onto the same position. This technique can be used e.g. in pre-chromatographic derivatization, spiking, etc.

### Key features

- Fully automatic sample application, suitable for routine
- Application in the form of spots, bands, or rectangles
- Data input and monitoring through *visionCATS* software
- Application of solutions onto any planar medium (FreeMode)



### Heated Spray Nozzle for ATS 4 (optional)

Heating at 60 °C cuts the time required for the application of aqueous solutions about in half. This is useful e.g. for trace analysis where comparatively large sample volumes have to be applied in order to reach a low detection limit

### Ordering information

**022.7400 CAMAG® Automatic TLC Sampler 4 (ATS 4), incl.**  
25 µL Dosing syringe (695.0053), Spray-on needle for dosing syringe (695.0046), Contact transfer needle for dosing syringe (695.0047), without software

**022.7410 CAMAG® Automatic TLC Sampler 4 (ATS 4), with heated spray nozzle, incl.** 25 µL Dosing syringe (695.0053), Spray-on needle for dosing syringe (695.0046), Contact transfer needle for dosing syringe (695.0047), without software

### Note

The Automatic TLC Sampler ATS 4 with *visionCATS* meets all the requirements of cGMP/cGLP and can be IQ/OQ qualified. If the instrument shall be used in a 21 CFR Part 11 environment, the *visionCATS* Option „21 CFR Part 11“ is required.

Detailed ordering information: [www.camag.com/ats4](http://www.camag.com/ats4)



### Operation of the ATS 4 with *visionCATS* HPTLC Software

Precise sample application is a crucial factor for the quality of the HPTLC analysis and the results obtained. When using *visionCATS* HPTLC software with its easy to navigate user interface to control the ATS 4, a fully automated sample application for routine use and high sample throughput is supported.

The dialog box for instrument parameters offers user-friendly default combinations. For instance, the user can select the solvent type most similar to the solvent actually used. The software will then automatically adapt the instrument defaults to optimize its application regarding viscosity, volatility and surface tension. Another example of a pre-selected combination is the filling/rinsing quality which determines how often the syringe is rinsed, the filling process repeated, etc. All these pre-selections can be individually adjusted to a specific task.

The dialog for entering the sequence of samples is clearly arranged and easy to use. Tracks can be automatically arranged evenly spaced across the plate, sample designations can be inserted from a prepared list, etc. The program progress is displayed on screen as long as the instrument remains connected to the computer.

The dialog box for ATS 4 application settings offers user-friendly default combinations. All pre-defined parameters can be individually adjusted.

Tr.	Vial ID	Description	Vol. (µl)	Position	Type	SST
1	R12345	Caffeine standard	2.0	A1	Reference	<input checked="" type="checkbox"/>
2	S12345	Tea sample 1	2.0	A2	Sample	<input checked="" type="checkbox"/>
3	S12345	Tea sample 1				<input type="checkbox"/>
4	R12345	Caffeine standard				<input type="checkbox"/>
5	S12346	Tea sample 2				<input type="checkbox"/>
6	S12346	Tea sample 2				<input type="checkbox"/>
7	R12345	Caffeine standard				<input type="checkbox"/>
8	S12347	Tea sample 3				<input type="checkbox"/>
9	S12347	Tea sample 3				<input type="checkbox"/>
10	R12345	Caffeine standard				<input type="checkbox"/>
11	S12348	Tea sample 4				<input type="checkbox"/>
12	S12348	Tea sample 4				<input type="checkbox"/>
13	R12345	Caffeine standard				<input type="checkbox"/>
14	S12349	Tea sample 5				<input type="checkbox"/>
15	S12349	Tea sample 5				<input type="checkbox"/>
16						<input type="checkbox"/>

Easy sequence setup with *visionCATS*: the sequence table holds all information required to fully automated run a series of samples, e.g. sample location (rack position and application position), sample volume, sample name, etc.

## CAMAG Linomat 5



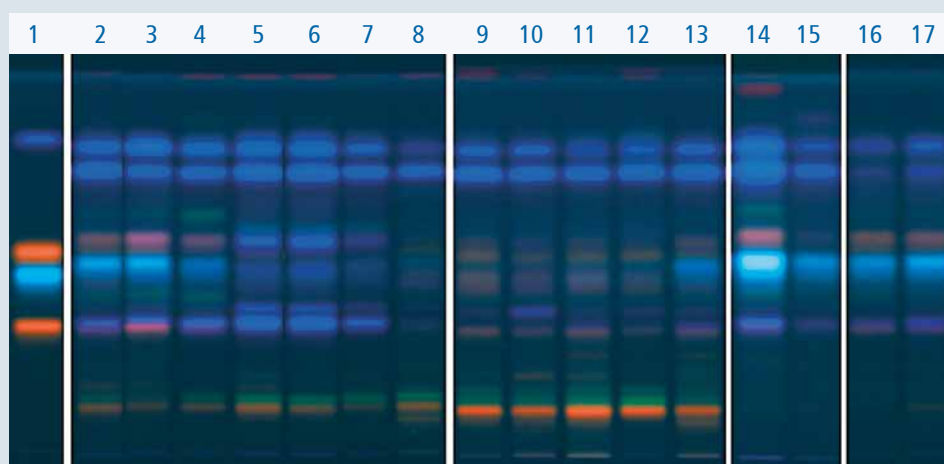
With the Linomat 5 samples are sprayed onto TLC/HPTLC plates in the form of bands with nitrogen or compressed air. Sample application is automatic, only changing the syringe (filling, inserting and rinsing) is manual. The Linomat is suitable for routine use.

### Software-controlled operation

A software-controlled operation of the CAMAG Linomat 5 allows to rapidly enter all data on the sample sequence, plate dimensions, number and distance of tracks, designation, sample volumes. All operating data are automatically transferred to the densitometric or image processing evaluation step.

### Operation in stand-alone mode

In order to meet the requirements of users employing the Linomat only occasionally it can also be operated in stand-alone mode. Up to 10 application programs can be entered either manually via the keypad or transferred from a computer.



### Sample application as bands

HPTLC fingerprint (flavonoids) of green tea samples representing different geographic origins.

### Track assignment

1 Reference substances with increasing  $R_f$ :  
rutin, chlorogenic acid, hyperoside, gallic acid

2–8 Samples from China

9–13 Samples from Japan

14–15 Samples from India

For comparison:

16–17 Black tea from Sri-Lanka

Tracks taken from different plates

### Ordering information

**022.7808 CAMAG® Linomat 5**, including one dosing syringe 100 µL, without software

695.0014 Dosing Syringe 100 µL for Linomat

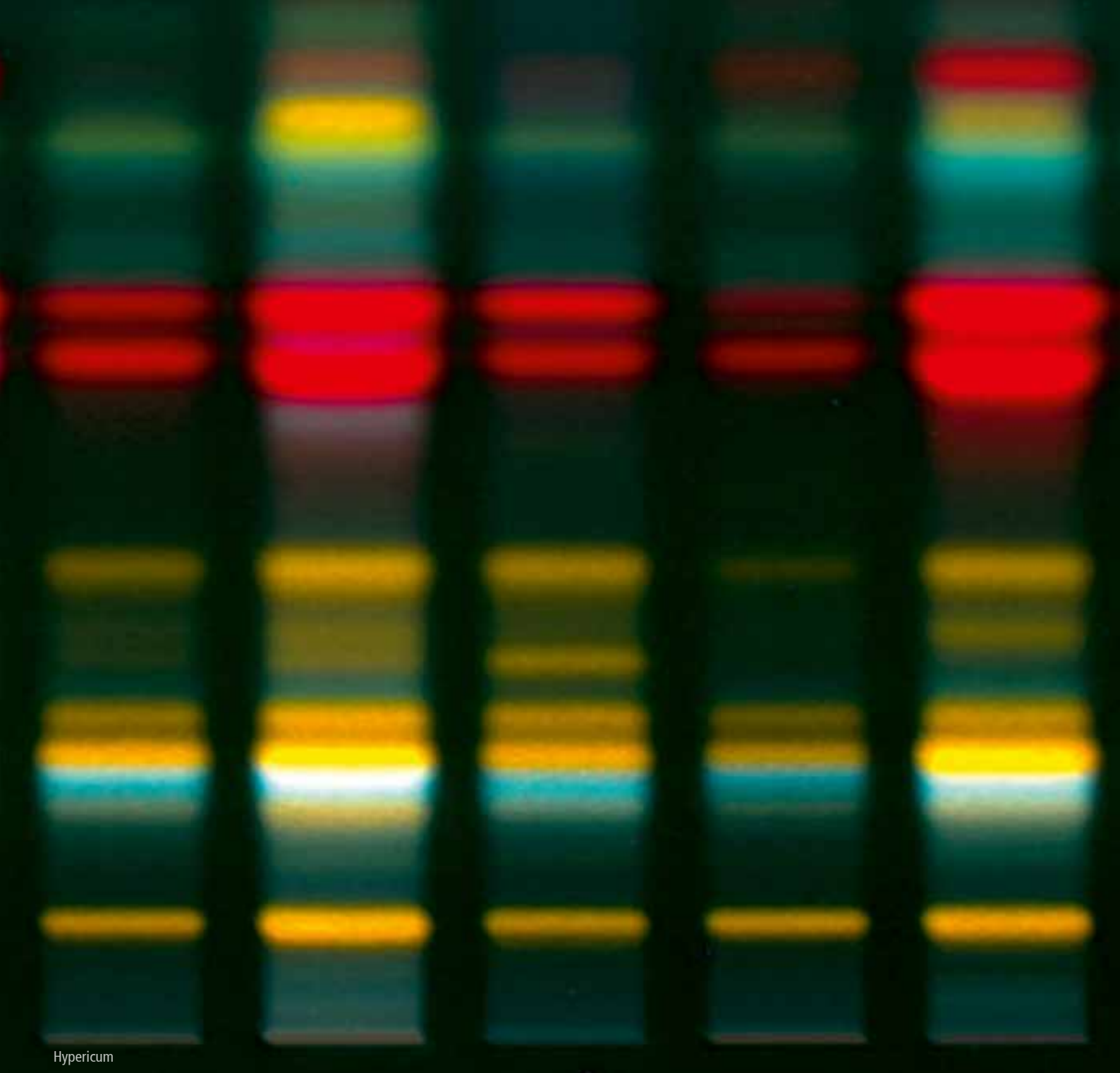
695.0015 Dosing Syringe 500 µL for Linomat

### Note

The Linomat 5 with *visionCATS* meets all the requirements of cGMP/cGLP and can be IQ/OQ qualified. If the instrument shall be used in a 21 CFR Part 11 environment, the *visionCATS* Option „21 CFR Part 11“ is required.

Detailed ordering information: [www.camag.com/linomat5](http://www.camag.com/linomat5)





Hypericum

# Chromatogram Development

Chromatogram development under reproducible standardized conditions is a key to the quality of the result

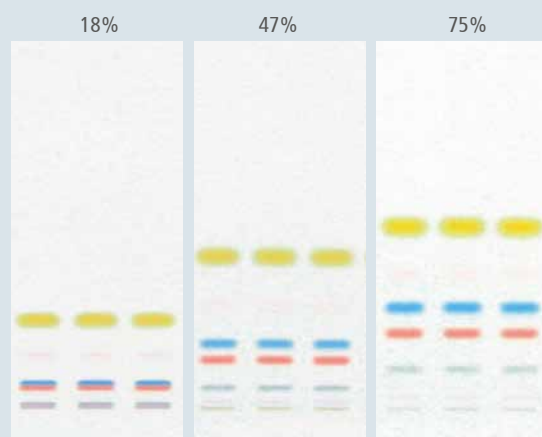
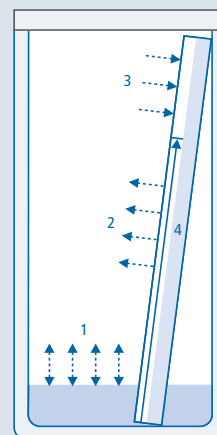
# Chromatogram Development

**TLC/HPTLC differs from all other chromatographic techniques in the fact that in addition to stationary and mobile phases, a gas phase is present, which can significantly influence the result of the separation.**

The following considerations primarily concern silica gel as stationary phase and a process usually described as adsorption chromatography.

**In the developing chamber four partially competing processes occur:**

- 1 Between the components of the developing solvent and its vapor, an equilibrium will be established gradually. This process is called chamber saturation. Depending on the vapor pressure of the solvent components the composition of the gas phase can differ from that of the developing solvent.
- 2 The part of the layer which is already wetted with mobile phase contributes to the formation of the equilibrium.
- 3 While still dry, the stationary phase adsorbs molecules from the gas phase. Thereby polar components will be preferentially withdrawn from the gas phase and loaded onto the surface of the stationary phase. Allowing the plate to interact with the gas phase prior to starting chromatographic development is called layer preconditioning, which is not possible with all types of developing chambers. Lining the chamber with filter paper soaked with developing solvent supports this process. In case that preconditioning is not desired, a counter glass plate arranged a few mm apart suppresses it. This is called sandwich configuration.
- 4 During solvent migration, the components of the mobile phase may be separated by the stationary phase under certain conditions, causing the formation of secondary fronts, which is usually not desired.



Influence of relative humidity ("activity of the layer") with the same solvent migration distance



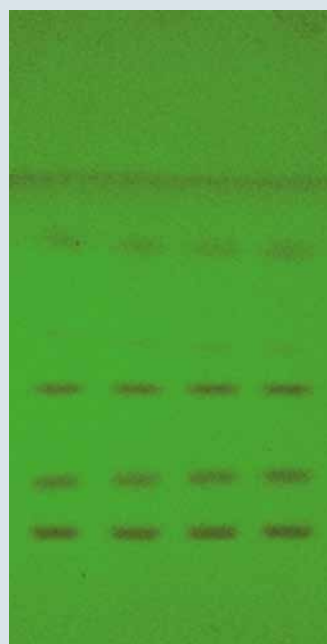
## Choosing the type of developing chamber

Selection of the "appropriate" chamber is made during method development, depending on what parameters such as chamber saturation, preconditioning the layer, relative humidity, etc. influence the result. Often "practical" considerations are followed such as which chamber is available, which one must be used due to an SOP, or which one has been used in the past if a results comparison is to be made. Economical aspects like solvent consumption, optimal use of layer space, etc. are also considerations. Preconditioning of the layer with solvent vapor is possible with all type chambers described except the flat bottom chamber.

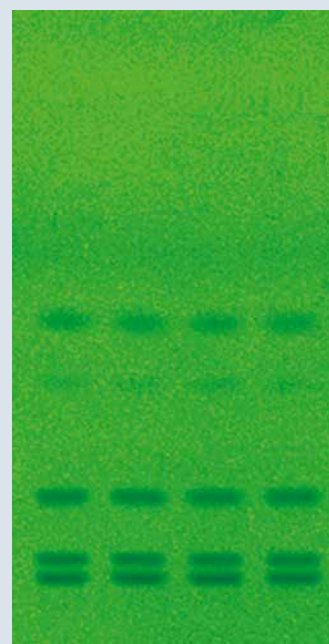
Efficient preconditioning at a controlled relative humidity is most conveniently effected with the ADC 2. Also the Horizontal Developing Chamber (HDC) provides this feature and – with limitations – the Twin Trough Chambers.

Sandwich configuration can be selected with the HDC.

Considered also should be the HPTLC Vario System (p. 18) which offers the time saving optimization of development conditions.



Development without preconditioning

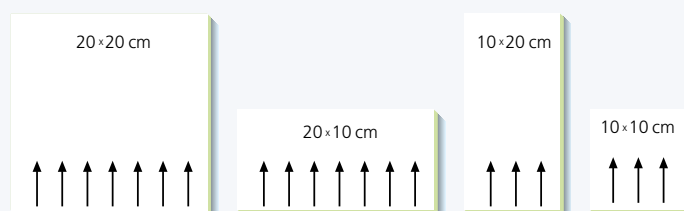


Development with preconditioning

## Definition of plate and chamber formats

These format definitions are used in this catalog as well as in all CAMAG literature.

Note: certain plates can be developed in one direction only, e.g. plates with a concentration zone, GLP coded plates.







## CAMAG Flat Bottom Chamber

This is the classical developing tank for Thin-Layer Chromatography. It permits the plate to be developed under conditions of partial or complete saturation of the tank atmosphere with solvent vapors. The degree of layer preconditioning can not be controlled unless additional accessories are used.



## CAMAG Twin Trough Chamber

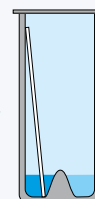
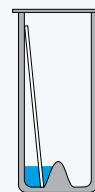
The CAMAG Twin Trough Chamber offer several ways to specifically influence chromatogram development in order to improve it.

### Twin Trough Chamber: Low solvent consumption

20 mL of solvent are sufficient for a 20 × 20 cm chamber, 10 mL for the 20 × 10 cm chamber and 5 mL for a 10 × 10 cm chamber. This reduces not only solvent consumption but also disposal problems.

### Reproducible preconditioning of the layer with solvent vapor

Developing solvent is placed in the trough opposite to the plate. Preconditioning can be performed with any solvent and for any duration. Development is started when developing solvent is placed into the trough with the plate.



### Ordering information

#### CAMAG® Flat Bottom Chamber

- 022.5259 for plates 20 × 20 cm, with stainless steel lid
- 022.5250 for plates 20 × 20 cm, with glass lid
- 022.5257 for plates 20 × 20 cm, without lid
- 022.5150 for plates 10 × 10 cm, with stainless steel lid
- 022.5151 for plates 10 × 10 cm, without lid
- 022.5275 light-weight for plates 20 × 20 cm, with glass lid
- 022.5270 light-weight for plates 20 × 10 cm, with glass lid

#### CAMAG® Twin Trough Chamber

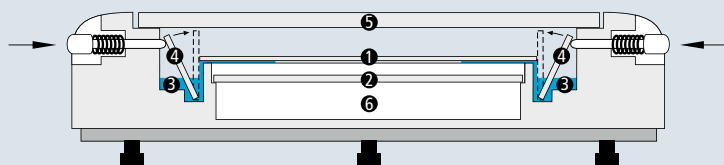
- 022.5256 for plates 20 × 20 cm, with stainless steel lid
- 022.5255 for plates 20 × 20 cm, with glass lid
- 022.5258 for plates 20 × 20 cm, without lid
- 022.5254 for plates 20 × 10 cm, with stainless steel lid
- 022.5253 for plates 20 × 10 cm, with glass lid
- 022.5261 for plates 20 × 10 cm, without lid
- 022.5155 for plates 10 × 10 cm, with stainless steel lid
- 022.5156 for plates 10 × 10 cm, without lid



## CAMAG Horizontal Developing Chamber

In the Horizontal Developing Chamber the HPTLC plate is developed from both opposing sides towards the middle. This permits the number of samples to be doubled as compared with development in a tank, provided the separation distance of 45 mm (i.e. 50 mm minus 5 mm distance from the edge, is sufficient). In case a longer separation distance is desired, the HDC can be used for development from one side.

In the Horizontal Developing Chamber, a plate can be developed in the sandwich configuration as well as in the tank configuration.



- 1 HPTLC plate (layer facing down)
- 2 Glass plate inserted to establish sandwich configuration
- 3 Reservoir for developing solvent
- 4 Glass strip for solvent transfer by capillary action
- 5 Cover plate
- 6 Conditioning tray

## CAMAG smartAlert solvent front monitor

smartAlert serves for dependable monitoring the development of a glass plate in a glass developing chamber.

- Gives acoustic and visual notice when the mobile phase has reached the desired developing distance
- Replaces a timer or stop watch
- Works with glass chambers for plate sizes 20 × 20, 20 × 10 and 10 × 10 cm
- Battery operated



## CAMAG smartCut plate cutter

Convenient and precise cutting of TLC/HPTLC plates

- Cuts glass plates with a thickness up to 3 mm
- Makes smooth cuts on sensitive layers
- Desired size can be read directly from a scale
- Easy handling

### Ordering information

022.8535 CAMAG® Horizontal Developing Chamber for plates 20 × 10 cm  
022.8530 CAMAG® Horizontal Developing Chamber for plates 10 × 10 cm

022.5300 CAMAG® smartAlert solvent front monitor  
022.4300 CAMAG® smartCut plate cutter

## CAMAG Automatic Developing Chamber 2 (ADC 2)



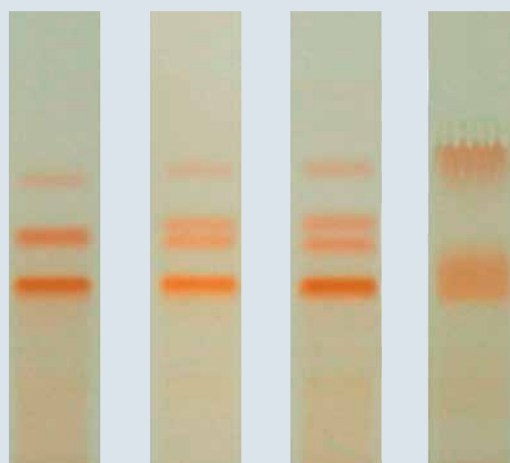
The Automatic Developing Chamber ADC 2 offers convenience, safety and reproducibility for the isocratic development of HPTLC plates and foils with the format 20 × 10 cm.

The Automatic Developing Chamber ADC 2 is the heart of a state-of-the-art HPTLC system. It performs the development step fully automatically, reproducibly, and independent of environmental effects. The activity and pre-conditioning of the layer, chamber saturation, developing distance and final drying can be pre-set and are automatically monitored by the ADC 2. Two modes of operation are possible: stand-alone with input of parameters via keypad, or remote operation by software with process monitoring, documentation of operating parameters, and reporting.

### Key features

- Fully automatic development of 20 × 10 cm TLC/HPTLC plates
- A conventional 20 × 10 cm Twin Trough Chamber is used for development.
- This way, chromatographic conditions of already existing analytical procedures can be retained, but environmental and operational effects are excluded.
- Operation in stand-alone mode or software controlled
- The user is freed of all process monitoring responsibilities, operation is fully traceable.
- The option "Humidity Control" allows reproducible chromatography at defined activity of the layer. This feature is essential in method development when the influence of relative humidity shall be investigated.

15 %      33 %      47 %      60 %



Effect of relative humidity on separation of polyphenols in green tea

Mobile phase: toluene – acetone – formic acid 9:9:2

### Ordering information

022.8350 CAMAG® Automatic Developing Chamber 2 (ADC 2), including CAMAG® Twin Trough Chamber for ADC 2 (022.5261) for 20 × 10 cm plates, without software  
Detailed ordering information: [www.camag.com/adc2](http://www.camag.com/adc2)

### Note

The Automatic Developing Chamber ADC 2 with *visionCATS* meets all the requirements of cGMP/cGLP and can be IQ/OQ qualified. If the instrument shall be used in a 21 CFR Part 11 environment, the *visionCATS* Option „21 CFR Part 11“ is required.

# CAMAG AMD 2 System Automated Multiple Development



The CAMAG AMD procedure allows Thin-Layer Chromatography to be utilized for tasks that could not be performed by TLC in the past. Only the AMD procedure can be successfully employed for reproducible gradient development with silica gel as the stationary phase. In column liquid chromatography, gradient elution is common, but on reversed phases only, because a normal phase column would be irreversibly degraded, which is not acceptable in a technique depending on multiple use of the stationary phase.

## The principle of the CAMAG AMD procedure

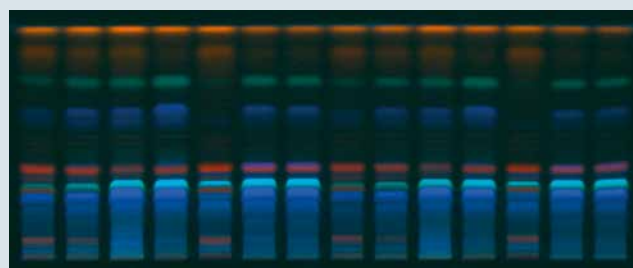
- The HPTLC plate is developed repeatedly in the same direction.
- Each successive run extends over a longer solvent migration distance than the one before.
- Between runs, the solvent is completely removed from the developing chamber and the layer is dried under vacuum.
- Each successive run uses a solvent of lower elution strength than that of the one used before. In this way, a stepwise elution gradient is formed.
- The combination of focusing effect and gradient elution results in extremely narrow bands. Their typical peak width is about 1 mm. This means that, within the available separation distance of 80 mm, up to 40 components can be completely resolved, i.e. with base line separation.

## AMD 2 under winCATS

The AMD 2 communicates with winCATS. The gradient, made from up to 5 solvent bottles, is defined by input into a table in winCATS. Gradient and developing distance for each run are graphically displayed for verification. All individual runs of the developing program are performed fully automatic and monitored by winCATS.

## Key features

- Multiple development using a solvent strength gradient
- Separation power improved over regular HPTLC development by about factor 3
- Data input and monitoring through winCATS
- Utilizing time outside working hours if required



Separation of various rhubarb samples by AMD

Detection: UV 366 nm

Gradient in 10 steps: Methanol – dichloromethane from 40:60 to 10:90 in 9 steps over 40 mm developing distance followed by one step methanol – dichloromethane 10:90 over 70 mm

## Ordering information

022.8860 CAMAG® AMD 2 System Automated Multiple Development comprising chromatogram developing module, standard accessories and Equilink, without software

Detailed ordering information: [www.camag.com/amd2](http://www.camag.com/amd2)

## Note

The AMD 2 with winCATS meets all the requirements of cGMP/cGLP and can be IQ/OQ qualified. If the instrument shall be used in a 21 CFR Part 11 environment, the option 21 CFR Part 11 "compliance ready" is required for each winCATS workstation.



# CAMAG HPTLC Vario System



## Key features

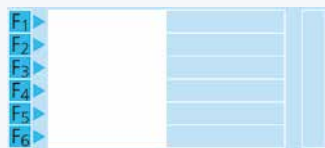
- Development with six different solvents can be tested side by side.
- Sandwich configuration as well as tank configuration can be simulated side by side, making results directly comparable.
- Six different conditions of pre-equilibration, including relative humidity, can be tested simultaneously.
- These variations of developing conditions can be freely combined.

## Time saving optimization of separation conditions using the HPTLC Vario System

Application examples, schematic:  $F_1 \dots$  = developing solvents,  $C_1 \dots$  = conditioning liquids

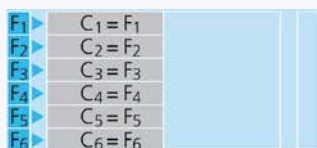
### Optimization of the developing solvent

Development with 6 different solvents side by side, without preconditioning = development in sandwich configuration.



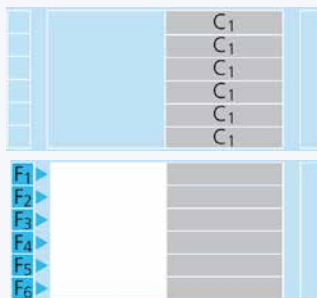
### Optimization of the development solvent

Development with 6 different solvents side by side whereby the conditioning troughs contain the same six solvents = simulated tank development



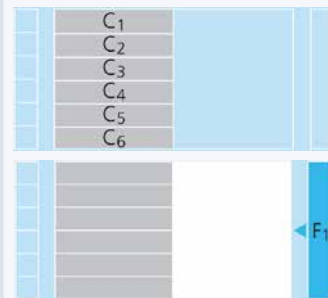
### Optimization of the development solvent after uniform layer preconditioning

First step: pre-equilibration of all six tracks with the same conditioning liquid; then development with six different solvents (in sandwich configuration).



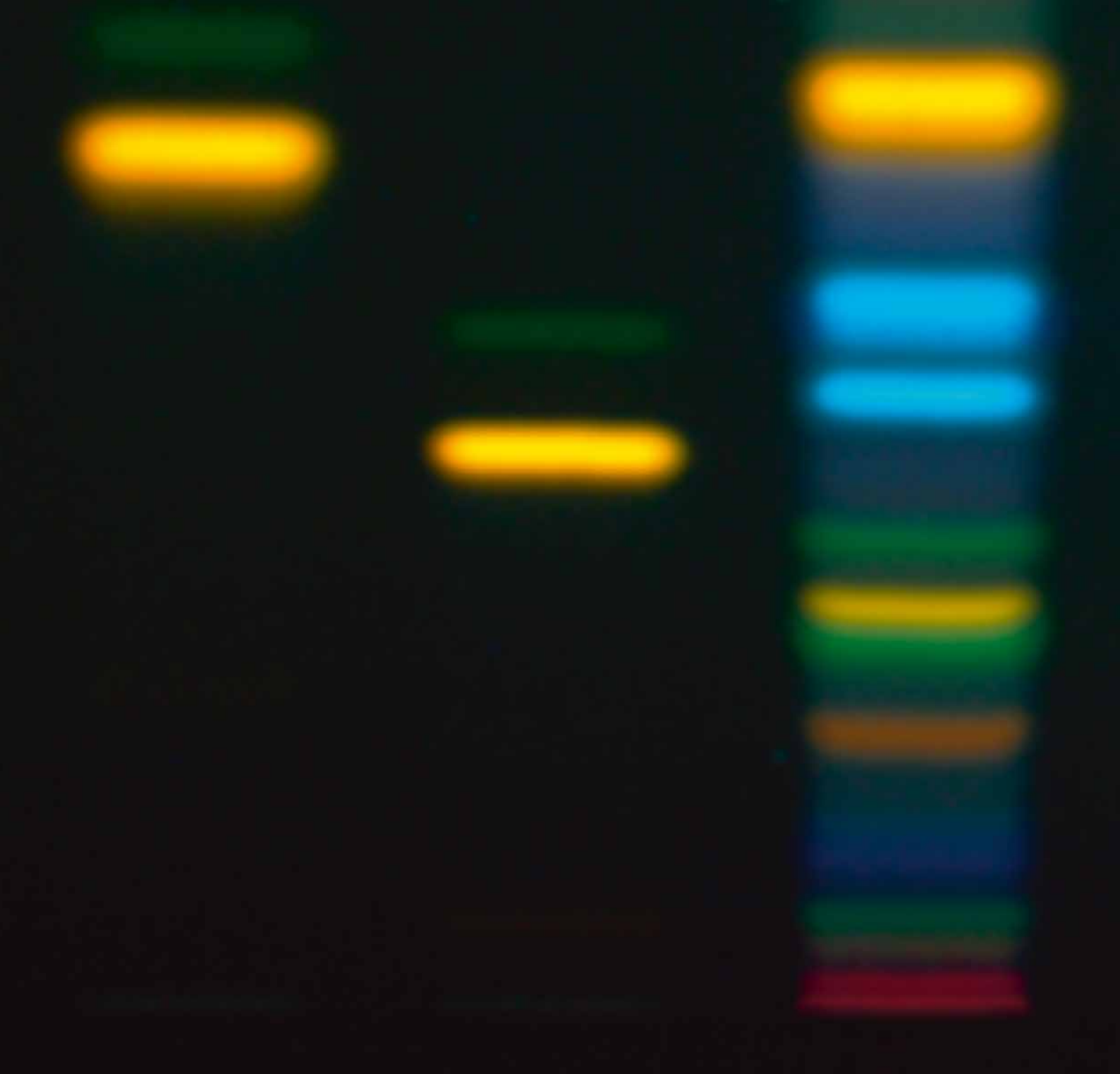
### Optimization of preconditioning

Pre-equilibration with six different conditioning liquids; then development of all tracks with the same solvent.



## Ordering information

022.8550 CAMAG® HPTLC Vario System, consisting of  
022.8555 CAMAG® HPTLC Vario Chamber and  
022.8556 HPTLC Scoring Unit



# Derivatization

The possibility of straight forward derivatization is a special feature  
of Thin-Layer Chromatography

# Pre- and Postchromatographic Derivatization

120 °C

It is an inherent advantage of TLC/HPTLC that all fractions remain stored on the plate and can be readily derivatized after chromatography. Substances that do not respond to visible or UV light can be rendered detectable. In many cases, substances or classes of substances can be identified by specific reagents, enabling their selective detection.

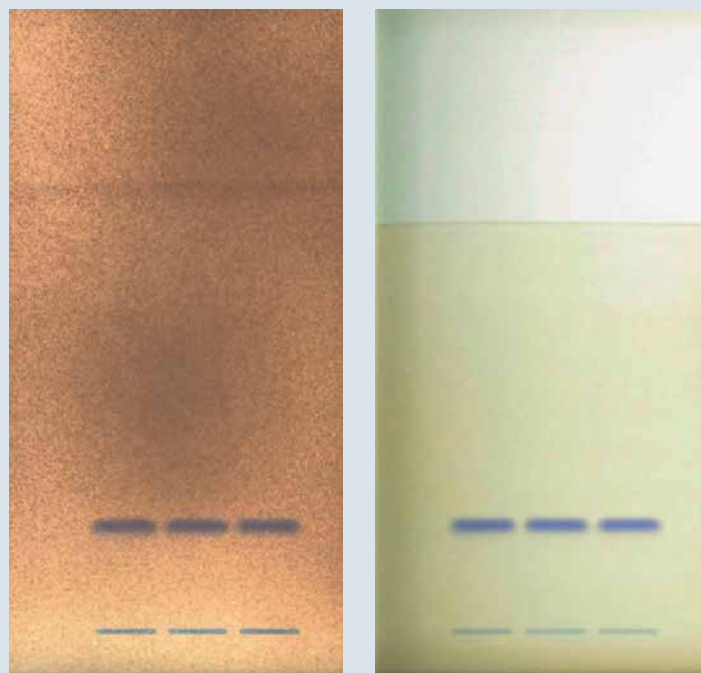
Pre-chromatographic derivatization is possible by overspraying the sample application zones with the Linomat 5 or the ATS 4.

For the transfer of liquid reagents for postchromatographic derivatization, one can choose between spraying or dipping. Provided the reagent is suitable, dipping is the preferred technique, particularly when a quantitative evaluation is intended. Usually reagent transfer by spraying can not be circumvented when two reagent solutions have to be applied in sequence without intermediate drying, for instance diazotation followed by coupling.

Whenever reagents are transferred by spraying, an efficient reagent mist removing device should be used to protect laboratory personnel against poisonous or irritating sprays or solvent vapors.

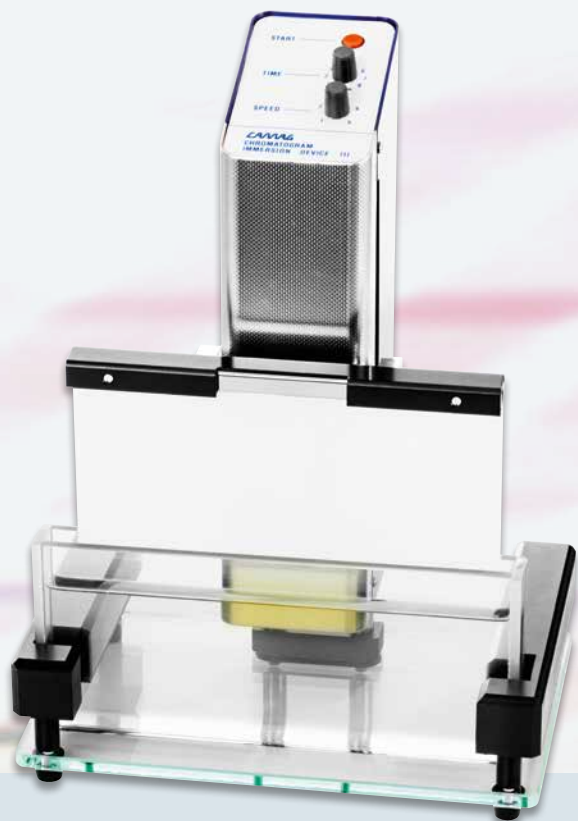
In most cases the derivatization reaction needs to be completed by heat treatment. Heating the chromatogram plate at the desired temperature with a plate heater specifically designed for this purpose is highly recommended. An oven used for this purpose will become permanently contaminated.

## Comparison of reagent transfer by spraying and dipping



Derivatization of capsaicin with dichloroquinone-chloroimide-reagent/ammonia by spraying (1 g/L left side) and by dipping (0.25 g/L right side)





## CAMAG Chromatogram Immersion Device

For proper execution of the dipping technique, the chromatogram plate must be immersed and withdrawn at a controlled uniform speed; otherwise tide marks may be left which interfere with densitometric evaluation. By maintaining a well defined vertical speed and immersion time, derivatization conditions can be standardized. The immersion device can also be used for the pre-washing of plates.

### Key features

- Uniform vertical speed, freely selectable between 30 mm/s and 50 mm/s
- Immersion time selectable between 1 and 8 seconds and indefinitely (upward movement at another touch of the button)
- The device can be set to accommodate 10 cm and 20 cm plate height.
- Battery operated

### Ordering information

- 022.6606 CAMAG® Chromatogram Immersion Device 3** for TLC and HPTLC plates up to 20 × 20 cm, without dip tank
- 022.6627 Dip tank for plates 20 × 20 cm, with lid
- 022.6628 Dip tank for plates 20 × 10 cm, with lid
- 022.6619 Bench top rack for three dip tanks



## CAMAG TLC/HPTLC Sprayer

The function is electro-pneumatic. Reagents are atomized into a fine aerosol spray with particles in the range of 0.3 to 10 µm. This ensures a homogeneous distribution over the layer at a low reagent consumption.

The TLC Sprayer consists of the charger and a pump unit with two kinds of spray heads, type A for spray solutions of normal viscosity (organic solvents), and type B for liquids of higher viscosity (e.g. sulfuric acid containing reagents).

## Glass Reagent Sprayer

This all glass reagent sprayer is a low cost alternative to the TLC/HPTLC Sprayer. It comes with a rubber pump but may also be operated from a compressed air or nitrogen supply. The Erlenmeyer flask may be closed with a standard glass stopper.

- 022.6530 TLC/HPTLC-Sprayer**, complete with spray head type A and B, reagent bottle 100 mL, reagent bottle 50 mL
- 022.6535 Pack of 5 spray heads type A and 1 type B
- 022.6538 Pack of 6 spray heads type B
- 022.6536 Reagent bottle 100 mL with cap, pack of 6
- 022.6537 Reagent bottle 50 mL with cap, pack of 6
- 022.6539 Service kit for TLC/HPTLC-Sprayer
- 022.6100 Glass reagent spray with 100 mL Erlenmeyer flask



## CAMAG TLC Plate Heater 3

The TLC Plate Heater is designed for heating a TLC/HPTLC plate to a selected temperature after a staining reagent has been applied.

The Plate Heater has a CERAN® heating surface which is resistant to all common reagents and is easily cleaned. The 20 × 20 cm heating surface has a grid to facilitate correct positioning of the TLC plate.

Programmed and actual temperature are digitally displayed. The temperature is selectable between 25 and 200 °C. The plate heater is protected from overheating.



## CAMAG TLC Spray Cabinet 2

The TLC Spray Cabinet is designed for the complete removal of excessive spray mist while spraying a TLC plate with reagent.

There is no deflection of the spray jet before it reaches the plate, an effect often encountered in a normal laboratory fume hood. Particles rebounding from the plate are completely removed. The Spray Cabinet is also useful for drying plates after development, with or without the assistance of a hair dryer.

The cabinet is made of PVC. The blower, a radial fan driven by a motor outside of the fume duct, produces an airflow of 130 cubic feet (3.7 cubic meter) per minute. The bottom of the spray cabinet has a built in tray, which is removable for easy cleaning.

### Ordering information

#### 022.3306 CAMAG® TLC Plate Heater 3

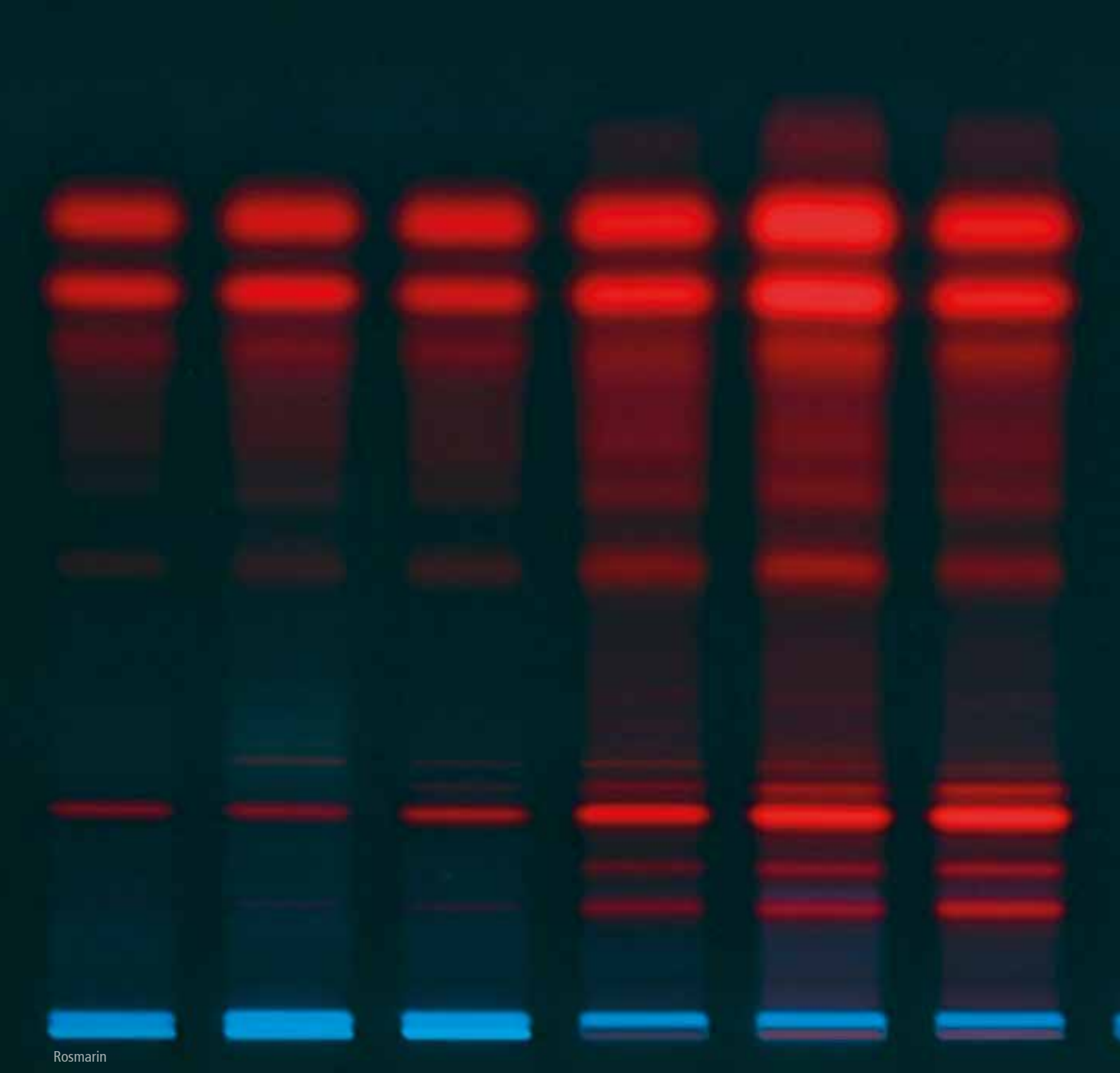
Stainless steel housing, flat ceramic top, for TLC plates up to 20 × 20 cm, digital temperature display, temperature range 25–200° C.

022.6230 CAMAG® TLC Spray Cabinet 2 with blower and flexible exhaust hose 1.5 m

022.6232 CAMAG® TLC Spray Cabinet 2 without blower, for connection to existing forced flow conduit, with 1.5 m flexible exhaust hose 127 mm diameter

022.6226 Exhaust hose extension 1.5 m with adapter

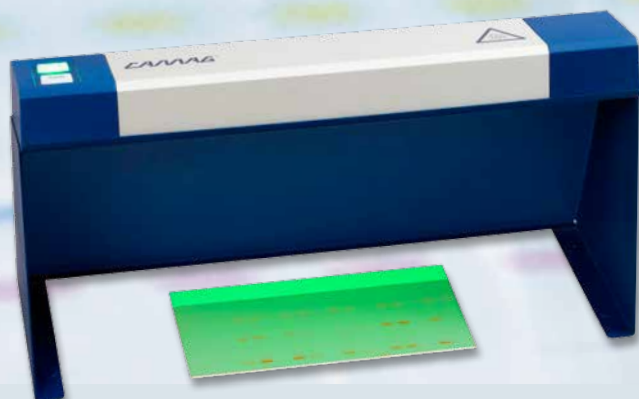
Further information can be found at [www.camag.com/derivatization](http://www.camag.com/derivatization)



# Chromatogram Evaluation

Chromatogram inspection under UV light \_\_\_\_\_ UV Lamp 4  
Documentation, image acquisition \_\_\_\_\_ TLC Visualizer  
Bioactivity detection \_\_\_\_\_ Bioluminizer  
Classical densitometry \_\_\_\_\_ TLC Scanner 4  
Hyphenation of TLC with MS \_\_\_\_\_ TLC-MS Interface 2

# Chromatogram Inspection under UV Light



## CAMAG UV Lamp 4

The CAMAG UV Lamp 4 is designed primarily for use in a TLC laboratory. Users benefit from a convenient one-button operation for each UV tube. In order to reduce the user's risk of UV radiation exposure, the CAMAG UV Lamp 4 is equipped with two safety features: in addition to the built-in timer (which automatically switches off the lamp after 10 minutes) a tilt sensor automatically turns off the lamp in case the lamp is tilted more than 30 degrees. Beyond optimized handling and improved safety features, the CAMAG UV Lamp 4 comes with a more homogeneous illumination and higher UV light intensity.

### Key features

- Two UV tubes for illumination (1 × UV 254 nm, 1 × UV 366 nm, each 8W)
- Convenient handling through one button operation for each UV tube
- Homogeneous illumination
- High level of user safety through tilt sensor and timer

**Two types of UV light are required for inspecting thin-layer chromatograms:**

#### Long-wave UV light 366 nm

Under long-wave UV light fluorescent substances appear as bright, often differently colored zones, on a dark background. The sensitivity increases with the intensity of the UV light and also with the efficiency visible light is eliminated.

#### Short-wave UV light 254 nm

Under 254 nm UV light substances absorbing light of that wavelength appear as dark zones on a bright background, when the TLC layer contains a fluorescent indicator excited by UV 254 nm.



## CAMAG UV Cabinet 4

The CAMAG UV Cabinet 4, a combination of the CAMAG UV Lamp 4 and the Viewing Box 4, is specially designed for UV observation with minimal influence of ambient light. Thanks to a compact footprint, the CAMAG UV Cabinet 4 requires only minimum space. The observation port has a built-in UV filter in the viewing window ensuring effective eye protection. The interior is accessible via a roller shutter on the front.

### Key features

- Chromatogram inspection with minimal influence of ambient light
- Eye protection through UV filter in the viewing window
- Minimum space requirements through compact footprint

### Ordering information

**040.2000 CAMAG® UV Cabinet 4**, incl. CAMAG® UV Lamp 4  
and CAMAG® Viewing Box 4

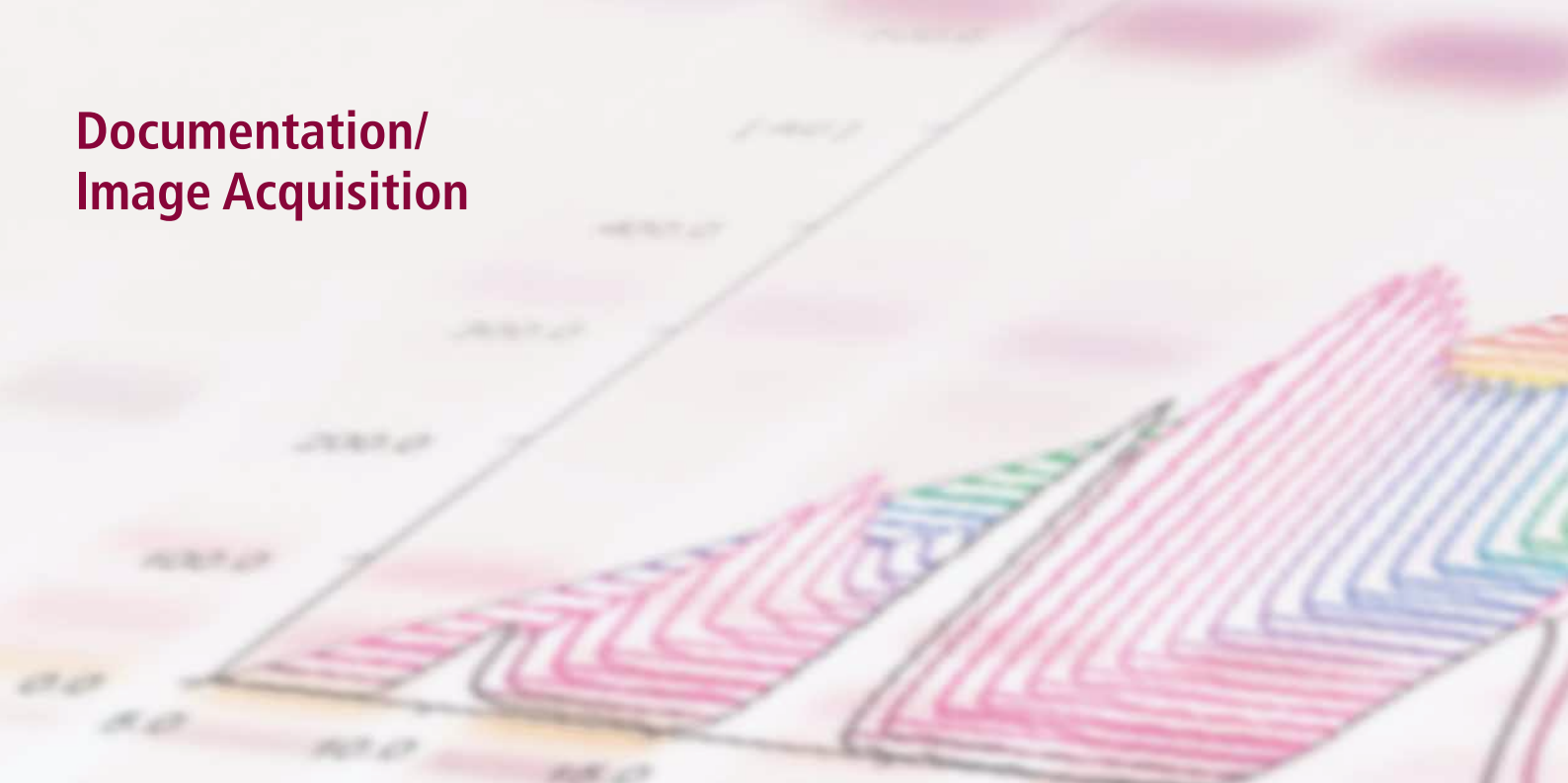
**022.9160 CAMAG® UV Lamp 4**, 254/366 nm, 2 x 8 W

**022.9060 CAMAG® Viewing Box 4**

**022.9165 Stand for CAMAG® UV Lamp 4**



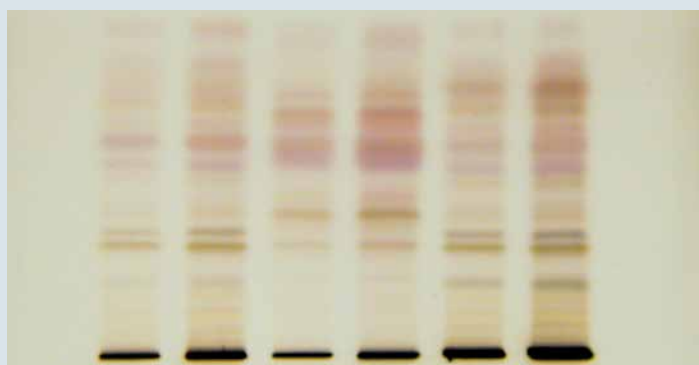
## Documentation/ Image Acquisition



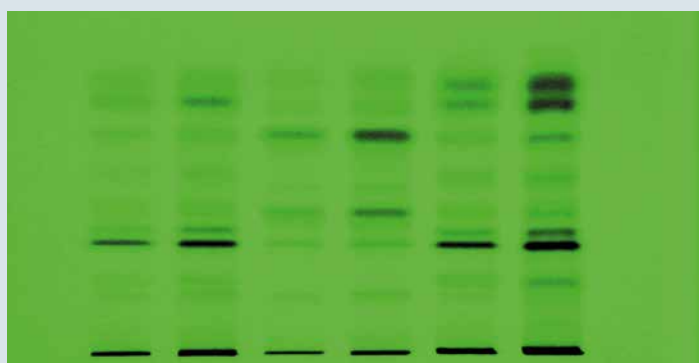
For electronic image acquisition visible polychromatic light is captured. When long-wave UV light is used for object illumination, the camera captures the light emitted by fluorescent substances. When short-wave UV light is used for illumination of a chromatogram layer containing fluorescence indicator, the camera – like the human eye – registers the visible light emitted from the layer background.

The quantification of image data is possible via the so called grey scale. Spectral selectivity is restricted to the colors of fluorescence.

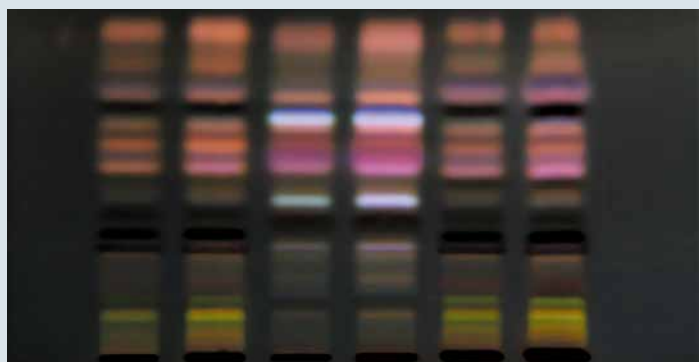
The strength of the electronic image acquisition is the overview of the complete chromatogram.



Chromatogram under white light



Chromatogram under UV 254 nm



Chromatogram under UV 366 nm



## CAMAG TLC Visualizer

### Imaging and Documentation System for TLC and HPTLC Plates

The visual impression of a TLC/HPTLC plate showing all samples and standards side by side is one of the most convincing arguments for the technique. To reproducibly capture and digitally preserve that impression using various illumination modes is the essential purpose of a state-of-the-art documentation system. The CAMAG TLC Visualizer captures images that are of the best quality in the field.

With *visionCATS* HPTLC software, users can choose between the conventional plate- or an all new sample-oriented approach, that allows for creating virtual plates from tracks originating from different plates, for e.g. batch-to-batch comparison or long-term stability testing.

### Key features

- UV tubes 254 nm
- UV tubes 366 nm
- White light tubes (remission, transmission or a combination of both)
- Light sources with high frequency to ensure best light efficiency and eliminate synchronization problems with the camera
- Complete exclusion of ambient light
- Automatic shut off for all UV illuminations protects the user from UV radiation
- Powerful high-resolution camera

### Ordering information

**022.9780 CAMAG® TLC Visualizer documentation system**, with 12 mm lens (for 20 × 20 cm plates), without winCATS or *visionCATS* software

**022.9781 CAMAG® TLC Visualizer documentation system**, with 16 mm lens (for 10 × 10 cm and 20 × 10 plates), without winCATS or *visionCATS* software

Detailed ordering information: [www.camag.com/tlcvisualizer](http://www.camag.com/tlcvisualizer)

### Note

The TLC Visualizer with *visionCATS* meets all the requirements of cGMP/ cGLP and can be IQ/OQ qualified. If the instrument shall be used in a 21 CFR Part 11 environment, the *visionCATS* Option „21 CFR Part 11“ is required.



## Documentation with CAMAG TLC Visualizer

Controlled by *visionCATS*, the CAMAG TLC Visualizer can generate low-noise, high-dynamic-range images (HDRI). These images can be separated into tracks representing single samples. Any sample that has ever been analyzed can be directly compared with any other sample using the fully integrated Image Comparison Viewer. Samples can be rearranged and compared to reference substances or samples, independent of their plate origin. Also 3D profiles of images can be generated.

The comprehensive set of Image Enhancement Tools in the Data View exploits the CAMAG TLC Visualizer's full potential. Images are automatically captured based on an optimized control of the illumination and parameters specified in the HPTLC method. Sophisticated algorithms ensure best image quality for identification of even the weakest zones.

The Data View allows visual evaluation of a plate in different illumination modes and offers a broad range of helpful tools, *e.g.* the  $R_f$  tool displays the  $R_f$  value of zones on the digital image, or a rectangular and/or linear zoom function.

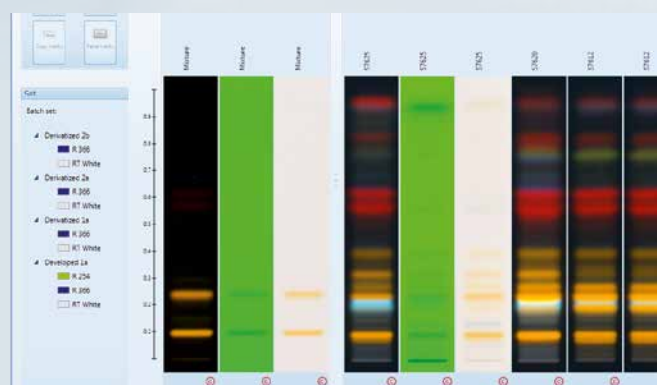


Image Comparison: side by side view of tracks originating from the same or different plates and/or different detection modes

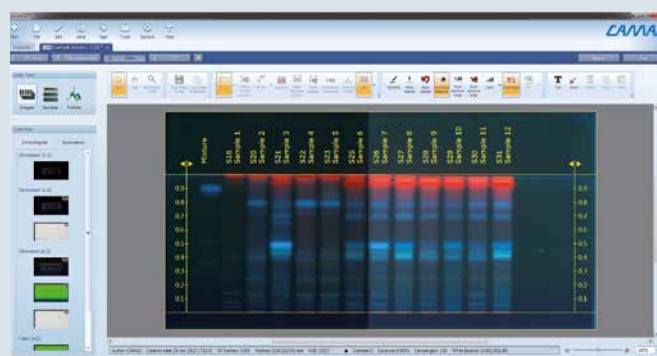
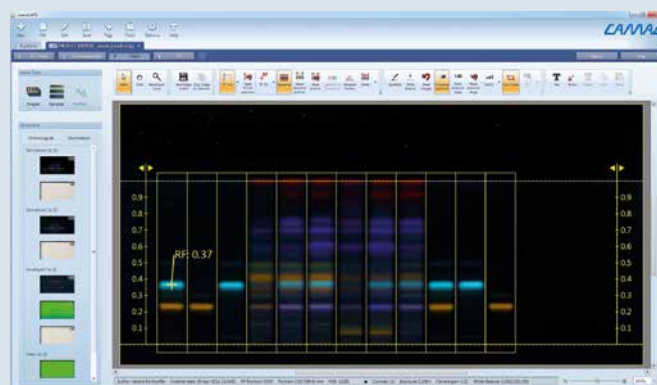


Image Enhancement: exposure normalization for visualization of weak zones (right) and original image (left)



Data View: all data gathered through the chromatographic process can be reviewed and processed



# Selective Detection of Bioactive Compounds

## CAMAG BioLuminizer®



The Bioluminizer system is consisting of a compartment excluding any extraneous light, climate controlled for extended stability of the plate, and a 16 bit CCD digital camera of high resolution and high quantum efficiency. It features ergonomic design and easy, intuitive handling in stand-alone mode using the special software.

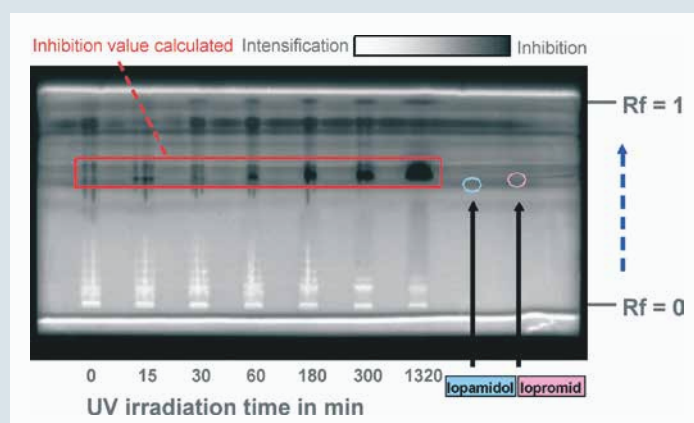
With the Bioluminizer bioactivity can be detected and registered economically and with short response time. Special antibacterial protection measures are not necessary, as the bioluminescent bacteria *Vibrio fischeri* are atoxic for humans.

- Cooled 16 bit CCD camera with high resolution and high quantum efficiency
- Climate controlled compartment for prolonged stability of the plate
- User friendly compact design, easy to clean

**Hyphenating TLC/HPTLC and bioassay is an excellent tool for identification of single toxic compounds in complex sample matrices.**

The method is suitable for the detection of toxins in foodstuff, beverages, cosmetics, waste water, drinking water and for the detection of bioactivity in natural products.

After chromatographic separation of the complex sample the plate is immersed in a suspension of bioluminescent bacteria *Vibrio fischeri*. The reaction takes place within a very short time. All zones with inhibitory or toxic effects appear as dark zones on the luminescent plate background.



### Example

Processed waste water containing X-ray contrast media is frequently irradiated with UV light. The HPTLC/bioluminescence image shows the bioactive effect of degradation products. As can be seen, an increase of the irradiation time generates substances with a distinctively inhibitory effect on the bioluminescent bacteria. In a cuvette test, this inhibitory effect would have been masked by degradation products.

The example is taken from an internship report at the "Zweckverband Landeswasserversorgung" in Langenau, Germany.



### Ordering information

022.9750 CAMAG BioLuminizer® for detection of bioluminescence patterns on HPTLC plates, including software

Detailed ordering information: [www.camag.com/bioluminizer](http://www.camag.com/bioluminizer)

# Classical Densitometry

In classical densitometry the tracks of the chromatogram are scanned with monochromatic light in the form of a slit selectable in length and width. The spectral range of the CAMAG TLC Scanner 4 is 190–900 nm. Reflected light is measured either in the absorbance or in the fluorescence mode. From the acquired data quantitative results are computed with high precision and spectral selectivity.

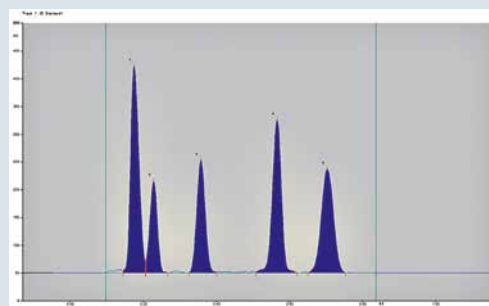
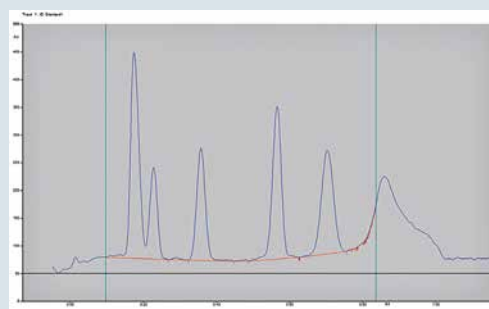
With the TLC Scanner 4 absorption and fluorescence excitation spectra can be recorded. The strengths of classical densitometry as compared with image evaluation are spectral selectivity and the higher precision of quantitative determinations.

## Recommendations

Applying samples in the form of narrow bands allows densitometric evaluation by aliquot scanning, i.e. scanning with a slit about  $\frac{2}{3}$  of the track width. This improves reproducibility as the center portion of the sample zone is homogeneous and positioning errors, which can occur with samples applied as spots, are avoided.

For quantification sample zones should always be scanned with the wavelength of maximum absorbance which can be determined by spectra recording or by multi-wavelength scanning.

For further recommendations reference the TLC Scanner 4 instruction manual.



Automatic baseline correction and peak integration of six different sulfonamides

## CAMAG TLC Scanner 4



The TLC Scanner 4 is the most advanced workstation for densitometric evaluation of TLC/HPTLC chromatograms and other planar objects.

All functions of the TLC Scanner 4 are controlled by *visionCATS* software. Only positioning of the object to be measured is performed manually and, if desired, switching on the internal illumination to assist correct positioning. Optimal settings of the electronic amplification are automatically selected for scanning in absorbance or fluorescence mode respectively.

The 16 bit A/D converter ensures optimally adapted resolution of the measurement signal.

### Key features

- Measurement of reflected light, either in absorbance or fluorescence mode
- Object formats up to 20 × 20 cm
- Spectral range from 190 to 900 nm
- Automatic start of all lamps: deuterium, halogen-tungsten, and high pressure mercury lamp
- Data step resolution 25–200 µm
- Scanning speed 1–100 mm/s
- Spectra recording with a speed up to 100 nm/s
- Automatic adjustment of the analog system
- Rapid data transfer

### Ordering information

**027.6200 CAMAG® TLC Scanner 4**, for the densitometric evaluation of TLC/HPTLC plates, spectral range 190 to 900 nm, plate sizes up to 20 x 20 cm, absorbance and fluorescence mode, without winCATS or *visionCATS* software

Detailed ordering information: [www.camag.com/tlcscanner](http://www.camag.com/tlcscanner)

### Note

The TLC Scanner 4 with *visionCATS* meets all the requirements of cGMP/ cGLP and can be IQ/OQ qualified. If the instrument shall be used in a 21 CFR Part 11 environment, the *visionCATS* Option „21 CFR Part 11“ is required.



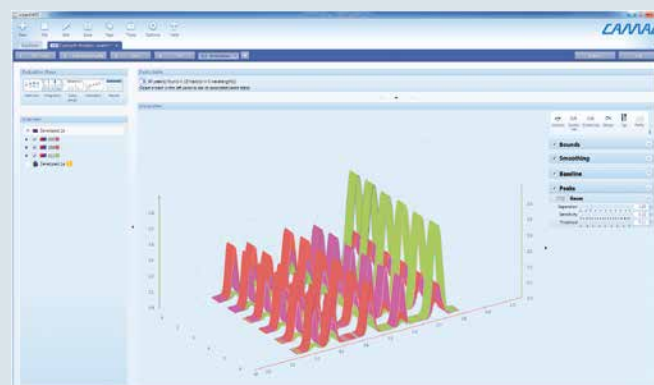
## Quantitative evaluation with CAMAG TLC Scanner

*visionCATS* controls the CAMAG TLC Scanner and enables quantitative evaluation of the generated densitometric data. The spectral range of light from 190 to 900 nm is available for selecting single wavelengths for Scanning Densitometry. Detection can thus be fine-tuned to match the spectral properties of the analyte to its optimized specificity and sensitivity of the detection. For almost unlimited flexibility, several scanning steps, e.g. before and after derivatization, can be selected. Each scanning step may also include up to 31 individual multi-wavelength scans using different light sources (deuterium lamp, mercury lamp, tungsten lamp). The detection modes absorption or fluorescence can be combined. The generated data can then be evaluated. Integration of peaks and assignment to separated substances is a matter of a few mouse clicks.

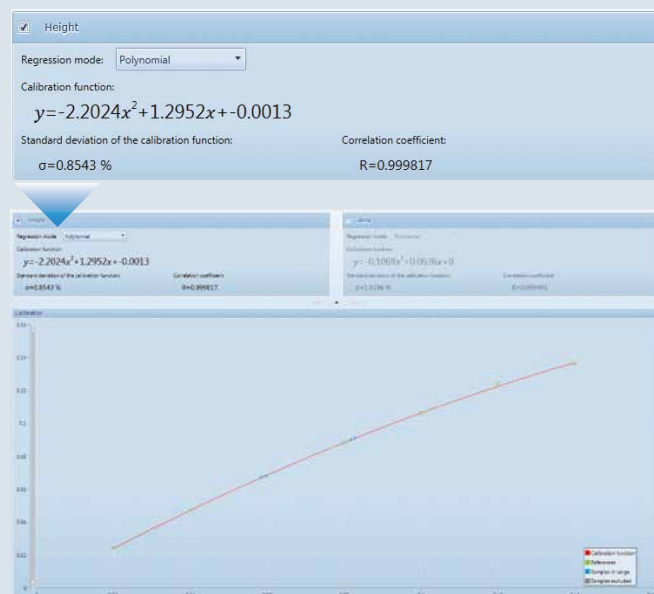
Quantification of substances can be performed via peak height or peak area. The best fitting calibration model with single-level calibration or multilevel calibration via linear, polynomial or Michaelis-Menten regression is selected. With *visionCATS* and the CAMAG TLC Scanner UV spectra can be measured as well. The selected peak positions, which are detected from a previous densitogram, are automatically scanned at the defined wavelengths. Spectra can be measured from 190 to 900 nm and displayed individually or overlaid in one diagram.



Peak Assignment: the separated compounds are assigned. For quantification, data from the multi-wavelength scan at the optimum wavelength for each compound is used.



3D View and Peak Integration: densitograms are displayed in 3D, top or front view. Several peak integration and baseline correction settings can be selected.





# Hyphenation of TLC with MS

## CAMAG TLC-MS Interface 2

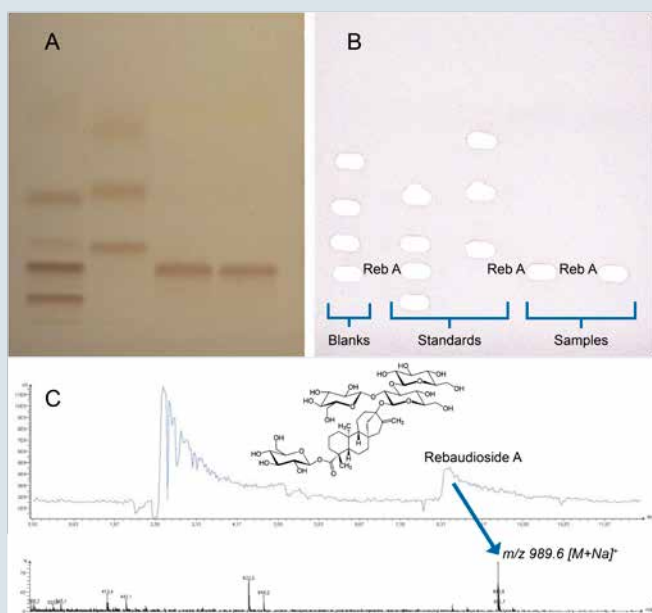


### Identification and confirmation of unknown substances

The elution-based CAMAG TLC-MS Interface 2 is a highly convenient and versatile instrument allowing for rapid and contamination-free elution of TLC/HPTLC zones with online transfer to a mass spectrometer. Through the pioneering concept of hyphenating high-performance Thin-Layer Chromatography with mass spectrometry unequivocal substance identification is possible. The CAMAG TLC-MS Interface 2 can be installed plug & play with any LC-MS system without adjustments or mass spectrometer modifications. Depending on the MS system, a substance can be identified within a minute via its mass spectrum, or for an unknown substance zone, the respective sum formula can be obtained. Furthermore, interesting zones can be eluted into vials for further investigations with, e.g., NMR, (ATR-)FTIR, ESI-MS, and MALDI-MS.

The chromatogram zones are eluted from the HPTLC plate with methanol or another suitable solvent with the flow speed appropriate for the LC-MS system. The round elution head is used for circular zones and the oval elution head for zones in the form of bands. After elution the eluate is either transferred online to the mass spectrometer or collected in a sample vial for further offline analysis.

The CAMAG TLC-MS Interface 2 features a modified elution head and an easily accessible, exchangeable filter, arranged in front of the valve. Cleaning is facilitated as compared to the previous version, making it highly efficient. By pushing a button, the elution path is cleaned of matrix particles with compressed air, increasing the lifetime of the filter and preventing the system from becoming blocked. These filters can be easily replaced without any modification to the elution head.



Characterization of separated compounds by mass spectrometry  
(Steviol glycosides in Stevia formulations\*)

A: Chromatogram for localizing the zones (derivatized with  $\beta$ -naphthol reagent)

B: HPTLC plate after elution of zones with the CAMAG TLC-MS Interface 2

C: HPTLC-ESI-MS spectra of Rebaudioside A,  $m/z$  989.6  $[M+H]^+$

\*Morlock et al., Journal of Chromatography, A, 1350 (2014) 102–111

### Ordering information

022.8440 CAMAG® TLC-MS Interface 2, including  
oval elution head  $4 \times 2$  mm

022.8441 CAMAG® TLC-MS Interface 2, including  
round elution head 4 mm

Detailed ordering information: [www.camag.com/tlc-ms2](http://www.camag.com/tlc-ms2)



# Software

*visionCATS*  
winCATS

Horizontal  
Developing Chamber

Stationary Phase

Nanomat

Developing Chamber

Manual Input

Definition

Sample  
Application

Chromatogram  
Development

Software-controlled

Samples

Automatic  
TLC Sampler ATS 4

Automatic  
Developing Chamber  
ADC 2

Standards

Linomat 5

## visionCATS HPTLC Software

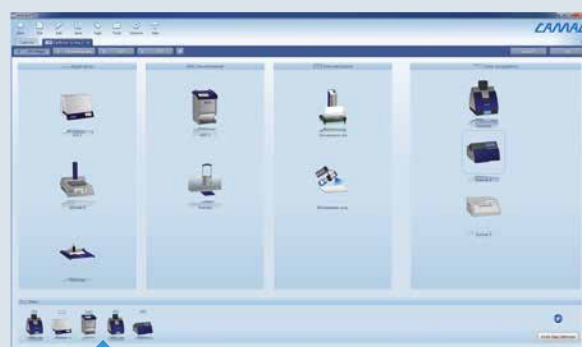
### HPTLC Analysis – made easy

*visionCATS* stands for ease of use and intuitive simplicity. The software organizes the workflow of HPTLC, controls the involved CAMAG instruments, and manages data.

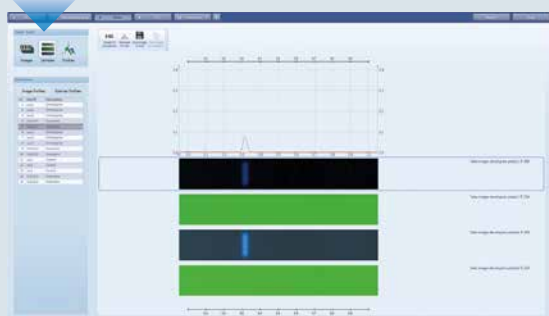
The easy to navigate user interface effectively guides the user through the chromatographic process – from definition of samples and substances to reporting of results. Simply select one of the default methods and start working: fill in the sequence table, select a mobile phase and the derivatization reagent.

If necessary modify detection parameters. Then *visionCATS* will guide you. Creating your own method is easy as well: just select the desired steps. The new sample-oriented approach allows for creating virtual plates from tracks originating from different plates, e.g. for batch-to-batch comparison or long-term stability testing.

With *visionCATS* relevant samples can be located easier and faster than ever: a powerful search tool within the file explorer that includes extended preview functionalities enables the user to easily search for text and date, samples, methods, and analysis files.



HPTLC Analysis – made easy: create your own method with a few mouse clicks



Sample View: all available data related to the sample are displayed



Guided Analysis: select a method and *visionCATS* will guide you



Chromatogram  
Immersion Device

TLC/HPTLC Sprayer

Derivatization	Evaluation: Detection	Evaluation: Documentation	Report
	TLC Scanner	TLC Visualizer	

## Key Features

### Image Comparison Viewer

With the fully integrated Image Comparison Viewer tracks originating from the same or different plates and/or different detection modes can be compared on the same screen side-by-side.

### Image Enhancement Tools

*visionCATS* supports low-noise, high-dynamic-range imaging (HDRI) and includes a comprehensive set of Image Enhancement Tools.

### Scanning Densitometry and Spectral Evaluation

Following their chromatographic separation substances on the plate can be measured by Scanning Densitometry. Recording of UV/Vis spectra and their comparison with reference spectra allows identification.

### Quantitative Analysis

To determine the substance concentration in a sample after densitometric or image analysis, five different quantification functions (e.g. linear and polynomial regression modes) are available. Several scanning steps and up to five different evaluations can be performed in one analysis file.

### HPTLC Method Library

For seamless import of validated methods and images of standards and reference materials, *visionCATS* provides a free of charge HPTLC Method Library for licensed users.

### Regulatory Compliance

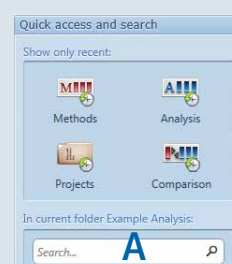
*visionCATS* supports compliance with cGMP/cGLP and 21 CFR Part 11.

### State-of-the-art Software Architecture

*visionCATS* is based on a client/server system, enabling scalability from a single workstation to a multi-user lab network.



Plate Preview: provides an overview of steps and samples of an analysis or method incl. instrument parameters and thumbnails of the acquired image



File Explorer: search entry for name, ID or keyword A; file results B; preview of a selected analysis with the thumbnail of the captured images C

Ordering information: [www.camag.com/visionCATS](http://www.camag.com/visionCATS)

## winCATS Software

### winCATS organizes the work flow of instrumental Thin-Layer Chromatography

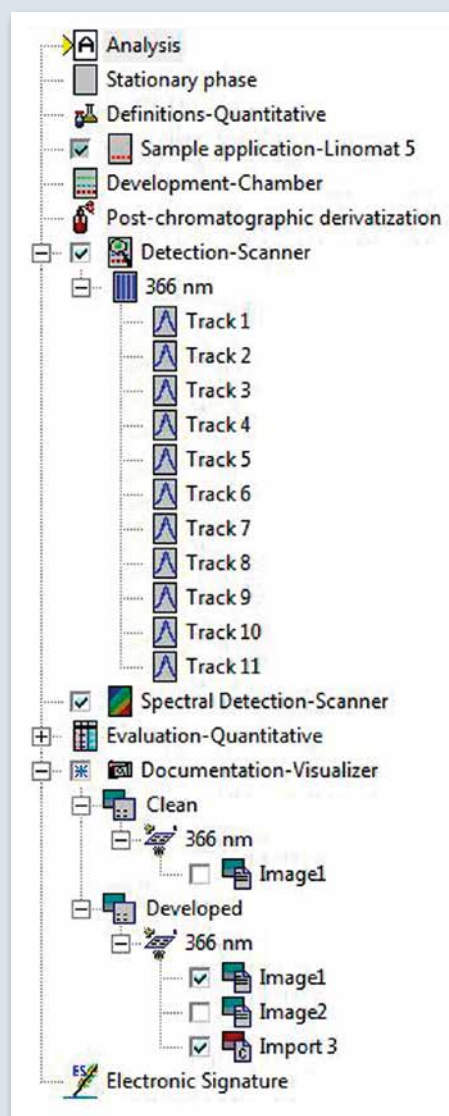
winCATS is the name of the integrated software concept that incorporates all steps of the procedure. The modular design of winCATS allows the user to select or deselect any step of the procedure as is appropriate for the given analytical task.

The explorer like tree structure provides an overview of the step and the progress of an analysis with all parameters and data.

- Stationary phase: input of plate material and pre-treatment of the layer
- Definition of samples, standards, and calibration method, if applicable
- Sample application: selection of the application device, input of control parameters and monitoring their execution. For manually operated devices all steps can be document as well.
- Chromatogram development: selection of the instrument, input of operating parameters and monitoring their execution
- Derivatization – pre- or postchromatographic
- Detection: selection of the instrument, input of control parameters and monitoring their execution, integration and peak assignment when applicable
- Quantitative evaluation: computing and presentation of results
- Image documentation: selection of device and camera, input of control parameters and monitoring the image capture and subsequent functions
- Electronic signature: part of the option 21 CFR part 11 "compliant ready", additional parts include the automatically created «Audit-Log» and "System-Log" and several security relevant functions.

For winCATS controlled instruments all steps used in each analysis are automatically performed and documented. For instruments not controlled by winCATS the user enters parameters manually through input dialogs. All data including images pertaining to the current analysis are finally stored by winCATS in one file and can be printed at any time.

### Keeping track of TLC analyses





# Basic Kits Consumables Accessories

# Basic Kits

All CAMAG Basic Kits have been composed so that a lab can efficiently start working with Thin-Layer Chromatography. These assemblies are configured to allow upgrading to a complete system for quantitative TLC without items becoming redundant. Also transition from using conventional TLC layers to high-performance layers is straight forward.



## 040.1200 CAMAG® HPTLC Basic Kit 20×10, consisting of

- 022.4730 CAMAG® Nanomat 4
- 022.7650 Capillary dispenser consisting of universal capillary holder (022.7786), one dispenser magazine for 1 µL capillaries (022.7661) and one package of 5 × 100 disposable capillary pipettes 1 µL (022.7771)
- 022.7660 Dispenser magazine for 0.5 µL capillaries, without capillaries
- 022.7770 Disposable capillary pipettes 0.5 µL, pack of 5 × 100
- 2 × 022.5254 CAMAG® Twin Trough Chamber, for 20 × 10 cm plates, with stainless steel lid
- 022.5244 Saturation pads, pack of 100 (20 × 20 cm)
- 022.5300 CAMAG® smartAlert solvent front monitor, (only suitable for glass plates)
- 022.8535 CAMAG® Horizontal Developing Chamber for 20 × 10 cm plates
- 022.6530 TLC/HPTLC-Sprayer
- 034.5642 MERCK HPTLC plates Silica gel 60 F254, 20 × 10 cm, pack of 50
- 022.9060 CAMAG® Viewing Box 4, for CAMAG UV lamps of the 022.91XX series
- 022.9160 CAMAG® UV Lamp dual wavelength, 254/366 nm, 2 × 8 W

## 040.1100 CAMAG® HPTLC Basic Kit 10×10, consisting of

- 022.4730 CAMAG® Nanomat 4
- 022.7650 Capillary dispenser consisting of universal capillary holder (022.7786), one dispenser magazine for 1 µL capillaries (022.7661) and one package of 5 × 100 disposable capillary pipettes 1 µL (022.7771)
- 022.7660 Dispenser magazine for 0.5 µL capillaries, without capillaries
- 022.7770 Disposable capillary pipettes 0.5 µL, pack of 5 × 100
- 2 × 022.5155 CAMAG® Twin Trough Chamber, for 10 × 10 cm plates, with stainless steel lid
- 022.5244 Saturation pads, pack of 100 (20 × 20 cm)
- 022.5300 CAMAG® smartAlert solvent front monitor (only suitable for glass plates)
- 022.8530 CAMAG® Horizontal Developing Chamber, for 10 × 10 cm plates
- 022.6530 TLC/HPTLC Sprayer
- 034.5628 MERCK HPTLC plates Silica gel 60 F254, 10 × 10 cm, pack of 25
- 022.9060 CAMAG® Viewing Box 4, for CAMAG UV lamps of the 022.91XX series
- 022.9160 CAMAG® UV Lamp dual wavelength, 254/366 nm, 2 × 8 W

## 040.1000 CAMAG® TLC Basic Kit 20×20, consisting of

- 022.4730 CAMAG® Nanomat 4
- 022.7650 Capillary dispenser consisting of universal capillary holder (022.7786), one dispenser magazine for 1 µL capillaries (022.7661) and one package of 5 × 100 disposable capillary pipettes 1 µL (022.7771)
- 022.7662 Dispenser Magazine for 2 µL capillary pipettes, without capillaries
- 022.7665 Dispenser Magazine for 5 µL capillary pipettes, without capillaries
- 022.7772 Disposable capillary pipettes 2 µL, pack of 5 × 100
- 022.7775 Disposable capillary pipettes 5 µL, pack of 5 × 100
- 2 × 022.5256 CAMAG® Twin Trough Chamber, for 20 × 20 cm plates, with stainless steel lid
- 022.5244 Saturation pads, pack of 100
- 022.5300 CAMAG® smartAlert solvent front monitor (only suitable for glass plates)
- 022.6100 Glass Reagent Sprayer, all glass, with 100 mL Erlenmeyer flask
- 034.5715 MERCK TLC plates silica gel 60F 254, 20 × 20 cm, pack of 25
- 022.9060 CAMAG® Viewing Box 4, for CAMAG UV lamps of the 022.91XX series
- 022.9160 CAMAG® UV Lamp dual wavelength, 254/366 nm, 2 × 8 W





## MERCK Precoated Layers for High-Performance Thin-Layer Chromatography (HPTLC)

Designation	layer (µm)	size (cm)	quant./pkg
034.5628 HPTLC plates silica gel 60 F254	200	10 × 10	25
034.5629 HPTLC plates silica gel 60 F254	200	10 × 10	100
034.3726 HPTLC plates RP-2 F254s	200	10 × 10	25
034.3725 HPTLC plates RP-8 F254s	200	10 × 10	25
034.3124 HPTLC plates RP-18 W F254s	200	10 × 10	25
034.3724 HPTLC plates RP-18 F254s	200	10 × 10	25
034.6464 HPTLC plates CN F254s	200	10 × 10	25
034.2668 HPTLC plates Diol F254	200	10 × 10	25
034.5647A HPTLC plates NH <sub>2</sub> F254s	200	10 × 10	25
034.5642 HPTLC plates silica gel 60 F254	200	20 × 10	50
034.5648 HPTLC plates silica gel 60 F254, ultra pure for pharmacopoeial methods	200	20 × 10	50
034.1552 HPTLC plates silica gel 60 WR F254s	200	20 × 10	25
034.5548 HPTLC aluminium sheets silica gel 60 F254	200	20 × 20	25
034.5445 HPTLC plates LiChrospher® Si 60 F254s	180	20 × 10	25
034.5647B HPTLC plates LiChrospher® Si 60 WR F254s	100	20 × 10	25

## MERCK Precoated Layers for Thin-Layer Chromatography (TLC)

Designation	layer (µm)	size (cm)	quant./pkg
034.5729 TLC plates silica gel 60 F254	250	10 × 20	50
034.5715 TLC plates silica gel 60 F254	250	20 × 20	25
034.1798 TLC plates silica gel 60 F254, with concentration zone	250	20 × 20	25
034.5423 TLC plates RP-18 F254s	200	10 × 20	50
034.5554 TLC aluminium sheets silica gel 60 F254	200	20 × 20	25
034.5559 TLC aluminium sheets RP-18 F254s	200	20 × 20	20
034.5804 LuxPlate Si 60 F254	250	10 × 20	50
034.5805 LuxPlate Si 60 F254	250	20 × 20	25

## CAMAG Test Dye Mixtures

Test dye mixtures are useful for functional checks on individual steps in the TLC procedure and for studying the influence of specific parameters.

### Ordering information

032.8001	Test Dye Mixture I, Toluene, 30 mL – for silica gel
032.8002	Test Dye Mixture II, Toluene, 30 mL – for aluminium oxide
032.8003	Test Dye Mixture III, Toluene, 10 mL – for HPTLC silica gel
032.8006	Test Dye Mixture VI, powder for 30 mL – for IQ/OQ under <i>visionCATS</i> Software



# In-House Preparation of TLC Plates

Today, in-house preparation of TLC plates is indicated when special layers are required which are not available as precoated plates, e.g. layers containing silver nitrate, buffer substances or other reagents, or layers of adsorbent mixtures. Logistic or economic reasons may play a role in exceptional cases.

## Automatic TLC Plate Coater

The glass plates to be coated are conveyed underneath a hopper filled with the adsorbent suspension. The layer thickness is governed by a fixed gate of 300 µm and 500 µm or by an adjustable gate for layer thicknesses 0–2 mm. The plate movement is motor driven at a uniform speed of 10 cm/s onto a plate holder for eight 20 × 20 cm plates

## TLC Plate Coater, hand operated

The manual plate coater functions in the same manner as the automatic coater, with the exception that the plates are pushed through by hand, one after the other and lifted off on the other side.

## TLC Plate Box

The TLC Plate Box holds ten 20 × 20 cm plates. The body with slide rails, the handle and the removable bottom are all made of stainless steel, the cover is of transparent plastic. Bottom and cover are removed for drying the plates in an oven to increase air circulation.

## Drying Rack

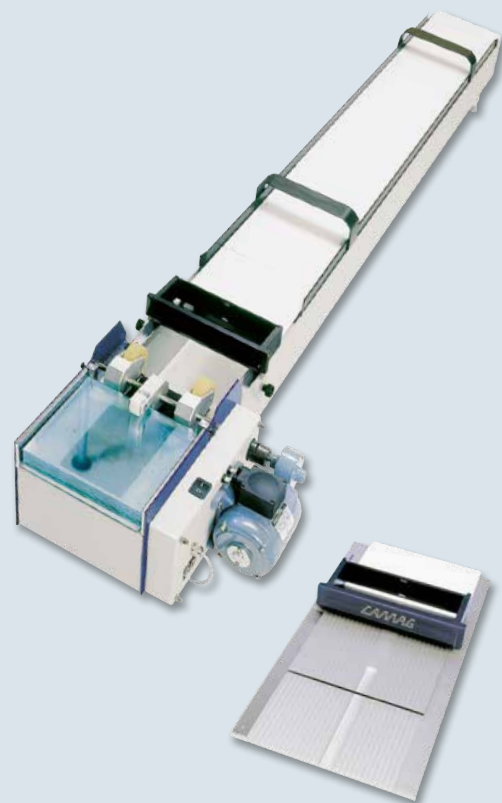
The Drying Rack consists of ten individual aluminum trays 20 × 20 cm, which can be stacked quickly and conveniently. The Drying Rack is convenient to use when plates are prepared with the automatic plate coater in runs of more than 8. The Drying Rack also comes in handy for plates smaller than 20 × 20 cm.

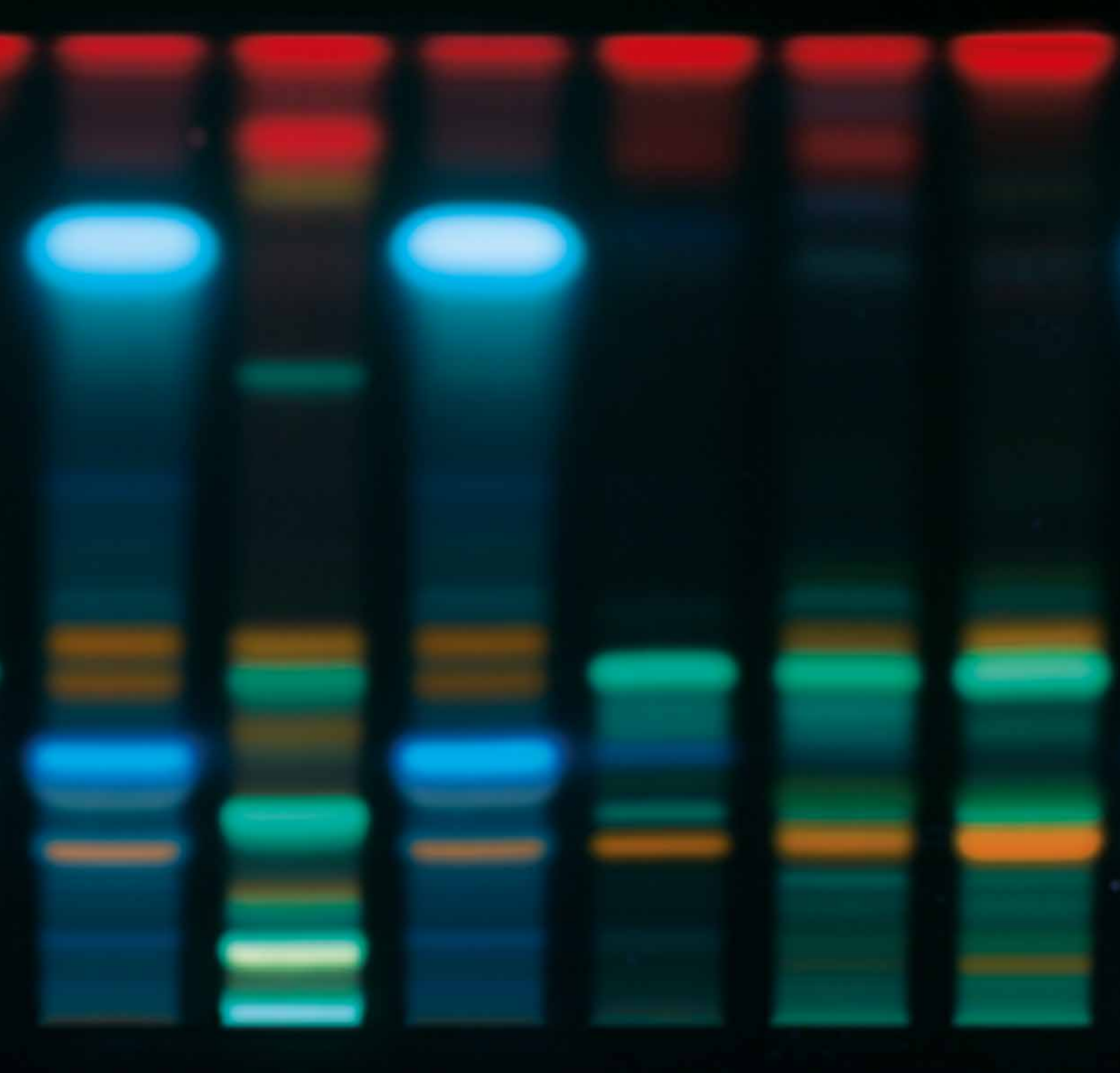
## Ordering information

022.1602	Automatic TLC Plate Coater
022.1251	TLC Plate Coater hand operated
022.3250	TLC Plate Box
022.3200	Drying Rack
022.2200	Glass Plates 20 × 20 cm, pack of 10
022.2100	Glass Plates 10 × 20 cm, pack of 10

## Adsorbents for in-house preparation of TLC plates

033.1092	Aluminium Oxide Merck GF (type 60/E), 500 g
033.7731	Silica Gel Merck G (type 60), 1 kg
033.7730	Silica Gel Merck GF (type 60), 1 kg
033.7736	Silica Gel Merck H (type 60), 1 kg
033.7739	Silica Gel Merck HF (type 60), 1 kg
033.7741	Silica Gel Merck HF254+366 (type 60), 1 kg





# CAMAG Services

Competent Advice  
Training Courses  
CAMAG Bibliography Service



## CAMAG Laboratory Services

The CAMAG Laboratory offers you professional HPTLC solutions for your analytical problem. The lab in Muttenz has existed for more than 40 years and has undergone many stages of development. Since 2012 it is supplemented by an application lab at CAMAG Berlin. The staff of both laboratories have many years of experience in development of customized HPTLC methods. While focusing on the analysis of medicinal plants and products derived thereof, expertise is also provided in HPTLC analysis of pharmaceuticals, food and beverages as well as environmental and forensic applications.

### 1) Method development and validation

Depending on the analytical goal qualitative and quantitative methods are developed from the basics or existing methods are customized and optimized.

### 2) Feasibility studies

Following a detailed discussion of the analytical goal with the customer, the lab can evaluate whether HPTLC or TLC can offer an advantageous solution. Costs of analysis per sample and general performance of a method during routine use are evaluated.

### 3) Contract analyses

Your samples are analyzed by HPTLC according to an existing method, e.g. AOAC, USP, PhEur, BHP, PhHelv, PhPRCh, AHP, etc. in an ISO 17025 or GMP compliant environment. The CAMAG laboratory can also work according to your in-house method or employ its own validated methods. A detailed analytical report is generated for each project.

### 4) Consulting and training

CAMAG helps you get started! Whether you intend setting up a new lab, ensuring compliance with cGMP, or you are dealing with the authorities concerning registration, we can offer HPTLC solutions that save you time, hassle and money. Select one of our courses or let us provide customized training at your site to stay up-to-date with new developments in HPTLC technology. Let us show you how to optimally use your equipment, get reliable results, and develop and validate methods yourself.

### 5) Applied research

We offer guest residences at our laboratory for students, scholars, and researchers to engage in research projects. These are focused on, but not limited to practical aspects of modern HPTLC and analysis of botanicals. We publish results in journals, textbooks, through conferences and seminars as well as on our website. It is our goal to make available to the public high quality data illustrating the capabilities of HPTLC.

## Education and training

The CAMAG Laboratory is also your partner when it comes to education and training in the field of planar chromatography.

**In Muttenz we offer courses on the following subjects:**

- HPTLC today
- HPTLC for the analysis of botanicals
- Method development and validation in HPTLC

The CAMAG lab in Berlin is focused on feasibility studies and assistance of our customers in their choice of equipment appropriate for their task.



winCATS Planar Chromatography Manager  
CAMAG Application Laboratory  
Schoenenbühlstrasse 11  
CH-4132 Muttenz / Switzerland

Self-test report TLC Scanner  
Self-test file C:\CAMAG\winCATS\1457\TLC Scanner\01190308\_0204

Test date: 08 March 2010 10:18:22 started by: Daniel Handwerker  
Device name: Scanner\_175401 SN: 175401 Firmware version: 2.00.01  
Software version: 1.4.5

	lower	upper	measured	status
Measuring electronics self diagnosis				
Main PMT dark signal	mv	0.01	45.00	passed
Reference PMT dark signal	mv	0.01	45.00	passed
PMT match test: gain	%	80	82	passed
PMT match test: high voltage	V	250	400	passed
PMT monitor sensitivity @ 400 nm	%	100.0	100.0	passed

Deuterium lamp tests  
Test date: 08 March 2010 10:27:01 started by: Daniel Handwerker  
Device name: Scanner\_175401 SN: 175401 Firmware version: 2.00.01  
Software version: 1.4.5

	lower	upper	measured	status
Relative intensity	%	0.00	100.0	passed
Output power	mW	0.00	6.25	passed
Lamp adjustment	%	0.00	6.25	passed
Stair illumination uniformity	%	9.00	9.89	passed
Equivalent burning time of this lamp	h	90.0	100.0	info only
Ignition of this lamp			5.1	info only

Temperature lamp tests  
Test date: 08 March 2010 10:31:08 started by: Daniel Handwerker  
Device name: Scanner\_175401 SN: 175401 Firmware version: 2.00.01  
Software version: 1.4.5

	lower	upper	measured	status
Output power	mW	0.00	9.89	passed
Stair illumination uniformity	%	9.00	9.89	passed
Equivalent burning time of this lamp	h	90.0	100.0	info only
Ignition of this lamp			6.2	info only

User: Jan Masthoff  
11 March 2010 10:13:12  
Approved: [Signature]  
Report ID: 01190308/01190308  
SN 20090701\_V1.4.5  
Page 1 of 2

winCATS Planar Chromatography Manager

Test date: 08 March 2010 10:18:22 started by: Daniel Handwerker  
Device name: Scanner\_175401 SN: 175401 Firmware version: 2.00.01  
Software version: 1.4.5

	lower	upper	measured	status
Measuring electronics self diagnosis				
Main PMT dark signal	mv	0.01	45.00	passed
Reference PMT dark signal	mv	0.01	45.00	passed
PMT match test: gain	%	80	82	passed
PMT match test: high voltage	V	250	400	passed
PMT monitor sensitivity @ 400 nm	%	100.0	100.0	passed

Deuterium lamp tests  
Test date: 08 March 2010 10:27:01 started by: Daniel Handwerker  
Device name: Scanner\_175401 SN: 175401 Firmware version: 2.00.01  
Software version: 1.4.5

	lower	upper	measured	status
Relative intensity	%	0.00	100.0	passed
Output power	mW	0.00	6.25	passed
Lamp adjustment	%	0.00	6.25	passed
Stair illumination uniformity	%	9.00	9.89	passed
Equivalent burning time of this lamp	h	90.0	100.0	info only
Ignition of this lamp			5.1	info only

Temperature lamp tests  
Test date: 08 March 2010 10:31:08 started by: Daniel Handwerker  
Device name: Scanner\_175401 SN: 175401 Firmware version: 2.00.01  
Software version: 1.4.5

	lower	upper	measured	status
Output power	mW	0.00	9.89	passed
Stair illumination uniformity	%	9.00	9.89	passed
Equivalent burning time of this lamp	h	90.0	100.0	info only
Ignition of this lamp			6.2	info only

User: Jan Masthoff  
11 March 2010 10:13:12  
Approved: [Signature]  
Report ID: 01190308/01190308  
SN 20090701\_V1.4.5  
Page 2 of 2

## Instrument Qualification

For customers working in a cGMP regulated environment, CAMAG offers Installation Qualification (IQ) and Operation Qualification (OQ) as service.

The Installation Qualification (IQ) is performed on the site and at the time of installation. It documents that all key aspects of the installation comply with the manufacturer's specifications, codes, safety and design parameters.

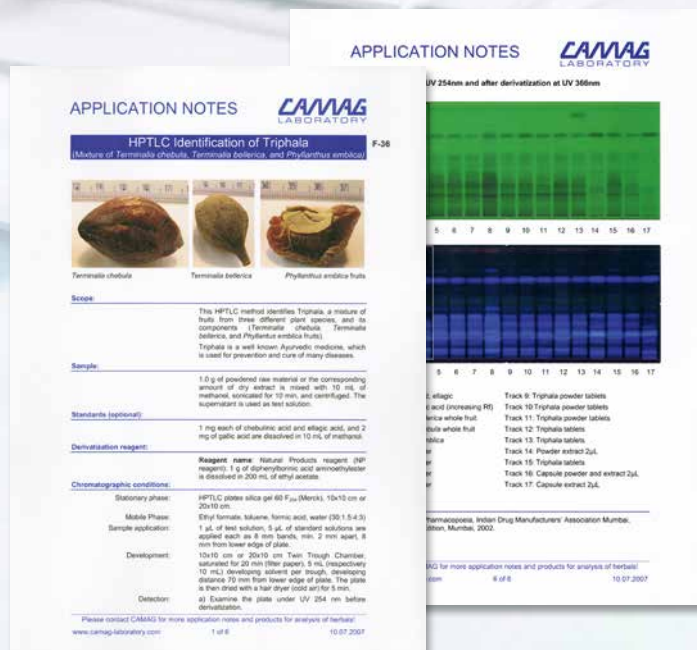
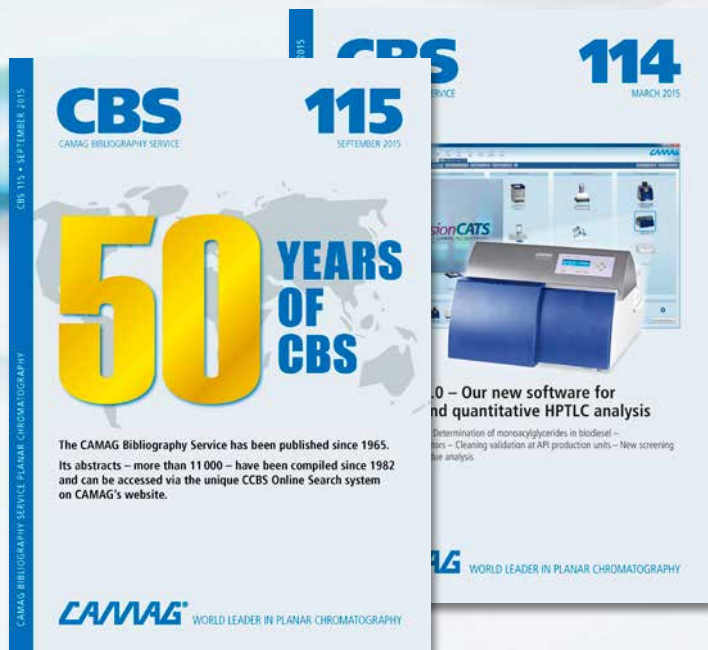
The Operation Qualification (OQ) is performed subsequent to installation and is repeated at certain intervals recommended by the manufacturer or defined by the customer. It documents that all modules of the equipment perform consistently throughout the specified operating ranges.

A Performance Qualification (PQ) is an ongoing process which documents that the instrument or system is suitable for the given task. Accordingly, only the user can perform PQs, employing his substances and following his specific task descriptions and his test procedures (SOPs).

**CAMAG offers qualification procedures for the following products:**

- AMD 2 System Automated Multiple Development
- Automatic Developing Chamber 2 (ADC 2)
- Automatic TLC Sampler 4 (ATS 4)
- DigiStore 2
- Linomat 5
- TLC Scanner 3
- TLC Scanner 4
- TLC Visualizer
- TLC-MS Interface
- TLC-MS Interface 2
- VideoScan
- visionCATS HPTLC Software
- winCATS – Planar Chromatography Manager





## CAMAG Bibliography Service "CBS" Planar Chromatography

CAMAG has been publishing this unique periodical on Thin-Layer Chromatography publications regularly since 1965. It appears twice a year, usually in March and September, and is available to CAMAG customers at no charge. The literature abstracts of the current CBS issue can also be accessed on the internet.

A "CBS" abstract contains – if quoted in the original publication:

- Name(s) of author(s)
- Address of corresponding author
- Original title, if published in one of the common Western hemisphere languages
- English translation of the title, if original is not English
- Publication details
- Brief abstract of the TLC related content with particular reference to separation systems, detection methods, quantification, results, etc.
- Key words

The purpose of the "CBS" is to inform readers about the existence of TLC related papers in their particular field of interest. Reprints or photocopies of papers abstracted in the CBS are not available from CAMAG.

## CUMULATIVE CAMAG BIBLIOGRAPHY SERVICE "CCBS"

With the CCBS Online Search, you can directly search for information within the CAMAG website. The CCBS covers more than 11'000 abstracts of TLC/HPTLC publications between 1982 and today. The database covers most relevant scientific journals in the field of Planar Chromatography including also various non-English publications in German, French, Spanish, Portuguese and Chinese. The CCBS features additional practical information for the analyst in the lab, for example details on the mobile phase or the detection. With CCBS the analyst is able to find relevant TLC/HPTLC publications which might be helpful for solving a particular analytical question.

Visit [www.camag.com/ccbs](http://www.camag.com/ccbs) and choose your preferred search option:

- Full text search
- Browse and search by CBS classification
- Alphabetical Search
- Search by CBS edition

## Application Notes/ HPTLC Fingerprint Analysis

On our website you can find application notes for qualitative and quantitative HPTLC analyses. Contact [lab@camag.com](mailto:lab@camag.com) for validated methods including the validation protocol.

Further available are methods for HPTLC fingerprint analysis/screening of numerous herbal drugs for their safe identification.



# Index

Adsorbents	40	Nanomat 4	7
AMD 2 System	17		
Application Notes	44	Photo documentation	25–28
ATS 4 Automatic TLC Sampler	8	Plate Coaters	40
Automatic Developing Chamber ADC 2	16	Plate Heater	22
Automated Multiple Development	17	Postchromatographic derivatization	19–22
Automatic Plate Coater	40	Precoated layers	39
Basic Kits	38	Quantitative evaluation	25–36
BioLuminizer®	28		
		Sample application	5–10
Capillary Dispenser	7	Scanner qualification	31
Capillary Pipettes	7	Self prepared TLC layers	40
CBS, Bibliography Service	44		
Chromatogram development	11–18	Sample spray-on techniques	6
Chromatogram evaluation	23–32	Services	41–44
Chromatogram Immersion Device	21	smartAlert	15
		smartCut	15
Derivatization	19–22	Spraying of reagents	20–22
Densitometry	29–31	Spray Cabinet	22
Developing chambers	14–15	Stainless steel lid	14
Dip tank	21		
Dispenser Magazine	7	Test dye mixtures	39
Dual-wavelength scan	31	TLC/HPTLC Basic Kits	38
Documentation system	26–27		
		TLC/HPTLC Sprayer	21
Fingerprint analysis	44	TLC-MS Interface 2	32
Flat Bottom Chambers	14	TLC Plate Box	40
		TLC Plate Heater 3	22
Glass plates	40	TLC Scanner 4	30–31
Glass sprayer	21	TLC Spray Cabinet 2	22
		TLC Visualizer	26–27
Horizontal Developing Chamber	15	Training courses	42
HPTLC Vario System	18	Twin Trough Chamber	14
Image acquisition	25–28	Universal Capillary Holder	7
Image evaluation	25–27	UV Cabinet 4	24
Immersion device	21	UV Lamp 4	24
Instrument service	43		
IQ/OQ qualification	43	Validated methods	42–44
		visionCATS software	34–35
Laboratory services	42		
		winCATS software	36
Manual Plate Coater	40		
Multiple development	17		
Multi-wavelength scan	31		

# CAMAG – Global Presence



CAMAG markets its products in Switzerland directly from the headquarters, in Germany and the United States through their subsidiaries. In more than 70 other countries CAMAG is represented by selected companies.

CAMAG distributors regularly send their product specialists for education and training to our headquarters. Furthermore CAMAG organizes training courses overseas, e.g. in the Far East. The task of CAMAG product specialists is to advise customers in system selection and application competence and in the operation of their CAMAG systems. Service engineers of our distributors are also regularly trained in Muttenz.

To our customers and distributors a comprehensive web-based information offer is available: [www.camag.com](http://www.camag.com) for product and company information, [www.camag-laboratory.com](http://www.camag-laboratory.com) for applications.

CAMAG is a flexible, customer-oriented and scientifically sound company, which in its 50 years company history has profiled as a valued partner in all areas of Planar Chromatography.

**CAMAG (Switzerland)** · Sonnenmattstrasse 11 · 4132 Muttenz

Phone +41 61 467 34 34 · Fax +41 61 461 07 02 · [info@camag.com](mailto:info@camag.com)

**CAMAG (Germany)** · Bismarckstrasse 27-29 · 12169 Berlin

Phone +49 30 516 555 0 · Fax +49 30 795 70 73 · [infoberlin@camag.com](mailto:infoberlin@camag.com)

**CAMAG Scientific (USA)** · 515 Cornelius Harnett Drive · Wilmington, NC 28401

Phone (800) 334 3909 · Fax (910) 343 1834 · [tlc@camag.com](mailto:tlc@camag.com)

[www.camag.com](http://www.camag.com)



# CAMAG®

WORLD LEADER IN PLANAR CHROMATOGRAPHY

