



## NUCLEODEX columns enantiomer separation based on cyclodextrins

### NUCLEODEX $\beta$ -OH $\beta$ -cyclodextrin (R = H; n = 2) · USP L45

#### Technical data

- Base material NUCLEOSIL<sup>®</sup> silica, particle size 5  $\mu\text{m}$ , pore size 100  $\text{\AA}$  modified cyclodextrins as chiral selectors
- Separation based on hydrogen bonds and dipole interactions between functional groups of the analyte and hydroxyl groups of the cyclodextrin
- Examples for successful enantiomer separations: chlorthalidone and other compounds, which require free hydroxyl groups for enantioselective interactions
- Eluent in column  $\text{CH}_3\text{OH}$  – 0.1 % TEAA pH 4 (55:45)

### NUCLEODEX $\alpha$ -PM permethylated $\alpha$ -cyclodextrin (R = $\text{CH}_3$ ; n = 1)

#### Technical data

- Base material NUCLEOSIL<sup>®</sup> silica, particle size 5  $\mu\text{m}$ , pore size 100  $\text{\AA}$  modified cyclodextrins as chiral selectors
- Examples for successful enantiomer separations: mecoprop and dichlorprop as free carboxylic acids, trans-stilbene oxide, styrene oxide
- Eluent in column  $\text{CH}_3\text{OH}$  – 50 mmol/L phosphate pH 3 (70:30)

### NUCLEODEX $\beta$ -PM permethylated $\beta$ -cyclodextrin (R = $\text{CH}_3$ ; n = 2) · USP L45

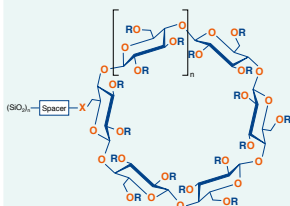
#### Technical data

- Base material NUCLEOSIL<sup>®</sup> silica, particle size 5  $\mu\text{m}$ , pore size 100  $\text{\AA}$  modified cyclodextrins as chiral selectors
- Examples for successful enantiomer separations: mephobarbital (prominal), pesticide derivatives mecoprop methyl and dichlorprop methyl
- Eluent in column  $\text{CH}_3\text{OH}$  – 0.1 % TEAA pH 4 (65:35)

### NUCLEODEX $\gamma$ -PM permethylated $\gamma$ -cyclodextrin (R = $\text{CH}_3$ ; n = 3)

#### Technical data

- Base material NUCLEOSIL<sup>®</sup> silica, particle size 5  $\mu\text{m}$ , pore size 100  $\text{\AA}$  modified cyclodextrins as chiral selectors
- Examples for successful enantiomer separations: steroids or other larger molecules
- Eluent in column  $\text{CH}_3\text{OH}$  – 0.1 % TEAA pH 4 (55:45)

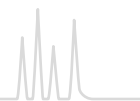


#### Recommended application

- NUCLEODEX phases are especially suited for the control of optical purity, but also for semipreparative separations and for the analysis of positional and cis-trans isomers.
- For numerous separations on NUCLEODEX phases please visit our website: [www.mn-net.com/apps](http://www.mn-net.com/apps)



# HPLC columns for enantiomer separations

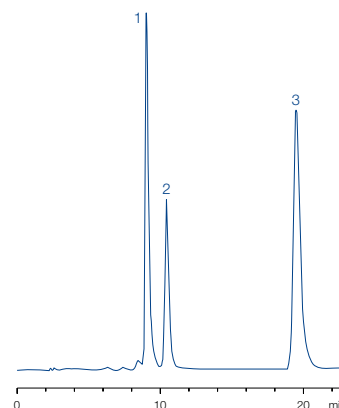


## Separation of the positional isomers of nitroaniline

MN Appl. No. 101420

Column: 200 x 4 mm NUCLEODEX β-OH  
 Eluent: methanol – 0.1 % triethylammonium acetate pH 4.0 (50:50, v/v)  
 Flow rate: 0.7 mL/min  
 Pressure: 180 bar  
 Detection: UV, 254 nm  
 Injection: 1 μL

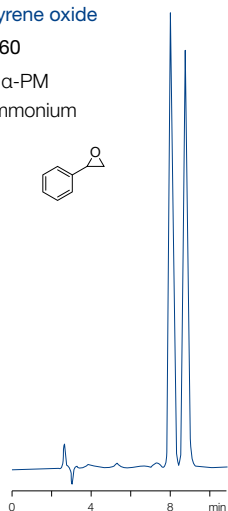
Peaks:  
 1. *m*-Nitroaniline  
 2. *o*-Nitroaniline  
 3. *p*-Nitroaniline



## Enantiomer separation of styrene oxide

MN Appl. No. 106160

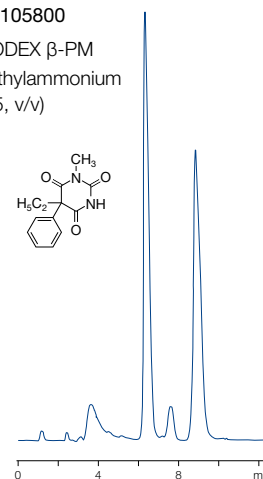
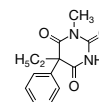
Column: 200 x 4 mm NUCLEODEX α-PM  
 Eluent: methanol – 0.1 % triethylammonium acetate pH 4.0 (60:40, v/v)  
 Flow rate: 0.7 mL/min  
 Pressure: 160 bar  
 Detection: UV, 230 nm  
 Injection: 2 μL



## Enantiomer separation of mephobarbital

MN Appl. No. 105800

Column: 200 x 4 mm NUCLEODEX β-PM  
 Eluent: methanol – 0.1 % triethylammonium acetate pH 4.0 (55:45, v/v)  
 Flow rate: 0.7 mL/min  
 Pressure: 180 bar  
 Detection: UV, 254 nm  
 Injection: 1 μL



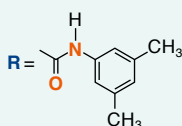
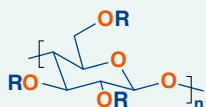
## Ordering information

ID	Length → 200 mm	EC guard columns*
<b>NUCLEODEX β-OH</b> eluent methanol – 0.1 % TEAA pH 4 (55:45)		
Analytical EC columns		
4 mm	720124.40	721171.30
<b>NUCLEODEX α-PM</b> eluent methanol – 50 mmol/L phosphate pH 3 (70:30)		
Analytical EC columns		
4 mm	720127.40	721469.30
<b>NUCLEODEX β-PM</b> eluent methanol – 0.1 % TEAA pH 4 (65:35)		
Analytical EC columns		
4 mm	720125.40	721176.30
<b>NUCLEODEX γ-PM</b> eluent methanol – 0.1 % TEAA pH 4 (55:45)		
Analytical EC columns		
4 mm	720752.40	721178.30
<b>NUCLEODEX CC screening kit</b>		
contains one CC 30/4 each with NUCLEODEX β-OH, α-PM, β-PM and γ-PM as well as one CC column holder 30 mm		721920

\* EC 4/3 guard columns for EC columns with 4 mm ID require the Column Protection System guard column holder (REF 718966, see page 251). Columns and guard columns in packs of 1.



## NUCLEOCEL DELTA enantiomer separation based on a cellulose derivative · USP L40



### Technical data

- Base material silica, chiral selector cellulose tris-(3,5-dimethylphenylcarbamate)
- High resolution type (S) with 5 µm particle size, allows use of shorter columns (150 mm) for faster separations, pressure stability up to ~150 bar (2000 psi), pH stability 1–9

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

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

### Recommended application

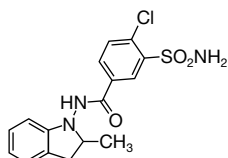
- Pharmaceutically active compounds, chiral pollutants (e.g., herbicides, PCB), chiral compounds in food (dyes, preservatives), chiral catalysts and bioorganic compounds

Similar phases: Chiralcel® OD, Kromasil® CelluCoat™, Eurocel® 01, Lux™ Cellulose-1

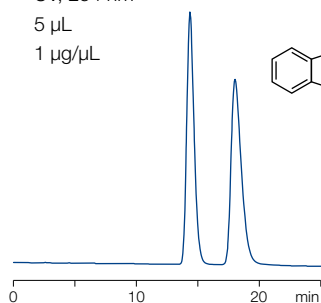
### Enantiomer separation of indapamide

MN Appl. No. 121230

Column: 250 x 4,6 mm NUCLEOCEL DELTA-RP S  
 Eluent: acetonitrile – water (40:60, v/v)  
 Flow rate: 0.5 mL/min  
 Temperature: 40 °C  
 Detection: UV, 254 nm  
 Injection: 5 µL  
 Concentration: 1 µg/µL



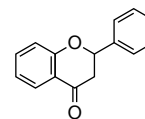
$\alpha = 1.3$   
 $R_s = 2.6$



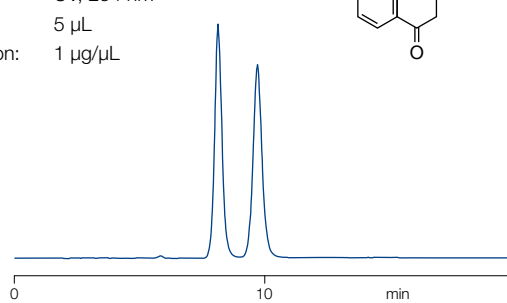
### Enantiomer separation of flavanone

MN Appl. No. 121260



Column: 250 x 4,6 mm NUCLEOCEL DELTA S  
 Eluent: *n*-heptane – 2-propanol (90:10, v/v)  
 Flow rate: 1 mL/min  
 Temperature: 25 °C  
 Detection: UV, 254 nm  
 Injection: 5 µL  
 Concentration: 1 µg/µL



$\alpha = 1.29$   
 $R_s = 2.6$



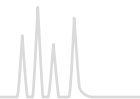
### Ordering information

ID	Length → 150 mm	250 mm		EC guard columns*
<b>NUCLEOCEL DELTA S, 5 µm</b> eluent <i>n</i> -heptane – 2-propanol (90:10, v/v)				
Analytical EC columns				
 4.6 mm		720445.46		721185.30
<b>NUCLEOCEL DELTA-RP S, 5 µm</b> eluent acetonitrile – water (40:60, v/v)				
Analytical EC columns				
 4.6 mm	720451.46	720450.46		721186.30

\* EC 4/3 guard column cartridges are used for EC columns of 4.6 mm ID with the Column Protection System guard column holder (REF 718966, see page 251). Columns and guard columns in packs of 1.



# HPLC columns for enantiomer separations



## RESOLVOSIL BSA-7 protein phase for enantiomer separation · USP L75

### Technical data

- Base material NUCLEOSIL® silica, particle size 7 µm, pore size 300 Å chiral selector bovine serum albumin (BSA)
- Separation based on selective interaction of proteins with low molecular compounds, i.e. principles of bioaffinity, including hydrophobic interactions (similar to a true reversed phase), interactions of polar groups and steric effects

### Recommended application

- Amino acid derivatives, aromatic amino acids, aromatic sulfoxides, barbiturates, benzodiazepinones, benzoin and benzoin derivatives, β-blockers, coumarin derivatives, and for monitoring stereoselective microbial and enzymatic conversions

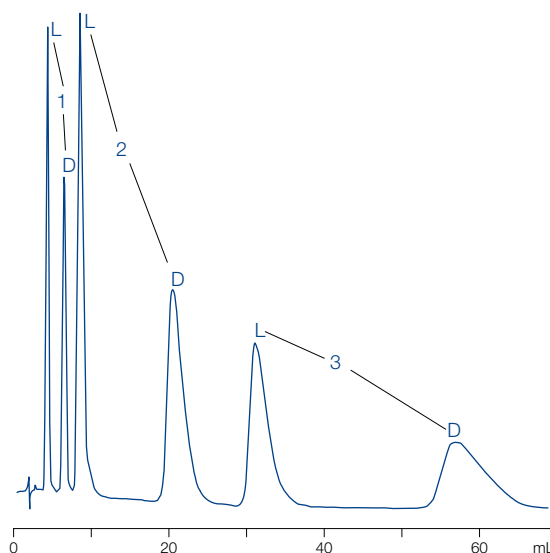
### Enantiomer separation of *N*-benzoyl-*D,L*-amino acids

MN Appl. No. 105450

S. Allenmark et al. in "Affinity chromatography and biological recognition" (I. Chaiken, M. Wilchek, and I. Parikh. Eds.), Academic Press, New York, 1983, 259–260

Column: 150 x 4 mm RESOLVOSIL BSA-7  
 Eluent: 50 mmol/L phosphate buffer pH 6.5  
 + 1 % 1-propanol  
 Flow rate: 0.70 mL/min  
 Detection: UV, 225 nm

- Peaks:
1. Serine
  2. Alanine
  3. Phenylalanine




### Ordering information

Eluent in column 0.1 mol/L phosphate buffer pH 7.5, 2 % 1-propanol

ID	Length → 150 mm	EC guard columns*
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### RESOLVOSIL BSA-7

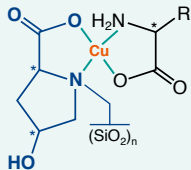
Analytical EC columns

 4 mm	720046.40	721402.30
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\* EC 4/3 guard columns for EC columns with 4 mm ID require the Column Protection System guard column holder (REF 718966, see page 251). Columns and guard columns in packs of 1.



## NUCLEOSIL® CHIRAL-1 enantiomer separation based on ligand exchange · USP L32



### 🔧 Technical data

- Base material NUCLEOSIL® silica, particle size 5 µm, pore size 120 Å chiral selector L-hydroxyproline – Cu<sup>2+</sup> complexes
- Principal interaction mode:
  - formation of ternary mixed-ligand complexes with Cu(II) ions; differences in the stability of the diastereomeric complexes cause chromatographic separation

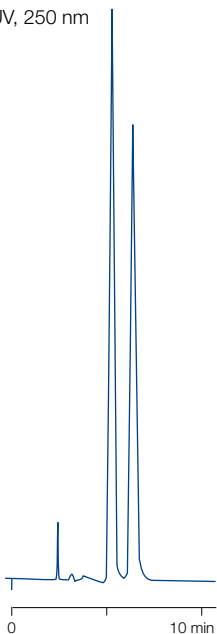
### ✓ Recommended application

- Enantiomers with two polar functional groups with the correct spacing such as α-amino acids, α-hydroxycarboxylic acids (e.g., lactic acid), *N*-alkyl-α-amino acids etc.

### *D,L*-alanine enantiomers

MN Appl. No. 105410

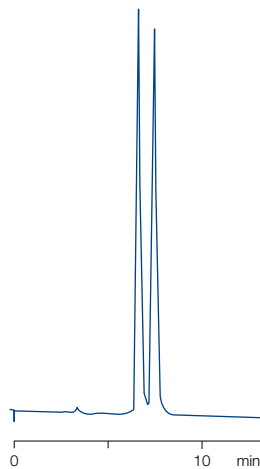
Column: 250 x 4 mm NUCLEOSIL® CHIRAL-1  
 Eluent: 0.5 mmol/L CuSO<sub>4</sub>  
 Flow rate: 1 mL/min  
 Pressure: 60 bar  
 Temperature: 60 °C  
 Detection: UV, 250 nm



### *D,L*-threonine enantiomers

MN Appl. No. 105410

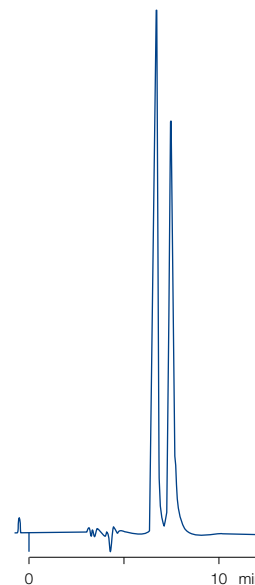
Column: 250 x 4 mm NUCLEOSIL® CHIRAL-1  
 Eluent: 0.25 mmol/L CuSO<sub>4</sub>  
 Flow rate: 0.8 mL/min  
 Pressure: 65 bar  
 Temperature: 60 °C  
 Detection: UV, 240 nm



### Lactic acid enantiomers

MN Appl. No. 105560

Column: 250 x 4 mm NUCLEOSIL® CHIRAL-1  
 Eluent: 0.5 mmol/L CuSO<sub>4</sub>  
 Flow rate: 0.8 mL/min  
 Temperature: 60 °C  
 Detection: UV, 240 nm  
 Injection: 1 µL



### Ordering information

Eluent in column 0.5 mmol/L copper sulfate solution

ID

Length →

250 mm

EC guard columns\*

### NUCLEOSIL® CHIRAL-1

Analytical EC columns



4 mm

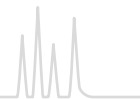
720081.40

721188.30

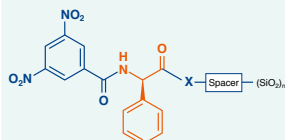
\* EC 4/3 guard columns for EC columns with 4 mm ID require the Column Protection System guard column holder (REF 718966, see page 251). Columns and guard columns in packs of 1.



# HPLC columns for enantiomer separations



## NUCLEOSIL® CHIRAL-2 · CHIRAL-3 enantiomer separation in organic eluent systems · USP L36



### Technical data

- Base material NUCLEOSIL® silica, particle size 5 µm, pore size 100 Å chiral selector for NUCLEOSIL® CHIRAL-2 is *N*-(3,5-dinitrobenzoyl)-*D*-phenylglycine, for CHIRAL-3 the optical antipode is used, “brush type” phases
- Principle interaction modes: charge-transfer interactions, hydrogen bonds, dipole-dipole interactions and steric effects

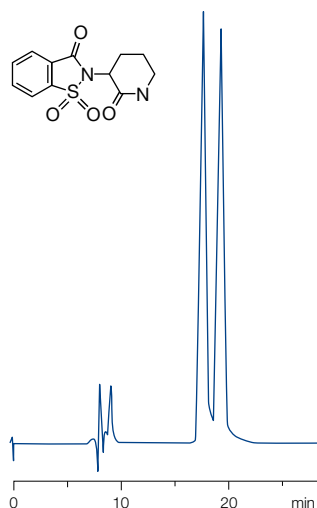
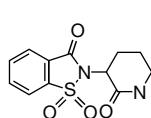
### Recommended application

- analysis of stereoisomers such as separation of enantiomers and diastereomers, control of optical purity of plant protectives (pesticides, e.g., propionic acid derived herbicides) pharmaceuticals etc. and for product control in chiral organic syntheses
- For control of optical purity of a substance, the columns NUCLEOSIL® CHIRAL-2 and NUCLEOSIL® CHIRAL-3 allow to select conditions such that the minor enantiomer, present as an impurity, is eluted before the main peak. Overlapping peaks are avoided. This makes an exact quantification of the impurity much easier.

### Enantiomer separation of *D,L*-supidimide

MN Appl. No. 105690

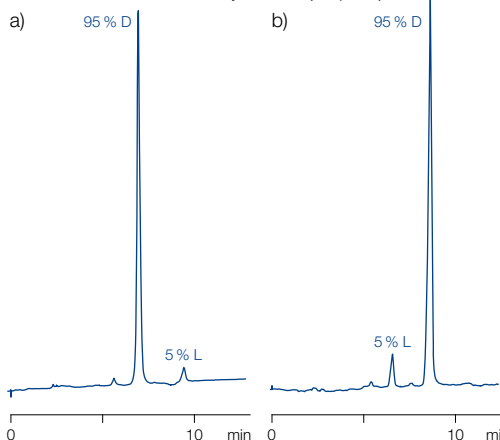
Column: 250 x 4 mm NUCLEOSIL® CHIRAL-2  
 Eluent: tetrahydrofuran – *n*-heptane (10:3, v/v)  
 Flow rate: 1.0 mL/min  
 Detection: UV, 220 nm



### Control of optical purity of mecoprop methyl

MN Appl. No. 111360

Columns: a) 250 x 4 mm NUCLEOSIL® CHIRAL-2  
 b) 250 x 4 mm NUCLEOSIL® CHIRAL-3  
 Eluent: *n*-heptane – 2-propanol – TFA (100:0.05:0.05, v/v/v)  
 Flow rate: 1 mL/min, ambient temperature  
 Detection: UV, 230 nm, Injection 1 µL (sample with 90 % ee)



### Ordering information

Eluent in column *n*-heptane – 2-propanol – TFAA (100:0.05:0.05, v/v/v)

ID	Length → 250 mm	EC guard columns*
<b>NUCLEOSIL® CHIRAL-2</b>		
Analytical EC columns		
4 mm	720088.40	721190.30
<b>NUCLEOSIL® CHIRAL-3</b>		
Analytical EC columns		
4 mm	720350.40	721190.30

Guard columns for NUCLEOSIL® CHIRAL-2 and CHIRAL-3 are identical.

\* EC 4/3 guard columns for EC columns with 4 mm ID require the Column Protection System guard column holder (REF 718966, see page 251). EC columns and EC guard columns in packs of 1.