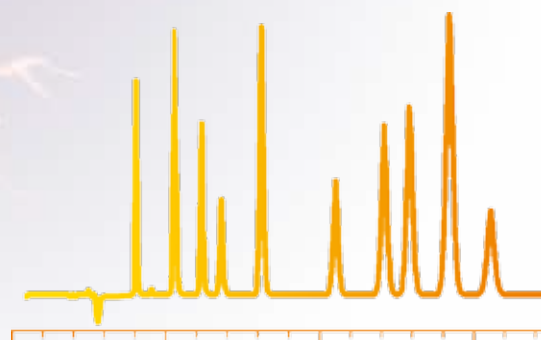


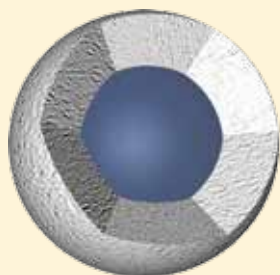
**Highest efficiency in HPLC by
core-shell technology**

HPLC methods for the future

NUCLEO SHELL



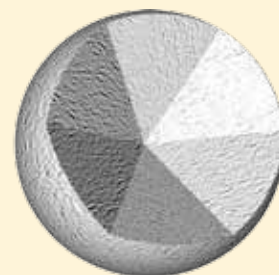
... we Meet your Needs



NUCLEOSHELL

Core-shell technology

- Solid core of silicon dioxide, homogeneous shell of porous silica
- Highest efficiency compared to totally porous silica particles
- Particle size 2.7 μm (core 1.7 μm); lower back pressure enables use on conventional LC systems



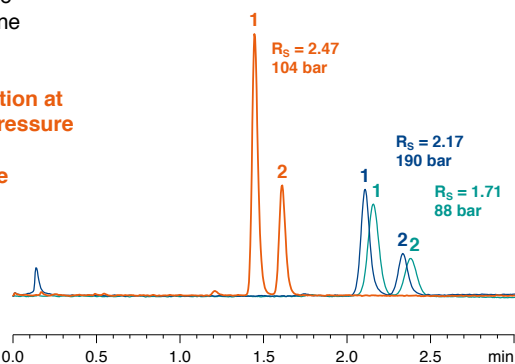
NUCLEODUR®

Resolution R_s as function of particle size

Column: 50 x 4 mm
NUCLEOSHELL RP 18, 2.7 μm
 NUCLEODUR® C₁₈ Gravity, 3 μm
 NUCLEODUR® C₁₈ Gravity, 1.8 μm
 Eluent: acetonitrile – water (60:40, v/v)
 Flow rate: 1 mL/min
 Temperature: 25 °C
 Detection: UV, 254 nm

Peaks:
 1. Naphthalene
 2. Ethylbenzene

Better resolution at lower back pressure and shorter retention time



MN Appl. No. 125270

$$R_s = \frac{\sqrt{N}}{4} \left(\frac{\alpha - 1}{\alpha} \right) \left(\frac{k'_i}{k'_i + 1} \right)$$

R_s = Resolution
 α = Selectivity
 k'_i = Retention
 N = Theoretical plates $N \propto 1/d_p$
 d_p = Particle size

Theoretical column efficiency (optimal conditions)

Silica phase	d_p [μm]	L [mm]	N	R_s	Analysis time
NUCLEOSHELL	2.7	100	25 000	112 %	40 %
NUCLEODUR®	5	250	20 000	100 %	100 %
	3	150	20 000	100 %	60 %
	1.8	100	22 000	105 %	40 %

Silica phase	d_p [μm]	HETP [μm]	Efficiency [plates/m]
NUCLEOSHELL	2.7	4	250 000
NUCLEODUR®	5	12.5	80 000
	3	7.5	133 333
	1.8	4.5	222 222

Benefits of core-shell technology

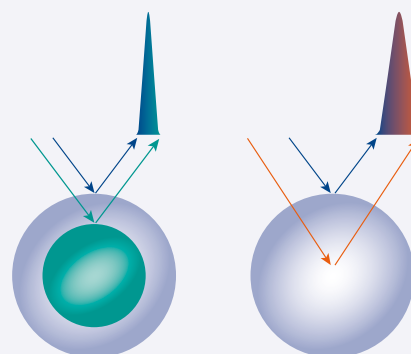
Short diffusion paths

- Fast mass transfer (C-Term of Van Deemter equation)
- High flow velocity without peak broadening for fast LC

Narrow particle size distribution ($d_{90}/d_{10} \sim 1.1$)

- Stable packing
- Column efficiency NUCLEOSHELL $\sim 250000 \text{ m}^{-1}$ (HETP $\sim 4 \mu\text{m}$)
- Minimized frictional heat

Core-shell particles vs. totally porous silica gel



Core-shell silica gel



NUCLEOSHELL RP 18

non polar octadecyl phase

Key features:

- Based on core-shell particle technology for fast and efficient HPLC
- Suitable for LC/MS and HPLC at pH extremes (pH 1-11)
- Superior base deactivation, ideal for method development

Technical characteristics:

Octadecyl modification, multi-encapped; pore size 90 Å; particle size 2.7 µm; carbon content 7.5 %

Recommended application:

Overall sophisticated analytical separations, e.g., analgesics, antiinflammatory drugs, antidepressants; herbicides; phytopharmaceuticals; immunosuppressants

USP L1

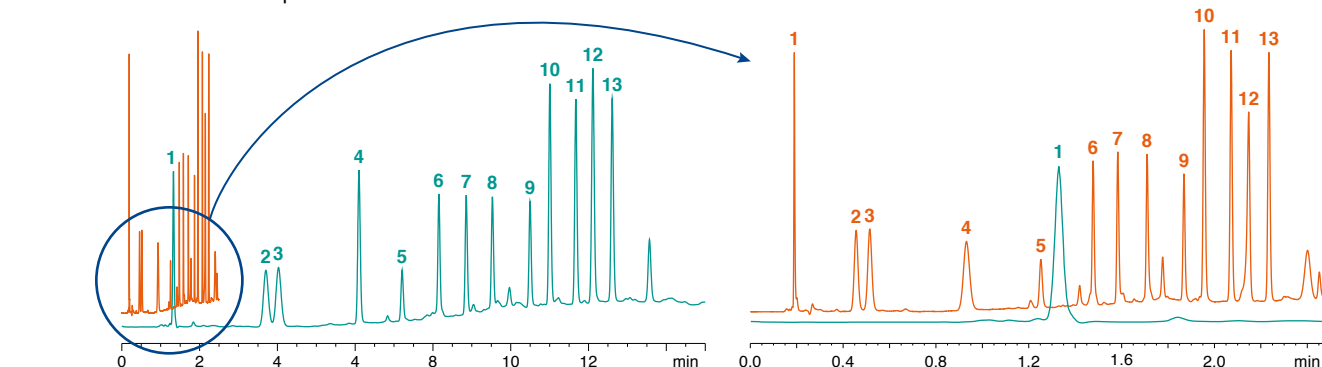
Separation of β-lactam antibiotics

Column: 50 x 4 mm NUCLEOSHELL RP 18, 2.7 µm
150 x 4 mm NUCLEODUR® C₁₈ Gravity, 5 µm
Eluent: A) acetonitrile; B) 20 mM KH₂PO₄ pH 3.5;
10 % A (0.5 min) → 50 % A in 1.5 min (0.5 min 50 % A)
10 % A (3 min) → 50 % A in 9 min (3 min 50 % A)

Flow rate: 2 mL/min, 1 mL/min
Pressure: 270 bar, 110 bar
Temperature: 25 °C
Detection: UV, 220 nm

Peaks:

- | | | | |
|----------------|-----------------|-----------------|-------------------|
| 1. Amoxicillin | 5. Cefoxitin | 9. Penicillin V | 12. Nafcillin |
| 2. Ampicillin | 6. Cefamandole | 10. Oxacillin | 13. Dicloxacillin |
| 3. Cephalexin | 7. Cephalothin | 11. Cloxacillin | |
| 4. Cefotaxime | 8. Piperacillin | | |



MN Appl. No. 124940

NUCLEOSHELL RP 18

Ordering information

Pore size 90 Å; octadecyl modification, multi-encapped, 7.5 % C; eluent in column acetonitrile – water

Length →	50 mm	100 mm	150 mm			
NUCLEOSHELL RP 18, 2.7 µm			particle size 2.7 µm			
EC analytical columns						
2 mm ID	763132.20	763134.20	763136.20			
3 mm ID	763132.30	763134.30	763136.30			
4 mm ID	763132.40	763134.40	763136.40			
4.6 mm ID	763132.46	763134.46	763136.46			
EC guard columns*		4 x 2 mm: 763138.20	4 x 3 mm: 763138.30			
EC columns in packs of 1, guard columns in packs of 3						
Guard column systems						
Guard columns for EC columns with ID		2 mm	3 mm	4 mm	4.6 mm	Guard column holder
* Column Protection System	EC	4/2	4/3	4/3	4/3	718966





NUCLEOSHELL core-shell silica gel

NUCLEOSHELL HILIC

zwitterionic phase

Key features:

- Based on core-shell particle technology for fast and efficient HPLC
- Ideal for reproducible and stable chromatography of highly polar analytes
- Very short column equilibration times

Technical characteristics:

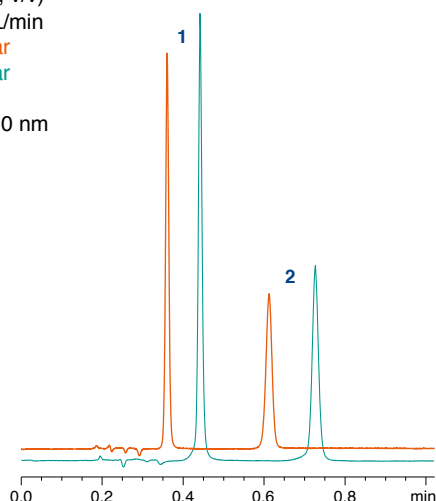
Ammonium – sulfonic acid modified silica; pore size 90 Å, particle size 2.7 µm; pH stability 2–8.5; suitable for LC/MS; carbon content 1.3 %

Recommended application:

Hydrophilic compounds such as organic polar acids and bases, polar natural compounds, nucleosides, oligonucleotides, amino acids, peptides, water soluble vitamins

Separation of creatine and creatinine

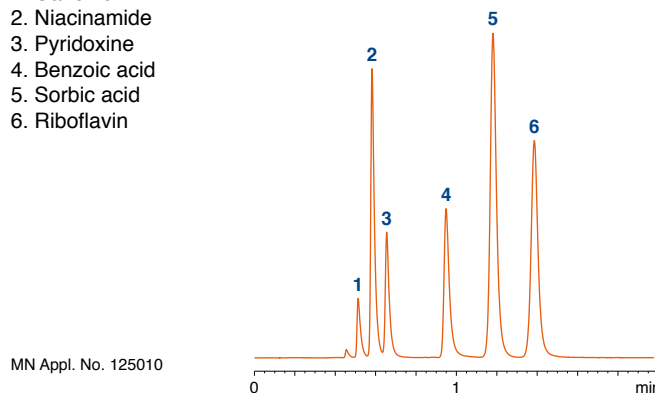
Column: 50 x 4 mm NUCLEOSHELL HILIC, 2.7 µm
50 x 4 mm NUCLEODUR® HILIC, 1.8 µm
Eluent: acetonitrile – 10 mM ammonium acetate, pH 4.0
(90:10, v/v)
Flow rate: 1.7 mL/min
Pressure: 129 bar
180 bar
Temperature: 25 °C
Detection: UV, 210 nm
Peaks:
1. Creatinine
2. Creatine



MN Appl. No. 124990

Analysis of an energy drink

Column: 100 x 4 mm NUCLEOSHELL HILIC, 2.7 µm
Eluent: acetonitrile – 100 mM ammonium acetate, pH 5.0
(90:10, v/v)
Flow rate: 1.7 mL/min
Temperature: 35 °C
Detection: UV, 254 nm
Peaks:
1. Caffeine
2. Niacinamide
3. Pyridoxine
4. Benzoic acid
5. Sorbic acid
6. Riboflavin



MN Appl. No. 125010

NUCLEOSHELL HILIC

Ordering information

Pore size 90 Å; octadecyl modification, multi-encapped, 1.3 % C; eluent in column acetonitrile – water

Length →	50 mm	100 mm	150 mm
NUCLEOSHELL HILIC, 2.7 µm			particle size 2.7 µm
EC analytical columns			
2 mm ID	763332.20	763334.20	763336.20
3 mm ID	763332.30	763334.30	763336.30
4 mm ID	763332.40	763334.40	763336.40
4.6 mm ID	763332.46	763334.46	763336.46
EC guard columns*		4 x 2 mm: 763338.20	4 x 3 mm: 763338.30
EC columns in packs of 1, guard columns in packs of 3, * see page before			

www.mn-net.com

MACHEREY-NAGEL



MACHEREY-NAGEL GmbH & Co. KG · Neumann-Neander-Str. 6–8 · 52355 Düren · Germany

Germany
and international:
Tel.: +49 24 21 969-0
Fax: +49 24 21 969-199
E-mail: info@mn-net.com

Switzerland:
MACHEREY-NAGEL AG
Tel.: +41 62 388 55 00
Fax: +41 62 388 55 05
E-mail: sales-ch@mn-net.com

France:
MACHEREY-NAGEL EURL
Tel.: +33 388 68 22 68
Fax: +33 388 51 76 88
E-mail: sales-fr@mn-net.com

USA:
MACHEREY-NAGEL Inc.
Tel.: +1 484 821 0984
Fax: +1 484 821 1272
E-mail: sales-us@mn-net.com

