

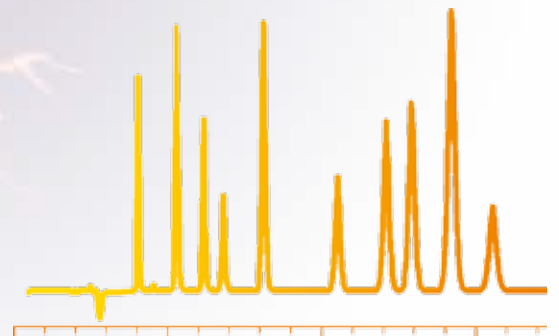
Chromatography

Highest efficiency in HPLC by  
core-shell technology

HPLC methods for the future



NUCLEO SHELL



... we Meet your Needs

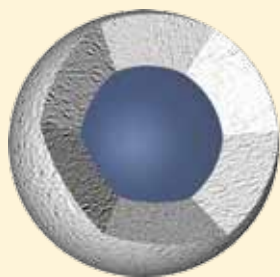
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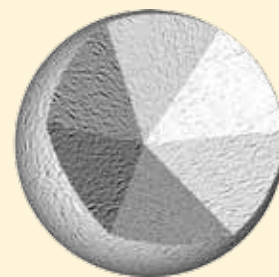
# NUCLEOSHELL



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®

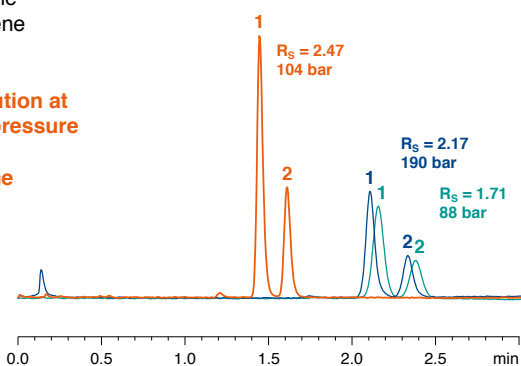
### Resolution $R_s$ as function of particle size

Column: 50 x 4 mm  
**NUCLEOSHELL RP 18, 2.7 μm**  
 NUCLEODUR® C<sub>18</sub> Gravity, 3 μm  
 NUCLEODUR® C<sub>18</sub> 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  
 $\alpha$  = 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

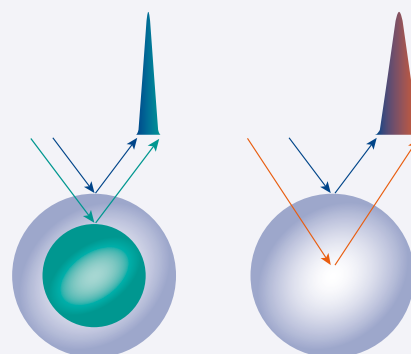
### Short diffusion paths

- 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  $\sim 4 \text{ μm}$ )
- 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

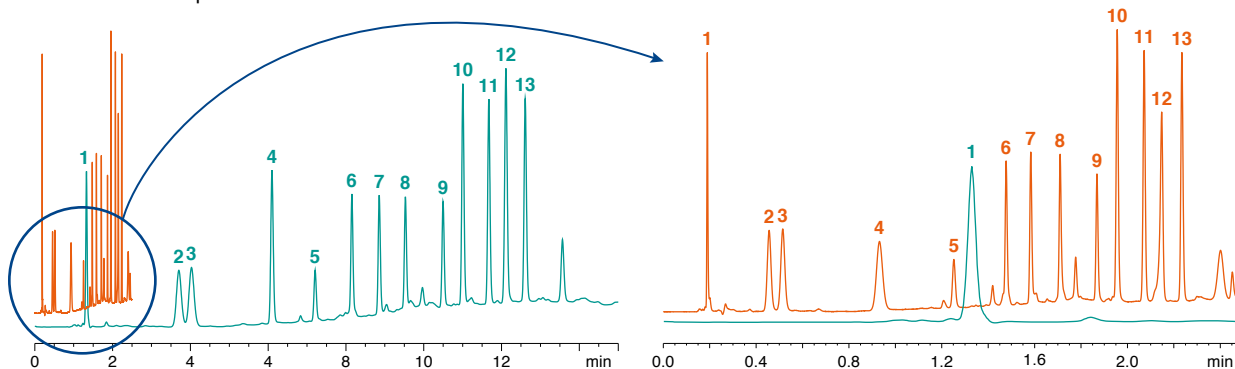
### Separation of β-lactam antibiotics

Column: 50 x 4 mm NUCLEOSHELL RP 18, 2.7 µm  
150 x 4 mm NUCLEODUR® C<sub>18</sub> Gravity, 5 µm  
Eluent: A) acetonitrile; B) 20 mM KH<sub>2</sub>PO<sub>4</sub> 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. Cephalixin  | 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
<b>NUCLEOSHELL RP 18, 2.7 µm</b>			particle size 2.7 µm
<b>EC analytical columns</b>			
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			
<b>Guard column systems</b>			
<b>Guard columns for EC columns with ID</b>		<b>2 mm</b>	<b>3 mm</b>
		<b>4 mm</b>	<b>4.6 mm</b>
* Column Protection System	EC	4/2	4/3
			4/3
			4/3
			Guard column holder
			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%

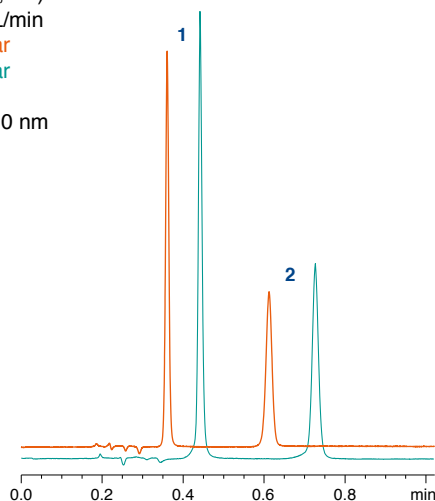
### Recommended application:

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

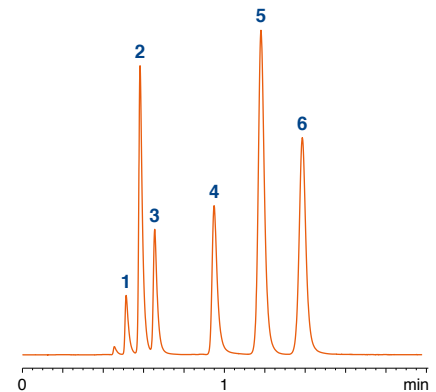


MN Appl. No. 124990

### 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
<b>NUCLEOSHELL HILIC, 2.7 µm</b>			particle size 2.7 µm
<b>EC analytical columns</b>			
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			

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