HPLC/UHPLC column

SunBridge

Ultra Hybrid Technology

Particle size:1.8 μm, 3 μm and 5 μm

The ultimate C18!

ChromaNyk
ChromaNik Technologies Inc.

ChromaNik Technologies

SunBridge

A hybrid that goes beyond hybrid—— "Ultra-hybrid" C18

■ Hybrid silica and highly inactivated silica

A hybrid column generally refers to a column that uses so-called hybrid silica (organic silica) particles, in which a certain proportion of ethylene bridges are applied to the silica gel skeleton (inorganic). Its main feature is said to be its high resistance to alkali.

However, the method of manufacturing highly alkaline-durable columns is not limited to using organic silica. It is also possible to increase durability by ingenuity in surface treatment (end-capping) after the introduction of functional groups. For example, Prominert, which we developed in 2022, has high pH durability comparable to that of hybrid columns by applying an advanced inactivation method.

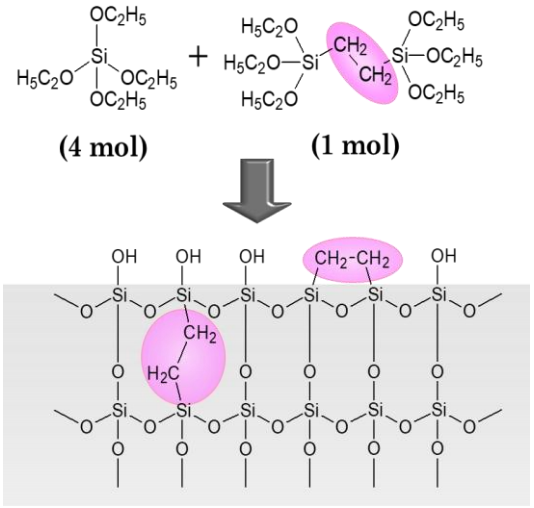
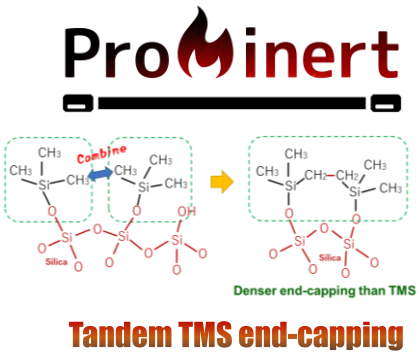


Fig. 1 Image of hybrid silica surface



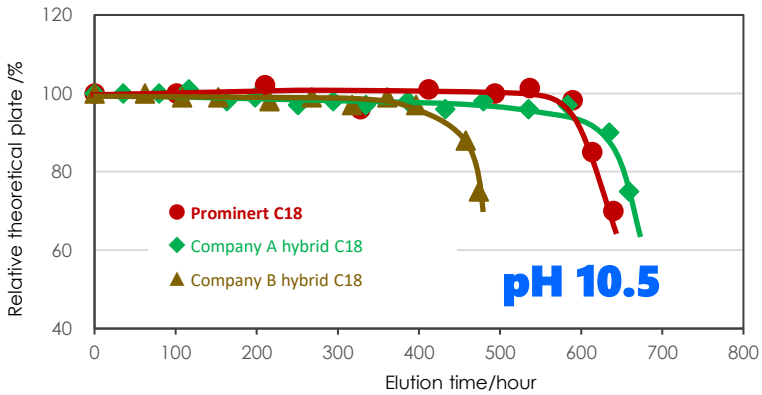


Fig. 2 Comparison of surface treatment technologies used in Prominert and alkaline durability

(detailed conditions are listed in the Prominert catalog)

■ Two types of hybrid silica particles

Hybrid silica particles are thought to be roughly divided into two types based on the manufacturing process. One is "fully hybrid particles" created from scratch, and the other is "partially hybrid particles" where the silica surface is modified and partially organicized.

The hybrids from companies A and B given as comparative examples for Prominert were both partial hybrid columns. Most of the columns on the market that are called "hybrid" are considered to be partial hybrid columns.

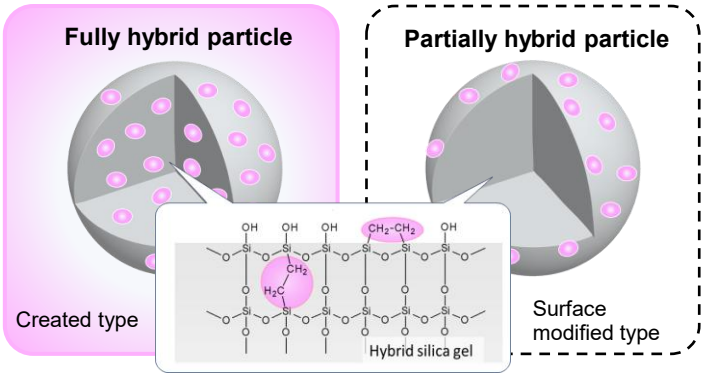
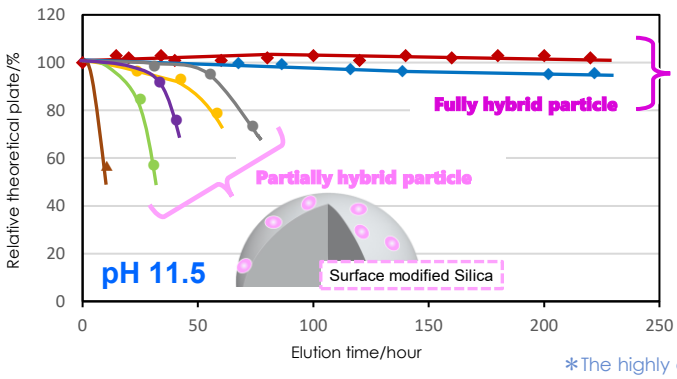
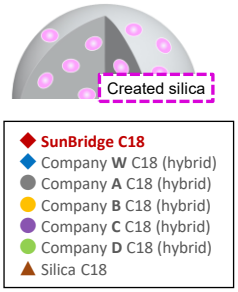


Fig. 3 Image of hybrid particles (created type or surface modified type)

■ Comparison of durability of hybrid columns under high and low pH conditions





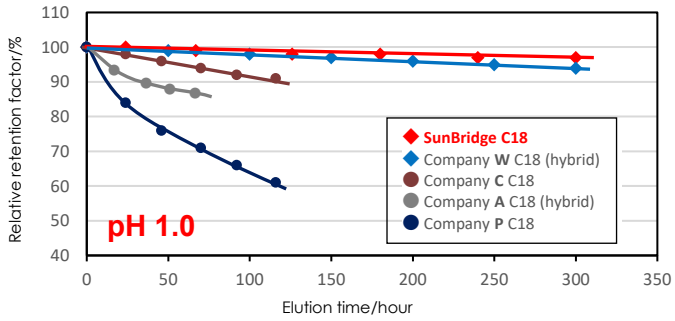
- SunBridge C18
- Company W C18 (hybrid)
- Company A C18 (hybrid)
- Company B C18 (hybrid)
- Company C C18 (hybrid)
- Company D C18 (hybrid)
- Silica C18

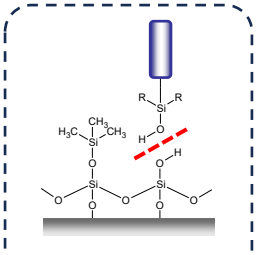
Durable test conditions (pH 11.5)
Column dimension: 150 x 4.6 mm
Mobile phase: Methanol/50 mM potassium phosphate pH 11.5=10/90
Flow rate: 1.0 mL/min
Temperature: 40 °C

Measurement conditions
Mobile phase: Acetonitrile/water=70/30
Flow rate: 1.0 mL/min
Temperature: 40 °C
Sample: 1 = Uracil, 2 = Butylbenzene

＊The highly end-capped silica was also classified as a partial hybrid based on its morphology.

Fig. 4-1 Comparison of durability of various columns under basic pH conditions (pH 11.5





Durable test conditions (pH 1.0)
Column dimension: 50 x 2.1 mm
Mobile phase: Acetonitrile/1.0% TFA pH 1=10/90
Flow rate: 0.4 mL/min
Temperature: 80 °C

Measurement conditions
Mobile phase: Acetonitrile/water=70/30
Flow rate: 1.0 mL/min
Temperature: 40 °C
Sample: 1 = Uracil, 2 = Butylbenzene

Fig. 4-2 Comparison of durability of various columns under acidic pH conditions (pH 1)

SunBridge C18 demonstrated durability equal to or greater than that of W's Hybrid C18 under both high pH (11.5) and low pH (1.0) conditions. In particular, the difference in durability compared to Hybrid C18 from other companies other than W's under high pH conditions was significant, and the difference due to the manufacturing method of the organic silica was clear.

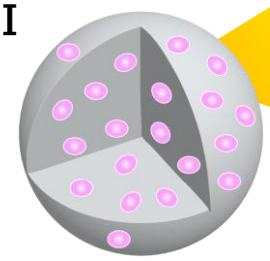
■ Overview of Ultra Hybrid Technology:

Ⅰ. Fully hybrid particles × Ⅱ. Advanced surface treatment

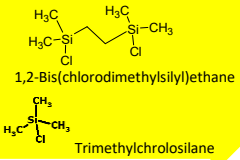
SunBridge was developed to be the ultimate in durability and stability for C18 (ODS) columns. Its core technology is Ultra Hybrid Technology, which combines a new fully hybrid particle with an advanced deactivation method. This innovation has resulted in the creation of a new generation of fully porous columns that combines high substrate durability with excellent peak shape.

A base material (artificial organic silica gel) synthesized by mixing tetraethoxysilane and bis(triethoxysilyl)ethane in a 4:1 ratio is bonded with a trifunctional C18 group.

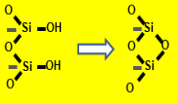
Ⅰ



Double End-capping



High temperature reaction



Ⅱ

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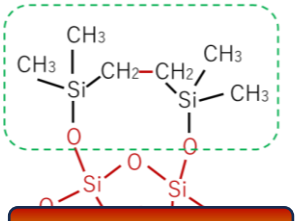


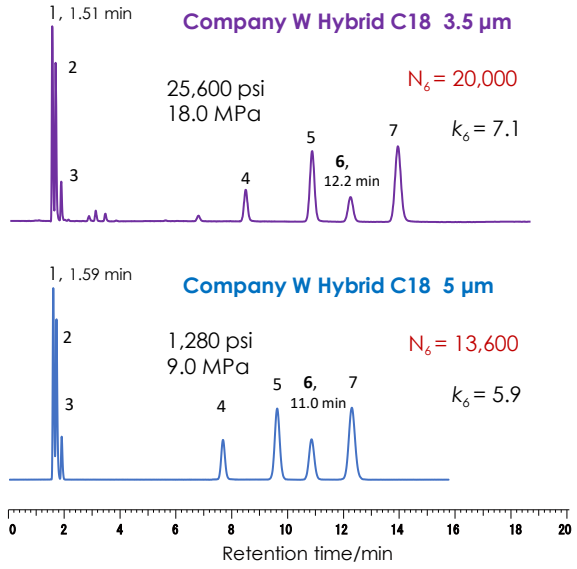
Tandem TMS

SunBridge

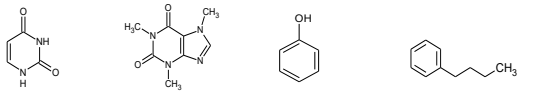
Comparison of basic performance and applications– v.s. Fully hybrid C18

■ Comparison of basic performance

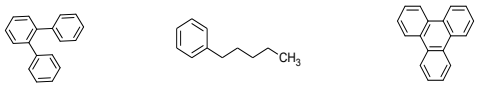
Evaluation of hydrogen bonding, hydrophobicity and steric selectivity



Column: Company W Hybrid C18 3.5 µm, 5 µm,
SunBridge C18 5 µm,
Column dimensions : 150 x 4.6 mm
Mobile phase: CH_3OH/H_2O=75/25
Flow rate: 1.0 mL/min, Temperature: 40 °C
Sample: 1 = Uracil, 2 = Caffeine, 3 = Phenol, 4 = Butylbenzene,



5 = o-Terphenyl, 6 = Amylbenzene, 7 = Triphenylene



(N: Theoretical plate, *k*: Retention factor)

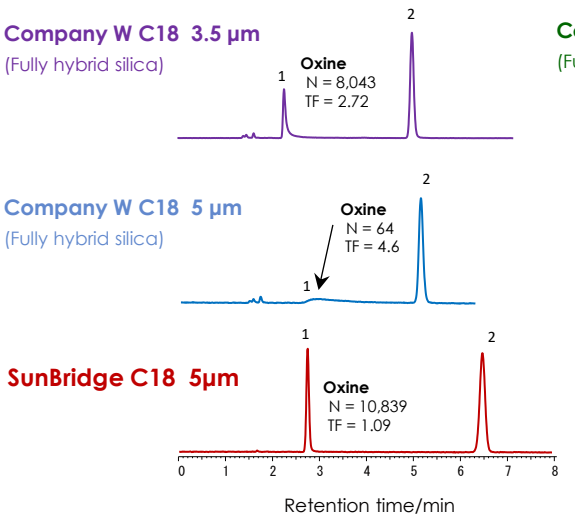
	Hydrogen bonding α(Caffeine/Phenol)	Hydrophobicity α(Amylbenzene/ Butylbenzene)	Steric selectivity α(Triphenylene/ o-Terphenyl)	Specific surface aera (m^2/g)	Carbon loading (%)
Company W Hybrid C18 3.5 µm	0.38	1.54	1.33	185	17.4%
Company W Hybrid C18 5 µm	0.39	1.52	1.33	188	18.0%
SunBridge C18 5µm	0.43	1.53	1.31	190	16.0%

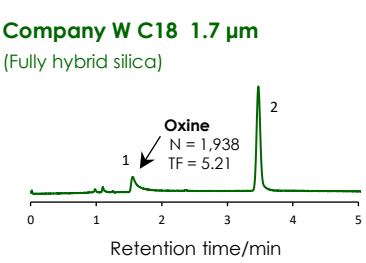
The basic specifications and selectivity trends of the two fully hybrid silica columns (SunBridge, W Company) are relatively similar.

SunBridge C18 5 µm had higher retention at lower pressures than Company W C18 of the same particle size, and the theoretical plate numbers were comparable.

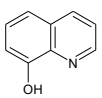
■ Comparison of chelating compound

(N: Theoretical plate, TF: Tailing factor)





Oxine



Metal Chelate Indicator compound

Column dimensions:
150 x 4.6 mm for 3.5 and 5 µm
100 x 2.1 mm for 1.7 µm
Mobile phase: CH_3CN/20 mM H_3PO_4=10/90
Flow rate: 1.0 mL/min for 3.5 and 5 µm
0.2 mL/min for 1.7 µm
Temperature: 40 °C
Detection: UV@250 nm
Sample: 1 = 8-Quinolinol (Oxine)
2 = Caffeine

For Company W C18, peak tailing for oxine was noticeable for all particle sizes.

SunBridge C18 showed a sharp peak for oxine without tailing.

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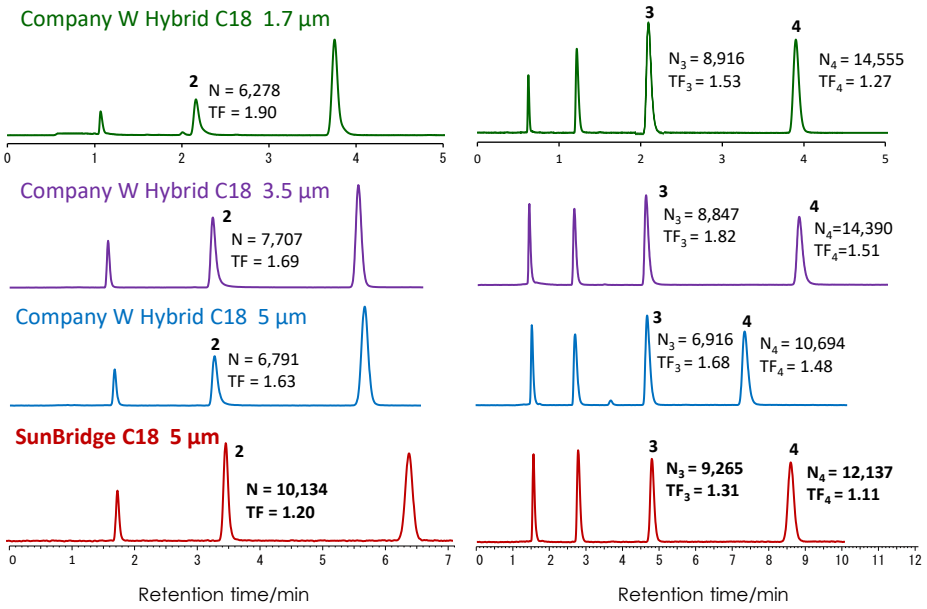
■ Comparison of basic compounds

(N: Theoretical plate, TF: Tailing factor)

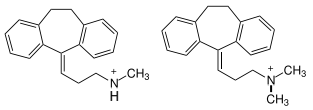
(1) Pyridine

(2) Nortriptyline and Amitriptyline



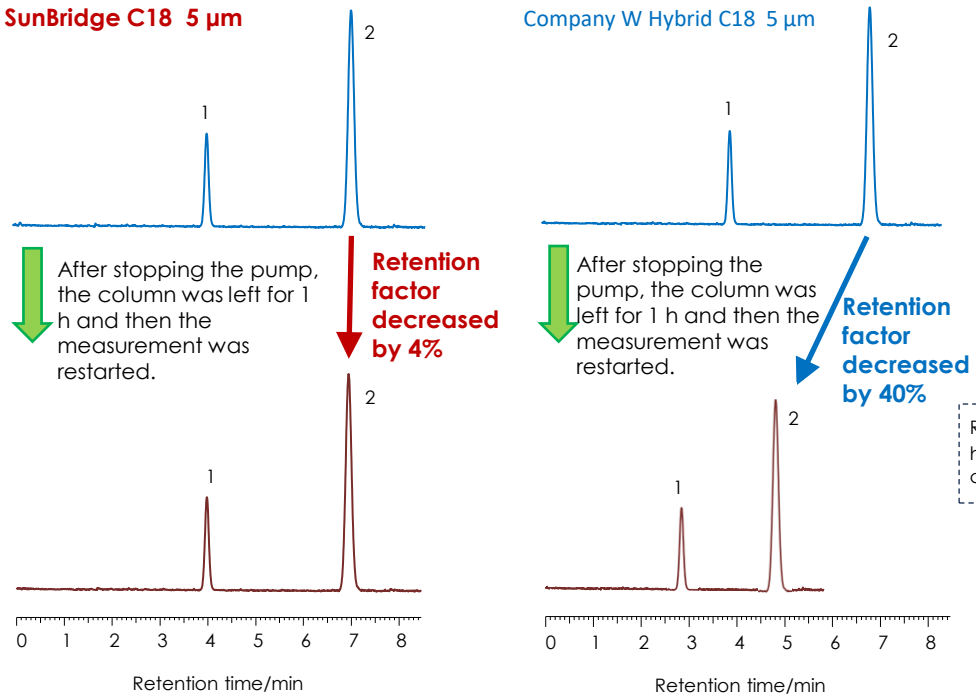
(1) Column dimensions:
150 x 4.6 mm for 3.5 and 5 µm
100 x 2.1 mm for 1.7 µm
Mobile phase: CH_3OH/H_2O=30/70
Flow rate: 1.0 mL/min for 3.5 and 5 µm
0.2 mL/min for 1.7 µm
Temperature: 40 °C
Detection: UV@250 nm
Sample: 1 = Uracil
2 = Pyridine
3 = Phenol

(2) Column dimensions:
150 x 4.6 mm for 3.5 and 5 µm
100 x 2.1 mm for 1.7 µm
Mobile phase: Acetonitrile/10 mM ammonium acetate pH 6.8=40/60
Flow rate: 1.0 mL/min for 3.5 and 5 µm
0.3 mL/min for 1.7 µm
Temperature: 40 °C
Detection: UV@250 nm
Sample: 1= Uracil, 2= Propranolol,
3= Nortriptyline, 4= Amitriptyline



SunBridge C18 was hardly affected by residual silanol groups, and the peak shapes of basic compounds were good.

■Comparison of retention reproducibility in 100% aqueous mobile phase



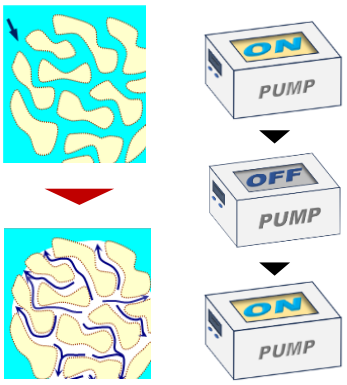


Illustration of water expelling out of pores

Reference: Technical Note 1006
https://chromanik.co.jp/technical/pdf/English_Tech_note_1006.pdf

Column dimension: 150 x 4.6 mm
Mobile phase:
10 mM phosphate buffer pH 7.0
Flow rate: 1.0 mL/min
Temperature: 40 °C
Detection: UV@250 nm
Sample: 1=Uridine, 2=Adenine

Tech_note_1006.pdf

SunBridge C18 could be used without issue, although there was a slight decrease in retention when the analysis was restarted with 100% aqueous mobile phase (pH 7.0).

<Additional Verification>

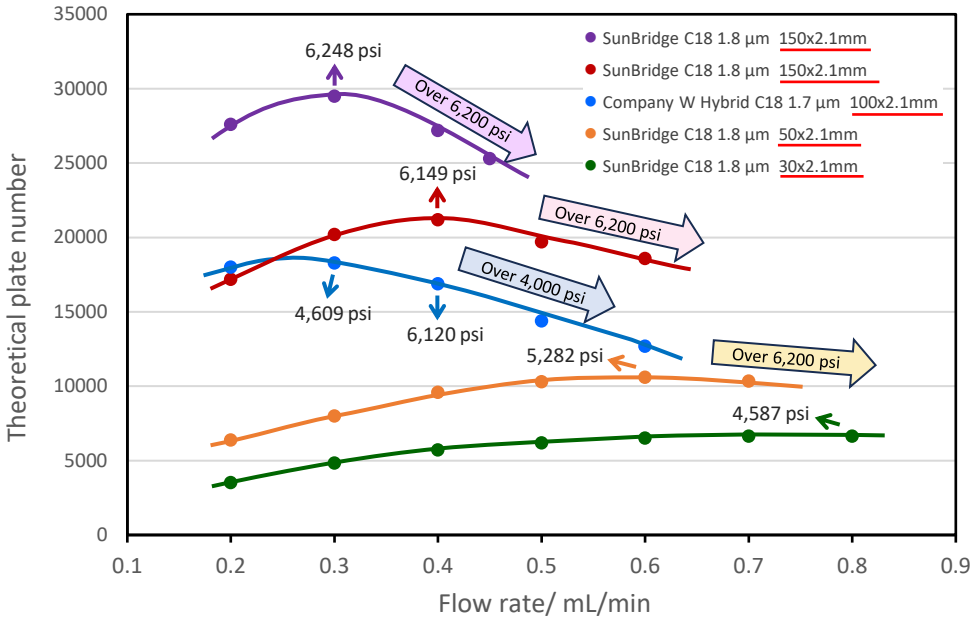
High pH conditions

★ Conditions: Potassium phosphate buffer pH 11.3 100% aqueous mobile phase continuously passed through (40°C)
Results after 300 hours: Theoretical plate number decrease was less than 5%, and retention time decrease was less than 3%.

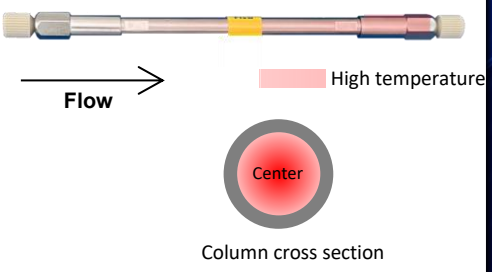
Durability of 300 hours or more even in 100% aqueous mobile phase with pH of 11 or higher

■Relationship between flow rate and theoretical plate number

Decreasing of theoretical plate number due to frictional heat effect



Column: SunBridge C18 1.8 µm
Company W hybrid C18 1.7 µm
Column dimension: 150 x 2.1 mm,100 x 2.1 mm.
50 x 2.1mm and 50 x 2.1 mm
Mobile phase: CH_3CN/H_2O=60/40
Temperature: 40 °C
Sample:
Acenaphthene for 150 and100 mm length,
Butylbenzene for 50 and 30 mm length

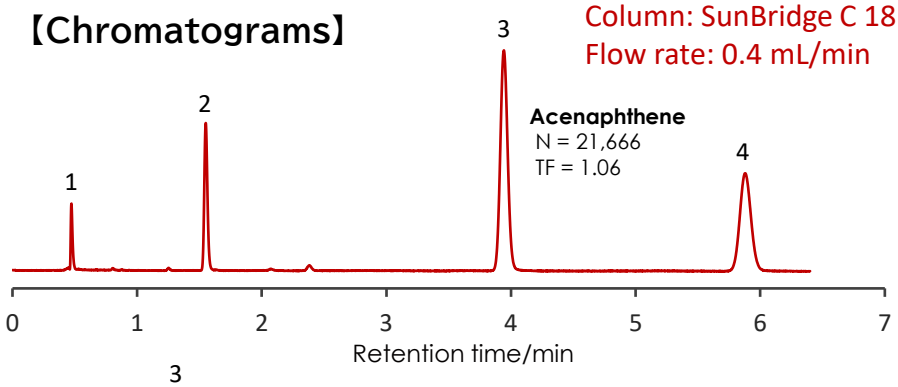


Columns packed with sub-2 µm particles experience high column backpressures, making the effects of frictional heat generated between the mobile phase and packing material unnegligible. The relationship between mobile phase flow rate and theoretical plate number is shown in the figure above. Although Company E hybrid C18 1.7 µm and SunBridge C18 1.8 µm columns experience nearly identical column backpressures and generate similar amounts of frictional heat due to column backpressure, the Company E hybrid C18 1.7 µm column begins to decrease in plate number at backpressures of 30 MPa or higher and flow rates of 0.28 mL/min or higher, while the SunBridge C18 1.8 µm column begins to decrease in plate number at backpressures of 43 MPa or higher and flow rates of 0.4 mL/min or higher. This confirms that frictional heat has less of an effect on theoretical plate number with SunBridge C18 1.8 µm. The difference in the effect of frictional heat is presumably due to the internal structure of the hybrid silica. We also confirmed that even when the column length was halved, the theoretical plate number decreased due to the effects of frictional heat at approximately the same column backpressure. The SunBridge C18 1.8 µm column maintains a theoretical plate number of approximately 20,000 up to a flow rate of 0.5 mL/min, even at a column length of 100 mm, enabling high-speed separation at a high theoretical plate number.

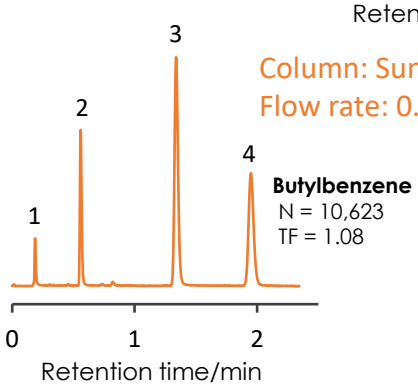
As frictional heat is generated, the temperature inside the column gradually rises toward the OUT side. As a result, a temperature difference occurs between the outside and inside of the column, causing the temperature at the center to rise. The higher the temperature, the lower the viscosity of the mobile phase, causing the mobile phase in the center to flow faster, resulting in broader peaks.
When a 150 mm long column was run at 70 MPa, the temperature of the column surface on the OUT side was 14° C higher than on the IN side.

【Chromatograms】

Column: SunBridge C 18 1.8 µm, 100 x 2.1 mm
Flow rate: 0.4 mL/min



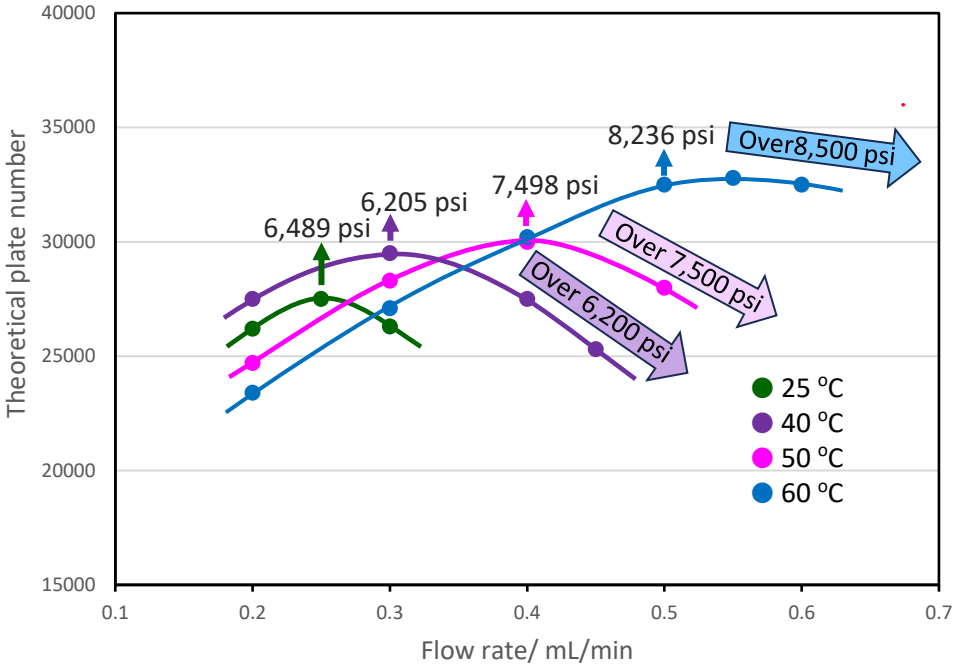
Column: SunBridge C18 1.8 µm, 50 x 2.1 mm
Flow rate: 0.6 mL/min



Column: SunBridge C18 1.8 µm
Column dimension: 100 x 2.1 mm and 50 x 2.1 mm
Mobile phase: CH_3CN/H_2O=60/40
Flow rate: 0.4 mL/min for 100 x 2.1mm
0.6 mL/min for 50 x 2.1 mm
Temperature: 40 °C
Sample: 1 = Uracil, 2 = Ethyl benzoate, 3 = Acenaphthene, 4 = Butylbenzene

■Relationship between flow rate and theoretical plate number

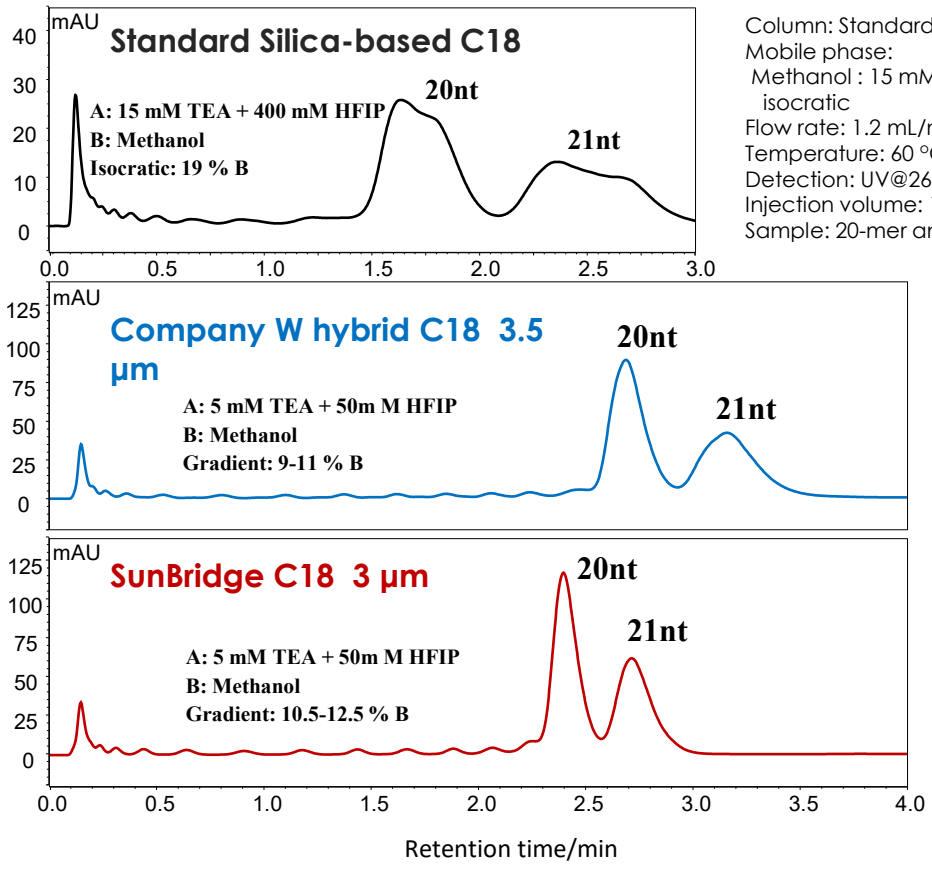
Frictional heat due to column temperature difference



Column: SunBridge C18 1.8 µm
Column dimension: 150 x 2.1 mm
Mobile phase: CH_3CN/H_2O=60/40
Temperature: Room temp. (25 °C、 no oven)
40 °C, 50 °C, 60 °C
Sample: Acenaphthene
Pre-heat system between Injector and column: No

Increasing the column temperature reduces the viscosity of the mobile phase, which in turn reduces the column back pressure. In other words, the higher the column temperature, the greater the theoretical plate number can be achieved at high flow rates. This is particularly noticeable when the column is long.

■ Rapid separation of oligonucleotides



Column: Standard C18, 3 µm, 30 x 2.1 mm i.d.
Mobile phase:
Methanol : 15 mM Triethylamine(TEA)+400 mM HFIP in water (19:81)
isocratic
Flow rate: 1.2 mL/min
Temperature: 60 °C
Detection: UV@260 nm
Injection volume: 1 µL
Sample: 20-mer and 21-mer dT oligonucleotides

Column: Company W hybrid C18, 3.5 µm
SunBridge C18, 3 µm,
30 x 2.1 mm i.d.
Mobile phase:
A) 5 mM Triethylamine(TEA)+50 mM HFIP in water
B) Methanol
Gradient program: shown in left figures (0-4 min)
Flow rate: 1.2 mL/min
Temperature: 60 °C
Detection: UV@260 nm
Injection volume: 1 µL
Sample: 20-mer and 21-mer dT oligonucleotides

When comparing the separation of oligonucleotides using mobile phases for LC/MS, SunBridge C18 showed the sharpest peaks without peak splitting.

SunBridge

- v.s. Partially hybrid C18, Core-Shell C18, other

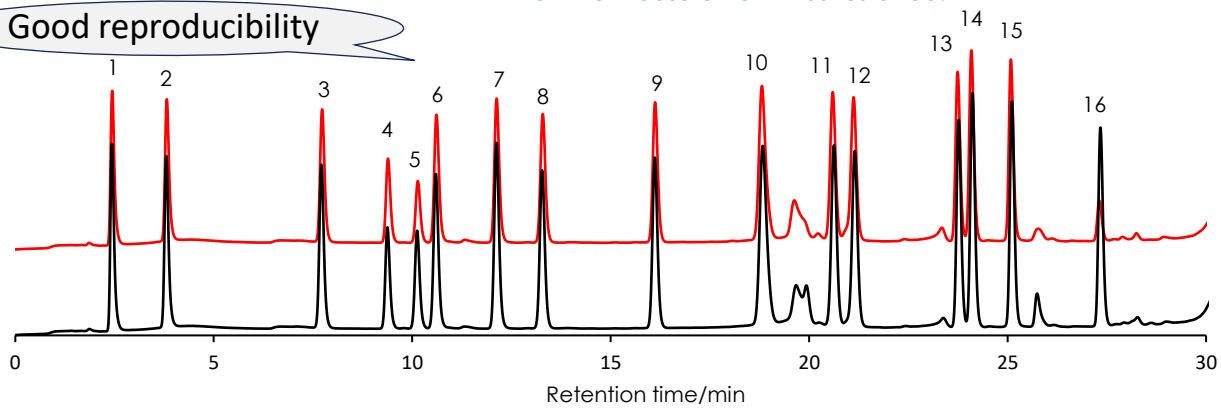
■ Simultaneous separation of OPA-derivatized amino acids

Day 1 ·····→ Day 4

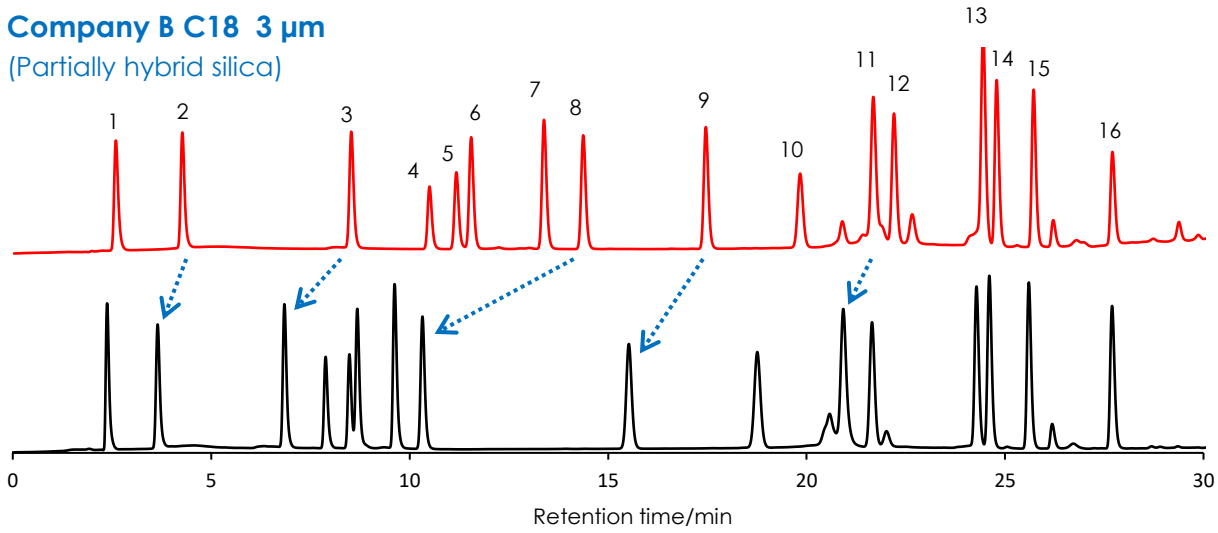
SunBridge C18 5 µm
(Ultra hybrid silica)

After leaving the column in a basic pH mobile phase (pH 8.2) for 3 days, the column was washed with 100% B for about 10 minutes, and then the measurement was restarted.

Good reproducibility



Company B C18 3 µm
(Partially hybrid silica)



HPLC Conditions

Column: SunBridge (Ultra hybrid silica) C18 5 µm, Company B (Partially hybrid silica) C18 3 µm

Column dimension: 150 x 3.0 mm

Mobile phase: A) 10 mM Na_2HPO_4 with 10 mM $Na_2B_4O_7$ pH 8.2
B) Acetonitrile / Methanol / Water = 45 / 45 / 10

Flow rate: 0.55 mL/min, Temperature: 40 °C

Detection (Fluorescent): Ex. at 350 nm, Em. at 450 nm

Labeling method: In autosampler * Instrument: Nexera LC-40 (Shimadzu)

Sample: 1 = Aspartate, 2 = Glutamate, 3 = Serine, 4 = Histidine, 5 = Glycine, 6 = Threonine, 7 = Arginine, 8 = Alanine, 9 = Thyrosine, 10 = Cystine, 11 = Valine, 12 = Methionine, 13 = Phenylalanine, 14 = Isoleucine, 15 = Leucine, 16 = Lysine
(Wako Amino Acids Mixture Standard Solution, Type H, 50 µM/sample)

Gradient program:

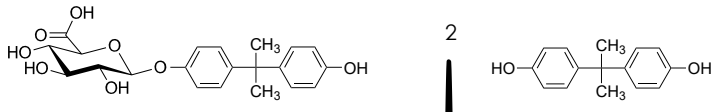
Time (min)	A(%)	B(%)
0	98	2
20	70	30
28.5	45	55
29.5	0	100
38	0	100
39	98	2

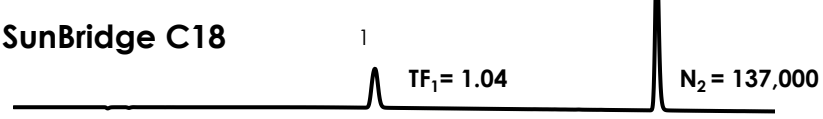
Courtesy by Osaka Research Institute of Industrial Science and Technology

Company B C18 (partial hybrid) showed retention fluctuations when restarted after being left stationary for three days in a weakly basic mobile phase.
When SunBridge C18 was left stationary under the exact same conditions and then restarted, good retention reproducibility was obtained.

■ Separation of bisphenol A and its glucuronide conjugates

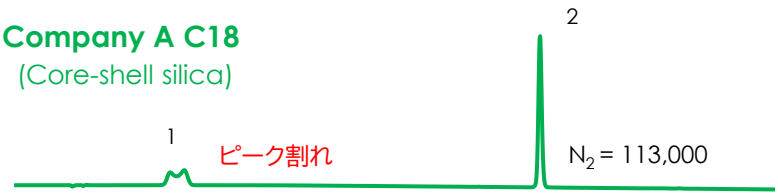
(N: Theoretical plate, TF: Tailing factor)

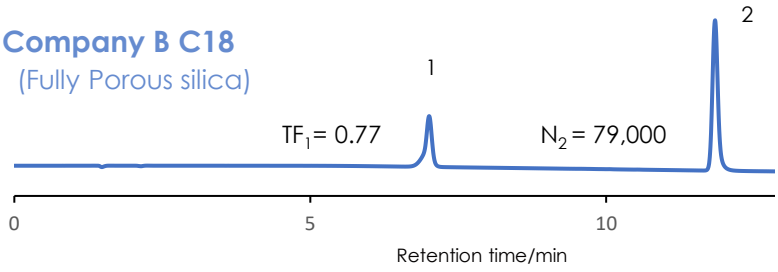




Gradient program:

Time (min)	A(%)	B(%)
0	80	20
15	5	95
18	5	95
19	80	20
30	80	20





Column: SunBridge C18 5 µm, 150 x 4.6 mm
Company A(Core-shell silica) 5 µm, 100 x 4.6 mm
Company B (Fully porous silica) 5 µm, 150 x 4.6 mm
Mobile phase:
A) 10 mM Ammonium acetate aq. B) Acetonitrile
Gradient program: shown above
Flow rate: 1.0 mL/min, Temperature: 40 °C,
Detection: UV@230 nm (PDA)
Sample: 1 = Bisphenol A Glucuronide (BPA-Glc),
2 = Bisphenol A (BPA)
(each 50 µM dissolved in 50% Acetonitrile)
Instrument: Shimadzu Prominence system

C18 columns from Company A and Company B showed poor peak shape for BPA-GLC (#1).
SunBridge C18 showed a good peak shape for peak #1 and a high theoretical plate number for peak #2.

■ Analysis of crude drugs using SunBridge C18: Japanese Pharmacopoeia - Pueraria root

○ Standard solution: Puerarin 0.1 mg/mL (50% MeOH)

(N: Theoretical plate, TF: Tailing factor)

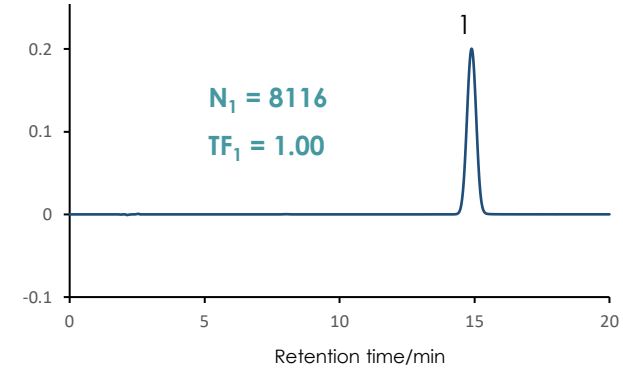
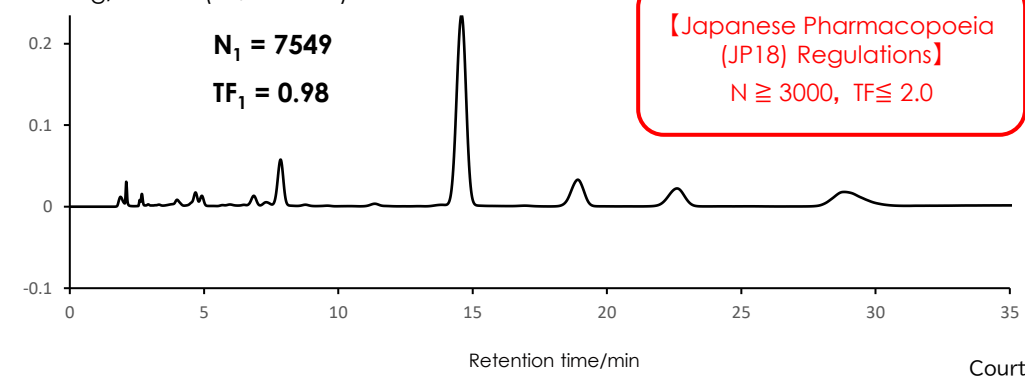


Photo by PhotoAC

Test conditions based on the 18th revised Japanese Pharmacopoeia

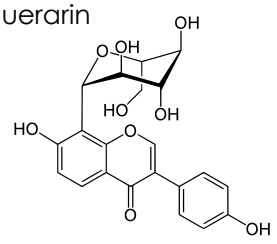
Column: SunBridge C18 5 µm , 150 x 4.6 mm
Mobile phase:
50 mM Sodium Dihydrogen Phosphate aq. / Acetonitrile = 9 / 1
Flow rate: 0.885 mL/min
Injection volume: 10 µL, Temperature: 40 °C
Detection: UV@250 nm (PDA)
Instrument: Waters Acquity UPLC H-Class
Sample: 1 = Puerarin

● Sample solution: Japanese Pharmacopoeia Kakkon 0.3 g/100 mL (50% MeOH)



【Japanese Pharmacopoeia (JP18) Regulations】
N ≧ 3000, TF≦ 2.0

1. Puerarin



Courtesy by: Iskra Industrial Co., Ltd.

Analysis of the Japanese Pharmacopoeia Puerarin showed that the theoretical plate number and symmetry factor fully met the prescribed values.

SunBridge
Ultra Hybrid Technology

ChromaNik Technologies Inc.

【Characteristics】

(Base material: Created ethylene cross-linked silica gel　End-capping: Tandem TMS end-capping)

Name	Particle size	Pore volume	Specific surface area	Pore diameter	Carbon loading	Available pH range
SunBridge C18	1.8 µm, 3 µm, 5 µm	0.8 mL/g	190 m^2/g	15 nm (150 Å)	16%	1 - 12

Ordering information of SunBridge

Packings	Inner diameter (mm)	2.1	3.0	4.6	10	20	USP category
	Length (mm)	Catalog number	Catalog number	Catalog number	Catalog number	Catalog number	
SunBridge C18, 1.8 µm	30	JBA931	JBA331	------	------	------	L1
	50	JBA941	JBA341	------	------	------	
	75	JBA951	JBA351	------	------	------	
	100	JBA961	JBA361	------	------	------	
	150	JBA971	JBA371				
SunBridge C18, 3 µm	50	JB2941	JB2341	JB2441	------	------	
	100	JB2961	JB2361	JB2461	------	------	
	150	JB2971	JB2371	JB2471	------	------	
	250	JB2981	JB2381	JB2481	------	------	
SunBridge C18, 5 µm	50	JB3941	JB3341	JB3441	------	------	
	100	JB3961	JB3361	JB3461	------	------	
	150	JB3971	JB3371	JB3471	------	JB3871	
	250	JB3981	JB3381	JB3481	JB3781	JB3881	

Ordering information of SunGuard Ultra
SunBridge guard cartridge column for 2.1 mm I.D.

Description	Catalog number
SunBridge Guard Cartridge RP 3x2mm Starter Kit (holder, cartridge, tubing)	JB32CK
SunBridge Guard Cartridge RP 3x2mm for exchange (2 PCS)	JB32CC
Guard Cartridge holder 3 mm x 2 mm ID	HOL2CC

Ordering information of SunGuard
SunBridge guard cartridge column for 4.6 mm I.D.

Description	Catalog number
SunBridge C18 Guard Cartridge column 5 µm 10 mm x 4 mm ID One cartridge, one holder and two plugs	JB3A1H
SunBridge C18 Guard Cartridge 5 µm 10 mm x 4 mm ID for exchange (4 PCS)	JB3A1C
Guard Cartridge holder 10 mm x 4 mm ID	HOLA1C

Cartridge and holder (10x4 mm)

Ordering information of SunGuard Prep
SunBridge guard cartridge column for 10 and20 mm I.D.

Description	Catalog number
SunBridge C18 5 µm Guard Prep Cartridge 10 x 10 mm Starter Kit (holder, cartridge, tubing)	JCB371K1
SunBridge C18 5 µm Guard Prep Cartridge 10 x 10 mm for exchange (2 PCS)	JB371C
Guard Cartridge holder 10 mm x 10 mm ID	HOL71C

Cartridge and holder (10x10 mm)

Manufacturer

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