2. Inner Diameter of Column (scale down and scale up)

Introduction

The figure below shows general parameters for 1.0 mm to 50 mm I.D. COSMOSIL columns : flow rate, equipment, inner diameter of pipe, application, surface ratio (compared with 4.6 mm I.D.) and particle size. It may help to scale up or down from the most commonly used 4.6 mm I.D. column.

Inner Diameter (mm I.D.)	1.0	2.0	3.0	4.6	10	20	28	50
Flow Rate (ml/min)	0.05	0.2	0.4	1.0	5.0	19	37	70
Detector Cell・Injector	for Semi–micro		for Analytical			for Preparative		
Inner Diameter of Pipe (mm)	0.05	0.1	0.2–0.3			1.0		
Application	LC–MS Solvent saving		Solvent saving with standard system	Standard	Preparative (small scale)	Preparative (medium scale)	Preparative (large scale)	Preparative (super large scale)
Surface Ratio with 4.6 mm I.D.	0.05	0.19	0.43	1.00	4.73	18.90	37.05	118.15
Particle Size (μm)	3 or 5				5		15 or more	

Scale Down

When scaling down from the most commonly used analytical column (4.6 mm I.D.) to a semi–micro or 3.0 mm I.D. analytical HPLC column (of the same column length), sample loading dose is proportionate to the cross section of column. The 3.0 mm I.D. columns provide high sensitivity and solvent saving without the need to change the existing equipment settings. Semi–micro columns (2.0 mm I.D. and 1.0 mm I.D.) provide higher sensitivity and enable analysis of minor components, but one needs to change the piping of HPLC equipment, the injector and the detector cell for semimicro columns.

Column Size	4.6 mm I.D. x 150 mm	3.0 mm I.D. x 150 mm	2.0 mm I.D. x 150 mm	1.0 mm I.D. x 150 mm
Chromatogram				
Flow Rate (ml/min)	1.0	0.4	0.2	0.05
Pressure (MPa)	3.4	3.6	3.8	3.6
Injection Volume (μl)	1.0	0.4	0.2	0.05
Detector Cell・Injector	for Analytical		for Semi–micro	
Detector sensitivity (AUFS)	0.08		0.04	
Inner diameter of pipe (mm)	0.25		0.10	0.05
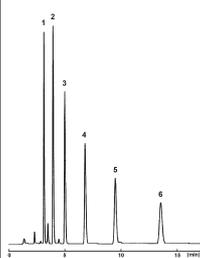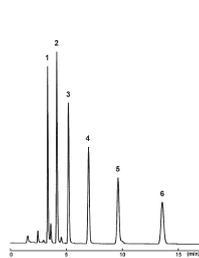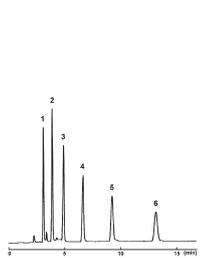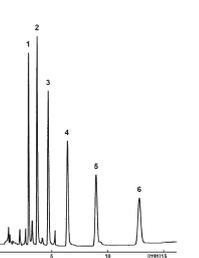
Column	COSMOSIL 5C$_{18}$–MS– II	Sample	
Mobile Phase	Acetonitrile : Water = 70 : 30	1. Benzene	4. Propylbenzene
Flow Rate	1.0 ml/min	2. Toluene	5. Butylbenzene
Temperature	30°C	3. Ethylbenzene	6. Amylbenzene
Detection	UV 254 nm		

I. HPLC Columns

II. UHPLC Columns

III. Preparative Packing Materials

IV. Related Products

V. Applications

VI. Technical Notes

VII. Index

Technical Information

Scale Up

When scaling up from analytical column (4.6 mm I.D.) to preparative column (of the same packing material (particle size) and length), sample loading capacity is proportionate to the cross section of column.

Column Size	4.6 mm I.D. x 250 mm	10 mm I.D. x 250 mm	20 mm I.D. x 250 mm
Chromatogram			
Flow Rate (ml/min)	1.0	5.0	18.9
Pressure (MPa)	5.5	5.9	5.8
Injection Volume (µl)	125	625	2,500
Detector Cell・Injector	for Analytical		Preparative
Inner Diameter of Pipe (mm)	0.25		1.0
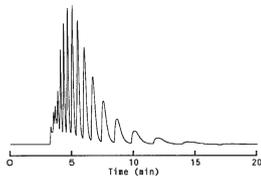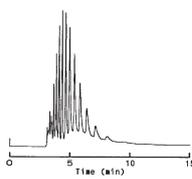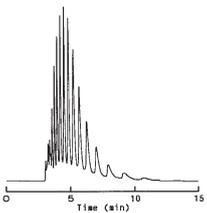
Column COSMOSIL 5SL–II
Mobile Phase Ethyl Acetate : Ethanol = 4 : 1
Temperature 30°C
Detection UV 254 nm
Sample Triton X–100

Comparison of Particle Size

When change particle size of packing material from 5 µm to 15 µm, the number of theoretical plate (N) is reduced by one–third, and the pressure is reduced by one–ninth. As shown in the figure below, when a small amount of sample is injected, there is a big difference in the number of theoretical plates between 5 µm and 15 µm. However, when a large amount of sample is injected, there is not much difference between the two. Therefore, the low pressure packing material (particle size 15 µm) is recommended for preparative column (28 mm I.D. or more).

Comparison of Particle Size

Column:
Column size: 4.6mmI.D.-250mm
Mobile phase: Methanol/ H_2O = 70/30
Flow rate: 1.0 ml/min
Temperature: 30°C
Detection: UV254nm

Sample: 1; Uracil
2; Methyl Benzoate
3; Toluene
4; Naphthalene

Injection Vol. 1 µl
5C$_{18}$-AR-II — N(Peak 4)= 23000, Pressure: 10.9MPa
15C$_{18}$-AR-II — N(Peak 4)= 5500, Pressure: 1.8MPa

Injection Vol. 100 µl
5C$_{18}$-AR-II — N(Peak 4)= 2800
15C$_{18}$-AR-II — N(Peak 4)= 2200

NACALAI TESQUE, INC

I. HPLC Columns

II. UHPLC Columns

III. Preparative Packing Materials

IV. Related Products

V. Applications

VI. Technical Notes

VII. Index