

# 08

## Reversed-Phase Columns

Types and characteristic of reversed-phase columns--	76-77
YMC-Pack <i>Pro</i> C18 -----	78
Hydrosphere C18-----	79
YMC-Pack <i>Pro</i> C18 RS-----	80
YMC-Pack <i>Pro</i> C8, C4 -----	81
YMC-Pack ODS-A -----	82
YMC-Pack ODS-AM -----	82
YMC-Pack ODS-AQ-----	83
YMC-Pack ODS-AL -----	83
YMC-Pack C <sub>8</sub> -----	84
YMC-Pack C <sub>4</sub> -----	84
YMC-Pack TMS-----	85
YMC-Pack Ph -----	85
YMC-Pack CN -----	86
YMC-Pack PROTEIN-RP-----	86
YMCbasic -----	87
YMC Carotenoid -----	87
J'sphere ODS-H80, ODS-M80, ODS-L80 -----	88
YMC-Pack PolymerC18-----	88
Ordering Information-----	89-93

## Types and characteristics of reversed-phase columns

YMC reversed-phase columns enabling column selection from a wide range of products to suit the sample characteristics.

### Elution behavior dependent on alkyl chain length

In reversed-phase chromatography, retention due to hydrophobicity generally depends directly on the carbon number of the stationary phase. The degree of retention due to hydrophobicity of the stationary phase can generally be listed in descending order by column type as ODS>C8>C4>TMS. Stationary phases with low hydrophobicity can be used effectively to reduce analysis time for samples having too strong of a retention on ODS. Stationary phases with low hydrophobicity are also useful for samples that are slightly soluble in organic solvents and need to be analyzed with mobile phase containing a low concentration of organic solvents.


### Elution behavior affected by other factors

Phenyl and CN have available  $\pi$  electrons derived from their bonded phases. Phenyl and CN sometimes show different separation characteristics from stationary phases that are chemically bonded with straight alkyl chains. Since CN has medium-polar bonded phases, it can be used in both normal-phase and reversed-phase separation modes, depending on the mobile phase used.

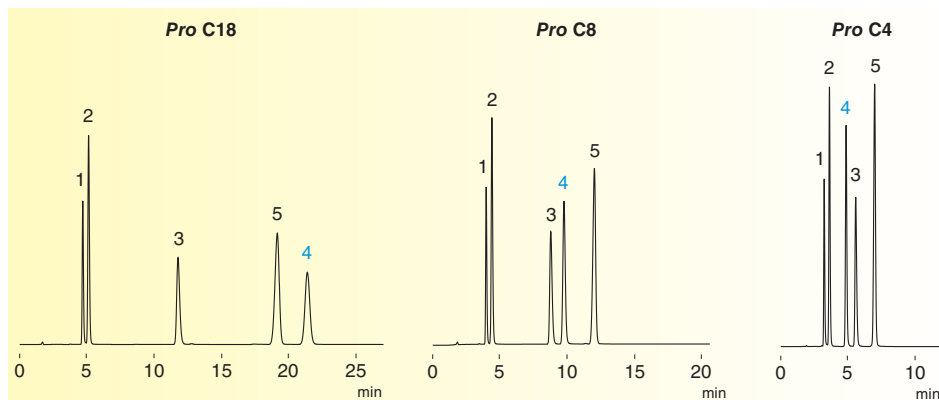
### Types of reversed-phase columns (I)

ODS	$-\text{C}_{18}\text{H}_{37}$	Retention due to hydrophobicity High $\updownarrow$ Low
C8	$-\text{C}_8\text{H}_{17}$	
C4	$-\text{C}_4\text{H}_9$	
TMS	$-\text{CH}_3$	

### Types of reversed-phase columns (II)

Phenyl (Ph)		$\pi$ electrons available
CN	$-(\text{CH}_2)_3\text{-CN}$	$\pi$ electrons available Can be used also in normal-phase

### Elution behavior dependent on alkyl chain length



1. Toluene
2. Deoxycorticosterone acetate
3. Imipramine hydrochloride
4. Triphenylene
5. *n*-Amylbenzene

Column	: 150 X 4.6 mm.I.D.
Eluent	: 20 mM $\text{KH}_2\text{PO}_4\text{-K}_2\text{HPO}_4$ (pH 6.9)/methanol (25/75)
Flow rate	: 1.0 mL/min
Temperature	: 37°C
Detection	: UV at 254 nm

In this example, the retention behavior of a variety of compounds is shown to be dependent on the alkyl chain length of the stationary phase. Shorter alkyl chain lengths like C4 show reduced retention for neutral compounds due to the diminished hydrophobicity of the C4 stationary phase relative to longer alkyl chains phases like C8 and C18. The differences in the selectivity of stationary phases of different alkyl chain length is also illustrated for triphenylene, a planar molecule with restricted rotational movement. Triphenylene shows much shorter retention on C4 relative to C8 and C18 than would be expected on the basis of hydrophobicity of the stationary phase. Note the difference in elution order for triphenylene relative to imipramine and amylbenzene for this mixture on this series of stationary phases.

## Types and characteristics of reversed-phase columns

Product name		Pore size (Å)	Particle size (µm)	C%	Endcapping	Usable pH range	Characteristics	Page
Pro series	YMC-UltraHT Pro C18	120	2	16	Yes	2-8	<ul style="list-style-type: none"> <li>● Processed with YMC CO., LTD.'s advanced endcapping technology</li> <li>● Superior separation of basic compounds</li> </ul>	78
	Pro C18		3, 5, 10					
	YMC-UltraHT Hydrosphere C18	120	2	12		2-8	<ul style="list-style-type: none"> <li>● Superior separation of hydrophilic compounds</li> <li>● Can be used with 100% aqueous mobile phase</li> </ul>	79
	Hydrosphere C18		3, 5					
	Pro C18 RS	80	3, 5	22		1-10	<ul style="list-style-type: none"> <li>● Highly durable ODS</li> <li>● Superior separation of basic compounds and hydrophobic compounds</li> </ul>	80
	Pro C8	120	3, 5	10		2-7.5	<ul style="list-style-type: none"> <li>● Processed with advanced endcapping technology</li> <li>● Superior separation of basic compounds</li> </ul>	81
	Pro C4	120	3, 5	7		2-7.5	<ul style="list-style-type: none"> <li>● Processed with advanced endcapping technology</li> <li>● Different selectivity from ODS</li> </ul>	81
YMC-Pack	ODS-A	120	3, 5, 10	17	Yes	2-7.5	<ul style="list-style-type: none"> <li>● Currently in use worldwide</li> <li>● ODS with wide pore size</li> <li>● For separation of peptides and proteins</li> </ul>	82
		200	5, 10	12				
		300	3, 5, 10	7				
	ODS-AM	120	3, 5	17			<ul style="list-style-type: none"> <li>● Outstanding batch-to-batch reproducibility</li> </ul>	82
	ODS-AQ	120	3, 5, 10	14			<ul style="list-style-type: none"> <li>● Superior separation of hydrophilic compounds</li> </ul>	83
		200	5, 10	10				
	ODS-AL	120	5	17	No	<ul style="list-style-type: none"> <li>● For separation utilizing residual silanol</li> </ul>	83	
	C <sub>8</sub>	120	3, 5, 10	10	Yes	2-7.5	<ul style="list-style-type: none"> <li>● Moderate hydrophobicity</li> <li>● Useful for separation of proteins and peptides</li> </ul>	84
		200	5, 10	7				
		300	5, 10	4				
	C <sub>4</sub>	120	3, 5, 10	7			<ul style="list-style-type: none"> <li>● Lower hydrophobicity than ODS and C<sub>8</sub></li> <li>● Useful for separation of proteins and peptides</li> </ul>	84
		200	5, 10	5				
		300	5, 10	3				
	TMS	120	3, 5, 10	4			<ul style="list-style-type: none"> <li>● Reversed-phase packing material with the lowest hydrophobicity</li> </ul>	85
	Ph	120	3, 5, 10	9			<ul style="list-style-type: none"> <li>● Reversed-phase packing material with π electrons</li> </ul>	85
CN	120	3, 5, 10	7	<ul style="list-style-type: none"> <li>● Can be used in both normal-phase and reversed-phase modes</li> </ul>			86	
	300	5	3					
PROTEIN-RP	200	5	4	—	1.5-7.5	<ul style="list-style-type: none"> <li>● Useful for separation of proteins and peptides</li> </ul>	86	
YMCbasic	200	3, 5	7	Yes	2-7.5	<ul style="list-style-type: none"> <li>● Superior separation of basic compounds</li> <li>● Useful for separation of proteins and peptides</li> </ul>	87	
YMC Carotenoid	—	3, 5	—	—	2-7.5	<ul style="list-style-type: none"> <li>● C30 bonded column</li> <li>● Useful for carotenoids separation</li> </ul>	87	
J'sphere	ODS-H80	80	4	22	Yes	1-9	<ul style="list-style-type: none"> <li>● High carbon ODS</li> </ul>	88
	ODS-M80	80	4	14		2-7.5	<ul style="list-style-type: none"> <li>● Medium carbon ODS</li> </ul>	
	ODS-L80	80	4	9			<ul style="list-style-type: none"> <li>● Low carbon ODS</li> </ul>	
YMC-Pack PolymerC18	—	6, 10	—	—	2-13	<ul style="list-style-type: none"> <li>● Polymer-based ODS</li> </ul>	88	

## Analytical columns

## YMC-UltraHT Pro C18 / YMC-Pack Pro C18

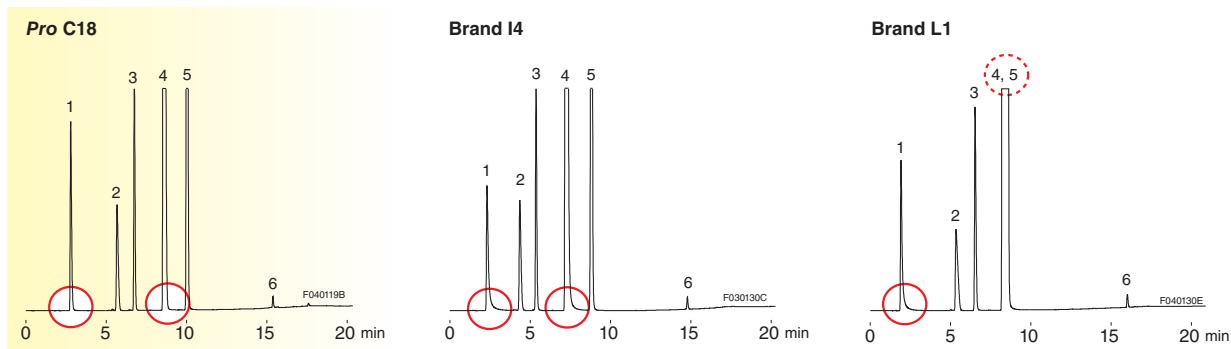
- Superior separation of basic compounds
- Processed with advanced endcapping technology
- Excellent reproducibility
- Utilizes highly pure silica gel base

- Pore size : 120 Å
- Carbon content : 16%
- Usable pH range : 2-8
- USP L1

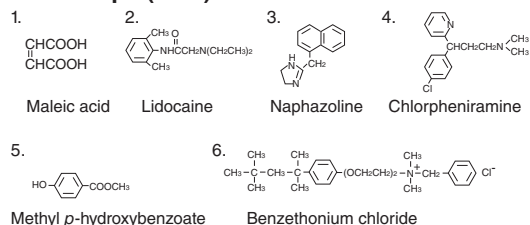
## Perfectly endcapped ODS

YMC-UltraHT Pro C18/YMC-Pack Pro C18 include more advanced endcapping technology for strictly controlled processing of residual silanol groups that are likely to affect quality. Pro C18 is highly appropriate for basic compounds, including pharmaceutical products and agricultural chemicals.

## Versatility ODS column in almost all fields



## Nose drops (OTC)

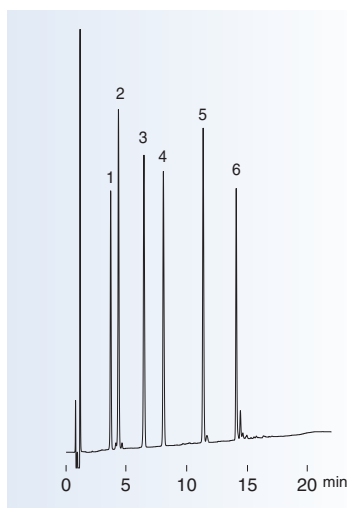


Column : 5  $\mu$ m, 150 X 4.6 mm I.D.  
 Eluent : A) 20 mM  $\text{KH}_2\text{PO}_4$ - $\text{H}_3\text{PO}_4$  (pH 2.5)  
 B) methanol  
 20-90%B (0-15 min), 90%B (15-20 min)  
 Flow rate : 1.0 mL/min  
 Temperature : 37°C  
 Detection : UV at 260 nm

YMC-Pack Pro C18 is a high performance ODS column providing standard hydrophobicity, high resolution, high durability and excellent reproducibility. This column is highly appropriate for basic compounds that often elute with poor peak shapes on competitive columns.

## Application

(A990121B)



## Peptides

1. Oxytocin
2. Met-Enkephalin
3. Leu-Enkephalin
4. Angiotensin I
5.  $\alpha$ -Mating factor
6. Insulin

Column : YMC-Pack Pro C18 (3  $\mu$ m, 120 Å)  
 75 X 4.6 mm I.D.  
 Eluent : A) water/TFA (100/0.1)  
 B) acetonitrile/TFA (100/0.1)  
 20-40%B (0-20 min)  
 Flow rate : 1.0 mL/min  
 Temperature : 37°C  
 Detection : UV at 220 nm

# YMC-UltraHT Hydrosphere C18 / Hydrosphere C18

- Strong retention of hydrophilic compounds
- Can be used with 100% aqueous mobile phase
- Superior separation of basic compounds
- Excellent reproducibility
- Utilizes highly pure silica gel base
- Pore size : 120 Å
- Carbon content : 12%
- Usable pH range : 2-8
- USP L1

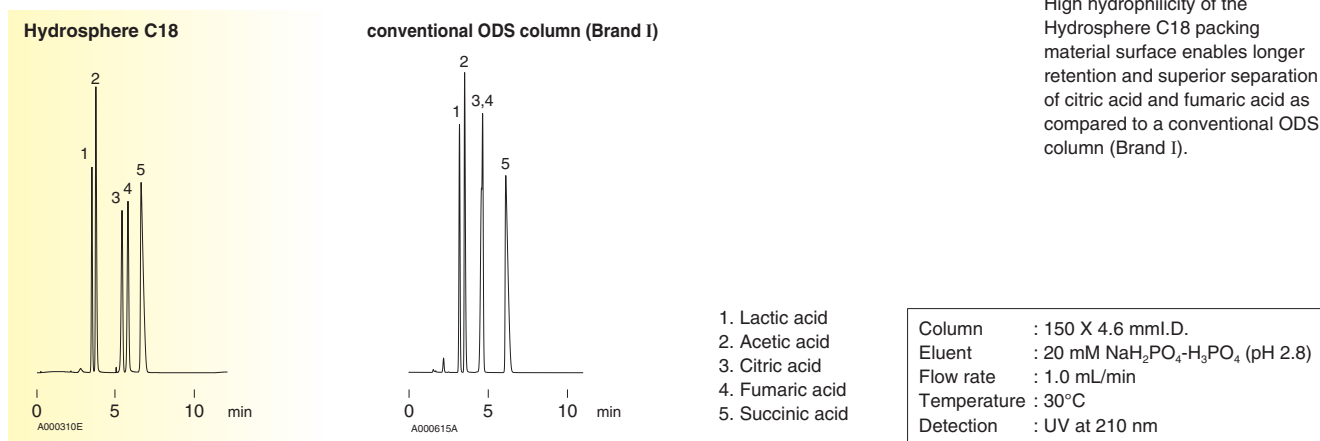
## Hydrophilic ODS

YMC-UltraHT Hydrosphere C18/Hydrosphere C18 are designed to maintain adequate hydrophilicity on the packing surface for superior separation of hydrophilic compounds.

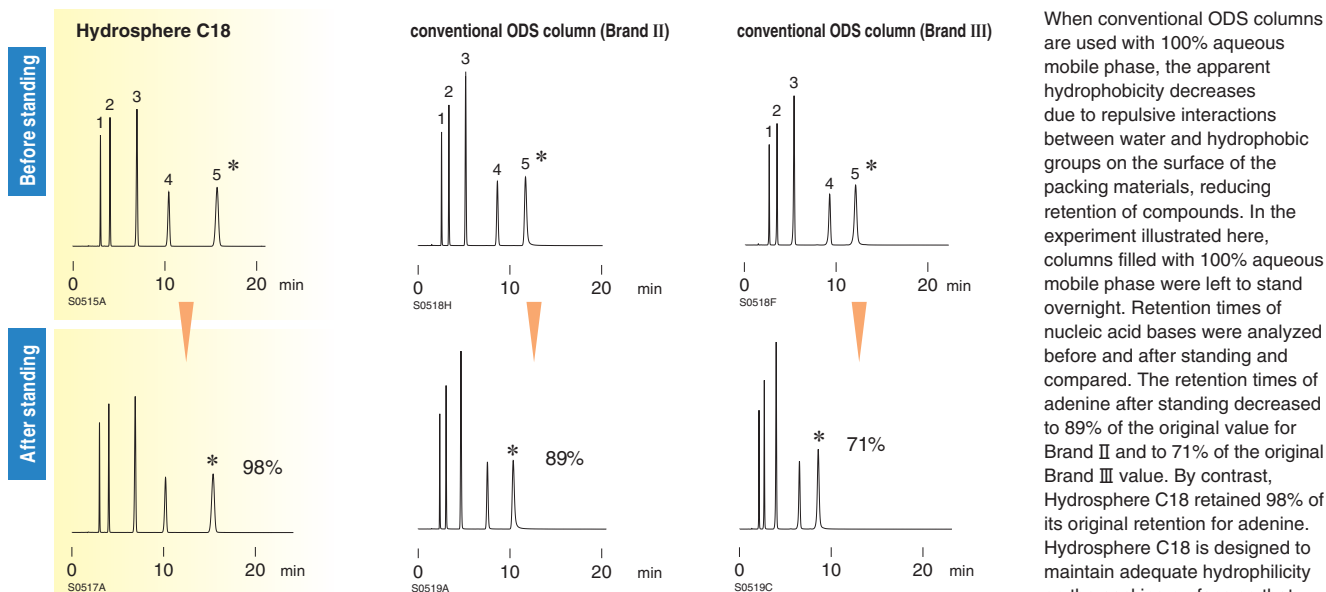
Hydrophilic compounds are retained with much greater affinity than with conventional ODS columns, permitting the product to be used with 100% aqueous mobile phase, a problematic mobile phase for conventional ODS columns. Hydrosphere C18 is useful for separating a wide range of compounds, including nucleic acids and their derivatives, organic acids, saccharides, glycosides and peptides.

## Appropriate for separation of hydrophilic compounds

### Separation of organic acids



## Reproducibility of retention time when used with 100% aqueous mobile phase



## Analytical columns

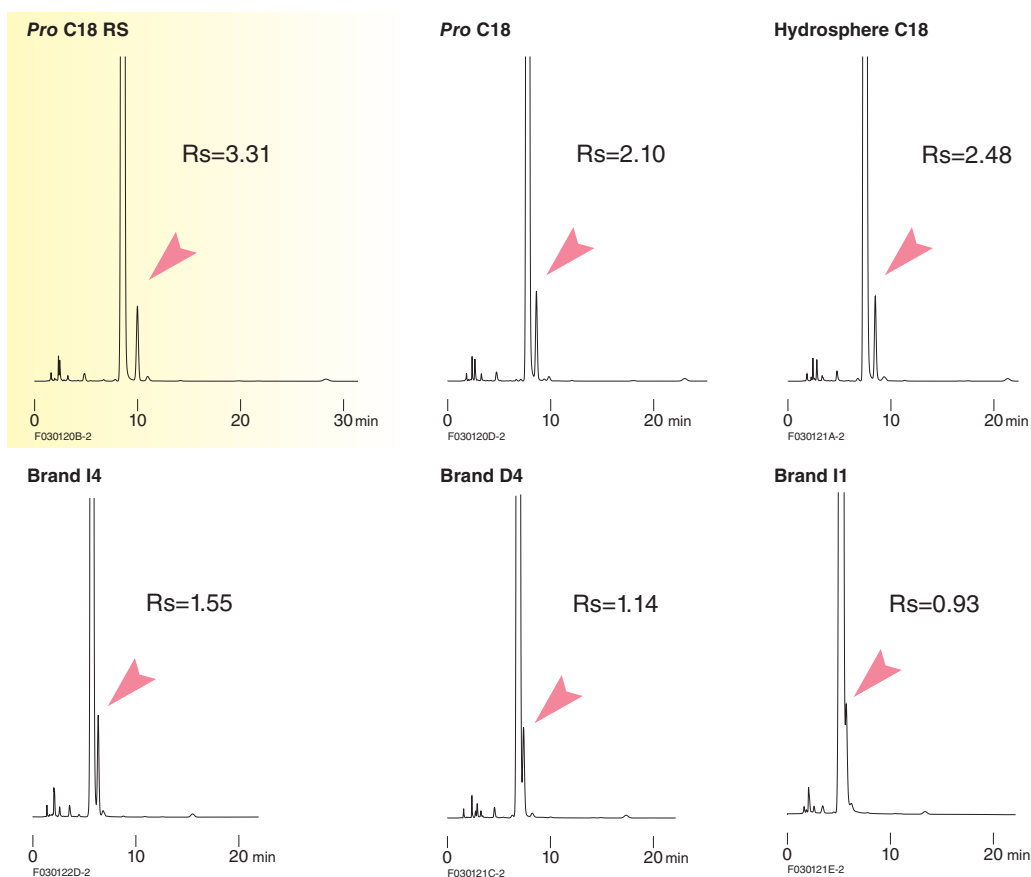
YMC-Pack *Pro* C18 RS

- Excellent acid resistance and alkaline resistance (pH 1 to 10)
- Superior separation of structural isomers and basic compounds
- Excellent reproducibility
- Utilizes highly pure silica gel base
- Pore size : 80 Å
- Carbon content : 22%
- Usable pH range : 1-10
- USP L1

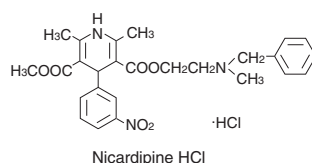
## High carbon ODS

YMC-Pack *Pro* C18 RS is a trifunctional type high carbon ODS column characterized by high resolution and high durability. It is applicable to a wide range of compounds, providing good separation of basic compounds that easily cause tailing peaks. The separation selectivity for compounds that differ only slightly in hydrophobicity is outstanding. It also has excellent resistance to acid and alkali, making it useful under demanding separation conditions.

## Nicardipine hydrochloride



The separation of degradation products of nicardipine hydrochloride, a compound with relatively high hydrophobicity, is shown left. The main peak and the degradation products are separated poorly on competitive columns. Even if *Pro* C18 or Hydrosphere C18 is used, baseline resolution is difficult. On the other hand, *Pro* C18 RS, superior in hydrophobicity and the ability to discern structural differences, can separate the main peak and degradation products completely. As seen here, *Pro* C18 RS shows excellent selectivity when components can elute very close together in the separation of compounds with high hydrophobicity.



Column	: 5 μm, 150 X 4.6 mm I.D.
Eluent	: 20 mM KH <sub>2</sub> PO <sub>4</sub> -K <sub>2</sub> HPO <sub>4</sub> (pH 6.9)/methanol (25/75)
Flow rate	: 1.0 mL/min
Temperature	: 37°C
Detection	: UV at 254 nm

# YMC-Pack Pro C8, C4

- Superior separation of basic compounds
- Excellent reproducibility
- Utilizes highly pure silica gel base

- C8 ■ Pore size : 120 Å  
 ■ Carbon content : 10%  
 ■ Usable pH range : 2-7.5  
 ■ USP L7

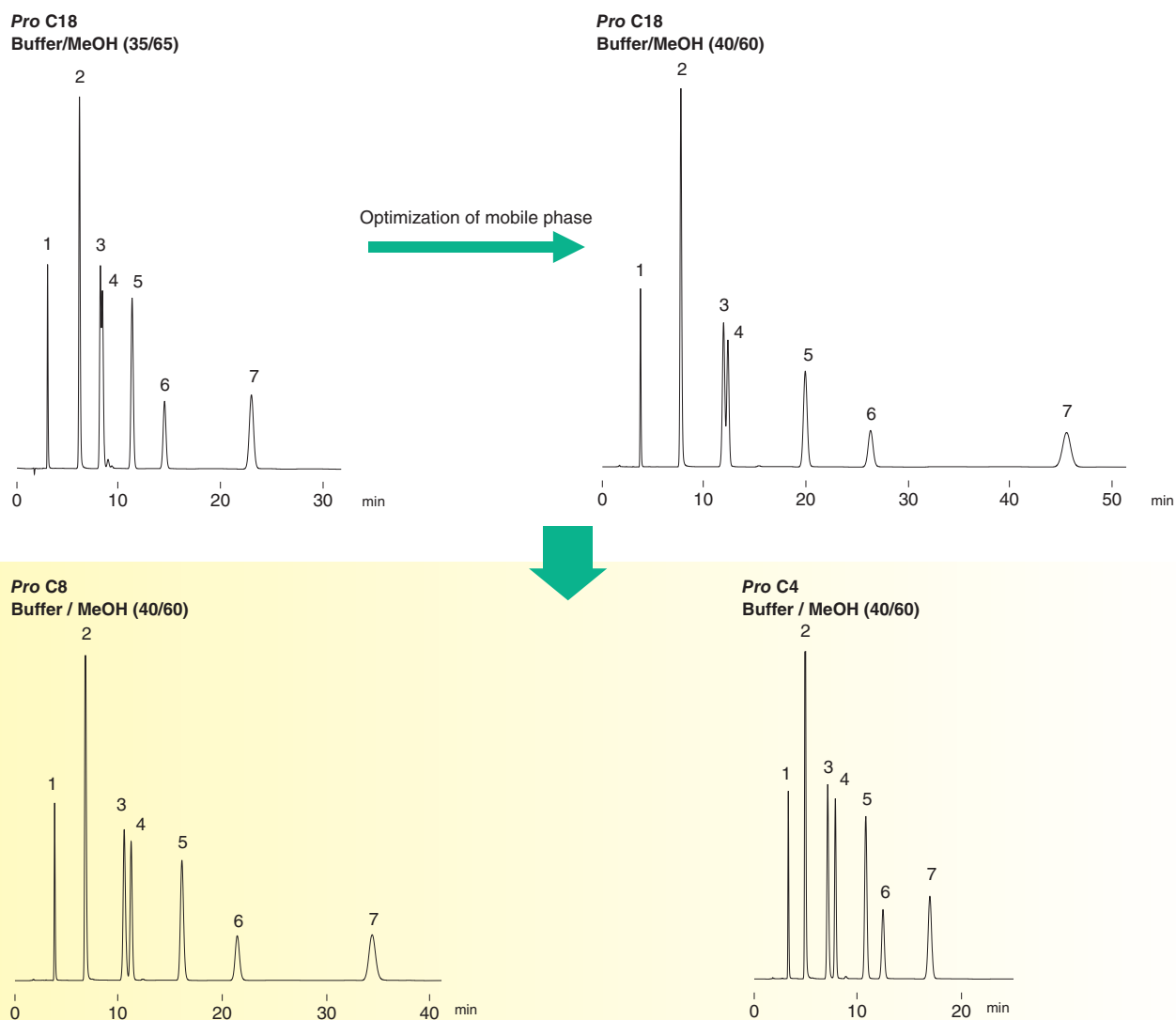
- C4 ■ Pore size : 120 Å  
 ■ Carbon content : 7%  
 ■ Usable pH range : 2-7.5  
 ■ USP L26

## Highly endcapped C8 and C4 reversed-phase columns

YMC-Pack Pro C8 and C4 are highly appropriate for basic compounds since more advanced endcapping technology is used for processing of their residual silanol groups that are likely to affect quality. The YMC-Pack Pro C8 and C4 stationary phase surface hydrophobicity is lower than that of ODS, making YMC-Pack Pro C8 and C4 useful for quick analysis of compounds that differ greatly in hydrophobicity. The separation behavior of hydrophilic compounds or planar compounds on YMC-Pack Pro C8 and C4 also differs from that on ODS, making YMC-Pack Pro C8 and C4 useful for separating compounds in cases where separation optimization is difficult to achieve using ODS.

## Optimization of separation using Pro C8 and Pro C4

### Separation of antiarrhythmics



1. Phenytoin
2. Propranolol HCl
3. Quinidine
4. Lidocaine
5. Diltiazem HCl
6. Verapamil HCl
7. Nicardipine HCl

Column	: 150 X 4.6 mm I.D.
Eluent	: 20 mM KH <sub>2</sub> PO <sub>4</sub> -K <sub>2</sub> HPO <sub>4</sub> (pH 6.9)/methanol
Flow rate	: 1.0 mL/min
Temperature	: 37°C
Detection	: UV at 220 nm

Retention times of analytes on Pro C8 and Pro C4 tend to be shorter than those on C18. When alkyl chain lengths of packing material bonded phases are shorter, hydrogen-bonding capacities tend to be greater; therefore, not only retention time, but also separation selectivity of Pro C8 and Pro C4 may differ from those of C18. Separation optimization is difficult to achieve for antiarrhythmics using Pro C18, even if the mobile phase is changed. In contrast, C8 and C4 can completely separate antiarrhythmics in a short time. As shown above, C8 and C4 may be useful in cases where separation optimization is difficult to achieve using C18.

## Analytical columns

## YMC-Pack ODS-A

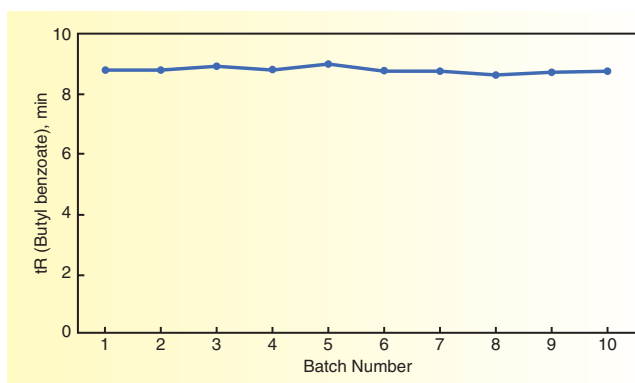
- Conventional ODS column
- Currently in use worldwide

- Pore size : 120, 200, 300 Å
- Carbon content : 17%, 12%, 7%
- Usable pH range : 2-7.5
- USP L1

## Standard ODS

YMC-Pack ODS-A has a highly endcapped surface structure and appropriate hydrophobicity for separation of a wide range of compounds. It is produced under strict quality control with respect to 50 or more parameters in order to ensure stable quality. This product is highly regarded as the standard YMC-Pack packing material in various countries around the world.

## Quality control system for excellent performance



The graph indicates batch-to-batch reproducibility with respect to hydrophobic interaction for 10 batches, an essential column performance characteristic. Extremely stable batch-to-batch reproducibility of the hydrophobic surface is achieved by strict control of variables.

In addition to measurement of the physical properties, a wide range of compounds including hydrophobic, acidic, basic and coordination compounds are analyzed under optimal conditions to evaluate column performance.

## Analytical columns

## YMC-Pack ODS-AM

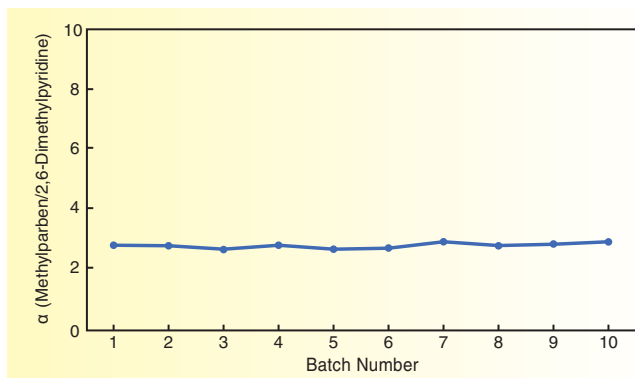
- Similar to ODS-A in selectivity
- Excellent reproducibility
- Useful for quality control purposes

- Pore size : 120 Å
- Carbon content : 17%
- Usable pH range : 2-7.5
- USP L1

## ODS with outstanding batch-to-batch reproducibility

YMC-Pack ODS-AM is a product which especially emphasizes batch-to-batch reproducibility of the packing material. Strict control is performed on all aspects of quality, including physical properties of silica gel base and surface modifying processes, in order to ensure stable quality.

## Special attention is given to batch-to-batch reproducibility



The separation factor ( $\alpha$ ) of methylparaben/2,6-dimethylpyridine for 10 batches of ODS-AM packing material is plotted on the left graph. Excellent batch-to-batch reproducibility is achieved even in separation of basic compounds.



## Analytical columns

## YMC-Pack ODS-AQ

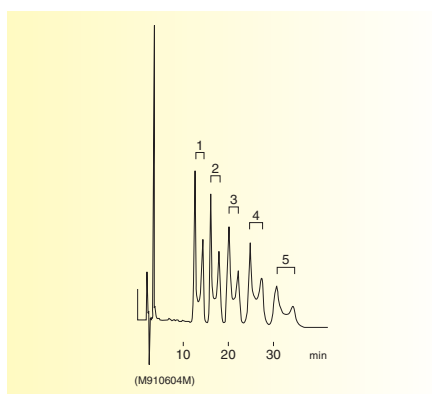
- Useful for separation of hydrophilic compounds
- Can be used with 100% aqueous mobile phase
- Different selectivity from conventional ODS

- Pore size : 120, 200 Å
- Carbon content : 14%, 10%
- Usable pH range : 2-7.5
- USP L1

## Hydrophilic ODS

YMC-Pack ODS-AQ has moderate hydrophobicity and hydrogen-bonding capacity. It shows different retention behavior from that of YMC-Pack ODS-A, for samples with relatively high hydrophilicity. It is useful in fields including carbohydrate chemistry for oligosaccharides and glycosides, pharmacognosy and natural product chemistry.

## Useful for separation of sugars



This product is useful for separations using mobile phases in which water content is relatively high, such as separation of sugars and glycosides.

1. Maltoundecaose (G<sub>11</sub>)
2. Maltododecaose (G<sub>12</sub>)
3. Maltotridecaose (G<sub>13</sub>)
4. Maltotetraose (G<sub>14</sub>)
5. Maltopentaose (G<sub>15</sub>)

Column	: YMC-Pack ODS-AQ (5 μm, 120 Å)
	150 X 4.6 mm I.D.
Eluent	: methanol/water (5/995)
Flow rate	: 1.0 mL/min
Temperature	: 37°C
Detection	: RI, 8×10 <sup>-6</sup> RIU/FS

## Analytical columns

## YMC-Pack ODS-AL

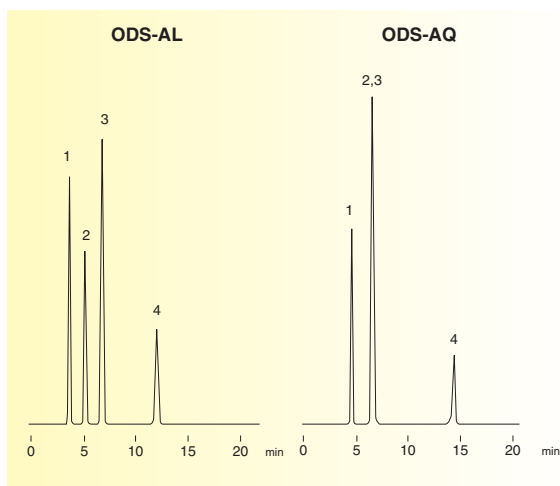
- ODS with residual silanol groups
- Utilizes secondary interaction caused by silanol groups

- Pore size : 120 Å
- Carbon content : 17%
- Usable pH range : 2-7.5
- USP L1

## Non-encapped ODS

YMC-Pack ODS-AL uses not only hydrophobic interaction but also secondary interaction caused by silanol groups that affect separation. This results in a different selectivity from conventional ODS columns. When ionic interaction is utilized, it is preferable to use a buffer in the mobile phase to achieve reproducibility of chromatograms.

## Utilizes residual silanol groups for separation



## Disinfectants

1. O=C(O)c1ccccc1  
Benzoic acid
2. O=C(O)c1ccc(O)cc1  
Salicylic acid
3. CN1C=NC2=C1C(=O)N(C)C2=O  
Theophylline (I.S.)
4. Oc1ccccc1  
Phenol

The figure shows separation of disinfectants under the conditions described in the Japanese Pharmacopoeia. The object is to select the column permitting the elution of benzoic acid, salicylic acid and theophylline, in this order, insuring complete separation of these peaks. With ODS-AQ, separation of salicylic acid and theophylline is incomplete. By contrast, ODS-AL provides excellent separation. Thus, ODS-AL may provide excellent separation when the separation conditions cannot be optimized on other ODS columns.

Column	: YMC-Pack ODS-AL and ODS-AQ (5 μm, 120 Å)
	150 X 4.6 mm I.D.
Eluent	: 100 mM KH <sub>2</sub> PO <sub>4</sub> -Na <sub>2</sub> HPO <sub>4</sub> (pH 7.0)/methanol (75/25)
Flow rate	: 0.8 mL/min
Temperature	: 30°C
Detection	: UV at 270 nm
(Conditions described in Japanese Pharmacopoeia 16th ed.)	

## Analytical columns

YMC-Pack C<sub>8</sub>

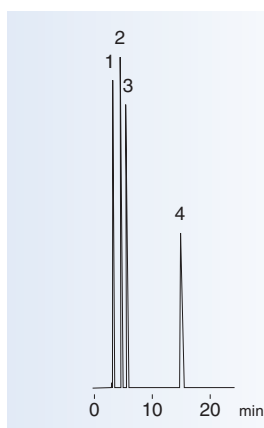
- Stationary phase with lower hydrophobicity than ODS
  - Useful for separating samples with relatively high hydrophobicity
  - Useful for separation of proteins and peptides
- Pore size : 120, 200, 300 Å
  - Carbon content : 10%, 7%, 4%
  - Usable pH range : 2-7.5
  - USP L7

## Reversed-phase column with moderate hydrophobicity

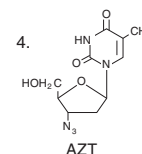
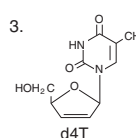
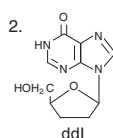
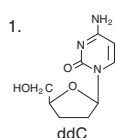
The hydrophobicity of YMC-Pack C<sub>8</sub> is moderate for a reversed-phase packing material. Retention times of samples on YMC-Pack C<sub>8</sub> tend to be shorter than those on ODS stationary phase. The moderate hydrophobicity of YMC-Pack C<sub>8</sub> makes it useful for separating samples with relatively high hydrophobicity.

## Application

(K930311A)



## Anti-HIV nucleoside derivatives



Column	: YMC-Pack C <sub>8</sub> (5 μm, 120 Å)
	150 X 4.6 mm I.D.
Eluent	: methanol/10 mM KH <sub>2</sub> PO <sub>4</sub> (10/60)
Flow rate	: 1.0 mL/min
Temperature	: 37°C
Detection	: UV at 254 nm

## Analytical columns

YMC-Pack C<sub>4</sub>

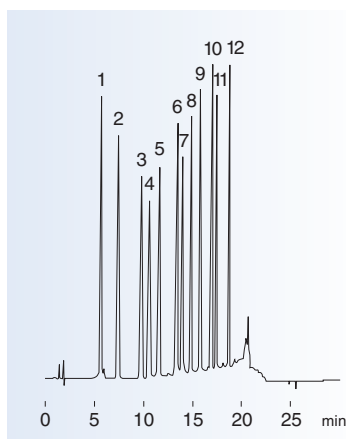
- Stationary phase with low hydrophobicity
  - Different separation characteristics from ODS
  - Useful for separation of proteins and peptides
- Pore size : 120, 200, 300 Å
  - Carbon content : 7%, 5%, 3%
  - Usable pH range : 2-7.5
  - USP L26

## Reversed-phase column with shorter alkyl chain

The YMC-Pack C<sub>4</sub> stationary phase surface hydrophobicity is lower than that of both ODS and C<sub>8</sub>. Retention times of samples on YMC-Pack C<sub>4</sub> therefore tend to be shorter than those on ODS or C<sub>8</sub>. Separation characteristics of YMC-Pack C<sub>4</sub> also differ from those of ODS. YMC-Pack C<sub>4</sub> achieves better separation than ODS for some types of samples.

## Application

(T920302A)



## 2,4-DNPH derivatives of aldehydes and ketones

1. Formaldehyde 2,4-DNPH
2. Acetaldehyde 2,4-DNPH
3. Acetone 2,4-DNPH
4. Acrolein 2,4-DNPH
5. Propionaldehyde 2,4-DNPH
6. Crotonaldehyde 2,4-DNPH
7. Methyl ethyl ketone 2,4-DNPH
8. Isobutyraldehyde 2,4-DNPH
9. Benzaldehyde 2,4-DNPH
10. *n*-Valeraldehyde 2,4-DNPH
11. *p*-Tolualdehyde 2,4-DNPH
12. Capronaldehyde 2,4-DNPH

Column	: YMC-Pack C <sub>4</sub> (5 μm, 120 Å)
	150 X 4.6 mm I.D.
Eluent	: A) tetrahydrofuran/water (10/90)
	B) acetonitrile
	35%B (0-7 min), 35-65%B (7-18 min),
	100%B (18-19 min), 35%B (19-35 min)
Flow rate	: 1.5 mL/min
Temperature	: 30°C
Detection	: UV at 360 nm

## Analytical columns

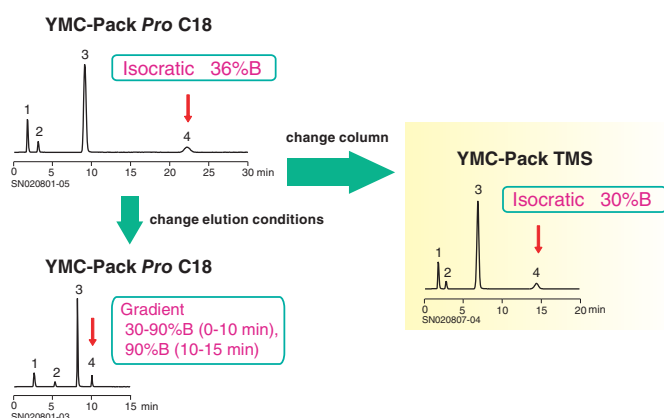
## YMC-Pack TMS

- Stationary phase with the lowest hydrophobicity among reversed-phase packing materials
- Different separation characteristics from ODS
- Pore size : 120 Å
- Carbon content : 4%
- Usable pH range : 2-7.5
- USP L13

## Reversed-phase column with the lowest hydrophobicity

YMC-Pack TMS shows lower retention due to hydrophobic interaction than other packing materials, and it is useful for eluting highly hydrophobic compounds in a short time. In addition, it can sometimes achieve greater retention and better separation of hydrophilic compounds than other reversed-phase columns.

## Shorten analysis time using TMS



## Soy isoflavones

1. Daidzin
2. Genistin
3. Daidzein
4. Genistein

Column	: 50 X 2.0 mm I.D.
Eluent	A) water/formic acid (100/0.05) B) acetonitrile/water/formic acid (50/50/0.05)
Flow rate	: 0.2 mL/min
Temperature	: 37°C
Detection	: ESI positive mode

TMS enables analysis time of highly hydrophobic compounds to shorten.

## Analytical columns

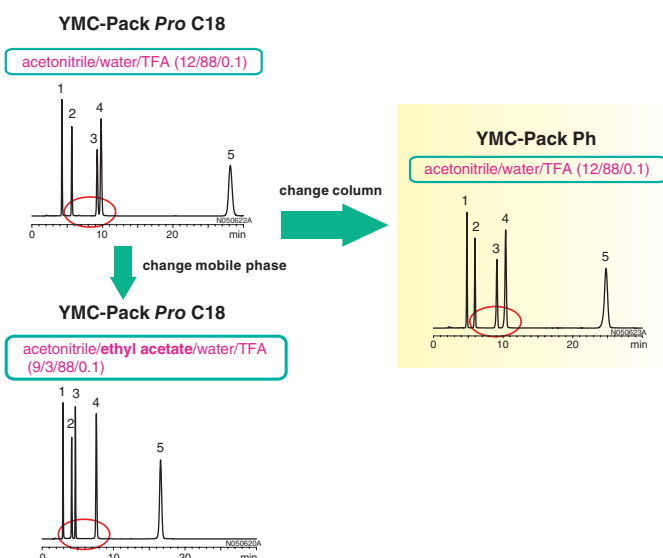
## YMC-Pack Ph

- Reversed-phase column with  $\pi$  electrons
- Unique selectivity due to  $\pi$ - $\pi$  interaction
- Useful in cases where separation optimization is difficult to achieve using ODS
- Pore size : 120 Å
- Carbon content : 9%
- Usable pH range : 2-7.5
- USP L11

## Different selectivity from ODS

YMC-Pack Ph has  $\pi$  electrons of phenyl group. YMC-Pack Ph shows different separation characteristics from alkyl-silica stationary phases including ODS for separation of solutes such as aromatic compounds, since  $\pi$ - $\pi$  interaction between the stationary phase and solutes, as well as hydrophobic interaction, contribute to the separation.

## Establishment of simple conditions using Ph



## Catechins

1. (-)-Epigallocatechin
2. (+)-Catechin
3. (-)-Epicatechin
4. (-)-Epigallocatechin gallate
5. (-)-Epicatechin gallate

Column	: 150 X 4.6 mm I.D.
Flow rate	: 1.0 mL/min
Temperature	: 37°C
Detection	: UV at 280 nm

Ph is suitable for separating catechins with simple mobile phase, whereas if using ODS and optimizing analysis conditions, the mobile phase, addition with ethyl acetate, is complicated.

## Analytical columns

## YMC-Pack CN

- Normal-phase and reversed-phase modes are selectable according to the purpose of analysis
- Low hydrophobicity
- Unique selectivity due to cyano group

- Pore size : 120, 300 Å
- Carbon content : 7%, 3%
- Usable pH range : 2-7.5
- USP L10

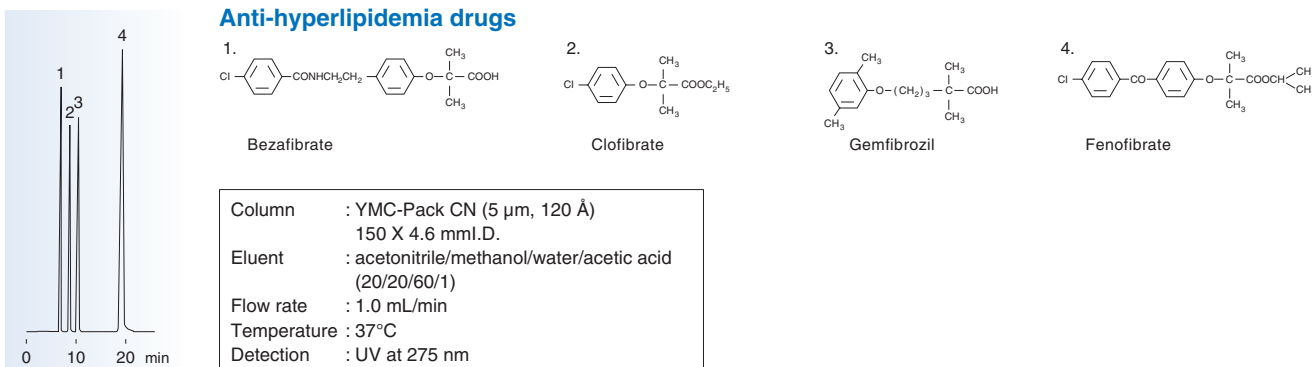
## Column can be used in both normal-phase and reversed-phase modes

YMC-Pack CN can be used in both normal-phase and reversed-phase modes, since it has cyanopropyl group of medium polarity chemically bonded to the stationary phase. It can be used in normal-phase mode with low-polarity mobile phase such as hexane. It can also be used in reversed-phase mode with highly-polar mobile phase such as methanol and water. The hydrophobicity of YMC-Pack CN is relatively low for a reversed-phase packing material, and it shows different selectivity from ODS due to  $\pi$  electrons of the cyano groups. YMC-Pack CN is useful for shortening analysis time when retention time is too long with ODS and useful in cases where separation optimization is difficult to achieve using ODS.

## Application

(S931025E)

## Anti-hyperlipidemia drugs



## Analytical columns

## YMC-Pack PROTEIN-RP

- Improved recovery of proteins or peptides
- Improved durability when used with TFA solution
- Enables elution of high molecular weight proteins

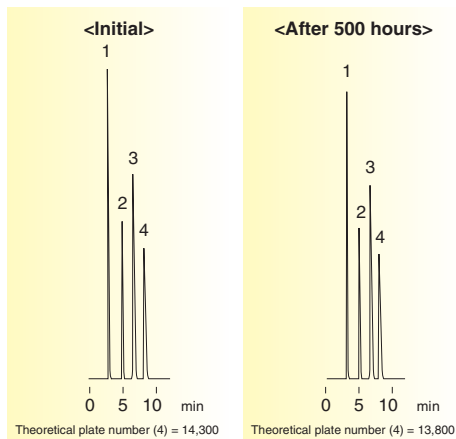
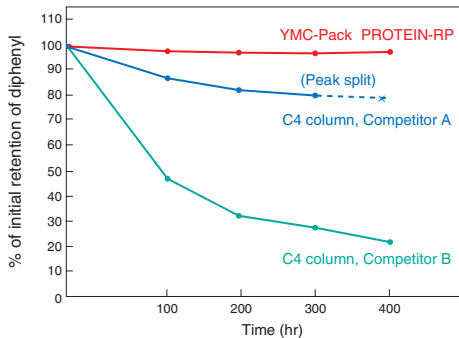
- Pore size : 200 Å
- Carbon content : 4%
- Usable pH range : 1.5-7.5
- USP L26

## Reversed-phase column for separation of proteins or peptides

YMC-Pack PROTEIN-RP is a reversed-phase column utilizing a silica gel base. It contains a stationary phase, specifically designed for separation of proteins or peptides. Problems that are associated with conventional reversed-phase columns with short alkyl chain lengths are minimized. Robust column lifetime and excellent recovery of hydrophobic proteins are typically possible with this phase.

## Improved durability when used with TFA solution

## 0.1%TFA condition



1. Uracil
2. Benzene
3. Naphthalene
4. Diphenyl

<Flow conditions>  
 Eluent : water/TFA (100/0.1)  
 Flow rate : 1.0 mL/min  
 Temperature : ambient

<Measurement conditions>  
 Column : YMC-Pack PROTEIN-RP  
 250 X 4.6 mm I.D.  
 Eluent : acetonitrile/water (40/60)  
 Flow rate : 1.0 mL/min  
 Temperature : 30°C  
 Detection : UV at 254 nm

Test results of the stability of stationary phase with 0.1% aqueous TFA is shown above. Retention of diphenyl on competitor's C4 columns greatly decreases as time passes. This is caused by cleavage of butyl groups from the packing material due to acid hydrolysis. Retention of diphenyl on PROTEIN-RP is shown to be stable after 500 hours of TFA solution flow.

## Analytical columns

## YMCbasic

- Superior separation of basic compounds
- Useful for separation of peptides
- Secondary interaction minimized as much as possible

- Pore size : 200 Å
- Carbon content : 7%
- Usable pH range : 2-7.5
- USP L7

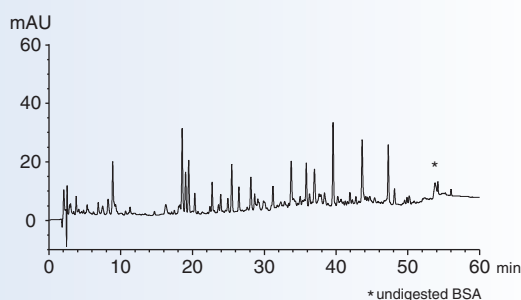
## Column for separation of basic compounds

YMCbasic is a reversed-phase silica-based C8 column designed for separation of basic compounds, including pharmaceutical products. It is highly evaluated as a base-deactivated phase in Europe and the U.S. It offers superior separation of acidic compounds as well as basic compounds. It is suitable for separating peptides with molecular weights in the range of several thousands, such as insulin.

## Application

(N061027C)

## Tryptic digest of BSA



Column	: YMCbasic (5 µm) 150 X 2.0 mm I.D.
Eluent	: A) water/TFA (100/0.1) B) acetonitrile/TFA (100/0.1) 5-35%B (0-50 min), 35-45%B (50-55 min), 45%B (55-60 min)
Flow rate	: 0.2 mL/min
Temperature	: 37°C
Detection	: UV at 220 nm

## Analytical columns

## YMC Carotenoid

- Resolves polar and nonpolar geometric carotenoid isomers
- Separates carotenoids in blood samples, food products, natural product extracts, and commercial preparations
- Operates with low aqueous or non aqueous mobile phases desirable in LC/MS and prep fraction recovery

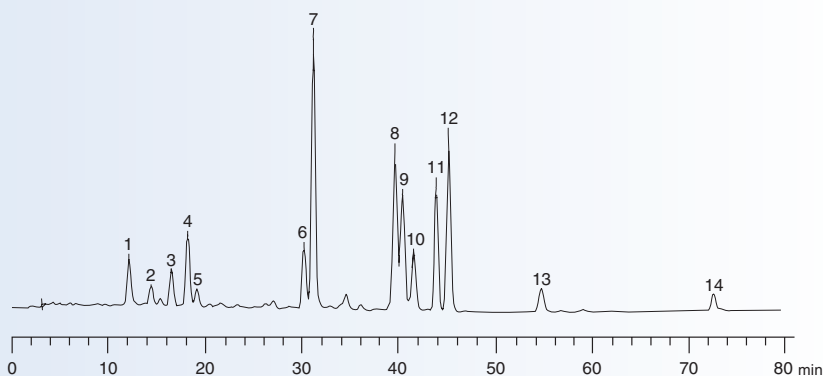
- Usable pH range : 2-7.5
- USP L62

## Carotenoid analytical column

YMC Carotenoid is C30 bonded silica-based reversed-phase column. It is for carotenoid analysis and useful for separation of geometric isomers.

## Application

(A110401A)



## Carotene and xanthophyll

- |                     |                               |
|---------------------|-------------------------------|
| 1. Astaxanthin      | 8. 15- <i>cis</i> β -Carotene |
| 2. Capsanthin       | 9. 13- <i>cis</i> β -Carotene |
| 3. Lutein           | 10. α -Carotene               |
| 4. Zeaxanthin       | 11. <i>trans</i> β -Carotene  |
| 5. Canthaxanthin    | 12. 9- <i>cis</i> β -Carotene |
| 6. β -Cryptoxanthin | 13. δ -Carotene               |
| 7. Echinenone       | 14. Lycopene                  |

Column	: YMC Carotenoid 250 X 4.6 mm I.D.
Eluent	: A) methanol/MTBE*/H <sub>2</sub> O (81/15/4) B) methanol/MTBE*/H <sub>2</sub> O (6/90/4) ** 0-100%B (0-90 min)
Flow rate	: 1.0 mL/min
Temperature	: ambient
Detection	: VIS at 450 nm
*methyl <i>tert</i> -butyl ether	
**Gradient elution was performed by ternary gradient elution. Mobile phase B) is not miscible in this proportion. For binary gradient elution, methanol/MTBE/H <sub>2</sub> O (7/90/3) is suitable as mobile phase B).	

## Analytical columns

## J'sphere ODS-H80, ODS-M80, ODS-L80

- Useful for method development
- High theoretical plate number

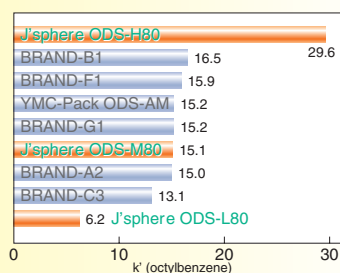
- Pore size : 80 Å
- Carbon content : ODS-H80 22% , ODS-M80 14% , ODS-L80 9%
- Usable pH range : ODS-H80 1-9, ODS-M80-L80 2-7.5
- USP L1

## Three types of ODS, each with different ligand coverage

J'sphere offers a choice from three kinds of ODS made from the same silica gel base, each with different ligand coverage. Differences in ligand coverage considerably affect the hydrophobic retention behavior of solutes, as well as the separation behavior resulting from solute bonded phases or tertiary structure. J'sphere is useful for the optimization of separation conditions, since there is almost no need to consider interactions other than hydrophobic and hydrogen-bonding interactions (e.g., ionic or coordinate interaction).

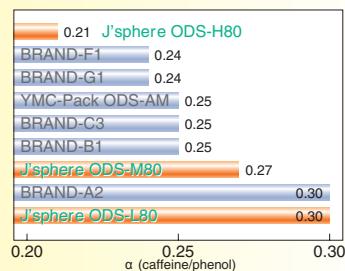
## Differences in separation characteristics

Comparison of hydrophobicity of ODSs produced by various manufacturers



Column : 150 X 4.6 mm I.D.  
Eluent : acetonitrile/water (75/25)  
Flow rate : 1.0 mL/min  
Temperature : 37°C  
Detection : UV at 254 nm

Comparison of hydrogen bonding capacity of ODSs produced by various manufacturers



Column : 150 X 4.6 mm I.D.  
Eluent : acetonitrile/20 mM KH<sub>2</sub>PO<sub>4</sub> (15/85)  
Flow rate : 1.0 mL/min  
Temperature : 37°C  
Detection : UV at 254 nm

ODS columns with different ligand coverage have different hydrophobicity, hydrogen bonding capacity and steric selectivity for tertiary structures. ODS-H80 has exceptionally high hydrophobicity and low hydrogen bonding capacity, ODS-M80 has moderate hydrophobicity and hydrogen bonding capacity and ODS-L80 has low hydrophobicity, comparable to that of C8 and high hydrogen bonding capacity. J'sphere can be used with confidence to identify structural differences of solutes and is useful for improving the efficiency of separation optimization.

## Analytical columns

## YMC-Pack PolymerC18

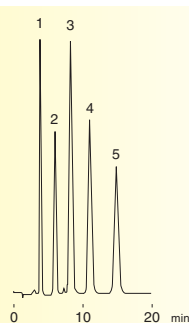
- Utilizes polymer base which is not affected by silanol
- Different separation characteristics from silica-based ODS
- Excellent pH stability

- Usable pH range : 2-13

## Polymer type C18

PolymerC18 is a C18 column made from methacrylate polymer. It has excellent pH stability and it is useful for separation of basic compounds because there are no silanol or metal impurities to cause secondary interaction. Since  $\pi$  electrons of the carbonyl group or the hydroxyl group on the surface of the base material show particular interactions with solutes, PolymerC18 can show different separation characteristics from silica-based ODS.

## Can be used with alkaline mobile phase



1. Barbitol
2. Phenobarbital
3. Pentobarbital
4. Hexobarbital
5. Secobarbital

Column : YMC-Pack PolymerC18  
150 X 4.6 mm I.D.  
Eluent : 50 mM Na<sub>2</sub>HPO<sub>4</sub>-Na<sub>3</sub>PO<sub>4</sub> (pH 11.0)/methanol (75/25)  
Flow rate : 0.5 mL/min  
Temperature : 30°C  
Detection : UV at 254 nm

## Ordering Information -Columns-

### YMC-UltraHT Pro C18/YMC-Pack Pro C18

Phase dimension	Column I.D. (mm)	Column length (mm)					Guard cartridges	
		50	75	100	150	250	I.D. (mm)	10 mm length
120 Å 2 µm	2.0	AS12S02-0502WT	AS12S02-L502WT	AS12S02-1002WT	—	—	—	—
	3.0	AS12S02-0503WT	AS12S02-L503WT	AS12S02-1003WT	—	—	—	—
120 Å 3 µm	2.0	AS12S03-0502WT	AS12S03-L502WT	AS12S03-1002WT	AS12S03-1502WT	—	2.1	AS12S03-01Q1GC
	3.0	AS12S03-0503WT	AS12S03-L503WT	AS12S03-1003WT	AS12S03-1503WT	—	3.0	AS12S03-0103GC
	4.6	AS12S03-0546WT	AS12S03-L546WT	AS12S03-1046WT	AS12S03-1546WT	—	4.0	AS12S03-0104GC
	6.0	AS12S03-0506WT	AS12S03-L506WT	AS12S03-1006WT	—	—	—	—
120 Å 5 µm	2.0	AS12S05-0502WT	AS12S05-L502WT	AS12S05-1002WT	AS12S05-1502WT	AS12S05-2502WT	2.1	AS12S05-01Q1GC
	3.0	AS12S05-0503WT	AS12S05-L503WT	AS12S05-1003WT	AS12S05-1503WT	AS12S05-2503WT	3.0	AS12S05-0103GC
	4.6	AS12S05-0546WT	AS12S05-L546WT	AS12S05-1046WT	AS12S05-1546WT	AS12S05-2546WT	4.0	AS12S05-0104GC
	6.0	—	—	—	AS12S05-1506WT	AS12S05-2506WT	—	—
	10	—	—	—	AS12S05-1510WT	AS12S05-2510WT	10	AS12S05-0110CC

### YMC-UltraHT Hydrosphere C18/Hydrosphere C18

Phase dimension	Column I.D. (mm)	Column length (mm)					Guard cartridges	
		50	75	100	150	250	I.D. (mm)	10 mm length
120 Å 2 µm	2.0	HS12S02-0502WT	HS12S02-L502WT	HS12S02-1002WT	—	—	—	—
	3.0	HS12S02-0503WT	HS12S02-L503WT	HS12S02-1003WT	—	—	—	—
120 Å 3 µm	2.0	HS12S03-0502WT	HS12S03-L502WT	HS12S03-1002WT	HS12S03-1502WT	—	2.1	HS12S03-01Q1GC
	3.0	HS12S03-0503WT	HS12S03-L503WT	HS12S03-1003WT	HS12S03-1503WT	—	3.0	HS12S03-0103GC
	4.6	HS12S03-0546WT	HS12S03-L546WT	HS12S03-1046WT	HS12S03-1546WT	—	4.0	HS12S03-0104GC
	6.0	HS12S03-0506WT	HS12S03-L506WT	HS12S03-1006WT	—	—	—	—
120 Å 5 µm	2.0	HS12S05-0502WT	HS12S05-L502WT	HS12S05-1002WT	HS12S05-1502WT	HS12S05-2502WT	2.1	HS12S05-01Q1GC
	3.0	HS12S05-0503WT	HS12S05-L503WT	HS12S05-1003WT	HS12S05-1503WT	HS12S05-2503WT	3.0	HS12S05-0103GC
	4.6	HS12S05-0546WT	HS12S05-L546WT	HS12S05-1046WT	HS12S05-1546WT	HS12S05-2546WT	4.0	HS12S05-0104GC
	6.0	—	—	—	HS12S05-1506WT	HS12S05-2506WT	—	—
	10	—	—	—	HS12S05-1510WT	HS12S05-2510WT	10	HS12S05-0110CC

### YMC-Pack Pro C18 RS

Phase dimension	Column I.D. (mm)	Column length (mm)					Guard cartridges	
		50	75	100	150	250	I.D. (mm)	10 mm length
80 Å 3 µm	2.0	RS08S03-0502WT	RS08S03-L502WT	RS08S03-1002WT	RS08S03-1502WT	—	2.1	RS08S03-01Q1GC
	3.0	RS08S03-0503WT	RS08S03-L503WT	RS08S03-1003WT	RS08S03-1503WT	—	3.0	RS08S03-0103GC
	4.6	RS08S03-0546WT	RS08S03-L546WT	RS08S03-1046WT	RS08S03-1546WT	—	4.0	RS08S03-0104GC
	6.0	RS08S03-0506WT	RS08S03-L506WT	RS08S03-1006WT	—	—	—	—
80 Å 5 µm	2.0	RS08S05-0502WT	RS08S05-L502WT	RS08S05-1002WT	RS08S05-1502WT	RS08S05-2502WT	2.1	RS08S05-01Q1GC
	3.0	RS08S05-0503WT	RS08S05-L503WT	RS08S05-1003WT	RS08S05-1503WT	RS08S05-2503WT	3.0	RS08S05-0103GC
	4.6	RS08S05-0546WT	RS08S05-L546WT	RS08S05-1046WT	RS08S05-1546WT	RS08S05-2546WT	4.0	RS08S05-0104GC
	6.0	—	—	—	RS08S05-1506WT	RS08S05-2506WT	—	—
	10	—	—	—	RS08S05-1510WT	RS08S05-2510WT	10	RS08S05-0110CC

\* Guard cartridge holder required, part no. XPGCH-Q1 for 2.1 - 4.0 mm I.D. and XPCHSPW1 for 10 mm I.D.

\* See pp.114-116 for preparative columns other than those listed above.



## Ordering Information -Columns-

## YMC-Pack Pro C8

Phase dimension	Column I.D. (mm)	Column length (mm)					Guard cartridges	
		50	75	100	150	250	I.D. (mm)	10 mm length
120 Å 3 µm	2.0	OS12S03-0502WT	OS12S03-L502WT	OS12S03-1002WT	OS12S03-1502WT	—	2.1	OS12S03-01Q1GC
	3.0	OS12S03-0503WT	—	OS12S03-1003WT	OS12S03-1503WT	—	3.0	OS12S03-0103GC
	4.6	OS12S03-0546WT	OS12S03-L546WT	OS12S03-1046WT	OS12S03-1546WT	—	4.0	OS12S03-0104GC
120 Å 5 µm	2.0	OS12S05-0502WT	OS12S05-L502WT	OS12S05-1002WT	OS12S05-1502WT	—	2.1	OS12S05-01Q1GC
	3.0	OS12S05-0503WT	—	—	OS12S05-1503WT	OS12S05-2503WT	3.0	OS12S05-0103GC
	4.6	OS12S05-0546WT	OS12S05-L546WT	OS12S05-1046WT	OS12S05-1546WT	OS12S05-2546WT	4.0	OS12S05-0104GC
	6.0	—	—	—	OS12S05-1506WT	—	—	—

## YMC-Pack Pro C4

Phase dimension	Column I.D. (mm)	Column length (mm)					Guard cartridges	
		50	75	100	150	250	I.D. (mm)	10 mm length
120 Å 3 µm	2.0	BS12S03-0502WT	BS12S03-L502WT	BS12S03-1002WT	BS12S03-1502WT	—	2.1	BS12S03-01Q1GC
	3.0	BS12S03-0503WT	—	BS12S03-1003WT	BS12S03-1503WT	—	3.0	BS12S03-0103GC
	4.6	BS12S03-0546WT	BS12S03-L546WT	BS12S03-1046WT	BS12S03-1546WT	—	4.0	BS12S03-0104GC
120 Å 5 µm	2.0	BS12S05-0502WT	BS12S05-L502WT	BS12S05-1002WT	BS12S05-1502WT	—	2.1	BS12S05-01Q1GC
	3.0	BS12S05-0503WT	—	—	BS12S05-1503WT	BS12S05-2503WT	3.0	BS12S05-0103GC
	4.6	BS12S05-0546WT	BS12S05-L546WT	BS12S05-1046WT	BS12S05-1546WT	BS12S05-2546WT	4.0	BS12S05-0104GC
	6.0	—	—	—	BS12S05-1506WT	—	—	—

## YMC-Pack ODS-A

Phase dimension	Column I.D. (mm)	Column length (mm)					Guard cartridges	
		50	75	100	150	250	I.D. (mm)	10 mm length
120 Å 3 µm	2.0	AA12S03-0502WT	AA12S03-L502WT	AA12S03-1002WT	AA12S03-1502WT	—	2.1	AA12S03-01Q1GC
	3.0	AA12S03-0503WT	—	AA12S03-1003WT	AA12S03-1503WT	—	3.0	AA12S03-0103GC
	4.6	—	AA12S03-L546WT	AA12S03-1046WT	AA12S03-1546WT	—	4.0	AA12S03-0104GC
	6.0	—	—	AA12S03-1006WT	AA12S03-1506WT	—	—	—
120 Å 5 µm	2.0	—	AA12S05-L502WT	—	AA12S05-1502WT	AA12S05-2502WT	2.1	AA12S05-01Q1GC
	3.0	—	—	—	AA12S05-1503WT	AA12S05-2503WT	3.0	AA12S05-0103GC
	4.6	—	AA12S05-L546WT	AA12S05-1046WT	AA12S05-1546WT	AA12S05-2546WT	4.0	AA12S05-0104GC
	6.0	—	—	AA12S05-1006WT	AA12S05-1506WT	AA12S05-2506WT	—	—
	10	—	—	—	AA12S05-1510WT	AA12S05-2510WT	10	AA12S05-0110CC
300 Å 5 µm	2.0	—	AA30S05-L502WT	—	AA30S05-1502WT	AA30S05-2502WT	2.1	AA30S05-01Q1GC
	4.6	—	AA30S05-L546WT	AA30S05-1046WT	AA30S05-1546WT	AA30S05-2546WT	4.0	AA30S05-0104GC
	6.0	—	—	AA30S05-1006WT	AA30S05-1506WT	AA30S05-2506WT	—	—
	10	—	—	—	AA30S05-1510WT	AA30S05-2510WT	10	AA30S05-0110CC

## YMC-Pack ODS-AM

Phase dimension	Column I.D. (mm)	Column length (mm)					Guard cartridges	
		50	75	100	150	250	I.D. (mm)	10 mm length
120 Å 3 µm	2.0	AM12S03-0502WT	AM12S03-L502WT	AM12S03-1002WT	AM12S03-1502WT	—	2.1	AM12S03-01Q1GC
	3.0	AM12S03-0503WT	—	AM12S03-1003WT	AM12S03-1503WT	—	3.0	AM12S03-0103GC
	4.6	—	AM12S03-L546WT	AM12S03-1046WT	AM12S03-1546WT	—	4.0	AM12S03-0104GC
	6.0	—	—	AM12S03-1006WT	AM12S03-1506WT	AM12S03-2506WT	—	—
120 Å 5 µm	2.0	—	AM12S05-L502WT	AM12S05-1002WT	AM12S05-1502WT	AM12S05-2502WT	2.1	AM12S05-01Q1GC
	3.0	—	—	—	AM12S05-1503WT	AM12S05-2503WT	3.0	AM12S05-0103GC
	4.6	—	AM12S05-L546WT	AM12S05-1046WT	AM12S05-1546WT	AM12S05-2546WT	4.0	AM12S05-0104GC
	6.0	—	—	AM12S05-1006WT	AM12S05-1506WT	AM12S05-2506WT	—	—
	10	—	—	—	AM12S05-1510WT	AM12S05-2510WT	10	AM12S05-0110CC

\* Guard cartridge holder required, part no. XPGCH-Q1 for 2.1 - 4.0 mm I.D. and XPCHSWP1 for 10 mm I.D.

\* See pp.114-116 for preparative columns other than those listed above.



## Ordering Information -Columns-

### YMC-Pack ODS-AQ

Phase dimension	Column I.D. (mm)	Column length (mm)					Guard cartridges	
		50	75	100	150	250	I.D. (mm)	10 mm length
120 Å 3 µm	2.0	AQ12S03-0502WT	AQ12S03-L502WT	AQ12S03-1002WT	AQ12S03-1502WT	—	2.1	AQ12S03-01Q1GC
	3.0	AQ12S03-0503WT	—	AQ12S03-1003WT	AQ12S03-1503WT	—	3.0	AQ12S03-0103GC
	4.6	—	—	AQ12S03-1046WT	AQ12S03-1546WT	—	4.0	AQ12S03-0104GC
	6.0	—	—	AQ12S03-1006WT	AQ12S03-1506WT	—	—	—
120 Å 5 µm	2.0	—	AQ12S05-L502WT	—	AQ12S05-1502WT	AQ12S05-2502WT	2.1	AQ12S05-01Q1GC
	3.0	—	—	—	AQ12S05-1503WT	AQ12S05-2503WT	3.0	AQ12S05-0103GC
	4.6	—	AQ12S05-L546WT	AQ12S05-1046WT	AQ12S05-1546WT	AQ12S05-2546WT	4.0	AQ12S05-0104GC
	6.0	—	—	AQ12S05-1006WT	AQ12S05-1506WT	AQ12S05-2506WT	—	—
	10	—	—	—	AQ12S05-1510WT	AQ12S05-2510WT	10	AQ12S05-0110CC

### YMC-Pack ODS-AL

Phase dimension	Column I.D. (mm)	Column length (mm)					Guard cartridges	
		50	75	100	150	250	I.D. (mm)	10 mm length
120 Å 5 µm	2.0	—	—	—	AL12S05-1502WT	AL12S05-2502WT	2.1	AL12S05-01Q1GC
	4.6	—	AL12S05-L546WT	AL12S05-1046WT	AL12S05-1546WT	AL12S05-2546WT	4.0	AL12S05-0104GC
	6.0	—	—	AL12S05-1006WT	AL12S05-1506WT	AL12S05-2506WT	—	—
	10	—	—	—	AL12S05-1510WT	AL12S05-2510WT	10	AL12S05-0110CC

### YMC-Pack C<sub>8</sub>

Phase dimension	Column I.D. (mm)	Column length (mm)					Guard cartridges	
		50	75	100	150	250	I.D. (mm)	10 mm length
120 Å 3 µm	2.0	OC12S03-0502WT	OC12S03-L502WT	OC12S03-1002WT	OC12S03-1502WT	—	2.1	OC12S03-01Q1GC
	3.0	OC12S03-0503WT	—	OC12S03-1003WT	OC12S03-1503WT	—	3.0	OC12S03-0103GC
	4.6	—	—	OC12S03-1046WT	OC12S03-1546WT	—	4.0	OC12S03-0104GC
120 Å 5 µm	2.0	—	—	—	OC12S05-1502WT	OC12S05-2502WT	2.1	OC12S05-01Q1GC
	4.6	—	OC12S05-L546WT	OC12S05-1046WT	OC12S05-1546WT	OC12S05-2546WT	4.0	OC12S05-0104GC
	6.0	—	—	OC12S05-1006WT	OC12S05-1506WT	OC12S05-2506WT	—	—
	10	—	—	—	OC12S05-1510WT	OC12S05-2510WT	10	OC12S05-0110CC
200 Å 5 µm	4.6	—	—	—	OC20S05-1546WT	OC20S05-2546WT	4.0	OC20S05-0104GC
300 Å 5 µm	2.0	—	—	—	OC30S05-1502WT	OC30S05-2502WT	2.1	OC30S05-01Q1GC
	4.6	—	OC30S05-L546WT	OC30S05-1046WT	OC30S05-1546WT	OC30S05-2546WT	4.0	OC30S05-0104GC
	6.0	—	—	OC30S05-1006WT	OC30S05-1506WT	OC30S05-2506WT	—	—
	10	—	—	—	OC30S05-1510WT	OC30S05-2510WT	10	OC30S05-0110CC

### YMC-Pack C<sub>4</sub>

Phase dimension	Column I.D. (mm)	Column length (mm)					Guard cartridges	
		50	75	100	150	250	I.D. (mm)	10 mm length
120 Å 3 µm	2.0	BU12S03-0502WT	BU12S03-L502WT	BU12S03-1002WT	BU12S03-1502WT	—	2.1	BU12S03-01Q1GC
	3.0	BU12S03-0503WT	—	BU12S03-1003WT	BU12S03-1503WT	—	3.0	BU12S03-0103GC
	4.6	—	—	BU12S03-1046WT	BU12S03-1546WT	—	4.0	BU12S03-0104GC
120 Å 5 µm	2.0	—	—	—	BU12S05-1502WT	BU12S05-2502WT	2.1	BU12S05-01Q1GC
	4.6	—	BU12S05-L546WT	BU12S05-1046WT	BU12S05-1546WT	BU12S05-2546WT	4.0	BU12S05-0104GC
	6.0	—	—	BU12S05-1006WT	BU12S05-1506WT	BU12S05-2506WT	—	—
	10	—	—	—	BU12S05-1510WT	BU12S05-2510WT	10	BU12S05-0110CC
300 Å 5 µm	2.0	—	—	—	BU30S05-1502WT	BU30S05-2502WT	2.1	BU30S05-01Q1GC
	4.6	—	BU30S05-L546WT	BU30S05-1046WT	BU30S05-1546WT	BU30S05-2546WT	4.0	BU30S05-0104GC
	6.0	—	—	BU30S05-1006WT	BU30S05-1506WT	BU30S05-2506WT	—	—
	10	—	—	—	BU30S05-1510WT	BU30S05-2510WT	10	BU30S05-0110CC

\* Guard cartridge holder required, part no. XPGCH-Q1 for 2.1 - 4.0 mm I.D. and XPCHPW1 for 10 mm I.D.

\* See pp.114-116 for preparative columns other than those listed above.

## Ordering Information -Columns-

## YMC-Pack TMS

Phase dimension	Column I.D. (mm)	Column length (mm)					Guard cartridges	
		50	75	100	150	250	I.D. (mm)	10 mm length
120 Å 3 µm	4.6	—	—	TM12S03-1046WT	TM12S03-1546WT	—	4.0	TM12S03-0104GC
	2.0	—	—	—	TM12S05-1502WT	TM12S05-2502WT	2.1	TM12S05-01Q1GC
120 Å 5 µm	4.6	—	TM12S05-L546WT	TM12S05-1046WT	TM12S05-1546WT	TM12S05-2546WT	4.0	TM12S05-0104GC
	6.0	—	—	TM12S05-1006WT	TM12S05-1506WT	TM12S05-2506WT	—	—
	10	—	—	—	TM12S05-1510WT	TM12S05-2510WT	10	TM12S05-0110CC

## YMC-Pack Ph

Phase dimension	Column I.D. (mm)	Column length (mm)					Guard cartridges	
		50	75	100	150	250	I.D. (mm)	10 mm length
120 Å 3 µm	2.0	PH12S03-0502WT	PH12S03-L502WT	PH12S03-1002WT	PH12S03-1502WT	—	2.1	PH12S03-01Q1GC
	3.0	PH12S03-0503WT	—	PH12S03-1003WT	PH12S03-1503WT	—	3.0	PH12S03-0103GC
	4.6	—	—	PH12S03-1046WT	PH12S03-1546WT	—	4.0	PH12S03-0104GC
120 Å 5 µm	2.0	—	—	—	PH12S05-1502WT	PH12S05-2502WT	2.1	PH12S05-01Q1GC
	4.6	—	PH12S05-L546WT	PH12S05-1046WT	PH12S05-1546WT	PH12S05-2546WT	4.0	PH12S05-0104GC
	6.0	—	—	PH12S05-1006WT	PH12S05-1506WT	PH12S05-2506WT	—	—
	10	—	—	—	PH12S05-1510WT	PH12S05-2510WT	10	PH12S05-0110CC

## YMC-Pack CN

Phase dimension	Column I.D. (mm)	Column length (mm)					Guard cartridges	
		50	75	100	150	250	I.D. (mm)	10 mm length
120 Å 3 µm	2.0	CN12S03-0502WT	CN12S03-L502WT	CN12S03-1002WT	CN12S03-1502WT	—	2.1	CN12S03-01Q1GC
	3.0	CN12S03-0503WT	—	CN12S03-1003WT	CN12S03-1503WT	—	3.0	CN12S03-0103GC
	4.6	—	—	CN12S03-1046WT	CN12S03-1546WT	—	4.0	CN12S03-0104GC
120 Å 5 µm	2.0	—	—	—	CN12S05-1502WT	CN12S05-2502WT	2.1	CN12S05-01Q1GC
	4.6	—	CN12S05-L546WT	CN12S05-1046WT	CN12S05-1546WT	CN12S05-2546WT	4.0	CN12S05-0104GC
	6.0	—	—	CN12S05-1006WT	CN12S05-1506WT	CN12S05-2506WT	—	—
	10	—	—	—	CN12S05-1510WT	CN12S05-2510WT	10	CN12S05-0110CC
300 Å 5 µm	2.0	—	—	—	CN30S05-1502WT	CN30S05-2502WT	2.1	CN30S05-01Q1GC
	4.6	—	CN30S05-L546WT	CN30S05-1046WT	CN30S05-1546WT	CN30S05-2546WT	4.0	CN30S05-0104GC
	6.0	—	—	CN30S05-1006WT	CN30S05-1506WT	CN30S05-2506WT	—	—

## YMC-Pack PROTEIN-RP

Particle size (µm)	Column I.D. (mm)	Column length (mm)					Guard cartridges	
		50	75	100	150	250	I.D. (mm)	10 mm length
5	2.0	—	—	—	PR99S05-1502WT	PR99S05-2502WT	2.1	PR99S05-01Q1GC
	4.6	—	—	—	PR99S05-1546WT	PR99S05-2546WT	4.0	PR99S05-0104GC
	10	—	—	—	—	PR99S05-2510WT	10	PR99S05-0110CC

## YMCbasic

Phase dimension	Column I.D. (mm)	Column length (mm)					Guard cartridges	
		50	75	100	150	250	I.D. (mm)	10 mm length
200 Å 3 µm	2.0	BA99S03-0502WT	BA99S03-L502WT	BA99S03-1002WT	BA99S03-1502WT	—	2.1	BA99S03-01Q1GC
	3.0	BA99S03-0503WT	—	BA99S03-1003WT	BA99S03-1503WT	—	3.0	BA99S03-0103GC
	4.6	BA99S03-0546WT	—	BA99S03-1046WT	BA99S03-1546WT	—	4.0	BA99S03-0104GC
200 Å 5 µm	2.0	—	—	—	BA99S05-1502WT	—	2.1	BA99S05-01Q1GC
	3.0	—	—	—	BA99S05-1503WT	—	3.0	BA99S05-0103GC
	4.6	BA99S05-0546WT	—	BA99S05-1046WT	BA99S05-1546WT	BA99S05-2546WT	4.0	BA99S05-0104GC
	6.0	—	—	—	BA99S05-1506WT	BA99S05-2506WT	—	—

## YMC Carotenoid

Particle size (µm)	Column I.D. (mm)	Column length (mm)					Guard cartridges	
		50	75	100	150	250	I.D. (mm)	10 mm length
3	4.6	—	—	CT99S03-1046WT	CT99S03-1546WT	—	4.0	CT99S03-0104GC
5	4.6	—	—	—	CT99S05-1546WT	CT99S05-2546WT	4.0	CT99S05-0104GC

\* Guard cartridge holder required, part no. XPGCH-Q1 for 2.1 - 4.0 mm I.D. and XPCHPW1 for 10 mm I.D.

\* See pp.115-116 for preparative columns other than those listed above.

## Ordering Information -Columns-

### J'sphere

Phase dimension	Column I.D. (mm)	Column length (mm)				Guard cartridges	
		75	100	150	250	I.D. (mm)	10 mm length
ODS-H80 80 Å 4 µm	2.0	JH08S04-L502WT	JH08S04-1002WT	JH08S04-1502WT	JH08S04-2502WT	2.1	JH08S04-01Q1GC
	3.0	—	—	JH08S04-1503WT	JH08S04-2503WT	3.0	JH08S04-0103GC
	4.6	JH08S04-L546WT	—	JH08S04-1546WT	JH08S04-2546WT	4.0	JH08S04-0104GC
	6.0	—	—	JH08S04-1506WT	JH08S04-2506WT	4.0	JH08S04-0104GC
	10	—	—	JH08S04-1510WT	JH08S04-2510WT	10	JH08S04-0110CC
ODS-M80 80 Å 4 µm	2.0	JM08S04-L502WT	JM08S04-1002WT	JM08S04-1502WT	JM08S04-2502WT	2.1	JM08S04-01Q1GC
	3.0	—	—	JM08S04-1503WT	JM08S04-2503WT	3.0	JM08S04-0103GC
	4.6	JM08S04-L546WT	—	JM08S04-1546WT	JM08S04-2546WT	4.0	JM08S04-0104GC
	6.0	—	—	JM08S04-1506WT	JM08S04-2506WT	4.0	JM08S04-0104GC
	10	—	—	JM08S04-1510WT	JM08S04-2510WT	10	JM08S04-0110CC
ODS-L80 80 Å 4 µm	2.0	JL08S04-L502WT	JL08S04-1002WT	JL08S04-1502WT	JL08S04-2502WT	2.1	JL08S04-01Q1GC
	3.0	—	—	JL08S04-1503WT	JL08S04-2503WT	3.0	JL08S04-0103GC
	4.6	JL08S04-L546WT	—	JL08S04-1546WT	JL08S04-2546WT	4.0	JL08S04-0104GC
	6.0	—	—	JL08S04-1506WT	JL08S04-2506WT	4.0	JL08S04-0104GC
	10	—	—	JL08S04-1510WT	JL08S04-2510WT	10	JL08S04-0110CC

### YMC-Pack PolymerC18

Particle size (µm)	Column I.D. (mm)	Column length (mm)				Guard cartridges	
		75	100	150	250	I.D. (mm)	10 mm length
6	2.0	PC99S06-L502WT	—	PC99S06-1502WT	—	2.1	PC99S06-01Q1GC
	4.6	—	—	PC99S06-1546WT	PC99S06-2546WT	4.0	PC99S06-0104GC
	6.0	—	—	PC99S06-1506WT	PC99S06-2506WT	4.0	PC99S06-0104GC
	10	—	—	—	PC99S06-2510WT	10	PC99S06-0110CC
10	4.6	—	—	—	PC99S10-2546WT	4.0	PC99S10-0104GC
	6.0	—	—	—	PC99S10-2506WT	4.0	PC99S10-0104GC
	10	—	—	—	PC99S10-2510WT	10	PC99S10-0110CC

\* Guard cartridge holder required, part no. XPGCH-Q1 for 2.1 - 4.0 mm I.D. and XPCHSPW1 for 10 mm I.D.

\* See pp.115-116 for preparative columns other than those listed above.