

# 11

## Preparative Columns

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## Preparative packed columns

### Overview of column selection and method development for isolation/purification

An overview for selecting optimum conditions for isolation/purification and check points are shown below.

#### Separation mode of chromatography

The following points should be considered for the selection of an appropriate separation mode:

- (1) Separation efficiency: Resolution, Loadability, Run time
- (2) Cost performance: Costs (packing materials/mobile phases), Throughput
- (3) Others: Safety, Characteristics of the target substances, Specification of the preparative LC system

#### Column size and particle size

##### Selection guide for the preparative column

When scaling up, column size and particle size of the packing materials should be selected depending on the amount of material and the required purity of the target molecules. If flow rate and sample loading amount are increased proportionally to the ratio of the column cross sectional areas while keeping both column length and particle size of the packing materials, both the same resolution and the same column pressure can be maintained before and after scaling up. Examples of typical scaling up studies are indicated by the arrow in the table below.

			Lab scale				Production scale				
Column inner diameter (mm)			4.6	10	20	30	50	100	200	500	1000
Cross sectional area ratio			1.0	4.7	19	42	118	473	1,890	11,800	47,300
Example of calculation	Flow rate (mL/min)		0.5	2.4	9.5	21	60	235	950	6,000 (6 L)	24,000 (24 L)
			1.0	4.7	19	42	120	470	1,900	12,000 (12 L)	47,000 (47 L)
	Loading (mg)		5	25	100	220	600	2,500	10,000	60,000 (60 g)	240,000 (240 g)
Particle size (μm)	Column efficiency Pressure Costs (High) ↑ ↓ (Low)	5	●	●	●	●	○	○	○		
		10	○	●	●	●	●	○	○	○	○
		10-20	○	○	○	○	●	●	●	○	○
		15-30		○	○	○	○	●	●	●	○
		50 -						○	○	○	●

● : Most appropriate   ○ : Appropriate   ○ : Depending on purpose

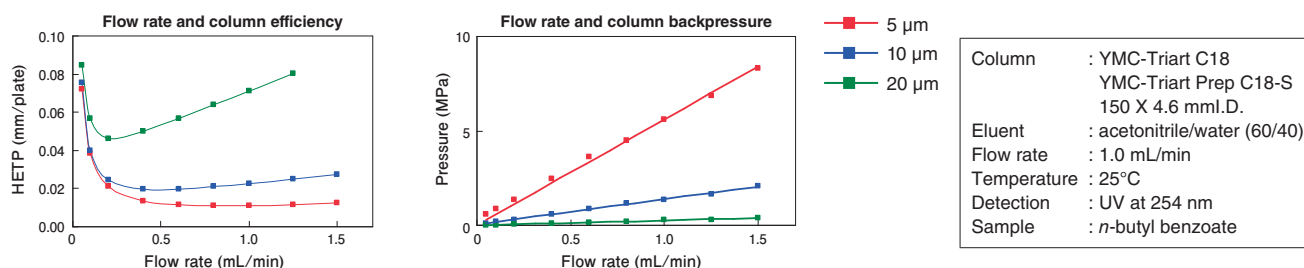
Flow rate equation \*Use the same equation to calculate the sample load

$$F' = F \times (Dc' / Dc)^2$$

F : Analytical column flow rate [mL/min]   Dc : Analytical column inner diameter [mm]  
 F' : Preparative column flow rate [mL/min]   Dc' : Preparative column inner diameter [mm]

## Relationship of particle size and column efficiency/column backpressure

Smaller particle sizes lead to higher column efficiencies, but at a higher cost. In addition the systems with higher pressure limit are required due to high backpressure. Smaller particle sizes are effective for higher resolution when the separation of the target peak and the close peak is insufficient. On the other hand, larger particle sizes lead to lower column efficiencies, but at a lower the costs of packing materials and at a lower the column operating pressure.



## Method development

Preparative separation conditions are optimized with analytical scale column packed with the selected particle size.

### (1) Separation conditions

When the particle size used in the preparative separation is larger than that used in the analytical scale, the required separation may not be achieved due to lower column efficiencies. The separation may be improved by adjusting the mobile phase composition or reducing the linear velocity. If the separation still doesn't improve, the column length or the particle size needs to be changed.

### (2) Loading study

Loading amount is gradually increased, and the obtained fractions are analyzed about purity and recovery rate. The appropriate loading amount is finally chosen based on the target purity and recovery.

### (3) Preparative LC system evaluation

It is essential to make sure that the required flow rate and pressure are suitable for the specifications of the preparative LC system. The same linear velocity used in analytical scale should be used to achieve the same resolution on the preparative column. Under the same linear velocity, operating pressure on the preparative column is as almost same as that on the analytical column. If the column pressure exceeds the limit of the system, the flow rate or column length needs to be reduced.

### (4) Performing preparative separation

A preparative separation should be performed and the recovery and purity are evaluated.

## High durability semi-preparative columns

## YMC-Actus series

## Axial Compression Technology for Ultimate Separation

- Improved durability by applying axial compression technology
- Prepacked column for milligram scale preparative HPLC
- Excellent resolution

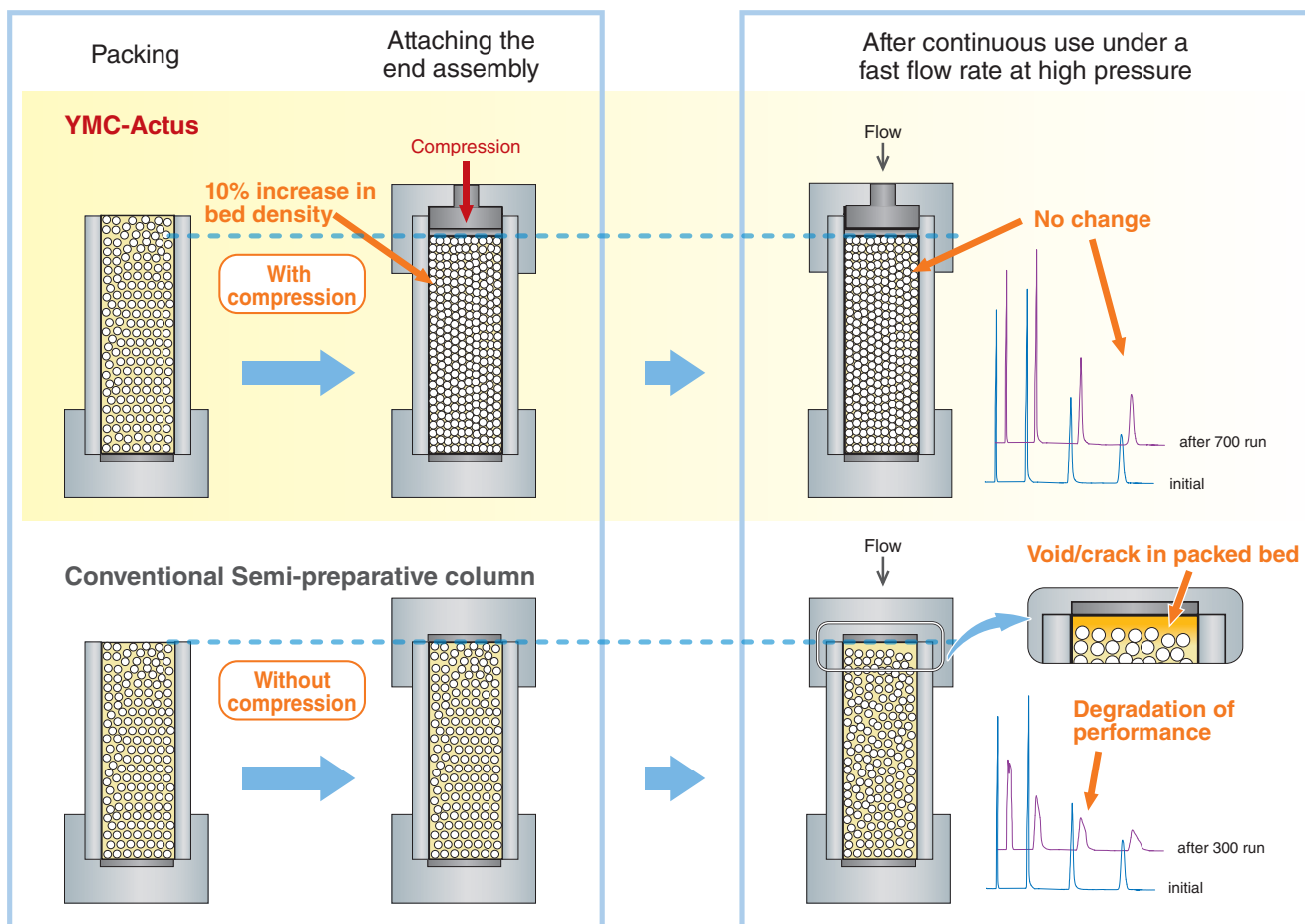
YMC-Actus series are semi-preparative HPLC columns that have excellent column durability and efficiency by applying axial compression technology. YMC-Actus series columns show high durability under high flow rate or steep gradient conditions and desirable for milligram scale preparative HPLC of various compounds.

## Specifications

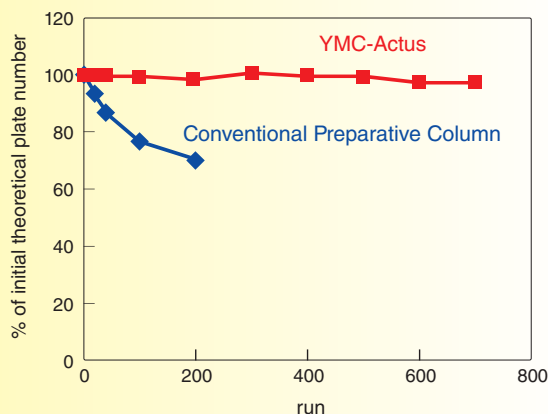
Packing material		Pore size (Å)	Particle size (µm)	C%	Usable pH range	Characteristics
YMC-Triart	Triart C18	120	5	20	1-12	<ul style="list-style-type: none"> <li>● Superior peak shape</li> <li>● Usable over wide range of pH and temperature</li> <li>● Usable with 100% aqueous mobile phase</li> </ul>
	Triart C18 ExRS	80	5	25		<ul style="list-style-type: none"> <li>● Excellent selectivity of isomers and structural analogs</li> <li>● Superior chemical durability</li> </ul>
	Triart C8	120	5	17		<ul style="list-style-type: none"> <li>● Compete with the versatility of C18</li> <li>● Usable over wide range of pH and temperature</li> <li>● Ideal for separations of isomers or structural analogs</li> </ul>
	Triart Phenyl	120	5	17	1-10	<ul style="list-style-type: none"> <li>● Unique selectivity due to <math>\pi</math>-<math>\pi</math> interaction</li> <li>● Excellent resolution without adsorption and tailing</li> </ul>
	Triart PFP	120	5	15	1-8	<ul style="list-style-type: none"> <li>● Alternative selectivity to C18/C8 due to unique polar interaction</li> <li>● Superior planar cognitive ability/steric selectivity</li> <li>● Ideal for separations of compounds or isomers</li> </ul>
	Triart Bio C4	300	5	—	1-10	<ul style="list-style-type: none"> <li>● Ideal for separation of biomolecules such as proteins and oligonucleotides</li> <li>● Good peak shapes with mobile phase suitable for LC/MS</li> </ul>
Pro series	Pro C18	120	5	16	2-8	<ul style="list-style-type: none"> <li>● High performance ODS packing material</li> </ul>
	Hydrosphere C18	120	5	12		<ul style="list-style-type: none"> <li>● Can be used with 100% aqueous mobile phase</li> <li>● Superior separation for hydrophilic compounds</li> </ul>
	Pro C18 RS	80	5	22	1-10	<ul style="list-style-type: none"> <li>● High carbon ODS packing material, high durability</li> </ul>
	Pro C8	120	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>
YMC-Pack	ODS-A	120	5	17	2-7.5	<ul style="list-style-type: none"> <li>● Standard ODS from analytical to preparative</li> </ul>
	ODS-AQ	120	5	14		<ul style="list-style-type: none"> <li>● Good separation for hydrophilic compounds</li> </ul>

## Great durability achieved by applying axial compression technology

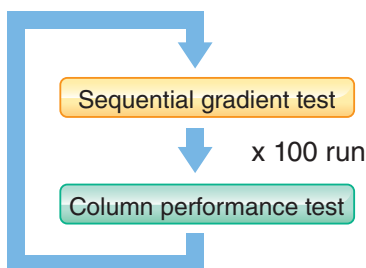
[Excellent durability provided by improved bed density]



### Column durability study



### Test protocols



#### Sequential gradient test

(high-speed and high-pressure)

Column size : 5  $\mu$ m, 50 X 20 mm I.D. or 50 X 19 mm I.D.

Eluent : A) water B) methanol

Gradient : 5%B (0-0.5 min),  
5-95%B (0.5-3.1 min),  
95%B (3.1-3.6 min),  
5%B (3.6-4.0 min)

Flow rate : 50 mL/min

Pressure : Max.17 MPa

#### Column performance test

Column size : 5  $\mu$ m, 50 X 20 mm I.D. or 50 X 19 mm I.D.

Eluent : methanol/water (60/40)

Flow rate : 10 mL/min

Sample : naphthalene

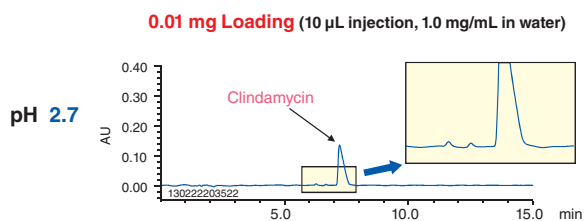
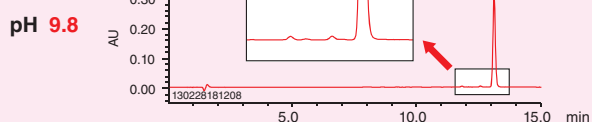
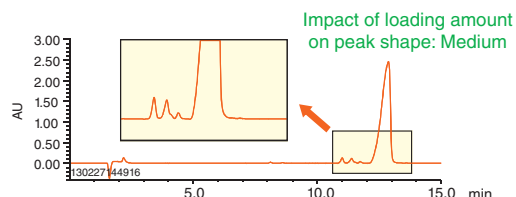
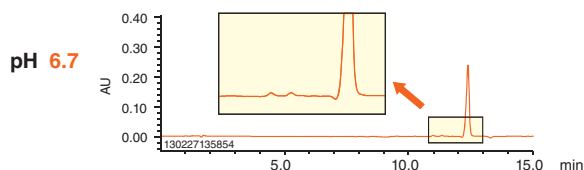
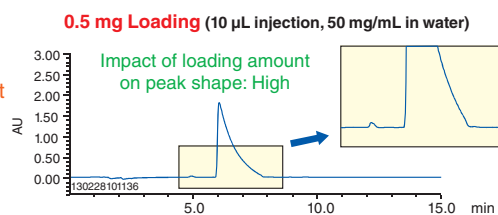
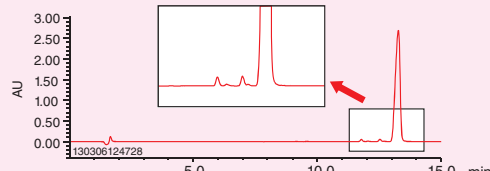
Uniformly high density packing is necessary for high performance HPLC column. DAC (Dynamic Axial Compression) column is widely used for preparative separation in pilot or production scale. It allows uniformly high density packing and prevents formation of voids during use by applying continuous compression.

YMC-Actus series have been developed by applying this Axial Compression Technology to semi-prep column. This column bed is compressed adequately by attaching the end assembly newly designed for YMC-Actus. It provides proper bed density (10% higher than conventional columns) and results in higher efficiency and durability.

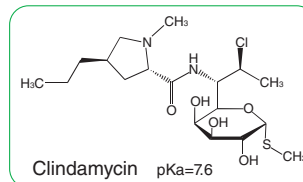
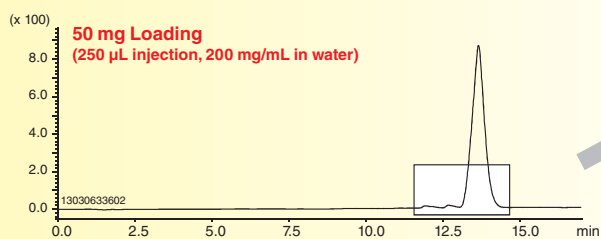
## Separation at high loading

[Purification of basic pharmaceutical: Clindamycin]

Purification method development

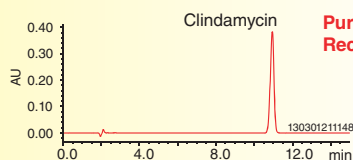
YMC-Triart C18 5  $\mu$ m, 150 X 4.6 mm.I.D.Increasing  
loading amountImpact of loading amount  
on peak shape: Low ..... Effective for purification  
at high loading

## Purification at pH 9.8

YMC-Actus Triart C18 5  $\mu$ m, 150 X 20 mm.I.D.

Eluent	A) 20 mM HCOOH for pH 2.7 20 mM HCOONH <sub>4</sub> for pH 6.7 20 mM HCOONH <sub>4</sub> -NH <sub>3</sub> for pH 9.8 B) acetonitrile 10-75%B (0-15 min)
Flow rate	: 1.0 mL/min for 150 X 4.6 mm.I.D. 18.9 mL/min for 150 X 20 mm.I.D.
Temperature	: 25°C for 150 X 4.6 mm.I.D. ambient for 150 X 20 mm.I.D.
Detection	: UV at 210 nm
Pressure	: 7.0 MPa for 150 X 4.6 mm.I.D. 8.4 MPa for 150 X 20 mm.I.D.

## Fraction analysis



Column	: YMC-Triart C18 5 $\mu$ m 150 X 4.6 mm.I.D.
Eluent	: 50 mM KH <sub>2</sub> PO <sub>4</sub> (pH 7.5 adjusted by 8 M KOH)/ acetonitrile (55/45)
Flow rate	: 1.0 mL/min
Temperature	: 25°C
Detection	: UV at 210 nm
Injection	: 20 $\mu$ L

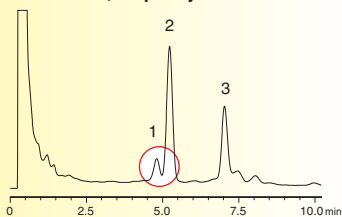
Clindamycin and its impurities (related compounds) are more hydrophobic in their un-ionized form and are retained stronger at pH 9.8. At higher pH condition, the resolution between main peak and impurities is improved and the peak shape is less affected by increase of mass loading.

Excellent chemical durability of YMC-Triart offers an option of purification at a high pH that is effective for basic compounds by increasing retention and mass loading. Moreover, highly efficient YMC-Actus Triart has identical performance to YMC-Triart analytical column. This enables direct scale up from analytical condition to preparative condition. The combination of YMC-Triart and YMC-Actus offers highly efficient purification of various compounds.

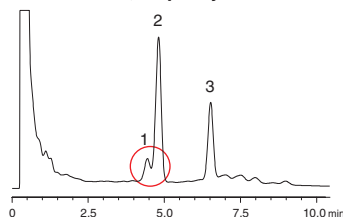
## Purification of hydrophobic compounds with similar structure –Capsaicinoids in red pepper–

### Analysis

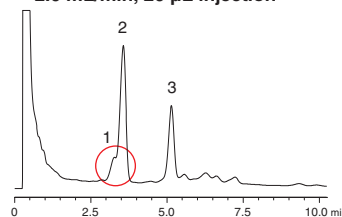
**YMC-Pack Pro C18 RS 5 µm**  
50 X 4.6 mmI.D.  
2.0 mL/min, 20 µL injection



**Brand G2 5 µm**  
50 X 4.6 mmI.D.  
2.0 mL/min, 20 µL injection

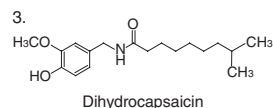
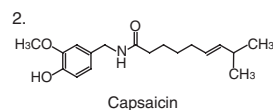
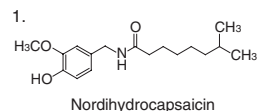
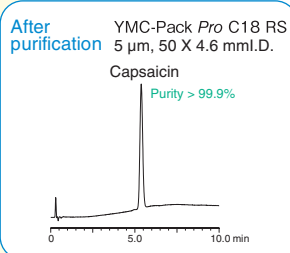
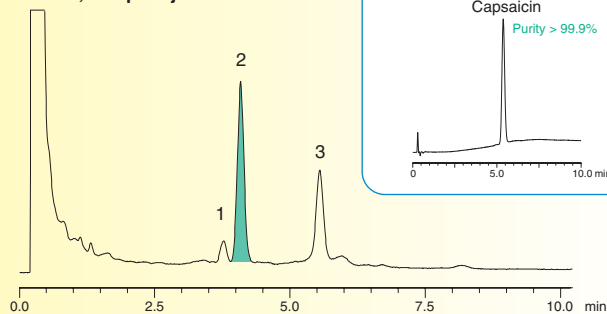


**Brand I8 5 µm**  
50 X 4.6 mmI.D.  
2.0 mL/min, 20 µL injection



### Purification

**YMC-Actus Pro C18 RS 5 µm**  
50 X 20 mmI.D.  
40 mL/min, 400 µL injection



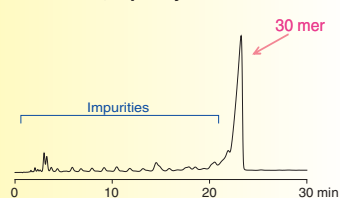
Eluent : A) methanol/water/TFA (50/50/0.1)  
B) methanol/TFA (100/0.1)  
10-30%B (0-5 min), 30%B (5-10 min)  
Temperature : 25°C for 50 X 4.6 mmI.D.  
ambient for 50 X 20 mmI.D.  
Detection : UV at 280 nm  
Sample : methanol extract of a commercial cayenne pepper  
(1 g cayenne pepper/3 mL)

Pro C18 RS has superior selectivity for hydrophobic compounds that differ slightly in structure and hydrophobicity, achieves better resolution between peak 1 and peak 2. Furthermore, analytical separation can be directly scaled up to preparative scale with YMC-Actus Pro C18 RS. YMC-Actus series have high resolution equal to analytical columns.

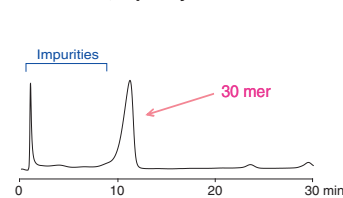
## Purification of highly polar compounds –Oligonucleotide–

### Analysis

**Hydrosphere C18 5 µm**  
50 X 4.6 mmI.D.  
1.0 mL/min, 5 µL injection

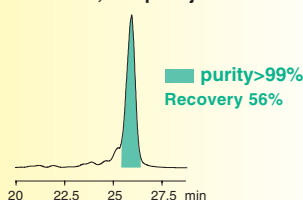


**Brand I1 5 µm**  
50 X 4.6 mmI.D.  
1.0 mL/min, 5 µL injection

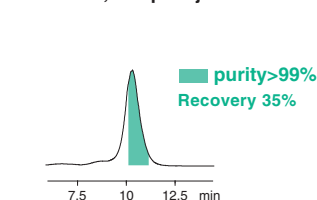


### Purification

**YMC-Actus Hydrosphere C18 5 µm**  
50 X 20 mmI.D.  
19 mL/min, 100 µL injection



**Brand I1 5 µm**  
50 X 19 mmI.D.  
19 mL/min, 100 µL injection



Crude synthetic 30 mer oligonucleotide  
5'-CCGCTCGAGCTAAAAAAGCTGTGTTACC-3'

Eluent : A) 10 mM DBAA\* (pH 6.0)/methanol (60/40)  
B) 10 mM DBAA\* (pH 6.0)/methanol (20/80)  
10-35%B (0-30 min)  
Temperature : ambient  
Detection : UV at 269 nm  
Sample : synthetic oligonucleotide (100 µM)  
\* di-*n*-butylammonium acetate

In analytical scale, many impurities could be separated from the target compound by onenucleotide difference on Hydrosphere C18. Even in purification scale, YMC-Actus gave superior separation and recovery. YMC-Actus Hydrosphere C18 is useful for purification of hydrophilic compounds such as oligonucleotides, organic acids, oligosaccharides and glycosides.

## Ordering Information –Columns–

## YMC-Actus series (Pressure limit : 30 MPa for 20 and 30 mmI.D., 20 MPa for 50 mmI.D.)

Particle size (µm)	Column size inner diameter X length (mm)	Triart C18 (120 Å)	Triart C18 ExRS (80 Å)	Triart C8 (120 Å)	Triart Phenyl (120 Å)	Triart PFP (120 Å)	Triart Bio C4 (300 Å)
5	20 X 50	TA12S05-0520WX	TAR08S05-0520WX	TO12S05-0520WX	TPH12S05-0520WX	TPF12S05-0520WX	TB30S05-0520WX
	20 X 100	TA12S05-1020WX	TAR08S05-1020WX	TO12S05-1020WX	TPH12S05-1020WX	TPF12S05-1020WX	TB30S05-1020WX
	20 X 150	TA12S05-1520WX	TAR08S05-1520WX	TO12S05-1520WX	TPH12S05-1520WX	TPF12S05-1520WX	TB30S05-1520WX
	20 X 250	TA12S05-2520WX	TAR08S05-2520WX	TO12S05-2520WX	TPH12S05-2520WX	TPF12S05-2520WX	TB30S05-2520WX
	30 X 50	TA12S05-0530WX	TAR08S05-0530WX	TO12S05-0530WX	TPH12S05-0530WX	TPF12S05-0530WX	TB30S05-0530WX
	30 X 75	TA12S05-L530WX	TAR08S05-L530WX	TO12S05-L530WX	TPH12S05-L530WX	TPF12S05-L530WX	TB30S05-L530WX
	30 X 100	TA12S05-1030WX	TAR08S05-1030WX	TO12S05-1030WX	TPH12S05-1030WX	TPF12S05-1030WX	TB30S05-1030WX
	30 X 150	TA12S05-1530WX	TAR08S05-1530WX	TO12S05-1530WX	TPH12S05-1530WX	TPF12S05-1530WX	TB30S05-1530WX
	30 X 250	TA12S05-2530WX	TAR08S05-2530WX	TO12S05-2530WX	TPH12S05-2530WX	TPF12S05-2530WX	TB30S05-2530WX
	50 X 250	TA12S05-2553AX	—	—	—	—	—

Particle size (µm)	Column size inner diameter X length (mm)	YMC-Pack Pro C18 (120 Å)	Hydrosphere C18 (120 Å)	YMC-Pack Pro C18 RS (80 Å)	YMC-Pack Pro C8 (120 Å)	YMC-Pack ODS-A (120 Å)	YMC-Pack ODS-AQ (120 Å)
5	20 X 50	AS12S05-0520WX	HS12S05-0520WX	RS08S05-0520WX	OS12S05-0520WX	AA12S05-0520WX	AQ12S05-0520WX
	20 X 100	AS12S05-1020WX	HS12S05-1020WX	RS08S05-1020WX	OS12S05-1020WX	AA12S05-1020WX	AQ12S05-1020WX
	30 X 50	AS12S05-0530WX	HS12S05-0530WX	RS08S05-0530WX	OS12S05-0530WX	AA12S05-0530WX	AQ12S05-0530WX
	30 X 75	AS12S05-L530WX	HS12S05-L530WX	RS08S05-L530WX	OS12S05-L530WX	AA12S05-L530WX	AQ12S05-L530WX
	30 X 100	AS12S05-1030WX	HS12S05-1030WX	RS08S05-1030WX	OS12S05-1030WX	AA12S05-1030WX	AQ12S05-1030WX

## YMC-Actus series guard cartridges

Particle size (µm)	Column size inner diameter X length (mm)	Triart C18 (120 Å)	Triart C18 ExRS (80 Å)	Triart C8 (120 Å)	Triart Phenyl (120 Å)	Triart PFP (120 Å)	Triart Bio C4 (300 Å)
5	20 X 10	TA12S05-0120CCN	TAR08S05-0120CCN	TO12S05-0120CCN	TPH12S05-0120CCN	TPF12S05-0120CCN	TB30S05-0120CCN
	30 X 10	TA12S05-0130CCN	TAR08S05-0130CCN	TO12S05-0130CCN	TPH12S05-0130CCN	TPF12S05-0130CCN	TB30S05-0130CCN

Particle size (µm)	Column size inner diameter X length (mm)	YMC-Pack Pro C18 (120 Å)	Hydrosphere C18 (120 Å)	YMC-Pack Pro C18 RS (80 Å)	YMC-Pack Pro C8 (120 Å)	YMC-Pack ODS-A (120 Å)	YMC-Pack ODS-AQ (120 Å)
5	20 X 10	AS12S05-0120CCN	HS12S05-0120CCN	RS08S05-0120CCN	OS12S05-0120CCN	AA12S05-0120CCN	AQ12S05-0120CCN
	30 X 10	AS12S05-0130CCN	HS12S05-0130CCN	RS08S05-0130CCN	OS12S05-0130CCN	AA12S05-0130CCN	AQ12S05-0130CCN

\*Guard cartridge holder required, part no. XPGHFSP20ID for 20 mmI.D. and XPGHFSP30ID for 30 mmI.D.



## Ordering Information -Columns-

### Preparative columns (Pressure limit : 10 MPa)

Particle size (µm)	Column size inner diameter X length (mm)	YMC-Pack Pro C18 (120 Å)	Hydrosphere C18 (120 Å)	YMC-Pack Pro C18 RS (80 Å)	YMC-Pack Pro C8 (120 Å)	YMC-Pack Pro C4 (120 Å)
5	20 X 150	AS12S05-1520WT	HS12S05-1520WT	RS08S05-1520WT	—	—
	20 X 250	AS12S05-2520WT	HS12S05-2520WT	RS08S05-2520WT	OS12S05-2520WT	BS12S05-2520WT
	30 X 150	AS12S05-1530WT	—	—	—	—

Particle size (µm)	Column size inner diameter X length (mm)	YMC-Pack ODS-A			YMC-Pack ODS-AQ		YMC-Pack ODS-AM (120 Å)	YMC-Pack ODS-AL (120 Å)
		(120 Å)	(200 Å)	(300 Å)	(120 Å)	(200 Å)		
5	20 X 100	—	—	—	—	—	AM12S05-1020WT	AL12S05-1020WT
	20 X 150	AA12S05-1520WT	AA20S05-1520WT	AA30S05-1520WT	AQ12S05-1520WT	AQ20S05-1520WT	AM12S05-1520WT	AL12S05-1520WT
	20 X 250	AA12S05-2520WT	AA20S05-2520WT	AA30S05-2520WT	AQ12S05-2520WT	AQ20S05-2520WT	AM12S05-2520WT	AL12S05-2520WT
	30 X 75	—	—	—	—	—	AM12S05-L530WT	AL12S05-L530WT
	30 X 100	—	—	—	—	—	AM12S05-1030WT	AL12S05-1030WT
	30 X 150	AA12S05-1530WT	—	—	AQ12S05-1530WT	—	AM12S05-1530WT	AL12S05-1530WT
	30 X 250	AA12S05-2530WT	AA20S05-2530WT	AA30S05-2530WT	AQ12S05-2530WT	AQ20S05-2530WT	AM12S05-2530WT	AL12S05-2530WT
	50 X 250	AA12S05-2552AR	AA20S05-2552AR	AA30S05-2552AR	AQ12S05-2552AR	AQ20S05-2552AR	AM12S05-2552AR	AL12S05-2552AR

Particle size (µm)	Column size inner diameter X length (mm)	YMC-Pack C <sub>8</sub>			YMC-Pack C <sub>4</sub>		
		(120 Å)	(200 Å)	(300 Å)	(120 Å)	(200 Å)	(300 Å)
5	20 X 100	OC12S05-1020WT	—	—	BU12S05-1020WT	—	—
	20 X 150	OC12S05-1520WT	OC20S05-1520WT	OC30S05-1520WT	BU12S05-1520WT	BU20S05-1520WT	BU30S05-1520WT
	20 X 250	OC12S05-2520WT	OC20S05-2520WT	OC30S05-2520WT	BU12S05-2520WT	BU20S05-2520WT	BU30S05-2520WT
	30 X 75	OC12S05-L530WT	—	—	BU12S05-L530WT	—	—
	30 X 100	OC12S05-1030WT	—	—	BU12S05-1030WT	—	—
	30 X 150	OC12S05-1530WT	—	—	BU12S05-1530WT	—	—
	30 X 250	OC12S05-2530WT	OC20S05-2530WT	OC30S05-2530WT	BU12S05-2530WT	BU20S05-2530WT	BU30S05-2530WT
	50 X 250	OC12S05-2552AR	OC20S05-2552AR	OC30S05-2552AR	BU12S05-2552AR	BU20S05-2552AR	BU30S05-2552AR

Particle size (µm)	Column size inner diameter X length (mm)	YMC-Pack TMS (120 Å)	YMC-Pack Ph (120 Å)	YMC-Pack CN		YMC-Pack PROTEIN-RP	YMC Carotenoid
				(120 Å)	(300 Å)		
5	20 X 100	TM12S05-1020WT	PH12S05-1020WT	CN12S05-1020WT	—	—	—
	20 X 150	TM12S05-1520WT	PH12S05-1520WT	CN12S05-1520WT	CN30S05-1520WT	PR99S05-1520WT	CT99S05-1520WT
	20 X 250	TM12S05-2520WT	PH12S05-2520WT	CN12S05-2520WT	CN30S05-2520WT	PR99S05-2520WT	CT99S05-2520WT
	30 X 75	TM12S05-L530WT	PH12S05-L530WT	CN12S05-L530WT	—	—	—
	30 X 100	TM12S05-1030WT	PH12S05-1030WT	CN12S05-1030WT	—	—	—
	30 X 150	TM12S05-1530WT	PH12S05-1530WT	CN12S05-1530WT	—	—	—
	30 X 250	TM12S05-2530WT	PH12S05-2530WT	CN12S05-2530WT	CN30S05-2530WT	—	—
	50 X 250	TM12S05-2552AR	PH12S05-2552AR	CN12S05-2552AR	CN30S05-2552AR	—	—

Particle size (µm)	Column size inner diameter X length (mm)	YMC-Pack SIL (120 Å)	YMC-Pack SIL-06 (60 Å)	YMC-Pack Diol-NP		YMC-Pack Polyamine II (120 Å)	YMC-Pack NH <sub>2</sub> (120 Å)
				(60 Å)	(120 Å)		
5	20 X 100	SL12S05-1020WT	SL06S05-1020WT	—	—	—	—
	20 X 150	SL12S05-1520WT	SL06S05-1520WT	DN06S05-1520WT	DN12S05-1520WT	—	NH12S05-1520WT
	20 X 250	SL12S05-2520WT	SL06S05-2520WT	DN06S05-2520WT	DN12S05-2520WT	PB12S05-2520WT	NH12S05-2520WT
	30 X 75	SL12S05-L530WT	SL06S05-L530WT	—	—	—	—
	30 X 100	SL12S05-1030WT	SL06S05-1030WT	—	—	—	—
	30 X 150	SL12S05-1530WT	SL06S05-1530WT	—	—	—	—
	30 X 250	SL12S05-2530WT	SL06S05-2530WT	—	—	—	NH12S05-2530WT
	50 X 250	SL12S05-2552AR	SL06S05-2552AR	—	—	—	—

Particle size (µm)	Column size inner diameter X length (mm)	J'sphere ODS-H80 (80 Å)	J'sphere ODS-M80 (80 Å)	J'sphere ODS-L80 (80 Å)
4	20 X 150	JH08S04-1520WT	JM08S04-1520WT	JL08S04-1520WT
	20 X 250	JH08S04-2520WT	JM08S04-2520WT	JL08S04-2520WT

## Ordering Information -Columns-

## Guard columns

Particle size (µm)	Column size inner diameter X length (mm)	YMC-Pack Pro C18 (120 Å)	Hydrosphere C18 (120 Å)	YMC-Pack Pro C18 RS (80 Å)	YMC-Pack Pro C8 (120 Å)	YMC-Pack Pro C4 (120 Å)
5	20 X 50	AS12S05-0520WTG	HS12S05-0520WTG	RS08S05-0520WTG	OS12S05-0520WTG	BS12S05-0520WTG
	30 X 50	AS12S05-0530WTG	—	—	—	—

Particle size (µm)	Column size inner diameter X length (mm)	YMC-Pack ODS-A			YMC-Pack ODS-AQ		YMC-Pack ODS-AM (120 Å)	YMC-Pack ODS-AL (120 Å)
		(120 Å)	(200 Å)	(300 Å)	(120 Å)	(200 Å)		
5	20 X 50	AA12S05-0520WTG	AA20S05-0520WTG	AA30S05-0520WTG	AQ12S05-0520WTG	AQ20S05-0520WTG	AM12S05-0520WTG	AL12S05-0520WTG
	30 X 50	AA12S05-0530WTG	AA20S05-0530WTG	AA30S05-0530WTG	AQ12S05-0530WTG	AQ20S05-0530WTG	AM12S05-0530WTG	AL12S05-0530WTG
	50 X 50	AA12S05-0552ARG	AA20S05-0552ARG	AA30S05-0552ARG	AQ12S05-0552ARG	AQ20S05-0552ARG	AM12S05-0552ARG	AL12S05-0552ARG

Particle size (µm)	Column size inner diameter X length (mm)	YMC-Pack C <sub>8</sub>			YMC-Pack C <sub>4</sub>		
		(120 Å)	(200 Å)	(300 Å)	(120 Å)	(200 Å)	(300 Å)
5	20 X 50	OC12S05-0520WTG	OC20S05-0520WTG	OC30S05-0520WTG	BU12S05-0520WTG	BU20S05-0520WTG	BU30S05-0520WTG
	30 X 50	OC12S05-0530WTG	OC20S05-0530WTG	OC30S05-0530WTG	BU12S05-0530WTG	BU20S05-0530WTG	BU30S05-0530WTG
	50 X 50	OC12S05-0552ARG	OC20S05-0552ARG	OC30S05-0552ARG	BU12S05-0552ARG	BU20S05-0552ARG	BU30S05-0552ARG

Particle size (µm)	Column size inner diameter X length (mm)	YMC-Pack TMS (120 Å)	YMC-Pack Ph (120 Å)	YMC-Pack CN		YMC-Pack PROTEIN-RP
				(120 Å)	(300 Å)	
5	20 X 50	TM12S05-0520WTG	PH12S05-0520WTG	CN12S05-0520WTG	CN30S05-0520WTG	PR99S05-0520WTG
	30 X 50	TM12S05-0530WTG	PH12S05-0530WTG	CN12S05-0530WTG	CN30S05-0530WTG	—
	50 X 50	TM12S05-0552ARG	PH12S05-0552ARG	CN12S05-0552ARG	CN30S05-0552ARG	—

Particle size (µm)	Column size inner diameter X length (mm)	YMC-Pack SIL (120 Å)	YMC-Pack SIL-06 (60 Å)	YMC-Pack Polyamine II (120 Å)	YMC-Pack NH <sub>2</sub> (120 Å)
5	20 X 50	SL12S05-0520WTG	SL06S05-0520WTG	PB12S05-0520WTG	NH12S05-0520WTG
	30 X 50	SL12S05-0530WTG	SL06S05-0530WTG	—	NH12S05-0530WTG
	50 X 50	SL12S05-0552ARG	SL06S05-0552ARG	—	—

Particle size (µm)	Column size inner diameter X length (mm)	J'sphere ODS-H80 (80 Å)	J'sphere ODS-M80 (80 Å)	J'sphere ODS-L80 (80 Å)
4	20 X 50	JH08S04-0520WTG	JM08S04-0520WTG	JL08S04-0520WTG

## CHIRAL ART preparative columns (Pressure limit : 30 MPa)

Particle size (µm)	Column size inner diameter X length (mm)	Immobilized type				Coated type	
		Amylose-SA	Cellulose-SB	Cellulose-SC	Cellulose-SJ	Amylose-C Neo	Cellulose-C
5	20 X 250	KSA99S05-2520WX	KSB99S05-2520WX	KSC99S05-2520WX	KSJ99S05-2520WX	KBN99S05-2520WX	KCN99S05-2520WX
	30 X 250	KSA99S05-2530WX	KSB99S05-2530WX	KSC99S05-2530WX	KSJ99S05-2530WX	KBN99S05-2530WX	KCN99S05-2530WX

## Alcyon SFC CSP preparative columns (Pressure limit : 20 MPa)

Particle size (µm)	Column size inner diameter X length (mm)	Immobilized type				Coated type	
		Amylose-SA	Cellulose-SB	Cellulose-SC	Cellulose-SJ	Amylose-C Neo	Cellulose-C
5	20 X 250	KSA99S05-2520WTS	KSB99S05-2520WTS	KSC99S05-2520WTS	KSJ99S05-2520WTS	KBN99S05-2520WTS	KCN99S05-2520WTS

## CHIRAL ART guard cartridges

Particle size (µm)	Column size inner diameter X length (mm)	Immobilized type				Coated type	
		Amylose-SA	Cellulose-SB	Cellulose-SC	Cellulose-SJ	Amylose-C Neo	Cellulose-C
5	20 X 10	KSA99S05-0120CCN	KSB99S05-0120CCN	KSC99S05-0120CCN	KSJ99S05-0120CCN	KBN99S05-0120CCN	KCN99S05-0120CCN
	30 X 10	KSA99S05-0130CCN	KSB99S05-0130CCN	KSC99S05-0130CCN	KSJ99S05-0130CCN	KBN99S05-0130CCN	KCN99S05-0130CCN

\*Guard cartridge holder required, part no. XPGHFSP20ID for 20 mml.D. and XPGHFSP30ID for 30 mml.D.

## YMC-GPC series

- Suitable for separation of polymer or oligomer on the basis of molecular weight
- Compatible with organic solvents with various polarities
- High resolution and long lifetime under a high flow rate condition
- High productivity by fast separation
- Ideal for recycling GPC that can improve resolution

### Polymer based preparative GPC columns

YMC-GPC is a column packed with highly cross-linked porous polystyrene/divinylbenzene media. It provides outstanding physical rigidity for extended lifetimes especially at a high temperatures and in aggressive solvents. YMC-GPC offers high productivity on preparative separation due to high resolution and high loadability, at a fast flow rate. Furthermore, higher resolution can be achieved on a sample that is hardly separated in combination with recycling chromatography method, even without changing mobile phase conditions or columns.

### Compatible with various organic solvents

Low polarity



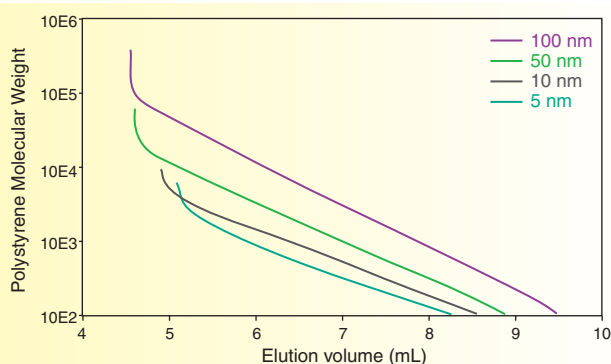
High polarity

Perfluoroalkane  
Hexane  
Cyclohexane  
Toluene  
Ethyl acetate  
Tetrahydrofuran (THF)  
Chloroform  
Methyl ethyl ketone (MEK)  
Dichloromethane  
Dichloroethene  
Acetone  
*o*-Dichlorobenzene (*o*-DCB)  
Trichlorobenzene (TCB)  
*m*-Cresol  
*o*-Chlorophenol (*o*-CP)  
Pyridine  
Dimethyl acetamide (DMAc)  
*n*-Methyl pyrrolidone (NMP)  
Dimethyl sulfoxide (DMSO)  
Dimethyl formamide (DMF)

YMC-GPC is normally supplied in ethylbenzene unless otherwise stated. The transferring procedure to other mobile phases is described in the instruction manual on our website.

YMC-GPC has excellent solvent versatility. It can be transferred easily and rapidly between solvents of varying polarity. It is possible to select the optimum mobile phase depending on the solubility and separation behavior of the sample.

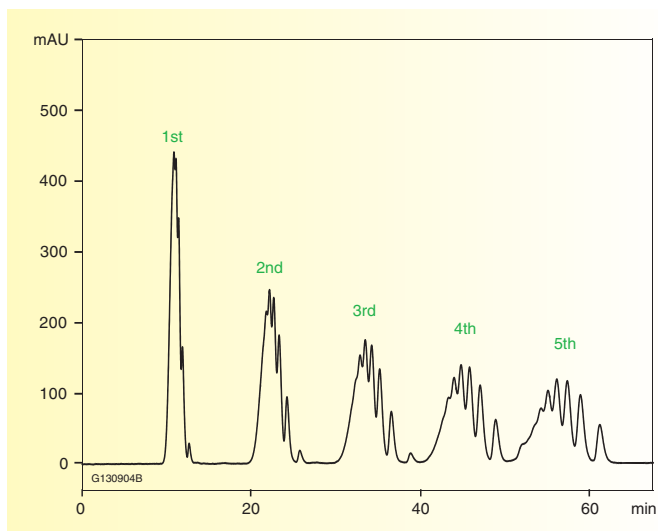
### Calibration curves



Column : 300 X 7.5 mm I.D.  
Eluent : THF  
Flow rate : 1.0 mL/min  
Sample : polystyrene

Calibration curves of polystyrene by YMC-GPC are shown left. The calibration curves are designed to be linear over a specified molecular weight range, ensuring that the same degree of resolution is achieved across the full operating range of the column. Desired separation can be achieved by selecting a column depending on the molecular weight range of a sample.

### Recycling chromatography separation of polystyrene oligomers



Column : YMC-GPC T4000 (10  $\mu$ m, 100 Å)  
 600 X 21.2 mm.I.D.  
 Eluent : chloroform  
 Flow rate : 10 mL/min  
 Detection : UV at 254 nm  
 Sample : polystyrene oligomers (50 mg/mL)  
 Injection : 1.4 mL

Recycling separation of polystyrene oligomers by YMC-GPC T4000 column is shown. By using recycling chromatography separation method, higher resolution can be achieved on a sample that is hardly separated, even without changing mobile phase conditions or columns. Furthermore, no solvent is consumed during recycling. It greatly contributes to reduction of solvent consumption on purification.

### Ordering Information -Columns-

#### YMC-GPC (Theoretical plate number > 20,000)

Product name	Phase dimension	Molecular weight range (g/mol)	Column size inner diameter X length (mm)	Product number
YMC-GPC T2000	50 Å	- 2,000	21.2 X 600	GP05S10-6020PT
YMC-GPC T2000-40	10 $\mu$ m		40 X 600	GP05S10-6040WT
YMC-GPC T4000	100 Å	- 4,000	21.2 X 600	GP10S10-6020PT
YMC-GPC T4000-40	10 $\mu$ m		40 X 600	GP10S10-6040WT
YMC-GPC T30000	500 Å	500 - 30,000	21.2 X 600	GP50S10-6020PT
YMC-GPC T30000-40	10 $\mu$ m		40 X 600	GP50S10-6040WT
YMC-GPC T60000	1000 Å	500 - 60,000	21.2 X 600	GPA0S10-6020PT
YMC-GPC T60000-40	10 $\mu$ m		40 X 600	GPA0S10-6040WT
YMC-GPC T10M	MIX	500 - 10,000,000	21.2 X 600	GP9BS10-6020PT
YMC-GPC T10M-40	10 $\mu$ m		40 X 600	GP9BS10-6040WT